C.T. MALE ASSOCIATES, P.C.

50 Century Hill Drive
P.O. Box 727
Latham, New York 12110
(518) 786-7400
FAX (518) 786-7299

Engineering
Land Surveying
Architecture
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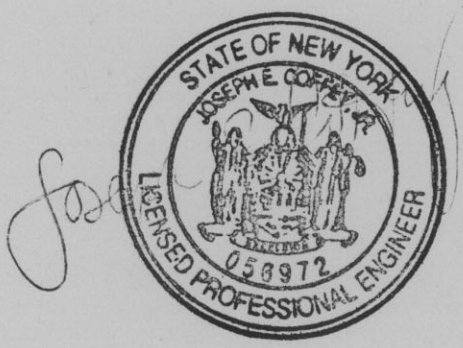
ENGINEERING REPORT
VAPOR EXTRACTION SYSTEM
INTERIM REMEDIAL MEASURES

ACTIVE INDUSTRIAL UNIFORM CO., INC.
63 WEST MERRICK ROAD
VILLAGE OF LINDENHURST, SUFFOLK COUNTY, NEW YORK

NYSDEC SITE NO. 152125

MARCH 1, 1991
REVISED APRIL 15, 1991



PREPARED BY:

C.T. MALE ASSOCIATES, P.C.
50 CENTURY HILL DRIVE
P.O. BOX 727
LATHAM, NEW YORK 12110
(518) 786-7400
CTMA PROJECT NO.: 88.2594

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APPENDICES

1.0 INTRODUCTION

This Engineering Report presents the design parameters and design drawings for a vapor extraction system to be installed at the Active Industrial Uniform Co., Inc. site located at 63 West Merrick Road in the Village of Lindenhurst, Long Island, New York. NYSDEC's comments on the Engineering Report dated March 1, 1991 were received on April 4, 1991 by fax and have been incorporated into this Engineering Report, revision date April 15, 1991. A Copy of NYSDEC's comments dated April 3, 1991 are enclosed in Appendix A.

A soil gas survey conducted on September 25, 1990 and presented in C.T. Male Associates report entitled "Interim Remedial Measures Investigation Report," dated November 26, 1990 identified the presence of chlorinated volatile hydrocarbons in the vadose zone of the soil at various locations on-site. The constituents detected were perchloroethylene (PCE), trichloroethylene (TCE), 1,1,1-trichloroethane (1,1,1 TCA), and trans 1,2-dichloroethylene (t1,2-DCE).

It is proposed to install a vapor extraction system to begin to address the source areas identified in the soil gas survey. The vapor extraction process involves creating a vacuum through the soil with a vacuum blower connected to screened vertical wells or horizontal laterals. As the vacuum from the extraction well extends laterally through the soil from the well, the hydrocarbons present are induced to volatilize and will migrate towards the well due to the negative pressure gradient created by the vacuum. The extent of volatilization and the resultant hydrocarbon extraction is dependent on the vapor pressure of the constituent, which is a function of temperature, the soil type (including organic matter compartment) and soil moisture content, the soil/air permeability and uniformity (fractures or channels), the depth to groundwater, the extraction rates,

moisture content of the air, and the extent of the vacuum, as well as any degradation or reaction of the constituents which may occur.

The vapor extraction system at this site is designed to remove the chlorinated volatile hydrocarbons from the vadose zone and soil in the unsaturated zone and will consist of the following:

1. Seven vertical extraction wells manifolded together prior to entering the moisture separator. To minimize the potential of short circuiting all or a portion of the surface of the areas being treated may be paved at some point after the system has been installed and monitored. The drainage basin (i.e., dry well) design requirements of the Village of Lindenhurst, are to provide the number of dry wells needed to contain the volume of 2-inches of rainfall over the area of the site. This would necessitate 12 dry wells, 10 feet in diameter and 4 feet deep. Due to space constraints, the amount of soil that would have to be excavated for the dry wells, and the potential of the dry wells interfering with the treatment process the paving of the surface is being postponed until other options are investigated and discussed with the Village.

2. An explosion-proof vacuum blower preceded by an inline filter to remove particulates and a moisture separator to remove moisture from the air stream and any liquid prior to the air entering the vacuum blower. The exhaust from the vapor extraction system will be treated by activated carbon absorption until the emissions are below annual guideline concentration (AGC) values for the constituents present. The AGC values are presented in Table III of

the New York State Air Guide - 1 1985-86 edition, September 1989 printing.

Design/construction drawings of the proposed vapor extraction system, CTMA Drawing No. 91-163, sheet 1 to 3 of 3, are enclosed in Appendix B.

2.0 SYSTEM DESIGN PARAMETERS

2.1 Flow Rate

The system flow rate or air evacuation rate was theoretically calculated taking into account the volume of soil to be treated, the porosity of the soil, and the turnover time of the contaminants. The turnover time is the time it takes to extract the volatile hydrocarbon from the soil and it is dependent on the vapor pressure of the compound among other factors. The most volatile substances have the highest vapor pressure and should take the shortest time to extract.

The following relationship was used to calculate the system flow rate:

$$\text{Flow (cu ft/min)} = \frac{\text{volume of soil (cu ft) x porosity of soil}}{\text{turnover time (min)}}$$

The volume of soil to be treated was calculated taking into account the areal extent of vadose zone contamination obtained during the soil gas survey. Investigations conducted on the site by Twin City Testing and presented in a report entitled "Preliminary Subsurface Contamination Assessment," dated December 7, 1987 indicates the water table to be approximately eight feet below grade. This was determined by a soil boring advanced on-site using a hand auger. Information obtained from the NYSDEC through a Freedom of Information Request on a spill site located at a parallel gradient to the site and approximately 300 feet east confirmed that the water table is approximately eight feet below grade in the area. In view of the above, an unsaturated soil depth of eight feet was used in calculating the volume of soil to be treated. The minimum area anticipated to be treated is 8,792 square feet based on a 20-

foot radius of influence for each of seven extraction wells. At a depth of 8 feet this would equal a volume of 70,336 cubic feet of soil to be treated. We are not planning to lower the groundwater table at this time by pumping to provide additional vadose zone.

The types of soils encountered at the site during the investigations conducted by Twin City Testing were predominantly sands and silty sands with gravel. Therefore a porosity of 35% was used in the calculations (Bouwer 1978).

The turnover time was calculated for PCE and TCE, the two primary constituents present at the site and using benzene as the baseline. Experience at gasoline spill sites has shown that a 30 to 45 minute turnover time is appropriate for extracting benzene from the soil. Benzene has a normal vapor pressure of 0.1 atm. PCE and TCE have normal vapor pressures of 0.018 atm and 0.026 atm, respectively. Since PCE and TCE are less volatile than benzene it will take longer to extract these constituents from the soil. A turnover time of 167 minutes for PCE and 115 minutes for TCE were estimated based on the following:

PCE: $\frac{0.1 \text{ atm}}{0.018 \text{ atm}}$ x 30 minutes = 167 minutes

TCE: $\frac{0.1 \text{ atm}}{0.026 \text{ atm}}$ x 30 minutes = 115 minutes

The flow requirements then for PCE and TCE are:

PCE: (70,336 CF x 0.35)/167 min = 147.4 CFM

TCE: (70,336 CF x 0.35)/115 min = 214 CFM

The average flow requirement is 180.7 cubic feet per minute (CFM). A flow rate of 180 CFM was used in the design. We note that the relationships are estimates and that the formula does not address relative vacuums, soil moistures and soil/organic phase differentials from the baseline cited.

2.2 Vacuum Extraction Wells

2.2.1 GENERAL

Vertical extraction wells are proposed at this site instead of horizontal laterals for the following reasons:

1. Vertical wells are reportedly more effective than horizontal laterals and can provide some groundwater treatment when they extend into the water table, especially if free product is present (Malot).

2. If it is determined in the future that a pump and treat groundwater system is necessary to be installed that results in a depressed water table and/or under fluctuating water table conditions, additional on site extraction wells should not be necessary since the proposed wells are designed to extend seven feet into the water table. The effective depth of treatment will then be greater than with horizontal laterals.

3. The extraction wells can be used as shallow groundwater sampling wells to determine the hydrocarbon concentrations in the groundwater.

4. During installation of the vapor extraction wells, the soils can be sampled and submitted for laboratory analyses to determine the hydrocarbon concentrations in the soil.

5. Less excavation and soil disturbance is required.

Some upwelling of the water table may occur due to the vacuum, but this could occur with horizontal laterals as well as with vertical wells.

2.2.2 WELL SPACING

The spacing of the extraction wells is dependent on the radius of influence that will be established by the vacuum, which in turn is dependent on the soil and air permeability, porosity and stratigraphic variability of the soil that the constituents are being extracted from. Ideally, a pilot study is performed to determine the radius of influence from the extraction point at varying cell/evacuation rates and vacuums. Since a pilot study was not performed the extraction wells were spaced conservatively at less than 40 feet apart. This is based on an assumed radius of influence of 20 feet per extraction well. It is anticipated that a radius of influence of at least 20 feet from the extraction wells will be obtained and that an overlap of the areas of influence will be evident based on available literature on pilot studies performed and vapor extraction systems installed at other sites with similar soil types (Malot; Malmanis, et.al.).

The configuration of the extraction wells is shown on the Site Plan, Drawing No. 91-163, Sheet 1 of 3 enclosed in Appendix B.

2.2.3 WELL CONSTRUCTION

The wells will be constructed of SCH40 2-inch PVC slotted pipe (0.02" slots) surrounded by a No. 1 Whitehead sand pack. A minimum six-inch thick layer of finer grained sand will be placed at the top of the filter pack. A bentonite seal, two feet thick, will be formed above the sand pack utilizing

bentonite slurry. A concrete seal will be placed above the bentonite seal at a thickness of six inches. The well will be slotted below the header pipe connection and solid above the header pipe connection. The total well depth/length will be 15 feet. The well will be completed with a watertight manhole at grade set in the concrete seal. A typical cross section of the vapor extraction well is shown in detail 2 on sheet 3 of 3 of Drawing No. 91-163 enclosed in Appendix B.

2.2.4 SOIL SAMPLING DURING WELL INSTALLATION

During advancement of the soil borings for the extraction well construction, standard split spoon sampling per ASTM D-1586 has been specified to obtain soil samples for head space analysis with a PID meter and laboratory analyses for volatile organic hydrocarbons by EPA Method 8240 (see General Note No. 12 on sheet 3 of 3 of Drawing No. 91-163). The soil samples for laboratory analysis will be placed in a cooler with ice packs to keep the samples cool (4°C) until delivered to the laboratory. A chain of custody will be used to track the samples from the time they are taken until delivered to the laboratory for analysis.

It is proposed to analyze two soil samples per extraction well in the laboratory depending on the head space analysis results. The head space analysis of the soil samples would be performed by C.T. Male Associates using a PID meter with an 11.7 ev lamp. The PID meter will be calibrated prior to its use in accordance with the manufacturer's instructions. The laboratory analysis of the soil samples would be performed by CTM Analytical Laboratories, LTD, a wholly owned subsidiary of C.T. Male Associates, P.C. CTM Analytical is a NYS Department of Health ELAP certified laboratory and a NYS Department of Environmental Conservation certified laboratory.

Subsurface logs will be prepared and include the following: soil boring nomenclature and elevation; date started and completed, weather and temperature; sampling intervals and depths; blows per six-inch increment of the split-barrel sampler; standard penetration values; soil classification; length of recovered sample; depth of first groundwater encountered; drilling depth per day; general moisture content of each sample and any other pertinent field observations collected during the drilling operations. The boring location nomenclature used on the subsurface logs will be identified on the laboratory analyses reports under sampling location.

Any soil cuttings from the borings advanced for the installation of the extraction wells will be utilized on site as trench native backfill material for around the extraction well header pipes in the same area the soil is generated.

2.3 Extraction Headers and Manifold

The header from each extraction well will be a solid 2-inch diameter PVC SCH40 pipe, except from well 1. The header pipe from well 1 will be 3-inch after it enters the main building. Each header will be sloped 1% in the opposite direction of airflow so that any moisture that condenses in the header pipe will flow back into the well. The header pipes from each well will be located in the same trench and not manifold together until after entering the control building. In the control building each header line will have a flow measuring station, sampling port, and globe valve in the order given. This arrangement will enable the system to be adjusted so that the removal of hydrocarbon vapors is maximized and will enable the hydrocarbon vapor recovery rate from each extraction well to be determined. A photoionization detection (PID) meter with an 11.7 ev lamp will be used to measure the concentration of volatile compounds in the individual header well via the

sampling port. The flow rate will be measured at the measuring station and will be adjusted as necessary by the globe valve. The flow measuring station will consist of a Dieterich Standard Annubar Model GCR-15-2SCH40-CB-MC2 or equal with adapter threaded into the 2-inch PVC header pipe. The annubar has two 1/8-inch threaded connections to facilitate attachment of a portable annubar indicator meter. The meter measures the differential pressure across the annubar and this difference in pressure is proportional to the flow rate. The meter displays the flow in cubic feet per minute. The appropriate meter is a Dieterich Standard Indicator Model EFP-F4-SCFM-80 or equal. Manufacturer's literature on the annubar and indicator meter are enclosed in Appendix C.

The manifold will consist of a solid 4-inch diameter PVC SCH40 pipe located in the control building and connecting the 2-inch header pipe from each extraction well. The manifold discharges to a cyclonic moisture separator to remove any moisture in the air stream prior to it entering the vacuum blower. The air outlet from the moisture separator discharges to an intake filter and then the vacuum blower. The exhaust from the vacuum blower discharges to an activated carbon absorption unit for removal of the volatile organic hydrocarbons in the air stream, and then it is discharged to the ambient air through a 4-inch diameter stack.

The moisture separator is equipped with an automatic liquid overflow shut-off valve. When the separator becomes full of liquid a mechanical float valve shuts off the air flow through the separator and a built-in release valve is activated (i.e., opens) to limit the vacuum of the blower. Liquid is manually drained from the separator through a ball valve at the bottom of the unit.

The liquid from the moisture separator will be collected and stored on-site in a 55 gallon DOT drum and labelled as a Hazardous Waste Liquid, N.O.S., ORM-E, NA9189, (F002) until sampling and laboratory analyses indicated otherwise. Once the drum is full, it will be sampled, analyzed in the laboratory for volatile organics by EPA Method 601 or equal method, to determine the proper method of disposal. NYSDEC will be notified of the disposal method, prior to the waste's disposal, for NYSDEC approval.

Manufacturer's literature on the moisture separator is enclosed in Appendix C.

2.4 Vacuum Blower

To size the vacuum blower the total pressure loss through the system was calculated in inches of water for a design flow of 180 CFM. The pressure losses through each run of extraction well, header pipe, manifold and fittings were determined as follows:

1. The design flow rate was proportioned to each well.

2. The valves and fittings in the system were converted to equivalent length of piping.

3. The friction loss per foot of pipe in inches of water was determined using a friction loss chart knowing the flow in the pipe and the pipe diameter.

4. The friction loss value was then multiplied by the approximate length of piping (i.e., for the fittings and valves in equivalent length of piping plus the straight run of piping) to determine to total loss through the pipe run.

The highest loss was calculated at 25± inches of water through the piping from the extraction well in the front of the building (NW corner of the property) to the blower. The loss through the moisture separator and inline filter were obtained from the manufacturer. To establish a pressure gradient through the soil being treated, a pressure drop of 10 to 20 inches of water was assumed to size the blower. A summary of the pressure losses is presented below:

Piping and Fittings:	29" of water
Moisture Separator:	1" of water
Inline Filter:	7" of water
Carbon Units:	5" of water (2 @ 2.5" each)
Through the Soil:	10-20" of water
Total	52" to 62" of water

The performance curves of Rotron vacuum blowers were reviewed to select the appropriate blower. At this pressure loss and a design flow of 180 CFM a Rotron Model DR8BD72W explosion proof 10 horsepower, 3 phase, 208 volts, 60 Hz vacuum blower (or equal) was selected. The specified blower housing, impeller and cover are constructed of aluminum and coated with Teflon to guard against the chlorinated compounds attacking the aluminum. At a pressure drop through the vacuum blower of 62 inches of water, a flow rate of 250± CFM is obtainable. The globe valve on each extraction well header pipe will be adjusted as necessary to achieve the desired flow rate.

The blower performance curve and literature is enclosed in Appendix C.

2.5 Air Inlet Wells

At this time, air inlet wells to replace the air being removed by the vapor extraction system are not proposed. Make-up air is anticipated to be able to be drawn from the unpaved surface to the subsurface. Air inlet wells will be installed at a later date if deemed necessary.

3.0 HYDROCARBON VAPOR RECOVERY RATES

The hydrocarbon (HC) vapor recovery rates, also known as the emission rates or emission rate potential, were calculated as follows:

$EiR = CiQ$ where EiR = emission rate of species i, g/min.
Q = venting rate, m^3/min.
Ci = concentration of species i, g/m^3

... [ppm HC front of bldg x flow (cu ft/min)+ ppm HC rear of bldg. x flow (cu ft/min)]/10^6 x

$$\frac{1}{\text{vol. air at } 55\ ^\circ F} \quad \frac{(\text{cu ft})}{(\text{lb mole})} \quad \times \text{ molecular weight of HC (lb/lb mole)}$$

x 60 min/hr = lbs/hr of hydrocarbon

The highest concentration of PCE, TCE, 1,1,1-TCA and t1,2-DCE obtained in the front and rear of the main building on-site during the soil gas survey conducted in September 1990 were used as the ppm of hydrocarbon in the above equation. The design flow of the vapor extraction system is 180 CFM and this was proportioned as follows: 72 CFM in the front well header and 108 CFM total in the rear well headers. The temperature of the air vapor being extracted from the soil is estimated at 55°F (average condition). At this temperature and standard pressure the volume of air is 375.35 cu.ft./lb mole. We note that air temperature will vary seasonally, and that system operating parameters may require periodic adjustments for optimum system performance.

Table 3.0-1 below presents the vapor recovery rates for the different constituents detected in the vadose zone during the soil gas survey.

Table 3.0-1
Hydrocarbon Vapor Recovery Rates

HC Contaminant	MW lb/lb mole	Highest Concentration in Soil Gas ppm Front	ppm Rear	ug/m^3 Front	ug/m^3 Rear	HC Vapor Recovery Rate lbs/hr
PCE	165.83	120	39	848,597	275,794	0.341
TCE	131.50	3.05	41	17,103	229,915	0.097
1,1,1-TCA	133.41	0.116	2.8	650	15,930	0.006
T1,2-DCE	96.95	0.022	0.132	91	546	0.0002
					Total	0.444

To convert from ppm of hydrocarbon contaminant to ug/m^3 the following formula was used:

ug/m^3 = (ppm contaminant x MW of contaminant x 1000)/23.45; where 23.45 l/g mole = volume of air at 55°F and 1 atm.

4.0 AIR QUALITY IMPACT SCREENING ANALYSIS

Based on hydrocarbon vapor recovery rates presented in Table 3.0-1 on page 15, the emission rate potential (ERP) in pounds per hour is 0.444. In reference to information obtained from Mr. John Conover of NYSDEC Region 1, the 6 NYCRR Part 212.9 environmental rating for the area is "B". In reference to Table 3 of 6 NYCRR Part 212.9, for an environmental rating of 'B' and an ERP of less than 1 pound per hour, the degree of air cleaning required is set by the Commissioner of the NYSDEC. The NYSDEC has set the following annual guideline concentration (AGC) at ground level for the constituents present:

PCE:	0.075 ug/m3
TCE:	0.45 ug/m^3
1,1,1-TCA:	45,000 ug/m^3
t1,2-DCE:	360 ug/m^3

In accordance with the "New York State Air Guide-1 Guidelines for the Control of Toxic Ambient Air Contaminants," 1985-86 edition, September 1989 printing, these constituents are considered moderate toxicity air contaminants. The AGC values were obtained from Table III in Appendix B of the NYS Air Guide-1.

To determine if the AGC value for PCE would be exceeded without control equipment in place, the screening analysis presented in Appendix A of the NYS Air Guide-1 was performed using the ERP for PCE presented in Table 3.0-1 on page 15. The screening analysis was only performed for PCE since it has the most strict AGC. The screening indicated the worst case annual concentration of PCE at ground level would be 2.22 ug/m^3 using the following equation from the NYS Air Guide-1:

C_a = $(4218 \times ER)/h_e$ Exp 2.16

C_a = Worst case annual concentration/impact at ground level in ug/m^3

h_e = effective stack height = 20 feet

ER = emission rate in lbs/hr = 0.341

This method assumes no plume rise. Since 2.22 ug/m^3 is greater than 0.075 ug/m^3 control (air cleaning) equipment is necessary. Per my request, NYSDEC Region 1 performed an additional screening analysis using a computer program called EPA Screen Model, which is a more refined model than the method used above. According to Mr. John Conover, an annual concentration of 0.2± ug/m^3 was obtained using the EPA Screen Model, indicating the exhaust from the vapor extraction system will have to be treated prior to it being discharged to the ambient air.

5.0 VAPOR TREATMENT SYSTEM AND RESULTING AIR EMISSIONS

5.1 Activated Carbon Treatment

Activated carbon absorption is proposed to remove the hydrocarbons present in the air stream from the vapor extraction system so that the AGCs set by NYSDEC are achieved. The carbon treatment system will be located on the exhaust side of the vacuum blower and will consist of two primary carbon units connected in parallel and one secondary unit connected in series with the other two units. Only one of the units in parallel will be used at one time and controlled through a ball valve on the inlet and outlet of the unit. The purpose for the second unit in parallel is to minimize the frequency the units have to be handled. When the carbon in the one unit becomes spent, as determined by a PID meter, the valves on the second unit are opened and closed on the first unit.

The secondary or back-up unit is to ensure continued treatment in case the primary unit becomes spent sooner than anticipated and to get the full use of the carbon in the primary unit. Once both primary units are spent the system is shut down and the carbon units are moved out using a forklift. The secondary unit is moved into a primary position and two other new units are brought in to replace the vacancies. The system is then restarted. The two spent carbon units will be transported by a 6 NYCRR Part 364 permitted hazardous waste transporter directly to a carbon regeneration facility such as Envirotrol, Inc. located in Beaver Falls, Pennsylvania that is permitted to accept this type of waste. The waste will be properly manifested in accordance with 6 NYCRR Part 372.

The proposed carbon unit, Odor-Miser Model OM-1000 manufactured by Hoyt Corporation of Westport, Massachusetts or equal, will be

constructed of carbon steel with a corrosion resistant coating and will contain 1,130 pounds of carbon. The type of carbon will be a Calgon BPL or equivalent which is a 4x8 mesh with a carbon tetrachloride absorption number of 60% minimum. The absorption capacity of the carbon is dependent on the temperature and relative humidity of the exhaust air stream and the constituents being removed. It can range from 15% to 35% according to the manufacturer of the carbon treatment unit. The carbon usage is then calculated as follows:

[HC Vapor Recovery Rate (lbs/hr) x 24 hrs/day] / Carbon Absorption Capacity = lbs/day of carbon

The range of carbon usage per day using the above formula and based on a total hydrocarbon vapor recovery rate of 0.444 lbs/hr is estimated at 71 lbs/day to 30.4 lbs/day.

At this range of carbon usage, the frequency the two primary units would need to be replaced would range from 32 days to 74 days [Ex., 1,130 lbs/unit x 2 units / (71 lbs/day) = 31.8 days].

5.2 Resulting Air Emissions

According to the manufacturer, the activated carbon treatment unit will remove 98% of the volatile organic compounds (VOCs) present. The worst case annual ground level concentration (Ca) for the constituents present based on this removal efficiency was calculated using the following relationship:

$$Ca = [4{,}218 \times ERP\ (lbs/hr)] / h_e^{2.16} \times (1-0.98\ \text{removal efficiency})$$

The calculated values for the constituents are presented in Table 5.2-1 on the following page.

Table 5.2-1

Worst Case Annual Concentration, Ca, Based On 98% Removal of Volatile Organic Compounds

Constituent	ERP (lbs/hr)	C_a (ug/m^3)	AGC (ug/m^3)
PCE	0.341	0.044	0.075
TCE	0.097	0.013	0.45
1,1,1-TCA	0.006	0.0007	45,000
t 1,2-DCE	0.0002	2.6×10^{-5}	360

Based on the above, activated carbon treatment will provide the degree of air cleaning required for the system to meet the AGC values for the constituents present.

5.3 Air Monitoring

The influent air stream and effluent air stream from the carbon units will be monitored to determine when the carbon units need to be changed and to assure the AGC for the constituents present are not exceeded.

To determine when the primary carbon unit needs to be changed, it is proposed to use a PID meter to measure the total volatile compounds concentration into and out of the primary carbon unit via the sampling ports in the discharge piping from the blower. This monitoring will be conducted weekly during the first month of operation and then will be changed to bi-monthly or less frequent as appropriate based on the results of the first month's monitoring. A change in the sampling frequency will be reviewed with NYSDEC for approval prior to implementation.

Once the PID meter indicates less than a 1% change (precision of instrument) in concentrations between the influent and effluent from the first primary carbon unit, the system will be changed

over to the second primary carbon unit (i.e., unit in parallel). Once the PID meter indicates less than a 1% change in concentration between the influent and effluent from the second primary carbon unit, the system will be shut down, and the primary carbon units will be replaced.

The total volatile compounds concentration in the effluent from the secondary carbon unit (i.e., unit in series) will be checked with the PID meter at the same time that the primary units are checked. However, since the detection limit of the PID meter is 0.1 ppm, this testing method does not have a low enough detection limit to determine if the AGC is being exceeded. Therefore, for compliance monitoring it is proposed to take a sample of the effluent from the secondary unit by drawing air through a charcoal absorption tube using a high volume pump attached to the sampling port in the discharge piping.

The charcoal tube will be submitted to a NYSDOH certified laboratory for analysis for halogenated volatile organics by NIOSH Method 1003. The concentration will be expressed in ug/m^3 (based on the sampling flow rate of the pump and the sampling time) for comparison to the AGC. Sampling of the effluent from the secondary carbon unit as described above, is proposed to be conducted once every two weeks during the first month of operation and then monthly or less frequent, as appropriate, based on the frequency the carbon units are replaced. A change in the sampling frequency will be reviewed with NYSDEC for approval prior to implementation.

6.0 HEALTH AND SAFETY PLAN

Pursuant to OSHA regulations, 29 CFR Part 1910.120, a Health and Safety Plan (HASP) has been formulated for this project and is attached under separate cover.

7.0 CONSTRUCTION OBSERVATION AND CERTIFICATION REPORT

A part-time construction observer from C.T. Male Associates, P.C. will be present during construction to assure the work is being conducted in accordance with the NYSDEC approved plans and specifications (Drawing No. 91-163, Sheet 1 to 3 of 3). The Project Engineer will also conduct periodic site visits during the construction. Daily field observation reports will be generated that will include the project name, location, time date, weather, temperature, work in progress, conformance with plans and specifications, items to verify, information or action required, any attachments identified and the reporting person's signature.

The personnel that will be working at the site will be certified with the minimum 40 hours of OSHA Hazardous Operations Health and Safety Training and required yearly updates in accordance with 29 CFR Part 1910.120.

After installation and testing, a construction certification report will be prepared and signed by a New York State Licensed Professional Engineer certifying that the vapor extraction system was substantially installed in accordance with the NYSDEC approved plans and specifications. The report will include the field observation reports and record drawings noting any deviations from the design drawings.

8.0 PROPOSED SCHEDULE

A proposed schedule for the project review, construction, start-up and preparation of the certification report is presented on the following page. NYSDEC will be notified at least ten (10) days in advance of the construction start date.

Respectfully submitted,

C.T. MALE ASSOCIATES, P.C.

Elizabeth W. Rovers

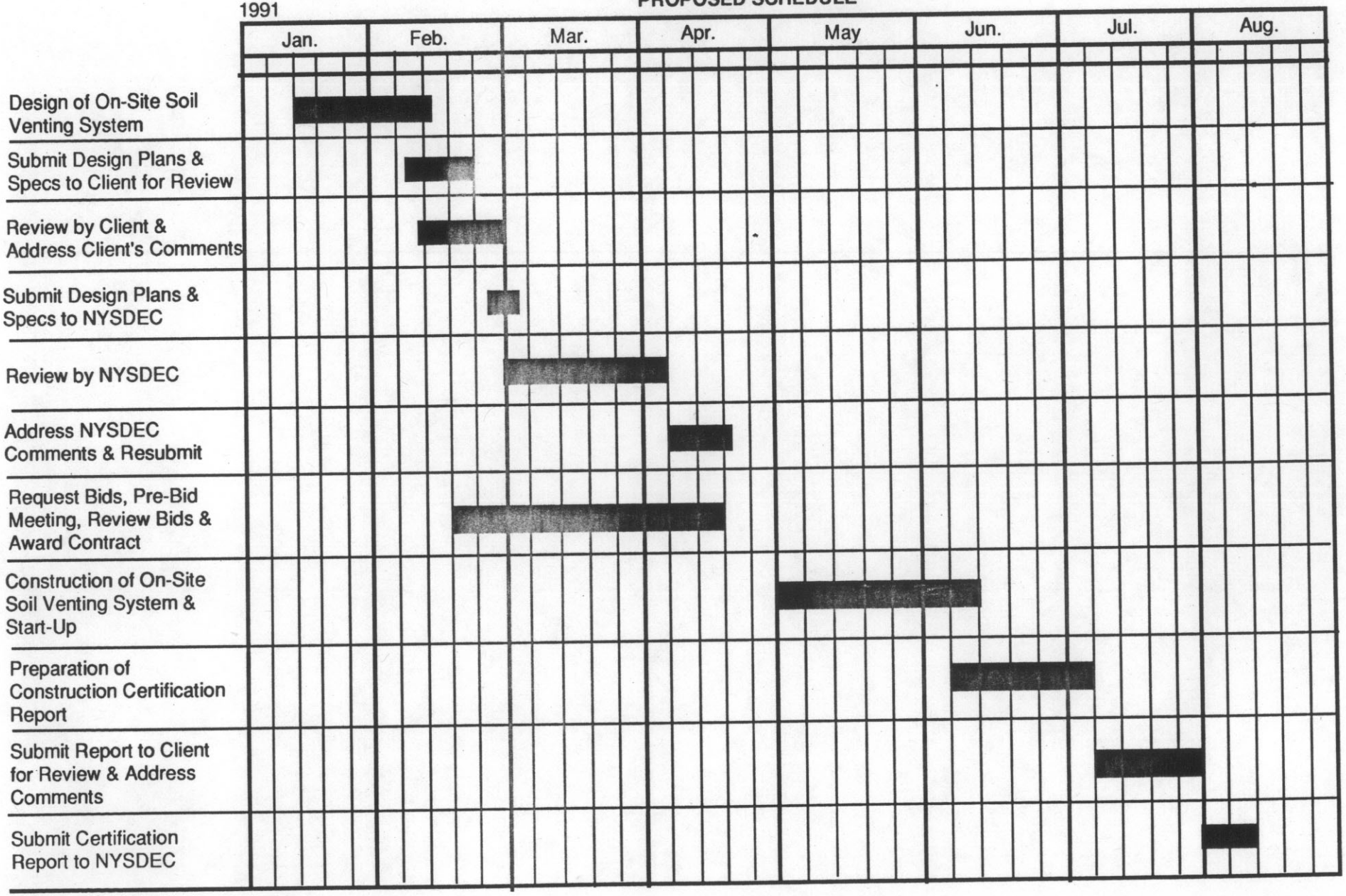
Elizabeth W. Rovers
Project Engineer

Reviewed and approved by:

Joseph E. Coffey, Jr., P.E.
Vice President, Engineering

LWR:bc

VAPOR EXTRACTION SYSTEM
INTERIM REMEDIAL MEASURES
ACTIVE INDUSTRIAL UNIFORM CO., INC.
PROPOSED SCHEDULE



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New York State Department of Environmental Conservation; 6 NYCRR Part 212, General Process Emission Sources.

New York State Department of Environmental Conservation; 6 NYCRR Part 372, "Hazardous Waste Management System and Related Standards for Generators, Transporters and Facilities", December 25, 1988.

New York State Department of Environmental Conservation. Foil Reference No. 91-123 for Spill No. 8806667.

NYSDEC. "New York State Air Guide-1 Guidelines for the Control of Toxic Ambient Air Contaminants". 1985-86 Edition, September, 1989 Printing.

The Spencer Turbine Company. Bulletin 8303.5. p. 10, Friction Loss Chart.

Twin City Testing. "Preliminary Subsurface Contaminant Assessment Report. December 7, 1987.

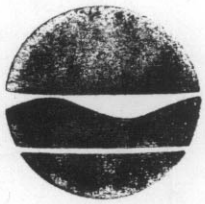
APPENDIX

A

APPENDIX A

NYSDEC CORRESPONDENCE

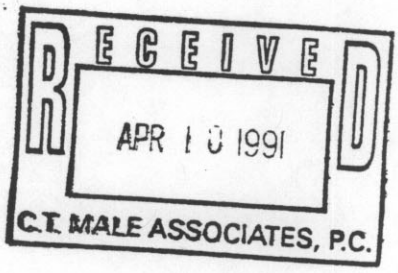
New York State Department of Environmental Conservation
Building 40—SUNY, Stony Brook, New York 11790-2356



Thomas C. Jorling
Commissioner

April 3, 1991

Ms. Elizabeth W. Rovers
C.T. Male Associates, P.C.
50 Century Hill Drive
P.O. Box 727
Latham, New York
12110



Re:Active Industrial Uniform, Site # 152125
IRM Workplan- Vapor Extraction System(3/1/91)
Off Site Soil Gas Survey Workplan(2/15/91)

Dear Ms. Rovers

These two documents have been reviewed by the NYSDOH, Bureau of Environmental Exposure Investigation(Albany); NYSDEC, Bureau of Eastern Remedial Action (Albany); and NYSDEC, Division of Hazardous Waste Remediation, Region 1 (Stony Brook).

Comments:

Off Site Soil Gas Survey Workplan:
Page 6- The citizens that live in the area should also be informed five days in advance of performing the work.

The on site soil gas survey conducted previously at the site indicated the presence of elevated levels of trichloroethene and tetrachloroethane in areas adjacent to the south western property boundary. This property boundary is adjacent to residential property; therefore, intrusion of soil gas into homes, especially basements, is a potential health concern. The off-site soil gas survey should include sampling on the adjacent residential property. The extent of the contamination plume on the residential property needs to be defined, down to below detection limits (2ppb). Indoor air sampling may be necessary if elevated levels of volatile organic compounds are found in close proximity to individual residences

Vapor Extraction Report,IRM:
page 10, paragraph 2- "...it is proposed to dispose of the water that is collected in the moisture separator back into the ground via the collection wells." Please be advised that this is not acceptable- the liquid from the moisture separator must be analyzed before the proper method of disposal can be determined. The liquid should be drummed, sampled, and analyzed and the disposal method must be approved by the NYSDEC.

page 18-re vapor phase carbon tanks- There should be sampling ports before, after, and between the carbon tanks so that the % removal efficiency can be confirmed and the carbon can be replaced at the appropriate time (replacing carbon too soon will

add extra cost and replacing carbon too late could cause a violation of NYSDEC air guidelines) Please include procedures for periodic testing of the influent and effluent of the carbon tanks. The tests should be taken weekly at the start up and after a month may be changed to every 2 or more weeks if the data shows that the exhaustion of the carbon can be predicted with a degree of accuracy. Changes in the weekly testing schedule should be done with the approval of this office.

Paving and Drywells-please include specifications of the paving material. The plan for the paving needs to be changed to assure that stormwater runoff does not discharge to an area that would carry the contamination plume further downgradient of the site (the proposed drywell in the driveway is not acceptable because it is downgradient of an area of soil contamination and could be over an area of groundwater contamination).

Please call with any questions.

Thanks,

John E Conover Jr

John E. Conover, Jr.
Environmental Engineer I
Hazardous Waste Remediation

cc: A Candela, NYSDEC
D Miles, NYSDOH
E Blackmer, NYSDEC
S Robbins, SCDOH
aiu3

B

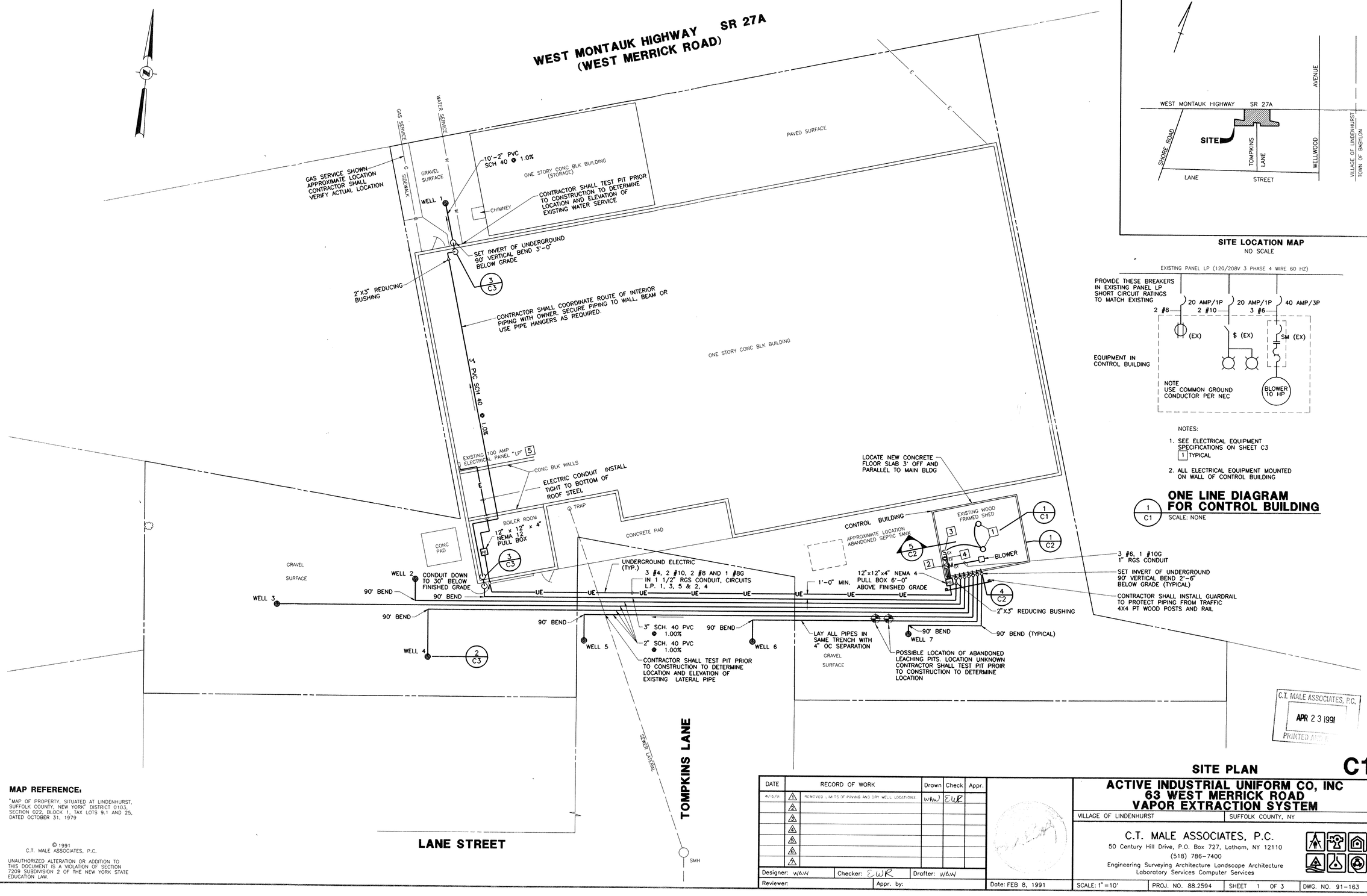
APPENDIX B

DRAWINGS

Apr 12, 1991 - 13:01

PLOT SCALE FACTOR: 1=10

CAD DWG. FILE NAME: ALC1.DWG



SITE LOCATION MAP
NO SCALE

NOTES:

1. SEE ELECTRICAL EQUIPMENT SPECIFICATIONS ON SHEET C3
   1 TYPICAL
2. ALL ELECTRICAL EQUIPMENT MOUNTED ON WALL OF CONTROL BUILDING

ONE LINE DIAGRAM FOR CONTROL BUILDING
1 / C1
SCALE: NONE

C.T. MALE ASSOCIATES, P.C.
APR 23 1991
PRINTED AND

SITE PLAN **C1**

MAP REFERENCE:

"MAP OF PROPERTY, SITUATED AT LINDENHURST, SUFFOLK COUNTY, NEW YORK" DISTRICT 0103, SECTION 022, BLOCK 1, TAX LOTS 9.1 AND 25, DATED OCTOBER 31, 1979

DATE		RECORD OF WORK	Drawn	Check	Appr.
4/15/91	1	REMOVED LIMITS OF PAVING AND DRY WELL LOCATIONS	WAW	EWR	
	2				
	3				
	4				
	5				
	6				
	7				

Designer: WAW | Checker: EWR | Drafter: WAW
Reviewer: | Appr. by:

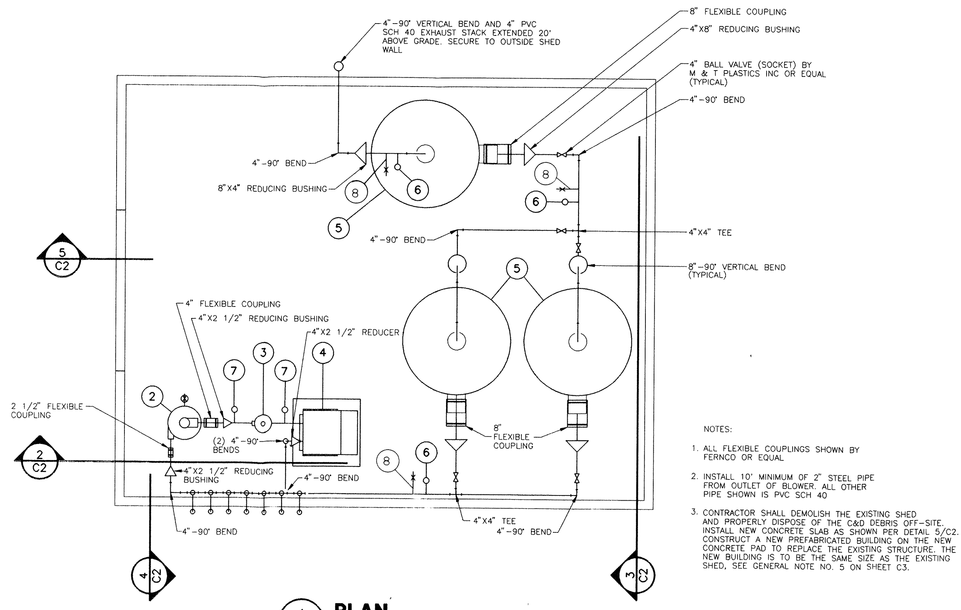
Date: FEB 8, 1991

ACTIVE INDUSTRIAL UNIFORM CO, INC
63 WEST MERRICK ROAD
VAPOR EXTRACTION SYSTEM

VILLAGE OF LINDENHURST | SUFFOLK COUNTY, NY

C.T. MALE ASSOCIATES, P.C.
50 Century Hill Drive, P.O. Box 727, Latham, NY 12110
(518) 786-7400
Engineering Surveying Architecture Landscape Architecture
Laboratory Services Computer Services

SCALE: 1"=10' | PROJ. NO. 88.2594 | SHEET 1 OF 3 | DWG. NO. 91-163



1 C2 **PLAN**
SCALE: 3/8"=1'-0"

NOTES:

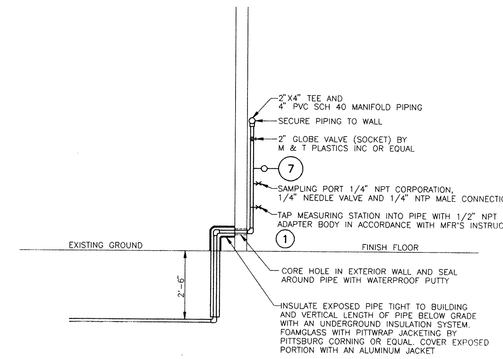
1. ALL FLEXIBLE COUPLINGS SHOWN BY FERNCO OR EQUAL
2. INSTALL 10' MINIMUM OF 2" STEEL PIPE FROM OUTLET OF BLOWER. ALL OTHER PIPE SHOWN IS PVC SCH 40
3. CONTRACTOR SHALL DEMOLISH THE EXISTING SHED AND PROPERLY DISPOSE OF THE C&D DEBRIS OFF-SITE. INSTALL NEW CONCRETE SLAB AS SHOWN PER DETAIL 5/C2. CONSTRUCT A NEW PREFABRICATED BUILDING ON THE NEW CONCRETE PAD TO REPLACE THE EXISTING STRUCTURE. THE NEW BUILDING IS TO BE THE SAME SIZE AS THE EXISTING SHED, SEE GENERAL NOTE NO. 5 ON SHEET C3.

2 C2 **SECTION**
SCALE: 3/8"=1'-0"

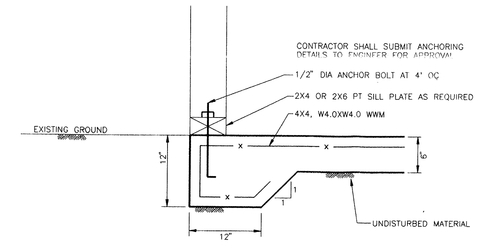
3 C2 **SECTION**
SCALE: 3/8"=1'-0"

GENERAL EQUIPMENT SPECIFICATIONS

1. PROVIDE SEVEN ANNUBAR FLOW SENSORS EACH WITH TWO 1/8" X 1/8" NPT BRASS BALL VALVES FOR HIGH AND LOW PRESSURE SIDES, MODEL NO. GCR-15-2SCH40-CB-MC2 BY DIETERICH STANDARD CORP. OR EQUAL. INSTALL ONE ANNUBAR ON EACH VAPOR EXTRACTION WELL HEADER PIPE IN THE CONTROL BUILDING WHERE SHOWN ON THE DRAWINGS. PROVIDE ONE PORTABLE EAGLE EYE INDICATOR/FLOW METER MODEL NO. EFP-F4-SCFM-80, 0-250 RANGE BY DIETERICH STANDARD CORPORATION OR EQUAL. THE DIETERICH STANDARD FLOW METER SHALL COME SUPPLIED WITH A MALE (PART 1206-01) AND FEMALE (PART 12005-01) QUICK DISCONNECT AND TWO 1/8" NIPPLES (PART 12201-01) TO FACILITATE CONNECTION TO THE DIETERICH STANDARD ANNUBAR.
2. PROVIDE AND INSTALL ONE CYCLONIC MOISTURE SEPARATOR WITH BUILT IN VACUUM RELIEF VALVE AND AUTOMATIC OVERFLOW SHUT-OFF, MODEL NO. MS300D BY EG & G ROTRON OR EQUAL. SHALL BE RATED UP TO 300 CFM.
3. PROVIDE AND INSTALL INLINE FILTER FOR VACUUM SYSTEM MODEL NO. 515256 BY EG & G ROTRON OR EQUAL.
4. PROVIDE AND INSTALL ONE REGENERATIVE EXPLOSION PROOF VACUUM BLOWER, MODEL NO. DR8BD72WRL BY EG & G ROTRON OR EQUAL. THE BLOWER HOUSING, IMPELLER AND COVER SHALL BE CONSTRUCTED OF ALUMINUM AND COATED WITH TEFLON. THE BLOWER HOUSING SHALL BE SEALED BY THE MANUFACTURER TO PREVENT LEAKAGE OF GASES. THE MOTOR SHALL BE 10 HP, 3 PHASE, 208 VOLTS, 60 HZ. NORMAL OPERATING CONDITIONS ARE EXPECTED TO APPROXIMATE 250 CFM AT 62" WATER.
5. PROVIDE FIVE ACTIVATED CARBON VAPOR PHASE TREATMENT UNITS, ODOR-MISER MODEL NO. OM-1000 BY HOYT CORPORATION OR EQUAL. THREE OF THE UNITS SHALL BE INSTALLED AS SHOWN ON THE DRAWINGS. THE OTHER TWO UNITS SHALL BE PLACED IN THE CONTROL BUILDING. THE CARBON UNIT SHALL BE CONSTRUCTED OF CARBON STEEL AND HAVE A CORROSION RESISTANT COATING. EACH UNIT SHALL CONTAIN 1,130 POUNDS OF ACTIVATED CARBON. THE ACTIVATED CARBON SHALL BE CALGON BPL OR EQUAL, 4 X 8 MESH WITH A CARBON TETRACHLORIDE ABSORPTION NUMBER OF 60 PERCENT MINIMUM. THE UNIT SHALL BE RATED UP TO A MAXIMUM AIR FLOW OF 1,000 SCFM.
6. PROVIDE 3 PRESSURE GAUGES PART NO. 271949 WITH 1/4" NPT BY EG & G ROTRON OR EQUAL. INSTALL THE GAUGES WHERE SHOWN ON THE DRAWINGS.
7. PROVIDE 9 VACUUM GAUGES PART NO. 271950 WITH 1/4" NPT BY EG & G ROTRON OR EQUAL. INSTALL THE GAUGES WHERE SHOWN ON THE DRAWINGS.
8. SAMPLING PORT 1/4" NPT CORPORATION, 1/4" NPT NEEDLE VALVE AND 1/4" MALE CONNECTION



4 C2 **TYPICAL RISER DETAIL AT CONTROL BUILDING**
SCALE: NONE



NOTE:
4000 LB PSI AIR ENTRAINED CONC, ALL CONCRETE MATERIAL AND WORKMANSHIP IN ACCORDANCE WITH ACI 301-89

5 C2 **NEW FLOOR DETAIL FOR NEW CONTROL BUILDING**
SCALE: NONE

CONTROL BUILDING DETAILS C2

DATE		RECORD OF WORK	Drawn	Check	Appr.
4/15/91	1	REVISED CONTROL BUILDING CONSTRUCTION REQUIREMENTS TO REPLACE EXISTING SHED AND SO AWAY WITH RAMP.	WAW	EWR	
	2				
	3				
	4				
	5				
	6				
	7				

Designer: WAW | Checker: EWR | Drafter: WAW
Reviewer: | Appr. by:

Date: FEB 8, 1991

ACTIVE INDUSTRIAL UNIFORM CO, INC
63 WEST MERRICK ROAD
VAPOR EXTRACTION SYSTEM
VILLAGE OF LINDENHURST | SUFFOLK COUNTY, NY

C.T. MALE ASSOCIATES, P.C.
50 Century Hill Drive, P.O. Box 727, Latham, NY 12110
(518) 786-7400
Engineering Surveying Architecture Landscape Architecture
Laboratory Services Computer Services

SCALE: AS SHOWN | PROJ. NO. 88.2594 | SHEET 2 OF 3 | DWG. NO. 91-163

Apr 12, 1991 - 13:32
PLOT SCALE FACTOR 1=32
CAD DWG. FILE NAME: ALC2.DWG

GENERAL NOTES

1. THE WORK SHALL CONSIST OF FURNISHING ALL LABOR, MATERIALS, TOOLS AND EQUIPMENT TO INSTALL SEVEN VAPOR EXTRACTION WELLS, HEADER PIPING, MANIFOLD, VALVES AND CONTROLS, MOISTURE SEPARATOR, INLINE FILTER, EXPLOSION PROOF BLOWER, CARBON TREATMENT UNITS, ELECTRICAL CONTROLS, NEW CONCRETE FLOOR IN THE CONTROL BUILDING, AND ANCILLARY EQUIPMENT WHERE SPECIFIED IN THE DRAWINGS.

2. THE CONTRACTOR SHALL SUBMIT A COPY OF HIS WORKER'S COMPENSATION, COMPREHENSIVE GENERAL LIABILITY, AND CONTRACTOR'S PROTECTIVE LIABILITY INSURANCE CERTIFICATES PRIOR TO THE START OF WORK. THE CONTRACTOR SHALL PROVIDE A SEPARATE PROTECTIVE LIABILITY POLICY NAMING THE OWNER, ACTIVE INDUSTRIAL UNIFORM CO., INC. AND THE ENGINEER, C.T. MALE ASSOCIATES, P.C. AS THE INSURED.

3. THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS/SUBMITTALS TO THE ENGINEER IN TRIPLICATE PRIOR TO THE START OF WORK FOR APPROVAL BY THE ENGINEER ON ALL EQUIPMENT, INCLUDING, BUT NOT LIMITED TO, MOISTURE SEPARATOR, VACUUM BLOWER, INLINE FILTER, ANNUBAR FLOW SENSOR AND INDICATOR/FLOW METER, CARBON TREATMENT UNITS, VALVES AND THE PREFABRICATED CONTROL BUILDING STRUCTURE. SUBMIT THREE COPIES OF OPERATIONS AND MAINTENANCE DATA FOR ALL EQUIPMENT PRIOR TO FINAL INSPECTION.

4. CONTRACTOR SHALL SUBMIT A SCHEDULE TO THE ENGINEER PRIOR TO START OF WORK SHOWING THE WORK ITEMS AND ANTICIPATED START AND COMPLETION DATES.

5. THE CONTRACTOR WILL BE RESPONSIBLE FOR OBTAINING A BUILDING PERMIT FROM THE VILLAGE OF LINDENHURST BUILDING DEPARTMENT FOR THE PREFABRICATED CONTROL BUILDING STRUCTURE. THE CONTRACTOR SHALL SUBMIT IN TRIPLICATE SHOP DRAWINGS/SUBMITTALS OF THE PREFABRACTED CONTROL BUILDING STRUCTURE TO THE ENGINEER FOR APPROVAL PRIOR TO APPLYING FOR THE BUILDING PERMIT. ONCE THE ENGINEER HAS APPROVED THE SUBMITTAL THE BUILDING PERMIT CAN BE APPLIED FOR BY THE CONTRACTOR.

6. THE CONTRACTOR SHALL PERFORM THE WORK IN ACCORDANCE WITH ALL APPLICABLE LOCAL, STATE AND FEDERAL REGULATIONS AND REQUIREMENTS, AND THESE SPECIFICATIONS. EQUIPMENT SHALL BE INSTALLED WHERE AND AS SHOWN ON THE DRAWINGS AND IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS.

7. ALL WORK SHALL BE COORDINATED WITH C.T. MALE ASSOCIATES, P.C. AND THE OWNER. THE CONTRACTOR SHALL LIMIT USE OF THE SITE TO ALLOW FOR OWNER TO PERFORM DAILY OPERATIONS.

8. THROUGHOUT THE WORK ALL PERSONNEL WILL BE REQUIRED TO FOLLOW PERSONAL SAFETY AND PROTECTIVE PRECAUTIONS ACCORDING TO APPLICABLE OSHA REQUIREMENTS, INCLUDING 29 CFR PART 1910.120. THE CONTRACTOR SHALL SUBMIT A COPY OF THE WORKERS CERTIFICATE OF 40 HOURS OF OSHA HAZARDOUS OPERATIONS HEALTH AND SAFETY TRAINING AND REQUIRED YEARLY UPDATES TO THE ENGINEER PRIOR TO THE START OF WORK.

9. THE CONTRACTOR SHALL SUPPLY A DECONTAMINATION FACILITY TO DECONTAMINATE ALL EQUIPMENT AND WORKERS THAT COME INTO CONTACT WITH POTENTIALLY CONTAMINATED SOIL AND OR GROUNDWATER. THE CONTRACTOR SHALL SUBMIT IN WRITING PRIOR TO THE START OF WORK HOW THE DECONTAMINATION FACILITY WILL BE CONSTRUCTED AND WHAT IT WILL CONSIST OF. WASTE DECONTAMINATION FLUID SHALL BE DISCHARGED TO THE GROUND IN AN AREA OF DOCUMENTED CONTAMINATION UNLESS DIRECTED OTHERWISE BY NYSDEC.

10. DISPOSABLE PROTECTIVE CLOTHING THAT COMES INTO CONTACT WITH POTENTIALLY CONTAMINATED SOIL OR GROUNDWATER WILL BE DISPOSED OF AS A HAZARDOUS WASTE BY THE CONTRACTOR. THIS WASTE SHALL BE MANIFESTED AS A HAZARDOUS WASTE SOLID, N.O.S., ORM-E, UN9189, F002.

11. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROPER DISPOSAL OFF-SITE OF ALL WASTES GENERATED DURING THE WORK UNLESS SPECIFIED OTHERWISE IN THESE SPECIFICATIONS. A COPY OF ALL WASTE TRANSPORTATION AND DISPOSAL DOCUMENTS AND APPLICABLE PERMITS (6 NYCRR PART 364 AND APPROVAL FORM FROM TSDF) SHALL BE SUBMITTED TO THE ENGINEER AND OWNER.

12. INSTALLATION OF VAPOR EXTRACTION WELLS:
    1. DURING ADVANCEMENT OF THE VAPOR EXTRACTION WELLS THE CONTRACTOR SHALL PERFORM STANDARD SPLIT SPOON SAMPLING PER THE PROCEDURES OF ASTM D-1586. FOUR SPLIT SPOON SOIL SAMPLES SHALL BE TAKEN PER BORING AT: 0-2 FT, 5-7 FT, 10-12 FT AND 15-17 FT. AFTER THE SPLIT SPOON HAS BEEN OPENED BY THE CONTRACTOR, C.T. MALE ASSOCIATES SHALL RETRIEVE THE SOIL SAMPLES FROM THE SPLIT SPOON DIRECTLY INTO CLEAN 4 OUNCE GLASS SYSTEM JARS (8-CHEM NO. 53210125 OR EQUAL) FOR LABORATORY ANALYSES AND A 12 OUNCE GLASS JAR FOR HEAD SPACE ANALYSIS. USING A CLEAN STAINLESS STEEL SCUPULA OR TROWEL AND THE JARS SHALL BE SEALED.
    2. THE CONTRACTOR SHALL CLEAN THE DRILLING EQUIPMENT WITH A HIGH TEMPERATURE HIGH PRESSURE WASHER (STEAM CLEANER) PRIOR TO THE START OF WORK AND IN BETWEEN EACH BORING AND AT COMPLETION OF WORK TO PREVENT CROSS CONTAMINATION.
    3. THE SPLIT SPOON AND STAINLESS STEEL SAMPLING EQUIPMENT SHALL BE CLEANED PRIOR TO THE START OF WORK, IN BETWEEN EACH USE AND AT COMPLETION OF WORK TO PREVENT CROSS CONTAMINATION AS FOLLOWS:
       WASH WITH TAP WATER AND NON-PHOSPHATE DETERGENT
       -- RINSE WITH TAP WATER
       -- RINSE WITH METHANOL
       -- RINSE WITH ACETONE
       -- RINSE WITH METHANOL
       -- RINSE WITH DEIONIZED WATER
       -- AIR DRY AND WRAP IN ALUMINUM FOIL

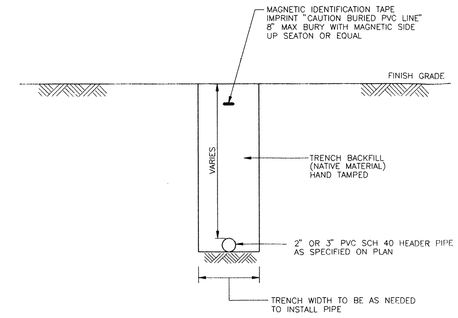
ELECTRICAL GENERAL NOTES

1. CONTRACTOR SHALL INSTALL EQUIPMENT IN COMPLIANCE WITH CURRENT N.E.C., APPLICABLE STATE AND LOCAL CODES, AND ACCEPTED GOOD CONSTRUCTION PRACTICE.
2. CONTRACTOR SHALL OBSERVE ALL OWNER'S SAFETY REQUIREMENTS AND GOOD HOUSEKEEPING OF JOB SITE.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR SECURITY OF ALL TOOLS AND EQUIPMENT ON SITE.
4. CONTRACTOR SHALL COORDINATE ALL WORK SCHEDULING WITH C.T. MALE ASSOCIATES AND OWNER ON DAILY BASIS.
5. CONTRACTOR SHALL REVIEW AND CONFIRM EXACT LOCATIONS OF ALL EQUIPMENT BEING INSTALLED WITH AUTHORIZED OWNER'S REPRESENTATIVE ON SITE. LOCATIONS SHOWN ON DRAWINGS ARE APPROXIMATELY SUBJECT TO OWNER'S FINAL APPROVAL.
6. CONTRACTOR SHALL OBTAIN ALL PERMITS AND FINAL INSPECTION CERTIFICATES, INCLUDING N.Y. FIRE UNDERWRITERS CERTIFICATES.
7. CONTRACTOR SHALL INSTALL ALL EQUIPMENT AS SHOWN EXCEPT AS OTHERWISE NOTED.
8. CONTRACTOR SHALL NOT USE NON-METALIC CONDUIT, BOXES, OR STRUCTURES UNLESS SPECIFICALLY ALLOWED ON THESE DRAWINGS.
9. CONTRACTOR SHALL USE A "GREEN" GROUND CONDUCTOR IN ALL CONDUITS AND FEEDERS. GROUND WIRE SHALL BOND TO ALL BOXES, ENCLOSURES, AND GROUND BARS.
10. CONTRACTORS SHALL PROVIDE WIRING AS FOLLOWS UNLESS OTHERWISE SPECIFIED:
    A. ALL WIRING SHALL BE DUAL RATED THWN/THHN.
    B. ALL GROUNDS SHALL BE "GREEN" A MINIMUM OF #12 AWG OR AS INDICATED.
    C. ALL NEUTRALS SHALL BE "WHITE" OR "GRAY" A MINIMUM OF #12 AWG.
    D. ALL 208 VAC POWER WIRES SHALL BE COLOR CODED AS FOLLOWS: PHASE A - BLACK
       PHASE B - RED
       PHASE C - BLUE

    EACH WIRE SHALL BE "TAGGED" FOR POINT OF ORIGIN AND DESTINATION.
11. CONTROL BUILDING AREA IS CLASSIFIED AS CLASS 1 DIVISION 2., GROUP C, D. ALL ELECTRICAL WORK SHALL CONFORM WITH REQUIREMENTS OF NATIONAL ELECTRIC CODE, CHAPTER 5, APPLICABLE TO THIS CLASSIFICATION.

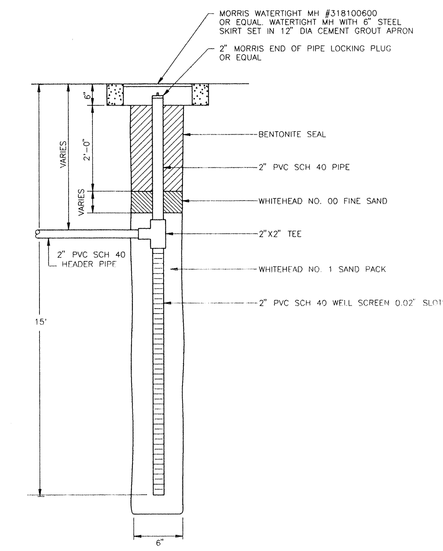
ELECTRICAL EQUIPMENT SPECIFICATIONS

1. PROVIDE TWO CROUSE-HINDS TYPE VXHA COMPLETE WITH GLOBE, LAMP AND GUARD. CEILING MOUNTED, 120V, 150 WATT INCANDESCENT FIXTURES. (VERIFY SUITABILITY WITH VENDOR FOR AREA CLASSIFICATION) OR ENGINEER APPROVED EQUAL. CONNECT TO CIRCUIT LP-2.
2. PROVIDE 3 POLE CIRCUIT BREAKER TYPE NEMA SIZE 2 COMBINATION MOTOR STARTER IN NEMA 719 ENCLOSURE WITH HEATERS, SUITABLE FOR A 10HP, 208 VOLTS, 3 PHASE MOTOR, SIMILAR TO ALLEN-BRADLEY BULLETIN #513-CEH-41.
3. PROVIDE 1 POLE, 20 A. 120/277 VAC RATED TOGGLE SWITCH SIMILAR TO CROUSE-HINDS NO. 3FSC-1129.
4. PROVIDE NEMA TYPE 5-20R RECEPTACLE IN FACTORY SEALED, CROUSE-HINDS ARK-GARD2 RECEPTACLE TYPE ENR, WITH MATCHING PLUG, TYPE ENP. COMPLETE WITH MOUNTING BOX.
5. PROVIDE 2-1P-20A CIRCUIT BREAKERS TO SERVE LIGHTS AND RECEPTACLES IN SHED AND 1-3 POLE-30 AMP CIRCUIT BREAKER TO SERVE BLOWER. INSTALL BREAKERS AT POSITIONS INDICATED.

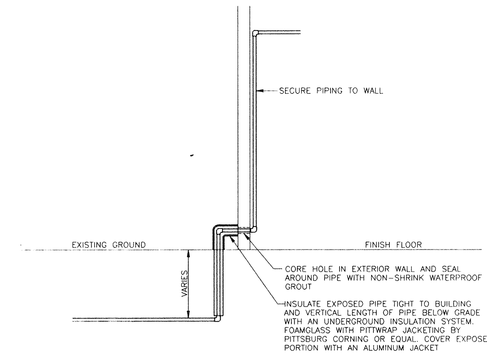


NOTE
THIS DETAIL IS ALSO TYPICAL FOR THE TRENCH WITH ALL THE INDIVIDUAL WELL HEADER PIPES

1/C3 **EXTRACTION WELL HEADER TRENCH DETAIL**
SCALE: NONE



2/C3 **VAPOR EXTRACTION WELL**
SCALE: NONE



3/C3 **TYPICAL RISER DETAIL AT MAIN BUILDING**
SCALE: NONE

C.T. MALE ASSOCIATES, P.C.
APR 2 3 1991
PRINTED AND IS

GENERAL DETAILS C3

DATE		RECORD OF WORK	Drawn	Check	Appr.
4-1-91	1	ADDED GENERAL NOTE 5 REMOVED HAVING DETAIL	WAW	EWR	
	2				
	3				
	4				
	5				
	6				
	7				

Designer: WAW | Checker: EWR | Drafter: WAW
Reviewer: | Appr. by:
Date: FEB 8, 1991

ACTIVE INDUSTRIAL UNIFORM CO, INC
63 WEST MERRICK ROAD
VAPOR EXTRACTION SYSTEM
VILLAGE OF LINDENHURST | SUFFOLK COUNTY, NY

C.T. MALE ASSOCIATES, P.C.
50 Century Hill Drive, P.O. Box 727, Latham, NY 12110
(518) 786-7400
Engineering Surveying Architecture Landscape Architecture
Laboratory Services Computer Services

SCALE: AS SHOWN | PROJ. NO. 88.2594 | SHEET 3 OF 3 | DWG. NO. 91-163

AUTOMATIC
PLOT SCALE FACTOR: 1=1
CAD DWG. FILE NAME: ALC3.DWG

C

APPENDIX C

MANUFACTURER'S LITERATURE

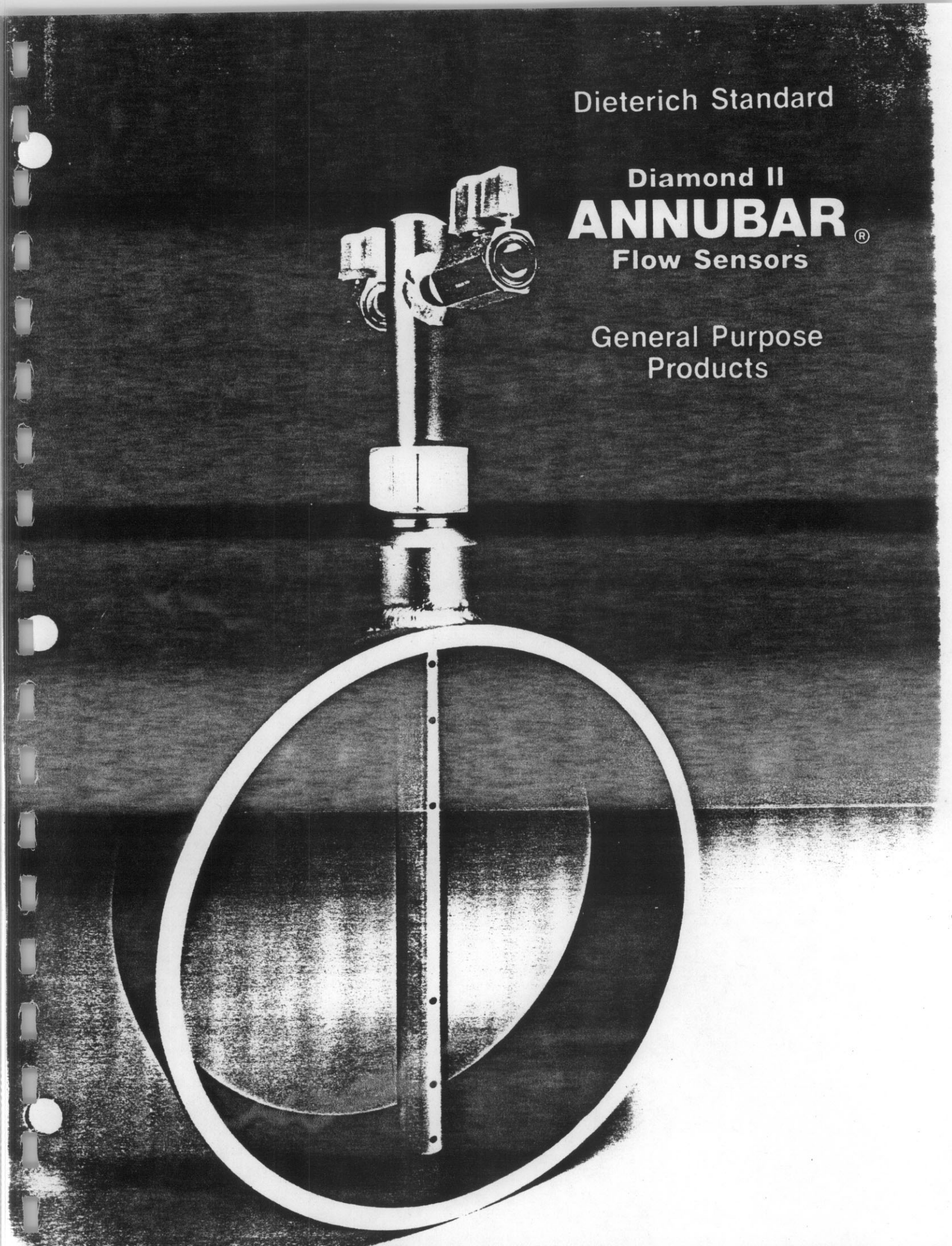
C.T. MALE ASSOCIATES, P.C.

DIETRICH STANDARD ANNUBAR AND INDICATOR

Dieterich Standard

Diamond II ANNUBAR® Flow Sensors

General Purpose Products



Annubar flow sensors

Diamond II Annubar General Purpose products

The General Purpose Annubar is a primary flow sensor designed to produce a differential pressure that is proportional to flow.

Annubar is compatible with a variety of secondary instrumentation for easy monitoring of gas and liquid* flow rates for totalizing, recording or control.

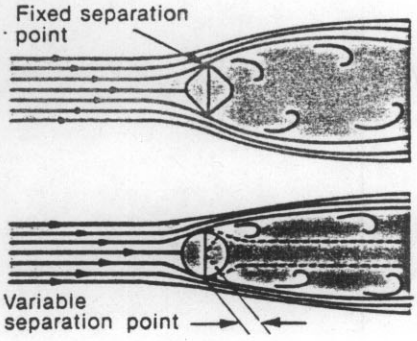
*For steam applications, consult industrial product catalog (DS-1001).

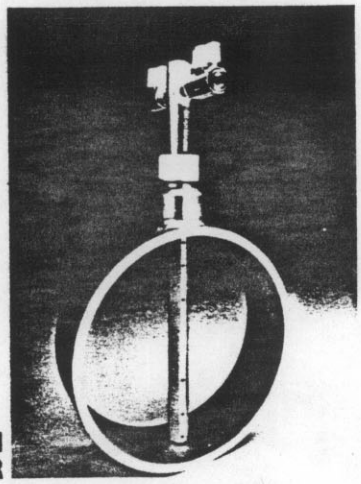
Annubar accuracy

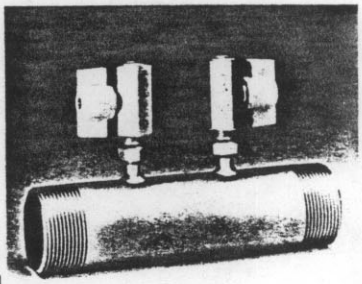
Accuracy: ±1.0% of actual value
Flow turndown: greater than 10:1
Repeatability: ±0.1% of actual value

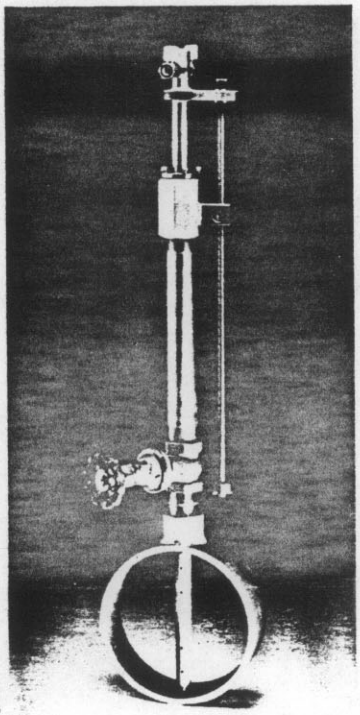
The diamond shape—key to accuracy.

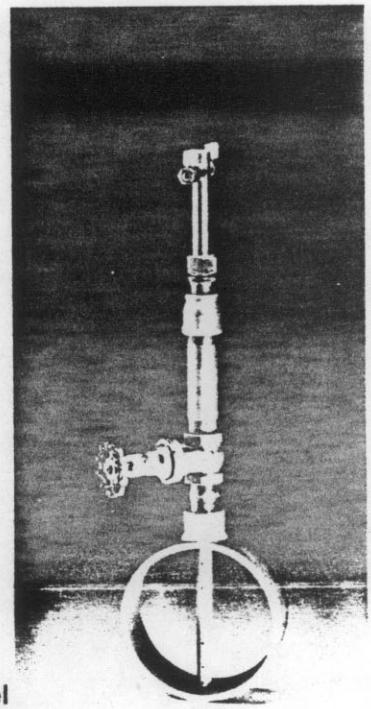
The diamond shape establishes a fixed separation point of the fluid from the sensor. The accuracy of the Diamond II Annubar is maintained regardless of the fluid velocity. Round sensors have a variable separation point of the fluid from the sensor. This causes the inaccuracy or error to increase with velocity (up to ±10%).




Model GCR


Model GNT


Model GMT


Model GLT

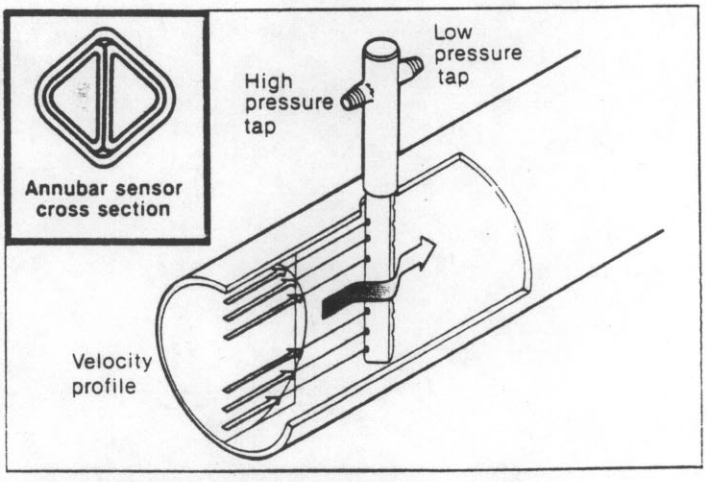
How Annubar works

High pressure averaging. The high pressure is sensed by impact ports located at specific points along the sensor facing up stream. Inside the high pressure chamber, an average pressure is transmitted to the high pressure tap.

Low pressure sensing. The rear ports pointing downstream sense the average low pressure.

Differential pressure (h_w). The difference between the high and the low pressure is the differential pressure or DP. This difference in pressure is proportional to the flow rate.

Instrument connections. The instrument connections transmit the high and low pressure to a local indicator, electronic transmitter, or other secondary devices where the signal is read as a flow rate.



® Annubar Registered Trademark of Dieterich Standard U.S. Patent No. 4,559,836 and various foreign patents. Other U.S. and foreign patents pending.

Annubar® models GNT/GCR—medium pressure, regular

2[illegible] psig @ 250°F maximum (For higher pressure and temperature, consult factory.)

How to specify

A. [illegible]st model, sensor and pipe size as illustrated below. (See sensor sizing and selection.)

B. [illegible]elect component options, Steps 1 and 2.

GNT-10, In-line model (½" to 2" pipe diameters)

GCR—Regular model

Code	Sensor (see sensor sizing and selection)
15	2" to 6" pipe diameters
16	2" to 12" pipe diameters—opposite side support
25	6" to 24" pipe diameters
26	6" to 24" pipe diameters—opposite side support
35	12" to 42" pipe diameters
36	24" to 42" pipe diameters—opposite side support

Pipe size and schedule or ID and wall thickness

Select one

Step 1 Instrument valve connections

Step 2 Mounting hardware

GCR-25, 10" Sch 40, CC, MG4 **Example**

Component options

Step 1. Instrument valve connections

Code C00—No valve required

Code CB		1/8"×1/8" NPT Ball valve Brass (225 psig @ 210°F max.)
Code CC		1/8"×1/8" NPT Needle valve Carbon steel (see note)
Code CS		1/8"×1/8" NPT Needle valve Stainless steel (see note)
Code CQ		1/8" NPT×quick disconnect valve Brass (300 psig @ 200°F max.)
Code CF Standard connection to Eagle Eye		1/8" NPT × 1/4" Flare valve Brass (225 psig @ 210° F max.)

Note:
This component option meets or exceeds 250 psig @ 250°F.

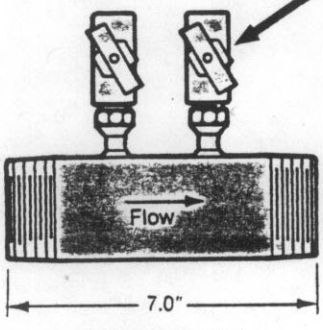
Step 2. Mounting hardware

Description	15/16	25/26	35/36
No mounting required*	M00	M00	M00
Regular mount (see note)	½"NPT	1"NPT	2"NPT
Weld fitting & comp. ferrule, CS	MG2	MG4	—
Weld fitting & comp. ferrule, SS	MG2S	MG4S	—
NPT male comp. fitting, CS	MC2	MC4	—
NPT male comp. fitting, SS	MC2S	MC4S	—
Pak-Lok mount, CS, graphite	—	—	MM8
Pak-Lok mount, SS, graphite	—	—	MM8S
Opposite support (see note)			
Weld fitting and plug, CS	MD2	MD4	MD6
Weld fitting and plug, SS	MD2S	MD4S	MD6S
Duct mount (see component description)			
Duct mount, CS	MG2CD	MG4CD	MG6CD
Duct mount, SS	MG2SD	MG4SD	MG6SD
Duct, opposite support, CS	MD2CD	MD4CD	MD6CD
Duct, opposite support, SS	MD2SD	MD4SD	MD6SD
Saddle mount (sensors 15 & 25 only)	½"NPT	1"NPT	—
2.35"—2.56" O.D.	NB2	—	—
2.41"—2.91" O.D.	NC2	—	—
2.97"—3.54" O.D.	ND2	—	—
3.74"—4.55" O.D.	NE2	NE4	—
5.94"—6.70" O.D.	NF2	NF4	—
8.54"—10.10" O.D.	—	NG4	—
10.64"—12.12" O.D.	—	NH4	—
12.67"—14.32" O.D.	—	NJ4	—

*If mounting is not supplied, the dimension from the pipe wall to the top of the mounting is required with the order.

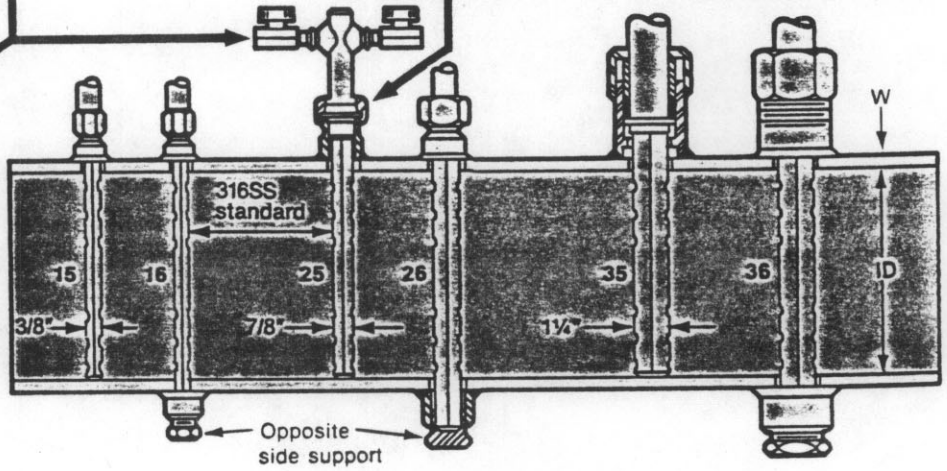
GNT—10

½" to 2" line sizes only



304 stainless steel

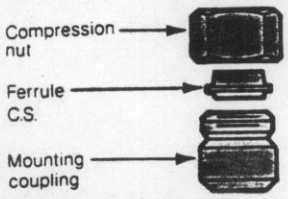
GCR



Component descriptions

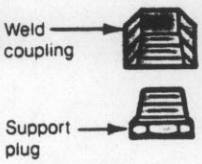
Mounting options

Weld fitting & compression ferrule



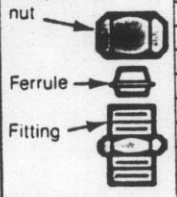
Codes
GCR-15/16
½"Nom.
MG2, MG2S
GCR-25/26
1" Nom.
MG4, MG4S

Opposite support mount



Codes
½" NPT
MD2, MD2S
1" NPT
MD4, MD4S
1½" NPT
MD6, MD6S

Compression fitting



Codes
½" NPT
MC2, MC2S
1" NPT
MC4, MC4S
2" NPT
MR8, MR8S
2" NPT is Pak-Lok design

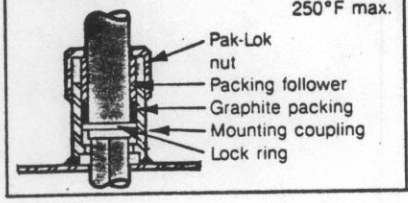
Weld couplings

To be used with NPT Male Compression Fittings (MC _____)

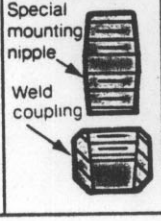
Material	15/16	25/26	35/36
Carbon steel	ME2	ME4	ME8
Stainless steel	ME2S	ME4S	ME8S
Aluminum	ME2A	ME4A	—
Copper	ME2K	ME4K	—
PVC (150°F max)	ME2P	ME4P	—

Pak-Lok mount (GCR 35/36 only)

MM6 & MM6S — 250 psig @ 250°F max.



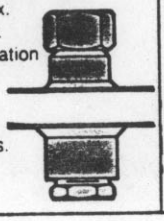
Coupling and nipple***



Codes
¾" NPT
MG3, MG3S
1¼" NPT
MG5, MG5S
2" NPT
MG8, MG8S

Duct mount*

10 psig max.
250°F max.
Duct installation require additional flow calculations. Consult the factory.



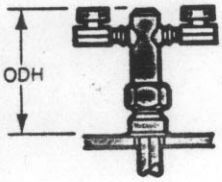
Saddle mounts**

300 psig max.
212° F. max.

Pipe O.D.	15/16	25/26
2.35" to 2.56"	NB2	—
2.41" to 2.91"	NC2	—
2.97" to 3.54"	ND2	—
3.74" to 4.55"	NE2	NE4
5.94" to 6.70"	NF2	NF4
8.54" to 10.10"	—	NG4
10.64" to 12.12"	—	NH4
12.62" to 14.32"	—	NJ4

Reference dimensions

Model GCR



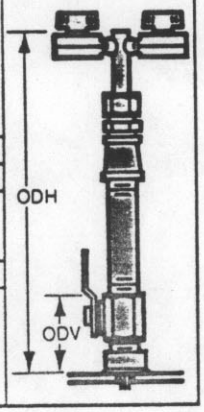
15/16	ODH
MG2 MG2S	4.5" 4.5"
25/26	ODH
MG4 MG4S	6.0" 6.0"
35/36	ODH
MM6 MM6S	8.0" 8.0"

Models GLT and GMT

ODH Calculations

Fully inserted	Fully retracted
ODH=D+W+ODV+C	ODH=2(D+W+ODV)+C

Where:
D=Inside pipe diameter
W=Pipe wall dimension
ODV=Top of pipe to top of valve
C=Constant



Sensor	Model GLT C	Model GMT C
15	11.8	12.52
25	12.69	14.58
35	—	16.32

Valve	ODV	Valve	ODV
VT3BG	4.46"	VT5SB	7.20"
VT3CB	6.21"	VT8BG	6.54"
VT3SB	6.21"	VT8CB	8.79"
VT5BG	5.26"	VT8SB	8.79"
VT5CB	7.20"		

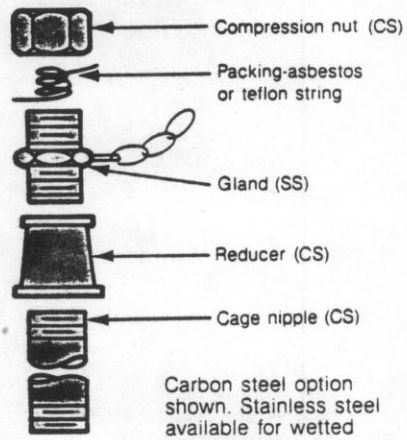
* Duct mount hardware is intended for use on sheet metal ducts using soft string packing. Each flange on the coupling is mounted to the duct through 4 screw holes. Because the duct may not provide adequate support for a cantilevered sensor, opposite supports are recommended for duct ID's greater than 6 inches.

** Saddle mounts are cast iron with double straps, for use on PVC, concrete, cast iron or other non-weldable pipes. An MC2, MC2S, MC4 or MC4S. NPT male compression fitting is required for mounting to model GCR. Additional models and line sizes can be accommodated as specials.

***Special mounting nipple is required for proper installation of all Flo-Tap models. Consult factory when using mounting hardware not supplied by Dieterich Standard.

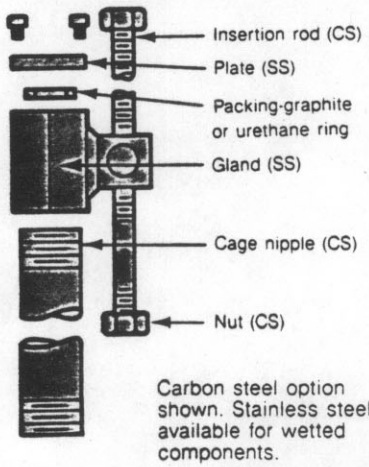
Flo-Tap packing glands

Model GLT — Sensors 15 and 25



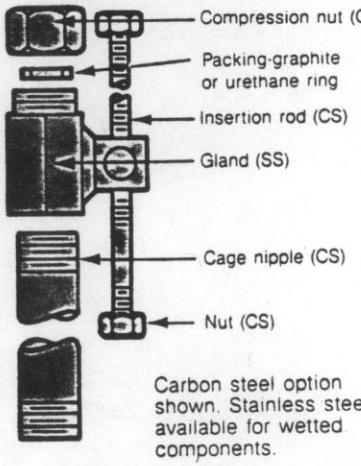
Carbon steel option shown. Stainless steel available for wetted components.

Model GMT — Sensors 25 and 35



Carbon steel option shown. Stainless steel available for wetted components.

Model GMT — Sensor 15



Carbon steel option shown. Stainless steel available for wetted components.

Sizing

Sensor sizing and selection

1. Supply general information and fluid parameters.
2. Select Annubar sensor based on pipe diameter.
3. Calculate approximate differential pressure, (h_w).
4. Verify the structural compatibility to the maximum allowable differential pressure.
5. Select model and specify component options.
6. Precise flow calculations are provided with your order.

Flow conditions

General information

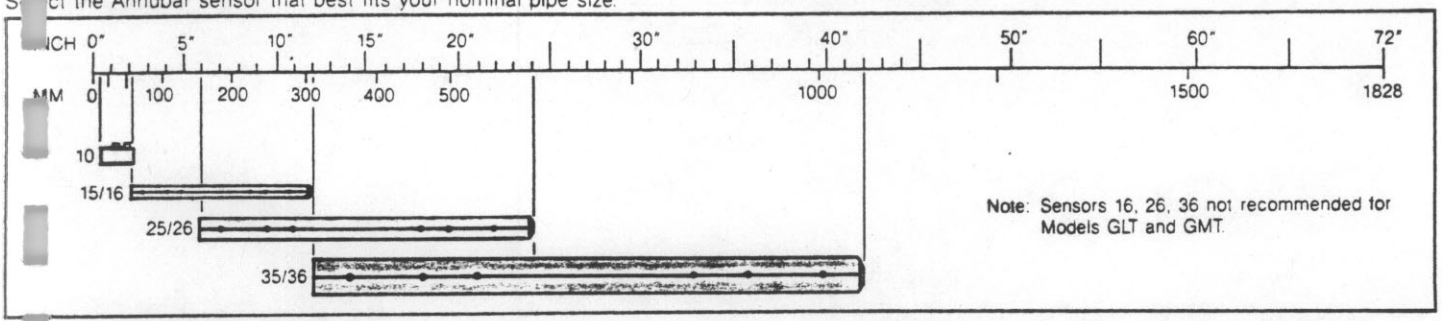
Description	
Pipe size, schedule or pipe ID, wall	
Tag number	
Fluid name	

Fluid parameters

Flow rate at maximum normal and minimum flow →	Maximum flow rate	Normal flow rate	Minimum flow rate	Units
Supply values at the above given flow rates	↓	↓	↓	↓
Temperature @				
Pressure (gage/abs.) @				
Vol. flow-gravity @				
Mass flow-density @				

Select sensor

Select the Annubar sensor that best fits your nominal pipe size.



Note: Sensors 16, 26, 36 not recommended for Models GLT and GMT.

Calculate approximate differential pressure (h_w)

Using the equations below or the Dieterich Standard flow calculator (DS-7400), calculate the differential pressure at maximum flow rate.

Liquid and gas (mass rate of flow)

$$h_w = \left(\frac{1}{\rho_f}\right)\left(\frac{lb_m/hr}{358.94\ K\ D^2}\right)^2$$

Liquid (volume rate of flow)

$$h_w = (G_f)\left(\frac{GPM}{5.666\ K\ D^2}\right)^2$$

Gas (volume rate of flow)

$$h_w = \left(\frac{T_f G}{P_f}\right)\left(\frac{SCFH}{7{,}711\ K\ D^2}\right)^2$$

Gas (actual volumetric flow)

$$h_w = (\rho_f)\left(\frac{ACFH}{358.94\ K\ D^2}\right)^2$$

h_w = differential pressure, inches of water at 68° F
K = flow coefficient
D = internal pipe diameter, inches
lb_m/hr = pounds mass per hour
GPM = U.S. gallons per minute
ACFH = Actual cubic feet per hour
SCFH = Standard cubic feet per hour (at 14.73 psia and 60° F)
ρ_f = flowing density, lb_m/ft^3 for gas:

$$\frac{P_f}{14.73} \times \frac{520}{T_f} \times .076487 \times G$$

.076487 lb_m/ft^3 = air density at 14.73 psia and 60°F
G_f = specific gravity of liquid
G = specific gravity of gas (molecular weight of air = 28.9644)
T_f = temperature of flowing gas in degrees Rankine (°R = °F + 460)
P_f = flowing pressure, psia

Flow coefficient—K

Sensor 10				Sensor 25/26			
Nom. pipe size	Pipe sch.	Pipe ID	K	Nom. pipe size	Pipe sch.	Pipe ID	K
1/2"	40	.622	.4265	5"	40	5.047	.5934
3/4"	40	.824	.5067	6"	40	6.065	.6047
1"	40	1.049	.5519	8"	40	7.981	.6173
1-1/4"	40	1.380	.5870	10"	40	10.020	.6250
1-1/2"	40	1.610	.0616	12"	40	11.938	.6298
2"	40	2.067	.6197	14"	STD	13.250	.6321
Sensors 15/16				16"	STD	15.250	.6349
2"	40	2.067	.5912	18"	STD	17.250	.6370
2-1/2"	40	2.469	.6026	20"	STD	19.250	.6387
3"	40	3.068	.6134	24"	STD	23.250	.6411
3-1/2"	40	3.548	.6192	Sensors 35/36			
4"	40	4.026	.6235	12"	40	11.938	.6186
5"	40	5.047	.6297	14"	STD	13.250	.6220
6"	40	6.065	.6337	16"	STD	15.250	.6269
8"	40	7.981	.6384	18"	STD	17.250	.6296
10"	40	10.020	.6413	20"	STD	19.250	.6321
12"	40	11.938	.6432	24"	STD	23.250	.6357
				30"	STD	29.250	.6393
				36"	STD	35.250	.6416
				42"	STD	41.250	.6432

Structural compatibility—maximum allowable differential pressure (h_w)

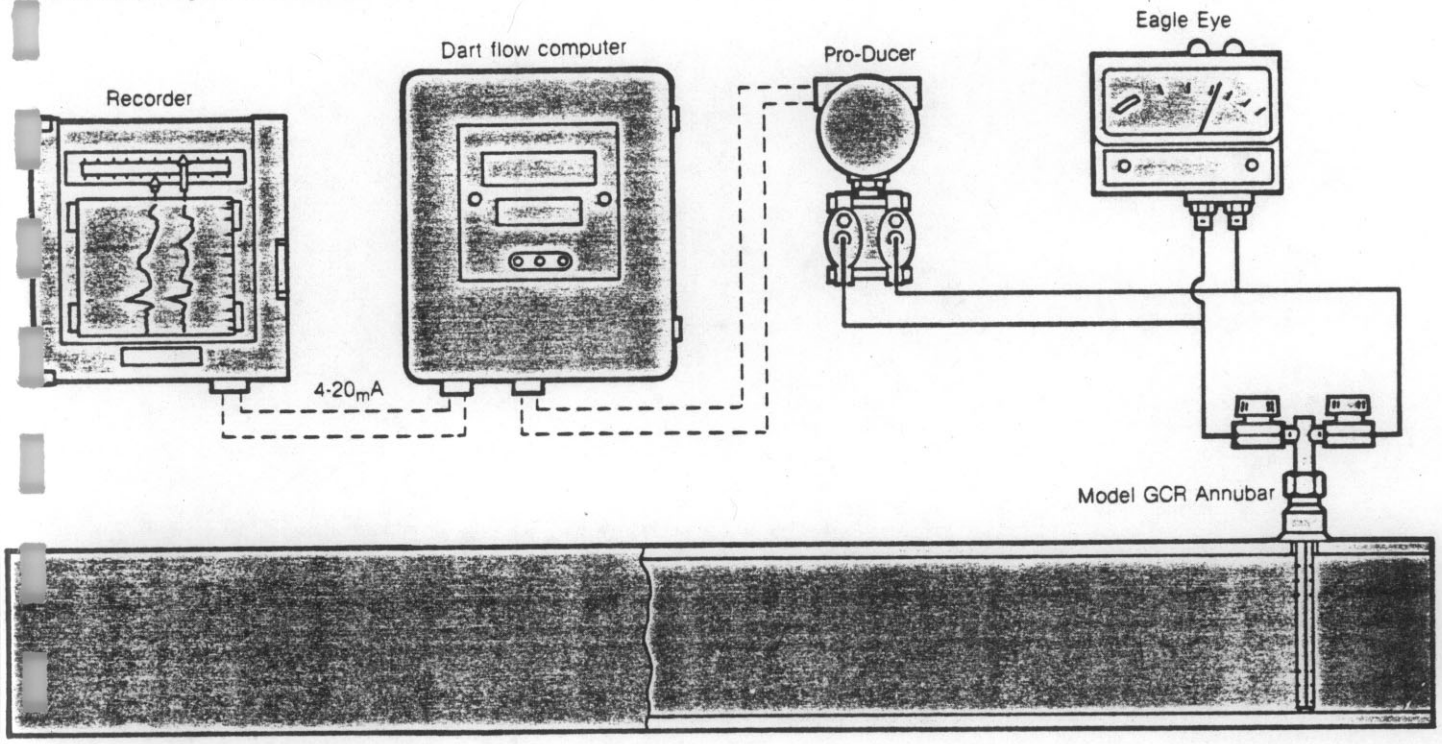
Compare your calculated differential pressure (h_w) for the selected sensor. If your calculated (h_w) is above the maximum allowed, select an opposite support mount or larger sensor and re-calculate the differential pressure (opposite support sensors not recommended for models GLT and GMT).

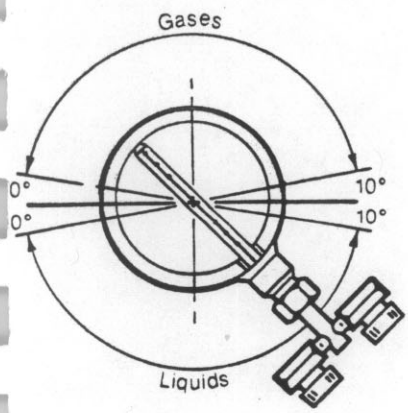
Sensor 10		Sensor 15		Sensor 16		Sensor 25		Sensor 26		Sensor 35		Sensor 36	
Pipe	h_w	Pipe	h_w	Pipe	h_w	Pipe	h_w	Pipe	h_w	Pipe	h_w	Pipe	h_w
½"	1500	2"	630	3"	300	6"	541	12"	157	12"	360	24"	107
¾"	1500	2½"	447	3½"	231	8"	327	14"	131	14"	300	30"	69
1"	1160	3"	300	4"	185	10"	216	16"	102	16"	232	36"	49
1¼"	620	3½"	231	5"	124	12"	157	18"	81	18"	185	42"	36
1½"	443	4"	185	6"	400	14"	131	20"	67	20"	151		
2"	260	5"	124	8"	220	16"	102	24"	47	24"	107		
		6"	100	10"	143	18"	81			30"	69		
				12"	100	20"	67			36"	49		
						24"	47			42"	36		

Complete flow package

Dart flow computer

Dart is a programmable microcomputer that takes up to four measurement variables, then calculates and averages flow rate and total.





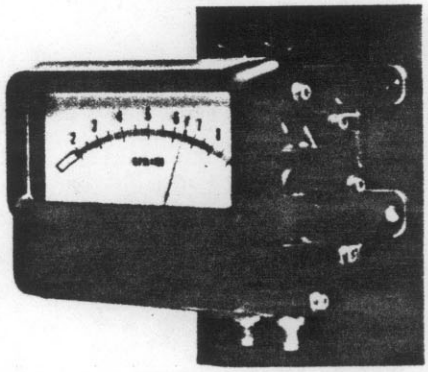
Note: instrument connections rotated 90° for clarity.

Simple, fast installation

Annubar is installed with a minimum of set-up, welding and clean-up time. Complete installation can be made in less than 30 minutes.

Annubar—Eagle Eye flow sets

If your flow measurement requirements encompass heating, ventilating and air conditioning or other air and water applications, the Annubar Eagle Eye flow package is the ideal choice for accurate, low cost measurement of flow rates.



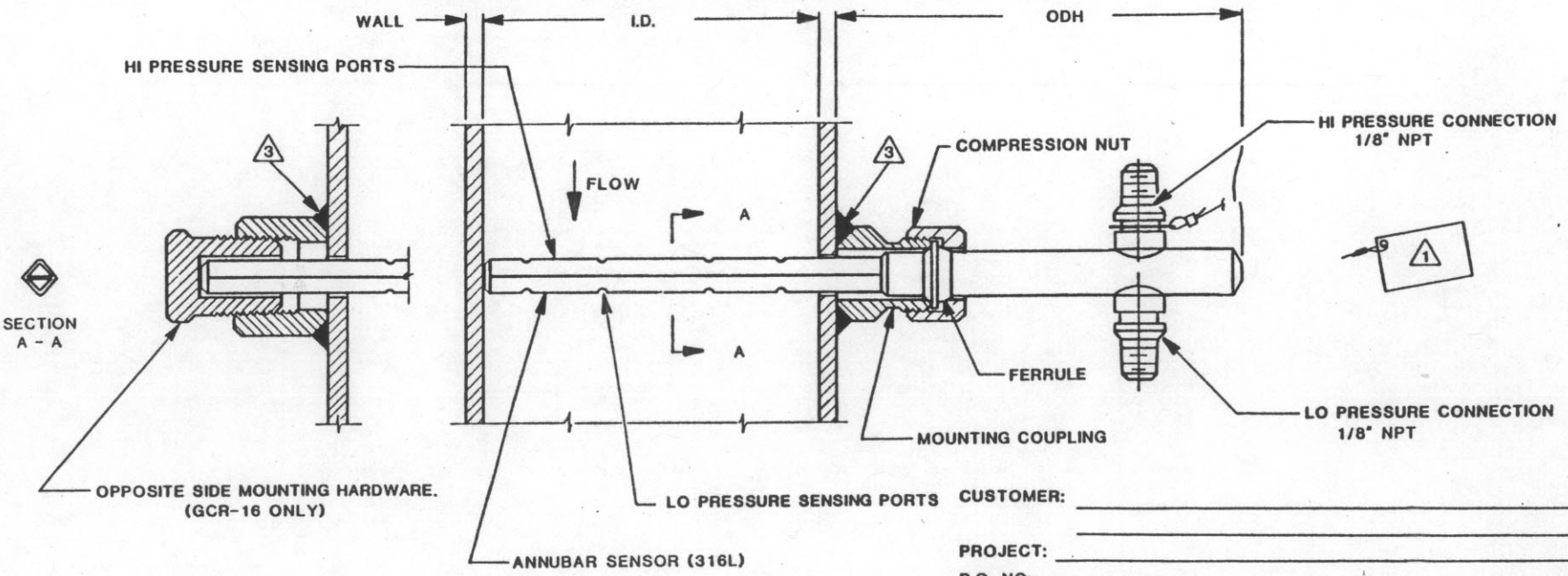
- Linear to flow rate
- Linear to differential pressure
- Electronic on-off control

Dieterich Standard A DOVER Industries Company Box 9000 Boulder, Colorado 80301 USA 303/530-9600 TLX 6837012 FAX 303/530-7064

DS-3001 (3/89)
Replaces DS-3001 (7/88)

ITEM	SERIAL NO.	TAG NO.	MODEL	SENSOR	I.D.	WALL	HEAD	VALVES *	MOUNTING ** HEAD SIDE	MOUNTING ** OPP SIDE	ODH	OTHER OPTIONS	NOTES:
			GCR	15/16			HG		MG2	MD2	4.5"		STANDARD CALLOUT SHOWN

* FOR INSTRUMENT VALVES OPTION SEE DWG # C-9102 ** FOR MOUNTING OPTIONS SEE DWG. # _____



CUSTOMER: _____

PROJECT: _____

P.O. NO: _____

DSC FILE NO. _____

NOTES:

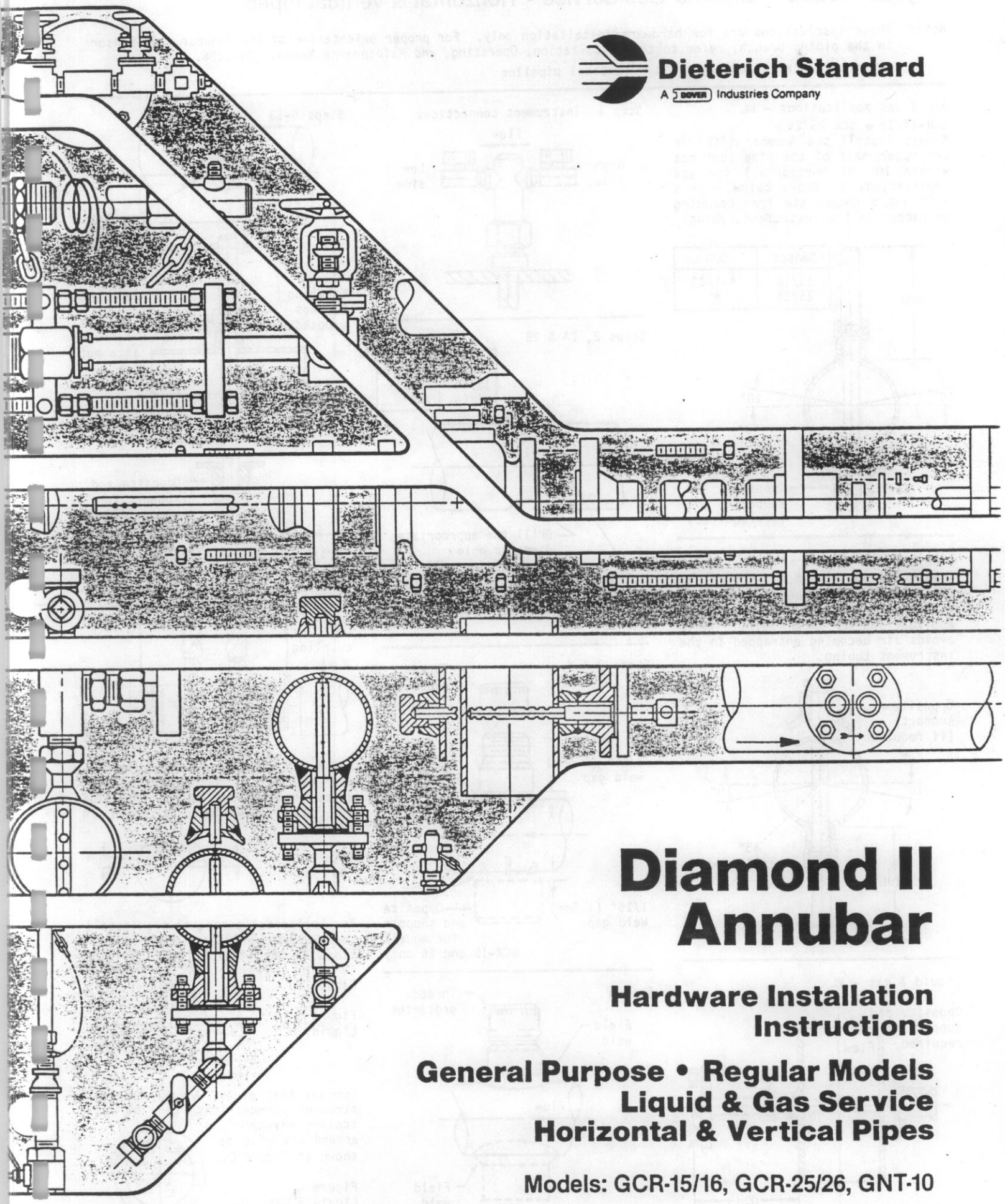
1. PERMANENT RUSTPROOF METAL TAG SHOWING MODEL NUMBER, PIPE SIZE, SERIAL NUMBER, STRUCTURAL LIMITS AND INFORMATION AS SUPPLIED BY CUSTOMER.
2. ANNUBAR ORIENTATION SHOWN FOR DETAIL ONLY. FOR ACTUAL RECOMMENDED LOCATION AND ORIENTATION SEE INSTALLATION INSTRUCTIONS.
3. FIELD WELD. SEE INSTALLATION INSTRUCTIONS FOR PROPER HOLE AND WELD REQUIREMENTS.
4. MAXIMUM PRESSURE, 250 PSIG, MAXIMUM TEMRERATURE 250°F (121°C).
5. ADDITIONAL NOTES: _____

PAGE of

GCR-15 AND GCR-16

APPROVAL By	APPROVAL Date	LATEST REVISION Letter	LATEST REVISION Date	
RCH	3/25/86			
Drawn by	**Checked by**	**Date drawn**	**Scale**	C-4580
Terri Zimmerman	J. Barnett	3-20-86	N.T.S.	

Dieterich Standard
A DOVER Industries Company
Box 9000 Boulder, Colorado 80301 USA



Dieterich Standard
A DOVER Industries Company

Diamond II Annubar

Hardware Installation Instructions

General Purpose • Regular Models
Liquid & Gas Service
Horizontal & Vertical Pipes

Models: GCR-15/16, GCR-25/26, GNT-10

Hardware Installation Instructions • General Purpose Regular Models • Liquid & Gas Service • Horizontal & Vertical Pipes

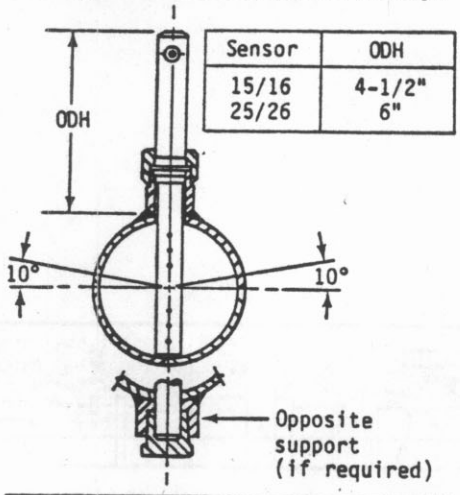
Note: These instructions are for hardware installation only. For proper orientation of the Annubar flow sensor in the piping branch, refer to the Installation, Operating, and Maintenance Manual, DS-1286.

HL = Horizontal pipeline VL = Vertical pipeline

Air & gas applications - HL

GCR-15/16 • GCR 25/26

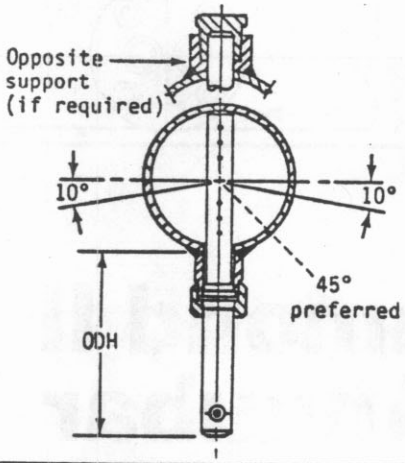
Always install the Annubar (GCR) in the upper half of the pipe (but not within 10° of horizontal) for gas applications as shown below. This will avoid condensate from becoming entrapped in the instrument tubing.



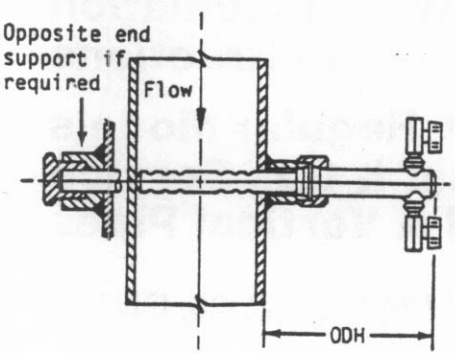
Sensor	ODH
15/16	4-1/2"
25/26	6"

Liquid applications - HL

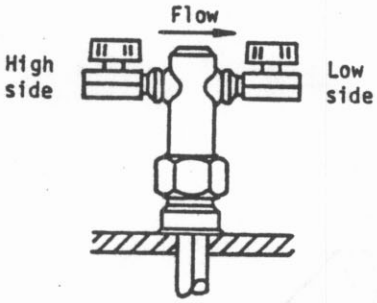
Always install the Annubar (GCR) in the lower half of the pipe (but not within 10° of horizontal) for liquid applications as shown below. This avoids air becoming entrapped in the instrument tubing.



Liquid & gas - VL

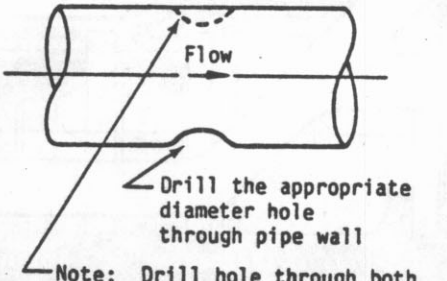


Step 1 Instrument connections



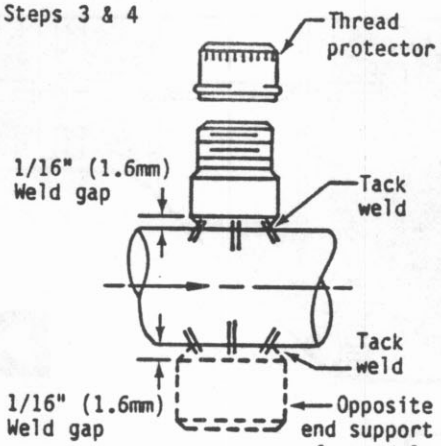
Steps 2, 2A & 2B

Sensor	Drill Dia.
15/16	7/16"
25/26	7/8"

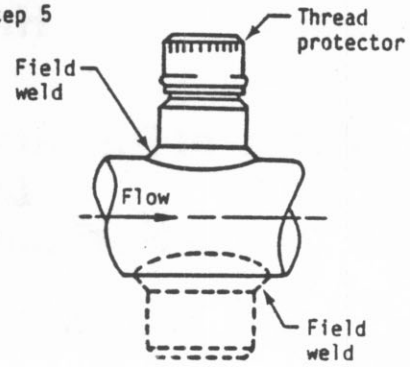


Note: Drill hole through both sides if opposite end support required.

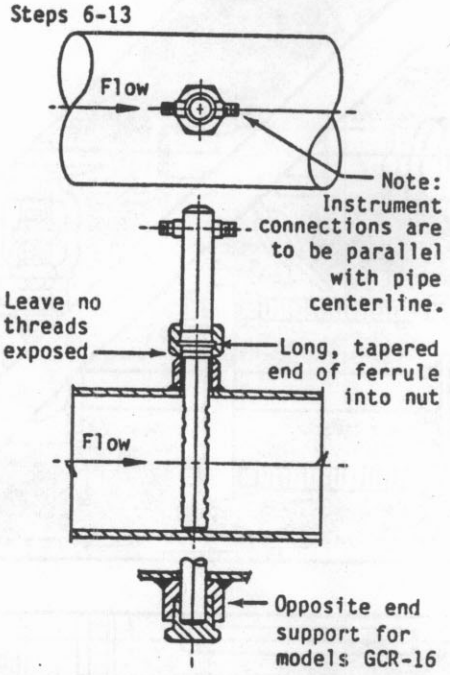
Steps 3 & 4



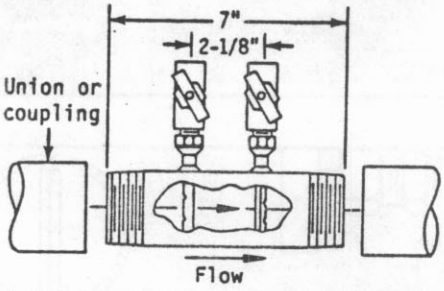
Step 5



Steps 6-13



GNT-10 Horizontal line & vertical line

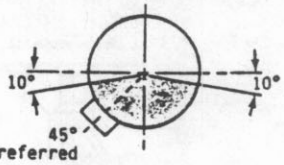


For horizontal pipes, always install the Annubar GNT instrument connections in the upper half of the pipe for gas applications as shown in Figure A.

Figure A Gas, HL

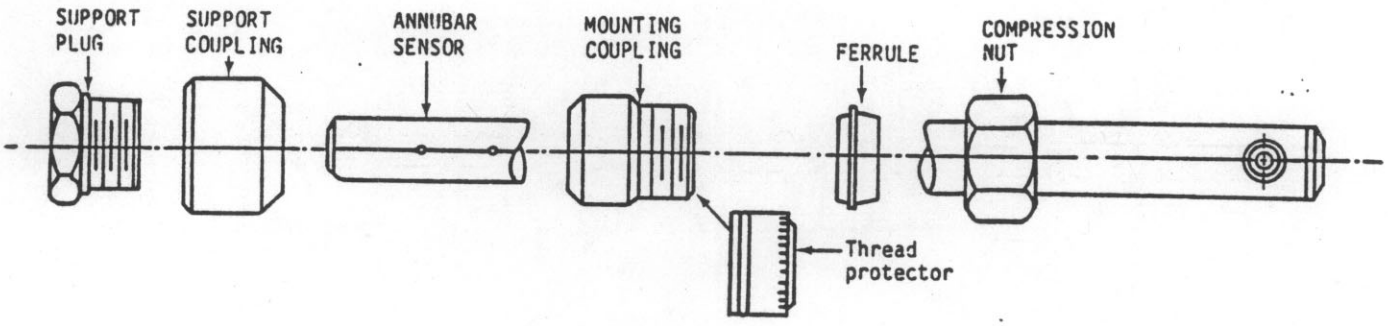
For horizontal pipes, always install the Annubar GNT instrument connections in the lower half of the pipe for liquid applications as shown in Figure B.

Figure B Liquid, HL



For vertical pipes, Annubar GNT instrument connections can be installed anywhere around the pipe as shown in Figure C.

Figure C Liquid & Gas, VL



GCR-15/16 • GCR-25/26

Step 1
Using a pipe thread sealant compound rated for use at the process line temperature, preassemble the instrument valves to the Annubar.

Step 2
Drill the appropriate diameter hole (see chart) through pipe wall. Deburr drilled hole on the inside of the pipe.

Step 2A (GCR-16 and 26 only)
Locate position for opposite side support weld coupling 180° from, and in the same plane as the first hole, by putting a piece of soft wire or string around the pipe. Measure halfway around the pipe from the center of the first hole and mark center for support coupling.

Step 2B (GCR-16 and 26 only)
Drill the appropriate diameter hole (see chart) through pipe wall. Deburr drilled hole on the inside of the pipe.

Step 3
The threads and sealing surface of the mounting coupling are to be protected during welding using the thread protector.

Step 4
Tack weld mounting coupling to pipe and tack weld support coupling to opposite side of pipe (if required). Check alignment and adjust as necessary by inserting the Annubar sensor through mounting coupling and through the pipe and support coupling.

Step 5
Remove Annubar sensor and complete welding the mounting coupling and the support coupling if required for opposite end support models.

Step 6
Remove thread protector and lubricate nut threads and mounting coupling threads with anti-sieze compound.

Note: Recommend "Chesterton" pure nickel-based compound (or equal).

Step 7
Slide compression nut onto Annubar sensor as shown.

Step 8
Slide ferrule onto Annubar sensor **"WITH LONG, TAPERED END INTO NUT."**

CAUTION: CORRECT INSTALLATION OF FERRULE IS CRITICAL FOR PROPER SEALING AND RETENTION OF ANNUBAR.

Step 9
Insert Annubar sensor through mounting coupling against far wall of pipe.

Step 9A (GCR-16 and 26 only)
Use pipe thread sealant compound rated for use at the process line temperature on the threads of support plug. Thread support plug into support coupling. Insert Annubar sensor through mounting coupling and through far wall of pipe until it enters opposite side support coupling. Guide the Annubar sensor into support plug until it "bottoms out." Tighten support plug until it is secure.

Step 10
Apply an anti-sieze compound to mounting coupling threads. Hand tighten compression nut.

Step 11
Looking down on the Annubar head with head flow arrow in direction of flow, rotate the Annubar sensor 180° counterclockwise.

Step 12
Hold Annubar sensor stationary and tighten nut until ferrule "bites" the Annubar.

Step 13
Tighten nut allowing the Annubar to turn until the flow arrow on the head is in line with the flow direction. Holding the Annubar sensor stationary, continue to tighten nut until no threads on mounting coupling are exposed.

GNT-10

Step 1
Installation of a GNT-10 threaded Annubar requires removal of a section of process pipe. Measure the nipple to determine exact dimension. Using a pipe thread compound suitable for the process line temperature, apply to the threads of the GNT-10.

Step 2
Install the GNT-10 threaded nipple with the flow arrow pointing in the direction of flow. If the installation is a retrofit, a union will be required on one end. The installation will be easier if one end of the piping branch is free to move slightly.

Step 3
Thread the pipe nipple into a threaded pipe coupling or union to connect to the process pipe on both ends.

Step 4
CAUTION: While assembling instrument valves to Annubar, hold Annubar fitting flats with a wrench to prevent damage to fittings.

Using a pipe thread sealant compound rated for use at the process line temperature, preassemble the valve assemblies to the Annubar instrument connections. Orient the assembly so the valve handles face away from each other.

Note: The instrument valves have removable bonnets. Remove one bonnet to allow the valves to be installed.

Dieterich Standard
A DOVER Industries Company
Flow Measurement Systems

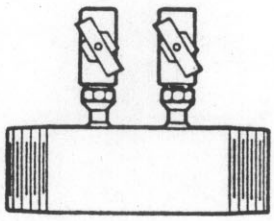
Diamond II Annubar

Installation, Operating and Maintenance Manual
General Purpose Products • Liquid & Gas Service

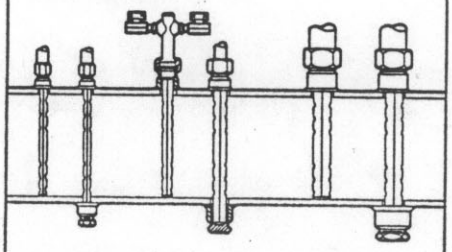
Models: GNT-10, GCR-15/16, GCR-25/26, GCR-35/36
GLT-15/16, GLT-25/26
GMT-15/16, GMT-25/26, GMT-35/36

Contents

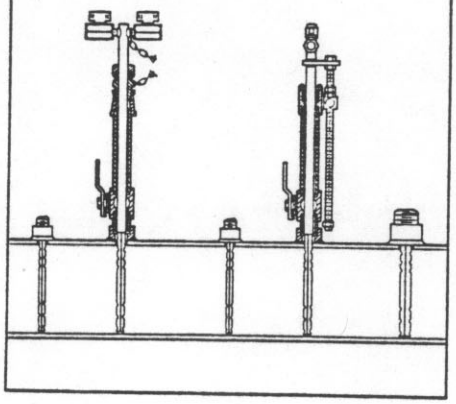
Model GNT



Model GCR



Models GLT & GMT



1. Receiving & inspection

Upon receipt of shipment, check the packing list against material received and the purchase order. All items are tagged with model number, serial number and customer tag number. Any damages should be reported to the carrier.

2. Annubar description

The Annubar is a primary flow sensor designed to produce a differential pressure that is proportional to flow.

The Annubar accurately measures liquid, air or gas in pipes or stacks.

The Annubar is available in many different models, each providing high, long term accuracy, low permanent pressure loss, low installed cost and low operating cost resulting in energy savings. The Annubar models include: Flo-Tap for installation without system shutdown, Regular for general purpose installation and In-line models for small pipe sizes.

3. Operating limitations

3.1 Structural limitations

The maximum allowable temperature, pressure, differential pressure and the vibration velocity range is printed on the metal tag attached to the Annubar. Operation within the resonance velocity range and/or in excess of any maximum flow parameter could result in severe damage to the flow sensor and surrounding system components.

3.2 Functional limitations

For the Annubar to produce accurate, repeatable flow measurement, the following must be considered:

1. For air and gas measurement the differential pressure at maximum flow should be above .5" inches water column.
2. For liquid measurement the differential pressure at maximum flow should be above 1" water column.
3. The Annubar will not accu-

4. Location

Location

Correct location of the Annubar in the pipe is important since flow disturbances can affect the accuracy of measurement.

4.1 Straight run requirements

Use chart A to determine proper installation location.

Notes:

- If longer lengths of straight run are available, position the Annubar where 80% of the run is upstream of the Annubar and 20% is downstream.
- Information applies only to circular pipes.
- Straightening vanes may be used to reduce the required straight run length.
- Annubar will provide a repeatable signal in straight runs less than shown. Consult your local Dieterich Standard representative or Dieterich Standard.
- Figure 6, Chart A, applies to gate, globe, plug, and other throttling valves that are partially opened. If a "through-type" valve is to be fully open, use values shown in Figure 5. The Annubar should be located downstream of control valves.

4.2 Alignment limits

The permissable misalignment is illustrated in Figure 1. Installation outside of these limits will cause error in flow measurement.

Figure 1 • Permissable misalignment

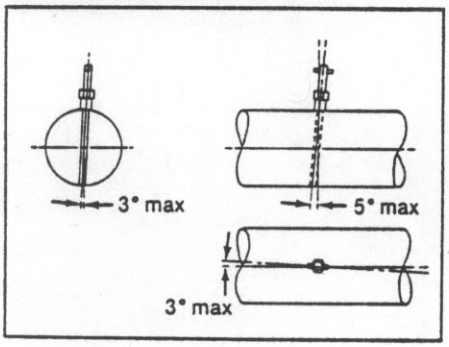


Chart A • Straight run requirements

Minimum diameters of straight pipe	Upstream dimension: Without straightening vanes, In plane A	Upstream dimension: Without straightening vanes, Out of plane A	Upstream dimension: With straightening vanes, A'	With straightening vanes, C	With straightening vanes, C'	Downstream dimension B
Fig. 1	7	9				3
			6	3	3	
Fig. 2	9	14				3
			8	4	4	
Fig. 3	19	24				4
			9	4	5	
Fig. 4	8	8				3
			8	4	4	
Fig. 5	8	8				3
			8	4	4	
Fig. 6	24	24				4
			9	4	5	

4.3 Pulsation & vibration

Location of the Annubar in pulsating flow will cause a noisy signal. Vibration can also distort the output signal and compromise the structural limits of the Annubar. Mount the Annubar in a secure run of pipe as far as possible from pulsation sources such as check valves, reciprocating compressors or pumps and control valves.

4.4 DP transmitter location

Before selecting an Annubar location, the D.P. transmitter location must be considered.

- Liquid applications - Locate below the level of the Annubar instrument connections.
- Air and gas applications - Locate above the level of the Annubar instrument connections.

Connecting lines should be as short as possible, but of sufficient length to cool the process fluid to the temperature limits of the transmitter. The transmitter and connecting lines should be mounted in a stable vibration-free environment.

5. Annubar orientation

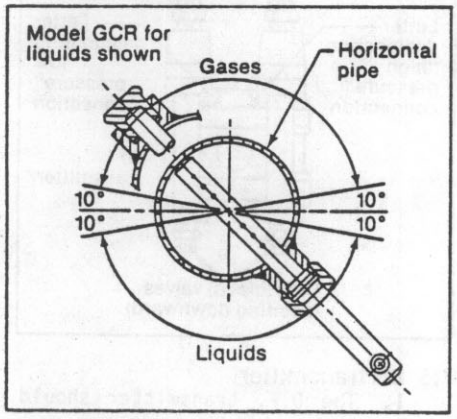
Annubar orientation

To ensure accurate flow sensing, proper orientation of the Annubar is important.

5.1 Horizontal pipes

- Liquid applications - The Annubar is to be located on the bottom half of the pipe, at least 10° below the horizontal line (45° preferred). See Figure 2.
- Air and gas applications - The Annubar is to be located on the upper half of the pipe at least 10° above the horizontal line. See Figure 2.

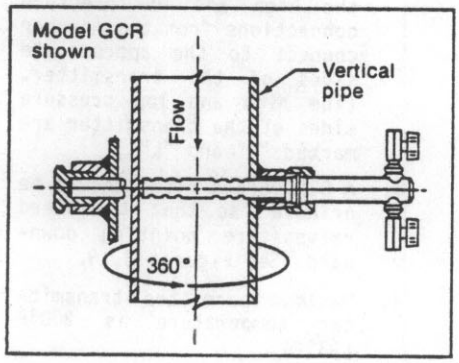
Figure 2 • Models GNT, GCR, GLT & GMT horizontal pipes



5.2 Vertical pipes

- Liquid, air and gas applications - The Annubar can be installed in any position around the circumference of the pipe (see Figure 3).

Figure 3 • Models GNT, GCR, GLT & GMT vertical pipes



6. Annubar installation

Annubar installation

6.1 Installation instructions

Refer to the following publications for specific Annubar model installation instructions (Chart B).

Chart B • Installation instructions

Annubar model	Publication no.
GNT 10 GCR 15/16 GCR 25/26	DS-1295
GCR 35/36	DS-1629
GLT 15/16 GLT 25/26	DS-1299
GMT 15/16 GMT 25/26 GMT 35/36	DS-1600
GCR 15/16 Special GCR 25/26 Mounts	DS-1620

6.2 Valves & fittings

Use only valves and fittings rated for the process line design pressure and temperature.

Use properly rated pipe thread sealant compound when installing valves and fittings.

Verify all connections are tight and instrument valves are fully closed.

Install valves and fittings per the applicable drawings.

Figure 4 • Horizontal pipes Models GNT-10

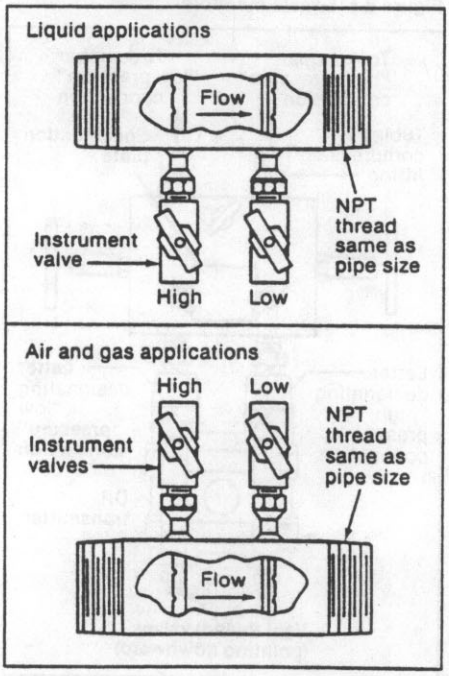


Figure 5 • Horizontal pipes Models GCR, GLT & GMT

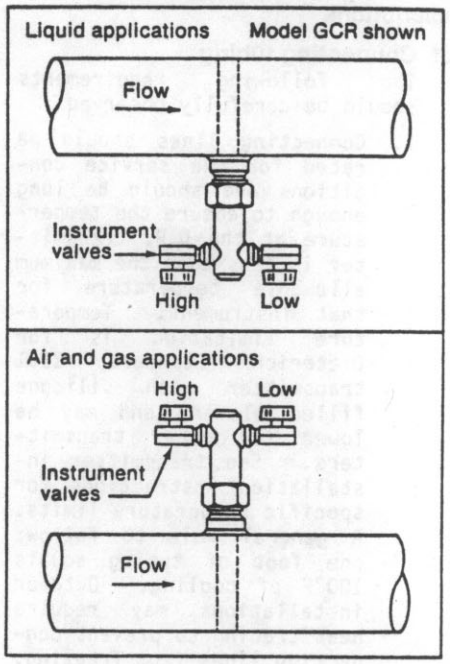


Figure 6 • Vertical pipes Model GNT-10

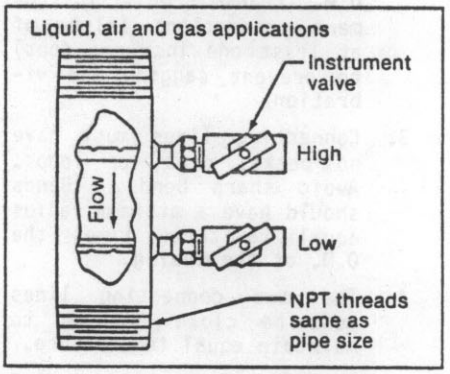
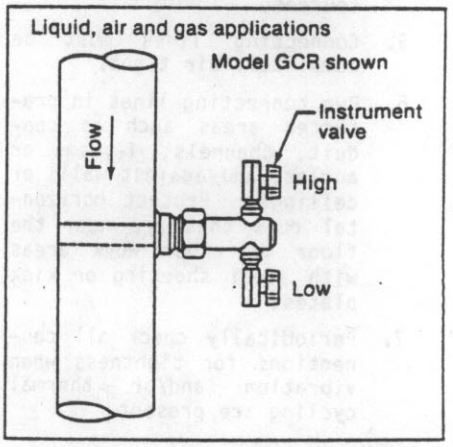


Figure 7 • Vertical pipes Models GCR, GLT & GMT



7. Secondary instrumentation descriptions

Secondary instrumentation descriptions

7.1 Connecting tubing

The following requirements should be carefully observed.

1. Connecting lines should be rated for the service conditions and should be long enough to ensure the temperature at the D.P. transmitter is less than the maximum allowable temperature for that instrument. Temperature limitation is for Dieterich Standard 1151 transmitter with silicone filled element and may be lower for other transmitters. See transmitter installation instructions for specific temperature limits. A general rule to follow: one foot of tubing equals 100°F of cooling. Outdoor installations may require heat tracing to prevent connecting lines from freezing.
2. Connecting lines must slope continuously downward to the D.P. transmitter's instrument connections (slope of at least one inch per foot) to prevent sagging and vibration.
3. Connecting lines must have no peaks, dips, or loops. Avoid sharp bends. Bends should have a minimum radius equal to three times the O.D. of the tubing.
4. The two connecting lines must be close together to maintain equal temperature.

   CAUTION: Do not allow nylon or rubber lines to contact hot pipes or other heat sources.
5. Connecting lines must be completely air tight.
6. Run connecting lines in protected areas such as conduit, channels, I-beams or angles, and against walls or ceilings. Protect horizontal runs that are near the floor or under work areas with steel sheeting or kick plates.
7. Periodically check all connections for tightness when vibration and/or thermal cycling are present.

7.2 Eagle Eye flow meter

Eagle Eye is a linear to flow or linear to DP meter for air or water applications.

The maximum fluid temperature and pressure limits for the Eagle Eye flow meter are as follows:

Chart C • Eagle Eye pressure and temperature limits

Meter body temperature Permanent & portable meters			
°F	psi	°C	Kpa
40 - 100	225	4 - 38	1551
100 - 140	150	38 - 60	1034
140 - 180	75	60 - 82	517

7.3 5-valve manifold

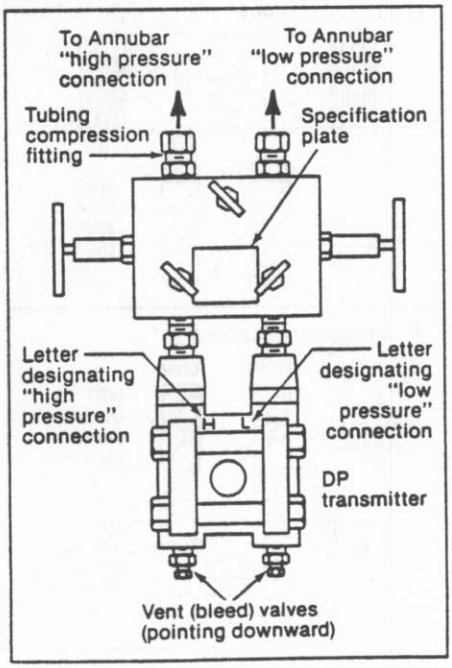
Isolating the process fluid from the transmitter using a manifold is recommended.

CAUTION: If no manifold is to be used, slowly open both Annubar valves during start-up to avoid damaging the DP transmitter or other secondary instrumentation.

A 5-valve manifold is preferred over a 3-valve. The two equalizer valves and vent valve of the 5-valve manifold provide two important advantages over a 3-valve manifold's single equalizer valve. See Figure 8.

Advantages:
1. Certainty of equalizer shut off.
2. Positive indication of equalizer valves needing repair.

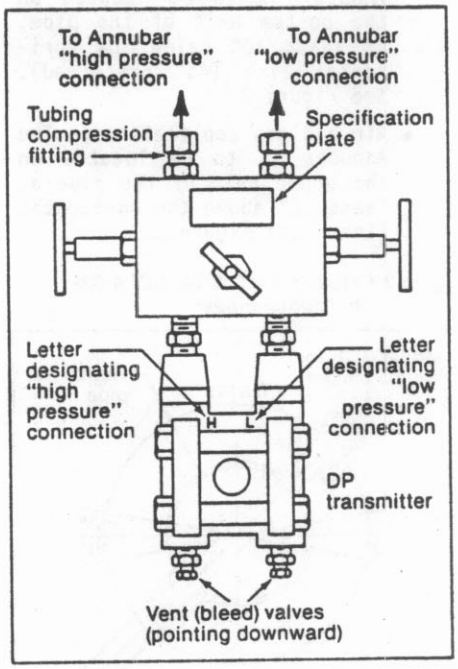
Figure 8 • 5-vavle manifold



7.4 3-valve manifold

A 3-valve manifold may be used but at the cost of losing the important advantages stated above. See Figure 9.

Figure 9 • 3-valve manifold



7.5 DP transmitter

1. The D.P. transmitter should be mounted as follows:
   Liquids - Locate below the level of the Annubar instrument connections.
   Air and gas - Locate above the level of the Annubar instrument connections.
2. Trace the connecting lines from the Annubar to the transmitter to verify that the high and low pressure connections from the Annubar connect to the appropriate sides of the transmitter. (The high and low pressure sides of the transmitter are marked "H" and "L".)
3. A D.P. transmitter should be oriented so that the bleed valves are pointing downward. See Figures 8, 9.
4. Maximum permitted transmitter temperature is 200°F (93°C).
5. Refer to the transmitter installation instructions, DS-4200, for wiring, other requirements, and limitations of the transmitter.
6. Readouts or controls receiving the transmitter's signal may be placed in any convenient location.

7.6 Secondary instrumentation orientation—liquids

The following diagrams are recommended secondary instrumentation orientation for specific liquid flow applications.

• Horizontal pipe, liquids

Figure 10 • Standard orientation All models

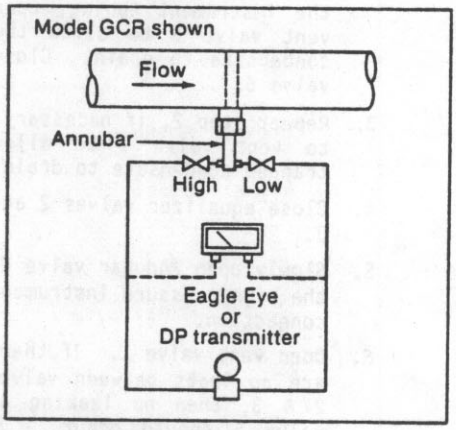
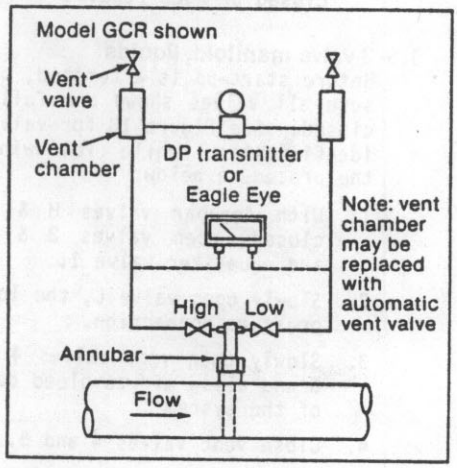


Figure 11 • Top of pipe installation All models



• Vertical pipe, liquids

Figure 12 • Standard orientation All models

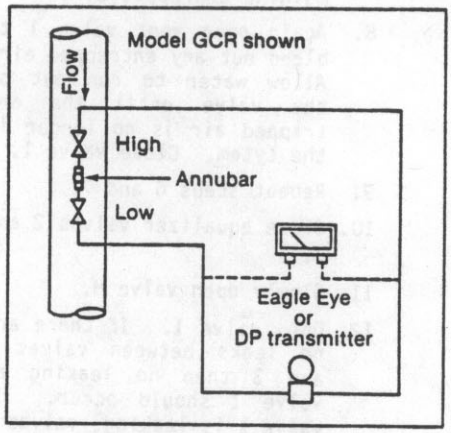
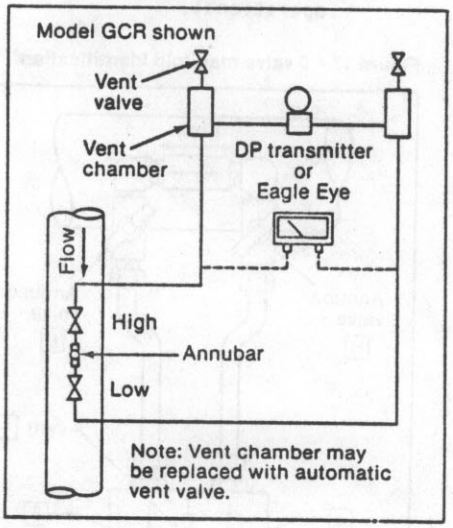


Figure 13 • Eagle Eye or transmitter mounted above Annubar All models



7.7 Secondary instrumentation orientation, air & gas

The following diagrams are recommended secondary instrumentation orientation for specific gas and air applications.

• Horizontal pipe, air & gas

Figure 14 • Standard orientation All models

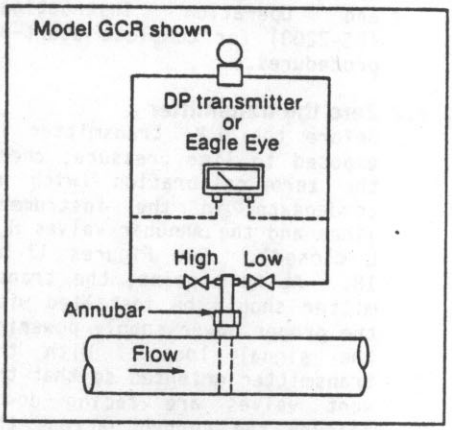
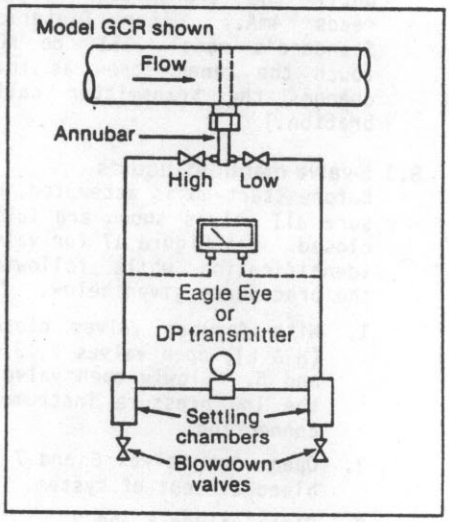
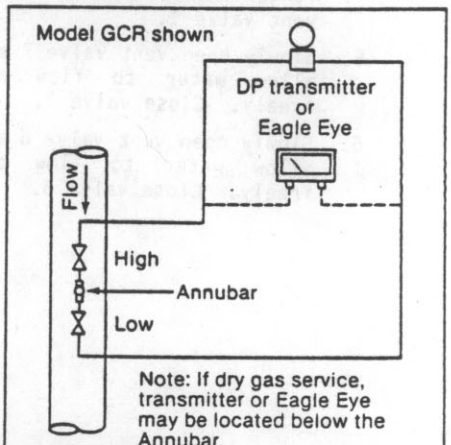


Figure 15 • Wet gas applications, Bottom of pipe installation All models



• Vertical pipe, air & gas

Figure 16 • Standard orientation All models



8. Start-up procedure

Start-up procedure

8.1 Start-up procedure—Eagle Eye flow meter

Consult Eagle Eye Installation and Operation instructions (DS-2200) for complete start-up procedures.

8.2 Zero the transmitter

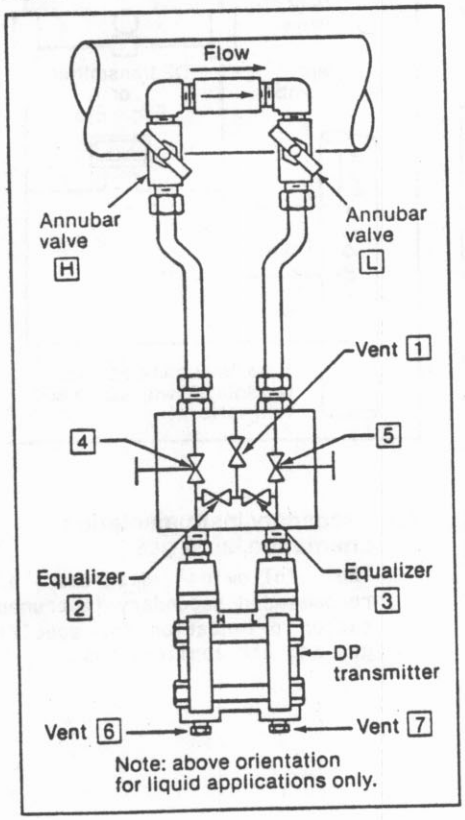
Before the D.P. transmitter is exposed to line pressure, check the zero calibration (with no condensate in the instrument lines and the Annubar valves H & L closed). See Figures 17 or 18. At this point, the transmitter should be installed with the proper power supply powering the signal loop. With the transmitter oriented so that the vent valves are facing down, measure the current across the "signal" terminals; the reading should be 4mA. If the current is not 4mA, adjust the zero until the transmitter signal reads 4mA. (For Dieterich Standard's model 1151, do NOT touch the range screw as this changes the transmitter calibration.)

8.3 5-valve manifold, liquids

Before start-up is attempted, be sure all valves shown are fully closed. See Figure 17 for valve identification while following the procedures given below.

1. With Annubar valves closed (H & L), open valves 2, 3, 4 and 5. Slowly open valve L the low pressure instrument connection.
2. Open vent valves 6 and 7 to bleed air out of system.
3. Close valves 6 and 7.
4. Slowly open vent valve 1 to bleed out any entrapped air in manifold. Allow water to run out of the valve until the entrapped air is no longer in the system. Close vent valve 1.
5. Slowly open vent valve 7 and allow water to flow out freely. Close valve 7.
6. Slowly open vent valve 6 and allow water to flow out freely. Close valve 6.
7. Gently tap transmitter body, valve manifold, and instrument tubing with a small wrench to dislodge any remaining entrapped air.
8. Again open vent valve 1 to bleed out any entrapped air. Allow water to run out of the valve until the entrapped air is no longer in the sytem. Close valve 1.
9. Repeat steps 6 and 7.
10. Close equalizer valves 2 and 3.
11. Slowly open valve H.
12. Open valve 1. If there are no leaks between valves 2 and 3 then no leaking at valve 1 should occur. If valve 1 is leaking, valves 2 and/or 3 are not fully closed or require repair.
13. The system is now fully operational.

Figure 17 • 5-valve manifold identification



8.4 5-valve manifold, air & gas

Before start-up is attempted, be sure all valves shown are fully closed. See Figure 17 for valve identification while following the procedures below.

1. With Annubar valves H & L closed, open valves 2, 3, 4 and 5. Slowly open valve L, the low pressure instrument connection.
2. If wet gas or moisture is in the instrument tubing, open vent valve 6 to allow the condensate to drain. Close valve 6.
3. Repeat step 2, if necessary, to vent valve 7 to allow trapped condensate to drain.
4. Close equalizer valves 2 and 3.
5. Slowly open Annubar valve H, the high pressure instrument connection.
6. Open vent valve 1. If there are no leaks between valves 2 & 3, then no leaking at valve 1 should occur. If valve 1 is leaking, valves 2 and/or 3 are not fully closed or need repair.

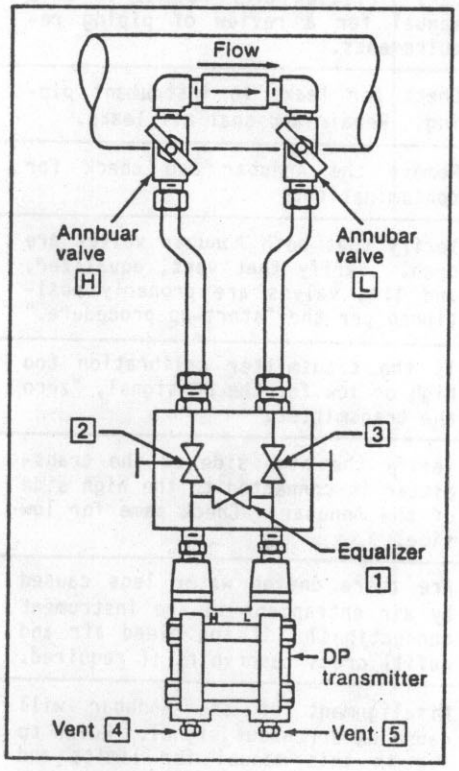
8.5 3-valve manifold, liquids

Before start-up is attempted, be sure all valves shown are fully closed. See Figure 18 for valve identification while following the procedure below:

1. With Annubar valves H & L closed, open valves 2 & 3 and equalizer valve 1.
2. Slowly open valve L, the low pressure connection.
3. Slowly open vent valves 4 & 5 and allow air to bleed out of the system.
4. Close vent valves 4 and 5.
5. Gently tap the transmitter body, valve manifold and instrument tubing with a wrench to dislodge any entrapped air.
6. Repeat steps 3 and 4.

7. Close equalizer valve 1.
8. Slowly open Annubar valve H, the high pressure instrument connection.
9. The system is now fully operational.

Figure 18 • 3-valve manifold identification



8.6 3-valve manifold, air & gas

Before start-up is attempted, be sure all valves shown are fully closed. See Figure 18 for valve identification while following the procedures below.

1. With Annubar valves H & L closed, open valves 2 & 3 and equalizer valve 1.
2. Slowly open valve L, the low pressure instrument connection.
3. If wet gas or moisture is in the instrument tubing, open vent valve 4 to allow the condensate to drain. Close valve 4.
4. Repeat step 3, if necessary, to vent valve 5 to allow trapped condensate to drain.
5. Close equalizer valve 1.
6. Slowly open Annubar valve H, the high pressure instrument connection.
7. The system is now fully operational.

Readings and calculations

The Annubar produces a differential pressure proportional to the square of the fluid velocity. This differential pressure is equated to a flow rate through equations described in the Annubar Flow Handbook. Calculations can be performed using these equations. Precise factory flow calculations are available for individual applications. Where less accuracy is acceptable, an Annubar flow calculator is available and may be used to determine flow rate from the differential pressure signal.

Maintenance

The Annubar is virtually a maintenance free device. However, an annual inspection is recommended. If the sensor needs cleaning, the following procedure can be followed:

1. Remove the Annubar sensor.
2. Blow out completely.
3. Hand clean with a soft wire brush.
4. Check the high and low pressure sensing ports. Clean as required. Do not use a tool that will deform the edge of the ports or change their diameter.
5. With a soft wire, rod the internal passages in the head of the Annubar.
6. Blow out instrument connections with water or compressed air.

11. Troubleshooting

Trouble	Possible cause	Investigative/corrective action
Questionable accuracy or erroneous DP signal	Improper installation	Is the Annubar flow arrow pointed in the direction of flow? Is there sufficient straight run upstream and downstream of the Annubar? Please refer to 4.1 in this manual for a review of piping requirements.
	System leaks	Check for leaks in instrument piping. Repair and seal all leaks.
	Contamination/plugging	Remove the Annubar and check for contamination.
	Closed valve	Verify that both Annubar valves are open. Verify that vent, equalizer, and line valves are properly positioned per the "start-up procedure."
	Transmitter calibration	Is the transmitter calibration too high or low for the DP signal, "zero the transmitter."
	Transmitter connections	Verify the high side of the transmitter is connected to the high side of the Annubar. Check same for low side.
	Entrapped air (liquid applications)	Are there uneven water legs caused by air entrapment in the instrument connections? If so, bleed air and refill cross reservoirs if required.
	Annubar misalignment	Misalignment of the Annubar will cause an erroneous signal. Refer to 4.2 in this manual for limits and guidelines.
	Opposite support Annubar	If the Annubar is an opposite side support model (-16, -26, -36), is it installed through the pipe wall into the support plug?
	Operating conditions	Do the operating conditions agree with those given to Dieterich Standard? Check the flow calculations and the fluid parameters for accuracy. Double-check pipe inside diameter for proper Annubar sizing.
	If Eagle Eye is being used as a secondary	Refer to Eagle Eye installation and operating instructions (DS-2200) for proper start-up procedure.
Spiking DP signal	Two-phase flow	The Annubar is a head measurement device and will not accurately measure two-phase flow.
	Excessive vibration	Check impulse piping for vibration. If excessive vibration is present signal spiking is possible.

Dieterich Standard
A DOVER Industries Company
Flow Measurement Systems

Eagle Eye Flow Meters

Installation & Operating Instructions

Contents

1. Inspection

Carefully unpack your Eagle Eye meter and inspect it as soon as it arrives. Any shortages should be reported immediately to your supplier and any damages reported to the delivering carrier.

2. Temperature and pressure limitations

The maximum fluid temperature and pressure limits for both permanent and portable meters using air and water applications are:

Meter Body Temperature Permanent and Portable Meters			
°F	psi	°C	Kpa
40-100	225	4-38	1551
100-140	150	38-60	1034
140-180	75	60-82	517

Water Line Temperature*	
Permanent Meters	
Maximum temp/press (nylon hose, brass valves)	130°F/225psi 54°C/1551Kpa
Portable Meters	
Maximum temp/press (Standard portable hoses)	225°F/225psi 107°C/1551Kpa
*Meter must be bled with cool water before each use.	

3. Selecting mounting locations

Accurate performance of both the Eagle Eye Meter and the Annubar primary flow sensor depends on proper mounting locations. For Industrial Annubar information and installation instructions, refer to DS-1200; for Commercial Annubar see DS-3200.

The distance between the meter and the Annubar flow sensor should be as short as possible. If the distance is under 50' (15m), ¼" (6mm) OD tubing is satisfactory.

The following is a checklist of general practices for connecting instrument tubing.

1. Connecting tubing must have a slope of at least 1" (25mm) per foot (30cm) and must be supported over its entire length to prevent sagging.
2. The two connecting lines should be run close together to maintain equal temperatures.

   CAUTION: Be sure nylon or rubber lines are kept away from hot lines or other heat sources.

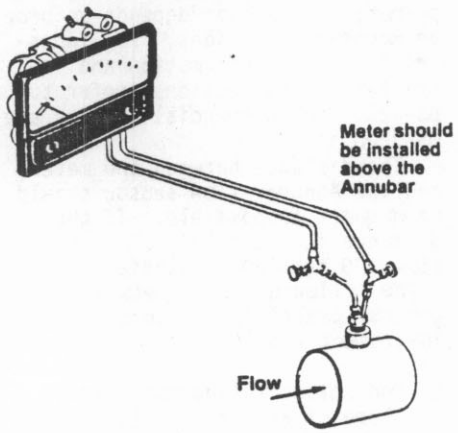
3. Run tubing where it will be accessible for maintenance.
4. Tubing must be absolutely air-tight. If vibration is expected, set up a periodic inspection procedure for checking all joints for leakage.

Do not make actual connections until Section 5, Operating Instructions.

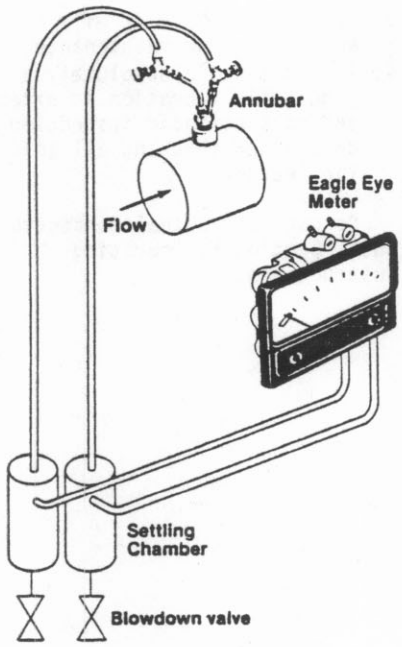
3. Selecting mounting locations (continued)

Air applications

It is best to mount the meter above the Annubar. This prevents condensation buildup.

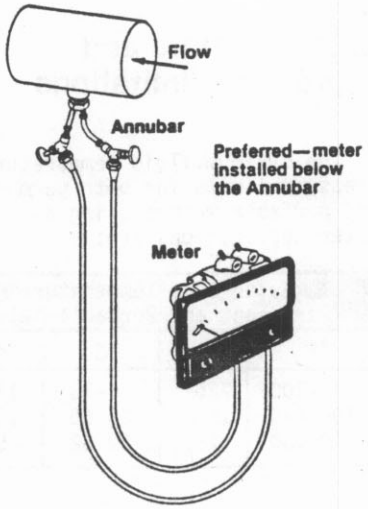


If the meter must be mounted below the Annubar, a settling chamber should be used. Instrument lines must slope down from the Annubar and down from the Eagle Eye toward the settling chamber. Liquid should be periodically drained from the traps.

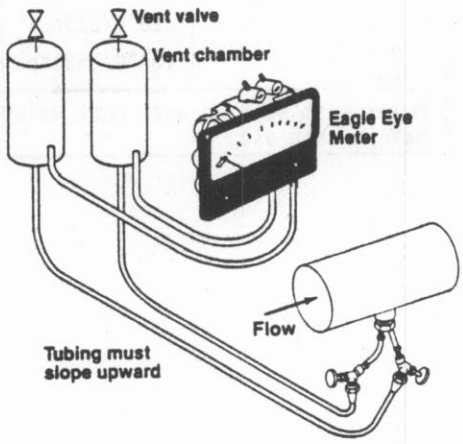


Water applications

Installation of the Eagle Eye below the Annubar is preferred for water service. Trapped air in the system is responsible for the majority of problems associated with water flow measurement. Differential pressure must be transmitted from the Annubar to the meter through a solid head of water.



If the meter must be mounted above the Annubar, a vent chamber and valve should be used. Instrument lines must slope upward from the Annubar and upward from the Eagle Eye meter toward the vent chamber.



Special applications

The magnetic coupling in the Eagle Eye Meter prohibits its installation in any strong magnetic field, e.g., near large generators, motors, etc.

Flow containing particles that are attracted to a magnet must be prevented from entering the Eagle Eye Meter. Collections of these particles on the magnet in the interior of the meter are almost impossible to flush and will eventually affect meter accuracy. Traps or screens should be installed in the instrument line between the meter and the sensor. Strainers are available from the factory.

When the flowing fluid is dirty (containing moisture if air, or dirt on water applications), traps or settling chambers should be installed in the connecting tubing. Sediment should be periodically cleaned from the traps. Strainers are available from the factory. Refer to the drawings under water and air applications showing vent valves and settling chambers.

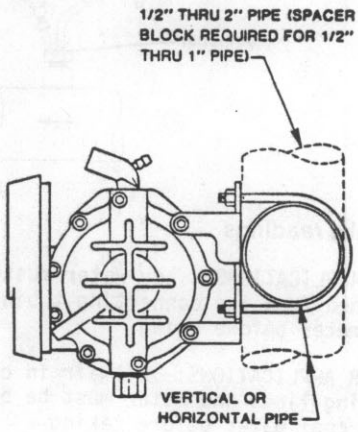
4. Eagle Eye installation

Permanent meters (Drawing C-9800)

Permanent meters must be installed with the dial face in a level vertical position. Use a level to check this. If the meter is to be used in any other position, recalibration is required.

Pipe mounting

The Eagle Eye can be mounted on any rigid vertical or horizontal pipe of ½" to 2" (13mm-51mm) diameter. A wood spacer of 2"x4"x3/4" (51mm x 10cm x 19 mm) is required for mounting on pipes of ½" to 1" (13mm-25mm). Screw holes are provided in the pipe mounting bracket for attaching the spacer. Insert the two "U" bolts provided through the large holes in the meter bracket for this type of mount.

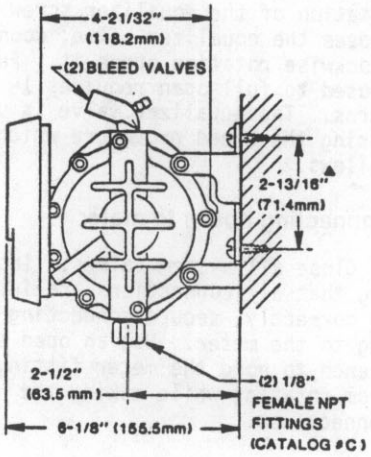


Wall mounting

The Eagle Eye may be wall mounted by removing the mounting bracket from the meter in order to give access to the two 3/16" (5mm) holes in the bracket. **Remove only the two flange bolts attaching the bracket to the meter body.** When the meter is reattached to the bracket, make sure the bracket is oriented correctly.

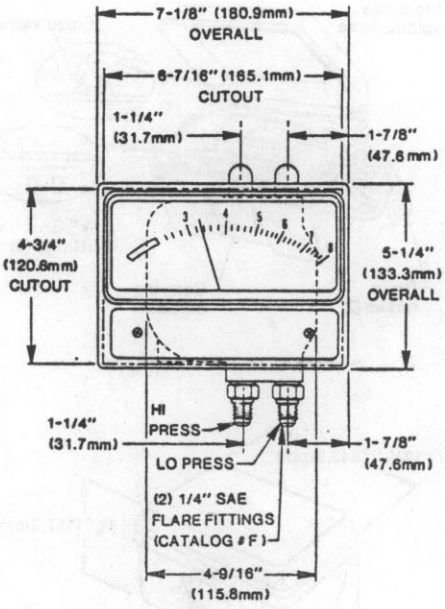
The long arm of the bracket attaches to the top of the meter.

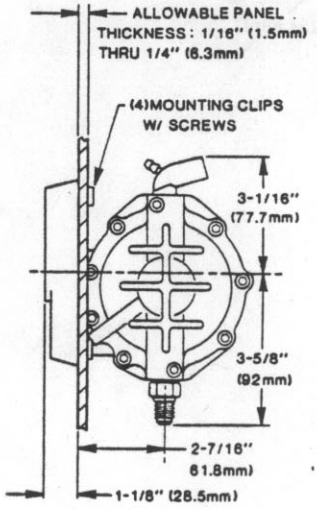
Torque the flange bolts to only 36 lb-in (4.1N•m), which is equivalent to tightening securely with a 4" (10cm) long Allen wrench.



Flush panel mounting

Clips are furnished for flush panel mounting. The meter can be flush mounted in panels 1/16" to ¼" (2mm-6mm) thick. The exact panel cutout size is 4-3/4" (12.1cm) high by 6 7/16" (16.4cm) wide.

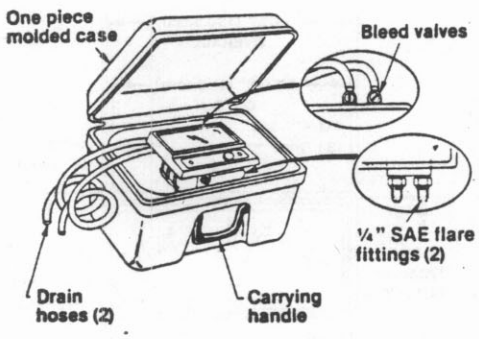


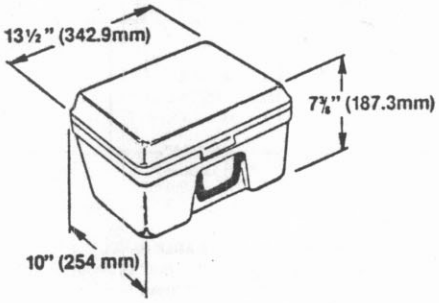


5. Operating instructions

Portable meters (Drawing C-9810)

Portable meters must be used with the dial face in a vertical position. Use in any other position requires recalibration.





Initial set-up

Mount the meter in the required vertical position, but do not connect it to the Annubar. Remove the cover access plate by unscrewing the two front cover screws and gently prying the cover from the right side. This gives access to the equalizer valve.

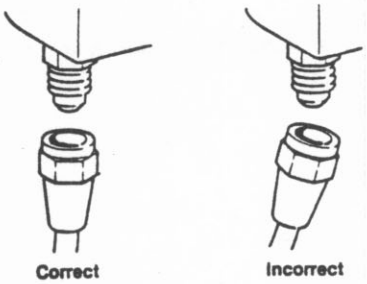
NOTE: Portable meters come with an external equalizer knob as standard.

Equalizing system

The equalizer valve provides a path between the high and low pressure sides of the meter. Clockwise rotation of the equalizer screw closes the equalizer valve, counter-clockwise rotation opens it. Full closed to full open requires 1½ to 2 turns. The equalizer valve is used during the bleed procedure which follows.

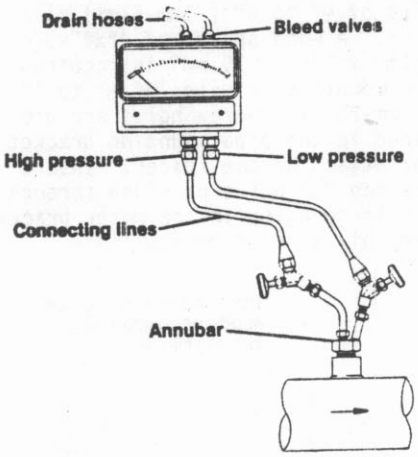
Connecting hoses to meter

Close all system valves. Insuring that all connections are installed correctly, secure connecting tubing to the meter. Use an open end wrench to hold the meter fittings from rotating while making the connections.



Connecting hoses to Annubar

Close all Annubar valves if not already closed. Connect the meter tubing to the Annubar following the general practices for connecting instrument tubing, Section 3, page 1. Be sure to connect the high pressure side of the meter to the high pressure side of the Annubar and likewise on the low pressure side.



To take readings

AIR APPLICATIONS: any water must be drained from the connecting tubing and meter before using.

WATER APPLICATIONS: all air in connecting lines and meter must be bled with cool water before taking readings.

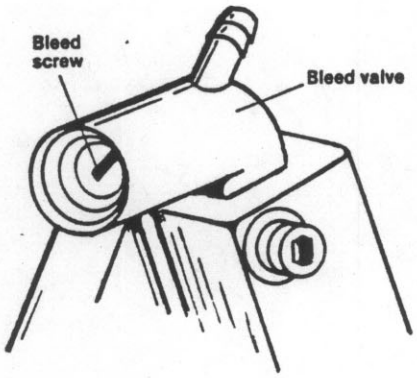
Bleeding instructions:

(For water service only.)

1. Install plastic drain tubing onto bleed valves and run tubing to a drain.
2. Place meter face in a vertical position.
3. Open the equalizer valve.
4. Open both bleed valves one turn counter-clockwise.
5. Open the Annubar low pressure valve slowly and just enough to send a slow, but constant stream of water through the Eagle Eye.
6. Similarly open the Annubar high pressure valve.

6. Removal from service
7. Trouble-shooting

7. When the water exiting the bleed valves is free of air, close both bleed valves, low side first.



8. Slowly close the equalizer, replace the access plate and the meter is in operation.

   NOTE: The pointer may register above zero even though the equalizer is open. This indicates the pressure drop across the equalizer.

   The meter must be bled after each system shutdown.

Calibration

The Eagle Eye Meter is calibrated at the factory and should not be recalibrated in the field.

The full scale calibration point is shown on the back of the meter. See the slot opposite "Scale/Range: on the black and silver tag.

CAUTION: Do not open the meter body.

6. Removal from service

Shut the system valves at the Annubar, then open the equalizer valve and disconnect the tubing.

If the meter will be exposed to freezing temperatures, all water must be drained from the meter.

When using multiple sensors with one portable meter, valves on each Annubar should be briefly opened, then closed, to remove any air that may have accumulated. Rebleeding of the meter on water applications is unnecessary unless air has entered the tubing or meter.

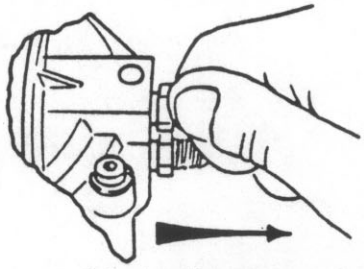
7. Trouble-shooting

Leakage

Check for leaks by shutting the Annubar valves with the Eagle Eye on the line and the equalizer closed. Any leaks will be indicated by a continuous pointer movement. If the pointer moves downscale, there is a leak in the high pressure instrument line. If the pointer moves upscale, there is a leak in the low pressure instrument line.

If a leak cannot be located, the meter should be returned to the factory.

If leakage occurs at the pressure fittings or bleed valves, replacement may be necessary. To remove a bleed valve or pressure fitting, first remove the retaining bolt that locks the fitting to the meter body. Then pull the valve or fitting from the meter. Install a new fitting or valve (always use a new O-ring); replacements may be ordered from the factory. When replacing the retaining bolt, torque the bolt to only 36 lb-in (4.1 N·m), which is equivalent to tightening securely with a 4" (10cm) long Allen wrench.



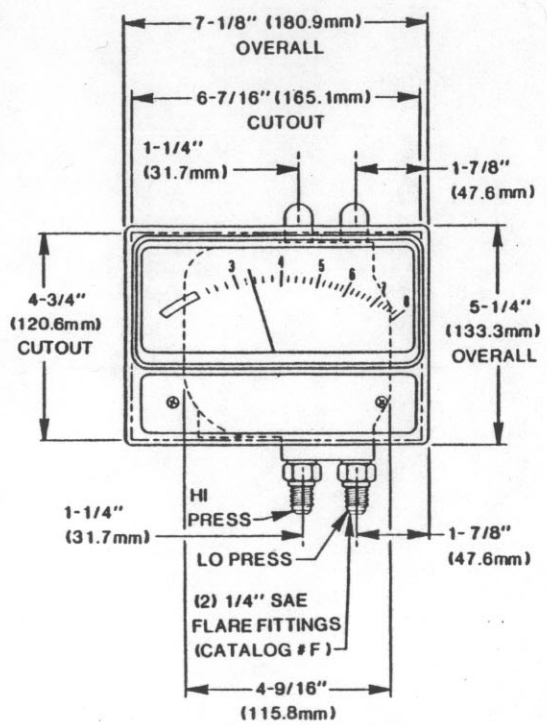
Pull outward to remove

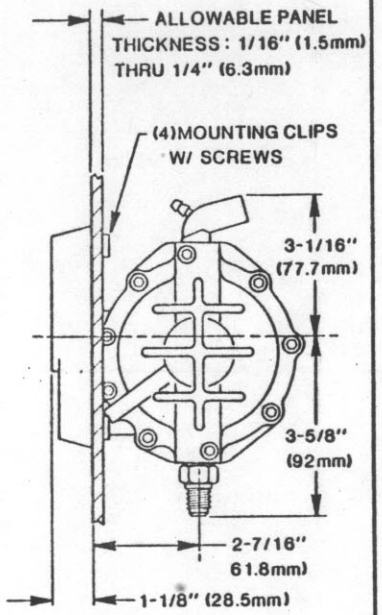
If leakage occurs at the main body seal, tighten the flange bolt nuts around the body. Do not exceed 36 lb-in (4.1 N·m) of torque, or the equivalent of tightening very securely with a 4" (10cm) long Allen wrench.

Accuracy discrepancy

The Eagle Eye Meter is one part of the complete system required to provide accurate flow measurement. Accuracy discrepancies may result from other components of the measuring system, sizing errors in ordering or problems external to the meter. Check all components in the system for proper sizing, installation and leakage.

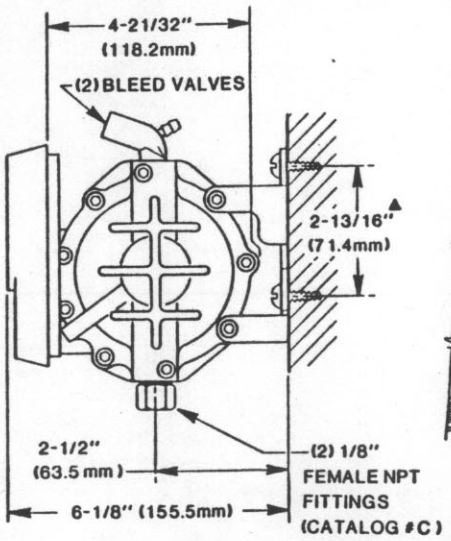
The operating environment must correspond with the specified conditions stated when the Eagle Eye Meter was ordered. If the meter is being used at different operating temperatures or pressures, or different orientation, recalibration must be done at the factory.

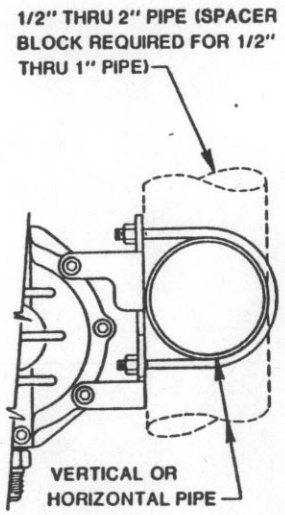




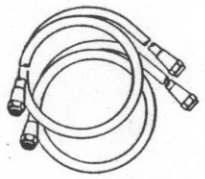
FLUSH PANEL MOUNT (CATALOG # F)

▲ – HORIZONTALLY & VERTICALLY

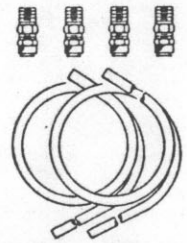




WALL AND PIPE MOUNTING (CATALOG # W)



(2) 10' (3048mm) LG × 1/4" O.D. NYLON TUBING. ASSEMBLED WITH 1/4" SAE FLARE NUTS. (CATALOG # 1)



(2) 10' (3048mm) LG × 1/4" O.D. NYLON TUBING WITH (4) 1/8" MALE NPT TO 1/4" COMPRESSION FITTINGS - UNASSEMBLED. (CATALOG #2)

CONNECTING HARDWARE PACKAGES

PROJECT:

LOCATION:

METER TYPE: MOUNTING:

INSTRUMENT FITTINGS:

CONNECTING HARDWARE PACKAGE:

MAXIMUM SCALE READING:

UNITS: MULTIPLIER:

Dieterich Standard Corporation • Subsidiary of DOVER Corporation

Box 9000 • Boulder, Colorado 80306 USA

STANDARD EAGLE EYE METER

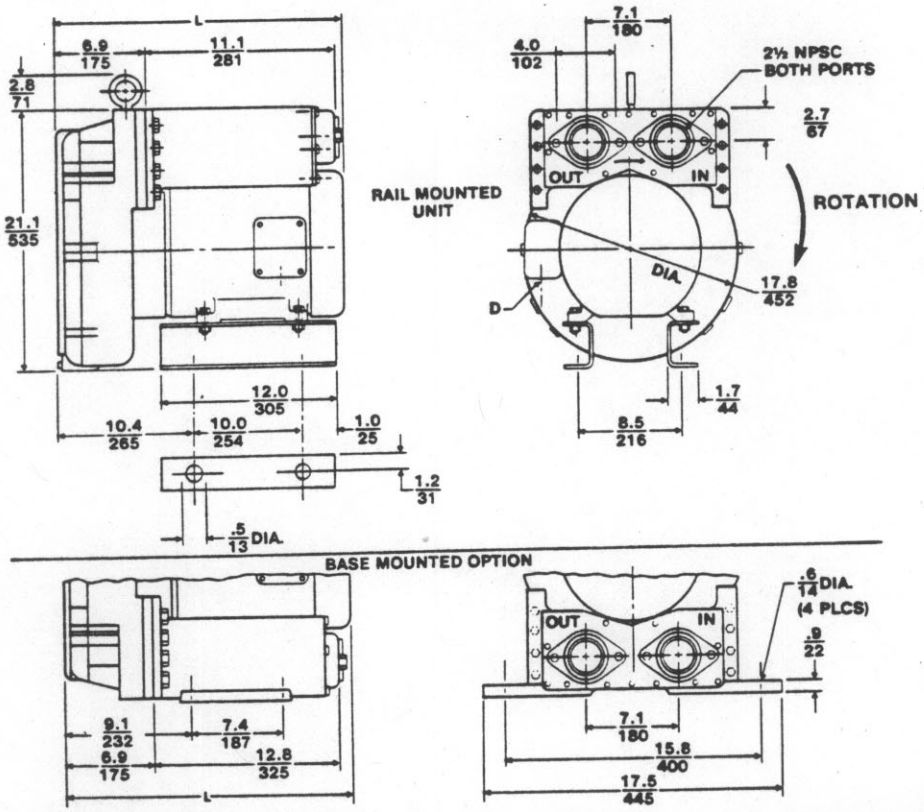
APPROVAL		LATEST REVISION	
By C. Britton	Date 20 Aug. 79	Letter	Date
Drawn by Dcutin	Checked by Hilda Dirth	Date Drawn 13 AUG 79	Scale N.T.S.

C-9800

C.T. MALE ASSOCIATES, P.C.

ROTRON VACUUM BLOWER

DR 8
Regenerative Blower



MODEL	L IN / MM	D IN / MM
DR8AY72	23.0 / 584	1.1 / 27
DR8BB72	24.1 / 613	1.1 / 27
DR8BD72	24.4 / 619	¾ NPT
DR8BB86	24.1 / 613	1.1 / 27
DR8D89	19.6 / 498	1.1 / 27

DIMENSIONS: IN / MM
TOLERANCE: .X ± .1 / 2.5

Specifications Subject To Change Without Notice.

SPECIFICATIONS

MODEL	DR8AY72W	DR8BB72W	DR8BD72W	DR8BB86W	DR8D89W
Part No.	036871	036732	036733	036734	036735
Motor Enclosure Type	TEFC	TEFC	XP	TEFC	TEFC
Motor Horsepower	7.5	10	10	10	5.0
Voltage[1]	230/460	230/460	230/460	575	230/460
Phase	3	3	3	3	3
Frequency[1] (Hz)	60	60	60	60	60
Insulation Class[2]	F	F	B	F	F
NEMA Rated Motor Amps	20/10	26/13	26/13	10.4	14/7
Service Factor	1.15	1.15	1.0	1.15	1.15
Locked Rotor Amps	140/70	155/78	155/78	84	96/48
Max. Blower Amps	27.6/13.8	30/15	26/13	11.0	17.2/8.6
Recommended NEMA Starter Size	1/1	2/1	2/1	1	1/0
Weight (lbs/Kg)	258/116	258/116	258/116	258/116	237/106
Model No. (Base Mount Option)	DR8AY72X	DR8BB72X	DR8BD72X	DR8BB86X	DR8D89X
Part No. (Base Mount Option)	036926	036737	036738	036739	
Blower Limitations for Continuous Duty (60 Hz/50 Hz)					
Max. Pressure-In. of water	106/90	126/96	126/96	126 (60 Hz)	45/50
Max. Suction-In. of water	100/78	104/78	104/78	104 (60 Hz)	50/50
Min. Flow-Pressure-SCFM	230/160	130/75	130/75	130 (60 Hz)	340/250
Min. Flow-Suction-SCFM	100/40	80/40	80/40	80 (60 Hz)	280/220

[1]All 3-phase motors are factory tested and certified to operate on 200-230/460 VAC-3 ph-60 Hz and 220-240/380-415 VAC-3 ph-50 Hz.

[2]Maximum operating temperatures: Motor winding temperature (winding rise plus ambient) should not exceed 140°C for Class F insulation or 110°C for Class B insulation. Blower outlet air temperature should not exceed 140°C (air temperature rise plus ambient).

DR 8
Regenerative Blower

FEATURES

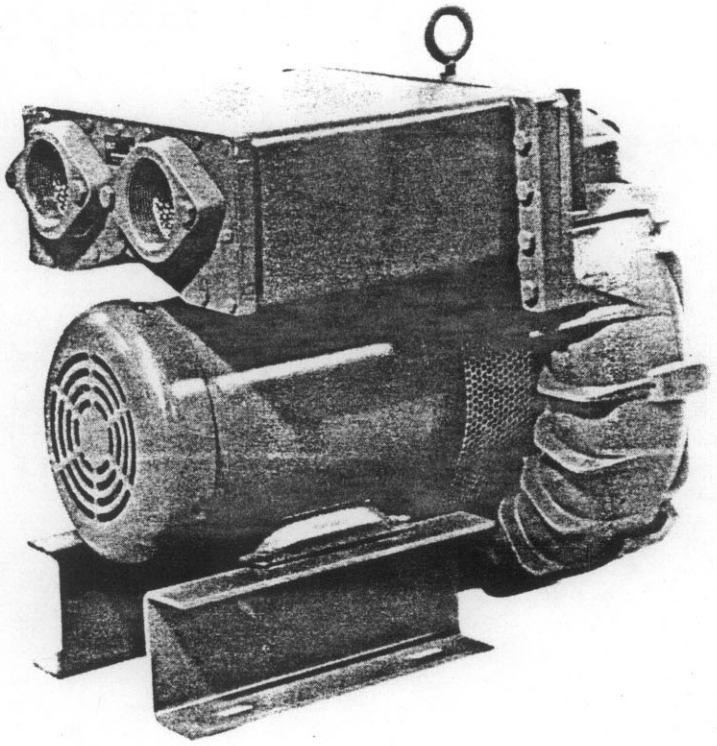
- Manufactured in the USA
- Maximum flow 400 SCFM
- Maximum pressure 128″ WG
- Maximum vacuum 7.7″ Hg
- 10 HP standard
- Blower construction—cast aluminum housing, impeller and cover
- Inlet and outlet internal muffling
- Noise level within OSHA standards
- Weight: 258 lbs. (116 Kg)

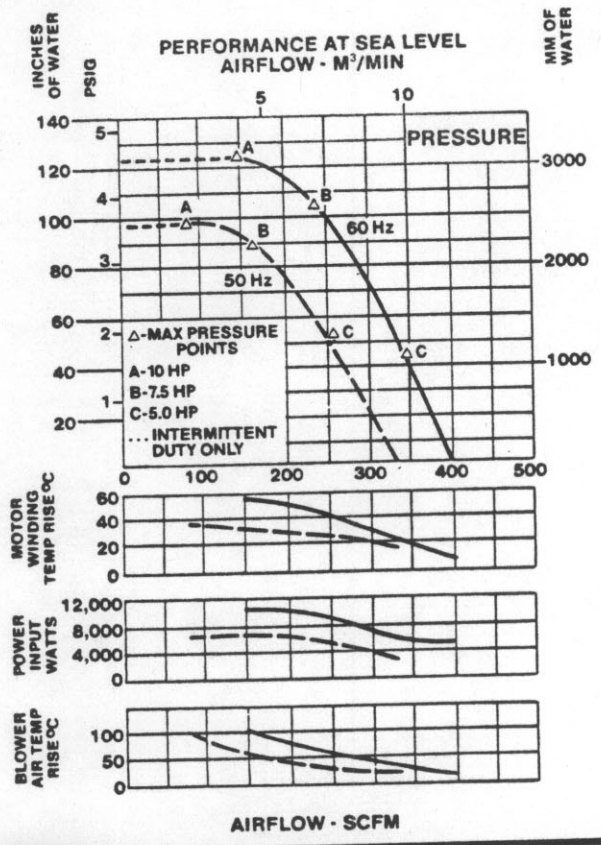
ACCESSORIES

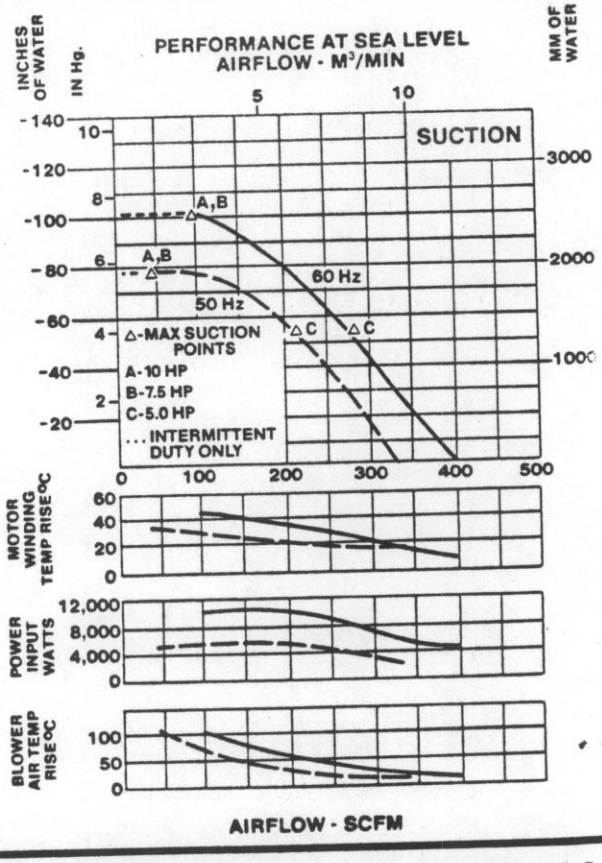
- Additional inlet/outlet mufflers
- Inlet and/or Inline filters
- Filter/silencers
- For details see Accessories Section

OPTIONS

- Smaller and larger horsepower motors
- 575-volt and XP motors
- Surface treatment or plating
- Gas tight sealing
- Bronze housing and impeller
- Belt drive (motorless) model; for details see Remote Drive Section







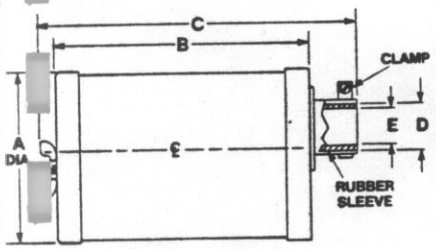
Blower Model Reference Key	
A=irals	E=DR606, DR707, DR4, DR5, DR6, DR7, DR75
B=1068, DR083, DR101, DR202	F=DR8, DR9, DR808, DR85
C=1303, DR312, DR353	G=DR10, DR11, DR12, DR13
D=DR313, DR404, DR454, DR505, DR513, DR523, DR543, DR555	H=DR14, DR15

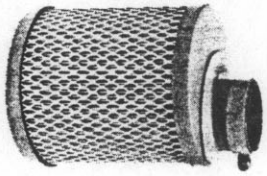
Accessories

nlet Filter (Single Connection)

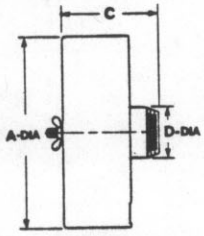
nle Filters protect the blower and the air distribution yst m from dust, and other airborne particles and con- aminants. Normally used in pressure systems.

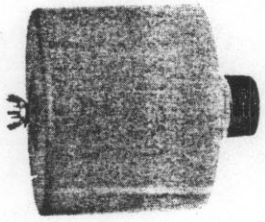
SPECIFICATIONS:
HOUSING-Steel
MEDIA-Polyester
EFFICIENCY-97-98% (8 to 10 micron particle size)
FILTER ELEMENT-Replaceable (see filter elements)
NOTE: "Z" MEDIA (1 to 3 micron particle size) available





477411 FOR SPIRAL BLOWERS





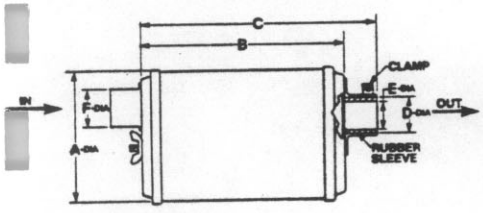
FOR DR BLOWER MODELS

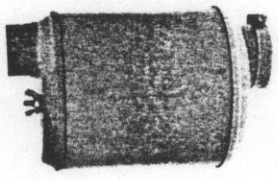
Part Number	Z Media Filter	Reference Blower Model	Connection		Dimensions (Inches)					Filter Element
			Inlet	Outlet	A	B	C	D	E	
477411		A	2.00 SO		4.56	5.06	7.00	2.00	1.75	271078
517609		B	0.75 NPT		3.25		3.75	0.75		517612
516466	517865	B	1.00 NPT		6.00		6.50	1.00		515132
515122	517866	C, D	1.50 NPT		6.00		6.50	1.50		515132
515123	517867	E	2.00 NPT		7.75		7.25	2.00		515133
515124	517868	E	2.00 NPT		10.00		12.25	2.00		515134
515125	517869	F	2.50 NPT		10.00		12.50	2.50		515134
515145	517870	G	3.00 NPT		10.00		13.00	3.00		515134
515151	517871	H	4.00 NPT		10.00		14.00	4.00		515135
516511	517872	H	6.00 NPT		16.00		15.00	6.00		516515
517347		H	8.00 NPT		22.50		23.00	8.00		517348

Inline Filter (Dual Connection)

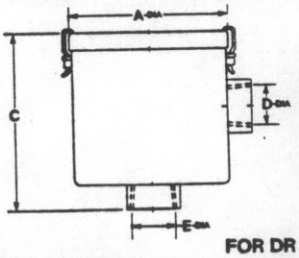
Inline Filters protect the blower from harmful dust and other particles that may be drawn into the blower through the air dis bution system. Normally used in vacuum systems.

SPECIFICATIONS:
HOUSING-Steel
MEDIA-Polyester
EFFICIENCY-97-98% (8 to 10 micron particle size)
FILTER ELEMENT-Replaceable (see filter elements)
NOTE: "Z" MEDIA (1 to 3 micron particle size) available





271200 FOR SPIRAL BLOWERS

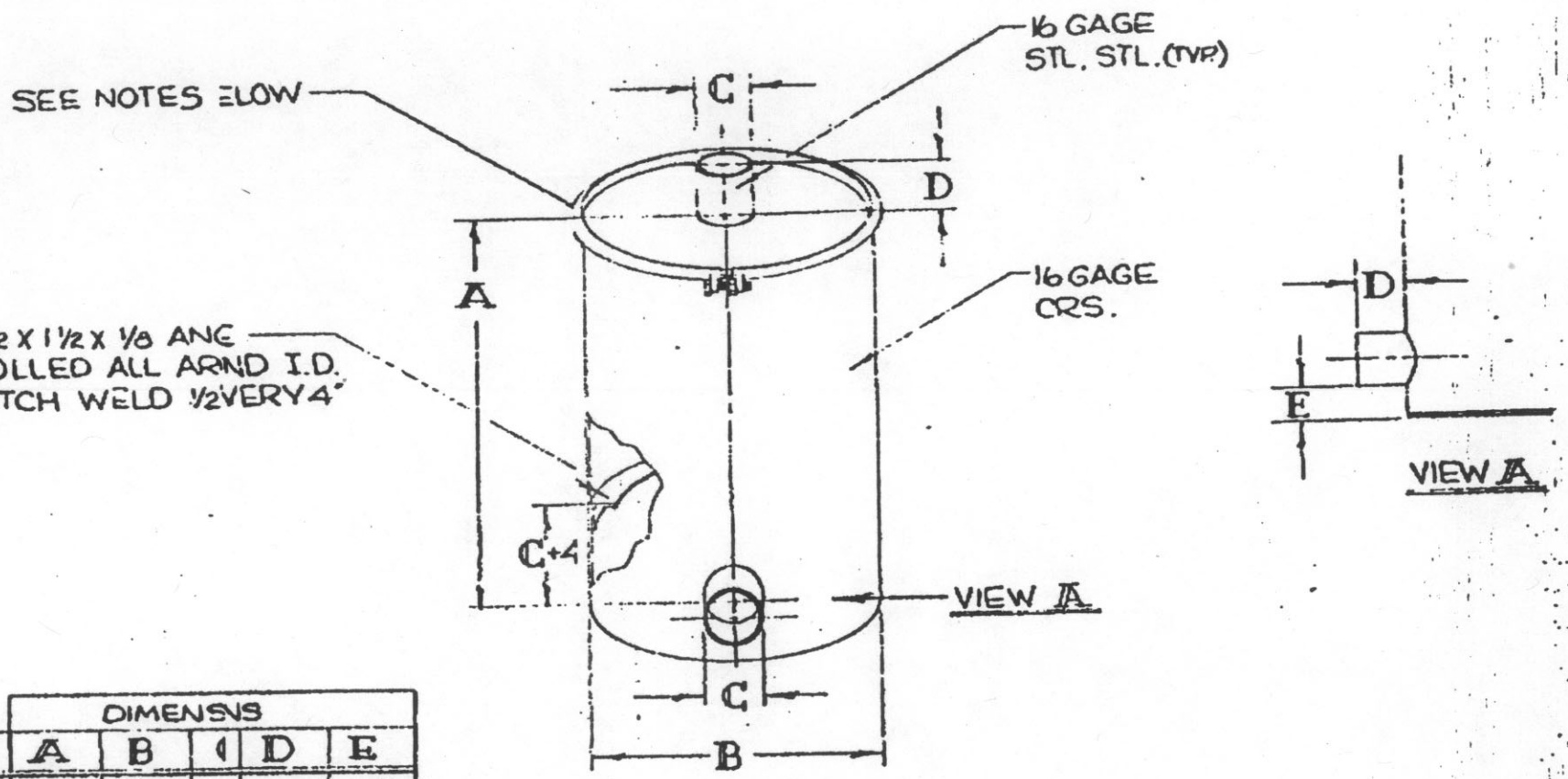


FOR DR BLOWER MODELS

Part Number	Z Media Filter	Reference Blower Model	Connection		Dimensions (Inches)						Filter Element
			Inlet	Outlet	A	B	C	D	E	F	
271200		A	1.75 SO	2.00 SO	5.25	6.25	8.31	2.00	1.75	1.75	271078
517610		B	0.75 NPSC	0.75 NPSC	5.50		4.38	0.75	0.75		517613
516461	517886	B	1.00 NPSC	1.00 NPSC	7.25		6.50	1.00	1.00		516434
515254	517887	C, D	1.50 NPSC	1.50 NPSC	7.00		6.50	1.50	1.50		516434
515255	517888	E	2.00 NPSC	2.00 NPSC	8.00		10.25	2.00	2.00		516435
515256	517889	F	2.50 NPSC	2.50 NPSC	8.00		10.25	2.50	2.50		516435
516463	517890	G	3.00 NPSC	3.00 NPSC	14.00		26.50	3.00	3.00		515135
516465	517891	H	4.00 NPSC	4.00 NPSC	14.00		27.00	4.00	4.00		515135
517611	517892	H	6.00 NPSC	6.00 NPSC	18.00		28.00	6.00	6.00		516515
517353		H	8.00 NPSC	8.00 NPSC	22.00		38.00	8.00	8.00		517348

C.T. MALE ASSOCIATES, P.C.

ODOR-MISER CARBON TREATMENT UNIT



#	DIMENSNS A	B		D	E
OM500	52"	36"	1	6"	2"
OM1000	56"	48"	.	8"	2"

NOTE:
1. BOLD RING THKNS. & DIM. TO ST WITH 5/8" X 3½ LONG THRDBOLT & LOCKING NUT
2. COVR TO HAVE STANDARD GASK/SEAL.

HOYT CORPORATION

TITLE: ODORMISER (LARGER)

MAT.

REQ'D.

DRWN P.A.P. CHKD

SCALE

REV.

DWG NO. TR2111A

DATE 9-6-89

Post-It™ brand fax transmittal memo 7671 | # of pages ▸ 2

To Liz Rovers	From Mike Morley
Co. CT Male Assoc.	Co. Hoyt Corp
Dept.	Phone # 215 767 7622
Fax # 518 786 7299	Fax #

ODOR-MISER™

ODOR-MISERS are vapor phase, activated carbon adsorbers designed to provide effective removal of offensive, low concentration odors in process air streams up to 1000 scfm, without the need for capital investment, dedicated personnel or complicated process equipment.

These canisters contain high grade, gas phase, activated carbon, are constructed of carbon steel and are coated for maximum corrosion resistance.

Typical applications include, the removal of air pollutants emitted by storage tanks, exhaust hoods, vacuum pumps, process air streams, etc.

LIQUID-MISER™

Designed to remove toxics, pollutants and organics from waste water streams, the HOYT LIQUID-MISERS can accommodate water flow rates up to 50 gpm and provide low cost, continuous control.

Materials of construction are identical to ODOR-MISER units except inlet and outlet connections are located on the canister's cover. Each Liquid-Miser contains hi-grade, liquid phase, activated carbon for maximum adsorption efficiency.

LIQUID-MISER™ MODELS
LM-7.5, LM-15
LM-25, and LM-50

READY FOR OPERATION

ODOR-MISERS and LIQUID-MISERS are delivered charged with activated carbon and ready for installation. Once inlet and outlet connections are made, Odor-Misers can be put into service at once. Note: For certain applications (e.g. ketones), Odor-Miser carbon should be wet down prior to service and a flame arrestor is recommended for flammable solvent applications. Liquid-Misers are typically back-flushed with water and then put into operation. Units can be installed, singularly, in parallel or in series. Parallel installations are utilized when air or water flows exceed flow rate specifications of the carbon canister. Series installations are utilized to provide longer contact time.

SPECIFICATIONS

ODOR-MISER™	OM-100	OM-250	OM-500	OM-1000
AIR FLOW (MAX. SCFM)	100 SCFM	250 SCFM	500 SCFM	1000 SCFM
PRESSURE DROP (MAX. INCHES H_2O)	13	13	13.5	14
DIAMETER (INCHES)	23	26	36	48
HEIGHT (INCHES)	36	38	52	56
CONNECTIONS (INCHES)	2 NPT	4 DUCT	6 DUCT	8 DUCT
BED DEPTH (INCHES)	24	27	36	36
ADSORBENT (CU. FT.)	5.5	8.3	22.2	37.7
MINIMUM CONTACT TIME (SEC.)	3.3	2.0	2.5	2.3
CARBON WEIGHT (LBS.)	165	250	640	1130
SHIPPING WEIGHT (LBS.)	300	400	900	1600

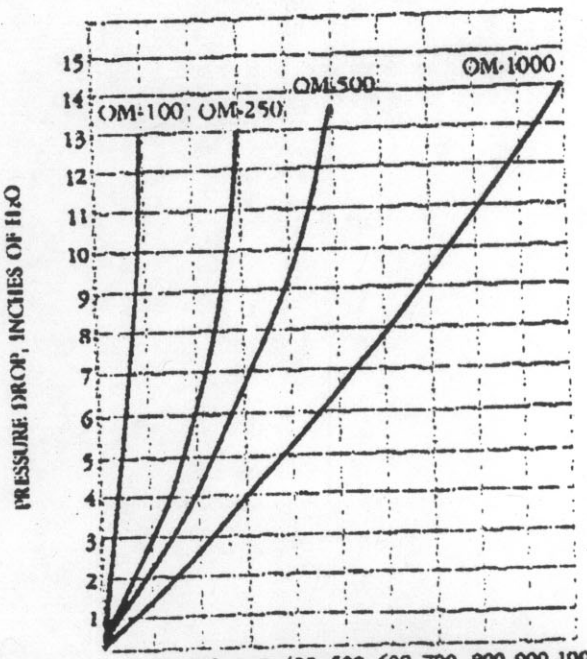
LIQUID-MISER™	LM-7.5	LM-15	LM-25	LM-50
WATER FLOW (MAX. GPM)	7.5 GPM	15 GPM	25 GPM	50 GPM
PRESSURE DROP (MAX. INCHES H_2O)	4	11	9	10
DIAMETER (INCHES)	23	26	36	48
HEIGHT (INCHES)	36	38	52	56
CONNECTIONS (INCHES)	¾ NPT (INLET) 1 NPT (OUTLET)	¾ NPT (INLET) 1 NPT (OUTLET)	1.5 NPT	2 NPT
BED DEPTH (INCHES)	27	27	45	45
ADSORBENT (CU. FT.)	6.2	8.3	25.1	50.1
MINIMUM CONTACT TIME (MIN.)	6.0	4.0	7.5	7.5
CARBON WEIGHT (LBS.)	165	225	675	1355
SHIPPING WEIGHT (LBS.)	300	375	935	1800

PARTIAL LIST OF ORGANICS REMOVED BY HOYT CARBON ADSORBERS

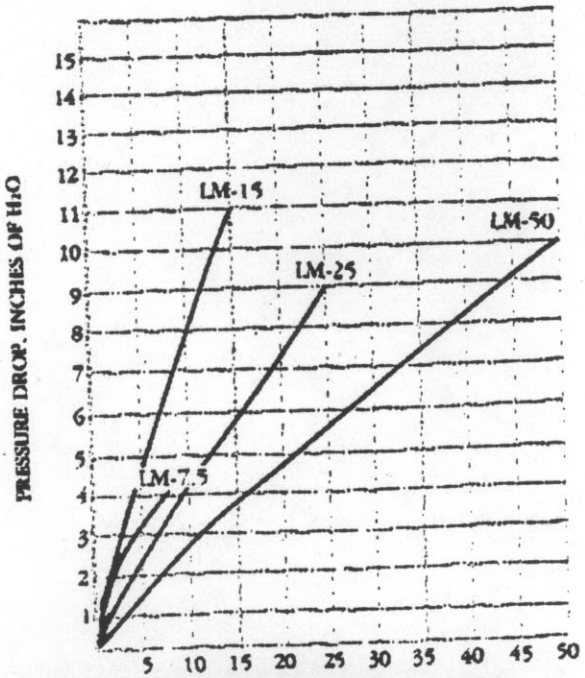
Acrylates
Alcohols
Aldehydes
Amines
Esters
Freons
Halogenated Hydrocarbons
Hydrocarbons
Ketones
Mercaptans
Benzene
Dimethyl Formamide
Ethanol
Ethyl Acetate
Hexane
Hydrogen Sulfide
Isopropyl Acetate
Isopropyl Alcohol
Methanol
Methylene Chloride
Methyl Acrylate
Methyl Cellosolve
Perchloroethylene
Tetrahydrofuran
Toluene
VM&P Naphtha
Xylene

PRESSURE DROP CHARACTERISTICS

ODOR-MISER™

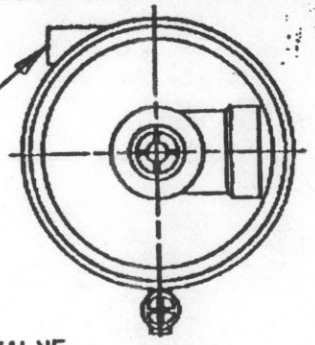


LIQUID-MISER™



C.T. MALE ASSOCIATES, P.C.

ROTRON MOISTURE SEPARATOR



NOTES:
1. FINISH: BLUE HAMMERTONE ENAMEL.
2. SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

REV.	C. O. NO.	ZONE	CHANGE	DATE	APP.
A	61110		SEE CHANGE ORDER 61110	6/90	JB
B	61191		SEE CHANGE ORDER 61191		

MODEL	"A" DIA.	CFM	"B"	"C"DIA.	"D"	"E"	"F"	"G"DIA.	DRAIN
MS200D	2.00	200	3.00	14.88	3.00	24.66	36.78	4.50	3/4" NPT
MS300D	2.50	300							
MS350B	3.00	350	6.00	23.44	5.00	34.37	46.50	6.63	1" NPT
MS500B		500					54.50		
MS600B	4.00	600	6.50						

MUST CONFORM TO ROTRON STD.NO.1 UNLESS OTHERWISE SPECIFIED

NO BURRS ALLOWED. INSIDE AND OUTSIDE CORNERS UNLESS SPECIFIED MAY HAVE .010 MAX. RADIUS.

TOLERANCE UNLESS SPECIFIED
2 PL.DEC.± .25
3 PL.DEC.± .030
ANGULAR±
DO NOT SCALE DRAWING

EG&G ROTRON
INDUSTRIAL DIV. ROTRON INC. NORTH BY. SAUGERTIES, NY 12477

MOISTURE SEPARATOR
OUTLINE DRAWING

MATERIAL

SCALE	DATE		LAYER
NONE	9/17/90	MC - 28967	B
DRAWN LCK	CHECK	DRAFTING STANDARD PER ANSI Y14.5M	REV
APPVD JB 9/90	SHEET 1 OF 1	DRAWING REVISIONS BY COMPUTER ONLY	

EG&G ROTRON
Industrial Division
North Street, Saugerties, NY 12477
TEL. (914) 246-3401 FAX: (914) 246-3802 TLX: 981511 TWX: 510-247-9033

MOISTURE SEPARATOR INSTALLATION, OPERATION AND MAINTENANCE

Thank you for purchasing an EG&G Rotron MS series moisture separator. When installed and maintained properly, this separator will effectively and efficiently remove moisture and particulates from the airstream. To insure good results, please take the time to read these instructions before starting the installation of your moisture separator.

Installation

Figure 1 shows the moisture separator in a typical soil venting set-up. It is attached to the system piping with flexible couplings. This minimizes the stress incurred by rigid system piping, and allows easy removal for maintenance purposes. The connections should be airtight, but not sealed with an adhesive. The separator will only work in an upright position as shown.

Typical Vapor Extraction System

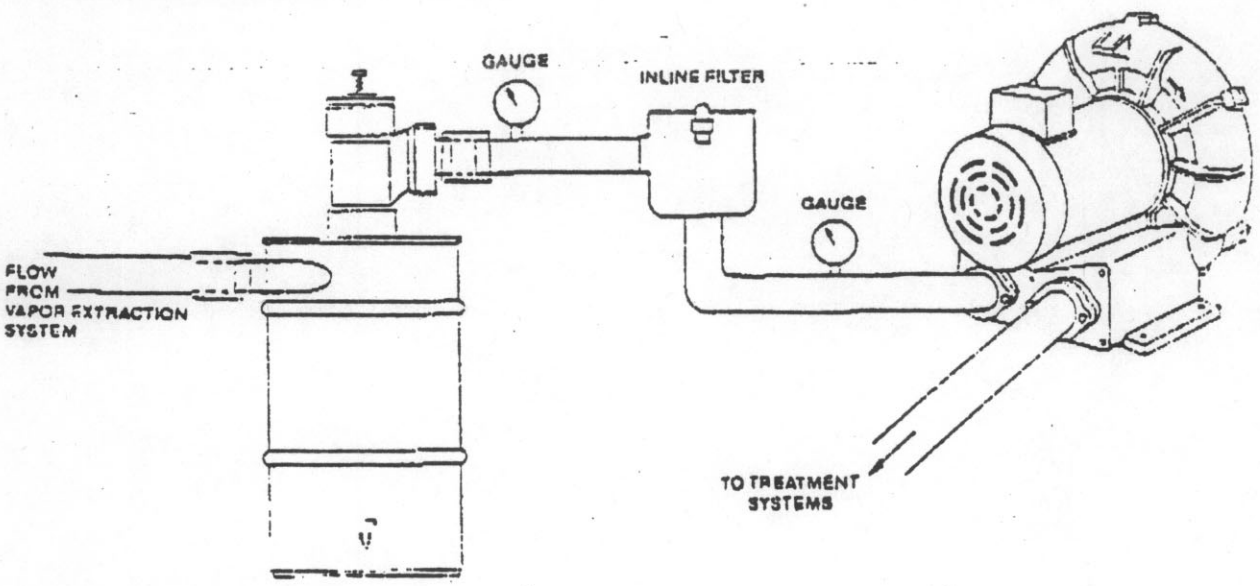


FIGURE 1

Note: A moisture separator is not a substitute for an inline air filter. A Rotron inline filter should be used to remove particles that pass through the separator.

The relief valve should be adjusted before using the moisture separator. First back off of the relief valve adjuster until it can easily be pushed in. Then while measuring the motor current adjust the valve until the motor current is 90% of the Max Blower Amps printed on the nameplate. Once adjusted the relief valve setting must be fixed. Turn off the unit and move the relief valve. Then use a center punch to peen the relief valve adjustment nut into the slot of the relief valve stem. This is to prevent the valve from losing its adjustment. Finally, reinstall the valve into the piping.

Depending on the amount of moisture in the system, a secondary vacuum duty reservoir tank may be advantageous. This will allow the system to run longer in-between service visits. The reservoir tank should be located below the separator, and connected to the separator via a non-collapsible vacuum duty hose.

Appropriate steps should be taken to prevent the unit from freezing in the Wintertime.

Operation

Moisture-laden air enters the separator through the tangential inlet. Cyclonic action removes the moisture from the airstream and allows the air to discharge through the top of the separator. When the separator is full the float valve shuts off the airflow through the separator, and the relief valve opens to limit the vacuum of the blower.

To drain the separator, turn off the blower and open the ball valve at the bottom of the separator. Caution: The liquid contained in the separator should be analyzed before it is released back into the environment. It may be considered hazardous waste in certain geographical areas, and require special treatment/disposal. Once the liquid is drained, the unit can be reset by turning the blower back on.

Maintenance

This MS series moisture separator has been designed to require minimal maintenance. During normal operation a layer of sludge may build up on the bottom of the separator. As necessary the top assembly of the moisture separator should be removed and the inside cleaned out with water. Keeping the inside clean will prevent the valve from becoming clogged with sediment.

The relief valve should be inspected upon emptying the separator. It should move freely when pressed. The original setting should be checked every six months to assure that it hasn't drifted from the 90% of maximum current setting.

If you have any questions regarding this product please call our Application Engineering Department at (914) 246-3401.