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Operation and Maintenance Manual MCB Camp Lejeune Groundwater Treatment System

Volume II of VII

Submitted to:

DEPARTMENT OF THE NAVY
Contract No. N62470-93-D-3032

Submitted by:

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

5335 Triangle Parkway, Suite 450
Norcross, GA 30092

OHM Project No. 16032

November 1996

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TABLE 1.1

MAJOR EQUIPMENT LIST

MCB Camp Lejeune - Groundwater Treatment System
OHM Project #16032

Item ID #	Component	Item ID#	Component
C - 200	Air stripping column	T - 220	Stripper effluent holding tank
F - 220A/B/C	Cartridge filter	T - 240	Treated effluent holding tank
K - 200	Air stripper column fan	X - 130	Mix Tank
P - 025	Building drainage pump (wet well)	A - 130	Mixer
P - 025A	Building drainage pump (wet well)	X - 131	Inclined plate clarifier
P - 110A	Air stripper feed pump	X - 132	Liquid polymer feed system
P - 110B	Air stripper feed pump (back-up)	X - 132A	Metal scavanger/Coagulant pump
P - 115	Containment area sump pump	X - 140	Plate and frame filter press
P - 120	Jet mixing pump	X - 150A/B	Air compressors
P - 121	50% NaOH feed pump	X - 150C	Refrigerated air dryer
P - 141	Filter press feed pump	X - 150D	Compressed air receiver
P - 143	Sludge blowdown pump	X - 150F	Compressed air oil separator
P - 145	Supernatant transfer pump	X - 150G	Compressed air particulate filter
P - 205	Spent backwash water pump	X - 220A	GAC adsorber
P - 211	93% H_2SO4 feed pump	X - 220B	GAC adsorber
P - 212	93% H_2SO_4 feed pump	P - 100	SRW-1 shallow well pump
P - 241	Backwash water pump	P - 102	SRW-2 shallow well pump
P - 245	Reuse water pump	P - 104	SRW-3 shallow well pump
P - 220A	GAC adsorber feed pump	P - 300	SRW-4 shallow well pump
P - 220B	GAC adsorber feed pump (back-up)	P - 302	SRW-5 shallow well pump
T - 025	Building drainage wet well	P - 304	SRW-6 shallow well pump
T - 110	Groundwater storage tank	P - 101	DRW-1 deep well pump
T - 121	50% NaOH storage tank	P - 103	DRW-2 deep well pump
T - 140	Sludge thickening tank	P - 105	DRW-3 deep well pump
T - 145	Head tank	P - 301	DMW-1 monitoring well pump
T - 205	Backwash water holding tank		
T - 211	93% H_2 SO4 storage tank		

TABLE 1.2.2

KEY CONTACT LIST

MCB Camp Lejeune - Groundwater Treatment System

OHM Project #16032

Company/Agency	Contact	Title	Phone Number
OHM Site			910-451-2390
OHM Personnel	Jim Dunn	Project Manager	770-734-8072
	Alan Whitt	Project Supervisor	910-451-2599
	Randy Smith	Project Supervisor	910-451-2599
	Dwayne Currie	Deputy Program Manager	770-453-7707
	Phil Verbout	Sr. Electrical Engineer	713-775-7631
	Steve Grant	Site H & S Officer	910-451-2390
	Terry Whitt	Sr. Project Chemist	770-453-7686
	Greg Gilles	Technical Manager	770-453-7687
	Kai Mak	Sr. Project Engineer	770-453-7607
	Tom McCrory	Sr. Project Hydrogeologist	770-453-7663
	Angelo Liberatore	Reg. H & S Manager	770-453-7671
Stone & Webster	Chuck Lawrence	QC Engineer	615-755-9753
MCB Camp	Vann Marshburn	Supervising Engineer	910-451-2583
	Lt. Cheryl Hansen	A-ROICC	910-451-2581
	John Cotton	Construction Inspector	910-451-5006
LANTDIV	Kate Landman	RPM	804-322-4811
	Jerry Haste	COTR	804-444-8422
IRD/EMD	Neal Paul		910-451-5068
	Tom Morris		910-451-5068
NC DEHNR	Patrick Watters	Superfund RPM	910-353-3558
EPA-Region IV	Gena Townsend	RPM	404-347-3066
Southerland Electric	Scott Sosa	Project Manager	910-347-1754
Hatcher Construct.	Donald Hatcher	Owner/PM	910-285-7633
N.E. Construction	Tom DeLong	Project Manager	910-733-2801

TABLE 1.2.3

VENDOR CONTACT LIST

MCB Camp Lejeune - Groundwater Treatment System
OHM Project #16032

Company	Equipment	Contact	Phone / Fax Number
Industrial Sales	Valves, gauges, fittings, pumps	Gene Wells	910-763-5126 910-763-3207
P.R. Bradley & Assoc.	Meter pumps, Lightinng mixer	Mike Wolfe	770-998-1956 770-998-0119
Drillers Services Inc.	Wells, well pumps	Terry Yount	800-334-2308 704-322-7674
Industrial Plastics	Plastic pipe & fittings	Steve Bailey	770-844-7324 912-748-8327
Carolina Plastic Supply	HDPE pipe & fittings	Marc Davis	704-588-0541 704-588-5742
Goulds Pumps Inc.	Pumps	Joe Ruggiero	770-446-3369 770-446-3651
Boart Longyear	Downwell tubing	Bob Beyer	770-469-2720 770-498-2841
Palmer Manufacturing	FRP Tanks (T-110)	Scott Case	770-925-4855 770-925-4869
Northeast Construction	Buildings	Steve Straper	910-353-3558 910-353-3005
Proco Products		Sylvia Augusto	800-344-3246 209-943-0242
Atlanta Rod	Nuts/ bolts	Mary White	770-889-2136 706-356-2940
Hilti Corp.	Nuts/bolts, fastners	David Holloway	800-879-8000 800-879-7000
Eco Equip. Inc.	Jet mixer pump system	Steve Hart	770-345-2118 770-345-2699
Hertz Equipment		Steve Koroly	910-799-9751 910-395-2405
Fowler Manf.	Platforms	Doug Wolcott	904-246-4886 904-241-8056
Chet Adams	Elec. & Gas Heaters	E. Adams	919-851-6331 919-851-6371
Ingersall Rand	Air compressors	Gary Michael	770-936-6200 770-936-8210
R&W Construction	Tanks, structure steel	Wayne Pierce	910-455-1830 910-455-9163
Ladder Distr. Inc.		Carl Jocobsen	770-447-9057 770-447-9057
Cowen Supply	Piping hardware	Greg Southwell	404-351-6351 404-351-1259
C.M. Kemp Manf.	Dri-breather	Venita Gornew	410-761-5100 410-766-9105
Envirotrol	Carbon filter system	Tim Sokol	412-741-2030 412-741-2670
Pumping Systems Inc.	Diaphragm Air pumps	Michael Konopa	770-458-9555 770-455-9133
Filtration Tech.	Cartridge/Air filters	Scott Matthews	919-859-0124 919-859-0370
Gray Bar Elect.	Electric material supplies	Doyle Strickland	770-441-5580 770-446-7693

TABLE 1.2.3 (Cont.)

VENDOR CONTACT LIST

MCB Camp Lejeune - Groundwater Treatment System
OHM Project #16032

Company	Equipment	Contact	Phone	Fax Number
Dewy Brothers	Manhole rings & covers	Pat Miller	800-931-9391	
Hercules Steel	Inffluent box	Claude Scott	910-488-5110	910-488-4040
National Environ. Systems	Air Stripper tower	Pixie Terreault	508-761-6611	508-761-6898
Saws controls	Ceramic Air diffusers	Larry Sears	770-993-4392	770-998-2430
Delta Sales	Eyewash stations	Gene Waters	770-934-9960	770-934-6865
Hugo Jahnz & Assoc.	Plastic tanks	Ansley Jimmerson	770-889-1732	770-887-7405
Engineered Fiberglass	FRP Well Building	Clarence Kazmir	770-475-2242	770-664-6906
Jenkins Gas & Oil	LP tank	Keith McGouden	910-455-1711	910-346-9404
George Selke Co.	HDPE tanks	Mike Callahan	770-925-4855	770-925-4869
Hoffman & Hoffman	Roof fans	Bill Poole	919-781-8011	919-787-6019
Tracon Inc.	Meter manhole		770-475-2242	770-664-6906
Parkson Corp.	Lamella separator	Larry Sears	770-993-4392	770-998-2430
Tindall Concrete	Concrete Manholes	Fred Bosket	864-576-3230	864-587-8828
J.L. Pierce Surveying	Surveyor	J. Pierce		
Semblex Inc.	Polymer feed system	Steve Hart	770-345-2118	770-345-2699
Netzsch Filter	Filter press	Robert N. Hanks	610-363-8010	610-363-0971
High Rise Service Co. Inc.	Acid containment area coating	Donnie Cannon	910-371-2325	
ISCO Inc.	Ultrasonic Effluent Flowmeter		800-228-4373	
Lightnin c/o Bradley & Assoc.	Mixer (A-130)	Mike Wolfe	404-998-1956	
Tencarva Machinery Co.	Service all Goulds Pumps	Scott Hudson	910-799-8800	910-799-8801
Utility Precast Inc.	Electric manholes	Tommy McClellan	704-596-6283	704-596-6289

Table 1.2.3 (Cont.)			
US Foundry & Manufacturing Corp.	Electrical manhole rings & cover	Steve Douglass	404-696-8810 404-696-9482
Worth Chemical Corp.	50% Caustic	Stan Tew	864-574-2785
KOCH Sulfur Products Co.	93% Sulfuric acid	Ray Wilson	800-414-2243
Betz Entec, Inc.	Polymer, metal scavenger chemicals	Barry Owings	919-783-7071 919-783-7093
Halliday Prods.	Alum access frame	Jim Cook	407-298-4470 407-298-4534
G.E. Supply	Transformer & Elec. Equip. Supplies	Dave Whinsile	404-840-4196
Bertsch Co.	Pipe fittings	Bunnie	419-666-6605 419-666-3344

NATIONAL ENVIRONMENTAL SYSTEMS (NES) - AIR STRIPPER

Site:	MCB Camp Lejeune, NC - OU2 Groundwater Treatment Plant Delivery Order No. 0015.
Date service rep on site:	February 14, 1996
Name of representatives:	Mr. Matt Sweeney Ms. Cathy Terreault (508) 761-6611

Questions & Comments:

Question: Can the air stripper fan run continuously even if no groundwater is being processed through the sytem?

Comments: Yes. The fan is designed for continuous duty and can operate continuously without damage to the blower.

Question: What is the function of the lower of the two magnehelic guages on the side of the stripper tower?

Comments: The guage is connected to a flow measuring pitot tube which measures high and low pressure differential. To convert to flow rate in cfm, use the feet per minute scale and multiply the number on the gauge by 7.065 which is the inlet cross sectional area. Therefore, fpm x area = cfm into the stripper column.

Question: What is the function of the upper of the two magnehelic gauages on the side of the stripper tower and what should it be measuring under normal operating conditions?

Comments: It measures the inlet pressure in inches of water. The guage should read between 1 and 10 inches of water column. The reading will vary with the water flow rate. Consult the blower curve in the O&M manual for scaled flow rate vs. pressure drop.

Question: What degree of pressure drop across the tower would indicate a problem such as fouling?

Comments: Typically, 5 inches of water column operating differential above the design capacity would indicate a problem. The system has a pressure switch on the blower with high and low set points which will interface with the PLC.

Question: What is the purpose of the blind flange on the top side of the stripper sump?

Comments: It is generally open to atmosphere and used as an overfill contingency to prevent water from reaching the air inlet level in the event of a high shut off switch failure. It is very important that the water level in the sump not rise into the column above the air inlet. Damage could occur to the fan if such a condition arises.

Question: How long should the fan continue to operate if water feeding the air stripper is stopped?

Comments: Allow the blower to run for approximately 15 minutes after flow to the stripper has been shut off. This will allow for any water within the stripper column to cascade through the tower and be treated properly before reaching the sump.

Question: Should the air filter intake be positioned vertically rather than horizontally? It is currently positioned horizontally.
Comments: Generally, yes. This is to prevent precipitation from entering the filter and blower housing. NES will check the proper orientation and shop drawings, and offer a solution as necessary. It may be necessary to supply a different air filter housing, cap, or reposition the filter.

Question: What should the pressure switch be set at on the discharge of the fan to the air stripper for high and low settings?
Comments:

Question: Who can be called for prompt service should the need arise?
Comments: Call NES and speak with Bob Davis, Matt Sweeney, or Pixie.

Question: What is the procedure for cleaning the air stripping packing should the need arise?
Comments: Detailed procedures are provided in the O&M manual.

NATIONAL
ENVIRONMENTAL INC.
SYSTEMS

36 Maple Avenue • Seekonk, Massachusetts 02771
508 761-6611 FAX 508 761-6898

OHM - Camp LeJuene
NES Proposal No. 01-042794.11.01

Index

Section I: Overview

Section II: Air Stripper Tower

Section III: Air Stripper Blower

Section IV: Air Stripper Internals

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NES Proposal No. 01-042794.11.01

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NATIONAL
ENVIRONMENTAL INC.
SYSTEMS

36 Maple Avenue • Seekonk, Massachusetts 02771
508 761-6611 FAX 508 761-6898

CORPORATE OVERVIEW

National Environmental Systems, Inc., is a corporation headquartered in Seekonk, Massachusetts, U.S.A., which specializes in the manufacture of subsurface hydrocarbon recovery and groundwater treatment equipment.

Our professional staff possesses combined experience of over 50 years designing and manufacturing groundwater remediation treatment systems, including air strippers for removal of volatile organic compounds from potable groundwater supplies, soil gas extraction systems, product and groundwater recovery pumps, integrated controls, and liquid and vapor phase carbon adsorption systems.

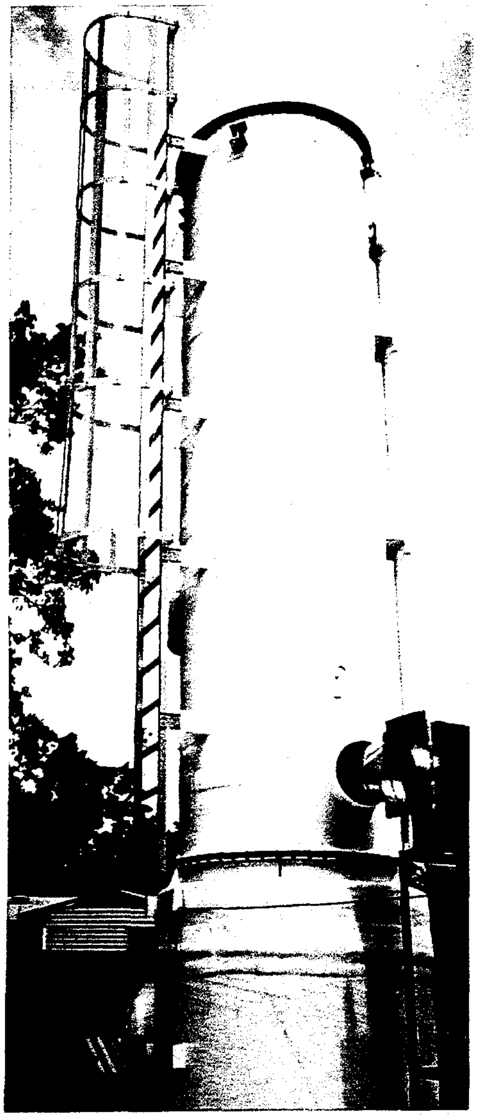
In addition to system design and manufacture, we provide on-site supervision and training, permitting assistance, turnkey installation and technical training seminars associated with the above-mentioned capabilities.

Clients of National Environmental Systems, Inc., are assured prompt, courteous, confidential response and personal attention. Providing timely information during implementation of your project and continued personalized service is our philosophy.

Air Stripping Systems

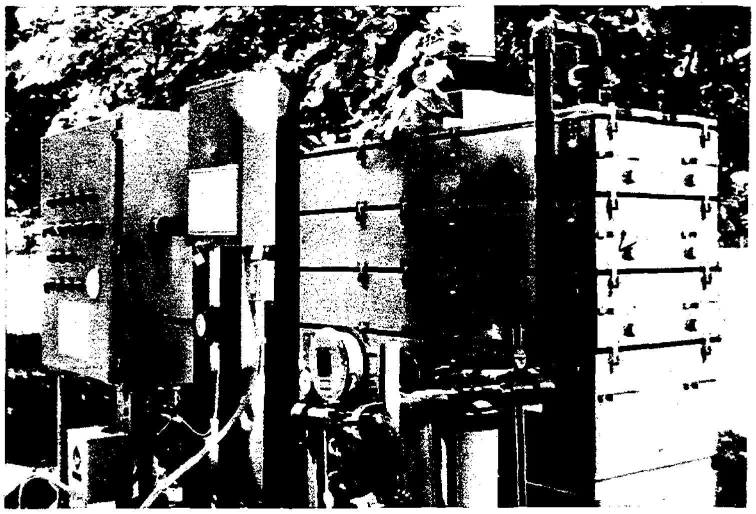
N A T I O N A L
ENVIRONMENTAL INC.
S Y S T E M S
36 Maple Avenue . Seekonk, Massachusetts 02771
508 761-6611 FAX 508 761-6898

Packed Columns



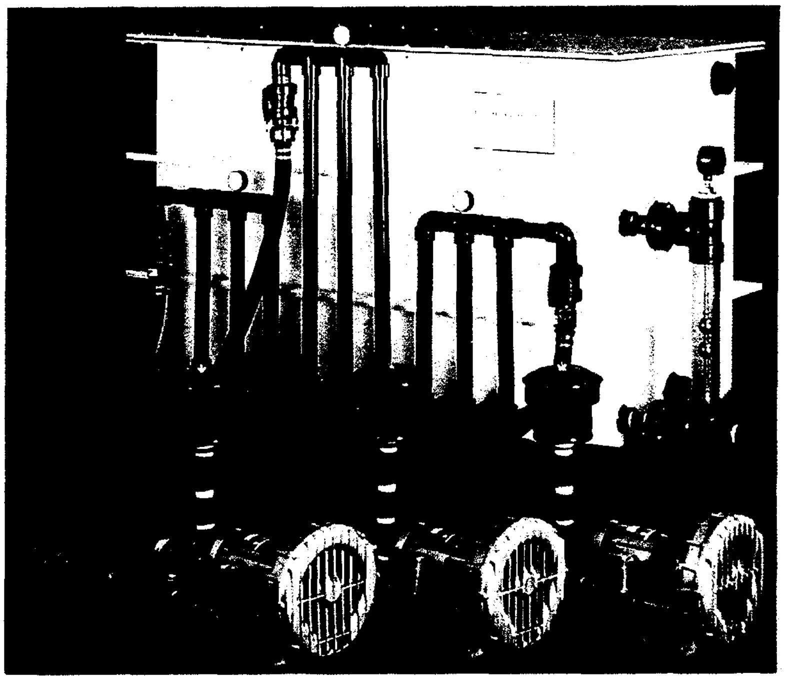
FRP (fiberglass reinforced plastic) packed towers for flow rates from 10 to 1200 gpm. Multiple optional features include clearwells, ladders and integrated controls.

Low Profile



Low Profile Air Strippers in polyethylene or stainless steel. Unobtrusive, compact designs provide high stripping efficiencies. Optional skid mounted packages including controls, telemetry, effluent pumps and accessories are available.

Aquarius



The "Aquarius" low profile air stripper is light weight, portable. Low capital and operating costs make this the unit of choice for low flow sites under 10 gpm. Available as a component of a complete remediation system or as a separate water treatment unit.

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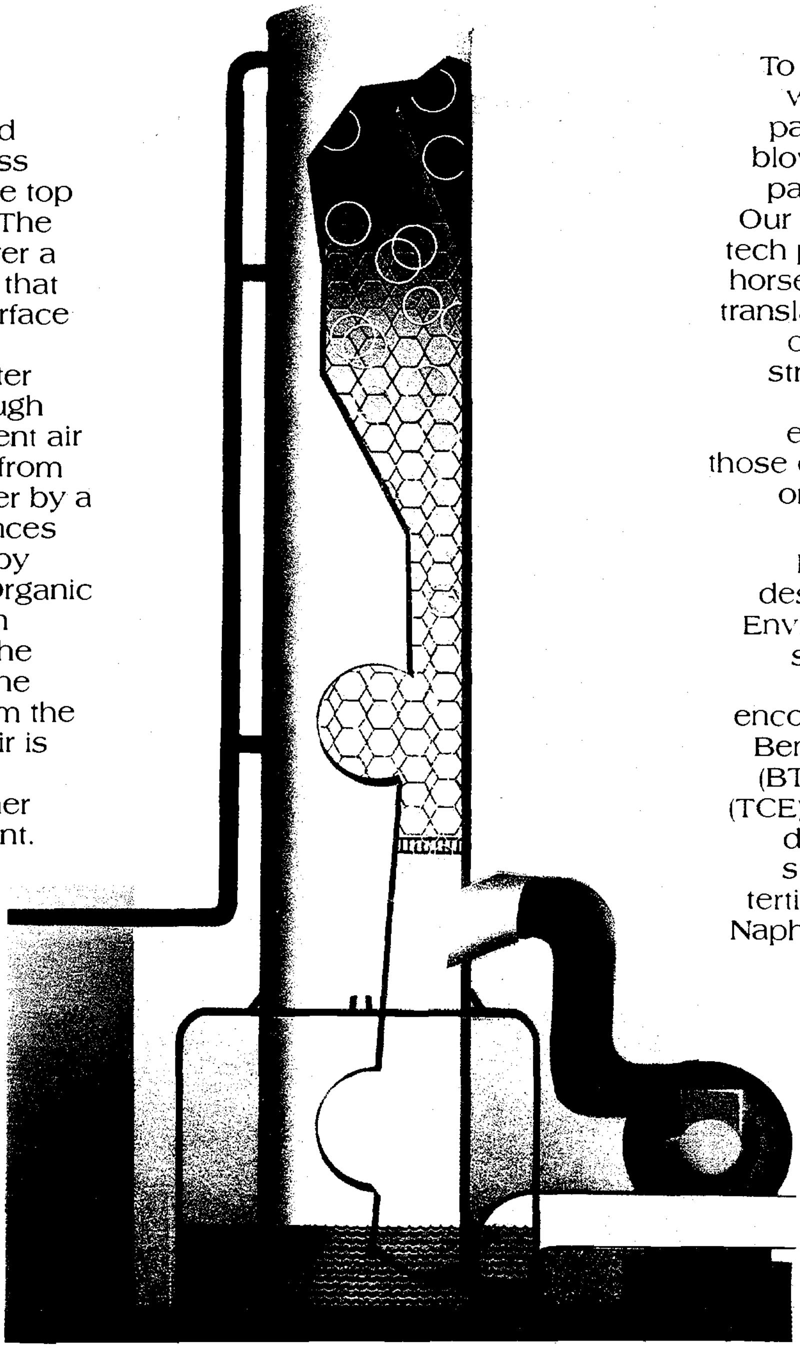
Air Stripping Systems / Contaminated Water Solutions

Air stripping is an economical process whereby contaminated groundwater or process water is pumped to the top of a packed column. The water is distributed over a bed of packing media that provides extensive surface area for contaminant extraction. As the water flows downward through the tower, clean ambient air is introduced upward from the bottom of the tower by a blower. The air enhances the stripping process by inducing the Volatile Organic Compounds (VOC'S) in water to transfer into the upward flowing air. The clean water drains from the tower sump and the air is dispersed into the atmosphere or to further treatment for abatement.

National Environmental Systems' air strippers are manufactured from corrosion resistant Fiberglass Reinforced Plastic (FRP). Our air strippers are available as a standard modular package, including visual inspection/ clean out port, influent pipe, influent spray assembly, siphon drain, pressure gauge, temperature gauge, blower, packing, and mist eliminator. We can incorporate various options into the tower design. These options include a clearwell for extra surge capacity with level controls and transfer pump, "birdscreen" top for weather protection, blower pressure switch, sump overflow switch or steel skid.

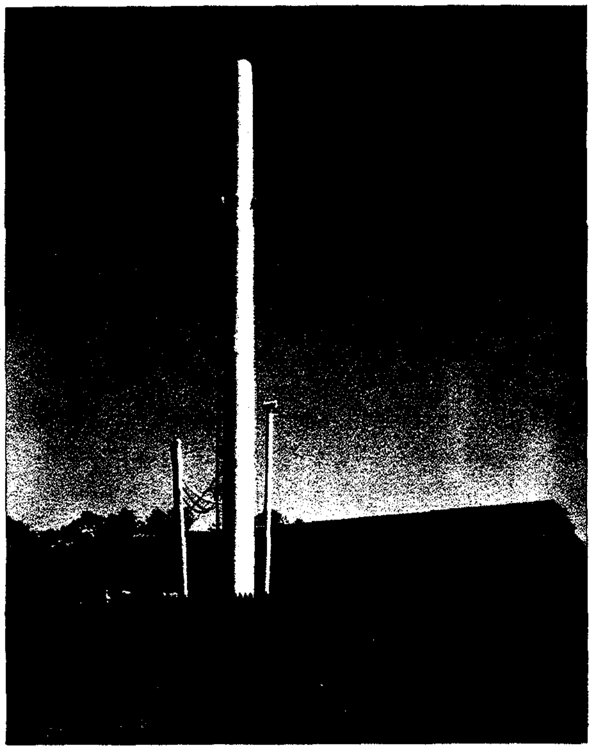


Air Stripper with optional clearwell.

To complete the package, we can supply a control panel for operation of the blower, transfer pump and packing cleaning system. Our air strippers utilize high tech packing media and low horsepower blowers, which translate into low capital and operating costs. Our air strippers are available for installation in harsh environments, including those exhibiting cold weather or hazardous properties.

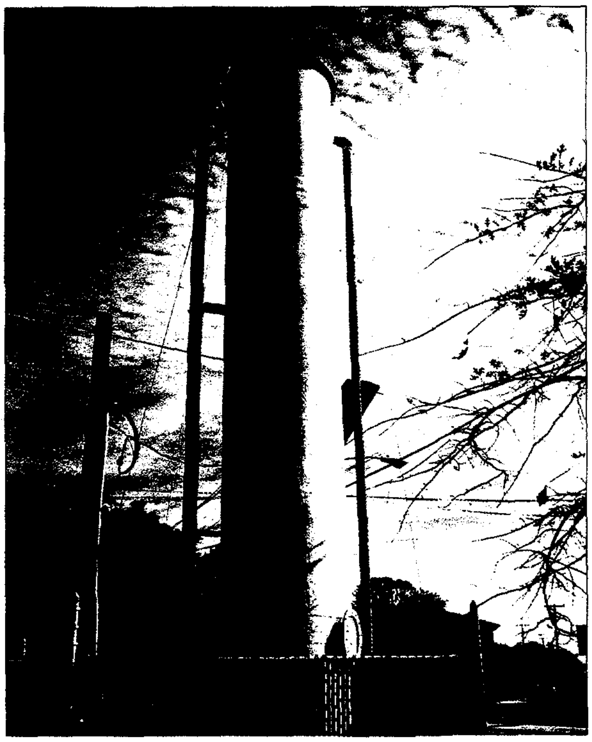
By using state-of-the-art design concepts, National Environmental Systems' air strippers are capable of removing commonly encountered VOC's such as Benzene, Toluene, Xylene (BTX) or Trichloroethylene (TCE) as well as those more difficult to remove by air stripping such as Methyl tertiary Butyl Ether (MTBE), Naphthalene, Chloroform or Ammonia.

In addition to the air stripping system, National Environmental Systems can provide detailed design calculations to substantiate the process design, which expedites the permitting process and installation time. Included with every air stripper is a process performance warranty and an installation and operating manual consisting of instructions, helpful hints, air stripper and blower blueprint, and blower operating curve. This additional support means that you, the customer, can permit, install, operate, and maintain a National Environmental Systems' air stripper in a cost effective manner.



Site A: Gasoline Station/Convenience Store

Tower Parameters	
Diameter	18 inches
Pack Height	33 feet
Overall Height	38 feet
Blower	1/2 horsepower
Design Parameters	
Flowrate	10 gpm
Water Temperature	55 °
Influent Water Concentrations	
Benzene	28,500 ppb
Toluene	26,150 ppb
Xylene	11,600 ppb
MTBE	16,000 ppb
Effluent Water Concentrations	
Benzene	1 ppb
MTBE	10 ppb



Site B: Gasoline Station

Tower Parameters	
Diameter	42 inches
Pack Height	17 feet
Overall Height	25.5 feet
Blower	5 horsepower
Design Parameters	
Flowrate	135 gpm
Water Temperature	55 °
Influent Water Concentrations	
Benzene	110 ppb
Toluene	530 ppb
Xylene	5388 ppb
Effluent Water Concentrations	
Benzene	5 ppb
Toluene	5 ppb
Xylene	5 ppb

In addition to air stripping systems, National Environmental Systems, Inc. also manufactures dual pump recovery equipment, soil gas extraction units, liquid phase carbon adsorbers and vapor phase carbon adsorbers. Each system can be operated independently or in conjunction with other pieces of our recovery/treatment equipment for a completely integrated and fail safe remediation process.

NATIONAL
ENVIRONMENTAL INC.
SYSTEMS

36 Maple Avenue • Seekonk, Massachusetts 02771
(508) 761-6611

Air Stripping Systems: A Design And Construction Overview

By Pixie Terreault

Air Stripping is the most economical, efficient process for removing volatile organic compounds (VOCs) from contaminated groundwater. To insure the client the most cost effective system, the chosen manufacturer requires information pertinent to the performance design and construction of the tower.

Before discussing the design and construction aspects of air stripping, let us briefly summarize the operation of an air stripping system.

The concept of air stripping incorporates a simple, effective process whereby the contaminated groundwater is introduced into the top of the tower through an influent distribution system. The water then flows downward through a bed of packing media. At the same time, air is being forced upward in a countercurrent direction through the tower. Clean water is then discharged from the tower base and air exits out the top of the tower to the atmosphere or to further treatment for abatement.

When choosing which packing media to utilize, the manufacturer considers several factors which are important in determining initial performance design and providing operating characteristic data. The surface area, number of drip points in each piece of pack, pressure drop characteristics, as well as the ability of the pack to become uniformly wet, contribute to the mass transfer capability of the packing. This is valuable because when a packing exhibits better mass transfer, it is more efficient. Increased packing efficiency results in a lower packing height as well as overall height of the tower which in turn reduces the cost of the tower. Plugging or fouling of pack is reduced by eliminating "dry spots" in packing. When fewer dry spots are available for solid particles to cling to, plugging and fouling effects are minimized.

Several pieces of information are required by the manufacturer in order to provide the client the most efficient air stripping system. They include flowrate and temperature of contaminated water, contaminated levels and chemical analysis of water, and effluent concentrations of water to be achieved by air stripping. In some areas, the water may be hard (high pH level) or may exhibit high iron concentrations. A laboratory analysis for this information should also be provided as it gives insight into packing fouling or plugging tendencies.

The water flowrate should be determined b means of a pump test. The pumping rate is d rectly related to the diameter of the tower. Over sizing of the tower results in higher custome costs. Understating the flowrate may result in tower incapable of handling the required flow The temperature should be the actual temperature of the groundwater, not merely an estimate This is especially important in areas where th water is cold (55°F or less) because a fluctuatio of even plus or minus 2° can affect the calculatio used to determine the packing height. If the temperature is estimated too high, it is possible t under-design the tower and risk not being abl to meet required effluent levels of the contaminants involved.

An accurate laboratory analysis of the contaminated water is perhaps the most critical criteri for design. Different test methods as required b the Environmental Protection Agency (EPA) are used for different chemical compounds. Chemicals must be identified by compounds not by generic terminology. For instance, "mineral spirits" contains many chemicals. In order to design a system to remove "mineral spirits," a breakdown of the chemicals contained in the compound is necessary. The test method for contaminated petroleum products, commonly referred to as the gasoline analytical group, should be EPA methods 601 and 602. Some states also require testing for 1, 2-Dibromoethane (1, 2-EDB) and lead. Petroleum chemicals in the gasoline group are benzene, toluene, xylene, ethylbenzene and Methyl tertiary Butyl Ether (MTBE). The second petroleum group, containing such chemicals as JP-4 (Jet Fuel) and kerosene, in addition to constituents in the gasoline group, are analyzed using EPA methods 610 and 418.1.

After completing the design of an air stripping system, a manufacturer must then assure the structural integrity of the tower. In order to accomplish this, determinations must be made in regard to location. They are the seismic zone and wind speed area in which the tower is to be erected, as well as the hydraulic load on the tower. These standards are set in accordance with the Uniform Building Code 1985 (UBC 1985).

The seismic zone takes into account placemen of a tower in areas of the United States where damage from an earthquake presents no risk

(Zone 0) to major damage probability (Zone 4) because of proximity to earthquake fault systems. The location of the tower (Town and State) must be made known to the manufacturer because within some states, more than one seismic zone exists. For example, Nevada is located within seismic zones 2, 3 and 4, and the construction of the tower would vary from zone to zone. The same can be said for wind loading. Certain areas of the country can experience winds of 110 miles per hour while others experience winds of 70 miles per hour maximum. The tower should be constructed in accordance to the geographic site location. Hydraulic loading is the calculated weight of the tower during operating conditions. These conditions include the weight of the tower shell and internals, packing, and contaminated water in the tower. The shell of the tower must be able to withstand all of the above loads without sustaining any structural damage such as surface cracks or buckling.

The next step taken by a manufacturer is to make sure the proper wall thickness is achieved. Manufacturers who use a contact-molded process follow the standards set in Voluntary Product Standard PS15-69 — "Custom Contact-Molded Reinforced-Polyester Chemical Resistant Process Equipment" developed by the National Bureau of Standards, U.S. Department of Commerce, for the fiberglass reinforced plastic industry. Manufacturers who use a filament-wound process have their towers conform to American Society for Testing and Materials, Specification D3299 — "Filament-Wound Glass-Fiberglass-Reinforced Thermoset Resin Chemical-Resistant Tanks". This standard specifies manufacturing processes for cylindrical tanks containing aggressive chemicals for above ground vertical installation. Filament wound fiberglass reinforced plastic (FRP) is usually specified instead of contact molding in large diameter and/or tall towers because of the increased structural strength achieved using this process.

In addition to conforming structurally to the above standards, other considerations to insure the longevity and efficiency of the air stripper should be considered. For instance, the use of resins manufactured to withstand aggressive chemicals can change. A different resin may be recommended for chloroform than for benzene in the inner corrosion barrier of the tower. Wall wipers may be placed along the inside wall in the packed section to prevent "channeling" of water going down the side of the tower without coming into contact with the packing media.

Other materials of construction may be considered in addition to fiberglass. They are stainless steel, aluminum, or poly vinyl chloride (PVC). Stainless Steel and aluminum are usually more expensive to manufacture than FRP. These towers have been traditionally used in some industrial and municipal water company applications. However, with the increased number of FRP towers proving their structural integrity and resistance to aggressive chemicals over long periods of time in these applications, FRP is now being used.

PVC is usually the least expensive material of construction. In areas not requiring seismic or high wind loading considerations (Zones 0 and 1, and 7- mph winds or less) it can be a viable alternative to FRP, stainless steel, or aluminum. However, PVC can become brittle because of "shrinking" and exhibit stress cracks when exposed to ultraviolet rays (sunshine). Some manufacturers compensate for this by providing an FRP overlay of layer to help prevent cracking.

In conclusion, providing the manufacturer or design engineer with complete information can indeed make air stripping the most cost effective, trouble free component in your treatment system.

For additional information, contact the author at National Environmental Systems Inc., 36 Maple Ave., Seekonk, MA 02771, 508/761-6611

Tyree Brothers Environmental Services, Inc.
208 Route 109. Farmingdale. NY 11735 · Fax: 516-249-3281 · Phone: 516-249-3150

September 1, 1992

National Environmental Systems Inc.
36 Maple Avenue
Seekonk , MA 02771

Attn: Pixie Terreault

Dear Ms. Terreault:

With over seventy-five active "Recovery Systems" in operation, I thought it necessary to advise you how pleased our firm is in doing business with National Environmental Systems, Inc.

Tyree Environmental Technologies has relied on your firm, on many occasions, to provide recovery and treatment equipment on a next day basis. National Environmental has always provided Tyree with state-of-the-art equipment at a fair market price.

I would also like to take this opportunity to thank each individual of National Environmental for their professionalism in dealing with the seriousness of our industry. You can be assured that Tyree will be turning to your company for our equipment needs on future projects.

My best wishes to you and your staff.

Best Regards,

Stephen J. Tyree
Partner

Member
Tyree
Environmental
Technologies

Sun Refining and
Marketing Company
Ten Penn Center
1801 Market Street
Philadelphia PA 19103-1

May 13, 1991

Ms. Pixie Terrault
National Environmental Systems
36 Maple Avenue
Seekonk, MA 02771

Dear Ms. Terrault:

Thank you and your staff at National Environmental systems for the quality air stripper design and construction services you have provided Sun Refining & Marketing Company.

The National Environmental Systems towers are without a doubt the best value on the market today. Keep up the good work!

Sincerely,

John J. Ennis
Retail Environmental Manager

JJE/gm

SUNOCO ATLANTIC

Mid-Continent Region
Production United States

Marathon Oil Company

P.O. Box 552
Midland, Texas 79702
Telephone 915/682-1626

August 22, 1991

John Haas
National Environmental Systems
36 Maple Avenue
Seekonk, Massachusetts 02771

John:

On August 6, 1991, I visited the Pauls Valley UST site and saw for the first time the groundwater cleanup equipment that we purchased from NES. I was very pleased with the setup and operation especially the non-complexity of the unit. The system was in operation for approximately one month and the analytical results received to date show the effluent is achieving the cleanup goals imposed by the State agencies.

Thanks again for your help and cooperation with this project. If I have a need for the services of NES in the future on any other projects, I will call.

Sincerely,

Thomas F. Zapatka
Advanced Environmental and Safety Engineer

TFZ/elk

TIBBETTS MECHANICAL CONTRACTORS
A Division of Natkin & Company

Industrial Piping • Millwright • Rigging • Air Conditioning • Plumbing • Heating

March 21, 1990

Ms. Pixie Terreault
National Environmental Systems, Inc.
36 Maple Avenue
Seekonk, Massachusetts 02771

Dear Ms. Terreault:

I write to report that the Oak Ridge Nonradiological Wastewater Treatment Facility which we recently completed has been put into full operation by the Energy Department.

One of the essential elements of this facility is the eight foot diameter Air Stripper furnished by your firm. I understand that the Plant Operating Contractor is well pleased with the performance of your equipment.

Pixie, I personally want to thank you and your staff for making our project a success. The professional attitude, knowledge and courtesy extended by your firm during the submittal, construction and start-up phases of the project were greatly appreciated.

I look forward to a continuing business relationship between our two companies.

Sincerely,

James S Bennett

James S. Bennett
Project Manager

Post Office Box 1276 Oak Ridge, Tennessee 37830 Phone 615/523-3183 or 615/576-7645

OHM Corporation

September 8, 1992

National Environmental Systems
36 Maple Avenue
Seekonk, MA 02771
ATTN: Ms. Pixie Therreault

Dear Ms. Therreault:

In the often frenetic environment of remediation contracting, it is refreshing to discover a new supplier that not only delivers what they promise, but takes pride in doing so. The recent experience with Shaw Air Force Base and the 500 GPM air stripper system you supplied was fraught with difficulties that would have taxed the abilities of every company with whom I personally, and OHM Corporation in general, have dealt with in the past. Beginning with the difficult and compressed bidding cycle, you out performed in price and responsiveness seven potential suppliers.

Initially, we were very concerned due to your size and our lack of experience with your company prior to this project. The technical assistance you extended before the award was invaluable in setting in motion the chain of events which followed. That you were capable of producing and deliveriing all of the components and drawings for this system in less than three weeks in spite of electrical specifications that were not finalized until two weeks before delivery was extraordinary, especially when considering that this unit had custom features and last minute nozzle location changes.

The quality of construction and fit-up of all the components was remarkable, also. It is rare to see fiberglass construction of this size without major visual flaws. All of the nozzles were within tolerances I have specified for towers for major chemical manufacturers without the written specification being required in the contract documents.

You and your staff are to be commended for performance above and beyond the call of duty. Rest assured that you have earned a permanent place on our bidders list in the southeast and that this letter is being copied to our corporate headquarters in Findlay, Ohio and all other technical centers throughout OHM Corporation.

Please feel free to use me and this project as a reference in the future. It has been, and I trust will yet again be, a pleasure doing business with you and your company.

Very Truly Yours,

David R. Rubin

David R. Rubin
Project Engineer

5335 Triangle Parkway, Suite 450 ▪ Norcross, Georgia 30092 ▪ 404-729-3900

N A T I O N A L
ENVIRONMENTAL
INC.
S Y S T E M S

36 Maple Avenue • Seekonk, Massachusetts 02771
508 761-6611 FAX 508 761-6898

PROJECT REFERENCES

1. **OHM Corporation**
   Norcross, Georgia
   Contact: Mr. Dave Rubin
   404-453-7648
   Site Description: Shaw Air Force Base - three 5 foot diameter
   Air Strippers - TCE contamination
   TCE Influent: 72 ppb
   TCE Effluent: 5 ppb
   Percent Removal: 93 %

2. **Groundwater Technology Inc.**
   Hollywood, Florida
   Contact: Mr. Paul Thornbury
   305-920-2006
   Site Description: various industrial and municipal application
   Air Strippers / 24 - 36 inch diameter

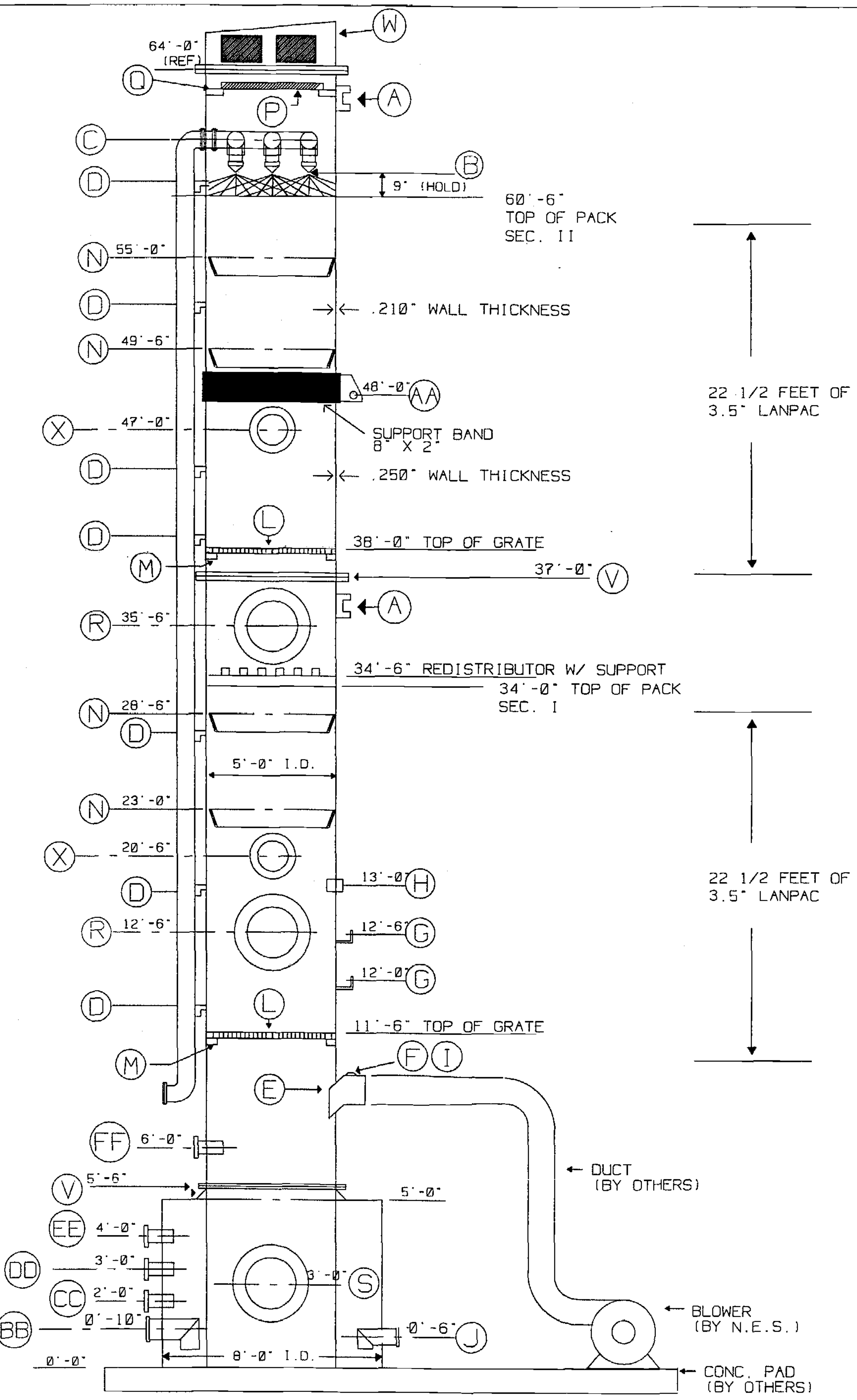
3. **Blasland, Bouck and Lee**
   Boca Raton, Florida
   Contact: Dave Faerman
   407-994-2711
   Site Description: Super Fund Site - Two 60 inch diameter
   Air Strippers

4. **Cunningham Associates**
   Milwaukee, Oregon
   Contact: Jim Helton
   503-653-0753
   Site Description: City of Milwaukee, Oregon
   Potable Water Treatment
   1 - 600 gpm, 72 inch diameter x 31 feet OVH Air
   Stripper
   1 - 1000 gpm, 96 inch diameter x 31 feet OVH Air
   Stripper
   TCE Contamination
   TCE Influent: 20 ppb
   TCE Effluent: 0.2 ppb
   Percent Removal: 99 %

PROJECT REFERENCES

5. **Linemaster Switch**
Woodstock, CT
Contact: Gary Kinnett
203-974-1000
Site Description: 48 inch diameter x 40 foot OVH Air Stripper - Super Fund Site - TCE Contamination
TCE Influent: 40,000 ppb
TCE Effluent: 5 ppb
Percent Removal: 99.875 %

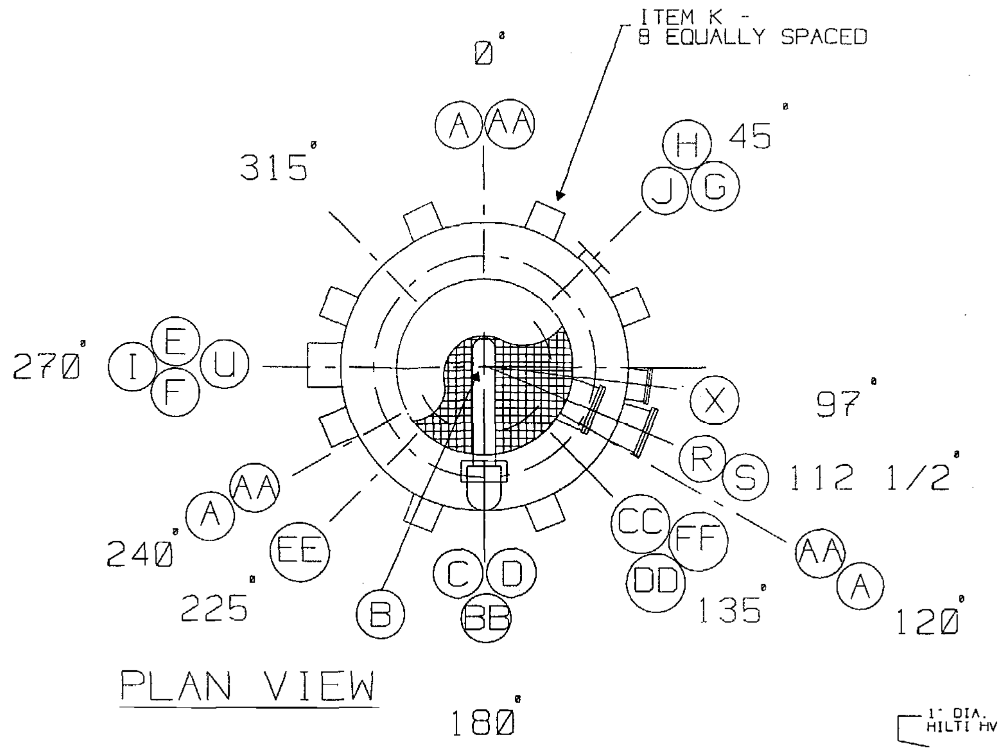
6. **Remediation, Inc.**
Glen Burnie, MD
Contact: Ken Johnston
717-292-4432
Site Description: 36 inch diameter Air Stripper Landfill Site - TCE Contamination
TCE Influent: 814 ppb
TCE Effluent: 5 ppb
Percent Removal: 99.38575 %



ELEVATION VIEW
"FRONT"

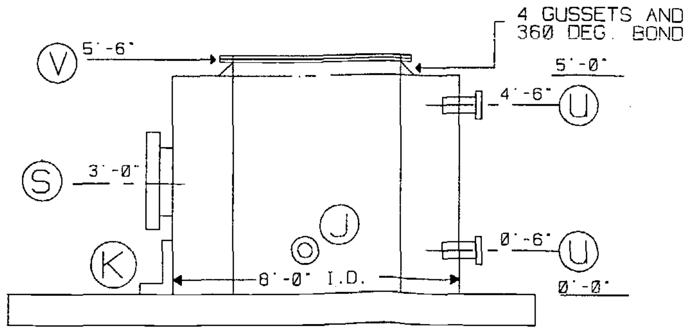
SEE PLAN VIEW FOR TRUE ORIENTATION

CONCENTRATIONS	INFLUENT	EFFLUENT
1.2-DICHLOROETHANE	30 ppb	0.38 ppb
1,2 DICHLOROETHYLENE (T)	30000 ppb	70.0 ppb
ETHYLBENZENE	52 ppb	29.0 ppb
TETRACHLOROETHENE	920 ppb	0.7 ppb
TRICHLOROETHYLENE	58000 ppb	2.8 ppb
VINYL CHLORIDE	800 ppb	1.4 ppb



PLAN VIEW

NOTE:
- ACCESS LADDER(S) AND PLATFORM(S) NOT SHOWN FOR CLARITY
- MINIMUM 6" ON ALL NOZZLE PROJECTIONS



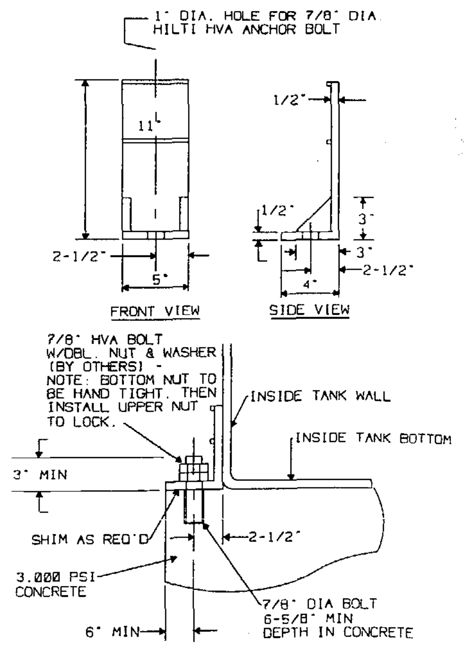
ELEVATION VIEW
"SIDE"

SEE PLAN VIEW FOR TRUE ORIENTATION

APPURTENANCE AND MATERIAL SCHEDULE LIST

ITEM	QTY	SIZE	DESCRIPTION	ELEV	ORNT
A	6	5/8"	STEEL LIFTING LUGS	TOP	#1
B	4	2"	PVC SPRAY NOZZLE	#1	#1
C	———	8"	FRP SCHEDULE 80 INLET PIPE AND FITTINGS	#1	180°
D	7	8"	U-BOLT PIPE SUPPORT FOR INLET PIPE	#1	180°
E	1	36" DIA	AIR INLET DUCT	#1	270°
F	1	1/8"	REINF. PAD W/ 1/8" NPT HOLE (PRESS PORT)	#1	270°
G	2	———	FRP GAUGE BRACKET	#1	45°
H	1	1/2"	FRP THD. HALF COUPLING (TEMPERATURE PORT)	13'-0"	45°
I	1	1/2"	REINF. PAD W/ 1/2" NPT HOLE (PITOT TUBE)	#1	270°
J	1	4"	FLANGED SIPHON DRAIN NOZZLE	0'-6"	45°
K	8	———	TIE DOWN LUG / TYPE II	0'-0"	#1
L	2	60" DIA	FRP GRATING	#1	———
M	2	———	I-BEAM SUPPORT FOR GRATING	#1	———
N	4	———	WALL WIPER	#1	———
P	1	60" DIA	DEMISTER	#1	———
O	1	60" DIA	FRP SUPPORT RING (FOR DEMISTER)	#1	———
R	2	24"	VIEWPORT W/ PLEXI - COVER	12'-6"	112.5°
S	1	24"	ACCESS PORT	#1	112.5°
U	2	2"	FRP THREADED HALF COUPLING (SIGHT GLASS)	#1	270°
V	2	60" DIA	NEOPRENE GASKET	#1	———
W	1	60" DIA	BIRD SCREEN	TOP	———
X	2	8"	VIEWPORT W/ PLEXI - COVER	#1	97°
AA	3	———	GUY WIRE LUGS	48'-0"	#1
BB	1	8"	FLANGE (PUMP JUCTION)	0'-10"	180°
CC	1	2"	FLANGE (SPARE)	2'-0"	135°
DD	1	4"	FLANGE (LIT)	3'-0"	135°
EE	1	3"	FLANGE (RECYCLE)	4'-0"	225°
FF	1	4"	FLANGE (OVERFLOW)	6'-0"	135°

#1 ELEVATIONS AND ORIENTATIONS ARE AS SHOWN



TYPE II TIE DOWN
LUG DETAIL

K

DESIGN INFORMATION	
TEMP.	55 F
WIND	100 M.P.H.
FLOW RATE	500 G.P.M.
SEISMIC	0
BLOWER	4680 CFM
MATERIALS	FRP
DRY WEIGHT	10900 LBS
OPERATING WEIGHT	22300 LBS

CONTRACT #N62470-93-D-3032 RFQ #16032-91518

NATIONAL ENVIRONMENTAL SYSTEMS
508-761-6611
36 MAPLE AVENUE, SEEKONK, MA 02771

AIR STRIPPER TOWER

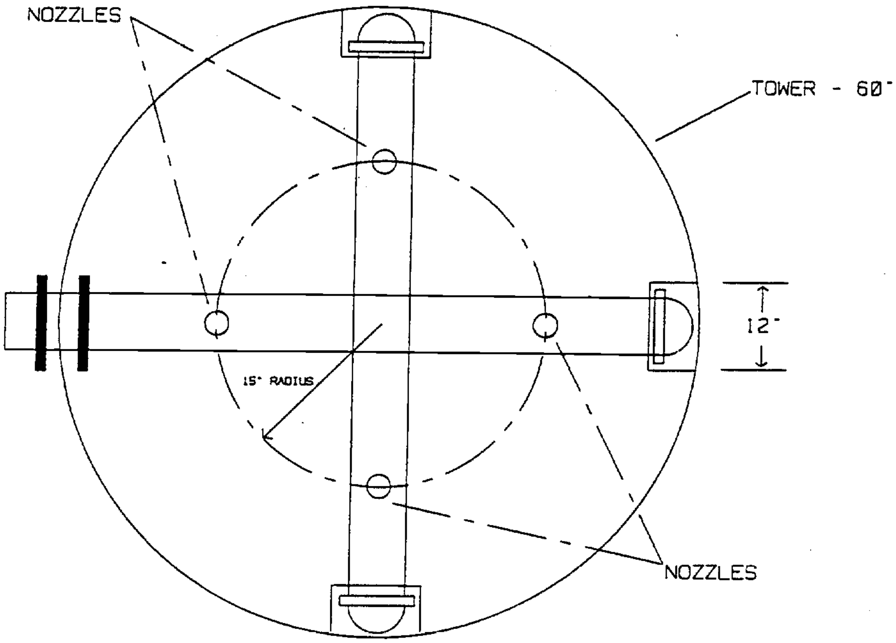
JOB NAME : OHM - CAMP LEJEUNE

NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 04-21-95	DRAWN: MTS	FILE NAME:	REV:
SCALE: N. T. S.	DESIGN: MAX	UU-AS-C	J

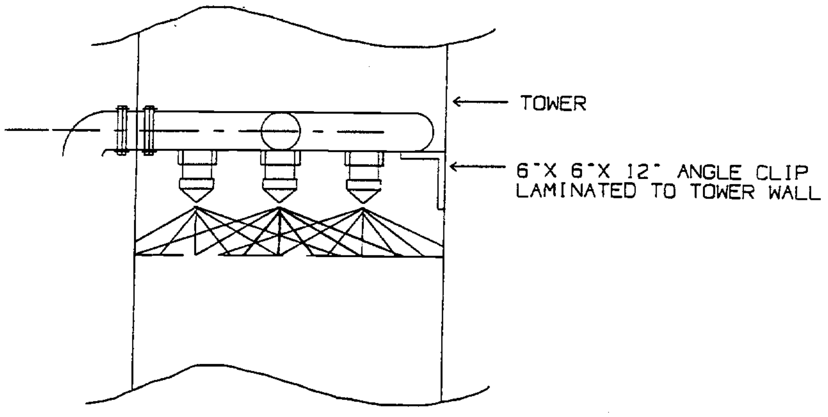
02348HH01Z

LIQUID DISTRIBUTOR

TOP VIEW OF LIQUID DISTRIBUTION ARRAY



SIDE VIEW OF LIQUID DISTRIBUTION ARRAY



NOTE:
FLOW RATE - 500 GPM
4 NOZZLES - EACH FLOW AT 125 GPM
NOZZLE MODEL # TF88FC

NATIONAL ENVIRONMENTAL SYSTEMS
508-761-6611
36 MAPLE AVENUE. SEEKONK. MA 02771

AIR STRIPPER
LIQUID DISTRIBUTOR \ SPRAY NOZZLES

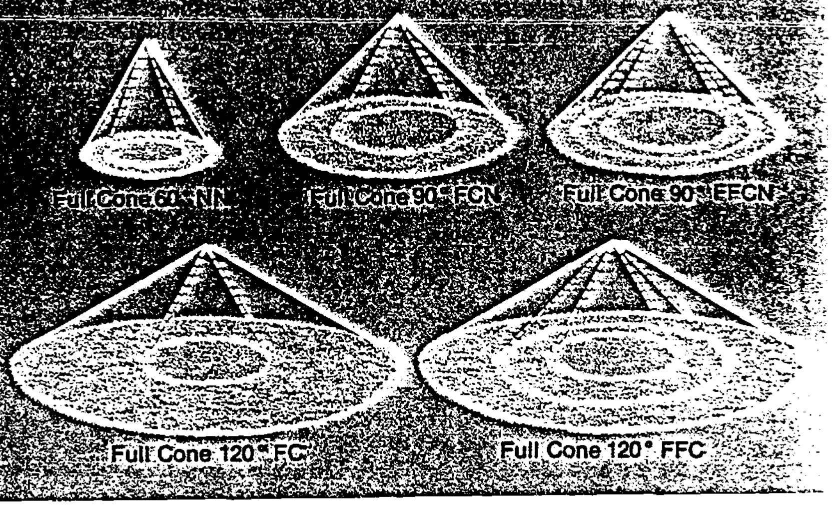
JOB NAME : OHM - CAMP LEJEUNE

NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 04-24-95	DRAWN: MTS	FILE NAME:	REV:
SCALE: N. T. S.	DESIGN: MAX	UU-NOZZ	I

SERIES

TF

Standard Line
Wide Range of Flows
Angles and Materials
Full and Hollow Cone



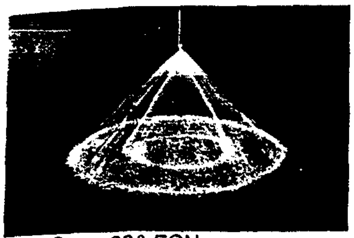
Spiral

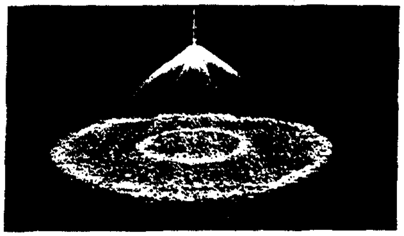
DESIGN

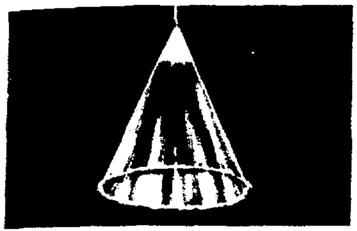
Unique Bete spiral nozzles
solve many difficult spray problems
HIGH ENERGY EFFICIENCY
One piece - no internal parts
Clog-free performance
High discharge velocity

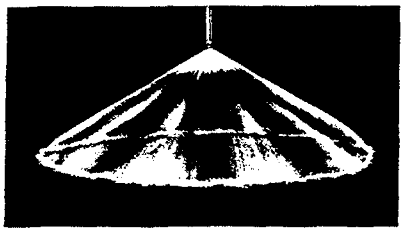
SPRAY CHARACTERISTICS

Wide range of flow rates and spray angles
Fine atomization
Spray patterns - full and hollow cone
Spray angles - 50° to 120°
Flow rates - .7 to 3350 gpm
Higher flow rates available


Full Cone 90° FCN


Full Cone 120° FC


Hollow Cone 50° N


Hollow Cone 120° W

MATERIALS
- PVC
- Polypropylene
- Teflon
- Brass
- 303 Stainless Steel
- 316 Stainless Steel
- C-20
- Hastelloy C
- Inconel 625
- Incoloy
- Tantalum
- Titanium
- Other materials on application

TYPICAL APPLICATIONS
- Chemical processing
- Cooling gases
- Deaerating
- Dry powder systems
- Dust removal
- Evaporative cooling
- Evaporative disposal
- Fixed fire protection
- Halon systems
- Scrubbers - air, gas, SO_2
- Snow making
- Spray absorption
- Spray ponds
- Tank rinsing
- Water purification

FULL CONE

Spray Angle	Male Pipe Size	Nozzle Number	Orifice Dia.	Free Passage Dia.	Overall Length	Hex. or Round Dia.	Weight		GALLONS PER MINUTE @ PSI									
							Plastic Oz.	Metal Oz.	10	20	30	40	50	60	80	100	200*	400*
120°	1/8	TF6FC	3/32	3/32	1 11/16	3/4	1/2	1	.7	1.0	1.2	1.4	1.6	1.7	2.0	2.2	3.1	4.4
		TF8FC	1/8	1/8	1 11/16	3/4	1/2	1	1.3	1.9	2.3	2.6	2.9	3.2	3.8	4.1	6.0	8.2
	1/4	TF6FC	3/32	3/32	1 7/8	3/4	1/2	1	.7	1.0	1.2	1.4	1.6	1.7	2.0	2.2	3.1	4.4
		TF8FC	1/8	1/8	1 7/8	3/4	1/2	1	1.3	1.9	2.3	2.6	2.9	3.2	3.8	4.1	6.0	8.2
		TF10FC	5/32	1/8	1 7/8	3/4	1/2	1	2.0	2.9	3.5	4.0	4.5	5.0	5.9	6.5	9.2	13.0
	3/8	TF12FC	3/16	1/8	1 7/8	3/4	3/4	1 1/2	3.0	4.2	5.2	6.0	6.7	7.4	8.5	9.5	13.4	19
		TF14FC	7/32	1/8	1 7/8	3/4	3/4	1 1/2	4.0	5.7	7.0	8.1	9.0	10.0	11.4	12.5	18	25
		TF16FC	1/4	1/8	1 7/8	3/4	3/4	1 1/2	5.3	7.5	9.2	10.6	11.8	13.0	15.0	16.7	24	33
		TF20FC	5/16	1/8	1 7/8	3/4	3/4	1 1/2	8.2	11.7	14.3	16.5	18.4	20.0	23.3	26.1	36	52
	1/2	TF24FC	3/8	3/16	2 1/2	7/8	1	2 3/4	12.0	17.0	20.8	24.1	26.8	29.4	34	38	54	76
		TF28FC	7/16	3/16	2 1/2	7/8	1	2 3/4	16.4	23	28	33	37	40	46	52	74	104
	3/4	TF32FC	1/2	3/16	2 3/4†	1 1/8	1 1/2	4 1/2	21	30	37	42	47	52	60	67	94	134
	1	TF40FC	5/8	1/4	3 5/8‡	1 3/8	2 1/2	7 1/2	34	48	57	67	74	81	94	105	148	210
		TF48FC	3/4	1/4	3 5/8‡	1 3/8	2 1/2	7 1/2	47	67	83	95	107	117	135	151	214	302
	1 1/2	TF56FC	7/8	5/16	4 3/8	2	5 1/2	21	64	93	112	129	145	159	184	205	290	410
		TF64FC	1	5/16	4 3/8	2	5 1/2	21	84	120	147	169	190	208	240	268	380	536
		TF72FC	1 1/8	5/16	4 3/8	2	5 1/2	21	96	137	165	192	213	235	270	302	426	604
	2	TF88FC	1 3/8	7/16	5 7/8	2 1/2	6 1/2	26	140	198	240	280	310	340	395	438	620	876
		TF96FFC	1 1/2	7/16	6 7/8	2 1/2	7 1/2	32	178	250	310	355	395	430	505	560	790	1120
	3	TF112FFC	1 3/4	9/16	8	3 1/2	26	104	256	362	448	516	580	636	736	810	1160	1720
		TF128FFC	2	9/16	8	3 1/2	26	104	336	480	588	676	760	832	960	1072	1520	2140
	4	TF160FFC	2 1/2	5/8	9	4 1/2	40	160	525	750	920	1058	1188	1300	1500	1675	2370	3350

HOLLOW CONE

Spray Angle	Male Pipe Size	Nozzle Number	Orifice Dia.	Free Passage Dia.	Overall Length	Hex. or Round Dia.	Weight		GALLONS PER MINUTE @ PSI									
							Plastic Oz.	Metal Oz.	10	20	30	40	50	60	80	100	200**	400**
50°	1/4	TF6N	3/32	3/32	1 7/8	3/4	1/2	1	.7	1.0	1.2	1.4	1.6	1.7	2.0	2.2	3.1	4.4
		TF8N	1/8	1/8	1 7/8	3/4	1/2	1	1.3	1.9	2.3	2.6	2.9	3.2	3.8	4.1	6.0	8.2
		TF10N	5/32	1/8	1 7/8	3/4	1/2	1	2.0	2.9	3.5	4.0	4.5	5.0	5.9	6.5	9.2	13.0
	3/8	TF12N	3/16	1/8	1 7/8	3/4	3/4	1 1/2	3.0	4.2	5.2	6.0	6.7	7.4	8.5	9.5	13.4	19
		TF14N	7/32	1/8	1 7/8	3/4	3/4	1 1/2	4.0	5.7	7.0	8.1	9.0	10.0	11.4	12.5	18	25
		TF16N	1/4	1/8	1 7/8	3/4	3/4	1 1/2	5.3	7.5	9.2	10.6	11.8	13.0	15.0	16.7	24	33
		TF20N	5/16	1/8	1 7/8	3/4	3/4	1 1/2	8.2	11.7	14.3	16.5	18.4	20.0	23.3	26.1	36	52
	1/2	TF24N	3/8	3/16	2 1/2	7/8	1	2 3/4	12.0	17.0	20.8	24.1	26.8	29.4	34	38	54	76
		TF28N	7/16	3/16	2 1/2	7/8	1	2 3/4	16.4	23	28	33	37	40	46	52	74	104
	3/4	TF32N	1/2	3/16	2 3/4 †	1 1/8	1 1/2	4 1/2	21	30	37	42	47	52	60	67	94	134
120°	1/4	TF6W	3/32	3/32	1 3/4	5/8	1/2	1	.7	1.0	1.2	1.4	1.6	1.7	2.0	2.2	3.1	4.4
		TF8W	1/8	1/8	1 3/4	5/8	1/2	1	1.3	1.9	2.3	2.6	2.9	3.2	3.8	4.1	6.0	8.2
		TF10W	5/32	1/8	1 3/4	5/8	1/2	1	2.0	2.9	3.5	4.0	4.5	5.0	5.9	6.5	9.2	13.0
	3/8	TF12W	3/16	1/8	1 7/8	3/4	3/4	1 1/2	3.0	4.2	5.2	6.0	6.7	7.4	8.5	9.5	13.4	19
		TF14W	7/32	1/8	1 7/8	3/4	3/4	1 1/2	4.0	5.7	7.0	8.1	9.0	10.0	11.4	12.5	18	25
		TF16W	1/4	1/8	1 7/8	3/4	3/4	1 1/2	5.3	7.5	9.2	10.6	11.8	13.0	15.0	16.7	24	33
		TF20W	5/16	1/8	1 7/8	3/4	3/4	1 1/2	8.2	11.7	14.3	16.5	18.4	20.0	23.3	26.1	36	52
	1/2	TF24W	3/8	3/16	2 1/2	7/8	1	2 3/4	12.0	17.0	20.8	24.1	26.8	29.4	34	38	54	76
		TF28W	7/16	3/16	2 1/2	7/8	1	2 3/4	16.4	23	28	33	37	40	46	52	74	104
	3/4	TF32W	1/2	3/16	2 3/4 †	1 1/8	1 1/2	4 1/2	21	30	37	42	47	52	60	67	94	134

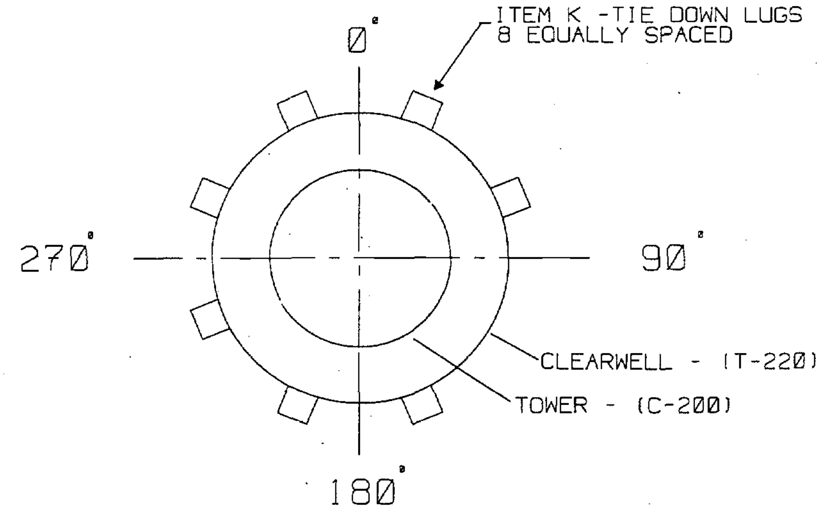
*High pressure operation recommended for metal nozzles only.

†Plastic length: 3 5/8"   ‡Plastic length: 4 3/8"

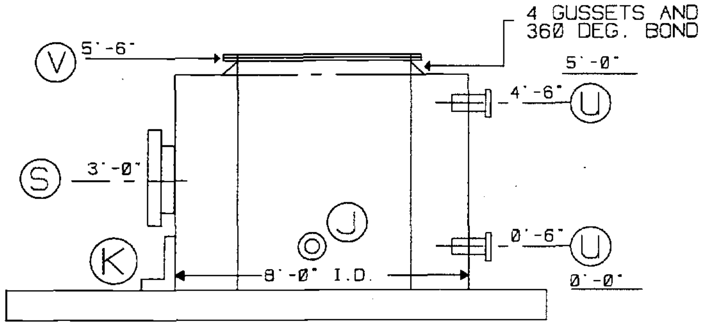
For adapters and bushings, refer to Accessories page

O ORDER: Specify Spray Angle, Pipe Size, Nozzle Number and Material

ANCHOR BOLT SETTING PLAN FOR AIR STRIPPER

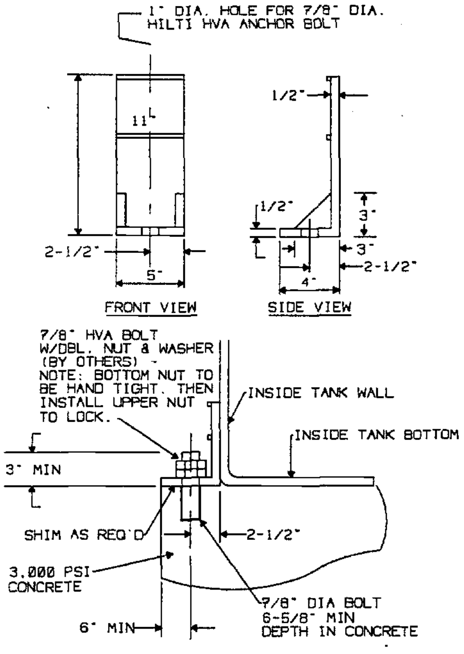


PLAN VIEW



ELEVATION VIEW "SIDE"

SEE PLAN VIEW FOR TRUE ORIENTATION



TYPE II TIE DOWN LUG DETAIL

K

NATIONAL ENVIRONMENTAL SYSTEMS
508-761-6611
36 MAPLE AVENUE. SEEKONK. MA 02771

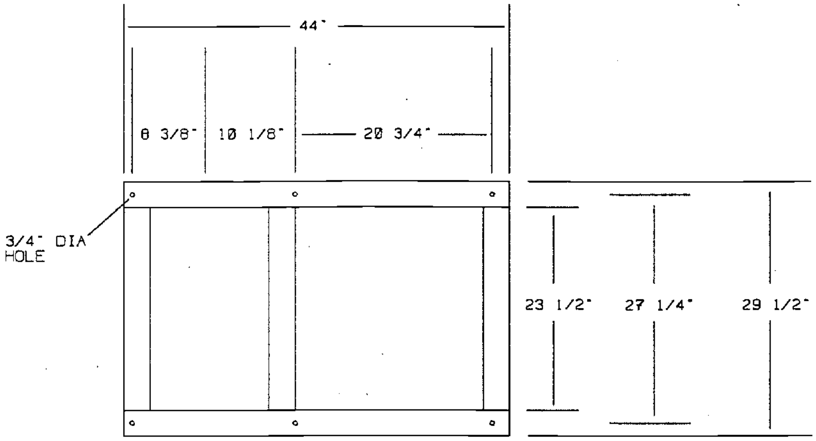
ANCHOR BOLT SETTING PLAN FOR AIR STRIPPER

JOB NAME : OHM - CAMP LEJEUNE

NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 03-20-95	DRAWN: MTS	FILE NAME:	REV:
SCALE: N. T. S.	DESIGN: MAX	UU-BOLT2	I

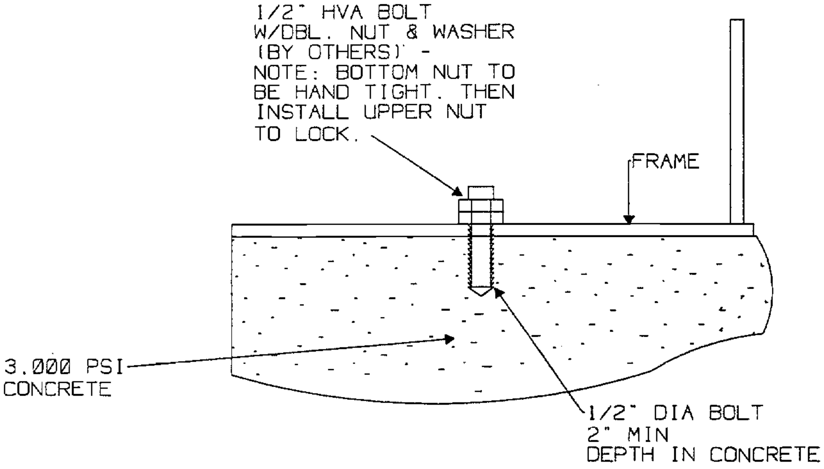
ANCHOR BOLT SETTING PLAN FOR BLOWER

BASE FRAME OF BLOWER



BASE HOLES - 3/4"
USE 1/2" DIA. HVA BOLT WITH DOUBLE NUT & WASHER
BOLT DEPTH INTO CONCRETE - 2" MINIMIUM

BOLT DETAIL



1/2" HVA BOLT
W/DBL. NUT & WASHER
(BY OTHERS) -
NOTE: BOTTOM NUT TO
BE HAND TIGHT. THEN
INSTALL UPPER NUT
TO LOCK.

3,000 PSI
CONCRETE

1/2" DIA BOLT
2" MIN
DEPTH IN CONCRETE

NATIONAL ENVIRONMENTAL SYSTEMS
508-761-6611
36 MAPLE AVENUE, SEEKONK, MA 02771

ANCHOR BOLT SETTING PLAN FOR BLOWER

JOB NAME : OHM - CAMP LEJEUNE

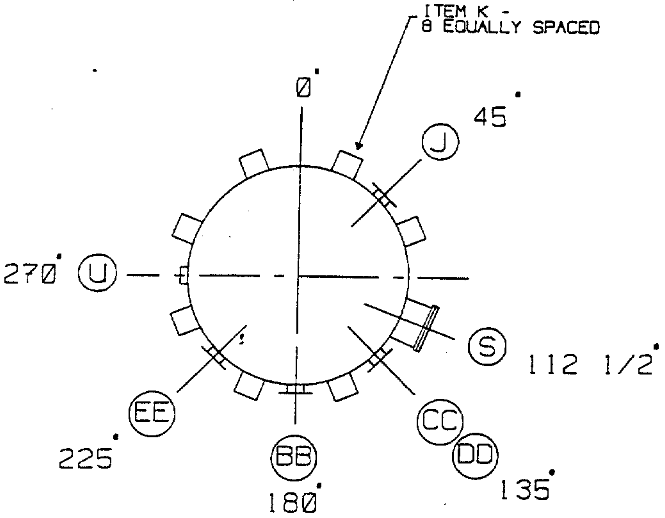
NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 04-24-95	DRAWN: MTS	FILE NAME:	REV:
SCALE: N. T. S.	DESIGN: MAX	UU-BOLT	-

APPURTENANCE AND MATERIAL SCHEDULE LIST

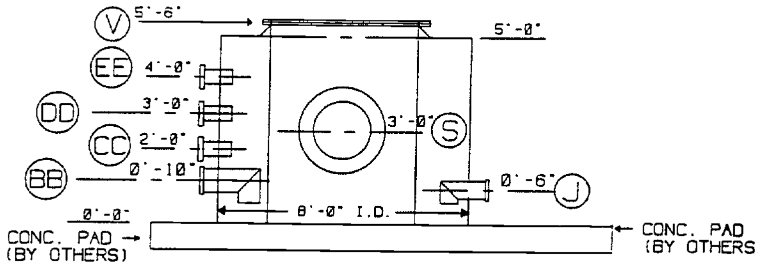
ITEM	QTY	SIZE	DESCRIPTION	ELEV	CRNT
J	1	4"	FLANGED SIPHON DRAIN NOZZLE	0'-6"	180°
K	8	———	TIE DOWN LUG / TYPE II	0'-0"	#1
S	2	24"	ACCESS PORT	#1	225°
U	2	2"	FRP THREADED HALF COUPLING (SIGHT GLASS)	#1	270°
V	2	60" DIA	NEOPRENE GASKET	#1	———
BB	1	8"	FLANGE (PUMP JUCTION)	0'-10"	180°
CC	1	2"	FLANGE (SPARE)	2'-0"	135°
DD	1	4"	FLANGE (LIT)	3'-0"	135°
EE	1	3"	FLANGE (RECYCLE)	4'-0"	225°

#1 ELEVATIONS AND ORIENTATIONS ARE AS SHOWN

SHOP DRAWING OF CLEARWELL - (T-220)

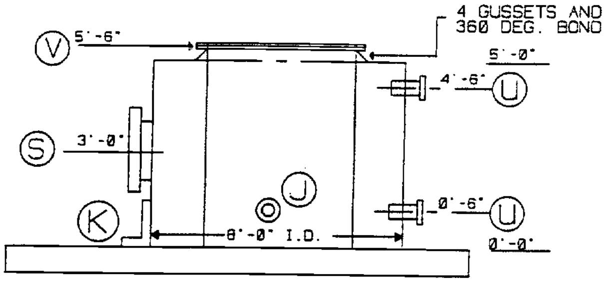


PLAN VIEW



ELEVATION VIEW
"FRONT"

SEE PLAN VIEW FOR TRUE ORIENTATION



ELEVATION VIEW
"SIDE"

SEE PLAN VIEW FOR TRUE ORIENTATION

NATIONAL ENVIRONMENTAL SYSTEMS
508-761-6611
36 MAPLE AVENUE, SEEKONK, MA 02771

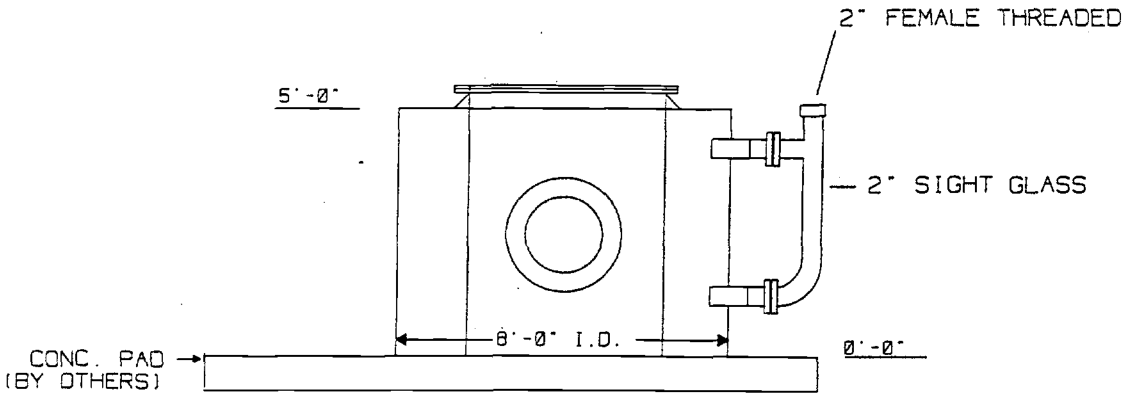
AIR STRIPPER CLEARWELL - (T-220)

JOB NAME : OHM - CAMP LEJEUNE

NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 03-20-95	DRAWN: MTS	FILE NAME:	REV:
SCALE: N. T. S.	DESIGN: MAX	UU-SUMP	I

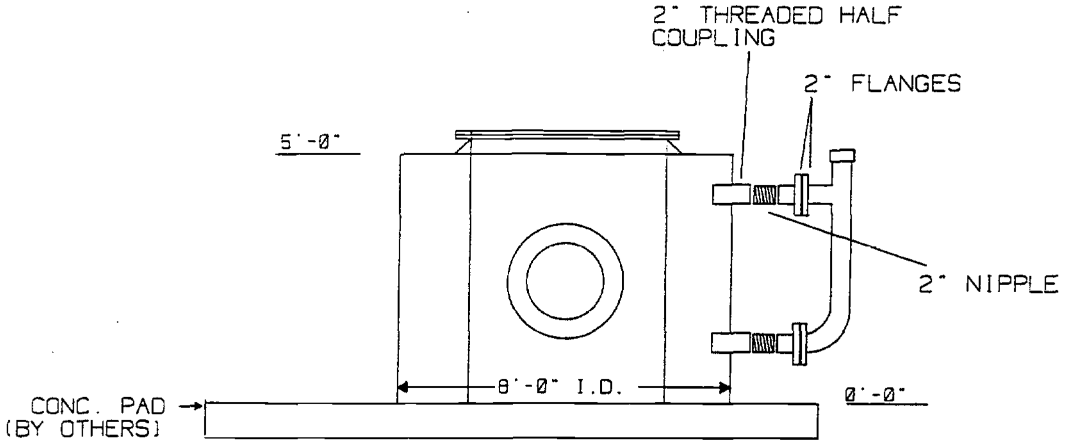
AIR STRIPPER SIGHT GLASS

ASSEMBLED VIEW OF SIGHT GLASS



ELEVATION VIEW:

UNASSEMBLED VIEW OF SIGHT GLASS



ELEVATION VIEW

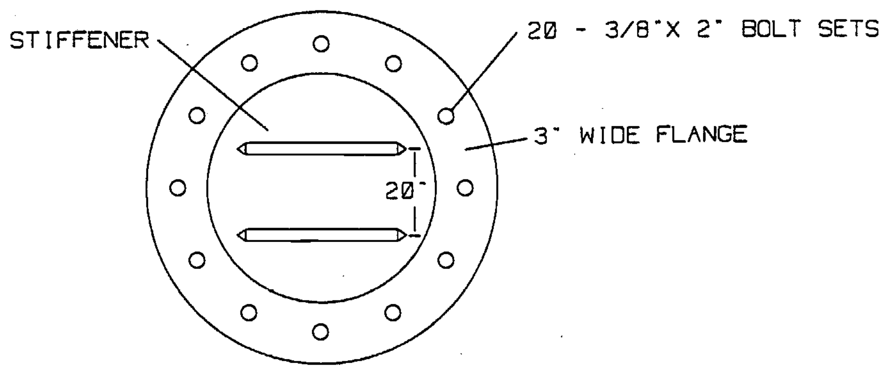
NATIONAL ENVIRONMENTAL SYSTEMS
508-761-6611
36 MAPLE AVENUE, SEEKONK, MA 02771

AIR STRIPPER SIGHT GLASS

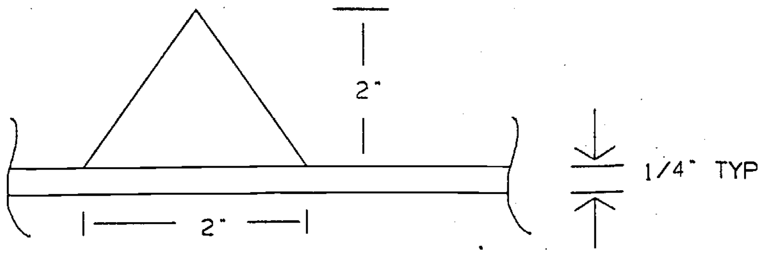
JOB NAME : OHM - CAMP LEJEUNE

NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 03-20-95	DRAWN: MTS	FILE NAME:	REV:
SCALE: N. T. S.	DESIGN: MAX	UU-SIGHT	I

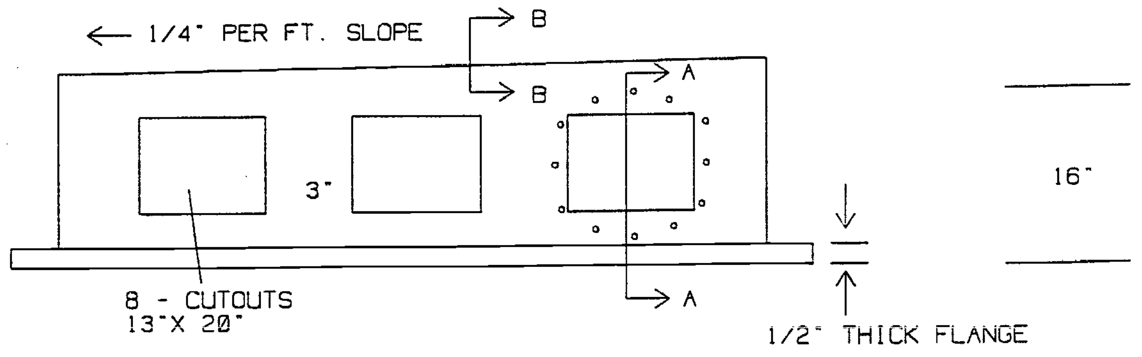
BIRDSCREEN TOP VIEW



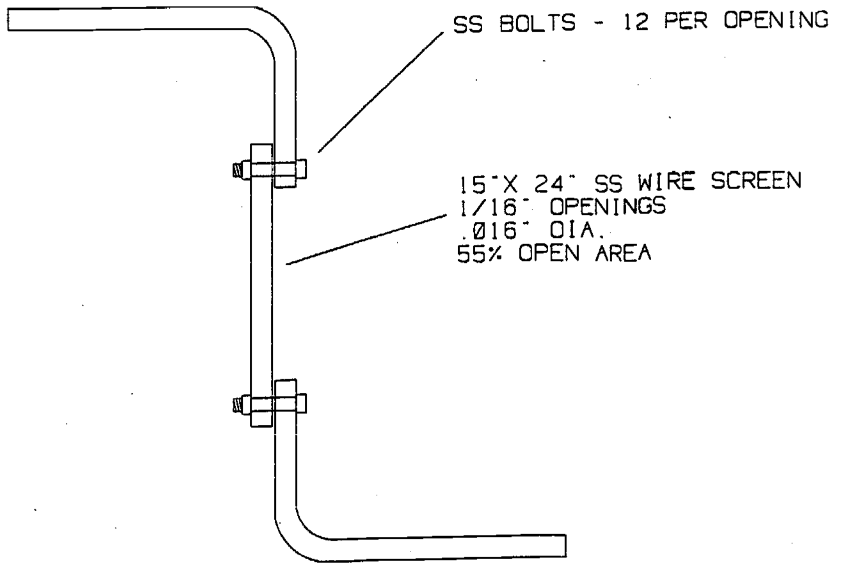
VIEW B-B STIFFENER DETAIL



BIRDSCREEN SIDE VIEW



VIEW A-A SCREEN DETAIL



NATIONAL ENVIRONMENTAL SYSTEMS
508-761-6611
36 MAPLE AVENUE. SEEKONK. MA 02771

AIR STRIPPER TOP\BIRDSCREEN

JOB NAME : OHM - CAMP LEJEUNE

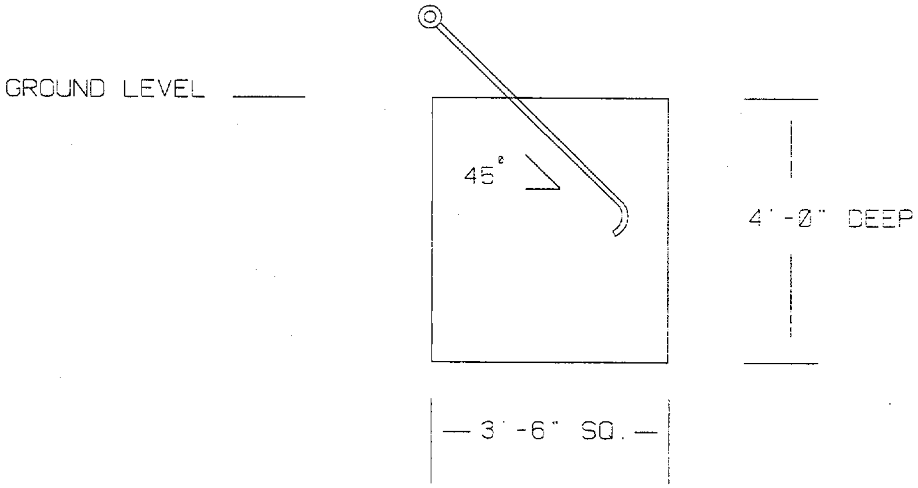
NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 04-24-95	DRAWN: MTS	FILE NAME:	REV:
SCALE: N. T. S.	DESIGN: MAX	UU-BRDSC	-

Guy Wires

The air stripper tower is secured by 1/2 inch stainless steel guy wire with a breaking strength of 30,000 pounds. The wire is clamped at one end to one of three guy wire lugs which are spaced 120 degrees apart on the tower at an elevation of 48 feet. *See Air Stripper Drawing Section II.* Each wire comes off the tower at 45 degrees and is anchored on the ground to an eye bolt embedded in a block of concrete. *See Anchoring Arrangement Drawing Section II.*

ANCHORING ARRANGEMENT

ANCHORING ARRANGEMENT IS A
24" EYE BOLT WITH A HOOKED END
EMBEDDED AT 45 DEGREES TOWARDS THE TOWER
INTO 46.5 CUBIC FEET OF CONCRETE
CONCRETE BLOCK IS:
3'-6" WIDE
3'-6" LONG
4'-0" DEEP



NATIONAL ENVIRONMENTAL SYSTEMS 508-761-6611 36 MAPLE AVENUE, SEEKONK, MA 02771			
AIR STRIPPER ANCHORING ARRANGEMENT			
JOB NAME : OHM - CAMP LEJEUNE			
NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 04-24-95	DRAWN: MTS	FILE NAME:	REV:
SCALE: N. T. S.	DESIGN: MAX	UU-ANCHO	1

DOLE J. KELLEY, JR., P.E.
Consulting Structural Engineer
JACKSONVILLE, FLORIDA

JOB TITLE ____________

____________ JOB NO. ____________

CALCULATED BY ____________ DATE ____________

CHECKED BY ____________ DATE ____________

SUBJECT ____________

SKETCH NO. ____________ SCALE ____________

____________ SH 1 OF 4

STRUCTURAL CALCULATIONS
FOR
AIR STRIPPER TOWER
CAMP LEJEUNE

FOR
NATIONAL ENVIRONMENTAL
SYSTEMS.

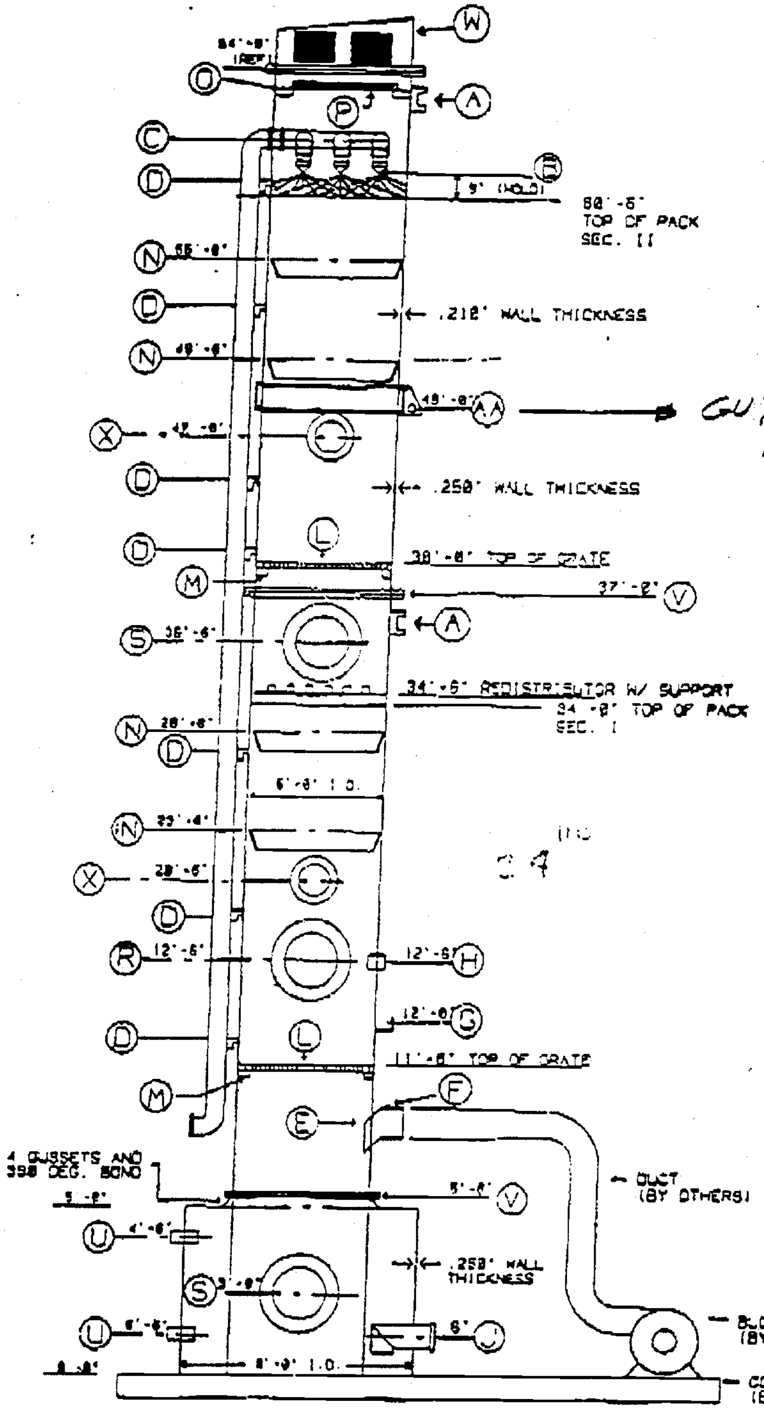
BY

Dole J Kelley Jr.
5/2/95

KELLEY ENGINEERING SERVICES, INC.
Consulting Structural Engineers
JACKSONVILLE, FLORIDA

CALCULATED BY DJK DATE 3/24
CHECKED BY ______ DATE ______
SKETCH NO. ______ SCALE ______

JOB TITLE NES.
______ JOB NO. ______
SUBJECT AIR STRIPPER TOWER SH 2 OF 4



ELEVATION VIEW
SEE PLAN VIEW FOR TRUE ORIENTATION

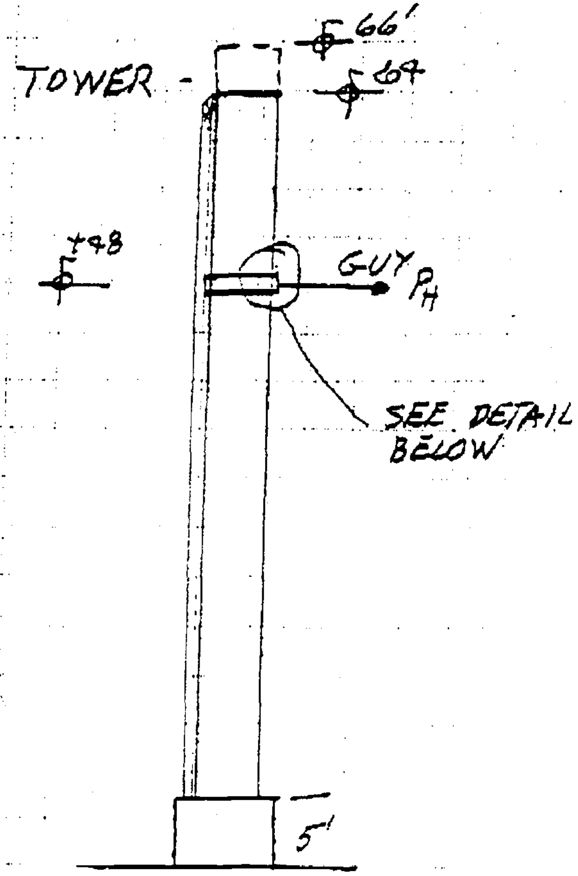
GUY WIRE
HORIZONTAL FORCE 6745 #
SEE SH 3 of 3
FOR CABLE AND
FOUNDATION.

KELLEY ENGINEERING SERVICES, INC.
Consulting Structural Engineers
JACKSONVILLE, FLORIDA

CALCULATED BY DJK DATE 3/24
CHECKED BY ______ DATE ______
SKETCH NO. ______ SCALE ______

JOB TITLE N.E.S.
JOB NO. ______
SUBJECT AIR STRIPPER TOWER SH 3 OF 4

DESIGN; WIND 100 MPH   ANSI/ASCE 7-88   TABLE 4

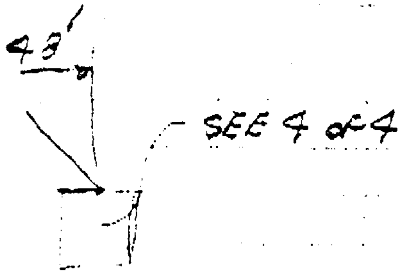


H = 66'
$F = q G_h C_f A_f$
I = 1.0 TABLE 5
$K_z = 1.21$ TABLE 6
$G_h = 1.2$ TABLE 8
$q = .00256 K_z (I V)^2$
$= .00256 \times 1.21 (1 \times 100)^2$
$= 30.98 \text{#}/\square'$
$C_f = h/b = 66/5 = 12$
$C_f = 0.7$ TABLE 1

$F = q G_h C_f A_f$
$= (30.98 \times 1.2 \times .7) A_f$
$= 26 \text{#}/\square' \times A_f$
$F = 26 \text{#}/\square \times 377\square' = 9811\text{#}$

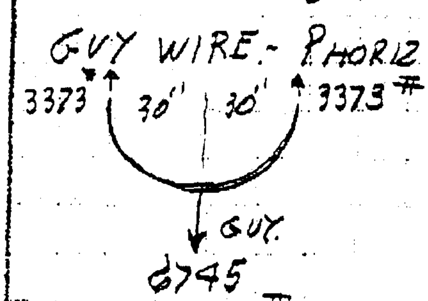
$A_f = 5 \times 61 = 305\square'$
PIPE $= .5 \times 64 = 32\square'$
$337\square'$
$+ 8' \times 5' = 40$
TOTAL $= 377\square'$

3-LUGS @ 48'



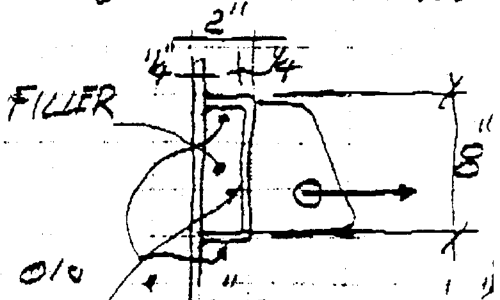
O.M. $= 9811\text{#} \times 33' = 323,763'\text{-#}$
P_H, GUY $= \frac{O.M.}{H} = \frac{323,763}{48'} = 6745\text{#}$
HORIZ. SHEAR AT BASE $= 9811 - 6745 = 3066\text{#}$ - 8 - 7/8"Ø BOLTS INTO FTG.
$v = \frac{3066}{8} = 384\text{#}/$BOLT. VERY LOW.

GUY WIRE - $P_{HORIZ} = 6745\text{#}$



$M = 3373\text{#} \times 30'' = 101,190''\text{-#}$
TRY 8"×2"×1/4" "S" $= 7.52 \text{IN}^3$
$f = \frac{M}{S} = \frac{101,190''\text{#}}{7.52 \text{IN}^3} = 13,456$ psi o/c

$= \frac{3373\text{#}}{4.59} = 735$ psi ok.



2×8 BAND × 16'-3"
AROUND TOWER

1/4" THICK BAND

DOLE J. KELLEY, JR., P.E.
Consulting Structural Engineer
JACKSONVILLE, FLORIDA

JOB TITLE N.E.S.

JOB NO.

CALCULATED BY DJK DATE 3/24

CHECKED BY DATE

SUBJECT

SKETCH NO. SCALE

SH 4 OF

FIBERGLASS TOWER:

DESIGN PER ASTM D-4097-88

8.1. STRAIGHT SHELL.

WALL THICKNESS - MIN: 3/16 = 0.1875" - USE .21" AT TOP, ABOVE +48'

USE .25" 0 TO +48

CHECK: $\text{PRESSURE} = \dfrac{8' \times 62.4\#/FT^2}{144\ IN^2/FT^2} = 3.466\#/IN^2$

$$t = \frac{PD}{2S_h} = \frac{3.466\#/IN^2 \times 60\,IN}{2 \times 1200\#/IN^2} = 0.086\ IN. < .21''$$

7.3.2.4. CUT OUT REINFORCEMENT THICKNESS $K=1$

$$t_R = \frac{PDK}{2S_r} = \frac{10\#/IN^2 \times 60'' \times 1.0}{2 \times 1200\#/IN^2} = 0.25''\ \text{THICK.}\ \ \text{OK.}$$

SEE SHEET NO 2 OF 3.

GUY WIRE - $P_H = 6745\#$

ASSUME 45° TIE DOWN ANGLE

CABLE TENSION = 6745# x 1.414 = 9539#

SAFETY FACTOR 3 TO 1 - USE MIN BREAKING STRENGTH OF 30,000#

ANCHOR - UPLIFT = 6745#

VOLUME OF CONCRETE = 6745#/145#/C.F = 46.5 C.F.

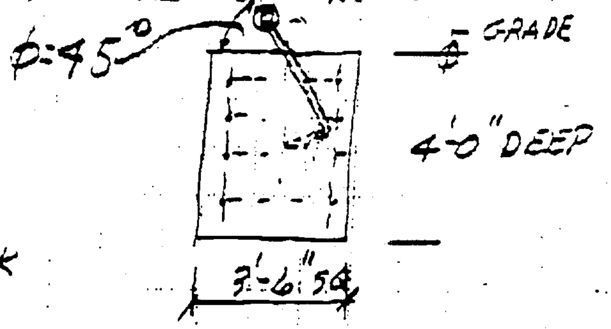
USE MAX. DEPTH = 4'-0"

$\text{SIDES} = \dfrac{46.5\ ft^3}{4.0\ ft} = 11.63\ ft^2 = 3.4$ USE 3'-6" x 3'-6" x 4'-0" DEEP

USE 12 #5 BARS x 3'-6" VERTICAL,

4 #4 TIES @ 12" O.C.

USE - 1"∅ STEEL EYE BOLT EMBEDED IN CONCRETE x 24" LONG WITH HOOK



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             NATIONAL ENVIRONMENTAL SYSTEMS INC.

      STRUCTURAL CALCULATIONS PROGRAM FOR FRP VESSELS

                  ******VERSION 1.0******


*===========================================================*
                 ****PROJECT INFORMATION****
*===========================================================*

* PROJECT NUMBER--  01-042794.11.01                         *
* PROJECT NAME--  OHM - CAMP LEJEUNE                        *
* FIRM NAME--                                               *
* CONTACT NAME--                                            *
* CUSTOMER TEL. NO.--                                       *
* CUSTOMER FAX  NO.--                                       *
*                                                           *
* DATE OF CALCULATION  05-03-1995                           *
* TIME OF CALCULATION  15:35:15                             *

*===========================================================*
                ****VESSEL INFORMATION****
*===========================================================*

* VESSEL INSIDE DIAMETER  5  FEET                           *
* LENGTH OF THE SHELL IN FEET  64  FEET                     *
* VESSEL IS GUYED                                           *
* GUY WIRE ELEVATION =  48  FEET
* THICKNESS OF CORROSION BARRIER =  100  MILS               *
* CORROSION BARRIER IS INCLUDED IN THE STRUCTURE            *
* SAFETY FACTOR FOR BUCKLING = 5                            *

*===========================================================*
              ****DESIGN CONDITIONS****
*===========================================================*

* TEMPERATURE = 55  DEGREES FAHRENHEIT                      *
* EFFECTIVE SPECIFIC GRAVITY OF CONTENTS =  .5              *
* VESSEL IS NOT DESIGNED TO BE WATER FILLED                 *
* INTERNAL PRESSURE = .5  PSI                               *
* WIND SPEED IN MPH = 100  MPH                              *
* SEISMIC ZONE = 0                                          *

*===========================================================*
```

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*===========================================================*

                 ****CALCULATION RESULTS****

*===========================================================*

       RESULTS FOR SECTION ABOVE GUY WIRES

*===========================================================*

* LAMINATE TYPE = MAT-WOVEN LAMINATE                        *
* WALL THICKNESS =   .19                                    *
* STRUCTURAL AXIAL MODULUS =   1448000  PSI                 *
* BENDING STRESS =  476  PSI                                *
* CRITICAL BUCKLING STRESS =  3541  PSI                     *
* BUCKLING SAFETY FACTOR =  7.4                             *

*===========================================================*

       RESULTS FOR SECTION BELOW GUY WIRES

*===========================================================*

* LAMINATE TYPE = MAT-WOVEN LAMINATE                        *
* WALL THICKNESS =   .23                                    *
* STRUCTURAL AXIAL MODULUS =   1590000  PSI                 *
* BENDING STRESS =  866  PSI                                *
* CRITICAL BUCKLING STRESS =  4666  PSI                     *
* BUCKLING SAFETY FACTOR =  5.3                             *
* NUMBER OF TYPE I LUGS REQUIRED =  4                       *
*===========================================================*
```

Designation: D 4097 - 82

AMERICAN SOCIETY FOR TESTING AND MATERIALS
1916 Race St., Philadelphia, Pa. 19103
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If not listed in the current combined index, will appear in the next edition.

Standard Specification for
CONTACT-MOLDED GLASS-FIBER-REINFORCED THERMOSET RESIN CHEMICAL-RESISTANT TANKS[1]

This standard is issued under the fixed designation D 4097; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers cylindrical tanks fabricated by contact molding for above-ground vertical installation, to contain aggressive chemicals at essentially atmospheric pressure, and made of a commercial-grade polyester, vinyl ester, or furan resin. Included are requirements for materials, properties, design, construction, dimensions, tolerances, workmanship, and appearance.

1.2 This specification does not cover the design of vessels intended for pressure above hydrostatic, vacuum conditions, or vessels intended for use with liquids heated above their flash points.

1.3 The values given in parentheses are provided for information purposes only.

NOTE 1—Special design consideration should be given to vessels subject to superimposed mechanical forces, such as earthquakes, wind load, or agitation, and to vessels subject to service temperature in excess of 180°F (82°C).

2. Applicable Documents

2.1 *ASTM Standards*:

C 581 Test for Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures[2]

C 582 Specification for Reinforced Plastic Laminates for Self-Supporting Structures for Use in a Chemical Environment[3]

D 618 Conditioning Plastics and Electrical Insulation Materials for Testing[4]

D 638 Test for Tensile Properties of Plastics[5]

D 790 Tests for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials[5]

D 883 Definitions of Terms Relating to Plastics[6]

D 2583 Test for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor[5]

D 2584 Test for Ignition Loss of Cured Reinforced Resins[2]

D 2996 Specification for Filament-Wound Reinforced Thermosetting Resin Pipe[3]

D 2997 Specification for Centrifugally Cast Reinforced Thermosetting Resin Pipe[3]

F 412 Definitions of Terms Relating to Plastic Piping Systems[3]

3. Terminology

3.1 *General*– Definitions are in accordance with Definitions D 883 and F 412, unless otherwise indicated.

3.2 *contact molding*—includes the "hand lay-up" or a combination of the "hand lay-up" and the "spray-up" manufacturing processes.

4. Classification

4.1 Tanks meeting this specification are classified according to type as follows:

4.1.1 *Type I*—Tanks manufactured with a single generic type of thermoset resin throughout.

4.1.2 *Type II*—Tanks manufactured with different generic types of thermoset resin in the barrier and the structural portion.

---

[1] This specification is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.23 on Reinforced Plastic Piping Systems and Chemical Equipment.

Current edition approved Jan. 29, 1982. Published May 1982.

[2] *Annual Book of ASTM Standards*, Parts 34 and 35.

[3] *Annual Book of ASTM Standards*, Part 34.

[4] *Annual Book of ASTM Standards*, Parts 22, 35, and 39.

[5] *Annual Book of ASTM Standards*, Part 35.

[6] *Annual Book of ASTM Standards*, Parts 34, 35, and 36.

[7] *Annual Book of ASTM Standards*, Part 36

Note 2—The external corrosive environment due to spillage or corrosive vapors should be considered when specifying Type II tanks (see 7.1.3.2).

5. Materials

5.1 *Resin*—The resin used shall be a commercial grade, corrosion-resistant thermoset that has either been evaluated in a laminate by test in accordance with 11.3, or that has been determined by previous documented service to be acceptable for the service conditions. Where service conditions have not been evaluated, a suitable resin may also be selected by agreement between manufacturer and purchaser.

5.1.1 The resin shall contain no fillers or pigments except as follows:

5.1.1.1 A thixotropic agent that does not interfere with visual inspection of laminate quality, or with the required corrosion resistance of the laminate, may be added for viscosity control.

Note 3—The addition of a thixotropic agent will reduce the resistance of many resin systems to certain corrosive chemical environments.

5.1.1.2 Resin shall contain no pigments, dyes, or colorants, except as agreed upon between the manufacturer and the purchaser.

Note 4—The addition of pigments, dyes, or colorants may interfere with visual inspection of laminate quality.

5.1.1.3 Ultraviolet absorbers may be added for improved weather resistance if agreed upon between the manufacturer and the purchaser.

5.1.1.4 Antimony compounds or other fire-retardant agents may be added to halogenated resins for improved fire resistance, if agreed upon between the manufacturer and the purchaser.

5.2 *Reinforcement*—The reinforcing materials used shall be commercial grades of glass fiber sized with coupling agents compatible with the resin used. The reinforcement for the inner surface (7.1.1) shall be a suitable chemical-resistant glass surfacing mat, or where specified, an organic fiber surfacing material. The reinforcement for the balance of the laminate shall be an E-glass fiber reinforcement.

6. Design Requirements

6.1 *Straight Shell*—The minimum required wall thickness of the cylindrical straight shell at any fluid level shall be determined by the following equation, but shall not be less than $\frac{3}{16}$ in.:

$$t = PD/2S_h = 0.036\ \gamma\ HD/2S_h \text{ or } (9807\ \gamma\ HD/2S_h)$$

where:

t = wall thickness, in. (mm),
S_h = allowable hoop tensile stress (not to exceed $\frac{1}{10}$ of the ultimate hoop strength), psi (see 11.8),
P = pressure, psi (kPa),
H = fluid head, in. (mm),
γ = specific gravity of fluid, and
D = inside diameter of tank, in. (mm).

Note 5—The calculation is suitable for the shell design of elevated dished-bottom tanks that are mounted or supported below the tangent of the dished-bottom head. Special consideration must be given to the loading on the straight shell at the support when tank has mounting supports located above the tangent line.

Note 6—Table X2.1, Appendix X2, illustrates typical straight-shell wall thicknesses.

6.2 *Top Head*—The top head, regardless of shape, shall be able to support a 250-lb (113.4 kg) load on a 4 by 4-in. (100 by 100 mm) area without damage and with a maximum deflection of ½ % of the tank diameter.

6.2.1 The minimum thickness of the top head shall be $\frac{3}{16}$ in. (4.8 mm).

Note 7—Support of auxiliary equipment, snow load, or operating personnel, may require additional reinforcement or the use of stiffening ribs, or both, sandwich construction, or other stiffening systems.

6.3 *Bottom Head*:

6.3.1 The minimum thickness for a fully supported flat-bottom head shall be as follows:

$\frac{3}{16}$ in. (4.8 mm) for 2 to 6-ft (0.6 to 1.8-m) diameter,
$\frac{1}{4}$ in. (6.4 mm) for over 6 to 12-ft (1.8 to 3.7-m) diameter, and
$\frac{3}{8}$ in. (9.5 mm) for over 12-ft (3.7-m) diameter.

6.3.2 Heads may be molded integrally with the straight-shell, or may be molded separately with a 4-in. (100-mm) minimum straight flange length for subsequent joining to shell.

6.3.3 The radius of the bottom knuckle of a flat-bottom tank shall be not less than 1½ in. (38 mm). The minimum thickness of the radiused section, shall be equal to the combined thickness of the shell wall and the bottom. The reinforcement of the knuckle radius area shall taper so that it is tangent with the flat bottom, and shall not extend beyond the tangent line onto the tank bottom, but shall extend up the vertical tank wall a minimum of 4 in. (100 mm) on tanks up to 4 ft (1.25 m) in diameter, and 12 in. (305 mm) on tanks over 4 ft (1.25 m) in diameter. The reinforcement shall then taper into the side wall over an additional length of 3 to 4 in. (76 to 100 mm) (see Fig. 1). Methods of manufacture that extend additional bottom reinforcement beyond the bottom knuckle radius tangent point, but maintain flat bottom configuration, are also permissible. The perimeter of the tank shall be a flat plane, and the bottom shall have no projections that will prevent uniform contact with a flat support surface when the tank is filled with liquid.

6.3.4 The thickness of an elevated dished bottom suitable for supporting the weight of the fluid head shall be determined by the following equation, but shall not be less than 3⁄16 in. (4.8 mm):

$$t = 0.885\ PR/S = 0.885\ (0.036\ \gamma\ HR)/S \text{ or } (0.885(9807\ \gamma\ HR)/S)$$

where:

t = thickness, in. (mm),
S = allowable stress (not to exceed 1⁄10 of ultimate strength), psi (kPa) (see 11.8),
γ = specific gravity of fluid,
P = pressure, psi (kPa),
R = inside radius of dished head, in. (mm), and
H = distance from the top of the fluid to the deepest portion of the bottom, in. (mm).

NOTE 8—This equation and the alternative shown in Appendix X3 should be used with caution since objection has been raised concerning their applicability to RTR materials. Discontinuity stresses at the knuckle should be considered. This is under study and this document will be revised when a solution has been determined.

6.3.5 The dished-bottom head shall have a radius of curvature that is equal to or less than the inside diameter of the tank straight shell, and a knuckle radius of at least 6 % of the diameter of the head.

6.4. *Open-Top Tanks*—The top edge of open-top tanks shall have a horizontal reinforcing flange or other means of reinforcement sufficiently rigid to maintain the shape of the tank after installation. The flange shall be in accordance with Table 1.

6.5. *Joints*:

6.5.1 The secondary laminate joints are used to join hoop segments of the straight shell, or to join the bottom or top head to the shell, the thickness of the structural joint overlay shall be equal to the shell thickness as determined in 6.1.

6.5.2 The minimum width of the structural joint overlay for bottom supported tanks is shown in Table 2.

6.5.3 The corrosion-resistant barrier component of the joint shall be formed in the same manner as the inner surface and the interior layer (7.1.1 and 7.1.2) and shall not be considered a structural element in determining joint thickness. The minimum overlay width shall be 4 in. (100 mm).

6.5.4 The thickness of a joint near the bottom tangent line shall not be considered to contribute to the knuckle reinforcement of 6.3.3, but shall be additive thereto.

6.6. *Fittings*:

6.6.1 The more common method of fabricating nozzles is by contact molding both the nozzle neck and flange to the dimensions shown in Table 3. The corrosion-resistant barrier of the nozzle shall be at least equivalent to the inner surface and interior layer (7.1.1 and 7.1.2) and shall be fabricated from the same resin as the tank head or shell to which it is attached.

6.6.2 Acceptable alternative methods are the use of contact-molded pipe, filament-wound pipe in accordance with Specification D 2996, or centrifugally cast pipe in accordance with Specification D 2997, joined to a suitable contact-molded, compression-molded, or filament-wound flange. The corrosion-resistant barrier of the contact molded portions of such nozzles shall be equivalent to the inner surface and interior layer (7.1.1 and 7.1.2) and shall be fabricated from the same resin as the tank head or shell to which it is attached.

6.6.3 Nozzles 4 in. (100 mm) and smaller shall be supported by a suitable gusseting technique using plate gussets or conical gussets, as shown in Figs. 2 and 3. Plate gussets, where needed, shall be evenly spaced around the nozzle and are to be added after complete assembly of nozzle on shell. Larger nozzles, subject to superimposed mechanical forces, require special consideration.

6.6.4 Manways are treated as nozzles and have a minimum inside diameter of 18 in. (460 mm). Table 7 should be used as a guide for flange and cover design for hydrostatic pressures up to 15 psig (103 kPa). A dished cover of reduced thickness designed in accordance with 6.3.4 may be used, provided the flange thickness is at least equal to that of the mating flange.

6.6.4.1 Manways installed in top heads may be of the flanged design indicated in 6.6.4 for atmospheric pressure, or may be of a non-flanged design, as agreed upon between the manufacturer and the purchaser.

6.6.5 Vents shall be provided on all closed-top tanks. Minimum vent size should exceed the size of the largest inlet or outlet nozzle.

NOTE 9—Special vent sizing consideration should be given to the numerous operating situations that could otherwise cause a positive or a negative pressure in a closed tank. Since overfilling a closed tank with a top vent can cause it to be overpressurized, a suitably sized overflow or other appropriate protection may be required to prevent overpressuring the tank.

6.7. *Hold-Down Lugs*—Hold-down lugs shall be a requirement on all tanks for outdoor service, or on tanks subject to seismic loads or vibration, unless otherwise agreed upon between the manufacturer and the purchaser.

6.7.1 Hold-down lugs shall be placed on the tank so they do not protrude below the bottom surface of the tank.

6.8 Lifting lugs or other provisions for lifting tanks (see Appendix X1) shall be provided for tanks over 500 lb (226.8 kg) in weight.

7. Laminate Construction Requirements

7.1. *Structural Tank*—The laminate comprising the structural tank (bottom, cylindrical shell, top head) shall consist of a corrosion-resistant barrier comprised of an inner surface and interior layer, plus a structural layer.

7.1.1. *Inner Surface*—The inner surface exposed to the chemical environment shall be a resin-rich layer 0.010 and 0.020 in. (0.254 to 0.508 mm) thick reinforced with a suitable chemical-resistant glass-fiber surfacing mat, or with an organic-fiber surfacing mat, in accordance with 5.2.

NOTE 10—This resin-rich inner surface will contain less than 20 % by weight of reinforcing material.

7.1.2. *Interior Layer*—The inner surface layer exposed to the corrosive environment shall be followed with a layer composed of resin reinforced only with noncontinuous glass-fiber strands applied in a minimum of two plies of chopped strand mat equivalent to a total of 3 oz/ft^2 (0.92 kg/m^2). As an alternative, a minimum of two passes of chopped roving, minimum length 0.5 in. (13 mm) to a maximum length of 2.0 in. (50.8 mm), shall be applied uniformly by the spray-up process to an equivalent weight. Each ply of mat or pass of chopped roving shall be well rolled prior to the application of additional reinforcement. The combined thickness of the inner surface and interior layer shall not be less than 0.10 in.

7.1.2.1 Glass content of the inner liner and the interior layer combined shall be 27 ± 5 % by weight, when tested in accordance with 11.4.

7.1.3. *Structural Layer*—Subsequent reinforcement shall consist of 1.5 oz/ft^2 (0.46 kg/m^2) chopped strand mat or equivalent weight of chopped roving and such additional number of alternating plies of 24 oz/yd^2 (814 g/m^2) woven roving and 1.5 oz/ft^2 (0.46 kg/m^2) mat or equivalent chopped roving as required to achieve the thickness as calculated according to 6.1. The designations of these specific weights of glass reinforcement are for reference only and may consist of other weight combinations of reinforcement materials, when agreed upon between the manufacturer and the purchaser. Each successive ply or pass of reinforcement shall be well-rolled prior to the application of additional reinforcement.

7.1.3.1 When the outer surface of this structural layer will be subject to spillage or a corrosive environment, a resin-rich layer in accordance with 7.1.1 shall be applied over the final layer of chopped strand glass reinforcement.

7.1.3.2 Where air-inhibited resin is exposed to air, full surface cure shall be obtained by coating such surface with a gel coat of resin containing 0.2 to 0.6 % paraffin with a melt point of 122 to 126°F (50 to 52°C). Other techniques such as sprayed, wrapped, or overlaid films are also acceptable methods to attain surface cure.

7.1.3.3 Tanks used for outdoor service or subject to ultraviolet exposure shall incorporate provisions to minimize ultraviolet degradation. Suitable methods include use of ultraviolet absorbers, screening agents, incorporation of pigment of sufficient opacity in the outer surface of the resin rich layer, or use of resins inherently resistant to ultraviolet degradation. Since pigmentation makes inspection difficult, it shall be added after inspection with supplier-purchaser agreement.

7.1.4 All woven roving and surfacing mat shall be overlapped. Laps in subsequent layers shall be staggered at least 2.25 in. (67 mm) from laps in the preceding layer.

7.1.5 Where woven roving is used, chopped-strand glass reinforcement shall be used as alternating and final layers.

7.2 *Joints*:

7.2.1 The width of the first layer of joint overlay shall be 3 in. (76 mm) minimum. Successive layers shall uniformly increase in width to that specified in Table 2 to form a smooth contour laminate centered on the joint.

7.2.2 A highly filled resin paste shall be placed in the crevices between joined pieces, leaving a smooth surface for lay-up.

7.2.3 The cured resin surfaces of parts to be joined shall be roughened to expose glass fibers. This roughened area shall extend beyond the lay-up areas so that no reinforcement is applied to an unprepared surface. Surfaces shall be clean and dry before lay-up. The entire roughened area shall be coated with paraffinated resin after joint overlay is made.

7.2.4 The interior overlay of a joint shall consist of a minimum of two plies of 1.5 oz/ft^2 (0.46 kg/m^2) chopped strand mat reinforcement, followed by a resin-rich layer reinforced with surfacing mat. This overlay shall be the equivalent of 7.1.1 and 7.1.2 combined, and shall be centered on the joint. It shall be finished in accordance with 7.1.3.2.

7.2.5 The outer structural overlay of a joint shall be centered on the joint, fabricated in accordance with 6.5.1, and shall be finished in accordance with 7.1.3.2.

7.3 *Fittings and Accessories*:

7.3.1 The surface of fittings, tank accessories, and the laminates required for their installation, that are exposed to the corrosive media, shall be constructed in accordance with 7.1.1 and 7.1.2.

7.3.1.1 The cut edges of laminates containing woven roving exposed to the chemical environment shall be sealed with a laminate conforming to 7.1.1 and 7.1.2. All other cut edges and any machined flange faces shall be coated with resin only. In either case, the resin used shall be that in the equipment laminate and must contain paraffin to assure adequate cure.

7.3.2 *Nozzle and Manway Installation*—Flanged nozzles may be installed with the pipe stub flush with the inside of the tank shell (Flush Type, Fig. 5) or projecting inside the tank (Penetrating Type, Fig. 6).

7.3.2.1 *Nozzle Projection*—The installed nozzle shall maintain a minimum clearance of 3 in. (76 mm) between the back face of the flange and the exterior of the cutout opening reinforcement. In addition, this clearance shall not be less than the shear distance required for proper installation of the nozzle (see 7.3.3).

7.3.2.2 *Cutout Reinforcement Laminate*—When a vessel shell or head is cut in an area bearing hydrostatic pressure, *P*, the cutout shall be reinforced on a circular area concentric with the cutout as shown in Figs. 5 and 6. Acceptable patterns of reinforcement placement are shown in Fig. 4.

7.3.2.3 *Cutout Reinforcement Diameter*—The outer diameter of the cutout reinforcing laminate, d_r, shall not be less than two times the nominal nozzle diameter. For nozzles less than 6 in. (152 mm) in diameter, the minimum cutout reinforcement diameter, d_r, shall be the nominal nozzle size plus 6 in. (152 mm).

7.3.2.4 *Cutout Reinforcement Thickness*—The thickness, t_r, of the cutout reinforcement laminate for nozzles installed in cylindrical shells or dished heads shall be determined as follows:

$$t_r = PDK/2S_r$$

where

K = 1.0 for nozzles 6-in. (152 mm) diameter and larger,
K = $d/d_r - d$ for nozzles less than 6-in. (152 mm) diameter,
P = hydrostatic pressure at the point of nozzle installation, psi (kPa),
D = inside diameter of tank, in. (mm),
S_r = allowable tensile stress (not to exceed $\frac{1}{10}$ of the ultimate strength of the cut-out reinforcing laminate) (Table 5),
d = nominal nozzle diameter, in. (mm), and
d_r = cutout reinforcement diameter, in. (mm).

This thickness, t_r, may be applied to the outer or inner surfaces, or be divided between them as shown in Fig. 4.

NOTE 11—When t_r is calculated to be $\frac{1}{8}$ in. (3.2 mm) or less, it can be disregarded, as the strength requirements will be met by t_m, the overlay thickness shown in Figs. 5 and 6.

7.3.2.5 When reinforcing materials are cut to facilitate placement around an installed nozzle, joints in successive reinforcing layers should be staggered to avoid overlapping and (on cylindrical shell installations) shall not be placed so they parallel the axis of the tank. The intent of this requirement is to avoid orienting joints in reinforcing layers perpendicular to the maximum load-bearing direction (circumferential).

7.3.3 *Nozzle Installation Laminates*- Nozzle installation laminate dimensions are shown in Figs. 5 and 6. Installation laminate placements are shown in Fig. 4. The all interior installation laminate placement is used only when the nozzle being installed has an integral conical gusset preventing application of an exterior laminate.

7.3.3.1 *Total Installation Thickness*- The inside and outside installation thicknesses shall be based on a combined total thickness, t_w, that shall be defined as the lesser of either the cutout reinforcement thickness, t_r, or two times the nozzle neck thickness, t_n.

7.3.3.2 *Inside Installation Laminate Construction*—The inside installation laminate shall be constructed using only noncontinuous glass reinforcements. When woven roving is used it must be covered by a laminate equivalent to 7.1.1 and 7.1.2. When the inside laminate consists only of a corrosion barrier, the length of the laminate, h_i, shall be the lesser of 3 in. (76 mm) or the nominal radius of the nozzle.

7.3.3.3 *Installation Laminate Lengths* The length of the outside laminate, h_o, and the inside laminate, h_i, shall each be equal to the shear length, h_s, given in Table 6, based on the thickness of the individual laminates.

7.3.3.4 In nozzle installations where the installation overlay is installed before the cutout reinforcement has fully cured, that portion of the overlay that extends onto the tank shell may be considered to become a part of the cutout reinforcement laminate if the installation laminate length is extended to the required cutout reinforcement diameter, d_r.

7.3.4 *Gussets*- If gussets (either plate or conical) are used to stiffen the installed nozzle, gusset installation laminates are in addition to the requirements of 7.3.3. Other gusseted nozzle installations may be used as agreed upon between the manufacturer and the purchaser.

7.3.5 *Location of Cutouts on the Shell* For cutouts made within 6 in. (152 mm) of the knuckle radius area of a head or within 6 in. (152 mm) of a shell-to-shell or shell-to-head joint additional hole cutout reinforcement is required, unless the area of installation is at a point within the vessel that operates at atmospheric pressure.

7.3.6 All nozzles and manways shall be installed in accordance with Figs. 5 and 6. The interior overlay shall present the same corrosion-resistant construction to the fluid as specified in 7.1.1 and 7.1.2.

8. Dimensions and Tolerances

8.1 Standard tank diameters, based on internal measurements with the tank in the vertical position, are listed in Table 4. Tolerance on the inside diameter, including out-of-roundness, shall be ±1 %.

8.2 Where employed, shell taper shall be additive to the figure used for the tank diameter, unless otherwise specified by the manufacturer and accepted by the purchaser. The shell taper shall not exceed ½° per side.

8.3 Tolerance on overall tank height shall be ½ %, but shall not exceed ±½ in. (±13 mm).

8.4 Nozzle flange faces shall be perpendicular to the centerline of the pipe within tolerances shown in Fig. 7, and shall be flat within ±1/32 in. (±0.8 mm) through 18-in. (457-mm) nozzle size and ±1/16 in. (±1.6 mm) for larger nozzle sizes.

8.5 The standard orientation of flanges shall provide bolt holes straddling the normal centerlines of the tank. Bolt holes of flanges located on the tank top or bottom shall straddle the principal *Y*-*Y* centerline of the vessel or lines parallel to it.

8.6 The location of nozzles shall be held to the tolerances shown in Fig. 7.

9. Workmanship

9.1 The finished laminate shall be free as commercially practicable from defects such as foreign inclusions, dry spots, air bubbles, pinholes, pimples, and delaminations that will impair the serviceability of the vessel.

NOTE 12—A representative laminate sample may be used for determination of an acceptable surface finish and acceptable level of visual imperfections.

9.2 The inner surface shall be smooth, free of cracks, and crazing, and be limited to two pits per square foot. The pits shall be less than ⅛ in. (3.2 mm) in diameter and less than 1/32 in. (0.8 mm) deep. All pits must be covered with sufficient resin to assure coverage of the inner surface reinforcement. Minor wrinkles are permissible provided their surface is smooth and free of cracks.

9.3 The outer surface of the laminate shall be relatively smooth and free of exposed fibers or sharp projections. Hand-sanded finish is acceptable but sufficient resin shall be present to prevent exposed fiber.

10. Requirements

10.1 *Physical Properties*—The minimum physical properties of the laminate constructions used to manufacture various portions of a tank and its accessories shall be as shown in Table 5 when tested in accordance with 11.5 and 11.6 or as agreed upon between the manufacturer and the purchaser.

NOTE 13—Some resin reinforcement combinations may provide ultimate values higher than shown in Table 5. Where higher values are used, they should be verified by the manufacturer and approved by the purchaser.

10.2 *Degree of Cure*—When tested in accordance with 11.7, the laminate shall have a Barcol hardness of at least 90 % of resin manufacturer's published Barcol hardness for a cured resin to indicate sufficient cure.

NOTE 14—The use of organic reinforcing materials or additives such as antimony trioxide may reduce the Barcol hardness readings without necessarily indicating undercure.

NOTE 15—A test for surface cure of polyester resins is as follows: Remove mold release or paraffin wax, if present, and wipe clean of dust. Rub a small amount of acetone on the laminate surface until acetone evaporates. If the surface becomes softened or tacky, it is an indication of possible undercure.

11. Test Methods

11.1 *Conditioning*—Condition the specimens prior to test at 23 ± 2°C (70 to 77°F) for not less than 40 h in accordance with Procedure A of Method D 618 for those tests when conditioning is required and in all cases of disagreement.

11.2 *Test Conditions*—Conduct the test at a laboratory temperature of 23 ± 2°C (70 to 77°F) unless otherwise specified.

11.3 *Chemical Resistance of Resin*—Determine the chemical resistance of the resin in accordance with Method C 581.

11.4 *Glass Content*—Determine the glass content of the inner liner and interior layer combined. Obtain a test sample by carefully splitting these combined areas from the structural layer. The glass content of the separated sample shall be determined in accordance with Method D 2584.

11.5 *Tensile Strength*—Tensile strength of the laminate shall be determined in accordance with Method D 638.

11.6 *Flexural Properties*—Determine the flexural strength and tangent modulus of elasticity of the laminate in accordance with Method D 790.

11.7 *Degree of Cure*—Degree of cure of the laminate shall be found by determining the Barcol hardness in accordance with Method D 2583.

11.8 *Physical Properties*—Where required, physical properties shall be determined in accordance with the test methods listed in Specification C 582.

12. Marking

12.1 The tank shall be marked to identify the producer, the date of manufacture, the capacity, all resins used, the inner surface reinforcements, and the words "Pressure-Atmospheric."

13. Shipping

13.1 Since there are variations in the design of support cradles, lifting and hold-down lugs, and methods of shipping, the manufacturer's special instructions shall be followed in all cases.

13.2 Tanks shall be mounted on cradles if shipping horizontally, or on a suitable skid of pallet if shipping in the vertical position. The cradles or skid shall be padded and secured to the bed of the vehicle in such a manner that will prevent damage to the tank with normal handling. The tank shall be secured to the cradles or skid so that there can be no movement of the tank in a relation to the skid or cradle under normal handling.

13.3 A suitable stiffening member shall be provided at the open end of open top tanks.

13.4 Tanks shall be loaded to provide at least 2-in. (50.8-mm) clearance between the tank (including fittings) and the bulkheads or bed of the vehicle.

13.5 When two or more tanks are shipped on the same vehicle, sufficient clearance or padding shall be provided between tanks to prevent contact in transit.

13.6 Upon arrival at the destination, the purchaser shall be responsible for inspection for damage in transit. If damage has occurred, a claim should be filed with the carrier by the purchaser and the supplier should be notified. If the damage is not first repaired by the fabricator prior to the tank being put into service, the purchaser accepts all future responsibility for the effects of tank failure resulting from such damage.

TABLE 1 Reinforcing Flange for Open-Top Tanks[A,B]

L	Tank Diameter, ft (m)								Flange Type	Flange Dimensions	
ft (m)	2 (0.610)	4 (1.219)	6 (1.829)	8 (2.438)	9 (2.743)	10 (3.048)	11 (3.353)	12 (3.658)		Width, in. (mm)	Thickness[C], in. (mm)
2(0.610)	A	A	A	C	D	E	F	G	A	2(51)	1/4(6)
4(1.219)	A	A	A	C	D	E	F	G	B	2(51)	3/8(10)
6(1.829)	A	A	A	C	D	E	F	G	C	2(51)	1/2(13)
8(2.438)	A	A	A	C	D	E	F	G	D	2 1/2(64)	3/8(10)
10(3.048)	A	A	B	C	D	E	F	G	E	2 1/2(64)	1/2(13)
12(3.658)	A	A	B	D	D	E	F	G	F	3(76)	3/8(10)
14(4.267)	A	A	B	D	E	F	F	G	G	3(76)	1/2(13)
16(4.877)	A	A	C	E	E	G	G	H	H	3(76)	5/8(16)
18(5.486)	A	A	C	E	F	G	G	H	J	3(76)	3/4(19)
20(6.096)	A	A	D	E	F	G	H	J	K	3(76)	1(25)
24(7.315)	A	B	D	F	G	H	J	K			
30(9.144)	A	B	E	G	H	H	K	K			
36(10.973)	A	B	E	H	J	K	K				
40(12.192)	A	B	E	H	J	K					

where: *L* = maximum distance from flange to tank bottom or uppermost shell stiffener if used.

[A] This table is based on handling considerations only. Significant superimposed loads, such as from wind or seismic conditions, should be considered independently.

[B] Reinforcement configurations other than flanges may be used if equal or greater stiffness is provided.

[C] Flange thickness shall be at least equal to adjacent vessel wall thickness.

TABLE 2 Minimum Widths of Joint Overlay for Circumferential Joints

$H \times D$ =	60	100	140	180	220	260	300	340	380	420	460	500
Minimum width of outside,[A] in. (mm)	4 (102)	4 (102)	5 (127)	6 (152)	7 (178)	8 (203)	9 (229)	10 (254)	11 (279)	12 (305)	13 (330)	14 (356)

where:

H = distance from the top of the liquid level to the joint, ft (m), and

D = inside diameter of the tank, ft (m)

[A] Axial joint overlay widths shall be twice the width shown below and in the table.

TABLE 3 Dimensions for Contact Molded Flanged Nozzles
(25 psi Rating)

Nozzle Inside Diameter, (*D*), in (mm)	Minimum Wall Thickness, (t_w), in. (mm)	Minimum Flange Thickness, (t_f), in (mm)	Minimum Hub Thickness, (t_h), in. (mm)	Minimum Hub Length, (*h*), in. (mm)
1(25)	3/16(5)	1/2(13)	1/4(6)	2(51)
1 1/2(38)	3/16(5)	1/2(13)	1/4(6)	2(51)
2(51)	3/16(5)	1/2(13)	1/4(6)	2(51)
3(76)	3/16(5)	1/2(13)	1/4(6)	2(51)
4(102)	3/16(5)	1/2(13)	1/4(6)	2(51)
6(152)	3/16(5)	1/2(13)	1/4(6)	2(51)
8(203)	3/16(5)	9/16(14)	5/16(8)	2 1/4(57)
10(254)	3/16(5)	11/16(17)	3/8(10)	2 3/4(70)
12(305)	3/16(5)	3/4(19)	3/8(10)	3(76)
14(356)	1/4(6)	13/16(21)	7/16(11)	3 1/4(83)
16(406)	1/4(6)	7/8(22)	7/16(11)	3 1/2(89)
18(457)	1/4(6)	15/16(24)	1/2(13)	3 3/4(95)
20(508)	1/4(6)	1(25)	1/2(13)	4(102)
24(610)	1/4(6)	1 1/8(29)	9/16(14)	4 1/2(114)

TABLE 4 Standard Tank Inside Diameters

in. (mm)
24(610)
30(762)
36(914)
42(1067)
48(1219)
54(1372)
60(1524)
66(1676)
72(1829)
84(2134)
96(2438)
108(2743)
120(3048)
132(3353)
144(3658)

TABLE 5 Laminate Physical Properties

Property	Thickness, in. (mm)			
	1/8 to 3/16 (3.2 to 4.8)	1/4 (6.4)	5/16 (7.9)	3/8 and up (9.5 and up)
Ultimate tensile strength, min, psi (mPa)	9 000(62)	12 000(83)	13 500(93)	15 000(103)
Flexural strength, min, psi (mPa)	16 000(110)	19 000(131)	20 000(138)	22 000(152)
Flexural modulus of elasticity (tangent), psi (mPa)	700 000(4 830)	800 000(5 520)	900 000(6 200)	1 000 000(6 900)

TABLE 6 Shear Bond Length (Fig. 5 & 6)

NOTE—When internal overlay serves only as a corrosion barrier, the total shear length must be placed on the exterior overlay.

Overlay Thickness, in. (mm)	1/4(6.4)	5/16(8)	3/8(9.5)	7/16(11)	1/2(13)	9/16(14)	5/8(16)	11/16(17.5)	3/4(19)	7/8(22)	1(25.4)
h (shear length), in. (mm)	3(76)	3(76)	3(76)	3 1/2(90)	4(100)	4 1/2(114)	5(127)	5 1/2(140)	6(152)	7(178)	8(203)

where: h = total shear length ($h_1 + h_2$) (Fig. 5 or 6.)

TABLE 7 Typical Dimensions of Manways

Size[A], in. (mm)	Diameter of Flange and Cover, in. (mm)	Thickness of Flange and Cover, in. (mm)	Diameter of Bolt Circle, in. (mm)	Number of Bolts	Bolt Hole Diameter, in. (mm)
		Side Shell Manway up to 15 psig hydrostatic head			
18(457)	25(635)	1(25)	22 3/4(578)	16	3/4(19)
20(508)	27(699)	1(25)	25(635)	20	7/8(22)
22(559)	30(762)	1(25)	27(686)	20	1(25)
24(610)	32(813)	1 1/8(29)	29 1/2(749)	20	1(25)
		Top Manway - atmospheric pressure			
18(457)	25(635)	3/8(10)	22 3/4(578)	16	1/2(13)
20(508)	27 1/2(699)	3/8(10)	25(635)	20	1/2(13)
22(559)	30(762)	3/8(10)	27(686)	20	1/2(13)
24(610)	32(813)	3/8(10)	29 1/2(749)	20	1/2(13)

[A] Bolt size = bolt hole diameter minus 1/8 in. (3 mm).

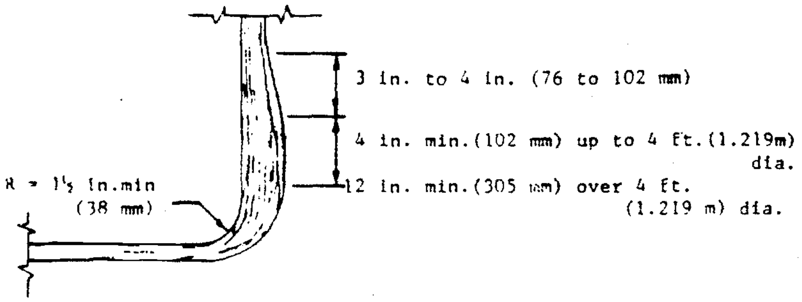


FIG. 1 Bottom Knuckle of Flat-Bottom Tank

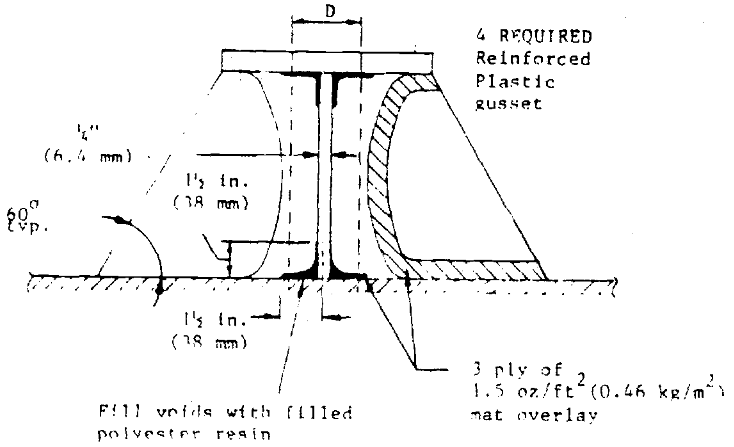


FIG. 2 Plate-Type Gussets

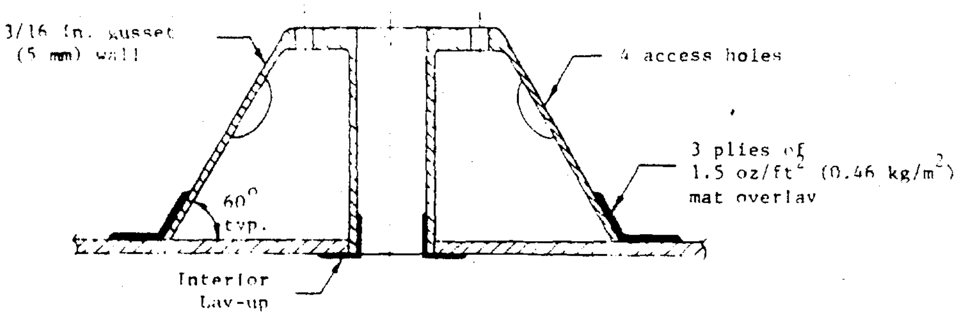
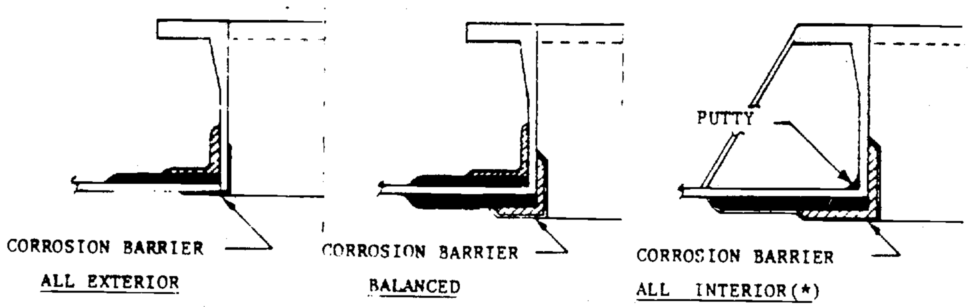
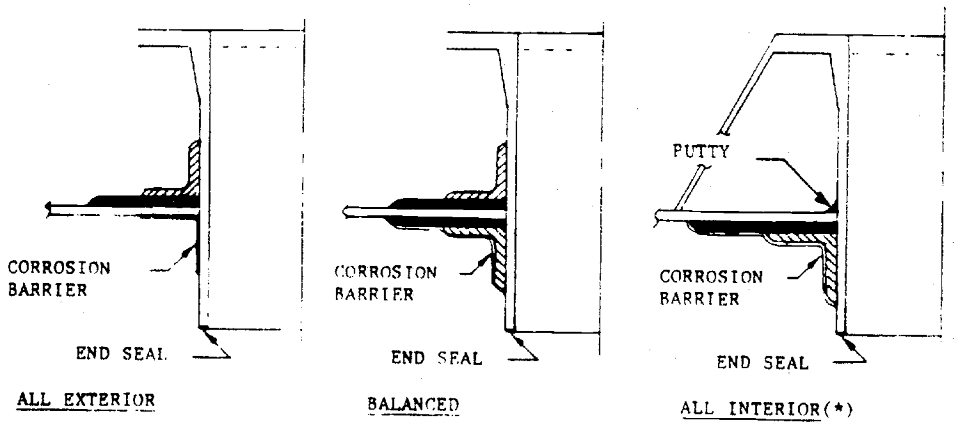


FIG. 3 Conical-Type Gussets

NOZZLE INSTALLATION AND CUT-OUT
REINFORCEMENT LOCATION ALTERNATE



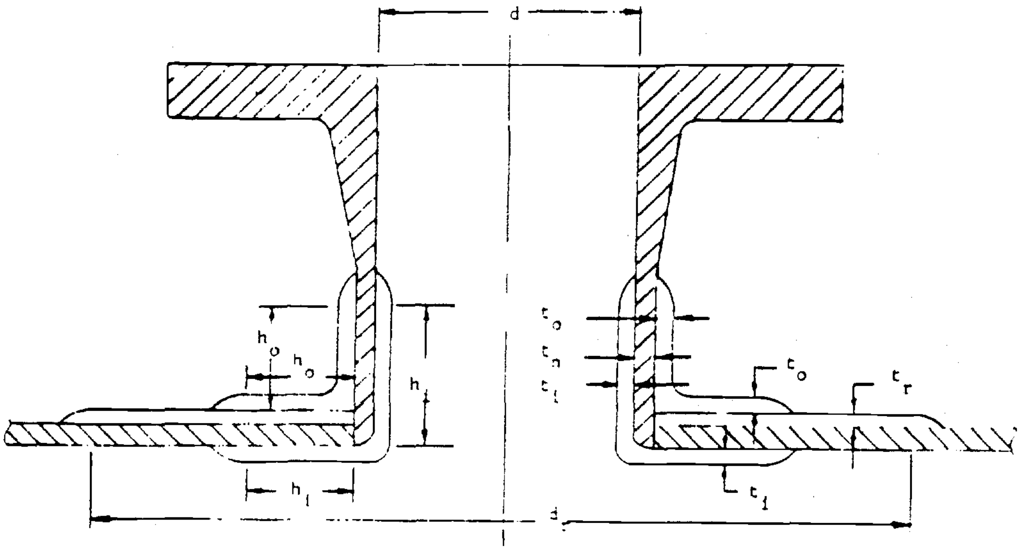
FLUSH-TYPE NOZZLE



PENETRATING-TYPE NOZZLE

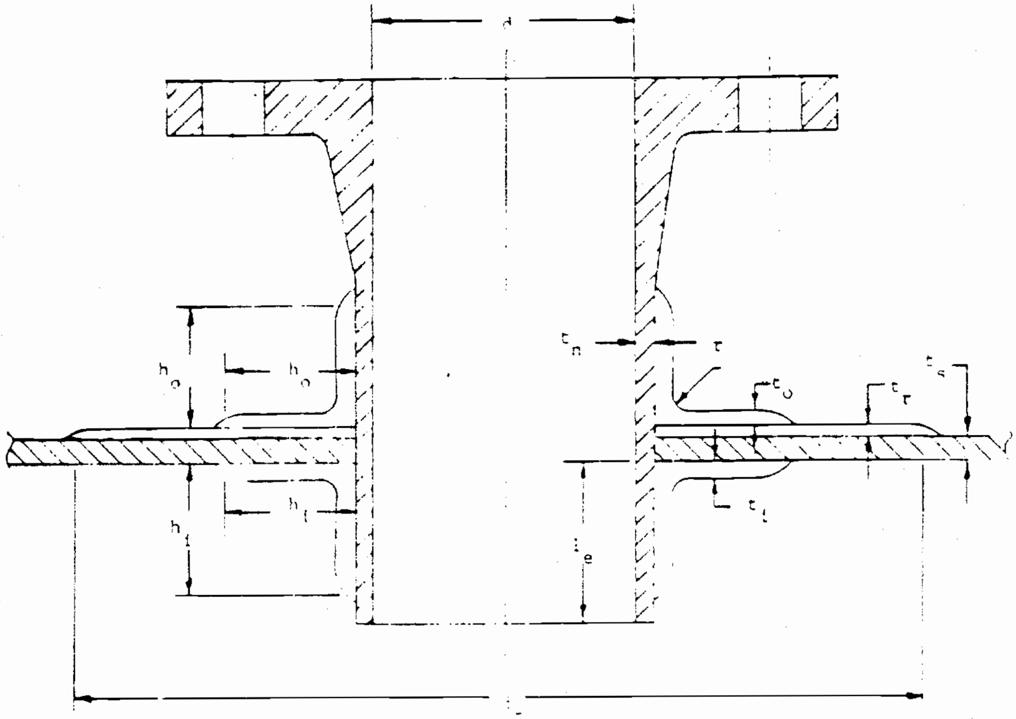
NOTE—This installation method is used only when the nozzle being installed has an integral conical gusset preventing application of an exterior laminate.

FIG. 4 Nozzle Installation and Cutout Reinforcement Location Alternate



d = nozzle diameter.
d_r = cutout reinforcement diameter – greater of 2 times d or the nozzle diameter plus 6 in. (152 mm) (see 7.3.2.3).
h_i = inside shear bond length (see 7.3.3.3).
h_o = outside shear bond length (see 7.3.3.3).
h_i, $h_o = h_s$
h_s = shear bond length (Table 6).
t_i = inside installation laminate thickness, $t_T - t_o$ (see 7.3.3.1).
t_o = outside installation thickness, (see 7.3.3.1).
t_r = cutout reinforcement laminate thickness (see 7.3.2.4), and
t_T = total installation thickness – lesser of t_r and 2 times t_n (see 7.3.3.1).

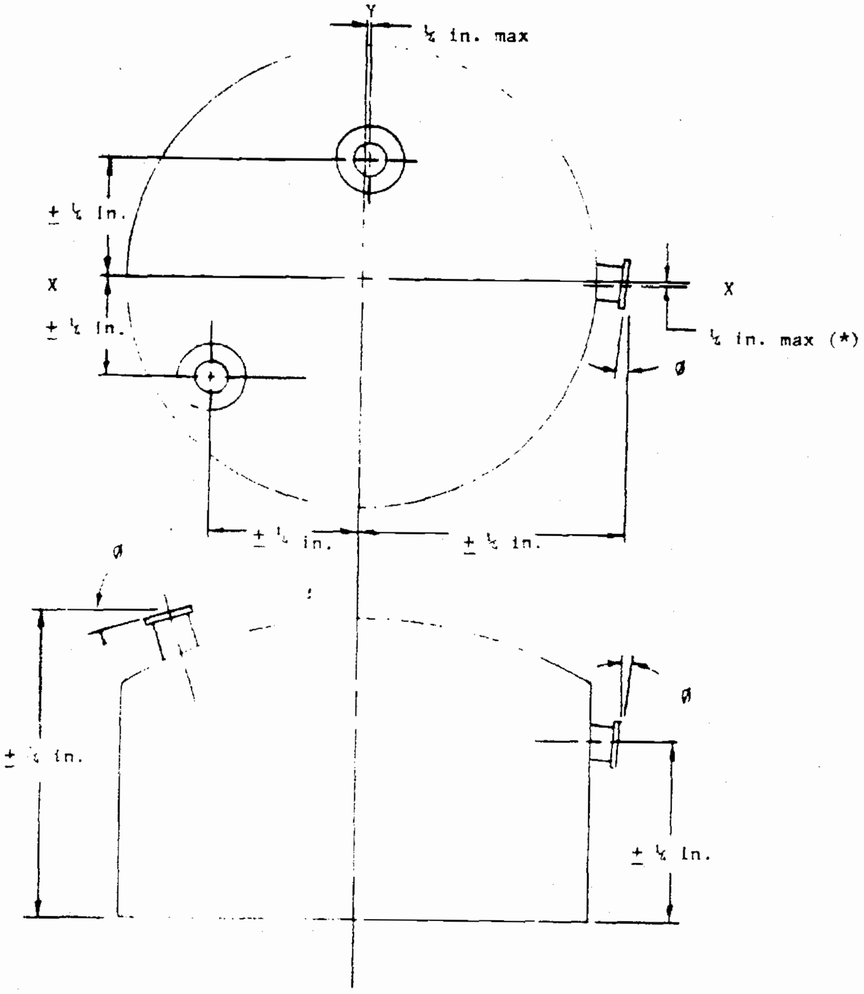
FIG. 5 Flush Nozzle Installation



- d = nozzle diameter,
- d_c = cutout reinforcement diameter (greater of 2 d or d + 6 in. (152 mm)) (see 7.3.2.3).
- t_s = shell thickness (see 6.1).
- t_n = nozzle stub thickness (see Table 3).
- t_r = cutout reinforcement laminate thickness (see 7.3.2.4)
- t_o = outside installation laminate thickness (see 7.3.3.1).
- t_i = inside installation laminate thickness t_i = t_o (see 7.3.3)
- t_w = total installation laminate thickness = lesser of t_n and 2 t_s (see 7.3.3.1).
- h_{oi} h_i = h_o = shear bond length (Table 6) (see 7.3.3.3)
- l_e = extension into tank 2 in. (51 mm), min, and
- r = fillet radius ⅜ in. (9.5 mm), min.

NOTE—All inside overlays will contain only mat reinforcement.

FIG. 6 Penetrating Nozzle Installation



Nozzle Inside Diameter, in	Permissible Angular Deviation Ø
Up to 10	1°
10 and larger	½°

FIG. 7 Nozzle Location and Orientation Tolerances

APPENDIXES

(NONMANDATORY INFORMATION)

X1. HANDLING AND INSTALLATION

X1.1 Handling

X1.1.1 The following normal precautions should be taken in handling the tank at the destination:

X1.1.1.1 Proper rigging practices should be observed at all times. Hoisting equipment operators should attach a guide line to prevent tank from swinging out of control.

X1.1.1.2 The tank should not be dropped or allowed to strike any other object. Damage caused by dropping or striking other objects may result in cracking the inner corrosion-resistant liner as well as the structural portion of the tank.

X1.1.1.3 The tank should not be rolled or slid on rough ground. Never set a tank upon a fitting or other protrusions that may be attached to the shell.

X1.1.1.4 In working around the tank, care should be exercised to prevent tools, scaffolding, or other objects from striking the tank or being dropped on or inside the tank. Soft-soled shoes should be worn by workman entering the tank. Where ladders are used (inside and outside) all points of contact with the tank should be cushioned to protect the surface from scratching or point loading.

X1.1.1.5 The use of a crane is recommended both in lifting and positioning the tank. The clearance between the head shackle of the crane and the tank should be at least equal to the span between the lugs used for lifting. If this is not possible, a spreader bar must be used to approximate the same angle in lifting.

X1.1.1.6 Where tanks are not equipped with lifting lugs, it is recommended that such tanks be lifted with rope slings (over 1 in. in diameter) or fabric straps positioned near each end of the tank. Tanks can be moved by positioning fork lift trucks on either side of the tank with forks padded.

X1.1.1.7 Under no conditions should chains or cables be allowed to contact a tank. Full protection must be provided when using chains or cables. Do not attach lifting devices to any fitting other than lifting lugs.

X1.1.1.8 When storing the tank on the ground prior to installation, it should be placed on the shipping cradles and tied down so that it cannot roll due to wind or sloping ground.

X1.2 Installation

X1.2.1 Vertical flat bottom tanks should be installed on a base providing continuous support and having sufficient strength to support the weight of the tank full of liquid with negligible deflection. Full support of the bottom should be obtained by one of the following:

X1.2.1.1 If the surface of the pad and the bottom of the tank are flat and have no projections from the plane surface, the tank may be set on such a surface.

X1.2.1.2 If the conditions of X1.2.1.1 cannot be met, methods of support recommended by the manufacturer should be used.

X1.2.2 If the tank has a bottom drain, a hole should be provided in the pad with sufficient clearance so that the drain and its flange will not contact the base at any point.

X1.2.3 *Erection of Vertical Tank*:

X1.2.3.1 Tanks should be handled with a crane, utilizing the lifting lugs provided. Do not attempt to lift tank by attaching to other fittings. Prior to hoisting the top end, a suitable protection pad of material should be placed under the bottom pivot point of tank so that as tank rises, the strain is taken on the pad. The hoist wire should be connected to the top lifting lugs, and tank should be raised carefully using guide ropes to prevent sudden swinging.

X1.2.3.2 All hold-down lugs supplied should be utilized to secure the tank to its pad. Hold-down lugs should be grouted or shimmed to prevent excessive loads being transferred to the tank shell.

X1.2.3.3 Valves, controllers, or other heavy items connected to tank nozzle should be independently supported.

X1.2.3.4 When agitators, mixers, cooling/heating coils are to be used, special design considerations are to be used.

X2. WALL THICKNESSES

X2.1 The wall thicknesses shown in Table X2.1 can be used as a guide for tanks designed in accordance with the equation in 6.1, using the minimum laminate physical properties given in Table 5.

```
*=================================================*
*          PROJECT INFORMATION ( TABLE 1 )        *
*=================================================*
*  PROJECT NUMBER          * 01-042494.11.01 11/11*
*  PROJECT NAME            * Camp LeJeune         *
*  FIRM NAME               * OHM Corporation      *
*  CONTACT NAME #1         * Dave Ruben           *
*  CONTACT NAME #2         *                      *
*  TEL. NO.                * 404-729-3900         *
*=================================================*

*=================================================*
*                 SITE PARAMETERS                 *
*-------------------------------------------------*
*  CONTAMINANT NUMBER #1   * 19                   *
*  CONTAMINANT NAME        * 1,2-DICHLOROETHANE   *
*  DATA AVAILABLE          * YES                  *
*  INFLUENT CONC. (ppb )   * 30                   *
*  EFFLUENT CONC. (ppb )   * 0.38                 *
*  PERCENT REMOVAL         * 98.73333%            *
*=================================================*
*  CONTAMINANT NUMBER #2   * 3                    *
*  CONTAMINANT NAME        * TRANS-1,2-DCE        *
*  DATA AVAILABLE          * YES                  *
*  INFLUENT CONC. (ppb )   * 30000                *
*  EFFLUENT CONC. (ppb )   * 70                   *
*  PERCENT REMOVAL         * 99.76667%            *
*=================================================*
*  CONTAMINANT NUMBER #3   * 28                   *
*  CONTAMINANT NAME        * ETHYL BENZENE        *
*  DATA AVAILABLE          * YES                  *
*  INFLUENT CONC. (ppb )   * 52                   *
*  EFFLUENT CONC. (ppb )   * 29                   *
*  PERCENT REMOVAL         * 44.23077%            *
*=================================================*
*  CONTAMINANT NUMBER #4   * 12                   *
*  CONTAMINANT NAME        * TETRACHLOROETHYLENE  *
*  DATA AVAILABLE          * YES                  *
*  INFLUENT CONC. (ppb )   * 920                  *
*  EFFLUENT CONC. (ppb )   * 0.7                  *
*  PERCENT REMOVAL         * 99.92391%            *
*=================================================*
*  CONTAMINANT NUMBER #5   * 13                   *
*  CONTAMINANT NAME        * TCE                  *
*  DATA AVAILABLE          * YES                  *
*  INFLUENT CONC. (ppb )   * 58000                *
*  EFFLUENT CONC. (ppb )   * 2.8                  *
*  PERCENT REMOVAL         * 99.99517%            *
*=================================================*
*  CONTAMINANT NUMBER #6   * 14                   *
*  CONTAMINANT NAME        * VINYL CHLORIDE       *
*  DATA AVAILABLE          * YES                  *
*  INFLUENT CONC. (ppb )   * 800                  *
*  EFFLUENT CONC. (ppb )   * 1.4                  *
*  PERCENT REMOVAL         * 99.82500%            *
*=================================================*
*  WATER FLOWRATE (GPM )   * 500                  *
*  WATER TEMP. (DEG. F )   * 55                   *
*  WATER TEMP. (DEG. C )   * 12.8                 *
*=================================================*
```

```
*==================================================*
*                PROJECT INFORMATION               *
*==================================================*
*  PROJECT NUMBER          * 01-042494.11.01 11/11*
*  PROJECT NAME            * Camp LeJeune          *
*  FIRM NAME               * OHM Corporation       *
*  CONTACT NAME #1         * Dave Ruben            *
*  CONTACT NAME #2         *                       *
*  TEL. NO.                * 404-729-3900          *
*==================================================*

*==================================================================================*
*   TOWER INFORMATION      *  PACK SAFETY FACTOR   *TOWER DIA.*   CFM    *AIR/WATER*
*                          *         1.1           *  60.0000 *  4679    *   70    *
*--------------------------*-----------------------*----------*----------*---------*
*  CONTAMINANT NUMBER      *   CONTAMINANT NAME    *  PH W/SF *PH NO/SF  *AIR/WATER*
*                          *                       *   (FT)   *  (FT)    * MIN/MAX *
*==================================================================================*
*  CONTAMINANT NUMBER #1 * 1,2-DICHLOROETHANE     *  37.4139 * 34.0126 * 30/100  *
*--------------------------*-----------------------*----------*----------*---------*
*  CONTAMINANT NUMBER #2 * TRANS-1,2-DCE          *  27.8618 * 25.3289 *  30/60  *
*--------------------------*-----------------------*----------*----------*---------*
*  CONTAMINANT NUMBER #3 * ETHYL BENZENE          *  2.0248  * 1.8407  * 100/300 *
*--------------------------*-----------------------*----------*----------*---------*
*  CONTAMINANT NUMBER #4 * TETRACHLOROETHYLENE    *  32.9479 * 29.9526 *  30/60  *
*--------------------------*-----------------------*----------*----------*---------*
*  CONTAMINANT NUMBER #5 * TCE                    *  45.3721 * 41.2474 *  30/60  *
*--------------------------*-----------------------*----------*----------*---------*
*  CONTAMINANT NUMBER #6 * VINYL CHLORIDE         *  24.1888 * 21.9898 *  30/60  *
*==================================================================================*

*=======================================================================*
*  CONTAMINANT NUMBER     *   CONTAMINANT NAME     * % REMOVAL*HENRY LAW*
*=======================================================================*
*  CONTAMINANT NUMBER #1 * 1,2-DICHLOROETHANE     * 98.7333% * 0.03403 *
*-------------------------*------------------------*----------*---------*
*  CONTAMINANT NUMBER #2 * TRANS-1,2-DCE          * 99.7667% * 0.18715 *
*-------------------------*------------------------*----------*---------*
*  CONTAMINANT NUMBER #3 * ETHYL BENZENE          * 44.2308% * 0.24670 *
*-------------------------*------------------------*----------*---------*
*  CONTAMINANT NUMBER #4 * TETRACHLOROETHYLENE    * 99.9239% * 0.70608 *
*-------------------------*------------------------*----------*---------*
*  CONTAMINANT NUMBER #5 * TCE                    * 99.9952% * 0.25521 *
*-------------------------*------------------------*----------*---------*
*  CONTAMINANT NUMBER #6 * VINYL CHLORIDE         * 99.8250% * 7.48615 *
*=======================================================================*
```

```
*==================================================*
*                  PROJECT INFORMATION             *
*==================================================*
   ROJECT NUMBER          * 01-042494.11.01 11/11*
*  PROJECT NAME           * Camp LeJeune          *
*  FIRM NAME              * OHM Corporation       *
*  CONTACT NAME #1        * Dave Ruben            *
*  CONTACT NAME #2        *                       *
*  TEL. NO.               * 404-729-3900          *
*==================================================*


*----------------------------------------------------------------------------------*
*  CONTAMINANT NUMBER    *   CONTAMINANT NAME    *     VC     *    A     *   ML    *
*==================================================================================*
*  CONTAMINANT NUMBER #1 * 1,2-DICHLOROETHANE    *     220    *  0.006   *  3.13   *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #2 * TRANS-1,2-DCE         *     250    *  0.006   *  3.13   *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #3 * ETHYL BENZENE         *     374    * 0.0042   *  3.13   *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #4 * TETRACHLOROETHYLENE   *     290    * 0.0060   *  3.13   *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #5 * TCE                   *     256    * 0.0060   *  3.13   *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #6 * VINYL CHLORIDE        *     169    * 0.0060   *  3.13   *
*==================================================================================*

*----------------------------------------------------------------------------------*
   ONTAMINANT NUMBER     *   CONTAMINANT NAME    *      L     *    PL    *HENRY LAW*
*==================================================================================*
*  CONTAMINANT NUMBER #1 * 1,2-DICHLOROETHANE    *    12743   *   62.4   * 0.03403 *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #2 * TRANS-1,2-DCE         *    12743   *   62.4   * 0.18715 *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #3 * ETHYL BENZENE         *    12743   *   62.4   * 0.24670 *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #4 * TETRACHLOROETHYLENE   *    12743   *   62.4   * 0.70608 *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #5 * TCE                   *    12743   *   62.4   * 0.25521 *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #6 * VINYL CHLORIDE        *    12743   *   62.4   * 7.48615 *
*==================================================================================*

*----------------------------------------------------------------------------------*
*  CONTAMINANT NUMBER    *   CONTAMINANT NAME    *     DL     *   A/W    *    R    *
*==================================================================================*
*  CONTAMINANT NUMBER #1 * 1,2-DICHLOROETHANE    * 3.10e-05   * 30/100   *  2.38   *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #2 * TRANS-1,2-DCE         * 2.86e-05   *  30/60   *  13.10  *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #3 * ETHYL BENZENE         * 2.22e-05   * 100/300  *  17.27  *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #4 * TETRACHLOROETHYLENE   * 2.60e-05   *  30/60   *  49.43  *
   ----------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #5 * TCE                   * 2.82e-05   *  30/60   *  17.86  *
*------------------------*-----------------------*------------*----------*---------*
*  CONTAMINANT NUMBER #6 * VINYL CHLORIDE        * 3.66e-05   *  30/60   * 524.03  *
*==================================================================================*
```

```
*==============================================*
*                PROJECT INFORMATION           *
 ==============================================*
  ROJECT NUMBER          * 01-042494.11.01 11/11*
*  PROJECT NAME          * Camp LeJeune         *
*  FIRM NAME             * OHM Corporation      *
*  CONTACT NAME #1       * Dave Ruben           *
*  CONTACT NAME #2       *                      *
*  TEL. NO.              * 404-729-3900         *
*==============================================*

*------------------------------------------------------------------------------*
*  CONTAMINANT NUMBER    *   CONTAMINANT NAME    * HENRY LAW*   HTU    *   NTU    *
*==============================================================================*
*  CONTAMINANT NUMBER #1 * 1,2-DICHLOROETHANE    *   0.034  *  5.15    *  6.61    *
*------------------------*----------------------*----------*----------*----------*
*  CONTAMINANT NUMBER #2 * TRANS-1,2-DCE         *   0.187  *  3.91    *  6.48    *
*------------------------*----------------------*----------*----------*----------*
*  CONTAMINANT NUMBER #3 * ETHYL BENZENE         *   0.247  *  3.11    *  0.59    *
*------------------------*----------------------*----------*----------*----------*
*  CONTAMINANT NUMBER #4 * TETRACHLOROETHYLENE   *   0.706  *  4.10    *  7.31    *
*------------------------*----------------------*----------*----------*----------*
*  CONTAMINANT NUMBER #5 * TCE                   *   0.255  *  3.94    *  10.47   *
*------------------------*----------------------*----------*----------*----------*
*  CONTAMINANT NUMBER #6 * VINYL CHLORIDE        *   7.486  *  3.46    *  6.36    *
*==============================================================================*

*-----------------------------------------------------------------*
   ONTAMINANT NUMBER    *   CONTAMINANT NAME    *    PH    *  PH/SF   *
*=================================================================*
*  CONTAMINANT NUMBER #1 * 1,2-DICHLOROETHANE    *  34.01   *  37.41   *
*------------------------*----------------------*----------*----------*
*  CONTAMINANT NUMBER #2 * TRANS-1,2-DCE         *  25.33   *  27.86   *
*------------------------*----------------------*----------*----------*
*  CONTAMINANT NUMBER #3 * ETHYL BENZENE         *  1.84    *  2.02    *
*------------------------*----------------------*----------*----------*
*  CONTAMINANT NUMBER #4 * TETRACHLOROETHYLENE   *  29.95   *  32.95   *
*------------------------*----------------------*----------*----------*
*  CONTAMINANT NUMBER #5 * TCE                   *  41.25   *  45.37   *
*------------------------*----------------------*----------*----------*
*  CONTAMINANT NUMBER #6 * VINYL CHLORIDE        *  21.99   *  24.19   *
*=================================================================*

*==============================================*
*               SITE PARAMETER                 *
*----------------------------------------------*
*  WATER FLOWRATE (GPM)   * 500                *
*  WATER TEMP. (DEG. F)   * 55                 *
*  WATER TEMP. (DEG. C)   * 12.8               *
*----------------------*-----------------------*
*              TOWER PARAMETER                 *
*----------------------*-----------------------*
*  DRIVING CONTAMINANT    * TCE                *
   OWER DIAMETER (IN)     * 60                 *
*  ACK HIGHT CALC.(FT)    * 45.37              *
*  AIR FLOW CALC. (CFM)   * 4679               *
*  AIR TO WATER RATIO     * 70                 *
*==============================================*
```

NATIONAL
ENVIRONMENTAL INC.
SYSTEMS

36 Maple Avenue • Seekonk, Massachusetts 02771
508 761-6611 FAX 508 761-6898

Air Stripper Blower Data

Manufacturer: New York Blower

Model: 294 DH Series 20

Performance: 4680 cfm at 10.0 inches s.p.

Blower Information

- Steel construction
- Belt driven
- Arrangement ten
- 1478 rpm
- 254T frame

Motor Information

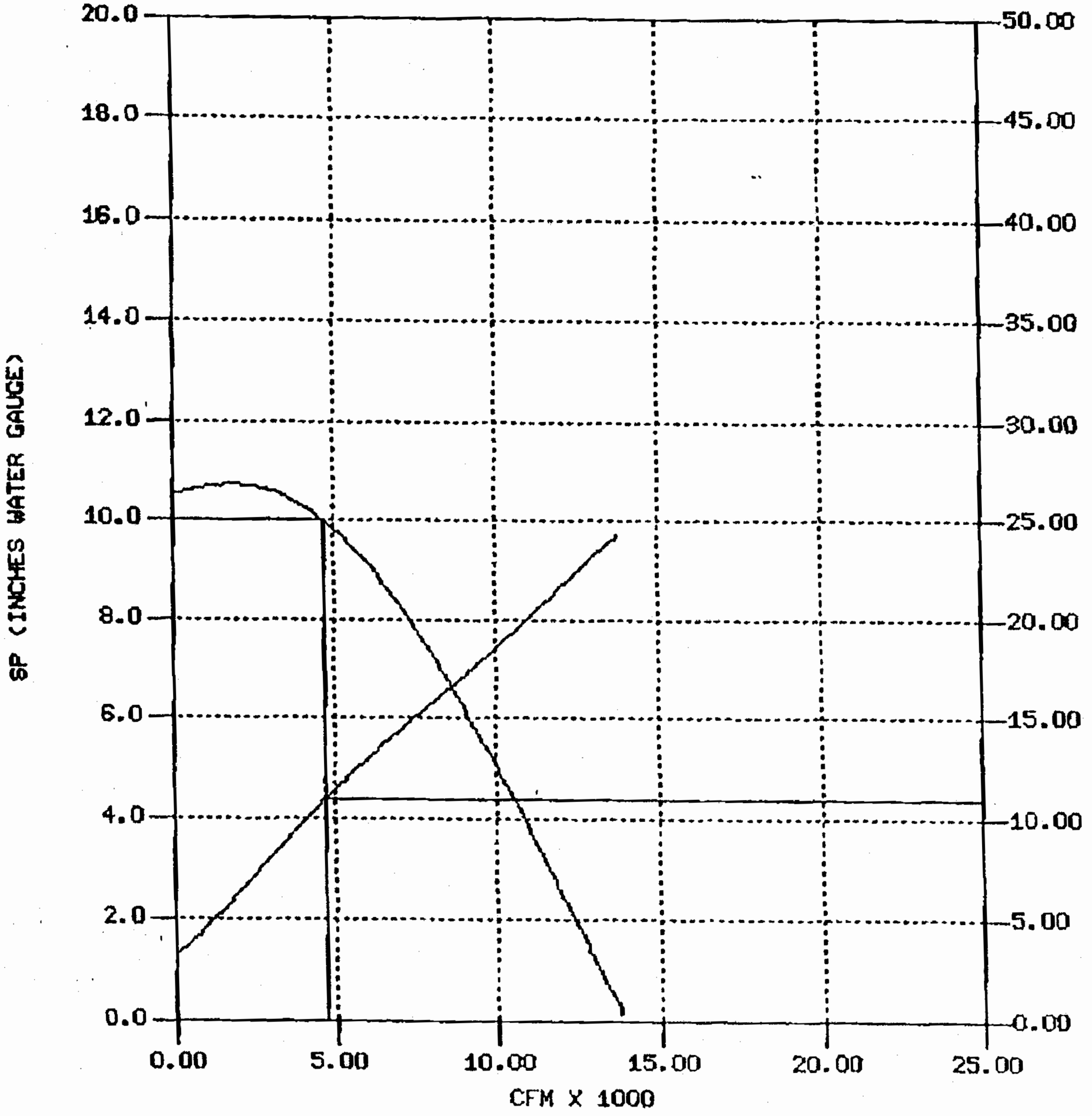
- Three phase
- 15 HP
- 230/460 VAC
- 60 Hz
- TEFC
- 1800 rpm

Accessories

- Aluminum wheel
- Weather cover
- Belt guard
- Bearings - B_{10} - 250,000 hours
- Inlet filter - 50 microns

THE NEW YORK BLOWER COMPANY

=FAN=TO=SIZE=



FAN INFORMATION

Series 20 - DH
Belt Drive MATL: Mild Steel
Size: 294
Tag :
Date: 4/17/1995
CFM : 4680 SP : 10.00
OV : 2962
RPM : 1478 BHP: 10.9
DEN : 0.0750
TEMP: 70 DEG F
SE : 67.1% ME : 70.8%

CUSTOMER

YOUR REPRESENTATIVE

L. J. FIORELLO COMPANY, INC

495 MAIN STREET P.O. BOX 67
SOUTHBRIDGE, MA
01550
Phone: (508) 765-0266
FAX : (508) 765-0328

v1.20

DIMENSIONS

L, M, and O are outside dimensions.

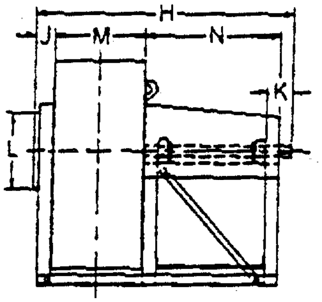
J is from housing side over inlet collar.

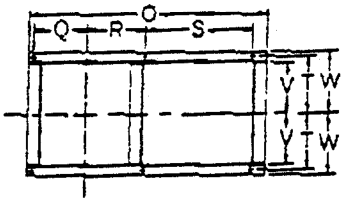
Tolerance: ±⅛"

Dimensions not to be used for construction unless certified.

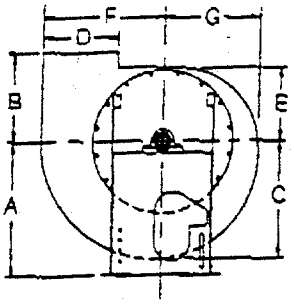
Refer to page 4 for maximum motor size limits.

ARRANGEMENT 10





Inlet bracket is omitted on Sizes 144 and 174.

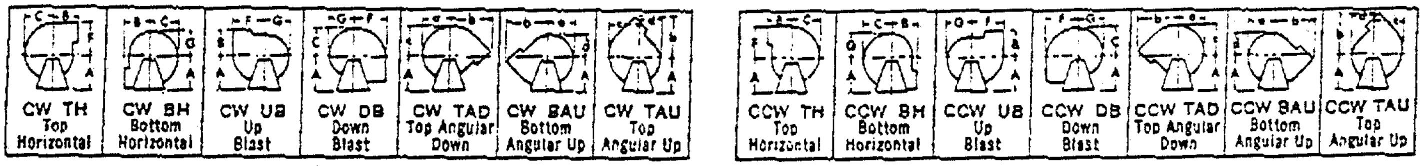


DIMENSIONS [Inches]

Size	A	B	C	D	E	F	G	H	J	K	L	M	N	O
144	15½	10½	11⅛	8¼	9⅜	12	10¼	30	1⅝	2½	9	7⅞	20	19⅞
174	17½	12⅝	13⅜	10⅛	11⅛	14½	12¼	34⅛	1⅝	3	11	9½	22	21⅞
194	21¼	14	16	10¼	11⅞	18	13⅞	36⅜	3⅛	3½	11	9¾	22	33⅞
224	25½	16½	18⅞	13	14	21¼	16⅜	41⅜	3⅛	4	13	10¾	26	38⅞
264	28	18½	21¾	15	16⅛	24½	18⅞	44½	4⅛	4½	15	12⅜	26	41½
294	32½	21	24⅝	16⅞	18¼	27¾	21⅜	48	4⅛	5½	17	14	26⅞	44
334	39½	23	27⅜	18¾	20⅜	30⅞	23⅞	53⅛	4⅛	6	19	15⅝	29⅞	48⅜
364	39½	25½	30¼	20¾	22½	34⅛	26⅜	56	5¼	6	21	17¼	30	50⅜

Size	Q	R	S	T	V	W	a	b	c	d	Shaft diameter	Keyway	Base holes
144	—	5⅞	16⅞	7⅜	6½	8	10¾	16	11½	9¾	1 7/16	⅜ x 3/16	9/16
174	—	6⅝	18⅜	8⅞	8	9½	13⅛	19¼	13¾	11½	1 7/16	⅜ x 3/16	9/16
194	6	7¼	17⅜	9⅜	8¼	10¼	15	22⅝	17	13	1 11/16	⅜ x 3/16	9/16
224	6½	8¼	20⅜	10⅞	9¾	11¾	17⅝	26⅝	20	15¼	1 15/16	½ x ¼	9/16
264	7⅞	9⅜	19⅞	12¼	11	13	20¼	30⅜	23	17½	1 15/16	½ x ¼	¾
294	8⅝	10⅛	20¾	13⅝	11¾	14¾	23	34⅜	26⅛	19⅞	1 15/16	½ x ¼	¾
334	9⅜	11	23¾	16	14	17	25¾	38⅛	29¼	22⅜	2 3/16	½ x ¼	¾
364	10¼	11⅞	23¾	16	14	17	28½	42⅛	32¼	24⅝	2 3/16	½ x ¼	¾

FAN DISCHARGES — VIEWED FROM DRIVE SIDE



Clockwise—Angular discharges at 45°

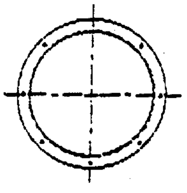
Counterclockwise—Angular discharges at 45°

FLANGED INLET OPTION

DIMENSIONS [Inches]

Size	I.D.*	B.C.	O.D.	Holes	
				No.	Dia.
144	8¾	10¼	11½	6	7/16
174	10¾	12¼	13½	6	7/16
194	10⅝	12½	14	8	7/16
224	12⅝	14½	16	8	7/16
264	14⅝	16½	18	8	7/16
294	16⅝	18½	20	8	7/16
334	18⅝	20½	22	16	7/16
364	20⅝	22½	24	16	7/16
404	22⅝	25	27	16	9/16
454	25⅝	28	30	16	9/16
504	28⅝	31	33	16	9/16
574	32⅝	35	37	16	9/16
644	36½	39	41	24	9/16
714	40½	43	45	24	9/16
784	44½	47	49	24	9/16
854	48½	51	53	24	9/16

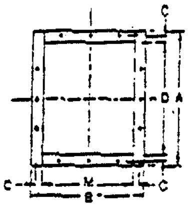
*Dimension shown is I.D. of inlet collar.



Furnished with holes starting on vertical centerline.

Inlet bar sizes:
Sizes 144-174
10 ga. x 1¼
Size 194
7 ga. x 1½
Sizes 224-364
¼ x 1½
Sizes 404-854
¼ x 2

FLANGED OUTLET OPTION



1. Mounted flush with edge of housing outlet.
2. Holes furnished on 4" centers on centerline.

Outlet flange angles:
Sizes 144-174
1¼ x 1¼ x 3/16
Sizes 194-364
1½ x 1½ x 3/16
Sizes 404-854
2 x 2 x 3/16

DIMENSIONS [Inches]

Size	A	B	C	D*	M*	Holes	
						No.	Dia.
144	10¾	10⅜	¾	8¼	7⅞	8	7/16
174	12⅝	12	¾	10⅛	9½	12	7/16
194	13¼	12¾	⅞	10¼	9¾	12	7/16
224	16	13¾	⅞	13	10¾	12	7/16
264	18	15⅜	⅞	15	12⅝	16	7/16
294	19⅞	17	⅞	16⅞	14	16	7/16
334	21¾	18⅝	⅞	18¾	15⅝	16	7/16
364	23¾	20¼	⅞	20¾	17¼	20	7/16
404	26⅞	23	1⅛	22⅞	19	24	9/16
454	29¾	25⅜	1⅛	25¾	21⅜	24	9/16
504	32¾	27⅞	1⅛	28¾	23⅞	24	9/16
574	36⅝	31⅛	1⅛	32⅝	27⅛	32	9/16
644	40⅝	34½	1⅛	36⅝	30½	32	9/16
714	44⅜	37⅝	1⅛	40⅜	33⅝	36	9/16
784	48⅛	40⅞	1⅛	44⅛	36⅞	40	9/16
854	52¼	44⅛	1⅛	48¼	40⅛	44	9/16

*Dimension shown is inside flange, outside outlet. Deduct housing material thickness to determine inside dimension of discharge.

nyb | The New York Blower Company®
7660 QUINCY STREET—WILLOWBROOK, ILLINOIS 60521-5596

INSTALLATION
MAINTENANCE,
OPERATING
INSTRUCTIONS

IM-110

CENTRIFUGAL FANS
General Industrial
Series 20, 30 & 45

CAUTION

THIS MACHINE HAS MOVING PARTS THAT CAN CAUSE SERIOUS BODILY INJURY. BEFORE OPERATING OR PERFORMING MAINTENANCE, THE FOLLOWING PRECAUTIONS MUST BE TAKEN.

1. MAKE SURE ALL MOVING PARTS ARE SHIELDED FROM PERSONNEL AND FALLING OBJECTS.
2. READ THE INSTALLATION AND MAINTENANCE INSTRUCTIONS, AS WELL AS THE RECOMMENDED SAFETY PRACTICES MANUAL FURNISHED WITH THIS UNIT.
3. DO NOT OPERATE AT SPEEDS OR TEMPERATURES HIGHER THAN PUBLISHED FOR THE SPECIFIC OPERATING CONDITIONS FOR WHICH THE MACHINE WAS PURCHASED.

A FAILURE TO TAKE THESE PRECAUTIONS COULD RESULT IN SERIOUS BODILY INJURY AND PROPERTY DAMAGE.

98-0250

A WORD ABOUT SAFETY

The above CAUTION decal appears on all nyb fans. Air moving equipment involves electrical wiring, moving parts, and air velocity or pressure which can create safety hazards if the equipment is not properly installed, operated and maintained. To minimize this danger, follow these instructions as well as the additional instructions and warnings on the equipment itself.

All installers, operators and maintenance personnel should study AMCA Publication 410, "Recommended Safety Practices for Air Moving Devices", which is included as part of every shipment. Additional copies can be obtained by writing to The New York Blower Company, 7660 Quincy Street, Willowbrook, IL 60521-5596.

ELECTRICAL DISCONNECTS

Every motor driven fan should have an independent disconnect switch to isolate the unit from the electrical supply. It should be near the fan and must be capable of being locked by maintenance personnel while servicing the unit, in accordance with OSHA procedures.

MOVING PARTS

All moving parts must have guards to protect personnel. Safety requirements vary, so the number and type of guards needed to meet company, local and OSHA standards must be determined and specified by the user. Never start a fan without having all safety guards installed. Check regularly for damaged or missing guards and do not operate any fan with guards removed. Fans can also become dangerous because of potential "windmilling," even though all electrical power is disconnected. Always block the rotating assembly before working on any moving parts.

AIR PRESSURE AND SUCTION

In addition to the normal dangers of rotating machinery, fans present another hazard from the suction created at the fan inlet. This suction can draw materials into the fan where they become high velocity projectiles at the outlet. It can also be extremely dangerous to persons in close proximity to the inlet, as the forces involved can overcome the strength of most individuals. Inlets and outlets that are not ducted should be screened to prevent entry and discharge of solid objects.

ACCESS DOORS

DANGER

DO NOT OPEN UNTIL THE POWER SUPPLY HAS BEEN LOCKED OFF AND THE SHAFT HAS STOPPED ROTATING.

FAILURE TO DO THIS CAN RESULT IN SERIOUS BODILY INJURY.

98-0249

The above DANGER decal is placed on all nyb cleanout doors. These doors, as well as access doors to the duct system, should never be opened while the fan is in operation. Serious injury could result from the effects of air pressure or suction.

Quick-opening doors must have the door handle bolts securely tightened to prevent accidental or unauthorized opening. Bolted doors must be tightened for the same reason.

RECEIVING AND INSPECTION

The fan and accessories should be inspected on receipt for any shipping damage. Turn the wheel by hand to see that it rotates freely and does not bind. If dampers or shutters are provided, check these accessories for free operation of all moving parts.

F.O.B. factory shipping terms require that the receiver be responsible for inspecting the equipment upon arrival. Note damage or shortages on the Bill of Lading and file any claims for damage or loss in transit. **nyb** will assist the customer as much as possible; however, claims must be originated at the point of delivery.

HANDLING AND STORAGE

Fans should be lifted by the base, mounting supports, or lifting eyes only. Never lift a fan by the wheel, shaft, motor, motor bracket, housing inlet, outlet, or any fan part not designed for lifting. A spreader should always be used to avoid damage.

On direct drive Arrangement 8 fans, lifting holes are provided in the motor base to assist in handling the fan assembly. These lifting holes should be used in conjunction with the lifting eyes when lifting and positioning the fan onto its foundation. A heavy round steel bar or appropriate fixture can be passed through the lifting holes to simplify attachment of the lifting device. Be sure to follow all local safety codes when moving heavy equipment.

Whenever possible, fans and accessories should be stored in a clean, dry location to prevent rust and corrosion of steel components. If outdoor storage is necessary, protection should be provided. Cover the inlet and outlet to prevent the accumulation of dirt and moisture in the housing. Cover motors with waterproof material. Refer to the bearing section for further storage instructions.

Check dampers for free operation and lubricate moving parts prior to storage. Inspect the stored unit periodically. **Rotate the wheel by hand every two weeks to redistribute grease on internal bearing parts.**

FAN INSTALLATION

nyb wheels are dynamically balanced when fabricated. Fully assembled fans are test run at operating speeds to check the entire assembly for conformance to **nyb** vibration limits. Nevertheless, all units must be adequately supported for smooth operation. Ductwork or stacks should be independently supported as excess weight may distort the fan housing and cause contact between moving parts. Where vibration isolators are used, consult the **nyb** certified drawing for proper location and adjustment.

Slab-Mounted Units

A correctly designed and level concrete foundation provides the best means of installing floor-mounted fans. The mass of the base must maintain the fan/driver alignment, absorb normal vibration, and resist lateral loads. The overall dimensions of the concrete base should extend at least six inches beyond the base of the fan. The weight of the slab should be two to three times the weight of the rotating assembly, including the motor. The foundation requires firmly anchored fasteners such as the anchor bolts shown in Figure 1. Hammer-drilled expansion fasteners can be used in less demanding applications.

Move the fan to the mounting location and lower it over the anchor bolts, leveling the fan with shims around the bolts. Fasten the fan securely. When grout is used, shim the fan at least 3/4-inch from the concrete base. (See Figure 1.) When isolation is used, check the **nyb** certified drawing for installation instructions.

Elevated Units

When an elevated or suspended structural steel platform is used, it must have sufficient bracing to support the unit load and prevent side sway. The platform should be of welded construction to maintain permanent alignment of all members.

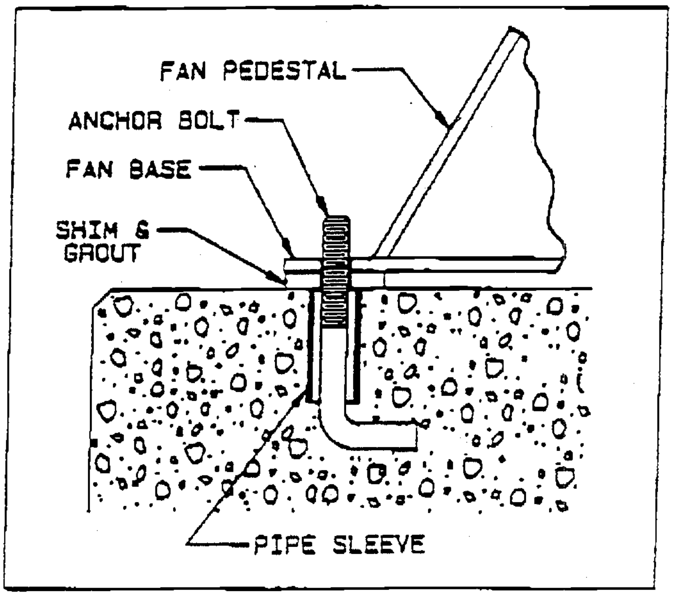


Figure 1

V-BELT DRIVE

Installation

1. Remove all foreign material from the fan and motor shafts. Coat shafts with machine oil for easier mounting. Mount the belt guard backplate at this time if partial installation is required prior to sheave mounting.
2. Mount sheaves on shafts after checking sheave bores and bushings for nicks or burrs. Avoid using force. If resistance is encountered, lightly polish the shaft with crocus cloth until the sheave slides on freely. Tighten tapered bushing bolts sequentially so that equal torque is applied to each.
3. Adjust the motor on its base to a position closest to the fan shaft. Install belts by working each one over the sheave grooves until all are in position. Never pry the belts into place. On **nyb** packaged fans, sufficient motor adjustment is provided for easy installation of the proper size belts.
4. Adjust sheaves and the motor shaft angle so that the sheaves faces are in the same plane. Check this by placing a straightedge across the faces of the sheave. Any gap between the edge and sheave faces indicates misalignment. Important: This method is only valid when the width of the surface between the belt edge and the sheave face is the same for both sheaves. When they are not equal, or when using adjustable-pitch sheaves, adjust so that all belts have approximately equal tension. Both shafts should be at the right angles to the center belt.

Belt Tensioning

1. Check belt tension with a tensioning gage and adjust using the motor slide base. Excess tension shortens bearing life while insufficient tension shortens belt life, can reduce fan performance and may cause vibration. The lowest allowable tension is that which prevents slippage under full load. Belts may slip during startup, but slipping should stop as soon as the fan reaches full speed. For more precise tensioning methods, consult the drive manufacturer's literature.

FAN MAINTENANCE

nyb fans are manufactured to high standards with quality materials and components. Proper maintenance will ensure a long and trouble-free service life.

Do not attempt any maintenance on a fan unless the electrical supply has been completely disconnected and locked. In many cases, a fan can windmill despite removal of all electrical power. The rotating assembly should be blocked securely before attempting maintenance of any kind.

The key to good fan maintenance is regular and systematic inspection of all fan parts. Inspection frequency is determined by the severity of the application and local conditions. Strict adherence to an inspection schedule is essential.

Regular fan maintenance should include the following:

1. Check the fan wheel for any wear or corrosion as either can cause catastrophic failures. Check also for the build up of material which can cause unbalance resulting in vibration, bearing wear and serious safety hazards. Clean or replace the wheel as required.
2. Check the V-belt drive for proper alignment and tension (see section on V-belt drives). If belts are worn, replace them as a set, matched to within manufacturer's tolerances. Lubricate the coupling of direct-drive units and check for alignment (see section on couplings).
3. Lubricate the bearings, but do not overlubricate (see the bearing section for detailed specifications).
4. Ceramic-felt shaft seals require no maintenance, although worn seals should be replaced. When lip-type shaft seals are provided, lubricate them with "NEVER-SEEZ" or other anti-seize compound.
5. During any routine maintenance, all setscrews and bolts should be checked for tightness. See the table for correct torques.
6. When installing a new wheel, the proper wheel-to-inlet clearance must be maintained (see Figure 3).

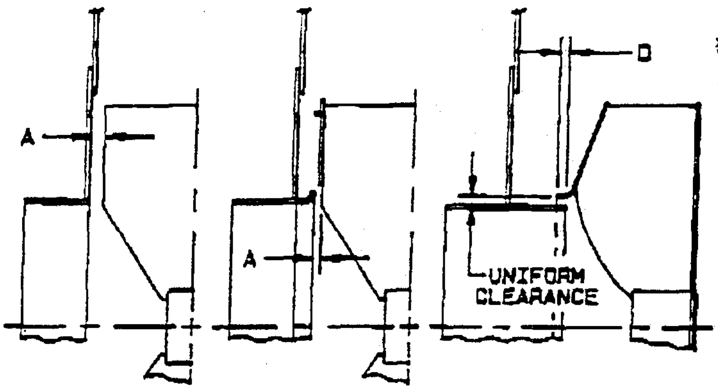
WHEEL BALANCE

Airstreams containing particulate or chemicals can cause abrasion or corrosion of the fan parts. This wear is often uneven and can lead to significant wheel unbalance over time. When such wear is discovered, a decision must be made as to whether to rebalance or replace the wheel.

The soundness of all parts should be determined if the original thickness of components is reduced. Be sure there is no hidden structural damage. The airstream components should also be cleaned to remove any build up of foreign material. Specialized equipment can be used to rebalance a cleaned wheel that is considered structurally sound.

Balance weights should be rigidly attached at a point that will not interfere with the housing nor disrupt airflow. Remember that centrifugal forces can be extremely high at the outer radius of a fan wheel. Welding is the preferred method of balance weight attachment. Be sure to ground welder directly to the fan wheel. Otherwise, the welding current could pass through the fan bearings and destroy them.

WHEEL-INLET CLEARANCES



LS & BP/RD RIM 334 & 384 — RIM 404 THRU 854 — DH

(Inches)

	"A" Dim LS/RIM			"A" Dim BP/RD	"D" Dim DH	
Series	20	30	45	ALL	20	30/45
Size						
14	3/4			1-9/16		
17	3/4			2-3/16		
19	3/4	9/16	9/16	1-5/16	9/16	7/16
22	3/4	3/4	3/4	1-5/16	7/16	1/2
26	3/4	7/8	7/8	1-9/16	1/2	9/16
29	1	1	1	1-13/16	9/16	5/8
33	1-1/8	1	1	2	5/8	11/16
36	1-1/4	1-1/8	1-1/8	2-3/8	11/16	3/4
40	1/2	3/4	1/4	3-3/16	3/4	9/16
45	9/16	3/4	5/16		13/16	13/16
50	5/8	7/8	3/8		1	1
57	3/4	7/8	5/16		1-1/8	1-1/8
64	7/8	1	7/16		1-3/16	1-3/16
71	7/8	1	1/2		1-5/16	1-5/16
78	1	1-1/8	5/8		1-7/16	1-7/16
85	1	1-1/4	5/8		1-11/16	1-11/16

Figure 3

BEARINGS

Storage

Any stored bearing can be damaged by condensation caused by temperature variations. Therefore, nyb fan bearings are filled with grease at the factory to exclude air and moisture. Such protection is adequate for shipment and subsequent immediate installation.

For long term or outdoor storage, mounted bearings should be regreased and wrapped with plastic for protection. **Rotate the fan wheel by hand at least every two weeks to redistribute grease on internal bearing parts.** Each month the bearings should be purged with new grease to remove condensation, since even a filled bearing can accumulate moisture. Use caution when purging, as excessive pressure can damage the seals. Rotate the shaft while slowly adding grease.

Operation

Check setscrew torque before startup (see table for correct values). Since bearings are completely filled with grease at the factory, they may run at an elevated temperature during initial operation. Surface temperatures may reach 180°F. and grease may bleed from the bearing seals. This is normal and no attempt should be made to replace lost grease. Bearing surface temperatures will decrease when the internal grease quantity reaches a normal operating level. Relubrication should follow the recommended schedule.

Lubrication

Use the table for relubrication scheduling according to operating speed and shaft diameter. Bearings should be lubricated with a good quality lithium-based grease conforming to NLGI Grade 2 consistency. Examples are:

Mobil	—	Mobilith 22
Texaco	—	Premium RB
Standard Oil	—	Amolith #2
Gulf Oil	—	Gulf Crown #2
Shell	—	Alvania #2

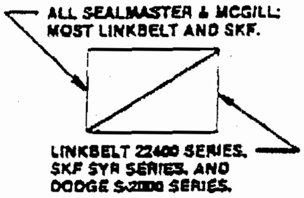
Do not use "high temperature" greases, as many are not formulated for the high speeds associated with fan bearings.

Add grease to the bearing while running the fan or rotating the shaft by hand. Be sure all guards are in place if lubrication is performed while the fan is operating. Add just enough grease to cause a slight purging at the seals. Do not overlubricate.

Split pillowblock bearings (Link-Belt P-LB6800 & P-LB6900, SKF SAF 22500, Dodge SAF-XT) should be cleaned and repacked at approximately every eighth lubrication interval. This requires removal of the bearing cap. Clean out old grease and repack the bearing with fresh grease. Pack the bearing fully and fill the housing reservoir to the bottom of the shaft on both sides of the bearing. Replace the bearing cap, being careful not to mix caps as they are not interchangeable from one bearing to another.

BEARING LUBRICATION INTERVAL (MONTHS)

RPM SHAFT DIAMETER	1-500	501-1000	1001-1500	1501-2000	2001-2500	2501-3000	3001-3500	3501-4000	4001-4500	4501-5000
5/8 thru 1	6	6	5-6	5-6	4-6	4-6	3-4	3-4	2	2
1 3/16 & 1 7/16	6 6	6 4	5-6 4	4-6 2	4-6 2	3-5 1	2-4 1	2-4 1	1-2 1	1 1/2
1 11/16 & 1 15/16	6 6	6 4	4-6 2	4-6 1	2-4 1	2-4 1	2 1/2	1-2 1/2	1-2	1
2 3/16	6 6	5-6 4	4-6 2	3-4 1	2-4 1	1-2 1/2	1-2	1-2		
2 7/16	6 4	4-6 2	4-6 1	3-4 1	2 1/2	1-2 1/2	1-2	1		
2 11/16 & 2 15/16	5-6 4	4-6 2	2-4 1	2 1	1-2 1/2	1				
3 3/16	6	6	4	2	2					
3 7/16 thru 4 3/16	4-6 4	3-5 2	2-4 1	1-2 1/2	1					
4 7/16	4-6 4	3-4 1	2 1/2	1						
4 15/16	4-6 2	3-4 1	2 1/2							
5 7/16	6	4	2							
6	6	4								



NOTE:

1. These are general recommendations only; specific manufacturer's recommendations may vary slightly.
2. Assumes clean environment, 0°F. to 120°F.
    - a. Consult The New York Blower Company for operation below 0°F. ambient.
    - b. Ambient temperatures greater than 120°F. will shorten bearing life.
    - c. Under extremely dirty conditions, lubricate more frequently.

COMMON FAN PROBLEMS

Excessive Vibration

A common complaint regarding industrial fans is "excessive vibration." nyb is careful to ensure that each fan is precise- lanced prior to shipment; however, there are many er causes of fan vibration including:

1. Loose mounting bolts, setscrews, bearings or couplings.
2. Misalignment or excessive wear of couplings or bearings.
3. Misaligned or unbalanced motor.
4. Bent shaft due to mishandling or material impact.
5. Accumulation of foreign material on the wheel.
6. Excessive wear or erosion of the wheel.
7. Excessive system pressure or restriction of airflow due to closed dampers.
8. Inadequate structural support, mounting procedures or materials.
9. Externally transmitted vibration.

Inadequate Performance

1. Incorrect testing procedures or calculations.
2. Fan running too slowly.
3. Fan wheel rotating in wrong direction or installed backwards on shaft.
4. Wheel not properly centered relative to inlet cone.
5. Damaged or incorrectly installed cut off sheet or diverter.
6. Poor system design, closed dampers, air leaks, clogged filters or coils.
7. Obstructions or sharp elbows near inlets.
8. Sharp deflection of airstream at fan outlet.

Excessive Noise

1. Fan operating near "stall" due to incorrect system design or installation.
2. Vibration originating elsewhere in the system.

ystem resonance or pulsation.

Improper location or orientation of fan intake and discharge.

5. Inadequate or faulty design of supporting structures.
6. Nearby sound reflecting surfaces.
7. Loose accessories or components.
8. Loose drive belts.
9. Worn bearings.

Premature Component Failure

1. Prolonged or major vibration.
2. Inadequate or improper maintenance.
3. Abrasive or corrosive elements in the airstream or surrounding environment.
4. Misalignment or physical damage to rotating components or bearings.
5. Bearing failure from incorrect or contaminated lubricant or grounding through the bearings while arc welding.
6. Excessive fan speed.
7. Extreme ambient or airstream temperatures.
8. Improper belt tension.
9. Improper tightening of wheel setscrews.

REPLACEMENT PARTS

It is recommended that only factory-supplied replacement parts be used. nyb fan parts are built to be fully compatible with the original fan, using specific alloys and tolerances. These parts carry a standard nyb warranty.

When ordering replacement parts, specify the part name, nyb shop and control number, fan size, type, rotation (viewed from drive end), arrangement and bearing size or bore. Most of this information is on the metal nameplate attached to the fan base.

Example: Part required: Wheel
Shop/control number: B-10106-100
Fan description: 264 Series 20 DH
Clockwise rotation
Arrangement: 1
Bearing: Link-Belt P335, 2-3/16 Bore

Suggested replacement parts include:

Wheel
Shaft
Bearings
Shaft Seal

Component parts: Damper
Motor
Coupling
Sheaves
V-Belts

LIMITED PRODUCT WARRANTY

All products are warranted by nyb to be free from defects in materials and workmanship for a period of one (1) year after shipment from its plant, provided buyer demonstrates to satisfaction of nyb that the product was properly installed and maintained in accordance with nyb's instructions and recommendations and that it was used under normal operating conditions.

This warranty is limited to the replacing and/or repairing by nyb of any part of parts which have been returned to nyb with nyb's written authorization and which in nyb's opinion are defective. Parts not manufactured by nyb but installed by nyb in equipment sold to the buyer shall carry the original manufacturer warranty only. All transportation charges and any and all sales and use taxes, duties, imports or excises for such part or parts shall be paid for by the buyer. nyb shall have the sole right to determine whether defective parts shall be repaired or replaced.

s warranty does not cover any customer labor charges or replacement of parts, adjustments or repairs, or any other work unless such charges shall be assumed or authorized in advance, in writing, by nyb.

This warranty does not cover any product which, in the judgement of nyb, has been subject to misuse or neglect, or which has been repaired or altered outside nyb's plant in any way which may have impaired its safety, operation or efficiency, or any product which has been subject to accident.

This warranty shall be null and void if any part not manufactured or supplied by nyb for use in any of its products shall have been substituted and used in place of a part manufactured or supplied by nyb for such use.

There are no warranties, other than those appearing on the acknowledgement form **INCLUDING NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE**, given in connection with the sale of the goods sold hereunder. The buyer agrees that his sole and exclusive remedy, and the limit of nyb's liability for loss from any cause whatsoever, shall be the purchase price of the goods sold hereunder for which a claim is made.

for rubbing, then complete the installation of the belt guard.

3. Belts tend to stretch somewhat after installation. Recheck tension after several days of operation. Check sheave alignment as well as setscrew and/or bushing bolt tightness.

COUPLING

Coupling alignment should be checked after installation and prior to start up. Alignment is set at the factory, but shipping, handling and installation can cause misalignment. Fans with wheel sizes 40" and larger are normally shipped with the flexible element removed to minimize potential for damage (see section on alignment procedure). Also check for proper coupling lubrication. For details on lubrication and for alignment tolerances on the particular coupling supplied, see the manufacturer's installation and maintenance supplement in the shipping envelope.

Installation

Most nyb fans are shipped with the coupling installed. In cases where the drive is assembled after shipping, install the coupling as follows:

1. Remove all foreign material from fan and motor shafts and coat with machine oil for easy mounting of coupling halves.
2. Mount the coupling halves on each shaft, setting the gap between the faces specified by the manufacturer. Avoid using force. If mounting difficulty is encountered, lightly polish the shaft with crocus cloth until the halves slide on freely.

Alignment

1. Align the coupling to within the manufacturer's limits for parallel and angular misalignment (see Figure 2). A dial indicator can also be used for alignment where greater precision is desired. Adjustments should be made by moving the motor to change shaft angle, and by the use of foot shims to change motor shaft height. Do not move the fan shaft or bearing.
2. When correctly aligned, install the flexible element and tighten all fasteners in the coupling and motor base. Lubricate the coupling if necessary.
3. Recheck alignment and gap after a short period of operation, and recheck the tightness of all fasteners in the coupling assembly.

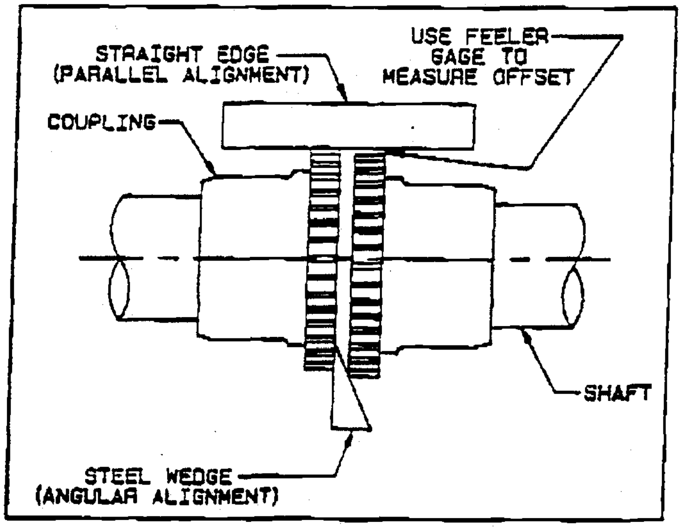


Figure 2

Safe operation and maintenance includes the selection and use of appropriate safety accessories for the specific installation. This is the responsibility of the system designer and requires consideration of equipment location and accessibility as well as adjacent components. All safety accessories must be installed properly prior to start up.

Safe operating speed is a function of system temperature and wheel design. Do not under any circumstances exceed the maximum safe fan speed published in the **nyb** bulletin, which is available from your nyb field sales representative.

Procedure

1. If the drive components are not supplied by **nyb**, verify with the manufacturer that the starting torque is adequate for the speed and inertia of the fan.
2. Inspect the installation prior to starting the fan. Check for any loose items or debris that could be drawn into the fan or dislodged by the fan discharge. Check the interior of the fan as well. Turn the wheel by hand to check for binding.
3. Check drive installation and belt tension.
4. Check the tightness of all setscrews, nuts and bolts. When furnished, tighten hub setscrews with the wheel oriented so that the setscrew is positioned underneath the shaft.
5. Install all remaining safety devices and guards. Verify that the supply voltage is correct and wire the motor. "Bump" the starter to check for proper wheel rotation.
6. Use extreme caution when testing the fan with ducting disconnected. Apply power and check for unusual sounds or excessive vibration. If either exists, see the section on Common Fan Problems. To avoid motor overload, do not run the fan for more than a few seconds if ductwork is not fully installed. Without the ductwork attached, normal operating speed may not be obtained without motor overload. Once ductwork is attached, check for correct fan speed and complete installation. Ductwork and guards must be fully installed for safety.
7. Setscrews should be rechecked after a few minutes, eight hours and two weeks of operation (see Tables 1 & 2 for correct tightening torques).

NOTE: Shut the fan down immediately if there is any sudden increase in fan vibration.

WHEEL SETSCREW TORQUES
TABLE 1

Setscrew Size Diameter (in.)	Carbon Steel Setscrew Torque*	
	lb.-in.	lb.-ft.
1/4"	75	6.2
5/16"	144	12
3/8"	252	21
7/16"	396	33
1/2"	600	50
5/8"	1164	97
3/4"	2016	168
7/8"	3204	267
1"	4800	400

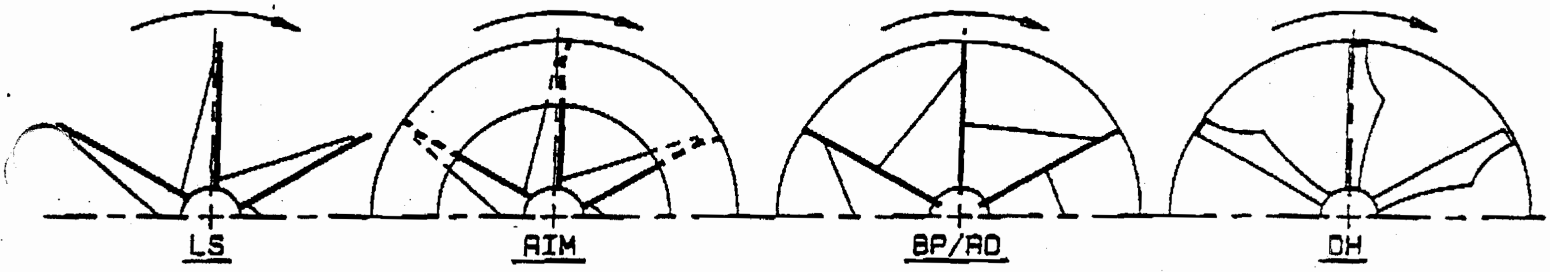
***Stainless Steel setscrews are not hardened and should not be tightened to more than 1/2 the values shown.**

BEARING SETSCREW TORQUE, lb.-in.
TABLE 2

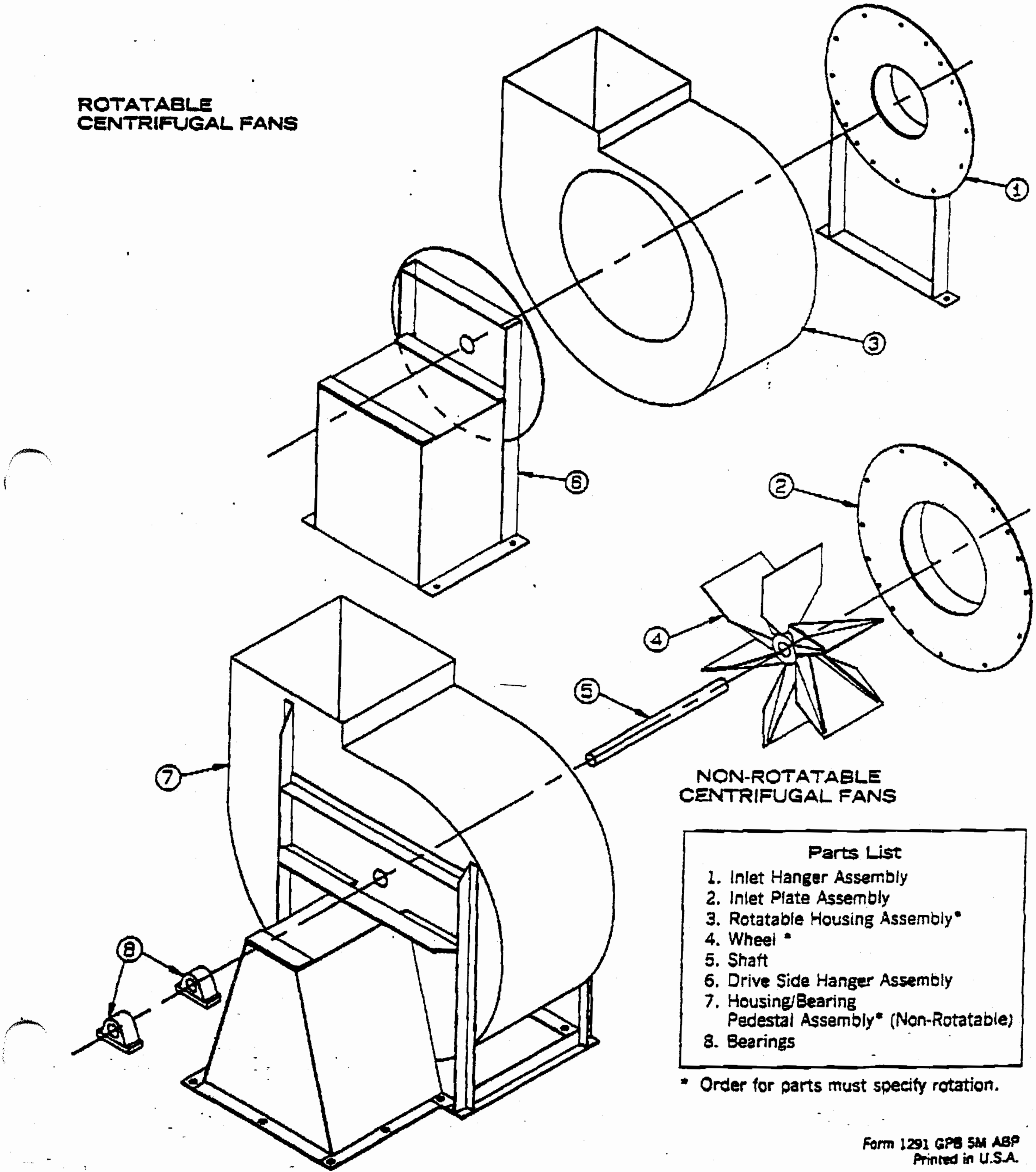
Setscrew Diameter	Manufacturer				
	Link-Belt	Seal-master	SKF	McGill	Dodge
#10	40	—	35	35	—
1/4"	90	65	50	85	—
5/16"	185	125	165	165	160
3/8"	325	230	290	290	275
7/16"	460	350	350	—	—
1/2"	680	500	620	—	600
5/8"	1350	1100	1325	—	1200
3/4"	2350	—	—	—	2000

Note: Split pillow block bearings are fixed to the shaft with tapered sleeves and generally do not have setscrews.

SPECIFY ROTATION AS VIEWED FROM DRIVE SIDE



ARROW INDICATES CLOCKWISE ROTATION



Parts List

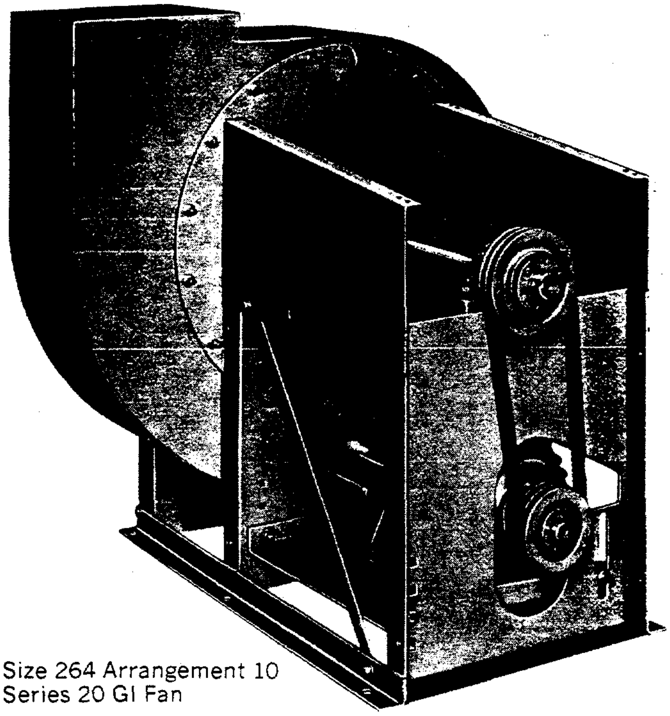
1. Inlet Hanger Assembly
2. Inlet Plate Assembly
3. Rotatable Housing Assembly*
4. Wheel *
5. Shaft
6. Drive Side Hanger Assembly
7. Housing/Bearing
   Pedestal Assembly* (Non-Rotatable)
8. Bearings

* Order for parts must specify rotation.

Factory assembly of fans, motors, and drives minimizes costly field labor and allows factory test-running of the complete fan-motor-drive package.

Packaged

ARRANGEMENT 10



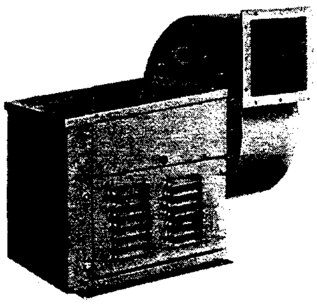
Size 264 Arrangement 10
Series 20 GI Fan

Arrangement 10 provides a compact package with good access to the motor, drive, and bearings for easy installation and maintenance.

Sizes 144 and 174 are available only with LS wheels. Sizes 194 through 364 are available with LS or DH wheels.

Maximum temperatures—standard fan: 200°F., heat fan: 600°F. Refer to page 11 for heat fan construction details.

ACCESSORIES



WEATHER COVER/ BELT GUARD

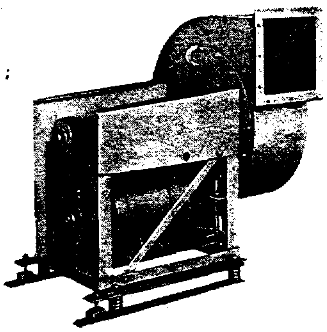
The four-piece steel assembly provides complete protection, and can be easily removed for inspection and maintenance. Louvered side panels provide ample motor ventilation.

POSITIVE SCREW ADJUSTMENT

Motor platform has threaded rods for ease in adjusting motor and setting proper belt tension.

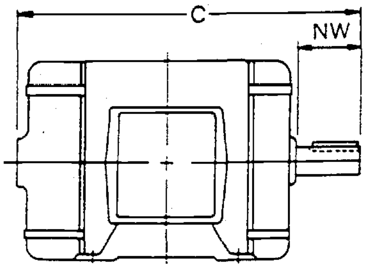
VIBRATION ISOLATION

Rubber-in-shear or spring-type isolation rails.



MAXIMUM MOTOR SIZE LIMITS

Motor frame sizes vary in length with different motor manufacturers. To determine whether a specific motor will fit, the frame size should be equal to or smaller than the maximum shown and the case length [NEMA C minus NEMA NW] must be equal to or less than the maximum allowable dimension shown.



DIMENSIONS [Inches]

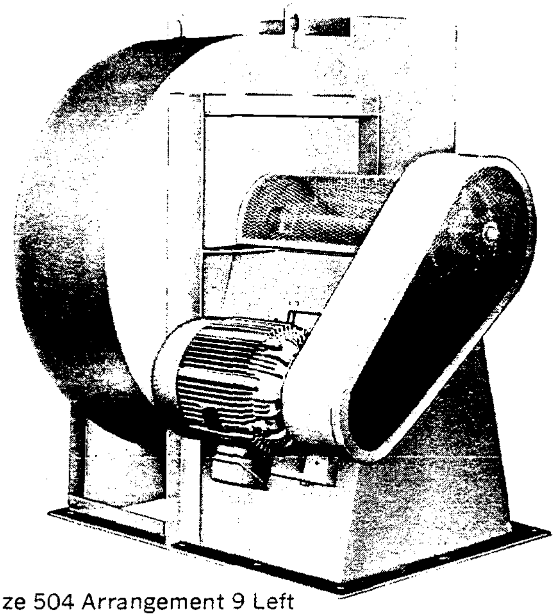
Size	Maximum motor frame		Maximum motor case length [C-NW]
	Open	TE	
144	184T	184T	14½
174	215T	215T	16⅝
194	215T	215T	16⅝
224	256T	254T	18⅝
264	256T	254T	18⅝
294	284T	254T	19½
334	324T	286T	22½
364	324T	286T	22½

D ods

BELT DRIVE

The use of standard V-belt drives provides flexibility in fan performance by changing sheaves and belts.

In the lower horsepower ranges, V-belt drive selection is relatively simple, but as horsepower requirements increase, V-belt drive selection becomes more complicated and requires more consideration of the drive's effect on fan and motor bearings.



Size 504 Arrangement 9 Left
Series 20 GI Fan

Although there are exceptions to every rule, there are a few general recommendations to remember:

1. 3600 RPM motors are not generally recommended for belt drive above 20 HP.
2. 1800 RPM motors are not generally recommended for belt drive above 300 HP.
3. All motors 125 HP and larger that are to be used with belt driven fans require that the motor manufacturer:
   a. Recommend the minimum diameter motor sheave that may be used.
   b. Recommend the maximum motor sheave width that may be used.

   With the above information from the motor manufacturer, the drive may be selected. All customer-supplied drives over 300 HP require approval by **nyb.**

When small motors are used with relatively large fans, they may not have sufficient torque to overcome the wheel's inertia. Chart I provides WR² values for wheels which, when corrected by the drive ratio, can be used in determining adequate motor size.

CHART I
WR² VALUES
OF GI WHEELS
[lb.-ft.²]

Size	LS	DH
144	1.5	–
174	2.8	–
194	5	11
224	13	21
264	30	36
294	42	69
334	63	119
364	86	178
404	114	327
454	294	515
504	423	805
574	630	1623
644	1290	2738
714	1744	4116
784	2970	5970
854	3800	7810

DIRECT DRIVE—ARRANGEMENT 8

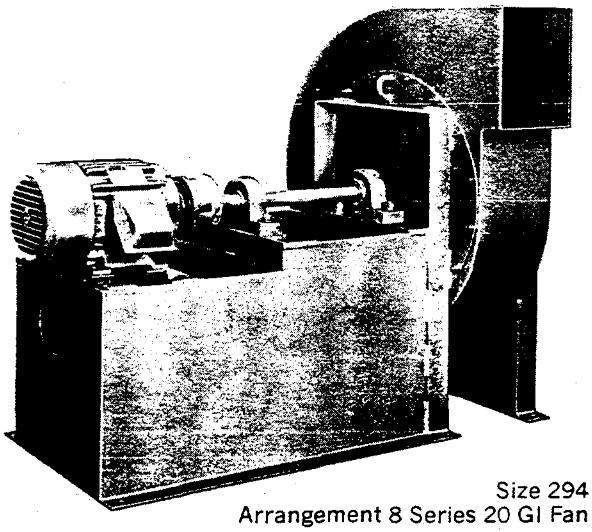
Series 20 GI Fans are available in Arrangement 8 with wheel and housing modifications to accommodate required performance and direct drive motor or turbine speed. Refer to separate **nyb** Engineering Supplement for details on how to select special width and special diameter direct drive fans.

Arrangement 8 construction includes driver sub-base integrated with fan bearing pedestal providing a unitary package in which driver is direct-coupled to the fan shaft with a flexible coupling.

Arrangement 1 construction can also be used for direct drive by mounting on field-erected concrete pad designed to accept the fan and motor.

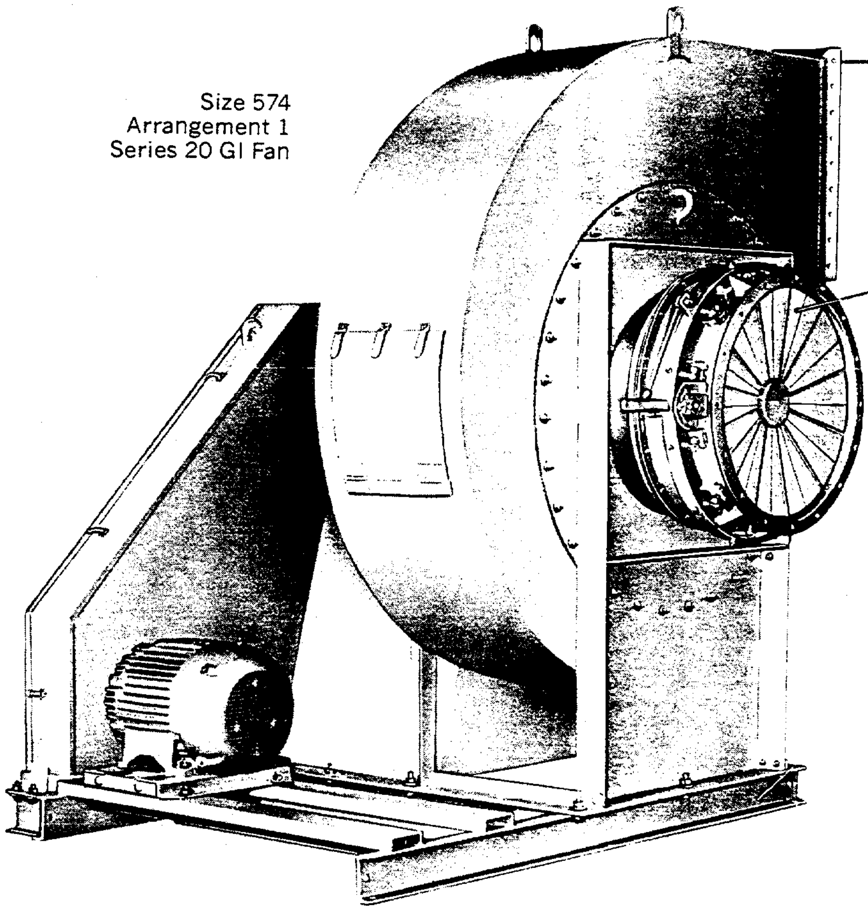
Maximum temperatures—standard fan: 300°F., heat fan: 800°F.

For applications requiring temperatures from 801°F.-1000°F., stainless steel wheel construction is required. Refer to page 11 for details.



Size 294
Arrangement 8 Series 20 GI Fan

Accessories



Size 574
Arrangement 1
Series 20 GI Fan

FLANGES

Outlet flange angles welded flush with fan outlet and provided with holes...inlet flange bar welded to inlet collar and provided with holes...companion flanges with matching hole patterns also available.

INLET DAMPER

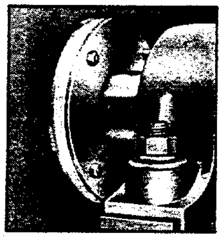
External vane construction for flange mounting to fan inlet...available for Sizes 294 and larger. The vanes spin the air in direction of rotation, providing power savings superior to that of outlet dampers. Recommended for use with DH wheel with relatively clean airstreams. Maximum temperature: 800°F. See **nyb** Engineering Letter for selection information.

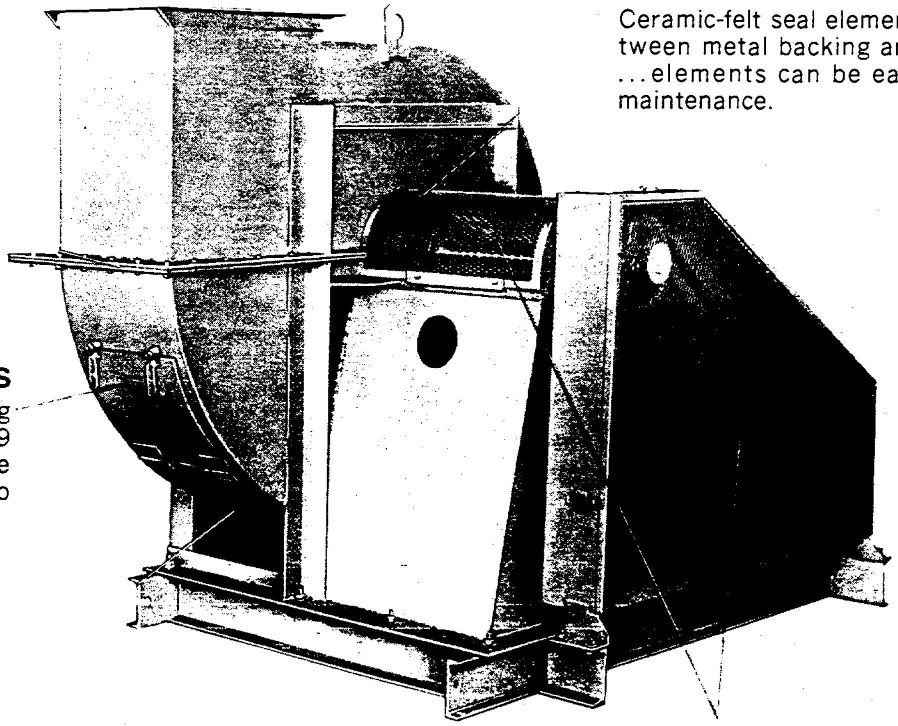
UNITARY BASE

Structural steel base provides common support for fan, motor, and drive components [see page 6]...also available with spring-type or rubber-in-shear isolators...flexible duct connections are necessary with isolation bases.

SHAFT SEAL

Ceramic-felt seal elements compressed between metal backing and retaining plates ...elements can be easily split for field maintenance.





Size 404
Arrangement 1
Series 20 GI Fan

SPLIT-HOUSING CONSTRUCTION

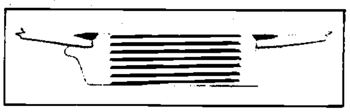
See page 10 for details.

CLEANOUT DOORS

Bolted and quick-opening types available [see page 9 for details]...shown here at 8 o'clock position due to split housing.

DRAIN

Threaded tank flange located at lowest point of scroll. 1-inch, Sizes 144 and 174. 1½-inch. Sizes 194 and larger.



SAFETY EQUIPMENT

Shaft and bearing guard and belt guard shown—see separate **nyb** Safety Equipment bulletin for details...also see page 10.

Heat fan construction

Successful operation of fans at elevated temperatures requires consideration of two main factors.

1. Effect of temperature on wheel maximum safe speeds [see page 12].
2. Effect of air density on aerodynamic performance [see page 12].

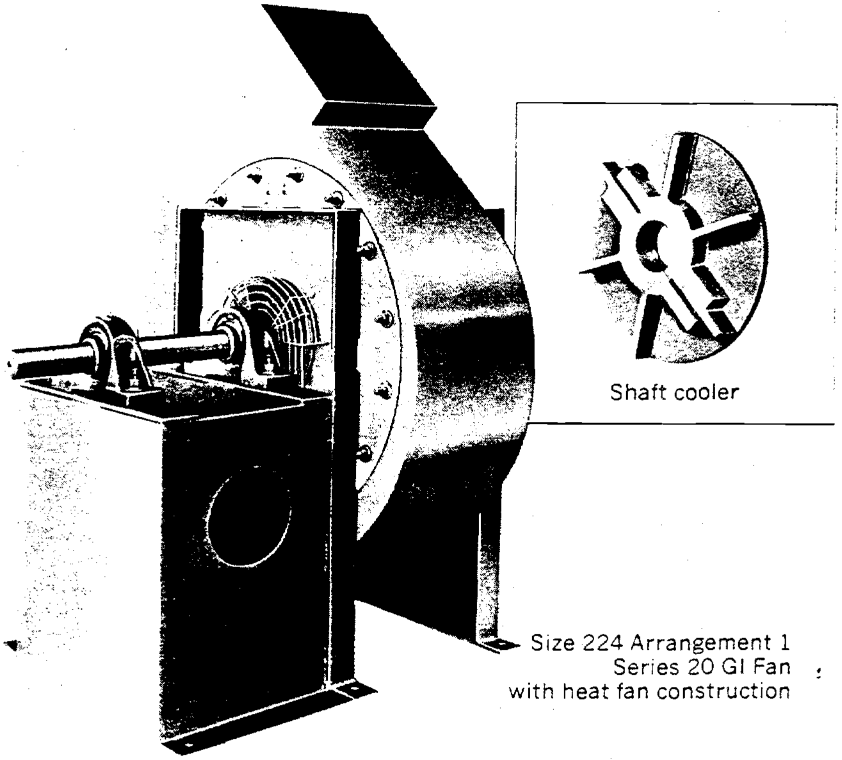
Heat fan modifications include shaft coolers and shaft-cooler guards on all arrangements and motor heat shields for Arrangements 9, 9F, and 10.

Aluminum shaft coolers are designed to move ambient air over the inboard bearing and dissipate heat transferred through the shaft.

Arrangements 1 and 8 Series 20 GI Fans can be modified for 801°F.-1000°F. operation. In this temperature range, stainless steel wheel and alloy shafting are required.

950X/960X alloy wheels are also available to maintain standard safe speed limits at 500°F.-800°F. temperatures when required.

NOTE: When temperature exceeds 500°F., high-temperature paint is furnished.



Shaft cooler

Size 224 Arrangement 1
Series 20 GI Fan
with heat fan construction

Selection of Series 20 GI Fans

The selection of a General Industrial Fan involves consideration of a number of factors. Initially, the type of wheel must be selected. For airstreams with moderate dust loads, the DH wheel is often chosen because of its higher operating efficiency. The LS wheel is more suited for airstreams containing material and particulate, but it is not as efficient as the DH wheel.

Note: For comparison convenience, LS performance tables in this bulletin face comparable size DH performance tables on pages 14 through 23.

Once a wheel type has been determined, a fan size must be selected. For any given performance requirement [CFM and static pressure], two, three, or more fan sizes may be chosen. As with the choice of wheel types, several factors can influence what fan size is chosen. In a material-handling application, a minimum conveying velocity may be required and the fan size should be selected to give the required velocity. For more details on material handling, refer to **nyb** Engineering Letter on pneumatic conveying. There may be size constraints and the smallest fan may be selected. Consider an application requiring 6300 CFM at 16"SP at 70°F. at sea level. The following fans could be chosen:

264 DH—2231 RPM, 25.0 BHP, 5080 OV
264 LS —2190 RPM, 27.9 BHP, 5080 OV

294 DH—1870 RPM, 23.4 BHP, 3960 OV
294 LS —1848 RPM, 26.2 BHP, 3960 OV

334 DH—1642 RPM, 23.9 BHP, 3200 OV
334 LS —1654 RPM, 26.8 BHP, 3200 OV

The energy savings provided by the DH design are readily apparent. For this example, assume that the DH wheel is suitable. Select a fan size. If the criteria is to choose the most efficient fan, the Size 294 DH is chosen. If space is limited, the Size 264 DH might be chosen. The requirements and limitations of the specific installation will determine the best choice.

If sound is a factor, generally the most efficient fan will be the quietest selection. Full sound power ratings are available on all GI Fans in a separate **nyb** Engineering Supplement.

MAXIMUM SAFE SPEED INFORMATION

Chart III details maximum safe speed of mild steel wheels at 70°F. When alloy construction is specified or when temperatures are involved, multiply the appropriate safe operating speed shown in Chart III by the factor shown in Chart IV.

CHART III

MAXIMUM SAFE SPEEDS FOR LS AND DH WHEELS AT 70°F.

ARRANGEMENT 10

Size	Speed
144	4605
174	3745
194	3114
224	2635
264	2280
294	1995
334	1790
364	1620

ARRANGEMENTS 1, 9, 9F

Size	Speed
144	4605
174	3930
194	3425
224	2898
264	2508
294	2194
334	2035
364	1837
404	1639
454	1457
504	1303
574	1144
644	1023
714	924
784	841
854	770

CHART IV
TEMPERATURE CORRECTION FACTORS FOR MAXIMUM SAFE SPEEDS

Temp. °F.	Materials of construction					
	Mild steel	950X/ 960X*	Aluminum	304 SST	316 SST	347 SST
70	1.0	1.0	1.0	1.0	.95	1.0
200	1.0	1.0	.97	.89	.92	1.0
300	1.0	1.0	—	.82	.88	.99
400	1.0	1.0	—	.78	.86	.97
500	.97	1.0	—	.75	.83	.97
600	.94	1.0	—	.73	.80	.97
700	.91	1.0	—	.71	.78	.96
800	.82	1.0	—	.70	.77	.96
900	—	—	—	.68	.76	.95
1000	—	—	—	—	.75	.94

*Material type at **nyb** option. Not available for Sizes 144 through 294 LS wheels. DH wheels are constructed of a combination of mild steel and alloy components.

The performance tables on the following pages are based on an airstream at 70°F. at sea level at a density of .075 lbs./cu. ft. When a fan handles other than air at a density of .075 lbs./cu. ft., a correction factor must be considered.

CALCULATING FANS AT TEMPERATURES OTHER THAN 70°F.

Chart V gives factors for correcting pressure and brake horsepower for temperatures other than 70°F.

EXAMPLE

1. Require 15,000 CFM at 10"SP at 300°F. at sea level.
2. Chart V indicates 1.43 factor for 300°F.
3. Select the fan for 14.3"SP [10" x 1.43] at 70°F.
4. Divide 70°F. brake horsepower by 1.43 to determine BHP at conditions.

CALCULATING FANS AT ALTITUDES OTHER THAN SEA LEVEL [29.92 in. Hg]

The method for correcting for altitude is the same as for temperature except using the factors in Chart VI.

NOTE: In addition to temperature and altitude, there are other factors that affect density. Moisture content, material in the airstream, gas composites, etc., need to be considered when selecting a fan. For a more detailed explanation of density effect on fan selection, see separate **nyb** Engineering Letter or consult your **nyb** representative.

CHART V
SP AND BHP CORRECTION FACTORS FOR TEMPERATURE [°F.]

Temp.	Factor
−50°	.77
−25°	.82
0°	.87
20°	.91
40°	.94
60°	.98
70°	1.00
80°	1.02
100°	1.06
120°	1.09
140°	1.13
160°	1.17
180°	1.21
200°	1.25
250°	1.34
300°	1.43
350°	1.53
400°	1.62
450°	1.72
500°	1.81
550°	1.91
600°	2.00
700°	2.19
800°	2.38
900°	2.56
1000°	2.76

CHART VI
SP AND BHP CORRECTION FACTORS FOR ALTITUDE [ft. above sea level]

Alt.	Factor
0	1.00
500	1.02
1000	1.04
1500	1.06
2000	1.08
2500	1.10
3000	1.12
3500	1.14
4000	1.16
4500	1.18
5000	1.20
5500	1.22
6000	1.25
6500	1.27
7000	1.30
7500	1.32
8000	1.35
9000	1.40
10000	1.45

NOTE: If correction factor for both temperature and altitude is required, multiply factors from Charts V and VI together:
600°F. and 3000'
2.00 x 1.12=2.24
[combined factor]

SIEMENS

SECTION 5
PART 2A
PAGE 2
DATE 6/86

INDUSTRIAL MOTOR DIVISION

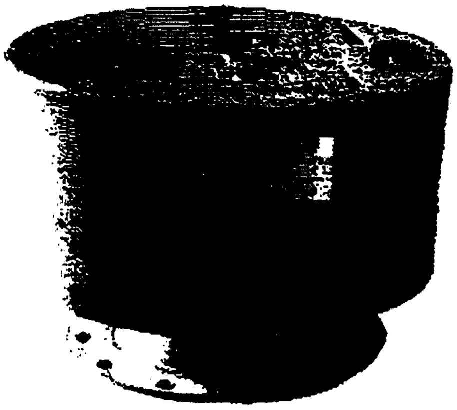
NEMA FRAMES APPLICATION MANUAL

STANDARD EFFICIENCY (CAST IRON CONSTRUCTION)

....MANCE DATA RGZ RGZZ TEFC & EXPLOSION-PROOF 460V 60 HZ

HP	FL RPM	FRAME	AMPS FL	AMPS LR	AMPS %LR	KVA CODE	EFFICIENCY GUAR	EFFICIENCY NOM	EFFICIENCY 3/4	EFFICIENCY 1/2	POWER FACTOR NOM	POWER FACTOR 3/4	POWER FACTOR 1/2	TORQUE FL	TORQUE LR	TORQUE PO	LR TIME HOT	LR TIME COLD
7.5	3490	213T	9.96	63.5	638	H	78.5	81.5	80.5	76.5	86.5	82.0	74.0	11.3	15.9	22.6	8	18
	1750	213T	9.96	63.5	638	H	82.5	85.5	84.5	81.5	82.5	77.5	66.0	22.5	39.4	48.4	11	23
	1165	254T	9.80	63.5	648	H	86.5	88.5	88.5	87.0	81.0	76.5	68.0	33.8	50.7	69.3	19	40
	870	256T	13.10	63.5	485	H	82.5	85.5	85.0	82.5	62.5	55.5	44.0	45.3	56.6	90.5	25	53
10	3500	215T	12.20	81.0	664	H	84.0	86.5	86.0	85.5	88.5	84.0	78.0	15.0	20.3	30.0	10	21
	1750	215T	12.70	81.0	638	H	84.0	86.5	86.5	84.5	85.0	81.5	72.5	30.0	49.5	60.0	10	19
	1155	256T	13.40	81.0	604	H	85.5	87.5	88.5	87.5	80.0	76.0	67.0	45.5	68.3	91.0	18	36
	875	284T	14.50	81.0	559	H	86.5	88.5	87.5	85.0	78.0	71.5	59.5	60.0	75.0	120.0	30	64
15	3515	254T	17.90	116.0	648	G	85.5	87.5	87.0	85.0	89.5	89.0	83.0	22.4	29.2	44.8	15	27
	1745	254T	19.80	116.0	586	G	82.5	85.5	85.0	82.5	83.0	80.0	73.0	45.1	72.7	90.2	20	42
	1170	284T	18.70	116.0	620	G	87.5	89.5	89.5	88.5	84.0	81.0	71.0	67.3	94.3	135.0	30	46
	870	286T	22.20	116.0	523	G	86.5	88.5	89.5	88.5	71.5	67.0	58.0	90.5	114.0	181.0	30	64
20	3510	256T	23.10	145.0	628	G	86.5	88.5	89.0	88.0	91.5	90.5	86.5	29.9	38.9	59.8	16	23
	1750	256T	25.00	145.0	580	G	85.5	87.5	87.5	85.5	85.5	83.0	77.0	60.0	90.0	120.0	19	40
	1150	286T	26.30	145.0	551	G	86.5	88.5	89.5	88.5	80.5	79.0	74.0	91.3	124.0	183.0	30	46
	865	324T	27.80	145.0	522	G	86.5	88.5	89.0	87.5	76.0	72.0	62.0	122.0	153.0	244.0	34	72
25	3525	284TS	29.10	182.5	627	G	85.5	87.5	89.0	87.0	92.0	91.5	89.0	37.2	48.4	74.4	15	27
	1740	284T	30.40	182.5	600	G	84.0	86.5	87.0	86.5	89.0	88.5	85.0	75.4	114.0	151.0	21	38
	1165	324T	32.40	182.5	563	G	88.5	90.2	90.0	89.0	80.0	77.0	69.0	113.0	153.0	226.0	30	52
	870	326T	33.70	182.5	542	G	88.5	90.2	90.5	90.0	77.0	73.5	65.5	151.0	189.0	302.0	34	72
30	3530	286TS	34.00	217.5	640	G	85.5	87.5	88.0	87.5	94.5	94.0	91.5	44.6	58.0	89.2	12	22
	1750	286T	35.50	217.5	613	G	86.5	88.5	88.5	86.5	89.5	88.0	84.5	90.0	135.0	180.0	16	31
	1165	326T	37.10	217.5	586	G	88.5	90.2	91.0	90.0	84.0	82.5	76.5	136.0	184.0	272.0	29	46
	880	364T	38.70	217.5	562	G	88.5	90.2	90.5	90.0	80.5	77.0	68.5	179.0	224.0	358.0	23	41

GMD



Features

- Low pressure drop
- Large dirt holding capacity
- All weather construction
- Direct or remote mounting
- Design flexibility

Options

- Silencer chamber
- Stainless steel construction
- Aluminum construction
- Horizontal installation
- Delta P taps
- Epoxy coating

Hat/Lid Type

GMD hat/lid air intake filters are designed to mount directly on a compressor, blower, or engine inlet. The air intake series efficiently removes dust, dirt and other contaminants from inlet air streams.

ALL WEATHER HOUSING: Constructed of heavy gauge carbon steel **phosphate coated** and treated with a rust preventative all-weather acrylic enamel finish. A weather hood shields against rain or snow in outdoor use. **Epoxy** coating is available as is **stainless** steel and **aluminum** construction. Horizontal installation can also be requested. See price sheet for additional costs.

MANOMETER TAPS: Delta P taps can be furnished to monitor air pressure differential across the element. There is no charge for this if requested at time of order. High quality Dwyer manometers are optional and available through your representative.

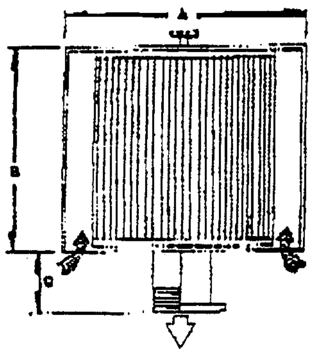
SILENCER CHAMBER: Can be added to all models at an additional cost, see price sheet. For available styles and ordering instructions, refer to "AIR INTAKE FILTER/ SILENCERS" flyer.

ELEMENT: Housing is supplied with a 10 micron element unless otherwise stated. Alternate media can be supplied from 3 to 100 micron nominal retention.

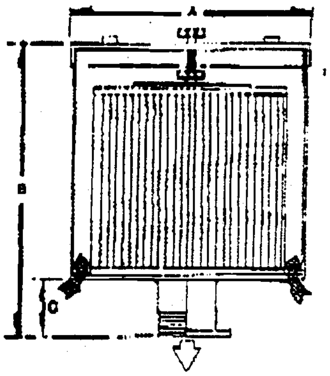
CONNECTION SIZES: 1/2" to 16". Consult factory for larger sizes.

Custom designs and material construction are welcome.

STYLE HT
The lid acts
as seal plate



STYLE LD
These units
have separate
seal plates



Building Part No. Options are designated with ( ).

MODEL NO.

HT - 10 - 4 - .50 - MPT - (TAP 1/4)

Housing Style — HT
CFM — 10
Lid Diameter "A" — 4
Connection Size — .50
Connection Type — MPT
Delta P Tap & Size — (TAP 1/4)

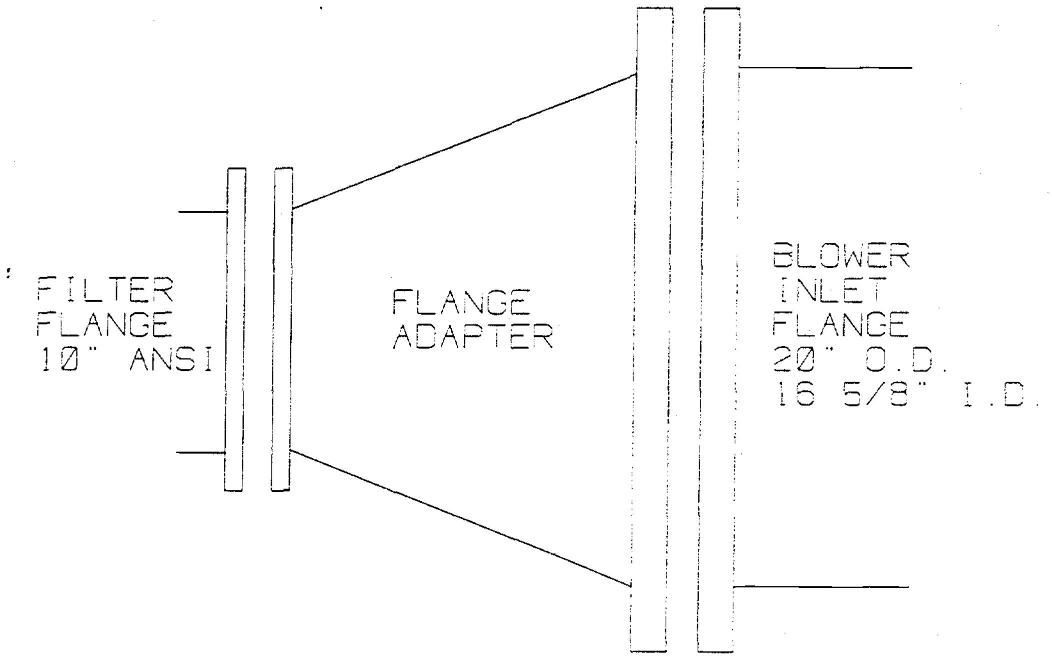
MODEL NO.	RATED CFM	INLET & OUTLET SIZE (in.)	INLET & OUTLET TYPE	ELEMENT PART NO	ELEMENT NO. REQ'D.	DIMENSIONS (Inches) A	DIMENSIONS (Inches) B	DIMENSIONS (Inches) C
HT-10-4	10	.50	MPT	M0356K5	1	4	2.5	2
T-20-4	20	.75	MPT	M0356K5	1	4	2.5	2
HT-35-4	35	1	MPT	M0358K5	1	4	4.5	2
HT-65-6	65	1.25	MPT	M0359K5	1	6	4.5	2
HT-100-6	100	1.50	MPT	M0360K5	1	6	6.0	2
HT-200-8.5	200	2	MPT	M0361K5	1	8.5	6.5	2
HT-300-8.5	300	2.50	MPT	M0362K5	1	8.5	8.5	2
HT-570-8.5	570	3	MPT	M0363K5	1	8.5	14.5	2
HT-1000-15	1000	4	MPT/FLG	M0367K5	1	15.0	9.0	4/6
HT-1500-15	1500	5	MPT/FLG	M0371K5	1	15.0	13.0	4/6
HT-2500-15	2500	6	MPT/FLG	M0373K5	1	15.0	19.0	4/6
HT-4000-24	4000	8	FLG	M0376K5	1	24.0	20.0	6
HT-6000-24	6000	10	FLG	M0377K5	1	24.0	26.0	6
HT-8000-24	8000	12	FLG	M0376K5	2	24.0	36.0	6
HT-10000-24	10000	14	FLG	M0378K5	2	24.0	44.0	6
LD-1000-15	1000	4	MPT/FLG	M0367K5	1	15.0	12.0	4/6
LD-1500-15	1500	5	MPT/FLG	M0371K5	1	15.0	16.0	4/6
LD-2500-15	2500	6	MPT/FLG	M0373K5	1	15.0	22.0	4/6
LD-4000-24	4000	8	FLG	M0376K5	1	24.0	20.0	6
LD-6000-24	6000	10	FLG	M0377K5	1	24.0	28.0	6
LD-8000-24	8000	12	FLG	M0376K5	2	24.0	36.0	6
LD-10000-24	10000	14	FLG	M0378K5	2	24.0	44.0	6
LD-12000-30	12000	16	FLG	S0064K5	2	30.0	44.5	6

Handles are standard on housings with 4" inlet and larger.
Higher CFM available. Consult factory.
ges match diameter and drilling for 150# ANSI.

FOR DELTA P TAPS: Add "TAP" after part number and specify size, i.e. 1/8", 1/4" or 1/2".

NOTE: To convert to metric dimensions (inches to centimeters) use a multiplier of 2.54.

FILTER TO BLOWER CONNECTION



NATIONAL ENVIRONMENTAL SYSTEMS
508-761-6611
36 MAPLE AVENUE, SEEKONK, MA 02771

FILTER TO BLOWER CONNECTION

JOB NAME : OHM - CAMP LEJEUNE

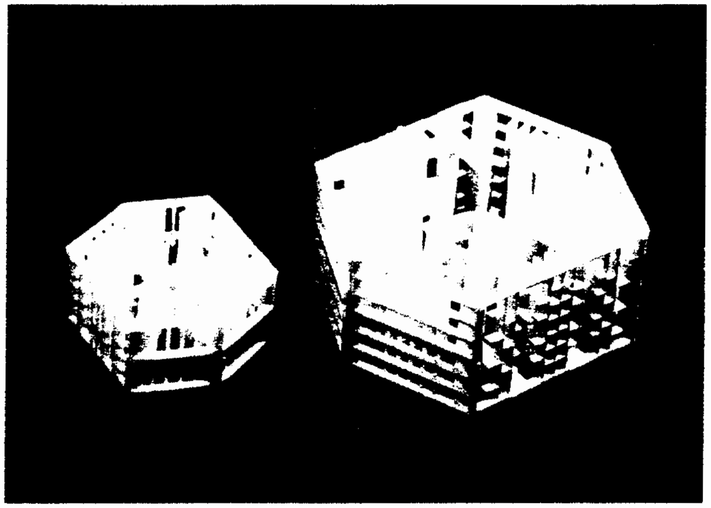
NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 03-20-95	DRAWN: MTS	FILE NAME:	REV:
SCALE: N. T S.	DESIGN: MAX	UU-FLANG	—

Tower Packing
Technology
Breakthrough
From LANTEC!

Delivering Tomorrow's Packing Technology Today!

LANPAC®

Proven LANPAC — Ideal for Scrubbing, Absorption, Air Stripping, Etc. — Reduces Costs Up to 60

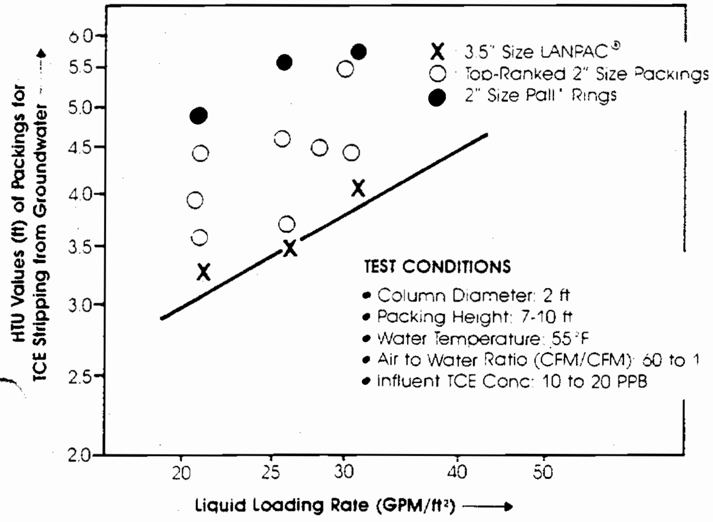


LANPAC is available in two sizes (2.3" and 3.5"). Test data demonstrate that this proven product is from 10% to 50% more efficient than competitive 2" packings, and reduces packing costs up to 60%.

SOME FIELD PERFORMANCE DATA OF 3.5" LANPAC FOR ABSORPTION SYSTEMS

Absorption System	Gas Loading Rate (lbs/hr/ft²)	Liquid Loading Rate (lbs/hr/ft²)	Temp. °F	Height of Transfer Unit (ft)
$H_2S/NaOH$	2,200	5,000	72	1.47
NH_3/H_2O	2,057	4,285	60	1.28
NH_3/H_2O	965	7,145	60	0.78
NH_3/H_2SO_4	2,200	1,090	68	1.02
NH_3/H_2SO_4	1,800	4,360	68	0.6
$HF/NaOH$	2,250	2,500	78	0.58
$Cl_2/NaOH$	1,350	5,000	68	1.42

3.5" LANPAC VS. TOP-RANKED 2" PACKINGS IN MASS TRANSFER



TEST CONDITIONS

- Column Diameter: 2 ft
- Packing Height: 7-10 ft
- Water Temperature: 55°F
- Air to Water Ratio (CFM/CFM): 60 to 1
- Influent TCE Conc: 10 to 20 PPB

LANPAC* packing is similar to IMPAC in the broad sense that it achieves significantly lower pressure drops and higher mass transfer efficiencies than other packings smaller in size. While LANPAC has a proven record of superior performance in packed towers of all sizes, IMPAC is considerably more efficient in towers of four feet or more in diameter.

Available in two sizes (2.3" and 3.5"), LANPAC is widely recognized throughout the United States as "the ultimate tower packing" by engineers in the air pollution, drinking water treatment, and chemical processing industries.

LANPAC's unique, patented geometry makes it measurably more efficient in both mass transfer capabilities and energy consumption rates. As a result, use of LANPAC reduces both the capital and operating costs for a packed column by as much as 60%!

Compared to other tower packings, LANPAC offers many unique features and benefits, including:

- Extremely large and effective surface area (45 sq. ft./cu. ft. for the 3.5" LANPAC, and 68 sq. ft./cu. ft. for the 2.3" unit).
- Near perfect geometric symmetry.
- Up to 50,000 liquid dripping points per cu. ft.
- Non-nesting, non-interlocking.
- Full field proven non-plugging capability.
- High surface accessibility.
- Enhanced surface wetability.

LANPAC's open and non-obstructive structure gives it the ability to disperse and distribute fluid flows evenly in both longitudinal and lateral directions. Consequently, LANPAC outperforms other tower packings smaller in size. For example, the 3.5" LANPAC is from 10% to 50% more efficient than competitive 2" packings (see chart with comparative test data at left).

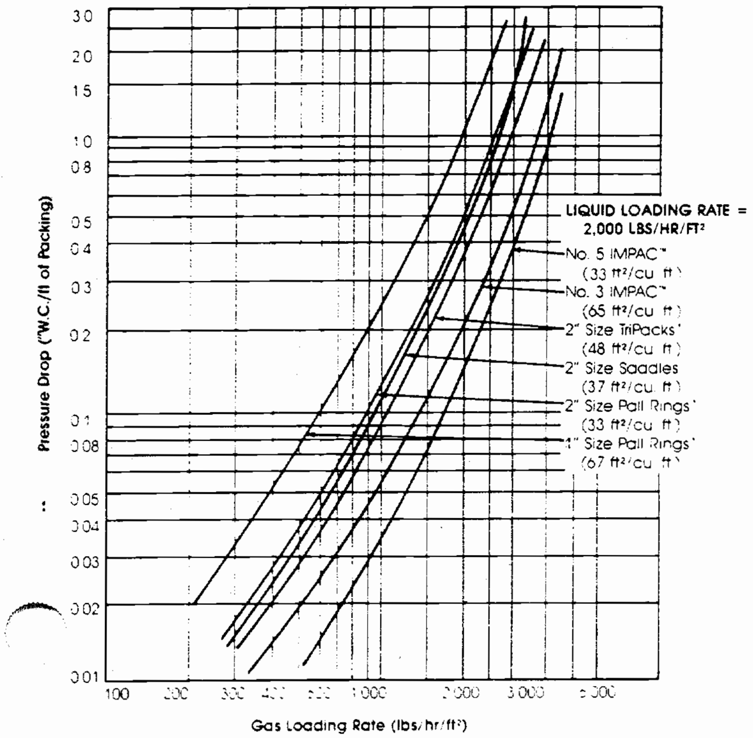
LANPAC is available in a variety of plastic materials including polypropylene, polyethylene, PVDF, Halar, Tefzel, PVC, CPVC, Teflon, etc.

CONTACT LANTEC FOR TEST DATA AND DETAILED SPECIFICATIONS.

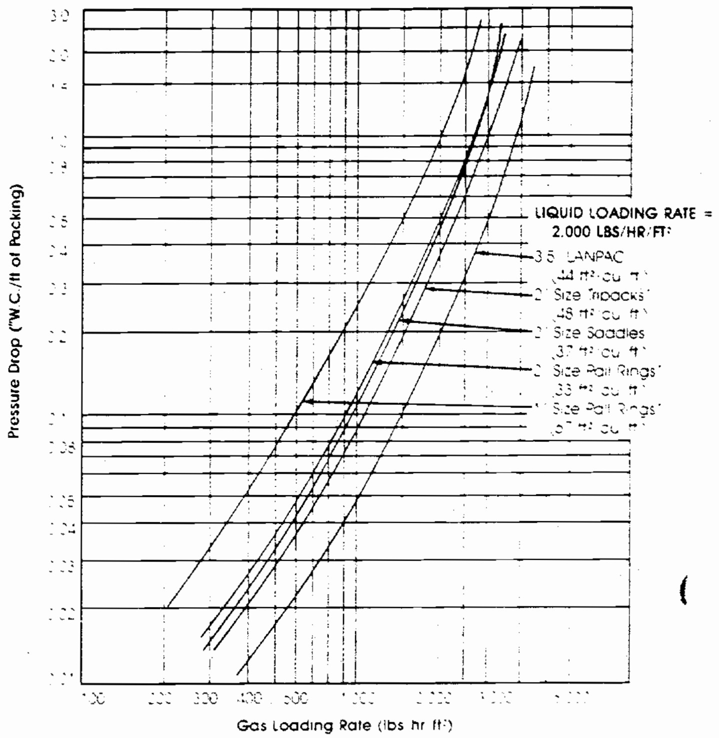
** U.S. Patent #4,668,442; Canada #1,245,975; worldwide patents pending*

IMPAC™ LANPAC®

PRESSURE DROP COMPARISON BETWEEN IMPAC AND OTHER PLASTIC PACKINGS (AIR/WATER SYSTEM)



PRESSURE DROP COMPARISON BETWEEN 3.5" LANPAC AND OTHER PLASTIC PACKINGS (AIR/WATER SYSTEM)



PHYSICAL CHARACTERISTICS

	No. 3 IMPAC™	No. 5 IMPAC™
Nominal Size	3.3"	5.5"
Void Fraction	91.4%	95%
Weight (lbs/cu. ft.) (Polypropylene)	5.2	3.0
Geometric Surface Area (ft²/cu. ft.)	65	33
No. of Pieces/cu. ft.	58	7.2
Packing Factor (1/ft.)	15	6

PHYSICAL CHARACTERISTICS

	3.5" LANPAC®	2.3" LANPAC®
Nominal Size	3.5"	2.3"
Void Fraction	92.5%	89%
Weight (lbs/cu. ft.) (Polypropylene)	4.2	6.2
Geometric Surface Area (ft²/cu. ft.)	45	68
No. of Pieces/cu. ft.	50	200
Packing Factor (1/ft.)	14	21

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LANPAC™ TOWER PACKING
A REVOLUTION

Technical Bulletin No. TL-90

CORRELATION EQUATIONS FOR PREDICTING THE PRESSURE DROP AND HTU VALUES OF 3.5" LANPAC™ IN VOC/AIR STRIPPING APPLICATIONS

$$HTU = A \times \left(\frac{L}{M_L}\right)^{0.33} \times \left(\frac{M_L}{\rho_L D_L}\right)^{0.5} \times \left(\frac{T}{286}\right)^{-4.255}$$

Where: A = 0.006 for Halogenated Hydrocarbons (TCE, PCE, 1, 1, 1-TCA, 1.1-DCE, etc.)

A = 0.0042 for Aromatics (BTX's, etc.)

HTU = Height of Transfer Unit in ft.

L = Liquid Loading Rate in $lbs/hr/ft^2$

M_L = Viscosity of Water in lbs/hr. ft.

(M_L = $4.3231 \times \left(\frac{T}{273}\right)^{-7}$ lbs/hr. ft.)

ρL : Density of Water in lbs/cu. ft.

T : Water Temperature in °K

D_L : Diffusivity of VOC Species in Water in ft^2/hr.

(D_L = $6.3635 \times 10^{-4} \times \left(\frac{T}{273}\right)^{8} \times \frac{1}{V_c^{\,0.6288}}$ ft^2/hr.)

V_c : Critical Molar Volume of VOC Species in Cm^3/g-mole

$$\text{Log}_{10} \left(\frac{\Delta P}{\rho_g U_G^2}\right) = -1.25 + 2.14 \times 10^{-5} \times L$$

Where: ΔP = Pressure Drop in "W.C./ft of Packing

L = Liquid Loading Rate in $lbs/hr/ft^2$

ρG = Gas Density in lbs/cu. ft

U_G = Superficial Gas Velocity in ft/sec

V_c VALUES FOR SOME VOLATILE ORGANIC COMPOUNDS*

Compound	V_c
Trifluorobromomethane	200
Chlorotrifluoromethane	180
Dichlorodifluoromethane	217
Trichlorofluoromethane	243
Carbon Tetrachloride	276
Carbon Tetrafluoride	140
Chlorodifluoromane	165
Dichloromonofluoromethane	197
Chloroform	239
Dibromomethane	-
Dichloromethane	193
Tetrachloroethylene	290
TCE	256
Vinyl Chloride	169
1-Chloro,1-Difluoroethylene	231
1,1,2-Trichloroethane	294
Ethylene	129
1,1-Dichloroethane	240
1,2-Dichloroethane	220
1,1-Difluoroethane	181
MEK	267
Bromobenzene	324
Chlorobenzene	308
Fluorobenzene	271
Benzene	259
Toluene	316
Xylene	375
Ethylbenzene	374

*Available in Appendix A, "The Properties of Gases and Liquids", 3rd Edition, By Reid, Prausnitz and Sherwood.

Lantec Products, Inc.
Technical
Bulletin No. TL-921

SOME FIELD PERFORMANCE DATA OF 3.5" LANPAC^{TM}

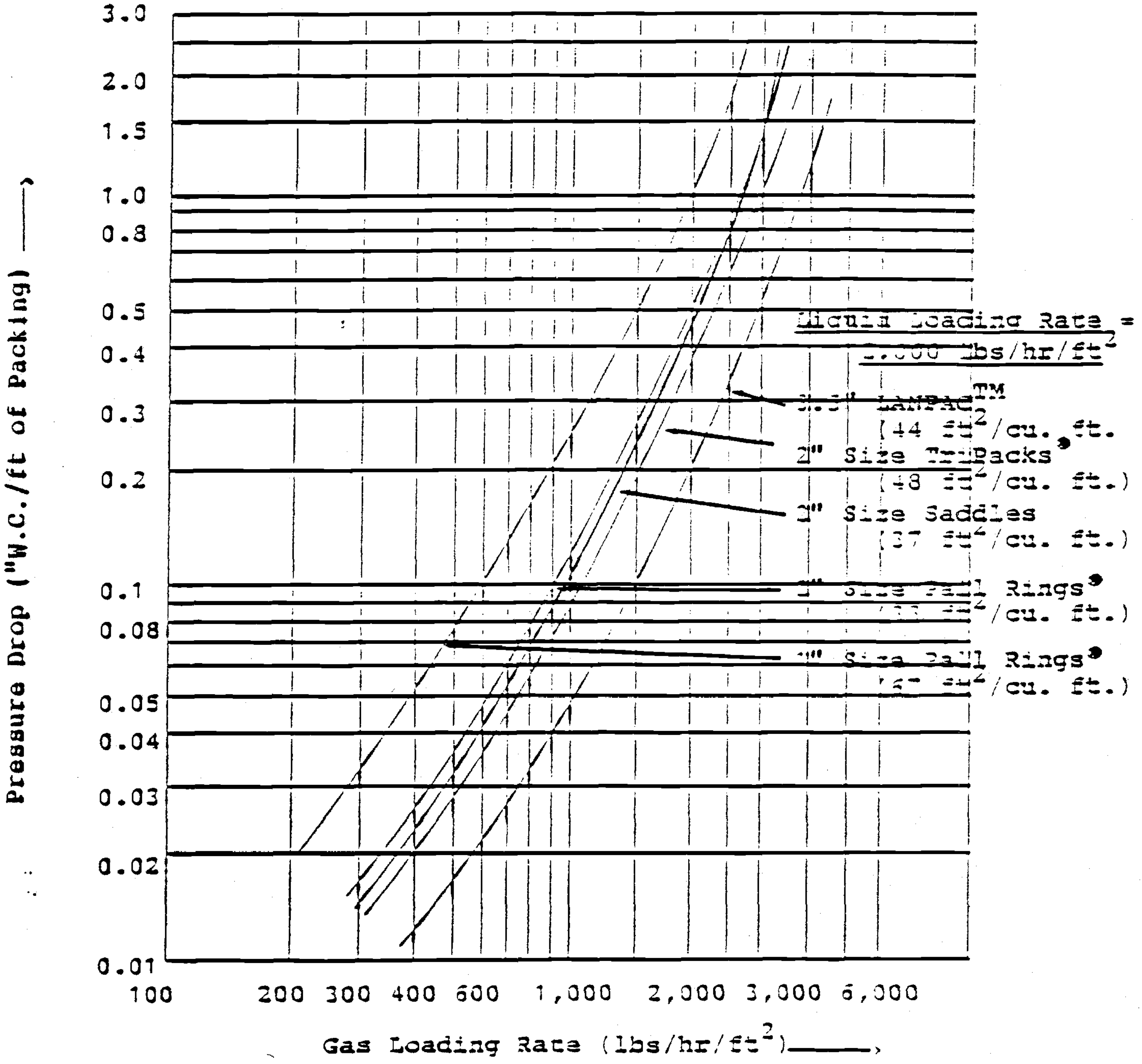
FOR ABSORPTION SYSTEMS

Absorption System	Gas Loading Rate (lbs/hr/ft^2)	Liquid Loading Rate (lbs/hr/ft^2)	Temp. °F	Height of Transfer Unit (ft)
H_2S/NaOH	2,200	5,000	72	1.47
NH_3/H_2O	2,057	4,285	60	1.28
NH_3/H_2O	965	7,145	60	0.78
NH_3/H_2SO_4	2,200	1,090	68	1.02
NH_3/H_2SO_4	1,800	4,360	68	0.6
HF/NaOH	2,250	2,500	78	0.58
cl_2/NaOH	1,350	5,000	68	1.42

Lantec Products, I
Technical
Bulletin No. TL-90

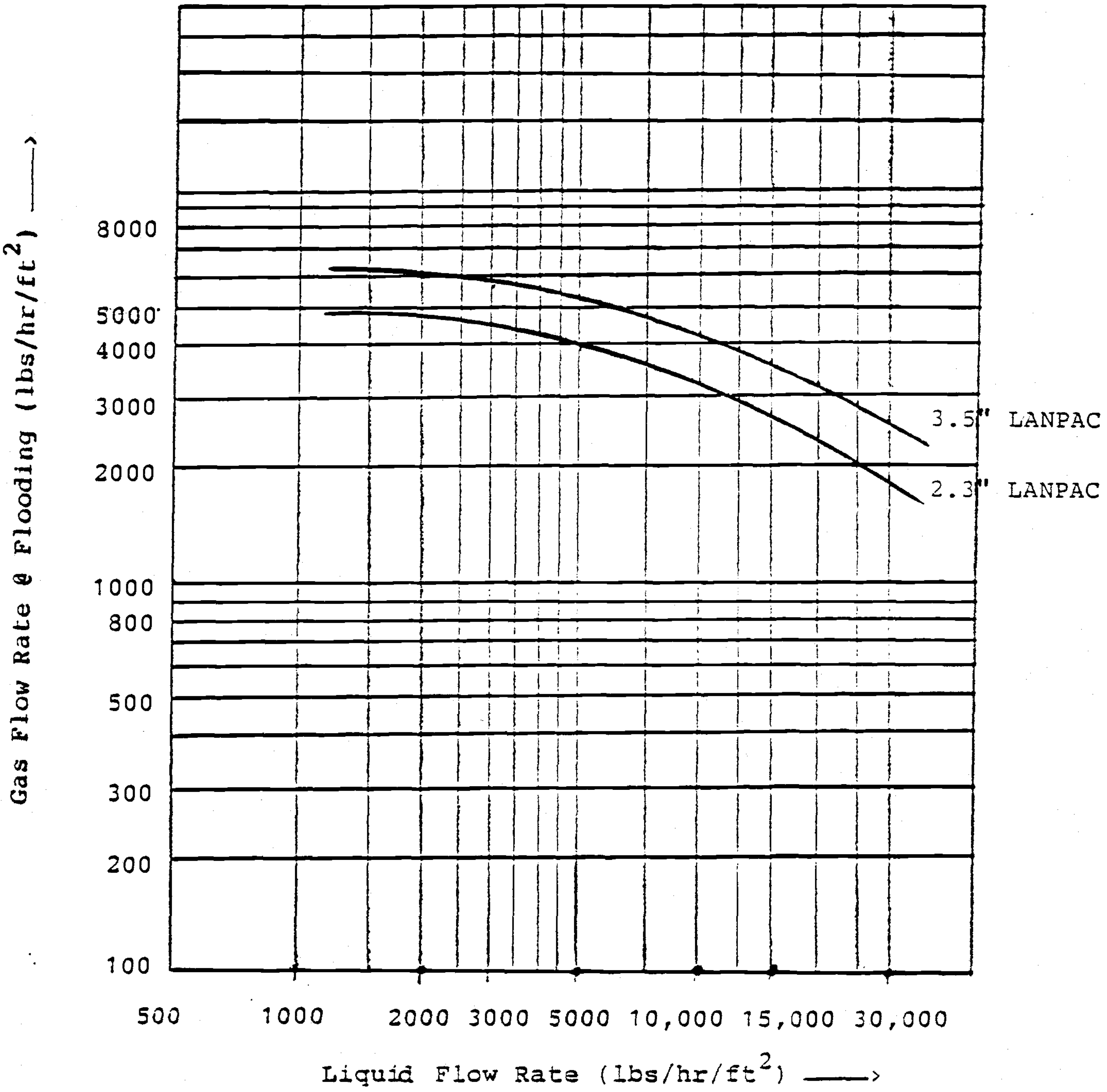
PRESSURE DROP COMPARISON BETWEEN 3.5" LANPAC™ AND OTHER PLASTIC PACKINGS

(AIR/WATER SYSTEM)



Lantec Products, In
Technical
Bulletin No. TL-90

FLOODING CURVES OF LANPAC™



Lantec Products, Inc
Technical
Bulletin No. TL-910

FIELD OPERATING DATA OF 3.5" LANPAC™ ON VOC/AIR STRIPPING

Date of Testing:	April 1988
Test Location:	Florida
Testing Conditions:	Column Dia. - 24" Water Temp. - 75 °F Air to Water Ratio - 300:1 (CFM/CFM) Liquid Loading Rate - 3 GPM/ft²

Type of Packing	**Packing Height**	**Benzene**		**Toulene**		**Xylene**	
		IN (PPb)	OUT (PPb)	IN (PPb)	OUT (PPb)	IN (PPb)	OUT (PPb)
No.2 Mini Ring®	15'	4,200	3	5.500	37	1,900	N.D.*
No.2 Mini Ring®	15'	5,400	5	5,600	7	1,900	3
No.2 Mini Ring®	15'	4,100	6	5,100	8	1,700	N.E.*
No.2 Mini Ring®	15'	9,300	6	5,800	3	2,300	4
3.5" LANPAC™	9'	8,000	N.D.*	18,000	N.D.*	840	N.D.*
3.5" LANPAC™	9'	7,500	N.D.*	12,000	N.D.*	1,700	N.D.*

***N.D. = Non-detectable**

Detection Limit is 0.5 PPb

Lantec Products, Inc.
Technical
Bulletin No. TL-911

MASS TRANSFER DATA OF 3.5" SIZE LANPAC™ VS. OTHER TOWER PACKINGS ON STRIPPING OF PCE (TETRACHLOROETHYLENE) FROM GROUND WATER*

HTU VALUES (FT.) DETERMINED FROM ACTUAL PCE REMOVAL DATA

Test No.	Air to Water Ratio (CFM/CFM)	Liquid Loading Rate(GPM/ft)	3.5" Pall Rings®	#3A Mini Rings®	3.5" Jaeger Tripacks®	Interlox® Snow Flake™	2" Jaeger Tripacks®	3.5" LANPAC™
1	93.5:1	14	4.07	3.26	3.63	3.45	2.63	2.41
2	62:1	21	4.58	3.58	4.06	3.77	2.84	2.40
3	50:1	26.5	4.78	3.83	4.25	3.78	2.71	2.93
4	82:1	14	3.95	3.08	3.10	3.28	2.54	2.44
5	55:1	21	3.82	3.56	3.74	3.93	2.99	2.63
6	44:1	26.5	4.96	3.49	4.15	4.23	3.19	2.87
7	75:1	14	4.02	2.72	3,36	3.68	2.66	1.84
8	50:1	21	4.40	3.52	4.07	4.08	2.75	2.46

*Footnotes:

1. Tests were conducted in San Bernardino Water District Pilot Test Column in Southern California in September 1988.

2. Pilot Column Conditions:
   - Column Diameter : 3 ft
   - Packing Depth : 7 to 17 ft
   - Water Temperature : 65 - 68 Degrees F
   - Influent PCE Conc. : About 40 to 130 PPb

Lantec Products, Inc
Technical
Bulletin No. TL-91

SOME FIELD PERFORMANCE DATA OF 3.5" LANPAC™ ON VOC/AIR STRIPPING

Location of Installation:	Minnesota
Date of Testing:	February, 1989
Column Diameter:	3'
Packing Height:	27'
Water Flow Rate:	125 GPM
Water Temperature:	45° F
Air Flow Rate:	900 CFM

VOC Species	Influent Conc.	Effluent Conc.
TCE	410 ppb	0.6 ppb
PCE	460 ppb	1.2 ppb

Lantec Products, Inc
Technical
Bulletin No. TL-913

SOME FIELD OPERATING DATA OF 3.5" LANPAC™ ON AIR STRIPPING OF TCE

Date of Testing: December, 1988

Test Location: New York

Column Operating Conditions:
Column Dia. - 6'
Water Temp. -51°F
Packing Height - 16'

Air to Water Ratio	Liq. Loading Rate (GPM/ft²)	Infl. TCE Conc. (PPb)	Effl. TCE Conc. (PPb)	NTU (No. of Transfer Units Achieved	HTU of LANPAC (ft)
73 to 1	19	329	7	3.976	4.02
73 to 1	19	296	7.8	3.754	4.26
73 to 1	19	270	6.1	3.822	4.186
73 to 1	19	267	6	3.92	4.08
73 to 1	19	268	6.2	3.89	4.11
73 to 1	19	278	6	3.96	4.04
49 to 1	31	291	9.5	3.605	4.44
40 to 1	35	400	15.9	3.436	4.66

Lantec Products, In
Technical
Bulletin No. TL-91

SOME VOC TEST DATA ON 3.5" LANPAC™

Date of Testing:	October 28, 1988
Testing Conditions:	Column Dia. - 2' Water Temp. - 55 °F Influent PCE (Tetrachloroethylene) Conc. - 170 - 290 PPb Influent TCE (Trichloroethylene) Conc. - 10 - 13 PPb Packing Height - 7 ft.

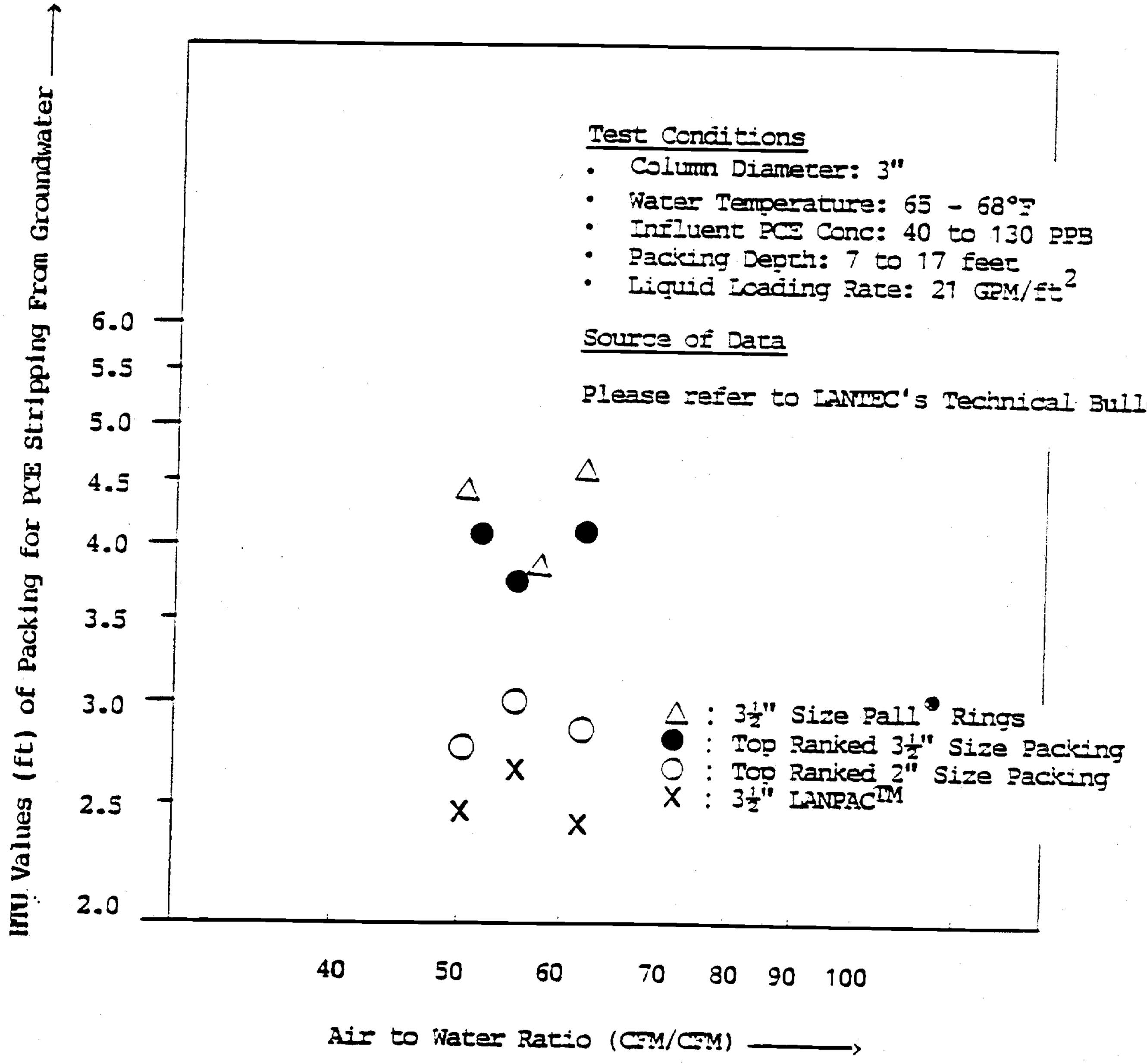
Air to Water Ratio (CFM/CFM)	Liq. Loading Rate (GPM/ft²)	PCE Removal %	* HTU for PCE (ft)	TCE Removal %	* HTU for TCE (ft)
30	25	82.96	3.8	80.87	4.07
60	25	86.77	3.34	86.40	3.40
30	30	83.89	3.69	81.51	3.99
60	30	82-92	3.82	82.22	3.92
100	20			84.52	3.60
80	20			88.55	3.15
60	20			88.10	3.20
40	20			84.62	3.62

$$* \quad HTU = \frac{\text{Packing Height}}{NTU}$$

$$NTU = \frac{C_1 - C_2/C_1\left[1 - \frac{1331.2}{H\,.\,Aw}\right] - C_2}{\text{In}\ \frac{\frac{1331.2}{[1 - H.Aw]}\,.\,C_1}{C_2}}$$

Where
C_1 = Influent Conc. (PPb)
C_2 = Effluent Conc. (PPb)
H = Henry's Law Constant (atm)
AW : Volumetric Air to Water Ratio
In : Natural Log

LANPAC VS OTHER TOWER PACKINGS IN MASS TRANSFER



Test Conditions

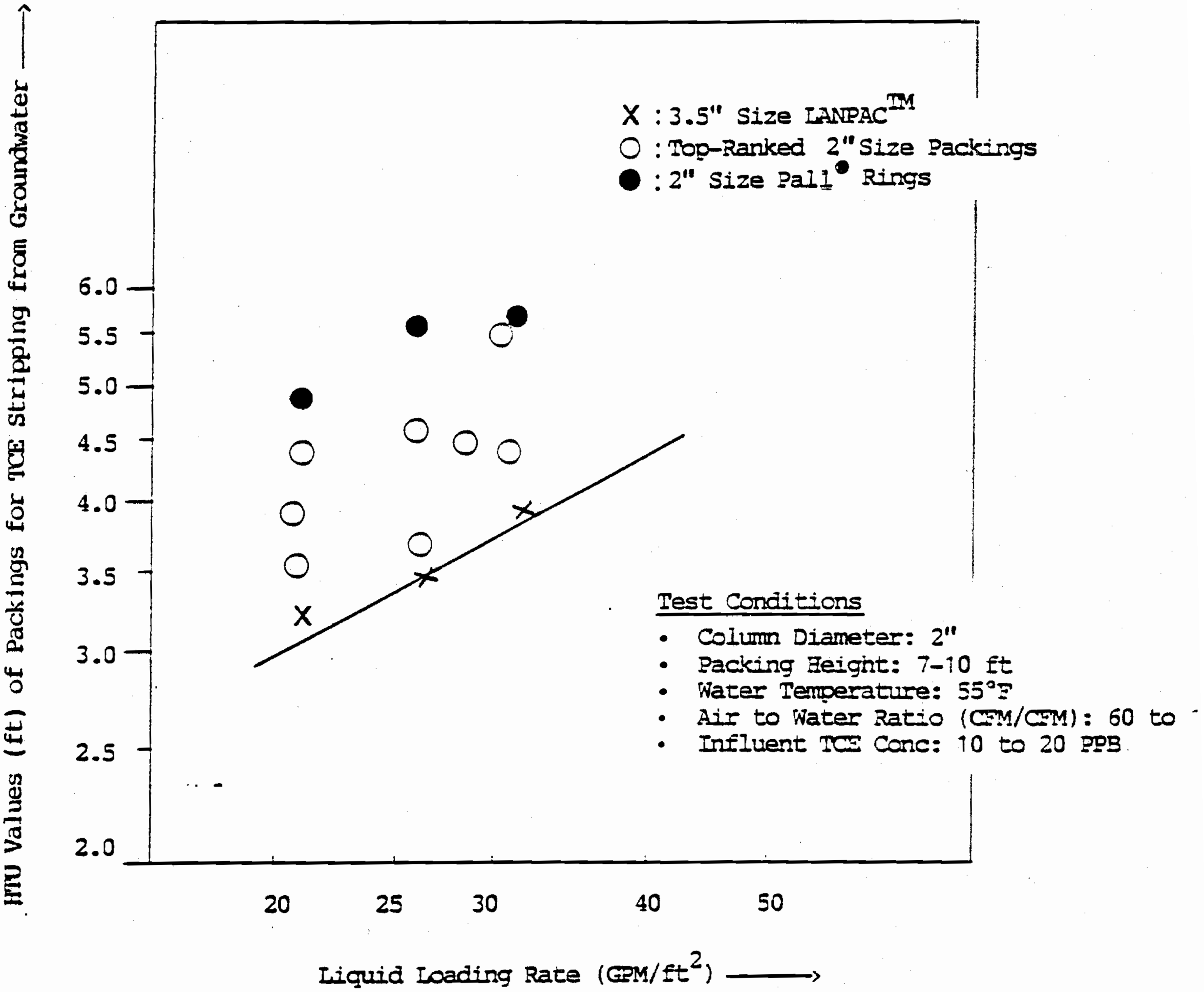
- Column Diameter: 3"
- Water Temperature: 65 - 68°F
- Influent PCE Conc: 40 to 130 PPB
- Packing Depth: 7 to 17 feet
- Liquid Loading Rate: 21 GPM/ft^2

Source of Data

Please refer to LANTEC's Technical Bulletin TL-

Lantec Products, Inc
Technical
Bulletin No. TL-916

3.5" LANPAC™ VS TOP-RANKED 2" PACKINGS IN MASS TRANSFER



Test Conditions

- Column Diameter: 2"
- Packing Height: 7-10 ft
- Water Temperature: 55°F
- Air to Water Ratio (CFM/CFM): 60 to
- Influent TCE Conc: 10 to 20 PPB

Lantec Products,
Technical
Bulletin No.TL-91

SOME COMPARATIVE PERFORMANCE DATA ON AIR STRIPPING OF PCE BETWEEN 3.5" - LANPAC™ AND 2.3" - LANPAC™

Date of Testing:	November, 1988
Test Location:	California
Column Operating Conditions:	Column Dia. - 30" Water Temp. - 60 - 62° F Influent PCE Conc. - 60 to 80 ppb Packing Height - 10'

Air to Water Ratio (CFM/CFM)	Liq. Loading Rate (GPM/ft^2)	HTU (ft) of 3.5" LANPAC	HTU (ft) OF 2.3" LANPAC
20	20	3.125	3.025
40	20	3.04	2.825
20	30	3.39	2.95
40	30	3.34	3.01
20	35	3.49	3.08
40	35	3.06	3.05

Lantec Products, Inc.
Technical
Bulletin No. TL-918

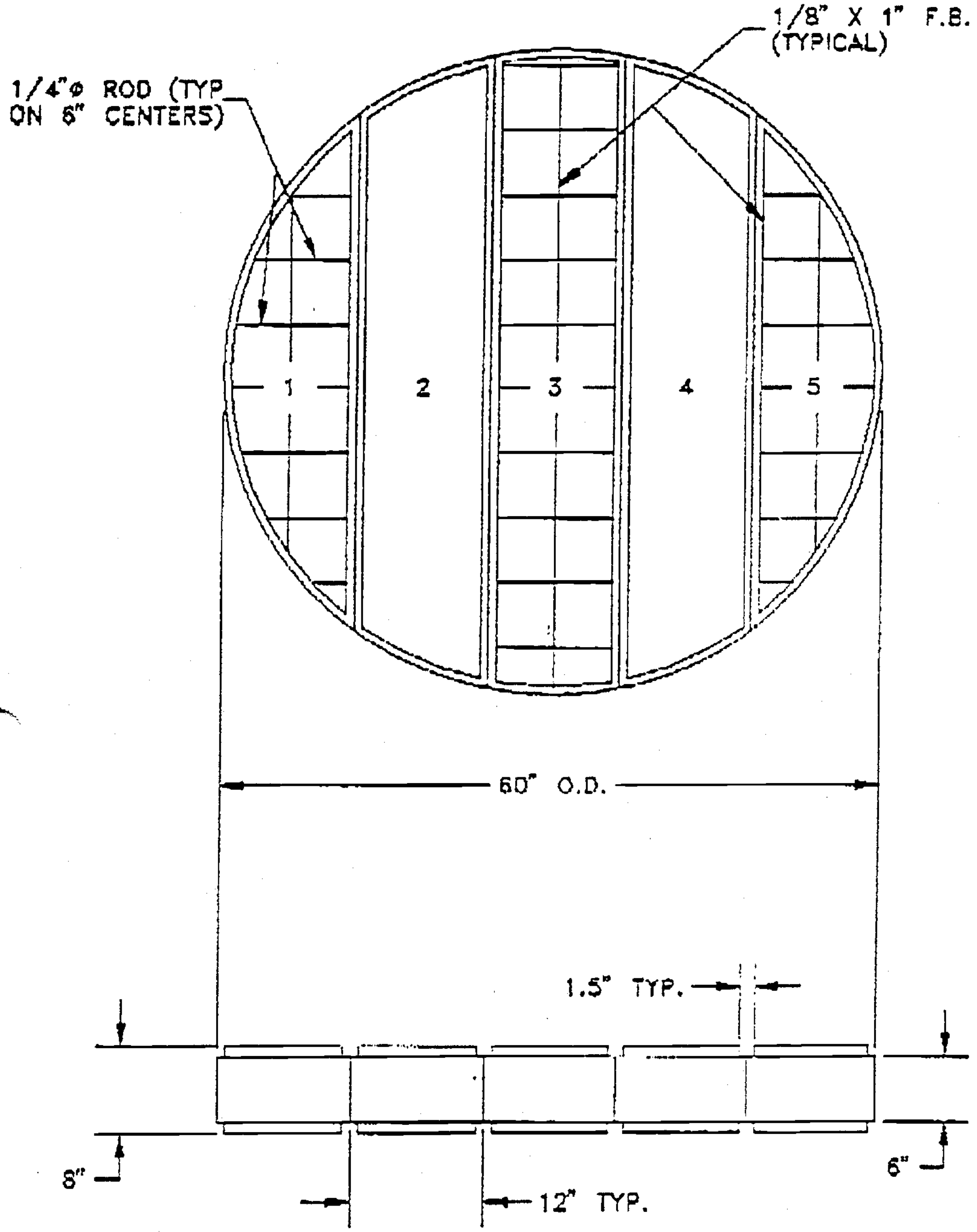
SOME FIELD PERFORMANCE DATA
OF 3.5" LANPAC™ ON VOC/AIR STRIPPING

Location of Installation:	Minneapolis, Minnesota
Date of Testing:	March, 1989
Column Diameter:	3'
Packing Height:	24'
Water Flow Rate:	83 GPM
Water Temperature:	50°F
Air Flow Rate:	2,000 CFM

VOC Species	Influent Conc.	Effluent Conc.
Xylene	18,310 ppb	Non-Detectable*
Ethyl Benzene	2,540 ppb	Non-Detectable*
Toulene	330 ppb	Non-Detectable*
Total VOC's	21,190 ppb	Non-Detectable*

*Detection limit is 0.5 ppb

NOTE: MESH IS OVERSIZED FOR SNUG FIT.



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Commercial Resins Division

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Saint Paul, Minnesota 55110-5145 U.S.A.
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TECHNICAL DATA SHEET

CORVE8300

CORVE8300 is a FDA approvable, corrosion resistant, non-accelerated, Bisphenol-A Epichlorohydrin based vinyl ester resin. Its uses include tank relining, pipe fabrication, tank construction, etc. See Commercial Resins publication VE91 under VE8300 for corrosion recommendations and general information.

TECHNICAL DATA

LIQUID RESIN PROPERTIES

Viscosity, Brookfield Model LVT, #3 @ 60 RPM, 77°F (25°C), CPS	400 - 600
100 Gram mass at 77°F (25°C), catalyzed with 1.2% Hi-Point 90* by volume, promoted with 0.20% of 12% Cobalt and 0.05% DMA by weight	
Gel Time (Minutes)	16 - 19
Gel to Peak Time (Minutes)	10 - 15
Peak Exotherm	330 - 360°F 165 - 182°C
Non-Volatile (%)	53.5 - 56.0
Density, gm/ml	1.02 - 1.05

TYPICAL PROPERTIES OF A 1/8" (3.175 MM) THICK CLEAR CASTING

Flexural Strength, ASTM D-790	19,000 PSI	131 MPa
Flexural Modulus, ASTM D-790	4.5×10^5 PSI	3103 MPa
Tensile Strength, ASTM D-638	11,500 PSI	79.3 MPa
Tensile Modulus, ASTM D-638	5.0×10^5 PSI	3448 MPa
Percent Elongation, ASTM D-638	5.0	5.0
Barcol Hardness (934-1), ASTM D-2583	35	35
Heat Distortion, ASTM D-648	210 °F	99 °C

* If using Methyl Ethyl Ketone Peroxide (MEKP) to gel and cure CoRezyn® vinyl esters, we recommend only these four: L-50 (Akzo Chemical); DHD-9 (Atochem); Hi-Point 90 (US Peroxygen); or MEKP-925 (Norac). These must be used at the appropriate percentage and suitable temperatures. Contact your Interplastic Corporation representative for assistance.

Date: March 8, 1995
Supersedes Date: January 30, 1995

ICPA SPI CFA

CoREZYN®

INTERPLASTIC CORPORATION
Commercial Resins Division

1225 Wolters Boulevard
Saint Paul, Minnesota 55110-5145 U.S.A.
+1 612 481-6860 FAX +1 612 481-9836

TECHNICAL DATA SHEET

CoRezyn® 75-AA-002

CoRezyn® 75-AA-002 is part of a series of specially designed isophthalic corrosion resins that meet the sophisticated demands of modern technology in various corrosion applications. It has chemical resistance, n fast wet-out, excellent handling characteristics, fast hardness development, and good adhesion to glass fibers. See Commercial Resins Isophthalic Resin Brochure for corrosion recommendations.

TECHNICAL DATA

LIQUID RESIN PROPERTIES

Viscosity, Brookfield Model LVT, #3 @ 60 RPM, 77°F (25°C), CPS	550 - 600
Thixotropic Index	2.6 - 2.9
100 Gram mass at 77°F (25°C), catalyzed with 1.0% DDM-9* by volume	
Gel Time (Minutes)	14 - 15
Gel to Peak Time (Minutes)	8 - 12
Peak Exotherm	390 - 420°F 198 - 215°C
Non-Volatile (%)	51 - 54
Density, gm/ml	1.04 - 1.08

TYPICAL PROPERTIES OF A 1/8" (3.175 MM) THICK CLEAR CASTING

Flexural Strength, ASTM D-790	18,500	PSI	128	MPa
Flexural Modulus, ASTM D-790	5.4×10^5	PSI	3724	MPa
Tensile Strength, ASTM D-638	9,500	PSI	66	MPa
Tensile Modulus, ASTM D-638	5.5×10^5	PSI	3793	MPa
Percent Elongation, ASTM D-638	1.7		1.7	
Barcol Hardness (934-1), ASTM D-2583	45		45	
Heat Distortion, ASTM D-648	220	°F	104	°C
Compressive Strength, ASTM D-695	26,400	PSI	182	PSI

PHYSICAL STRENGTH PROPERTIES 1/8" (3.175 MM) LAMINATE, 33% GLASS MAT (4 PLIES OF 1.5 OZ)

Flexural Strength, ASTM D-790	25,000	PSI	172	MPa
Flexural Modulus, ASTM D-790	11.5×10^5	PSI	7931	MPa
Tensile Strength, ASTM D-638	16,000	PSI	110	MPa
Tensile Modulus, ASTM D-638	11.7×10^5	PSI	8069	MPa
Percent Elongation, ASTM D-638	2.0		2.0	
Barcol Hardness (934-1), ASTM D-2583	45		45	

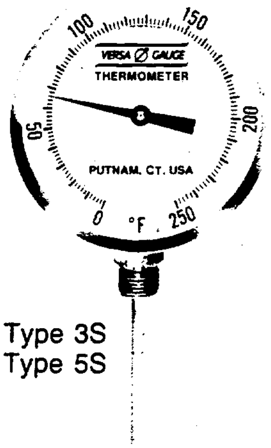
* The use of different Methyl Ethyl Ketone Peroxides (MEKP's) can change the gel time, cure time, and peak exotherm. If a MEKP other than the one listed above is used the customer should run a gel time to determine its suitability for their process.

All specification and properties shown are approximate. Specifications and properties of material delivered may vary slightly from those given above. Interplastic Corporation makes no representations [illegible]t regarding the material except those specified above. No person has any authority to bind Interplastic Corporation to any representation except those specified above. Final determination [illegible] suitability of the material for the use contemplated is the sole responsibility of the Buyer. Commercial Resins sales representatives will assist in developing procedures to fit individual requirements.

Date: March 21, 1996
Supersedes: November 17, 1994

ICPA SPI CFA

3″ and 5″ Bottom Connected



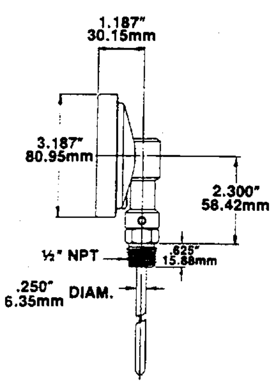
3″ Dial - Type 3S
5″ Dial - Type 5S

STEM LENGTH	MODEL NUMBERS STRAIGHT FORM 3″	MODEL NUMBERS STRAIGHT FORM 5″
2½″	3S02	5S02
4″	3S04	5S04
6″	3S06	5S06
9″	3S09	5S09
12″	3S12	5S12
15″	3S15	5S15
18″	3S18	5S18
24″	3S24	5S24

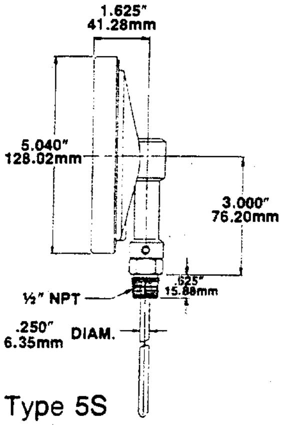
STANDARD FEATURES

- 304 stainless steel construction
- Rustproof - Dustproof - Leakproof; hermetically sealed
- External recalibration adjustment
- Anti-parallax dial
- Accurate to ±1% of scale range

WHEN ORDERING:
Give (1) Type number, (2) Stem length, (3) Range, and (4) Variations from standard, if any.

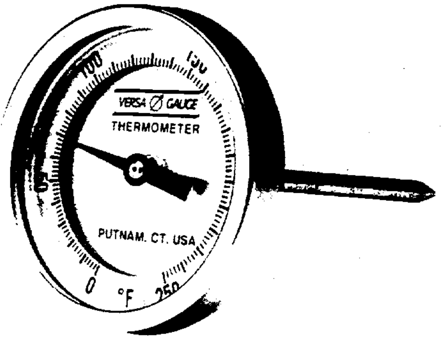


3″ Dial - Type 3S



5″ Dial - Type 5S

3″ and 5″ Back Connected

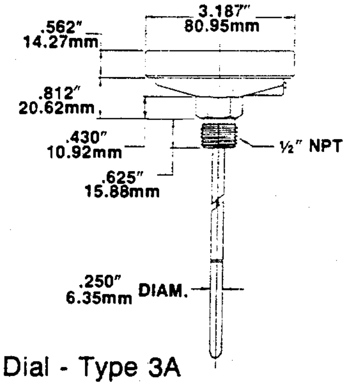


3″ Dial - Type 3A
5″ Dial - Type 5A

STANDARD FEATURES

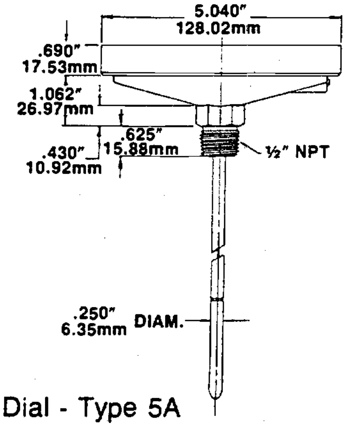
- 304 stainless steel construction
- Rustproof - Dustproof - Leakproof; hermetically sealed
- External recalibration adjustment
- Anti-parallax dial
- Accurate to ±1% of scale range

WHEN ORDERING:
Give (1) Type number, (2) Stem length, (3) Range, and (4) Variations from standard, if any.



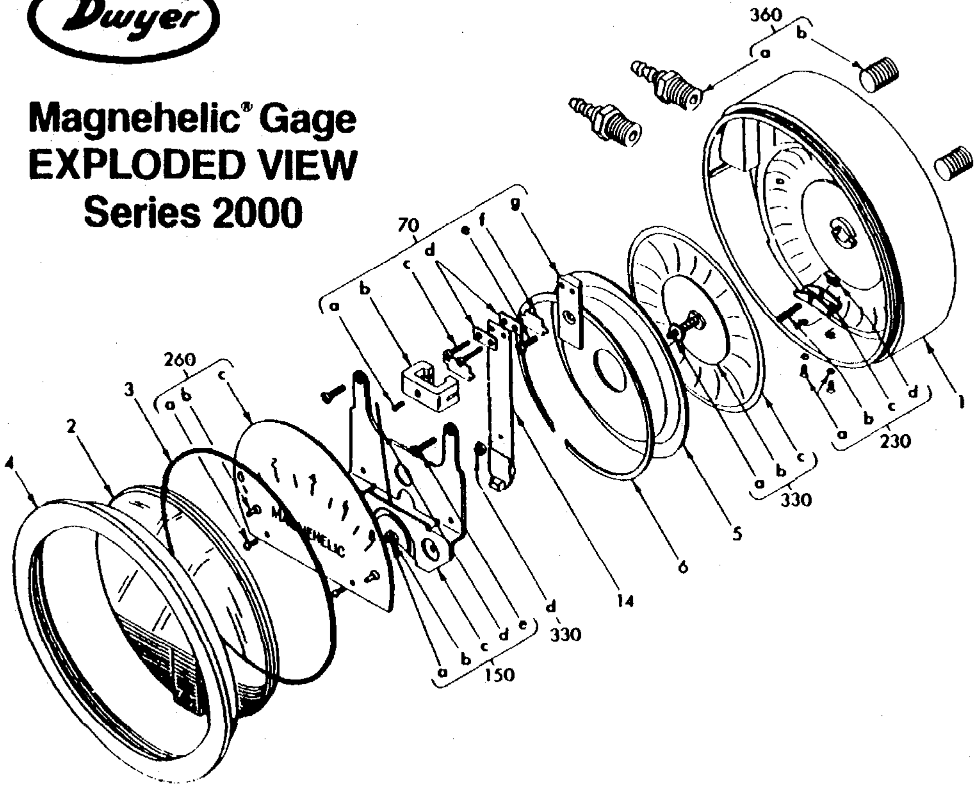
3″ Dial - Type 3A

STEM LENGTH	MODEL NUMBERS 90° BACK ANGLE FORM 3″	MODEL NUMBERS 90° BACK ANGLE FORM 5″
2½″	3A02	5A02
4″	3A04	5A04
6″	3A06	5A06
9″	3A09	5A09
12″	3A12	5A12
15″	3A15	5A15
18″	3A18	5A18
24″	3A24	5A24



5″ Dial - Type 5A

Magnehelic® Gage EXPLODED VIEW Series 2000



1. Case
2. Cover with zero adjust assy.
3. "O" ring seal
4. Bezel
5. Diaphragm sealing plate
6. Retaining ring

70. Range Spring assembly
    a. Clamp set screw
    b. Clamp
    c. Mounting screws (2 req'd)
    d. Clamping shoe (2 req'd)
    e. Clamp plate screw
    f. Spacer (2 req'd)
    g. Clamp plate

14. Range Spring with magnet

150. Wishbone Assembly – consists of:
    a. Front jewel
    b. Locking nut
    c. Wishbone
    d. Pointer
    e. Mounting screws (2 req'd)
    f. Helix assembly (not shown)
    g. Pivots (2 req'd) (not shown)
    h. Rear jewel (not shown)

230 Zero adjust assembly - consists of:
    a. Foot screws with washers (2 req'd)
    b. Adjust screw
    c. Foot
    d. Finger

260. Scale Assembly – consists of:
    a. Mounting screws (2 req'd)
    b. Bumper pointer stop (2 req'd)
    c. Scale

330. Diaphragm Assembly – consists of:
    (Arbor press needed to install)
    a. Linkage assy., complete
    b. Front plate
    c. Diaphragm
    d. Rear plate (not shown)
    e. Plate washer (not shown)

360. Mounting Hardware Kit
    a. Adapter – pipe plug 1/8" NPT to rubber tubing – (2 req'd)
    b. Pipe plug 1/8" NPT – (2 req'd)
    c. Mounting lug (3 req'd)
    d. Long screw (3 req'd)
    e. Short screw (3 req'd)

Ordering Instructions:

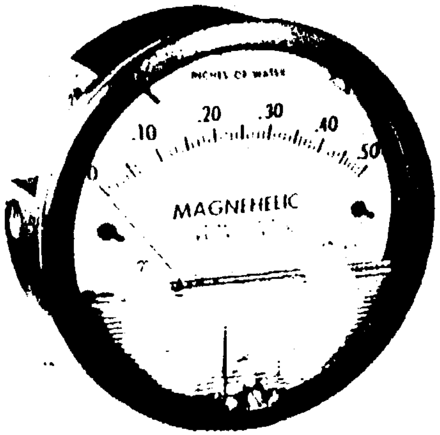
When corresponding with the factory regarding Magnehelic® gage problems, refer to the call-out numbers in this view. Be sure to include model number, pressure range, and any special options. Field repair is not recommended; contact the factory for repair service information.

Litho in U.S.A. 7/88

BULLETIN NO. A-27

OPERATING INSTRUCTIONS and PARTS LIST

Magnehelic® Differential Pressure Gage



SPECIFICATIONS

Dimensions: 4-3/4" dia. X 2-3/16" deep.

Weight: 1 lb. 2 oz.

Finish: Baked dark gray enamel.

Connections: 1/8 N.P.T. high and low pressure taps, duplicated, one pair side and one pair back.

Accuracy: Plus or minus 2% of full scale, at 70°F. (Model 2000-0, 3%; 2000-00, 4%).

Pressure Rating: 15 PSI.

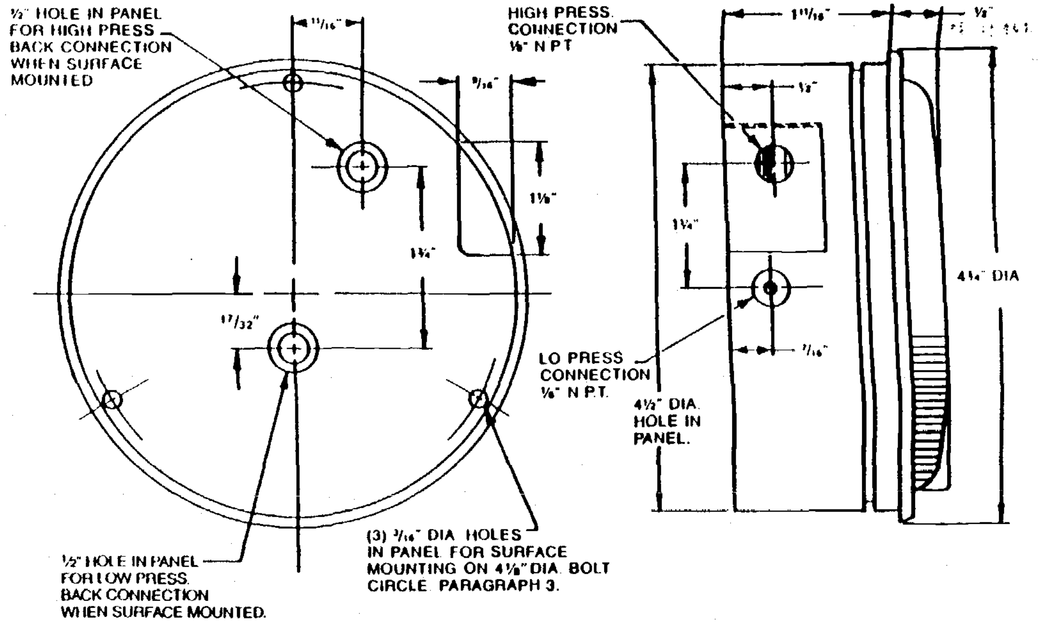
Ambient Temperature Range: 20° to 140°F.

Standard gage accessories include two 1/8" N.P.T. plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapters, and three flush mounting adapters with screws.

Caution: For use with air or compatible gases only.

For repeated over-ranging or high cycle rates, contact factory.

Hydrogen Gas Precautionary Note: The rectangular rare earth magnet used in the standard gage may not be suitable for use with hydrogen gas since a toxic and explosive gas may form. For hydrogen service, consult the factory for an alternate gage construction

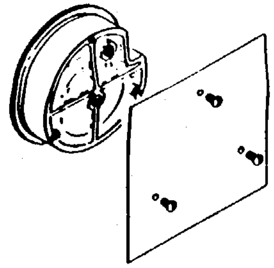


MAGNEHELIC® INSTALLATION

1. Select a location free from excessive vibration and where the ambient temperature will not exceed 140°F. Also, avoid direct sunlight which accelerates discoloration of the clear plastic cover. Sensing lines may be run any necessary distance. Long tubing lengths will not affect accuracy but will increase response time slightly. Do not restrict lines. If pulsating pressures or vibration cause excessive pointer oscillation, consult the factory for ways to provide additional damping.

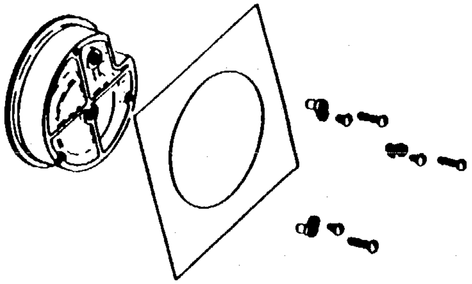
2. All standard Magnehelic gages are calibrated with the diaphragm vertical and should be used in that position for maximum accuracy. If gages are to be used in other than vertical position, this should be specified on the order. Many higher range gages will perform within tolerance in other positions with only rezeroing. Low range Model 2000-00 and metric equivalents must be used in the vertical position only.

3. Surface Mounting



Locate mounting holes, 120° apart on a 4-1/8" dia. circle. Use No. 6-32 machine screws of appropriate length.

4. Flush Mounting



Provide a 4½" dia. opening in panel. Insert gage and secure in place with No. 6-32 machine screws of appropriate length, with adaptors, Part No. 360c, firmly secured in place. To mount gage on 1¼"-2" pipe, order

5. To zero the gage after installation

Set the indicating pointer exactly on the zero mark, using the external zero adjust screw on the cover at the bottom. Note that the zero check or adjustment can only be made with the high and low pressure taps both open to atmosphere.

Operation

Positive Pressure: Connect tubing from source of pressure to either of the two high pressure ports. Plug the port not used. Vent one or both low pressure ports to atmosphere.

Negative Pressure: Connect tubing from source of vacuum or negative pressure to either of the two low pressure ports. Plug the port not used. Vent one or both high pressure ports to atmosphere.

Differential Pressure: Connect tubing from the greater of two pressure sources to either high pressure port and the lower to either low pressure port. Plug both unused ports.

When one side of gage is vented in a dirty, dusty atmosphere, we suggest an A-331 Filter Vent Plug be installed in the open port to keep inside of gage clean.

a. For portable use or temporary installation, use 1/8" pipe thread to rubber tubing adapter and connect to source of pressure with rubber or Tygon tubing.

b. For permanent installation, 1/4" O.D., or larger, copper or aluminum tubing is recommended. See accessory bulletin S-101 for fittings.

MAINTENANCE

Maintenance: No lubrication or periodic servicing is required. Keep case exterior and cover clean. Occasionally disconnect pressure lines to vent both sides of gage to atmosphere and re-zero. Optional vent valves, (bulletin S-101), should be used in permanent installations.

Calibration Check: Select a second gage or manometer of known accuracy and in an appropriate range. Using short lengths of rubber or vinyl tubing, connect the high pressure side of the Magnehelic gage and the test gage to two legs of a tee. Very slowly apply pressure through the third leg. Allow a few seconds for pressure to equalize, fluid to drain, etc., and compare readings. If accuracy unacceptable, gage may be returned to factory for recalibration. To calibrate in the field, use the following procedure.

Calibration:

1. With gage case, P/N 1, held firmly, loosen bezel, P/N 4 by turning counterclockwise. To avoid damage, a canvas strap wrench or similar tool should be used.
2. Lift out plastic cover and "O" ring.
3. Remove scale screws and scale assembly. Be careful not to damage pointer.
4. The calibration is changed by moving the clamp, P/N. 70-b. Loosen the clamp screw(s) and move slightly toward the helix if gage is reading high, and away if reading low. Tighten clamp screw and install scale assembly.
5. Place cover and O-ring in position. Make sure the hex shaft on inside of cover is properly engaged in zero adjust screw, P/N 230-b.
6. Secure cover in place by screwing bezel down snug. Note that the area under the cover is pressurized in operation and therefore gage will leak if not properly tightened.
7. Zero gage and compare to test instrument. Make further adjustments as necessary.

Caution: If bezel binds when installing, lubricate threads sparingly with light oil or molybdenum disulphide compound.

Warning: Attempted field repair may void your warranty. Recalibration or repair by the user is not recommended. For best results, return gage to the factory. Ship prepaid to:

Dwyer Instruments, Inc.
Attn. Repair Dept.
55 Ward St.
Wakarusa, IN 46573

Trouble Shooting Tips:

- *Gage won't indicate or is sluggish.*

1. Duplicate pressure port not plugged.
2. Diaphragm ruptured due to overpressure.
3. Fittings or sensing lines blocked, pinched, or leaking.
4. Cover loose or "O" ring damaged, missing.
5. Pressure sensors, (static tips, Pitot tube, etc.) improperly located.
6. Ambient temperature too low. For operation below 20°F, order gage with low temperature, (LT) option.

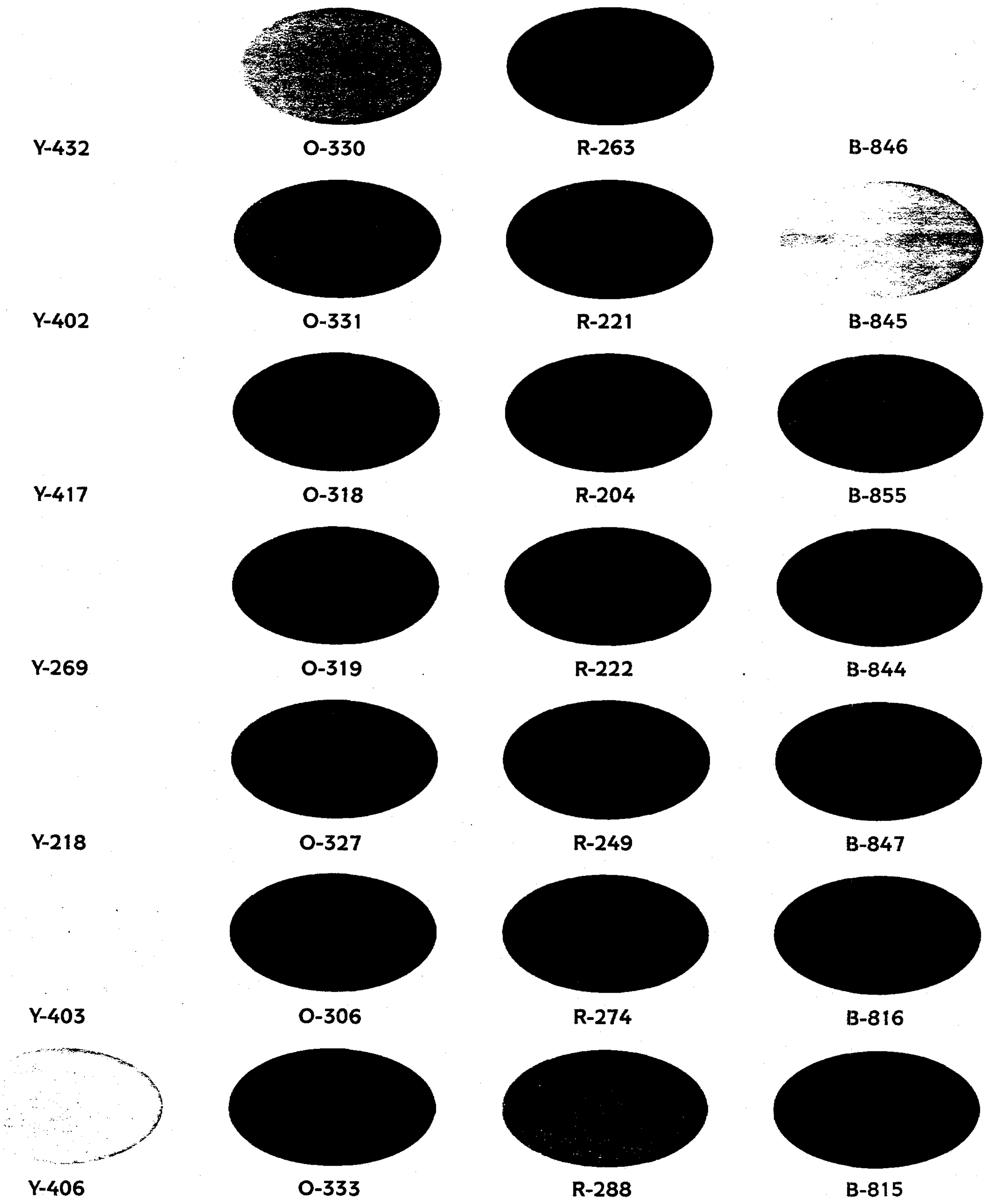
- *Pointer stuck-gage can't be zeroed.*

1. Scale touching pointer.
2. Spring/magnet assembly shifted and touching helix.
3. Metallic particles clinging to magnet and interfering with helix movement.
4. Cover zero adjust shaft broken or not properly engaged in P/N 230-b adjusting screw.

We generally recommend that gages needing repair be returned to the factory. Parts used in various sub-assemblies vary from one range of gage to another, and use of incorrect components may cause improper operation or failure. Gages repaired at the factory are carefully calibrated and tested to assure "like-new" operation. After receipt and inspection, we will be happy to quote repair costs before proceeding.

Consult factory for assistance on unusual applications or conditions.

Use with air or compatible gases only.



All colors shown have been matched to existing control standards within limits of reproduction methods and color is not guaranteed. Gel coat and colorant matches are to color standards maintained in the Gel Coat and Colorant Research and Development Department.

CoREZYN COLOR

	N-586	A-185	G-167
W-142	N-571	A-191	G-129
W-176	N-714	A-614	G-166
W-173	N-747	A-292	G-599
W-113	N-701	A-685	G-510
W-231	N-744	A-224	G-502
W-117	N-783	A-632	G-590

CoREZYN® gel coats have a gel time of 5-18 minutes at 1½ percent MEKP catalyst and viscosity ranges of 9,000 to 20,000 cps with a Brookfield viscometer at 6 RPM.

CoREZYN® has been a leader in the formulation of specialty gel coats and colorants for over thirty years. We make gel coats and colorants in a rainbow of colors providing an unmatched spectrum of colorful solutions for all your gel coat and colorant needs – large or small.

Nobody has more experience or expertise with gel coats, colorants and resins. And nobody knows more about how to make them work together for you. Each gel coat and colorant is designed to give you the best results whatever your application. In addition to isophthalic and neopentyl glycol/isophthalic gel coats, we offer the following:

Marble clear
Fire retardant
Sanding primers
Surface coats
Chemical resistant
Marine quality
Sanitary ware
Tooling gel coats

Colorants are available in all the colors shown in a polyester base. Custom formulations and epoxy based colorants are available by special order.

Talk to your CoREZYN® representative about your gel coat and colorant needs. They are ready to assist you with a solution to your most demanding application challenges.

CoREZYN

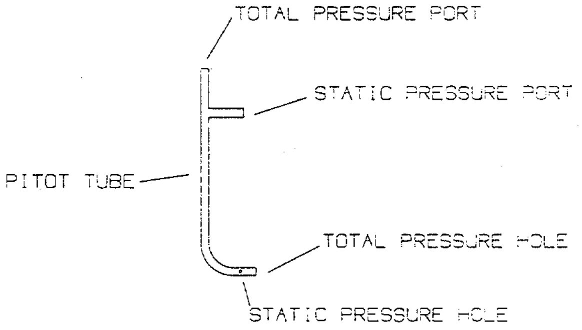
Interplastic Corporation
1219 Wolters Boulevard
Vadnais Heights, MN 55110
(612) 481-6860 Fax (612) 482-9041

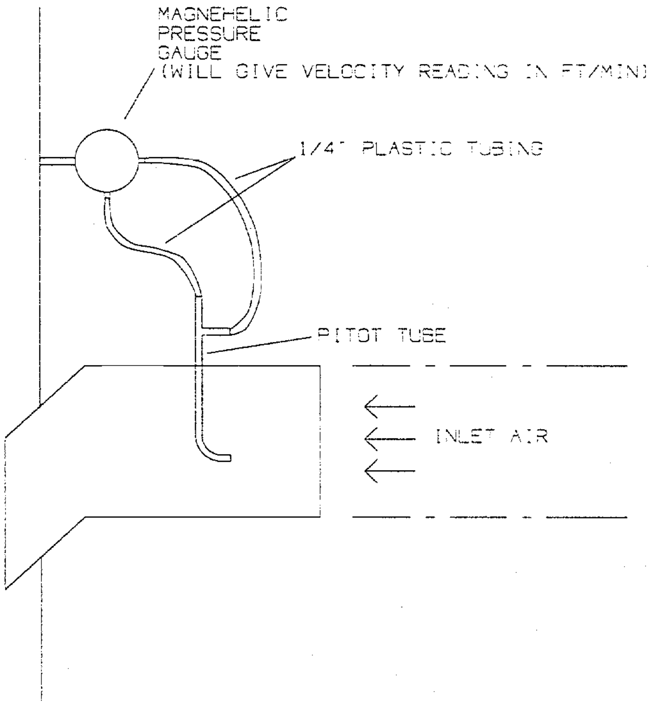
Installation of Flowmeter

The flowmeter consists of a pitot tube, a duct mounting gland and a magnehelic gauge. The pitot tube will be inserted into the top of the air inlet. The duct mounting gland will hold the pitot tube in place and the magnehelic gauge will provide the flow measurement. A picture of the duct mount gland is provided in the lower left corner (under accessories) on the page titled *Stainless Steel Pitot Tubes*. This picture shows a compression fitting and a hex nut used to hold the pitot tube. The hex nut will not be used on this tower because the compression fitting will screw into a 1/2 inch FNPT hole in the air inlet.

Slip the compression fitting onto the pitot tube. Move the fitting 18 inches up the pitot tube. When the pitot tube is finally secured the total pressure hole should be in the middle of the 36 inch inlet duct. Next, slip the curved end of the pitot tube into the hole provided at the top of air inlet duct. Position the pitot tube so that the total pressure hole is pointing directly towards the incoming air. Now screw the compression fitting into the FNPT hole in the air inlet duct. This will secure the pitot tube in place. Once the pitot tube is secure, place the magnehelic gauge on the gauge bracket provided on the tower. Then take one of the 1/4 inch plastic tubes provided and place it on the end of the static pressure port of the pitot tube. Next take the other end of the same tube and place it on the low pressure port of the magnehelic gauge. Repeat this procedure using the other 1/4 inch plastic tube, connecting the total pressure port to the high pressure port of the magnehelic gauge. The pitot tube will deflect the pressure gauge to a reading in feet per minute. Multiply that reading by 7.065, which is the area of the inlet duct, and the result is the air flow in cfm.

FLOWMETER





PITOT TUBE WILL DEFLECT PRESSURE
GAUGE TO A READING IN FT/MIN.
MULTIPLY THAT READING BY 7.065
(WHICH IS THE AREA OF INLET DUCT)
AND THE RESULT IS THE AIR FLOW IN CFM.

NATIONAL ENVIRONMENTAL SYSTEMS
508-761-6611
36 MAPLE AVENUE, SEEKONK, MA 02771

AIR STRIPPER FLOWMETER

JOB NAME : OHM - CAMP LEJEUNE

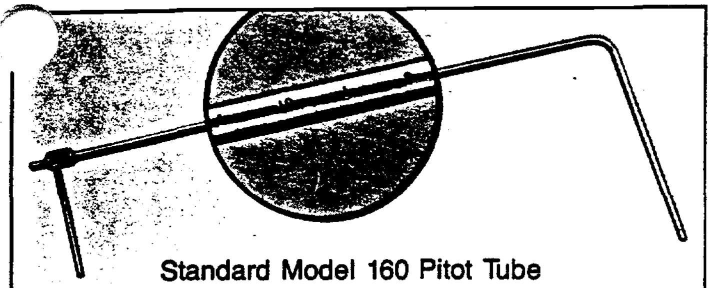
NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 03-20-95	DRAWN MTS	FILE NAME:	REV:
SCALE: N. T. S.	DESIGN: MAX	UU-FLOW	—

Dwyer

Series 160

Stainless Steel Pitot Tubes

ASME Design Meets AMCA and ASHRAE Codes.



Standard Model 160 Pitot Tube

Ideal for use with our precision manometers and air velocity gages. Dwyer Pitot Tubes are constructed from corrosion resistant stainless steel for a lifetime of service. ASME design meets AMCA and ASHRAE specifications for maximum accuracy over a wide variety of flow conditions. No correction factors required as ASHRAE tip design yields a calibration factor of 1. ASHRAE design needs no calibration! Permanent, stamped insertion depth graduation on sides of 160 series facilitate accurate positioning. Static pressure port is parallel to sensing tube allowing quick, easy alignment of tube with air flow. Low sensitivity to misalignment gives accurate reading even when tube is misaligned up to 15 degrees. Various standard sizes are available for use in ducts as small as 4" dia. or as large as 36 ft. dia. A universal model fits user supplied ¾" schedule 40 (standard) pipe in any length. Several convenient mounting options are available for permanent installations.

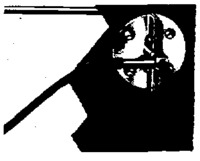
- No calibration needed.
- Precisely located, burr-free static pressure holes.
- Hemispherical tip design, best for accuracy if imperfectly aligned and nearly impossible to damage.
- [illegible]g lasting 304 stainless steel construction.
- [illegible]er soldered connections for leak-proof operation.
- ASME design meets AMCA and ASHRAE specifications.
- Coefficient of "1."
- 5/16" models rated to 1500°F, ⅛" models to 800°F.
- Extended static connection helps guide tip within recommended 15° of air flow direction.
- Inch graduations on sides of 160 series to quickly determine exact insertion depth.
- Dwyer Air Velocity Calculator, direct reading flow charts and instructions included.
- Use ⅛" models in ducts as small as 4", 5/16" models in ducts 10" or larger.
- Optional mounting gland or split flange make permanent installation fast and simple.

ACCESSORIES

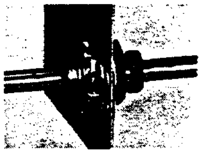
No. A-158 Split Flange Mounting can be added to any Dwyer No. 160 Standard Pitot Tube. Cadmium plated steel. Gasket is pattern for mounting holes. Secure flange loosely to tube, adjust tube depth and tighten screws. Gasket of 1/16" Neoprene fits tightly around tube and against duct for leak-proof seal. Nuts, washers included.

No. A-159 Mounting Gland – Versatile adapter slips on any Series 160, 5/16" standard pitot tube made after Dec. 1990. Two-part stainless steel fitting slides over tube and provides permanent, secure mounting. Where duct interior is accessible, use the washers and jam nut supplied. For blind applications or in thicker materials, install in a standard 1/2" pipe flange. Once tube is adjusted to proper depth and angle, tighten smaller hex bushing to lock position. G[illegible]e bushing inside assures leak-proof seal e[illegible] higher temperatures. Teflon bushing also available. NOTE: For full insertion with this fitting, order next longer pitot tube.

No. A-397 Step Drill. For fast, convenient installation of pitot tubes in sheet metal ducts. No center punch needed; automatic de-burring. Drills six sizes from 3/16" – 1/2" in 1/16" increments.



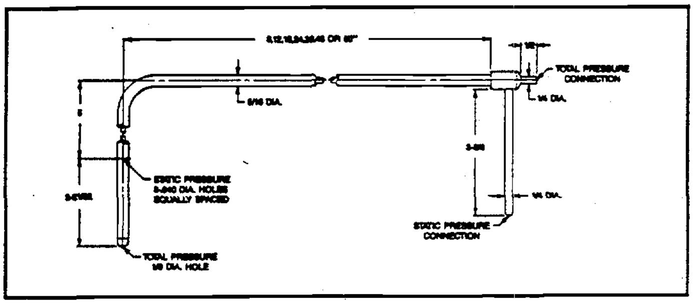
A-158 Split Flange Mounting



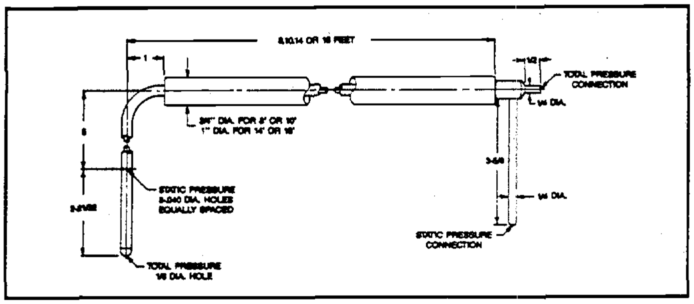
A-159 Duct Mounting Gland

A-159 Flange Mounting Gland

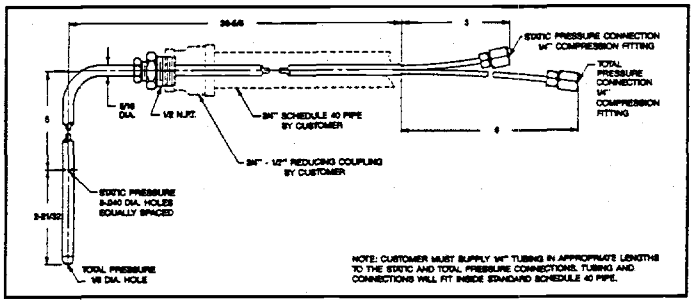
A-397 Step Drill



160 SERIES

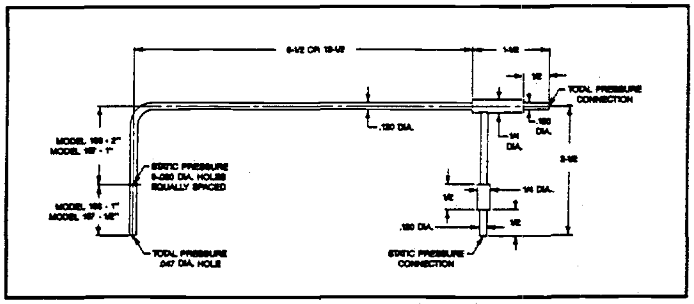


160 SERIES LONGER MODELS WITH STIFFENER



NOTE: CUSTOMER MUST SUPPLY 1/4" TUBING IN APPROPRIATE LENGTHS TO THE STATIC AND TOTAL PRESSURE CONNECTIONS. TUBING AND CONNECTIONS WILL FIT INSIDE STANDARD SCHEDULE 40 PIPE.

MODEL 160-U



166/167 SERIES

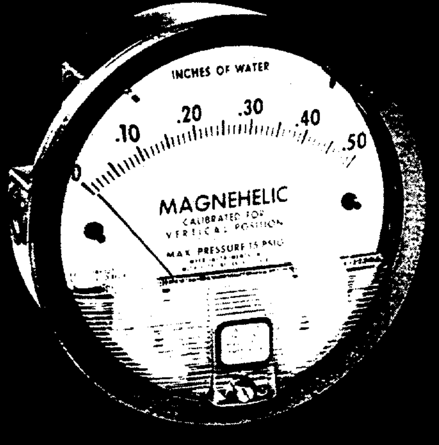
MODEL NUMBERS & SIZES

MODEL NUMBER	INSERTION LENGTH	DIAMETER
STANDARD 5/16" MODELS		
160-8	8"	5/16"
160-12	12"	5/16"
160-18	18"	5/16"
160-24	24"	5/16"
160-36	36"	5/16"
160-48	48"	5/16"
160-60	60"	5/16"
UNIVERSAL MODEL FOR 3/4" PIPE		
160-U	DETERMINED BY PIPE*	3/4" PIPE

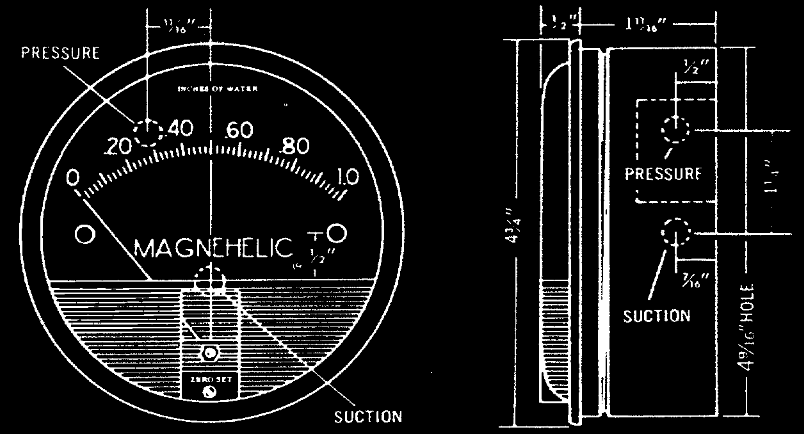
MODEL NUMBER	INSERTION LENGTH	DIAMETER
LONGER MODELS WITH STIFFENER		
160-96	96"(8 ft)	3/4"
160-120	120"(10ft)	3/4"
160-168	168"(14ft)	1"
160-216	216"(18ft)	1"
POCKET SIZE 1/8" MODELS		
166-6	6"	1/8"
166-12	12"	1/8"
167-6	6"	1/8"
167-12	12"	1/8"

*Universal model for permanent installation and connection to metal tubing. Create any length pitot tube with your own 3/4" sch. 40 pipe. 3/4" - 1/2" reducing coupling and 1/4" metal tubing.

SERIES 2000 Magnehelic® Differential Pressure Gages



Standard Magnehelic® Pressure Gage has a large, easy-to-read 4" dial.



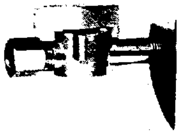
Dimensions, Standard Series 2000 Magnehelic® Pressure Gages. (Slightly different on medium and high pressure models)

Select the Dwyer Magnehelic® gage for high accuracy – guaranteed within 2% of full scale – and for the wide choice of 81 ranges available to suit your needs precisely. Using Dwyer's simple, frictionless Magnehelic® movement, it quickly indicates low air or non-corrosive gas pressures – either positive, negative (vacuum) or differential. The design resists shock, vibration and over-pressures. No manometer fluid to evaporate, freeze or cause toxic or leveling problems. It's inexpensive, too.

Widely used to measure fan and blower pressures, filter resistance, air velocity, furnace draft, pressure drop across orifice plates, liquid levels with bubbler systems and pressures in fluid amplifier or fluidic systems. It also checks gas-air ratio controls and automatic valves, and monitors blood and respiratory pressures in medical care equipment.

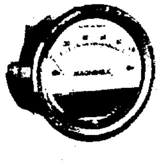
Flush...Surface...or Pipe Mounted

Mounting. A single case size is used for most ranges of Magnehelic gages. They can be flush or surface mounted with standard hardware supplied. With the optional A-610 Pipe Mounting Kit they may be conveniently installed on horizontal or vertical 1¼" – 2" pipe. Although calibrated for vertical position, many ranges above 1 inch may be used at any angle by simply re-zeroing. However, for maximum accuracy, they must be calibrated in the same position in which they are used. These characteristics make Magnehelic gages ideal for both stationary and portable applications. A 4$\frac{9}{16}$" hole is required for flush panel mounting. Complete mounting and connection fittings plus instructions are furnished with each instrument.



Vent valves

In applications where pressure is continuous and the Magnehelic gage is connected by metal or plastic tubing which cannot be easily removed, we suggest using Dwyer A-310A vent valves to connect gage. Pressure can then be removed to check or re-zero the gage.



HIGH AND MEDIUM PRESSURE MODELS

Installation is similar to standard gages except that a 4$\frac{13}{16}$" hole is needed for flush mounting. The medium pressure construction is rated for internal pressures up to 35 psig and the high pressure up to 80 psig. Available in all ranges. Because of larger case, will not fit in portable case. Weight 1 lb., 10 oz. (Installation of the A-321 safety relief valve on standard Magnehelic gages often provides adequate protection against infrequent overpressure; see Bulletin S-101).

PHYSICAL DATA

Ambient temperature range: 20° to 140° F.*

Rated total pressure: –20" Hg. to 15 psig.†

Overpressure: Relief plug opens at approximately 25 psig.

Connections: ⅛" NPT female high and low pressure taps, duplicated – one pair side and one pair back.

Housing: Die cast aluminum. Case and aluminum parts Iridite-dipped to withstand 168 hour salt spray test. Exterior finish is baked dark gray hammerloid.

Accuracy: Plus or minus 2% of full scale (3% on –0 and 4% on –00 ranges), throughout range at 70°F.

Standard accessories: Two ⅛" NPT plugs for duplicate pressure taps, two ⅛" pipe thread to rubber tubing adapters, and three flush mounting adapters with screws. (Mounting ring and snap ring retainer substituted for 3 adapters in MP & HP gage accessories.)

Weight: 1 lb. 2 oz.

*Low temperature models available as special option.

†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.

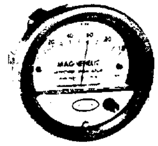
OPTIONS AND ACCESSORIES

Transparent overlays

Furnished in red and green to highlight and emphasize critical pressures.

Adjustable signal flag

Integral with plastic gage cover; has external reset screw. Available for most ranges except those with medium or high pressure construction. Can be ordered with gage or separately.



LED Setpoint Indicator

Bright red LED on right of scale shows when setpoint is reached. Field adjustable from gage face, unit operates on 12 – 24 VDC. Requires MP or HP style cover and bezel.

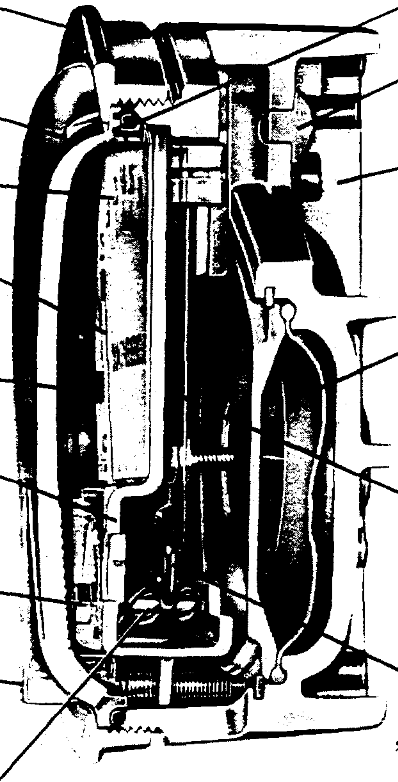
Portable units

Combine carrying case with any Magnehelic gage of standard range (not high pressure). Includes 9 ft. of $\frac{3}{16}$" I.D. rubber tubing, stand-hang bracket, and terminal tube with holder.

Air filter gage accessory package

Adapts any standard Magnehelic for use as an air filter gage. Includes aluminum surface-mounting bracket with screws, two 5 ft. lengths of ¼" aluminum tubing, two static pressure tips and two molded plastic vent valves, integral compression fittings on both tips and valves.

Quality design and construction features



Bezel provides flange for flush mounting in panel.

[illegible] **plastic face** is highly resistant to breakage. Provides undistorted viewing of pointer and scale.

Precision litho-printed scale is accurate and easy to read.

Red tipped pointer of heat treated aluminum tubing is easy to see. It is rigidly mounted on helix shaft.

Pointer stops of molded rubber prevent pointer over-travel without damage.

"Wishbone" assembly provides mounting for helix, helix bearings and pointer shaft.

Sapphire bearings are shock-resistant mounted; provide virtually friction-free motion for helix. Motion damped with high viscosity silicone fluid.

Zero adjustment screw is conveniently located in plastic cover, accessible without removing cover. "O" ring seal provides pressure tightness.

"O" ring seal for cover assures pressure integrity of case.

Blowout plug of silicone rubber protects against overpressure on 15 PSIG rated models. Opens at approximately 25 PSIG.

Die cast aluminum case is precision made. Iridite-dipped to withstand 168 hour salt spray test. Exterior finished in baked dark gray hammerloid. One case size used for all standard pressure ranges, and for both surface and flush mounting.

Silicone rubber diaphragm with integrally molded "O" ring is supported by front and rear plates. It is locked and sealed in position with a sealing plate and retaining ring. Diaphragm motion is restricted to prevent damage due to overpressures.

Calibrated range spring is a flat leaf of Swedish spring steel in temperature compensated design. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.

Alnico magnet mounted at one end of range spring rotates helix without mechanical linkages.

Helix is precision milled from an alloy of high magnetic permeability, deburred and annealed in a hydrogen atmosphere for best magnetic qualities. Mounted in jeweled bearings. it turns freely to align with magnetic field of magnet to transmit pressure indication to pointer.

SERIES 2000 MAGNEHELIC® – MODELS AND RANGES

The models below will fulfill most requirements. Page 5 also shows examples of special models built for OEM customers. For special scales furnished in ounces per square inch, inches of mercury, metric units, etc., contact the factory.

[illegible]

Ladders and Platforms
Orientations and Details

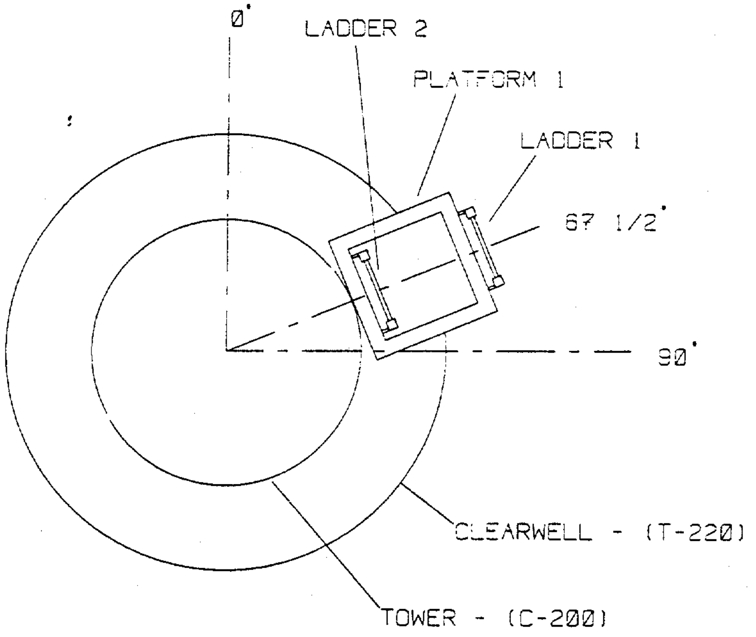
The orientation and details for the air stripper ladders and platforms are supplied on the following drawings. The air stripper tower and ladder/platform assembly are shipped separately. After the air stripper tower is upright and secure, mounting of the ladders and platforms can begin. Use a crane to lift the ladder or platform into position. A person in a boom truck then bolts the ladder or platform to the clips which are bonded to the tower. Use 3/8 inch bolts, nuts and washers for the ladders. Use 1/2 inch bolts, nuts and washers for the platforms.

TOP VIEW OF BOTTOM LADDER & PLATFORM ORIENTATION

PLATFORM 1 - 18" X 24"
ELEVATION IS 5'-6"

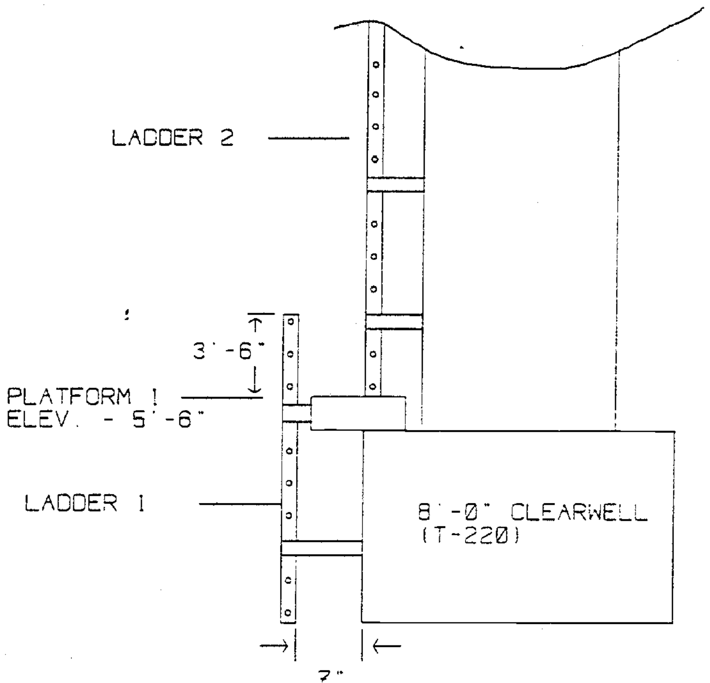
LADDER 1 STARTS AT BASE OF
TOWER & ENDS AT PLATFORM 1

LADDER 2 STARTS AT PLATFORM 1
& CONTINUES UP TOWER

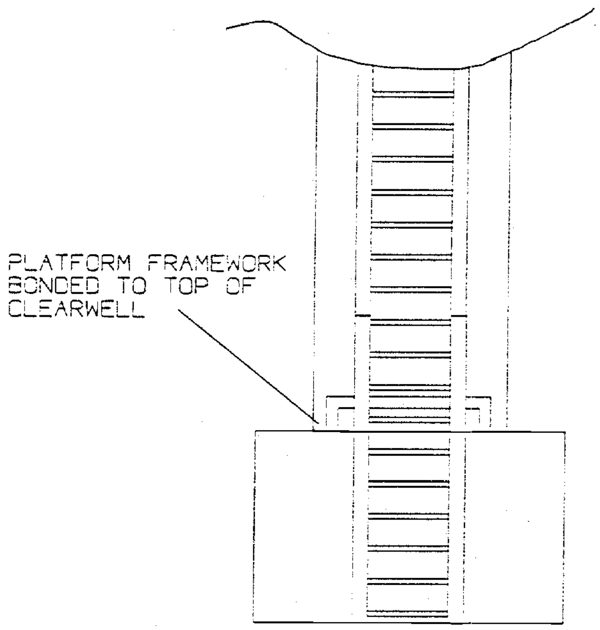


NATIONAL ENVIRONMENTAL SYSTEMS 508-761-6611 36 MAPLE AVENUE, SEEKONK, MA 02771			
AIR STRIPPER LADDER ORIENTATION			
JOB NAME : OHM - CAMP LEJEUNE			
NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 03-20-95	DRAWN: MTS	FILE NAME:	REV:
SCALE: N. T. S.	DESIGN: MAX	UU-LAD1	I

ELEVATION VIEW OF LOWER LADDER AND PLATFORM



SIDE VIEW



FRONT VIEW

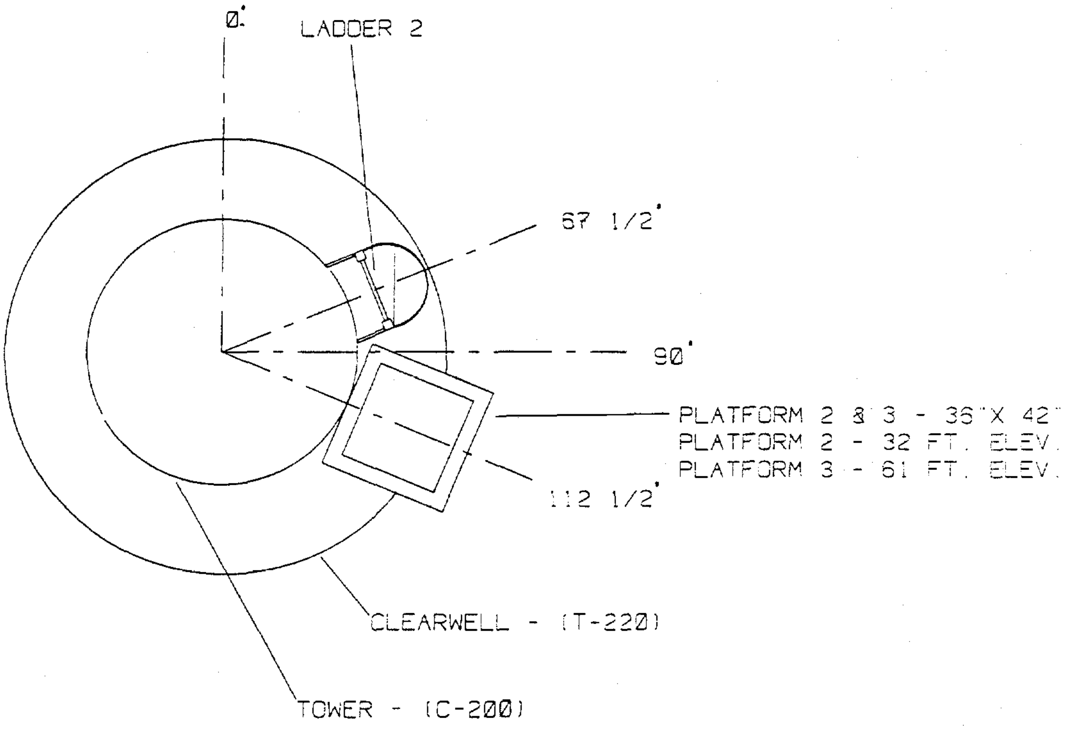
NATIONAL ENVIRONMENTAL SYSTEMS
508-761-6611
36 MAPLE AVENUE, SEEKONK, MA 02771

AIR STRIPPER LOWER LADDER & PLATFORM

JOB NAME : OHM - CAMP LEJEUNE

NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 03-20-95	DRAWN: MTS	FILE NAME:	REV:
SCALE: N. T. S.	DESIGN: MAX	UU-LA02	I

TOP VIEW OF TOP LADDER & PLATFORMS ORIENTATION



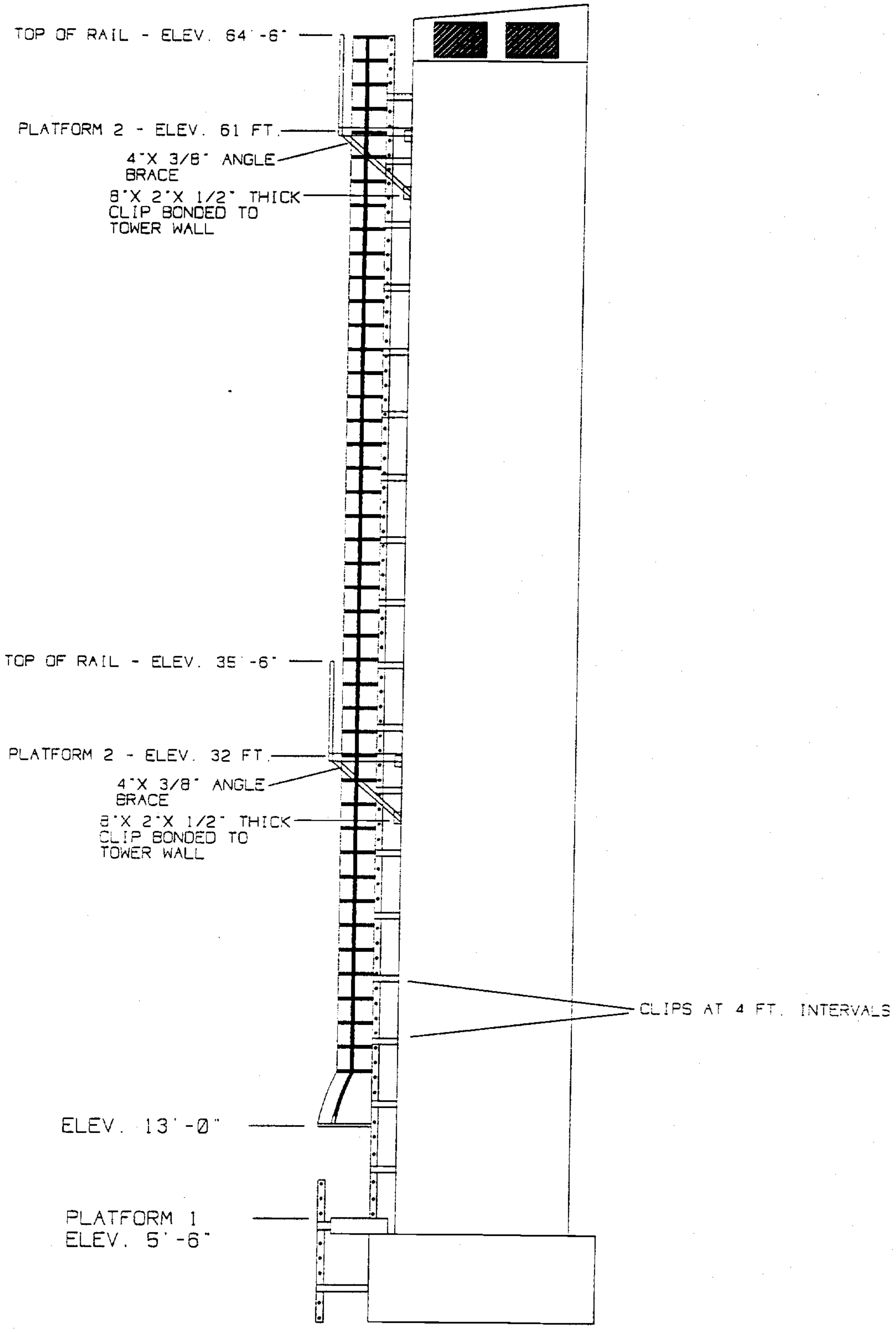
NATIONAL ENVIRONMENTAL SYSTEMS
508-761-6611
36 MAPLE AVENUE, SEEKONK, MA 02771

AIR STRIPPER ORIENTATION

JOB NAME : OHM - CAMP LEJEUNE

NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 03-20-95	DRAWN: MTS	FILE NAME:	REV:
SCALE: N. T. S.	DESIGN: MAX	UU-LAD3	—

ELEVATION VIEW OF LADDERS AND PLATFORMS



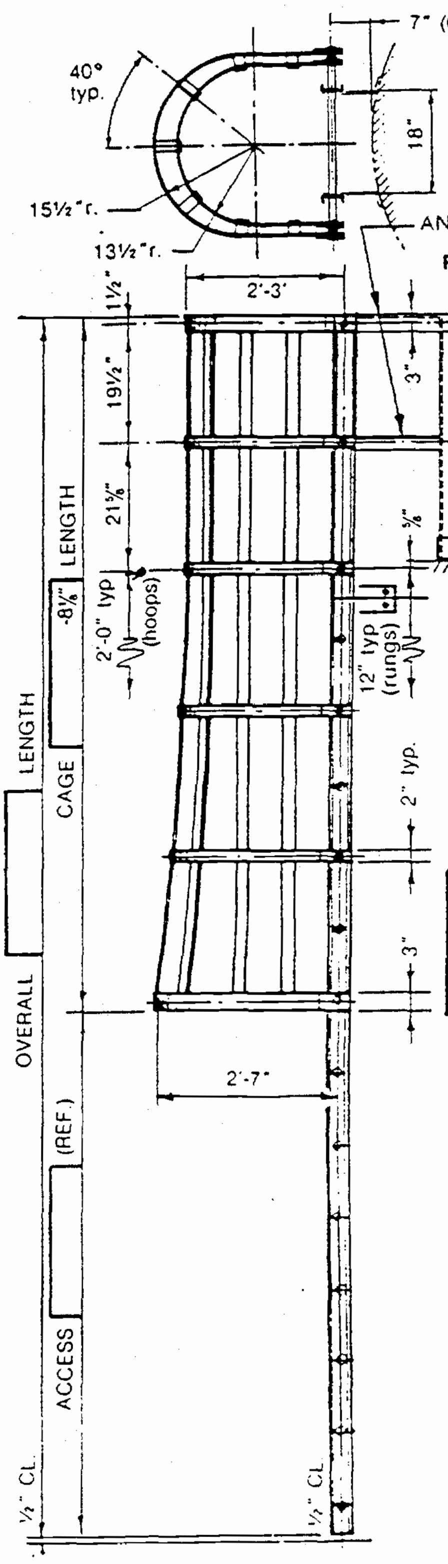
NATIONAL ENVIRONMENTAL SYSTEMS
508-761-6611
36 MAPLE AVENUE, SEEKONK, MA 02771

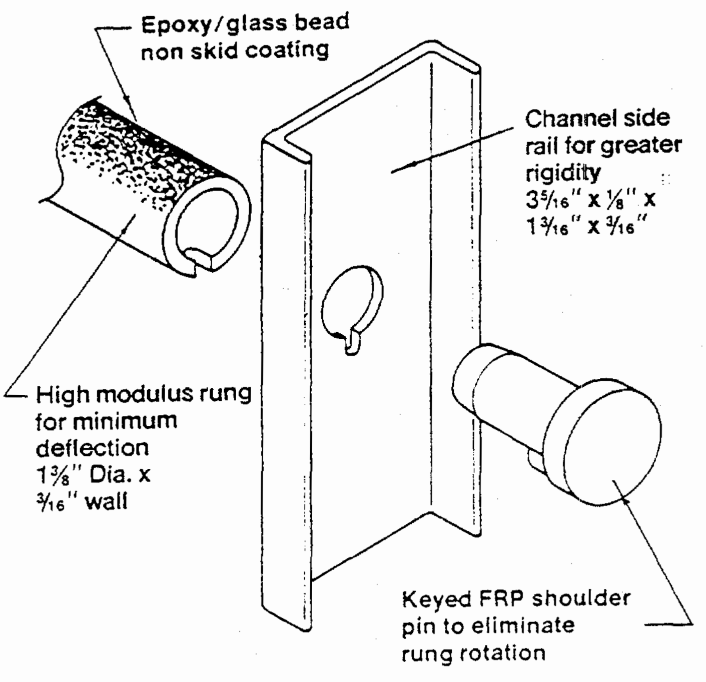
AIR STRIPPER LADDER & PLATFORMS

JOB NAME : OHM - CAMP LEJEUNE

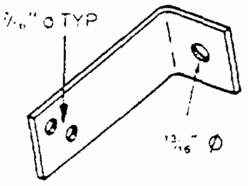
NES PROJECT #01-042794.11.01		SHEET 1 OF 1	
DATE: 04-24-95	DRAWN: MTS	FILE NAME:	REV:
SCALE: N. T. S.	DESIGN: MAX	UU-LAD4	I

INSTALLATION DETAILS

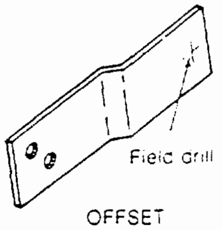




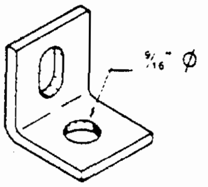
IMPORTANT NOTE: The upper 3'-6" ladder walk-thru extension MUST be braced to a guardrail system or roof turn with angle clips (by IMCO or others). Standoff clips (by IMCO or others) MUST be used from the step-off point downward at 6'-0" maximum vertical centers.



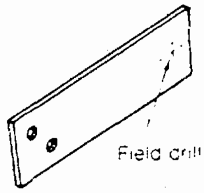
ANGLE



OFFSET

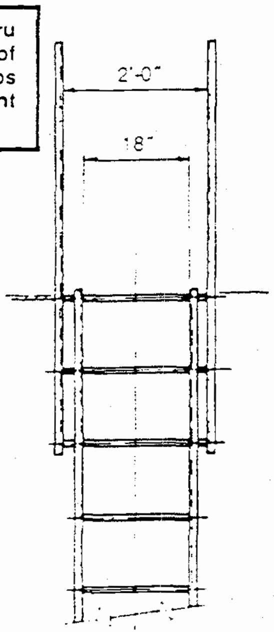


STANDARD
BOTTOM ANGLE CLIP



STRAIGHT

OPTIONAL
FRP STANDOFF CLIPS



OPTIONAL
24" WALK-THRU

Representative:

P.O. Box 534, Moorestown, New Jersey 08057
(609)-235-7254 telex 831-602

P.O. Box 415, Fairburn, Georgia 30213
(404)-964-0887 telex 804-298

FIXED INDUSTRIAL LADDERS

This is the **PERFORMANCE PROVEN** fiberglass ladder used successfully in the Chemical Process, Pulp and Paper, Wastetreatment, and related industries for the past ten years. Our field experience, coupled with ongoing product research, has resulted in the design changes that help keep IMCO ladders unique in their field: **FIRST IN QUALITY AND SAFETY.**

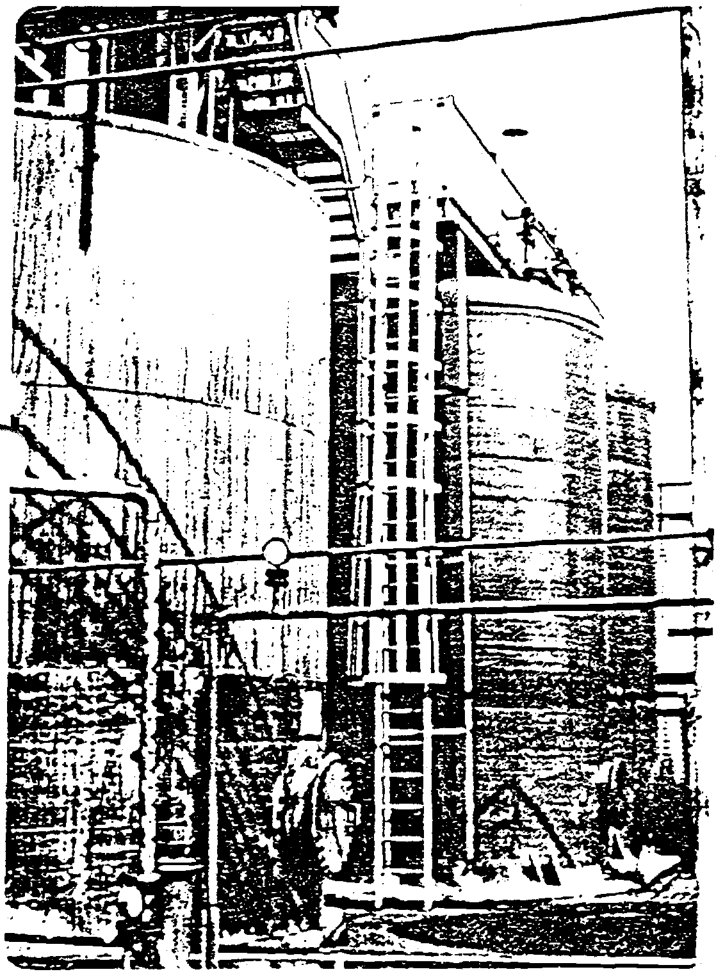
Completely non-metallic **CORROSION RESISTANT** fiberglass (FRP) construction means that you can stop worrying about costly routine maintenance (sand blasting/painting) and the possibility of personal injury on corroded equipment. A synthetic surfacing veil is used to maximize this resistance and minimize the weathering effects of outdoor exposure.

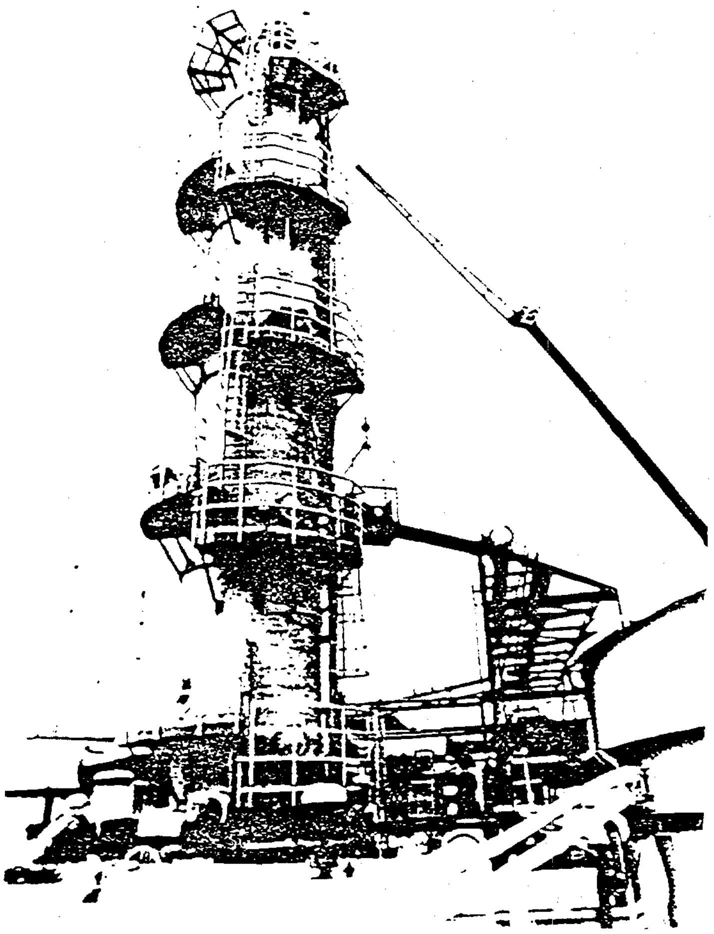
HIGH STRENGTH FRP structural pultrusions are used exclusively in IMCO ladders and cages. The high modulus/high glass content of this material yields a product with a higher strength to weight ratio than those of wood, aluminum, steel, or contact molded fiberglass. We not only meet OSHA's strength requirements, we exceed them by 6 to 1!

The **NON-CONDUCTIVE, DIELECTRIC,** and **FIRE-RETARDANT** properties of these ladders make them perfect for use near electrical equipment, transmitters, or radar antenna.

A **CHOICE OF RESIN SYSTEMS** for varying requirements helps keep costs down. Select our standard **ISO-POLYESTER** system (yellow color) for atmospheric use and some immersion applications, or use our **ATLAC 382** system (beige color) for maximum corrosion resistance in immersion service. (Cages are not available in Atlac.) Let us know what your particular application is and we'll be happy to make a recommendation!

Our **IN-DEPTH SERVICE CAPABILITIES** include engineering design, drafting, technical assistance, and custom fabrication of special ladders as well as related equipment such as intermediate landing platforms and structural supports. Our own Grating and Guardrail System complement many of our ladder installations. Let the IMCO professionals assist your next FRP requirement.





ABOUT OSHA

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has set forth certain guidelines (Paragraph 1910.27) pertaining to the construction and installation of fixed ladders.

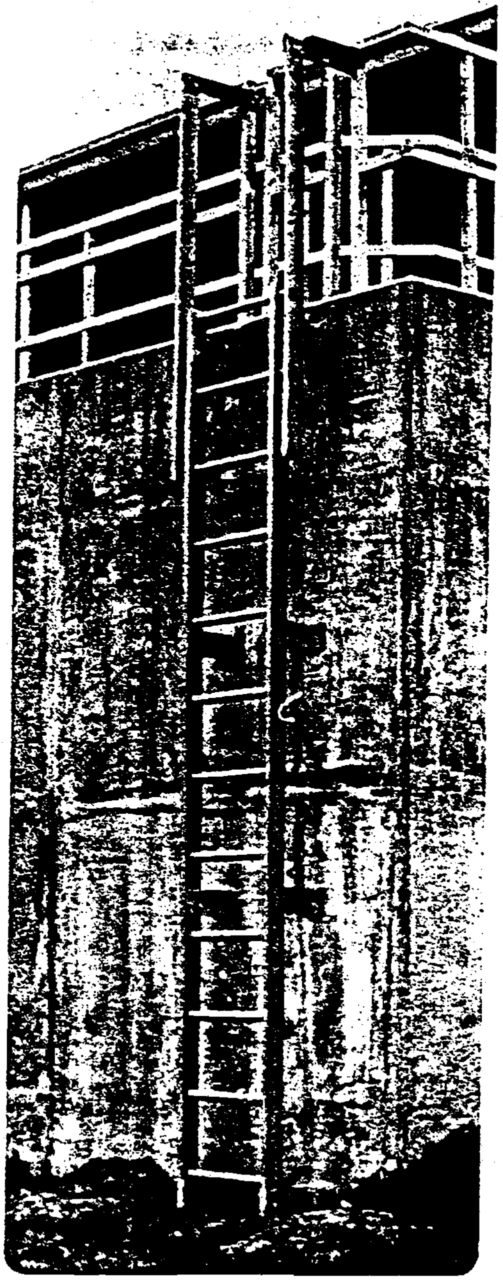
The minimum design live load is given as a concentrated load of 200 pounds. In laboratory tests, single 18" wide rungs of an IMCO Ladder section withstood in excess of **1200 POUNDS** concentrated vertical load before failure. That's **6 TIMES STRONGER** than the minimum OSHA requirement.

The reason for this strength is really to minimize deflection. No one trusts a wobbly ladder—especially at heights. IMCO Ladders "feel" safe because they're made stronger to counteract the natural tendency of fiberglass. That's why our rungs are [illegible] diameter, compared to [illegible] minimum diameter for steel rungs.

IMCO Ladders also conform to the dimensional standards established by OSHA, as do our cages. If you're concerned about OSHA compliance you can trust in IMCO Ladders. Just like the people that climb them.

DESIGN CRITERIA

The following guidelines are offered as an aid to the designer. They represent both legal requirements as stated by OSHA and specific recommendations from the manufacturer. As such, they present an overview of the most basic ladder requirements, and should be used in conjunction with the more detailed information available from OSHA.



LADDERS should be installed at an angle of 75° to 90° from the horizontal. The vertical distance between rungs must be uniform and no greater than 12", with one rung located at the level of the landing served by the ladder. The side rail should extend 3'-6" above the landing for a walk-thru type ladder and 4'-0" above for a side access ladder. The maximum allowable length for fixed ladders is 30 feet (plus rail extensions), except for smokestacks or towers. The minimum allowable clear rungs width is 16".

CLEARANCE must be maintained on all sides of the ladder: 7" minimum from the center line of the rungs to the nearest permanent object behind the ladder; 15" minimum clearance to each side from the center line of the ladder as climbing; 30" minimum from the center line of rungs to any obstruction behind the climber.

CAGES must be used on ladders greater than 20 feet high to a maximum unbroken length of 30 feet (plus extension). Cages are also recommended for short ladders at high or hazardous locations. Cages must start no less than 7 feet nor more than 8 feet above the base of the ladder.

LANDING PLATFORMS must be used at each 30 feet of height for caged ladders or 20 feet of height for uncaged ladders. Platforms must be a minimum of 24" wide by 30" long, with standard railing and toeplate. Adjacent ladder sections must be offset at each landing, but not more than 18" apart.

STANDOFF CLIPS must be used to anchor the ladder at no greater than 6 foot vertical centers.

ROOF TURNS are required at the upper platform level to brace the ladder siderail extensions, unless a guardrail or other structure can be used for support.

SUGGESTED SPECIFICATIONS

DESIGN FRP Ladders & Cages furnished under this specification shall comply with OSHA pp. 1910.27 entitled "Fixed Ladders," and shall be able to withstand a 1200 pound vertical concentrated load at midspan of a rung. Ladders shall utilize channel side rails and 1¾" minimum diameter round rungs both of special high-modulus fiberglass composition. Rung to side rail connections shall utilize a keyed, pinned, and bonded joint for positive prevention of rung rotation and pull out. Rungs shall have a factory applied epoxy/blass bead non-skid coating for maximum safety. The ladder shall be entirely non-metallic, with the exception of spliced and mounting fasteners. Standoff clips shall be provided at every 6 feet (or increment) of ladder height.

MATERIAL Material of construction shall be pultruded structural fiberglass shapes utilizing a synthetic surfacing veil for chemical and ultraviolet resistance, and Special high-modulus pultrusion process for strength. Minimum glass content shall be 60 percent, comprising both longitudinal strands and continuous strand mat so aligned as to prevent splitting due to laminar shear. The FRP shapes shall possess Class I fire retardance, with an ASTM E-84 flame-spread rating of 25 maximum. Color shall be safety yellow (beige for immersed ladders). Fiberglass pultruded parts shall be "Extren" series 525, as manufacture by Morrison Moled Fiberglass Co. with the following properties:

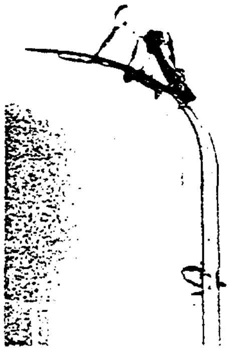
Ultimate tensile strength—30,000 psi	Modulus of elasticity—3.0×10^6
Ultimate compressive strength—30,000 psi	Barcol hardness 50

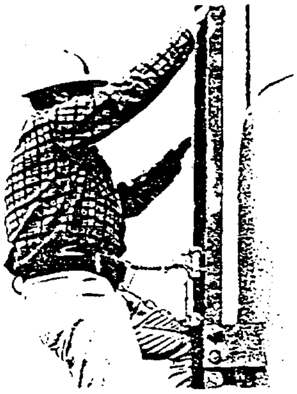
FABRICATION Shop drawings covering sizes and installation details shall be submitted. Fabrication shall not proceed until approval of drawings by purchaser or other authority. Ladders and cages shall be supplied completely assembled, ready for installation. All cut edges and holes shall be sealed with a compatible resin system. Each unit must be tagged with the manufacturer's drawing and part number of ease of field installation.

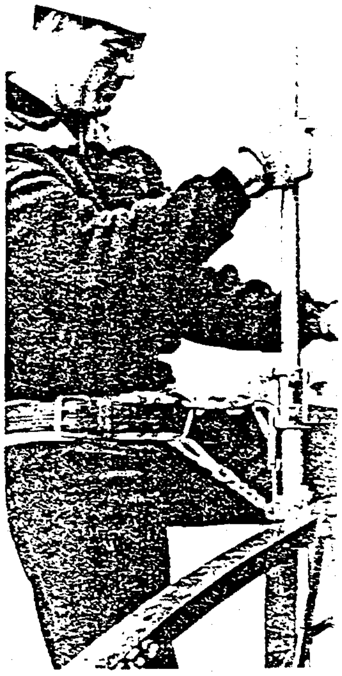
GENERAL Ladders and cages shall be shipped from the manufacturer's plant in fully enclosed crates to prevent damage in shipment and shall be as manufactured by IMCO Reinforced Plastics, Inc.

SAF-T-CLIMB

FALL PREVENTION SYSTEM



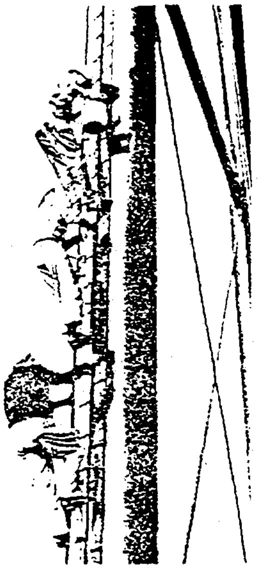


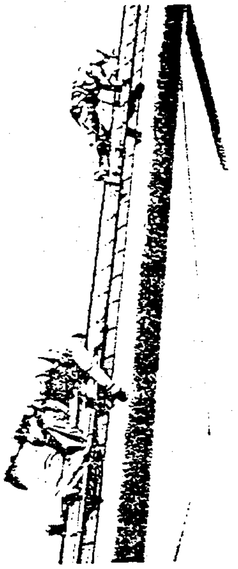


Versatile SAF-T-CLIMB can be attached to any structure that requires climbing whether above or below ground. Ladders on curved structures both convex and concave can be fitted with SAF-T-CLIMB for climber protection. Whether it be tanks, towers, silos, walls, stacks or hatch covered climbs. SAF-T-CLIMB has proven its safety, versatility and acceptance by the workers as the leader in fall prevention systems.

RESCUE

ANY NUMBER OF WORKERS CAN CLIMB SAFELY . . . on the same structure at the same time with complete individual safety [illegible] each climber is using the SAF-T-CLIMB fall prevention device. It is recommended that at least one additional sleeve and belt be available at each installation so that in an emergency, the rescuer too will have the full protection of SAF-T-CLIMB.





SAF-T-BELT

This belt withstands a minimum drop test of 250 pounds in a 6 foot free fall. Safety belt includes front rectangular "D" ring designed for attaching SAF-T-LOK sleeve snaps for positioning in the center of the climbers waist with two side "D" rings for attaching SAF-T-LANYARD or tools.

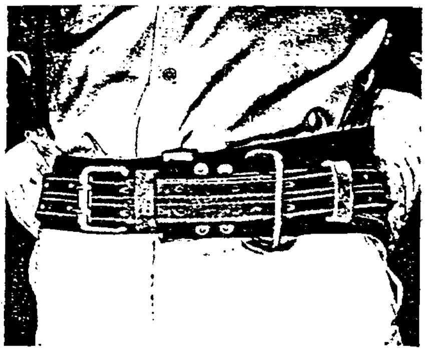
Safety Belt Parts and Material Body Pad: Three inch, black polyester with minimum strength 1,650 lbs. Harness leather loops.

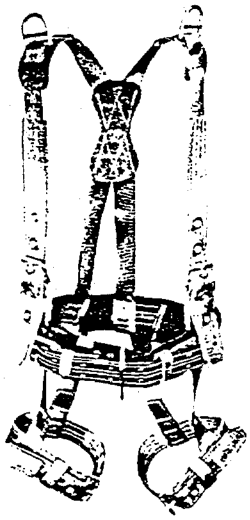
Body Strap: Type XIII nylon web with elk leather wrap. Stitching is 3060 denier nylon thread-handset copper rivets.

"D" RING: 3/8" drop forged steel. Withstands minimum tensile test of 5000 lbs. without fracture or failure.

Buckle: Drop forged mild steel with drop forged tongue and sheet steel roller, pull test 1/64" maximum deformation at 1,500 lbs.

Weight: 2-1/2 lbs.





SAF-T-CLIMB HARNESS

1. DESCRIPTION: The harness is made of woven nylon webbing straps—reinforced with elk tanned leather grommets and "D" pad. It includes; a single bar drop-forged circle "D" ring at the back; adjustable triangular drop-forged rings on each shoulder strap; forged tongue buckles for easy adjustment: shoulder and leg straps, and a waist belt with center "D" ring for attaching SAF-T-LOK sleeve snaps.

2. APPLICATIONS: The harness is designed to distribute the impact forces of a fall over the thighs, buttock, chest and shoulders. It is recommended for use where quick rescue from above a workman is necessary. A life line may be attached to either the shoulder or back "D" rings for worker rescue. The SAF-T-LOK sleeve will disengage sufficiently with upward pressure to allow raising.

Weight: 8 lbs.

SAF-T-LANYARD

A 1/2" diameter nylon filament rope adjustable from 36"—72" with a double locking snap at each end. This positioning device allows a worker using the SAF-T-BELT to attach himself to the structure, ladder rungs, stringers, etc., when he detaches himself from the security of the SAF-T-CLIMB® equipment.

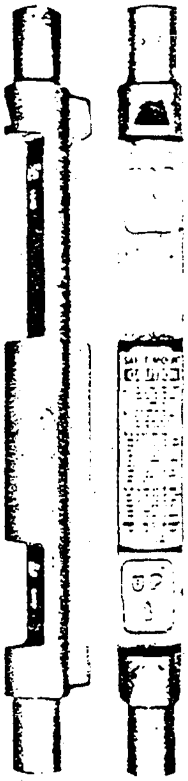
Weight: 2 lbs.

This device is for permanent insertion within the SAF-T-NOTCH rail at any desired point of climb and allows the SAF-T-LOK sleeve to be mounted or removed at these points of the climb. To use the SAF-T-MOUNT section always disconnect sleeve from belt before mounting or removing sleeve from rail. For maximum safety, use a safety lanyard when mounting or removing sleeve.

1. Manually lift locking pawl—align sleeve with SAF-T-MOUNT notched sections.
2. Turn sleeve 90° until it locks into normal position on rail.
3. Lower to waist level and connect snaps to center D ring on belt.

1. With sleeve unsnapped—align with SAF-T-MOUNT notches.
2. Manually disengage (lift) locking pawl.
3. Turn sleeve 90° and remove.

The petrochemical industry often requires more than one climber to work on the same climb at different levels. SAF-T-MOUNT sections installed 5 feet above work platform bases allows SAF-T-LOK sleeve removal so that climbers can ascend to other work platforms. The device provides access to mount the SAF-T-LOK sleeve onto the carrier rail above water surfaces where level variance occurs. Installing the device at intervals on climbs within chimneys where manlifts are used allows access to the carrier rail for emergency exits. The device has application in the grain industry where emergency escape is required.

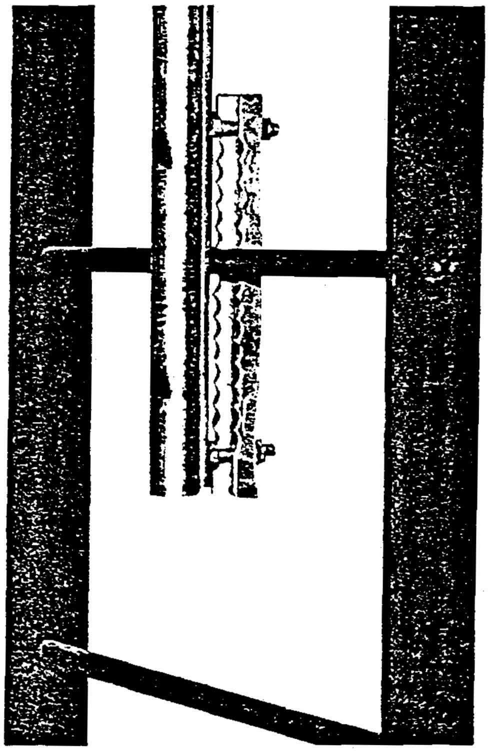


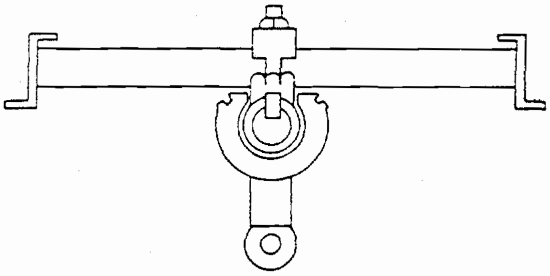
O.D. 1-5/16"
Length 15"—when installed eliminates 12" of SAF-T-NOTCH rail.

TENSILE
Cast-65,000 MIN. P.S.I.
Shipping Weight: 4-1/2 lbs.
Material Type: Ductile Iron C57G
Finish Hot Dipped Galvanized to ASTM-A-153
YIELD
45,000 MIN. P.S.I.

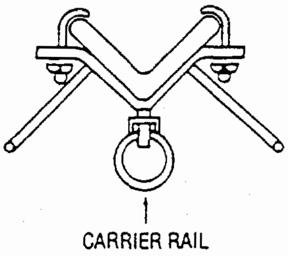
SAF-T-CLIMB® MOUNTING BRACKETS

LADDER RUNG CLAMP ASSEMBLY used to install SAF-T-NOTCH rigid notched carrier rail assembly on rung type ladders and directly onto cross members of tower structures. Assembly shall be so designed to be universally adaptable for use with any rung configuration.



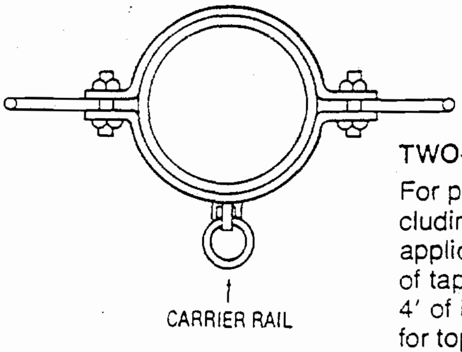


Parts and materials shall consist of a ductile iron rung clamp casting per ASTM-A-395 Class 60-40-18, 11 inches long x 1.25 inches wide with 2 slots 7/16 inch x 1.25 inch at 9 inch centers and serrated on one side. Attaching hardware to be hot dipped galvanized per ASTM-A-153 and shall include: 2 studs with 3/8-16 thread each end, 5/8" hex shoulder, 1038 steel heat treated to 120,000 PSI; 2 washers 3/8 inch flat x 1 inch O.D. type A; 2 nuts, 3/8-16 square head; and 2 locknuts, 3/8-16 hex head Palnut.



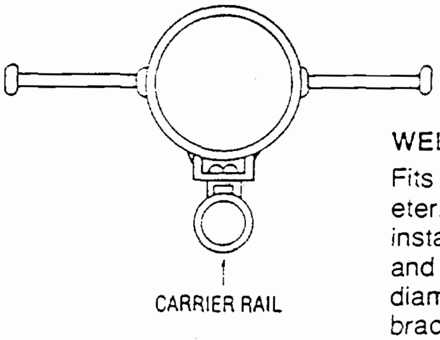
ANGLE IRON "Y" BRACKET ASSEMBLY

Fits 1-1/4" to 8" angle iron, (specify ar
iron size and whether 60° or 90° angle
Order one bracket for each 4' of instal
tion in addition to one each for top anc
bottom. Includes "J" bolts, nuts, wash
and locknuts.



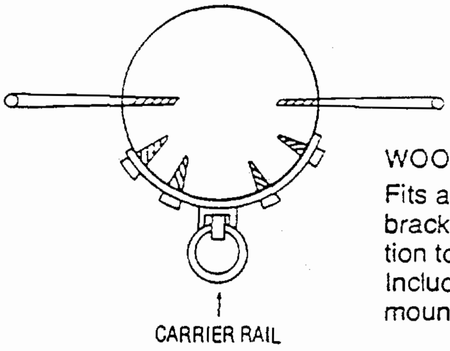
TWO-WAY POLE BANDS

For poles from 4" to 24" in diameter in
cluding tapered poles. On tapered pole
applications, please specify dimension
of taper. Order one pole band set for e
4' of installation in addition to one eac
for top and bottom. For poles less thar
diameter, contact factory for special
brackets. Includes bolts, nuts and
washers.



WELD-ON BRACKETS

Fits all shape poles 3" or more in diar
eter. Order one bracket for each 4' of
installation, in addition to one each fo
and bottom. For poles less than 3" in
diameter contact factory for special
brackets. Includes mounting bolt.

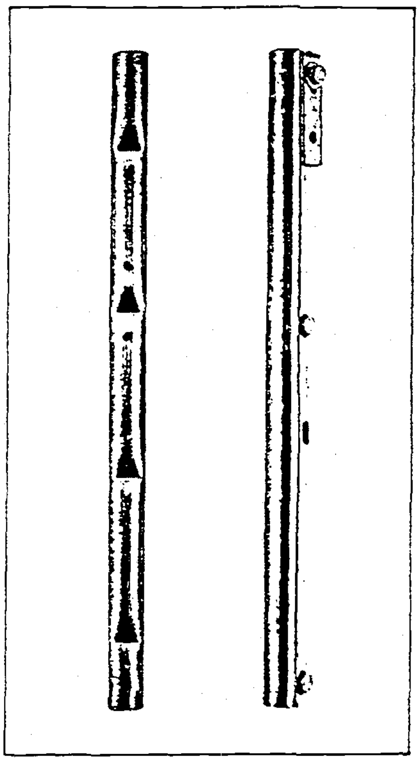


WOOD POLE BRACKETS

Fits any diameter wood pole. Order c
bracket for each 4' of installation in a
tion to one each for top and bottom.
Includes four 3/8"x 2" lag screws anc
mounting bolt.

SAF-T-NOTCH, RIGID NOTCHED CARRIER RAIL

Shall consist of mechanical steel tubing and guide channel, that is designed to form a carrier rail over which the SAF-T-LOK sleeve travels. The carrier rail shall incorporate notches every six (6) inches to provide a positive stop and lock point for the SAF-T-LOK Sleeve locking pawl to engage. The carrier rail is to be furnished in maximum 21 feet lengths or shorter random lengths in such a manner as to permit adequate connection of each of the lengths to complete the total climb requirement. SAF-T-NOTCH rail is also available in type 304 STAINLESS STEEL, and type 6061-T6 ALUMINUM and in interference free, non-magnetic, non-conductive FIBERGLASS.



SAF-T-NOTCH Carrier Rail Assembly shall consist of four (4) major components and cap screws.

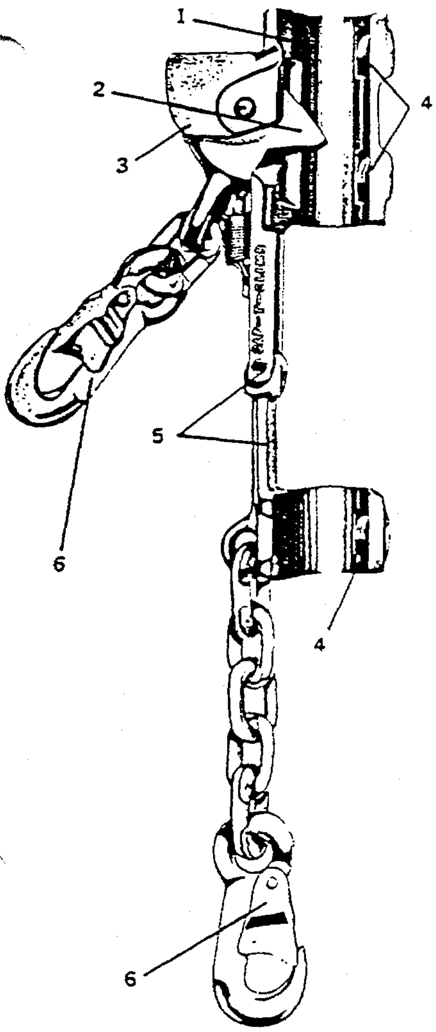
1. Rail Tubing. 1-5/16 inch O.D. x 1-inch I.D. mechanical steel tubing; .120 inch wall thickness, H.R.E.W.; standard length 21 feet; notched .875"x .875"x 5/32" at 6 inch centers; tapped 3/8"-16 at 9 inch centers opposite notches, hot dipped galvanized per ASTM-A-123.

2. Guide Channel, M-1015 steel channel 3/4"x 3/8"x 1/8" slotted 7/8"x 7/16," hot dipped galvanized per ASTM-A-123.

3. Internal Alignment Guide 1 inch OD x .065 wall x 5" C.R.E.W. tubing, hot dipped galvanized per ASTM-A-153

4. Connecting Strap. 1020 HR Steel bar 1/4"x 1"x 4" hot dipped galvanized per ASTM-A-153.

5. Cap Screws. Channel is centered on tube, with 3/8"-16 hex head cap screws with 13/32 inch shoulder, hot dipped galvanized per ASTM-A-153.



SAF-T-LOK, SLEEVE, SAFETY LOCKING MECHANISM

FIG. 1

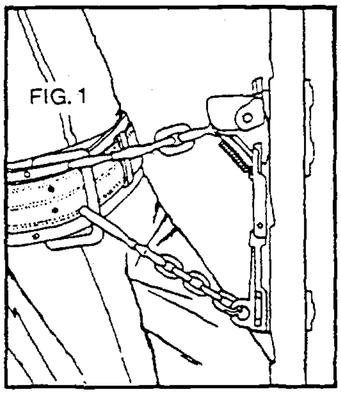
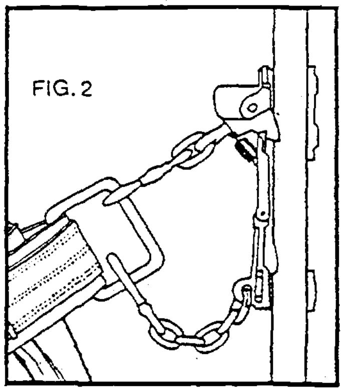


FIG. 2



Total weight approximately 4 pounds with an over-all length of approximately 9-3/4 inches.

Sleeve, cast from manganese bronze tensile strength of 110,000 P.S.I.

Locking Pawl, tensile strength of 110,000 P.S.I.

Sleeve Springs, dual stainless steel springs military specifications QQ-W-423B.

Roller Bearings six steel roller bearings Killian type SR-200-89DS provide smooth travel on carrier rail.

Snaps and Links, The Snaps are drop-forged steel. Upper Snap is proof load tested to 5,000 pounds.

The simple locking mechanism assures dependable and trouble free performance.

1. INSIDE BARREL of the sleeve is precision turned to provide correct tolerance for smooth travel on the rail.

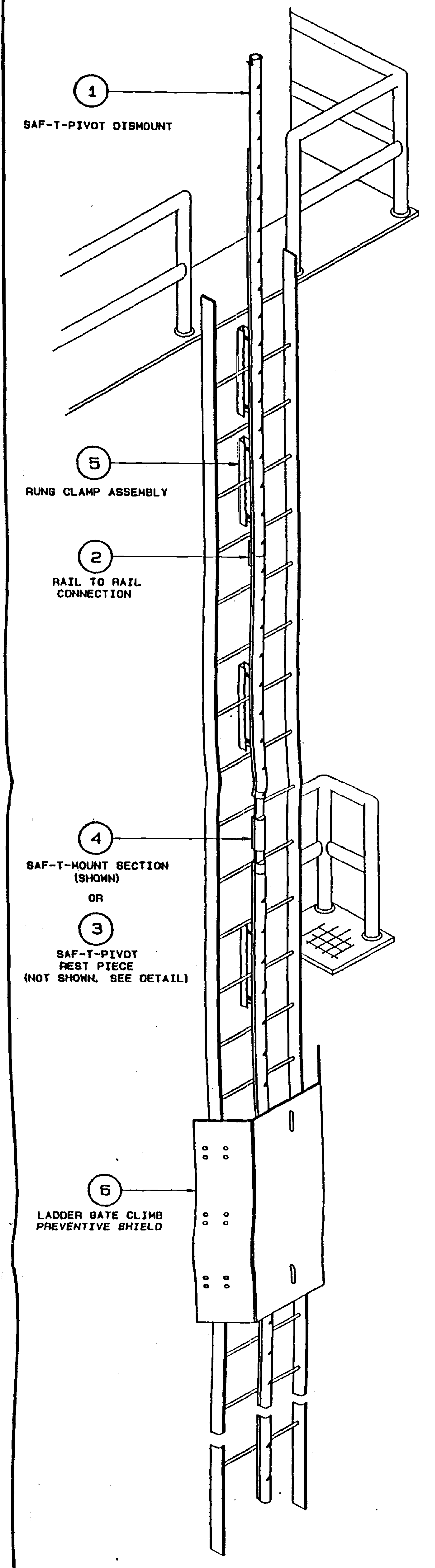
2. LOCKING PAWL is the key to the life-saving action of SAF-T-CLIMB. Figure 1 shows pawl in unlocked position as worker climbs. Figure 2 shows pawl having instantaneously locked when worker is in other than normal climbing position.

3. HOUSING contains positioning spring and stainless steel pin, which holds locking pawl in place.

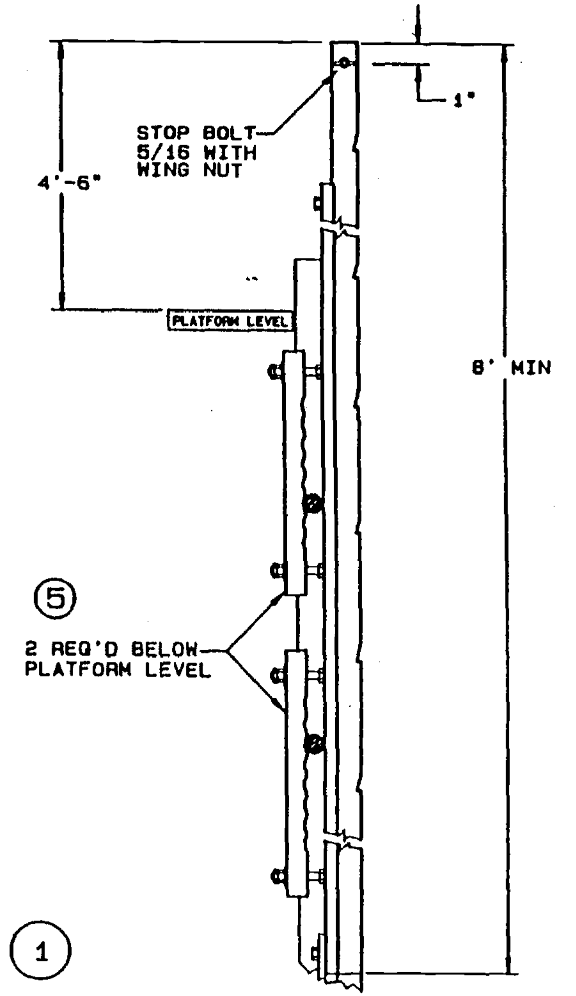
4. SIX ROLLER BEARINGS assure free travel of the sleeve on the carrier rail.

5. LOWER SLEEVE provides lift for sleeve assembly and is hinged to permit travel over curves where they exist.

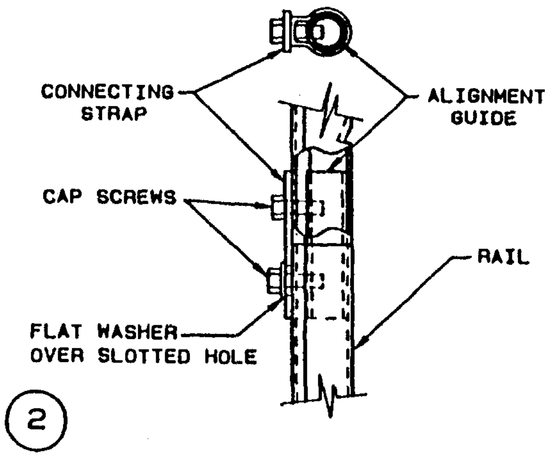
6. SAFETY SNAPS attach the sleeve to the front "D" rings on the SAFETY BELT. Upper snap controls the action of the locking mechanism of the sleeve.



FOR USE AT TOP OF CLIMB WHERE SLEEVE MAY NEED TO PIVOT OR BE REMOVED.

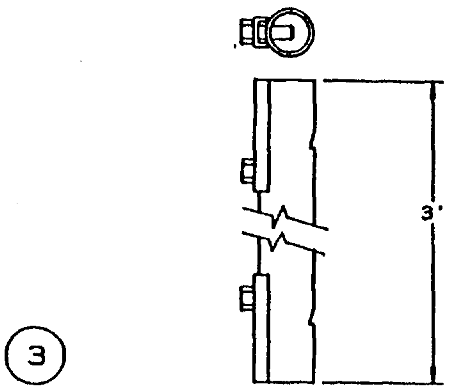


SAF-T-PIVOT DISMOUNT



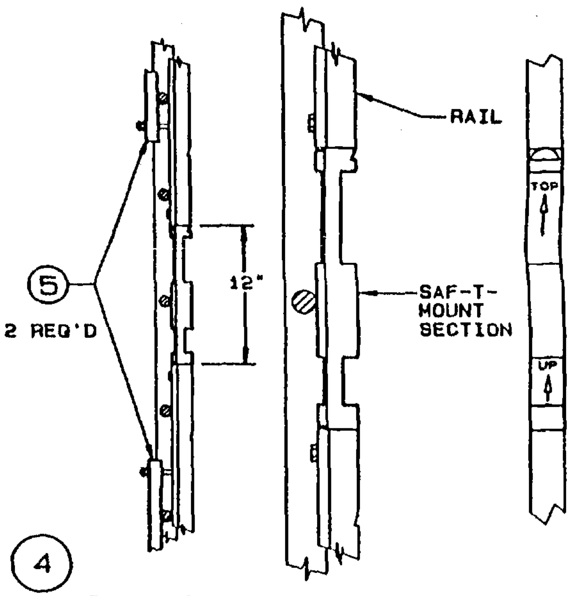
RAIL TO RAIL CONNECTION

FOR USE AT LANDING POINTS WHERE SLEEVE NEEDS TO PIVOT, BUT <u>DOES NOT</u> ALLOW SLEEVE TO BE REMOVED FROM RAIL.



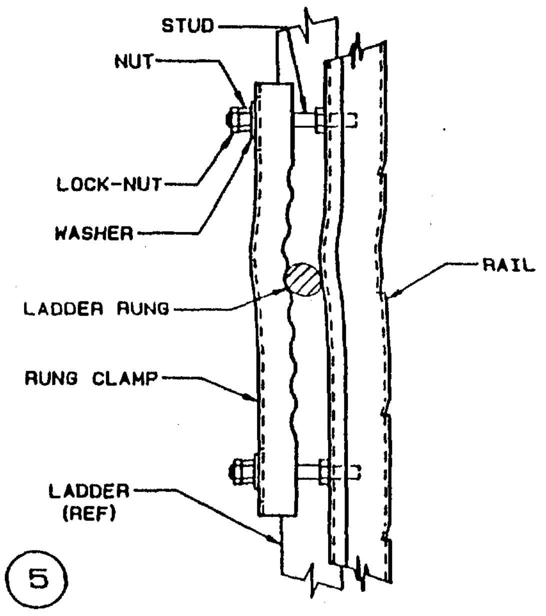
SAF-T-PIVOT REST PIECE

FOR USE AT LANDING POINTS WHERE SLEEVE NEEDS TO BE REMOVED FROM RAIL.

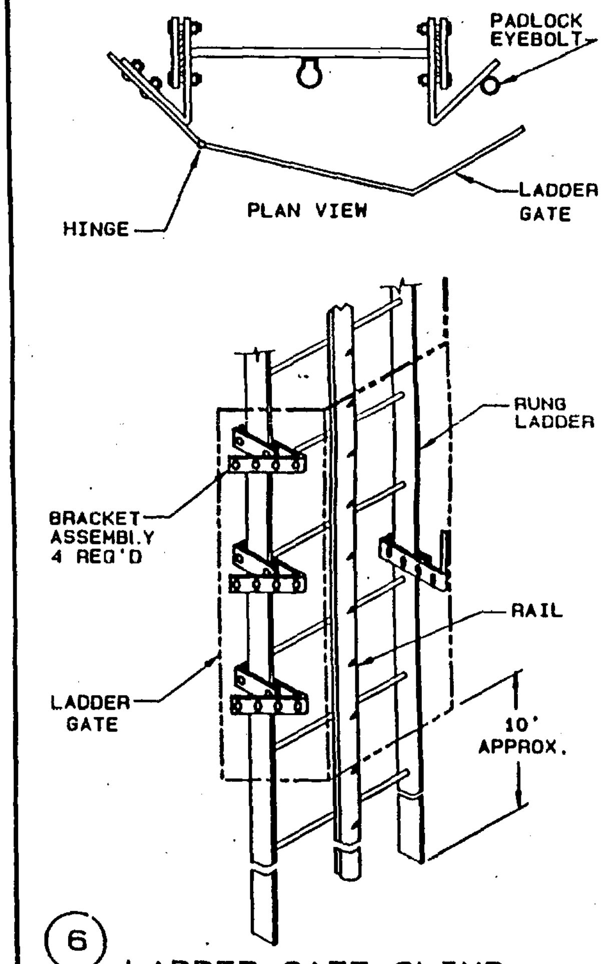


SAF-T-MOUNT SECTION

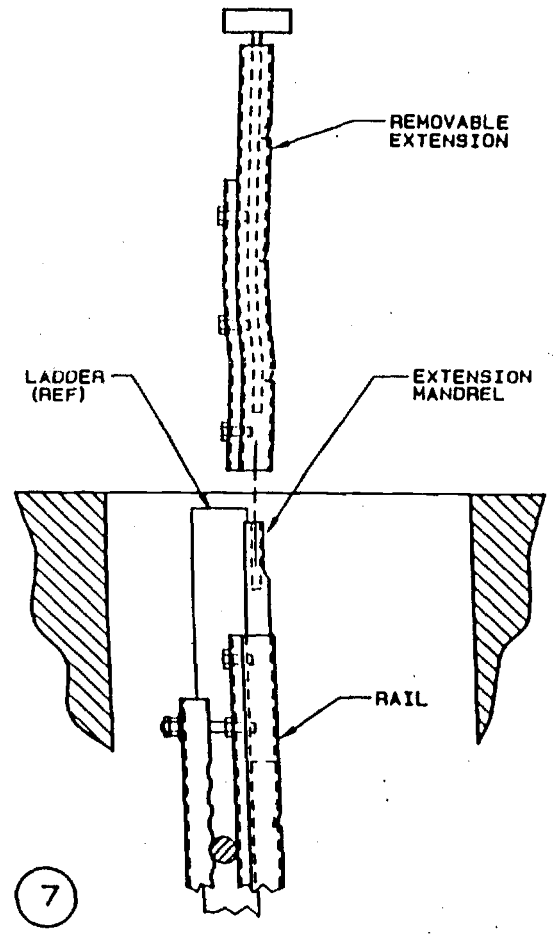
RUNG CLAMP ASSY TO BE AT 6' MAXIMUM SPACING.



RUNG CLAMP ASSEMBLY



LADDER GATE CLIMB PREVENTIVE SHIELD ASSY



REMOVABLE EXTENSION KIT

NORTH CONSUMER PRODUCTS
2664-B SATURN ST., BREA, CA. 92621
714-524-1665

SAF-T-CLIMB APPLICATION TO RUNG LADDER

SCALE NONE
DRAWN BY [illegible] DESIGN DRAFTING SANTA ANA, CA. [illegible] 714-[illegible]
DATE 8-23-88
REV

02348HH032

National Environmental Systems, Inc.
Paint System

The 500 Hour Salt-Spray Fog Test is applicable for a painting system applied to a metal tower. Since the tower National Environmental Systems (NES) is providing is fiberglass and this test is not performed on fiberglass towers, we are unable to provide certification of this salt-spray test.

NES has provided numerous painted/surface coated air stripper towers to numerous locations and we have had no problems with the paint/surface coat of these towers because the paint is pigmented within the gel coat.

COREZYN®

TECHNICAL DATA SHEET

INTERPLASTIC CORPORATION
Commercial Resins Division

1219 Wolters Boulevard
Saint Paul, Minnesota 55110-5145
(612) 481-6860 Fax (612) 482-9041

W-113-SCN

Off White NPG Surface Coat

DESCRIPTION:

W-113-SCN, Off White NPG Surface Coat, is made from an Isophthalic NPG base resin and is compounded to produce an air dry, flat, tough, hard and durable finish with high resistance to moisture penetration, staining, crazing, abrasion, and weathering.

W-113-SCN is designed for use on any laminated surface, concrete, masonite, masonry blocks, wood, and on metals provided the surface is properly primed.

TYPICAL PROPERTIES:

Viscosity, Brookfield LVF #4 spindle @ 06 rpm @ 77°F:	12,000 - 14,000 cps
Thix Index:	5.3 - 7.0
Gel Time @ 77°F with 2% MEK Peroxide:	8 - 10 minutes
Weight/Gallon:	9.80 - 11.00 lbs.

APPLICATIONS AND PRECAUTIONS:

W-113-SCN is applied by spray with conventional and airless spray equipment. Brushing or rolling are not recommended due to poor flow and leveling of the product by such application process. The product must not be used when temperature conditions are below 77°F as curing properties may be adversely affected.

STORAGE LIMITATIONS AND HANDLING:

W-113-SCN is stable for three months when stored at 70°F to 77°F in a closed and opaque container. Refer to Material Safety Data Sheet for details on safety and handling of W-113-SCN, Off White NPG Surface Coat.

TDS: 4/24/95

KMK:spc

ICPA SP

I.

Warranty Information

Your National Environmental Systems air stripper will give you long term corrosion-free performance when it is handled and installed in accordance with this specification. This manual should be read in its entirety before proceeding further. Failure to comply with these provisions shall invalidate the warranty, regardless of the inclusion or omission of any applicable suggestion in these instructions.

The Purchaser is fully responsible for proper inspection, handling and installation. Purchaser shall insure that good workmanship practices and construction procedures are followed during the handling and installation of the system. The Purchaser accepts all liability for loss of or damage to the air stripper resulting from improper handling and/or installation. Unknown situations or conditions not covered in this specification must be the responsibility of the Purchaser. The presence of a National Environmental Systems Representative at the site does not relieve the Purchaser of its responsibility for proper handling and installation. Any questions should be directed to the factory in Seekonk, Massachusetts, at (508) 761-6611 or to your local National Environmental Systems Representative.

Effective 5/15/90

Warranty Conditions

This Warranty is a LIMITED warranty; anything in the warranty notwithstanding. Implied warranties for particular purpose and merchantability shall be limited to the duration of the express warranty. National Environmental Systems, Inc. expressly disclaims and excludes any liability of consequential or incidental damages for breach of any express or implied warranty.

National Environmental Systems, Inc., equipment is warranted as to workmanship, material, and performance when properly installed, used, and cared for provided that all original design parameters including water temperature, influent concentrations, flow rate, and other analyses provided represent actual field parameters at the time of operation, subject to verification by an EPA certified laboratory. All electrical connections should be installed by an electrician licensed within the State of installation. Should any part prove defective within twelve (12) months from date of shipment, it will be replaced F.O. B. destination without charge, provided the part is returned to National Environmental System, Inc. transportation charges prepaid. Exception to this warranty will be pump hoses and pump seals; these items will be subject to the same warranty except for a period of six (6) months from date of shipment. Due to the wide variety of possible applications and conditions of use, no express or implied warranty is made for carbon adsorption systems for performance, safety, or suitability for particular purpose.

No allowance will be made for labor, transportation, or other charges incurred in the replacement or repair of defective parts by the customer. This warranty does not apply when damage is caused by sand or abrasive materials pumped with the fluids, lightning, improper voltage supply, careless handling, improper installation, improper well design, or corrosion due to substances that were unknown to National Environmental Systems, Inc. at the time of shipment.

Any alteration or disassembly of equipment without proper authorization from National Environmental System, Inc. voids all warranties stated herein.

Prices and Specifications are effective only in the continental USA and are subject to change without notice.

F.O. B. Point and Title: All material is sold F.O. B. factory. Title to all material sold shall pass to buyer upon delivery by Seller to carrier at shipping point.

Special Data and Drawing Charges are subject to Factory determination.

II.

Inspection, Handling and Off Loading of Air Strippers

INSPECTION

Inspect your air stripper immediately upon receipt. Claims for any damage which might have occurred in transit should be filed promptly by the Purchaser with the delivering carrier.

National Environmental Systems air stripper are crated, skidded, or blocked for shipment in accordance with the carrier's rules and are thoroughly inspected prior to shipment. Nevertheless, damage can occur in transit because of the extreme magnitude of physical shock which transportation methods can occasionally cause.

What to Look For

First of all, there can be structural damage which will be quite obvious such as a break or tear right through the tower wall, as could occur, for example, if the tower hit an overpass during transit.

Most inspections, however, will be concerned with damage caused by reverse impact, i.e., because of physical impact on the exterior, the tower will have been bent in to the point where it cracked the interior resin rich surface and then returned to its normal position. Such damage might occur at the points of blocking when, for example, a freight car is "bumped" severely. There is usually a readily visible discoloring of the tower wall in these areas. Such damage, confined solely to the exterior tower surface, may be merely superficial. Whenever there are cracks or star-shaped crazes which are actual breaks in the interior resin rich surface, repair work, which is usually quite simple, is nevertheless essential.

Call your National Environmental Systems Sales Representative to discuss any questions after noting the damaged condition on the carrier Bill of Lading.

HANDLING

National Environmental Systems air stripper are designed to withstand normal handling procedures. Listed below are procedures to follow to avoid damage:

1. Proper rigging practices should be observed at all times. Hoisting equipment operators should attach a guide line to prevent the tower from swinging out of control and striking another object.
2. Do not drop the tower or allow it to fall hard in the process of inverting, turning, or moving.
3. Do not roll or slide the tower on rough surfaces of gravel, and never roll over a fitting.
4. In working around the tower, care should be exercised to prevent tools from striking or being dropped inside it. Ladders used outside in contact with the tower must be wooden or have rubber protection on both ends and not be permitted to scratch the surface.
5. Under no conditions should chains or cables be put around the tower.
6. When storing the tower on the ground prior to installation, place it on the shipping cradles with their padding and tie it down so that it cannot roll due to winds or sloping elevation.

OFF LOADING/PRE-INSTALLATION PROCEDURES

National Environmental systems air strippers are shipped horizontally on shipping cradles and either strapped to the cradles or strapped to the flat car or truck bed. The Air Stripper blueprint at the end of this manual gives approximate weight and dimensions.

If possible, set the load on dollies to transport to the desired location. If a fork lift truck must be used make certain the forks are long enough so the points will not dig into the tower wall, or use padding where necessary.

Larger air strippers are shipped either on a ail flat car or flat bed truck and strapped to the car or the truck bed. The recommended method for removing and placing such a tower is to lift with slings and a spreader bar. Place the slings to balance the load and use a guide line to keep the load under control. Use canvas or nylon slings properly sized to lift the load (consult your crane operator for specific lifting instructions). If the air stripper is not immediately going to be installed onto the foundation, be certain to set it on the ground using the shipping saddles and padding where needed, and tie the unit down.

Depending upon Air Stripper weight, it may be necessary to use two lifting cranes with single or double slings. Consult your crane operator for specific lifting instructions.

The tower influent piping is shipped unattached to the tower itself. It may be easiest to assemble and attach this piping to the support brackets while the tower is in the horizontal position before being set on the concrete pad. Any hardware or couplings needed are shipped in a smaller carton. This carton may be placed inside the air stripper top spray area before the wooden shipping plate is secured to the tower. This plate ensures that the packing media will not roll out during transit. This plate **must be removed** before system start-up and may be best done during the uprighting procedure, when the tower is at an inclined angle from the horizontal position.

A mist eliminator is used to remove any moisture from the exiting air stream. It is shipped with the blower and instrumentation and should be installed onto its support ring during the uprighting procedure.

Turning Air Strippers Upright

Care must be exercised in turning horizontally shipped air strippers into the upright position. Air strippers are specially designed with lifting eye bolts or lifting lugs. Refer to your air stripper blueprint for this information.

To turn your air stripper upright, use the lifting devices attached to the air stripper and a spreader bar to avoid bending the air stripper out-of-round. When top flange eye bolts are provided, it is important to use heavy washers or plates on both side of the flange to prevent damage.

III.

Installation of the Air Stripping System

TOWER INSTALLATION

Air Strippers must be installed on a level foundation which provides firm and continuous support. The foundation must have sufficient strength to support the weight of the air stripper under operating conditions without any sagging. A qualified civil engineer should be consulted on the foundation design and construction. See air stripper blueprint for approximate operating weight. The length and width of this foundation depends on tower diameter and other components in the treatment system.

If the foundation is rough (use of existing pad, poor concerete finish work, etc.), grouting is recommended.

When providing for openings in the foundation for bottom projecting fittings, always keep the unsupported area around the fitting to a minimum, and round all the corners of the foundation cut-out.

All tie down lugs must be used to secure the air stripper to its pad. Before the lugs are tightened, level the air stripper. Shim the lugs whenever there is any space beneath the lugs. Bolt sizes and proper tightening procedures are illustrated on the air striper blueprint.

Guy wires and turnbuckles should be used to further support the tower. National Environmental Systems, Inc., suggests using 1/4 inch or 3/8 inch insulated aircraft cable for guy wires. Eyebolts, lifting lugs or specially designed guy wire lugs may be used, depending on the air stripper height. The lugs are indicated on the air stripper blueprint. Three or four equally spaced guy wires should be installed at a 45° angle from the tower.

The instrumentation supplied by NES should be installed next. The temperature gauge should be threaded into the 1/2 inch FNPT coupling provided in the tower shell. The magnehelic gauge should then be installed. Using the hardware provided with the magnehelic gauge, plug both the high and low pressure ports located on the back of the gauge. Thread one of the 1/8 in MNPT hose barb fittings into the high pressure port located on the side of the gauge. Leave the low pressure port on the side of the gauge open to atmosphere.

The magnehelic gauge is then installed onto the FRP gauge bracket. Thread the other 1/8 inch MNPT hose barb fitting into the matching FNPT coupling provided in the tower shell. The two fittings may now be connected using the vinyl tubing provided. For exact locations of instrumentation items, refer to your air stripper blueprint. The gauge is used to measure the approximate pressure drop across the packed section of the tower.

Valves and piping attached to the air stripper should be independently supported. Follow accepted good piping practices. Flanged nozzles must be gasketed with 1/8 inch thick full face gaskets.

In geographical regions where freezing of stagnant water is a possibility, freeze protection on the system should be considered. The influent piping running up to the top of the tower, the tower sump up to the air inlet, the siphon drain, and any piping running above ground or not buried below the frost line are most susceptible to freezing. A method of freeze protection is to heat tape and insulate (with foam) all of the above mentioned areas of the air stripper. Installing the system inside a heated shed will also prevent freezing.

BLOWER INSTALLATION

The blower is installed on the concrete pad or a stand. Both must be properly anchored. The blower is connected to the tower air inlet by using a flexible duct kit, which includes; duct, neoprene wrap, and clamps. The neoprene wrap can be used to make a flexible connection between two pieces of duct that are the same inside diameter. To join the two sections of duct, butt them together and then back off so that a 1/4 inch gap is visible between the two ends. Wrap the neoprene around the gap and the two duct ends using clamps. NES provides a transition piece so that the blower to tower air inlet connection can be easily made.

Once the blower has been anchored down and it is connected to the tower air inlet, it must be wired to a power source by a licensed electrician. A motor wiring diagram is provided on the motor housing to indicate proper electrical connections. Proper wire and circuit breaker sizing is essential and accepted electrical practices must be followed.

Note: The blower is normally shipped with damper in closed position. The damper must be opened prior to start up.

IV.

System Start-Up

During initial start-up as well as during each and every monitoring period, several items should be checked and their status noted. These are water temperature, magnehelic reading, packing fouling, and influent water flow rate. A general overview of the entire system should also be noted. Throughout the monitoring period, influent and effluent water samples, are necessary to evaluate system performance. This is in addition to those items mentioned above. An air stripper needs several hours of "packing wetting" upon start up for the packing media to reach peak efficiency.

The blower air damper can be adjusted to increase or decrease the air flow rate. The damper may be one of two types: a slide gate device mounted on the blower air inlet or a blade type mounted on the blower discharge. To operate the slide gate type, loosen the thumb screw or bolt. Slide the gate to adjust desired air flow and tighten. To operate blade type, loosen the wiring nut. Adjust the blades by moving the control arm to adjust desired air flow, then lock into place by tightening the wing nut.

V.

Optional Accessories

National Environmental System, Inc., can provide various accessories with its air stripper. If your system utilizes any of these accessories, a specification sheet is included in the back of this manual. Please consult NES for additional wiring assistance. Installation of accessories is discussed below:

1. **BLOWER PRESSURE SWITCH** - The blower pressure switch will sense complete loss of blower air pressure and in turn, shut down influent water supply pumps. It is connected to the differential pressure port previously discussed by using the tee fitting and tubing provided in the switch carton. This switch can be Normally Open (N.O.) or Normally Closed (N.C.).
2. **SUMP OVERFLOW SWITCH** - This is used to shut down any influent water supply pumps if the tower sump backs up with water due to effluent piping or infiltration gallery plugging. This switch is threaded into the 3-inch FNPT half coupling provided in the tower (at an elevation below to the air inlet) by using the reducer bushings provided. This switch can be Normally Open (N.O.) or Normally Closed (N.C.).
3. **CLEARWELL** - A clearwell is an enlarged sump at the base of the tower and its diameter is larger than that of the tower itself. Each clearwell is individually sized in accordance with the system's flow rate and design requirements. The size is illustrated on the air stripper blueprint.

   When installing the stack section onto the clearwell, make sure that the proper orientation of the two sections (stack and clearwell) is obtained as shown on the air stripper blueprint. Bolt the top clearwell flange to the tower section bottom flange using the gasket and bolt sets provided. The gasket and bolt sets are shipped separately in a carton.
4. **DOME TOP** - A dome top can be supplied to provide for easy attachment of ductwork to the air stripper top. If the air stripper is provided with a dome top, it should be connected to the top flange using the gasket and bolt sets provided. The gasket and bolt sets are shipped separately in a carton.
5. **SITE GLASS** - A site glass is used to inspect the water level in the air stripper sump or clearwell. It is attached to the flanged connections, as shown on the air stripper blueprint, using the gasket and bolt sets provided.

VI.

Packing Maintenance

In order to avoid problems associated with fouled packing, the pack should be cleaned as a part of regular maintenance procedure. If the packing has become fouled or clogged, you may correct the situation by cleaning with an acid wash solution or by changing the packing. Refer to the acid supplier's recommendations for handling the acid solution. The entire system should be shut down prior to changing or cleaning the packing.

I. Cleaning Packing

Shut down water supply to the air stripper tower. Circulate an acid wash solution through the air stripper influent piping. The frequency and number of cleaning passes will depend on degree of packing fouling. Note that the blower should remain turned off during the cleaning process. Check your local regulations for disposal of the acid material. The following wash solutions are recommended: for iron oxide fouling, use a 3% muriatic acid solution; for calcium carbonate fouling, use a 3% to 5% polysodium phosphate solution; for biological fouling, use a 3% to 5% potassium permanganate solution.

II. Changing Packing

To remove fouled packing, unbolt the viewport (see air stripper blueprint for location). If the packing is too fouled to fall out smoothly, it may have to be "prodded" out with a pole. After packing has been removed, reassemble the viewport. Remove demister and/or dome top and dump in packing to the height shown on the air stripper blueprint.

VII.

Trouble Shooting

I. Misting

- Check water distribution spray pattern at tower top and make sure spray is hitting packing media and <u>not</u> the air stripper wall. Check to see if there is proper spacing as indicated on the air stripper blueprint.

- Check actual influent water flow rate with a flow meter and adjust flow rate to be in accordance design flow rate.

- Check to see if spray nozzle(s) is out of plumb and readjust if necessary. If using a pipe wrench, caution should be used in order to prevent piping damage.

- Check for excessive blower pressure or air flow rate using the magnehelic gauge and blower performance data located in the back of this manual. Adjust the blower damper as previously discussed to correct for excessive air flow rate and /or pressure.

II. Efficiency Loss

- Check operating conditions (flow rate, temperature, contaminant levels) against design parameters. Either adjust these conditions so that they are in accordance with initial design parameters or retrofit the system with necessary changes.

- Check for packing fouling. Refer to packing maintenance section of this manual.

- Check for water channeling down the inside wall of the air stripper by checking the water distribution pattern at the tower top.

III. Noisy Blower

- Check the condition of the motor bearings and replace or lubricate noisy bearings as per the motor manufacturer and/or National Environmental Systems.

- Check for a dented inlet screen mounted on the blower air inlet and the screen guard located on the end of the motor housing. To correct, remove the screen(s), correct any dents, and replace.

- On belt driven fans, check for rubbing between the fan wheel blades and the inlet cone of the blower air inlet (see the blower section of this manual for location of these components). To correct, loosen the bolts around the perimeter of the inlet cone section, adjust the inlet cone and tighten the bolts.

NATIONAL
ENVIRONMENTAL INC.
SYSTEMS

36 Maple Avenue • Seekonk, Massachusetts 02771
508 761-6611 FAX 508 761-6898

OHM - Camp LeJeune

Engineering

Air Stripper Process Calculations.	with submittals
Air Stripper Structural Calculations.	with submittals

Fabrication Schedule

Purchase Air Stripper Components.	week 1 *
Fabricate Air Stripper Components.	weeks 1 - 3 *
Fabricate Air Stripper Shell.	weeks 1 - 4 *
Assemble Air Stripper Shell.	weeks 4 - 6 *
Install Air Stripper Components.	weeks 6 - 7 *
Fabricate Ladders and Platforms.	weeks 1 - 8 *
Install Ladders and Platforms.	weeks 8 - 9 *
Paint Air Stripper.	weeks 9 - 10*
Final QC of Air Stripper.	week 10 *

* after approval

TS to 20
diff press
Change Cart

END HD: 8" STD WELD CAP	SA-403-304
ENTRY FLANGE: 8"-150# RFWN FLG	SA-182-304
VALVES: GRINNELL (#S15W-2122-1)	
SKID:	SA-36

DESIGN INFORMATION

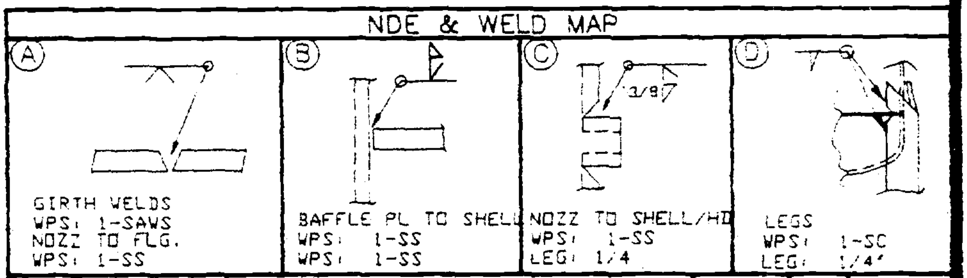
ASME CODE "U" STAMP PER SEC. 8 DIV. 1 E92 A93

MAWP	150 PSIG 100°F
MDMT	0°F AT 150 PSIG
NATIONAL BOARD	NO
CORROSION ALLOWANCE	NONE
POSTWELD HEAT TREAT	NONE

NON-DESTRUCTIVE TESTING

1	RADIOGRAPHY:	NONE
2	HYDROSTATIC TEST PRESSURE:	225
3	PNEUMATIC:	NONE
4	MAGNETIC PARTICLE:	NONE
5	BRINELL:	NONE

NDE & WELD MAP



TOLERANCES
FAB ± .063
MACH. ± 0.032
ANGLES ± 0.5

REVISION	DATE	BY	REV. NO.
ADDED FLG GASKET & O-RING SEALS	5/15/95	CK	2
CHANGE IN/OUT LOCATION	5/5/95	CK	1
APPROVAL DRAWING	3/31/95	CK	0

QUALITY
CRALL
ENGINEERED PRODUCTS

748 S. PRICE RD. BOX 1640
PAMPA TEXAS 79066

PHONE (806) 665-8446
FAX (806) 665-9736

ASEM. NO	MODEL NO. 3PS-S04-16-18-54-S	EST DRY WT 150 EA
NAME	CRALL FILTER VESSEL	
CUSTOMER	JOHNSON FILTRATION	
EQUIP NO		
SERVICE		

DRAWN:	CHECKED	APPROVED	CRALL JOB NO.
C.KADRMAS			32832
SIMILAR TO	DATE	SCALE NTS	

MITTAL REVIEW
; FOR GENERAL COMPLIANCE
CONTRACT DOCUMENTS
ONSIBILITY IS ASSUMED FOR
SS OF DIMENSIONS OR DETAILS.
ACTOR/SUPPLIER SHALL ASSUME
NSIBILITY FOR DEVIATIONS FROM
EQUIREMENTS NOT SPECIFICALLY
ATED ON THIS SUBMITTAL.

PTIONS ☐ MAKE CORRECTIONS NOTED

ND
T ☐ REJECTED - SEE REMARKS

-95 BY

M EMEDIATION
E CES CORP.
NORCROSS, GEORGIA

Johnson
Filtration Products, Inc.
P. O. Box 30010
Amarillo, Texas 79120-0010
(806) 371-8033

A Leading Edge Company In Filtration . . .
Johnson Brings You High Tech Solutions
To Your Filtration Problems.

Our Filters Meet The Rigid Requirements Of:

- U. S. Government
- Power generation companies
- Petro/chemical industries
- Water treatment plants
- High tech industries
- Scientific/research applications
- Medical installations
- Nuclear plants
- Aerospace
- Beverage industry
- Food and drug industry
- Oil and gas industry

Standard Filter Cartridge Specifications

J ~~X~~ EP 10 R ~~18~~ 30 P — — —

J SERIES

MEDIA

C = Bleached Cotton [illegible]
EC = White Cotton
U = Natural Cotton
R = Rayon
EP = Polypropylene
[illegible] = Polypropylene [illegible]
[illegible] = [illegible]
G = Fiberglass
[illegible] = [illegible]
Z = [illegible]
Y = Polyester
N = Nylon
O = Acrylic
M = Modacrylic
X = Special

CORE EXTENDERS

No Symbol = None
EP = Polypropylene
E[illegible] = [illegible] S.S.

END TREATMENT

No Symbol = None
[illegible]
[illegible]
[illegible]
G = Gaskets

CORE COVERS

No Symbol = None
V = Cover compatible w/filter media

MICRON RATING

.5	15	75
1	20	100
2	25	125
3	30	150
5	40	200
10	50	350

CORE MATERIAL

T — Tinned Plated Steel
P — Polypropylene
PH — Heavywall Polypropylene
S — 304 S.S.
A — 316 S.S.
1 — [illegible]
PF — Polypropylene [illegible]
X — Special

DIAMETER

T = 2"
F = 2¼"
R = 2½"
S = 2¾"
P = 3"
X = Special

LENGTH

10	19	30	50
12	20	36	60
[illegible]	27	39	70
18	29¾	40"	72"

SUBMITTAL REVIEW

REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS. [illegible]

CONTRACT REQUIREMENTS [illegible] INDICATED ON THIS SUBMITTAL.

☒ NO EXCEPTIONS ☐ MAKE CORRECTIONS NOTED

☐ AMEND AND RESUBMIT ☐ REJECTED - SEE REMARKS

Date 6-12-95

OHM REMEDIATION SERVICES CORP.
NORCROSS, GEORGIA

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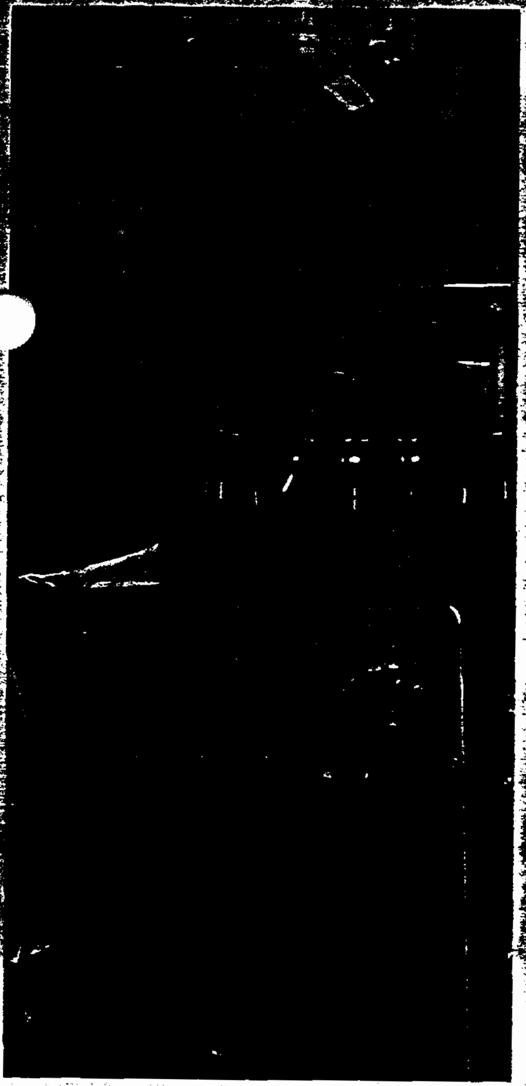
FAX (806) 372-5257

VERS AND . . .

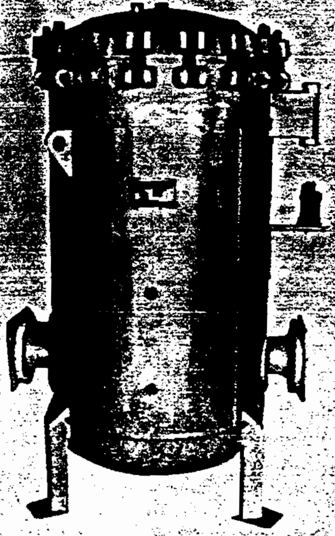
Johnson . . .

A Name That Stands For Service To Our Customers.

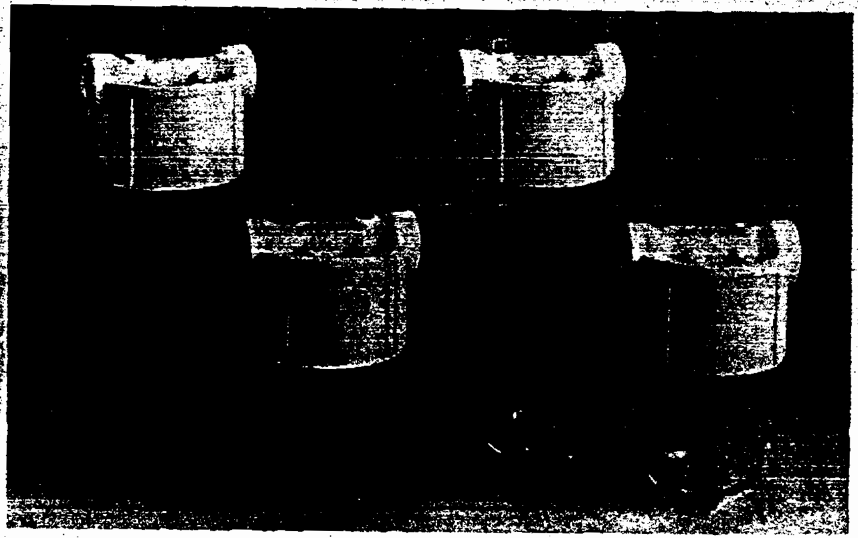
We offer field service, inspection and troubleshooting to support our cartridge and vessel systems. We provide a complete line of metallic and non-metallic filter vessels.



Field Service & Troubleshooting



Metallic & Non-metallic Filter Vessels



. . . MORE . . .

PROBLEM - SO

Our Innovative Filtration Solutions Are Supported By More Than Twenty Years Of Filtration Expertise.

Special winding and high quality materials assure better filtration, longer life and an overall performance that results in cost savings and more productivity for people who select Johnson products.

Our Continuous-Wound Cartridges Feature:

- No joints
- Uniform flow through the entire element
- No bypass
- Uniform winding assures accurate micron retention
- Horn pattern winding gives progressive depth filtration
- Quality materials
- Unlimited continuous lengths

Johnson

Filtration Products, Inc.

P. O. Box 30010
Amarillo, Texas 79120-0010
(806) 371-8053

A Leading Edge Company In Filtration...

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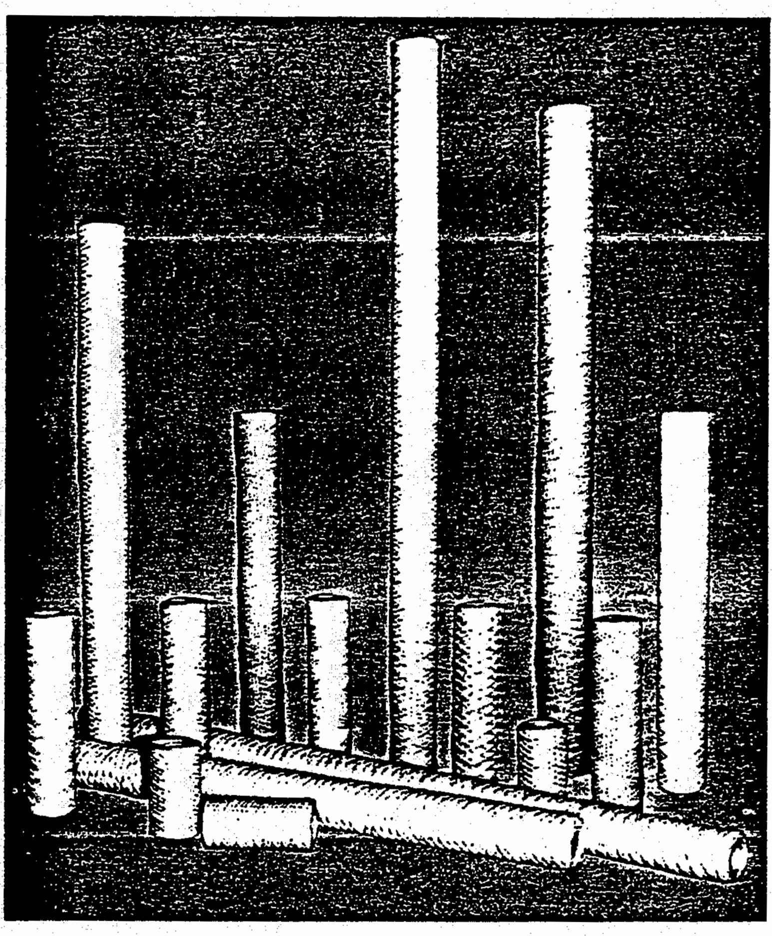

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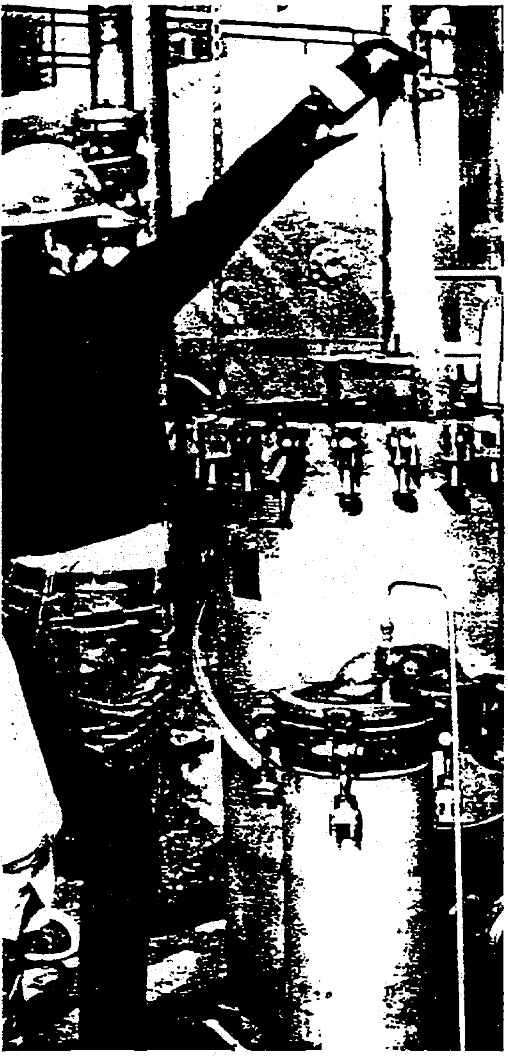
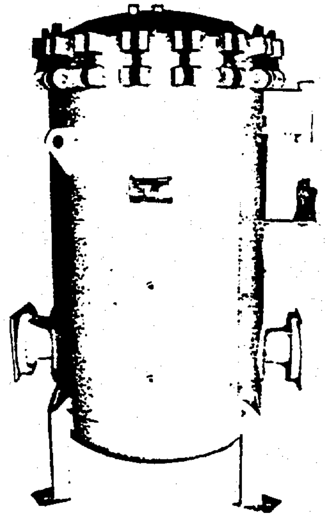
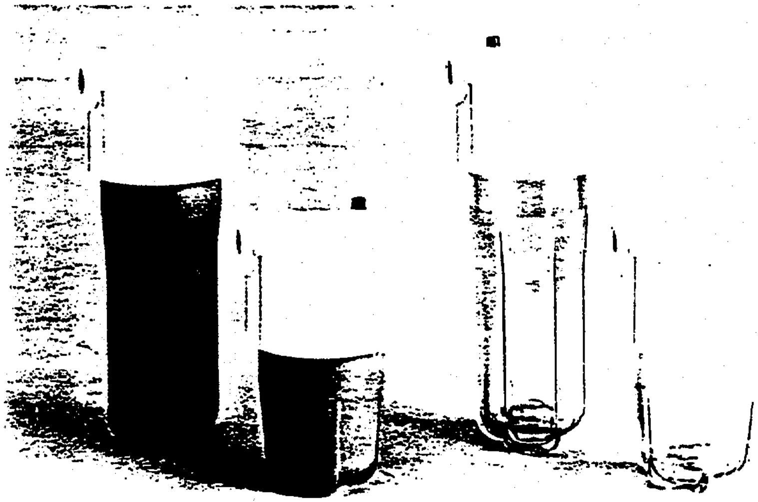


Field Service & Troubleshooting



Metallic & Non-metallic Filter Vessels



. . . MORE . . .

Our Filters Meet The Rigid Requirements Of:

- U. S. Government
- Power generation companies
- Petro/chemical industries
- Water treatment plants
- High tech industries
- Scientific/research applications
- Medical installations
- Nuclear plants
- Aerospace
- Beverage industry
- Food and drug industry
- Oil and gas industry

Standard Filter Cartridge Specifications

J ~~R~~ EP 10 R ~~10~~ 30 P — — —

"J" SERIES

MEDIA

C — Bleached Cotton (FDA)
EC — White Cotton
U — Natural Cotton
R — Rayon
EP — Polypropylene
P — Polypropylene (FDA)
F — Fibrillated Polypropylene
G — Fiberglass
GH — Heat-Treated Fiberglass
A — Cellulose Acetate
Y — Polyester
N — Nylon
O — Acrylic
M — Modacrylic
X — Special

MICRON RATING

.5	15	75
1	20	100
2	25	125
3	30	150
5	40	200
10	50	350

DIAMETER

T = 2"
F = 2⅜"
R = 2½"
S = 2¾"
P = 3"
X = Special

CORE EXTENDERS

No Symbol — None
EP — Polypropylene
EA — 316 S. S.

END TREATMENT

No Symbol — None
B — Burn
A — Acetone
L — Lacquer
G — Gaskets

CORE COVERS

No Symbol — None
V — Cover compatible w/filter media

CORE MATERIAL

T — Tinned Plated Steel
P — Polypropylene
PH — Heavywall Polypropylene
S — 304 S.S.
A — 316 S.S.
L — Steel (1 9/16" I.D.)
PR — Polypropylene (1 9/16" I.D.)
X — Special

LENGTH

[illegible]½"	7	10"	19½"	30"	50"
4"	8	12"	20"	36"	60"
[illegible]	9	12½"	27"	39"	70"
6"	9¼"	18"	29¼"	40"	72"

SUBMITTAL REVIEW

REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS
NO RESPONSIBILITY IS ASSUMED FOR CORRECTNESS OF DIMENSIONS OR DETAILS.
THE CONTRACTOR/SUPPLIER SHALL ASSUME FULL RESPONSIBILITY FOR DEVIATIONS FROM CONTRACT REQUIREMENTS NOT SPECIFICALLY INDICATED ON THIS SUBMITTAL.

☒ NO EXCEPTIONS
☐ MAKE CORRECTIONS NOTED
☐ AMEND AND RESUBMIT
☐ REJECTED - SEE REMARKS

Date: 6-12-95

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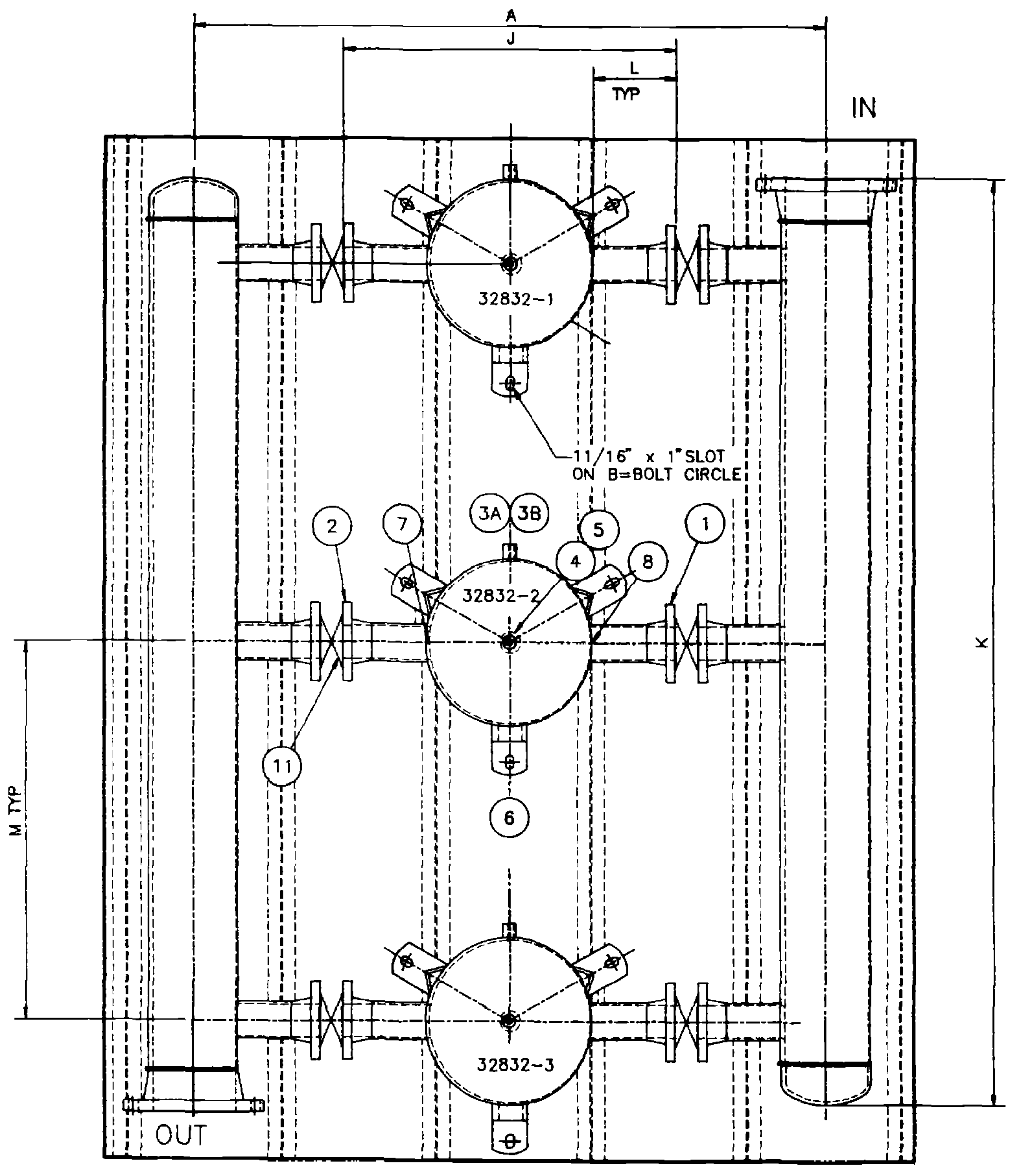
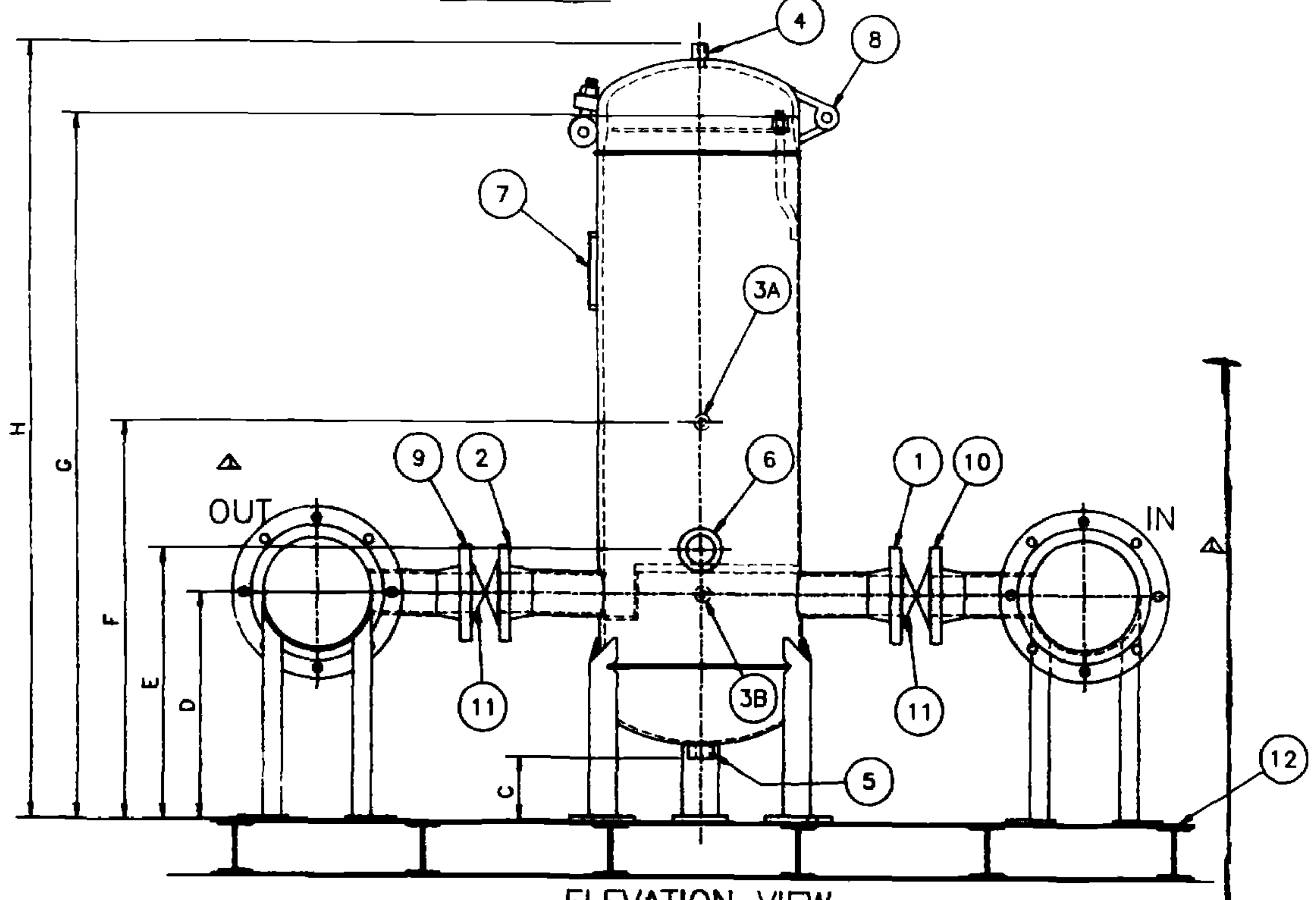
Amarillo, Texas 79120-0010
(806) 371-8033
FAX (806) 372-5257

CERTIFIED AS BUILT



TOP VIEW



ELEVATION VIEW

DIM'S	
	INCHES
A	60.750
B	22.000
C	5.000
D	17 750
E	21 313
F	31.313
G	55 000
H	60 813
J	32 000
K	88 000
L	8.000
M	36 000
N	
P	
Q	

SCHEDUE OF OPENINGS & ATTACHMENTS

ITEM	QTY	DESCRIPTION	SERVICE
1	3	3"-150# RFWN FLG	INLET
2	3	3"-150# RFWN FLG	OUTLET
3	6	.500"-3000# CPLG	DIFF PRESS.
4	3	500"-3000# CPLG	VENT
		W/0-150 GAGE	
5	3	1"-3000# CPLG	DRAIN
6	3	2"-3000# CPLG	DRAIN
7	3	CRALL NAMEPLATE	ID
8	3	HINGE ASSY	LIFT ASSIST
9	3	3"-150# RFWN FLG	MANIFOLD
10	3	3"-150# RFNW FLG	MANIFOLD
11	6	GRINNELL VALVE	CONTROL
12	1	78" x 102" SKID	MOBILITY
13	12	FLANGE GASKETS	SEAL
14	3	16" BUNA-N O-RING	VESSEL SEAL

MATERIAL INFORMATION

TOP HEAD 16" OD x 500" w/t ELL HD	SA-240-304
BTM HEAD 16" OD x .250" w/t ELL HD	SA-240-304
HUB 16" OD x 500" w/t WLD PIPE	SA-312-304
SHELL 16" OD x 250" w/t WLD PIPE	SA-312-304
FLANGE/COUPLING ANSI B16 5	SA-182-304
IN/OUT NOZZ. 3 5" OD x 216" w/t WLD PIPE	SA-312-304
EYEBOLTS (0 625")	SA-325
O-RING	BUNA-N
ALL WETTED MAT'L	304SS
MANIFOLD INFORMATION	
FLANGES ANSI B16.5	SA-182-304
NOZZ 3 5" OD x .216" w/t WLD PIPE	SA-312-304
SHELL 8.625" OD x 250" w/t WLD PIPE	SA-312-304
END HD 8" STD WELD CAP	SA-403-304
ENTRY FLANGE 8"-150# RFWN FLG	SA-182-304
VALVES GRINNELL (#S15W-2122-1)	
SKID	SA-36

DESIGN INFORMATION

ASME CODE "U" STAMP PER SEC 8 DIV. 1 E92 A93	
MAWP	150 PSIG 100°F
MDMT	0°F AT 150 PSIG
NATIONAL BOARD	NO
CORROSION ALLOWANCE	NONE
POSTWELD HEAT TREAT	NONE

NON-DESTRUCTIVE TESTING

1	RADIOGRAPHY	NONE
2	HYDROSTATIC TEST PRESSURE	225
3	PNEUMATIC:	NONE
4	MAGNETIC PARTICLE	NONE
5	BRINELL.	NONE

SUBMITTAL REVIEW

REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS NO RESPONSIBILITY IS ASSUMED FOR CORRECTNESS OF DIMENSIONS OR DETAILS THE CONTRACTOR/SUPPLIER SHALL ASSUME FULL RESPONSIBILITY FOR DEVIATIONS FROM CONTRACT REQUIREMENTS NOT SPECIFICALLY INDICATED ON THIS SUBMITTAL.

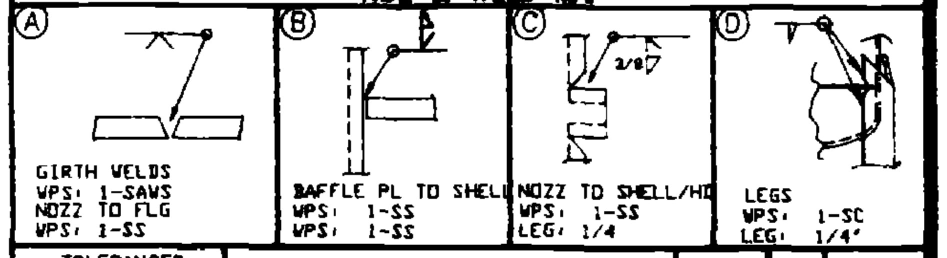
☒ NO EXCEPTIONS ☐ MAKE CORRECTIONS NOTED

☐ AMEND AND RESUBMIT ☐ REJECTED - SEE REMARKS

Date 6-12-95 By

OHM REMEDIATION SERVICES CORP.
NORCROSS, GEORGIA

NDE & WELD MAP



GIRTH WELDS
WPS: 1-SAWS
NOZZ TO FLG
WPS: 1-SS

BAFFLE PL TO SHELL
WPS: 1-SS
WPS: 1-SS

NOZZ TO SHELL/HD
WPS: 1-SS
LEG: 1/4

LEGS
WPS: 1-SC
LEG: 1/4"

TOLERANCES
FAB ± 063
MACH ± 0 032
ANGLES ± 0 5

REVISION	DATE	BY	REV NO
ADDED FLG GASKET & O-RING SEALS	5/15/95	CK	△
CHANGE IN/OUT LOCATION	5/5/95	CK	△
APPROVAL DRAWING	3/31/95	CK	△

QUALITY CRALL ENGINEERED PRODUCTS

740 S PRICE RD - BOX 1641
PAMPA TEXAS 79066
PHONE (806) 665-8446
FAX (806) 665-9736

ASEAL NO	
MODEL NO	3PS-S04-16-18-54-S
EST DRY WT	250 EA
NAME	CRALL FILTER VESSEL
CUSTOMER	JOHNSON FILTRATION
EQUIP NO.	
SERVICE	
DRAWN	C.KADRMAS
CHECKED	
APPROVED	
SIMILAR TO	
DATE	3/29/95
SCALE	NTS
CRALL JOB NO	32832

ENVIROTROL, INC. - CARBON VESSELS

Site: MCB Camp Lejeune, NC - OU2
Groundwater Treatment Plant
Delivery Order No. 0015.

Date service rep on site: February 16, 1996

Name of representatives: Mr. Steve Matta
Mr. Tim Sokol
(412) 741-2030

Questions & Comments:

Question: How should carbon treatment be initiated for best results following wetting?
Comments: Fill the vessel with water to the top to evacuate air within the vessels. Make sure that the vent is open.

Question: Should the carbon be wetted initially by filling the vessels to the top?
Comments: No. Wetting should be performed as described in the O&M manual. Some head space should be allowed for entrained air to vent.

Question: What should be the initial pressure loss through the vessels?
Comments: The pressure loss over each vessel should be < 5 psi.

Question: What are the pressure relief valves set at from the factory?
Comments: 75 psi plus or minus 2 %

Question: What is the design operating pressure for the vessels?
Comments: 60 psi.

Question: At what point should the carbon vessels be backwashed?
Comments: When the pressure differential reaches 15 psi or 7.5 psi per vessel when operated in parallel at 250 gpm.

Question: What is the maximum flow rate that should be moved through the vessels?
Comments: Flow should not exceed 450 gpm in either direction.

Question: What is the gallon capacity of each carbon vessel?
Comments: 2,850 gallons empty bed.

Question: Will an initial charge of carbon affect the pH of the water?
Comments: Yes. For the first 3 to 4 bed volumes, the pH often increases a couple units due to the ash content of the carbon. It will return to normal with no affect on pH thereafter.

Question: Will the color of the water be different during the initial startup?
Comments: Yes. Typically, some fines are carried through causing a black color for the first few thousand gallons (2-3 bed volumes). The color will return to normal thereafter.

Question: Once carbon is spent, how is the carbon removed?
Comments: The carbon can be removed manually through the manway or via the discharge port as a slurry using a vac truck. To remove it as a slurry, be sure the carbon cell is filled with water. Connect the vac truck hose to the exit port. Open up the compressed air line to the vessel providing approximately 40 psi pressure and drain the carbon to the vac truck. Consult the O&M manual for more detailed procedures.

Question: How is new carbon introduced into the vessels?
Comments: Carbon can be charged dry or wet. The simplest way to charge the cells is to add it as a slurry. The vessels are equipped with a fill port to accommodate this type of filling. A fresh water supply of approximately 60 gpm (2,500 gallons) is needed to fill the cells up to the distribution laterals.

Question: Can the two vessels be operated in parallel or in series?
Comments: Yes. This can be done through some simple valve changes using system provided.

OPERATING MANUAL

MODEL LPS-210 BW

GRANULAR CARBON ADSORPTION SYSTEM
(X-220 A/B)

FOR

MARINE CORPS BASE

CAMP LEJEUNE, NORTH CAROLINA

OHM REMEDIATION SERVICES CORPORATION

GENERAL CONTRACTOR
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OPERATING MANUAL

Model LPS-210 BW

for

Marine Corps Base
Camp Lejeune, NC

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INTRODUCTION

1.1 GENERAL

This manual contains a complete description of the Envirotrol liquid phase granular carbon system at the Marine Corps Base at Camp Lejeune, NC, along with detailed instructions for safe and proper operation of the system.

The Manual covers the various operating conditions expected at this site; however, unexpected conditions may be encountered, and operating personnel might have to modify some of the procedures to suit. Should additional assistance be required, contact Envirotrol, Inc., at (412) 741-2030.

Operation of the system should be assigned only to properly trained personnel. A copy of this Manual should be available to operators at all times. An Envirotrol Field Representative will be available, if requested, to assist in a test run at plant start-up.

1.2 OPERATOR'S LOGBOOK

It is highly recommended that a logbook be maintained to record all pertinent operating and maintenance data involving the Granular Carbon System.. Operators should record at regular intervals such data as flow rate, influent temperature, pH, inlet pressure, pressure drop across each bed, suspended solids in feed, and SVOC's and VOC's in and out of the system. A record should also be maintained of all operating configurations and the time and duration of any changes, maintenance procedures, overhauls, carbon changeouts, etc.

1.3 APPLICATION

The Granular Carbon Adsorber System (X-220A/B) is intended to remove semi-volatile organic compounds (SVOC's) and residual volatile organic compounds remaining after extensive pretreatment of a contaminated groundwater system. The carbon unit will be preceded by pH adjustment (utilizing sodium hydroxide), chemical oxidation and precipitation, clarification, sand filtration and air stripping.

The unit has been designed for installation indoors in Seismic Zone 1, Importance Factor 1.0.

1.4 SERVICE CONDITIONS AND PERFORMANCE REQUIREMENTS

Water Source	- Groundwater
Design Flow Rate	- 250 GPM
Maximum Operating Pressure	- 60 PSIG
Maximum Operating Temperature	- 100 deg. F
Normal Operating Temperature	- 50 deg. F to 60 deg. F

1.4 SERVICE CONDITIONS AND PERFORMANCE REQUIREMENTS (cont.)

Inlet pH	- 6.5 to 7.5
Inlet Suspended Solids	- 2 mg./L
Inlet SVOC's, as humic acid	- 10,000 ug/L
Outlet SVOC's, as humic acid	- 1,000 ug/L
Inlet VOC's, as 1-2 DCA	- 23 ug/L
Outlet VOC's, as 1-2 DCA	- 0.4 ug/L

1.5 SYSTEM DESCRIPTION

The Envirotrol Model LPS-210 BW adsorption system consists of two vertical cylindrical pressure vessels, each containing 8,000 pounds of granular activated carbon. The vessels are equipped with internal inlet baffles, internal underdrain systems, inlet and outlet service water piping and valves, inlet and outlet carbon transfer piping and valves, vessel vent piping with pressure relief system, instrument and sampling connections. The entire system is completely shop-assembled and is delivered as a complete unit. An Envirotrol Representative who witnessed the shop assembly will be on site to supervise installation of the system, if requested.

After connection of the influent, effluent, piping by others, the system may be operated with the two beds in parallel or in series mode. Series mode is expected to be the normal configuration for this system, since it most effectively utilizes the carbon's capacity to adsorb organics.

The unit is arranged so that one unit can operate normally while the other is backwashed and either unit can be backflushed using the effluent from the other unit.

Granular activated carbon will be delivered to the site in Envirotrol's bulk trailers for initial fill of the vessels. Water will be added to the truck at the site and carbon will be transferred into the empty adsorbers as a slurry using compressed air to move it.

When the system is ready to be put "on stream", valves are set in position so water enters the top of the first bed, passes through the first bed, exits through the underdrain, passes to the top of the second adsorber, through that bed, out the underdrain and exits the system.

When the system is first put into operation, the impurities in the influent water are adsorbed by the carbon in the upper part of the first bed. As the carbon at the top of the bed becomes saturated with organics, adsorption takes place lower in the bed. Eventually the entire bed becomes saturated and the water leaving the first bed is essentially the same as the influent to the first bed.

When this condition attains, the adsorber is considered to be exhausted and the carbon is removed for disposal or reactivation and is replaced with virgin or reactivated carbon. This exchange is effected in the same manner as the initial fill. Carbon is transferred to a bulk truck and replaced with new carbon, all transfers being made in slurry form using compressed air to make the transfer. When the adsorber is refilled, the system is put back into operation with the newly filled vessel in the second stage position and the former second stage vessel now in the first stage position.

1.6 SYSTEM SPECIFICATIONS

Number of Adsorber Vessels	- Two (2)
Adsorber Size	- 8' -0" O.D. x 5' -3" S.S.
Top Head	- ASME Flanged and Dished
Bottom Head	- ASME 2:1 Semi-elliptical
Material of Construction	- Carbon Steel, ASTM A516, Grade 70
Vessel Design Pressure	- 75 PSIG
Construction Stamp	- ASME Section VIII, Div. 1
Vessel Lining	- Plasite 4110
Vessel Capacity	- 2850 US Gal. each
Carbon in each Adsorber	- 8,000 pounds
Carbon Bed Depth	- Approx. 5' each Adsorber
Service Piping	- 4" sch. 40 steel, ASTM A53
Service Pipe Fittings	- Butt welded steel and cast ductile iron
Vent Piping	- 4" sch. 40 steel, ASTM A53
Vent Piping Fittings	- Butt welded Steel
Pressure Relief Device	- 1"x2" ASME relief valve
Maximum Recommended Operating Pr.	- 60 PSIG
System Backwashable	- Yes (20% bed expansion max.)
Empty Bed Contact Time at 250 GPM	- 8.5 Minutes per bed
System Shipping Weight	- Approximately 13,500 pounds
Heaviest Piece to be Handled	- Approximately 13,500 pounds
System Pressure Drop (At start-up)	- 15 PSIG (series flow @ 250 GPM)

1.7 UTILITIES REQUIRED

Compressed Air for Carbon Transfer	- 100 SCFM at 15-18 PSIG
Water for Carbon Transfer	- 100 GPM at 30 PSIG min. - 9000 Gal. max.

1.8 BULK TRUCK DATA

Number of Carbon Compartments	- Three (3)
Compartment Capacity	- Two (2) at 10,000 lbs. One (1) at 20,000 lbs.
Height	- 13' -6"
Empty Weight	- 35,000 lbs.
Filled Weight	- 77,000 lbs. (Drained) 100,000 lbs. max. (before draining)

2.0 INSTALLATION

2.1 FOUNDATIONS

The Envirotrol Field Representative will, if requested, inspect the foundations before proceeding with erection of the system. Anchor bolt and foundation concrete design and construction are by others, based upon the bolt location plan furnished by Envirotrol. Foundation must be level and the anchor bolts accurately set. Bolt locations must be accurate within 1/4" from the system centerlines, or set in sleeves which permit adjustment at installation.

2.2 UNLOADING AND ASSEMBLY

A crane of adequate capacity and reach is required to unload the adsorber skid and place it on the foundation. The entire unit is pre-assembled and skid-mounted and requires no additional assembly. A spreader bar is shipped with the unit and may be used to unload and set the unit in place. The entire unit weighs approximately 14,000 pounds including the spreader bar. The spreader bar is to be returned to Envirotrol.

A properly trained and experienced rigging crew should be used to unload and set the equipment. Installation of field piping requires only the connection of threaded pressure gauges which may have been removed and packed separately. Install all in accordance with the instructions included in the appendix under Section I - Assembly Instructions.

An Envirotrol Field Representative will be available, if requested, for assistance in erection and assembly of the system. Following completion of erection, inlet and outlet flanges shall be blanked, the entire system filled with clean water and hydrostatically tested at 35 PSIG. Pressure should be maintained for 8 hours or more and all leaks corrected.

3.0 OPERATOR PRESTART

3.1 CHECK-OUT

The Granular Carbon System is the final unit operation in this groundwater treatment system. Before the Carbon System is put into operation, all preceding equipment must be checked out and properly working. It is particularly important that the sand filter immediately ahead of the Carbon System be operating effectively so that the adsorbers are not plugged with suspended solids.

3.2 FILLING ADSORBERS WITH CARBON

After the system has been checked, the adsorbers can be filled with granular activated carbon. The carbon is delivered in Envirotrol bulk trailers, and is transferred to the adsorbers as a water slurry, using compressed air as the motive force. Detailed instructions for making connections to the trailer and operating the necessary valves will be coordinated by the carbon delivery driver.

The trailer driver is experienced in loading and unloading operations and will make the necessary hose connections and operate the valves on the trailer. The plant operator must be available to operate the valves on the adsorbers. For the initial fill the operator can depend on the driver to see that proper procedures are followed.

Following the carbon transfer, the truck driver will disconnect the hoses and operate the valves on the truck. The Operator will close the carbon fill valves and the adsorber vent valves, and carbon transfer is complete.

3.3 WETTING THE CARBON

Carbon which is shipped dry has air trapped in the pores plus a small amount of adsorbed oxygen. This amounts to a total air quantity of 40 to 50 percent of the bed volume. It is extremely important that this air be displaced by water before the adsorbers are placed into operation. If this air is not displaced before operation begins, it will be displaced later, fill voids between granules, and result in excessive pressure drop, reduced capacity and channeling of water flow through the carbon. Air will not migrate out of the bed during normal downflow operation.

Elimination of this air is called "wetting" and usually takes several days to accomplish. The required time depends upon carbon size, and water temperature. Finer carbon takes longer and colder water (higher viscosity) also requires longer time to wet the carbon.

After the carbon is transferred to the adsorbers, and allowed to sit for several days if time is available, the vent valve should be opened and the adsorber drained. The adsorber should then be filled with clean water through the bottom outlet, at a rate of not more than 200 GPM, until water flows out the vent line.

Should it be necessary to place the adsorbers on stream without time for proper wetting, the adsorbers should be drained and backfilled as described above, when the pressure drop becomes excessive (25 PSIG) or after two days of operation, whichever occurs first.

3.4 BACKFLUSHING AND BACKWASHING AN ADSORBER

Backflushing and backwashing an adsorber are procedures in which clean uncontaminated water flows upward through the carbon bed at a controlled rate. As the water flows through the bed it expands the bed upward and causes lighter and finer materials to migrate to the top of the bed and out the vent opening.

The water can be from an external source or can be the effluent of the other adsorber. The Model LPS-210 BW at this installation is configured to use water from either source.

3.4.1 BACKFLUSHING

Backflushing is usually conducted at flow rates of 2 to 4 GPM/sq. ft. (100 to 200 GPM). This can usually be accomplished most simply by using the effluent of the other adsorber. A detailed description of this procedure is shown by the Valve Sequence Chart in Appendix II and the Operations Diagram in Appendix III.

Backflushing is done to remove air from the bed at initial startup and fines from the top of the bed. The velocity is too low to expand the bed enough to permit fines from the lower parts of the bed to migrate upward through the bed.

Normal pressure drop through the lead adsorber should be about 10 PSI. A pressure drop of 15 to 20 PSI indicates the presence of air in the bed or fines on top of the bed. If this condition occurs it is suggested that the bed first be backflushed using effluent from the other adsorbers.

When it is established that backflushing the bed is necessary, it is advisable to drain the bed before backflushing, in the event that the increased pressure drop is due to air in the bed. The bed should then be backflushed at a flow rate of 100 to 200 GPM for a period of at least one hour. After the Adsorber System is filled with carbon and wetted or backflushed as described above, the system is ready for operation.

When normal downflow operation is started, the effluent could be dark due to a small quantity of fines. This should clear up in 5 to 15 minutes.

3.4.2 BACKWASHING

If the high pressure drop persists when the system is put back on stream, following backflushing, the adsorber should be backwashed.

Backwashing, as described here, utilizes water from an external source, controlled at a rate which will expand the carbon bed "no more than 20%". Depending upon the water temperature, this would require 400 to 600 GPM. A detailed description of this procedure is shown by the Valve Sequencing Chart in Appendix II and the Operating Diagram in Appendix III. Backwashing should be continued for at least 15 minutes or until the backwash discharge is clear.

3.4.2 BACKWASHING (Continued)

In addition to removing air and fines from the bed, backwashing tends to classify the carbon bed. Therefore, before initial startup and following each carbon change, the bed should be backwashed so that on subsequent backwashing the bed is restored to its original configuration. It is important that the backwash rate be the same each time an adsorber is backwashed. The Operator should record rate, water temperature and duration for each backwash.

Following backwashing, the system can be put back into normal downflow series operation. Again, the effluent may be dark due to the presence of a small quantity of fines, but this should clear up in 5 to 15 minutes.

4.0 INITIAL STARTUP

4.1 FEED SYSTEM

The Adsorber System at this installation is preceded by a pressure filtration system. The Adsorption System should not be operated without the filter system on line.

Prior to startup of the Adsorber System, the feed pump should be started and the pressure at the feed pump discharge should be observed with the pump discharge valve closed. If this "shutoff" head is 60 PSIG or greater, care must be taken that the Adsorption System is not subjected to this pressure. This means that the adsorbers must be taken off line by closing the inlet valves first, and must be put on line by opening the inlet valves last.

The Adsorber vessels are designed and stamped for 75 PSIG and are protected by relief valves set at 75 PSIG. However, it is important to maintain the vessel pressure comfortably below the set pressure of the disks and it is our recommendation that the vessels be operated at a maximum of 60 PSIG. The operating description that follows assumes that the feed pump shutoff head exceeds 60 PSIG. If this shutoff head is actually below 60 PSIG, the valve opening sequence can be reversed, should that be more convenient.

4.2 SERIES FLOW

The Adsorption System can be operated with the two adsorbers in either series or parallel configuration. Series mode is assumed to be the normal method of operation since this results in more efficient use of the carbon than the parallel mode. In the series mode the various valves are set so that the water from the filters enters the top of one adsorber, designated as the "lead" adsorber, passes downflow through the first carbon bed, and exits through the underdrain in the bottom of the bed. The water then passes to the top of the other adsorber, called the "lag" or "polish" adsorber, down through the second carbon bed, out the underdrain and then exits the system.

The following steps should be followed to put the system on line in the series mode:

1. Check that all valves on the Adsorption System are closed.

2. Open the discharge valve from the vessel chosen to be the "lag " or "polish" adsorber.

3. Open the valve(s) in the crossover line from the other adsorber outlet to the "lag" adsorber inlet.

4. Start the feed pump and slowly open the influent valve to the "lead" adsorber. The pressure will increase to the normal operating reading.

5. Open the vent valve from the top of the "lead" adsorber to bleed out any air that may have been trapped in the top of the vessel. Close the vent valve when water flows from it in a steady stream. Repeat this procedure with the "lag" adsorber, closing the vent when water flow stabilizes. Observe the pressure gauges on the adsorbers when venting them. Should the gauge read less than 5 PSIG, it will be necessary to partially close the adsorber discharge valve to build up a pressure to vent the vessels.

A detailed description of this procedure utilizing valve identification numbers is included in Appendix II - Valve Sequencing Chart and Appendix III - Operating Diagram.

4.3 PARALLEL FLOW

The following steps should be followed to put the system on line in the parallel mode:

1. Check that all valves are closed.

2. Open the effluent valves from both adsorbers.

3. Start the feed pump and slowly open the inlet valves to both adsorbers.

4. If the pressure gauges on the adsorbers indicate pressure in either adsorber to be below 5 PSIG, throttle the discharge valves until the gauge reads about 10 PSIG.

5. Open the vent valves from the two adsorbers to vent accumulated air. Close the vent valves when water flows from them in a steady stream.

A detailed description of this procedure utilizing valve identification numbers shown on the Operations Diagram is included in Appendix II - Valve Sequencing Chart and Appendix III - Operating Diagram.

5.0 SHUTDOWN

5.1 SHORT TERM SHUTDOWN

To take the Adsorption System off line the inlet valve to the "lead" adsorber should be closed first, if the system is in series mode. If the system is in parallel mode both inlet valves should be closed. The feed pump should then be shut down, and all the remaining valves closed.

For shutdowns expecting to last less than two weeks, the only precaution that need be taken is to open the vent valves.

5.2 EXTENDED SHUTDOWNS

Adsorbers are taken off line as describe above. The vent valves should be opened and the adsorbers drained.

A detailed description of shutdown procedure utilizing valve identification numbers shown on the Flow Diagram is included in Appendix II-Valve Sequence Chart and Appendix III-Operations Diagram.

5.3 STARTUP FOLLOWING EXTENDED SHUTDOWNS

Following an extended shutdown during which the system has been drained, the adsorbers should be backflushed prior to startup. In addition, if there is any indication that bacterial growth has occurred in the carbon bed(s), the adsorber(s) should be disinfected.

The procedure for backflushing is described in Paragraph 3.4. The following procedure should be used to disinfect a carbon bed:

1. Drain the vessel with the vent valve open, if the adsorber has not already been drained.
2. Inject a 5% caustic (NaOH) solution into the bottom of the adsorber. For an 8,000 pound carbon bed this should take about 1,500 gallons of solution to completely submerge the carbon.
3. Allow the adsorber to soak for a minimum of 8 hours, preferably overnight.
4. Drain the adsorber and backflush it to remove the caustic. Continue the flow until the pH of the affluent is the same as the influent.
5. Put the system back on line in either series or parallel mode as chosen.
6. Monitor the effluent for coliform count. Also monitor the pressure drop across the adsorbers since bacterial growth is frequently manifested in blocking of the carbon bed and increased pressure drop.

6.0 NORMAL OPERATION

6.1 STEADY STATE CONDITIONS

Since the Adsorption System is put on line in either series or parallel mode with the flow rate set as required, no further adjustments need be made for a prolonged period. The Operators should utilize this period to collect data by maintaining the Operator's Logbook, monitoring flow rate, pressure gauge readings, temperature, influent analysis, effluent analysis, interstate analysis (when in series mode) and additional data as available.

6.2 SAMPLING

Sample connections are provided at the inlet of each adsorber, which enables the Operator to extract samples of system influent and interstate flow when operating in series. Since this is the final step in the treatment process monitoring of the Adsorption System, effluent sampling is undoubtedly provided external to the system. This effluent data should be maintained in the Carbon System Logbook.

6.3 PRESSURE GAUGES

Pressure gauges are provided at the inlet of each adsorber, which enable the Operator to monitor the pressure drop across the "lead" adsorber. Should solids escape the filtration system they will collect on top of the carbon bed in this adsorber, and will be reflected in an increase in pressure drop across the adsorber.

6.4 CARBON EXHAUSTION

As the influent water passes down through the "lead" adsorber, the organics are removed in the upper part of the bed. When the carbon in the top of the bed becomes saturated with organics, adsorption takes place lower in the bed. Eventually the entire bed becomes saturated and adsorption proceeds in the "polish" adsorber.

When monitoring of the interstate water indicates that it is approaching the influent to the system, it is time to change the carbon in the "lead" adsorber.

7.0 CARBON TRANSFER PROCEDURES

7.1 GENERAL

The following description is based upon delivery and removal of carbon using Envirotrol's standard truck-trailer units. Data on this trailer is contained in Paragraph 1.8 BULK TRUCK DATA.

This trailer permits delivery of fresh carbon and removal of spent carbon using only one trailer.

Envirotrol's truck drivers are thoroughly trained and experienced in all phases of carbon transfer and are capable of directing the carbon transfer in a safe and efficient manner.

7.2 SITE REQUIREMENTS

A flat paved area is required adjacent to the Adsorption System to park the carbon truck for carbon transfer. When the spent carbon slurry is transferred to the trailer, total weight of the unit could be as much as 100,000 pounds.

7.3 UTILITY REQUIREMENTS

A 1½" compressed air line at 60 PSIG maximum should be connected to each adsorber. It is recommended that this be a permanent connection. Minimum pressure required is 25 PSIG.

Clean plant water should be available at about 100 GPM and 30 to 60 PSIG. This could be connected by hose to the 1½" drain connection provided at the bottom of each adsorber. If the system is equipped for backwashing or backflushing, that source could be utilized for carbon transfers.

A minimum ¾" compressed air hose connection is required to furnish 15 PSIG air to the trailer.

Clean plant water should also be available at 100 GPM and 15 PSIG for the trailer.

7.4 TRANSFERRING SPENT CARBON TO THE TRAILER

Prior to the arrival of the Envirotrol Carbon Trailer, the adsorber containing spent carbon should have been taken "off-line", and the other adsorber set in the single stage mode. When the trailer arrives on-site hoses are connected from the adsorber carbon outlet to the trailer spent carbon inlet, the adsorber is pressurized with compressed air and the carbon is transferred. When the transfer is complete the compressed air is shut off, the adsorber vented and the trailer drained.

The following steps are taken to accomplish this spent carbon transfer:

1. With all adsorber valves closed, connect a 4" hose from the quick-connect coupling at the adsorber carbon outlet to the quick-connect on the trailer. The driver will make all connections at the trailer.

2. The driver will open one of the trailer manways or a vent valve to vent the trailer and will open the inlet valve on the trailer.

3. Connect a water hose to the ¾" quick-connect coupling just after the 4" carbon valve at the adsorber outlet. Open the 3/4" valve and fill the 4" transfer hose with water, then turn off the valve.

4. Check that the adsorber is filled with water, then open the compressed air valve until the adsorber is pressurized to 25 to 30 PSIG.

5. Open the 4" adsorber carbon outlet valve and continue to monitor the adsorber pressure to maintain it in the 25 to 30 PSIG range.

6. The transfer should require about 15 to 20 minutes. When the transfer is finished the adsorber pressure will drop and the Operator will be able to hear the sound of air passing through the transfer hose.

7. In case there is a heel of carbon remaining in the adsorber, close the carbon outlet valve from the adsorber and add water to the bottom of the adsorber either through the 1½" drain connection or by directing the outlet from the other adsorber through the spent adsorbers underdrain outlet valve. Leave the compressed air valve open and leave the water flow for about 5 minutes.

8. Close the water valve and when the adsorber pressure builds up to 25 to 30 PSIG, reopen 4" carbon valve and repeat step 6 above.

9. Close the adsorber air valve and open the adsorber vent valve. The adsorber will also vent through the trailer vent valve (or manway).

10. Close the adsorber carbon outlet valve and disconnect all hoses. The driver will disconnect hoses from the trailer and operate the trailer valves as required.

11. The driver will close the trailer manway, connect the air hose to the trailer spent carbon compartment, pressurize the trailer to 12 to 14 PSIG and will open the trailer drain valve to remove the water from the spent carbon.

12. When the spent carbon compartment is drained the driver will disconnect the air hose, open the vent valve and close the drain valves.

7.5 TRANSFERRING FRESH CARBON TO THE ADSORBER

After the spent carbon transfer is completed the adsorber is empty and ready to be filled with fresh carbon. The carbon, air and water hoses are reconnected, a "heel" of water is added to the adsorber, the trailer is pressurized and the carbon is transferred. When the fresh carbon transfer is complete, adsorber and truck are vented, the truck is ready to leave the site and the adsorber is ready to be placed back into service.

The following steps are taken to accomplish this fresh carbon transfer:

1. Fill the fresh carbon compartments of the trailer with water. If the carbon was delivered wet, about 1,000 gallons of water will be required; if the carbon was delivered dry, about 2,000 gallons of water will be required. Connect the water line to the trailer. The driver will open the manway covers and open the manual vent valves, as necessary. The plant water valve can then be opened. The driver will monitor the filling operation and tell the operator when it is necessary to close the plant water valve. The driver will then close the manways and vent valves and disconnect the water hose from the truck.

2. Place 500-800 gallons of water in the empty adsorber. This serves as a cushion to protect the underdrain and tank lining from the incoming carbon slurry. This can be accomplished by connecting the plant water hose to the 1½" drain connection from the effluent pipe at the bottom of the adsorber.

3. Connect a 4" hose from the adsorber carbon fill line to the trailer.

4. Connect the plant compressed air line to the air connection on the trailer.

5. Open the vent valve from the adsorber and close all other adsorber valves.

6. Fill the 4" carbon transfer hose and piping with water. This can be done by connecting a hose to the ¾" flush connection adjacent to the 4" carbon inlet valve at the adsorber.

7. The driver will now pressurize the fresh carbon compartments of the trailer by slowly opening the air valve and bringing the trailer pressure up to 15 PSIG.

8. Open the adsorber carbon fill valve. The driver will then open the carbon valves on the trailer to initiate the carbon slurry transfer.

9. Open the 1½" drain valve at the adsorber effluent pipe and permit water to drain to the floor. Since there is substantially more water transferred than required to slurry the carbon this will minimize the amount of excess water vented from the adsorber in the later stages of the carbon transfer.

10. When all the slurry and water are transferred from the trailer, air will start to vent from the adsorber indicating completion of the transfer.

11. Close the air valve to the trailer. The driver will close the other valves as required and open the trailer vent valves to relieve the pressure to the trailer.

12. Close the adsorber drain valve.

13. When the adsorber and truck are completely vented, close the carbon inlet valve and disconnect the hoses. Before disconnecting the hose from the carbon inlet, open the adjacent ¾" flush valve to be certain the line is not under pressure.

14. Before putting the adsorber on line, it may have to be backflushed as described in Paragraph 3.4.

8.0 MAINTENANCE

The adsorbers are ASME rated pressure vessels, protected by safety valves to prevent their exposure to pressure in excess of 75 PSIG. An annual inspection of the exterior and interior of the vessels should be made. This can best be done during the carbon exchange since the interior can only be examined after the carbon is removed. At this time, the vessel lining should be examined for wear and the underdrain examined for possible damage. The vessel exterior can be examined at any time for signs of leakage or damage.

Pressure gauges have been installed and will enable the Operator to determine the pressure drop across each adsorber. If these readings are recorded regularly, the Operator will be able to tell when normal values are exceeded. This would indicate the possible accumulation of fines or dirt on the top of the carbon bed. Since this unit is preceded by pressure filters, it is unlikely that this should occur. If it should, the adsorber should be backflushed as described Paragraph 3.4.

In the event that something should damage or break an underdrain nozzle, carbon would enter the underdrain and the adsorber effluent line. A fine mesh screen has been provided at the effluent nozzle at the bottom of the adsorber, to intercept the carbon in the event of a nozzle failure. This condition will be accompanied by a very rapid rise in pressure drop across the adsorber. Should this occur, the adsorber must be emptied of carbon and drained so the underdrain can be accessed and repairs made. Several spare nozzles have been provided with the system in case they are required. The other adsorber should be operated in single stage mode until repairs can be made.

Liquid relief valves are provided for the adsorber vessels. These valves are ASME approved for this service and are rated to relief within ± 3% of the 75 PSIG maximum allowable working pressure. It is recommended that the system be operated at 65 PSIG or less. Since the normal operating pressure should be less that 35 PSIG this allows a generous margin for operation.

9.0 SAFETY

9.1 OXYGEN DEPLETION IN CARBON VESSELS

It has been observed that atmospheres in vessels containing wet, drained granular activated carbon are oxygen defficient. Laboratory experiments since have confirmed that granular activated carbon in a wet or moist condition can adsorb oxygen content of air in an isolated space below the level required to support life.

It appears that this phenomenon occurs with all types of wet, activated carbon, and the rate of depletion of course varies with the degree of exposure to the air. Thus, it is relatively rapid in a drained carbon bed.

It must be assumed that this occurs with spent as well as virgin or reactivated carbon. Accordingly, all confined spaces containing activated carbon must be assumed to be hazardous. A confined space entry procedure should be established and all OSHA regulations regarding safety procedures applicable to respiratory protection in oxygen deficient atmospheres strictly followed.

9.2 EMERGENCY PROCEDURES

Should some malfunction require shutdown of an adsorber, it can be taken "Off Line" and the flow diverted to the second adsorber, or the flow can be stopped and the entire system shut down.

If a major leak or similar problem occur, the necessary elements shall be shut down or taken off line immediately. Repairs should be made and the system leak tested before resuming operation. "Note" that the adsorber vessels are "Lined Carbon Steel" and no welding should be done on the tanks without first emptying the vessel and subsequently repairing the lining.

9.3 RECORD KEEPING

The Operator's Log should maintain a continuous record of adsorber system configuration, flow rate, and pressure readings. Water samples should be taken regularly and records maintained of the influent and effluent analysis of each adsorber. This might include pH, TOC level, BOD, COD, toxicity, specific organic concentrations, and inorganic concentration data.

APPENDIX I

ASSEMBLY INSTRUCTIONS

CAMP LEJEUNE - OHM

Special Note

The box that is included with this shipment contains some fragile items and must be unpacked carefully and stored in a safe location until needed. All fragile items are located in the upper portion of the drum. These items are pressure gages (with glass fronts), plastic orthos nozzles, and gaskets.

Items	Descriptions
1	One (1) channel skid with 8'-0" diameter tanks attached (2 tanks per skid).
2	One (1) box containing the following bags and items: One (1) bag marked Pressure Gages - this bag contains 2 pressure gages which install in the top ports of the two 1/2" sample valves installed in the front (manway slide) piping of the unit. These ports presently have 1/2" steel plugs marked A and B. Remove plug A and B and install the gages in these ports. One (1) bag marked spare orthos nozzles - this bag contains 8 spare underdrain nozzles which will install as needed. One (1) bag marked Spare O-rings - this bag contains 1 spare 6" manway O-ring and 1 spare 18" manway O-ring. Install as needed.
3	One (1) lifting beam - this lifting beam is being provided for proper and safe lifting of the units. Please return with truck.

APPENDIX II

VALVE SEQUENCING CHART

			VALVE																				
OPERATION	ADSORBER NO.1	ADSORBER NO.2	V-1	V-2	V-3	V-4	V-5	V-6	V-7	V-8	V-9	V-10	V-11	V-12	V-13	V-14	V-15	V-16	V-17	V-18	V-19	V-20	V-21
Series	Lead	Lag	O	X	X	O	O	X	X	O	X	X	X	X	X	X	X	X	X	X	X	X	X
Series	Lag	Lead	X	O	O	X	X	O	O	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Parallel	Lead	Lead	O	O	X	X	X	X	O	O	X	X	X	X	X	X	X	X	X	X	X	X	X
Single Stage	Lead	Off-line	O	X	X	X	X	X	O	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Single Stage	Off-line	Lead	X	O	X	X	X	X	X	O	X	X	X	O	X	X	X	X	X	X	X	X	X
Drain	Lead	Draining	O	X	X	X	X	X	O	X	X	O	O	X	X	X	X	X	X	X	X	X	X
Drain	Draining	Lead	X	O	X	X	X	X	X	O	O	X	X	X	X	X	X	X	X	X	X	X	X
Backflush	Lead	Backflush	O	X	X	X	O	O	X	X	X	O	X	X	X	X	X	X	X	X	X	X	X
Backflush	Backflush	Lead	X	O	X	X	O	O	X	X	O	X	X	X	X	X	X	X	X	X	X	X	X
Backwash	Lead	Backwash	O	X	X	X	X	O	O	X	X	X	X	X	X	X	X	X	X	X	X	O	O
Backwash	Backwash	Lead	X	O	X	X	O	X	X	O	X	X	X	X	X	X	X	X	X	X	O	X	O
Remove Carbon	Lead	Remove Carbon	O	X	X	X	X	X	O	X	X	X	X	X	X	O	X	O	X	X	X	X	X
Remove Carbon	Remove Carbon	Lead	X	O	X	X	X	X	X	O	X	X	X	X	O	X	O	X	X	X	X	X	X
Carbon Fill	Lead	Carbon Fill	O	X	X	X	X	X	O	X	X	O	X	O	X	X	X	X	X	O	X	X	X
Carbon Fill	Carbon Fill	Lead	X	O	X	X	X	X	X	O	O	X	O	X	X	X	X	X	O	X	X	X	X
Shutdown	Off-line	Off-line	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

O – VALVE OPEN
X – VALVE CLOSED

ENVIROTROL, INC.
Activated Carbon Services
Sewickley, Pa.

PROJECT
OHM CORPORATION
MCB CAMP LEJEUNE, NC

DRAWN BY	APPROVED BY	CHECKED BY	SCALE
	SRM	SRM	N.T.S.

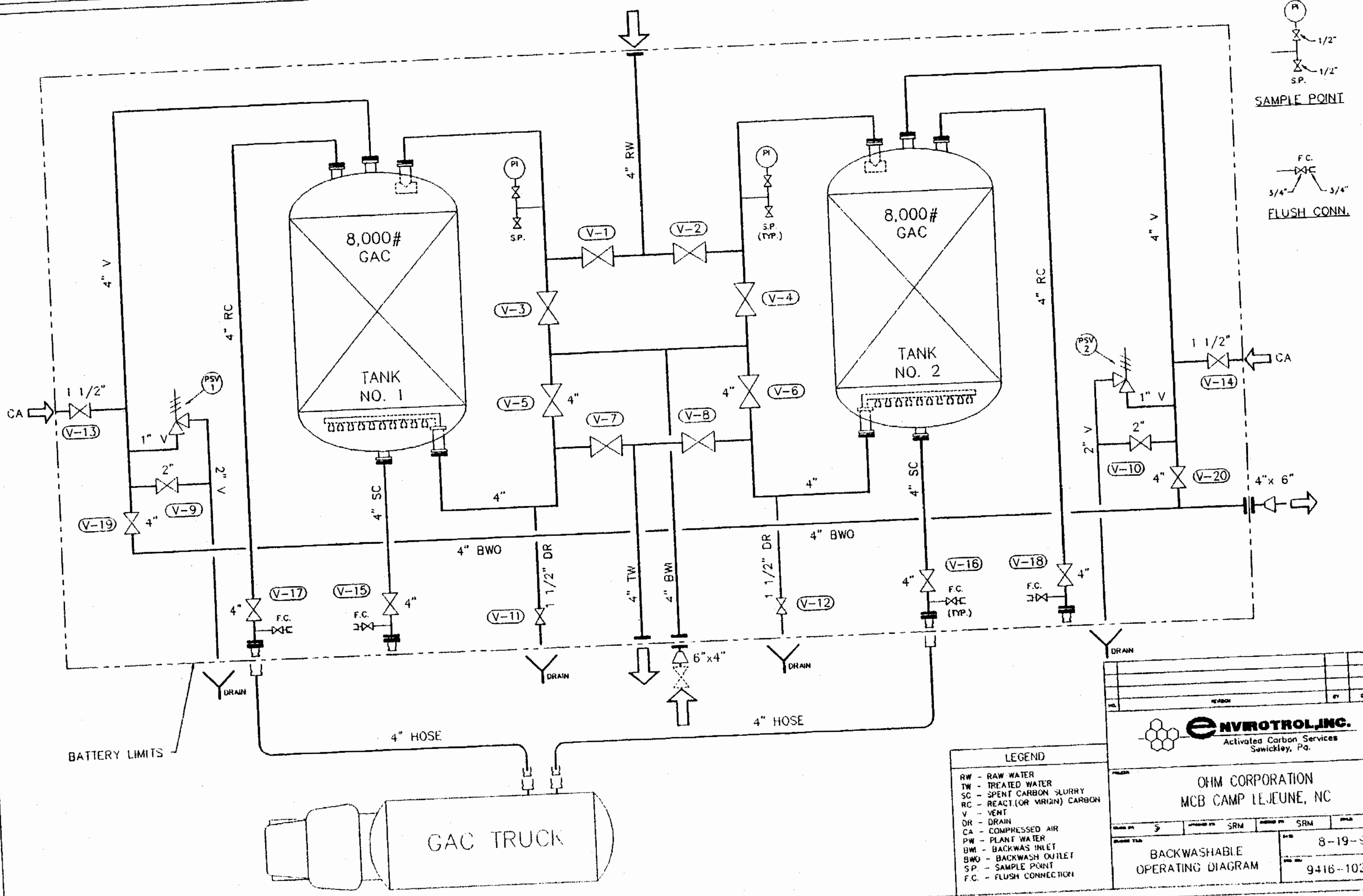
DRAWING TITLE
VALVE SEQUENCING CHART

DATE 9-10-95

DWG NO. 9416-103

REV. 0

APPENDIX III



LEGEND

RW - RAW WATER
TW - TREATED WATER
SC - SPENT CARBON SLURRY
RC - REACT.(OR VIRGIN) CARBON
V - VENT
DR - DRAIN
CA - COMPRESSED AIR
PW - PLANT WATER
BWI - BACKWAS INLET
BWO - BACKWASH OUTLET
S.P. - SAMPLE POINT
F.C. - FLUSH CONNECTION

NO.	REVISION	BY	DATE

ENVIROTROL, INC.
Activated Carbon Services
Sewickley, Pa.

OHM CORPORATION
MCB CAMP LEJEUNE, NC

S SRM SRM N.T.S.

BACKWASHABLE
OPERATING DIAGRAM

8-19-95

9416-102 0

APPENDIX IV

DATA PACKAGE

CUSTOMER: **Envirotrol, Inc.**

LOCATION: 432 Green St., Sewickley. Pa. 15143-0061

PURCHASE ORDER NO.: 11970

DESCRIPTION: 8' Diameter Adsorber Tank

ITEM NO.: - -

NATIONAL BOARD NO.: 0054

PA. TANK & TUBE SERIAL NO.: 0175-1

data/tlm

DATA PACKAGE

CUSTOMER: Envirotrol, Inc.

LOCATION: 432 Green St., Sewickley, Pa. 15143-0061

PURCHASE ORDER NO.: 11970

DESCRIPTION: 8' Diameter Adsorber Tank

ITEM NO.: - -

NATIONAL BOARD NO.: 0055

PA. TANK & TUBE SERIAL NO.: 0175-2

data/tlm

PENNSYLVANIA TANK & TUBE, INC.

- 409 Saxonburg Blvd., P. O. Box 217, Saxonburg, Pa. 16056 Phone (412) 352-1277 Fax (412) 352-0166 -

TANKS / HEAT EXCHANGERS/ SPECIALTY FABRICATIONS / FIELD REPAIR

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2. MANUFACTURERS DATA REPORT (If Required)
3. PHOTOCOPY OF NAME PLATE
4. MATERIAL TEST REPORTS
5. NDE REPORTS (If Required)

~~6. HEAT TREATING CHARTS (If Required)~~

7. WELDING PROCEDURE SPECIFICATIONS
   PROCEDURE QUALIFICATION RECORDS
   WELDER PERFORMANCE QUALIFICATIONS
8. DESIGN CALCULATIONS
9. SHOP/FIELD FABRICATION TRAVELER

table/tlm

THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

Certificate of Authorization

Number - R 3890

THIS IS TO CERTIFY *that* PENNSYLVANIA TANK & TUBE, INC.

409 SAXONBURG BLVD., SAXONBURG, PENNSYLVANIA 16056*********

****

is hereby authorized to use the Repair Symbol

of The National Board of Boiler and Pressure Vessel Inspectors for

"NATIONAL BOARD CODE REPAIRS AND/OR ALTERATIONS AT THE ABOVE LOCATION AND EXTENDED FOR FIELD REPAIRS AND/OR ALTERATIONS CONTROLLED BY THIS LOCATION"

in accordance with the applicable rules of The National Board of Boiler and Pressure Vessel Inspectors. The use of the Repair symbol and the authority granted by this Certificate of Authorization are subject to the provisions of the agreement set forth in the application. Any repair stamped with this symbol shall have been made strictly in accordance with the provisions of the National Board Inspection Code.

THIS AUTHORIZATION *issued or renewed on* MARCH 24, 1994

and expires on MARCH 23, 1997 *by*

THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

Chairman

Executive Director Albert J. Justin

Secretary Joseph R. Rigsby

NB-207
Rev. 2

FORM U-1 MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

1 Manufactured and certified by **Pennsylvania Tank & Tube, Inc., 409 Saxonburg Blvd., Saxonburg, Pa. 16056**
(Name and address of Manufacturer)

2 Manufactured for **Envirotrol, Inc., 432 Green St., Sewickley, Pa. 15143-0061**
(Name and address of Purchaser)

3 Location of Installation **Unknown**
(Name and address)

4 Type: **Vertical** (Horiz. vert. or sphere) — **8'-0" Dia. Adsorber Tank** (Tank, separator, jkt. vessel, heat exch., etc.) — **0175-2** (Mfg's serial No.)

— (CRN) — **D-1075-1 Rev. 0** (Drawing No.) — **0055** (Nat'l. Board No.) — **1995** (Year built)

5 *ASME Code, Section VIII, Div. 1* **1992, 93A** (Edition and Addenda (date)) — (Code Case No.) — (Special Service per UG-120(d))

Items 6 - 11 incl. to be completed for single wall vessels, jackets of jacketed vessels, shell of heat exchangers, or chamber of multi-chamber vessels

6 Shell (a) No. of course(s): **One** (b) Overall length (ft. & in.): **5'-2 1/2"**

Course(s)			Material	Thickness		Long Joint (Cat. A)			Circum Joint (Cat. A, B & C)			Heat Treatment	
No.	Diameter, in	Length (ft & in)	Spec/Grade or Type	Nom.	Corr	Type	Full, Spot, None	Eff	Type	Full, Spot, None	Eff	Temp	Time
1	96	5-2 1/2"	SA516-70	.313	0	1	Spot	85	1	None	85	None	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—

7 Heads: (a) **SA516-70** (Mat'l Spec No., Grade or Type) H.T. Time & Temp (b) **SA516-70** (Mat'l Spec No., Grade or Type) H.T. Time & Temp

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical	Conical	Hemispherical	Flat	Side to Pressure		Category A		
		Min	Corr	Crown	Knuckle	Ratio	Apex Angle	Radius	Diameter	Convex	Concave	Type	Full, Spot, None	Eff
(a)	Top	0.438	0	96.0	7.00	—	—	—	—	—	X	S	None	100
(b)	Bottom	0.313	0	—	—	2:1	—	—	—	—	X	S	None	100

If Removable, bolts used (describe other fastening) — (Mat'l Spec. No., Grade, Size, No.)

8 Type of jacket — Jacket closure — (Describe as ogee & weld, bar, etc.)

If bar, give dimensions — If bolted, describe or sketch.

9 MAWP **75** (internal) — (external) psi at max. temp. **150** (internal) — (external) deg. F. Min. design metal temp. **-20** deg. F at **75** psi

10 Impact test **No, UG20(f) Exempt**
(Indicate yes or no and the component(s) impact tested)

11 Hydro., ~~pneu., or comb~~. test press. **113** Proof Test —

Items 12 and 13 to be completed for tube sections.

12 Tubesheet: — Stationary (Mat'l. Spec. No.) — Dia. in. (subject to stress) — Nom. thk., in. — Corr. Allow., in — Attachment (welded or bolted)

— Floating (Mat'l. Spec. No.) — Dia. in. — Nom. thk., in. — Corr. Allow., in. — Attachment

13 Tubes: — Mat'l Spec. No., Grade or Type — O.D., in. — Nom. thk., in. — Number — Type (Straight or U)

Items 14-15 to be completed for inner chambers of jacketed vessels or channels of heat exchangers.

14 Shell (a) No. of course(s): — (b) Overall length (ft. & in.): —

Course(s)			Material	Thickness		Long Joint (Cat. A)			Circum Joint (Cat. A, B, & C)			Heat Treatment	
No.	Diameter in	Length (ft & in)	Spec/Grade or Type	Nom.	Corr	Type	Full, Spot, None	Eff	Type	Full, Spot, None	Eff	Temp	Time
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—

15 Heads: (a) — (Mat'l Spec No., Grade or Type) H.T. Time & Temp (b) — (Mat'l Spec No., Grade or Type) H.T. Time & Temp

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical	Conical	Hemispherical	Flat	Side to Pressure		Category A		
		Min	Corr	Crown	Knuckle	Ratio	Apex Angle	Radius	Diameter	Convex	Concave	Type	Full, Spot, None	Eff
(a)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(b)	—	—	—	—	—	—	—	—	—	—	—	—	—	—

If Removable, bolts used (describe other fastening) — (Mat'l Spec. No., Grade, Size, No.)

FORM U-1 MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

1 Manufactured and certified by **Pennsylvania Tank & Tube, Inc., 409 Saxonburg Blvd., Saxonburg, Pa. 16056**
(Name and address of Manufacturer)

2 Manufactured for **Envirotrol, Inc., 432 Green St., Sewickley, Pa. 15143-0061**
(Name and address of Purchaser)

3 Location of Installation **Unknown**
(Name and address)

4 Type: **Vertical** (Horiz. vert. or sphere) **8'-0" Dia. Adsorber Tank** (Tank, separator, jkt. vessel, heat exch., etc.) **0175-1** (Mfg's. serial No.)

— (CRN) **D-1075-1 Rev. 0** (Drawing No.) **0054** (Nat'l. Board No.) **1995** (Year Built)

5 ASME Code, Section VIII, Div. 1 **1992, 93A** (Edition and Addenda (date)) — (Code Case No.) — (Special Service per UG 120(d))

Items 6 - 11 incl. to be completed for single wall vessels, jackets of jacketed vessels, shell of heat exchangers, or chamber of multi-chamber vessels

6 Shell (a) No. of course(s): **One** (b) Overall length (ft. & in.): **5'-2 1/2"**

Course(s)			Material	Thickness		Long Joint (Cat. A)			Circum Joint (Cat A, B & C)			Heat Treatment	
No.	Diameter in	Length (ft & in)	Spec/Grade or Type	Nom.	Corr	Type	Full, Spot, None	Eff	Type	Full, Spot, None	Eff	Temp	Time
1	96	5-2 1/2"	SA516-70	.313	0	1	Spot	85	1	None	85	None	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—

7 Heads: (a) **SA516-70** (Mat'l Spec No., Grade or Type) H T Time & Temp (b) **SA516-70** (Mat'l Spec No., Grade or Type) H T Time & Temp

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure		Category A		
		Min	Corr	Crown	Knuckle					Convex	Concave	Type	Full, Spot, None	Eff
(a)	Top	0.438	0	96.0	7.00	—	—	—	—	—	X	S	None	100
(b)	Bottom	0.313	0	—	—	2:1	—	—	—	—	X	S	None	100

If Removable, bolts used (describe other fastening) — (Mat'l Spec. No., Grade, Size, No.)

8 Type of jacket — Jacket closure — (Describe as ogee & weld, bar, etc.)

If bar, give dimensions — If bolted, describe or sketch

9 MAWP **75** (internal) — (external) psi at max. temp. **150** (internal) — (external) deg. F. Min. design metal temp. **-20** deg. F at **75** psi.

10 Impact test **No, UG20(f) Exempt** (Indicate yes or no and the component(s) impact tested)

11 Hydro., [illegible]b. test press. **113** Proof Test —

Items 12 and 13 to be completed for tube sections.

12 Tubesheet: — Stationary (Mat'l. Spec. No.) — Dia. in. (subject to stress) — Nom. thk., in. — Corr. Allow., in. — Attachment (welded or bolted)

— Floating (Mat'l. Spec. No.) — Dia. in. — Nom. thk., in. — Corr. Allow., in. — Attachment

13 Tubes: — Mat'l Spec. No., Grade or Type — O.D. in. — Nom. thk., in. — Number — Type (Straight or U)

Items 14-18 to be completed for inner chambers of jacketed vessels or channels of heat exchangers.

14 Shell (a) No. of course(s): — (b) Overall length (ft. & in.): —

Course(s)			Material	Thickness		Long Joint (Cat. A)			Circum Joint (Cat A, B & C)			Heat Treatment	
No.	Diameter in	Length (ft & in)	Spec/Grade or Type	Nom.	Corr	Type	Full, Spot, None	Eff	Type	Full, Spot, None	Eff	Temp	Time
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—

15 Heads: (a) — (Mat'l Spec No., Grade or Type) H T Time & Temp (b) — (Mat'l Spec No., Grade or Type) H T Time & Temp

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure		Category A		
		Min	Corr	Crown	Knuckle					Convex	Concave	Type	Full, Spot, None	Eff
(a)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(b)	—	—	—	—	—	—	—	—	—	—	—	—	—	—

If Removable, bolts used (describe other fastening) — (Mat'l Spec. No., Grade, Size, No.)

The American Society of Mechanical Engineers

CERTIFICATE OF AUTHORIZATION

This certificate accredits the named company as authorized to use the indicated symbol of the American Society of Mechanical Engineers (ASME) for the scope of activity shown below in accordance with the applicable rules of the ASME Boiler and Pressure Vessel Code. The use of the code symbol and the authority granted by this Certificate of Authorization are subject to the provisions of the agreement set forth in the application. Any construction stamped with this symbol shall have been built strictly in accordance with the provisions of the ASME Boiler and Pressure Vessel Code.

COMPANY

PENNSYLVANIA TANK & TUBE, INC.
SAXONBURG PLANT
409 SAXONBURG BLVD.
SAXONBURG, PENNSYLVANIA 16056

SCOPE

PRESSURE VESSELS AT THE ABOVE LOCATION
AND FIELD SITES CONTROLLED BY THIS LOCATION

AUTHORIZED	FEBRUARY 11, 1994
EXPIRES	FEBRUARY 11, 1997
CERTIFICATE NUMBER	27,545
SYMBOL	U

Domenic A. Canonico
CHAIRMAN OF THE BOILER
AND PRESSURE VESSEL COMMITTEE

Alan Bagner
DIRECTOR, ACCREDITATION AND CERTIFICATION

CERTIFICATE OF AUTHORIZATION

The American Society of Mechanical Engineers

This certificate accredits the named company as authorized to use the indicated symbol of the American Society of Mechanical Engineers (ASME) for the scope of activity shown below in accordance with the applicable rules of the ASME Boiler and Pressure Vessel Code. The use of the code symbol and the authority granted by this Certificate of Authorization are subject to the provisions of the agreement set forth in the application. Any construction stamped with this symbol shall have been built strictly in accordance with the provisions of the ASME Boiler and Pressure Vessel Code.

COMPANY

PENNSYLVANIA TANK & TUBE, INC.
SAXONBURG PLANT
409 SAXONBURG BLVD.
SAXONBURG, PENNSYLVANIA 16056

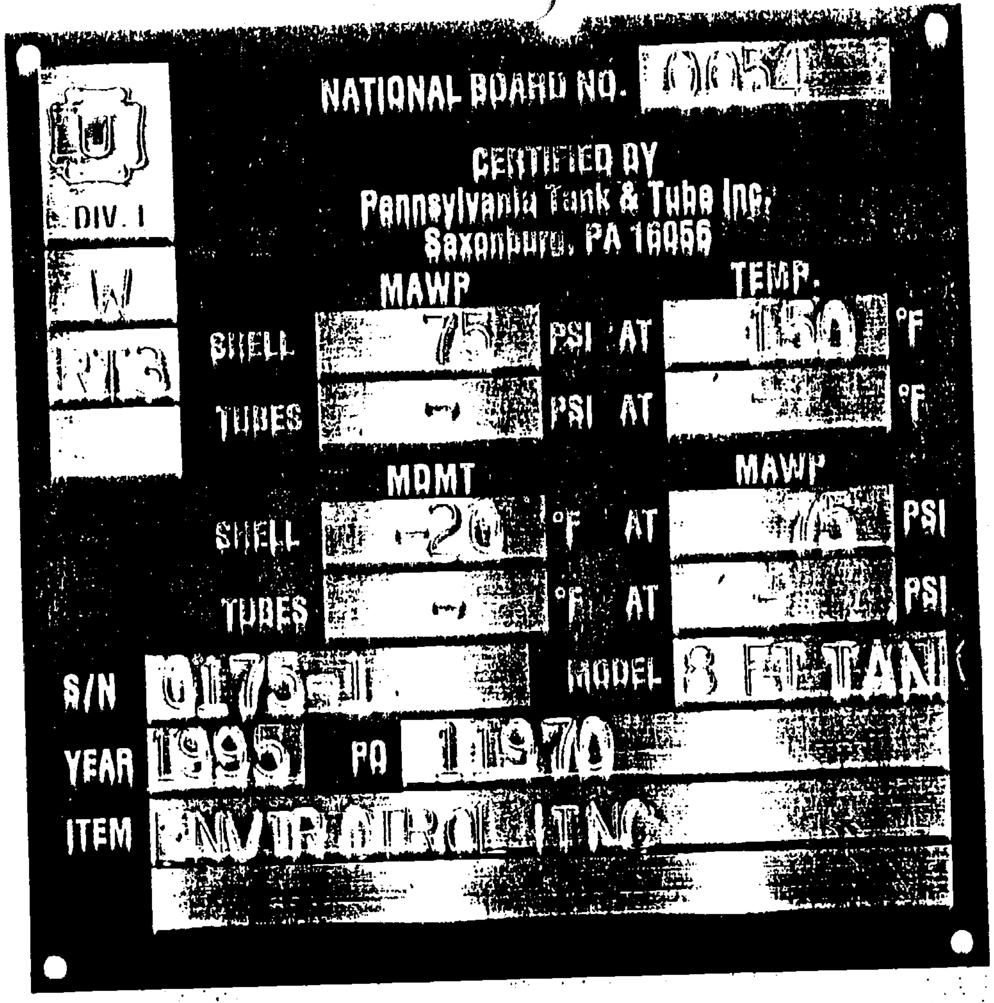
SCOPE

POWER BOILERS AT THE ABOVE LOCATION
AND FIELD SITES CONTROLLED BY THIS LOCATION

AUTHORIZED	FEBRUARY 11, 1994
EXPIRES	FEBRUARY 11, 1997
CERTIFICATE NUMBER	27,544
SYMBOL	S

Domenic A. Canonico
CHAIRMAN OF THE BOILER
AND PRESSURE VESSEL COMMITTEE

Alan Bagner
DIRECTOR, ACCREDITATION AND CERTIFICATION



U
DIV. 1
W
RT3

NATIONAL BOARD NO. 0054

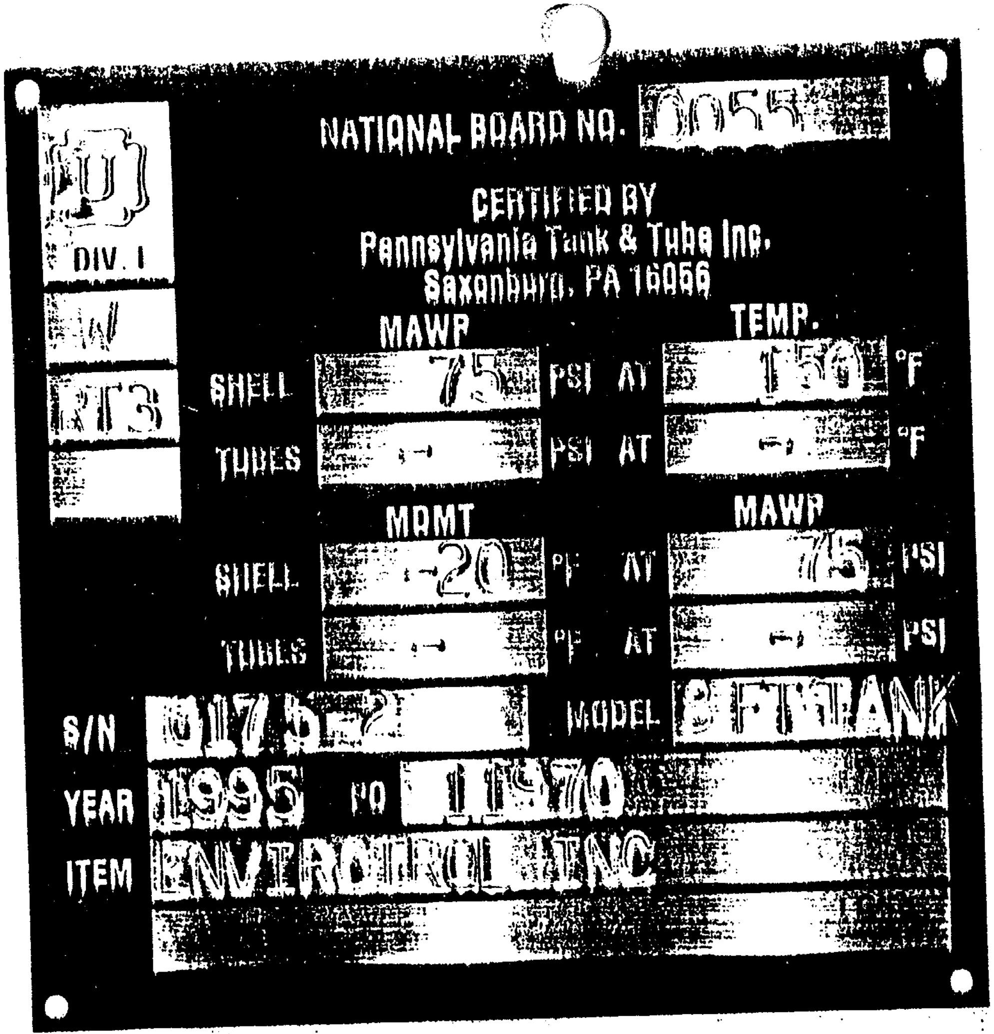
CERTIFIED BY
Pennsylvania Tank & Tube Inc.
Saxonburg, PA 16056

	MAWP			TEMP.	
SHELL	75	PSI	AT	150	°F
TUBES	—	PSI	AT	—	°F
	MDMT			MAWP	
SHELL	-20	°F	AT	75	PSI
TUBES	—	°F	AT	—	PSI

S/N 0175-1 MODEL 8 FT TANK

YEAR 1995 PO 11970

ITEM ENVIROGEN INC



U
DIV. I
W
RT3

NATIONAL BOARD NO. 0055

CERTIFIED BY
Pennsylvania Tank & Tube Inc.
Saxonburg, PA 16056

	MAWP			TEMP.	
SHELL	75	PSI	AT	150	°F
TUBES	—	PSI	AT	—	°F

	MDMT			MAWP	
SHELL	-20	°F	AT	75	PSI
TUBES	—	°F	AT	—	PSI

S/N 0175-2 MODEL 8 FT TANK
YEAR 1995 PO 11970
ITEM ENVIROTROL INC

PENNSYLVANIA TANK & TUBE, INC. BILL OF MATERIALS (Continued) Page 2 of 2

Revision 0
Date 9/20/93

S/O - Date 0175 3/15/95	ASME Code Section/Year VIII, DIV. 1 1992/93A	Prepared By/Date MARK HADLEY 4/11/95	Approved By/Date JOHN TOUNSEND 6/2/95

Rev. No 0
Date 4/11/95

Mark No.	* **	Quantity	Item Description	Material Spec.	B/M Number	Quantity	Purchase	Vendor	P. O. No.	Due Date	Heat No.
F		2	18" HINGED CLOSURE WITH DATA REPORT	SA-106B	8	2	SAME				SEE BELOW
F1		2	RE-PAD 3/8" x 25" O.D. ROLL TO 96" I.D.	SA-516 70			CHECK STOCK				Z406171-9012
G		2	6" HINGED CLOSURE WITH DATA REPORT	SA-106 B	9	2	SAME				SEE BELOW
X		12	3/8" x 4½" x 6" (PUNCH PER DETAIL)	SA-36			STOCK				Z406171-9012
											AYTV
F		2	18" XH WELD CAP	SA234WPB							AZJY
F		2	18" (.500 WALL) PIPE	SA106B							L22395
											—
G		2	6" XS WELD CAP	SA234WPB							RC4GB-41911
G		2	6" (.432 WALL) PIPE	SA106B							SLN-HW0405

*Material Test Reports Required **Material Stamping Required

PENNSYLVANIA TANK & TUBE, INC. BILL OF MATERIALS FOR (2) VESSELS Page 1 of 2

[illegible] COPY

APPROVED FOR FABRICATION 6-1-95 BY

6-2-95 John Townsend

S/O - Date: 0175 3/15/95

ASME Code Section/Year: VIII, DIV. 1 1992/93A

Prepared By/Date: MARK HADLEY 4/11/95

Approved By/Date: JOHN TOWNSEND 6/2/95

Rev. No. 0

Date 4/11/95

Customer: ENVIROTROL, INC.

Description: (2) 8' OD ADSORBER VESSELS

Drawing Numbers: 0175-1 ; 9416-301

6-5-95

Mark No.	* **	Quantity	Item Description	Material Spec.	B/M Number	Quantity	Purchase	Vendor	P. O. No.	Due Date	Heat No.
1	*	2	TOP HEAD 96" O.D. F+D x 7/16" NOM	SA-516 70	1	2	SAME	C.E. MACPHERSON	0495-0175	5/4	ALG0854S-50336
			DOUBLE BEVEL + I.D. TAPER TO 5/16"								—
2	*	2	BOTTOM HEAD 96" O.D. 2:1 ELLIPT. x 5/16" NOM.		2	2	SAME				ALG9335P-387
			DOUBLE BEVEL								—
3	* **	2	SHELLS 5/16" x 62 1/2" x 300 7/16"		3	2					328L01C20 328L01030
4		10	LIFTING LUG 3/4" THK	SA-36							802L41970
5	*	8	LEGS, 6x6x1/2" THK.								181N144
6		8	BASE PLATE 5/8" x 8" x 8"								542/393-4902
A	**	2	4" 150# RFSO	SA-182 F304L	4	4	SAME				467960
A1		2	4" SCH-40 WLD.	SA-312 T-304L	5						716152
A2		2	4" SCH-10 BW TEE	304L	6	2	SAME				N210021
B		2	4" 150# RFSO	SA-182 F304L			GET FROM 4				467960
B1		2	4" SCH-40	SA-312 T-304L			CUT FROM 5				716152
B2		2	1/4" PL FLANGE TO MATCH 4" 150#	304L			STOCK				53803-1B
C		2	4" 150# FFSO	SA-105	7	6	SAME				C.O.C.
C1		2	4" STD. WALL PIPE	SA-106B			STOCK				N89566
D		2	4" 150# FFSO	SA-105			GET FROM 7				C.O.C
D1		2	4" STD. WALL PIPE	SA-106B			STOCK				N89566
E		2	4" 150#	SA-105			GET FROM 7				C.O.C.
E1		2	4" STD. WALL PIPE	SA-106B			STOCK				N89566
E2		2	5/16" x 8" O.D. RE-PAD (USE DROP FROM SHELL OR HEAD)	SA-516-70			STOCK				328L01C20 328L01030

*Material Test Reports Required **Material Stamping Required

C E MACPHERSON COMPANY
Division of Canadian Erectors Ltd.
KINGSTON, ONTARIO K7L 4W2

CERTIFICATE OF COMPLIANCE

DATE 04/17/95

CUSTOMER PENNSYLVANIA TANK & TUBE, INC.

ATTN: QUALITY CONTROL

Q.T
4/20/95
1942/93A
SA516-70

PURCHASE ORDER # 0495-0175

WORK ORDER # 62864

DESCRIPTION 2 ASME FD 96.000" OD 0.438"t 1.50"SF
96.0"DR 7.000"ICR 16.781"IDD

QUANTITY	*MILL TEST NUMBER*	*MATERIAL SA 516-70*
2	ALG 0854S - 50336	

WE HEREBY CERTIFY THAT THESE HEADS CONFORM TO THE ABOVE DESCRIPTION AND THAT THEY WERE FORMED TO A.S.M.E. CODE SECTION VIII DIVISION 1 LATEST EDITION INCLUDING UCS 79(d), UG-81 AND WERE NOT POST FORMED HEAT TREATED.

NOTE: We must receive written notice at time of order if vessel will contain lethal substances.

AUTHORIZED SIGNATURE

TEST REPORTS

We are pleased to attach your copies of Mill Test Reports and/or Letter of Compliance for material on your above order.

ALGOMA TEEL INC.

Alg Steel Inc. P.O. Box 1400
Sau. . Marie, Ontario, Canada P6A 5P2

CUSTOMER PURCHASE ORDER NUMBER	ENTRY DATE	SHIP DATE	TALLY NUMBER	SHIPPER'S NUMBER	CARRIER	PAGE	MILL ORDER
15035	NOV 01/94	95-01-05	243862	02-	F & J CARTAGE -10	2	12868

CHARGE TO CUSTOMER NAME AND ADDRESS
ALGOMA STEEL INC FOR
C E MCPHERSON CO - DIV CDN ERECTORS LTD
PO BOX 320,
KINGSTON, ONTARIO K7L 4W2

SHIP TO CUSTOMER NAME AND ADDRESS
ALGOMA STEEL INC FOR
C E MACPHERSON C/O CHINA STEEL LTD
164 INDUSTRIAL PARK CRESCENT,
SAULT STE. MARIE, ONTARIO 18

MILL TEST REPORTS

ALGOMA STEEL INC. HEREBY CERTIFIES THAT THE MATERIAL HEREIN DESCRIBED WAS MADE AND TESTED IN ACCORDANCE WITH THE RULES OF THE SPECIFICATION SHOWN HEREIN AND AS CONTAINED IN THE COMPANY RECORDS.

A. Riutta
MANAGING METALLURGIST

CUSTOMER SPECIFICATION
HR PLATE - CARBON - ASME SA 516 70 (1992) - PVQ - FOR DISHED AND COLD FLANGED HEADS

RECEIVED
JAN 12 1995
C. E. MACPHERSON COMPANY

SUPPLEMENTARY INSTRUCTIONS
MAIL TEST REPORTS TO CHARGE TO ADDRESS

INSP T/R TEST REPORTS REQUIRED

CUST USE DISHED & C/F HEADS

* * * * * * * * * * * * * * * * * * * PRODUCT SHIPPED *

CUSTOMER ITEM 7 OUR ITEM 007 DIMENSIONS 7/16 X 107-1/2 X 326-1/2 "

PLATE NUMBER	HEAT	NO. PIECES	WEIGHT	PLATE NUMBER	HEAT	NO. PIECES	WEIGHT
50336	0854S 55	1	4355				

* * * * * * * * * * * * * * * * * MECHANICAL PROPERTIES *

HEAT	PLATE NUMBER	SAMPLE GAUGE	TEST COND.	TEST METH.	TEST DIR.	YIELD KSI	TENSILE KSI	% ELONG 2"	% ELONG 8"
0854S	50336	.4375	AR	.2	T	49 ✓	79 ✓		24 ✓

* * * * * * * * * * * * * * * * * CHEMICAL PROPERTIES *

HEAT	C	MN	S	P	SI	CR	NI	CU	MO	ALT	ALS	CB	V	B	TI	N
0854S 55	.21 ✓	1.05 ✓	.009 ✓	.010 ✓	.22 ✓	.02	.01	.01	.01	.029	.026	<.008	<.008			

QT 4/20/95
1992/93A
SA516-70

ACCEPTABLE TO
ASME
REQUIREMENTS
PER M Jan 12/95

CONTINUED ON NEXT PAGE

** WARNING ** THE TEST RESULTS AND VALUES REPORTED HEREIN INDICATE ONLY THAT (1) THE PARTICULAR STEEL FOR WHICH THIS CERTIFICATE IS ISSUED MEETS THE MINIMUM SPECIFIED YIELD STRENGTH AND (2) THE CHEMICAL ANALYSIS AND PHYSICAL PROPERTIES OF SUCH STEEL ARE IN CONFORMANCE WITH THE REQUIREMENTS OF

C E MACPHERSON COMPANY
Division of Canadian Erectors Ltd.
KINGSTON, ONTARIO K7L 4W2

CERTIFICATE OF COMPLIANCE

DATE 04/17/95

CUSTOMER PENNSYLVANIA TANK & TUBE, INC.

ATTN: QUALITY CONTROL

PURCHASE ORDER # 0495-0175

WORK ORDER # 62863

DESCRIPTION 2 ASME 2:1 SE 96.000" OD 0.313"t 2.00"SF
23.844"IDD

QUANTITY	MILL TEST NUMBER	MATERIAL SA 516-70
2	ALG 9335P - 38796	

QT 4/20/95
1992/93A
SA516-70

WE HEREBY CERTIFY THAT THESE HEADS CONFORM TO THE ABOVE DESCRIPTION AND THAT THEY WERE FORMED TO A.S.M.E. CODE SECTION VIII DIVISION 1 LATEST EDITION INCLUDING UCS 79(d), UG-81 AND WERE NOT POST FORMED HEAT TREATED.

NOTE: We must receive written notice at time of order if vessel will contain lethal substances.

AUTHORIZED SIGNATURE

TEST REPORTS

We are pleased to attach your copies of Mill Test Reports and/or Letter of Compliance for material on your above order.

ALGOMA TEEL INC.

Algc teel Inc. P.O. Box 1400
Sault . Marie, Ontario, Canada P6A 5P2

CUSTOMER PURCHASE ORDER NUMBER	ENTRY DATE	SHIP DATE	TALLY NUMBER	SHIPPER'S NUMBER	CARRIER	PAGE	MILL ORDER
8655	AUG 12/94	94-10-20	231189	02-	SUREWAY TRANSPORT CO. LTD 225	2	7950

CHARGE TO CUSTOMER NAME AND ADDRESS

CONREX STEEL LTD.
50 TABER ROAD
REXDALE, ONTARIO
M9W 3A8

SHIP TO CUSTOMER NAME AND ADDRESS

CONREX STEEL LTD
50 TABER ROAD
REXDALE ONTARIO
M9W 3A8

MILL TEST REPORTS

ALGOMA STEEL INC. HEREBY CERTIFIES THAT THE MATERIAL HEREIN DESCRIBED WAS MADE AND TESTED IN ACCORDANCE WITH THE RULES OF THE SPECIFICATION SHOWN HEREIN AND AS CONTAINED IN THE COMPANY RECORDS.

A. RIUTTA
MANAGING METALLURGIST

CUSTOMER SPECIFICATION

HR PLATE - CARBON - ASME SA 516 70 (1992) - PVQ - SHEARED - FOR DISHED AND COLD FLANGED HEADS - TO BE SUPPLIED IN THE AS ROLLED CONDITION WITH TEST BASED ON AS ROLLED AND NORMALIZED TEST COUPONS - NORMALIZE AT 1650F 1 HR PER INCH OF THICKNESS

SUPPLEMENTARY INSTRUCTIONS

FAX SM & TR ATTN VICKI CASEY (416-747-4667)

INSP T/R TEST REPORTS REQ'D - NORM & AS ROLLED COUPONS

CUST USE DISHED AND COLD FLANGED HEADS

* PRODUCT SHIPPED * * * * * * * * * * * * * * * * * * *

CUSTOMER ITEM 5 OUR ITEM 005 DIMENSIONS .3125 X 119 X 240 "

PLATE NUMBER	HEAT	NO. PIECES	WEIGHT	PLATE NUMBER	HEAT	NO. PIECES	WEIGHT
38791	8857P 06	2	5062	38796	9335P 02	2	5062

* * * * * * * * * * * * * * * * MECHANICAL PROPERTIES * * * * * * * * * * * * * * * *

HEAT	PLATE NUMBER	SAMPLE GAUGE	TEST COND.	TEST METH.	TEST DIR.	YIELD KSI	TENSILE KSI	% ELONG 2"	% ELONG 8"
8857P	38791	.3125	AR	.2	T	56	85		20
		.3125	N	.2	T	51	81		23
9335P	38796	.3125	AR	.2	T	55 ✓	84 ✓		20 ✓
		.3125	N	.2	T	49	81		23

* * * * * * * * * * * * * * * * * CHEMICAL PROPERTIES * * * * * * * * * * * * * * * * *

HEAT	C ✓	MN ✓	S ✓	P ✓	SI ✓	CR	NI	CU	MO	ALT	ALS	CB	V	B	TI	N
8857P 06	.24	1.02	.010	.014	.21	.11	.09	.08	.01	.041	.039	<.008	<.008			
9335P 02	.26	1.04	.012	.012	.23	.10	.09	.10	.01	.041	.034	<.008	<.008			

"MEET SPECIFICATIONS"

APPROVED

DATE: Oct 25/94

SIGNED FOR CSL V Casey

9T 4/20/95
1992/93A
SA516-70

CONTINUED ON NEXT PAGE

* * WARNING * * THE TEST RESULTS AND VALUES REPORTED HEREIN INDICATE ONLY THAT (1) THE PARTICULAR STEEL FOR WHICH THIS CERTIFICATE IS ISSUED MEETS THE MINIMUM ... AND PHYSICAL PROPERTIES OF SUCH STEEL ARE IN CONFORMANCE WITH THE REQUIREMENTS OF

F4868700
(REV. 03-84)

SO# 0175

BETHLEHEM STEEL CORPORATION
QUALITY ASSURANCE DEPARTMENT
REPORT OF TESTS AND ANALYSES

BURNS HARBOR DIVISION

SHIPMENT NO.	DATE SHIPPED	CAR OR VEHICLE NO.		
803-06242	3-27-95	PEOPLES TRKG	TRLR 1439A	PAGE 2

SOLD TO
A M CASTLE & CO
3400 N WOLF RD
FRANKLIN PARK IL 60131

SHIP TO
A M CASTLE & CO
3400 N WOLF RD BAY 4
FRANKLIN PARK IL 60131

* THIS TEST REPORT CANNOT BE ALTERED & MUST BE TRANSMITTED INTACT WITH ANY SUBQ 3RD PRTY TST RPT IF RQRD

PLATES - K02700-64 REV 7 DTD 07/13/94, ASTM A516-90 GR 70 PVQ. ASME SA516 GR 70 1992 EDITION UP TO AND INCLUDING 1993 ADD --- TEST CERTIFICATES ARE PREPARED IN ACCORDANCE WITH PROCEDURE OUTLINED IN DIN 50049 PARA 3.18

MFST - MON/FRI 8A/11A MFST TEST CERTIFICATES ARE PREPARED IN ACCORDANCE WITH PROCEDURE MFST OUTLINED IN DIN 50049 PARA 3.18 LIFT MAX 5 TON-SIZES & GRADES SEP UNLDG OH-PLATE HOOK

CO# 01-73507 GH 826-2691A

YIELD STRENGTH @ .5% E.U.L.
MERCURY IN ANY FORM HAS NOT BEEN USED
IN THE PRODUCTION OF THIS ORDER

NOTE	SERIAL NUMBER	PAT. NO.	HEAT NUMBER	SIZE AND QUANTITY NO. PCS.	THICKNESS INCHES	WIDTH OR DIA. INCHES	LENGTH INCHES	WEIGHT POUNDS	YIELD POINT PSI	TENSILE STRENGTH PSI	ELONG. IN	ELONG. %	RED. %
	A 70451 (M55)MFST		328L01020 REF#:23164	2	5/16	72	380	4850	51200 ✓	78000 ✓	8	22 ✓	
	A 70450 (M55)MFST		328L01030 REF#:23164	3	5/16	72	380	7275	51100 ✓	76000 ✓	8	24 ✓	

NOTE: Q—QUENCH TEMPERATURE T—TEMPER TEMPERATURE N—NORMALIZE TEMPERATURE

QT 4/30/95
1992/93A
SA516-70

SERIAL NUMBER	PAT. NO.	HEAT NUMBER	HARD	BEND	THICKNESS INCHES	TYPE	SIZE	DIR.	TEST TEMP. F	CHARPY IMPACT ENERGY FT. LBS. 1	2	3	SHEAR (%) 1	2	3	LAT. EXP. MILS 1	2	3

CASTLE METALS - FP
DATE REC'D 3-9-95
REC'D FROM
APPROVED BY

SUBSCRIBED AND SWORN TO BEFORE ME
THIS 28 DAY OF [illegible] 19 95
NOTARY PUBLIC BRIAN A. [illegible]
PORTER COUNTY INDIANA
MY COMMISSION EXPIRES JULY 31, [illegible]
COUNTY OF RESIDENCE: PORTER

HEAT NUMBER	C ✓	Mn ✓	P ✓	S ✓	Si ✓	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N		McQUAID GRAIN SIZE
328L01020	.22	1.06	.018	.005	.230	.030	.02	.03	.001	.001		.039		.001			
328L01030	.21	1.08	.018	.008	.230	.030	.02	.03	.001	.001		.042		.001			

I CERTIFY THAT THE ABOVE RESULTS ARE A TRUE AND CORRECT COPY OF ACTUAL RESULTS CONTAINED IN RECORDS MAINTAINED BY BETHLEHEM AND ARE IN FULL COMPLIANCE WITH THE REQUIREMENTS OF THE SPECIFICATION CITED ABOVE. THIS TEST REPORT CANNOT BE ALTERED AND MUST BE TRANSMITTED INTACT WITH ANY SUBSEQUENT THIRD PARTY TEST REPORTS, IF REQUIRED.

R. F. Hartmann
SUPT. QUALITY ASSURANCE
PER

LADISH CO. aps | INDUSTRIAL PRODUCTS DIV.
MAIN OFFICE, CUDAHY, WI 53110
BRANCH PLANTS. RUSSELLVILLE, AR • CYNTHIANA, KY • HOUSTON, TX • CUDAHY, WI

CERTIFIED MATERIAL TEST REPORT

PETROLEUM PIPE AND SPLY
P.O. BOX 545
CARNEGIE, PA 15106

9773-95
1992/93A
SA234WPB

CUSTOMER ORDER NO.	LADISH ORDER NO	LADISH INVOICE NO
04031-S	G47973A	A69026

"SHIP TO" CUSTOMER'S NAME AND ORDER REFERENCE. MARK. ETC.
PETROLEUM PIPE & SUPPLY HEIDELBERG, PA

SHIPPING PLANT	DATE SHIPPED	DATE OF REPORT
CYNTHIANA, KY		06/07/95

ITEM NO.	QTY.	DESCRIPTION	SPECIFICATION	CODE	HEAT NO.
17	5	6 XS CAP	ASTM A234-94 WPB	RC4GB	41911

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	V	CB	Yield KSI	Tensile KSI	Elong. %	R A
.21 ✓	1.02 ✓	.022 ✓	.009 ✓	.18 ✓	.02	.02	.02	.02	.02	.02	58.0 ✓	76.5 ✓	33 ✓	67

CE = .39

ITEM NO.	QTY.	DESCRIPTION	SPECIFICATION	CODE	HEAT NO.

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	V	CB	Yield KSI	Tensile KSI	Elong. %	R A

ITEM NO.	QTY.	DESCRIPTION	SPECIFICATION	CODE	HEAT NO.

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	V	CB	Yield KSI	Tensile KSI	Elong. %	R.A.

NO.	QTY.	DESCRIPTION	SPECIFICATION	CODE	HEAT NO.

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	V	CB	Yield KSI	Tensile KSI	Elong. %	R A

ITEM	CHARPY (SIZE) V NOTCH	TEMP. °F	FOOT POUNDS	% SHEAR	MILS LATERAL EXP.

		ITEM	TENSILE SPECIME
ABOVE	FITTINGS HAVE A MAXIMUM HARDNESS OF 197 BHN		STD. RD.
	FITTINGS CONFORM TO THE REQUIREMENTS OF MSS-SP75		FULL SEC.
	MAGNETIC PARTICLE INSPECTED AND ACCEPTED PER LADISH PROC.		STRIP
	ULTRASONICALLY INSPECTED AND ACCEPTED PER LADISH PROC.	**ITEM**	**HEAT TREATMEN**
			NOT REQUIRED
	LIQUID PENETRANT INSPECTED AND ACCEPTED PER LADISH PROC.		STRESS RELIEVE 125
		ABOVE	NORM 1650°F
	WELD(S) RADIOGRAPHICALLY INSPECTED AND ACCEPTED PER		NORM 1750°F & TEMPER 1300°F
			WATER QUENCH 1650 TEMPER
			WATER QUENCH 165 TEMPER 1200°F
			SOLN. ANNEAL

NOTES:

STARTING RAW MATERIAL: PLATE (SEAMLESS)

COLD FORMED. THESE CAPS MEET THE DEMENSIONAL TOLERANCE OF UG-81, UG-79 and UCS-79 of the A.S.M.E. CODE.

COMPANY NAME Pennsylvania Tank & Valve
YOUR P.O. # CSE7-115
OUR P.O. # 63615

Kenneth D. Cobb
LADISH

HACKNEY, INC.

SC# 0175

A DIVISION OF TRINITY INDUSTRIES
P.O. Box 568887 • 2525 Stemmons Freeway
Dallas, Texas 75356-8887 • (214) 634-2850

YOUR ORDER NUMBER	REFERENCE	CUSTOMER NO.	INVOICE NO	INVOICE DATE	DATE SHIPP
1267-PLY	C136427	287485	815377	10/26/94	10/26/9

QT 7-3-95
1992/93A
SA234WPB

LD TO: GRAFF VALVE & FITTINGS
12345 S. MARSHFIELD AVE
CALUMET PARK IL 60643

SHIP TO: GRAFF VALVE & FITTING
700 W. TABOR ROAD
PHILADELPHIA, PA 19120

CERTIFIED TEST REPORT

1414 (1-12/93)

TEM	QUANTITY	DESCRIPTION/SPECIFICATION		HEAT CODE
25	1	20 STD SR 90 A106B 29 / 659109	A234-92A/SA234 WPB HOT FORMED	JBMW
30	10	4 STD TEE A106B 39 / C34883	A234-92A/SA234 WPB STRESS RELIEVED AT 1200 F	LVZ1
40	1	18 XH WC A516-70 5446	A234-92A/SA234 WPB	AZJY
	2	8X6 XH ECC A106B 39 / X63386	A234-92A/SA234 WPB	XLJ

CHEMICAL ANALYSIS

HEAT CODE	C	Mn	P	S	Si	Cr	Mo	Cu	Ni	V	Nb		C.E.=
JBMW	.20	.68	.015	.002	.21	.04	.01	.02	.02	.01	.00		.33
LVZ1	.20	.76	.009	.008	.21	.03	.01	.04	.02	.00	.00		.34
AZJY	.18 ✓	1.10 ✓	.015 ✓	.010 ✓	.26 ✓	.03	.02	.05	.04	.01	.01		.38
XLJ	.18	.84	.008	.005	.25	.02	.01	.01	.01	.00	.00		.33

PHYSICAL PROPERTIES / CHARPY RESULTS

HEAT CODE	TENSILE * KSI	YIELD KSI	% Elong. IN 2"	Hardness HB	Size MM x 10 mm	Temp. °F	FOOT POUNDS	LATERAL EXPANSION	% SHEAR
JBMW	69.2 L	45.8	38.0	197 MAX					
LVZ1	71.5 L	52.5	31.0	130					
AZJY	76.9 T ✓	54.5 ✓	35.0 ✓	129 ✓					
XLJ	59.0 L	44.0	48.4	197 MAX					

= LONGITUDINAL, T = TRANSVERSE, R = ROUND, S = STRIP

CKNEY is a domestic manufacturer, and these items conform to the following specifications as they apply
FITTINGS: ASTM A234 WPB, ASME SA234 WPB, ANSI B16.9, B16.28, AND NACE MR01-75.
FLANGES: ASTM A105 AND A516-70, ASME SA105, ANSI B16.5, and NACE MR01-75.
Items were heat treated as required by the applicable specification. They also conform to the requirements of Parts 192 and 195, Title 49, Code of Federal gulations. All welded fittings are welded by certified welders to ASME Section IX, and 100% radiographically examined per Article 2, ASME Section V. All are npliance with the requirements of Paragraph UG-11, Section VIII, Division 1 of the ASME code. Hackney weld caps meet ASME Division 1, Section VIII Pres ssel Code Requirements, Paragraph UCS-79c. We certify these flanges and fittings capable of passing a hydrostatic test compatible with their rating, and th ove figures are correct as contained in the records of the Company. Hardness testing and stamping are per NACE MR01-75.

SC# 0175

HACKNEY, INC.

A DIVISION OF TRINITY INDUSTRIES
P.O. Box 568887 • 2525 Stemmons Freeway
Dallas, Texas 75356-8887 • (214) 634-2350

YOUR ORDER NUMBER	REFERENCE	CUSTOMER NO.	INVOICE NO.	INVOICE DATE	DATE SH
549	C034016	287435	903517	02/07/92	02/07.

QT 7-3-95
1992 / 93A
SA234WPB

SOLD TO: GRAFF VALVE & FITTINGS
12345 S. MARSHFIELD AVE
CALUMET PARK IL 60643

SHIP TO: GRAFF VALVE & FITTING
12345 S. MARSHFIELD AVE.
CALUMET PARK, IL 60643

CERTIFIED TEST REPORT

TR1414 (8/91)

ITEM	QUANTITY	DESCRIPTION/SPECIFICATION		HEAT COI
1	40	12 STD W/C A516-70 NATL C16586	A234-90A/SA234 WPB	AYUP
4	10	18 XH W/C A516-70 OXELO 562501	A234- /SA234 WPB	AYTV

CHEMICAL ANALYSIS

HEAT CODE	C	Mn	P	S	Si	Cr	Mo	Cu	Ni	V	Nb		C.E.=
AYUP	.17	1.16	.018	.006	.23	.04	.01	.02	.01	.02	.03		.38
AYTV	.23	1.14 ✓	.012 ✓	.002 ✓	.30 ✓	.02	.00	.02	.03	.01	.00		.43

PHYSICAL PROPERTIES ... CHARPY RESULTS

HEAT CODE	TENSILE * KSI	YIELD KSI	% Elong. IN 2"	Hardness HB	Size MM x 10 mm	Temp. °F	FOOT POUNDS	LATERAL EXPANSION	% SHEAR
AYUP	73.8 T	54.8	37.0						
AYTV	78.3 ✓	47.8 ✓	32.0 ✓	197 MAX ✓					

L = LONGITUDINAL, T = TRANSVERSE

AYUP AYTV CONFORM TO THE REQUIREMENTS OF NACE MR0175-90

Above items were heat treated in accordance with the requirements of the specification to which they were manufactured.

We certify that the products covered by this report comply with the applicable requirements of ASTM and/or ASME specifications, as noted for each item.

We hereby certify that the above figures are correct, as contained in the records of the Company.

By:

USS

US
A sion of USX Corporation

TUBULAR PRODUCTS

METALLURGICAL TEST REPORT

01554

JOB. CONTRACT NO.	P O DATE	PURCHASE ORDER NO 01554-S		
	SHIPPERS NO.	MILL ORDER NO. DR23780	INVOICE NO.	
	VEHICLE IDENTITY			

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MFG., SAMPLED, TESTED, AND/OR INSPD. IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS REQUIREMENTS IN SUCH RESPECTS.

APPROVED BY THE OFFICE OF:
D.S. DABKOWSKI MGR. MET. &
Q.A. USS TUBULAR PRODUCTS
DATE 05/01/92

USS TUBULAR PRODUCTS

SOLD TO
PETROLEUM PIPE &
SUPPLY CO INC
P O BOX 545
CARNEGIE PA 15106 0545

MAIL TO
PETROLEUM PIPE &
SUPPLY CO INC
P O BOX 545
CARNEGIE PA 15106-0545

9T 7-3-95
1992/93A
SA106B

COMPANY NAME
YOUR P.O. # 6587-DIST
OUR P.O. # 6-20-95

ITEM NO	MATERIAL DESCRIPTION SIZE	WALL	SPECIFICATION & GRADE	MATL	HEAT/ LOT NO.	MIN HYDRO PSI	YIELD STR PSI	TENSILE STR PSI	ELONG. % IN 2"	GAGE WIDTH IN.	FLAT	BEND
2	18	.500	ASTM A53-90A GR. B ASME SA53 GR. B 89 ED. 90 ADD. ASTM A106 90 GR. B ASME SA106 GR. B 89 ED. 90 ADD. API 5L GR. B 39TH ED. 6/91	SMLS	L22395 1L3122	1960	43000 ✓	77600 ✓	42.00 ✓	1 1/2	OK	

ITEM NO.	HEAT NO.	TYPE	C ✓	MN ✓	P ✓	S ✓	SI ✓	CU ✓	NI ✓	CR ✓	MO ✓	SN	AL	N	V	B	TI	CB	CO
2	L22395 ✓	HEAT	.23	.65	016	007	.24	.01	.02	.04	.01				.001				
2	1L3122	PROD	.22	.67	017	007	.25	.01	.01	.04	.01				.001				

* * END OF DATA THIS SHEET * * ALL MELTING AND MANUFACTURING TOOK PLACE IN THE USA

NORTH STAR STEEL
Seamless Tubular Products

CERTIFIED TEST REPORT

HEAT NO.: SLN HW0405

PRODUCT DESCRIPTION :
6.625 OD 0.432 WALL 28.57 LBS/FT PEB DRL

GRADE :API 5L X42/B

CUSTOMER :
PETROLEUM PIPE & SUPPLY

CUSTOMER ORDER NO.:
03805-S

CUSTOMER SPEC.:

NSSO MILL ORDER NO.:
0-0021975-0

NSSH W/O NO.:

NSSH LOT NO.:

MECHANICAL PROPERTIES: LONGITUDINAL

SPECIMEN CROSS SECTION			ACTUAL LOAD (KIPS)		STRENGTH (KSI)		ELONGATION	
WIDTH (IN)	THICK (IN)	AREA (SQIN)	YIELD	TENSILE	YIELD ✓	TENSILE ✓	GAGE LENGTH	% ELONG ✓
1.500	0.426	0.6390	32.9	47.7	51.5	74.6	2.0	38.9

COMPANY NAME [illegible]

YOUR P.O. # 6587-0151

OUR P.O. # 6-30-95

COMMENTS

This pipe is also manufactured to:
ASTM A106B/C Rev.93
ASME SA106-B/C Rev.93
ASTM A53B Rev.93a
ASME SA53-B Rev.93a

QT 7-3-95
1992/931
SA106B

CHEMICAL ANALYSIS: NS61

	C ✓	Mn ✓	P ✓	S ✓	Si ✓	Cu ✓	Ni ✓	Cr ✓	Mo ✓	Sn ✓	Cb	V ✓	Al	Ca	B	Ti	N	CE
HEAT	0.21	0.77	0.007	0.004	0.23	0.28	0.17	0.12	0.05	0.017	0.000	0.002	0.030	0.0019	0.0000	0.000	0.0066	0.40
PRODUCT #1	0.21	0.77	0.007	0.004	0.24	0.27	0.16	0.12	0.05	0.017	0.000	0.002	0.030	0.0021	0.0000	0.000	0.0069	0.40
PRODUCT #2	0.21	0.76	0.007	0.005	0.24	0.27	0.16	0.12	0.05	0.017	0.000	0.002	0.031	0.0020	0.0000	0.000		0.40

HYDROSTATIC TEST (psi): 3000

SUPPLEMENTAL REQUIREMENTS	YES	NO	REMARKS
HARDNESS	X		RB AV 82
CHARPY IMPCT TST			
FLATTENING TEST	X		PASSED
NACE TEST		X	
JOMINY HARDEN			
GRAIN SIZE			
OTHER			Satisfies NACE MR-01-75

This material has been produced and tested in accordance with the requirements of applicable specifications unless otherwise listed below. We hereby certify that the above test results are representative of those contained in the records of the company. Any modification to this certification as provided by North Star Steel without the expressed written consent of North Star Steel negates the validity of this test report.
North Star Steel is not responsible for the inability of this material to meet specific applications.

SIGNED: Lynn Huffley

DATE: 12/7/94

SWORN AND SUBSCRIBED TO BEFORE ME

THIS__________ DAY__________

Notary Public

MY COMMISSION EXPIRES __________

THIS CERTIFICATE IS NOTORIZED ONLY WHEN REQUESTED

REPORT OF TESTS
AND INSPECTION

BETHLEHEM STRUCTURAL PRODUCTS CORPORATION

A SUBSIDIARY OF BETHLEHEM STEEL CORPORATION

115 95 3270 PAGE 1 F1457508 (REV.12-94)AFP

PURCHASE ORDER NO.	MILL ORDER NO.	SHIPPER'S NO.	SHIPPED FROM	DATE SHIPPED
P-29000	319-6615	0104-10105-04/05	BETHLEHEM	4/25/95

SOLD TO
ONEAL STEEL INC
PO BOX 98
BIRMINGHAM AL 35201

SHIP TO
ONEAL STEEL INC
2975 DUSS AVE
AMBRIDGE PA 15003

QUALITY STEEL MELTED AND MANUFACTURED IN USA

SPECIFICATION
ASTM A36-94

9T
5-12-95
1992/93A
5A36

INSPECTION-TEST REPORTS
10538 3 SWORN TEST REPORTS
REFER TO ORDER FOR SPECIAL MAILING

HEAT NO.	NO. PIECES	DESCRIPTION	LENGTH			WEIGHT	YIELD POINT	TENSILE STRENGTH	ELONG		BENDS
			FEET	IN.	FRCT.				%	IN	
181N144	4	L6X6X1/2	40			3136	46600	68500	25.0	8	
181N144	11	L6X6X1/2	20			4312	46600	68500	25.0	8	
181N143	40	L6X6X1/2	20			15680	48800	71500	27.0	8	

NOTARIAL SEAL
Edward J. August, Notary Public
City of Bethlehem, Northampton County, Pa.
My Commission Expires Aug. 18, 1997

SUBSCRIBED AND SWORN
TO BEFORE ME
APR 26 1995

Edward J. August
Notary Public

CH[illegible]CAL ANALYSIS

HEAT NO.	C	MN	P	S	SI	CU	NI	CR	MO	V	N	CB	ZR
181N144	.24	.73	.009	.032	.07	.04	.02	.04	.01	.001		.001	
181N143	.24	.72	.011	.037	.07	.04	.05	.05	.01	.001		.001	

"I CERTIFY THAT THE ABOVE RESULTS ARE A TRUE AND CORRECT COPY OF ACTUAL RESULTS CONTAINED IN RECORDS MAINTAINED BY BETHLEHEM AND ARE IN FULL COMPLIANCE WITH THE REQUIREMENTS OF THE SPECIFICATION CITED ABOVE. I FURTHER CERTIFY THAT THE MATERIAL HAS BEEN TESTED AND INSPECTED IN ACCORDANCE WITH THE CITED SPECIFICATION AND IS IN CONFORMANCE THERETO. THIS TEST REPORT CANNOT BE ALTERED AND MUST BE TRANSMITTED INTACT WITH ANY SUBSEQUENT THIRD PARTY TEST REPORTS, IF REQUIRED."

R C Atkinson
CHIEF METALLURGIST

SO# 0192 **Avesta Sheffield Plate Inc.**

Certificate of Analysis and Tests

OUR ORDER 3091 - 01 HEAT & PIECE 53803-1B 4/18/

SOLD TO: WILLIAMS & COMPANY
901 PENNSYLVANIA AVE
PITTSBURGH PA 15233

SHIP TO: WILLIAMS & COMPANY
7640 REINHOLD DRIVE
513-821-5555
CINCINNATI OH 452
965001-03

YOUR ORDER & DATE

65634995 0306 3/16/95 TAG# 06-200-04101

ITEM DESCRIPTION

HEAT & PIECE	53803 - 1B					
WEIGHT						
FINISH	1					
GRADE	304L			UNS-S30403		
DIMENSIONS	.250	x	96.000	x	293.000	EXACT

SPECIFICATIONS

ASTM A240-94A, ASME SA240-92
MIL-I-45208A AMEND. 1
QQ-S-766D COND A EX P 4.5.2
ASTM A312-93 CHEM ONLY
ASTM A167-93
FREE/KNOWN LOW MELT CONTAMIN
ASTM A262-93 PRAC A

WMS SPEC 06-210 4/16/86
ASTM A262-93 PRAC E
PDS 10710 BG
ASTM A276-92 CHEM, MECH ONLY
ASTM A480/A480M-94B

PLATES & TEST PCS SOLUTION ANNEALED @ 1950 DEGREES FARENHEIT MINIMUM.
THEN WATER COOLED OR RAPIDLY COOLED BY AIR
FREE OF MERCURY CONTAMINATION
HOT ROLLED, ANNEALED & PICKLED (HRAP)

MECHANICAL & OTHER TESTS

HARDNESS RB	86 ✓
YIELD STRENGTH (PSI)	43209 ✓
TENSILE STRENGTH (PSI)	84820 ✓
BEND	OK
INTERGRANULAR CORROSION	OK
ELONGATION % IN 2"	55.7 ✓
REDUCTION OF AREA %	71.9

9T
5-4-95
1992/93A
SA240-304L

CHEMICAL COMPOSITION

CARBON	(C)	.015 ✓
MANGANESE	(MN)	1.80 ✓
PHOSPHORUS	(P)	.034 ✓
SULFUR	(S)	.001 ✓
SILICON	(SI)	.38 ✓
CHROMIUM	(CR)	18.18 ✓
NICKEL	(NI)	8.59 ✓
COBALT	(CO)	.16
COPPER	(CU)	.28
MOLY	(MO)	.42
NITROGEN	(N)	.07 ✓
COLUMBIUM	(CB)	.010
TITANIUM	(TI)	.010
ALUMINUM	(AL)	.007
TIN	(SN)	.011
TANTALUM	(TA)	.001

WMS & CO.
QA [illegible]
APR 27 '95
W. Werke

KNOWINGLY & WILLFULLY FALSIFYING OR CONCEALING A MATERIAL FACT ON THIS FORM, OR MAKING FALSE, FICTITIOUS OR FRAUDULENT STATEMENTS OR REPRESENTATIONS HEREIN COULD CONSTITUTE A FELONY PUNISHABLE UNDER FEDERAL STATUTES.

Avesta Sheffield Plate Inc.
P.O. Box 370
New Castle, Indiana 47362

J. G. DOURMAN, Q. A. MANAGER

ABNAHMEPRÜFZEUGNIS
CERTIFIED MATERIAL TEST REPORT

Schulz (Mfg) Sdn Bhd
Lot 8 Jalan Perusahaan 6
45000 Kuala Selangor
Selangor Malaysia
Tel: 603-8891566
Fax: 603-8891559

Kunde:
Customer: ROBERT JAMES SALES

Zeugnis-Nr.:
Certificate No.: M16026

Bestellung Nr./vom/your Order No. P.O.1435/A2800

Unsere Kom.-Nr./Our Order No. M16000

Kuala Selangor May 23, 1994 Unser Zeichen tH

Abnahmebedingungen:
Requirements:

Vormaterial:
Base material: ASTM A 312 / SA 312

Artikel:
Article: ASTM A 304-M91/SA 403-Ed.92/ANSI B 16.9-Ed 86

Werkstoff-Normbez.:
Standart-Grade of Material: S 30403

Werkstoff-Nr.:
Material-No.: 304/304L

Ausführungsart:
kaltverformt/cold formed

Artikel:
Article: TEE ,304L,5010S,4.0000000

Erschmelzungsart:
Kind of melting: E

Mechaniche Eigenschaften/Mechanical Properties

Pos Item	Stück-zahl Pieces	Abmessung: Dimension	Schmelze Nr. Heat No.	Probe Nr. Test No.	L T Q	Prüf-temp. Test temp. °C	Streckgrenze Yield point 0.2% N/mm²	Streckgrenze Yield point 1% N/mm²	Zug-festigkeit Tensile str. N/mm²	Deh-nung Elon-gation %	Ein-schnü. Reduct. %	Kerb-schlagz.k. Impact Streng DVM/ISO-V J/cm²
			Anforderungen: Requirements:			RT	205		515	28		
26	75	4" SCH 10 S	N 210021	43684	L	RT	✓ 275	317	✓ 536	✓ 56		

ROBERT JAMES S [illegible]
THESE TEST REP[illegible] TO

Penn Tank
C03074

Schmelze-Nr. Heat-No.	% C	% Si	% Mn	% P	% S	% Cr	% Ni	% Mo	% Ti	% N	%
N 210021	✓ 0.026	✓ 0.42	✓ 1.31	✓ 0.025	✓ 0.004	✓ 18.16	✓ 10.18	✓		0.033	

14883
4-26-95

Bemerkungen:
Remarks: QT 4-28-95
1992/934
SA312-304/304L

Stempelbild/Marking of the fittings:

SA 403
WP-W 304/304L
CH. N 210021
4" SCH 10 S
PMI
MALAYSIA

Anlagen:
Annex:

Die Analyse wurde vom Vormaterial-Zeugnis übernommen.
The analyse is according to the base material.

Wir bestätigen hiermit, daß die Fittings gemäß der oben genannten Spezifikation gefertigt und geprüft wurden.
We certify that the material was manufactured and tested in accordance with the above specification.

Schweißphase gemäß:
Welding bevels according to:

Besichtigung und Maßkontrolle wurden durchgeführt ohne Beanstandung
Surface and dimensions controlled without complaints

Interkristalline Korrosion (DIN 50914)
Intergranular Attack

Herstellerzeichen:
Trade mark:

Wärmebehandlung/Wasser
Heat Treatment/water quench 1050°C

Prüfstempel:
Inspectors stamp:

Verwechslungsprüfung 100%
(Spektrotest) ohne Beanstandung
without complaints

Der Werkssachverständige
Works-inspector te Heesen

Avesta Sheffield
1101 North Main Street
Wildwood, Florida 34785-9601
(904) 748-1313
(904) 748-0533 (FAX)

Material Test Report

SOLD TO:
ROBERT-JAMES SALES, INC.
P.O. BOX 1672

BUFFALO, NY 14216

Purchase Order number : A6750
Customer / ASI number : C056636D
Load number : 4232 1-4
Ship date : 08 Nov 94

REMARKS:

ROBERT - JAMES SALES INC
THESE TEST REPORTS APPLY TO
Penn Tank
P. O. 0501 - Dist
ROBERT JAMES NO. C0171
FOOTAGE ______ DATE 4/24/95
ITEM NO. ______
MARK NO. ______

PART NUMBER	QUANTITY	DESCRIPTION	SPECIFICATIONS AND PROCEDURES
1320BD	1,040' 4"	4"SCH 40S NPS TP304/TP304L	ASME SA312-93, ASTM A312-93 WELDED

974-17-95
1992/93A
SA312-304/304L

PART NUMBER	MILL #	HEAT #	PLATE	PIPE BM	PIPE WELD	C ✓	Mn ✓	P ✓	S ✓	Si ✓	Cr ✓	Ni ✓	Mo	N2	Ti	Other
						CHEMICAL ANALYSIS										
1320BD	35253	915789	X			0.018	1.76	0.030	0.012	0.48	18.32	8.81				
1320BD	42055	716128	X			0.020	1.77	0.031	0.010	0.43	18.56	8.32				
1320BD	42175	716152	X			0.016	1.72	0.027	0.013	0.47	18.21	8.27				
1320BD	42369	240932	X			0.021	1.58	0.023	0.016	0.60	18.10	9.08				
1320BD	42718	9507	X			0.012	1.79	0.026	0.002	0.47	18.13	9.77				

PART NUMBER	MILL #	HEAT #	PLATE	PIPE	PSI YIELD ✓	PSI TENSILE ✓	2 IN ELONG ✓	HARDNESS	T.P. HYDRO	EDDY	FLAT	REV FLAT	GUIDED BENDS FACE/ROOT/SIDE	OTHER TESTS FLARE/FLANGE
1320BD	35253	915789		X	41,580	85,052	60.		1600		OK			
1320BD	42055	716128		X	46,201	87,143	54.		1600		OK			
1320BD	42175	716152		X	47,150	88,471	56.		1600		OK			
1320BD	42369	240932		X	48,021	89,815	60.		1600		OK			
1320BD	42718	9507		X	42,310	85,330	54.		1600		OK			

CAUTION: Processing that produces fumes and dust may cause respiratory disease: Especially alloys containing Chromium and Nickel.

CERTIFICATION: We certify that the analysis figures are correct as contained in the records of the company and that the material is free from mercury and low melting alloy contamination. This product is manufactured in the USA.

HEAT TREATMENT: Solution annealed at a minimum of 1900 F and water quenched to below 800 F within 3 minutes.

Francis M. Reed
QUALITY CONTROL DEPARTMENT

ROBERT - JAMES SALES, INC.
THESE TEST REPORTS APPLY TO
PENN TANK
P. O. 0501-DIST
ROBERT - JAMES NO. CO77
FOOTAGE ________ DATE 4-25-95
ITEM NO. ________
MARK NO. ________

METALFAR
Prodotti Industriali s.p.a.
22036 CESANA BRIANZA (Co.mo) ITALY
Tel. (031) 655041
Telex 330052 METLFR I - Telefax 655149
SALA PROVE ED ANALISI MATERIALI

CERTIFICATO DI COLLAUDO

INSPECTION CERTIFICATE DIN 50049 /21 CERTIFICAT DE RECEPTION

N. 3077
DATE 30/0
SHEET 1 OF

FATTURA/INVOICE N° 1787 DATE 27/5

ANALISI CHIMICA - CHEMICAL COMPOSITION - COMPOSITION CHIMIQUE

Materiale Material Matériel	Colata Cast Heat	Posizione Sample Position	Quant.	Descrizione prodotto Product description Description du produit	Carbon C %	Silicon Si %	Manganese Mn %	Sulfur S %	Phosphorus P %	Nickel Ni %	Chromium Cr %	Molybd. Mo %	Titanium Ti %	Vanadium V %	Copper Cu %
A182 F316/F316L	370906		120	W/N 150 RF 3" 10S	0.028	0.470	1.840	0.019	0.032	11.000	16.610	2.040			00.062
A182 F304/F304L	370933		150	W/N 150 RF 2" 40S	0.023	0.460	1.660	0.023	0.030	10.070	10.240				00.079
A182 F316/F316L	370906		30	W/N 150 RF 3" 40S	0.020	0.470	1.040	0.013	0.030	11.030	16.610	2.040			00.067
A182 F316/F316L	370947		10	W/N 300 RF 2" 40S	0.023	0.490	1.030	0.019	0.028	11.070	16.650	2.000			00.056
A182 F304/F304L	467960		300	S/O 150 RF 4"	0.027	0.310	1.250	0.020	0.020	08.700	18.373				00.075
A182 F304/F304L	431968		200	S/O 150 RF 6"	0.022	0.320	1.350	0.024	0.025	08.650	18.370				00.075
A182 F304/F304L	469671		90	BLIND 150 RF 4"	0.029	0.270	1.130	0.017	0.021	08.420	18.250				00.074

97 4-17-95
1992/93A
SA182-304/304L

CARATTERISTICHE MECCANICHE - MECHANICAL TESTS - ESSAIS MECANIQUES

Fornitore Supplier Fournisseur	Colata Cast Coulée	Posizione Specimen Éprouvette	Ø mm	Sezione Section	Lunghezza Length	1	Snervamento Yield point N/mm2 Req 0.2%	Result 0.2%	Req 1%	Result 1%	Rottura Tensile st. N/mm2 Req	Result	Allungam. Elongation % Min Req	Result	Strizione Reduction of area Min Req	Result	Resilienza - Impact value - Résilience - Joule Type	1.	2.	3.	Media	°C	Durezza Hardness HB
COGNE S.P.A.	370906		12.70	126.60	50.80		205	298.00			515	527.00	30	63.00	50	74.00							162 1
COGNE S.P.A.	370933		12.70	126.60	50.80		205	267.00			515	527.00	30	65.00	50	72.00							160 1
COGNE S.P.A.	370906		12.70	126.60	50.80		205	298.00			515	527.00	30	63.00	50	74.00							162 1
COGNE S.P.A.	370947		12.70	126.60	50.80		205	295.00			515	527.00	30	63.00	50	73.00							170 1
SANDVIK	467960		12.70	126.60	50.80		205	301.00			515	527.00	30	56.00	50	62.00							159 1
SANDVIK	431968		12.70	126.60	50.80		205	298.00			515	579.00	30	69.00	50	79.00							173 17
SANDVIK	469671		12.70	126.60	50.80		205	270.00			515	527.00	30	56.00	50	60.00							160 16

5W

DIMENSIONS IN ACCORDANCE TO ANSI B16.5
VISUAL AND DIMENSIONAL INSPECTION:
SATISFACTORY

MATERIAL CONFORM TO
ASTM A182/92 AND ASME SA182/92

TRATTAMENTO TERMICO - HEAT TREATMENT - TRAITEMENT THERMIQUE
SOLUTION TREATED 1040° C WATER

SIGLA PRODUTTORE
MARK OF THE MANUFACTURER
SIGLE DU PRODUCTEUR
MF

1) POSIZIONE - ORIENTATION
A = Beginning; E = End; F = Foot; T = Top; L = Longitudinal;
T = Transverse; T = Tangential; R = Radial; V = vertical

CERTIFICHIAMO CHE LA FORNITURA E' STATA CONTROLLATA ED E' CONFORME ALLE PRESCRIZIONI DELL'ORDINE.
WE HEREBY CERTIFY THAT THE MATERIAL DESCRIBED ABOVE HAS BEEN TESTED AND COMPLIES WITH THE TERMS OF THE ORDER CONTRACT

p. METALFAR S.p.A.

RESPONSABILE CONTROLLO QUALITÀ
QUALITY CONTROL DEPT.
Rossi Lorenzo

ENTE COLLAUDATORE

BRISTOL METALS INC.
MILL TEST REPORT

5

TO: ROBERT JAMES SALES
PO BOX # 1672
BUFFALO, NY.
14216

CUST NO: 37200011
JOB NO: 2575B
PO NO: A6760 ADD-BILL F.
DATE: 11/23/94

HEAT NO.	ITEM DESCRIPTION
917711	4" PIPE SCH 40S TP304L/TP304 ASTM A312-93/ASME SA312-93,WELDED

HEAT NO.	C ✓	MN ✓	P ✓	S ✓	SI ✓	NI ✓	CR ✓
917711	.020	01.840	.031	.013	.46	08.250	18.240

HEAT NO.	MO	CU	CB	N2	TENSILE ✓	YIELD ✓
917711	0.33	.40	.00	.080	90,400	39,700

HEAT NO.	CO		
917711	.011		

QT 5-20-95
1992/93A
SA312-304L

J&L CONTINUOUS CAST

HEAT NO.	HARDNESS	ELONGATION	BEND	FLATTENING	TENSION
917711	HB150	50.00 % ✓	NA	OK	OK

FLANGE	FLARE	EDDY CURRENT	HYDRO
NA	NA	NA	1600 PSI

HEAT NO.	ANNEALED AT 1900 DEG F. AND WATER QUENCHED TO BELOW 800 DEG. F. IN LESS THAN 3 MIN.	RADIOGRAPHIC EXAMINATION COMPLETED
917711	YES	NA

ROBERT - JAMES SALES INC
THESE TEST REPORTS APPLY TO Penn Tank
P. O. 0547-C192
ROBERT - JAMES NO. CC572
FOOTAGE 3' DATE 5/17/9
ITEM NO. ____
MARK NO. ____

WE CERTIFY THIS REPORT TO BE
TRUE AND ACCURATE, ACCORDING
TO OUR RECORDS ON FILE.

BRISTOL METALS INC.
David Singleton
REPRESENTATIVE

MO

U.S. S[illegible] A division of USX Corporation

USS, USX, USX are trademark Corporation

INSPECTION CERT[illegible]TE

(TYPE B - IN ACCORDANCE WITH ISO 1 EN10204/DIN50049)

MILL ORDER/ITEM NO.	SHIPPERS NO.	P.O. NUMBER	VEHICLE I.D.
DR53760 01	T61465	94-49RK	AB07557PA

SOLD TO ADDRESS

ALLEGHENY PIPE & SUPPLY CO
PO BOX 9340
PITTSBURGH PA 15225-0340

MAIL TO ADDRESS

ALLEGHENY PIPE & SUPPLY CO
PO BOX 9340
PITTSBURGH PA 15225-0340

VENDOR

USS TUBULAR PRODUCTS
1807 EAST 28TH ST.
LORAIN, OH 44055

4" Std A-106-B

SPECIFICATION AND GRADE

PIPE CARBON SMLS STD PIPE API 5L-*40TH EDITION DTD 11/1/92 GRADE B AND GRADE X42 ASTM A53-*93A ASTM A106-*93 GRADE B QUAD STENCIL ASME SA53-*1992 EDITION 1993 ADDENDUM ASME SA106-*1992 EDITION 1993 ADDENDUM GRADE B BLK RLG MILL COAT PE BEV 30 DEG

QT 3-13-95
1992/93A
SA106B
SO# 0169

MATERIAL COND: AS ROLLED

O.D. in (mm): 4.500(114.300)

WALL in (mm): 0.237 (6.019)

PRODUCT IDENTIFICATION	TENSILE TEST TYPE/ ORIENTATION	TEST COND	GAUGE WIDTH IN	YIELD PSI	EXT % .50	TENSILE PSI	Y/T	ELONG % (IN 2")	HARDNESS SCALE: HRB	MIN HYDRO PSI	DWELL (SEC)
				MIN: 42000 MAX: ✓		MIN: 60000 MAX: ✓	MAX:	MIN: ✓ 33.0	MIN: MAX: 100.0	2650	5
N89566 ✓	STRIP/L/B	AR	1.500	43800	.50	75800	0.64	39.0	B 81.7	2650	5

** END OF DATA THIS SHEET **

LEGEND: L - LONGITUDINAL U - UPSET T - TRANSVERSE N - NORMALIZED QT - QUENCHED & TEMPERED SR - STRESS RELIEVED AR - AS ROLLED B - BODY W - WELD

PRODUCT IDENTIFICATION	TYPE		C	MN	P	S	SI	CU	NI	CR	MO	AL	N	V	B	TI	CB	CO				C.E.*
			✓	✓	✓	✓	✓	✓	✓	✓	✓			✓								
N89566	HEAT		17	[illegible]	007	004	23	01	0[illegible]	04	01			001								
N89566	PROD		16	77	005	006	24	01	01	03	01			001								
N89566	PROD		16	77	005	006	24	01	01	03	01			001								

** END OF DATA THIS SHEET **

*C.E. IS BASED ON THE FOLLOWING EQUATION(S):

U.S. ST L GROUP
A divisic f USX Corporation

INSPECTION CER ATE

(TYPE B - IN ACCORDANCE WITH ISO 1 4/EN10204/DIN50049)

TIME: 13.46. USX
USS, USX, USX are trademar X Corporation

MILL ORDER/ITEM NO.	SHIPPERS NO.	P.O NUMBER	INVOICE NUMBER
DR53760 01	T61426	94-497RF	0021742

MATERIAL / COND AS-ROLLED	OD. 4.500(114.300) in (mm)	WALL 0.237 (6.019) in (mm)	

PRODUCT IDENTIFICATION	FLAT	BEND	GRAIN SIZE	MIN COLLAPSE	CHARPY V-NOTCH IMPACT TESTING DIR	TEST LOC.	TEMP	SIZE	TEST COND	FT-LBS 1	FT-LBS 2	FT-LBS 3	FT-LBS AVG	% SHEAR 1	% SHEAR 2	% SHEAR 3	% SHEAR AVG
N89066	OK		** END OF DATA THIS SHEET **														

LEGEND L - LONGITUDINAL T - TRANSVERSE B - BODY W - WELD HAZ - HEAT AFFECTED ZONE

TESTING / INSPECTION INFORMATION

TEST / INSPECTION	YES	RESULTS / COMMENTS
FULL LENGTH VISUAL	X	
FULL LENGTH EMI		OD ____ OD/ID ____ L ____ L/T ____
FULL LENGTH MPI		
FULL LENGTH UT		OD ____ OD/ID ____ L ____ L/T ____
END AREA INSPECTION (PLAIN END)		MPI ____ UT ____
SPECIAL END AREA (SEA) INSP.		MPI ____ UT ____
FULL LENGTH DRIFT		DRIFT MANDREL SIZE:

ADDITIONAL NOTES/COMMENTS

ALL MELTING AND MANUFACTURING TOOK PLACE IN THE USA. NO REPAIRS BY WELDING. NO MERCURY OR MERCURY COMPOUNDS ARE ADDED TO THE STEEL AND ALL MERCURY BEARING EQUIPMENT IS PROTECTED BY A DOUBLE BOUNDARY OF CONTAINMENT.

97 3-13-95
1992/93A
SA106B
SO# 0169

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND/OR INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS THE REQUIREMENTS IN SUCH RESPECTS

PREPARED BY THE OFFICE OF D.S. DABKOWSKI MGR. MET. & Q.A. USS TUBULAR PRODUCTS

DATE 03/09/95

Castle Metals A. M. CASTLE

Y2

TOMER REQUISITION / ER	CUSTOMER ORDER NUMBER 0521-01ST	ACCOUNT 67178	ALES 061	TERR 02	SHIP VIA OT
CHASING AGENT BOB	PHONE 412 352-1277	H/C 2	TAX 0	NO ORD 1	DELIVERY ZONE P1

F.O.B.
DELIVERED

BILL

B/L NUMBER

TO:
ENNSYLVANIA TANK AND TUBE
/O WOODWARD INC.
VANS CITY ROAD/ ATTN:FRED
ARS PA 16046

SOLD TO:
PENNSYLVANIA TANK AND TUBE
PO BOX 217
SAXONBURG PA 16056

CREDIT INFORMATION

ROUTE
TOPCLEVELAND

IVERY INSTRUCTIONS
BQ-E03335

DELIVERY INSTRUCTIONS (CONT'D.)

DELIVERY INSTRUCTIONS (CONT'D.)

SCRIPTION - ITEM 1
/8 PLATE A/SA 516 G70 HR 96" X 168.5"
RANGE & BLUE

QTY/UNIT ORDERED 1 PCS	PCS/FT ORD PCS	WT ORDERED 1721
BUNDLES	PCS/FT. SHIPPED	WT. SHIPPED

CERTIFICATE OF CONFORMANCE

A.M. Castle & Co. certifies that the material(s) supplied under this document will meet and conform to the specifications of the product(s) described hereon.
A.M. Castle & Co.

INSTRUCTIONS
TOL + 1/8" - 0
PER PC:00529 CUT IN 000 PIERCE

S/S G-4109 45E

HEAT INFO QTY

15.320SQF

SHAPE

I.A.C.
28469

INSTRUCTIONS (CONT'D.)

WHSE.
3N

WEIGHT FOR SHIPPING PURPOSES ONLY. SEE INVOICES FOR ACCURATE BILLING WEIGHT. PLEASE SIGN AND DATE DRIVER'S COPY FOR RECEIPT OF MATERIAL AND, IF CHECKED, TEST REPORTS. ☐

SCRIPTION - ITEM 2
/8 PLATE A/SA 516 G70 HR 96" X 140"
RANGE & BLUE

QTY/UNIT ORDERED 1 PCS	PCS/FT ORD PCS	WT ORDERED 2383
BUNDLES 1	PCS/FT. SHIPPED 1	WT. SHIPPED 2415/2383

TERMS AND CONDITIONS OF SALE

CUSTOMER NOTICE

DISCLAIMER OF WARRANTIES AND LIMITATIONS OF LIABILITY

RE ARE NO WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, INCLUDING ANY ARDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, EXCEPT AS EX LY STATED ON THE FRONT OF THIS DOCUMENT
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INSTRUCTIONS
TOL + 1/8" - 0
PER PC:00472 CUT IN 000 PIERCE

S/S G-3684 330C

HEAT INFO QTY
5421383
4902

25.530SQF

SHAPE

I.A.C.
6401

INSTRUCTIONS (CONT'D.)

3-31C

WHSE.
3S

SCRIPTION - ITEM 3

QTY/UNIT ORDERED	PCS/FT ORD	WT ORDERED
BUNDLES	PCS/FT SHIPPED	WT. SHIPPED

ALL EXCEPTIONS FOR SHORTAGE OR DAMAGE MUST BE NOTED ON THE DRIVER COPY & CUSTOMER COPY OF THE DELIVERY RECEIPTS & SIGNED BY THE DRIVER & CUSTOMER. COPY OF SUCH RECEIPT PROPERLY NOTED MUST BE SUBMITTED WITHIN 10 DAYS WHEN CREDIT IS REQUESTED.

INSTRUCTIONS

QT 5-11-95
1992/93A
SA516-70

RECEIVED
MAY 1 1

HEAT INFO QTY

SHAPE

I.A.C.

INSTRUCTIONS (CONT'D.)

WHSE

ME (PRINT ONLY)

CEIVED BY

DATE RECEIVED

DELIVERY RECEIPT

1AC 6401

9T 5-11-95
1992/1931
SA516-70

Customer	CARGILL INCORPORATED ACCOUNT CARGILL FERROUS INTERNATIONAL P O BOX 9300 MINNEAPOLIS MINNESOTA 55440	

ISCOR (LTD), VANDERBIJLPARK
REPUBLIC OF SOUTH AFRICA
Reg. No 89/02164/06
TEST AND ANALYSIS CERTIFICATE
SABS 0157 Listing no. LS 0208

Cust Order no.	P73317
Order no.	MPX 4050259
Cert Number	0616
Gross Mass	25210 Kg 55577 Lbs
Invoice Mass	24069 Kg 53062 Lbs
Exp Permit no.	
Transport	RAIL
Page	1 of 1
Dimensions	06096 X 2438 X 015,87 2401 X 961 X 5/81

Description of material	STEEL PLATES
Specification	ASTM A516 GR 70-90/ASME SA 516 GR 70-92
Edition	1992
Material supplied	AS ROLLED
Test pieces tested	AS ROLLED

SPECIFICATION REQUIREMENTS

Test Piece Positions	YS Min	YS Max	TS Min	TS Max	El. %	RA Min	Hardness Unit	Hardness Min	Hardness Max	Bend Angle	Grain Type
TX	260		485	620	17,0						
										Dia	Min / Max

L.	C	MN	P	S	SI	CU	NI	CR	MO	V	NB	ALT
Min		0,8500			0,1500							0,0200
Max	0,2800	1,2000	0,0350	0,0350	0,4000	0,4000	0,4000	0,3000	0,1200	0,0300	0,0200	0,0800
L. Min												
Max												

TEST RESULTS

Cast no. Lift card	Serial / Qty.	Impact tests: Test Piece Dimensions mm ins Wth	Thk	Test Piece Position	Temp °C °F	Results Joules Ft.lbs 1	2	3	Avrg.	Lat. Exp. mm ins
5421383 VPD40852	4905									
5421383 VPD40852	4904									
5421383 VPD40853	4990									
5421383 VPD40853	4901									
5421383 VPD40854	4902									
5421383 VPD41209	9013									
5421383 VPD40854	4903									

Cast no. Lift card	Tensile tests: Test Piece Position	YS (MPa) (KSI)	TS (MPa) (KSI)	Yield / Tensile Ratio	El. 200 mm %	RA %	Hardness Test	Hot Test °C °F YS (MPa) (KSI)
5421383 VPD40852	TX	310 045	518 075	0,59 0,60	26			
5421383 VPD40852	TX	327 047	519 075	0,63 0,63	27			
5421383 VPD40853	TX	314 046	511 074	0,61 0,62	25			
5421383 VPD40853	TX	358 052	526 076	0,68 0,68	23			
5421383 VPD40854	TX	319 046	516 075	0,61 0,61	27			
5421383 VPD41209	TX	303 044	520 075	0,58 0,59	28			
5421383 VPD40854	TX	319 046	515 075	0,61 0,61	24			
		✓	✓	✓				

Cast no. Lift card	Chemical analysis: ANAL.	C MO %	MN V %	P NB %	S ALT %	SI %	CU %	NI %	CR %	CI
5421383 VPD40852	L.	0,2000 0,0100	1,0400 0,0010	0,0060 0,0020	0,0010 0,0340	0,3400	0,0520	0,0350	0,0160	
5421383 VPD40852	L.	0,2000 0,0100	1,0400 0,0010	0,0060 0,0020	0,0010 0,0340	0,3400	0,0520	0,0350	0,0160	
5421383 VPD40853	L.	0,2000 0,0100	1,0400 0,0010	0,0060 0,0020	0,0010 0,0340	0,3400	0,0520	0,0350	0,0160	
5421383 VPD40853	L.	0,2000 0,0100	1,0400 0,0010	0,0060 0,0020	0,0010 0,0340	0,3400	0,0520	0,0350	0,0160	
5421383 VPD40854	L.	0,2000 0,0100	1,0400 0,0010	0,0060 0,0020	0,0010 0,0340	0,3400	0,0520	0,0350	0,0160	
5421383 VPD41209	L.	0,2000 0,0100	1,0400 0,0010	0,0060 0,0020	0,0010 0,0340	0,3400	0,0520	0,0350	0,0160	
5421383 VPD40854	L.	0,2000 0,0100	1,0400 0,0010	0,0060 0,0020	0,0010 0,0340	0,3400	0,0520	0,0350	0,0160	

CASTLE METALS - CILV
DATE REC'D 11/94
REC'D FROM
APPROVED BY

Customer's representative

Additional test results

Report can be reproduced only with written approval
All other requirements in accordance with the suppliers official order acceptance

Shipname = EVRIMEDON

Ultrasonic test

Inspection

Date 1994-06-16

For Div. Manager, Product Technology

Cast no. prefix denotes	Test piece position	Analysis
5 VAD-DEGASSED + LADLE FURNACE CONCAST(PTA)	TX = TOP TRANSVERSE	L = LADLE ANALYSIS

Castle Metals® A. M. CASTL[illegible]o.

ST	ORDER NO			FROM
[illegible]	768339		3339	10

DATE SHIPPED

768339

CUSTOMER REQUISITION NUMBER

CUSTOMER ORDER NUMBER: 0521-DIST

ACCOUNT	SALES	TERR.	SHIP VIA
67178	061	82	OT

PURCHASING AGENT: [illegible]

PHONE	H/C	TAX	NO ORD	DELIVERY ZONE	F.O.B.	BILL	B/L NUMBER
412 352-1277	2	0	1	P1	DELIVERED		

SHIP TO:
PENNSYLVANIA TANK AND TUBE
C/O WOODWARD INC.
EVANS CITY ROAD/ ATTN:FRED
MARS PA 16046

SOLD TO:
PENNSYLVANIA TANK AND TUBE
PO BOX 217
SAXONBURG PA 16056

CREDIT INFORMATION

ROUTE
10*CLEVELAND

DELIVERY INSTRUCTIONS
INQ-E03335

DELIVERY INSTRUCTIONS (CONT'D.)

DELIVERY INSTRUCTIONS (CONT'D.)

DESCRIPTION - ITEM 1
7/8 PLATE A/SA 516 G70 HR 96" X 168.5"
ORANGE & BLUE

QTY/UNIT ORDERED	PCS/FT ORD	WT. ORDERED
1 PCS	PCS	1721

BUNDLES	PCS./FT. SHIPPED	WT. SHIPPED
1	1	1743/1721

CERTIFICATE OF CONFORMANCE

A.M. Castle & Co. certifies that the material(s) supplied under this document will meet and conform to the specifications of the product(s) described hereon.
A.M. Castle & Co.

INSTRUCTIONS
TOL + 1/8" - 0
PER PC:00529 CUT IN 000 PIERCE

S/S G-4109 45E

HEAT INFO: 2406171
8012

QTY

15.320SQF

SHAPE

I.A.C.: 26469

INSTRUCTIONS (CONT'D.)

WHSE.: 3N

WEIGHT FOR SHIPPING PURPOSES ONLY. SEE INVOICES FOR ACCURATE BILLING WEIGHT. PLEASE SIGN AND DATE DRIVER'S COPY FOR RECEIPT OF MATERIAL AND, IF CHECKED, TEST REPORTS. ☐

DESCRIPTION - ITEM 2
7/8 PLATE A/SA 516 G70 HR 96" X 140"
ORANGE & BLUE

QTY/UNIT ORDERED	PCS/FT ORD	WT. ORDERED
1 PCS	PCS	2383

BUNDLES	PCS./FT. SHIPPED	WT. SHIPPED
1	1	2415/2383

TERMS AND CONDITIONS OF SALE

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INSTRUCTIONS
TOL + 1/8" - 0
PER PC:00472 CUT IN 000 PIERCE

S/S G-3684 330C

HEAT INFO: 5421383
4902

QTY

25.530SQF

SHAPE

I.A.C.: 6401

INSTRUCTIONS (CONT'D.)

3-31 C

WHSE.: 3S

DESCRIPTION - ITEM 3

QTY/UNIT ORDERED	PCS/FT ORD	WT. ORDERED

BUNDLES	PCS./FT. SHIPPED	WT. SHIPPED

ALL EXCEPTIONS FOR SHORTAGE OR DAMAGE MUST BE NOTED ON THE DRIVER COPY & CUSTOMER COPY OF THE DELIVERY RECEIPTS & SIGNED BY THE DRIVER & CUSTOMER. COPY OF SUCH RECEIPT PROPERLY NOTED MUST BE SUBMITTED WITHIN 10 DAYS WHEN CREDIT IS REQUESTED.

INSTRUCTIONS

RECEIVED
MAY 11 1995

9T 5-11-95
1992/934
SA516-70

HEAT INFO

QTY

SHAPE

I.A.C.

INSTRUCTIONS (CONT'D.)

WHSE.

NAME (PRINT ONLY)

RECEIVED BY

DATE RECEIVED

DELIVERY RECEIPT

1AC 17113

Customer	CARGILL INCORPORATED ACCOUNT CARGILL FERROUS INTERNATIONAL P O BOX 9300 MINNEAPOLIS MINNESOTA 55440

9T 5-11-95
1992/93A
SA516-70

ISCOR (LTD), VANDERBIJLPARK
REPUBLIC OF SOUTH AFRICA

Reg. No 89/02164/06

TEST AND ANALYSIS CERTIFICATE

SABS 0157 Listing no. LS 0208

Cust.Order no.	P7974		
Order no.	MPX 4070186	Cert Number	1014
Gross Mass	28250 Kg 62279 Lbs	Invoice Mass	26656 Kg 58765 Lbs

Description of material	STEEL PLATES		
Specification	ASTM A516 GR 70-90/ASME SA 516 GR 70-92	Edition	1992
Exp Permit no.		Transport	RAIL
Page	1 of 1		
Material supplied	AS ROLLED		
Test pieces tested	AS ROLLED		
Dimensions	09144 X 2438 X 009,52 3601 X 961 X0.37501		

SPECIFICATION REQUIREMENTS

Test Piece Positions			YS Min	YS Max	TS Min	TS Max	EL %	RA Min	Hardness Unit	Hardness Min	Hardness Max	Bend Angle
TX			260		485	620	17,0					
												Dia

Grain Type	L	C	MN	P	S	SI	CU	NI	CR	MO	V	NB	ALT
	Min		0,8500			0,1500							0,0200
	Max	0,3100	1,2000	0,0350	0,0350	0,4000	0,4000	0,4000	0,3000	0,1200	0,0300	0,0200	0,0800
Min Max	L												
	Min												
	Max												

TEST RESULTS

Cast no. Lift card	Serial / Qty.	Impact tests: Test Piece Dimensions mm ins Wth	Thk	Test Piece Position	Temp °C °F	Results Decajoules Ft lbs 1	2	3	Avrg.	Lat. Exp. mm ins	Tensile tests: Test Piece Position	YS (MPa) (KSI)	TS (MPa) (KSI)	Yield / Tensile Ratio	EL 200 mm %	RA %	Hardness Test	Hot Test °C °F YS (MPa) (KSI)	ANAL	Chemical Analysis: C MO %	MN V %	P NB %	S ALT %	SI %	CU %	NI %	CR %
Z406171 VPD44130	8023										TX	345 050	526 076	0,65 0,66	26				L	0,1750 0,0090	1,0400 0,0000	0,0110 0,0000	0,0050 0,0360	0,3260	0,0100	0,0100	0,0230
Z406171 VPD44130	8013										TX	334 048	507 074	0,65 0,65	27				L	0,1750 0,0090	1,0400 0,0000	0,0110 0,0000	0,0050 0,0360	0,3260	0,0100	0,0100	0,0230
Z406171 VPD44131	8021										TX	336 049	524 076	0,64 0,64	25				L	0,1750 0,0090	1,0400 0,0000	0,0110 0,0000	0,0050 0,0360	0,3260	0,0100	0,0100	0,0230
Z406171 VPD44131	8012										TX	330 048	515 075	0,64 0,64	24				L	0,1750 0,0090	1,0400 0,0000	0,0110 0,0000	0,0050 0,0360	0,3260	0,0100	0,0100	0,0230
Z406171 VPD44132	8022										TX	318 046	525 076	0,60 0,61	27				L	0,1750 0,0090	1,0400 0,0000	0,0110 0,0000	0,0050 0,0360	0,3260	0,0100	0,0100	0,0230
Z406171 VPD44132	4802										TX	317 046	529 077	0,59 0,60	27				L	0,1750 0,0090	1,0400 0,0000	0,0110 0,0000	0,0050 0,0360	0,3260	0,0100	0,0100	0,0230
Z406171 VPD44133	4801										TX	325 047	525 076	0,61 0,62	25				L	0,1750 0,0090	1,0400 0,0000	0,0110 0,0000	0,0050 0,0360	0,3260	0,0100	0,0100	0,0230
Z406171 VPD44133	8011										TX	358 052	525 076	0,68 0,68	28				L	0,1750 0,0090	1,0400 0,0000	0,0110 0,0000	0,0050 0,0360	0,3260	0,0100	0,0100	0,0230
Z406171 VPD44134	8011										TX	358 052	525 076	0,68 0,68	28				L	0,1750 0,0090	1,0400 0,0000	0,0110 0,0000	0,0050 0,0360	0,3260	0,0100	0,0100	0,0230
												✓	✓		✓					✓	✓	✓	✓	✓	✓	✓	✓

CASTLE METALS - CLV
DATE REC'D 1/95
REC'D FROM
APPROVED BY C

Customer's representative

Additional test results

Report can be reproduced only with written approval
All other requirements in accordance with the suppliers official order acceptance

Shipname = INFANTA

MATERIAL PRODUCED WITH INCLUSION SHAPE CONTROL

Ultrasonic test

Inspection

Date 1994-10-14

Cast no. prefix denotes	Test piece position	Analysis
Z VAD-DEGASSED + CALCIUM TREATED CONCAST(ARC)	TX = TOP TRANSVERSE	L = LADLE ANALYSIS

For Div. Manager, Product Technology

PROFESSIONAL QUALITY TESTING COMPANY

(412) 337-9810 P.O. BOX 327, NEW KENSINGTON, PENNSYLVANIA

RADIOGRAPHIC INSPECTION REPORT

PAGE 1 OF 1

STOMER Penna Tank + Tube JOB NO.

JOB LOCATION Saltsburg, Pa

WELDING PROCESS ☐ GTAW ☐ SMAW ☐ SAW OTHER

MTL TYPE C/S MTL THICKNESS .312 DIA./LENGTH

ISOTOPE ☑ IR192 ☐ CO.60 CURIES 23 SIZE .1x.1 ☐ X RAY KV MA SIZE

DISTANCE 12" TIME 1 min FILM TYPE Kodak AA FILM SIZE 4.5x10 QUALITY LEVEL 2T

PENETRAMETER ☐ FILM SIDE ☒ SOURCE SIDE SIZE 15 MATL C/S TYPE ASME FILM LOAD ☑ SINGLE ☐ DOUBLE

SHIM MTL. C/S SHIM THK. .060 TECHNIQUE USED ☑ SINGLE WALL ☐ DOUBLE WALL ☐ ELLIPTICAL ☐ PANARAMIC VIEW ☑ SINGLE WALL ☐ DOUBLE WALL

SCREENS FRONT ☐ .005 ☑ .010 BACK ☐ .005 ☑ .010 PROCESSING Manual DENSITY RANGE 2.0 - 4.0

GEOMETRIC UNSHARPNESS (UG) LESS THAN ☑ .020 ☐ .030 ☐ .040 ☐ .070 SPECFICATION/ACCEPT. ASME Sect VIII UW52

ITEM NUMBER	LOCATION MARKER	ACCEPT	REJECT	POROSITY	SLAG	CRACK	INC. PEN	INC. FUSION	CONCAVITY	CONVEXITY	UNDERCUT	SURFACE	TUNGSTON	OXIDATION	BURN THROUGH	ARTIFACT			Mark under discontinuity ☑ Present but acceptable ☒ Present but unacceptable REMARKS/INDICATIONS
0175-1-A	0-1	✓																	
0175-1-R	0-1	✓																	
0175-2-A	0-1	✓														✓			
0175-2-R	0-1	✓		✓															

O.D.X	WT.	4	ea. 4½"x10"
O.D.X	WT.		ea. 4½"x17"
O.D.X	WT.		ea. 5"x7"
Plate X	WT.		ea.
Plate X	WT.		ea.

HOURS: S.T. O.T. TOTAL:

MILEAGE: FROM TO TOTAL:

REMARKS

II

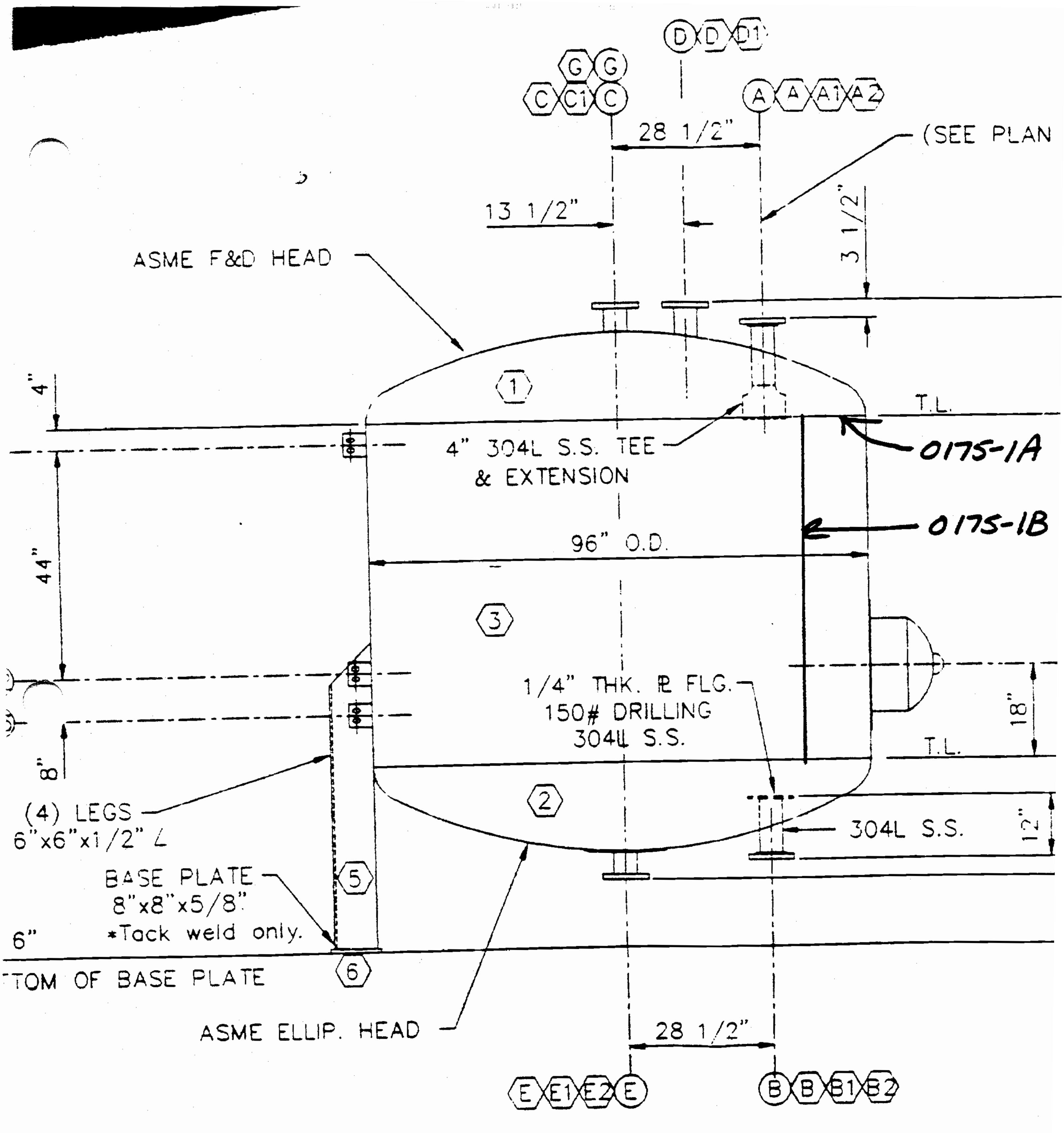
TECHNICIAN / LEVEL

7-7-95

DATE

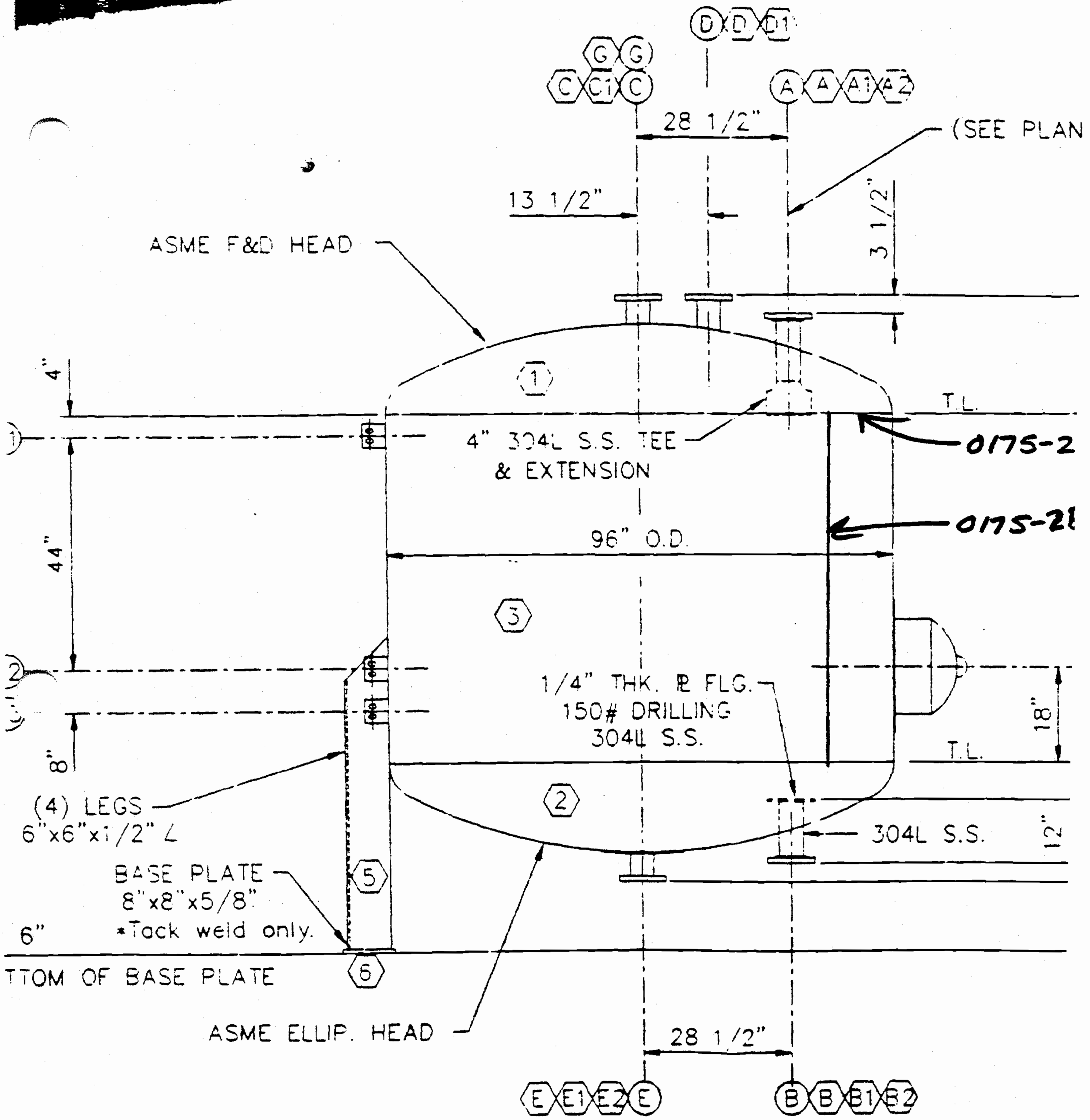
CLIENT'S REPRESENTATIVE

WHITE COPY — INVOICE YELLOW COPY — CUSTOMER



LOCATION OF X-RAYS

SO# 0175-1



LOCATION OF X-RAYS

SO# 0175-2

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)

(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name **Pennsylvania Tank & Tube, Inc.** By: **Mark W. Hadley**

Welding Procedure Specification No. **GTSM 8-8** Date **10/1/93** Supporting PQR No.(s) **GTSMGM 8-8**

Revision No. **0** Date & **GTSMGM 8-8A**

Welding Process(es) **GTAW/SMAW** Type(s) **Manual**

P-8 to P-8

JOINTS (QW-402)

Details

Joint Design **Single or double bevel; U, J, V Groove & Fillet**

Backing (Yes) **SMAW-Yes** (No) **GTAW-Yes & No**

Backing Material (Type) **compatible with base metal, if used**

(Refer to both backing and retainers.)

☒ Metal ☒ Nonfusing Metal

☒ Nonmetallic ☐ Other

With or without backing

With back gouge only

Sketches, Production Drawings, Weld Symbols or Written Descritption should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Mfgr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

Root gap is 3/32" + or - 1/32"

Included angle to be 60 degrees minimum

*BASE METALS (QW-404)

P-No. **8** Group No. **1 thru 4** to P-No. **8** Group No. **1 thru 4**

OR

Specification type and grade **Not Applicable**

to Specification type and grade **Not Applicable**

OR

Chem. Analysis and Mech. Prop. **Not Applicable**

to Chem. Analysis and Mech. Prop. **Not Applicable**

Thickness Range:

Base Metal: Groove **1/16" to 1.5"** Fillet **All**

Pipe Dia. Range: Groove **All** Fillet **All**

Other

*FILLER METALS (QW-404)

	GTAW	SMAW
Spec. No. (SFA)	5.9	5.4
AWS No. (Class)	ER3XX (Note 1)	E3XX (Note 1)
F-No.	6	5
A-No.	A-8	A-8
Size of Filler Metals	1/16", 3/32", 1/8"	3/32", 1/8", 5/32"
Deposited Weld Metal Thickness Range:		
Groove	0.300	0.300
Fillet	All	All
Electrode-Flux (Class)	None	None
Flux Trade Name	N/A	N/A
Consumable Insert	N/A	N/A
Other		

*Each base metal-filler metal combination should be recorded individually.

***QW-403.9 NO PASSES GREATER THAN 1/2" THICK.**

***QW-402.11 WITH OR WITHOUT NON-METALLIC OR NON-FUSING METAL RETAINERS.**

***QW-410.2 CLOSED TO OUT CHAMBER IS NOT APPLICABLE TO THESE BASE METALS**

***QW-402.11 WITH OR WITHOUT NON-METALLIC OR NON-FUSING METAL RETAINERS.**

***QW-403.13 (P-9 & P-10) IS NOT APPLICABLE**

***QW-404.22 WITH OR WITHOUT CONSUMABLE INSERT**

Note 1: This procedure does not cover the use of 310, 320, or 330. See production drawings for filler metal specification.

(12/89) This form (E00006) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300.

QW-482 (Back) **WPS No.** GTSM 8-8 **Rev.** 0

POSITIONS (QW-405)
Position(s) of Groove All
Welding Progression: Uphill
Position(s) of Fillet All

POSTWELD HEAT TREATMENT (QW-407)
Temperature Range none
Time Range N/A

PREHEAT (QW-406)
Preheat Temp. Min 60 F min.
Interpass Temp. Max. 300 F max.
Preheat Maintenance None
(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding - GTAW	Argon	100	35 to 45 CFH
Trailing	None		
Backing - GTAW	Argon*	100	5 CFH

*Use backing gas for 1st two passes of single sided welds.

ELECTRICAL CHARACTERISTICS (QW-409)
Current AC or DC See Below Polarity See Below
Amps (Range) See Below Volts (Range) See Below
(Amps and volts range should be recorded for each electrode size, position and thickness, etc. This information may be listed in a tabular form similar to that shown below.)

Tungsten Electrode Size and Type 1/16" & 3/32" EWTh-2 - for GTAW
(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW Not Applicable
(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range Not Applicable

TECHNIQUE (QW-410)
String or Weave Bead String Bead or Weave bead. Bead size should not exceed 3X dia. of wire
Orifice or Gas Cup Size 1/4" to 1/2" Diameter for GTAW.
Initial and Interpass Cleaning (Brushing, Grinding, Etc.) Remove scale from base metal and de-grease. Wire brush clean between passes using SS brushes. Grind stops & starts to obtain good bead overlap.
Method of Back Gouging Grind or air arc to sound metal as required. Visual inspect for cracks or voids.
Oscillation None
Contact Tube to Work Distance Not Applicable
Multiple or Single Pass (per side) Multiple pass.
Multiple or Single Electrodes Single
Travel Speed (Range) See Below
Peening Not permitted
Other 100% visual inspection for alignment, laps, profile, weld spatter, undercut, cracks, porosity underfill and incomplete penetration. LPT of back gouged areas is optional, unless specifically required as stated on blueprints.

		Filler Metal		Current				
Weld Layer(s)	Process	Class	Dia.	Type Polar.	Amp Range	Volt Range	Travel Speed Range	Other (e.g., Remarks, Comments, Hot Wire Addition, Technique, Torch Angle, Etc.)
All	GTAW	ER-3XX-X	1/16"	DC-SP	30-135	11-22	3-6 IPM	
All	GTAW	ER-3XX-X	3/32"	DC-SP	50-180	11-22	3-6 IPM	
All	GTAW	ER-3XX-X	1/8"	DC-SP	80-220	11-22	3-6 IPM	
All	SMAW	E-3XX-X	3/32"	DC-RP	90-120	23 - 26	4 - 6 IPM	
All	SMAW	E-3XX-X	1/8"	DC-RP	110-150	23 - 28	5 - 8 IPM	
All	SMAW	E-3XX-X	5/32"	DC-RP	130-180	23 - 28	6 - 10 IPM	

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)

(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name **Pennsylvania Tank & Tube, Inc.** By: **Mark W. Hadley**
Welding Procedure Specification No. **GTSMGM 8-8** Date **10/1/93** Supporting PQR No.(s) **GTSMGM 8-8**
Revision No. **0** Date **GTSMGM 8-8A**
Welding Process(es) **GTAW - SMAW - GMAW** Type(s) **Manual - Manual - Semi-automatic**
P-8 to P-8

JOINTS (QW-402)

Details

Joint Design **Single or double bevel; U, J, V Groove & Fillet**
Backing (Yes) **with** (No) **or without**
Backing Material (Type) **compatible with base metal, if used**
(Refer to both backing and retainers.)

☒ Metal ☒ Nonfusing Metal
☒ Nonmetallic ☐ Other

With or without backing

Sketches, Production Drawings, Weld Symbols or Written Descritption should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

With back gouge only

(At the option of the Mfgr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

Root gap is 3/32" + or - 1/32"
Included angle to be 60 degrees minimum

*BASE METALS (QW-404)
P-No. **8** Group No. **1 thru 4** to P-No. **8** Group No. **1 thru 4**
OR
Specification type and grade **Not Applicable**
to Specification type and grade **Not Applicable**
OR
Chem. Analysis and Mech. Prop. **Not Applicable**
to Chem. Analysis and Mech. Prop. **Not Applicable**
Thickness Range:
Base Metal: Groove **1/16" to 1.5"** Fillet **All**
Pipe Dia. Range: Groove **All** Fillet **All**
Other

*FILLER METALS (QW-404)	Root (GTAW)	Cover (SMAW)	Cover (GMAW)
Spec. No. (SFA)	5.9	5.4	5.9
AWS No. (Class)	ER3XX (Note 1)	E3XX (Note 1)	ER3XX (Note 1)
F-No.	6	5	6
A-No.	A-8	A-8	A-8
Size of Filler Metals	1/16", 3/32", 1/8"	3/32", 1/8", 5/32"	.035", .045", .0625"
Deposited Weld Metal Thickness Range:			
Groove	0.300	0.300	.900"
Fillet	All	All	All
Electrode-Flux (Class)	None	None	None
Flux Trade Name	N/A	N/A	N/A
Consumable Insert	N/A	N/A	N/A
Other			

*Each base metal-filler metal combination should be recorded individually.

***QW-404.14 FILLER METAL MUST BE USED.** **Note 1: This procedure does not cover the use of 310, 320, or 330.**
***QW-403.9 NO PASSES GREATER THAN 1/2" THICK.**
***QW-410.2 CLOSED TO OUT CHAMBER IS NOT APPLICABLE TO THESE BASE METALS**
***QW-402.11 WITH OR WITHOUT NON-METALLIC OR NON-FUSING METAL RETAINERS.**
***QW-404.24 & QW-404.25 WITHOUT SUPLEMENTARY FILLER OR POWDERED FILLER METAL.**
***QW-403.10 (SHORT ARC) IS NOT APPLICABLE**
***QW-403.13 (P-9 & P-10) IS NOT APPLICABLE**
***QW-404.22 WITH OR WITHOUT CONSUMABLE INSERT**

QW-482 (Back) WPS No. GTSMGM 8-8 Rev. 0

POSITIONS (QW-405)

Position(s) of Groove All

Welding Progression: SEE BELOW

Position(s) of Fillet All

GTAW & SMAW - UPHILL; GMAW - DOWNHILL

PREHEAT (QW-406)

Preheat Temp. Min 60 F min.

Interpass Temp. Max. 300 F max.

Preheat Maintenance None

(Continuous or special heating where applicable should be recorded)

POSTWELD HEAT TREATMENT (QW-407)

Temperature Range none

Time Range N/A

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding - GTAW	Argon	100	35 to 45 CFH
Shielding - GMAW	Ar/O2	98/2	35 to 45 CFH
Backing - GTAW	Argon*	100	5 CFH

*Use backing gas for 1st two passes of single sided welds

ELECTRICAL CHARACTERISTICS (QW-409)

Current AC or DC See Below Polarity See Below

Amps (Range) See Below Volts (Range) See Below

(Amps and volts range should be recorded for each electrode size, position and thickness, etc. This information may be listed in a tabular form similar to that shown below.)

Tungsten Electrode Size and Type 1/16" & 3/32" EWTh-2 - for GTAW

(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW Spray Arc

(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range 250 to 500 IPM

TECHNIQUE (QW-410)

String or Weave Bead String Bead or Weave bead. Bead size should not exceed 3X dia. of wire

Orifice or Gas Cup Size 1/4" to 1/2" Diameter for GTAW. #6 thru #8 for GMAW.

Initial and Interpass Cleaning (Brushing, Grinding, Etc.) Remove scale from base metal and de-grease. Wire brush clean between passes using SS brushes. Grind stops & starts - SMAW & GMAW.

Method of Back Gouging Grind or air arc to sound metal as required. Visual inspect for cracks or voids.

Oscillation None

Contact Tube to Work Distance 5/8" +/- 1/8" for GMAW

Multiple or Single Pass (per side) Multiple pass.

Multiple or Single Electrodes Single

Travel Speed (Range) 12 to 24 IPM

Peening Not permitted

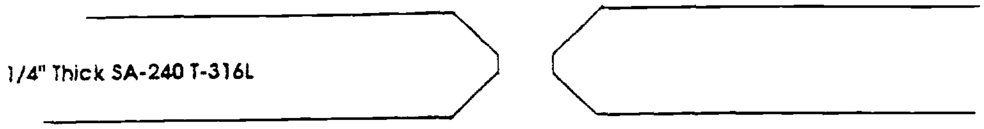
Other 100% visual inspection for alignment, laps, profile, weld spatter, undercut, cracks, porosity underfill and incomplete penetration. LPT of back gouged areas is optional, unless specifically required as stated on blueprints.

		Filler Metal		Current				
Weld Layer(s)	Process	Class	Dia.	Type Polar.	Amp Range	Volt Range	Travel Speed Range	Other (e.g., Remarks, Comments, Hot Wire Addition, Technique, Torch Angle. Etc.)
All	GTAW	ER-3XX-X	1/16"	DC-SP	30-135	11-22	3-6 IPM	
All	GTAW	ER-3XX-X	3/32"	DC-SP	50-180	11-22	3-6 IPM	
All	GTAW	ER-3XX-X	1/8"	DC-SP	80-220	11-22	3-6 IPM	
All	SMAW	E-3XX-X	3/32"	DC-RP	90-120	23 - 26	4 - 6 IPM	
All	SMAW	E-3XX-X	1/8"	DC-RP	110-150	23 - 28	5 - 8 IPM	
All	SMAW	E-3XX-X	5/32"	DC-RP	130-180	23 - 28	6 - 10 IPM	
All	GMAW	ER-3XX-X	0.035	DC-RP	70-210	22-28	12-24 IPM	
All	GMAW	ER-3XX-X	0.045	DC-RP	100-230	22-28	12-24 IPM	
All	GMAW	ER-3XX-X	0.062	DC-RP	170-300	22-28	12-24 IPM	

QW-483 SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION RECORD (PQR)
(See QW-201.2, Section IX, ASME Boiler and Pressure Vessel Code)
Record Actual Conditions Used to Weld Test Coupon.

Company Name **Pennsylvania Tank & Tube, Inc., 409 Saxonburg Blvd., Saxonburg, Pa. 16056**
Procedure Qualification Record No. GTSMGM 8-8A Date 12/3/93
WPS No. GTSMGM 8-8
Welding Process(es) GTAW - SMAW - GMAW
Types (Manual, Automatic, Semi-Auto.) Manual - Manual - Semi-automatic

JOINTS (QW-402)



Root Gap 3/32" +/- 1/32"
Included bevel angle 60 degrees
Land 1/16" +/- 1/32"
Weld two passes of GTAW one side with back purge.
Weld one pass of SMAW same side.
Flip plate, weld out other side with GMAW - do not back gouge.

Groove Design of Test Coupon

(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.)

BASE METALS (QW-403)
Material Spec. SA-240
Type or Grade T-316L
P-No. 8 to P-No. 8
Thickness of Test Coupon 1/4"
Diameter of Test Coupon Plate
Other

POSTWELD HEAT TREATMENT (QW-407)
Temperature None
Time N/A
Other

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate	
Shielding	AR	100%	35 CFH	GTAW
Shielding	AR/O2	98/2	35 CFH	GMAW
Backing	AR	100%	5 CFH	GTAW

FILLER METALS (QW-404)

	GTAW	SMAW	GMAW
SFA Specification	5.9	5.4	5.9
AWS Classification	ER-308L	E308L-15	ER-308L
Filler Metal F-No.	6	5	6
Weld Metal Analysis A-No.	8	8	8
Size of Filler Metal	3/32"	3/32"	.035"
Other			
Deposited Weld Metal	1/8"	1/16"	1/16"

ELECTRICAL CHARACTERISTICS (QW-409)
Current DC - ALL
Polarity RP - SMAW & GMAW; SP - GTAW
Amps See Below Volts See Below
Tungsten Electrode Size 3/32" EWTh-2
Other GTAW 90 Amps 17 Volts
SMAW 100 Amps 24 Volts
GMAW 210 Amps 25 Volts

POSITION (QW-405)
Position of Groove 3G
Weld Progression (Uphill, Downhill) GTAW & SMAW UPHILL
Other GMAW DOWNHILL

TECHNIQUE (QW-410)
Travel Speed 12 to 20 IPM
String or Weave Bead String Bead
Oscillation None
Multipass or Single Pass (per side) Multi-pass
Single or Multiple Electrodes Single
Other Wire feed speed at 450 IPM for GMAW

PREHEAT (QW-406)
Preheat Temp. 100 deg F.
Interpass Temp. 350 F max.
Other

(12/86) This form (E00007) may be obtained from the Order Dept., ASME, 345 E. 47th St., New York, N.Y. 10017

QW-483 (Back)

PQR No. *GTSMGM 8-8A*

Tensile Test (QW-150)

Specimen No.	Width	Thickness	Area	Ultimate Total Load lb	Ultimate Unit Stress psi	Type of Failure & Location
T-1	*0.749*	*0.175*	*0.1280*	*10374*	*81,047*	*BASE MATERIAL*
T-2	*0.749*	*0.171*	*0.1281*	*10526*	*82,170*	*BASE MATERIAL*

Guided-Bend Tests (QW-160)

Type and Figure No.	Result
SIDE BEND #1- QW 462.2	*ACCEPT*
SIDE BEND #2- QW 462.2	*ACCEPT*
SIDE BEND #3 - QW 462.2	*ACCEPT*
SIDE BEND #4- QW 462.2	*ACCEPT*

Toughness Tests (QW-170)

N/A

Specimen No.	Notch Location	Notch Type	Test Temp.	Impact Values	Lateral Exp.		Drop Weight	
					% Shear	Mils	Break	No Break
Not Applicable								

Fillet-Weld Test (QW-180)

Result -- Satisfactory: Yes________ No________ Penetration into parent metal: Yes______ No______

Macro – Results ____________________

Other Tests

Type of Test none

Deposit Analysis ____________________

Other ____________________

Welder's Name *Michael Bain* Clock No. —— Stamp No. *B*

Tests conducted by: **Professional Quality Testing** Laboratory Test No. *1141A*

We certify that the statements in this record are correct and that the test coupongs were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer **PENNSYLVANIA TANK & TUBE, INC.**

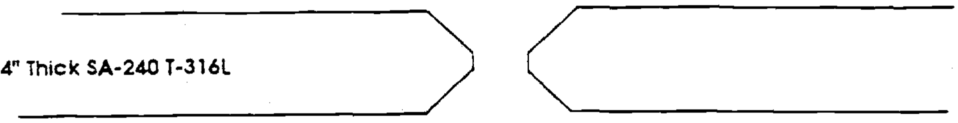
Date 1/4/94 By

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

QW-483 SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION RECORD (PQR)
(See QW-201.2, Section IX, ASME Boiler and Pressure Vessel Code)
Record Actual Conditions Used to Weld Test Coupon.

Company Name **Pennsylvania Tank & Tube, Inc., 409 Saxonburg Blvd., Saxonburg, Pa. 16056**
Procedure Qualification Record No. GTSMGM 8-8 Date 12/3/93
WPS No. GTSMGM 8-8
Welding Process(es) GTAW - SMAW - GMAW
Types (Manual, Automatic, Semi-Auto.) Manual - Manual - Semi-automatic

JOINTS (QW-402)



Root Gap 3/32" +/- 1/32"
Included bevel angle 60 degrees
Land 1/16" +/- 1/32"
Weld two passes of GTAW one side with back purge.
Weld one pass of SMAW same side.
Flip plate, weld out other side with GMAW - do not back gouge.

Groove Design of Test Coupon
(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.)

BASE METALS (QW-403)
Material Spec. *SA-240*
Type or Grade *T-316L*
P-No. *8* to P-No. *8*
Thickness of Test Coupon *3/4"*
Diameter of Test Coupon *Plate*
Other

FILLER METALS (QW-404)	GTAW	SMAW	GMAW
SFA Specification	5.9	5.4	5.9
AWS Classification	ER-308L	E308L-15	ER-308L
Filler Metal F-No.	6	5	6
Weld Metal Analysis A-No.	8	8	8
Size of Filler Metal	3/32"	3/32"	.035"
Other			
Deposited Weld Metal	0.150	0.150	0.450

POSITION (QW-405)
Position of Groove *3G*
Weld Progression (Uphill, Downhill) *GTAW & SMAW UPHILL*
Other *GMAW DOWNHILL*

PREHEAT (QW-406)
Preheat Temp. *100 deg F.*
Interpass Temp. *350 F max.*
Other

POSTWELD HEAT TREATMENT (QW-407)
Temperature *None*
Time *N/A*
Other

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate	
Shielding	AR	100%	35 CFH	GTAW
Shielding	AR/O2	98/2	35 CFH	GMAW
Backing	AR	100%	5 CFH	GTAW

ELECTRICAL CHARACTERISTICS (QW-409)
Current *DC - ALL*
Polarity *RP - SMAW & GMAW; SP - GTAW*
Amps *See Below* Volts *See Below*
Tungsten Electrode Size *3/32" EWTh-2*
Other *GTAW 90 Amps 17 Volts*
SMAW 100 Amps 24 Volts
GMAW 210 Amps 25 Volts

TECHNIQUE (QW-410)
Travel Speed *12 to 20 IPM*
String or Weave Bead *String Bead*
Oscillation *None*
Multipass or Single Pass (per side) *Multi-pass*
Single or Multiple Electrodes *Single*
Other *Wire feed speed at 450 IPM for GMAW*

(12/86) This form (E00007) may be obtained from the Order Dept., ASME, 345 E. 47th St., New York, N.Y. 10017

QW-483 (Back)

PQR No. *GTSMGM 8-8*

Tensile Test (QW-150)

Specimen No.	Width	Thickness	Area	Ultimate Total Load lb	Ultimate Unit Stress psi	Type of Failure & Location
T-1	*0.749*	*0.650*	*0.4869*	*41533*	*85,300*	***BASE MATERIAL***
T-2	*0.749*	*0.656*	*0.4913*	*41869*	*85.200*	***BASE MATERIAL***

Guided-Bend Tests (QW-160)

Type and Figure No.	Result
SIDE BEND #1- QW 462.2	***ACCEPT***
SIDE BEND #2- QW 462.2	***ACCEPT***
SIDE BEND #3 - QW 462.2	***ACCEPT***
SIDE BEND #4- QW 462.2	***ACCEPT***

Toughness Tests (QW-170)

N/A

Specimen No.	Notch Location	Notch Type	Test Temp.	Impact Values	Lateral Exp.		Drop Weight	
					% Shear	Mils	Break	No Break
Not Applicable								

Fillet-Weld Test (QW-180)

Result -- Satisfactory: Yes________No________ Penetration into parent metal: Yes______ No______

Macro -- Results ____________________

Other Tests

Type of Test none

Deposit Analysis ____________________

Other ____________________

Welder's Name ***Michael Bain*** Clock No. ——— Stamp No. ***B***

Tests conducted by: **Professional Quality Testing** Laboratory Test No. ***1141***

We certify that the statements in this record are correct and that the test coupongs were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer **PENNSYLVANIA TANK & TUBE, INC.**

Date 1/4/94 By

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)

(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name **Pennsylvania Tank & Tube, Inc.** By: **Mark W. Hadley**

Welding Procedure Specification No. **FC 1-1** Date **10/1/93** Supporting PQR No.(s) **FC 1-1**

Revision No. **0** Date

Welding Process(es) **FCAW** Type(s) **Semi-automatic**

P-1 to P-1 Flux Core Wire, without PWHT, without Notch Toughness

JOINTS (QW-402)

Details

Joint Design **Single or double bevel; U, J, V Groove & Fillet**

Backing (Yes) **X** (No)

Backing Material (Type) **compatible with base metal, if used**

(Refer to both backing and retainers.)

☒ Metal ☒ Nonfusing Metal

☒ Nonmetallic ☐ Other

With backing

Sketches, Production Drawings, Weld Symbols or Written Descritption should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

With back gouge only

(At the option of the Mfgr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

Root gap is 3/32" + or - 1/32"

Included angle to be 60 degrees minimum

*BASE METALS (QW-404)

P-No. **1** Group No. **1 thru 4** to P-No. **1** Group No. **1 thru 4**

OR

Specification type and grade Not Applicable

to Specification type and grade Not Applicable

OR

Chem. Analysis and Mech. Prop. Not Applicable

to Chem. Analysis and Mech. Prop. Not Applicable

Thickness Range:

Base Metal: Groove **3/16" to 1-1/2"** Fillet **All**

Pipe Dia. Range: Groove **All** Fillet **All**

Other

*FILLER METALS (QW-404)		
Spec. No. (SFA)	5.20	
AWS No. (Class)	E-71T-1	
F-No.	6	
A-No.	A-1 & A-2	
Size of Filler Metals	.035 - .045 - .062	
Deposited Weld Metal Thickness Range:		
Groove	1-1/2"	
Fillet	All	
Electrode-Flux (Class)	None	
Flux Trade Name	N/A	
Consumable Insert	N/A	
Other		

*Each base metal-filler metal combination should be recorded individually.

***QW-402.11 WITH OR WITHOUT NON-METALLIC OR NON-FUSING METAL RETAINERS.**

***QW-403.9 NO PASSES GREATER THAN 1/2" THICK.**

***QW-404.24 & QW-404.25 WITHOUT SUPLEMENTARY FILLER OR POWDERED FILLER METAL.**

***QW-403.10 (SHORT ARC) IS NOT APPLICABLE**

***QW-403.13 (P-9 & P-10) IS NOT APPLICABLE**

***QW-404.22 WITH OR WITHOUT CONSUMABLE INSERT**

QW-482 (Back)

WPS No. FC 1-1 **Rev.** 0

POSITIONS (QW-405)
Position(s) of Groove All
Welding Progression: Up XX Down
Position(s) of Fillet All

POSTWELD HEAT TREATMENT (QW-407)
Temperature Range none
Time Range N/A

PREHEAT (QW-406) over 3/4" thick 200 F min
Preheat Temp. Min 60 F min.
Interpass Temp. Max. 350 F max.
Preheat Maintenance None
(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding	CO2	100	35 to 45 CFH
Trailing	None		
Backing	None		

ELECTRICAL CHARACTERISTICS (QW-409)
Current AC or DC DC Polarity RP
Amps (Range) See Below Volts (Range) See Below
(Amps and volts range should be recorded for each electrode size, position and thickness, etc. This information may be listed in a tabular form similar to that shown below.)

Tungsten Electrode Size and Type N/A
(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW Spray Arc
(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range 250 to 500 IPM

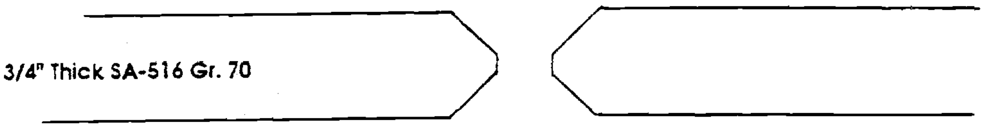
TECHNIQUE (QW-410)
String or Weave Bead String Bead or Weave bead. Bead size should not exceed 3X dia. of wire
Orifice or Gas Cup Size #52, 53, & 54 Gas Diffusers
Initial and Interpass Cleaning (Brushing, Grinding, Etc.) Remove scale from base metal and de-grease. Wire brush clean between passes. Grind all starts and stops to obtain good bead overlap.
Method of Back Gouging Grind or air arc to sound metal as required. Visual inspect for cracks or voids.
Oscillation None
Contact Tube to Work Distance 5/8" to 1-1/4" electrical stickout
Multiple or Single Pass (per side) Multiple pass.
Multiple or Single Electrodes Single
Travel Speed (Range) 12 to 24 IPM
Peening Not permitted
Other 100% visual inspection for alignment, laps, profile, weld spatter, undercut, cracks, porosity underfill and incomplete penetration. LPT of back gouged areas is optional, unless specifically required as stated on blueprints.

		Filler Metal		Current				
Weld Layer(s)	Process	Class	Dia.	Type Polar.	Amp Range	Volt Range	Travel Speed Range	Other (e.g., Remarks, Comments, Hot Wire Addition, Technique, Torch Angle, Etc.)
Root	FCAW	E-71T-1	0.035	DC-RP	130-230	22-28	12-24 IPM	
Cover	FCAW	E-71T-1	0.045	DC-RP	160-280	22-28	12-24 IPM	
Cover	FCAW	E-71T-1	0.062	DC-RP	190-320	22-28	12-24 IPM	

QW-483 SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION RECORD (PQR)
(See QW-201.2, Section IX, ASME Boiler and Pressure Vessel Code)
Record Actual Conditions Used to Weld Test Coupon.

ompany Name **Pennsylvania Tank & Tube, Inc., 409 Saxonburg Blvd., Saxonburg, Pa. 16056**
rocedure Qualification Record No. FC 1-1 Date 12/2/93
WPS No. FC 1-1
Welding Process(es) FCAW
Types (Manual, Automatic, Semi-Auto.) **Semi-automatic**

JOINTS (QW-402)



Root Gap 3/32" +/- 1/32"
Included bevel angle 60 degrees
Land 1/16" +/- 1/32"
Weld one side, back gouge to sound metal, weld other side.

Groove Design of Test Coupon
(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.)

BASE METALS (QW-403)
Material Spec. *SA-516*
Type or Grade *Gr. 70*
P-No. *1* to P-No. *1*
Thickness of Test Coupon *3/4"*
Diameter of Test Coupon *Plate*
Other

FILLER METALS (QW-404)
SFA Specification *5.20*
AWS Classification *E-71T-1*
Filler Metal F-No. *6*
Weld Metal Analysis A-No. *1*
Size of Filler Metal *0.045*
Other
Deposited Weld Metal *3/4"*

POSITION (QW-405)
Position of Groove *3G*
Weld Progression (Uphill, Downhill) *UPHILL*
Other

PREHEAT (QW-406)
Preheat Temp. *100 deg F.*
Interpass Temp. *350 F max.*
Other

POSTWELD HEAT TREATMENT (QW-407)
Temperature *None*
Time *N/A*
Other

GAS (QW-408)

	Percent Composition		
	Gas(es)	(Mixture)	Flow Rate
Shielding	*CO2*	*100%*	*35 CFH*
Trailing	None		
Backing	None		

ELECTRICAL CHARACTERISTICS (QW-409)
Current *DC*
Polarity *RP*
Amps *210* Volts *25.5*
Tungsten Electrode Size *N/A*
Other

TECHNIQUE (QW-410)
Travel Speed *12 to 20 IPM*
String or Weave Bead *String Bead*
Oscillation *None*
Multipass or Single Pass (per side) *Multi-pass*
Single or Multiple Electrodes *Single*
Other *Wire feed speed at 400 IPM*

(12/86) This form (E00007) may be obtained from the Order Dept., ASME, 345 E. 47th St., New York, N.Y. 10017

QW-483 (Back)

PQR No. FC 1-1

Tensile Test (QW-150)

Specimen No.	Width	Thickness	Area	Ultimate Total Load lb	Ultimate Unit Stress psi	Type of Failure & Location
T-1	*0.749*	*0.655*	*0.4906*	*37775*	*77,000*	*BASE MATERIAL*
T-2	*0.748*	*0.656*	*0.4907*	*37636*	*76,700*	*BASE MATERIAL*

Guided-Bend Tests (QW-160)

Type and Figure No.	Result
SIDE BEND #1- QW 462.2	*ACCEPT*
SIDE BEND #2 - QW 462.2	*ACCEPT*
SIDE BEND #3 - QW 462.2	*ACCEPT*
SIDE BEND #4- QW 462.2	*ACCEPT*

Toughness Tests (QW-170)

N/A

Specimen No.	Notch Location	Notch Type	Test Temp.	Impact Values	Lateral Exp.		Drop Weight	
					% Shear	Mils	Break	No Break
Not Applicable								

Fillet-Weld Test (QW-180)

Result -- Satisfactory: Yes________ No________ Penetration into parent metal: Yes______ No______

Macro – Results ________________

Other Tests

Type of Test none

Deposit Analysis ________________

Other ________________

Welder's Name *Michael Bain* Clock No. —— Stamp No. *B*

Tests conducted by: **Professional Quality Testing** Laboratory Test No. 1142

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer **PENNSYLVANIA TANK & TUBE, INC.**

Date 12/15/93 By

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)

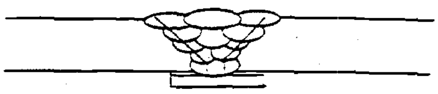
(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name **Pennsylvania Tank & Tube, Inc.** By: **Mark W. Hadley**
Welding Procedure Specification No. FC 1-8 Date 5/25/94 Supporting PQR No.(s) FC 1-8
Revision No. 0 Date
Welding Process(es) **FCAW** Type(s) **Semi-automatic**
P-1 to P-8 Flux Core Wire, without PWHT, without Notch Toughness

JOINTS (QW-402)

Details

Joint Design **Single or double bevel; U, J, V Groove & Fillet**
Backing (Yes) X (No)
Backing Material (Type) **compatible with base metal, if used**
(Refer to both backing and retainers.)


With backing

☒ Metal ☒ Nonfusing Metal
☒ Nonmetallic ☐ Other


With back gouge only

Sketches, Production Drawings, Weld Symbols or Written Descritption should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Mfgr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

Root gap is 3/32" + or - 1/32"
Included angle to be 60 degrees minimum

*BASE METALS (QW-404)

P-No. 1 Group No. 1 thru 4 to P-No. 8 Group No. 1 thru 4
OR
Specification type and grade Not Applicable
to Specification type and grade Not Applicable
OR
Chem. Analysis and Mech. Prop. Not Applicable
to Chem. Analysis and Mech. Prop. Not Applicable
Thickness Range:
Base Metal: Groove 3/16" to 1-1/2" Fillet All
Pipe Dia. Range: Groove All Fillet All
Other

*FILLER METALS (QW-404)			
Spec. No. (SFA)		5.22	
AWS No. (Class)		E-309L T-1	
F-No.		6	
A-No.		A-8	
Size of Filler Metals		.035 - .045 - .062	
Deposited Weld Metal Thickness Range:			
Groove		1-1/2"	
Fillet		All	
Electrode-Flux (Class)		None	
Flux Trade Name		N/A	
Consumable Insert		N/A	
Other			

*Each base metal-filler metal combination should be recorded individually.

***QW-402.11 WITH OR WITHOUT NON-METALLIC OR NON-FUSING METAL RETAINERS.**
***QW-403.9 NO PASSES GREATER THAN 1/2" THICK.**
***QW-404.24 & QW-404.25 WITHOUT SUPLEMENTARY FILLER OR POWDERED FILLER METAL.**
***QW-403.10 (SHORT ARC) IS NOT APPLICABLE**
***QW-403.13 (P-9 & P-10) IS NOT APPLICABLE**
***QW-404.22 WITH OR WITHOUT CONSUMABLE INSERT**

QW-482 (Back)

WPS No. FC 1-8 **Rev.** 0

POSITIONS (QW-405)
Position(s) of Groove All
Welding Progression: Up XX Down
Position(s) of Fillet All

POSTWELD HEAT TREATMENT (QW-407)
Temperature Range none
Time Range N/A

PREHEAT (QW-406) over 3/4" thick 200 F min
Preheat Temp. Min 60 F min.
Interpass Temp. Max. 350 F max.
Preheat Maintenance None
(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding	CO2	100	35 to 45 CFH
Trailing	None		
Backing	None		

ELECTRICAL CHARACTERISTICS (QW-409)
Current AC or DC DC Polarity RP
Amps (Range) See Below Volts (Range) See Below
(Amps and volts range should be recorded for each electrode size, position and thickness, etc. This information may be listed in a tabular form similar to that shown below.)

Tungsten Electrode Size and Type N/A
(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW Spray Arc
(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range 250 to 500 IPM

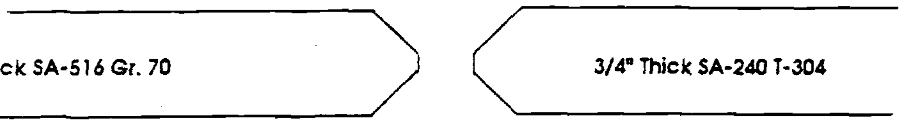
TECHNIQUE (QW-410)
String or Weave Bead String Bead or Weave bead. Bead size should not exceed 3X dia. of wire
Orifice or Gas Cup Size #52, 53, & 54 Gas Diffusers
Initial and Interpass Cleaning (Brushing, Grinding, Etc.) Remove scale from base metal and de-grease. Wire brush clean between passes. Grind all starts and stops to obtain good bead overlap.
Method of Back Gouging Grind or air arc to sound metal as required. Visual inspect for cracks or voids.
Oscillation None
Contact Tube to Work Distance 5/8" to 1-1/4" electrical stickout
Multiple or Single Pass (per side) Multiple pass.
Multiple or Single Electrodes Single
Travel Speed (Range) 12 to 24 IPM
Peening Not permitted
Other 100% visual inspection for alignment, laps, profile, weld spatter, undercut, cracks, porosity underfill and incomplete penetration. LPT of back gouged areas is optional, unless specifically required as stated on blueprints.

Weld Layer(s)	Process	Filler Metal		Current		Volt Range	Travel Speed Range	Other (e.g., Remarks, Comments, Hot Wire Addition, Technique, Torch Angle, Etc.)
		Class	Dia.	Type Polar.	Amp Range			
Root	FCAW	E-309L T-1	0.035	DC-RP	130-230	22-28	12-24 IPM	
Cover	FCAW	E-309L T-1	0.045	DC-RP	160-280	22-28	12-24 IPM	
Cover	FCAW	E-309L T-1	0.062	DC-RP	190-320	22-28	12-24 IPM	

QW-483 SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION RECORD (PQR)
(See QW-201.2, Section IX, ASME Boiler and Pressure Vessel Code)
Record Actual Conditions Used to Weld Test Coupon.

Company Name **Pennsylvania Tank & Tube, Inc., 409 Saxonburg Blvd., Saxonburg, Pa. 16056**
Procedure Qualification Record No. FC 1-8 Date 5/27/94
WPS No. FC 1-8
Welding Process(es) FCAW
Types (Manual, Automatic, Semi-Auto.) Semi-automatic

JOINTS (QW-402)



Root Gap 3/32" +/- 1/32"
Included bevel angle 60 degrees
Land 1/16" +/- 1/32"
Weld one side, back gouge to sound metal, weld other side.

Groove Design of Test Coupon
(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.)

BASE METALS (QW-403)

Material Spec.	SA-516	SA-240
Type or Grade	Gr. 70	T-304
P-No.	1	to P-No. 8
Thickness of Test Coupon	3/4"	
Diameter of Test Coupon	Plate	
Other		

POSTWELD HEAT TREATMENT (QW-407)

Temperature None
Time N/A
Other

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding	CO2	100%	35 CFH
Trailing	None		
Backing	None		

FILLER METALS (QW-404)

SFA Specification	5.22
AWS Classification	E-309L T-1
Filler Metal F-No.	6
Weld Metal Analysis A-No.	8
Size of Filler Metal	0.045
Other	
Deposited Weld Metal	3/4"

ELECTRICAL CHARACTERISTICS (QW-409)

Current DC
Polarity RP
Amps 210 Volts 25
Tungsten Electrode Size N/A
Other

POSITION (QW-405)

Position of Groove 3G
Weld Progression (Uphill, Downhill) UPHILL
Other

PREHEAT (QW-406)

Preheat Temp. 100 deg F.
Interpass Temp. 350 F max.
Other

TECHNIQUE (QW-410)

Travel Speed 12 to 20 IPM
String or Weave Bead String Bead
Oscillation None
Multipass or Single Pass (per side) Multi-pass
Single or Multiple Electrodes Single
Other Wire feed speed at 400 IPM

(12/86) This form (E00007) may be obtained from the Order Dept., ASME, 345 E. 47th St., New York, N.Y. 10017

QW-483 (Back)

PQR No. FC 1-8

Tensile Test (QW-150)

Specimen No.	Width	Thickness	Area	Ultimate Total Load lb	Ultimate Unit Stress psi	Type of Failure & Location
T-1	0.999	0.655	0.6540	51339	78,500	BASE MATERIAL
T-2	1.000	0.656	0.6560	50906	77,600	BASE MATERIAL

Guided-Bend Tests (QW-160)

Type and Figure No.	Result
SIDE BEND #1- QW 462.2	ACCEPT
SIDE BEND #2 - QW 462.2	ACCEPT
SIDE BEND #3 - QW 462.2	ACCEPT
SIDE BEND #4- QW 462.2	ACCEPT

Toughness Tests (QW-170)

N/A

Specimen No.	Notch Location	Notch Type	Test Temp.	Impact Values	Lateral Exp.		Drop Weight	
					% Shear	Mils	Break	No Break
Not Applicable								

Fillet-Weld Test (QW-180)

Result -- Satisfactory: Yes________No________ Penetration into parent metal: Yes______ No______

Macro -- Results ________

Other Tests

Type of Test none

Deposit Analysis ________

Other ________

Welder's Name **Michael Bain** Clock No. —— Stamp No. B

Tests conducted by: **Professional Quality Testing** Laboratory Test No. 1225

We certify that the statements in this record are correct and that the test coupongs were prepared. welded. and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer **PENNSYLVANIA TANK & TUBE, INC.**

Date 5-28-94 By John Townsend

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)

(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

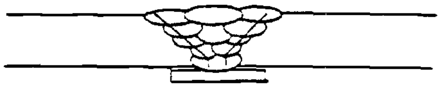
Company Name **Pennsylvania Tank & Tube, Inc.** By: **Mark W. Hadley**
Welding Procedure Specification No. **SAW 1-1** Date **2/1/94** Supporting PQR No. **SAW 1-1**
Revision No. **0** Date
Welding Process(es) **SAW** Type(s) **Semi-automatic**
P-1 to P-1 without PWHT, without Notch Toughness

JOINTS (QW-402)

Joint Design **Butt Joint; Single or double bevel: U, J, V Groove & Fillet**
Backing (Yes) **With** (No) **Double Welded**
Backing Material (Type) **compatible with base metal, if used**
(Refer to both backing and retainers.)

☒ Metal ☒ Nonfusing Metal
☒ Nonmetallic ☐ Other

Details



With backing

Double Welded

Sketches, Production Drawings, Weld Symbols or Written Descritption should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Mfgr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

See Prod. Dwgs. for Joint Design

*BASE METALS (QW-404)

P-No. **1** Group No. **1 thru 4** to P-No. **1** Group No. **1 thru 4**
OR
Specification type and grade **Not Applicable**
to Specification type and grade **Not Applicable**
OR
Chem. Analysis and Mech. Prop. **Not Applicable**
to Chem. Analysis and Mech. Prop. **Not Applicable**
Thickness Range:
Base Metal: Groove **3/16" to 1-1/2"** Fillet **All**
Pipe Dia. Range: Groove **All** Fillet **All**
Other

*FILLER METALS (QW-404)

Spec. No. (SFA)		**5.17**	
AWS No. (Class)		**F7A2-EM12K**	
F-No.		**6**	
A-No.	**C-.05/.15, Mn- .80/1.25, Si- .10/.35, S- .03, P- .03, Cu-.35**		
Size of Filler Metals		**1/16", 3/32", 1/8"**	
Deposited Weld Metal Thickness Range:			
Groove		**1-1/2" Max**	
Fillet		**All**	
Electrode-Flux (Class)		**F7A2-EM12K**	
Flux Trade Name		**Lincoln 860/L-61**	
Consumable Insert		**N/A**	
Other			

*Each base metal-filler metal combination should be recorded individually.

***QW-402.11 WITH OR WITHOUT NON-METALLIC OR NON-FUSING METAL RETAINERS.**
***QW-403.9 NO PASSES GREATER THAN 1/2" THICK.**
***QW-404.24 & QW-404.25 WITHOUT SUPLEMENTARY FILLER OR POWDERED FILLER METAL.**

(12/89) This form (E00006) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300.

QW-482 (Back)

WPS No. SAW 1-1 **Rev.** 0

POSITIONS (QW-405)
Position(s) of Groove All
Welding Progression: Flat
Position(s) of Fillet All

POSTWELD HEAT TREATMENT (QW-407)
Temperature Range none
Time Range N/A

PREHEAT (QW-406) over1-1/4" thick 200 F min
Preheat Temp. Min 60 F min.
Interpass Temp. Max. 350 F max.
Preheat Maintenance None
(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding	None		
Trailing	None		
Backing	None		

ELECTRICAL CHARACTERISTICS (QW-409)
Current AC or DC See Below Polarity See Below
Amps (Range) See Below Volts (Range) See Below
(Amps and volts range should be recorded for each electrode size, position and thickness, etc. This information may be listed in a tabular form similar to that shown below.)

Tungsten Electrode Size and Type N/A
(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW N/A
(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range N/A

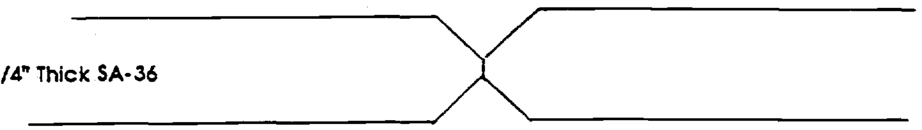
TECHNIQUE (QW-410)
String or Weave Bead String Bead.
Orifice or Gas Cup Size N/A
Initial and Interpass Cleaning (Brushing, Grinding, Etc.) Remove scale from base metal and de-grease. Wire brush clean between passes. Grind all starts and stops to obtain good bead overlap.
Method of Back Gouging Grind or air arc to sound metal as required. Visual inspect for cracks or voids.
Oscillation None
Contact Tube to Work Distance 1" to 2"
Multiple or Single Pass (per side) Single or Multiple pass.
Multiple or Single Electrodes Single
Travel Speed (Range) 12 to 24 IPM
Peening Not permitted
Other 100% visual inspection for alignment, laps, profile, weld spatter, undercut, cracks, porosity underfill and incomplete penetration. LPT of back gouged areas is optional, unless specifically required as stated on blueprints.

Weld Layer(s)	Process	Filler Metal		Current		Volt Range	Travel Speed Range	Other (e.g., Remarks, Comments, Hot Wire Addition, Technique, Torch Angle, Etc.)
		Class	Dia.	Type Polar.	Amp Range			
All	SAW	EM12K	5/64"	DC-RP	200-450	28-35	12-24 IPM	
All	SAW	EM12K	3/32"	DC-RP	300-480	28-35	12-24 IPM	
All	SAW	EM12K	1/8"	DC-RP	400-620	28-35	12-24 IPM	

QW-483 SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION RECORD (PQR)
(See QW-201.2, Section IX, ASME Boiler and Pressure Vessel Code)
Record Actual Conditions Used to Weld Test Coupon.

npany Name **Pennsylvania Tank & Tube, Inc., 409 Saxonburg Blvd., Saxonburg, Pa. 16056**
ocedure Qualification Record No. SAW 1-1 Date 3/2/94
WPS No. SAW 1-1
Welding Process(es) SAW
Types (Manual, Automatic, Semi-Auto.) Semi-Automatic

JOINTS (QW-402)



3/4" Thick SA-36

Root Gap 0"
Included bevel angle 60 degrees
Land 1/4" +/- 1/32"
Weld one side, do not back gouge, weld other side.

Groove Design of Test Coupon
(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.)

BASE METALS (QW-403)

Material Spec. *SA-36*
pe or Grade *N/A*
lo. *1* to P-No. *1*
ickness of Test Coupon *3/4"*
Diameter of Test Coupon *Plate*
Other

FILLER METALS (QW-404)

SFA Specification	*5.17*
AWS Classification	*F7A2-EM12K*
Filler Metal F-No.	*6*
Weld Metal Analysis A-No.	*See Other Below*
Size of Filler Metal	*1/8"*
Other	C-.05/.15, Mn-.80/1.25, Si-.10/.35, S-.03, P-.03, Cu-.35
Deposited Weld Metal	*3/4"*

POSITION (QW-405)

Position of Groove *1F Flat*
Weld Progression (Uphill, Downhill) *N/A*
Other

PREHEAT (QW-406)

Preheat Temp. *100 deg F.*
Interpass Temp. *350 F max.*
ther

POSTWELD HEAT TREATMENT (QW-407)

Temperature *None*
Time *N/A*
Other

GAS (QW-408)

	Percent Composition		
	Gas(es)	(Mixture)	Flow Rate
Shielding	None		
Trailing	None		
Backing	None		

ELECTRICAL CHARACTERISTICS (QW-409)

Current *DC*
Polarity *RP*
Amps *600* Volts *35*
Tungsten Electrode Size *N/A*
Other

TECHNIQUE (QW-410)

Travel Speed *First Pass-21 IPM; Cover 15 IPM*
String or Weave Bead *String Bead*
Oscillation *None*
Multipass or Single Pass (per side) *Multi-pass*
Single or Multiple Electrodes *Single*
Other

(12/86) This form (E00007) may be obtained from the Order Dept., ASME, 345 E. 47th St., New York, N.Y. 10017

QW-483 (Back)

PQR No. *SAW 1-1*

Tensile Test (QW-150)

Specimen No.	Width	Thickness	Area	Ultimate Total Load lb	Ultimate Unit Stress psi	Type of Failure & Location
T-1	*0.749*	*0.665*	*0.4981*	*30834*	*61,903*	*BASE MATERIAL*
T-2	*0.750*	*0.672*	*0.5040*	*31531*	*62,562*	*BASE MATERIAL*

Guided-Bend Tests (QW-160)

Type and Figure No.	Result
SIDE BEND #1- QW 462.2	*ACCEPT*
SIDE BEND #2 - QW 462.2	*ACCEPT*
SIDE BEND #3 - QW 462.2	*ACCEPT*
SIDE BEND #4- QW 462.2	*ACCEPT*

Toughness Tests (QW-170)

N/A

Specimen No.	Notch Location	Notch Type	Test Temp.	Impact Values	Lateral Exp.		Drop Weight	
					% Shear	Mils	Break	No Break
Not Applicable								

Fillet-Weld Test (QW-180)

Result -- Satisfactory: Yes________ No________ Penetration into parent metal: Yes______ No______

Macro -- Results ________________

Other Tests

Type of Test none

Deposit Analysis ________________

Other ________________

Welder's Name **Michael Bain** Clock No. —— Stamp No. **B**

Tests conducted by: **Professional Quality Testing** Laboratory Test No. **1204**

We certify that the statements in this record are correct and that the test coupongs were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer **PENNSYLVANIA TANK & TUBE, INC.**

Date 3/4/94 By

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)

(See QW-301. Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name Lee Solada Clock number ---- Stamp no. Y
Welding process(es) used FCAW Type Semi-Automatic
Identification of WPS followed by welder during welding of test coupon FC 1-1
Base material(s) welded SA 516-70 to SA 516-70 Thickness .625

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	Weld Metal	Weld Metal
ASME P-No. 1 to ASME P-No. (QW 403)	1	P1 thru P11 & P4X
(X) Plate ( ) Pipe (enter diameter, if pipe)	.625"	1.25"
Filler metal specification (SFA): 5.20 Classification (QW-404)	5.20	
Filler metal F-No.	6	6
Consumable insert for GTAW or PAW	n/a	n/a
Weld deposit thickness for each welding process	.625"	1.25"
Welding position (1G, 5G, etc.) (QW-405)	1G	1G
Progression (uphill/downhill)	uphill	uphill
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	n/a	n/a
GMAW transfer mode (QW-409)	n/a	n/a
GTAW welding current type/polarity	n/a	n/a

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control	n/a	n/a
Automatic voltage control (GTAW)	n/a	n/a
Automatic joint tracking	n/a	n/a
Welding position (1G, 5G, etc.)	n/a	n/a
Consumable insert	n/a	n/a
Backing (metal, weld metal, welded from both sides, flux, etc.)	n/a	n/a

Guided Bend Test Results

Guided Bend Tests Type	( ) QW-462.2 (Side) Results	( ) QW-462.3(a) (Trans. R & F) Type	( ) QW-462.3(b) (Long. R & F) Results

Visual examination results (QW-302.4) Acceptable
Radiographic test results (QW-304 and QW-305) 0 - 1 Acceptable
(For alternative qualification of groove welds by radiography)
Fillet Weld -- Fracture test - Length and percent of defects - in.
Macro test fusion - Fillet leg size - in. X - in. Concavity/convexity - in.
Welding test conducted by Pennsylvania Tank & Tube, Inc.
Mechanical tests conducted by Professional Quality Testing, Inc. Laboratory test no. PQT 1191

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization PENNSYLVANIA TANK & TUBE, INC.

Date 2-10-95 By John Townsend

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name Lee Solada Clock number ---- Stamp no. Y
Welding process(es) used GTAW Type Manual
Identification of WPS followed by welder during welding of test coupon GT 1-1
Base material(s) welded SA 516-70 to SA 516-70 Thickness 0.375

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	Weld Metal	Weld Metal
ASME P-No. 1 to ASME P-No. (QW 403)	1	P1 thru P11 & P4X
(X) Plate ( ) Pipe (enter diameter, if pipe)	0.375	0.75
Filler metal specification (SFA): 5.18 Classification (QW-404)	5.18	
Filler metal F-No.	6	6
Consumable insert for GTAW or PAW	none	none
Weld deposit thickness for each welding process	0.375	0.75
Welding position (1G, 5G, etc.) (QW-405)	1G	1G
Progression (uphill/downhill)	uphill	uphill
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	none	none
GMAW transfer mode (QW-409)	n/a	n/a
GTAW welding current type/polarity	straigtht	straight

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control	n/a	n/a
Automatic voltage control (GTAW)	n/a	n/a
Automatic joint tracking	n/a	n/a
Welding position (1G, 5G, etc.)	n/a	n/a
Consumable insert	n/a	n/a
Backing (metal, weld metal, welded from both sides, flux, etc.)	n/a	n/a

Guided Bend Test Results

Guided Bend Tests Type	( ) QW-462.2 (Side) Results	( ) QW-462.3(a) (Trans. R & F) Type	( ) QW-462.3(b) (Long. R & F) Results
	N/A		

Visual examination results (QW-302.4) Acceptable
Radiographic test results (QW-304 and QW-305) 0 - 1 Acceptable
(For alternative qualification of groove welds by radiography)
Fillet Weld – Fracture test - Length and percent of defects - in.
Macro test fusion - Fillet leg size - in. X - in. Concavity/convexity - in.
Welding test conducted by Pennsylvania Tank & Tube, Inc.
Mechanical tests conducted by Professional Quality Testing, Inc. Laboratory test no. PQT 1191

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization PENNSYLVANIA TANK & TUBE, INC.

Date 5-1-95 By John Townsend

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)
(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name **Mike Claypoole** Clock number ---- Stamp no. **D**
Welding process(es) used **SAW** Type **Semi-Automatic**
Identification of WPS followed by welder during welding of test coupon **SAW 1-1**
Base material(s) welded **SA516-70 to SA516-70** Thickness **.500"**

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	WITH	WITH
ASME P-No. 1 to ASME P-No. (QW 403)	1	1 thru 11 & P-4X
(X) Plate ( ) Pipe (enter diameter, if pipe)	Plate	2-7/8" & over
Filler metal specification (SFA): 5.17 Classification (QW-404)	5.17	
Filler metal F-No.	6	6
Consumable insert for GTAW or PAW	n/a	n/a
Weld deposit thickness for each welding process	.500"	1"
Welding position (1G, 5G, etc.) (QW-405)	1G	1G
Progression (uphill/downhill)	n/a	n/a
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	n/a	n/a
GMAW transfer mode (QW-409)	n/a	n/a
GTAW welding current type/polarity	n/a	n/a

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control	n/a	n/a
Automatic voltage control (GTAW)	n/a	n/a
Automatic joint tracking	n/a	n/a
Welding position (1G, 5G, etc.)	n/a	n/a
Consumable insert	n/a	n/a
Backing (metal, weld metal, welded from both sides, flux, etc.)	n/a	n/a

Guided Bend Test Results

Guided Bend Tests Type	( ) QW-462.2 (Side) Results	( ) QW-462.3(a) (Trans. R & F) Type	( ) QW-462.3(b) (Long. R & F) Resu
		Not required for performance	

Visual examination results (QW-302.4) **Acceptable**
Radiographic test results (QW-304 and QW-305) **0 - 1 Acceptable**
(For alternative qualification of groove welds by radiography)
Fillet Weld -- Fracture test - Length and percent of defects -
Macro test fusion - Fillet leg size - in. X - in. Concavity/convexity -
Welding test conducted by **Pennsylvania Tank & Tube, Inc.**
Mechanical tests conducted by **Professional Quality Testing, Inc.** Laboratory test no. **PQT 1191**

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization **PENNSYLVANIA TANK & TUBE, INC.**

Date 4-21-95 By John Townsend

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name Mike Claypoole Clock number ---- Stamp no. D

Welding process(es) used FCAW Type Semi-Automatic

Identification of WPS followed by welder during welding of test coupon FC 1-1

Base material(s) welded SA 516-70 to SA 516-70 Thickness .500"

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	Weld Metal	Weld Metal
ASME P-No. 1 to ASME P-No. (QW 403)	1	P1 thru P11 & P4X
(X) Plate ( ) Pipe (enter diameter, if pipe)	.500"	1.00"
Filler metal specification (SFA): 5.20 Classification (QW-404)	5.20	
Filler metal F-No.	6	6
Consumable insert for GTAW or PAW	n/a	n/a
Weld deposit thickness for each welding process	.500"	1.00"
Welding position (1G, 5G, etc.) (QW-405)	1G	1G
Progression (uphill/downhill)	uphill	uphill
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	n/a	n/a
GMAW transfer mode (QW-409)	n/a	n/a
GTAW welding current type/polarity	n/a	n/a

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control	n/a	n/a
Automatic voltage control (GTAW)	n/a	n/a
Automatic joint tracking	n/a	n/a
Welding position (1G, 5G, etc.)	n/a	n/a
Consumable insert	n/a	n/a
Backing (metal, weld metal, welded from both sides, flux, etc.)	n/a	n/a

Guided Bend Test Results

Guided Bend Tests Type	( ) QW-462.2 (Side) Results	( ) QW-462.3(a) (Trans. R & F) Type	( ) QW-462.3(b) (Long. R & F) Results

Visual examination results (QW-302.4) Acceptable

Radiographic test results (QW-304 and QW-305) 0 - 1 Acceptable

(For alternative qualification of groove welds by radiography)

Fillet Weld -- Fracture test - Length and percent of defects - in.

Macro test fusion - Fillet leg size - in. X - in. Concavity/convexity - in.

Welding test conducted by Pennsylvania Tank & Tube, Inc.

Mechanical tests conducted by Professional Quality Testing, Inc. Laboratory test no. PQT 1191

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization PENNSYLVANIA TANK & TUBE, INC.

Date 1-24-95

By John Townsend

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name **Matt River** Clock number **- - - -** Stamp no. **M**

Welding process(es) used **GTAW** Type **Manual**

Identification of WPS followed by welder during welding of test coupon **GTSM 1-1**

Base material(s) welded **P-1 to P-1** Thickness **.218"**

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	WITHOUT	+ or -
ASME P-No. 1 to ASME P-No. (QW 403)	1	1 thru 11 & P-4X
( ) Plate ( ) Pipe (enter diameter, if pipe)	2-3/8"	1" & over
Filler metal specification (SFA): 5.18 Classification (QW-404)	5.18	
Filler metal F-No.	6	6
Consumable insert for GTAW or PAW	none	without
Weld deposit thickness for each welding process	.218	.436
Welding position (1G, 5G, etc.) (QW-405)	6G	All
Progression (uphill/downhill)	uphill	uphill
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	Ar-100%	Ar-100%
GMAW transfer mode (QW-409)	n/a	n/a
GTAW welding current type/polarity	DC-SP	DC-SP

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control		
Automatic voltage control (GTAW)		
Automatic joint tracking		
Welding position (1G, 5G, etc.)		
Consumable insert		
Backing (metal, weld metal, welded from both sides, flux, etc.)		

Guided Bend Test Results

Guided Bend Tests Type	(X) QW-462.2 (Side) Results	( ) QW-462.3(a) (Trans. R & F) Type	( ) QW-462.3(b) (Long. R & F) Results

Visual examination results (QW-302.4) **Acceptable**

Radiographic test results (QW-304 and QW-305) **Acceptable**

(For alternative qualification of groove welds by radiography)

Fillet Weld -- Fracture test ______ Length and percent of defects ______ in.

Macro test fusion ______ Fillet leg size ______ in. X ______ in. Concavity/convexity ______ in.

Welding test conducted by **Pennsylvania Tank & Tube, Inc.**

Mechanical tests conducted by **Professional Quality Testing, Inc.** Laboratory test no. **1141**

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization **PENNSYLVANIA TANK & TUBE, INC.**

Date 4/5/94 By

This form (E00008) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NH 07007-2300

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)
(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name **Matt River** Clock number ---- Stamp no. **M**
Welding process(es) used **FCAW** Type **Semi-Automatic**
Identification of WPS followed by welder during welding of test coupon **FC 1-1**
Base material(s) welded **P-1 TO P-1** Thickness **.375"**

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	WITH	WITH
ASME P-No. 1 to ASME P-No. (QW 403)	1	1 thru 11 & P-4X
(X) Plate ( ) Pipe (enter diameter, if pipe)	Plate	2-7/8" & over
Filler metal specification (SFA): 5.28 Classification (QW-404)	5.28	
Filler metal F-No.	6	6
Consumable insert for GTAW or PAW	n/a	n/a
Weld deposit thickness for each welding process	.375"	.750"
Welding position (1G, 5G, etc.) (QW-405)	3G	F & V
Progression (uphill/downhill)	uphill	uphill
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	None	None
GMAW transfer mode (QW-409)	Spray Arc	Spray Arc
GTAW welding current type/polarity	n/a	n/a

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control		
Automatic voltage control (GTAW)		
Automatic joint tracking		
Welding position (1G, 5G, etc.)		
Consumable insert		
Backing (metal, weld metal, welded from both sides, flux, etc.)		

Guided Bend Test Results

Guided Bend Tests Type	( ) QW-462.2 (Side) Results	( ) QW-462.3(a) (Trans. R & F) Type	( ) QW-462.3(b) (Long. R & F) Results

Visual examination results (QW-302.4) **Acceptable**
Radiographic test results (QW-304 and QW-305) **Acceptable**
(For alternative qualification of groove welds by radiography)
Fillet Weld – Fracture test ________ Length and percent of defects ________ in.
Macro test fusion ________ Fillet leg size ________ in. X ________ in. Concavity/convexity ________ in.
Welding test conducted by **Pennsylvania Tank & Tube, Inc.**
Mechanical tests conducted by **Professional Quality Testing, Inc.** Laboratory test no. **1143**

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization **PENNSYLVANIA TANK & TUBE, INC.**

Date 12/31/93

By Mark Holley

This form (E00008) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NH 07007-2300

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name Matt River Clock number ---- Stamp no. M
Welding process(es) used SMAW Type Manual
Identification of WPS followed by welder during welding of test coupon GTSM 1-1
Base material(s) welded P-1 to P-1 Thickness 0.218

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	With	With
ASME P-No. 1 to ASME P-No. (QW 403)	1	1 thru 11 & P-4X
(X) Plate ( ) Pipe (enter diameter, if pipe)	Plate	2-7/8" & over
Filler metal specification (SFA): 5.1 Classification (QW-404)	5.1	
Filler metal F-No.	4	1 thru 4
Consumable insert for GTAW or PAW	n/a	n/a
Weld deposit thickness for each welding process	.093"	0.186
Welding position (1G, 5G, etc.) (QW-405)	6G	All
Progression (uphill/downhill)	uphill	uphill
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	n/a	n/a
GMAW transfer mode (QW-409)	n/a	n/a
GTAW welding current type/polarity	n/a	n/a

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control		
Automatic voltage control (GTAW)		
Automatic joint tracking		
Welding position (1G, 5G, etc.)		
Consumable insert		
Backing (metal, weld metal, welded from both sides, flux, etc.)		

Guided Bend Test Results

Guided Bend Tests Type	(X) QW-462.2 (Side) Results	( ) QW-462.3(a) (Trans. R & F) Type	( ) QW-462.3(b) (Long. R & F) Results

Visual examination results (QW-302.4) Acceptable
Radiographic test results (QW-304 and QW-305) Acceptable
(For alternative qualification of groove welds by radiography)
Fillet Weld – Fracture test ______ Length and percent of defects ______ in.
Macro test fusion ______ Fillet leg size ______ in. X ______ in. Concavity/convexity ______ in.
Welding test conducted by Pennsylvania Tank & Tube, Inc.
Mechanical tests conducted by Professional Quality Testing, Inc. Laboratory test no. 1141

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization PENNSYLVANIA TANK & TUBE, INC.

Date 4/5/94 By

This form (E00008) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NH 07007-2300

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name **Shawn Hatbob** Clock number ---- Stamp no. **H**

Welding process(es) used **FCAW** Type **Semi-Automatic**

Identification of WPS followed by welder during welding of test coupon **FC 1-1**

Base material(s) welded **P-1 TO P-1** Thickness **.750"**

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	WITH	WITH
ASME P-No. 1 to ASME P-No. (QW 403)	1	1 thru 11 & P-4X
(☒) Plate ( ) Pipe (enter diameter, if pipe)	Plate	2-7/8" & over
Filler metal specification (SFA): 5.28 Classification (QW-404)	5.28	
Filler metal F-No.	6	6
Consumable insert for GTAW or PAW	n/a	n/a
Weld deposit thickness for each welding process	.750"	max to be welded
Welding position (1G, 5G, etc.) (QW-405)	3G	F & V
Progression (uphill/downhill)	uphill	uphill
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	None	None
GMAW transfer mode (QW-409)	Spray Arc	Spray Arc
GTAW welding current type/polarity	n/a	n/a

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control		
Automatic voltage control (GTAW)		
Automatic joint tracking		
Welding position (1G, 5G, etc.)		
Consumable insert		
Backing (metal, weld metal, welded from both sides, flux, etc.)		

Guided Bend Test Results

Guided Bend Tests Type	( ) QW-462.2 (Side) Results	( ) QW-462.3(a) (Trans. R & F) Type	( ) QW-462.3(b) (Long. R & F) Results

Visual examination results (QW-302.4) **Acceptable**

Radiographic test results (QW-304 and QW-305) **Acceptable**

(For alternative qualification of groove welds by radiography)

Fillet Weld – Fracture test ______ Length and percent of defects ______ in.

Macro test fusion ______ Fillet leg size ______ in. X ______ in. Concavity/convexity ______ in.

Welding test conducted by **Pennsylvania Tank & Tube, Inc.**

Mechanical tests conducted by **Professional Quality Testing, Inc.** Laboratory test no. **1143**

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization **PENNSYLVANIA TANK & TUBE, INC.**

Date 12-31-93 By John C Chebal

This form (E00008) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NH 07007-2300

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name **Shawn Hatbob** Clock number ---- Stamp no. **H**

Welding process(es) used **GTAW** Type **Manual**

Identification of WPS followed by welder during welding of test coupon **GT 1-1**

Base material(s) welded **P-1 to P-1** Thickness **.218"**

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	WITHOUT	+ or -
ASME P-No. 1 to ASME P-No. (QW 403)	1	1 thru 11 & P-4X
( ) Plate (X) Pipe (enter diameter, if pipe)	2-3/8"	1" & over
Filler metal specification (SFA): 5.18 Classification (QW-404)	5.18	
Filler metal F-No.	6	6
Consumable insert for GTAW or PAW	none	without
Weld deposit thickness for each welding process	0.218"	0.436
Welding position (1G, 5G, etc.) (QW-405)	6G	All
Progression (uphill/downhill)	uphill	uphill
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	Ar-100%	Ar-100%
GMAW transfer mode (QW-409)	n/a	n/a
GTAW welding current type/polarity	DC-SP	DC-SP

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control		
Automatic voltage control (GTAW)		
Automatic joint tracking		
Welding position (1G, 5G, etc.)		
Consumable insert		
Backing (metal, weld metal, welded from both sides, flux, etc.)		

Guided Bend Test Results

Guided Bend Tests Type ( ) QW-462.2 (Side) Results ( ) QW-462.3(a) (Trans. R & F) Type ( ) QW-462.3(b) (Long. R & F) Results

Visual examination results (QW-302.4) **Acceptable**

Radiographic test results (QW-304 and QW-305) **Acceptable**

(For alternative qualification of groove welds by radiography)

Fillet Weld – Fracture test ______ Length and percent of defects ______ in.

Macro test fusion ______ Fillet leg size ______ in. X ______ in. Concavity/convexity ______ in.

Welding test conducted by **Pennsylvania Tank & Tube, Inc.**

Mechanical tests conducted by **Professional Quality Testing, Inc.** Laboratory test no. **1144**

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization **PENNSYLVANIA TANK & TUBE, INC.**

Date 12-31-93

By John C Chelal

This form (E00008) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NH 07007-2300

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name **Shawn Hatbob** Clock number ---- Stamp no. **H**
Welding process(es) used SMAW Type **Manual**
Identification of WPS followed by welder during welding of test coupon **GTSM 8-8**
Base material(s) welded **P-8 to P-8** Thickness **.218"**

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	With	With
ASME P-No. 8 to ASME P-No. (QW 403)	8	1 thru 11 & P-4X
☐ Plate ☒ Pipe (enter diameter, if pipe)	2-3/8"	1" & over
Filler metal specification (SFA): 5.4 Classification (QW-404)	5.4	
Filler metal F-No.	5	5
Consumable insert for GTAW or PAW	N/A	N/A
Weld deposit thickness for each welding process	0.156	0.312
Welding position (1G, 5G, etc.) (QW-405)	6G	All
Progression (uphill/downhill)	uphill	uphill
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	N/A	N/A
GMAW transfer mode (QW-409)	n/a	n/a
GTAW welding current type/polarity	DC-RP	DC-RP

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control		
Automatic voltage control (GTAW)		
Automatic joint tracking		
Welding position (1G, 5G, etc.)		
Consumable insert		
Backing (metal, weld metal, welded from both sides, flux, etc.)		

Guided Bend Test Results

Guided Bend Tests Type	☐ QW-462.2 (Side) Results	☐ QW-462.3(a) (Trans. R & F) Type	☐ QW-462.3(b) (Long. R & F) Results

Visual examination results (QW-302.4) **Acceptable**
Radiographic test results (QW-304 and QW-305) **Acceptable**
(For alternative qualification of groove welds by radiography)
Fillet Weld -- Fracture test ____ Length and percent of defects ____ in.
Macro test fusion ____ Fillet leg size ____ in. X ____ in. Concavity/convexity ____ in.
Welding test conducted by **Pennsylvania Tank & Tube, Inc.**
Mechanical tests conducted by **Professional Quality Testing, Inc.** Laboratory test no. **1144**

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization **PENNSYLVANIA TANK & TUBE, INC.**

Date 2-2-94 By

This form (E00008) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NH 07007-2300

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name **Jody Michael** Clock number ---- Stamp no. **J**

Welding process(es) used **FCAW** Type **Semi-Automatic**

Identification of WPS followed by welder during welding of test coupon **FC 1-1**

Base material(s) welded **P-1 TO P-1** Thickness **.375"**

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	WITH	WITH
ASME P-No. 1 to ASME P-No. (QW 403)	1	1 thru 11 & P-4X
☒ Plate ☐ Pipe (enter diameter, if pipe)	Plate	2-7/8" & over
Filler metal specification (SFA): 5.28 Classification (QW-404)	5.28	
Filler metal F-No.	6	6
Consumable insert for GTAW or PAW	n/a	n/a
Weld deposit thickness for each welding process	0.375"	.750"
Welding position (1G, 5G, etc.) (QW-405)	3G	F & V
Progression (uphill/downhill)	uphill	uphill
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	None	None
GMAW transfer mode (QW-409)	Spray Arc	Spray Arc
GTAW welding current type/polarity	n/a	n/a

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control		
Automatic voltage control (GTAW)		
Automatic joint tracking		
Welding position (1G, 5G, etc.)		
Consumable insert		
Backing (metal, weld metal, welded from both sides, flux, etc.)		

Guided Bend Test Results

Guided Bend Tests Type	☐ QW-462.2 (Side) Results	☐ QW-462.3(a) (Trans. R & F) Type	☐ QW-462.3(b) (Long. R & F) Results

Visual examination results (QW-302.4) **Acceptable**

Radiographic test results (QW-304 and QW-305) **Acceptable**

(For alternative qualification of groove welds by radiography)

Fillet Weld -- Fracture test ________ Length and percent of defects ________ in.

Macro test fusion ________ Fillet leg size ________ in. X ________ in. Concavity/convexity ________ in

Welding test conducted by **Pennsylvania Tank & Tube, Inc.**

Mechanical tests conducted by **Professional Quality Testing, Inc.** Laboratory test no. **1143**

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization **PENNSYLVANIA TANK & TUBE, INC.**

Date 7-9-94

By John

This form (E00008) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NH 07007-2300

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)
(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name **Jody Michael** Clock number **----** Stamp no. **J**
Welding process(es) used **GTAW** Type **Manual**
Identification of WPS followed by welder during welding of test coupon **GTSM 1-1**
Base material(s) welded **P-1 to P-1** Thickness **.218"**

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	WITHOUT	+ or -
ASME P-No. **1** to ASME P-No. (QW 403)	1	1 thru 11 & P-4X
( ) Plate (X) Pipe (enter diameter, if pipe)	2-3/8"	1" & over
Filler metal specification (SFA): **5.18** Classification (QW-404)	5.18	
Filler metal F-No.	6	6
Consumable insert for GTAW or PAW	none	without
Weld deposit thickness for each welding process	1/8"	1/4"
Welding position (1G, 5G, etc.) (QW-405)	6G	All
Progression (uphill/downhill)	uphill	uphill
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	Ar-100%	Ar-100%
GMAW transfer mode (QW-409)	n/a	n/a
GTAW welding current type/polarity	DC-SP	DC-SP

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control		
Automatic voltage control (GTAW)		
Automatic joint tracking		
Welding position (1G, 5G, etc.)		
Consumable insert		
Backing (metal, weld metal, welded from both sides, flux, etc.)		

Guided Bend Test Results

Guided Bend Tests Type	(X) QW-462.2 (Side) Results	( ) QW-462.3(a) (Trans. R & F) Type	( ) QW-462.3(b) (Long. R & F) Results
Side Bend 1	Acceptable		
Side Bend 2	Acceptable		

Visual examination results (QW-302.4) **Acceptable**
Radiographic test results (QW-304 and QW-305) **n/a**
(For alternative qualification of groove welds by radiography)
Fillet Weld – Fracture test ______ Length and percent of defects ______ in.
Macro test fusion ______ Fillet leg size ______ in. X ______ in. Concavity/convexity ______ in.
Welding test conducted by **Pennsylvania Tank & Tube, Inc.**
Mechanical tests conducted by **Professional Quality Testing, Inc.** Laboratory test no. **1141**

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization **PENNSYLVANIA TANK & TUBE, INC.**

Date 7-9-94 By John Townsend

This form (E00008) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NH 07007-2300

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name **Jody Michael** Clock number ---- Stamp no. J

Welding process(es) used **SMAW** Type **Manual**

Identification of WPS followed by welder during welding of test coupon **GTSM 1-1**

Base material(s) welded **P-1 to P-1** Thickness **0.218**

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	With	With
ASME P-No. 1 to ASME P-No. (QW 403)	1	1 thru 11 & P-4X
( ) Plate (X) Pipe (enter diameter, if pipe)	Plate	2-7/8" & over
Filler metal specification (SFA): 5.1 Classification (QW-404)	5.1	
Filler metal F-No.	4	1 thru 4
Consumable insert for GTAW or PAW	n/a	n/a
Weld deposit thickness for each welding process	.093"	0.186
Welding position (1G, 5G, etc.) (QW-405)	6G	All
Progression (uphill/downhill)	uphill	uphill
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	n/a	n/a
GMAW transfer mode (QW-409)	n/a	n/a
GTAW welding current type/polarity	n/a	n/a

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control		
Automatic voltage control (GTAW)		
Automatic joint tracking		
Welding position (1G, 5G, etc.)		
Consumable insert		
Backing (metal, weld metal, welded from both sides, flux, etc.)		

Guided Bend Test Results

Guided Bend Tests Type	(X) QW-462.2 (Side) Results	( ) QW-462.3(a) (Trans. R & F) Type	( ) QW-462.3(b) (Long. R & F) Results
Side Bend 1	Acceptable		
Side Bend 2	Acceptable		

Visual examination results (QW-302.4) **Acceptable**

Radiographic test results (QW-304 and QW-305) **n/a**

(For alternative qualification of groove welds by radiography)

Fillet Weld – Fracture test ______ Length and percent of defects ______ in.

Macro test fusion ______ Fillet leg size ______ in. X ______ in. Concavity/convexity ______ in.

Welding test conducted by **Pennsylvania Tank & Tube, Inc.**

Mechanical tests conducted by **Professional Quality Testing, Inc.** Laboratory test no. **1141**

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization **PENNSYLVANIA TANK & TUBE, INC.**

Date 7-9-94 By John Townsend

This form (E00008) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NH 07007-2300

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name Jody Michael Clock number ---- Stamp no. J
Welding process(es) used GTSM 1-8 Type Manual
Identification of WPS followed by welder during welding of test coupon GTSM 1-8
Base material(s) welded SA106B to SA106B Thickness .154"

Manual or Semiautomatic Variables for each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)	Weld Metal	With or Without
ASME P-No. 1 to ASME P-No. (QW 403)	P1	P1 thru P11 & P4X
( ) Plate (X) Pipe (enter diameter, if pipe)	2.375"	1" & over
Filler metal specification (SFA): 5.9 (GT) Classification (QW-404)	5.4 (SM)	
Filler metal F-No.	6 & 5	6 & 5
Consumable insert for GTAW or PAW	n/a	n/a
Weld deposit thickness for each welding process	.063(GT) .091(SM)	.125(GT) .182(SM)
Welding position (1G, 5G, etc.) (QW-405)	6G	All
Progression (uphill/downhill)	uphill	uphill
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408	argon	argon
GMAW transfer mode (QW-409)	n/a	n/a
GTAW welding current type/polarity	DC-Straight	DC-Straight

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control	n/a	n/a
Automatic voltage control (GTAW)	n/a	n/a
Automatic joint tracking	n/a	n/a
Welding position (1G, 5G, etc.)	n/a	n/a
Consumable insert	n/a	n/a
Backing (metal, weld metal, welded from both sides, flux, etc.)	n/a	n/a

Guided Bend Test Results

Guided Bend Tests Type	( ) QW-462.2 (Side) Results	( ) QW-462.3(a) (Trans. R & F) Type	( ) QW-462.3(b) (Long. R & F) Results
		Not Required for Performance	

Visual examination results (QW-302.4) Acceptable
Radiographic test results (QW-304 and QW-305) 0 & 90 Acceptable
(For alternative qualification of groove welds by radiography)
Fillet Weld — Fracture test - Length and percent of defects - in.
Macro test fusion - Fillet leg size - in. X - in. Concavity/convexity - in.
Welding test conducted by Pennsylvania Tank & Tube, Inc.
Mechanical tests conducted by Professional Quality Testing, Inc. Laboratory test no. PQT 1191

We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Organization PENNSYLVANIA TANK & TUBE, INC.

Date 6/29/94 By John Townsend

This form (E00006) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NH 07007-2300

Report Date: 4/ 7/9

Pennsylvania Tank & Tube, Inc.
P. O. Box 217, Saxonburg, Pa. 16056

CUSTOMER
Envirotrol Incorporated

PROJECT
Camp Lejeune, NC

VESSEL DESCRIPTION
(2) 10,000# Adsorber Vessels
Vessel Number: 0175-A & B
Drawing Number: 9416-301
ASME Code stamped: Yes
Vessel designed per the ASME Boiler & Pressure Vessel Code, Section VIII, Division 1. 1992 Edition, 1993 Addenda

JOB NUMBER
0175

NAMEPLATE INFORMATION
MAWP: 75.00 PSI at 150°F
MDMT: -20°F at 75.00 PSI

Serial Number(s): 0175-1 & 0175-2
National Board Number(s): 0054 & 0055

Year built: 1995
Radiography: RT 3
Postweld heat treated: No
Lethal service: No

Engineering Manager ______________ date: 4 / 7 /

Q.C. Manager John Townsend date: 4 / 7 / 9

Authorized Inspector ______________ date: 6 / 5 /

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Vessel Components **Page**

```
                        Pennsylvania Tank & Tube, Inc.
                                April 7, 1995

                        ASME Section VIII, Division 1
                          1992 Edition, 1993 addenda
                           Advanced Pressure Vessel
                                Version 5.42a                   Page  1 of 2

Job/Quote No : 0175             Customer: Envirotrol Incorporated
Shell Desc.   : 8' OD Adsorbers (2)
Designed: Mark W. Hadley                      Design Date: April 7, 1995
Checked :                                Approved:
                    External loads do not control design.

                     Cylindrical Shell - Internal Pressure
Design Pressure :   75.00 PSI                     Static Head:     4.00 PSI
Shell Material  : SA-516, Grade 70          Joint Efficiency:       85 Pct.
                                          Design Temperature:      150 °F
Matl stress(hot):   17500 PSI         Material stress (cold):    17500 PSI
Shell Length    :  68.000 In.          Corrosion Allowance :   0.0000 In.
Shell Area      :   142.4 Sq. Ft.         Outside diameter :  96.0000 In.
Shell Weight    :  1807.8 Lbs.
Specific Gravity:  1.0000                Shell Estimated Volume:   2103.3 Gal.
Weight of Fluid :   17571 Lbs.     Total Flooded Shell Weight:  19379.1 Lbs.
Actual Stress   :   14239 PSI      Actual Longitudinal Stress:     7073 PSI


Min. temp curve : B          Minimum Design Metal Temperature:      -20 °F
Pressure at MDMT:      75.00 PSI   Computed minimum temperature:      -50 °F
UCS-66(b) reduction:   Yes               UCS-68(c) reduction:      No

                 Longitudinal Stress Calculations - UG-27(c)(2):
t = PR /(2SE +0.4P) =79 * 47.6875 /(2 * 17500 * 0.85 + 0.4 * 79)
t =   0.1265 +0.0000 (corrosion)                          =  0.1265 In. min

                     Design Thickness per Appendix 1-1(a)(1)
                     Circumferential Stress Calculations:
t = PRo /(SE +0.4P) = 79 * 48.0000 / (17500 * 0.85 + 0.4 * 79)
t =   0.2544 +0.0000 (corrosion)                          =  0.2544 In. min

                 NOMINAL SHELL THICKNESS SELECTED = 0.3125 Inches
```

```
                              Nozzle in the shell

Job/Quote No : 0175                              Nozzle Number: F
Description  : Manway in shell                          Quantity:  1
Configuration: Nozzle passing thru the vessel, attached by a groove weld.
             : Nozzle does not pass thru a category A joint.
                   Required shell thickness per UG-37(a)
Shell material : SA-516, Grade 70                Material Stress:  17500
Shell wall, new: 0.3125                      Shell wall, corroded: 0.3125
tr = PRo / (SE + 0.4P)
tr =  79 * 48.0000 / (17500 * 1 + 0.4 *  79) = 0.2163


Nozzle Material: SA-106, Grade B, SMLS
Stress (hot)       :   15000 PSI                 Stress (cold):  15000 PSI
Nozzle pipe size   : 18 In                Nozzle pipe schedule: STD
Joint efficiency E1:    1.00        Nozzle corrosion allowance: 0.0000 In.
Nozzle ID, new     : 17.2500 In.               Nozzle wall, new: 0.3750 In.
Nozzle ID, corroded: 17.2500 In.          Nozzle wall, corroded: 0.3750 In.
OD, limit of reinf : 34.5000 In.            Correction factor F:   1.00
External projection:  6.0000 In.            Internal projection: 0.0000 In.
Outer "h" limit    :  0.7813 In.             Internal "h" limit: 0.7813 In.
Upper weld, weld 41:  0.2500 In.        Internal weld, weld 43: 0.0000 In.
Groove weld depth  :  0.3125 In.
Reinforcing Mat'l  : SA-516, Grade 70
Stress, Sp (hot)   :   17500 PSI        Reinf. plate thickness: 0.2500 In.
Stress, Sp (cold)  :   17500 PSI           Plate weld, weld 42: 0.1786 In.
O.D., Reinf. Mat'l : 25.0000 In.            RePad groove depth: 0.2500 In.

fr1= Sn/Sv = 15000 / 17500= 0.857      fr2= Sn/Sv = 15000 / 17500= 0.857
fr3= Sn/Sv = 15000 / 17500= 0.857      fr4= Sp/Sv = 17500 / 17500= 1.000
                           MDMT Calculations
Min. temp curve : B         Minimum Design Metal Temperature:    -20 °F
Pressure at MDMT:    75.0 PSI     Computed minimum temperature:   -125 °F
UCS-66(b) reduction: Yes                  UCS-68(c) reduction:    No

                            UG-45 Calculations
 The wall thickness shall not be less than the greater of the following:

     UG-45(a) - thickness for pressure loading plus corrosion.
t = (P Rn / (SE - 0.6 P)) + CA                 nozzle efficiency(E): 100 %
t = ( 79 * 8.6250 / (15000 * 1.00 - 0.6 *  79)) + 0.0000        = 0.0456 In

      UG-45(b) - the smaller of UG-45(b)(1) or UG-45(b)(4):

UG-45(b)(1) - the thickness (plus CA) required for internal pressure.
t = PRo / (SE + 0.4P) + corrosion
t =  79 * 48.0000 / (17500 * 1 + 0.4 *  79) + 0.0000           : 0.2163 In.



UG-45(b)(4) - minimum thickness of standard wall pipe plus CA   : 0.3281 In.
                                                      UG-45(b) = 0.2163 In
Wall thickness for pipe = tn * 0.875
Wall thickness of 0.3281 is greater than or equal to UG-45 value of 0.2163
```

```
Job/Quote No: 0175                                 Nozzle Number: F
           Required nozzle thickness per UG-37(a) - Internal Pressure
trn= PRn/SE - 0.6P =  79.00 * 8.6250 / 15000 *1.00 -0.6 *  79.00 = 0.0456 In
                         Area Required - Internal Pressure
A   = d tr F + 2tn tr F (1 - fr1)
A   = 17.2500 *0.2163 *1.00 + 2 *0.3750 *0.2163 *1.00(1-0.857) = 3.7544 Sq.In
                        Area Available - Internal Pressure
A1 = Larger value of the following :
   = d(E1 t - F tr) -2tn (E1 t - F tr)(1 - fr1)
   = 17.2500 (1.00 * 0.3125 - 1.00 * 0.2163) - 2 * 0.3750
       (1.00 * 0.3125 - 1.00 * 0.2163)(1 -0.857) = 1.6491
OR = 2(t + tn)(E1 t - F tr) -2tn (E1 t - F tr)(1 - fr1)
   = 2(0.3125 + 0.3750)(1.00 *0.3125 - 1.00 *0.2163)-2 *0.3750
     (1.00 * 0.3125 - 1.00 * 0.2163) (1 - 0.857) = 0.1220
                                                           A1 = 1.6491 Sq.In
A2 = Smaller value of the following :
   = 5 (tn - trn) fr2 * t
   = 5 (0.3750 - 0.0456) 0.857 * 0.3125              = 0.4411
OR = 2 (tn - trn) (2.5 * tn + te) fr2
   = 2(0.3750 - 0.0456)(2.5 * 0.3750 + 0.2500) 0.857 = 0.6705
                                                           A2 = 0.4411 Sq.In
A3 = 2(tn-c)fr2 *h = 2(0.3750 -0.0000) 0.857 *0.0000       A3 = 0.0000 Sq.In
A41= (leg)squared * fr3 = 0.2500 * 0.2500 * 0.857          A41= 0.0536 Sq.In
A42= (leg)squared * fr4 = 0.1786 * 0.1786 * 1.000          A42= 0.0319 Sq.In
A43= (leg)squared * fr2 = 0.0000 * 0.0000 * 0.857          A43= 0.0000 Sq.In
A5 = (Dp - d - 2tn) te * fr4
   = ( 25.0000 -   17.2500- 2 * 0.3750) 0.2500 * 1.000     A5 = 1.7500 Sq.In
 A1 +A2 +A3 +A41 +A42 +A43 +A5 = 3.9257 which is greater than A of  3.7544

                  OPENING IS ADEQUATELY REINFORCED WITH THE PAD.
```

Check the welds per UW-16

tmin, weld 41 = lesser of 0.75 or te or tn = 0.75 or 0.2500 or 0.3750 = **0.250**
Weld 41, leg min.=(lesser of 0.25 or (tmin * 0.7))/0.7 = 0.1750 / 0.7 = **0.250**
Weld 41, actual weld leg = **0.250**

tmin, weld 42 = lesser of 0.75 or t or te = 0.75 or 0.3125 or 0.2500 = **0.250**
Weld 42, leg min. = (0.5 * tmin) / 0.7 = (0.5 * 0.2500) / 0.7 = **0.178**
Weld 42, actual weld leg = **0.178**

Unit Stresses per UG-45(c) and UW-15

Nozzle wall in shear = 0.70 * 15000 = **10500** PSI
Upper fillet, weld 41, in shear = 0.49 * 15000 = **7350** PSI
Vessel groove weld in tension = 0.74 * 15000 = **11100** PSI

Outer fillet, weld 42, in shear = 0.49 * 17500 = **8575** PSI
Reinf. pad groove weld in tension = 0.74 * 15000 = **11100** PSI

Strength of connection elements

Nozzle wall in shear = Pi/2 * mean nozzle diameter * tn * 10500
= 1.57 * 17.6250 * 0.3750 * 10500 = **109000** Lbs.
Upper fillet in shear = Pi/2 * nozzle O.D. * weld leg * 7350
= 1.57 * 18.0000 * 0.2500 * 7350 = **51900** Lbs.
Groove weld tension = Pi/2 * nozzle O.D. * weld leg * 11100
= 1.57 * 18.0000 * 0.3125 * 11100 = **98000** Lbs.

Outer fillet in shear = Pi/2 * plate O.D. * weld leg * 8575
= 1.57 * 25.0000 * 0.1786 * 8575 = **60100** Lbs.
Repad groove weld = Pi/2 * nozzle O.D. * weld leg * 11100
= 1.57 * 18.0000 * 0.2500 * 11100 = **78400** Lbs.

Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)

W = [A -(d - 2tn)(E1t - Ftr)]s = [3.7544-(17.2500 -2 *0.3750)
(1.00 * 0.3125 - 1.00 * 0.2163)] * 17500 = **37900** Lbs.

W1-1 = (A2 + A5 + A41 + A42) * S
= (0.4411 + 1.7500 + 0.0536 + 0.0319) * 17500 = **39800** Lbs.

W2-2 = (A2 + A3 + A41 + A43 + 2tn *t *fr1) S = (0.4411 + 0.0000
+0.0536 +0.0000 +2 * 0.3750 * 0.3125 * 0.857) 17500 = **12200** Lbs.
W3-3 = (A2 +A3 +A5 +A41 +A42 +A43 + 2tn * t * fr1) S
(0.4411 + 0.0000 + 1.7500 +0.0536 +0.0319 +0.0000
+ 2 * 0.3750 * 0.3125 * 0.857) * 17500 = **43400** Lbs.

Check strength paths

Path 1-1 = 60100 + 109000 = **169100** Lbs.
Path 2-2 = 51900 + 78400 + 98000 = **228300** Lbs.
Path 3-3 = 60100 + 0 + 98000 = **158100** Lbs.

Plate strength = A5 * Sp = 1.7500 * 17500 = **30625** Lbs.
Outer fillet weld strength of 60100 is greater than plate strength.

```
                         Pennsylvania Tank & Tube, Inc.
                                April 7, 1995

                         ASME Section VIII, Division 1
                          1992 Edition, 1993 addenda
                           Advanced Pressure Vessel
                                Version 5.42a

Job/Quote No : 0175              Customer: Envirotrol Incorporated
Head Desc.   : 8' OD Adsorber top head
Designed: Mark W. Hadley                        Design Date: April 7, 1995
Checked :                               Approved:
                   External loads do not control design.

                   ASME F & D Head - Internal Pressure
Design Pressure :   75.00 PSI                       Static Head:    0.00 PSI
Head Material   : SA-516, Grade 70            Joint efficiency:     100 Pct.
                                            Design Temperature:     150 °F
Matl stress(hot):   17500 PSI           Material stress (cold):   17500 PSI
Actual Stress   :   16917 PSI             Corrosion Allowance:   0.0000 In.
Head Location   : Top                       Outside diameter :  96.0000 In.
Head Quantity   :       1
Total Head Area :    62.4 Sq. Ft.      Total Head Est. Volume:    391.4 Gal.
Total Head Wt.  :  1112.3 Lbs.              Weight of Fluid :     3265 Lbs.
Specific Gravity:  1.0000             Total Flooded Head Weight:  4376.9 Lbs.

Straight Flange :  2.0000 In.                      Thin Out :    0.0625 In.
Knuckle (r)     :  5.7600 In.              Crown Radius (Lo):   96.0000 In.
                                     M = 1/4 [3 + Sq Rt(L/r)]:   1.7683


Min. temp curve : B          Minimum Design Metal Temperature:      -20 °F
Pressure at MDMT:   75.00 PSI    Computed minimum temperature:      -23 °F
UCS-66(b) reduction:  Yes               UCS-68(c) reduction:      No

                 Design Thickness per APPENDIX 1-4(d)
t =  PLoM / (2 SE + P(M - 0.2))
t = 75 * 96.0000 * 1.7683 / (2 *17500 * 1.00 + 75 (1.7683 - 0.2))
t = 0.3626 +0.0000 (corrosion) +0.0625 (thin out) = 0.4251 In. min.

            NOMINAL HEAD THICKNESS SELECTED = 0.4375 Inches
```

Nozzle in an ASME head

Job/Quote No : 0175 Nozzle Number: **A**
Description : Inlet Quantity: 1
Configuration: Nozzle passing thru the vessel, attached by a groove weld.
: Nozzle does not pass thru a category A joint.

Required head thickness per UG-37(a)

Head material : SA-516, Grade 70 Material Stress: 17500
Head wall, nom.: 0.4375 Head wall, corroded and thinned: 0.3750
tr = P Lo M / (2 SE + P(M - 0.2))
tr = 75 *96.0000 *1.0000/(2 *17500*1 + 75(1.0000-0.2))= 0.2054

Flange Class:**150** Material Gr.: **1.1** Maximum Pressure: **273**
Nozzle Material: **SA-312, Type TP304L, WLD** Condition: **S30403, HIGH**
Stress (hot) : **14100** PSI Stress (cold): **14200** PSI
Nozzle pipe size : **4 In** Nozzle pipe schedule: **40**
Joint efficiency E1: **1.00** Nozzle corrosion allowance: **0.0000** In.
Nozzle ID, new : **4.0260** In. Nozzle wall, new: **0.2370** In.
Nozzle ID, corroded: **4.0260** In. Nozzle wall, corroded: **0.2370** In.
OD, limit of reinf : **8.0520** In. Correction factor F: **1.00**
External projection: **6.0000** In. Internal projection: **0.5925** In.
Outer "h" limit : **0.5925** In. Internal "h" limit: **0.5925** In.
Upper weld, weld 41: **0.2370** In. Internal weld, weld 43: **0.2370** In.
Groove weld depth : **0.4375** In.

fr1= Sn/Sv = 14100 / 17500= 0.806 fr2= Sn/Sv = 14100 / 17500= 0.806
fr3= Sn/Sv = 14100 / 17500= 0.806
Material is not required to have minimum temperature calculations
Minimum Design Metal Temperature: **-20** °F

UG-45 Calculations

The wall thickness shall not be less than the greater of the following:

UG-45(a) - thickness for pressure loading plus corrosion.

t = (P Rn / (SE - 0.6 P)) + CA nozzle efficiency(E): 100 %
t = (75 * 2.0130 / (14100 * 1.00 - 0.6 * 75)) + 0.0000 = **0.0107** In

UG-45(b) - the smaller of UG-45(b)(1) or UG-45(b)(4):

UG-45(b)(1) - the thickness (plus CA) required for internal pressure.
t = P Lo M / (2 SE + P(M - 0.2)) + corrosion
t = 75*96.0000*1.7683/(2*17500*1+75(1.7683-0.2))+0.0000 : **0.3625** In

UG-45(b)(4) - minimum thickness of standard wall pipe plus CA : **0.2074** In
UG-45(b) = **0.2074** I

Wall thickness for pipe = tn * 0.875
Wall thickness of **0.2074** is greater than or equal to UG-45 value of **0.2074**

```
Job/Quote No: 0175                                     Nozzle Number: A
          Required nozzle thickness per UG-37(a) - Internal Pressure
trn= PRn/SE - 0.6P =  75.00 * 2.0130 / 14100 *1.00 -0.6 *  75.00 = 0.0107 In.
                          Area Required - Internal Pressure
A   = d tr F + 2tn tr F (1 - fr1)
A   = 4.0260 *0.2054 *1.00 + 2 *0.2370 *0.2054 *1.00(1-0.806)   = 0.8458 Sq.In.
                         Area Available - Internal Pressure
A1 = Larger value of the following :
   = d(E1 t - F tr) -2tn (E1 t - F tr)(1 - fr1)
   =  4.0260 (1.00 * 0.3750 - 1.00 * 0.2054) - 2 * 0.2370
       (1.00 * 0.3750 - 1.00 * 0.2054)(1 -0.806) = 0.6672
OR = 2(t + tn)(E1 t - F tr) -2tn (E1 t - F tr)(1 - fr1)
   = 2(0.3750 + 0.2370)(1.00 *0.3750 - 1.00 *0.2054)-2 *0.2370
     (1.00 * 0.3750 - 1.00 * 0.2054) (1 - 0.806) = 0.1920
                                                          A1 = 0.6672 Sq.In.
A2 = Smaller value of the following :
   = 5 (tn - trn) fr2 * t
   = 5 (0.2370 - 0.0107) 0.806 * 0.3750                 = 0.3420
OR = 5 (tn - trn) fr2 * tn
   = 5 (0.2370 - 0.0107) 0.806 * 0.2370                 = 0.2161
                                                          A2 = 0.2161 Sq.In
A3 = 2(tn-c)fr2 *h = 2(0.2370 -0.0000) 0.806 *0.5925      A3 = 0.2264 Sq.In
A41= (leg)squared * fr2 = 0.2370 * 0.2370 * 0.806         A41= 0.0453 Sq.In

A43= (leg)squared * fr2 = 0.2370 * 0.2370 * 0.806         A43= 0.0453 Sq.In


    A1 + A2 + A3 + A41 + A43  = 1.2003 which is greater than A of  0.8458

            OPENING IS ADEQUATELY REINFORCED - NO PAD REQUIRED.
```

Check the welds per UW-16

```
tmin, weld 41 = lesser of 0.75 or t  or tn = 0.75 or 0.3750 or 0.2370 = 0.237
Weld 41, leg min.=(lesser of 0.25 or (tmin * 0.7))/0.7 = 0.1659 / 0.7 = 0.237
                                        Weld 41, actual weld leg = 0.237
```

```
tmin, weld 43 = lesser of 0.75 or t  or tn = 0.75 or 0.3750 or 0.2370 = 0.237
Weld 43, leg min.=(lesser of 0.25 or (tmin * 0.7))/0.7 = 0.1659 / 0.7 = 0.237
                                        Weld 43, actual weld leg = 0.237
```

Unit Stresses per UG-45(c) and UW-15

```
Nozzle wall in shear              = 0.70 *  14100          =    9870 PSI
Upper fillet, weld 41, in shear   = 0.49 *  14100          =    6909 PSI
Vessel groove weld in tension     = 0.74 *  14100          =   10434 PSI
Inner fillet, weld 43, in shear   = 0.49 *  14100          =    6909 PSI
```

Strength of connection elements

```
Nozzle wall in shear  = Pi/2 * mean nozzle diameter * tn *   9870
                      = 1.57 *  4.2630 * 0.2370 *   9870   =   15700 Lbs.
Upper fillet in shear = Pi/2 * nozzle O.D. * weld leg *   6909
                      = 1.57 *  4.5000 * 0.2370 *   6909   =   11600 Lbs.
Groove weld tension   = Pi/2 * nozzle O.D. * weld leg *  10434
                      = 1.57 *  4.5000 * 0.4375 *  10434   =   32300 Lbs.
Inner fillet in shear = Pi/2 * nozzle O.D. * weld leg *   6909
                      = 1.57 *  4.5000 * 0.2370 *   6909   =   11600 Lbs.
```

Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)

```
W    = [A -(d - 2tn)(E1t - Ftr)]s = [ 0.8458-( 4.0260 -2 *0.2370)
       (1.00 * 0.3750 - 1.00 * 0.2054)] *  17500           =    4300 Lbs.

W1-1 = (A2 + A5 + A41 + A42) * S
     = ( 0.2161 +  0.0000 + 0.0453 + 0.0000) *  17500      =    4600 Lbs.


W2-2 = (A2 + A3 + A41 + A43 + 2tn *t *fr1) S = ( 0.2161 +  0.2264
        +0.0453 +0.0453 +2 * 0.2370 * 0.3750 * 0.806)  17500 =  11800 Lbs.
W3-3 = (A2 +A3 +A5 +A41 +A42 +A43 + 2tn * t * fr1) S
       ( 0.2161 + 0.2264 + 0.0000 +0.0453 +0.0000 +0.0453
        + 2 * 0.2370 * 0.3750 * 0.806) *  17500            =   11800 Lbs.
```

Check strength paths

```
Path 1-1 =    11600 +    15700                             =   27300 Lbs.
Path 2-2 =    11600 +    32300 +    11600                  =   55500 Lbs.
Path 3-3 =    11600 +    11600 +    32300                  =   55500 Lbs.
```

Nozzle in an ASME head

```
Job/Quote No : 0175                                  Nozzle Number: C & D
Description  : Vent, Carbon Inlet                          Quantity:  1
Configuration: Nozzle passing thru the vessel, attached by a groove weld.
             : Nozzle does not pass thru a category A joint.
                    Required head thickness per UG-37(a)
Head material   : SA-516, Grade 70                 Material Stress:  17500
Head wall, nom.: 0.4375         Head wall, corroded and thinned: 0.3750
tr = P Lo M / (2 SE + P(M - 0.2))
tr = 75 *96.0000 *1.0000/(2 *17500*1 + 75(1.0000-0.2))= 0.2054

Flange Class:150    Material Gr.: 1.1         Maximum Pressure:    273
Nozzle Material: SA-106, Grade B, SMLS
Stress (hot)      :   15000 PSI                 Stress (cold):  15000 PSI
Nozzle pipe size   : 4 In                 Nozzle pipe schedule: 40
Joint efficiency E1:     1.00        Nozzle corrosion allowance: 0.0000 In.
Nozzle ID, new     :  4.0260 In.             Nozzle wall, new: 0.2370 In.
Nozzle ID, corroded:  4.0260 In.        Nozzle wall, corroded: 0.2370 In.
OD, limit of reinf :  8.0520 In.          Correction factor F:   1.00
External projection:  6.0000 In.          Internal projection: 0.0000 In.
Outer "h" limit    :  0.5925 In.           Internal "h" limit: 0.5925 In.
Upper weld, weld 41:  0.2370 In.       Internal weld, weld 43: 0.0000 In.
Groove weld depth  :  0.4375 In.



fr1= Sn/Sv = 15000 / 17500= 0.857        fr2= Sn/Sv = 15000 / 17500= 0.857
fr3= Sn/Sv = 15000 / 17500= 0.857
                            MDMT Calculations
Min. temp curve : B          Minimum Design Metal Temperature:    -20 °F
Pressure at MDMT:     75.0 PSI      Computed minimum temperature:   -125 °F
UCS-66(b) reduction: Yes                       UCS-68(c) reduction:    No

                             UG-45 Calculations
 The wall thickness shall not be less than the greater of the following:

        UG-45(a) - thickness for pressure loading plus corrosion.
t = (P Rn / (SE - 0.6 P)) + CA                  nozzle efficiency(E): 100 %
t = ( 75 * 2.0130 / (15000 * 1.00 - 0.6 *  75)) + 0.0000          = 0.0101 In

          UG-45(b) - the smaller of UG-45(b)(1) or UG-45(b)(4):

UG-45(b)(1) - the thickness (plus CA) required for internal pressure.
t = P Lo M / (2 SE + P(M - 0.2)) + corrosion
t = 75*96.0000*1.7683/(2*17500*1+75(1.7683-0.2))+0.0000         : 0.3625 In


UG-45(b)(4) - minimum thickness of standard wall pipe plus CA    : 0.2074 In
                                                     UG-45(b) = 0.2074 I
Wall thickness for pipe = tn * 0.875
Wall thickness of 0.2074 is greater than or equal to UG-45 value of 0.2074
```

```
         Required nozzle thickness per UG-37(a) - Internal Pressure
trn= PRn/SE - 0.6P =  75.00 * 2.0130 / 15000 *1.00 -0.6 *  75.00 = 0.0101 In
                   Area Required - Internal Pressure
A   = d tr F + 2tn tr F (1 - fr1)
A   = 4.0260 *0.2054 *1.00 + 2 *0.2370 *0.2054 *1.00(1-0.857)  = 0.8409 Sq.In
                   Area Available - Internal Pressure
A1  = Larger value of the following :
    = d(E1 t - F tr) -2tn (E1 t - F tr)(1 - fr1)
    =  4.0260 (1.00 * 0.3750 - 1.00 * 0.2054) - 2 * 0.2370
        (1.00 * 0.3750 - 1.00 * 0.2054)(1 -0.857) = 0.6713
OR  = 2(t + tn)(E1 t - F tr) -2tn (E1 t - F tr)(1 - fr1)
    = 2(0.3750 + 0.2370)(1.00 *0.3750 - 1.00 *0.2054)-2 *0.2370
      (1.00 * 0.3750 - 1.00 * 0.2054) (1 - 0.857) = 0.1961
                                                          A1  = 0.6713 Sq.In
A2  = Smaller value of the following :
    = 5 (tn - trn) fr2 * t
    = 5 (0.2370 - 0.0101) 0.857 * 0.3750               = 0.3646
OR  = 5 (tn - trn) fr2 * tn
    = 5 (0.2370 - 0.0101) 0.857 * 0.2370               = 0.2304
                                                          A2  = 0.2304 Sq.In
A3  = 2(tn-c)fr2 *h = 2(0.2370 -0.0000) 0.857 *0.0000     A3  = 0.0000 Sq.In
A41= (leg)squared * fr2 = 0.2370 * 0.2370 * 0.857         A41= 0.0481 Sq.In

A43= (leg)squared * fr2 = 0.0000 * 0.0000 * 0.857         A43= 0.0000 Sq.In


     A1 + A2 + A3 + A41 + A43   = 0.9498 which is greater than A of  0.8409

               OPENING IS ADEQUATELY REINFORCED - NO PAD REQUIRED.
```

Check the welds per UW-16

```
tmin, weld 41 = lesser of 0.75 or t  or tn = 0.75 or 0.3750 or 0.2370 = 0.237
Weld 41, leg min.=(lesser of 0.25 or (tmin * 0.7))/0.7 = 0.1659 / 0.7 = 0.237
                                     Weld 41, actual weld leg = 0.237
```

Unit Stresses per UG-45(c) and UW-15

```
Nozzle wall in shear              = 0.70 *  15000          =    10500 PSI
Upper fillet, weld 41, in shear   = 0.49 *  15000          =     7350 PSI
Vessel groove weld in tension     = 0.74 *  15000          =    11100 PSI
```

Strength of connection elements

```
Nozzle wall in shear   = Pi/2 * mean nozzle diameter * tn *  10500
                       = 1.57 *  4.2630 * 0.2370 *  10500      =    16700 Lbs.
Upper fillet in shear  = Pi/2 * nozzle O.D. * weld leg *   7350
                       = 1.57 *  4.5000 * 0.2370 *   7350      =    12300 Lbs.
Groove weld tension    = Pi/2 * nozzle O.D. * weld leg *  11100
                       = 1.57 *  4.5000 * 0.3750 *  11100      =    29400 Lbs.
```

Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)

```
W     = [A -(d - 2tn)(E1t - Ftr)]s = [ 0.8409-( 4.0260 -2 *0.2370)
        (1.00 * 0.3750 - 1.00 * 0.2054)] *  17500              =     4200 Lbs.

W1-1 = (A2 + A5 + A41 + A42) * S
     = ( 0.2304 +  0.0000 + 0.0481 + 0.0000) *  17500          =     4900 Lbs.


W2-2 = (A2 + A3 + A41 + A43 + 2tn *t *fr1) S = ( 0.2304 +  0.0000
        +0.0481 +0.0000 +2 * 0.2370 * 0.3750 * 0.857)  17500 =     7500 Lbs.
W3-3 = (A2 +A3 +A5 +A41 +A42 +A43 + 2tn * t * fr1) S
       ( 0.2304 + 0.0000 + 0.0000 +0.0481 +0.0000 +0.0000
        + 2 * 0.2370 * 0.3750 * 0.857) *  17500                =     7500 Lbs.
```

Check strength paths

```
Path 1-1 =    12300 +    16700                                 =    29000 Lbs.
Path 2-2 =    12300 +    29400                                 =    41700 Lbs.
Path 3-3 =    12300 +        0 +    29400                      =    41700 Lbs.
```

```
Job/Quote No : 0175                                   Nozzle Number: G
Description  : Handhole with hinge                         Quantity:   1
Configuration: Nozzle passing thru the vessel, attached by a groove weld.
             : Nozzle does not pass thru a category A joint.
                 Required head thickness per UG-37(a)
Head material   : SA-516, Grade 70                   Material Stress:  17500
Head wall, nom.: 0.4375          Head wall, corroded and thinned: 0.3750
tr = P Lo M / (2 SE + P(M - 0.2))
tr = 75 *96.0000 *1.0000/(2 *17500*1 + 75(1.0000-0.2))= 0.2054


Nozzle Material: SA-106, Grade B, SMLS
Stress (hot)        :   15000 PSI                   Stress (cold):  15000 PSI
Nozzle pipe size    : 6 In                    Nozzle pipe schedule: 40
Joint efficiency E1:    1.00             Nozzle corrosion allowance: 0.0000 In.
Nozzle ID, new      :  6.0650 In.                 Nozzle wall, new: 0.2800 In.
Nozzle ID, corroded:   6.0650 In.            Nozzle wall, corroded: 0.2800 In.
OD, limit of reinf :  12.1300 In.              Correction factor F:   1.00
External projection:   6.0000 In.              Internal projection: 0.0000 In.
Outer "h" limit     :  0.7000 In.               Internal "h" limit: 0.7000 In.
Upper weld, weld 41:   0.2800 In.          Internal weld, weld 43: 0.0000 In.
Groove weld depth   :  0.4375 In.



fr1= Sn/Sv = 15000 / 17500= 0.857         fr2= Sn/Sv = 15000 / 17500= 0.857
fr3= Sn/Sv = 15000 / 17500= 0.857
                         MDMT Calculations
Min. temp curve : B           Minimum Design Metal Temperature:     -20 °F
Pressure at MDMT:      75.0 PSI     Computed minimum temperature:   -125 °F
UCS-66(b) reduction: Yes                     UCS-68(c) reduction:     No

                          UG-45 Calculations
 The wall thickness shall not be less than the greater of the following:

      UG-45(a) - thickness for pressure loading plus corrosion.
t = (P Rn / (SE - 0.6 P)) + CA                  nozzle efficiency(E): 100 %
t = ( 75 * 3.0325 / (15000 * 1.00 - 0.6 *  75)) + 0.0000           = 0.0152 In

        UG-45(b) - the smaller of UG-45(b)(1) or UG-45(b)(4):

UG-45(b)(1) - the thickness (plus CA) required for internal pressure.
t = P Lo M / (2 SE + P(M - 0.2)) + corrosion
t = 75*96.0000*1.7683/(2*17500*1+75(1.7683-0.2))+0.0000          : 0.3625 In.



UG-45(b)(4) - minimum thickness of standard wall pipe plus CA   : 0.2450 In.
                                                    UG-45(b) = 0.2450 In
Wall thickness for pipe = tn * 0.875
Wall thickness of 0.2450 is greater than or equal to UG-45 value of 0.2450
```

```
Job/Quote No: 0175                                  Nozzle Number: G
          Required nozzle thickness per UG-37(a) - Internal Pressure
trn= PRn/SE - 0.6P =  75.00 * 3.0325 / 15000 *1.00 -0.6 *  75.00 = 0.0152 In
                      Area Required - Internal Pressure
A  = d tr F + 2tn tr F (1 - fr1)
A  = 6.0650 *0.2054 *1.00 + 2 *0.2800 *0.2054 *1.00(1-0.857)  = 1.2622 Sq.In
                     Area Available - Internal Pressure
A1 = Larger value of the following :
   = d(E1 t - F tr) -2tn (E1 t - F tr)(1 - fr1)
   =  6.0650 (1.00 * 0.3750 - 1.00 * 0.2054) - 2 * 0.2800
       (1.00 * 0.3750 - 1.00 * 0.2054)(1 -0.857) = 1.0150
OR = 2(t + tn)(E1 t - F tr) -2tn (E1 t - F tr)(1 - fr1)
   = 2(0.3750 + 0.2800)(1.00 *0.3750 - 1.00 *0.2054)-2 *0.2800
     (1.00 * 0.3750 - 1.00 * 0.2054) (1 - 0.857) = 0.2086
                                                       A1 = 1.0150 Sq.In
A2 = Smaller value of the following :
   = 5 (tn - trn) fr2 * t
   = 5 (0.2800 - 0.0152) 0.857 * 0.3750            = 0.4255
OR = 5 (tn - trn) fr2 * tn
   = 5 (0.2800 - 0.0152) 0.857 * 0.2800            = 0.3177
                                                       A2 = 0.3177 Sq.In
A3 = 2(tn-c)fr2 *h = 2(0.2800 -0.0000) 0.857 *0.0000   A3 = 0.0000 Sq.In
A41= (leg)squared * fr2 = 0.2800 * 0.2800 * 0.857      A41= 0.0672 Sq.In

A43= (leg)squared * fr2 = 0.0000 * 0.0000 * 0.857      A43= 0.0000 Sq.In


    A1 + A2 + A3 + A41 + A43  = 1.3999 which is greater than A of  1.2622

           OPENING IS ADEQUATELY REINFORCED - NO PAD REQUIRED.
```

```
                    Check the welds per UW-16
tmin, weld 41 = lesser of 0.75 or t  or tn = 0.75 or 0.3750 or 0.2800 = 0.280
Weld 41, leg min.=(lesser of 0.25 or (tmin * 0.7))/0.7 = 0.1960 / 0.7 = 0.280
                                        Weld 41, actual weld leg = 0.280



                 Unit Stresses per UG-45(c) and UW-15
Nozzle wall in shear           = 0.70 *  15000            =   10500 PSI
Upper fillet, weld 41, in shear = 0.49 *  15000            =    7350 PSI
Vessel groove weld in tension  = 0.74 *  15000            =   11100 PSI


                  Strength of connection elements
Nozzle wall in shear  = Pi/2 * mean nozzle diameter * tn *  10500
                      = 1.57 *  6.3450 * 0.2800 *  10500     =   29300 Lbs.
Upper fillet in shear = Pi/2 * nozzle O.D. * weld leg *   7350
                      = 1.57 *  6.6250 * 0.2800 *   7350     =   21400 Lbs.
Groove weld tension   = Pi/2 * nozzle O.D. * weld leg *  11100
                      = 1.57 *  6.6250 * 0.3750 *  11100     =   43300 Lbs.



 Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)
W     = [A -(d - 2tn)(Elt - Ftr)]s = [ 1.2622-( 6.0650 -2 *0.2800)
        (1.00 * 0.3750 - 1.00 * 0.2054)] *  17500            =    5700 Lbs.

W1-1 = (A2 + A5 + A41 + A42)  * S
     = ( 0.3177 +  0.0000 + 0.0672 + 0.0000) *  17500         =    6700 Lbs.


W2-2 = (A2 + A3 + A41 + A43 + 2tn *t *fr1) S = ( 0.3177 +  0.0000
        +0.0672 +0.0000 +2 * 0.2800 * 0.3750 * 0.857)  17500 =    9900 Lbs.
W3-3 = (A2 +A3 +A5 +A41 +A42 +A43 + 2tn * t * fr1) S
       ( 0.3177 + 0.0000 + 0.0000 +0.0672 +0.0000 +0.0000
        + 2 * 0.2800 * 0.3750 * 0.857) *  17500              =    9900 Lbs.

                      Check strength paths
Path 1-1 =    21400 +   29300                                =   50700 Lbs.
Path 2-2 =    21400 +   43300                                =   64700 Lbs.
Path 3-3 =    21400 +       0 +   43300                      =   64700 Lbs.
```

```
                  Pennsylvania Tank & Tube, Inc.
                          April 7, 1995

                  ASME Section VIII, Division 1
                    1992 Edition, 1993 addenda
                     Advanced Pressure Vessel
                          Version 5.42a                     Page 15 of 2

Job/Quote No : 0175              Customer: Envirotrol Incorporated
Head Desc.    : 8' OD Adsorbers-Bottom Hd.
Designed: Mark W. Hadley                      Design Date: April 7, 1995
Checked :                            Approved:
                   External loads do not control design.

                  Ellipsoidal Head - Internal Pressure
Design Pressure :   75.00 PSI                      Static Head:     4.00 PSI
Head Material    : SA-516, Grade 70            Joint efficiency:     100 Pct.
                                             Design Temperature:     150 °F
Matl stress(hot):   17500 PSI           Material stress (cold):    17500 PSI
Actual Stress    :   15097 PSI             Corrosion Allowance:   0.0000 In.
Head Location    : Bottom                    Outside diameter :  96.0000 In.
Head Quantity    :        1
Total Head Area :    73.5 Sq. Ft.       Total Head Est. Volume:    553.5 Gal.
Total Head Wt.   :   935.8 Lbs.               Weight of Fluid :     4617 Lbs.
Specific Gravity:  1.0000            Total Flooded Head Weight:   5552.3 Lbs.

Straight Flange :  2.0000 In.                        Thin Out :   0.0625 In.

Head Depth (ho) : 24.1563 In.        K = 1/6 [2 + Sq (D/2h)]:     1.00


Min. temp curve : B        Minimum Design Metal Temperature:      -20 °F
Pressure at MDMT:   75.00 PSI   Computed minimum temperature:      -38 °F
UCS-66(b) reduction:  Yes                 UCS-68(c) reduction:     No

                 Design Thickness per APPENDIX 1-4(c)
t =  PDoK / (2 SE + 2 P(K - 0.1))
t = 79 * 96.0000 * 1.00 / (2 *17500 * 1.00 + 2 * 79 (1.00 - 0.1))
t = 0.2158 +0.0000 (corrosion) +0.0625 (thin out) = 0.2783 In. min.


           NOMINAL HEAD THICKNESS SELECTED = 0.3125 Inches
```

Nozzle in an ellipsoidal head

```
Job/Quote No  : 0175                                   Nozzle Number: B
Description   : Outlet                                     Quantity:   1
Configuration: Nozzle passing thru the vessel, attached by a groove weld.
             : Nozzle does not pass thru a category A joint.
                      Required head thickness per UG-37(a)
Head material   : SA-516, Grade 70                Material Stress:  17500
Head wall, nom.: 0.3125          Head wall, corroded and thinned: 0.2500
tr = P K1 Do / (2 SE + 0.8 P)
tr =79 *0.90 *96.0000/(2 *17500 *1 + 0.8 *79)= 0.1947

Flange Class:150    Material Gr.: 1.1           Maximum Pressure:    273
Nozzle Material: SA-312, Type TP304L, WLD          Condition: S30403, HIGH
Stress (hot)        :    14100 PSI                Stress (cold):  14200 PSI
Nozzle pipe size    : 4 In                   Nozzle pipe schedule: 40
Joint efficiency E1:      1.00         Nozzle corrosion allowance: 0.0000 In.
Nozzle ID, new      :   4.0260 In.                Nozzle wall, new: 0.2370 In.
Nozzle ID, corroded:    4.0260 In.           Nozzle wall, corroded: 0.2370 In.
OD, limit of reinf :    8.0520 In.             Correction factor F:   1.00
External projection:    6.0000 In.             Internal projection: 0.5925 In.
Outer "h" limit     :   0.5925 In.              Internal "h" limit: 0.5925 In.
Upper weld, weld 41:    0.3750 In.         Internal weld, weld 43: 0.2500 In.
Groove weld depth   :   0.3125 In.




fr1= Sn/Sv = 14100 / 17500= 0.806         fr2= Sn/Sv = 14100 / 17500= 0.806
fr3= Sn/Sv = 14100 / 17500= 0.806
Material is not required to have minimum temperature calculations
                              Minimum Design Metal Temperature:    -20 °F


                          UG-45 Calculations
 The wall thickness shall not be less than the greater of the following:

      UG-45(a) - thickness for pressure loading plus corrosion.
t = (P Rn / (SE - 0.6 P)) + CA                   nozzle efficiency(E): 100 %
t = ( 79 * 2.0130 / (14100 * 1.00 - 0.6 *  79)) + 0.0000            = 0.0113 I

       UG-45(b) - the smaller of UG-45(b)(1) or UG-45(b)(4):

UG-45(b)(1) - the thickness (plus CA) required for internal pressure.
t = P K Do / (2 SE + 2P (K - 0.1)) + corrosion
t =79*1.00*96.0000/(2*17500*1+2*79(1.00-0.1))+0.0000                : 0.2158 In


UG-45(b)(4) - minimum thickness of standard wall pipe plus CA     : 0.2074 In
                                                       UG-45(b) = 0.2074 I
Wall thickness for pipe = tn * 0.875
Wall thickness of 0.2074 is greater than or equal to UG-45 value of 0.2074
```

```
            Required nozzle thickness per UG-37(a) - Internal Pressure
trn= PRn/SE - 0.6P =  79.00 * 2.0130 / 14100 *1.00 -0.6 *  79.00 = 0.0113 In.
                         Area Required - Internal Pressure
A   = d tr F + 2tn tr F (1 - fr1)
A   = 4.0260 *0.1947 *1.00 + 2 *0.2370 *0.1947 *1.00(1-0.806)   = 0.8018 Sq.In
                        Area Available - Internal Pressure
A1  = Larger value of the following :
    = d(E1 t - F tr) -2tn (E1 t - F tr)(1 - fr1)
    =  4.0260 (1.00 * 0.2500 - 1.00 * 0.1947) - 2 * 0.2370
        (1.00 * 0.2500 - 1.00 * 0.1947)(1 -0.806) = 0.2176
OR  = 2(t + tn)(E1 t - F tr) -2tn (E1 t - F tr)(1 - fr1)
    = 2(0.2500 + 0.2370)(1.00 *0.2500 - 1.00 *0.1947)-2 *0.2370
      (1.00 * 0.2500 - 1.00 * 0.1947) (1 - 0.806) = 0.0488
                                                           A1 = 0.2176 Sq.In
A2  = Smaller value of the following :
    = 5 (tn - trn) fr2 * t
    = 5 (0.2370 - 0.0113) 0.806 * 0.2500                = 0.2274
OR  = 5 (tn - trn) fr2 * tn
    = 5 (0.2370 - 0.0113) 0.806 * 0.2370                = 0.2156
                                                           A2  = 0.2156 Sq.In
A3  = 2(tn-c)fr2 *h = 2(0.2370 -0.0000) 0.806 *0.5925      A3  = 0.2264 Sq.In
A41= (leg)squared * fr2 = 0.3750 * 0.3750 * 0.806          A41= 0.1133 Sq.In

A43= (leg)squared * fr2 = 0.2500 * 0.2500 * 0.806          A43= 0.0504 Sq.In


    A1 + A2 + A3 + A41 + A43   = 0.8233 which is greater than A of  0.8018

              OPENING IS ADEQUATELY REINFORCED - NO PAD REQUIRED.
```

Check the welds per UW-16

```
tmin, weld 41 = lesser of 0.75 or t  or tn = 0.75 or 0.2500 or 0.2370 = 0.237
Weld 41, leg min.=(lesser of 0.25 or (tmin * 0.7))/0.7 = 0.1659 / 0.7 = 0.237
                                         Weld 41, actual weld leg = 0.375
```

```
tmin, weld 43 = lesser of 0.75 or t  or tn = 0.75 or 0.2500 or 0.2370 = 0.237
Weld 43, leg min.=(lesser of 0.25 or (tmin * 0.7))/0.7 = 0.1659 / 0.7 = 0.237
                                         Weld 43, actual weld leg = 0.250
```

Unit Stresses per UG-45(c) and UW-15

```
Nozzle wall in shear               = 0.70 *  14100            =     9870 PSI
Upper fillet, weld 41, in shear    = 0.49 *  14100            =     6909 PSI
Vessel groove weld in tension      = 0.74 *  14100            =    10434 PSI
Inner fillet, weld 43, in shear    = 0.49 *  14100            =     6909 PSI
```

Strength of connection elements

```
Nozzle wall in shear   = Pi/2 * mean nozzle diameter * tn *   9870
                       = 1.57 *  4.2630 * 0.2370 *    9870     =    15700 Lbs.
Upper fillet in shear  = Pi/2 * nozzle O.D. * weld leg *   6909
                       = 1.57 *  4.5000 * 0.3750 *    6909     =    18300 Lbs.
Groove weld tension    = Pi/2 * nozzle O.D. * weld leg *  10434
                       = 1.57 *  4.5000 * 0.3125 *   10434     =    23000 Lbs.
Inner fillet in shear  = Pi/2 * nozzle O.D. * weld leg *   6909
                       = 1.57 *  4.5000 * 0.2500 *    6909     =    12200 Lbs.
```

Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)

```
W    = [A -(d - 2tn)(E1t - Ftr)]s = [ 0.8018-( 4.0260 -2 *0.2370)
       (1.00 * 0.2500 - 1.00 * 0.1947)] *  17500              =    10600 Lbs.

W1-1 = (A2 + A5 + A41 + A42) * S
     = ( 0.2156 +  0.0000 + 0.1133 + 0.0000) *  17500         =     5800 Lbs.


W2-2 = (A2 + A3 + A41 + A43 + 2tn *t *fr1) S = ( 0.2156 +  0.2264
        +0.1133 +0.0504 +2 * 0.2370 * 0.2500 * 0.806)  17500 =    12300 Lbs.
W3-3 = (A2 +A3 +A5 +A41 +A42 +A43 + 2tn * t * fr1) S
       ( 0.2156 + 0.2264 + 0.0000 +0.1133 +0.0000 +0.0504
        + 2 * 0.2370 * 0.2500 * 0.806) *  17500               =    12300 Lbs.
```

Check strength paths

```
Path 1-1 =    18300 +    15700                                 =    34000 Lbs.
Path 2-2 =    18300 +    23000 +    12200                      =    53500 Lbs.
Path 3-3 =    18300 +    12200 +    23000                      =    53500 Lbs.
```

Nozzle in an ellipsoidal head

```
Job/Quote No  : 0175                                      Nozzle Number: E
Description   : Carbon Outlet                                  Quantity:  1
Configuration: Nozzle passing thru the vessel, attached by a groove weld.
              : Nozzle does not pass thru a category A joint.
                Required head thickness per UG-37(a)
Head material   : SA-516, Grade 70                      Material Stress:  17500
Head wall, nom.: 0.3125          Head wall, corroded and thinned: 0.2500
tr = P K1 Do / (2 SE + 0.8 P)
tr =79 *0.90 *96.0000/(2 *17500 *1 + 0.8 *79)= 0.1947

Flange Class:150    Material Gr.: 1.1          Maximum Pressure:     273
Nozzle Material: SA-106, Grade B, SMLS
Stress (hot)        :    15000 PSI                   Stress (cold):  15000 PSI
Nozzle pipe size    : 4 In                  Nozzle pipe schedule: STD
Joint efficiency E1:     1.00         Nozzle corrosion allowance: 0.0000 In.
Nozzle ID, new      :  4.0260 In.                Nozzle wall, new: 0.2370 In.
Nozzle ID, corroded:  4.0260 In.            Nozzle wall, corroded: 0.2370 In.
OD, limit of reinf :  8.0520 In.              Correction factor F:   1.00
External projection:  6.0000 In.              Internal projection: 0.0000 In.
Outer "h" limit     :  0.6250 In.              Internal "h" limit: 0.5925 In.
Upper weld, weld 41:  0.2370 In.         Internal weld, weld 43: 0.0000 In.
Groove weld depth   :  0.3125 In.
Reinforcing Mat'l   : SA-516, Grade 70
Stress, Sp (hot)    :   17500 PSI        Reinf. plate thickness: 0.3125 In.
Stress, Sp (cold)   :   17500 PSI           Plate weld, weld 42: 0.1786 In.
O.D., Reinf. Mat'l :  8.0000 In.             RePad groove depth: 0.3125 In.

fr1= Sn/Sv = 15000 / 17500= 0.857        fr2= Sn/Sv = 15000 / 17500= 0.857
fr3= Sn/Sv = 15000 / 17500= 0.857        fr4= Sp/Sv = 17500 / 17500= 1.000
                              MDMT Calculations
Min. temp curve : B          Minimum Design Metal Temperature:    -20 °F
Pressure at MDMT:     75.0 PSI    Computed minimum temperature:   -125 °F
UCS-66(b) reduction: Yes                    UCS-68(c) reduction:    No

                              UG-45 Calculations
 The wall thickness shall not be less than the greater of the following:

        UG-45(a) - thickness for pressure loading plus corrosion.
t = (P Rn / (SE - 0.6 P)) + CA                 nozzle efficiency(E): 100 %
t = ( 79 * 2.0130 / (15000 * 1.00 - 0.6 *  79)) + 0.0000          = 0.0106 I

         UG-45(b) - the smaller of UG-45(b)(1) or UG-45(b)(4):

UG-45(b)(1) - the thickness (plus CA) required for internal pressure.
t = P K Do / (2 SE + 2P (K - 0.1)) + corrosion
t =79*1.00*96.0000/(2*17500*1+2*79(1.00-0.1))+0.0000            : 0.2158 In



UG-45(b)(4) - minimum thickness of standard wall pipe plus CA    : 0.2074 Ir
                                                     UG-45(b) = 0.2074 :
Wall thickness for pipe = tn * 0.875
Wall thickness of 0.2074 is greater than or equal to UG-45 value of 0.2074
```

```
Job/Quote No: 0175                                    Nozzle Number: E
              Required nozzle thickness per UG-37(a) - Internal Pressure
trn= PRn/SE - 0.6P =  79.00 * 2.0130 / 15000 *1.00 -0.6 *  79.00 = 0.0106 In
                     Area Required - Internal Pressure
A   = d tr F + 2tn tr F (1 - fr1)
A   = 4.0260 *0.1947 *1.00 + 2 *0.2370 *0.1947 *1.00(1-0.857)  = 0.7971 Sq.In
                     Area Available - Internal Pressure
A1 = Larger value of the following :
   = d(E1 t - F tr) -2tn (E1 t - F tr)(1 - fr1)
   =  4.0260 (1.00 * 0.2500 - 1.00 * 0.1947) - 2 * 0.2370
       (1.00 * 0.2500 - 1.00 * 0.1947)(1 -0.857) = 0.2189
OR = 2(t + tn)(E1 t - F tr) -2tn (E1 t - F tr)(1 - fr1)
   = 2(0.2500 + 0.2370)(1.00 *0.2500 - 1.00 *0.1947)-2 *0.2370
     (1.00 * 0.2500 - 1.00 * 0.1947) (1 - 0.857) = 0.0501
                                                          A1 = 0.2189 Sq.In
A2 = Smaller value of the following :
   = 5 (tn - trn) fr2 * t
   = 5 (0.2370 - 0.0106) 0.857 * 0.2500               = 0.2425
OR = 2 (tn - trn) (2.5 * tn + te) fr2
   = 2(0.2370 - 0.0106)(2.5 * 0.2370 + 0.3125) 0.857 = 0.3512
                                                          A2 = 0.2425 Sq.I
A3 = 2(tn-c)fr2 *h = 2(0.2370 -0.0000) 0.857 *0.0000      A3 = 0.0000 Sq.I
A41= (leg)squared * fr3 = 0.2370 * 0.2370 * 0.857         A41= 0.0481 Sq.I
A42= area remaining * fr4                                 A42= 0.0086 Sq.I
A43= (leg)squared * fr2 = 0.0000 * 0.0000 * 0.857         A43= 0.0000 Sq.I
A5 = (Dp - d - 2tn) te * fr4
   = (  8.0000 -    4.0260- 2 * 0.2370) 0.3125 * 1.000    A5 = 1.0938 Sq.I
 A1 +A2 +A3 +A41 +A42 +A43 +A5 = 1.6119 which is greater than A of  0.7971

             OPENING IS ADEQUATELY REINFORCED WITH THE PAD.
```

Check the welds per UW-16

tmin, weld 41 = lesser of 0.75 or te or tn = 0.75 or 0.3125 or 0.2370 = **0.237**
Weld 41, leg min.=(lesser of 0.25 or (tmin * 0.7))/0.7 = 0.1659 / 0.7 = **0.237**
Weld 41, actual weld leg = **0.237**

tmin, weld 42 = lesser of 0.75 or t or te = 0.75 or 0.2500 or 0.3125 = **0.250**
Weld 42, leg min. = (0.5 * tmin) / 0.7 = (0.5 * 0.2500) / 0.7 = **0.178**
Weld 42, actual weld leg = **0.178**

Unit Stresses per UG-45(c) and UW-15

Nozzle wall in shear = 0.70 * 15000 = **10500** PSI
Upper fillet, weld 41, in shear = 0.49 * 15000 = **7350** PSI
Vessel groove weld in tension = 0.74 * 15000 = **11100** PSI

Outer fillet, weld 42, in shear = 0.49 * 17500 = **8575** PSI
Reinf. pad groove weld in tension = 0.74 * 15000 = **11100** PSI

Strength of connection elements

Nozzle wall in shear = Pi/2 * mean nozzle diameter * tn * 10500
= 1.57 * 4.2630 * 0.2370 * 10500 = **16700** Lbs.
Upper fillet in shear = Pi/2 * nozzle O.D. * weld leg * 7350
= 1.57 * 4.5000 * 0.2370 * 7350 = **12300** Lbs.
Groove weld tension = Pi/2 * nozzle O.D. * weld leg * 11100
= 1.57 * 4.5000 * 0.2500 * 11100 = **19600** Lbs.

Outer fillet in shear = Pi/2 * plate O.D. * weld leg * 8575
= 1.57 * 8.0000 * 0.1786 * 8575 = **19200** Lbs.
Repad groove weld = Pi/2 * nozzle O.D. * weld leg * 11100
= 1.57 * 4.5000 * 0.3125 * 11100 = **24500** Lbs.

Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)

W = [A -(d - 2tn)(Elt - Ftr)]s = [0.7971-(4.0260 -2 *0.2370)
(1.00 * 0.2500 - 1.00 * 0.1947)] * 17500 = **10500** Lbs.

W1-1 = (A2 + A5 + A41 + A42) * S
= (0.2425 + 1.0938 + 0.0481 + 0.0086) * 17500 = **24400** Lbs.

W2-2 = (A2 + A3 + A41 + A43 + 2tn *t *fr1) S = (0.2425 + 0.0000
+0.0481 +0.0000 +2 * 0.2370 * 0.2500 * 0.857) 17500 = **6900** Lbs.
W3-3 = (A2 +A3 +A5 +A41 +A42 +A43 + 2tn * t * fr1) S
(0.2425 + 0.0000 + 1.0938 +0.0481 +0.0086 +0.0000
+ 2 * 0.2370 * 0.2500 * 0.857) * 17500 = **26200** Lbs.

Check strength paths

Path 1-1 = 19200 + 16700 = **35900** Lbs.
Path 2-2 = 12300 + 24500 + 19600 = **56400** Lbs.
Path 3-3 = 19200 + 0 + 19600 = **38800** Lbs.

Plate strength = A5 * Sp = 1.0938 * 17500 = **19142** Lbs.
Outer fillet weld strength of 19200 is greater than plate strength.

— MAWP Report by Component —

Item	Design Pressure	Static Head	MAWP New & Cold	MAWP Hot & Corr.
8' OD Adsorbers (2)	75.00	4.00	76.81	76.81
Nozzle No. F	75.00	4.00	76.81	76.81
8' OD Adsorber top head	75.00	0.00	77.59	77.59
Nozzle No. A	75.00	0.00	95.16	95.16
ANSI Flange Cl: 150 Gr:1.1	75.00	0.00	285.00	273.00
Nozzle No. C & D	75.00	0.00	79.93	79.93
ANSI Flange Cl: 150 Gr:1.1	75.00	0.00	285.00	273.00
Nozzle No. G	75.00	0.00	79.12	79.12
8' OD Adsorbers-Bottom Hd.	75.00	4.00	76.70	76.70
Nozzle No. B	75.00	4.00	76.70	76.70
ANSI Flange Cl: 150 Gr:1.1	75.00	4.00	281.00	269.00
Nozzle No. E	75.00	4.00	97.52	97.52
ANSI Flange Cl: 150 Gr:1.1	75.00	4.00	281.00	269.00

— SUMMARY —

New and cold component with lowest MAWP: (MAWP = 76.70 PSI)
8' OD Adsorbers-Bottom Hd.

Hot and corroded component with lowest MAWP: (MAWP = 76.70 PSI)
8' OD Adsorbers-Bottom Hd.

Pressures are exclusive of any external loads.

— MDMT Report by Component —

Job: 0175

Item	Material	Curve	Pressure	MDMT
8' OD Adsorbers (2)	SA-516, Grade 70	B	75.00	-50
Nozzle No. F	SA-106, Grade B, SMLS	B	75.00	-125
8' OD Adsorber top head	SA-516, Grade 70	B	75.00	-23
Nozzle No. A	SA-312, Type TP316, WLD	material	exempt	
Nozzle No. C & D	SA-106, Grade B, SMLS	B	75.00	-125
Nozzle No. G	SA-106, Grade B, SMLS	B	75.00	-125
8' OD Adsorbers-Bottom Hd.	SA-516, Grade 70	B	75.00	-38
Nozzle No. B	SA-312, Type TP316, WLD	material	exempt	
Nozzle No. E	SA-106, Grade B, SMLS	B	75.00	-125

— SUMMARY —

Component with highest MDMT: 8' OD Adsorber top head.
(Computed MDMT = -23)

All components meet or exceed the design MDMT of -20.

WEIGHTS:

	dry	flooded
Shell weight	1808 Lbs.	19379 Lbs.
Head weight	2048 Lbs.	9929 Lbs.
Total Weights	3856 Lbs.	29308 Lbs.

VOLUME:

Shell volume	2103 Gallons
Head volume	945 Gallons
Total Volume	3048 Gallons

AREA:

Shell area	142 Sq. Ft.
Head area	136 Sq. Ft.
Total Area	278 Sq. Ft.

HYDRO TEST INFORMATION
Gauge at Top

Controlling Components

Ratio: 8' OD Adsorbers (2)
Pressure: 8' OD Adsorbers (2)

```
Design Pressure * 1.5 * (Cold Stress / Hot Stress) = Hydro Test Pressure
     75.00    * 1.5 * (  17500    /   17500 ) =    112.50 PSI
```

```
Job/Quote No : 0175              Customer: Envirotrol Incorporated
Head Desc.   : 18" Pipe Cap Manway
Designed: Mark W. Hadley                    Design Date: July 12, 1995
Checked :                              Approved:
                  External loads do not control design.

                  ASME F & D Head - Internal Pressure
Design Pressure :  75.00 PSI                   Static Head:     0.00 PSI
Head Material   : SA-234, Grade WPB        Joint efficiency:      85 Pct.
                                         Design Temperature:     150 °F
Matl stress(hot):  15000 PSI         Material stress (cold):   15000 PSI
Actual Stress   :   3119 PSI           Corrosion Allowance:  0.0000 In.
Head Location   : Right end             Outside diameter :  18.0000 In.
Head Quantity   :      1
Total Head Area :    2.7 Sq. Ft.     Total Head Est. Volume:     3.8 Gal.
Total Head Wt.  :   55.3 Lbs.              Weight of Fluid :      32 Lbs.
Specific Gravity: 1.0000           Total Flooded Head Weight:    87.3 Lbs.

Straight Flange : 2.0000 In.                     Thin Out :   0.0625 In.
Knuckle (r)     : 1.0800 In.           Crown Radius (Lo):  18.0000 In.
                                 M = 1/4 [3 + Sq Rt(L/r)]:   1.7563


Min. temp curve : B          Minimum Design Metal Temperature:     -20 °F
Pressure at MDMT:   75.00 PSI   Computed minimum temperature:     -118 °F
UCS-66(b) reduction:  Yes               UCS-68(c) reduction:      No

                  Design Thickness per APPENDIX 1-4(d)
t =  PLoM / (2 SE + P(M - 0.2))
t = 75 * 18.0000 * 1.7563 / (2 *15000 * 0.85 + 75 (1.7563 - 0.2))
t = 0.0926 +0.0000 (corrosion) +0.0625 (thin out) = 0.1551 In. min.

            NOMINAL HEAD THICKNESS SELECTED = 0.5000 Inches
```

S.O. 0175 25-

QUICK OPENING
CLOSURES

Calculations of a Bolted Cover Using a Pipe Cap

Design Data

$P = 75\,\mathrm{psi}$ $ID = 17.25 \cdot \mathrm{in}$

$d_b = \frac{3}{4} \cdot \mathrm{in}$ $t_{lug} = \frac{1}{4} \cdot \mathrm{in}$ $w_{lug} = 1.75 \cdot \mathrm{in}$

$A_b = .334\,\mathrm{in}^2$ $N_b = 4$

Initial Calculations:

$A_{id} = \frac{\pi}{4} \cdot ID^2$ $A_{id} = 233.705 \cdot \mathrm{in}^2$

$F = P \cdot A_{id}$ $F = 17527.878 \cdot \mathrm{lbf}$

$F_b = \frac{F}{N_b}$ $F_b = 4381.97 \cdot \mathrm{lbf}$

$\sigma_b = \frac{F_b}{A_b}$ $\sigma_b = 13119.009 \cdot \mathrm{psi}$

$D_{pin} = 2 \cdot d_b$ $D_{pin} = 1.5 \cdot \mathrm{in}$

$A_{pin} = \frac{\pi}{4} \cdot D_{pin}^2 - D_{pin} \cdot d_b$ $A_{pin} = 0.642 \cdot \mathrm{in}^2$

$\sigma_{pin} = \frac{F_b}{A_{pin}}$ $\sigma_{pin} = 6823.947 \cdot \mathrm{psi}$

$D_{slv} = 1.9 \cdot \mathrm{in}$ This is a 1-1/2" XS pipe

$t_{slv} = .2 \cdot \mathrm{in}$

$w_{slv} = 1.5 \cdot \mathrm{in}$

$A_{slv} = t_{slv} \cdot w_{slv}$ $A_{slv} = 0.3 \cdot \mathrm{in}^2$

$F_{slv} = \frac{F_b}{2}$

$\sigma_{slv} = \frac{F_{slv}}{A_{slv}}$ $\sigma_{slv} = 7303.283 \cdot \mathrm{psi}$

Analize the Weld of the Sleeve to the head Assume two fillets @ .25 D slv off Center

$L_{slv} = \frac{D_{slv}}{2}$

$M_{slv} = F_{slv} \cdot L_{slv}$ $M_{slv} = 2081.436 \cdot lbf \cdot in$ Moment on Welds

$h_{wld} = \frac{1}{4} \cdot in$ Fillet weld size

$l_{wld} = 2 \cdot .25 \cdot D_{slv}$ $l_{wld} = 0.95 \cdot in$

$w_{wld} = w_{slv}$

$I_{wld} = \frac{w_{wld} \cdot l_{wld}^2 \cdot .707 \cdot h_{wld}}{2}$ $I_{wld} = 0.12 \cdot in^4$

$S_{wld} = \frac{I_{wld} \cdot 2}{l_{wld}}$ $S_{wld} = 0.252 \cdot in^3$

$\sigma_{bnd} = \frac{M_{slv}}{S_{wld}}$ $\sigma_{bnd} = 8263.969 \cdot psi$

$A_{wld} = 2 \cdot .707 \cdot h_{wld} \cdot w_{wld}$ $A_{wld} = 0.53 \cdot in^2$

$\sigma_{shr} = \frac{F_{slv}}{A_{wld}}$ $\sigma_{shr} = 4131.984 \cdot psi$

$\sigma_{wldtot} = \sqrt{\sigma_{shr}^2 - \sigma_{bnd}^2}$ $\sigma_{wldtot} = 9239.398 \cdot psi$

Lug Desing Assume moment on lug is over 3/4 times D bolt

$L_{lug} = \frac{3}{4} \cdot d_b$ $L_{lug} = 0.563 \cdot in$

$M_{lug} = \frac{F_b \cdot L_{lug}}{2}$ $M_{lug} = 1232.429 \cdot lbf \cdot in$

$I_{lug} = \frac{t_{lug} \cdot w_{lug}^3}{12}$ $I_{lug} = 0.112 \cdot in^4$

$S_{lug} = \frac{I_{lug} \cdot 2}{w_{lug}}$ $S_{lug} = 0.128 \cdot in^3$

$\sigma_{lugbnd} = \frac{M_{lug}}{S_{lug}}$ $\sigma_{lugbnd} = 9658.219 \cdot psi$

$A_{lug} = t_{lug} \cdot w_{lug}$

$\sigma_{lugshr} = \frac{F_b}{2 \cdot A_{lug}}$ $\sigma_{lugshr} = 5007.965 \cdot psi$

$\sigma_{lugtot} = \sqrt{\sigma_{lugshr}^2 - \sigma_{lugbnd}^2}$ $\sigma_{lugtot} = 10879.38 \cdot psi$

Calculate Lug fillet size

$h_{flt} = \frac{1}{4} \cdot in$ Fillet all around lug

$I_{flt} = .707 \cdot h_{flt} \cdot \frac{w_{lug}^2}{6} \cdot 3 \cdot t_{lug} + w_{lug}$ $I_{flt} = 0.226 \cdot in^4$

$S_{flt} = \frac{I_{flt} \cdot 2}{w_{lug}}$ $S_{flt} = 0.258 \cdot in^3$

$\sigma_{fltbnd} = \frac{M_{lug}}{S_{flt}}$ $\sigma_{fltbnd} = 4781.296 \cdot psi$

$A_{flt} = 1.414 \cdot h_{flt} \cdot t_{lug} + w_{lug}$ $A_{flt} = 0.707 \cdot in^2$

$\sigma_{fltshr} = \frac{F_b}{A_{flt} \cdot 2}$ $\sigma_{fltshr} = 3098.988 \cdot psi$

$\sigma_{flttot} = \sqrt{\sigma_{fltshr}^2 + \sigma_{fltbnd}^2}$ $\sigma_{flttot} = 5697.765 \cdot psi$

```
Job/Quote No : 0175              Customer: Envirotrol Incorporated
Head Desc.   : 6" Pipe Manway
Designed: Mark W. Hadley                   Design Date: July 12, 1995
Checked :                               Approved:
                   External loads do not control design.

                   ASME F & D Head - Internal Pressure
Design Pressure :  75.00 PSI                 Static Head:       0.00 PSI
Head Material   : SA-516, Grade 70       Joint efficiency:        85 Pct.
                                      Design Temperature:       150 °F
Matl stress(hot):  17500 PSI       Material stress (cold):     17500 PSI
Actual Stress   :   1306 PSI         Corrosion Allowance:     0.0000 In.
Head Location   : Ends                 Outside diameter :     6.6250 In.
Head Quantity   :      1
Total Head Area :    0.5 Sq. Ft.     Total Head Est. Volume:     0.3 Gal.
Total Head Wt.  :    9.1 Lbs.            Weight of Fluid :         2 Lbs.
Specific Gravity: 1.0000            Total Flooded Head Weight:  11.5 Lbs.

Straight Flange : 2.0000 In.                   Thin Out :     0.0625 In.
Knuckle (r)     : 0.3975 In.            Crown Radius (Lo):     6.6250 In.
                                     M = 1/4 [3 + Sq Rt(L/r)]: 1.7368


Min. temp curve : B         Minimum Design Metal Temperature:    -20 °F
Pressure at MDMT:  75.00 PSI   Computed minimum temperature:    -125 °F
UCS-66(b) reduction:  Yes           UCS-68(c) reduction:        No

                  Design Thickness per APPENDIX 1-4(d)
t =  PLoM / (2 SE + P(M - 0.2))
t = 75 * 6.6250 * 1.7368 / (2 *17500 * 0.85 + 75 (1.7368 - 0.2))
t = 0.0289 +0.0000 (corrosion) +0.0625 (thin out) = 0.0914 In. min.

          NOMINAL HEAD THICKNESS SELECTED = 0.4320 Inches
```

Calculations of a Bolted Cover Using a 6" Pipe Cap

Design Data

$P = 150 \cdot psi$ $ID = 6.065 \cdot in$

$d_b = \frac{1}{2} \cdot in$ $t_{lug} = \frac{1}{4} \cdot in$ $w_{lug} = 1 \cdot in$

$A_b = .142 \cdot in^2$ $N_b = 3$

$D_{slv} = 1.315 \cdot in$ This is a 1" STD pipe

$t_{slv} = .133 \cdot in$

Initial Calculations:

$A_{id} = \frac{\pi}{4} \cdot ID^2$ $A_{id} = 28.89 \cdot in^2$

$F = P \cdot A_{id}$ $F = 4333.539 \cdot lbf$

$F_b = \frac{F}{N_b}$ $F_b = 1444.513 \cdot lbf$

$\sigma_b = \frac{F_b}{A_b}$ $\sigma_b = 10172.628 \cdot psi$

$D_{pin} = 2 \cdot d_b$ $D_{pin} = 1 \cdot in$

$A_{pin} = \frac{\pi}{4} \cdot D_{pin}^2 - D_{pin} \cdot d_b$ $A_{pin} = 0.285 \cdot in^2$

$\sigma_{pin} = \frac{F_b}{A_{pin}}$ $\sigma_{pin} = 5061.396 \cdot psi$

$w_{slv} = 1 \cdot in$

$A_{slv} = t_{slv} \cdot w_{slv}$ $A_{slv} = 0.133 \cdot in^2$

$F_{slv} = \frac{F_b}{2}$

$\sigma_{slv} = \frac{F_{slv}}{A_{slv}}$ $\sigma_{slv} = 5430.501 \cdot psi$

Analize the Weld of the Sleeve to the head Assume two fillets @ .25 D slv off Center

$L_{slv} \quad \frac{D_{slv}}{2}$

$M_{slv} = F_{slv} \cdot L_{slv}$ $\qquad M_{slv} = 474.884 \cdot lbf\ in$ Moment on Welds

$h_{wld} = \frac{1}{4}\ in$ Fillet weld size

$l_{wld} = 2 \cdot .25 \cdot D_{slv}$ $\qquad l_{wld} = 0.658 \cdot in$

$w_{wld} = w_{slv}$

$I_{wld} = \frac{w_{wld} \cdot l_{wld}^{2} \cdot .707 \cdot h_{wld}}{2}$ $\qquad I_{wld} = 0.038 \cdot in^{4}$

$S_{wld} = \frac{I_{wld} \cdot 2}{l_{wld}}$ $\qquad S_{wld} = 0.116 \cdot in^{3}$

$\sigma_{bnd} = \frac{M_{slv}}{S_{wld}}$ $\qquad \sigma_{bnd} = 4086.317 \cdot psi$

$A_{wld} = 2 \cdot .707 \cdot h_{wld} \cdot w_{wld}$ $\qquad A_{wld} = 0.354 \cdot in^{2}$

$\sigma_{shr} = \frac{F_{slv}}{A_{wld}}$ $\qquad \sigma_{shr} = 2043.159 \cdot psi$

$\sigma_{wldtot} = \sqrt{\sigma_{shr}^{2} + \sigma_{bnd}^{2}}$ $\qquad \sigma_{wldtot} = 4568.642 \cdot psi$

Lug Desing Assume moment on lug is over 3/4 times D bolt

$L_{lug} = .75 \cdot d_{b}$ $\qquad L_{lug} = 0.375 \cdot in$

$M_{lug} = \frac{F_{b} \cdot L_{lug}}{2}$ $\qquad M_{lug} = 270.846 \cdot lbf\ in$

$I_{lug} = \frac{t_{lug} \cdot w_{lug}^{3}}{12}$ $\qquad I_{lug} = 0.021 \cdot in^{4}$

$S_{lug} = \frac{I_{lug} \cdot 2}{w_{lug}}$ $\qquad S_{lug} = 0.042 \cdot in^{3}$

$\sigma_{lugbnd} = \frac{M_{lug}}{S_{lug}}$ $\qquad \sigma_{lugbnd} = 6500.309 \cdot psi$

$A_{lug} = t_{lug} \cdot w_{lug}$

$\sigma_{lugshr} = \frac{F_{b}}{2 \cdot A_{lug}}$ $\qquad \sigma_{lugshr} = 2889.026 \cdot psi$

$\sigma_{lugtot} = \sqrt{\sigma_{lugshr}^{2} + \sigma_{lugbnd}^{2}}$ $\qquad \sigma_{lugtot} = 7113.402 \cdot psi$

Calculate Lug fillet size

$h_{flt} = \frac{1}{4} \cdot in$ Fillet all around lug

$I_{flt} = .707 \cdot h_{flt} \cdot \frac{w_{lug}^2}{6} \cdot (3 \cdot t_{lug} + w_{lug})$ $I_{flt} = 0.052 \cdot in^4$

$S_{flt} = \frac{I_{flt} \cdot 2}{w_{lug}}$ $S_{flt} = 0.103 \cdot in^3$

$\sigma_{fltbnd} = \frac{M_{lug}}{S_{flt}}$ $\sigma_{fltbnd} = 2626.918 \cdot psi$

$A_{flt} = 1.414 \cdot h_{flt} \cdot (t_{lug} + w_{lug})$ $A_{flt} = 0.442 \cdot in^2$

$\sigma_{fltshr} = \frac{F_b}{A_{flt} \cdot 2}$ $\sigma_{fltshr} = 1634.527 \cdot psi$

$\sigma_{flttot} = \sqrt{\sigma_{fltshr}^2 + \sigma_{fltbnd}^2}$ $\sigma_{flttot} = 3093.926 \cdot psi$

Pennsylvania Tank & Tube, Inc. **RECORD COPY**

Revision 0
Date 9/20/93

Traveler
Page 1 of 3

Customer ENVIROTROL, INC
Order Date 3/15/95
Shop Order 0175-1
Description ADSORBER TANK
Code Section ASME SECTION VIII
Q.C. Manager John Townsend

* Denotes QC Hold Points H - Denotes AI Hold Points

Function	Examination Record	AI or QC	QC	AI	Customer
Initial Review			* JT 3-31-95	H Rot 6-5-95	
Order Entry			* JT 3-15-95		
Calculations			* JT 4-7-95	H Rot 6-5-95	
Drawings - Preliminary			* JT 3-31-95	H Rot 6-5-95	
Drawings - Approved			* JT 6-2-95	H Rot 7-12-95	
Bill of Material			* JT 6-2-95	H Rot 6-5-95	
Matl. Inspection/MTR's & I.D.	SEE BILL OF				
Matl. Inspection/MTR's & I.D.	MATERIAL				
Matl. Inspection/MTR's & I.D.	FOR HEAT NO.'S				
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
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Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
WPS Review			* JT 6-2-95		
Fit Up/Welding See Page 3					

RECORD COPY

Pennsylvania Tank & Tube, Inc.

Revision 0
Date 9/20/93

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Page 2 of 3

Customer ENVIROTROL, INC
Shop Order 0175-1
Code Section ASME SECTION VIII
Order Date 3/15/95
Description ADSORBER TANK
Q.C. Manager John Townsend

* Denotes QC Hold Points H - Denotes AI Hold Points

Function	Examination Record	AI or QC	QC	AI	Customer
Ultrasonic Exam					
Radiographic Exam	(SPOT)		* jcc 7/12/95	H RBK 7-12-95	
Other NDE					
Welder Stamps Inspected			* 7/12/95 jcc	H RBK 7-12-95	
PWHT Charts					
Non-Conformities					
Final Dimensional Check			* JT 7-7-95		
Hydrostatic Test			* jcc 7/12/95	H RBK 7-12-95	
Hydrostatic Test					
Nameplate or Stamping			* jcc 7/12/95	H RBK 7-12-95	
Data Reports			* jcc 7/12/95	H RBK 7-12-95	
Q.C. Package Mailed			* JT 8-15-95		

Additional inspections, comments, or explanations can be added below.

RECORD COPY

Pennsylvania Tank & Tube, Inc.

Revision 0
Date 9/20/93

Traveler
Page 3 of 3
Welding Inspection Record

Customer ENVIROTROL INC
Shop Order 0175-1
Code Section ASME SECTION VIII
Order Date 3/15/95
Description ADSORBER TANK
Q.C. Manager John

* Denotes QC Hold Points H - Denotes AI Hold Points

Description	Fit-Up		Backgouge or root		Final	
	AI	QC	AI	QC	AI	QC
FINAL WELD INSP.	—	—	—	—	H Ron 7-12-95	* JC 7/12/95
TOP HEAD TO SHELL		* 9T 6-20-95		* 9T 6-21-95	—	—
BOTTOM HEAD TO SHELL		* 9T 6-20-95		* 9T 6-21-95	—	—
SHELL LONG SEAM		* 9T 6-20-95		* 9T 6-21-95	—	—
MANWAY TO HEAD		* 9T 7-7-95		* 9T 7-7-95	—	—
MANWAY TO SHELL		* 9T 7-7-95		* 9T 7-7-95	—	—
NOZ. E TO BOTTOM HD.		* 9T 6-22-95		* 9T 6-22-95	—	—
NOZ. D TO TOP HD.		* 9T 6-22-95		* 9T 6-22-95	—	—
NOZ. C TO TOP HD.		* 9T 6-15-95		* 9T 6-16-95	—	—
NOZ. B TO BOTTOM HD.		* 9T 6-27-95		* 9T 6-27-95	—	—
NOZ. A TO TOP HD.		* 9T 6-15-95		* 9T 6-16-95	—	—
LEGS TO SHELL		* 9T 6-26-95		* 9T 6-26-95	—	—

Note: Drawings may be used to document these inspections in lieu of this page.

If the drawings are used, please note the drawing numbers and your choice of this option

Pennsylvania Tank & Tube, Inc.

RECORD COPY

Revision 0
Date 9/20/93

Traveler
Page 1 of 3

Customer	ENVIROTROL, INC	Order Date	3/15/95
Shop Order	0175-2	Description	ADSORBER TANK
Code Section	ASME SECTION VIII	Q.C. Manager	John Townsend

* Denotes QC Hold Points   H - Denotes AI Hold Points

Function	Examination Record	AI or QC	QC	AI	Customer
Initial Review			* JT 3-31-95	H Roy 6-5-95	
Order Entry			* JT 3-15-95		
Calculations			* JT 4-7-95	H Roy 6-5-95	
Drawings - Preliminary			* JT 3-31-95	H Roy 6-5-95	
Drawings - Approved			* JT 6-2-95	H Roy 7-12-95	
Bill of Material			* JT 6-2-95	H Roy 6-5-95	
Matl. Inspection/MTR's & I.D.	SEE BILL				
Matl. Inspection/MTR's & I.D.	OF MATERIAL				
Matl. Inspection/MTR's & I.D.	FOR HEAT No.'S				
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
Matl. Inspection/MTR's & I.D.					
WPS Review			* JT 6-2-95		
Fit Up/Welding See Page 3					

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Pennsylvania Tank & Tube, Inc.

Revision 0
Date 9/20/93

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Page 2 of 3

Customer: ENVIROTROL, INC
Shop Order: 0175-2
Code Section: ASME SECTION VIII
Order Date: 3/15/95
Description: ADSORBER TANK
Q.C. Manager: John Townsend

* Denotes QC Hold Points H - Denotes AI Hold Points

Function	Examination Record	AI or QC	QC	AI	Customer
Ultrasonic Exam					
Radiographic Exam	SPOT		* jcc 7/12/95	H Roy 7-12-95	
Other NDE					
Welder Stamps Inspected			* jcc 7/12/95	H Roy 7-12-95	
PWHT Charts					
Non-Conformities					
Final Dimensional Check			* GT 7-7-95		
Hydrostatic Test			* jcc 7/14/95	H Roy 7-12-95	
Hydrostatic Test					
Nameplate or Stamping			* jcc 7/12/95	H Roy 7-12-95	
Data Reports			* jcc 7/12/95	H Roy 7-12-95	
Q.C. Package Mailed			* GT 8-15-95		
Additional inspections, comments, or explanations can be added below.					

RECORD COPY

Pennsylvania Tank & Tube, Inc.

Revision 0
Date 9/20/93

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Welding Inspection Record

Customer ENVIROTROL INC
Shop Order 0175-2
Code Section ASME SECTION VIII

Order Date 3/15/95
Description ADSORBER TANK
Q.C. Manager John T

* Denotes QC Hold Points H - Denotes AI Hold Points

Description	Fit-Up		Backgouge or root		Final	
	AI	QC	AI	QC	AI	QC
FINAL WELD INSP.	—	—	—	—	H RGK 7-12-95	* JTC 7/12/95
TOP HEAD TO SHELL		* JT 6-21-95		* JT 6-22-95	—	—
BOTTOM HEAD TO SHELL		* JT 6-21-95		* JT 6-22-95	—	—
SHELL LONG SEAM		* JT 6-21-95		* JT 6-22-95	—	—
MANWAY TO HEAD		* JT 7-7-95		* JT 7-7-95	—	—
MANWAY TO SHELL		* JT 7-7-95		* JT 7-7-95	—	—
NOZ. E TO BOTTOM HD.		* JT 6-19-95		* JT 6-19-95	—	—
NOZ. D TO TOP HD.		* JT 6-22-95		* JT 6-22-95	—	—
NOZ. C TO TOP HD.		* JT 6-19-95		* JT 6-19-95	—	—
NOZ. B TO BOTTOM HD.		* JT 6-19-95		* JT 6-19-95	—	—
NOZ. A TO TOP HD.		* JT 6-15-95		* JT 6-15-95	—	—
LEGS TO SHELL		* JT 6-26-95		* JT 6-27-95	—	—

Note: Drawings may be used to document these inspections in lieu of this page.

If the drawings are used, please note the drawing numbers and your choice of this option

APPENDIX V

ENVIROTROL, INC.
432 Green Street, P.O. Box 61 • Sewickley, Pennsylvania 15143-0061
(412) 741-2030 • FAX 412-741-2670

REACTIVATED LIQUID PHASE CARBON

EI-30R/EI-840R are reactivated liquid phase carbons from Envirotrol's custom segregated reactivation process. **EI-30R** is our premium grade reactivation carbon which provides superior performance in the removal of a wide variety of organic contaminants in liquid applications. Our **EI-840R** is a reactivated carbon that has excellent adsorptive properties for a wide variety of applications. These products will provide performance equivalent to virgin carbon but at a significant cost savings.

SPECIFICATIONS	EI-30R	EI-840R
Iodine Number (mg/g), Minimum	900	750
Molasses Number, Minimum	200	200
Abrasion Number, Minimum	70	70
Moisture (as packed), Maximum	2.0%	2.0%
U.S. Standard Sieve Size		
Greater than No. 8 (Maximum)	15%	15%
Less than No. 30 (Maximum)	5%	5%
Total Ash (wt. %), Typical	5-15%	5-15%

TYPICAL PROPERTIES*

Apparent Density (g/ml)	0.47-0.52	0.50-0.575
Iodine Number (mg/g)	900-1000	750-900
Molasses Number	200-275	200-275

*The quality of each lot of carbon purchased from Envirotrol can be certified in writing prior to delivery.

CAUTION: WET ACTIVATED CARBON DEPLETES OXYGEN FROM AIR

Whenever workers enter a vessel containing carbon, all precautions must be taken because dangerously low levels of oxygen may be encountered. Atmosphere sampling and work procedures for potentially low oxygen areas should be followed.

SHIPPING INFORMATION:

F.O.B POINTS:
Beaver Falls, PA
Darlington, PA
Rochester, PA

Grades EI-30R/EI-840R are available in 35 ft^3 bulk sacks and in bulk. Other packaging is available at a premium and include 50 lb. bags, metal drums, and fiber drums.

MATERIAL SAFETY DATA SHEET

ENVIROTROL, INC.
P.O. BOX 61
SEWICKLEY, PA 15143

EMERGENCY PHONE: (412) 741-2030

CHEMICAL NAME:	Carbon	CAS REGISTRY NO.:	74401-44-0
TRADE NAME:	Powdered Activated or Reactivated Carbon	FORMULA:	C
COMMON NAME:	Carbon	CHEMICAL FAMILY:	Element, Group IV-A

INGREDIENTS: (Typical Values)

Carbon	90-100%
Inert Ingredients	0- 10%

SECTION 1 - PHYSICAL DATA

- Boiling point: 872°F, 4827°C (approx.)
- Vapor pressure: N/A
- Vapor density: N/A
- Solubility in water: Insoluble
- Specific gravity ($H_2O = 1$): .2 - .75
- Percent, volatile by volume: N/A
- Evaporation rate: N/A

- Appearance: Black, odorless; granular, pelletized, powder

SECTION 2 - FIRE AND EXPLOSION HAZARD DATA

- Flash point: N/A
- Ignition point: 500-800°F
- Extinguishing media: Dry chemical, water fog, foam
- Special fire fighting procedures: Wear positive pressure self-contained breathing apparatus if fire occurs in enclosed space. Oxygen starved fires may result in the release of carbon monoxide.
- Unusual fires and explosion hazards: Avoid producing suspensions of dust during handling, and avoid exposure of suspensions to sources of ignition. Suspensions of -40 mesh powdered activated carbon may explode if exposed to strong sources of ignition.

MATERIAL SAFETY DATA SHEET

ENVIROTROL, INC.
P.O. BOX 61
SEWICKLEY, PA 15143

EMERGENCY PHONE: (412) 741-2030

CHEMICAL NAME: Carbon

CAS REGISTRY NO.: 74401-44-0

TRADE NAME: Powdered Activated or Reactivated Carbon

FORMULA: C

COMMON NAME: Carbon

CHEMICAL FAMILY: Element, Group IV-A

INGREDIENTS: (Typical Values)

Carbon——————————90-100%
Inert Ingredients——————————0- 10%

SECTION 1 - PHYSICAL DATA

- Boiling point: 872°F, 467°C (approx.)
- Vapor pressure: N/A
- Vapor density: N/A
- Solubility in water: Insoluble
- Specific gravity ($H_2O = 1$): .2 - .75
- Percent, volatile by volume: N/A
- Evaporation rate: N/A

- Appearance: Black, odorless; granular, pelletized, powder

SECTION 2 - FIRE AND EXPLOSION HAZARD DATA

- Flash point: N/A
- Ignition point: 500-800°F
- Extinguishing media: Dry chemical, water fog, foam
- Special fire fighting procedures: Wear positive pressure self-contained breathing apparatus if fire occurs in enclosed space. Oxygen starved fires may result in the release of carbon monoxide.
- Unusual fires and explosion hazards: Avoid producing suspensions of dust during handling, and avoid exposure of suspensions to sources of ignition. Suspensions of -40 mesh powdered activated carbon may explode if exposed to strong sources of ignition.

SECTION 8 - SPECIAL PRECAUTIONS AND ADDITIONAL INFORMATION

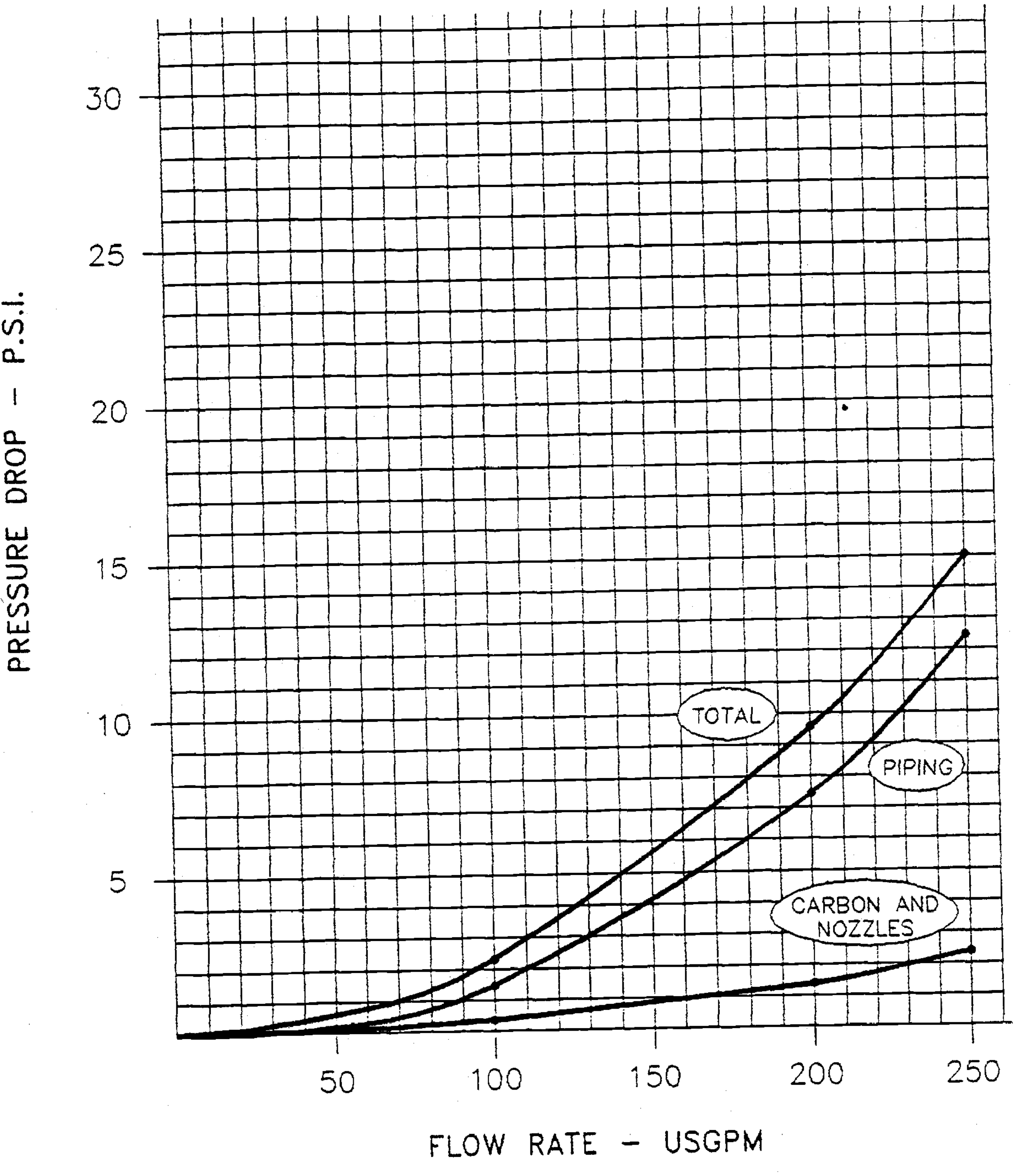
Precautions to be taken in handling and storage: Keep dry; wet carbon will adsorb oxygen and may reduce oxygen levels in confined spaces to dangerous levels. Adequate ventilation and precautions should be employed whenever closed tanks, receptacles or other enclosed spaces containing carbon are accessed. Suspensions of dust should be avoided and exposure of suspensions of dust to sources of ignition should be avoided.

SECTION 8 - SPECIAL PRECAUTIONS AND ADDITIONAL INFORMATION

Precautions to be taken in handling and storage: Keep dry; wet carbon will adsorb oxygen and may reduce oxygen levels in confined spaces to dangerous levels. Adequate ventilation and precautions should be employed whenever closed tanks, receptacles or other enclosed spaces containing carbon are accessed. Suspensions of dust should be avoided and exposure of suspensions of dust to sources of ignition should be avoided.

APPENDIX VI

PRESSURE DROP THROUGH TWO-STAGE CARBON ADSORBERS
ADSORBER DIAM. – 96", 8,000 LB. CARBON 8x30 EACH ADSORBER
4" SCH. 40 PIPE SYSTEM



ENVIROTROL, INC.
Activated Carbon Services
Sewickley, Pa.

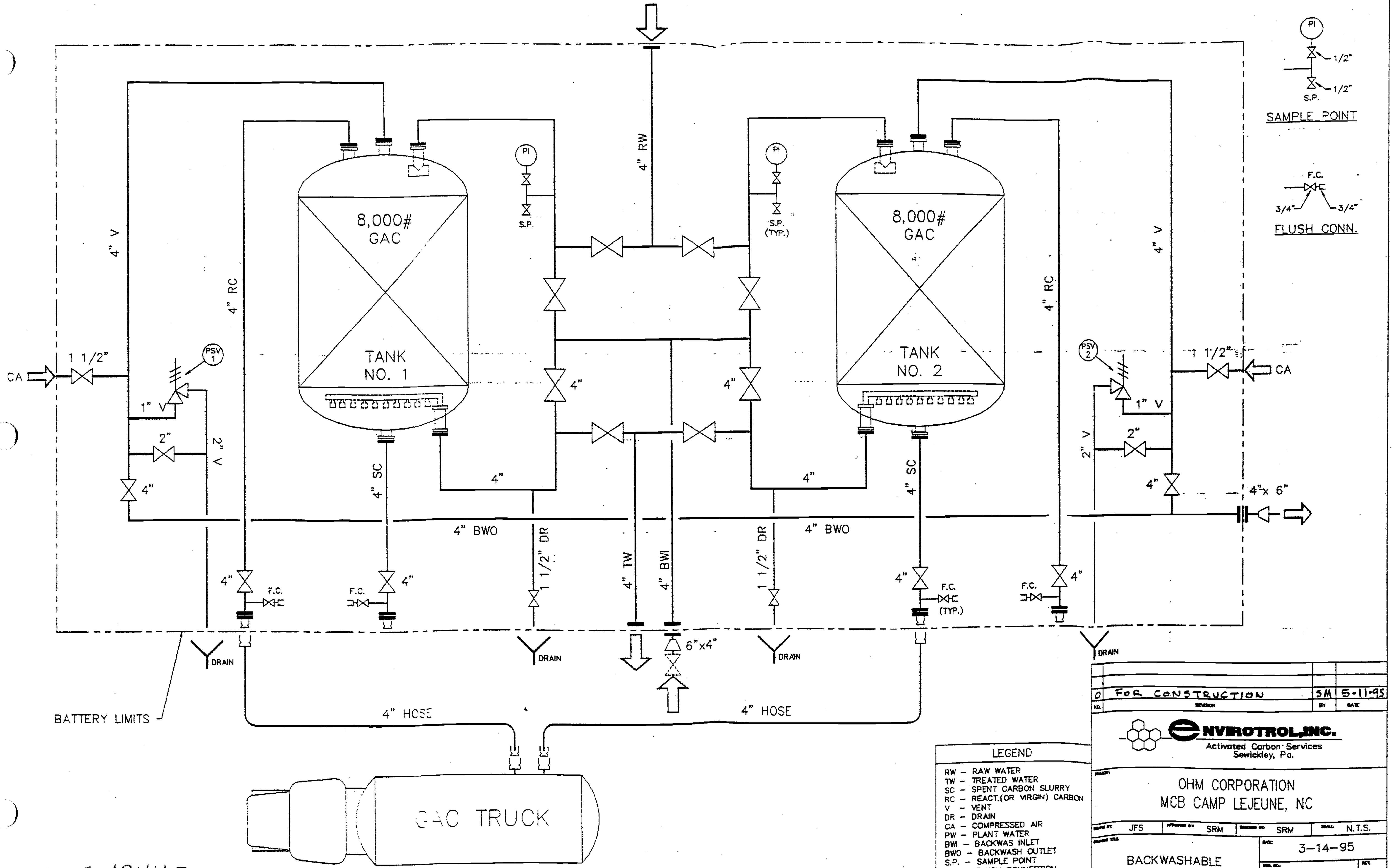
OHM CORPORATION
MCB CAMP LEJEUNE, NC

S	SRM	SRM	N.T.S.

PRESSURE DROP
CHART

9-10-95

9416-104 | 0



02348HHBIZ

LEGEND

RW – RAW WATER
TW – TREATED WATER
SC – SPENT CARBON SLURRY
RC – REACT.(OR VIRGIN) CARBON
V – VENT
DR – DRAIN
CA – COMPRESSED AIR
PW – PLANT WATER
BWI – BACKWAS INLET
BWO – BACKWASH OUTLET
S.P. – SAMPLE POINT
F.C. – FLUSH CONNECTION

NO.	REVISION	BY	DATE
0	FOR CONSTRUCTION	SM	5-11-95

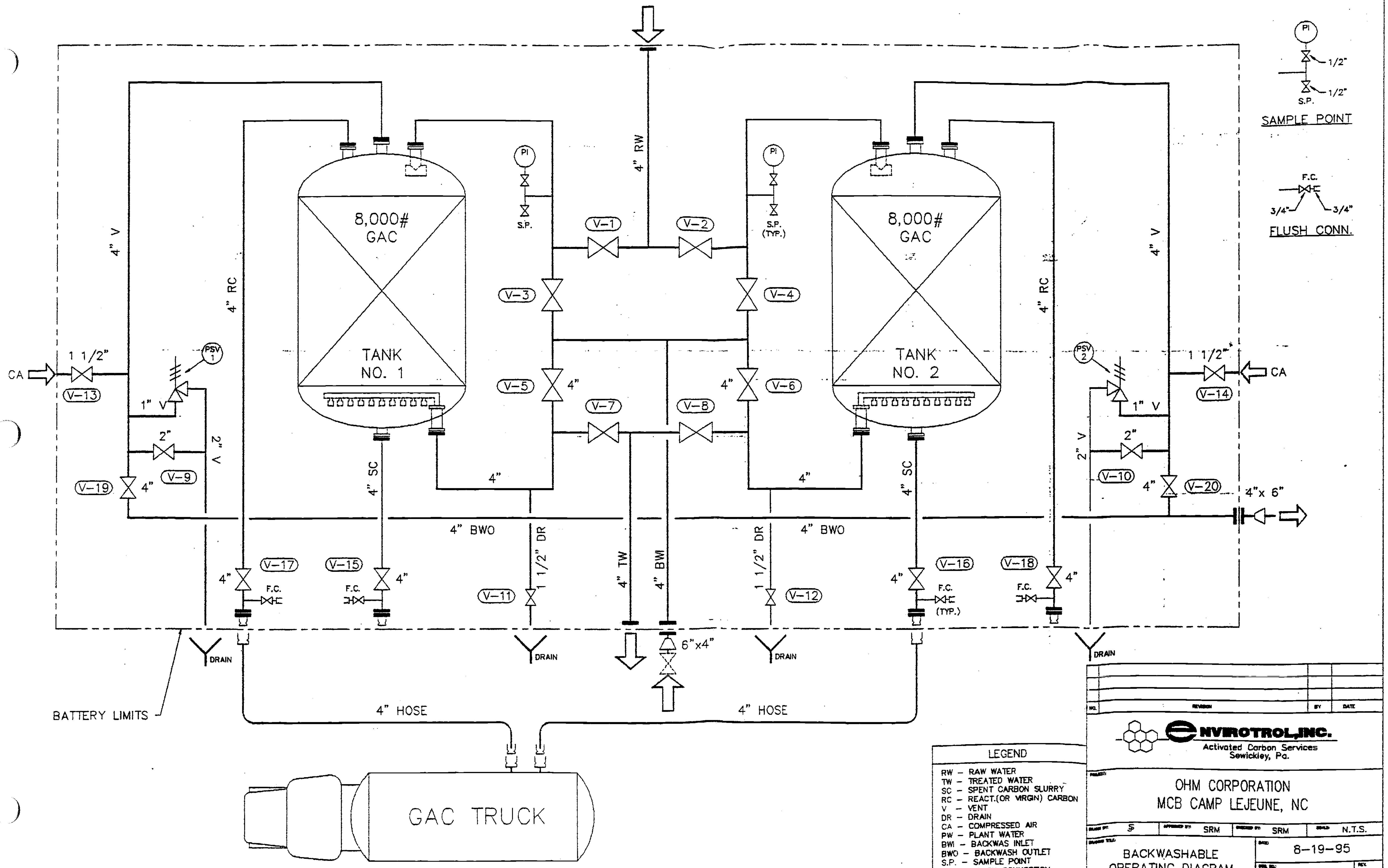
ENVIROTROL, INC.
Activated Carbon Services
Sewickley, Pa.

PROJECT:
OHM CORPORATION
MCB CAMP LEJEUNE, NC

DRAWN BY: JFS
APPROVED BY: SRM
CHECKED BY: SRM
SCALE: N.T.S.

DRAWING TITLE:
BACKWASHABLE
FLOW DIAGRAM

DATE: 3-14-95
DWG. NO.: 9416-101
REV. 0



LEGEND

RW – RAW WATER
TW – TREATED WATER
SC – SPENT CARBON SLURRY
RC – REACT.(OR VIRGIN) CARBON
V – VENT
DR – DRAIN
CA – COMPRESSED AIR
PW – PLANT WATER
BWI – BACKWAS INLET
BWO – BACKWASH OUTLET
S.P. – SAMPLE POINT
F.C. – FLUSH CONNECTION

NO.	REVISION	BY	DATE

ENVIROTROL, INC.
Activated Carbon Services
Sewickley, Pa.

PROJECT:
OHM CORPORATION
MCB CAMP LEJEUNE, NC

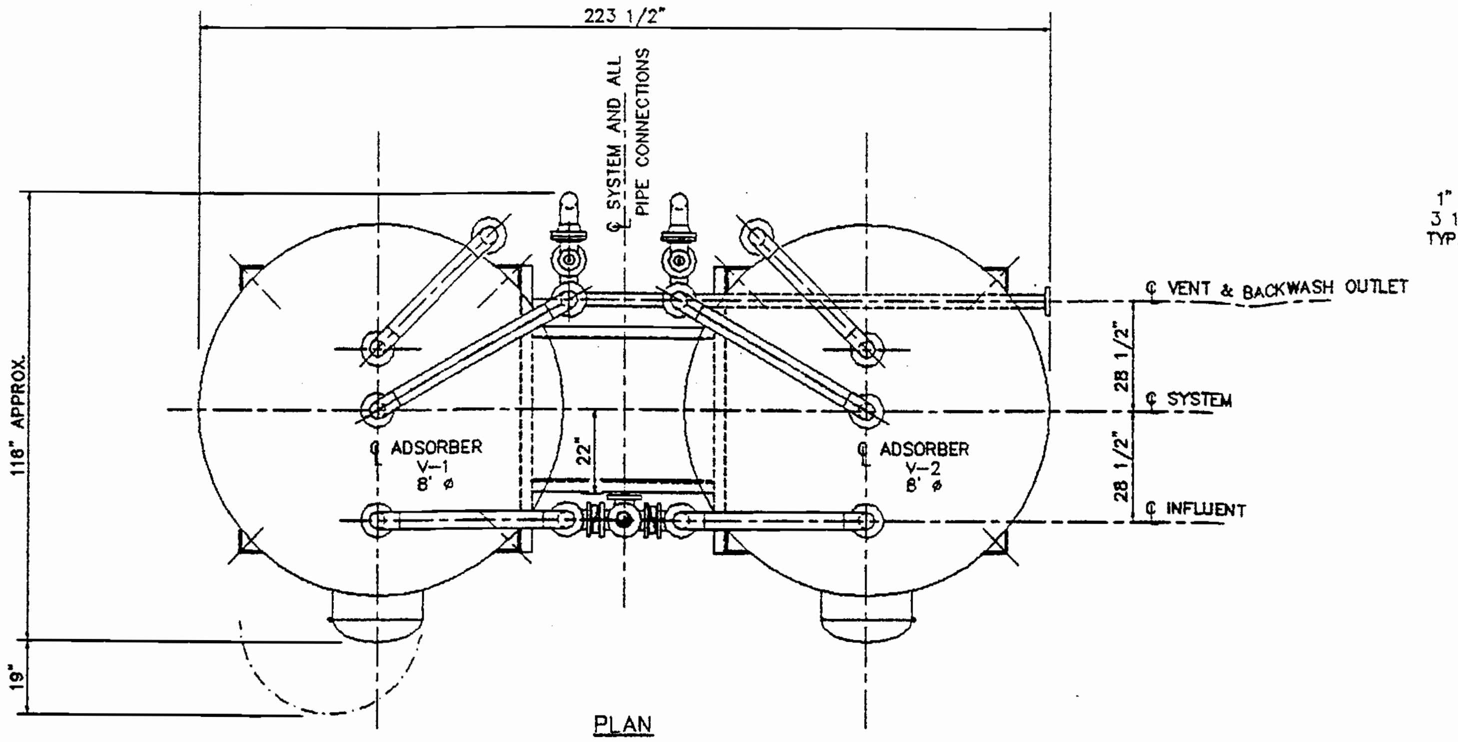
DRAWN BY:	APPROVED BY:	CHECKED BY:	SCALE:
S	SRM	SRM	N.T.S.

DRAWING TITLE:
BACKWASHABLE
OPERATING DIAGRAM

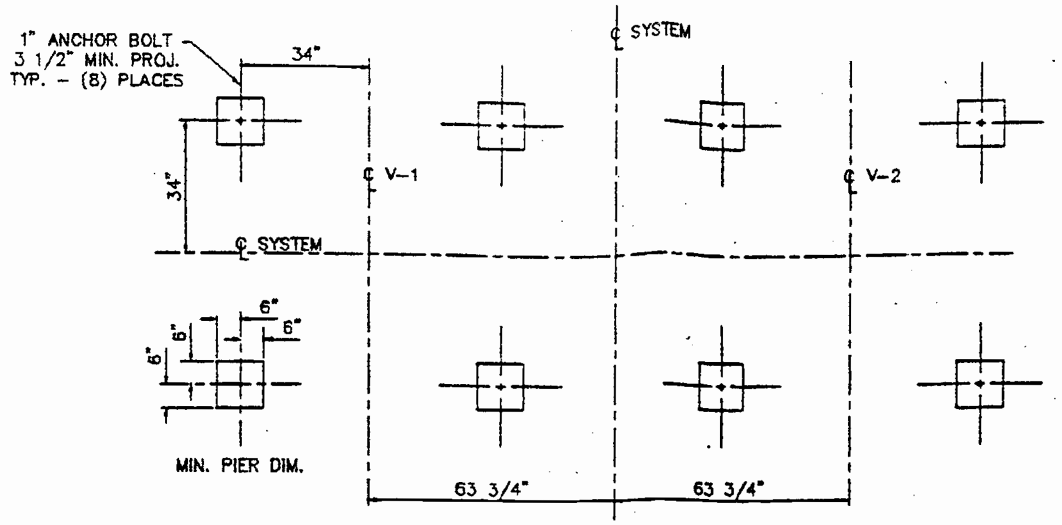
DATE: 8-19-95

DWG. NO.: 9416-102

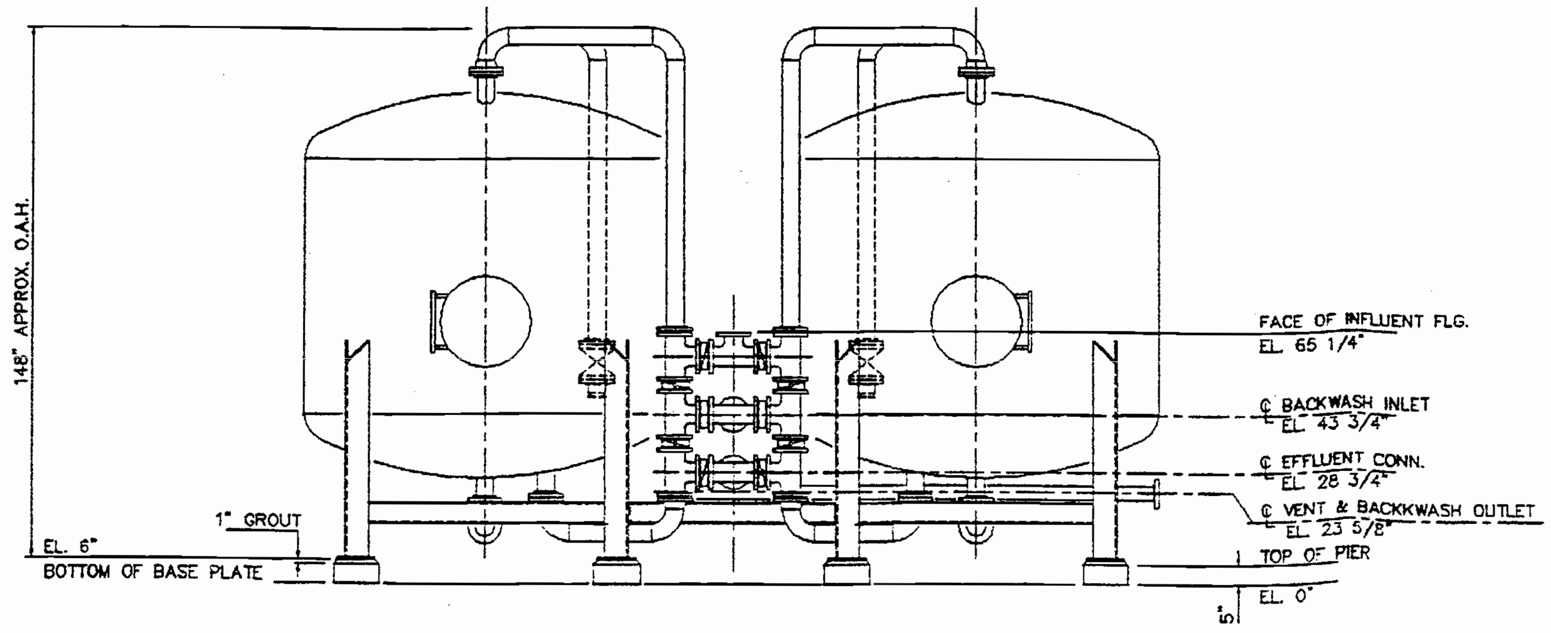
REV. 0



PLAN



ANCHOR BOLT PLAN



ELEVATION

NOTES:

1. SHIPPING WEIGHT – APPROX. 13,500 POUNDS. HEAVIEST PIECE – 5,500 POUNDS.
2. OPERATING WEIGHT – 79,600 POUNDS.
3. INLET, EFFLUENT, BACKWASH IN & BACKWASH OUT CONNECTIONS 4"–125 LB. FLANGES.
4. INITIAL PRESSURE DROP AT 250 GPM SERIES FLOW – 13.0 PSI.
5. ANCHOR BOLTS BY FOUNDATION CONTRACTOR.
6. COMPRESSED AIR CONNECTIONS – 1 1/2" FNPT (2 REQ'D.)
7. SEE OPERATING MANUAL FOR HANDLING AND ASSEMBLY INSTRUCTIONS.

No	REVISION	BY	DATE
0	FOR CONSTRUCTION	SM	5-11-95

ENVIROTROL, INC.
Activated Carbon Services
Sewickley, Pa.

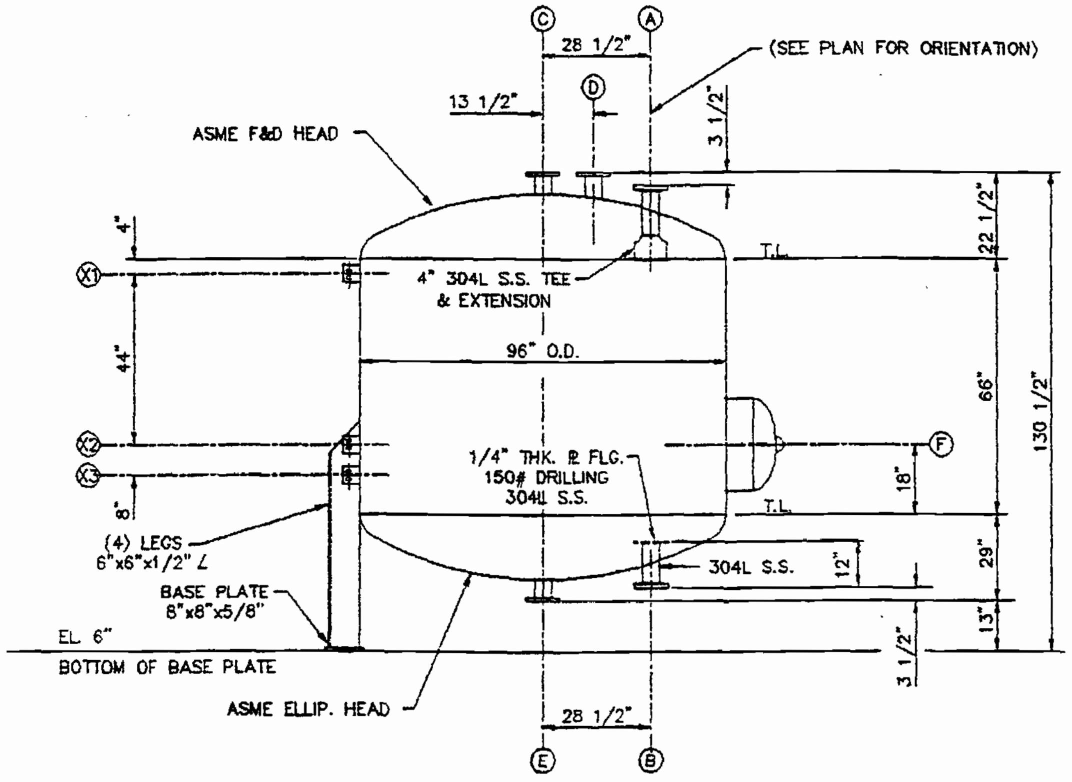
OHM CORPORATION
MCB CAMP LEJEUNE, NC

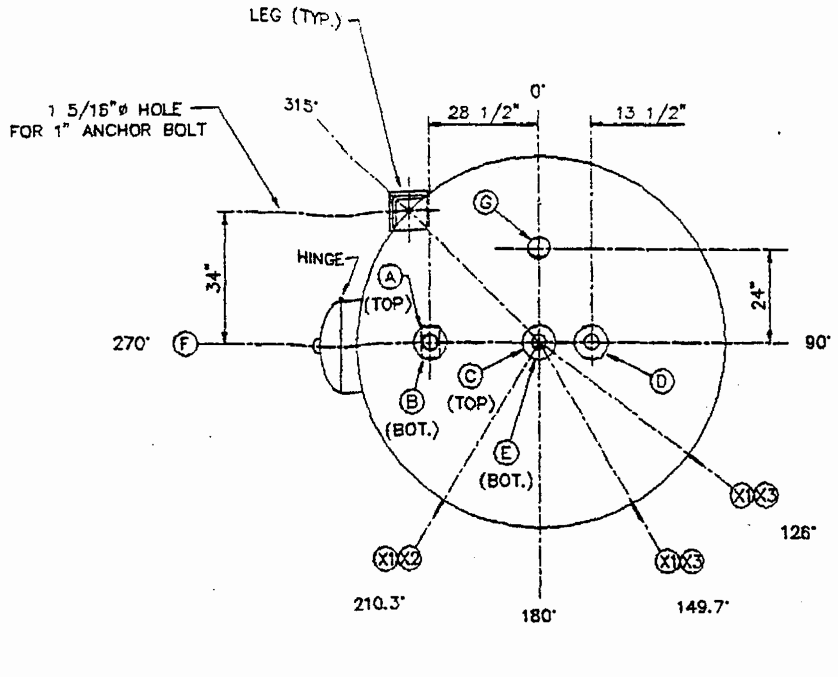
JFS | SRM | SRM | N.T.S.

GEN. ARRANGEMENT

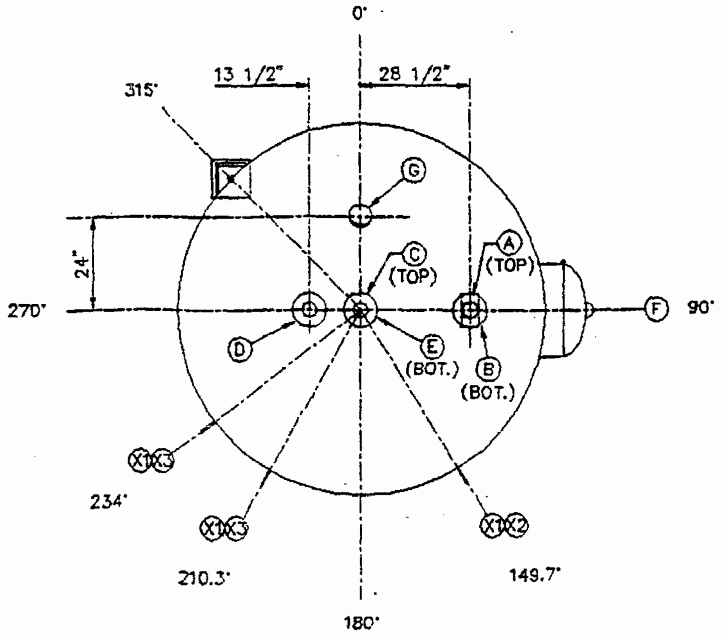
3-6-95

9416-201 | 0





ORIENTATION PLAN – TANK #1



ORIENTATION PLAN – TANK #2

ITEM NO.		NO. REQ'D. (2)
REFERENCE		
VESSEL SPECIFICATION		
DESIGN CONDITIONS		
SHELL	75 PSIG @ 150° F	
OPERATING CONDITIONS		
SHELL	MAX.60 PSIG @ 50–60° F	
MATERIALS		
SHELL, HEADS	ASTM A-516, GR. 70	
NOZZLES	SA 106B, SEAMLESS (U.N.O.)	
LINING	BY OTHERS	
GASKETS	1/8" NEOPRENE (45–55 DUROMETER)	
BOLTING	A 307B	
SUPPORTS	A 36	
CORROSION ALLOWANCE	NONE	
THICKNESS–MINIMUM TO BE		
SHELL	PER CODE	
HEADS	PER CODE	
CONSTRUCTION	FUSION WELDED	
CODE	ASME SECT. VIII, DIV.1	
STRESS RELIEF	NONE	RADIOGRAPH | PER CODE
TESTING	HYDRO @ 1.5 TIMES MAWP	
INSPECTION	BY PURCHASER AND CODE AGENCY	
STAMPING	ASME	
NAME PLATE	LATER	
PAINT	BY OTHERS	

OPERATING CAPACITY	2850	GAL.	% FILL	100	
FULL CAPACITY	2850	GAL.	PROD.SP.GR.	1.28	
ESTIMATED WEIGHT					
EMPTY	5010	LB.	FULL H O	28800	LB.
OPERATING	33400	LB.	FULL PROD.	35400	LB.
INSULATION SUPPORTS	NONE				
SEISMIC LOADING	ZONE 2A – IMPORTANCE FACTOR=1.0				
WIND LOADING					

MK	REQ'D	SIZE	DRILLING	FACING	DESCRIPTION
G	1	6"	N.A.	N.A.	HINGED MANWAY W/4 QUICK DISC.
F	1	18"	N.A.	N.A.	HINGED MANWAY W/8 QUICK DISC.
E	1	4"	150 LB.	F.F.	CARBON OUTLET
D	1	4"	150 LB.	F.F.	CARBON INLET
C	1	4"	150 LB.	F.F.	VENT
B	1	4"	150 LB.	F.F.	OUTLET (W/INTERNAL FLG.)(304L SS)
A	1	4"	150 LB.	F.F.	INLET (W/INTERNAL TEE)

NOZZLE SCHEDULE

NOTES:

1. ALL INTERIOR WELDS AND EDGES TO BE GROUND SMOOTH IN PREPARATION FOR LINING.
2. ALL NOZZLES TO BE FLUSH ON INSIDE OF SHELL IN PREPARATION FOR LINING UNLESS NOTED.
3. PROVIDE LIFTING LUGS FOR HOISTING EMPTY TANK BOTH VERTICALLY AND HORIZONTALLY.
4. SET AND WELD BASE PLATES AFTER ANGLES ARE WELDED TO TANK.

0	FOR CONSTRUCTION		3-11-95
No	REVISION	BY	DATE

ENVIROTROL, INC.
Activated Carbon Services
Sewickley, Pa.

OHM CORPORATION
MCB CAMP LEJEUNE, NC

JFS	SRM	SRM	N.T.S.

VESSEL

3-13-95

9416-301 | 0

APPENDIX VII

OHM

CAMP LEJEUNE

MANUFACTURER DATA

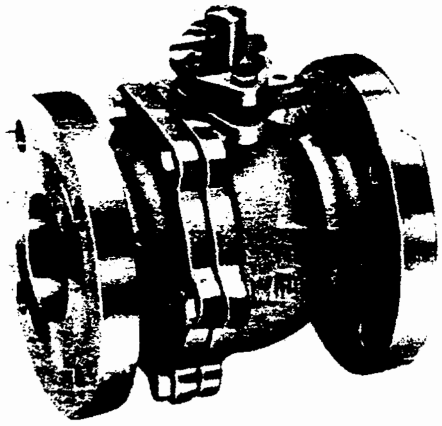
ITEM	DESCRIPTION	RECOMMENDED SPARE PARTS
1	Carbon Valves	*
2	Connectors	
	A. 4" (carbon lines)	*
	B. 3/4" (flush points)	*
3	Flush Connector Valve	*
4	Process Valves	
	A. 2" and larger	*
	B. 1 1/2" and smaller	*
5	Pressure Gauges	*
6	Sample Point Valves	*
7	Relief Valve	*
8	Underdrain Nozzles	*
9	System Protector	*

*Readily Available - None Required

STAINLESS STEEL FLANGE END BALL VALVES

Split Body, Full Bore, ANSI 150 LB, 300 LB

CAMP LEJUENE **1. CARBON VALVES**



Full Bore 1/2" – 12"

Fig. No. VL-11-150 (ANSI 150LB)
~~Fig. No. VL-11-300 (ANSI 300LB~~)

SPECIFICATIONS:

* Split Body 2 Piece Type. to Allow Inspection and Maintance on All Internal Parts
* Available in Carbon or Stainless Steel Body Construction
* Anti Blow-Out Stem
* Anti-Static Device
* Fire-Safe Design
* Temperature Range: –20 to 450°C
* Face to Face: ANSI B 16.10
* Flange Dimension: ANSI B16.5 150 LB and 300 LB
On Request Drilling to: ISO (DIN) PN10/16
* Operator: Level Operator, Gear Operator, Electric Operator, Pneumatic Operator

MATERIAL:

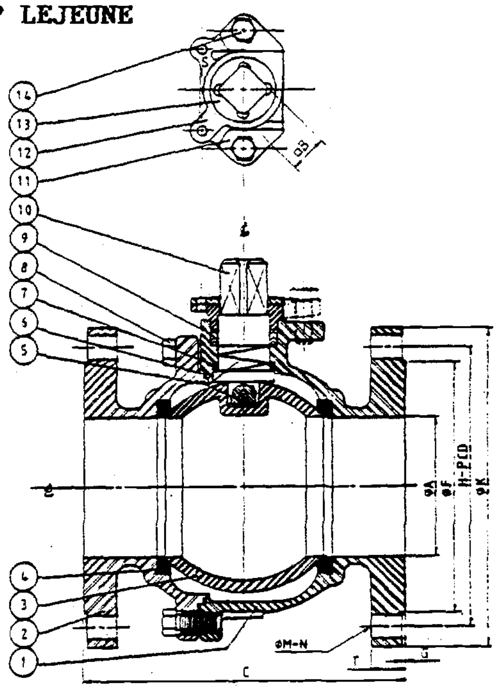
* ASTM A351 GR. CF8
* ASTM A351 GR. CF8M
* ASTM A216 GR. WCB.
* Special Alloy upon Request

STAINLESS STEEL FLANGE END BALL VALVES

Split Body, Full Bore, ANSI 150 LB, 300 LB

CAMP LEJEUNE

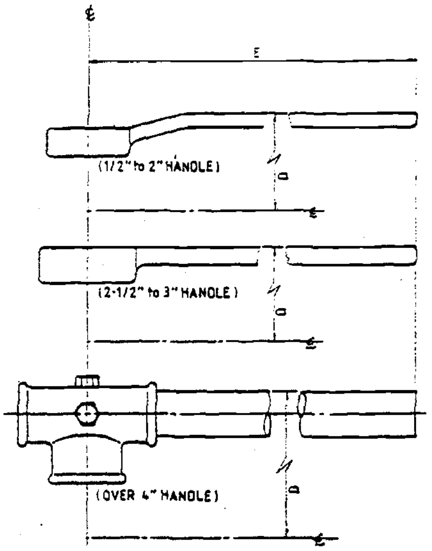
1. CARBON VALVES

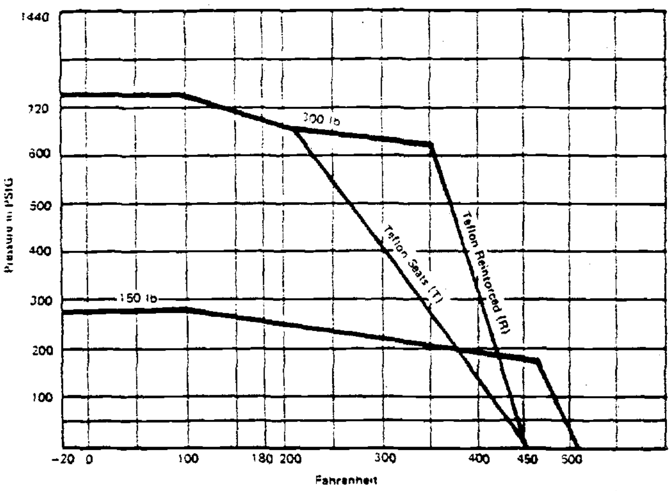


MATERIAL LIST

No.	PARTS NAME	SPECIFICATION	Q'TY
1	BODY	ASTM-A351-GRADE-CF8M	1
2	END CAP	ASTM-A351-GRADE-CF8M	1
3	BALL	ASTM-A351-GRADE-CF8M	1
4	SEAT RING	REINFORCED TFE*	2
5	STATIC DEVICE	SPRING	2
6	JOINT GASKET	ASBESTOS OR GRAPHITE	1
7	THRUST WASHER	REINFORCED TFE*	1
8	BOLT	SS304	4 or 8
9	STEM PACKING	TEFLON	2
10	STEM	SS316	1
11	GLAND	SS304	1
12	TRAVEL STOP	SS304	1
13	SNAP CATCH	SPRING	1
14	GLAND BOLT	SS304	2
	HANDLE	FC20	1

* DuPont Reg. T.M.





DIMENSIONS (ANSI 150 LBS & 300 LBS) (mm)

SIZE	A	B	C		D	E	F	H		K		T		G	M		N	
INCH			150	300				150	300	150	300	150	300		150	300	150	300
1/2"	.591	.394	4.25	5.51	2.84	4.53	1.38	2.38	2.63	3.50	3.75	.44	.56	.06	.63	.63	.16	.16
3/4"	.787	.394	4.61	5.98	2.95	4.53	1.69	2.76	3.25	3.86	4.61	.50	.63	.06	.63	.75	.16	.16
1"	.984	.472	5.00	6.50	3.66	5.12	2.01	3.13	3.50	4.25	4.88	.56	.69	.06	.63	.75	.16	.16
1¼"	1.260	.472	5.51	7.01	4.13	5.12	2.48	3.50	3.87	4.61	5.24	.63	.75	.06	.63	.75	.16	.16
1½"	1.575	.670	6.50	7.48	4.53	8.58	2.87	3.88	4.50	5.00	6.14	.69	.81	.06	.63	.87	.16	.16
2"	1.969	.670	7.00	8.50	4.72	8.58	3.62	4.74	5.00	5.98	6.50	.75	.87	.06	.75	.75	.16	.31
2½"	2.560	.827	7.48	9.49	5.32	11.61	4.13	5.49	5.87	7.01	7.48	.88	1.00	.06	.75	.87	.16	.31
3"	3.150	.827	7.99	11.14	5.71	11.61	5.00	6.00	6.63	7.48	8.27	.94	1.13	.06	.75	.87	.16	.31
➡ 4"	3.937	1.063	9.02	12.01	7.87	15.75	6.18	7.50	7.87	9.02	10.00	.94	1.25	.06	.75	.87	.31	.31 ⬅
5"	4.921	1.063	14.02	—	8.66	21.65	7.32	8.50	—	10.00	—	.94	—	.06	.87	—	.31	—
6"	5.910	1.063	15.51	15.87	9.45	21.65	8.50	9.51	10.63	10.98	12.52	1.00	1.44	.06	.87	.87	.31	.47
8"	7.874	1.378	17.99	19.76	11.81	39.37	10.63	11.75	13.00	13.50	15.00	1.13	1.63	.06	.87	.98	.31	.47
10"	9.843	1.378	20.98	22.36	13.98	39.31	12.76	14.25	15.25	15.98	17.52	1.19	1.87	.06	.98	1.14	.47	.63

CAMP LEJEUNE

2A. CONNECTOR - 4" CARBON

KURIYAMA OF AMERICA, INC.

MAIN OFFICE 1221 Landmeier Rd. Elk Grove Village, IL 60007 (708) 228-0300 FAX 1-800-800-0320 Toll Free

★ SALES OFFICES - CONTACT LOCATION BELOW WHICH SERVES YOUR AREA

SOUTHWEST WAREHOUSE
KURIYAMA OF AMERICA, INC.,
HOUSTON
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HOUSTON, TX 77029
713/674-8212
FAX 1 (713) 674-5214
FAX 1 (800) 800-5214 Toll Free

WESTERN WAREHOUSE
KURIYAMA OF AMERICA.
SANTA FE SPRINGS
10748 BLOOMFIELD AVE.
SANTA FE SPRINGS, CA 90670
310/941-4507
FAX 1 (310) 941-8940
FAX 1 (800) 326-8940 Toll Free

SOUTHEAST WAREHOUSE
FORTNEY SALES
393 SESSIONS ST.
MARIETTA, GA 30060
404/427-6528
FAX 1 (404) 423-9249
FAX 1 (800) 423-9249 Toll Free

EASTERN WAREHOUSE
EASTERN RUBBER & PLASTICS CO., INC.
PLUMSTEAD INDUSTRIAL PARK RT. 537
P.O. BOX 176
NEW EGYPT, N.J. 08533-0176
609/758-0100
FAX 1 (609) 758-0102
FAX 1 (800) 445-7138 Toll Free

NEW FEATURE— LOCKING HANDLES

GLASS REINFORCED NYLON COUPLINGS

4/95

QUICK ACTING—HOSE NIPPLES

Coupler Parts "B", "C", "D", "DC" are Supplied with Stainless Steel Handles.
Use Safety Clips Provided in Handles to Make Locking Handle. A SAFETY FEATURE

PART A

ADAPTOR X FEMALE NPT

Item Code	Size	Weight Ea.	Std. Pkg.	Suggested List Price Ea.
~~GRA100~~	~~1"~~	~~0.16~~	~~80~~	~~$ 3.21~~
~~GRA150~~	~~1½"~~	~~0.18~~	~~50~~	~~5.00~~
~~GRA200~~	~~2"~~	~~0.26~~	~~80~~	~~5.48~~
~~GRA300~~	~~3"~~	~~0.46~~	~~44~~	~~11.80~~
~~GRA400~~	~~4"~~	~~0.92~~	~~18~~	~~21.95~~

PART B

COUPLER X MALE NPT

Item Code	Size	Weight Ea.	Std. Pkg.	Suggested List Price Ea.
~~GRB100~~	~~1"~~	~~0.16~~	~~80~~	~~$ 8.50~~
~~GRB150~~	~~1½"~~	~~0.46~~	~~60~~	~~11.33~~
~~GRB200~~	~~2"~~	~~0.52~~	~~50~~	~~12.74~~
~~GRB300~~	~~3"~~	~~1.02~~	~~25~~	~~21.71~~
~~GRB400~~	~~4"~~	~~1.34~~	~~20~~	~~30.21~~

PART C

COUPLER X HOSE SHANK

Item Code	Size	Weight Ea.	Std. Pkg.	Suggested List Price Ea.
~~GRC100~~	~~1"~~	~~0.18~~	~~60~~	~~$ 8.12~~
~~GRC150~~	~~1½"~~	~~0.50~~	~~65~~	~~11.33~~
~~GRC200~~	~~2"~~	~~0.58~~	~~44~~	~~12.84~~
~~GRC300~~	~~3"~~	~~1.24~~	~~18~~	~~20.77~~
~~GRC400~~	~~4"~~	~~1.60~~	~~12~~	~~30.21~~

PART D

COUPLER X FEMALE NPT

Item Code	Size	Weight Ea.	Std. Pkg.	Suggested List Price Ea.
~~GRD100~~	~~1"~~	~~0.18~~	~~60~~	~~$ 8.02~~
~~GRD150~~	~~1½"~~	~~0.50~~	~~70~~	~~11.52~~
~~GRD200~~	~~2"~~	~~0.58~~	~~50~~	~~12.84~~
~~GRD300~~	~~3"~~	~~1.04~~	~~25~~	~~22.18~~
~~GRD400~~	~~4"~~	~~1.48~~	~~16~~	~~32.10~~

"GRN" HOSE NIPPLES

Item Code	Size	Weight Ea.	Std. Pkg.	Suggested List Price Ea.
~~GRN050~~	~~½"~~	~~0.02~~	~~250~~	~~$ 1.51~~
~~GRN075~~	~~¾"~~	~~0.04~~	~~125~~	~~1.70~~
~~GRN100~~	~~1"~~	~~0.06~~	~~125~~	~~1.89~~
~~GRN125~~	~~1¼"~~	~~0.08~~	~~80~~	~~2.27~~
~~GRN150~~	~~1½"~~	~~0.12~~	~~150~~	~~2.45~~
~~GRN200~~	~~2"~~	~~0.22~~	~~80~~	~~3.78~~
~~GRN300~~	~~3"~~	~~0.54~~	~~32~~	~~8.50~~
~~GRN400~~	~~4"~~	~~0.80~~	~~18~~	~~12.27~~

PART E

ADAPTOR X HOSE SHANK

Item Code	Size	Weight Ea.	Std. Pkg.	Suggested List Price Ea.
~~GRE100~~	~~1"~~	~~0.08~~	~~45~~	~~$ 4.34~~
~~GRE150~~	~~1½"~~	~~0.18~~	~~45~~	~~5.10~~
~~GRE200~~	~~2"~~	~~0.28~~	~~30~~	~~5.85~~
~~GRE300~~	~~3"~~	~~0.66~~	~~32~~	~~11.23~~
~~GRE400~~	~~4"~~	~~1.04~~	~~16~~	~~20.77~~

PART F

ADAPTOR X MALE NPT

Item Code	Size	Weight Ea.	Std. Pkg.	Suggested List Price Ea.
GRF100	1"	0.10	100	$ 4.06
GRF150	1½"	0.18	120	5.29
GRF200	2"	0.28	75	5.66
GRF300	3"	0.66	33	14.16
GRF400	4"	0.90	12	22.66 ◄

DUST CAP

Item Code	Size	Weight Ea.	Std. Pkg.	Suggested List Price Ea.
~~GRDC100~~	~~1"~~	~~0.16~~	~~80~~	~~$ 7.55~~
~~GRDC150~~	~~1½"~~	~~0.46~~	~~80~~	~~11.14~~
~~GRDC200~~	~~2"~~	~~0.50~~	~~70~~	~~12.56~~
~~GRDC300~~	~~3"~~	~~0.96~~	~~30~~	~~19.35~~
~~GRDC400~~	~~4"~~	~~1.16~~	~~20~~	~~25.96~~

DUST PLUG

Item Code	Size	Weight Ea.	Std. Pkg.	Suggested List Price Ea.
~~GRDP100~~	~~1"~~	~~0.06~~	~~100~~	~~$ 3.40~~
~~GRDP150~~	~~1½"~~	~~0.12~~	~~45~~	~~4.06~~
~~GRDP200~~	~~2"~~	~~0.20~~	~~25~~	~~4.91~~
~~GRDP300~~	~~3"~~	~~0.36~~	~~25~~	~~12.27~~
~~GRDP400~~	~~4"~~	~~0.60~~	~~36~~	~~15.58~~

~~REPLACEMENT GASKETS— AVAILABLE IN BUNA-N OR EPT (BUNA-N FURNISHED AS STANDARD ON PARTS B, C, D, & DC)~~

Size	Std. Pkg.	Wt. Ea.	Buna-N Sugg. List Price Ea.	Ept Sugg. List Price Ea.
~~1"~~	~~10*~~	~~.010~~	~~$ .45~~	~~$ .45~~
~~1½"~~	~~10*~~	~~.018~~	~~.50~~	~~.50~~
~~2"~~	~~10*~~	~~.024~~	~~.50~~	~~.50~~
~~3"~~	~~10*~~	~~.038~~	~~.62~~	~~.62~~
~~4"~~	~~10*~~	~~.062~~	~~.89~~	~~.89~~

~~*Sold in standard package only.~~

TEMPERATURE RANGE

Normal Conditions: — 30°F to + 200°F

WORKING PRESSURES

Size	PSI	Size	PSI
½" to 1"	175	3"	125
1½" to 2"	150	4"	75

CAM and GROOVE

DIXON "ANDREWS" / "BOSS-LOCK" CAM AND GROOVE ADAPTERS

Type F
Male Adapter x Male NPT

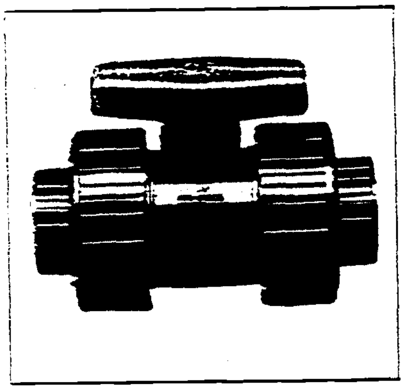
Size	Part #	Aluminum -AL	Pkg Qty	Aluminum Hard Coat -ALH	Pkg Qty	Brass -BR	Pkg Qty	Plated Malleable Iron -PM	Pkg Qty	Unplated Malleable Iron -MI	Pkg Qty	Stainless Steel -SS	Pkg Qty
1/2"	*50-F*	$5.15	10	——		$9.10	10	——				$38.80	10
3/4" x 1/2"	*7550-F*	6.40	10	——		9.60	10	$8.15	10	——		41.70	10
3/4"	*75-F*	6.40	10	——		9.60	10	9.60	10	——		40.45	10
1"	*100-F*	7.40	10	——		12.80	10	10.65	10	——		47.05	10
1 1/4"	*125-F*	10.00	10	——		17.80	10	16.05	10	——		56.50	10
1 1/2"	*150-F*	10.00	10	$15.90	10	18.85	10	16.30	10	$15.70	10	59.65	10
2"	*200-F*	12.55	10	19.55	10	23.70	10	20.65	10	19.65	10	65.95	10
2 1/2"	*250-F*	22.80	10	——		41.60	10	33.55	10	——		115.70	10
3"	*300-F*	25.25	10	33.75	10	49.90	10	38.90	5	37.10	5	130.75	10
4"	*400-F*	47.50	10	64.80	10	88.10	5	61.55	5	58.40	5	196.60	5
5"	*500-F*	83.70	5	——		POR		——		——		——	
6"	*600-F*	105.50	2	135.20	2	221.85	1	125.30	2	——		382.85	2
8"AND *	*800-F*	POR		——		——		——		——		——	
8" BL *	*801-F*	POR		——		——		——		——		——	

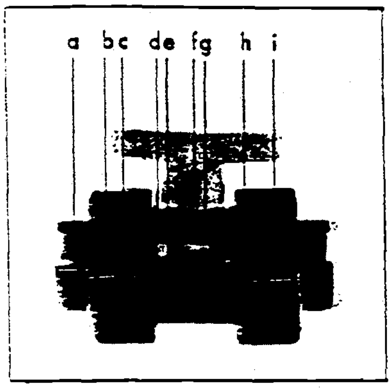
Type DP
Dust Plug

Size	Part #	Aluminum -AL	Pkg Qty	Aluminum Hard Coat -ALH	Pkg Qty	Brass -BR	Pkg Qty	Plated Malleable Iron -PM	Pkg Qty	Unplated Malleable Iron -MI	Pkg Qty	Stainless Steel -SS	Pkg Qty
1/2"	*50-DP*	——		——		$10.70	10	——		——		$30.45	10
3/4"	*75-DP*	$6.90	10	——		10.80	10	POR	10	——		30.45	10
1"	*100-DP*	7.70	10	——		10.95	10	$8.75	10	——		32.90	10
1 1/4"	*125-DP*	9.55	10	——		16.85	10	8.75	10	——	10	38.75	10
1 1/2"	*150-DP*	9.80	10	$14.50	10	18.10	10	11.40	10	$10.85	10	40.80	10
2"	*200-DP*	10.55	10	15.20	10	20.05	10	17.40	10	16.55	10	48.35	10
2 1/2"	*250-DP*	14.35	10	——		27.40	10	20.35	10	——		68.30	10
3"	*300-DP*	16.05	10	23.25	10	28.55	10	28.75	10	20.95	10	77.90	10
4"	*400-DP*	24.50	5	32.75	5	46.45	5	38.35	5	33.90	5	113.25	5
5"	*500-DP*	44.00	5	——		——		——		——		——	
6"	*600-DP*	51.25	5	78.30	2	157.50	2	83.35	2	——		286.55	3
8" AND *	*800-DP*	165.25		——		——		——		——		——	
8" BL *	*801-DP*	165.25		——		——		——		——		——	

* "Andrews" and "Boss-Lock" Cam and Groove Couplings DO NOT INTERCHANGE IN THE 8" SIZE
The 8" "Boss-Lock" were designed to interchange with 8" Cam & Groove couplings manufactured by P.T. Coupling.

George Fischer Ball Valve Type 560





The George Fischer 560 Ball Valve permits radial installation or removal and allows flow in either direction irrespective of installation position. Available in PVC and CPVC in sizes 1/2" through 4", the Type 560 is rated at 150 psi, non-shock, with a maximum operating pressure at 73° F. The Type 560 valve features superior chemical and corrosion resistance and is assembled with soapy water solution for high purity applications.

Technical Features

a) True Union Ball valves 1/2" through 2" are furnished with a pair of threaded and a pair of socket end connectors for simplification of distributor and end-user inventories.

b) Union ends allow for repair or replacement. Also allow positioning of valve.

c) Full block valve functions.

d) Seat backing O-rings provide a self-adjusting seal between seat and floating ball. O-ring seals are offered in either Viton® or EPDM.

e) Ball seals are made from PFA Teflon™, a fluorocarbon material that is virtually insoluble and chemically inert. PFA Teflon™ seals provide both extremely high mechanical strength and lubricity to make valve operation smooth, with minimal wear.

f) Snap-on handle indicates open or close, ensures proper mounting, and maintains clearance for knuckles. The handle remains firmly fixed.

g) Stem seal.

h) Seat carrier seal.

i) Union seal.

ate the ball (5) into the "closed" position. It can now be pushed out with a soft plastic or wooden rod. Press stem (6) into body (1) and remove.

Lubrication Note:
Lubrication of the stem seal and the seat carrier body seal depends on end use and seal material.

1. The Type 560 valve was designed to be used as a manually operated valve. It is suitable for applications where purity is important and where various lubricants are undesirable. It has been factory assembled with a soapy water solution which makes it satisfactory for use in:

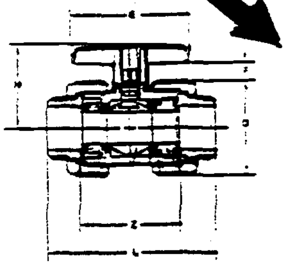
a. Semi-conductor high purity water return lines.
b. Sensitive solutions used in the manufacture of photographic films and papers.
c. Automotive paint lines using water based paints.
d. Similar applications in other industries.

2. If the valve is being used for other applications EPDM seals may be lubricated with either a silicon or polyglycol based grease. **Vaseline or mineral oils in particular are not to be used.**

Component Parts in accordance with part numbers

		1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
1 Valve Body	PVC	161.560.201	161.560.202	161.560.203	161.560.204	161.560.205	161.560.206	161.560.207	161.560.207	161.560.209
	[redacted]	163.560.301	163.560.302	163.560.303	163.560.304	163.560.305	163.560.306	163.560.307	163.560.307	163.560.309
2 Seat Carrier	PVC	161.560.214	161.560.215	161.560.216	161.560.217	161.560.218	161.560.219	161.560.220	161.560.220	161.560.222
	[redacted]	163.560.314	163.560.315	163.560.316	163.560.317	163.560.318	163.560.319	163.560.320	163.560.320	163.560.322
3 End Connector	PVC (1)	161.560.226	161.560.227	161.560.228	161.560.229	161.560.230	161.560.231	161.560.232	161.560.233	161.560.234
	[redacted]	161.560.238	161.560.239	161.560.240	161.560.241	161.560.242	161.560.243	161.560.244	161.560.245	161.560.246
	[redacted]	163.560.326	163.560.327	163.560.328	163.560.329	163.560.330	163.560.331	163.560.332	163.560.333	163.560.334
	[redacted]	163.560.338	163.560.339	163.560.340	163.560.341	163.560.342	163.560.343	163.560.344	163.560.345	163.560.346
4 Valve Nut	PVC	161.560.251	161.560.252	161.560.253	161.560.254	161.560.255	161.560.256	161.560.257	161.560.258	161.560.259
	[redacted]	163.560.351	163.560.352	163.560.353	163.560.354	163.560.355	163.560.356	163.560.357	163.560.358	163.560.359
5 Ball	PVC	161.560.264	161.560.265	161.560.266	161.560.267	161.560.268	161.560.269	161.560.270	161.560.270	161.560.272
	[redacted]	163.560.364	163.560.365	163.560.366	163.560.367	163.560.368	163.560.369	163.560.370	163.560.370	163.560.372
6 Stem	PVC	161.560.276	161.560.277	161.560.278	161.560.279	161.560.280	161.560.281	161.560.282	161.560.282	161.560.284
	[redacted]	163.560.376	163.560.377	163.560.378	163.560.379	163.560.380	163.560.381	163.560.382	163.560.382	163.560.384
7 Ball Seat	PFA	161.560.388	161.560.389	161.560.390	161.560.391	161.560.392	161.560.393	161.560.394	161.560.394	161.560.396
8 Backing Seal	EPDM	748.410.059	748.410.106	161.560.403	748.410.100	161.560.405	161.560.406	161.560.407	161.560.407	748.410.111
	[redacted]	749.410.059	749.410.106	161.560.416	749.410.100	161.560.418	161.560.419	161.560.420	161.560.420	749.410.111
9 Body Seal	EPDM	748.410.117	161.560.427	748.410.100	748.410.127	161.560.430	748.410.121	161.560.432	161.560.432	161.560.434
	[redacted]	161.560.438	161.560.439	749.410.100	749.410.127	161.560.442	749.410.121	161.560.444	161.560.444	161.560.446
10 Union Seal (solid end)	EPDM	748.410.059	748.410.106	161.560.403	748.410.027	161.560.455	161.560.456	161.560.458	161.560.458	161.560.459
	[redacted]	749.410.059	749.410.106	161.560.416	749.410.027	161.560.468	161.560.469	161.560.471	161.560.471	161.560.472
11 Seat Carrier Union Seal	EPDM	161.560.451	748.410.137	748.410.133	748.410.102	161.560.454	161.560.457	161.560.458	161.560.458	161.560.459
	[redacted]	161.560.464	161.560.465	749.410.133	749.410.102	161.560.466	161.560.467	161.560.471	161.560.471	161.560.472
12 Stem Seal	EPDM	748.410.089	748.410.063	161.560.478	161.560.479	161.560.480	748.410.000	161.560.482	161.560.482	161.560.482
	[redacted]	749.410.089	749.410.063	161.560.490	161.560.491	161.560.492	749.410.000	161.560.494	161.560.494	161.560.494
13 Handle	PVC	161.560.288	161.560.289	161.560.290	161.560.291	161.560.292	161.560.293	161.560.294	161.560.294	161.560.294
14 Assembly Tool		VT 005-012	VT 005-012	VT 005-012	VT 005-012	VT 015-040	VT 015-040	VT 015-040	VT 015-040	VT 015-040

(1) solvent cement socket (2) NPT threaded



All dimensions shown apply to the new design valve to be released during 1993. If above dimensions are critical to the installation, please contact factory at time of order to obtain correct dimensions of valve currently being supplied.

Dimensions PVC/CPVC*

Inch	D	Z (socket)	L	H	E	F	Face to Face Flange Valve
1/2	2.56	3.31	5.11	2.34	2.75	0.50	6.76
3/4	3.00	4.02	6.14	2.67	3.25	0.61	7.92
1	3.41	4.23	6.48	2.81	3.75	0.48	8.53
1 1/4	3.66	4.48	7.00	3.30	4.13	0.81	9.08
1 1/2	4.36	5.28	8.05	3.66	4.50	0.78	10.15
2	5.16	5.72	8.72	4.33	5.25	0.92	11.30
2 1/2	7.36	8.41	11.88	5.83	9.84	1.30	14.69
3	7.36	8.16	11.91	5.83	9.72	1.30	15.16
4	8.91	8.22	12.70	6.75	10.83	1.20	15.75
6**		17.47	23.45				26.97

(**4" valve with adapters)

Part Numbers

CPVC

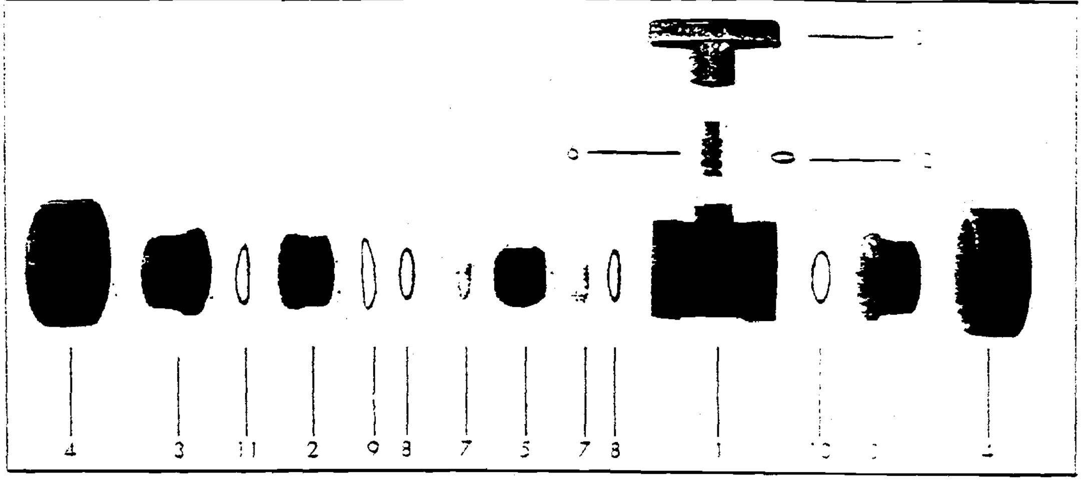
Inch Size	Solvent Cement Socket*** FPM (Viton)	NPT Thread*** FPM (Viton)
1/2	163.560.017	163.560.017
3/4	163.560.018	163.560.018
1	163.560.019	163.560.019
1 1/4	163.560.020	163.560.020
1 1/2	163.560.021	163.560.021
2	163.560.022	163.560.022
2 1/2	163.560.023	163.560.053
3	163.560.024	163.560.054
4	163.560.025	163.560.055

PVC

Inch Size	Solvent Cement Socket*** EPDM	NPT Thread*** EPDM	Solvent Cement Socket*** FPM (Viton)	NPT Thread*** FPM (Viton)
1/2	161.560.002	161.560.002	161.560.017	161.560.017
3/4	161.560.003	161.560.003	161.560.018	161.560.018
1	161.560.004	161.560.004	161.560.019	161.560.019
1 1/4	161.560.005	161.560.005	161.560.020	161.560.020
1 1/2	161.560.006	161.560.006	161.560.021	161.560.021
2	161.560.007	161.560.007	161.560.022	161.560.022
2 1/2	161.560.008	161.560.038	161.560.023	161.560.053
3	161.560.009	161.560.039	161.560.024	161.560.054
4	161.560.010	161.560.040	161.560.025	161.560.055

***1/2" - 2" are packaged with both threaded and socket end connectors.

	PVC	CPVC
6" adapters (for 4" valve); 2 required (6" socket x 4" spigot)	150.100.400	150.100.401



Assembly Instructions

Introduce seat backing seal (8) and PFA ball seat (7) into the groove of the fixed stop inside the body.

Position stem seal (12) into groove on stem (6). (See note below regarding lubrication.)

Introduce the stem assembly (12 & 6) into the body (1) from the inside and press until fully seated. Push the ball (5) onto the stem guide inside the body.

Draw the body seal (9) into the external groove of the seat carrier (2). (See note below regarding lubrication.) Mount the seat backing seal (8) and the ball seat (7) into the groove on the inner face of the seat carrier (2).

Screw the seat carrier (2) into the body (1). Note this is a standard clockwise thread to tighten and counter clockwise thread to loosen. Use the universal lug key (14) together with a standard 1/4" or 1/2" socket drive wrench to tighten. Tighten until the ball can still be rotated snugly.

Place seal carrier union seal (11) into the groove of the seat carrier (2) and solid end union seal (10) into the groove on the solid end of the body (1). Assemble the end connectors (3) to the body using the union nuts (4). Tighten union nuts sufficiently to compress the union seals slightly. Do not over tighten.

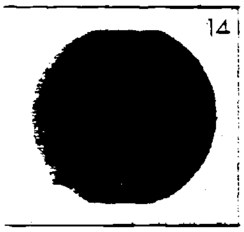
Mount the double lever handle (13) onto the stem (6). Note that groove in the stem socket must line up with raised key on the stem.

Dismantling

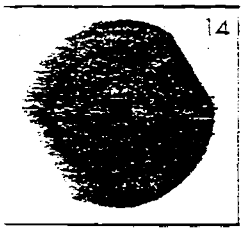
Please note: Do not dismantle while under pressure. Drain pipeline.

Loosen valve nuts (4) and remove radially from pipeline.

Remove the seat carrier (2) using the universal lug key together with a socket drive wrench. The seat carrier unscrews in a counterclockwise direction. On larger diameter valves it is necessary to use a holding fixture to contain the valve body firmly while unscrewing the seat carrier. Downward pressure on the lug key is necessary to insure that it remains firmly seated.
Note: There is one lug key for valves 1/2" through 1-1/4" and another for valves 1-1/2" through 4".



[illegible] /4"



[illegible] 4"

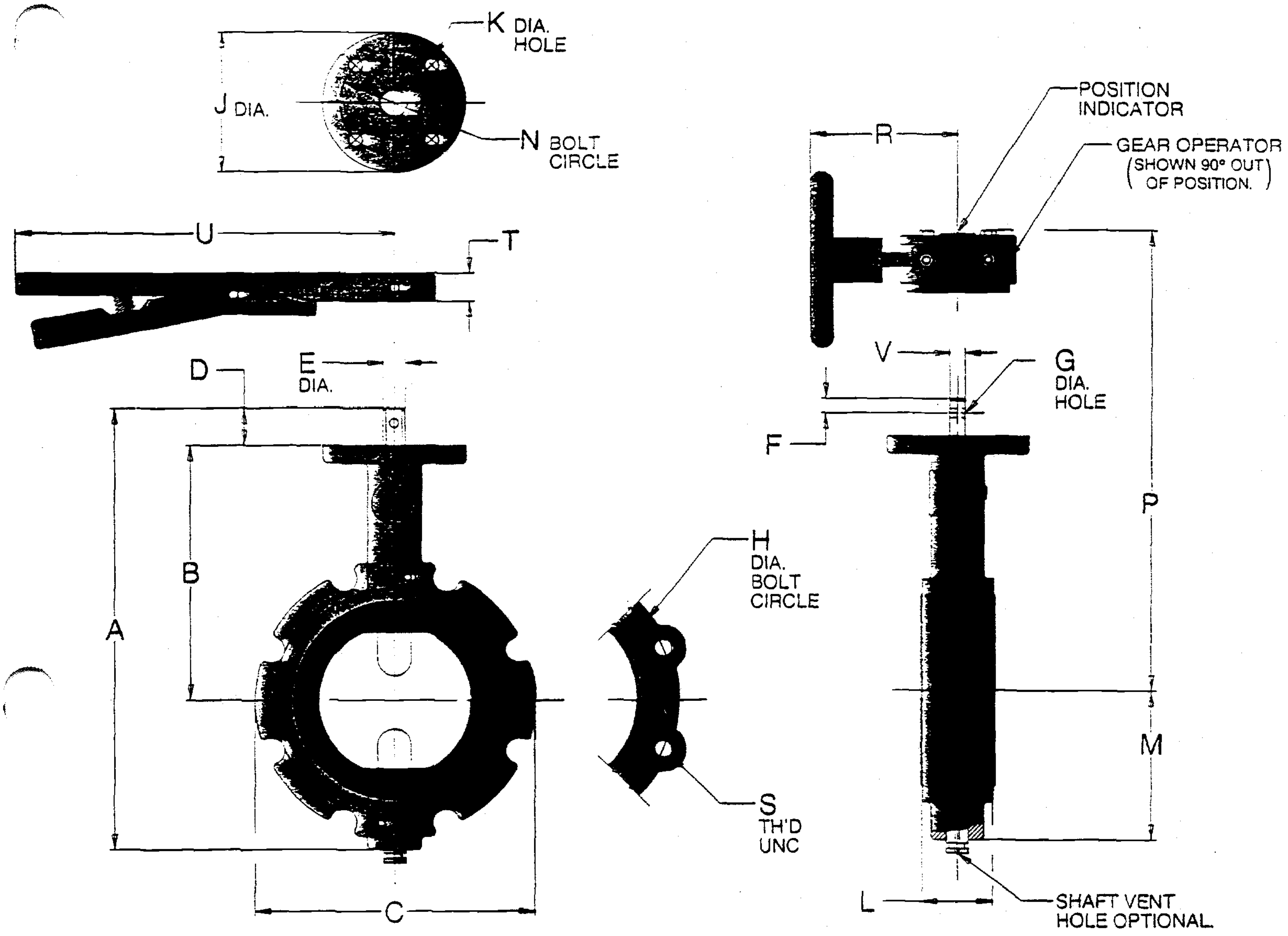
CUSTOM SPECIFICATION

CAMP LEJEUNE

Product:	**Series 8000 Butterfly Valve 2-12 WC-B202-3-0**
Body Style:	Wafer style body to fit between ANSI 150 class flanges. Water body to have locating ribs to properly align valve between flanges.
Body Material:	Body material to be cast iron ASTM A126, Class B, long neck design, rated to 200 PSI.
Seat Material:	Seat material to be Buna N. Liner to be phenolic backed cartridge type seat. No boot type liners will be allowed. All liners to have crowned seat for medium disc engagement. Liners to have molded O-rings in stem journals for secondary stem seal.
Disc Material:	Disc material to be nickel plated ductile iron. Disc to be floating disc design with flatted areas at shaft holes for increased disc/liner interference. Disc to attach to stems with slotted "D" drive connection. No pins or screws allowed for attachment of disc to stem.
Stem:	Shaft material to be 418 stainless steel with bronze bushings. Shaft to be two piece design with drive shaft to be flat at top and bottom to indicate valve position without handle attached. Lower shaft to be stub shaft. Shafts to be made blow out proof by pinning shaft into body, allowing removal of operator while under full pressure.
Manufactured:	Tested for AWWA C504

GRINNELL

Dimensions: 2"-12" Series 8000 Butterfly Valves



DIMENSIONS (INCHES)

VALVE SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	NO. OF LUGS	T	U	V	GEAR OPERATOR
2"	9.40	5.75	4.12	1.09	.56	.45	.25	4.75	4.00	.41	1.62	2.56	3.00	8.00	4.12	5/8	4	.81	10.5	.44	~~GG-4~~
~~2½"~~	~~10.22~~	~~6.25~~	~~4.84~~	~~1.09~~	~~.56~~	~~.45~~	~~.25~~	~~5.50~~	~~4.00~~	~~.41~~	~~1.75~~	~~2.87~~	~~3.00~~	~~8.50~~	~~4.12~~	[illegible]	~~4~~	~~.81~~	~~10.5~~	~~.44~~	~~GG-4~~
~~3"~~	~~10.84~~	~~6.50~~	~~5.34~~	~~1.09~~	~~.56~~	~~.45~~	~~.25~~	~~6.00~~	~~4.00~~	~~.41~~	~~1.75~~	~~3.25~~	~~3.00~~	~~8.75~~	~~4.12~~	[illegible]	~~4~~	~~.81~~	~~10.5~~	~~.44~~	~~GG-4~~
4"	12.59	7.25	6.88	1.09	.62	.45	.25	7.50	4.00	.41	2.00	4.25	3.00	9.50	4.12	5/8	8	.81	10.5	.44	~~GG-4~~
~~5"~~	~~14.10~~	~~7.75~~	~~7.72~~	~~1.09~~	~~.88~~	~~.45~~	~~.25~~	~~8.50~~	~~4.00~~	~~.41~~	~~2.12~~	~~5.31~~	~~3.00~~	~~10.00~~	~~4.12~~	[illegible]	~~8~~	~~.81~~	~~10.5~~	~~.44~~	~~GG-4~~
~~6"~~	~~15.47~~	~~8.38~~	~~8.75~~	~~1.09~~	~~1.00~~	~~.45~~	~~.25~~	~~9.50~~	~~4.00~~	~~.41~~	~~2.12~~	~~6.00~~	~~3.00~~	~~10.62~~	~~4.12~~	[illegible]	~~8~~	~~.81~~	~~10.5~~	~~.44~~	~~GG-4~~
~~8"~~	~~19.81~~	~~9.62~~	~~11.00~~	~~1.62~~	~~1.12~~	~~.56~~	~~.38~~	~~11.75~~	~~6.00~~	~~.53~~	~~2.38~~	~~7.56~~	~~5.00~~	~~12.56~~	~~9.87~~	[illegible]	~~8~~	~~1.25~~	~~15~~	~~.75~~	~~GR-8~~
~~10"~~	~~21.62~~	~~11.00~~	~~13.38~~	~~1.62~~	~~*1.12~~	~~.56~~	~~.38~~	~~14.25~~	~~6.00~~	~~.53~~	~~2.75~~	~~9.00~~	~~5.00~~	~~14.00~~	~~9.87~~	[illegible]	~~12~~	~~1.25~~	~~15~~	~~.75~~	~~GR-8~~
~~12"~~	~~24.44~~	~~12.50~~	~~16.12~~	~~1.62~~	~~*1.12~~	~~.56~~	~~.38~~	~~17.00~~	~~6.00~~	~~.53~~	~~3.00~~	~~10.31~~	~~5.00~~	~~15.50~~	~~9.87~~	[illegible]	~~12~~	~~1.25~~	~~15~~	~~.75~~	~~GR-8~~

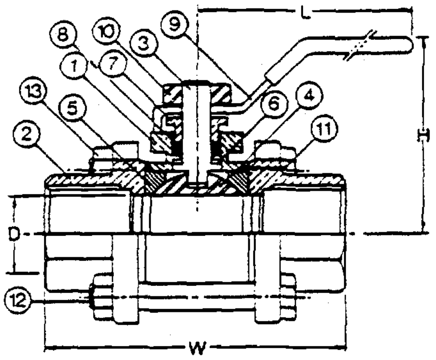
*Actual shaft size is 1.38" dia. for 10" and 1.50" dia. for 12".

BALL VALVE-3 PIECE

BRONZE

FULLPORT

600 WOG ¼" - 1" • 400 WOG 1¼" - 2"
150 SWP ¼" - 2"

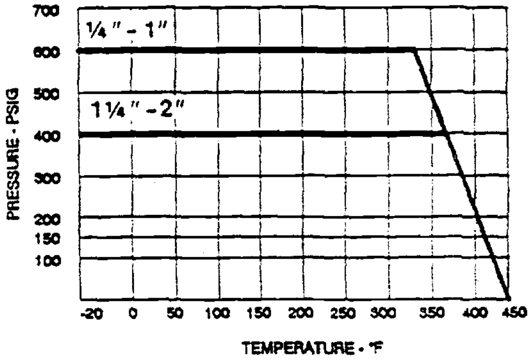


BA-300	— FNPT Ends
BA-300S	— FNPT Ends, SS Ball, Stem
BA-350	— Solder Ends
BA-350S	— Solder Ends, SS Ball, Stem

SPECIFICATIONS

Meets WW-V-35 Design Requirements

PRESSURE - TEMPERATURE CHART



MATERIAL LIST

NO.	PART	MATERIAL
1	Body	Bronze-B62
2	End - Cap	Bronze-B62
3	Stem[1]	Brass
4	Ball[1]	Brass-B16 Chr. Plate
5	Seats	15% Gl. Filled PTFE
6	Stem Washer	15% Gl. Filled PTFE
7	Gland	Brass
8	Stem - Seal	PTFE
9	Handle	Steel
10	Handle Nut	Steel
11	Body Seal	PTFE
12	Body Bolt	Steel
13	Body Nut	Steel

BA-300 DIMENSIONS-INCHES

SIZE	D	W	H	L
¼	0.375	2.06	1.551	3.366
⅜	0.375	2.06	1.551	3.366
½	0.5	2.228	1.708	3.366
¾	0.75	3.25	2.074	3.642
1	0.98	3.875	2.484	4.389
1¼	1.22	4.5	2.638	4.389
1½	1.49	5	3.114	6.122
2	1.969	5.62	3.437	6.122

[1] Alternate GR.316 Stainless Steel

TORQUE RATING

SIZE	MAXIMUM BREAKAWAY TORQUE (IN LBS.)	SIZE	MAXIMUM BREAKAWAY TORQUE (IN LBS.)
¼	60	1	230
⅜	60	1¼	230
½	170	1½	320
¾	200	2	500

BA-350 DIMENSIONS — INCHES

~~SIZE~~	~~D~~	~~W~~	~~H~~	~~L~~
~~⅜~~	~~0.375~~	~~2.06~~	~~1.551~~	~~3.366~~
~~½~~	~~0.5~~	~~2.228~~	~~1.708~~	~~3.366~~
~~¾~~	~~0.75~~	~~3.25~~	~~2.074~~	~~3.642~~
~~1~~	~~0.98~~	~~3.875~~	~~2.484~~	~~4.389~~
~~1¼~~	~~1.22~~	~~4.5~~	~~2.638~~	~~4.389~~
~~1½~~	~~1.49~~	~~5~~	~~3.114~~	~~6.122~~
~~2~~	~~1.969~~	~~5.62~~	~~3.437~~	~~6.122~~

MILWAUKEE VALVE COMPANY

2375 South Burrell Street Milwaukee, Wisconsin 53207
Telephone Area Code 414/744-5240 • Telex 2-69437 • Fax No. (414) 744-5840

Marsh Process Gauges
Series "P"

Specifications

Accuracy - ASME Grade 2A - ±0.5%

Ranges - Compound, vacuum and pressure to 20,000 psi.

Temperature Limit - Ambient operating temperature for the liquid filled gauge option is 0 to 150°F (-15 to 65°C). Operating range for the dry construction is -40 to 160°F (-40 to 71°C).

Dial Size - 4 1/2"

Bourdon Tube/Socket - 316 Stainless steel. Bourdon tube TIG welded to socket. Phosphor bronze bourdon tube soft-soldered to brass socket for ranges through 300 psi; ranges 400 and 600 psi feature silver solder joint. Higher pressures feature silver brazed tube socket assembly.

Movement - Three distinct assemblies designed to work in conjunction with tube and socket materials.

- Copper Alloy tube/socket design features brass sector and pinion with polycarbonate side plates.
- Stainless tube/socket design features rotary geared stainless steel movement.
- Stainless/Alloy combination features stainless sector and pinion with polycarbonate side plates.
- Monel tube/socket features rotary geared stainless steel movement.

Case - Vented, turret style glass-filled polypropylene case with solid front construction, full pressure relief back. Phenolic available as option. Aluminum case options outlined as shown.

Window - Glass standard (dry), acrylic standard (liquid-filled) or safety glass (optional).

Dial - White coated aluminum with black scales. Single scale (psi) is standard. Custom dials upon request.

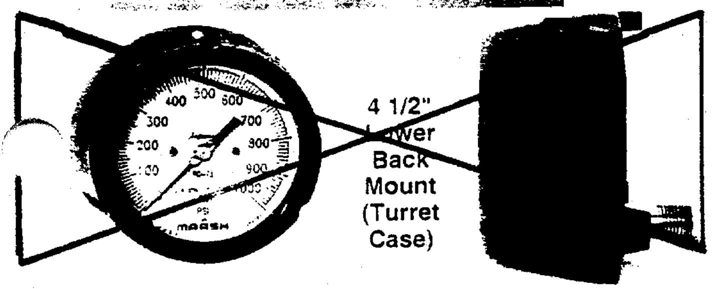
Pointer - Micrometer standard.

Connection - 1/2" or 1/4" NPT

Liquid Fill - Glycerin (standard), silicone or other fill materials available.

Options - *Consult factory for details*

-Fill Kit Part No. 79999-93
-Front Flange Adaptor Rings (Chrome) Part No. 9-79999-20 (Black) Part No. 9-79999-1
-Metric Dials
- Special Threads
-Special Fill Materials


4 1/2" Lower Back Mount (Turret Case)

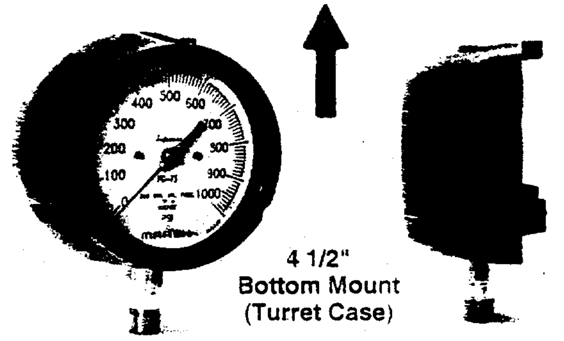
4 1/2" Polypropylene Case Options:

4 1/2" BOTTOM MOUNT (TURRET CASE)

NPT Bottom Connections	Copper Alloy Bourdon Tube, Tip, and Socket 1/4"	Copper Alloy Bourdon Tube, Tip, and Socket 1/2"	316 S.S Bourdon Tube, Alloy Tip and Socket 1/4"	316 S.S Bourdon Tube, Alloy Tip and Socket 1/2"	316 S/S Bourdon Tube Tip and Socket 1/4"	316 S/S Bourdon Tube Tip and Socket 1/2"	Monel* Bourdon Tube, Tip and Socket 1/4"	Monel* Bourdon Tube, Tip and Socket 1/2"
RANGES								
30" Vacuum	P0105	P0505	P2205	P2605	P5105	P5605	P4505	P3205
30" x 15 psi	P0110	P0510	P2210	P2610	P5110	P5610	P4510	P3210
30" x 30 psi	P0112	P0512	P2212	P2612	P5112	P5612	P4512	P3212
30" x 60 psi	P0114	P0514	P2214	P2614	P5114	P5614	P4514	P3214
30" x 100 psi	P0116	P0516	P2216	P2616	P5116	P5616	P4516	P3216
30" x 200 psi	P0120	P0520	P2220	P2620	P5120	P5620	P4520	P3220
30" x 300 psi	P0124	P0524	P2224	P2624	P5124	P5624	P4524	P3224
0 to 15 psi	P0140	P0540	P2240	P2640	P5140	P5640	P4540	P3240
0 to 30 psi	P0142	P0542	P2242	P2642	P5142	P5642	P4542	P3242
0 to 60 psi	P0146	P0546	P2246	P2646	P5146	P5646	P4546	P3246
0 to 100 psi	P0148	P0548	P2248	P2648	P5148	P5648	P4548	P3248
0 to 160 psi	P0152	P0552	P2252	P2652	P5152	P5652	P4552	P3252
0 to 200 psi	P0154	P0554	P2254	P2654	P5154	P5654	P4554	P3254
0 to 300 psi	P0158	P0558	P2258	P2658	P5158	P5658	P4558	P3258
0 to 400 psi	P0160	P0560	P2260	P2660	P5160	P5660	P4560	P3260
0 to 600 psi	P0164	P0564	P2264	P2664	P5164	P5664	P4564	P3264
0 to 800 psi	P0166	P0566	P2266	P2666	P5166	P5666	P4566	P3266
0 to 1,000 psi	P0168	P0568	P2268	P2668	P5168	P5668	P4568	P3268
0 to 1,500 psi	-	-	-	P2674	-	P5674		
0 to 2,000 psi	-	-	-	P2676	-	P5676		
0 to 3,000 psi	-	-	-	P2678	-	P5678		
0 to 5,000 psi	-	-	-	P2682	-	P5682		
0 to 10,000 psi	-	-	-	P2690	-	P5690		
0 to 15,000 psi	-	-	-	P2692	-	P5692		
0 to 20,000 psi	-	-	-	P2694	-	P5694		

NOTE: The above part numbers denote our standard product which is a dry gauge. To order a liquid-filled gauge from the factory, add the suffix "P" to the part number, and adjust the list price according to the instructions in the price sheet.

To order Liquid-Fill Kit for field-filling, request part number 9-79999-10.


4 1/2" Bottom Mount (Turret Case)

4 1/2" LOWER BACK MOUNT (TURRET CASE)

NPT LB Connections	~~Copper Alloy Bourdon~~ Tube, Tip, and Socket 1/4"	~~Copper Alloy Bourdon~~ Tube, Tip, and Socket 1/2"	~~316 S/S Bourdon Tube~~ Alloy Tip and Socket 1/4"	~~316 S/S Bourdon Tube~~ Alloy Tip and Socket 1/2"	~~316 S/S Bourdon Tube~~ Tip and Socket 1/4"	~~316 S/S Bourdon Tube~~ Tip and Socket 1/2"
RANGES						
30" Vacuum	P0205	P0605	P2305	P2705	P5205	P5705
30" x 15 psi	P0210	P0610	P2310	P2710	P5210	P5710
30" x 30 psi	P0212	P0612	P2312	P2712	P5212	P5712
30" x 60 psi	P0214	P0614	P2314	P2714	P5214	P5714
30" x 100 psi	P0216	P0616	P2316	P2716	P5216	P5716
30" x 200 psi	P0220	P0620	P2320	P2720	P5220	P5720
30" x 300 psi	P0224	P0624	P2324	P2724	P5224	P5724
0 to 15 psi	P0240	P0640	P2340	P2740	P5240	P5740
0 to 30 psi	P0242	P0642	P2342	P2742	P5242	P5742
0 to 60 psi	P0246	P0646	P2346	P2746	P5246	P5746
0 to 100 psi	P0248	P0648	P2348	P2748	P5248	P5748
0 to 160 psi	P0252	P0652	P2352	P2752	P5252	P5752
0 to 200 psi	P0254	P0654	P2354	P2754	P5254	P5754
0 to 300 psi	P0258	P0658	P2358	P2758	P5258	P5758
0 to 400 psi	P0260	P0660	P2360	P2760	P5260	P5760
0 to 600 psi	P0264	P0664	P2364	P2764	P5264	P5764
0 to 800 psi	P0266	P0666	P2366	P2766	P5266	P5766
0 to 1,000 psi	P0268	P0668	P2368	P2768	P5268	P5768
0 to 1,500 psi	-	-	-	P2774	-	P5774
0 to 2,000 psi	-	-	-	P2776	-	P5776
0 to 3,000 psi	-	-	-	P2778	-	P5778
0 to 5,000 psi	-	-	-	P2782	-	P5782
0 to 10,000 psi	-	-	-	P2790	-	P5790
0 to 15,000 psi	-	-	-	P2792	-	P5792
0 to 20,000 psi	-	-	-	P2794	-	P5794

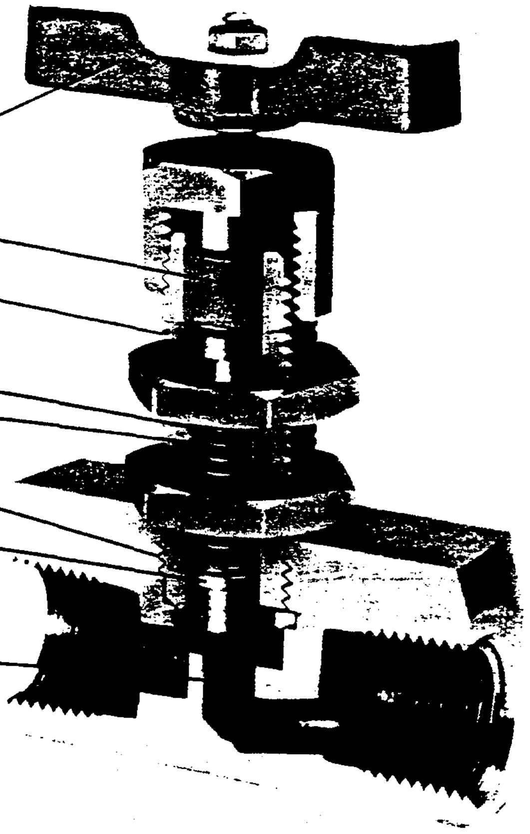
NOTE: The above gauges are not liquid fillable.

MARSH METAL-TO-METAL SEAT NEEDLE VALVES

Alloy Steel

A proven rugged and reliable needle valve in a variety of industrial applications for over 30 years. The perfect valve for regulating pressures up to 10,000 psi where media are least corrosive. For this use, alloy steel needle valves are the most economical.

- Two-prong handle, color coded for ease of identification.
- Zero-clearance washers and nongalling Teflon* packing.
- Outside threaded bonnet, one model serves either in-line or panel-mounting applications.
- Roll-formed stem threads for longer life.
- Precision-machined stem for perfect concentricity, easier operation.
- Bonnet screwed into body and staked for added security.
- Integral back-seated stem (standard on globe patterns ½" and under) or stem retaining ring. Exclusive safety feature prevents accidental removal of stem.
- Metal-to-metal seat.
- Pressure rating, 10,000 psi.



Specifications and Description

Body and Bonnet Material: AISI 1213 alloy steel.

Stem Material: 416 stainless steel, hardened.

Pressure Limits: 10,000 psi (70,000 kPa).

Temperature Limits: -100° to 500°F (-73° to 260°C).

Packing: Two-piece molded Teflon* (PTFE asbestos).

Seat: Metal-to-metal.

Handle: Yellow, two-prong. Cast aluminum for ⅛" through ½" sizes. Malleable iron for ¾" and 1" sizes.

Connection: National Pipe Thread, meeting specifications of Federal Standard H-28. MS threads available on special orders.

Finish: Clear zinc chromate plating.

Stem Retaining Method: All globe valves ½" and under feature integral back-seated stem to prevent accidental removal. Stem retaining E-ring in ¾" and 1" sizes and all angle valves.

Assembly: Bonnet on all globe valves ½" and under is threaded into body and staked to prevent turning. Body and bonnet on all angle valves and ¾" and 1" globe valves are machined from a solid bar. Body and body insert for angle valves fused into single unit through a welding process.

Pattern & Connection Size		Product Number	
		In-Line	Panel-Mounted
FFG	⅛" NPT	N1511	See "PANEL-MOUNT ADAPTATION KIT" table below for converting in-line models to panel-mounting.
FFG	¼" NPT	N1512	
FFG	⅜" NPT	N1513	
FFG	½" NPT	N1514	
FFG	¾" NPT	N1516	
FFG	1" NPT	N1518	
MFG	¼" NPT	N1532	
MFG	½" NPT	N1534	
FFA	⅛" NPT	N1551	
FFA	¼" NPT	N1552	
FFA	⅜" NPT	N1553	
FFA	½" NPT	N1554	
FFA	¾" NPT	N1556	
FFA	1" NPT	N1558	
MFA	¼" NPT	N1572	
MFA	½" NPT	N1574	

Valve Size	Kit Number
⅛"	9-1483-1S3
¼"	9-1483-1S3
⅜"	9-1477-1S3
½"	9-1477-1S3
¾"	9-1484-1S3
1"	9-1484-1S3

Panel-Mount Adaptation Kit

Each kit contains two stainless steel mounting nuts. Be sure to order the proper size. (Note: Interchangeable with those used on the 316 SST models.)

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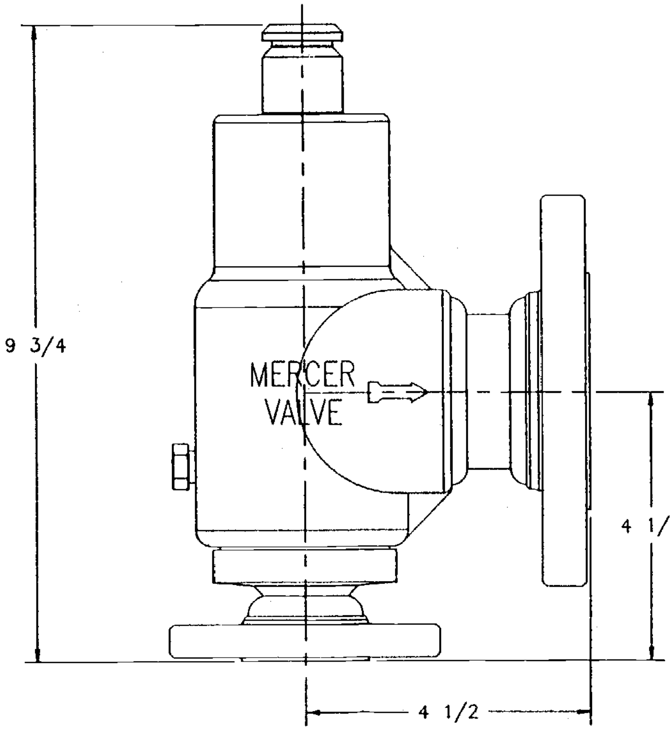
*Teflon is a registered trademark of DuPont.

REVISIONS

SYM.	DESCRIPTION	ECN	DATE
A	FIRST ISSUE	–	07/15/95



USED ON	PART NO.	MATERIAL
E ORIFICE FLANGED S.R.V.'S		

UNLESS OTHERWISE SPECIFIED:
TOLERANCE:
FRACTIONS ±1/64
TWO PLACE DECIMALS ±.010
THREE PLACE DECIMALS ±.005
ANGULAR ±1°
ALL DIMENSIONS IN INCHES

MERCER VALVE CO.

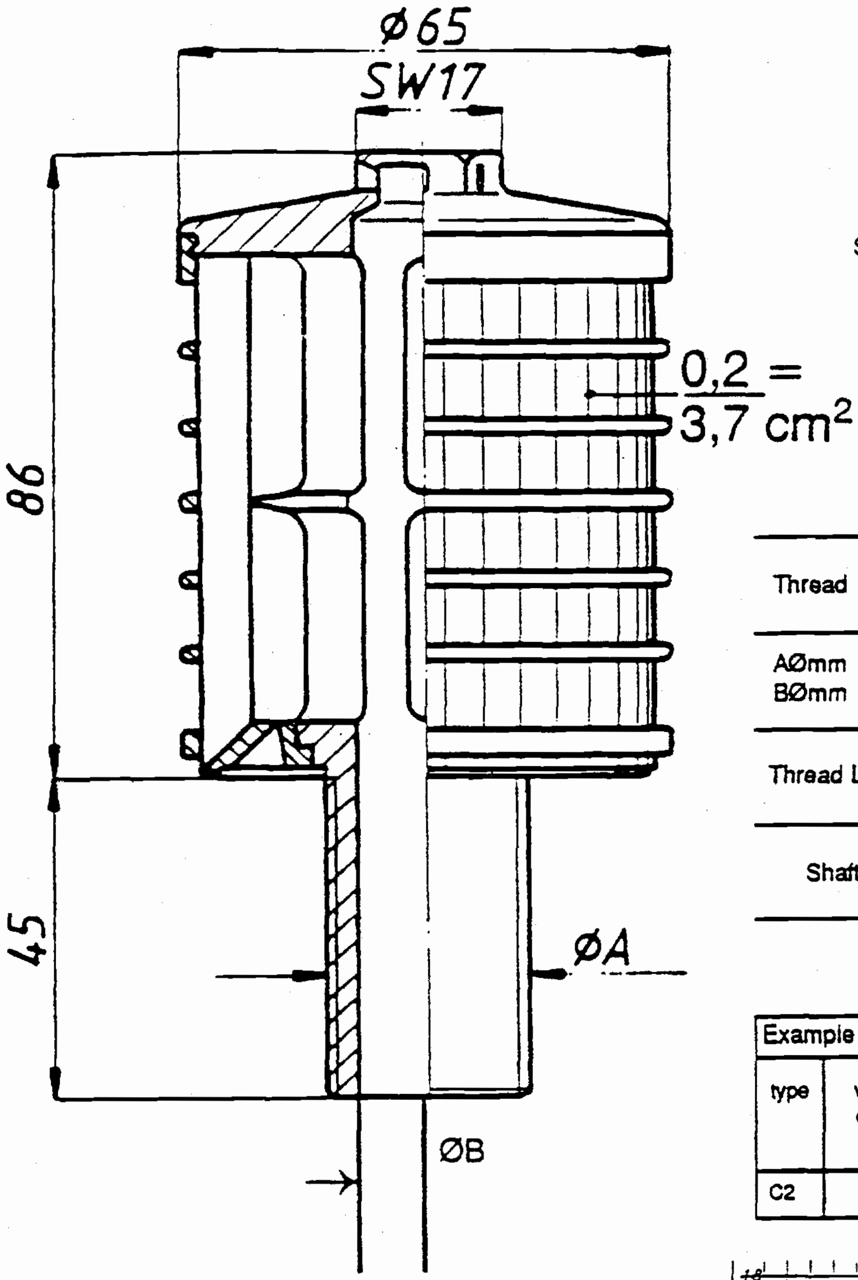
1:2
07/15/95
A. 1.
RHE

8100 SERIES FLANGED S.R.V.'S

1"–150# RF X 2"–150# RF
OUTLINE DRAWING

EN–1000

FILTER NOZZLE ~ ORTHO	TYPE C2	PAGE 28



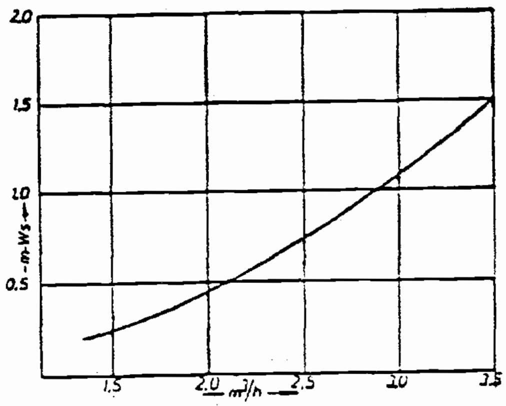
Slots | 0,2 mm = 3.7 cm^2
0,3 mm = 5.55 cm^2

or on request

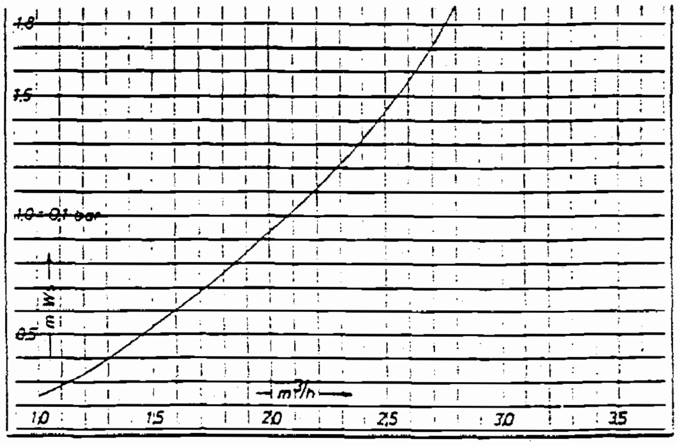
Thread	M24	1"WW	3/4" NPT	1-1/4" WW
AØmm BØmm	24 16 (2,0 cm^2)	25,4 16 (2,0 cm^2)	26,4 16 (2,0 cm^2)	32 21 (3,4 cm^2)

Thread Length	45 mm (20/60) or on request
Shaft(L)	20, 45, 60, 80, 110, 140, 200, 220, 250 mm or on request

Example for ordering				
type	width of slot	thread	thread length	air flush pipe (shaft)
C2	0,2	M24	45	80



C2 0.2 BØ=21

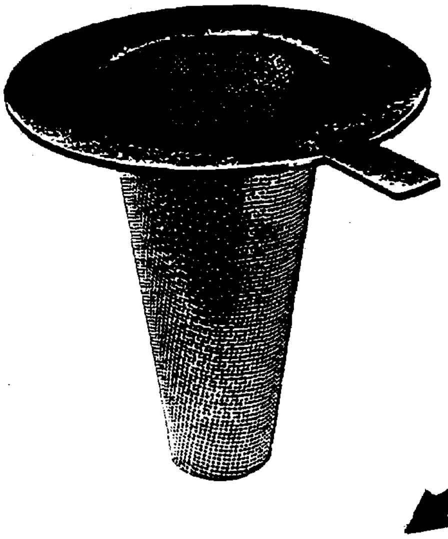


C2 0.2 BØ=16

MUESSCO®

TEMPORARY STRAINERS (BASKET, CONICAL & PLATE)

CERTIFIED CORRECT
MUELLER STEAM SPECIALTY
RAYMOND E. GUILLEMME, JR.



(Model illustrated is basket type Mod. 22)

SERVICE RECOMMENDATIONS: Designed to provide inexpensive protection for costly pumps, meters, valves and other mechanical equipment from dirt, scale and other foreign matter.

FEATURES: Available in dimensions shown below or with special lengths providing straining ratios of many times the pipe area.

INSTALLATION: These units are installed between flanges, ideal for applications where space restrictions are an important factor.

MATERIALS OF CONSTRUCTION: Available in carbon steel, stainless steel, and many other materials.

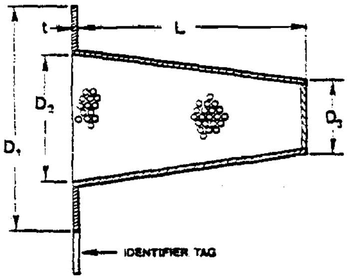
PERFORATIONS: Available in perforated and/or mesh for straining foreign matter as coarse as ½" or as fine as 5 microns. (.0002).

STANDARD PERFORATIONS:

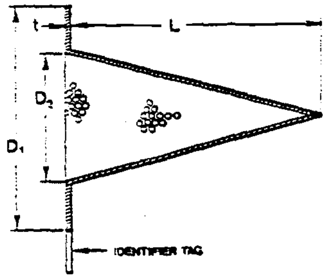
Sizes	Water	Steam, gas, air
½" - 2"	1/16"	1/32"
2½" Up	1/8"	mesh lined

PRESSURE DROP: Comparable to "Y" strainers. Consult our factory for exact values.

ENGINEERING SPECIFICATIONS: Temporary strainers shall be Model No. (22, 23, 24) as manufactured by Mueller Steam Specialty; and shall be constructed of (specify material) perforated and/or mesh lined material with retention of all particles________ inch in diameter and larger.



BASKET TYPE
MODEL 22



CONICAL TYPE
MODEL 23

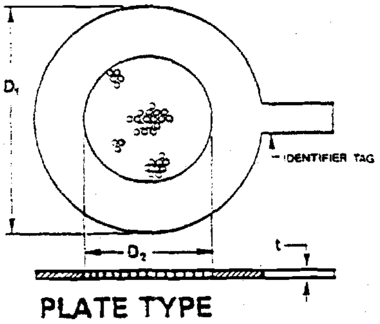


PLATE TYPE
MODEL 24

DIMENSIONS AND WEIGHTS - APPROXIMATE "APPLY FOR CERTIFIED DRAWINGS"

	D1		D2		D3	t	L PERFORATED 1/8" DIA. HOLES ON 3/16" CENTERS. % OPEN AREA COMPARED TO CROSS SECTION SCHEDLE 40 PIPE.								
							CONES				BASKET				
SIZE	150 - 300 lb.	600 lb.	150 - 300 lb.	600 lb.	ALL PRESS.	ALL PRESS.	100%	150%	200%	300%	100%	150%	200%	300%	SIZE
1 1/2	3 1/4	3 5/8	1 9/16	1 3/8	1	16 GA.	3	4	5 3/4	8 1/4	1 3/4	2 1/4	3	4 1/2	1 1/2
2	4	4 1/4	2	1 3/4	1 1/4		3 3/4	5	7 1/4	10 1/2	2	2 3/4	3 3/4	5 3/4	2
2 1/2	4 3/4	5	2 7/16	2 1/4	1 1/2		4 1/4	5 3/4	8	11 3/4	2 1/4	3 1/4	4 1/2	6 1/2	2 1/2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	6 3/4	7 1/2	3 15/16	3 11/16	2 1/2		6	8 1/2	11 3/4	17 1/4	3 1/4	5	6 1/2	10	4
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	10 7/8	12 1/2	7 7/8	7 9/16	5 1/2	14 GA.	11	16	22	32 3/4	5 3/4	8 1/2	11 1/2	17 3/4	8
10	13 1/4	15 5/8	9 15/16	9 5/8	7		13 1/2	20	27	40 1/2	7	10 1/2	14 1/4	22	10
12	16	17 7/8	11 7/8	11 1/2	8 1/2		15 3/4	23 1/2	32	48	8	12 1/4	17	26	12
14	17 5/8	19 1/4	13	—	10		17 1/4	26	35	52 1/2	8 1/4	13	18	27 1/2	14
16	20 1/8	22 1/8	14 7/8	—	11 1/2		19 1/2	29	40	60	9 1/4	14 1/2	20 1/4	31	16
18	21 1/2	24	16 3/4	—	13		21 1/2	32 1/2	44	66 1/2	10 1/2	16 1/2	22 1/2	35	18
20	23 3/4	26 3/4	18 3/4	—	14 1/2		23 1/2	36	48 1/2	73 1/2	11 1/2	19	25 1/2	39	20
24	28 1/8	31	22 1/2	—	17	11 GA.	28 1/4	43	58 1/2	—	13 3/4	22	30 1/2	47	24

5" and sizes larger than 24" on request

MUELLER STEAM SPECIALTY

ROUTE 2, BOX 44/N.C. HWY 20 WEST ST PAULS, NC
TEL: 910-865-8241 FAX: 910-865-8245

PARKSON CORPORATION - LAMELLA CLARIFIER

Site: MCB Camp Lejeune, NC - OU2
Groundwater Treatment Plant
Delivery Order No. 0015.

Date service rep on site: February 12, 1996

Name of representative: Mr. A. Page Gough
(305) 974-6610

Questions & Comments:

Question: At what incoming concentration of suspended solids would one consider recycle?
Comments: Less than 100-200 mg/l of inlet TSS one may wish to recycle back to the mix tank

Question: How can one determine if recycle is warranted?
Comments: You can obtain a 500 ml water sample using a glass beaker from the third stage of the mix tank near the outlet. Allow to settle for approximately 3 minutes. The top 200 ml should clear within that time. The key is to note how fast the floc is settling out.

Question: What is the target sludge percent solids in the clarifier (without recycle)?
Comments: 0.5 - 1.0 percent total suspended solids

Question: What will occur if the polymer is dosed too high?
Comments: The sludge will appear as a dark, slick looking, sticky sludge, and will settle out very rapidly. Too much polymer can change the properties of the sludge. The floc can also cling to the sides of the clarifier or channel through in globules.

Question: How much settling area does the clarifier have in square feet?
Comments: 125 square feet: 100 square feet for clarification and 25 feet for thickening

Question: What is the design throughput for this setting area?
Comments: 0.3 gpm/square foot; it can go as high as 0.6 gpm/ft

Question: What is the ideal settling rate for the floc?
Comments: At the design rate of 0.3 gpm/square foot, settling should occur in approximately 4 minutes

Question: Where should samples be taken for subsequent jar tests if needed to optimize polymer dosage?
Comments: From the second compartment of the mix tank

Question: What if the floc does not want to settle? I've seen floating flocs which have a tendency to remain suspended.
Comments: Check the speed of the mixer in the third compartment of the mix tank. If the speed is too

high, air will be entrained in the floc and it will have a tendency to float rather than settle. Too rapid mixing can also shear the floc. The vortex of the flash mixer should not extend down to the impeller. The goal is to have thorough mixing without creating turbulent conditions.

Question: What is the sluge holding capacity in the clarifier?
Comments: Approximately 100 gallons

Question: What is the normal procedure for determining sludge level in the clarifier?
Comments: Obtain a 1000 ml sample from each of the two drains on the clarifier. Use glass or clear graduated cylinders or beakers. Allow to set for approximately 20 minutes. The sample from the bottom valve should be considerable higher in sludge content relative to the sample from the upper tap. When the sludge from the lower tap after settling occupies nearly 100% of the volume of the cylinder or beaker, the sludge reservoir is near full.

Question: How can you tell when it is time to manually remove sludge from the clarifier?
Comments: When the sludge level from the lower tap is nearly 100% as measured above. The sludge volume in the sample from the upper tap should be approximately 10% of the volume in the cylinder or beaker, with 90% being clear supernatant.

Question: What is the recommended sludge pump out rate from the clarifier?
Comments: Approximately 1 gpm.

Question: Should we ever need to adjust the plates in the clarifier?
Comments: No.

Question: How frequently should the clarifier plates be cleaned?
Comments: It varies from several months to 2 years.

Question: Should the overflow weir ever need adjustment?
Comments: Only if the unit is not level; typically once the unit is leveled at the time of installation, adjustment is not necessary.

Question: Are there any special shut down procedures?
Comments: Normally, its best to either leave the clarifier full. For a long-term shutdown, one can drain and flush the plates from the top with a garden hose to clean out.

OPERATING MANUAL

FOR A

MODEL 125/55 LAMELLA® GRAVITY SETTLER

OHM REMEDIATION SERVICES CORPORATION FOR

CAMP LEJEUNE

JACKSONVILLE, NORTH CAROLINA

CUSTOMER P.O. NO. 1002896

X

PARKSON LGS-4126

5-17-95 B Matthews

PREFACE

THE OPERATING AND MAINTENANCE PROCEDURES OUTLINED IN THIS MANUAL ARE INTENDED AS GUIDELINES TO ASSIST THE OPERATING PERSONNEL IN THE DAY-TO-DAY OPERATION AND MAINTENANCE OF THE PARKSON LAMELLA® GRAVITY SETTLER OPERATING PERSONNEL SHOULD ALWAYS FOLLOW PROPER SAFETY PROCEDURES IN ACCORD WITH BOTH INDUSTRY SAFETY STANDARDS AND THEIR OWN COMPANY SAFETY POLICIES WHEN PROCEEDING WITH OPERATION, MAINTENANCE AND REPAIR OF THE LAMELLA GRAVITY SETTLER . THIS MANUAL IS NEITHER DESIGNED NOR INTENDED AS A SUBSTITUTE FOR SAFE OPERATING PROCEDURES WHICH MUST BE FOLLOWED WHILE IMPLEMENTING THE MAINTENANCE/OPERATION PROCEDURES OUTLINED IN THIS MANUAL. IT IS ASSUMED THAT OPERATION AND MAINTENANCE PERSONNEL ARE QUALIFIED AND EXPERIENCED. THE PRIMARY RESPONSIBILITY FOR SAFETY IN THE OPERATION AND MAINTENANCE OF THE PARKSON LAMELLA GRAVITY SETTLER IS WITH THE OWNER-OPERATOR AND THE PERSONNEL CONDUCTING THE MAINTENANCE AND OPERATION.

INDEX

LGS

LAMELLA® GRAVITY SETTLER (/THICKENER) PRE-STARTUP CHECK LIST

****

Review the following points before starting up your Lamella® Gravity Settler (/Thickener).

1. When plastic Lamella System plates are used, do not expose plates to direct sunlight until the unit is full of fluid.

2. Level the top of the Lamella System tank in both directions. Equal flow distribution will not be obtained if the unit is not level.

3. The adjustable overflow weir in the overflow box must be level in order to obtain uniform flow distribution.

   After the overflow weir has been adjusted, measure the distance from the bottom of the overflow flume to the top of the weir. Once the Lamella System is in service, you can check the Lamella System feed rate by stopping the Lamella System underflow pump and measuring the head of water above the overflow weir. Measurements of the depth of water in the overflow flume should be taken at least one foot away from the overflow weir. A rectangular weir table is attached to these instructions for your convenience.

4. When supplied by Parkson, the flash mixer and flocculator should be rotating in a clockwise direction when viewed from the top of the unit.

   Make sure addition of oil to the flocculator drive and lubrication of the flash mixer and flocculator drive motors are as per manufacturers' recommendations. Install ventilated-type oil-fill plug when required by manufacturer.

   NOTE:

   Normally, gearboxes are shipped full of oil to protect the gearbox from rust before operation. The oil MUST BE DRAINED TO THE OPERATING LEVEL (check plug) BEFORE OPERATING TO PREVENT DAMAGE TO THE SEALS.

Checking the following items prior to putting your Lamella System into service can save you a lot of time:

1. FEED

   Using the polymer recommended by Parkson in their process design, or polymer recommended by your supplier, run a settling test on the feed as per Parkson's settling test procedure (see Settling Tests). If satisfactory results are not obtained, it will probably be necessary to use a different coagulant aid or adjust the dosage rate. This test is well worth the time it takes because occasionally characteristics of a waste stream change radically between the time the stream was originally tested and the time the Lamella System is put into service.

2. FEED STREAM

Eliminate any aeration of the feed prior to entering the Lamella System without a deaeration step prior to the unit.

3. FEED STREAM PH

Should be maintained as closely as possible to the process design. Check out pH-monitoring and control systems to assure that they are in operating order.

4. FEED PUMP

Your Lamella System is sized to process a predetermined number of gallons per minute. Check your feed pump capacity to make sure it is not higher than the process design rate. The pump should be run to assure that no mechanical problems exist.

5. UNDERFLOW PUMP

To get a ballpark figure for the necessary underflow capacity, use the following formula:

Concentration of suspended solids in the Lamella System feed divided by the predicted underflow concentration times the Lamella System feed rate in GPM equals the underflow rate in gallons per minute. More specific figures can only be obtained by noting the sludge-forming characteristics when the Lamella System is in service.

$$\frac{SS_F}{SS_{UF}} \times Q_F = Q_{UF}$$

6. POLYMER SOLUTION - Also see Polyelectrolyte Guidelines

Generally speaking, it is best to work with polymer solutions of 0.25% to 0.50% and use a two-tank system. Sizing the polymer tank to hold a minimum of eight hours' to a maximum of 24 hours' capacity is the general practice. To ensure getting a homogenous polymer solution, each tank should be fitted with a mechanical mixer with a speed in the range of 450 to 500 R.P.M.

7. POLYMER PUMP

Most variable-speed, screw-type and gear pumps and controlled-volume metering pumps will perform well in this application. When sizing the polymer pump, a great deal of flexibility can be gained if it is sized to operate at 50% capacity at process design operating conditions. A bulletin dealing with the calculation of polymer requirements and costs is attached to these instructions (TB-103).

8. POLYMER DILUTION

Polymers should be further diluted to less than 0.1% after the injection pump to achieve maximum efficiency. This may be simply accomplished by including a 'tee' connection with water hooked up.

9. LEAK CHECKING

Although your Lamella System is completely factory pre-assembled, some disassembly is required for shipment. After erection, the unit should be filled with water (preferably potable) to assure that no leaks are present.

10. FINAL CHECKOUT

If possible, water should be run through the whole system as a final system checkout. If impossible, then each component should be individually checked to assure readiness for operation.

GUIDELINES FOR POLYELECTROLYTE DOSING SYSTEM DESIGN AND SIZING

A well-planned polymer system is an important first step in liquid/solid separation. If a few simple procedures are followed, many problems can be avoided.

The polyelectrolyte supplier should be contacted for information concerning mixing and utilization of his materials. Should a packaged mixing/dosing station be desired, he may also be able to supply a system. The supplier should be contacted for his recommendations before manufacturing or purchasing a system.

I. <u>MIX TANK</u> (powdered polymer)

A. This should include a tank of sufficient size as to mix approximately an eight-hour supply of polymer. In some cases a 24-hour supply may be more desirable. Tank size should be based upon cost/space requirements as well as operator availability. The polymer supplier can recommend and supply the proper tankage for the chosen polyelectrolyte.

B. A good mixer should be one which will stir the polymer into solution without sucking air down a vortex (450 rpm or less). The polymer need only be stirred to go into solution and not during the entire operation period. Usually this is for approximately one hour. No further stirring is required unless the solution is allowed to set for a day or two. In this case, a 15- to 30-minute cycle will be sufficient for re-mixing. The polymer manufacturer should supply mixing instructions when the polymer is purchased.

C. The polymer should be added very slowly to the tank. This is done while the water is being added and the mixer is on. This is a very important step in the mix operation. If polymer is added too quickly, especially the dry type, "fish-eyes" or "globs" will occur and they will not mix into solution. This will result in a lower percent than calculated. These globs will also clog lines and pumps. If a dry material is used, a simple dry powder aspirating wetter is recommended.

D. The mix tank should also include a valve at the bottom to discharge the mixed solution into a supply tank.

E. The strength of the mixed solution is also important to any operation. If the polymer is too thick, pumping may become impossible. If the polymer is too thin, a large pump may be required which may be economically unfeasible. A moderately average percent solution for most polymers is approximately 0.25%.

II. SUPPLY TANK

A. This should be the same volume as the mix tank.

B. It also should include a valve at the bottom of the tank.

C. This valve should be followed by a variable-speed metering pump. As a reference to required pumping rates, refer to the attachment.

D. A mixer may or may not be required in the supply tank. This depends upon the polymer being used (emulsion-type, etc.). More details can be obtained from the polymer representative.

III. DILUTION WATER

After the supply tank and the metering pump, dilution water should be added. The further dilution of the polymer at this point assures better solids-to-mixture contact. The distance between the dilution of the polymer and contact with the influent solids should be about ten feet. If this is not feasible, an in-line mixer may be warranted.

IV. POLYELECTROLYTE USAGE

A. In most cases, the dosage rate of the polymer has been determined during laboratory testing. Refer to the Laboratory Settling Test Summary or Quotation for dosages used. If no samples were tested, consult Parkson or the supplier for experience in similar applications. Also, the polymer supplier c run on-site jar tests for a determination.

B. Usage rates and costs can be determined from the attached Parkson Bulletin TB-103. This bulletin may also be used to determine order frequency and size.

POLYMER MIX = 0.25% SOLUTION

Influent (GPM)	Polymer Rate (GPM)			
	Dosage: 1 ppm	Dosage: 2 ppm	Dosage: 3 ppm	Dosage: 4 ppm
10	.004	.008	.012	.016
20	.008	.016	.024	.032
30	.012	.024	.036	.048
40	.016	.032	.048	.064
50	.020	.040	.060	.080
60	.024	.048	.072	.096
70	.028	.056	.084	.112
80	.032	.064	.096	.128
90	.036	.072	.108	.144
100	.040	.080	.120	.160

PARKSON CORPORATION

OPERATING INSTRUCTIONS

FOR THE

ONE MODEL 125/55 LAMELLA GRAVITY SETTLER

REFERENCE NUMBER: LGS-4126

[When contacting Parkson, kindly use this reference number which identifies your specific equipment.]

OHM REMEDIATION SERVICES CORPORATION
NORCROSS, GEORGIA

for

OHM REMEDIATION SERVICES CORPORATION
CAMP LEJUENE PROJECT
JACKSONVILLE, NORTH CAROLINA

JUNE - 1995

The Lamella® Gravity Settler described herein operates under the following U.S. patents: 3,551,330; 3,794,167; 3,894,955 and 4,290,898. Additional patents are pending.

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PARKSON CORPORATION

LAMELLA®
GRAVITY SETTLER

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PARKSON CORPORATION

LAMELLA® GRAVITY SETTLER

TECHNICAL BULLETIN TB-103

Subject: Calculating Polymer Requirements and Costs

Assume that 1000 GPM of wastewater is to be dosed with 1.0 ppm of polymer. 1.0 ppm means "one-part-per-million" or one pound of dry polymer per million pounds of wastewater.

Therefore:

$$\frac{1000\text{ gal}}{\text{min}} \times \frac{60\text{ min}}{\text{hr}} \times \frac{8.33\text{ lb}}{\text{gal}} \times \frac{1\text{ lb}}{1{,}000{,}000\text{ lb}} = \begin{array}{l}\text{0.5 lb/hr of dry}\\ \text{polymer must be fed}\\ \text{to the wastewater.}\end{array}$$

This means that twelve pounds of dry polymer must be purchased for each 24-hour day of operation.

Now, assume that the polymer is made up in the polymer feed tank at a concentration of 0.5% or 5000 ppm. That is, the solution consists of 0.5 pounds of dry polymer in approximately 100 pounds of water. Therefore, the polymer solution feed rate will be:

$$\frac{0.5\text{ lb dry poly}}{\text{hr}} \times \frac{100\text{ lb water}}{0.5\text{ lb dry poly}} \times \frac{\text{gal}}{8.33\text{ lb}} = 12\text{ GPH.}$$

As a check:

$$\frac{12\text{ GPH poly solution}}{60{,}000\text{ GPH wastewater}} \times 5000\text{ ppm} = 1.0\text{ ppm.}$$

At 12 GPH, the polymer feed tank must have a capacity of at least 100 gallons if a new batch is made up once each shift.

If the polymer is made up at a solution concentration of 1.0% instead of 0.5%, it will be fed at half the rate (6 GPH) and the tank can be half the size, other things being equal. Obviously, this does not affect the dosage based on dry polymer (still 1.0 ppm).

The choice of polymer solution strength is a balance between tank/pump size and polymer solution viscosity. If the solution is too concentrated, it will be difficult to dissolve the dry polymer, difficult to pump the polymer solution, and most importantly, the polymer solution will be very difficult to mix into the wastewater. The latter will result in poor performance and/or excessive polymer consumption.

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L

To obtain the best results, the polymer solution is often diluted with water in between the polymer feed tank and the point where it is injected into the wastewater. For example, 12 GPH at a 0.5% concentration might be diluted to 60 GPH at 0.1% by adding 48 GPH of water. It is important that good mixing of the concentrated solution in the water be obtained by having a fairly long run of pipe, preferably including a number of elbows or possibly a static mixer. The polymer supplier should be consulted to obtain the best polymer solution strength in the tank and the recommended dilution water rate, if any.

Excessive dilution water should be avoided as it is wasteful and it adds to the load on the clarifier.

Some polymers are supplied in a liquid form. Base the above calculations on the assumption that the liquid is at "100% strength", i.e. treat it the same as a dry polymer.

Polymers range in price from $0.50 to $2.00/lb. Assuming a price of $1.00/lb in the above example, the polymer cost will be $12/day or $4400/year if the unit is operated continuously.

PARKSON CORPORATION

LAMELLA® GRAVITY SETTLER

THEORY AND DESIGN

The Lamella® Gravity Settler is an inclined plate, shallow depth sedimentation device. By comparison, it offers a number of advantages which overcome the limitations of other products designed for the same performance applications, advantages which yield savings in space requirements, capital and operating costs.

It performs the same function as a conventional clarifier or settling basin, but it occupies only a fraction of the space. In outward appearance it resembles a simple plate or tube settler, but due to some unique design features, it can be operated at a much higher loading rate and yield better performance.

In order to better understand the design advantages inherent in the Lamella Gravity Settler, it is best to begin by describing some basic principles of sedimentation theory.

In certain suspensions, particles exhibit *"free settling."* This phenomenon occurs when the concentration of particles is low enough that the individual particles or flocs settle independently of one another and follow Stokes' Law. At higher concentrations, the settling particles interfere with each other, and *"hindered settling"* is encountered. It is characterized by a clearly defined interface between the suspension and the clarified liquid; this creates a settling operation of greater complexity. The Lamella Gravity Settler can be used for both free settling and hindered settling, but in the interest of simplicity, it is easier to describe the theory of the former.

The basic equations for sizing settling basins were formulated over seventy years ago. Consider for the moment an ideal settling basic (Figure 1). The suspension enters at one end of the basin, flows uniformly along its length at velocity V_L, and exits at the other end. The particles settle towards the bottom at velocity V_S. The trajectory of the particles is indicated by the vector V_P. If this trajectory takes the particles to the bottom of the basin before they reach the far end, it is assumed that they are removed from the liquid. Therefore, a particle starting at the top must settle through the distance H at velocity V_S in the same time (or less) that the liquid is in the basin. Thus,

$$\frac{H\ (\text{ft})}{V_S\ (\text{ft/min})} \leqslant \frac{L \times W \times H\ (\text{ft}^3)}{Q\ (\text{ft}^3/\text{min})}$$

Simplifying,

$$\frac{Q}{L \times W} = \frac{Q(\text{ft}^3/\text{min})}{A\ (\text{ft}^2)} \leqslant V_S\ (\text{ft/min})$$

where A is the settling area of the basin and Q/A is known as the *"overflow rate"* or *"surface loading rate"* (usually expressed in gpm/ft² or gpd/ft²). From this relationship it can be seen that all particles are removed which have a settling rate equal to or greater than the overflow rate, and that the height (or detention time) of the basin is not one of the main parameters affecting the separation efficiency. This is the theoretical keystone of the Lamella Gravity Settler's achievement in optimizing efficiency within greatly reduced spacial requirements.

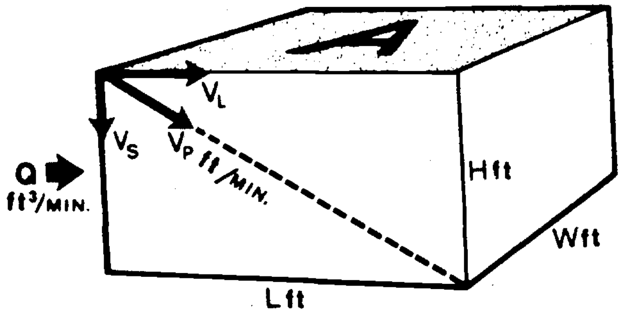

FIGURE 1.

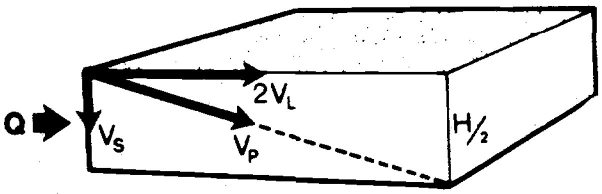

FIGURE 2.

The fact that this is true can be illustrated another way. Compare Figures 1 and 2; the only difference is that the second basin is half the height of the first. As a result the detention time is only half as much and the suspen-

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sion moves through the basin at twice the velocity V_L. The trajectory of the particles has only half the slope, but since the basin is only half as deep, the particles are still removed.

If the height of the basin is reduced to a few inches and a number of such units are stacked on top of each other, the result is a primitive shallow depth sedimentation device. Figure 3 shows a unit containing ten parallel compartments. Theoretically it can handle ten times the flow rate as could the same basin without any plates. The liquid detention time is one-tenth as long. However, the same separation efficiency is achieved since the overflow rate is still the same (10Q/10A = Q/A). Note that the settling area now includes the area of all the plates.

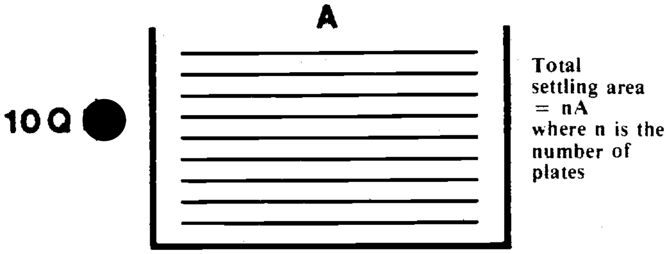

FIGURE 3.

In theory, fine. In practice, however, the shallow depth sedimentation device suggested by Figure 3 is impractical since it is difficult to remove sludge from the plates. Either the space between the plates must be large enough to accommodate mechanical scrapers or the unit must be shut down periodically and back-flushed. While both systems are used occasionally for special applications, in general they are impractical.

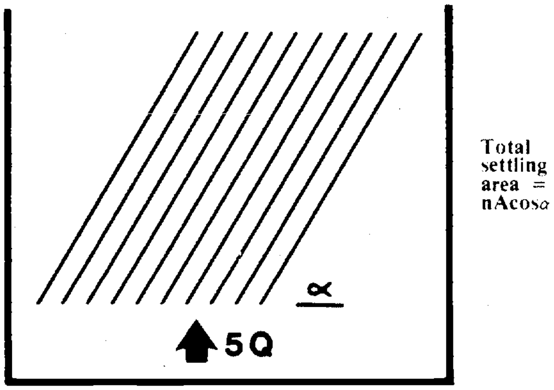

FIGURE 4.

A solution to the problem of removing sludge build-up from the otherwise efficient horizontal plate stack is to incline the plates at an angle so the sludge will be self-draining. Figure 4 shows an arrangement containing ten plates set at an angle of 60° above the horizontal. The total plate area is derived as above, but the plate area must be multiplied by the cosine of the angle to correctly determine the effective settling area. (Thus only the projected area of each plate on a horizontal plane is "counted.") In this example, the total settling area is 10A cos. 60° = 5A and the capacity of the unit is 5Q.

The design shown in Figure 4 is exemplified by the present-day tube settler. Tubes instead of plates are used, but the basic principle is the same. The tubes are generally about two inches square in cross-section and two feet long. This design, however, suffers from two very serious limitations. First, there is no means provided to ensure that the flow is uniformly distributed throughout the settler. As a result, parts of the settler may be overloaded while other parts may be underloaded. Secondly, the sludge which collects in the tubes must settle through the incoming feed in order to reach the bottom of the basin and be removed. Consequently, the solids, particularly in hindered settling operations, may be reentrained by the feed. Tube settlers and similar devices have no provision for hindered settling. Due to these limitations, such a settler must be operated at a loading rate of only 25-50% of its theoretical "overflow rate." (For more detailed background on this specific subject, please refer to (2) and (3) below.)

The Lamella Gravity Settler design successfully overcomes these limitations. Uniform flow distribution is attained by designing for a small pressure drop (2-4 inches of water) at the discharge of each plate. This pressure drop controls flow by creating the same hydraulic conditions above each plate so flow will be uniformly distributed. Sludge reentrainment is avoided by the fact that settling and thickening occur below the influent

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(2) "Design of High-Rate Settlers," Kuan M. Yao, Journal of the Environmental Engineering Division, October 1973.

(3) "Design of High-Rate Settlers," Discussion by A. George Gebauer, Journal of the Environmental Engineering Division, October 1974.

of each plate and by segregating the feed, effluent and sludge. In this way, the Lamella Gravity Settler provides for hindered settling applications.

These features are shown schematically in Figure 5. The feed enters at the sides of the plates and clear effluent discharges at the top. The solids slide down the plates and drop into the quiescent sludge hopper. The three streams do not interfere with one another. The effluent passes from each plate through a throttling hole located at the bottom of the effluent flume. The separate holes for each plate ensure uniform pressure drop over each plate and thus equal flow through the unit.

The throttling holes range from about 1/2 to 1 inch in diameter, large enough to preclude plugging. Also, since the effluent is throttled as opposed to the influent, most of the solids have been removed at this point. In any event, influent throttling would be unacceptable whenever flocculation is necessary, since throttling would destroy the flocs.

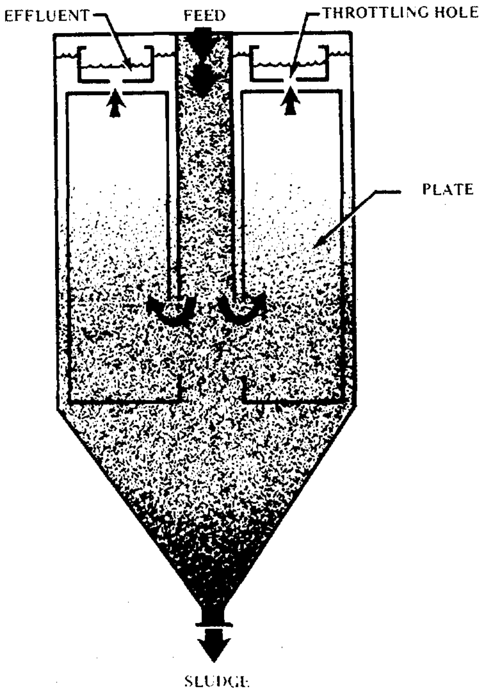

FIGURE 5. LAMELLA GRAVITY SETTLER (END-VIEW)

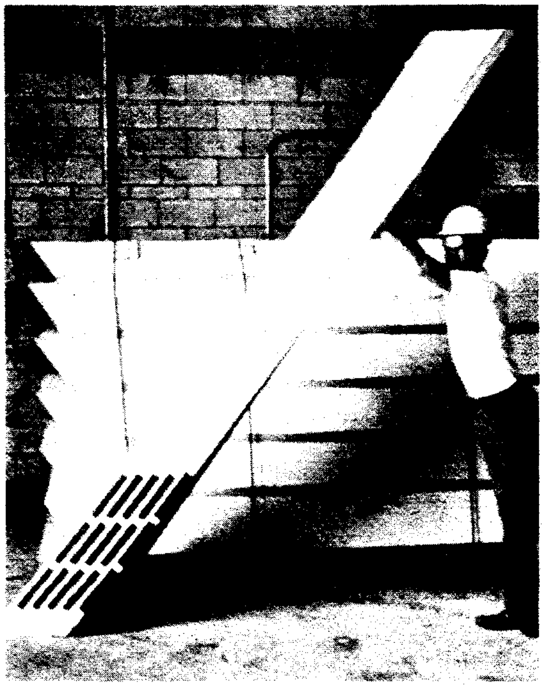

FIGURE 6. TYPICAL PLATES

A typical Lamella Gravity Settler plate (Figure 6) is usually two feet wide by ten feet long, is spaced two inches from adjacent plates, and is inclined at an angle of 45 or 55 degrees. In some units, double plates are used. They are four feet wide by ten feet long and are fed from both sides. The ten foot plate length is divided into two sections, one above and one below the feed point. The section above is called *"clarification area"* and is actually the area used in sizing the equipment based on the overflow rate. The section below the feed point is called *"thickening area"* and is used to prethicken the sludge before it enters the hopper. A common split for free settling applications is 80% clarification area (A_C), 20% thickening area (A_T).

The Lamella Gravity Settler is generally designed to operate in the orderly streamline or laminar flow regime between the plates. This effectively limits the overflow rate to about 1.2 gpm/ft^2, although for some solids which settle very rapidly, this limit can be exceeded somewhat.

The plate spacing is a critical variable. It must be large enough to prevent scouring of settled solids by the upward flowing liquid, to transport the solids down to the hopper, and to avoid plugging of these solids. Two inches is generally quite safe. For some applications having (a) slow settling particles (and therefore requiring a low overflow rate) and (b) a low sludge volume, a plate spacing down to one inch can be used.

In some applications, to facilitate sludge consolidation, the Lamella Gravity Settler is fitted with a vibrator in the sludge hopper (except in very large installations which employ a mechanical scraper under packs of plates). Vibrations are transmitted to a nest of elements in the hopper from an external vibrator motor. The two are connected by a shaft which passes through a flexible rubber seal at the tank wall. The purpose of the vibrator is to vibrate the sludge, not the tank. The vibrations, which are low frequency (60hz) and low amplitude (about 0.2 mm), promote thickening and compression of the sludge and produce a lower apparent viscosity (especially for thixotropic sludges) which facilitates sludge removal from the hopper.

A flash mixer and/or flocculator may be required ahead of the Lamella Gravity Settler (as with all settlers) to mix in polyelectrolytes which promote floc growth and enhance the clarification process. Care must be taken to transport the flocculated feed to the LGS to avoid floc break up. Generally the velocity at this point is held under 1.0 fps.

The Lamella Gravity Settler is a simple unit to operate. The only item requiring operator attention is the sludge withdrawal rate. This is usually controlled by a variable speed, positive displacement pump which is manually set (once or twice a shift is usually sufficient) or automatically set by a detector which monitors either the sludge level in the hopper or the consistency of the underflow.

The Lamella Gravity Settler may be constructed of various materials. Wetted surfaces are usually mild steel or 316 stainless. For some applications, PVC or fiberglass reinforced plastic plates are used with rubber-lined mild steel tanks.

The Lamella Gravity Settler is sized by laboratory settling tests to determine the particle settling velocity V_S, (to set the overflow rate and effluent quality), the sludge volume (to set the underflow solids concentration), and what pretreatment is required (polyelectrolyte addition, flash mixing, flocculation, etc.). Laboratory results may be confirmed by pilot testing for new applications.

A properly designed shallow depth sedimentation device such as the Lamella Gravity Settler offers a number of advantages compared with a conventional clarifier or settling basin. The Lamella Gravity Settler:

1. **Occupies about one-tenth the floor space or land area**
2. **Costs less on a total installed basis**
3. **Is factory preassembled, resulting in shorter deliveries and minimal field erection work**
4. **Is simple to start up and shut down**
5. **May be installed indoors or covered at much less cost**
6. **Has a much lower evaporation and/or heat loss**
7. **Costs less to insulate**
8. **May be moved easily**
9. **Has far fewer moving parts**
10. **Is not affected by wind or thermal currents**
11. **Weighs less, and**
12. **Contains a lower inventory (important if liquid or solid is valuable)**

OPERATING INSTRUCTIONS

FOR THE

LAMELLA GRAVITY SETTLER

REFERENCE NUMBER: LGS-4126

[When contacting Parkson, kindly use this reference number which identifies your specific equipment.]

****

(Depending on your model, some instructions may not be pertinent.)

It is assumed that the Lamella Gravity Settler [LGS] has been assembled and installed according to the **Assembly Instructions** and that all lines and electrical connections have been made. It is also assumed that the LGS has been **leveled.**

A. Assembling the LGS:

Check your Assembly Instructions to make sure your LGS is correctly assembled.

B. Start-up:

1. Start the feed pump.
2. Start the chemical dosage equipment (if applicable).
3. Start the sludge pump. Refer to D.4. to determine withdrawal rate.

C. <u>Running Adjustments</u>:

1. Check the feed rate 30 GPM (0.3 GPM/sq.ft.) with suspended solids of LESS THAN 500 PPM.

2. Check the dosages of chemicals. Adjust to proper amount.

   a. Polymer rate and selection of (BY CUSTOMER)
   ______ ppm of ______________________________
   (if required). **DETERMINE AT TIME OF START-UP.**

   b. pH adjustment to neutral (if required).

3. Adjust the RPM of the flocculator to achieve good settling flocs. The start-up engineer will determine the initial settling. If the speed of the agitator is too high, the flocs will break down and settle very slowly, and it will also result in a poorer quality effluent. If the speed is too low, the floc buildup will not be good, and the result will be the same as described above.

4. Adjust the sludge pump to discharge a volume equal to the percentage volume of solids going into the LGS. This percentage can be determined approximately by filling up a 1000 ml graduated cylinder with liquid from the flash mixer. The liquid sample should be taken 4-8" from the wall adjacent to the LGS tank and at a depth of 2-3 feet. The volume of solids in the graduate should be measured after 5 minutes.

   If the sludge volume in the cylinder is 100 ml, the sludge pump should discharge an average rate equal to 10% of the feed rate. If the LGS is provided with a timer, this should be set so that the pump is discharging the same AVERAGE rate.

   Example: Feed Rate: 1000 GPM; pump capacity: 400 GPM; sludge volume: 10% of the feed, or 100 GPM. The timer should be "ON" during one minute and "OFF" during three minutes.

   The sludge level should be maintained between the upper two sample taps.

5. Sample Taps: Make sure the sludge level is not above the uppermost tap in the sludge hopper or as determined by the specification. Overthickening may cause the torque limiter to shut off the system.

D. <u>Shut-down</u>:

1. Stop the feed pump.
2. Stop the chemical dosage equipment.
3. Set the timer (if provided with such) controlling the sludge pump for continuous discharge.
4. When the unit is empty, hose it clean.
5. Make sure the unit is completely drained. This is most important during the winter season to avoid any damages due to freezing.
6. Stop the sludge pump.

E. <u>Trouble-shooting</u>:

1. <u>If the effluent has a high content of suspended solids</u>:
    a. Check to see that the feed rate is within the design criteria. Refer to the attached rectangular weir table.
    b. Check to see if the amount of chemicals added is enough for the flow rate and the pH is in the proper range.
    c. Check to see that good flocs are formed in the flocculation tank. If not enough polymer is added, the solids will not settle in the required time and, thus, will be carried with the effluent. If too much polymer is added, the solids may become very sticky. This can plug the plates and perhaps the hopper.

d. Check to see that the sludge rate is correct. If it is too low, a buildup of solids will occur in the unit and will be carried over the top. If a buildup of solids in the hopper occurs and a high underflow rate is attempted, this may clear the center ("rathole"), but leave the sides. If ratholing occurs and continues, the solids may continue to build up the sides of the hopper and clog those plates around the sides of the LGS.

e. Take a sample of the dirty overflow. If solids but no floc are present, either "b" or "c" above are the cause. If solids are good flocs, then either "a" or "d" may be the cause.

f. If none of the above corrections will decrease the content of suspended solids in the effluent, we suggest that a static settling test be conducted. A procedure for the test is attached. From this test it can be determined if the settling velocity of the particles has changed. For your application we also need to know the sludge volume after 5 minutes in a graduate as described under D.4.

g. Try recycle of sludge to increase the concentration of suspended solids in the mix tank to obtain good flocculation.

2. <u>If the sludge concentration is too low</u>:

Check to see that the sludge rate is correct. If the sludge rate is too high, the sludge will be discharged before it is thickened.

3. <u>If the sludge concentration is too high</u>:

The sludge rate is too low. Increase the "ON" time if a timer is provided, or increase the pumping rate.

4. <u>If no sludge can be withdrawn from the LGS</u>:

a. Check whether or not the sludge pump is working.

b. Check whether or not the sludge line is blocked between the sludge tank and the discharge point.

c. Connect a hose to the sludge line flush connection and backflush into the sludge tank.

5. <u>If liquid overflows the sides of the feed box, the effluent flumes, or the sides of the tank</u>:

   a. Check the feed rate and, if it is too high, correct it to the proper rate.

   b. Check to see that the holes in the effluent flumes are open.

   c. Check to see that the effluent line is not blocked for any reason.

F. <u>SAFETY</u>:

1. Maintenance requirements on a Parkson-supplied flash mix and flocculation tank must be done within the limits of an OSHA-approved ladder and platform. A Parkson-supplied ladder and platform conforms to OSHA regulations.

2. If an OSHA-approved ladder and platform have not been supplied, access to the top of the Lamella Gravity Settler should only be made using industry safety and health standards as stated in the U. S. Department of Labor Occupational Safety and Health Administration Manual.

UNDER NO OTHER CIRCUMSTANCES SHOULD ANYONE ATTEMPT TO CLIMB THE LAMELLA GRAVITY SETTLER.

SECTION 27. RECTANGULAR WEIR TABLE FOR WEIRS WITH FREE DISCHARGE INTO ATMOSPHERE

No side contraction assumed. Calculated from Francis formula: $Q = 3\,b\,d^{3/2}$ where Q = gpm; b = breadth or length of the weirs in inches and d = depth or head over weir in inches. For one side contraction reduce *b* or 0.1 *d*. Depth (d) over weir, in table, must be measured 12" back from weir.

Depth over Weir (d)	b = Length of Weir																	Depth over Weir (d)
	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"	13"	14"	15"	16"	17"	18"	
	Flow over Weir in gpm																	
1"	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	1"
1¼"	8	13	17	21	25	29	34	38	42	46	50	54	59	63	67	71	75	1¼"
1½"	11	17	22	28	33	39	44	50	55	61	66	72	77	83	88	94	99	1½"
1¾"	14	21	28	34	42	48	56	63	69	76	83	90	97	104	111	118	125	1¾"
2"	17	25	34	43	51	59	68	76	85	93	102	110	119	127	136	144	153	2"
2¼"	20	30	40	51	61	71	81	91	101	112	122	132	142	152	162	172	183	2¼"
2½"	24	36	48	60	71	83	95	107	119	130	142	154	166	178	190	201	213	2½"
2¾"	27	41	55	69	82	96	109	123	137	150	164	178	192	204	218	232	246	2¾"
3"	31	47	62	78	93	109	125	140	156	171	187	203	218	234	248	264	280	3"
3¼"	35	53	70	88	105	123	141	158	176	193	211	229	246	264	281	299	316	3¼"
3½"	39	59	79	99	118	138	157	177	197	216	236	255	275	295	314	334	354	3½"
3¾"	44	65	87	109	131	152	174	196	218	240	261	283	305	327	348	370	392	3¾"
4"	48	72	96	120	144	168	192	216	240	264	288	312	336	360	384	408	432	4"
4¼"	53	79	105	131	158	184	210	237	263	289	315	342	368	394	420	447	473	4¼"
4½"	57	86	114	143	172	200	229	258	286	315	344	372	401	430	458	487	516	4½"
4¾"	62	93	124	155	186	217	248	279	311	342	373	404	435	466	497	528	559	4¾"

Depth over Weir (d)	b = Length of Weir																	Depth over Weir (d)
	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"	13"	14"	15"	16"	17"	18"	
	Flow over Weir in gpm																	
5"	67	100	134	168	201	235	268	302	335	369	402	436	470	503	537	570	604	5"
5¼"	75	112	149	186	216	252	288	324	361	397	433	470	505	541	577	614	650	5¼"
5½"	77	116	154	193	231	270	309	347	386	424	463	503	540	579	617	655	695	5½"
5¾"	83	120	166	207	249	290	332	373	415	456	497	540	581	622	664	705	746	5¾"
6"	88	132	177	220	265	309	353	397	441	486	530	574	618	662	706	750	794	6"
6¼"	94	141	187	234	281	328	375	422	469	516	562	610	656	703	750	796	843	6¼"
6½"	100	149	199	248	298	348	398	448	496	547	596	646	696	746	795	846	896	6½"
6¾"	105	157	209	261	317	370	423	476	529	581	634	686	740	793	845	899	951	6¾"
7"	111	166	222	278	333	389	445	500	555	611	666	722	777	833	889	944	1000	7"
7¼"	118	176	235	294	351	410	467	526	585	643	701	760	819	876	935	995	1051	7¼"
7½"	124	185	247	309	371	433	495	557	619	680	742	804	866	927	990	1051	1112	7½"
7¾"	130	195	259	324	390	454	519	584	648	714	778	844	908	973	1039	1100	1169	7¾"
8"	136	204	271	339	407	475	543	611	679	746	814	881	950	1018	1084	1152	1220	8"
8¼"	143	214	286	357	428	500	571	643	714	785	856	927	1000	1070	1141	1213	1285	8¼"
8½"	149	223	298	372	446	521	596	669	745	819	893	967	1041	1115	1190	1264	1340	8½"
8¾"	156	234	312	390	467	545	623	700	778	855	934	1010	1089	1165	1243	1321	1400	8¾"
9"	162	243	324	405	486	567	650	730	810	892	973	1051	1135	1214	1295	1375	1459	9"
9¼"	169	253	337	422	507	592	676	761	845	931	1015	1100	1183	1269	1351	1440	1521	9¼"
9½"	176	264	352	440	527	615	704	791	880	968	1064	1141	1230	1320	1405	1494	1581	9½"
9¾"	182	274	365	456	547	639	730	821	912	1004	1094	1186	1279	1370	1460	1550	1642	9¾"
10"	190	284	379	475	569	664	760	855	949	1042	1139	1232	1328	1420	1515	1610	1708	10"

PARKSON CORPORATION

LAMELLA® GRAVITY SETTLER

Laboratory Settling Test Procedure

Introduction

A particle of a certain minimum size in a dilute suspension will settle provided the density of the particle is greater than that of the liquid.

In a sufficiently dilute suspension, the particles will initially settle independently of one another. This type of sedimentation is called free settling. The settling rate for particles undergoing free settling increases with increasing particle size and particle density (specific gravity) but decreases with increasing liquid viscosity.

When a particle moves downwards in a suspension, an equal volume of fluid is displaced upwards. As the settling progresses and leaves clear liquid at the top of the suspension, the distance between individual particles in the lower part of the suspension will decrease. This means that the displaced fluid will have a decreased cross-sectional area available for upward flow and this results in a higher upward fluid flow velocity. This, in turn, will decrease the settling rate of the particles. As the settling further progresses, the concentration of particles in the lower part of the suspension increases and there will be partial contact between particles. A loose structure will result in which particiles are trapped; which will eventually force all particles to settle with the same velocity irrespective of size and shape. The settling rate will now ideally be a function of concentration alone (concentration = lbs. of particles per lb. of suspension). This type of settling is called hindered settling. As all particles during hindered settling have the same velocity, a sharp interface between clear liquid and slurry will form.

Most sedimentation applications involve both free and hindered settling, i.e., the suspension is originally not concentrated enough to give hindered settling, but as the settling progresses, hindered settling will occur. The free settling characteristics will usually determine the overflow (clear liquid) quality and the hindered settling characteristics will determine the underflow (sludge) quality. The settling test described, when properly followed, will give enough information to choose the critical parameters for a Lamella Gravity Settler/Thickener.

2727 N.W. 62nd Street
P.O. Box 408399
Fort Lauderdale, Florida 33340-8399
Telephone: 305 974-6610
FAX: 305 974-6182

An Axel Johnson Inc. Company

Standard Settling Test

This test simulates the separation effect of a Lamella Gravity Settler and is performed in 500 ml graduated cylinders (see Figure 1). The test cylinder and the suspension should have the same temperature as the surroundings, and, if possible, the test should be performed at the same temperature as the full-scale settler is intended to work. If the test has to be carried out at a different temperature, a correction for different liquid viscosity has to be included in the design.

It is important to have the test sample in thermal equilibrium with the surroundings in order to avoid disturbances by thermal convection. The presence of thermal convection currents in the liquid will always give less effective settling. (Thermal effects strong enough to influence the settling can be caused, e.g. by draft from open windows and doors and by radiation from the sun or other heat sources).

Prepare the suspension to be tested the same way as in the full-size operation. Make sure you have a homogeneous representative feed sample.

1. Fill a 500 ml graduated cylinder with the suspension to be tested.

2. Flocculation

   a. Add flocculant (polyelectrolyte, alum, etc.) if necessary, to achieve settleable flocs. The flocculant should be added approximately one inch below the surface of the sample to ensure against floating. Stir rapidly using an up-and-down motion with a stirrer as shown in Figure 1 for ten seconds (without whipping in air) to obtain uniform distribution of flocculant. The polyelectrolyte solution should preferably be added as a 0.05% solution. 1 ml of 0.05% solution added to 500 ml corresponds to 1 ppm.

   b. Flocculate, if necessary to obtain settleable flocs (see Figure 1). Flocculation is done by slow movements, but they have to be rapid enough to prevent the big flocs from settling to the bottom of the cylinder. With light flocs (e.g. metal hydroxides) the movements should not be rapid enough to break the flocs. The range between too fast and too slow is fairly wide.

3. When the convection eddies from the stirring have ceased (usually within 5-10 seconds) start a stopwatch.

4. To simulate the clarity of the supernatant (overflow) at a specific loading rate, pipette out the upper 100 ml (2-1/8") of the suspension column in the graduated cylinder after the corresponding time t (see below for definition).

   To determine an optimum loading rate, several tests should be made at different loading rates and corresponding times: t_1, t_2, t_3 . . . . t_n (see Figure 2).

   Ideally, test loading rates should be based on the design flow rate in several different sized LGS(T) units.

5. The following observations and analysis should be made. A sample data form with positions for the most frequent data is enclosed.

   a. Concentration of suspended solids in a feed sample. (For method, see attachment.) For some wastes containing a large portion of very fast settling material (e.g. large sand particles), it is very hard to obtain a representative feed sample. For those wastes, all of the sludge in the graduate cylinder should be dried and weighed after the settling test is finished. If necessary, the large particles can also be screened away.

   b. Concentration of suspended solids in the pipetted 100 ml from each graduated cylinder.

   c. During the settling test, the volume of settled sludge (or the interface between clear liquid and slurry at hindered settling) should be recorded versus time until the volume is constant. Read the sludge volume after 1, 2, 3, 5, 10, 15, 20, 30, 45, and 60 minutes, and longer if necessary.

   d. pH

   e. For concentrated suspensions, the specific gravity of the suspension should be determined. (The weight of 50 ml suspension is sufficiently accurate.)

f. Note the distance between the 0 and 500 ml marks for the graduated cylinder. It is usually approximately 10-3/4".

g. In some instances "sludge recycle" may be necessary. This is the case when insufficient particles are in the feed to promote settleable flocs. After the above procedure has been followed, the following should be done:

   1) Slowly pour off the clear liquid, making sure to leave the sludge. Note the sludge level left.

   2) Add fresh feed sample to the chlinder (up to the 500 ml mark) and proceed as before, i.e. add flocculant, rapid stir, slow stir (flocculate), etc.

   3) This procedure should be repeated as many times as necessary to attain efficient flocculation.

h. "Overflow recycle" can be used when the sample suspended solids level is higher than expected (i.e. too much sludge) or where the settling is very hindered. The net effect is diluting the feed to allow free settling in the upper plate section and compaction of solids in the lower plate section and hopper. For overflow recycle simulation:

   1) Allow a 500 ml feed sample to settle (after proper chemical treatment).

   2) Decant the clear overflow and save it.

   3) Discard the sludge.

   4) Add a pre-measured amount of the overflow to fresh feed and repeat the test procedure until an acceptable settling rate is attained.

   5) Overflow recycle success is determined by whether or not the original feed concentration is improved upon (i.e. if a 5 wt.% feed is diluted 4:1 with overflow recycle, the final sludge concentration must better the 5% figure to be practical).

6. A few simple observations during settling tests will help to attain maximum results.

   a. pH is very important, particularly with metal hydroxide wastes. The optimum pH should be at a level to maximize precipitation of matter from solution.

   b. With some material, if too much flocculant is added, a "light, fluffy, floating" floc will be produced.

   c. If the sample has a combination of solids types, more than one polyelectrolyte may be required.

Calculation of Surface Loading Rate

Ideally, for a given suspension, the only variable influencing the overflow quality during sedimentation is the surface loading rate. The surface loading rate is usually expressed in gallons per minute per square foot of surface area available for settling (gpm/ft.^{2}). It can easily be shown that one particular surface loading rate is equivalent to one particular settling rate.

An ideal settler working at one surface loading rate will settle all particles having a settling rate greater than the settling rate corresponding to this surface loading rate.

The surface loading rate used during a test performed in this manner is calculated as follows:

> Assume that the last of the 100 ml fraction was removed after 3 minutes and 19 seconds and that the height of the 100 ml in the graduate is 2-1/8". The loading rate will be:

$$\frac{\text{2-1/2 inches} \times 7.5\ \text{gal/ft.}^3}{\text{3-19/60 min.} \times 12\ \text{inches/ft.}} = 0.4\ \text{gpm/ft.}^2$$

The following formula can be derived assuming the top 100 ml layer in the graduated cylinder is 2-1/8".

Surface loading rate:

$$Y = \frac{1.33}{t}$$

t in minutes gives y in gpm/ft.^{2}

This formula has been used to calculate the following chart, which can be used when the top 100 ml layer in the graduated cylinder is 2-1/8".

Y **Surface Loading Rate** **gpm/ft.^{2}**	**t** **Settling Time in Minutes** **(top 100 ml)**
0.1	13 minutes, 18 seconds
0.2	6 minutes, 39 seconds
0.3	4 minutes, 26 seconds
0.4	3 minutes, 19 seconds
0.5	2 minutes, 40 seconds
0.6	2 minutes, 13 seconds
0.7	1 minute, 54 seconds
0.8	1 minute, 40 seconds
0.9	1 minute, 29 seconds
1.0	1 minute, 20 seconds
1.5	53 seconds
2.0	40 seconds

Enclosures: Data collection forms
Method for determination of suspended solids

Method for Suspended Solids

Apparatus

Gooch crucible (25 ml volume Coors #04)
Glass fiber filters (1" diameter Gelman Type A Glass fiber #61693)
Crucible holder
Filter flash
Drying oven (103 - 105°C)
Vacuum desiccator
Desiccant - Dryrite
Vacuum source (water aspirator)

Preparation of Crucible

1. Plate Gelman glass fiber filter into crucible.

2. Wash 3 times with 25 ml distilled water allowing to drain between washes.

3. Dry the washed crucible in drying oven 103 - 105°C for a minimum of one hour.

4. Remove from oven and allow to cool in vacuum desiccator under vacuum for at least 30 minutes.

Procedure

1. Take a known sample by weight (or by volume, if the S.G., approximately 1.00).

2. Take tare weight of washed and dried crucible to be used.

3. Vacuum filter the known sample making certain all solids are washed into the crucible by using distilled water.

4. When the filtration has been completed, place the crucible into the drying oven 103 - 105°C for a minimum of 8 hours.

5. After drying in the oven, remove and place in the vacuum desiccator for at least 30 minutes under vacuum for cooling.

6. Re-weigh the crucible.

Calculations

A - B = C

PPM =

$$\frac{C}{W} \times 1{,}000{,}000$$

A = Gross weight of crucible after filtering sample, drying in oven, and cooling in desiccator, grams.

B = Tare weight of crucible just before filtering sample, grams.

C = Net weight of suspended solids, grams

W = Weight of sample filtered, grams (or volume if volume was used, ml).

Reference: FWPCA Methods for Chemical Analysis of Water and Wastes, Nov., 1969, U.S. Dept. of the Interior (p. 265 - Solids, Non-Filterable).

Calculations

$A - B = C$

$$\text{PPM} = \frac{C}{W} \times 1{,}000{,}000$$

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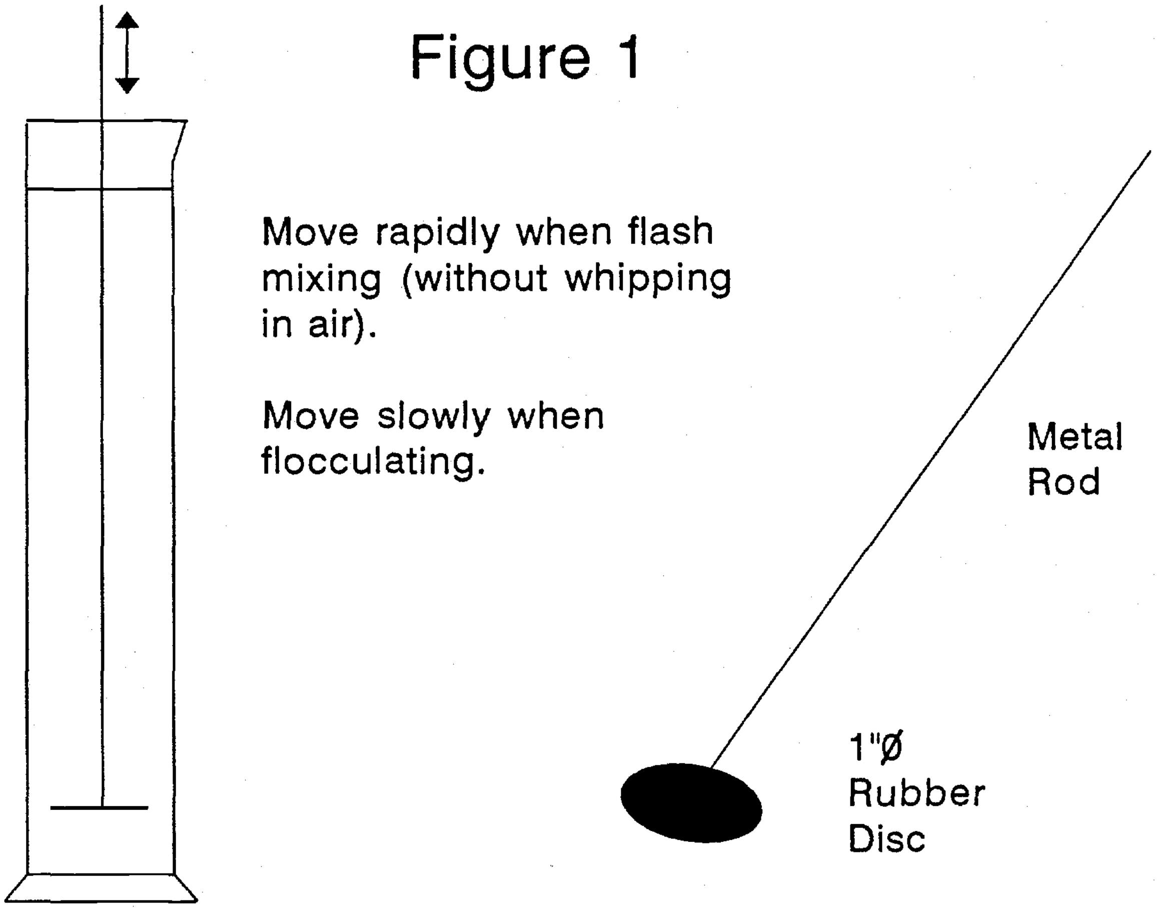
W = Weight of sample filtered, grams (or volume if volume was used, ml).

Reference: FWPCA Methods for Chemical Analysis of Water and Wastes, Nov., 1969, U.S. Dept. of the Interior (p. 265 - Solids, Non-Filterable).

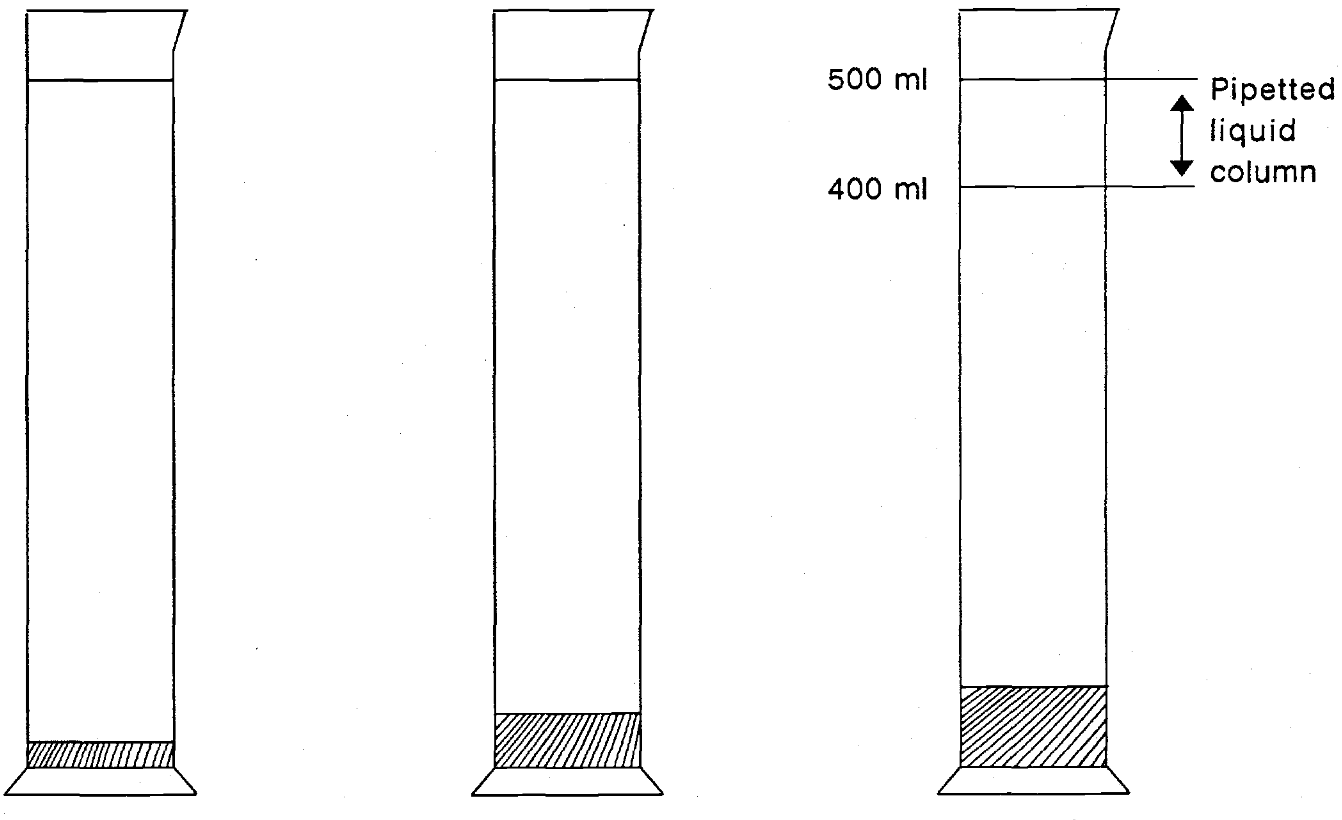
Figure 1



Move rapidly when flash mixing (without whipping in air).

Move slowly when flocculating.

Figure 2



t1 min t2 min tn min

mella® Gravity Settler / Thickener

Company: *ABC Company*

Location: *Huntsville, Alabama*

Sample Identification:

Application: *Rinsewater from pickling operation*

Test Date: *January 21, 1981*

Agent: *PHE Engineers*

feed as received suspended solids ppm or %	feed as received suspended solids pH	pretreatment chemical plus dosage in ppm	after pretreatment suspended solids ppm or %	after pretreatment suspended solids pH	polymer type / dosage in ppm	flash mixing time in secs.	flocc. time in secs.	settling time in min. and secs.	o'flow rate - gpm/ft.²	o'flow or susp. solids in ppm	sludge volume in ml after: 1 / 2 min.	3 / 4 min.	5 / 10 min.	15 / 20 min.	30 / 45 min.	sludge concen. - %	remarks
20	2.7	lime slurry	250	7.5	anionic 1	5	60	2'13"	0.6	10	100 75	53 36	32 28	26 25	23 22		
					anionic 1	5	60	3'19"	0.4	10	105 77	54 37	32 28	25 24	22 22		
					none	5	60	2'13"	0.6	25	350 250	160 160	60 35	26 23	21 20		
					anionic 1	5	-	2'13"	0.6	13	107 76	54 36	33 27	24 22	20 20		

Sludge Sticky? Yes ____
No √

Floaters? Yes ____
No √

Free Settling √ or
Hindered Settling ____*

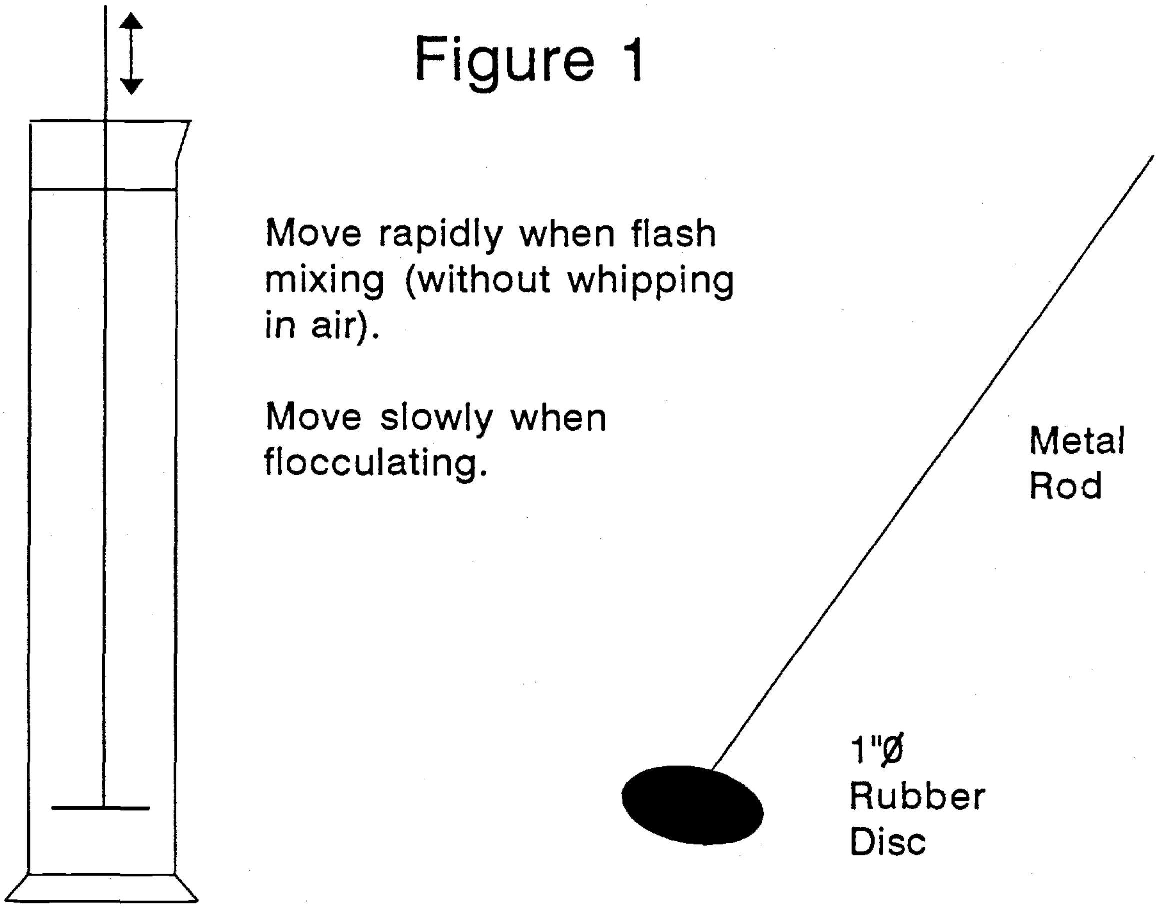
Test Temperature 24 °C

Heavies? Yes ____
No √

* Use supplemental data sheet if necessary

Size of Graduated Cylinder 500 ml

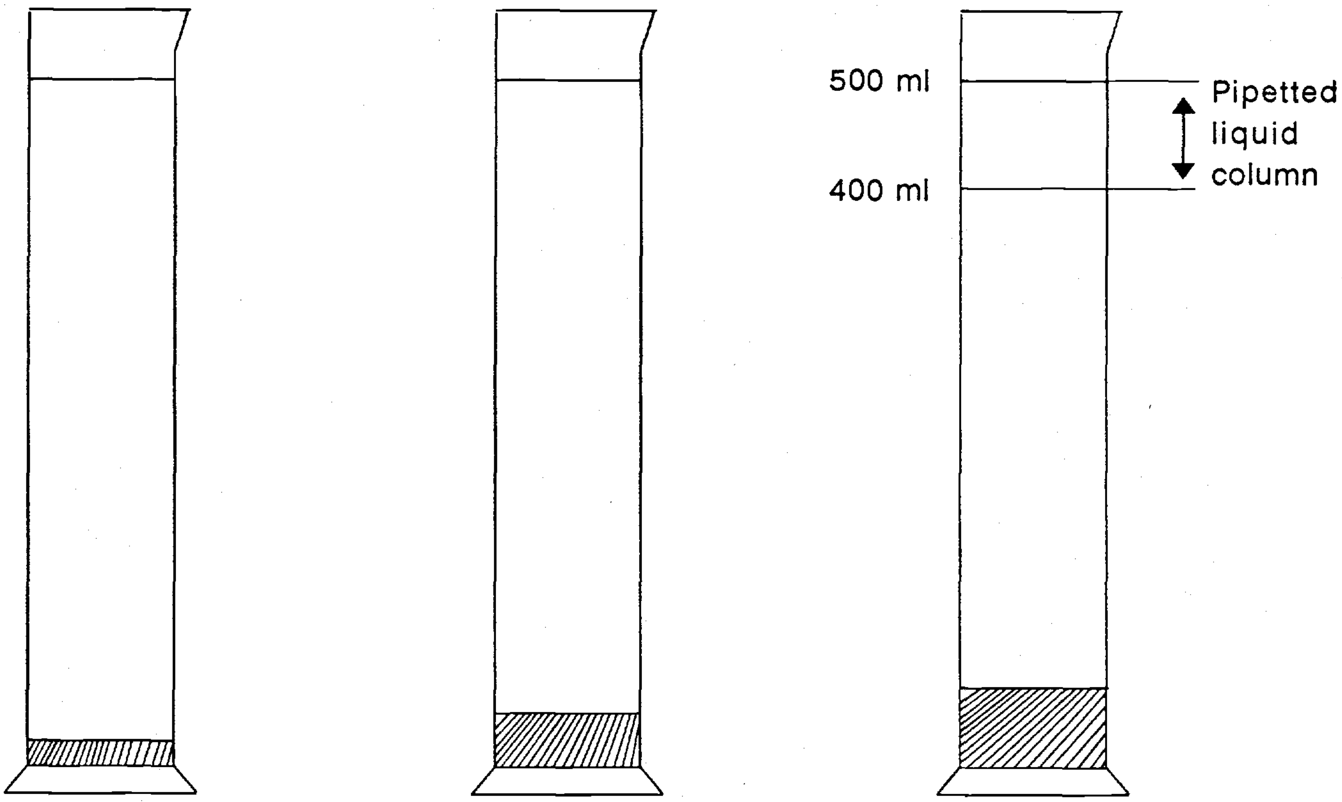
Figure 1



Move rapidly when flash mixing (without whipping in air).

Move slowly when flocculating.

Figure 2



t1 min t2 min tn min

Lamella® Gravity Settler / Thickener

Company:

Sample Identification:

Test Date:

Location:

Application:

Agent:

feed as received		pretreatment chemical plus dosage in ppm	after pretreatment		polymer type plus dosage in ppm	flash mixing time in secs.	flocc. time in secs.	settling time in min. and secs.	o'flow rate - gpm/ft.^{2}	o'flow or susp. solids in ppm	sludge volume in ml after:					sludge concen. - %	remarks
suspended solids			suspended solids														
ppm or %	pH		ppm or %	pH							min.	min.	min.	min.	min.		

Sludge Sticky? Yes ___
No ___

Test Temperature ___°C

Size of Gr[illegible]ted Cylinder _____ml

Floaters? Yes ____
No ____

Heavies? Yes ____
No ____

Free Settling _____ or
Hindered Settling ____*

* Use supplemental data sheet if [illegible]ssary

INSTALLATION INSTRUCTIONS

FOR A

MODEL 125/55 LAMELLA® GRAVITY SETTLER

K

5-17-95 B Hawkins

OHM REMEDIATION SERVICES CORPORATION FOR

CAMP LEJEUNE

JACKSONVILLE, NORTH CAROLINA

CUSTOMER P.O. NO. 1002896

PARKSON LGS-4126

INDEX

LGS

PART I INSTALLATION INSTRUCTIONS

Section 1 Safety

The personnel directly responsible for operation and maintenance of the equipment must be given instructions in safety.

Guards and other safety devices furnished by the manufacturer must be installed. Also, the procedures indicated in these instructions and Maintenance Manual must be followed carefully.

The user is also responsible for furnishing and installing any guards or other safety equipment as needed to protect operating personnel, even though such safety equipment may not have been furnished by the seller with the purchased equipment.

Maintenance requirements on a Parkson-supplied flash mix and flocculation tanks must be done within the limits of an OSHA-approved ladder and platform. A Parkson-supplied ladder and platform conforms to OSHA regulations.

If an OSHA-approved ladder and platform have not been supplied, access to the top of the Lamella Gravity Settler/Thickener should only be made using industry safety and health standards as stated in the U.S. Department of Labor Occupational Safety and Health Administration Manual. **UNDER NO OTHER CIRCUMSTANCES SHOULD ANYONE ATTEMPT TO CLIMB THE LAMELLA GRAVITY SETTLER/THICKENER, FLASH MIX AND/OR FLOCCULATION TANK.**

All unauthorized personnel should be required to remain a safe distance away from rotating shafts, couplings, sheaves, belts, etc.

Section 2 Introduction

These instructions and Mechanical Operation & Maintenance Manual cover specific information on installation, operation and maintenance for the Parkson Corporation equipment and its components, such as gear reducers and motors. This equipment is a high quality machine of rugged design to give long hours of trouble-free service. Continued optimum performance will not be maintained unless the precautions and procedures specified herein for handling, installation, initial operation and servicing are observed.

Should questions arise about characteristics of this equipment or its operation that are not covered by these instructions, additional information can be obtained by contacting Parkson Corporation, Fort Lauderdale, FL., Telephone 305/974-6610-- Fax No. 305/974-6182. The following information should accompany all inquiries: Parkson No. LGS-4126.

NOTE

Orders for renewal parts should include the description and the part numbers shown on the parts lists in the Maintenance Manual.

Section 3 Shipping

In general, an LGS is shipped in the following arrangement:

One	(1)	Lamella Tank Assembly.
One	(1)	Floc and/or Flash Mix Tank Assembly including Floc Drive.
One	(1)	Set of Lamella Tank support columns and bracing.
One	(1)	Floc and/or Flash Mix Tank support frame.
One	(1)	Set of Floc and/or Flash Mix Tank support columns and bracing.
One	(1)	Flash Mixer Prop. & Shaft.
One	(1)	Flash Mixer Drive.
One	(1)	Set of Hardware consisting of nuts, bolts, washers, and gaskets for assembly of the above unit.

Section 4 Receiving

All precautions are taken during loading and shipping to prevent short shipments and damages. It is, however, advisable that you check carefully all received materials against the Bill of Lading, particularly with regard to components shipped loose, and inspect all materials for damage before or during unloading. Notify the shipping firm and Parkson Corporation immediately of any shortages discrepancies, or damage. Since the equipment is usually shipped F.O.B. Fort Lauderdale, it is the contractor's responsibility to make claim against the shipper for damaged equipment.

Section 5 Handling and Transporting

When handling or transporting this equipment, care should be taken to avoid supporting or lifting in a manner that places excessive stress on parts that are not designed to support the unit weight. Never lay unit on its side. Keep in vertical position or on its back as received, if necessary. Lifting devices must be at the jobsite for removing the equipment from the carrier and for installing the equipment.

Never use motor eye-bolt to lift the total assembly, since this eye-bolt is not designed to carry additional equipment other than the motor itself. Never put a sling around shafts or other exterior protrusions, and care should be taken that attached items such as lube lines, etc. will not be damaged.

To lift the LGS/T equipment, use all of the lifting lugs provided. Note: Spreader bars must be used between cables when lifting the equipment to eliminate side loads to tankage and excessive bending moments on lifting lugs. For special lifting instructions, consult the drawings, specific instructions, and/or Parkson Corporation.

The following additional precautions should be observed in handling of equipment:

a) Use proper clothing, tools, and methods of handling, otherwise, serious injury may result.
b) Never drag a unit. This will damage machined surfaces, surface protection, and may overstress the unit.
c) When attaching slings, attention should be given to the sling underload to prevent crushing or ripping off exterior protrusions.

CAUTION

PVC and FRP parts are sensitive to heat and direct sunlight. Therefore, tankage and/or plate packs should be sheltered under a suitable covering with sufficient air space between tankage and/or plate packs and covering to allow for circulation.

For special (not epoxy painted) equipment coatings and linings, contact Parkson Corporation.

Section 6 Storage

Never lay unit on its side. Keep in vertical position or on its back as received, if necessary.

IMPROPER STORAGE WILL VOID WARRANTY.

Section 7 Pre-Erection Storage

Should it be necessary to delay installation and subsequent operation of a unit, special precautions must be taken. If possible, all equipment should be stored indoors in a clean, dry and sheltered environment having a relatively constant temperature and humidity. Tankage that cannot be stored indoors must be raised off the ground, out of water, mud, etc., and covered by a tarpaulin or equivalent protective covering. Always allow sufficient air space between tankage and covering to allow for circulation. For tankage with special coatings or linings (not epoxy painted), contact Parkson Corporation for specific storage instructions.

Gear reducers, motors, motor controllers, electrical and mechanical equipment, etc. must be stored indoors in a clean, dry and sheltered environment having a relatively constant temperature and humidity, and having adequate air circulation. This equipment must be kept free of dust, moisture, and excessive heat.

Non-protected carbon steel surfaces should be coated with oil, grease or equivalent rust inhibitor. If indoor storage space is not available for this equipment, contact Parkson Corporation.

If the aforementioned equipment is to be stored for longer than sixty (60) days, contact Parkson Corporation and perform the following procedure:

> Again, all equipment must be stored indoors as specified above and treat gear reducers as follows:
>
> Fill gear reducer to the top with S.A.E. #30 Oil (Infilrex #603 or equal) to prevent damage during idle period. Rotate by hand once every week to distribute oil and grease. After installation is complete and prior to start-up, drain oil completely and refill to proper operating level with new oil per manufacturer's recommendations for applicable season or operating temperatures.
>
> With Grease Lubricated units, it may be necessary to clean and repack the Reducers. See Manufacturer's Recommendations.

Section 8 Post-Erection Storage

The following procedure must be followed if gear reducers, etc. are to sit idle for more than five (5) days, or two (2) days during winter months:

With the correct quantity of running oil, run the equipment for approximately 30 minutes each day to warm up the drive and to get any moisture out which may have accumulated due to condensation. Keep the same frequency to grease any bearings as under Operating Conditions.

During any idle period, always protect the equipment from rain, snow, and ice.

If the equipment cannot be operated as above or will remain idle for sixty (60) days or longer, follow the procedure specified in Section 7, Pre-Erection Storage. Again, the equipment should be stored indoors as specified in Section 7, and if this is not possible, contact Parkson Corporation.

For storage of tankage with special coatings or linings, contact Parkson Corporation for specific instructions.

Section 9 Installation

The contractor should determine what equipment is required to install the unit using drawings and specific instructions provided.

(Continued on following pages)

NOTES: FOR SPECIFIC INFORMATION REGARDING MECHANICAL OR ELECTRICAL EQUIPMENT, REFER TO THE INSTALLATION, LUBRICATION, WIRING, TEST, CHECK-OUT, START-UP, TROUBLE SHOOTING AND ALL WARNING INSTRUCTIONS CONTAINED IN THE VENDOR'S MAINTENANCE MANUALS FOR THE SPECIFIC UNIT. AGAIN, FAILURE TO DO SO PRIOR TO INSTALLATION OR START-UP COULD RESULT IN SERIOUS DAMAGE TO THE EQUIPMENT AND VOIDANCE OF ANY WARRANTIES.

WE DO NOT ACCEPT LIABILITY FOR ANY CORRECTIVE OR OTHER WORK, OR EXPENDITURES OF ANY KIND THAT HAVE NOT BEEN AUTHORIZED BY PARKSON CORPORATION IN WRITING PRIOR TO THE COMMENCEMENT OF SUCH WORK OR PRIOR TO COMMITTING TO SUCH EXPENDITURES, WITHOUT EXCEPTION.

REASSEMBLY

Refer to General Arrangement Drawing: LG4126-10.

Parts having connections to be made in the field have been assigned Item Numbers. Use connection hardware in appropriately marked bags.

For a description of the Item Numbers refer to the material list on the General Arrangement Drawing. Multiple items of the same number are interchangeable.

Lift Lamella Tank Assembly 1 and set in place. While supporting the unit install columns 2, 3, 4, 5 to Lamella Tank Assembly 1 with hardware marked 6, 7, 8.

Level top of Lamella tank in both directions. Shim as necessary. Note: Equal flow distribution will not be obtained if the unit is not level.

The adjustable overflow weir in the overflow box **MUST BE LEVEL** in order to obtain uniform flow distribution.

See Drawing 1T-2601:

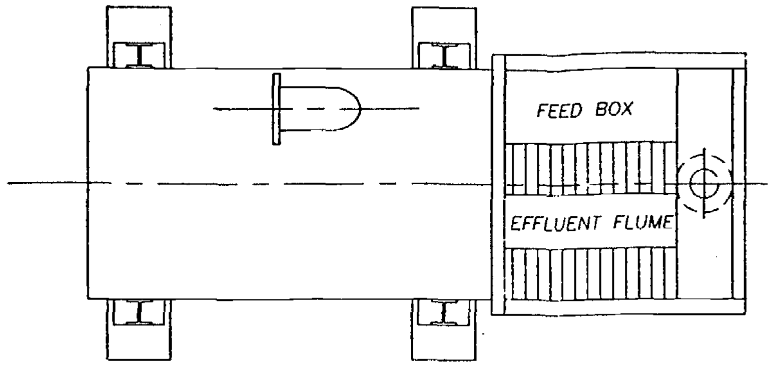
Remove Shipping wire from turnbuckle.

NOTE: Make sure all turnbuckles are in place before removing wire so turnbuckles don't fall into tank.

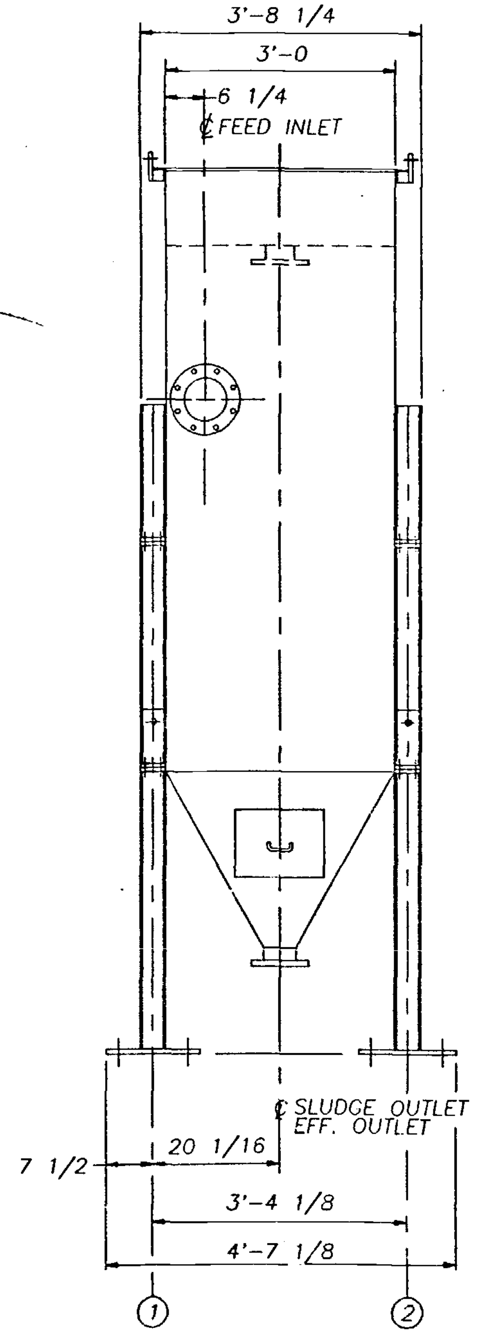
Check Lamella Plate Gasket to make sure it is in place and check all turnbuckles to make sure they are tight. Tighten as required.

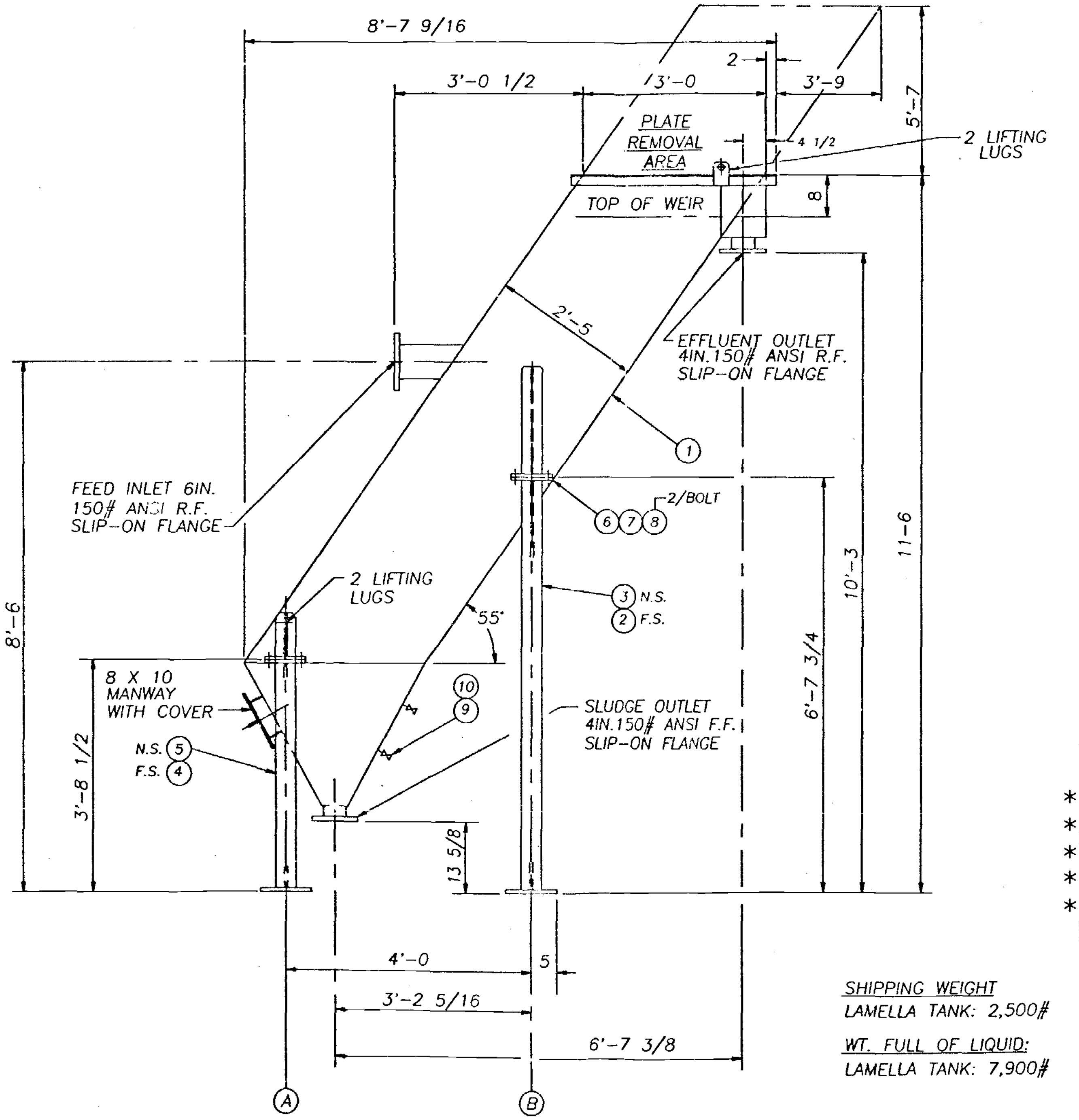
Install sample valves 10 and pipe nipple 9.

Use paint kit 11 for touch-up. Follow instructions on paint can.



PLAN VIEW





SHIPPING WEIGHT
LAMELLA TANK: 2,500#

WT. FULL OF LIQUID:
LAMELLA TANK: 7,900#

NOTES:

1. MATERIALS OF CONSTRUCTION:
   LAMELLA PLATES: ORTHO FRP W/PVC STIFFENERS
   LAMELLA TANK: 1/4 PL. A-36 C.S.
   HOPPER: 1/4 PL. A-36 C.S.

   STRUCTURAL MEMBERS: A-36 C.S.
2. SEE PAINT SPECIFICATIONS FOR PREPARATION AND COATINGS.
3. USED SPREADER BARS OF ADEQUATE WIDTH AND CAPACITY WHEN LIFTING LAMELLA TANK.
4. ALL BOLT HOLES AT 150# FLANGED PIPE CONNECTIONS STRADDLE NORMAL CENTERLINES.
5. ITEMS MARKED WITH (*), TO BE USED FOR SHOP ASSEMBLY

ZP058ZB	11	1	PAINT KIT	NOT SHOWN	SHIP LOOSE	
VG005GB	10	2	VALVE-SAMPLE	1/2-150 GATE	BRONZE	THD.
NP160BB	9	2	NIPPLE-PIPE-TBE	1/2 SCH.40x3IN.	304 SS	
ZG010AB	8	36	WASHER-FLAT	5/8 DIA	C.S.	ZN PL
ZD010AB	7	18	NUT-HEX	5/8-11	A307	ZN PL
ZA185AB	6	18	BOLT-HEX	5/8-11 x 2 LG	A307GRB	ZN PL
* 01-4126-54	5	1	COLUMN-FRONT	L00258		
* 01-4126-53	4	1	COLUMN-FRONT	L00258		
* 01-4126-52	3	1	COLUMN-REAR	L00259		
* 01-4126-51	2	1	COLUMN-REAR	L00259		
* 01-4126-50	1	1	LAMELLA TK ASS'Y	SEE DWG. LIST		
Part No.	Item	Qty.	Description	Reference	Mat'l	Remarks

PARKSON CORPORATION

Description: LAMELLA GRAVITY SETTLER
MODEL 125/55 (BARE UNIT)
GENERAL ARRANGEMENT

Revision: By | Chk'd | Date | By | Chk'd | Date | By | Chk'd | Date

Drawn By	Checked By	Approved By	Micro Rev.	
LAS	RDN	SNF	—	
Date 3-29-95	Date 4-5-95	Date 4/12/95	Date 4-13-95	Scale

Location

Dwg. No. LG4126-10

Rev. —

LGA125

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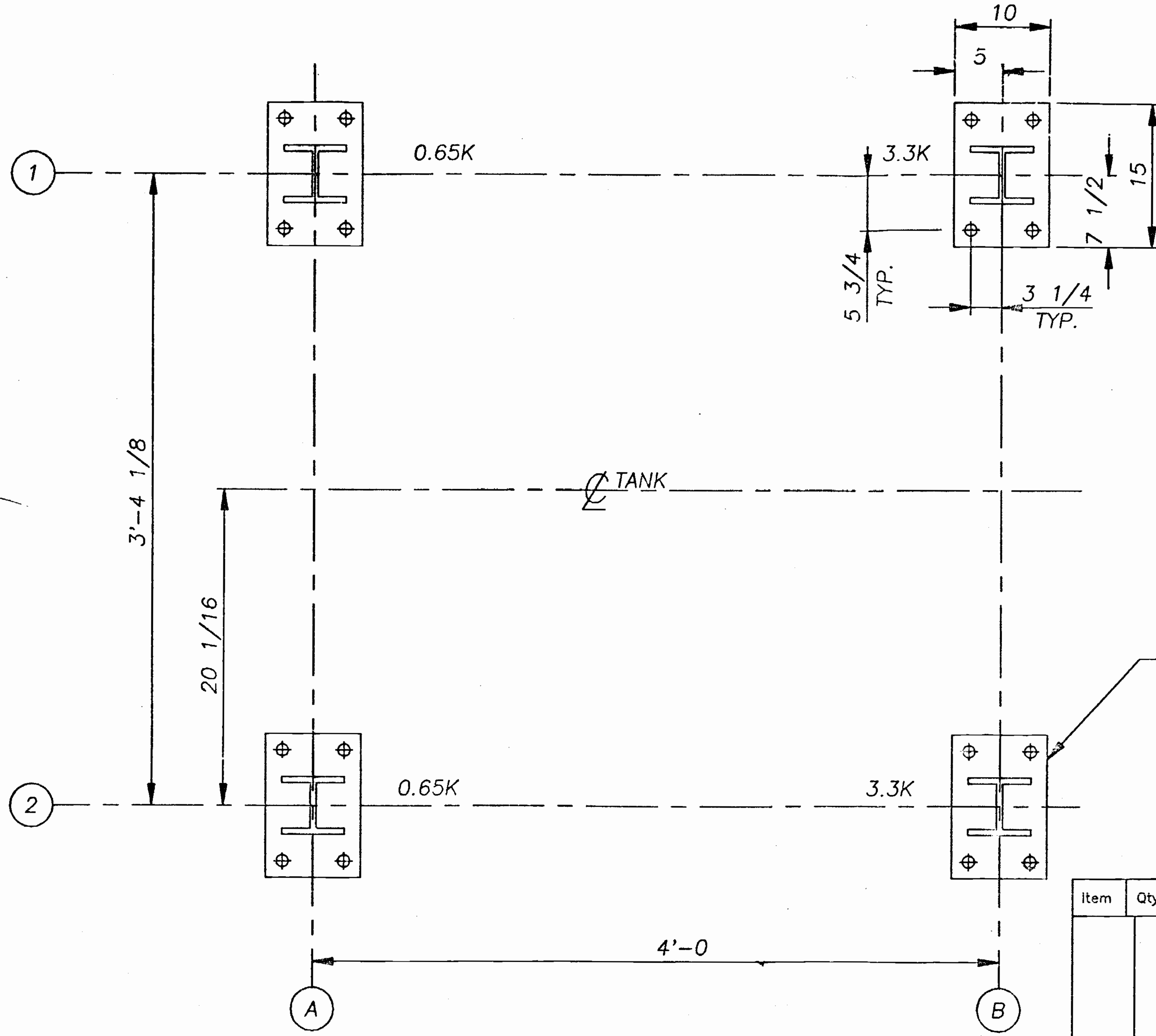


NOTES:

1. CUSTOMER TO PROVIDE ALLOWANCE FOR A MINIMUM OF 1" OF GROUT BELOW BASE PLATES.

Item	Qty.	Description	Reference	Mat'l	Remarks

Revision: By | Chk'd | Date | By | Chk'd | Date | By | Chk'd | Date

PARKSON CORPORATION

LAMELLA GRAVITY SETTLER LOADING DIAGRAM

MODEL 125/55 & 55X (BARE UNIT)

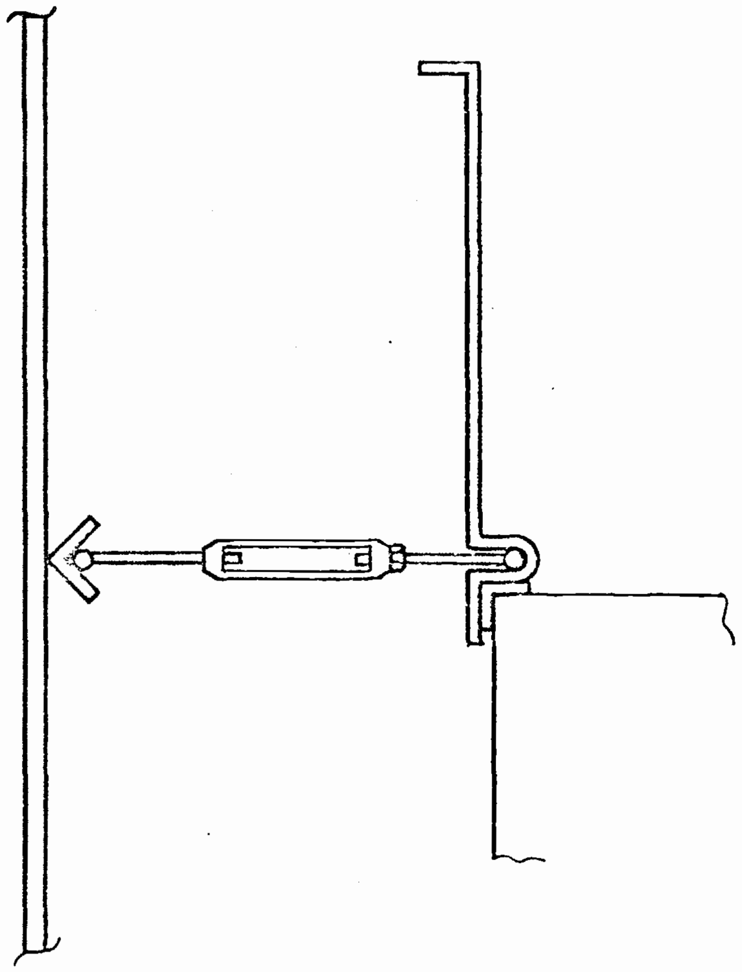
Drawn By LAS	Checked By HDH	Approved By SNF	Micro Rev. —	
Date 3-29-95	Date 4-4-95	Date 4/12/95	Date 4-[illegible]-95	Scale

Location

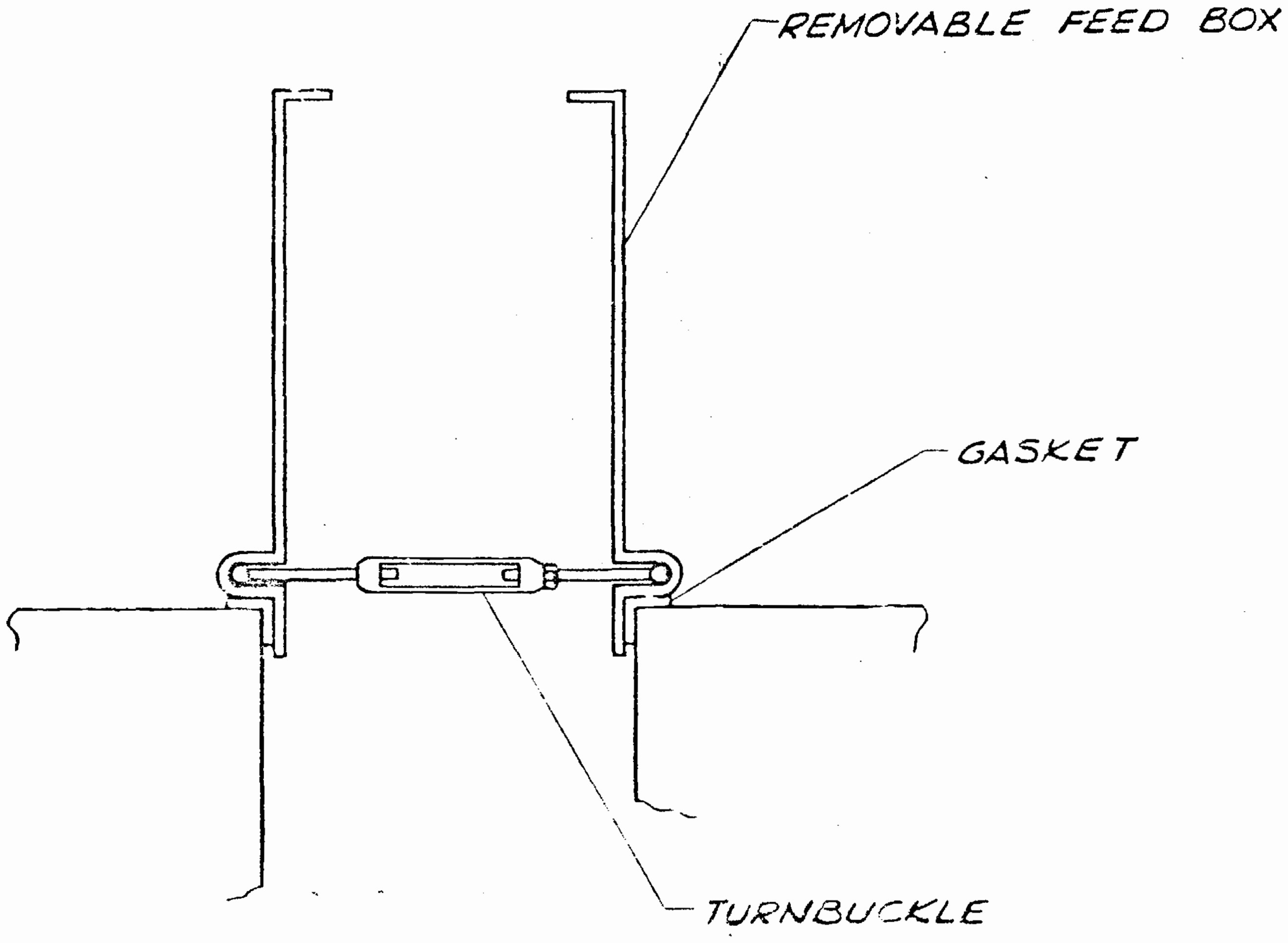
Dwg. No. LG4126-11

Rev —

Drw. No. IT-2601 Rev.



MODEL 125/55 ONLY



ALL OTHER MODELS

Item No.	Qty.	Description	Reference	Material	Remarks	Std. Ref.	Zone

Drawn FML 6-13-79
Checked ROD 6-13-79
Std.
Approved
Scale —
Preceding Drw.
Superceding Drw.

Parkson CORPORATION
5601 N.E. 14th Avenue
Ft. Lauderdale, Fl. 33334
Phone: (305) 772-
TWX: 510-
A SUBSIDIARY OF A. JOHNSON & CO. INC

Lamella GRAVITY SETTLER
Title LAMELLA PLATE SEAL ARRANGEMENT

Reg.
Micro
Date
Code
Drw. No. IT-2601
Rev.

Rev.	Ind.	Revision/Change Note No.	Date	Rev. by	Zone	Rev.	Ind.	Revision/Change Note No.	Date	Rev. by	Zone

Drw. No. IT-2601 Rev.

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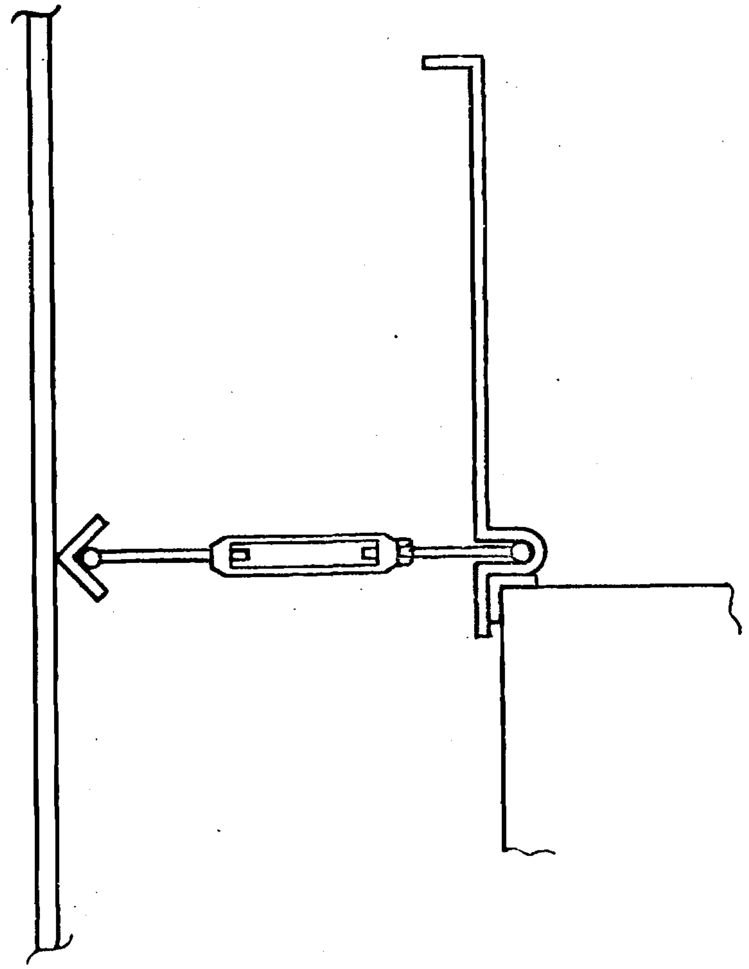
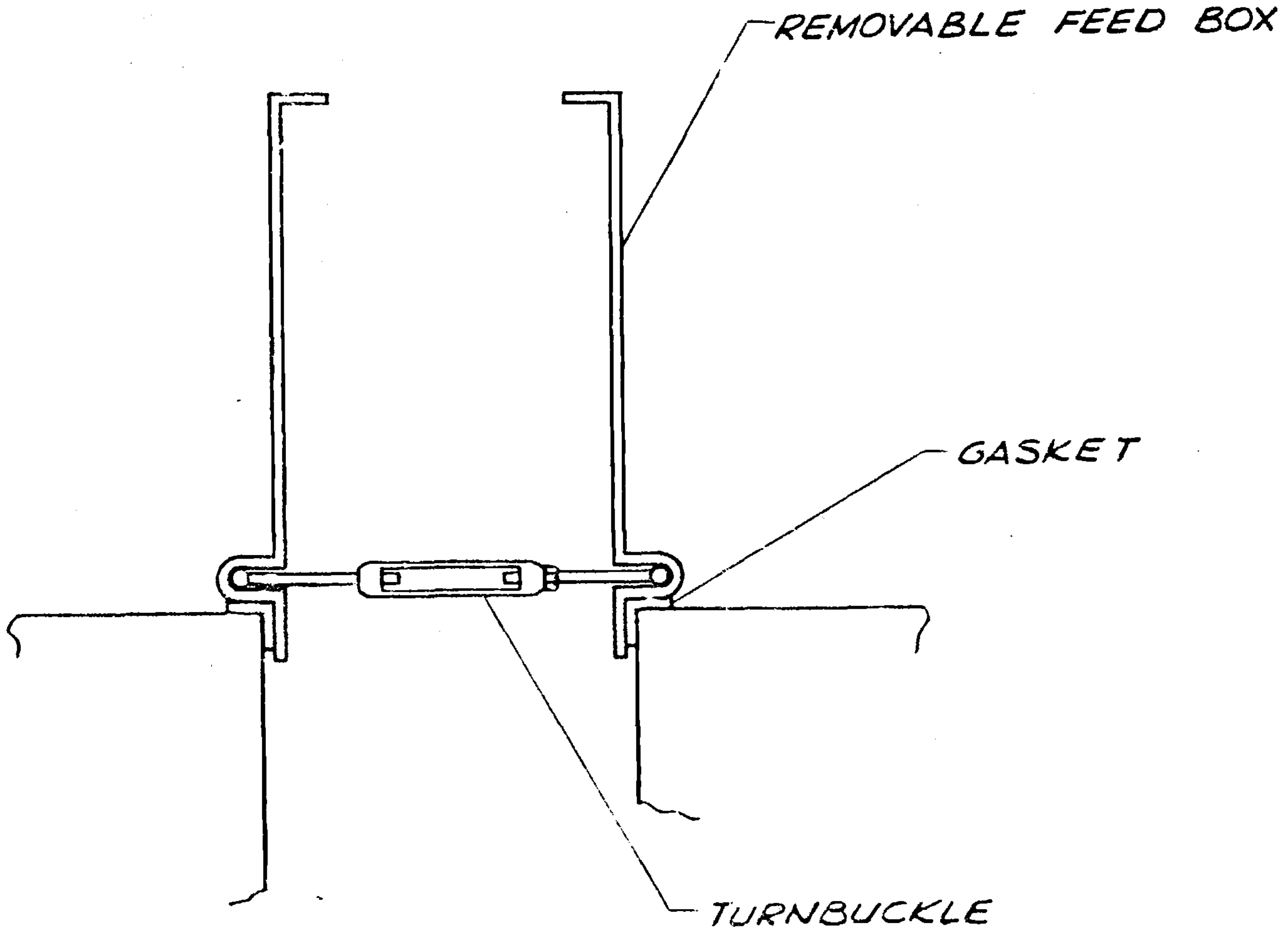


MODEL 125/55 ONLY



ALL OTHER MODELS

Item No.	Qty.	Description	Reference	Material	Remarks	Std. Ref.	Zone

Drawn FTM 6-13-79
Checked RDD 6-13-79
Std.
Approved
Scale —
Preceding Drw.
Superceding Drw.

Parkson CORPORATION
5601 N.E. 14th Avenue
Ft. Lauderdale, Fl. 33334
Phone: (305) 772-5860
TWX: 510-955-9874
A SUBSIDIARY OF A. JOHNSON & CO., INC

Lamella GRAVITY SETTLER
Title LAMELLA PLATE
SEAL ARRANGEMENT

Reg.
Micro
Date
Code —
Drw. No. IT-2601
Rev.

Rev.	Ind.	Revision/Change Note No.	Date	Rev. by	Zone	Rev.	Ind.	Revision/Change Note No.	Date	Rev. by	Zone

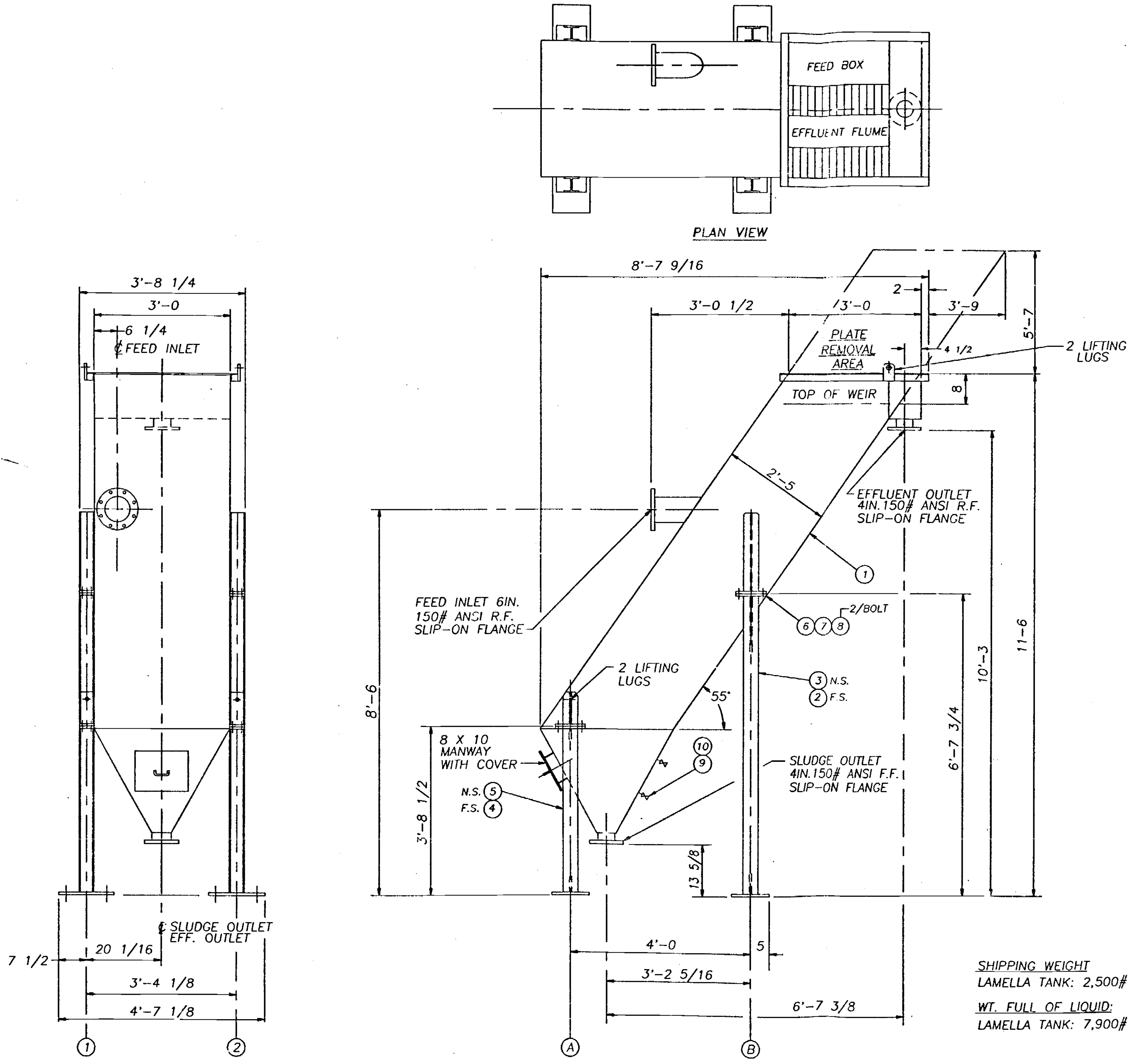
DC1-7506

BRUNING 44-131 28121-1

NOTES:

1. MATERIALS OF CONSTRUCTION:
   LAMELLA PLATES: ORTHO FRP W/PVC STIFFENERS
   LAMELLA TANK: 1/4 PL. A-36 C.S.
   HOPPER: 1/4 PL. A-36 C.S.

   STRUCTURAL MEMBERS: A-36 C.S.
2. SEE PAINT SPECIFICATIONS FOR PREPARATION AND COATINGS.
3. USED SPREADER BARS OF ADEQUATE WIDTH AND CAPACITY WHEN LIFTING LAMELLA TANK.
4. ALL BOLT HOLES AT 150# FLANGED PIPE CONNECTIONS STRADDLE NORMAL CENTERLINES.
5. ITEMS MARKED WITH (*), TO BE USED FOR SHOP ASSEMBLY



SHIPPING WEIGHT
LAMELLA TANK: 2,500#

WT. FULL OF LIQUID:
LAMELLA TANK: 7,900#

	Part No.	Item	Qty.	Description	Reference	Mat'l	Remarks
	ZP058ZB	11	1	PAINT KIT	NOT SHOWN	SHIP LOOSE	
	VG005GB	10	2	VALVE-SAMPLE	1/2-150 GATE	BRONZE	THD.
	NP160BB	9	2	NIPPLE-PIPE-TBE	1/2 SCH.40x3IN.	304 SS	
	ZG010AB	8	36	WASHER-FLAT	5/8 DIA	C.S.	ZN PL
	ZD010AB	7	18	NUT-HEX	5/8-11	A307	ZN PL
	ZA185AB	6	13	BOLT-HEX	5/8-11 x 2 LG	A307GRB	ZN PL
*	01-4126-54	5	1	COLUMN-FRONT	L00258		
*	01-4126-53	4	1	COLUMN-FRONT	L00258		
*	01-4126-52	3	1	COLUMN-REAR	L00259		
*	01-4126-51	2	1	COLUMN-REAR	L00259		
*	01-4126-50	1	1	LAMELLA TK ASS'Y	SEE DWG. LIST		

PARKSON CORPORATION

LAMELLA GRAVITY SETTLER
MODEL 125/55 (BARE UNIT)
GENERAL ARRANGEMENT

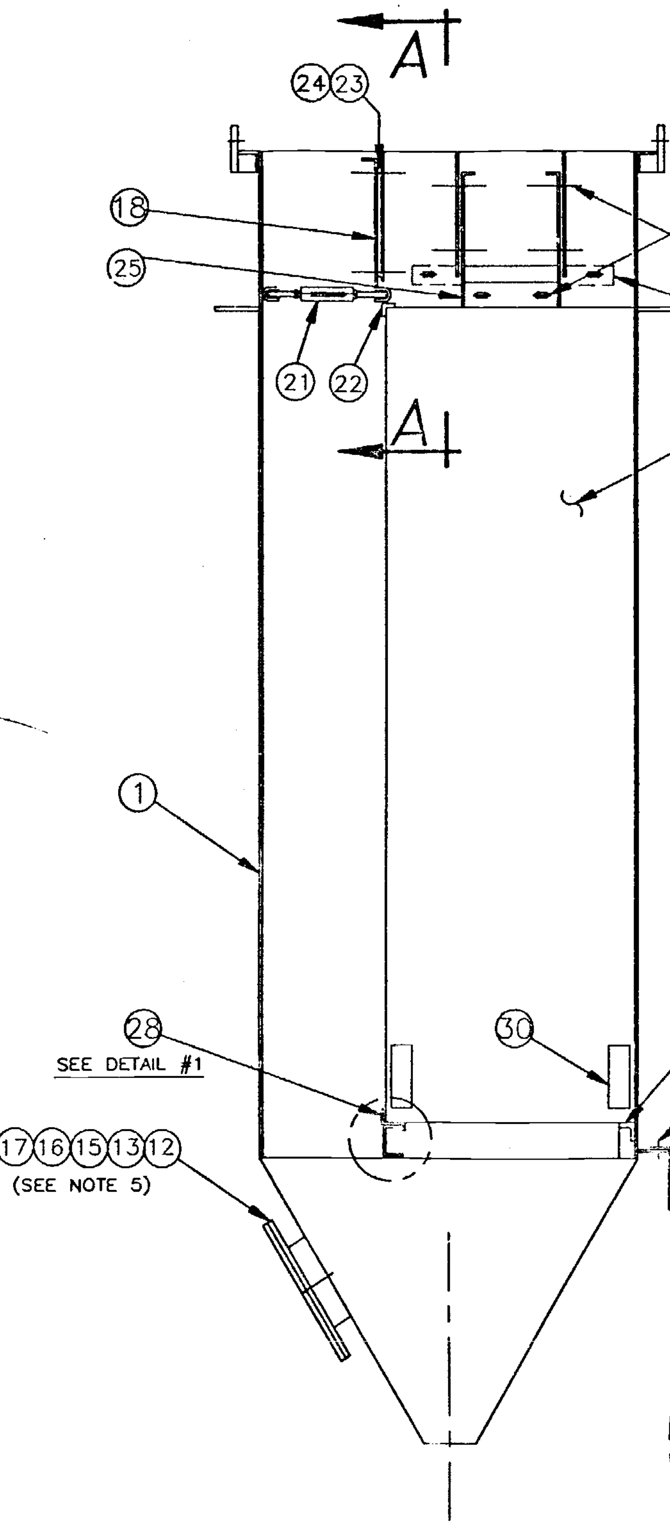
Drawn By	Checked By	Approved By	Micro Rev.	
LAS	NDS	SNF	—	
Date 3-29-95	Date 4-5-95	Date 4/12/95	Date 4-5-95	Scale

Location

Dwg. No. LG4126-10

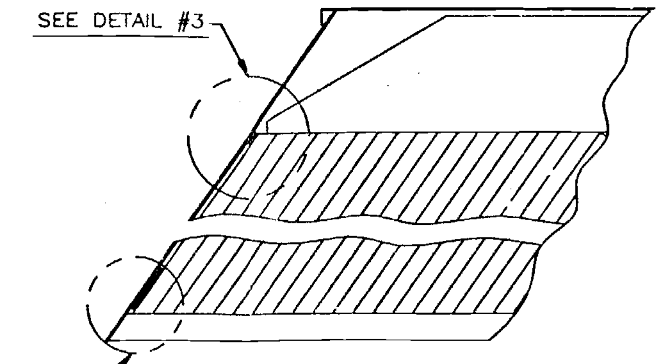
Rev. —

LGA125

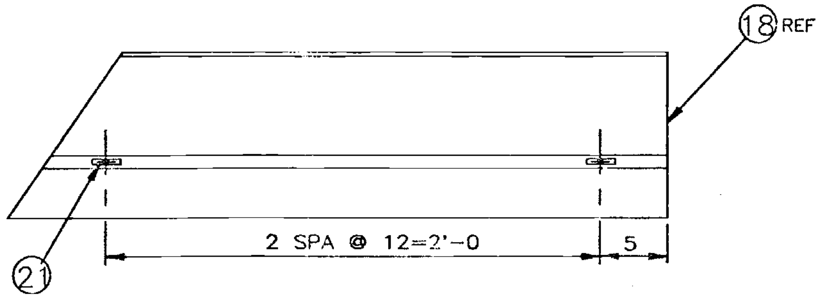


NOTES:

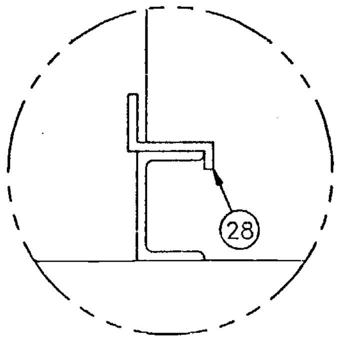
1. NON-SNAPPING LAMELLA PLATES TO BE LAMELLA PLATE #6&11. STARTING FROM REAR OF PLATE PACK.
2. CUT TO SUIT AND CEMENT TO LAM. PLATE.
3. LOCTITE 242 SHALL BE USED ON ALL SHOP ASSEMBLED THREADED FASTENERS AT ASSEMBLY. UNLESS OTHERWISE NOTED.
4. USE GE RTV SILICONE ADHESIVE SEALANT OR EQUAL.
5. FOR ORIENTATION OF INSPECTION OPENING, SLUDGE OUTLET, SAMPLE VALVES, SEE LAMELLA TANK INLET AND OUTLET. ASSEMBLY DRAWING.
6. SECURE ITEM 2 ON THE BRACKET BETWEEN COLUMNS. CENTER ITEMS 7 & 8 ON ITEM 2, WITH ITEM 8 TO THE LEFT, USING BLIND RIVETS (ITEM 31).



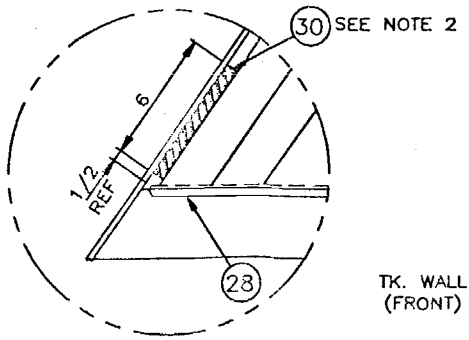
SIDE SECTION VIEW
(ENLARGED)



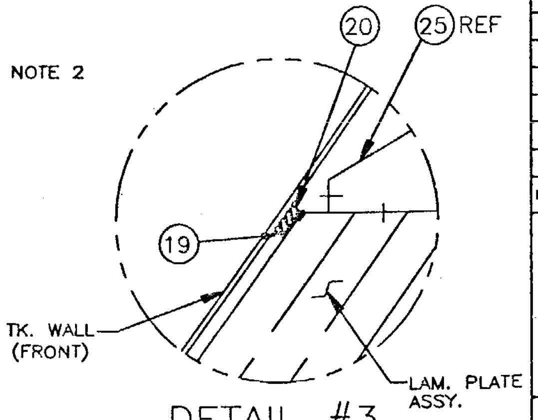
SECTION A-A (ENLARGED)



DETAIL #1
(ENLARGED)



DETAIL #2
(ENLARGED)



DETAIL #3
(ENLARGED)

Item	Qty	Description	Reference	Mat'l	Remarks
31	10	BLIND RIVET	4-6	ALUM.	
30	8 LF.	GASKET NON-STICK	1/4x2 CUT TO SUIT	NEOPRENE	DURO 50-60
29					
28	1	LAM PL. SUPPORT STOP	1T-2502		
27	1	LAM PL. SUPPORT ANGLE	1T-2514		
26	1	WEIR PLATE	1T-148		
25	1	EFFLUENT FLUME	SEE DWG LIST		
24	1	GASKET, REAR	1T-703-1		
23	1	GASKET, FRONT	1T-703-2		
22	4 FT.	GASKET, LAM. PLATES	1/2x6 CUT TO SUIT	PORON CELLULAR URETHANE 4701-01-15500-1604-IPSA	
21	3	TURNBUCKLE ASSY	1T-2090		
20	2 LF.	PLATE SEAL GASKET	1/2x2 CUT TO SUIT	PORON CELLULAR URETHANE 4701-01-15500-1604-IPSA	
19	1	PLATE SEAL STOP	1T-762		
18	1	FEED BOX PLATE	2T-497		
17	1	GASKET-COVER, INSP.	L00090		
16	1	COVER-INSPECTION	L00091		
15	24	NUT	1/2	304 S.S.	
14	6	WASHER-LOCK	1/2	304 S.S.	
13	48	FLAT WASHER	1/2	304 S.S.	
12	24	BOLT	1/2x1 1/2	304 S.S.	
11	6	WASHER-FLAT	3/8	304 S.S.	
10	3	NUT-HEX	3/8	304 S.S.	
9	3	BOLT-HEX	3/8 x 1 1/2	304 S.S.	
8	1	SERIAL NO PLATE	1T-4541		
7	1	PARKSON NAME PLATE	3J-1362		
6	11	LAMELLA PLATE ASSY.	1T-1778		
5	2	LAMELLA PLATE ASSY.	1T-1779		
4	1	LAMELLA PLATE ASSY.	1T-1764		
3					
2	1	MOUNTING BRACKET	L00085		
1	1	LAMELLA TANK DET.	SEE DWG. LIST		

Revision	Description	By	Chk'd	Date
A	REDRAWN IN CAD.	NJC	SNF	11-8-94

PARKSON CORPORATION

LAMELLA GRAVITY SETTLER
LAMELLA TANK ASSEMBLY-MODEL 125/55
W/REMOVABLE FEED BOX

Drawn By	Checked By	Approved By	Micro Rev.	
NJC	HDH	SNF	A	CAD
Date 8-24-94	Date 8-26-94	Date 8-26-94	Date 11-15-94	Scale

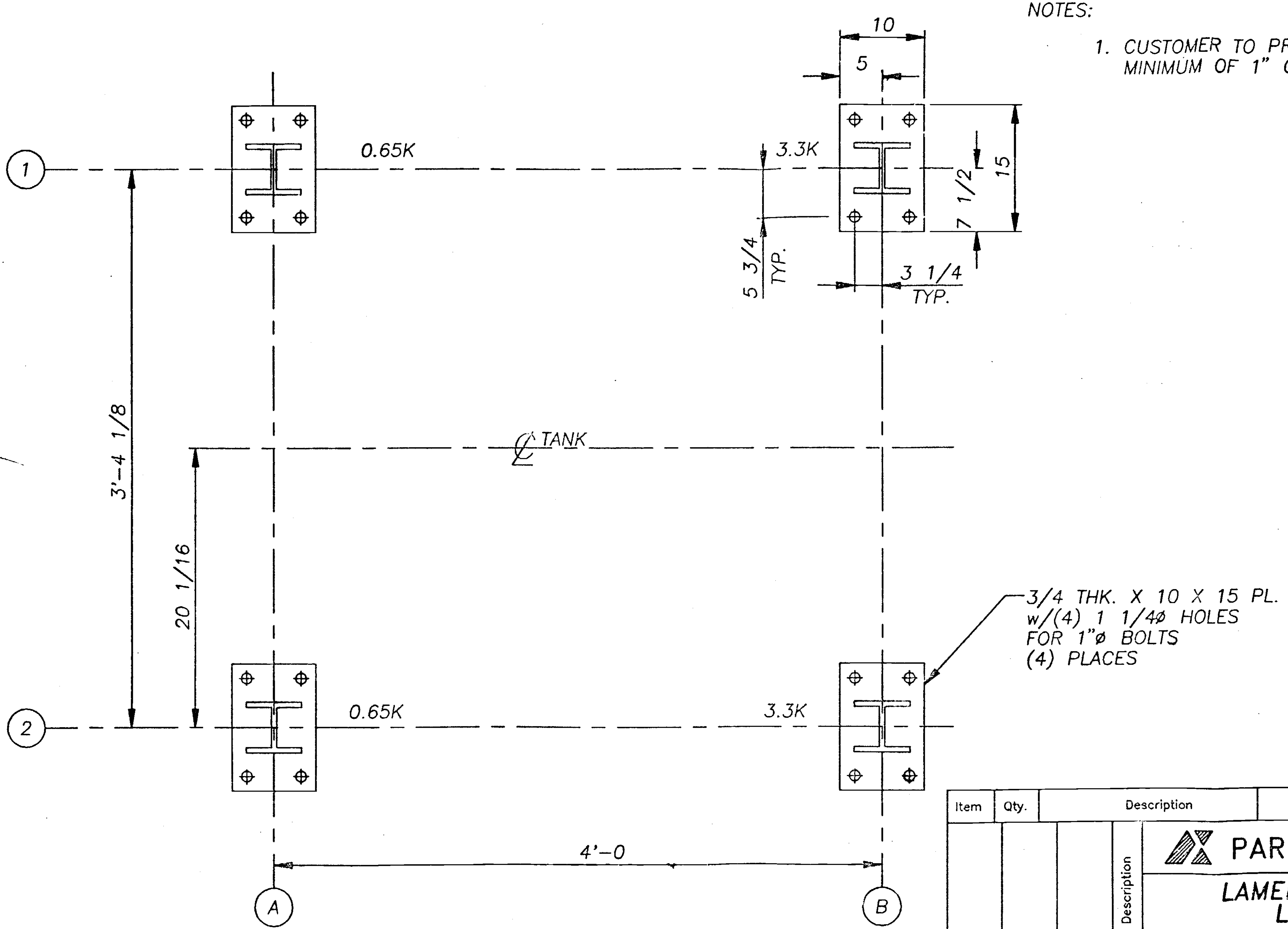
Location

Dwg. No. L00151

Rev. A

NOTES:

1. CUSTOMER TO PROVIDE ALLOWANCE FOR A MINIMUM OF 1" OF GROUT BELOW BASE PLATES.



Item	Qty.	Description	Reference	Mat'l	Remarks

PARKSON CORPORATION

LAMELLA GRAVITY SETTLER LOADING DIAGRAM

MODEL 125/55 & 55X (BARE UNIT)

Drawn By	Checked By	Approved By	Micro Rev.	
LAS	HDH	SNF	—	
Date 3-29-95	Date 4-4-95	Date 4/12/95	Date 4-12-95	Scale

Location

Dwg. No. LG4126-11

Rev. —

Revision: By | Chk'd | Date | By | Chk'd | Date | By | Chk'd | Date