Queens West Development

Parcel 9

QUEENS, NEW YORK

Site Management Plan

NYSDEC BCP Number: C241049

Prepared for:

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December 2006

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April 2016

Revisions to Final Approved Site Management Plan:

Revision #	Submitted Date	Summary of Revision	DEC Approval Date
01	02/11/2014	Frequency of Groundwater Monitoring changed from quarterly to semi-annual and sampling of air effluent discontinued	06/04/2013 and 12/20/2013
02	04/20/2016	Groundwater Monitoring was discontinued.	11/24/2015

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1.0 INTRODUCTION

1.1 SITE DESCRIPTION

This document is prepared as a requirement for fulfillment of remedial action at the Queens West Parcel 9 site (the "site") under the New York State Brownfield Program (BCP) administered by the New York State Department of Environmental Conservation (NYSDEC) and New York State Department of Health (NYSDOH). The site was remediated in accordance with the Brownfield Cleanup Agreement (Index No. W2-1060-05-03, Site No. C241049).

The Queens West Development is a project of the Queens West Development Corporation (QWDC), a subsidiary of New York State's Empire State Development Corp., under the collective sponsorship of The Port Authority of New York and New Jersey, The New York City Economic Development Corporation, and Empire State Development Corporation. The overall Queens West Development site comprises 74 acres along the East River in Hunters Point, Queens, extending from Anable Basin to the north to Newtown Creek to the south, as shown on Figure 1. Stage I of the development involves construction of residential buildings on the portion of the site between 47th Road and 50th Avenue. The Queens West development parcels, including Parcel 9, are shown on Figure 2.

In August 1998, a Voluntary Cleanup Agreement was entered into between NYSDEC and QWDC. This agreement covered Parcels 8, 9, and 11 and the portion of Center Boulevard between Parcels 8 and 9. In July 2000, the Voluntary Cleanup Agreement was amended to allow it to be separated into separate agreements for each parcel, which would be executed by the designated developer for the parcel. Accordingly, after AvalonBay Communities was selected as the developer of Parcels 8, 9, and 11, AvalonBay executed separate agreements for each of the three parcels in September 2000. In March 2004, AvalonBay requested that DEC transition Parcels 8 and 9 into the BCP.

Under the BCP, AKRF Engineering, P.C. (AKRF) conducted a Supplemental Remedial Investigation (RI) and additional delineation sampling of Parcel 9 in early 2005, and Remedial Work Plan (RWP) was submitted to the NYSDEC in May 2005. Remediation of hydrocarbon contaminated soil at the site commenced in August 2005 and was completed in May 2006. Installation of a sub-slab vapor mitigation system was also completed in late November 2006. Redevelopment of the site consisted of the construction of a high-rise apartment building with ground level retail space, townhouses, and a parking garage. First occupancy of the residential buildings occurred in the summer of 2007, and all construction was completed in April 2008.

1.2 METES AND BOUNDS DESCRIPTION

All of that certain plot, piece or parcel of land situated, lying and being in the Borough and County of Queens, City and State of New York, bounded and described as follows:

BEGINNING at the corner formed by the intersection of the westerly side of 5th Street (60 feet wide) with the northerly side of 48th Avenue (104 feet wide);

RUNNING THENCE westerly along the northerly side of 48th Avenue, 399.58 feet to a point of curvature;

RUNNING THENCE northwesterly, northerly and northeasterly along a curve bearing to the right having a radius of 20.00 feet and arc length of 38.80 feet to a point of tangency on the southeasterly side of Center Boulevard (100 feet wide);

RUNNING THENCE northeasterly along the southeasterly side of Center Boulevard 185.26 feet to the southerly side of 47th Road (60 feet wide);

RUNNING THENCE easterly along the southerly side of 47th Road, 351.37 feet to the westerly side of 5th Street;

RUNNING THENCE southerly along the westerly side of 5th Street, 200.00 feet to the corner formed by the intersection of the westerly side of 5th Street with the northerly side of 48th Avenue the point of place of Beginning.

1.3 OVERVIEW

The site has residual contamination that has been left on the site after completion of the remedial action performed under the Brownfield Cleanup Program. Engineering controls have been incorporated in the remedy for the site to render the residual contamination protective of public health and the environment. An environmental easement has been recorded for the site that provides an enforceable means of ensuring the continued future protection of the site, and requires adherence by the Grantor and Grantor's successors and assigns to the engineering controls and a series of institutional controls that provide restrictions on site usage and mandate operation, maintenance, monitoring and reporting measures for the engineering and institutional controls. This Site Management Plan (SMP) is the document that ensures compliance with engineering and institutional controls for residual contamination at the site. This Site Management Plan has been approved by the NYSDEC and compliance with this plan is required by the Grantor of the environmental easement and all successors and assigns.

This SMP provides a detailed description of the procedures warranted to properly manage the engineering controls installed and monitor the environmental conditions described in Section 2.0. Proper management and monitoring will be achieved by conducting the tasks outlined in Sections 3.0 through 6.0. Site management is the last phase of remediation, which begins with the approval of the Final Engineering Report and subsequent issuance of the Certificate of Completion (COC), and continues until the remedial action objectives for the site have been satisfied and until the environmental easement is modified or extinguished. The remedial party is responsible to ensure that all site management responsibilities are performed. Implementation of this SMP is the responsibility of the owner(s) and all future owner(s) of the site.

This SMP is intended to provide a detailed description of the procedures required to properly manage residual contamination left in place at the site following completion of the remedial action in accordance with the New York State Brownfield Cleanup Agreement with the NYSDEC. These procedures include: development, implementation and management of all engineering and institutional controls; development and implementation of monitoring systems and a monitoring plan; development of a plan to operate and maintain any treatment, collection, containment or recovery systems; submittal of Periodic Review Reports (PRR), performance of inspections and certification of results/insurance of proper communication of site information to the Department; and defining criteria for termination of treatment system operation.

This SMP includes four plans, an Institutional and Engineering Control Plan for implementation and management of institutional and engineering controls; a Monitoring Plan for implementation of site monitoring; an Operation and Maintenance Plan for implementation of remedial collection, containment, treatment and recovery systems; and a PRR Plan for submittal of data, information, recommendations and certifications to the Department.

Where the remedial action objectives call for residual contaminants to be retained and managed on-site, the requirements outlined in this Site Management Plan are to be in place in perpetuity, or

until removal of the environmental easement according to an approval by the Department, or until otherwise approved by the Department. This SMP that was approved initially on 12/2006 has been revised. Revision #1 includes changes in monitoring. Soil vapor effluent was discontinued and groundwater monitoring frequency was reduced from Quarterly monitoring to semi-annual. Revision #2 reflects the discontinuation of groundwater monitoring and closure of the groundwater monitoring wells.

This SMP defines the means for implementation of environmental easement requirements. Site management activities, reporting and institutional and engineering control certification will be completed an annual basis. The owner or operator of the site will identify a qualified environmental consultant to provide all services described in this SMP. The environmental easement is binding and enforceable. Penalty for failure to implement this SMP is revocation of the COC.

2.0 BACKGROUND

2.1 SITE DESCRIPTION

2.1.1 Site Location

Parcel 9 is located in the Hunters Point section of Queens, New York. The parcel is bounded by 5th Street on the east, 48th Avenue on the south, Center Boulevard on the west, and 47th Road on the north. It has a total area of approximately 1.79 acres, and is defined as Lots 1, 5, and 19 of Tax Block 19 of Queens County. A property survey of the site is provided in Attachment A.

2.1.2 Site and Vicinity Characteristics

The site layout for the finished development, shown on Figure 3, includes an L-shaped high-rise apartment building located in the western and southwestern portions of the site, a multi-level parking garage located in the eastern portion of the site, with townhouses located south of the garage, along 48th Avenue. Approximately 2,300 square feet of retail space is located on the ground floor of the residential building, along Center Boulevard. A courtyard and driveway area are located in the center of the site, in front of the main entrance of the high-rise apartment building.

Parcel 10, located across 48th Avenue south of the site, is occupied by a high-rise residential building which also includes a public elementary school, P.S. 78. Parcel 8, located across Center Boulevard west of the site, is vacant. The area between Parcel 8 and the East River is part of the Queens West waterfront park. The East River is located roughly 500 feet west of the site.

The areas north and west of the site (i.e., across 47th Road and 5th Street) are currently undergoing construction for future residential development. The area east of the site, across 5th Street, is not part of the Queens West Development. This area is occupied by a mix of light industrial, commercial, and residential uses.

2.1.3 Site History

The history of the site and the surrounding area is summarized in the Hunters Point Development Final Environmental Impact Statement (June 1990). The Hunters Point area was originally a rocky outcrop surrounded by low-lying marshlands and tidal meadows. Filling of the wetlands and development of the area began in the mid-19th century. Starting around 1890, the area became a major industrial center. Historic Sanborn Insurance Maps indicate that the eastern end of Parcel 9 was occupied by varnish or paint manufacturers from sometime prior to 1915 until the 1970's, and was mostly vacant since that time. The western portion of the site was occupied by a variety of manufacturing uses. The Blau Gas Company of America occupied a portion of the site in 1915, but was gone by 1936. The Blau Gas process involved "cracking" petroleum to increase the concentrations of the lighter fractions, which were then distilled off, purified, and compressed into cylinders. The Blau Gas plant on the site was a small facility which occupied about a one-half acre portion of the site, and is not comparable to a typical Manufactured Gas Plant (MPG) facility either in the type of process or the scale of operations. Other historic uses on the western portion of the site included: an asphalt company; the Warren Chemical Company, which manufactured insecticides and roofing materials; a plumbing supply manufacturer; a refrigeration equipment manufacturer; a barrel manufacturer; and an auto repair shop.

2.2 REMEDIAL INVESTIGATION FINDINGS

The Supplementary Remedial Investigation Report and other environmental investigation reports for Parcel 9 can be found at the offices of the NYSDEC or successor agency performing the same function. At the time of preparing this SMP, these documents are also available at the local document repositories, including the Long Island City Public Library (Court Square Branch) and the New York City Community Board No. 2 Office. A general discussion of environmental activities conducted at the site is provided below.

2.2.1 Site Geology and Hydrogeology

Results from the Supplementary Remedial Investigation (RI) of the site indicated that the top 10 to 12 feet of soil on the parcel consisted of miscellaneous fill. This was underlain at most locations by a layer of alluvial sand up to 17 feet thick. Organic deposits, consisting of soft gray organic silty clay, generally less than 10 feet thick, were found directly below the fill at some locations, and interlayered with the sand stratum at others. Below the sand and organic deposits was a layer of glacial till up to 30 feet thick and consisting of compact fine to coarse sand with some gravel, silt, clay, clay pockets, and boulders. The surface of the till was found at an elevation of -10 to -12 feet (Queens Borough Datum) over most of the parcel, but dipped sharply to a depth of -30 feet in the southwest corner of the parcel. Bedrock was found at elevation -20 to -30 feet over most of the parcel, dipping in the southwest corner to a minimum elevation of -55 feet. Groundwater at the site was approximately 5 to 9 feet below grade, and the general groundwater flow direction is from the northeast to the southwest, with some tidal influence possible. Groundwater elevation contours for November 15, 2005 are shown on Figure 4.

2.2.2 Nature and Extent of Contamination

Environmental investigation of the site is documented in the following reports: Supplemental Remedial Investigation Report, dated April 2005; Additional Delineation Testing Report, dated June 2005; and Remedial Work Plan (RWP), dated August 2005.

Soil Contamination

The RI identified two separate types of soil contamination on the site, as shown on Figure 5. Petroleum contamination, including the presence of light non-aqueous phase liquid (LNAPL) was found centered in the north-central portion of the site. Coal tar contamination, including the presence of dense non-aqueous phase liquid (DNAPL), was found in the southwestern corner of the site, and along the western boundary of the site adjacent to Center Boulevard. The petroleum-contaminated soil extended from the "smear zone" near the groundwater surface down to the surface of the till layer at an elevation of approximately -10 feet (Queens Borough Datum), thinning out to the east, west, and south of the apparent source area. The petroleum-contaminated soil was characterized by high levels of BTEX, as well as other relatively light, monocyclic hydrocarbons, including cyclohexane and methylcyclohexane. Naphthalene was present in the petroleum-contaminated soil, but at lower levels than the monocyclic compounds. The coal tar contamination included an area of deep contamination and DNAPL in the southwestern corner of the site, corresponding to a low point in the lower confining layer (till or clay). The coal tar contamination extended from this source area northward along the western boundary of the site. In this area, the contamination extended from the "smear zone" near the groundwater surface down to the surface of the till layer, thinning out to the north and south. The coal tar-contaminated soil was characterized by high levels of naphthalene and 2-methylnaphthalene, with relatively lower levels of benzene, toluene, ethylbenzene, and xylenes (BTEX). Cross section A-A' on Figure 6 shows a

soil profile through both the coal tar-contaminated area at the west end of the site, and the petroleum-contaminated area towards the center of the site.

The surface soils on the site were found to consist of historic fill materials incorporating ash as well as brick, concrete, and other demolition debris. The fill contained higher and more variable concentrations of metals and heavy polycyclic aromatic hydrocarbons (PAHs) than the underlying native soils. Metals were detected generally at concentrations typical of soil background levels. Above-background concentrations of mercury were detected in a few soil samples. However, they appeared to be randomly distributed in the fill. In all cases where an elevated mercury concentration was detected, the levels in the adjacent samples (from two feet above and two feet below) were within the normal background range. In general, BTEX, naphthalene, and total semivolatile organic compound (SVOC) concentrations were below their respective site Specific Soil Action Levels (SSSALs) in fill material overlying the hydrocarbon-contaminated soil in the western portion of the site and above the native soil in the eastern portion of the site (outside of the area of hydrocarbon contamination). However, fill from approximately 0 to 2 feet below grade in boring location P-16, located just outside the area of hydrocarbon-contamination, exhibited a naphthalene concentration of 64 parts per million (ppm) (above the 13-ppm SSSAL) and a total SVOC concentration of 8,760 ppm (above the 500-ppm SSSAL).

Groundwater Contamination

Petroleum and coal tar-related volatile organic compounds (VOCs) and SVOCs were present at elevated levels in groundwater samples from wells in the northwest quadrant and the area of coal tar contamination at the southwestern corner and along the western edge of the site. The most common compounds detected were BTEX, naphthalene, and 2-methylnaphthalene. Methyl and dimethyl phenols, typical of coal tar, were detected in a number of samples, particularly from the wells along the western edge of the site adjacent to Center Boulevard. In general, the higher levels of naphthalene were associated with the coal tar contamination along the western edge of the site, and the higher levels of benzene are associated with the petroleum contamination in the north-central portion of the site. Metals were generally either undetected or detected at concentrations well below the Class GA groundwater standards. The exception was the upgradient well, A-8, located in the northeastern corner of the site, where the detected antimony concentration (1,220 parts per billion) exceeded the applicable groundwater standard. This result was suspected of being an anomaly, and not indicative of overall site conditions. Neither polychlorinated biphenyls (PCBs) nor pesticides were detected in any of the groundwater samples analyzed.

Soil Gas Contamination

Petroleum/coal tar-related compounds were prevalent in several of soil gas samples collected around the site periphery, with the highest concentrations detected near the northwestern corner of Parcel 9. Elevated concentrations of chlorinated compounds, including tetrachloroethene (PCE) at 3,250 micrograms per cubic meter (ug/m^3) to 3,900 ug/m^3, were detected at the southeastern corner of Center Boulevard and 48^{th} Avenue, adjacent to the Citilights residential apartment building. PCE was prevalent at relatively low concentrations (6 to 29 ug/m^3) in many of the sampling locations, with a higher concentration of 290 ug/m^3 detected near the southeastern portion of Parcel 9. The soil and groundwater data collected at Parcel 9 did not contain elevated concentrations of chlorinated VOCs, suggesting that Parcel 9 is not the source of chlorinated compounds detected in the soil gas samples.

2.3 SUMMARY OF REMEDIAL ACTIONS

The following activities were conducted as part of the implementation of the NYSDEC-approved RI and RWP:

- Erection of a temporary containment structure to control potential contaminant vapors and odors during all contaminated soil excavation.
- Installation of a containment wall around the entire hydrocarbon-contaminated soil excavation area to facilitate removal of the contaminated soil and to prevent migration of off-site contamination onto the Site during and after the remediation activities.
- Excavation and off-site disposal of petroleum- and coal tar-contaminated soil above the SSSALs within the containment wall.
- Excavation and off-site disposal of the small area of historic fill containing naphthalene and total SVOC levels exceeding the SSSALs outside of the containment structure.
- Off-site disposal of a total of 54,507 tons of contaminated soil as part of the remediation activities.
- Implementation of an environmental health and safety plan (HASP), air monitoring plan, and stormwater pollution prevention plan (SWPPP) to ensure protection of site workers, the surrounding community, and nearby surface water during the soil excavation activities. The data confirmed that no long term exceedances of the VOC, particulate, or odor action levels were detected at the monitoring stations during the remediation activities.
- Installation of a sub-slab vapor mitigation system under the occupied buildings, which includes a vapor barrier and active sub-slab depressurization system to prevent migration of potential vapors.
- Installation of a site cover consisting of concrete building slabs, asphalt and concrete paving, and two feet of clean fill in areas without building or pavement coverage.
- Implementation of institutional controls to prevent exposure to residual contamination left in place following soil removal.

Details of the remediation are described in the following sections.

2.3.1 Soil Excavation

The selected remedy for the site included excavating and disposing of all hydrocarbon-contaminated (coal tar and petroleum-contaminated) soil and historic fill containing contaminant concentrations exceeding the SSSALs listed in the following table:

Compound	SSSAL (ppm)
Benzene	0.06
Toluene	1.5
Ethylbenzene	5.5
O-xylene	1.2
M/P-xylene	0.6
Naphthalene	13.0

Compound	SSSAL (ppm)
Total VOCs	10.0
Total SVOCs	500
Lead	1,000
Mercury	2
Arsenic	25
Other Criteria	Grossly contaminated soil

The excavation was backfilled with environmentally clean imported fill material and on-site historic fill meeting the SSSALs. All excavation of the hydrocarbon-contaminated soil was conducted under a temporary containment structure to control contaminant vapors and odors. Excavation of the small area of historic fill containing naphthalene and total SVOC levels exceeding the SSSALs was conducted outside of the containment structure. The limits of the soil removal are shown in Figure 7. Several underground storage tanks encountered during the soil excavation activities were properly excavated, cleaned, and removed from the site in accordance with applicable regulations. An updated Petroleum Bulk Storage (PBS) form reflecting the removed status of the tanks is included in the Final Engineering Report. A HASP, air monitoring plan, and SWPPP were implemented during the remediation activities to ensure protection of site workers, the surrounding community, and nearby surface water.

2.3.2 Engineering and Institutional Controls

Engineering controls implemented as part of site remediation include the following:

- Installation of a containment wall around the entire hydrocarbon-contaminated soil excavation area to facilitate removal of the contaminated soil and to prevent migration of off-site contamination on to the parcel during and after the remediation activities;
- Installation of a sub-slab vapor mitigation system under the residential buildings to prevent potential vapor migration into the buildings; and
- Placement of a concrete/asphalt cover or two feet of clean fill over the entire site to prevent exposure to residual contamination that was left in place following soil removal.

Institutional controls incorporated into the remedy include an environmental easement to prohibit certain on-site uses, and implementation of a Site Management Plan specifying soil management, operation, maintenance, monitoring, and reporting procedures during future site use. Engineering and Institutional Controls are described in more detail in Section 3.0.

2.3.3 Monitoring

Long-term site management previously included: periodic groundwater sampling to monitor dissolved contaminant concentrations within and outside of the hydraulic barrier and periodic monitoring of vapor emissions. Groundwater and vapor monitoring are described in more detail in Section 4.0 Based on modifications to the SMP, this monitoring is no longer required.

2.4 RESIDUAL ON-SITE CONTAMINATION

The site remediation activities implemented as part of the RWP (summarized above) resulted in contaminants remaining on the site. Specifically, the following known contamination remains on-site:

2.4.1 Soil

Residual contaminant concentrations in soil that exceed the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046 Recommended Soil Cleanup Objectives (RSCOs) are summarized in Tables 1, 2, and 3, and illustrated on Figure 8. Such exceedances occur in material located below the site cover; therefore, the interval immediately under the site cover is designated as the Residuals Management Zone (RMZ). The elevations of the top of the RMZ are shown on Figure 9.

2.4.2 Groundwater

During the Supplemental Remedial Investigation, groundwater beneath the site was found to contain dissolved VOCs, SVOCs, and low level exceedances of dissolved metals. It is anticipated that the removal of nearly all recoverable hydrocarbon contaminated soil and non-aqueous phase liquid (NAPL) from the site subsurface and installation of a hydraulic barrier around the entire soil removal area resulted in a marked decrease in groundwater contaminant levels. Initially, groundwater sampling was conducted quarterly; however, on June 4, 2013, NYSDEC approved a changed in frequency of groundwater sampling to semi-annually. During the 2014 reporting period, contaminant levels in groundwater within the containment wall for MW-11R and MW-12R were all non-detected. The results indicated that the groundwater containment wall was effectively isolating the Parcel 9 site from contamination on surrounding properties, allowing natural attenuation of residual groundwater contamination within the barrier. Subsequently, NYSDEC approved the discontinuation of groundwater monitoring and the decommissioning of the six on-site and two off-site monitoring wells in letters dated November 24, 2015 and March 22, 2016. These monitoring wells were permanently closed in accordance with NYSDEC CP-43 on April 4 and 5, 2016.

2.4.3 Soil Gas

Soil gas present beneath the building is expected to contain low levels of VOCs due to residual soil contamination at depth. The active sub-slab vapor mitigation system is designed to prevent migration of potential vapors to the occupied buildings on the site.

2.5 PROVISIONS IN ENVIRONMENTAL EASEMENT

An environmental easement has been recorded for the property and includes the following site use restrictions:

- Use of the site for "Restricted Residential Use".
- All engineering controls (including the site cover and sub slab vapor depressurization and active venting system) must be operated and maintained as specified in the NYSDEC-approved Site Management Plan. No Engineering and Institutional Controls may be discontinued without a NYSDEC-approved amendment or extinguishment of the Environmental Easement and/or Site Management Plan.
- Annual inspections, certifications of Institutional & Engineering controls, site usage, and PRRs to the Department must be conducted in accordance with the NYSDEC-approved Site

Management Plan.

- All future soil disturbance activities on the site that will impact residual contaminated material, including, but not limited to, building construction or expansion, sub-grade utility line construction or repair, must be conducted in accordance with the Soil Management provisions in the NYSDEC-approved Site Management Plan.
- Operation Monitoring and Maintenance (OM&M) of the sub-slab depressurization system must be performed in a manner specified in the NYSDEC-approved Site Management Plan.
- Groundwater and other environmental or public health monitoring required by the NYSDEC-approved Site Management Plan, and reporting of information thus obtained, must be performed in a manner specified in that Plan.
- On-site environmental monitoring devices must be protected and replaced as necessary to ensure continued functioning in the manner specified in the NYSDEC-approved Site Management Plan.
- The use of the groundwater underlying the site is prohibited without treatment rendering it safe for intended purpose.
- Vegetable gardens are prohibited.
- The site may not be used for a higher level of use such as unrestricted use, without proper notification of NYSDEC of the change of use, approval of that use by the NYSDEC, and an amendment of the Site Management Plan approved by NYSDEC.

The environmental easement includes: institutional controls that describe use restrictions for the site; institutional controls that ensure proper operation, maintenance, monitoring, and reporting for the engineering controls under the NYSDEC-approved SMP, and a metes and bounds description of the site. The property deed and all subsequent instruments of conveyance will contain language indicating that the site is subject to the environmental easement.

3.0 INSTITUTIONAL AND ENGINEERING CONTROL PLAN

This Institutional and Engineering Control Plan details the oversight steps and any media-specific requirements necessary to assure that the institutional and engineering controls for the site remain in place and effective. This section includes a description and objectives for all institutional and engineering controls. Plans for annual inspection and certification of the institutional and engineering controls, including identification of the issues to be specifically evaluated as part of the inspection and certification and any criteria that might apply, are included in Sections 4.0 and 6.0. A copy of the environmental easement requiring the institutional and engineering controls for the site is included in Attachment B

3.1 ENGINEERING CONTROL COMPONENTS

Engineering controls incorporated into the site remedy are as follows:

- Site cover;
- Hydraulic barrier consisting of water-tight steel sheeting; and
- Vapor mitigation system including a vapor barrier and active sub-slab ventilation system.

A site plan illustrating the location of the engineering control components, including the site cover, hydraulic barrier, and vapor mitigation system, is provided as Figure 10. Details of each of the engineering control components are further described in the following sections.

3.1.1 Site Cover

A cover has been installed over at the entire site to prevent direct exposure to underlying soil that could contain residual contaminant concentrations exceeding the NYSDEC TAGM 4046 RSCOs. The current cover, shown on Figure 10, consists of: concrete building foundations in the area of the high-rise residential building, town houses, and garage; concrete sidewalks around the site perimeter; and a minimum of two feet of clean fill meeting the NYSDEC TAGM 4046 RSCOs in the courtyard area and a portion of the garage. The permanent cover, which will include concrete over the entire garage area and paving in portions of the courtyard area, is included in Figure 11. The purpose of the site cover is to provide a barrier between known contaminated soil and future users of the property. The site cover will be inspected and maintained in accordance with the Operation and Maintenance Plan in Section 5.0.

3.1.2 Hydraulic Barrier

Prior to starting the remedial excavation activities, permanent interlocking steel sheeting was installed around the entire soil remediation area to facilitate excavation for soil remediation and to isolate the site from off-site contamination. The sheeting was driven into the low-permeability till or clay layer, and the seams in the sheeting were sealed with hydrocarbon-resistant Adeka gaskets to prevent infiltration of contaminants back onto the site. The as-built location of the hydraulic barrier is shown on Figures 10 and 11. The hydraulic barrier was installed below grade, and does not require maintenance. Routine groundwater monitoring will be conducted as specified in Section 4.0 to gauge the effectiveness of the barrier.

3.1.3 Vapor Mitigation System

A sub-slab vapor mitigation system has been installed under all on-site buildings, exclusive of the open-air parking garage, to prevent potential migration of contaminant

vapors into the buildings, as depicted in Figures 10 and 11. The mitigation system design consists of four separate sub-slab depressurization piping networks placed beneath a 60-mil thick Liquid Boot® spray-applied vapor membrane, steel pipe risers for each network, and aboveground blowers/instrumentation. The risers penetrate the building slab at four locations to connect to the aboveground blower assemblies, which will be housed in mechanical rooms located on the ground floor of the residential apartment buildings and at the eastern end of the townhouses. Temporary blower assemblies, as described in the FER, were installed and operational as of December 21, 2006. An operation and maintenance (O&M) plan for the system, provided in Section 5.0, specifies the installation of permanent blower assemblies, which will be completed as building construction progresses. The O&M plan includes daily system checks to ensure that the system remains operational, and quarterly inspections to optimize system performance and perform required maintenance. Reporting of the O&M activities will be included as part of the annual PRR. An as-built drawing of the vapor mitigation system is provided in Attachment C.

3.2 INSTITUTIONAL CONTROL COMPONENTS

Institutional controls specified in the environmental easement for the site remedy are as follows:

- Use of the project site for "Restricted Residential Use". Notification will be provided to the NYSDEC if there is a proposed change in use.
- The use of the groundwater underlying the site is prohibited without treatment rendering it safe for intended purpose.
- Vegetable gardens at the site are prohibited.
- Annual inspections and certifications, as described in Section 6.0.
- Inspection, operation, maintenance, and monitoring of the engineering controls, as described in Section 5.0.
- Future soil disturbance activities, including building renovation/expansion, subgrade utility line repair/relocation, and new construction, conducted in accordance with the Soil Management Plan, as described in Section 3.3.
- Groundwater and other environmental or public health monitoring specified in the Monitoring Plan in Section 4.0.

3.2.1 Environmental Easement

As described in Section 2.5, an environmental easement was recorded for the site to ensure compliance with site use restrictions and adherence to the requirements of the NYSDEC-approved SMP. These measures will protect future site occupants from exposure to residual contamination in the site subsurface. A copy of the environmental easement is provided in Attachment B. Site-wide inspections will be conducted on an annual basis, as described in Section 6.0, to ensure compliance with the site use restrictions and SMP.

The Applicant will provide, in a computer database format acceptable to the NYSDEC, the following information for the environmental easement:

- Site summary;
- Name of current site owner and/or the Applicant implementing this SMP for the site;
- Location of the site;
- The current status of site remedial activity;
- Copy of the environmental easement; and
- Contact name and phone number of a person knowledgeable of the easement, in order for the NYSDEC to obtain additional information.

If and when an environmental easement is modified or extinguished, the copy of the environmental easement contained in the database will be updated accordingly.

3.2.2 Annual Certification

Annual Certifications will be submitted to the NYSDEC to document the effectiveness of the remedy. The Annual Certification will be signed by a professional engineer or a qualified environmental professional to the NYSDEC and will certify that: the institutional and engineering controls are unchanged from the previous certification; nothing has occurred that would impair the ability of the controls to protect public health and the environment; and no violations of the site management plan have occurred. The certification will include the monitoring data collected during the reporting period as specified in this plan.

3.2.3 Soil Management

Future activities at the site that could require intrusive work, involving disturbance and handling of soils in the Residual Management Zone (below the site cover), include the following:

- Trenching and excavation for utility maintenance, repair, and replacement;
- Excavation for landscaping (likely limited to 2-foot cover soils); and
- Potential excavation for renovations/additions to the on-site buildings.

These activities will be conducted in accordance with the soil management procedures described in Section 3.3 to minimize impacts to human health and the environment from residual contamination under the site cover.

3.3 SOIL MANAGEMENT PLAN

This section of this SMP provides procedures for future soil disturbance activities, including building renovation/expansion, subgrade utility line repair/relocation, and new construction. All such projects involving disturbance of soil containing contaminant concentrations above the RSCOs in TAGM 4046 (located beneath the site cover) must be overseen by a full-time qualified environmental professional. The NYSDEC will be notified of all such work, and the work will be certified according to this SMP.

Soil below the site cover is assumed to contain contaminants above the RSCOs in TAGM 4046. As a result, subsurface soil excavated from these areas must be handled as regulated material if they are exported off-site. All exported soil excavated from below the site cover would be considered a regulated waste, subject to management under NYSDEC regulation (6 NYCRR 360). Excavated soil that remains on-site as fill and any certified soil imported to the site are not

considered regulated waste. This Soil Management Plan addresses the management of any soil generated by potential future soil disturbances or soil imported onto the property, and addresses related contingencies.

Particulate air monitoring of fugitive dust will be conducted on the site at all times when soil below the site cover is disturbed. Air monitoring will conducted consistent with the air monitoring plan, as described in Section 3.4.3.

3.3.1 Environmental Oversight and Notification

All invasive work below the site cover and any load-out of contaminated soil for off-site disposal will be overseen by a full-time environmental professional experienced in environmental monitoring of contaminated soil/groundwater remediation. Resumes of the environmental monitoring personnel that are anticipated to conduct the work are provided in Attachment D. The NYSDEC will be notified at least 7 days prior to the initiation of any soil disturbance below the site cover and/or off-site disposal of contaminated soil.

3.3.2 Site Preparation

Prior to conducting any intrusive activities for future maintenance conducted below the site cover, fencing or other barriers will be erected around the soil disturbance work zone, which will be designated as the exclusion zone. The barriers will include, at a minimum, high-visibility safety fencing, traffic cones and caution tape, or other similar measures. Any sediment and erosion control measures will be installed prior to the intrusive activities, as described in Section 3.3.8.

3.3.3 Soil Excavation

All excavations will be considered open excavations and will be managed according to applicable local, state, and federal regulations. All excavations will be backfilled as soon as the work allows. Excavations not secured with fencing will not be left open overnight. Any backfilled areas where the site cover is not immediately restored, as described in Section 3.3.12, will be temporarily stabilized with plastic sheeting or other measures.

3.3.4 Stockpiling

Any soil excavated from below the site cover will be staged in approximately 500 cubic yard (yd^3) stockpiles to be characterized for potential on-site reuse as backfill. During excavation and stockpiling, the on-site field personnel will continuously monitor the excavated soil for evidence of contamination and conduct periodic screening for VOCs using a photoionization detector (PID). Soil exhibiting obvious contamination (e.g., staining, odors, elevated PID readings) will be stockpiled separately to prevent mixing with potentially uncontaminated excavated material. All soil stockpiles will have side slopes not to exceed 2:1 and will be placed on a base consisting of minimum 6-mil plastic sheeting that is bermed with hay bales and/or silt fence at the edges. Stockpiles will be kept covered whenever excavation and/or loading operations are not occurring with appropriately anchored tarps or plastic sheeting that will be routinely inspected for damage, and replaced, as needed.

3.3.5 Soil/Fill Characterization and Reuse

For soil excavated from below the site cover, one multi-point composite soil sample will be collected from each 1,000 cubic yards (yd^3) of soil stockpile and analyzed for VOCs

by EPA Method 8260, SVOCs by EPA Method 8270, and Target Analyte List (TAL) metals. If analytical results indicate that contaminant concentrations exceed the SSSALs, the corresponding stockpile will be disposed of off-site according to applicable regulations as described in Section 3.3.6. If analytical results indicate that all contaminant concentrations in the composite sample are below the SSSALs, the corresponding stockpile will be used as backfill below the site cover. Excavated material will be prohibited from use in landscaping berms/planters, around plant or tree roots, in the upper 2 feet of landscapes areas, and as backfill in along utility lines.

3.3.6 Off-Site Disposal of Excess Material

If analytical results indicate that contaminant concentrations in excavated soil exceed the SSSALs, the corresponding stockpile(s) will be disposed of off-site according to applicable regulations. Additional waste characterization will be conducted as required by the disposal facility. Fill material that meet the SSSALs, but that cannot be used for backfill due to its mechanical properties or composition or because it is in excess of the volume required for backfilling, will be separately stockpiled for waste characterization analysis and off-site disposal. Organic matter derived from on-site will be prohibited from reuse on-site. These materials will be tested in accordance with the requirements of the receiving facility, and disposed of as municipal solid waste per 6 NYCRR Part 360-1.2. Copies of correspondence with disposal facilities concerning classification of materials, testing, and permits/approvals will be included in the annual PRR submitted to NYSDEC, as described in Section 6.0. All exported soil will be considered a regulated waste, at a minimum subject to management under NYSDEC regulation (6 NYCRR 360).

Depending on the requirements of the receiving facility, large debris may be segregated from other soils, and characterized for separate disposal or possible on-site reuse. Fresh chip samples will be collected from segregated construction and demolition debris for analysis of VOCs, SVOCs, and metals at a frequency of two samples for the first 1,000 yd^3 and one sample for each additional 1,000 yd^3. If this material is found to meet the SSSALs, it may be reused on-site as described in Section 3.3.5.

Any disposal facility receiving soil or waste from the site will be provided with all waste characterization data, and will be informed that the material originated from a NYSDEC BCP site. A written statement will be obtained from the receiving facility acknowledging that it has been informed of the origin and character of the soil, and that the facility is legally allowed to accept such materials.

3.3.7 Imported Backfill

Any off-site material used as backfill will be documented as having originated from locations having no evidence of disposal or release of hazardous, toxic, or radioactive substances, wastes, or petroleum products. If the contractor designates a source of soil, it shall be further documented in writing to be soil from areas not having supported any known prior industrial or commercial development, or agricultural use. Native material from a virgin quarry source will not be sampled prior to use as backfill on the site. All other imported material will be tested via collection of one composite sample per 1000 yd^3 of material from each source. Samples will be analyzed for VOCs using EPA Method 8260, SVOCs using EPA Method 8270, TAL metals using EPA Method 6000/7000 series, PCBs using EPA Method 8082, pesticides using EPA Method 8081, and

herbicides using EPA Method 8151. Soils will be considered appropriate for use as on-site backfill if contaminant concentrations are less than the applicable TAGM 4046 RSCOs.

If more than 1,000 cubic yards of soil are imported from a given off-site, non-virgin soil source area and both samples of the first 1,000 cubic yards meet the limits described above, the sample collection frequency will be reduced to one composite sample for every 2,500 cubic yards of additional soils from the same source, up to 5,000 cubic yards. For sources greater than 5,000 cubic yards, sampling frequency may be reduced to one sample per 5,000 cubic yards, provided that all earlier samples meet the prescribed limits.

The owner can seek approval from the NYSDEC Division of Environmental Remediation to be exempt from the testing requirements for imported fill dependent upon the source.

3.3.8 Erosion Control/Stormwater Management

Smaller-scale soil disturbances for future utility maintenance and landscaping conducted after the completion of site redevelopment are not anticipated to require coverage under the New York SPDES General Stormwater Permit for Construction Activity (Permit Number GP-02-01). However, best management practices, such as the placement of straw bales and silt fencing around soil stockpiles and/or the use of polyethylene liners and covers to temporarily stabilize excavations, will be implemented during small-scale soil disturbance. If major renovations involving one acre or greater of land disturbance occur at the site, coverage under the NYSDEC General Stormwater Permit (Number GP-02-01) will be obtained, and a Stormwater Pollution Prevention Plan (SWPPP) will be prepared and implemented.

3.3.9 Health and Safety

All work that involves soil disturbance will be performed in accordance with all applicable local, state and federal regulations to protect worker health and safety. The site-specific health and safety plan (HASP), included in Attachment E, provides details of personnel protection, air monitoring and particulate/VOC response levels, and other health and safety protocols, procedures and requirements. The HASP will be implemented during all future maintenance work that involves disturbance below the site cover. The HASP is intended to protect the health of workers who have the potential to come in contact with known on-site contaminants.

3.3.10 Odor and Dust Control

Air monitoring will be performed during disturbance below the site cover in accordance with the site-specific HASP. If the air monitoring program identifies potential exposure of field personnel or the public to potential environmental hazards in the soil or groundwater, appropriate measures will be taken to control odors/dust and community air monitoring will be initiated as described in Section 3.4.3. Soil stockpiles will be kept covered whenever excavation and/or loading operations are not occurring with appropriately anchored tarps and/or plastic sheeting that will be routinely inspected for damage, and replaced as needed. Open excavated areas will be covered with plastic sheeting whenever excavation operations are not occurring to minimize emission of contaminant vapors. Water will be used as necessary to minimize the generation of dust

during loading operations. Foam will be available, as needed, to control potential vapors or odors.

3.3.11 Construction Water Management

Dewatering will be performed as necessary to complete excavation work below the water table. If the excavation work requires only minimal groundwater removal, a vacuum truck will be utilized to dewater the excavation. If larger scale dewatering efforts are required, submersible pumps will be used to remove groundwater from gravel-lined sumps dug at the bottom of the excavations. The groundwater will be pumped to a treatment unit designed specifically for the anticipated dewatering requirements. The treatment unit should contain a settling tank(s) to remove suspended solids and filters to remove suspended particles from the water stream. The treated water will be discharged to the New York City sanitary sewer under NYCDEP sewer connection and discharge permits, or to the storm sewer under a NYSDEC SPDES permit, as appropriate. A sample of the treated water will be collected prior to the sewer connection at the time of system activation and will be analyzed for NYCDEP or NYSDEC discharge parameters to ensure that effluent limitations are met. Additional sampling and analysis of the dewatering discharge will be completed as required by the NYCDEP or NYSDEC. Waste materials from the water treatment system (e.g., bag filters and sediment from the settling tanks) will be characterized and disposed of at an appropriate waste receiving facility. No dewatering fluids will be recharged back to the land surface or subsurface of the site. Long Island Well Permits will be obtained for the dewatering points, if required.

3.3.12 Cap Restoration

The site cover will be repaired following any soil disturbance activities to restore it to its original condition and ensure that it continues to be effective at preventing direct exposure to residual contamination in the RMZ. Restoration of the soil cover will include replacing any excavated cover soil/top soil in landscapes area with at least 2 feet of material that meets the NYSDEC TAGM 4046 RSCOs, and stabilizing the affected area using plantings, paving stones, and/or other stabilization measures. Any portions of the cover where asphalt or concrete paving is removed will be restored by patching the area with asphalt or concrete at least four inches in thickness. If the vapor barrier is breached during the soil disturbance activities, the affected portion will be repaired in accordance with the manufacturer (Liquid Boot) recommendations prior to placement of the concrete patch.

3.3.13 Access Control

As described in Section 3.3.2, barriers will be erected around any areas of the site where soils are disturbed and obvious access points will be established. Unauthorized persons will not be allowed access to the work zones while excavation or handling of potentially contaminated soil is taking place.

3.3.14 Truck Management

All trucks carrying excavated soil off-site will be lined and covered with plastic, will have tight-fitting covers, and will be washed prior to leaving the site on a properly constructed truck wash pad. Truck wash waters will be collected and disposed offsite in

an appropriate manner. Egress points for truck and equipment transport from the site will be kept clean of dirt and other materials during future soil disturbance. Queuing of trucks will be performed on-site in order to minimize off-site disturbance to the extent practicable.

3.3.15 QA/QC

All waste and reuse characterization samples collected during soil disturbance activities will be analyzed using the most recent NYSDEC Analytical Services Protocol (ASP). Analytical data will be submitted in complete ASP Category B data packages including documentation of laboratory QA/QC procedures that will provide legally defensible data in a court of law.

The laboratory proposed to perform the analyses will be certified through the NYSDOH Environmental Laboratory Approval Program (ELAP) to perform Contract Laboratory Program (CLP) analyses and Solid Waste and Hazardous Waste Analytical testing on all media to be sampled. The laboratory will maintain this certification for the duration of this project.

Where appropriate, trip blanks, field blanks, field duplicates, and matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a frequency of 5% (1 set of QA/QC samples per 20 field samples), and will be used to assess the quality of the data.

3.3.16 Recordkeeping

A project logbook will be maintained during any soil disturbance activities below the site cover and/or loading out of soil for off-site disposal. The log book will be made available for NYSDEC and NYSDOH inspection, and will include the following information:

- Date, weather, and site conditions;
- Names and companies of all on-site personnel;
- Makes, models, and calibration records for all monitoring equipment;
- Makes and models of excavation/loading equipment;
- Sample numbers and descriptions;
- A truck log listing license plate numbers and arrival/departure times; and
- Site sketches showing excavation areas, sampling locations, and stockpiles (if any).

Copies of all waste manifests and bills of lading will be also be maintained with the project logbook.

3.3.17 Reporting

If requested by the NYSDEC, daily reports will be provided to the NYSDEC/NYSDOH project managers via email during excavation activities below the site cover. The reports will include a summary of daily activities and air sampling results (including any exceedances), and will describe any odor or dust problems and corrective actions taken. A site map will be submitted, as required, to identity work areas described in the reports. Any time-sensitive information (e.g., the occurrence of a spill or an emergency situation) will be communicated directly to the NYSDEC project manager.

A close-out report will be completed upon completion of any soil disturbance activities below the site cover. The report will include:

- A narrative describing the purpose, location, and extent of the soil disturbance;
- Analytical results for reuse and waste characterization samples;
- An accounting of the destination of all material removed from the site and associated manifests/bills of lading and certificates of disposal from the respective receiving facilities;
- Documentation of source approval and sampling for backfill materials imported from off-site;
- A summary of air monitoring results.

The close out report will be submitted to the NYSDEC as part of the Annual PRR, as described in Section 6.0.

3.4 SOIL MANAGEMENT CONTINGENCY PLAN

All excavation will be continuously monitored for the presence of buried tanks, drums or other containers, sludges, or soil which shows evidence of obvious contamination, such as heavy staining, sheen, or strong odors. If any of these are detected, excavation in the area will be halted, and the NYSDEC will be notified.

The affected area will be cordoned off and no further work will be performed at that location until the appropriate contingency response plan is implemented. Work zone air monitoring will be conducted during all contingency response actions, as described in the project HASP (see Attachment E). In addition, community air monitoring will be conducted as described in Section 3.4.3.

3.4.1 Petroleum Tank Removal Contingency

In the event that an underground storage tank or buried drum is encountered during soil excavation activities, the tank/drum and any appurtenances will be cleaned, removed and disposed of in accordance with accepted industry standards and applicable federal, state, and local regulatory agency requirements. Soil removal from the vicinity of discovered underground storage tank/drum will be conducted in consultation with the NYSDEC project manager.

According to 6 NYCRR Part 612.2, the existing State Petroleum Bulk Storage listing for the site will be updated to reflect the discovery and subsequent removal of any known or additional tanks from the site. Tank removal activities and any associated petroleum-contaminated soil removal will be documented in a Spill Closure Report, which will be submitted to NYSDEC. In addition, the removal of any gasoline underground storage tanks will be reported to the New York City Fire Department.

Typical tank removal procedures are summarized below:

1. Open fill cap or vent pipe and measure for product. Collect a sample of the product. Tank contents will be sampled in accordance with applicable federal, state and local requirements and tested in accordance with the requirements of the receiving facility. Proper disposal of tank contents at an approved facility will be dictated by sample results.

2. Excavate to expose the tank. Vacuum liquid tank contents and pumpable tank bottom residue.
3. Excavate around the tank with care to avoid release of tank and piping contents. Hand excavation around the tank may be necessary. The sides of all excavated areas will be properly stabilized in accordance with OSHA regulations. Continuously monitor the excavated areas in the worker breathing zone for the presence of flammable, toxic or oxygen deficient atmosphere with a photoionization detector (PID), a combustible gas indicator (CGI), and an oxygen meter.
4. Inert the tank of flammable vapors using dry ice and verify using an oxygen meter (less than 7 percent). An access hole will be cut in the tank and the tank will be thoroughly cleaned of residual liquids and sludges.
5. Entry of the tank, if necessary, shall be conducted in conformance with OSHA confined space requirements.
6. Remaining fuels, loose slurry, sludge materials and wastewater will be collected in DOT-approved drums, sampled and analyzed for disposal characterization. After disposal characterization, waste material will be removed and disposed of in accordance with applicable regulations.
7. Remove the tank and all associated piping from the ground and clean the outside of the tank. The tank and piping will be rendered "not reusable," removed from the site and disposed of according to applicable regulations with proper documentation. Remove and dispose of all concrete tank support structures or vaults as encountered.
8. Spill reporting to the NYSDEC Spill Hotline (800-457-7362) shall be conducted, as necessary.
9. After tank removal, examine for evidence of petroleum releases in accordance with NYSDEC requirements.
10. Suspect materials will be field-screened with a PID. If soil contamination is present, excavate and remove contaminated soil from the tank areas in accordance with the stockpiling and disposal procedures presented in Sections 3.3.4 and 3.3.6. Material will be excavated until field screening with a PID yields concentrations of less than 20 ppm and until there are no remaining visible signs of contamination or odors. Endpoint sampling will be conducted as directed by the NYSDEC.
11. Photo-document all procedures and record all procedures in a bound field notebook.
12. Copies of all testing results, correspondence with disposal facilities concerning classification of materials, and permits/approvals will be maintained by the project manager and will be submitted to the NYSDEC in a Tank Closure Report.
13. A signed affidavit shall be prepared by the licensed tank installation (removal) contractor and submitted to the New York City Fire Department certifying proper removal of the tank(s).

3.4.2 Soil Contamination Contingency

If sludges or soil exhibiting gross contamination, such as heavy staining, sheen, NAPL, or strong odors, are encountered during future soil disturbance, the following procedures will be implemented:

1. Spill reporting to the NYSDEC Spill Hotline (800-457-7362) will be conducted as necessary.
2. The grossly contaminated soil will be excavated and stockpiled in accordance with the procedures presented in Section 3.3.
3. The excavation will continue vertically until no evidence of contamination is noted in the base of the excavation or until groundwater or other physical limitation is encountered. The excavation will continue horizontally until no evidence of contamination is noted in the sidewalls of the excavation, unless physical limitations are encountered. Post-excavation endpoint samples will be collected from the sides and bottom of the excavated area, as required by the NYSDEC. Analytic parameters for post excavation soil samples will be determined based on communications with NYSDEC. If post-excavation samples exceed action levels, then additional excavation will be performed, as warranted.
4. The stockpiled soil will be sampled for laboratory analyses. Soil samples will be analyzed for parameters required by the intended disposal facility.
5. Upon acceptance to an appropriate receiving facility, the contaminated soil will be disposed of off-site in accordance with Section 3.3.6.
6. Copies of correspondence with disposal facilities concerning classification of materials, testing results, and permits/approvals will be maintained by the project manager and will be submitted to NYSDEC as part of a close-out report, as described in Section 3.3.16.

3.4.3 Community Air Monitoring and Odor Control

If work zone air monitoring conducted as part of the HASP exhibits evidence of elevated VOCs, particulate, and/or nuisance odors, the following Community Air Monitoring and Odor Control Plan will be implemented. This plan is intended to protect the health of community residents who have the potential to be exposed to known on-site contaminants as a result of fugitive discharge of dusts, vapors, and/or nuisance odors. Furthermore, in the event that underground storage tanks and/or grossly contaminated soil are encountered during future excavation activities, the following plan will be implemented.

Walk-around air monitoring will be conducted along the upgradient and downgradient boundaries of the site boundaries to monitor for elevated levels of VOCs/particulates, visible dust, and odor. The walk-around monitoring will be conducted with the results being logged at least once per hour. More frequent monitoring will be implemented based upon visible dust, odors, detection of VOCs/particulates at concentrations approaching or exceeding an alert level, or other conditions, as warranted.

VOC concentrations will be monitored with a Thermo 580B PID or equivalent. A Dust Trak® dust monitor or equivalent will be used to monitor particulate matter. Field equipment will be calibrated at the start of each workday in accordance with the manufacturers' requirements. Instrument readings, observable odors, and visible dust will be documented in the field book. The following table presents the appropriate action levels and responses for the Community Air Monitoring Plan and Odor Control Plan.

Alert Level	Action Level	Response Action
Green	VOCs < 3.3 ppm PM10 < 100 µg/m^3 No Visible Dust No Odors Along Perimeter	**None – continue monitoring**
Yellow	VOCs ≥ 3.3 ppm, but less than 5.0 ppm	1. Confirm VOC source is from site emissions – if not, continue total VOC monitoring (green alert) 2. If VOCs are from site emissions, notify NYSDEC 3. If VOC levels persist, then cover exposed affected soils or stockpile soil with tarpaulins and/or vapor suppressing foam
Yellow	PM10 ≥ 100 µg/m^3, but <150 µg/m^3 Visible Dust Odors Along Perimeter or Odor Complaints	1. Confirm particulate or odor exceedances are downwind of work area and are from site activities 2. If particulates are attributable to site activities, then cover exposed affected soils or stockpile soil with tarpaulins, vapor suppressing foam, and/or apply water, as appropriate.
Red	VOCs ≥ 5.0 ppm PM10 ≥ 150 µg/m^3 Visible Dust Odors Along Perimeter or Odor Complaints	1. Apply yellow alert controls 2. Cease activities if action level exceedance(s) not resolved 3. Re-initiate activities after reaching concurrence between site personnel & NYSDEC

4.0 MONITORING PLAN

4.1 MONITORING PLAN OBJECTIVES

The objectives of the monitoring plan are as follows:

- Monitoring groundwater conditions to assess the efficacy of the hydraulic barrier;
- Prepare the necessary reports to document and evaluate the monitoring results.

4.2 GROUNDWATER MONITORING

Groundwater monitoring was conducted on a quarterly, then semi-annual basis to determine whether the hydraulic barrier is effectively isolating the site from off-site contamination and to determine whether residual soil contamination left on-site is adversely affecting groundwater. Groundwater monitoring was discontinued in 2015with approval by the NYSDEC. Groundwater samples were collected from two on-site monitoring wells (MW-11R and MW-12), and five wells outside of the hydraulic barrier (MW-2, MW-8 and MW-14 through MW-16). Monitoring well locations are shown on Figure 10. Logs for the off-site monitoring wells, which were installed during previous investigations, are provided as Attachment F. The groundwater samples were collected using low-flow sampling methods and analyzed for VOCs by EPA Method 8260 and SVOCs by EPA Method 8270. During each sampling event, the depth to water was measured in all monitoring wells to determine groundwater elevation and flow patterns. Potential LNAPL and DNAPL were gauged at each well using an oil-water interface probe and/or weighted tape. Monitoring well installation/development and low-flow groundwater sampling were conducted in accordance with the Standard Operating Procedures (SOPs) described in Section 4.6. The following sections describe the procedures that were followed.

4.3 MONITORING POINT REPAIR/REPLACEMENT

4.3.1 Monitoring Wells

The on-site and off-site monitoring wells will be inspected on a semi-annual basis at the time of each scheduled sampling event. Inspection will consist of lowering a weighted measuring tape to the bottom of the well to ensure that it has not been filled in with silt, and visual assessment of the well casing, cap, and road box. Any minor damage (e.g., missing well cap, cracked riser) will be repaired and documented. If significant silting is identified, the well will be re-developed as described in Section 4.6.1. If the well is found to be damaged beyond repair, it will be decommissioned and a replacement well will be installed in accordance with the SOPs described in Section 4.6.2.

4.4 REPORTING

Monitoring reports will be prepared on an annual basis and will include figures displaying groundwater elevation contours from each monitoring event, tables summarizing all field and laboratory analytical data, and a comparison of analytical results to applicable regulatory standards. The reports also will document any replacement or repair of environmental monitoring devices (e.g., monitoring wells). Copies of laboratory analytical data reports will be provided as attachments. The monitoring reports will be incorporated into the annual PRR, as described in Section 6.3.

4.5 STANDARD OPERATING PROCEDURES

The following sections describe the standard operating procedures for collecting and handling samples in the field and for performing decontamination of sampling equipment. During these operations, safety monitoring will be performed as described in the project Health and Safety Plan (HASP) and all field personnel will wear appropriate personal protective equipment.

4.5.1 Monitoring Well Installation

Borings for the monitoring wells will be advanced to the desired depth using 6.25-inch outside diameter hollow stem augers and a truck-mounted drill rig. Once reaching the desired depth monitoring wells will be installed in the boring using two-inch diameter PVC well materials according to the following procedure:

- Measure the depth to water in the open hole using an oil/water interface probe.
- Place PVC riser with a ten-foot length of PVC 0.02-slotted screen at the bottom of the borehole. For shallow wells, the screen should be placed with approximately six feet of screen above and four feet of screen below the water table. At locations where groundwater is encountered at less than five feet deep, the screen should be placed with approximately two feet of screen above the water table to allow room for the filter pack and bentonite seal. For wells advanced to the bedrock surface or potential DNAPL the well screen should contain a sump consisting of two feet of solid PVC riser and a bottom cap.
- Install the sand filter pack around the well screen to a depth of one to two feet above the top of the screen.
- Install a bentonite seal to a depth of one to two feet above the filter pack.
- Backfill the remainder of the annular space using a bentonite-cement grout.
- Complete the well with a locking cap flush-with-grade curb box set in cement. Provide a cement apron around the curb box to direct run-off away from the well.
- Decontaminate the augers prior to and following installation of each well as described in Section 4.6.5.
- Document well installation data (location, depth, construction details, water level measurements) in the field logbook or on field data sheets.

4.5.2 Monitoring Well Development

Following well installation, all new and existing wells will be developed according to the following procedure:

- Measure the depth to water using an oil/water interface probe and the total depth of the well using a weighted tape. Use these measurements to calculate the length of the water column (total depth minus depth to water). Calculate the volume of water in the well using the following conversion factors:

Well Diameter (inches)	Volume per Foot of Water Column (gallons)
2	0.163
4	0.653
6	1.469

- Develop the well using a submersible pump and discharge the water to 5-gallon buckets. Transfer water from the buckets to 55-gallon drums designated for well development water.
- During development, collect periodic samples and analyze for turbidity and water quality indicators (e.g., pH, temperature, and specific conductivity) with measurements collected approximately every five minutes.
- Continue developing the well until turbidity is less than 10 nephelometric turbidity units (NTUs) for three successive readings or until water quality indicators have stabilized to the extent practicable. The criteria for stabilization will be three successive readings within ±10% for pH, temperature and specific conductivity. A minimum of three well volumes of water should be removed.
- Document the volume of water removed and any other observations made during well development in the field logbook or on field data sheets.
- Decontaminate the equipment prior to and following development at each well location as described in Section 4.6.5.

4.5.3 Monitoring Well Sampling

Groundwater samples will be collected at least two weeks following well development according to the following procedure:

- Prepare the sampling area by placing plastic sheeting over the well. Cut a hole in the sheeting to provide access to the well manhole.
- Remove the locking cap and measure the vapor concentrations in the well with a PID.
- Measure the total well depth, depth to water and check for the presence of light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL) using an oil/water interface probe. Groundwater samples will not be collected from wells containing measurable NAPL.
- Use the water level and total well depth measurements to calculate the length of the mid-point of the water column within the screened interval. For example, for a shallow well where the total depth is 15 feet, screened interval is five to 15 feet, and depth to water is seven feet, the mid-point of the water column within the screened interval would be 11 feet. Similarly for a deep well where the total depth is 40 feet, screened interval is 30 to 40 feet, and depth to water is 15 feet, the mid-point of the water column within the screened interval would be 35 feet.
- Connect dedicated tubing to either a submersible or bladder pump and lower the pump such that the intake of the pump is set at the mid-point of water column within the screened interval of the well. Connect the discharge end of the tubing to the flow- through cell of a Hydrolab Quanta multi-parameter (or equivalent) meter. Connect

tubing to the output of the cell and place the discharge end of the tubing in a 5-gallon bucket.

- Activate the pump at the lowest flow rate setting of the pump.
- Measure the depth to water within the well. The pump flow rate may be increased such that the water level measurements do not change by more than 0.3 feet as compared to the initial static reading.
- Transfer discharged water from the 5-gallon buckets to 55-gallons drums designated for well-purge water.
- During purging, collect periodic samples and analyze for water quality indicators (e.g., turbidity, pH, temperature, dissolved oxygen, reduction-oxidation potential, and specific conductivity) with measurements collected approximately every five minutes.
- Continue purging the well until turbidity and water quality indicators have stabilized to the extent practicable. The criteria for stabilization will be three successive readings for the following parameters and criteria:

Parameter	Stabilization Criteria
pH	+/- 0.1 pH units
Specific Conductance	+/- 3% S/cm
ORP/Eh	+/- 10mV
Turbidity	+/- 10% NTUs (for values > 1 NTU)
Dissolved Oxygen	+/- 0.3 mg/l

- If the water quality parameters do not stabilize within four hours, purging may be discontinued. Efforts to stabilize the water quality for the well must be recorded in the field book, and samples may then be collected as described below.
- After purging, disconnect the tubing to the inlet of the flow-through cell. Collect groundwater samples directly from the discharge end of the tubing and place into the required sample containers as described in Section 3.0. Label the containers as described in Section 4.8 and place in an ice-filled cooler. Samples should be collected first for VOCs, then SVOCs, and the remaining inorganic analyses.
- Collect one final field sample and analyze for turbidity and water quality parameters (e.g., pH, temperature, dissolved oxygen, reduction-oxidation potential, and specific conductivity).
- Once sampling is complete, remove the pump and tubing from the well. Disconnect the tubing and place it back in the well for reuse during the next sampling event. Dispose of the sample filter in a 55-gallon drum designated for disposable sampling materials.
- Decontaminate the pump, oil/water interface probe, and flow-through cell as described in Section 4.6.5.
- Record all measurements (depth to water, depth to NAPL, water quality parameters, turbidity), calculations (well volume) and observations in the project logbook and field data sheet, if applicable.

4.5.4 Decontamination Procedures

Decontamination will be conducted on plastic sheeting or other containment unit that is bermed to prevent runoff to the ground. Prior to use on-site and between sampling locations, the split spoon, submersible pump, oil/water interface probe, and other non-disposable sampling equipment will be decontaminated using the following procedures:

- Scrub using tap water/Simple Green→ mixture and bristle brush.
- Rinse with tap water.
- Scrub again with tap water/ Simple Green→ and bristle brush.
- Rinse again with tap water.
- Final rinse with distilled water.
- Air dry the equipment.

The hollow stem augers will be decontaminated with a pressure washer using a tap water/Simple Green→ solution.

4.5.5 Monitoring Well Decommissioning

Damaged or inoperable wells will be decommissioned in accordance with the NYSDEC document "Groundwater Monitoring Well Decommissioning Procedures", dated October 1996. It is anticipated the "pulling casing" method will be appropriate for monitoring wells used at the site. General procedures for pulling well casings are described below:

- Puncture the bottom of the well if possible; otherwise, perforate the screen and casing to allow grouting of the well.
- Flush the well with water if necessary to remove sand (to prevent "lock-up" as the casing is pulled).
- Pressure grout the well using a tremie pipe lowered to the bottom of the well.
- Use jacks as necessary to loosen the casing from the surrounding formation.
- Lift the casing from the ground, if possible, using a drill rig, back hoe, crane, or other appropriate equipment.
- Add additional grout as casing is pulled to ensure complete grouting of the borehole.
- Record all measurements (depth to water, depth to NAPL), calculations (well volume), and observations in the project logbook and field data sheet, if applicable.
- Decontaminate the equipment following well decommissioning as described in Section 4.6.5.

4.5.6 Sample Handling

Sample Identification

All samples will be consistently identified in all field documentation, chain-of-custody documents and laboratory reports using an alpha-numeric code. Groundwater samples will be identified by the monitoring well number.

The designation "MS" will be added at the end of the designation for matrix spike/matrix spike duplicate samples. The field duplicate samples will be labeled with a dummy

sample location to ensure that they are submitted as blind samples to the laboratory. The dummy identification will consist of the sample type followed by a letter. Trip blanks and field blanks will be identified with "TB" and "FB", respectively.

Sample Labeling and Shipping

All sample containers will be provided with labels containing the following information:

- Project identification
- Sample identification
- Date and time of collection
- Analysis(es) to be performed
- Samplers initials

Once the groundwater samples are collected and labeled, they will be placed in ice-filled coolers and stored in a cool area away from direct sunlight to await shipment to the laboratory. The samples will be prepared for shipment by placing each sample in a sealable plastic bag, then wrapping each container in bubble wrap to prevent breakage, adding fresh ice in two sealable plastic bags and the chain-of-custody (COC) form. Samples will be shipped overnight (e.g., via Federal Express) or transported by a laboratory courier. All coolers shipped to the laboratory will be sealed with mailing tape and a COC seal to ensure that the coolers remain sealed during delivery.

Sample Custody

Field personnel will be responsible for maintaining the sample coolers in a secured location until they are delivered to the laboratory. The record of possession of samples from the time they are obtained in the field to the time they are delivered to the laboratory or shipped off-site will be documented on COC forms. The COC forms will contain the following information: project name; names of sampling personnel; sample number; date and time of collection and matrix; and signatures of individuals involved in sample transfer, and the dates and times of transfers. Laboratory personnel will note the condition of the custody seal at sample check-in.

4.5.7 Field Instrumentation

Field personnel will be trained in the proper operation of all field instruments. Instruction manuals for the equipment will be available on-site for referencing proper operation, maintenance and calibration procedures.

The equipment will be calibrated according to manufacturer specifications at the start of each day of fieldwork. If an instrument fails calibration, the project manager or QA/QC officer will be contacted immediately to obtain a replacement instrument and arrange for repairs. A calibration log will be maintained to record the date of each calibration, any failure to calibrate and corrective actions taken. The PID will be calibrated each day using 100 parts per million (ppm) isobutylene standard gas.

4.6 QA/QC

All groundwater samples collected during remediation monitoring activities will be analyzed using the most recent NYSDEC ASP. Analytical data will be submitted in complete ASP Category B data packages including documentation of laboratory QA/QC procedures that will

provide legally defensible data in a court of law.

The laboratory proposed to perform the analyses will be certified through the NYSDOH ELAP to perform CLP analyses and Solid Waste and Hazardous Waste Analytical testing on all media to be sampled. The laboratory will maintain this certification for the duration of this project.

Where appropriate, trip blanks, field blanks, field duplicates, and MS/MSD samples will be collected at a frequency of 5% (1 set of QA/QC samples per 20 field samples), and will be used to assess the quality of the data.

5.0 OPERATION AND MAINTENANCE PLAN

This Operation and Maintenance Plan describes the measures necessary to inspect, operate, and/or maintain the engineering control components of the remedy. The main objectives of the O&M plan are as follows:

- Inspect and maintain the site cover;
- Describe the operation and maintenance of the vapor mitigation system;
- Specify personnel responsible for operation/maintenance tasks;
- Ensure proper operation and maintenance of the system to confirm that it continues to be effective for the protection of human health; and

The O&M plan will be updated as necessary during use to reflect changes in site conditions or the manner in which the treatment system is operated and maintained. A copy of this plan will be kept on-site at all times.

5.1 SITE COVER

The site cover will be inspected on an annual basis to ensure that it continues to be an effective preventing direct exposure to residual contamination (below the site cover). Inspections of the site cover also will be conducted whenever a severe condition, such as major erosion or flooding occurs at the site. The inspections will consist of checking the asphalt/concrete paving for cracking and/or signs of wear, and checking for erosion of the soil cover in unpaved areas. If minor cracking or damage is observed over less than 25 percent of the paved areas, cracks and/or holes will be patched or repaired as required. If cracking and/or other damage is observed over greater than 25 percent of the paved areas, the area will be repaved with asphalt or concrete to restore a thickness of at least four inches. If signs of erosion to the soil cover are observed, the corresponding portion of the cover will be stabilized using plantings, paving stones, and/or other stabilization measures. Inspection logs and records of any repairs made to the site cover will be included in the PRR, as described in Section 6.1. An example Site Cap Inspection Log is included in Attachment G.

5.2 VAPOR MITIGATION SYSTEM DESCRIPTION

The vapor mitigation system design consists of a vapor barrier, a sub-slab gas collection network, steel pipe risers, and aboveground blowers/instrumentation. The risers penetrate the building slab at four locations to connect to the aboveground equipment, which will be housed in mechanical rooms located on the ground floor of the residential apartment building and at the eastern end of the townhouses. The location of the vapor barrier and sub-slab ventilation system components are shown on the as-built drawing provided in Attachment C.

5.2.1 Vapor Barrier

The vapor barrier consists of a 60-mil thick, spray-applied, LiquidBoot gas vapor membrane. A base fabric T-60 non-woven geotextile was installed under the membrane, and a protective Liquid Boot Ultrashield layer was installed on top of the membrane.

5.2.2 Gas Collection Network

The subsurface gas collection pipe network consists of schedule 40, 4-inch diameter PVC piping with 0.02-inch slots installed in a 12-inch thick layer of gas-permeable aggregate. The slotted piping is installed in four separate zones under the on-site residential buildings, as follows:

- Zone 1 – Northern wing of high-rise building (facing Center Boulevard)
- Zone 2 – Central tower portion of high-rise building
- Zone 3 – Southern wing of high-rise building (facing 48th Avenue)
- Zone 4 – Townhouses

All subsurface piping is installed horizontally with a minimum one percent slope to prevent accumulation of water that may collect in the piping. Hangers are provided every five feet and anchored in the concrete building slab to prevent damage to the piping in the event of subsurface settlement. In each zone, a length of solid 4-inch diameter Schedule 40 PVC piping leads from the slotted piping network to an interior riser, as shown on the drawings in Attachment C. The solid PVC piping is connected to 4-inch diameter Schedule 40 steel risers via Fernco couplings. Cleanouts are provided at each riser at approximately 12-inches above the floor penetration.

5.2.3 Blower Assemblies

Blower assemblies are connected to each interior steel riser to draw vapors from the four subsurface piping zones. The specified permanent blowers are American Fan Company® cast aluminum centrifugal blowers capable of providing 250 cubic feet per minute (CFM) at 15 inches of water gauge. A particulate filter and dilution valve will be installed on the suction side of each blower. The inlet and outlet sides of each particulate filter will be equipped with unions and vacuum gauges. A sample port, flow meter, and silencer will be provided on the outlet side of each blower. Each blower unit will be connected to an adjacent control panel that contains a motor starter, Hand/Off/Auto switch, and a timer. Manufacturer specification sheets for the blowers and instrumentation are included in Attachment C.

5.3 PERMITTING

The vapor mitigation system will be installed and operated under the NYSDEC BCP requirements; therefore, formal NYSDEC Title V registration and permitting are not required. However, an Air Facility Registration Form will be submitted to the NYSDEC project manager prior to system activation to demonstrate that the potential emissions from the vapor mitigation system will meet the NYSDEC emission standards.

5.4 O&M PERSONNEL

Inspection, maintenance, and monitoring activities will be performed by personnel possessing training and expertise to conduct the tasks described in this O&M Plan. Key project personnel and their responsibilities are described below:

Project Engineer/Project Manager

The project engineer will be responsible for overseeing system start-up activities to ensure that the system is operating properly. After system start-up, he/she will train the project manager, O&M Field Technician and Site Representative on routine O&M procedures. The project engineer is also responsible for ensuring the weekly and routine inspections are conducted as required.

O&M Field Technician

The O&M field technician will be responsible for conducting/supervising periodic O&M of the system, including: vacuum and air-flow measurements and equipment maintenance. He/she will report to the Project Engineer/Project Manager on a regular basis regarding O&M.

Site Representative

The Site Representative will be responsible for routine checks of system and alerting appropriate personnel of any system shutdown or other emergency conditions. The Site Representative duties will be assigned to on-site AvalonBay maintenance personnel.

5.5 ACTIVE OPERATION

5.5.1 Start-Up Procedures

Prior to activating the system for the first time, the operator should measure the voltage to the blowers to ensure 230V operation and check the rotation of the blower vanes to ensure the correct direction of air flow. After making any necessary adjustments, the blowers should be operated using the following procedures:

- Check to ensure that all valves are open
- Turn the blower switch to the AUTO position (green light will appear)
- Throttle the dilution valve so that the flow rate is approximately 250 CFM

At the initial start-up, all gauge readings, including vacuums and flow rates, will be recorded in the system log book, which will be maintained in one of the control rooms. Any subsequent start-up of the system (e.g., following an emergency shut-down) will be conducted using the same procedures described above. During system start-up, the Project Engineer will train the O&M Technician and Site Representative in system inspection and O&M procedures.

5.5.2 Inspections

Routine System Checks

The Site Representative will conduct system checks on a routine basis. The routine check will consist of inspecting the control panel status light to ensure that the blower is operational, and noting any unusual conditions such as leaks or odors. If the system is not functioning properly (i.e., the blower is not operational or leaks are noted), the Site Representative will immediately notify an emergency contact of the condition. Phone numbers for the emergency contacts will be posted next to the blower in each control room and on the Routine System Check log sheet. Routine checks will be conducted daily during the first month of operation and weekly thereafter. A copy of the log sheet is provided in Attachment G.

Periodic Inspections

Routine inspections will be conducted by the O&M Technician, and will consist of adjusting system components to optimize system efficiency and recording all gauge and meter readings (i.e., flow meter, vacuum/pressure gauges) in the system log book and on Routine Inspection Forms (provided in Attachment G). Any required maintenance will also be conducted during routine inspections. Routine inspections will be conducted on a weekly basis during the first month of system operation, monthly for the subsequent two months, and on a quarterly basis thereafter.

Emergency Inspections

An inspection and evaluation of the system will occur whenever there is a shutdown of the vapor mitigation system or after any severe condition such as flooding occurs at the site. Any damage or operational problems and steps taken to correct the problems will be noted in the field book.

5.5.3 Maintenance

Following system activation, the pressure and flow rates will be recorded to establish values for normal operating conditions. During each subsequent routine inspection, vacuum and flow rate readings will be compared to normal operating conditions. The inline filters will be replaced if the differential between vacuum readings before and after the filter is greater than 3 inches of water over normal conditions.

5.6 SECURITY MEASURES

All vapor mitigation equipment will be housed within control rooms in maintenance areas of the residential buildings. The doors to the control rooms will remain locked during all times that O&M activities are not being conducted. Access to the controls rooms will be limited to persons knowledgeable of the system O&M and safety requirements. A list of emergency contacts will be posted in each control room.

5.7 REPORTING

O&M Reports will be prepared on an annual basis. The reports will document all routine maintenance activities and system malfunctions/repairs. The reports will also provide an evaluation of system performance and make recommendations for changes in system operation, if warranted. Copies of analytical data reports and O&M inspection sheets will be provided as attachments. The O&M reports will be incorporated into the annual PRR, as described in Section 6.3.

6.0 PERIODIC REVIEW REPORT PLAN

6.1 PERIODIC REVIEW REPORTS (PRR)

A PRR will be submitted on an annual basis, and will include a certification of all institutional and engineering controls (as described in Section 6.3), and a summary of required site inspections (as described in Section 6.2). The PRR will identify all institutional and engineering controls specified in the RWP; evaluate the Engineering and Institutional Control Plan, and assess and certify the continued effectiveness of all institutional and/or engineering controls. The PRR will document all site inspections, monitoring, O&M activities, and soil disturbance (if any), and provide an overall assessment of the status of the site remedy. The PRR will include the following:

- Tables and figures summarizing all monitoring and O&M data collected during the reporting period;
- A description of any soil disturbance activities, and associated soil management requirements that were addressed;
- An evaluation of the effectiveness of the vapor mitigation system, including identification of any needed repairs or modifications and an assessment of compliance with applicable discharge standards;
- Any new conclusions or observations regarding the site contamination based on the inspections or data generated by the site monitoring plan for the media being monitored;
- An assessment of the overall performance and effectiveness of the remedy, and its compliance with the decision document for the site;
- Recommendations regarding any necessary changes to the remedy and/or monitoring plan.

Copies of the annual monitoring and O&M reports, site cover and site-wide inspection logs, soil management close-out reports, and the Institutional Control/Engineering Control (IC/EC) Annual Certification will be included as attachments to the PRR. Any conclusions and recommendations based on evaluation of the information will be included in the report. The PRR will be prepared annually on a calendar year basis and will be submitted to the NYSDEC by March 31 of the following year.

6.2 SITE INSPECTIONS

In addition to the site cover inspections described in Section 3.0 and vapor mitigation system inspections described in Section 5.0, site-wide inspections will be conducted to ensure that all aspects of the remedy remain in place and effective. The site-wide inspections will be conducted at least annually and whenever a severe condition, such as major erosion, flooding, which could affect engineering controls, or a breakdown of the treatment system occurs at a site. The site-wide inspection will include an evaluation of the following:

- Compliance with site usage restrictions;
- Compliance with soil management procedures;
- Compliance with groundwater monitoring requirements;
- Compliance with permits, inspection, and maintenance schedules included in the Institutional and Engineering Control Plan and O&M plan; and,

- Compliance with recordkeeping requirements.

6.3 ANNUAL CERTIFICATION OF INSTITUIONAL AND ENGINEERING CONTROLS

The results of the site-wide inspection and the monitoring and O&M data will be evaluated to confirm the following:

- The engineering controls (site cover, hydraulic barrier, and vapor mitigation system) and institutional controls are in place, are performing properly, and remain effective;
- Operation and maintenance activities are being conducted properly; and
- The overall remedy continues to be protective of public health and the environment and compliant with the decision document for the site.

An Annual Certification consisting of a written statement prepared and signed by a professional engineer or qualified environmental professional acceptable to the NYSDEC, will be based on the evaluation described above and included in the PRR. The document will certify that:

- The institutional controls and/or engineering controls employed at the site are unchanged from the previous certification, remain in-place and effective, and are performing as designed (IC/EC Certification);
- Nothing has occurred that would impair the ability of the controls to protect the public health and environment;
- Nothing has occurred that would constitute a violation or failure to comply with any operation and maintenance plan for such controls;
- Access is available to the site to evaluate continued maintenance of such controls; and
- Site usage is compliant with the environmental easement.

The project site is a BCP site determined to be significant threat site, which contains contaminants in groundwater that contravene drinking water standards at the site border. A professional engineer or a qualified environmental professional acceptable to the NYSDEC will certify on a yearly basis that no new information, including groundwater monitoring data from wells located at the site boundary, has come to his/her attention to indicate that the assumptions made in the qualitative exposure assessment of off-site contamination are no longer valid. In addition, the Applicant will certify every five years that the assumptions made in the qualitative exposure assessment remain valid.

An example IC/EC Certification Form is provided in Attachment G.

ATTACHMENT A

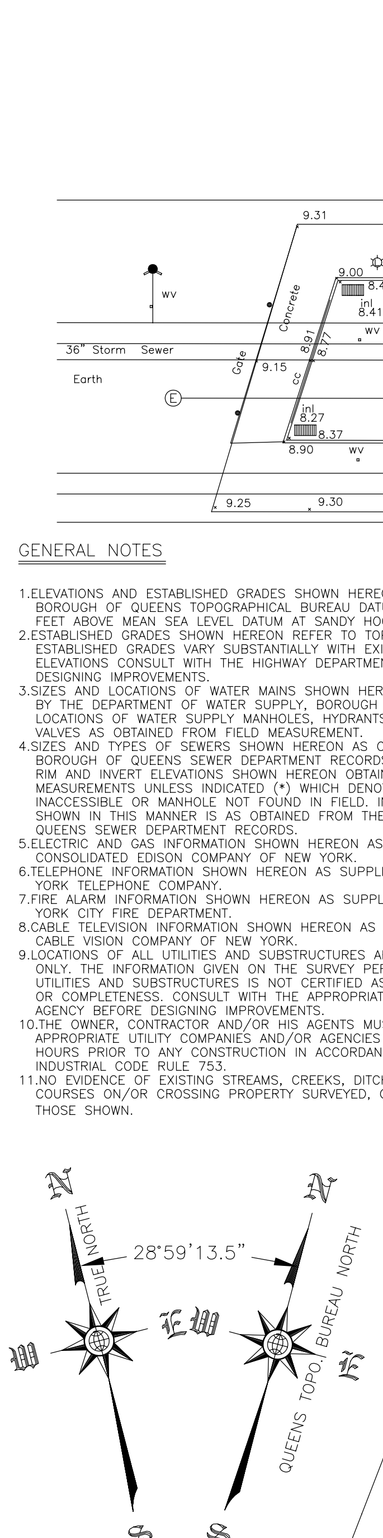
SITE SURVEY

SURVEY No. 59186

59186001.DWG
59186001.CRD

GENERAL NOTES

1. ELEVATIONS AND ESTABLISHED GRADES SHOWN HEREON REFER TO THE BOROUGH OF QUEENS TOPOGRAPHICAL BUREAU DATUM WHICH IS 2.725 FEET ABOVE MEAN SEA LEVEL DATUM AT SANDY HOOK N.J. 1929
2. ESTABLISHED GRADES SHOWN HEREON REFER TO TOP OF CURB. IF ESTABLISHED GRADES VARY SUBSTANTIALLY WITH EXISTING ELEVATIONS CONSULT WITH THE HIGHWAY DEPARTMENT BEFORE DESIGNING IMPROVEMENTS.
3. SIZES AND LOCATIONS OF WATER MAINS SHOWN HEREON AS SUPPLIED BY THE DEPARTMENT OF WATER SUPPLY, BOROUGH OF QUEENS. LOCATIONS OF WATER SUPPLY MANHOLES, HYDRANTS AND WATER VALVES AS OBTAINED FROM FIELD MEASUREMENT.
4. SIZES AND TYPES OF SEWERS SHOWN HEREON AS OBTAINED FROM THE BOROUGH OF QUEENS SEWER DEPARTMENT RECORDS. SEWER MANHOLE RIM AND INVERT ELEVATIONS SHOWN HEREON OBTAINED BY FIELD MEASUREMENTS UNLESS INDICATED (*) WHICH DENOTES INVERT INACCESSIBLE OR MANHOLE NOT FOUND IN FIELD. INFORMATION SHOWN IN THIS MANNER IS AS OBTAINED FROM THE BOROUGH OF QUEENS SEWER DEPARTMENT RECORDS.
5. ELECTRIC AND GAS INFORMATION SHOWN HEREON AS SUPPLIED BY THE CONSOLIDATED EDISON COMPANY OF NEW YORK.
6. TELEPHONE INFORMATION SHOWN HEREON AS SUPPLIED BY THE NEW YORK TELEPHONE COMPANY.
7. FIRE ALARM INFORMATION SHOWN HEREON AS SUPPLIED BY THE NEW YORK CITY FIRE DEPARTMENT.
8. CABLE TELEVISION INFORMATION SHOWN HEREON AS SUPPLIED BY THE CABLE VISION COMPANY OF NEW YORK.
9. LOCATIONS OF ALL UTILITIES AND SUBSTRUCTURES ARE APPROXIMATE ONLY. THE INFORMATION GIVEN ON THE SURVEY PERTAINING TO UTILITIES AND SUBSTRUCTURES IS NOT CERTIFIED AS TO ACCURACY OR COMPLETENESS. CONSULT WITH THE APPROPRIATE COMPANY OR AGENCY BEFORE DESIGNING IMPROVEMENTS.
10. THE OWNER, CONTRACTOR AND/OR HIS AGENTS MUST NOTIFY THE APPROPRIATE UTILITY COMPANIES AND/OR AGENCIES AT LEAST 72 HOURS PRIOR TO ANY CONSTRUCTION IN ACCORDANCE WITH INDUSTRIAL CODE RULE 753.
11. NO EVIDENCE OF EXISTING STREAMS, CREEKS, DITCHES OR WATER COURSES ON/OR CROSSING PROPERTY SURVEYED, OTHER THAN THOSE SHOWN.



47th ROAD

48th AVENUE

5th STREET

CENTER BLVD

ZONE A
(EL 10)

ZONE B

TAX BLOCK 19

AREA= 77,814 SQ.FT.
OR 1.7864 ACRES

TAX LOT 19

TAX LOT 5

N 14°42'54.9" W
(200' TAX MAP)
199.39'

S 75°17'05.1" W
351.37'

N 75°17'05.1" E
399.58'

S 06°26'24.3" W
185.26'

L = 311.00'
R = 200.00'
Δ = 89°08'02"

FLOOD HAZARD NOTE

THE PARCEL SURVEYED IS COMPRISED OF AREAS DESIGNATED AS ZONE A (EL 10) & B
FEDERAL EMERGENCY MANAGEMENT AGENCY
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP
COMMUNITY PANEL NUMBER 360497 0039 B & 360497 0040 B
EFFECTIVE DATE NOVEMBER 16, 1983

SPECIAL NOTES:

1. STREET LINES SHOWN HEREON AS PER ALTERATION MAP No: 4876
2. BEARINGS SHOWN HEREON REFER TO QUEENS TOPO. BUREAU MERIDIAN

LEGEND

ASPH.....ASPHALT
BK.....BRICK
BSMT.....BASEMENT
CC.....CURB CUT
CCR.....CONCRETE CURB ROUND
CD.....CELLAR DOOR
CLF.....CHAIN LINK FENCE
CO.....CATCH BASIN CLEAN CUT
CONC.....CONCRETE
CRF.....CHAIN ROPE FENCE
CWA.....CELLAR WINDOW AREA
DR.....DRAIN
EL.....ELEVATION
FAB.....FIRE ALARM BOX
FC.....FILL CAP
FL EL.....FLOOR ELEVATION
GP.....GUARD POLE
GV.....GAS VALVE
IF.....IRON FENCE
INL.....CATCH BASIN INLET ELEVATION
INV.....SEWER INVERT ELEVATION
.....LIGHT POLE
MB.....MAIL BOX
MHU.....UNKNOWN MANHOLE
OF.....OIL FILL
OHW.....OVERHEAD WIRES
P.....POLE
PAVT.....PAVEMENT
PM.....PARKING METER
PMULT.....POLE, MULTIPLE USAGE
PR.....PEDESTRIAN RAMP
RET.....RETAINING
RIM.....RIM ELEVATION SEWER MANHOLE
SFCR...STEEL FACED CURB ROUND
STY.....STORY
TB.....TOP OF BANK ELEVATION
.....TRAFFIC LIGHT
TEL.....TELEPHONE
TP.....TREE PIT
.....TRAFFIC SIGN
TW.....ELEVATION AT TOP OF WALL
UP.....UTILITY POLE
VU.....VALVE UNKNOWN
VLTU.....VAULT UNKNOWN
VP.....VENT PIPE
WV.....WATER VALVE
12"G.....GAS MAIN WITH SIZE
12"S.....SEWER MAIN WITH SIZE
12"W.....WATER MAIN WITH SIZE
.....CATCH BASIN
.....ELECTRIC MANHOLE / VAULT
.....FIRE MANHOLE
.....GAS MANHOLE
.....SEWER MANHOLE
.....TELEPHONE MANHOLE
.....WATER MANHOLE
.....TRAFFIC VAULT
.....HYDRANT
.....TREE WITH SIZE
17.0.....ESTABLISHED GRADE

REV	DATE	DESCRIPTION	ck	dm
	10-01-03	ARCHITECTURAL SURVEY		
A	---	ADDITIONAL SEWER INFORMATION		
B	---	PARCEL DIMENSIONS REVISED, AREA ADDED, AND ADDITIONAL UTILITY INFORMATION ADDED		
C	---	SEWER MANHOLE LOCATION & FLOOD ZONE ADDED		

UNAUTHORIZED ALTERATION OR ADDITION TO THIS SURVEY IS A VIOLATION OF SECTION 7209 OF THE NEW YORK STATE EDUCATION LAW

ONLY COPIES FROM THE ORIGINAL OF THIS SURVEY MARKED WITH AN ORIGINAL OF THE LAND SURVEYOR'S INKED SEAL OR HIS EMBOSSED SEAL SHALL BE CONSIDERED TO BE VALID TRUE COPIES

CERTIFICATIONS INDICATED HEREON SHALL RUN ONLY TO THE PERSON FOR WHOM THE SURVEY IS PREPARED AND TO HIS BEHALF, TO THE TITLE COMPANY, GOVERNMENTAL AGENCY AND LENDING INSTITUTION LISTED HEREON, AND TO THE ASSIGNEES OF THE LENDING INSTITUTION. CERTIFICATIONS ARE NOT TRANSFERABLE TO ADDITIONAL INSTITUTIONS OR SUBSEQUENT OWNERS

MONTROSE
SURVEYING CO., LLP.
CITY & LAND SURVEYORS
116 20 METROPOLITAN AVE • RICHMOND HILL NY 11418-1090 • (718) 849-0600

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CITY OF NEW YORK
COUNTY OF QUEENS
TAX BLOCK 19
TAX LOT 5 & 19

SCALE 1" = 20'

DRN: V.B./M.F.

ESTABLISHED 1876 * SUCCESSOR TO:
B.G. MENKHEIM C.S.*C.U. POWELL C.E.,C.S.*,C.L. SMITH C.S.*NATHAN CAMPBELL C.E.,C.S.*A.U. WHITSON C.E.,C.S.*
WILLIAM L. SAVACOOL C.E.,L.S.,C.S.*A.U. WHITSON INC. C.E.,C.S.*G. WEBER L.S.,C.S.*C. STOOLPH R.A.,L.S.*WHITSON & POWELL INC. P.E.,L.S.,C.S.*KELLER & POWELL P.E.,L.S.,C.S.*LOUIS MONTROSE C.E.,L.S.,C.S.*FRED J. POWELL P.E.,L.S.,C.S.*

ATTACHMENT B

ENVIRONMENTAL EASEMENT

ENVIRONMENTAL EASEMENT

THIS INDENTURE made this 29th day of December, 2006, between **Queens West Development Corporation**, a subsidiary of the New York State Urban Development Corporation d/b/a Empire State Development Corporation, a corporate governmental agency of the State of New York, constituting a public benefit corporation and a political subdivision thereof, having an office at 633 Third Avenue, New York, NY 10017 (the "Grantor"), and The People of the State of New York (the "Grantee"), acting through their Commissioner of the Department of Environmental Conservation (the "Commissioner", or "NYSDEC" or "Department" as the context requires) with its headquarters located at 625 Broadway, Albany, New York 12233,

WHEREAS, the Legislature of the State of New York has declared that it is in the public interest to encourage the remediation of abandoned and likely contaminated properties ("brownfield sites") that threaten the health and vitality of the communities they burden while at the same time ensuring the protection of public health and the environment; and

WHEREAS, the Legislature of the State of New York has declared that it is in the public interest to establish within the Department a statutory environmental remediation program that includes the use of environmental easements as an enforceable means of ensuring the performance of operation, maintenance, and/or monitoring requirements and of ensuring the potential restriction of future uses of the land, when an environmental remediation project leaves residual contamination at levels that have been determined to be safe for a specific use, but not all uses, or which includes engineered structures that must be maintained or protected against damage to perform properly and be effective, or which requires groundwater use or soil management restrictions; and

WHEREAS, the Legislature of the State of New York has declared that environmental easement shall mean an interest in real property, created under and subject to the provisions of Article 71, Title 36 of the New York State Environmental Conservation Law ("ECL") which contains a use restriction and/or a prohibition on the use of land in a manner inconsistent with engineering controls which are intended to ensure the long term effectiveness of a brownfield site remedial program or eliminate potential exposure pathways to hazardous waste or petroleum; and;

WHEREAS, Grantor, is the owner of real property located in the Borough of Queens, Queens County, New York known and designated on the tax map of the City of New York as those portions of tax section 1, block 19, lots 1, 5 and 19, being the same as that property conveyed to Grantor by:

1. Order of Acquisition, Index #15278/98, recorded in Queens County Register's Office on August 13, 1998 in Reel 4944, page 137 (Block 19, Lot 19 (formerly owned by Pamela Rankin-Smith et al);

2. Order of Acquisition, Index #15279/98, recorded in Queens County Register's Office on August 13, 1998 in Reel 4944, page 130 (Block 19, Lots 1 and 5 (formerly owned by M.O. Associates, L.P.); and

3. Letters Patent on December 10, 1999, and recorded in the Land Records of the City of New York Register's Office, Borough of Queens, Division of Land at Reel 5690, Page 1561, recorded on October 4, 2000,

in total comprised of approximately 1.7864 acres and hereinafter more fully described in Schedule A attached hereto and made a part hereof (the " Controlled Property"); and;

WHEREAS, the Commissioner does hereby acknowledge that the Department accepts this Environmental Easement in order to ensure the protection of human health and the environment and to achieve the requirements for remediation established at this Controlled Property until such time as this Environmental Easement is extinguished pursuant to ECL Article 71, Title 36;and

NOW THEREFORE, in consideration of the covenants and mutual promises contained herein and the terms and conditions of **Brownfield Cleanup Agreement Index Number W2-1060-05-03, Site Number C241049**, Grantor grants, conveys and releases to Grantee a permanent Environmental Easement pursuant to Article 71, Title 36 of the ECL in, on, over, under, and upon the Controlled Property as more fully described herein ("Environmental Easement").

1. Purposes. Grantor and Grantee acknowledge that the Purposes of this Environmental Easement are: to convey to Grantee real property rights and interests that will run with the land in perpetuity in order to provide an effective and enforceable means of encouraging the reuse and redevelopment of this Controlled Property at a level that has been determined to be safe for a specific use while ensuring the performance of operation, maintenance, and/or monitoring requirements; and to ensure the potential restriction of future uses of the land that are inconsistent with the above-stated purpose.

2. Institutional and Engineering Controls. The following controls apply to the use of the Controlled Property, run with the land are binding on the Grantor and the Grantor's successors and assigns, and are enforceable in law or equity against any owner of the Controlled Property, any lessees, and any person using the Controlled Property:

A. The Controlled Property may be used for **restricted residential** use as long as the following long-term engineering and institutional controls are employed:

a) all engineering controls (including the site cover and subslab vapor depressurization and active venting system) must be operated and

maintained as specified in the NYSDEC-approved Site Management Plan. No Engineering and Institutional Controls may be discontinued without a NYSDEC-approved amendment or extinguishment of this Environmental Easement;

b) annual inspections of the Site, certifications of Institutional & Engineering controls and Site usage of controlled property, and Site Management Reporting to the Department must be conducted in accordance with the NYSDEC-approved Site Management Plan;

c) all future soil disturbance activities on the Site that will impact residual contaminated material, including, but not limited to, building construction or expansion, subgrade utility line construction or repair, must be conducted in accordance with the Soil Management provisions in the NYSDEC-approved Site Management Plan;

d) Operation Monitoring and Maintenance (OM&M) of the sub-slab depressurization system must be performed in a manner specified in the NYSDEC-approved Site Management Plan;

e) groundwater and other environmental or public health monitoring required by the NYSDEC-approved Site Management Plan must be performed in a manner specified in that Plan;

f) onsite environmental monitoring devices, including but not limited to, groundwater monitor wells and soil vapor probes, must be protected and replaced as necessary to ensure continued functioning in the manner specified in the NYSDEC-approved Site Management Plan;

g) the use of the groundwater underlying the Controlled Property is prohibited without treatment rendering it safe for intended purpose

h) vegetable gardens are prohibited.

B. The Controlled Property may not be used for a higher level of use such as **unrestricted residential,** without proper notification of NYSDEC of the change of, approval of that use by the NYSDEC, and an amendment of the Site Management Plan approved by NYSDEC.

C. Grantor covenants and agrees that until such time as the Environmental Easement is extinguished in accordance with the requirements of Article 71, Title 36 of the ECL, the property deed and all subsequent instruments of conveyance relating to the Controlled Property shall state in at least fifteen-point bold-faced type:

This property is subject to an environmental easement held by the New York State Department of Environmental Conservation pursuant of Title 36 to Article 71 of the Environmental Conservation Law.

D. Grantor covenants and agrees that this Environmental Easement shall be incorporated in full or by reference in any leases, licenses, or other instruments granting a right to use the Controlled Property.

E. Grantor covenants and agrees that it shall annually, or such time as NYSDEC may allow, submit to NYSDEC a written statement by an expert the NYSDEC may find acceptable certifying under penalty of perjury that the controls employed at the Controlled Property are unchanged from the previous certification or that any changes to the controls employed at the Controlled Property were approved by the NYSDEC, and that nothing has occurred that would impair the ability of such control to protect the public health and environment or constitute a violation or failure to comply with any Site Management Plan for such controls and giving access to such Controlled Property to evaluate continued maintenance of such controls.

3. Right to Enter and Inspect. Grantee, its agents, employees, or other representatives of the State may enter and inspect the Controlled Property in a reasonable manner and at reasonable times to assure compliance with the above-stated restrictions.

4. Reserved Grantor's Rights. Grantor reserves for itself, its assigns, representatives, and successors in interest with respect to the Property, all rights as fee owner of the Controlled Property, including:

1. Use of the Controlled Property for all purposes not inconsistent with, or limited by the terms of this Environmental Easement;

2. The right to give, sell, assign, or otherwise transfer the underlying fee interest to the Controlled Property by operation of law, by deed, or by indenture, subject and subordinate to this Environmental Easement;

5. Enforcement

A. This environmental easement is enforceable in law or equity in perpetuity by Grantor, Grantee, or any affected local government, as defined in ECL Section 71-3603, against the owner of the Property, any lessees, and any person using the land. Enforcement shall not be defeated because of any subsequent adverse possession, laches, estoppel, or waiver. It is not a defense in any action to enforce this environmental easement that: it is not appurtenant to an interest in real property; it is not of a character that has been recognized traditionally at common law; it imposes a negative burden; it imposes affirmative obligations upon the owner of any interest in the burdened property;

the benefit does not touch or concern real property; there is no privity of estate or of contract; or it imposes an unreasonable restraint on alienation.

B. If any person intentionally violates this environmental easement, the Grantee may revoke the Certificate of Completion provided under ECL Article 27, Title 14, or the Satisfactory Completion of Project provided under ECL Article 56, Title 5 with respect to the Controlled Property.

C. Grantee shall notify Grantor of a breach or suspected breach of any of the terms of this Environmental Easement. Such notice shall set forth how Grantor can cure such breach or suspected breach and give Grantor a reasonable amount of time from the date of receipt of notice in which to cure. At the expiration of such period of time to cure, or any extensions granted by Grantee, the Grantee shall notify Grantor of any failure to adequately cure the breach or suspected breach. Grantor shall then have a reasonable amount of time from receipt of such notice to cure. At the expiration of said second period, Grantee may commence any proceedings and take any other appropriate action reasonably necessary to remedy any breach of this Environmental Easement in accordance with applicable law to require compliance with the terms of this Environmental Easement.

D. The failure of Grantee to enforce any of the terms contained herein shall not be deemed a waiver of any such term nor bar its enforcement rights in the event of a subsequent breach of or noncompliance with any of the terms of this Environmental easement.

6. Notice. Whenever notice to the State (other than the annual certification) or approval from the State is required, the Party providing such notice or seeking such approval shall identify the Controlled Property by referencing its County tax map number or the Liber and Page or computerized system tracking / identification number and address correspondence to:

Division of Environmental Enforcement
Office of General Counsel
New York State Department of Environmental Conservation
625 Broadway
Albany New York 12233-5500

Such correspondence shall be delivered by hand, or by registered mail or by Certified mail and return receipt requested. The Parties may provide for other means of receiving and communicating notices and responses to requests for approval.

7. Recordation. Grantor shall record this instrument, within thirty (30) days of execution of this instrument by the Commissioner or her/his authorized representative in the office of the recording officer for the county or counties where the Property is situated in the manner prescribed by Article 9 of the Real Property Law.

8. Amendment. This environmental easement may be amended only by an amendment executed by the Commissioner of the New York State Department of Environmental Conservation and filed with the office of the recording officer for the county or counties where the Property is situated in the manner prescribed by Article 9 of the Real Property Law.

9. Extinguishment. This environmental easement may be extinguished only by a release by the Commissioner of the New York State Department of Environmental Conservation and filed with the office of the recording officer for the county or counties where the Property is situated in the manner prescribed by Article 9 of the Real Property Law.

10. Joint Obligation. If there are two or more parties identified as Grantor herein, the obligations imposed by this instrument upon them shall be joint and several.

IN WITNESS WHEREOF, Grantor has caused this instrument to be signed in its name.

Grantor's Name Queens West Development Company

By: _____

Title: President

Date: 12-19-2006

THIS ENVIRONMENTAL EASEMENT IS HEREBY ACCEPTED BY THE PEOPLE OF THE STATE OF NEW YORK, Acting By and Through the Department of Environmental Conservation

By: _____
Denise M. Sheehan, Commissioner

Grantor's Acknowledgment

STATE OF NEW YORK)
) ss:
COUNTY OF New York)

On the 19th day of December, in the year 2006, before me, the undersigned, personally appeared Alexander B. Federbush, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

Suzanna Blaskovic
Notary Public - State of New York

SUZANNA BLASKOVIC
NOTARY PUBLIC, State of New York
No. 01BL5079348
Qualified in Queens County
Commission Expires June 2, 2007

Grantee's Acknowledgment

STATE OF NEW YORK)
) ss:
COUNTY OF)

On the 22nd day of December, in the year 2006, before me, the undersigned, personally appeared Denise M. Sheehan, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/ executed the same in his/her/ capacity as Commissioner of the State of New York Department of Environmental Conservation, and that by his/her/ signature on the instrument, the individual, or the person upon behalf of which the individual acted, executed the instrument.

Lisa A. Wilkinson
Notary Public - State of New York

LISA A. WILKINSON
Notary Public, State of New York
No. 02WI5036652
Qualified in Albany County
Commission Expires Dec. 5, 2008

EXHIBIT A

Controlled Property Description

All of that certain plot, piece or parcel of land situated, lying and being in the Borough and County of Queens, City and State of New York, bounded and described as follows:

BEGINNING at the corner formed by the intersection of the westerly side of 5th Street (60 feet wide) with the northerly side of 48th Avenue (104 feet wide);

RUNNING THENCE westerly along the northerly side of 48th Avenue, 399.58 feet to a point of curvature;

RUNNING THENCE northwesterly, northerly and northeasterly along a curve bearing to the right having a radius of 20.00 feet and arc length of 38.80 feet to a point of tangency on the southeasterly side of Center Boulevard (100 feet wide);

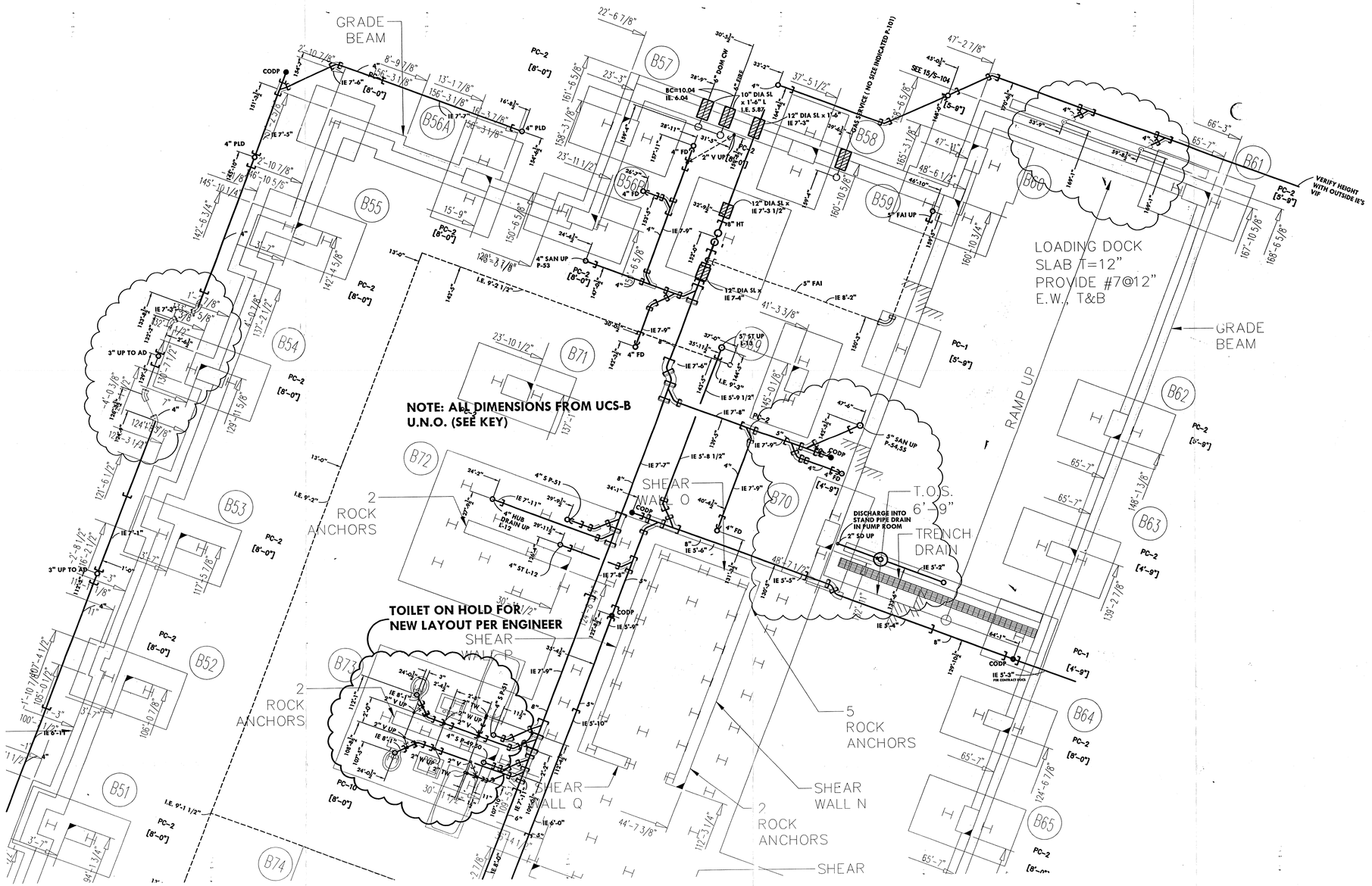
RUNNING THENCE northeasterly along the southeasterly side of Center Boulevard 185.26 feet to the southerly side of 47th Road (60 feet wide);

RUNNING THENCE easterly along the southerly side of 47th Road, 351.37 feet to the westerly side of 5th Street;

RUNNING THENCE southerly along the westerly side of 5th Street, 200.00 feet to the corner formed by the intersection of the westerly side of 5th Street with the northerly side of 48th Avenue the point of place of Beginning.

ATTACHMENT C

VAPOR MITIGATION SYSTEM AS-BUILT DRAWINGS & CUT SHEETS



ALMAR PLUMBING SUBMITTED FOR APPROVAL

SUBMISSION NO. | DATE: 3-22-06

GENERAL NOTES

ARCH ENG — ALL ITEMS INDICATED AS PLEASE ADVISE THAT ARE NOT ADDRESSED SHALL BE CONSIDERED ACCURATE AS SHOWN.

ARCH ENG — VERIFY AND CONFIRM ALL INVERT ELEVATIONS, DIMENSIONS, & DRAIN LOCATIONS.

ALL ITEMS INDICATED AS ⟹ ARE COMMENTS FOR THE PLUMBER

ARCH ENG — ALL SLEEVES AND DRAINS TO BE COORDINATED WITH ALL PADS AND EQUIPMENT

NO DIMENSIONS GIVEN FOR AREA DRAINS, PLANTER DRAINS AND FLOOR DRAINS PLEASE REVIEW LOCATIONS & DIMENSIONS.

SERVICES ENTERING BIUILDING TO BE FIELD VERIFIED.

HOUSE TRAP PITS NOT INDICATED ON STRUCTURAL DRAWINGS PLEASE ADVISE

NO AXIS LINES AVAILABLE AT THIS TIME 9/7/5.

NO MAIN SIZES INDICATED ON FLOOR PLAN OR RISER DIAGRAM PLEASE REVIEW AND ADVISE.

Rev. No.	Revision	Date	By
3	REVISED PER ENGINEERS COMMENTS AND MEETING	3/17/06	WK
2	ADDED VAPOR BARRIER PIPING	2/1/6	RT
1	REVISED PER ARCH REVIEW	1/5/06	WK
0	ISSUED FOR ENGINEERS REVIEW	9/12/05	WK

ALMAR
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116-14 ROCKAWAY BLVD.
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T 1-718-835-5000 F 1-718-641-2469

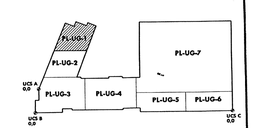
Owner: AVALON RIVERVIEW III, LLC
C.O AVALON BAY COMMUNITIES, INC.
259 FIFTH AVENUE
NEW YORK, NY 10017

Arch. PERKINS EASTMAN ARCHITECTS PC
115 FIFTH AVENUE
NEW YORK, NY 10003 1004

Engineer: COSENTINI ASSOCIATES
TWO PENNSYLVANIA PLAZA
NEW YORK, N.Y. 10121

Project: **AVALON BAY - PARCEL 9**
LONG ISLAND CITY, NY 11101

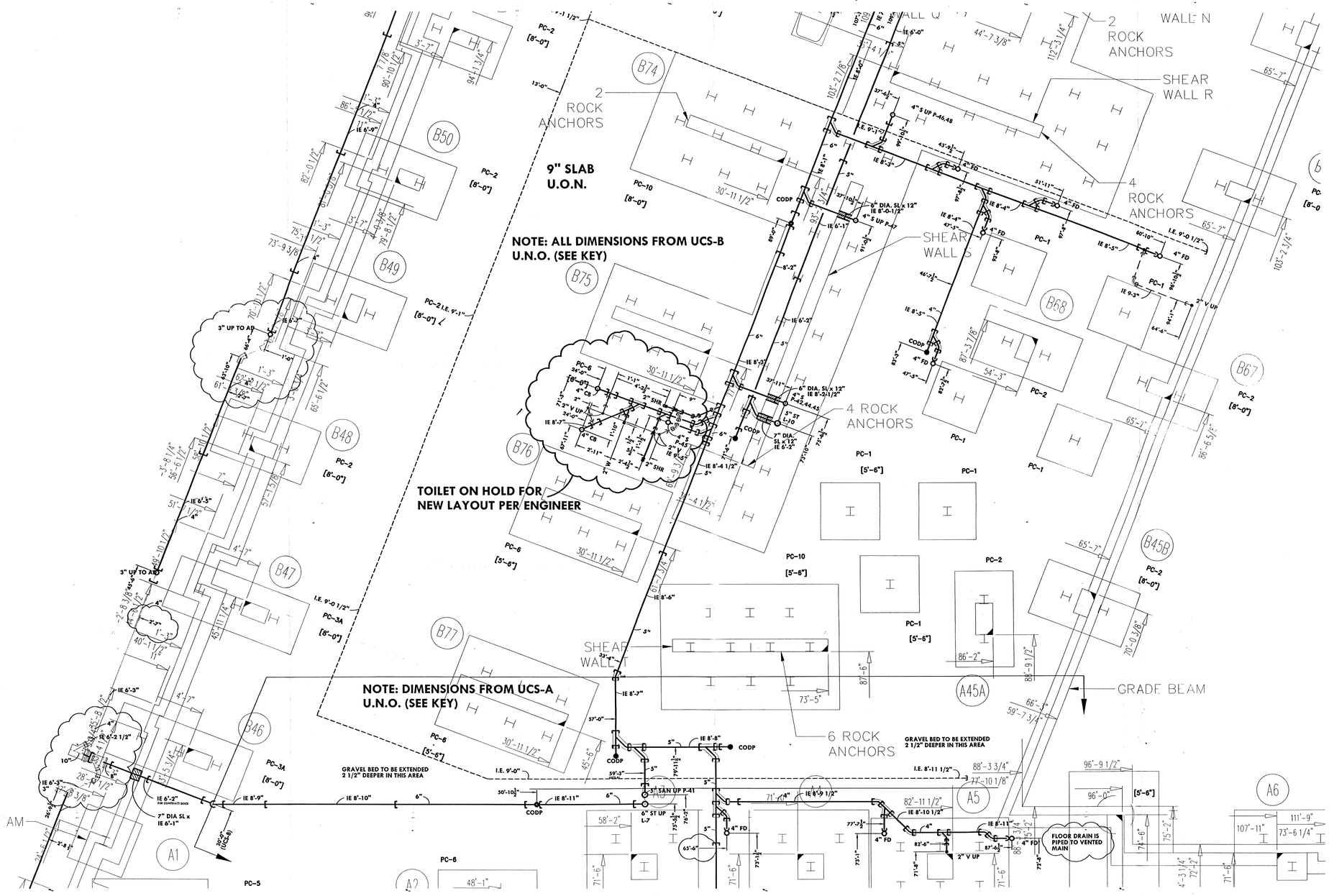
Key Plan:



ALM-115490-15000-020 Rev 3

Drawing Title: **PLUMBING - UNGER GROUND PARTIAL FLOOR PLAN**

Project North	Scale:	Dwg. By:	Sheet No.	Drawing No.
NORTH	3/16"=1'-0"	W.K.	1 OF 7	PL-UG-1
	Date: 9/12/05	Chk'd: R.T.		



ALMAR PLUMBING SUBMITTED FOR APPROVAL

SUBMISSION NO. | DATE: 9-5-05

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Rev. No.	Revision	Date	By
3	REVISED PER ENGINEERS COMMENTS AND MEETING	3/17/06	MK
2	ADDED VAPOR BARRIER PIPING	2/1/6	RT
1	REVISED PER ARCH REVIEW	1/3/06	MK
0	ISSUED FOR ENGINEERS REVIEW	9/12/05	MK

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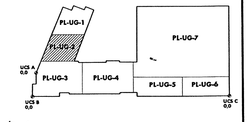
Owner: AVALON RIVERVIEW III, LLC
C.O AVALON BAY COMMUNITIES, INC.
625 FIFTH AVENUE
NEW YORK, NY 10017

Arch.: PERKINS EASTMAN ARCHITECTS PC
115 FIFTH AVENUE
NEW YORK, NY 10003 1004

Engineer: COSENTINI ASSOCIATES
TWO PENNSYLVANIA PLAZA
NEW YORK, N.Y. 10121

Project: AVALON BAY - PARCEL 9
LONG ISLAND CITY, NY 11101

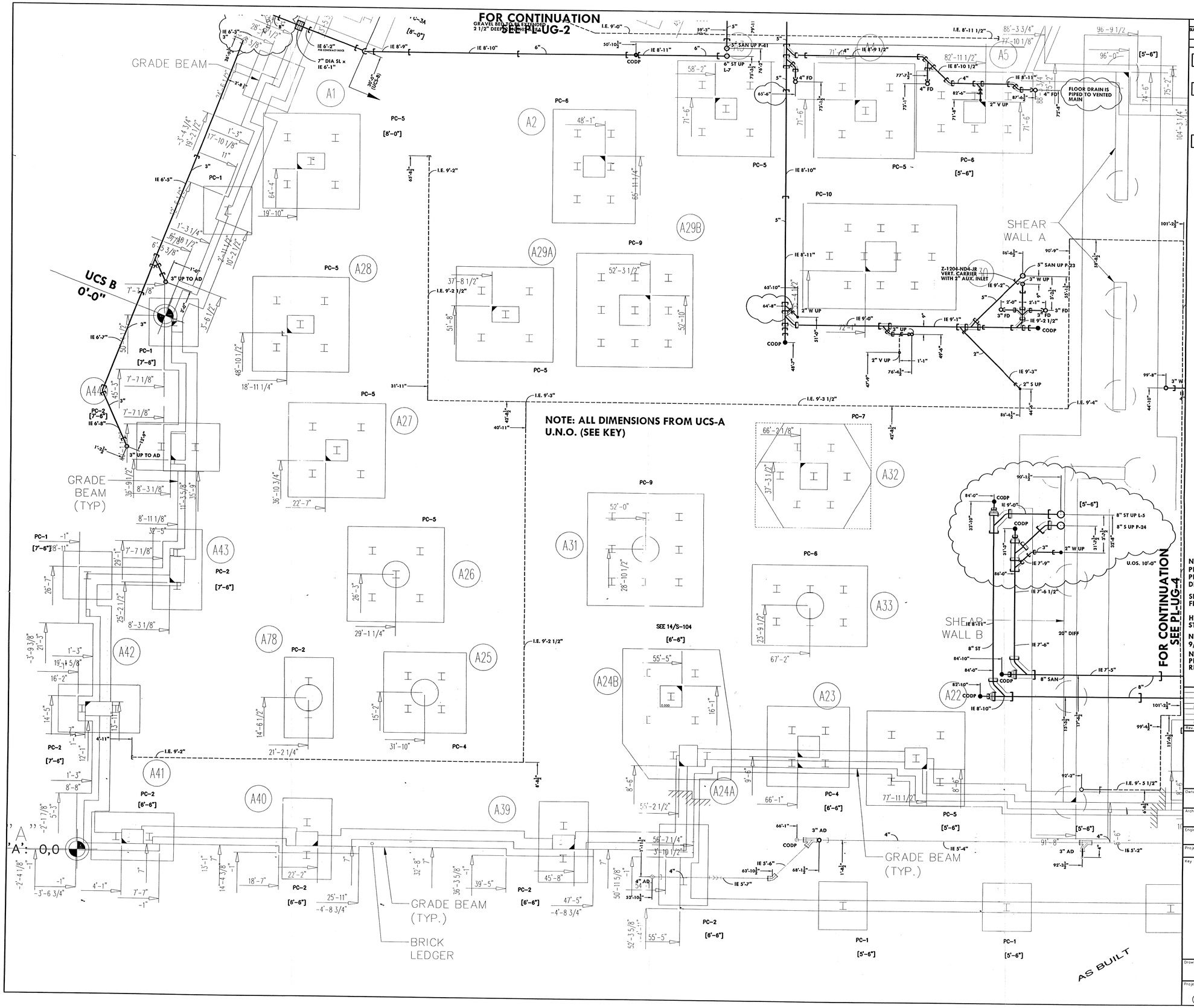
Key Plan:



ALH-115440-15000-020-Rev 3

Drawing Title: PLUMBING - UNGER GROUND PARTIAL FLOOR PLAN

Project North	Scale	Dwg. By	Sheet No.	Drawing No.
	3/32"=1'-0"	M.K.	2 Of 7	PL-UG-2
	Date: 9/12/05	Chk'd. R.T.		



ALMAR PLUMBING SUBMITTED FOR APPROVAL

SUBMISSION NO. | DATE: 3-20-06

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1	REVISED PER ARCH REVIEW	1/2/06	WK
0	ISSUED FOR ENGINEERS REVIEW	9/12/05	WK

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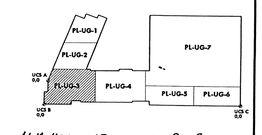
Owner: AVALON RIVERVIEW III, LLC ; C.O AVALON BAY COMMUNITIES, INC. 535 FIFTH AVENUE NEW YORK, NY 10017

Arch.: PERKINS EASTMAN ARCHITECTS PC 115 FIFTH AVENUE NEW YORK, NY 10003 1004

Engineer: COSENTINI ASSOCIATES TWO PENNSYLVANIA PLAZA NEW YORK, N.Y. 10121

Project: AVALON BAY - PARCEL 9 LONG ISLAND CITY, NY 11101

Key Plan:



ALM-115440-15000-020 Rev 3

Drawing Title: **PLUMBING - UNGER GROUND PARTIAL FLOOR PLAN**

Project North	Scale:	Dwg. By:	Sheet No.	Drawing No.
GRID	3/8"=1'-0"	W.K.	3 OF 7	PL-UG-3
	Date: 9/12/05	Chk'd: R.T.		

ALMAR PLUMBING SUBMITTED FOR APPROVAL

SUBMISSION NO. | DATE: 9-26-05

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NOTE: ALL DIMENSIONS FROM UCS-A U.N.O. (SEE KEY)

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FOR CONTINUATION SEE PL-UG-3

FOR CONTINUATION SEE PL-UG-5

AS BUILT

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3	REVISED PER ENGINEERS COMMENTS AND MEETING	3/17/06	WK
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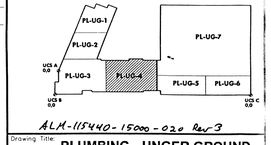
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Engineer: COSENTINI ASSOCIATES
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Project: AVALON BAY - PARCEL 9
LONG ISLAND CITY, NY. 11101

Key Plan:



ALM-115440-15000-020 Rev 3

Drawing Title: PLUMBING - UNGER GROUND PARTIAL FLOOR PLAN

Project North	Scale:	Dwg. By:	Sheet No.	Drawing No.
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	Date: 9/12/05	Chk'd: R.T.	of 7	

ALMAR PLUMBING SUBMITTED FOR APPROVAL

SUBMISSION NO. PL-UG-5 DATE 9/11/06

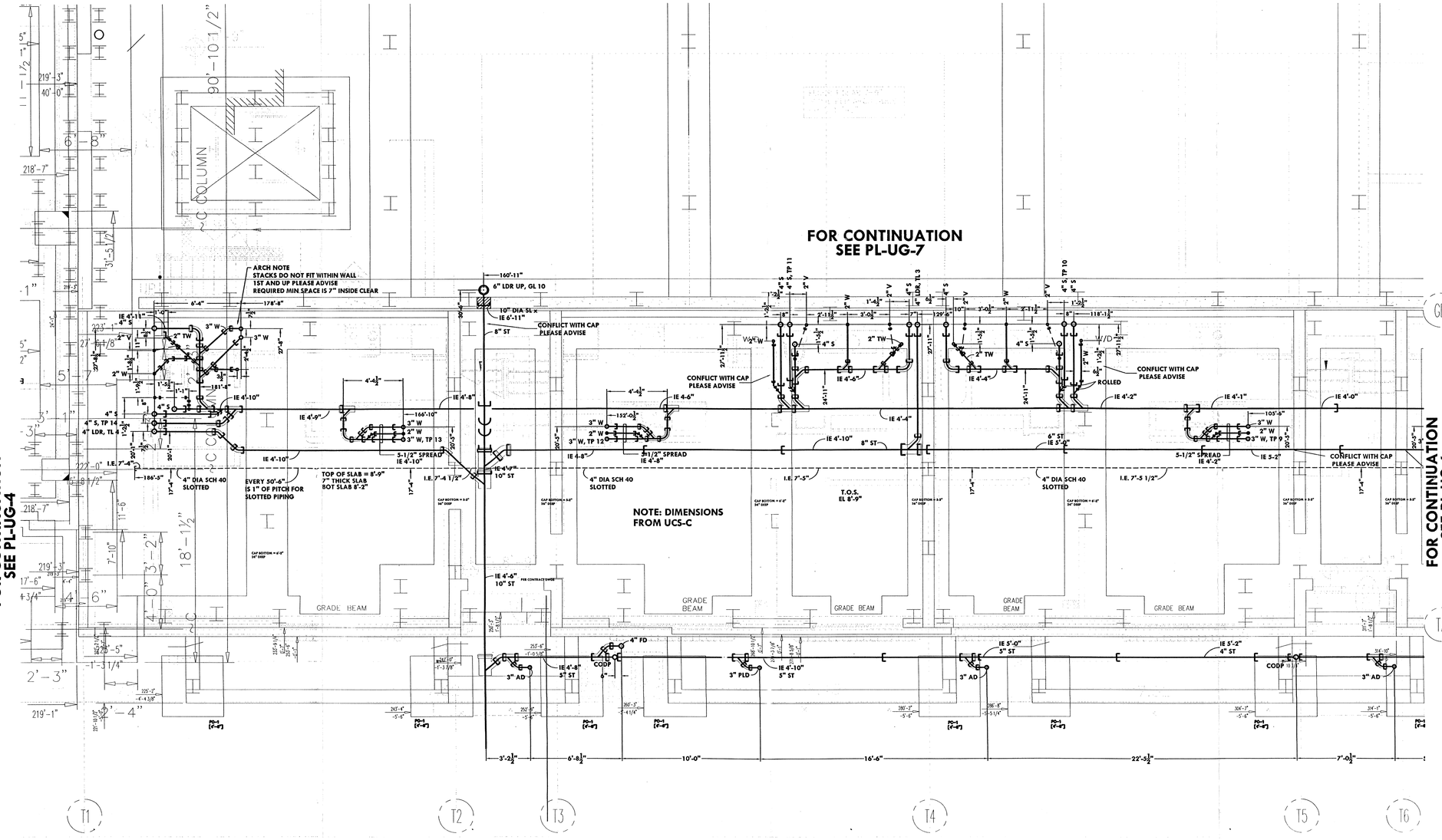
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SOUTH OZONE PARK, N.Y.
T 1-718-835-5000 F 1-718-641-2469

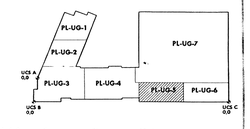
Owner: AVALON RIVERVIEW III, LLC
C.O AVALON BAY COMMUNITIES, INC.
625 FIFTH AVENUE
NEW YORK, NY 10017

Arch.: PERKINS EASTMAN ARCHITECTS PC
115 FIFTH AVENUE
NEW YORK, NY 10003 1004

Engineer: COSENTINI ASSOCIATES
TWO PENNSYLVANIA PLAZA
NEW YORK, N.Y. 10121

Project: AVALON BAY - PARCEL 9
LONG ISLAND CITY, NY 11101

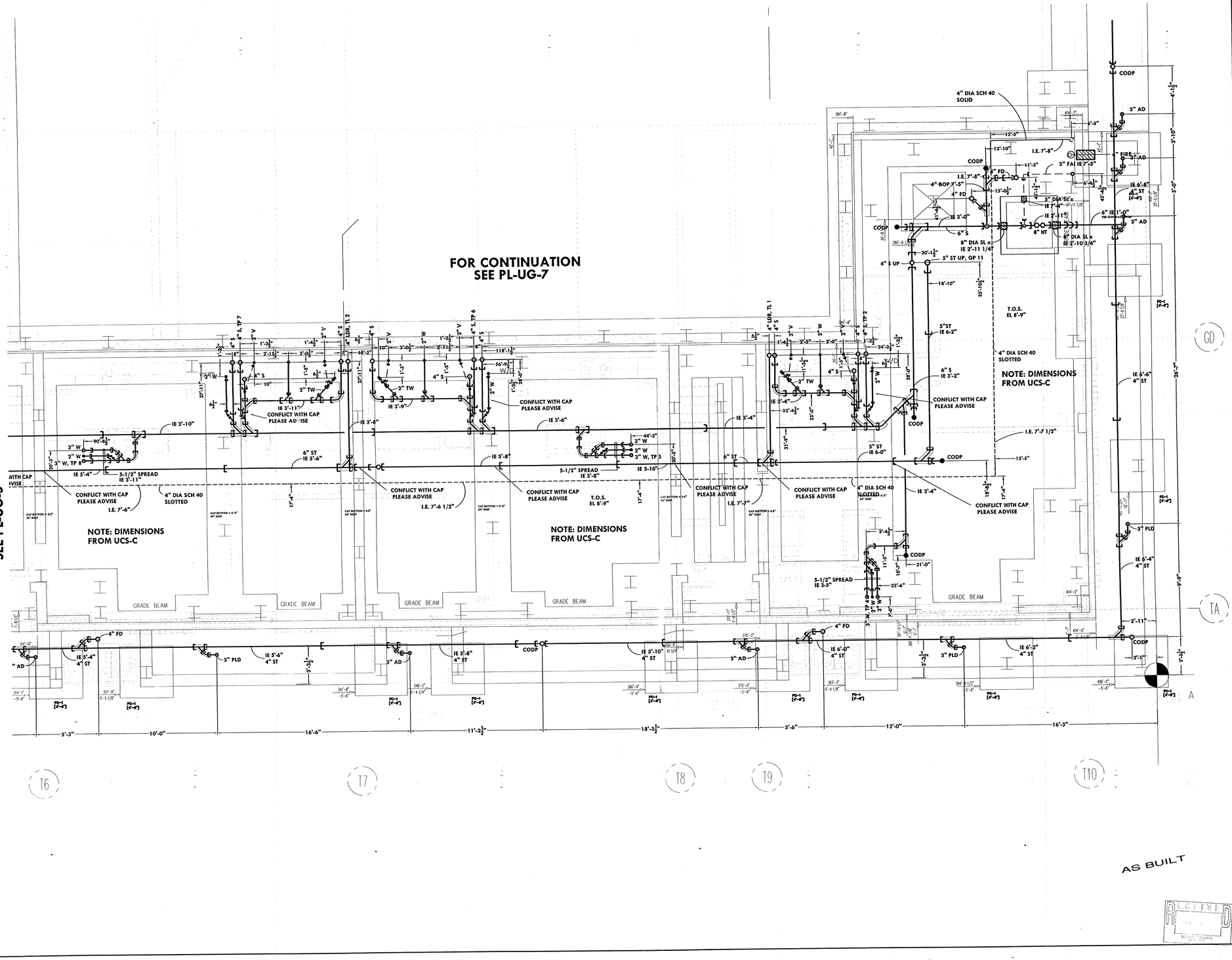
Key Plan:



ALM-115440-15000-030

Drawing Title: PLUMBING - UNGER GROUND PARTIAL FLOOR PLAN

Project North	Scale	Dwg. By	Sheet No.	Drawing No.
	3/8"=1'-0"	W.K.	5	PL-UG-5
	Date 9/12/05	Chk'd R.T.	Of 7	



ALMAR PLUMBING SUBMITTED FOR APPROVAL

SUBMISSION NO. PL-UG-6 DATE 2-1-06

GENERAL NOTES

ARCH ENG. ALL ITEMS INDICATED AS PLEASE ADVISE THAT ARE NOT ADDRESSED SHALL BE CONSIDERED ACCURATE AS SHOWN.

ARCH ENG. VERIFY AND CONFIRM ALL INVERT ELEVATIONS, DIMENSIONS, & DRAIN LOCATIONS.

ALL ITEMS INDICATED AS ⟹ ARE COMMENTS FOR THE PLUMBER

ARCH ENG. ALL SLEEVES AND DRAINS TO BE COORDINATED WITH ALL PADS AND EQUIPMENT

NO DIMENSIONS GIVEN FOR AREA DRAINS, PLANTER DRAINS AND FLOOR DRAINS PLEASE REVIEW LOCATIONS & DIMENSIONS.

SERVICES ENTERING BIUILDING TO BE FIELD VERIFIED.

HOUSE TRAP PITS NOT INDICATED ON STRUCTURAL DRAWINGS PLEASE ADVISE

NO AXIS LINES AVAILABLE AT THIS TIME 9/7/5.

NO MAIN SIZES INDICATED ON FLOOR PLAN OR RISER DIAGRAM PLEASE REVIEW AND ADVISE.

Rev. No.	Revision	Date	By
2	ADDED VAPOR BARRIER PIPING	2/1/6	RT
0	ISSUED FOR ENGINEERS REVIEW	9/12/05	WK

ALMAR
PLUMBING & HEATING CORP.
116-14 ROCKAWAY BLVD.
SOUTH OZONE PARK, N.Y.
T 1-718-835-3600 F 1-718-641-2469

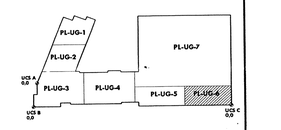
Owner: AVALON RIVERVIEW III, LLC
C.O AVALON BAY COMMUNITIES, INC.
625 FIFTH AVENUE
NEW YORK, NY 10017

Arch. PERKINS EASTMAN ARCHITECTS PC
115 FIFTH AVENUE
NEW YORK, NY 10003 1004

Engineer: COSENTINI ASSOCIATES
TWO PENNSYLVANIA PLAZA
NEW YORK, N.Y. 10121

Project: AVALON BAY - PARCEL 9
LONG ISLAND CITY, NY 11101

Key Plan:



Drawing Title: PLUMBING - UNGER GROUND PARTIAL FLOOR PLAN

Project North	Scale:	Dwg. By:	Sheet No.	Drawing No.
GRID NORTH	3/8"=1'-0"	W.K.	8 Of 7	PL-UG-6
	Date: 9/12/05	Chk'd. R.T.		

REVIEWED

LEGEND:

- SOLID 4" SCH 40 PVC PIPE
- 4" SCH 40 PVC 0.020 SLOTTED PIPE
- 4" SCH 40 PVC 0.020 SLOTTED PIPE TERMINATION
- 4" SOLID PVC TRANSITION TO 4" SOLID STEEL VENT RISER
- PILE CAP LOCATION
- EXTENT OF 60 DRY MIL LIQUID BOOT VAPOR BARRIER MEMBRANE
- 0.33% SLOPE — SLOPE OF SLOTTED PIPE

NOTES:

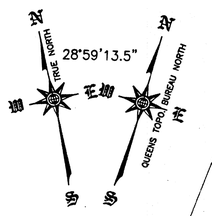
1. ELEVATION OF BOTTOM OF AGGREGATE IS 12" BELOW BOTTOM OF FLOOR SLAB.
2. PERFORATED PIPE SHALL SLOPE AS INDICATED ON PLAN.
3. LINER MATERIAL TO BE PLACED AT BOTTOM OF SLAB.
4. ALL PIPE TERMINATIONS SHALL HAVE END CAPS.
5. ALL PVC PIPING SHALL BE PLACED IN A 12" LAYER OF AGGREGATE. PIPE BEDDING WILL RANGE FROM 2" OF BEDDING AT PIPE TERMINATION TO 6" OF BEDDING AT TRANSITION TO SOLID PIPE.
6. A LAYER OF NON-WOVEN GEOTEXTILE SHALL BE PLACED BELOW AGGREGATE.
7. ALL BELOW SLAB PIPING AND SERVICES MUST BE IN PLACE BEFORE LIQUID BOOT APPLICATION.

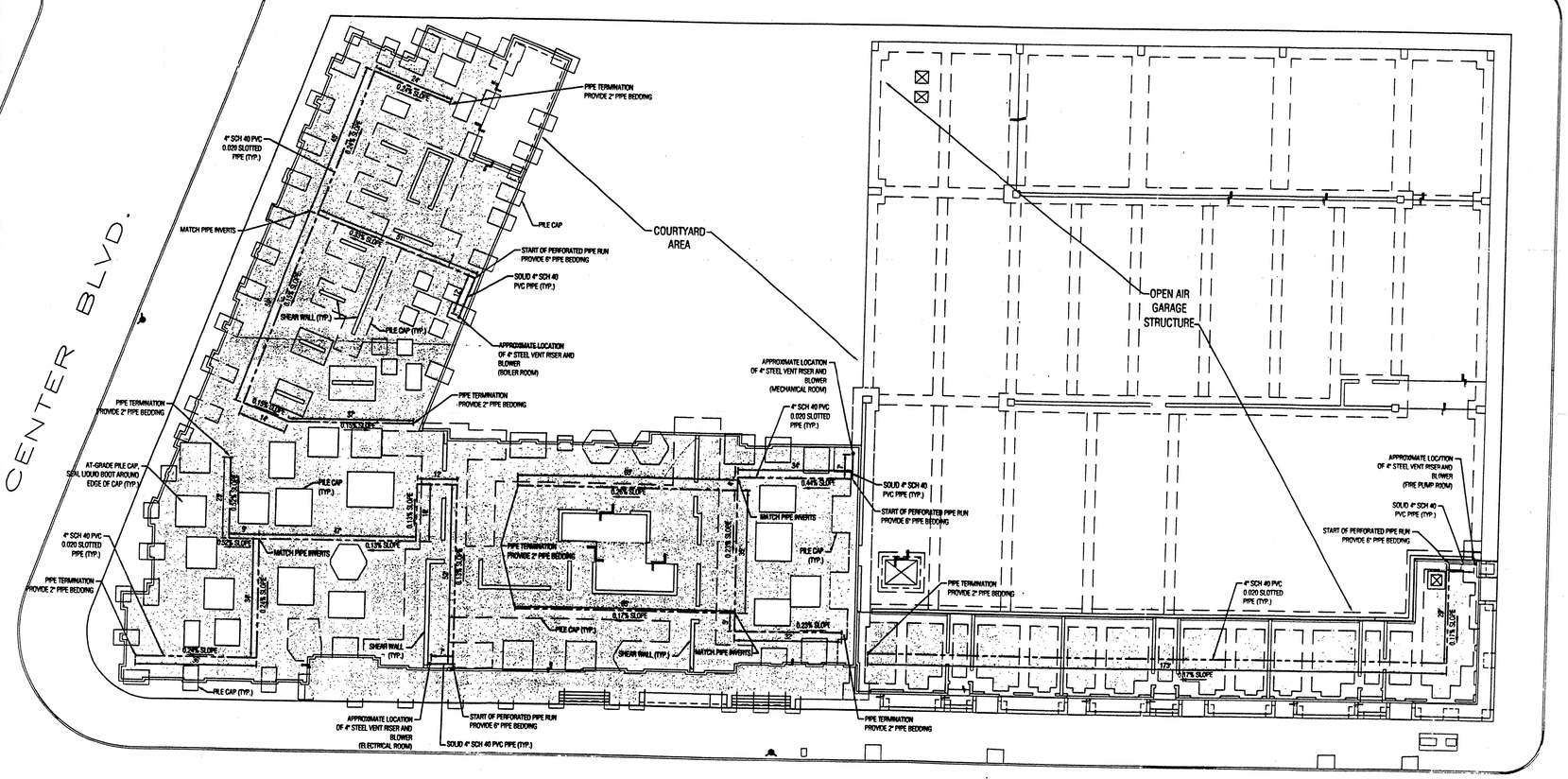
47th ROAD

CENTER BLVD.

5th STREET

48th AVENUE





AS BUILT

0 10 20 40
SCALE: 1" = 20'

REVISIONS

No.	DATE	DESCRIPTION

PREPARED BY

EAI, Inc.
Environmental Management Services

435 Mercer Street
Jersey City, NJ 07302
Tel: 201-395-0010 Ext. 229
Fax: 201-395-0020

Cell: 201-696-7222
Email: robc@eaiinc.com
Web: www.eaiinc.com
800-486-FAIR (3247)

Environmental Testing & Remediation - Survey/Design/Management

PREPARED FOR

AVALON BAY COMMUNITIES, INC.
535 FIFTH AVENUE
NEW YORK, NY 10017

SHEET TITLE

EXTENT OF VAPOR BARRIER

BOROUGH OF QUEENS SOUTH
RECEIVED
NOV 21 2006

ATTACHMENT D

RESUMES OF ENVIRONMENTAL MONITORING PERSONNEL

JED A. MYERS, PH.D.
Senior Project Manager

PROFESSIONAL SUMMARY

Dr. Myers is a Senior Project Manager for Cardno ATC Environmental Group. He has over thirty years of experience managing large scale environmental assessment and remediation projects within the tri-state area. He has a broad range of consulting and management experience in the areas of brownfield redevelopment, UST removal and replacement, remedial investigations, soil and groundwater remediation strategies, emergency response, environmental assessments, hazardous waste management, and regulatory compliance.

Over 30 years of experience managing environmental assessment and remediation projects within metro New York and Long Island.

Dr. Myers has completed numerous projects for clients in different market sectors including industrial, commercial, petroleum and public sector government facilities throughout New York and New Jersey. He is experienced and familiar with EPA, NYDEC and NJDEP regulations, policy and guidance.

PROJECT EXPERIENCE

Site Investigation and Remediation

- **New York City Brownfield Projects / NYC Developers / New York City Boroughs / 2010 to Present / $500K.** Provided environmental consulting services to support the redevelopment of contaminated properties within the New York City Brownfield Program. Developed and implemented Remedial Action Workplans to support property redevelopment that have included soil excavation, design and installation of both soil vapor barriers and sub-slab depressurization systems in multi-story residential buildings.

- **Remedial System Operation / NYC Department of Design & Construction (URS Corporation) / New York, New York / 2007 – 2009 / $960K**. Managed the operation & maintenance of eight remedial systems at city-managed commercial sites throughout Manhattan, New York. Responsible for the continuous operation, weekly monitoring, and monthly reporting of dual phase high-vac extraction systems. Successfully dismantled and closed six of the eight sits. Designed and completed a combined soil vapor and aquifer pump test as part of a system redesign.

- **Brownfield Project / Cargo Ventures Inc / Long Island, New York / 2007- 2011 $200K**. Developed and executed a Remedial Investigation Workplan to define the nature and extent of soil and groundwater contamination for a NYSDEC Brownfield Cleanup Site. Delineated the horizontal and vertical extent of a combined hydrocarbon and chlorinated groundwater plume. Aquifer properties and natural attenuation parameters were investigated to evaluate possible remedial options. To evaluate soil vapor intrusion, soil vapor samples were collected near the perimeter of the Site and sub-slab vapor samples were collected from beneath an on-site building. Developed a remedial action plan that included the excavation of impacted soil, in-situ oxidation of a portion of the petroleum and chlorinated groundwater plume and reductive dechlorination for the remaining chlorinated groundwater plume.

- **In-Situ Chemical Oxidation / Macerich / Yonkers, New York / 2006-2010 / $140K**. As part of redevelopment activities for a major shopping center, directed the investigation and design for the remediation of petroleum impacted groundwater at a former service station.Completed subsurface investigations to delineate soil and groundwater impact both on and off-site. Designed and executed an In-Situ Chemical Oxidation/Enhanced Bioremediation approach to remediate impacted groundwater. Submitted remedial action report to the NYSDEC and obtain case closure using natural attenuation as the final remedy.

- **In-Situ Chemical Oxidation / Golf Course / Staten Island, New York / 2007-2008 / $55K**. Successfully executed a pneumatic fracturing and atomization process to inject oxidizing and bio-enhancing chemicals to remediate soil and groundwater at a former petroleum underground storage tank area. Obtained site closure from the New York State Department of Environmental Conservation.

- **Site Redevelopment / Mega Contracting / Bronx, New York / 2007-2008 / $1.2 Million**. Successfully executed the remedial action plan for the redevelopment of a New York City e-designated site as a 7-story residential and commercial building. Oversaw and coordinated the proper disposal of over 18,000 tons of impacted soil. To facilitate dewatering for soil excavation activities, designed and installed a groundwater treatment system. Oversaw the installation of a vapor barrier under the new building and a topsoil cap for landscaped areas of the site. Prepared final closure report and Operations and Management Plan for the vapor barrier and landscape cap, and received site closure from the New York City Department of Environmental Protection.

- **Superfund Site / Performing Parties Group / Long Island, New York / 2000-2007 / $120K per Year**. Responsible for the monitoring, and operations and maintenance of an integrated air sparge/soil vent, groundwater pump & treat and bioremediation system. Thermal oxidizer and shallow tray air stripper were used to treat groundwater and effluent from 5 groundwater wells, 21 vertical and horizontal soil vapor extraction (SVE) and 54 air sparge (AS) wells. Extracted groundwater was treated to remove dissolved iron, and nutrients were added before re-injected on-site. Designed and supervised a system modification to optimize performance and obtained regulatory approval to shutdown sections of the system where cleanup objectives had been achieved.

- **Remedial System Installation / NYC Department of Design & Construction (O'Brien Kreitzberg) / New York / 2004-2006 / $1.8 Million**. Successfully managed the installation and operation & maintenance of six remedial systems at city-managed commercial sites and reservoirs throughout New York and Westchester Counties. This included soil vapor extraction and dual phase high-vac extraction systems.

- **Environmental Projects / Confidential Land Developers / New York City and Long Island / 1989-2000 / $100K per Year**. Supervise environmental projects ranging from real estate audits, UST closure assessments, drywell (UIC) remediation, soil and groundwater contaminant investigations and studies, remediation system O & M and monitoring, and regulatory interfacing for the redevelopment and resale of contaminated properties.

- **Services Provided, Client Name, Site Location** Project Manager responsible for managing XYZ for various sites. Responsible for insert a brief project description here. Project Manager responsible for managing XYZ for various sites. Responsible for insert a brief project description here, insert a brief project description here, insert a brief project description here.

- **Services Provided, Client Name, Site Location** Project Manager responsible for managing XYZ for various sites. Responsible for insert a brief project description here. Project Manager responsible for managing XYZ for various sites. Responsible for insert a brief project description here, insert a brief project description here, insert a brief project description here.

Retail Petroleum

- **Remedial Action / Phillips 66 / Long Island, New York / 2012 to Present / $149K** Installed an oxygen infusion system to enhance the biodegradation of remaining groundwater contaminants at a former service station, which included the installation of injection wells and subsurface vaults for oxygen tanks and associated equipment. Prepared subcontractor bid specifications, oversaw installation and start-up of system. Continue to monitor system performance and prepare regulatory reports.

- **Remedial Design / Exxon Mobil / New York / 1990-1995 & 2000-2006 / $5 Million per Year.** Principal hydrogeologist responsible for the technical oversight of hydrogeological investigations and remedial system designs of over 100 retail petroleum locations. Responsibilities included the leadership of project managers each overseeing a group of technical staff. Responsible for group profitability and productivity, technical and regulatory guidance, training and client relations. Was presented a personal 1993 Quality Recognition Award from Exxon Company, USA, for overall management of Exxon programs.

- **Environmental Services / Getty Petroleum-Equiva / New York and Connecticut / 1989-1993 / $1 Million per Year**. Technical director for environmental services specializing in soil/groundwater remediation for petroleum marketers and refiners. Programs included design and installation of remediation technologies, soil and ground water investigations, environmental audits and emergency spill response.

- **Project Oversight / Resource Environmental LLC / Red Bank, New Jersey / 2006-2010 / $1.1 Million**. Implemented the remedial action plan for commingled plumes originating from two retail gasoline service stations at two separate locations within New Jersey. Supervised semi-annual groundwater monitoring and sampling events and submitted annual Remedial Action Status Reports to NJDEP. Prepared and submitted documentation to establish a Groundwater Classification Exception Area for monitored natural attenuation of an off-site petroleum hydrocarbon groundwater plume. Prepared work plan for approval by NJDEP, implemented plan and submitted investigation report to NJDEP for vapor intrusion investigations at residential properties. Successfully completed post-remedial soil investigation to achieve no further action for soils.

- **Remedial System Installation / Resource Environmental LLC / Englewood, New Jersey / 2006-2008 / $3 Million**. Completed the assessment and implemented the remedial action plan for commingled plumes originating from two retail gasoline service stations at two separate locations within New Jersey. To select and implement the remedial actions, completed an assessment of both the horizontal and vertical extent of off-site groundwater plumes, supervised and directed UST closure and excavation of over 3,000 tons of petroleum impacted soil, and oversaw the design and installation of a vapor mitigation system for new construction.

- **Remedial Action / Leon Petroleum / Long Island, New York / 2006 – 2011 / $50K**. Designed and implemented a remedial action approach to for a gasoline retail facility to obtain regulatory closure. Previous remedial systems had achieved asymptotic groundwater contaminant levels. Remedial approach included, enhance fluid recovery events surrounding existing USTs, and in-situ chemical oxidation and enhance bioremediation of remaining groundwater plume. Submitted remedial action report to the NYSDEC and obtain case closure using natural attenuation as the final remedy. **Services Provided, Client Name, Site Location** Project Manager responsible for managing XYZ for various sites. Responsible for insert a brief project description here. Project Manager responsible for managing XYZ for various sites. Responsible for insert a brief project description here, insert a brief project description here, insert a brief project description here.

- **Exposure Assessments / Tartan Oil Company / Long Island, New York / 1989-2000 / $100K per Year.** Completed exposure assessments using RBCA approach for the closure of petroleum retail sites, including the application of Fate & Transport groundwater models. Designed and installed contaminant remediation systems, including soil vapor extraction, pump and treat and air sparging.

- **Hazardous Waste Management / British Petroleum / Amoco / NY City and Long Island / 1995-2000 / $500K per Year**. Manage technical team responsible for hazardous waste management and transportation services, including condensate removal from gasoline storage tanks, contaminated from UST removals and tank bottom sludge.

EDUCATION

- Ph.D., Soil Chemistry, The Ohio State University, 1985
- M.S., Soil Chemistry, The Ohio State University, 1981
- B.S., Biology, Heidelberg College, 1978

TRAINING AND CERTIFICATIONS

- OSHA 40 Hour HazMat Certified
- OSHA 8 Hour HazMat Refresher

PUBLICATIONS

- Myers, J.A., E.O. McLean, and J. M. Bigham. 1988. Reductions in Exchangeable Magnesium with Liming of Acid Ohio Soils. Soil Sci. Soc. Am. J. 50: 131-136.

Denise Cosenza
Project Manager

PROFESSIONAL SUMMARY

Ms. Cosenza is experienced working with large environmental projects for both public/private sector clients. Her project experience includes Phase I and II Environmental Site Assessments, UST closures, soil and groundwater investigation and remediation projects and preparation of associated technical documents and client reports. She is well versed in the interpretation of drawings and specifications and is familiar with New York City, New York State and New Jersey environmental regulations and standards.

PROJECT EXPERIENCE

- **Phase II Site Assessment / FedEx / Brooklyn, New York / 2015**. As part of the redevelopment of an industrial property executed a Remedial Investigation Workplan to define the nature and extent of soil and groundwater contamination, as well as potential soil vapor intrusion. Directed geophysical survey for location of potential underground tanks and utilities. Oversaw and directed the advancement of soil borings and collection of samples for laboratory analyses. On-site geoscientist to direct and log the installation of several monitoring wells, soil vapor points and sub-slab soil vapor points. Lead geoscientist for collection of groundwater samples, soil vapor samples, and coordinated analyses with laboratory. Surveyed monitoring well for development of local groundwater elevation map. Directed subcontractor for a camera investigation of sanitary system and the collection of bottom sediment samples for analyses. Coordinated all site activities whit the client, regulatory agencies, and client site developers.

- **Phase II Site Assessment / Pepsi Bottling Venture, LLC/ Garden City and Patchogue, New York / 2015**. Executed a Limited Subsurface Site Investigation Workplan to define the nature and extent of soil and groundwater contamination at two Pepsi locations on Long Island, NY. Directed geophysical survey for location of potential underground tanks and utilities. Oversaw and directed the advancement of soil borings and collection of samples for laboratory analyses. On-site geoscientist to direct and log the installation of several monitoring wells and collection of soil sample beneath existing floor drains. Lead geoscientist for collection of groundwater elevation data, water samples, and coordinated analyses with laboratory. Surveyed monitoring wells for development of local groundwater elevation map. Directed drilling subcontractor and coordinated all site activities with client and property owner consultant.

- **Phase I and II Environmental Site Assessments / Department of Design and Construction / New York. Project Manager**. Coordinate all aspects of Phase I and II ESAs under $2.0M on-call Requirements Contract for DDC. Project activities include management and execution of site activities including asbestos, mold and lead based paint inspections as part of Phase I ESA; background research, including interviews and document review; determinations as to the potential impact of hazardous materials on soil and groundwater on sites and final reporting.

- **Phase I and II Environmental Site Assessments / Department of Design and Construction / New York. Project Manager**. Coordinate all aspects of Phase I and II ESAs under $2.0M on-call Requirements Contract for DDC. Project activities include management and execution of site activities including asbestos, mold and lead based paint inspections as part of Phase I ESA; background research, including interviews and document review; determinations as to the potential impact of hazardous materials on soil and groundwater on sites and final reporting.

- **Phase I and II Environmental Site Assessments / Preliminary Assessment / Bed, Bath & Beyond / New York / New Jersey**. Project Manager. Coordinate all aspects of Phase I and II ESA and New Jersey Department of Environmental Protection (NJDEP) Preliminary Assessment (PA) for the sale and acquisition of commercial properties as well as redevelopment of commercial properties. Project activities include management and execution of site activities including asbestos, mold and lead based paint inspections as part of Phase I ESA; background research, including interviews and extensive document

review; determinations as to the potential impact of hazardous materials on soil and groundwater on site via a subsurface investigations and final reporting.

- **PCB Assessments and Sampling / New York City School Construction Authority / New York.** Project Manager for the sampling of soil and building material for PCB contaminant. Created sampling plan, developed site health and safety plane, and implemented sampling of soil, caulk and other building material. Created report for abatement and abatement costs.

- **Phase I and II Environmental Site Assessments / Prudential Real Estate Investors / New York / New Jersey.** Project Manager. Coordinate all aspects of Phase I and II ESAs for potential purchase and redevelopment. Project activities include management and execution of site activities including asbestos, mold and lead based paint inspections as part of Phase I ESA; background research, including interviews and document review; determinations as to the potential impact of hazardous materials on soil and groundwater on sites and final reporting.

- **Water Well Evaluation Assessments / Bank of America / New York / New Jersey. Project Manager.** Coordinate all aspects of the water well evaluation services to determine the compliance status of on-site wells at banking facilities. Project activities include management and execution of site activities including site investigation including well water sampling as required by local and federal regulatory agencies, background research, including interviews, document review and regulatory research; determinations as to the potential impact of hazardous materials on groundwater on sites and final reporting.

- **Phase I and II Environmental Site Assessments / Verizon / New York.** Project Manager. Coordinate all aspects of Phase I and II ESAs for potential purchase and redevelopment for franchising purposes. Project activities include management and execution of site activities including asbestos and lead based paint inspections as part of Phase I ESA; background research, including interviews and extensive document review; determinations as to the potential impact of hazardous materials on soil and groundwater on sites and final reporting.

- **Phase I and II Environmental Site Assessments / T-Mobile / New York**. Project Manager. Coordinate all aspects of Phase I and II ESAs for potential lease of land for wireless antennas and associated equipment. Project activities include management and execution of site activities including asbestos and lead based paint inspections as part of Phase I ESA; background research, including interviews and document review; determinations as to the potential impact of hazardous materials on soil and groundwater on sites; collecting and field screening soil samples, and final reporting.

EDUCATION

- B.S., Environmental Science and Geology, City University of New York, Queens College, 2002

TRAINING AND CERTIFICATIONS

- OSHA 40 Hour 29 CFR 1910.120
- OSHA 10 Hour Construction Safety
- Red Cross CPR & First Aid Certified
- OSHA 10 Hour Safety Certification

GILBERT GEDEON, PE
Environmental Engineer

PROFESSIONAL SUMMARY

Mr. Gedeon is a civil and environmental engineer with twenty years of diversified experience in engineering and management. He has provided a wide range of civil and environmental engineering services in support of capital improvement projects ranging from $100 thousand to $30 million. Mr. Gedeon expertise focuses on the management and administration of term, indefinite quantity contracts for city, state and federal agencies. Task orders cover environmental compliance and remedial management for projects involving demolition, renovation, modernization and life safety upgrades.

His work experience involved environmental investigations and remedial design of hazardous material and building toxics, design and supervision of subsurface investigations, monitoring well design and installation, groundwater plume delineations and analysis, management of underground storage system upgrade/closure, supervision of wastewater treatment plant operations, development and review of spill prevention control and counter measure plans, management of environmental compliance audit, supervision of geotechnical borings, excavations, and shoring systems, preparation and review of environmental and geotechnical reports.

Mr. Gedeon also has special expertise in development of contract specifications, design drawings, technical reports and cost estimates. He has managed contract documents from production to execution including proposals, bid evaluations, contract negotiations, award, and administration, review and approval of contractor submittals.

PROJECT EXPERIENCE

- **Asbestos and Hazardous Material / United Nations – CMP / New York**. Managed the environmental inspection and remedial design of hazardous material as part of the overall capital master plan proposed for the entire United Nations Headquarters in order to meet local and international building codes as well as incorporate new security systems. Lead and supervised a group of engineers to undertake the remediation effort for the 17-acre complex which included the Secretariat Building, General Assembly, Conference Building, North Lawn, Library, South Annex and the Garages. Coordinated and streamlined all design efforts as the only environmental sub-consultant to four different engineering firms assigned to different sections of the complex to facilitate project completion.

- **Environmental Engineering / Port Authority of New York & New Jersey / New York and New Jersey**. Functions as the ATC contact and coordinator for preconstruction engineering design, updating and maintaining the Project Management Plan, maintaining and analyzing project costs and schedules, managing design review, and, where appropriate, prepare recommendations to reduce costs, improve schedules and minimize impacts of construction. Provide a wide range of environmental engineering services in support of capital improvement projects. Manage contract documents from production to execution including proposals, bid evaluations, contract award, review and approval of contract submittals. Managed authority-wide environmental investigation and remediation projects in support of real estate transactions and property development. Supervised a professional staff of consulting engineers involved with the delivery of Capital and Operating Programs. Develop and manage project budgets and schedules in accordance with the Capital Program Authorization Process to ensure project delivery. Provided support and expert testimony for multi-million dollar cost-recovery efforts. Conducted environmental baseline assessments for lease agreements between the Port Authority and its tenants.

- **TSA Baggage Screening Program, LaGuardia, Kennedy and Newark Airports, NY & NJ** Designed and supervised the remedial activities of hazardous material associated with the installation of explosive detection systems at three international passenger airport terminals. Performed value engineering to accommodate changes in project parameters and/or evaluate alternative approaches that may be identified. Value engineering activities included: evaluation of remediation phasing alternatives to

accommodate overall construction critical path; bidding portions of the remediation work to exploit available access within specific areas of the facility; and evaluation of the impact of operational constraints.

- **Redevelopment Program, Moynihan Station (James A. Farley), New York City, NY** Provided hazardous material investigation and remediation services in support of real estate transaction and property development for the largest United States Postal Service building (1.3 million square feet) in the world. Developed a rigorous remediation phasing plan while this occupied postal facility was being converted into a transportation facility including a hotel, restaurants, retail shops, and a smaller post office. Analyzed and developed optimal design alternatives, selected the most feasible remedial option, and implemented a comprehensive remediation design. Worked closely with construction managers to execute this phased project without disruption of the facility operations and equipment.

- **Asbestos Management / Triborough Bridge & Tunnel Authority / New York**. Overall manager of two contracts to provide asbestos air monitoring and design services during the abatement of suspect ACM. These services were provided on an as-needed basis as determined by TBTA's Construction Manager. Developed a streamlined management system to service each project in accordance with TBTA's specifications and has provide support services during abatement of ACM at various facilities. Managed a team of five senior project managers and more than 20 technicians to fully service TBTA with all labor, equipment, and materials required to perform air monitor and support services.

- **Asbestos and Lead Management / IQC United States Postal Service / New York & Central New Jersey**. ATC Program Manager for U.S. Postal Service responsible for the management of the ACBM and LBP inspection services for over 200 postal facilities in the New York & Central New Jersey District Responsible for the staff coordination, management, technical support during all construction phases and final report preparation.

- **Asbestos and Lead Management / New York City Housing Authority / New York**. Mr. Gedeon is the account manager for NYCHA and has managed and provided various long term environmental services including but not limited to Asbestos, Lead, Industrial Hygiene services. Under multiple term contracts ATC has conducted Lead Based Paint (LBP) Risk Assessments and LBP Inspections for over some of the largest developments within the five boroughs. Each project and facility has been successfully completed within time and budget.

- **Environmental Requirements Contract / New York City Department of Design and Construction.** Client Manager for on-call, requirements contract valued at over $2.0M. Oversees all contract activities including work plans and budgets, site staffing and scheduling, regulatory permitting, abatement cost estimating, contractor selection and bidding, contractor oversight and clearance and final reporting for the City's construction management agency. Projects include hazardous material management and compliance during renovation and demolition activities at city owned firehouses, libraries, police precincts, courthouses and senior centers.

- **UST Closure and Subsurface Investigation, Brooklyn Piers, Brooklyn, NY** Designed and supervised the removal and closure of two fuel-oil UST's. Excavated and remediated off-site piles of contaminated soil using a low temperature thermal desorption system. Conducted a post-excavation and soil remediation, as well as a remedial investigation. Prepared and submitted a UST Closure Report, as well as a Remedial Investigation Report, that was approved by the NYSDEC.

- **Site Investigation and Remediation Design, JFK Airport Bulk Fuel Farm, Jamaica, NY** Participated in the design, installation, operation and maintenance of several multi-million dollar soil vapor extraction, and air sparging/in-situ bioremediation treatment systems in the Bulk Fuel Farm of the Central Terminal Area of JFK under an administrative consent order with the NYSDEC. These systems were installed over 70 acres, using both vertical and horizontal wells, and represent one of the largest in-situ treatment systems ever installed and operated in the United States. These systems have removed and degraded

hundreds of thousands of gallons of jet fuel in the subsurface soil and groundwater originating from an underground jet fuel hydrant distribution system.

- **Expert Due-Diligence and Depositions, Port Authority Litigation, New York City, NY** Performed environmental investigations and prepared complete and accurate investigation findings reports in support of a class action lawsuit. Evaluated the technical merits of the defendant's case and provided recommendations. Participated in expert depositions for multi-million dollar environmental cost-recovery effort.

- **Environmental Compliance Auditing, JFK Airport, Jamaica, New York** Provided overall management for a NYSDEC ACO-required comprehensive environmental audit encompassing all federal and state environmental compliance programs for all JFKIA facilities (230 buildings on 5,200 acres) including the fuel storage and distribution facilities that represent the third largest petroleum distribution site in the world (1.2 billion gallons per year), as well as a Health and Safety audit of all PANYNJ-operated facilities. This audit was conducted over the course of a 19-month schedule and represented one of the largest environmental audits ever performed in the United States.

PROFESSIONAL REGISTRATIONS

- Professional Engineer (NY, #075399-1; NJ #40715)
- NYS DOL Project Designer, Inspector (#94-04294)
- NYC DEP Certified Asbestos Investigator (#98876)
- US EPA Lead Inspector/Assessor (#NY-R 1004-1)

EDUCATION

- M.S., Environmental Engineering, New Jersey Institute of Technology, New Jersey
- B.S., Civil Engineering, New Jersey Institute of Technology, New Jersey

TRAINING AND CERTIFICATIONS

- OSHA 10 Hour Construction Safety

ATTACHMENT E

ENVIRONMENTAL HEALTH AND SAFETY PLAN

ENVIRONMENTAL • GEOTECHNICAL
BUILDING SCIENCES • MATERIALS TESTING

HEALTH AND SAFETY PLAN

Queens West Development
Parcel 9
Long Island City, New York

Prepared By:
ATC Group Services, LLC
104 East 25th Street, 10th Floor
New York, New York 10010



Prepared For:
AvalonBay Communities
275 Seventh Avenue, 25th Floor
New York, NY 100001



ATC
HEALTH AND SAFETY PLAN (HASP)
REVIEW AND APPROVAL

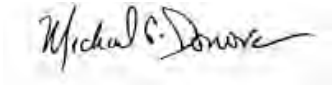
CLIENT: AvalonBay Communities

PROJECT NUMBER: Z214DC0032

SITE NAME/LOCATION: Queens West Parcel 9
Long Island City, New York

PROJECT DESCRIPTION: Operation and maintenance of the vapor mitigation system.

PREPARED BY: Denise Cosenza
TITLE: Project Manager

Denise Cosenza		April 19, 2016
Project Manger	Signature	Date
Michael G. Donovan, CIH		April 19, 2016
Reviewer's Name	Signature	Date

This Health and Safety Plan (Plan) has been written for the use of ATC and its employees. It may also be used as a guidance document by properly trained and experienced ATC subcontractors. However, ATC does not guarantee the health or safety of any person entering this Site.

Due to the potential hazardous nature of this Site and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards which may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury at this Site. The health and safety guidelines in this Plan were prepared specifically for this Site and should not be used on any other Site without prior research by trained health and safety specialists.

ATC claims no responsibility for use of this Plan by others. The Plan is written for the specific Site conditions, purposes, dates, and personnel specified and must be amended if these conditions change.

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APPENDIX C - List of Approved Amendments/Changes
Acknowledgement/Agreement Form
Visitors Log
Tailgate Safety Meeting Form
Air Quality Monitoring Record
Equipment Calibration Log
Checklist for Subsurface Clearance
Monthly Heavy Equipment Safety Inspection Checklist

APPENDIX D - Excavating and Trenching

APPENDIX E - Lockout/Tagout Requirements and Procedures

EMERGENCY INFORMATION

Site Emergencies Call:

Ambulance	**911**
Fire:	**911**
Police:	**911**
Dig Safe New York	**811 or (800) 962-7962**
CHN (24 hour First-Aid)	**(855) 282-6331**
Poison Control Center:	**(800) 222-1222**
National Response Center:	**(800) 424-8802**

Spills:	**NYSDEC Office**	**800-457-7362**
	State Health Department	
	Environmental Health	**800-458-1158**

Hospital (718) 932-1000
Mt. Sinai Hospital of Queens
25-10 30th Avenue, Astoria, New York

See attached directions.
Approximate distance: 3.1 miles
Approximate travel time: 17 minutes

EMERGENCY ASSEMBLY LOCATION: At the site entrance along 48th Avenue.

FIRST-AID MEASURES

VOCs may be present in soil vapor.

The following procedures will be used:

Eye Contact: Flush eye immediately with copious amount of water for a minimum of 15 minutes. Repeat until irritation is eliminated and seek medical attention.

Skin Contact: Wash exposed area with soap and water for at least 15 minutes. If dermatitis or severe reddening occurs, seek medical attention.

Inhalation: Move the person into fresh air. If symptoms persist, seek medical attention.

Ingestion: Do not induce vomiting. Seek immediate medical attention.

Important Numbers:

Senior Project Manager: ……	Jed A. Myers	212-353-8280
Project Manager: ……..	Denise Cosenza	718-490-0614
Site Safety and Health Officer: ……	Jed Myers	718-490-0614
Site Supervisor: ……...	Jed Myers	212-353-8280
Branch Safety Coordinator: ……..	Michael Donovan	917-578-0730
Regional Safety Coordinator ……..	Dave Reinbold	610-313-3100
Client Contact: ……	Jonathan Ream	315.461.3622
State Utility Locate Service: ……...	Dig Safely New York	800-272-4480
Site Utility Repair Contractor: ……	PSE&G LI	631-490-0075
Site Utility Repair Contractor: ……	National Grid	800-490-0045
ATC Lifelines: ……	CORE HEALTH Networks	800-756-1133

NOTE: For additional emergencies/important contacts, refer to your ATC Lifelines Card.

EMERGENCY MEDICAL ROUTE TO HOSPITAL



Avalon Riverview
4-75 48th Ave, Long Island City, NY 11109

1. Head west on 48th Ave toward Center Blvd — 289 ft
2. Turn right onto Center Blvd — 289 ft
3. Turn right at the 1st cross street onto 47th Rd — 0.2 mi
4. Turn left at the 2nd cross street onto Vernon Blvd — 1.5 mi
5. Turn right onto 35th Ave — 0.4 mi
6. Turn left onto 21st St — 0.7 mi
7. Turn right onto 30th Ave — 0.2 mi
   Destination will be on the right

1.0 - INTRODUCTION

1.1 Scope and Applicability of the Site Health and Safety Plan

This Health and Safety Plan (HASP) has been prepared by ATC Group Services LLC (or ATC) for the activities associated with the AvalonBay project that includes the operation and maintenance of the vapor mitigation system at the property located at 4-75 48th Avenue, Long Island City, New York (hereinafter collectively referred to as the "Site").

The health and safety protocols established in this Plan are based on the ATC Employee Health and Safety Policy Manual, the Occupational Safety and Health Administration (OSHA) Regulations, past field experiences, specific Site conditions, and chemical hazards known or anticipated to be present from available Site data. The following Site Health and Safety Plan (HASP) are intended solely for use during the proposed activities described in the project documents and technical specifications. Specifications herein are subject to review and revision based on actual conditions encountered in the field during Site characterization activities. Such changes may be instituted by using the HASP List of Approved Amendments and/or Changes (see Appendix C).

Before Site operations begin, all employees, including subcontractors for ATC covered by this plan, involved in these operations will have read and understood this HASP and all revisions. All Site personnel have the authority to "Stop Work" if unsafe conditions are present or discovered during Site activities. Before work begins, all affected workers will sign the Heath and Safety Plan Acknowledgment Form (see Appendix C). By signing this form, all individuals recognize the requirements of the HASP, known or suspected hazards, and will adhere to the protocols required for the project Site.

1.2 Historical Overview

Parcel 9 is located in the Hunters Point section of Queens, New York. The parcel is bounded by 5th Street on the east, 48th Avenue on the south, Center Boulevard on the west, and 47th Road on the north. It has a total area of approximately 1.79 acres and lies at an elevation of 8 to 10 feet (relative to Queens Borough Datum). The East River is located roughly 500 feet west of the site.

The Supplemental Remedial Investigation Report for Queens West Parcel 9 (April 2005) identified two areas of hydrocarbon contamination on the site: an area of petroleum contamination in the north-central portion of the site, around the location where a vault with three 10,000-gallon tanks was discovered; and an area of contamination associated with coal tar detected in a deep well in the southwest corner of the site and extending along the western boundary of the site adjacent to Center Boulevard.

Remediation of the contamination identified during the Remedial Investigation consisted of excavating all soil containing contaminant concentrations exceeding the Site Specific Soil Action Levels (SSSALs) and included pumping out and removing several additional underground storage tanks that were discovered during soil excavation activities. During site redevelopment, a sub-slab vapor mitigation system was installed under the residential buildings to prevent potential vapor intrusion, and a cap was placed over the entire footprint of the site to prevent exposure to underlying soil.

Development on Parcel 9 consists of a multi-tenant residential complex with low-rise and hi-rise structures located on the western half of the site. A multi-level parking garage occupies the eastern half of the site, with townhouses located south of the garage, along 48th Avenue. Neither structure has a basement or any subgrade levels.

The Site Management Plan (SMP) for Parcel 9 includes requirements for operation, maintenance and monitoring of the vapor mitigation system, maintenance of the site cap, and groundwater monitoring. The plan also provides guidance for soil disturbances related to utility repair, landscaping activities, and other renovations/repairs. This environmental Health and Safety Plan (HASP) has been developed for implementation of Site Management Plan conducted by all personnel on-site, both ATC employees and others. This HASP does not discuss other routine health and safety issues common to general construction/excavation, including but not limited to slips, trips, falls, shoring, and other physical hazards.

1.3 Visitors

All visitors to the Site must be instructed about the hazards of the activities that ATC or its subcontractors are performing. All visitors must sign the ATC Visitors Log (see Appendix C).

1.4 Subcontractor Activities

All subcontractors used at the Site have been Pre-Approved in the ATC Subcontractor Prequalification System.

2.0 - PROJECT ORGANIZATION

All personnel and visitors who may enter work areas on this Site must comply with the requirements of this HASP. All Site personnel have the authority to "Stop Work" if unsafe conditions are present. The specific responsibilities and authority of management, safety and health, and other personnel on this Site are detailed in the following sections.

2.1 Site Safety and Health Officer (SSHO)

The Site Safety and Health Officer (SSHO) has the responsibility and authority to develop and implement this HASP and to verify compliance. The SSHO reports to the Project Manager; both must be designated prior to commencement of work. The SSHO is on-site during all work operations and has the responsibility to halt Site work if unsafe conditions are detected. The responsibilities of the SSHO at the Site include the following:

- Managing the health and safety functions on the Site;
- Ensuring Site monitoring, worker training, and effective selection and use of PPE;
- Conducting daily Tailgate Safety Meetings for Site personnel and subcontractors and summarize the training on the Tailgate Meeting Form (see Appendix C). The following topics should be covered during safety meetings:
  - Hazard Communication (i.e., MSDS location, and container labeling, chemical hazards of non-routine tasks)
  - Determine applicability of Standard Operating Procedures (SOP) in Section 8 and communicate procedures
  - Review Site safety requirements
  - Give refresher training on heat or cold stress (Section 5.2 and 5.3) when appropriate
  - Review Site emergency procedures
  - Discuss location and use of a rig kill switch for drilling/boring operations
- Conducting daily safety inspections of the Site looking for unsafe acts or conditions and providing corrective action as appropriate.

2.2 Site Supervisor

The Site Supervisor is responsible for field operations and reports to the Project Manager. The Site Supervisor is the On-site Coordinator and overseer of operations; both must be designated prior to commencement of work. It is the Site Supervisor's duty to maintain Site security, supervise the personnel on the Site, coordinate the activities of the subcontractor personnel, and check that the HASP is followed and modified when necessary. The Site Supervisor's specific responsibilities include:

- Executing the work plan and schedule as detailed by the Project Manger
- Coordination with the SSHO on health and safety issues
- Ensuring Site work compliance with the requirements of the HASP
- Before Site activities, contact the hospital emergency room, local fire department, and local police department, as applicable. If outside town, contact county officials and local emergency services.

2.3 Project Manager (PM)

The Project Manager (PM) has the primary responsibility for the fulfillment of the terms of the contract and overseeing operations for the purpose that includes meeting legal and safety requirements. It is the PM's responsibility to keep the project on schedule, within budget, and communicate with the Client regarding the progress toward specified goals.

The PM will inform the Regional Safety Coordinator of all HASP modifications, violations, injuries, exposures, and near-miss situations. The PM responsibilities include:

- Provide personnel time to read and understand the Site Health and Safety Plan (HASP) before fieldwork.
- Conduct project start-up health and safety briefing for: Field personnel, the Site Supervisor, the project team.
- Check that each subcontractor is pre-approved and that each subcontractor's Site workers have appropriate HAZWOPER Training Certificates.
- Check that Site personnel, if required, have received Respiratory Protection Training, Fit testing, and physician's approval to wear a respirator.
- That hazards identified during any Site audits are corrected. If necessary for immediate hazards, shut down field operations if hazards can not be corrected or the hazards present an immediate threat to life and health.

2.4 Regional Safety Coordinator (RSC)

The Regional Safety Coordinator (RSC) is responsible for providing professional health and safety advice and oversight management to the project. The RSC will review and provide support for concerns regarding the health and safety of field personnel assigned to this project, including:

- If requested by the Project Manager, approval of Routine HASP;
- Approval of all Non-Routine HASP;
- Review of incident reports, inspections, and air monitoring results;
- When required, the RSC will conduct a field audit of the Site to evaluate the adequacy of the program and implement the necessary changes through the HASP.

2.5 Project Field Team

The Project Team includes technicians, engineers, scientists, geologists, and possibly subcontractors who perform field activities. Each individual team member will be responsible for understanding and personally complying with the HASP and Site health and safety requirements. Project Team members will report health and safety violations to either the Site Supervisor or the SSHO. Health and safety responsibilities, as discussed in this Plan, which are shared by all Site personnel include:

- Complying with the requirements of the HASP.
- Reporting unsafe acts or conditions
- Retain copies at the Site of the following health and safety records:
  - Current HAZWOPER Training Certificate.
  - Respiratory Protection Training Certificate and current fit test record for potential respirator users.
  - Physician's approval for hazardous-waste fieldwork and/or respirator use.
  - First-aid/CPR and bloodborne pathogens training certificate.

3.0 – TASK/OPERATION HEALTH AND SAFETY RISK ANALYSIS SUMMARY

This chapter of the HASP describes the safety and health hazards associated with the Site work and control measures selected to protect workers. The purpose of the Job Safety Analysis (JSA) is to identify the routine safety and health hazards associated with the routine Site tasks and operations. Using this information, appropriate control methods are selected to eliminate the identified risks or effectively control them.

3.1 Job Safety Analysis (JSA)

Each specific JSA appears on a separate copy of the spreadsheets in Appendix A. A single JSA may be used for a task/operation performed in multiple locations if the hazards, potential exposures, and controls are the same at each location.

3.2 Health Analysis and Chemical Risk Assessment

Chemicals may be purchased and transported to the Site to support Site characterization and remediation operations. The principal chemical contaminants at the Site are expected to be PCBs and metals. Appendix B contains information from the National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards about each of these chemicals. Additionally, the Hazard Communication Program (Policy No. 21) requires ATC to provide employees, contractors, subcontractors, and visitors with information on the health effects of these chemicals and necessary actions to protect against exposure. This information is transmitted through Material Safety Data Sheets (MSDS), the NIOSH Pocket Guide, container labels, training, and a written Hazard Communication program.

Site activities will adhere to the ATC Hazard Communication Program as described in the Policy. All Site personnel, including subcontractors, will be briefed on this Program as part of the Site orientation training before starting work. In accordance with this Program, the PM and Site Supervisor will check that each chemical brought to the Site is accompanied by its MSDS. A copy of each MSDS will be made available to each Site employee who may be potentially exposed to the chemical. In addition, the Site Supervisor will check that all subcontractors bring at least one copy of MSDS for each chemical they bring onto the Site. The Site Supervisor will also check that all chemical containers brought to the Site to determine if they are labeled as to its contents and appropriate hazard warnings.

3.4 Noise Hazards and Controls

Exposure to high levels of noise may occur when working near heavy equipment. Also, depending upon where the work is being performed, local equipment (e.g., airports, factory machines, etc.) may produce high levels of noise. Employees exposed to noise levels in excess of the action level of 85 decibels (A-weighted, Slow Response) will be included into the ATC Policy on Hearing Conservation (Policy No. 34). The SSHO may evaluate employee noise exposures using a Noise Survey Meter or a Noise Dosimeter. The RSC may conduct additional noise monitoring to determine the appropriate response to be taken. Employees will be provided with ear plugs and/or earmuffs when exposed to noise levels in excess of the 8-hour Permissible Exposure Limit (PEL) of 90 decibel (A-weighted, Slow Response). This hearing protection shall have a Noise Reduction Rating (NRR) to protect hearing in accordance with Policy No. 34, including the NRR de-rating factor of [(NRR-7)/2].

3.5 Biological Hazards

Site activities on this Site may expose workers to other hazards such as poisonous plants, insects, animals, and indigenous pathogens. Protective clothing and respiratory protection equipment, and being capable of identifying poisonous plants, animals, and insects, can greatly reduce the chances of exposure. Thoroughly washing any exposed body parts, clothing, and equipment will also protect against infections. If working in wooded/grassy areas, use appropriate insect repellants (containing DEET and/or Permethrin) and apply them per the manufacturers' directions.

3.6 Other Hazards

All ATC employees and subcontractors working on this task should be aware of potential cold stress and should take appropriate measures as required.

4.0 - AIR MONITORING AND PERSONAL PROTECTIVE EQUIPMENT

4.1 Site Air Monitoring Requirements

No air monitoring is required during this phase. However if conditions change, to prevent exposure to hazardous conditions and aid in the selection of personal protective equipment, monitoring for the presence of airborne contaminants will occur when Site conditions indicate their potential presence. One or more of the following direct-reading instruments may be used to aid in this determination. Photoionization Detectors (PID) and Flame Ionization Detectors (FID) measures non-specific organic gases and vapors. Combustible Gas Indicators (CGI) will detect explosive atmospheres. Oxygen (O_2) meters will detect fluctuations in oxygen concentrations. A Dust Trak Aerosol Monitor to measure particulate concentrations. These instruments should be calibrated or bump tested daily and whenever the readings may be erratic. All readings should be recorded in the field log books.

Colorimetric detector tubes supplement PID and/or FID readings to measure specific gases and vapors. Other direct-reading instruments are available for use to monitor for the presence of specific airborne Site contaminants.

If conditions change that suggest the presence of airborne contaminants the breathing zone of the employee(s) anticipated to have the highest potential for exposure for each task will be monitored using an appropriate combination of some or all of these direct-reading instruments. Air monitoring should occur every 15 minutes during non-intrusive activities, or every 5 feet of penetration during intrusive activities. Generic Site tasks and air monitoring requirements are shown in Table 4-1. Additional Site monitoring may occur at the discretion of the SSHO, Site Supervisor, or RSC.

4.2 Action Levels for Personal Protection Equipment

The first and foremost means of protecting employees from injuries or exposures is to eliminate the exposure. The general hierarchy for controlling potential exposures is: (1) Engineering Controls; (2) Administrative Controls; and (3) the use of PPE. PPE is a means of preventing injury or exposure when exposure elimination and/or other control means are not feasible.

The initial level of protection and the Action Levels at which the PPE will be upgraded are determined based on the identification of specific chemicals expected to be present at a Site and the established OSHA Permissible Exposure Levels (PEL) or ACGIH Threshold Limit Values (TLVs), whichever is lower. In the event more than one chemical is expected or exists at a Site, the most hazardous chemical will dictate the level of personal protection required. Table 4-2 shows the action levels for levels of personal protection equipment.

Table 4-2
Action Levels for Personal Protection Equipment

Monitoring Equipment	Hazard	Action Level Above Background	Action
PID	Organic gas/vapor	< 10 ppm	Level D.
		10 to 50 ppm	Level C. Move upwind and continue air monitoring, cease operations, or use detector tube(s) for (contaminant) and reference Table 4-3 below.
		> 50 ppm	Immediate Withdrawal. Contact the PM and RSC for further instructions to proceed.

Monitoring Equipment	Hazard	Action Level Above Background	Action
Dust Trak	Particulate matter less than 10 micrometers in size (PM-10)	> 100 mcg/m^3	Dust suppression techniques will be employed (i.e clean water spray)
		> 150 mcg/m^3	If, after implementation of dust suppression techniques, elevated level remain work will be stopped and a re-evaluation of activities initiated

Detector tubes to be used are indicated for given ranges based upon the PID readings (Table 4-2). As appropriate, PID readings in conjunction with detector tubes will be utilized during the field activity and location anticipated having the highest level of contamination. This location will be selected by the Site Supervisor. If these measurements indicate exposure levels appropriate for Level D work, the use of detector tubes will be limited to situations where field conditions or activities have changed. Detector tubes will be available for use at the discretion of the Site Supervisor and the SSHO.

Any upgrading to higher levels of protection may require additional personal sampling using National Institute for Occupational Safety and Health (NIOSH) or Occupational Safety and Health Administration (OSHA) methods for the collection and analysis of airborne contaminants.

Air monitoring equipment used on the Site should be calibrated with the following:

Calibration/Response Check

Types	Frequency	Gas Standard
PID	Daily	100 ppm isobutylene in air

Field personnel, in conjunction with the Site Supervisor and SSHO, may choose to allow ventilation of vapors before resuming work (rather than using higher levels of PPE). If ventilation is conducted, additional air monitoring will be performed prior to the resumption of work to determine the level of PPE required.

4.3 Levels of Protection

Levels of protection for Site activities are described on the Site Air Monitoring Summary. The protection levels may include all or some of the following, based on work scope.

Level D:

- Work uniform – Long pants and shirt with sleeves (no tank tops) – refer to Policy No. 25 Personal Protective Equipment (Section 5.5)
- Disposable, inner nitrile gloves
- Chemical-resistant boots with steel toe
- Safety glasses with side shields
- High Visibility Reflective Vest Class 1, Class 2, or Class 3 (select based on Traffic speed)
- Hard hat
- Disposable, chemical-resistant outer boot covers*
- Hearing protection*

LEVEL C:

- Half-face or full-face, air purifying respirator (NIOSH approved)
- Disposable, hooded, chemical-resistant clothing
- Disposable, chemical-resistant outer gloves
- Disposable, inner nitrile gloves
- Chemical-resistant boots with steel toe
- Disposable boot covers
- Hard hat
- Safety Glasses with side shields
- High Visibility Reflective Vest Class 1, Class 2, or Class 3 (select based on Traffic speed)
- Coveralls*
- Hearing protection*

(* Optional Equipment, depending on conditions/exposures)

4.4 Respiratory Protection

Respiratory protection requirements are described in detail in the ATC Respiratory Protection Program. Basic rules of respiratory usage are listed below:

- Facial hair that interferes with a satisfactory fit of the mask-to-face seal is not allowed on personnel required to wear respirators.
- Respirator cartridges should be replaced after approximately 8-hours of continuous or intermittent usage, unless otherwise noted. Cartridges should also be replaced if they become damaged, after the expiration date is exceeded, if vapor smell breakthrough occurs, or if filters become clogged causing resistance to breathing.
- Contact lenses may be worn when respiratory protection is required, in conjunction with additional eye protection to protect against particles or splashes, provided there is no interference with the respirator seal.
- Respirators shall be cleaned and disinfected after each day's use or more often, if necessary.
- Prior to donning, respirators will be inspected for worn or deteriorated parts. Emergency respirators or self-contained devices will be inspected at least once a month and after each use.
- After donning, personnel should perform a positive and negative user fit-check to determine if a good seal has been achieved.
- Each employee shall make sure that they have an annual respirator fit test and respiratory protection training.

5.0 - HEALTH SURVEILLANCE PROGRAM

5.1 Employee Medical Examinations

All ATC employees involved in work at the Site will participate in ATC's Medical Surveillance Program administered by Health Resources. Additionally, when respirators are required (as determined by the SSHO and project manager), each employee will also have current respirator clearance.

A post project, follow-up exam may be required if an exposure incident is reported or an employee shows specific symptoms associated with the known or suspected hazardous chemicals. The RSC and the Project Manager will determine when post project exams are required.

5.2 Heat Stress Program

This procedure applies to all employees when heat stress conditions exist at project sites.

5.2.1 Training

The SSHO will have received acceptable training in first-aid and Cardiopulmonary Resuscitation (CPR), including training in heat-related illnesses. The SSHO shall also be trained on the requirements of the ATC Policy for Industrial Hygiene (Policy No. 23), which contains the requirement for Heat Stress monitoring. All workers should be capable of recognizing and treating the signs and symptoms of heat stress conditions. During potential heat stress conditions, ice should be readily available to rapidly cool victims.

5.2.2 Fluid Replacement

Water will be made available at the Site for employee fluid replacement. When heat stress is determined to be a problem by the SSHO, employees will be provided with balanced, electrolyte solutions to replace fluid and electrolyte loss. Employees will be provided with replacement fluids at a minimum rate of 8 ounces every 15 to 20 minutes per person.

5.2.3 Acclimatization

Acclimatization is a gradual physiological adaptation that improves an individual's ability to tolerate heat stress. Full-heat acclimatization requires up to 3 weeks of continued physical activity under heat-stress conditions similar to those anticipated for the work. Its loss begins when the work activity in the heat stress conditions is discontinued. A noticeable loss usually occurs within 3 – 4 days.

5.2.4 Rest Breaks

When heat stress conditions are applicable, all rest breaks should be taken out of the zone of exclusion into a cooler, shaded, rest area. If these conditions are not available, more frequent rest breaks will be taken.

5.2.5 Heat Stress Monitoring

Heat Stress and heat strain are conditions resulting from environmental factors including temperature, relative humidity, radiant heat transfer, and air movement, as they are affected by clothing. The primary objective of the heat stress management program is to prevent heat stroke which is life threatening and the most serious of the heat-induced disabilities. Extra caution should be taken for workers who are not acclimated to working in the heat.

The following Heat Stress Index (refer to ATC Policy No. 23) should be used as a guide to evaluate heat stress situations. If the Heat Stress exceeds 105^{o} F, contact the RSC prior to work for detailed guidance.

Heat Stress Index

Temp. °F	Relative Humidity								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
105	98	104	110	120	132				
102	97	101	108	117	125				
100	95	99	105	110	120	132			
98	93	97	101	106	110	125			
96	91	95	98	104	108	120	128		
94	89	93	95	100	105	111	122		
92	87	90	92	96	100	106	114	122	
90	85	88	90	92	96	100	106	114	122
88	82	86	87	89	93	95	100	106	115
86	80	84	85	87	90	92	96	100	109
84	78	81	83	85	86	89	91	95	99
82	77	79	80	81	84	86	89	91	95
80	75	77	78	79	81	83	85	86	89
78	72	75	77	78	79	80	81	83	85
76	70	72	75	76	77	77	77	78	79
74	68	70	73	74	75	75	75	76	77

NOTES: Add 10° F when protective clothing is being used; Add 10° F when in direct sunlight

HSI Temp	Category	Injury Threat
Above 130° F	Extreme Danger	No work unless emergency exists. Contact ATC RSC and Corporate Risk Management Department prior to proceeding. Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity.
105° to 130° F	Danger	Contact RSC prior to proceeding. Requires strict adherence to ACGIH Heat Stress Guidelines, including use of on-site WBGT equipment. Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity.
90° to 105° F	Extreme Caution	Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity.
80° to 90° F	Caution	Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity.
Below 80° F	Normal Range	Typical conditions for time of year. Little or no danger under normal circumstances. As always, anticipate problems and work safely.

5.3 Cold Stress Program

This procedure applies to all employees who perform field work in cold environments at risk of cold stress injury and intended to protect workers from the most severe effects of cold stress.

5.3.1 Training

ATC Site employees have been trained in cold stress as part of their HAZWOPER 40-hour initial training. Site workers will receive refresher training by the SSHO in cold stress safety and health procedures. The training program will include, as a minimum, instruction in the following areas:

- Proper first-aid treatment
- Proper clothing practices
- Proper eating and drinking habits
- Recognition of impending frostbite
- Recognition of the signs and symptoms of impending hypothermia or excessive cooling of the body when shivering does not occur
- Safe working practices

The SSHO will be trained in first-aid, CPR, and cold stress conditions.

5.3.2 Environmental Monitoring

Frostbite and hypothermia are two types of cold injury that personnel must be protected against during the performance of field duties. The objective is to prevent the deep body temperature from falling below 96.8° F and to prevent cold injury to body extremities. Two factors influence the development of a cold injury the ambient temperature, and wind velocity.

The SSHO will monitor environmental conditions by recording ambient temperature and estimated wind-speed. Information contained in Tables 5-1 and 5-2 will be used to evaluate the possibility of hypothermia among workers on-site.

5.3.3 Protective Clothing and Rest Breaks

Use appropriate cold weather clothing when temperatures are at or below 40°F as exposed skin surfaces must be protected. These protective items can include facemask, hand wear, and foot wear. Workers handling evaporative solvents during cold stress conditions will take special precautions to avoid soaking gloves and clothing because of the added danger of prolonged skin contact and evaporative cooling. Personnel will wear protective clothing appropriate for the level of cold and planned physical activity. The objective is to protect all parts of the body, with emphasis on the hands and feet. Eye protection against glare and ultraviolet light should be worn in snowy and icy conditions.

The work rate should not be so great as to cause heavy sweating that could result in wet clothing. If heavy work must be done, opportunities for rest breaks will be provided where workers have the opportunity to change into dry clothing. Conversely, plan work activities to minimize time spent sitting or standing still. Rest breaks should be taken in a warm, dry area. Windbreaks can also be used to shield the work area from the cooling effects of wind.

5.3.4 Identification and Treatment of Cold Stress

When frostbite, hypothermia, or other cold stress symptoms are suspected, treat the patient to relieve symptoms or transport them to the medical facility identified on page TC-4.

TABLE 5-1
Threshold Limit Values Work/Warm-up Schedule
for Four-Hour Shift*

Air-Temperature--Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx.)	°F (approx.)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm. Breaks) 1		(Norm. Breaks) 1		75 min	2	55 min	3	40 min	4
-29° to -31°	-20° to -24°	(Norm. Breaks) 1		75 min	2	55 min	3	40 min	4	30 min	5
-32° to -34°	-25° to -29°	75 min	2	55 min	3	40 min	4	30 min	5	Non-emergency work should cease	
-35° to -37°	-30° to -34°	55 min	3	40 min	4	30 min	5	Non-emergency work should cease		Non-emergency work should cease	
-38° to -39°	-35° to -39°	40 min	4	30 min	5	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease	
-40° to -42°	-40° to -44°	30 min	5	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease	
-43° & below	-45° & below	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease	

*1. Schedule applies to any 4-hour work period with moderate to heavy work activity, with warm-up periods of ten. (10) Minutes in a warm location and with an extended break (e.g., lunch) at the end of the 4-hour work period in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule on step lower. For example, at -35°C (-30°F) with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).

2. The following is suggested as a guide for estimating wind velocity if accurate information is not available: 5 mph: light flag moves; 10 mph: light flag fully extended: 15 mph: raises a newspaper sheet: 20 mph: blowing and drifting snow.

3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be 1) special warm-up breaks should be initiated at a wind chill cooling rate of about 1750 watts per square meter (W/m^2); 2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m^2. In general, the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly overcompensates for the actual temperatures in the cooler ranges because windy conditions rarely prevail at extremely low temperatures.

4. TLVs apply only for workers in dry clothing.

* Adapted from Occupational Health & Safety Division, Saskatchewan Department of Labor.

TABLE 5-2
Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)*

Estimated Wind Speed (mph)	Actual Temperature Reading (degrees F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent chill Temperature (degrees F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds > 40 mph have little additional effect)	LITTLE DANGER If < hr with dry skin. Maximum danger of false sense of security				INCREASING DANGER Danger from freezing of exposed flesh within one minute.			GREAT DANGER Flesh may freeze within 30 seconds.				
	Trench foot and immersion foot may occur at any point on this chart.											

* Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA

6.0 - SITE SECURITY AND CONTROL

6.1 Work Zones

Restricted Site areas will include, but not necessarily be limited to, the following zones:

- **Exclusion Zone or Hot Zone** - any area where contamination is either known or likely to be present in concentrations that could pose a threat to human health and safety or that potential for harm to personnel exists because of the type of work activities being conducted. Appropriate PPE should be utilized in this area.
- **Contamination Reduction Zone** - any area where workers conduct personal and equipment decontamination.
- **Support Zone** - areas where access is controlled, but the chance to encounter hazardous materials or conditions are minimal.

Access to the work zones will be controlled by work zone delineators, as necessary (e.g. traffic cones, flags, vehicles, DOT approved devices, temporary or permanent fencing, and/or safety barrier tape). Figure 6-1 is an example of a work zone. Additionally ATC employees should follow the requirements of the Employee Health and Safety Policy Manual, Policy No. 36, Work Zones in Traffic Areas for additional information.

In the event on-site personnel must upgrade their personal protective equipment, the work zones may require substantial modification in order to provide for the safety of nearby personnel not associated with this work. Any upgrade level will be communicated by the Site Supervisor to the PM. The PM will then inform the RSC of this occurrence.

Work Zone	Level of Protection	Required Protective Equipment (specify exact type, e.g. nitrile gloves)	
Exclusion Zone		Respirator:	None
		Filters/Cartridges:	NA
		Boots:	Yes
		Inner Gloves:	None
		Outer Gloves:	Nitrile
		Protective Coverall:	None
		Hard Hat:	Yes
		Eye Protection:	Yes
		Other:	Reflective Vests, Hearing Protection where needed

Contamination		Respirator:	
Reduction Zone		Filters/Cartridges:	
		Boots:	Yes
		Inner Gloves:	
		Outer Gloves:	
		Protective Coverall:	
		Hard Hat:	Yes
		Eye Protection:	Yes
		Other:	

Exceptions and Modifications:

6.2 Buddy System

The Buddy System will be used at all times by field personnel in the Exclusion Zones. The Buddy System means that personnel work in pairs and stay in close visual contact to be able to observe one another and summon rapid assistance in case of emergency. No one is to perform fieldwork without the approval of the Branch Safety Officer and/or the Regional Safety Officer.

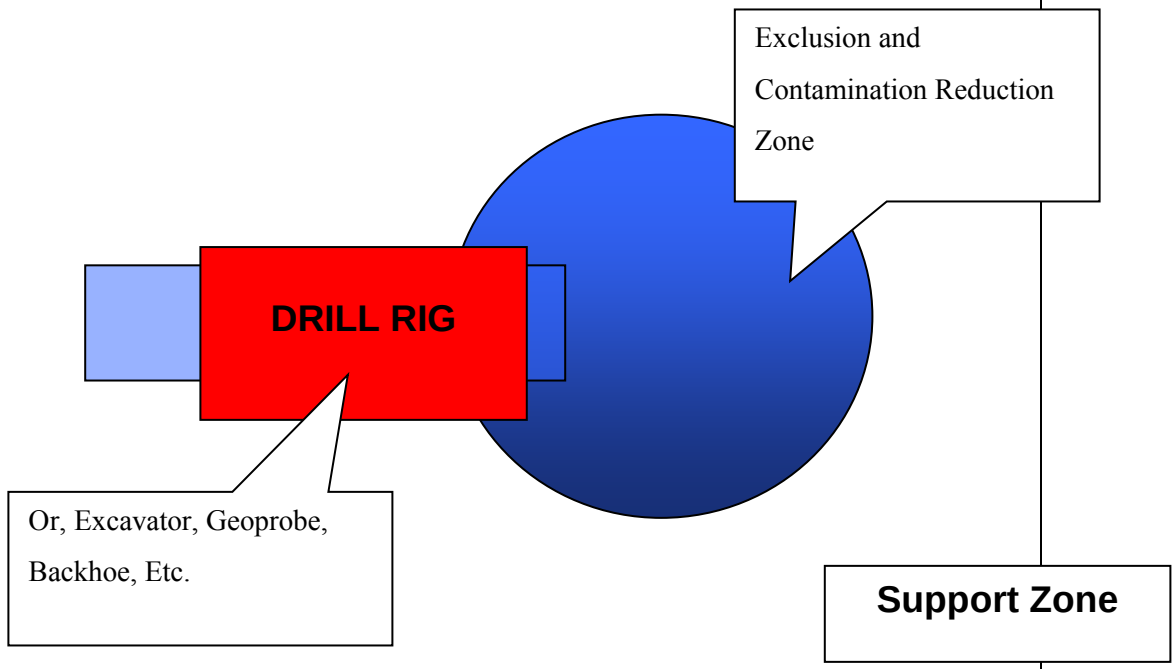
6.3 Site Communication

A loud and clear form of communication should be made available for Site personnel entering the work zones. Site communication may be in the form of hand signals, voice, or other communication devices. All forms of communication should be understood by all workers on the Site prior to starting work.

6.4 Roadway Work Zones

When ATC employee and subcontractors are required to perform Site operation in a city street or public right-of-way, a Traffic Control Plan may be required and included with this HASP. Check with the State or local government Department of Transportation for when a traffic control plan is required. Traffic Control Plans will include Transition Areas, Activity Areas, and Termination Areas.

FIGURE 6-1
TYPICAL EXCLUSION ZONE



7.0 - DECONTAMINATION PROCEDURES

7.1 Personnel Decontamination

All personnel must complete appropriate decontamination procedures in a way that is responsive to actual Site conditions before leaving the Site. The decontamination of personnel and equipment will be performed within the exclusion and contamination reduction zones. Wash tubs containing an appropriate decon solution and soft bristle brushes will be used to decontaminate personal protective clothing and boots. Deionized water will be used for the final rinse. The SSHO will visually inspect all PPE and other equipment once decontamination procedures are completed. In general, the four types of decontamination solutions to be considered for PPE include:

- Water for removal of low-molecular weight hydrocarbons, inorganic compounds, salts, some organic acids, and other polar compounds.
- Dilute acids (vinegar) for removal of basic (caustic) compounds, amines, and hydrazines.
- Dilute bases (soaps and detergents) for removal of acidic compounds, phenols, thiols, and some nitro and sulfonic compounds.
- Organic solvents for removal of nonpolar compounds (organic).

LEVEL D/LEVEL C

- Establish a segregated equipment drop
- Remove disposable, outer boot covers, if applicable
- Remove chemical resistant, outer gloves, if applicable
- Remove hard hat and goggles, safety glasses, or face shield
- Remove disposable, inner gloves
- Remove full-face air purifying respirator (Level C only)

Each individual will be responsible for inspecting and decontaminating their own respirator in accordance with the ATC Respiratory Protection Program (Policy No. 27).

At a minimum the hands and face of each employee must be thoroughly washed upon leaving the work area. Trash receptacles will be provided for all disposable clothing. Commercial laundries or cleaning establishments that decontaminate clothing or equipment will be informed of the potentially harmful effects of exposure.

Decontamination Solution: Soap and water, fresh rinse

STATION #1: Wash hands, dispose of outer gloves and coveralls

Equipment Required: Wash basin

STATION #2: NA

Equipment Required: NA

STATION #3: NA

Equipment Required: NA

STATION #4: NA

Equipment Required: NA

7.2 Equipment Decontamination

The subcontractor will decontaminate field equipment according to the work plan. This may include manual removal of gross contamination with shovels or other tools, followed by a high-pressure, hot water sprayer. Because decontamination at the high-pressure, hot water station poses the possibility of a splash and/or mist inhalation hazard, the task should be performed using Level D personal protective equipment at a minimum.

Field tool including split-barrel soil samplers, brass liners, and sample knives and trowels will be decontaminated. The field tools may be scrubbed visually clean using a detergent solution (Alconox/Liquinox) with water and a stiff, long-bristled scrub brush. Following the solution scrubbing, the tools may be rinsed with distilled water or isopropyl alcohol.

Equipment Decontamination

Gross Removal By:

X	Hand Scrubbing
	Cold High Pressure Wash
	Hot High Pressure Wash
	Steam Cleaning
	Other (specify)
	Clean Rinse
X	Decon solution (specify) ALCONOX

7.3 Disposition of Decontamination Wastes

All materials and equipment used for decontamination should be disposed of in accordance with local, State, and/or Federal Regulations. Clothing, tools, buckets, brushes, and all other equipment that is contaminated must be properly packaged and stored on the Site until disposal arrangements are finalized. Clothing not completely decontaminated on-site should be secured in plastic bags before being removed from the Site.

Decontamination Waste Water

Collection (specify how): Wash basin

Direct Discharge (specify how and where): 55-gallon drum

Pre-Treatment (specify): None

Disposal (specify how and where): Contractor

8.0 - STANDARD OPERATING PROCEDURES

The following Standard Operating Procedures (SOPs) will be applied to each location and activity where work is performed on a hazardous chemical site. As hazards increase or decrease on the Site, the applicability of each SOP must be determined by the SSHO with the approval of any changes by the Project Manager or the RSC.

8.1 Personnel Precautions

1. Eating, drinking, chewing gum or tobacco, smoking, and any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in the exclusion and contamination reduction zone or in any area known to be contaminated.

2. When decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

3. Contact with contaminated or suspected contaminated surfaces should be avoided. When possible, do not walk through puddles, leachate, or discolored surfaces; kneel on the ground; or lean, sit, or place equipment on drums, containers, or the ground.

4. Medicines and alcohol can increase the effects from exposure to toxic chemicals. Personnel should not take prescribed drugs at hazardous waste operations where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Alcoholic beverage intake should be minimized or avoided.

5. All personnel must be familiar with Standard Operating Procedures and any additional instructions and information contained in this HASP. All visitors and subcontractors will read the HASP before entering the Site.

6. All personnel will be aware of symptoms for heat or cold stress.

7. All personnel will be familiar with the chemicals used on-site and the associated hazards as described in each respective MSDS. The MSDS for the chemicals on-site will be available and located in the company vehicle.

8.2 Operations

1. All personnel going to the Site must be adequately trained and thoroughly briefed on anticipated hazards, equipment, safety practices, emergency procedures, and communications.

2. Personnel on the Site must use the Buddy System when engaged in Level C work as specified in ATC Policy No. 35 (Hazwoper). The purpose of the Buddy System is to provide rapid assistance to employees in the event of an emergency.

3. Visual contact must be maintained between pairs of Site and safety personnel. Entry team members should remain close to assist each other during emergencies.

4. Personnel should practice unfamiliar operations before the actual procedure.

5. Entrance and exit locations must be designated, and emergency escape routes delineated. Warning signals for Site evacuation must be established by the SSHO before field activities.

6. Communications using radios, hand signals, or other means, must be maintained between initial entry members at all times. Emergency communications should be prearranged in case of radio failure, the necessity for evacuating the Site, or other reasons.

7. Wind indicators visible to all personnel should be strategically located throughout the Site.

8. Personnel and equipment in the contaminated area should be minimized, consistent with effective Site operations.

9. Work areas for various operational activities will be established.

10. Procedures for leaving a contaminated area will be planned and implemented before going to the Site. Work areas and decontamination procedures will be established based on expected Site conditions.

11. Frequent and regular inspections of Site operations will be conducted by the SSHO to check compliance with this HASP. If changes in operation occur, the HASP must be modified to reflect these changes.

12. All electrical equipment (power tools, extension cords, instruments, radios, etc.) will conform with ATC Policy No. 12 (Electrical) The SSHO will ensure that electrical equipment is free from recognized hazards that may cause physical harm to employees.

13. Fire prevention and protection (appropriate signs for flammable liquids, smoking areas, storage areas of combustible or flammable materials, etc.) will be according to ATC Policy No. 18, Fire Protection.

14. Site Tailgate Safety Meetings will be held daily to discuss anticipated Site conditions and daily activities. This meeting will be summarized in field logbooks and the Tailgate Safety Meeting Form (see Appendix C).

9.0 - CONTINGENCY PLAN

This chapter of the HASP describes potential emergencies at this Site and the procedures for responding to those emergencies.

9.1 Medical Emergencies

1. The name, address, telephone number, travel distance, and travel time to the nearest medical treatment facility are found in the Emergency Information section (see Page TC-4) of this HASP. A map and direction for locating the facility is available in the Emergency Information section (see Page TC-6) of this HASP.

2. Emergency routes will be verified and driven before any Site activities. It may be quicker to transport a person with minor injuries than to wait for Emergency Medical Services (EMS) to respond. Check with the local authorities for response times. Life threatening emergency situations will only be handled by emergency medical services.

3. Before mobilization on-site, the Site Supervisor will contact the local hospital emergency room personnel, local fire department, and local police department to brief them regarding the scope and hazards associated with the scheduled fieldwork. If the Site is outside an established town, contact will be made with county officials and local emergency services.

4. An emergency first-aid kit with contents per ATC Policy No. 20 (First-Aid) will be readily available (if corrosive materials are present) on the Site, and personnel will have first-aid training. The first-aid kit also contains equipment necessary to protect first-aid providers against exposure to bloodborne pathogens. All first-aid providers will have received Bloodborne Pathogens training and can receive Hepatitis B vaccinations according to the ATC Policy No. 09 (Bloodborne Pathogens) if exposed to bodily fluids.

5. Any person who becomes ill or injured in the exclusion zone must be decontaminated as well as possible with consideration to which risk will be greater, the spread of contamination or the health of the individual. If the injury or illness is minor, full decontamination (remove contaminated clothing and wash hands and face with soap and water, See Section 7.0) should be completed and first-aid administered before transport. If the patient's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in a blanket). First-aid should be administered while awaiting an ambulance or paramedics.

6. The following steps should be followed if an injury or illness case occurs:

    - Check the Scene.
    - If safe to do so, check the condition of the injured.
    - Call 911 if the victim is unconscious or your training dictates to do so.
    - Care for the injured. Always use “Universal Precautions”.
    - Call CORE HEALTH NETWORKS (CHN) 855-ATC-MED1 or 855-282-6331 , if the injury is non-life threatening. CHN will assist you with the location of the nearest clinic, if referral is needed.

7. Provisions must be made to identify the substance to which the worker has been exposed. This information must be given to medical personnel.

9.2 Emergency Equipment

1. A personal eyewash unit that meets ANSI Z358.1-1998, Section 6 will be available in each ATC field vehicle at the Site if corrosive chemicals (chemicals with a pH of <3 or >11) will be on-site.

2. An emergency first-aid kit with contents as per ATC Policy No. 20 (First-Aid). The Site Supervisor shall be trained and certified in first-aid and CPR.

3. An emergency spill cleanup kit will be available at the Site at all times. Unplanned releases will be reported to the SSHO and/or Site Supervisor as soon as possible.

4. Sufficient water and/or multipurpose dry chemical (Class A, B, and C) fire extinguishers, rated not less than 2A:10B:C, will be maintained on the Site to cope with any situation until emergency services arrive.

9.3 Flammable Conditions

In the event that combustible vapors exceed 10 percent of the LEL or strong odors are detected in the borehole, the following actions should be taken:

- Continue investigation using extreme caution. Personal protective equipment may need to be upgraded.
- Allow vapors to dissipate or use intrinsically-safe mechanical ventilation.
- If atmospheric conditions do not change, call in the listed sequence:
  - ─Project Manager
  - ─Regional Safety Coordinator
  - ─Fire Department
- Provide answering personnel with the call back numbers, locations, directions, and situation assessment.

9.4 Site Evacuation Conditions

The following conditions will necessitate the cessation of field work in the area of concern, withdrawal from the work area, and revisions to this HASP:

- Fires and/or explosions
- Unexploded ordnance is detected
- A major incident or injury occurs
- Flammable atmosphere readings above 10 percent LEL
- Oxygen readings above 23.5 percent oxygen concentration
- Oxygen readings at or below 19.5 percent oxygen concentration
- PID readings over 50 ppm sustained for more than 5 minutes

9.5 Emergency Communication System

Emergency contacts and telephone numbers are provided at the beginning of this HASP. Field crews will have some communication device at each active work location. These may include radios, mobile telephones, or walkie-talkies. Such communication devices will have sufficient range to contact the field office and/or emergency services. If an emergency occurs on-site, the Site Supervisor is responsible for checking that appropriate emergency contact has been notified. At the time of the emergency response, the Site Supervisor or designee will brief the emergency personnel on the status of the emergency, including Site conditions.

Field personnel will use hand signals if there are noisy working conditions on the Site. The hand signals that will be used are shown below and will be reviewed by the SSHO during the on-site safety briefing.

Signal	**Meaning**
Hands on top of head	Need assistance
Grip partner′s wrist or place both hands around partner′s arm	Leave area immediately
Thumbs up	OK; I am all right
Thumbs down	No; Negative
Hand gripping throat	Cannot breathe; Out of air

9.6 Emergency Response Follow-Up

If there is an incident, near-miss, or emergency response, the SSHO will notify the Project Manager and Regional Safety Coordinator. The Project Manager or the Branch Safety Officer will complete a Supervisor's Investigation Report (SIR) (Policy No. 51; Appendix 51-1) and submit to the appropriate Regional distribution list. Prior to resuming work, a Site safety meeting should be held to discuss the circumstances surrounding the incident and what should be done to prevent a re-occurrence.

10.0 - EMPLOYEE TRAINING

10.1 Pre-Assignment and Annual Refresher Training

All ATC Employees and Subcontractors will participate in routine health and safety education and training programs. These programs are designed to provide employees with a thorough knowledge of hazardous materials, health and safety hazard potential, and Federal Occupational Safety and Health Administration (OSHA) requirements published in 29 Code of Federal Regulations (CFR) Part 1910. According to 29 CFR 1910.120(e), Site employees will have received 40 hours of initial Hazardous Waste Operations & Emergency Response (HAZWOPER) instruction and 24 hours of supervised field experience. Attending an annual 8-hour HAZWOPER refresher training session maintains this initial training. It is the responsibility of the Project Manager and each subcontractor's supervising manager to determine if the subcontractor staff meets these training requirements.

10.2 Site Supervisor's Training

On-site Managers and Supervisors on hazardous waste sites who are directly responsible for or who supervise workers engaged in hazardous wastes operations receive, in addition to the initial 40 HAZWOPER training, 8 additional hours of specialized supervisory training in compliance with the OSHA regulations. This training includes training on the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazards monitoring procedure and techniques.

10.3 Site Safety Training and Briefing Topics

The SSHO will conduct Site-specific health and safety briefing for field personnel before the start of all field work. Briefing attendees will include the Site Supervisor, the Project Team, and Subcontractor personnel. At the conclusion of the meeting, personnel are to sign the HASP Agreement and Acknowledgement Form in the Appendices. As additional people are assigned to the Site, it is the responsibility of the SHSO to ensure that new personnel are briefed on health and safety protocols and ensure that they have reviewed and signed the HASP Agreement and Acknowledgement Form. Items to be covered include:

- Site-specific health and safety rules
- Client-specific health and safety rules
- Health effects of various chemicals used on the Site
- Emergency response actions pertaining to operations on-Site

Additionally, daily Site Tailgate Safety Meetings will be conducted to review past activities, plan ahead for new or changed operations, to understand any near-miss and "lessons learned, establish safe working procedures for anticipated hazards, and provide pertinent safety and health training and motivation. The SSHO will complete the Tailgate Safety Meeting Form located in the Appendices.

10.4 Visitors

All visitors entering the designated work zones will be subject to all applicable health and safety requirements during field operations at the Site. All visitors to a work Site will be given the opportunity to review the HASP, will be escorted at all times, and will be required to stay a safe distance from Site activities. The Site Supervisor and/or the SSHO will be responsible for briefing all visitors on the Site hazards, Site safety precautions, and the Site emergency response plan.

APPENDIX A
Job Safety Analysis (JSA)

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT			
☒ REFLECTIVE VEST	☒ LONG PANTS	☐ AIR PURIFYING RESPIRATOR	☐ OTHER:
☐ HARD HAT	☒ COTTON, LEATHER, OR CRAFTSMAN GLOVES	☐ SUPPLIED AIR RESPIRATOR	☐ OTHER:
☒ SAFETY TOED BOOTS	☐ CHEMICAL RESISTANT GLOVE:	☐ CHEMICAL RESISTANT CLOTHING:	☐ OTHER:
☐ SAFETY GLASSES	☒ HEARING PROTECTION	☐ GOGGLES	☐ OTHER:
☐ FACE SHIELD			☐ OTHER:
REQUIRED TOOLS/EQUIPMENT/SUPPLIES			
☐ DRINKING WATER	☐ RATCHET WITH EXTENSION	☐ OTHER:	☐ OTHER:
☐ BUG REPELLENT	☐ WELL MAGNET	☐ OTHER:	☐ OTHER:
☒ TRAFFIC CONTROL DEVICES	☐ AIR MONITORING **SELECT FROM LIST**	☐ OTHER:	☐ OTHER:
☐ LADDER	☐ LOCKOUT/TAGOUT EQUIPMENT	☐ OTHER:	☐ OTHER:

1 JOB STEPS	2 POTENTIAL HAZARDOUS CONDITIONS or UNSAFE PRACTICES	3 SAFE PROCEDURES and PREVENTATIVE MEASURES
Drive to project site	See JSA for Driving	• See JSA for Driving
Complete Site walk	Operating facility (facility is currently being used or occupied)	• Check in with site contact. Ask about all required PPE to be worn while walking within the facility. Describe task and ask if there is any safety concerns or issues that you should know of before beginning task. • Follow all site/facility health and safety rules.
	Moving vehicles	• Wear traffic reflective vest. • Wear hard hat. • Maintain awareness of surrounding areas. Do not assume that the driver sees you. Wait for them to signal that they see you. • If working low to the ground for extend periods of time, a second employee should be used or traffic candles (42 inches high) to mark location for drivers. • Use sidewalks or pedestrian walking areas as much as possible. • Limit your distractions while in parking lots or on roads
	Terrain/Natural Hazards	• Wear safety toed boots with ankle support. • Avoid steep slopes and loose debris. • Limit the amount of material you are carrying so that you can see the path while walking. • Ask for a ladder or path to be carved in steep slopes. If not possible side step or lower yourself closer to the ground while traveling down steep slopes. • Pay attention to surroundings when walking to avoid slip, trip and fall hazards. Use sidewalks, pedestrian walking areas, or developed paths as much as possible. Do not take short cuts. • Be able to recognize poison or irritant plants (i.e. poison ivy, poison oak, thistle, burs, etc.)

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT			
☒ REFLECTIVE VEST	☒ LONG PANTS	☐ AIR PURIFYING RESPIRATOR	☐ OTHER:
☐ HARD HAT	☒ COTTON, LEATHER, OR CRAFTSMAN GLOVES	☐ SUPPLIED AIR RESPIRATOR	☐ OTHER:
☒ SAFETY TOED BOOTS	☐ CHEMICAL RESISTANT GLOVE:	☐ CHEMICAL RESISTANT CLOTHING:	☐ OTHER:
☐ SAFETY GLASSES	☒ HEARING PROTECTION	☐ GOGGLES	☐ OTHER:
☐ FACE SHIELD			☐ OTHER:
REQUIRED TOOLS/EQUIPMENT/SUPPLIES			
☐ DRINKING WATER	☐ RATCHET WITH EXTENSION	☐ OTHER:	☐ OTHER:
☐ BUG REPELLENT	☐ WELL MAGNET	☐ OTHER:	☐ OTHER:
☒ TRAFFIC CONTROL DEVICES	☐ AIR MONITORING **SELECT FROM LIST**	☐ OTHER:	☐ OTHER:
☐ LADDER	☐ LOCKOUT/TAGOUT EQUIPMENT	☐ OTHER:	☐ OTHER:

1 JOB STEPS	2 POTENTIAL HAZARDOUS CONDITIONS or UNSAFE PRACTICES	3 SAFE PROCEDURES and PREVENTATIVE MEASURES
	Physical Hazards	• Prior to entering vacant structures, visually assess the structural integrity of floors, walls and ceilings. • Wear PPE based on site conditions or when specifically required by site specific non-ATC safety plans
	Crime	• Prior to leaving office, leave cell phone number on in/out board or with your supervisor. • Check in with the office prior to accessing and exiting the site. • Have another employee accompany you on your site walk or ask that a site representative meet you at the project site. • Do not visit the project site at night or early morning hours.
	Foot injuries	• Wear safety toed boots with ankle support. • Due to uneven walking surfaces and loose soils, boots with coverage extending over ankles is preferred to minimize turning of ankles. • Do not walk on construction debris. • Walk in maintained areas.
	Eye injuries	• Wear approved safety glasses with side shields. • If high winds and blowing dust goggles must be worn.
	Animals	• Do not disturb – leave them alone. • If stray dogs are present go indoors and the cab of the truck and wait for it to leave. Call animal control.
	Insects – bees, wasps, hornets, ticks, or black widow spiders	• Keep hands and feet out of areas you cannot see. • Wear bug repellant that contains DEET. • Wear long sleeve shirt and tuck pant legs into socks.
	Inadequate lighting	• Make sure appropriate lighting is available. • Have a primary (as well as a back-up) light when entering any areas that do not have lighting. • Where needed, provide fixed lighting to free hands while collecting samples. If the building does not appear to be structurally sound, notify your supervisor immediately and do NOT proceed if there is insufficient lighting.

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT			
☒ REFLECTIVE VEST	☒ LONG PANTS	☐ AIR PURIFYING RESPIRATOR	☐ OTHER:
☐ HARD HAT	☒ COTTON, LEATHER, OR CRAFTSMAN GLOVES	☐ SUPPLIED AIR RESPIRATOR	☐ OTHER:
☒ SAFETY TOED BOOTS	☐ CHEMICAL RESISTANT GLOVE:	☐ CHEMICAL RESISTANT CLOTHING:	☐ OTHER:
☐ SAFETY GLASSES	☒ HEARING PROTECTION	☐ GOGGLES	☐ OTHER:
☐ FACE SHIELD			☐ OTHER:
REQUIRED TOOLS/EQUIPMENT/SUPPLIES			
☐ DRINKING WATER	☐ RATCHET WITH EXTENSION	☐ OTHER:	☐ OTHER:
☐ BUG REPELLENT	☐ WELL MAGNET	☐ OTHER:	☐ OTHER:
☒ TRAFFIC CONTROL DEVICES	☐ AIR MONITORING **SELECT FROM LIST**	☐ OTHER:	☐ OTHER:
☐ LADDER	☐ LOCKOUT/TAGOUT EQUIPMENT	☐ OTHER:	☐ OTHER:

1 JOB STEPS	2 POTENTIAL HAZARDOUS CONDITIONS or UNSAFE PRACTICES	3 SAFE PROCEDURES and PREVENTATIVE MEASURES
	Falls from height	• Inspect all fixed ladders and scaffolds prior to use. If installed by others, check for safe condition. Where scaffolds are erected by others, check if erected under supervision of a Competent Person and determine if inspections are being conducted. • For portable ladders, conduct physical inspection to ensure no damage and that ladder is safe to use. • For extension ladders, ensure gripping feet are in good condition and on stable, level ground. Ensure extension ladder is placed at proper standoff distance from base of wall. Tie-off top of ladder and/or use assistant to help in stabilizing ladder. • Keep hands free of tools or other equipment while climbing (use tool belt if necessary). • Only climb ladder rungs designated for that purpose. • If exposed to a fall hazard greater than 6 feet, fall protection must be used. If a guardrail is not present then a fall protection system must be used. Consult your Project Manager or Branch Safety Officer prior to using a fall protection system.
	Temperature extremes	• Wear the appropriate clothing for environment. • To minimize heat stress, use lightweight and light colored clothing. Take frequent breaks. • Drink fluids on routine schedule. • Take TrainingMine Heat Stress training course to understand the signs & symptoms of heat stress and the prevention steps to take. • For cold stress, ensure adequate "layers" of clothing to ensure maintaining body heat without buildup of moisture under clothing. • Cover exposed skin. • Review Cold Stress guidance to understand the symptoms of cold stress and prevention methods.

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT			
☒ REFLECTIVE VEST	☒ LONG PANTS	☐ AIR PURIFYING RESPIRATOR	☐ OTHER:
☐ HARD HAT	☒ COTTON, LEATHER, OR CRAFTSMAN GLOVES	☐ SUPPLIED AIR RESPIRATOR	☐ OTHER:
☒ SAFETY TOED BOOTS	☐ CHEMICAL RESISTANT GLOVE:	☐ CHEMICAL RESISTANT CLOTHING:	☐ OTHER:
☐ SAFETY GLASSES	☒ HEARING PROTECTION	☐ GOGGLES	☐ OTHER:
☐ FACE SHIELD			☐ OTHER:
REQUIRED TOOLS/EQUIPMENT/SUPPLIES			
☐ DRINKING WATER	☐ RATCHET WITH EXTENSION	☐ OTHER:	☐ OTHER:
☐ BUG REPELLENT	☐ WELL MAGNET	☐ OTHER:	☐ OTHER:
☒ TRAFFIC CONTROL DEVICES	☐ AIR MONITORING **SELECT FROM LIST**	☐ OTHER:	☐ OTHER:
☐ LADDER	☐ LOCKOUT/TAGOUT EQUIPMENT	☐ OTHER:	☐ OTHER:

1 JOB STEPS	2 POTENTIAL HAZARDOUS CONDITIONS or UNSAFE PRACTICES	3 SAFE PROCEDURES and PREVENTATIVE MEASURES
		•
		•

APPENDIX B
Chemical Hazard Information

A

Acetaldehyde

Formula:	CAS#:	RTECS#:	IDLH:
CH_3CHO	75-07-0	AB1925000	Ca [2000 ppm]

Conversion: 1 ppm = 1.80 mg/m^3 **DOT:** 1089 129

Synonyms/Trade Names: Acetic aldehyde, Ethanal, Ethyl aldehyde

Exposure Limits:
NIOSH REL: Ca
See Appendix A
See Appendix C (Aldehydes)
OSHA PEL†: TWA 200 ppm (360 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2018, 2538, 3507
OSHA 68

Physical Description: Colorless liquid or gas (above 69°F) with a pungent, fruity odor.

Chemical & Physical Properties:
MW: 44.1
BP: 69°F
Sol: Miscible
Fl.P: -36°F
IP: 10.22 eV
Sp.Gr: 0.79
VP: 740 mmHg
FRZ: -190°F
UEL: 60%
LEL: 4.0%
Class IA Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids, bases, alcohols, ammonia & amines, phenols, ketones, HCN, H_2S [**Note:** Prolonged contact with air may cause formation of peroxides that may explode and burst containers; easily undergoes polymerization.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose, throat; eye, skin burns; derm; conj; cough; CNS depres; delayed pulm edema; in animals: kidney, repro, terato effects; [carc]
TO: Eyes, skin, resp sys, kidneys, CNS, repro sys [in animals: nasal cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Acetic acid

Formula:	CAS#:	RTECS#:	IDLH:
CH_3COOH	64-19-7	AF1225000	50 ppm

Conversion: 1 ppm = 2.46 mg/m^3 **DOT:** 2790 153 (10-80% acid); 2789 132 (>80% acid)

Synonyms/Trade Names: Acetic acid (aqueous), Ethanoic acid, Glacial acetic acid (pure compound), Methanecarboxylic acid [**Note:** Can be found in concentrations of 5-8% in vinegar.]

Exposure Limits:
NIOSH REL: TWA 10 ppm (25 mg/m^3)
ST 15 ppm (37 mg/m^3)
OSHA PEL: TWA 10 ppm (25 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1603
OSHA ID186SG

Physical Description: Colorless liquid or crystals with a sour, vinegar-like odor. [**Note:** Pure compound is a solid below 62°F. Often used in an aqueous solution.]

Chemical & Physical Properties:
MW: 60.1
BP: 244°F
Sol: Miscible
Fl.P: 103°F
IP: 10.66 eV
Sp.Gr: 1.05
VP: 11 mmHg
FRZ: 62°F
UEL(200°F): 19.9%
LEL: 4.0%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (>10%)
Eyes: Prevent eye contact
Wash skin: When contam (>10%)
Remove: When wet or contam (>10%)
Change: N.R.
Provide: Eyewash (>5%)
Quick drench (>50%)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 ppm: Sa:Cf£/PaprOv£/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers (especially chromic acid, sodium peroxide & nitric acid), strong caustics [**Note:** Corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, nose, throat; eye, skin burns; skin sens; dental erosion; black skin, hyperkeratosis; conj, lac; phar edema, chronic bron
TO: Eyes, skin, resp sys, teeth

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Acetic anhydride	**Formula:** $(CH_3CO)_2O$	**CAS#:** 108-24-7	**RTECS#:** AK1925000	**IDLH:** 200 ppm

Conversion: 1 ppm = 4.18 mg/m^3 **DOT:** 1715 137

Synonyms/Trade Names: Acetic acid anhydride, Acetic oxide, Acetyl oxide, Ethanoic anhydride

Exposure Limits:
NIOSH REL: C 5 ppm (20 mg/m^3)
OSHA PEL†: TWA 5 ppm (20 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 3506
OSHA 82, 102

Physical Description: Colorless liquid with a strong, pungent, vinegar-like odor.

Chemical & Physical Properties:
MW: 102.1
BP: 282°F
Sol: 12%
Fl.P: 120°F
IP: 10.00 eV
Sp.Gr: 1.08
VP: 4 mmHg
FRZ: -99°F
UEL: 10.3%
LEL: 2.7%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
125 ppm: Sa:Cf£/PaprOv£
200 ppm: CcrFOv/GmFOv/PaprTOv£/ ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Water, alcohols, strong oxidizers (especially chromic acid), amines, strong caustics [**Note:** Corrosive to iron, steel & other metals. Reacts with water to form acetic acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Conj, lac, corn edema, opac, photo; nasal, phar irrit; cough, dysp, bron; skin burns, vesic, sens derm
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Acetone	**Formula:** $(CH_3)_2CO$	**CAS#:** 67-64-1	**RTECS#:** AL3150000	**IDLH:** 2500 ppm [10%LEL]

Conversion: 1 ppm = 2.38 mg/m^3 **DOT:** 1090 127

Synonyms/Trade Names: Dimethyl ketone, Ketone propane, 2-Propanone

Exposure Limits:
NIOSH REL: TWA 250 ppm (590 mg/m^3)
OSHA PEL†: TWA 1000 ppm (2400 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1300, 2555, 3800
OSHA 69

Physical Description: Colorless liquid with a fragrant, mint-like odor.

Chemical & Physical Properties:
MW: 58.1
BP: 133°F
Sol: Miscible
Fl.P: 0°F
IP: 9.69 eV
Sp.Gr: 0.79
VP: 180 mmHg
FRZ: -140°F
UEL: 12.8%
LEL: 2.5%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
2500 ppm: CcrOv*/PaprOv*/GmFOv/ Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose, throat; head, dizz, CNS depres; derm
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

A

Acetone cyanohydrin

Formula: $CH_3C(OH)CNCH_3$ | **CAS#:** 75-86-5 | **RTECS#:** OD9275000 | **IDLH:** N.D.

Conversion: 1 ppm = 3.48 mg/m^3 | **DOT:** 1541 155 (stabilized)

Synonyms/Trade Names: Cyanohydrin-2-propanone, 2-Cyano-2-propanol, α-Hydroxyisobutyronitrile, 2-Hydroxy-2-methyl-propionitrile, 2-Methyllactonitrile

Exposure Limits:
NIOSH REL: C 1 ppm (4 mg/m^3) [15-minute]
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 2506

Physical Description: Colorless liquid with a faint odor of bitter almond. [**Note:** Forms cyanide in the body.]

Chemical & Physical Properties:
MW: 85.1
BP: 203°F
Sol: Miscible
Fl.P: 165°F
IP: ?
Sp.Gr(77°F): 0.93
VP: 0.8 mmHg
FRZ: -4°F
UEL: 12.0%
LEL: 2.2%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
10 ppm: Sa
25 ppm: Sa:Cf
50 ppm: ScbaF/SaF
250 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Sulfuric acid, caustics [**Note:** Slowly decomposes to acetone & HCN at room temperatures; rate is accelerated by an increase in pH, water content, or temperature.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; dizz, lass, head, conf, convuls; liver, kidney inj; pulm edema, asphy
TO: Eyes, skin, resp sys, CNS, CVS, liver, kidneys, GI tract

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Acetonitrile

Formula: CH_3CN | **CAS#:** 75-05-8 | **RTECS#:** AL7700000 | **IDLH:** 500 ppm

Conversion: 1 ppm = 1.68 mg/m^3 | **DOT:** 1648 127

Synonyms/Trade Names: Cyanomethane, Ethyl nitrile, Methyl cyanide [**Note:** Forms cyanide in the body.]

Exposure Limits:
NIOSH REL: TWA 20 ppm (34 mg/m^3)
OSHA PEL†: TWA 40 ppm (70 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1606

Physical Description: Colorless liquid with an aromatic odor.

Chemical & Physical Properties:
MW: 41.1
BP: 179°F
Sol: Miscible
Fl.P(oc): 42°F
IP: 12.20 eV
Sp.Gr: 0.78
VP: 73 mmHg
FRZ: -49°F
UEL: 16.0%
LEL: 3.0%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
200 ppm: CcrOv/Sa
500 ppm: Sa:Cf/PaprOv/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit nose, throat; asphy; nau, vomit; chest pain; lass; stupor, convuls; in animals: liver, kidney damage
TO: Resp sys, CVS, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

2-Acetylaminofluorene	Formula: $C_{15}H_{13}NO$	CAS#: 53-96-3	RTECS#: AB9450000	IDLH: Ca [N.D.]
Conversion:	**DOT:**			

Synonyms/Trade Names: AAF, 2-AAF, 2-Acetaminofluorene, N-Acetyl-2-aminofluorene, FAA, 2-FAA, 2-Fluorenylacetamide

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1014] See Appendix B

Measurement Methods (see Table 1):
None available

Physical Description: Tan, crystalline powder.

Chemical & Physical Properties:
MW: 223.3
BP: ?
Sol: Insoluble
Fl.P: ?
IP:?
Sp.Gr: ?
VP: ?
MLT: 381°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Reduced function of liver, kidneys, bladder, pancreas; [carc]
TO: Liver, bladder, kidneys, pancreas, skin [in animals: tumors of the liver, bladder, lungs, skin & pancreas]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Acetylene	Formula: HC≡CH	CAS#: 74-86-2	RTECS#: AO9600000	IDLH: N.D.
Conversion: 1 ppm = 1.06 mg/m^3	**DOT:** 1001 116			

Synonyms/Trade Names: Ethine, Ethyne [**Note:** A compressed gas used in the welding & cutting of metals.]

Exposure Limits:
NIOSH REL: C 2500 ppm (2662 mg/m^3)
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH
Acetylene Criteria Document

Physical Description: Colorless gas with a faint, ethereal odor. [**Note:** Commercial grade has a garlic-like odor. Shipped under pressure dissolved in acetone.]

Chemical & Physical Properties:
MW: 26.0
BP: Sublimes
Sol: 2%
Fl.P: NA (Gas)
IP: 11.40 eV
RGasD: 0.91
VP: 44.2 atm
FRZ: -119°F (Sublimes)
UEL: 100%
LEL: 2.5%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Zinc; oxygen & other oxidizing agents such as halogens [**Note:** Forms explosive acetylide compounds with copper, mercury, silver & brasses (containing more than 66% copper).]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Head, dizz; asphy; liquid: frostbite
TO: CNS, resp sys

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Fresh air

Acetylene tetrabromide

Formula: $CHBr_2CHBr_2$ | **CAS#:** 79-27-6 | **RTECS#:** KI8225000 | **IDLH:** 8 ppm

Conversion: 1 ppm = 14.14 mg/m^3 | **DOT:** 2504 159

Synonyms/Trade Names: Symmetrical tetrabromoethane, TBE, Tetrabromoacetylene, Tetrabromoethane, 1,1,2,2-Tetrabromoethane

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL: TWA 1 ppm (14 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2003

Physical Description: Pale-yellow liquid with a pungent odor similar to camphor or iodoform. [**Note:** A solid below 32°F.]

Chemical & Physical Properties:
MW: 345.7
BP: 474°F (Decomposes)
Sol: 0.07%
Fl.P: NA
IP: ?
Sp.Gr: 2.97
VP: 0.02 mmHg
FRZ: 32°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
OSHA
8 ppm: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong caustics; hot iron; reducing metals such as aluminum, magnesium, and zinc

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose; anor, nau; head; abdom pain; jaun; leucyt; CNS depres
TO: Eyes, resp sys, liver, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Acetylsalicyclic acid

Formula: $CH_3COOC_6H_4COOH$ | **CAS#:** 50-78-2 | **RTECS#:** VO0700000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: o-Acetoxybenzoic acid, 2-Acetoxybenzoic acid, Aspirin

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 0500

Physical Description: Odorless, colorless to white, crystal-line powder. [aspirin]
[**Note:** Develops the vinegar-like odor of acetic acid on contact with moisture.]

Chemical & Physical Properties:
MW: 180.2
BP: 284°F (Decomposes)
Sol(77°F): 0.3%
Fl.P: NA
IP: NA
Sp.Gr: 1.35
VP: 0 mmHg (approx)
MLT: 275°F
UEL: NA
LEL: NA
MEC: 40 g/m^3
Combustible Powder; explosion hazard if dispersed in air.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: N.R.
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Solutions of alkali hydroxides or carbonates, strong oxidizers, moisture
[**Note:** Slowly hydrolyzes in moist air to salicyclic & acetic acids.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; incr blood clotting time; nau, vomit; liver, kidney inj
TO: Eyes, skin, resp sys, blood, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Acrolein

Formula:	CAS#:	RTECS#:	IDLH:
CH_2=CHCHO	107-02-8	AS1050000	2 ppm

Conversion: 1 ppm = 2.29 mg/m^3

DOT: 1092 131P (inhibited)

Synonyms/Trade Names: Acraldehyde, Acrylaldehyde, Acrylic aldehyde, Allyl aldehyde, Propenal, 2-Propenal

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.25 mg/m^3)
ST 0.3 ppm (0.8 mg/m^3)
See Appendix C (Aldehydes)
OSHA PEL†: TWA 0.1 ppm (0.25 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2501
OSHA 52

Physical Description: Colorless or yellow liquid with a piercing, disagreeable odor.

Chemical & Physical Properties:
MW: 56.1
BP: 127°F
Sol: 40%
Fl.P: -15°F
IP: 10.13 eV
Sp.Gr: 0.84
VP: 210 mmHg
FRZ: -126°F
UEL: 31%
LEL: 2.8%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2 ppm: Sa:Cf*/PaprOv*/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, acids, alkalis, ammonia, amines [**Note:** Polymerizes readily unless inhibited--usually with hydroquinone. May form shock-sensitive peroxides over time.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; decr pulm func; delayed pulm edema; chronic resp disease
TO: Eyes, skin, resp sys, heart

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Acrylamide

Formula:	CAS#:	RTECS#:	IDLH:
CH_2=$CHCONH_2$	79-06-1	AS3325000	Ca [60 mg/m^3]

Conversion:

DOT: 2074 153P

Synonyms/Trade Names: Acrylamide monomer, Acrylic amide, Propenamide, 2-Propenamide

Exposure Limits:
NIOSH REL: Ca
TWA 0.03 mg/m^3 [skin]
See Appendix A
OSHA PEL†: TWA 0.3 mg/m^3 [skin]

Measurement Methods (see Table 1):
OSHA 21, PV2004

Physical Description: White crystalline, odorless solid.

Chemical & Physical Properties:
MW: 71.1
BP: 347-572°F (Decomposes)
Sol(86°F): 216%
Fl.P: 280°F
IP: 9.50 eV
Sp.Gr: 1.12
VP: 0.007 mmHg
MLT: 184°F
UEL: ?
LEL: ?
Combustible Solid (may also be dissolved in flammable liquids).

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers
[**Note:** May polymerize violently upon melting.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; ataxia, numb limbs, pares; musc weak; absent deep tendon reflex; hand sweat; lass, drow; repro effects; [carc]
TO: Eyes, skin, CNS, PNS, repro sys [in animals: tumors of the lungs, testes, thyroid & adrenal glands]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Acrylic acid

Formula:	CAS#:	RTECS#:	IDLH:
CH_2=CHCOOH	79-10-7	AS4375000	N.D.

Conversion: 1 ppm = 2.95 mg/m^3 **DOT:** 2218 132P (inhibited)

Synonyms/Trade Names: Acroleic acid, Aqueous acrylic acid (technical grade is 94%), Ethylenecarboxylic acid, Glacial acrylic acid (98% in aqueous solution), 2-Propenoic acid

Exposure Limits:
NIOSH REL: TWA 2 ppm (6 mg/m^3) [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA 28, PV2005

Physical Description: Colorless liquid or solid (below 55°F) with a distinctive, acrid odor. [**Note:** Shipped with an inhibitor (e.g., hydroquinone) since it readily polymerizes.]

Chemical & Physical Properties:
MW: 72.1
BP: 286°F
Sol: Miscible
Fl.P: 121°F
IP: ?
Sp.Gr: 1.05
VP: 3 mmHg
FRZ: 55°F
UEL: 8.02%
LEL: 2.4%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers, amines, alkalis, ammonium hydroxide, chloro-sulfonic acid, oleum, ethylene diamine, ethyleneimine, 2-aminoethanol [**Note:** Corrosive to many metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; eye, skin burns; skin sens; in animals: lung, liver, kidney inj
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Acrylonitrile

Formula:	CAS#:	RTECS#:	IDLH:
CH_2=CHCN	107-13-1	AT5250000	Ca [85 ppm]

Conversion: 1 ppm = 2.17 mg/m^3 **DOT:** 1093 131P (inhibited)

Synonyms/Trade Names: Acrylonitrile monomer, AN, Cyanoethylene, Propenenitrile, 2-Propenenitrile, VCN, Vinyl cyanide

Exposure Limits:
NIOSH REL: Ca
TWA 1 ppm
C 10 ppm [15-minute] [skin]
See Appendix A
OSHA PEL: [1910.1045] TWA 2 ppm
C 10 ppm [15-minute] [skin]

Measurement Methods (see Table 1):
NIOSH 1604
OSHA 37

Physical Description: Colorless to pale-yellow liquid with an unpleasant odor. [**Note:** Odor can only be detected above the PEL.]

Chemical & Physical Properties:
MW: 53.1
BP: 171°F
Sol: 7%
Fl.P: 30°F
IP: 10.91 eV
Sp.Gr: 0.81
VP: 83 mmHg
FRZ: -116°F
UEL: 17%
LEL: 3.0%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Strong oxidizers, acids & alkalis; bromine; amines [**Note:** Unless inhibited (usually with methylhydroquinone), may polymerize spontaneously or when heated or in presence of strong alkali. Attacks copper.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; asphy; head; sneez; nau, vomit; lass, dizz; skin vesic; scaling derm; [carc]
TO: Eyes, skin, CVS, liver, kidneys, CNS [brain tumors, lung & bowel cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Adiponitrile	**Formula:** $NC(CH_2)_4CN$	**CAS#:** 111-69-3	**RTECS#:** AV2625000	**IDLH:** N.D.

Conversion: 1 ppm = 4.43 mg/m^3 **DOT:** 2205 153

Synonyms/Trade Names: 1,4-Dicyanobutane, Hexanedinitrile, Tetramethylene cyanide

Exposure Limits:
NIOSH REL: TWA 4 ppm (18 mg/m^3) **OSHA PEL:** none

Physical Description: Water-white, practically odorless, oily liquid. [**Note:** A solid below 34°F. Forms cyanide in the body.]

Measurement Methods (see Table 1):
NIOSH
Nitriles Criteria Document

Chemical & Physical Properties:
MW: 108.2
BP: 563°F
Sol: 4.5%
Fl.P(oc): 199°F
IP: ?
Sp.Gr: 0.97
VP: 0.002 mmHg
FRZ: 34°F
UEL: 5.0%
LEL: 1.7%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
40 ppm: Sa
100 ppm: Sa:Cf
200 ppm: ScbaF/SaF
250 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers (e.g., perchlorates, nitrates), strong acids (e.g., sulfuric acid) [**Note:** Decomposes above 194°F, forming hydrogen cyanide.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; head, dizz, lass, conf, convuls; blurred vision; dysp; abdom pain, nau, vomit
TO: Eyes, skin, resp sys, CNS, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Aldrin	**Formula:** $C_{12}H_8Cl_6$	**CAS#:** 309-00-2	**RTECS#:** IO2100000	**IDLH:** Ca [25 mg/m^3]

Conversion: **DOT:** 2761 151

Synonyms/Trade Names: HHDN, Octalene, 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-endo-1,4-exo-5,8-dimethanonaphthalene

Exposure Limits:
NIOSH REL: Ca
TWA 0.25 mg/m^3 [skin]
See Appendix A
OSHA PEL: TWA 0.25 mg/m^3 [skin]

Physical Description: Colorless to dark-brown crystalline solid with a mild chemical odor. [**Note:** Formerly used as an insecticide.]

Measurement Methods (see Table 1):
NIOSH 5502

Chemical & Physical Properties:
MW: 364.9
BP: Decomposes
Sol: 0.003%
Fl.P: NA
IP: ?
Sp.Gr: 1.60
VP: 0.00008 mmHg
MLT: 219°F
UEL: NA
LEL: NA
Noncombustible Solid, but may be dissolved in flammable liquids.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Concentrated mineral acids, active metals, acid catalysts, acid oxidizing agents, phenol

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Head, dizz; nau, vomit, mal; myoclonic jerks of limbs; clonic, tonic convuls; coma; hema, azotemia; [carc]
TO: CNS, liver, kidneys, skin [in animals: tumors of the lungs, liver, thyroid & adrenal glands]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Allyl alcohol

Formula:	CAS#:	RTECS#:	IDLH:
CH_2=CHCH$_2$OH	107-18-6	BA5075000	20 ppm

Conversion: 1 ppm = 2.38 mg/m^3 **DOT:** 1098 131

Synonyms/Trade Names: AA, Allylic alcohol, Propenol, 1-Propen-3-ol, 2-Propenol, Vinyl carbinol

Exposure Limits:
NIOSH REL: TWA 2 ppm (5 mg/m^3)
ST 4 ppm (10 mg/m^3) [skin]
OSHA PEL†: TWA 2 ppm (5 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1402, 1405

Physical Description: Colorless liquid with a pungent, mustard-like odor.

Chemical & Physical Properties:
MW: 58.1
BP: 205°F
Sol: Miscible
Fl.P: 70°F
IP: 9.63 eV
Sp.Gr: 0.85
VP: 17 mmHg
FRZ: -200°F
UEL: 18.0%
LEL: 2.5%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
20 ppm: Sa:Cf*/PaprOv*/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids, carbon tetrachloride
[**Note:** Polymerization may be caused by elevated temperatures, oxidizers, or peroxides.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Eye irrit, tissue damage; irrit upper resp sys, skin; pulm edema
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Allyl chloride

Formula:	CAS#:	RTECS#:	IDLH:
CH_2=CHCH$_2$Cl	107-05-1	UC7350000	250 ppm

Conversion: 1 ppm = 3.13 mg/m^3 **DOT:** 1100 131

Synonyms/Trade Names: 3-Chloropropene, 1-Chloro-2-propene, 3-Chloropropylene

Exposure Limits:
NIOSH REL: TWA 1 ppm (3 mg/m^3)
ST 2 ppm (6 mg/m^3)
OSHA PEL†: TWA 1 ppm (3 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1000
OSHA 7

Physical Description: Colorless, brown, yellow, or purple liquid with a pungent, unpleasant odor.

Chemical & Physical Properties:
MW: 76.5
BP: 113°F
Sol: 0.4%
Fl.P: -25°F
IP: 10.05 eV
Sp.Gr: 0.94
VP: 295 mmHg
MLT: -210°F
UEL: 11.1%
LEL: 2.9%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
25 ppm: Sa:Cf*
50 ppm: ScbaF/SaF
250 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids, amines, iron & aluminum chlorides, magnesium, zinc

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, muc memb; pulm edema; in animals: liver, kidney inj
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Allyl glycidyl ether

Formula:	CAS#:	RTECS#:	IDLH:
$C_6H_{10}O_2$	106-92-3	RR0875000	50 ppm

Conversion: 1 ppm = 4.67 mg/m^3 **DOT:** 2219 129

Synonyms/Trade Names: AGE, 1-Allyloxy-2,3-epoxypropane, Glycidyl allyl ether, [(2-Propenyloxy)methyl] oxirane

Exposure Limits:
NIOSH REL: TWA 5 ppm (22 mg/m^3) [skin]
ST 10 ppm (44 mg/m^3)
OSHA PEL†: C 10 ppm (45 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2545

Physical Description: Colorless liquid with a pleasant odor.

Chemical & Physical Properties:
MW: 114.2
BP: 309°F
Sol: 14%
Fl.P: 135°F
IP: ?
Sp.Gr: 0.97
VP: 2 mmHg
FRZ: -148°F [forms glass]
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
50 ppm: CcrOv/PaprOv/
GmFOv/Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, resp sys; derm; pulm edema; narco; possible hemato, repro effects
TO: Eyes, skin, resp sys, blood, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Allyl propyl disulfide

Formula:	CAS#:	RTECS#:	IDLH:
$H_2C{=}CHCH_2S_2CH_2CH_2CH_3$	2179-59-1	JO0350000	N.D.

Conversion: 1 ppm = 6.07 mg/m^3 **DOT:**

Synonyms/Trade Names: 4,5-Dithia-1-octene, Onion oil, 2-Propenyl propyl disulfide, Propyl allyl disulfide

Exposure Limits:
NIOSH REL: TWA 2 ppm (12 mg/m^3)
ST 3 ppm (18 mg/m^3)
OSHA PEL†: TWA 2 ppm (12 mg/m^3)

Measurement Methods (see Table 1):
OSHA PV2086

Physical Description: Pale-yellow liquid with a strong & irritating onion-like odor. [**Note:** The chief volatile component of onion oil.]

Chemical & Physical Properties:
MW: 148.3
BP: ?
Sol: Insoluble
Fl.P: ?
IP: ?
Sp.Gr(59°F): 0.93
VP: ?
FRZ: 5°F
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose, resp sys; lac
TO: Eyes, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

α-Alumina

Formula: Al_2O_3 | **CAS#:** 1344-28-1 | **RTECS#:** BD1200000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: Alumina, Aluminum oxide, Aluminum trioxide [**Note:** α-Alumina is the main component of technical grade alumina. Corundum is natural Al_2O_3. Emery is an impure crystalline variety of Al_2O_3.]

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600
OSHA ID109SG, ID198SG

Physical Description: White, odorless, crystalline powder.

Chemical & Physical Properties:
MW: 101.9
BP: 5396°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 4.0
VP: 0 mmHg (approx)
MLT: 3632°F
UEL: NA
LEL: NA
Noncombustible solid, but dusts may form explosive mixtures in air.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Chlorine trifluoride, hot chlorinated rubber, acids, oxidizers [**Note:** Hydrogen gas may be formed when finely divided iron contacts moisture during crushing & milling operations.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Blot/brush away
Breath: Fresh air
Swallow: Medical attention immed

Aluminum

Formula: Al | **CAS#:** 7429-90-5 | **RTECS#:** BD0330000 | **IDLH:** N.D.

Conversion: | **DOT:** 1309 170 (powder, coated); 1396 138 (powder, uncoated); 9260 169 (molten)

Synonyms/Trade Names: Aluminium, Aluminum metal, Aluminum powder, Elemental aluminum

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 7013, 7300, 7301, 7303
OSHA ID121

Physical Description: Silvery-white, malleable, ductile, odorless metal.

Chemical & Physical Properties:
MW: 27.0
BP: 4221°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 2.70
VP: 0 mmHg (approx)
MLT: 1220°F
UEL: NA
LEL: NA
Combustible Solid, finely divided dust is easily ignited; may cause explosions.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers & acids, halogenated hydrocarbons
[**Note:** Corrodes in contact with acids & other metals. Ignition may occur if powders are mixed with halogens, carbon disulfide, or methyl chloride.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, resp sys
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Aluminum (pyro powders and welding fumes, as Al)	**Formula:**	**CAS#:**	**RTECS#:**	**IDLH:** N.D.
Conversion:	**DOT:** 1383 135 (powder, pyrophoric)			
Synonyms/Trade Names: Synonyms vary depending upon the specific aluminum compound.				
Exposure Limits: **NIOSH REL:** TWA 5 mg/m^3 **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **NIOSH** 7300, 7301, 7303	
Physical Description: Appearance and odor vary depending upon the specific aluminum compound.				
Chemical & Physical Properties: Properties vary depending upon the specific aluminum compound.	**Personal Protection/Sanitation (see Table 2):** **Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Varies				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit skin, resp sys; pulm fib **TO:** Skin, resp sys		**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed		

Aluminum (soluble salts and alkyls, as Al)	**Formula:**	**CAS#:**	**RTECS#:**	**IDLH:** N.D.
Conversion:	**DOT:** 3051 135 (Aluminum alkyls)			
Synonyms/Trade Names: Synonyms vary depending upon the specific aluminum compound.				
Exposure Limits: **NIOSH REL:** TWA 2 mg/m^3 **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **NIOSH** 7013, 7300, 7301, 7303 **OSHA** ID121	
Physical Description: Appearance and odor vary depending upon the specific aluminum compound.				
Chemical & Physical Properties: Properties vary depending upon the specific aluminum compound.	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Varies				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit skin, resp sys; skin burns **TO:** Skin, resp sys		**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed		

4-Aminodiphenyl

Formula:	CAS#:	RTECS#:	IDLH:
$C_6H_5C_6H_4NH_2$	92-67-1	DU8925000	Ca [N.D.]

Conversion: **DOT:**

Synonyms/Trade Names: 4-Aminobiphenyl, p-Aminobiphenyl, p-Aminodiphenyl, 4-Phenylaniline

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1011] See Appendix B

Measurement Methods (see Table 1):
NIOSH P&CAM269 (II-4)
OSHA 93

Physical Description: Colorless crystals with a floral odor.
[**Note:** Turns purple on contact with air.]

Chemical & Physical Properties:
MW: 169.2
BP: 576°F
Sol: Slight
Fl.P: ?
IP: ?
Sp.Gr: 1.16
VP(227°F): 1 mmHg
MLT: 127°F
UEL: ?
LEL: ?
Combustible Solid, but must be preheated before ignition possible.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Oxidized by air

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Head, dizz; drow, dysp; ataxia, lass; methemo; urinary burning; acute hemorrhagic cystitis; [carc]
TO: Bladder, skin [bladder cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

2-Aminopyridine

Formula:	CAS#:	RTECS#:	IDLH:
$NH_2C_5H_4N$	504-29-0	US1575000	5 ppm

Conversion: 1 ppm = 3.85 mg/m^3 **DOT:** 2671 153

Synonyms/Trade Names: α-Aminopyridine, α-Pyridylamine

Exposure Limits:
NIOSH REL: TWA 0.5 ppm (2 mg/m^3)
OSHA PEL: TWA 0.5 ppm (2 mg/m^3)

Measurement Methods (see Table 1):
NIOSH S158 (II-4)

Physical Description: White powder, leaflets, or crystals with a characteristic odor.

Chemical & Physical Properties:
MW: 94.1
BP: 411°F
Sol: >100%
Fl.P: 154°F
IP: 8.00 eV
Sp.Gr: ?
VP(77°F): 0.8 mmHg
MLT: 137°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 ppm: Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose, throat; head, dizz; excitement; nau; high BP; resp distress; lass; convuls; stupor
TO: CNS, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Amitrole

Formula:	CAS#:	RTECS#:	IDLH:
$C_2H_4N_4$	61-82-5	XZ3850000	Ca [N.D.]

Conversion:

DOT:

Synonyms/Trade Names: Aminotriazole; 3-Aminotriazole; 2-Amino-1,3,4-triazole; 3-Amino-1,2,4-triazole

Exposure Limits:
NIOSH REL: Ca
TWA 0.2 mg/m^3
See Appendix A

OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 0500
OSHA PV2006

Physical Description: Colorless to white, crystalline powder. [herbicide]
[**Note:** Odorless when pure.]

Chemical & Physical Properties:
MW: 84.1
BP: ?
Sol(77°F): 28%
Fl.P: NA
IP: ?
Sp.Gr: 1.14
VP: <0.000008 mmHg
MLT: 318°F
UEL: NA
LEL: NA
Noncombustible Solid, but may be dissolved in flammable liquids.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Light (decomposes), strong oxidizers
[**Note:** Corrosive to iron, aluminum & copper.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin; dysp, musc spasms, ataxia, anor, salv, incr body temperature; lass, skin dryness, depres (thyroid func suppression)
TO: Eyes, skin, thyroid [in animals: liver, thyroid & pituitary gland tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Ammonia

Formula:	CAS#:	RTECS#:	IDLH:
NH_3	7664-41-7	BO0875000	300 ppm

Conversion: 1 ppm = 0.70 mg/m^3

DOT: 1005 125 (anhydrous); 2672 154 (10-35% solution); 2073 125 (>35-50% solution); 1005 125 (>50% solution)

Synonyms/Trade Names: Anhydrous ammonia, Aqua ammonia, Aqueous ammonia
[**Note:** Often used in an aqueous solution.]

Exposure Limits:
NIOSH REL: TWA 25 ppm (18 mg/m^3)
ST 35 ppm (27 mg/m^3)

OSHA PEL†: TWA 50 ppm (35 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 3800, 6015, 6016
OSHA ID188

Physical Description: Colorless gas with a pungent, suffocating odor.
[**Note:** Shipped as a liquefied compressed gas. Easily liquefied under pressure.]

Chemical & Physical Properties:
MW: 17.0
BP: -28°F
Sol: 34%
Fl.P: NA (Gas)
IP: 10.18 eV
RGasD: 0.60
VP: 8.5 atm
FRZ: -108°F
UEL: 28%
LEL: 15%

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam (solution)
Remove: When wet or contam (solution)
Change: N.R.
Provide: Eyewash (>10%)
Quick drench (>10%)

Respirator Recommendations (see Tables 3 and 4):
NIOSH
250 ppm: CcrS*/Sa*
300 ppm: Sa:Cf*/PaprS*/CcrFS/GmFS/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

[**Note:** Although NH_3 does not meet the DOT definition of a Flammable Gas (for labeling purposes), it should be treated as one.]

Incompatibilities and Reactivities: Strong oxidizers, acids, halogens, salts of silver & zinc
[**Note:** Corrosive to copper & galvanized surfaces.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing (solution), Con (solution/liquid)
SY: Irrit eyes, nose, throat; dysp, wheez, chest pain; pulm edema; pink frothy sputum; skin burns, vesic; liquid: frostbite
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed (solution/liquid)
Skin: Water flush immed (solution/liquid)
Breath: Resp support
Swallow: Medical attention immed (solution)

Ammonium chloride fume

Formula:	CAS#:	RTECS#:	IDLH:
NH_4Cl	12125-02-9	BP4550000	N.D.

Conversion: **DOT:**

Synonyms/Trade Names: Ammonium chloride, Ammonium muriate fume, Sal ammoniac fume

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3
ST 20 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA ID188

Physical Description: Finely divided, odorless, white particulate dispersed in air.

Chemical & Physical Properties:
MW: 53.5
BP: Sublimes
Sol: 37%
Fl.P: NA
IP: NA
Sp.Gr: 1.53
VP(321°F): 1 mmHg
MLT: 662°F (Sublimes)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Alkalis & their carbonates, lead & silver salts, strong oxidizers, ammonium nitrate, potassium chlorate, bromine trifluoride [**Note:** Corrodes most metals at high (i.e., fire) temperatures.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, resp sys; cough, dysp, pulm sens
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support

Ammonium sulfamate

Formula:	CAS#:	RTECS#:	IDLH:
$NH_4OSO_2NH_2$	7773-06-0	WO6125000	1500 mg/m^3

Conversion: **DOT:**

Synonyms/Trade Names: Ammate herbicide, Ammonium amidosulfonate, AMS, Monoammonium salt of sulfamic acid, Sulfamate

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH S348 (II-5)

Physical Description: Colorless to white crystalline, odorless solid. [herbicide]

Chemical & Physical Properties:
MW: 114.1
BP: 320°F (Decomposes)
Sol: 200%
Fl.P: NA
IP: ?
Sp.Gr: 1.77
VP: 0 mmHg (approx)
MLT: 268°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
50 mg/m^3: Qm
100 mg/m^3: 95XQ/Sa
250 mg/m^3: Sa:Cf/PaprHie
500 mg/m^3: SaT:Cf/PaprTHie/100F/ScbaF/SaF
1500 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Acids, hot water
[**Note:** Elevated temperatures cause a highly exothermic reaction with water.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, nose, throat; cough, dysp
TO: Eyes, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

n-Amyl acetate	Formula: $CH_3COO[CH_2]_4CH_3$	CAS#: 628-63-7	RTECS#: AJ9250000	IDLH: 1000 ppm
Conversion: 1 ppm = 5.33 mg/m^3	**DOT:** 1104 129			
Synonyms/Trade Names: Amyl acetic ester, Amyl acetic ether, 1-Pentanol acetate, Pentyl ester of acetic acid, Primary amyl acetate				
Exposure Limits: **NIOSH REL:** TWA 100 ppm (525 mg/m^3) **OSHA PEL:** TWA 100 ppm (525 mg/m^3) **Physical Description:** Colorless liquid with a persistent banana-like odor.			**Measurement Methods (see Table 1):** **NIOSH** 1450, 2549 **OSHA** 7	
Chemical & Physical Properties: **MW:** 130.2 **BP:** 301°F **Sol:** 0.2% **Fl.P:** 77°F **IP:** ? **Sp.Gr:** 0.88 **VP:** 4 mmHg **FRZ:** -95°F **UEL:** 7.5% **LEL:** 1.1% Class IC Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **1000 ppm:** CcrOv*/GmFOv/PaprOv*/ Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, nose; derm; possible CNS depres, narco **TO:** Eyes, skin, resp sys, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed	

sec-Amyl acetate	Formula: $CH_3COOCH(CH_3)C_3H_7$	CAS#: 626-38-0	RTECS#: AJ2100000	IDLH: 1000 ppm
Conversion: 1 ppm = 5.33 mg/m^3	**DOT:** 1104 129			
Synonyms/Trade Names: 1-Methylbutyl acetate, 2-Pentanol acetate, 2-Pentyl ester of acetic acid				
Exposure Limits: **NIOSH REL:** TWA 125 ppm (650 mg/m^3) **OSHA PEL:** TWA 125 ppm (650 mg/m^3) **Physical Description:** Colorless liquid with a mild odor.			**Measurement Methods (see Table 1):** **NIOSH** 1450, 2549 **OSHA** 7	
Chemical & Physical Properties: **MW:** 130.2 **BP:** 249°F **Sol:** Slight **Fl.P:** 89°F **IP:** ? **Sp.Gr:** 0.87 **VP:** 7 mmHg **FRZ:** -109°F **UEL:** 7.5% **LEL:** 1% Class IC Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **1000 ppm:** CcrOv*/GmFOv/PaprOv*/ Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose; narco; derm; possible kidney, liver inj; possible CNS depres **TO:** Eyes, skin, resp sys, kidneys, liver, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Aniline (and homologs)

Formula:	CAS#:	RTECS#:	IDLH:
$C_6H_5NH_2$	62-53-3	BW6650000	Ca [100 ppm]

Conversion: 1 ppm = 3.81 mg/m^3 **DOT:** 1547 153

Synonyms/Trade Names: Aminobenzene, Aniline oil, Benzenamine, Phenylamine

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: TWA 5 ppm (19 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2002, 2017, 8317
OSHA PV2079

Physical Description: Colorless to brown, oily liquid with an aromatic amine-like odor. [**Note:** A solid below 21°F.]

Chemical & Physical Properties:
MW: 93.1
BP: 363°F
Sol: 4%
Fl.P: 158°F
IP: 7.70 eV
Sp.Gr: 1.02
VP: 0.6 mmHg
FRZ: 21°F
UEL: 11%
LEL: 1.3%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids, toluene diisocyanate, alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Head, lass, dizz; cyan; ataxia; dysp on effort; tacar; irrit eyes; methemo; cirr; [carc]
TO: Blood, CVS, eyes, liver, kidneys, resp sys [bladder cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

o-Anisidine

Formula:	CAS#:	RTECS#:	IDLH:
$NH_2C_6H_4OCH_3$	90-04-0	BZ5410000	Ca [50 mg/m^3]

Conversion: **DOT:** 2431 153

Synonyms/Trade Names: ortho-Aminoanisole, 2-Anisidine, o-Methoxyaniline
[**Note:** o-Anisidine has been used as a basis for many dyes.]

Exposure Limits:
NIOSH REL: Ca
0.5 mg/m^3 [skin]
See Appendix A
OSHA PEL: TWA 0.5 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 2514

Physical Description: Red or yellow, oily liquid with an amine-like odor. [**Note:** A solid below 41°F.]

Chemical & Physical Properties:
MW: 123.2
BP: 437°F
Sol(77°F): 1%
Fl.P(oc): 244°F
IP: 7.44 eV
Sp.Gr: 1.10
VP: <0.1 mmHg
FRZ: 41°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Head, dizz; cyan; RBC Heinz bodies; [carc]
TO: Blood, kidneys, liver, CVS, CNS [in animals: tumors of the thyroid gland, bladder & kidneys]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

p-Anisidine	Formula: $NH_2C_6H_4OCH_3$	CAS#: 104-94-9	RTECS#: BZ5450000	IDLH: 50 mg/m^3

Conversion: **DOT:** 2431 153

Synonyms/Trade Names: para-Aminoanisole, 4-Anisidine, p-Methoxyaniline

Exposure Limits:
NIOSH REL: TWA 0.5 mg/m^3 [skin]
OSHA PEL: TWA 0.5 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 2514

Physical Description: Yellow to brown, crystalline solid with an amine-like odor.

Chemical & Physical Properties:
MW: 123.2
BP: 475°F
Sol: Moderate
Fl.P: ?
IP: 7.44 eV
Sp.Gr: 1.07
VP(77°F): 0.006 mmHg
MLT: 135°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: 95XQ/Sa
12.5 mg/m^3: Sa:Cf/PaprHie
25 mg/m^3: 100F/PaprTHie*/ScbaF/SaF
50 mg/m^3: Sa:Pd,Pp*
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Head, dizz; cyan; RBC Heinz bodies
TO: Blood, kidneys, liver, CVS, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Antimony	Formula: Sb	CAS#: 7440-36-0	RTECS#: CC4025000	IDLH: 50 mg/m^3 (as Sb)

Conversion: **DOT:** 1549 157 (inorganic compounds, n.o.s.); 2871 170 (powder); 3141 157 (inorganic liquid compounds, n.o.s.)

Synonyms/Trade Names: Antimony metal, Antimony powder, Stibium

Exposure Limits:
NIOSH REL*: TWA 0.5 mg/m^3
OSHA PEL*: TWA 0.5 mg/m^3
[***Note:** The REL and PEL also apply to other antimony compounds (as Sb).]

Measurement Methods (see Table 1):
NIOSH 7301, 7303, P&CAM 261 (II-4)
OSHA ID121, ID125G, ID206

Physical Description: Silver-white, lustrous, hard, brittle solid; scale-like crystals; or a dark-gray, lustrous powder.

Chemical & Physical Properties:
MW: 121.8
BP: 2975°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 6.69
VP: 0 mmHg (approx)
MLT: 1166°F
UEL: NA
LEL: NA

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: 95XQ/Sa
12.5 mg/m^3: Sa:Cf/PaprHie
25 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
50 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Noncombustible Solid in bulk form, but a moderate explosion hazard in the form of dust when exposed to flame.

Incompatibilities and Reactivities: Strong oxidizers, acids, halogenated acids
[**Note:** Stibine is formed when antimony is exposed to nascent (freshly formed) hydrogen.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat, mouth; cough; dizz; head; nau, vomit, diarr; stomach cramps; insom; anor; unable to smell properly
TO: Eyes, skin, resp sys, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

ANTU

Formula: $C_{10}H_7NHC(NH_2)S$ | **CAS#:** 86-88-4 | **RTECS#:** YT9275000 | **IDLH:** 100 mg/m^3

Conversion: **DOT:** 1651 153

Synonyms/Trade Names: α-Naphthyl thiocarbamide, 1-Naphthyl thiourea, α-Naphthyl thiourea

Exposure Limits:
NIOSH REL: TWA 0.3 mg/m^3
OSHA PEL: TWA 0.3 mg/m^3

Measurement Methods (see Table 1):
NIOSH S276 (II-5)

Physical Description: White crystalline or gray, odorless powder. [rodenticide]

Chemical & Physical Properties:
MW: 202.3
BP: Decomposes
Sol: 0.06%
Fl.P: NA
IP: ?
Sp.Gr: ?
VP: Low
MLT: 388°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
3 mg/m^3: CcrOv95/Sa
7.5 mg/m^3: Sa:Cf/PaprOvHie
15 mg/m^3: CcrFOv100/GmFOv100/ PaprTOvHie/SaT:Cf/ScbaF/SaF
100 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, silver nitrate

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing
SY: After ingestion of large doses: vomit, dysp, cyan, coarse pulm rales; liver damage
TO: Resp sys, blood, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Arsenic (inorganic compounds, as As)

Formula: As (metal) | **CAS#:** 7440-38-2 (metal) | **RTECS#:** CG0525000 (metal) | **IDLH:** Ca [5 mg/m^3 (as As)]

Conversion: **DOT:** 1558 152 (metal); 1562 152 (dust)

Synonyms/Trade Names: **Arsenic metal:** Arsenia
Other synonyms vary depending upon the specific As compound. [**Note:** OSHA considers "Inorganic Arsenic" to mean copper acetoarsenite & all inorganic compounds containing arsenic except ARSINE.]

Exposure Limits:
NIOSH REL: Ca
C 0.002 mg/m^3 [15-minute]
See Appendix A
OSHA PEL: [1910.1018] TWA 0.010 mg/m^3

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303, 9102, 7900
OSHA ID105

Physical Description: Metal: Silver-gray or tin-white, brittle, odorless solid.

Chemical & Physical Properties:
MW: 74.9
BP: Sublimes
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 5.73 (metal)
VP: 0 mmHg (approx)
MLT: 1135°F (Sublimes)
UEL: NA
LEL: NA

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFAg100/ScbaE

See Appendix E (page 351)

Metal: Noncombustible Solid in bulk form, but a slight explosion hazard in the form of dust when exposed to flame.

Incompatibilities and Reactivities: Strong oxidizers, bromine azide
[**Note:** Hydrogen gas can react with inorganic arsenic to form the highly toxic gas arsine.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Con, Ing
SY: Ulceration of nasal septum, derm, GI disturbances, peri neur, resp irrit, hyperpig of skin, [carc]
TO: Liver, kidneys, skin, lungs, lymphatic sys [lung & lymphatic cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Arsenic (organic compounds, as As)	Formula:	CAS#:	RTECS#:	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Synonyms vary depending upon the specific organic arsenic compound.

Exposure Limits:
NIOSH REL: none
OSHA PEL: TWA 0.5 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5022

Physical Description: Appearance and odor vary depending upon the specific organic arsenic compound.

Chemical & Physical Properties:
Properties vary depending upon the specific organic arsenic compound.

Personal Protection/Sanitation (see Table 2):
Recommendations regarding personal protective clothing vary depending upon the specific compound.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Varies

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: irrit skin, possible derm; resp distress; diarr; kidney damage; musc tremor, convuls; possible GI tract, repro effects; possible liver damage
TO: Skin, resp sys, kidneys, CNS, liver, GI tract, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Arsine	Formula: AsH_3	CAS#: 7784-42-1	RTECS#: CG6475000	IDLH: Ca [3 ppm]
Conversion: 1 ppm = 3.19 mg/m^3	**DOT:** 2188 119			

Synonyms/Trade Names: Arsenic hydride, Arsenic trihydride, Arseniuretted hydrogen, Arsenous hydride, Hydrogen arsenide

Exposure Limits:
NIOSH REL: Ca
C 0.002 mg/m^3 [15-minute]
See Appendix A
OSHA PEL: TWA 0.05 ppm (0.2 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 6001
OSHA ID105

Physical Description: Colorless gas with a mild, garlic-like odor.
[**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 78.0
BP: -81°F
Sol: 20%
Fl.P: NA (Gas)
IP: 9.89 eV
RGasD: 2.69
VP(70°F): 14.9 atm
FRZ: -179°F
UEL: 78%
LEL: 5.1%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, chlorine, nitric acid
[**Note:** Decomposes above 446°F. There is a high potential for the generation of arsine gas when inorganic arsenic is exposed to nascent (freshly formed) hydrogen.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Head, mal, lass, dizz; dysp; abdom, back pain; nau, vomit; bronze skin; hema; jaun; peri neur; liquid: frostbite; [carc]
TO: Blood, kidneys, liver [lung & lymphatic cancer]

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Asbestos

Formula:	CAS#:	RTECS#:	IDLH:
Hydrated mineral silicates	1332-21-4	CI6475000	Ca [N.D.]

Conversion: **DOT:** 2212 171 (blue, brown); 2590 171 (white)

Synonyms/Trade Names: Actinolite, Actinolite asbestos, Amosite (cummingtonite-grunerite), Anthophyllite, Anthophyllite asbestos, Chrysotile, Crocidolite (Riebeckite), Tremolite, Tremolite asbestos

Exposure Limits:
NIOSH REL: Ca
See Appendix A
See Appendix C
OSHA PEL: [1910.1001] [1926.1101] See Appendix C

Measurement Methods (see Table 1):
NIOSH 7400, 7402
OSHA ID160, ID191

Physical Description: White or greenish (chrysotile), blue (crocidolite), or gray-green (amosite) fibrous, odorless solids.

Chemical & Physical Properties:
MW: Varies
BP: Decomposes
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: ?
VP: 0 mmHg (approx)
MLT: 1112°F (Decomposes)
UEL: NA
LEL: NA
Noncombustible Solids

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Asbestosis (chronic exposure): dysp, interstitial fib, restricted pulm function, finger clubbing; irrit eyes; [carc]
TO: Resp sys, eyes [lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Asphalt fumes

Formula:	CAS#:	RTECS#:	IDLH:
	8052-42-4	CI9900000	Ca [N.D.]

Conversion: **DOT:** 1999 130 (asphalt)

Synonyms/Trade Names: **Asphalt:** Asphaltum, Bitumen (European term), Petroleum asphalt, Petroleum bitumen, Road asphalt, Roofing asphalt

Exposure Limits:
NIOSH REL: Ca
C 5 mg/m^3 [15-minute]
See Appendix A
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 5042

Physical Description: Fumes generated during the production or application of asphalt (a dark-brown to black cement-like substance manufactured by the vacuum distillation of crude petroleum oil).

Chemical & Physical Properties:
Properties vary depending upon the specific asphalt formulation or mixture.

Asphalt: Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: None reported [**Note:** Asphalt becomes molten at about 200°F.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Con
SY: Irrit eyes, resp sys; [carc]
TO: Eyes, resp sys [in animals: skin tumors]

First Aid (see Table 6):
Eye: Irr immed
Breath: Resp support

Atrazine	**Formula:** $C_8H_{14}ClN_5$	**CAS#:** 1912-24-9	**RTECS#:** XY5600000	**IDLH:** N.D.
Conversion:	**DOT:** 2763 151 (triazine pesticide)			

Synonyms/Trade Names: 2-Chloro-4-ethylamino-6-isopropylamino-s-triazine; 6-Chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5602, 8315

Physical Description: Colorless or white, odorless, crystalline powder. [herbicide]

Chemical & Physical Properties:
MW: 215.7
BP: Decomposes
Sol: 0.003%
Fl.P: NA
IP: NA
Sp.Gr: 1.19
VP: 0.0000003 mmHg
MLT: 340°F
UEL: NA
LEL: NA
Noncombustible Solid, but may be mixed with flammable liquids.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong acids, strong bases

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin; derm, sens skin; dysp, lass, inco, salv; hypothermia; liver inj
TO: Eyes, skin, resp sys, CNS, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Azinphos-methyl	**Formula:** $C_{10}H_{12}O_3PS_2N_3$ [$(CH_3O)_2P(S)SCH_2(N_3C_7H_4O)$]	**CAS#:** 86-50-0	**RTECS#:** TE1925000	**IDLH:** 10 mg/m^3
Conversion:	**DOT:** 2783 152 (organophosphorus pesticide, solid, toxic)			

Synonyms/Trade Names: O,O-Dimethyl-S-4-oxo-1,2,3-benzotriazin-3(4H)-ylmethyl phosphorodithioate; Guthion®; Methyl azinphos

Exposure Limits:
NIOSH REL: TWA 0.2 mg/m^3 [skin]
OSHA PEL: TWA 0.2 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 5600
OSHA PV2087

Physical Description: Colorless crystals or a brown, waxy solid. [insecticide]

Chemical & Physical Properties:
MW: 317.3
BP: Decomposes
Sol: 0.003%
Fl.P: NA
IP: ?
Sp.Gr: 1.44
VP: 8 x 10^{-9} mmHg
MLT: 163°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2 mg/m^3: CcrOv95/Sa
5 mg/m^3: Sa:Cf/PaprOvHie
10 mg/m^3: CcrFOv100/GmFOv100/ PaprTOvHie/SaT:Cf/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Miosis; ache eyes; blurred vision, lac, rhin; head; chest tight, wheez, lar spasm; salv; cyan; anor; nau, vomit, diarr; sweat; twitch, para, convuls; low BP, card irreg
TO: Resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

B

Barium chloride (as Ba)

Formula:	CAS#:	RTECS#:	IDLH:
$BaCl_2$	10361-37-2	CQ8750000	50 mg/m^3 (as Ba)

Conversion: **DOT:** 1564 154 (barium compound, n.o.s.)

Synonyms/Trade Names: Barium dichloride

Exposure Limits:
NIOSH REL*: TWA 0.5 mg/m^3
OSHA PEL*: TWA 0.5 mg/m^3
[***Note:** The REL and PEL also apply to other soluble barium compounds (as Ba) except Barium sulfate.]

Measurement Methods (see Table 1):
NIOSH 7056, 7303
OSHA ID121

Physical Description: White, odorless solid.

Chemical & Physical Properties:
MW: 208.2
BP: 2840°F
Sol: 38%
Fl.P: NA
IP: ?
Sp.Gr: 3.86
VP: Low
MLT: 1765°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: 95XQ/Sa
12.5 mg/m^3: Sa:Cf/PaprHie
25 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
50 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Acids, oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; skin burns; gastroenteritis; musc spasm; slow pulse, extrasystoles; hypokalemia
TO: Eyes, skin, resp sys, heart, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Barium nitrate (as Ba)

Formula:	CAS#:	RTECS#:	IDLH:
$Ba(NO_3)_2$	10022-31-8	CQ9625000	50 mg/m^3 (as Ba)

Conversion: **DOT:** 1446 141

Synonyms/Trade Names: Barium dinitrate, Barium(II) nitrate (1:2), Barium salt of nitric acid

Exposure Limits:
NIOSH REL*: TWA 0.5 mg/m^3
OSHA PEL*: TWA 0.5 mg/m^3
[***Note:** The REL and PEL also apply to other soluble barium compounds (as Ba) except Barium sulfate.]

Measurement Methods (see Table 1):
NIOSH 7056
OSHA ID121

Physical Description: White, odorless solid.

Chemical & Physical Properties:
MW: 261.4
BP: Decomposes
Sol: 9%
Fl.P: NA
IP: ?
Sp.Gr: 3.24
VP: Low
MLT: 1094°F
UEL: NA
LEL: NA
Noncombustible Solid, but will accelerate the burning of combustible materials.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: 95XQ/Sa
12.5 mg/m^3: Sa:Cf/PaprHie
25 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
50 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Acids, oxidizers, aluminum-magnesium alloys, (barium dioxide + zinc)
[**Note:** Contact with combustible material may cause fire.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; skin burns; gastroenteritis; musc spasm; slow pulse, extrasystoles; hypokalemia
TO: Eyes, skin, resp sys, heart, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Barium sulfate	**Formula:** $BaSO_4$	**CAS#:** 7727-43-7	**RTECS#:** CR0600000	**IDLH:** N.D.
Conversion:	**DOT:** 1564 154 (barium compound, n.o.s.)			
Synonyms/Trade Names: Artificial barite, Barite, Barium salt of sulfuric acid, Barytes (natural)				

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: White or yellowish, odorless powder.

Chemical & Physical Properties:
MW: 233.4
BP: 2912°F (Decomposes)
Sol(64°F): 0.0002%
Fl.P: NA
IP: NA
Sp.Gr: 4.25-4.5
VP: 0 mmHg (approx)
MLT: 2876°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: N.R.
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Phosphorus, aluminum
[**Note:** Aluminum in the presence of heat can cause an explosion.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, nose, upper resp sys; benign pneumoconiosis (baritosis)
TO: Eyes, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Benomyl	**Formula:** $C_{14}H_{18}N_4O_3$	**CAS#:** 17804-35-2	**RTECS#:** DD6475000	**IDLH:** N.D.
Conversion:	**DOT:** 2757 151 (carbamate pesticide, solid)			
Synonyms/Trade Names: Methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate				

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600
OSHA PV2107

Physical Description: White crystalline solid with a faint, acrid odor. [fungicide]
[**Note:** Decomposes without melting above 572°F.]

Chemical & Physical Properties:
MW: 290.4
BP: Decomposes
Sol: 0.0004%
Fl.P: NA
IP: NA
Sp.Gr: ?
VP: <0.00001 mmHg
MLT: >572°F (Decomposes)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Heat, strong acids, strong alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; skin sens; possible repro, terato effects
TO: Eyes, skin, resp sys, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

B

Benzene

Formula:	CAS#:	RTECS#:	IDLH:
C_6H_6	71-43-2	CY1400000	Ca [500 ppm]

Conversion: 1 ppm = 3.19 mg/m^3 **DOT:** 1114 130

Synonyms/Trade Names: Benzol, Phenyl hydride

Exposure Limits:
NIOSH REL: Ca
TWA 0.1 ppm
ST 1 ppm
See Appendix A

OSHA PEL: [1910.1028]
TWA 1 ppm
ST 5 ppm
See Appendix F

Measurement Methods (see Table 1):
NIOSH 1500, 1501, 3700, 3800
OSHA 12, 1005

Physical Description: Colorless to light-yellow liquid with an aromatic odor. [**Note:** A solid below 42°F.]

Chemical & Physical Properties:
MW: 78.1
BP: 176°F
Sol: 0.07%
Fl.P: 12°F
IP: 9.24 eV
Sp.Gr: 0.88
VP: 75 mmHg
FRZ: 42°F
UEL: 7.8%
LEL: 1.2%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Strong oxidizers, many fluorides & perchlorates, nitric acid

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, resp sys; dizz; head, nau, staggered gait; anor, lass; derm; bone marrow depres; [carc]
TO: Eyes, skin, resp sys, blood, CNS, bone marrow [leukemia]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Benzenethiol

Formula:	CAS#:	RTECS#:	IDLH:
C_6H_5SH	108-98-5	DC0525000	N.D.

Conversion: 1 ppm = 4.51 mg/m^3 **DOT:** 2337 131

Synonyms/Trade Names: Mercaptobenzene, Phenyl mercaptan, Thiophenol

Exposure Limits:
NIOSH REL: C 0.1 ppm (0.5 mg/m^3) [15-minute]
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2075

Physical Description: Water-white liquid with an offensive, garlic-like odor. [**Note:** A solid below 5°F.]

Chemical & Physical Properties:
MW: 110.2
BP: 336°F
Sol(77°F): 0.08%
Fl.P: 132°F
IP: 8.33 eV
Sp.Gr: 1.08
VP(65°F): 1 mmHg
FRZ: 5°F
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
1 ppm: CcrOv/Sa
2.5 ppm: Sa:Cf/PaprOv
5 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong acids & bases, calcium hypochlorite, alkali metals
[**Note:** Oxidizes on exposure to air.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; derm; cyan; cough, wheez, dysp, pulm edema, pneu; head, dizz, CNS depres; nau, vomit; kidney, liver, spleen damage
TO: Eyes, skin, resp sys, CNS, kidneys, liver, spleen

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Benzidine

Formula: $NH_2C_6H_4C_6H_4NH_2$ | **CAS#:** 92-87-5 | **RTECS#:** DC9625000 | **IDLH:** Ca [N.D.]

Conversion: | **DOT:** 1885 153

Synonyms/Trade Names: Benzidine-based dyes; 4,4'-Bianiline; 4,4'-Biphenyldiamine; 1,1'-Biphenyl-4,4'-diamine; 4,4'-Diaminobiphenyl; p-Diaminodiphenyl [**Note:** Benzidine has been used as a basis for many dyes.]

Exposure Limits:
NIOSH REL: Ca
See Appendix A
See Appendix C

OSHA PEL: [1910.1010]
See Appendix B
See Appendix C

Measurement Methods (see Table 1):
NIOSH 5509
OSHA 65

Physical Description: Grayish-yellow, reddish-gray, or white crystalline powder. [**Note:** Darkens on exposure to air and light.]

Chemical & Physical Properties:
MW: 184.3
BP: 752°F
Sol(54°F): 0.04%
Fl.P: ?
IP: ?
Sp.Gr: 1.25
VP: Low
MLT: 239°F
UEL: ?
LEL: ?
Combustible Solid, but difficult to burn.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Red fuming nitric acid

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Hema; secondary anemia from hemolysis; acute cystitis; acute liver disorders; derm; painful, irreg urination; [carc]
TO: Bladder, skin, kidneys, liver, blood [liver, kidney & bladder cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Benzoyl peroxide

Formula: $(C_6H_5CO)_2O_2$ | **CAS#:** 94-36-0 | **RTECS#:** DM8575000 | **IDLH:** 1500 mg/m^3

Conversion: | **DOT:**

Synonyms/Trade Names: Benzoperoxide, Dibenzoyl peroxide

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL: TWA 5 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5009

Physical Description: Colorless to white crystals or a granular powder with a faint, benzaldehyde-like odor.

Chemical & Physical Properties:
MW: 242.2
BP: Decomposes explosively
Sol: <1%
Fl.P: 176°F
IP: ?
Sp.Gr: 1.33
VP: <1 mmHg
MLT: 217°F
UEL: ?
LEL: ?
Combustible Solid (easily ignited and burns very rapidly).

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 mg/m^3: 95XQ*/Sa*
125 mg/m^3: Sa:Cf*/PaprHie*
250 mg/m^3: 100F/PaprTHie*/ScbaF/SaF
1500 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Combustible substances (wood, paper, etc.), acids, alkalis, alcohols, amines, ethers [**Note:** Containers may explode when heated. Extremely explosion-sensitive to shock, heat & friction.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; sens derm
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

B

Benzyl chloride

Formula: $C_6H_5CH_2Cl$ | **CAS#:** 100-44-7 | **RTECS#:** XS8925000 | **IDLH:** 10 ppm

Conversion: 1 ppm = 5.18 mg/m^3 | **DOT:** 1738 156

Synonyms/Trade Names: Chloromethylbenzene, α-Chlorotoluene

Exposure Limits:
NIOSH REL: C 1 ppm (5 mg/m^3) [15-minute]
OSHA PEL: TWA 1 ppm (5 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 7

Physical Description: Colorless to slightly yellow liquid with a pungent, aromatic odor.

Chemical & Physical Properties:
MW: 126.6
BP: 354°F
Sol: 0.05%
Fl.P: 153°F
IP: ?
Sp.Gr: 1.10
VP: 1 mmHg
FRZ: -38°F
UEL: ?
LEL: 1.1%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 ppm: CcrOvAg*/GmFOvAg/
PaprOvAg*/Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOvAg/ScbaE

Incompatibilities and Reactivities: Oxidizers, acids, copper, aluminum, magnesium, iron, zinc, tin [**Note:** Can polymerize when in contact with all common metals except nickel & lead. Hydrolyzes in H_2O to benzyl alcohol.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose; lass; irrity; head; skin eruption; pulm edema
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Beryllium & beryllium compounds (as Be)

Formula: Be (metal) | **CAS#:** 7440-41-7 (metal) | **RTECS#:** DS1750000 (metal) | **IDLH:** Ca [4 mg/m^3 (as Be)]

Conversion: | **DOT:** 1566 154 (compounds); 1567 134 (powder)

Synonyms/Trade Names: **Beryllium metal:** Beryllium
Other synonyms vary depending upon the specific beryllium compound.

Exposure Limits:
NIOSH REL: Ca
Not to exceed 0.0005 mg/m^3
See Appendix A
OSHA PEL: TWA 0.002 mg/m^3
C 0.005 mg/m^3 0.025 mg/m^3 [30-minute maximum peak]

Measurement Methods (see Table 1):
NIOSH 7102, 7300, 7301, 7303, 9102
OSHA ID125G, ID206

Physical Description: Metal: A hard, brittle, gray-white solid.

Chemical & Physical Properties:
MW: 9.0
BP: 4532°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 1.85 (metal)
VP: 0 mmHg (approx)
MLT: 2349°F
UEL: NA
LEL: NA

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Metal: Noncombustible Solid in bulk form, but a slight explosion hazard in the form of a powder or dust.

Incompatibilities and Reactivities: Acids, caustics, chlorinated hydrocarbons, oxidizers, molten lithium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Berylliosis (chronic exposure): anor, low-wgt, lass, chest pain, cough, clubbing of fingers, cyan, pulm insufficiency; irrit eyes; derm; [carc]
TO: Eyes, skin, resp sys [lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Bismuth telluride, doped with Selenium sulfide (as Bi_2Te_3)	**Formula:**	**CAS#:**	**RTECS#:**	**IDLH:** N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Doped bismuth sesquitelluride, Doped bismuth telluride, Doped bismuth tritelluride, Doped tellurobismuthite [**Note:** Doped with selenium sulfide. Commercial mix may contain 80% Bi_2Te_3, 20% stannous telluride, plus some tellurium.]

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 0500
OSHA ID121

Physical Description: Gray, crystalline solid that has been enhanced (doped) with a small amount of selenium sulfide (SeS).
[**Note:** Doping alters the conductivity of a semiconductor.]

Chemical & Physical Properties:
Properties are unavailable but should be similar to Bismuth telluride, undoped.

Sp.Gr: ?

Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers, moisture

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, upper resp sys; garlic breath; in animals: pulm lesions (nonfibrotic)
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Bismuth telluride, undoped	**Formula:** Bi_2Te_3	**CAS#:** 1304-82-1	**RTECS#:** EB3110000	**IDLH:** N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Bismuth sesquitelluride, Bismuth telluride, Bismuth tritelluride, Tellurobismuthite

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600
OSHA ID121

Physical Description: Gray, crystalline solid.

Chemical & Physical Properties:
MW: 800.8
BP: ?
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 7.7
VP: 0 mmHg (approx)
MLT: 1063°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers (e.g., bromine, chlorine, or fluorine), moisture, nitric acid (decomposes)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, upper resp sys; garlic breath
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

B

Borates, tetra, sodium salts (Anhydrous)	Formula: $Na_2B_4O_7$	CAS#: 1330-43-4	RTECS#: ED4588000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Anhydrous borax, Borax dehydrated, Disodium salt of boric acid, Disodium tetrabromate, Fused borax, Sodium borate (anhydrous), Sodium tetraborate

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3
OSHA PEL†: none

Physical Description: White to gray, odorless powder. [herbicide]
[**Note:** Becomes opaque on exposure to air.]

Measurement Methods (see Table 1):
NIOSH 0500
OSHA ID125G

Chemical & Physical Properties:
MW: 201.2
BP: 2867°F (Decomposes)
Sol: 4%
Fl.P: NA
IP: NA
Sp.Gr: 2.37
VP: 0 mmHg (approx)
MLT: 1366°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: Daily
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Moisture [**Note:** Forms partial hydrate in moist air.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; derm; epis; cough, dysp
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Borates, tetra, sodium salts (Decahydrate)	Formula: $Na_2B_4O_7{\times}10H_2O$	CAS#: 1303-96-4	RTECS#: VZ2275000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Borax, Borax decahydrate, Sodium borate decahydrate, Sodium tetraborate decahydrate

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL†: none

Physical Description: White, odorless, crystalline solid. [herbicide]
[**Note:** Becomes anhydrous at 608°F.]

Measurement Methods (see Table 1):
NIOSH 0500
OSHA ID125G

Chemical & Physical Properties:
MW: 381.4
BP: 608°F
Sol: 6%
Fl.P: NA
IP: NA
Sp.Gr: 1.73
VP: 0 mmHg (approx)
MLT: 167°F
UEL: NA
LEL: NA
Noncombustible Solid (an inherent fire retardant).

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: Daily
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Zirconium, strong acids, metallic salts

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; derm; epis; cough, dysp
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Borates, tetra, sodium salts (Pentahydrate)	**Formula:** $Na_2B_4O_7 \times 5H_2O$	**CAS#:** 12179-04-3	**RTECS#:** VZ2540000	**IDLH:** N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Borax pentahydrate, Sodium borate pentahydrate, Sodium tetraborate pentahydrate

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 0500
OSHA ID125G

Physical Description: Colorless or white, odorless crystals or free-flowing powder. [herbicide] [**Note:** Begins to lose water of hydration at 252°F.]

Chemical & Physical Properties:
MW: 291.4
BP: ?
Sol: 3%
Fl.P: NA
IP: NA
Sp.Gr: 1.82
VP: 0 mmHg (approx)
MLT: 392°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: Daily
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported
[**Note:** See the reactivities & incompatibilities reported for the related substance Borax decahydrate above.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; derm; epis; cough, dysp
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Boron oxide	**Formula:** B_2O_3	**CAS#:** 1303-86-2	**RTECS#:** ED7900000	**IDLH:** 2000 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names: Boric anhydride, Boric oxide, Boron trioxide

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3
OSHA PEL†: TWA 15 mg/m^3

Measurement Methods (see Table 1):
NIOSH 0500

Physical Description: Colorless, semitransparent lumps or hard, white, odorless crystals.

Chemical & Physical Properties:
MW: 69.6
BP: 3380°F
Sol: 3%
Fl.P: NA
IP: 13.50 eV
Sp.Gr: 2.46
VP: 0 mmHg (approx)
MLT: 842°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
50 mg/m^3: Qm*
100 mg/m^3: 95XQ*/Sa*
250 mg/m^3: Sa:Cf*/PaprHie*
500 mg/m^3: 100F/PaprTHie*/ScbaF/SaF
2000 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Water [**Note:** Reacts slowly with water to form boric acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; cough; conj; skin eryt
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Fresh air
Swallow: Medical attention immed

B

Boron tribromide

Formula:	CAS#:	RTECS#:	IDLH:
BBr_3	10294-33-4	ED7400000	N.D.

Conversion: 1 ppm = 10.25 mg/m^3 **DOT:** 2692 157

Synonyms/Trade Names: Boron bromide, Tribromoborane

Exposure Limits:
NIOSH REL: C 1 ppm (10 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless, fuming liquid with a sharp, irritating odor.

Chemical & Physical Properties:
MW: 250.5
BP: 194°F
Sol: Decomposes
Fl.P: NA
IP: 9.70 eV
Sp.Gr(65°F): 2.64
VP(57°F): 40 mmHg
FRZ: -51°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Moisture, water, heat, potassium, sodium, alcohols
[**Note:** Attacks metals, wood & rubber. Reacts with water to form boric acid and hydrogen bromide.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; eye, skin burns; dysp, pulm edema
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Boron trifluoride

Formula:	CAS#:	RTECS#:	IDLH:
BF_3	7637-07-2	ED2275000	25 ppm

Conversion: 1 ppm = 2.77 mg/m^3 **DOT:** 1008 125

Synonyms/Trade Names: Boron fluoride, Trifluoroborane

Exposure Limits:
NIOSH REL: C 1 ppm (3 mg/m^3)
OSHA PEL: C 1 ppm (3 mg/m^3)

Measurement Methods (see Table 1):
None available

Physical Description: Colorless gas with a pungent, suffocating odor.
[**Note:** Forms dense white fumes in moist air. Shipped as a nonliquefied compressed gas.]

Chemical & Physical Properties:
MW: 67.8
BP: -148°F
Sol: 106% (in cold H_2O)
Fl.P: NA
IP: 15.50 eV
RGasD: 2.38
VP: >50 atm
FRZ: -196°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 ppm: Sa*
25 ppm: Sa:Cf*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Alkali metals, calcium oxide
[**Note:** Hydrolyzes in moist air or hot water to form boric acid, hydrogen fluoride & fluoboric acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, nose, resp sys; epis; eye, skin burns; in animals: pneu; kidney damage
TO: Eyes, skin, resp sys, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support

Bromacil

Formula: $C_9H_{13}BrN_2O_2$ | **CAS#:** 314-40-9 | **RTECS#:** YQ9100000 | **IDLH:** N.D.

Conversion: 1 ppm = 10.68 mg/m^3 | **DOT:**

Synonyms/Trade Names: 5-Bromo-3-sec-butyl-6-methyluracil, 5-Bromo-6-methyl-3-(1-methylpropyl)uracil

Exposure Limits:
NIOSH REL: TWA 1 ppm (10 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 0500

Physical Description: Odorless, colorless to white, crystalline solid. [herbicide]
[**Note:** Commercially available as a wettable powder or in liquid formulations.]

Chemical & Physical Properties:
MW: 261.2
BP: Sublimes
Sol(77°F): 0.08%
Fl.P: NA
IP: ?
Sp.Gr: 1.55
VP(212°F): 0.0008 mmHg
MLT: 317°F (Sublimes)
UEL: NA
LEL: NA
Noncombustible Solid, but may be dissolved in flammable liquids.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong acids (decomposes slowly), oxidizers, heat, sparks, open flames

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; in animals: thyroid inj
TO: Eyes, skin, resp sys, thyroid

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Bromine

Formula: Br_2 | **CAS#:** 7726-95-6 | **RTECS#:** EF9100000 | **IDLH:** 3 ppm

Conversion: 1 ppm = 6.54 mg/m^3 | **DOT:** 1744 154

Synonyms/Trade Names: Molecular bromine

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.7 mg/m^3)
ST 0.3 ppm (2 mg/m^3)
OSHA PEL†: TWA 0.1 ppm (0.7 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 6011
OSHA ID108

Physical Description: Dark reddish-brown, fuming liquid with suffocating, irritating fumes.

Chemical & Physical Properties:
MW: 159.8
BP: 139°F
Sol: 4%
Fl.P: NA
IP: 10.55 eV
Sp.Gr: 3.12
VP: 172 mmHg
FRZ: 19°F
UEL: NA
LEL: NA
Noncombustible Liquid, but accelerates the burning of combustibles.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2.5 ppm: Sa:Cf£/PaprS¿£
3 ppm: CcrFS¿/GmFS¿/PaprTS¿£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS¿/ScbaE

Incompatibilities and Reactivities: Combustible organics (sawdust, wood, cotton, straw, etc.), aluminum, readily oxidizable materials, ammonia, hydrogen, acetylene, phosphorus, potassium, sodium
[**Note:** Corrodes iron, steel, stainless steel & copper.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Dizz, head; lac, epis; cough, feeling of oppression, pulm edema, pneu; abdom pain, diarr; measle-like eruptions; eye, skin burns
TO: Resp sys, eyes, CNS, skin

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

B

Bromine pentafluoride

Formula:	CAS#:	RTECS#:	IDLH:
BrF_5	7789-30-2	EF9350000	N.D.

Conversion: 1 ppm = 7.15 mg/m^3 **DOT:** 1745 144

Synonyms/Trade Names: Bromine fluoride

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.7 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless to pale-yellow, fuming liquid with a pungent odor. [**Note:** A colorless gas above 105°F. Shipped as a compressed gas.]

Chemical & Physical Properties:
MW: 174.9
BP: 105°F
Sol: Reacts violently
Fl.P: NA
IP: ?
Sp.Gr: 2.48
VP: 328 mmHg
FRZ: -77°F
UEL: NA
LEL: NA
Noncombustible Liquid, but a very powerful oxidizer.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Acids, halogens, arsenic, selenium, sulfur, glass, organic materials, water [**Note:** Reacts with all elements except inert gases, nitrogen & oxygen.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; corn nec; skin burns; cough, dysp, pulm edema; liver, kidney inj
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Bromoform

Formula:	CAS#:	RTECS#:	IDLH:
$CHBr_3$	75-25-2	PB5600000	850 ppm

Conversion: 1 ppm = 10.34 mg/m^3 **DOT:** 2515 159

Synonyms/Trade Names: Methyl tribromide, Tribromomethane

Exposure Limits:
NIOSH REL: TWA 0.5 ppm (5 mg/m^3) [skin]
OSHA PEL: TWA 0.5 ppm (5 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 7

Physical Description: Colorless to yellow liquid with a chloroform-like odor. [**Note:** A solid below 47°F.]

Chemical & Physical Properties:
MW: 252.8
BP: 301°F
Sol: 0.1%
Fl.P: NA
IP: 10.48 eV
Sp.Gr: 2.89
VP: 5 mmHg
FRZ: 47°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
12.5 ppm: Sa:Cf£/PaprOv£
25 ppm: CcrFOv/GmFOv/PaprTOv£/ ScbaF/SaF
850 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Lithium, sodium, potassium, calcium, aluminum, zinc, magnesium, strong caustics, acetone [**Note:** Gradually decomposes, acquiring yellow color; air & light accelerate decomposition.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; CNS depres; liver, kidney damage
TO: Eyes, skin, resp sys, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

1,3-Butadiene

Formula: CH_2=CHCH=CH_2 | **CAS#:** 106-99-0 | **RTECS#:** EI9275000 | **IDLH:** Ca [2000 ppm] [10%LEL]

Conversion: 1 ppm = 2.21 mg/m^3 | **DOT:** 1010 116P (inhibited)

Synonyms/Trade Names: Biethylene, Bivinyl, Butadiene, Divinyl, Erythrene, Vinylethylene

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1051] TWA 1 ppm
ST 5 ppm

Measurement Methods (see Table 1):
NIOSH 1024
OSHA 56

Physical Description: Colorless gas with a mild aromatic or gasoline-like odor.
[**Note:** A liquid below 24°F. Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 54.1
BP: 24°F
Sol: Insoluble
Fl.P: NA (Gas)
-105°F (Liquid)
IP: 9.07 eV
RGasD: 1.88
Sp.Gr: 0.65 (Liquid at 24°F)
VP: 2.4 atm
FRZ: -164°F
UEL: 12.0%
LEL: 2.0%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Phenol, chlorine dioxide, copper, crotonaldehyde [**Note:** May contain inhibitors (e.g., tributylcatechol) to prevent self-polymerization. May form explosive peroxides upon exposure to air.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Irrit eyes, nose, throat; drow, dizz; liquid: frostbite; terato, repro effects; [carc]
TO: Eyes, resp sys, CNS, repro sys [hemato cancer]

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

n-Butane

Formula: $CH_3CH_2CH_2CH_3$ | **CAS#:** 106-97-8 | **RTECS#:** EJ4200000 | **IDLH:** N.D.

Conversion: 1 ppm = 2.38 mg/m^3 | **DOT:** 1011 115; 1075 115

Synonyms/Trade Names: normal-Butane, Butyl hydride, Diethyl, Methylethylmethane
[**Note:** Also see specific listing for Isobutane.]

Exposure Limits:
NIOSH REL: TWA 800 ppm (1900 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA 56

Physical Description: Colorless gas with a gasoline-like or natural gas odor.
[**Note:** Shipped as a liquefied compressed gas. A liquid below 31°F.]

Chemical & Physical Properties:
MW: 58.1
BP: 31°F
Sol: Slight
Fl.P: NA (Gas)
IP: 10.63 eV
RGasD: 2.11
Sp.Gr: 0.6 (Liquid at 31°F)
VP: 2.05 atm
FRZ: -217°F
UEL: 8.4%
LEL: 1.6%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers (e.g., nitrates and perchlorates), chlorine, fluorine, (nickel carbonyl + oxygen)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Drow, narco, asphy; liquid: frostbite
TO: CNS

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

B

2-Butanone

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3COCH_2CH_3$	78-93-3	EL6475000	3000 ppm

Conversion: 1 ppm = 2.95 mg/m^3 **DOT:** 1193 127

Synonyms/Trade Names: Ethyl methyl ketone, MEK, Methyl acetone, Methyl ethyl ketone

Exposure Limits:
NIOSH REL: TWA 200 ppm (590 mg/m^3)
ST 300 ppm (885 mg/m^3)
OSHA PEL†: TWA 200 ppm (590 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2500, 2555, 3800
OSHA 16, 84, 1004

Physical Description: Colorless liquid with a moderately sharp, fragrant, mint- or acetone-like odor.

Chemical & Physical Properties:
MW: 72.1
BP: 175°F
Sol: 28%
Fl.P: 16°F
IP: 9.54 eV
Sp.Gr: 0.81
VP: 78 mmHg
FRZ: -123°F
UEL(200°F): 11.4%
LEL(200°F): 1.4%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
3000 ppm: Sa:Cf£/PaprOv£/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, amines, ammonia, inorganic acids, caustics, isocyanates, pyridines

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose; head; dizz; vomit; derm
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Fresh air
Swallow: Medical attention immed

2-Butoxyethanol

Formula:	CAS#:	RTECS#:	IDLH:
$C_4H_9OCH_2CH_2OH$	111-76-2	KJ8575000	700 ppm

Conversion: 1 ppm = 4.83 mg/m^3 **DOT:** 2369 152

Synonyms/Trade Names: Butyl Cellosolve®, Butyl oxitol, Dowanol® EB, EGBE, Ektasolve EB®, Ethylene glycol monobutyl ether, Jeffersol EB

Exposure Limits:
NIOSH REL: TWA 5 ppm (24 mg/m^3) [skin]
OSHA PEL†: TWA 50 ppm (240 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1403
OSHA 83

Physical Description: Colorless liquid with a mild, ether-like odor.

Chemical & Physical Properties:
MW: 118.2
BP: 339°F
Sol: Miscible
Fl.P: 143°F
IP: 10.00 eV
Sp.Gr: 0.90
VP: 0.8 mmHg
FRZ: -107°F
UEL(275°F): 12.7%
LEL(200°F): 1.1%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
50 ppm: CcrOv*/Sa*
125 ppm: Sa:Cf*/PaprOv*
250 ppm: CcrFOv/GmFOv/PaprTOv*/ScbaF/SaF
700 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong caustics

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; hemolysis, hema; CNS depres, head; vomit
TO: Eyes, skin, resp sys, CNS, hemato sys, blood, kidneys, liver, lymphoid sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

2-Butoxyethanol acetate

Formula: $C_4H_9O(CH_2)_2OCOCH_3$ | **CAS#:** 112-07-2 | **RTECS#:** KJ8925000 | **IDLH:** N.D.

Conversion: 1 ppm = 6.55 mg/m^3 | **DOT:**

Synonyms/Trade Names: 2-Butoxyethyl acetate, Butyl Cellosolve® acetate, Butyl glycol acetate, EGBEA, Ektasolve EB® acetate, Ethylene glycol monobutyl ether acetate

Exposure Limits:
NIOSH REL: TWA 5 ppm (33 mg/m^3)
OSHA PEL: none

Measurement Methods (see Table 1):
OSHA 83

Physical Description: Colorless liquid with a pleasant, sweet, fruity odor.

Chemical & Physical Properties:
MW: 160.2
BP: 378°F
Sol: 1.5%
Fl.P: 160°F
IP: ?
Sp.Gr: 0.94
VP: 0.3 mmHg
FRZ: -82°F
UEL(275°F): 8.54%
LEL(200°F): 0.88%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
50 ppm: CcrOv*/Sa*
125 ppm: Sa:Cf*/PaprOv*
250 ppm: CcrFOv/GmFOv/PaprTOv*/ ScbaF/SaF
700 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; hemolysis, hema; CNS depres, head; vomit
TO: Eyes, skin, resp sys, CNS, hemato sys, blood, kidneys, liver, lymphoid sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

n-Butyl acetate

Formula: $CH_3COO[CH_2]_3CH_3$ | **CAS#:** 123-86-4 | **RTECS#:** AF7350000 | **IDLH:** 1700 ppm [10%LEL]

Conversion: 1 ppm = 4.75 mg/m^3 | **DOT:** 1123 129

Synonyms/Trade Names: Butyl acetate, n-Butyl ester of acetic acid, Butyl ethanoate

Exposure Limits:
NIOSH REL: TWA 150 ppm (710 mg/m^3)
ST 200 ppm (950 mg/m^3)
OSHA PEL†: TWA 150 ppm (710 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1450
OSHA 7

Physical Description: Colorless liquid with a fruity odor.

Chemical & Physical Properties:
MW: 116.2
BP: 258°F
Sol: 1%
Fl.P: 72°F
IP: 10.00 eV
Sp.Gr: 0.88
VP: 10 mmHg
FRZ: -107°F
UEL: 7.6%
LEL: 1.7%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1500 ppm: CcrOv*/Sa*
1700 ppm: Sa:Cf*/PaprOv*/CcrFOv/ GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; head, drow, narco
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

B

sec-Butyl acetate

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3COOCH(CH_3)CH_2CH_3$	105-46-4	AF7380000	1700 ppm [10%LEL]

Conversion: 1 ppm = 4.75 mg/m^3 **DOT:** 1123 129

Synonyms/Trade Names: sec-Butyl ester of acetic acid, 1-Methylpropyl acetate

Exposure Limits:
NIOSH REL: TWA 200 ppm (950 mg/m^3)
OSHA PEL: TWA 200 ppm (950 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1450
OSHA 7

Physical Description: Colorless liquid with a pleasant, fruity odor.

Chemical & Physical Properties:
MW: 116.2
BP: 234°F
Sol: 0.8%
Fl.P: 62°F
IP: 9.91 eV
Sp.Gr: 0.86
VP: 10 mmHg
FRZ: -100°F
UEL: 9.8%
LEL: 1.7%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1700 ppm: Sa:Cf£/PaprOv£/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes; head; drow; dryness upper resp sys, skin; narco
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

tert-Butyl acetate

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3COOC(CH_3)_3$	540-88-5	AF7400000	1500 ppm [10%LEL]

Conversion: 1 ppm = 4.75 mg/m^3 **DOT:** 1123 129

Synonyms/Trade Names: tert-Butyl ester of acetic acid

Exposure Limits:
NIOSH REL: TWA 200 ppm (950 mg/m^3)
OSHA PEL: TWA 200 ppm (950 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1450
OSHA 7

Physical Description: Colorless liquid with a fruity odor.

Chemical & Physical Properties:
MW: 116.2
BP: 208°F
Sol: Insoluble
Fl.P: 72°F
IP: ?
Sp.Gr: 0.87
VP: ?
FRZ: ?
UEL: ?
LEL: 1.5%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1500 ppm: Sa:Cf£/PaprOv£/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Itch, inflamm eyes; irrit upper resp tract; head; narco; derm
TO: Resp sys, eyes, skin, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Butyl acrylate	**Formula:** CH_2=$CHCOOC_4H_9$	**CAS#:** 141-32-2	**RTECS#:** UD3150000	**IDLH:** N.D.
Conversion: 1 ppm = 5.24 mg/m^3	**DOT:** 2348 130P			

Synonyms/Trade Names: n-Butyl acrylate, Butyl ester of acrylic acid, Butyl-2-propenoate

Exposure Limits:
NIOSH REL: TWA 10 ppm (55 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2011

Physical Description: Clear, colorless liquid with a strong, fruity odor. [**Note:** Highly reactive; may contain an inhibitor to prevent spontaneous polymerization.]

Chemical & Physical Properties:
MW: 128.2
BP: 293°F
Sol: 0.1%
Fl.P: 103°F
IP: ?
Sp.Gr: 0.89
VP: 4 mmHg
FRZ: -83°F
UEL: 9.9%
LEL: 1.5%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong acids & alkalis, amines, halogens, hydrogen compounds, oxidizers, heat, flame, sunlight [**Note:** Polymerizes readily on heating.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, upper resp sys; sens derm; dysp
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

n-Butyl alcohol	**Formula:** $CH_3CH_2CH_2CH_2OH$	**CAS#:** 71-36-3	**RTECS#:** EO1400000	**IDLH:** 1400 ppm [10%LEL]
Conversion: 1 ppm = 3.03 mg/m^3	**DOT:** 1120 129			

Synonyms/Trade Names: 1-Butanol, n-Butanol, Butyl alcohol, 1-Hydroxybutane, n-Propyl carbinol

Exposure Limits:
NIOSH REL: C 50 ppm (150 mg/m^3) [skin]
OSHA PEL†: TWA 100 ppm (300 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1401, 1405
OSHA 7

Physical Description: Colorless liquid with a strong, characteristic, mildly alcoholic odor.

Chemical & Physical Properties:
MW: 74.1
BP: 243°F
Sol: 9%
Fl.P: 84°F
IP: 10.04 eV
Sp.Gr: 0.81
VP: 6 mmHg
FRZ: -129°F
UEL: 11.2%
LEL: 1.4%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
1250 ppm: Sa:Cf£/PaprOv£
1400 ppm: CcrFOv/GmFOv/PaprTOv£/ ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong mineral acids, alkali metals, halogens

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose, throat; head, dizz, drow; corn inflamm, blurred vision, lac, photo; derm; possible auditory nerve damage, hearing loss; CNS depres
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

B

sec-Butyl alcohol

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3CH(OH)CH_2CH_3$	78-92-2	EO1750000	2000 ppm

Conversion: 1 ppm = 3.03 mg/m^3 **DOT:** 1120 129

Synonyms/Trade Names: 2-Butanol, Butylene hydrate, 2-Hydroxybutane, Methyl ethyl carbinol

Exposure Limits:
NIOSH REL: TWA 100 ppm (305 mg/m^3)
ST 150 ppm (455 mg/m^3)
OSHA PEL†: TWA 150 ppm (450 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1401, 1405
OSHA 7

Physical Description: Colorless liquid with a strong, pleasant odor.

Chemical & Physical Properties:
MW: 74.1
BP: 211°F
Sol: 16%
Fl.P: 75°F
IP: 10.10 eV
Sp.Gr: 0.81
VP: 12 mmHg
FRZ: -175°F
UEL(212°F): 9.8%
LEL(212°F): 1.7%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
1000 ppm: CcrOv*/Sa*
2000 ppm: Sa:Cf*/PaprOv*/CcrFOv/
GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, organic peroxides, perchloric & permonosulfuric acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; narco
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

tert-Butyl alcohol

Formula:	CAS#:	RTECS#:	IDLH:
$(CH_3)_3COH$	75-65-0	EO1925000	1600 ppm

Conversion: 1 ppm = 3.03 mg/m^3 **DOT:** 1120 129

Synonyms/Trade Names: 2-Methyl-2-propanol, Trimethyl carbinol

Exposure Limits:
NIOSH REL: TWA 100 ppm (300 mg/m^3)
ST 150 ppm (450 mg/m^3)
OSHA PEL†: TWA 100 ppm (300 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1400
OSHA 7

Physical Description: Colorless solid or liquid (above 77°F) with a camphor-like odor. [**Note:** Often used in aqueous solutions.]

Chemical & Physical Properties:
MW: 74.1
BP: 180°F
Sol: Miscible
Fl.P: 52°F
IP: 9.70 eV
Sp.Gr: 0.79 (Solid)
VP(77°F): 42 mmHg
FRZ: 78°F
UEL: 8.0%
LEL: 2.4%
Combustible Solid
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1600 ppm: Sa:Cf£/PaprOv£/CcrFOv/
GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong mineral acids, strong hydrochloric acid, oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; drow, narco
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

n-Butylamine	Formula: $CH_3CH_2CH_2CH_2NH_2$	CAS#: 109-73-9	RTECS#: EO2975000	IDLH: 300 ppm
Conversion: 1 ppm = 2.99 mg/m^3	**DOT:** 1125 132			
Synonyms/Trade Names: 1-Aminobutane, Butylamine				

Exposure Limits:
NIOSH REL: C 5 ppm (15 mg/m^3) [skin]
OSHA PEL: C 5 ppm (15 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2012

Physical Description: Colorless liquid with a fishy, ammonia-like odor.

Chemical & Physical Properties:
MW: 73.2
BP: 172°F
Sol: Miscible
Fl.P: 10°F
IP: 8.71 eV
Sp.Gr: 0.74
VP: 82 mmHg
FRZ: -58°F
UEL: 9.8%
LEL: 1.7%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 ppm: CcrS*/Sa*
125 ppm: Sa:Cf*/PaprS*
250 ppm: CcrFS/GmFS/PaprTS*/ScbaF/SaF
300 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids
[**Note:** May corrode some metals in presence of water.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; head; skin flush, burns
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

tert-Butyl chromate	Formula: $[(CH_3)_3CO]_2CrO_2$	CAS#: 1189-85-1	RTECS#: GB2900000	IDLH: Ca [15 mg/m^3 {as Cr(VI)}]
Conversion:	**DOT:**			
Synonyms/Trade Names: di-tert-Butyl ester of chromic acid				

Exposure Limits:
NIOSH REL: Ca
TWA 0.001 mg Cr(VI)/m^3
See Appendix A
See Appendix C
OSHA PEL: C 0.1 mg CrO_3/m^3 [skin]
See Appendix C

Measurement Methods (see Table 1):
NIOSH 7604
OSHA ID103, ID215

Physical Description: Liquid. [**Note:** Solidifies at 32-23°F.]

Chemical & Physical Properties:
MW: 230.3
BP: ?
Sol: ?
Fl.P: ?
IP: ?
Sp.Gr: ?
VP: ?
FRZ: 32-23°F
UEL: ?
LEL: ?

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Reducing agents, moisture, acids, alcohols, hydrazine, combustible materials

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; eye, skin burns; drow, musc weak; skin ulcers; lung changes; [carc]
TO: Eyes, skin, resp sys, CNS [lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

B

n-Butyl glycidyl ether

Formula:	CAS#:	RTECS#:	IDLH:
$C_7H_{14}O_2$	2426-08-6	TX4200000	250 ppm

Conversion: 1 ppm = 5.33 mg/m^3 **DOT:**

Synonyms/Trade Names: BGE; 1,2-Epoxy-3-butoxypropane

Exposure Limits:
NIOSH REL: C 5.6 ppm (30 mg/m^3) [15-minute]
OSHA PEL†: TWA 50 ppm (270 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1616
OSHA 7

Physical Description: Colorless liquid with an irritating odor.

Chemical & Physical Properties:
MW: 130.2
BP: 327°F
Sol: 2%
Fl.P: 130°F
IP: ?
Sp.Gr: 0.91
VP(77°F): 3 mmHg
FRZ: ?
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
56 ppm: CcrOv*/Sa*
140 ppm: Sa:Cf*/PaprOv*
250 ppm: CcrFOv/GmFOv/PaprTOv*/ ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong caustics

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose; skin sens; narco; possible hemato effects; CNS depres
TO: Eyes, skin, resp sys, CNS, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

n-Butyl lactate

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3CH(OH)COOC_4H_9$	138-22-7	OD4025000	N.D.

Conversion: 1 ppm = 5.98 mg/m^3 **DOT:** 1993 128 (combustible liquid, n.o.s.)

Synonyms/Trade Names: Butyl ester of 2-hydroxypropanoic acid, Butyl ester of lactic acid, Butyl lactate

Exposure Limits:
NIOSH REL: TWA 5 ppm (25 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Clear, colorless to white liquid with a mild, transient odor.

Chemical & Physical Properties:
MW: 146.2
BP: 370°F
Sol: Slight
Fl.P: 160°F
IP: ?
Sp.Gr: 0.98
VP: 0.4 mmHg
FRZ: -45°F
UEL: ?
LEL: 1.15%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong acids & bases, strong oxidizers, heat, sparks, open flames

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; drow, head, CNS depres; nau, vomit
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

n-Butyl mercaptan	Formula: $CH_3CH_2CH_2CH_2SH$	CAS#: 109-79-5	RTECS#: EK6300000	IDLH: 500 ppm
Conversion: 1 ppm = 3.69 mg/m^3	**DOT:** 2347 130			

Synonyms/Trade Names: Butanethiol, 1-Butanethiol, n-Butanethiol, 1-Mercaptobutane

Exposure Limits:
NIOSH REL: C 0.5 ppm (1.8 mg/m^3) [15-minute]
OSHA PEL†: TWA 10 ppm (35 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2525, 2542

Physical Description: Colorless liquid with a strong, garlic-, cabbage-, or skunk-like odor.

Chemical & Physical Properties:
MW: 90.2
BP: 209°F
Sol: 0.06%
Fl.P: 35°F
IP: 9.15 eV
Sp.Gr: 0.83
VP: 35 mmHg
FRZ: -176°F
UEL: ?
LEL: ?
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: CcrOv/Sa
12.5 ppm: Sa:Cf/PaprOv
25 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
500 ppm: Sa:Pd,Pp*
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers (such as dry bleaches), acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin; musc weak, mal, sweat, nau, vomit, head, conf; in animals: narco, inco, lass; cyan, pulm irrit; liver, kidney damage
TO: Eyes, skin, resp sys, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

o-sec-Butylphenol	Formula: $CH_3CH_2CH(CH_3)C_6H_4OH$	CAS#: 89-72-5	RTECS#: SJ8920000	IDLH: N.D.
Conversion: 1 ppm = 6.14 mg/m^3	**DOT:**			

Synonyms/Trade Names: 2-sec-Butylphenol; 2-(1-Methylpropyl)phenol

Exposure Limits:
NIOSH REL: TWA 5 ppm (30 mg/m^3) [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid or solid (below 61°F).

Chemical & Physical Properties:
MW: 150.2
BP: 227°F
Sol: Insoluble
Fl.P: 225°F
IP: ?
Sp.Gr: 0.89
VP: Low
FRZ: 61°F
UEL: ?
LEL: ?
Class IIB Combustible Liquid
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; skin burns
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

B

p-tert-Butyltoluene

Formula:	CAS#:	RTECS#:	IDLH:
$(CH_3)_3CC_6H_4CH_3$	98-51-1	XS8400000	100 ppm

Conversion: 1 ppm = 6.07 mg/m^3 **DOT:** 2667 152

Synonyms/Trade Names: 4-tert-Butyltoluene, 1-Methyl-4-tert-butylbenzene

Exposure Limits:
NIOSH REL: TWA 10 ppm (60 mg/m^3)
ST 20 ppm (120 mg/m^3)
OSHA PEL†: TWA 10 ppm (60 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1501
OSHA 7

Physical Description: Colorless liquid with a distinct aromatic odor, somewhat like gasoline.

Chemical & Physical Properties:
MW: 148.3
BP: 379°F
Sol: Insoluble
Fl.P: 155°F
IP: 8.28 eV
Sp.Gr: 0.86
VP(77°F): 0.7 mmHg
FRZ: -62°F
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
100 ppm: Sa:Cf£/PaprOv£/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin; dry nose, throat; head; low BP, tacar, abnor CVS stress; CNS, hemato depres; metallic taste; liver, kidney inj
TO: Eyes, skin, resp sys, CVS, CNS, bone marrow, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

n-Butyronitrile

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3CH_2CH_2CN$	109-74-0	ET8750000	N.D.

Conversion: 1 ppm = 2.83 mg/m^3 **DOT:** 2411 131

Synonyms/Trade Names: Butanenitrile, Butyronitrile, 1-Cyanopropane, Propyl cyanide, n-Propyl cyanide

Exposure Limits:
NIOSH REL: TWA 8 ppm (22 mg/m^3)
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 1606 (adapt)

Physical Description: Colorless liquid with a sharp, suffocating odor.
[**Note:** Forms cyanide in the body.]

Chemical & Physical Properties:
MW: 69.1
BP: 244°F
Sol(77°F): 3%
Fl.P: 62°F
IP: 11.67 eV
Sp.Gr: 0.81
VP: 14 mmHg
FRZ: -170°F
UEL: ?
LEL: 1.65%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
80 ppm: CcrOv/Sa
200 ppm: Sa:Cf/PaprOv
400 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
1000 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers & reducing agents, strong acids & bases

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; head, dizz, lass, conf, convuls; dysp; abdom pain, nau, vomit
TO: Eyes, skin, resp sys, CNS, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Cadmium dust (as Cd)	**Formula:** Cd (metal)	**CAS#:** 7440-43-9 (metal)	**RTECS#:** EU9800000 (metal)	**IDLH:** Ca [9 mg/m^3 (as Cd)]
Conversion:	**DOT:** 2570 154 (cadmium compound)			

Synonyms/Trade Names: **Cadmium metal:** Cadmium
Other synonyms vary depending upon the specific cadmium compound.

Exposure Limits:
NIOSH REL*: Ca
See Appendix A
OSHA PEL*: [1910.1027] TWA 0.005 mg/m^3
[***Note:** The REL and PEL apply to all Cadmium compounds (as Cd).]

Measurement Methods (see Table 1):
NIOSH 7048, 7300, 7301, 7303, 9102
OSHA ID121, ID125G, ID189, ID206

Physical Description: Metal: Silver-white, blue-tinged lustrous, odorless solid.

Chemical & Physical Properties:
MW: 112.4
BP: 1409°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 8.65 (metal)
VP: 0 mmHg (approx)
MLT: 610°F
UEL: NA
LEL: NA
Metal: Noncombustible Solid in bulk form, but will burn in powder form.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: Daily
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Strong oxidizers; elemental sulfur, selenium & tellurium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing
SY: Pulm edema, dysp, cough, chest tight, subs pain; head; chills, musc aches; nau, vomit, diarr; anos, emphy, prot, mild anemia; [carc]
TO: Resp sys, kidneys, prostate, blood [prostatic & lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Cadmium fume (as Cd)	**Formula:** CdO/Cd	**CAS#:** 1306-19-0 (CdO)	**RTECS#:** EV1930000 (CdO)	**IDLH:** Ca [9 mg/m^3 (as Cd)]
Conversion:	**DOT:**			

Synonyms/Trade Names: **CdO:** Cadmium monoxide, Cadmium oxide fume **Cd:** Cadmium

Exposure Limits:
NIOSH REL*: Ca
See Appendix A
OSHA PEL*: [1910.1027] TWA 0.005 mg/m^3
[***Note:** The REL and PEL apply to all Cadmium compounds (as Cd).]

Measurement Methods (see Table 1):
NIOSH 7048, 7300, 7301, 7303
OSHA ID121, ID125G, ID189, ID206

Physical Description: Odorless, yellow-brown, finely divided particulate dispersed in air. [**Note:** See listing for Cadmium dust for properties of Cd.]

Chemical & Physical Properties:
MW: 128.4
BP: Decomposes
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 8.15 (crystalline form)
6.95 (amorphous form)
VP: 0 mmHg (approx)
MLT: 2599°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: Daily
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Not applicable

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh
SY: Pulm edema, dysp, cough, chest tight, subs pain; head; chills, musc aches; nau, vomit, diarr; emphy, prot, anos, mild anemia; [carc]
TO: Resp sys, kidneys, blood [prostatic & lung cancer]

First Aid (see Table 6):
Breath: Resp support

C

Calcium arsenate (as As)

Formula: $Ca_3(AsO_4)_2$ | **CAS#:** 7778-44-1 | **RTECS#:** CG0830000 | **IDLH:** Ca [5 mg/m^3 (as As)]

Conversion: | **DOT:** 1573 151

Synonyms/Trade Names: Calcium salt (2:3) of arsenic acid, Cucumber dust, Tricalcium arsenate, Tricalcium ortho-arsenate [**Note:** Also see specific listing for Arsenic (inorganic compounds, as As).]

Exposure Limits:
NIOSH REL: Ca
C 0.002 mg/m^3 [15-minute]
See Appendix A
OSHA PEL: [1910.1018] TWA 0.010 mg/m^3

Measurement Methods (see Table 1):
NIOSH 7900
OSHA ID105

Physical Description: Colorless to white, odorless solid. [insecticide/herbicide]

Chemical & Physical Properties:
MW: 398.1
BP: Decomposes
Sol(77°F): 0.01%
Fl.P: NA
IP: NA
Sp.Gr: 3.62
VP: 0 mmHg (approx)
MLT: ?
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported
[**Note:** Produces toxic fumes of arsenic when heated to decomposition.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Lass; GI dist; peri neur; skin hyperpig, palmar planter hyperkeratoses; derm; [carc]; in animals: liver damage
TO: Eyes, resp sys, liver, skin, CNS, lymphatic sys [lymphatic & lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Calcium carbonate

Formula: $CaCO_3$ | **CAS#:** 1317-65-3 | **RTECS#:** EV9580000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: Calcium salt of carbonic acid
[**Note:** Occurs in nature as as limestone, chalk, marble, dolomite, aragonite, calcite & oyster shells.]

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 7020, 7303
OSHA ID121

Physical Description: White, odorless powder or colorless crystals.

Chemical & Physical Properties:
MW: 100.1
BP: Decomposes
Sol: 0.001%
Fl.P: NA
IP: NA
Sp.Gr: 2.7-2.95
VP: 0 mmHg (approx)
MLT: 1517-2442°F (Decomposes)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Acids, alum, ammonium salts, mercury & hydrogen, fluorine, magnesium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, resp sys; cough
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Fresh air

Calcium cyanamide

Formula:	CAS#:	RTECS#:	IDLH:
$CaCN_2$	156-62-7	GS6000000	N.D.

Conversion: **DOT:** 1403 138 (with >0.1% calcium carbide)

Synonyms/Trade Names: Calcium carbimide, Cyanamide, Lime nitrogen, Nitrogen lime
[**Note:** Cyanamide is also a synonym for Hydrogen cyanamide, NH_2CN.]

Exposure Limits:
NIOSH REL: TWA 0.5 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 0500

Physical Description: Colorless, gray, or black crystals or powder. [fertilizer]
[**Note:** Commercial grades may contain calcium carbide.]

Chemical & Physical Properties:
MW: 80.1
BP: Sublimes
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 2.29
VP: 0 mmHg (approx)
MLT: 2444°F
UEL: NA
LEL: NA
Noncombustible Solid, but a fire risk if it contains calcium carbide.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Water
[**Note:** May polymerize in water or alkaline solutions to dicyanamide. Decomposes in water to form acetylene & ammonia.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; head, dizz, rapid breath, low BP, nau, vomit; skin burns, sens; cough; Antabuse-like effects
TO: Eyes, skin, resp sys, vasomotor sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Calcium hydroxide

Formula:	CAS#:	RTECS#:	IDLH:
$Ca(OH)_2$	1305-62-0	EW2800000	N.D.

Conversion: **DOT:**

Synonyms/Trade Names: Calcium hydrate, Caustic lime, Hydrated lime, Slaked lime

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 7020
OSHA ID121

Physical Description: White, odorless powder.
[**Note:** Readily absorbs CO_2 from the air to form calcium carbonate.]

Chemical & Physical Properties:
MW: 74.1
BP: Decomposes
Sol(32°F): 0.2%
Fl.P: NA
IP: NA
Sp.Gr: 2.24
VP: 0 mmHg (approx)
MLT: 1076°F (Decomposes) (Loses H_2O)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Maleic anhydride, phosphorus, nitroethane, nitromethane, nitroparaffins, nitropropane [**Note:** Attacks some metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; eye, skin burns; skin vesic; cough, bron, pneu
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

C

Calcium oxide

Formula: CaO | **CAS#:** 1305-78-8 | **RTECS#:** EW3100000 | **IDLH:** 25 mg/m^3

Conversion: | **DOT:** 1910 157

Synonyms/Trade Names: Burned lime, Burnt lime, Lime, Pebble lime, Quick lime, Unslaked lime

Exposure Limits:
NIOSH REL: TWA 2 mg/m^3
OSHA PEL: TWA 5 mg/m^3

Measurement Methods (see Table 1):
NIOSH 7020, 7303
OSHA ID121

Physical Description: White or gray, odorless lumps or granular powder.

Chemical & Physical Properties:
MW: 56.1
BP: 5162°F
Sol: Reacts
Fl.P: NA
IP: NA
Sp.Gr: 3.34
VP: 0 mmHg (approx)
MLT: 4662°F
UEL: NA
LEL: NA
Noncombustible Solid, but will support combustion by liberation of oxygen.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
10 mg/m^3: Qm
20 mg/m^3: 95XQ/Sa
25 mg/m^3: Sa:Cf/PaprHie/100F/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Water (liberates heat), fluorine, ethanol
[**Note:** Reacts with water to form calcium hydroxide.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp tract; ulcer, perf nasal septum; pneu; derm
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Calcium silicate

Formula: $CaSiO_3$ | **CAS#:** 1344-95-2 | **RTECS#:** VV9150000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: Calcium hydrosilicate, Calcium metasilicate, Calcium monosilicate, Calcium salt of silicic acid, Wollastonite (mineral)

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 7020
OSHA ID121

Physical Description: White or cream-colored, free-flowing powder.
[**Note:** The commercial product is prepared from diatomaceous earth & lime.]

Chemical & Physical Properties:
MW: 116.2
BP: ?
Sol: 0.01%
Fl.P: NA
IP: NA
Sp.Gr: 2.9
VP: 0 mmHg (approx)
MLT: 2804°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported
[**Note:** After prolonged contact with water, solution reverts to soluble calcium salts & amorphous silica.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, upper resp sys
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Fresh air

Calcium sulfate

Formula:	CAS#:	RTECS#:	IDLH:
$CaSO_4$	7778-18-9	WS6920000	N.D.

Conversion: **DOT:**

Synonyms/Trade Names: Anhydrous calcium sulfate, Anhydrous gypsum, Anhydrous sulfate of lime, Calcium salt of sulfuric acid [**Note:** Gypsum is the dihydrate form & Plaster of Paris is the hemihydrate form.]

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Odorless, white powder or colorless, crystalline solid. [**Note:** May have blue, gray, or reddish tinge.]

Chemical & Physical Properties:
MW: 136.1
BP: Decomposes
Sol: 0.3%
Fl.P: NA
IP: NA
Sp.Gr: 2.96
VP: 0 mmHg (approx)
MLT: 2840°F (Decomposes)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Diazomethane, aluminum, phosphorus, water [**Note:** Hygroscopic (i.e., absorbs moisture from the air). Reacts with water to form Gypsum & Plaster of Paris.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, upper resp sys; conj; rhinitis, epis
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Fresh air

Camphor (synthetic)

Formula:	CAS#:	RTECS#:	IDLH:
$C_{10}H_{16}O$	76-22-2	EX1225000	200 mg/m^3

Conversion: **DOT:** 2717 133

Synonyms/Trade Names: 2-Camphonone, Gum camphor, Laurel camphor, Synthetic camphor

Exposure Limits:
NIOSH REL: TWA 2 mg/m^3
OSHA PEL: TWA 2 mg/m^3

Measurement Methods (see Table 1):
NIOSH 1301, 2553
OSHA 7

Physical Description: Colorless or white crystals with a penetrating, aromatic odor.

Chemical & Physical Properties:
MW: 152.3
BP: 399°F
Sol: Insoluble
Fl.P: 150°F
IP: 8.76 eV
Sp.Gr: 0.99
VP: 0.2 mmHg
MLT: 345°F
UEL: 3.5%
LEL: 0.6%
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 mg/m^3: Sa:Cf£/PaprOvHie£
100 mg/m^3: CcrFOv100/GmFOv100/PaprTOvHie£/ScbaF/SaF
200 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers (especially chromic anhydride & potassium permanganate)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb; nau, vomit, diarr; head, dizz, excitement, epilep convuls
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

C

Caprolactam

Formula: $C_2H_{11}NO$ | **CAS#:** 105-60-2 | **RTECS#:** CM3675000 | **IDLH:** N.D.

Conversion: 1 ppm = 4.63 mg/m^3 | **DOT:**

Synonyms/Trade Names: Aminocaproic lactam, epsilon-Caprolactam, Hexahydro-2H-azepin-2-one, 2-Oxohexamethyleneimine

Exposure Limits:
NIOSH REL: Dust: TWA 1 mg/m^3
ST 3 mg/m^3
Vapor: TWA 0.22 ppm (1 mg/m^3)
ST 0.66 ppm (3 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2012

Physical Description: White, crystalline solid or flakes with an unpleasant odor.
[**Note:** Significant vapor concentrations would be expected only at elevated temperatures.]

Chemical & Physical Properties:
MW: 113.2
BP: 515°F
Sol: 53%
Fl.P: 282°F
IP: ?
Sp.Gr: 1.01
VP: 0.00000008 mmHg
MLT: 156°F
UEL: 8.0%
LEL: 1.4%
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers, (acetic acid + dinitrogen trioxide)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit skin, eyes, resp sys; epis; derm, skin sens; asthma; irrity, conf, dizz, head; abdom cramps, diarr, nau, vomit; liver, kidney inj
TO: Eyes, skin, resp sys, CNS, CVS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Captafol

Formula: $C_{10}H_9Cl_{14}NO_2S$ | **CAS#:** 2425-06-1 | **RTECS#:** GW4900000 | **IDLH:** Ca [N.D.]

Conversion: | **DOT:**

Synonyms/Trade Names: Captofol; Difolatan®; N-((1,1,2,2-Tetrachloroethyl)thio)-4-cyclohexene-1,2-dicarboximide

Exposure Limits:
NIOSH REL: Ca
TWA 0.1 mg/m^3 [skin]
See Appendix A
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 0500

Physical Description: White, crystalline solid with a slight, characteristic pungent odor. [fungicide]
[**Note:** Available commercially as a wettable powder or in liquid form.]

Chemical & Physical Properties:
MW: 349.1
BP: Decomposes
Sol: 0.0001%
Fl.P: NA
IP: NA
Sp.Gr: ?
VP: 0.000008 mmHg
MLT: 321°F (Decomposes)
UEL: NA
LEL: NA
Noncombustible Solid, but may be dissolved in flammable liquids.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Acids, acid vapors, strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; derm, skin sens; conj; bron, wheez; diarr, vomit; liver, kidney inj; high BP; in animals: terato effects; [carc]
TO: Eyes, skin, resp sys, CNS, liver, kidneys, CVS [in animals: tumors at many sites]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Captan

Formula:	CAS#:	RTECS#:	IDLH:
$C_9H_8Cl_3NO_2S$	133-06-2	GW5075000	Ca [N.D.]

Conversion: **DOT:**

Synonyms/Trade Names: Captane; N-Trichloromethylmercapto-4-cyclohexene-1,2-dicarboximide

Exposure Limits:
NIOSH REL: Ca
TWA 5 mg/m^3
See Appendix A
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5601, 9202, 9205

Physical Description: Odorless, white, crystalline powder. [fungicide]
[**Note:** Commercial product is a yellow powder with a pungent odor.]

Chemical & Physical Properties:
MW: 300.6
BP: Decomposes
Sol(77°F): 0.0003%
Fl.P: ?
IP: NA
Sp.Gr: 1.74
VP: 0 mmHg (approx)
MLT: 352°F (Decomposes)
UEL: ?
LEL: ?
Combustible Solid; may be dissolved in flammable liquids.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong alkaline materials (e.g., hydrated lime) [**Note:** Corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, upper resp sys; blurred vision; derm, skin sens; dysp; diarr, vomit; [carc]
TO: Eyes, skin, resp sys, GI tract, liver, kidneys [in animals: duodenal tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Carbaryl

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3NHCOOC_{10}H_7$	63-25-2	EC5950000	100 mg/m^3

Conversion: **DOT:** 2757 151

Synonyms/Trade Names: α-Naphthyl N-methyl-carbamate, 1-Naphthyl N-Methyl-carbamate, Sevin®

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL: TWA 5 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5006, 5601
OSHA 63

Physical Description: White or gray, odorless solid. [pesticide]

Chemical & Physical Properties:
MW: 201.2
BP: Decomposes
Sol: 0.01%
Fl.P: NA
IP: ?
Sp.Gr: 1.23
VP(77°F): <0.00004 mmHg
MLT: 293°F
UEL: NA
LEL: NA
Noncombustible Solid, but may be dissolved in flammable liquids.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 mg/m^3: Sa*
100 mg/m^3: Sa:Cf*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strongly alkaline pesticides

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Miosis, blurred vision, tear; rhin, salv; sweat; abdom cramps, nau, vomit, diarr; tremor; cyan; convuls; irrit skin; possible repro effects
TO: Resp sys, CNS, CVS, skin, blood chol, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

C

Carbofuran

Formula:	CAS#:	RTECS#:	IDLH:
$C_{12}H_{15}NO_3$	1563-66-2	FB9450000	N.D.

Conversion: **DOT:** 2757 151

Synonyms/Trade Names: 2,3-Dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate; Furacarb®; Furadan®

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5601

Physical Description: Odorless, white or grayish, crystalline solid. [insecticide]
[**Note:** May be dissolved in a liquid carrier.]

Chemical & Physical Properties:
MW: 221.3
BP: ?
Sol(77°F): 0.07%
Fl.P: NA
IP: NA
Sp.Gr: 1.18
VP(77°F): 0.000003 mmHg
MLT: 304°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Alkaline substances, acid, strong oxidizers (e.g., perchlorates, peroxides, chlorates, nitrates, permanganates)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Miosis, blurred vision; sweat, salv, abdom cramps, diarr, head, nau, vomit; lass, musc twitch, inco, convuls
TO: CNS, PNS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Fresh air
Swallow: Medical attention immed

Carbon black

Formula:	CAS#:	RTECS#:	IDLH:
C	1333-86-4	FF5800000	1750 mg/m^3

Conversion: **DOT:**

Synonyms/Trade Names: Acetylene black, Channel black, Furnace black, Lamp black, Thermal black

Exposure Limits:
NIOSH REL: TWA 3.5 mg/m^3
Carbon black in presence of polycyclic aromatic hydrocarbons (PAHs):
Ca
TWA 0.1 mg PAHs/m^3
See Appendix A
See Appendix C
OSHA PEL: TWA 3.5 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5000
OSHA ID196

Physical Description: Black, odorless solid.

Chemical & Physical Properties:
MW: 12.0
BP: Sublimes
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 1.8-2.1
VP: 0 mmHg (approx)
MLT: Sublimes
UEL: NA
LEL: NA
Combustible Solid that may contain flammable hydrocarbons.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: Daily
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
17.5 mg/m^3: Qm
35 mg/m^3: 95XQ/Sa
87.5 mg/m^3: Sa:Cf/PaprHie
175 mg/m^3: 100F/PaprTHie/ScbaF/SaF
1750 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

In presence of polycyclic aromatic hydrocarbons:
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers such as chlorates, bromates & nitrates

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Cough; irrit eyes; in presence of polycyclic aromatic hydrocarbons: [carc]
TO: Resp sys, eyes [lymphatic cancer (in presence of PAHs)]

First Aid (see Table 6):
Eye: Irr prompt
Breath: Fresh air

Carbon dioxide

Formula:	CAS#:	RTECS#:	IDLH:
CO_2	124-38-9	FF6400000	40,000 ppm

Conversion: 1 ppm = 1.80 mg/m^3

DOT: 1013 120; 1845 120 (dry ice); 2187 120 (liquid)

Synonyms/Trade Names: Carbonic acid gas, Dry ice [**Note:** Normal constituent of air (about 300 ppm)].

Exposure Limits:
NIOSH REL: TWA 5000 ppm (9000 mg/m^3)
ST 30,000 ppm (54,000 mg/m^3)
OSHA PEL†: TWA 5000 ppm (9000 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 6603
OSHA ID172

Physical Description: Colorless, odorless gas.
[**Note:** Shipped as a liquefied compressed gas. Solid form is utilized as dry ice.]

Chemical & Physical Properties:
MW: 44.0
BP: Sublimes
Sol(77°F): 0.2%
FI.P: NA
IP: 13.77 eV
RGasD: 1.53
VP: 56.5 atm
MLT: -109°F (Sublimes)
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
40,000 ppm: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: ScbaE

Incompatibilities and Reactivities: Dusts of various metals, such as magnesium, zirconium, titanium, aluminum, chromium & manganese are ignitable and explosive when suspended in carbon dioxide. Forms carbonic acid in water.

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid/solid)
SY: Head, dizz, restless, pares; dysp; sweat, mal; incr heart rate, card output, BP; coma; asphy; convuls; frostbite (liq, dry ice)
TO: Resp sys, CVS

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Carbon disulfide

Formula:	CAS#:	RTECS#:	IDLH:
CS_2	75-15-0	FF6650000	500 ppm

Conversion: 1 ppm = 3.11 mg/m^3

DOT: 1131 131

Synonyms/Trade Names: Carbon bisulfide

Exposure Limits:
NIOSH REL: TWA 1 ppm (3 mg/m^3)
ST 10 ppm (30 mg/m^3) [skin]
OSHA PEL†: TWA 20 ppm
C 30 ppm
100 ppm (30-minute maximum peak)

Measurement Methods (see Table 1):
NIOSH 1600, 3800

Physical Description: Colorless to faint-yellow liquid with a sweet ether-like odor.
[**Note:** Reagent grades are foul smelling.]

Chemical & Physical Properties:
MW: 76.1
BP: 116°F
Sol: 0.3%
FI.P: -22°F
IP: 10.08 eV
Sp.Gr: 1.26
VP: 297 mmHg
FRZ: -169°F
UEL: 50.0%
LEL: 1.3%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
10 ppm: CcrOv/Sa
25 ppm: Sa:Cf/PaprOv
50 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
500 ppm: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers; chemically-active metals such as sodium, potassium & zinc; azides; rust; halogens; amines
[**Note:** Vapors may be ignited by contact with an ordinary light bulb.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Dizz, head, poor sleep, lass, anxi, anor, low-wgt; psychosis; polyneur; Parkinson-like syndrome; ocular changes; coronary heart disease; gastritis; kidney, liver inj; eye, skin burns; derm; repro effects
TO: CNS, PNS, CVS, eyes, kidneys, liver, skin, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

C

Carbon monoxide

Formula:	CAS#:	RTECS#:	IDLH:
CO	630-08-0	FG3500000	1200 ppm

Conversion: 1 ppm = 1.15 mg/m^3

DOT: 1016 119; 9202 168 (cryogenic liquid)

Synonyms/Trade Names: Carbon oxide, Flue gas, Monoxide

Exposure Limits:
NIOSH REL: TWA 35 ppm (40 mg/m^3)
C 200 ppm (229 mg/m^3)
OSHA PEL†: TWA 50 ppm (55 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 6604
OSHA ID209, ID210

Physical Description: Colorless, odorless gas.
[**Note:** Shipped as a nonliquefied or liquefied compressed gas.]

Chemical & Physical Properties:
MW: 28.0
BP: -313°F
Sol: 2%
Fl.P: NA (Gas)
IP: 14.01 eV
RGasD: 0.97
VP: >35 atm
MLT: -337°F
UEL: 74%
LEL: 12.5%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
350 ppm: Sa
875 ppm: Sa:Cf
1200 ppm: GmFS†/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS†/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, bromine trifluoride, chlorine trifluoride, lithium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Head, tachypnea, nau, lass, dizz, conf, halu; cyan; depres S-T segment of electrocardiogram, angina, syncope
TO: CVS, lungs, blood, CNS

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Carbon tetrabromide

Formula:	CAS#:	RTECS#:	IDLH:
CBr_4	558-13-4	FG4725000	N.D.

Conversion: 1 ppm = 13.57 mg/m^3

DOT: 2516 151

Synonyms/Trade Names: Carbon bromide, Methane tetrabromide, Tetrabromomethane

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (1.4 mg/m^3)
ST 0.3 ppm (4 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless to yellow-brown crystals with a slight odor.

Chemical & Physical Properties:
MW: 331.7
BP: 374°F
Sol: 0.02%
Fl.P: NA
IP: 10.31 eV
Sp.Gr: 3.42
VP(205°F): 40 mmHg
MLT: 194°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: Daily
Remove: N.R.
Change: Daily
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers, hexacyclohexyldilead, lithium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; lac; lung, liver, kidney inj; in animals: corn damage
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Carbon tetrachloride

Formula:	CAS#:	RTECS#:	IDLH:
CCl_4	56-23-5	FG4900000	Ca [200 ppm]

Conversion: 1 ppm = 6.29 mg/m^3 **DOT:** 1846 151

Synonyms/Trade Names: Carbon chloride, Carbon tet, Freon® 10, Halon® 104, Tetrachloromethane

Exposure Limits:
NIOSH REL: Ca
ST 2 ppm (12.6 mg/m^3) [60-minute]
See Appendix A
OSHA PEL†: TWA 10 ppm
C 25 ppm
200 ppm (5-minute maximum peak in any 4 hours)

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 7

Physical Description: Colorless liquid with a characteristic ether-like odor.

Chemical & Physical Properties:
MW: 153.8
BP: 170°F
Sol: 0.05%
Fl.P: NA
IP: 11.47 eV
Sp.Gr: 1.59
VP: 91 mmHg
FRZ: -9°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as sodium, potassium & magnesium; fluorine; aluminum [**Note:** Forms highly toxic phosgene gas when exposed to flames or welding arcs.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; CNS depres; nau, vomit; liver, kidney inj; drow, dizz, inco; [carc]
TO: CNS, eyes, lungs, liver, kidneys, skin [in animals: liver cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Carbonyl fluoride

Formula:	CAS#:	RTECS#:	IDLH:
COF_2	353-50-4	FG6125000	N.D.

Conversion: 1 ppm = 2.70 mg/m^3 **DOT:** 2417 125

Synonyms/Trade Names: Carbon difluoride oxide, Carbon fluoride oxide, Carbon oxyfluoride, Carbonyl difluoride, Fluoroformyl fluoride, Fluorophosgene

Exposure Limits:
NIOSH REL: TWA 2 ppm (5 mg/m^3)
ST 5 ppm (15 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless gas with a pungent and very irritating odor. [**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 66.0
BP: -118°F
Sol: Reacts
Fl.P: NA
IP: 13.02 eV
RGasD: 2.29
VP: 55.4 atm
FRZ: -173°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Heat, moisture, hexafluoroisopropylideneamino-lithium
[**Note:** Reacts with water to form hydrogen fluoride & carbon dioxide.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, muc memb, resp sys; eye, skin burns; lac; cough, pulm edema, dysp; chronic exposure: GI pain, musc fib, skeletal fluorosis; liquid: frostbite
TO: Eyes, skin, resp sys, bone

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

C

Catechol

Formula:	CAS#:	RTECS#:	IDLH:
$C_6H_4(OH)_2$	120-80-9	UX1050000	N.D.

Conversion: 1 ppm = 4.50 mg/m^3 **DOT:**

Synonyms/Trade Names: 1,2-Benzenediol; o-Benzenediol; 1,2-Dihydroxybenzene; o-Dihydroxybenzene; 2-Hydroxyphenol; Pyrocatechol

Exposure Limits:
NIOSH REL: TWA 5 ppm (20 mg/m^3) [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2014

Physical Description: Colorless, crystalline solid with a faint odor.
[**Note:** Discolors to brown in air & light.]

Chemical & Physical Properties:
MW: 110.1
BP: 474°F
Sol: 44%
Fl.P: 261°F
IP: ?
Sp.Gr: 1.34
VP(244°F): 10 mmHg
MLT: 221°F
UEL: ?
LEL: 1.4%
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers, nitric acid

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; skin sens, derm; lac, burns eyes; convuls, incr BP, kidney inj
TO: Eyes, skin, resp sys, CNS, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Cellulose

Formula:	CAS#:	RTECS#:	IDLH:
$(C_6H_{10}O_5)_n$	9004-34-6	FJ5691460	N.D.

Conversion: **DOT:**

Synonyms/Trade Names: Hydroxycellulose, Pyrocellulose

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600, 7404

Physical Description: Odorless, white substance.
[**Note:** The principal fiber cell wall material of vegetable tissues (wood, cotton, flax, grass, etc.).]

Chemical & Physical Properties:
MW: 160,000-560,000
BP: Decomposes
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 1.27-1.61
VP: 0 mmHg (approx)
MLT: 500-518°F (Decomposes)
UEL: NA
LEL: NA
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Water, bromine pentafluoride, sodium nitrate, fluorine, strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, muc memb
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Fresh air

Cesium hydroxide

Formula: CsOH | **CAS#:** 21351-79-1 | **RTECS#:** FK9800000 | **IDLH:** N.D.

Conversion: **DOT:** 2682 157; 2681 154 (solution)

Synonyms/Trade Names: Cesium hydrate, Cesium hydroxide dimer

Exposure Limits:
NIOSH REL: TWA 2 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless or yellowish, crystalline solid.
[**Note:** Hygroscopic (i.e., absorbs moisture from the air).]

Chemical & Physical Properties:
MW: 149.9
BP: ?
Sol(59°F): 395%
Fl.P: NA
IP: NA
Sp.Gr: 3.68
VP: 0 mmHg (approx)
MLT: 522°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Water, acids, CO_2, metals (e.g., Al, Pb, Sn, Zn), oxygen
[**Note:** CsOH is a strong base, causing the generation of considerable heat in contact with water or moisture.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; eye, skin burns
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Chlordane

Formula: $C_{10}H_6Cl_8$ | **CAS#:** 57-74-9 | **RTECS#:** PB9800000 | **IDLH:** Ca [100 mg/m^3]

Conversion: **DOT:** 2996 151

Synonyms/Trade Names: Chlordan; Chlordano;
1,2,4,5,6,7,8,8-Octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindane

Exposure Limits:
NIOSH REL: Ca
TWA 0.5 mg/m^3 [skin]
See Appendix A
OSHA PEL: TWA 0.5 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 5510
OSHA 67

Physical Description: Amber-colored, viscous liquid with a pungent, chlorine-like odor. [insecticide]

Chemical & Physical Properties:
MW: 409.8
BP: Decomposes
Sol: 0.0001%
Fl.P: NA
IP: ?
Sp.Gr(77°F): 1.6
VP: 0.00001 mmHg
FRZ: 217-228°F
UEL: NA
LEL: NA
Noncombustible Liquid, but may be utilized in flammable solutions.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, alkaline reagents

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Blurred vision; conf; ataxia, delirium; cough; abdom pain, nau, vomit, diarr; irrity, tremor, convuls; anuria; in animals: lung, liver, kidney damage; [carc]
TO: CNS, eyes, lungs, liver, kidneys [in animals: liver cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

C

Chlorinated camphene	Formula: $C_{10}H_{10}Cl_8$	CAS#: 8001-35-2	RTECS#: XW5250000	IDLH: Ca [200 mg/m^3]
Conversion:	**DOT:** 2761 151			

Synonyms/Trade Names: Chlorocamphene, Octachlorocamphene, Polychlorocamphene, Toxaphene

Exposure Limits:
NIOSH REL: Ca [skin]
See Appendix A
OSHA PEL†: TWA 0.5 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 5039

Physical Description: Amber, waxy solid with a mild, piney, chlorine- and camphor-like odor. [insecticide]

Chemical & Physical Properties:
MW: 413.8
BP: Decomposes
Sol: 0.0003%
Fl.P: NA
IP: ?
Sp.Gr: 1.65
VP(77°F): 0.4 mmHg
MLT: 149-194°F
UEL: NA
LEL: NA
Noncombustible Solid, but may be dissolved in flammable liquids.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers [**Note:** Slightly corrosive to metals under moist conditions.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Nau, conf, agitation, tremor, convuls, uncon; dry, red skin; [carc]
TO: CNS, skin [in animals: liver cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Chlorinated diphenyl oxide	Formula: $C_{12}H_{10-n}Cl_nO$	CAS#:	RTECS#:	IDLH: 5 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names: Synonyms depend on the degree of chlorination of diphenyl oxide [$(C_6H_5)_2O$], ranging from monochlorodiphenyl oxide [$(C_6H_4Cl)O(C_6H_5)$] to decachlorodiphenyl oxide [$(C_6Cl_5)O(C_6Cl_5)$].

Exposure Limits:
NIOSH REL: TWA 0.5 mg/m^3
OSHA PEL: TWA 0.5 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5025

Physical Description: Appearance and odor vary depending upon the specific compound.

Chemical & Physical Properties:
Properties vary depending upon the specific compound.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOvAg100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Acne-form derm, liver damage
TO: Skin, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Chlorine

Formula:	CAS#:	RTECS#:	IDLH:
Cl_2	7782-50-5	FO2100000	10 ppm

Conversion: 1 ppm = 2.90 mg/m^3 **DOT:** 1017 124

Synonyms/Trade Names: Molecular chlorine

Exposure Limits:
NIOSH REL: C 0.5 ppm (1.45 mg/m^3) [15-minute]
OSHA PEL†: C 1 ppm (3 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 6011
OSHA ID101, ID126SGX

Physical Description: Greenish-yellow gas with a pungent, irritating odor. [**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 70.9
BP: -29°F
Sol: 0.7%
Fl.P: NA
IP: 11.48 eV
RGasD: 2.47
VP: 6.8 atm
FRZ: -150°F
UEL: NA
LEL: NA
Nonflammable Gas, but a strong oxidizer.

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: CcrS*/Sa*
10 ppm: Sa:Cf*/PaprS*/CcrFS/GmFS/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Reacts explosively or forms explosive compounds with many common substances such as acetylene, ether, turpentine, ammonia, fuel gas, hydrogen & finely divided metals.

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Burning of eyes, nose, mouth; lac, rhin; cough, choking, subs pain; nau, vomit; head, dizz; syncope; pulm edema; pneu; hypox; derm; liquid: frostbite
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Chlorine dioxide

Formula:	CAS#:	RTECS#:	IDLH:
ClO_2	10049-04-4	FO3000000	5 ppm

Conversion: 1 ppm = 2.76 mg/m^3 **DOT:** 9191 143 (hydrate, frozen)

Synonyms/Trade Names: Chlorine oxide, Chlorine peroxide

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.3 mg/m^3)
ST 0.3 ppm (0.9 mg/m^3)
OSHA PEL†: TWA 0.1 ppm (0.3 mg/m^3)

Measurement Methods (see Table 1):
OSHA ID126SGX, ID202

Physical Description: Yellow to red gas or a red-brown liquid (below 52°F) with an unpleasant odor similar to chlorine and nitric acid.

Chemical & Physical Properties:
MW: 67.5
BP: 52°F
Sol(77°F): 0.3%
Fl.P: NA (Gas) ? (Liquid)
IP: 10.36 eV
RGasD: 2.33
Sp.Gr: 1.6 (Liquid at 32°F)
VP: >1 atm
FRZ: -74°F
UEL: ?
LEL: ?
Flammable Gas, Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (liquid)
Eyes: Prevent eye contact (liquid)
Wash skin: When contam (liquid)
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash (liquid)
Quick drench (liquid)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1 ppm: CcrS/Sa
2.5 ppm: Sa:Cf£/PaprS£
5 ppm: CcrFS/GmFS/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS¿/ScbaE

Incompatibilities and Reactivities: Organic materials, heat, phosphorus, potassium hydroxide, sulfur, mercury, carbon monoxide [**Note:** Unstable in light. A powerful oxidizer.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing (liquid), Con
SY: Irrit eyes, nose, throat; cough, wheez, bron, pulm edema; chronic bron
TO: Eyes, resp sys

First Aid (see Table 6):
Eye: Irr immed (liquid)
Skin: Soap wash immed (liquid)
Breath: Resp support
Swallow: Medical attention immed (liquid)

C

Chlorine trifluoride

Formula: ClF_3 | **CAS#:** 7790-91-2 | **RTECS#:** FO2800000 | **IDLH:** 20 ppm

Conversion: 1 ppm = 3.78 mg/m^3 | **DOT:** 1749 124

Synonyms/Trade Names: Chlorine fluoride, Chlorotrifluoride

Exposure Limits:
NIOSH REL: C 0.1 ppm (0.4 mg/m^3)
OSHA PEL: C 0.1 ppm (0.4 mg/m^3)

Measurement Methods (see Table 1):
None available

Physical Description: Colorless gas or a greenish-yellow liquid (below 53°F) with a somewhat sweet, suffocating odor. [**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 92.5
BP: 53°F
Sol: Reacts
Fl.P: NA
IP: 13.00 eV
RGasD: 3.21
Sp.Gr: 1.77 (Liquid at 53°F)
VP: 1.4 atm
FRZ: -105°F
UEL: NA
LEL: NA
Nonflammable Gas
Noncombustible Liquid, but contact with organic materials may result in SPONTANEOUS ignition.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam (liquid)
Remove: When wet or contam (liquid)
Change: N.R.
Provide: Eyewash (liquid)
Quick drench (liquid)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2.5 ppm: Sa:Cf£
5 ppm: ScbaF/SaF
20 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Oxidizers, water, acids, combustible materials, sand, glass, metals (corrosive)
[**Note:** Reacts with water to form chlorine & hydrofluoric acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing (liquid), Con
SY: Eye, skin burns (liq or high vap conc); resp irrit; in animals: lac, corn ulcer; pulm edema
TO: Skin, eyes, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed (liquid)

Chloroacetaldehyde

Formula: $ClCH_2CHO$ | **CAS#:** 107-20-0 | **RTECS#:** AB2450000 | **IDLH:** 45 ppm

Conversion: 1 ppm = 3.21 mg/m^3 | **DOT:** 2232 153

Synonyms/Trade Names: Chloroacetaldehyde (40% aqueous solution), 2-Chloroacetaldehyde, 2-Chloroethanal

Exposure Limits:
NIOSH REL: C 1 ppm (3 mg/m^3)
OSHA PEL: C 1 ppm (3 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2015
OSHA 76

Physical Description: Colorless liquid with an acrid, penetrating odor.
[**Note:** Typically found as a 40% aqueous solution.]

Chemical & Physical Properties:
MW: 78.5
BP: 186°F
Sol: Miscible
Fl.P: 190°F (40% solution)
IP: 10.61 eV
Sp.Gr: 1.19 (40% solution)
VP: 100 mmHg
FRZ: -3°F (40% solution)
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 ppm: CcrOv*/Sa*
25 ppm: Sa:Cf*/PaprOv*
45 ppm: CcrFOv/GmFOv/PaprTOv*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit skin, eyes, muc memb; skin burns; eye damage; pulm edema; skin, resp sys sens
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

α-Chloroacetophenone

Formula:	CAS#:	RTECS#:	IDLH:
$C_6H_5COCH_2Cl$	532-27-4	AM6300000	15 mg/m^3

Conversion: 1 ppm = 6.32 mg/m^3 **DOT:** 1697 153

Synonyms/Trade Names: 2-Chloroacetophenone, Chloromethyl phenyl ketone, Mace®, Phenacyl chloride, Phenyl chloromethyl ketone, Tear gas

Exposure Limits:
NIOSH REL: TWA 0.3 mg/m^3 (0.05 ppm)
OSHA PEL: TWA 0.3 mg/m^3 (0.05 ppm)

Measurement Methods (see Table 1):
NIOSH P&CAM291 (II-5)

Physical Description: Colorless to gray crystalline solid with a sharp, irritating odor.

Chemical & Physical Properties:
MW: 154.6
BP: 472°F
Sol: Insoluble
Fl.P: 244°F
IP: 9.44 eV
Sp.Gr: 1.32
VP: 0.005 mmHg
MLT: 134°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
3 mg/m^3: CcrOv95/Sa
7.5 mg/m^3: Sa:Cf£/PaprOvHie£
15 mg/m^3: CcrFOv100/GmFS100/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS100/ScbaE

Incompatibilities and Reactivities: Water, steam, strong oxidizers [**Note:** Slowly corrodes metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; pulm edema
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Chloroacetyl chloride

Formula:	CAS#:	RTECS#:	IDLH:
$ClCH_2COCl$	79-04-9	AO6475000	N.D.

Conversion: 1 ppm = 4.62 mg/m^3 **DOT:** 1752 156

Synonyms/Trade Names: Chloroacetic acid chloride, Chloroacetic chloride, Monochloroacetyl chloride

Exposure Limits:
NIOSH REL: TWA 0.05 ppm (0.2 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless to yellowish liquid with a strong, pungent odor.

Chemical & Physical Properties:
MW: 112.9
BP: 223°F
Sol: Decomposes
Fl.P: NA
IP: 10.30 eV
Sp.Gr: 1.42
VP: 19 mmHg
FRZ: -7°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Water, alcohols, bases, metals (corrosive), amines
[**Note:** Decomposes in water to form chloroacetic acid & hydrogen chloride gas.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; eye, skin burns; cough, wheez, dysp; lac
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

C

Chlorobenzene	Formula: C_6H_5Cl	CAS#: 108-90-7	RTECS#: CZ0175000	IDLH: 1000 ppm
Conversion: 1 ppm = 4.61 mg/m^3	DOT: 1134 130			
Synonyms/Trade Names: Benzene chloride, Chlorobenzol, MCB, Monochlorobenzene, Phenyl chloride				
Exposure Limits: NIOSH REL: See Appendix D OSHA PEL: TWA 75 ppm (350 mg/m^3)				Measurement Methods (see Table 1): NIOSH 1003 OSHA 7
Physical Description: Colorless liquid with an almond-like odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 112.6 BP: 270°F Sol: 0.05% Fl.P: 82°F IP: 9.07 eV Sp.Gr: 1.11 VP: 9 mmHg FRZ: -50°F UEL: 9.6% LEL: 1.3% Class IC Flammable Liquid	Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contam Remove: When wet (flamm) Change: N.R.	OSHA 1000 ppm: Sa:Cf£/PaprOv£/CcrFOv/ GmFOv/ScbaF/SaF §: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers	
Exposure Routes, Symptoms, Target Organs (see Table 5): ER: Inh, Ing, Con SY: Irrit eyes, skin, nose; drow, inco; CNS depres; in animals: liver, lung, kidney inj TO: Eyes, skin, resp sys, CNS, liver	First Aid (see Table 6): Eye: Irr immed Skin: Soap wash prompt Breath: Resp support Swallow: Medical attention immed

o-Chlorobenzylidene malononitrile	Formula: $ClC_6H_4CH=C(CN)_2$	CAS#: 2698-41-1	RTECS#: OO3675000	IDLH: 2 mg/m^3
Conversion: 1 ppm = 7.71 mg/m^3	DOT: 2810 153			
Synonyms/Trade Names: 2-Chlorobenzalmalonitrile, CS, OCBM				
Exposure Limits: NIOSH REL: C 0.05 ppm (0.4 mg/m^3) [skin] OSHA PEL†: TWA 0.05 ppm (0.4 mg/m^3)				Measurement Methods (see Table 1): NIOSH P&CAM304 (II-5)
Physical Description: White crystalline solid with a pepper-like odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 188.6 BP: 590-599°F Sol: Insoluble Fl.P: ? IP: ? Sp.Gr: ? VP: 0.00003 mmHg MLT: 203-205°F UEL: ? LEL: ? MEC: 25 g/m^3 Combustible Solid	Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contam/Daily Remove: When wet or contam Change: Daily	NIOSH/OSHA 2 mg/m^3: Sa:Cf£/GmFS100/ScbaF/SaF §: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba Escape: GmFS100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers	
Exposure Routes, Symptoms, Target Organs (see Table 5): ER: Inh, Abs, Ing, Con SY: Pain, burn eyes, lac, conj; eryt eyelids, blepharospasm; irrit throat, cough, chest tight; head; eryt, vesic skin TO: Eyes, skin, resp sys	First Aid (see Table 6): Eye: Irr immed Skin: Soap wash immed Breath: Resp support Swallow: Medical attention immed

Chlorobromomethane

Formula:	CAS#:	RTECS#:	IDLH:
CH_2BrCl	74-97-5	PA5250000	2000 ppm

Conversion: 1 ppm = 5.29 mg/m^3 **DOT:** 1887 160

Synonyms/Trade Names: Bromochloromethane, CB, CBM, Fluorocarbon 1011, Halon® 1011, Methyl chlorobromide

Exposure Limits:
NIOSH REL: TWA 200 ppm (1050 mg/m^3)
OSHA PEL: TWA 200 ppm (1050 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1003

Physical Description: Colorless to pale-yellow liquid with a chloroform-like odor. [**Note:** May be used as a fire extinguishing agent.]

Chemical & Physical Properties:
MW: 129.4
BP: 155°F
Sol: Insoluble
Fl.P: NA
IP: 10.77 eV
Sp.Gr: 1.93
VP: 115 mmHg
FRZ: -124°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2000 ppm: Sa:Cf£/PaprOv£/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as calcium, powdered aluminum, zinc, and magnesium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, throat; conf, dizz, CNS depres; pulm edema
TO: Eyes, skin, resp sys, liver, kidneys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Chlorodifluoromethane

Formula:	CAS#:	RTECS#:	IDLH:
$CHClF_2$	75-45-6	PA6390000	N.D.

Conversion: 1 ppm = 3.54 mg/m^3 **DOT:** 1018 126

Synonyms/Trade Names: Difluorochloromethane, Fluorocarbon-22, Freon® 22, Genetron® 22, Monochlorodifluoromethane, Refrigerant 22

Exposure Limits:
NIOSH REL: TWA 1000 ppm (3500 mg/m^3)
ST 1250 ppm (4375 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 1018

Physical Description: Colorless gas with a faint, sweetish odor. [**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 86.5
BP: -41°F
Sol(77°F): 0.3%
Fl.P: NA
IP: 12.45 eV
RGasD: 3.11
VP: 9.4 atm
FRZ: -231°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Alkalis, alkaline earth metals (e.g., powdered aluminum, sodium, potassium, zinc)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Irrit resp sys; conf, drow, ringing in ears; heart palp, card arrhy; asphy; liver, kidney, spleen inj; liquid: frostbite
TO: Resp sys, CVS, CNS, liver, kidneys, spleen

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

C

Chlorodiphenyl (42% chlorine)	Formula: $C_6H_4ClC_6H_3Cl_2$ (approx)	CAS#: 53469-21-9	RTECS#: TQ1356000	IDLH: Ca [5 mg/m^3]
Conversion:	**DOT:** 2315 171			

Synonyms/Trade Names: Aroclor® 1242, PCB, Polychlorinated biphenyl

Exposure Limits:
NIOSH REL*: Ca
TWA 0.001 mg/m^3
See Appendix A
[***Note:** The REL also applies to other PCBs.]
OSHA PEL: TWA 1 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 5503
OSHA PV2089

Physical Description: Colorless to light-colored, viscous liquid with a mild, hydrocarbon odor.

Chemical & Physical Properties:
MW: 258 (approx)
BP: 617-691°F
Sol: Insoluble
Fl.P: NA
IP: ?
Sp.Gr(77°F): 1.39
VP: 0.001 mmHg
FRZ: -2°F
UEL: NA
LEL: NA

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Nonflammable Liquid, but exposure in a fire results in the formation of a black soot containing PCBs, polychlorinated dibenzofurans & chlorinated dibenzo-p-dioxins.

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes; chloracne; liver damage; repro effects; [carc]
TO: Skin, eyes, liver, repro sys [in animals: tumors of the pituitary gland & liver, leukemia]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Chlorodiphenyl (54% chlorine)	Formula: $C_6H_3Cl_2C_6H_2Cl_3$ (approx)	CAS#: 11097-69-1	RTECS#: TQ1360000	IDLH: Ca [5 mg/m^3]
Conversion:	**DOT:** 2315 171			

Synonyms/Trade Names: Aroclor® 1254, PCB, Polychlorinated biphenyl

Exposure Limits:
NIOSH REL*: Ca
TWA 0.001 mg/m^3
See Appendix A
[***Note:** The REL also applies to other PCBs.]
OSHA PEL: TWA 0.5 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 5503
OSHA PV2088

Physical Description: Colorless to pale-yellow, viscous liquid or solid (below 50°F) with a mild, hydrocarbon odor.

Chemical & Physical Properties:
MW: 326 (approx)
BP: 689-734°F
Sol: Insoluble
Fl.P: NA
IP: ?
Sp.Gr(77°F): 1.38
VP: 0.00006 mmHg
FRZ: 50°F
UEL: NA
LEL: NA

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Nonflammable Liquid, but exposure in a fire results in the formation of a black soot containing PCBs, polychlorinated dibenzofurans, and chlorinated dibenzo-p-dioxins.

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, chloracne; liver damage; repro effects; [carc]
TO: Skin, eyes, liver, repro sys [in animals: tumors of the pituitary gland & liver, leukemia]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Chloroform

Formula:	CAS#:	RTECS#:	IDLH:
$CHCl_3$	67-66-3	FS9100000	Ca [500 ppm]

Conversion: 1 ppm = 4.88 mg/m^3 **DOT:** 1888 151

Synonyms/Trade Names: Methane trichloride, Trichloromethane

Exposure Limits:
NIOSH REL: Ca
ST 2 ppm (9.78 mg/m^3) [60-minute]
See Appendix A
OSHA PEL†: C 50 ppm (240 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1003

Physical Description: Colorless liquid with a pleasant odor.

Chemical & Physical Properties:
MW: 119.4
BP: 143°F
Sol(77°F): 0.5%
Fl.P: NA
IP: 11.42 eV
Sp.Gr: 1.48
VP: 160 mmHg
FRZ: -82°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong caustics; chemically-active metals such as aluminum or magnesium powder, sodium & potassium; strong oxidizers [**Note:** When heated to decomposition, forms phosgene gas.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; dizz, mental dullness, nau, conf; head, lass; anes; enlarged liver; [carc]
TO: Liver, kidneys, heart, eyes, skin, CNS [in animals: liver & kidney cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

bis-Chloromethyl ether

Formula:	CAS#:	RTECS#:	IDLH:
$(CH_2Cl)_2O$	542-88-1	KN1575000	Ca [N.D.]

Conversion: **DOT:** 2249 131

Synonyms/Trade Names: BCME, bis-CME, Chloromethyl ether, Dichlorodimethyl ether, Dichloromethyl ether, Oxybis(chloromethane)

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1008]
See Appendix B

Measurement Methods (see Table 1):
OSHA 10

Physical Description: Colorless liquid with a suffocating odor.

Chemical & Physical Properties:
MW: 115.0
BP: 223°F
Sol: Reacts
Fl.P: <66°F
IP: ?
Sp.Gr: 1.32
VP(72°F): 30 mmHg
FRZ: -43°F
UEL: ?
LEL: ?
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet (flamm)
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Acids, water
[**Note:** Reacts with water to form hydrochloric acid & formaldehyde.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb, resp sys; pulm congestion, edema; corn damage, nec; decr pulm function, cough, dysp, wheez; blood-stained sputum, bronchial secretions; [carc]
TO: Eyes, skin, resp sys [lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

C

Chloromethyl methyl ether	Formula: CH_3OCH_2Cl	CAS#: 107-30-2	RTECS#: KN6650000	IDLH: Ca [N.D.]
Conversion:	**DOT:** 1239 131			

Synonyms/Trade Names: Chlorodimethyl ether, Chloromethoxymethane, CMME, Dimethylchloroether, Methylchloromethyl ether

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1006]
See Appendix B

Measurement Methods (see Table 1):
NIOSH P&CAM220 (II-1)
OSHA 10

Physical Description: Colorless liquid with an irritating odor.

Chemical & Physical Properties:
MW: 80.5
BP: 138°F
Sol: Reacts
Fl.P(oc): 32°F
IP: 10.25 eV
Sp.Gr: 1.06
VP(70°F): 192 mmHg
FRZ: -154°F
UEL: ?
LEL: ?
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet (flamm)
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Water [**Note:** Reacts with water to form hydrochloric acid & formaldehyde.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb; pulm edema, pulm congestion, pneu; skin burns, nec; cough, wheez, pulm congestion; blood stained-sputum; low-wgt; bronchial secretions; [carc]
TO: Eyes, skin, resp sys [in animals: skin & lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

1-Chloro-1-nitropropane	Formula: $CH_3CH_2CHClNO_2$	CAS#: 600-25-9	RTECS#: TX5075000	IDLH: 100 ppm
Conversion: 1 ppm = 5.06 mg/m^3	**DOT:**			

Synonyms/Trade Names: Korax®, Lanstan®

Exposure Limits:
NIOSH REL: TWA 2 ppm (10 mg/m^3)
OSHA PEL†: TWA 20 ppm (100 mg/m^3)

Measurement Methods (see Table 1):
NIOSH S211 (II-5)

Physical Description: Colorless liquid with an unpleasant odor. [fungicide]

Chemical & Physical Properties:
MW: 123.6
BP: 289°F
Sol: 0.5%
Fl.P(oc): 144°F
IP: 9.90 eV
Sp.Gr: 1.21
VP(77°F): 6 mmHg
FRZ: ?
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
20 ppm: Sa*
50 ppm: Sa:Cf*/PaprOv*
100 ppm: CcrFOv/GmFOv/PaprTOv*/ ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: irrit eyes; pulm edema; liver, kidney, heart damage
TO: Resp sys, liver, kidneys, CVS, eyes

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Chloropentafluoroethane	**Formula:** $CClF_2CF_3$	**CAS#:** 76-15-3	**RTECS#:** KH7877500	**IDLH:** N.D.

Conversion: 1 ppm = 6.32 mg/m^3 **DOT:** 1020 126

Synonyms/Trade Names: Fluorocarbon-115, Freon® 115, Genetron® 115, Halocarbon 115, Monochloropentafluoroethane

Exposure Limits:
NIOSH REL: TWA 1000 ppm (6320 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless gas with a slight, ethereal odor.
[**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 154.5
BP: -38°F
Sol(77°F): 0.006%
Fl.P: NA
IP: 12.96 eV
RGasD: 5.55
VP(70°F): 7.9 atm
FRZ: -223°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Alkalis, alkaline earth metals (e.g., aluminum powder, sodium, potassium, zinc)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Dysp; dizz, inco, narco; nau, vomit; heart palp, card arrhy, asphy; liquid: frostbite, derm
TO: Skin, CNS, CVS

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Chloropicrin	**Formula:** CCl_3NO_2	**CAS#:** 76-06-2	**RTECS#:** PB6300000	**IDLH:** 2 ppm

Conversion: 1 ppm = 6.72 mg/m^3 **DOT:** 1580 154; 1583 154 (mixture, n.o.s.)

Synonyms/Trade Names: Nitrochloroform, Nitrotrichloromethane, Trichloronitromethane

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.7 mg/m^3)
OSHA PEL: TWA 0.1 ppm (0.7 mg/m^3)

Measurement Methods (see Table 1):
None available

Physical Description: Colorless to faint-yellow, oily liquid with an intensely irritating odor. [pesticide]

Chemical & Physical Properties:
MW: 164.4
BP: 234°F
Sol: 0.2%
Fl.P: NA
IP: ?
Sp.Gr: 1.66
VP: 18 mmHg
FRZ: -93°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2 ppm: Sa:Cf£/PaprOv£/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers
[**Note:** The material may explode when heated under confinement.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; lac; cough, pulm edema; nau, vomit
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

β-Chloroprene	Formula: CH_2=CClCH=CH_2	CAS#: 126-99-8	RTECS#: EI9625000	IDLH: Ca [300 ppm]
Conversion: 1 ppm = 3.62 mg/m^3	**DOT:** 1991 131P (inhibited)			
Synonyms/Trade Names: 2-Chloro-1,3-butadiene; Chlorobutadiene; Chloroprene				

Exposure Limits:
NIOSH REL: Ca
C 1 ppm (3.6 mg/m^3) [15-minute]
See Appendix A
OSHA PEL†: TWA 25 ppm (90 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1002
OSHA 112

Physical Description: Colorless liquid with a pungent, ether-like odor.

Chemical & Physical Properties:
MW: 88.5
BP: 139°F
Sol: Slight
Fl.P: -4°F
IP: 8.79 eV
Sp.Gr: 0.96
VP: 188 mmHg
FRZ: -153°F
UEL: 11.3%
LEL: 1.9%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Peroxides & other oxidizers
[**Note:** Polymerizes at room temperature unless inhibited with antioxidants.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; anxi, irrity; derm; alopecia; repro effects; [carc]
TO: Eyes, skin, resp sys, repro sys [lung & skin cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

o-Chlorostyrene	Formula: ClC_6H_4CH=CH_2	CAS#: 2039-87-4	RTECS#: WL4160000	IDLH: N.D.
Conversion: 1 ppm = 5.67 mg/m^3	**DOT:**			
Synonyms/Trade Names: 2-Chlorostyrene, ortho-Chlorostyrene, 1-Chloro-2-ethenylbenzene				

Exposure Limits:
NIOSH REL: TWA 50 ppm (285 mg/m^3)
ST 75 ppm (428 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid.

Chemical & Physical Properties:
MW: 138.6
BP: 372°F
Sol: Insoluble
Fl.P: 138°F
IP: ?
Sp.Gr: 1.10
VP(77°F): 0.96 mmHg
FRZ: -82°F
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: irrit eyes, skin; hema, prot, acidosis; enlarged liver, jaun
TO: Eyes, skin, liver, kidneys, CNS, PNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

o-Chlorotoluene

Formula: $ClC_6H_4CH_3$ | **CAS#:** 95-49-8 | **RTECS#:** XS9000000 | **IDLH:** N.D.

Conversion: 1 ppm = 5.18 mg/m^3 | **DOT:** 2238 129

Synonyms/Trade Names: 1-Chloro-2-methylbenzene, 2-Chloro-1-methylbenzene, 2-Chlorotoluene, o-Tolyl chloride

Exposure Limits:
NIOSH REL: TWA 50 ppm (250 mg/m^3)
ST 75 ppm (375 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with an aromatic odor.

Chemical & Physical Properties:
MW: 126.6
BP: 320°F
Sol(77°F): 0.009%
Fl.P: 96°F
IP: 8.83 eV
Sp.Gr: 1.08
VP(77°F): 4 mmHg
FRZ: -31°F
UEL: ?
LEL: ?
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Acids, alkalis, oxidizers, reducing materials, water

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb; derm; drow, inco, anes; cough; liver, kidney inj
TO: Eyes, skin, resp sys, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

2-Chloro-6-trichloromethyl pyridine

Formula: $C_5H_3NCCl_3$ | **CAS#:** 1929-82-4 | **RTECS#:** US7525000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: 2-Chloro-6-(trichloro-methyl)pyridine; Nitrapyrin; N-serve®; 2,2,2,6-Tetrachloro-2-picoline

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
ST 20 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
None available

Physical Description: Colorless or white, crystalline solid with a mild, sweet odor.

Chemical & Physical Properties:
MW: 230.9
BP: ?
Sol: Insoluble
Fl.P: ?
IP: ?
Sp.Gr: ?
VP(73°F): 0.003 mmHg
MLT: 145°F
UEL: ?
LEL: ?
Combustible Solid [Explosive]

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Aluminum, magnesium
[**Note:** Emits oxides of nitrogen and chloride ion when heated to decomposition.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: No adverse effects noted in ingestion studies with animals.
TO: Eyes, skin

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

C

Chlorpyrifos

Formula: $C_9H_{11}Cl_3NO_3PS$ | **CAS#:** 2921-88-2 | **RTECS#:** TF6300000 | **IDLH:** N.D.

Conversion: **DOT:** 2783 152

Synonyms/Trade Names: Chlorpyrifos-ethyl; O,O-Diethyl O-3,5,6-trichloro-2-pyridyl phosphorothioate; Dursban®

Exposure Limits:
NIOSH REL: TWA 0.2 mg/m^3
ST 0.6 mg/m^3 [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5600 **OSHA** 62

Physical Description: Colorless to white, crystalline solid with a mild, mercaptan-like odor. [pesticide]
[**Note:** Commercial formulations may be combined with combustible liquids.]

Chemical & Physical Properties:
MW: 350.6
BP: 320°F (Decomposes)
Sol: 0.0002%
Fl.P: ?
IP: ?
Sp.Gr: 1.40 (Liquid at 110°F)
VP: 0.00002 mmHg
MLT: 108°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong acids, caustics, amines
[**Note:** Corrosive to copper & brass.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Wheez, lar spasms, salv; bluish lips, skin; miosis, blurred vision; nau, vomit, abdom cramps, diarr
TO: Resp sys, CNS, PNS, plasma chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Chromic acid and chromates

Formula: CrO_3 (acid) | **CAS#:** 1333-82-0 (CrO_3) | **RTECS#:** GB6650000 (CrO_3) | **IDLH:** Ca [15 mg/m^3 {as Cr(VI)}]

Conversion: **DOT:** 1755 154 (acid solution); 1463 141 (acid, solid)

Synonyms/Trade Names: **Chromic acid (CrO_3):** Chromic anhydride, Chromic oxide, Chromium(VI) oxide (1:3), Chromium trioxide. Synonyms of chromates (i.e., chromium(VI) compounds) such as zinc chromate vary depending upon the specific compound.

Exposure Limits:
NIOSH REL (as Cr): Ca
TWA 0.001 mg/m^3
See Appendix A
See Appendix C
OSHA PEL (as CrO_3): C 0.1 mg/m^3 See Appendix C

Measurement Methods (see Table 1):
NIOSH 7600, 7604, 7605
OSHA ID103, ID215, W4001

Physical Description: CrO_3: Dark-red, odorless flakes or powder.
[**Note:** Often used in an aqueous solution (H_2CrO_4).]

Chemical & Physical Properties:
MW: 100.0
BP: 482°F (Decomposes)
Sol: 63%
Fl.P: NA
IP: NA
Sp.Gr: 2.70 (CrO_3)
VP: Very low
MLT: 387°F (Decomposes)
UEL: NA
LEL: NA
CrO_3: Noncombustible Solid, but will accelerate the burning of combustible materials.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Combustible, organic, or other readily oxidizable materials (paper, wood, sulfur, aluminum, plastics, etc.); corrosive to metals

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit resp sys; nasal septum perf; liver, kidney damage; leucyt, leupen, eosin; eye inj, conj; skin ulcer, sens derm; [carc]
TO: Blood, resp sys, liver, kidneys, eyes, skin [lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Chromium(II) compounds (as Cr)	Formula:	CAS#:	RTECS#:	IDLH: 250 mg/m^3 [as Cr(II)]
Conversion:	**DOT:**			

Synonyms/Trade Names: Synonyms vary depending upon the specific Chromium(II) compound.
[**Note:** Chromium(II) compounds include soluble chromous salts.]

Exposure Limits:	**Measurement Methods (see Table 1):**
NIOSH REL: TWA 0.5 mg/m^3 See Appendix C **OSHA PEL:** TWA 0.5 mg/m^3 See Appendix C	**NIOSH** 7024, 7300, 7301, 7303, 9102 **OSHA** ID121, ID125G

Physical Description: Appearance and odor vary depending upon the specific compound.

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
Properties vary depending upon the specific compound.	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.	**NIOSH/OSHA** **2.5 mg/m^3:** Qm* **5 mg/m^3:** 95XQ*/Sa* **12.5 mg/m^3:** Sa:Cf*/PaprHie* **25 mg/m^3:** 100F/PaprTHie*/ScbaF/SaF **250 mg/m^3:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE

Incompatibilities and Reactivities: Varies

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Ing, Con **SY:** Irrit eyes; sens derm **TO:** Eyes, skin	**Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed

Chromium(III) compounds (as Cr)	Formula:	CAS#:	RTECS#:	IDLH: 25 mg/m^3 [as Cr(III)]
Conversion:	**DOT:**			

Synonyms/Trade Names: Synonyms vary depending upon the specific Chromium(III) compound.
[**Note:** Chromium(III) compounds include soluble chromic salts.]

Exposure Limits:	**Measurement Methods (see Table 1):**
NIOSH REL: TWA 0.5 mg/m^3 See Appendix C **OSHA PEL:** TWA 0.5 mg/m^3 See Appendix C	**NIOSH** 7024, 7300, 7301, 7303, 9102 **OSHA** ID121, ID125G

Physical Description: Appearance and odor vary depending upon the specific compound.

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
Properties vary depending upon the specific compound.	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.	**NIOSH/OSHA** **2.5 mg/m^3:** Qm* **5 mg/m^3:** 95XQ*/Sa* **12.5 mg/m^3:** Sa:Cf*/PaprHie* **25 mg/m^3:** 100F/PaprTHie*/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE

Incompatibilities and Reactivities: Varies

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Ing, Con **SY:** Irrit eyes; sens derm **TO:** Eyes, skin	**Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed

C

Chromium metal

Formula:	CAS#:	RTECS#:	IDLH:
Cr	7440-47-3	GB4200000	250 mg/m^3 (as Cr)

Conversion: **DOT:**

Synonyms/Trade Names: Chrome, Chromium

Exposure Limits:
NIOSH REL: TWA 0.5 mg/m^3
See Appendix C
OSHA PEL*: TWA 1 mg/m^3
See Appendix C
[***Note:** The PEL also applies to insoluble chromium salts.]

Measurement Methods (see Table 1):
NIOSH 7024, 7300, 7301, 7303, 9102
OSHA ID121, ID125G

Physical Description: Blue-white to steel-gray, lustrous, brittle, hard, odorless solid.

Chemical & Physical Properties:
MW: 52.0
BP: 4788°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 7.14
VP: 0 mmHg (approx)
MLT: 3452°F
UEL: NA
LEL: NA
Noncombustible Solid in bulk form, but finely divided dust burns rapidly if heated in a flame.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
2.5 mg/m^3: Qm*
5 mg/m^3: 95XQ*/Sa*
12.5 mg/m^3: Sa:Cf*/PaprHie*
25 mg/m^3: 100F/PaprTHie*/ScbaF/SaF
250 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers (such as hydrogen peroxide), alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin; lung fib (histologic)
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Chromyl chloride

Formula:	CAS#:	RTECS#:	IDLH:
$Cr(OCl)_2$	14977-61-8	GB5775000	Ca [N.D.]

Conversion: **DOT:** 1758 137

Synonyms/Trade Names: Chlorochromic anhydride, Chromic oxychloride, Chromium chloride oxide, Chromium dichloride dioxide, Chromium dioxide dichloride, Chromium dioxychloride, Chromium oxychloride, Dichlorodioxochromium

Exposure Limits:
NIOSH REL: Ca
0.001 mg Cr(VI)/m^3
See Appendix A, See Appendix C
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Deep-red liquid with a musty, burning, acrid odor. [**Note:** Fumes in moist air.]

Chemical & Physical Properties:
MW: 154.9
BP: 243°F
Sol: Reacts
Fl.P: NA
IP: 12.60 eV
Sp.Gr(77°F): 1.91
VP: 20 mmHg
FRZ: -142°F
UEL: NA
LEL: NA
Noncombustible Liquid, but a powerful oxidizer.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Water, combustible substances, halides, phosphorus, turpentine [**Note:** Reacts violently in water; forms chromic acid, chromic chloride, hydrochloric acid & chlorine. Corrodes common metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, upper resp sys; eye, skin burns [carc]
TO: Eyes, skin, resp sys [lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Clopidol	**Formula:** $C_7H_7Cl_2NO$	**CAS#:** 2971-90-6	**RTECS#:** UU7711500	**IDLH:** N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: Coyden®; 3,5-Dichloro-2,6-dimethyl-4-pyridinol				

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
ST 20 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: White to light-brown, crystalline solid.

Chemical & Physical Properties:
MW: 192.1
BP: ?
Sol: Insoluble
Fl.P: NA
IP: ?
Sp.Gr: ?
VP: ?
MLT: >608°F
UEL: NA
LEL: NA
Noncombustible Solid, but dust may explode in cloud form.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, nose, throat; cough
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Fresh air

Coal dust	**Formula:**	**CAS#:**	**RTECS#:** GF8281000	**IDLH:** N.D.
Conversion:	**DOT:** 1361 133			
Synonyms/Trade Names: Anthracite coal dust, Bituminous coal dust, Lignite coal dust				

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: TWA 2.4 mg/m^3 [respirable, <5% SiO_2]
TWA (10 mg/m^3)/(%SiO_2 + 2) [respirable, ≥ 5% SiO_2]
See Appendix C (Mineral Dusts)

Measurement Methods (see Table 1):
NIOSH 0600, 7500

Physical Description: Dark-brown to black solid dispersed in air.

Chemical & Physical Properties:
Properties vary depending upon the specific coal type.

Combustible Solid; slightly explosive when exposed to flame.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh
SY: Chronic bron, decr pulm func, emphy
TO: Resp sys

First Aid (see Table 6):
Breath: Fresh air

C

Coal tar pitch volatiles

Formula:	CAS#:	RTECS#:	IDLH:
	65996-93-2	GF8655000	Ca [80 mg/m^3]

Conversion: **DOT:** 2713 153 (acridine)

Synonyms/Trade Names: Synonyms vary depending upon the specific compound (e.g., pyrene, phenanthrene, acridine, chrysene, anthracene & benzo(a)pyrene).
[**Note:** NIOSH considers coal tar, coal tar pitch, and creosote to be coal tar products.]

Exposure Limits:
NIOSH REL: Ca
TWA 0.1 mg/m^3 (cyclohexane-extractable fraction)
See Appendix A
See Appendix C
OSHA PEL: TWA 0.2 mg/m^3 (benzene-soluble fraction) [1910.1002]
See Appendix C

Measurement Methods (see Table 1):
OSHA 58

Physical Description: Black or dark-brown amorphous residue.

Chemical & Physical Properties:
Properties vary depending upon the specific compound.
Combustible Solids

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Derm, bron, [carc]
TO: Resp sys, skin, bladder, kidneys [lung, kidney & skin cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Cobalt carbonyl (as Co)

Formula:	CAS#:	RTECS#:	IDLH:
$C_8Co_2O_8$	10210-68-1	GG0300000	N.D.

Conversion: **DOT:**

Synonyms/Trade Names: di-mu-Carbonylhexacarbonyldicobalt, Cobalt octacarbonyl, Cobalt tetracarbonyl dimer, Dicobalt carbonyl, Dicobalt Octacarbonyl, Octacarbonyldicobalt

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Orange to dark-brown, crystalline solid.
[**Note:** The pure substance is white.]

Chemical & Physical Properties:
MW: 341.9
BP: 126°F (Decomposes)
Sol: Insoluble
Fl.P: NA
IP: ?
Sp.Gr: 1.87
VP: 0.7 mmHg
MLT: 124°F
UEL: NA
LEL: NA
Noncombustible Solid, but flammable carbon monoxide is emitted during decomposition.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Air
[**Note:** Decomposes on exposure to air or heat; stable in atmosphere of hydrogen & carbon monoxide.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb; cough, decr pulm func, wheez, dysp; in animals: liver, kidney inj, pulm edema
TO: Eyes, skin, resp sys, blood, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Cobalt hydrocarbonyl (as Co)	**Formula:** $HCo(CO)_4$	**CAS#:** 16842-03-8	**RTECS#:** GG0900000	**IDLH:** N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: Hydrocobalt tetracarbonyl, Tetracarbonylhydridocobalt, Tetracarbonylhydrocobalt				
Exposure Limits: **NIOSH REL:** TWA 0.1 mg/m^3 **OSHA PEL†:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Gas with an offensive odor.				
Chemical & Physical Properties: **MW:** 172.0 **BP:** ? **Sol:** 0.05% **Fl.P:** NA (Gas) **IP:** ? **RGasD:** 5.93 **VP:** >1 atm **FRZ:** -15°F **UEL:** ? **LEL:** ? Flammable Gas	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Air [**Note:** Unstable gas that decomposes rapidly in air at room temperature to cobalt carbonyl & hydrogen.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Con **SY:** In animals: irrit resp sys; dysp, cough, decr pulm func, pulm edema **TO:** Eyes, skin, resp sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash **Breath:** Resp support	

Cobalt metal dust and fume (as Co)	**Formula:** Co	**CAS#:** 7440-48-4	**RTECS#:** GF8750000	**IDLH:** 20 mg/m^3 (as Co)
Conversion:	**DOT:**			
Synonyms/Trade Names: Cobalt metal dust, Cobalt metal fume				
Exposure Limits: **NIOSH REL:** TWA 0.05 mg/m^3 **OSHA PEL†:** TWA 0.1 mg/m^3			**Measurement Methods (see Table 1):** **NIOSH** 7027, 7300, 7301, 7303, 9102 **OSHA** ID121, ID125G, ID213	
Physical Description: Odorless, silver-gray to black solid.				
Chemical & Physical Properties: **MW:** 58.9 **BP:** 5612°F **Sol:** Insoluble **Fl.P:** NA **IP:** NA **Sp.Gr:** 8.92 **VP:** 0 mmHg (approx) **MLT:** 2719°F **UEL:** NA **LEL:** NA Noncombustible Solid in bulk form, but finely divided dust will burn at high temperatures.	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** N.R. **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **0.25 mg/m^3:** Qm **0.5 mg/m^3:** 95XQ*/Sa* **1.25 mg/m^3:** Sa:Cf*/PaprHie* **2.5 mg/m^3:** 100F/ScbaF/SaF **20 mg/m^3:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers, ammonium nitrate				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Cough, dysp, wheez, decr pulm func; low-wgt; derm; diffuse nodular fib; resp hypersensitivity, asthma **TO:** Skin, resp sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash **Breath:** Resp support **Swallow:** Medical attention immed	

Coke oven emissions

Formula: | **CAS#:** | **RTECS#:** GH0346000 | **IDLH:** Ca [N.D.]

Conversion: | **DOT:**

Synonyms/Trade Names: Synonyms vary depending upon the specific constituent.

Exposure Limits:
NIOSH REL: Ca
TWA 0.2 mg/m^3 (benzene-soluble fraction)
See Appendix A
See Appendix C
OSHA PEL: [1910.1029] TWA 0.150 mg/m^3 (benzene-soluble fraction)

Measurement Methods (see Table 1):
OSHA 58

Physical Description: Emissions released during the carbonization of bituminous coal for the production of coke. [**Note:** See Appendix C for more information.]

Chemical & Physical Properties:
Properties vary depending upon the constituent.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, resp sys; cough, dysp, wheez; [carc]
TO: Skin, resp sys, urinary sys [skin, lung, kidney & bladder cancer]

First Aid (see Table 6):
Eye: Irr immed
Breath: Resp support

Copper (dusts and mists, as Cu)

Formula: Cu | **CAS#:** 7440-50-8 | **RTECS#:** GL5325000 | **IDLH:** 100 mg/m^3 (as Cu)

Conversion: | **DOT:**

Synonyms/Trade Names: Copper metal dusts, Copper metal fumes

Exposure Limits:
NIOSH REL*: TWA 1 mg/m^3
OSHA PEL*: TWA 1 mg/m^3
[***Note:** The REL and PEL also apply to other copper compounds (as Cu) except copper fume.]

Measurement Methods (see Table 1):
NIOSH 7029, 7300, 7301, 7303, 9102
OSHA ID121, ID125G

Physical Description: Reddish, lustrous, malleable, odorless solid.

Chemical & Physical Properties:
MW: 63.5
BP: 4703°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 8.94
VP: 0 mmHg (approx)
MLT: 1981°F
UEL: NA
LEL: NA
Noncombustible Solid in bulk form, but powdered form may ignite.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: Qm*
10 mg/m^3: 95XQ*/Sa*
25 mg/m^3: Sa:Cf*/PaprHie*
50 mg/m^3: 100F/PaprTHie*/ScbaF/SaF
100 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Oxidizers, alkalis, sodium azide, acetylene

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose, pharynx; nasal septum perf; metallic taste; derm; in animals: lung, liver, kidney damage; anemia
TO: Eyes, skin, resp sys, liver, kidneys (incr risk with Wilson's disease)

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Copper fume (as Cu)

Formula: CuO/Cu | **CAS#:** 1317-38-0 (CuO) | **RTECS#:** GL7900000 (CuO) | **IDLH:** 100 mg/m^3 (as Cu)

Conversion: | **DOT:**

Synonyms/Trade Names: **Cu:** Copper fume **CuO:** Black copper oxide fume, Copper monoxide fume, Copper(II) oxide fume, Cupric oxide fume
[**Note:** Also see specific listing for Copper (dusts and mists).]

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3
OSHA PEL: TWA 0.1 mg/m^3

Physical Description: Finely divided black particulate dispersed in air.
[**Note:** Exposure may occur in copper & brass plants and during the welding of copper alloys.]

Measurement Methods (see Table 1):
NIOSH 7029, 7300, 7301, 7303
OSHA ID121, ID125G, ID206

Chemical & Physical Properties:
MW: 79.5
BP: Decomposes
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 6.4 (CuO)
VP: 0 mmHg (approx)
MLT: 1879°F (Decomposes)
UEL: NA
LEL: NA
CuO: Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1 mg/m^3: 95XQ/Sa
2.5 mg/m^3: Sa:Cf/PaprHie
5 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
100 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: **CuO:** Acetylene, zirconium
[**Note:** See Copper (dusts and mists) for properties of Copper metal.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, upper resp sys; metal fume fever: chills, musc ache, nau, fever, dry throat, cough, lass; metallic or sweet taste; discoloration skin, hair
TO: Eyes, skin, resp sys (incr risk with Wilson's disease)

First Aid (see Table 6):
Breath: Resp support

Cotton dust (raw)

Formula: | **CAS#:** | **RTECS#:** GN2275000 | **IDLH:** 100 mg/m^3

Conversion: | **DOT:** 1365 133 (cotton)

Synonyms/Trade Names: Raw cotton dust

Exposure Limits:
NIOSH REL: TWA <0.200 mg/m^3
See Appendix C
OSHA PEL: [Z-1-A & 1910.1043]
See Appendix C

Physical Description: Colorless, odorless solid.

Measurement Methods (see Table 1):
OSHA [1910.1043]

Chemical & Physical Properties:
MW: ?
BP: Decomposes
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: ?
VP: 0 mmHg (approx)
MLT: Decomposes
UEL: NA
LEL: NA
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
1 mg/m^3: Qm
2 mg/m^3: 95XQ/Sa
5 mg/m^3: Sa:Cf/PaprHie
10 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
100 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE
See Appendix E (page 351)

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh
SY: Byssinosis: chest tight, cough, wheez, dysp; decr FEV; bron; mal; fever, chills, upper resp symptoms after initial exposure
TO: CVS, resp sys

First Aid (see Table 6):
Breath: Fresh air

C

Crag® herbicide

Formula:	CAS#:	RTECS#:	IDLH:
$C_6H_3Cl_2OCH_2CH_2OSO_3Na$	136-78-7	KK4900000	500 mg/m^3

Conversion:
DOT:

Synonyms/Trade Names: Crag® herbicide No. 1; 2-(2,4-Dichlorophenoxy)ethyl sodium sulfate; Sesone

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH S356 (II-5)

Physical Description: Colorless to white crystalline, odorless solid. [herbicide]

Chemical & Physical Properties:
MW: 309.1
BP: Decomposes
Sol(77°F): 26%
Fl.P: NA
IP: ?
Sp.Gr: 1.70
VP: 0.1 mmHg
MLT: 473°F (Decomposes)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
50 mg/m^3: Qm
100 mg/m^3: 95XQ/Sa
250 mg/m^3: Sa:Cf/PaprHie
500 mg/m^3: 100F/PaprTHie*/SaT:Cf*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin; liver, kidney damage; in animals: CNS effects, convuls
TO: Eyes, skin, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash prompt
Breath: Resp support
Swallow: Medical attention immed

m-Cresol

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3C_6H_4OH$	108-39-4	GO6125000	250 ppm

Conversion: 1 ppm = 4.43 mg/m^3
DOT: 2076 153

Synonyms/Trade Names: meta-Cresol, 3-Cresol, m-Cresylic acid, 1-Hydroxy-3-methylbenzene, 3-Hydroxytoluene, 3-Methyl phenol

Exposure Limits:
NIOSH REL: TWA 2.3 ppm (10 mg/m^3)
OSHA PEL: TWA 5 ppm (22 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2546
OSHA 32

Physical Description: Colorless to yellowish liquid with a sweet, tarry odor. [**Note:** A solid below 54°F.]

Chemical & Physical Properties:
MW: 108.2
BP: 397°F
Sol: 2%
Fl.P: 187°F
IP: 8.98 eV
Sp.Gr: 1.03
VP(77°F): 0.14 mmHg
FRZ: 54°F
UEL: ?
LEL(300°F): 1.1%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
23 ppm: CcrOv95/Sa
57.5 ppm: Sa:Cf/PaprOvHie
115 ppm: CcrFOv100/GmFOv100/PaprTOvHie*/SaT:Cf*/ScbaF/SaF
250 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb; CNS effects: conf, depres, resp fail; dysp, irreg rapid resp, weak pulse; eye, skin burns; derm; lung, liver, kidney, pancreas damage
TO: Eyes, skin, resp sys, CNS, liver, kidneys, pancreas, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

o-Cresol

Formula: $CH_3C_6H_4OH$ | **CAS#:** 95-48-7 | **RTECS#:** GO6300000 | **IDLH:** 250 ppm

Conversion: 1 ppm = 4.43 mg/m^3 | **DOT:** 2076 153

Synonyms/Trade Names: ortho-Cresol, 2-Cresol, o-Cresylic acid, 1-Hydroxy-2-methylbenzene, 2-Hydroxytoluene, 2-Methyl phenol

Exposure Limits:
NIOSH REL: TWA 2.3 ppm (10 mg/m^3)
OSHA PEL: TWA 5 ppm (22 mg/m^3) [skin]

Physical Description: White crystals with a sweet, tarry odor.
[**Note:** A liquid above 88°F.]

Measurement Methods (see Table 1):
NIOSH 2546
OSHA 32

Chemical & Physical Properties:
MW: 108.2
BP: 376°F
Sol: 2%
Fl.P: 178°F
IP: 8.93 eV
Sp.Gr: 1.05
VP(77°F): 0.29 mmHg
MLT: 88°F
UEL: ?
LEL(300°F): 1.4%
Combustible Solid
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
23 ppm: CcrOv95/Sa
57.5 ppm: Sa:Cf/PaprOvHie
115 ppm: CcrFOv100/GmFOv100/PaprTOvHie*/SaT:Cf*/ScbaF/SaF
250 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb; CNS effects: conf, depres, resp fail; dysp, irreg rapid resp, weak pulse; eye, skin burns; derm; lung, liver, kidney, pancreas damage
TO: Eyes, skin, resp sys, CNS, liver, kidneys, pancreas, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

p-Cresol

Formula: $CH_3C_6H_4OH$ | **CAS#:** 106-44-5 | **RTECS#:** GO6475000 | **IDLH:** 250 ppm

Conversion: 1 ppm = 4.43 mg/m^3 | **DOT:** 2076 153

Synonyms/Trade Names: para-Cresol, 4-Cresol, p-Cresylic acid, 1-Hydroxy-4-methylbenzene, 4-Hydroxytoluene, 4-Methyl phenol

Exposure Limits:
NIOSH REL: TWA 2.3 ppm (10 mg/m^3)
OSHA PEL: TWA 5 ppm (22 mg/m^3) [skin]

Physical Description: Crystalline solid with a sweet, tarry odor.
[**Note:** A liquid above 95°F.]

Measurement Methods (see Table 1):
NIOSH 2546
OSHA 32

Chemical & Physical Properties:
MW: 108.2
BP: 396°F
Sol: 2%
Fl.P: 187°F
IP: 8.97 eV
Sp.Gr: 1.04
VP(77°F): 0.11 mmHg
MLT: 95°F
UEL: ?
LEL(300°F): 1.1%
Combustible Solid
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
23 ppm: CcrOv95/Sa
57.5 ppm: Sa:Cf/PaprOvHie
115 ppm: CcrFOv100/GmFOv100/PaprTOvHie*/SaT:Cf*/ScbaF/SaF
250 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb; CNS effects: conf, depres, resp fail; dysp, irreg rapid resp, weak pulse; eye, skin burns; derm; lung, liver, kidney, pancreas damage
TO: Eyes, skin, resp sys, CNS, liver, kidneys, pancreas, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

C

Crotonaldehyde

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3CH=CHCHO$	4170-30-3	GP9499000	50 ppm

Conversion: 1 ppm = 2.87 mg/m^3

DOT: 1143 131P (inhibited)

Synonyms/Trade Names: 2-Butenal, β-Methyl acrolein, Propylene aldehyde

Exposure Limits:
NIOSH REL: TWA 2 ppm (6 mg/m^3)
See Appendix C (Aldehydes)
OSHA PEL: TWA 2 ppm (6 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 3516
OSHA 81

Physical Description: Water-white liquid with a suffocating odor.
[**Note:** Turns pale-yellow on contact with air.]

Chemical & Physical Properties:
MW: 70.1
BP: 219°F
Sol: 18%
Fl.P: 45°F
IP: 9.73 eV
Sp.Gr: 0.87
VP: 19 mmHg
FRZ: -101°F
UEL: 15.5%
LEL: 2.1%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
20 ppm: CcrOv*/Sa*
50 ppm: Sa:Cf*/PaprOv*/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Caustics, ammonia, strong oxidizers, nitric acid, amines
[**Note:** Polymerization may occur at elevated temperatures, such as in fire conditions.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, resp sys; in animals: dysp, pulm edema, irrit skin
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Crufomate

Formula:	CAS#:	RTECS#:	IDLH:
$C_{12}H_{19}ClNO_3P$	299-86-5	TB3850000	N.D.

Conversion:

DOT:

Synonyms/Trade Names: 4-t-Butyl-2-chlorophenylmethyl methylphosphoramidate, Dowco® 132, Ruelene®

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
ST 20 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 0500
OSHA PV2015

Physical Description: White, crystalline solid in pure form. [pesticide]
[**Note:** Commercial product is a yellow oil.]

Chemical & Physical Properties:
MW: 291.7
BP: Decomposes
Sol: Insoluble
Fl.P: ?
IP: ?
Sp.Gr: 1.16
VP(243°F): 0.01 mmHg
MLT: 140°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strongly alkaline & strongly acidic media
[**Note:** Unstable over long periods in aqueous preparations or above 140°F.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; wheez, dysp; blurred vision, lac; sweat; abdom cramps, diarr, nau, anor
TO: Eyes, skin, resp sys, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Cumene	**Formula:** $C_6H_5CH(CH_3)_2$	**CAS#:** 98-82-8	**RTECS#:** GR8575000	**IDLH:** 900 ppm [10%LEL]
Conversion: 1 ppm = 4.92 mg/m^3	**DOT:** 1918 130			
Synonyms/Trade Names: Cumol, Isopropyl benzene, 2-Phenyl propane				
Exposure Limits: **NIOSH REL:** TWA 50 ppm (245 mg/m^3) [skin] **OSHA PEL:** TWA 50 ppm (245 mg/m^3) [skin]				**Measurement Methods (see Table 1):** **NIOSH** 1501
Physical Description: Colorless liquid with a sharp, penetrating, aromatic odor.				
Chemical & Physical Properties: **MW:** 120.2 **BP:** 306°F **Sol:** Insoluble **Fl.P:** 96°F **IP:** 8.75 eV **Sp.Gr:** 0.86 **VP:** 8 mmHg **FRZ:** -141°F **UEL:** 6.5% **LEL:** 0.9% Class IC Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **500 ppm:** CcrOv*/Sa* **900 ppm:** Sa:Cf*/PaprOv*/CcrFOv/ GmFOv/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Oxidizers, nitric acid, sulfur acid [**Note:** Forms cumene hydroperoxide upon long exposure to air.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, muc memb; derm; head, narco, coma **TO:** Eyes, skin, resp sys, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Cyanamide	**Formula:** NH_2CN	**CAS#:** 420-04-2	**RTECS#:** GS5950000	**IDLH:** N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: Amidocyanogen, Carbimide, Carbodiimide, Cyanogen nitride, Hydrogen cyanamide [**Note:** Cyanamide is also a synonym for Calcium cyanamide.]				
Exposure Limits: **NIOSH REL:** TWA 2 mg/m^3 **OSHA PEL†:** none				**Measurement Methods (see Table 1):** **NIOSH** 0500
Physical Description: Crystalline solid.				
Chemical & Physical Properties: **MW:** 42.1 **BP:** 500°F (Decomposes) **Sol(59°F):** 78% **Fl.P:** 286°F **IP:** 10.65 eV **Sp.Gr:** 1.28 **VP:** ? **MLT:** 113°F **UEL:** ? **LEL:** ? Combustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily **Provide:** Eyewash Quick drench		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Above 104°F: Moisture, acids, or alkalis; 1,2-phenylene diamine salts [**Note:** Polymerization may occur on evaporation of aqueous solutions.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, resp sys; eye, skin burns; miosis, salv, lac, twitch; Antabuse-like effects **TO:** Eyes, skin, resp sys, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed	

Cyanogen	Formula: NCCN	CAS#: 460-19-5	RTECS#: GT1925000	IDLH: N.D.
Conversion: 1 ppm = 2.13 mg/m^3	**DOT:** 1026 119			
Synonyms/Trade Names: Carbon nitride, Dicyan, Dicyanogen, Ethanedinitrile, Oxalonitrile				
Exposure Limits: **NIOSH REL:** TWA 10 ppm (20 mg/m^3) **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **OSHA** PV2104	
Physical Description: Colorless gas with a pungent, almond-like odor. [**Note:** Shipped as a liquefied compressed gas. Forms cyanide in the body.]				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 52.0 **BP:** -6°F **Sol:** 1% **Fl.P:** NA (Gas) **IP:** 13.57 eV **RGasD:** 1.82 **Sp.Gr:** 0.95 (Liquid at -6°F) **VP(70°F):** 5.1 atm **FRZ:** -18°F **UEL:** 32% **LEL:** 6.6% Flammable Gas	**Skin:** Frostbite **Eyes:** Prevent eye contact/Frostbite **Wash skin:** N.R. **Remove:** When wet (flamm) **Change:** N.R. **Provide:** Frostbite wash	Not available.

Incompatibilities and Reactivities: Acids, water, strong oxidizers (e.g., dichlorine oxide, fluorine)
[**Note:** Slowly hydrolyzed in water to form hydrogen cyanide, oxalic acid, or ammonia.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Con **SY:** Irrit eyes, nose, upper resp sys; lac; cherry red lips, tachypnea, hypernea, bradycardia; head, convuls; dizz, loss of appetite, low-wgt; liquid: frostbite **TO:** Eyes, resp sys, CNS, CVS	**Eye:** Frostbite **Skin:** Frostbite **Breath:** Resp support

Cyanogen chloride	Formula: ClCN	CAS#: 506-77-4	RTECS#: GT2275000	IDLH: N.D.
Conversion: 1 ppm = 2.52 mg/m^3	**DOT:** 1589 125 (inhibited)			
Synonyms/Trade Names: Chlorcyan, Chlorine cyanide, Chlorocyanide, Chlorocyanogen				
Exposure Limits: **NIOSH REL:** C 0.3 ppm (0.6 mg/m^3) **OSHA PEL†:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Colorless gas or liquid (below 55°F) with an irritating odor. [**Note:** Shipped as a liquefied gas. A solid below 20°F. Forms cyanide in the body.]				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 61.5 **BP:** 55°F **Sol:** 7% **Fl.P:** NA **IP:** 12.49 eV **RGasD:** 2.16 **Sp.Gr:** 1.22 (Liquid at 32°F) **VP:** 1010 mmHg **FRZ:** 20°F **UEL:** NA **LEL:** NA Nonflammable Gas	**Skin:** Prevent skin contact (liquid) **Eyes:** Prevent eye contact (liquid) **Wash skin:** When contam (liquid) **Remove:** When wet or contam (liquid) **Change:** N.R. **Provide:** Eyewash (liquid) Quick drench (liquid)	Not available.

Incompatibilities and Reactivities: Water, acids, alkalis, ammonia, alcohols
[**Note:** Can react very slowly with water to form hydrogen cyanide. May be stabilized to prevent polymerization.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Abs (liquid), Ing (liquid), Con (liquid) **SY:** Irrit eyes, upper resp sys; cough, delayed pulm edema; lass, head, dizz, conf, nau, vomit; irreg heartbeat; irrit skin (liquid) **TO:** Eyes, skin, resp sys, CNS, CVS	**Eye:** Irr immed **Skin:** Water wash immed (liquid) **Breath:** Resp support **Swallow:** Medical attention immed (liquid)

Cyclohexane

Formula: C_6H_{12} | **CAS#:** 110-82-7 | **RTECS#:** GU6300000 | **IDLH:** 1300 ppm [10%LEL]

Conversion: 1 ppm = 3.44 mg/m^3 | **DOT:** 1145 128

Synonyms/Trade Names: Benzene hexahydride, Hexahydrobenzene, Hexamethylene, Hexanaphthene

Exposure Limits:
NIOSH REL: TWA 300 ppm (1050 mg/m^3)
OSHA PEL: TWA 300 ppm (1050 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1500
OSHA 7

Physical Description: Colorless liquid with a sweet, chloroform-like odor. [**Note:** A solid below 44°F.]

Chemical & Physical Properties:
MW: 84.2
BP: 177°F
Sol: Insoluble
Fl.P: 0°F
IP: 9.88 eV
Sp.Gr: 0.78
VP: 78 mmHg
FRZ: 44°F
UEL: 8%
LEL: 1.3%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1300 ppm: Sa:Cf£/PaprOv£/CcrFOv/ GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; drow; derm; narco, coma
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Cyclohexanethiol

Formula: $C_6H_{11}SH$ | **CAS#:** 1569-69-3 | **RTECS#:** GV7525000 | **IDLH:** N.D.

Conversion: 1 ppm = 4.75 mg/m^3 | **DOT:** 3054 129

Synonyms/Trade Names: Cyclohexylmercaptan, Cyclohexylthiol

Exposure Limits:
NIOSH REL: C 0.5 ppm (2.4 mg/m^3) [15-minute]
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with a strong, offensive odor.

Chemical & Physical Properties:
MW: 116.2
BP: 316°F
Sol: Insoluble
Fl.P: 110°F
IP: ?
Sp.Gr: 0.98
VP: 10 mmHg
FRZ: -181°F
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: CcrOv/Sa
12.5 ppm: Sa:Cf/PaprOv
25 ppm: CcrFOv/GmFOv/PaprTOv/ ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, reducing agents, strong acids, alkali metals

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; head, dizz, lass, nau, vomit, convuls; cough, wheez, laryngitis, dysp
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Cyclohexanol	Formula: $C_6H_{11}OH$	CAS#: 108-93-0	RTECS#: GV7875000	IDLH: 400 ppm
Conversion: 1 ppm = 4.10 mg/m^3	**DOT:** 1993 128 (combustible liquid, n.o.s.)			
Synonyms/Trade Names: Anol, Cyclohexyl alcohol, Hexahydrophenol, Hexalin, Hydralin, Hydroxycyclohexane				
Exposure Limits: **NIOSH REL:** TWA 50 ppm (200 mg/m^3) [skin] **OSHA PEL†:** TWA 50 ppm (200 mg/m^3)				**Measurement Methods (see Table 1):** **NIOSH** 1402, 1405 **OSHA** 7
Physical Description: Sticky solid or colorless to light-yellow liquid (above 77°F) with a camphor-like odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 100.2 **BP:** 322°F **Sol:** 4% **Fl.P:** 154°F **IP:** 10.00 eV **Sp.Gr:** 0.96 **VP:** 1 mmHg **MLT:** 77°F **UEL:** ? **LEL:** ? Class IIIA Combustible Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily	**NIOSH/OSHA** **400 ppm:** CcrOv*/PaprOv*/GmFOv/ Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers (such as hydrogen peroxide & nitric acid)

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, nose, throat; narco **TO:** Eyes, skin, resp sys	**Eye:** Irr immed **Skin:** Water wash prompt **Breath:** Resp support **Swallow:** Medical attention immed

Cyclohexanone	Formula: $C_6H_{10}O$	CAS#: 108-94-1	RTECS#: GW1050000	IDLH: 700 ppm
Conversion: 1 ppm = 4.02 mg/m^3	**DOT:** 1915 127			
Synonyms/Trade Names: Anone, Cyclohexyl ketone, Pimelic ketone				
Exposure Limits: **NIOSH REL:** TWA 25 ppm (100 mg/m^3) [skin] **OSHA PEL†:** TWA 50 ppm (200 mg/m^3)				**Measurement Methods (see Table 1):** **NIOSH** 1300, 2555 **OSHA** 1
Physical Description: Water-white to pale-yellow liquid with a peppermint- or acetone-like odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 98.2 **BP:** 312°F **Sol:** 15% **Fl.P:** 146°F **IP:** 9.14 eV **Sp.Gr:** 0.95 **VP:** 5 mmHg **FRZ:** -49°F **UEL:** 9.4% **LEL(212°F):** 1.1% Class IIIA Combustible Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.	**NIOSH** **625 ppm:** Sa:Cf£/PaprOv£ **700 ppm:** CcrFOv/GmFOv/PaprTOv£/ ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, nitric acid

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, muc memb; head; narco, coma; derm; in animals: liver, kidney damage **TO:** Eyes, skin, resp sys, CNS, liver, kidneys	**Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed

Cyclohexene	Formula: C_6H_{10}	CAS#: 110-83-8	RTECS#: GW2500000	IDLH: 2000 ppm
Conversion: 1 ppm = 3.36 mg/m^3	**DOT:** 2256 130			
Synonyms/Trade Names: Benzene tetrahydride, Tetrahydrobenzene				
Exposure Limits: **NIOSH REL:** TWA 300 ppm (1015 mg/m^3) **OSHA PEL:** TWA 300 ppm (1015 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1500 **OSHA** 7	
Physical Description: Colorless liquid with a sweet odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 82.2 **BP:** 181°F **Sol:** Insoluble **Fl.P:** 11°F **IP:** 8.95 eV **Sp.Gr:** 0.81 **VP:** 67 mmHg **FRZ:** -154°F **UEL:** ? **LEL:** ? Class IB Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.	**NIOSH/OSHA** **2000 ppm:** Sa:Cf£/PaprOv£/CcrFOv/ GmFOv/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers [**Note:** Forms explosive peroxides with oxygen upon storage.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Ing, Con **SY:** Irrit eyes, skin, resp sys; drow **TO:** Eyes, skin, resp sys, CNS	**Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed

Cyclohexylamine	Formula: $C_6H_{11}NH_2$	CAS#: 108-91-8	RTECS#: GX0700000	IDLH: N.D.
Conversion: 1 ppm = 4.06 mg/m^3	**DOT:** 2357 132			
Synonyms/Trade Names: Aminocyclohexane, Aminohexahydrobenzene, Hexahydroaniline, Hexahydrobenzenamine				
Exposure Limits: **NIOSH REL:** TWA 10 ppm (40 mg/m^3) **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **NIOSH** 2010 **OSHA** PV2016	
Physical Description: Colorless or yellow liquid with a strong, fishy, amine-like odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 99.2 **BP:** 274°F **Sol:** Miscible **Fl.P:** 88°F **IP:** 8.37 eV **Sp.Gr:** 0.87 **VP:** 11 mmHg **FRZ:** 0°F **UEL:** 9.4% **LEL:** 1.5% Class IC Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R. **Provide:** Eyewash Quick drench	Not available.

Incompatibilities and Reactivities: Oxidizers, organic compounds, acid anhydrides, acid chlorides, acids, lead [**Note:** Corrosive to copper, aluminum, zinc & galvanized steel.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, muc memb, resp sys; eye, skin burns; skin sens; cough, pulm edema; drow, dizz; diarr, nau, vomit **TO:** Eyes, skin, resp sys, CNS	**Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed

C

Cyclonite	Formula: $C_3H_6N_6O_6$	CAS#: 121-82-4	RTECS#: XY9450000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Cyclotrimethylenetrinitramine; Hexahydro-1,3,5-trinitro-s-triazine; RDX; Trimethylenetrinitramine; 1,3,5-Trinitro-1,3,5-triazacyclohexane

Exposure Limits:
NIOSH REL: TWA 1.5 mg/m^3
ST 3 mg/m^3 [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 0500

Physical Description: White, crystalline powder. [**Note:** A powerful high explosive.]

Chemical & Physical Properties:
MW: 222.2
BP: ?
Sol: Insoluble
Fl.P: Explodes
IP: ?
Sp.Gr: 1.82
VP(230°F): 0.0004 mmHg
MLT: 401°F
UEL: ?
LEL: ?
Combustible Solid [EXPLOSIVE!]

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers, combustible materials, heat
[**Note:** Detonates on contact with mercury fulminate.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; head, irrity, lass, tremor, nau, dizz, vomit, insom, convuls
TO: Eyes, skin, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Cyclopentadiene	Formula: C_5H_6	CAS#: 542-92-7	RTECS#: GY1000000	IDLH: 750 ppm
Conversion: 1 ppm = 2.70 mg/m^3	**DOT:**			

Synonyms/Trade Names: 1,3-Cyclopentadiene

Exposure Limits:
NIOSH REL: TWA 75 ppm (200 mg/m^3)
OSHA PEL: TWA 75 ppm (200 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2523

Physical Description: Colorless liquid with an irritating, terpene-like odor.

Chemical & Physical Properties:
MW: 66.1
BP: 107°F
Sol: Insoluble
Fl.P(oc): 77°F
IP: 8.56 eV
Sp.Gr: 0.80
VP: 400 mmHg
FRZ: -121°F
UEL: ?
LEL: ?
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
750 ppm: CcrOv/GmFOv/PaprOv/Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, fuming nitric acid, sulfuric acid
[**Note:** Polymerizes to dicyclopentadiene upon standing.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose
TO: Eyes, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Cyclopentane	**Formula:** C_5H_{10}	**CAS#:** 287-92-3	**RTECS#:** GY2390000	**IDLH:** N.D.
Conversion: 1 ppm = 2.87 mg/m^3	**DOT:** 1146 128			
Synonyms/Trade Names: Pentamethylene				
Exposure Limits: **NIOSH REL:** TWA 600 ppm (1720 mg/m^3) **OSHA PEL†:** none				**Measurement Methods (see Table 1):** None available
Physical Description: Colorless liquid with a mild, sweet odor.				

Chemical & Physical Properties:	**Personal Protection/Sanitation (see Table 2):**	**Respirator Recommendations (see Tables 3 and 4):**
MW: 70.2 **BP:** 121°F **Sol:** Insoluble **Fl.P:** -35°F **IP:** 10.52 eV **Sp.Gr:** 0.75 **VP(88°F):** 400 mmHg **FRZ:** -137°F **UEL:** 8.7% **LEL:** 1.1% Class IB Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** Daily **Remove:** When wet (flamm) **Change:** N.R.	Not available.

Incompatibilities and Reactivities: Strong oxidizers (e.g., chlorine, bromine, fluorine)	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat; dizz, euph, inco, nau, vomit, stupor; dry, cracking skin **TO:** Eyes, skin, resp sys, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash **Breath:** Resp support **Swallow:** Medical attention immed

Cyhexatin	**Formula:** $(C_6H_{11})_3SnOH$	**CAS#:** 13121-70-5	**RTECS#:** WH8750000	**IDLH:** 80 mg/m^3 [25 mg/m^3 (as Sn)]
Conversion:	**DOT:**			
Synonyms/Trade Names: TCHH, Tricyclohexylhydroxystannane, Tricyclohexylhydroxytin, Tricyclohexylstannium hydroxide, Tricyclohexyltin hydroxide				
Exposure Limits: **NIOSH REL:** TWA 5 mg/m^3 **OSHA PEL†:** TWA 0.32 mg/m^3 [0.1 mg/m^3 (as Sn)]				**Measurement Methods (see Table 1):** **NIOSH** 5504
Physical Description: Colorless to white, nearly odorless, crystalline powder. [insecticide]				

Chemical & Physical Properties:	**Personal Protection/Sanitation (see Table 2):**	**Respirator Recommendations (see Tables 3 and 4):**
MW: 385.2 **BP:** 442°F (Decomposes) **Sol:** Insoluble **Fl.P:** NA **IP:** NA **Sp.Gr:** ? **VP:** 0 mmHg (approx) **MLT:** 383°F **UEL:** NA **LEL:** NA	**Skin:** Prevent skin contact **Eyes:** N.R. **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily	**OSHA** **3.2 mg/m^3:** CcrOv95/Sa **8 mg/m^3:** Sa:Cf/PaprOvHie **16 mg/m^3:** CcrFOv100/GmFOv100/ PaprTOvHie/SaT:Cf/ScbaF/SaF **80 mg/m^3:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, ultraviolet light	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, resp sys; head, dizz; sore throat, cough; abdom pain, vomit; skin burns, pruritus; in animals: liver, kidney damage **TO:** Eyes, skin, resp sys, liver, kidneys	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed

D

2,4-D	Formula: $Cl_2C_6H_3OCH_2COOH$	CAS#: 94-75-7	RTECS#: AG6825000	IDLH: 100 mg/m^3
Conversion:	**DOT:** 2765 152			

Synonyms/Trade Names: Dichlorophenoxyacetic acid; 2,4-Dichlorophenoxyacetic acid

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3
OSHA PEL: TWA 10 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5001

Physical Description: White to yellow, crystalline, odorless powder. [herbicide]

Chemical & Physical Properties:
MW: 221.0
BP: Decomposes
Sol: 0.05%
Fl.P: NA
IP: ?
Sp.Gr: 1.57
VP(320°F): 0.4 mmHg
MLT: 280°F
UEL: NA
LEL: NA
Noncombustible Solid, but may be dissolved in flammable liquids.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
100 mg/m^3: CcrOv95/GmFOv100/ PaprOvHie/Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Lass, stupor, hyporeflexia, musc twitch; convuls; derm; in animals: liver, kidney inj
TO: Skin, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

DDT	Formula: $(C_6H_4Cl)_2CHCCl_3$	CAS#: 50-29-3	RTECS#: KJ3325000	IDLH: Ca [500 mg/m^3]
Conversion:	**DOT:** 2761 151			

Synonyms/Trade Names: p,p'-DDT; Dichlorodiphenyltrichloroethane; 1,1,1-Trichloro-2,2-bis(p-chlorophenyl)ethane

Exposure Limits:
NIOSH REL: Ca
TWA 0.5 mg/m^3
See Appendix A
OSHA PEL: TWA 1 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH S274 (II-3)

Physical Description: Colorless crystals or off-white powder with a slight, aromatic odor. [pesticide]

Chemical & Physical Properties:
MW: 354.5
BP: 230°F (Decomposes)
Sol: Insoluble
Fl.P: 162-171°F
IP: ?
Sp.Gr: 0.99
VP: 0.0000002 mmHg
MLT: 227°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; pares tongue, lips, face; tremor; anxi, dizz, conf, mal, head, lass; convuls; paresis hands; vomit; [carc]
TO: Eyes, skin, CNS, kidneys, liver, PNS [in animals: liver, lung & lymphatic tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Decaborane	Formula: $B_{10}H_{14}$	CAS#: 17702-41-9	RTECS#: HD1400000	IDLH: 15 mg/m^3
Conversion: 1 ppm = 5.00 mg/m^3	**DOT:** 1868 134			
Synonyms/Trade Names: Decaboron tetradecahydride				

Exposure Limits:
NIOSH REL: TWA 0.3 mg/m^3 (0.05 ppm) [skin]
ST 0.9 mg/m^3 (0.15 ppm)
OSHA PEL†: TWA 0.3 mg/m^3 (0.05 ppm) [skin]

Measurement Methods (see Table 1):
None available

Physical Description: Colorless to white crystalline solid with an intense, bitter, chocolate-like odor.

Chemical & Physical Properties:
MW: 122.2
BP: 415°F
Sol: Slight
Fl.P: 176°F
IP: 9.88 eV
Sp.Gr: 0.94
VP: 0.2 mmHg
MLT: 211°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
3 mg/m^3: Sa
7.5 mg/m^3: Sa:Cf
15 mg/m^3: SaT:Cf/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Oxidizers, water, halogenated compounds (especially carbon tetrachloride) [**Note:** May ignite SPONTANEOUSLY on exposure to air. Decomposes slowly in hot water.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Dizz, head, nau, drow; inco, local musc spasm, tremor, convuls; lass; in animals: dysp; lass; liver, kidney damage
TO: CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

1-Decanethiol	Formula: $CH_3(CH_2)_9SH$	CAS#: 143-10-2	RTECS#:	IDLH: N.D.
Conversion: 1 ppm = 7.13 mg/m^3	**DOT:** 1228 131			
Synonyms/Trade Names: Decylmercaptan, n-Decylmercaptan, 1-Mercaptodecane				

Exposure Limits:
NIOSH REL: C 0.5 ppm (3.6 mg/m^3) [15-minute]
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with a strong odor.

Chemical & Physical Properties:
MW: 174.4
BP: 465°F
Sol: Insoluble
Fl.P: 209°F
IP: ?
Sp.Gr: 0.84
VP: ?
FRZ: -15°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: CcrOv/Sa
12.5 ppm: Sa:Cf/PaprOv
25 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, strong acids & bases, alkali metals, nitric acid

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; conf, dizz, head, drow, nau, vomit, lass, convuls
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

D

Demeton

Formula:	CAS#:	RTECS#:	IDLH:
$(C_2H_5O)_2PSOC_2H_4SC_2H_5$	8065-48-3	TF3150000	10 mg/m^3

Conversion: **DOT:**

Synonyms/Trade Names: O-O-Diethyl-O(and S)-2-(ethylthio)ethyl phosphorothioate mixture, Systox®

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3 [skin]
OSHA PEL: TWA 0.1 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 5514

Physical Description: Amber, oily liquid with a sulfur-like odor. [insecticide]

Chemical & Physical Properties:
MW: 258.3
BP: Decomposes
Sol: 0.01%
Fl.P: 113°F
IP: ?
Sp.Gr: 1.12
VP: 0.0003 mmHg
FRZ: <-13°F
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1 mg/m^3: Sa
2.5 mg/m^3: Sa:Cf
5 mg/m^3: SaT:Cf/ScbaF/SaF
10 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, alkalis, water

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; miosis, ache eyes, rhin, head; chest tight, wheez, lar spasm, salv, cyan; anor, nau, vomit, abdom cramps, diarr; local sweat; musc fasc, lass, para; dizz, conf, ataxia; convuls, coma; low BP; card irreg
TO: Eyes, skin, resp sys, CVS, CNS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Diacetone alcohol

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3COCH_2C(CH_3)_2OH$	123-42-2	SA9100000	1800 ppm [10%LEL]

Conversion: 1 ppm = 4.75 mg/m^3 **DOT:** 1148 129

Synonyms/Trade Names: Diacetone, 4-Hydroxy-4-methyl-2-pentanone, 2-Methyl-2-pentanol-4-one

Exposure Limits:
NIOSH REL: TWA 50 ppm (240 mg/m^3)
OSHA PEL: TWA 50 ppm (240 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1402, 1405
OSHA 7

Physical Description: Colorless liquid with a faint, minty odor.

Chemical & Physical Properties:
MW: 116.2
BP: 334°F
Sol: Miscible
Fl.P: 125°F
IP: ?
Sp.Gr: 0.94
VP: 1 mmHg
FRZ: -47°F
UEL: 6.9%
LEL: 1.8%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1250 ppm: Sa:Cf£/PaprOv£
1800 ppm: CcrFOv/GmFOv/PaprTOv£/ ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; corn damage; in animals: narco, liver damage
TO: Eyes, skin, resp sys, CNS, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

2,4-Diaminoanisole (and its salts)

Formula:	CAS#:	RTECS#:	IDLH:
$(NH_2)_2C_6H_3OCH_3$	615-05-4	BZ8580500	Ca [N.D.]

Conversion: **DOT:**

Synonyms/Trade Names: 1,3-Diamino-4-methoxybenzene; 4-Methoxy-1,3-benzene-diamine; 4-Methoxy-m-phenylene-diamine (Synonyms of salts vary depending upon the specific compound.)

Exposure Limits:
NIOSH REL: Ca
Minimize occupational exposure (especially skin exposures)
See Appendix A
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless solid (needles).
[**Note:** The primary use (including its salts such as 2,4-diaminoanisole sulfate) is a component of hair & fur dye formulations.]

Chemical & Physical Properties:
MW: 138.2
BP: ?
Sol: ?
Fl.P: ?
IP: ?
Sp.Gr: ?
VP: ?
MLT: 153°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: In animals: irrit skin; thyroid, liver changes; terato effects; [carc]
TO: Skin, thyroid, liver, repro sys [in animals: thyroid, liver, skin & lymphatic sys tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

o-Dianisidine

Formula:	CAS#:	RTECS#:	IDLH:
$(NH_2C_6H_3OCH_3)_2$	119-90-4	DD0875000	Ca [N.D.]

Conversion: **DOT:**

Synonyms/Trade Names: Dianisidine; 3,3'-Dianisidine; 3,3'-Dimethoxybenzidine

Exposure Limits:
NIOSH REL: Ca
See Appendix A
See Appendix C
OSHA PEL: See Appendix C

Measurement Methods (see Table 1):
NIOSH 5013
OSHA 71

Physical Description: Colorless crystals that turn a violet color on standing.
[**Note:** Used as a basis for many dyes.]

Chemical & Physical Properties:
MW: 244.3
BP: ?
Sol: Insoluble
Fl.P: 403°F
IP: ?
Sp.Gr: ?
VP: ?
MLT: 279°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit skin; in animals: kidney, liver damage; thyroid, spleen changes; [carc]
TO: Skin, kidneys, liver, thyroid, liver [in animals: bladder, liver, stomach & mammary gland tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Diazinon®

Formula:	CAS#:	RTECS#:	IDLH:
$C_{12}H_{21}N_2O_3PS$	333-41-5	TF3325000	N.D.

Conversion: **DOT:** 2783 152

Synonyms/Trade Names: Basudin®; Diazide®; O,O-Diethyl-O-2-isopropyl-4-methyl-6-pyrimidinyl-phosphorothioate; Spectracide®

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3 [skin]
OSHA PEL†: none

Physical Description: Colorless liquid with a faint ester-like odor. [insecticide] [**Note:** Technical grade is pale to dark brown.]

Measurement Methods (see Table 1):
NIOSH 5600
OSHA 62

Chemical & Physical Properties:
MW: 304.4
BP: Decomposes
Sol: 0.004%
Fl.P: 180°F
IP: ?
Sp.Gr: 1.12
VP: 0.0001 mmHg
FRZ: ?
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong acids & alkalis, copper-containing compounds [**Note:** Hydrolyzes slowly in water & dilute acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes; miosis, blurred vision; dizz, conf, lass, convuls; dysp; salv, abdom cramps, nau, vomit
TO: Eyes, resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Diazomethane

Formula:	CAS#:	RTECS#:	IDLH:
CH_2N_2	334-88-3	PA7000000	2 ppm

Conversion: 1 ppm = 1.72 mg/m^3 **DOT:**

Synonyms/Trade Names: Azimethylene, Azomethylene, Diazirine

Exposure Limits:
NIOSH REL: TWA 0.2 ppm (0.4 mg/m^3)
OSHA PEL: TWA 0.2 ppm (0.4 mg/m^3)

Physical Description: Yellow gas with a musty odor. [**Note:** Shipped as a liquefied compressed gas.]

Measurement Methods (see Table 1):
NIOSH 2515

Chemical & Physical Properties:
MW: 42.1
BP: -9°F
Sol: Reacts
Fl.P: NA (Gas)
IP: 9.00 eV
RGasD: 1.45
VP: >1 atm
FRZ: -229°F
UEL: ?
LEL: ?
Flammable Gas [EXPLOSIVE!]

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2 ppm: Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Alkali metals, water, drying agents such as calcium arsenate [**Note:** May explode violently on heating, exposure to sunlight, or contact with rough edges such as ground glass.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Irrit eyes; cough, short breath; head, lass; flush skin, fever; chest pain, pulm edema, pneu; asthma; liquid: frostbite
TO: Eyes, resp sys

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Diborane

Formula: B_2H_6 | **CAS#:** 19287-45-7 | **RTECS#:** HQ9275000 | **IDLH:** 15 ppm

Conversion: 1 ppm = 1.13 mg/m^3 | **DOT:** 1911 119

Synonyms/Trade Names: Boroethane, Boron hydride, Diboron hexahydride

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.1 mg/m^3)
OSHA PEL: TWA 0.1 ppm (0.1 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 6006

Physical Description: Colorless gas with a repulsive, sweet odor.
[**Note:** Usually shipped in pressurized cylinders diluted with hydrogen, argon, nitrogen, or helium.]

Chemical & Physical Properties:
MW: 27.7
BP: -135°F
Sol: Reacts
Fl.P: NA (Gas)
IP: 11.38 eV
RGasD: 0.97
VP(62°F): 39.5 atm
FRZ: -265°F
UEL: 88%
LEL: 0.8%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1 ppm: Sa
2.5 ppm: Sa:Cf
5 ppm: SaT:Cf/ScbaF/SaF
15 ppm: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Water, halogenated compounds, aluminum, lithium, oxidized surfaces, acids [**Note:** Will ignite spontaneously in moist air at room temperature. Reacts with water to form hydrogen & boric acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh
SY: Chest tight, precordial pain, short breath, nonproductive cough, nau; head, dizz, chills, fever, lass, tremor, musc fasc; in animals: liver, kidney damage; pulm edema; hemorr
TO: Resp sys, CNS, liver, kidneys

First Aid (see Table 6):
Breath: Resp support

1,2-Dibromo-3-chloropropane

Formula: $CH_2BrCHBrCH_2Cl$ | **CAS#:** 96-12-8 | **RTECS#:** TX8750000 | **IDLH:** Ca [N.D.]

Conversion: 1 ppm = 9.67 mg/m^3 | **DOT:** 2872 159

Synonyms/Trade Names: 1-Chloro-2,3-dibromopropane; DBCP; Dibromochloropropane

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1044] TWA 0.001 ppm

Measurement Methods (see Table 1):
None available

Physical Description: Dense yellow or amber liquid with a pungent odor at high concentrations. [pesticide]
[**Note:** A solid below 43°F.]

Chemical & Physical Properties:
MW: 236.4
BP: 384°F
Sol: 0.1%
Fl.P(oc): 170°F
IP: ?
Sp.Gr: 2.05
VP: 0.8 mmHg
FRZ: 43°F
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Chemically-active metals such as aluminum, magnesium & tin alloys [**Note:** Corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; drow; nau, vomit; pulm edema; liver, kidney inj; sterility; [carc]
TO: Eyes, skin, resp sys, CNS, liver, kidneys, spleen, repro sys, digestive sys [in animals: cancer of the nasal cavity, tongue, pharynx, lungs, stomach, adrenal & mammary glands]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

2-N-Dibutylaminoethanol	Formula: $(C_4H_9)_2NCH_2CH_2OH$	CAS#: 102-81-8	RTECS#: KK3850000	IDLH: N.D.
Conversion: 1 ppm = 7.09 mg/m^3	**DOT:** 2873 153			
Synonyms/Trade Names: Dibutylaminoethanol; 2-Dibutylaminoethanol; 2-Di-N-butylaminoethanol; 2-Di-N-butylaminoethyl alcohol; N,N-Dibutylethanolamine				
Exposure Limits: **NIOSH REL:** TWA 2 ppm (14 mg/m^3) [skin] **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **NIOSH** 2007	
Physical Description: Colorless liquid with a faint, amine-like odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 173.3 **BP:** 446°F **Sol:** 0.4% **Fl.P:** 195°F **IP:** ? **Sp.Gr:** 0.86 **VP:** 0.1 mmHg **FRZ:** ? **UEL:** ? **LEL:** ? Class IIIA Combustible Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R. **Provide:** Eyewash Quick drench	Not available.

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Abs, Ing, Con **SY:** In animals: irrit eyes, skin, nose; derm; skin, corn nec; low-wgt **TO:** Eyes, skin, resp sys	**Eye:** Irr immed **Skin:** Soap flush immed **Breath:** Resp support **Swallow:** Medical attention immed

2,6-Di-tert-butyl-p-cresol	Formula: $[C(CH_3)_3]_2CH_3C_6H_2OH$	CAS#: 128-37-0	RTECS#: GO7875000	IDLH: N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: BHT; Butylated hydroxytoluene; Dibutylated hydroxytoluene; 4-Methyl-2,6-di-tert-butyl phenol				
Exposure Limits: **NIOSH REL:** TWA 10 mg/m^3 **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **NIOSH** P&CAM226 (II-1) **OSHA** PV2108	
Physical Description: White to pale-yellow, crystalline solid with a slight, phenolic odor. [food preservative]				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 220.4 **BP:** 509°F **Sol:** 0.00004% **Fl.P:** 261°F **IP:** ? **Sp.Gr:** 1.05 **VP:** 0.01 mmHg **MLT:** 158°F **UEL:** ? **LEL:** ? Class IIIB Combustible Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily	Not available.

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Ing, Con **SY:** Irrit eyes, skin; in animals: decr growth rate, incr liver weight **TO:** Eyes, skin	**Eye:** Irr immed **Skin:** Soap wash **Breath:** Fresh air **Swallow:** Medical attention immed

Dibutyl phosphate	**Formula:** $(C_4H_9O)_2(OH)PO$	**CAS#:** 107-66-4	**RTECS#:** TB9605000	**IDLH:** 30 ppm
Conversion: 1 ppm = 8.60 mg/m^3	**DOT:**			
Synonyms/Trade Names: Dibutyl acid o-phosphate, Di-n-butyl hydrogen phosphate, Dibutyl phosphoric acid				

Exposure Limits:
NIOSH REL: TWA 1 ppm (5 mg/m^3)
ST 2 ppm (10 mg/m^3)
OSHA PEL†: TWA 1 ppm (5 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 5017

Physical Description: Pale-amber, odorless liquid.

Chemical & Physical Properties:
MW: 210.2
BP: 212°F (Decomposes)
Sol: Insoluble
Fl.P: ?
IP: ?
Sp.Gr: 1.06
VP: 1 mmHg (approx)
FRZ: ?
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 ppm: Sa
25 ppm: Sa:Cf
30 ppm: SaT:Cf/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; head
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Dibutyl phthalate	**Formula:** $C_6H_4(COOC_4H_9)_2$	**CAS#:** 84-74-2	**RTECS#:** TI0875000	**IDLH:** 4000 mg/m^3
Conversion: 1 ppm = 11.57 mg/m^3	**DOT:**			
Synonyms/Trade Names: DBP; Dibutyl-1,2-benzene-dicarboxylate; Di-n-butyl phthalate				

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL: TWA 5 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5020
OSHA 104

Physical Description: Colorless to faint-yellow, oily liquid with a slight, aromatic odor.

Chemical & Physical Properties:
MW: 278.3
BP: 644°F
Sol(77°F): 0.001%
Fl.P: 315°F
IP: ?
Sp.Gr: 1.05
VP: 0.00007 mmHg
FRZ: -31°F
UEL: ?
LEL(456°F): 0.5%
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 mg/m^3: 95F
125 mg/m^3: Sa:Cf£/PaprHie£
250 mg/m^3: 100F/ScbaF/SaF
4000 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids; liquid chlorine

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, upper resp sys, stomach
TO: Eyes, resp sys, GI tract

First Aid (see Table 6):
Eye: Irr immed
Skin: Wash regularly
Breath: Resp support
Swallow: Medical attention immed

Dichloroacetylene

Formula:	CAS#:	RTECS#:	IDLH:
C_2Cl_2	7572-29-4	AP1080000	Ca [N.D.]

Conversion: 1 ppm = 3.88 mg/m^3 **DOT:**

Synonyms/Trade Names: DCA, Dichloroethyne
[**Note:** DCA is a possible decomposition product of trichloroethylene or trichloroethane.]

Exposure Limits:
NIOSH REL: Ca
C 0.1 ppm (0.4 mg/m^3)
See Appendix A
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Volatile oil with a disagreeable, sweetish odor.
[**Note:** A gas above 90°F. DCA is not produced commercially.]

Chemical & Physical Properties:
MW: 94.9
BP: 90°F (Explodes)
Sol: ?
Fl.P: ?
IP: ?
Sp.Gr: 1.26
VP: ?
FRZ: -58 to -87°F
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, heat, shock

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Head, loss of appetite, nau, vomit, intense jaw pain, cranial nerve palsy; in animals: kidney, liver, brain inj; low-wgt; [carc]
TO: CNS [in animals: kidney tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

o-Dichlorobenzene

Formula:	CAS#:	RTECS#:	IDLH:
$C_6H_4Cl_2$	95-50-1	CZ4500000	200 ppm

Conversion: 1 ppm = 6.01 mg/m^3 **DOT:** 1591 152

Synonyms/Trade Names: o-DCB; 1,2-Dichlorobenzene; ortho-Dichlorobenzene; o-Dichlorobenzol

Exposure Limits:
NIOSH REL: C 50 ppm (300 mg/m^3)
OSHA PEL: C 50 ppm (300 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 7

Physical Description: Colorless to pale-yellow liquid with a pleasant, aromatic odor. [herbicide]

Chemical & Physical Properties:
MW: 147.0
BP: 357°F
Sol: 0.01%
Fl.P: 151°F
IP: 9.06 eV
Sp.Gr: 1.30
VP: 1 mmHg
FRZ: 1°F
UEL: 9.2%
LEL: 2.2%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
200 ppm: CcrFOv/PaprOv£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, aluminum, chlorides, acids, acid fumes

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose; liver, kidney damage; skin blisters
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

p-Dichlorobenzene	Formula: $C_6H_4Cl_2$	CAS#: 106-46-7	RTECS#: CZ4550000	IDLH: Ca [150 ppm]
Conversion: 1 ppm = 6.01 mg/m^3	**DOT:**			

Synonyms/Trade Names: p-DCB; 1,4-Dichlorobenzene; para-Dichlorobenzene; Dichlorocide

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: TWA 75 ppm (450 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 7

Physical Description: Colorless or white crystalline solid with a mothball-like odor. [insecticide]

Chemical & Physical Properties:
MW: 147.0
BP: 345°F
Sol: 0.008%
Fl.P: 150°F
IP: 8.98 eV
Sp.Gr: 1.25
VP: 1.3 mmHg
MLT: 128°F
UEL: ?
LEL: 2.5%
Combustible Solid, but may take some effort to ignite.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers (such as chlorine or permanganate)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Eye irrit, swell periorb; profuse rhinitis; head, anor, nau, vomit; low-wgt, jaun, cirr; in animals: liver, kidney inj; [carc]
TO: Liver, resp sys, eyes, kidneys, skin [in animals: liver & kidney cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

3,3'-Dichlorobenzidine (and its salts)	Formula: $NH_2ClC_6H_3C_6H_3ClNH_2$	CAS#: 91-94-1	RTECS#: DD0525000	IDLH: Ca [N.D.]
Conversion:	**DOT:**			

Synonyms/Trade Names: 4,4'-Diamino-3,3'-dichlorobiphenyl; Dichlorobenzidine base; o,o'-Dichlorobenzidine; 3,3'-Dichlorobiphenyl-4,4'-diamine; 3,3'-Dichloro-4,4'-biphenyldiamine; 3,3'-Dichloro-4,4'-diaminobiphenyl

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1007] See Appendix B

Measurement Methods (see Table 1):
NIOSH 5509
OSHA 65

Physical Description: Gray to purple, crystalline solid.

Chemical & Physical Properties:
MW: 253.1
BP: 788°F
Sol(59°F): 0.07%
Fl.P: ?
IP: ?
Sp.Gr: ?
VP: ?
MLT: 271°F
UEL: ?
LEL: ?

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Skin sens, derm; head, dizz; caustic burns; frequent urination, dysuria; hema; GI upset; upper resp infection; [carc]
TO: Bladder, liver, lung, skin, GI tract [in animals: liver & bladder cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Dichlorodifluoromethane	**Formula:** CCl_2F_2	**CAS#:** 75-71-8	**RTECS#:** PA8200000	**IDLH:** 15,000 ppm
Conversion: 1 ppm = 4.95 mg/m^3	**DOT:** 1028 126			

Synonyms/Trade Names: Difluorodichloromethane, Fluorocarbon 12, Freon® 12, Genetron® 12, Halon® 122, Propellant 12, Refrigerant 12

Exposure Limits:
NIOSH REL: TWA 1000 ppm (4950 mg/m^3)
OSHA PEL: TWA 1000 ppm (4950 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1018

Physical Description: Colorless gas with an ether-like odor at extremely high concentrations. [**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 120.9
BP: -22°F
Sol(77°F): 0.03%
Fl.P: NA
IP: 11.75 eV
RGasD: 4.2
VP: 5.7 atm
FRZ: -252°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10,000 ppm: Sa
15,000 ppm: Sa:Cf/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as sodium, potassium, calcium, powdered aluminum, zinc & magnesium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Dizz, tremor, asphy, uncon, card arrhy, card arrest; liquid: frostbite
TO: CVS, PNS

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

1,3-Dichloro-5,5-dimethylhydantoin	**Formula:** $C_5H_6Cl_2N_2O_2$	**CAS#:** 118-52-5	**RTECS#:** MU0700000	**IDLH:** 5 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names: Dactin, DDH, Halane

Exposure Limits:
NIOSH REL: TWA 0.2 mg/m^3
ST 0.4 mg/m^3
OSHA PEL†: TWA 0.2 mg/m^3

Measurement Methods (see Table 1):
None available

Physical Description: White powder with a chlorine-like odor.

Chemical & Physical Properties:
MW: 197.0
BP: ?
Sol: 0.2%
Fl.P: 346°F
IP: ?
Sp.Gr: 1.5
VP: ?
MLT: 270°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2 mg/m^3: Sa
5 mg/m^3: Sa:Cf/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS100/ScbaE

Incompatibilities and Reactivities: Water, strong acids, easily oxidized materials such as ammonia salts & sulfides

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, muc memb, resp sys
TO: Eyes, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

1,1-Dichloroethane

Formula:	CAS#:	RTECS#:	IDLH:
$CHCl_2CH_3$	75-34-3	KI0175000	3000 ppm

Conversion: 1 ppm = 4.05 mg/m^3

DOT: 2362 130

Synonyms/Trade Names: Asymmetrical dichloroethane; Ethylidene chloride; 1,1-Ethylidene dichloride

Exposure Limits:
NIOSH REL: TWA 100 ppm (400 mg/m^3)
See Appendix C (Chloroethanes)
OSHA PEL: TWA 100 ppm (400 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 7

Physical Description: Colorless, oily liquid with a chloroform-like odor.

Chemical & Physical Properties:
MW: 99.0
BP: 135°F
Sol: 0.6%
Fl.P: 2°F
IP: 11.06 eV
Sp.Gr: 1.18
VP: 182 mmHg
FRZ: -143°F
UEL: 11.4%
LEL: 5.4%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1000 ppm: Sa
2500 ppm: Sa:Cf
3000 ppm: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong caustics

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit skin; CNS depres; liver, kidney, lung damage
TO: Skin, liver, kidneys, lungs, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush prompt
Breath: Resp support
Swallow: Medical attention immed

1,2-Dichloroethylene

Formula:	CAS#:	RTECS#:	IDLH:
ClCH=CHCl	540-59-0	KV9360000	1000 ppm

Conversion: 1 ppm = 3.97 mg/m^3

DOT: 1150 130P

Synonyms/Trade Names: Acetylene dichloride, cis-Acetylene dichloride, trans-Acetylene dichloride, sym-Dichloroethylene

Exposure Limits:
NIOSH REL: TWA 200 ppm (790 mg/m^3)
OSHA PEL: TWA 200 ppm (790 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 7

Physical Description: Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor.

Chemical & Physical Properties:
MW: 97.0
BP: 118-140°F
Sol: 0.4%
Fl.P: 36-39°F
IP: 9.65 eV
Sp.Gr(77°F): 1.27
VP: 180-265 mmHg
FRZ: -57 to -115°F
UEL: 12.8%
LEL: 5.6%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2000 ppm: Sa:Cf£/PaprOv£/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong alkalis, potassium hydroxide, copper [**Note:** Usually contains inhibitors to prevent polymerization.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, resp sys; CNS depres
TO: Eyes, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Dichloroethyl ether

Formula:	CAS#:	RTECS#:	IDLH:
$(ClCH_2CH_2)_2O$	111-44-4	KN0875000	Ca [100 ppm]

Conversion: 1 ppm = 5.85 mg/m^3 **DOT:** 1916 152

Synonyms/Trade Names: bis(2-Chloroethyl)ether; 2,2'-Dichlorodiethyl ether, 2,2'-Dichloroethyl ether

Exposure Limits:
NIOSH REL: Ca
TWA 5 ppm (30 mg/m^3)
ST 10 ppm (60 mg/m^3) [skin]
See Appendix A
OSHA PEL†: TWA 15 ppm (90 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1004
OSHA 7

Physical Description: Colorless liquid with a chlorinated solvent-like odor.

Chemical & Physical Properties:
MW: 143.0
BP: 352°F
Sol: 1%
Fl.P: 131°F
IP: ?
Sp.Gr: 1.22
VP: 0.7 mmHg
FRZ: -58°F
UEL: ?
LEL: 2.7%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers
[**Note:** Decomposes in presence of moisture to form hydrochloric acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit nose, throat, resp sys; lac; cough; nau, vomit; in animals: pulm edema; liver damage; [carc]
TO: Eyes, resp sys, liver [in animals: liver tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Dichloromonofluoromethane

Formula:	CAS#:	RTECS#:	IDLH:
$CHCl_2F$	75-43-4	PA8400000	5000 ppm

Conversion: 1 ppm = 4.21 mg/m^3 **DOT:** 1029 126

Synonyms/Trade Names: Dichlorofluoromethane, Fluorodichloromethane, Freon® 21, Genetron® 21, Halon® 112, Refrigerant 21

Exposure Limits:
NIOSH REL: TWA 10 ppm (40 mg/m^3)
OSHA PEL†: TWA 1000 ppm (4200 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2516

Physical Description: Colorless gas with a slight, ether-like odor.
[**Note:** A liquid below 48°F. Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 102.9
BP: 48°F
Sol(86°F): 0.7%
Fl.P: NA
IP: 12.39 eV
RGasD: 3.57
VP(70°F): 1.6 atm
FRZ: -211°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
100 ppm: Sa
250 ppm: Sa:Cf
500 ppm: ScbaF/SaF
5000 ppm: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as sodium, potassium, calcium, powdered aluminum, zinc & magnesium; acid; acid fumes

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Asphy, card arrhy, card arrest; liquid: frostbite
TO: Resp sys, CVS

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

1,1-Dichloro-1-nitroethane	Formula: $CH_3CCl_2NO_2$	CAS#: 594-72-9	RTECS#: KI0500000	IDLH: 25 ppm
Conversion: 1 ppm = 5.89 mg/m^3	**DOT:** 2650 153			
Synonyms/Trade Names: Dichloronitroethane				

Exposure Limits:
NIOSH REL: TWA 2 ppm (10 mg/m^3)
OSHA PEL†: C 10 ppm (60 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1601
OSHA 7

Physical Description: Colorless liquid with an unpleasant odor. [fumigant]

Chemical & Physical Properties:
MW: 143.9
BP: 255°F
Sol: 0.3%
Fl.P: 136°F
IP: ?
Sp.Gr: 1.43
VP: 15 mmHg
FRZ: ?
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
20 ppm: Sa
25 ppm: Sa:Cf/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers [**Note:** Corrosive to iron in presence of moisture.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: irrit eyes, skin; liver, heart, kidney damage; pulm edema, hemorr
TO: Eyes, skin, resp sys, liver, kidneys, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

1,3-Dichloropropene	Formula: $ClHC{=}CHCH_2Cl$	CAS#: 542-75-6	RTECS#: UC8310000	IDLH: Ca [N.D.]
Conversion: 1 ppm = 4.54 mg/m^3	**DOT:** 2047 129			
Synonyms/Trade Names: 3-Chloroallyl chloride; DCP; 1,3-Dichloro-1-propene; 1,3-Dichloropropylene; Telone®				

Exposure Limits:
NIOSH REL: Ca
TWA 1 ppm (5 mg/m^3) [skin]
See Appendix A
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless to straw-colored liquid with a sharp, sweet, irritating, chloroform-like odor. [insecticide] [**Note:** Exists as mixture of cis- & trans-isomers.]

Chemical & Physical Properties:
MW: 111.0
BP: 226°F
Sol: 0.2%
Fl.P: 77°F
IP: ?
Sp.Gr: 1.21
VP: 28 mmHg
FRZ: -119°F
UEL: 14.5%
LEL: 5.3%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Aluminum, magnesium, halogens, oxidizers [**Note:** Epichlorohydrin may be added as a stabilizer.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; eye, skin burns; lac; head, dizz; in animals; liver, kidney damage; [carc]
TO: Eyes, skin, resp sys, CNS, liver, kidneys [in animals: cancer of the bladder, liver, lung & forestomach]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

D

2,2-Dichloropropionic acid

Formula:	CAS#:	RTECS#:	IDLH:
CH_3CCl_2COOH	75-99-0	UF0690000	N.D.

Conversion: 1 ppm = 5.85 mg/m^3 **DOT:**

Synonyms/Trade Names: Dalapon; 2,2-Dichloropropanoic acid; α,α-Dichloropropionic acid

Exposure Limits:
NIOSH REL: TWA 1 ppm (6 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2017

Physical Description: Colorless liquid with an acrid odor. [herbicide] [**Note:** A white to tan powder below 46°F. The sodium salt, a white powder, is often used.]

Chemical & Physical Properties:
MW: 143.0
BP: 374°F
Sol: 50%
Fl.P: NA
IP: ?
Sp.Gr: 1.40
VP: ?
FRZ: 46°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Metals
[**Note:** Very corrosive to aluminum & copper alloys. Reacts slowly in water to form hydrochloric & pyruvic acids.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; skin burns; lass, loss of appetite, diarr, vomit, slowing of pulse; CNS depres
TO: Eyes, skin, resp sys, GI tract, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Dichlorotetrafluoroethane

Formula:	CAS#:	RTECS#:	IDLH:
$CClF_2CClF_2$	76-14-2	KI1101000	15,000 ppm

Conversion: 1 ppm = 6.99 mg/m^3 **DOT:** 1958 126

Synonyms/Trade Names: 1,2-Dichlorotetrafluoroethane; Freon® 114; Genetron® 114; Halon® 242; Refrigerant 114

Exposure Limits:
NIOSH REL: TWA 1000 ppm (7000 mg/m^3)
OSHA PEL: TWA 1000 ppm (7000 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1018

Physical Description: Colorless gas with a faint, ether-like odor at high concentrations. [**Note:** A liquid below 38°F. Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 170.9
BP: 38°F
Sol: 0.01%
Fl.P: NA
IP: 12.20 eV
RGasD: 5.93
VP(70°F): 1.9 atm
FRZ: -137°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10,000 ppm: Sa
15,000 ppm: Sa:Cf/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as sodium, potassium, calcium, powdered aluminum, zinc & magnesium; acids; acid fumes

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Irrit resp sys; asphy; card arrhy, card arrest; liquid: frostbite
TO: Resp sys, CVS

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Dichlorvos	**Formula:** $(CH_3O)_2P(O)OCH=CCl_2$	**CAS#:** 62-73-7	**RTECS#:** TC0350000	**IDLH:** 100 mg/m^3
Conversion: 1 ppm = 9.04 mg/m^3	**DOT:** 2783 152			
Synonyms/Trade Names: DDVP; 2,2-Dichlorovinyl dimethyl phosphate				

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3 [skin]
OSHA PEL: TWA 1 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH P&CAM295 (II-5)
OSHA 62

Physical Description: Colorless to amber liquid with a mild, chemical odor. [**Note:** Insecticide that may be absorbed on a dry carrier.]

Chemical & Physical Properties:
MW: 221.0
BP: Decomposes
Sol: 0.5%
Fl.P: >175°F
IP: ?
Sp.Gr(77°F): 1.42
VP: 0.01 mmHg
FRZ: ?
UEL: ?
LEL: ?
Class III Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 mg/m^3: Sa
25 mg/m^3: Sa:Cf
50 mg/m^3: SaT:Cf/ScbaF/SaF
100 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong acids, strong alkalis [**Note:** Corrosive to iron & mild steel.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; miosis, ache eyes; rhin; head; chest tight, wheez, lar spasm, salv; cyan; anor, nau, vomit, diarr; sweat; musc fasc, para, dizz, ataxia; convuls; low BP, card irreg
TO: Eyes, skin, resp sys, CVS, CNS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Dicrotophos	**Formula:** $C_8H_{16}NO_5P$	**CAS#:** 141-66-2	**RTECS#:** TC3850000	**IDLH:** N.D.
Conversion: 1 ppm = 9.70 mg/m^3	**DOT:**			
Synonyms/Trade Names: Bidrin®, Carbicron®, 2-Dimethyl-cis-2-dimethylcarbamoyl-1-methylvinylphosphate				

Exposure Limits:
NIOSH REL: TWA 0.25 mg/m^3 [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5600

Physical Description: Yellow-brown liquid with a mild, ester odor. [insecticide]

Chemical & Physical Properties:
MW: 237.2
BP: 752°F
Sol: Miscible
Fl.P: >200°F
IP: ?
Sp.Gr(59°F): 1.22
VP: 0.0001 mmHg
FRZ: ?
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Metals [**Note:** Corrosive to cast iron, mild steel, brass & stainless steel.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Head, nau, dizz, anxi, restless, musc twitch, lass, tremor, inco, vomit, abdom cramps, diarr; salv, sweat, lac, rhinitis; anor, mal
TO: CNS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Dicyclopentadiene	Formula: $C_{10}H_{12}$	CAS#: 77-73-6	RTECS#: PC1050000	IDLH: N.D.
Conversion: 1 ppm = 5.41 mg/m^3	**DOT:** 2048 130			

Synonyms/Trade Names: Bicyclopentadiene; DCPD; 1,3-Dicyclopentadiene dimer; 3a,4,7,7a-Tetrahydro-4,7-methanoindene [**Note:** Exists in two stereoisomeric forms.]

Exposure Limits:
NIOSH REL: TWA 5 ppm (30 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2098

Physical Description: Colorless, crystalline solid with a disagreeable, camphor-like odor. [**Note:** A liquid above 90°F.]

Chemical & Physical Properties:
MW: 132.2
BP: 342°F
Sol: 0.02%
Fl.P(oc): 90°F
IP: ?
Sp.Gr: 0.98 (Liquid at 95°F)
VP: 1.4 mmHg
FRZ: 90°F
UEL: 6.3%
LEL: 0.8%
Class IC Flammable Liquid
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers [**Note:** Depolymerizes at boiling point and forms two molecules of cyclopentadiene. Must be inhibited and maintained under an inert atmosphere to prevent polymerization.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; inco, head; sneez, cough; skin blisters; in animals: kidney, lung damage
TO: Eyes, skin, resp sys, CNS, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Dicyclopentadienyl iron	Formula: $(C_5H_5)_2Fe$	CAS#: 102-54-5	RTECS#: LK0700000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: bis(Cyclopentadienyl)iron, Ferrocene, Iron dicyclopentadienyl

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
OSHA ID125G

Physical Description: Orange, crystalline solid with a camphor-like odor.

Chemical & Physical Properties:
MW: 186.1
BP: 480°F
Sol: Insoluble
Fl.P: ?
IP: 6.88 eV
Sp.Gr: ?
VP: ?
MLT: 343°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Ammonium perchlorate, tetranitromethane, mercury(II) nitrate

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Possible irrit eyes, skin, resp sys; in animals: liver, RBC, testicular changes
TO: Eyes, skin, resp sys, liver, blood, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Dieldrin	**Formula:** $C_{12}H_8Cl_6O$	**CAS#:** 60-57-1	**RTECS#:** IO1750000	**IDLH:** Ca [50 mg/m^3]
Conversion:	**DOT:** 2761 151			

Synonyms/Trade Names: HEOD;
1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo,exo-5,8-dimethanonaphthalene

Exposure Limits:
NIOSH REL: Ca
TWA 0.25 mg/m^3 [skin]
See Appendix A
OSHA PEL: TWA 0.25 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH S283 (II-3)

Physical Description: Colorless to light-tan crystals with a mild, chemical odor. [insecticide]

Chemical & Physical Properties:
MW: 380.9
BP: Decomposes
Sol: 0.02%
Fl.P: NA
IP: ?
Sp.Gr: 1.75
VP(77°F): 8 x 10^{-7} mmHg
MLT: 349°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, active metals such as sodium, strong acids, phenols

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Head, dizz; nau, vomit, mal, sweat; myoclonic limb jerks; clonic, tonic convuls; coma; [carc]; in animals: liver, kidney damage
TO: CNS, liver, kidneys, skin [in animals: lung, liver, thyroid & adrenal gland tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Diesel exhaust	**Formula:**	**CAS#:**	**RTECS#:** HZ1755000	**IDLH:** Ca [N.D.]
Conversion:	**DOT:**			

Synonyms/Trade Names: Synonyms vary depending upon the specific diesel exhaust component.

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 2560, 5040

Physical Description: Appearance and odor vary depending upon the specific diesel exhaust component.

Chemical & Physical Properties:
Properties vary depending upon the specific component diesel exhaust component.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Varies

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Eye irrit, pulm func changes; [carc]
TO: Eyes, resp sys [in animals: lung tumors]

First Aid (see Table 6):
Breath: Resp support

Diethanolamine

Formula: $(HOCH_2CH_2)_2NH$ | **CAS#:** 111-42-2 | **RTECS#:** KL2975000 | **IDLH:** N.D.

Conversion: 1 ppm = 4.30 mg/m^3 | **DOT:**

Synonyms/Trade Names: DEA; Di(2-hydroxyethyl)amine; 2,2'-Dihydroxydiethyamine; Diolamine; bis(2-Hydroxyethyl)amine; 2,2'-Iminodiethanol

Exposure Limits:
NIOSH REL: TWA 3 ppm (15 mg/m^3)
OSHA PEL†: none

Physical Description: Colorless crystals or a syrupy, white liquid (above 82°F) with a mild, ammonia-like odor.

Measurement Methods (see Table 1):
NIOSH 3509
OSHA PV2018

Chemical & Physical Properties:
MW: 105.2
BP: 516°F (Decomposes)
Sol: 95%
Fl.P: 279°F
IP: ?
Sp.Gr: 1.10
VP: <0.01 mmHg
MLT: 82°F
UEL: 9.8%
LEL: 1.6%
Class IIIB Combustible Liquid
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers, strong acids, acid anhydrides, halides
[**Note:** Reacts with CO_2 in the air. Hygroscopic (i.e., absorbs moisture from the air). Corrosive to copper, zinc, and galvanized iron.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; eye burns, corn nec; skin burns; lac, cough, sneez
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Diethylamine

Formula: $(C_2H_5)_2NH$ | **CAS#:** 109-89-7 | **RTECS#:** HZ8750000 | **IDLH:** 200 ppm

Conversion: 1 ppm = 2.99 mg/m^3 | **DOT:** 1154 132

Synonyms/Trade Names: Diethamine; N,N-Diethylamine; N-Ethylethanamine

Exposure Limits:
NIOSH REL: TWA 10 ppm (30 mg/m^3)
ST 25 ppm (75 mg/m^3)
OSHA PEL†: TWA 25 ppm (75 mg/m^3)

Physical Description: Colorless liquid with a fishy, ammonia-like odor.

Measurement Methods (see Table 1):
NIOSH 2010
OSHA 41

Chemical & Physical Properties:
MW: 73.1
BP: 132°F
Sol: Miscible
Fl.P: -15°F
IP: 8.01 eV
Sp.Gr: 0.71
VP: 192 mmHg
FRZ: -58°F
UEL: 10.1%
LEL: 1.8%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash (>0.5%)
Quick drench (liquid)

Respirator Recommendations (see Tables 3 and 4):
NIOSH
200 ppm: Sa:Cf£/PaprS£/CcrFS/GmFS/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids, cellulose nitrate

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; in animals; myocardial degeneration
TO: Eyes, skin, resp sys, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

2-Diethylaminoethanol

Formula: $(C_2H_5)_2NCH_2CH_2OH$ | **CAS#:** 100-37-8 | **RTECS#:** KK5075000 | **IDLH:** 100 ppm

Conversion: 1 ppm = 4.79 mg/m^3 | **DOT:** 2686 132

Synonyms/Trade Names: Diethylaminoethanol; 2-Diethylaminoethyl alcohol; N,N-Diethylethanolamine; Diethyl-(2-hydroxyethyl)amine; 2-Hydroxytriethylamine

Exposure Limits:
NIOSH REL: TWA 10 ppm (50 mg/m^3) [skin]
OSHA PEL: TWA 10 ppm (50 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2007

Physical Description: Colorless liquid with a nauseating, ammonia-like odor.

Chemical & Physical Properties:
MW: 117.2
BP: 325°F
Sol: Miscible
Fl.P: 126°F
IP: ?
Sp.Gr: 0.89
VP: 1 mmHg
FRZ: -94°F
UEL: 11.7%
LEL: 6.7%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash (>5%)
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
100 ppm: CcrOv*/GmFOv/PaprOv*/Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; nau, vomit
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Diethylenetriamine

Formula: $(NH_2CH_2CH_2)_2NH$ | **CAS#:** 111-40-0 | **RTECS#:** IE1225000 | **IDLH:** N.D.

Conversion: 1 ppm = 4.22 mg/m^3 | **DOT:** 2079 154

Synonyms/Trade Names: N-(2-Aminoethyl)-1,2-ethanediamine; bis(2-Aminoethyl)amine; DETA; 2,2'-Diaminodiethylamine

Exposure Limits:
NIOSH REL: TWA 1 ppm (4 mg/m^3) [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 2540
OSHA 60

Physical Description: Colorless to yellow liquid with a strong, ammonia-like odor. [**Note:** Hygroscopic (i.e., absorbs moisture from the air).]

Chemical & Physical Properties:
MW: 103.2
BP: 405°F
Sol: Miscible
Fl.P: 208°F
IP: ?
Sp.Gr: 0.96
VP: 0.4 mmHg
FRZ: -38°F
UEL: 6.7%
LEL: 2%
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers, strong acids, cellulose nitrate
[**Note:** May form explosive complexes with silver, cobalt, or chromium compounds. Corrosive to aluminum, copper, brass & zinc.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb, upper resp sys; derm, skin sens; eye, skin nec; cough, dysp, pulm sens
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

D

Diethyl ketone

Formula: $CH_3CH_2COCH_2CH_3$ | **CAS#:** 96-22-0 | **RTECS#:** SA8050000 | **IDLH:** N.D.

Conversion: 1 ppm = 3.53 mg/m^3 | **DOT:** 1156 127

Synonyms/Trade Names: DEK, Dimethylacetone, Ethyl ketone, Metacetone, 3-Pentanone, Propione

Exposure Limits:
NIOSH REL: TWA 200 ppm (705 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with an acetone-like odor.

Chemical & Physical Properties:
MW: 86.2
BP: 215°F
Sol: 5%
Fl.P(oc): 55°F
IP: 9.32 eV
Sp.Gr: 0.81
VP(77°F): 35 mmHg
FRZ: -44°F
UEL: 6.4%
LEL: 1.6%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers, alkalis, mineral acids, (hydrogen peroxide + nitric acid)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb, resp sys; cough, sneez
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Diethyl phthalate

Formula: $C_6H_4(COOC_2H_5)_2$ | **CAS#:** 84-66-2 | **RTECS#:** TI1050000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: DEP, Diethyl ester of phthalic acid, Ethyl phthalate

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA 104

Physical Description: Colorless to water-white, oily liquid with a very slight, aromatic odor. [pesticide]

Chemical & Physical Properties:
MW: 222.3
BP: 563°F
Sol(77°F): 0.1%
Fl.P(oc): 322°F
IP: ?
Sp.Gr: 1.12
VP(77°F): 0.002 mmHg
FRZ: -41°F
UEL: ?
LEL(368°F): 0.7%
Class IIIB Combustible Liquid; however, ignition is difficult.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers, strong acids, nitric acid, permanganates, water

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; head, dizz, nau; lac; possible polyneur, vestibular dysfunc; pain, numb, lass, spasms in arms & legs; in animals: repro effects
TO: Eyes, skin, resp sys, CNS, PNS, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Wash regularly
Breath: Resp support
Swallow: Medical attention immed

Difluorodibromomethane

Formula:	CAS#:	RTECS#:	IDLH:
CBr_2F_2	75-61-6	PA7525000	2000 ppm

Conversion: 1 ppm = 8.58 mg/m^3 **DOT:** 1941 171

Synonyms/Trade Names: Dibromodifluoromethane, Freon® 12B2, Halon® 1202

Exposure Limits:
NIOSH REL: TWA 100 ppm (860 mg/m^3)
OSHA PEL: TWA 100 ppm (860 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1012
OSHA 7

Physical Description: Colorless, heavy liquid or gas (above 76°F) with a characteristic odor.

Chemical & Physical Properties:
MW: 209.8
BP: 76°F
Sol: Insoluble
Fl.P: NA
IP: 11.07 eV
Sp.Gr(59°F): 2.29
VP: 620 mmHg
FRZ: -231°F
UEL: NA
LEL: NA
Noncombustible Liquid
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1000 ppm: Sa
2000 ppm: Sa:Cf/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as sodium, potassium, calcium, powdered aluminum, zinc & magnesium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: irrit resp sys; CNS symptoms; liver damage
TO: Resp sys, CNS, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Diglycidyl ether

Formula:	CAS#:	RTECS#:	IDLH:
$C_6H_{10}O_3$	2238-07-5	KN2350000	Ca [10 ppm]

Conversion: 1 ppm = 5.33 mg/m^3 **DOT:**

Synonyms/Trade Names: Diallyl ether dioxide; DGE; Di(2,3-epoxypropyl) ether; 2-Epoxypropyl ether; bis(2,3-Epoxypropyl) ether

Exposure Limits:
NIOSH REL: Ca
TWA 0.1 ppm (0.5 mg/m^3)
See Appendix A
OSHA PEL†: C 0.5 ppm (2.8 mg/m^3)

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with a strong, irritating odor.

Chemical & Physical Properties:
MW: 130.2
BP: 500°F
Sol: ?
Fl.P: 147°F
IP: ?
Sp.Gr: 1.12
VP(77°F): 0.09 mmHg
FRZ: ?
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; skin burns; in animals: hemato sys, lung, liver, kidney damage; repro effects; [carc]
TO: Eyes, skin, resp sys, repro sys [in animals: skin tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

D

Diisobutyl ketone

Formula:	CAS#:	RTECS#:	IDLH:
$[(CH_3)_2CHCH_2]_2CO$	108-83-8	MJ5775000	500 ppm

Conversion: 1 ppm = 5.82 mg/m^3 **DOT:** 1157 128

Synonyms/Trade Names: DIBK; sym-Diisopropyl acetone; 2,6-Dimethyl-4-heptanone; Isovalerone; Valerone

Exposure Limits:
NIOSH REL: TWA 25 ppm (150 mg/m^3)
OSHA PEL†: TWA 50 ppm (290 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1300, 2555
OSHA 7

Physical Description: Colorless liquid with a mild, sweet odor.

Chemical & Physical Properties:
MW: 142.3
BP: 334°F
Sol: 0.05%
Fl.P: 120°F
IP: 9.04 eV
Sp.Gr: 0.81
VP: 2 mmHg
FRZ: -43°F
UEL(200°F): 7.1%
LEL(200°F): 0.8%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: N.R.
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
500 ppm: Sa:Cf£/PaprOv£/CcrFOv/ GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; head, dizz; derm; liver, kidney damage
TO: Eyes, skin, resp sys, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Diisopropylamine

Formula:	CAS#:	RTECS#:	IDLH:
$[(CH_3)_2CH]_2NH$	108-18-9	IM4025000	200 ppm

Conversion: 1 ppm = 4.14 mg/m^3 **DOT:** 1158 132

Synonyms/Trade Names: DIPA, N-(1-Methylethyl)-2-propanamine

Exposure Limits:
NIOSH REL: TWA 5 ppm (20 mg/m^3) [skin]
OSHA PEL: TWA 5 ppm (20 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH S141 (II-4)

Physical Description: Colorless liquid with an ammonia- or fish-like odor.

Chemical & Physical Properties:
MW: 101.2
BP: 183°F
Sol: Miscible
Fl.P: 20°F
IP: 7.73 eV
Sp.Gr: 0.72
VP: 70 mmHg
FRZ: -141°F
UEL: 7.1%
LEL: 1.1%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact (>5%)
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash (>5%)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
125 ppm: Sa:Cf£/PaprOv£
200 ppm: CcrFOv/GmFOv/PaprTOv£/ ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; nau, vomit; head; vis dist
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Dimethyl acetamide	**Formula:** $CH_3CON(CH_3)_2$	**CAS#:** 127-19-5	**RTECS#:** AB7700000	**IDLH:** 300 ppm
Conversion: 1 ppm = 3.56 mg/m^3	**DOT:**			
Synonyms/Trade Names: N,N-Dimethyl acetamide; DMAC				

Exposure Limits:
NIOSH REL: TWA 10 ppm (35 mg/m^3) [skin]
OSHA PEL: TWA 10 ppm (35 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2004

Physical Description: Colorless liquid with a weak, ammonia- or fish-like odor.

Chemical & Physical Properties:
MW: 87.1
BP: 329°F
Sol: Miscible
Fl.P(oc): 158°F
IP: 8.81 eV
Sp.Gr: 0.94
VP: 2 mmHg
FRZ: -4°F
UEL(320°F): 11.5%
LEL(212°F): 1.8%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
100 ppm: Sa
250 ppm: Sa:Cf
300 ppm: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Carbon tetrachloride, other halogenated compounds when in contact with iron, oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit skin; jaun, liver damage; depres, drow, halu, delusions
TO: Skin, liver, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Dimethylamine	**Formula:** $(CH_3)_2NH$	**CAS#:** 124-40-3	**RTECS#:** IP8750000	**IDLH:** 500 ppm
Conversion: 1 ppm = 1.85 mg/m^3	**DOT:** 1032 118 (anhydrous); 1160 132 (solution)			
Synonyms/Trade Names: Dimethylamine (anhydrous), N-Methylmethanamine				

Exposure Limits:
NIOSH REL: TWA 10 ppm (18 mg/m^3)
OSHA PEL: TWA 10 ppm (18 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2010
OSHA 34

Physical Description: Colorless gas with an ammonia- or fish-like odor.
[**Note:** A liquid below 44°F. Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 45.1
BP: 44°F
Sol(140°F): 24%
Fl.P: NA (Gas) 20°F (Liquid)
IP: 8.24 eV
RGasD: 1.56
Sp.Gr: 0.67 (Liquid at 44°F)
VP: 1.7 atm
FRZ: -134°F
UEL: 14.4%
LEL: 2.8%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (liquid)
Frostbite
Eyes: Prevent eye contact (liquid)
Frostbite
Wash skin: When contam (liquid)
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash (liquid)
Quick drench (liquid)
Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
250 ppm: Sa:Cf£
500 ppm: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, chlorine, mercury, acraldehyde, fluorides, maleic anhydride, aluminum, brass, copper, zinc

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Irrit nose, throat; sneez, cough, dysp; pulm edema; conj; derm; liquid: frostbite
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed (liquid)/Frostbite
Skin: Water flush immed (liquid)/Frostbite
Breath: Resp support

D

4-Dimethylaminoazobenzene

Formula: $C_6H_5NNC_6H_4N(CH_3)_2$ | **CAS#:** 60-11-7 | **RTECS#:** BX7350000 | **IDLH:** Ca [N.D.]

Conversion: | **DOT:**

Synonyms/Trade Names: Butter yellow; DAB; p-Dimethylaminoazobenzene; N,N-Dimethyl-4-aminoazobenzene; Methyl yellow

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1015] See Appendix B

Measurement Methods (see Table 1):
NIOSH P&CAM284 (II-4)

Physical Description: Yellow, leaf-shaped crystals.

Chemical & Physical Properties:
MW: 225.3
BP: Sublimes
Sol: 0.001%
Fl.P: ?
IP: ?
Sp.Gr: ?
VP: 0.0000003 mmHg (est.)
MLT: 237°F
UEL: ?
LEL: ?

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Enlarged liver; liver, kidney dist; contact derm; cough, wheez, dysp; bloody sputum; bronchial secretions; frequent urination, hema, dysuria; [carc]
TO: Skin, resp sys, liver, kidneys, bladder [in animals: liver & bladder tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

bis(2-(Dimethylamino)ethyl)ether

Formula: $C_8H_{20}N_2O$ | **CAS#:** 3033-62-3 | **RTECS#:** KR9460000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: NIAX® A99; NIAX® Catalyst A1; 2,2'-Oxybis(N,N-dimethyl ethylamine)
[**Note:** A component (5%) of NIAX® Catalyst ESN, along with dimethylaminopropionitrile (95%).]

Exposure Limits:
NIOSH REL: See Appendix C (NIAX® Catalyst ESN)
OSHA PEL: See Appendix C (NIAX® Catalyst ESN)

Measurement Methods (see Table 1):
None available

Physical Description: Liquid.

Chemical & Physical Properties:
MW: 160.3
BP: 372°F
Sol: ?
Fl.P: ?
IP: ?
Sp.Gr: ?
VP: ?
FRZ: ?
UEL: ?
LEL: ?

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Possible urinary dist, neurological disorders; in animals: irrit eyes, skin
TO: Eyes, skin, urinary tract, PNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Dimethylaminopropionitrile	**Formula:** $(CH_3)_2NCH_2CH_2CN$	**CAS#:** 1738-25-6	**RTECS#:** UG1575000	**IDLH:** N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: 3-(Dimethylamino)propionitrile; N,N-Dimethylamino-3-propionitrile
[**Note:** A component (95%) of NIAX® Catalyst ESN, along with bis(2-(dimethylamino)ethyl) ether (5%).]

Exposure Limits:
NIOSH REL: See Appendix C (NIAX® Catalyst ESN)
OSHA PEL: See Appendix C (NIAX® Catalyst ESN)

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid.

Chemical & Physical Properties:
MW: 98.2
BP: 342°F
Sol: Miscible
Fl.P: 147°F
IP: ?
Sp.Gr(86°F): 0.86
VP(135°F): 10 mmHg
FRZ: -48°F
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers
[**Note:** Emits toxic oxides of nitrogen and cyanide fumes when heated to decomposition.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; urinary dist; neurological disorders; pins & needles in hands & feet; musc weak, lass, nau, vomit; decr nerve conduction in lower legs
TO: Eyes, skin, CNS, urinary tract

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

N,N-Dimethylaniline	**Formula:** $C_6H_5N(CH_3)_2$	**CAS#:** 121-69-7	**RTECS#:** BX4725000	**IDLH:** 100 ppm
Conversion: 1 ppm = 4.96 mg/m^3	**DOT:** 2253 153			

Synonyms/Trade Names: N,N-Dimethylbenzeneamine; N,N-Dimethylphenylamine
[**Note:** Also known as Dimethylaniline which is a correct synonym for Xylidine.]

Exposure Limits:
NIOSH REL: TWA 5 ppm (25 mg/m^3)
ST 10 ppm (50 mg/m^3) [skin]
OSHA PEL†: TWA 5 ppm (25 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2002
OSHA PV2064

Physical Description: Pale yellow, oily liquid with an amine-like odor. [**Note:** A solid below 36°F.]

Chemical & Physical Properties:
MW: 121.2
BP: 378°F
Sol: 2%
Fl.P: 142°F
IP: 7.14 eV
Sp.Gr: 0.96
VP: 1 mmHg
FRZ: 36°F
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
50 ppm: Sa
100 ppm: Sa:Cf/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids, benzoyl peroxide

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Anoxia symptoms: cyan, lass, dizz, ataxia; methemo
TO: Blood, kidneys, liver, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

D

Dimethyl carbamoyl chloride	Formula: $(CH_3)_2NCOCl$	CAS#: 79-44-7	RTECS#: FD4200000	IDLH: Ca [N.D.]
Conversion:	**DOT:** 2262 156			

Synonyms/Trade Names: Chloroformic acid dimethylamide; Dimethylcarbamic chloride; N,N-Dimethylcarbamoyl chloride; DMCC

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Clear, colorless liquid.

Chemical & Physical Properties:
MW: 107.6
BP: 329°F
Sol: Reacts
Fl.P: 155°F
IP: ?
Sp.Gr: 1.17
VP: ?
FRZ: -27°F
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Acids, water
[**Note:** Rapidly hydrolyzes in water to dimethylamine, carbon dioxide, and hydrogen chloride.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat, resp sys; eye, skin burns; cough, wheez, larnygitis, dysp; head, nau, vomit; liver inj; [carc]
TO: Eyes, skin, resp sys, liver [in animals: nasal cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Dimethyl-1,2-dibromo-2,2-dichlorethyl phosphate	Formula: $(CH_3O)_2P(O)OCHBrCBrCl_2$	CAS#: 300-76-5	RTECS#: TB9450000	IDLH: 200 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names: Dibrom®; 1,2-Dibromo-2,2-dichloroethyl dimethyl phosphate; Naled

Exposure Limits:
NIOSH REL: TWA 3 mg/m^3 [skin]
OSHA PEL†: TWA 3 mg/m^3

Measurement Methods (see Table 1):
None available

Physical Description: Colorless to white solid or straw-colored liquid (above 80°F) with a slightly pungent odor. [insecticide]

Chemical & Physical Properties:
MW: 380.8
BP: Decomposes
Sol: Insoluble
Fl.P: NA
IP: ?
Sp.Gr(77°F): 1.96
VP: 0.0002 mmHg
MLT: 80°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
30 mg/m^3: 95XQ/Sa
75 mg/m^3: Sa:Cf/PaprHie
150 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
200 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids, sunlight, water
[**Note:** Corrosive to metals. Hydrolyzed in presence of water.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; miosis, lac; head; chest tight, wheez, lar spasm; salv; cyan; anor, nau, vomit, abdom cramp, diarr; lass, twitch, para; dizz, ataxia, convuls; low BP; card irreg
TO: Eyes, skin, resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Dimethylformamide	**Formula:** $HCON(CH_3)_2$	**CAS#:** 68-12-2	**RTECS#:** LQ2100000	**IDLH:** 500 ppm
Conversion: 1 ppm = 2.99 mg/m^3	**DOT:** 2265 129			
Synonyms/Trade Names: Dimethyl formamide; N,N-Dimethylformamide; DMF				

Exposure Limits:
NIOSH REL: TWA 10 ppm (30 mg/m^3) [skin]
OSHA PEL: TWA 10 ppm (30 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2004
OSHA 66

Physical Description: Colorless to pale-yellow liquid with a faint, amine-like odor.

Chemical & Physical Properties:
MW: 73.1
BP: 307°F
Sol: Miscible
Fl.P: 136°F
IP: 9.12 eV
Sp.Gr: 0.95
VP: 3 mmHg
FRZ: -78°F
UEL: 15.2%
LEL(212°F): 2.2%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
100 ppm: Sa*
250 ppm: Sa:Cf*
500 ppm: SaT:Cf*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Carbon tetrachloride; other halogenated compounds when in contact with iron; strong oxidizers; alkyl aluminums; inorganic nitrates

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; nau, vomit, colic; liver damage, enlarged liver; high BP; face flush; derm; in animals: kidney, heart damage
TO: Eyes, skin, resp sys, liver, kidneys, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

1,1-Dimethylhydrazine	**Formula:** $(CH_3)_2NNH_2$	**CAS#:** 57-14-7	**RTECS#:** MV2450000	**IDLH:** Ca [15 ppm]
Conversion: 1 ppm = 2.46 mg/m^3	**DOT:** 1163 131			
Synonyms/Trade Names: Dimazine, DMH, UDMH, Unsymmetrical dimethylhydrazine				

Exposure Limits:
NIOSH REL: Ca
C 0.06 ppm (0.15 mg/m^3) [2-hr]
See Appendix A
OSHA PEL: TWA 0.5 ppm (1 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 3515

Physical Description: Colorless liquid with an ammonia- or fish-like odor.

Chemical & Physical Properties:
MW: 60.1
BP: 147°F
Sol: Miscible
Fl.P: 5°F
IP: 8.05 eV
Sp.Gr: 0.79
VP: 103 mmHg
FRZ: -72°F
UEL: 95%
LEL: 2%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Oxidizers, halogens, metallic mercury, fuming nitric acid, hydrogen peroxide [**Note:** May ignite SPONTANEOUSLY in contact with oxidizers.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; choking, chest pain, dysp; drow; nau; anoxia; convuls; liver inj; [carc]
TO: CNS, liver, GI tract, blood, resp sys, eyes, skin [in animals: tumors of the lungs, liver, blood vessels & intestines]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

D

Dimethylphthalate	Formula: $C_6H_4(COOCH_3)_2$	CAS#: 131-11-3	RTECS#: TI1575000	IDLH: 2000 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names: Dimethyl ester of 1,2-benzenedicarboxylic acid; DMP

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL: TWA 5 mg/m^3

Measurement Methods (see Table 1):
OSHA 104

Physical Description: Colorless, oily liquid with a slight, aromatic odor.
[**Note:** A solid below 42°F.]

Chemical & Physical Properties:
MW: 194.2
BP: 543°F
Sol: 0.4%
Fl.P: 295°F
IP: 9.64 eV
Sp.Gr: 1.19
VP: 0.01 mmHg
FRZ: 42°F
UEL: ?
LEL(358°F): 0.9%
Class IIIB Combustible Liquid; however, ignition is difficult.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 mg/m^3: 95F
125 mg/m^3: Sa:Cf£/PaprHie£
250 mg/m^3: 100F/ScbaF/SaF
2000 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, upper resp sys; stomach pain
TO: Eyes, resp sys, GI tract

First Aid (see Table 6):
Eye: Irr prompt
Skin: Wash regularly
Breath: Resp support
Swallow: Medical attention immed

Dimethyl sulfate	Formula: $(CH_3)_2SO_4$	CAS#: 77-78-1	RTECS#: WS8225000	IDLH: Ca [7 ppm]
Conversion: 1 ppm = 5.16 mg/m^3	**DOT:** 1595 156			

Synonyms/Trade Names: Dimethyl ester of sulfuric acid, Dimethylsulfate, Methyl sulfate

Exposure Limits:
NIOSH REL: Ca
TWA 0.1 ppm (0.5 mg/m^3) [skin]
See Appendix A
OSHA PEL†: TWA 1 ppm (5 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2524

Physical Description: Colorless, oily liquid with a faint, onion-like odor.

Chemical & Physical Properties:
MW: 126.1
BP: 370°F (Decomposes)
Sol(64°F): 3%
Fl.P: 182°F
IP: ?
Sp.Gr: 1.33
VP: 0.1 mmHg
FRZ: -25°F
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, ammonia solutions
[**Note:** Decomposes in water to sulfuric acid; corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose; head; dizz; conj; photo; periorb edema; dysphonia, aphonia, dysphagia, productive cough; chest pain; dysp, cyan; vomit, diarr; dysuria; analgesia; fever; prot, hema; eye, skin burns; delirium; [carc]
TO: Eyes, skin, resp sys, liver, kidneys, CNS [in animals: nasal & lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Dinitolmide	**Formula:** $(NO_2)_2C_6H_2(CH_3)CONH_2$	**CAS#:** 148-01-6	**RTECS#:** XS4200000	**IDLH:** N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: 3,5-Dinitro-o-toluamide; 2-Methyl-3,5-dinitrobenzamide; Zoalene

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 0500

Physical Description: Yellowish, crystalline solid.

Chemical & Physical Properties:
MW: 225.2
BP: ?
Sol: Slight
Fl.P: NA
IP: ?
Sp.Gr: ?
VP: ?
MLT: 351°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Contact eczema; in animals: methemo, liver changes
TO: Skin, liver, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

m-Dinitrobenzene	**Formula:** $C_6H_4(NO_2)_2$	**CAS#:** 99-65-0	**RTECS#:** CZ7350000	**IDLH:** 50 mg/m^3
Conversion:	**DOT:** 1597 152			

Synonyms/Trade Names: meta-Dinitrobenzene; 1,3-Dinitrobenzene

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3 [skin]
OSHA PEL: TWA 1 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH S214 (II-4)

Physical Description: Pale-white or yellow solid.

Chemical & Physical Properties:
MW: 168.1
BP: 572°F
Sol: 0.02%
Fl.P: 302°F
IP: 10.43 eV
Sp.Gr: 1.58
VP: ?
MLT: 192°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: Qm
10 mg/m^3: 95XQ/Sa
25 mg/m^3: Sa:Cf/PaprHie
50 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, caustics, metals such as tin & zinc
[**Note:** Prolonged exposure to fire and heat may result in an explosion due to SPONTANEOUS decomposition.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Anoxia, cyan; vis dist, central scotomas; bad taste, burning mouth, dry throat, thirst; yellowing hair, eyes, skin; anemia; liver damage
TO: Eyes, skin, blood, liver, CVS, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

D

o-Dinitrobenzene	Formula: $C_6H_4(NO_2)_2$	CAS#: 528-29-0	RTECS#: CZ7450000	IDLH: 50 mg/m^3
Conversion:	**DOT:** 1597 152			
Synonyms/Trade Names: ortho-Dinitrobenzene; 1,2-Dinitrobenzene				

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3 [skin]
OSHA PEL: TWA 1 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH S214 (II-4)

Physical Description: Pale-white or yellow solid.

Chemical & Physical Properties:
MW: 168.1
BP: 606°F
Sol: 0.05%
Fl.P: 302°F
IP: 10.71 eV
Sp.Gr: 1.57
VP: ?
MLT: 244°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: Qm
10 mg/m^3: 95XQ/Sa
25 mg/m^3: Sa:Cf/PaprHie
50 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, caustics, metals such as tin & zinc
[**Note:** Prolonged exposure to fire and heat may result in an explosion due to SPONTANEOUS decomposition.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Anoxia, cyan; vis dist, central scotomas; bad taste, burning mouth, dry throat, thirst; yellowing hair, eyes, skin; anemia; liver damage
TO: Eyes, skin, blood, liver, CVS, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

p-Dinitrobenzene	Formula: $C_6H_4(NO_2)_2$	CAS#: 100-25-4	RTECS#: CZ7525000	IDLH: 50 mg/m^3
Conversion:	**DOT:** 1597 152			
Synonyms/Trade Names: para-Dinitrobenzene; 1,4-Dinitrobenzene				

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3 [skin]
OSHA PEL: TWA 1 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH S214 (II-4)

Physical Description: Pale-white or yellow solid.

Chemical & Physical Properties:
MW: 168.1
BP: 570°F
Sol: 0.01%
Fl.P: ?
IP: 10.50 eV
Sp.Gr: 1.63
VP: ?
MLT: 343°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: Qm
10 mg/m^3: 95XQ/Sa
25 mg/m^3: Sa:Cf/PaprHie
50 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, caustics, metals such as tin & zinc
[**Note:** Prolonged exposure to fire and heat may result in an explosion due to SPONTANEOUS decomposition.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Anoxia, cyan; vis dist, central scotomas; bad taste, burning mouth, dry throat, thirst; yellowing hair, eyes, skin; anemia; liver damage
TO: Eyes, skin, blood, liver, CVS, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Dinitro-o-cresol	**Formula:** $CH_3C_6H_2OH(NO_2)_2$	**CAS#:** 534-52-1	**RTECS#:** GO9625000	**IDLH:** 5 mg/m^3
Conversion:	**DOT:** 1598 153			

Synonyms/Trade Names: 4,6-Dinitro-o-cresol; 3,5-Dinitro-2-hydroxytoluene; 4,6-Dinitro-2-methyl phenol; DNC; DNOC

Exposure Limits:
NIOSH REL: TWA 0.2 mg/m^3 [skin]
OSHA PEL: TWA 0.2 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH S166 (II-5)

Physical Description: Yellow, odorless solid. [insecticide]

Chemical & Physical Properties:
MW: 198.1
BP: 594°F
Sol: 0.01%
Fl.P: NA
IP: ?
Sp.Gr: 1.1 (estimated)
VP: 0.00005 mmHg
MLT: 190°F
UEL: NA
LEL: NA
MEC: 30 g/m^3
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2 mg/m^3: 95F
5 mg/m^3: 100F/Sa:Cf£/PaprHie£/ ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Sense of well being; head, fever, lass, profuse sweat, excess thirst, tacar, hyperpnea, cough, short breath, coma
TO: CVS, endocrine sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Dinitrotoluene	**Formula:** $CH_3C_6H_3(NO_2)_2$	**CAS#:** 25321-14-6	**RTECS#:** XT1300000	**IDLH:** Ca [50 mg/m^3]
Conversion:	**DOT:** 1600 152 (molten); 2038 152 (solid)			

Synonyms/Trade Names: Dinitrotoluol, DNT, Methyldinitrobenzene [**Note:** Various isomers of DNT exist.]

Exposure Limits:
NIOSH REL: Ca
TWA 1.5 mg/m^3 [skin]
See Appendix A
OSHA PEL: TWA 1.5 mg/m^3 [skin]

Measurement Methods (see Table 1):
OSHA 44

Physical Description: Orange-yellow crystalline solid with a characteristic odor. [**Note:** Often shipped molten.]

Chemical & Physical Properties:
MW: 182.2
BP: 572°F
Sol: Insoluble
Fl.P: 404°F
IP: ?
Sp.Gr: 1.32
VP: 1 mmHg
MLT: 158°F
UEL: ?
LEL: ?
Combustible Solid, but difficult to ignite.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, caustics, metals such as tin & zinc
[**Note:** Commercial grades will decompose at 482°F, with self-sustaining decomposition at 536°F.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Anoxia, cyan; anemia, jaun; repro effects; [carc]
TO: Blood, liver, CVS, repro sys [in animals: liver, skin & kidney tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Di-sec octyl phthalate

Formula:	CAS#:	RTECS#:	IDLH:
$C_{24}H_{38}O_4$	117-81-7	TI0350000	Ca [5000 mg/m^3]

Conversion:

DOT:

Synonyms/Trade Names: DEHP, Di(2-ethylhexyl)phthalate, DOP, bis-(2-Ethylhexyl)phthalate, Octyl phthalate

Exposure Limits:
NIOSH REL: Ca
TWA 5 mg/m^3
ST 10 mg/m^3
See Appendix A
OSHA PEL†: TWA 5 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5020

Physical Description: Colorless, oily liquid with a slight odor.

Chemical & Physical Properties:
MW: 390.5
BP: 727°F
Sol(75°F): 0.00003%
Fl.P(oc): 420°F
IP: ?
Sp.Gr: 0.99
VP: <0.01 mmHg
FRZ: -58°F
UEL: ?
LEL(474°F): 0.3%
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, acids & alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, muc memb; in animals: liver damage; terato effects; [carc]
TO: Eyes, resp sys, CNS, liver, repro sys, GI tract [in animals: liver tumors]

First Aid (see Table 6):
Eye: Irr immed
Breath: Resp support
Swallow: Medical attention immed

Dioxane

Formula:	CAS#:	RTECS#:	IDLH:
$C_4H_8O_2$	123-91-1	JG8225000	Ca [500 ppm]

Conversion: 1 ppm = 3.60 mg/m^3

DOT: 1165 127

Synonyms/Trade Names: Diethylene dioxide; Diethylene ether; Dioxan; p-Dioxane; 1,4-Dioxane

Exposure Limits:
NIOSH REL: Ca
C 1 ppm (3.6 mg/m^3) [30-minute]
See Appendix A
OSHA PEL†: TWA 100 ppm (360 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1602
OSHA 7

Physical Description: Colorless liquid or solid (below 53°F) with a mild, ether-like odor.

Chemical & Physical Properties:
MW: 88.1
BP: 214°F
Sol: Miscible
Fl.P: 55°F
IP: 9.13 eV
Sp.Gr: 1.03
VP: 29 mmHg
FRZ: 53°F
UEL: 22%
LEL: 2.0%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, decaborane, triethynyl aluminum

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; drow, head; nau, vomit; liver damage; kidney failure; [carc]
TO: Eyes, skin, resp sys, liver, kidneys [in animals: lung, liver & nasal cavity tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash prompt
Breath: Resp support
Swallow: Medical attention immed

Dioxathion

Formula: $C_4H_6O_2[SPS(OC_2H_5)_2]_2$ | **CAS#:** 78-34-2 | **RTECS#:** TE3350000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: Delnav®; p-Dioxane-2,3-diyl ethyl phosphorodithioate; Dioxane phosphate; 2,3-p-Dioxanethiol-S,S-bis(O,O-diethyl phosphoro-dithioate); Navadel®

Exposure Limits:
NIOSH REL: TWA 0.2 mg/m^3 [skin]
OSHA PEL†: none

Physical Description: Viscous, brown, tan, or dark-amber liquid. [insecticide] [**Note:** Technical product is a mixture of cis- & trans-isomers.]

Measurement Methods (see Table 1):
None available

Chemical & Physical Properties:
MW: 456.6
BP: ?
Sol: Insoluble
Fl.P: NA
IP: ?
Sp.Gr(79°F): 1.26
VP: ?
FRZ: -4°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Alkalis, iron or tin surfaces, heat

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; head, dizz, lass; rhin, chest tight; miosis; nau, vomit, abdom cramps, diarr, salv; musc fasc; conf, drow
TO: Eyes, skin, resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Diphenyl

Formula: $C_6H_5C_6H_5$ | **CAS#:** 92-52-4 | **RTECS#:** DU8050000 | **IDLH:** 100 mg/m^3

Conversion: 1 ppm = 6.31 mg/m^3 | **DOT:**

Synonyms/Trade Names: Biphenyl, Phenyl benzene

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3 (0.2 ppm)
OSHA PEL: TWA 1 mg/m^3 (0.2 ppm)

Physical Description: Colorless to pale-yellow solid with a pleasant, characteristic odor. [fungicide]

Measurement Methods (see Table 1):
NIOSH 2530
OSHA PV2022

Chemical & Physical Properties:
MW: 154.2
BP: 489°F
Sol: Insoluble
Fl.P: 235°F
IP: 7.95 eV
Sp.Gr: 1.04
VP: 0.005 mmHg
MLT: 156°F
UEL(311°F): 5.8%
LEL(232°F): 0.6%
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash (molt)
Quick drench (molt)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 mg/m^3: CcrOv95/Sa
25 mg/m^3: Sa:Cf*/PaprOvHie*
50 mg/m^3: CcrFOv100/GmFOv100/ PaprTOvHie*/ScbaF/SaF
100 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, throat; head, nau, lass, numb limbs; liver damage
TO: Eyes, resp sys, liver, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

D

Diphenylamine

Formula: $(C_6H_5)_2NH$ | **CAS#:** 122-39-4 | **RTECS#:** JJ7800000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: Anilinobenzene, DPA, Phenylaniline, N-Phenylaniline, N-Phenylbenzenamine
[**Note:** The carcinogen 4-Aminodiphenyl may be present as an impurity in the commercial product.]

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA 22, 78

Physical Description: Colorless, tan, amber, or brown crystalline solid with a pleasant, floral odor. [fungicide]

Chemical & Physical Properties:
MW: 169.2
BP: 576°F
Sol: 0.03%
Fl.P: 307°F
IP: 7.40 eV
Sp.Gr: 1.16
VP(227°F): 1 mmHg
MLT: 127°F
UEL: ?
LEL: ?
Combustible Solid; explosive if a cloud of dust is exposed to a source of ignition.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers, hexachloromelamine, trichloromelamine

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb; eczema; tacar, hypertension; cough, sneez; methemo; incr BP, heart rate; prot, hema, bladder inj; in animals: terato effects
TO: Eyes, skin, resp sys, CVS, blood, bladder, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Dipropylene glycol methyl ether

Formula: $CH_3OC_3H_6OC_3H_6OH$ | **CAS#:** 34590-94-8 | **RTECS#:** JM1575000 | **IDLH:** 600 ppm

Conversion: 1 ppm = 6.06 mg/m^3 | **DOT:**

Synonyms/Trade Names: Dipropylene glycol monomethyl ether, Dowanol® 50B

Exposure Limits:
NIOSH REL: TWA 100 ppm (600 mg/m^3)
ST 150 ppm (900 mg/m^3) [skin]
OSHA PEL†: TWA 100 ppm (600 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2554, S69 (II-2)

Physical Description: Colorless liquid with a mild, ether-like odor.

Chemical & Physical Properties:
MW: 148.2
BP: 408°F
Sol: Miscible
Fl.P: 180°F
IP: ?
Sp.Gr: 0.95
VP: 0.5 mmHg
FRZ: -112°F
UEL: 3.0%
LEL(392°F): 1.1%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
600 ppm: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose, throat; lass, dizz, head
TO: Eyes, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash prompt
Breath: Resp support
Swallow: Medical attention immed

Dipropyl ketone	Formula: $(CH_3CH_2CH_2)_2CO$	CAS#: 123-19-3	RTECS#: MJ5600000	IDLH: N.D.
Conversion: 1 ppm = 4.67 mg/m^3	**DOT:** 2710 128			
Synonyms/Trade Names: Butyrone, DPK, 4-Heptanone, Heptan-4-one, Propyl ketone				

Exposure Limits:
NIOSH REL: TWA 50 ppm (235 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA 7

Physical Description: Colorless liquid with a pleasant odor.

Chemical & Physical Properties:
MW: 114.2
BP: 291°F
Sol: Insoluble
Fl.P: 120°F
IP: 9.10 eV
Sp.Gr: 0.82
VP: 5 mmHg
FRZ: -27°F
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin; CNS depres, dizz, drow, decr breath; in animals: liver inj; narco
TO: Eyes, skin, CNS, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Diquat (Diquat dibromide)	Formula: $C_{12}H_{12}N_2Br_2$	CAS#: 85-00-7	RTECS#: JM5690000	IDLH: N.D.
Conversion:	**DOT:** 2781 151 (solid); 2782 131 (liquid)			

Synonyms/Trade Names: Diquat dibromide; 1,1'-Ethylene-2,2'-bipyridyllium dibromide
[**Note:** Diquat is a cation ($C_{12}H_{12}N_2^{++}$; 1,1'-Ethylene-2,2-bipyridyllium ion). Various diquat salts are commercially available.]

Exposure Limits:
NIOSH REL: TWA 0.5 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Dibromide salt: Yellow crystals. [herbicide]
[**Note:** Commercial product may be found in a liquid concentrate or a solution.]

Chemical & Physical Properties:
MW: 344.1
BP: Decomposes
Sol: 70%
Fl.P: ?
IP: ?
Sp.Gr: 1.22-1.27
VP: <0.00001 mmHg
MLT: 635°F
UEL: ?
LEL: ?
Combustible Solid, but does not readily ignite and burns with difficulty.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Alkalis, UV light, basic solutions
[**Note:** Concentrated diquat solutions corrode aluminum.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb, resp sys; rhin, epis; skin burns; nau, vomit, diarr, mal; kidney, liver inj; cough, chest pain, dysp, pulm edema; tremor, convuls; delayed healing of wounds
TO: Eyes, skin, resp sys, kidneys, liver, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

D

Disulfiram

Formula:	CAS#:	RTECS#:	IDLH:
$[(C_2H_5)_2NCS]_2S_2$	97-77-8	JO1225000	N.D.

Conversion: **DOT:**

Synonyms/Trade Names: Antabuse®, bis(Diethylthiocarbamoyl) disulfide, Ro-Sulfiram®, TETD, Tetraethylthiuram disulfide

Exposure Limits:
NIOSH REL: TWA 2 mg/m^3
[Precautions should be taken to avoid concurrent exposure to ethylene dibromide.]
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: White, yellowish, or light-gray powder with a slight odor. [fungicide]

Chemical & Physical Properties:
MW: 296.6
BP: ?
Sol: 0.02%
Fl.P: NA
IP: ?
Sp.Gr: 1.30
VP: ?
MLT: 158°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; sens derm; lass, tremor, restless, head, dizz; metallic taste; peri neur; liver damage
TO: Eyes, skin, resp sys, CNS, PNS, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Disulfoton

Formula:	CAS#:	RTECS#:	IDLH:
$C_8H_{19}O_2PS_3$	298-04-4	TD9275000	N.D.

Conversion: **DOT:** 2783 152

Synonyms/Trade Names: O,O-Diethyl S-2-(ethylthio)-ethyl phosphorodithioate; Di-Syston®; Thiodemeton

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3 [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5600

Physical Description: Oily, colorless to yellow liquid with a characteristic, sulfur odor. [insecticide] [**Note:** Technical product is a brown liquid.]

Chemical & Physical Properties:
MW: 274.4
BP: ?
Sol(73°F): 0.003%
Fl.P: >180°F
IP: ?
Sp.Gr: 1.14
VP: 0.0002 mmHg
FRZ: >-13°F
UEL: ?
LEL: ?
Combustible Liquid, but will not ignite easily.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; nau, vomit, abdom cramps, diarr, salv; head, dizz, lass; rhin, chest tight; blurred vision, miosis; card irreg; musc fasc; dysp; eye, skin burns
TO: Eyes, skin, resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Diuron	**Formula:** $C_6H_3Cl_2NHCON(CH_3)_2$	**CAS#:** 330-54-1	**RTECS#:** YS8925000	**IDLH:** N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: 3-(3,4-Dichlorophenyl)-1,1-dimethylurea; Direx®; Karmex®				
Exposure Limits: **NIOSH REL:** TWA 10 mg/m^3 **OSHA PEL†:** none				**Measurement Methods (see Table 1):** **NIOSH** 5601 **OSHA** PV2097
Physical Description: White, odorless, crystalline solid. [herbicide]				
Chemical & Physical Properties: **MW:** 233.1 **BP:** 356°F (Decomposes) **Sol:** 0.004% **Fl.P:** NA **IP:**? **Sp.Gr:** ? **VP:** 0.000000002 mmHg **MLT:** 316°F **UEL:** NA **LEL:** NA Noncombustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** Daily **Remove:** N.R. **Change:** Daily		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Strong acids				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat; in animals: anemia, methemo **TO:** Eyes, skin, resp sys, blood	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed			

Divinyl benzene	**Formula:** $C_6H_4(HC=CH_2)_2$	**CAS#:** 1321-74-0 (mixed isomers)	**RTECS#:** CZ9370000	**IDLH:** N.D.
Conversion: 1 ppm = 5.33 mg/m^3	**DOT:** 2049 130			
Synonyms/Trade Names: Diethyl benzene, DVB, Vinylstyrene [**Note:** Commercial product contains all 3 isomers, but m-isomer predominates. Usually contains an inhibitor to prevent polymerization.]				
Exposure Limits: **NIOSH REL:** TWA 10 ppm (50 mg/m^3) **OSHA PEL†:** none				**Measurement Methods (see Table 1):** **OSHA** 89
Physical Description: Pale, straw-colored liquid.				
Chemical & Physical Properties: **MW:** 130.2 **BP:** 392°F **Sol:** 0.005% **Fl.P(oc):** 169°F **IP:** ? **Sp.Gr:** 0.93 **VP:** 0.7 mmHg **FRZ:** -88°F **UEL:** 6.2% **LEL:** 1.1% Class IIIA Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R. **Provide:** Eyewash Quick drench		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: None reported				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, resp sys; skin burns; in animals: CNS depres **TO:** Eyes, skin, resp sys, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap flush immed **Breath:** Resp support **Swallow:** Medical attention immed			

1-Dodecanethiol	Formula: $CH_3(CH_2)_{11}SH$	CAS#: 112-55-0	RTECS#: JR3155000	IDLH: N.D.
Conversion: 1 ppm = 8.28 mg/m^3	**DOT:** 1228 131			

Synonyms/Trade Names: Dodecyl mercaptan, 1-Dodecyl mercaptan, n-Dodecyl mercaptan, Lauryl mercaptan, n-Lauryl mercaptan, 1-Mercaptododecane

Exposure Limits:
NIOSH REL: C 0.5 ppm (4.1 mg/m^3) [15-minute]
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless, water-white, or pale-yellow, oily liquid with a mild, skunk-like odor. [**Note:** A solid below 15°F.]

Chemical & Physical Properties:
MW: 202.4
BP: 441-478°F
Sol: Insoluble
Fl.P(oc): 190°F
IP: ?
Sp.Gr: 0.85
VP(77°F): 3 mmHg
FRZ: 15°F
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: CcrOv/Sa
12.5 ppm: Sa:Cf/PaprOv
25 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers & acids, strong bases, reducing agents, alkali metals, water, steam

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; cough; dizz, dysp, lass, conf, cyan; abdom pain, nau; skin sens
TO: Eyes, skin, resp sys, CNS, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Emery	Formula: Al_2O_3	CAS#: 1302-74-5 (corundum)	RTECS#: GN2310000 (corundum)	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Aluminum oxide, Aluminum trioxide, Corundum, Impure corundum, Natural aluminum oxide [**Note:** Emery is an impure variety of Al_2O_3 which may contain small impurities of iron, magnesium & silica Corundum is natural Al_2O_3.]

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Odorless, white, crystalline powder.

Chemical & Physical Properties:
See α-Alumina for physical & chemical properties.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities:

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air
Swallow: Medical attention immed

Endosulfan

Formula: $C_9H_6Cl_6O_3S$ | **CAS#:** 115-29-7 | **RTECS#:** RB9275000 | **IDLH:** N.D.

Conversion: | **DOT:** 2761 151

Synonyms/Trade Names: Benzoepin; Endosulphan; 6,7,8,9,10-Hexachloro-1,5,5a,6,9,9a-hexachloro-6,9-methano-2,4,3-benzo-dioxathiepin-3-oxide; Thiodan®

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3 [skin] **OSHA PEL†:** none

Measurement Methods (see Table 1):
OSHA PV2023

Physical Description: Brown crystals with a slight, sulfur dioxide odor. [insecticide] [**Note:** Technical product is a tan, waxy, isomer mixture.]

Chemical & Physical Properties:
MW: 406.9
BP: Decomposes
Sol: 0.00001%
Fl.P: NA
IP: ?
Sp.Gr: 1.74
VP(77°F): 0.00001 mmHg
MLT: 223°F
UEL: NA
LEL: NA Noncombustible Solid, but may be dissolved in flammable liquids.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Alkalis, acids, water [**Note:** Corrosive to iron. Hydrolyzes slowly on contact with water or decomposes in presence of alkalis and acids to form sulfur dioxide.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit skin; nau, conf, agitation, flushing, dry mouth, tremor, convuls, head; in animals: kidney, liver inj; decr testis weight
TO: Skin, CNS, liver, kidneys, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Endrin

Formula: $C_{12}H_8Cl_6O$ | **CAS#:** 72-20-8 | **RTECS#:** IO1575000 | **IDLH:** 2 mg/m^3

Conversion: | **DOT:** 2761 151

Synonyms/Trade Names: Hexadrin®, 1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo,endo-5,8-dimethanonaphthalene

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3 [skin]
OSHA PEL: TWA 0.1 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 5519

Physical Description: Colorless to tan, crystalline solid with a mild, chemical odor. [insecticide]

Chemical & Physical Properties:
MW: 380.9
BP: Decomposes
Sol: Insoluble
Fl.P: NA
IP: ?
Sp.Gr: 1.70
VP: Low
MLT: 392°F (Decomposes)
UEL: NA
LEL: NA Noncombustible Solid, but may be dissolved in flammable liquids.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1 mg/m^3: CcrOv95/Sa
2 mg/m^3: Sa:Cf/PaprOvHie/CcrFOv100/GmFOv100/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids, parathion [**Note:** May emit hydrogen chloride & phosgene when heated or burned.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Epilep convuls; stupor, head, dizz; abdom discomfort, nau, vomit; insom; aggressiveness, conf; drow, lass; anor; in animals: liver damage
TO: CNS, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

E

Enflurane

Formula:	CAS#:	RTECS#:	IDLH:
CHF_2OCF_2CHClF	13838-16-9	KN6800000	N.D.

Conversion: 1 ppm = 7.55 mg/m^3 **DOT:**

Synonyms/Trade Names: 2-Chloro-1-(difluoromethoxy)-1,1,2-trifluoroethane; 2-Chloro-1,1,2-trifluoroethyl difluoromethyl ether; Ethrane®

Exposure Limits:
NIOSH REL*: C 2 ppm (15.1 mg/m^3) [60-minute]
[***Note:** REL for exposure to waste anesthetic gas.]
OSHA PEL: none

Measurement Methods (see Table 1):
OSHA 29, 103

Physical Description: Clear, colorless liquid with a mild, sweet odor. [inhalation anesthetic]

Chemical & Physical Properties:
MW: 184.5
BP: 134°F
Sol: Low
Fl.P: NA
IP: ?
Sp.Gr(77°F): 1.52
VP: 175 mmHg
FRZ: ?
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes; CNS depres, analgesia, anes, convuls, resp depres
TO: Eyes, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Epichlorohydrin

Formula:	CAS#:	RTECS#:	IDLH:
C_3H_5OCl	106-89-8	TX4900000	Ca [75 ppm]

Conversion: 1 ppm = 3.78 mg/m^3 **DOT:** 2023 131P

Synonyms/Trade Names: 1-Chloro-2,3-epoxypropane; 2-Chloropropylene oxide; γ-Chloropropylene oxide

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: TWA 5 ppm (19 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1010
OSHA 7

Physical Description: Colorless liquid with a slightly irritating, chloroform-like odor.

Chemical & Physical Properties:
MW: 92.5
BP: 242°F
Sol: 7%
Fl.P: 93°F
IP: 10.60 eV
Sp.Gr: 1.18
VP: 13 mmHg
FRZ: -54°F
UEL: 21.0%
LEL: 3.8%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOvAg/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids, certain salts, caustics, zinc, aluminum, water [**Note:** May polymerize in presence of strong acids and bases, particularly when hot.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin with deep pain; nau, vomit; abdom pain; resp distress, cough; cyan; repro effects; [carc]
TO: Eyes, skin, resp sys, kidneys, liver, repro sys [in animals: nasal cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

EPN

Formula:	CAS#:	RTECS#:	IDLH:
$C_{14}H_{14}O_4NSP$	2104-64-5	TB1925000	5 mg/m^3

Conversion:

DOT:

Synonyms/Trade Names: Ethyl p-nitrophenyl benzenethionophosphonate, O-Ethyl O-(4-nitrophenyl) phenylphosphonothioate

Exposure Limits:
NIOSH REL: TWA 0.5 mg/m^3 [skin]
OSHA PEL: TWA 0.5 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 5012

Physical Description: Yellow solid with an aromatic odor. [pesticide]
[**Note:** A brown liquid above 97°F.]

Chemical & Physical Properties:
MW: 323.3
BP: ?
Sol: Insoluble
Fl.P: NA
IP: ?
Sp.Gr(77°F): 1.27
VP(212°F): 0.0003 mmHg
MLT: 97°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; miosis, lac; rhin; head; chest tight, wheez, lar spasm; salv; cyan; anor, nau, abdom cramps, diarr; para, convuls; low BP, card irreg
TO: Eyes, skin, resp sys, CVS, CNS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Ethanolamine

Formula:	CAS#:	RTECS#:	IDLH:
$NH_2CH_2CH_2OH$	141-43-5	KJ5775000	30 ppm

Conversion: 1 ppm = 2.50 mg/m^3

DOT: 2491 153

Synonyms/Trade Names: 2-Aminoethanol, β-Aminoethyl alcohol, Ethylolamine, 2-Hydroxyethylamine, Monoethanolamine

Exposure Limits:
NIOSH REL: TWA 3 ppm (8 mg/m^3)
ST 6 ppm (15 mg/m^3)
OSHA PEL†: TWA 3 ppm (6 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2007

Physical Description: Colorless, viscous liquid or solid (below 51°F) with an unpleasant, ammonia-like odor.

Chemical & Physical Properties:
MW: 61.1
BP: 339°F
Sol: Miscible
Fl.P: 186°F
IP: 8.96 eV
Sp.Gr: 1.02
VP: 0.4 mmHg
FRZ: 51°F
UEL: 23.5%
LEL(284°F): 3.0%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
30 ppm: CcrS*/GmFS/PaprS*/Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids, iron
[**Note:** May attack copper, brass, and rubber.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; drow
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

E

Ethion

Formula:	CAS#:	RTECS#:	IDLH:
$[(C_2H_5O)_2P(S)S]_2CH_2$	563-12-2	TE4550000	N.D.

Conversion:
DOT:

Synonyms/Trade Names: O,O,O',O'-Tetraethyl S,S'-methylene di(phosphorodithioate)

Exposure Limits:
NIOSH REL: 0.4 mg/m^3 [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5600

Physical Description: Colorless to amber-colored, odorless liquid. [insecticide]
[**Note:** A solid below 10°F. The technical product has a very disagreeable odor.]

Chemical & Physical Properties:
MW: 384.5
BP: >302°F (Decomposes)
Sol: 0.0001%
Fl.P: 349°F
IP: ?
Sp.Gr: 1.22
VP: 0.0000015 mmHg
FRZ: 10°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Acids, alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; nau, vomit, abdom cramps, diarr, salv; head, dizz, lass; rhin, chest tight; blurred vision, miosis; card irreg; musc fasc; dysp
TO: Eyes, skin, resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

2-Ethoxyethanol

Formula:	CAS#:	RTECS#:	IDLH:
$C_2H_5OCH_2CH_2OH$	110-80-5	KK8050000	500 ppm

Conversion: 1 ppm = 3.69 mg/m^3
DOT: 1171 127

Synonyms/Trade Names: Cellosolve®, EGEE, Ethylene glycol monoethyl ether

Exposure Limits:
NIOSH REL: TWA 0.5 ppm (1.8 mg/m^3) [skin]
OSHA PEL: TWA 200 ppm (740 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1403
OSHA 53, 79

Physical Description: Colorless liquid with a sweet, pleasant, ether-like odor.

Chemical & Physical Properties:
MW: 90.1
BP: 275°F
Sol: Miscible
Fl.P: 110°F
IP: ?
Sp.Gr: 0.93
VP: 4 mmHg
FRZ: -130°F
UEL(200°F): 15.6%
LEL(200°F): 1.7%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: Sa*
12.5 ppm: Sa:Cf*
25 ppm: ScbaF/SaF
500 ppm: Sa:Pd,Pp*
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: In animals: irrit eyes, resp sys; blood changes; liver, kidney, lung damage; repro, terato effects
TO: Eyes, resp sys, blood, kidneys, liver, repro sys, hemato sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

2-Ethoxyethyl acetate	Formula: $CH_3COOCH_2CH_2OC_2H_5$	CAS#: 111-15-9	RTECS#: KK8225000	IDLH: 500 ppm
Conversion: 1 ppm = 5.41 mg/m^3	**DOT:** 1172 129			
Synonyms/Trade Names: Cellosolve® acetate, EGEEA, Ethylene glycol monoethyl ether acetate, Glycol monoethyl ether acetate				
Exposure Limits: **NIOSH REL:** TWA 0.5 ppm (2.7 mg/m^3) [skin] **OSHA PEL:** TWA 100 ppm (540 mg/m^3) [skin]			**Measurement Methods (see Table 1):** **NIOSH** 1450 **OSHA** 53	
Physical Description: Colorless liquid with a mild odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 132.2 **BP:** 313°F **Sol:** 23% **FI.P:** 124°F **IP:** ? **Sp.Gr:** 0.98 **VP:** 2 mmHg **FRZ:** -79°F **UEL:** ? **LEL:** 1.7% Class II Combustible Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.	**NIOSH** **5 ppm:** CcrOv*/Sa* **12.5 ppm:** Sa:Cf*/PaprOv* **25 ppm:** CcrFOv/GmFOv/PaprTOv*/ ScbaF/SaF **500 ppm:** Sa:Pd,Pp* **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, nose; vomit; kidney damage; para; in animals: repro, terato effects **TO:** Eyes, resp sys, GI tract, repro sys, hemato sys	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed

Ethyl acetate	Formula: $CH_3COOC_2H_5$	CAS#: 141-78-6	RTECS#: AH5425000	IDLH: 2000 ppm [10%LEL]
Conversion: 1 ppm = 3.60 mg/m^3	**DOT:** 1173 129			
Synonyms/Trade Names: Acetic ester, Acetic ether, Ethyl ester of acetic acid, Ethyl ethanoate				
Exposure Limits: **NIOSH REL:** TWA 400 ppm (1400 mg/m^3) **OSHA PEL:** TWA 400 ppm (1400 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1457 **OSHA** 7	
Physical Description: Colorless liquid with an ether-like, fruity odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 88.1 **BP:** 171°F **Sol(77°F):** 10% **FI.P:** 24°F **IP:** 10.01 eV **Sp.Gr:** 0.90 **VP:** 73 mmHg **FRZ:** -117°F **UEL:** 11.5% **LEL:** 2.0% Class IB Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.	**NIOSH/OSHA** **2000 ppm:** Sa:Cf£/PaprOv£/CcrFOv/ GmFOv/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat; narco; derm **TO:** Eyes, skin, resp sys	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed

E

Ethyl acrylate

Formula: CH_2=$CHCOOC_2H_5$ | **CAS#:** 140-88-5 | **RTECS#:** AT0700000 | **IDLH:** Ca [300 ppm]

Conversion: 1 ppm = 4.09 mg/m^3 | **DOT:** 1917 129P (inhibited)

Synonyms/Trade Names: Ethyl acrylate (inhibited), Ethyl ester of acrylic acid, Ethyl propenoate

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: TWA 25 ppm (100 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1450
OSHA 92

Physical Description: Colorless liquid with an acrid odor.

Chemical & Physical Properties:
MW: 100.1
BP: 211°F
Sol: 2%
Fl.P: 48°F
IP: 10.30 eV
Sp.Gr: 0.92
VP: 29 mmHg
FRZ: -96°F
UEL: 14%
LEL: 1.4%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, peroxides, polymerizers, strong alkalis, moisture, chlorosulfonic acid [**Note:** Polymerizes readily unless an inhibitor such as hydroquinone is added.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; [carc]
TO: Eyes, skin, resp sys [in animals: tumors of the forestomach]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Ethyl alcohol

Formula: CH_3CH_2OH | **CAS#:** 64-17-5 | **RTECS#:** KQ6300000 | **IDLH:** 3300 ppm [10%LEL]

Conversion: 1 ppm = 1.89 mg/m^3 | **DOT:** 1170 127

Synonyms/Trade Names: Alcohol, Cologne spirit, Ethanol, EtOH, Grain alcohol

Exposure Limits:
NIOSH REL: TWA 1000 ppm (1900 mg/m^3)
OSHA PEL: TWA 1000 ppm (1900 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1400
OSHA 100

Physical Description: Clear, colorless liquid with a weak, ethereal, vinous odor.

Chemical & Physical Properties:
MW: 46.1
BP: 173°F
Sol: Miscible
Fl.P: 55°F
IP: 10.47 eV
Sp.Gr: 0.79
VP: 44 mmHg
FRZ: -173°F
UEL: 19%
LEL: 3.3%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
3300 ppm: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: ScbaE

Incompatibilities and Reactivities: Strong oxidizers, potassium dioxide, bromine pentafluoride, acetyl bromide, acetyl chloride, platinum, sodium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose; head, drow, lass, narco; cough; liver damage; anemia; repro, terato effects
TO: Eyes, skin, resp sys, CNS, liver, blood, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Fresh air
Swallow: Medical attention immed

Ethylamine

Formula: $CH_3CH_2NH_2$ | **CAS#:** 75-04-7 | **RTECS#:** KH2100000 | **IDLH:** 600 ppm

Conversion: 1 ppm = 1.85 mg/m^3 | **DOT:** 1036 118

Synonyms/Trade Names: Aminoethane, Ethylamine (anhydrous), Monoethylamine

Exposure Limits:
NIOSH REL: TWA 10 ppm (18 mg/m^3)
OSHA PEL: TWA 10 ppm (18 mg/m^3)

Measurement Methods (see Table 1):
NIOSH S144 (II-3)
OSHA 36

Physical Description: Colorless gas or water-white liquid (below 62°F) with an ammonia-like odor. [**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 45.1
BP: 62°F
Sol: Miscible
FI.P: 1°F
IP: 8.86 eV
RGasD: 1.61
Sp.Gr: 0.69 (Liquid)
VP: 874 mmHg
FRZ: -114°F
UEL: 14.0%
LEL: 3.5%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (liquid)
Eyes: Prevent eye contact (liquid)
Wash skin: When contam (liquid)
Remove: When wet or contam (liquid)
Change: N.R.
Provide: Eyewash (liquid)
Quick drench (liquid)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
250 ppm: Sa:Cf£/PaprS£
500 ppm: CcrFS/GmFS/ScbaF/SaF
600 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Strong acids; strong oxidizers; copper, tin & zinc in presence of moisture; cellulose nitrate; chlorine; hypochlorites

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs (liquid), Ing (liquid), Con (liquid)
SY: Irrit eyes, skin, resp sys; skin burns, derm
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed (liquid)
Skin: Water flush immed (liquid)
Breath: Resp support
Swallow: Medical attention immed (liquid)

Ethyl benzene

Formula: $CH_3CH_2C_6H_5$ | **CAS#:** 100-41-4 | **RTECS#:** DA0700000 | **IDLH:** 800 ppm [10%LEL]

Conversion: 1 ppm = 4.34 mg/m^3 | **DOT:** 1175 130

Synonyms/Trade Names: Ethylbenzol, Phenylethane

Exposure Limits:
NIOSH REL: TWA 100 ppm (435 mg/m^3)
ST 125 ppm (545 mg/m^3)
OSHA PEL†: TWA 100 ppm (435 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1501
OSHA 7, 1002

Physical Description: Colorless liquid with an aromatic odor.

Chemical & Physical Properties:
MW: 106.2
BP: 277°F
Sol: 0.01%
FI.P: 55°F
IP: 8.76 eV
Sp.Gr: 0.87
VP: 7 mmHg
FRZ: -139°F
UEL: 6.7%
LEL: 0.8%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
800 ppm: CcrOv*/GmFOv/PaprOv*/Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; head; derm; narco, coma
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

E

Ethyl bromide

Formula:	CAS#:	RTECS#:	IDLH:
CH_3CH_2Br	74-96-4	KH6475000	2000 ppm

Conversion: 1 ppm = 4.46 mg/m^3 **DOT:** 1891 131

Synonyms/Trade Names: Bromoethane, Monobromoethane

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: TWA 200 ppm (890 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1011
OSHA 7

Physical Description: Colorless to yellow liquid with an ether-like odor. [**Note:** A gas above 101°F.]

Chemical & Physical Properties:
MW: 109.0
BP: 101°F
Sol: 0.9%
Fl.P: <4°F
IP: 10.29 eV
Sp.Gr: 1.46
VP: 375 mmHg
FRZ: -182°F
UEL: 8.0%
LEL: 6.8%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
OSHA
2000 ppm: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as sodium, potassium, calcium, powdered aluminum, zinc & magnesium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; CNS depres; pulm edema; liver, kidney disease; card arrhy, card arrest
TO: Eyes, skin, resp sys, liver, kidneys, CVS, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush prompt
Breath: Resp support
Swallow: Medical attention immed

Ethyl butyl ketone

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3CH_2CO[CH_2]_3CH_3$	106-35-4	MJ5250000	1000 ppm

Conversion: 1 ppm = 4.67 mg/m^3 **DOT:** 1224 127

Synonyms/Trade Names: Butyl ethyl ketone, 3-Heptanone

Exposure Limits:
NIOSH REL: TWA 50 ppm (230 mg/m^3)
OSHA PEL: TWA 50 ppm (230 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1301, 2553
OSHA 7

Physical Description: Colorless liquid with a powerful, fruity odor.

Chemical & Physical Properties:
MW: 114.2
BP: 298°F
Sol: 1%
Fl.P(oc): 115°F
IP: 9.02 eV
Sp.Gr: 0.82
VP: 4 mmHg
FRZ: -38°F
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
500 ppm: CcrOv*/Sa*
1000 ppm: Sa:Cf*/PaprOv*/CcrFOv/ GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, acetaldehyde, perchloric acid

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; head, narco, coma; derm
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush
Breath: Resp support
Swallow: Medical attention immed

Ethyl chloride	Formula: CH_3CH_2Cl	CAS#: 75-00-3	RTECS#: KH7525000	IDLH: 3800 ppm [10%LEL]
Conversion: 1 ppm = 2.64 mg/m^3	**DOT:** 1037 115			
Synonyms/Trade Names: Chloroethane, Hydrochloric ether, Monochloroethane, Muriatic ether				
Exposure Limits: **NIOSH REL:** Handle with caution in the workplace. See Appendix C (Chloroethanes) **OSHA PEL:** TWA 1000 ppm (2600 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 2519	
Physical Description: Colorless gas or liquid (below 54°F) with a pungent, ether-like odor. [**Note:** Shipped as a liquefied compressed gas.]				
Chemical & Physical Properties: **MW:** 64.5 **BP:** 54°F **Sol:** 0.6% **Fl.P:** NA (Gas) -58°F (Liquid) **IP:** 10.97 eV **RGasD:** 2.23 **Sp.Gr:** 0.92 (Liquid at 32°F) **VP:** 1000 mmHg **FRZ:** -218°F **UEL:** 15.4% **LEL:** 3.8% Flammable Gas	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact (liquid) **Eyes:** Prevent eye contact (liquid) **Wash skin:** N.R. **Remove:** When wet (flamm) **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **OSHA** **3800 ppm:** Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Chemically-active metals such as sodium, potassium, calcium, powdered aluminum, zinc & magnesium; oxidizers; water or steam [**Note:** Reacts with water to form hydrochloric acid.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs (liquid), Ing (liquid), Con **SY:** Inco, inebri; abdom cramps; card arrhy, card arrest; liver, kidney damage **TO:** Liver, kidneys, resp sys, CVS, CNS			**First Aid (see Table 6):** **Eye:** Irr immed (liquid) **Skin:** Water flush prompt (liquid) **Breath:** Resp support **Swallow:** Medical attention immed (liquid)	

Ethylene chlorohydrin	Formula: CH_2ClCH_2OH	CAS#: 107-07-3	RTECS#: KK0875000	IDLH: 7 ppm
Conversion: 1 ppm = 3.29 mg/m^3	**DOT:** 1135 131			
Synonyms/Trade Names: 2-Chloroethanol, 2-Chloroethyl alcohol, Ethylene chlorhydrin				
Exposure Limits: **NIOSH REL:** C 1 ppm (3 mg/m^3) [skin] **OSHA PEL†:** TWA 5 ppm (16 mg/m^3) [skin]			**Measurement Methods (see Table 1):** **NIOSH** 2513 **OSHA** 7	
Physical Description: Colorless liquid with a faint, ether-like odor.				
Chemical & Physical Properties: **MW:** 80.5 **BP:** 262°F **Sol:** Miscible **Fl.P:** 140°F **IP:** 10.90 eV **Sp.Gr:** 1.20 **VP:** 5 mmHg **FRZ:** -90°F **UEL:** 15.9% **LEL:** 4.9% Class IIIA Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R. **Provide:** Eyewash Quick drench		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **7 ppm:** Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers, strong caustics, water or steam				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit muc memb; nau, vomit; dizz, inco; numb; vis dist; head; thirst; delirium; low BP; collapse, shock, coma; liver, kidney damage **TO:** Resp sys, liver, kidneys, CNS, CVS, eyes			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed	

E

Ethylenediamine

Formula:	CAS#:	RTECS#:	IDLH:
$NH_2CH_2CH_2NH_2$	107-15-3	KH8575000	1000 ppm

Conversion: 1 ppm = 2.46 mg/m^3 **DOT:** 1604 132

Synonyms/Trade Names: 1,2-Diaminoethane; 1,2-Ethanediamine; Ethylenediamine (anhydrous)

Exposure Limits:
NIOSH REL: TWA 10 ppm (25 mg/m^3)
OSHA PEL: TWA 10 ppm (25 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2540
OSHA 60

Physical Description: Colorless, viscous liquid with an ammonia-like odor. [fungicide] [**Note:** A solid below 47°F.]

Chemical & Physical Properties:
MW: 60.1
BP: 241°F
Sol: Miscible
Fl.P: 93°F
IP: 8.60 eV
Sp.Gr: 0.91
VP: 11 mmHg
FRZ: 47°F
UEL(212°F): 12%
LEL(212°F): 2.5%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash (>5%)
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
250 ppm: Sa:Cf£/PaprS£
500 ppm: CcrFS/GmFS/PaprTS£/ ScbaF/SaF
1000 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Strong acids & oxidizers, carbon tetrachloride & other chlorinated organic compounds, carbon disulfide [**Note:** Corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit nose, resp sys; sens derm; asthma; liver, kidney damage
TO: Skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Ethylene dibromide

Formula:	CAS#:	RTECS#:	IDLH:
$BrCH_2CH_2Br$	106-93-4	KH9275000	Ca [100 ppm]

Conversion: 1 ppm = 7.69 mg/m^3 **DOT:** 1605 154

Synonyms/Trade Names: 1,2-Dibromoethane; Ethylene bromide; Glycol dibromide

Exposure Limits:
NIOSH REL: Ca
TWA 0.045 ppm
C 0.13 ppm [15-minute]
See Appendix A
OSHA PEL: TWA 20 ppm
C 30 ppm
50 ppm [5-minute maximum peak]

Measurement Methods (see Table 1):
NIOSH 1008
OSHA 2

Physical Description: Colorless liquid or solid (below 50°F) with a sweet odor. [fumigant]

Chemical & Physical Properties:
MW: 187.9
BP: 268°F
Sol: 0.4%
Fl.P: NA
IP: 9.45 eV
Sp.Gr: 2.17
VP: 12 mmHg
FRZ: 50°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as sodium, potassium, calcium, hot aluminum & magnesium; liquid ammonia; strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; derm with vesic; liver, heart, spleen, kidney damage; repro effects; [carc]
TO: Eyes, skin, resp sys, liver, kidneys, repro sys [in animals: skin & lung tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Ethylene dichloride	Formula: $ClCH_2CH_2Cl$	CAS#: 107-06-2	RTECS#: KI0525000	IDLH: Ca [50 ppm]
Conversion: 1 ppm = 4.05 mg/m^3	**DOT:** 1184 131			
Synonyms/Trade Names: 1,2-Dichloroethane; Ethylene chloride; Glycol dichloride				

Exposure Limits:
NIOSH REL: Ca
TWA 1 ppm (4 mg/m^3)
ST 2 ppm (8 mg/m^3)
See Appendix A,
See Appendix C (Chloroethanes)
OSHA PEL†: TWA 50 ppm
C 100 ppm
200 ppm [5-minute maximum peak in any 3 hours]

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 3

Physical Description: Colorless liquid with a pleasant, chloroform-like odor. [**Note:** Decomposes slowly, becomes acidic & darkens in color.]

Chemical & Physical Properties:
MW: 99.0
BP: 182°F
Sol: 0.9%
Fl.P: 56°F
IP: 11.05 eV
Sp.Gr: 1.24
VP: 64 mmHg
FRZ: -32°F
UEL: 16%
LEL: 6.2%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers & caustics; chemically-active metals such as magnesium or aluminum powder, sodium & potassium; liquid ammonia [**Note:** Decomposes to vinyl chloride & HCl above 1112°F.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Abs, Con
SY: Irrit eyes, corn opac; CNS depres; nau, vomit; derm; liver, kidney, CVS damage; [carc]
TO: Eyes, skin, kidneys, liver, CNS, CVS [in animals: forestomach, mammary gland & circulatory sys cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Ethylene glycol	Formula: $HOCH_2CH_2OH$	CAS#: 107-21-1	RTECS#: KW2975000	IDLH: N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: 1,2-Dihydroxyethane; 1,2-Ethanediol; Glycol; Glycol alcohol; Monoethylene glycol				

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5523
OSHA PV2024

Physical Description: Clear, colorless, syrupy, odorless liquid. [antifreeze] [**Note:** A solid below 9°F.]

Chemical & Physical Properties:
MW: 62.1
BP: 388°F
Sol: Miscible
Fl.P: 232°F
IP: ?
Sp.Gr: 1.11
VP: 0.06 mmHg
FRZ: 9°F
UEL: 15.3%
LEL: 3.2%
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers, chromium trioxide, potassium permanganate, sodium peroxide
[**Note:** Hygroscopic (i.e., absorbs moisture from the air).]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; nau, vomit, abdom pain, lass; dizz, stupor, convuls, CNS depres; skin sens
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

E

Ethylene glycol dinitrate

Formula: $O_2NOCH_2CH_2ONO_2$ | **CAS#:** 628-96-6 | **RTECS#:** KW5600000 | **IDLH:** 75 mg/m^3

Conversion: 1 ppm = 6.22 mg/m^3 | **DOT:**

Synonyms/Trade Names: EGDN; 1,2-Ethanediol dinitrate; Ethylene dinitrate; Ethylene nitrate; Glycol dinitrate; Nitroglycol

Exposure Limits:
NIOSH REL: ST 0.1 mg/m^3 [skin]
OSHA PEL†: C 0.2 ppm (1 mg/m^3) [skin]

Physical Description: Colorless to yellow, oily, odorless liquid. [**Note:** An explosive ingredient (60-80%) in dynamite along with nitroglycerine (40-20%).]

Measurement Methods (see Table 1):
NIOSH 2507
OSHA 43

Chemical & Physical Properties:
MW: 152.1
BP: 387°F
Sol: Insoluble
Fl.P: 419°F
IP: ?
Sp.Gr: 1.49
VP: 0.05 mmHg
FRZ: -8°F
UEL: ?
LEL: ?
Explosive Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
1 mg/m^3: Sa*
2.5 mg/m^3: Sa:Cf*
5 mg/m^3: SaT:Cf*/ScbaF/SaF
75 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Acids, alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Throb head; dizz; nau, vomit, abdom pain; hypotension, flush, palp, angina; methemo; delirium, CNS depres; irrit skin; in animals: anemia; liver, kidney damage
TO: Skin, CVS, blood, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Ethyleneimine

Formula: C_2H_5N | **CAS#:** 151-56-4 | **RTECS#:** KX5075000 | **IDLH:** Ca [100 ppm]

Conversion: 1 ppm = 1.76 mg/m^3 | **DOT:** 1185 131P (inhibited)

Synonyms/Trade Names: Aminoethylene, Azirane, Aziridine, Dimethyleneimine, Dimethylenimine, Ethylenimine, Ethylimine

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1012] See Appendix B

Physical Description: Colorless liquid with an ammonia-like odor. [**Note:** Usually contains inhibitors to prevent polymerization.]

Measurement Methods (see Table 1):
NIOSH 3514

Chemical & Physical Properties:
MW: 43.1
BP: 133°F
Sol: Miscible
Fl.P: 12°F
IP: 9.20 eV
Sp.Gr: 0.83
VP: 160 mmHg
FRZ: -97°F
UEL: 54.8%
LEL: 3.3%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Polymerizes explosively in presence of acids [**Note:** Explosive silver derivatives may be formed with silver alloys (e.g., silver solder).]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; nau, vomit; head, dizz; pulm edema; liver, kidney damage; eye burns; skin sens; [carc]
TO: Eyes, skin, resp sys, liver, kidneys [in animals: lung & liver tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Ethylene oxide

Formula: C_2H_4O | **CAS#:** 75-21-8 | **RTECS#:** KX2450000 | **IDLH:** Ca [800 ppm]

Conversion: 1 ppm = 1.80 mg/m^3 | **DOT:** 1040 119P

Synonyms/Trade Names: Dimethylene oxide; 1,2-Epoxy ethane; Oxirane

Exposure Limits:
NIOSH REL: Ca
TWA <0.1 ppm (0.18 mg/m^3)
C 5 ppm (9 mg/m^3) [10-min/day]
See Appendix A
OSHA PEL: [1910.1047] TWA 1 ppm
5 ppm [15-minute Excursion]

Measurement Methods (see Table 1):
NIOSH 1614, 3800
OSHA 30, 49, 50

Physical Description: Colorless gas or liquid (below 51°F) with an ether-like odor.

Chemical & Physical Properties:
MW: 44.1
BP: 51°F
Sol: Miscible
Fl.P: NA (Gas)
-20°F (Liquid)
IP: 10.56 eV
RGasD: 1.49
Sp.Gr: 0.82 (Liquid at 50°F)
VP: 1.46 atm
FRZ: -171°F
UEL: 100%
LEL: 3.0%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (liquid)
Eyes: Prevent eye contact (liquid)
Wash skin: When contam (liquid)
Remove: When wet (flamm)
Change: N.R.
Provide: Quick drench (liquid)

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: GmFS†/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS†/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Strong acids, alkalis & oxidizers; chlorides of iron, aluminum & tin; oxides of iron & aluminum; water

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, (liquid), Con
SY: Irrit eyes, skin, nose, throat; peculiar taste; head; nau, vomit, diarr; dysp, cyan, pulm edema; drow, lass, inco; EKG abnor; eye, skin burns (liq or high vap conc); liquid: frostbite; repro effects; [carc]; in animals: convuls; liver, kidney damage
TO: Eyes, skin, resp sys, liver, CNS, blood, kidneys, repro sys [peritoneal cancer, leukemia]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed (liquid)

Ethylene thiourea

Formula: $C_3H_6N_2S$ | **CAS#:** 96-45-7 | **RTECS#:** NI9625000 | **IDLH:** Ca [N.D.]

Conversion: | **DOT:**

Synonyms/Trade Names: 1,3-Ethylene-2-thiourea; N,N-Ethylenethiourea; ETU; 2-Imidazolidine-2-thione

Exposure Limits:
NIOSH REL: Ca **OSHA PEL:** none
Use encapsulated form.
See Appendix A

Measurement Methods (see Table 1):
NIOSH 5011
OSHA 95

Physical Description: White to pale-green, crystalline solid with a faint, amine odor. [**Note:** Used as an accelerator in the curing of polychloroprene & other elastomers.]

Chemical & Physical Properties:
MW: 102.2
BP: 446-595°F
Sol(86°F): 2%
Fl.P: 486°F
IP: 8.15 eV
Sp.Gr: ?
VP: 16 mmHg
MLT: 392°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Acrolein

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes; in animals: thickening of the skin; goiter; terato effects; [carc]
TO: Eyes, skin, thyroid, repro sys [in animals: liver, thyroid & lymphatic sys tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

E

Ethyl ether	Formula: $C_2H_5OC_2H_5$	CAS#: 60-29-7	RTECS#: KI5775000	IDLH: 1900 ppm [10%LEL]
Conversion: 1 ppm = 3.03 mg/m^3	**DOT:** 1155 127			
Synonyms/Trade Names: Diethyl ether, Diethyl oxide, Ethyl oxide, Ether, Solvent ether				
Exposure Limits: **NIOSH REL:** See Appendix D **OSHA PEL†:** TWA 400 ppm (1200 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1610 **OSHA** 7	
Physical Description: Colorless liquid with a pungent, sweetish odor. [**Note:** A gas above 94°F.]				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 74.1 **BP:** 94°F **Sol:** 8% **Fl.P:** -49°F **IP:** 9.53 eV **Sp.Gr:** 0.71 **VP:** 440 mmHg **FRZ:** -177°F **UEL:** 36.0% **LEL:** 1.9% Class IA Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** N.R. **Remove:** When wet (flamm) **Change:** N.R.	**OSHA** **1900 ppm:** CcrOv*/GmFOv/PaprOv*/ Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, halogens, sulfur, sulfur compounds [**Note:** Tends to form explosive peroxides under influence of air and light.]	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, upper resp sys; dizz, drow, head, excited, narco; nau, vomit **TO:** Eyes, skin, resp sys, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water wash prompt **Breath:** Resp support **Swallow:** Medical attention immed

Ethyl formate	Formula: CH_3CH_2OCHO	CAS#: 109-94-4	RTECS#: LQ8400000	IDLH: 1500 ppm
Conversion: 1 ppm = 3.03 mg/m^3	**DOT:** 1190 129			
Synonyms/Trade Names: Ethyl ester of formic acid, Ethyl methanoate				
Exposure Limits: **NIOSH REL:** TWA 100 ppm (300 mg/m^3) **OSHA PEL:** TWA 100 ppm (300 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1452 **OSHA** 7	
Physical Description: Colorless liquid with a fruity odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 74.1 **BP:** 130°F **Sol(64°F):** 9% **Fl.P:** -4°F **IP:** 10.61 eV **Sp.Gr:** 0.92 **VP:** 200 mmHg **FRZ:** -113°F **UEL:** 16.0% **LEL:** 2.8% Class IB Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.	**NIOSH/OSHA** **1500 ppm:** Sa:Cf£/PaprOv£/CcrFOv/ GmFOv/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids [**Note:** Decomposes slowly in water to form ethyl alcohol and formic acid.]	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, upper resp sys; in animals: narco **TO:** Eyes, resp sys, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed

Ethylidene norbornene	**Formula:** C_9H_{12}	**CAS#:** 16219-75-3	**RTECS#:** RB9450000	**IDLH:** N.D.
Conversion: 1 ppm = 4.92 mg/m^3	**DOT:**			

Synonyms/Trade Names: ENB, 5-Ethylidenebicyclo(2.2.1)hept-2-ene, 5-Ethylidene-2-norbornene
[**Note:** Due to its reactivity, ENB may be stabilized with tert-butyl catechol.]

Exposure Limits:
NIOSH REL: C 5 ppm (25 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless to white liquid with a turpentine-like odor.

Chemical & Physical Properties:
MW: 120.2
BP: 298°F
Sol: ?
Fl.P(oc): 101°F
IP: ?
Sp.Gr: 0.90
VP: 4 mmHg
FRZ: -112°F
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxygen
[**Note:** ENB should be stored in a nitrogen atmosphere since it reacts with oxygen.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; head; cough, dysp; nau, vomit; olfactory, taste changes; chemical pneu (aspir liquid); in animals: liver, kidney, urogenital inj; bone marrow effects
TO: Eyes, skin, resp sys, CNS, liver, kidneys, urogenital system, bone marrow

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Ethyl mercaptan	**Formula:** CH_3CH_2SH	**CAS#:** 75-08-1	**RTECS#:** KI9625000	**IDLH:** 500 ppm
Conversion: 1 ppm = 2.54 mg/m^3	**DOT:** 2363 129			

Synonyms/Trade Names: Ethanethiol, Ethyl sulfhydrate, Mercaptoethane

Exposure Limits:
NIOSH REL: C 0.5 ppm (1.3 mg/m^3) [15-minute]
OSHA PEL†: C 10 ppm (25 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2542

Physical Description: Colorless liquid with a strong, skunk-like odor.
[**Note:** A gas above 95°F.]

Chemical & Physical Properties:
MW: 62.1
BP: 95°F
Sol: 0.7%
Fl.P: -55°F
IP: 9.29 eV
Sp.Gr: 0.84
VP: 442 mmHg
FRZ: -228°F
UEL: 18.0%
LEL: 2.8%
Class IA Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: CcrOv/Sa
12.5 ppm: Sa:Cf/PaprOv
25 ppm: CcrFOv/GmFOv/SaT:Cf/PaprTOv/ScbaF/SaF
500 ppm: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers [**Note:** Reacts violently with calcium hypochlorite.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit muc memb; head, nau; in animals: inco, lass; liver, kidney damage; cyan; narco
TO: Eyes, resp sys, liver, kidneys, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

N-Ethylmorpholine

Formula:	CAS#:	RTECS#:	IDLH:
$C_4H_8ONCH_2CH_3$	100-74-3	QE4025000	100 ppm

Conversion: 1 ppm = 4.71 mg/m^3 **DOT:**

Synonyms/Trade Names: 4-Ethylmorpholine

Exposure Limits:
NIOSH REL: TWA 5 ppm (23 mg/m^3) [skin]
OSHA PEL†: TWA 20 ppm (94 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH S146 (II-3)

Physical Description: Colorless liquid with an ammonia-like odor.

Chemical & Physical Properties:
MW: 115.2
BP: 281°F
Sol: Miscible
Fl.P(oc): 90°F
IP: ?
Sp.Gr: 0.90
VP: 6 mmHg
FRZ: -81°F
UEL: ?
LEL: ?
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash (>15%)
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
50 ppm: CcrOv*/Sa*
100 ppm: Sa:Cf*/PaprOv*/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong acids, strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose, throat; vis dist: corn edema, blue-gray vision, colored haloes
TO: Eyes, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Ethyl silicate

Formula:	CAS#:	RTECS#:	IDLH:
$(C_2H_5)_4SiO_4$	78-10-4	VV9450000	700 ppm

Conversion: 1 ppm = 8.52 mg/m^3 **DOT:** 1292 129

Synonyms/Trade Names: Ethyl orthosilicate, Ethyl silicate (condensed), Tetraethoxysilane, Tetraethyl orthosilicate, Tetraethyl silicate

Exposure Limits:
NIOSH REL: TWA 10 ppm (85 mg/m^3)
OSHA PEL†: TWA 100 ppm (850 mg/m^3)

Measurement Methods (see Table 1):
NIOSH S264 (II-3)

Physical Description: Colorless liquid with a sharp, alcohol-like odor.

Chemical & Physical Properties:
MW: 208.3
BP: 336°F
Sol: Reacts
Fl.P: 99°F
IP: 9.77 eV
Sp.Gr: 0.93
VP: 1 mmHg
FRZ: -117°F
UEL: ?
LEL: ?
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
100 ppm: Sa*
250 ppm: Sa:Cf*
500 ppm: ScbaF/SaF
700 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, water
[**Note:** Reacts with water to form a silicone adhesive (a milky-white mass).]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose; in animals: lac; dysp, pulm edema; tremor, narco; liver, kidney damage; anemia
TO: Eyes, resp sys, liver, kidneys, blood, skin

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Fenamiphos	**Formula:** $C_{13}H_{22}NO_3PS$	**CAS#:** 22224-92-6	**RTECS#:** TB3675000	**IDLH:** N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Ethyl 3-methyl-4-(methylthio)phenyl-(1-methylethyl)phosphoramidate, Nemacur®, Phenamiphos

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3 [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5600

Physical Description: Off-white to tan, waxy solid. [insecticide]
[**Note:** Found commercially as a granular ingredient (5-15%) or in an emulsifiable concentrate (400 g/l).]

Chemical & Physical Properties:
MW: 303.4
BP: ?
Sol: 0.03%
Fl.P: ?
IP: ?
Sp.Gr: 1.14
VP: 0.00005 mmHg
MLT: 121°F
UEL: ?
LEL: ?

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported [**Note:** May hydrolyze under alkaline conditions.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Nau, vomit, abdom cramps, diarr, salv; head, dizz, lass; rhin, chest tight; blurred vision, miosis; card irreg; musc fasc; dysp
TO: Resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Fensulfothion	**Formula:** $C_{11}H_{17}O_4PS_2$	**CAS#:** 115-90-2	**RTECS#:** TF3850000	**IDLH:** N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Dasanit®; O,O-Diethyl O-(p-methylsulfinyl)phenyl)phosphorothioate; Terracur P®

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Brown liquid or yellow oil. [pesticide]

Chemical & Physical Properties:
MW: 308.4
BP: ?
Sol(77°F): 0.2%
Fl.P: ?
IP: ?
Sp.Gr: 1.20
VP: ?
FRZ: ?
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit skin; nau, vomit, abdom cramps, diarr, salv; head, dizz, lass; rhin, chest tight; blurred vision, miosis; card irreg; musc fasc; dys
TO: Skin, resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

F

Fenthion

Formula:	CAS#:	RTECS#:	IDLH:
$C_{10}H_{15}O_3PS$	55-38-9	TF9625000	N.D.

Conversion: **DOT:**

Synonyms/Trade Names: Baytex; Entex; O,O-Dimethyl O-3-methyl-4-methylthiophenyl phosphorothioate

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless to brown liquid with a slight, garlic-like odor. [insecticide]

Chemical & Physical Properties:
MW: 278.3
BP: ?
Sol: 0.006%
Fl.P: NA
IP: ?
Sp.Gr: 1.25
VP: 0.0003 mmHg
FRZ: 43°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Nau, vomit, abdom cramps, diarr, salv; head, dizz, lass; rhin, chest tight; blurred vision, miosis; card irregularities; musc fasc; dysp
TO: Resp sys, CNS, CVS, plasma chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Ferbam

Formula:	CAS#:	RTECS#:	IDLH:
$[(CH_3)_2NCS_2]_3Fe$	14484-64-1	NO8750000	800 mg/m^3

Conversion: **DOT:**

Synonyms/Trade Names: tris(Dimethyldithiocarbamato)iron, Ferric dimethyl dithiocarbamate

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3
OSHA PEL†: TWA 15 mg/m^3

Measurement Methods (see Table 1):
NIOSH 0500

Physical Description: Dark brown to black, odorless solid. [fungicide]

Chemical & Physical Properties:
MW: 416.5
BP: Decomposes
Sol: 0.01%
Fl.P: ?
IP: 7.72 eV
Sp.Gr: ?
VP: 0 mmHg (approx)
MLT: >356°F (Decomposes)
UEL: ?
LEL: ?
MEC: 55 g/m^3
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
50 mg/m^3: Qm
100 mg/m^3: 95XQ*/Sa*
250 mg/m^3: Sa:Cf*/PaprHie*
500 mg/m^3: 100F/SaT:Cf*/PaprTHie*/ ScbaF/SaF
800 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, moisture

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, resp tract; derm; GI dist
TO: Eyes, skin, resp sys, GI tract

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Ferrovanadium dust	**Formula:** FeV	**CAS#:** 12604-58-9	**RTECS#:** LK2900000	**IDLH:** 500 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names: Ferrovanadium

Exposure Limits:
NIOSH REL*: TWA 1 mg/m^3
ST 3 mg/m^3
[***Note:** The REL also applies to Vanadium metal and Vanadium carbide.]
OSHA PEL†: TWA 1 mg/m^3

Measurement Methods (see Table 1):
OSHA ID121, ID125G

Physical Description: Dark, odorless particulate dispersed in air.
[**Note:** Ferrovanadium metal is an alloy usually containing 50-80% vanadium.]

Chemical & Physical Properties:
MW: 106.8
BP: ?
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: ?
VP: 0 mmHg (approx)
MLT: 2696-2768°F
UEL: NA
LEL: NA
MEC: 1.3 g/m^3
Metal: Noncombustible Solid, but dust may be an explosion hazard.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: Qm*
10 mg/m^3: 95XQ*/Sa*
25 mg/m^3: Sa:Cf*/PaprHie*
50 mg/m^3: 100F/SaT:Cf*/PaprTHie*/ScbaF/SaF
500 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, resp sys; in animals: bron, pneu
TO: Eyes, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Resp support

Fibrous glass dust	**Formula:**	**CAS#:**	**RTECS#:** LK3651000	**IDLH:** N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Fiber glas®, Fiberglass, Glass fibers, Glass wool
[**Note:** Usually produced from borosilicate & low alkali silicate glasses.]

Exposure Limits:
NIOSH REL: TWA 3 fibers/cm^3 (fibers ≤ 3.5 µm in diameter & ≤ 10 µm in length)
TWA 5 mg/m^3 (total)
OSHA PEL: TWA 15 mg/m3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 7400

Physical Description: Typically, glass filaments >3 µm in diameter or glass "wool" with diameters down to 0.05 µm & >1 µm in length.

Chemical & Physical Properties:
MW: NA
BP: NA
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 2.5
VP: 0 mmHg (approx)
MLT: ?
UEL: NA
LEL: NA
Noncombustible Fibers

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5X REL: Qm
10X REL: 95XQ/Sa
25X REL: Sa:Cf/PaprHie
50X REL: 100F/PaprTHie/ScbaF/SaF
1000X REL: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, nose, throat; dysp
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

F

Fluorine

Formula:	CAS#:	RTECS#:	IDLH:
F_2	7782-41-4	LM6475000	25 ppm

Conversion: 1 ppm = 1.55 mg/m^3

DOT: 1045 124; 9192 167 (cryogenic liquid)

Synonyms/Trade Names: Fluorine-19

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.2 mg/m^3)
OSHA PEL: TWA 0.1 ppm (0.2 mg/m^3)

Measurement Methods (see Table 1):
None available

Physical Description: Pale-yellow to greenish gas with a pungent, irritating odor.

Chemical & Physical Properties:
MW: 38.0
BP: -307°F
Sol: Reacts
Fl.P: NA
IP: 15.70 eV
RGasD: 1.31
VP: >1 atm
FRZ: -363°F
UEL: NA
LEL: NA
Nonflammable Gas, but an extremely strong oxidizer.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (liquid)
Eyes: Prevent eye contact (liquid)
Wash skin: When contam (liquid)
Remove: When wet or contam (liquid)
Change: N.R.
Provide: Eyewash (liquid)
Quick drench (liquid)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1 ppm: Sa*
2.5 ppm: Sa:Cf*
5 ppm: ScbaF/SaF
25 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS¿/ScbaE

Incompatibilities and Reactivities: Water, nitric acid, oxidizers, organic compounds
[**Note:** Reacts violently with all combustible materials, except the metal containers in which it is shipped. Reacts with H_2O to form hydrofluoric acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, nose, resp sys; lar spasm, wheez; pulm edema; eye, skin burns; in animals: liver, kidney damage
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support

Fluorotrichloromethane

Formula:	CAS#:	RTECS#:	IDLH:
CCl_3F	75-69-4	PB6125000	2000 ppm

Conversion: 1 ppm = 5.62 mg/m^3

DOT:

Synonyms/Trade Names: Freon® 11, Monofluorotrichloromethane, Refrigerant 11, Trichlorofluoromethane, Trichloromonofluoromethane

Exposure Limits:
NIOSH REL: C 1000 ppm (5600 mg/m^3)
OSHA PEL†: TWA 1000 ppm (5600 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1006

Physical Description: Colorless to water-white, nearly odorless liquid or gas (above 75°F).

Chemical & Physical Properties:
MW: 137.4
BP: 75°F
Sol(75°F): 0.1%
Fl.P: NA
IP: 11.77 eV
RGasD: 4.74
Sp.Gr: 1.47 (Liquid at 75°F)
VP: 690 mmHg
FRZ: -168°F
UEL: NA
LEL: NA
Noncombustible Liquid
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2000 ppm: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as sodium, potassium, calcium, powdered aluminum, zinc, magnesium & lithium shavings; granular barium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Inco, tremor; derm; card arrhy, card arrest; asphy; liquid: frostbite
TO: Skin, resp sys, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Fluoroxene

Formula:	CAS#:	RTECS#:	IDLH:
$CF_3CH_2OCH=CH_2$	406-90-6	KO4250000	N.D.

Conversion: 1 ppm = 5.16 mg/m^3 **DOT:**

Synonyms/Trade Names: 2,2,2-Trifluoroethoxyethene; 2,2,2-Trifluoroethyl vinyl ether

Exposure Limits:
NIOSH REL*: C 2 ppm (10.3 mg/m^3) [60-minute]
[***Note:** REL for exposure to waste anesthetic gas.]
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Liquid. [inhalation anesthetic] [**Note:** A gas above 109°F.]

Chemical & Physical Properties:
MW: 126.1
BP: 109°F
Sol: ?
Fl.P: ?
IP: ?
Sp.Gr: 1.14
VP: 286 mmHg
FRZ: ?
UEL: ?
LEL: ?
Combustible Liquid
[Potentially EXPLOSIVE!]

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes; CNS depres, analgesia, anes, convuls, resp depres
TO: Eyes, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Fonofos

Formula:	CAS#:	RTECS#:	IDLH:
$C_{10}H_{15}OPS_2$	944-22-9	TA5950000	N.D.

Conversion: 1 ppm = 10.07 mg/m^3 **DOT:**

Synonyms/Trade Names: Dyfonate®, Dyphonate, O-Ethyl-S-phenyl ethylphosphorothioate, Fonophos

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3 [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5600
OSHA PV2027

Physical Description: Light-yellow liquid with an aromatic odor. [insecticide]

Chemical & Physical Properties:
MW: 246.3
BP: ?
Sol: 0.001%
Fl.P: >201°F
IP: ?
Sp.Gr: 1.15
VP(77°F): 0.0002 mmHg
FRZ: ?
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Nau, vomit, abdom cramps, diarr, salv; head, dizz, lass; rhin, chest tight; blurred vision, miosis; card irreg; musc fasc; dysp
TO: Resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

F

Formaldehyde

Formula: HCHO | **CAS#:** 50-00-0 | **RTECS#:** LP8925000 | **IDLH:** Ca [20 ppm]

Conversion: 1 ppm = 1.23 mg/m^3 | **DOT:**

Synonyms/Trade Names: Methanal, Methyl aldehyde, Methylene oxide

Exposure Limits:
NIOSH REL: Ca
TWA 0.016 ppm
C 0.1 ppm [15-minute]
See Appendix A
OSHA PEL: [1910.1048] TWA 0.75 ppm
ST 2 ppm

Measurement Methods (see Table 1):
NIOSH 2016, 2541, 3500, 3800
OSHA ID205, 52

Physical Description: Nearly colorless gas with a pungent, suffocating odor. [**Note:** Often used in an aqueous solution (see specific listing for Formalin).]

Chemical & Physical Properties:
MW: 30.0
BP: -6°F
Sol: Miscible
Fl.P: NA (Gas)
IP: 10.88 eV
RGasD: 1.04
VP: >1 atm
FRZ: -134°F
UEL: 73%
LEL: 7.0%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Strong oxidizers, alkalis & acids; phenols; urea [**Note:** Pure formaldehyde has a tendency to polymerize. Reacts with HCl to form bis-Chloromethyl ether.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, nose, throat, resp sys; lac; cough; wheez; [carc]
TO: Eyes, resp sys [nasal cancer]

First Aid (see Table 6):
Eye: Irr immed
Breath: Resp support

Formalin (as formaldehyde)

Formula: | **CAS#:** | **RTECS#:** | **IDLH:** Ca [20 ppm]

Conversion: | **DOT:** 1198 132; 2209 132

Synonyms/Trade Names: Formaldehyde solution
[**Note:** Formalin is an aqueous solution that is 37% formaldehyde by weight; inhibited solutions usually contain 6-12% methyl alcohol. Also see specific listings for Formaldehyde and Methyl alcohol.]

Exposure Limits:
NIOSH REL: Ca
TWA 0.016 ppm
C 0.1 ppm [15-minute]
See Appendix A
OSHA PEL: [1910.1048] TWA 0.75 ppm
ST 2 ppm

Measurement Methods (see Table 1):
NIOSH 2016, 2541, 3500, 3800
OSHA ID205, 52

Physical Description: Colorless liquid with a pungent odor.

Chemical & Physical Properties:
MW: Varies
BP: 214°F
Sol: Miscible
Fl.P: 185°F
IP: ?
Sp.Gr(77°F): 1.08
VP: 1 mmHg
FRZ: ?
UEL: 73%
LEL: 7%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Strong oxidizers, alkalis & acids; phenols; urea; oxides; isocyanates; caustics; anhydrides

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose, throat, resp sys; lac; cough; wheez, derm; [carc]
TO: Eyes, skin, resp sys [nasal cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Formamide	**Formula:** $HCONH_2$	**CAS#:** 75-12-7	**RTECS#:** LQ0525000	**IDLH:** N.D.
Conversion: 1 ppm = 1.85 mg/m^3	**DOT:**			
Synonyms/Trade Names: Carbamaldehyde, Methanamide				
Exposure Limits: **NIOSH REL:** TWA 10 ppm (15 mg/m^3) [skin] **OSHA PEL†:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Colorless, oily liquid. [**Note:** A solid below 37°F.]				
Chemical & Physical Properties: **MW:** 45.1 **BP:** 411°F (Decomposes) **Sol:** Miscible **Fl.P(oc):** 310°F **IP:** 10.20 eV **Sp.Gr:** 1.13 **VP(86°F):** 0.1 mmHg **FRZ:** 37°F **UEL:** ? **LEL:** ? Class IIIB Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** N.R. **Eyes:** Prevent eye contact **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Oxidizers, iodine, pyridine, sulfur trioxide, copper, brass, lead [**Note:** Hygroscopic (i.e., absorbs moisture from the air).]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, muc memb; drow, lass; nau; acidosis; skin eruptions; in animals: repro effects **TO:** Eyes, skin, resp sys, CNS, repro sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water wash **Breath:** Resp support **Swallow:** Medical attention immed	

Formic acid	**Formula:** HCOOH	**CAS#:** 64-18-6	**RTECS#:** LQ4900000	**IDLH:** 30 ppm
Conversion: 1 ppm = 1.88 mg/m^3	**DOT:** 1779 153			
Synonyms/Trade Names: Formic acid (85-95% in aqueous solution); Hydrogen carboxylic acid; Methanoic acid				
Exposure Limits: **NIOSH REL:** TWA 5 ppm (9 mg/m^3) **OSHA PEL:** TWA 5 ppm (9 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 2011 **OSHA** ID186SG	
Physical Description: Colorless liquid with a pungent, penetrating odor. [**Note:** Often used in an aqueous solution.]				
Chemical & Physical Properties: **MW:** 46.0 **BP:** 224°F (90% solution) **Sol:** Miscible **Fl.P(oc):** 122°F (90% solution) **IP:** 11.05 eV **Sp.Gr:** 1.22 (90% solution) **VP:** 35 mmHg **FRZ:** 20°F (90% solution) **UEL:** 57% (90% solution) **LEL:** 18% (90% solution) Class II Combustible Liquid (90% solution)	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R. **Provide:** Eyewash Quick drench		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **30 ppm:** Sa*/ScbaF **§:** ScbaF:Pd,Pp/ SaF:Pd,Pp:AScba **Escape:** GmFOv100/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers, strong caustics, concentrated sulfuric acid [**Note:** Corrosive to metals.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes; skin, throat; skin burns, derm; lac; rhin; cough, dysp; nau **TO:** Eyes, skin, resp sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed	

F

Furfural	Formula: $C_5H_4O_2$	CAS#: 98-01-1	RTECS#: LT7000000	IDLH: 100 ppm
Conversion: 1 ppm = 3.93 mg/m^3	**DOT:** 1199 132P			
Synonyms/Trade Names: Fural, 2-Furancarboxaldehyde, Furfuraldehyde, 2-Furfuraldehyde				
Exposure Limits: **NIOSH REL:** See Appendix D **OSHA PEL†:** TWA 5 ppm (20 mg/m^3) [skin]			**Measurement Methods (see Table 1):** **NIOSH** 2529 **OSHA** 72	
Physical Description: Colorless to amber liquid with an almond-like odor. [**Note:** Darkens in light and air.]				
Chemical & Physical Properties: **MW:** 96.1 **BP:** 323°F **Sol:** 8% **Fl.P:** 140°F **IP:** 9.21 eV **Sp.Gr:** 1.16 **VP:** 2 mmHg **FRZ:** -34°F **UEL:** 19.3% **LEL:** 2.1% Class IIIA Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **OSHA** **50 ppm:** CcrOv*/Sa* **100 ppm:** Sa:Cf*/CcrFOv/PaprOv*/ GmFOv/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Strong acids, oxidizers, strong alkalis [**Note:** May polymerize on contact with strong acids or strong alkalis.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, upper resp sys; head; derm **TO:** Eyes, skin, resp sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Furfuryl alcohol	Formula: $C_5H_6O_2$	CAS#: 98-00-0	RTECS#: LU9100000	IDLH: 75 ppm
Conversion: 1 ppm = 4.01 mg/m^3	**DOT:** 2874 153			
Synonyms/Trade Names: 2-Furylmethanol, 2-Hydroxymethylfuran				
Exposure Limits: **NIOSH REL:** TWA 10 ppm (40 mg/m^3) [skin] ST 15 ppm (60 mg/m^3) **OSHA PEL†:** TWA 50 ppm (200 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 2505	
Physical Description: Colorless to amber liquid with a faint, burning odor. [**Note:** Darkens on exposure to light.]				
Chemical & Physical Properties: **MW:** 98.1 **BP:** 338°F **Sol:** Miscible **Fl.P:** 149°F **IP:** ? **Sp.Gr:** 1.13 **VP(77°F):** 0.6 mmHg **FRZ:** 6°F **UEL:** 16.3% **LEL:** 1.8% Class IIIA Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R. **Provide:** Quick drench		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **75 ppm:** CcrOv*/GmFOv/PaprOv*/ Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers & acids [**Note:** Contact with organic acids may lead to polymerization.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, muc memb; dizz; nau, diarr; diuresis; resp, body temperature depres; vomit; derm **TO:** Eyes, skin, resp sys, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed	

Gasoline

Formula:
CAS#: 8006-61-9
RTECS#: LX3300000
IDLH: Ca [N.D.]

Conversion: 1 ppm = 4.5 mg/m^3 (approx)
DOT: 1203 128

Synonyms/Trade Names: Motor fuel, Motor spirits, Natural gasoline, Petrol
[**Note:** A complex mixture of volatile hydrocarbons (paraffins, cycloparaffins & aromatics).]

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2028

Physical Description: Clear liquid with a characteristic odor.

Chemical & Physical Properties:
MW: 110 (approx)
BP: 102°F
Sol: Insoluble
Fl.P: -45°F
IP: ?
Sp.Gr(60°F): 0.72-0.76
VP: 38-300 mmHg
FRZ: ?
UEL: 7.6%
LEL: 1.4%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers such as peroxides, nitric acid & perchlorates

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb; derm; head, lass, blurred vision, dizz, slurred speech, conf, convuls; chemical pneu (aspir liquid); possible liver, kidney damage; [carc]
TO: Eyes, skin, resp sys, CNS, liver, kidneys [in animals: liver & kidney cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Germanium tetrahydride

Formula: GeH_4
CAS#: 7782-65-2
RTECS#: LY4900000
IDLH: N.D.

Conversion: 1 ppm = 3.13 mg/m^3
DOT: 2192 119

Synonyms/Trade Names: Germane, Germanium hydride, Germanomethane, Monogermane
[**Note:** Used chiefly for the production of high purity germanium for use in semiconductors.]

Exposure Limits:
NIOSH REL: TWA 0.2 ppm (0.6 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless gas with a pungent odor.
[**Note:** Shipped as a compressed gas.]

Chemical & Physical Properties:
MW: 76.6
BP: -127°F
Sol: Insoluble
Fl.P: NA (Gas)
IP: 11.34 eV
RGasD: 2.65
VP: >1 atm
FRZ: -267°F
UEL: ?
LEL: ?
Flammable Gas (may ignite SPONTANEOUSLY in air).

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Bromine

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh
SY: Mal, head, dizz, fainting; dysp; nau, vomit; kidney inj; hemolytic effects
TO: CNS, kidneys, blood

First Aid (see Table 6):
Breath: Resp support

Glutaraldehyde

Formula: $OCH(CH_2)_3CHO$ | **CAS#:** 111-30-8 | **RTECS#:** MA2450000 | **IDLH:** N.D.

Conversion: 1 ppm = 4.09 mg/m^3 | **DOT:**

Synonyms/Trade Names: Glutaric dialdehyde; 1,5-Pentanedial

Exposure Limits:
NIOSH REL: C 0.2 ppm (0.8 mg/m^3)
See Appendix C (Aldehydes)
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 2532
OSHA 64

Physical Description: Colorless liquid with a pungent odor.

Chemical & Physical Properties:
MW: 100.1
BP: 212°F
Sol: Miscible
Fl.P: NA
IP: ?
Sp.Gr: 1.10
VP: 17 mmHg
FRZ: 7°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers, strong bases [**Note:** Alkaline solutions of glutaraldehyde (i.e., activated glutaraldehyde) react with alcohol, ketones, amines, hydrazines & proteins.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; derm, sens skin; cough, asthma; nau, vomit
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Glycerin (mist)

Formula: $HOCH_2CH(OH)CH_2OH$ | **CAS#:** 56-81-5 | **RTECS#:** MA8050000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: Glycerin (anhydrous); Glycerol; Glycyl alcohol; 1,2,3-Propanetriol; Trihydroxypropane

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Clear, colorless, odorless, syrupy liquid or solid (below 64°F).
[**Note:** The solid form melts above 64°F but the liquid form freezes at a much lower temperature.]

Chemical & Physical Properties:
MW: 92.1
BP: 554°F (Decomposes)
Sol: Miscible
Fl.P: 320°F
IP: ?
Sp.Gr: 1.26
VP(122°F): 0.003 mmHg
MLT: 64°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers (e.g., chromium trioxide, potassium chlorate, potassium permanganate) [**Note:** Hygroscopic (i.e., absorbs moisture from the air).]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, resp sys; head, nau, vomit; kidney inj
TO: Eyes, skin, resp sys, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash
Breath: Fresh air

Glycidol	Formula: $C_3H_6O_2$	CAS#: 556-52-5	RTECS#: UB4375000	IDLH: 150 ppm
Conversion: 1 ppm = 3.03 mg/m^3	**DOT:**			

Synonyms/Trade Names: 2,3-Epoxy-1-propanol; Epoxypropyl alcohol; Glycide; Hydroxymethyl ethylene oxide; 2-Hydroxymethyl oxiran; 3-Hydroxypropylene oxide

Exposure Limits:
NIOSH REL: TWA 25 ppm (75 mg/m^3)
OSHA PEL†: TWA 50 ppm (150 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1608
OSHA 7

Physical Description: Colorless liquid.

Chemical & Physical Properties:
MW: 74.1
BP: 320°F (Decomposes)
Sol: Miscible
Fl.P: 162°F
IP: ?
Sp.Gr: 1.12
VP(77°F): 0.9 mmHg
FRZ: -49°F
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
150 ppm: Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, nitrates

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; narco
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash prompt
Breath: Resp support
Swallow: Medical attention immed

Glycolonitrile	Formula: $HOCH_2CN$	CAS#: 107-16-4	RTECS#: AM0350000	IDLH: N.D.
Conversion: 1 ppm = 2.34 mg/m^3	**DOT:**			

Synonyms/Trade Names: Cyanomethanol, Formaldehyde cyanohydrin, Glycolic nitrile, Glyconitrile, Hydroxyacetonitrile

Exposure Limits:
NIOSH REL: C 2 ppm (5 mg/m^3) [15-minute]
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless, odorless, oily liquid.
[**Note:** Forms cyanide in the body.]

Chemical & Physical Properties:
MW: 57.1
BP: 361°F (Decomposes)
Sol: Soluble
Fl.P: ?
IP: ?
Sp.Gr(66°F): 1.10
VP(145°F): 1 mmHg
FRZ: <-98°F
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
20 ppm: Sa
50 ppm: Sa:Cf
100 ppm: ScbaF/SaF
250 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Traces of alkalis (promote violent polymerization)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; head, dizz, lass, conf, convuls; dysp; abdom pain, nau, vomit
TO: Eyes, skin, resp sys, CNS, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Grain dust (oat, wheat, barley)	Formula:	CAS#:	RTECS#:	IDLH:
			MD7900000	N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: None
[**Note:** Grain dust consists of 60-75% organic materials (cereal grains) & 25-40% inorganic materials (soil), and includes fertilizers, pesticides & microorganisms.]

Exposure Limits:
NIOSH REL: TWA 4 mg/m^3
OSHA PEL: TWA 10 mg/m^3

Measurement Methods (see Table 1):
NIOSH 0500

Physical Description: Mixture of grain and all the other substances associated with its cultivation & harvesting.

Chemical & Physical Properties:
Properties depend upon the specific component of the grain dust.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, upper resp sys; cough, dysp, wheez, asthma, bron, chronic obstructive pulm disease; conj, derm, rhinitis, grain fever
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Graphite (natural)	Formula:	CAS#:	RTECS#:	IDLH:
	C	7782-42-5	MD9659600	1250 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names: Black lead, Mineral carbon, Plumbago, Silver graphite, Stove black
[**Note:** Also see specific listing for Graphite (synthetic).]

Exposure Limits:
NIOSH REL: TWA 2.5 mg/m^3 (resp)
OSHA PEL†: TWA 15 mppcf

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Steel gray to black, greasy feeling, odorless solid.

Chemical & Physical Properties:
MW: 12.0
BP: Sublimes
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 2.0-2.25
VP: 0 mmHg (approx)
MLT: 6602°F (Sublimes)
UEL: NA
LEL: NA
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
12.5 mg/m^3: Qm
25 mg/m^3: 95XQ/Sa
62.5 mg/m^3: PaprHie/Sa:Cf
125 mg/m^3: 100F/PaprTHie/SaT:Cf/ScbaF/SaF
1250 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Very strong oxidizers such as fluorine, chlorine trifluoride & potassium peroxide

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Cough, dysp, black sputum, decr pulm func, lung fib
TO: Resp sys, CVS

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Graphite (synthetic)	Formula: C	CAS#: 7440-44-0 (synthetic)	RTECS#: FF5250100 (synthetic)	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Acheson graphite, Artificial graphite
[**Note:** Also see specific listing for Graphite (natural).]

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Steel gray to black, greasy feeling, odorless solid.

Chemical & Physical Properties:
MW: 12.0
BP: Sublimes
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 1.5-1.8
VP: 0 mmHg (approx)
MLT: 6602°F (Sublimes)
UEL: NA
LEL: NA
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Very strong oxidizers such as fluorine, chlorine trifluoride & potassium peroxide

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Cough, dysp, black sputum, decr pulm func, lung fib
TO: Resp sys, CVS

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Gypsum	Formula: $CaSO_4 \times 2H_2O$	CAS#: 13397-24-5	RTECS#: MG2360000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Calcium(II) sulfate dihydrate, Gypsum stone, Hydrated calcium sulfate, Mineral white
[**Note:** Gypsum is the dihydrate form of calcium sulfate; Plaster of Paris is the hemihydrate form.]

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: White or nearly white, odorless, crystalline solid.

Chemical & Physical Properties:
MW: 172.2
BP: ?
Sol(77°F): 0.2%
Fl.P: NA
IP: NA
Sp.Gr: 2.32
VP: 0 mmHg (approx)
MLT: 262-325°F (Loses H_2O)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Aluminum (at high temperatures), diazomethane

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, muc memb, upper resp sys; cough, sneez, rhin
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Hafnium

Formula:	CAS#:	RTECS#:	IDLH:
Hf	7440-58-6	MG4600000	50 mg/m^3 (as Hf)

Conversion: **DOT:** 1326 170 (powder, wet); 2545 135 (powder, dry)

Synonyms/Trade Names: Celtium, Elemental hafnium, Hafnium metal

Exposure Limits:
NIOSH REL*: TWA 0.5 mg/m^3
OSHA PEL*: TWA 0.5 mg/m^3
[***Note:** The REL and PEL also apply to other hafnium compounds (as Hf).]

Measurement Methods (see Table 1):
NIOSH S194 (II-5)
OSHA ID121

Physical Description: Highly lustrous, ductile, grayish solid.

Chemical & Physical Properties:
MW: 178.5
BP: 8316°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 13.31
VP: 0 mmHg (approx)
MLT: 4041°F
UEL: NA
LEL: NA

Explosive in powder form (either dry or with <25% water); finely divided powder can be ignited by static electricity or even SPONTANEOUSLY.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2.5 mg/m^3: Qm
5 mg/m^3: 95XQ/Sa
12.5 mg/m^3: Sa:Cf*/PaprHie*
25 mg/m^3: 100F/SaT:Cf*/PaprTHie*/ScbaF/SaF
50 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, chlorine

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: irrit eyes, skin, muc memb; liver damage
TO: Eyes, skin, muc memb, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Halothane

Formula:	CAS#:	RTECS#:	IDLH:
$CF_3CHBrCl$	151-67-7	KH6550000	N.D.

Conversion: 1 ppm = 8.07 mg/m^3 **DOT:**

Synonyms/Trade Names: 1-Bromo-1-chloro-2,2,2-trifluoroethane; 2-Bromo-2-chloro-1,1,1-trifluoroethane; 1,1,1-Trifluoro-2-bromo-2-chloroethane; 2,2,2-Trifluoro-1-bromo-1-chloroethane

Exposure Limits:
NIOSH REL*: C 2 ppm (16.2 mg/m^3) [60-minute]
[***Note:** REL for exposure to waste anesthetic gas.]
OSHA PEL: none

Measurement Methods (see Table 1):
OSHA 29

Physical Description: Clear, colorless liquid with a sweetish, pleasant odor. [inhalation anesthetic]

Chemical & Physical Properties:
MW: 197.4
BP: 122°F
Sol: 0.3%
Fl.P: NA
IP: ?
Sp.Gr: 1.87
VP: 243 mmHg
FRZ: -180°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: May attack rubber & some plastics; sensitive to light.
[**Note:** Light causes decomposition. May be stabilized with 0.01% thymol.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; conf, drow, dizz, nau, analgesia, anes; card arrhy; liver, kidney damage; decr audio-visual performance; in animals: repro effects
TO: Eyes, skin, resp sys, CVS, CNS, liver, kidneys, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Heptachlor	Formula: $C_{10}H_5Cl_7$	CAS#: 76-44-8	RTECS#: PC0700000	IDLH: Ca [35 mg/m^3]
Conversion:	**DOT:** 2761 151 (organochlorine pesticide, solid)			
Synonyms/Trade Names: 1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene				

Exposure Limits:
NIOSH REL: Ca
TWA 0.5 mg/m^3 [skin]
See Appendix A
OSHA PEL: TWA 0.5 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH S287 (II-5)
OSHA PV2029

Physical Description: White to light-tan crystals with a camphor-like odor. [insecticide]

Chemical & Physical Properties:
MW: 373.4
BP: 293°F (Decomposes)
Sol: 0.0006%
Fl.P: NA
IP: ?
Sp.Gr: 1.66
VP(77°F): 0.0003 mmHg
MLT: 203°F
UEL: NA
LEL: NA
Noncombustible Solid, but may be dissolved in flammable liquids.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Iron, rust

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: In animals: tremor, convuls; liver damage; [carc]
TO: CNS,liver [in animals: liver cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

n-Heptane	Formula: $CH_3[CH_2]_5CH_3$	CAS#: 142-82-5	RTECS#: MI7700000	IDLH: 750 ppm
Conversion: 1 ppm = 4.10 mg/m^3	**DOT:** 1206 128			
Synonyms/Trade Names: Heptane, normal-Heptane				

Exposure Limits:
NIOSH REL: TWA 85 ppm (350 mg/m^3)
C 440 ppm (1800 mg/m^3) [15-minute]
OSHA PEL†: TWA 500 ppm (2000 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1500
OSHA 7

Physical Description: Colorless liquid with a gasoline-like odor.

Chemical & Physical Properties:
MW: 100.2
BP: 209°F
Sol: 0.0003%
Fl.P: 25°F
IP: 9.90 eV
Sp.Gr: 0.68
VP(72°F): 40 mmHg
FRZ: -131°F
UEL: 6.7%
LEL: 1.05%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
750 ppm: CcrOv/GmFOv/PaprOv/ Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Dizz, stupor, inco; loss of appetite, nau; derm; chemical pneu (aspir liquid); uncon
TO: Skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

1-Heptanethiol

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3[CH_2]_6SH$	1639-09-4	MJ1400000	N.D.

Conversion: 1 ppm = 5.41 mg/m^3 **DOT:** 1228 131

Synonyms/Trade Names: Heptyl mercaptan, n-Heptyl mercaptan

Exposure Limits:
NIOSH REL: C 0.5 ppm (2.7 mg/m^3) [15-minute]
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with a strong odor.

Chemical & Physical Properties:
MW: 132.3
BP: 351°F
Sol: Insoluble
Fl.P: 115°F
IP: ?
Sp.Gr: 0.84
VP: ?
FRZ: -46°F
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: CcrOv/Sa
12.5 ppm: Sa:Cf/PaprOv
25 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, reducing agents, strong acids & bases, alkali metals

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; lass, cyan, incr respiration, nau, drow, head, vomit
TO: Eyes, skin, resp sys, CNS, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Hexachlorobutadiene

Formula:	CAS#:	RTECS#:	IDLH:
$Cl_2C{=}CClCCl{=}CCl_2$	87-68-3	EJ07000	Ca [N.D.]

Conversion: 1 ppm = 10.66 mg/m^3 **DOT:** 2279 151

Synonyms/Trade Names: HCBD; Hexachloro-1,3-butadiene; 1,3-Hexachlorobutadiene; Perchlorobutadiene

Exposure Limits:
NIOSH REL: Ca
TWA 0.02 ppm (0.24 mg/m^3) [skin]
See Appendix A
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 2543

Physical Description: Clear, colorless liquid with a mild, turpentine-like odor.

Chemical & Physical Properties:
MW: 260.7
BP: 419°F
Sol: Insoluble
Fl.P: ?
IP: ?
Sp.Gr: 1.55
VP: 0.2 mmHg
FRZ: -6°F
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: In animals: irrit eyes, skin, resp sys; kidney damage; [carc]
TO: Eyes, skin, resp sys, kidneys [in animals: kidney tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Hexachlorocyclopentadiene

Formula:	CAS#:	RTECS#:	IDLH:
C_5Cl_6	77-47-4	GY1225000	N.D.

Conversion: 1 ppm = 11.16 mg/m^3 **DOT:** 2646 151

Synonyms/Trade Names: HCCPD; Hexachloro-1,3-cyclopentadiene; 1,2,3,4,5,5-Hexachloro-1,3-cyclopentadiene; Perchlorocyclopentadiene

Exposure Limits:
NIOSH REL: TWA 0.01 ppm (0.1 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 2518

Physical Description: Pale-yellow to amber-colored liquid with a pungent, unpleasant odor. [**Note:** A solid below 16°F.]

Chemical & Physical Properties:
MW: 272.8
BP: 462°F
Sol(77°F): 0.0002% (Reacts)
Fl.P: NA
IP: ?
Sp.Gr: 1.71
VP(77°F): 0.08 mmHg
FRZ: 16°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Water, light
[**Note:** Reacts slowly with water to form hydrochloric acid; will corrode iron & most metals in presence of moisture. Explosive hydrogen gas may collect in enclosed spaces in the presence of moisture.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; eye, skin burns; lac; sneez, cough, dysp, salv, pulm edema; nau, vomit, diarr; in animals: liver, kidney inj
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Hexachloroethane

Formula:	CAS#:	RTECS#:	IDLH:
Cl_3CCCl_3	67-72-1	KI4025000	Ca [300 ppm]

Conversion: 1 ppm = 9.68 mg/m^3 **DOT:**

Synonyms/Trade Names: Carbon hexachloride, Ethane hexachloride, Perchloroethane

Exposure Limits:
NIOSH REL: Ca
TWA 1 ppm (10 mg/m^3) [skin]
See Appendix A
See Appendix C (Chloroethanes)
OSHA PEL: TWA 1 ppm (10 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 7

Physical Description: Colorless crystals with a camphor-like odor.

Chemical & Physical Properties:
MW: 236.7
BP: Sublimes
Sol(72°F): 0.005%
Fl.P: NA
IP: 11.22 eV
Sp.Gr: 2.09
VP: 0.2 mmHg
MLT: 368°F (Sublimes)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Alkalis; metals such as zinc, cadmium, aluminum, hot iron & mercury

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb; in animals: kidney damage; [carc]
TO: Eyes, skin, resp sys, kidneys [in animals: liver cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Hexachloronaphthalene	Formula: $C_{10}H_2Cl_6$	CAS#: 1335-87-1	RTECS#: QJ7350000	IDLH: 2 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names: Halowax® 1014

Exposure Limits:
NIOSH REL: TWA 0.2 mg/m^3 [skin]
OSHA PEL: TWA 0.2 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH S100 (II-2)

Physical Description: White to light-yellow solid with an aromatic odor.

Chemical & Physical Properties:
MW: 334.9
BP: 650-730°F
Sol: Insoluble
Fl.P: NA
IP: ?
Sp.Gr: 1.78
VP: <1 mmHg
MLT: 279°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2 mg/m^3: Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Acne-form derm, nau, conf, jaun, coma
TO: Skin, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

1-Hexadecanethiol	Formula: $CH_3[CH_2]_{15}SH$	CAS#: 2917-26-2	RTECS#:	IDLH: N.D.
Conversion: 1 ppm = 10.59 mg/m^3	**DOT:** 1228 131 (liquid)			

Synonyms/Trade Names: Cetyl mercaptan, Hexadecanethiol-1, n-Hexadecanethiol, Hexadecyl mercaptan

Exposure Limits:
NIOSH REL: C 0.5 ppm (5.3 mg/m^3) [15-minute]
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid or solid (below 64-68°F) with a strong odor.

Chemical & Physical Properties:
MW: 258.5
BP: ?
Sol: Insoluble
Fl.P: 215°F
IP: ?
Sp.Gr: 0.85
VP: 0.1 mmHg
FRZ: 64-68°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: CcrOv/Sa
12.5 ppm: Sa:Cf/PaprOv
25 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, strong acids & bases, alkali metals, reducing agents

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; head, dizz, lass, cyan, nau, convuls
TO: Eyes, skin, resp sys, CNS, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Hexafluoroacetone

Formula: $(CF_3)_2CO$ | **CAS#:** 684-16-2 | **RTECS#:** UC2450000 | **IDLH:** N.D.

Conversion: 1 ppm = 6.79 mg/m^3 | **DOT:** 2420 125

Synonyms/Trade Names: Hexafluoro-2-propanone; 1,1,1,3,3,3-Hexafluoro-2-propanone; HFA; Perfluoroacetone

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.7 mg/m^3) [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless gas with a musty odor.
[**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 166.0
BP: -18°F
Sol: Reacts
Fl.P: NA
IP: 11.81 eV
RGasD: 5.76
VP: 5.8 atm
FRZ: -188°F
UEL: NA
LEL: NA
Nonflammable Gas, but highly reactive with water & other substances, releasing heat.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact/Frostbite
Eyes: Prevent eye contact/Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Water, acids
[**Note:** Hygroscopic (i.e., absorbs moisture from the air); reacts with moisture to form a highly acidic sesquihydrate.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Con
SY: Irrit eyes, skin, muc memb, resp sys; pulm edema; liquid: frostbite; in animals: terato, repro effects; kidney inj
TO: Eyes, skin, resp sys, kidneys, repro sys

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Hexamethylene diisocyanate

Formula: $OCN[CH_2]_6NCO$ | **CAS#:** 822-06-0 | **RTECS#:** MO1740000 | **IDLH:** N.D.

Conversion: 1 ppm = 6.88 mg/m^3 | **DOT:** 2281 156

Synonyms/Trade Names: 1,6-Diisocyanatohexane; HDI; Hexamethylene-1,6-diisocyanate; 1,6-Hexamethylene diisocyanate; HMDI

Exposure Limits:
NIOSH REL: TWA 0.005 ppm (0.035 mg/m^3)
C 0.020 ppm (0.140 mg/m^3) [10-minute]
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 5521, 5522, 5525
OSHA 42

Physical Description: Clear, colorless to slightly yellow liquid with a sharp, pungent odor.

Chemical & Physical Properties:
MW: 168.2
BP: 415°F
Sol: Low (Reacts)
Fl.P: 284°F
IP:?
Sp.Gr(77°F): 1.04
VP(77°F): 0.5 mmHg
FRZ: -89°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
0.05 ppm: Sa*
0.125 ppm: Sa:Cf*
0.25 ppm: ScbaF/SaF
1 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Water, alcohols, strong bases, amines, carboxylic acids, organotin catalysts
[**Note:** Reacts slowly with water to form carbon dioxide. Avoid heating above 392°F (polymerizes).]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; cough, dysp, bron, wheez, pulm edema, asthma; corn damage, skin blisters
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Hexamethyl phosphoramide	Formula: $[(CH_3)_2N]_3PO$	CAS#: 680-31-9	RTECS#: TD0875000	IDLH: Ca [N.D.]
Conversion:	**DOT:**			

Synonyms/Trade Names: Hexamethylphosphoric triamide, Hexamethylphosphorotriamide, HMPA, Tris(dimethylamino)phosphine oxide

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Clear, colorless liquid with an aromatic or mild, amine-like odor. [**Note:** A solid below 43°F.]

Chemical & Physical Properties:
MW: 179.2
BP: 451°F
Sol: Miscible
Fl.P: 220°F
IP: ?
Sp.Gr: 1.03
VP: 0.03 mmHg
FRZ: 43°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, strong acids, chemically-active metals (e.g., potassium, sodium, magnesium, zinc)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; dysp; abdom pain; [carc]
TO: Eyes, skin, resp sys, CNS, GI tract [in animals: cancer of the nasal cavity]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

n-Hexane	Formula: $CH_3[CH_2]_4CH_3$	CAS#: 110-54-3	RTECS#: MN9275000	IDLH: 1100 ppm [10%LEL]
Conversion: 1 ppm = 3.53 mg/m^3	**DOT:** 1208 128			

Synonyms/Trade Names: Hexane, Hexyl hydride, normal-Hexane

Exposure Limits:
NIOSH REL: TWA 50 ppm (180 mg/m^3)
OSHA PEL†: TWA 500 ppm (1800 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1500, 3800
OSHA 7

Physical Description: Colorless liquid with a gasoline-like odor.

Chemical & Physical Properties:
MW: 86.2
BP: 156°F
Sol: 0.002%
Fl.P: -7°F
IP: 10.18 eV
Sp.Gr: 0.66
VP: 124 mmHg
FRZ: -219°F
UEL: 7.5%
LEL: 1.1%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
500 ppm: Sa*
1100 ppm: Sa:Cf*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose; nau, head; peri neur: numb extremities, musc weak; derm; dizz; chemical pneu (aspir liquid)
TO: Eyes, skin, resp sys, CNS, PNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Hexane isomers (excluding n-Hexane)	Formula: C_6H_{14}	CAS#:	RTECS#:	IDLH: N.D.
Conversion: 1 ppm = 3.53 mg/m^3	**DOT:** 1208 128			

Synonyms/Trade Names: Diethylmethylmethane; Diisopropyl; 2,2-Dimethylbutane; 2,3-Dimethylbutane; Isohexane; 2-Methylpentane; 3-Methylpentane [**Note:** Also see specific listing for n-Hexane.]

Exposure Limits:
NIOSH REL: TWA 100 ppm (350 mg/m^3)
C 510 ppm (1800 mg/m^3) [15-minute]
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Clear liquids with mild, gasoline-like odors.
[**Note:** Includes all the isomers of hexane except n-hexane.]

Chemical & Physical Properties:
MW: 86.2
BP: 122-145°F
Sol: Insoluble
Fl.P: -54 to 19°F
IP: ?
Sp.Gr: 0.65-0.66
VP: ?
FRZ: -245 to -148°F
UEL: ?
LEL: ?
Class IB Flammable Liquids

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
1000 ppm: Sa*
2500 ppm: Sa:Cf*
5000 ppm: SaT:Cf*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; head, dizz; nau; chemical pneu (aspir liquid); derm
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

n-Hexanethiol	Formula: $CH_3[CH_2]_5SH$	CAS#: 111-31-9	RTECS#: MO4550000	IDLH: N.D.
Conversion: 1 ppm = 4.83 mg/m^3	**DOT:** 1228 131			

Synonyms/Trade Names: 1-Hexanethiol, Hexyl mercaptan, n-Hexyl mercaptan, n-Hexylthiol

Exposure Limits:
NIOSH REL: C 0.5 ppm (2.7 mg/m^3) [15-minute]
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with an unpleasant odor.

Chemical & Physical Properties:
MW: 118.2
BP: 304°F
Sol: Insoluble
Fl.P: 68°F
IP: ?
Sp.Gr: 0.84
VP: ?
FRZ: -113°F
UEL: ?
LEL: ?
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: CcrOv/Sa
12.5 ppm: Sa:Cf/PaprOv
25 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, reducing agents, strong acids & bases, alkali metals

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; lass, cyan, incr respiration, nau, drow, head, vomit
TO: Eyes, skin, resp sys, CNS, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

2-Hexanone	Formula: $CH_3CO[CH_2]_3CH_3$	CAS#: 591-78-6	RTECS#: MP1400000	IDLH: 1600 ppm

Conversion: 1 ppm = 4.10 mg/m^3 **DOT:**

Synonyms/Trade Names: Butyl methyl ketone, MBK, Methyl butyl ketone, Methyl n-butyl ketone

Exposure Limits:
NIOSH REL: TWA 1 ppm (4 mg/m^3)
OSHA PEL†: TWA 100 ppm (410 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1300, 2555
OSHA PV2031

Physical Description: Colorless liquid with an acetone-like odor.

Chemical & Physical Properties:
MW: 100.2
BP: 262°F
Sol: 2%
Fl.P: 77°F
IP: 9.34 eV
Sp.Gr: 0.81
VP: 11 mmHg
FRZ: -71°F
UEL: 8%
LEL: ?
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
10 ppm: Sa
25 ppm: Sa:Cf
50 ppm: SaT:Cf/ScbaF/SaF
1600 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose; peri neur: lass, pares; derm; head, drow
TO: Eyes, skin, resp sys, CNS, PNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Hexone	Formula: $CH_3COCH_2CH(CH_3)_2$	CAS#: 108-10-1	RTECS#: SA9275000	IDLH: 500 ppm

Conversion: 1 ppm = 4.10 mg/m^3 **DOT:** 1245 127

Synonyms/Trade Names: Isobutyl methyl ketone, Methyl isobutyl ketone, 4-Methyl 2-pentanone, MIBK

Exposure Limits:
NIOSH REL: TWA 50 ppm (205 mg/m^3)
ST 75 ppm (300 mg/m^3)
OSHA PEL†: TWA 100 ppm (410 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1300, 2555
OSHA 1004

Physical Description: Colorless liquid with a pleasant odor.

Chemical & Physical Properties:
MW: 100.2
BP: 242°F
Sol: 2%
Fl.P: 64°F
IP: 9.30 eV
Sp.Gr: 0.80
VP: 16 mmHg
FRZ: -120°F
UEL(200°F): 8.0%
LEL(200°F): 1.2%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
500 ppm: CcrOv*/GmFOv/PaprTOv*/ Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, potassium tert-butoxide

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; head, narco, coma; derm; in animals: liver, kidney damage
TO: Eyes, skin, resp sys, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

sec-Hexyl acetate	Formula: $C_8H_{16}O_2$	CAS#: 108-84-9	RTECS#: SA7525000	IDLH: 500 ppm
Conversion: 1 ppm = 5.90 mg/m^3	**DOT:** 1233 130			
Synonyms/Trade Names: 1,3-Dimethylbutyl acetate; Methylisoamyl acetate				
Exposure Limits: **NIOSH REL:** TWA 50 ppm (300 mg/m^3) **OSHA PEL:** TWA 50 ppm (300 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1450 **OSHA** 7	
Physical Description: Colorless liquid with a mild, pleasant, fruity odor.				
Chemical & Physical Properties: **MW:** 144.2 **BP:** 297°F **Sol:** 0.08% **Fl.P:** 113°F **IP:** ? **Sp.Gr:** 0.86 **VP:** 3 mmHg **FRZ:** -83°F **UEL:** ? **LEL:** ? Class II Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **500 ppm:** CcrOv*/GmFOv/PaprOv*/ Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat; head; in animals: narco **TO:** Eyes, skin, resp sys, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Hexylene glycol	Formula: $(CH_3)_2COHCH_2CHOHCH_3$	CAS#: 107-41-5	RTECS#: SA0810000	IDLH: N.D.
Conversion: 1 ppm = 4.83 mg/m^3	**DOT:**			
Synonyms/Trade Names: 2,4-Dihydroxy-2-methylpentane; 2-Methyl-2,4-pentanediol; 4-Methyl-2,4-pentanediol; 2-Methylpentane-2,4-diol				
Exposure Limits: **NIOSH REL:** C 25 ppm (125 mg/m^3) **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **OSHA** PV2101	
Physical Description: Colorless liquid with a mild, sweetish odor.				
Chemical & Physical Properties: **MW:** 118.2 **BP:** 388°F **Sol:** Miscible **Fl.P:** 209°F **IP:** ? **Sp.Gr:** 0.92 **VP:** 0.05 mmHg **FRZ:** -58°F (Sets to glass) **UEL(est):** 7.4% **LEL(calc):** 1.3% Class IIIB Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R. **Provide:** Eyewash		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Strong oxidizers, strong acids [**Note:** Hygroscopic (i.e., absorbs moisture from the air).]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, resp sys; head, dizz, nau, inco, CNS depres; derm, skin sens **TO:** Eyes, skin, resp sys, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water wash immed **Breath:** Resp support **Swallow:** Medical attention immed	

Hydrazine

Formula:	CAS#:	RTECS#:	IDLH:
H_2NNH_2	302-01-2	MU7175000	Ca [50 ppm]

Conversion: 1 ppm = 1.31 mg/m^3

DOT: 2029 132 (anhydrous); 3293 152 (≤ 37% solution); 2030 153 (37-64% solution); 2029 132 (>64% solution)

Synonyms/Trade Names: Diamine, Hydrazine (anhydrous), Hydrazine base

Exposure Limits:
NIOSH REL: Ca
C 0.03 ppm (0.04 mg/m^3) [2-hour]
See Appendix A
OSHA PEL†: TWA 1 ppm (1.3 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 3503
OSHA 20, 108

Physical Description: Colorless, fuming, oily liquid with an ammonia-like odor. [**Note:** A solid below 36°F.]

Chemical & Physical Properties:
MW: 32.1
BP: 236°F
Sol: Miscible
Fl.P: 99°F
IP: 8.93 eV
Sp.Gr: 1.01
VP: 10 mmHg
FRZ: 36°F
UEL: 98%
LEL: 2.9%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: ScbaE

Incompatibilities and Reactivities: Oxidizers, hydrogen peroxide, nitric acid, metallic oxides, acids
[**Note:** Can ignite SPONTANEOUSLY on contact with oxidizers or porous materials such as earth, wood & cloth.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; temporary blindness; dizz, nau; derm; eye, skin burns; in animals: bron, pulm edema; liver, kidney damage; convuls; [carc]
TO: Eyes, skin, resp sys, CNS, liver, kidneys [in animals: tumors of the lungs, liver, blood vessels & intestine]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Hydrogenated terphenyls

Formula:	CAS#:	RTECS#:	IDLH:
$(C_6H_n)_3$	61788-32-7	WZ6535000	N.D.

Conversion: 1 ppm = 12.19 mg/m^3 (40% hydrogenated)

DOT:

Synonyms/Trade Names: Hydrogenated diphenylbenzenes, Hydrogenated phenylbiphenyls, Hydrogenated triphenyls [**Note:** Complex mixture of terphenyl isomers that are partially hydrogenated.]

Exposure Limits:
NIOSH REL: TWA 0.5 ppm (5 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Clear, oily, pale-yellow liquids with a faint odor. [plasticizer/heat-transfer media]

Chemical & Physical Properties:
MW: 298 (40% hydrogenated)
BP: 644°F (40% hydrogenated)
Sol: Insoluble
Fl.P: 315°F (40% hydrogenated)
IP: ?
Sp.Gr(77°F): 1.003-1.009 (40% hydrogenated)
VP: ?
FRZ: ?
UEL: ?
LEL: ?
Class IIIB Combustible Liquids

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported [**Note:** When heated, irritating vapors will be released.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; liver, kidney, hemato damage
TO: Eyes, skin, resp sys, liver, kidneys, hemato sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Hydrogen bromide

Formula:	CAS#:	RTECS#:	IDLH:
HBr	10035-10-6	MW3850000	30 ppm

Conversion: 1 ppm = 3.31 mg/m^3

DOT: 1048 125 (anhydrous); 1788 154 (solution)

Synonyms/Trade Names: Anhydrous hydrogen bromide; Aqueous hydrogen bromide (i.e., Hydrobromic acid)

Exposure Limits:
NIOSH REL: C 3 ppm (10 mg/m^3)
OSHA PEL†: TWA 3 ppm (10 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 7903
OSHA ID165SG

Physical Description: Colorless gas with a sharp, irritating odor.
[**Note:** Shipped as a liquefied compressed gas. Often used in an aqueous solution.]

Chemical & Physical Properties:
MW: 80.9
BP: -88°F
Sol: 49%
Fl.P: NA
IP: 11.62 eV
RGasD: 2.81
VP: 20 atm
FRZ: -124°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (solution)/Frostbite
Eyes: Prevent eye contact (solution)/Frostbite
Wash skin: When contam (solution)
Remove: When wet or contam (solution)
Change: N.R.
Provide: Eyewash (liquid)
Quick drench (solution)
Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
30 ppm: Sa:Cf£/PaprAg£/GmFAg/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFAg/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong caustics, moisture, copper, brass, zinc
[**Note:** Hydrobromic acid is highly corrosive to most metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing (solution), Con
SY: Irrit eyes, skin, nose, throat; solution: eye, skin burns; liquid: frostbite
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed (solution)/Frostbite
Skin: Water flush immed (solution)/Frostbite
Breath: Resp support
Swallow: Medical attention immed (solution)

Hydrogen chloride

Formula:	CAS#:	RTECS#:	IDLH:
HCl	7647-01-0	MW4025000	50 ppm

Conversion: 1 ppm = 1.49 mg/m^3

DOT: 1050 125 (anhydrous); 1789 157 (solution)

Synonyms/Trade Names: Anhydrous hydrogen chloride;
Aqueous hydrogen chloride (i.e., Hydrochloric acid, Muriatic acid) [**Note:** Often used in an aqueous solution.]

Exposure Limits:
NIOSH REL: C 5 ppm (7 mg/m^3)
OSHA PEL: C 5 ppm (7 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 7903
OSHA ID174SG

Physical Description: Colorless to slightly yellow gas with a pungent, irritating odor.
[**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 36.5
BP: -121°F
Sol(86°F): 67%
Fl.P: NA
IP: 12.74 eV
RGasD: 1.27
VP: 40.5 atm
FRZ: -174°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (solution)/Frostbite
Eyes: Prevent eye contact/Frostbite
Wash skin: When contam (solution)
Remove: When wet or contam (solution)
Change: N.R.
Provide: Eyewash (solution)
Quick drench (solution)
Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 ppm: CcrS*/GmFS/PaprS*/Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFAg/ScbaE

Incompatibilities and Reactivities: Hydroxides, amines, alkalis, copper, brass, zinc
[**Note:** Hydrochloric acid is highly corrosive to most metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing (solution), Con
SY: Irrit nose, throat, larynx; cough, choking; derm; solution: eye, skin burns; liquid: frostbite; in animals: lar spasm; pulm edema
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed (solution)/Frostbite
Skin: Water flush immed (solution)/Frostbite
Breath: Resp support
Swallow: Medical attention immed (solution)

Hydrogen cyanide

Formula:	CAS#:	RTECS#:	IDLH:
HCN	74-90-8	MW6825000	50 ppm

Conversion: 1 ppm = 1.10 mg/m^3

DOT: 1051 117 (>20% solution); 1051 117 (anhydrous); 1613 154 (20% solution)

Synonyms/Trade Names: Formonitrile, Hydrocyanic acid, Prussic acid

Exposure Limits:
NIOSH REL: ST 4.7 ppm (5 mg/m^3) [skin]
OSHA PEL†: TWA 10 ppm (11 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 6010, 6017

Physical Description: Colorless or pale-blue liquid or gas (above 78°F) with a bitter, almond-like odor. [**Note:** Often used as a 96% solution in water.]

Chemical & Physical Properties:
MW: 27.0
BP: 78°F (96%)
Sol: Miscible
Fl.P: 0°F (96%)
IP: 13.60 eV
Sp.Gr: 0.69
VP: 630 mmHg
FRZ: 7°F (96%)
UEL: 40.0%
LEL: 5.6%
Class IA Flammable Liquid
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
47 ppm: Sa
50 ppm: Sa:Cf/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Amines, oxidizers, acids, sodium hydroxide, calcium hydroxide, sodium carbonate, caustics, ammonia [**Note:** Can polymerize at 122-140°F.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Asphy; lass, head, conf; nau, vomit; incr rate and depth of respiration or respiration slow and gasping; thyroid, blood changes
TO: CNS, CVS, thyroid, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Hydrogen fluoride

Formula:	CAS#:	RTECS#:	IDLH:
HF	7664-39-3	MW7875000	30 ppm

Conversion: 1 ppm = 0.82 mg/m^3

DOT: 1052 125 (anhydrous); 1790 157 (solution)

Synonyms/Trade Names: Anhydrous hydrogen fluoride; Aqueous hydrogen fluoride (i.e., Hydrofluoric acid); HF-A

Exposure Limits:
NIOSH REL: TWA 3 ppm (2.5 mg/m^3)
C 6 ppm (5 mg/m^3) [15-minute]
OSHA PEL†: TWA 3 ppm

Measurement Methods (see Table 1):
NIOSH 3800, 7902, 7903, 7906
OSHA ID110

Physical Description: Colorless gas or fuming liquid (below 67°F) with a strong, irritating odor. [**Note:** Shipped in cylinders.]

Chemical & Physical Properties:
MW: 20.0
BP: 67°F
Sol: Miscible
Fl.P: NA
IP: 15.98 eV
RGasD: 1.86
Sp.Gr: 1.00 (Liquid at 67°F)
VP: 783 mmHg
FRZ: -118°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (liquid)
Eyes: Prevent eye contact (liquid)
Wash skin: When contam (liquid)
Remove: When wet or contam (liquid)
Change: N.R.
Provide: Eyewash (liquid)
Quick drench (liquid)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
30 ppm: CcrS*/PaprS*/GmFS/Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Metals, water or steam
[**Note:** Corrosive to metals. Will attack glass and concrete.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs (liquid), Ing (solution), Con
SY: Irrit eyes, skin, nose, throat; pulm edema; eye, skin burns; rhinitis; bron; bone changes
TO: Eyes, skin, resp sys, bones

First Aid (see Table 6):
Eye: Irr immed (solution/liquid)
Skin: Water flush immed (solution/liquid)
Breath: Resp support
Swallow: Medical attention immed (solution)

Hydrogen peroxide	Formula: H_2O_2	CAS#: 7722-84-1	RTECS#: MX0900000	IDLH: 75 ppm
Conversion: 1 ppm = 1.39 mg/m^3	**DOT:** 2984 140 (8-20% solution); 2014 140 (20-60% solution); 2015 143 (>60% solution)			

Synonyms/Trade Names: High-strength hydrogen peroxide, Hydrogen dioxide, Hydrogen peroxide (aqueous), Hydroperoxide, Peroxide

Exposure Limits:	Measurement Methods (see Table 1):
NIOSH REL: TWA 1 ppm (1.4 mg/m^3) **OSHA PEL:** TWA 1 ppm (1.4 mg/m^3)	**OSHA** ID126SG

Physical Description: Colorless liquid with a slightly sharp odor.
[**Note:** The pure compound is a crystalline solid below 12°F. Often used in an aqueous solution.]

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 34.0 **BP:** 286°F **Sol:** Miscible **Fl.P:** NA **IP:** 10.54 eV **Sp.Gr:** 1.39 VP(86°F): 5 mmHg **FRZ:** 12°F **UEL:** NA **LEL:** NA Noncombustible Liquid, but a powerful oxidizer.	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R. **Provide:** Eyewash Quick drench	**NIOSH/OSHA** **10 ppm:** Sa* **25 ppm:** Sa:Cf* **50 ppm:** ScbaF/SaF **75 ppm:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFS/ScbaE

Incompatibilities and Reactivities: Oxidizable materials, iron, copper, brass, bronze, chromium, zinc, lead, silver, manganese [**Note:** Contact with combustible material may result in SPONTANEOUS combustion.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Ing, Con **SY:** Irrit eyes, nose, throat; corn ulcer; eryt, vesic skin; bleaching hair **TO:** Eyes, skin, resp sys	**Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed

Hydrogen selenide	Formula: H_2Se	CAS#: 7783-07-5	RTECS#: MX1050000	IDLH: 1 ppm
Conversion: 1 ppm = 3.31 mg/m^3	**DOT:** 2202 117 (anhydrous)			

Synonyms/Trade Names: Selenium dihydride, Selenium hydride

Exposure Limits:	Measurement Methods (see Table 1):
NIOSH REL: TWA 0.05 ppm (0.2 mg/m^3) **OSHA PEL:** TWA 0.05 ppm (0.2 mg/m^3)	None available

Physical Description: Colorless gas with an odor resembling decayed horseradish.
[**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 81.0 **BP:** -42°F **Sol(73°F):** 0.9% **Fl.P:** NA (Gas) **IP:** 9.88 eV **RGasD:** 2.80 **VP(70°F):** 9.5 atm **FRZ:** -87°F **UEL:** ? **LEL:** ? Flammable Gas	**Skin:** Frostbite **Eyes:** Frostbite **Wash skin:** N.R. **Remove:** When wet (flamm) **Change:** N.R. **Provide:** Frostbite wash	**NIOSH/OSHA** **0.5 ppm:** Sa **1 ppm**: Sa:Cf*/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFS¿/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids, water, halogenated hydrocarbons

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Con **SY:** Irrit eyes, nose, throat; nau, vomit, diarr; metallic taste, garlic breath; dizz, lass; liquid: frostbite; in animals: pneu; liver damage **TO:** Eyes, resp sys, liver	**Eye:** Frostbite **Skin:** Frostbite **Breath:** Resp support

Hydrogen sulfide	Formula: H_2S	CAS#: 7783-06-4	RTECS#: MX1225000	IDLH: 100 ppm
Conversion: 1 ppm = 1.40 mg/m^3	**DOT:** 1053 117			
Synonyms/Trade Names: Hydrosulfuric acid, Sewer gas, Sulfuretted hydrogen				
Exposure Limits: **NIOSH REL:** C 10 ppm (15 mg/m^3) [10-minute] **OSHA PEL†:** C 20 ppm 50 ppm [10-minute maximum peak]			**Measurement Methods (see Table 1):** **NIOSH** 6013 **OSHA** ID141	
Physical Description: Colorless gas with a strong odor of rotten eggs. [**Note:** Sense of smell becomes rapidly fatigued & can NOT be relied upon to warn of the continuous presence of H_2S. Shipped as a liquefied compressed gas.]				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 34.1 **BP:** -77°F **Sol:** 0.4% **Fl.P:** NA (Gas) **IP:** 10.46 eV **RGasD:** 1.19 **VP:** 17.6 atm **FRZ:** -122°F **UEL:** 44.0% **LEL:** 4.0% Flammable Gas	**Skin:** Frostbite **Eyes:** Frostbite **Wash skin:** N.R. **Remove:** When wet (flamm) **Change:** N.R. **Provide:** Frostbite wash	**NIOSH** **100 ppm:** PaprS/GmFS/Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFS/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong nitric acid, metals	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Con **SY:** Irrit eyes, resp sys; apnea, coma, convuls; conj, eye pain, lac, photo, corn vesic; dizz, head, lass, irrity, insom; GI dist; liquid: frostbite **TO:** Eyes, resp sys, CNS	**First Aid (see Table 6):** **Eye:** Frostbite **Skin:** Frostbite **Breath:** Resp support

Hydroquinone	Formula: $C_6H_4(OH)_2$	CAS#: 123-31-9	RTECS#: MX3500000	IDLH: 50 mg/m^3
Conversion:	**DOT:** 2662 153			
Synonyms/Trade Names: p-Benzenediol; 1,4-Benzenediol; Dihydroxybenzene; 1,4-Dihydroxybenzene; Quinol				
Exposure Limits: **NIOSH REL:** C 2 mg/m^3 [15-minute] **OSHA PEL:** TWA 2 mg/m^3			**Measurement Methods (see Table 1):** **NIOSH** 5004 **OSHA** PV2094	
Physical Description: Light-tan, light-gray, or colorless crystals.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 110.1 **BP:** 545°F **Sol:** 7% **Fl.P:** 329°F (Molten) **IP:** 7.95 eV **Sp.Gr:** 1.33 **VP:** 0.00001 mmHg **MLT:** 338°F **UEL:** ? **LEL:** ? Combustible Solid; dust cloud may explode if ignited in an enclosed area.	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily **Provide:** Eyewash (>7%)	**NIOSH/OSHA** **50 mg/m^3:** PaprHie£/100F/SaT:Cf£/ ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, alkalis	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes; conj; kera; CNS excitement; colored urine, nau, dizz, suffocation, rapid breath; musc twitch, delirium; collapse; skin irrit, sens, derm **TO:** Eyes, skin, resp sys, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush **Breath:** Resp support **Swallow:** Medical attention immed

2-Hydroxypropyl acrylate	Formula: CH_2=CHCOOCH$_2$CHOHCH$_3$	CAS#: 999-61-1	RTECS#: AT1925000	IDLH: N.D.
Conversion: 1 ppm = 5.33 mg/m^3	**DOT:**			
Synonyms/Trade Names: HPA, β-Hydroxypropyl acrylate, Propylene glycol monoacrylate				
Exposure Limits: **NIOSH REL:** TWA 0.5 ppm (3 mg/m^3) [skin] **OSHA PEL†:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Clear to light-yellow liquid with a sweetish, solvent odor.				
Chemical & Physical Properties: **MW:** 130.2 **BP:** 376°F **Sol:** ? **Fl.P:** 149°F **IP:** ? **Sp.Gr:** 1.05 **VP:** ? **FRZ:** ? **UEL:** ? **LEL:** 1.8% Class IIIA Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R. **Provide:** Eyewash Quick drench		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Water [**Note:** Can become unstable at high temperatures & pressures or may react with water with some release of energy, but not violently.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, resp sys; eye, skin burns; cough, dysp **TO:** Eyes, skin, resp sys		**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap flush immed **Breath:** Resp support **Swallow:** Medical attention immed		

Indene	Formula: C_9H_8	CAS#: 95-13-6	RTECS#: NK8225000	IDLH: N.D.
Conversion: 1 ppm = 4.75 mg/m^3	**DOT:**			
Synonyms/Trade Names: Indonaphthene				
Exposure Limits: **NIOSH REL:** TWA 10 ppm (45 mg/m^3) **OSHA PEL†:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Colorless liquid. [**Note:** A solid below 29°F.]				
Chemical & Physical Properties: **MW:** 116.2 **BP:** 359°F **Sol:** Insoluble **Fl.P:** 173°F **IP:** 8.81 eV **Sp.Gr:** 0.997 **VP:** ? **FRZ:** 29°F **UEL:** ? **LEL:** ? Class IIIA Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** Daily **Remove:** When wet or contam **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: None reported [**Note:** Polymerizes & oxidizes on standing. It has exploded during nitration with (H_2SO_4 + HNO_3).]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** In animals: irrit eyes, skin, muc memb; derm, skin sens; chemical pneu (aspir liquid); liver, kidney, spleen inj **TO:** Eyes, skin, resp sys, liver, kidneys, spleen		**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash **Breath:** Resp support **Swallow:** Medical attention immed		

Indium	Formula: In	CAS#: 7440-74-6	RTECS#: NL1050000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Indium metal

Exposure Limits: **NIOSH REL*:** TWA 0.1 mg/m^3 [***Note:** The REL also applies to other indium compounds (as In).] **OSHA PEL†:** none **Physical Description:** Ductile, shiny, silver-white metal that is softer than lead.	**Measurement Methods (see Table 1):** **NIOSH** 7303, P&CAM173 (II-5) **OSHA** ID121

Chemical & Physical Properties: **MW:** 114.8 **BP:** 3767°F **Sol:** Insoluble **Fl.P:** NA **IP:** NA **Sp.Gr:** 7.31 **VP:** 0 mmHg (approx) **MLT:** 314°F **UEL:** NA **LEL:** NA Noncombustible Solid in bulk form, but may ignite in powdered or dust form.	**Personal Protection/Sanitation (see Table 2):** **Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.	**Respirator Recommendations (see Tables 3 and 4):** Not available.

Incompatibilities and Reactivities: (Dinitrogen tetraoxide + acetonitrile), mercury(II) bromide (at 662°F), sulfur (mixtures ignite when heated) [**Note:** oxidizes readily at higher temperatures.]

Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, resp sys; possible liver, kidney, heart, blood effects; pulm edema **TO:** Eyes, skin, resp sys, liver, kidneys, heart, blood	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash **Breath:** Resp support **Swallow:** Medical attention immed

Iodine	Formula: I_2	CAS#: 7553-56-2	RTECS#: NN1575000	IDLH: 2 ppm
Conversion: 1 ppm = 10.38 mg/m^3	**DOT:**			

Synonyms/Trade Names: Iodine crystals, Molecular iodine

Exposure Limits: **NIOSH REL:** C 0.1 ppm (1 mg/m^3) **OSHA PEL:** C 0.1 ppm (1 mg/m^3) **Physical Description:** Violet solid with a sharp, characteristic odor.	**Measurement Methods (see Table 1):** **NIOSH** 6005 **OSHA** ID212

Chemical & Physical Properties: **MW:** 253.8 **BP:** 365°F **Sol:** 0.01% **Fl.P:** NA **IP:** 9.31 eV **Sp.Gr:** 4.93 **VP(77°F):** 0.3 mmHg **MLT:** 236°F **UEL:** NA **LEL:** NA Noncombustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily **Provide:** Eyewash (>7%) Quick drench (>7%)	**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **1 ppm**: Sa* **2 ppm:** Sa:Cf*/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFAg100/ScbaE

Incompatibilities and Reactivities: Ammonia, acetylene, acetaldehyde, powdered aluminum, active metals, liquid chlorine

Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose; lac; head; chest tight; skin burns, rash; cutaneous hypersensitivity **TO:** Eyes, skin, resp sys, CNS, CVS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed

Iodoform	Formula: CHI_3	CAS#: 75-47-8	RTECS#: PB7000000	IDLH: N.D.
Conversion: 1 ppm = 16.10 mg/m^3	**DOT:**			
Synonyms/Trade Names: Triiodomethane				
Exposure Limits: **NIOSH REL:** TWA 0.6 ppm (10 mg/m^3) **OSHA PEL†:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Yellow to greenish-yellow powder or crystalline solid with a pungent, disagreeable odor. [antiseptic for external use]				
Chemical & Physical Properties: **MW:** 393.7 **BP:** 410°F (Decomposes) **Sol:** 0.01% **Fl.P:** NA **IP:** ? **Sp.Gr:** 4.01 **VP:** ? **MLT:** 246°F **UEL:** NA **LEL:** NA Noncombustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Strong oxidizers, lithium, metallic salts (e.g., mercuric oxide, silver nitrate), strong bases, calomel, tannin				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin; lass, dizz, nau, inco, CNS depres; dysp; liver, kidney, heart damage; vis dist **TO:** Eyes, skin, resp sys, liver, kidneys, heart			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed	

Iron oxide dust and fume (as Fe)	Formula: Fe_2O_3	CAS#: 1309-37-1	RTECS#: NO7400000 NO7525000 (fume)	IDLH: 2500 mg/m^3 (as Fe)
Conversion:	**DOT:** 1376 135 (spent)			
Synonyms/Trade Names: Ferric oxide, Iron(III) oxide				
Exposure Limits: **NIOSH REL:** TWA 5 mg/m^3 **OSHA PEL:** TWA 10 mg/m^3			**Measurement Methods (see Table 1):** **NIOSH** 7300, 7301, 7303, 9102 **OSHA** ID121, ID125G	
Physical Description: Reddish-brown solid. [**Note:** Exposure to fume may occur during the arc-welding of iron.]				
Chemical & Physical Properties: **MW:** 159.7 **BP:** ? **Sol:** Insoluble **Fl.P:** NA **IP:** NA **Sp.Gr:** 5.24 **VP:** 0 mmHg (approx) **MLT:** 2664°F **UEL:** NA **LEL:** NA Noncombustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **50 mg/m^3:** 95XQ/Sa **125 mg/m^3:** Sa:Cf/PaprHie **250 mg/m^3:** 100F/SaT:Cf/PaprTHie/ScbaF/SaF **2500 mg/m^3:** Sa:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE	
Incompatibilities and Reactivities: Calcium hypochlorite				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh **SY:** Benign pneumoconiosis with X-ray shadows indistinguishable from fibrotic pneumoconiosis (siderosis) **TO:** Resp sys			**First Aid (see Table 6):** **Breath:** Resp support	

Iron pentacarbonyl (as Fe)	Formula: $Fe(CO)_5$	CAS#: 13463-40-6	RTECS#: NO4900000	IDLH: N.D.
Conversion: 1 ppm = 2.28 mg/m^3 (as Fe)	**DOT:** 1994 131			
Synonyms/Trade Names: Iron carbonyl, Pentacarbonyl iron				
Exposure Limits: **NIOSH REL:** TWA 0.1 ppm (0.23 mg/m^3) ST 0.2 ppm (0.45 mg/m^3) **OSHA PEL†:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Colorless to yellow to dark-red, oily liquid.				
Chemical & Physical Properties: **MW:** 195.9 **BP(749 mmHg):** 217°F **Sol:** Insoluble **Fl.P:** 5°F **IP:** ? **Sp.Gr:** 1.46-1.52 **VP(87°F):** 40 mmHg **FRZ:** -6°F **UEL:** ? **LEL:** ? Class IB Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R. **Provide:** Quick drench		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Oxidizers, nitrogen oxide, (zinc + cobalt halides) [**Note:** Pyrophoric (i.e., ignites spontaneously in air). Decomposed by light or air, releasing carbon monoxide.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, muc memb, resp sys; head, dizz, nau, vomit; fever, cyan, cough, dysp; liver, kidney, lung inj; degenerative changes in CNS **TO:** Eyes, resp sys, CNS, liver, kidneys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap flush immed **Breath:** Resp support **Swallow:** Medical attention immed	

Iron salts (soluble, as Fe)	Formula:	CAS#:	RTECS#:	IDLH: N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: **$FeSO_4$:** Ferrous sulfate, Iron(II) sulfate; **$FeCl_2$:** Ferrous chloride, Iron(II) chloride; **$Fe(NO_3)_3$:** Ferric nitrate, Iron(III) nitrate; **$Fe(SO_4)_3$:** Ferric sulfate, Iron(III) sulfate; **$FeCl_3$:** Ferric chloride, Iron (III) chloride				
Exposure Limits: **NIOSH REL:** TWA 1 mg/m^3 **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **NIOSH** 7300, 7301, 7303, 9102 **OSHA** ID121, ID125G	
Physical Description: Appearance and odor vary depending upon the specific soluble iron salt.				
Chemical & Physical Properties: Properties vary depending upon the specific soluble iron salt. Noncombustible Solids	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** Daily **Remove:** N.R. **Change:** Daily		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Varies				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, muc memb; abdom pain, diarr, vomit; possible liver damage **TO:** Eyes, skin, resp sys, liver, GI tract			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash **Breath:** Resp support **Swallow:** Medical attention immed	

Isoamyl acetate	Formula: $CH_3COOCH_2CH_2CH(CH_3)_2$	CAS#: 123-92-2	RTECS#: NS9800000	IDLH: 1000 ppm
Conversion: 1 ppm = 5.33 mg/m^3	**DOT:** 1104 129			
Synonyms/Trade Names: Banana oil, Isopentyl acetate, 3-Methyl-1-butanol acetate, 3-Methylbutyl ester of acetic acid, 3-Methylbutyl ethanoate				
Exposure Limits: **NIOSH REL:** TWA 100 ppm (525 mg/m^3) **OSHA PEL:** TWA 100 ppm (525 mg/m^3) **Physical Description:** Colorless liquid with a banana-like odor.			**Measurement Methods (see Table 1):** **NIOSH** 1450 **OSHA** 7	
Chemical & Physical Properties: **MW:** 130.2 **BP:** 288°F **Sol:** 0.3% **Fl.P:** 77°F **IP:** ? **Sp.Gr:** 0.87 **VP:** 4 mmHg **FRZ:** -109°F **UEL:** 7.5% **LEL(212°F):** 1.0% Class IC Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **1000 ppm:** CcrOv/PaprOv/GmFOv/ Sa/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat; derm; in animals: narco **TO:** Eyes, skin, resp sys, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Isoamyl alcohol (primary)	Formula: $(CH_3)_2CHCH_2CH_2OH$	CAS#: 123-51-3	RTECS#: EL5425000	IDLH: 500 ppm
Conversion: 1 ppm = 3.61 mg/m^3	**DOT:** 1105 129			
Synonyms/Trade Names: Fermentation amyl alcohol, Fusel oil, Isobutyl carbinol, Isopentyl alcohol, 3-Methyl-1-butanol, Primary isoamyl alcohol				
Exposure Limits: **NIOSH REL:** TWA 100 ppm (360 mg/m^3) ST 125 ppm (450 mg/m^3) **OSHA PEL†:** TWA 100 ppm (360 mg/m^3) **Physical Description:** Colorless liquid with a disagreeable odor.			**Measurement Methods (see Table 1):** **NIOSH** 1402, 1405	
Chemical & Physical Properties: **MW:** 88.2 **BP:** 270°F **Sol(57°F):** 2% **Fl.P:** 109°F **IP:** ? **Sp.Gr(57°F):** 0.81 **VP:** 28 mmHg **FRZ:** -179°F **UEL(212°F):** 9.0% **LEL:** 1.2% Class II Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **500 ppm:** Sa:Cf£/CcrFOv/GmFOv/ PaprOv£/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat; head, dizz; cough, dysp, nau, vomit, diarr; skin cracking; in animals: narco **TO:** Eyes, skin, resp sys, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Isoamyl alcohol (secondary)	Formula: $(CH_3)_2CHCH(OH)CH_3$	CAS#: 6032-29-7	RTECS#: SA4900000	IDLH: 500 ppm
Conversion: 1 ppm = 3.61 mg/m^3	**DOT:** 1105 129			
Synonyms/Trade Names: 3-Methyl-2-butanol, Secondary isoamyl alcohol				

Exposure Limits:
NIOSH REL: TWA 100 ppm (360 mg/m^3)
ST 125 ppm (450 mg/m^3)
OSHA PEL†: TWA 100 ppm (360 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1402

Physical Description: Colorless liquid with a disagreeable odor.

Chemical & Physical Properties:
MW: 88.2
BP: 234°F
Sol: ?
Fl.P(oc): 95°F
IP: ?
Sp.Gr: 0.82
VP: 1 mmHg
FRZ: ?
UEL: ?
LEL: ?
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
500 ppm: Sa:Cf£/CcrFOv/GmFOv/PaprOv£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; head, dizz; cough, dysp, nau, vomit, diarr; skin cracking; in animals: narco
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Isobutane	Formula: $CH_3CH(CH_3)_2$	CAS#: 75-28-5	RTECS#: TZ4300000	IDLH: N.D.
Conversion: 1 ppm = 2.38 mg/m^3	**DOT:** 1075 115; 1969 115			
Synonyms/Trade Names: 2-Methylpropane [**Note:** Also see specific listing for n-Butane.]				

Exposure Limits:
NIOSH REL: TWA 800 ppm (1900 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless gas with a gasoline-like or natural gas odor.
[**Note:** Shipped as a liquefied compressed gas. A liquid below 11°F.]

Chemical & Physical Properties:
MW: 58.1
BP: 11°F
Sol: Slight
Fl.P: NA (Gas)
IP: 10.74 eV
RGasD: 2.06
VP(70°F): 3.1 atm
FRZ: -255°F
UEL: 8.4%
LEL: 1.6%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers (e.g., nitrates & perchlorates), chlorine, fluorine, (nickel carbonyl + oxygen)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Drow, narco, asphy; liquid: frostbite
TO: CNS

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Isobutyl acetate	Formula: $CH_3COOCH_2CH(CH_3)_2$	CAS#: 110-19-0	RTECS#: AI4025000	IDLH: 1300 ppm [10%LEL]
Conversion: 1 ppm = 4.75 mg/m^3	**DOT:** 1213 129			
Synonyms/Trade Names: Isobutyl ester of acetic acid, 2-Methylpropyl acetate, 2-Methylpropyl ester of acetic acid, β-Methylpropyl ethanoate				
Exposure Limits: **NIOSH REL:** TWA 150 ppm (700 mg/m^3) **OSHA PEL:** TWA 150 ppm (700 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1450 **OSHA** 7	
Physical Description: Colorless liquid with a fruity, floral odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 116.2 **BP:** 243°F **Sol(77°F):** 0.6% **Fl.P:** 64°F **IP:** 9.97 eV **Sp.Gr:** 0.87 **VP:** 13 mmHg **FRZ:** -145°F **UEL:** 10.5% **LEL:** 1.3% Class IB Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.	**NIOSH/OSHA** **1300 ppm:** Sa:Cf£/CcrFOv/GmFOv/PaprOv£/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, upper resp sys; head, drow, anes; in animals: narco **TO:** Eyes, skin, resp sys, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed

Isobutyl alcohol	Formula: $(CH_3)_2CHCH_2OH$	CAS#: 78-83-1	RTECS#: NP9625000	IDLH: 1600 ppm
Conversion: 1 ppm = 3.03 mg/m^3	**DOT:** 1212 129			
Synonyms/Trade Names: IBA, Isobutanol, Isopropylcarbinol, 2-Methyl-1-propanol				
Exposure Limits: **NIOSH REL:** TWA 50 ppm (150 mg/m^3) **OSHA PEL†:** TWA 100 ppm (300 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1401, 1405 **OSHA** 7	
Physical Description: Colorless, oily liquid with a sweet, musty odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 74.1 **BP:** 227°F **Sol:** 10% **Fl.P:** 82°F **IP:** 10.12 eV **Sp.Gr:** 0.80 **VP:** 9 mmHg **FRZ:** -162°F **UEL(202°F):** 10.6% **LEL(123°F):** 1.7% Class IC Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.	**NIOSH** **500 ppm:** CcrOv*/Sa* **1250 ppm:** Sa:Cf*/PaprOv* **1600 ppm:** CcrFOv/GmFOv/PaprTOv*/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, throat; head, drow; skin cracking; in animals: narco **TO:** Eyes, skin, resp sys, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed

Isobutyronitrile

Formula:	CAS#:	RTECS#:	IDLH:
$(CH_3)_2CHCN$	78-82-0	TZ4900000	N.D.

Conversion: 1 ppm = 2.83 mg/m^3 **DOT:** 2284 131

Synonyms/Trade Names: Isopropyl cyanide, 2-Methylpropanenitrile, 2-Methylpropionitrile

Exposure Limits:
NIOSH REL: TWA 8 ppm (22 mg/m^3)
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 1606 (adapt)

Physical Description: Colorless liquid with an almond-like odor.
[**Note:** Forms cyanide in the body.]

Chemical & Physical Properties:
MW: 69.1
BP: 219°F
Sol: Slight
Fl.P: 47°F
IP: ?
Sp.Gr: 0.76
VP(130°F): 100 mmHg
FRZ: -97°F
UEL: ?
LEL: ?
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
80 ppm: CcrOv/Sa
200 ppm: Sa:Cf/PaprOv
400 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
1000 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, reducing agents, strong acids & bases

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; head, dizz, lass, conf, convuls; dysp; abdom pain, nau, vomit
TO: Eyes, skin, resp sys, CNS, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Isooctyl alcohol

Formula:	CAS#:	RTECS#:	IDLH:
$C_7H_{15}CH_2OH$	26952-21-6	NS7700000	N.D.

Conversion: 1 ppm = 5.33 mg/m^3 **DOT:**

Synonyms/Trade Names: Isooctanol, Oxooctyl alcohol [**Note:** A mixture of closely related isomeric, primary alcohols with branched chains such as 2-Ethylhexanol, $CH_3(CH_2)_3CH(CH_2CH_3)CH_2OH$.]

Exposure Limits:
NIOSH REL: TWA 50 ppm (270 mg/m^3) [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2033

Physical Description: Clear, colorless liquid.

Chemical & Physical Properties:
MW: 130.3
BP: 367°F
Sol: Insoluble
Fl.P(oc): 180°F
IP: ?
Sp.Gr: 0.83
VP: 0.4 mmHg
FRZ: <-105°F
UEL(est.): 5.7%
LEL(calc.): 0.9%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: N.R.
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; eye, skin burns
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Isophorone	Formula: $C_9H_{14}O$	CAS#: 78-59-1	RTECS#: GW7700000	IDLH: 200 ppm
Conversion: 1 ppm = 5.65 mg/m^3	**DOT:** 1993 128 (combustible liquid, n.o.s.)			
Synonyms/Trade Names: Isoacetophorone; 3,5,5-Trimethyl-2-cyclohexenone; 3,5,5-Trimethyl-2-cyclo-hexen-1-one				

Exposure Limits:
NIOSH REL: TWA 4 ppm (23 mg/m^3)
OSHA PEL†: TWA 25 ppm (140 mg/m^3)

Physical Description: Colorless to white liquid with a peppermint-like odor.

Measurement Methods (see Table 1):
NIOSH 2508, 2556
OSHA 7

Chemical & Physical Properties:
MW: 138.2
BP: 419°F
Sol: 1%
Fl.P: 184°F
IP: 9.07 eV
Sp.Gr: 0.92
VP: 0.3 mmHg
FRZ: 17°F
UEL: 3.8%
LEL: 0.8%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
40 ppm: CcrOv*/Sa*
100 ppm: Sa:Cf*/PaprOv*
200 ppm: CcrFOv/GmFOv/PaprTOv*/SaT:Cf*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, strong alkalis, amines

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose, throat; head, nau, dizz, lass, mal, narco; derm; in animals: kidney, liver damage
TO: Eyes, skin, resp sys, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Isophorone diisocyanate	Formula: $C_{12}H_{18}N_2O_2$	CAS#: 4098-71-9	RTECS#: NQ9370000	IDLH: N.D.
Conversion: 1 ppm = 9.09 mg/m^3	**DOT:** 2290 156			
Synonyms/Trade Names: IPDI; 3-Isocyanatomethyl-3,5,5-trimethylcyclohexyl-isocyanate; Isophorone diamine diisocyanate				

Exposure Limits:
NIOSH REL: TWA 0.005 ppm (0.045 mg/m^3) [skin]
ST 0.02 ppm (0.180 mg/m^3)
OSHA PEL†: none

Physical Description: Colorless to slightly yellow liquid with a pungent odor.

Measurement Methods (see Table 1):
NIOSH 5525
OSHA PV2034

Chemical & Physical Properties:
MW: 222.3
BP: ?
Sol: Decomposes
Fl.P: 311°F
IP: ?
Sp.Gr: 1.06
VP: 0.0003 mmHg
FRZ: -76°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
0.05 ppm: Sa*
0.125 ppm: Sa:Cf*
0.25 ppm: ScbaF/SaF
1 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Water, alcohols, phenols, amines, mercaptans, amides, urethanes, ureas [**Note:** Reacts with water to form carbon dioxide.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; chest tight, dysp, cough, sore throat; bron, wheez, pulm edema; possible resp sens, asthma
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

2-Isopropoxyethanol	Formula: $(CH_3)_2CHOCH_2CH_2OH$	CAS#: 109-59-1	RTECS#: KL5075000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Ethylene glycol isopropyl ether, β-Hydroxyethyl isopropyl ether, Isopropyl Cellosolve®, Isopropyl glycol

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with a mild, ethereal odor.

Chemical & Physical Properties:
MW: 104.2
BP: 283°F
Sol: Miscible
Fl.P(oc): 92°F
IP: ?
Sp.Gr: 0.90
VP: 3 mmHg
FRZ: ?
UEL: ?
LEL: ?
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: In animals: irrit eyes, skin; hema, anemia, pulm edema
TO: Eyes, skin, resp sys, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Isopropyl acetate	Formula: $CH_3COOCH(CH_3)_2$	CAS#: 108-21-4	RTECS#: AI4930000	IDLH: 1800 ppm
Conversion: 1 ppm = 4.18 mg/m^3	**DOT:** 1220 129			

Synonyms/Trade Names: Isopropyl ester of acetic acid, 1-Methylethyl ester of acetic acid, 2-Propyl acetate

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: TWA 250 ppm (950 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1454, 1460
OSHA 7

Physical Description: Colorless liquid with a fruity odor.

Chemical & Physical Properties:
MW: 102.2
BP: 194°F
Sol: 3%
Fl.P: 36°F
IP: 9.95 eV
Sp.Gr: 0.87
VP: 42 mmHg
FRZ: -92°F
UEL: 8%
LEL(100°F): 1.8%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
OSHA
1800 ppm: Sa:Cf£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose; derm; in animals: narco
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Isopropyl alcohol

Formula: $(CH_3)_2CHOH$ | **CAS#:** 67-63-0 | **RTECS#:** NT8050000 | **IDLH:** 2000 ppm [10%LEL]

Conversion: 1 ppm = 2.46 mg/m^3 | **DOT:** 1219 129

Synonyms/Trade Names: Dimethyl carbinol, IPA, Isopropanol, 2-Propanol, sec-Propyl alcohol, Rubbing alcohol

Exposure Limits:
NIOSH REL: TWA 400 ppm (980 mg/m^3)
ST 500 ppm (1225 mg/m^3)
OSHA PEL†: TWA 400 ppm (980 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1400
OSHA 109

Physical Description: Colorless liquid with the odor of rubbing alcohol.

Chemical & Physical Properties:
MW: 60.1
BP: 181°F
Sol: Miscible
Fl.P: 53°F
IP: 10.10 eV
Sp.Gr: 0.79
VP: 33 mmHg
FRZ: -127°F
UEL(200°F): 12.7%
LEL: 2.0%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2000 ppm: Sa:Cf£/CcrFOv/GmFOv/
PaprOv£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acetaldehyde, chlorine, ethylene oxide, acids, isocyanates

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose, throat; drow, dizz, head; dry cracking skin; in animals: narco
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush
Breath: Resp support
Swallow: Medical attention immed

Isopropylamine

Formula: $(CH_3)_2CHNH_2$ | **CAS#:** 75-31-0 | **RTECS#:** NT8400000 | **IDLH:** 750 ppm

Conversion: 1 ppm = 2.42 mg/m^3 | **DOT:** 1221 132

Synonyms/Trade Names: 2-Aminopropane, Monoisopropylamine, 2-Propylamine, sec-Propylamine

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: TWA 5 ppm (12 mg/m^3)

Measurement Methods (see Table 1):
NIOSH S147 (II-3)

Physical Description: Colorless liquid with an ammonia-like odor.
[**Note:** A gas above 91°F.]

Chemical & Physical Properties:
MW: 59.1
BP: 91°F
Sol: Miscible
Fl.P(oc): -35°F
IP: 8.72 eV
Sp.Gr: 0.69
VP: 460 mmHg
FRZ: -150°F
UEL: ?
LEL: ?
Class IA Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
OSHA
125 ppm: Sa:Cf£/PaprS£
250 ppm: CcrFS/GmFS/PaprTS£/
ScbaF/SaF
750 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Strong acids, strong oxidizers, aldehydes, ketones, epoxides

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; pulm edema; vis dist; eye, skin burns; derm
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

N-Isopropylaniline

Formula: $C_6H_5NHCH(CH_3)_2$ | **CAS#:** 768-52-5 | **RTECS#:** BY4190000 | **IDLH:** N.D.

Conversion: 1 ppm = 5.53 mg/m^3 | **DOT:**

Synonyms/Trade Names: N-IPA, Isopropylaniline, N-(1-Methylethyl)-benzenamine, N-Phenylisopropylamine

Exposure Limits:
NIOSH REL: TWA 2 ppm (10 mg/m^3) [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA 78

Physical Description: Clear, yellowish liquid with a sweet, aromatic odor.

Chemical & Physical Properties:
MW: 135.2
BP: 397°F
Sol: ?
Fl.P(oc): 190°F
IP: ?
Sp.Gr(60°F): 0.93
VP(77°F): 0.03 mmHg
FRZ: -58°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; head, lass, dizz; cyan; ataxia; dysp on effort; tacar; methemo
TO: Eyes, skin, resp sys, blood, CVS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Isopropyl ether

Formula: $(CH_3)_2CHOCH(CH_3)_2$ | **CAS#:** 108-20-3 | **RTECS#:** TZ5425000 | **IDLH:** 1400 ppm [10%LEL]

Conversion: 1 ppm = 4.18 mg/m^3 | **DOT:** 1159 127

Synonyms/Trade Names: Diisopropyl ether, Diisopropyl oxide, 2-Isopropoxy propane

Exposure Limits:
NIOSH REL: TWA 500 ppm (2100 mg/m^3)
OSHA PEL: TWA 500 ppm (2100 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1618
OSHA 7

Physical Description: Colorless liquid with a sharp, sweet, ether-like odor.

Chemical & Physical Properties:
MW: 102.2
BP: 154°F
Sol: 0.2%
Fl.P: -18°F
IP: 9.20 eV
Sp.Gr: 0.73
VP: 119 mmHg
FRZ: -76°F
UEL: 7.9%
LEL: 1.4%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1400 ppm: CcrOv*/PaprOv*/GmFOv/Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids
[**Note:** Unstable peroxides may form on long contact with air.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose; resp discomfort; derm; in animals: drow, dizz, uncon, narco
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Isopropyl glycidyl ether	**Formula:** $C_6H_{12}O_2$	**CAS#:** 4016-14-2	**RTECS#:** TZ3500000	**IDLH:** 400 ppm
Conversion: 1 ppm = 4.75 mg/m^3	**DOT:**			
Synonyms/Trade Names: 1,2-Epoxy-3-isopropoxypropane; IGE; Isopropoxymethyl oxirane				
Exposure Limits: **NIOSH REL:** C 50 ppm (240 mg/m^3) [15-minute] **OSHA PEL†:** TWA 50 ppm (240 mg/m^3)				**Measurement Methods (see Table 1):** **NIOSH** 1620 **OSHA** 7
Physical Description: Colorless liquid.				

Chemical & Physical Properties:	**Personal Protection/Sanitation (see Table 2):**	**Respirator Recommendations (see Tables 3 and 4):**
MW: 116.2 **BP:** 279°F **Sol:** 19% **Fl.P:** 92°F **IP:** ? **Sp.Gr:** 0.92 **VP(77°F):** 9 mmHg **FRZ:** ? **UEL:** ? **LEL:** ? Class IC Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.	**NIOSH/OSHA** **400 ppm:** Sa:Cf£/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong caustics [**Note:** May form explosive peroxides upon exposure to air or light.]	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, upper resp sys; skin sens; possible hemato, repro effects **TO:** Eyes, skin, resp sys, blood, repro sys	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed

Kaolin	**Formula:**	**CAS#:** 1332-58-7	**RTECS#:** GF1670500	**IDLH:** N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: China clay, Clay, Hydrated aluminum silicate, Hydrite, Porcelain clay [**Note:** Main constituent of Kaolin is Kaolinite ($Al_2Si_2O_5(OH)_4$).]				
Exposure Limits: **NIOSH REL:** TWA 10 mg/m^3 (total) TWA 5 mg/m^3 (resp) **OSHA PEL†:** TWA 15 mg/m^3 (total) TWA 5 mg/m^3 (resp)				**Measurement Methods (see Table 1):** **NIOSH** 0500, 0600
Physical Description: White to yellowish or grayish powder. [**Note:** When moistened, darkens & develops a clay-like odor.]				

Chemical & Physical Properties:	**Personal Protection/Sanitation (see Table 2):**	**Respirator Recommendations (see Tables 3 and 4):**
MW: varies **BP:** ? **Sol:** Insoluble **Fl.P:** NA **IP:** NA **Sp.Gr:** 1.8-2.6 **VP:** 0 mmHg (approx) **MLT:** ? **UEL:** NA **LEL:** NA Noncombustible Solid	**Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.	Not available.

Incompatibilities and Reactivities: None reported	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Con **SY:** Chronic pulm fib, stomach granuloma **TO:** Resp sys, stomach	**First Aid (see Table 6):** **Eye:** Irr immed **Breath:** Fresh air

Kepone

Formula: $C_{10}Cl_{10}O$ | **CAS#:** 143-50-0 | **RTECS#:** PC8575000 | **IDLH:** Ca [N.D.]

Conversion: | **DOT:**

Synonyms/Trade Names: Chlordecone; Decachlorooctahydro-1,3,4-metheno-2H-cyclobuta(cd)-pentalen-2-one; Decachlorooctahydro-kepone-2-one; Decachlorotetrahydro-4,7-methanoindeneone

Exposure Limits:
NIOSH REL: Ca
TWA 0.001 mg/m^3
See Appendix A
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 5508

Physical Description: Tan to white, crystalline, odorless solid. [insecticide]

Chemical & Physical Properties:
MW: 490.6
BP: Sublimes
Sol(212°F): 0.5%
Fl.P: NA
IP: ?
Sp.Gr: ?
VP(77°F): 3 x 10^{-7} mmHg
MLT: 662°F (Sublimes)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Acids, acid fumes

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Head, anxi, tremor; liver, kidney damage; vis dist; ataxia, chest pain, skin eryt; testicular atrophy, low sperm count; [carc]
TO: Eyes, skin, resp sys, CNS, liver, kidneys, repro sys [in animal: liver cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Kerosene

Formula: | **CAS#:** 8008-20-6 | **RTECS#:** OA5500000 | **IDLH:** N.D.

Conversion: | **DOT:** 1223 128

Synonyms/Trade Names: Fuel Oil No. 1, Range oil
[**Note:** A refined petroleum solvent (predominantly C_9-C_{16}), which typically is 25% normal paraffins, 11% branched paraffins, 30% monocycloparaffins, 12% dicycloparaffins, 1% tricycloparaffins, 16% mononuclear aromatics, and 5% dinuclear aromatics.]

Exposure Limits:
NIOSH REL: TWA 100 mg/m^3
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 1550

Physical Description: Colorless to yellowish, oily liquid with a strong, characteristic odor.

Chemical & Physical Properties:
MW: 170 (approx)
BP: 347-617°F
Sol: Insoluble
Fl.P: 100-162°F
IP: ?
Sp.Gr: 0.81
VP(100°F): 5 mmHg
FRZ: -50°F
UEL: 5%
LEL: 0.7%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
1000 mg/m^3: CcrOv/Sa
2500 mg/m^3: Sa:Cf/PaprOv
5000 mg/m^3: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; burning sensation in chest; head, nau, lass, restless, inco, conf, drow; vomit, diarr; derm; chemical pneu (aspir liquid)
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Ketene

Formula: CH_2=CO | **CAS#:** 463-51-4 | **RTECS#:** OA7700000 | **IDLH:** 5 ppm

Conversion: 1 ppm = 1.72 mg/m^3 | **DOT:**

Synonyms/Trade Names: Carbomethene, Ethenone, Keto-ethylene

Exposure Limits:
NIOSH REL: TWA 0.5 ppm (0.9 mg/m^3)
ST 1.5 ppm (3 mg/m^3)
OSHA PEL†: TWA 0.5 ppm (0.9 mg/m^3)

Measurement Methods (see Table 1):
NIOSH S92 (II-2)

Physical Description: Colorless gas with a penetrating odor.

Chemical & Physical Properties:
MW: 42.0
BP: -69°F
Sol: Reacts
Fl.P: NA (Gas)
IP: 9.61 eV
RGasD: 1.45
VP: >1 atm
FRZ: -238°F
UEL: ?
LEL: ?
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 ppm: Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Water, alcohols, ammonia
[**Note:** Readily polymerizes. Reacts with water to form acetic acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, nose, throat, resp sys; pulm edema
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Breath: Resp support

L

Lead

Formula: Pb | **CAS#:** 7439-92-1 | **RTECS#:** OF7525000 | **IDLH:** 100 mg/m^3 (as Pb)

Conversion: | **DOT:**

Synonyms/Trade Names: Lead metal, Plumbum

Exposure Limits:
NIOSH REL*: TWA 0.050 mg/m^3
See Appendix C
OSHA PEL*: [1910.1025] TWA 0.050 mg/m^3
See Appendix C
[***Note:** The REL and PEL also apply to other lead compounds (as Pb) -- see Appendix C.]

Measurement Methods (see Table 1):
NIOSH 7082, 7105, 7300, 7301, 7303, 7700, 7701, 7702, 9102, 9105
OSHA ID121, ID125G, ID206

Physical Description: A heavy, ductile, soft, gray solid.

Chemical & Physical Properties:
MW: 207.2
BP: 3164°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 11.34
VP: 0 mmHg (approx)
MLT: 621°F
UEL: NA
LEL: NA
Noncombustible Solid in bulk form.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.5 mg/m^3: 100XQ/Sa
1.25 mg/m^3: Sa:Cf/PaprHie
2.5 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
50 mg/m^3: Sa:Pd,Pp
100 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Strong oxidizers, hydrogen peroxide, acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Lass, insom; facial pallor; anor, low-wgt, malnut; constip, abdom pain, colic; anemia; gingival lead line; tremor; para wrist, ankles; encephalopathy; kidney disease; irrit eyes; hypotension
TO: Eyes, GI tract, CNS, kidneys, blood, gingival tissue

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush prompt
Breath: Resp support
Swallow: Medical attention immed

Limestone

Formula:	CAS#:	RTECS#:	IDLH:
$CaCO_3$	1317-65-3		N.D.

Conversion: **DOT:**

Synonyms/Trade Names: Calcium carbonate, Natural calcium carbonate
[**Note:** Calcite & aragonite are commercially important natural calcium carbonates.]

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Odorless, white to tan powder.

Chemical & Physical Properties:
MW: 100.1
BP: Decomposes
Sol: 0.001%
Fl.P: NA
IP: NA
Sp.Gr: 2.7-2.9
VP: 0 mmHg (approx)
MLT: 1517-2442°F (Decomposes)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Fluorine, magnesium, acids, alum, ammonium salts

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, muc memb; cough, sneez, rhin; lac
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Fresh air

Lindane

Formula:	CAS#:	RTECS#:	IDLH:
$C_6H_6Cl_6$	58-89-9	GV4900000	50 mg/m^3

Conversion: **DOT:** 2761 151

Synonyms/Trade Names: BHC; HCH; γ-Hexachlorocyclohexane; gamma isomer of 1,2,3,4,5,6-Hexachlorocyclohexane

Exposure Limits:
NIOSH REL: TWA 0.5 mg/m^3 [skin]
OSHA PEL: TWA 0.5 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 5502

Physical Description: White to yellow, crystalline powder with a slight, musty odor. [pesticide]

Chemical & Physical Properties:
MW: 290.8
BP: 614°F
Sol: 0.001%
Fl.P: NA
IP: ?
Sp.Gr: 1.85
VP: 0.00001 mmHg
MLT: 235°F
UEL: NA
LEL: NA
Noncombustible Solid, but may be dissolved in flammable liquids.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: N.R.
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: CcrOv95/Sa
12.5 mg/m^3: Sa:Cf*/PaprOvHie*
25 mg/m^3: CcrFOv100/GmFOv100/PaprTOvHie*/ScbaF/SaF
50 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Corrosive to metals

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; head; nau; clonic convuls; resp difficulty; cyan; aplastic anemia; musc spasm; in animals: liver, kidney damage
TO: Eyes, skin, resp sys, CNS, blood, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Lithium hydride

Formula: LiH | **CAS#:** 7580-67-8 | **RTECS#:** OJ6300000 | **IDLH:** 0.5 mg/m^3

Conversion: **DOT:** 1414 138; 2805 138 (fused, solid)

Synonyms/Trade Names: Lithium monohydride

Exposure Limits:
NIOSH REL: TWA 0.025 mg/m^3
OSHA PEL: TWA 0.025 mg/m^3

Measurement Methods (see Table 1):
OSHA ID121

Physical Description: Odorless, off-white to gray, translucent, crystalline mass or white powder.

Chemical & Physical Properties:
MW: 7.95
BP: Decomposes
Sol: Reacts
Fl.P: NA
IP: NA
Sp.Gr: 0.78
VP: 0 mmHg (approx)
MLT: 1256°F
UEL: NA
LEL: NA
Combustible Solid that can form airborne dust clouds which may explode on contact with flame, heat, or oxidizers.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Brush (DO NOT WASH)
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench (>0.5 mg/m^3)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.25 mg/m^3: 100XQ/Sa
0.5 mg/m^3: Sa:Cf*/100F/PaprHie*/ ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, halogenated hydrocarbons, acids, water
[**Note:** May ignite SPONTANEOUSLY in air and may reignite after fire is extinguished. Reacts with water to form hydrogen & lithium hydroxide.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin; eye, skin burns; mouth, esophagus burns (if ingested); nau; musc twitches; mental conf; blurred vision
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Brush (DO NOT WASH)
Breath: Resp support
Swallow: Medical attention immed

L.P.G.

Formula: $C_3H_8/C_3H_6/C_4H_{10}/C_4H_8$ | **CAS#:** 68476-85-7 | **RTECS#:** SE7545000 | **IDLH:** 2000 ppm [10%LEL]

Conversion: 1 ppm = 1.72-2.37 mg/m^3 **DOT:** 1075 115

Synonyms/Trade Names: Bottled gas, Compressed petroleum gas, Liquefied hydrocarbon gas, Liquefied petroleum gas, LPG [**Note:** A fuel mixture of propane, propylene, butanes & butylenes.]

Exposure Limits:
NIOSH REL: TWA 1000 ppm (1800 mg/m^3)
OSHA PEL: TWA 1000 ppm (1800 mg/m^3)

Measurement Methods (see Table 1):
NIOSH S93 (II-2)

Physical Description: Colorless, noncorrosive, odorless gas when pure.
[**Note:** A foul-smelling odorant is usually added. Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 42-58
BP: >-44°F
Sol: Insoluble
Fl.P: NA (Gas)
IP: 10.95 eV
RGasD: 1.45-2.00
VP: >1 atm
FRZ: ?
UEL: 9.5% (Propane) 8.5% (Butane)
LEL: 2.1% (Propane) 1.9% (Butane)
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2000 ppm: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: ScbaE

Incompatibilities and Reactivities: Strong oxidizers, chlorine dioxide

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Dizz, drow, asphy; liquid: frostbite
TO: Resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed (liquid)
Skin: Water flush immed (liquid)
Breath: Resp support

Magnesite

Formula:	CAS#:	RTECS#:	IDLH:
$MgCO_3$	546-93-0	OM2470000	N.D.

Conversion: **DOT:**

Synonyms/Trade Names: Carbonate magnesium, Hydromagnesite, Magnesium carbonate, Magnesium(II) carbonate [**Note:** Magnesite is a naturally-occurring form of magnesium carbonate.]

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: White, odorless, crystalline powder.

Chemical & Physical Properties:
MW: 84.3
BP: Decomposes
Sol: 0.01%
Fl.P: NA
IP: NA
Sp.Gr: 2.96
VP: 0 mmHg (approx)
MLT: 662°F (Decomposes)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Acids, formaldehyde

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, resp sys; cough
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

M

Magnesium oxide fume

Formula:	CAS#:	RTECS#:	IDLH:
MgO	1309-48-4	OM3850000	750 mg/m^3

Conversion: **DOT:**

Synonyms/Trade Names: Magnesia fume

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: TWA 15 mg/m^3

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303
OSHA ID121

Physical Description: Finely divided white particulate dispersed in air.
[**Note:** Exposure may occur when magnesium is burned, thermally cut, or welded upon.]

Chemical & Physical Properties:
MW: 40.3
BP: 6512°F
Sol(86°F): 0.009%
Fl.P: NA
IP: NA
Sp.Gr: 3.58
VP: 0 mmHg (approx)
MLT: 5072°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
OSHA
150 mg/m^3: 95XQ/Sa
375 mg/m^3: Sa:Cf/PaprHie
750 mg/m^3: 100F/PaprTHie*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Chlorine trifluoride, phosphorus pentachloride

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, nose; metal fume fever: cough, chest pain, flu-like fever
TO: Eyes, resp sys

First Aid (see Table 6):
Breath: Resp support

Malathion

Formula:	CAS#:	RTECS#:	IDLH:
$C_{10}H_{19}O_6PS_2$	121-75-5	WM8400000	250 mg/m^3

Conversion: **DOT:** 2783 152

Synonyms/Trade Names: S-[1,2-bis(ethoxycarbonyl) ethyl]O,O-dimethyl-phosphorodithioate; Diethyl (dimethoxyphosphinothioylthio) succinate

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 [skin]
OSHA PEL†: TWA 15 mg/m^3 [skin]

Physical Description: Deep-brown to yellow liquid with a garlic-like odor. [insecticide] [**Note:** A solid below 37°F.]

Measurement Methods (see Table 1):
NIOSH 5600
OSHA 62

Chemical & Physical Properties:
MW: 330.4
BP: 140°F (Decomposes)
Sol: 0.02%
Fl.P(oc): >325°F
IP: ?
Sp.Gr: 1.21
VP: 0.00004 mmHg
FRZ: 37°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid, but may be difficult to ignite.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
100 mg/m^3: CcrOv95/Sa
250 mg/m^3: Sa:Cf*/CcrFOv100/GmFOv100/PaprOvHie*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, magnesium, alkaline pesticides [**Note:** Corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; miosis, aching eyes, blurred vision, lac; salv; anor, nau, vomit, abdom cramps, diarr, dizz, conf, ataxia; rhin, head; chest tight, wheez, lar spasm
TO: Eyes, skin, resp sys, liver, blood chol, CNS, CVS, GI tract

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Maleic anhydride

Formula:	CAS#:	RTECS#:	IDLH:
$C_4H_2O_3$	108-31-6	ON3675000	10 mg/m^3

Conversion: 1 ppm = 4.01 mg/m^3 **DOT:** 2215 156

Synonyms/Trade Names: cis-Butenedioic anhydride; 2,5-Furanedione; Maleic acid anhydride; Toxilic anhydride

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3 (0.25 ppm)
OSHA PEL: TWA 1 mg/m^3 (0.25 ppm)

Physical Description: Colorless needles, white lumps, or pellets with an irritating, choking odor.

Measurement Methods (see Table 1):
NIOSH 3512
OSHA 25, 86

Chemical & Physical Properties:
MW: 98.1
BP: 396°F
Sol: Reacts
Fl.P: 218°F
IP: 9.90 eV
Sp.Gr: 1.48
VP: 0.2 mmHg
MLT: 127°F
UEL: 7.1%
LEL: 1.4%
Combustible Solid, but may be difficult to ignite.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 mg/m^3: Sa:Cf£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, water, alkalis, metals, caustics, and amines above 150°F
[**Note:** Reacts slowly with water (hydrolyzes) to form maleic acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit nose, upper resp sys; conj; photo, double vision; bronchial asthma; derm
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Malonaldehyde

Formula: $CHOCH_2CHO$ | **CAS#:** 542-78-9 | **RTECS#:** TX6475000 | **IDLH:** Ca [N.D.]

Conversion: | **DOT:**

Synonyms/Trade Names: Malonic aldehyde; Malonodialdehyde; Propanedial; 1,3-Propanedial
[**Note:** Pure Malonaldehyde is unstable and may be used as its sodium salt.]

Exposure Limits:
NIOSH REL: Ca
See Appendix A
See Appendix C (Aldehydes)
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Solid (needles).

Chemical & Physical Properties:
MW: 72.1
BP: ?
Sol: ?
Fl.P: ?
IP: ?
Sp.Gr: ?
VP: ?
MLT: 161°F
UEL: ?
LEL: ?

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Proteins
[**Note:** Pure compound is stable under neutral conditions, but not under acidic conditions.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; CNS depres; [carc]
TO: Eyes, skin, resp sys, CNS [in animals: thyroid gland tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Malononitrile

Formula: $NCCH_2CN$ | **CAS#:** 109-77-3 | **RTECS#:** OO3150000 | **IDLH:** N.D.

Conversion: 1 ppm = 2.70 mg/m^3 | **DOT:** 2647 153

Synonyms/Trade Names: Cyanoacetonitrile, Dicyanomethane, Malonic dinitrile

Exposure Limits:
NIOSH REL: TWA 3 ppm (8 mg/m^3)
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH Nitriles Criteria Document

Physical Description: White powder or colorless crystals.
[**Note:** Melts above 90°F. Forms cyanide in the body.]

Chemical & Physical Properties:
MW: 66.1
BP: 426°F
Sol: 13%
Fl.P(oc): 266°F
IP: 12.88 eV
Sp.Gr: 1.19
VP: ?
MLT: 90°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
80 mg/m^3: Sa
200 mg/m^3: Sa:Cf
400 mg/m^3: ScbaF/SaF
667 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong bases [**Note:** May polymerize violently on prolonged heating at 265°F, or in contact with strong bases at lower temperatures.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; head, dizz, lass, conf, convuls; dysp; abdom pain, nau, vomit
TO: Eyes, skin, resp sys, CNS, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Manganese compounds and fume (as Mn)

Formula: Mn (metal)
CAS#: 7439-96-5 (metal)
RTECS#: OO9275000 (metal)
IDLH: 500 mg/m^3 (as Mn)

Conversion:
DOT:

Synonyms/Trade Names: **Manganese metal:** Colloidal manganese, Manganese-55
Synonyms of other compounds vary depending upon the specific manganese compound.

Exposure Limits:
NIOSH REL*: TWA 1 mg/m^3
ST 3 mg/m^3
[***Note:** Also see specific listings for Manganese cyclopentadienyl tricarbonyl, Methyl cyclopentadienyl manganese tricarbonyl, and Manganese tetroxide.]
OSHA PEL*: C 5 mg/m^3
[***Note:** Also see specific listings for Manganese cyclopentadienyl tricarbonyl and Methyl cyclopentadienyl manganese tricarbonyl.]

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303, 9102
OSHA ID121, ID125G

Physical Description: A lustrous, brittle, silvery solid.

Chemical & Physical Properties:
MW: 54.9
BP: 3564°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 7.20 (metal)
VP: 0 mmHg (approx)
MLT: 2271°F
UEL: NA
LEL: NA
Metal: Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
10 mg/m^3: 95XQ/Sa
25 mg/m^3: Sa:Cf/PaprHie
50 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
500 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Oxidizers
[**Note:** Will react with water or steam to produce hydrogen.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing
SY: Parkinson's; asthenia, insom, mental conf; metal fume fever: dry throat, cough, chest tight, dysp, rales, flu-like fever; low-back pain; vomit; mal; lass; kidney damage
TO: Resp sys, CNS, blood, kidneys

First Aid (see Table 6):
Breath: Resp support
Swallow: Medical attention immed

M

Manganese cyclopentadienyl tricarbonyl (as Mn)

Formula: $C_5H_5Mn(CO)_3$
CAS#: 12079-65-1
RTECS#: OO9720000
IDLH: N.D.

Conversion:
DOT:

Synonyms/Trade Names: Cyclopentadienylmanganese tricarbonyl, Cyclopentadienyl tricarbonyl manganese, MCT

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3 [skin]
OSHA PEL†: C 5 mg/m^3

Measurement Methods (see Table 1):
None available

Physical Description: Yellow, crystalline solid with a characteristic odor.
[**Note:** An antiknock additive for gasoline. May be found in an oil & gaseous solution.]

Chemical & Physical Properties:
MW: 204.1
BP: Sublimes
Sol: Slight
Fl.P: ?
IP: ?
Sp.Gr: ?
VP: ?
MLT: 167°F (Sublimes)
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxygen

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: In animals: irrit skin; pulm edema; convuls; CNS, resp sys, kidney changes; decr resistance to infection
TO: Skin, resp sys, CNS, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Manganese tetroxide (as Mn)

Formula: Mn_3O_4 | **CAS#:** 1317-35-7 | **RTECS#:** OP0895000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: Manganese oxide, Manganomanganic oxide, Trimanganese tetraoxide, Trimanganese tetroxide

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: C 5 mg/m^3

Physical Description: Brownish-black powder.
[**Note:** Fumes are generated whenever manganese oxides are heated strongly in air.]

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303, 9102
OSHA ID121, ID125G

Chemical & Physical Properties:
MW: 228.8
BP: ?
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 4.88
VP: 0 mmHg (approx)
MLT: 2847°F
UEL: NA
LEL: NA

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Soluble in hydrochloric acid (liberates chlorine gas)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Asthenia, insom, mental conf; low-back pain; vomit; mal, lass; kidney damage; pneu
TO: Resp sys, CNS, blood, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Marble

Formula: $CaCO_3$ | **CAS#:** 1317-65-3 | **RTECS#:** EV9580000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: Calcium carbonate, Natural calcium carbonate
[**Note:** Marble is a metamorphic form of calcium carbonate.]

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Physical Description: Odorless, white powder.

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Chemical & Physical Properties:
MW: 100.1
BP: Decomposes
Sol: 0.001%
Fl.P: NA
IP: NA
Sp.Gr: 2.7-2.9
VP: 0 mmHg (approx)
MLT: 1517-2442°F (Decomposes)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Fluorine, magnesium, acids, alum, ammonium salts

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, muc memb, upper resp sys; cough, sneez, rhin; lac
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Fresh air

Mercury compounds [except (organo) alkyls] (as Hg)

Formula: Hg (metal) | **CAS#:** 7439-97-6 (metal) | **RTECS#:** OV4550000 (metal) | **IDLH:** 10 mg/m^3 (as Hg)

Conversion: **DOT:** 2809 172 (metal)

Synonyms/Trade Names: **Mercury metal:** Colloidal mercury, Metallic mercury, Quicksilver
Synonyms of "other" Hg compounds vary depending upon the specific compound.

Exposure Limits:
NIOSH REL: Hg Vapor: TWA 0.05 mg/m^3 [skin]
Other: C 0.1 mg/m^3 [skin]
OSHA PEL†: C 0.1 mg/m^3

Measurement Methods (see Table 1):
NIOSH 6009 **OSHA** ID140

Physical Description: Metal: Silver-white, heavy, odorless liquid.
[**Note:** "Other" Hg compounds include all inorganic & aryl Hg compounds except (organo) alkyls.]

Chemical & Physical Properties:
MW: 200.6
BP: 674°F
Sol: Insoluble
Fl.P: NA
IP: ?
Sp.Gr: 13.6 (metal)
VP: 0.0012 mmHg
FRZ: -38°F
UEL: NA
LEL: NA
Metal: Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: N.R.
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Mercury vapor:
NIOSH
0.5 mg/m^3: CcrS†/Sa
1.25 mg/m^3: Sa:Cf/PaprS†(canister)
2.5 mg/m^3: CcrFS†/GmFS†/SaT:Cf/
PaprTS(canister)/ScbaF/SaF
10 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Other mercury compounds:
NIOSH/OSHA
1 mg/m^3: CcrS†/Sa
2.5 mg/m^3: Sa:Cf/PaprS†(canister)
5 mg/m^3: CcrFS†/GmFS†/SaT:Cf/
PaprTS(canister)/ScbaF/SaF
10 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Acetylene, ammonia, chlorine dioxide, azides, calcium (amalgam formation), sodium carbide, lithium, rubidium, copper

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; cough, chest pain, dysp, bron, pneu; tremor, insom, irrity, indecision, head, lass; stomatitis, salv; GI dist, anor, low-wgt; prot
TO: Eyes, skin, resp sys, CNS, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Mercury (organo) alkyl compounds (as Hg)

Formula: | **CAS#:** | **RTECS#:** | **IDLH:** 2 mg/m^3 (as Hg)

Conversion: **DOT:**

Synonyms/Trade Names: Synonyms vary depending upon the specific (organo) alkyl mercury compound.

Exposure Limits:
NIOSH REL: TWA 0.01 mg/m^3
ST 0.03 mg/m^3 [skin]
OSHA PEL†: TWA 0.01 mg/m^3
C 0.04 mg/m^3

Measurement Methods (see Table 1):
None available

Physical Description: Appearance and odor vary depending upon the specific (organo) alkyl mercury compound.

Chemical & Physical Properties:
Properties vary depending upon the specific (organo) alkyl mercury compound.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.1 mg/m^3: Sa
0.25 mg/m^3: Sa:Cf
0.5 mg/m^3: SaT:Cf/ScbaF/SaF
2 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: ScbaE

Incompatibilities and Reactivities: Strong oxidizers such as chlorine

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Pares; ataxia, dysarthria; vision, hearing dist; spasticity, jerking limbs; dizz; salv; lac; nau, vomit, diarr, constip; skin burns; emotional dist; kidney inj; possible terato effects
TO: Eyes, skin, CNS, PNS, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Mesityl oxide

Formula:	CAS#:	RTECS#:	IDLH:
$(CH_3)_2C=CHCOCH_3$	141-79-7	SB4200000	1400 ppm [10%LEL]

Conversion: 1 ppm = 4.02 mg/m^3

DOT: 1229 129

Synonyms/Trade Names: Isobutenyl methyl ketone, Isopropylideneacetone, Methyl isobutenyl ketone, 4-Methyl-3-penten-2-one

Exposure Limits:
NIOSH REL: TWA 10 ppm (40 mg/m^3)
OSHA PEL†: TWA 25 ppm (100 mg/m^3)

Physical Description: Oily, colorless to light-yellow liquid with a peppermint- or honey-like odor.

Measurement Methods (see Table 1):
NIOSH 1301, 2553
OSHA 7

Chemical & Physical Properties:
MW: 98.2
BP: 266°F
Sol: 3%
Fl.P: 87°F
IP: 9.08 eV
Sp.Gr(59°F): 0.86
VP: 9 mmHg
FRZ: -52°F
UEL: 7.2%
LEL: 1.4%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
250 ppm: Sa:Cf£/PaprOv£
500 ppm: CcrFOv/GmFOv/PaprTOv£/ ScbaF/SaF
1400 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; narco, coma; in animals: liver, kidney damage; CNS effects
TO: Eyes, skin, resp sys, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Methacrylic acid

Formula:	CAS#:	RTECS#:	IDLH:
$CH_2=C(CH_3)COOH$	79-41-4	OZ2975000	N.D.

Conversion: 1 ppm = 3.52 mg/m^3

DOT: 2531 153P (inhibited)

Synonyms/Trade Names: Methacrylic acid (glacial), Methacrylic acid (inhibited), α-Methacrylic acid, 2-Methylacrylic acid, 2-Methylpropenoic acid

Exposure Limits:
NIOSH REL: TWA 20 ppm (70 mg/m^3) [skin]
OSHA PEL†: none

Physical Description: Colorless liquid or solid (below 61°F) with an acrid, repulsive odor.

Measurement Methods (see Table 1):
OSHA PV2005

Chemical & Physical Properties:
MW: 86.1
BP: 325°F
Sol(77°F): 9%
Fl.P(oc): 171°F
IP: ?
Sp.Gr: 1.02 (Liquid)
VP: 0.7 mmHg
FRZ: 61°F
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers, elevated temperatures, hydrochloric acid
[**Note:** Typically contains 100 ppm of the monomethyl ether of hydroquinone to prevent polymerization.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb; eye, skin burns
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Methomyl	**Formula:** $CH_3C(SCH_3)NOC(O)NHCH_3$	**CAS#:** 16752-77-5	**RTECS#:** AK2975000	**IDLH:** N.D.
Conversion:	**DOT:** 2757 151 (carbamate pesticide, solid, toxic)			
Synonyms/Trade Names: Lannate®, Methyl N-((methylamino)carbonyl)oxy)ethanimidothioate, S-Methyl-N-(methylcarbamoyloxy)thioacetimidate				
Exposure Limits: **NIOSH REL:** TWA 2.5 mg/m^3 **OSHA PEL†:** none **Physical Description:** White, crystalline solid with a slight, sulfur-like odor. [insecticide]				**Measurement Methods (see Table 1):** **NIOSH** 5601
Chemical & Physical Properties: **MW:** 162.2 **BP:** ? **Sol(77°F):** 6% **Fl.P:** NA **IP:** ? **Sp.Gr(75°F):** 1.29 **VP(77°F):** 0.00005 mmHg **MLT:** 172°F **UEL:** NA **LEL:** NA Noncombustible Solid, but may be dissolved in flammable liquids.	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily **Provide:** Quick drench		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Strong bases				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes; blurred vision, miosis; salv; abdom cramps, nau, vomit; dysp; lass, musc twitch; liver, kidney damage **TO:** Eyes, resp sys, CNS, CVS, liver, kidneys, blood chol			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed	

M

Methoxychlor	**Formula:** $(C_6H_4OCH_3)_2CHCCl_3$	**CAS#:** 72-43-5	**RTECS#:** KJ3675000	**IDLH:** Ca [5000 mg/m^3]
Conversion:	**DOT:** 2761 151 (organochlorine pesticide, solid, toxic)			
Synonyms/Trade Names: p,p'-Dimethoxydiphenyltrichloroethane; DMDT; Methoxy-DDT; 2,2-bis(p-Methoxyphenyl)-1,1,1-trichloroethane; 1,1,1-Trichloro-2,2-bis-(p-methoxyphenyl)ethane				
Exposure Limits: **NIOSH REL:** Ca See Appendix A **OSHA PEL†:** TWA 15 mg/m^3 **Physical Description:** Colorless to light-yellow crystals with a slight, fruity odor. [insecticide]				**Measurement Methods (see Table 1):** **NIOSH** S371 (II-4) **OSHA** PV2038
Chemical & Physical Properties: **MW:** 345.7 **BP:** Decomposes **Sol:** 0.00001% **Fl.P:** ? **IP:** ? **Sp.Gr:** 1.41 **VP:** Very low **MLT:** 171°F **UEL:** ? **LEL:** ? Combustible Solid, but difficult to burn.	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** N.R. **Wash skin:** When contam/Daily **Remove:** When wet or contam **Change:** Daily		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **¥:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv100/ScbaE	
Incompatibilities and Reactivities: Oxidizers				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing **SY:** In animals: fasc, trembling, convuls; kidney, liver damage; [carc] **TO:** CNS, liver, kidneys [in animals: liver & ovarian cancer]			**First Aid (see Table 6):** **Skin:** Soap wash **Breath:** Fresh air **Swallow:** Medical attention immed	

Methoxyflurane	Formula: $CHCl_2CF_2OCH_3$	CAS#: 76-38-0	RTECS#: KN7820000	IDLH: N.D.
Conversion: 1 ppm = 6.75 mg/m^3	**DOT:**			

Synonyms/Trade Names: 2,2-Dichloro-1,1-difluoroethyl methyl ether; 2,2-Dichloro-1,1-difluoro-1-methoxyethane; Methoflurane; Methoxyfluorane; Penthrane

Exposure Limits:
NIOSH REL*: C 2 ppm (13.5 mg/m^3) [60-minute]
[***Note:** REL for exposure to waste anesthetic gas.]
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with a fruity odor. [inhalation anesthetic]

Chemical & Physical Properties:
MW: 165.0
BP: 220°F
Sol: Slight
Fl.P: ?
IP: ?
Sp.Gr(77°F): 1.42
VP: 23 mmHg
FRZ: -31°F
UEL: ?
LEL(176°F): 7%
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes; CNS depres, analgesia, anes, convuls, resp depres; liver, kidney inj; in animals: repro, terato effects
TO: Eyes, CNS, liver, kidneys, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

M

4-Methoxyphenol	Formula: $CH_3OC_6H_4OH$	CAS#: 150-76-5	RTECS#: SL7700000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Hydroquinone monomethyl ether, p-Hydroxyanisole, Mequinol, p-Methoxyphenol, Monomethyl ether hydroquinone

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless to white, waxy solid with an odor of caramel & phenol.

Chemical & Physical Properties:
MW: 124.2
BP: 469°F
Sol(77°F): 4%
Fl.P(oc): 270°F
IP: 7.50 eV
Sp.Gr: 1.55
VP: <0.01 mmHg
MLT: 135°F
UEL: ?
LEL: ?
Combustible Solid; under certain conditions, a dust cloud can probably explode if ignited by a spark or flame.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers, strong bases, acid chlorides, acid anhydrides

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat, upper resp sys; eye, skin burns; CNS depres
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Methyl acetate	Formula: CH_3COOCH_3	CAS#: 79-20-9	RTECS#: AI9100000	IDLH: 3100 ppm [10%LEL]
Conversion: 1 ppm = 3.03 mg/m^3	**DOT:** 1231 129			
Synonyms/Trade Names: Methyl ester of acetic acid, Methyl ethanoate				

Exposure Limits:
NIOSH REL: TWA 200 ppm (610 mg/m^3)
ST 250 ppm (760 mg/m^3)
OSHA PEL†: TWA 200 ppm (610 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1458
OSHA 7

Physical Description: Colorless liquid with a fragrant, fruity odor.

Chemical & Physical Properties:
MW: 74.1
BP: 135°F
Sol: 25%
Fl.P: 14°F
IP: 10.27 eV
Sp.Gr: 0.93
VP: 173 mmHg
FRZ: -145°F
UEL: 16%
LEL: 3.1%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2000 ppm: CcrOv*/Sa*
3100 ppm: Sa:Cf*/CcrFOv/GmFOv/PaprOv*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids; water
[**Note:** Reacts slowly with water to form acetic acid & methanol.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; head, drow; optic nerve atrophy; chest tight; in animals: narco
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

M

Methyl acetylene	Formula: $CH_3C{\equiv}CH$	CAS#: 74-99-7	RTECS#: UK4250000	IDLH: 1700 ppm [10%LEL]
Conversion: 1 ppm = 1.64 mg/m^3	**DOT:**			
Synonyms/Trade Names: Allylene, Propine, Propyne, 1-Propyne				

Exposure Limits:
NIOSH REL: TWA 1000 ppm (1650 mg/m^3)
OSHA PEL: TWA 1000 ppm (1650 mg/m^3)

Measurement Methods (see Table 1):
NIOSH S84 (II-5)

Physical Description: Colorless gas with a sweet odor.
[**Note:** A fuel that is shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 40.1
BP: -10°F
Sol: Insoluble
Fl.P: NA (Gas)
IP: 10.36 eV
RGasD: 1.41
VP: 5.2 atm
FRZ: -153°F
UEL: ?
LEL: 1.7%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1700 ppm: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers (such as chlorine), copper alloys
[**Note:** Can decompose explosively at 4.5 to 5.6 atmospheres of pressure.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Irrit resp sys; tremor, hyperexcitability, anes; liquid: frostbite
TO: Resp sys, CNS

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Methyl acetylene-propadiene mixture

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3{\equiv}CH/CH_2{=}C{=}CH_2$	59355-75-8	UK4920000	3400 ppm [10%LEL]

Conversion: 1 ppm = 1.64 mg/m^3

DOT: 1060 116P (stabilized)

Synonyms/Trade Names: MAPP gas, Methyl acetylene-allene mixture, Propadiene-methyl acetylene, Methyl acetylene-propadiene mixture (stabilized), Propyne-allene mixture, Propyne-propadiene mixture

Exposure Limits:
NIOSH REL: TWA 1000 ppm (1800 mg/m^3)
ST 1250 ppm (2250 mg/m^3)
OSHA PEL†: TWA 1000 ppm (1800 mg/m^3)

Measurement Methods (see Table 1):
NIOSH S85 (II-6)
OSHA 7

Physical Description: Colorless gas with a strong, characteristic, foul odor.
[**Note:** A fuel that is shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 40.1
BP: -36 to -4°F
Sol: Insoluble
Fl.P: NA (Gas)
IP: ?
RGasD: 1.48
VP: >1 atm
FRZ: -213°F
UEL: 10.8%
LEL: 3.4%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
3400 ppm: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, copper alloys
[**Note:** Forms explosive compounds at high pressure in contact with alloys containing more than 67% copper.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Irrit resp sys; excitement, conf, anes; liquid: frostbite
TO: Resp sys, CNS

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Methyl acrylate

Formula:	CAS#:	RTECS#:	IDLH:
$CH_2{=}CHCOOCH_3$	96-33-3	AT2800000	250 ppm

Conversion: 1 ppm = 3.52 mg/m^3

DOT: 1919 129P (inhibited)

Synonyms/Trade Names: Methoxycarbonylethylene, Methyl ester of acrylic acid, Methyl propenoate

Exposure Limits:
NIOSH REL: TWA 10 ppm (35 mg/m^3) [skin]
OSHA PEL: TWA 10 ppm (35 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1459, 2552
OSHA 92

Physical Description: Colorless liquid with an acrid odor.

Chemical & Physical Properties:
MW: 86.1
BP: 176°F
Sol: 6%
Fl.P: 27°F
IP: 9.90 eV
Sp.Gr: 0.96
VP: 65 mmHg
FRZ: -106°F
UEL: 25%
LEL: 2.8%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
100 ppm: Sa*
250 ppm: Sa:Cf*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Nitrates, oxidizers such as peroxides, strong alkalis
[**Note:** Polymerizes easily; usually contains an inhibitor such as hydroquinone.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, upper resp sys
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Methylacrylonitrile	Formula: $CH_2=C(CH_3)CN$	CAS#: 126-98-7	RTECS#: UD1400000	IDLH: N.D.
Conversion: 1 ppm = 2.74 mg/m^3	**DOT:** 3079 131P (inhibited)			
Synonyms/Trade Names: 2-Cyanopropene-1, 2-Cyano-1-propene, Isoprene cyanide, Isopropenylnitrile, Methacrylonitrile, α-Methylacrylonitrile, 2-Methylpropenenitrile				
Exposure Limits: **NIOSH REL:** TWA 1 ppm (3 mg/m^3) [skin] **OSHA PEL†:** none				**Measurement Methods (see Table 1):** None available
Physical Description: Colorless liquid with an odor like bitter almonds.				
Chemical & Physical Properties: **MW:** 67.1 **BP:** 195°F **Sol:** 3% **Fl.P:** 34°F **IP:** ? **Sp.Gr:** 0.80 **VP(77°F):** 71 mmHg **FRZ:** -32°F **UEL:** 6.8% **LEL:** 2% Class IB Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Strong acids, strong oxidizers, alkali, light [**Note:** Polymerization may occur due to elevated temperature, visible light, or contact with a concentrated alkali.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin; lac; in animals: convuls, loss of motor control in hind limbs **TO:** Eyes, skin, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed	

M

Methylal	Formula: $CH_3OCH_2OCH_3$	CAS#: 109-87-5	RTECS#: PA8750000	IDLH: 2200 ppm [10%LEL]
Conversion: 1 ppm = 3.11 mg/m^3	**DOT:** 1234 127			
Synonyms/Trade Names: Dimethoxymethane, Formal, Formaldehyde dimethylacetal, Methoxymethyl methyl ether, Methylene dimethyl ether				
Exposure Limits: **NIOSH REL:** TWA 1000 ppm (3100 mg/m^3) **OSHA PEL:** TWA 1000 ppm (3100 mg/m^3)				**Measurement Methods (see Table 1):** **NIOSH** 1611
Physical Description: Colorless liquid with a chloroform-like odor.				
Chemical & Physical Properties: **MW:** 76.1 **BP:** 111°F **Sol:** 33% **Fl.P(oc):** -26°F **IP:** 10.00 eV **Sp.Gr:** 0.86 **VP:** 330 mmHg **FRZ:** -157°F **UEL:** 13.8% **LEL:** 2.2% Class IB Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **2200 ppm:** Sa/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers, acids				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, upper resp sys; anes **TO:** Eyes, skin, resp sys, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Methyl alcohol

Formula:	CAS#:	RTECS#:	IDLH:
CH_3OH	67-56-1	PC1400000	6000 ppm

Conversion: 1 ppm = 1.31 mg/m^3 **DOT:** 1230 131

Synonyms/Trade Names: Carbinol, Columbian spirits, Methanol, Pyroligneous spirit, Wood alcohol, Wood naphtha, Wood spirit

Exposure Limits:
NIOSH REL: TWA 200 ppm (260 mg/m^3)
ST 250 ppm (325 mg/m^3) [skin]
OSHA PEL†: TWA 200 ppm (260 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2000, 3800
OSHA 91

Physical Description: Colorless liquid with a characteristic pungent odor.

Chemical & Physical Properties:
MW: 32.1
BP: 147°F
Sol: Miscible
Fl.P: 52°F
IP: 10.84 eV
Sp.Gr: 0.79
VP: 96 mmHg
FRZ: -144°F
UEL: 36%
LEL: 6.0%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2000 ppm: Sa
5000 ppm: Sa:Cf
6000 ppm: SaT:Cf/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, upper resp sys; head, drow, dizz, nau, vomit; vis dist, optic nerve damage (blindness); derm
TO: Eyes, skin, resp sys, CNS, GI tract

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Methylamine

Formula:	CAS#:	RTECS#:	IDLH:
CH_3NH_2	74-89-5	PF6300000	100 ppm

Conversion: 1 ppm = 1.27 mg/m^3 **DOT:** 1061 118 (anhydrous); 1235 132 (aqueous)

Synonyms/Trade Names: Aminomethane, Methylamine (anhydrous), Methylamine (aqueous), Monomethylamine

Exposure Limits:
NIOSH REL: TWA 10 ppm (12 mg/m^3)
OSHA PEL: TWA 10 ppm (12 mg/m^3)

Measurement Methods (see Table 1):
OSHA 40

Physical Description: Colorless gas with a fish- or ammonia-like odor.
[**Note:** A liquid below 21°F. Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 31.1
BP: 21°F
Sol: Soluble
Fl.P: NA (Gas)
14°F (Liquid)
IP: 8.97 eV
RGasD: 1.08
Sp.Gr: 0.70 (Liquid at 13°F)
VP: 3.0 atm
FRZ: -136°F
UEL: 20.7%
LEL: 4.9%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (solution)
Frostbite
Eyes: Prevent eye contact (solution)
Frostbite
Wash skin: When contam (solution)
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
100 ppm: CcrFS/GmFS/PaprS£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Mercury, strong oxidizers, nitromethane
[**Note:** Corrosive to copper & zinc alloys, aluminum & galvanized surfaces.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs (solution), Ing (solution), Con (solution/liquid)
SY: Irrit eyes, skin, resp sys; cough; skin, muc memb burns; derm; conj; liquid: frostbite
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed (solution)/Frostbite
Skin: Water flush immed (solution)/Frostbite
Breath: Resp support
Swallow: Medical attention immed (solution)

Methyl (n-amyl) ketone	Formula: $CH_3CO[CH_2]_4CH_3$	CAS#: 110-43-0	RTECS#: MJ5075000	IDLH: 800 ppm
Conversion: 1 ppm = 4.67 mg/m^3	**DOT:** 1110 127			
Synonyms/Trade Names: Amyl methyl ketone, n-Amyl methyl ketone, 2-Heptanone				
Exposure Limits: **NIOSH REL:** TWA 100 ppm (465 mg/m^3) **OSHA PEL:** TWA 100 ppm (465 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1301, 2553	
Physical Description: Colorless to white liquid with a banana-like, fruity odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 114.2 **BP:** 305°F **Sol:** 0.4% **Fl.P:** 102°F **IP:** 9.33 eV **Sp.Gr:** 0.81 **VP:** 3 mmHg **FRZ:** -32°F **UEL(250°F):** 7.9% **LEL(151°F):** 1.1% Class II Combustible Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.	**NIOSH/OSHA** **800 ppm:** CcrOv*/PaprOv*/GmFOv/ Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Strong acids, alkalis & oxidizers [**Note:** Will attack some forms of plastic.]	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, muc memb; head; narco, coma; derm **TO:** Eyes, skin, resp sys, CNS, PNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash **Breath:** Fresh air **Swallow:** Medical attention immed

M

Methyl bromide	Formula: CH_3Br	CAS#: 74-83-9	RTECS#: PA4900000	IDLH: Ca [250 ppm]
Conversion: 1 ppm = 3.89 mg/m^3	**DOT:** 1062 123			
Synonyms/Trade Names: Bromomethane, Monobromomethane				
Exposure Limits: **NIOSH REL:** Ca See Appendix A **OSHA PEL†:** C 20 ppm (80 mg/m^3) [skin]			**Measurement Methods (see Table 1):** **NIOSH** 2520 **OSHA** PV2040	
Physical Description: Colorless gas with a chloroform-like odor at high concentrations. [**Note:** A liquid below 38°F. Shipped as a liquefied compressed gas.]				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 95.0 **BP:** 38°F **Sol:** 2% **Fl.P:** NA (Gas) **IP:** 10.54 eV **RGasD:** 3.36 **Sp.Gr:** 1.73 (Liquid at 32°F) **VP:** 1.9 atm **FRZ:** -137°F **UEL:** 16.0% **LEL:** 10% Flammable Gas, but only in presence of a high energy ignition source.	**Skin:** Prevent skin contact (liquid) **Eyes:** Prevent eye contact (liquid) **Wash skin:** When contam (liquid) **Remove:** When wet (flamm) **Change:** N.R. **Provide:** Quick drench (liquid)	**NIOSH** **¥:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Aluminum, magnesium, strong oxidizers [**Note:** Attacks aluminum to form aluminum trimethyl, which is SPONTANEOUSLY flammable.]	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs (liquid), Con (liquid) **SY:** Irrit eyes, skin, resp sys; musc weak, inco, vis dist, dizz; nau, vomit, head; mal; hand tremor; convuls; dysp; skin vesic; liquid: frostbite; [carc] **TO:** Eyes, skin, resp sys, CNS [in animals: lung, kidney & forestomach tumors]	**First Aid (see Table 6):** **Eye:** Irr immed (liquid) **Skin:** Water flush immed (liquid) **Breath:** Resp support

Methyl Cellosolve®	Formula: $CH_3OCH_2CH_2OH$	CAS#: 109-86-4	RTECS#: KL5775000	IDLH: 200 ppm
Conversion: 1 ppm = 3.11 mg/m^3	**DOT:** 1188 127			

Synonyms/Trade Names: EGME, Ethylene glycol monomethyl ether, Glycol monomethyl ether, 2-Methoxyethanol

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.3 mg/m^3) [skin]
OSHA PEL: TWA 25 ppm (80 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1403
OSHA 53, 79

Physical Description: Colorless liquid with a mild, ether-like odor.

Chemical & Physical Properties:
MW: 76.1
BP: 256°F
Sol: Miscible
Fl.P: 102°F
IP: 9.60 eV
Sp.Gr: 0.96
VP: 6 mmHg
FRZ: -121°F
UEL: 14%
LEL: 1.8%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
1 ppm: Sa*
2.5 ppm: Sa:Cf*
5 ppm: ScbaF/SaF
100 ppm: Sa:Pd,Pp*
200 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, caustics

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose, throat; head, drow, lass; ataxia, tremor; anemic pallor; in animals: repro, terato effects
TO: Eyes, resp sys, CNS, blood, kidneys, repro sys, hemato sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Methyl Cellosolve® acetate	Formula: $CH_3COOCH_2CH_2OCH_3$	CAS#: 110-49-6	RTECS#: KL5950000	IDLH: 200 ppm
Conversion: 1 ppm = 4.83 mg/m^3	**DOT:** 1189 129			

Synonyms/Trade Names: EGMEA, Ethylene glycol monomethyl ether acetate, Glycol monomethyl ether acetate, 2-Methoxyethyl acetate

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.5 mg/m^3 [skin]
OSHA PEL: TWA 25 ppm (120 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1451
OSHA 53, 79

Physical Description: Colorless liquid with a mild, ether-like odor.

Chemical & Physical Properties:
MW: 118.1
BP: 293°F
Sol: Miscible
Fl.P: 120°F
IP: ?
Sp.Gr: 1.01
VP: 2 mmHg
FRZ: -85°F
UEL: 8.2%
LEL: 1.7%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
1 ppm: Sa*
2.5 ppm: Sa:Cf*
5 ppm: ScbaF/SaF
100 ppm: Sa:Pd,Pp*
200 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose, throat; kidney, brain damage; in animals: narco; repro, terato effects
TO: Eyes, resp sys, kidneys, brain, CNS, PNS, repro sys, hemato sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Methyl chloride

Formula: CH_3Cl | **CAS#:** 74-87-3 | **RTECS#:** PA6300000 | **IDLH:** Ca [2000 ppm]

Conversion: 1 ppm = 2.07 mg/m^3 | **DOT:** 1063 115

Synonyms/Trade Names: Chloromethane, Monochloromethane

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: TWA 100 ppm
C 200 ppm
300 ppm (5-minute maximum peak in any 3 hours)

Measurement Methods (see Table 1):
NIOSH 1001

Physical Description: Colorless gas with a faint, sweet odor which is not noticeable at dangerous concentrations. [**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 50.5
BP: -12°F
Sol: 0.5%
Fl.P: NA (Gas)
IP: 11.28 eV
RGasD: 1.78
VP: 5.0 atm
FRZ: -144°F
UEL: 17.4%
LEL: 8.1%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as potassium, powdered aluminum, zinc, and magnesium; water [**Note:** Reacts with water (hydrolyzes) to form hydrochloric acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Dizz, nau, vomit; vis dist, stagger, slurred speech, convuls, coma; liver, kidney damage; liquid: frostbite; repro, terato effects; [carc]
TO: CNS, liver, kidneys, repro sys [in animals: lung, kidney & forestomach tumors]

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

M

Methyl chloroform

Formula: CH_3CCl_3 | **CAS#:** 71-55-6 | **RTECS#:** KJ2975000 | **IDLH:** 700 ppm

Conversion: 1 ppm = 5.46 mg/m^3 | **DOT:** 2831 160

Synonyms/Trade Names: Chlorothene; 1,1,1-Trichloroethane; 1,1,1-Trichloroethane (stabilized)

Exposure Limits:
NIOSH REL: C 350 ppm (1900 mg/m^3) [15-minute]
See Appendix C (Chloroethanes)
OSHA PEL†: TWA 350 ppm (1900 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1003

Physical Description: Colorless liquid with a mild, chloroform-like odor.

Chemical & Physical Properties:
MW: 133.4
BP: 165°F
Sol: 0.4%
Fl.P: ?
IP: 11.00 eV
Sp.Gr: 1.34
VP: 100 mmHg
FRZ: -23°F
UEL: 12.5%
LEL: 7.5%
Combustible Liquid, but burns with difficulty.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
700 ppm: Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong caustics; strong oxidizers; chemically-active metals such as zinc, aluminum, magnesium powders, sodium & potassium; water
[**Note:** Reacts slowly with water to form hydrochloric acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin; head, lass, CNS depres, poor equi; derm; card arrhy; liver damage
TO: Eyes, skin, CNS, CVS, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Methyl-2-cyanoacrylate	Formula: $CH_2=C(CN)COOCH_3$	CAS#: 137-05-3	RTECS#: AS7000000	IDLH: N.D.
Conversion: 1 ppm = 4.54 mg/m^3	**DOT:**			
Synonyms/Trade Names: Mecrylate, Methyl cyanoacrylate, Methyl α-cyanoacrylate, Methyl ester of 2-cyanoacrylic acid				
Exposure Limits: **NIOSH REL:** TWA 2 ppm (8 mg/m^3) ST 4 ppm (16 mg/m^3) **OSHA PEL†:** none **Physical Description:** Colorless liquid with a characteristic odor.			**Measurement Methods (see Table 1):** **OSHA** 55	
Chemical & Physical Properties: **MW:** 111.1 **BP:** ? **Sol:** 30% **Fl.P:** 174°F **IP:** ? **Sp.Gr(81°F):** 1.10 **VP(77°F):** 0.2 mmHg **FRZ:** ? **UEL:** ? **LEL:** ? Class IIIA Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** Daily **Remove:** N.R. **Change:** N.R. **Provide:** Eyewash		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Moisture [**Note:** Contact with moisture causes rapid polymerization.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose; blurred vision, lac; rhinitis **TO:** Eyes, skin, resp sys		**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water wash **Breath:** Resp support **Swallow:** Medical attention immed		

M

Methylcyclohexane	Formula: $CH_3C_6H_{11}$	CAS#: 108-87-2	RTECS#: GV6125000	IDLH: 1200 ppm [LEL]
Conversion: 1 ppm = 4.02 mg/m^3	**DOT:** 2296 128			
Synonyms/Trade Names: Cyclohexylmethane, Hexahydrotoluene				
Exposure Limits: **NIOSH REL:** TWA 400 ppm (1600 mg/m^3) **OSHA PEL†:** TWA 500 ppm (2000 mg/m^3) **Physical Description:** Colorless liquid with a faint, benzene-like odor.			**Measurement Methods (see Table 1):** **NIOSH** 1500 **OSHA** 7	
Chemical & Physical Properties: **MW:** 98.2 **BP:** 214°F **Sol:** Insoluble **Fl.P:** 25°F **IP:** 9.85 eV **Sp.Gr:** 0.77 **VP:** 37 mmHg **FRZ:** -196°F **UEL:** 6.7% **LEL:** 1.2% Class IB Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **1200 ppm:** Sa/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat; dizz, drow; in animals: narco **TO:** Eyes, skin, resp sys, CNS		**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed		

Methylcyclohexanol	Formula: $CH_3C_6H_{10}OH$	CAS#: 25639-42-3	RTECS#: GW0175000	IDLH: 500 ppm
Conversion: 1 ppm = 4.67 mg/m^3	**DOT:** 2617 129			
Synonyms/Trade Names: Hexahydrocresol, Hexahydromethylphenol				
Exposure Limits: **NIOSH REL:** TWA 50 ppm (235 mg/m^3) **OSHA PEL†:** TWA 100 ppm (470 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1404	
Physical Description: Straw-colored liquid with a weak odor like coconut oil.				
Chemical & Physical Properties: **MW:** 114.2 **BP:** 311-356°F **Sol:** 4% **Fl.P:** 149-158°F **IP:** 9.80 eV **Sp.Gr:** 0.92 **VP(86°F):** 2 mmHg **FRZ:** -58°F **UEL:** ? **LEL:** ? Class IIIA Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **500 ppm:** Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, upper resp sys; head; in animals: narco; liver, kidney damage **TO:** Eyes, skin, resp sys, CNS, kidneys, liver			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed	

o-Methylcyclohexanone	Formula: $CH_3C_6H_9O$	CAS#: 583-60-8	RTECS#: GW1750000	IDLH: 600 ppm
Conversion: 1 ppm = 4.59 mg/m^3	**DOT:** 2297 128			
Synonyms/Trade Names: 2-Methylcyclohexanone				
Exposure Limits: **NIOSH REL:** TWA 50 ppm (230 mg/m^3) [skin] ST 75 ppm (345 mg/m^3) **OSHA PEL†:** TWA 100 ppm (460 mg/m^3) [skin]			**Measurement Methods (see Table 1):** **NIOSH** 2521	
Physical Description: Colorless liquid with a weak, peppermint-like odor.				
Chemical & Physical Properties: **MW:** 112.2 **BP:** 325°F **Sol:** Insoluble **Fl.P:** 118°F **IP:** ? **Sp.Gr:** 0.93 **VP:** 1 mmHg **FRZ:** 7°F **UEL:** ? **LEL:** ? Class II Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **500 ppm:** Sa* **600 ppm:** Sa:Cf*/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** In animals: irrit eyes, muc memb; narco; derm **TO:** Skin, resp sys, liver, kidneys, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Methyl cyclopentadienyl manganese tricarbonyl (as Mn)	Formula: $CH_3C_5H_4Mn(CO)_3$	CAS#: 12108-13-3	RTECS#: OP1450000	IDLH: N.D.
Conversion:	DOT:			

Synonyms/Trade Names: CI-2, Combustion Improver-2, Manganese tricarbonylmethylcyclopentadienyl, 2-Methylcyclopentadienyl manganese tricarbonyl, MMT

Exposure Limits:
NIOSH REL: TWA 0.2 mg/m^3 [skin]
OSHA PEL†: C 5 mg/m^3

Measurement Methods (see Table 1):
None available

Physical Description: Yellow to dark-orange liquid with a faint, pleasant odor. [**Note:** A solid below 36°F.]

Chemical & Physical Properties:
MW: 218.1
BP: 449°F
Sol: Insoluble
Fl.P: 230°F
IP: ?
Sp.Gr: 1.39
VP(212°F): 7 mmHg
FRZ: 36°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Light (decomposes)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes; dizz, nau, head; in animals: tremor, severe clonic spasms, lass, slow respiration; liver, kidney inj
TO: Eyes, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

M

Methyl demeton	Formula: $C_6H_{15}O_3PS_2$	CAS#: 8022-00-2	RTECS#: TG1760000	IDLH: N.D.
Conversion:	DOT:			

Synonyms/Trade Names: Demeton methyl; O,O-Dimethyl 2-ethylmercaptoethyl thiophosphate; Metasystox®; Methyl mercaptophos; Methyl systox®

Exposure Limits:
NIOSH REL: TWA 0.5 mg/m^3 [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Oily, colorless to pale-yellow liquid with an unpleasant odor. [insecticide] [**Note:** Technical grade consists of 2 isomers: thiono & thiolo.]

Chemical & Physical Properties:
MW: 230.3
BP: Decomposes
Sol: 0.03-0.3%
Fl.P: ?
IP: ?
Sp.Gr: 1.20
VP: 0.0004 mmHg
FRZ: ?
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers, alkalis, water

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; ache eyes, rhin; nau, head, dizz, vomit
TO: Eyes, skin, resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

4,4'-Methylenebis(2-chloroaniline)	Formula: $CH_2(C_6H_4ClNH_2)_2$	CAS#: 101-14-4	RTECS#: CY1050000	IDLH: Ca [N.D.]
Conversion:	**DOT:**			

Synonyms/Trade Names: DACPM; 3,3'-Dichloro-4,4'-diaminodiphenylmethane; MBOCA; 4,4'-Methylenebis(o-chloro aniline); 4,4'-Methylenebis(2-chlorobenzenamine); MOCA

Exposure Limits:
NIOSH REL: Ca
TWA 0.003 mg/m^3 [skin]
See Appendix A
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA 24, 71

Physical Description: Tan-colored pellets or flakes with a faint, amine-like odor.

Chemical & Physical Properties:
MW: 267.2
BP: ?
Sol: Slight
Fl.P: ?
IP: ?
Sp.Gr: 1.44
VP(77°F): 0.00001 mmHg
MLT: 230°F
UEL: ?
LEL: ?

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Chemically-active metals (e.g., potassium, sodium, magnesium, zinc)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Hema, cyan, nau, methemo, kidney irrit; [carc]
TO: Liver, blood, kidneys [in animals: liver, lung & bladder tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

M

Methylene bis(4-cyclohexylisocyanate)	Formula: $CH_2[(C_6H_{10})NCO]_2$	CAS#: 5124-30-1	RTECS#: NQ9250000	IDLH: N.D.
Conversion: 1 ppm = 10.73 mg/m^3	**DOT:**			

Synonyms/Trade Names: Dicyclohexylmethane 4,4'-diisocyanate; DMDI; bis(4-Isocyanatocyclohexyl)methane; HMDI; Hydrogenated MDI; Reduced MDI; Saturated MDI

Exposure Limits:
NIOSH REL: C 0.01 ppm (0.11 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5525
OSHA PV2092

Physical Description: Clear, colorless to light-yellow liquid.

Chemical & Physical Properties:
MW: 262.4
BP: ?
Sol: Reacts
Fl.P: >395°F
IP: ?
Sp.Gr(77°F): 1.07
VP(77°F): 0.001 mmHg
FRZ: <14°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
0.1 ppm: Sa*
0.25 ppm: Sa:Cf*
0.5 ppm: ScbaF/SaF
1 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Water, ethanol, alcohols, amines, bases, acids, organotin catalysts [**Note:** May slowly polymerize if heated above 122°F.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; skin, resp sens; chest tight, dysp, cough, dry throat, wheez, pulm edema; skin blisters
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Methylene bisphenyl isocyanate	Formula: $CH_2(C_6H_4NCO)_2$	CAS#: 101-68-8	RTECS#: NQ9350000	IDLH: 75 mg/m^3
Conversion: 1 ppm = 10.24 mg/m^3	**DOT:**			

Synonyms/Trade Names: 4,4'-Diphenylmethane diisocyanate; MDI; Methylene bis(4-phenyl isocyanate); Methylene di-p-phenylene ester of isocyanic acid

Exposure Limits:
NIOSH REL: TWA 0.05 mg/m^3 (0.005 ppm)
C 0.2 mg/m^3 (0.020 ppm) [10-minute]
OSHA PEL: C 0.2 mg/m^3 (0.02 ppm)

Measurement Methods (see Table 1):
NIOSH 5521, 5522, 5525
OSHA 18

Physical Description: White to light-yellow, odorless flakes. [**Note:** A liquid above 99°F.]

Chemical & Physical Properties:
MW: 250.3
BP: 597°F
Sol: 0.2%
Fl.P: 390°F
IP: ?
Sp.Gr: 1.23 (Solid at 77°F)
1.19 (Liquid at 122°F)
VP(77°F): 0.000005 mmHg
MLT: 99°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
0.5 mg/m^3: Sa*
1.25 mg/m^3: Sa:Cf*
2.5 mg/m^3: ScbaF/SaF
75 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong alkalis, acids, alcohol [**Note:** Polymerizes at 450°F.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose, throat; resp sens; cough, pulm secretions, chest pain, dysp; asthma
TO: Eyes, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Methylene chloride	Formula: CH_2Cl_2	CAS#: 75-09-2	RTECS#: PA8050000	IDLH: Ca [2300 ppm]
Conversion: 1 ppm = 3.47 mg/m^3	**DOT:** 1593 160			

Synonyms/Trade Names: Dichloromethane, Methylene dichloride

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1052] TWA 25 ppm
ST 125 ppm

Measurement Methods (see Table 1):
NIOSH 1005, 3800
OSHA 59, 80

Physical Description: Colorless liquid with a chloroform-like odor. [**Note:** A gas above 104°F.]

Chemical & Physical Properties:
MW: 84.9
BP: 104°F
Sol: 2%
Fl.P: ?
IP: 11.32 eV
Sp.Gr: 1.33
VP: 350 mmHg
FRZ: -139°F
UEL: 23%
LEL: 13%
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Strong oxidizers; caustics; chemically-active metals such as aluminum, magnesium powders, potassium & sodium; concentrated nitric acid

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; lass, drow, dizz; numb, tingle limbs; nau; [carc]
TO: Eyes, skin, CVS, CNS [in animals: lung, liver, salivary & mammary gland tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

4,4'-Methylenedianiline	Formula: $CH_2(C_6H_4NH_2)_2$	CAS#: 101-77-9	RTECS#: BY5425000	IDLH: Ca [N.D.]
Conversion:	**DOT:**			

Synonyms/Trade Names: 4,4'-Diaminodiphenylmethane; para, para'-Diaminodiphenyl-methane; Dianilinomethane; 4,4'-Diphenylmethanediamine; MDA

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1050] TWA 0.010 ppm
ST 0.100 ppm

Measurement Methods (see Table 1):
NIOSH 5029

Physical Description: Pale-brown, crystalline solid with a faint, amine-like odor.

Chemical & Physical Properties:
MW: 198.3
BP: 748°F
Sol: 0.1%
Fl.P: 374°F
IP: 10.70 eV
Sp.Gr: 1.06 (Liquid at 212°F)
VP(77°F): 0.0000002 mmHg
MLT: 198°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes; jaun, hepatitis; myocardial damage; in animals: heart, liver, spleen damage; [carc]
TO: Eyes, liver, CVS, spleen [in animals: bladder cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Methyl ethyl ketone peroxide	Formula: $C_8H_{16}O_4$	CAS#: 1338-23-4	RTECS#: EL9450000	IDLH: N.D.
Conversion: 1 ppm = 7.21 mg/m^3	**DOT:**			

Synonyms/Trade Names: 2-Butanone peroxide, Ethyl methyl ketone peroxide, MEKP, MEK peroxide, Methyl ethyl ketone hydroperoxide

Exposure Limits:
NIOSH REL: C 0.2 ppm (1.5 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 3508
OSHA 77

Physical Description: Colorless liquid with a characteristic odor.
[**Note:** Explosive decomposition occurs at 230°F.]

Chemical & Physical Properties:
MW: 176.2
BP: 244°F (Decomposes)
Sol: Soluble
Fl.P(oc): 125-200°F (60% MEKP)
IP: ?
Sp.Gr(59°F): 1.12
VP: ?
FRZ: ?
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Organic materials, heat, flames, sunlight, trace contaminants
[**Note:** A strong oxidizing agent. Pure MEKP is shock sensitive. Commercial product is diluted with 40% dimethyl phthalate, cyclohexane peroxide, or diallyl phthalate to reduce sensitivity to shock.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; cough, dysp, pulm edema; blurred vision; blisters, scars skin; abdom pain, vomit, diarr; derm; in animals: liver, kidney damage
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Methyl formate	Formula: $HCOOCH_3$	CAS#: 107-31-3	RTECS#: LQ8925000	IDLH: 4500 ppm
Conversion: 1 ppm = 2.46 mg/m^3	**DOT:** 1243 129			
Synonyms/Trade Names: Methyl ester of formic acid, Methyl methanoate				
Exposure Limits: **NIOSH REL:** TWA 100 ppm (250 mg/m^3) ST 150 ppm (375 mg/m^3) **OSHA PEL†:** TWA 100 ppm (250 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** S291 (II-5) **OSHA** PV2041	
Physical Description: Colorless liquid with a pleasant odor. [**Note:** A gas above 89°F.]				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 60.1 **BP:** 89°F **Sol:** 30% **Fl.P:** -2°F **IP:** 10.82 eV **Sp.Gr:** 0.98 **VP:** 476 mmHg **FRZ:** -148°F **UEL:** 23% **LEL:** 4.5% Class IA Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.	**NIOSH/OSHA** **1000 ppm:** Sa* **2500 ppm:** Sa:Cf* **4500 ppm:** ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers
[**Note:** Reacts slowly with water to form methanol & formic acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Abs, Ing, Con **SY:** Irrit eyes, nose; chest tight, dysp; vis dist; CNS depres; in animals: pulm edema; narco **TO:** Eyes, resp sys, CNS	**Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed

5-Methyl-3-heptanone	Formula: $C_2H_5COCH_2CH(CH_3)CH_2CH_3$	CAS#: 541-85-5	RTECS#: MJ7350000	IDLH: 100 ppm
Conversion: 1 ppm = 5.24 mg/m^3	**DOT:** 2271 127			
Synonyms/Trade Names: Amyl ethyl ketone, Ethyl amyl ketone, 3-Methyl-5-heptanone				
Exposure Limits: **NIOSH REL:** TWA 25 ppm (130 mg/m^3) **OSHA PEL:** TWA 25 ppm (130 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1301, 2553	
Physical Description: Colorless liquid with a pungent odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 128.2 **BP:** 315°F **Sol:** Insoluble **Fl.P:** 138°F **IP:** ? **Sp.Gr:** 0.82 **VP:** 2 mmHg **FRZ:** -70°F **UEL:** ? **LEL:** ? Class II Combustible Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.	**NIOSH/OSHA** **100 ppm:** CcrOv*/PaprOv*/GmFOv/ Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Ing, Con **SY:** Irrit eyes, skin, muc memb; head; narco, coma; derm **TO:** Eyes, skin, resp sys, CNS	**Eye:** Irr immed **Skin:** Water flush **Breath:** Resp support **Swallow:** Medical attention immed

Methyl hydrazine

Formula:	CAS#:	RTECS#:	IDLH:
CH_3NHNH_2	60-34-4	MV5600000	Ca [20 ppm]

Conversion: 1 ppm = 1.89 mg/m^3 **DOT:** 1244 131

Synonyms/Trade Names: MMH, Monomethylhydrazine

Exposure Limits:
NIOSH REL: Ca
C 0.04 ppm (0.08 mg/m^3) [2-hr]
See Appendix A
OSHA PEL: C 0.2 ppm (0.35 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 3510

Physical Description: Fuming, colorless liquid with an ammonia-like odor.

Chemical & Physical Properties:
MW: 46.1
BP: 190°F
Sol: Miscible
Fl.P: 17°F
IP: 8.00 eV
Sp.Gr(77°F): 0.87
VP: 38 mmHg
FRZ: -62°F
UEL: 92%
LEL: 2.5%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: ScbaE

Incompatibilities and Reactivities: Oxides of iron; copper; manganese; lead; copper alloys; porous materials such as earth, asbestos, wood & cloth; strong oxidizers such as fluorine & chlorine; nitric acid; hydrogen peroxide

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; vomit, diarr, tremor, ataxia; anoxia, cyan; convuls; [carc]
TO: Eyes, skin, resp sys, CNS, liver, blood, CVS [in animals: lung, liver, blood vessel & intestine tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

M

Methyl iodide

Formula:	CAS#:	RTECS#:	IDLH:
CH_3I	74-88-4	PA9450000	Ca [100 ppm]

Conversion: 1 ppm = 5.80 mg/m^3 **DOT:** 2644 151

Synonyms/Trade Names: Iodomethane, Monoiodomethane

Exposure Limits:
NIOSH REL: Ca
TWA 2 ppm (10 mg/m^3) [skin]
See Appendix A
OSHA PEL: TWA 5 ppm (28 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1014

Physical Description: Colorless liquid with a pungent, ether-like odor. [**Note:** Turns yellow, red, or brown on exposure to light & moisture.]

Chemical & Physical Properties:
MW: 141.9
BP: 109°F
Sol: 1%
Fl.P: NA
IP: 9.54 eV
Sp.Gr: 2.28
VP: 400 mmHg
FRZ: -88°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers [**Note:** Decomposes at 518°F.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; nau, vomit; dizz, ataxia; slurred speech, drow; derm; [carc]
TO: Eyes, skin, resp sys, CNS [in animals: lung, kidney & forestomach tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Methyl isoamyl ketone	Formula: $CH_3COCH_2CH_2CH(CH_3)_2$	CAS#: 110-12-3	RTECS#: MP3850000	IDLH: N.D.
Conversion: 1 ppm = 4.67 mg/m^3	**DOT:** 2302 127			
Synonyms/Trade Names: Isoamyl methyl ketone, Isopentyl methyl ketone, 2-Methyl-5-hexanone, 5-Methyl-2-hexanone, MIAK				
Exposure Limits: **NIOSH REL:** TWA 50 ppm (240 mg/m^3) **OSHA PEL†:** TWA 100 ppm (475 mg/m^3)			**Measurement Methods (see Table 1):** **OSHA** PV2042	
Physical Description: Colorless, clear liquid with a pleasant, fruity odor.				
Chemical & Physical Properties: **MW:** 114.2 **BP:** 291°F **Sol:** 0.5% **Fl.P:** 97°F **IP:** 9.284 eV **Sp.Gr:** 0.81 **VP:** 5 mmHg **FRZ:** -101°F **UEL(200°F):** 8.2% **LEL(200°F):** 1.0% Class IC Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **500 ppm:** CcrOv*/Sa* **1250 ppm:** Sa:Cf*/PaprOv* **2500 ppm:** CcrFOv/GmFOv/PaprTOv*/ SaT:Cf*/ScbaF/SaF **5000 ppm:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Oxidizers				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, muc memb; head, narco, coma; derm; in animals: liver, kidney damage **TO:** Eyes, skin, resp sys, CNS, liver, kidneys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap flush prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Methyl isobutyl carbinol	Formula: $(CH_3)_2CHCH_2CH(OH)CH_3$	CAS#: 108-11-2	RTECS#: SA7350000	IDLH: 400 ppm
Conversion: 1 ppm = 4.18 mg/m^3	**DOT:** 2053 129			
Synonyms/Trade Names: Isobutylmethylcarbinol, Methyl amyl alcohol, 4-Methyl-2-pentanol, MIBC				
Exposure Limits: **NIOSH REL:** TWA 25 ppm (100 mg/m^3) ST 40 ppm (165 mg/m^3) [skin] **OSHA PEL†:** TWA 25 ppm (100 mg/m^3) [skin]			**Measurement Methods (see Table 1):** **NIOSH** 1402, 1405 **OSHA** 7	
Physical Description: Colorless liquid with a mild odor.				
Chemical & Physical Properties: **MW:** 102.2 **BP:** 271°F **Sol:** 2% **Fl.P:** 106°F **IP:** ? **Sp.Gr:** 0.81 **VP:** 3 mmHg **FRZ:** -130°F **UEL:** 5.5% **LEL:** 1.0% Class II Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **250 ppm:** Sa* **400 ppm:** Sa:Cf*/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin; head, drow; derm; in animals: narco **TO:** Eyes, skin, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Methyl isocyanate	Formula: CH_3NCO	CAS#: 624-83-9	RTECS#: NQ9450000	IDLH: 3 ppm
Conversion: 1 ppm = 2.34 mg/m^3	**DOT:** 2480 155			
Synonyms/Trade Names: Methyl ester of isocyanic acid, MIC				
Exposure Limits: **NIOSH REL:** TWA 0.02 ppm (0.05 mg/m^3) [skin] **OSHA PEL:** TWA 0.02 ppm (0.05 mg/m^3) [skin]			**Measurement Methods (see Table 1):** **OSHA** 54	
Physical Description: Colorless liquid with a sharp, pungent odor.				
Chemical & Physical Properties: **MW:** 57.1 **BP:** 102-104°F **Sol(59°F):** 10% **Fl.P:** 19°F **IP:** 10.67 eV **Sp.Gr:** 0.96 **VP:** 348 mmHg **FRZ:** -49°F **UEL:** 26% **LEL:** 5.3% Class IB Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R. **Provide:** Eyewash Quick drench		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **0.2 ppm:** Sa* **0.5 ppm:** Sa:Cf* **1 ppm**: ScbaF/SaF **3 ppm**: SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Water, oxidizers, acids, alkalis, amines, iron, tin, copper [**Note:** Usually contains inhibitors to prevent polymerization.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, nose, throat; resp sens, cough, pulm secretions, chest pain, dysp; asthma; eye, skin damage; in animals: pulm edema **TO:** Eyes, skin, resp sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed	

Methyl isopropyl ketone	Formula: $CH_3COCH(CH_3)_2$	CAS#: 563-80-4	RTECS#: EL9100000	IDLH: N.D.
Conversion: 1 ppm = 3.53 mg/m^3	**DOT:** 2397 127			
Synonyms/Trade Names: 2-Acetyl propane, Isopropyl methyl ketone, 3-Methyl-2-butanone, 3-Methyl butan-2-one, MIPK				
Exposure Limits: **NIOSH REL:** TWA 200 ppm (705 mg/m^3) **OSHA PEL†:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Colorless liquid with an acetone-like odor.				
Chemical & Physical Properties: **MW:** 86.2 **BP:** 199°F **Sol:** Very slight **Fl.P:** ? **IP:** 9.32 eV **Sp.Gr:** 0.81 **VP:** 42 mmHg **FRZ:** -134°F **UEL:** ? **LEL:** ? Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Oxidizers				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, muc memb, resp sys; cough **TO:** Eyes, skin, resp sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed	

Methyl mercaptan

Formula: CH_3SH | **CAS#:** 74-93-1 | **RTECS#:** PB4375000 | **IDLH:** 150 ppm

Conversion: 1 ppm = 1.97 mg/m^3 | **DOT:** 1064 117

Synonyms/Trade Names: Mercaptomethane, Methanethiol, Methyl sulfhydrate

Exposure Limits:
NIOSH REL: C 0.5 ppm (1 mg/m^3) [15-minute]
OSHA PEL†: C 10 ppm (20 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2542
OSHA 26

Physical Description: Colorless gas with a disagreeable odor like garlic or rotten cabbage. [**Note:** A liquid below 43°F. Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 48.1
BP: 43°F
Sol: 2%
Fl.P: NA (Gas)
(oc) 0°F (Liquid)
IP: 9.44 eV
RGasD: 1.66
Sp.Gr: 0.90 (Liquid at 32°F)
VP: 1.7 atm
FRZ: -186°F
UEL: 21.8%
LEL: 3.9%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (liquid)
Frostbite
Eyes: Prevent eye contact (liquid)
Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash (liquid)
Quick drench (liquid)
Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: CcrOv/Sa
12.5 ppm: Sa:Cf/PaprOv
25 ppm: CcrFOv/GmFOv/PaprTOv/
SaT:Cf/ScbaF/SaF
150 ppm: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, bleaches, copper, aluminum, nickel-copper alloys

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Irrit eyes, skin, resp sys; narco; cyan; convuls; liquid: frostbite
TO: Eyes, skin, resp sys, CNS, blood

First Aid (see Table 6):
Eye: Irr immed (liquid)/Frostbite
Skin: Water flush immed (liquid)/Frostbite
Breath: Resp support

Methyl methacrylate

Formula: $CH_2=C(CH_3)COOCH_3$ | **CAS#:** 80-62-6 | **RTECS#:** OZ5075000 | **IDLH:** 1000 ppm

Conversion: 1 ppm = 4.09 mg/m^3 | **DOT:** 1247 129P (inhibited)

Synonyms/Trade Names: Methacrylate monomer, Methyl ester of methacrylic acid, Methyl-2-methyl-2-propenoate

Exposure Limits:
NIOSH REL: TWA 100 ppm (410 mg/m^3)
OSHA PEL: TWA 100 ppm (410 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2537
OSHA 94

Physical Description: Colorless liquid with an acrid, fruity odor.

Chemical & Physical Properties:
MW: 100.1
BP: 214°F
Sol: 1.5%
Fl.P(oc): 50°F
IP: 9.70 eV
Sp.Gr: 0.94
VP: 29 mmHg
FRZ: -54°F
UEL: 8.2%
LEL: 1.7%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1000 ppm: Sa:Cf£/CcrFOv/GmFOv/
PaprOv£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Nitrates, oxidizers, peroxides, strong alkalis, moisture [**Note:** May polymerize if subjected to heat, oxidizers, or ultraviolet light. Usually contains an inhibitor such as hydroquinone.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; derm
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Methyl parathion

Formula: $(CH_3O)_2P(S)OC_6H_4NO_2$ | **CAS#:** 298-00-0 | **RTECS#:** TG0175000 | **IDLH:** N.D.

Conversion: **DOT:** 2783 152 (solid); 3018 152 (liquid)

Synonyms/Trade Names: Azophos®; O,O-Dimethyl-O-p-nitrophenylphosphorothioate; Parathion methyl

Exposure Limits:
NIOSH REL: TWA 0.2 mg/m^3 [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5600
OSHA PV2112

Physical Description: White to tan, crystalline solid or powder with a pungent, garlic-like odor. [pesticide] [**Note:** The commercial product in xylene is a tan liquid.]

Chemical & Physical Properties:
MW: 263.2
BP: 289°F
Sol(77°F): 0.006%
Fl.P: ?
IP: ?
Sp.Gr: 1.36
VP: 0.00001 mmHg
MLT: 99°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
2 mg/m^3: CcrOv95/Sa
5 mg/m^3: Sa:Cf/PaprOvHie
10 mg/m^3: CcrFOv100/GmFOv100/PaprTOvHie/SaT:Cf/ScbaF/SaF
200 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, water [**Note:** Explosive risk when heated above 122°F.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; nau, vomit, abdom cramps, diarr, salv; head, dizz, lass; rhin, chest tight; blurred vision, miosis; card irreg; musc fasc; dysp
TO: Eyes, skin, resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Methyl silicate

Formula: $(CH_3O)_4Si$ | **CAS#:** 681-84-5 | **RTECS#:** VV9800000 | **IDLH:** N.D.

Conversion: 1 ppm = 6.23 mg/m^3 **DOT:** 2606 155

Synonyms/Trade Names: Methyl orthosilicate, Tetramethoxysilane, Tetramethyl ester of silicic acid, Tetramethyl silicate

Exposure Limits:
NIOSH REL: TWA 1 ppm (6 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Clear, colorless liquid. [**Note:** A solid below 28°F.]

Chemical & Physical Properties:
MW: 152.3
BP: 250°F
Sol: Soluble
Fl.P: 205°F
IP: ?
Sp.Gr: 1.02
VP(77°F): 12 mmHg
FRZ: 28°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet or contam
Change: N.R.
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers; hexafluorides of rhenium, molybdenum & tungsten

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, corn damage (following even short-term exposure to the vapor); lung, kidney inj; pulm edema
TO: Eyes, resp sys, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

α-Methyl styrene	Formula: $C_6H_5C(CH_3)=CH_2$	CAS#: 98-83-9	RTECS#: WL5075300	IDLH: 700 ppm
Conversion: 1 ppm = 4.83 mg/m^3	**DOT:**			
Synonyms/Trade Names: AMS, Isopropenyl benzene, 1-Methyl-1-phenylethylene, 2-Phenyl propylene				
Exposure Limits: **NIOSH REL:** TWA 50 ppm (240 mg/m^3) ST 100 ppm (485 mg/m^3) **OSHA PEL†:** C 100 ppm (480 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1501 **OSHA** 7	
Physical Description: Colorless liquid with a characteristic odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 118.2 **BP:** 330°F **Sol:** Insoluble **Fl.P:** 129°F **IP:** 8.35 eV **Sp.Gr:** 0.91 **VP:** 2 mmHg **FRZ:** -10°F **UEL:** 6.1% **LEL:** 1.9% Class II Combustible Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.	**NIOSH** **500 ppm:** CcrOv*/Sa* **700 ppm:** Sa:Cf*/CcrFOv/GmFOv/PaprOv*/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, peroxides, halogens, catalysts for vinyl or ionic polymers; aluminum, iron chloride, copper [**Note:** Usually contains an inhibitor such as tert-butyl catechol.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat; drow; derm **TO:** Eyes, skin, resp sys, CNS	**Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed

Metribuzin	Formula: $C_8H_{14}N_4OS$	CAS#: 21087-64-9	RTECS#: XZ2990000	IDLH: N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: 4-Amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4H)-one				
Exposure Limits: **NIOSH REL:** TWA 5 mg/m^3 **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **OSHA** PV2044	
Physical Description: Colorless, crystalline solid. [herbicide]				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 214.3 **BP:** ? **Sol:** 0.1% **Fl.P:** NA **IP:** ? **Sp.Gr:** 1.31 **VP:** 0.0000004 mmHg **MLT:** 257°F **UEL:** NA **LEL:** NA Noncombustible Solid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam/Daily **Remove:** When wet or contam **Change:** Daily	Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Ing, Con **SY:** In animals: CNS depres; thyroid, liver enzyme changes **TO:** CNS, thyroid, liver	**Eye:** Irr immed **Skin:** Soap wash **Breath:** Fresh air **Swallow:** Medical attention immed

Mica (containing less than 1% quartz)	Formula:	CAS#: 12001-26-2	RTECS#: VV8760000	IDLH: 1500 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names: Biotite, Lepidolite, Margarite, Muscovite, Phlogopite, Roscoelite, Zimmwaldite

Exposure Limits:
NIOSH REL: TWA 3 mg/m^3 (resp)
OSHA PEL†: TWA 20 mppcf

Measurement Methods (see Table 1):
NIOSH 0600

Physical Description: Colorless, odorless flakes or sheets of hydrous silicates.

Chemical & Physical Properties:
MW: 797 (approx)
BP: ?
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 2.6-3.2
VP: 0 mmHg (approx)
MLT: ?
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
15 mg/m^3: Qm
30 mg/m^3: 95XQ/Sa
75 mg/m^3: Sa:Cf/PaprHie
150 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
1500 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes; pneumoconiosis, cough, dysp; lass; low-wgt
TO: Resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

M

Mineral wool fiber	Formula:	CAS#:	RTECS#: PY8070000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Manmade mineral fibers, Rock wool, Slag wool, Synthetic vitreous fibers
[**Note:** Produced by blowing steam or air through molten rock (rock wool) or various furnace slags that are by-products of metal smelting or refining processes (slag wool).]

Exposure Limits:
NIOSH REL: TWA 3 fibers/cm^3 (fibers ≤ 3.5 µm diameter & ≥ 10 µm in length)
TWA 5 mg/m^3 (total)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 7400

Physical Description: Typically, a mineral "wool" with diameters >0.5 µm & >1.5 µm in length.

Chemical & Physical Properties:
MW: varies
BP: NA
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: ?
VP: 0 mmHg (approx)
MLT: ?
UEL: NA
LEL: NA
Noncombustible Fibers

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5X REL: Qm
10X REL: 95XQ/Sa
25X REL: Sa:Cf/PaprHie
50X REL: 100F/PaprTHie/ScbaF/SaF
1000X REL: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, resp sys; dysp
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Molybdenum

Formula:	CAS#:	RTECS#:	IDLH:
Mo	7439-98-7	QA4680000	5000 mg/m^3 (as Mo)

Conversion: **DOT:**

Synonyms/Trade Names: Molybdenum metal

Exposure Limits:
NIOSH REL*: See Appendix D
OSHA PEL*†: TWA 15 mg/m^3
[***Note:** The PEL also applies to other insoluble molybdenum compounds (as Mo).]

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303, 9102
OSHA ID121, ID125G

Physical Description: Dark gray or black powder with a metallic luster.

Chemical & Physical Properties:
MW: 95.9
BP: 8717°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 10.28
VP: 0 mmHg (approx)
MLT: 4752°F
UEL: NA
LEL: NA
Combustible Solid in form of dust or powder.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
OSHA
75 mg/m^3: Qm
150 mg/m^3: 95XQ/Sa
375 mg/m^3: Sa:Cf/PaprHie
750 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
5000 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: irrit eyes, nose, throat; anor, diarr, low-wgt; listlessness; liver, kidney damage
TO: Eyes, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Breath: Resp support
Swallow: Medical attention immed

M

Molybdenum (soluble compounds, as Mo)

Formula:	CAS#:	RTECS#:	IDLH:
			1000 mg/m^3 (as Mo)

Conversion: **DOT:**

Synonyms/Trade Names: Synonyms vary depending upon the specific soluble molybdenum compound.

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL: TWA 5 mg/m^3

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303, 9102
OSHA ID121, ID125G

Physical Description: Appearance and odor vary depending upon the specific soluble molybdenum compound.

Chemical & Physical Properties:
Properties vary depending upon the specific soluble molybdenum compound.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
OSHA
25 mg/m^3: Qm*
50 mg/m^3: 95XQ*/Sa*
125 mg/m^3: Sa:Cf*/PaprHie*
250 mg/m^3: 100F/SaT:Cf*/PaprTHie*/ScbaF/SaF
1000 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Varies

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: irrit eyes, nose, throat; anor; inco; dysp; anemia
TO: Eyes, resp sys, kidneys, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush
Breath: Resp support
Swallow: Medical attention immed

Monocrotophos	**Formula:** $C_7H_{14}NO_5P$	**CAS#:** 6923-22-4	**RTECS#:** TC4375000	**IDLH:** N.D.
Conversion:	**DOT:** 2783 152 (organophosphorus pesticide, solid)			
Synonyms/Trade Names: Azodrin®, 3-Hydroxy-N-methylcrotonamide dimethylphosphate, Monocron				
Exposure Limits: **NIOSH REL:** TWA 0.25 mg/m^3 **OSHA PEL†:** none				**Measurement Methods (see Table 1):** **NIOSH** 5600 **OSHA** PV2045
Physical Description: Colorless to reddish-brown solid with a mild, ester odor. [insecticide]				
Chemical & Physical Properties: **MW:** 223.2 **BP:** 257°F **Sol:** Miscible **Fl.P:** >200°F **IP:** ? **Sp.Gr:** ? **VP:** 0.000007 mmHg **MLT:** 129°F **UEL:** ? **LEL:** ? Combustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Metals, low molecular weight alcohols & glycols [**Note:** Corrosive to black iron, drum steel, stainless steel 304 & brass. Should be stored at 70-80°F.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, miosis, blurred vision; dizz, convuls; dysp; salv, abdom cramps, nau, diarr, vomit; in animals: possible terato effects **TO:** Eyes, resp sys, CNS, CVS, blood chol, repro sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed	

M

Monomethyl aniline	**Formula:** $C_6H_5NHCH_3$	**CAS#:** 100-61-8	**RTECS#:** BY4550000	**IDLH:** 100 ppm
Conversion: 1 ppm = 4.38 mg/m^3	**DOT:** 2294 153			
Synonyms/Trade Names: MA, (Methylamino)benzene, N-Methyl aniline, Methylphenylamine, N-Phenylmethylamine				
Exposure Limits: **NIOSH REL:** TWA 0.5 ppm (2 mg/m^3) [skin] **OSHA PEL†:** TWA 2 ppm (9 mg/m^3) [skin]				**Measurement Methods (see Table 1):** **NIOSH** 3511
Physical Description: Yellow to light-brown liquid with a weak, ammonia-like odor.				
Chemical & Physical Properties: **MW:** 107.2 **BP:** 384°F **Sol:** Insoluble **Fl.P:** 175°F **IP:** 7.32 eV **Sp.Gr:** 0.99 **VP:** 0.3 mmHg **FRZ:** -71°F **UEL:** ? **LEL:** ? Class IIIA Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **5 ppm:** Sa **12.5 ppm:** Sa:Cf **25 ppm:** SaT:Cf/ScbaF/SaF **100 ppm:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFS/ScbaE	
Incompatibilities and Reactivities: Strong acids, strong oxidizers				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Lass, dizz, head; dysp, cyan; methemo; pulm edema; liver, kidney damage **TO:** Resp sys, liver, kidneys, blood, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed	

Morpholine

Formula:	CAS#:	RTECS#:	IDLH:
C_4H_9ON	110-91-8	QD6475000	1400 ppm [10%LEL]

Conversion: 1 ppm = 3.56 mg/m^3 **DOT:** 2054 132

Synonyms/Trade Names: Diethylene imidoxide; Diethylene oximide; Tetrahydro-1,4-oxazine; Tetrahydro-p-oxazine

Exposure Limits:
NIOSH REL: TWA 20 ppm (70 mg/m^3) [skin]
ST 30 ppm (105 mg/m^3)
OSHA PEL†: TWA 20 ppm (70 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH S150 (II-3)

Physical Description: Colorless liquid with a weak, ammonia- or fish-like odor. [**Note:** A solid below 23°F.]

Chemical & Physical Properties:
MW: 87.1
BP: 264°F
Sol: Miscible
Fl.P(oc): 98°F
IP: 8.88 eV
Sp.Gr: 1.007
VP: 6 mmHg
FRZ: 23°F
UEL: 11.2%
LEL: 1.4%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash (>15%)
Quick drench (>25%)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
500 ppm: Sa:Cf£/PaprOv£
1000 ppm: CcrFOv/GmFOv/PaprTOv£/ ScbaF/SaF
1400 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong acids, strong oxidizers, metals, nitro compounds [**Note:** Corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, resp sys; vis dist; cough; in animals: liver, kidney damage
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Naphtha (coal tar)

Formula:	CAS#:	RTECS#:	IDLH:
	8030-30-6	DE3030000	1000 ppm [10%LEL]

Conversion: 1 ppm = 4.50 mg/m^3 (approx) **DOT:**

Synonyms/Trade Names: Crude solvent coal tar naphtha, High solvent naphtha, Naphtha

Exposure Limits:
NIOSH REL: TWA 100 ppm (400 mg/m^3)
OSHA PEL: TWA 100 ppm (400 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1550

Physical Description: Reddish-brown, mobile liquid with an aromatic odor.

Chemical & Physical Properties:
MW: 110 (approx)
BP: 320-428°F
Sol: Insoluble
Fl.P: 100-109°F
IP: ?
Sp.Gr: 0.89-0.97
VP: <5 mmHg
FRZ: ?
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1000 ppm: Sa:Cf£/CcrFOv/GmFOv/ PaprOv£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose; dizz, drow; derm; in animals: liver, kidney damage
TO: Eyes, skin, resp sys, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Naphthalene

Formula: $C_{10}H_8$ | **CAS#:** 91-20-3 | **RTECS#:** QJ0525000 | **IDLH:** 250 ppm

Conversion: 1 ppm = 5.24 mg/m^3

DOT: 1334 133 (crude or refined); 2304 133 (molten)

Synonyms/Trade Names: Naphthalin, Tar camphor, White tar

Exposure Limits:
NIOSH REL: TWA 10 ppm (50 mg/m^3)
ST 15 ppm (75 mg/m^3)
OSHA PEL†: TWA 10 ppm (50 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1501
OSHA 35

Physical Description: Colorless to brown solid with an odor of mothballs.
[**Note:** Shipped as a molten solid.]

Chemical & Physical Properties:
MW: 128.2
BP: 424°F
Sol: 0.003%
Fl.P: 174°F
IP: 8.12 eV
Sp.Gr: 1.15
VP: 0.08 mmHg
MLT: 176°F
UEL: 5.9%
LEL: 0.9%
Combustible Solid, but will take some effort to ignite.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
100 ppm: CcrOv95*/Sa*
250 ppm: Sa:Cf*/CcrFOv100/ PaprOvHie*/ ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, chromic anhydride

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes; head, conf, excitement, mal; nau, vomit, abdom pain; irrit bladder; profuse sweat; jaun; hema, renal shutdown; derm, optical neuritis, corn damage
TO: Eyes, skin, blood, liver, kidneys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Molten flush immed/sol-liq soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Naphthalene diisocyanate

Formula: $C_{10}H_6(NCO)_2$ | **CAS#:** 3173-72-6 | **RTECS#:** NQ9600000 | **IDLH:** N.D.

Conversion: 1 ppm = 8.60 mg/m^3

DOT:

Synonyms/Trade Names: 1,5-Diisocyanatonaphthalene; 1,5-Naphthalene diisocyanate; 1,5-Naphthalene ester of isocyanic acid; NDI

Exposure Limits:
NIOSH REL: TWA 0.040 mg/m^3 (0.005 ppm)
C 0.170 mg/m^3 (0.020 ppm) [10-minute]
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 5525
OSHA PV2046

Physical Description: White to light-yellow, crystalline flakes.

Chemical & Physical Properties:
MW: 210.2
BP: 505°F
Sol: ?
Fl.P(oc): 311°F
IP: ?
Sp.Gr: ?
VP(75°F): 0.003 mmHg
MLT: 261°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
0.05 ppm: Sa*
0.125 ppm: Sa:Cf*
0.25 ppm: ScbaF/SaF
1 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose, throat; resp sens, cough, pulm secretions, chest pain, dysp; asthma
TO: Eyes, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

α-Naphthylamine

Formula:	CAS#:	RTECS#:	IDLH:
$C_{10}H_7NH_2$	134-32-7	QM1400000	Ca [N.D.]

Conversion: **DOT:** 2077 153

Synonyms/Trade Names: 1-Aminonaphthalene, 1-Naphthylamine

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1004] See Appendix B

Measurement Methods (see Table 1):
NIOSH 5518
OSHA 93

Physical Description: Colorless crystals with an ammonia-like odor.
[**Note:** Darkens in air to a reddish-purple color.]

Chemical & Physical Properties:
MW: 143.2
BP: 573°F
Sol: 0.002%
Fl.P: 315°F
IP: 7.30 eV
Sp.Gr: 1.12
VP(220°F): 1 mmHg
MLT: 122°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Oxidizes in air

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Derm; hemorrhagic cystitis; dysp, ataxia, methemo; hema; dysuria; [carc]
TO: Bladder, skin [bladder cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

β-Naphthylamine

Formula:	CAS#:	RTECS#:	IDLH:
$C_{10}H_7NH_2$	91-59-8	QM2100000	Ca [N.D.]

Conversion: **DOT:** 1650 153

Synonyms/Trade Names: 2-Aminonaphthalene, 2-Naphthylamine

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1009] See Appendix B

Measurement Methods (see Table 1):
NIOSH 5518
OSHA 93

Physical Description: Odorless, white to red crystals with a faint, aromatic odor.
[**Note:** Darkens in air to a reddish-purple color.]

Chemical & Physical Properties:
MW: 143.2
BP: 583°F
Sol: Miscible in hot water
Fl.P: 315°F
IP: 9.71 eV
Sp.Gr(208°F): 1.06
VP(226°F): 1 mmHg
MLT: 232°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Derm; hemorrhagic cystitis; dysp; ataxia; methemo, hema; dysuria; [carc]
TO: Bladder, skin [bladder cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Niax® Catalyst ESN	Formula:	CAS#: 62765-93-9	RTECS#: QR3900000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: None
[**Note:** A mixture of 95% dimethylaminopropionitrile & 5% bis(2-dimethylamino)ethyl ether.]

Exposure Limits:
NIOSH REL: See Appendix C
OSHA PEL: See Appendix C

Measurement Methods (see Table 1):
None available

Physical Description: A liquid mixture.
[**Note:** Used in the past as a catalyst in the manufacture of flexible polyurethane foams.]

Chemical & Physical Properties:
MW: mixture
BP: ?
Sol: ?
Fl.P: ?
IP: ?
Sp.Gr: ?
VP: ?
FRZ: ?
UEL: ?
LEL: ?

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; urinary dist; neurological disorders; pins & needles in hands & feet; musc weak, lass, nau, vomit; decr nerve conduction in lower legs
TO: Eyes, skin, urinary tract, PNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Nickel carbonyl	Formula: $Ni(CO)_4$	CAS#: 13463-39-3	RTECS#: QR6300000	IDLH: Ca [2 ppm]
Conversion: 1 ppm = 6.98 mg/m^3	**DOT:** 1259 131			

Synonyms/Trade Names: Nickel tetracarbonyl, Tetracarbonyl nickel

Exposure Limits:
NIOSH REL: Ca
TWA 0.001 ppm (0.007 mg/m^3)
See Appendix A
OSHA PEL: TWA 0.001 ppm (0.007 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 6007

Physical Description: Colorless to yellow liquid with a musty odor. [**Note:** A gas above 110°F.]

Chemical & Physical Properties:
MW: 170.7
BP: 110°F
Sol: 0.05%
Fl.P: <-4°F
IP: 8.28 eV
Sp.Gr(63°F): 1.32
VP: 315 mmHg
FRZ: -13°F
UEL: ?
LEL: 2%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Nitric acid, bromine, chlorine & other oxidizers; flammable materials

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Abs, Con
SY: Head, dizz; nau, vomit, epigastric pain; substernal pain; cough, hyperpnea; cyan; lass; leucyt, pneu; delirium, convuls; [carc]; in animals: repro, terato effects
TO: Lungs, paranasal sinus, CNS, repro sys [lung & nasal cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Nickel metal and other compounds (as Ni)

Formula:	CAS#:	RTECS#:	IDLH:
Ni (metal)	7440-02-0 (metal)	QR5950000 (metal)	Ca [10 mg/m^3 (as Ni)]

Conversion: **DOT:**

Synonyms/Trade Names: **Nickel metal:** Elemental nickel, Nickel catalyst
Synonyms of other nickel compounds vary depending upon the specific compound.

Exposure Limits:
NIOSH REL*: Ca
TWA 0.015 mg/m^3
See Appendix A
OSHA PEL*†: TWA 1 mg/m^3
[***Note:** The REL and PEL do not apply to Nickel carbonyl.]

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303, 9102
OSHA ID121, ID125G

Physical Description: Metal: Lustrous, silvery, odorless solid.

Chemical & Physical Properties:
MW: 58.7
BP: 5139°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 8.90 (Metal)
VP: 0 mmHg (approx)
MLT: 2831°F
UEL: NA
LEL: NA
Metal: Combustible Solid; nickel sponge catalyst may ignite SPONTANEOUSLY in air.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: N.R.
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong acids, sulfur, selenium, wood & other combustibles, nickel nitrate

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Sens derm, allergic asthma, pneu; [carc]
TO: Nasal cavities, lungs, skin [lung and nasal cancer]

First Aid (see Table 6):
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Nicotine

Formula:	CAS#:	RTECS#:	IDLH:
$C_5H_4NC_4H_7NCH_3$	54-11-5	QS5250000	5 mg/m^3

Conversion: **DOT:** 1654 151

Synonyms/Trade Names: 3-(1-Methyl-2-pyrrolidyl)pyridine

Exposure Limits:
NIOSH REL: TWA 0.5 mg/m^3 [skin]
OSHA PEL: TWA 0.5 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 2544, 2551

Physical Description: Pale-yellow to dark-brown liquid with a fish-like odor when warm. [insecticide]

Chemical & Physical Properties:
MW: 162.2
BP: 482°F (Decomposes)
Sol: Miscible
Fl.P: 203°F
IP: 8.01 eV
Sp.Gr: 1.01
VP: 0.08 mmHg
FRZ: -110°F
UEL: 4.0%
LEL: 0.7%
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Nau, salv, abdom pain, vomit, diarr; head, dizz, hearing, vis dist; conf, lass, inco; card arrhy; convuls, dysp; in animals: terato effects
TO: CNS, CVS, lungs, GI tract, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Nitric acid

Formula: HNO_3 | **CAS#:** 7697-37-2 | **RTECS#:** QU5775000 | **IDLH:** 25 ppm

Conversion: 1 ppm = 2.58 mg/m^3

DOT: 2032 157 (fuming); 2031 157 (other than red fuming)

Synonyms/Trade Names: Aqua fortis, Engravers acid, Hydrogen nitrate, Red fuming nitric acid (RFNA), White fuming nitric acid (WFNA)

Exposure Limits:
NIOSH REL: TWA 2 ppm (5 mg/m^3)
ST 4 ppm (10 mg/m^3)
OSHA PEL†: TWA 2 ppm (5 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 7903
OSHA ID165SG

Physical Description: Colorless, yellow, or red, fuming liquid with an acrid, suffocating odor. [**Note:** Often used in an aqueous solution. Fuming nitric acid is concentrated nitric acid that contains dissolved nitrogen dioxide.]

Chemical & Physical Properties:
MW: 63.0
BP: 181°F
Sol: Miscible
Fl.P: NA
IP: 11.95 eV
Sp.Gr(77°F): 1.50
VP: 48 mmHg
FRZ: -44°F
UEL: NA
LEL: NA
Noncombustible Liquid, but increases the flammability of combustible materials.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash (pH<2.5)
Quick drench (pH<2.5)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
25 ppm: Sa:Cf*/CcrFS¿/GmFS¿/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS¿/ScbaE

Incompatibilities and Reactivities: Combustible materials, metallic powders, hydrogen sulfide, carbides, alcohols [**Note:** Reacts with water to produce heat. Corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; delayed pulm edema, pneu, bron; dental erosion
TO: Eyes, skin, resp sys, teeth

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

N

Nitric oxide

Formula: NO | **CAS#:** 10102-43-9 | **RTECS#:** QX0525000 | **IDLH:** 100 ppm

Conversion: 1 ppm = 1.23 mg/m^3

DOT: 1660 124

Synonyms/Trade Names: Mononitrogen monoxide, Nitrogen monoxide

Exposure Limits:
NIOSH REL: TWA 25 ppm (30 mg/m^3)
OSHA PEL: TWA 25 ppm (30 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 6014
OSHA ID190

Physical Description: Colorless gas. [**Note:** Shipped as a nonliquefied compressed gas.]

Chemical & Physical Properties:
MW: 30.0
BP: -241°F
Sol: 5%
Fl.P: NA
IP: 9.27 eV
RGasD: 1.04
VP: 34.2 atm
FRZ: -263°F
UEL: NA
LEL: NA
Nonflammable Gas, but will accelerate the burning of combustible materials.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
100 ppm: Sa:Cf*/CcrFS¿/PaprS*¿/GmFS¿/Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS¿/ScbaE

Incompatibilities and Reactivities: Fluorine, combustible materials, ozone, NH_3, chlorinated hydrocarbons, metals, carbon disulfide [**Note:** Reacts with water to form nitric acid. Rapidly converted in air to nitrogen dioxide.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh
SY: Irrit eyes, wet skin, nose, throat; drow, uncon; methemo
TO: Eyes, skin, resp sys, blood, CNS

First Aid (see Table 6):
Breath: Resp support

p-Nitroaniline	Formula: $NO_2C_6H_4NH_2$	CAS#: 100-01-6	RTECS#: BY7000000	IDLH: 300 mg/m^3
Conversion:	**DOT:** 1661 153			

Synonyms/Trade Names: para-Aminonitrobenzene, 4-Nitroaniline, 4-Nitrobenzenamine, p-Nitrophenylamine, PNA

Exposure Limits:
NIOSH REL: TWA 3 mg/m^3 [skin]
OSHA PEL†: TWA 6 mg/m^3 (1 ppm) [skin]

Measurement Methods (see Table 1):
NIOSH 5033

Physical Description: Bright yellow, crystalline powder with a slight ammonia-like odor.

Chemical & Physical Properties:
MW: 138.1
BP: 630°F
Sol: 0.08%
Fl.P: 390°F
IP: 8.85 eV
Sp.Gr: 1.42
VP: 0.00002 mmHg
MLT: 295°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
30 mg/m^3: Sa*
75 mg/m^3: Sa:Cf*
150 mg/m^3: ScbaF/SaF
300 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong reducers
[**Note:** May result in spontaneous heating of organic materials in the presence of moisture.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit nose, throat; cyan, ataxia; tacar, tachypnea; dysp; irrity; vomit, diarr; convuls; resp arrest; anemia; methemo; jaundice
TO: Resp sys, blood, heart, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Nitrobenzene	Formula: $C_6H_5NO_2$	CAS#: 98-95-3	RTECS#: DA6475000	IDLH: 200 ppm
Conversion: 1 ppm = 5.04 mg/m^3	**DOT:** 1662 152			

Synonyms/Trade Names: Essence of mirbane, Nitrobenzol, Oil of mirbane

Exposure Limits:
NIOSH REL: TWA 1 ppm (5 mg/m^3) [skin]
OSHA PEL: TWA 1 ppm (5 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2005, 2017

Physical Description: Yellow, oily liquid with a pungent odor like paste shoe polish.
[**Note:** A solid below 42°F.]

Chemical & Physical Properties:
MW: 123.1
BP: 411°F
Sol: 0.2%
Fl.P: 190°F
IP: 9.92 eV
Sp.Gr: 1.20
VP(77°F): 0.3 mmHg
FRZ: 42°F
UEL: ?
LEL(200°F): 1.8%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 ppm: CcrOv*/Sa*
25 ppm: Sa:Cf*/PaprOv*
50 ppm: CcrFOv/GmFOv/PaprTOv*/ ScbaF/SaF
200 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Concentrated nitric acid, nitrogen tetroxide, caustics, phosphorus pentachloride, chemically-active metals such as tin or zinc

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; anoxia; derm; anemia; methemo; in animals: liver, kidney damage; testicular effects
TO: Eyes, skin, blood, liver, kidneys, CVS, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

4-Nitrobiphenyl	Formula: $C_6H_5C_6H_4NO_2$	CAS#: 92-93-3	RTECS#: DV5600000	IDLH: Ca [N.D.]
Conversion:	**DOT:**			

Synonyms/Trade Names: p-Nitrobiphenyl, p-Nitrodiphenyl, 4-Nitrodiphenyl, p-Phenylnitrobenzene, 4-Phenylnitrobenzene, PNB

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1003] See Appendix B

Measurement Methods (see Table 1):
NIOSH P&CAM273 (II-4)
OSHA PV2082

Physical Description: White to yellow, needle-like, crystalline solid with a sweetish odor.

Chemical & Physical Properties:
MW: 199.2
BP: 644°F
Sol: Insoluble
Fl.P: 290°F
IP: ?
Sp.Gr: ?
VP: ?
MLT: 237°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Strong reducers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Head, drow, dizz; dysp; ataxia, lass; methemo; urinary burning; acute hemorrhagic cystitis; [carc]
TO: Bladder, blood [in animals: bladder tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

N

p-Nitrochlorobenzene	Formula: $ClC_6H_4NO_2$	CAS#: 100-00-5	RTECS#: CZ1050000	IDLH: Ca [100 mg/m^3]
Conversion:	**DOT:** 1578 152			

Synonyms/Trade Names: p-Chloronitrobenzene, 4-Chloronitrobenzene, 1-Chloro-4-nitrobenzene, 4-Nitrochlorobenzene, PCNB, PNCB

Exposure Limits:
NIOSH REL: Ca
See Appendix A [skin]
OSHA PEL: TWA 1 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 2005

Physical Description: Yellow, crystalline solid with a sweet odor.

Chemical & Physical Properties:
MW: 157.6
BP: 468°F
Sol: Slight
Fl.P: 261°F
IP: 9.96 eV
Sp.Gr: 1.52
VP(86°F): 0.2 mmHg
MLT: 182°F
UEL: ?
LEL: ?
Solid that does not burn, or burns with difficulty.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Anoxia; unpleasant taste; anemia; methemo; in animals: hema; spleen, kidney, bone marrow changes; repro effects; [carc]
TO: Blood, liver, kidneys, CVS, spleen, bone marrow, repro sys [in animals: vascular & liver tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Nitroethane

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3CH_2NO_2$	79-24-3	KI5600000	1000 ppm

Conversion: 1 ppm = 3.07 mg/m^3

DOT: 2842 129

Synonyms/Trade Names: Nitroetan

Exposure Limits:
NIOSH REL: TWA 100 ppm (310 mg/m^3)
OSHA PEL: TWA 100 ppm (310 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2526

Physical Description: Colorless, oily liquid with a mild, fruity odor.

Chemical & Physical Properties:
MW: 75.1
BP: 237°F
Sol: 5%
Fl.P: 82°F
IP: 10.88 eV
Sp.Gr: 1.05
VP(77°F): 21 mmHg
FRZ: -130°F
UEL: ?
LEL: 3.4%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1000 ppm: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: ScbaE

Incompatibilities and Reactivities: Amines; strong acids, alkalis & oxidizers; hydrocarbons; combustibles; metal oxides

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Derm; in animals: lac; dysp, pulm rales, edema; liver, kidney inj; narco
TO: Skin, resp sys, CNS, kidneys, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Nitrogen dioxide

Formula:	CAS#:	RTECS#:	IDLH:
NO_2	10102-44-0	QW9800000	20 ppm

Conversion: 1 ppm = 1.88 mg/m^3

DOT: 1067 124

Synonyms/Trade Names: Dinitrogen tetroxide (N_2O_4), Nitrogen peroxide

Exposure Limits:
NIOSH REL: ST 1 ppm (1.8 mg/m^3)
OSHA PEL†: C 5 ppm (9 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 6014
OSHA ID182

Physical Description: Yellowish-brown liquid or reddish-brown gas (above 70°F) with a pungent, acrid odor. [**Note:** In solid form (below 15°F) it is found structurally as N_2O_4.]

Chemical & Physical Properties:
MW: 46.0
BP: 70°F
Sol: Reacts
Fl.P: NA
IP: 9.75 eV
RGasD: 2.62
Sp.Gr: 1.44 (Liquid at 68°F)
VP: 720 mmHg
FRZ: 15°F
UEL: NA
LEL: NA
Noncombustible Liquid/Gas, but will accelerate the burning of combustible materials.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
20 ppm: Sa:Cf£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS¿/ScbaE

Incompatibilities and Reactivities: Combustible material, water, chlorinated hydrocarbons, carbon disulfide, ammonia [**Note:** Reacts with water to form nitric acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose, throat; cough, mucoid frothy sputum, decr pulm func, chronic bron, dysp; chest pain; pulm edema, cyan, tachypnea, tacar
TO: Eyes, resp sys, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Nitrogen trifluoride	Formula: NF_3	CAS#: 7783-54-2	RTECS#: QX1925000	IDLH: 1000 ppm
Conversion: 1 ppm = 2.90 mg/m^3	**DOT:** 2451 122			
Synonyms/Trade Names: Nitrogen fluoride, Trifluoramine, Trifluorammonia				
Exposure Limits: **NIOSH REL:** TWA 10 ppm (29 mg/m^3) **OSHA PEL:** TWA 10 ppm (29 mg/m^3)			**Measurement Methods (see Table 1):** None available	
Physical Description: Colorless gas with a moldy odor. [**Note:** Shipped as a nonliquefied compressed gas.]				
Chemical & Physical Properties: **MW:** 71.0 **BP:** -200°F **Sol:** Slight **Fl.P:** NA **IP:** 12.97 eV **RGasD:** 2.46 **VP:** >1 atm **FRZ:** -340°F **UEL:** NA **LEL:** NA Nonflammable Gas	**Personal Protection/Sanitation (see Table 2):** **Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **100 ppm:** CcrS/Sa **250 ppm:** Sa:Cf/PaprS **500 ppm:** CcrFS/GmFS/PaprTS*/ SaT:Cf*/ScbaF/SaF **1000 ppm:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFS/ScbaE	
Incompatibilities and Reactivities: Water, oil, grease, oxidizable materials, ammonia, carbon monoxide, methane, hydrogen, hydrogen sulfide, activated charcoal, diborane				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh **SY:** In animals: anoxia, cyan; methemo; lass, dizz, head; liver, kidney inj **TO:** Blood, liver, kidneys			**First Aid (see Table 6):** **Breath:** Resp support	

Nitroglycerine	Formula: $CH_2NO_3CHNO_3CH_2NO_3$	CAS#: 55-63-0	RTECS#: QX2100000	IDLH: 75 mg/m^3
Conversion: 1 ppm = 9.29 mg/m^3	**DOT:** 1204 127 (≤ 1% solution in alcohol); 3064 127 (1-5% solution in alcohol)			
Synonyms/Trade Names: Glyceryl trinitrate; NG; 1,2,3-Propanetriol trinitrate; Trinitroglycerine				
Exposure Limits: **NIOSH REL:** ST 0.1 mg/m^3 [skin] **OSHA PEL†:** C 0.2 ppm (2 mg/m^3) [skin]			**Measurement Methods (see Table 1):** **NIOSH** 2507 **OSHA** 43	
Physical Description: Colorless to pale-yellow, viscous liquid or solid (below 56°F). [**Note:** An explosive ingredient in dynamite (20-40%) with ethylene glycol dinitrate (80-60%).]				
Chemical & Physical Properties: **MW:** 227.1 **BP:** Begins to decompose at 122-140°F **Sol:** 0.1% **Fl.P:** Explodes **IP:** ? **Sp.Gr:** 1.60 **VP:** 0.0003 mmHg **FRZ:** 56°F **UEL:** ? **LEL:** ? Explosive Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** Daily **Provide:** Quick drench		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **1 mg/m^3:** Sa* **2.5 mg/m^3:** Sa:Cf* **5 mg/m^3:** SaT:Cf*/ScbaF/SaF **75 mg/m^3:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv100/ScbaE	
Incompatibilities and Reactivities: Heat, ozone, shock, acids [**Note:** An OSHA Class A Explosive (1910.109).]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Throb head; dizz; nau, vomit, abdom pain; hypotension; flush; palp; methemo; delirium, CNS depres; angina; skin irrit **TO:** CVS, blood, skin, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed	

Nitromethane	Formula: CH_3NO_2	CAS#: 75-52-5	RTECS#: PA9800000	IDLH: 750 ppm
Conversion: 1 ppm = 2.50 mg/m^3	**DOT:** 1261 129			
Synonyms/Trade Names: Nitrocarbol				
Exposure Limits: **NIOSH REL:** See Appendix D **OSHA PEL:** TWA 100 ppm (250 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 2527	
Physical Description: Colorless, oily liquid with a disagreeable odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 61.0 **BP:** 214°F **Sol:** 10% **Fl.P:** 95°F **IP:** 11.08 eV **Sp.Gr:** 1.14 **VP:** 28 mmHg **FRZ:** -20°F **UEL:** ? **LEL:** 7.3% Class IC Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.	**OSHA** **750 ppm:** Sa:Cf£/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** ScbaE

Incompatibilities and Reactivities: Amines; strong acids, alkalis & oxidizers; hydrocarbons & other combustible materials; metallic oxides [**Note:** Slowly corrodes steel & copper when wet.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Ing, Con **SY:** Derm; in animals: irrit eyes, resp sys; convuls, narco; liver damage **TO:** Eyes, skin, CNS, liver	**Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed

N

2-Nitronaphthalene	Formula: $C_{10}H_7NO_2$	CAS#: 581-89-5	RTECS#: QJ9760000	IDLH: Ca [N.D.]
Conversion:	**DOT:** 2538 133			
Synonyms/Trade Names: β-Nitronaphthalene				
Exposure Limits: **NIOSH REL:** Ca* See Appendix A [***Note:** Since metabolized to β-Naphthylamine.] **OSHA PEL:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Colorless solid.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 178.2 **BP:** ? **Sol:** Insoluble **Fl.P:** ? **IP:** 8.67 eV **Sp.Gr:** ? **VP:** ? **MLT:** 174°F **UEL:** ? **LEL:** ? Combustible Solid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam/Daily **Remove:** When wet or contam **Change:** Daily **Provide:** Eyewash Quick drench	**NIOSH** **¥:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv100/ScbaE

Incompatibilities and Reactivities: For “Nitrates” in general: Aluminum, cyanides, esters, phosphorus, tin chlorides, thiocyanates, sodium hypophosphite

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Abs, Ing, Con **SY:** Irrit skin, resp sys; derm; [carc] **TO:** Skin, resp sys [bladder cancer]	**Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed

1-Nitropropane	Formula: $CH_3CH_2CH_2NO_2$	CAS#: 108-03-2	RTECS#: TZ5075000	IDLH: 1000 ppm
Conversion: 1 ppm = 3.64 mg/m^3	**DOT:** 2608 129			
Synonyms/Trade Names: Nitropropane, 1-NP				

Exposure Limits:
NIOSH REL: TWA 25 ppm (90 mg/m^3)
OSHA PEL: TWA 25 ppm (90 mg/m^3)

Measurement Methods (see Table 1):
OSHA 46

Physical Description: Colorless liquid with a somewhat disagreeable odor.

Chemical & Physical Properties:
MW: 89.1
BP: 269°F
Sol: 1%
Fl.P: 96°F
IP: 10.81 eV
Sp.Gr: 1.00
VP: 8 mmHg
FRZ: -162°F
UEL: ?
LEL: 2.2%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
250 ppm: Sa*
625 ppm: Sa:Cf*
1000 ppm: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: ScbaE

Incompatibilities and Reactivities: Amines; strong acids, alkalis & oxidizers; hydrocarbons & other combustible materials; metal oxides

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes; head, nau, vomit, diarr; in animals: liver, kidney damage
TO: Eyes, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

N

2-Nitropropane	Formula: $(CH_3)_2CH(NO_2)$	CAS#: 79-46-9	RTECS#: TZ5250000	IDLH: Ca [100 ppm]
Conversion: 1 ppm = 3.64 mg/m^3	**DOT:** 2608 129			
Synonyms/Trade Names: Dimethylnitromethane, iso-Nitropropane, 2-NP				

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: TWA 25 ppm (90 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2528
OSHA 15, 46

Physical Description: Colorless liquid with a pleasant, fruity odor.

Chemical & Physical Properties:
MW: 89.1
BP: 249°F
Sol: 2%
Fl.P: 75°F
IP: 10.71 eV
Sp.Gr: 0.99
VP: 13 mmHg
FRZ: -135°F
UEL: 11.0%
LEL: 2.6%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: ScbaE

Incompatibilities and Reactivities: Amines; strong acids, alkalis & oxidizers; metal oxides; combustible materials

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, resp sys; head, anor, nau, vomit, diarr; kidney, liver damage; [carc]
TO: Eyes, skin, resp sys, CNS, kidneys, liver [in animals: liver tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

N-Nitrosodimethylamine

Formula:	CAS#:	RTECS#:	IDLH:
$(CH_3)_2N_2O$	62-75-9	IQ0525000	Ca [N.D.]

Conversion: **DOT:**

Synonyms/Trade Names: Dimethylnitrosamine; N,N-Dimethylnitrosamine; DMNA; N-Methyl-N-nitroso-methanamine; NDMA; N-Nitroso-N,N-dimethylamine

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1016] See Appendix B

Measurement Methods (see Table 1):
NIOSH 2522
OSHA 38

Physical Description: Yellow, oily liquid with a faint, characteristic odor.

Chemical & Physical Properties:
MW: 74.1
BP: 306°F
Sol: Soluble
Fl.P: ?
IP: 8.69 eV
Sp.Gr: 1.005
VP: 3 mmHg
FRZ: ?
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Strong oxidizers [**Note:** Should be stored in dark bottles.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Nau, vomit, diarr, abdom cramps; head; fever; enlarged liver, jaun; decr liver, kidney, pulm func; [carc]
TO: Liver, kidneys,lungs [in animals; lung, kidney, liver & nasal cavity tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

m-Nitrotoluene

Formula:	CAS#:	RTECS#:	IDLH:
$NO_2C_6H_4CH_3$	99-08-1	XT2975000	200 ppm

Conversion: 1 ppm = 5.61 mg/m^3 **DOT:** 1664 152

Synonyms/Trade Names: m-Methylnitrobenzene, 3-Methylnitrobenzene, meta-Nitrotoluene, 3-Nitrotoluene

Exposure Limits:
NIOSH REL: TWA 2 ppm (11 mg/m^3) [skin]
OSHA PEL†: TWA 5 ppm (30 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2005

Physical Description: Yellow liquid with a weak, aromatic odor.
[**Note:** A solid below 59°F.]

Chemical & Physical Properties:
MW: 137.1
BP: 450°F
Sol: 0.05%
Fl.P: 223°F
IP: 9.48 eV
Sp.Gr: 1.16
VP: 0.1 mmHg
FRZ: 59°F
UEL: ?
LEL: 1.6%
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
20 ppm: Sa*
50 ppm: Sa:Cf*
100 ppm: SaT:Cf*/ScbaF/SaF
200 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, sulfuric acid

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Anoxia, cyan; head, lass, dizz; ataxia; dysp; tacar; nau, vomit
TO: Blood, CNS, CVS, skin, GI tract

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

o-Nitrotoluene	Formula: $NO_2C_6H_4CH_3$	CAS#: 88-72-2	RTECS#: XT3150000	IDLH: 200 ppm
Conversion: 1 ppm = 5.61 mg/m^3	**DOT:** 1664 152			
Synonyms/Trade Names: o-Methylnitrobenzene, 2-Methylnitrobenzene, ortho-Nitrotoluene, 2-Nitrotoluene				
Exposure Limits: **NIOSH REL:** TWA 2 ppm (11 mg/m^3) [skin] **OSHA PEL†:** TWA 5 ppm (30 mg/m^3) [skin]			**Measurement Methods (see Table 1):** **NIOSH** 2005	
Physical Description: Yellow liquid with a weak, aromatic odor. [**Note:** A solid below 25°F.]				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 137.1 **BP:** 432°F **Sol:** 0.07% **Fl.P:** 223°F **IP:** 9.43 eV **Sp.Gr:** 1.16 **VP:** 0.1 mmHg **FRZ:** 25°F **UEL:** ? **LEL:** 2.2% Class IIIB Combustible Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.	**NIOSH** **20 ppm:** Sa* **50 ppm:** Sa:Cf* **100 ppm:** SaT:Cf*/ScbaF/SaF **200 ppm:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, sulfuric acid	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Anoxia, cyan; head, lass, dizz; ataxia; dysp; tacar; nau, vomit **TO:** Blood, CNS, CVS, skin, GI tract	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed

p-Nitrotoluene	Formula: $NO_2C_6H_4CH_3$	CAS#: 99-99-0	RTECS#: XT3325000	IDLH: 200 ppm
Conversion: 1 ppm = 5.61 mg/m^3	**DOT:** 1664 152			
Synonyms/Trade Names: p-Methylnitrobenzene, 4-Methylnitrobenzene, para-Nitrotoluene, 4-Nitrotoluene				
Exposure Limits: **NIOSH REL:** TWA 2 ppm (11 mg/m^3) [skin] **OSHA PEL†:** TWA 5 ppm (30 mg/m^3) [skin]			**Measurement Methods (see Table 1):** **NIOSH** 2005	
Physical Description: Crystalline solid with a weak, aromatic odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 137.1 **BP:** 460°F **Sol:** 0.04% **Fl.P:** 223°F **IP:** 9.50 eV **Sp.Gr:** 1.12 **VP:** 0.1 mmHg **MLT:** 126°F **UEL:** ? **LEL:** 1.6% Combustible Solid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily	**NIOSH** **20 ppm:** Sa* **50 ppm:** Sa:Cf* **100 ppm:** SaT:Cf*/ScbaF/SaF **200 ppm:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, sulfuric acid	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Anoxia, cyan; head, lass, dizz; ataxia; dysp; tacar; nau, vomit **TO:** Blood, CNS, CVS, skin, GI tract	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed

Nitrous oxide

Formula:	CAS#:	RTECS#:	IDLH:
N_2O	10024-97-2	QX1350000	N.D.

Conversion: 1 ppm = 1.80 mg/m^3

DOT: 1070 122; 2201 122 (refrigerated liquid)

Synonyms/Trade Names: Dinitrogen monoxide, Hyponitrous acid anhydride, Laughing gas

Exposure Limits:
NIOSH REL*: TWA 25 ppm (46 mg/m^3) (TWA over the time exposed)
[***Note:** REL for exposure to waste anesthetic gas.]
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 3800, 6600
OSHA ID166

Physical Description: Colorless gas with a slightly sweet odor. [inhalation anesthetic]
[**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 44.0
BP: -127°F
Sol(77°F): 0.1%
Fl.P: NA
IP: 12.89 eV
RGasD: 1.53
VP: 51.3 atm
FRZ: -132°F
UEL: NA
LEL: NA
Nonflammable Gas, but supports combustion at elevated temperatures.

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Aluminum, boron, hydrazine, lithium hydride, phosphine, sodium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Dysp; drow, head; asphy; repro effects; liquid: frostbite
TO: Resp sys, CNS, repro sys

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Fresh air

Nonane

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3(CH_2)_7CH_3$	111-84-2	RA6115000	N.D.

Conversion: 1 ppm = 5.25 mg/m^3

DOT: 1920 128

Synonyms/Trade Names: n-Nonane, Nonyl hydride

Exposure Limits:
NIOSH REL: TWA 200 ppm (1050 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with a gasoline-like odor.

Chemical & Physical Properties:
MW: 128.3
BP: 303°F
Sol: Insoluble
Fl.P: 88°F
IP: 10.21 eV
Sp.Gr: 0.72
VP: 3 mmHg
FRZ: -60°F
UEL: 2.9%
LEL: 0.8%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers (e.g., peroxides, nitrates, perchlorates)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; head, drow, dizz, conf, nau, tremor, inco; chemical pneu (aspir liquid)
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

1-Nonanethiol	Formula: $CH_3(CH_2)_8SH$	CAS#: 1455-21-6	RTECS#:	IDLH: N.D.
Conversion: 1 ppm = 6.56 mg/m^3	**DOT:** 1228 131			
Synonyms/Trade Names: 1-Mercaptononane, n-Nonyl mercaptan, Nonylthiol				
Exposure Limits: **NIOSH REL:** C 0.5 ppm (3.3 mg/m^3) [15-minute] **OSHA PEL:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Liquid.				
Chemical & Physical Properties: **MW:** 160.3 **BP:** ? **Sol:** Insoluble **Fl.P:** ? **IP:** ? **Sp.Gr:** ? **VP:** ? **FRZ:** ? **UEL:** ? **LEL:** ? Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **5 ppm:** CcrOv/Sa **12.5 ppm:** Sa:Cf/PaprOv **25 ppm:** CcrFOv/GmFOv/PaprTOv/ ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Oxidizers, reducing agents, strong acids & bases, alkali metals				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat; lass, cyan, incr respiration, nau, drow, head, vomit **TO:** Eyes, skin, resp sys, blood, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash **Breath:** Resp support **Swallow:** Medical attention immed	

Octachloronaphthalene	Formula: $C_{10}C_{l8}$	CAS#: 2234-13-1	RTECS#: QK0250000	IDLH: See Appendix F
Conversion:	**DOT:**			
Synonyms/Trade Names: Halowax® 1051; 1,2,3,4,5,6,7,8-Octachloronaphthalene; Perchloronaphthalene				
Exposure Limits: **NIOSH REL:** TWA 0.1 mg/m^3 ST 0.3 mg/m^3 [skin] **OSHA PEL†:** TWA 0.1 mg/m^3 [skin]			**Measurement Methods (see Table 1):** **NIOSH** S97 (II-2)	
Physical Description: Waxy, pale-yellow solid with an aromatic odor.				
Chemical & Physical Properties: **MW:** 403.7 **BP:** 770°F **Sol:** Insoluble **Fl.P:** NA **IP:** ? **Sp.Gr:** 2.00 **VP:** <1 mmHg **MLT:** 365°F **UEL:** NA **LEL:** NA Noncombustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam/Daily **Remove:** When wet or contam **Change:** Daily		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **1 mg/m^3:** Sa/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv100/ScbaE **See Appendix F**	
Incompatibilities and Reactivities: Strong oxidizers				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Acne-form derm; liver damage, jaun **TO:** Skin, liver			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed	

1-Octadecanethiol

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3(CH_2)_{17}SH$	2885-00-9		N.D.

Conversion: 1 ppm = 11.72 mg/m^3 **DOT:** 1228 131 (liquid)

Synonyms/Trade Names: 1-Mercaptooctadecane, Octadecyl mercaptan, Stearyl mercaptan

Exposure Limits:
NIOSH REL: C 0.5 ppm (5.9 mg/m^3) [15-minute]
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Solid or liquid (above 77°F).

Chemical & Physical Properties:
MW: 286.6
BP: ?
Sol: Insoluble
Fl.P: ?
IP: ?
Sp.Gr: 0.85
VP: ?
MLT: 77°F
UEL: ?
LEL: ?
Combustible Solid
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: CcrOv/Sa
12.5 ppm: Sa:Cf/PaprOv
25 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, reducing agents, strong acids & bases, alkali metals

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; head, dizz, lass, cyan, nau, convuls
TO: Eyes, skin, resp sys, CNS, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Octane

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3[CH_2]_6CH_3$	111-65-9	RG8400000	1000 ppm [10%LEL]

Conversion: 1 ppm = 4.67 mg/m^3 **DOT:** 1262 128

Synonyms/Trade Names: n-Octane, normal-Octane

Exposure Limits:
NIOSH REL: TWA 75 ppm (350 mg/m^3)
C 385 ppm (1800 mg/m^3) [15-minute]
OSHA PEL†: TWA 500 ppm (2350 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1500
OSHA 7

Physical Description: Colorless liquid with a gasoline-like odor.

Chemical & Physical Properties:
MW: 114.2
BP: 258°F
Sol(77°F): 0.00007%
Fl.P: 56°F
IP: 9.82 eV
Sp.Gr: 0.70
VP: 10 mmHg
FRZ: -70°F
UEL: 6.5%
LEL: 1.0%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
750 ppm: Sa*
1000 ppm: Sa:Cf*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose; drow; derm; chemical pneu (aspir liquid); in animals: narco
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

1-Octanethiol	Formula: $CH_3(CH_2)_7SH$	CAS#: 111-88-6	RTECS#:	IDLH: N.D.
Conversion: 1 ppm = 5.98 mg/m^3	**DOT:** 1228 131			
Synonyms/Trade Names: 1-Mercaptooctane, n-Octyl mercaptan, Octylthiol, 1-Octylthiol				
Exposure Limits: **NIOSH REL:** C 0.5 ppm (3.0 mg/m^3) [15-minute] **OSHA PEL:** none			**Measurement Methods (see Table 1):** **NIOSH** 2510	
Physical Description: Water-white liquid with a mild odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 146.3 **BP:** 390°F **Sol:** Insoluble **Fl.P(oc):** 115°F **IP:** ? **Sp.Gr:** 0.84 **VP(212°F):** 3 mmHg **FRZ:** -57°F **UEL:** ? **LEL:** ? Class II Combustible Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.	**NIOSH** **5 ppm:** CcrOv/Sa **12.5 ppm:** Sa:Cf/PaprOv **25 ppm:** CcrFOv/GmFOv/PaprTOv/ ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, reducing agents, strong acids & bases, alkali metals	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat; lass, cyan, incr respiration, nau, drow, head, vomit **TO:** Eyes, skin, resp sys, blood, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed

Oil mist (mineral)	Formula:	CAS#: 8012-95-1	RTECS#: PY8030000	IDLH: 2500 mg/m^3
Conversion:	**DOT:**			
Synonyms/Trade Names: Heavy mineral oil mist, Paraffin oil mist, White mineral oil mist				
Exposure Limits: **NIOSH REL:** TWA 5 mg/m^3 ST 10 mg/m^3 **OSHA PEL:** TWA 5 mg/m^3			**Measurement Methods (see Table 1):** **NIOSH** 5026, 5524	
Physical Description: Colorless, oily liquid aerosol dispersed in air. [**Note:** Has an odor like burned lubricating oil.]				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: Varies **BP:** 680°F **Sol:** Insoluble **Fl.P(oc):** 380°F **IP:** ? **Sp.Gr:** 0.90 **VP:** <0.5 mmHg **FRZ:** 0°F **UEL:** ? **LEL:** ? Class IIIB Combustible Liquid	**Skin:** Prevent skin contact **Eyes:** N.R. **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily	**NIOSH/OSHA** **50 mg/m^3:** 100XQ/Sa **125 mg/m^3:** Sa:Cf/PaprHie **250 mg/m^3:** 100F/SaT:Cf/PaprTHie/ ScbaF/SaF **2500 mg/m^3:** Sa:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE

Incompatibilities and Reactivities: None reported	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Con **SY:** Irrit eyes, skin, resp sys **TO:** Eyes, skin, resp sys	**First Aid (see Table 6):** **Skin:** Soap wash **Breath:** Fresh air

Osmium tetroxide

Formula:	CAS#:	RTECS#:	IDLH:
OsO_4	20816-12-0	RN1140000	1 mg/m^3

Conversion: 1 ppm = 10.40 mg/m^3 **DOT:** 2471 154

Synonyms/Trade Names: Osmic acid anhydride, Osmium oxide

Exposure Limits:
NIOSH REL: TWA 0.002 mg/m^3 (0.0002 ppm)
ST 0.006 mg/m^3 (0.0006 ppm)
OSHA PEL†: TWA 0.002 mg/m^3

Measurement Methods (see Table 1):
None available

Physical Description: Colorless, crystalline solid or pale-yellow mass with an unpleasant, acrid, chlorine-like odor. [**Note:** A liquid above 105°F.]

Chemical & Physical Properties:
MW: 254.2
BP: 266°F
Sol(77°F): 6%
Fl.P: NA
IP: 12.60 eV
Sp.Gr: 5.10
VP: 7 mmHg
MLT: 105°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.1 mg/m^3: CcrFS100/GmFS100/ScbaF/SaF
1 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS100/ScbaE

Incompatibilities and Reactivities: Hydrochloric acid, easily oxidized organic materials
[**Note:** Begins to sublime below BP. Contact with other materials may cause fire.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, resp sys; lac, vis dist; conj; head; cough, dysp; derm
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

O

Oxalic acid

Formula:	CAS#:	RTECS#:	IDLH:
HOOCCOOH×2H_2O	144-62-7	RO2450000	500 mg/m^3

Conversion: **DOT:**

Synonyms/Trade Names: Ethanedioic acid, Oxalic acid (aqueous), Oxalic acid dihydrate

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3
ST 2 mg/m^3
OSHA PEL†: TWA 1 mg/m^3

Measurement Methods (see Table 1):
None available

Physical Description: Colorless, odorless powder or granular solid.
[**Note:** The anhydrous form $(COOH)_2$ is an odorless, white solid.]

Chemical & Physical Properties:
MW: 126.1
BP: Sublimes
Sol: 14%
Fl.P: ?
IP: ?
Sp.Gr: 1.90
VP: <0.001 mmHg
MLT: 215°F (Sublimes)
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
25 mg/m^3: Sa:Cf£/PaprHie£
50 mg/m^3: 100F/ScbaF/SaF
500 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, silver compounds, strong alkalis, chlorites
[**Note:** Gives off water of crystallization at 215°F and begins to sublime.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; eye burns; local pain, cyan; shock, collapse, convuls; kidney damage
TO: Eyes, skin, resp sys, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Oxygen difluoride	Formula: OF_2	CAS#: 7783-41-7	RTECS#: RS2100000	IDLH: 0.5 ppm
Conversion: 1 ppm = 2.21 mg/m^3	**DOT:** 2190 124			
Synonyms/Trade Names: Difluorine monoxide, Fluorine monoxide, Oxygen fluoride				
Exposure Limits: **NIOSH REL:** C 0.05 ppm (0.1 mg/m^3) **OSHA PEL†:** TWA 0.05 ppm (0.1 mg/m^3)			**Measurement Methods (see Table 1):** None available	
Physical Description: Colorless gas with a peculiar, foul odor. [**Note:** Shipped as a nonliquefied compressed gas.]				
Chemical & Physical Properties: **MW:** 54.0 **BP:** -230°F **Sol:** 0.02% **Fl.P:** NA **IP:** 13.11 eV **RGasD:** 1.88 **VP:** >1 atm **FRZ:** -371°F **UEL:** NA **LEL:** NA Nonflammable Gas, but a strong oxidizer.	**Personal Protection/Sanitation (see Table 2):** **Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **0.5 ppm:** Sa/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFS¿/ScbaE	
Incompatibilities and Reactivities: Combustible materials, chlorine, bromine, iodine, platinum, metal oxides, moist air, hydrogen sulfide, hydrocarbons, water [**Note:** Reacts very slowly with water to form hydrofluoric acid.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Con **SY:** Irrit eyes, skin, resp sys; head; pulm edema; eye, skin burns (from contact with the gas under pressure) **TO:** Eyes, skin, resp sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support	

Ozone	Formula: O_3	CAS#: 10028-15-6	RTECS#: RS8225000	IDLH: 5 ppm
Conversion: 1 ppm = 1.96 mg/m^3	**DOT:**			
Synonyms/Trade Names: Triatomic oxygen				
Exposure Limits: **NIOSH REL:** C 0.1 ppm (0.2 mg/m^3) **OSHA PEL†:** TWA 0.1 ppm (0.2 mg/m^3)			**Measurement Methods (see Table 1):** **OSHA** ID214	
Physical Description: Colorless to blue gas with a very pungent odor.				
Chemical & Physical Properties: **MW:** 48.0 **BP:** -169°F **Sol(32°F):** 0.001% **Fl.P:** NA **IP:** 12.52 eV **RGasD:** 1.66 **VP:** >1 atm **FRZ:** -315°F **UEL:** NA **LEL:** NA Nonflammable Gas, but a powerful oxidizer.	**Personal Protection/Sanitation (see Table 2):** **Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **1 ppm**: CcrS¿/Sa **2.5 ppm:** Sa:Cf/PaprS¿ **5 ppm:** CcrFS¿/GmFS¿/SaT:Cf/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFS¿/ScbaE	
Incompatibilities and Reactivities: All oxidizable materials (both organic & inorganic)				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Con **SY:** Irrit eyes, muc memb; pulm edema; chronic resp disease **TO:** Eyes, resp sys			**First Aid (see Table 6):** **Eye:** Medical attention **Breath:** Fresh air; 100% O_2	

Paraffin wax fume

Formula: C_nH_{2n+2} | **CAS#:** 8002-74-2 | **RTECS#:** RV0350000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: Paraffin fume, Paraffin scale fume

Exposure Limits:
NIOSH REL: TWA 2 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2047

Physical Description: Paraffin wax is a white to slightly yellowish, odorless solid.
[**Note:** Consists of a mixture of high molecular weight hydrocarbons (e.g., $C_{36}H_{74}$).]

Chemical & Physical Properties:
MW: 350-420
BP: ?
Sol: Insoluble
Fl.P: 390°F
IP: ?
Sp.Gr: 0.88-0.92
VP: ?
MLT: 115-154°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, resp sys; discomfort, nau
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Resp support

Paraquat (Paraquat dichloride)

Formula: $CH_3(C_5H_4N)_2CH_3{\times}2Cl$ | **CAS#:** 1910-42-5 | **RTECS#:** DW2275000 | **IDLH:** 1 mg/m^3

Conversion: | **DOT:**

Synonyms/Trade Names: 1,1'-Dimethyl-4,4'-bipyridinium dichloride; N,N'-Dimethyl-4,4'-bipyridinium dichloride; Paraquat chloride; Paraquat dichloride
[**Note:** Paraquat is a cation ($C_{12}H_{14}N_2^{++}$; 1,1-Dimethyl-4,4-bipyridinium ion); the commercial product is the dichloride salt of paraquat.]

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3 (resp) [skin]
OSHA PEL†: TWA 0.5 mg/m^3 (resp) [skin]

Measurement Methods (see Table 1):
NIOSH 5003

Physical Description: Yellow solid with a faint, ammonia-like odor. [herbicide]
[**Note:** Paraquat may also be found commercially as a methyl sulfate salt $C_{12}H_{14}N_2{\times}2CH_3SO_4$.]

Chemical & Physical Properties:
MW: 257.2
BP: Decomposes
Sol: Miscible
Fl.P: NA
IP: ?
Sp.Gr: 1.24
VP: <0.0000001 mmHg
MLT: 572°F (Decomposes)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
1 mg/m^3: CcrOv95*/PaprOvHie*/ Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, alkylaryl-sulfonate wetting agents
[**Note:** Corrosive to metals. Decomposes in presence of ultraviolet light.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat, resp sys; epis; derm; fingernail damage; irrit GI tract; heart, liver, kidney damage
TO: Eyes, skin, resp sys, heart, liver, kidneys, GI tract

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Parathion	**Formula:** $(C_2H_5O)_2P(S)OC_6H_4NO_2$	**CAS#:** 56-38-2	**RTECS#:** TF4550000	**IDLH:** 10 mg/m^3
Conversion:	**DOT:** 2783 152			

Synonyms/Trade Names: O,O-Diethyl-O(p-nitrophenyl) phosphorothioate; Diethyl parathion; Ethyl parathion; Parathion-ethyl

Exposure Limits:
NIOSH REL: TWA 0.05 mg/m^3 [skin]
OSHA PEL: TWA 0.1 mg/m^3 [skin]

Physical Description: Pale-yellow to dark-brown liquid with a garlic-like odor. [**Note:** A solid below 43°F. Pesticide that may be absorbed on a dry carrier.]

Measurement Methods (see Table 1):
NIOSH 5600
OSHA 62

Chemical & Physical Properties:
MW: 291.3
BP: 707°F
Sol: 0.001%
Fl.P(oc): 392°F
IP: ?
Sp.Gr: 1.27
VP: 0.00004 mmHg
FRZ: 43°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
0.5 mg/m^3: CcrOv95/Sa
1.25 mg/m^3: Sa:Cf/PaprOvHie
2.5 mg/m^3: CcrFOv100/SaT:Cf/PaprTOvHie/ScbaF/SaF
10 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, alkaline materials

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; miosis; rhin; head; chest tight, wheez, lar spasm, salv, cyan; anor, nau, vomit, abdom cramps, diarr; sweat; musc fasc, lass, para; dizz, conf, ataxia; convuls, coma; low BP; card irreg
TO: Eyes, skin, resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

P

Particulates not otherwise regulated	**Formula:**	**CAS#:**	**RTECS#:**	**IDLH:** N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: "Inert" dusts, Nuisance dusts, PNOR
[**Note:** Includes all inert or nuisance dusts, whether mineral, inorganic, not listed specifically in 1910.1000.]

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Physical Description: Dusts from solid substances without specific occupational exposure standards.

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Chemical & Physical Properties:
Properties vary depending upon the specific solid.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Varies

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, throat, upper resp sys
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Pentaborane

Formula:	CAS#:	RTECS#:	IDLH:
B_5H_9	19624-22-7	RY8925000	1 ppm

Conversion: 1 ppm = 2.58 mg/m^3 **DOT:** 1380 135

Synonyms/Trade Names: Pentaboron nonahydride

Exposure Limits:
NIOSH REL: TWA 0.005 ppm (0.01 mg/m^3)
ST 0.015 ppm (0.03 mg/m^3)
OSHA PEL†: TWA 0.005 ppm (0.01 mg/m^3)

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with a pungent odor like sour milk.

Chemical & Physical Properties:
MW: 63.1
BP: 140°F
Sol: Reacts
Fl.P: 86°F
IP: 9.90 eV
Sp.Gr: 0.62
VP: 171 mmHg
FRZ: -52°F
UEL: ?
LEL: 0.42%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.05 ppm: Sa
0.125 ppm: Sa:Cf
0.25 ppm: SaT:Cf/ScbaF/SaF
1 ppm: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Oxidizers, halogens, water, halogenated hydrocarbons
[**Note:** May ignite SPONTANEOUSLY in moist air. Corrosive to natural rubber. Hydrolyzes slowly with heat in water to form boric acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; dizz, head, drow, inco, tremor, convuls, behavioral changes; tonic spasm face, neck, abdom, limbs
TO: Eyes, skin, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

P

Pentachloroethane

Formula:	CAS#:	RTECS#:	IDLH:
$CHCl_2CCl_3$	76-01-7	KI6300000	N.D.

Conversion: **DOT:** 1669 151

Synonyms/Trade Names: Ethane pentachloride, Pentalin

Exposure Limits:
NIOSH REL: Handle with care in the workplace.
See Appendix C (Chloroethanes)
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 2517

Physical Description: Colorless liquid with a sweetish, chloroform-like odor.

Chemical & Physical Properties:
MW: 202.3
BP: 322°F
Sol: 0.05%
Fl.P: ?
IP: 11.28 eV
Sp.Gr: 1.68
VP: 3 mmHg
FRZ: -20°F
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: (Sodium-potassium alloy + bromoform), alkalis, metals, water
[**Note:** Hydrolysis produces dichloroacetic acid. Reaction with alkalis & metals produces spontaneously explosive chloroacetylenes.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: irrit eyes, skin; lass, restless, irreg respiration, musc inco; liver, kidney, lung changes
TO: Eyes, skin, resp sys, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Pentachloronaphthalene	**Formula:** $C_{10}H_3Cl_5$	**CAS#:** 1321-64-8	**RTECS#:** QK0300000	**IDLH:** See Appendix F
Conversion:	**DOT:**			
Synonyms/Trade Names: Halowax® 1013; 1,2,3,4,5-Pentachloronaphthalene				

Exposure Limits: **NIOSH REL:** TWA 0.5 mg/m^3 [skin] **OSHA PEL:** TWA 0.5 mg/m^3 [skin]	**Measurement Methods (see Table 1):** **NIOSH** S96 (II-2)
Physical Description: Pale-yellow or white solid or powder with an aromatic odor.	

Chemical & Physical Properties: **MW:** 300.4 **BP:** 636°F **Sol:** Insoluble **Fl.P:** NA **IP:** ? **Sp.Gr:** 1.67 **VP:** <1 mmHg **MLT:** 248°F **UEL:** NA **LEL:** NA Noncombustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily	**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **5 mg/m^3:** Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv100/ScbaE **See Appendix F**

Incompatibilities and Reactivities: Strong oxidizers	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Head, lass, dizz, anor; pruritus, acne-form skin eruptions; jaun, liver nec **TO:** Skin, liver, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap prompt/molten flush immed **Breath:** Resp support **Swallow:** Medical Attention immed

Pentachlorophenol	**Formula:** C_6Cl_5OH	**CAS#:** 87-86-5	**RTECS#:** SM6300000	**IDLH:** 2.5 mg/m^3
Conversion:	**DOT:** 3155 154			
Synonyms/Trade Names: PCP; Penta; 2,3,4,5,6-Pentachlorophenol				

Exposure Limits: **NIOSH REL:** TWA 0.5 mg/m^3 [skin] **OSHA PEL:** TWA 0.5 mg/m^3 [skin]	**Measurement Methods (see Table 1):** **NIOSH** 5512
Physical Description: Colorless to white, crystalline solid with a benzene-like odor. [fungicide]	

Chemical & Physical Properties: **MW:** 266.4 **BP:** 588°F (Decomposes) **Sol:** 0.001% **Fl.P:** NA **IP:** NA **Sp.Gr:** 1.98 **VP(77°F):** 0.0001 mmHg **MLT:** 374°F **UEL:** NA **LEL:** NA Noncombustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily **Provide:** Eyewash Quick drench	**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **2.5 mg/m^3:** CcrOv95*/PaprOvHie*/ Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids, alkalis	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, nose, throat; sneez, cough; lass, anor, low-wgt; sweat; head, dizz; nau, vomit; dysp, chest pain; high fever; derm **TO:** Eyes, skin, resp sys, CVS, liver, kidneys, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed

Pentaerythritol

Formula: $C(CH_2OH)_4$ | **CAS#:** 115-77-5 | **RTECS#:** RZ2490000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: 2,2-bis(Hydroxymethyl)-1,3-propanediol; Methane tetramethylol; Monopentaerythritol; PE; Tetrahydroxymethylolmethane; Tetramethylolmethane

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Colorless to white, crystalline, odorless powder.
[**Note:** Technical grade is 88% monopentaerythritol & 12% dipentaerythritol.]

Chemical & Physical Properties:
MW: 136.2
BP: Sublimes
Sol(59°F): 6%
Fl.P: ?
IP: ?
Sp.Gr: 1.38
VP: 0.00000008 mmHg
MLT: 500°F (Sublimes)
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Organic acids, oxidizers
[**Note:** Explosive compound is formed when a mixture of PE & thiophosphoryl chloride is heated.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, resp sys
TO: Eyes, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash
Breath: Fresh air
Swallow: Medical attention immed

P

n-Pentane

Formula: $CH_3[CH_2]_3CH_3$ | **CAS#:** 109-66-0 | **RTECS#:** RZ9450000 | **IDLH:** 1500 ppm [10%LEL]

Conversion: 1 ppm = 2.95 mg/m^3 | **DOT:** 1265 128

Synonyms/Trade Names: Pentane, normal-Pentane

Exposure Limits:
NIOSH REL: TWA 120 ppm (350 mg/m^3)
C 610 ppm (1800 mg/m^3) [15-minute]
OSHA PEL†: TWA 1000 ppm (2950 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1500
OSHA 7

Physical Description: Colorless liquid with a gasoline-like odor.
[**Note:** A gas above 97°F. May be utilized as a fuel.]

Chemical & Physical Properties:
MW: 72.2
BP: 97°F
Sol: 0.04%
Fl.P: -57°F
IP: 10.34 eV
Sp.Gr: 0.63
VP: 420 mmHg
FRZ: -202°F
UEL: 7.8%
LEL: 1.5%
Class IA Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
1200 ppm: Sa
1500 ppm: Sa:Cf/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose; derm; chemical pneu (aspir liquid); drow; in animals: narco
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash prompt
Breath: Resp support
Swallow: Medical attention immed

1-Pentanethiol	Formula: $CH_3(CH_2)_4SH$	CAS#: 110-66-7	RTECS#: SA3150000	IDLH: N.D.
Conversion: 1 ppm = 4.26 mg/m^3	**DOT:** 1111 130			
Synonyms/Trade Names: Amyl hydrosulfide, Amyl mercaptan, Amyl sulfhydrate, Pentyl mercaptan				
Exposure Limits: **NIOSH REL:** C 0.5 ppm (2.1 mg/m^3) [15-minute] **OSHA PEL:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Water-white to yellowish liquid with a strong, garlic-like odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 104.2 **BP:** 260°F **Sol:** Insoluble **Fl.P(oc):** 65°F **IP:** ? **Sp.Gr:** 0.84 **VP(77°F):** 14 mmHg **FRZ:** -104°F **UEL:** ? **LEL:** ? Class IB Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.	**NIOSH** **5 ppm:** CcrOv/Sa **12.5 ppm:** Sa:Cf/PaprOv **25 ppm:** CcrFOv/GmFOv/PaprTOv/ ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, reducing agents, alkali metals, calcium hypochlorite, concentrated nitric acid	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat, resp sys; head, nau, dizz; vomit, diarr; derm, skin sens **TO:** Eyes, skin, resp sys, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed

2-Pentanone	Formula: $CH_3COCH_2CH_2CH_3$	CAS#: 107-87-9	RTECS#: SA7875000	IDLH: 1500 ppm
Conversion: 1 ppm = 3.52 mg/m^3	**DOT:** 1249 127			
Synonyms/Trade Names: Ethyl acetone, Methyl propyl ketone, MPK				
Exposure Limits: **NIOSH REL:** TWA 150 ppm (530 mg/m^3) **OSHA PEL†:** TWA 200 ppm (700 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1300, 2555	
Physical Description: Colorless to water-white liquid with a characteristic acetone-like odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 86.1 **BP:** 215°F **Sol:** 6% **Fl.P:** 45°F **IP:** 9.39 eV **Sp.Gr:** 0.81 **VP:** 27 mmHg **FRZ:** -108°F **UEL:** 8.2% **LEL:** 1.5% Class IB Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.	**NIOSH** **1500 ppm:** CcrOv*/PaprOv*/GmFOv/ Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, bromine trifluoride	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, muc memb; head; derm; narco, coma **TO:** Eyes, skin, resp sys, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush **Breath:** Resp support **Swallow:** Medical attention immed

Perchloromethyl mercaptan

Formula:	CAS#:	RTECS#:	IDLH:
Cl_3CSCl	594-42-3	PB0370000	10 ppm

Conversion: 1 ppm = 7.60 mg/m^3 **DOT:** 1670 157

Synonyms/Trade Names: PCM, PMM, Trichloromethane sulfenyl chloride, Trichloromethyl sulfur chloride

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.8 mg/m^3)
OSHA PEL: TWA 0.1 ppm (0.8 mg/m^3)

Measurement Methods (see Table 1):
None available

Physical Description: Pale-yellow, oily liquid with an unbearable, acrid odor.

Chemical & Physical Properties:
MW: 185.9
BP: 297°F (Decomposes)
Sol: Insoluble
Fl.P: NA
IP: ?
Sp.Gr: 1.69
VP: 3 mmHg
FRZ: ?
UEL: NA
LEL: NA
Noncombustible Liquid, but will support combustion.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1 ppm: CcrOv*/Sa*
2.5 ppm: Sa:Cf*/PaprOv*
5 ppm: CcrFOv/GmFOv/PaprTOv*/ SaT:Cf*/ScbaF/SaF
10 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Alkalis, amines, hot iron, water
[**Note:** Corrosive to most metals. Forms HCl, sulfur & CO_2 on contact with water.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; lac; cough, dysp, deep breath pain, coarse rales; vomit; pallor, tacar; acidosis; anuria; liver, kidney damage
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

P

Perchloryl fluoride

Formula:	CAS#:	RTECS#:	IDLH:
ClO_3F	7616-94-6	SD1925000	100 ppm

Conversion: 1 ppm = 4.19 mg/m^3 **DOT:** 3083 124

Synonyms/Trade Names: Chlorine fluoride oxide, Chlorine oxyfluoride, Trioxychlorofluoride

Exposure Limits:
NIOSH REL: TWA 3 ppm (14 mg/m^3)
ST 6 ppm (28 mg/m^3)
OSHA PEL†: TWA 3 ppm (13.5 mg/m^3)

Measurement Methods (see Table 1):
None available

Physical Description: Colorless gas with a characteristic, sweet odor.
[**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 102.5
BP: -52°F
Sol: 0.06%
Fl.P: NA
IP: 13.60 eV
RGasD: 3.64
VP: 10.5 atm
FRZ: -234°F
UEL: NA
LEL: NA
Nonflammable Gas, but will support combustion.

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
30 ppm: Sa
75 ppm: Sa:Cf*
100 ppm: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS¿/ScbaE

Incompatibilities and Reactivities: Combustibles, strong bases, amines, finely divided metals, reducing agents, alcohols

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Irrit resp sys; liquid: frostbite; in animals: methemo; cyan; lass, dizz, head; pulm edema; pneu; anoxia
TO: Skin, resp sys, blood

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Perlite

Formula:
CAS#: 93763-70-3
RTECS#: SD5254000
IDLH: N.D.

Conversion:
DOT:

Synonyms/Trade Names: Expanded perlite
[**Note:** An amorphous material consisting of fused sodium potassium aluminum silicate.]

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Odorless, light-gray to glassy-black solid.
[**Note:** Expanded perlite is a fluffy, white particulate.]

Chemical & Physical Properties:
MW: varies
BP: ?
Sol: <1%
Fl.P: NA
IP: NA
Sp.Gr: 2.2 - 2.4 (crude)
0.05 - 0.3 (expanded)
VP: 0 mmHg (approx)
MLT: >2000°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, throat, upper resp sys
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

P

Petroleum distillates (naphtha)

Formula:
CAS#: 8002-05-9
RTECS#: SE7449000
IDLH: 1100 ppm [10%LEL]

Conversion: 1 ppm = 4.05 mg/m^3
DOT:

Synonyms/Trade Names: Aliphatic petroleum naphtha, Petroleum naphtha, Rubber solvent

Exposure Limits:
NIOSH REL: TWA 350 mg/m^3
C 1800 mg/m^3 [15-minute]
OSHA PEL†: TWA 500 ppm (2000 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1550

Physical Description: Colorless liquid with a gasoline- or kerosene-like odor.
[**Note:** A mixture of paraffins (C_5 to C_{13}) that may contain a small amount of aromatic hydrocarbons.]

Chemical & Physical Properties:
MW: 99 (approx)
BP: 86-460°F
Sol: Insoluble
Fl.P: -40 to -86°F
IP: ?
Sp.Gr: 0.63-0.66
VP: 40 mmHg (approx)
FRZ: -99°F
UEL: 5.9%
LEL: 1.1%
Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
850 ppm: Sa
1100 ppm: Sa:Cf*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose, throat; dizz, drow, head, nau; dry cracked skin; chemical pneu (aspir liquid)
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Phenol

Formula: C_6H_5OH | **CAS#:** 108-95-2 | **RTECS#:** SJ3325000 | **IDLH:** 250 ppm

Conversion: 1 ppm = 3.85 mg/m^3

DOT: 1671 153 (solid); 2312 153 (molten); 2821 153 (solution)

Synonyms/Trade Names: Carbolic acid, Hydroxybenzene, Monohydroxybenzene, Phenyl alcohol, Phenyl hydroxide

Exposure Limits:
NIOSH REL: TWA 5 ppm (19 mg/m^3) [skin]
C 15.6 ppm (60 mg/m^3) [15-minute]
OSHA PEL: TWA 5 ppm (19 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2546
OSHA 32

Physical Description: Colorless to light-pink, crystalline solid with a sweet, acrid odor. [**Note:** Phenol liquefies by mixing with about 8% water.]

Chemical & Physical Properties:
MW: 94.1
BP: 359°F
Sol(77°F): 9%
Fl.P: 175°F
IP: 8.50 eV
Sp.Gr: 1.06
VP: 0.4 mmHg
MLT: 109°F
UEL: 8.6%
LEL: 1.8%
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 ppm: CcrOv95/Sa
125 ppm: Sa:Cf/PaprOvHie
250 ppm: CcrFOv100/GmFOv100/PaprTOvHie/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, calcium hypochlorite, aluminum chloride, acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose, throat; anor, low-wgt; lass, musc ache, pain; dark urine; cyan; liver, kidney damage; skin burns; derm; ochronosis; tremor, convuls, twitch
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

P

Phenothiazine

Formula: $S(C_6H_4)_2NH$ | **CAS#:** 92-84-2 | **RTECS#:** SN5075000 | **IDLH:** N.D.

Conversion:

DOT:

Synonyms/Trade Names: Dibenzothiazine, Fenothiazine, Thiodiphenylamine

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3 [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2048

Physical Description: Grayish-green to greenish-yellow solid. [insecticide]

Chemical & Physical Properties:
MW: 199.3
BP: 700°F
Sol: Insoluble
Fl.P: ?
IP: ?
Sp.Gr: ?
VP: 0 mmHg (approx)
MLT: 365°F
UEL: ?
LEL: ?
Combustible Solid, but not a high fire risk.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: N.R.
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Itching, irrit, reddening skin; hepatitis, hemolytic anemia, abdom cramps, tacar; kidney damage; skin photo sens
TO: Skin, CVS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

p-Phenylene diamine	Formula: $C_6H_4(NH_2)_2$	CAS#: 106-50-3	RTECS#: SS8050000	IDLH: 25 mg/m^3
Conversion:	**DOT:** 1673 153			

Synonyms/Trade Names: 4-Aminoaniline; 1,4-Benzenediamine; p-Diaminobenzene; 1,4-Diaminobenzene; 1,4-Phenylene diamine

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3 [skin]
OSHA PEL: TWA 0.1 mg/m^3 [skin]

Measurement Methods (see Table 1):
OSHA 87

Physical Description: White to slightly red, crystalline solid.

Chemical & Physical Properties:
MW: 108.2
BP: 513°F
Sol(75°F): 4%
Fl.P: 312°F
IP: 6.89 eV
Sp.Gr: ?
VP: <1 mmHg
MLT: 295°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2.5 mg/m^3: Sa:Cf£
5 mg/m^3: ScbaF/SaF
25 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit pharynx, larynx; bronchial asthma; sens derm
TO: Resp sys, skin

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Phenyl ether (vapor)	Formula: $C_6H_5OC_6H_5$	CAS#: 101-84-8	RTECS#: KN8970000	IDLH: 100 ppm
Conversion: 1 ppm = 6.96 mg/m^3	**DOT:**			

Synonyms/Trade Names: Diphenyl ether, Diphenyl oxide, Phenoxy benzene, Phenyl oxide

Exposure Limits:
NIOSH REL: TWA 1 ppm (7 mg/m^3)
OSHA PEL: TWA 1 ppm (7 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1617
OSHA PV2022

Physical Description: Colorless, crystalline solid or liquid (above 82°F) with a geranium-like odor.

Chemical & Physical Properties:
MW: 170.2
BP: 498°F
Sol: Insoluble
Fl.P: 239°F
IP: 8.09 eV
Sp.Gr: 1.08
VP(77°F): 0.02 mmHg
MLT: 82°F
UEL: 6.0%
LEL: 0.7%
Combustible Solid
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
25 ppm: Sa:Cf£/PaprOvHie£
50 ppm: CcrFOv100/GmFOv100/ ScbaF/SaF
100 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, nose, skin; nau
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support

Phenyl ether-biphenyl mixture (vapor)

Formula:	CAS#:	RTECS#:	IDLH:
$C_6H_5OC_6H_5/C_6H_5C_6H_5$	8004-13-5	DV1500000	10 ppm

Conversion: 1 ppm = 6.79 mg/m^3 (approx)

DOT:

Synonyms/Trade Names: Diphenyl oxide-diphenyl mixture, Dowtherm® A

Exposure Limits:
NIOSH REL: TWA 1 ppm (7 mg/m^3)
OSHA PEL: TWA 1 ppm (7 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2013

Physical Description: Colorless to straw-colored liquid or solid (below 54°F) with a disagreeable, aromatic odor.
[**Note:** A mixture typically contains 75% phenyl ether & 25% biphenyl.]

Chemical & Physical Properties:
MW: 166 (approx)
BP: 495°F
Sol: Insoluble
Fl.P: 239°F
IP: ?
Sp.Gr(77°F): 1.06
VP(77°F): 0.08 mmHg
FRZ: 54°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 ppm: Sa:Cf£/CcrFOv100/GmFOv100/PaprOvHie£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, nose, skin; nau
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support

P

Phenyl glycidyl ether

Formula:	CAS#:	RTECS#:	IDLH:
$C_9H_{10}O_2$	122-60-1	TZ3675000	Ca [100 ppm]

Conversion: 1 ppm = 6.14 mg/m^3

DOT:

Synonyms/Trade Names: 1,2-Epoxy-3-phenoxy propane; Glycidyl phenyl ether; PGE; Phenyl 2,3-epoxypropyl ether

Exposure Limits:
NIOSH REL: Ca
C 1 ppm (6 mg/m^3) [15-minute]
See Appendix A
OSHA PEL†: TWA 10 ppm (60 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1619
OSHA 7

Physical Description: Colorless liquid. [**Note:** A solid below 38°F.]

Chemical & Physical Properties:
MW: 150.1
BP: 473°F
Sol: 0.2%
Fl.P: 248°F
IP: ?
Sp.Gr: 1.11
VP: 0.01 mmHg
FRZ: 38°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, amines, strong acids, strong bases

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; upper resp sys; skin sens; narco; possible hemato, repro effects; [carc]
TO: Eyes, skin, CNS, hemato sys, repro sys [in animals: nasal cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Phenylhydrazine

Formula: $C_6H_5NHNH_2$ | **CAS#:** 100-63-0 | **RTECS#:** MV8925000 | **IDLH:** Ca [15 ppm]

Conversion: 1 ppm = 4.42 mg/m^3 | **DOT:** 2572 153

Synonyms/Trade Names: Hydrazinobenzene, Monophenylhydrazine

Exposure Limits:
NIOSH REL: Ca
C 0.14 ppm (0.6 mg/m^3) [2-hr] [skin]
See Appendix A
OSHA PEL†: TWA 5 ppm (22 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 3518

Physical Description: Colorless to pale-yellow liquid or solid (below 67°F) with a faint, aromatic odor.

Chemical & Physical Properties:
MW: 108.1
BP: 470°F (Decomposes)
Sol: Slight
Fl.P: 190°F
IP: 7.64 eV
Sp.Gr: 1.10
VP(77°F): 0.04 mmHg
FRZ: 67°F
UEL: ?
LEL: ?
Class IIIA Combustible Liquid
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: ScbaE

Incompatibilities and Reactivities: Strong oxidizers, lead dioxide

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Skin sens, hemolytic anemia, dysp, cyan; jaun; kidney damage; vascular thrombosis; [carc]
TO: Blood, resp sys, liver, kidneys, skin [in animals: tumors of the lungs, liver, blood vessels & intestine]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

P

N-Phenyl-β-naphthylamine

Formula: $C_{10}H_7NHC_6H_5$ | **CAS#:** 135-88-6 | **RTECS#:** QM4550000 | **IDLH:** Ca [N.D.]

Conversion: | **DOT:**

Synonyms/Trade Names: 2-Anilinonaphthalene, β-Naphthylphenylamine, PBNA, 2-Phenylaminonaphthalene, Phenyl-β-naphthylamine

Exposure Limits:
NIOSH REL: Ca*
See Appendix A
[***Note:** Since metabolized to β-Naphthylamine.]
OSHA PEL: none

Measurement Methods (see Table 1):
OSHA 96

Physical Description: White to yellow crystals or gray to tan flakes or powder.
[**Note:** Commercial product may contain 20-30 ppm of β-Naphthylamine.]

Chemical & Physical Properties:
MW: 219.3
BP: 743°F
Sol: Insoluble
Fl.P: ?
IP: ?
Sp.Gr: 1.24
VP: ?
MLT: 226°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irritation; leucoplakia; acne, hypersensitivity to sunlight; [carc]
TO: Eyes, skin, bladder [bladder cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Phenylphosphine

Formula: $C_6H_5PH_2$ | **CAS#:** 638-21-1 | **RTECS#:** SZ2100000 | **IDLH:** N.D.

Conversion: 1 ppm = 4.50 mg/m^3 | **DOT:**

Synonyms/Trade Names: Fenylfosfin, PF, Phosphaniline

Exposure Limits:
NIOSH REL: C 0.05 ppm (0.25 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Clear, colorless liquid with a foul odor.

Chemical & Physical Properties:
MW: 110.1
BP: 320°F
Sol: Insoluble
Fl.P: ?
IP: ?
Sp.Gr(59°F): 1.001
VP: ?
FRZ: ?
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported [**Note:** Spontaneously combustible in high concentrations in air. Potential exposure to gaseous PF when polyphosphinates are heated above 392°F.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: blood changes, anemia, testicular degeneration; loss of appetite, diarr, lac, hind leg tremor; derm
TO: Blood, CNS, skin, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

P

Phorate

Formula: $(C_2H_5O)_2P(S)SCH_2SC_2H_5$ | **CAS#:** 298-02-2 | **RTECS#:** TD9450000 | **IDLH:** N.D.

Conversion: | **DOT:** 3018 152 (organophosphorus pesticide, liquid, toxic)

Synonyms/Trade Names: O,O-Diethyl S-(ethylthio)methylphosphorodithioate; O,O-Diethyl S-ethylthiomethylthiothionophosphate; Thimet; Timet

Exposure Limits:
NIOSH REL: TWA 0.05 mg/m^3
ST 0.2 mg/m^3 [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5600

Physical Description: Clear liquid with a skunk-like odor. [insecticide]

Chemical & Physical Properties:
MW: 260.4
BP: ?
Sol: 0.005%
Fl.P(oc): 320°F
IP: ?
Sp.Gr(77°F): 1.16
VP: 0.0008 mmHg
FRZ: -45°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid, but does not readily ignite.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Water, alkalis [**Note:** Hydrolyzed in the presence of moisture and by alkalis.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; miosis; rhin; head; chest tight, wheez, lar spasm, salv, cyan; anor, nau, vomit, abdom cramps, diarr; sweat; musc fasc, lass, para; dizz, conf, ataxia; convuls, coma; low BP; card irreg
TO: Eyes, skin, resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Phosdrin

Formula: $C_7H_{13}PO_6$ | **CAS#:** 7786-34-7 | **RTECS#:** GQ5250000 | **IDLH:** 4 ppm

Conversion: 1 ppm = 9.17 mg/m^3 | **DOT:** 2783 152

Synonyms/Trade Names: 2-Carbomethoxy-1-methylvinyl dimethyl phosphate, Mevinphos
[**Note:** Commercial product is a mixture of the cis- & trans-isomers.]

Exposure Limits:
NIOSH REL: TWA 0.01 ppm (0.1 mg/m^3) [skin]
ST 0.03 ppm (0.3 mg/m^3)
OSHA PEL†: TWA 0.1 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 5600

Physical Description: Pale-yellow to orange liquid with a weak odor.
[**Note:** Insecticide that may be absorbed on a dry carrier.]

Chemical & Physical Properties:
MW: 224.2
BP: Decomposes
Sol: Miscible
Fl.P(oc): 347°F
IP: ?
Sp.Gr: 1.25
VP: 0.003 mmHg
FRZ: 44°F (trans-)
70°F (cis-)
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.1 ppm: Sa
0.25 ppm: Sa:Cf
0.5 ppm: SaT:Cf/ScbaF/SaF
4 ppm: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers [**Note:** Corrosive to cast iron, some stainless steels & brass.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; miosis; rhin; head; chest tight, wheez, lar spasm, salv, cyan; anor, nau, vomit, abdom cramps, diarr; para; ataxia, convuls; low BP, card irreg
TO: Eyes, skin, resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

P

Phosgene

Formula: $COCl_2$ | **CAS#:** 75-44-5 | **RTECS#:** SY5600000 | **IDLH:** 2 ppm

Conversion: 1 ppm = 4.05 mg/m^3 | **DOT:** 1076 125

Synonyms/Trade Names: Carbon oxychloride, Carbonyl chloride, Carbonyl dichloride, Chloroformyl chloride

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.4 mg/m^3)
C 0.2 ppm (0.8 mg/m^3) [15-minute]
OSHA PEL: TWA 0.1 ppm (0.4 mg/m^3)

Measurement Methods (see Table 1):
OSHA 61

Physical Description: Colorless gas with a suffocating odor like musty hay.
[**Note:** A fuming liquid below 47°F. Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 98.9
BP: 47°F
Sol: Slight
Fl.P: NA
IP: 11.55 eV
RGasD: 3.48
Sp.Gr: 1.43 (Liquid at 32°F)
VP: 1.6 atm
FRZ: -198°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (liquid)
Eyes: Prevent eye contact (liquid)
Wash skin: When contam (liquid)
Remove: When wet or contam (liquid)
Change: N.R.
Provide: Quick drench (liquid)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1 ppm: Sa*
2 ppm: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Moisture, alkalis, ammonia, alcohols, copper
[**Note:** Reacts slowly in water to form hydrochloric acid & carbon dioxide.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Irrit eyes; dry burning throat; vomit; cough, foamy sputum, dysp, chest pain, cyan; liquid: frostbite
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed (liquid)
Skin: Water flush immed (liquid)
Breath: Resp support

Phosphine

Formula:	CAS#:	RTECS#:	IDLH:
PH_3	7803-51-2	SY7525000	50 ppm

Conversion: 1 ppm = 1.39 mg/m^3

DOT: 2199 119

Synonyms/Trade Names: Hydrogen phosphide, Phosphorated hydrogen, Phosphorus hydride, Phosphorus trihydride

Exposure Limits:
NIOSH REL: TWA 0.3 ppm (0.4 mg/m^3)
ST 1 ppm (1 mg/m^3)
OSHA PEL†: TWA 0.3 ppm (0.4 mg/m^3)

Measurement Methods (see Table 1):
OSHA 1003, ID180

Physical Description: Colorless gas with a fish- or garlic-like odor. [pesticide]
[**Note:** Shipped as a liquefied compressed gas. Pure compound is odorless.]

Chemical & Physical Properties:
MW: 34.0
BP: -126°F
Sol: Slight
Fl.P: NA (Gas)
IP: 9.96 eV
RGasD: 1.18
VP: 41.3 atm
FRZ: -209°F
UEL: ?
LEL: 1.79%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
3 ppm: Sa
7.5 ppm: Sa:Cf
15 ppm: GmFS/ScbaF/SaF
50 ppm: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Air, oxidizers, chlorine, acids, moisture, halogenated hydrocarbons, copper [**Note:** May ignite SPONTANEOUSLY on contact with air.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Nau, vomit, abdom pain, diarr; thirst; chest tight, dysp; musc pain, chills; stupor or syncope; pulm edema; liquid: frostbite
TO: Resp sys

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

P

Phosphoric acid

Formula:	CAS#:	RTECS#:	IDLH:
H_3PO_4	7664-38-2	TB6300000	1000 mg/m^3

Conversion:

DOT: 1805 154 (liquid or solution); 3453 154 (solid)

Synonyms/Trade Names: Orthophosphoric acid, Phosphoric acid (aqueous), White phosphoric acid

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3
ST 3 mg/m^3
OSHA PEL†: TWA 1 mg/m^3

Measurement Methods (see Table 1):
NIOSH 7903
OSHA ID165SG

Physical Description: Thick, colorless, odorless, crystalline solid. [**Note:** Often used in an aqueous solution.]

Chemical & Physical Properties:
MW: 98.0
BP: 415°F
Sol: Miscible
Fl.P: NA
IP: ?
Sp.Gr(77°F): 1.87 (pure)
1.33 (50% solution)
VP: 0.03 mmHg
MLT: 108°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash (>1.6%)
Quick drench (>1.6%)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
25 mg/m^3: Sa:Cf*
50 mg/m^3: 100F/ScbaF/SaF
1000 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong caustics, most metals [**Note:** Readily reacts with metals to form flammable hydrogen gas. DO NOT MIX WITH SOLUTIONS CONTAINING BLEACH OR AMMONIA.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; eye, skin, burns; derm
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush Immed
Breath: Resp support
Swallow: Medical attention immed

Phosphorus (yellow)

Formula:	CAS#:	RTECS#:	IDLH:
P_4	7723-14-0	TH3500000	5 mg/m^3

Conversion: **DOT:** 1381 136

Synonyms/Trade Names: Elemental phosphorus, White phosphorus

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3
OSHA PEL: TWA 0.1 mg/m^3

Measurement Methods (see Table 1):
NIOSH 7905

Physical Description: White to yellow, soft, waxy solid with acrid fumes in air.
[**Note:** Usually shipped or stored in water.]

Chemical & Physical Properties:
MW: 124.0
BP: 536°F
Sol: 0.0003%
Fl.P: ?
IP: ?
Sp.Gr: 1.82
VP: 0.03 mmHg
MLT: 111°F
UEL: ?
LEL: ?
Flammable Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact*****
[***Note:** Flame retardant personal protective equipment should be provided.]
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1 mg/m^3: Sa
2.5 mg/m^3: Sa:Cf£
5 mg/m^3: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: ScbaE

Incompatibilities and Reactivities: Air, oxidizers (including elemental sulfur & strong caustics), halogens
[**Note:** Ignites SPONTANEOUSLY in moist air.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, resp tract; eye, skin burns; abdom pain, nau, jaun; anemia; cachexia; dental pain, salv, jaw pain, swell
TO: Eyes, skin, resp sys, liver, kidneys, jaw, teeth, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Phosphorus oxychloride

Formula:	CAS#:	RTECS#:	IDLH:
$POCl_3$	10025-87-3	TH4897000	N.D.

Conversion: 1 ppm = 6.27 mg/m^3 **DOT:** 1810 137

Synonyms/Trade Names: Phosphorus chloride, Phosphorus oxytrichloride, Phosphoryl chloride

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.6 mg/m^3)
ST 0.5 ppm (3 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Clear, colorless to yellow, oily liquid with a pungent & musty odor.
[**Note:** A solid below 34°F.]

Chemical & Physical Properties:
MW: 153.3
BP: 222°F
Sol: Decomposes
Fl.P: NA
IP: ?
Sp.Gr(77°F): 1.65
VP(81°F): 40 mmHg
FRZ: 34°F
UEL: NA
LEL: NA
Noncombustible Liquid, but may set fire to combustible materials.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Water, combustible materials, carbon disulfide, dimethyl-formamide, metals (except nickel & lead) [**Note:** Decomposes in water to hydrochloric & phosphoric acids.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; eye, skin burns; dysp, cough, pulm edema; dizz, head, lass; abdom pain, nau, vomit; neph
TO: Eyes, skin, resp sys, CNS, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Phosphorus pentachloride

Formula: PCl_5 | **CAS#:** 10026-13-8 | **RTECS#:** TB6125000 | **IDLH:** 70 mg/m^3

Conversion: **DOT:** 1806 137

Synonyms/Trade Names: Pentachlorophosphorus, Phosphoric chloride, Phosphorus perchloride

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3
OSHA PEL: TWA 1 mg/m^3

Measurement Methods (see Table 1):
NIOSH S257 (II-5)

Physical Description: White to pale-yellow, crystalline solid with a pungent, unpleasant odor.

Chemical & Physical Properties:
MW: 208.3
BP: Sublimes
Sol: Reacts
Fl.P: NA
IP: ?
Sp.Gr: 3.60
VP(132°F): 1 mmHg
MLT: 324°F (Sublimes)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 mg/m^3: Sa*
25 mg/m^3: Sa:Cf*
50 mg/m^3: ScbaF/SaF
70 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Water, magnesium oxide, chemically-active metals such as sodium and potassium, alkalis, amines
[**Note:** Hydrolyzes in water (even in humid air) to form hydrochloric acid & phosphoric acid. Corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; bron; derm
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

P

Phosphorus pentasulfide

Formula: P_2S_5/P_4S_{10} | **CAS#:** 1314-80-3 | **RTECS#:** TH4375000 | **IDLH:** 250 mg/m^3

Conversion: **DOT:** 1340 139

Synonyms/Trade Names: Phosphorus persulfide, Phosphorus sulfide, Sulfur phosphide

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3
ST 3 mg/m^3
OSHA PEL†: TWA 1 mg/m^3

Measurement Methods (see Table 1):
None available

Physical Description: Greenish-gray to yellow, crystalline solid with an odor of rotten eggs.

Chemical & Physical Properties:
MW: 222.3 (P_2S_5)
444.6 (P_4S_{10})
BP: 957°F
Sol: Reacts
Fl.P: ?
IP: ?
Sp.Gr: 2.09
VP(572°F): 1 mmHg
MLT: 550°F
UEL: ?
LEL: ?
Flammable Solid, which may SPONTANEOUSLY ignite in presence of moisture.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 mg/m^3: Sa*
25 mg/m^3: Sa:Cf*
50 mg/m^3: ScbaF/SaF
250 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS100/ScbaE

Incompatibilities and Reactivities: Water, alcohols, strong oxidizers, acids, alkalis [**Note:** Reacts with water to form hydrogen sulfide, sulfur dioxide, and phosphoric acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; apnea, coma, convuls; conj pain, lac, photo, kerato-conj, corn vesic; dizz; head; lass; irrity, insom; GI dist
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Dust off solid; water flush
Breath: Resp support
Swallow: Medical attention immed

Phosphorus trichloride

Formula: PCl_3 | **CAS#:** 7719-12-2 | **RTECS#:** TH3675000 | **IDLH:** 25 ppm

Conversion: 1 ppm = 5.62 mg/m^3 | **DOT:** 1809 137

Synonyms/Trade Names: Phosphorus chloride

Exposure Limits:
NIOSH REL: TWA 0.2 ppm (1.5 mg/m^3)
ST 0.5 ppm (3 mg/m^3)
OSHA PEL†: TWA 0.5 ppm (3 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 6402

Physical Description: Colorless to yellow, fuming liquid with an odor like hydrochloric acid.

Chemical & Physical Properties:
MW: 137.4
BP: 169°F
Sol: Reacts
Fl.P: NA
IP: 9.91 eV
Sp.Gr: 1.58
VP: 100 mmHg
FRZ: -170°F
UEL: NA
LEL: NA
Noncombustible Liquid; however, a strong oxidizer that may ignite combustibles upon contact.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
10 ppm: ScbaF/SaF
25 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS¿/ScbaE

Incompatibilities and Reactivities: Water, chemically-active metals such as sodium & potassium, aluminum, strong nitric acid, acetic acid, organic matter [**Note:** Hydrolyzes in water to form hydrochloric acid and phosphoric acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; pulm edema; eye, skin burns
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Phthalic anhydride

Formula: $C_6H_4(CO)_2O$ | **CAS#:** 85-44-9 | **RTECS#:** TI3150000 | **IDLH:** 60 mg/m^3

Conversion: 1 ppm = 6.06 mg/m^3 | **DOT:** 2214 156

Synonyms/Trade Names: 1,2-Benzenedicarboxylic anhydride; PAN; Phthalic acid anhydride

Exposure Limits:
NIOSH REL: TWA 6 mg/m^3 (1 ppm)
OSHA PEL†: TWA 12 mg/m^3 (2 ppm)

Measurement Methods (see Table 1):
NIOSH S179 (II-3)
OSHA 90

Physical Description: White solid (flake) or a clear, colorless, mobile liquid (molten) with a characteristic, acrid odor.

Chemical & Physical Properties:
MW: 148.1
BP: 563°F
Sol: 0.6%
Fl.P: 305°F
IP: 10.00 eV
Sp.Gr: 1.53 (Flake)
1.20 (Molten)
VP: 0.0015 mmHg
MLT: 267°F
UEL: 10.5%
LEL: 1.7%
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
30 mg/m^3: Qm*
60 mg/m^3: 95XQ*/95F/PaprHie*/
Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, water [**Note:** Converted to phthalic acid in hot water.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; conj; nasal ulcer bleeding; bron, bronchial asthma; derm; in animals: liver, kidney damage
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

m-Phthalodinitrile

Formula:	CAS#:	RTECS#:	IDLH:
$C_6H_4(CN)_2$	626-17-5	CZ1900000	N.D.

Conversion: **DOT:**

Synonyms/Trade Names: 1,3-Benzenedicarbonitrile; m-Dicyanobenzene; 1,3-Dicyanobenzene; Isophthalodinitrile; m-PDN

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Needle-like, colorless to white, crystalline, flaky solid with an almond-like odor.

Chemical & Physical Properties:
MW: 128.1
BP: Sublimes
Sol: Slight
Fl.P: ?
IP: ?
Sp.Gr: 4.42
VP: 0.01 mmHg
MLT: 324°F (Sublimes)
UEL: ?
LEL: ?
Combustible Solid and a severe explosion hazard.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers (e.g., chlorine, bromine, fluorine)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Head, nau, conf; in animals: irrit eyes, skin
TO: Eyes, skin, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

P

Picloram

Formula:	CAS#:	RTECS#:	IDLH:
$C_6H_3Cl_3O_2N_2$	1918-02-1	TJ7525000	N.D.

Conversion: **DOT:**

Synonyms/Trade Names: 4-Amino-3,5,6-trichloropicolinic acid; 4-Amino-3,5,6-trichloro-2-picolinic acid; ATCP; Tordon®

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: TWA 15 mg/m^3 (total) TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Colorless to white crystals with a chlorine-like odor. [herbicide]

Chemical & Physical Properties:
MW: 241.5
BP: Decomposes
Sol: 0.04%
Fl.P: ?
IP: ?
Sp.Gr: ?
VP(95°F): 0.0000006 mmHg
MLT: 424°F (Decomposes)
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Hot concentrated alkali (hydrolyzes)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; nau; in animals: liver, kidney changes
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Fresh air
Swallow: Medical attention immed

Picric acid	**Formula:** $(NO_2)_3C_6H_2OH$	**CAS#:** 88-89-1	**RTECS#:** TJ7875000	**IDLH:** 75 mg/m^3
Conversion: 1 ppm = 9.37 mg/m^3	**DOT:** 1344 113 (wet, ≥ 10% water); 3364 113 (wetted, ≥ 10% water)			
Synonyms/Trade Names: Phenol trinitrate; 2,4,6-Trinitrophenol [**Note:** An OSHA Class A Explosive (1910.109).]				
Exposure Limits: **NIOSH REL:** TWA 0.1 mg/m^3 ST 0.3 mg/m^3 [skin] **OSHA PEL:** TWA 0.1 mg/m^3 [skin]				**Measurement Methods (see Table 1):** **NIOSH** S228 (II-4)
Physical Description: Yellow, odorless solid. [**Note:** Usually used as an aqueous solution.]				

Chemical & Physical Properties:	**Personal Protection/Sanitation (see Table 2):**	**Respirator Recommendations (see Tables 3 and 4):**
MW: 229.1 **BP:** Explodes above 572°F **Sol:** 1% **Fl.P:** 302°F **IP:** ? **Sp.Gr:** 1.76 **VP(383°F):** 1 mmHg **MLT:** 252°F **UEL:** ? **LEL:** ? Combustible Solid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam/Daily **Remove:** When wet or contam **Change:** Daily	**NIOSH/OSHA** **0.5 mg/m^3:** Qm **1 mg/m^3:** 95XQ/Sa **2.5 mg/m^3:** Sa:Cf/PaprHie **5 mg/m^3:** 100F/SaT:Cf/PaprTHie/ScbaF/SaF **75 mg/m^3:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE

Incompatibilities and Reactivities: Copper, lead, zinc & other metals; salts; plaster; concrete; ammonia [**Note:** Corrosive to metals. An explosive mixture results when the aqueous solution crystallizes.]	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin; sens derm; yellow-stained hair, skin; lass, myalgia, anuria, polyuria; bitter taste, GI dist; hepatitis, hema, album, neph **TO:** Eyes, skin, kidneys, liver, blood	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed

P

Pindone	**Formula:** $C_9H_5O_2C(O)C(CH_3)_3$	**CAS#:** 83-26-1	**RTECS#:** NK6300000	**IDLH:** 100 mg/m^3
Conversion:	**DOT:**			
Synonyms/Trade Names: tert-Butyl valone; 1,3-Dioxo-2-pivaloy-lindane; Pival®; Pivalyl; 2-Pivalyl-1,3-indandione				
Exposure Limits: **NIOSH REL:** TWA 0.1 mg/m^3 **OSHA PEL:** TWA 0.1 mg/m^3				**Measurement Methods (see Table 1):** None available
Physical Description: Bright-yellow powder with almost no odor. [rodenticide]				

Chemical & Physical Properties:	**Personal Protection/Sanitation (see Table 2):**	**Respirator Recommendations (see Tables 3 and 4):**
MW: 230.3 **BP:** Decomposes **Sol(77°F):** 0.002% **Fl.P:** ? **IP:** ? **Sp.Gr:** 1.06 **VP:** Very low **MLT:** 230°F **UEL:** ? **LEL:** ?	**Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** Daily	**NIOSH/OSHA** **0.5 mg/m^3:** Qm **1 mg/m^3:** 95XQ/Sa **2.5 mg/m^3:** Sa:Cf/PaprHie **5 mg/m^3:** 100F/SaT:Cf/PaprTHie/ScbaF/SaF **100 mg/m^3:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE

Incompatibilities and Reactivities: None reported	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing **SY:** Epis, excess bleeding from minor cuts, bruises; smoky urine, black tarry stools; abdom, back pain **TO:** Blood prothrombin	**First Aid (see Table 6):** **Eye:** Irr immed **Breath:** Resp support **Swallow:** Medical attention immed

Piperazine dihydrochloride	Formula: $C_4H_{10}N_2 \times 2HCl$	CAS#: 142-64-3	RTECS#: TL4025000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Piperazine hydrochloride
[**Note:** The monochloride, $C_4H_{10}N_2 \times HCl$ is also commercially available.]

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: White to cream-colored needles or powder.

Chemical & Physical Properties:
MW: 159.1
BP: ?
Sol: 41%
Fl.P: ?
IP: ?
Sp.Gr: ?
VP: ?
MLT: 635°F
UEL: ?
LEL: ?
Combustible Solid, but does not ignite easily.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Water [**Note:** Slightly hygroscopic (i.e., absorbs moisture from the air).]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; skin burns, sens; asthma; GI upset, head, nau, vomit, inco, musc weak
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

P

Plaster of Paris	Formula: $CaSO_4 \cdot 0.5H_2O$	CAS#: 26499-65-0	RTECS#: TP0700000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Calcium sulfate hemihydrate, Dried calcium sulfate, Gypsum hemihydrate, Hemihydrate gypsum
[**Note:** Plaster of Paris is the hemihydrate form of Calcium Sulfate & Gypsum is the dihydrate form.]

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: White or yellowish, finely divided, odorless powder.

Chemical & Physical Properties:
MW: 145.2
BP: ?
Sol(77°F): 0.3%
Fl.P: NA
IP: NA
Sp.Gr: 2.5
VP: 0 mmHg (approx)
MLT: 325°F (Loses H_2O)
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Moisture, water
[**Note:** Hygroscopic (i.e., absorbs moisture from the air). Reacts with water to form Gypsum.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb, resp sys; cough
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Resp support
Swallow: Medical attention immed

Platinum	Formula: Pt	CAS#: 7440-06-4	RTECS#: TP2160000	IDLH: N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: Platinum black, Platinum metal, Platinum sponge				
Exposure Limits: **NIOSH REL:** TWA 1 mg/m^3 **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **NIOSH** 7300, 7303 **OSHA** ID121, ID130SG	
Physical Description: Silvery, whitish-gray, malleable, ductile metal.				
Chemical & Physical Properties: **MW:** 195.1 **BP:** 6921°F **Sol:** Insoluble **Fl.P:** NA **IP:** NA **Sp.Gr:** 21.45 **VP:** 0 mmHg (approx) **MLT:** 3222°F **UEL:** NA **LEL:** NA Noncombustible Solid in bulk form, but finely divided powder can be dangerous to handle.	**Personal Protection/Sanitation (see Table 2):** **Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** Daily		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Aluminum, acetone, arsenic, ethane, hydrazine, hydrogen peroxide, lithium, phosphorus, selenium, tellurium, various fluorides				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit skin, resp sys; derm **TO:** Eyes, skin, resp sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash **Breath:** Resp support **Swallow:** Medical attention immed	

Platinum (soluble salts, as Pt)	Formula:	CAS#:	RTECS#:	IDLH: 4 mg/m^3 (as Pt)
Conversion:	**DOT:**			
Synonyms/Trade Names: Synonyms vary depending upon the specific soluble platinum salt.				
Exposure Limits: **NIOSH REL:** TWA 0.002 mg/m^3 **OSHA PEL:** TWA 0.002 mg/m^3			**Measurement Methods (see Table 1):** **NIOSH** 7300, 7303, S191 (II-7)	
Physical Description: Appearance and odor vary depending upon the specific soluble platinum salt.				
Chemical & Physical Properties: Properties vary depending upon the specific soluble platinum salt.	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **0.05 mg/m^3:** Sa:Cf£ **0.1 mg/m^3:** 100F/ScbaF/SaF **4 mg/m^3:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE	
Incompatibilities and Reactivities: Varies				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, nose; cough, dysp, wheez, cyan; derm, sens skin; lymphocytosis **TO:** Eyes, skin, resp sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed	

Portland cement	Formula:	CAS#:	RTECS#:	IDLH:
		65997-15-1	VV8770000	5000 mg/m^3

Conversion: **DOT:**

Synonyms/Trade Names: Cement, Hydraulic cement, Portland cement silicate [**Note:** A class of hydraulic cements containing tri- and dicalcium silicate in addition to alumina, tricalcium aluminate, and iron oxide.]

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL†: TWA 50 mppcf

Measurement Methods (see Table 1):
NIOSH 0500
OSHA ID207

Physical Description: Gray, odorless powder.

Chemical & Physical Properties:
MW: ?
BP: NA
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: ?
VP: 0 mmHg (approx)
MLT: NA
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
50 mg/m^3: Qm
100 mg/m^3: 95XQ/Sa
250 mg/m^3: Sa:Cf/PaprHie
500 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
5000 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose; cough, expectoration; exertional dysp, wheez, chronic bron; derm
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Fresh air
Swallow: Medical attention immed

P

Potassium cyanide (as CN)	Formula:	CAS#:	RTECS#:	IDLH:
	KCN	151-50-8	TS8750000	25 mg/m^3 (as CN)

Conversion: **DOT:** 1680 157 (solid); 3413 157 (solution)

Synonyms/Trade Names: Potassium salt of hydrocyanic acid

Exposure Limits:
NIOSH REL*: C 5 mg/m^3 (4.7 ppm) [10-minute]
OSHA PEL*: TWA 5 mg/m^3
[***Note:** The REL and PEL also apply to other cyanides (as CN) except Hydrogen cyanide.]

Measurement Methods (see Table 1):
NIOSH 6010, 7904

Physical Description: White, granular or crystalline solid with a faint, almond-like odor.

Chemical & Physical Properties:
MW: 65.1
BP: 2957°F
Sol(77°F): 72%
Fl.P: NA
IP: NA
Sp.Gr: 1.55
VP: 0 mmHg (approx)
MLT: 1173°F
UEL: NA
LEL: NA
Noncombustible Solid, but contact with acids releases highly flammable hydrogen cyanide.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
25 mg/m^3: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers (such as acids, acid salts, chlorates & nitrates)
[**Note:** Absorbs moisture from the air forming a syrup.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, upper resp sys; asphy; lass, head, conf; nau, vomit; incr resp rate, slow gasping respiration; thyroid, blood changes
TO: Eyes, skin, resp sys, CVS, CNS, thyroid, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Potassium hydroxide	**Formula:** KOH	**CAS#:** 1310-58-3	**RTECS#:** TT2100000	**IDLH:** N.D.
Conversion:	**DOT:** 1813 154 (dry, solid); 1814 154 (solution)			
Synonyms/Trade Names: Caustic potash, Lye, Potassium hydrate				
Exposure Limits: **NIOSH REL:** C 2 mg/m^3 **OSHA PEL†:** none				**Measurement Methods (see Table 1):** **NIOSH** 7401
Physical Description: Odorless, white or slightly yellow lumps, rods, flakes, sticks, or pellets. [**Note:** May be used as an aqueous solution.]				
Chemical & Physical Properties: **MW:** 56.1 **BP:** 2415°F **Sol(59°F):** 107% **Fl.P:** NA **IP:** ? **Sp.Gr:** 2.04 **VP(1317°F):** 1 mmHg **MLT:** 716°F **UEL:** NA **LEL:** NA Noncombustible Solid; however, may react with H_2O & other substances and generate sufficient heat to ignite combustible materials.	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily **Provide:** Eyewash Quick drench		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Acids, water, metals (when wet), halogenated hydrocarbons, maleic anhydride [**Note:** Heat is generated if KOH comes in contact with H_2O & CO_2 from the air.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, resp sys; cough, sneez; eye, skin burns; vomit, diarr **TO:** Eyes, skin, resp sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed	

P

Propane	**Formula:** $CH_3CH_2CH_3$	**CAS#:** 74-98-6	**RTECS#:** TX2275000	**IDLH:** 2100 ppm [10%LEL]
Conversion: 1 ppm = 1.80 mg/m^3	**DOT:** 1075 115; 1978 115			
Synonyms/Trade Names: Bottled gas, Dimethyl methane, n-Propane, Propyl hydride				
Exposure Limits: **NIOSH REL:** TWA 1000 ppm (1800 mg/m^3) **OSHA PEL:** TWA 1000 ppm (1800 mg/m^3)				**Measurement Methods (see Table 1):** **NIOSH** S87 (II-2) **OSHA** PV2077
Physical Description: Colorless, odorless gas. [**Note:** A foul-smelling odorant is often added when used for fuel purposes. Shipped as a liquefied compressed gas.]				
Chemical & Physical Properties: **MW:** 44.1 **BP:** -44°F **Sol:** 0.01% **Fl.P:** NA (Gas) **IP:** 11.07 eV **RGasD:** 1.55 **VP(70°F):** 8.4 atm **FRZ:** -306°F **UEL:** 9.5% **LEL:** 2.1% Flammable Gas	**Personal Protection/Sanitation (see Table 2):** **Skin:** Frostbite **Eyes:** Frostbite **Wash skin:** N.R. **Remove:** When wet (flamm) **Change:** N.R. **Provide:** Frostbite wash		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **2100 ppm:** Sa/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** ScbaE	
Incompatibilities and Reactivities: Strong oxidizers				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Con (liquid) **SY:** Dizz, conf, excitation, asphy; liquid: frostbite **TO:** CNS			**First Aid (see Table 6):** **Eye:** Frostbite **Skin:** Frostbite **Breath:** Resp support	

Propane sultone

Formula:	CAS#:	RTECS#:	IDLH:
$C_3H_6O_3S$	1120-71-4	RP5425000	Ca [N.D.]

Conversion: **DOT:**

Synonyms/Trade Names: 3-Hydroxy-1-propanesulphonic acid sultone; 1,3-Propane sultone

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: White, crystalline solid or a colorless liquid (above 86°F). [**Note:** Releases a foul odor as it melts.]

Chemical & Physical Properties:
MW: 122.2
BP: ?
Sol: 10%
Fl.P: >235°F
IP: ?
Sp.Gr: 1.39
VP: ?
MLT: 86°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; [carc]
TO: Eyes, skin, resp sys [in animals: skin tumors, leukemia, gliomas]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

P

1-Propanethiol

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3CH_2CH_2SH$	107-03-9	TZ7300000	N.D.

Conversion: 1 ppm = 3.12 mg/m^3 **DOT:** 2402 130

Synonyms/Trade Names: 3-Mercaptopropane, Propane-1-thiol, Propyl mercaptan, n-Propyl mercaptan

Exposure Limits:
NIOSH REL: C 0.5 ppm (1.6 mg/m^3) [15-minute]
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with an offensive, cabbage-like odor.

Chemical & Physical Properties:
MW: 76.2
BP: 153°F
Sol: Slight
Fl.P: -5°F
IP: 9.195 eV
Sp.Gr: 0.84
VP(77°F): 155 mmHg
FRZ: -172°F
UEL: ?
LEL: ?
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 ppm: CcrOv/Sa
12.5 ppm: Sa:Cf/PaprOv
25 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, reducing agents, strong acids & bases, alkali metals, calcium hypochlorite

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat, resp sys; head, nau, dizz, cyan; in animals: liver, kidney damage
TO: Eyes, skin, resp sys, CNS, blood, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Propargyl alcohol	Formula: C_3H_3OH	CAS#: 107-19-7	RTECS#: UK5075000	IDLH: N.D.
Conversion: 1 ppm = 2.29 mg/m^3	**DOT:** 1986 131			
Synonyms/Trade Names: 1-Propyn-3-ol; 2-Propyn-1-ol; 2-Propynyl alcohol				
Exposure Limits: **NIOSH REL:** TWA 1 ppm (2 mg/m^3) [skin] **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **OSHA** 97	
Physical Description: Colorless to straw-colored liquid with a mild, geranium odor.				
Chemical & Physical Properties: **MW:** 56.1 **BP:** 237°F **Sol:** Miscible **Fl.P(oc):** 97°F **IP:** 10.51 eV **Sp.Gr:** 0.97 **VP:** 12 mmHg **FRZ:** -62°F **UEL:** ? **LEL:** ? Class IC Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R. **Provide:** Eyewash Quick drench		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Phosphorus pentoxide, oxidizers				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit skin, muc memb; CNS depres; in animals: liver, kidney damage **TO:** Skin, resp sys, CNS, liver, kidneys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed	

β-Propiolactone	Formula: $C_3H_4O_2$	CAS#: 57-57-8	RTECS#: RQ7350000	IDLH: Ca [N.D]
Conversion:	**DOT:**			
Synonyms/Trade Names: BPL; Hydroacrylic acid, β-lactone; 3-Hydroxy-β-lactone; 3-Hydroxy-propionic acid; β-Lactone; 2-Oxetanone; 3-Propiolactone				
Exposure Limits: **NIOSH REL:** Ca See Appendix A **OSHA PEL:** [1910.1013] See Appendix B			**Measurement Methods (see Table 1):** None available	
Physical Description: Colorless liquid with a slightly sweet odor.				
Chemical & Physical Properties: **MW:** 72.1 **BP:** 323°F (Decomposes) **Sol:** 37% **Fl.P:** 165°F **IP:** ? **Sp.Gr:** 1.15 **VP(77°F):** 3 mmHg **FRZ:** -28°F **UEL:** ? **LEL:** 2.9% Class IIIA Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam/Daily **Remove:** When wet or contam **Change:** Daily **Provide:** Eyewash Quick drench		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **¥:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE **See Appendix E** (page 351)	
Incompatibilities and Reactivities: Acetates, halogens, thiocyanates, thiosulfates [**Note:** May polymerize upon storage.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Skin irrit, blistering, burns; corn opac; frequent urination; dysuria; hema; [carc] **TO:** Kidneys, skin, lungs, eyes [in animals: tumors of the liver, skin & stomach]			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed	

Propionic acid

Formula:	CAS#:	RTECS#:	IDLH:
CH_3CH_2COOH	79-09-4	UE5950000	N.D.

Conversion: 1 ppm = 3.03 mg/m^3 **DOT:** 1848 132

Synonyms/Trade Names: Carboxyethane, Ethanecarboxylic acid, Ethylformic acid, Metacetonic acid, Methyl acetic acid, Propanoic acid

Exposure Limits:
NIOSH REL: TWA 10 ppm (30 mg/m^3)
ST 15 ppm (45 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless, oily liquid with a pungent, disagreeable, rancid odor. [**Note:** A solid below 5°F.]

Chemical & Physical Properties:
MW: 74.1
BP: 286°F
Sol: Miscible
Fl.P: 126°F
IP: 10.24 eV
Sp.Gr: 0.99
VP: 3 mmHg
FRZ: 5°F
UEL: 12.1%
LEL: 2.9%
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Alkalis, strong oxidizers (e.g., chromium trioxide) [**Note:** Corrosive to steel.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; blurred vision, corn burns; skin burns; abdom pain, nau, vomit
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

P

Propionitrile

Formula:	CAS#:	RTECS#:	IDLH:
CH_3CH_2CN	107-12-0	UF9625000	N.D.

Conversion: 1 ppm = 2.25 mg/m^3 **DOT:** 2404 131

Synonyms/Trade Names: Cyanoethane, Ethyl cyanide, Propanenitrile, Propionic nitrile, Propiononitrile

Exposure Limits:
NIOSH REL: TWA 6 ppm (14 mg/m^3)
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 1606 (adapt)

Physical Description: Colorless liquid with a pleasant, sweetish, ethereal odor. [**Note:** Forms cyanide in the body.]

Chemical & Physical Properties:
MW: 55.1
BP: 207°F
Sol: 11.9%
Fl.P: 36°F
IP: 11.84 eV
Sp.Gr: 0.78
VP: 35 mmHg
FRZ: -133°F
UEL: ?
LEL: 3.1%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
60 ppm: CcrOv/Sa
150 ppm: Sa:Cf/PaprOv
300 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
1000 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers & reducing agents, strong acids & bases
[**Note:** Hydrogen cyanide is produced when propionitrile is heated to decomposition.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; nau, vomit; chest pain; lass; stupor, convuls; in animals: liver, kidney damage
TO: Eyes, skin, resp sys, CVS, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Propoxur	**Formula:** $CH_3NHCOOC_6H_4OCH(CH_3)_2$	**CAS#:** 114-26-1	**RTECS#:** FC3150000	**IDLH:** N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Aprocarb®, o-Isopropoxyphenyl-N-methylcarbamate, N-Methyl-2-isopropoxyphenyl-carbamate

Exposure Limits:
NIOSH REL: TWA 0.5 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5601
OSHA PV2007

Physical Description: White to tan, crystalline powder with a faint, characteristic odor. [insecticide]

Chemical & Physical Properties:
MW: 209.3
BP: Decomposes
Sol: 0.2%
Fl.P: >300°F
IP: ?
Sp.Gr: ?
VP: 0.000007 mmHg
MLT: 187-197°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers, alkalis
[**Note:** Emits highly toxic methyl isocyanate fumes when heated to decomposition.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Miosis, blurred vision; sweat, salv; abdom cramps, nau, diarr, vomit; head, lass, musc twitch
TO: CNS, liver, kidneys, GI tract, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

P

n-Propyl acetate	**Formula:** $CH_3COOCH_2CH_2CH_3$	**CAS#:** 109-60-4	**RTECS#:** AJ3675000	**IDLH:** 1700 ppm
Conversion: 1 ppm = 4.18 mg/m^3	**DOT:** 1276 129			

Synonyms/Trade Names: Propylacetate, n-Propyl ester of acetic acid

Exposure Limits:
NIOSH REL: TWA 200 ppm (840 mg/m^3)
ST 250 ppm (1050 mg/m^3)
OSHA PEL†: TWA 200 ppm (840 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1450
OSHA 7

Physical Description: Colorless liquid with a mild, fruity odor.

Chemical & Physical Properties:
MW: 102.2
BP: 215°F
Sol: 2%
Fl.P: 55°F
IP: 10.04 eV
Sp.Gr: 0.84
VP: 25 mmHg
FRZ: -134°F
UEL: 8%
LEL(100°F): 1.7%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1700 ppm: Sa:Cf£/CcrFOv/GmFOv/PaprOv£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Nitrates; strong oxidizers, alkalis & acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: irrit eyes, nose, throat; narco; derm
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

n-Propyl alcohol

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3CH_2CH_2OH$	71-23-8	UH8225000	800 ppm

Conversion: 1 ppm = 2.46 mg/m^3 **DOT:** 1274 129

Synonyms/Trade Names: Ethyl carbinol, 1-Propanol, n-Propanol, Propyl alcohol

Exposure Limits:
NIOSH REL: TWA 200 ppm (500 mg/m^3) [skin]
ST 250 ppm (625 mg/m^3)
OSHA PEL†: TWA 200 ppm (500 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1401, 1405
OSHA 7

Physical Description: Colorless liquid with a mild, alcohol-like odor.

Chemical & Physical Properties:
MW: 60.1
BP: 207°F
Sol: Miscible
Fl.P: 72°F
IP: 10.15 eV
Sp.Gr: 0.81
VP: 15 mmHg
FRZ: -196°F
UEL: 13.7%
LEL: 2.2%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
800 ppm: CcrOv*/PaprOv*/GmFOv/Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose, throat; dry cracking skin; drow, head; ataxia, GI pain; abdom cramps, nau, vomit, diarr; in animals: narco
TO: Eyes, skin, resp sys, GI tract, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush
Breath: Resp support
Swallow: Medical attention immed

P

Propylene dichloride

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3CHClCH_2Cl$	78-87-5	TX9625000	Ca [400 ppm]

Conversion: 1 ppm = 4.62 mg/m^3 **DOT:** 1279 130

Synonyms/Trade Names: Dichloro-1,2-propane; 1,2-Dichloropropane

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: TWA 75 ppm (350 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1013
OSHA 7

Physical Description: Colorless liquid with a chloroform-like odor. [pesticide]

Chemical & Physical Properties:
MW: 113.0
BP: 206°F
Sol: 0.3%
Fl.P: 60°F
IP: 10.87 eV
Sp.Gr: 1.16
VP: 40 mmHg
FRZ: -149°F
UEL: 14.5%
LEL: 3.4%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids, active metals

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; drow, dizz; liver, kidney damage; in animals: CNS depres; [carc]
TO: Eyes, skin, resp sys, liver, kidneys, CNS [in animals: liver & mammary gland tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Propylene glycol dinitrate	Formula: $CH_3CNO_2OHCHNO_2OH$	CAS#: 6423-43-4	RTECS#: TY6300000	IDLH: N.D.
Conversion: 1 ppm = 6.79 mg/m^3	**DOT:**			

Synonyms/Trade Names: PGDN; Propylene glycol-1,2-dinitrate; 1,2-Propylene glycol dinitrate

Exposure Limits:
NIOSH REL: TWA 0.05 ppm (0.3 mg/m^3) [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with a disagreeable odor. [**Note:** A solid below 18°F.]

Chemical & Physical Properties:
MW: 166.1
BP: ?
Sol: 0.1%
Fl.P: ?
IP: ?
Sp.Gr(77°F): 1.23
VP(72°F): 0.07 mmHg
FRZ: 18°F
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Ammonia compounds, amines, oxidizers, reducing agents, combustible materials [**Note:** Similar to Ethylene glycol dinitrate in explosion potential.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes; conj; methemo; head, impaired balance, vis dist; in animals: liver, kidney damage
TO: Eyes, CNS, blood, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Propylene glycol monomethyl ether	Formula: $CH_3OCH_2CHCH_3$	CAS#: 107-98-2	RTECS#: UB7700000	IDLH: N.D.
Conversion: 1 ppm = 3.69 mg/m^3	**DOT:**			

Synonyms/Trade Names: Dowtherm® 209, 1-Methoxy-2-hydroxypropane, 1-Methoxy-2-propanol, 2-Methoxy-1-methylethanol, Propylene glycol methyl ether

Exposure Limits:
NIOSH REL: TWA 100 ppm (360 mg/m^3)
ST 150 ppm (540 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 2554
OSHA 99

Physical Description: Clear, colorless liquid with a mild, ethereal odor.

Chemical & Physical Properties:
MW: 90.1
BP: 248°F
Sol: Miscible
Fl.P: 97°F
IP: ?
Sp.Gr: 0.96
VP(77°F): 12 mmHg
FRZ: -139°F (Sets to glass)
UEL(calc): 13.8%
LEL(calc.): 1.6%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers, strong acids [**Note:** Hygroscopic (i.e., absorbs moisture from air). May slowly form reactive peroxides during prolonged storage.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; head, nau, dizz, drow, inco; vomit, diarr
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash
Breath: Resp support
Swallow: Medical attention immed

Propylene imine	Formula: C_3H_7N	CAS#: 75-55-8	RTECS#: CM8050000	IDLH: Ca [100 ppm]
Conversion: 1 ppm = 2.34 mg/m^3	**DOT:** 1921 131P (inhibited)			

Synonyms/Trade Names: 2-Methylaziridine, 2-Methylethyleneimine, Propyleneimine, Propylene imine (inhibited), Propylenimine

Exposure Limits:
NIOSH REL: Ca
TWA 2 ppm (5 mg/m^3) [skin]
See Appendix A
OSHA PEL: TWA 2 ppm (5 mg/m^3) [skin]

Measurement Methods (see Table 1):
None available

Physical Description: Colorless, oily liquid with an ammonia-like odor.

Chemical & Physical Properties:
MW: 57.1
BP: 152°F
Sol: Miscible
Fl.P: 25°F
IP: 9.00 eV
Sp.Gr: 0.80
VP: 112 mmHg
FRZ: -85°F
UEL: ?
LEL: ?
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Acids, strong oxidizers, water, carbonyl compounds, quinones, sulfonyl halides
[**Note:** Subject to violent polymerization in contact with acids. Hydrolyzes in water to form methylethanolamine.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Eye, skin burns; [carc]
TO: Eyes, skin [in animals: nasal tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

P

Propylene oxide	Formula: C_3H_6O	CAS#: 75-56-9	RTECS#: TZ2975000	IDLH: Ca [400 ppm]
Conversion: 1 ppm = 2.38 mg/m^3	**DOT:** 1280 127P			

Synonyms/Trade Names: 1,2-Epoxy propane; Methyl ethylene oxide; Methyloxirane; Propene oxide; 1,2-Propylene oxide

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: TWA 100 ppm (240 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1612
OSHA 88

Physical Description: Colorless liquid with a benzene-like odor. [**Note:** A gas above 94°F.]

Chemical & Physical Properties:
MW: 58.1
BP: 94°F
Sol: 41%
Fl.P: -35°F
IP: 9.81 eV
Sp.Gr: 0.83
VP: 445 mmHg
FRZ: -170°F
UEL: 36%
LEL: 2.3%
Class IA Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Anhydrous metal chlorides; iron; strong acids, caustics & peroxides
[**Note:** Polymerization may occur due to high temperatures or contamination with alkalis, aqueous acids, amines & acidic alcohols.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; skin blisters, burns; [carc]
TO: Eyes, skin, resp sys [in animals: nasal tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

n-Propyl nitrate	Formula: $CH_3CH_2CH_2ONO_2$	CAS#: 627-13-4	RTECS#: UK0350000	IDLH: 500 ppm
Conversion: 1 ppm = 4.30 mg/m^3	**DOT:** 1865 131			
Synonyms/Trade Names: Propyl ester of nitric acid				
Exposure Limits: **NIOSH REL:** TWA 25 ppm (105 mg/m^3) ST 40 ppm (170 mg/m^3) **OSHA PEL†:** TWA 25 ppm (110 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** S227 (II-3) **OSHA** 7	
Physical Description: Colorless to straw-colored liquid with an ether-like odor.				
Chemical & Physical Properties: **MW:** 105.1 **BP:** 231°F **Sol:** Slight **Fl.P:** 68°F **IP:** 11.07 eV **Sp.Gr:** 1.07 **VP:** 18 mmHg **FRZ:** -148°F **UEL:** 100% **LEL:** 2% Class IB Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **250 ppm:** Sa **500 ppm:** Sa:Cf/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFS¿/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers, combustible materials [**Note:** Forms explosive mixtures with combustible materials.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** In animals: irrit eyes, skin; methemo, anoxia, cyan; dysp, lass, dizz, head **TO:** Eyes, skin, blood			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Pyrethrum	Formula: $C_{20}H_{28}O_3/C_{21}H_{28}O_5/C_{21}H_{30}O_3/C_{22}H_{30}O_5/C_{21}H_{28}O_3/C_{22}H_{28}O_5$	CAS#: 8003-34-7	RTECS#: UR4200000	IDLH: 5000 mg/m^3
Conversion:	**DOT:**			
Synonyms/Trade Names: Cinerin I or II, Jasmolin I or II, Pyrethrin I or II, Pyrethrum I or II [**Note:** Pyrethrum is a variable mixture of Cinerin, Jasmolin, and Pyrethrin.]				
Exposure Limits: **NIOSH REL:** TWA 5 mg/m^3 **OSHA PEL:** TWA 5 mg/m^3			**Measurement Methods (see Table 1):** **NIOSH** 5008 **OSHA** 70	
Physical Description: Brown, viscous oil or solid. [insecticide]				
Chemical & Physical Properties: **MW:** 316-374 **BP:** ? **Sol:** Insoluble **Fl.P:** 180-190°F **IP:** ? **Sp.Gr:** 1 (approx) **VP:** Low **MLT:** ? **UEL:** ? **LEL:** ? Class IIIA Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **50 mg/m^3:** CcrOv95*/Sa* **125 mg/m^3:** Sa:Cf*/PaprOvHie* **250 mg/m^3:** CcrFOv100/PaprTOvHie*/ScbaF/SaF **5000 mg/m^3:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv100/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Erythema, derm, papules, pruritus, rhin; sneez; asthma **TO:** Resp sys, skin, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed	

Pyridine

Formula:	CAS#:	RTECS#:	IDLH:
C_5H_5N	110-86-1	UR8400000	1000 ppm

Conversion: 1 ppm = 3.24 mg/m^3 **DOT:** 1282 129

Synonyms/Trade Names: Azabenzene, Azine

Exposure Limits:
NIOSH REL: TWA 5 ppm (15 mg/m^3)
OSHA PEL: TWA 5 ppm (15 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1613
OSHA 7

Physical Description: Colorless to yellow liquid with a nauseating, fish-like odor.

Chemical & Physical Properties:
MW: 79.1
BP: 240°F
Sol: Miscible
Fl.P: 68°F
IP: 9.27 eV
Sp.Gr: 0.98
VP: 16 mmHg
FRZ: -44°F
UEL: 12.4%
LEL: 1.8%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
125 ppm: Sa:Cf£/PaprOv£
50 ppm: CcrFOv/GmFOv/PaprTOv£/ ScbaF/SaF
1000 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes; head, anxi, dizz, insom; nau, anor; derm; liver, kidney damage
TO: Eyes, skin, CNS, liver, kidneys, GI tract,

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Quinone

Formula:	CAS#:	RTECS#:	IDLH:
OC_6H_4O	106-51-4	DK2625000	100 mg/m^3

Conversion: 1 ppm = 4.42 mg/m^3 **DOT:** 2587 153

Synonyms/Trade Names: 1,4-Benzoquinone; p-Benzoquinone; 1,4-Cyclohexadiene dioxide; p-Quinone

Exposure Limits:
NIOSH REL: TWA 0.4 mg/m^3 (0.1 ppm)
OSHA PEL: TWA 0.4 mg/m^3 (0.1 ppm)

Measurement Methods (see Table 1):
NIOSH S181 (II-4)

Physical Description: Pale-yellow solid with an acrid, chlorine-like odor.

Chemical & Physical Properties:
MW: 108.1
BP: Sublimes
Sol: Slight
Fl.P: 100-200°F
IP: 9.68 eV
Sp.Gr: 1.32
VP(77°F): 0.1 mmHg
MLT: 240°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 mg/m^3: Sa:Cf£
20 mg/m^3: ScbaF/SaF
100 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Eye irrit, conj; kera; skin irrit
TO: Eyes, skin

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Resorcinol

Formula: $C_6H_4(OH)_2$ | **CAS#:** 108-46-3 | **RTECS#:** VG9625000 | **IDLH:** N.D.

Conversion: 1 ppm = 4.50 mg/m^3 | **DOT:** 2876 153

Synonyms/Trade Names: 1,3-Benzenediol; m-Benzenediol; 1,3-Dihydroxybenzene; m-Dihydroxybenzene; 3-Hydroxyphenol; m-Hydroxyphenol

Exposure Limits:
NIOSH REL: TWA 10 ppm (45 mg/m^3)
ST 20 ppm (90 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5701
OSHA PV2053

Physical Description: White needles, plates, crystals, flakes, or powder with a faint odor. [**Note:** Turns pink on exposure to air or light, or contact with iron.]

Chemical & Physical Properties:
MW: 110.1
BP: 531°F
Sol: 110%
Fl.P: 261°F
IP: 8.63 eV
Sp.Gr: 1.27
VP(77°F): 0.0002 mmHg
MLT: 228°F
UEL: ?
LEL(392°F): 1.4%
Class IIIB Combustible Liquid, but may be difficult to ignite.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Acetanilide, albumin, alkalis, antipyrine, camphor, ferric salts, menthol, spirit nitrous ether, strong oxidizers & bases
[**Note:** Hygroscopic (i.e., absorbs moisture from the air).]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat, upper resp sys; methemo; cyan, convuls; restless, bluish skin, incr heart rate, dysp; dizz, drow, hypothermia, hema; spleen, kidney, liver changes; derm
TO: Eyes, skin, resp sys, CVS, CNS, blood, spleen, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Rhodium (metal fume and insoluble compounds, as Rh)

Formula: Rh (metal) | **CAS#:** 7440-16-6 (metal) | **RTECS#:** VI9069000 | **IDLH:** 100 mg/m^3 (as Rh)

Conversion: | **DOT:**

Synonyms/Trade Names: **Rhodium metal:** Elemental rhodium
Synonyms of other insoluble rhodium compounds vary depending upon the specific compound.

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3
OSHA PEL: TWA 0.1 mg/m^3

Measurement Methods (see Table 1):
NIOSH S188 (II-3)

Physical Description: Metal: White, hard, ductile, malleable solid with a bluish-gray luster.

Chemical & Physical Properties:
MW: 102.9
BP: 6741°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 12.41 (metal)
VP: 0 mmHg (approx)
MLT: 3571°F
UEL: NA
LEL: NA
Metal: Noncombustible Solid in bulk form, but flammable as dust or powder.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.5 mg/m^3: Qm
1 mg/m^3: 95XQ/Sa
2.5 mg/m^3: Sa:Cf/PaprHie
5 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
100 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Chlorine trifluoride, oxygen difluoride

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh
SY: Possible resp sens
TO: Resp sys

First Aid (see Table 6):
Breath: Resp support
Swallow: Medical attention immed

Rhodium (soluble compounds, as Rh)	Formula:	CAS#:	RTECS#:	IDLH:
				2 mg/m^3 (as Rh)
Conversion:	**DOT:**			

Synonyms/Trade Names: Synonyms vary depending upon the specific soluble rhodium compound.

Exposure Limits:
NIOSH REL: TWA 0.001 mg/m^3
OSHA PEL: TWA 0.001 mg/m^3

Measurement Methods (see Table 1):
NIOSH S189 (II-3)

Physical Description: Appearance and odor vary depending upon the specific soluble rhodium compound.

Chemical & Physical Properties:
Properties vary depending upon the specific soluble rhodium compound.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.01 mg/m^3: 100XQ*/Sa*
0.025 mg/m^3: Sa:Cf*/PaprHie*
0.05 mg/m^3: 100F/PaprTHie*/ScbaF/SaF
2 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Varies

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: irrit eyes; CNS damage
TO: Eyes, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush
Breath: Resp support
Swallow: Medical attention immed

Ronnel	Formula:	CAS#:	RTECS#:	IDLH:
	$(CH_3O)_2P(S)OC_6H_2Cl_3$	299-84-3	TG0525000	300 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names: O,O-Dimethyl O-(2,4,5-trichlorophenyl) phosphorothioate; Fenchlorophos

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3
OSHA PEL†: TWA 15 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5600
OSHA PV2054

Physical Description: White to light-tan, crystalline solid. [insecticide] [**Note:** A liquid above 106°F.]

Chemical & Physical Properties:
MW: 321.6
BP: Decomposes
Sol(77°F): 0.004%
Fl.P: NA
IP: ?
Sp.Gr(77°F): 1.49
VP(77°F): 0.0008 mmHg
MLT: 106°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
100 mg/m^3: CcrOv95/Sa
250 mg/m^3: Sa:Cf/PaprOvHie
300 mg/m^3: CcrFOv100/GmFOv100/ PaprTOvHie*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: irrit eyes; chol inhibition; liver, kidney damage
TO: Eyes, liver, kidneys, blood plasma

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Rosin core solder, pyrolysis products (as formaldehyde)	**Formula:**	**CAS#:**	**RTECS#:**	**IDLH:** N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Rosin flux pyrolysis products, Rosin core soldering flux pyrolysis products

Exposure Limits:
NIOSH REL*: TWA 0.1 mg/m^3
[***Note:** "Ca" in the presence of formaldehyde, acetaldehyde, or malonaldehyde. See Appendices A & C (Aldehydes).]
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 2541, 3500

Physical Description: Pyrolysis products of rosin core solder include acetone, aliphatic aldehydes, methyl alcohol, methane, ethane, various abietic acids (the major components of rosin), CO & CO_2.

Chemical & Physical Properties:
Properties vary depending upon the specific rosin core solder being used.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

In the presence of Formaldeyde, Acetaldehyde, or Malonaldehyde:
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Varies

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh
SY: Irrit eyes, nose, throat, upper resp sys [carc (in the presence of Formaldehyde, Acetaldehyde, or Malonaldehyde)]
TO: Eyes, resp sys [nasal cancer; thyroid gland tumors in animals (in the presence of Formaldehyde, Acetaldehyde, or Malonaldehyde)]

First Aid (see Table 6):
Eye: Irr immed
Breath: Resp support

Rotenone	**Formula:** $C_{23}H_{22}O_6$	**CAS#:** 83-79-4	**RTECS#:** DJ2800000	**IDLH:** 2500 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names:
1,2,12,12a-Tetrahydro-8,9-dimethoxy-2-(1-methylethenyl)-[1]benzopyrano[3,4-b]furo[2,3-h][1]benzopyran-6(6aH)-one

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL: TWA 5 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5007

Physical Description: Colorless to red, odorless, crystalline solid. [insecticide]

Chemical & Physical Properties:
MW: 394.4
BP: Decomposes
Sol: Insoluble
Fl.P: ?
IP: ?
Sp.Gr: 1.27
VP: <0.00004 mmHg
MLT: 330°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: CcrOv95/Sa
125 mg/m^3: Sa:Cf/PaprOvHie
250 mg/m^3: CcrFOv100/GmFOv100/ PaprTOvHie/SaT:Cf/ ScbaF/SaF
2500 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; numb muc memb; nau, vomit, abdom pain; musc tremor, inco, clonic convuls, stupor
TO: Eyes, skin, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Rouge

Formula:	CAS#:	RTECS#:	IDLH:
Fe_2O_3	1309-37-1	NO7400000	N.D.

Conversion: **DOT:**

Synonyms/Trade Names: Iron(III)oxide, Iron oxide red, Red iron oxide, Red oxide

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: A fine, red powder of ferric oxide.
[**Note:** Usually used in cake form or impregnated in paper or cloth.]

Chemical & Physical Properties:
MW: 159.7
BP: ?
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 5.24
VP: 0 mmHg (approx)
MLT: 2849°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Calcium hypochlorite, carbon monoxide, hydrogen peroxide

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, resp sys
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Selenium

Formula:	CAS#:	RTECS#:	IDLH:
Se	7782-49-2	VS7700000	1 mg/m^3 (as Se)

Conversion: **DOT:** 2658 152 (powder)

Synonyms/Trade Names: Elemental selenium, Selenium alloy

Exposure Limits:
NIOSH REL*: TWA 0.2 mg/m^3
OSHA PEL*: TWA 0.2 mg/m^3
[***Note:** The REL and PEL also apply to other selenium compounds (as Se) except Selenium hexafluoride.]

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303, 9102, S190 (II-7)
OSHA ID121

Physical Description: Amorphous or crystalline, red to gray solid.
[**Note:** Occurs as an impurity in most sulfide ores.]

Chemical & Physical Properties:
MW: 79.0
BP: 1265°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 4.28
VP: 0 mmHg (approx)
MLT: 392°F
UEL: NA
LEL: NA
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: N.R.
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1 mg/m^3: Qm*/95XQ*/100F/PaprHie*/PaprHie*/Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Acids, strong oxidizers, chromium trioxide, potassium bromate, cadmium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; vis dist; head; chills, fever; dysp, bron; metallic taste, garlic breath, GI dist; derm; eye, skin burns; in animals: anemia; liver nec, cirr; kidney, spleen damage
TO: Eyes, skin, resp sys, liver, kidneys, blood, spleen

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Selenium hexafluoride	Formula: SeF_6	CAS#: 7783-79-1	RTECS#: VS9450000	IDLH: 2 ppm
Conversion: 1 ppm = 7.89 mg/m^3	**DOT:** 2194 125			
Synonyms/Trade Names: Selenium fluoride				
Exposure Limits: **NIOSH REL:** TWA 0.05 ppm **OSHA PEL:** TWA 0.05 ppm (0.4 mg/m^3)			**Measurement Methods (see Table 1):** None available	
Physical Description: Colorless gas.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 193.0 **BP:** -30°F **Sol:** Insoluble **Fl.P:** NA **IP:** ? **RGasD:** 6.66 **VP:** >1 atm **FRZ:** -59°F **UEL:** NA **LEL:** NA Nonflammable Gas	**Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.	**NIOSH/OSHA** **0.5 ppm:** Sa **1.25 ppm:** Sa:Cf **2 ppm:** SaT:Cf/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFS/ScbaE

Incompatibilities and Reactivities: Water [**Note:** Hydrolyzes very slowly in cold water.]	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh **SY:** In animals: pulm irrit, edema **TO:** Resp sys	**First Aid (see Table 6):** **Breath:** Resp support

Silica, amorphous	Formula: SiO_2	CAS#: 7631-86-9	RTECS#: VV7310000	IDLH: 3000 mg/m^3
Conversion:	**DOT:**			
Synonyms/Trade Names: Diatomaceous earth, Diatomaceous silica, Diatomite, Precipitated amorphous silica, Silica gel, Silicon dioxide (amorphous)				
Exposure Limits: **NIOSH REL:** TWA 6 mg/m^3 **OSHA PEL†:** TWA 20 mppcf [(80 mg/m^3)/%SiO_2]			**Measurement Methods (see Table 1):** **NIOSH** 7501	
Physical Description: Transparent to gray, odorless powder. [**Note:** Amorphous silica is the non-crystalline form of SiO_2.]				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 60.1 **BP:** 4046°F **Sol:** Insoluble **Fl.P:** NA **IP:** NA **Sp.Gr:** 2.20 **VP:** 0 mmHg (approx) **MLT:** 3110°F **UEL:** NA **LEL:** NA Noncombustible Solid	**Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.	**NIOSH** **30 mg/m^3:** Qm **60 mg/m^3:** 95XQ/Sa **150 mg/m^3:** Sa:Cf/PaprHie **300 mg/m^3:** 100F/SaT:Cf/PaprTHie/ScbaF/SaF **3000 mg/m^3:** Sa:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE

Incompatibilities and Reactivities: Fluorine, oxygen difluoride, chlorine trifluoride	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Con **SY:** Irrit eyes, pneumoconiosis **TO:** Eyes, resp sys	**First Aid (see Table 6):** **Eye:** Irr immed **Breath:** Fresh air

Silica, crystalline (as respirable dust)	**Formula:** SiO_2	**CAS#:** 14808-60-7	**RTECS#:** VV7330000	**IDLH:** Ca [25 mg/m^3 (cristobalite, tridymite); 50 mg/m^3 (quartz, tripoli)]
Conversion:	**DOT:**			

Synonyms/Trade Names: Cristobalite, Quartz, Tridymite, Tripoli

Exposure Limits:
NIOSH REL: Ca
TWA 0.05 mg/m^3
See Appendix A
OSHA PEL: See Appendix C (Mineral Dusts)

Measurement Methods (see Table 1):
NIOSH 7500, 7601, 7602
OSHA ID142

Physical Description: Colorless, odorless solid. [**Note:** A component of many mineral dusts.]

Chemical & Physical Properties:
MW: 60.1
BP: 4046°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 2.66
VP: 0 mmHg (approx)
MLT: 3110°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
0.5 mg/m^3: 95XQ
1.25 mg/m^3: PaprHie/Sa:Cf
2.5 mg/m^3: 100F/PaprTHie
25 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Powerful oxidizers: fluorine, chlorine trifluoride, manganese trioxide, oxygen difluoride, hydrogen peroxide, etc.; acetylene; ammonia

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Cough, dysp, wheez; decr pulm func, progressive resp symptoms (silicosis); irrit eyes; [carc]
TO: Eyes, resp sys [in animals: lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Silicon	**Formula:** Si	**CAS#:** 7440-21-3	**RTECS#:** VW0400000	**IDLH:** N.D.
Conversion:	**DOT:** 1346 170 (amorphous powder)			

Synonyms/Trade Names: Elemental silicon
[**Note:** Does not occur free in nature, but is found in silicon dioxide (silica) & in various silicates.]

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Black to gray, lustrous, needle-like crystals.
[**Note:** The amorphous form is a dark-brown powder.]

Chemical & Physical Properties:
MW: 28.1
BP: 4271°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr(77°F): 2.33
VP: 0 mmHg (approx)
MLT: 2570°F
UEL: NA
LEL: NA
MEC: 160 g/m^3
Combustible Solid in powder form.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: Prevent eye contact
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Chlorine, fluorine, oxidizers, calcium, cesium carbide, alkaline carbonates

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; cough
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air
Swallow: Medical attention immed

Silicon carbide	Formula: SiC	CAS#: 409-21-2	RTECS#: VW0450000	IDLH: N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: Carbon silicide, Carborundum®, Silicon monocarbide				
Exposure Limits: **NIOSH REL:** TWA 10 mg/m^3 (total) TWA 5 mg/m^3 (resp) **OSHA PEL†:** TWA 15 mg/m^3 (total) TWA 5 mg/m^3 (resp)			**Measurement Methods (see Table 1):** **NIOSH** 0500, 0600	
Physical Description: Yellow to green to bluish-black, iridescent crystals.				
Chemical & Physical Properties: **MW:** 40.1 **BP:** Sublimes **Sol:** Insoluble **Fl.P:** NA **IP:** 9.30 eV **Sp.Gr:** 3.23 **VP:** 0 mmHg (approx) **MLT:** 4892°F (Sublimes) **UEL:** NA **LEL:** NA Noncombustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: None reported [**Note:** Sublimes with decomposition at 4892°F.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, upper resp sys; cough **TO:** Eyes, skin, resp sys		**First Aid (see Table 6):** **Eye:** Irr immed **Breath:** Fresh air **Swallow:** Medical attention immed		

Silicon tetrahydride	Formula: SiH_4	CAS#: 7803-62-5	RTECS#: VV1400000	IDLH: N.D.
Conversion: 1 ppm = 1.31 mg/m^3	**DOT:** 2203 116			
Synonyms/Trade Names: Monosilane, Silane, Silicane				
Exposure Limits: **NIOSH REL:** TWA 5 ppm (7 mg/m^3) **OSHA PEL†:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Colorless gas with a repulsive odor.				
Chemical & Physical Properties: **MW:** 32.1 **BP:** -169°F **Sol:** Decomposes **Fl.P:** NA (Gas) **IP:** ? **RGasD:** 1.11 **VP:** >1 atm **FRZ:** -301°F **UEL:** ? **LEL:** ? Flammable Gas (may ignite SPONTANEOUSLY in air).	**Personal Protection/Sanitation (see Table 2):** **Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Halogens (bromine, chlorine, carbonyl chloride, antimony pentachloride, tin(IV) chloride), water				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh **SY:** Irrit eyes, skin, muc memb; nau, head **TO:** Eyes, skin, resp sys, CNS		**First Aid (see Table 6):** **Breath:** Resp support		

Silver (metal dust and soluble compounds, as Ag)

Formula: Ag (metal)
CAS#: 7440-22-4 (metal)
RTECS#: VW3500000 (metal)
IDLH: 10 mg/m^3 (as Ag)

Conversion:
DOT:

Synonyms/Trade Names: **Silver metal:** Argentum
Synonyms of soluble silver compounds such as Silver nitrate ($AgNO_3$) vary depending upon the specific compound.

Exposure Limits:
NIOSH REL: TWA 0.01 mg/m^3
OSHA PEL: TWA 0.01 mg/m^3

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 9102
OSHA ID121

Physical Description: Metal: White, lustrous solid.

Chemical & Physical Properties:
MW: 107.9
BP: 3632°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 10.49 (metal)
VP: 0 mmHg (approx)
MLT: 1761°F
UEL: NA
LEL: NA
Metal: Noncombustible Solid, but flammable in form of dust or powder.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam ($AgNO_3$)
Change: Daily
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.25 mg/m^3: Sa:Cf£/PaprHie£
0.5 mg/m^3: 100F/ScbaF/SaF
10 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Acetylene, ammonia, hydrogen peroxide, bromoazide, chlorine trifluoride, ethyleneimine, oxalic acid, tartaric acid

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Blue-gray eyes, nasal septum, throat, skin; irrit, ulceration skin; GI dist
TO: Nasal septum, skin, eyes

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush
Breath: Resp support
Swallow: Medical attention immed

Soapstone (containing less than 1% quartz)

Formula: 3MgO-4SiO_2-H_2O
CAS#:
RTECS#: VV8780000
IDLH: 3000 mg/m^3

Conversion:
DOT:

Synonyms/Trade Names: Massive talc, Soapstone silicate, Steatite

Exposure Limits:
NIOSH REL: TWA 6 mg/m^3 (total)
TWA 3 mg/m^3 (resp)
OSHA PEL†: TWA 20 mppcf

Measurement Methods (see Table 1):
NIOSH 0500

Physical Description: Odorless, white-gray powder.

Chemical & Physical Properties:
MW: 379.3
BP: ?
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 2.7-2.8
VP: 0 mmHg (approx)
MLT: ?
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
30 mg/m^3: Qm
60 mg/m^3: 95XQ/Sa
150 mg/m^3: PaprHie
300 mg/m^3: 100F/SaT:Cf*/PaprTHie*/ ScbaF/SaF
3000 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Pneumoconiosis: cough, dysp; digital clubbing; cyan; basal crackles, cor pulmonale
TO: Resp sys, CVS

First Aid (see Table 6):
Eye: Irr immed
Breath: Resp support

Sodium aluminum fluoride (as F)	**Formula:** Na_3AlF_6	**CAS#:** 15096-52-3	**RTECS#:** WA9625000	**IDLH:** 250 mg/m^3 (as F)
Conversion:	**DOT:**			
Synonyms/Trade Names: Cryocide, Cryodust, Cryolite, Sodium hexafluoroaluminate				

Exposure Limits:
NIOSH REL*: TWA 2.5 mg/m^3
OSHA PEL*: TWA 2.5 mg/m^3
[***Note:** The REL and PEL also apply to other inorganic, solid fluorides (as F).]

Measurement Methods (see Table 1):
NIOSH 7902
OSHA ID110

Physical Description: Colorless to dark odorless solid. [pesticide]
[**Note:** Loses color on heating.]

Chemical & Physical Properties:
MW: 209.9
BP: Decomposes
Sol: 0.04%
Fl.P: NA
IP: NA
Sp.Gr: 2.90
VP: 0 mmHg (approx)
MLT: 1832°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
12.5 mg/m^3: Qm
25 mg/m^3: 95XQ*/Sa*
62.5 mg/m^3: Sa:Cf*/PaprHie*+
125 mg/m^3: 100F+/ScbaF/SaF
250 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F+/ScbaE

+Note: May need acid gas sorbent

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, resp sys; nau, abdom pain, diarr; salv, thirst, sweat; stiff spine; derm; calcification of ligaments of ribs, pelvis
TO: Eyes, skin, resp sys, CNS, skeleton, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Fresh air
Swallow: Medical attention immed

Sodium azide	**Formula:** NaN_3	**CAS#:** 26628-22-8	**RTECS#:** VY8050000	**IDLH:** N.D.
Conversion:	**DOT:** 1687 153			
Synonyms/Trade Names: Azide, Azium, Sodium salt of hydrazoic acid				

Exposure Limits:
NIOSH REL: C 0.1 ppm (as HN_3) [skin]
C 0.3 mg/m^3 (as NaN_3) [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA ID121, ID211

Physical Description: Colorless to white, odorless, crystalline solid. [pesticide]
[**Note:** Forms hydrazoic acid (HN_3) in water.]

Chemical & Physical Properties:
MW: 65.0
BP: Decomposes
Sol(63°F): 42%
Fl.P: ?
IP: 11.70 eV
Sp.Gr: 1.85
VP: ?
MLT: 527°F (Decomposes)
UEL: ?
LEL: ?
Combustible Solid (if heated above 572°F).

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Acids, metals, water
[**Note:** Over a period of time, sodium azide may react with copper, lead, brass, or solder in plumbing systems to form an accumulation of the HIGHLY EXPLOSIVE compounds of lead azide & copper azide.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; head, dizz, lass, blurred vision; low BP, bradycardia; kidney changes
TO: Eyes, skin, CNS, CVS, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Sodium bisulfite

Formula:	CAS#:	RTECS#:	IDLH:
$NaHSO_3$	7631-90-5	VZ2000000	N.D.

Conversion: **DOT:** 2693 154 (solution)

Synonyms/Trade Names: Monosodium salt of sulfurous acid, Sodium acid bisulfite, Sodium bisulphite, Sodium hydrogen sulfite

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 0500

Physical Description: White crystals or powder with a slight odor of sulfur dioxide.

Chemical & Physical Properties:
MW: 104.1
BP: Decomposes
Sol: 29%
Fl.P: NA
IP: NA
Sp.Gr: 1.48
VP: ?
MLT: Decomposes
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Heat (decomposes) [**Note:** Slowly oxidized to the sulfate on exposure to air.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air
Swallow: Medical attention immed

Sodium cyanide (as CN)

Formula:	CAS#:	RTECS#:	IDLH:
NaCN	143-33-9	VZ7525000	25 mg/m^3 (as CN)

Conversion: **DOT:** 1689 157 (solid); 3414 157 (solution)

Synonyms/Trade Names: Sodium salt of hydrocyanic acid

Exposure Limits:
NIOSH REL*: C 5 mg/m^3 (4.7 ppm) [10-minute]
OSHA PEL*: TWA 5 mg/m^3
[***Note:** The REL and PEL also apply to other cyanides (as CN) except Hydrogen cyanide.]

Measurement Methods (see Table 1):
NIOSH 6010, 7904

Physical Description: White, granular or crystalline solid with a faint, almond-like odor.

Chemical & Physical Properties:
MW: 49.0
BP: 2725°F
Sol(77°F): 58%
Fl.P: NA
IP: NA
Sp.Gr: 1.60
VP: 0 mmHg (approx)
MLT: 1047°F
UEL: NA
LEL: NA
Noncombustible Solid, but contact with acids releases highly flammable hydrogen cyanide.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
25 mg/m^3: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers (such as acids, acid salts, chlorates & nitrates) [**Note:** Absorbs moisture from the air forming a syrup.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; asphy; lass, head, conf; nau, vomit; incr resp rate; slow gasping respiration; thyroid, blood changes
TO: Eyes, skin, CVS, CNS, thyroid, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Sodium fluoride (as F)

Formula:	CAS#:	RTECS#:	IDLH:
NaF	7681-49-4	WB0350000	250 mg/m^3 (as F)

Conversion: **DOT:** 1690 154

Synonyms/Trade Names: Floridine, Sodium monofluoride

Exposure Limits:
NIOSH REL*: TWA 2.5 mg/m^3
OSHA PEL*: TWA 2.5 mg/m^3
[***Note:** The REL and PEL also apply to other inorganic, solid fluorides (as F).]

Measurement Methods (see Table 1):
NIOSH 7902, 7906
OSHA ID110

Physical Description: Odorless, white powder or colorless crystals.
[**Note:** Pesticide grade is often dyed blue.]

Chemical & Physical Properties:
MW: 42.0
BP: 3099°F
Sol: 4%
Fl.P: NA
IP: NA
Sp.Gr: 2.78
VP: 0 mmHg (approx)
MLT: 1819°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
12.5 mg/m^3: Qm
25 mg/m^3: 95XQ*/Sa*
62.5 mg/m^3: Sa:Cf*/PaprHie*+
125 mg/m^3: 100F+/ScbaF/SaF
250 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F+/ScbaE

+Note: May need acid gas sorbent

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, resp sys; nau, abdom pain, diarr; salv, thirst, sweat; stiff spine; derm; calcification of ligaments of ribs, pelvis
TO: Eyes, skin, resp sys, CNS, skeleton, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Fresh air
Swallow: Medical attention immed

Sodium fluoroacetate

Formula:	CAS#:	RTECS#:	IDLH:
FCH_2COONa	62-74-8	AH9100000	2.5 mg/m^3

Conversion: **DOT:** 2629 151

Synonyms/Trade Names: SFA, Sodium monofluoroacetate

Exposure Limits:
NIOSH REL: TWA 0.05 mg/m^3
ST 0.15 mg/m^3 [skin]
OSHA PEL†: TWA 0.05 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH S301 (II-5)

Physical Description: Fluffy, colorless to white (sometimes dyed black), odorless powder. [**Note:** A liquid above 95°F.] [rodenticide]

Chemical & Physical Properties:
MW: 100.0
BP: Decomposes
Sol: Miscible
Fl.P: NA
IP: ?
Sp.Gr: ?
VP: Low
MLT: 392°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.25 mg/m^3: Qm
0.5 mg/m^3: 95XQ/Sa
1.25 mg/m^3: Sa:Cf/PaprHie
2.5 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Vomit; anxi, auditory halu; facial pares; twitch face musc; pulsus altenans, ectopic heartbeat, tacar, card arrhy; pulm edema; nystagmus; convuls; liver, kidney damage
TO: Resp sys, CVS, liver, kidneys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Sodium hydroxide	Formula: NaOH	CAS#: 1310-73-2	RTECS#: WB4900000	IDLH: 10 mg/m^3
Conversion:	**DOT:** 1823 154 (dry, solid); 1824 154 (solution)			
Synonyms/Trade Names: Caustic soda, Lye, Soda lye, Sodium hydrate				
Exposure Limits: **NIOSH REL:** C 2 mg/m^3 **OSHA PEL†:** TWA 2 mg/m^3			**Measurement Methods (see Table 1):** **NIOSH** 7401	
Physical Description: Colorless to white, odorless solid (flakes, beads, granular form).				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 40.0 **BP:** 2534°F **Sol:** 111% **Fl.P:** NA **IP:** NA **Sp.Gr:** 2.13 **VP:** 0 mmHg (approx) **MLT:** 605°F **UEL:** NA **LEL:** NA Noncombustible Solid, but when in contact with water may generate sufficient heat to ignite combustible materials.	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily **Provide:** Eyewash Quick drench	**NIOSH/OSHA** **10 mg/m^3:** Sa:Cf£/100F/PaprHie£/ ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE

Incompatibilities and Reactivities: Water; acids; flammable liquids; organic halogens; metals such as aluminum, tin & zinc; nitromethane [**Note:** Corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Ing, Con **SY:** Irrit eyes, skin, muc memb; pneu; eye, skin burns; temporary loss of hair **TO:** Eyes, skin, resp sys	**Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed

Sodium metabisulfite	Formula: $Na_2S_2O_5$	CAS#: 7681-57-4	RTECS#: UX8225000	IDLH: N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: Disodium pyrosulfite, Sodium metabisulphite, Sodium pyrosulfite				
Exposure Limits: **NIOSH REL:** TWA 5 mg/m^3 **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **NIOSH** 0500	
Physical Description: White to yellowish crystals or powder with an odor of sulfur dioxide.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 190.1 **BP:** Decomposes **Sol:** 54% **Fl.P:** NA **IP:** NA **Sp.Gr:** 1.4 **VP:** ? **MLT:** >302°F (Decomposes) **UEL:** NA **LEL:** NA Noncombustible Solid	**Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.	Not available.

Incompatibilities and Reactivities: Heat (decomposes)
[**Note:** Slowly oxidized to the sulfate on exposure to air & moisture.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Ing, Con **SY:** Irrit eyes, skin, muc memb **TO:** Eyes, skin, resp sys	**Eye:** Irr immed **Breath:** Fresh air **Swallow:** Medical attention immed

Starch

Formula: $(C_6H_{10}O_5)n$ | **CAS#:** 9005-25-8 | **RTECS#:** GM5090000 | **IDLH:** N.D.

Conversion:

DOT:

Synonyms/Trade Names: Corn starch, Rice starch, Sorghum gum, α-Starch, Starch gum, Tapioca starch

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Fine, white, odorless powder.
[**Note:** A carbohydrate polymer composed of 25% amylose & 75% amylpectin.]

Chemical & Physical Properties:
MW: varies
BP: Decomposes
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 1.45
VP: 0 mmHg (approx)
MLT: Decomposes
UEL: NA
LEL: NA
MEC: 50 g/m^3
Noncombustible Solid, but may form explosive mixture with air.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers, acids, iodine, alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; cough, chest pain; derm; rhin
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Fresh air
Swallow: Medical attention immed

Stibine

Formula: SbH_3 | **CAS#:** 7803-52-3 | **RTECS#:** WJ0700000 | **IDLH:** 5 ppm

Conversion: 1 ppm = 5.10 mg/m^3

DOT: 2676 119

Synonyms/Trade Names: Antimony hydride, Antimony trihydride, Hydrogen antimonide

Exposure Limits:
NIOSH REL: TWA 0.1 ppm (0.5 mg/m^3)
OSHA PEL: TWA 0.1 ppm (0.5 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 6008

Physical Description: Colorless gas with a disagreeable odor like hydrogen sulfide.

Chemical & Physical Properties:
MW: 124.8
BP: -1°F
Sol: Slight
Fl.P: NA (Gas)
IP: 9.51 eV
RGasD: 4.31
VP: >1 atm
FRZ: -126°F
UEL: ?
LEL: ?
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1 ppm: Sa
2.5 ppm: Sa:Cf
5 ppm: SaT:Cf/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Acids, halogenated hydrocarbons, oxidizers, moisture, chlorine, ozone, ammonia

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh
SY: Head, lass; nau, abdom pain; lumbar pain, hema, hemolytic anemia; jaun; pulm irrit
TO: Blood, liver, kidneys, resp sys

First Aid (see Table 6):
Breath: Resp support

Stoddard solvent	Formula:	CAS#:	RTECS#:	IDLH:
		8052-41-3	WJ8925000	20,000 mg/m^3

Conversion: **DOT:** 1268 128 (petroleum distillates, n.o.s.)

Synonyms/Trade Names: Dry cleaning safety solvent, Mineral spirits, Petroleum solvent, Spotting naphtha [**Note:** A refined petroleum solvent with a flash point of 102-110°F, boiling point of 309-396°F, and containing >65% C_{10} or higher hydrocarbons.]

Exposure Limits:
NIOSH REL: TWA 350 mg/m^3
C 1800 mg/m^3 [15-minute]
OSHA PEL†: TWA 500 ppm (2900 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1550

Physical Description: Colorless liquid with a kerosene-like odor.

Chemical & Physical Properties:
MW: Varies
BP: 309-396°F
Sol: Insoluble
Fl.P: 102-110°F
IP: ?
Sp.Gr: 0.78
VP: ?
FRZ: ?
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
3500 mg/m^3: CcrOv*/Sa*
8750 mg/m^3: Sa:Cf*/PaprOv*
17,500 mg/m^3: CcrFOv/GmFOv/PaprTOv*/ScbaF/SaF
20,000 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose, throat; dizz; derm; chemical pneu (aspir liquid); in animals: kidney damage
TO: Eyes, skin, resp sys, CNS, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Strychnine	Formula:	CAS#:	RTECS#:	IDLH:
	$C_{21}H_{22}N_2O_2$	57-24-9	WL2275000	3 mg/m^3

Conversion: **DOT:** 1692 151

Synonyms/Trade Names: Nux vomica, Strynchnos

Exposure Limits:
NIOSH REL: TWA 0.15 mg/m^3
OSHA PEL: TWA 0.15 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5016

Physical Description: Colorless to white, odorless, crystalline solid. [pesticide]

Chemical & Physical Properties:
MW: 334.4
BP: Decomposes
Sol: 0.02%
Fl.P: ?
IP: ?
Sp.Gr: 1.36
VP: Low
MLT: 514°F
UEL: ?
LEL: ?
Combustible Solid, but difficult to ignite.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: N.R.
Wash skin: When contam
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.75 mg/m^3: Qm
1.5 mg/m^3: 95XQ/Sa
3 mg/m^3: Sa:Cf/PaprHie/100F/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Stiff neck, facial musc; restless, anxi, incr acuity of perception; incr reflex excitability; cyan; tetanic convuls with opisthotonos
TO: CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Styrene	**Formula:** $C_6H_5CH=CH_2$	**CAS#:** 100-42-5	**RTECS#:** WL3675000	**IDLH:** 700 ppm
Conversion: 1 ppm = 4.26 mg/m^3	**DOT:** 2055 128P (inhibited)			
Synonyms/Trade Names: Ethenyl benzene, Phenylethylene, Styrene monomer, Styrol, Vinyl benzene				

Exposure Limits:
NIOSH REL: TWA 50 ppm (215 mg/m^3)
ST 100 ppm (425 mg/m^3)
OSHA PEL†: TWA 100 ppm
C 200 ppm
600 ppm (5-minute maximum peak in any 3 hours)

Measurement Methods (see Table 1):
NIOSH 1501, 3800
OSHA 9, 89

Physical Description: Colorless to yellow, oily liquid with a sweet, floral odor.

Chemical & Physical Properties:
MW: 104.2
BP: 293°F
Sol: 0.03%
Fl.P: 88°F
IP: 8.40 eV
Sp.Gr: 0.91
VP: 5 mmHg
FRZ: -23°F
UEL: 6.8%
LEL: 0.9%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
500 ppm: CcrOv*/Sa*
700 ppm: Sa:Cf*/CcrFOv/GmFOv/PaprOv*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, catalysts for vinyl polymers, peroxides, strong acids, aluminum chloride [**Note:** May polymerize if contaminated or subjected to heat. Usually contains an inhibitor such as tert-butylcatechol.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose, resp sys; head, lass, dizz, conf, mal, drow, unsteady gait; narco; defatting derm; possible liver inj; repro effects
TO: Eyes, skin, resp sys, CNS, liver, repro sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush
Breath: Resp support
Swallow: Medical attention immed

Subtilisins	**Formula:**	**CAS#:** 1395-21-7 (BPN) 9014-01-1 (Carlsburg)	**RTECS#:** CO9450000 (BPN) CO9550000 (Carlsburg)	**IDLH:** N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: Bacillus subtilis, Bacillus subtilis BPN, Bacillus subtilis Carlsburg, Proteolytic enzymes, Subtilisin BPN, Subtilisin Carlsburg [**Note:** Commercial proteolytic enzymes are used in laundry detergents.]				

Exposure Limits:
NIOSH REL: ST 0.00006 mg/m^3 [60-minute]
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Light-colored, free-flowing powders.
[**Note:** A protein containing numerous amino acids.]

Chemical & Physical Properties:
MW: 28,000 (approx)
BP: ?
Sol: ?
Fl.P: NA
IP: NA
Sp.Gr: ?
VP: 0 mmHg (approx)
MLT: ?
UEL: NA
LEL: NA

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; resp sens (enzyme asthma): sweat, head, chest pain, flu-like symptoms, cough, breathlessness, wheez
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Succinonitrile

Formula:	CAS#:	RTECS#:	IDLH:
$NCCH_2CH_2CN$	110-61-2	WN3850000	N.D.

Conversion: 1 ppm = 3.28 mg/m^3

DOT:

Synonyms/Trade Names: Butanedinitrile; 1,2-Dicyanoethane; Dinile; Ethylene cyanide; Ethylene dicyanide; Succinic dinitrile

Exposure Limits:
NIOSH REL: TWA 6 ppm (20 mg/m^3)
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH Nitriles Criteria Document

Physical Description: Colorless, odorless, waxy solid.
[**Note:** Forms cyanide in the body.]

Chemical & Physical Properties:
MW: 80.1
BP: 509°F
Sol: 13%
Fl.P: 270°F
IP: ?
Sp.Gr: 0.99
VP(212°F): 2 mmHg
MLT: 134°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
60 ppm: Sa
150 ppm: Sa:Cf
250 ppm: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; head, dizz, lass, conf, convuls; blurred vision; dysp; abdom pain, nau, vomit
TO: Eyes, skin, resp sys, CNS, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Sucrose

Formula:	CAS#:	RTECS#:	IDLH:
$C_{12}H_{22}O_{11}$	57-50-1	WN6500000	N.D.

Conversion:

DOT:

Synonyms/Trade Names: Beet sugar, Cane sugar, Confectioner's sugar, Granulated sugar, Rock candy, Saccarose, Sugar, Table sugar

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Hard, white, odorless crystals, lumps, or powder.
[**Note:** May have a characteristic, caramel odor when heated.]

Chemical & Physical Properties:
MW: 342.3
BP: Decomposes
Sol: 200%
Fl.P: NA
IP: NA
Sp.Gr: 1.59
VP: 0 mmHg (approx)
MLT: 320-367°F (Decomposes)
UEL: NA
LEL: NA
MEC: 45 g/m^3
Noncombustible Solid, but fine airborne dust may explode.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers, sulfuric acid, nitric acid

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, upper resp sys; cough
TO: Eyes, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Sulfur dioxide

Formula:	CAS#:	RTECS#:	IDLH:
SO_2	7446-09-5	WS4550000	100 ppm

Conversion: 1 ppm = 2.62 mg/m^3

DOT: 1079 125

Synonyms/Trade Names: Sulfurous acid anhydride, Sulfurous oxide, Sulfur oxide

Exposure Limits:
NIOSH REL: TWA 2 ppm (5 mg/m^3)
ST 5 ppm (13 mg/m^3)
OSHA PEL†: TWA 5 ppm (13 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 3800, 6004
OSHA ID104, ID200

Physical Description: Colorless gas with a characteristic, irritating, pungent odor. [**Note:** A liquid below 14°F. Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 64.1
BP: 14°F
Sol: 10%
Fl.P: NA
IP: 12.30 eV
RGasD: 2.26
VP: 3.2 atm
FRZ: -104°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet or contam (liquid)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
20 ppm: CcrS*/Sa*
50 ppm: Sa:Cf*/PaprS*
100 ppm: CcrFS/GmFS/PaprTS*/SaT:Cf*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Powdered alkali metals (such as sodium & potassium), water, ammonia, zinc, aluminum, brass, copper [**Note:** Reacts with water to form sulfurous acid (H_2SO_3).]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, nose, throat; rhin; choking, cough; reflex bronchoconstriction; liquid: frostbite
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Sulfur hexafluoride

Formula:	CAS#:	RTECS#:	IDLH:
SF_6	2551-62-4	WS4900000	N.D.

Conversion: 1 ppm = 5.98 mg/m^3

DOT: 1080 126

Synonyms/Trade Names: Sulfur fluoride [**Note:** May contain highly toxic sulfur pentafluoride as an impurity.]

Exposure Limits:
NIOSH REL: TWA 1000 ppm (6000 mg/m^3)
OSHA PEL: TWA 1000 ppm (6000 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 6602

Physical Description: Colorless, odorless gas. [**Note:** Shipped as a liquefied compressed gas. Condenses directly to a solid upon cooling.]

Chemical & Physical Properties:
MW: 146.1
BP: Sublimes
Sol(77°F): 0.003%
Fl.P: NA
IP: 19.30 eV
RGasD: 5.11
VP: 21.5 atm
FRZ: -83°F (Sublimes)
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Disilane

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh
SY: Asphy: incr breath rate, pulse rate; slight musc inco, emotional upset; lass, nau, vomit, convuls; liquid: frostbite
TO: Resp sys

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Sulfuric acid

Formula:	CAS#:	RTECS#:	IDLH:
H_2SO_4	7664-93-9	WS5600000	15 mg/m^3

Conversion: **DOT:** 1830 137; 1831 137 (fuming); 1832 137 (spent)

Synonyms/Trade Names: Battery acid, Hydrogen sulfate, Oil of vitriol, Sulfuric acid (aqueous)

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3
OSHA PEL: TWA 1 mg/m^3

Measurement Methods (see Table 1):
NIOSH 7903
OSHA ID113, ID165SG

Physical Description: Colorless to dark-brown, oily, odorless liquid.
[**Note:** Pure compound is a solid below 51°F. Often used in an aqueous solution.]

Chemical & Physical Properties:
MW: 98.1
BP: 554°F
Sol: Miscible
Fl.P: NA
IP: ?
Sp.Gr: 1.84 (96-98% acid)
VP: 0.001 mmHg
FRZ: 51°F
UEL: NA
LEL: NA
Noncombustible Liquid, but capable of igniting finely divided combustible materials.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash (>1%)
Quick drench (>1%)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
15 mg/m^3: Sa:Cf£/PaprAgHie£/CcrFAg100/GmFAg100/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFAg100/ScbaE

Incompatibilities and Reactivities: Organic materials, chlorates, carbides, fulminates, water, powdered metals
[**Note:** Reacts violently with water with evolution of heat. Corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; pulm edema, bron; emphy; conj; stomatis; dental erosion; eye, skin burns; derm
TO: Eyes, skin, resp sys, teeth

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Sulfur monochloride

Formula:	CAS#:	RTECS#:	IDLH:
S_2Cl_2	10025-67-9	WS4300000	5 ppm

Conversion: 1 ppm = 5.52 mg/m^3 **DOT:** 1828 137

Synonyms/Trade Names: Sulfur chloride, Sulfur subchloride, Thiosulfurous dichloride

Exposure Limits:
NIOSH REL: C 1 ppm (6 mg/m^3)
OSHA PEL†: TWA 1 ppm (6 mg/m^3)

Measurement Methods (see Table 1):
None available

Physical Description: Light-amber to yellow-red, oily liquid with a pungent, nauseating, irritating odor.

Chemical & Physical Properties:
MW: 135.0
BP: 280°F
Sol: Decomposes
Fl.P: 245°F
IP: 9.40 eV
Sp.Gr: 1.68
VP: 7 mmHg
FRZ: -107°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 ppm: CcrFS/GmFS/PaprS£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Peroxides, oxides of phosphorous, organics, water
[**Note:** Decomposes violently in water to form hydrochloric acid, sulfur dioxide, sulfur, sulfite, thiosulfate, and hydrogen sulfide. Corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; lac; cough; eye, skin burns; pulm edema
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Sulfur pentafluoride	Formula: S_2F_{10}	CAS#: 5714-22-7	RTECS#: WS4480000	IDLH: 1 ppm
Conversion: 1 ppm = 10.39 mg/m^3	**DOT:**			
Synonyms/Trade Names: Disulfur decafluoride, Sulfur decafluoride				
Exposure Limits: **NIOSH REL:** C 0.01 ppm (0.1 mg/m^3) **OSHA PEL†:** TWA 0.025 ppm (0.25 mg/m^3)			**Measurement Methods (see Table 1):** None available	
Physical Description: Colorless liquid or gas (above 84°F) with an odor like sulfur dioxide.				
Chemical & Physical Properties: **MW:** 254.1 **BP:** 84°F **Sol:** Insoluble **Fl.P:** NA **IP:** ? **RGasD:** 8.77 **Sp.Gr(32°F):** 2.08 **VP:** 561 mmHg **FRZ:** -134°F **UEL:** NA **LEL:** NA Noncombustible Liquid Nonflammable Gas	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** N.R. **Remove:** When wet or contam **Change:** N.R. **Provide:** Eyewash Quick drench		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **0.1 ppm**: Sa **0.25 ppm:** Sa:Cf **0.5 ppm:** SaT:Cf/ScbaF/SaF **1 ppm**: Sa:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFAg/ScbaE	
Incompatibilities and Reactivities: None reported				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, resp sys; in animals: pulm edema, hemorr **TO:** Eyes, skin, resp sys, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed	

Sulfur tetrafluoride	Formula: SF_4	CAS#: 7783-60-0	RTECS#: WT4800000	IDLH: N.D.
Conversion: 1 ppm = 4.42 mg/m^3	**DOT:** 2418 125			
Synonyms/Trade Names: Tetrafluorosulfurane				
Exposure Limits: **NIOSH REL:** C 0.1 ppm (0.4 mg/m^3) **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **OSHA** ID110	
Physical Description: Colorless gas with an odor like sulfur dioxide. [**Note:** Shipped as a liquefied compressed gas.]				
Chemical & Physical Properties: **MW:** 108.1 **BP:** -41°F **Sol:** Reacts **Fl.P:** NA **IP:** 12.63 eV **RGasD:** 3.78 **VP(70°F):** 10.5 atm **FRZ:** -185°F **UEL:** NA **LEL:** NA Nonflammable Gas	**Personal Protection/Sanitation (see Table 2):** **Skin:** Frostbite **Eyes:** Frostbite **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R. **Provide:** Frostbite wash		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Moisture, concentrated sulfuric acid, dioxygen difluoride [**Note:** Readily hydrolyzed by moisture, forming hydrofluoric acid & thionyl fluoride.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Con **SY:** Irrit eyes, skin, muc memb; eye, skin burns (from SF_4 releasing hydrofluoric acid on exposure to moisture); liquid: frostbite; in animals: dysp, lass, rhin **TO:** Eyes, skin, resp sys			**First Aid (see Table 6):** **Eye:** Frostbite **Skin:** Frostbite **Breath:** Resp support	

Sulfuryl fluoride

Formula:	CAS#:	RTECS#:	IDLH:
SO_2F_2	2699-79-8	WT5075000	200 ppm

Conversion: 1 ppm = 4.18 mg/m^3 **DOT:** 2191 123

Synonyms/Trade Names: Sulfur difluoride dioxide, Vikane®

Exposure Limits:
NIOSH REL: TWA 5 ppm (20 mg/m^3)
ST 10 ppm (40 mg/m^3)
OSHA PEL†: TWA 5 ppm (20 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 6012

Physical Description: Colorless, odorless gas. [insecticide/fumigant]
[**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 102.1
BP: -68°F
Sol(32°F): 0.2%
Fl.P: NA
IP: 13.04 eV
RGasD: 3.72
VP(70°F): 15.8 atm
FRZ: -212°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 ppm: Sa*
125 ppm: Sa:Cf*
200 ppm: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Conj, rhinitis, pharyngitis, pares; liquid: frostbite: in animals: narco, tremor, convuls; pulm edema; kidney inj
TO: Eyes, skin, resp sys, CNS, kidneys

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Sulprofos

Formula:	CAS#:	RTECS#:	IDLH:
$C_{12}H_{19}O_2PS_3$	35400-43-2	TE4165000	N.D.

Conversion: 1 ppm = 13.19 mg/m^3 **DOT:**

Synonyms/Trade Names: Bolstar®, O-Ethyl O-(4-methylthio)phenyl S-propylphosphorodithioate

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5600
OSHA PV2037

Physical Description: Tan-colored liquid with a sulfide-like odor.

Chemical & Physical Properties:
MW: 322.5
BP: ?
Sol: Low
Fl.P: ?
IP: ?
Sp.Gr: 1.20
VP: <8 mmHg
FRZ: ?
UEL: ?
LEL: ?

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: N.R.
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing
SY: Nau, vomit, abdom cramps, diarr, salv; head, dizz, lass; rhin, chest tight; blurred vision, miosis; card irreg; musc fasc; dysp
TO: Resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

2,4,5-T	Formula: $Cl_3C_6H_2OCH_2COOH$	CAS#: 93-76-5	RTECS#: AJ8400000	IDLH: 250 mg/m^3
Conversion:	**DOT:** 2765 152			

Synonyms/Trade Names: 2,4,5-Trichlorophenoxyacetic acid

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3
OSHA PEL: TWA 10 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5001

Physical Description: Colorless to tan, odorless, crystalline solid. [herbicide]

Chemical & Physical Properties:
MW: 255.5
BP: Decomposes
Sol(77°F): 0.03%
Fl.P: ?
IP: ?
Sp.Gr: 1.80
VP: 1 x 10^{-7} mmHg
MLT: 307°F
UEL: ?
LEL: ?
Combustible Solid, but burns with difficulty.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 mg/m^3: Qm
100 mg/m^3: 95XQ/Sa
250 mg/m^3: Sa:Cf/100F/PaprHie/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: ataxia; skin irrit, acne-like rash; liver damage
TO: Skin, liver, GI tract

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Talc (containing no asbestos and less than 1% quartz)	Formula: $Mg_3Si_4O_{10}(OH)_2$	CAS#: 14807-96-6	RTECS#: WW2710000	IDLH: 1000 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names: Hydrous magnesium silicate, Steatite talc

Exposure Limits:
NIOSH REL: TWA 2 mg/m^3 (resp)
OSHA PEL†: TWA 20 mppcf

Measurement Methods (see Table 1):
NIOSH P&CAM355 (III)

Physical Description: Odorless, white powder.

Chemical & Physical Properties:
MW: Varies
BP: ?
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 2.70-2.80
VP: 0 mmHg (approx)
MLT: 1652°F to 1832°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
10 mg/m^3: Qm
20 mg/m^3: 95XQ/Sa
50 mg/m^3: PaprHie/Sa:Cf
100 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
1000 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Fibrotic pneumoconiosis, irrit eyes
TO: Eyes, resp sys, CVS

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Tantalum (metal and oxide dust, as Ta)

Formula:	CAS#:	RTECS#:	IDLH:
Ta (metal)	7440-25-7 (metal)	WW5505000 (metal)	2500 mg/m^3 (as Ta)

Conversion: **DOT:**

Synonyms/Trade Names: **Tantalum metal:** Tantalum-181
Synonyms of other tantalum dusts (including oxide dusts) vary depending upon the specific compound.

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
ST 10 mg/m^3
OSHA PEL: TWA 5 mg/m^3

Measurement Methods (see Table 1):
NIOSH 0500

Physical Description: Metal: Steel-blue to gray solid or black, odorless powder.

Chemical & Physical Properties:
MW: 180.9
BP: 9797°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 16.65 (metal)
14.40 (powder)
VP: 0 mmHg (approx)
MLT: 5425°F
UEL: NA
LEL: NA
MEC: <200 g/m^3
Metal: Combustible Solid; powder ignites SPONTANEOUSLY in air.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
25 mg/m^3: Qm
50 mg/m^3: 95XQ/Sa
125 mg/m^3: Sa:Cf/PaprHie
250 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
2500 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: HieF/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, bromine trifluoride, fluorine

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin; in animals: pulm irrit
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Resp support

TEDP

Formula:	CAS#:	RTECS#:	IDLH:
[$(CH_3CH_2O)_2PS]_2O$	3689-24-5	XN4375000	10 mg/m^3

Conversion: 1 ppm = 13.18 mg/m^3 **DOT:** 1704 153

Synonyms/Trade Names: Bladafum®, Dithion®, Sulfotep, Tetraethyl dithionopyrophosphate, Tetraethyl dithiopyrophosphate, Thiotepp®

Exposure Limits:
NIOSH REL: TWA 0.2 mg/m^3 [skin]
OSHA PEL: TWA 0.2 mg/m^3 [skin]

Measurement Methods (see Table 1):
None available

Physical Description: Pale-yellow liquid with a garlic-like odor. [**Note:** A pesticide that may be absorbed on a solid carrier or mixed in a more flammable liquid.]

Chemical & Physical Properties:
MW: 322.3
BP: Decomposes
Sol: 0.0007%
Fl.P: ?
IP: ?
Sp.Gr(77°F): 1.20
VP: 0.0002 mmHg
FRZ: ?
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2 mg/m^3: Sa
5 mg/m^3: Sa:Cf
10 mg/m^3: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, iron [**Note:** Corrosive to iron.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; eye pain, blurred vision, lac; rhin; head; cyan; anor, nau, vomit, diarr; local sweat, lass, twitch, para, Cheyne-Stokes respiration, convuls, low BP, card irreg
TO: Eyes, skin, resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Tellurium	Formula: Te	CAS#: 13494-80-9	RTECS#: WY2625000	IDLH: 25 mg/m^3 (as Te)
Conversion:	**DOT:**			
Synonyms/Trade Names: Aurum paradoxum, Metallum problematum				
Exposure Limits: **NIOSH REL*:** TWA 0.1 mg/m^3 **OSHA PEL*:** TWA 0.1 mg/m^3 [***Note:** The REL and PEL also apply to other tellurium compounds (as Te) except Tellurium hexafluoride and Bismuth telluride.]			**Measurement Methods (see Table 1):** **NIOSH** 7300, 7301, 7303, 9102 **OSHA** ID121	
Physical Description: Odorless, dark-gray to brown, amorphous powder or grayish-white, brittle solid.				
Chemical & Physical Properties: **MW:** 127.6 **BP:** 1814°F **Sol:** Insoluble **Fl.P:** NA **IP:** NA **Sp.Gr:** 6.24 **VP:** 0 mmHg (approx) **MLT:** 842°F **UEL:** NA **LEL:** NA Combustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.	**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **0.5 mg/m^3:** Qm **1 mg/m^3:** 95XQ/Sa **2.5 mg/m^3:** Sa:Cf/PaprHie **5 mg/m^3:** 100F/SaT:Cf/PaprTHie/ScbaF/SaF **25 mg/m^3:** Sa:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE		
Incompatibilities and Reactivities: Oxidizers, chlorine, cadmium				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Garlic breath, sweat; dry mouth, metallic taste; drow; anor, nau, no sweat; derm; in animals: CNS, red blood cell changes **TO:** Skin, CNS, blood		**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed		

Tellurium hexafluoride	Formula: TeF_6	CAS#: 7783-80-4	RTECS#: WY2800000	IDLH: 1 ppm
Conversion: 1 ppm = 9.88 mg/m^3	**DOT:** 2195 125			
Synonyms/Trade Names: Tellurium fluoride				
Exposure Limits: **NIOSH REL:** TWA 0.02 ppm (0.2 mg/m^3) **OSHA PEL:** TWA 0.02 ppm (0.2 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** S187 (II-3)	
Physical Description: Colorless gas with a repulsive odor.				
Chemical & Physical Properties: **MW:** 241.6 **BP:** Sublimes **Sol:** Decomposes **Fl.P:** NA **IP:** ? **RGasD:** 8.34 **VP:** >1 atm **FRZ:** -36°F (Sublimes) **UEL:** NA **LEL:** NA Nonflammable Gas	**Personal Protection/Sanitation (see Table 2):** **Skin:** N.R. **Eyes:** N.R. **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R.	**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **0.2 ppm:** Sa **0.5 ppm:** Sa:Cf **1 ppm**: SaT:Cf/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFS/ScbaE		
Incompatibilities and Reactivities: Water [**Note:** Hydrolyzes slowly in water to telluric acid.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh **SY:** Head; dysp; garlic breath; in animals: pulm edema **TO:** Resp sys		**First Aid (see Table 6):** **Breath:** Resp support		

Temephos	**Formula:** $S[C_6H_4OP(S)(OCH_3)_2]_2$	**CAS#:** 3383-96-8	**RTECS#:** TF6890000	**IDLH:** N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Abate®; Temefos; O,O,O'O'-Tetramethyl O,O'-thiodi-p-phenylene phosphorothioate

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600
OSHA PV2056

Physical Description: White, crystalline solid or liquid (above 87°F). [insecticide]
[**Note:** Technical grade is a viscous, brown liquid.]

Chemical & Physical Properties:
MW: 466.5
BP: 248-257°F (Decomposes)
Sol: Insoluble
Fl.P: ?
IP: ?
Sp.Gr: 1.32
VP(77°F): 0.00000007 mmHg
MLT: 87°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, blurred vision; dizz; dysp; salv; abdom cramps, nau, diarr, vomit
TO: Eyes, resp sys, CNS, CVS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

TEPP	**Formula:** $[(CH_3CH_2O)_2PO]_2O$	**CAS#:** 107-49-3	**RTECS#:** UX6825000	**IDLH:** 5 mg/m^3
Conversion: 1 ppm = 11.87 mg/m^3	**DOT:** 2783 152 (solid); 3018 152 (liquid)			

Synonyms/Trade Names: Ethyl pyrophosphate, Tetraethyl pyrophosphate, Tetron®

Exposure Limits:
NIOSH REL: TWA 0.05 mg/m^3 [skin]
OSHA PEL: TWA 0.05 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 2504

Physical Description: Colorless to amber liquid with a faint, fruity odor. [insecticide]
[**Note:** A solid below 32°F.]

Chemical & Physical Properties:
MW: 290.2
BP: Decomposes
Sol: Miscible
Fl.P: NA
IP: ?
Sp.Gr: 1.19
VP: 0.0002 mmHg
FRZ: 32°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.5 mg/m^3: Sa
1.25 mg/m^3: Sa:Cf
2.5 mg/m^3: SaT:Cf/ScbaF/SaF
5 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, alkalis, water
[**Note:** Hydrolyzes quickly in water to form pyrophosphoric acid.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Eye pain, blurred vision, lac; rhin; head, chest tight, cyan; anor, nau, vomit, diarr; lass, twitch, para, Cheyne-Stokes respiration, convuls; low BP, card irreg; sweat
TO: Eyes, resp sys, CNS, CVS, GI tract, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

m-Terphenyl	Formula: $C_6H_5C_6H_4C_6H_5$	CAS#: 92-06-8	RTECS#: WZ6470000	IDLH: 500 mg/m^3
Conversion: 1 ppm = 9.57 mg/m^3	**DOT:**			

Synonyms/Trade Names: m-Diphenylbenzene; 1,3-Diphenylbenzene; Isodiphenylbenzene; 3-Phenylbiphenyl; 1,3-Terphenyl; meta-Terphenyl; m-Triphenyl

Exposure Limits:
NIOSH REL: C 5 mg/m^3 (0.5 ppm)
OSHA PEL†: C 9 mg/m^3 (1 ppm)

Measurement Methods (see Table 1):
NIOSH 5021

Physical Description: Yellow solid (needles).

Chemical & Physical Properties:
MW: 230.3
BP: 689°F
Sol: Insoluble
Fl.P(oc): 375°F
IP: 8.01
Sp.Gr: 1.23
VP(200°F): 0.01 mmHg
MLT: 192°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
25 mg/m^3: Qm£
50 mg/m^3: 95XQ£/Sa£
125 mg/m^3: Sa:Cf£/PaprHie£
250 mg/m^3: 100F/ScbaF/SaF
500 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; thermal skin burns; head; sore throat; in animals: liver, kidney damage
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

o-Terphenyl	Formula: $C_6H_5C_6H_4C_6H_5$	CAS#: 84-15-1	RTECS#: WZ6472000	IDLH: 500 mg/m^3
Conversion: 1 ppm = 9.42 mg/m^3	**DOT:**			

Synonyms/Trade Names: o-Diphenylbenzene; 1,2-Diphenylbenzene; 2-Phenylbiphenyl; 1,2-Terphenyl; ortho-Terphenyl; o-Triphenyl

Exposure Limits:
NIOSH REL: C 5 mg/m^3 (0.5 ppm)
OSHA PEL†: C 9 mg/m^3 (1 ppm)

Measurement Methods (see Table 1):
NIOSH 5021

Physical Description: Colorless or light-yellow solid.

Chemical & Physical Properties:
MW: 230.3
BP: 630°F
Sol: Insoluble
Fl.P(oc): 325°F
IP: 7.99 eV
Sp.Gr: 1.1
VP(200°F): 0.09 mmHg
MLT: 136°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
25 mg/m^3: Qm£
50 mg/m^3: 95XQ£/Sa£
125 mg/m^3: Sa:Cf£/PaprHie£
250 mg/m^3: 100F/ScbaF/SaF
500 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; thermal skin burns; head; sore throat; in animals: liver, kidney damage
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

p-Terphenyl	Formula: $C_6H_5C_6H_4C_6H_5$	CAS#: 92-94-4	RTECS#: WZ6475000	IDLH: 500 mg/m^3
Conversion: 1 ppm = 9.57 mg/m^3	**DOT:**			

Synonyms/Trade Names: p-Diphenylbenzene; 1,4-Diphenylbenzene; 4-Phenylbiphenyl; 1,4-Terphenyl; para-Terphenyl; p-Triphenyl

Exposure Limits:
NIOSH REL: C 5 mg/m^3 (0.5 ppm)
OSHA PEL†: C 9 mg/m^3 (1 ppm)

Measurement Methods (see Table 1):
NIOSH 5021

Physical Description: White or light-yellow solid.

Chemical & Physical Properties:
MW: 230.3
BP: 761°F
Sol: Insoluble
Fl.P: 405°F
IP: 7.78
Sp.Gr: 1.23
VP: Very low
MLT: 415°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
25 mg/m^3: Qm£
50 mg/m^3: 95XQ£/Sa£
125 mg/m^3: Sa:Cf£/PaprHie£
250 mg/m^3: 100F/ScbaF/SaF
500 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; thermal skin burns; head; sore throat; in animals: liver, kidney damage
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

2,3,7,8-Tetrachloro-dibenzo-p-dioxin	Formula: $C_{12}H_4Cl_4O_2$	CAS#: 1746-01-6	RTECS#: HP3500000	IDLH: Ca [N.D.]
Conversion:	**DOT:**			

Synonyms/Trade Names: Dioxin; Dioxine; TCDBD; TCDD; 2,3,7,8-TCDD
[**Note:** Formed during past production of 2,4,5-trichlorophenol, 2,4,5-T & 2(2,4,5-trichlorophenoxy)propionic acid.]

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless to white, crystalline solid.
[**Note:** Exposure may occur through contact at previously contaminated worksites.]

Chemical & Physical Properties:
MW: 322.0
BP: Decomposes
Sol: 0.00000002%
Fl.P: ?
IP: ?
Sp.Gr: ?
VP(77°F): 0.000002 mmHg
MLT: 581°F
UEL: ?
LEL: ?

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: UV light (decomposes)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes; allergic derm, chloracne; porphyria; GI dist; possible repro, terato effects; in animals: liver, kidney damage; hemorr; [carc]
TO: Eyes, skin, liver, kidneys, repro sys [in animals: tumors at many sites]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

1,1,1,2-Tetrachloro-2,2-difluoroethane	Formula: CCl_3CClF_2	CAS#: 76-11-9	RTECS#: KI1425000	IDLH: 2000 ppm
Conversion: 1 ppm = 8.34 mg/m^3	**DOT:**			
Synonyms/Trade Names: 2,2-Difluoro-1,1,1,2-tetrachloroethane; Freon® 112a; Halocarbon 112a; Refrigerant 112a				

Exposure Limits: **NIOSH REL:** TWA 500 ppm (4170 mg/m^3) **OSHA PEL:** TWA 500 ppm (4170 mg/m^3) **Physical Description:** Colorless solid with a slight, ether-like odor. [**Note:** A liquid above 105°F.]	**Measurement Methods (see Table 1):** **NIOSH** 1016 **OSHA** 7

Chemical & Physical Properties: **MW:** 203.8 **BP:** 197°F **Sol:** 0.01% **Fl.P:** NA **IP:** ? **Sp.Gr:** 1.65 **VP:** 40 mmHg **MLT:** 105°F **UEL:** NA **LEL:** NA Noncombustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.	**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **2000 ppm:** Sa/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as potassium, beryllium, powdered aluminum, zinc, calcium, magnesium & sodium; acids

Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin; CNS depres; pulm edema; drow; dysp **TO:** Eyes, skin, resp sys, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed

1,1,2,2-Tetrachloro-1,2-difluoroethane	Formula: CCl_2FCCl_2F	CAS#: 76-12-0	RTECS#: KI1420000	IDLH: 2000 ppm
Conversion: 1 ppm = 8.34 mg/m^3	**DOT:**			
Synonyms/Trade Names: 1,2-Difluoro-1,1,2,2-tetrachloroethane; Freon® 112; Halocarbon 112; Refrigerant 112				

Exposure Limits: **NIOSH REL:** TWA 500 ppm (4170 mg/m^3) **OSHA PEL:** TWA 500 ppm (4170 mg/m^3) **Physical Description:** Colorless solid or liquid (above 77°F) with a slight, ether-like odor.	**Measurement Methods (see Table 1):** **NIOSH** 1016 **OSHA** 7

Chemical & Physical Properties: **MW:** 203.8 **BP:** 199°F **Sol(77°F):** 0.01% **Fl.P:** NA **IP:** 11.30 eV **Sp.Gr:** 1.65 **VP:** 40 mmHg **MLT:** 77°F **UEL:** NA **LEL:** NA Noncombustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.	**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **2000 ppm:** Sa/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as potassium, beryllium, powdered aluminum, zinc, magnesium, calcium & sodium; acids

Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** In animals: irrit eyes, skin; conj; pulm edema; narco **TO:** Eyes, skin, resp sys, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed

1,1,1,2-Tetrachloroethane	Formula: CCl_3CH_2Cl	CAS#: 630-20-6	RTECS#: KI8450000	IDLH: N.D.
Conversion:	**DOT:** 1702 151			

Synonyms/Trade Names: None

Exposure Limits:
NIOSH REL: Handle with caution in the workplace.
See Appendix C (Chloroethanes)
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Yellowish-red liquid.

Chemical & Physical Properties:
MW: 167.9
BP: 267°F
Sol: 0.1%
Fl.P: ?
IP: ?
Sp.Gr: 1.54
VP(77°F): 14 mmHg
FRZ: -94°F
UEL: ?
LEL: ?

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Potassium; sodium; dinitrogen tetraoxide; potassium hydroxide; nitrogen tetroxide; sodium potassium alloy; 2,4-dinitrophenyl disulfide

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin; lass, restless, irreg respiration, musc inco; in animals: liver changes
TO: Eyes, skin, CNS, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

1,1,2,2-Tetrachloroethane	Formula: $CHCl_2CHCl_2$	CAS#: 79-34-5	RTECS#: KI8575000	IDLH: Ca [100 ppm]
Conversion: 1 ppm = 6.87 mg/m^3	**DOT:** 1702 151			

Synonyms/Trade Names: Acetylene tetrachloride, Symmetrical tetrachloroethane

Exposure Limits:
NIOSH REL: Ca
TWA 1 ppm (7 mg/m^3) [skin]
See Appendix A
See Appendix C (Chloroethanes)
OSHA PEL†: TWA 5 ppm (35 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 1019, 2562
OSHA 7

Physical Description: Colorless to pale-yellow liquid with a pungent, chloroform-like odor.

Chemical & Physical Properties:
MW: 167.9
BP: 296°F
Sol: 0.3%
Fl.P: NA
IP: 11.10 eV
Sp.Gr(77°F): 1.59
VP: 5 mmHg
FRZ: -33°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals, strong caustics, fuming sulfuric acid
[**Note:** Degrades slowly when exposed to air.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Nau, vomit, abdom pain; tremor fingers; jaun, hepatitis, liver tend; derm; leucyt; kidney damage; [carc]
TO: Skin, liver, kidneys, CNS, GI tract [in animals: liver tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Tetrachloroethylene	Formula: $Cl_2C=CCl_2$	CAS#: 127-18-4	RTECS#: KX3850000	IDLH: Ca [150 ppm]
Conversion: 1 ppm = 6.78 mg/m^3	**DOT:** 1897 160			
Synonyms/Trade Names: Perchlorethylene, Perchloroethylene, Perk, Tetrachlorethylene				

Exposure Limits:
NIOSH REL: Ca
Minimize workplace exposure concentrations.
See Appendix A
OSHA PEL†: TWA 100 ppm
C 200 ppm
300 ppm (5-minute maximum peak in any 3-hours)

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 1001

Physical Description: Colorless liquid with a mild, chloroform-like odor.

Chemical & Physical Properties:
MW: 165.8
BP: 250°F
Sol: 0.02%
Fl.P: NA
IP: 9.32 eV
Sp.Gr: 1.62
VP: 14 mmHg
FRZ: -2°F
UEL: NA
LEL: NA
Noncombustible Liquid, but decomposes in a fire to hydrogen chloride and phosgene.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers; chemically-active metals such as lithium, beryllium & barium; caustic soda; sodium hydroxide; potash

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat, resp sys; nau; flush face, neck; dizz, inco; head, drow; skin eryt; liver damage; [carc]
TO: Eyes, skin, resp sys, liver, kidneys, CNS [in animals: liver tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Tetrachloronaphthalene	Formula: $C_{10}H_4Cl_4$	CAS#: 1335-88-2	RTECS#: QK3700000	IDLH: See Appendix F
Conversion:	**DOT:**			
Synonyms/Trade Names: Halowax®, Nibren wax, Seekay wax				

Exposure Limits:
NIOSH REL: TWA 2 mg/m^3 [skin]
OSHA PEL: TWA 2 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH S130 (II-2)

Physical Description: Colorless to pale-yellow solid with an aromatic odor.

Chemical & Physical Properties:
MW: 265.9
BP: 599-680°F
Sol: Insoluble
Fl.P(oc): 410°F
IP: ?
Sp.Gr: 1.59-1.65
VP: <1 mmHg
MLT: 360°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
20 mg/m^3: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

See Appendix F

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Acne-form derm; head, lass, anor, dizz; jaun, liver inj
TO: Liver, skin, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Tetraethyl lead (as Pb)

Formula:	CAS#:	RTECS#:	IDLH:
$Pb(C_2H_5)_4$	78-00-2	TP4550000	40 mg/m^3 (as Pb)

Conversion: **DOT:** 1649 131

Synonyms/Trade Names: Lead tetraethyl, TEL, Tetraethylplumbane

Exposure Limits:
NIOSH REL: TWA 0.075 mg/m^3 [skin]
OSHA PEL: TWA 0.075 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 2533

Physical Description: Colorless liquid (unless dyed red, orange, or blue) with a pleasant, sweet odor.
[**Note:** Main usage is in anti-knock additives for gasoline.]

Chemical & Physical Properties:
MW: 323.5
BP: 228°F (Decomposes)
Sol: 0.00002%
Fl.P: 200°F
IP: 11.10 eV
Sp.Gr: 1.65
VP: 0.2 mmHg
FRZ: -202°F
UEL: ?
LEL: 1.8%
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (>0.1%)
Eyes: Prevent eye contact
Wash skin: When contam (>0.1%)
Remove: When wet or contam (>0.1%)
Change: Daily
Provide: Quick drench (>0.1%)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.75 mg/m^3: Sa
1.875 mg/m^3: Sa:Cf
3.75 mg/m^3: SaT:Cf/ScbaF/SaF
40 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, sulfuryl chloride, rust, potassium permanganate
[**Note:** Decomposes slowly at room temperature and more rapidly at higher temperatures.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Insom, lass, anxiety; tremor, hyper-reflexia, spasticity; bradycardia, hypotension, hypothermia, pallor, nau, anor, low-wgt; conf, halu, psychosis, mania, convuls, coma; eye irrit
TO: CNS, CVS, kidneys, eyes

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Tetrahydrofuran

Formula:	CAS#:	RTECS#:	IDLH:
C_4H_8O	109-99-9	LU5950000	2000 ppm [10%LEL]

Conversion: 1 ppm = 2.95 mg/m^3 **DOT:** 2056 127

Synonyms/Trade Names: Diethylene oxide; 1,4-Epoxybutane; Tetramethylene oxide; THF

Exposure Limits:
NIOSH REL: TWA 200 ppm (590 mg/m^3)
ST 250 ppm (735 mg/m^3)
OSHA PEL†: TWA 200 ppm (590 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1609, 3800
OSHA 7

Physical Description: Colorless liquid with an ether-like odor.

Chemical & Physical Properties:
MW: 72.1
BP: 151°F
Sol: Miscible
Fl.P: 6°F
IP: 9.45 eV
Sp.Gr: 0.89
VP: 132 mmHg
FRZ: -163°F
UEL: 11.8%
LEL: 2%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2000 ppm: Sa:Cf£/CcrFOv/GmFOv/PaprOv£/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, lithium-aluminum alloys
[**Note:** Peroxides may accumulate upon prolonged storage in presence of air.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con, Ing
SY: Irrit eyes, upper resp sys; nau, dizz, head, CNS depres
TO: Eyes, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

Tetramethyl lead (as Pb)	Formula: $Pb(CH_3)_4$	CAS#: 75-74-1	RTECS#: TP4725000	IDLH: 40 mg/m^3 (as Pb)
Conversion:	**DOT:**			

Synonyms/Trade Names: Lead tetramethyl, Tetramethylplumbane, TML

Exposure Limits:
NIOSH REL: TWA 0.075 mg/m^3 [skin]
OSHA PEL: TWA 0.075 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 2534

Physical Description: Colorless liquid (unless dyed red, orange, or blue) with a fruity odor. [**Note:** Main usage is in anti-knock additives for gasoline.]

Chemical & Physical Properties:
MW: 267.3
BP: 212°F (Decomposes)
Sol: 0.002%
Fl.P: 100°F
IP: 8.50 eV
Sp.Gr: 2.00
VP: 23 mmHg
FRZ: -15°F
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (>0.1%)
Eyes: Prevent eye contact
Wash skin: When contam (>0.1%)
Remove: When wet or contam (>0.1%)
Change: Daily
Provide: Quick drench (>0.1%)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.75 mg/m^3: Sa
1.875 mg/m^3: Sa:Cf
3.75 mg/m^3: SaT:Cf/ScbaF/SaF
40 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers such as sulfuryl chloride or potassium permanganate

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Insom, bad dreams, restless, anxious; hypotension; nau, anor; delirium, mania, convuls; coma
TO: CNS, CVS, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Tetramethyl succinonitrile	Formula: $(CH_3)_2C(CN)C(CN)(CH_3)_2$	CAS#: 3333-52-6	RTECS#: WN4025000	IDLH: 5 ppm
Conversion: 1 ppm = 5.57 mg/m^3	**DOT:**			

Synonyms/Trade Names: Tetramethyl succinodinitrile, TMSN

Exposure Limits:
NIOSH REL: TWA 3 mg/m^3 (0.5 ppm) [skin]
OSHA PEL: TWA 3 mg/m^3 (0.5 ppm) [skin]

Measurement Methods (see Table 1):
NIOSH S155 (II-3)
OSHA 7

Physical Description: Colorless, odorless solid. [**Note:** Forms cyanide in the body.]

Chemical & Physical Properties:
MW: 136.2
BP: Sublimes
Sol: Insoluble
Fl.P: ?
IP: ?
Sp.Gr: 1.07
VP: ?
MLT: 338°F (Sublimes)
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
28 mg/m^3: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Head, nau; convuls, coma; liver, kidney, GI effects
TO: CNS, liver, kidneys, GI tract

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Tetranitromethane	Formula: $C(NO_2)_4$	CAS#: 509-14-8	RTECS#: PB4025000	IDLH: 4 ppm
Conversion: 1 ppm = 8.02 mg/m^3	**DOT:** 1510 143			
Synonyms/Trade Names: Tetan, TNM				
Exposure Limits: **NIOSH REL:** TWA 1 ppm (8 mg/m^3) **OSHA PEL:** TWA 1 ppm (8 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 3513	
Physical Description: Colorless to pale-yellow liquid or solid (below 57°F) with a pungent odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 196.0 **BP:** 259°F **Sol:** Insoluble **Fl.P:** ? **IP:** ? **Sp.Gr:** 1.62 **VP:** 8 mmHg **FRZ:** 57°F **UEL:** ? **LEL:** ? Combustible Liquid, but difficult to ignite.	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** Daily **Provide:** Eyewash	**NIOSH/OSHA** **4 ppm:** Sa:Cf£/CcrFS¿/GmFS¿/ PaprS¿£/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFS¿/ScbaE

Incompatibilities and Reactivities: Hydrocarbons, alkalis, metals, oxidizers, aluminum, toluene, cotton [**Note:** Combustible material wet with tetranitromethane may be highly explosive.]	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat; dizz, head; chest pain, dysp; methemo, cyan; skin burns **TO:** Eyes, skin, resp sys, blood, CNS	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed

Tetrasodium pyrophosphate	Formula: $Na_4P_2O_7$	CAS#: 7722-88-5	RTECS#: UX7350000	IDLH: N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: Pyrophosphate, Sodium pyrophosphate, Tetrasodium diphosphate, Tetrasodium pyrophosphate (anhydrous), TSPP				
Exposure Limits: **NIOSH REL:** TWA 5 mg/m^3 **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **NIOSH** 0500	
Physical Description: Odorless, white powder or granules. [**Note:** The decahydrate ($Na_4P_2O_7 \times 10H_2O$) is in the form of colorless, transparent crystals.]				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 265.9 **BP:** Decomposes **Sol(77°F):** 7% **Fl.P:** NA **IP:** NA **Sp.Gr:** 2.45 **VP:** 0 mmHg (approx) **MLT:** 1810°F **UEL:** NA **LEL:** NA Noncombustible Solid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily **Provide:** Eyewash (solution)	Not available.

Incompatibilities and Reactivities: Strong acids	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat; derm **TO:** Eyes, skin, resp sys	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water wash prompt **Breath:** Resp support **Swallow:** Medical attention immed

Tetryl	**Formula:** $(NO_2)_3C_6H_2N(NO_2)CH_3$	**CAS#:** 479-45-8	**RTECS#:** BY6300000	**IDLH:** 750 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names: N-Methyl-N,2,4,6-tetranitroaniline; Nitramine; 2,4,6-Tetryl; 2,4,6-Trinitrophenyl-N-methylnitramine

Exposure Limits:
NIOSH REL: TWA 1.5 mg/m^3 [skin]
OSHA PEL: TWA 1.5 mg/m^3 [skin]

Physical Description: Colorless to yellow, odorless, crystalline solid.

Measurement Methods (see Table 1):
NIOSH S225 (II-3)

Chemical & Physical Properties:
MW: 287.2
BP: 356-374°F (Explodes)
Sol: 0.02%
Fl.P: Explodes
IP: ?
Sp.Gr: 1.57
VP: <1 mmHg
MLT: 268°F
UEL: ?
LEL: ?
Combustible Solid
(Class A Explosive)

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
7.5 mg/m^3: Qm
15 mg/m^3: 95XQ*/Sa*
37.5 mg/m^3: Sa:Cf*/PaprHie*
75 mg/m^3: 100F/ScbaF/SaF
750 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Oxidizable materials, hydrazine

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Sens derm, itch, eryt; edema on nasal folds, cheeks, neck; kera; sneez; anemia; cough, coryza; irrity; mal, head, lass, insom; nau, vomit; liver, kidney damage
TO: Eyes, skin, resp sys, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Thallium (soluble compounds, as Tl)	**Formula:**	**CAS#:**	**RTECS#:**	**IDLH:** 15 mg/m^3 (as Tl)
Conversion:	**DOT:** 1707 151 (compounds, n.o.s.)			

Synonyms/Trade Names: Synonyms vary depending upon the specific soluble thallium compound.

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3 [skin]
OSHA PEL: TWA 0.1 mg/m^3 [skin]

Physical Description: Appearance and odor vary depending upon the specific soluble thallium compound.

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303, 9102
OSHA ID121

Chemical & Physical Properties:
Properties vary depending upon the specific soluble thallium compound.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.5 mg/m^3: Qm
1 mg/m^3: 95XQ/Sa
2.5 mg/m^3: Sa:Cf/PaprHie
5 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
15 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Varies

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Nau, diarr, abdom pain, vomit; ptosis, strabismus; peri neuritis, tremor; retster tight, chest pain, pulm edema; convuls, chorea, psychosis; liver, kidney damage; alopecia; pares legs
TO: Eyes, resp sys, CNS, liver, kidneys, GI tract, body hair

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

4,4'-Thiobis(6-tert-butyl-m-cresol)	Formula: $[CH_3(OH)C_6H_2C(CH_3)_3]_2S$	CAS#: 96-69-5	RTECS#: GP3150000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: 4,4'-Thiobis(3-methyl-6-tert-butylphenol); 1,1'-Thiobis(2-methyl-4-hydroxy-5-tert-butylbenzene)

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Light-gray to tan powder with a slightly aromatic odor.

Chemical & Physical Properties:
MW: 358.6
BP: ?
Sol: 0.08%
Fl.P: 420°F
IP: ?
Sp.Gr: 1.10
VP: 0.0000006 mmHg
MLT: 302°F
UEL: NA
LEL: NA
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air
Swallow: Medical attention immed

Thioglycolic acid	Formula: $HSCH_2COOH$	CAS#: 68-11-1	RTECS#: AI5950000	IDLH: N.D.
Conversion: 1 ppm = 3.77 mg/m^3	**DOT:** 1940 153			

Synonyms/Trade Names: Acetyl mercaptan, Mercaptoacetate, Mercaptoacetic acid, 2-Mercaptoacetic acid, 2-Thioglycolic acid, Thiovanic acid

Exposure Limits:
NIOSH REL: TWA 1 ppm (4 mg/m^3) [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless liquid with a strong, disagreeable odor characteristic of mercaptans. [**Note:** Olfactory fatigue may occur after short exposures.]

Chemical & Physical Properties:
MW: 92.1
BP: ?
Sol: Miscible
Fl.P: >230°F
IP: ?
Sp.Gr: 1.32
VP(64°F): 10 mmHg
FRZ: 2°F
UEL: ?
LEL: 5.9%
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Air, strong oxidizers, bases, active metals (e.g., sodium potassium, magnesium, calcium) [**Note:** Readily oxidized by air.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; lac, corn damage; skin burns, blisters; in animals: lass; gasping respirations; convuls
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Thionyl chloride	**Formula:** $SOCl_2$	**CAS#:** 7719-09-7	**RTECS#:** XM5150000	**IDLH:** N.D.
Conversion: 1 ppm = 4.87 mg/m^3	**DOT:** 1836 137			
Synonyms/Trade Names: Sulfinyl chloride, Sulfur chloride oxide, Sulfurous dichloride, Sulfurous oxychloride, Thionyl dichloride				
Exposure Limits: **NIOSH REL:** C 1 ppm (5 mg/m^3) **OSHA PEL†:** none **Physical Description:** Colorless to yellow to reddish liquid with a pungent odor like sulfur dioxide. [**Note:** Fumes form when exposed to moist air.]			**Measurement Methods (see Table 1):** None available	
Chemical & Physical Properties: **MW:** 119.0 **BP:** 169°F **Sol:** Reacts **Fl.P:** NA **IP:** ? **Sp.Gr:** 1.64 **VP(70°F):** 100 mmHg **FRZ:** -156°F **UEL:** NA **LEL:** NA Noncombustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R. **Provide:** Eyewash Quick drench		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Water, acids, alkalis, ammonia, chloryl perchlorate [**Note:** Reacts violently with water to form sulfur dioxide & hydrogen chloride.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, muc memb; eye, skin burns **TO:** Eyes, skin, resp sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Water flush immed **Breath:** Resp support **Swallow:** Medical attention immed	

Thiram	**Formula:** $C_6H_{12}N_2S_4$	**CAS#:** 137-26-8	**RTECS#:** JO1400000	**IDLH:** 100 mg/m^3
Conversion:	**DOT:** 2771 151			
Synonyms/Trade Names: bis(Dimethylthiocarbamoyl) disulfide, Tetramethylthiuram disulfide				
Exposure Limits: **NIOSH REL:** TWA 5 mg/m^3 **OSHA PEL:** TWA 5 mg/m^3 **Physical Description:** Colorless to yellow, crystalline solid with a characteristic odor. [**Note:** Commercial pesticide products may be dyed blue.]			**Measurement Methods (see Table 1):** **NIOSH** 5005	
Chemical & Physical Properties: **MW:** 240.4 **BP:** Decomposes **Sol:** 0.003% **Fl.P:** ? **IP:** ? **Sp.Gr:** 1.29 **VP:** 0.000008 mmHg **MLT:** 312°F **UEL:** ? **LEL:** ? Combustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** Daily		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **50 mg/m^3:** CcrOv95*/Sa* **100 mg/m^3:** Sa:Cf*/CcrFOv100/GmFOv100/ PaprOvHie*/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv100/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers, strong acids, oxidizable materials				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, muc memb; derm; Antabuse-like effects **TO:** Eyes, skin, resp sys, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Tin

Formula:	CAS#:	RTECS#:	IDLH:
Sn	7440-31-5	XP7320000	100 mg/m^3 (as Sn)

Conversion: **DOT:**

Synonyms/Trade Names: Metallic tin, Tin flake, Tin metal, Tin powder

Exposure Limits:
NIOSH REL*: TWA 2 mg/m^3
OSHA PEL*: TWA 2 mg/m^3
[***Note:** The REL and PEL also apply to other inorganic tin compounds (as Sn) except tin oxides.]

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303
OSHA ID121, ID206

Physical Description: Gray to almost silver-white, ductile, malleable, lustrous solid.

Chemical & Physical Properties:
MW: 118.7
BP: 4545°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 7.28
VP: 0 mmHg (approx)
MLT: 449°F
UEL: NA
LEL: NA
Noncombustible Solid, but powdered form may ignite.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 mg/m^3: Qm*
20 mg/m^3: 95XQ*/Sa*
50 mg/m^3: Sa:Cf*/PaprHie*
100 mg/m^3: 100F/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Chlorine, turpentine, acids, alkalis

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, resp sys; in animals: vomit, diarr, para with musc twitch
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Tin (organic compounds, as Sn)

Formula:	CAS#:	RTECS#:	IDLH:
			25 mg/m^3 (as Sn)

Conversion: **DOT:**

Synonyms/Trade Names: Synonyms vary depending upon the specific organic tin compound.
[**Note:** Also see specific listing for Cyhexatin.]

Exposure Limits:
NIOSH REL*: TWA 0.1 mg/m^3 [skin]
[***Note:** The REL applies to all organic tin compounds except Cyhexatin.]
OSHA PEL*: TWA 0.1 mg/m^3
[***Note:** The PEL applies to all organic tin compounds.]

Measurement Methods (see Table 1):
NIOSH 5504

Physical Description: Appearance and odor vary depending upon the specific organic tin compound.

Chemical & Physical Properties:
Properties vary depending upon the specific organic tin compound.

Personal Protection/Sanitation (see Table 2):
Recommendations regarding personal protective clothing vary depending upon the specific compound.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1 mg/m^3: CcrOv95/Sa
2.5 mg/m^3: Sa:Cf/PaprOvHie
5 mg/m^3: CcrFOv100/GmFOv100/ PaprTOvHie/SaT:Cf/ScbaF/SaF
25 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Varies

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, resp sys; head, dizz; psycho-neurologic dist; sore throat, cough; abdom pain, vomit; urine retention; paresis, focal anes; skin burns, pruritus; in animals: hemolysis; hepatic nec; kidney damage
TO: Eyes, skin, resp sys, CNS, liver, kidneys, urinary tract, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Tin(II) oxide (as Sn)	Formula: SnO	CAS#: 21651-19-4	RTECS#: XQ3700000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Stannous oxide, Tin protoxide [**Note:** Also see specific listing for Tin(IV) oxide (as Sn).]

Exposure Limits:
NIOSH REL: TWA 2 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303

Physical Description: Brownish-black powder.

Chemical & Physical Properties:
MW: 134.7
BP: Decomposes
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 6.3
VP: 0 mmHg (approx)
MLT(600 mmHg): 1976°F (Decomposes)
UEL: NA
LEL: NA

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Stannosis (benign pneumoconiosis): dysp, decr pulm func
TO: Resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Tin(IV) oxide (as Sn)	Formula: SnO_2	CAS#: 18282-10-5	RTECS#: XQ4000000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Stannic dioxide, Stannic oxide, White tin oxide
[**Note:** Also see specific listing for Tin(II) oxide (as Sn).]

Exposure Limits:
NIOSH REL: TWA 2 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303

Physical Description: White or slightly gray powder.

Chemical & Physical Properties:
MW: 150.7
BP: Decomposes
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 6.95
VP: 0 mmHg (approx)
MLT: 2966°F (Decomposes)
UEL: NA
LEL: NA

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Chlorine trifluoride

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Stannosis (benign pneumoconiosis): dysp, decr pulm func
TO: Resp sys

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Titanium dioxide

Formula:	CAS#:	RTECS#:	IDLH:
TiO_2	13463-67-7	XR2275000	Ca [5000 mg/m^3]

Conversion: **DOT:**

Synonyms/Trade Names: Rutile, Titanium oxide, Titanium peroxide

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: TWA 15 mg/m^3

Measurement Methods (see Table 1):
NIOSH S385 (II-3)

Physical Description: White, odorless powder.

Chemical & Physical Properties:
MW: 79.9
BP: 4532-5432°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 4.26
VP: 0 mmHg (approx)
MLT: 3326-3362°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh
SY: Lung fib; [carc]
TO: Resp sys [in animals: lung tumors]

First Aid (see Table 6):
Breath: Resp support

o-Tolidine

Formula:	CAS#:	RTECS#:	IDLH:
$C_{14}H_{16}N_2$	119-93-7	DD1225000	Ca [N.D.]

Conversion: **DOT:**

Synonyms/Trade Names: 4,4'-Diamino-3,3'-dimethylbiphenyl; Diaminoditolyl; 3,3'-Dimethylbenzidine; 3,3'-Dimethyl-4,4'-diphenyldiamine; 3,3'-Tolidine

Exposure Limits:
NIOSH REL: Ca
C 0.02 mg/m^3 [60-minute] [skin]
See Appendix A
See Appendix C
OSHA PEL: See Appendix C

Measurement Methods (see Table 1):
NIOSH 5013
OSHA 71

Physical Description: White to reddish crystals or powder.
[**Note:** Darkens on exposure to air. Often used in paste or wet cake form. Used as a basis for many dyes.]

Chemical & Physical Properties:
MW: 212.3
BP: 572°F
Sol: 0.1%
Fl.P: ?
IP: ?
Sp.Gr: ?
VP: ?
MLT: 264°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose; in animals: liver, kidney damage; [carc]
TO: Eyes, resp sys, liver, kidneys [in animals: liver, bladder & mammary gland tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Toluene

Formula: $C_6H_5CH_3$ | **CAS#:** 108-88-3 | **RTECS#:** XS5250000 | **IDLH:** 500 ppm

Conversion: 1 ppm = 3.77 mg/m^3 | **DOT:** 1294 130

Synonyms/Trade Names: Methyl benzene, Methyl benzol, Phenyl methane, Toluol

Exposure Limits:
NIOSH REL: TWA 100 ppm (375 mg/m^3)
ST 150 ppm (560 mg/m^3)
OSHA PEL†: TWA 200 ppm
C 300 ppm
500 ppm (10-minute maximum peak)

Measurement Methods (see Table 1):
NIOSH 1500, 1501, 3800, 4000
OSHA 111

Physical Description: Colorless liquid with a sweet, pungent, benzene-like odor.

Chemical & Physical Properties:
MW: 92.1
BP: 232°F
Sol(74°F): 0.07%
Fl.P: 40°F
IP: 8.82 eV
Sp.Gr: 0.87
VP: 21 mmHg
FRZ: -139°F
UEL: 7.1%
LEL: 1.1%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
500 ppm: CcrOv*/PaprOv*/
GmFOv/Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose; lass, conf, euph, dizz, head; dilated pupils, lac; anxi, musc ftg, insom; pares; derm; liver, kidney damage
TO: Eyes, skin, resp sys, CNS, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Toluenediamine

Formula: $CH_3C_6H_3(NH_2)_2$ | **CAS#:** 25376-45-8 95-80-7 (2,4-TDA) | **RTECS#:** XS9445000 XS9625000 (2,4-TDA) | **IDLH:** Ca [N.D.]

Conversion: | **DOT:** 1709 151 (2,4-Toluenediamine)

Synonyms/Trade Names: Diaminotoluene, Methylphenylene diamine, TDA, Toluenediamine isomers, Tolylenediamine [**Note:** Various isomers of TDA exist.]

Exposure Limits:
NIOSH REL: Ca (all isomers)
See Appendix A
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 5516
OSHA 65

Physical Description: Colorless to brown, needle-shaped crystals or powder.
[**Note:** Tends to darken on storage and exposure to air. Properties given are for 2,4-TDA.]

Chemical & Physical Properties:
MW: 122.2
BP: 558°F
Sol: Soluble
Fl.P: 300°F
IP: ?
Sp.Gr: 1.05 (Liquid at 212°F)
VP(224°F): 1 mmHg
MLT: 210°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; derm; ataxia, tacar, nau, vomit, convuls, resp depres; methemo, cyan, head, lass, dizz, bluish skin; liver inj; [carc]
TO: Eyes, skin, resp sys, blood, CVS, liver [in animals: liver, skin & mammary gland tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Toluene-2,4-diisocyanate	Formula: $CH_3C_6H_3(NCO)_2$	CAS#: 584-84-9	RTECS#: CZ6300000	IDLH: Ca [2.5 ppm]
Conversion: 1 ppm = 7.13 mg/m^3	**DOT:** 2078 156			

Synonyms/Trade Names: TDI; 2,4-TDI; 2,4-Toluene diisocyanate

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: C 0.02 ppm (0.14 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2535, 5521, 5522, 5525
OSHA 18, 33, 42

Physical Description: Colorless to pale-yellow solid or liquid (above 71°F) with a sharp, pungent odor.

Chemical & Physical Properties:
MW: 174.2
BP: 484°F
Sol: Insoluble
Fl.P: 260°F
IP: ?
Sp.Gr: 1.22
VP(77°F): 0.01 mmHg
MLT: 71°F
UEL: 9.5%
LEL: 0.9%
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, water, acids, bases & amines (may cause foam & spatter); alcohols [**Note:** Reacts slowly with water to form carbon dioxide and polyureas.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; choke, paroxysmal cough; chest pain, retster soreness; nau, vomit, abdom pain; bron, bronchospasm, pulm edema; dysp, asthma; conj, lac; derm, skin sens; [carc]
TO: Eyes, skin, resp sys [in animals: pancreas, liver, mammary gland, circulatory sys & skin tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

m-Toluidine	Formula: $CH_3C_6H_4NH_2$	CAS#: 108-44-1	RTECS#: XU2800000	IDLH: N.D.
Conversion:	**DOT:** 1708 153			

Synonyms/Trade Names: 3-Amino-1-methylbenzene, 1-Aminophenylmethane, m-Aminotoluene, 3-Methylaniline, 3-Methylbenzenamine, 3-Toluidine, meta-Toluidine, m-Tolylamine

Exposure Limits:
NIOSH REL: See Appendix D
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 2002
OSHA 73

Physical Description: Colorless to light-yellow liquid with an aromatic, amine-like odor. [**Note:** Used as a basis for many dyes.]

Chemical & Physical Properties:
MW: 107.2
BP: 397°F
Sol: 2%
Fl.P: 187°F
IP: 7.50 eV
Sp.Gr: 0.999
VP(106°F): 1 mmHg
FRZ: -23°F
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers, acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; derm; hema, methemo; cyan, nau, vomit, low BP, convuls; anemia, lass
TO: Eyes, skin, blood, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

o-Toluidine

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3C_6H_4NH_2$	95-53-4	XU2975000	Ca [50 ppm]

Conversion: 1 ppm = 4.38 mg/m^3 **DOT:** 1708 153

Synonyms/Trade Names: o-Aminotoluene, 2-Aminotoluene, 1-Methyl-2-aminobenzene, o-Methylaniline, 2-Methylaniline, ortho-Toluidine, o-Tolylamine

Exposure Limits:
NIOSH REL: Ca [skin]
See Appendix A
OSHA PEL: TWA 5 ppm (22 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2002, 2017, 8317
OSHA 73

Physical Description: Colorless to pale-yellow liquid with an aromatic, aniline-like odor.

Chemical & Physical Properties:
MW: 107.2
BP: 392°F
Sol: 2%
Fl.P: 185°F
IP: 7.44 eV
Sp.Gr: 1.01
VP: 0.3 mmHg
FRZ: 6°F
UEL: ?
LEL: ?
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, nitric acid, bases

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes; anoxia, head, cyan; lass, dizz, drow; micro hema; eye burns; derm; [carc]
TO: Eyes, skin, blood, kidneys, liver, CVS [bladder cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

p-Toluidine

Formula:	CAS#:	RTECS#:	IDLH:
$CH_3C_6H_4NH_2$	106-49-0	XU3150000	Ca [N.D.]

Conversion: **DOT:** 1708 153

Synonyms/Trade Names: 4-Aminotoluene, 4-Methylaniline, 4-Methylbenzenamine, 4-Toluidine, para-Toluidine, p-Tolylamine

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 2002
OSHA 73

Physical Description: White solid with an aromatic odor.
[**Note:** Used as a basis for many dyes.]

Chemical & Physical Properties:
MW: 107.2
BP: 393°F
Sol: 0.7%
Fl.P: 188°F
IP: 7.50 eV
Sp.Gr: 1.05
VP(108°F): 1 mmHg
MLT: 111°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Oxidizers, acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; derm; hema, methemo; cyan, nau, vomit, low BP, convuls; anemia, lass; [carc]
TO: Eyes, skin, blood, CVS [in animals: liver tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Tributyl phosphate

Formula:	CAS#:	RTECS#:	IDLH:
$(CH_3[CH_2]_3O)_3PO$	126-73-8	TC7700000	30 ppm

Conversion: 1 ppm = 10.89 mg/m^3 **DOT:**

Synonyms/Trade Names: Butyl phosphate, TBP, Tributyl ester of phosphoric acid, Tri-n-butyl phosphate

Exposure Limits:
NIOSH REL: TWA 0.2 ppm (2.5 mg/m^3)
OSHA PEL†: TWA 5 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5034

Physical Description: Colorless to pale-yellow, odorless liquid.

Chemical & Physical Properties:
MW: 266.3
BP: 552°F (Decomposes)
Sol: 0.6%
Fl.P(oc): 295°F
IP: ?
Sp.Gr: 0.98
VP(77°F): 0.004 mmHg
FRZ: -112°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
2 ppm: Sa
5 ppm: Sa:Cf
10 ppm: ScbaF/SaF
30 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Alkalis, oxidizers, water, moist air

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys, head; nau
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Trichloroacetic acid

Formula:	CAS#:	RTECS#:	IDLH:
CCl_3COOH	76-03-9	AJ7875000	N.D.

Conversion: 1 ppm = 6.68 mg/m^3 **DOT:** 1839 153 (solid); 2564 153 (solution)

Synonyms/Trade Names: TCA, Trichloroethanoic acid

Exposure Limits:
NIOSH REL: TWA 1 ppm (7 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2017

Physical Description: Colorless to white, crystalline solid with a sharp, pungent odor.

Chemical & Physical Properties:
MW: 163.4
BP: 388°F
Sol: Miscible
Fl.P: NA
IP: ?
Sp.Gr: 1.62
VP(124°F): 1 mmHg
MLT: 136°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Moisture, iron, zinc, aluminum, strong oxidizers
[**Note:** Decomposes on heating to form phosgene & hydrogen chloride. Corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat, resp sys; cough, dysp, delayed pulm edema; eye, skin burns; derm; salv, vomit, diarr
TO: Eyes, skin, resp sys, GI tract

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

1,2,4-Trichlorobenzene	Formula: $C_6H_3Cl_3$	CAS#: 120-82-1	RTECS#: DC2100000	IDLH: N.D.
Conversion: 1 ppm = 7.42 mg/m^3	**DOT:** 2321 153 (liquid)			
Synonyms/Trade Names: unsym-Trichlorobenzene; 1,2,4-Trichlorobenzol				
Exposure Limits: **NIOSH REL:** C 5 ppm (40 mg/m^3) **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **NIOSH** 5517	
Physical Description: Colorless liquid or crystalline solid (below 63°F) with an aromatic odor.				
Chemical & Physical Properties: **MW:** 181.4 **BP:** 416°F **Sol:** 0.003% **Fl.P:** 222°F **IP:** ? **Sp.Gr:** 1.45 **VP:** 1 mmHg **FRZ:** 63°F **UEL(302°F):** 6.6% **LEL(302°F):** 2.5% Class IIIB Combustible Liquid Combustible Solid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
	Incompatibilities and Reactivities: Acids, acid fumes, oxidizers, steam			
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, muc memb; in animals: liver, kidney damage; possible terato effects **TO:** Eyes, skin, resp sys, liver, repro sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash **Breath:** Resp support **Swallow:** Medical attention immed	

1,1,2-Trichloroethane	Formula: $CHCl_2CH_2Cl$	CAS#: 79-00-5	RTECS#: KJ3150000	IDLH: Ca [100 ppm]
Conversion: 1 ppm = 5.46 mg/m^3	**DOT:**			
Synonyms/Trade Names: Ethane trichloride, β-Trichloroethane, Vinyl trichloride				
Exposure Limits: **NIOSH REL:** Ca TWA 10 ppm (45 mg/m^3) [skin] See Appendix A See Appendix C (Chloroethanes) **OSHA PEL:** TWA 10 ppm (45 mg/m^3) [skin]			**Measurement Methods (see Table 1):** **NIOSH** 1003 **OSHA** 11	
Physical Description: Colorless liquid with a sweet, chloroform-like odor.				
Chemical & Physical Properties: **MW:** 133.4 **BP:** 237°F **Sol:** 0.4% **Fl.P:** ? **IP:** 11.00 eV **Sp.Gr:** 1.44 **VP:** 19 mmHg **FRZ:** -34°F **UEL:** 15.5% **LEL:** 6% Combustible Liquid, forms dense soot.	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R. **Provide:** Eyewash Quick drench		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **¥:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers & caustics; chemically-active metals (such as aluminum, magnesium powders, sodium & potassium)				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, nose; CNS depres; liver, kidney damage; derm; [carc] **TO:** Eyes, resp sys, CNS, liver, kidneys [in animals: liver cancer]			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Trichloroethylene

Formula:	CAS#:	RTECS#:	IDLH:
$ClCH{=}CCl_2$	79-01-6	KX4550000	Ca [1000 ppm]

Conversion: 1 ppm = 5.37 mg/m^3 **DOT:** 1710 160

Synonyms/Trade Names: Ethylene trichloride, TCE, Trichloroethene, Trilene

Exposure Limits:
NIOSH REL: Ca
See Appendix A
See Appendix C
OSHA PEL†: TWA 100 ppm
C 200 ppm
300 ppm (5-minute maximum peak in any 2 hours)

Measurement Methods (see Table 1):
NIOSH 1022, 3800
OSHA 1001

Physical Description: Colorless liquid (unless dyed blue) with a chloroform-like odor.

Chemical & Physical Properties:
MW: 131.4
BP: 189°F
Sol: 0.1%
Fl.P: ?
IP: 9.45 eV
Sp.Gr: 1.46
VP: 58 mmHg
FRZ: -99°F
UEL(77°F): 10.5%
LEL(77°F): 8%
Combustible Liquid, but burns with difficulty.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong caustics & alkalis; chemically-active metals (such as barium, lithium, sodium, magnesium, titanium & beryllium)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; head, vis dist, lass, dizz, tremor, drow, nau, vomit; derm; card arrhy, pares; liver inj; [carc]
TO: Eyes, skin, resp sys, heart, liver, kidneys, CNS [in animals: liver & kidney cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Trichloronaphthalene

Formula:	CAS#:	RTECS#:	IDLH:
$C_{10}H_5Cl_3$	1321-65-9	QK4025000	See Appendix F

Conversion: **DOT:**

Synonyms/Trade Names: Halowax®, Nibren wax, Seekay wax

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3 [skin]
OSHA PEL: TWA 5 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH S128 (II-2)

Physical Description: Colorless to pale-yellow solid with an aromatic odor.

Chemical & Physical Properties:
MW: 231.5
BP: 579-669°F
Sol: Insoluble
Fl.P(oc): 392°F
IP: ?
Sp.Gr: 1.58
VP: <1 mmHg
MLT: 199°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 mg/m^3: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

See Appendix F

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Anor, nau; dizz; jaun, liver inj
TO: Liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

1,2,3-Trichloropropane	Formula: $CH_2ClCHClCH_2Cl$	CAS#: 96-18-4	RTECS#: TZ9275000	IDLH: Ca [100 ppm]
Conversion: 1 ppm = 6.03 mg/m^3	**DOT:**			

Synonyms/Trade Names: Allyl trichloride, Glycerol trichlorohydrin, Glyceryl trichlorohydrin, Trichlorohydrin

Exposure Limits:
NIOSH REL: Ca
TWA 10 ppm (60 mg/m^3) [skin]
See Appendix A
OSHA PEL†: TWA 50 ppm (300 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 7

Physical Description: Colorless liquid with a chloroform-like odor.

Chemical & Physical Properties:
MW: 147.4
BP: 314°F
Sol: 0.1%
Fl.P: 160°F
IP: ?
Sp.Gr: 1.39
VP: 3 mmHg
FRZ: 6°F
UEL(302°F): 12.6%
LEL(248°F): 3.2%
Class IIIA Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals, strong caustics & oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, nose, throat; CNS depres; in animals: liver, kidney inj; [carc]
TO: Eyes, skin, resp sys, CNS, liver, kidneys [in animals: forestomach, liver & mammary gland cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

1,1,2-Trichloro-1,2,2-trifluoroethane	Formula: CCl_2FCClF_2	CAS#: 76-13-1	RTECS#: KJ4000000	IDLH: 2000 ppm
Conversion: 1 ppm = 7.67 mg/m^3	**DOT:**			

Synonyms/Trade Names: Chlorofluorocarbon-113, CFC-113, Freon® 113, Genetron® 113, Halocarbon 113, Refrigerant 113, TTE

Exposure Limits:
NIOSH REL: TWA 1000 ppm (7600 mg/m^3)
ST 1250 ppm (9500 mg/m^3)
OSHA PEL†: TWA 1000 ppm (7600 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1020
OSHA 113

Physical Description: Colorless to water-white liquid with an odor like carbon tetrachloride at high concentrations. [**Note:** A gas above 118°F.]

Chemical & Physical Properties:
MW: 187.4
BP: 118°F
Sol(77°F): 0.02%
Fl.P: ?
IP: 11.99 eV
Sp.Gr(77°F): 1.56
VP: 285 mmHg
FRZ: -31°F
UEL: ?
LEL: ?
Noncombustible Liquid at ordinary temperatures, but the gas will ignite and burn weakly at 1256°F.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
2000 ppm: Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as calcium, powdered aluminum, zinc, magnesium & beryllium [**Note:** Decomposes if in contact with alloys containing >2% magnesium.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit skin, throat, drow, derm; CNS depres; in animals: card arrhy, narco
TO: Skin, heart, CNS, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Triethylamine	Formula: $(C_2H_5)_3N$	CAS#: 121-44-8	RTECS#: YE0175000	IDLH: 200 ppm
Conversion: 1 ppm = 4.14 mg/m^3	**DOT:** 1296 132			
Synonyms/Trade Names: TEA				
Exposure Limits: **NIOSH REL:** See Appendix D **OSHA PEL†:** TWA 25 ppm (100 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** S152 (II-3) **OSHA** PV2060	
Physical Description: Colorless liquid with a strong, ammonia-like odor.				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 101.2 **BP:** 193°F **Sol:** 2% **Fl.P:** 20°F **IP:** 7.50 eV **Sp.Gr:** 0.73 **VP:** 54 mmHg **FRZ:** -175°F **UEL:** 8.0% **LEL:** 1.2% Class IB Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R. **Provide:** Eyewash (>1%) Quick drench (>1%)	**OSHA** **200 ppm:** Sa:Cf£/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFS/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids, chlorine, hypochlorite, halogenated compounds	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, resp sys; in animals: myocardial, kidney, liver damage **TO:** Eyes, skin, resp sys, CVS, liver, kidneys	**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed

Trifluorobromomethane	Formula: $CBrF_3$	CAS#: 75-63-8	RTECS#: PA5425000	IDLH: 40,000 ppm
Conversion: 1 ppm = 6.09 mg/m^3	**DOT:** 1009 126			
Synonyms/Trade Names: Bromotrifluoromethane, Fluorocarbon 1301, Freon® 13B1, Halocarbon 13B1, Halon® 1301, Monobromotrifluoromethane, Refrigerant 13B1, Trifluoromonobromomethane				
Exposure Limits: **NIOSH REL:** TWA 1000 ppm (6100 mg/m^3) **OSHA PEL:** TWA 1000 ppm (6100 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1017	
Physical Description: Colorless, odorless gas. [**Note:** Shipped as a liquefied compressed gas.]				

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 148.9 **BP:** -72°F **Sol:** 0.03% **Fl.P:** NA **IP:** 11.78 eV **RGasD:** 5.14 **VP:** >1 atm **FRZ:** -267°F **UEL:** NA **LEL:** NA Nonflammable Gas	**Skin:** Frostbite **Eyes:** Frostbite **Wash skin:** N.R. **Remove:** N.R. **Change:** N.R. **Provide:** Frostbite wash	**NIOSH/OSHA** **10,000 ppm:** Sa **25,000 ppm:** Sa:Cf **40,000 ppm:** SaT:Cf/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals (such as calcium, powdered aluminum, zinc, and magnesium)	
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Con (liquid) **SY:** Dizz; card arrhy; liquid: frostbite **TO:** CNS, heart	**First Aid (see Table 6):** **Eye:** Frostbite **Skin:** Frostbite **Breath:** Resp support

Trimellitic anhydride

Formula:	CAS#:	RTECS#:	IDLH:
$C_9H_4O_5$	552-30-7	DC2050000	N.D.

Conversion: 1 ppm = 7.86 mg/m^3 **DOT:**

Synonyms/Trade Names: 1,2,4-Benzenetricarboxylic anhydride; 4-Carboxyphthalic anhydride; TMA; TMAN; Trimellic acid anhydride [**Note:** TMA is also a synonym for Trimethylamine.]

Exposure Limits:
NIOSH REL: TWA 0.005 ppm (0.04 mg/m^3)
Should be handled in the workplace as an extremely toxic substance.
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 5036
OSHA 98

Physical Description: Colorless solid.

Chemical & Physical Properties:
MW: 192.1
BP: ?
Sol: ?
Fl.P: NA
IP: ?
Sp.Gr: ?
VP: 0.000004 mmHg
MLT: 322°F
UEL: NA
LEL: NA
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, resp sys; pulm edema, resp sens; rhinitis, asthma, cough, wheez, dysp, mal, fever, musc aches, sneez
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Trimethylamine

Formula:	CAS#:	RTECS#:	IDLH:
$(CH_3)_3N$	75-50-3	PA0350000	N.D.

Conversion: 1 ppm = 2.42 mg/m^3 **DOT:** 1083 118 (anhydrous); 1297 132 (aqueous solution)

Synonyms/Trade Names: N,N-Dimethylmethanamine; TMA
[**Note:** May be used in an aqueous solution (typically 25%, 30%, or 40% TMA.]

Exposure Limits:
NIOSH REL: TWA 10 ppm (24 mg/m^3) **OSHA PEL†:** none
ST 15 ppm (36 mg/m^3)

Measurement Methods (see Table 1):
OSHA PV2060

Physical Description: Colorless gas with a fishy, amine odor.
[**Note:** A liquid below 37°F. Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 59.1
BP: 37°F
Sol(86°F): 48%
Fl.P: NA (Gas)
20°F (Liquid)
IP: 7.82 eV
RGasD: 2.09
VP(70°F): 1454 mmHg
FRZ: -179°F
UEL: 11.6%
LEL: 2.0%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (liquid/solution)
Frostbite
Eyes: Prevent eye contact (liquid/solution)
Frostbite
Wash skin: When contam (solution)
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash (liquid/solution)
Quick drench (liquid/solution)
Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Strong oxidizers (including bromine), ethylene oxide, nitrosating agents (e.g., sodium nitrite), mercury, strong acids [**Note:** Corrosive to many metals (e.g., zinc, brass, aluminum, copper).]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing (solution), Con
SY: Irrit eyes, skin, nose, throat, resp sys; cough, dysp, delayed pulm edema; blurred vision, corn nec; skin burns; liquid: frostbite
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed (liquid/solution)/Frostbite
Skin: Water flush immed (liquid/solution)/Frostbite
Breath: Resp support
Swallow: Medical attention immed (solution)

1,2,3-Trimethylbenzene	Formula: $C_6H_3(CH_3)_3$	CAS#: 526-73-8	RTECS#: DC3300000	IDLH: N.D.
Conversion: 1 ppm = 4.92 mg/m^3	**DOT:**			

Synonyms/Trade Names: Hemellitol
[**Note:** Hemimellitene is a mixture of the 1,2,3-isomer with up to 10% of related aromatics such as the 1,2,4-isomer.]

Exposure Limits:
NIOSH REL: TWA 25 ppm (125 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2091

Physical Description: Clear, colorless liquid with a distinctive, aromatic odor.

Chemical & Physical Properties:
MW: 120.2
BP: 349°F
Sol: Low
Fl.P: ?
IP: 8.48 eV
Sp.Gr: 0.89
VP(62°F): 1 mmHg
FRZ: -14°F
UEL: 6.6%
LEL: 0.8%
Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers, nitric acid

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat, resp sys; bron; hypochromic anemia; head, drow, lass, dizz, nau, inco; vomit, conf; chemical pneu (aspir liquid)
TO: Eyes, skin, resp sys, CNS, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

1,2,4-Trimethylbenzene	Formula: $C_6H_3(CH_3)_3$	CAS#: 95-63-6	RTECS#: DC3325000	IDLH: N.D.
Conversion: 1 ppm = 4.92 mg/m^3	**DOT:**			

Synonyms/Trade Names: Asymmetrical trimethylbenzene, psi-Cumene, Pseudocumene
[**Note:** Hemimellitene is a mixture of the 1,2,3-isomer with up to 10% of related aromatics such as the 1,2,4-isomer.]

Exposure Limits:
NIOSH REL: TWA 25 ppm (125 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2091

Physical Description: Clear, colorless liquid with a distinctive, aromatic odor.

Chemical & Physical Properties:
MW: 120.2
BP: 337°F
Sol: 0.006%
Fl.P: 112°F
IP: 8.27 eV
Sp.Gr: 0.88
VP(56°F): 1 mmHg
FRZ: -77°F
UEL: 6.4%
LEL: 0.9%
Class II Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers, nitric acid

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat, resp sys; bron; hypochromic anemia; head, drow, lass, dizz, nau, inco; vomit, conf; chemical pneu (aspir liquid)
TO: Eyes, skin, resp sys, CNS, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

1,3,5-Trimethylbenzene	Formula: $C_6H_3(CH_3)_3$	CAS#: 108-67-8	RTECS#: OX6825000	IDLH: N.D.
Conversion: 1 ppm = 4.92 mg/m^3	**DOT:** 2325 129			
Synonyms/Trade Names: Mesitylene, Symmetrical trimethylbenzene, sym-Trimethylbenzene				
Exposure Limits: **NIOSH REL:** TWA 25 ppm (125 mg/m^3) **OSHA PEL†:** none			**Measurement Methods (see Table 1):** **OSHA** PV2091	
Physical Description: Clear, colorless liquid with a distinctive, aromatic odor.				
Chemical & Physical Properties: **MW:** 120.2 **BP:** 329°F **Sol:** 0.002% **Fl.P:** 122°F **IP:** 8.39 eV **Sp.Gr:** 0.86 **VP:** 2 mmHg **FRZ:** -49°F **UEL:** ? **LEL:** ? Class II Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Oxidizers, nitric acid				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, nose, throat, resp sys; bron; hypochromic anemia; head, drow, lass, dizz, nau, inco; vomit, conf; chemical pneu (aspir liquid) **TO:** Eyes, skin, resp sys, CNS, blood			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash **Breath:** Resp support **Swallow:** Medical attention immed	

Trimethyl phosphite	Formula: $(CH_3O)_3P$	CAS#: 121-45-9	RTECS#: TH1400000	IDLH: N.D.
Conversion: 1 ppm = 5.08 mg/m^3	**DOT:** 2329 129			
Synonyms/Trade Names: Methyl phosphite, Trimethoxyphosphine, Trimethyl ester of phosphorous acid				
Exposure Limits: **NIOSH REL:** TWA 2 ppm (10 mg/m^3) **OSHA PEL†:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Colorless liquid with a distinctive, pungent odor.				
Chemical & Physical Properties: **MW:** 124.1 **BP:** 232°F **Sol:** Reacts **Fl.P:** 82°F **IP:** ? **Sp.Gr:** 1.05 **VP(77°F):** 24 mmHg **FRZ:** -108°F **UEL:** ? **LEL:** ? Class IC Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R. **Provide:** Quick drench		**Respirator Recommendations (see Tables 3 and 4):** Not available.	
Incompatibilities and Reactivities: Magnesium perchlorate, water [**Note:** Reacts (hydrolyzes) with water.]				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Irrit eyes, skin, upper resp sys; derm; in animals: terato effects **TO:** Eyes, skin, resp sys, repro sys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap flush immed **Breath:** Resp support **Swallow:** Medical attention immed	

2,4,6-Trinitrotoluene	Formula: $CH_3C_6H_2(NO_2)_3$	CAS#: 118-96-7	RTECS#: XU0175000	IDLH: 500 mg/m^3
Conversion:	**DOT:** 1356 113 (wet)			

Synonyms/Trade Names: 1-Methyl-2,4,6-trinitrobenzene; TNT; Trinitrotoluene; sym-Trinitrotoluene; Trinitrotoluol

Exposure Limits:
NIOSH REL: TWA 0.5 mg/m^3 [skin]
OSHA PEL†: TWA 1.5 mg/m^3 [skin]

Measurement Methods (see Table 1):
OSHA 44

Physical Description: Colorless to pale-yellow, odorless solid or crushed flakes.

Chemical & Physical Properties:
MW: 227.1
BP: 464°F (Explodes)
Sol(77°F): 0.01%
Fl.P: ? (Explodes)
IP: 10.59 eV
Sp.Gr: 1.65
VP: 0.0002 mmHg
MLT: 176°F
UEL: ?
LEL: ?
Combustible Solid (Class A Explosive)

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
5 mg/m^3: Sa*
12.5 mg/m^3: Sa:Cf*
25 mg/m^3: ScbaF/SaF
500 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, ammonia, strong alkalis, combustible materials, heat
[**Note:** Rapid heating will result in detonation.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit skin, muc memb; liver damage, jaun; cyan; sneez; cough, sore throat; peri neur, musc pain; kidney damage; cataract; sens derm; leucyt; anemia; card irreg
TO: Eyes, skin, resp sys, blood, liver, CVS, CNS, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Triorthocresyl phosphate	Formula: $(CH_3C_6H_4O)_3PO$	CAS#: 78-30-8	RTECS#: TD0350000	IDLH: 40 mg/m^3
Conversion:	**DOT:** 2574 151			

Synonyms/Trade Names: TCP, TOCP, Tri-o-cresyl ester of phosphoric acid, Tri-o-cresyl phosphate

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3 [skin]
OSHA PEL†: TWA 0.1 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5037

Physical Description: Colorless to pale-yellow, odorless liquid or solid (below 52°F).

Chemical & Physical Properties:
MW: 368.4
BP: 770°F (Decomposes)
Sol: Slight
Fl.P: 437°F
IP: ?
Sp.Gr: 1.20
VP(77°F): 0.00002 mmHg
FRZ: 52°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: N.R.
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.5 mg/m^3: Qm
1 mg/m^3: 95XQ/Sa
2.5 mg/m^3: Sa:Cf/PaprHie
5 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
40 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: GI dist; peri neur; cramps in calves, pares in feet or hands; weak feet, wrist drop, para
TO: PNS, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Triphenylamine	Formula: $(C_6H_5)_3N$	CAS#: 603-34-9	RTECS#: YK2680000	IDLH: N.D.
Conversion:	**DOT:**			
Synonyms/Trade Names: N,N-Diphenylaniline; N,N-Diphenylbenzenamine				

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless solid.

Chemical & Physical Properties:
MW: 245.3
BP: 689°F
Sol: Insoluble
Fl.P: ?
IP: 7.60 eV
Sp.Gr: 0.77
VP: ?
MLT: 261°F
UEL: ?
LEL: ?

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: N.R.
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: In animals: irrit skin
TO: Skin

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Triphenyl phosphate	Formula: $(C_6H_5O)_3PO$	CAS#: 115-86-6	RTECS#: TC8400000	IDLH: 1000 mg/m^3
Conversion:	**DOT:**			
Synonyms/Trade Names: Phenyl phosphate, TPP, Triphenyl ester of phosphoric acid				

Exposure Limits:
NIOSH REL: TWA 3 mg/m^3
OSHA PEL: TWA 3 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5038

Physical Description: Colorless, crystalline powder with a phenol-like odor.

Chemical & Physical Properties:
MW: 326.3
BP: 776°F
Sol(129°F): 0.002%
Fl.P: 428°F
IP: ?
Sp.Gr: 1.29
VP(380°F): 1 mmHg
MLT: 120°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
15 mg/m^3: Qm
30 mg/m^3: 95XQ/Sa
75 mg/m^3: Sa:Cf/PaprHie
150 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
1000 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing
SY: Minor changes in blood enzymes; in animals: musc weak, para
TO: Blood, PNS

First Aid (see Table 6):
Breath: Resp support
Swallow: Medical attention immed

Tungsten	Formula: W	CAS#: 7440-33-7	RTECS#: YO7175000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Tungsten metal, Wolfram

Exposure Limits:
NIOSH REL*: TWA 5 mg/m^3
ST 10 mg/m^3
[***Note:** The REL also applies to other insoluble tungsten compounds (as W).]
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 7074, 7300, 7301
OSHA ID213

Physical Description: Hard, brittle, steel-gray to tin-white solid.

Chemical & Physical Properties:
MW: 183.9
BP: 10,701°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 19.3
VP: 0 mmHg (approx)
MLT: 6170°F
UEL: NA
LEL: NA
Combustible in the form of finely divided powder; may ignite spontaneously.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
50 mg/m^3: 100XQ/Sa/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100XQ/ScbaE

Incompatibilities and Reactivities: Bromine trifluoride, chlorine trifluoride, fluorine, iodine pentafluoride

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; diffuse pulm fib; loss of appetite, nau, cough; blood changes
TO: Eyes, skin, resp sys, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Fresh air
Swallow: Medical attention immed

Tungsten (soluble compounds, as W)	Formula:	CAS#:	RTECS#:	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: Synonyms vary depending upon the specific soluble tungsten compound.

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3
ST 3 mg/m^3
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 7074, 7300, 7301
OSHA ID213

Physical Description: Appearance and odor vary depending upon the specific soluble tungsten compound.

Chemical & Physical Properties:
Properties vary depending upon the specific soluble tungsten compound.

Personal Protection/Sanitation (see Table 2):
Recommendations regarding personal protective clothing vary depending upon the specific compound.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
10 mg/m^3: 100XQ/Sa
25 mg/m^3: Sa:Cf
50 mg/m^3: 100F/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Varies

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; in animals: CNS disturbances; diarr; resp failure; behavioral, body weight, blood changes
TO: Eyes, skin, resp sys, CNS, GI tract

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash
Breath: Resp support
Swallow: Medical attention immed

Tungsten carbide (cemented)

Formula: WC/Co/Ni/Ti

CAS#: 1: 11107-01-0 2: 12718-69-3 3: 37329-49-0

RTECS#: 1: YO7350000 2: YO7525000 3: YO7700000

IDLH: N.D.

Conversion:

DOT:

Synonyms/Trade Names: Cemented tungsten carbide, Cemented WC, Hard metal
[**Note:** The tungsten carbide (WC) content is generally 85-95% & the cobalt content is generally 5-15%.]
[**1:** 85% WC, 15% Co; **2:** 92% WC, 8% Co; **3:** 78% WC, 14% Co, 8% Ti]

Exposure Limits:
NIOSH REL: See Appendix C **OSHA PEL†:** See Appendix C

Physical Description: A mixture of tungsten carbide, cobalt, and sometimes other metals & metal oxides or carbides.

Measurement Methods (see Table 1):
None available

Chemical & Physical Properties:
Properties vary depending upon the specific mixture.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily (Ni)
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH
0.25 mg Co/m^3: Qm
0.5 mg Co/m^3: 95XQ*/Sa*
1.25 mg Co/m^3: Sa:Cf*/PaprHie*/PaprHie*
2.5 mg Co/m^3: 100F/ScbaF/SaF
20 mg Co/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Tungsten carbide (cemented) containing Nickel:
NIOSH
¥:ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Tungsten carbide: Fluorine, chlorine trifluoride, oxides of nitrogen, lead dioxide

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, resp sys; possible skin sens to cobalt, nickel; diffuse pulm fib; loss of appetite, nau, cough; blood changes
TO: Eyes, skin, resp sys, blood

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Fresh air
Swallow: Medical attention immed

Turpentine

Formula: $C_{10}H_{16}$ (approx)

CAS#: 8006-64-2

RTECS#: YO8400000

IDLH: 800 ppm

Conversion: 1 ppm = 5.56 mg/m^3 (approx)

DOT: 1299 128

Synonyms/Trade Names: Gumspirits, Gum turpentine, Spirits of turpentine, Steam distilled turpentine, Sulfate wood turpentine, Turps, Wood turpentine

Exposure Limits:
NIOSH REL: TWA 100 ppm (560 mg/m^3)
OSHA PEL: TWA 100 ppm (560 mg/m^3)

Physical Description: Colorless liquid with a characteristic odor.

Measurement Methods (see Table 1):
NIOSH 1551

Chemical & Physical Properties:
MW: 136 (approx)
BP: 309-338°F
Sol: Insoluble
Fl.P: 95°F
IP: ?
Sp.Gr: 0.86
VP: 4 mmHg
FRZ: -58 to -76°F
UEL: ?
LEL: 0.8%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
800 ppm: Sa:Cf£/PaprOv£/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, chlorine, chromic anhydride, stannic chloride, chromyl chloride

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; head, dizz, convuls; skin sens; hema, prot; kidney damage; abdom pain, nau, vomit, diarr; chemical pneu (aspir liquid)
TO: Eyes, skin, resp sys, CNS, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

1-Undecanethiol	Formula: $CH_3(CH_2)_{10}SH$	CAS#: 5332-52-5	RTECS#:	IDLH: N.D.
Conversion: 1 ppm = 7.71 mg/m^3	**DOT:** 1228 131			
Synonyms/Trade Names: Undecyl mercaptan				
Exposure Limits: **NIOSH REL:** C 0.5 ppm (3.9 mg/m^3) [15-minute] **OSHA PEL:** none			**Measurement Methods (see Table 1):** None available	
Physical Description: Liquid.				
Chemical & Physical Properties: **MW:** 188.4 **BP:** 495°F **Sol:** Insoluble **Fl.P:** ? **IP:** ? **Sp.Gr:** 0.84 **VP:** ? **FRZ:** 27°F **UEL:** ? **LEL:** ? Combustible Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **5 ppm:** CcrOv/Sa **12.5 ppm:** Sa:Cf/PaprOv **25 ppm:** CcrFOv/GmFOv/PaprTOv/ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Oxidizers, reducing agents, strong acids & bases, alkali metals				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, resp sys; conf, dizz, head, drow, nau, vomit, lass, convuls **TO:** Eyes, skin, resp sys, CNS			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash **Breath:** Resp support **Swallow:** Medical attention immed	

Uranium (insoluble compounds, as U)	Formula: U (metal)	CAS#: 7440-61-1 (metal)	RTECS#: YR3490000 (metal)	IDLH: Ca [10 mg/m^3 (as U)]
Conversion:	**DOT:** 2979 162 (metal, pyrophoric)			
Synonyms/Trade Names: **Uranium metal:** Uranium I Synonyms of other insoluble uranium compounds vary depending upon the specific compound.				
Exposure Limits: **NIOSH REL:** Ca TWA 0.2 mg/m^3 ST 0.6 mg/m^3 See Appendix A **OSHA PEL†:** TWA 0.25 mg/m^3			**Measurement Methods (see Table 1):** None available	
Physical Description: Metal: Silver-white, malleable, ductile, lustrous solid. [**Note:** Weakly radioactive.]				
Chemical & Physical Properties: **MW:** 238.0 **BP:** 6895°F **Sol:** Insoluble **Fl.P:** NA **IP:** NA **Sp.Gr:** 19.05 (metal) **VP:** 0 mmHg (approx) **MLT:** 2097°F **UEL:** NA **LEL:** NA **MEC:** 60 g/m^3 Metal: Combustible Solid, especially turnings and powder.	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam/Daily **Remove:** When wet or contam **Change:** Daily **Provide:** Eyewash		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **¥:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE	
	Incompatibilities and Reactivities: Carbon dioxide, carbon tetrachloride, nitric acid, fluorine [**Note:** Complete coverage of uranium metal scrap with oil is essential for prevention of fire.]			
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Ing, Con **SY:** Derm; kidney damage; blood changes; [carc]; in animals: lung, lymph node damage; [carc] Potential for cancer is a result of alpha-emitting properties & radioactive decay products (e.g., radon). **TO:** Skin, kidneys, bone marrow, lymphatic sys [lung cancer]			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed	

Uranium (soluble compounds, as U)	**Formula:**	**CAS#:**	**RTECS#:**	**IDLH:** Ca [10 mg/m^3 (as U)]
Conversion:	**DOT:**			

Synonyms/Trade Names: Synonyms vary depending upon the specific soluble uranium compound.

Exposure Limits:
NIOSH REL: Ca
TWA 0.05 mg/m^3
See Appendix A
OSHA PEL: TWA 0.05 mg/m^3

Measurement Methods (see Table 1):
None available

Physical Description: Appearance and odor vary depending upon the specific soluble uranium compound.

Chemical & Physical Properties:
Properties vary depending upon the specific soluble uranium compound.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash (UF_6), Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape (Halides): GmFAg100/ScbaE
Escape (Non-halides): 100F/ScbaE

Incompatibilities and Reactivities: **Uranyl nitrate:** combustibles; **Uranium hexafluoride:** water

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Lac, conj; short breath, cough, chest rales; nau, vomit; skin burns; RBC, casts in urine; prot; high BUN; [carc] Potential for cancer is a result of alpha-emitting properties & radioactive decay products (e.g., radon).
TO: Resp sys, blood, liver, kidneys, lymphatic sys, skin, bone marrow [lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

n-Valeraldehyde	**Formula:** $CH_3(CH_2)_3CHO$	**CAS#:** 110-62-3	**RTECS#:** YV3600000	**IDLH:** N.D.
Conversion: 1 ppm = 3.53 mg/m^3	**DOT:** 2058 129			

Synonyms/Trade Names: Amyl aldehyde, Pentanal, Valeral, Valeraldehyde, Valeric aldehyde

Exposure Limits:
NIOSH REL: TWA 50 ppm (175 mg/m^3)
See Appendix C (Aldehydes)
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 2018, 2536
OSHA 85

Physical Description: Colorless liquid with a strong, acrid, pungent odor.

Chemical & Physical Properties:
MW: 86.2
BP: 217°F
Sol: Slight
Fl.P: 54°F
IP: 9.82 eV
Sp.Gr: 0.81
VP: 26 mmHg
FRZ: -133°F
UEL: ?
LEL: ?
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Vanadium dust

Formula:	CAS#:	RTECS#:	IDLH:
V_2O_5	1314-62-1	YW2450000	35 mg/m^3 (as V)

Conversion: **DOT:** 2862 151

Synonyms/Trade Names: Divanadium pentoxide dust, Vanadic anhydride dust, Vanadium oxide dust, Vanadium pentaoxide dust. Other synonyms vary depending upon the specific vanadium compound.

Exposure Limits:
NIOSH REL*: C 0.05 mg V/m^3 [15-minute]
[***Note:** The REL applies to all vanadium compounds except Vanadium metal and Vanadium carbide (see Ferrovanadium dust).]
OSHA PEL†: C 0.5 mg V_2O_5/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303, 7504, 9102
OSHA ID185

Physical Description: Yellow-orange powder or dark-gray, odorless flakes dispersed in air.

Chemical & Physical Properties:
MW: 181.9
BP: 3182°F (Decomposes)
Sol: 0.8%
Fl.P: NA
IP: NA
Sp.Gr: 3.36
VP: 0 mmHg (approx)
MLT: 1274°F
UEL: NA
LEL: NA
Noncombustible Solid, but may increase intensity of fire when in contact with combustible materials.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH (as V)
0.5 mg/m^3: 100XQ*/Sa*
1.25 mg/m^3: Sa:Cf*/PaprHie*
2.5 mg/m^3: 100F/PaprTHie*/ScbaF/SaF
35 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Lithium, chlorine trifluoride

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, throat; green tongue, metallic taste, eczema; cough; fine rales, wheez, bron, dysp
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Vanadium fume

Formula:	CAS#:	RTECS#:	IDLH:
V_2O_5	1314-62-1	YW2460000	35 mg/m^3 (as V)

Conversion: **DOT:** 2862 151

Synonyms/Trade Names: Divanadium pentoxide fume, Vanadic anhydride fume, Vanadium oxide fume, Vanadium pentaoxide fume. Other synonyms vary depending upon the specific vanadium compound.

Exposure Limits:
NIOSH REL: C 0.05 mg V/m^3 [15-minute]
OSHA PEL†: C 0.1 mg V_2O_5/m^3

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303, 7504
OSHA ID185

Physical Description: Finely divided particulate dispersed in air.

Chemical & Physical Properties:
MW: 181.9
BP: 3182°F (Decomposes)
Sol: 0.8%
Fl.P: NA
IP: NA
Sp.Gr: 3.36
VP: 0 mmHg (approx)
MLT: 1274°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH (as V)
0.5 mg/m^3: 100XQ*/Sa*
1.25 mg/m^3: Sa:Cf*/PaprHie*
2.5 mg/m^3: 100F/PaprTHie*/ScbaF/SaF
35 mg/m^3: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Lithium, chlorine trifluoride

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, throat; green tongue, metallic taste; cough, fine rales, wheez, bron, dysp; eczema
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Breath: Resp support

Vegetable oil mist	Formula:	CAS#:	RTECS#:	IDLH:
		68956-68-3	YX1850000	N.D.

Conversion: **DOT:**

Synonyms/Trade Names: Vegetable mist

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: An oil extracted from the seeds, fruit, or nuts of vegetables or other plant matter.

Chemical & Physical Properties:
MW: varies
BP: ?
Sol: Insoluble
Fl.P: 323-540°F
IP: ?
Sp.Gr: 0.91-0.95
VP: ?
FRZ: ?
UEL: ?
LEL: ?
Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, resp sys; lac
TO: Eyes, skin, resp sys Determine based on working conditions

First Aid (see Table 6):
Eye: Irr immed
Breath: Fresh air

Vinyl acetate	Formula:	CAS#:	RTECS#:	IDLH:
	CH_2=CHOOCCH$_3$	108-05-4	AK0875000	N.D.

Conversion: 1 ppm = 3.52 mg/m^3 **DOT:** 1301 129P

Synonyms/Trade Names: 1-Acetoxyethylene, Ethenyl acetate, Ethenyl ethanoate, VAC, Vinyl acetate monomer, Vinyl ethanoate

Exposure Limits:
NIOSH REL: C 4 ppm (15 mg/m^3) [15-minute]
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 1453
OSHA 51

Physical Description: Colorless liquid with a pleasant, fruity odor.
[**Note:** Raw material for many polyvinyl resins.]

Chemical & Physical Properties:
MW: 86.1
BP: 162°F
Sol: 2%
Fl.P: 18°F
IP: 9.19 eV
Sp.Gr: 0.93
VP: 83 mmHg
FRZ: -136°F
UEL: 13.4%
LEL: 2.6%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
40 ppm: CcrOv*/Sa*
100 ppm: Sa:Cf*/PaprOv*
200 ppm: CcrFOv/GmFOv/PaprTOv*/ScbaF/SaF
4000 ppm: Sa:Pd,Pp*
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Acids, bases, silica gel, alumina, oxidizers, azo compounds, ozone
[**Note:** Usually contains a stabilizer (e.g., hydroquinone or diphenylamine) to prevent polymerization.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, nose, throat; hoarseness, cough; loss of smell; eye burns, skin blisters
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Vinyl bromide

Formula:	CAS#:	RTECS#:	IDLH:
CH_2=CHBr	593-60-2	KU8400000	Ca [N.D.]

Conversion: 1 ppm = 4.38 mg/m^3

DOT: 1085 116P (inhibited)

Synonyms/Trade Names: Bromoethene, Bromoethylene, Monobromoethylene

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 1009
OSHA 8

Physical Description: Colorless gas or liquid (below 60°F) with a pleasant odor.
[**Note:** Shipped as a liquefied compressed gas with 0.1% phenol added to prevent polymerization.]

Chemical & Physical Properties:
MW: 107.0
BP: 60°F
Sol: Insoluble
Fl.P: NA (Gas)
IP: 9.80 eV
RGasD: 3.79
Sp.Gr: 1.49 (Liquid at 60°F)
VP: 1.4 atm
FRZ: -219°F
UEL: 15%
LEL: 9%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact (liquid)
Eyes: Prevent eye contact (liquid)
Wash skin: When contam (liquid)
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers (e.g., perchlorates, peroxides, chlorates, permanganates & nitrates.)
[**Note:** May polymerize in sunlight.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing (liquid), Con
SY: Irrit eyes, skin; dizz, conf, inco, narco, nau, vomit; liquid: frostbite; [carc]
TO: Eyes, skin, CNS, liver [in animals: liver & lymph node tumors]

First Aid (see Table 6):
Eye: Irr immed (liquid)
Skin: Water flush immed (liquid)
Breath: Resp support
Swallow: Medical attention immed (liquid)

Vinyl chloride

Formula:	CAS#:	RTECS#:	IDLH:
CH_2=CHCl	75-01-4	KU9625000	Ca [N.D.]

Conversion: 1 ppm = 2.56 mg/m^3

DOT: 1086 116P (inhibited)

Synonyms/Trade Names: Chloroethene, Chloroethylene, Ethylene monochloride, Monochloroethene, Monochloroethylene, VC, Vinyl chloride monomer (VCM)

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1017] TWA 1 ppm
C 5 ppm [15-minute]

Measurement Methods (see Table 1):
NIOSH 1007
OSHA 4, 75

Physical Description: Colorless gas or liquid (below 7°F) with a pleasant odor at high concentrations.
[**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 62.5
BP: 7°F
Sol(77°F): 0.1%
Fl.P: NA (Gas)
IP: 9.99 eV
RGasD: 2.21
VP: 3.3 atm
FRZ: -256°F
UEL: 33.0%
LEL: 3.6%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Copper, oxidizers, aluminum, peroxides, iron, steel [**Note:** Polymerizes in air, sunlight, or heat unless stabilized by inhibitors such as phenol. Attacks iron & steel in presence of moisture.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Lass; abdom pain, GI bleeding; enlarged liver; pallor or cyan of extremities; liquid: frostbite; [carc]
TO: Liver, CNS, blood, resp sys, lymphatic sys [liver cancer]

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Vinyl cyclohexene dioxide

Formula:	CAS#:	RTECS#:	IDLH:
$C_8H_{12}O_2$	106-87-6	RN8640000	Ca [N.D.]

Conversion: 1 ppm = 5.73 mg/m^3 **DOT:**

Synonyms/Trade Names: 1-Epoxyethyl-3,4-epoxy-cyclohexane; 4-Vinylcyclohexene diepoxide; 4-Vinyl-1-cyclohexene dioxide

Exposure Limits:
NIOSH REL: Ca
TWA 10 ppm (60 mg/m^3) [skin]
See Appendix A
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA PV2083

Physical Description: Colorless liquid.

Chemical & Physical Properties:
MW: 140.2
BP: 441°F
Sol: High
Fl.P(oc): 230°F
IP: ?
Sp.Gr: 1.10
VP: 0.1 mmHg
FRZ: -164°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Alcohols, amines, water [**Note:** Slowly hydrolyzes in water.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: In animals: irrit eyes, skin, resp sys; testicular atrophy; leupen, nec thymus; skin sens; [carc]
TO: Eyes, skin, resp sys, blood, thymus, repro sys [in animals: skin tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water wash immed
Breath: Resp support
Swallow: Medical attention immed

Vinyl fluoride

Formula:	CAS#:	RTECS#:	IDLH:
CH_2=CHF	75-02-5	YZ3510000	N.D.

Conversion: 1 ppm = 1.89 mg/m^3 **DOT:** 1860 116P (inhibited)

Synonyms/Trade Names: Fluoroethene, Fluoroethylene, Monofluoroethylene, Vinyl fluoride monomer

Exposure Limits:
NIOSH REL: TWA 1 ppm
C 5 ppm [use 1910.1017]
OSHA PEL: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless gas with a faint, ethereal odor.
[**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 46.1
BP: -98°F
Sol: Insoluble
Fl.P: NA (Gas)
IP: 10.37 eV
RGasD: 1.60
VP: 25.2 atm
FRZ: -257°F
UEL: 21.7%
LEL: 2.6%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
10 ppm: CcrOv/Sa
25 ppm: Sa:Cf/PaprOv
50 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
200 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: None reported [**Note:** Inhibited with 0.2% terpenes to prevent polymerization.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Head, dizz, conf, inco, narco, nau, vomit; liquid: frostbite
TO: CNS

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Vinylidene chloride	Formula: $CH_2=CCl_2$	CAS#: 75-35-4	RTECS#: KV9275000	IDLH: Ca [N.D.]
Conversion:	**DOT:** 1303 130P (inhibited)			

Synonyms/Trade Names: 1,1-DCE; 1,1-Dichloroethene; 1,1-Dichloroethylene; VDC; Vinylidene chloride monomer; Vinylidene dichloride

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 1015
OSHA 19

Physical Description: Colorless liquid or gas (above 89°F) with a mild, sweet, chloroform-like odor.

Chemical & Physical Properties:
MW: 96.9
BP: 89°F
Sol: 0.04%
Fl.P: -2°F
IP: 10.00 eV
Sp.Gr: 1.21
VP: 500 mmHg
FRZ: -189°F
UEL: 15.5%
LEL: 6.5%
Class IA Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Aluminum, sunlight, air, copper, heat
[**Note:** Polymerization may occur if exposed to oxidizers, chlorosulfonic acid, nitric acid, or oleum. Inhibitors such as the monomethyl ether of hydroquinone are added to prevent polymerization.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, throat; dizz, head, nau, dysp; liver, kidney dist; pneu; [carc]
TO: Eyes, skin, resp sys, CNS, liver, kidneys [in animals: liver & kidney tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush immed
Breath: Resp support
Swallow: Medical attention immed

Vinylidene fluoride	Formula: $CH_2=CF_2$	CAS#: 75-38-7	RTECS#: KW0560000	IDLH: N.D.
Conversion: 1 ppm = 2.62 mg/m^3	**DOT:** 1959 116P			

Synonyms/Trade Names: Difluoro-1,1-ethylene; 1,1-Difluoroethene; 1,1-Difluoroethylene; Halocarbon 1132A; VDF; Vinylidene difluoride

Exposure Limits:
NIOSH REL: TWA 1 ppm
C 5 ppm [use 1910.1017]
OSHA PEL: none

Measurement Methods (see Table 1):
NIOSH 3800

Physical Description: Colorless gas with a faint, ethereal odor. [**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 64.0
BP: -122°F
Sol: Insoluble
Fl.P: NA (Gas)
IP: 10.29 eV
RGasD: 2.21
VP: 35.2 atm
FRZ: -227°F
UEL: 21.3%
LEL: 5.5%
Flammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: When wet (flamm)
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
NIOSH
10 ppm: CcrOv/Sa
25 ppm: Sa:Cf/PaprOv
50 ppm: CcrFOv/GmFOv/PaprTOv/ScbaF/SaF
200 ppm: SaF:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, aluminum chloride
[**Note:** Violent reaction with hydrogen chloride when heated under pressure.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con (liquid)
SY: Dizz, head, nau; liquid: frostbite
TO: CNS

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

Vinyl toluene	**Formula:** $CH_2=CHC_6H_4CH_3$	**CAS#:** 25013-15-4 (inhibited)	**RTECS#:** WL5075000	**IDLH:** 400 ppm
Conversion: 1 ppm = 4.83 mg/m^3	**DOT:** 2618 130P (inhibited)			
Synonyms/Trade Names: Ethenylmethylbenzene, Methylstyrene, Tolyethylene				
Exposure Limits: **NIOSH REL:** TWA 100 ppm (480 mg/m^3) **OSHA PEL:** TWA 100 ppm (480 mg/m^3)				**Measurement Methods (see Table 1):** **NIOSH** 1501 **OSHA** 7
Physical Description: Colorless liquid with a strong, disagreeable odor.				

Chemical & Physical Properties:	**Personal Protection/Sanitation (see Table 2):**	**Respirator Recommendations (see Tables 3 and 4):**
MW: 118.2 **BP:** 339°F **Sol:** 0.009% **Fl.P:** 127°F **IP:** 8.20 eV **Sp.Gr:** 0.89 **VP:** 1 mmHg **FRZ:** -106°F **UEL:** 11.0% **LEL:** 0.8% Class II Combustible Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.	**NIOSH/OSHA** **400 ppm:** CcrOv*/PaprOv*/ GmFOv/Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Oxidizers, peroxides, strong acids, iron or aluminum salts
[**Note:** Usually inhibited with tert-butyl catechol to prevent polymerization.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	**First Aid (see Table 6):**
ER: Inh, Ing, Con **SY:** Irrit eyes, skin, upper resp sys; drow; in animals: narco **TO:** Eyes, skin, resp sys, CNS	**Eye:** Irr immed **Skin:** Soap flush prompt **Breath:** Resp support **Swallow:** Medical attention immed

VM & P Naphtha	**Formula:**	**CAS#:** 8032-32-4	**RTECS#:** OI6180000	**IDLH:** N.D.
Conversion:	**DOT:** 1268 128 (petroleum distillates, n.o.s.)			
Synonyms/Trade Names: Ligroin, Painters naphtha, Petroleum ether, Petroleum spirit, Refined solvent naphtha, Varnish makers' & painters' naphtha				
Exposure Limits: **NIOSH REL:** TWA 350 mg/m^3 C 1800 mg/m^3 [15-minute] **OSHA PEL†:** none				**Measurement Methods (see Table 1):** **NIOSH** 1550 **OSHA** 48
Physical Description: Clear to yellowish liquid with a pleasant, aromatic odor.				

Chemical & Physical Properties:	**Personal Protection/Sanitation (see Table 2):**	**Respirator Recommendations (see Tables 3 and 4):**
MW: 87-114 (approx) **BP:** 203-320°F **Sol:** Insoluble **Fl.P:** 20-55°F **IP:** ? **Sp.Gr(60°F):** 0.73-0.76 **VP:** 2-20 mmHg **FRZ:** ? **UEL:** 6.0% **LEL:** 1.2% Class IB Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.	**NIOSH** **3500 mg/m^3:** CcrOv/Sa **8750 mg/m^3:** Sa:Cf/PaprOv **17,500 mg/m^3:** CcrFOv/GmFOv/PaprTOv/ ScbaF/SaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: None reported
[**Note:** VM&P Naphtha is a refined petroleum solvent predominantly C_7-C_{11} which is typically 55% paraffins, 30% monocycloparaffins, 2% dicycloparaffins & 12% alklybenzenes.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	**First Aid (see Table 6):**
ER: Inh, Ing, Con **SY:** Irrit eyes, upper resp sys; derm; CNS depres; chemical pneu (aspir liquid) **TO:** Eyes, skin, resp sys, CNS	**Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed

Warfarin

Formula:	CAS#:	RTECS#:	IDLH:
$C_{19}H_{16}O_4$	81-81-2	GN4550000	100 mg/m^3

Conversion:

DOT:

Synonyms/Trade Names: 3-(α-Acetonyl)-benzyl-4-hydroxycoumarin; 4-Hydroxy-3-(3-oxo-1-phenyl butyl)-2H-1-benzopyran-2-one; WARF

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3
OSHA PEL: TWA 0.1 mg/m^3

Measurement Methods (see Table 1):
NIOSH 5002

Physical Description: Colorless, odorless, crystalline powder. [rodenticide]

Chemical & Physical Properties:
MW: 308.3
BP: Decomposes
Sol: 0.002%
Fl.P: ?
IP: ?
Sp.Gr: ?
VP(71°F): 0.09 mmHg
MLT: 322°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: N.R.
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
0.5 mg/m^3: Qm
1 mg/m^3: 95XQ/Sa
2.5 mg/m^3: Sa:Cf/PaprHie
5 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
100 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Hema, back pain; hematoma arms, legs; epis, bleeding lips, muc memb hemorr; abdom pain, vomit, fecal blood; petechial rash; abnor hematologic indices
TO: Blood, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Welding fumes

Formula:	CAS#:	RTECS#:	IDLH:
		ZC2550000	Ca [N.D.]

Conversion:

DOT:

Synonyms/Trade Names: Synonyms vary depending upon the specific component of the welding fumes.

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL†: none

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303

Physical Description: Fumes generated by the process of joining or cutting pieces of metal by heat, pressure, or both.

Chemical & Physical Properties:
Properties vary depending upon the specific component of the welding fumes.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Varies

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Symptoms vary depending upon the specific component of the welding fumes; metal fume fever: flu-like symptoms, dysp, cough, musc pain, fever, chills; interstitial pneu; [carc]
TO: Eyes, skin, resp sys, CNS [lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support

Wood dust	Formula:	CAS#:	RTECS#:	IDLH:
			ZC9850000	Ca [N.D.]

Conversion: **DOT:**

Synonyms/Trade Names: Hard wood dust, Soft wood dust, Western red cedar dust

Exposure Limits:
NIOSH REL: Ca
TWA 1 mg/m^3
See Appendix A
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500

Physical Description: Dust from various types of wood.

Chemical & Physical Properties:
MW: varies
BP: NA
Sol: ?
Fl.P: NA
IP: NA
Sp.Gr: ?
VP: 0 mmHg (approx)
MLT: NA
UEL: NA
LEL: NA
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes; epis; derm; resp hypersensitivity; granulomatous pneu; asthma, cough, wheez, sinusitis; prolonged colds; [carc]
TO: Eyes, skin, resp sys [nasal cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Fresh air

m-Xylene	Formula:	CAS#:	RTECS#:	IDLH:
	$C_6H_4(CH_3)_2$	108-38-3	ZE2275000	900 ppm

Conversion: 1 ppm = 4.34 mg/m^3 **DOT:** 1307 130

Synonyms/Trade Names: 1,3-Dimethylbenzene; meta-Xylene; m-Xylol

Exposure Limits:
NIOSH REL: TWA 100 ppm (435 mg/m^3)
ST 150 ppm (655 mg/m^3)
OSHA PEL†: TWA 100 ppm (435 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1501, 3800
OSHA 1002

Physical Description: Colorless liquid with an aromatic odor.

Chemical & Physical Properties:
MW: 106.2
BP: 282°F
Sol: Slight
Fl.P: 82°F
IP: 8.56 eV
Sp.Gr: 0.86
VP: 9 mmHg
FRZ: -54°F
UEL: 7.0%
LEL: 1.1%
Class IC Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
900 ppm: CcrOv*/PaprOv*/ Sa*/ScbaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong acids

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat; dizz, excitement, drow, inco, staggering gait; corn vacuolization; anor, nau, vomit, abdom pain; derm
TO: Eyes, skin, resp sys, CNS, GI tract, blood, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

o-Xylene	Formula: $C_6H_4(CH_3)_2$	CAS#: 95-47-6	RTECS#: ZE2450000	IDLH: 900 ppm
Conversion: 1 ppm = 4.34 mg/m^3	**DOT:** 1307 130			
Synonyms/Trade Names: 1,2-Dimethylbenzene; ortho-Xylene; o-Xylol				
Exposure Limits: **NIOSH REL:** TWA 100 ppm (435 mg/m^3) ST 150 ppm (655 mg/m^3) **OSHA PEL†:** TWA 100 ppm (435 mg/m^3) **Physical Description:** Colorless liquid with an aromatic odor.			**Measurement Methods (see Table 1):** **NIOSH** 1501, 3800 **OSHA** 1002	
Chemical & Physical Properties: **MW:** 106.2 **BP:** 292°F **Sol:** 0.02% **Fl.P:** 90°F **IP:** 8.56 eV **Sp.Gr:** 0.88 **VP:** 7 mmHg **FRZ:** -13°F **UEL:** 6.7% **LEL:** 0.9% Class IC Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **900 ppm:** CcrOv*/PaprOv*/ Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers, strong acids				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, nose, throat; dizz, excitement, drow, inco, staggering gait; corn vacuolization; anor, nau, vomit, abdom pain; derm **TO:** Eyes, skin, resp sys, CNS, GI tract, blood, liver, kidneys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed	

p-Xylene	Formula: $C_6H_4(CH_3)_2$	CAS#: 106-42-3	RTECS#: ZE2625000	IDLH: 900 ppm
Conversion: 1 ppm = 4.41 mg/m^3	**DOT:** 1307 130			
Synonyms/Trade Names: 1,4-Dimethylbenzene; para-Xylene; p-Xylol				
Exposure Limits: **NIOSH REL:** TWA 100 ppm (435 mg/m^3) ST 150 ppm (655 mg/m^3) **OSHA PEL†:** TWA 100 ppm (435 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 1501, 3800 **OSHA** 1002	
Physical Description: Colorless liquid with an aromatic odor. [**Note:** A solid below 56°F.]				
Chemical & Physical Properties: **MW:** 106.2 **BP:** 281°F **Sol:** 0.02% **Fl.P:** 81°F **IP:** 8.44 eV **Sp.Gr:** 0.86 **VP:** 9 mmHg **FRZ:** 56°F **UEL:** 7.0% **LEL:** 1.1% Class IC Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R.		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH/OSHA** **900 ppm:** CcrOv*/PaprOv*/ Sa*/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE	
Incompatibilities and Reactivities: Strong oxidizers, strong acids				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, nose, throat; dizz, excitement, drow, inco, staggering gait; corn vacuolization; anor, nau, vomit, abdom pain; derm **TO:** Eyes, skin, resp sys, CNS, GI tract, blood, liver, kidneys			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed	

m-Xylene α,α'-diamine	Formula: $C_6H_4(CH_2NH_2)_2$	CAS#: 1477-55-0	RTECS#: PF8970000	IDLH: N.D.
Conversion:	**DOT:**			

Synonyms/Trade Names: 1,3-bis(Aminomethyl)benzene; 1,3-Benzenedimethanamine; MXDA; m-Phenylenebis(methylamine); m-Xylylenediamine

Exposure Limits:
NIOSH REL: C 0.1 mg/m^3 [skin]
OSHA PEL†: none

Measurement Methods (see Table 1):
OSHA 105

Physical Description: Colorless liquid.

Chemical & Physical Properties:
MW: 136.2
BP: 477°F
Sol: Miscible
Fl.P: 243°F
IP: ?
Sp.Gr: 1.032
VP(77°F): 0.03 mmHg
FRZ: 58°F
UEL: ?
LEL: ?
Class IIIB Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: None reported

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: In animals: irrit eyes, skin; liver, kidney, lung damage
TO: Eyes, skin, resp sys, liver, kidneys

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush immed
Breath: Resp support
Swallow: Medical attention immed

Xylidine	Formula: $(CH_3)_2C_6H_3NH_2$	CAS#: 1300-73-8	RTECS#: ZE8575000	IDLH: 50 ppm
Conversion: 1 ppm = 4.96 mg/m^3	**DOT:** 1711 153			

Synonyms/Trade Names: Aminodimethylbenzene, Aminoxylene, Dimethylaminobenzene, Dimethylaniline, Xylidine isomers (e.g., 2,4-Dimethylaniline)
[**Note:** Dimethylaniline is also used as a synonym for N,N-Dimethylaniline.]

Exposure Limits:
NIOSH REL: TWA 2 ppm (10 mg/m^3) [skin]
OSHA PEL†: TWA 5 ppm (25 mg/m^3) [skin]

Measurement Methods (see Table 1):
NIOSH 2002

Physical Description: Pale-yellow to brown liquid with a weak, aromatic, amine-like odor.

Chemical & Physical Properties:
MW: 121.2
BP: 415-439°F
Sol: Slight
Fl.P: 206°F (2,3-)
IP: 7.65 eV (2,4-)
7.30 eV (2,6-)
Sp.Gr: 0.98
VP: <1 mmHg
FRZ: -33°F
UEL: ?
LEL: 1.0% (o-isomer)
Class IIIB Combustible Liquid (2,3-)

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
20 ppm: CcrOv/Sa
50 ppm: Sa:Cf/CcrFOv/GmFOv/PaprOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, hypochlorite salts

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Anoxia, cyan, methemo; lung, liver, kidney damage
TO: Resp sys, blood, liver, kidneys, CVS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

X

Yttrium

Formula:	CAS#:	RTECS#:	IDLH:
Y	7440-65-5	ZG2980000	500 mg/m^3 (as Y)

Conversion: **DOT:**

Synonyms/Trade Names: Yttrium metal

Exposure Limits:
NIOSH REL*: TWA 1 mg/m^3
OSHA PEL*: TWA 1 mg/m^3
[***Note:** The REL and PEL also apply to other yttrium compounds (as Y).]

Measurement Methods (see Table 1):
NIOSH 7300, 7301, 7303, 9102
OSHA ID121

Physical Description: Dark-gray to black, odorless solid.

Chemical & Physical Properties:
MW: 88.9
BP: 5301°F
Sol: Soluble in hot H_2O
Fl.P: NA
IP: NA
Sp.Gr: 4.47
VP: 0 mmHg (approx)
MLT: 2732°F
UEL: NA
LEL: NA
Noncombustible Solid in bulk form.

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
5 mg/m^3: Qm
10 mg/m^3: 95XQ/Sa
25 mg/m^3: Sa:Cf/PaprHie
50 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
500 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes; in animals: pulm irrit; eye inj; possible liver damage
TO: Eyes, resp sys, liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Zinc chloride fume

Formula:	CAS#:	RTECS#:	IDLH:
$ZnCl_2$	7646-85-7	ZH1400000	50 mg/m^3

Conversion: **DOT:** 2331 154

Synonyms/Trade Names: Zinc dichloride fume

Exposure Limits:
NIOSH REL: TWA 1 mg/m^3
ST 2 mg/m^3
OSHA PEL†: TWA 1 mg/m^3

Measurement Methods (see Table 1):
OSHA ID121

Physical Description: White particulate dispersed in air.

Chemical & Physical Properties:
MW: 136.3
BP: 1350°F
Sol(70°F): 435%
Fl.P: NA
IP: NA
Sp.Gr(77°F): 2.91
VP: 0 mmHg (approx)
MLT: 554°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
10 mg/m^3: 95XQ*/Sa*
25 mg/m^3: Sa:Cf*/PaprHie*
50 mg/m^3: 100F/PaprTHie*/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Potassium

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, nose, throat; conj; cough, copious sputum; dysp, chest pain, pulm edema, pneu; pulm fib, cor pulmonale; fever; cyan; tachypnea; skin burns
TO: Eyes, skin, resp sys, CVS

First Aid (see Table 6):
Breath: Resp support

Zinc oxide

Formula: ZnO | **CAS#:** 1314-13-2 | **RTECS#:** ZH4810000 | **IDLH:** 500 mg/m^3

Conversion: | **DOT:** 1516 143

Synonyms/Trade Names: Zinc peroxide

Exposure Limits:
NIOSH REL: Dust: TWA 5 mg/m^3
C 15 mg/m^3
Fume: TWA 5 mg/m^3
ST 10 mg/m^3
OSHA PEL†: TWA 5 mg/m^3 (fume)
TWA 15 mg/m^3 (total dust)
TWA 5 mg/m^3 (resp dust)

Measurement Methods (see Table 1):
NIOSH 7303, 7502
OSHA ID121, ID143

Physical Description: White, odorless solid.

Chemical & Physical Properties:
MW: 81.4
BP: ?
Sol(64°F): 0.0004%
Fl.P: NA
IP: NA
Sp.Gr: 5.61
VP: 0 mmHg (approx)
MLT: 3587°F
UEL: NA
LEL: NA
Noncombustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 mg/m^3: 95XQ/Sa
125 mg/m^3: Sa:Cf/PaprHie
250 mg/m^3: 100F/SaT:Cf/PaprTHie/ScbaF/SaF
500 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: 100F/ScbaE

Incompatibilities and Reactivities: Chlorinated rubber (at 419°F), water
[**Note:** Slowly decomposed by water.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh
SY: Metal fume fever: chills, musc ache, nau, fever, dry throat, cough; lass; metallic taste; head; blurred vision; low back pain; vomit; mal; chest tight; dysp, rales, decr pulm func
TO: Resp sys

First Aid (see Table 6):
Breath: Resp support

Zinc stearate

Formula: $Zn(C_{18}H_{35}O_2)_2$ | **CAS#:** 557-05-1 | **RTECS#:** ZH5200000 | **IDLH:** N.D.

Conversion: | **DOT:**

Synonyms/Trade Names: Dibasic zinc stearate, Zinc salt of stearic acid, Zinc distearate

Exposure Limits:
NIOSH REL: TWA 10 mg/m^3 (total)
TWA 5 mg/m^3 (resp)
OSHA PEL†: TWA 15 mg/m^3 (total)
TWA 5 mg/m^3 (resp)

Measurement Methods (see Table 1):
NIOSH 0500, 0600

Physical Description: Soft, white powder with a slight, characteristic odor.

Chemical & Physical Properties:
MW: 632.4
BP: ?
Sol: Insoluble
Fl.P(oc): 530°F
IP: NA
Sp.Gr: 1.10
VP: 0 mmHg (approx)
MLT: 266°F
UEL: ?
LEL: ?
MEC: 20 g/m^3
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Oxidizers, dilute acids
[**Note:** Hydrophobic (i.e., repels water).]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, upper resp sys; cough
TO: Eyes, skin, resp sys

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Fresh air
Swallow: Medical attention immed

Zirconium compounds (as Zr)	Formula: Zr (metal)	CAS#: 7440-67-7 (metal)	RTECS#: ZH7070000 (metal)	IDLH: 50 mg/m^3 (as Zr)
Conversion:	**DOT:** 1358 170 (powder, wet); 1932 135 (scrap); 2008 135 (powder, dry)			

Synonyms/Trade Names: **Zirconium metal:** Zirconium
Synonyms of other zirconium compounds vary depending upon the specific compound.

Exposure Limits:	Measurement Methods (see Table 1):
NIOSH REL*: TWA 5 mg/m^3 ST 10 mg/m^3 [***Note:** The REL applies to all zirconium compounds (as Zr) except Zirconium tetrachloride.] **OSHA PEL†:** TWA 5 mg/m^3	**NIOSH** 7300, 7301, 9102 **OSHA** ID121

Physical Description: Metal: Soft, malleable, ductile, solid or gray to gold, amorphous powder.

Chemical & Physical Properties:	Personal Protection/Sanitation (see Table 2):	Respirator Recommendations (see Tables 3 and 4):
MW: 91.2 **BP:** 6471°F **Sol:** Insoluble **Fl.P:** NA **IP:** NA **Sp.Gr:** 6.51 (Metal) **VP:** 0 mmHg (approx) **MLT:** 3375°F **UEL:** NA **LEL:** NA Metal: Combustible, but solid form is difficult to ignite; however, powder form may ignite SPONTANEOUSLY and can continue burning under water.	Recommendations regarding personal protective clothing vary depending upon the specific compound.	**NIOSH/OSHA** **25 mg/m^3:** Qm **50 mg/m^3:** 95XQ/PaprHie/100F/Sa/ScbaF **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE

Incompatibilities and Reactivities: Potassium nitrate, oxidizers
[**Note:** Fine powder may be stored completely immersed in water.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	First Aid (see Table 6):
ER: Inh, Con **SY:** Skin, lung granulomas; in animals: irrit skin, muc memb; X-ray evidence of retention in lungs **TO:** Skin, resp sys	**Eye:** Irr immed **Skin:** Soap wash **Breath:** Resp support **Swallow:** Medical attention immed

APPENDIX C
List of Approved Amendments/changes
HASP Acknowledgement/Agreement Form
Visitors Log
Tailgate Safety Meeting Form
Air Quality Monitoring Record
Equipment Calibration Log
Checklist for Subsurface Investigation
Monthly Heavy Equipment Safety Inspection Checklist

HEALTH AND SAFETY PLAN (HASP)
List of Approved Amendments/Changes

Date	Name	Signature	Changes/Comments	Section Added

HEALTH AND SAFETY PLAN (HASP)
Acknowledgement/Agreement Form

(All ATC, Subcontractor & Client Personnel Must Sign)

Client Site Name: _____ Project Site No. _____

ATC Project No. _____ Task No. _____

I acknowledge I have reviewed a copy of the Health and Safety Plan for this project, understand it, and agree to comply with all of its provisions. I also understand I could be prohibited by the Site Health and Safety Coordinator or other ATC personnel from working on this project for not complying with any aspect of this Health and Safety Plan:

PRINT NAME	SIGNATURE	COMPANY	DATE

HEALTH AND SAFETY PLAN (HASP)
Visitors Log

Client Site Name: _____ Project Site No. _____

ATC Project No. _____ Task No. _____

PRINT NAME	SIGNATURE	COMPANY	DATE

HEALTH AND SAFETY PLAN (HASP)
Tailgate Safety Meeting Form

Site Name & Number: _____

ATC Project Number: _____

Work Being Performed: _____

Date & Time of Meeting: _____

Name of Presenter: _____

NOTE: On the initial day of the project, the Project Manager or designee should conduct a visual inspection of the project site (using the Site Safety Checklist) prior to the Tailgate Safety Meeting. This inspection should include a review of project site equipment, hazards, and specific job tasks, activities or operations to be performed for that day. These specific items must be covered during the Tailgate Safety Meeting. For subsequent days, any changes to the site or operations must be covered in the Tailgate Safety Meeting. In addition, "Task-Specific" Job Safety Analysis (JSA) for the tasks/activities at the project site must be integrated into the HASP and Tailgate discussions.

Itemize the Specific Topics Discussed (if more space is needed use the back of this page):

❑ Are all employees okay? ❑ Are all employees physically able to perform their job duties? ❑ "Shared Learning" items?
❑ Has PPE been checked? ❑Emergency evacuation area identified? ❑ Asked for Sub interactions or questions?

❑ **Client Requirements** - By checking the box to the left, the Presenter of the Tailgate Meeting acknowledges that all Client-specific requirements have been completed for both ATC and Subcontractor employees.

Participants (if needed, list additional participants on back of this page):

Print Name	Signature	Company	Date

A Tailgate Safety Meeting must be conducted and documented at the beginning of each workday when two or more ATC employees and/or Subcontractor representatives are present on site. Employees, client representatives and subcontractors who arrive at the site after the Tailgate Safety Meeting has been conducted must be briefed on the topics and acknowledge by signing this form. The JSA must be completed at the beginning of each day when one or more ATC employees and/or subcontractor representatives are present on a site.

HEALTH AND SAFETY PLAN (HASP)
Air Quality Monitoring Record

DATE	TIME	LOCATION	INSTRUMENT	CONCENTRATION (UNITS)	SAMPLED BY

HEALTH AND SAFETY PLAN (HASP)
Equipment Calibration Log

DATE	INSTRUMENT/ MODEL NO.	ZERO ADJUST OK?	CALIBRATION GAS (PPM)	READING (PPM)	LEAK CHECK	PERFORMED BY	COMMENTS

CHECKLIST FOR SUBSURFACE CLEARANCE

MUST be filled out PRIOR to the Start of Field Activities
NO subsurface work in road Right of Ways or Off-Site (property boundary) without Written Authorization

Site Name: _____

Site Address: _____

Project No.: _____

To understand and use this checklist correctly you must refer to and follow ATC's Subsurface Investigation Procedures.

	Person Verifying Each Item to Place Initials On Lines Below and Sign Bottom of Page	Comments
PRE-DRILLING PREPARATION		
Review definition of "Critical" and "Non-Critical" areas.		
Request as-built drawings, and/or approval to use private utility locator service and/or air knife to locate/protect subsurface utilities.		
Obtain Site access agreement.		
Pre-plan boring locations.		
Establish surface boring method.		If not using Air Knife-type technology, why?
Obtain permits and clearances.		
Do borehole and utility markouts.		
Establish Site-specific Health and Safety Plan		
Notify Client, owner, operator prior to mobilization.		
ON-SITE PROCEDURES		
Conduct tailgate safety meeting with topics as indicated in procedure.		
Read and follow Drilling/Probing procedures		
--1. Do Site walk and verify that utility location checklist is complete.		
--2. Locate all markouts and planned borehole locations. Start intrusive procedures at least 5 feet away from and perpendicular to utility markouts.		
--3. Break surface cover.		
--4. Do surface boring to required depth using hand auger, post-hole digger, shovel or "air knife".		
--5. If necessary, use alternate procedure for surface boring.		
--6. Collect soil samples by hand augering to required depth.		
--7. Protect the borehole from pedestrian and vehicular traffic.		

*Buried utilities can be found at any depth, but are most often found within the first 5 feet below the ground surface. Proceed slowly and with extra caution when working within 5 feet of the ground surface.
NOTES:

_____

SIGNATURE DATE

MUST be filled out PRIOR to the Start of Field Activities

NO subsurface work in road Right of Ways or Off-Site (property boundary) without Written Authorization

Site Address: _____ **If Present --**

Site Safety Documents (on-site during activities)	**"Yes or No"**	**Fill Out, as applicable**
Utility Staking Request Form (properly completed for current scope of work)?	**Yes No**	Ticket # and Expir. Date: # / /
Site Health and Safety Plan?	**Yes No**	Hospital Location Map Available **Yes No**

Utility Identification "color" Above Ground (AG) / Buried (B)			**Identify on a Site Map the Location of ALL Lines & Meters (or actual utility) and Indicate Nearest Building Quadrant (NE, SE, SW, or NW)**			
Natural Gas (Yellow) / Staked?	AG / B	**Yes No**	NW	NE	SE	SW
Electrical (Red) / Staked?	AG / B	**Yes No**	NW	NE	SE	SW
Telephone/Fiber Optic (Orange) / Staked?	AG / B	**Yes No**	NW	NE	SE	SW
Cable TV (Orange) / Staked?	AG / B	**Yes No**	NW	NE	SE	SW
Water (Blue) / Staked?	AG / B	**Yes No**	NW	NE	SE	SW
Sewer (Green) / Staked?	AG / B	**Yes No**	NW	NE	SE	SW

Significant Site Features		**Site Feature Located in Closest Property Quadrant (NE, SE, SW, or NW). Also Identify on Site Map.**
UST system (UST cavity, dispenser islands, piping runs, vent pipes etc.)?	**Yes No**	
Above Ground Storage Tanks – ASTs (dispenser islands, piping runs)?	**Yes No**	
Electrical Transformers?	**Yes No**	
Area Lighting (Pole mounted lighting, etc.)?	**Yes No**	
Signage with electrical power (Business/Company signs, etc.)?	**Yes No**	
Underground lawn/landscaping sprinkler system?	**Yes No**	
Storm drain catch basins / man-ways and potential connecting conduits/lines?	**Yes No**	

Other		**"Other" Concerns Located in Closest Property Quadrant (NE, SE, SW, or NW). Identify on Site Map.**
Pavement distress (Cracked pavement, "buckled" asphalt, etc.)?	**Yes No**	

*Buried utilities can be found at any depth, but are most often found within the first 5 feet below the ground surface. Proceed slowly and with extra caution when working within 5 feet of the ground surface.

NOTES:

_____

SIGNATURE DATE

Monthly Mobile/Heavy Equipment Safety Inspection Checklist

This form is to be completed by the qualified operator of the equipment

Date:		Project No.:		Site/Location:	
Equipment Type:		Model No.:		Odometer:	
Operator/Inspector Name:				Machine Hours:	

Warning: Do not operate a malfunctioning machine until corrective measures have been taken and all discrepancies have been cleared by a qualified operator/mechanic. In addition to elements on this checklist, the owner's manual for the specific piece of equipment being operated may contain other daily inspection checks and/or preventative maintenance procedures.

General Safety	☐	Operator Qualification	☐	PPE Supplies	☐	Fire Extinguisher (ready-to-use)
	☐	Owner's Manual (present)	☐	DriverCheck (decal in place)	☐	First-Aid Kit (present & stocked)
	☐	Manufacturer Specs Followed	☐	Access Ladder (secure and ok)	☐	Housekeeping (clean)
	☐	Emergency Kit (signs, flares)	☐	Flashlight	☐	Markers (cones, barricades, etc.)
Vehicle, Engine, and Hydraulic Systems (note any added fluid)	☐	Engine Oil (fluid level, condition)	☐	Fuel Level	☐	Other Fluid
	☐	Transmission (fluid level, fluid condition, unit operation)	☐	Brake Fluid	☐	Steering (power steering fluid level, no play in steering)
	☐	Radiator (coolant level, hose condition)	☐	Fan Belts (tension/condition)	☐	Brakes (vehicle, parking)
	☐	Hydraulic System (fluid level, fluid condition, hose condition, cylinders, leakage)	☐	Chassis (proper lubrication)	☐	Tires (condition, inflation)
	☐	Outriggers (operational, if equipped)	☐		☐	
Tracked Vehicles	☐	Track Tension (proper tension)	☐	Plates and/or Shoes	☐	Grouser Plates
	☐	Rollers	☐	Drive Sprockets		
Lights and alarms (clean and functional)	☐	Headlights (hi, low, run beams)	☐	Parking Lights	☐	Revolving Flashing Lights (if required)
	☐	Reverse Lights (backup)	☐	Equipment Work Lights	☐	Horn
	☐	Brake/Tail Lights	☐	Turn Signals/Hazard Flashers	☐	Reverse Alarms (backup)
Vehicle cab (clean and functional)	☐	Seatbelts (if required)	☐	Windshield Wipers	☐	Body Damage
	☐	Housekeeping	☐	2 Way Communication	☐	Speed/Hour Meter
	☐	Fuel Gauge	☐	Horn (operational)	☐	Windshield (glass ok, clean)
	☐	Controls Operational	☐	Mirrors (rear view, side)		

Maintenance/ Equipment Request	Corrected By:	Date:

Inspectors Signature:		
		Date

APPENDIX D
Excavating & Trenching

All ATC employees and subcontractors shall be trained and be familiar with the OSHA Excavation Standard and the ATC Employee Health and Safety Policy Manual, Policy No. 16 (Excavation and Trenching) and Policy No. 33 (Subsurface Investigation).

1.0 UNDERGROUND UTILITIES

Prior to any work beginning, the estimated location of utility installations (such as sewer, telephone, fuel, electric, water lines, or any other underground installation) that reasonably may be expected to be encountered during excavation work must be determined prior to opening an excavation. Utility companies or owners shall be contacted and advised of the proposed work and asked to establish the location of the utility underground installations. When utility companies or owners cannot respond to a request to locate underground utilities within 24-48 hours (unless a longer period is required by State or local law), or cannot establish the exact location of these installations, the work may proceed, provided that the work is conducted with caution, and provided detection equipment or other acceptable means to located utilities are used.

When excavation operations approach the estimated location of underground installations (approximately 18 inches from the installation), the exact location of the installations shall be determined by a safe and acceptable means. While the excavation is open, underground installations shall be protected, supported, or removed to safeguard employees.

2.0 ENTERING EXCAVATIONS OR TRENCHES

Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a "*Competent Person"* for evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the Competent Person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard increasing occurrence. All inspections made by the Competent Person should be recorded in the field log book.

No person(s) shall perform work in a trench or excavation that contains accumulated water.

2.1.1 Access/Egress

A stairway, ladder, ramp, or other safe means of egress shall be located in trench excavations that are 4 feet or more in depth so as to require no more than 25 feet of lateral travel distance in any direction.

2.1.2 Exposure to Falling Loads

No employee or subcontractor is permitted underneath loads handled by lifting or digging equipment. All personnel shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by spilling or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the equipment is provided with a cab shield and/or canopy adequate to protect the operator from falling materials.

2.1.3 Warning Systems

When mobile equipment is operated adjacent to an excavation and the operators/drivers do not have a clear and direct view of the edge of the excavation, a warning system such as barricades, hand or mechanical signals, or stop logs are required.

APPENDIX D
Excavating & Trenching

2.1.4 Protection from Loose Rock or Soil

Adequate protection shall be provided to protect employees from loose rock or soil that could pose a hazard to personnel in the excavation. All temporary spoil piles shall be kept at least 2 feet away from the edge of the excavation. Spoil piles should be placed to channel rainwater or other run-off water away from the excavation.

2.1.5 Hazardous Atmospheres

All excavations deeper than 4 feet deep and which have the potential to have a hazardous atmosphere or oxygen deficient atmospheres (Less than 19.5% oxygen) must be tested to ensure safe working conditions, prior to entry. Air monitoring shall be conducted in accordance with Section 4.0 of the HASP.

2.1.6 Protective Systems

Each employee in an excavation shall be protected from cave-ins by an adequate protective system except when excavations are made entirely in stable rock or the excavation is less than 5 feet in depth and examination by the Competent Person provides no indication of a potential cave-in. Protective systems consist of sloping or benching, use of trench boxes or other shielding mechanisms, or the use of a shoring system in accordance with the regulations.

APPENDIX E
Lockout/Tagout Requirements & Procedures

1.0 DEFINITIONS

1. Lockout – Involves using a device such as a padlock, blank pipe flange, chain key block, etc. to isolate energy from employee exposure.
2. Tagout – Involves applying a tag to the energy isolating device with written information concerning the date and name of person who applied the lock and tag.

2.0 LOCKOUT/TAGOUT POLICY

This procedure establishes the minimum requirements for lockout/tagout of electrical energy sources, mechanical, hydraulic, pneumatic, thermal or chemical process energy. It is to be used to ensure that conductors and circuit parts are disconnected from sources of electrical energy, locked (tagged), and tested before work begins where employees or subcontractor could be exposed to dangerous conditions. Sources of stored energy, such as capacitors or springs, shall be relieved of their energy, and a mechanism shall be engaged to prevent the re-accumulation of energy.

Lockout/tagout procedures shall be used prior to performing tie-in operations, maintenance, repair or adjustment of any device where exposure to hazardous energy sources may occur.

3.0 RESPONSIBILITY

All effected employees and subcontractors shall be instructed in the safety significance of the lockout/tagout procedure. All new or transferred employees and all other persons whose work operations are or might be in the area shall be instructed in the purpose and use of this procedure. The ATC Project Manager shall ensure that appropriate personnel receive instructions on their roles and responsibilities. All persons installing a lockout/tagout device shall sign their names and the date on the tag and on the Lockout/Tagout Isolation Record (see Appendix E.1).

4.0 PREPARATION FOR LOCKOUT/TAGOUT

1. Review current diagrammatic drawings (or other equally effective means), tags, labels, and signs to identify and locate all disconnecting means to determine that the source of energy is interrupted by a physical break and not de-energized by a circuit interlock. Make a list of disconnecting means to be locked/tagged.
2. Review other work activities to identify where and how other personnel might be exposed to sources of energy. Establish energy control methods for control of other hazardous energy sources in the area.
3. Provide an adequately rated voltage detector to test each electrical phase conductor or circuit part to verify that they are de-energized. Test the voltage detector to make sure that it is working properly.

5.0 LOCKOUT PROCEDURE

1. Complete the Lockout/Tagout Isolation Record (see Appendix E.1).
2. All affected employees in the area shall be notified that a lockout is being performed.
3. The equipment being locked out shall be shut down using normal shutdown procedures. (i.e. operator's control station, stop button, etc.).
4. Any residual energy shall be identified and dissipated at this time.
5. All equipment energy sources shall be neutralized. (i.e. electrical disconnects shall be opened, valves closed, blanks inserted in piping, springs returned to neutral position, other energy sources as required)

6. The qualified employee performing the lockout shall place his/her personal lock and tag on EACH energy isolation point isolated in Step 4. If more than two (2) isolation points are required to lockout the device, a group lockbox may be used. A tag indicating all persons who applied a lock, date, time, equipment type, and number and duration of lockout shall also be applied at this time. A subcontractor representative and an ATC employee shall also apply a lock at this time.
7. Test the lockout by clearing the area and attempting to operate the machine or attempting to operate disconnecting means to determine that the operation is prohibited. A voltage-detecting instrument should be used for electrical components. Inspect the instrument prior to use for physical damage and operation.

6.0 REMOVAL OF LOCKOUT/TAGOUT

1. Upon completion of the lockout an authorized employee must check the area for completeness of work. If the employee who initiated the lockout is available, he/she should conduct this inspection.
2. Remove all tools and nonessential items from the area.
3. Replace all guards.
4. Ensure all employees are clear of the equipment/process.
5. Notify all affected employees in the area that the lockout device(s) are being removed.
6. Remove lockout device(s).
7. Restart the machine to insure proper operation.

7.0 GROUP LOCKOUT

1. When multiple isolation points, three (3) or more, must be controlled during a lockout, or when multiple persons (craft) are involved, a group lockout shall be used.
2. Follow the steps for a normal lockout as documented in steps 1-6 above.
3. Each key for the locks used shall be placed in a group lockout box. The group lockbox shall be kept in view of the work being performed when practical.
4. A Job Control Lock shall be installed on the group lockbox by an ATC Employee. This lock shall remain in place until the lockout has been completed.
5. Each employee shall remove their own lock when their portion of the work is completed or at the end of each shift.
6. Upon completion of the work, the ATC employee shall inspect the work area for completeness.
7. When all of the conditions of the lockout termination procedures have been satisfied, the Job Control Lock shall be removed from the group lockbox.

8.0 EMERGENCY REMOVAL LOCKOUT/TAGOUT DEVICE

1. If an employee leaves the facility without removing his/her lock and tag, an effort shall be made to notify the employee that the supervisor in charge will authorize the removal of their lock. It must be deemed necessary that removal of the lock is required by at least two supervisory personnel, but only after confirming beyond any doubt it is safe to do so.
2. Verify the employee has left the Site.
3. Check with co-workers.
4. Check the employee's time card.
5. Attempt to reach him/her at home.

APPENDIX E
Lockout/Tagout Requirements & Procedures

6. Verify the employee is not in the equipment.
7. Visually confirm the completeness of work.
8. Contact the Regional Safety Coordinator and the Project Manager.
9. An authorized employee, under the direct supervision of an ATC Supervisor shall remove the lock.
10. Upon return to the Site by the employee involved, he/she shall be informed of the removal.
11. A review of the incident may be conducted by the ATC RSC Coordinator to determine any disciplinary actions necessary.

APPENDIX E-1
Lockout/Tagout Isolation Record

System:		Isolation Record	Status	Tagging Authority
Equipment Tag:		Equipment Description:	☐ Construction	
			☐ Startup	
			☐ Operations	

LOTO No.	DNO Tag No.	Equipment Tag No.	Equipment Description	Pos.	LOTO Placed By:	Date	LOTO Removed BY:	Date

Tagging Authority Approval:		
	Signature	Date

Holder List:

PTW No.	Signed Onto LOTO Name	Date / Time	Signed Off LOTO Name	Date / Time

ATTACHMENT F

SITE INSPECTION LOG FORMS

SITE WIDE INSPECTION FORM
QUEENS WEST PARCEL 9
48th AVE. AND CENTER BLVD., LONG ISLAND CITY, NEW YORK

Inspector: _____

Date: _____

1. Site Use Restrictions

No on-site vegetable gardens?

No groundwater withdrawal for potable/non-potable use?

Restricted residential maintained (single owner, or common ownership)?

2. Site Cap

Note the date that the annual site cap inspection was performed:

Repairs made as noted during inspection?

3. Soil Management

Note the date(s) of any soil disturbance activities conducted during the past year:

Proper soil management procedures implemented (cite appropriate close out reports)?

4. Groundwater Monitoring

Monitoring being conducted on a quarterly basis (note the dates of sampling conducted)?

All on-site monitoring wells in working condition (note any repairs/replacement)?

5. Vapor Discharge Monitoring

Monitoring being conducted on a quarterly basis (note the dates of sampling conducted)?

All vapor monitoring points in working condition (note any repairs/replacement)?

SITE WIDE INSPECTION FORM
QUEENS WEST PARCEL 9
48th AVE. AND CENTER BLVD., LONG ISLAND CITY, NEW YORK

6. Permits

Do vapor emissions meet NYSDEC regulatory standards?

7. Vapor mitigation system O&M

Are routine system check logs being completed by on-site representative?

Are Periodic Inspections being conducted as scheduled (note the dates of all inspections)?

8. Recordkeeping

Check that the following records/reports are being maintained/completed (note report/log dates as appropriate):

1) Annual site cap inspection log

2) Close-out report(s) for soil disburbance activities (including manifests for soil disposal)

3) Annual groundwater monitoring reports (including laboratory analytical data reports/groundwater contours)

4) Annual vapor discharge monitoring reports

5) Routine System Check Log for vapor mitigation system

6) Periodic Inspection Log for vapor mitigation system

7) Annual vapor mitigation system O&M reports

9. Comments

(Note any deficiencies and recommendations for corrective actions.)

SITE CAP INSPECTION FORM
QUEENS WEST PARCEL 9
48th AVE. AND CENTER BLVD., LONG ISLAND CITY, NEW YORK

Inspector: _____

Date: _____

1. Courtyard/landscaped areas:

Adequate top soil cover present?

Signs of erosion?

Recommended corrective action:

2. Outdoor paving/sidewalks:

Note any signs of cracking or other damage:

Note any areas where greater than 25% of surface is cracked/damaged:

Recommended corrective action:

3. Lower level garage slab:

Note any signs of cracking or other damage:

Note any areas where greater than 25% of surface is cracked/damaged:

Recommended corrective action:

Comments (attach photos/sketches to illustrate any damage noted): _____

ROUTINE SYSTEM CHECK

PARCEL 9 VAPOR MITIGATION SYSTEM

48th AVE. AND CENTER BLVD., LONG ISLAND CITY, NEW YORK

ZONE: 1 2 3 4 (Circle One)

Readings/Observations to be recorded by AvalonBay Site Representative.

1. Record Inspector Name and Date.
2. Observe and record if blower light is on or off. **If light is off, immediately notify an emergency contact listed on attached page.**
3. Record any other comments e.g., unusual odors, spills, leaks, etc. **If such conditions exsist, immediately notify an emergency contact listed on attached page.**
4. Retain this page on-site for collection by AKRF.
5. Conduct inspections daily during first month of operation and weekly thereafter.

Inpsector Name	Date	Blower Light On/Off	Observations
		☐LIGHT ON ☐LIGHT OFF	
		☐LIGHT ON ☐LIGHT OFF	
		☐LIGHT ON ☐LIGHT OFF	
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ROUTINE SYSTEM CHECK

PARCEL 9 VAPOR MITIGATION SYSTEM

48th AVE. AND CENTER BLVD., LONG ISLAND CITY, NEW YORK

ZONE: 1 2 3 4 (Circle One)

Emergency Contact Information

Name	Title	Contact Number
Steve Spiro	AVB Project Manager	212-309-1616 (office) 917-301-1325 (cell)
Marc Godick	AKRF Project Director	914-922-2356 (office) 917-991-4030 (cell)
Becky Kinal	AKRF Project Manager	914-922-2362(office) 914-263-8730 (cell)
Michelle Lapin	AKRF Project Engineer	646-388-9520 (office) 917-612-7109 (cell)
Karen Franz	Alt. AKRF Project Engineer	646-388-9750 (office)

PERIODIC INSPECTION FORM
PARCEL 9 VAPOR MITIGATION SYSTEM
48th AVE. AND CENTER BLVD., LONG ISLAND CITY, NEW YORK

Inspector Name:	**Date:**
Time IN:	**Time OUT:**

GENERAL

Are there any leaks in system? yes or no (circle one)

If yes, plans for repair:

Are daily system checks being completed? yes or no (circle one)

If no, corrective actions taken:

FLOW RATES

Location	**Run Time** (hours)	**Flow Rate** (cfm)	
Zone 1			
Zone 2			
Zone 3			
Zone 4			

Comments:

Notes:
1. Blower flow rates should be ~250 cfm

VACUUM READINGS (at particulate filter) **(after filter change)**

	Inlet "H_2O	**Oulet "H_2O**	**Differential "H_2O**	**Filter Changed?**	**Inlet "H_2O**	**Oulet "H_2O**	**Differential "H_2O**
Zone 1							
Zone 2							
Zone 3							
Zone 4							

Comments:

Notes:
1. If differential (inlet-outlet pressure) > 3 "H_2O above normal conditions, change out filter.

PERIODIC INSPECTION FORM
PARCEL 9 VAPOR MITIGATION SYSTEM
48th AVE. AND CENTER BLVD., LONG ISLAND CITY, NEW YORK

Inspector Name:		**Date:**	
Time IN:		**Time OUT:**	
VAPOR SAMPLES			
	PID Readings (ppm)	**Laboratory Sample ID (method TO-15)**	
Zone 1			
Zone 2			
Zone 3			
Zone 4			

ATTACHMENT G

EXAMPLE IC/EC CERTIFICATION FORM

ENCLOSURE 1
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
INSTITUTIONAL AND ENGINEERING CONTROLS CERTIFICATION FORM

SITE DETAILS

SITE NO.	**C-41049**
SITE NAME:	**Queens West Parcel 9**
SITE ADDRESS:	4-75 48th Street
ZIP CODE:	11101
CITY/TOWN:	Long Island City
COUNTY:	New York
CURRENT USE:	Residential and Commercial

CURRENT CERTIFICATION FREQUENCY: EVERY 1 YEAR(S)

VERIFICATION OF SITE DETAILS

		YES	NO
1.	Are the SITE DETAILS above, correct?	☐	☐
	If NO, are changes handwritten above or included on a separate sheet?	☐	
2.	Has some or all of the site property been sold, subdivided, merged, or undergone a tax map amendment since the initial/last certification?	☐	☐
	If YES, is documentation or evidence that documentation has been previously submitted included with this certification?	☐	
3.	Have any federal, state, and/or local permits (e.g., building, discharge) been issued for or at the property since the initial/last certification?	☐	☐
	If YES, is documentation or evidence that documentation has been previously submitted included with this certification?	☐	
4.	Has a change of use occurred since the initial/last certification?	☐	☐
	If YES, is documentation or evidence that documentation has been previously submitted included with this certification?	☐	
5.	Has any new information come to your attention to indicate that assumptions made in the qualitative exposure assessment for offsite contamination are no longer valid (applies to non-significant threat sites subject to ECL 27-1415.7(c)?	☐	☐
	If YES, is the new information or evidence that new information has been previously submitted included with this certification?	☐	
6.	Are the assumptions in the qualitative exposure assessment still valid (must be certified every five years for non-significant threat sites subject to ECL 27-1415.7(c)?	☐	☐
	If NO, are changes in the assessment included with this certification:	☐	☐

Description of Institutional/Engineering Control	Control Certification
	YES
ENVIRONMENTAL EASEMENT	☐
DEED RESTRICTIONS	☐
OTHER CONTROLS	
COVER MATERIAL	☐
VAPOR BARRIER	☐

CONTROL CERTIFICATION STATEMENT

For each institutional or engineering control listed above, I certify by checking “Yes” that all of the following statements are true:

(a) the institutional control and/or engineering control employed at this site is unchanged from the date the control was put in-place, or last approved by the Department;’

(b) nothing has occurred that would impair the ability of such control to protect public health and the environment;

(c) nothing has occurred that would constitute a violation or failure to comply with any Site Management Plan for this control; and

(d) access to the site will continue to be provided to the Department to evaluate the remedy, including access to evaluate the continued maintenance of this control.

(e) if a financial assurance mechanism is required under the remedial work plan for the site, the mechanism remains valid and sufficient for their intended purpose under the work plan.

SITE OWNER OR DESIGNATED REPRESENTATIVE SIGNATURE

I certify that all information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

I _____ (print name), _____

(print business address), am certifying as _____ (Owner or Owner's Designated Site Representative (if the site consists of multiple properties, I have been authorized and designated by all site owners to sign this certification) for the Site named in the Site Details section of this form.

_____ _____

Signature of Site Owner or Representative Rendering Certification Date

QUALIFIED ENVIRONMENTAL PROFESSIONAL (QEP) SIGNATURE

I certify that all information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

I _____ (print name), _____

(print business address), am certifying as a Qualified Environmental Professional for the _____

_____ (Owner or Owner's Representative) for the Site named in the Site Details section of this form.

Signature of Qualified Environmental Professional, for Site Owner or Representative, Rendering Certification | Stamp (if Required) | Date

Enclosure 2

Certification of Institutional Controls/Engineering Controls (ICs/ECs)
Step-by-Step Instructions, Certification Requirements and Definitions

The Site owner, or Site owner's representative, and when necessary, a Professional Engineer (P.E.), or the Qualified Environmental Professional (QEP), must review and complete the IC/EC Certification Form, sign it, and return it, along with the Periodic Site Management Report, within 45 days of the date of this notice.

Institutional Controls (defined below) are organized into 4 categories: Governmental Controls (e.g., groundwater-use restrictions), Proprietary Controls (e.g., Environmental Easements), Enforcement and Permit Tools (e.g., Consent Orders), and Information Devices (e.g., State Registries of Inactive Hazardous Waste Sites). The Certification Form shows the Control information the Department has for this Site. Please use the following instructions to complete the IC/EC Certification.

I. Verification of Site Details (First and Second Boxes):

1. Verify the accuracy of information in the **Site Details** section by answering the 6 questions. If necessary, you and/or your P.E. or QEP may handwrite changes and submit supporting documentation.

II. Verification of Institutional/Engineering Controls (Third and Fourth Boxes):

1. Review the listed Institutional/Engineering Controls and select "YES" or "NO" for **Control Certification** for each IC/EC, based on Sections (a)-(d) of the **Control Certification Statement.**

2. If you cannot certify "Yes" for each Control, please continue to complete the remainder of this **Control Certification** form. Attach supporting documentation that explains why the **Control Certification** cannot be rendered, as well as a statement of proposed corrective measures, and an associated schedule for completing the corrective measures. Note that this **Control Certification** form must be submitted even if an IC or EC cannot be certified; however, the certification process will not be considered complete until corrective action is conducted.

   If the Department concurs with the explanation, the corrective measures, and the proposed schedule, a letter authorizing the implementation of those corrective measures will be issued. If the Department has any questions or concerns regarding the completion of the certification, the Project Manager will contact you.

III. Certification of Signature (Fifth and Sixth Boxes):

1. WHY IC/EC Certification is required:
   The Section of the New York Environmental Conservation Law that includes the requirement of a periodic certification of IC(s) and EC(s) is as follows:

   For Environmental Restoration Projects: N.Y. Envtl Conserv. Law Section 56-0503 (Environmental restoration projects; state assistance)

   For State Superfund Projects: Envtl Conserv. Law Section 27-1415. (Remedial program requirements)

   Voluntary Cleanup Program: Applicable program guidance.

2. To determine WHO signs the **Control Certification,** please use the following table:

Signature Requirements for IC/EC Certification Form		
Type of Control	**Example of IC/EC**	**Required Signatures**
IC	Environmental Easement Deed Restriction.	Site Owner or their designated representative, e.g., a Property Manager.
EC with no treatment system, or engineered caps.	Fence, Clean Soil Cover.	Site Owner or their designated representative, and QEP. (P.E. license not required)
EC that includes treatment systems, or engineered caps.	Pump & Treat System providing hydraulic control of a plume, Part 360 Cap.	Site Owner or his designated representative, and QEP with P.E. License.

3. WHERE to mail the signed Certification Form within 45 days of the date of the notice:

New York State Department of Environmental Conservation
Division of Environmental Remediation, Region 2
47-40 21st Street
Long Island City, NY 11101-5407
Attn: Shaminder Chawla, Project Manager

Please note that extra postage may be required.

IV. Definitions:

"Engineering Control" (EC), means any physical barrier or method employed to actively or passively contain, stabilize, or monitor any hazardous waste or petroleum waste to ensure the long-term effectiveness of an inactive site remedial program or brownfield site remedial program or environmental restoration project, or to eliminate potential exposure pathways to any such hazardous waste or petroleum waste. Engineering Controls include, but are not limited to: pavement, caps, covers, subsurface barriers and slurry walls; building ventilation systems; fences, other barriers and access controls; and provision of alternative water supplies via connection to an existing public water supply, addition of treatment technologies to an existing public water supply, and installation of filtration devices on an existing private water supply.

"Institutional Control" (IC), means any non-physical means of enforcing a restriction on the use of real property, that limits human or environmental exposure to any hazardous waste or petroleum waste, restricts the use of groundwater; provides notice to potential owners, operators, or members of the public; or prevents actions that would interfere with the effectiveness of an inactive site remedial program or brownfield site remedial program or environmental restoration project, or with the effectiveness and/or integrity of Site Management activities at or pertaining to any site.

"Professional Engineer" means a person, including a firm headed by such a person, who holds a current New York State Professional Engineering license or registration, and has the equivalent of three (3) years of full-time relevant experience in site investigation and remediation of the type detailed in this Control Certification.

"Property Owner" means, for purposes of an IC/EC certification, the actual owner of a property. If the site has multiple properties with different owners, the Department requires that the owners be represented by a single representative to sign the certification.

"Oversight Document" means any document the Department issues pursuant to each Remedial Program (see below) to define the role of a person participating in the investigation and/or remediation of a site or area(s) of concern. Examples for the various programs are as follows:

BCP (after approval of the BCP application by DEC) – Brownfield Site Cleanup Agreement.
ERP (after approval of the ERP application by DEC) – State Assistance Contract.
Federal Superfund Sites - Federal Consent Decrees, Administrative Orders on Consent or Unilateral Orders issued pursuant to CERCLA.
Oil Spill Program – Order on Consent, or Stipulation pursuant to Article 12 of the Navigation Law (and the New York Environmental Conservation Law).
State Superfund Program – Administrative Consent Order.
VCP (after approval of the VCP application by DEC) – Voluntary Cleanup Agreement.
RCRA Corrective Action Sites - Federal Consent Decrees, Administrative Orders on Consent or permit conditions issued pursuant to RCRA.

"Qualified Environmental Professional" (QEP), means a person, including a firm headed by such a person, who possesses sufficient specific education, training, and experience necessary to exercise professional judgment, to develop opinions and conclusions regarding the presence of releases or threatened releases to the surface or subsurface of a property or off-site areas, sufficient to meet the objectives and performance factors for the areas of practice identified by this guidance (DER10 Technical Guide).

1. Such a person must:
   i. Hold a current Professional Engineering or a Professional Geologist license or registration, and have the equivalent of three (3) years of full-time relevant experience in site investigation and remediation of the type detailed in this guidance; or
   ii. Be a site remediation professional licensed or certified by the federal government, a state; or a recognized, accrediting agency, to perform investigation or remediation tasks identified by this guidance, and have the equivalent of three (3) years of full-time relevant experience. Examples of such license or certification include, but are not limited to, the following titles:
      - Licensed Site Professional, by the State of Massachusetts
      - Licensed Environmental Professional, by the State of Connecticut
      - Qualified Environmental Professional, by the Institute of Professional Environmental Practice
      - Certified Hazardous Materials Manager, by the Institute of Hazardous Materials Management

2. The definition of QEP provided above does not preempt State Professional licensing or registration requirements such as those for a Professional Geologist, Engineer, or Site Remediation Professional. Before commencing work, a person should determine the applicability of State professional licensing or registration laws to the activities to be undertaken pursuant to section 1.5 (DER10 Technical Guide).

3. A person who does not meet the above definition of a QEP under the foregoing definition may assist in the conduct of all appropriate investigation or remediation activities in accordance with this document is such person is under the supervision or responsible charge of a person meeting the definition provided above.

"Remedial Party" means any person or persons, as defined in 6NYCRR 375, who executes, or is otherwise subject to, an oversight document (State Superfund, BCP, ERP or VCP Program). For purposes of this guidance, remedial party also includes:

1. Any person or persons who is performing the investigation and/or remediation, or has control over the person (for example, contractor or consultant) who is performing the investigation and/or remediation, including, without limitation, an owner, operator or volunteer; and

2. The DER for State-funded investigation and/or remediation activities.

"Site Management" (SM) means the activities included in the last phase of the remediation of a site, in accordance with a Site Management Plan, which continue until the remedial action objectives for the project are met and the site can be closed-out. Site Management includes the management of the institutional and engineering controls required for a site, as well as the implementation of any necessary long-term monitoring and/or operation and maintenance of the remedy. (Formerly referred to as Operation and Maintenance (O&M)).

“Site Management Plan” (SMP) means a document which details the steps necessary to assure that the institutional and engineering controls required for a site are in-place, and any physical components of the remedy are operated, maintained and monitored to assure their continued effectiveness, developed pursuant to Section 6 (DER10 Technical Guide).

“Site Owner” means the actual owner of a site. If the site has multiple owners of multiple properties with ICs and/or ECs, the Department requires that the owners designate a single representative for IC/EC Certification activities.

“Site Owner’s Designated Representative” means a person, including a firm headed by such a person, who has been designated in writing by the Site Owner(s) to complete and sign the Institutional and Engineering Controls Certification Form.