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Material Safety Data Sheets Collection:

Sheet No. 316
Benzene

Issued: 11/78 Revision: E, 8/90

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Section 1. Material Identification

Benzene (C_6H_6) Description: Derived by fractional distillation of coal tar, hydrodealkylation of toluene or pyrolysis of gasoline, catalytic reforming of petroleum, and transalkylation of toluene by disproportionation reaction. Used as a fuel; a chemical reagent; a solvent for a large number of materials such as paints, plastics, rubber, inks, oils, and fats; in manufacturing phenol, ethylbenzene (for styrene monomer), nitrobenzene (for aniline), dodecylbenzene (for detergents), cyclohexane (for nylon), chlorobenzene, diphenyl, benzene hexachloride, maleic anhydride, benzene-sulfonic acid, artificial leather, linoleum, oil cloth, varnishes, and lacquers; for printing and lithography; in dry cleaning; in adhesives and coatings; for extraction and rectification; as a degreasing agent; in the tire industry; and in shoe factories. Benzene has been banned as an ingredient in products intended for household use and is no longer used in pesticides.
Other Designations: CAS No. 0071-43-2, benzol, carbon oil, coal naphtha, cyclohexatriene, mineral naphtha, nitration benzene, phene, phenyl hydride, pyrobenzol.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R 1
I 4
S 2*
K 4
*Skin absorption

NFPA
3
2 0
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HMIS
H 3
F 3
R 0
PPG†
† Sec. 8

Cautions: Benzene is a confirmed *human carcinogen* by the IARC. *Chronic low-level exposure may cause cancer (leukemia) and bone marrow damage, with injury to blood-forming tissue.* It is also a dangerous fire hazard when exposed to heat or flame.

Section 2. Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

1989 OSHA PELs
(29 CFR 1910.1000, Table Z-1-A)
8-hr TWA: 1 ppm, 3 mg/m^3
15-min STEL: 5 ppm, 15 mg/m^3

(29 CFR 1910.1000, Table Z-2)
8-hr TWA: 10 ppm
Acceptable Ceiling Concentration: 25 ppm
Acceptable Maximum Peak: 50 ppm (10 min)†

1989-90 ACGIH
TLV-TWA: 10 ppm, 32 mg/m^3

1988 NIOSH RELs
TWA: 0.1 ppm, 0.3 mg/m^3
Ceiling: 1 ppm, 3 mg/m^3

1985-86 Toxicity Data‡
Man, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted
Man, inhalation, TC_{Lo}: 150 ppm inhaled intermittently over 1 yr in a number of discrete, separate doses affects the blood (other changes) and nutritional and gross metabolism (body temperature increase)
Rabbit, eye: 2 mg administered over 24 hr produces severe irritation

* OSHA 29 CFR 1910.1000, Subpart Z, states that the final benzene standard in 29 CFR 1910.1028 applies to all occupational exposures to benzene except in some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply.
† Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift.
‡ See NIOSH, *RTECS* (CY1400000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 176 °F (80 °C)
Melting Point: 42 °F (5.5 °C)
Vapor Pressure: 100 mm Hg at 79 °F (26.1 °C)
Vapor Density (Air = 1): 2.7
Evaporation Rate (Ether = 1): 2.8

Molecular Weight: 78.11
Specific Gravity (15 °C/4 °C): 0.8787
Water Solubility: Slightly (0.180 g/100 g of H_2O at 25 °C)
% Volatile by Volume: 100
Viscosity: 0.6468 mPa at 20 °C

Appearance and Odor: A colorless liquid with a characteristic sweet, aromatic odor. The odor recognition threshold (100% of panel) is approximately 5 ppm (unfatigued) in air. Odor *is not* an adequate warning of hazard.

Section 4. Fire and Explosion Data

Flash Point: 12 °F (-11.1 °C), CC	**Autoignition Temperature:** 928 °F (498 °C)	**LEL:** 1.3% v/v	**UEL:** 7.1% v/v

Extinguishing Media: Use dry chemical, foam, or carbon dioxide to extinguish benzene fires. Water may be ineffective as an extinguishing agent since it can scatter and spread the fire. Use water spray to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.
Unusual Fire or Explosion Hazards: Benzene is a Class 1B flammable liquid. A concentration exceeding 3250 ppm is considered a potential fire explosion hazard. Benzene vapor is heavier than air and can collect in low lying areas or travel to an ignition source and flash back. Explosive and flammable benzene vapor-air mixtures can easily form at room temperature. Eliminate all ignition sources where benzene is used, handled, or stored.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Structural firefighter's protective clothing provides limited protection. Stay out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Runoff to sewer can create pollution, fire, and explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Benzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Benzene explodes on contact with diborane, permanganic acid, bromine pentafluoride, peroxodisulfuric acid, and peroxomonosulfuric acid. It ignites on contact with dioxygen difluoride, dioxygenyl tetrafluoroborate, iodine heptafluoride, and sodium peroxide + water. Benzene forms sensitive, explosive mixture with iodine pentafluoride, ozone, liquid oxygen, silver perchlorate, nitryl perchlorate, nitric acid, and arsenic pentafluoride + potassium methoxide (explodes above 30 °C). A vigorous or incandescent reaction occurs with bromine trifluoride, uranium hexafluoride, and hydrogen + Raney nickel [above 410 °F (210 °C)]. Benzene is incompatible with oxidizing materials.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of benzene can produce toxic gases and vapors such as carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: The ACGIH, OSHA, and IARC list benzene as, respectively, a supected human carcinogen, a cancer hazard, and, based on sufficient human and animal evidence, a human carcinogen (Group 1).

Summary of Risks: Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. The most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level exposure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.

Medical Conditions Aggravated by Long-Term Exposure: Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS.

Target Organs: Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.

Primary Entry Routes: Inhalation, skin contact.

Acute Effects: Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, drowsiness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a drying rash (dermatitis).

Chronic Effects: Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) to leukemia.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Immediately rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.

Inhalation: Remove exposed person to fresh air. Emergency personnel should protect against inhalation exposure. Provide CPR to support breathing or circulation as necessary. Keep awake and transport to a medical facility.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, ***do not induce vomiting*** since aspiration may be fatal. Call a physician immediately.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Physician's Note: Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any early indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. Acute management is primarily supportive for CNS depression.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a benzene spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation, eye contact, and skin absorption. Absorb as much benzene as possible with an inert, noncombustible material. For large spills, dike far ahead of spill and contain liquid. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of confined spaces such as sewers, watersheds, and waterways because of explosion danger. Follow applicable OSHA regulations (29 CFR 1910.120).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307 (a), 311 (b)(4), 112; and per RCRA, Sec. 3001]

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

Listed as SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at least below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials. *Caution! Benzene vapor may form explosive mixtures in air.* To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. When opening or closing benzene containers, use nonsparking tools. Keep fire extinguishers readily available.

Engineering Controls: Because OSHA specifically regulates benzene (29 CFR 1910.1028), educate workers about its potential hazards and dangers. Minimize all possible exposures to carcinogens. If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if absolutely essential. Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Designate regulated areas of benzene use (see legend in the box below) and label benzene containers with "DANGER, CONTAINS BENZENE, CANCER HAZARD."

Other Precautions: Provide preplacement and periodic medical examinations with emphasis on a history of blood disease or previous exposure.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Benzene (*benzol*)
DOT Hazard Class: Flammable liquid
ID No.: UN1114
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Benzene
IMO Hazard Class: 3.2
ID No.: UN1114
IMO Label: Flammable liquid
IMDG Packaging Group: II

DANGER
BENZENE
CANCER HAZARD
FLAMMABLE–NO SMOKING
AUTHORIZED PERSONNEL ONLY
RESPIRATOR REQUIRED

MSDS Collection **References:** 1, 2, 12, 26, 73, 84-94, 100, 101, 103, 109, 124, 126, 127, 132, 134, 136, 138, 139, 143

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Material Safety Data Sheets Collection:

Sheet No. 385
Ethylbenzene

Issued: 8/78 Revision: B, 9/92

Section 1. Material Identification

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Ethylbenzene ($C_6H_5C_2H_5$) Description: Derived by heating benzene and ethylene in presence of aluminum chloride with subsequent distillation, by fractionation directly from the mixed xylene stream in petroleum refining, or dehydrogenation of naphthenes. Used as a solvent, an antiknock agent in gasoline; and as an intermediate in production of synthetic rubber, styrene, cellulose acetate, diethylbenzene, acetophenone, ethyl anthraquinone, propyl oxide, and α-methylbenzol alcohol.
Other Designations: CAS No. 100-41-4, ethylbenzol, EB, phenylethane, NCI-C56393.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

R 1
I 3
S 2*
K 4
* Skin absorption

NFPA
3
2 0
-

HMIS
H 2†
F 3
R 0
PPE - Sec. 8
† Chronic effects

Cautions: Ethylbenzene is a skin and mucous membrane irritant considered the most irritating of the benzene series. Inhalation causes acute and chronic central nervous system (CNS) effects. It is highly flammable and forms explosive mixtures with air.

Section 2. Ingredients and Occupational Exposure Limits

Ethylbenzene, ca >99.0%. Impurities include ~ 0.1% *meta & para* xylene, ~ 0.1% cumene, and ~ 0.1% toluene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m^3)
15-min STEL: 125 ppm (545 mg/m^3)
Action Level: 50 ppm (217 mg/m^3)

1990 IDLH Level
2000 ppm

1990 NIOSH REL
TWA: 100 ppm (435 mg/m^3)
STEL: 125 ppm (545 mg/m^3)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m^3)
STEL: 125 ppm (545 mg/m^3)

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m^3)
Category 1: local irritants
Peak Exposure Limit: 200 ppm, 5 min momentary value, max of 8/shift
Danger of cutaneous absorption

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 100 ppm/8 hr caused eye effects, sleep, and respiratory changes.
Human, lymphocyte: 1 mmol/L induced sister chromatid exchange.
Rat, oral, LD_{50}: 3500 mg/kg; toxic effects not yet reviewed
Rat (female), inhalation, TC_{Lo}: 1000 ppm/7 hr/day, 5 days/wk, for 3 wk prior to mating and daily for 19 days of gestation produced pups with high incidence of extra ribs.[179]

* See NIOSH, *RTECS* (DA0700000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 277 °F (136 °C)
Melting Point: -139 °F (-95 °C)
Surface Tension: 31.5 dyne/cm
Ionization Potential: 8.76 eV
Viscosity: 0.64 cP at 77 °F (25 °C)
Refraction Index: 1.4959 at 68 °F (20 °C)
Relative Evaporation Rate (ether = 1): 0.0106
Bulk Density: 7.21 lb/Gal at 77 °F (25 °C)
Critical Temperature: 651 °F (343.9 °C)
Critical Pressure: 35.6 atm
Molecular Weight: 106.16
Density: 0.863 at 77 °F (25 °C)
Water Solubility: Slightly, 14 mg/100 mL at 59 °F (15 °C)
Other Solubilities: Miscible in alcohol, ether; soluble in carbon tetrachloride, benzene, sulfur dioxide, and many organic solvents; insoluble in ammonia
Odor Threshold: 2.3 ppm
Vapor Pressure: 7.1 mm Hg at 68 °F (20 °C); 10 mmHg at 78.62 °F (25.9 °C); 100 mm Hg 165.38 °F (74.1 °C)
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.0768 lb/ft^3 or 1.2298 kg/m^3

Appearance and Odor: Colorless, flammable liquid with a pungent odor.

Section 4. Fire and Explosion Data

Flash Point: 64 °F (18 °C) CC	**Autoignition Temperature:** 810 °F (432 °C)	**LEL:** 1.0% v/v	**UEL:** 6.7% v/v

Extinguishing Media: Class 1B Flammable liquid. For small fires, use dry chemical, carbon dioxide, or 'alcohol-resistant' foam. For large fires, use fog or 'alcohol-resistant' foam. Use water only if other agents are unavailable; EB floats on water and may travel to an ignition source and spread fire. **Unusual Fire or Explosion Hazards:** Burning rate = 5.8 mm/min. Vapors may travel to an ignition source and flash back. Container may explode in heat of fire. EB poses a vapor explosion hazard indoors, outdoors, and in sewers. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Cool container sides with water until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Withdraw immediately if you hear rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Ethylbenzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Reacts vigorously with oxidizers.
Conditions to Avoid: Exposure to heat and oxidizers.
Hazardous Products of Decomposition: Thermal oxidative decomposition of EB can produce acrid smoke and irritating fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list EB as a carcinogen. **Summary of Risks:** Occupational exposure to EB alone is rare since it is usually present together with other solvents. EB is irritating to the eyes, skin, and respiratory tract. Vapor inhalation produces varying degrees of CNS effects depending on concentration. The liquid is absorbed through the skin but vapors are not. 56 to 64% of inhaled ethylbenzene is retained and metabolized. Urinary metabolites following exposure to 23 to 85 ppm for 8 hr are mandelic acid (64%), phenylglyoxylic acid (25%), and methylphenylcarbinol/1-phenyl ethanol (5%). Concurrent exposure to xylene and ethylbenzene causes slower excretion of EB metabolites. Based on the rat LD_{50}, one manufacturer gives 3 to 4 oz. as the lethal dose for a 100 lb person.

Continue on next page

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Skin and CNS diseases and impaired pulmonary function (especially obstructive airway disease). **Target Organs:** Eyes, respiratory system, skin, CNS, blood. **Primary Entry Routes:** Inhalation, skin and eye contact. **Acute Effects:** Vapor inhalation of 200 ppm caused transient eye irritation; 1000 ppm caused eye irritation with profuse watering (tolerance developed rapidly); 2000 ppm caused severe and immediate eye irritation and watering, nasal irritation, chest constriction, and vertigo; 5000 ppm was intolerable and caused eye and nose irritation. Inhalation of high concentrations may cause narcosis, cramps, and death due to respiratory paralysis. Skin exposed to pure ethylbenzene for 10 to 15 min absorbed 22 to 33 mg/cm^2/hr. Immersion of hand in solutions of 112 & 156 mg/L for 1 hr absorbed 118 & 215.7 μg/cm^2/hr, respectively. **Chronic Effects:** Repeated skin contact may cause dryness, scaling, and fissuring. Workers chronically exposed to > 100 ppm complained of fatigue, sleepiness, headache, and mild irritation of the eyes and respiratory tract. Repeated vapor inhalation may result in blood disorders, particularly leukopenia (abnormally low level of white blood cells) and lymphocytosis.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting! Aspiration of even a small amount of EB in vomitus can cause severe damage since its low viscosity and surface tension will cause it to spread over a large area of the lung tissue.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: BEI = mandelic acid in urine (1.5 g/g of creatinine), sample at end of shift at workweeks end. Since this test is not specific, test for EB in expired air for confirmation.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate and ventilate area, deny entry and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container. Dike far ahead of large spill for later reclamation or disposal. Report any release >1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** If released to soil, EB partially evaporates into the atmosphere, with a half-life of hrs to wks, and some leaches into groundwater, especially in soil with low organic carbon content. Biodegradation occurs with a half-life of 2 days. Some EB may absorb to sediment or bioconcentrate in fish. Evidence points to slow biodegradation in groundwater. In air, it reacts with photochemically produced hydroxyl radicals with a half-life of hrs to 2 days. Additional amounts may be removed by rain. **Ecotoxicity Values:** Shrimp (*Mysidopsis bahia*), LC_{50} = 87.6 mg/L/96 hr; sheepshead minnow (*Cyprinodon variegatus*) LC_{50} = 275 mg/L/96 hr; fathead minnow (*Pimephales promelas*) LC_{50} = 42.3 mg/L/96 hr in hard water & 48.5 mg/L/96 hr in softwater. **Disposal:** A candidate for rotary kiln incineration at 1508 to 2912°F (820 to 1600°C), liquid injection incineration at 1202 to 2912°F (650 to 1600°C), and fluidized bed incineration at 842 to 1796°F (450 to 980°C). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.21): No. D001
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311 (b)(4) & CWA, Sec. 307 (a)]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use a powered air-purifying respirator with an appropriate organic vapor cartridge, a supplied-air respirator (SAR), SCBA, or chemical cartridge respirator with appropriate organic vapor cartridge. For < 2000 ppm, use a SAR or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of Viton or polyvinylchloride to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a cool, dry, well-ventilated area away from ignition sources and oxidizers. Outside or detached storage is preferred. If inside, store in a standard flammable liquids cabinet. Containers should have flame-arrester or pressure-vacuum venting. To prevent static sparks, electrically ground and bond all equipment used with ethylbenzene. Install Class 1, Group D electrical equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain levels as low as possible. Purge and ventilate reaction vessels before workers are allowed to enter for maintenance or cleanup. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, skin, blood, and respiratory system.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Ethylbenzene
DOT Hazard Class: 3
ID No.: UN1175
DOT Packing Group: II
DOT Label: Flammable liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60 L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: —

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 153, 159, 162, 163, 164, 167, 168, 171, 176, 179

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** W Silverman, MD

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Material Safety Data Sheets Collection:
Sheet No. 317
Toluene
Issued: 8/79 Revision: E, 9/92

Section 1. Material Identification

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Toluene ($C_6H_5CH_3$) **Description:** Derived from petroleum i.e., dehydrogenation of cycloparaffin fractions followed by the aromatization of saturated aromatic hydrocarbons or by fractional distillation of coal-tar light oil and purified by rectification. Used widely as a solvent (replacing benzene in many cases) for oils, resins, adhesives, natural rubber, coal tar, asphalt, pitch, acetyl celluloses, cellulose paints and varnishes; a diluent for photogravure inks, raw material for organic synthesis (benzoyl & benzilidene chlorides, saccharine, TNT, toluene diisocyanate, and many dyestuffs), in aviation and high octane automobile gasoline, as a nonclinical thermometer liquid and suspension solution for navigational instruments.

Other Designations: CAS No. 108-88-3, Methacide, methylbenzene, methylbenzol, phenylmethane, toluol, Tolu-sol.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Toluene is an eye, skin, and respiratory tract irritant becoming narcotic at high centrations. Liver and kidney damage has occurred. Pregnant women chronically exposed to toluene have shown teratogenic effects. Toluene is highly flammable.

R 1
I 3
S 2*
K 3
* Skin absorption

NFPA
3
2 0

HMIS
H 2- Chronic effects
F 3
R 0
PPE-Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Toluene, < 100%; may contain a small amount of benzene (~ 1%), xylene, and nonaromatic hydrocarbons.

1991 OSHA PELs
8-hr TWA: 100 ppm (375 mg/m³)
15-min STEL: 150 ppm (560 mg/m³)

1990 IDLH Level
2000 ppm

1990 NIOSH RELs
TWA: 100 ppm (375 mg/m³)
STEL: 150 ppm (560 mg/m³)

1992-93 ACGIH TLV (Skin)
TWA: 50 ppm (188 mg/m³)

1990 DFG (Germany) MAK*
TWA: 100 ppm (380 mg/m³)
Half-life: 2 hr to end of shift
Category II: Substances with systemic effects
Peak Exposure Limit: 500 ppm, 30 min average value, 2/shift

1985-86 Toxicity Data†
Man, inhalation, TC_{Lo}: 100 ppm caused hallucinations, and changes in motor activity and changes in psychophysiological tests.
Human, oral, LD_{Lo}: 50 mg/kg; toxic effects not yet reviewed
Human, eye: 300 ppm caused irritation.
Rat, oral, LD_{50}: 5000 mg/kg
Rat, liver: 30 µmol/L caused DNA damage.

* Available information suggests damage to the developing fetus is probable.
† See NIOSH, *RTECS* (XS5250000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 232 °F (110.6 °C)
Melting Point: -139 °F (-95 °C)
Molecular Weight: 92.15
Density: 0.866 at 68 °F (20/4 °C)
Surface Tension: 29 dyne/cm at 68 °F (20 °C)
Viscosity: 0.59 cP at 68 °F (20 °C)
Refraction Index: 1.4967 at 20 °C/D
Water Solubility: Very slightly soluble, 0.6 mg/L at 68 °F (20 °C)
Other Solubilities: Soluble in acetone, alcohol, ether, benzene, chloroform, glacial acetic acid, petroleum ether, and carbon disulfide.
Vapor Pressure: 22 mm Hg at 68 °F (20 °C); 36.7 mm Hg at 86 °F (30 °C)
Saturated Vapor Density (Air = 0.075 lb/ft³ or 1.2 kg/m³): 0.0797 lb/ft³ or 1.2755 kg/m³
Odor Threshold (range of all referenced values): 0.021 to 69 ppm

Appearance and Odor: Colorless liquid with a sickly sweet odor.

Section 4. Fire and Explosion Data

Flash Point: 40 °F (4.4 °C) CC	**Autoignition Temperature:** 896 °F (480 °C)	**LEL:** 1.27% v/v	**UEL:** 7.0% v/v

Extinguishing Media: Toluene is a Class 1B flammable liquid. To fight fire, use dry chemical carbon dioxide, or 'alcohol-resistant' foam. Water spray may be ineffective as toluene floats on water and may actually spread fire. **Unusual Fire or Explosion Hazards:** Concentrated vapors are heavier than air and may travel to an ignition source and flash back. Container may explode in heat of fire. Toluenes' burning rate = 5.7 mm/min and its flame speed = 37 cm/sec. Vapor poses an explosion hazard indoors, outdoors, and in sewers. May accumulate static electricity. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing provides only limited protection. Apply cooling water to sides of tanks until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from fire and let burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire because a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Toluene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization can't occur. **Chemical Incompatibilities:** Strong oxidizers, concentrated nitric acid, nitric acid + sulfuric acid, dinitrogen tetroxide, silver perchlorate, bromine trifluoride, tetranitromethane, and 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione. **Conditions to Avoid:** Contact with heat, ignition sources, or incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of toluene can produce carbon dioxide, and acrid, irritating smoke.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list toluene as a carcinogen. **Summary of Risks:** Toluene is irritating to the eyes, nose, and respiratory tract. Inhalation of high concentrations produces a narcotic effect sometimes leading to coma as well as liver and kidney damage. 93% of inhaled toluene is retained in the body of which 80% is metabolized to benzoic acid, then to hippuric acid and excreted in urine. The remainder is metabolized to *o*-cresol and excreted or exhaled unchanged. Toluene metabolism is inhibited by alcohol ingestion and is synergistic with benzene, asphalt fumes, or chlorinated hydrocarbons (i.e. perchloroethylene). Toluene is readily absorbed through the skin at 14 to 23 mg/cm²/hr. Toluene is absorbed quicker during exercise than at rest and appears to be retained longer in obese versus thin victims; presumably due to its lipid solubility. There is inconsistent data on toluene's ability to damage bone marrow; chronic poisoning has resulted in anemia and leucopenia with biopsy showing bone marrow hypo-plasia. These reports are few and some authorities argue that the effects may have been due to benzene contaminants. Chronic inhalation during pregnancy has been associated with teratogenic effects on the fetus including microcephaly, CNS dysfunction, attentional deficits, developmental delay + language impairment, growth retardation, and physical defects including a small midface, short palpebral fissures, with deep-set eyes, low-set ears, flat nasal bridge with a small nose, micrognathia, and blunt fingertips. There is some evidence that toluene causes an autoimmune illness in which the body produces antibodies that cause inflammation of its own kidney.

Continue on next page

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Alcoholism and CNS, kidney, skin, or liver disease. **Target Organs:** CNS, liver, kidney, skin. **Primary Entry Routes:** Inhalation, skin contact/absorption. **Acute Effects:** Vapor inhalation causes respiratory tract irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, watering eyes, nervousness, insomnia, parasthesis, and vertigo progressing to narcotic coma. Death may result from cardiac arrest due to ventricular fibrillation with catecholamines loss. Liquid splashed in the eye causes conjunctival irritation, transient corneal damage and possible burns. Prolonged skin contact leads to drying and fissured dermatitis. Ingestion causes GI tract irritation and symptoms associated with inhalation. **Chronic Effects:** Symptoms include mucous membrane irritation, headache, vertigo, nausea, appetite loss and alcohol intolerance. Repeated heavy exposure may result in encephalopathies (cerebellar ataxia and cognitive dysfunction), liver enlargement, and cerebral atrophy (wasting away). Symptoms usually appear at workdays end, worsen at weeks end and decrease or disappear over the weekend.

FIRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult an ophthalmologist immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting because of danger of aspiration into the lungs. Gastric lavage may be indicated if large amounts are swallowed; potential toxicity needs to be weighed against aspiration risk when deciding for or against gastric lavage. **Note to Physicians:** Monitor cardiac function. If indicated, use epinephrine and other catecholamines carefully, because of the possibility of a lowered myocardial threshold to the arrhythmogenic effects of such substances. Obtain CBC, electrolytes, and urinalysis. Monitor arterial blood gases. If toluene has > 0.02% (200 ppm) benzene, evaluate for potential benzene toxicity. BEI: hippuric acid in urine, sample at shift end (2.5 g/g creatinine); Toluene in venous blood, sample at shift end (1.0 mg/L).

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel protect against inhalation and skin/eye contact. Use water spray to cool and disperse vapors but it may not prevent ignition in closed spaces. Cellosolve, hycar absorbent materials, and fluorocarbon water can also be used for vapor suppression/containment. Take up small spill with earth, sand, vermiculite, or other absorbent, noncombustible material. Dike far ahead of large spills for later reclamation or disposal. For water spills, (10 ppm or greater) apply activated carbon at 10X the spilled amount and remove trapped material with suction hoses or use mechanical dredges/lifts to remove immobilized masses of pollutants and precipitates. Toluene can undergo fluidized bed incineration at 842 to 1796 °F (450 to 980 °C), rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C) or liquid injection incineration at 1202 to 2912 °F (650 to 1600 °C). Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Blue gill, LC_{50} = 17 mg/L/24 hr; shrimp (*Crangonfracis coron*), LC_{50} = 4.3 ppm/96 hr; fathead minnow (*Pimephales promelas*), LC_{50} = 36.2 mg/L/96 hr. **Environmental Degradation:** If released to land, toluene evaporates and undergoes microbial degradation. In water, toluene volatilizes and biodegrades with a half-life of days to several weeks. In air, toluene degrades by reaction with photochemically produced hydroxyl radicals. **Disposal:** Treat contaminated water by gravity separation of solids, followed by skimming of surface. Pass through dual media filtration and carbon absorption units (carbon ratio 1 kg to 10 kg soluble material). Return waste water from backwash to gravity separator. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U220
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg)
* per RCRA, Sec. 3001; CWA, Sec. 311 (b)(4); CWA, Sec. 307 (a)]
Listed as a SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses with shatter-resistant glass and side-shields or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 100 ppm, use any chemical cartridge respirator with appropriate organic vapor cartridges, any supplied-air respirator (SAR), or SCBA. For < 200 ppm, use any SAR operated in continuous-flow mode, any SAR or SCBA with a full facepiece, or any air-purifying respirator with a full facepiece having a chin-style, front or back mounted organic vapor canister. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl alcohol with a breakthrough time of > 8 hr. Teflon and Viton are recommended as suitable materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(23) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove toluene from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from ignition sources and incompatibles. Outside or detached storage is preferred. If stored inside, use a standard flammable liquids warehouse, room, or cabinet. To prevent static sparks, electrically ground and bond all equipment used with toluene. Do not use open lights in toluene areas. Install Class 1, Group D electrical equipment. Check that toluene is free of or contains < 1% benzene before use. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Adopt controls for confined spaces (29 CFR 1910.146) if entering areas of unknown toluene levels (holes, wells, storage tanks). Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, liver, kidney, and skin. Include hemocytometric and thrombocyte count in cases where benzene is a contaminant of toluene. Monitor air at regular intervals to ensure effective ventilation.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Toluene
DOT Hazard Class: 3
ID No.: UN1294
DOT Packing Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 150
b) Non-bulk Packaging: 202
c) Bulk Packaging: 242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
Vessel Stowage: B
Other: –

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 140, 148, 153, 159, 163, 164, 167, 169, 171, 174, 175, 176, 180.
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, CIH, MPH; **Medical Review:** AC Darlington, MD, MPH

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Material Safety Data Sheets Collection:

Sheet No. 318
Xylene *(Mixed Isomers)*

Issued: 11/80   Revision: E, 9/92

Section 1. Material Identification

Xylene (Mixed Isomers) (C_8H_{10}) Description: The commercial product is a blend of the three isomers [*ortho*-(*o*-), *meta*-(*m*-), *para*-(*p*-)] with the largest proportion being *m*- xylene. Xylene is obtained from coal tar, toluene by transalkylation, and pseudocumene. Used in the manufacture of dyes, resins, paints, varnishes, and other organics; as a general solvent for adhesives, a cleaning agent in microscope technique; as a solvent for Canada balsam microscopy; as a fuel component in aviation gasoline, protective coatings, sterilizing catgut, hydrogen peroxide, perfumes, insect repellants, pharmaceuticals, and the leather industry; in the production of phthalic anhydride, isophthalic, and terephthalic acids and their dimethyl esters which are used in the manufacture of polyester fibers; and as an indirect food additive as a component of adhesives. Around the home, xylene is found as vehicles in paints, paint removers, degreasing cleaners, lacquers, glues and cements and as solvent/vehicles for pesticides.

Other Designations: CAS No. 1330-20-7 [95-47-6; 108-38-3; 106-42-3 (*o*-, *m*-, *p*-isomers)], dimethylbenzene, methyltoluene, NCI-C55232, Violet 3, xylol.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Xylene is an eye, skin, and mucous membrane irritant and may be narcotic in high concentrations. It is a dangerous fire hazard.

R	1
I	2
S	2
K	3

NFPA
3
2 0
–

HMIS

H	2†
F	3
R	0
PPE	‡

† Chronic Effects
‡ Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Xylene (mixed isomers): the commercial product generally contains ~ 40% *m*-xylene; 20% each of *o*-xylene, *p*-xylene, and ethylbenzene; and small quantities of toluene. Unpurified xylene may contain pseudocumene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m^3)
15-min STEL: 150 ppm (655 mg/m^3)

1990 IDLH Level
1000 ppm

1990 NIOSH RELs
TWA: 100 ppm (435 mg/m^3)
STEL: 150 ppm (655 mg/m^3)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m^3)
STEL: 150 ppm (651 mg/m^3)
BEI (Biological Exposure Index): Methylhippuric acids in urine at end of shift: 1.5 g/g creatinine

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m^3)
Category II: Substances with systemic effects
Half-life: < 2 hr
Peak Exposure: 200 ppm, 30 min, average value, 4 peaks per shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 200 ppm produced olfaction effects, conjunctiva irritation, and other changes involving the lungs, thorax, or respiration.
Man, inhalation, LC_{Lo}: 10000 ppm/6 hr; toxic effects not yet reviewed.
Human, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted.
Rat, oral, LD_{50}: 4300 mg/kg; toxic effect not yet reviewed.
Rat, inhalation, LC_{50}: 5000 ppm/4 hr; toxic effects not yet reviewed.

* See NIOSH, *RTECS* (XE2100000), for additional toxicity data.

Section 3. Physical Data

Boiling Point Range: 279 to 284 °F (137 to 140 °C)*
Boiling Point: *ortho:* 291 °F (144 °C); *meta:* 281.8 °F (138.8 °C); *para:* 281.3 °F (138.5 °C)
Freezing Point/Melting Point: *ortho:* -13 °F (-25 °C); *meta:* -53.3 °F (- 47.4 °C); *para:* 55 to 57 °F (13 to 14 °C)
Vapor Pressure: 6.72 mm Hg at 70 °F (21 °C)
Saturated Vapor Density (Air = 1.2 kg/m^3): 1.23 kg/m^3, 0.077 lbs/ft^3

Appearance and Odor: Clear, sweet-smelling liquid.

* Materials with wider and narrower boiling ranges are commercially available.

Molecular Weight: 106.16
Specific Gravity: 0.864 at 20 °C/4 °C
Water Solubility: Practically insoluble
Other Solubilities: Miscible with absolute alcohol, ether, and many other organic liquids.
Octanol/Water Partition Coefficient: logKow = 3.12-3.20
Odor Threshold: 1 ppm
Viscosity: <32.6 SUS

Section 4. Fire and Explosion Data

Flash Point: 63 to 77 °F (17 to 25 °C) CC	Autoignition Temperature: 982 °F (527 °C) (*m*-)	LEL: 1.1 (*m*-, *p*-); 0.9 (*o*-)	UEL: 7.0 (*m*-, *p*-); 6.7 (*o*-)

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2), water spray or regular foam. For large fires, use water spray, fog or regular foam. Water may be ineffective. Use water spray to cool fire-exposed containers. **Unusual Fire or Explosion Hazards:** Xylene vapors or liquid (which floats on water) may travel to an ignition source and flash back. The heat of fire may cause containers to explode and/or produce irritating or poisonous decomposition products. Xylene may present a vapor explosion hazard indoors, outdoors, or in sewers. Accumulated static electricity may occur from vapor or liquid flow sufficient to cause ignition. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing will provide limited protection. If feasible and without risk, move containers from fire area. Otherwise, cool fire-exposed containers until well after fire is extinguished. Stay clear of tank ends. Use unmanned hose holder or monitor nozzles for massive cargo fires. If impossible, withdraw from area and let fire burn. Withdraw immediately in case of any tank discoloration or rising sound from venting safety device. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Xylene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Xylene is easily chlorinated, sulfonated, or nitrated. **Chemical Incompatibilities:** Incompatibilities include strong acids and oxidizers and 1,3-dichloro-5,5-dimethyl-2,4-imidazolidindione (dichlorohydrantoin). Xylene attacks some forms of plastics, rubber, and coatings. **Conditions to Avoid:** Avoid heat and ignition sources and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of xylene can produce carbon dioxide, carbon monoxide, and various hydrocarbon products.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list xylene as a carcinogen. **Summary of Risks:** Xylene is an eye, mucous membrane, and respiratory tract irritant. Irritation starts at 200 ppm; severe breathing difficulties which may be delayed in onset can occur at high concentrations. It is a central nervous system (CNS) depressant and at high concentrations can cause coma. Kidney and liver damage can occur with xylene exposure. With prolonged or repeated cutaneous exposure, xylene produces a defatting dermatitis. Chronic toxicity is not well defined, but it is less toxic than benzene. Prior to the 1950s, benzene was often found as a contaminant of xylene and the effects attributed to xylene such as blood dyscrasias are questionable. Since the late 1950s, xylenes have been virtually benzene-free and blood dyscrasias have not been associated with xylenes. Chronic exposure to high concentrations of xylene in animal studies have demonstrated milk reversible decrease in red and white cell counts as well as increases in platelet counts.

Continue on next page

Section 6. Health Hazard Data, *continued*

irregularity was reported in association with workplace exposure to xylene perhaps due to effects on liver metabolism. Xylene crosses the human placenta, but does not appear to be teratogenic under conditions tested to date. **Medical Conditions Aggravated by Long-Term Exposure:** CNS, respiratory, eye, skin, gastrointestinal (GI), liver and kidney disorders. **Target Organs:** CNS, eyes, GI tract, liver, kidneys, and skin. **Primary Entry Routes:** Inhalation, skin absorption (slight), eye contact, ingestion. **Acute Effects:** Inhalation of high xylene concentrations may cause dizziness; nausea, vomiting, and abdominal pain; eye, nose, and throat irritation; respiratory tract irritation leading to pulmonary edema (fluid in lungs); drowsiness; and unconsciousness. Direct eye contact can result in conjunctivitis and corneal burns. Ingestion may cause a burning sensation in the oropharynx and stomach and transient CNS depression. **Chronic Effects:** Repeated or prolonged skin contact may cause drying and defatting of the skin leading to dermatitis. Repeated eye exposure to high vapor concentrations may cause reversible eye damage, peripheral and central neuropathy, and liver damage. Other symptoms of chronic exposure include headache, fatigue, irritability, chronic bronchitis, and GI disturbances such as nausea, loss of appetite, and gas.

FIRST AID *Emergency personnel should protect against exposure.* **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. Carefully dispose of contaminated clothing as it may pose a fire hazard. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. Monitor exposed person for respiratory distress. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, *do not induce vomiting!* If spontaneous vomiting should occur, keep exposed person's head below the hips to prevent aspiration (breathing liquid xylene into the lungs). *Aspiration of a few millimeters of xylene can cause chemical pneumonitis, pulmonary edema, and hemorrhage.* **Note to Physicians:** Hippuric acid or the ether glucuronide of *ortho*-toluic acid may be useful in diagnosis of *meta-*, *para-* and *ortho*-xylene exposure, respectively. Consider gastric lavage if a large quantity of xylene was ingested. Proceed gastric lavage with protection of the airway from aspiration; consider endotracheal intubation with inflated cuff.

Section 7. Spill, Leak, and Disposal Procedures

Spill Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and ventilate spill area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If feasible and without undue risk, stop leak. Use appropriate foam to blanket release and suppress vapors. Water spray may reduce vapor, but does not prevent ignition in closed spaces. For small spills, absorb on paper and evaporate in appropriate exhaust hood or absorb with sand or some non-combustible absorbent and place in containers for later disposal. For large spills dike far ahead of liquid to contain. Do not allow xylene to enter a confined space such as sewers or drains. On land, dike to contain or divert to impermeable holding area. Apply water spray to control flammable vapor and remove material with pumps or vacuum equipment. On water, contain material with natural barriers, booms, or weirs; apply universal gelling agent; and use suction hoses to remove spilled material. Report any release in excess of 1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** Little bioconcentration is expected. Biological oxygen demand 5 (after 5 days at 20 °C): 0.64 (no stated isomer). **Ecotoxicity values:** LD_{50}, Goldfish, 13 mg/L/24 hr, conditions of bioassay not specified, no specific isomer. **Environmental Degradation:** In the atmosphere, xylenes degrade by reacting with photochemically produced hydroxyl radicals with a half-life ranging from 1-1.7 hr. in the summer to 10-18 hr in winter or a typical loss of 67-86% per day. Xylenes are resistant to hydrolysis. **Soil Absorption/Mobility:** Xylenes have low to moderate adsorption to soil and when spilled on land, will volatilize and leach into groundwater. **Disposal:** As a hydrocarbon, xylene is a good candidate for controlled incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

Listed as a SARA Toxic Chemical (40 CFR 372.65)

Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U239, F003 (spent solvent)

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per Clean Water Act, Sec. 311(b)(4); per RCRA, Sec. 3001]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For concentrations >1000 ppm, use any chemical cartridge respirator with organic vapor cartridges; any powered, air-purifying respirator with organic vapor cartridges; any supplied-air respirator; or any self-contained breathing apparatus. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. With breakthrough times > 8 hr, consider polyvinyl alcohol and fluorocarbon rubber (Viton) as materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in clearly labelled, tightly closed, containers in a cool, well-ventilated place, away from strong oxidizing materials and heat and ignition sources. During transferring operations, electrically ground and bond metal containers. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Use hermetically sealed equipment, transfer xylene in enclosed systems, avoid processes associated with open evaporating surfaces, and provide sources of gas release with enclosures and local exhaust ventilation. Use Class I, Group D electrical equipment. **Administrative Controls:** Establish air and biological monitoring programs and evaluate regularly. Consider preplacement and periodic medical examinations including a complete blood count, a routine urinalysis, and liver function tests. Consider hematologic studies if there is any significant contamination of the solvent with benzene. If feasible, consider the replacement of xylene by less toxic solvents such as petrol (motor fuel) or white spirit. Before carrying out maintenance and repair work, steam and flush all equipment to remove any xylene residues.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Xylenes
DOT Hazard Class: 3
ID No.: UN1307
DOT Packing Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 173.150
b) Nonbulk Packaging : 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: –

***MSDS Collection* References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 171, 174, 176, 180.

Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** W Silverman, MD

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Material Safety Data Sheets Collection:

Sheet No. 713
Lead (Inorganic)

Issued: 8/90

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Section 1. Material Identification

Lead (Inorganic) (Pb) Description: Exists widely throughout the world in a number of ores. Its main commercial source is galena (lead sulphide). Lead mineral is separated from crude ores by blast-furnace smelting, drossing, or electrolytic refining. Lead is used mostly in manufacturing storage batteries. Other uses are in manufacturing tetraethyllead and both organic and inorganic lead compounds in ceramics, plastics, and electronic devices; in producing ammunition, solder, cable covering, sheet lead, and other metal products (brass, pipes, caulking); in metallurgy; in weights and as ballast; as a chemical intermediate for lead alkyls and pigments; as a constuction material for the tank linings, piping, and equipment used to handle the corrosive gases and liquids used in sulfuric acid manufacturing, petroleum refining, halogenation, sulfonation, extraction, and condensation; and for x-ray and atomic radiation protection.

Other Designations: CAS No. 7439-92-1, lead oxide; lead salts, inorganic; metallic lead; plumbum.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

Cautions: *Inorganic lead is a potent systemic poison.* Organic lead (for example, tetraethyl lead) has severe, but different, health effects. Occupational lead poisoning is due to inhalation of dust and fumes. Major affected organ systems are the nervous, blood, and reproductive systems, and kidneys. Health impairment or disease may result from a severe acute short- or long-term exposure.

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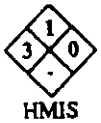
Genium



HMIS
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Section 2. Ingredients and Occupational Exposure Limits

Lead (inorganic) fumes and dusts, as Pb, ca 100%

1989 OSHA PELs (Lead, inorganic compounds)
8-hr TWA: 50 μg/m³
Action Level TWA*: 30 μg/m³

29 CFR 1910.1025 Lead Standard
Blood Lead Level: 40 μg/100 g

1989-90 ACGIH TLV (Lead, inorganic, fumes and dusts)
TLV-TWA: 150 μg/m³

1988 NIOSH REL
10-hr TWA: <100 μg/m³

1985-86 Toxicity Data†
Human, inhalation, TC_{Lo}: 10 μg/m³ affects gastrointestinal tract and liver
Human, oral, TD_{Lo}: 450 mg/kg ingested over 6 yr affects peripheral and central nervous systems
Rat, oral, TD_{Lo}: 790 mg/kg affects multigeneration reproduction

* Action level applies to employee exposure without regard to respirator use.
† See NIOSH, *RTECS* (OF7525000), for additional mutative, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 3164 °F (1740 °C)
Melting Point: 621.3 °F (327.4 °C)
Vapor Pressure: 1.77 mm Hg at 1832 °F (1000 °C)
Viscosity: 3.2 cp at 621.3 °F (327.4 °C)
Molecular Weight: 207.20
Specific Gravity (20 °C/4 °C): 11.34
Water Solubility: Relatively insoluble in hot or cold water*

Appearance and Odor: Bluish-white, silvery, gray, very soft metal.

* Lead dissolves more easily at a low pH.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or foam to extinguish fire.
Unusual Fire or Explosion Hazards: Flammable and moderately explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Lead is stable at room temperature in closed containers under normal storage and handling conditions. It tarnishes on exposure to air. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Mixtures of hydrogen peroxide + trioxane explode on contact with lead. Lead is incompatible with sodium azide, zirconium, disodium acetylide, and oxidants. A violent reaction on ignition may occur with concentrated hydrogen peroxide, chlorine trifluoride, sodium acetylide (with powdered lead), ammonium nitrate (below 200 °C with powdered lead). Lead is attacked by pure water and weak organic acids in the presence of oxygen. Lead is resistant to tap water, hydrofluoric acid, brine, and solvents.
Conditions to Avoid: Rubber gloves containing lead may ignite in nitric acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of lead can produce highly toxic fumes of lead.

Section 6. Health Hazard Data

Carcinogenicity: Although the NTP and OSHA do not list lead as a carcinogen, the IARC lists it as probably carcinogenic to humans, but having (usually) no human evidence. However, the literature reports instances of lead-induced neoplasms, both benign and malignant, of the kidney and other organs in laboratory rodents. Excessive exposure to lead has resulted in neurologic disorders in infants. Experimental studies show lead has reproductive and teratogenic effects in laboratory animals. Human male and female reproductive effects are also documented.
Summary of Risks: Lead is a potent, systemic poison that affect a variety of organ systems, including the nervous system, kidneys, reproductive system, blood formation, and gastrointestinal (GI) system . The most important way lead enters the body is through inhalation, but it can also be ingested when lead dust or unwashed hands contaminate food, drink, or cigarettes. Much of ingested lead passes through feces without absorption into the body. Adults may absorb only 5 to 15% of ingested lead; children may absorb a much larger fraction. Once in the body, lead enters the bloodstream and circulates to various organs. Lead concentrates and remains in bone for many years. The amount of lead the body stores increases as exposure continues, with possibly cumulative effects. Depending on the dose entering the body, lead can be deadly within several days or affect health after many years. Very high doses can cause brain damage (encephalopathy).
Medical Conditions Aggravated by Exposure: Lead may aggravate nervous system disorders (e.g., epilepsy, neuropathies), kidney diseases, high blood pressure (hypertension), infertility, and anemia. Lead-induced anemia and its effect on blood presssure can aggravate cardiovascular disease.

Continue on next page

Section 6. Health Hazard Data, *continued*

Target Organs: Blood, central and peripheral nervous systems, kidneys, and gastrointestinal (GI) tract.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: An acute, short-term dose of lead could cause acute encephalopathy with seizures, coma, and death. However, short-term exposures of this magnitude are rare. Reversible kidney damage can occur from acute exposure, as well as anemia.
Chronic Effects: Symptoms of chronic long-term overexposure include appetite loss, nausea, metallic taste in the mouth, lead line on gingival (gum) tissue, constipation, anxiety, anemia, pallor of the face and the eye grounds, excessive tiredness, weakness, insomnia, headache, nervous irritability, fine tremors, numbness, muscle and joint pain, and colic accompanied by severe abdominal pain. Paralysis of wrist and, less often, ankle extensor muscles may occur after years of increased lead absorption. Kidney disease may also result from chronic overexposure, but few, if any, symptoms appear until severe kidney damage has occurred. Reproductive damage is characterized by decreased sex drive, impotence, and sterility in men; and decreased fertility, abnormal menstrual cycles, and miscarriages in women. Unborn children may suffer neurologic damage or developmental problems due to excessive lead exposure in pregnant women. Lead poisoning's severest result is encephalopathy manifested by severe headache, convulsions, coma, delirium, and possibly death.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Consult a physician if any health complaints develop.
Inhalation: Remove exposed person to fresh air and support breathing as needed. Consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If large amounts of lead were ingested, induce vomiting with Ipecac syrup. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: For diagnosis, obtain blood pressure, blood lead level (PbB), zinc protoporphyrin (ZPP), complete blood count for microcytic anemia and basophilic stippling, urinalysis, and blood urea nitrogen (BUN) of creatinine. Examine peripheral motor neuropathy, pallor, and gingival lead line. Use Ca-EDTA to treat poison, but *never* chelate prophylactically. Consult an occupational physician or toxicologist.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel immediately. Cleanup personnel should protect against inhalation of dusts or fume and contact with skin or eyes. Avoid creating dusty conditions. Water sprays may be used in large quantities to prevent the formation of dust. Cleanup methods such as vacuuming (with an appropriate filter) or wet mopping minimizes dust dispersion. Scoop the spilled material into closed containers for disposal or reclamation. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33, Appendix II—EP Toxicity Test Procedures)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Protective clothing made of man-made fibers and lacking turn-ups, pleats, or pockets retain less dust from lead.
Ventilation: Provide general and local ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially washing hands before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all incompatible materials, direct sunlight, and heat and ignition sources.
Engineering Controls: Educate worker about lead's hazards. Follow and inform employees of the lead standard (29 CFR 1910.1025). Avoid inhalation of lead dust and fumes and ingestion of lead. Use only with appropriate personal protective gear and adequate ventilation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Avoid creating dusty conditions. Segregate and launder contaminated clothing. Take precautions to protect laundry personnel. Practice good personal hygiene and housekeeping procedures. For a variety of reasons, the lead concentration in workroom air may not correlate with the blood lead levels in individuals.
Other Precautions: Provide preplacement and periodic medical examinations which emphasize blood, nervous system, gastrointestinal tract, and kidneys, including a complete blood count and urinalysis. Receive a complete history including previous surgeries and hospitalization, allergies, smoking history, alcohol consumption, proprietary drug intake, and occupational and nonoccupational lead exposure. Maintain records for medical surveillance, airborne exposure monitoring, employee complaints, and physician's written opinions for at least 40 years or duration of employment plus 20 years. Measurement of blood lead level (PbB) and zinc protoporphyrin (ZPP) are useful indicators of your body's lead absorption level. Maintain worker PbBs at or below 40 µg/100 g of whole blood. To minimize adverse reproductive health effects to parents and developing fetus, maintain the PbBs of workers intending to have children below 30 µg/100 g. Elevated PbBs increase your risk of disease, and the longer you have elevated PbBs, the greater your chance of substantial permanent damage.

Transportation Data (49 CFR 172.102)

IMO Shipping Name: Lead compounds, soluble, n.o.s.
IMO Hazard Class: 6.1
ID No.: UN2291
IMO Label: St. Andrews Cross (X, Stow away from foodstuffs)
IMDG Packaging Group: III

MSDS Collection **References:** 26, 38, 73, 84, 85, 88, 89, 90, 100, 101, 103, 109, 124, 126, 132, 133, 134, 136, 138, 139, 142, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

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Schenectady, NY 12303-1836 USA
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Material Safety Data Sheets Collection:

Sheet No. 467
Automotive Gasoline, Lead-free

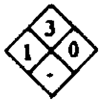
Issued: 10/81 Revision: A, 9/91

Section 1. Material Identification

Automotive Gasoline, Lead-free, Description: A mixture of volatile hydrocarbons composed mainly of branched-chain paraffins, cycloparaffins, olefins, naphthenes, and aromatics. In general, gasoline is produced from petroleum, shale oil, Athabasca tar sands, and coal. Motor gasolines are made chiefly by cracking processes, which convert heavier petroleum fractions into more volatile fractions by thermal or catalytic decomposition. Widely used as fuel in internal combustion engines of the spark-ignited, reciprocating type. Automotive gasoline has an octane number of approximately 90. A high content of aromatic hydrocarbons and a consequent high toxicity are also associated with a high octane rating. Some gasolines sold in the US contain a minor proportion of tetraethyllead, which is added in concentrations not exceeding 3 ml per gallon to prevent engine "knock." However, methyl-tert-butyl ether (MTBE) has almost completely replaced tetraethyllead.

R 1
I 2
S 2*
K 4
* Skin absorption

NFPA



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† Sec. 8

Other Designations: CAS No. 8006-61-9, benzin, gasoline, gasolene, motor spirits, natural gasoline, petrol.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*⁽⁷³⁾ for a suppliers list.

Cautions: Inhalation of automotive gasoline vapors can cause intense burning in throat and lungs, central nervous system (CNS) depression, and possible fatal pulmonary edema. Gasoline is a dangerous fire and explosion hazard when exposed to heat and flames.

Section 2. Ingredients and Occupational Exposure Limits

Automotive gasoline, lead-free*

1990 OSHA PELs
8-hr TWA: 300 ppm, 900 mg/m³
15-min STEL: 500 ppm, 1500 mg/m³

1990-91 ACGIH TLVs
TWA: 300 ppm, 890 mg/m³
STEL: 500 ppm, 1480 mg/m³

1990 NIOSH REL
None established

1985-86 Toxicity Data†
Man, inhalation, TC_{Lo}: 900 ppm/1 hr; toxic effects include sense organs and special senses (conjunctiva irritation), behavioral (hallucinations, distorted perceptions), lungs, thorax, or respiration (cough)
Human, eye: 140 ppm/8 hr; toxic effects include mild irritation
Rat, inhalation, LC_{50}: 300 g/m³/5 min

* A typical modern gasoline composition is 80% paraffins, 14% aromatics, and 6% olefins. The mean benzene content is approximately 1%. Other additives include sulfur, phosphorus, and MTBE.
† See NIOSH, *RTECS* (LX3300000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: Initially, 102 °F (39 °C); after 10% distilled, 140 °F (60 °C); after 50% distilled, 230 °F (110 °C); after 90% distilled, 338 °F (170 °C); final boiling point, 399 °F (204 °C)
Vapor Density (air = 1): 3.0 to 4.0

Density/Specific Gravity: 0.72 to 0.76 at 60 °F (15.6 °C)
Water Solubility: Insoluble

Appearance and Odor: A clear (gasoline may be colored with dye), mobile liquid with a characteristic odor recognizable at about 10 ppm in air.

Section 4. Fire and Explosion Data

Flash Point: -45 °F (-43 °C)	**Autoignition Temperature:** 536 to 853 °F (280 to 456 °C)	**LEL:** 1.3% v/v	**UEL:** 6.0% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, or alcohol foam as extinguishing media. Use of water may be ineffective to extinguish fire, but use water spray to knock down vapors and to cool fire-exposed drums and tanks to prevent pressure rupture. Do not use a solid stream of water since it may spread the fuel.
Unusual Fire or Explosion Hazards: Automobile gasoline is an OSHA Class IB flammable liquid and a dangerous fire and explosion hazard when exposed to heat and flames. Vapors can flow to an ignition source and flash back. Automobile gasoline can also react violently with oxidizing agents.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode, and full protective clothing. When the fire is extinguished, use nonsparking tools for cleanup. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Automotive gasoline is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Automotive gasoline can react with oxidizing materials such as peroxides, nitric acid, and perchlorates.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of automotive gasoline can produce oxides of carbon and partially oxidized hydrocarbons.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC list gasoline as a possible human carcinogen (Group 2B). Although the IARC has assigned an overall evaluation to gasoline, it has not assigned an overall evaluation to specific substances within this group (inadequate human evidence).
Summary of Risks: Gasoline vapors are considered moderately poisonous. Vapor inhalation can cause central nervous system (CNS) depression and mucous membrane and respiratory tract irritation. Brief inhalations of high concentrations can cause a fatal pulmonary edema. Reported responses to gasoline vapor concentrations are: 160 to 270 ppm causes eye and throat irritation in several hours; 500 to 900 ppm causes eye, nose, and throat irritation, and dizziness in 1 hr; and 2000 ppm produces mild anesthesia in 30 min. Higher concentrations are intoxicating in 4 to 10 minutes. If large areas of skin are exposed to gasoline, toxic amounts may be absorbed. Repeated or prolonged skin exposure causes dermatitis. Certain individuals may develop hypersensitivity. Ingestion can cause CNS depression. Pulmonary aspiration after ingestion can cause severe pneumonitis. In adults, ingestion of 20 to 50 g gasoline may produce severe symptoms of poisoning.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Skin, eye, respiratory and central nervous systems.
Primary Entry Routes: Inhalation, ingestion, skin contact.
Acute Effects: Acute inhalation produces intense nose, throat, and lung irritation; headaches; blurred vision; conjunctivitis; flushing of the face; mental confusion; staggering gait; slurred speech; and unconsciousness, sometimes with convulsions. Ingestion causes inebriation (drunkenness), vomiting, dizziness, fever, drowsiness, confusion, and cyanosis (a blue to dark purplish coloration of skin and mucous membrane caused by lack of oxygen). Aspiration causes choking, cough, shortness of breath, increased rate of respiration, excessively rapid heartbeat, fever, bronchitis, and pneumonitis. Other symptoms following acute exposure include acute hemorrhage of the pancreas, fatty degeneration of the liver and kidneys, and passive congestion of spleen.
Chronic Effects: Chronic inhalation results in appetite loss, nausea, weight loss, insomnia, and unusual sensitivity (hyperesthesia) of the distal extremities followed by motor weakness, muscular degeneration, and diminished tendon reflexes and coordination. Repeated skin exposure can cause blistering, drying, and lesions.

FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. Give conscious victim a mixture of 2 tablespoons of activated charcoal mixed in 8 oz of water to drink. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Use nonsparking tools. Take up small spills with sand or other noncombustible adsorbent. Dike storage areas to control leaks and spills. Follow applicable OSHA regulations (29 CFR 1910.120).
Aquatic Toxicity: Bluegill, freshwater, LC_{50} 8 ppm/96 hr.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
RCRA Hazardous Waste (40 CFR 261.21): Characteristic of ignitability
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. There are no specific NIOSH recommendations. However, for vapor concentrations not immediately dangerous to life or health, use chemical cartridge respirator equipped with organic vapor cartridge(s), or a supplied-air respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Materials such as neoprene or polyvinyl alcohol provide excellent/good resistance for protective clothing. Note: Resistance of specific materials can vary from product to product.
Ventilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed containers in a cool, dry, well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. Avoid direct sunlight. Storage must meet requirements of OSHA Class IB liquid. Outside or detached storage preferred.
Engineering Controls: Avoid vapor inhalation and skin or eye contact. Consider a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Indoor use of this material requires explosion-proof exhaust ventilation to remove vapors. Only use gasoline as a fuel source due to its volatility and flammable/explosive nature. Practice good personal hygiene and housekeeping procedures. Wear clean work clothing daily.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Gasoline (*including casing-head and natural*)
DOT Hazard Class: Flammable liquid
ID No.: UN1203
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Gasoline
IMO Hazard Class: 3.1
ID No.: UN1203
IMO Label: Flammable liquid
IMDG Packaging Group: II

MSDS Collection **References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 140, 143, 146, 153, 159
Prepared by: M Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

APPENDIX B

Respirator Protection Program for ORU West Nyack Investigation

APPENDIX B

RESPIRATOR PROGRAM FOR ORU WEST NYACK

The following respirator program is in accordance with OSHA 29 CFR 1910.134 Respiratory Protection Program requirements. This program governs the selection and use of respirators on-site. Respirators for Rust employees will be provided by Rust. The respirator protection program will be administered by, and is the responsibility of, the REHSM and/or SSO for the site. Subcontractors (*e.g.*, drillers) will furnish their own respirators and medical surveillance for their employees. The REHSM and/or SSO will be responsible for ensuring that they are in compliance with this respirator program.

The respirators will be selected according to the hazard and level of protection determined by monitoring action levels and the decision of the REHSM and/or the SSO. The respirators and levels are:

Level	Respirator
B	Positive Pressure-Pressure Demand SCBA or Supplied Air Respirator with 5-minute escape bottle. Level B is >50 ppm or >2.5 mg/m3 particulates in BZ above background in (BZ).
C	Full-face air purifying respirator with combination dust (HEPA) and organic vapor/acid gas cartridge. Level C is 5 ppm to 50 ppm above background VOC's or 1.0 to 2.5 mg/m3 particulates in BZ based on identification of contaminant present. The full facepiece respirator with combination dust and organic vapor/acid gas cartridge will be appropriate for the dust conditions and organics that may be encountered.
D	No respirator required. Continuous reading of background to 5 ppm VOC's or <1.0 mg/m3 particulates in the worker's BZ based on identification of contaminant present.

The respirator users will be fit tested with the size, style, and make of the respirator they will be using on-site. The fit test will be recorded and these Fit Test Records will be maintained in the Command Post.

Employee respirator training is provided on an annual basis and at site-specific training sessions. This training includes:

- A discussion of the nature of the respiratory hazards and the dangers if the respirator is not used properly.
- The reasons that respirators are required for protection, along with any engineering controls that may be used.

- Instruction in the selection, use, sanitary care, maintenance, proper storage, and limitation of the full facepiece respirator with combination cartridge, and the SCBA.
- Practice in proper fitting, wearing, adjusting, and checking face seal of the respirator.
- An opportunity to handle the respirator.
- Instruction on how to recognize and cope with emergency situations requiring respiratory protection.
- Explanation of the requirements for a self-contained breathing device for work in unknown concentrations and Immediately Dangerous to Life or Health (IDLH) atmosphere and for fire fighting.
- Explanation of the medical surveillance program and how it relates to respirator use.
- Explanation of the requirements for maintaining a tight seal, why beard and facial hair is prohibited, and why use of contact lenses while wearing respirators is prohibited.

Respirators will be assigned to individual workers. Each individual shall be responsible for cleaning and maintaining their assigned respirator. They will be cleaned and disinfected before being reassigned. Respirators will be cleaned after each day of work according to manufacturer's instruction. The cleaning will be done at the Command Post. Used cartridges will be disposed of and replaced with new ones.

After cleaning, the respirators will be inspected and checked for defects such as excessive dirt, cracks or other distortions, scratches, incorrectly mounted lens, broken or worn cartridge holders on the facepiece, breaks, loss of elasticity, broken buckles, and excessively worn serrations on head harness that may cause slippage on the head straps or head harness.

Further checks include:

a) A check of the tightness of the connections.
b) A check of the facepiece, valves, connecting tube, and canisters.
c) A check of the regulator and warning devices on SCBA for proper functioning.
d) For air purifying:

    (1) Check the exhalation valve after removing its cover for:
    - o Foreign material, such as detergent residue, dust particles, or human hair under the valve seat
    - o Cracks, tears, or distortion in the valve material
    - o Improper insertion of the valve body in the facepiece
    - o Cracks, breaks, or chips in the valve body, particularly in the sealing surface
    - o Missing or defective valve cover
    - o Improper installation of the valve in the valve body.

    (2) Check the air purifying elements for:
    - o Incorrect cartridges, canister, or filter for the hazard

- Incorrect installation, loose connections, missing or worn gaskets, or cross threading in holder
- Expired shelf life of cartridge or canister
- Cracks, dents, or breaks in the cartridge or canisters case
- Evidence of prior use of cartridge or canister, such as broken seal tape foil or other sealing material.

(3) Check the corrugated breathing tube for:
  - Broken or missing end connectors, gaskets, or O-rings
  - Missing or loose hose clamp
  - Deterioration (done by stretching hose and looking for cracks).

e) For air supplied respirators, check the air supply system for:
  (1) Integrity and condition of air supply lines and hoses, including attachments and end fitting
  (2) Correct operation and condition of all regulators, valves, or other air-flow regulators
  (3) If SCBA, that the cylinder is sufficiently charged for the intended use, preferably fully charged (mandatory on an emergency device). The emergency SCBA will have a tag for logging in the monthly inspections.

Monitoring of the work area will be performed and the results will be used to select the appropriate level of protection. Refer to air monitoring section of the HASP (Section 9.0).

This program will be re-evaluated and revisions and updates added regularly.

Persons will not be assigned to tasks requiring the use of respirators unless it has been determined that they are physically able to perform the work and use the equipment. The Rust Medical Director will determine what health and physical conditions are pertinent.

Only those respirators jointly approved by NIOSH/MSHA shall be used. All component parts (*e.g.*, canister, replacement straps, *etc.*), will be of the same make.

APPENDIX C

Health & Safety Field Forms

- Supervisor's Incident Report (SIR)
- Job Exposure Report
- HASP Modification Form
- Site Safety Meeting Form (or Document in Field Log Book)
- Instrument Calibration Form (or Document in Field Log Book)
- Atmospheric Monitoring Form (or Document in Field Log Book)
- First Aid Log

RUST ENVIRONMENT & INFRASTRUCTURE

Supervisor's Incident Report

Date of this report: ____ / ____ / ____

Fax this report within 24 hours to Rust International Inc.: 708-916-0592 *Telephone: 708-684-7832*
Attention: Claims Management Department

Group: **R66** (Rust E&I) **Region:** ____ **Office/Division:** ____

TYPE OF INCIDENT: Inspection: ____ Accident: ____ Injury: ____ Spill: ____ Fire: ____ Other: ____
Agency: ____ Inspector's Name: ____ Type Inspection: ____
Agency Address: ____ Phone: ____

EMPLOYEE INFORMATION:
Employee's Name: ____ Social Security No.: ____
Address: ____ Phone: ____
Date of Birth: ____ Number of Minor Dependents: ____ Marital Status: Single ____ Widowed ____ Married ____ Divorced ____
Date of Hire: ____ Wage Rate: $____ Hourly: ____ Annually: ____ Job No.: ____
Employee Hours on Date of Incident: ____ Employee Hrs. on Project: ____ Days/Wk.: ____ Hrs./Day: ____
Employee's Occupation When Incident Occurred?: ____ Years of Experience in This Occupation?: ____

INCIDENT INFORMATION:
Date of Incident: ____ Time: ____ Witness(s): ____
Date Reported to Supervisor: ____ Was Incident Believed to be Result of Employment?: Yes ____ No ____
If on Job Site, Name of Job: ____ Location on Job Site Where Incident Occurred: ____
Address Where Incident Occurred: ____
If First Aid Applied, by Whom: ____
Type of Injury and Part of Body Affected: ____
Name/Address Medical Provider: ____
Brief Description of Incident: ____

Employee Activity at Time of Incident: ____

Description of Property Damaged: ____

OSHA 200 LOG INFORMATION:

Is incident OSHA recordable?: **Yes** ☐ **No** ☐
Does incident involve fatality?: **Yes** ☐ **No** ☐
Does incident involved lost time/restricted activity?: **Yes** ☐ **No** ☐
Does incident involve medical treatment?: **Yes** ☐ **No** ☐
Does incident involve first aid only?: **Yes** ☐ **No** ☐
Current Status: ____

Employee's Supervisor: ____ Project Manager: ____

See reverse side for instructions.

RUST ENVIRONMENT & INFRASTRUCTURE

Job Exposure Report

Instructions: This report is to be completed by the Site Safety Officer at the end of each Rust E&I Employee's participation in site activities. A copy of this report must be submitted to the REHSM for placement in the employee's medical file.

Employee Name: ______________________________

Social Security Number: ______________________________

Project Name: ______________________________

Project Number: ______________________________

Location: ______________________________

Site Function: ______________________________

Level of Protection: ______________________________

Dates of Site Participation: ______________________________

1. Were action levels exceeded in the work area (breathing zone)? Yes _______ No _______

2. If yes, list type of monitoring and readings: ______________________________

____

____

3. List known or suspected contaminants on-site (list from HASP):

______________	______________
______________	______________
______________	______________
______________	______________

4. Personal exposure monitoring data attached? Yes _____ No_____ N/A _____

SSO Name (Print): ______________________________

SSO Signature: ______________________________

Date: ______________________________

RUST ENVIRONMENT & INFRASTRUCTURE

Health and Safety Plan Field Modification Form

Page No. _____ of _____

Project: ____________________

Project Location: ____________________

Project No.: ____________________

Site Safety Officer: ____________________

Field Modification to HASP: ____________________

Prepared By: ____________________
Site Safety Officer Date

Accepted By: ____________________
Rust Environment & Infrastructure Field Manager Date

Accepted By: ____________________
Contractor Representative (If Applicable) Date

Approved By: ____________________
Rust Environment & Infrastructure Region Environmental Health and Safety Manager or Alternate HASP Reviewer Date

NOTE: Field Modifications to HASPs must be discussed with the Rust Environment & Infrastructure REHSM or CEHSD with subsequent written approval. Secure approval through fax.

RUST ENVIRONMENT & INFRASTRUCTURE

Site Safety Meeting

Page _____ of _____

Project: ______________________________ Date: ______________________________

Project Number: ______________________________ Time: ______________________________

Meeting Conducted By: ______________________________ ______________________________

Name Signature

Summary Of Items Discussed: ______________________________

Personnel Present

	Name	Representing	Signature
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			

NOTE: Place in project files.

Rev. 11/94

F027/Corp.H&S

RUST ENVIRONMENT & INFRASTRUCTURE

Health and Safety
Instrument Calibration Log

INSTRUMENT: ____________________

Date Calibrated	Known Standard	Actual Instrument Reading	Adjustments Made	Calibrated By	Comments

COMMENTS: ____________________

____

____

____

____

NOTE: Place in project files and/or Instrument Maintenance file.

RUST ENVIRONMENT & INFRASTRUCTURE

Atmospheric Monitoring Log
Field Health and Safety

Page _____ of _____
Date _____/_____/_____
Circle: Sun Mon Tue Wed Thu Fri Sat

Site: ______________________________ Project No.: ______________

Site Safety Officer: ______________________________

Action Levels: D ☐ ——▷ C ☐ ——▷ B ☐ ——▷ (Stop work, call in for instructions)

(Check box and write in levels for upgrade)

Task/Equipment: ______________________________

Weather: ______________________________

Time	OVA PPM	HNu PPM	O_2 %	LEL %	H_2S PPM	Comments: Duration of Readings, Upgrades, Location, etc.

Additional Comments: ______________________________

____

____

Signature: ______________________________

NOTE: Place in project files.

Rev. 11/94

F024/Corp.H&S

Site/Division Location: ______________________

Date	Employee Name	Injury	Treatment	Care Provider

NOTE: This log is to be maintained by the Division Office Administrator and/or Site Manager.

RUST ENVIRONMENT & INFRASTRUCTURE

Speed Memo/Notice of Condition

TO: ____________________ Contractor   CC: ____________________ Owner

FROM: RUST Environment & Infrastructure Inc.

RE: ____________________ Site

The following condition has been observed on the above referenced site:

You are advised that it is RUST E&I policy not to permit its employees to expose themselves to unsafe working conditions. Therefore, RUST E&I employees will not perform services which require them to be exposed to the above-described condition until it no longer presents danger to their personal safety.

ISSUANCE OF THIS NOTICE IS FOR YOUR INFORMATION ONLY. RUST E&I HAS NO DUTY TO, AND DOES NOT, BY ISSUANCE OF THIS NOTICE, UNDERTAKE TO PERFORM SAFETY INSPECTIONS OR PROVIDE SAFETY INFORMATION OR ADVICE TO PERSONS OTHER THAN ITS OWN EMPLOYEES.

Date: ____________________   Signature: ____________________

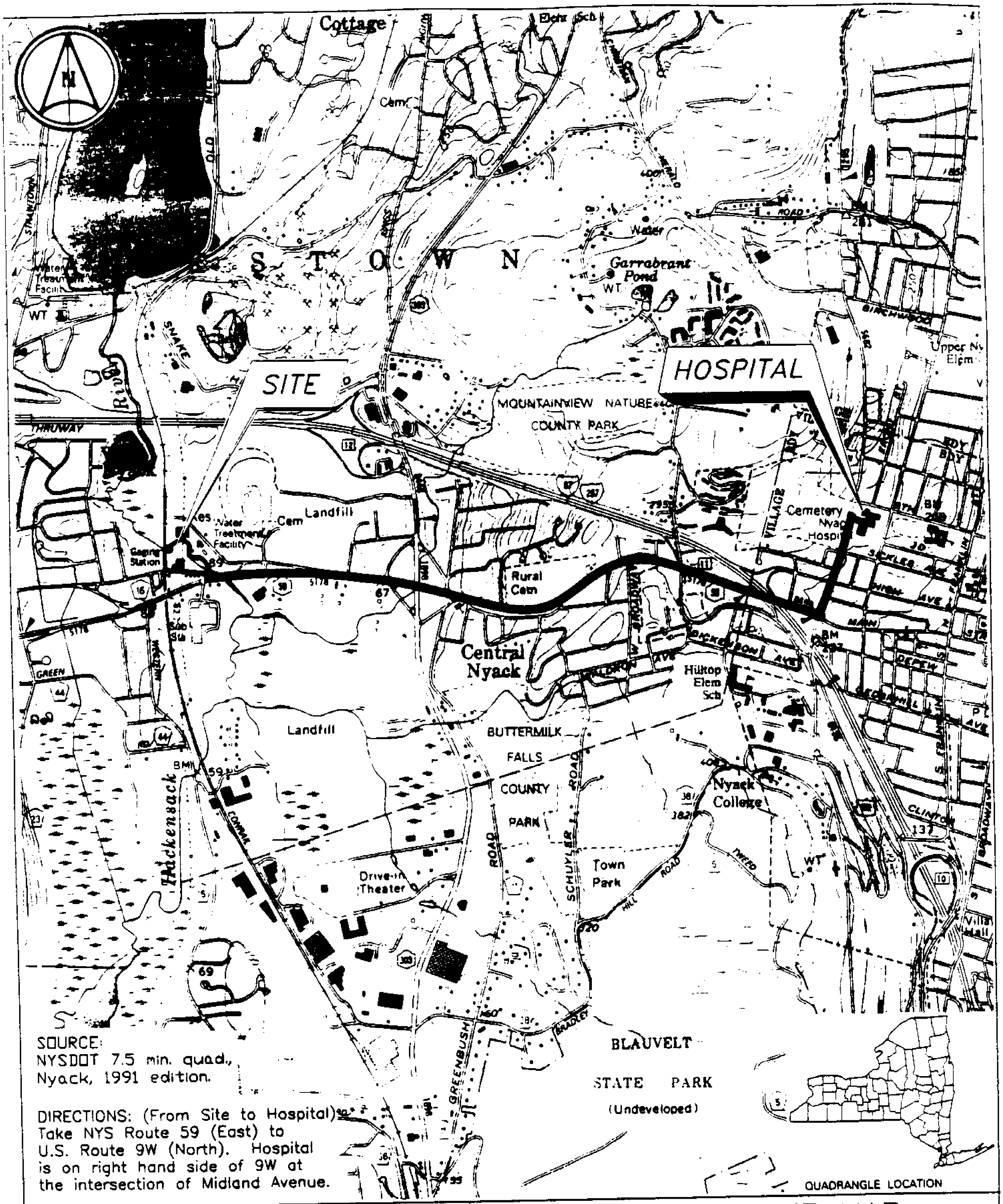
White Copy - Contractor   Yellow Copy - Owner   Pink Copy - Project File   Gold Copy - Region Environmental, Health & Safety Manager

Rev. 11/94

F023/Markelz

APPENDIX D

Hospital Route Map and Directions



SOURCE:
NYSDOT 7.5 min. quad.,
Nyack, 1991 edition.

DIRECTIONS: (From Site to Hospital)
Take NYS Route 59 (East) to
U.S. Route 9W (North). Hospital
is on right hand side of 9W at
the intersection of Midland Avenue.

RUST ENVIRONMENT & INFRASTRUCTURE

HOSPITAL ROUTE MAP
ORANGE & ROCKLAND UTILITIES
TOWN OF CLARKSTOWN
ROCKLAND COUNTY, NEW YORK

PROJECT No. 38301.200	DATE AUGUST 1994	SCALE 1" = 2000'	FIGURE No. 12-1

APPENDIX C

TECHNICAL SPECIFICATIONS AND DRAWINGS

SECTION 1 - PRE-CONSTRUCTION

A. SCHEDULE OF VALUES

1. **Submit** a detailed breakdown of the Bid Price showing values allocated to each of the various parts of the Work, unit rates for labor and equipment, and back-up for lump sum items.

B. HEALTH AND SAFETY

1. **Submit** a Health & Safety Plan (HASP) that, at a minimum, addresses the elements specified in 29 CFR 1910.120(l)(2). The HASP shall designate the individuals with on-site and corporate responsibility for compliance with the HASP. The CONTRACTOR is responsible and liable for the health and safety of all on-site personnel and off-site community impacted by the remediation.

2. All on-site workers must comply with the requirements of the HASP. The CONTRACTOR's HASP must comply with all applicable federal and state regulations protecting human health and the environment from the hazards posed by activities during this site remediation.

3. Failure to adhere to the HASP shall constitute grounds for a stop work order. Any cost resulting from such work stoppage shall be borne entirely by the CONTRACTOR.

4. Maintain OSHA 40-hour certificates for all workers on site and make certificates available to ENGINEER for inspection. Workers without proof of required training will be removed from the site or restricted in their duties.

C. SUBCONTRACTORS

1. CONTRACTOR shall **Submit** for ENGINEER'S approval the name, qualifications, and scope of work for all proposed Subcontractors including waste haulers whose work will be more than $5000. Any Subcontractor may be rejected at the ENGINEER'S discretion.

2. Use of Subcontractors shall not relieve CONTRACTOR of its responsibilities in any way.

3. No work shall be performed by Subcontractors on site unless the CONTRACTOR'S Superintendent is present, or unless this requirement is waived on a case by case basis by the ENGINEER.

D. INSURANCE AND BONDS

1. CONTRACTOR shall **Submit** Certificate of Insurance which names Orange & Rockland as additional insured. Insurance shall be provided by the CONTRACTOR in amounts as may be required by the OWNER. Insurance coverage shall extend throughout the Contract period.

2. CONTRACTOR, shall execute and **Submit** a Performance Bond in the full amount of the Contract price. The Bond shall be provided at the time CONTRACTOR executes the Contract.

SECTION 2 - GENERAL REQUIREMENTS

A. TEMPORARY FACILITIES.

1. Provide temporary facilities or contingency equipment as required to properly carry out the Contract work. Remove all temporary facilities at the conclusion of work.

2. Complete all work in conformance with Town of Clarkston Code § 290-17 Part L.

3. Coordinate location of all temporary items with the ENGINEER. Locate items where they are approved and in such a manner as to cause minimum interference with the project work and operation of other site activities. Relocate, modify, and extend services and facilities as required to accommodate the Project, or as directed by the ENGINEER, throughout the course of the work.

4. Install and maintain temporary barriers as may be required to prevent access to active work areas. All work areas shall be marked off with warning tape at a minimum. More substantial barriers as dictated by site circumstances an as approved by the ENGINEER shall be maintained at all times around open excavation more than 1-ft deep.

5. Provide temporary potable and utility water service while on site as necessary. Obtain hydrant permits or other approvals and pay fees as needed.

6. Provide temporary sanitary facilities in good condition and in sufficient quality as required by OSHA or local codes.

7. The OWNER will provide access to electric service at the Building and electric at no cost to the CONTRACTOR. CONTRACTOR shall provide a weatherproof, grounded temporary electrical power service and distribution system of sufficient size, capacity, and power characteristics to accommodate performance of work. The power service shall be removed at completion of the work. Make all materials and installations to conform to NEC and local or State codes.

8. Keep work areas clean and free of combustible materials. Provide fire extinguishers in all vehicles and equipment on site at all times. Comply with all local and State fire codes.

9. CONTRACTOR's vehicles and equipment shall be operated as to minimize noise, dust, and off-site traffic restrictions to the greatest degree practicable.

B. DECONTAMINATION

1. CONTRACTOR shall provide Decontamination Facilities as follow:
    a. Personnel decontamination facilities shall be provided in accordance with the CONTRACTORS approved HASP.
    b. Equipment decontamination facilities shall be constructed in accordance with plans approved by the ENGINEER. The decontamination facility shall, at a minimum consist of the following components or their approved equal.
        (1.) 40-mil HDPE liner, placed on prepared subgrade, and sloped to drain to a collection point,
        (2.) 6-in free draining crushed stone or gravel over the liner,
        (3.) sideboards and collection sump,
        (4.) high pressure steam washer.

2. Decontamination shall be performed as follow:
    a. Personnel decontamination when workers leave the active work areas.
    b. Equipment decontamination shall be performed:
        (1.) On haul trucks prior to trucks leaving the site.
        (2.) On equipment when it is moved between different areas of the site.
        (3.) On all equipment removed from the site.

3. Remove temporary decontamination facilities, personnel protective equipment (PPE) and all other decontamination residues and dispose off-site at the conclusion of work.

4. Perform sampling of former decontamination areas and other areas as directed by the ENGINEER to verify the decontamination. CONTRACTOR shall be responsible for demonstrating that his activities did not result in the spread of contamination on the site. The scope of sampling required herein will depend upon the degree to which CONTRACTOR acted during the remediation to minimize the spread of contaminants.
    a. Coordinate sampling locations and timing with the ENGINEER, and allow for observation of the sampling.
    b. Analyze samples for petroleum constituents (Method 8021) and PCBs (Method 8082).
    c. Analysis shall be performed by a ELAP certified laboratory and Category B deliverables shall be provided.
    d. Submit analytical data to the ENGINEER.
    e. In the event that previously clean areas have become contaminated, CONTRACTOR shall be responsible for removal and disposal costs as well as incidental costs incurred by ORU (such as lab analysis and ENGINEER'S fees).

C. POLLUTION CONTROL

1. Install erosion control structures as shown on the plans. Maintain erosion control structures until vegetation is established. Upon ENGINEER'S approval, remove and dispose all erosion control structures and dispose waste materials off-site.

2. Provide 110% secondary containment around dewatering effluent treatment system tanks. Maintain all piping and hoses used for pumping contaminated water in good condition. Temporary fuel tanks will not be allowed on the job site.

3. Suppress dust from contaminated areas of the site. Provide equipment suitable for watering disturbed areas and wet down bare soils with clean water upon visual observation of dust or as directed by the ENGINEER. If water is insufficient to control visible dust, water amended with an appropriate surfactant, used in accordance with the manufacturer's recommendations, or other means, shall be used.

4. Maintain traffic ways clear of excess soils to prevent tracking of soils onto public roads. Clean all public roads where visible soil tracking has occurred due to CONTRACTOR traffic.

5. The CONTRACTOR shall be fully responsible for any and all damages to life and property that occur as a result of his activities. Damages resulting from polluting watercourses shall be repaired, restored, or compensated for by the CONTRACTOR.

6. Place PPE and other decon wastes in steel drums and maintain wastes in an orderly condition in a single area on site, prior to off site disposal. CONTRACTOR is responsible for characterization and proper disposal of PPE and decon waste.

7. Provide equipment and personnel to perform emergency measures required to contain spillages and to remove spilled materials and soils or liquids contaminated due to spillage. Collected spill material shall be properly disposed of at no additional cost to the OWNER.

8. Notify the ENGINEER immediately in the event of liquid or contaminated soil spillage outside of contaminated excavation areas.

D. SURFACE AND GROUND WATER CONTROL

1. Surface Water Control
    - a. The CONTRACTOR shall furnish all labor, tools, materials, equipment, and incidentals necessary for surface water control. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
    - b. Control fill, grading and ditching to direct water away from excavations, pits, and other construction areas; and to direct drainage to proper runoff courses so as to prevent any erosion, damage or nuisance.
    - c. Surface water from areas of the excavation which have not been disturbed and which do not show signs of contamination shall be prevented from entering areas where construction or work is in progress or contaminated areas.
    - d. Surface water from areas of exposed refuse or other known areas of contamination shall be collected prior to leaving those areas and transported or pumped through watertight pipes to a temporary storage tank for later treatment through the water treatment system. Disposal shall be in accordance with all Federal and State regulations.
    - e. In the event surface runoff is the cause of existing clean areas, or subsequently cleaned areas, becoming contaminated, the affected areas shall be cleaned in accordance with instructions given by the ENGINEER. The CONTRACTOR shall be responsible for all costs associated with mitigating the affects of contaminated runoff migrating to clean areas or off site during the duration of the contract.

2. Groundwater Control
    - a. CONTRACTOR shall maintain excavations free of water to allow excavation of soils at their natural density and water content, so as to minimize disposal and hauling fees.
    - b. Prior to commencing excavation of soils below the water table, CONTRACTOR shall perform initial dewatering as specified below or as approved by the ENGINEER.
        - (1.) CONTRACTOR shall install and operate dewatering systems to reduce groundwater levels within the excavation area prior to the start of excavation. Existing Monitoring Wells shall be used to estimate groundwater levels. CONTRACTOR shall dewater the excavation area using the following:
            - (a) CMP slotted culvert section(s) installed to 2-ft below the anticipated depth of the excavation and bedded in clean crushed stone.
            - (b) Well point systems.
            - (c) Alternate dewatering systems as approved by the ENGINEER.
        - (2.) CONTRACTOR shall install suitable pumping equipment and dewater the area for at least 72-hours or until water levels have, in the ENGINEERS judgement, been suitably reduced to allow excavation.
        - (3.) Dewatering effluent shall be treated in the CONTRACTOR'S on-site water treatment system.
    - c. During excavation below the water table, CONTRACTOR shall pump water from temporary sumps as may needed to maintain the excavation free of water to allow

excavation of soils at their natural density and water content. Temporary sumps shall be constructed to minimize pumping of silt to the water treatment system.

3. Water Treatment
   - a. CONTRACTOR shall treat all groundwater and run-off from contaminated areas as specified below.
   - b. Install a water treatment system as shown on the plans, and as follows.
     - (1.) Coordinate placement of the system and components with the ENGINEER and allow inspection on delivery before installation.
     - (2.) Use only piping, valves, fittings and appurtenances that are new or in serviceable condition.
     - (3.) Supply sufficent storage to accomadate water being held pending analysis prior to discharge. This will require a minimum of two (2) fractionation tanks.
     - (4.) Support piping and other units as needed to maintain a useable system.
     - (5.) Protect the system as needed to allow operations through December 31.
   - c. Maintain the system in good working order and process at rates required to keep storage volume at a minimum.
     - (1.) Treat all water generated by dewatering of CONTRACTOR'S excavation and any contaminated run-off or run-on water.
     - (2.) Treat water generated by dewatering for the new UST being installed being installed under a separate Contract concurrent with the CONTRACTOR'S work
     - (3.) Change bag filters when back pressure rises 15 psi .
     - (4.) Backwash GAC beds when back pressure rises 15 psi in the first adsorber.
     - (5.) Replace failed or worn components as needed to operate the system.
     - (6.) Collect system operating data at the start and end of each day including gage readings, flow meter reading, tank level(s), service performed, and any other data relevant to the operation of the system. Maintain data in a log book and make the log book available to the ENGINEER for review.
   - d. Sample treated effluent.
     - (1.) Analyze samplesand demonstrate compliance with the NYSDEC effluent discharge limits (Attached).
     - (2.) Analysis shall be performed by a laboratory with NY State ELAP certification.

E. Protection of Existing Facilities

1. Contact Dig-Safe/UFPO prior to any excavation. Make all reasonable efforts to obtain information from personnel at the on-site business as to underground/overhead utilities. Protect existing utilities. CONTRACTOR shall locate existing utilities and shall repair any damage at no added cost to the OWNER.
2. Locate and temporarily divert the existing oil/water separator discharge line. Replace damaged sections of the existing discharge line with Sch 80 PVC and pressure test the line prior to reconnecting the separator discharge pump.
3. Provide temporary diversion and control of water to prevent erosion and shall repair in a permanent manner any erosion which does occur.
4. Protect and maintain on- and off-site roads against damage from equipment and vehicular traffic. Maintain access and on-site roads to provide positive drainage, dust and mud control, and vehicle access. Repair damage at no added cost to the OWNER.
5. CONTRACTOR shall maintain his site traffic and activities within the CONTRACTOR'S designated work areas and shall not use traffic, storage, or other areas reserved by the OWNER and tenants as shown on the PLANS.

F. SCHEDULE

1. The schedule for completion of the project is as follows:

a.	Pre-Bid site meeting	9/26/97
b.	Bids due	10/3/97
c.	Selected Bidder receipt of Contract	10/10/97
d.	Executed Contract returned to ORU	10/14/97
e.	Notice to Proceed	10/16/97
f.	Completion of Fall Season work	12/31/97
g.	Final Completion	5/14/97

2. Excavation, backfill, and paving of the Southeast PCB area shall be completed within 30 days of Notice to Proceed.
3. Fall Season work as referenced above shall include all Contract work except for final preparation and paving of the Northern excavation area and final demobilization. Decontamination shall be completed at the end of the Fall Season.
4. In the event CONTRACTOR fails to adhere to the above schedule,
    a. No stand-by or winterization charges will be allowed.
    b. CONTRACTOR stipulates to pay late charges of $500 per day for failure to adhere to Substantial and Final Completion dates, unless in the ENGINEER'S judgement circumstances beyond the CONTRACTOR'S control arose which caused the delay.

SECTION 3 - EXCAVATION AND BACKFILL

A. GENERAL

1. CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to perform all excavating, backfilling and grading of earth materials. All necessary preparation of subgrade is included. All necessary excavation backfilling and grading from borrow sources is included. All necessary support of excavation and adjoining structures is included. CONTRACTOR shall collect and analyze soil samples as directed by the ENGINEER and as required for the work contained in this contract.

2. Permits and Regulations: CONTRACTOR shall perform excavation and backfill work in accordance with applicable requirements of governing authorities having jurisdiction. Strict compliance with NYS Industrial Code 53 and OSHA 40 CFR Part 1910 and 1926 shall be required at all times.

3. The proposed extent of soil excavation is as specified and shown on Sheet 1 of the PLANS. Supplemental instructions may be furnished by the ENGINEER in the field.

4. All excavation outside the lines and grades shown and which is not approved by the ENGINEER, together with the removal and disposal of the associated material shall be at the CONTRACTOR's expense. The unauthorized excavation shall be filled and compacted with approved backfill by the CONTRACTOR, at his expense.
5. The CONTRACTOR shall keep materials classified for different types of disposal. Excavation and stockpiling operations for the different materials must not be mixed.

6. The CONTRACTOR is physically and financially responsible for the clean-up of their cross-contamination.

B. SEQUENCE AND SCHEDULE OF EXCAVATION

1. Unless otherwise approved by the ENGINEER, the sequence of excavation shall be as follows:

a. Southeast PCB area. Excavate and load for disposal soils designated by the ENGINEER (PCBs greater than 10ppm). Excavate and stage over the North PCB area soils designated by the ENGINEER (PCBs greater than 1 ppm, but less than 10 ppm).

b. BTEX area, beginning in the west and proceeding east and north, excavate and load for disposal designated by the ENGINEER. Backfill excavations to 2-ft below final grade with soils stockpiled from excavation of the SE PCB area.

c. North PCB area. Excavate and load for disposal soils designated by the ENGINEER (PCBs greater than 10ppm). Excavate soil designated by the ENGINEER (PCBs greater than 1 ppm, but less than 10 ppm) and use to backfill the BTEX excavation.

d. Backfill operations are addressed in detail in SECTION 5 - BACKFILL.

2. CONTRACTOR shall plan and make accommodations for routine sampling and analysis of soils as may be required to determine needs for off site disposal or needs for further excavation. CONTRACTOR shall coordinate the excavation schedule with the ENGINEER to minimize delays as follows:

    (1.) Meet with the ENGINEER daily to review the status of analytical work and decisions on excavation and disposal.
    (2.) Estimate the excavation sequence 2-days in advance.
    (3.) Provide sufficient off-site shipping capacity to accommodate the excavations schedule on a daily basis.
    (4.) Inform ENGINEER of the daily schedule for trucks on site to pick up waste for off-site disposal.

C. STAGING AREAS

1. Staging areas shall be located on the site in areas approved by the ENGINEER in order to minimize possible cross contamination. Prior to starting excavation, CONTRACTOR shall **SUBMIT** to the ENGINEER A site lay-out indicating the sequence of excavation activities and proposed stockpile locations.

2. Waste materials shall be placed on, and covered at all times by a minimum 5-mil polyethylene sheeting to prevent contaminated runoff and odors. All staging areas shall be constructed to prevent the spread of any contamination to the surrounding soils, surfaces, and/or groundwater

D. SUPPORT OF EXCAVATIONS

1. Shoring shall be provided as necessary to conform to OSHA requirements (29 CFR, Part 1926). Shoring is required wherever an excavation exceeds 5 feet in depth and the side slopes are not laid back to a safe gradient as set forth in Title 29 Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction (OSHA).

2. The CONTRACTOR shall take all measures necessary to protect the structural integrity of the adjacent building.

3. CONTRACTOR is responsible for all excavation supports regardless of whether actual excavation depth exceed those shown on the plans.

E. BACKFILL REQUIREMENTS

1. CONTRACTOR shall furnish and place aggregates of the types specified and shown. Comply with State of New York Department of Transportation design and Construction Division "Standard Specifications", Construction and Materials. (NYSDOTSS), unless otherwise specified herein.

2. Prior to using a backfill material on-site, CONTRACTOR shall supply representative samples, test results, and source certifications for all materials furnished and shall advise ENGINEER of the source location. Such data shall be provided to the ENGINEER for approval a reasonable time before material is required for use on site. No backfill shall be brought on site prior to receipt and approval of test data.

3. Depending upon the source and nature of proposed backfill materials, the ENGINEER may require chemical analysis of the backfill to verify that material is not contaminated.

4. Materials supplied by CONTRACTOR for backfill shall be as follow:
    a. Where available, materials specified herein shall come from sources and stockpiles possessing current NYSDOT certification for item supplied.
    b. Materials from non-NYSDOT approved sources may be acceptable to ENGINEER provided material testing and acceptance criteria of NYSDOTSS are met and mining permits have been obtained. In the event borrow materials are not from a commercial source, CONTRACTOR shall allow ENGINEER the opportunity to observe sampling to verify that the sample is representative.

5. Testing:
    a. CONTRACTOR shall supply representative test data of materials specified herein for the following minimum parameters at no additional cost to the OWNER prior to delivering material to the site: Particle Size Analysis of Soils, Maximum Index Density, Minimum Index Density, Moisture Content, Atterberg Limits.
    b. CONTRACTOR shall perform density testing of compacted backfill materials to demonstrate that the compaction methods employed attain the compaction requirements stated herein. The CONTRACTOR shall account for testing on-site on not less than 3 occasions. In the event CONTRACTOR varies from approved compaction methods, the CONTRACTOR shall remove the work or supply to the ENGINEER additional test data verifying that an adequate degree of compaction has been attained.
    c. CONTRACTOR shall perform testing of the properties listed above for soils excavated on site and proposed for backfill to allow in-place density testing of the completed backfill.

6. Materials
    a. Subbase Course, Type 1 - material shall meet NYSDOTSS Item 304.02.
    b. Common Fill - material shall meet the following criteria: Plasticity Index less than 10, less than 30% passing a #200 screen, and no material larger than 6".
    c. Alternate backfill - material may be supplied by the OWNER and consists of a processed C&D waste.
    d. On-site soil - material will be excavated on-site and used for backfill elsewhere as directed by the ENGINEER.
    e. Fine Stone Filling - material shall meet NYSDOTSS Item 620.02.

7. All backfill materials shall be compacted to meet 90% Standard Proctor density. Crushed Stone shall be compacted by vibratory plate compactor. All backfill materials shall be placed in maximum 6-inch lifts (final thickness). The ground surface on which the backfill is to be placed shall be free of brush, trees, stumps, and other objectionable material and shall be dressed to a smooth surface.

F. TRANSPORTATION

1. Only NYS licensed haulers with Part 364 Permits for the designated facilities and previously approved by the OWNER shall be used for transporting waste off-site.

2. CONTRACTOR shall coordinate as necessary to schedule orderly deliveries of waste to the disposal facilities.
3. Any increased costs from the disposal facility that arise from the transporters actions as well as demurrage which the transporter may charge due to delays at the disposal facility shall be borne by the CONTRACTOR.
4. CONTRACTOR shall supply certified weigh records as may be required by the disposal facility and shall supply a copy to the ENGINEER.

SECTION 4 - UNDERGROUND TANK REMOVAL

A. GENERAL

1. Tank is 5000 gallon steel tank which will be used until the start of the Contract work for storage of diesel fuel. Information is available from the OWNER on the tank. During removal of the tank, CONTRACTOR is responsible for field verifying the condition of the tank, and the location, arrangement, or condition of underground pipe or structures as may be required for proper execution of the work.

2. Removal and closure of the tank(s) will be performed by the Contractor in accordance with the requirements of this specification all applicable regulations.

3. CONTRACTOR shall remove the tank as described below. The use of the procedures below does not relieve the CONTRACTOR of responsibility for performing safe work practices that may not be specifically listed below.

B. TANK REMOVAL PROCEDURE

1. The CONTRACTOR shall arrange for removal of product from the tank to lowest drain-off point.

2. CONTRACTOR shall drain and flush piping into the tank.

3. The liquid below the draw-off point (the tank bottom - which consists of a floating layer of product, water and sediments) shall be pumped into 55 gallon drums until the interface of water and product is reached. The remaining liquid is primarily contaminated water and shall be treated as contaminated water.

4. CONTRACTOR shall excavate to the base of the tank. Walls shall be sufficiently sloped to prevent collapse and the excavation shall be kept in a dry condition.

5. Remove the fill tube and disconnect the fill, gauge, product and vent lines, if present. All piping shall be removed by manual disconnection or approved cold cutting methods. When removing piping, drain lines into the tanks or other appropriate containers. Cap or plug open ends of lines which are not to be used further at the limit of excavation.

6. Flammable vapors shall be removed from the tank prior to lifting by using one of the following methods:
   a. Addition of dry ice: 1.5 pounds per 100 gallons of tank capacity. The dry ice should be crushed and distributed evenly over the greatest possible area of the tank's interior. As the dry ice vaporizes, flammable vapors will flow out of the tank. Therefore, all safety precautions must be observed regarding flammable vapors.
   b. Introduction of nitrogen or other inert gas may be an acceptable method for removing flammable vapors from the tank. At least one (1) storage tank volume of gas will be required, and a specific proposal for use of this procedure must be

submitted to the ENGINEER for approval at least 24 hours prior to initiation of this phase of the project.

7. The contractor shall verify that the tank atmosphere is less than 10% of the lower explosive limit.

8. Remove all tank hold down straps/attachments via cold cutting methods.

9. Temporarily plug all tank openings, complete the excavation as necessary, and remove the tank in a safe manner utilizing lifting equipment of appropriate capacity. The tank must be placed on polyethylene sheeting in a secure location and chocked to prevent rolling.

10. Following removal, the tank shall be cleaned of all residue and cut into pieces at the project site for subsequent disposal in accordance with Part C of this Section.

C. CLEANING AND DISPOSAL OF UST

1. In order to make a tank acceptable for disposal at a scrap yard or sanitary landfill, the following steps shall be taken by the CONTRACTOR.

2. All product, residue and sludge must be completely removed and the tank interior must be cleaned. This is generally accomplished by manual scraping of the tank with a shovel and/or scrub brush. Residues and wastes generated by the cleaning of the tank and lines shall be disposed with petroleum contaminated soils being removed from the site.

3. The tank shall then be rinsed clean with water. Rinse water shall be disposed in the on-site water treatment system.

4. Access to the tank shall be provided through removal of both end caps. Prior to any cutting or entry, the CONTRACTOR shall ensure that the tank atmosphere registers less than 10% of the lower explosive limit and greater than 19.5 % oxygen and utilize cold non-sparking explosion proof equipment for all cutting operations.

5. CONTRACTOR shall observe also appropriate confined space procedures. Tank entry for cleaning requires protective clothing and air purifying respirators for personnel involved.

6. CONTRACTOR shall dispose the cleaned and cut up tank at a sanitary landfill or scrap yard. CONTRACTOR shall notify the OWNER of the proposed disposition of the tank.

7. CONTRACTOR is responsible for the disposal of all piping, fuels pumps, and appurtenances as well as tank bottoms.

SECTION 5 - PAVING AND FINISHING

A. GENERAL

1. The CONTRACTOR shall furnish all labor, materials, and equipment necessary to install asphalt concrete paving.

2. Codes and Standards: Comply with NYSDOT standard specifications, latest edition.

3. Weather Limitations: Apply prime and tack coats when ambient temperature is above 50°F (10°C), and when temperature has not been below 35°F (1°C) for 12 hrs immediately prior to application. Do not apply when base is wet or contains an excess of moisture.

4. Construct asphalt concrete surface course when atmospheric temperature is above 40°F (4°C), and when base is dry. Binder course may be placed when air temperature is above 30°F (-1°C) and rising.

5. Transport bituminous mixtures in covered trucks During rainy weather and when air temperature is less than 60°F.

6. Adjust weight, type, capacity, haul routes, and method of operation of hauling vehicles so no damage results to existing streets, subgrade or base course.

B. MATERIALS

1. Type 2 Base Course - shall meet the requirements for NYSDOTSS Item 403.12.

2. Type 3 Binder Course - shall meet the requirements for NYSDOTSS Item 403.13.

3. Type 6 Top Course - shall meet the requirements for NYSDOTSS Item 403.16.

4. Curb - machine made 6- in high continuous curb.

C. PAVEMENT PREPARATION

1. Remove loose material from compacted subbase immediately before applying prime coat.

2. If sufficient time as passed since placement of subbase that base course is rutted, loose or uneven, proof roll prepared surface to check for unstable areas and areas requiring additional compaction. Do not begin paving work until deficient areas have been re-graded and corrected and are ready to receive paving.

3. Prime Coat:
   a. Apply at rate of 0.20 to 0.50 gal per sq yd, over compacted subgrade.
   b. Apply material to penetrate and seal, but not flood, surface.
   c. Cure and dry as long as necessary to attain penetration and evaporation of volatile.

4. Tack Coat:
   a. Apply to contact surfaces of previously constructed asphalt or portland cement concrete and surfaces abutting or projecting into asphalt concrete pavement.
   b. Distribute at rate of 0.05 to 0.15 gal per sq yd of surface.
   c. Allow to dry until at proper condition to receive paving.
   d. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.

D. PLACING MIX

1. General: Place asphalt concrete mixture on prepared surface, spread, and strike-off. Spread mixture at minimum temperature of 225°F (107°C). Place inaccessible and small areas by hand. Place course to required grade, cross-section, and compacted thickness.

2. Placing:

a. Place in strips not less than 10-ft wide, unless otherwise acceptable to ENGINEER.
b. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips.
c. Grade Control: Establish and maintain required lines and elevations to within 3/8-in.

3. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

E. ROLLING

1. General - Begin rolling when mixture will bear roller weight without excessive displacement. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

2. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.

3. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.

4. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.

5. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.

6. Protection- After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Protect paving from traffic until mixture has cooled.

F. FIELD QUALITY CONTROL

1. Pavement Testing:
   a. General: Test in-place asphalt concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving.
   b. Tolerances: In-place compacted thickness shall meet or exceed dimensions specified on the drawings.
   c. Surface Smoothness Tolerances: Test finished surface of final asphalt concrete course for smoothness, using 10-ft straightedge applied parallel with, and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding 1/8-in. tolerance for smoothness.

SECTION 6 - PROJECT CLOSE-OUT AND SITE RESTORATION

1. Repair access and on-site roads if damaged during Work activities to condition equal to that at completion of site preparation. Clean up debris and other site damage resulting from CONTRACTOR activities.

2. Decontaminate vehicles and CONTRACTOR equipment prior to removal from site. The ENGINEER will inspect and approve decontamination of vehicles and equipment prior to removal from Project site.

3. Package, transport, and dispose of contaminated items, equipment, wastewater, and clothing as specified herein and in accordance with applicable regulations.

4. Disconnect and remove temporary utilities and structures, excluding equipment decontamination facility.

5. Complete record keeping and documentation and transmit to the ENGINEER.

6. CONTRACTOR shall restore all excavated and disturbed areas of the site. Restoration activities include, but are limited to regrading, hydroseeding and establishment of permanent vegetation cover, removal of debris, cleaning of pavement, and repair of erosion.

SECTION 7 - MEASUREMENT AND PAYMENT

A. Payment shall be based on quantities of work actually completed and the Schedule of Values submitted by the CONTRACTOR.

B. CONTRACTOR shall give notice immediately if added work is required and CONTRACTOR believes the added work should result in a change in the Contract price. CONTRACTOR shall give such notice immediately to the ENGINEER and within 3 days in writing to the OWNER. Failure to give prompt notice of and may result in rejection of the claim.

C. Any added work performed will generally be reimbursed on a time and material basis, with a mark up on materials not to exceed 10%.

D. Payment Items are listed on the Bid Form and are further described as follows.
1. General Construction - shall include work described as follows:
    a. Section 1 - Pre-Construction
    b. Section 2 - General Requirements
        (1.) Part A - Temporary Facilities
        (2.) Part B - Decontamination
        (3.) Part C - Pollution Control
        (4.) Part E - Protection of Existing Facilities
    c. Section 6 - Project Close-out and Site Restoration
    d. All work included in the Supplemental Conditions or elsewhere in the Contract Documents which is not specifically included under other pay items.
2. Dewatering and Water Treatment - shall include work described as follows:
    a. Section 2 - General Requirements
        (1.) Part D - Surface and Groundwater Control
3. Excavation - shall include work described as follows:
    a. Section 3 - Excavation and Backfill
        (1.) Part A - General (where applicable)
        (2.) Part B - Sequence and Schedule of Excavation
        (3.) Part C - Staging Areas
        (4.) Part D - Support of Excavations
    b. Section 4 - Underground Tank Removal
4. Transportation - shall include work described as follows:
    a. Section 3 - Excavation and Backfill
        (1.) Part F - Waste Transportation

5. Backfill - shall include work described as follows:
    a. Section 3, Part E.
6. Paving - shall include work described as follows:
    a. Section 5 - Paving and Finishing
7. Disposal
    a. CONTRACTOR may submit pricing for disposal at facilities other than those listed here.
    b. Alternate facilities will be evaluated for possible used based upon cost and environmental compliance of the facility, among other items.
    c. In the event an alternate disposal facility proposed by the CONTRACTOR is ultimately used, the OWNER reserves the right to Contract directly with the facility for disposal.
    d. CONTRACTOR shall submit the name and pertinent information about the proposed alternate facility

E. Measurement for payment shall be based on the following.
  1. General
      a. General work shall be considered 25% complete on ENGINEER'S determination that mobilization is complete.
      b. 25% of the General Work pay item shall be withheld until ENGINEER'S determination that CONTRACTOR has demobilized and restored the site per Section 6 as well as other Contract requirements
      c. Remaining payment for General construction shall be based on percent progress of the other Contract work items.
  2. Dewatering and water treatment
      a. Dewatering Operations - shall be paid commensurate with progress.
      b. Water treatment system set up - shall be paid commensurate with progress.
      c. Watering Treatment Operations - shall be paid commensurate with progress.
      d&e. Water sample analysis - shall be paid based on the number of samples which the ENGINEER directs to be collected. Water samples collected by the CONTRACTOR for his own purposes in operating the system will be paid at the ENGINEER'S discretion.
  3. Excavation
      a. Soil excavation - shall be paid based on in-place cubic yards of soil which CONTRACTOR excavates, under the ENGINEER'S direction, and stockpiles on site or loads in trucks for shipment off site. Payment will not be made for over-excavation. In the event over-excavated soils cannot be returned to the excavation for any reason, CONTRACTOR shall bear the cost of disposing of the over-excavated soil.
      b. Tank removal - payment shall be made upon removal of the tank and suitable disposal off-site as well as completion of any other requirements of Section 4.

  4. Transportation
      a. Payment will be based on the weight records recorded as received by the facility. Transport of PPE and similar project waste, for which the CONTRACTOR is responsible for disposal shall not be paid.

  5. Backfill
      a. Subbase Type 1 - shall be paid based on the volume supplied and placed and for materials placed in accordance with the specifications and as directed by the ENGINEER.
      b. Subbase Type 1 - for OWNER supplied Type 1, item shall be paid based on the volume placed in accordance with the specifications and as directed by the ENGINEER.

c. Common Fill - shall be paid based on the volume supplied and placed and for materials placed in accordance with the specifications and as directed by the ENGINEER.

d. Alternate Backfill - for OWNER supplied material, item shall be paid based on the volume placed and for materials placed in accordance with the specifications and as directed by the ENGINEER.

e. Site Soil - shall be paid based on the volume placed and for materials placed in accordance with the specifications and as directed by the ENGINEER.

6. Paving

    a. Surface preparation - shall be paid upon completion of grading and preparation of a suitable subgrade for placement of the Binder Course.

    b. Type 3 Binder Course - shall be paid by the square yard of material placed to the thickness and specifications required.

    c. Type 3 Top Course - shall be paid by the square yard of material placed to the thickness and specifications required and upon sealing of all joints.

    d. Fine Stone Filling - shall be paid by the ton of material placed to the thickness and specifications required.

7. Disposal (Optional)

    a. Payment shall be based on weigh records submitted per Item 4 - Transportation above.

ADDENDUM No. 1

ORU - W. NYACK, NY

SECTION ARE REVISED TO READ AS FOLLOWS

SECTION 2 - GENERAL REQUIREMENTS

D. SURFACE AND GROUND WATER CONTROL

3. Water Treatment

ADD THE FOLLOWING

Flowrates from dewatering are estimated. If needed to properly complete the work, CONTRACTOR shall install additional tanks, filters and other equipment as necessary to process the actual flow.

CONTRACTOR shall treat additional flow from dewatering activities of others.

CONTRACTOR shall meter total flow processed in the treatment system.

REPLACE THE SECTION AS FOLLOWS

E. SCHEDULE

1. The schedule for completion of the project is as follows:

a.	Pre-qualification Site meeting	9/26/97
b.	Bids due	10/10/97
c.	Selected Bidder receipt of Contract	10/17/97
d.	Executed Contract returned to ORU	10/21/97
e.	Notice to Proceed	10/23/97
f.	Completion of Fall Season work	12/31/97
g.	Final Completion	5/14/98

SECTION 3 - EXCAVATION AND BACKFILL

ADD THE FOLLOWING

A. GENERAL

7. Fence removal and replacement in kind may be required based on the results of sampling which will be conducted by the ENGINEER prior to the start of construction.

REPLACE THE SECTION AS FOLLOWS

D. SUPPORT OF EXCAVATIONS

1. Shoring shall be provided as necessary to conform to OSHA requirements (29 CFR, Part 1926). Shoring is required wherever an excavation exceeds 5 feet in depth and the side slopes are not laid back to a safe gradient as set forth in Title 29 Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction (OSHA).
2. The CONTRACTOR shall take all measures necessary to protect the structural integrity of the adjacent building and shall pay for repairs of any damage resulting from CONTRACTOR'S work.
    a. CONTRACTOR shall install shoring and bracing as needed to protect the ORU facilities adjacent to the excavation. At a minimum, shoring and bracing shall be provided along the southern limit of the excavation to protect the building.
    b. CONTRACTOR shall submit to the ENGINEER plans for excavation support prior to commencing excavation. The excavation support plans shall be designed and certified by a NY Professional Engineer.
3. Excavation support - For the CONTRACTOR'S information, Rust has further reviewed the proposed work and does not believe that excavation support, other than to protect buildings, is essential, and that the excavation can be done through a combination of dewatering and benching the edge of the excavations.

4. CONTRACTOR shall excavate beyond the limits of soil removal as needed to provide stable side slopes. Excavated soil may be backfilled else where in the excavation. This added excavation and backfill of uncontaminated soil will not be paid under the excavation and backfill items.
5. Based on site information CONTRACTOR may propose to use excavation support. CONTRACTOR shall state on the Bid Form the estimated maximum quantity of support to be used.

SECTION 5 - PAVING AND FINISHING

REVISE AS FOLLOWS

Plan Sheet no. 3 is revised to include paving of additional portions of the site as delineated following soil excavation. The increased area may include the entire site.

SECTION 7 - MEASUREMENT AND PAYMENT

D. Payment Items

ADD THE FOLLOWING

3.1 Support shall include work as described in Section 3(D.). Payment for Additional Support shall only be allowed if such installation is approved by the ENGINEER as necessary for proper conduct of the work. CONTRACTOR shall make any request for approval for payment sufficiently in advance of the need for use of Additional Support, so as to allow ENGINEER time to review the request. Nothing here limits the CONTRACTOR'S use of excavation support should he deem it necessary for the safe conduct of the work.

3.2 Fence removal and replacement - Shall include work as described under Section 3, Part A, No. 7, which is contained in this Addendum, above.

E. Measurement for Payment

ADD THE FOLLOWING

2. Dewatering and water treatment
   - c. If dewatering flow from the work of others exceeds 20% of the total flow treated by the CONTRACTOR, the amount in excess of 20% will be paid on a time and materials basis.

3. Excavation - Payment will be based on the dry weight of soil. Initial testing of the soil water content shall be performed by the CONTRACTOR to allow calculation of the payment quantity. Periodic re-testing shall be performed by the CONTRACTOR, as directed by the ENGINEER, if materials change during excavation.

3.1 All excavation support shall be paid based on the square footage of the soil face in contact with the support.

3.2 Fence shall be paid based on the linear foot of fence replaced at the ENGINEER'S direction. Payment will not be allowed for fence unnecessarily or accidentally damaged by the CONTRACTOR.