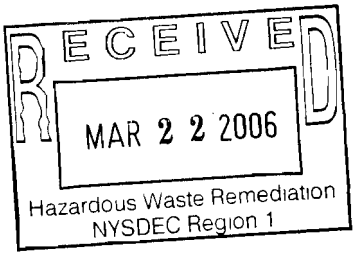
Appendix E – Volume 2 Manufacturers Supplied Equipment Information

Operation, Maintenance and Monitoring Manual



Off-Site Interim Remedial Measure
Former Unisys Facility
Great Neck, New York

NYSDEC Site ID# 130045

March 2006

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

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AA. Auto-Dialer
BB. Recovery Well Process Meter
CC. Fiber Optical Cable Enclosure Panel
DD. 12 Fiber Optical Cable
EE. Fiber Optic Fan Out Kit
FF. Fiber Optic Distribution Patch Panel
GG. Optical Fiber Patch Panel Adapter Kit

Section 4

Section 4-A

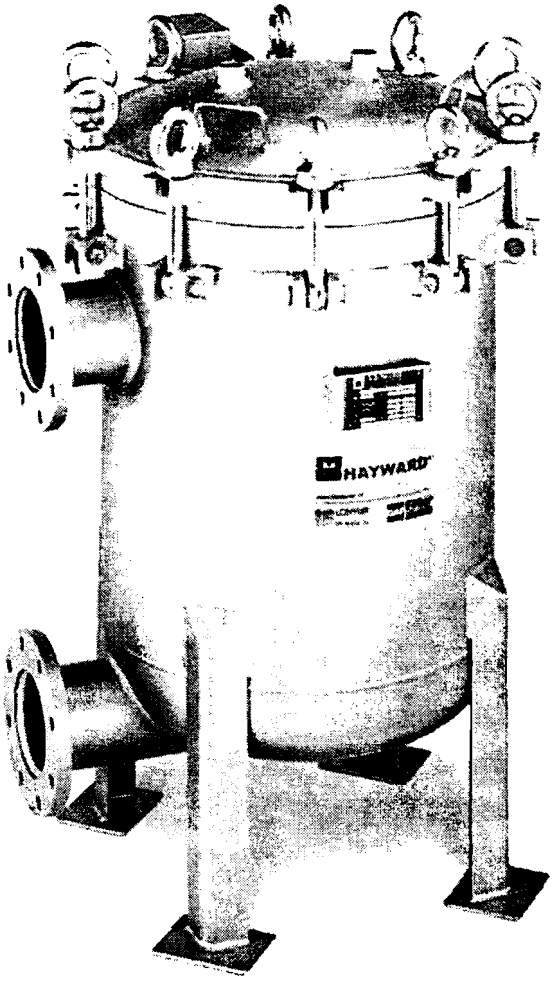
Water Filters (F-410, F-420)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

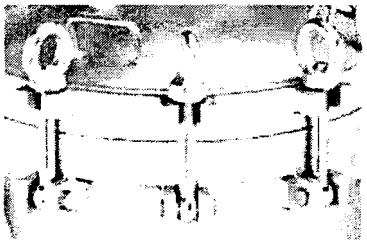
MAXILINE™ MBF HE

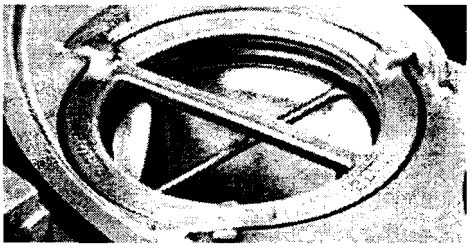
MAXILINE™ MBF HE

The user friendly, cost effective bag filter housing for high volume, multiple applications and processes.

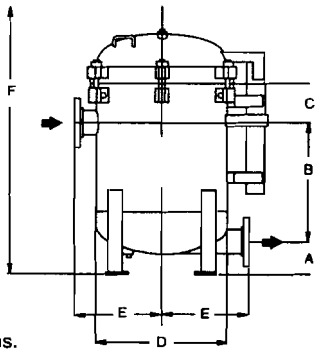


- The bag filter housing is designed with a proven swing eye bolt or segment clamp closure mechanism.
- Unique 3 point hold down or bayonet fittings ensure high quality of seal between each filter bag and housing body. Special tool (supplied) ensures simple, effective operation.
- A counter balanced spring assisted cover lifter balances the cover perfectly giving it a weightless feel. Opening and closing of the cover with the "little finger" is a reality.
- Positive O ring sealing offers easy and safe operation.
- Side inlet and bottom outlet provides easy and full drainage, tangential outlet option available to reduce housing height.
- Available in carbon steel or Type 316 stainless steel for high corrosion resistance.
- Housing volume is optimized to minimize product loss.
- 6 standard sizes with 4 through to 24 bag housings available (size 02).





These value added features:	Give these benefits
Low profile design with tangential inlet/outlet	Reduces housing height to make bag changing easier. No need for ladders, stools or catwalks.
Positive, 3 point bag hold downs	Individual, bag sealing for by pass free filtration.
Spring assisted cover lifter	Quick, easy opening and closing of even the largest size covers.
Eye bolt cover closure	Rugged, proven design, easy to use.



See page 5 for dimensions.

TECHNICAL DATA

SERIES	Type*	No. Of Bags	Bag Size	Max. Flow [2] GPM	Material [1]	Max. Allowable Pressure	Max. Allowable Temperature**	Housing Volume	Housing Weight	Inlet Outlet Connection	Type	Vent [4]	Dimensions In Inches					
						PSI	°F	GAL	LBS			IN	A	B	C	D	E	F
MAXILINE VMBF SE	VMBF 0402 AB10 040A UT 11SE	4	2	400	SS	150	250	69	484	4"	Flanged	1"	6.00	20.00	10.50	22.00	15.75	68.00
	VMBF 0602 AB10 060A UT 11SE	6	2	900	SS	150	250	139	983	6"	Flanged	1"	7.25	20.00	13.00	31.50	20.75	80.00
	VMBF 0802 AB10 080A UT 11SE	8	2	1750	SS	150	250	141	1023	8"	Flanged	1"	8.25	19.00	12.80	31.50	20.50	80.00
MAXILINE MBF HE	MBF 0302 AB10 030A UT 11HE	3	2	230	SS or CS	150	250	40	245	3"	Flanged	1"	6.00	22.50	6.40	18.00	12.75	60.00
	MBF 0402 AB10 040A UT 11HE	4	2	400	SS or CS	150	250	69	380	4"	Flanged	1"	6.00	22.20	7.40	24.00	16.00	68.40
	MBF 0602 AB10 060A UT 11HE	6	2	900	SS or CS	150	250	90	440	6"	Flanged	1"	7.50	19.50	9.03	24.00	16.50	68.80
	MBF 0802 AB10 080A UT 11HE	8	2	1750	SS or CS	150	250	140	655	8"	Flanged	1"	8.25	19.00	10.78	30.00	20.50	66.00
MAXILINE MBF HD	MBF 0302 AB10 030A UT 11HD	3	2	230	SS or CS	150	250	40	255	3"	Flanged	1"	6.00	22.50	6.40	18.00	12.75	66.00
	MBF 0402 AB10 040A UT 11HD	4	2	400	SS or CS	150	250	54	390	4"	Flanged	1"	6.00	22.20	7.80	24.00	16.00	68.00
	MBF 0602 AB10 060A UT 11HD	6	2	900	SS or CS	150	250	95	460	6"	Flanged	1"	7.00	20.00	9.80	26.00	18.50	68.00
	MBF 0802 AB10 080A UT 11HD	8	2	1750	SS or CS	150	250	140	655	8"	Flanged	1"	8.25	19.00	10.78	30.00	20.50	66.00
	MBF 1002 AB10 100A UT 11HD	10	2	2600	SS or CS	150	250	215	1400	10"	Flanged	1"	10.00	17.00	13.30	36.00	24.50	70.00
	MBF 1202 AB10 100A UT 11HD	12	2	2600	SS or CS	150	250	245	1500	10"	Flanged	1"	10.00	17.00	13.80	38.00	24.50	72.00
	MBF 1402 AB10 100A UT 11HD	14	2	2600	SS or CS	150	250	311	1800	10"	Flanged	1"	11.50	20.00	11.81	42.00	28.00	76.00
	MBF 1602 AB10 120A UT 11HD	16	2	3500	SS or CS	150	250	317	1875	12"	Flanged	1"	11.50	20.00	11.81	42.00	28.00	76.00
	MBF 1802 AB10 120A UT 11HD	18	2	3500	SS or CS	150	250	446	2420	12"	Flanged	1"	12.50	22.00	10.69	48.00	31.00	88.00
	MBF 2002 AB10 140A UT 11HD	20	2	4500	SS or CS	150	250	454	2505	14"	Flanged	1"	12.50	22.00	10.69	48.00	31.00	88.00
	MBF 2202 AB10 140A UT 11HD	22	2	4500	SS or CS	150	250	570	2730	14"	Flanged	1"	12.50	22.00	13.44	52.00	33.00	92.00
	MBF 2402 AB10 140A UT 11HD	24	2	4500	SS or CS	150	250	570	2800	14"	Flanged	1"	12.50	22.00	13.44	52.00	33.00	92.00
TOPLINE	TBF 0101 AB10 020A	1	1	90	SS or CS	150	400	3.5	80	2"	Flanged	1/4"	17.70	15.50	1.93	8.62	12.08	53.50
	TBF 0102 AB10 020A	1	2	180	SS or CS	150	400	7.25	93	2"	Flanged	1/4"	17.70	31.00	1.93	8.62	12.08	84.25
	TBF 0102 AB10 020R M32B0	1	2	180	SS	150	400	7.25	93	2"	Tri Clamp	1/4"	15.80	32.78	1.93	8.62	12.83	84.25
SIDELINE	SBF 0101 AB10 020A	1	1	90	SS	150	400	4.75	84	2"	Flanged	1/4"	17.70	19.50	3.15	8.62	8.66	54.70
	SBF 0101 AB10 030A	1	1	90	SS	150	400	4.75	84	3"	Flanged	1/4"	17.70	19.50	3.15	8.62	8.66	54.70
	SBF 0102 AB10 020A	1	2	180	SS	150	400	8.5	102	2"	Flanged	1/4"	17.70	35.00	3.15	8.62	8.66	85.50
	SBF 0102 AB10 030A	1	2	180	SS	150	400	8.5	102	3"	Flanged	1/4"	17.70	35.00	3.15	8.62	8.66	85.50
	SBF 0103 AB21 015N	1	3	25	SS	300	225	0.5	26	1 1/2"	NPT	1/4"	na	11.77	2.95	4.50	3.50	21.80
	SBF 0104 AB21 015N	1	4	50	SS	300	225	0.7	29	1 1/2"	NPT	1/4"	na	17.87	2.95	4.50	3.50	33.90
DUOLINE	TOPLINE	2	2	180	SS or CS	150	250	16	240	2"	Flanged	1/4"	17.70	24.50	1.93	8.62	37.45	84.25
	SIDELINE	2	2	180	SS	150	250	16	300	2"	Flanged	1/4"	17.70	27.50	3.15	8.62	30.82	85.50
	SIDELINE	2	2	180	SS	150	250	17	330	3"	Flanged	1/4"	17.70	27.50	3.15	8.62	33.32	85.50
	FLOWLINE	2	2	180	SS or CS	150	250	15	200	2"	Flanged	1/4"	17.70	28.44	3.34	7.68	37.45	85.50
MODULINE	TOPLINE	1+1	2	360	SS or CS	150	250	16	230	2"	Flanged	1/4"	17.70	24.50	1.93	8.62	34.32	84.25
	SIDELINE	1+1	2	360	SS	150	250	16	230	2"	Flanged	1/4"	17.70	27.50	3.15	8.62	27.44	85.50
	SIDLINE	1+1	2	360	SS	150	250	17	300	3"	Flanged	1/4"	17.70	27.00	3.15	8.62	29.70	85.50
	FLOWLINE	1+1	2	360	SS or CS	150	250	15	170	2"	Flanged	1/4"	17.70	28.44	3.34	7.68	26.64	85.50
POLYLINE	PBF 0101 PV/CP10 020A/N/S	1	1	50	PVC/CPVC	150	70	3.6	50	2"	Flg/Skt/NPT	1/4"	7.87	13.75	9.20	6.13	10.90	32.63
	PBF 0102 PV/CP10 020A/N/S	1	2	100	PVC/CPVC	150	70	6.5	75	2"	Flg/Skt/NPT	1/4"	7.87	29.75	9.20	6.13	10.90	74.63
	PBF 0101 PO10 020A	1	1	50	PPL	150	70	6.6	55	2"	Flanged	1/4"	3.26	20.75	3.38	10.35	8.50	60.00
	PBF 0101 PO10 020N	1	1	50	PPL	150	70	6.6	51	2"	NPT	1/4"	3.26	20.75	3.38	10.35	6.14	60.00
	PBF 0102 PO10 020A	1	2	100	PPL	150	70	9.5	68	2"	Flanged	1/4"	3.26	36.75	3.38	10.35	8.50	76.00
	PBF 0102 PO10 020N	1	2	100	PPL	150	70	9.5	64	2"	NPT	1/4"	3.26	36.75	3.38	10.35	6.14	76.00
	PBF 0102 PF07 020A	1	2	100	PVDF	100	80	9.5	100	2"	Flanged	1/4"	3.26	36.00	3.88	10.35	8.50	75.25
FLOWLINE	FBF 0101 AB10 020A	1	1	90	SS or CS	150	250	4	30	2"	Flanged	1/4"	17.70	20.75	3.34	7.68	6.70	54.90
	FBF 0101 AB10 020N	1	1	90	SS or CS	150	250	4	30	2"	NPT	1/4"	17.70	19.64	3.34	7.68	5.37	54.90
	FBF 0102 AB10 020A	1	2	180	SS or CS	150	250	7	43	2	Flanged	1/4"	17.70	36.31	3.34	7.68	6.70	85.70
	FBF 0102 AB10 020N	1	2	180	SS or CS	150	250	7	43	2"	NPT	1/4"	17.70	35.19	3.34	7.68	5.37	85.70
ECOLINE	EBF 0101 AB10 020N	1	1	90	SS	100	250	4	25	2"	NPT	1/4"	na	19.64	3.24	7.68	5.37	37.00
	EBF 0102 AB10 020N	1	2	180	SS	100	250	7	38	2"	NPT	1/4"	na	35.19	3.24	7.68	5.37	68.00
	EBF 0103 AB10 015N	1	3	25	SS	150	250	0.5	9	1 1/2"	NPT	1/4"	na	11.77	2.78	4.50	3.50	22.45
	EBF 0104 AB10 015N	1	4	50	SS	150	250	0.7	11	1 1/2"	NPT	1/4"	na	17.87	2.78	4.50	3.50	33.84

* Type number is for stainless steel construction. Change AB to CS for carbon steel. ** Depending on seal material

1) SS = Austenitic Stainless Steel SS 316 and CF8M or better

2) Maximum theoretical flow based on water viscosity, bag specific

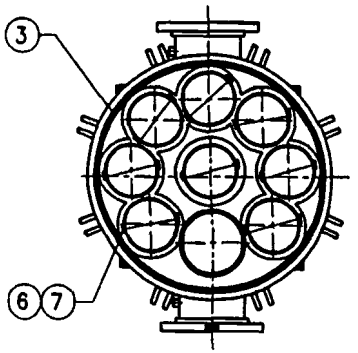
3) Dimensions for reference only and approximate. Exact dimensions for installation purposes available on request.

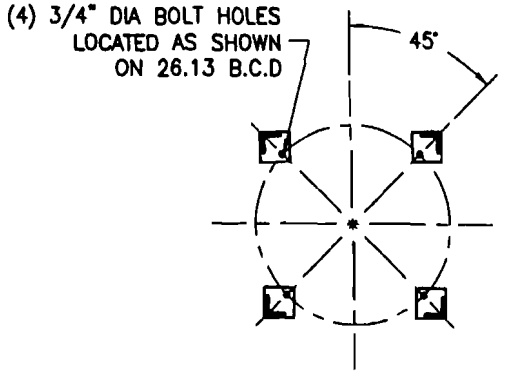
4) For details, see available product specific data sheet

Product Codes

D –	MBF –	04	02 –	AC	10 –	050	D
D DUOLINE	VMBF MAXILINE	No. of bags	Bag Size	Material	Pressure rating	Connection Size	Connection Type
M MODULINE	MBF MAXILINE	01, 02,	01 short 7"	AB SS316	07 100 psi	050 1/2"	A ANSI Flange
	TBF TOPLINE	04, 08,	02 short 7"	CP CPVC	10 150 psi	010 1"	N NPT Female Thread
	SBF SIDELINE	12, 16,	03 short 4"	CS Carbon Steel	21 300 psi	012 1 1/4"	R Tri Clamp
	PBF POLYLINE	20, 24	04 short 4"	PO Polypropylene		015 1 1/2"	S Socket
	FBF FLOWLINE			PF PVDF		020 2"	
	EBF ECOLINE			PV PVC		Up to 140 14"	

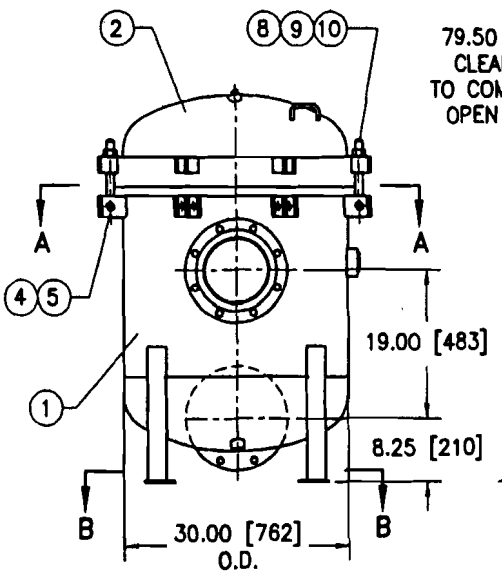
TO BOM



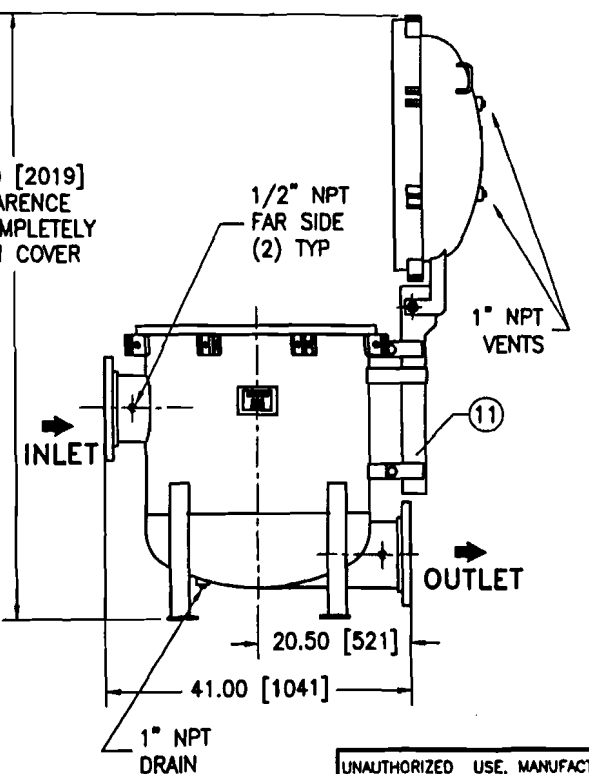


ITEM	PART NAME	MATERIAL
1	BODY	SA240-316/316L
2	COVER	SA240-316/316L
3	O-RING	BUNA-N
4	PIN	SA193 B7 ZINC PL
5	SNAP RING	STEEL ZINC PL
6	BASKET RESTRAINER	316 SS
7	FILTER BAG RETAINER	316 SS
8	EYE BOLT	SA193 B7 ZINC PL
9	HEX NUT	SA194 2H ZINC PL
10	WASHER	STEEL ZINC PL
11	SPRING ASSISTED MECHANISM	STAINLESS STEEL

SECTION A-A



SECTION B-B



NOTES:

1. UNITS ARE TO BE DESIGNED, FABRICATED & "U" STAMPED IN ACCORDANCE WITH ASME SECT. VIII,DIV. 1 BOILER & PRESSURE VESSEL CODE, IN COMPLIANCE TO LATEST ADDENDA.
2. INLET / OUTLET FLANGE CONNECTIONS PER ANSI B 16.5.
3. DESIGN PRESSURE: 150 PSI (MAWP)
   DESIGN TEMPERATURE 250° F.
   MDMT - -20° F @ 150 PSI.
4. ALL DIMENSIONS ARE IN INCHES / (MM).
5. ALL BOLT HOLES ARE TO STRADDLE NATURAL CENTERLINES.
6. APPROX. WEIGHT (DRY) 644 LB. (292 KG.)

CERTIFIED FOR:

P.O. NO.:

REG. NO.:

QUOTE NO.:

TAG NO.:

VESSEL CODE: MBF-0802-AB10-080A-UT-11HE

HAYWARD PART NO.: F3AV0800001

ELECTRONIC FILE NAME: HE0808TS.DWG

REF. ECR 8864 | DATE 9/15/00

HAYWARD INDUSTRIAL PRODUCTS, INC.
Manufacturers of LOEFFLER FILTRATION & GAF® FILTER SYSTEMS
900 FAIRMOUNT AVENUE, ELIZABETH, NEW JERSEY 07207

NAME MAXILINE MBF0602HE FILTER VESSEL
8" 150# RF INLET / TANGENTIAL OUTLET
STAINLESS STEEL

DRAWN	DATE	CERT.	DATE
SD	9/5/00	LF	9/15/00

SIZE	DWG NO	REV
A	HE0808TS	A

REV 8/00

Operating Manual

MAXILINE MBF – Bag Filters

Bedienungsanweisung

Beutelfilter MAXILINE MBF

Mode d´emploi

Filtre à poches série MAXILINE MBF

HAYWARD Industrial Products GmbH; Phone: +49 (0)2486 – 809- 0; Fax: +49 (0)2486 – 809- 800; mailto:info@haywardindl.com

1.General Instructions

HAYWARD filter bags are carefully constructed and manufactured. They undergo stringent quality controls (according to ISO 9001) and are thus correspondingly safe to use.

However, the filter may become a source of danger if not used or installed properly.

The operator must evaluate the impact of filter failure on the environment within the framework of his own safety guidelines and decide whether additional measures are necessary to ensure operator safety.

The filter must be operated in a safe manner.

All general rules and regulations for safe operation and avoidance of injury must be followed.

No work on a filter may be performed without first shutting it down completely and releasing the pressure.
HAYWARD filters are to be serviced by authorized personnel only.

1. Allgemeine Hinweise

HAYWARD Beutelfilter sind sorgfältig konstruiert, gefertigt und unterliegen einer strengen Qualitätskontrolle und sind somit entsprechend betriebssicher.
Von dem Filter können jedoch Gefahren ausgehen, wenn sie nicht bestimmungsgemäß oder unsachgemäß eingesetzt werden.
Der Betreiber muß im Rahmen seines Sicherheitskonzeptes prüfen, welche Auswirkungen auf die Umwelt mit einem Versagen des Filters verbunden sein können und ob zusätzliche Sicherheitsmaßnahmen zum Personenschutz getroffen werden müssen.
Die allgemeinen Vorschriften der Arbeitssicherheit und Unfallverhütung müssen beachtet werden. Insbesondere wird auf das Gesetz über technische Arbeitsmittel (Gerätesicherheitsgesetz GSG) und die Druckbehälterverordnung (DruckbehV) hingewiesen.
Eine die Betriebssicherheit beeinträchtigende Fahrweise des Filters ist zu unterlassen.
Arbeiten am Filter sind grundsätzlich nur im Stillstand und im drucklosen Zustand erlaubt und auszuführen. **HAYWARD** Filter dürfen nur von entsprechend eingewiesenem Personal bedient und gewartet werden.

1. Généralités

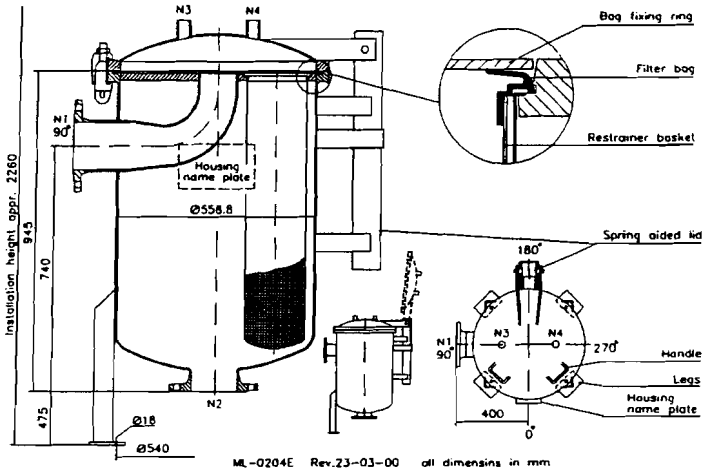
Les filtres à poches **HAYWARD** sont étudiés et construits avec le plus grand soin et sont soumis à un contrôle de qualité sévère; ils sont par conséquent d'un fonctionnement fiable.
Mais ces appareils peuvent, comme toutes les machines, être à l'origine de certains dangers s'ils ne sont pas mis en oeuvre conformément à leur destination ou s'ils le sont de manière incorrecte.
L'exploitant doit, dans le cadre de sa politique de sécurité, déterminer quels risques pour l'environnement peut faire courir une défaillance du filtre et s'il est nécessaire de prendre des mesures de sécurité additionnelles pour la protection du personnel.
Il convient de respecter la réglementation générale sur la sécurité du travail et la protection contre les accidents, et notamment celles concernant les équipements de travail et les appareils à pression.
Il ne faut jamais faire fonctionner le filtre d'une manière telle qu'elle puisse nuire à la sécurité d'exploitation.
Les travaux sur le filtre ne sont autorisés et ne doivent être exécutés que si cet appareil est à l'arrêt et n'est pas sous pression. Les filtres **HAYWARD** ne doivent être exploités et entretenus que par du personnel formé à cet effet.

***Follow these operating instructions carefully.**
***Die Betriebsanleitung ist zu beachten.**
***Suivez scrupuleusement les instructions du présent manuel.**

2. Typical design

2. Typische Bauart

2. Description



1. Filter housing
2. Lid
3. Lid gasket
4. Locking screw
5. Spring-aided lid lift
6. Handle
7. Bag fixing ring
8. Filter bag ring
9. Filter bag
10. Restrainer basket
11. Legs

1. Filtergehäuse
2. Deckel
3. Deckeldichtung
4. Verschlußschraube
5. Federheber
6. Handgriff
7. Beutelandruckring
8. Filterbeutelring
9. Filterbeutel
10. Druckaufnahmekorb
11. Füße

1. Corps de filtre
2. Couvercle
3. Joint de couvercle
4. Fermeture à boulons / crampons
5. Ressort de levage
6. Poignée
7. Arceau de maintien de poche
8. Anneau de poche
9. Poche filtrante
10. Panier-support
11. Pieds

3. Installation and Adjustment

Important:

Before installing the bag filter check that the operating parameters have been met.
The specifications on the bag filter label must be checked against operating conditions. Do not exceed the listed operating pressure and temperature.
Also make sure that the materials which are going to come into contact with the product are chemically suitable.
This applies to the materials used for the filter housing, the gaskets and the filter media.
HAYWARD assumes no liability for incompatibility of materials.

Installation Instructions:
Carefully unpack and check for damage.
Remove all enclosed operating instructions, data sheets, illustrations etc., read carefully and set aside for future use.
Make sure all accessories are enclosed.
Remove the plastic protective caps from the flanges.

3. Installation, Einbau

Wichtig:

Vor der Installation des Beutelfilters sind unbedingt die Betriebsbedingungen zu überprüfen. Die auf dem Kesselschild des Beutelfilters angegebenen Betriebsdaten sind mit den tatsächlichen Betriebsbedingungen zu vergleichen. Der zulässige Betriebsdruck wie auch die zulässige Betriebstemperatur dürfen nicht überschritten werden. Sorgfältiger Überprüfung bedarf auch die Eignung der verwendeten produktberührten Materialien hinsichtlich Ihrer chemischen Beständigkeit (Werkstoffe für Filtergehäuse, Dichtungen und Filterelemente).
HAYWARD übernimmt hinsichtlich der Eignung keine Garantien.

Beim Installieren des Beutelfilters ist auf folgendes zu achten:
Sorgfältig auspacken und auf eventuellen Transportschaden überprüfen. Der Lieferung beiliegende Unterlagen entnehmen, beachten und sorgfältig aufbewahren. Mitgeliefertes Zubehör auf Vollständigkeit überprüfen. Verschlußkappen von den Flanschen entfernen.

3. Installation et montage

Important :

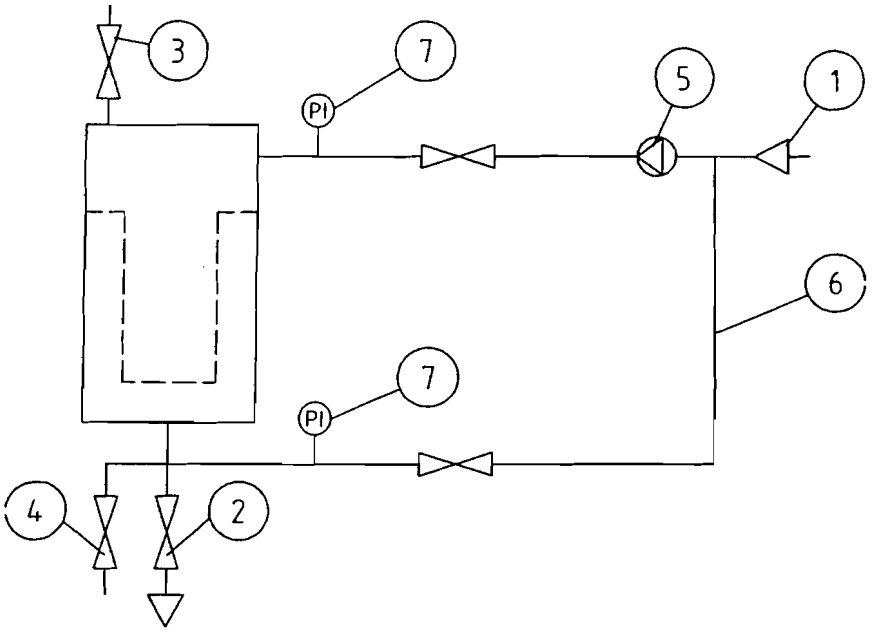
Il faut impérativement contrôler les conditions d'exploitation avant l'installation du filtre à poches. Les caractéristiques de fonctionnement indiquées sur la plaque signalétique placée sur la cuve du filtre doivent être comparées aux conditions d'exploitation réelles. Il ne faut pas dépasser la pression et la température de fonctionnement autorisées.
Il faut également s'assurer que les matériaux en contact avec le produit
(matériaux de la cuve, des joints et de l'élément filtrant) présentent une résistance chimique adéquate aux produits traités. HAYWARD ne donne aucune garantie de compatibilité.

Faire attention aux points suivants lors de l'installation du filtre :
Déballer soigneusement la marchandise et s'assurer de l'absence de détériorations qui seraient survenues pendant le transport. Enlever les documents joints à l'envoi, tenir compte des observations qu'ils contiennent et les conserver soigneusement. S'assurer de la présence de tous les accessoires fournis.

Here is a diagram of a typical filter installation

Eine typische und optimale Filterinstallation wird hier schematisch gezeigt.

Le schéma suivant montre une installation de filtre typique et correctement conçue.



1. Inlet
2. Outlet
3. Vent
4. Drain
5. Pump
6. Circulation line
7. Pressure gauge

1. Zulauf
2. Filterablauf
3. Entlüftung
4. Entleerung
5. Förderpumpe
6. Kreislaufleitung
7. Druckmessung

1. Entrée
2. Sortie
3. Event
4. Vidange
5. Pompe
6. By Pass
7. Manomètre

The filter housing in the example given is equipped with shut-off devices for discharge and venting. Pressure gauges for measuring the differential pressure are installed in the in- and outflow lines.

There should be a re-circulation line for cleaning the system if this is feasible and suitable.

Please note: the parts described above are not included at delivery.

Das Gehäuse im Beispiel ist mit Absperrorganen im Zu-und Ablauf wie auch für die Entleerung und Entlüftung versehen. Druckmeßgeräte zur Erfassung des Differenzdruckes sind im Zu- und Ablauf installiert.
Eine Kreislaufleitung zur Systemreinigung sollte vorhanden sein, soweit dieses für den Filtrationsprozeß möglich und notwendig ist.

Bitte beachten Sie: diese beschriebenen Armaturen und Rohrleitungsteile gehören nicht zum Lieferumfang.

Pour utiliser ce type de filtre, il faut en principe prévoir:
1 vanne d'arrêt à l'entrée et à la sortie
1 vanne de purge sur le couvercle
1 robinet de vidange à la sortie
1 système de contrôle de pression
et éventuellement un by-pass.
Ces éléments ne sont pas fournis avec le filtre.

Remarque : la robinetterie et les tuyauteries indiquées sur ce schéma ne font pas partie de la fourniture.

When installing take care not to reverse the inlet and outlet.
The direction of flow is not always marked, but can be determined by noting that the inflow lies above the outflow. The outflow is usually at the bottom.
The inflow for the liquid is inside the bag, since it must flow from the inside to the outside.
1. Vent 2. Inlet 3. Outlet

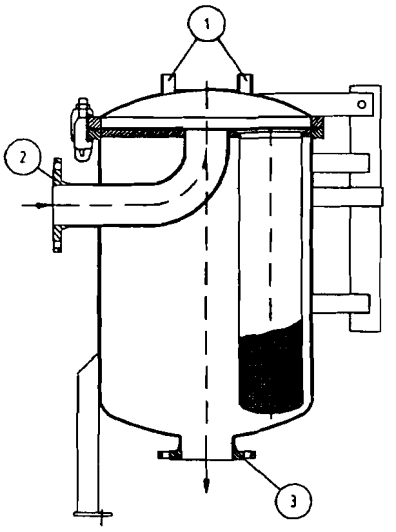
Mount the filter system tension-free in the pipe.

Beim Einbau ist darauf zu achten, daß Ein- und Austritt nicht vertauscht werden.
Die Durchflußrichtung ist vielfach nicht gekennzeichnet, jedoch daran zu erkennen, daß der Eintritt über dem Austritt liegt. Der Austritt ist in aller Regel im Boden angeordnet.
Der Flüssigkeitseintritt erfolgt in den Beutel, denn dieser muß von innen nach außen durchflossen werden.
1. Entlüftung 2. Eintritt 3. Austritt

Der Filterapparat ist spannungsfrei in die Rohrleitung einzubauen.

Veiller à ne pas confondre entrée et sortie lors de l'installation.
Le sens d'écoulement n'est pas toujours indiqué, mais on le reconnaît à ce que l'entrée se trouve au-dessus de la sortie. La sortie est en règle générale placée sur le fond.
Le liquide à filtrer est introduit à l'intérieur de la poche, car celle-ci doit être traversée de l'intérieur vers l'extérieur
1. Event 2. Entrée 3. Sortie

Le filtre doit être raccordé aux tuyauteries sans y créer de tensions.



4. Start-Up

Since the filter housings are not delivered with the filter bags installed, they must be installed as follows:

To open the housing first loosen the eye nuts on the top.
Where segment clamp screws are used the appropriate spanner should be used.
The eye nuts can loosened using a small bar
Segment clamp screws and nuts should be loosened enough to allow for them to be swung clear of the lid.

The lid itself is effectively counter-balanced by a spring-loaded lever, can be raised easily and remains in any given position upon release. Open the lid to the fullest extent when changing the filter bags.
The restrainer baskets ,if not already installed, should be positioned in the housing.
Some models have O ring gaskets under the holders. Check these for damage and tight fit. The filter bag can now be inserted into the holders and molded flush with the holder for complete support. Remove the label before inserting the bag. Center the collar of the bag on the holder rim to achieve a tight seal.
Once the filter bags have been installed the adjustment ring can be replaced ensuring that its lugs located in the bayonet catches.
To do this operation a small tool is supplied.
To lock the adjustment ring into place turn it clockwise taking care the tool does not slip off the adjustment ring causing injury.

4. Inbetriebnahme

Das Filtergehäuse ist bei Lieferung nicht mit Filterbeuteln ausgerüstet. Das Gehäuse ist wie folgt mit Filterbeuteln zu bestücken:
Zum Öffnen des Behälters müssen zunächst die Behälterflanschschrauben gelöst werden.
Bei Segmentklammerschrauben ist ein geeigneter Schlüssel zu verwenden, die Ringmuttern auf den Augenschrauben können mit einer passenden Stange gelöst werden.
Sowohl Segmentklammerschrauben als auch Augenschrauben sind soweit zu lösen, daß die Schrauben nach unten weggeklappt werden können. Der Deckel selbst ist durch einen Federheber weitgehend gewichtslos ausbalanciert, kann mit wenig Kraftaufwand angehoben werden und bleibt in jeder Position nach dem Loslassen stehen. Zum Filterbeutelwechsel ist der Deckel ganz zu öffnen.
Die Druckaufnahmekörbe sind, soweit noch nicht installiert, in das Gehäuse einzusetzen.
Bei einigen Konstruktionen sind O-Ring-Dichtungen unter den Druckaufnahmekörben vorgesehen. Die Dichtungen sind auf Beschädigung und richtigen Sitz in der Nut zu überprüfen. Die Filterbeutel können jetzt in die einzelnen Druckaufnahmekörbe eingesetzt werden. Das Etikett ist zuvor zu entfernen. Die Beutel sollten an den Druckaufnahmekorb angeformt werden, um eine einwandfreie Unterstützung zu gewährleisten.
Der Ring des Filterbeutels muß in der Führungsnut des Druckaufnahmekorbes liegen, um eine zuverlässige Abdichtung zu erreichen. Jetzt können die Beutelandruckringe eingesetzt werden. Durch Drehen müssen diese in die Verriegelungen eingerastet werden. Zum einfacheren Bedienen steht ein gesondertes Werkzeug (Schlüssel) zur Verfügung. Am vorderen Teil des "Schlüssels" ist ein Aufsatz mit einer Nut.

4. Mise en service

Les filtres ne sont pas munis de leurs poches lors de la livraison.
Le montage des poches s'exécute de la manière suivante :
Pour ouvrir le corps de filtre, il faut d'abord desserrer les boulons du couvercle. Les boulons à oeil peuvent être dévissés à l'aide d'une barre métallique, les crampons avec une clef correspondante.
Les crampons ainsi que les boulons à oeil doivent être desserrés de façon telle qu'il soit possible de rabattre les boulons vers le bas.
Le couvercle lui-même est équilibré pour ainsi dire totalement par un système de compensation par ressort ; un faible effort suffit pour le soulever et il reste en place dans n'importe quelle position quand on le relâche. Il faut que le couvercle dégage complètement l'ouverture de la cuve pour que l'on puisse remplacer les poches.
Mettre dans la cuve du filtre les paniers support si cela n'a pas encore été fait.
Des logements de joints toriques ont été ménagés au-dessous des paniers dans certains filtres. S'assurer que les joints sont en bon état et qu'ils sont correctement placés dans leurs logements.
On peut à présent placer les poches dans les paniers, après avoir enlevé les étiquettes. Appliquer les poches contre la paroi des paniers pour leur assurer un bon supportage.
L'anneau de la poche doit porter, bien centré, sur le bord du panier, pour obtenir une étanchéité fiable.
On peut alors mettre en place les étriers des poches. Il faut faire tourner ceux-ci pour qu'ils s'engagent dans les encoches de verrouillage. Un outil spécial facilite l'opération.

Before closing the lid ensure that the sealing surfaces along with the gasket are clean and damage free.

Dieser Aufsatz kann auf den Griffsteg der Andruckringe gesetzt werden und erleichtert durch den vorhandenen Hebel das Einriegeln. Der "Schlüssel" ist über dem Andruckring mit einer Hand niederzuhalten, sonst besteht die Gefahr, daß der Schlüssel abgleitet. (Verletzungsgefahr)
Vor dem Schließen des Deckels sind die Dichtflächen und Dichtung auf Beschädigung und Sauberkeit zu überprüfen. Der richtige Sitz der Dichtung muß gewährleistet sein.

A l'avant de cette "clef" se trouve un bec avec une gorge ; ce bec peut être placé sur la barrette des étriers de maintien ; le levier de l'outil facilite l'encliquetage dans les encoches de verrouillage. Il faut appuyer la "clef" sur l'étrier de maintien avec une main, sinon il peut glisser (risque de blessure).S'assurer avant de fermer le couvercle que le joint et les surfaces d'étanchéité sont propres et en bon état. Il faut que le joint porte
parfaitement.

*** Discard damaged gaskets !**
*** Beschädigte Dichtungen sind auszutauschen !**
*** Tout joint endommagé doit être remplacé !**

To close the filters reverse the above steps. MAXILINE bag filter housings have "O" ring gaskets as standard, however if special construction is required by application flat gaskets are also available.
If the housing is fitted with "O" ring gaskets then a high turning force is not required on the bolts please see the table below. However if flat gaskets are used then a greater force of is required. Overtightening of the bolts should be avoided to prevent damage to the bolts and lid.

Strict attention must be made to ensure that force used to seal the filter is in accordance with the data given in the table below, and that the bolts are not over tightened.

Das Schließen des Filters erfolgt sinngemäß in umgekehrter Reihenfolge wie das Öffnen. Beutelfiltergehäuse MBF sind in aller Regel mit O-Ringdichtungen versehen. Anwendungsbedingt werden jedoch auch Flachdichtungen verwendet.
Sofern das Gehäuse mit einer O-Ring-Dichtung ausgerüstet ist, ist es nicht notwendig die Schrauben mit übermäßig großer Kraft anzuziehen. Wird das Filter wechsellastig (pulsierender Druck) betrieben, so sind die Schrauben mit dem zulässigen Drehmoment anzuziehen.Bei Flachdichtungen sind abhängig vom Dichtungswerkstoff höhere Kräfte zur Vorverformung der Dichtung notwendig, so daß die Schrauben mit höheren Kräften angezogen werden müssen. Die zulässigen Drehmomente dürfen dabei nicht überschritten werden. Bei Verwendung von gebräuchlichen Werkzeugen und Anwendung normaler Körperkraft ist ein Überschreiten dieser Werte nicht zu befürchten Bei Benutzung von Verlängerungen für Schlüssel oder Schlagschrauben ist jedoch besonderes Augenmerk darauf zu richten, das die Schrauben nicht überlastet werden. Ein Aufbringen erhöhter Schließkräfte in der Hauptflanschverbindung durch übermäßig starkes Anziehen der Verschlußschrauben, um die Flanschverbindung dicht zu bekommen, ist nicht erlaubt.
Nachfolgend aufgeführte Anziehdrehmomente in Nm sollten an den Schraubverbindungen in keinem Fall überschritten werden.

La fermeture du filtre s'opère en sens inverse de l'ouverture.
Les corps de filtres MBF sont équipés de joints toriques.
En fonction de l'utilisation, des joints plats peuvent également être utilisés pour des versions spéciales. De ce fait, il n'est pas nécessaire de forcere sur le serrage des boulons du couvercle. Dans le cas de joints plats, et en fonction de la souplesse de l'élastomère utilisé, il faudra plus au moins insister sur le serrage des boulons du couvercle pour obtenir une bonne étanchéité. Il faut veiller à ne pas dépasser le couple de serrage déterminé pour une étanchéité correcte.
Si l'on utilise des outils usuels avec la force musculaire normale, on ne risque pas de dépasser ce couple de serrage.
Attention cependant à ne pas excercer de couple excessif lors de l'utilisation d'un tube de rallonge.
Dans le cas de l'utilisation d'une clé dynamométrique, les couples Nm ci-dessous ne doivent pas être dépassés. (Cette tentation est à éviter même dans le cas de défauts d'étanchéité du couvercle).

metric screw, metrische Schraube, Filetage métrique	M16	M20	M24	M30	M36
	Nm	Nm	Nm	Nm	Nm
unoiled, ungeschmiert, non graissé	95	184	315	635	1110
oiled, geölt, huilé	88	171	295	590	1030
MoS_2-paste, MoS_2-Paste, pâte au MoS_2	76	148	255	510	885

Solid class 5.6 according DIN 267
For galvanized degreased screws use medium value of oiled screws.

Festigkeitsklasse 5.6 nach DIN 267
Für galvanisch verzinkte ungeschmierte Schrauben ist der mittlere Wert wie für geölte Schrauben anzusetzen.

Classe de solidité 5.6 selon DIN 267.
Pour des écrous galvanisés non graissés, utiliser une valeur de Nm intermédiaire entre non graissé et huilé.

To avoid tension in the lid tighten the screws overcrossing according a certain succession.

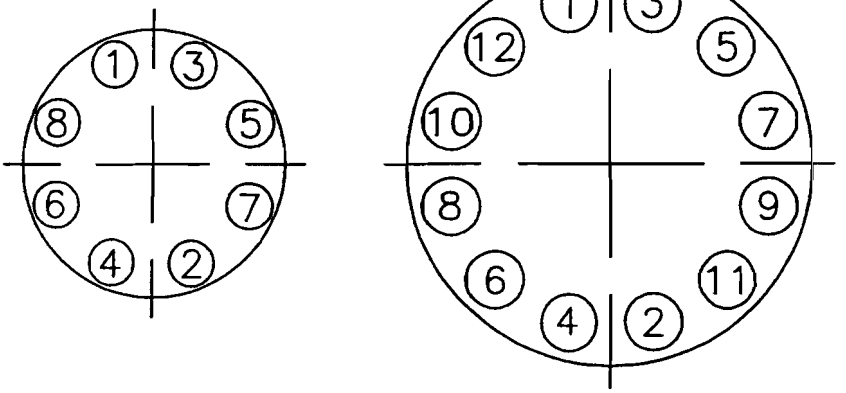
Um Verspannung im Apparateflansch zu verhindern, sind die Schrauben gleichmäßig über Kreuz in einer bestimmten Reihenfolge anzuziehen.

Pour éviter des tensions au couvercle, il est nécessaire de procéder au serrage progressif en croix des boulons du couvercle

for example:

zum Beispiel:

par exemple :



When using max. allowable torque, procceed in several steps as follows:

1. Step: 50 % of torque
2. Step: 80 % of torque
3. Step: max torque

The filter is now ready for use. Slowly open the valve on the inlet The vent valve at this stage should be open to ensure there is no air lock in the top of the filter housing. This should be closed as soon as the liquid runs out. In all cases (whether or not hazardous liquids are being filtered) precautions should be taken to prevent injury from spraying liquid.
If the filter is not vented any air in the filter will mean that that part of the filter bags will not be use thereby rendering the filter inefficient. Generally if air gets into the system this should be vented off immediately. Also when filtering gaseous the filter should be vented at regular periods.

The outlet valve is now slowly opened.
Due to the fact that most filter bags on the market could release some particles when first used, we recommend re-circulation of the filtrate. The length of time for re-circulation will depend on the individual product and level of filtration. That way released particles from newly inserted filter bags will be collected and safely removed from filtrate.

Sofern das volle Drehmoment aufgebracht werden soll (nicht immer notwendig, da abhängig von der Dichtung und dem Dichtungswerkstoff) ist wie folgt vorzugehen:
Die Schrauben sind in mehreren Durchgängen anzuziehen.

1. Durchgang: 50 % des max. Drehmomentes
2. Durchgang: 80 % des max. Drehmomentes
3. Durchgang: volles zulässiges Drehmoment

Das Filter ist jetzt betriebsfertig, und die Absperrarmatur in der Eintrittsrohrleitung kann langsam geöffnet werden. Die Entlüftung sollte geöffnet sein. Sie ist zu schließen, sobald Flüssigkeit austritt. Bei gefährlichen Flüssigkeiten ist durch geeignete Maßnahmen eine Gefährdung der Bedienungspersonals durch herausspritzende Flüssigkeit zu verhindern.
Wird die Entlüftung nicht geöffnet, so entsteht im Gehäuse ein Luftpolster, welches einen Teil im oberen Bereich des Filtergehäuses frei von Flüssigkeit hält und somit die betroffene Filterfläche unwirksam macht.
Stört Luft grundsätzlich im System, so ist in jedem Fall zu entlüften. Bei gashaltigen Flüssigkeiten ist ggf. periodisch zu entlüften.
Jetzt kann langsam die Absperrung der Austrittsrohrleitung geöffnet werden.
Da erfahrungsgemäß die meisten handelsüblichen Filterbeutel beim Einsetzen in das Gehäuse Partikel freisetzen, ist je nach Anforderung an das Filtrat, eine Rückführung des Filtrates (Kreislauffiltration) für eine kurze Zeit zu empfehlen. Die Dauer der Kreislauffiltration ist abhängig vom Prozeß und daher in der Praxis zu ermitteln. Von den Filterbeuteln anfänglich abgelöste Partikel werden so auf der Innenseite des Filterbeutels wieder angelagert und sicher aus dem Filtrat entfernt.

Dans le mesure ou le couple maximum de serrage est utilisé, procéder graduellement à :

1er serrage à 50 % du couple maximum
2ème serrage à 80 % du couple maximum
3ème serrage à 100 % du couple maximum

Le filtre est alors prêt à fonctionner et l'on peut ouvrir lentement la vanne sur la tuyauterie d'alimentation. Il faut toujours éviter une ouverture brutale, car elle pourrait endommager aussi bien la cuve du filtre que les éléments filtrants. Ouvrir l'évent et le refermer dès qu'il en sort du liquide. Si le liquide est dangereux, il faut prendre des mesures appropriées pour ne pas exposer le personnel à un risque par une sortie brutale de liquide hors du filtre.
Si l'on omet d'ouvrir l'évent, il se crée un matelas d'air dans la cuve qui empêche le liquide de remplir la cuve jusqu'en haut et rend inactive la surface filtrante correspondante. Si la présence d'air risque de gêner le fonctionnement du système, il faut impérativement purger pour évacuer l'air. Si le liquide renferme des gaz, il convient de purger périodiquement.
On peut à présent ouvrir lentement la vanne sur la tuyauterie de refoulement. L'expérience montre que la plupart des poches neuves libèrent des particules lorsqu'on les met en place dans le filtre ; il est recommandé, si la qualité du filtrat l'exige, de renvoyer le filtrat à l'alimentation pendant un bref laps de temps. La durée de la filtration avec recyclage dépend du process et doit donc être déterminée cas par cas. Les particules relarguées au début par la poche sont alors arrêtées sur la paroi interne de celle-ci et éliminées en toute certitude du filtrat.

5. Maintenance of the Filter Housing

The filter itself does not need any special maintenance with normal use. All parts should be regularly checked for corrosion and other damage.
Install a new filter bag at every product change or if the bag becomes contaminated.
Differential pressure (the difference in pressure before and after the filter) will reveal if contamination has occurred
HAYWARD recommends changing the filter bag at a differential pressure of 1.5 bar, but up to a maximum of 3.5 bar is permissible.

To remove the filter bag release the pressure in the housing by opening the pressure relief valve. The method for opening and closing the housing is described in Section 4.
Attention should always be given to the gaskets and sealing surfaces ensuring that they are clean and undamaged.
Damaged gaskets should be replaced

5. Wartung des Beutelfilters

Der Filter selbst bedarf in aller Regel keiner besonderen Wartung. Alle Teile sind jedoch regelmäßig auf Korrosionsschäden sowie andere Beschädigungen zu überprüfen.
Die Filterbeutel sind bei Verschmutzung oder Produktwechsel auszutauschen.
Die Verschmutzung eines Filterbeutels ist am Differenzdruck (Druckunterschied vor und nach dem Filter) erkenntlich.
HAYWARD empfiehlt die Filterbeutel spätestens bei einem Differenzdruck von 1,5 bar zu wechseln. Zulässig ist ein Differenzdruck von max. 3,5 bar.
Zum Ausbau der Filterbeutel ist das Gehäuse durch Öffnen der Entlüftung drucklos zu machen. Das Öffnen und Schließen geschieht wie unter Inbetriebnahme Pkt. 4 geschildert.
Besonderes Augenmerk ist auf die Dichtflächen und Dichtungen zu richten. Eine Beschädigung der Dichtflächen ist in jedem Fall zu vermeiden. Beschädigte Dichtungen sind auszutauschen.

5. Maintenance du filtre

Le filtre lui-même ne requiert généralement aucune maintenance particulière. Il faut cependant contrôler régulièrement toutes les pièces pour s'assurer qu'elles ne sont pas corrodées ou autrement endommagées.
Remplacer les poches si elles sont colmatées ou si l'on change de produit. Le colmatage d'une poche se reconnaît à la valeur de la pression différentielle (différence de pression entre l'amont et l'aval du filtre).
HAYWARD recommande le remplacement des poches au plus tard lorsque la pression différentielle atteint 1,5 bar. La pression différentielle maximale autorisée est de 3,5 bar.
Pour enlever les poches, il faut d'abord dépressuriser le filtre en ouvrant le robinet à boule de dépressurisation. L'ouverture et la fermeture du filtre s'opèrent comme indiqué à la section 4, "Mise en service".
Une attention particulière doit être portée à l'examen des portées de joints et des joints. Veiller à ne pas endommager les portées de joints. Un joint défectueux devra être changé.

Note:

HAYWARD joins many gasket manufacturers in recommending that gaskets be replaced after a pressurized container is opened. In practice, gaskets are often used many times. This may result in a faulty seal which in no way indicates a defect in the system.

Hinweis:

Viele Dichtungshersteller weisen darauf hin, daß nach jedem Öffnen einer druckdichten Verbindung die Dichtungen zu erneuern sind.
HAYWARD schließt sich dieser Empfehlung an.
In der Praxis werden häufig die Dichtungen vielfach benutzt. Daraus resultierende Undichtigkeiten sind kein Zeichen für die Fehlfunktion des Systems.

Observation :

De nombreux fabricants de joints conseillent de remplacer les joints après chaque ouverture d'un récipient sous pression.
HAYWARD fait sienne cette recommandation.
Dans la pratique courante, les joints sont souvent réutilisés plusieurs fois. Les fuites qui en résultent ne sont pas un symptôme de mauvais fonctionnement du matériel.

6. Maintenance of the Spring Lid Lift

The spring lid lift works mechanically and can be adjusted infinitely. Made out of stainless steel 1.4301, it enables even heavy housing lids to be balanced almost weightless. The lid will remain open in any given position.

6.1 Maintenance

The spring lid lift is maintenance free. Special attention is not required. If any noise is heard in the mechanism (squeaking, scratching) remove the dust cover and spray on a little oil.

6. Wartung der Federhebers

Der Federheber arbeitet mechanisch, ist stufenlos einstellbar und aus Werkstoff Edelstahl 1.4301 gefertigt. Mit seiner Hilfe können selbst schwere Gehäusedeckel nahezu gewichtslos ausbalanciert werden. Der Deckel bleibt in jeder Position stehen.

6.1 Wartung

Der Federheber ist wartungsfrei, besondere Arbeiten sind nicht durchzuführen.
Eine Geräuschentwicklung im Federheber (Quietschen, Kratzen) hat keinen Einfluß auf die Funktion des Federhebers, kann aber durch Einsprühen eines Gleitmittels vermindert werden.

6. Maintenance du système de compensation par ressort

Le système de compensation par ressort travaille mécaniquement, il est réglable en continu et fabriqué en acier inoxydable 1.4301 (AISI 304). Il permet d'équilibrer presque parfaitement même des couvercles lourds. Le couvercle reste stable en n'importe quelle position.

6.1 Maintenance

Le système de compensation par ressort ne demande aucun entretien, il n'y a pas lieu de pratiquer d'interventions. L'apparition de bruits dans cet accessoire (grincements, raclements) n'est nullement signe de mauvais fonctionnement ; on peut réduire ces bruits en pulvérisant un lubrifiant par dessous dans le système de compensation par ressort (enlever d'abord le capot de protection).

6.2 Installation

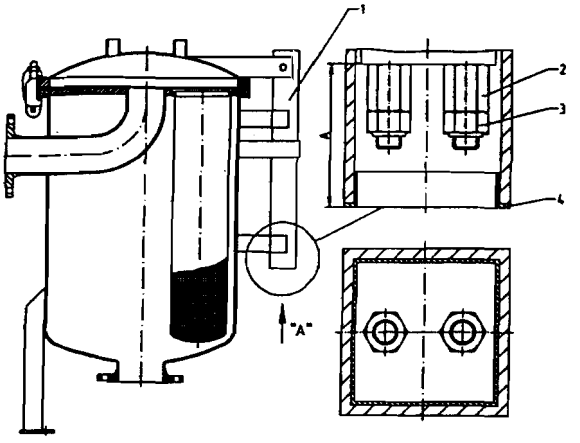
The spring lid lift is balanced to the weight of the lid at the factory. Additional fixtures, such as gauges, can raise the weight of the lid and make a re-adjustment necessary.

6.2 Einstellung

Der Federheber wird werkseitig mit dem Gewicht des Deckels ausbalanciert.
Der Anbau zusätzlicher Armaturen, Meßgeräte o.ä. kann jedoch das Gewicht des Deckels erhöhen und eine Neueinstellung notwendig machen.

6.2 Réglage

Le système de compensation par ressort a été équilibré en usine avec le poids du couvercle. Mais le montage de robinetterie supplémentaire, d'appareils de mesure, etc. peut accroître le poids du couvercle et rendre un nouveau réglage nécessaire



1. Spring-aided lid lift
2. Adjusting nuts
3. Lock nuts
4. Dust cover
„A" View

1. Federheber
2. Verstellmutter
3. Kontermutter
4. Staubschutzkappe
„A" Ansicht

1. Système de compensation par ressort
2. Ecrou de réglage
3. Contre-écrou
4.Capot de protection
Schéma „A"

Remove the dust cover from the lower end of the spring lid lift. Seen from below there are a total of four hexagonal nuts. Two adjusting nuts are secured by self locking lock nuts against loosening or inadvertent removal. Loosen the lock nuts. Now the load bearing capacity of the spring lift can be adjusted by simultaneously turning both adjusting nuts. Turning the nut to the right (clockwise) increases the tension and thus the lifting capacity. Turning the nut to the left (counter clockwise) lessens the tension and the lifting capacity.
After making adjustments secure the lock nuts and replace the dust cover.
The opening and closing limits of measurement A are 200mm (open) and 80mm (closed) and must not be exceeded

Dazu ist die Staubschutzkappe am unteren Ende des Federhebers zu entfernen.
Von unten gesehen sind insgesamt zwei Gewindestangen mit Sechskantmuttern zu erkennen. Zwei Verstellmuttern sind durch selbstsichernde Sechskantmuttern gegen Verstellung und Herausdrehen durch Kontern gesichert.
Die Kontermuttern müssen gelöst werden.
Jetzt kann durch gleichmäßiges Verdrehen beider Verstellmuttern die Tragkraft des Federhebers verändert werden.
Rechtsdrehen (im Uhrzeigersinn) erhöht die Vorspannung und somit die Tragkraft.
Linksdrehen (gegen den Uhrzeigersinn) vermindert die Vorspannung und somit die Tragkraft.
Nach erfolgter Einstellung sind die Kontermuttern festzuziehen.
Die Staubschutzkappe kann aufgesetzt werden.
Das Maß A darf in den Endlagen (Auf- bzw. Zustellung) 200 mm nicht überschreiten und 80 mm nicht unterschreiten.

Enlever d'abord à cet effet le capot de protection en bas du système de compensation. On peut voir par dessous deux tiges filetées munies d'écrous. Deux écrous de réglage sont bloqués par des contre-écrous autobloquants pour éviter tout déréglage et dévissage intempestifs. Desserrer d'abord les contre-écrous, puis faire tourner également les deux écrous de réglage pour modifier la force portante du système de compensation. Quand on tourne dans le sens des aiguilles d'une montre, on augmente la tension et donc la force portante. En tournant dans le sens inverse, on diminue la tension et donc la force portante. Une fois le réglage effectué, serrer à fond les contre-écrous puis remettre le capot de protection. La cote A ne doit ni dépasser 200 mm ni être inférieure à 80 mm dans les positions extrêmes (ouverture et fermeture).

Safety Precautions

The spring lid lift should be protected from corrosive or caustic materials.
While the spring lid lift is very safe, for safety reasons no part of the body should be placed under the raised weight while it is moving, just like any other "suspended load".
The lid should always be in the fully opened position before changing the filter bag.

Vorsichtsmaßregeln

Der Federheber ist gegen aggressive und ätzende Stoffe zu schützen.
Der Federheber ist sehr sicher, jedoch sollten aus Sicherheitsgründen während der Bewegungsphase wie bei allen "schwebenden Lasten" keine Körperteile unter das angehobene Gewicht gebracht werden.

Précautions à prendre

Il faut protéger le système de compensation par ressort contre toute matière corrosive.
Ce dispositif est très sûr mais - comme pour toute "charge suspendue" - il ne faut mettre, par sécurité, aucune partie du corps sous le poids en mouvement.

Important:
Open the lid fully to the upright position before removing the spring lid lift.

7. Technical Data

All information regarding dimensions, technical details, spare parts, materials used will be found in the current data sheets and their associated illustrations.

8. General Operating Instructions

The filter elements used in the filter bag housing are usually made from industrial felt, monofilament mesh or "melt blown" micro fibers. In addition, filter baskets are also used. For technical details please refer to the appropriate literature.
The speed of the flow of the material through the filter is a major factor in achieving good, yet economic filtering results. The goal, with a few exceptions, is to keep the speed of the throughput as low as possible. Low pressure on the filter enhances separation and increases the service life of the filter unit, thus reducing the operating cost of the whole system.
At the same time the flow should be as even as possible, so that, for example, a centrifugal pump is a better choice as a feed pump than a piston-driven one which delivers unevenly. As a rule it is better to avoid uneven feed or intermittent operation as much as possible to prevent backup-up in the filter housing.
Such conditions could cause the filter bag to lift up with pressure changes in the filter housing so that it no longer fits snugly in the restrainer basket. At worst, this could result in a tearing of the filter element. Filter bag lift up can be effectively prevented by the use of an (optional) bag positioning device.

Wichtig:
Der Ausbau des Federhebers darf nur mit geöffnetem Deckel erfolgen. (senkrechte Stellung des Deckels).

7. Technische Daten

Abmessungen, Einzelheiten, Ersatzteile, verwendete Werkstoffe usw. ergeben sich aus den jeweils gültigen Daten- und Maßblättern sowie gegebenenfalls zugehörigen Zeichnungen.

8. Allgemeine Betriebshinweise

Die in Beutelfiltergehäusen verwendeten Filterelemente sind in aller Regel Filterbeutel aus Nadelfilz, Monofilgeweben oder aber "melt blown" Mikrofasern. Zusätzlich werden auch Siebkörbe verwendet.
Technische Einzelheiten sind aus den entsprechenden Unterlagen zu entnehmen.

Für ein wirtschaftliches und gutes Filtrationsergebnis spielt neben vielen anderen Faktoren die Strömungsgeschwindigkeit durch das Filtermittel eine herausragende Rolle.
Es ist stets anzustreben die Strömungsgeschwindigkeit, von Ausnahmen abgesehen, so gering wie möglich zu halten. Eine geringe Belastung des Filters erhöht die Abscheideleistung, die Standzeit und damit die Qualität des Filtrates wie auch die Wirtschaftlichkeit des gesamten Filtersystems.
Zudem sollte die Durchströmung des Filtermittels so gleichmäßig wie möglich erfolgen, d.h. als Förderpumpen sind beispielsweise Kreiselpumpen den stoßweise fördernden Kolbenpumpen o.ä. vorzuziehen. Grundsätzlich ist stoßweise Förderung oder unterbrechender Betrieb möglichst zu vermeiden, um einen Rückstau im Filtergehäuse zu verhindern.
Diese Betriebsarten haben gegebenenfalls zur Folge, daß der Filterbeutel durch Druckwechsel im Filtergehäuse "aufschwimmt" und nicht mehr ausreichend durch den Druckaufnahmekorb unterstützt wird. Die Folge kann im ungünstigsten Falle ein Reißen des Filterelements sein.
Das "Aufschwimmen des Filterbeutels kann u.a. durch den Einsatz eines Beutelniederhalters (Zubehör) wirkungsvoll verhindert werden.

Important :
Le système de compensation par ressort ne doit être démonté qu'avec la cuve totalement ouverte (couvercle en position verticale)

7. Caractéristiques techniques

On trouvera les dimensions, les détails de construction, la liste des pièces de rechange, la nature des matériaux, etc. dans les feuilles de caractéristiques techniques et éventuellement sur les plans correspondant au matériel fourni.

8. Consignes générales d'utilisation

Les éléments filtrants des filtres à poches sont généralement des poches en feutre aiguilleté, en tissu monofilament ou en microfibres "melt blown". On utilise également des paniers à tamis.
On trouvera tous les détails techniques dans les documents correspondants.
La vitesse de passage à travers le media filtrant joue un rôle extrêmement important dans l'obtention d'une filtration économique et de qualité, parallèlement à d'autres facteurs.
Il faut toujours s'efforcer, sauf cas exceptionnels, de maintenir une vitesse de passage aussi faible que possible. Une faible charge du filtre augmente le taux de rétention des particules, la durée de vie du media et donc la qualité du filtrat ainsi que la rentabilité de toute l'installation de filtration.
De plus, la vitesse de passage doit être aussi régulière que possible ; il faut donc préférer par exemple, comme pompe d'alimentation, une pompe centrifuge à une pompe à piston, qui refoule par à-coups. Il faut par principe proscrire toute alimentation ou tout fonctionnement intermittent pour éviter un reflux dans la cuve du filtre.
En effet, de tels modes de fonctionnement peuvent avoir comme conséquence que la poche remonte dans la cuve du filtre et n'est plus suffisamment soutenue par le panier support. Il peut en résulter une déchirure de la poche dans un cas extrême.
La remontée de la poche peut être efficacement empêchée, par exemple, par la mise en place d'une forme anti-retour (livrable en option).

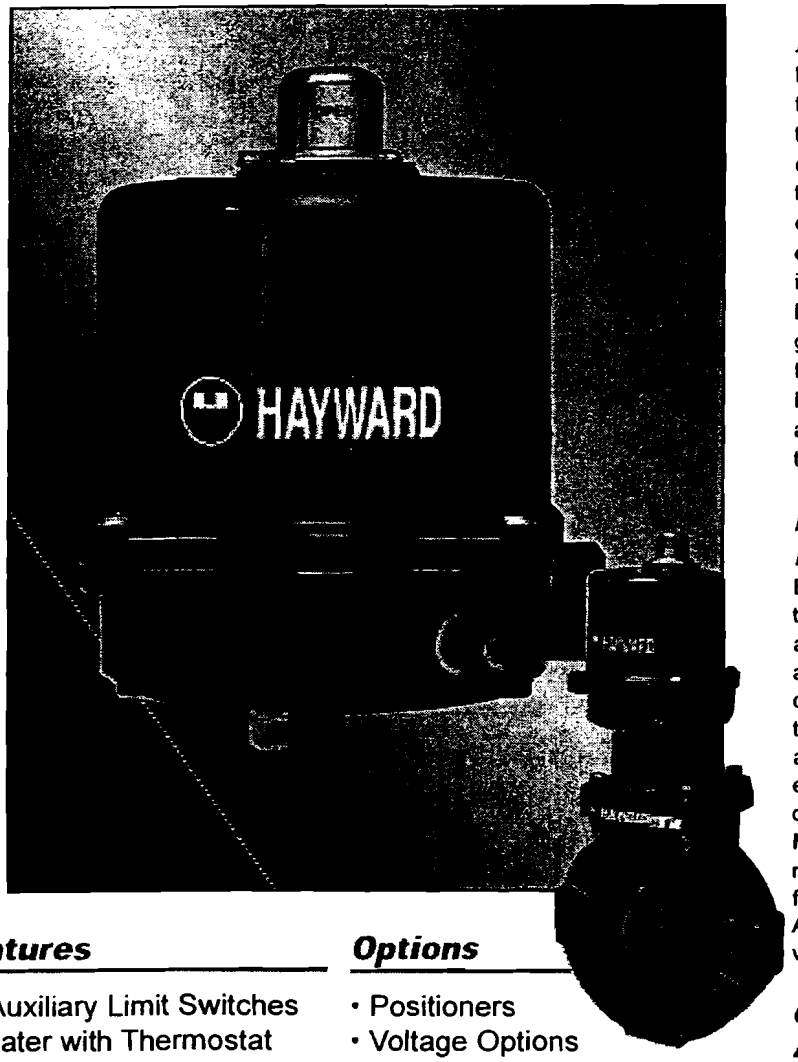
Section 4-B

Motorized Shut-Off Valves (FV-411, FV-421)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Series EJM Electric Actuators

For All Sizes of Ball Valves and Butterfly Valves up to 24"



Features

- 2 Auxiliary Limit Switches
- Heater with Thermostat
- NEMA 4/4X Housing
- Position Indicator
- Manual Override
- Self-Locking Gear Train
- Permanently Lubricated
- Thermal Overload Protection
- CE and CSA Approved
- ISO 5211 Mounting Base

Options

- Positioners
- Voltage Options
- 3 Phase Motors (On/Off, 800 in-lbs and Larger Models Only)
- Feedback Potentiometer
- Control Stations

The Best Actuator for Most Applications

EJM Electric Actuators have been designed to meet the requirements of most applications without the need for extra cost, add-on options. These rugged, heavy-duty actuators come standard with features that cost extra on other actuators. These include two extra auxiliary limit switches for end of travel indication, heater and thermostat for cold or high humidity applications, a self-locking gear train to prevent drifting at the end of the actuation cycle and a manual override. Now, cost-sensitive applications can take advantage of an exceptional electric actuator with the EJM Series.

Rugged, Reliable Cost Effective Design

EJM Electric Actuators have been designed to endure the most demanding applications and provide years of trouble-free service at a cost effective price. The heavy duty gear drive train is built to withstand stalled conditions without gear failure. The NEMA 4/4X aluminum alloy housing is dry powder coated to stand up to harsh environmental conditions encountered in many applications. Motor burn out is prevented by reliable thermal overload protection. These are just a few of the features built into every EJM Actuator to insure a long, trouble-free service life.

Options for Unique Applications

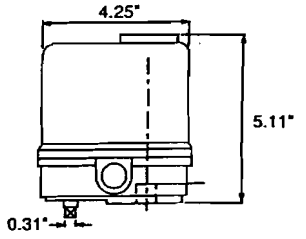
Applications with very special requirements can take advantage of the EJM Actuator by utilizing a choice of options. Positioners are available for throttling or modulating applications as are feedback potentiometers that signal the valves position. Several different voltage options are available as well as 3-phase motors on 800 in-lb actuators and larger.

Technical Information

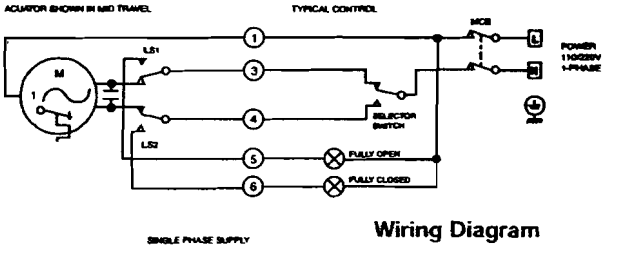
Actuator Specifications

Model	EJM2S2T	EJM3S2T	EJM8S2T	EJM13S2T	EJM35S2T	EJM130S2T
Torque - lbs	150	300	800	1300	3500	13,300
Housing	Aluminum Alloy, Dry Powder Coated					
Conduit Size - inches	1/2"					
Std. Duty Cycle on/off	25%					
ISO 5211 Mount	FO3/FO5		FO7		F10	F14
Output Shaft	.55" Sq FEM, .59" Deep		.86" Sq FEM, 1.18" Deep		1.45" Sq FEM, 1.57" Deep	1.40" Rnd. Keyed FEM 2.4" Deep
Cycle Time 90° seconds	8	12	15	22	22	46
Std Motor Voltage	50/60 Hz, 115 VAC, 1 Phase, PSC					
Max Current Amps @ 120 VAC	.60		1.8		3.6	10.0
Enclosure	NEMA 4 / 4X					
Brake	Self-Locking Gear Train					
Manual Overide	Standard (Handwheel Included on 800 in lb Models and Larger)					
Operation	Reversing					
Weight-lbs	5		20		40	52

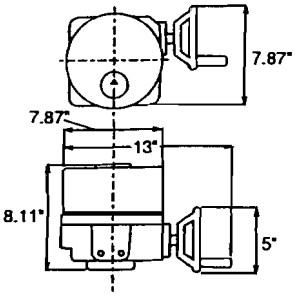
EJM Series Dimensions / Wiring Diagram



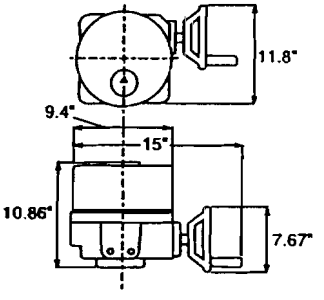
EJM2S2T/EJM3S2T



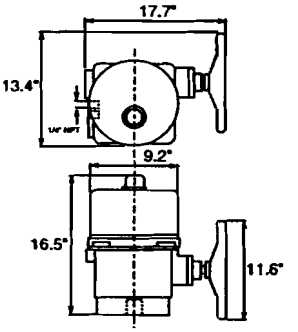
Wiring Diagram



EJM8S2T/EJM13S2T



~~EJM35S2T~~



~~EJM130S2T~~

Ball Valve Selection Chart*

Valve Size	True Union Ball Valve	Three Way Ball Valve
1/2" to 2"	EJM2S2T	EJM2S2T
2-1/2" to 6"	EJM3S2T	EJM8S2T

*Actuator size selections based on clear water @ 70°F.

Butterfly Valve Selection Chart*

Valve Size	Butterfly Valve
1-1/2", 2", 3"	EJM3S2T
4", 6"	EJM8S2T
8"	EJM13S2T
10", 12"	EJM35S2T
14", to 24"	EJM130S2T

HAYWARD®

Hayward Industrial Products, Inc.
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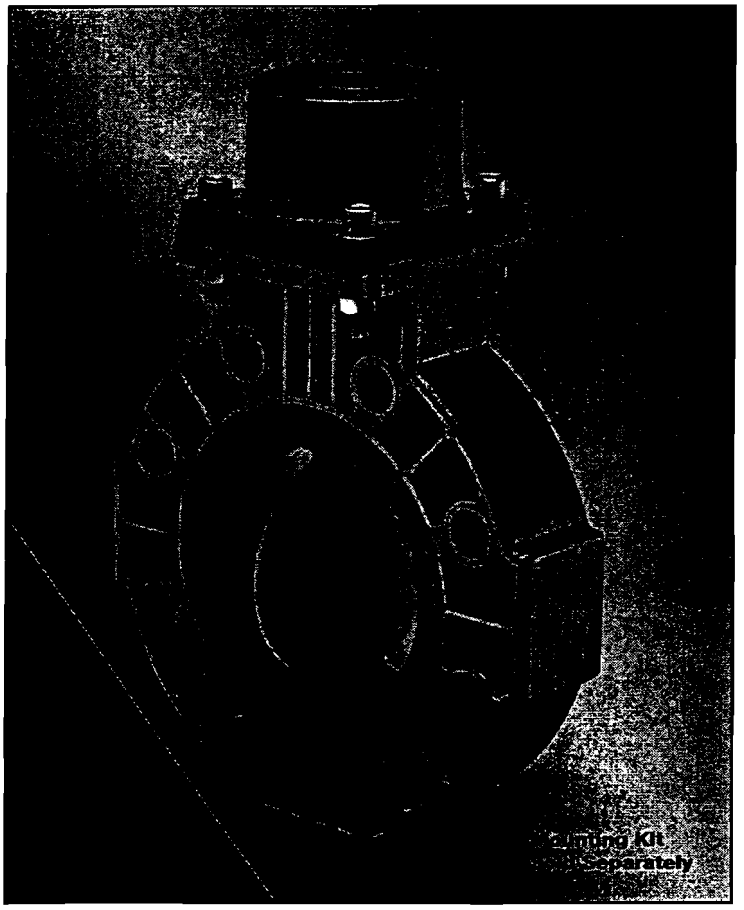
E-mail: industrial@haywardnet.com
Web Site: http://www.haywardindustrial.com

MC-6-EJM Printed in U.S.A.

Butterfly Valves for Actuation

1-1/2" to 8" PVC Bodies with PVC, PPL or PVDF Disks
1-1/2" to 8" CPVC Bodies with CPVC Disks
1-1/2" to 24" PPL Bodies with PPL Disks



Remote Control Valves

Hayward Modular Series Butterfly Valves, designed for actuator mounting, are ideal for reliable control of process fluids in a piping system. They enable all Hayward actuators and accessories to be mounted quickly with accurate alignment and proper support. They work equally well in both on/off and modulating services.

Advanced Design

These valves have blowout-proof stainless steel stems and a unique liner with a "V" notch retention design that ensures positive sealing of the liner to the disk. An integral face seal eliminates the need for additional flange mounting gaskets. The rock solid, integrally molded mounting pad insures that the actuator aligns correctly to the valve stem and functions reliably.

No Metal, No Process Media Contamination

Hayward Butterfly Valves for Actuation have no metal in contact with the process media. They cannot corrode or rust, nor will they contaminate sensitive fluids flowing through them.

Never a Problem with Valve Corrosion

Because of the valves' all-plastic construction, they will never rust or corrode – and they can survive corrosive environments without the need for painting or expensive epoxy coating.

Features

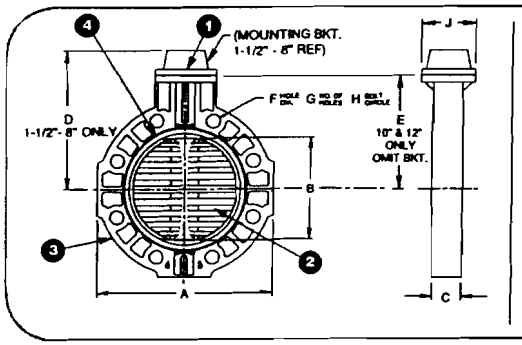
- Viton®, EPDM or Nitrile Seals
- Rated to a Full 150 PSI
- Blowout-Proof Stem
- Wafer Body Design
- Stainless Steel Shafts

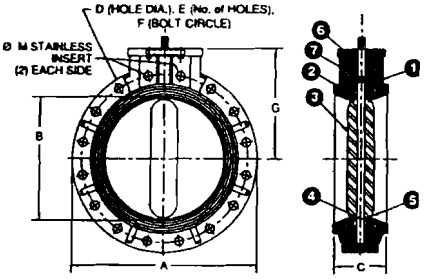
Viton® is trademark of DuPont Dow Elastomers

Options

- Electric Actuators
- Pneumatic Actuators
- Stem Extensions
- Titanium Shafts
- Lug Design Bodies
- Mounting Kits

Technical Information





Parts List for 1-1/2" to 12" Butterfly Valves for Actuation

1. Mounting Kit (Optional)
2. Disc, PVC, PPL or PVDF
3. Body PVC, PPL on 10" & 12"
4. Liner, Viton, EPDM or Nitrile

Parts List for 14" to 24" Butterfly Valves for Actuation

1. PPL Body
2. Body Liner
3. PPL Disk
4. O-Ring Seal
5. O-Ring Seal
6. Stainless Steel Shaft
7. Stem O-Rings (2)

Dimensions - Inches / Millimeters

Size	A	B	C	D	E (Lug Thd)	F	G	H	J	Weight (lb / kg)
1-1/2 / 50 & 2 / 63	6.00 / 152	1.75 / 44	1.50 / 38	6.25 / 159	.63-11UNC	.63 / .75 16 / 19	4	3.88 / 4.75 99 / 121	4.38 / 111	3.40 / 1.5
3 / 90	7.75 / 197	3.12 / 79	2.00 / 51	7.12 / 181	.63-11UNC	.75 / 19	4	6.00 / 152	4.38 / 111	4.50 / 2.0
4 / 110	9.25 / 235	3.94 / 100	2.19 / 56	8.19 / 208	.63-11UNC	.75 / 19	8	7.50 / 191	4.38 / 111	7.20 / 3.3
6 / 160	11.25 / 286	5.81 / 148	2.31 / 59	9.75 / 248	.75-10 UNC	.87 / 22	8	9.50 / 241	5.75 / 146	11.2 / 5.1
8 / 225	13.75 / 349	7.75 / 197	2.50 / 64	10.88 / 276	.75-10 UNC	.87 / 22	8	11.75 / 298	5.75 / 146	16.3 / 7.4
10 / 280	16.00 / 406	9.76 / 248	3.00 / 76	10.88 / 276	.88-9 UNC	1.00 / 25	12	14.25 / 362	6.00 / 152	37.0 / 16.8
12 / 315	19.00 / 483	11.50 / 292	3.18 / 81	12.38 / 314	.88-9 UNC	1.00 / 25	12	17.00 / 432	6.00 / 152	49.0 / 22.3
14	20.47 / 520	14.09 / 358	5.20 / 132	12.65 / 321	1.00-8 UNC	1.09 / 28	12	18.75 / 475	8.03 / 204	114 / 52
16	23.62 / 600	15.69 / 400	6.65 / 170	14.25 / 362	1.00-8 UNC	1.09 / 28	16	21.25 / 540	10.83 / 275	206 / 94
18	25.20 / 640	17.75 / 450	7.13 / 180	14.63 / 372	1.13-7 UNC	1.26 / 32	16	22.75 / 578	7.80 / 198	225 / 103
20	28.00 / 711	19.70 / 500	7.48 / 190	16.25 / 413	1.13-7 UNC	1.26 / 32	20	25.00 / 635	11.30 / 287	254 / 116
24	32.00 / 813	23.66 /600	8.23 / 210	18.88 / 480	1.25-7 UNC	1.38 / 35	20	29.50 / 750	13.40 / 340	350 / 160

Selection Chart

Size	Body Material	Disc Material	Shaft Material	Liner	Operator	Pressure Rating
1-1/2" to 8"	CPVC	CPVC	316 SSTL	Viton®, EPDM or Nitrile	Electric or Pneumatic Actuator	150 PSI @70F Non-Shock
1-1/2" to 8"	PVC	PVC, PPL or PVDF				
1-1/2" to 12"	PPL	PPL				
14" to 24"	PPL	PPL	410 SSTL			See Chart Below

Cv Factors

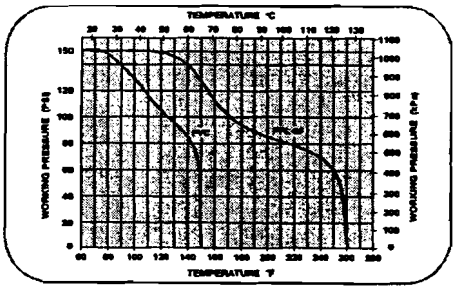
Size	Value	Size	Value
1-1/2"	90	12"	7100
2"	125	14"	7200
3"	280	16"	8300
4"	575	18"	10900
6"	1100	20"	14100
8"	2500	24"	18500
10"	4700		

Pressure Loss Calculation Formula

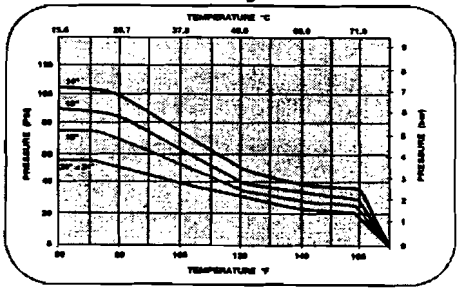
$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

Operating Temperature/Pressure 1-1/2" - 12" Butterfly Valves



Operating Temperature/Pressure 14" - 24" Butterfly Valves



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Section 4-C

Butterfly Shut-Off Valves (V-412, V-422)

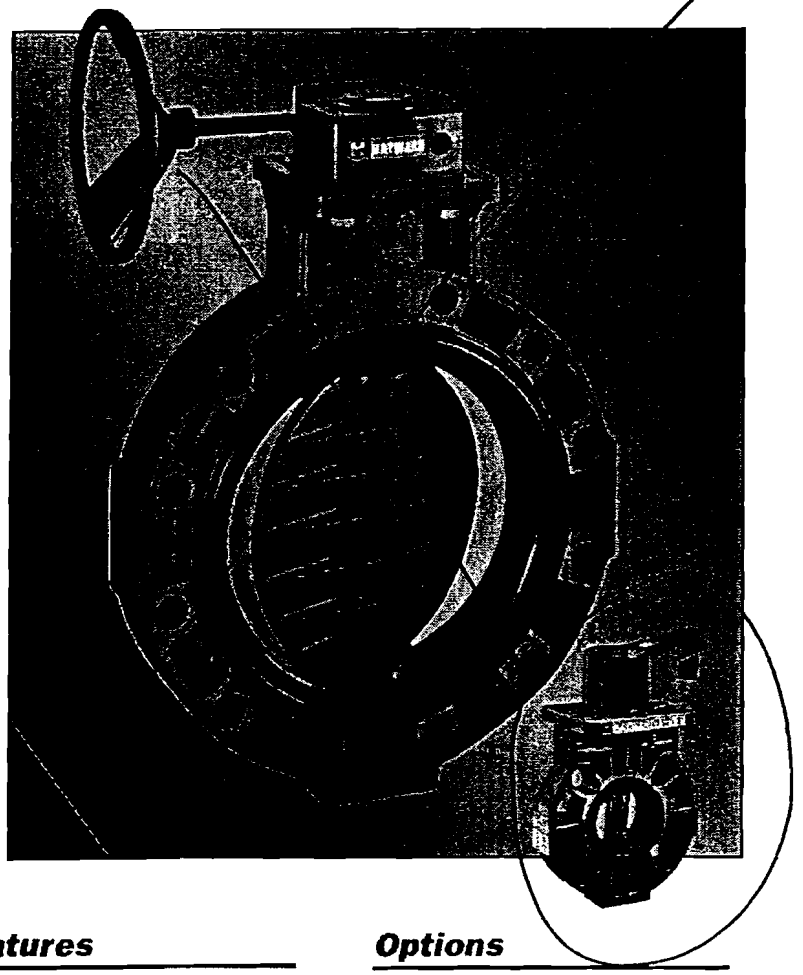
BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

HAYWARD®

FlowControl

Butterfly Valves

1-1/2" to 12" • Bodies – PVC, Corzan® CPVC, PPL Disks – PVC, Corzan® CPVC, PPL, PVDF



Features

- Rated at 150 PSI
- Stainless Steel Shaft
- Fully Supported Flange Bolt Holes
- Full Body, V-Notch Liner
- Blowout-Proof Shaft
- Viton, EPDM or Nitrile Liners

Options

- Stem Extensions
- Lug Body Design
- Gear Operators
- Electric Actuators
- Pneumatic Actuators
- Titanium Shaft
- 2" Square Operating Nut
- PVDF Discs

A Better Butterfly Valve

Hayward 1-1/2" through 12" all-Plastic Butterfly Valves are rated at a full 150 psi. Unlike other plastic butterfly valves, Hayward valves are constructed from a one piece body that incorporates fully supported flanged bolt holes to prevent stressing of the mating pipe flanges. Their heavy duty construction stands up to the most demanding applications. The rock solid integral mounting pad insures that the valve operator will function reliably – whichever operator is used, lever handle, gear box or actuator.

Extra Features, No Extra Cost

Hayward Butterfly Valves feature a blowout-proof stainless steel stem and a unique, full body liner that has a V-notch retention design. This assures positive sealing of the liner to the valve body. An integrally molded face seal provides positive sealing against the mating flange without the need for additional gaskets. And the lever handle has a built in lockout feature.

Better Sealing

Other plastic butterfly valves have only a thin o-ring on the disk to seal the valve, but Hayward valves feature a full body liner seal. This means that the process media never contacts the valve body. And you can count on the full liner seal to perform reliably, year after year.

Easy Retrofit

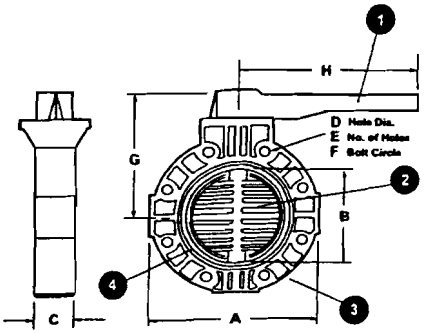
Hayward Butterfly Valves can be easily fitted into a metal piping system. All valve sizes meet industry face-to-face standards – allowing simple retrofit.

No Metal, No Corrosion

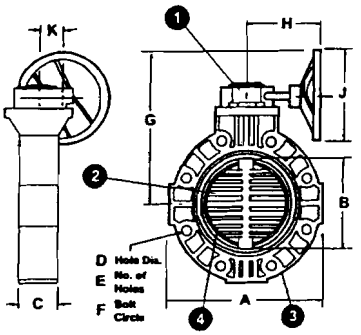
These valves have no metal in contact with the process media. They cannot corrode or rust – nor will they contaminate sensitive fluids flowing through them.

Technical Information

Lever Handle Operator



Gear Box Operator



Parts List
Butterfly Valves

1. Operator (Lever or Gear Box)
2. Disc
3. Body
4. Liner

Dimensions - Inches / Millimeters

Size	A	B	C	D	E	F	G		H		J	K	Wt. Lb / Kg
							Gear Box	Lever	Gear Box	Lever			
1-1/2 / 50	6.00 / 152	1.75 / 44	1.50 / 38	.63 / 16	4	3.88 / 99	9.31 / 236	6.25 / 159	7.13 / 181	10.50 / 267	8.00 / 203	1.88 / 48	10.5 / 4.8
2 / 63	6.00 / 152	1.75 / 44	1.50 / 38	.75 / 19	4	4.75 / 121	9.31 / 236	6.25 / 159	7.13 / 181	10.50 / 267	8.00 / 203	1.88 / 48	10.5 / 4.8
3 / 90	7.75 / 197	3.13 / 80	2.00 / 51	.75 / 19	4	6.00 / 152	9.75 / 248	6.69 / 170	7.13 / 181	10.50 / 267	8.00 / 203	1.88 / 48	11.6 / 5.3
4 / 110	9.25 / 235	3.94 / 100	2.19 / 56	.75 / 19	8	7.50 / 191	10.19 / 259	7.94 / 202	7.13 / 181	12.00 / 305	8.00 / 203	1.88 / 48	14.3 / 6.5
6 / 160	11.25 / 286	5.81 / 148	2.31 / 59	.88 / 22	8	9.50 / 241	12.38 / 314	9.50 / 241	7.13 / 181	14.00 / 356	8.00 / 203	1.88 / 48	15.4 / 7.0
8 / 225	13.75 / 349	7.75 / 197	2.50 / 64	.88 / 22	8	11.75 / 298	13.50 / 343	10.63 / 270	7.13 / 181	16.00 / 406	8.00 / 203	1.88 / 48	23.5 / 10.7
10 / 280	16.00 / 406	9.76 / 248	3.00 / 76	1.00 / 25	12	14.25 / 362	16.00 / 406	N/A	8.09 / 205	N/A	8.00 / 203	2.36 / 59	39.0 / 17.7
12 / 315	19.00 / 483	11.50 / 292	3.18 / 81	1.00 / 25	12	17.00 / 432	17.50 / 445	N/A	8.09 / 205	N/A	8.00 / 203	2.36 / 59	51.0 / 23.1

DIN metric flanges available

Cv Factors

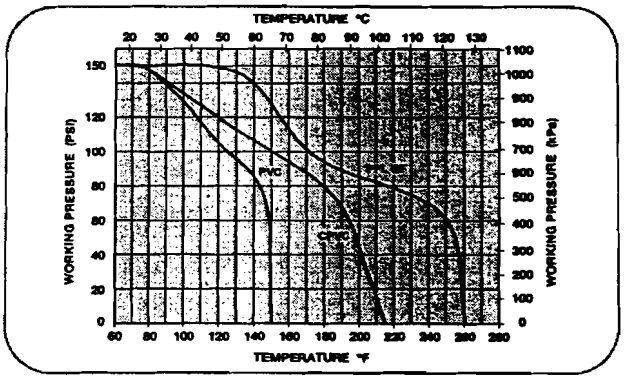
Size	Factor	Size	Factor
1-1/2"	90	6"	1100
2"	125	8"	2500
3"	280	10"	4700
4"	675	12"	7100

Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

Operating Temperature/Pressure



Selection Chart

Size	Body Material	Disc Material	Shaft Material	Liner	Operator	Pressure Rating
*1-1/2" to 8"	CPVC	CPVC	316 SSTL	Viton®, EPDM or Nitrile	Lever or Gear Box	150 PSI @70F Non-Shock
1-1/2" to 8"	PVC	PVC, PPL, or PVDF				
1-1/2" to 12"	PPL	PPL				

* CPVC/CPVC 8" gear operated only

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Section 4-D

Water Filter Drain Pump

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

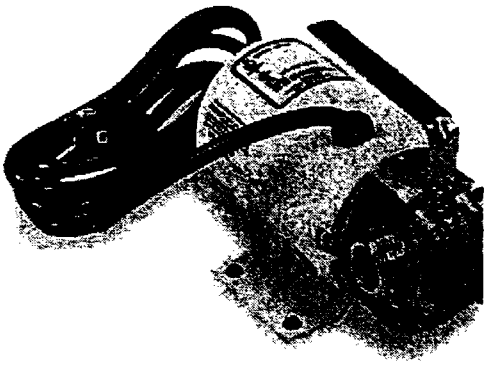
Item Details

< Back

Pumps & Plumbing > Sump, Effluent and Sewage > Marine-RV Pumps

Pump,Utility,115 V

Portable Utility Pump, Motor Voltage 115 Volts, Motor Current 1.4 to 1.7 Amps, Water Flow @ 1 Foot of Head 360 GPH, Water Flow @ 10 Feet of Head 300 GPH, Water Flow @ 20 Feet of Head 270 GPH, Water Flow @ 40 Feet of Head 90 GPH, Water Flow @ 30 Feet of Head 198 GPH, Water Flow @ 5 Feet of Head 342 GPH, Cord 6 Feet, 3 Conductors, Shut Off 48.3 Feet, Compact, Self Priming Pump with Flexible Impeller, AC/DC Motor



Grainger Item:	1P579	Ship Qty :	1
Price (ea) :	$75.10	Sell Qty (Will-Call) :	1
Manufacturer:	TEEL	Usually Ships :	Today
Mfg. Model#:	1P579	Catalog 395 Page:	3107

Qty. Add to Order

Price shown may not reflect your price. *Log-in* above, or click here to register.

TECHNICAL SPECIFICATIONS

Item	Compact Self-priming Marine-utility Pump
Volts	115VAC
Amps	1.4 to 1.7
Length (In.)	6 5/8
Height (In.)	3 1/2
Width (In.)	4
Application	For Marine and General Commercial and Industrial Applications
Max. Head (Ft.)	48.3

NOTES & RESTRICTIONS

See Catalog 395 Page for application and/or safety information.

OPTIONAL ACCESSORIES

Pump Repair Kit

Pump Repair Kit, Fits Pump 1P579 and 1P580, For B and C Model Impellers, Cam and Gaskets

Price (ea): $12.41 Usually Ships : Today
Grainger Item#: 1R230

Qty. Add to Order

Pump Repair Kit

Pump Repair Kit, Fits 1P579 and 1P580 Pump, Models D, E and F, Proven Pump Models 360 and 365, Impellers, Cam, Gasket

Price (ea): $10.35 Usually Ships : Today
Grainger Item#: 1R387

Qty. Add to Order

Hose,Water

Water Hose, Hose Inside Diameter 5/8 Inch x 50 Feet Length, Hose Description Weather Master Reinforced Vinyl Hose, Maximum Pressure 100 PSI, Water Flow

Price (ea): $13.04 Usually Ships : Today
Grainger Item#: 1P648

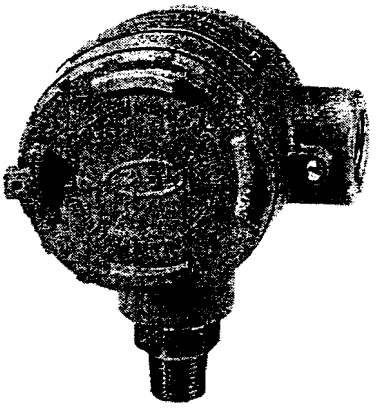
Section 4-E

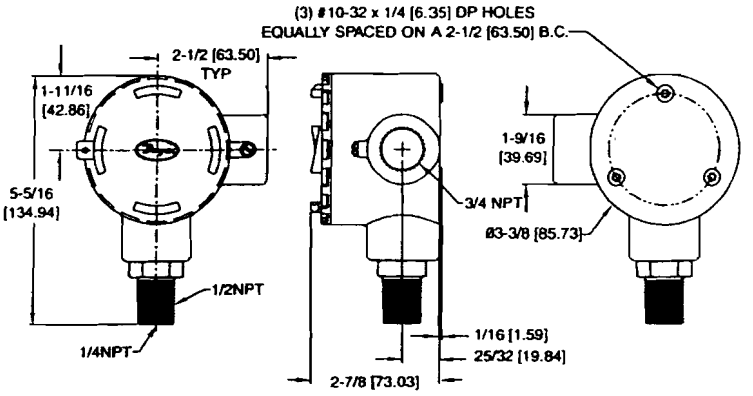
Water Filter Pressure Transmitters (PT-401, PT-402)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions





The **Series 634ES Pressure Transmitter** senses a single air, compatible gas or liquid pressure and converts it into a standard 4-20 mA output signal. Ranges are available from 0-10 through 0-6000 psi. All models are field adjustable so any range within these limits can be achieved by recalibration using the easily accessible span and zero potentiometers.

Positive pressure can be measured within an accuracy of ±0.5% of span. The Series 634ES uses an isolated piezoresistive pressure sensor to produce a resistance change across a wheatstone bridge. The signal is conditioned and converted into a 4-20 mA output signal.

For applications requiring direct pressure or percent of full span readings, the optional A-701 digital readout makes an ideal companion device, providing a bright .6" high, 3-1/2" digit LED and supplying power to the Series 634ES Transmitter.

Model Number	Series 634ES Models and Ranges in PSI (bar)			
	As Stocked	Min. Range	Max. Range	Max Pressure
634ES-0	10 (.69)	10 (.69)	20 (1.38)	30 (2.07)
634ES-1	30 (2.07)	20 (1.38)	40 (2.76)	60 (4.14)
634ES-2	50 (3.45)	40 (2.76)	60 (4.14)	100 (6.9)
634ES-3	100 (6.9)	60 (4.14)	120 (8.3)	200 (13.8)
634ES-4	200 (13.8)	100 (6.9)	250 (17.2)	400 (27.6)
634ES-5	300 (20.7)	250 (17.2)	350 (24.1)	500 (34.5)
634ES-6	500 (34.5)	350 (24.1)	600 (41.4)	1000 (69)
634ES-7	1000 (69)	600 (41.4)	1250 (86)	2000 (138)
634ES-8	2000 (138)	1250 (86)	2500 (172)	4000 (276)
634ES-9	4000 (276)	2500 (172)	6000 (414)	7500 (517)

PHYSICAL DATA

GENERAL

Maximum Pressure: See chart on this page.
Wetted Parts: 316, 316L Stainless Steel.
Housing: Designed to meet NEMA-4X.

ELECTRICAL

Power Supply: 12.3-35 VDC-2 wire.
Output Signal: 4-20 mA DC (limited at 38 mA DC).
Loop Resistance: 0 - 1100 ohms from 12.3 to 35 VDC.

$$R_{L\ max} = \frac{Vps - 12.3V}{20\ mA}$$

Current Consumption: DC: 38 mA max.

MATERIALS

Housing: Cast aluminum; textured gray polyurethane finish.
Pressure Connection: Stainless Steel.

MECHANICAL

Weight: 1 lb., 12 oz. (.8 kg).
Span and Zero Adjustments: Protected potentiometers, located in auxiliary housing.
Pressure Connection: 1/4" female NPT x 1/2" male NPT.

PERFORMANCE AT 70°F (21.1°C)

Zero Output: 4 mA DC.
Full Span: 16 mA DC.
Accuracy: ±0.5% of span.
Warm-up Time: 10 minutes.

STABILITY/ENVIRONMENTAL

Operating Temperature: 20 to 120°F (- 6.7 to 48.9°C).
Thermal Errors: ± 0.02%/°F typical.
Stability: 1% F.S./yr.

STANDARD ACCESSORIES

(3) "Z" mounting brackets.
(3) 10-32 x 4" RH machine screws.

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Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

INSTALLATION

LOCATION: Select a location where temperature of the unit will be between 20°F and 120°F. Distance from the receiver is limited only by total loop resistance. See "Electrical Connections." The tube feeding the pressure to the instrument can be run practically any length required, but long lengths will slightly increase response time. Avoid surfaces with excessive vibration.

POSITION: A vertical position is recommended, as all stocked models are spanned and zeroed at the factory in this position. They can be used at other angles, but final spanning and zeroing must be done while transmitter is in the alternative position.

PRESSURE CONNECTIONS: A single pressure connection is provided at the bottom of the transmitter housing. It has1/4" female NPT and 1/2" male NPT threads. Attach positive pressure to this port.

MOUNTING: The Series 634ES Transmitter can be mounted three ways:

(A) Supported directly by pipe providing pressure.

(B) Attached to a mounting surface with 10-32 x 1/4" machine screws (included). The machine screws are installed through the mounting surface into tapped holes on back of unit.

(C) Mounted with "Z" brackets (included). Attach "Z" brackets to tapped holes on back of unit and fasten to front of mounting surface.

ELECTRICAL CONNECTIONS

CAUTION: DO NOT EXCEED SPECIFIED SUPPLY VOLTAGE RATINGS. PERMANENT DAMAGE NOT COVERED BY WARRANTY WILL RESULT. THIS UNIT IS NOT DESIGNED FOR AC VOLTAGE OPERATION.

Electrical connections to the Series 634ES Transmitter are made inside the enclosure. Remove the cover, feed stripped and tinned leads through the conduit opening and connect to terminal block screws marked + and -. See Figure A for locations of terminal block, span and zero adjust potentiometers. See Figure B (Pg. 3) for schematic diagram.

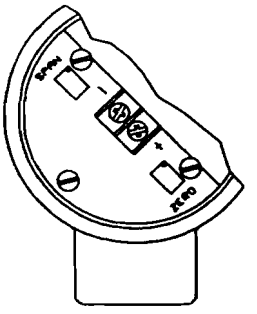

FIG. A

An external power supply delivering 12.3 to 35 VDC with minimum current capability of 40 mA must be used to power the control loop in which the Series 634ES Transmitter is connected. See Figure B for connection of the power supply, transmitter and receiver.

The range of appropriate receiver load resistance (R_L) for the power supply voltage available is given by the formula and graph in Figure C on Pg. 3.

Shielded 2-wire cable is recommended for control loop wiring, and the cable shielding may be grounded if desired. Note also that the receiver may be connected in either the negative or positive side of the loop, whichever is most convenient.

Should polarity of the transmitter or receiver inadvertently become reversed, the loop will not function properly, but no damage will be done to the transmitter.

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

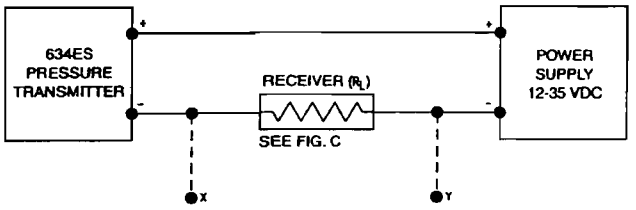

FIG. B

Series 634ES Transmitters can be used with receivers requiring 1-5 volt input rather than 4-20 mA. If the receiver requires a 1-5 volt input, insert a 250 ohm, 2 watt resistor in series with the current loop but in parallel with the receiver input. Referring to Figure B, R_L becomes the 250 ohm resistor and points X and Y are connected to the receiver input, point X being positive (+) and point Y negative (-) or ground. The resistor should be connected at the panel end of the transmitter current loop close to the receiver input to take advantage of the immunity of the current loop to electrical noise pickup. Most electronic component distributors stock a 249 Ω, 2 watt, ± 1% tolerance metal film resistor which is adequate for this application.

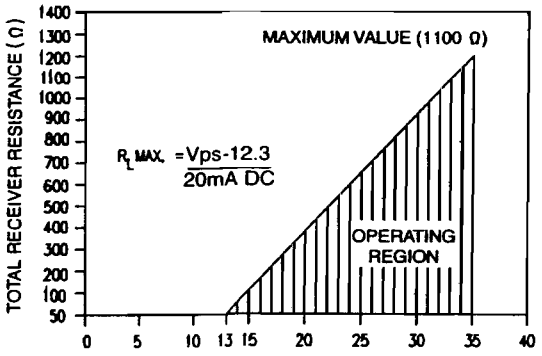

FIG. C

WIRE LENGTH - The maximum length of wire connecting transmitter and receiver is a function of wire size and receiver resistance. Wiring should not contribute more than 10% of receiver resistance to total loop resistance. For extremely long runs (over 1000 feet) choose receivers with higher resistances to minimize size and costs of connecting leads. When wiring length is under 100 feet, lead wire as small as 22 AWG can be used.

PRESSURE RANGING - Each Series 634ES Transmitter is factory-calibrated to the range given in the model number chart. However, special calibration is also available. If this is the case, the transmitter will be so marked. For purposes of clarification in these instructions, range is defined as that pressure which, applied to the transmitter, produces 20 mA of current in the loop. Zero pressure is always assumed to be 4 mA. If a transmitter pressure range other than that supplied is required, follow the re-ranging procedure described on Pg. 4.

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

PRESSURE RE-RANGING PROCEDURE

1. With the transmitter correctly connected to the companion receiver, an accurate milliameter with a full scale reading of approximately 30 mA should be inserted in series with the current loop. A controllable pressure source capable of achieving the desired range should be connected to the pressure port of the transmitter and teed into an accurate reference pressure gauge or manometer. The instrument must be ranged in the same position in which it will be used. Vertical mounting is recommended.

2. Apply electrical power to the system and allow it to stabilize for 10 minutes.

3. With no pressure applied to the transmitter, adjust "zero" control so that loop current is 4 mA.

4. Apply full range pressure and adjust loop current to 20 mA using "span" control.

5. Relieve pressure and allow transmitter to stabilize for two minutes.

6. Zero and span adjustments may be interactive, so repeat steps 3 through 5 until zero and full range pressures consistently produce loop currents of 4 and 20 mA respectively.

7. Remove the milliameter from the current loop and proceed with final installation of the transmitter and receiver.

MULTIPLE RECEIVER INSTALLATION

An advantage of the standard 4-20 mA output signal provided by the Series 634ES Pressure Transmitter is that any number of receivers can be connected in series in the current loop. Thus, an A-701 Digital Readout Accessory, an analog panel meter, a chart recorder, process controlling equipment, or any combination of these devices can be operated simultaneously. It is only necessary that these devices all be equipped with a standard 4-20 mA input and that proper polarity of the input connections be observed when inserting the device in the current loop. If any of the receiving devices displays a negative or downscale reading, this indicates that the signal input leads are reversed.

MAINTENANCE

Upon final installation of the Series 634ES Transmitter and the companion receiver, including the A-701 Digital Readout, no routine maintenance is required. A periodic check of system calibration is recommended. The Series 634ES Pressure Transmitter is not field serviceable and should be returned, freight prepaid, to the factory if repair is required. The A-701 Digital Readout should be returned to the manufacturer if service is needed. Refer to the A-701 instruction sheet.

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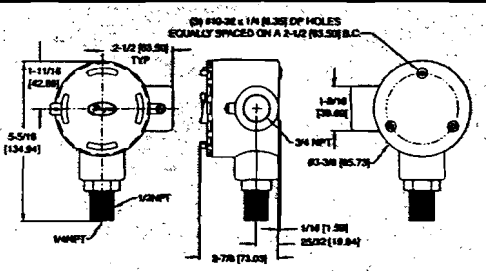
Series 634ES Adjustable Range Pressure Transmitter

0.5% Full Span Accuracy, Ranges to 5000 psi

CE



Series 634ES Transmitters sense a single pressure for air, compatible gas or liquid and provide 4-20 mA output signal. Positive pressure can be measured within an accuracy of ±0.5% of span. The Series 634ES uses an isolated piezoresistive pressure sensor to produce a resistance change across a wheatstone bridge. Convenient 2-wire operation simplifies installation. Zero and span adjustments are fully protected inside a rugged die cast aluminum housing with durable gray polyurethane finish. Enclosure is designed to meet NEMA 4X requirements.

STOCKED MODELS

Model Number	Range in psi (bar)	Min. Range in psi (bar)	Max. Range in psi (bar)
634ES-0	15 (1.035)	7.5 (0.517)	40 (2.76)
634ES-1	30 (2.07)	20 (1.38)	40 (2.76)
634ES-2	50 (3.45)	40 (2.76)	60 (4.14)
634ES-3	100 (6.9)	60 (4.14)	120 (8.3)
634ES-4	200 (13.8)	100 (6.9)	250 (17.2)
634ES-5	300 (20.7)	250 (17.2)	350 (24.1)
634ES-6	500 (34.5)	350 (24.1)	600 (41.4)
634ES-7	1000 (69)	600 (41.4)	1250 (86)
634ES-8	2000 (138)	1250 (86)	2500 (172)
634ES-9	4000 (276)	2500 (172)	5000 (414)

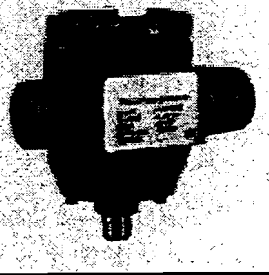
SPECIFICATIONS

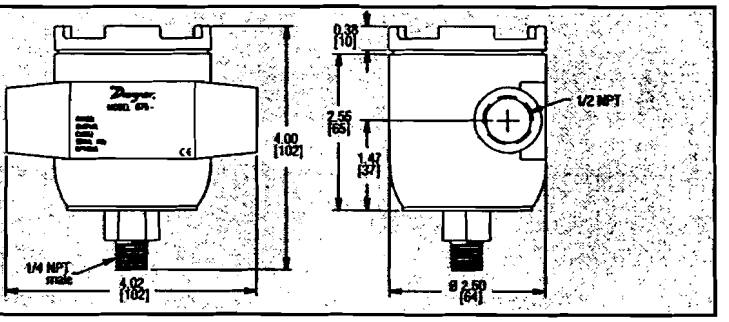
Service: Compatible, gases & liquids.
Wetted Materials: Types 316, 316L SS.
Accuracy: ±0.5% F.S.
Stability: ±1% F.S./yr.
Temperature Limits: 0 to 140°F (-17.8 to 60°C).
Compensated Temperature Limits: 20 to 120°F (-6.67 to 48.9°C).
Pressure Limit: 1.5x maximum pressure range.
Thermal Effect: ±0.025% F.S./°F (0.045% F.S./°C).
Power Requirements: 10 to 35 VDC (2-wire).
Output Signal: 4 to 20 mA.
Zero & Span Adjustments: Protected potentiometers located in auxiliary housing.
Loop Resistance: 1250 ohms DC max.
Current Consumption: 38 mA DC max.
Electrical Connections: Terminal block.
Process Connection: 1/4" (6.35 mm) female NPT x 1/2" (12.7 mm) male NPT.
Enclosure Rating: Designed to meet NEMA 4x.
Mounting Orientation: Not position sensitive.
Weight: 1 lb, 10.6 oz (754 g).
Agency Approvals: CE.

Series 679 Weatherproof Pressure Transmitter

±0.25% FS Accuracy, Compatible with Corrosive Materials, 4-20 mA Output

CE





The Series 679 Pressure Transmitter is compatible with a wide range of gases and liquids, and is specially designed for weatherproof service (NEMA 4/IP56). The Model 679 can measure pressures with an accuracy of ±.25%. This model provides a 4-20 mA output and is field adjustable.

STOCKED MODELS in bold

Model Number	Range	Overpressure	
679-0	0 to 25 psi	100 psi	
679-1	0 to 50 psi	150 psi	
679-2	0 to 100 psi	300 psi	
679-3	0 to 250 psi	500 psi	
679-4	0 to 500 psi	1000 psi	
679-5	0 to 1000 psi	2000 psi	
679-6	0 to 3000 psi	4500 psi	
679-7	0 to 5000 psi	7500 psi	
679-8	0 to 10,000 psi	12,000 psi	

SPECIFICATIONS

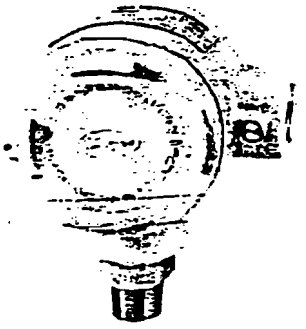
Service: Corrosive liquids and gases.
Accuracy: ±.25% FS (includes non-linearity, hysteresis and non-repeatability).
Pressure Limits: See table.
Output: 4-20 mA, 2-wire.
Supply Voltage: 9-30 VDC.
Loop Resistance: 800 ohms.
Zero and Span Adjustment: ±15%, non-interactive.
Stability: Less than .5% FS/year.
Temperature Limits: -40 to 260°F (-40 to 125°C) 10 to 90% RH, non-condensing.
Compensated Temperature Range: -4 to 176°F (-20 to 80°C).
Pressure Connection: 1/4" male NPT.
Wetted Parts: Corrosive resistant 17-4 PH Stainless Steel.
Enclosure: Aluminum.
Electrical Connections: Two 1/2" conduit ports.
Weight: 13.4 oz (380 g).
Agency Approvals: CE.

Series 634ES

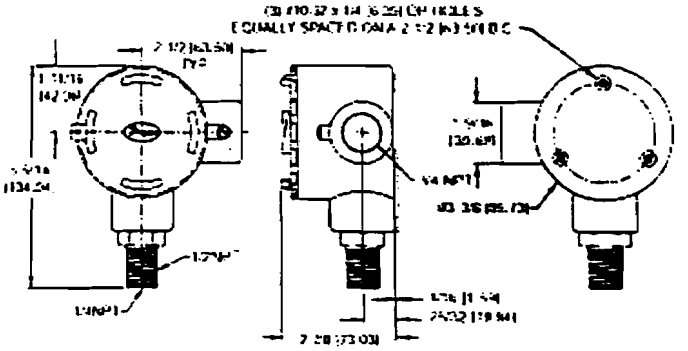
Adjustable Range Pressure Transmitter

CE

0.5% Full Span Accuracy, Ranges to 5000 psi



Service Manual Catalog Page



Dimensional Enlargement

Series 634ES Transmitters sense a single pressure for air, compatible gas or liquid and provide 4-20 mA output signal. Positive pressure can be measured within an accuracy of ±0.5% of span. The Series 634ES uses an isolated piezoresistive pressure sensor to produce a resistance change across a wheatstone bridge. Convenient 2-wire operation simplifies installation. Zero and span adjustments are fully protected inside a rugged die cast aluminum housing with durable gray polyurethane finish. Enclosure is designed to meet NEMA 4X requirements.

POPULAR MODELS

Model Number	Range in psi (bar)	Min. Range in psi (bar)	Max. Range in psi (bar)	Price	Discount Schedule
634ES-0	15 (1.035)	7.5 (0.517)	40 (2.76)	$198.50	Standard
634ES-1	30 (2.07)	20 (1.38)	40 (2.76)	$198.50	Standard
634ES-2	50 (3.45)	40 (2.76)	60 (4.14)	$198.50	Standard
634ES-3	100 (6.9)	60 (4.14)	120 (8.3)	$198.50	Standard
634ES-4	200 (13.8)	100 (6.9)	250 (17.2)	$198.50	Standard
634ES-5	300 (20.7)	250 (17.2)	350 (24.1)	$198.50	Standard

SPECIFICATIONS

Service: Compatible, gases & liquids.
Wetted Materials: Types 316, 316L SS.
Accuracy: ±0.5% F.S.
Stability: ±1% F.S./yr.
Temperature Limits: 20 to 120°F (-6.67 to 48.9°C).
Compensated Temperature Limits: 20 to 120° (-6.67 to 48.9°C).
Pressure Limit: 1.5x maximum pressure range.
Thermal Effect: ±0.025% F.S./°F (0.045% F.S./°C).
Power Requirements: 10 to 35 VDC (2 wire).
Output Signal: 4 to 20 mA.
Zero and Span Adjustments: Protected potentiometers located in auxiliary housing.
Loop Resistance: 1250 ohms DC max.
Current Consumption: 38 mA DC max.
Electrical Connections: Terminal block.
Process Connection: 1/4" (6.35 mm) female NPT x 1/2" (12.7 mm) male NPT.
Enclosure Rating: Designed to meet NEMA 4x.
Mounting Orientation: Not position sensitive.
Weight: 1 lb, 10.6 oz (754 g).
Agency Approvals: CE.

Section 4-F

Water Filter Pressure Indicators (PI-401, PI-402)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Bourdon Tube Pressure Gauges

Forged Brass Case / Copper Alloy Wetted Parts

Industrial Series Liquid Filled • Type 213.40

Pressure Gauges

Application
Heavy-duty instrument intended for adverse service conditions where pulsation or vibration exists. Fluid medium which does not clog connection port or corrode copper alloy.

Sizes
2½" and 4" (63 and 100 mm)

Accuracy
2½" ±1.5% of span
4" ±1.0% of span (ASME B40.1 Grade 1A)

Ranges (All ranges not stocked)
Vacuum / Compound to 30"HG / 0 / 200 PSI
Pressure from 10 PSI to 15,000 PSI
or other equivalent units of pressure or vacuum

Working Range

2½"	Steady:	3/4 of full scale value
	Fluctuating:	2/3 of full scale value
	Short time:	full scale value
4"	Steady:	Full scale value
	Fluctuating:	0.9 x full scale value
	Short time:	1.3 x full scale value

Operating Temperature

Ambient:	-4°F to 140°F (-20°C to 60°C) - glycerine
	-40°F to 140°F (-40°C to 60°C) - silicone
Media:	max. 140°F (+60°C) - soldered
	max. 212°F (+100°C) - brazed

Temperature Error
Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.

Standard Features

Connection
Material: copper alloy
Lower mount (LM)
Center back mount (CBM) 2½"
Lower back mount (LBM) 4"
1/4" NPT or 1/2" NPT limited to wrench flat area
(7/16"-20 SAE thread for Type **213.40S**)

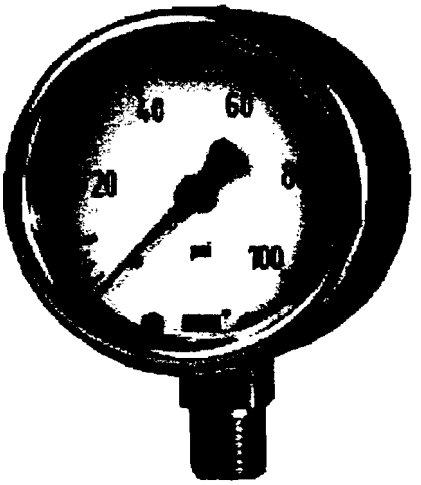
Bourdon Tube
2½" Size - Material: Copper alloy
30"Hg (Vac) to 1000 PSI - C-type (soldered)
1500 PSI to 15,000 PSI - helical type (soldered)

4" Size - Material: Copper alloy < 1000PSI
316 stainless steel > 1500 PSI
30"Hg (Vac) to 1000 PSI - C-type (soldered)
1500 PSI to 15,000 PSI - helical type (brazed)

Movement
Copper alloy

Dial
White aluminum with stop pin and black and red lettering

Pointer
Black aluminum



Case
Gold painted forged brass with integral connection and vent plug with high gloss brass plated ABS cover ring (2½"). Silver painted forged brass with integral connection and blow-out plug with chrome plated brass cover ring (4").

Standard Scales
2½": PSI, PSI/KPA, PSI/BAR
4": PSI

Weather Protection
Weather tight (NEMA 4X / IP 65)

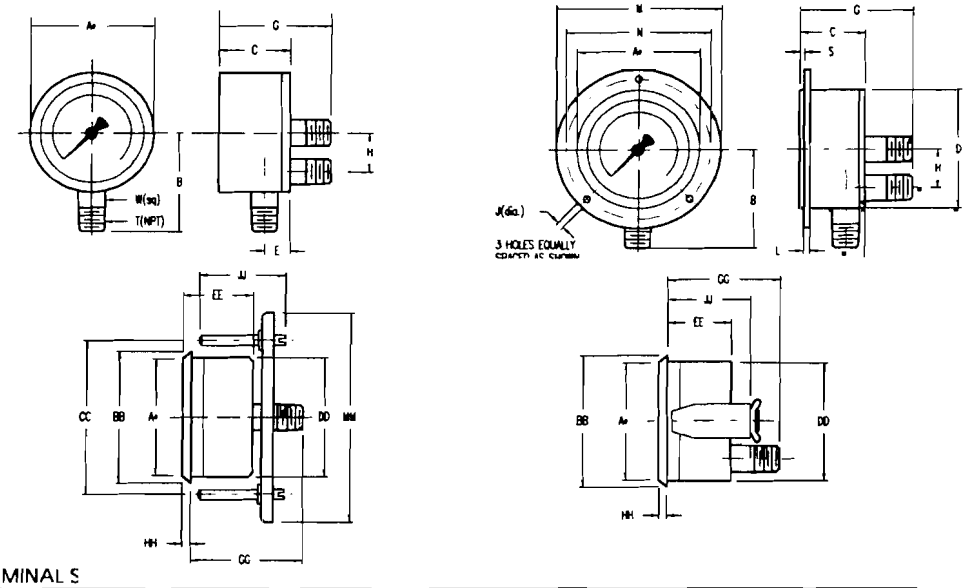
Window Gasket
Buna-N

Window
Acrylic

Liquid Filled
213.40 - Glycerine 99.7%

Order Options (min. order may apply)
Front or rear flange
U-Clamp
Brass threaded or press-fit restrictor
Front flange for 4½" panel cutout for 4" gauge
Plastic adaptor ring for 2½" non-metric panel cutout
Special case colors
Safety glass window
Externally adjustable red drag pointer (max. hand)
Externally adjustable red mark pointer (set pointer)
Glass window
Special connections, limited to wrench flat area
Custom dial layout
DIN standards
Other pressure scales available:
Bar, kPa, MPa, Kg/cm² and dual scales
Silicone or fluorocarbon fill

Dimensions:



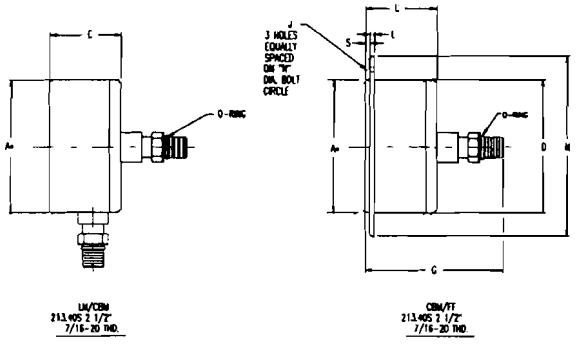
A* NOMINAL S

TYPE/SIZE	WEIGHT	KEY	A*	B (1)	C	D	E	G	H	J	K	L	M
213.40 2.5"	0.66 lbs.	mm	63	53	37	63	11	63	--	3.5	14	2	85
		in	2.5	2.09	1.46	2.48	.43	2.48	--	.14	.55	.08	3.35
213.40 4"	2.43 lbs.	mm	100	80	49	101	13.5	74	30	5	17	2	132
		in	4.0	3.15	1.93	3.98	.53	2.91	1.18	20	67	.08	5.2

KEY	N	O	P	R	S	T	W	BB	CC	DD	EE	GG	HH	JJ	MM
mm	75	79	39	5.5	2	--	14	68	72	63	36.5	61	3	50	91
in	2.95	3.11	1.54	.22	.08	1/4"	.55	2.68	2.83	2.48	1.44	2.4	.12	1.97	3.58
mm	115	122	52.5	5.5	3.5	--	22	107	--	101	48	75.5	5	59	--
in	4.35	4.80	2.07	.22	.14	1/2"	.87	4.21	--	3.98	1.89	2.97	.20	2.32	--

(1) For 4" gauges with 1/2" NPT connection, B dimension changes to 85mm/3.35in.

Optional Type 213.40S - 7/16"-20 SAE connection



A* NOMINAL SIZE

TYPE/SIZE	WEIGHT	KEY	A*	B	C	F	G	J
213.40S 2.5"	0.68 lbs.	mm	63	55	37	6.2	63	3.5
		in	2.5	2.17	1.46	.25	2.48	.14

KEY	L	M	N	S	W
mm	2.0	85	75	2.0	22
in	.08	3.35	2.95	.08	0.87

T=7/16"-20 SAE connection with hex nut, Viton o-ring, and zinc-plated steel washer

THE MEASURE OF

Total Performance™

Ordering Information:
State computer part number (if available) / type number / size / range / connection size and location / options required.

05/01

WIKA Instrument Corporation
1000 Wiegand Boulevard
Lawrenceville, Georgia 30043-5868
Tel: 770-513-8200 Fax: 770-338-5118
http://www.wika.com e-mail: info@wika.com

Section 5

Section 5-A

Treatment Building Effluent Flow Indicating Transmitter (FE/FIQT-401)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Propeller

CONFIGURATION SHEET
MAIN LINE FLOWMETER

MODEL MW500 / MZ500

DESCRIPTION

Model MW500 and MZ500 Main Line Propeller Flowmeters are manufactured to comply with the applicable provisions of the American Water Works Association Standard No. C704-92 for propeller type flowmeters. The model MW500 is designed for a maximum continuous working pressure of up to 150 psi and is fitted with AWWA Class D flanges. The model MZ500 is designed for a continuous working pressure of up to 300 psi and is fitted with ANSI B16.5 Class 300 flanges. The impeller and drive assembly are easily removed through the top flange connection. The meter flow tubes are coated with fusion-bonded epoxy for maximum corrosion protection, and integral flow straightening vanes reduce upstream flow turbulence. As with all McCrometer propeller flowmeters, standard features include a magnetically coupled drive, instantaneous flowrate indicator and straight reading, six-digit totalizer.

Impellers are manufactured of high-impact plastic, capable of retaining their shape and accuracy over the life of the meter. Each impeller is individually calibrated at the factory to accommodate the use of any standard McCrometer register. The MW500 and MZ500 can be field-serviced without the need for factory recalibration. Factory lubricated, stainless steel bearings are used to support the impeller shaft. The shielded bearing design limits the entry of materials and fluids into the bearing chamber providing maximum bearing protection.

The instantaneous flowrate indicator is standard and available in gallons per minute, cubic feet per second, liters per second and other units. The register is driven by a flexible steel cable encased within a protective vinyl liner. The register housing protects both the register and cable drive system from moisture while allowing clear reading of the flowrate indicator and totalizer.

INSTALLATION

Standard installation is horizontal mount. If the meter is to be mounted in the vertical position, please advise the factory. A straight run of full pipe the length of five diameters ahead and one diameter behind the meter is the minimum normally recommended.

The McCrometer Propeller flowmeter comes with a standard instantaneous flowrate indicator and straight-reading totalizer. An optional electronic register is also available. *Typical face plates.*

APPLICATIONS

The McCrometer propeller meter is the most widely used flowmeter for municipal and wastewater treatment applications as well as agricultural and turf irrigation measurement. Typical applications include:

- Water and wastewater management
- Center pivot systems
- Sprinkler irrigation systems
- Drip irrigation systems
- Golf course and park water management
- Gravity turnouts from underground pipelines
- Commercial nurseries

SHOWN: MODEL MW500

McCROMETER
3255 West Stetson Avenue
Hemet CA 92545-7799 USA
909-652-6811 / FAX 909-652-3078
e-mail: info@mccrometer.com
Web Site: http://www.mccrometer.com

Lit#24517-20 Rev 1.4/8-02

MAIN LINE FLOWMETER MODEL MW500 / MZ500

SPECIFICATIONS

PERFORMANCE

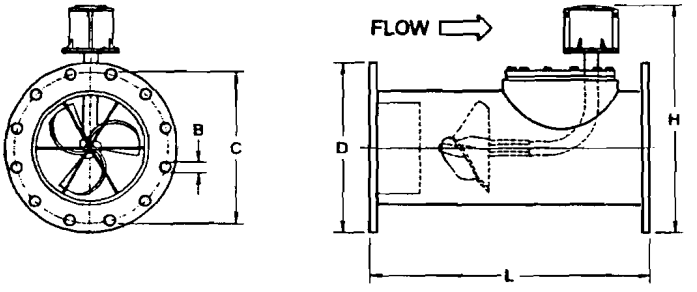
ACCURACY: ±2% of reading guaranteed throughout range.
RANGE: See dimensions chart below
HEAD LOSS: See dimensions chart below
MAXIMUM TEMPERATURE: (Standard Construction) 160°F constant
PRESSURE RATING: Model MW500: 150 psi
Model MZ500: 300 psi

MATERIALS

BEARING ASSEMBLY: Impeller shaft is 316 stainless steel. Ball bearings are 440C stainless steel.
MAGNETS: (Permanent type) Cast or sintered Alnico
BEARING HOUSING: Brass; Stainless Steel optional
REGISTER: An instantaneous flowrate indicator and six-digit straight-reading totalizer are standard. The register is hermetically sealed within a die cast aluminum case. This protective housing includes a domed acrylic lens and hinged cover with locking hasp.
IMPELLER: Impellers are manufactured of high-impact plastic, retaining their shape and accuracy over the life of the meter. High temperature impeller is optional.

OPTIONS

- International flange standards available
- Other than standard laying lengths available
- Register extensions available
- Forward/reverse flow measurement
- All stainless steel construction
- High temperature construction
- "Over Run" bearing assembly for higher-than-normal flowrates
- Electronic propeller meter available in all sizes of this model
- A complete line of flow recording/control instrumentation
- Certified calibration test results



McCROMETER reserves the right to change design or specifications without notice.

MW500/MZ500	DIMENSIONS														
Meter and Nominal Pipe Size	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24	30	36
Maximum Flow U.S. GPM	250	250	250	600	1200	1500	1800	2500	3000	4000	5000	6000	8500	12,500	17,000
Minimum Flow. U.S. GPM	40	40	40	50	90	100	125	150	250	275	400	475	700	1200	1500
Approx. Head Loss in Inches at Max. Flow	29.50	29.50	29.50	23.00	17.00	6.75	3.75	2.75	2.00	1.75	1.50	1.25	1.00	1.00	1.00
MW500															
Approx. Shipping Weight-lbs.	36	36	43	54	115	135	197	325	465	530	744	890	1,293	1450	1650
B (inches)	3/4	3/4	3/4	3/4	7/8	7/8	1	1	1 1/8	1 1/8	1 1/4	1 1/4	1 3/8	1 3/8	1 5/8
C (inches)	4 3/4	5 1/2	6	7 1/2	9 1/2	11 3/4	14 1/4	17	18 3/4	21 1/4	22 3/4	25	29 1/2	36	42 3/4
D (inches)	6	7	7 1/2	9	11	13 1/2	16	19	21	23 1/2	25	27 1/2	32	38 3/4	46
H (inches)	11 3/4	12 1/4	12 1/2	15 1/4	16 1/4	18 1/2	21 3/4	24 1/4	25 1/4	28 1/2	29 1/4	32 1/2	36 3/4	42 3/4	49 1/4
L (inches)	14	16	16	20	22	24	26	28	42	48	54	60	60	60	60
No. of Bolts per Flange	4	4	4	8	8	8	12	12	12	16	16	20	20	28	32
MZ500															
Approx. Shipping Weight-lbs.	50	55	62	90	145	220	340	430	650	820	1,315	1,508	2,165		
B (inches)	3/4	7/8	7/8	7/8	7/8	1	1 1/8	1 1/4	1 1/4	1 3/8	1 3/8	1 3/8	1 5/8		
C (inches)	5	5 7/8	6 5/8	7 7/8	10 5/8	13	15 1/4	17 3/4	20 1/4	22 1/2	24 3/4	27	32		
D (inches)	6 1/2	7 1/2	8 1/4	10	12 1/2	15	17 1/2	20 1/2	23	25 1/2	28	30 1/2	36		
H (inches)	12	12 1/2	12 7/8	15 3/4	17	19 1/4	22 1/2	25	26 1/4	29 1/2	32 3/4	34	38 3/4		
L (inches)	20	20	20	24	26	28	30	32	42	48	54	60	60		
No. of Bolts per Flange	8	8	8	8	12	12	16	16	20	20	24	24	24		

Note: *Flanges meet ASTM-A-181 specs. Larger flowmeters on special order.*

REPRESENTED BY:

McCROMETER
3255 West Stetson Avenue
Hemet CA 92545-7799 USA
909-652-6811 / FAX 909-652-3078
e-mail: info@mccrometer.com
Web Site: http://www.mccrometer.com

Lit#24517-20 Rev 1.4/8-02

Flowmeter Accuracy Rests On Proper Installation

Flow meters are becoming mandatory for agricultural irrigation systems in an increasing number of counties and states as stricter water management programs are implemented.

Adding flowmeters to systems designed originally without them is not difficult but requires consideration of a few important installation guidelines to assure the accuracy of the device.

Propeller flowmeters are most common in agriculture and are the subject of this article. While there are many technologies available for measuring flow, the propeller meter has cost and space advantages, especially when it is to be installed in an existing irrigation system.

Because the measuring element of this type of a flowmeter is a propeller positioned in the center of the flowstream, the pipe must be completely full and the flow of the water must not swirl. These basic conditions must be met to assure the accuracy of the flowmeter.

Upstream Disturbances

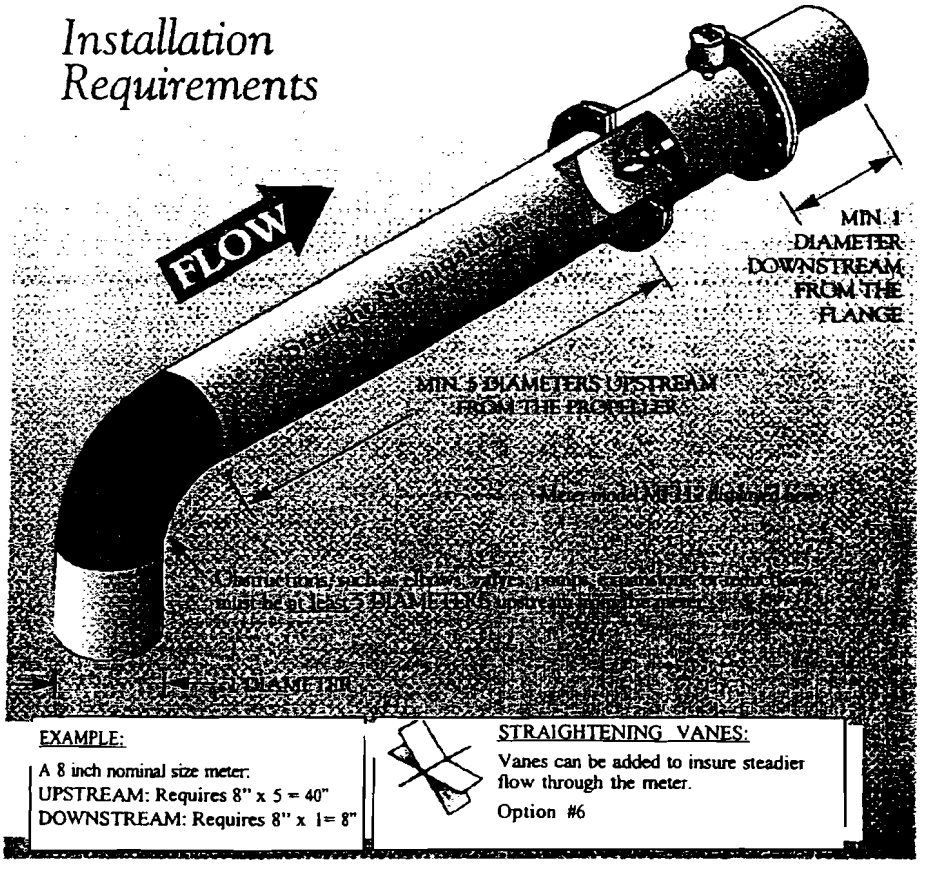
Flowmeters sense water velocity so they are vulnerable to certain upstream disturbances. Upstream obstructions, such as elbows, valves, pumps, and different sized pipe, can disturb the even flow of water through the meter. To solve these disturbances, the flowmeter should be installed downstream of obstructions on straight pipe at least five pipe diameters in length. For example, a flowmeter installed on eight-inch diameter pipe should be at least 40 inches (5 x 8") downstream of any obstruction. In addition, no obstruction should be located within one pipe diameter downstream of the flowmeter. The downstream pipe should be straight for this distance as well.

Certain conditions can cause excessive swirling of the water flow. A centrifugal sand separator or two elbows in different planes are examples. Well-developed swirls created by either of these conditions can travel up to 100 pipe diameters downstream if unobstructed.

Since most installations have less than 100 diameters to work with, straightening vanes can be placed just ahead of the meter. The vanes will break up most swirls and ensure accurate measurement. Some flowmeters include vanes as a feature.

Gravity also conditions flow. Mounting the meter vertically to take advantage of gravity flow conditioning offers some slight advantages. It is important to specify the orientation of the meter when ordering.

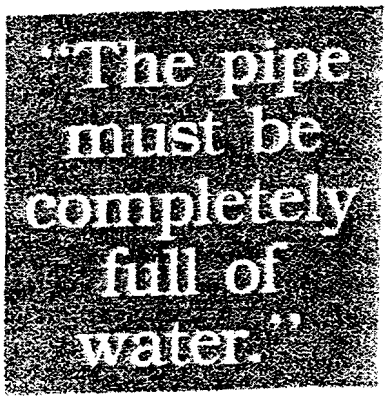
Installation Requirements



Calculate Flow Range

Naturally, a flowmeter is most accurate when used within its design specifications. One of the most important is the range of flow rates. The irrigation manager must calculate the flow rates he needs for his irrigation system in order to select the right flowmeter. The range is typically very large and is expressed as the turndown of the meter. The turndown is the ratio of the maximum flow rate to the minimum flow rate and is often 15: 1. That means the meter would remain accurate up to 15 times it's minimum flow rate. For example, a meter with a minimum flow rate of 100 gpm and a turndown of 15:1 would remain accurate up to a flow of 1,500 gpm. Meters for smaller pipes tend to have lower turndowns and a narrower range of flow rates than larger pipes.

As long as the pipe is full, flowmeters will work within a wide range of pressure. Maximum pressure is the only limitation. Standard meters have a maximum pressure tolerance of 150 psi. This should cover most agricultural applications. If not, meters are available with higher pressure ratings.



The pressure loss caused by the meter (headloss) is minimal when the pipe and meter are sized properly for the flow. The greatest headloss occurs with smaller pipe at high water velocity. By sizing pipe and flowmeter to fit the needed volume of water at a reasonable velocity, headloss is less than one psi.

Propeller flowmeters have an average accuracy of plus or minus two percent when operating within their designed flow range. This further supports the need for selecting the right flowmeter for the particular irrigation system.

Reading Flowmeters

Finally, flowmeters are available that provide totals in specific units, i.e. gallons, acre feet, acre inches, cubic feet etc. Be sure you select a flowmeter that reports and totals in the unit of measurement most appropriate in your area.

Some guidelines are helpful for reading totalizers on flowmeters. All totalizers on propeller meters have a "multiplier." For example, an eight-inch flowmeter that totalizes in gallons will have a multiplier of (X) times 100. That means that the last digit on the right of the six digit totalizer is not gallons, but hundreds of gallons. Usually two zeros are printed on the dial face to the right of the last digit to signify the multiplier.

Four-, six-, and eight-inch meters in gallons have multipliers of 100. Ten-, 12-, and 14- inch meters have multipliers of 1,000.

The same eight-inch flowmeter totalizing in acre feet will have a multiplier of .001. Now zeroes are not added to the reading but a decimal point is included after the first three digits. Usually the digits that signify fractions of acre feet are in a different color and/or X. .001 is printed below the totalizer. As the meter size goes up, the decimal point moves to the right. The person reading the meter must be careful to add the correct amount of zeroes or place the decimal point in the right place. The meter reading can be off by a factor of 10, 100, or 1000!

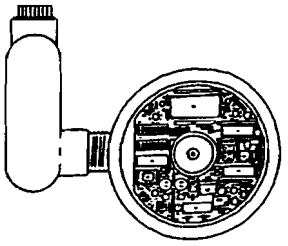
Flowmeters are an important tool in irrigation management and water conservation. Learn how to install them properly and read them accurately. •

Editor's Note: This article was prepared with the assistance of Glenn Voss of McCrometer in Hemet, California and appeared in "Irrigation Journal" April, 1992.

E 7000 - W/C TRANSMITTER

Specification Sheet

Model:	Description:	Document #:	Rev:	Date
E7000	Two-Wire 4-20 mA Transmitter	24527-13	1.2	06/02



Features:

- Industry standard 2-wire 4-20 mA output
- Output is linear with flowrate
- Compatible with all McCrometer propeller meters with a mechanical register
- Installation can be accomplished without meter removal from pipe
- For meter sizes up to 24"
- Signal can travel up to 5000 feet
- Additional pulse output and anti-reverse options

E 7 0 0 0 - 0 x x

Anti-Reverse
0 - No
1 - Yes

Pulse Output
0 - None
1 - Dry Contact
2 - Open Collector

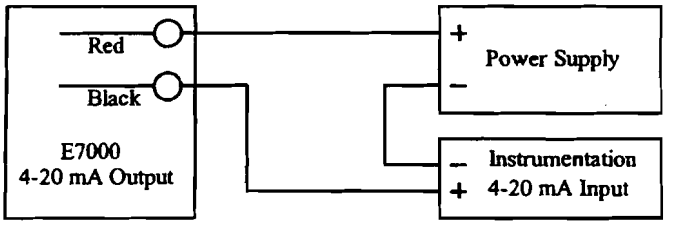
E7000 Model:	4-20 mA Output	Dry Contact	Open Collector	Anti-Reverse
E7000-000	•			
E7000-001	•	•		
E7000-002	•		•	
E7000-010	•			•
E7000-011	•	•		•
E7000-012	•		•	•

Electrical Characteristics:

4-20 mA Output:

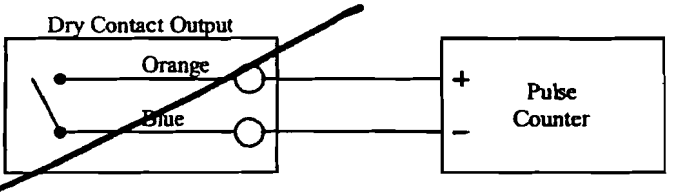
Operating Temperature:	+25 to +130 degrees F
Supply Voltage:	16 - 40 VDC
Temperature Coefficient:	±1.0%
Linearity:	0.1%
Accuracy:	0.5% over the entire range
Maximum Resistive Load:	Supply Voltage Dependent*
Reverse Voltage Protection:	-300V Maximum

Typical Wiring Diagrams:



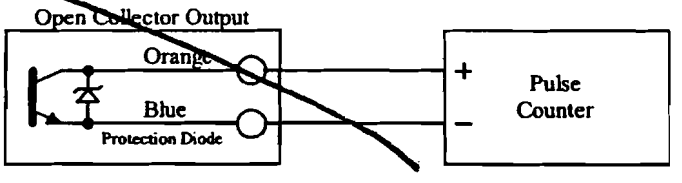
Dry Contact Output:**

Type:	Relay Contact, Norm. Open
Rated Load (AC):	0.5 A at 125 VAC
Rated Load (DC):	1 A at 30 VDC
Max. Operating Current:	1 A
Max. Switching Power:	30 W, 62.5 VA
Contact Closure Duration:	20 milliseconds
Max. Clicks per Minute:	10



Open Collector Output:**

Type:	NPN Darlington, Isolated
Isolation Voltage:	5000 VAC
Collector to Emitter Voltage:	40 VDC Maximum
Collector Current:	200 mA Maximum
Pulse Output Duration:	20 milliseconds
Max. Pulses per Minute:	350



* - Use formula (Supply Voltage - 16) ÷ 0.02 = Maximum Load(Ω)
** - Totalizer output operates only when power is applied to the 4-20 mA loop.

McCROMETER
3255 W. Stetson Ave., Hemet, CA 92545-7799 USA – Phone (909) 652-6811 / Fax (909) 652-3078
Web Site: http:// www.mccrometer.com e-mail: info@mccrometer.com

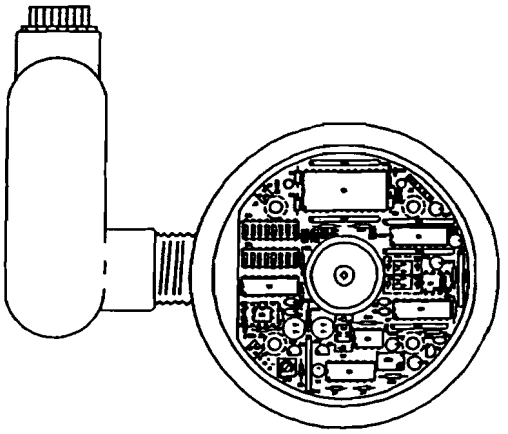
INSTALLATION, OPERATION

AND MAINTENANCE MANUAL

FOR

E7000 AND E7500

4 TO 20 mA ANALOG TRANSMITTERS



McCROMETER

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e-mail: info@mccrometer.com
Website: http://www.mccrometer.com

Table of Contents

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I. GENERAL INFORMATION

A. Unpacking and Inspection

Your **E7000** ANALOG TRANSMITTER is engineered to be a highly reliable, accurate system. It has been systematically assembled, inspected, tested and calibrated; then carefully packed or installed on your new McCrometer flowmeter before shipment. If not installed, unpack the transmitter **carefully** and inspect each assembly thoroughly for obvious shipping damage. Notify the freight carrier immediately upon discovery of any damage. The inspection should include the following after carefully removing it from the carton (Figure 1).

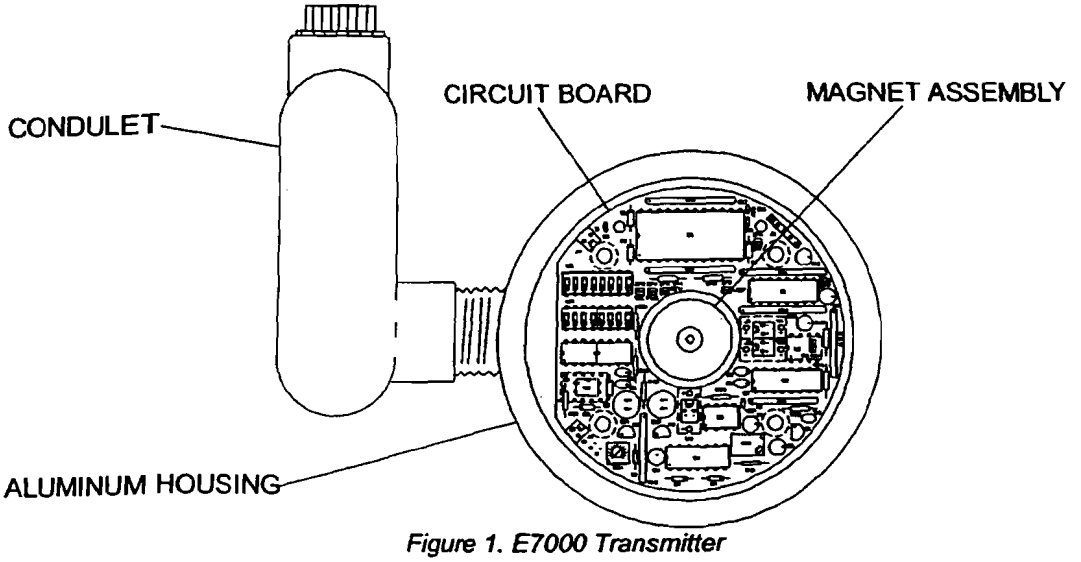

Figure 1. E7000 Transmitter

1. Look for obvious physical damage such as cracks in the housing, loose circuit board, screws, magnet assembly, or condulet.

2. Rotate the magnet by hand and check for smooth rotation of the magnet assembly. Binding or rough operation may indicate that the bearing has been damaged.

3. Check the alignment of the condulet to the body of the housing, they should be parallel. A slight mis-alignment is acceptable but it should be tight. A loose condulet could allow moisture to enter the transmitter or terminal area of the condulet and cause failure. The condulet is attached by a 1/2" close nipple with thread lock on both ends. If the condulet was moved in shipment, the seal of the thread may have been broken.

4. Finally, make sure that all parts are included in the shipment listed below and shown in figure 2.

1. E7000 Analog Transmitter Assembly
2. EH222-10 Installation Kit that contains:

EH221-00	Cable Extension	1 each
10142-20	Screw 10-32 x 3" Long w/ Seal Hole	1 each
10142-30	Screw 10-32 x 2-3/4" Long	5 each
10180-00	O-Ring 3-5/8" OD	1 each
10262-00	Gasket Flat	1 each

3. Operation & Maintenance Manual

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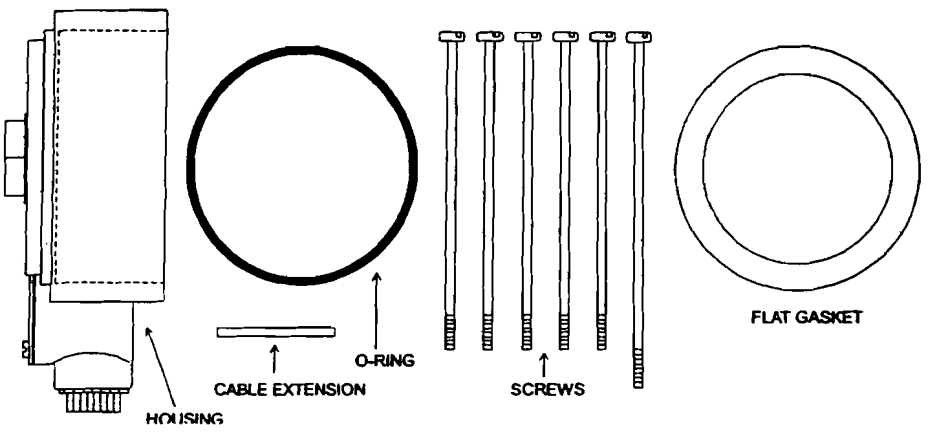

Figure 2. E7000 Retrofit Parts Kit

B. Precautions

Avoid rough handling of the transmitter. The electronic circuits are of solid state technology but damage can result from shock in a fall. During unpacking and installation avoid dusty areas as much as possible. Fine dust or sand can cause erratic operation or failure of the circuitry. Once installed properly, the transmitter assembly is nearly impervious to environmental effects.

When connecting the cables and connectors, be sure that the screws are securely fastened and that the connectors are firmly pressed into place. Normally, you will not have to be concerned with the internal connections unless you are performing maintenance on the assembly after years of perfect operation prior to some inadvertent failure.

Double check the installation, wiring, and power supply used to excite the transmitter to assure that specifications are adhered to properly and precisely to avoid failure and violation of warranty.

C. Description

1. General

The E7000 transmitter is a single assembly mounted on the flowmeter beneath the register assembly. It is contained in an aluminum housing 4.25" in diameter and approximately 2" high. It comes equipped with a standard 1/2" electrical LL19 condulet attached by a brass 1/2" close nipple.

The E7000 uses the mechanical rotation of the flexible drive shaft to turn a magnet assembly generating an electric pulse. The pulse is generated by a rotating magnet assembly that has four or eight magnets placed evenly around the assembly.

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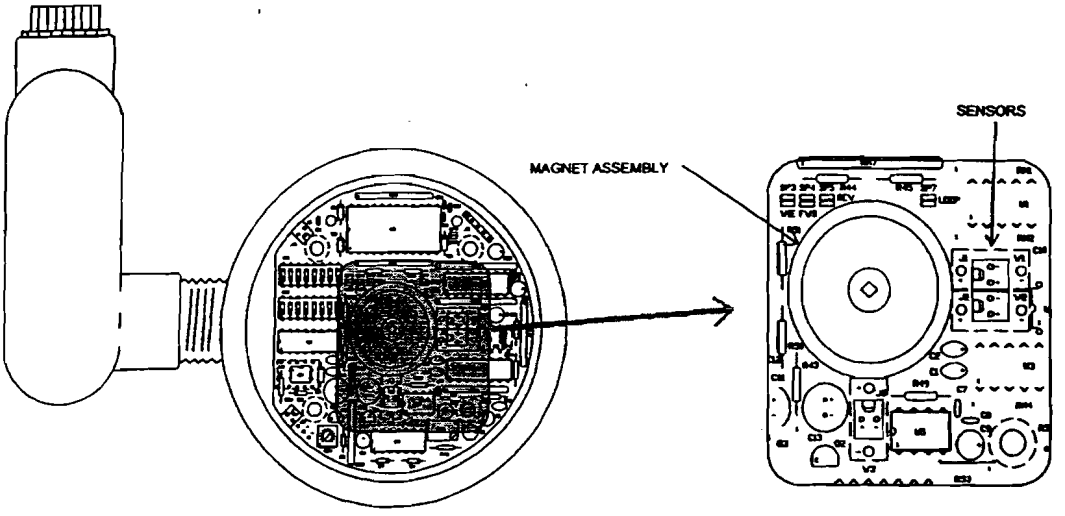

Figure 3. Location of Magnets and Sensors

The magnets pass by the sensor (Figure 3) or sensors depending on whether you have the standard (one sensor) or the anti-reverse (two sensors) transmitter, and in doing so the magnet generates a pulse output that either goes to a digital to analog converter circuitry (standard), or to the quadrature IC (for anti-reverse) and then to the digital to analog converter circuitry.

2. Totalizer Output Circuit

With the E7000 there are **two** totalizer output options. These options must be ordered when the transmitter is manufactured.

1. The DRY CONTACT output.
   This is an internal relay rated at .5 Amps. resistive, 125 VAC, 1 Amp 30 VDC.

2. The optically isolated NPN transistor output.
   The end user supplies the power (up to 40 VDC) and ground to the open collector output.

The pulse output from the Totalizer varies with different pipe sizes. When using the RELAY option the transmitter is limited to under 10 pulses per minute, when using the OPEN COLLECTOR output you can achieve a much greater pulse rate, up to 700 pulses per minute.

3. Switch Selected Scale Output

The E7000 Totalizer output can be reprogrammed in the field. What this means is that the amount of fluid that passes through the meter before one totalizer pulse can be changed by simply changing the switch settings on the board shown in Figure 4. Contact McCrometer if the totalizer scaled pulses will be set to a different value.

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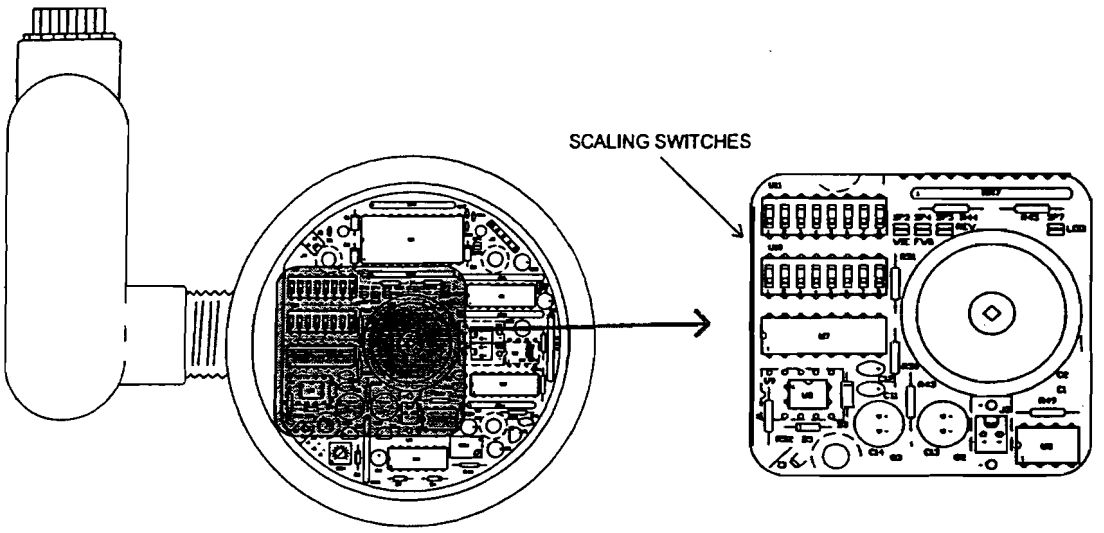

Figure 4. Location of Scaling Switches

II SPECIFICATIONS

A. Overall Systems Specifications

Accuracy: 0.5% over entire range
Linearity: 0.1%
Operation Temperature: 25 to 130 ° F
Supply Voltage: 16 to 40 VDC, Nominal 24 VDC, Minimum 25mA
Maximum Resistive Load = 1200 Ohms
(Power Supply Voltage - 16 VDC)/20 mA
Example: (40 VDC - 16 VDC)/20 mA = 1200 Ohms
Temperature Coefficient: +/- 1% Over Entire Temperature Range

Option 1, Dry Contact Relay
Maximum Contact Closures per Minute:10
Contact Closure Duration: 20 milliseconds
Rated Load: 0.5 A at 125 VAC, 1 A at 30 VDC
Maximum Operating Voltage: 125 VAC, 110 VDC
Maximum Switched Power: 30W, 62.5 VA

Option 2, Optically Isolated Transistor
Output Type: NPN Darlington, Optically Isolated
Isolation Voltage: 5000 Vac
Totalizing Pulse Duration: 10 Milliseconds
Collector to Emitter Voltage: 40 VDC Maximum
Collector Current: 200 mA Maximum
Maximum Pulses per Minute: 700

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III. INSTALLATION

A. Disassembly

It is necessary to remove the canopy and the register. The analog transmitter mounts between the register and the register mounting plate already installed on top of the pipe protruding from the top of the meter.

* Note: If your meter has the old style plastic canopy and gasket you must replace both the canopy and the base plate with new aluminum ones (Order Canopy Kit RO143).

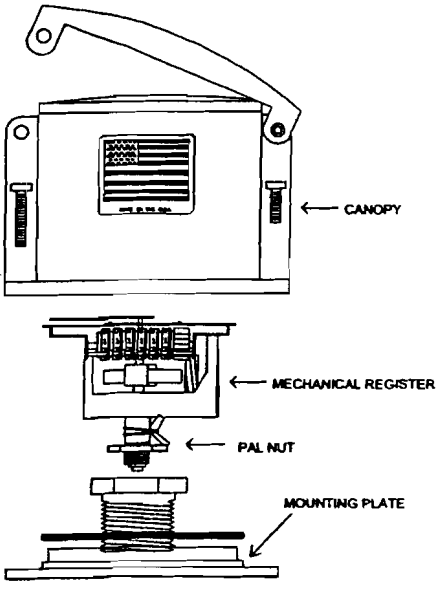

Figure 5. Canopy, Register Removal

THE FLOWMETER CAN BE IN FULL OPERATION DURING THIS PROCEDURE

1. Canopy Removal

Remove the six (6) screws holding the Canopy to the mounting plate and discard, Figure 5. One of the screws has a seal attached, remove it prior to removing that screw. Lift off the canopy carefully to prevent damage to the register.

2. Register Removal

Loosen the pal nut located on the threaded shaft of the register. Carefully unscrew the register counter clockwise and lift it from the bushing.

CAUTION:

Protect the Register from dust while it is outside of the Canopy.

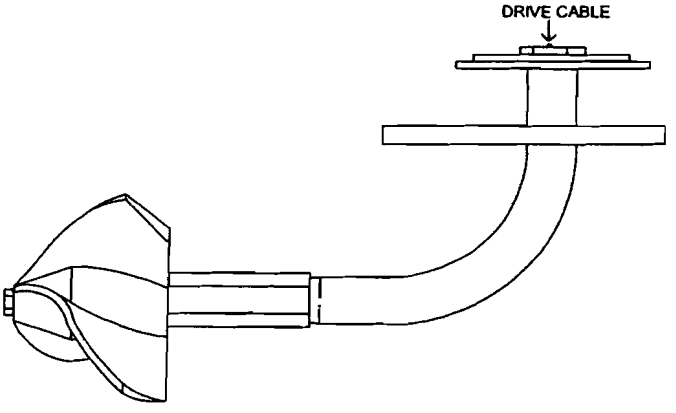

Figure 6. Location of The Drive Cable

You can now see the open end of the ELL with the drive cable, Figure 6. If the flowmeter is in operation the cable will be rotating. If the flowmeter is not installed turn the propeller by hand to check that the bearing and cable rotate freely with no excess play.

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B. Re-assembly

1. Analog Transmitter Installation

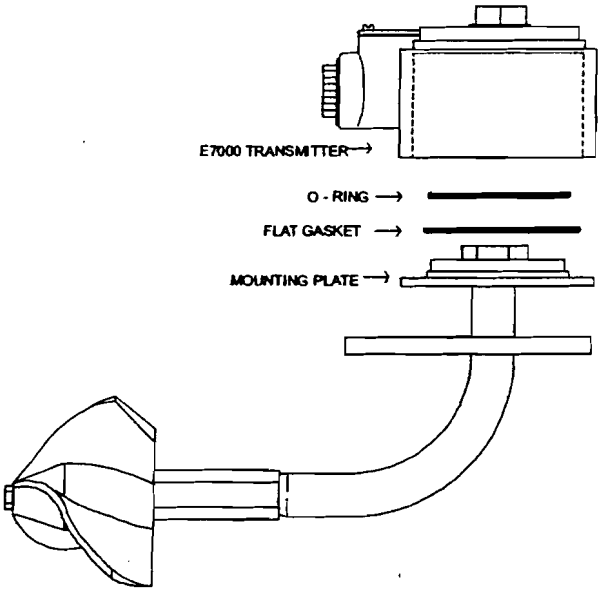

Figure 7. Installation Of The Transmitter

Cleanliness is vital for the operation of the transmitter and the register. Check the threaded area and the mounting plate, Figure 7, they should be free of grease, dust, or any other foreign materials. Place the o-ring over the lip on the mounting plate. Use a small amount of oil to lubricate the o-ring. Rotate the transmitter to align and locate the condulet to the desired position. Lower the transmitter to insert the cable into the center shaft of the transmitter. Continue to lower the unit until it touches the o-ring on the Plate. Work the transmitter carefully down over the o-ring, seat it firmly into place. Avoid unnecessary movement to prevent damage to the o-ring.

Find the short cable extension in the installation kit and insert it into the center of the bearing on top of the transmitter. Place the register with the Pal nut still in place on this cable extension and rotate it clockwise three (3) or four (4) turns. Stop when the register is positioned as it was prior to its' removal and snug up the pal nut. If the flowmeter is operating turn register in until there is a slight binding of the cable in the Register and back out approximately two (2) turns and then tighten the Pal nut; this should give you smooth operation and be correctly positioned.

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2. Canopy Installation

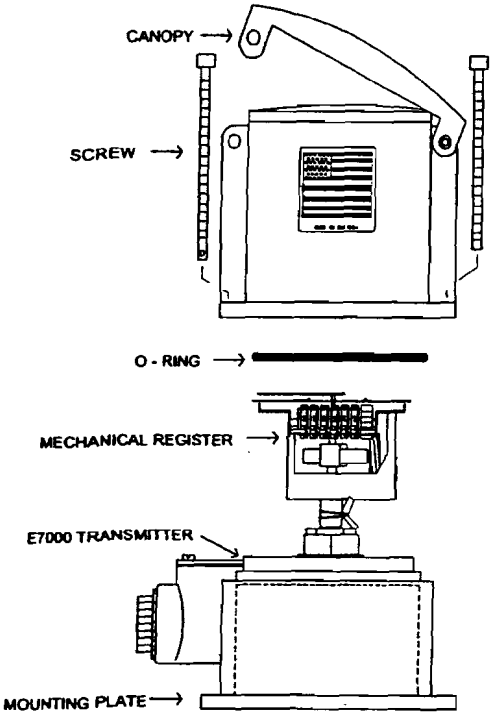

Figure 8. Canopy Installation

The canopy can now be installed. Check the transmitter housing and the canopy for cleanliness and clean if needed, Figure 8. Orient the canopy and lower it carefully over the lubricated o-ring and seat it firmly onto the Transmitter Housing. Again, be careful so that the o-ring on the transmitter housing is not damaged.

Locate the long screws; insert the screws through the canopy, transmitter housing, and the Plate. Tighten them using the crisscross method. Use caution when tightening the screws to prevent thread damage. The o-ring will seal the transmitter and mechanical register from environmental contaminants.

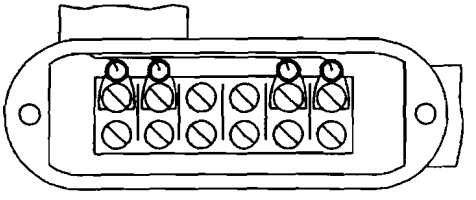

Figure 9.Condulet Wiring

C. Electrical Specifications

1. The Electrical Requirements are:

   a. 16-40 VDC
   b. 20 mAdc minimum per 4-20 mA loop

2. Remove the cover from the condulet and observe the wires connected to the terminal strip, Figure 9.

The color codes is as follows:

   a. Black = RETURN positive 4-20 mA out
   b. Red = Positive (+) from external power
   c. Orange = Positive collector (collector output), or relay contact (normally open)
   d. Blue = Negative emitter (collector output), or relay contact (common)

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3. Connect the external power and loads to the terminals in the condulet as follows:

a. Connect the positive (+) lead from the external power supply to the terminal with the RED wire connected inside the condulet, and the negative (-) side of the power supply to the negative side of the LOAD, then connect a wire from the Positive side of the LOAD to the BLACK wire inside the condulet as shown in Figure 10.

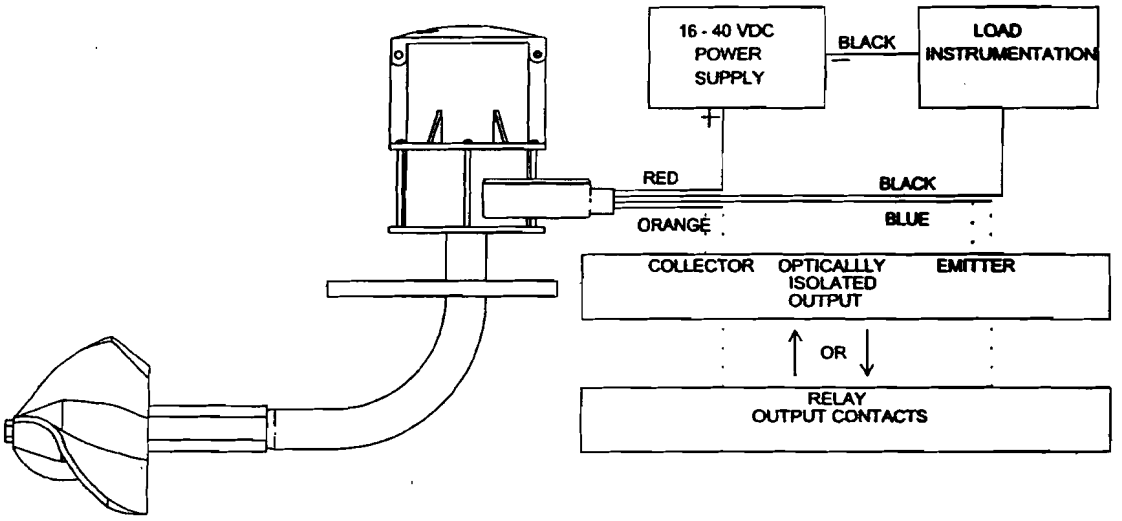

Figure 10.Electrical Connections

b. For quantified pulse output (i.e. 1P=100 gal) use the ORANGE and BLUE wires, depending on what option that you ordered. The ORANGE wire will be either the Collector output or the Normally Open output. And the BLUE wire will be either the Emitter or the Common output.

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IV. OPERATION

A. Function Description

Refer to the Block Diagram in Figure 11 for the following description of the overall system operation. The scope of this manual does not allow a circuit analysis but merely a general outline of the system for a further understanding of the equipment that you have purchased.

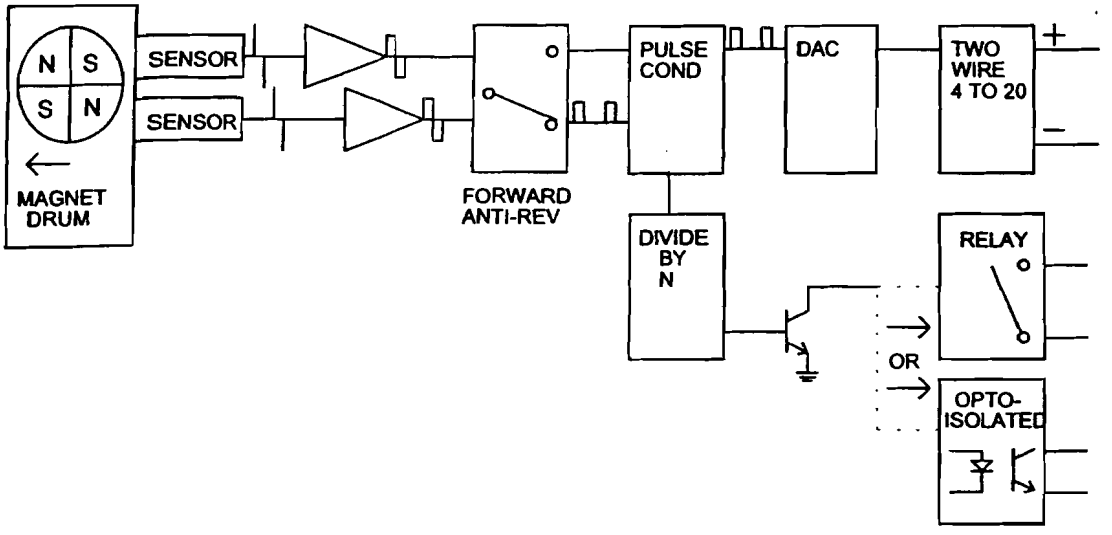

Figure 11 Block Diagram of the E7000

The E7000 was designed as a fully functional integrated system depending only on an external power source. It is composed of one circuit board with several different functions. The magnet drum rotates on the shaft, which passes by the sensor that produces a pulse which is then transformed into a square wave and goes to the directional sensor. Depending on what model of E7000 you have, the directional sensor will either send the pulse to the correct digital to analog converter or only allow the forward pulses to advance to the digital to analog converter.

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V. TROUBLESHOOTING

A. Normal Conditions

1. One of three (3) conditions could exist:
    1. Flowmeter with transmitter in line with flow.
    2. Flowmeter with transmitter in line without flow.
    3. Transmitter not installed on flowmeter

In any of the conditions above the outputs with the magnet rotating at a known speed (RPM) should be at a predicted level. The 4-20 mAdc output should be a steady level of current and the output should be as described on the calibration sheet which can be obtained on request from McCrometer.

B. Troubles and Remedies

Table 1 has a list of conditions, things to check, possible causes of the troubles, and what to do to correct the problems.

Table 1. Troubleshooting

CONDITION	CHECK	POSSIBLE CAUSE	REMEDY
No output	Power supply.	Wrong power supply. or faulty power supply	Replace power supply
	Check AC power at Source	Power supply not plugged in or no power to power supply	Plug in power supply to AC at Source
16 - 40 VDC to E7000 but no outputs	Wiring	Loose or disconnected Wire(s)	Fix Wire(s)
Incorrect Output	Load	Load Exceeds limit	Decrease Load Resistance (RL)
	Magnet	Magnet Assembly Set Screw Loose	Tighten Set Screw

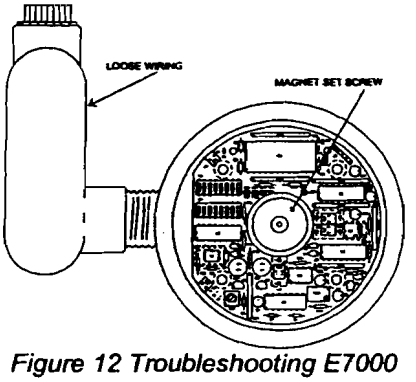

Figure 12 Troubleshooting E7000

VI. CALIBRATION

It is necessary that you be able to rotate the magnet in the transmitter at a controlled rate and read the current output. The following list of equipment is meant as a reference only, but is the equipment we use in our electronics department at McCrometer. You may use any desired test equipment as long as it has the accuracy and you know the RPM-s applied. Your calibration is only as good as the equipment used and the skill and knowledge of the Technician. If you lack the necessary equipment to calibrate the transmitter, it can be sent to McCrometer for calibration.

1. Fluke 8060A Digital Multimeter
   Used to measure milliamps

2. A known controlled means of rotating the magnet.
   Minarik Electric (818) 507-6500 has quality equipment and a variety from which to choose. (MM21111A - DC Speed Control, 504-00-042 - Rae 1/50HP DC Motor)

A. Preparation

1. Refer to Set Up drawing, Figure 13 and connect the equipment accordingly.
2. Calculate the required motor speed and the corresponding current reading.
3. Ensure that the motor turns the mechanical linkage clockwise when looking at the top of the transmitter.

B. Calculations

Attached to each E7000 is a label showing a full scale propeller RPM. Set the motor at that speed to adjust the current output to 20 mAdc.

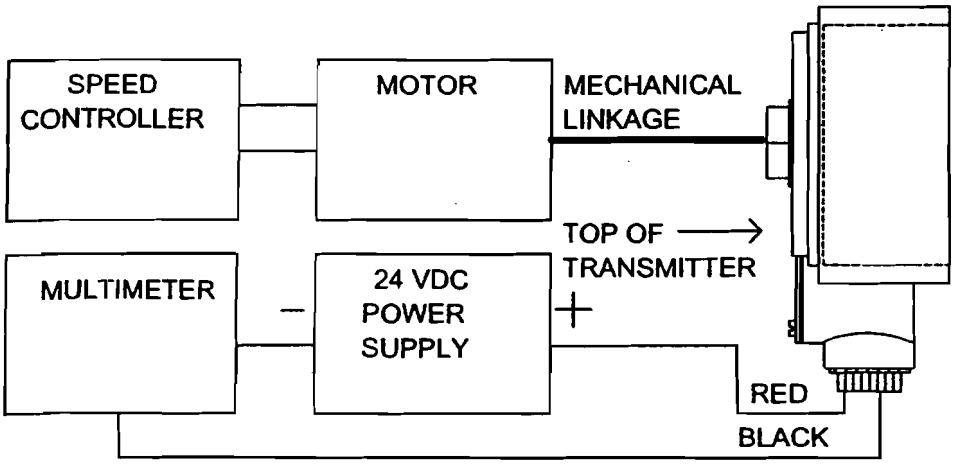

Figure 13 Block Diagram of Calibration Set Up

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C. Calibration

1. With the motor at zero RPM, adjust the potentiometer farthest to the left end of the E7000 circuit board to read 4.0 mAdc on the multimeter, see Figure 14.

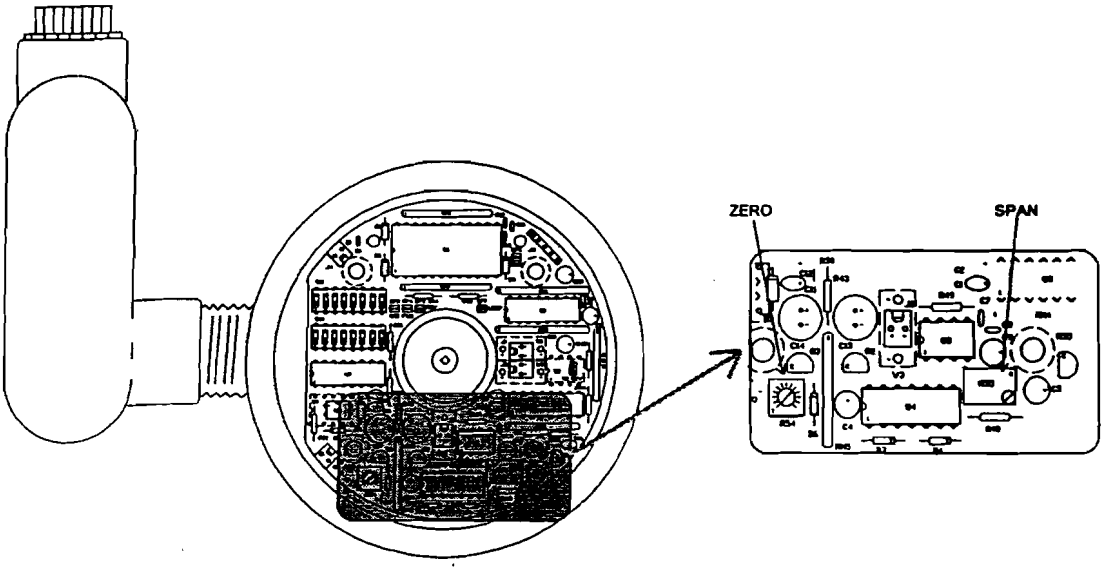

Figure 14 Calibration Of Zero and Span

2. Apply power to the speed control system that you are using and set for Full Scale RPM.

3. Adjust the pot on the right hand side for a reading of 20 mAdc on the multimeter.

4. Stop the rotation of the magnet and check the 4 mAdc reading. It may take a few seconds to stabilize; check and if necessary re-adjust the left potentiometer to obtain the 4 mAdc reading on the multimeter.

5. You may have to repeat the zero and span adjustments two or three times to be sure that the adjustments are stable.

6. Once you are satisfied that the transmitter is calibrated properly and within specifications the equipment can be disconnected from power and stored in a clean and temperature stable environment.

7. A suggestion at this point in your calibration is to put a drop of fingernail polish, or enamel on the adjustment end of the potentiometer to prevent them from turning due to vibration from the flow tubes.

Install the transmitter referring to the INSTALLATION Section.

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VII. WARRANTY

This Warranty Shall apply to and be limited to the original purchaser consumer of any McCrometer product. Meters or instruments defective because of faulty material or workmanship will be repaired or replaced, at the option of McCrometer, free of charge, FOB the factory in Hemet, California, within a period of one (1) year from the date of delivery.

Repairs or modifications by others than McCrometer or their authorized representatives shall render this Warranty null and void in the event that factory examination reveals that such repair or modification was detrimental to the meter or instrument. Any deviations from the factory calibration require notification in writing to McCrometer of such recalibrations or this warranty shall be voided.

In case of a claim under this Warranty, the claimant is instructed to contact McCrometer, 3255 West Stetson Ave., Hemet, California 92545, and to provide an identification or description of the meter or instrument, the date of delivery, and the nature of the problem.

The Warranty provided above is the only warranty made by McCrometer with respect to its products or any parts thereof and is made expressly in lieu of any other warranties, by course of dealing, usages of trade or otherwise, expressed or implied, including but not limited to any implied warranties of fitness for any particular purpose or of merchantability under the uniform commercial code. It is agreed this warranty is in lieu of and buyer hereby waives all other warranties, guarantees or liabilities arising by law or otherwise. Seller shall not incur any other obligations or liabilities or be liable to buyer, or any customer of buyer for any anticipated or lost profits, incidental or consequential damages, or any other losses or expenses incurred by reason of the purchase, installation, repair, use or misuse by buyer or third parties of its products (including any parts repaired or replaced); and seller does not authorize any person to assume for seller any other liability in connection with the products or parts thereof. This Warranty cannot be extended, altered or varied except by a written instrument signed by seller and buyer.

This Warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

McCrometer reserves the right to make improvements and repairs on product components which are beyond the warranty period at the manufacturer's option and expense, without obligation to renew the expired warranty on the components or on the entire unit. Due to the rapid advancement of meter design technology, McCrometer reserves the right to make improvements in design and material without prior notice to the trade.

All sales and all agreements in relation to sales shall be deemed made at the manufacturer's place of business in Hemet, California, and any dispute arising from any sale or agreement shall be interpreted under the laws of the State of California.

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OTHER McCROMETER PRODUCTS INCLUDE:

Propeller Liquid Flowmeters

Differential Pressure Flowmeters

Differential Pressure Flowmeters

Variable Area Meters

Magnetic Flowmeters

Electronic Instrumentation for Remote Display and Control

FOR MORE INFORMATION CONTACT:

Represented by:

McCROMETER
3255 W. Stetson Avenue, Hemet, CA 92545-7799
Phone: (909) 652-6811 Fax: (909) 652-3078
e-mail: info@mccrometer.com Web Site: http://www.mccrometer.com
Hours: 8 a.m. - 4:30 p.m. PST, Monday-Friday

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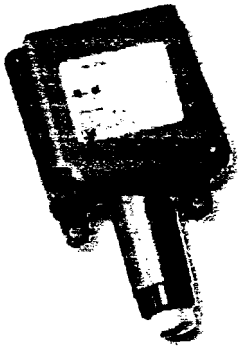
Section 5-B

Treatment Building Effluent Pressure Swtich (PLS-404)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction



100 Series
Pressure Switch

Types H100 H100K
(Differential Pressure)

UNITED ELECTRIC CONTROLS

Installation and Maintenance Instructions

Please read all instructional literature carefully and thoroughly before starting. Refer to the final page for the listing of Recommended Practices, Liabilities and Warranties.

GENERAL

BEFORE INSTALLING, CHECK THE SENSOR MODEL SELECTED FOR COMPATIBILITY TO THE PROCESS MEDIA IN CONTACT WITH THE SENSOR AND WETTED PARTS.

The H100 and H100K differential pressure switches are activated when a bellows, diaphragm or piston sensor responds to a pressure change. This response, at a pre-determined set point, actuates a single snap-acting switch, converting the pressure signal into an electrical signal. Control set point may be varied by turning the internal adjustment hex. (See Adjustment -PART II).

PROOF PRESSURE* LIMITS STATED IN THE LITERATURE AND ON NAMEPLATES MUST NEVER BE EXCEEDED, EVEN BY SURGES IN THE SYSTEM. OCCASIONAL OPERATION OF UNIT UP TO PROOF PRESSURE IS ACCEPTABLE (E.G., START-UP, TESTING). CONTINUOUS OPERATION SHOULD NOT EXCEED THE DESIGNATED OVER RANGE PRESSURE.

*Proof Pressure

The maximum pressure to which a pressure sensor may be occasionally subjected, which causes no permanent damage (e.g., start-up, testing). The unit may require re-gapping.

Part I - Installation

Tools Needed
Adjustable Wrench
Screwdriver
Hammer (for alternate wire knockouts)

MOUNTING

INSTALL UNIT WHERE SHOCK, VIBRATION AND TEMPERATURE FLUCTUATIONS ARE MINIMAL. ORIENT UNIT SO THAT MOISTURE IS PREVENTED FROM ENTERING THE ENCLOSURE. IF UNIT IS BEING INSTALLED WHERE HEAVY CONDENSATION IS EXPECTED, VERTICAL MOUNTING (PRESSURE CONNECTION DOWN) IS REQUIRED. DO NOT MOUNT IN AMBIENT TEMPERATURES EXCEEDING PUBLISHED LIMITS.

Controls may be mounted and operated in any position. They may be surface mounted via the two mounting ears on either side of the enclosure, or directly to a rigid pipe by using the pressure connection. Low pressure and differential pressure units, models 520-535, 540-543, 544-548, are also available with an optional surface mounting bracket. Should the control be installed where condensation is expected, vertical mounting is recommended as a means of keeping water away from switch terminals.
Never use the enclosure for leverage to hand tighten the pressure connection. Always use a wrench to tighten the pressure connection to the pipe.To prevent damaging the pressure sensor, use a back-up wrench to hold the hex nut in place when surface mounting.

On models supplied with an external manual reset button, be sure to leave sufficient finger space over the reset button for the operator to reset the control. See Mounting Diagram.

WIRING

DISCONNECT ALL SUPPLY CIRCUITS BEFORE WIRING.

ELECTRICAL RATINGS STATED IN LITERATURE AND ON NAMEPLATES SHOULD NEVER BE EXCEEDED. OVERLOAD ON A SWITCH CAN CAUSE FAILURE ON THE FIRST CYCLE.

WIRE UNITS ACCORDING TO NATIONAL AND LOCAL ELECTRICAL CODES. MAXIMUM RECOMMENDED WIRE SIZE IS 14 AWG.

Remove the two screws retaining the cover and cover gasket. Two cast-in knockouts for 1/2" conduit are located on the side and back of enclosure. These can easily be knocked out by placing the blade of a screwdriver in the groove and tapping sharply with a hammer. A 1/2" NPT conduit connection is also provided on the left hand side of the enclosure. The three switch terminals are clearly labeled "common", "normally open" and "normally closed". For switches supplied with leadwires, the following color coding applies:

	Manual Reset SPDT	**DPDT (Option 1010) SWT1**	**SWT2**
Common	Violet	Violet	Yellow
Normally Open	Blue	Blue	Orange
Normally Closed	Black	Black	Red

A grounding screw and clamp (cast in symbol) is provided which meets a 35 lb. pull test. Keep the wire as short as possible to prevent interface with the plunger and the adjustable differential switch wheel, if applicable.

Part II - Adjustments

Tools Needed
5/8" Open End Wrench

SOME MODELS HAVE A TWO-PIECE, ADJUSTABLE PLUNGER. THIS FEATURE IS CHARACTERIZED BY A 3/16" HEX HEAD SCREW INSTALLED IN THE 1/4" HEX PLUNGER. THE LENGTH OF THIS ASSEMBLY IS ADJUSTED AT OUR FACTORY AND IS CRITICAL TO THE FUNCTION OF THE CONTROL.

H100 and H100K

Remove pressure switch cover. Loosen Phillips screw adjustment lock. Adjust set point by turning 5/8" hex adjustment screw clockwise (in) to raise set point, or counter clockwise (out) to lower set point. Tension on adjustment screw can be increased by tightening adjustment lock onto it. (See diagram 1). Controls include uncalibrated reference scales for high, low or mid range settings.

Adjustable Differential Models

Model 15623 and control types with option code 1519 incorporate a snap switch with internal adjustment wheel. Turning this wheel raises or lowers the pressure rise set point. The fall set point remains constant. Consult factory for additional information.

Manual Reset Button

Control types with option code 1530 incorporate a snap switch which when actuated, remains actuated until the pressure drops sufficiently to allow the reset button (located on top of the control) to be manually depressed to reset the switch.

Gapping

1) Loosen adjustment lock.
2) Turn 5/8" hex adjustment screw in, to approximately mid range. This puts a load on the sensor and exposes the plunger flats. Using a 1/4" wrench on the plunger and a 3/16" wrench on the plunger hex screw, turn hex screw out from plunger until switch actuates. If switch is already actuated, turn plunger hex screw in, until switch deactuates. Turn hex screw in from this point. (See chart 1 for Flats and approximate Gap.)
3) Check set point according to Part II Adjustments.
4) Connect wires and replace cover securely.

Models	Flats	Approx. Gap
171-174	2-2 1/2	.0085 to .0105"
183-194	1-1 1/2	.004 to .006"
483-494	1-1 1/2	.004 to .006"
358-376	5-6	.020 to .025"
700-706	3 1/2 - 4	.014 to .017"
521-525	2-2 1/2	.0085 to .0105"
531-535	2-2 1/2	.0085 to .0105"
540-548	2-2 1/2	.0085 to .0105"
560-567	1-1 1/2	.004 to .006"
15623	5-6	.020 to .025"

Chart 1

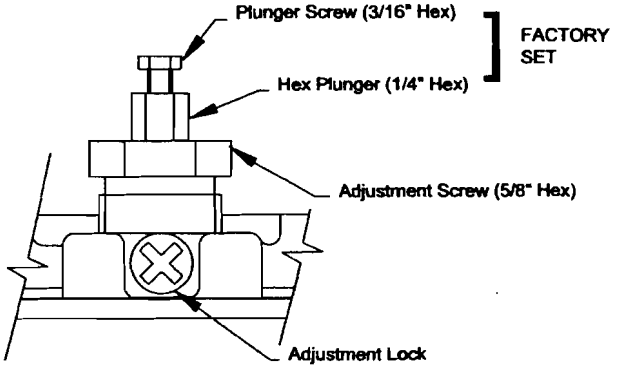
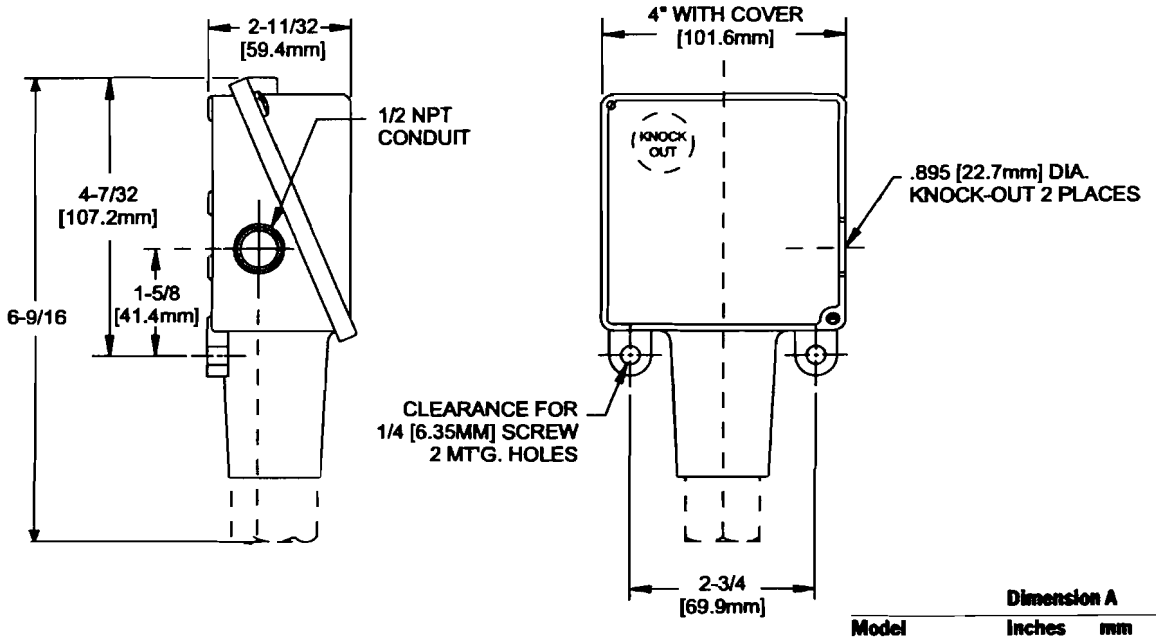
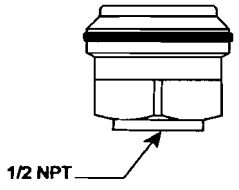


Diagram 1

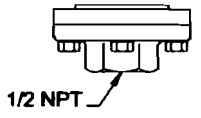
Dimensions



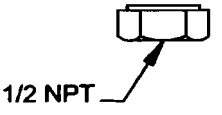
Model	Dimension A Inches	mm	NPT
171-174	7.50	190,5	1/2"
183-186	7.56	192,0	1/2"
188,189	6.62	168,1	1/2"
190-194	6.63	168,4	1/2"
218-274	6.56	166,6	1/4"
358-376	7.03	178,6	1/4"
483-486	7.56	192,0	1/2"
488,489	6.62	168,1	1/2"
490-494	6.63	168,4	1/2"
520-525	8.44	214,4	1/2"
530-535	8.00	203,2	1/2"
540-548	8.34	211,8	1/8"
560-564	6.62	168,1	2" Sanitary fitting
565-567	6.62	168,1	1 1/2" Sanitary fitting
610-616	7.00	177,8	1/4"
680	6.97	177,0	1/4"
701-706	6.57	166,9	1/4"
15623	6.57	166,9	1/4"



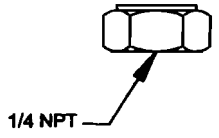
Models 171-174, 471-474



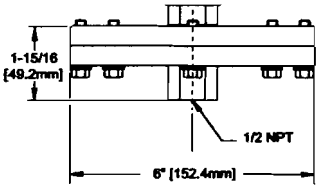
Models 183-186, 483-486



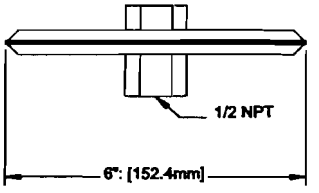
Models 188-194. 488-494



Models 218-376, 610-706, 15623

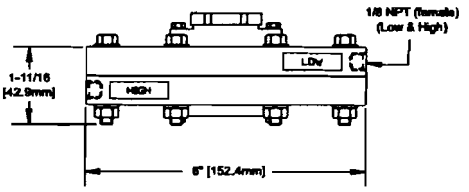


Models 520-525

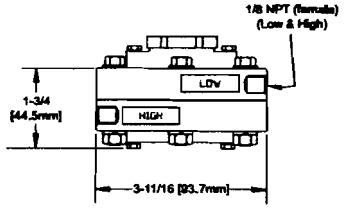


Models 530-535

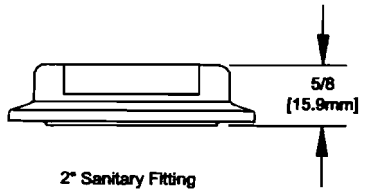
Dimensions



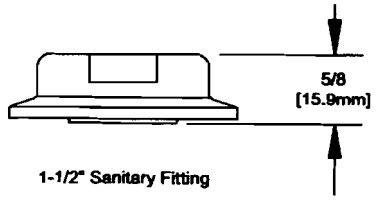
Model 540-543



Models 544-548



Models 560-564



Models 565-567

RECOMMENDED PRACTICES AND WARNINGS

United Electric Controls Company recommends careful consideration of the following factors when specifying and installing UE pressure and temperature units. Before installing a unit, the Installation and Maintenance instructions provided with unit must be read and understood.

- To avoid damaging unit, proof pressure and maximum temperature limits stated in literature and on nameplates must never be exceeded, even by surges in the system. Operation of the unit up to maximum temperature is acceptable on a limited basis (i.e., start-up, testing) but continuous operation must be restricted to the designated adjustable range. Excessive cycling at maximum temperature limits could reduce sensor life.
- A back-up unit is necessary for applications where damage to a primary unit could endanger life, limb or property. A high or low limit switch is necessary for applications where a dangerous runaway condition could result.
- The adjustable range must be selected so that incorrect, inadvertent or malicious setting at any range point cannot result in an unsafe system condition.
- Install unit where shock, vibration and ambient temperature fluctuations will not damage unit or affect operation. Orient unit so that moisture does not enter the enclosure via the electrical connection. When appropriate, this entry point should be sealed to prevent moisture entry.
- Unit must not be altered or modified after shipment. Consult UE if modification is necessary.
- Monitor operation to observe warning signs of possible damage to unit, such as drift in set point or faulty display. Check unit immediately.
- Preventative maintenance and periodic testing is necessary for critical applications where damage could endanger property or personnel.
- For all applications, a factory set unit should be tested before use.
- Electrical ratings stated in literature and on nameplate must not be exceeded. Overload on a switch can cause damage, even on the first cycle. Wire unit according to local and national electrical codes, using wire size recommended in installation sheet.
- Do not mount unit in ambient temp. exceeding published limits.

LIMITED WARRANTY

Seller warrants that the product hereby purchased is, upon delivery, free from defects in material and workmanship and that any such product which is found to be defective in such workmanship or material will be repaired or replaced by Seller (Ex-works, Factory, Watertown, Massachusetts. INCOTERMS); provided, however, that this warranty applies only to equipment found to be so defective within a period of 24 months from the date of manufacture by the Seller. Seller shall not be obligated under this warranty for alleged defects which examination discloses are due to tampering, misuse, neglect, improper storage, and in any case where products are disassembled by anyone other than authorized Seller's representatives. EXCEPT FOR THE LIMITED WARRANTY OF REPAIR AND REPLACEMENT STATED ABOVE, SELLER DISCLAIMS ALL WARRANTIES WHATSOEVER WITH RESPECT TO THE PRODUCT, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

LIMITATION OF SELLER'S LIABILITY

Seller's liability to Buyer for any loss or claim, including liability incurred in connection with (i) breach of any warranty whatsoever, expressed or implied, (ii) a breach of contract, (iii) a negligent act or acts (or negligent failure to act) committed by Seller, or (iv) an act for which strict liability will be inputted to seller, is limited to the "limited warranty" of repair and/or replacement as so stated in our warranty of product. In no event shall the Seller be liable for any special, indirect, consequential or other damages of a like general nature, including, without limitation, loss of profits or production, or loss or expenses of any nature incurred by the buyer or any third party.

UE specifications subject to change without notice.

UNITED ELECTRIC CONTROLS

180 Dexter Ave. P.O. Box 9143, Watertown, MA 02472-9143 USA
617 926-1000 Fax 617 926-2568
www.ueonline.com

Section 5-C

Treatment Building Effluent Pressure Indicator (PI-403)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Bourdon Tube Pressure Gauges

Forged Brass Case / Copper Alloy Wetted Parts

Industrial Series Liquid Filled • Type 213.40

Pressure Gauges

Application
Heavy-duty instrument intended for adverse service conditions where pulsation or vibration exists. Fluid medium which does not clog connection port or corrode copper alloy.

Sizes
2½" and 4" (63 and 100 mm)

Accuracy
2½" ±1.5% of span
4" ±1.0% of span (ASME B40.1 Grade 1A)

Ranges (All ranges not stocked)
Vacuum / Compound to 30"HG / 0 / 200 PSI
Pressure from 10 PSI to 15,000 PSI
or other equivalent units of pressure or vacuum

Working Range

2½"	Steady:	3/4 of full scale value
	Fluctuating:	2/3 of full scale value
	Short time:	full scale value
4"	Steady:	Full scale value
	Fluctuating:	0.9 x full scale value
	Short time:	1.3 x full scale value

Operating Temperature

Ambient:	-4°F to 140°F (-20°C to 60°C) - glycerine
	-40°F to 140°F (-40°C to 60°C) - silicone
Media:	max. 140°F (+60°C) - soldered
	max. 212°F (+100°C) - brazed

Temperature Error
Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.

Standard Features

Connection
Material: copper alloy
Lower mount (LM)
Center back mount (CBM) 2½"
Lower back mount (LBM) 4"
1/4" NPT or 1/2" NPT limited to wrench flat area
(7/16"-20 SAE thread for **Type 213.40S**)

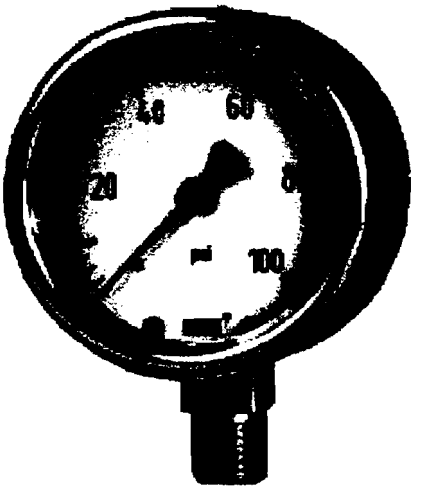
Bourdon Tube
2½" Size - Material: Copper alloy
30"Hg (Vac) to 1000 PSI - C-type (soldered)
1500 PSI to 15,000 PSI - helical type (soldered)

4" Size - Material: Copper alloy < 1000PSI
316 stainless steel > 1500 PSI
30"Hg (Vac) to 1000 PSI - C-type (soldered)
1500 PSI to 15,000 PSI - helical type (brazed)

Movement
Copper alloy

Dial
White aluminum with stop pin and black and red lettering

Pointer
Black aluminum



Case
Gold painted forged brass with integral connection and vent plug with high gloss brass plated ABS cover ring (2½"). Silver painted forged brass with integral connection and blow-out plug with chrome plated brass cover ring (4").

Standard Scales
2½": PSI, PSI/KPA, PSI/BAR
4": PSI

Weather Protection
Weather tight (NEMA 4X / IP 65)

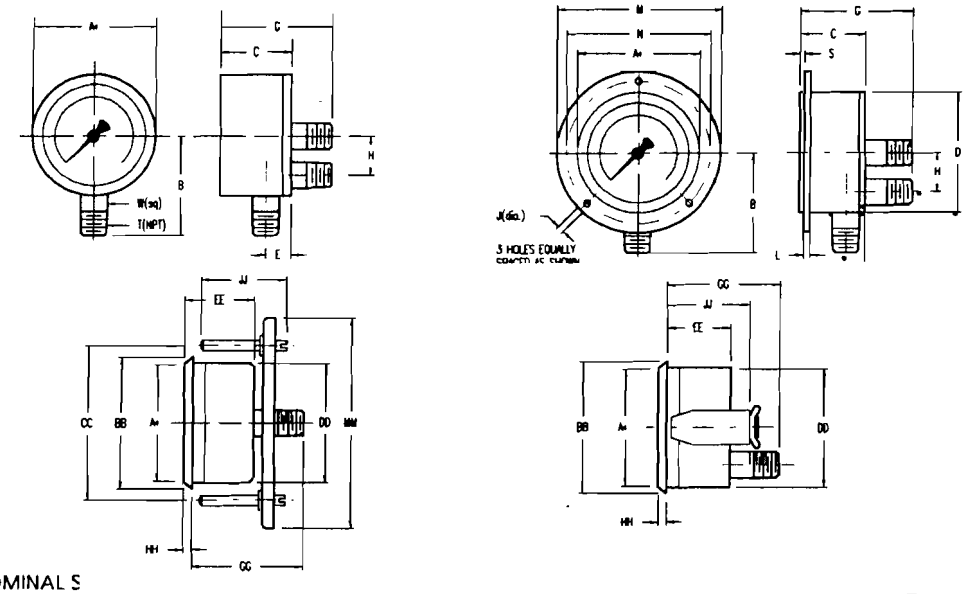
Window Gasket
Buna-N

Window
Acrylic

Liquid Filled
213.40 - Glycerine 99.7%

Order Options (min. order may apply)
Front or rear flange
U-Clamp
Brass threaded or press-fit restrictor
Front flange for 4½" panel cutout for 4" gauge
Plastic adaptor ring for 2½" non-metric panel cutout
Special case colors
Safety glass window
Externally adjustable red drag pointer (max. hand)
Externally adjustable red mark pointer (set pointer)
Glass window
Special connections, limited to wrench flat area
Custom dial layout
DIN standards
Other pressure scales available:
Bar, kPa, MPa, Kg/cm² and dual scales
Silicone or fluorocarbon fill

Dimensions:



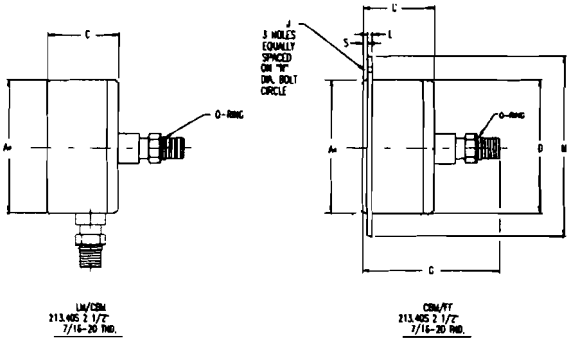
A* NOMINAL S

TYPE/SIZE	WEIGHT	KEY	A*	B (1)	C	D	E	G	H	J	K	L	M
213.40 2.5"	0.66 lbs.	mm	63	53	37	63	11	63	--	3.5	14	2	85
		in	2.5	2.09	1.46	2.48	.43	2.48	--	.14	.55	.08	3.35
213.40 4"	2.43 lbs.	mm	100	80	49	101	13.5	74	30	5	17	2	132
		in	4.0	3.15	1.93	3.98	.53	2.91	1.18	20	67	.08	5.2

KEY	N	O	P	R	S	T	W	BB	CC	DD	EE	GG	HH	JJ	MM
mm	75	79	39	5.5	2	--	14	68	72	63	36.5	61	3	50	91
in	2.95	3.11	1.54	.22	.08	1/4"	.55	2.68	2.83	2.48	1.44	2.4	.12	1.97	3.58
mm	115	122	52.5	5.5	3.5	--	22	107	--	101	48	75.5	5	59	--
in	4.35	4.80	2.07	.22	.14	1/2"	.87	4.21	--	3.98	1.89	2.97	.20	2.32	--

(1) For 4" gauges with 1/2" NPT connection, B dimension changes to 85mm/3.35in.

Optional Type 213.40S - 7/16"-20 SAE connection



A* NOMINAL SIZE

TYPE/SIZE	WEIGHT	KEY	A*	B	C	F	G	J
213.40S 2.5"	0.68 lbs.	mm	63	55	37	6.2	63	3.5
		in	2.5	2.17	1.46	.25	2.48	.14

KEY	L	M	N	S	W
mm	2.0	85	75	2.0	22
in	.08	3.35	2.95	.08	0.87

T=7/16"-20 SAE connection with hex nut, Viton o-ring, and zinc-plated steel washer

THE MEASURE OF

Total Performance™

Ordering Information:
State computer part number (if available) / type number / size / range / connection size and location / options required.

05/01

WIKA Instrument Corporation
1000 Wiegand Boulevard
Lawrenceville, Georgia 30043-5868
Tel: 770-513-8200 Fax: 770-338-5118
http://www.wika.com e-mail: info@wika.com

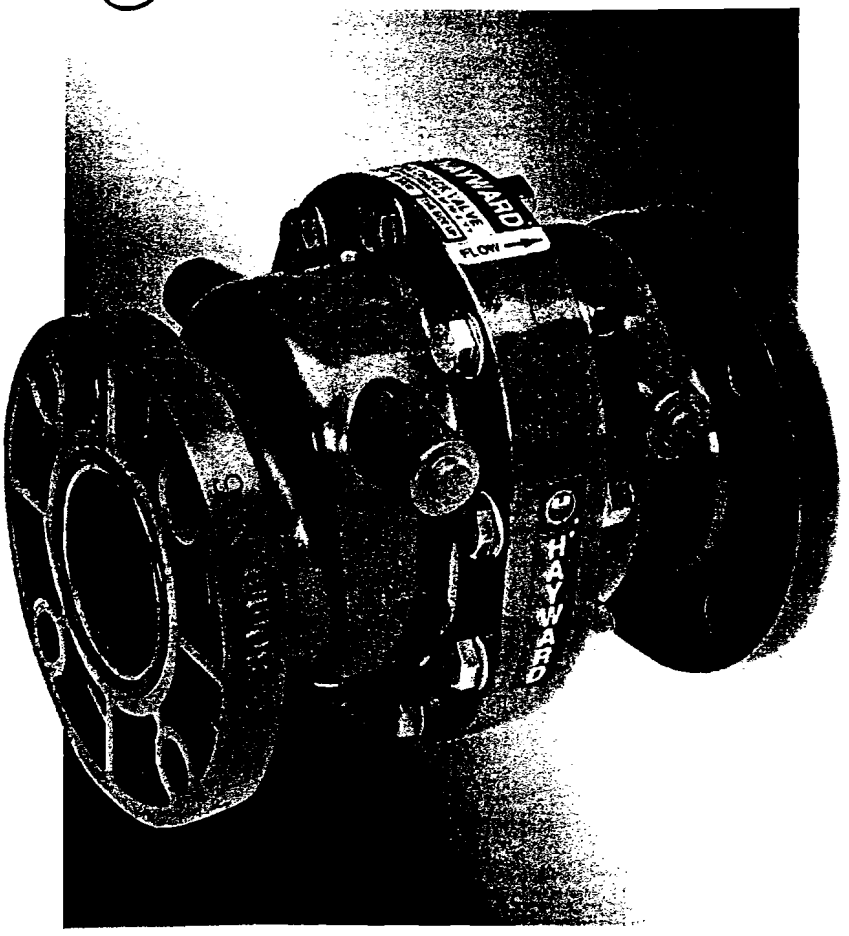
Section 5-D

Treatment Building Effluent Check Valve (V-401)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

All-Plastic Swing Check Valves

3", 4", 6" and 8" – PVC, PPL and Corzan® CPVC



Features

- Viton® or EPDM seals
- Flanged Connections
- Two Drain Ports
- Horizontal or Vertical Installation
- No flange gaskets required

Options

- Counterweight for Closing Assistance
- Limit Switch for Position Indication
- Spring Assist Closure

Corzan® CPVC is a trademark of Noveon, Inc.
Viton® is a trademark of DuPont Dow Elastomers

Twice The Temperature/Pressure Rating Of Other Plastic Swing Check Valves

Hayward swing check valves have up to twice the temperature/pressure rating of other plastic swing check valves...and can often replace metal valves in many applications. Compare the temperature/pressure rating of Hayward Swing Check Valves to others — and see the difference.

Unique Two-In-One Seat™ Design

Swing check valves are often used with slurries or other liquids that can damage the valve seat. A damaged seat in an ordinary swing check results in a useless, destroyed valve. But not with Hayward Swing Check Valves. They feature a unique *Two-In-One Seat* ™ design that doubles the valve's service life. The valve body is constructed from two identical halves. If one seat is damaged, simply re-position the clapper so that it seats against the other body seat. Then reverse the valve in the pipeline. The valve is again ready for service.

Built-In O-Ring Flange Seals

Hayward Swing Check Valves are furnished ready for installation with two built-in O-ring flange seals. There is no need to purchase additional, expensive flange gaskets.

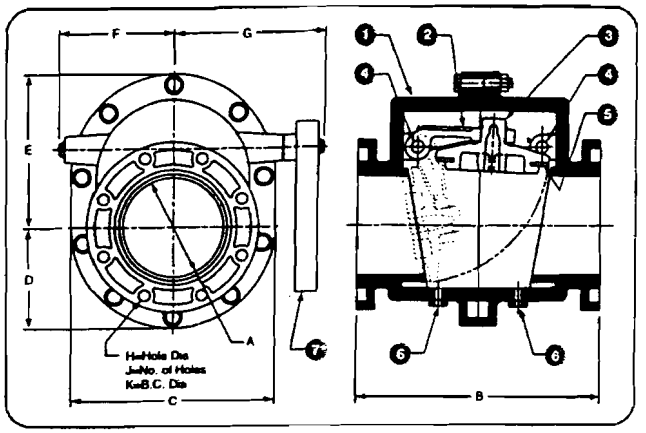
Self-Aligning Clapper Seal

Bubble-tight checking, with a minimum of only 3 psi back pressure, is assured with Hayward's rugged, self-aligning clapper seal design.

No Corrosion — Ever!

Because of their all-plastic construction, Hayward Swing Check Valves will never stick or jam as a result of rust or corrosion. And they can survive corrosive environments and harsh weather conditions, places where a metal check valve has to be painted or epoxy-coated just to survive.

Technical Information



Parts List

1. Body
2. Swing Arm
3. Clapper
4. Shaft*
5. Seal
6. Drain Plug (2)
7. Counter Weight (Optional)

**PVC with PVC valves*
PVDF with PPL valves
CPVC with CPVC valves

Selection Chart

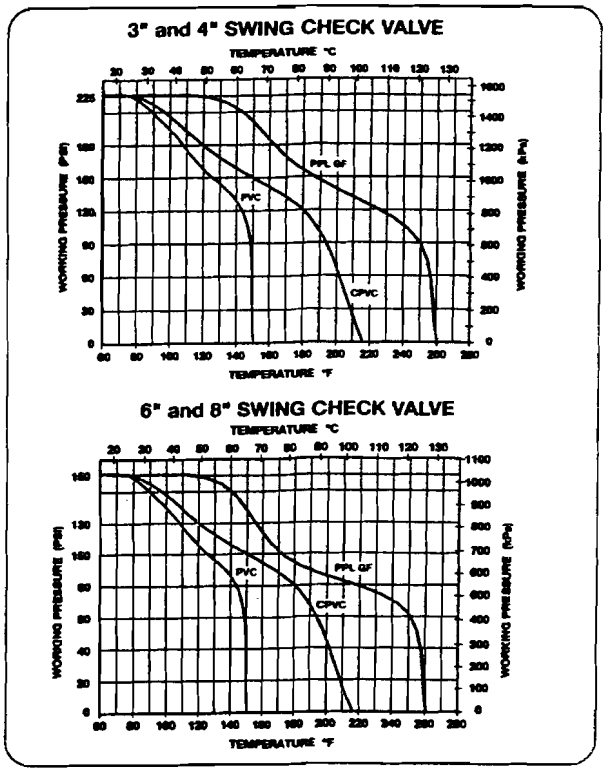
Sizes	Material	End Conn.	Seals	Pressure Rating
3" and 4"	PVC, Glass Reinforced PPL or CPVC	Flanged	Viton or EPDM	225 psi @ 70F
6" and 8"				150 psi @ 70F

Dimensions - Inches / Millimeters

Size	A	B	C	D	E	F	G	H	J	K	Minimum Back Pressure To Close - PSI	Weight (lb / kg)
Inches/Millimeters												
3 / 75	3.00 / 76	10.24 / 260	7.50 / 190	3.75 / 95	5.21 / 132	3.90 / 99	4.91 / 48	0.625 / M16	4	6.00 / 150	3	10 / 4.5
4 / 100	3.90 / 99	11.81 / 300	9.25 / 235	4.63 / 117	6.75 / 171	4.80 / 122	6.15 / 156	0.625 / M16	8	7.50 / 180	3	21 / 9.5
6 / 150	5.91 / 150	15.75 / 400	12.75 / 323	6.38 / 162	9.25 / 235	6.47 / 164	8.30 / 210	0.75 / M20	8	9.50 / 240	3	47 / 21.4
8 / 200	7.87 / 199	19.69 / 500	16.00 / 406	8.00 / 203	12.00 / 304	8.96 / 227	11.54 / 293	0.75 / M20	8	11.75 / 295	3	90 / 41.0

DIN metric flange standard

Operating Temperature/Pressure



Cv Factors

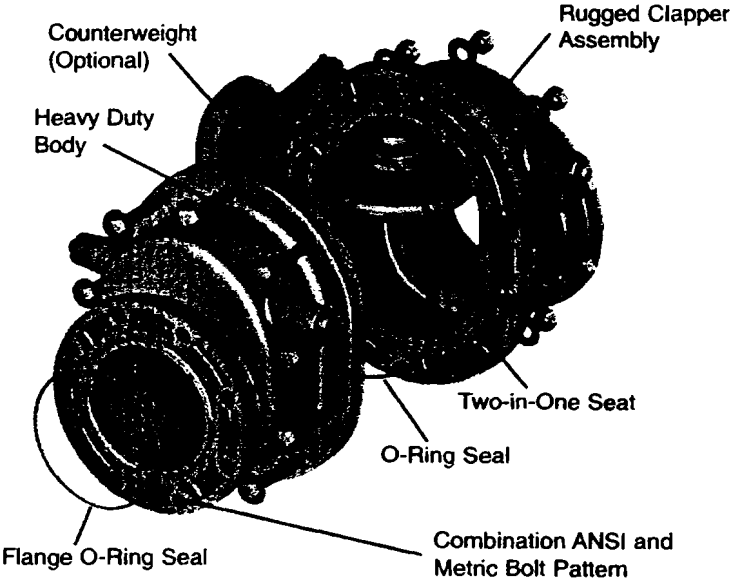
Valve Size	Factor
3"	328
4"	514
6"	1278
8"	2549

Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure drop
Q = Flow in GPM
Cv = Flow coefficient

Features



HAYWARD®

Hayward Industrial Products, Inc.
One Hayward Industrial Drive, Clemmons, NC 27012
Tel: 1-888-429-4635 (1-888-HAYINDL) • Fax: 1-888-778-8410
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MC-2-SWCHK Rev. 4 Printed in U.S.A.

Section 5-E

Effluent Butterfly Shut-Off Valves (V-402, V-701, V-703)

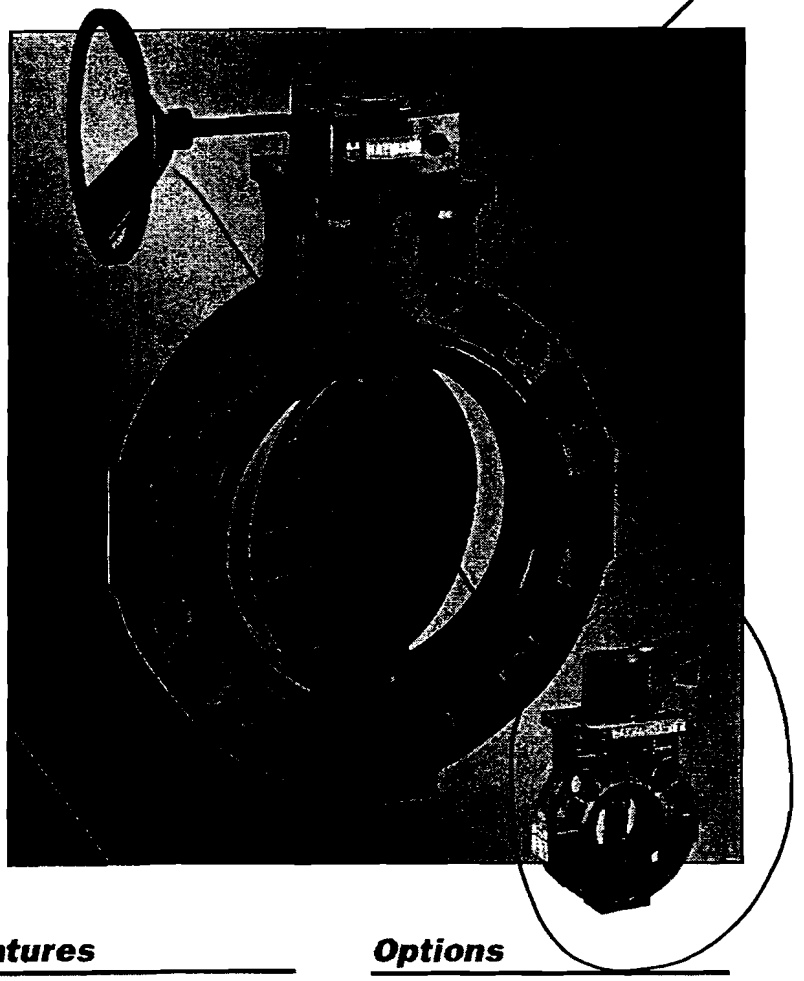
BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

HAYWARD®

FlowControl

Butterfly Valves

1-1/2" to 12" • Bodies – PVC, Corzan® CPVC, PPL
Disks – PVC, Corzan® CPVC, PPL, PVDF



Features

- Rated at 150 PSI
- Stainless Steel Shaft
- Fully Supported Flange Bolt Holes
- Full Body, V-Notch Liner
- Blowout-Proof Shaft
- Viton, EPDM or Nitrile Liners

Options

- Stem Extensions
- Lug Body Design
- Gear Operators
- Electric Actuators
- Pneumatic Actuators
- Titanium Shaft
- 2" Square Operating Nut
- PVDF Discs

A Better Butterfly Valve

Hayward 1-1/2" through 12" all-Plastic Butterfly Valves are rated at a full 150 psi. Unlike other plastic butterfly valves, Hayward valves are constructed from a one piece body that incorporates fully supported flanged bolt holes to prevent stressing of the mating pipe flanges. Their heavy duty construction stands up to the most demanding applications. The rock solid integral mounting pad insures that the valve operator will function reliably – whichever operator is used, lever handle, gear box or actuator.

Extra Features, No Extra Cost

Hayward Butterfly Valves feature a blowout-proof stainless steel stem and a unique, full body liner that has a V-notch retention design. This assures positive sealing of the liner to the valve body. An integrally molded face seal provides positive sealing against the mating flange without the need for additional gaskets. And the lever handle has a built in lockout feature.

Better Sealing

Other plastic butterfly valves have only a thin o-ring on the disk to seal the valve, but Hayward valves feature a full body liner seal. This means that the process media never contacts the valve body. And you can count on the full liner seal to perform reliably, year after year.

Easy Retrofit

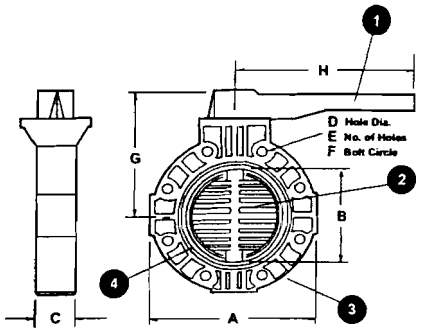
Hayward Butterfly Valves can be easily fitted into a metal piping system. All valve sizes meet industry face-to-face standards – allowing simple retrofit.

No Metal, No Corrosion

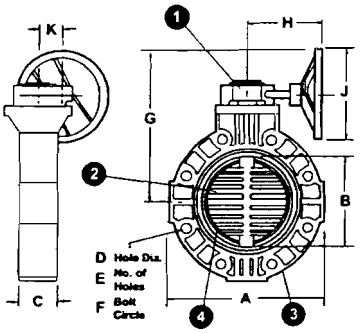
These valves have no metal in contact with the process media. They cannot corrode or rust – nor will they contaminate sensitive fluids flowing through them.

Technical Information

Lever Handle Operator



Gear Box Operator



Parts List
Butterfly Valves

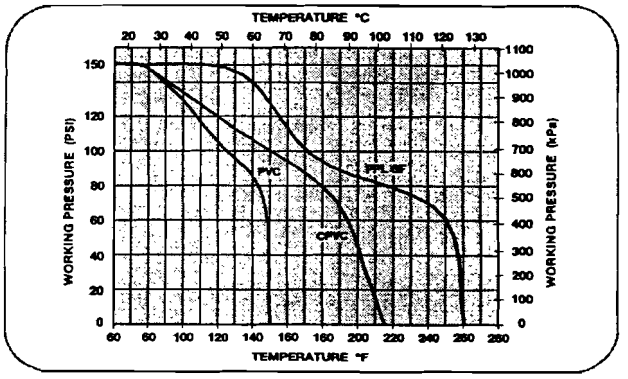
1. Operator (Lever or Gear Box)
2. Disc
3. Body
4. Liner

Dimensions - Inches / Millimeters

Size	A	B	C	D	E	F	G		H		J	K	Wt. Lb / Kg
							Gear Box	Lever	Gear Box	Lever			
1-1/2 / 50	6.00 / 152	1.75 / 44	1.50 / 38	.63 / 16	4	3.88 / 99	9.31 / 236	6.25 / 159	7.13 / 181	10.50 / 267	8.00 / 203	1.88 / 48	10.5 / 4.8
2 / 63	6.00 / 152	1.75 / 44	1.50 / 38	.75 / 19	4	4.75 / 121	9.31 / 236	6.25 / 159	7.13 / 181	10.50 / 267	8.00 / 203	1.88 / 48	10.5 / 4.8
3 / 90	7.75 / 197	3.13 / 80	2.00 / 51	.75 / 19	4	6.00 / 152	9.75 / 248	6.69 / 170	7.13 / 181	10.50 / 267	8.00 / 203	1.88 / 48	11.6 / 5.3
4 / 110	9.25 / 235	3.94 / 100	2.19 / 56	.75 / 19	8	7.50 / 191	10.19 / 259	7.94 / 202	7.13 / 181	12.00 / 305	8.00 / 203	1.88 / 48	14.3 / 6.5
6 / 160	11.25 / 286	5.81 / 148	2.31 / 59	.88 / 22	8	9.50 / 241	12.38 / 314	9.50 / 241	7.13 / 181	14.00 / 356	8.00 / 203	1.88 / 48	15.4 / 7.0
8 / 225	13.75 / 349	7.75 / 197	2.50 / 64	.88 / 22	8	11.75 / 298	13.50 / 343	10.63 / 270	7.13 / 181	16.00 / 406	8.00 / 203	1.88 / 48	23.5 / 10.7
10 / 280	16.00 / 406	9.76 / 248	3.00 / 76	1.00 / 25	12	14.25 / 362	16.00 / 406	N/A	8.09 / 205	N/A	8.00 / 203	2.36 / 59	39.0 / 17.7
12 / 315	19.00 / 483	11.50 / 292	3.18 / 81	1.00 / 25	12	17.00 / 432	17.50 / 445	N/A	8.09 / 205	N/A	8.00 / 203	2.36 / 59	51.0 / 23.1

DIN metric flanges available

Operating Temperature/Pressure



Cv Factors

Size	Factor	Size	Factor
1-1/2"	90	6"	1100
2"	125	8"	2500
3"	280	10"	4700
4"	675	12"	7100

Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

Selection Chart

Size	Body Material	Disc Material	Shaft Material	Liner	Operator	Pressure Rating
*1-1/2" to 8"	CPVC	CPVC	316 SSTL	Viton®, EPDM or Nitrile	Lever or Gear Box	150 PSI @70F Non-Shock
1-1/2" to 8"	PVC	PVC, PPL, or PVDF				
1-1/2" to 12"	PPL	PPL				

* CPVC/CPVC 8" gear operated only

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Section 5-F

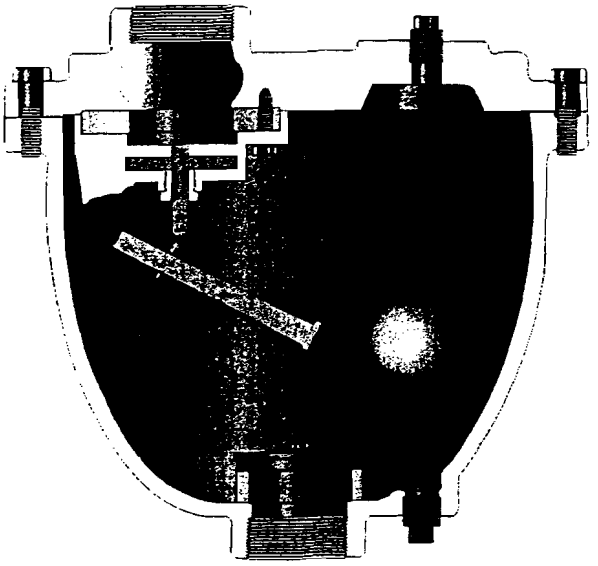
Discharge Pipeline Air Release Valves (V-704, V-705)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

CLA-VAL®

— Series — 36

Combination Air Release and



- **Stainless Steel or Bronze Trim Standard**
- **Stainless Steel Floats Guaranteed**
- **Fully Ported Valves - No Restrictions**
- **Easily Serviced Without Removal From Pipeline**
- **Engineered For Drip Tight Seal At Low Pressures**

The Cla-Val Series 36 Air and Vacuum Valve is a multipurpose valve that combines the operation of both the Model 34 Air Release Valve and Model 35 Air and Vacuum Valve. It functions to exhaust large quantities of air in the pipeline during the filling cycle and to admit air, as necessary, to prevent potentially dangerous vacuum from forming when being emptied either intentionally or as a result of pipeline breakage.

Installation

The Series 36 Combination Air Valve should be installed at high points at grade changes within the pipeline.

Mount the unit in the vertical position on top of the pipeline with an isolation valve installed below each valve in the event servicing is required. A vault with adequate venting and drainage should also be provided.

Purchase Specification

The combination air valve shall combine the operating features of both an air and vacuum valve and an air release valve in one housing. The air and vacuum valve portion shall automatically exhaust large quantities of air during the filling of the pipeline and automatically allow air to reenter the pipeline when the internal pressure of the pipeline approaches a negative value due to column separation, draining of the pipeline, or other emergency. The air release valve portion shall automatically release small amounts of air from the pipeline while it is under pressure.

The inlet and outlet of the valve shall have the same cross-section area. The float shall be guided by a stainless steel guide shaft and seat drip tight against a synthetic rubber seal. 4" and larger valves shall have dual guided shafts of hexagonal cross section and a protective discharge hood.

The float shall be of all stainless steel construction and capable of withstanding maximum system surge pressure without failure. The body and cover shall be concentrically located and of cast iron and the valve internal parts shall be of stainless steel or Buna-N® rubber.

The Combination Air Release and Vacuum Valve shall be Series 36 from Cla-Val., Newport Beach, CA, U.S.A.

General Specifications

Size Inlet/Outlet
1", 2", 3", 4" NPT
3" through 8"
125 lb. flange & ANSI
300 lb. flange & ANSI

Pressure Ratings (see note)
150 psi
300 psi

Temperature Range
Water to 180°F

Note: Specify when operating pressure below 10 PSI

Materials
Body and Cover:
Cast Iron ASTM A 126, Class B

Float:
Stainless Steel

Internal Parts:
Stainless Steel or Bronze

Seal: Buna-N® Rubber

When Ordering, Please Specify

1. Model Number
2. Inlet/Outlet Size
3. Inlet Pressure Rating
4. Orifice Size

For improved control of air flow and water surges, this valve can be ordered with optional Arrestor Check accessory installed.
See E-AC Data Sheet.
Order with suffix "AC".

Series 36

Vacuum Valve Data and Sizing Guide

Air and Vacuum Valve Sizing

1. Series 36 Combination Air Release and Vacuum Valves should be sized to handle the maximum amount of air to be exhausted **or** admitted into the pipeline and not exceed an acceptable pressure differential across the valve discharge orifice.
2. Each high point or change in grade must be examined independently when determining valve size. Use the steepest slope for calculations.
3. Use the flow capacity charts located on Series 36 Data Sheet to assist in valve sizing.
4. Determine the smallest valve size capable of **exhausting** air equal to the filling rate of the pipeline in CFS while not exceeding a pressure differential of 2 psi across the valve orifice. (Based on pump capacity).

   The following formula is recommended to calculate the rate of flow in CFS for filling the pipeline:

$$CFS = \frac{GPM}{448.83}$$

   Where: CFS = Cubic feet per second
   GPM= Gallons per minute

5. Determine the smallest valve size capable of **admitting** air equal to the potential flow in CFS while not exceeding a pressure differential of 5 psi across the valve orifice. (Based on gravity flow).

   The following formula should be used to calculate the rate of flow in CFS that can occur within the pipeline under gravity flow conditions.

$$Q = .000787 \quad \overline{S\ D^5}$$

   Where: Q = Flow of water in cubic feet per second
   C = Coefficient in Chezy's formula = 110
   S = Slope in feet per foot of length
   D = Inside pipe diameter in inches

6. If thin wall pipe is being used, the risk of pipeline collapse due to the formation of vacuum must be considered. The following formula may be used to calculate the collapsing pressure of thin walled cylindrical steel pipe using a safety factor of four:

$$P = 16{,}250{,}000 \left(\frac{T}{D}\right)^3$$

   Where: P = Collapsing pressure in psi
   T = Thickness of pipe in inches
   D = Diameter of pipe in inches

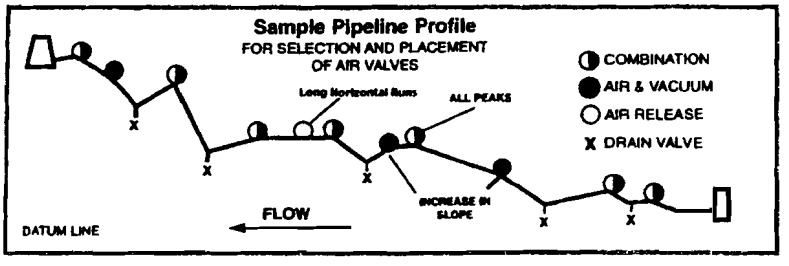
7. For other pipe materials or thickness consult pipe manufacturer for pipe collapsing pressure.

8. Determine the smallest valve size capable of admitting the required air in CFS (as found in step 5) without exceeding the collapsing pressure (as found in step 6) or 5 psi, whichever is less. Do not exceed a pressure differential greater than 5 psi.

9. Finally compare the valve size determined in step 4 with the valve size determined in steps 5 or 6. If they differ, always select the larger valve size.

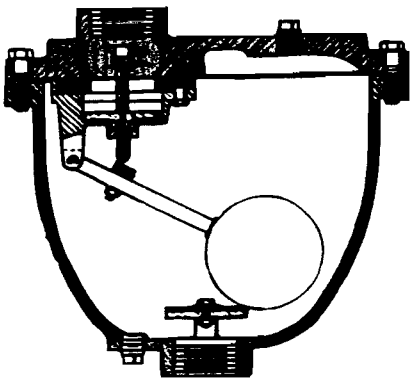
10. Cla-Val Co. has available upon request, a Slide Rule Air Valve Calculator. It will greatly reduce the amount of time necessary to size valves for pipeline service.

11. Valve effectiveness is affected by location in piping system. The Series 36 Combination Air Release and Vacuum Valves should be installed at all high points or changes in grade in a pipeline system. They should also be installed in high points where air will tend to accumulate during normal pressurized operation. For more information, see "Sizing Guide for Model 34 Air Release Valves" Data Sheet.



COMBINATION AIR RELEASE AND VACUUM VALVES

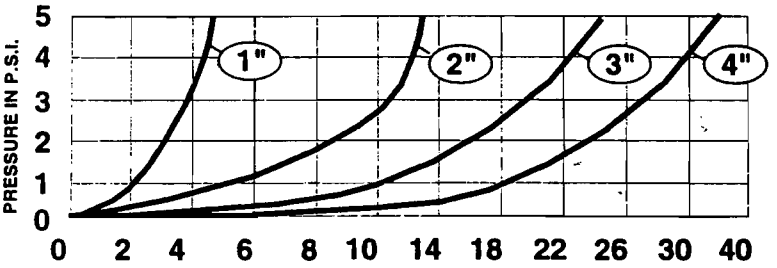
Single body Style



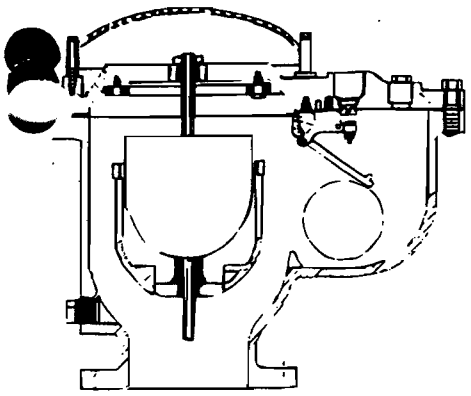
Series 36
1" through 4"

Model No.	Large Orifice Inlet x Outlet Inches	Small Orifice Diameter	Max W.P.	Height	Width	Wt. Lbs
361-CAV564B*	1 X 1	5/64"	300 psi	10 1/2"	11 /38"	40
361-CAV564	1 X 1	5/64"	300 psi	10 1/2"	11 /38"	40
362-CAV332	2 X 2	3/32"	300 psi	13"	14"	71
364-CAV332	4 X 4	3/32"	300 psi	19"	18 1/2"	170

*Bronze trim at reduced cost

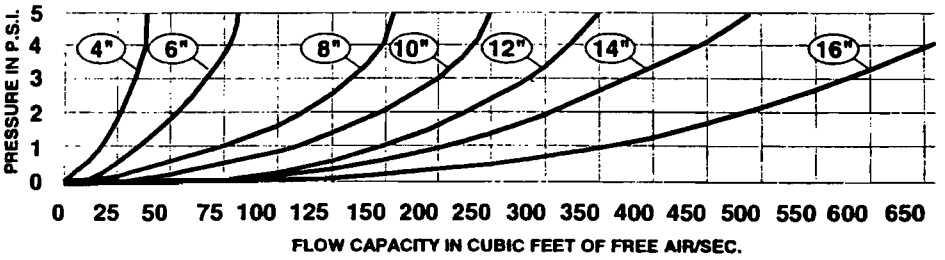


Single body Style

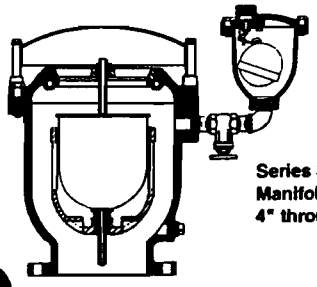


Series 36
6" through 8"

Model No.	Large Orifice Inlet x Outlet Inches	Small Orifice Diameter	Max W.P.	Height	Width	Wt. Lbs
366-CAV038	6 x 6	3/8"	150 psi	20 1/4"	21"	225
366-CAV732.3	6 x 6	7/32"	300 psi	20 1/4"	21"	225
368-CAV038	8 x 8	3/8"	150 psi	23 1/2"	25"	320
368-CAV732.3	8 x 8	7/32	300 psi	23 1/2"	25"	320



Dual body Style



Series 36 MTP Type
Manifold Design
4" through 16"

Model No. 125	Model No. 250	Large Orifice Inlet/Outlet Inches	Small Orifice Inches 125	Small Orifice Inches 250	Inches Height	Inches Width	Weight lbs. 125	Weight lbs. 250
MTP364/34.332	MTP364/34.116.3	4 x 4	3/32	1/16	21	20	125	132
MTP366/34.332	MTP364/34.116.3	6 x 6	3/32	1/16	21	20	175	195
MTP368/34.332	MTP364/34.116.3	8 x 8	3/32	1/16	21	20	226	255
MTP3610/34.332	MTP364/34.116.3	10 x 10	3/32	1/16	21	20	385	425
MTP3612/34.332	MTP364/34.116.3	12 x 12	3/32	1/16	21	20	580	625
MTP3614/34.332	MTP364/34.116.3	14 x 14	3/32	1/16	21	20	685	750
MTP3616/34.332	MTP364/34.116.3	16 x 16	3/32	1/16	21	20	875	985

For sizing assistance, see sizing guide or request a Cla-Val Air Valve Slide rule Calculator.

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

Section 5-G

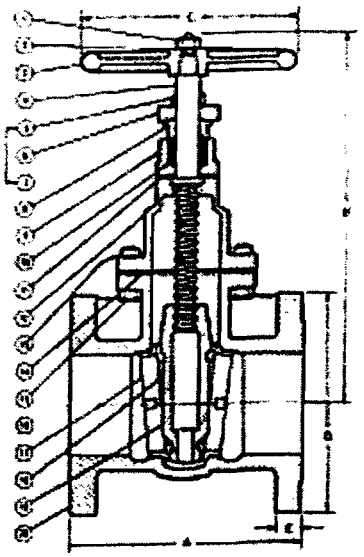
Diffusion Well Gate Shut-Off Valves (V-711, V-721, V-731)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

class 150 ductile iron body gate

Raised Face Flanges ● Bolted Bonnet ● Non-rising Stem ● Solid Wedge ● 316 SS Trim

285 PSI Non-Shock Cold Water, Oil or Gas to
-20°F to 100°F or -29°C to 38°C
Testing Specification: MSS SP-70



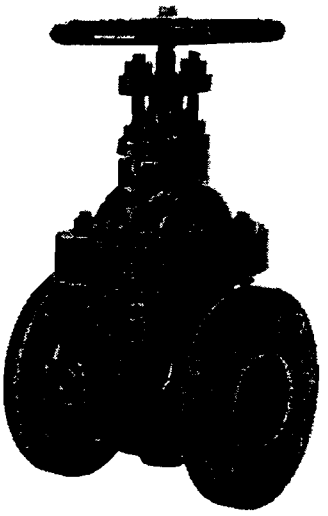
F-639-33 flanged

MATERIAL LIST

PART		SPECIFICATION
1.	Handwheel Nut	Steel ASTM A-307
2.	Identification Plate	Aluminum
3.	Handwheel	Iron ASTM A-126 Class B
4.	Stem	Stainless Steel ASTM A-276
5.	Gland Follower Nut	Steel ASTM A-307
6.	Gland Follower	Ductile Iron ASTM A-536
7.	Gland Follower Bolt	Steel ASTM A-307
8.	Packing Gland	Stainless Steel ASTM A-276
9.	Stuffing Box	Ductile Iron ASTM A-536
10.	Packing	TFE Braided
11.	Stuffing Box Gasket	Synthetic Fibers
12.	Bonnet	Ductile Iron ASTM A-395
13.	Body bolt	Steel ASTM A-307
14.	Body Gasket	Synthetic Fibers
15.	Body Nut	Steel ASTM A-307
16.	'Seat Ring	Stainless Steel ASTM A-351-CF8M
17.	Wedge Face Ring	Stainless Steel ASTM A-351-CF8M
18.	Wedge	Ductile Iron ASTM A-395
19.	Body	Ductile Iron ASTM A-395
20.	Stuffing Box Nut	Steel ASTM A-307 (Not Shown)

[1] Lugs may be removed at customer's request—POA

Position indicators available.



F-639-33
flanged-raised face

DIMENSIONS — WEIGHTS

DN (mm)	Nominal Size	Dimensions A (in)	A (mm)	B	C	D	E	Approx. Net Weight Lbs.	Kg
50	2	7	178	11	7	6	5/8	32.0	15
65	2 1/2	7 1/2	191	12 1/2	7	7	11/16	43.0	20
80	3	8	203	13 1/8	8	7 1/2	3/4	56.0	25
100	4	9	229	15 3/4	10	9	15/16	88.0	40
125	5	10	254	17	10	10	15/16	122.0	55
150	6	10 1/2	267	19 3/4	12	11	1	157.0	71
200	8	11 1/2	292	25	14	13 1/2	1 1/8	271.0	123
250	10	13	330	29	16	16	1 3/16	429.0	195
300	12	14	356	34 1/2	18	19	1 1/4	615.0	280
350	14	15	381	40 3/8	20	21	1 3/8	869.0	395
400	16	16	407	45 3/4	22	23 1/2	1 7/8	1223.0	556

FREEZING WEATHER PRECAUTION — Subsequent to testing a piping system, gate valves should be in an open position to allow complete drainage.

Position indicators available

For operating pressure, refer to Pressure Temperature Chart

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www.nibco.com

Ductile Iron Valve Specification

VALVES 2½" AND LARGER — 285 PSI CWP APPLICATION

Gate Valves

Valves to be Class 150 and 285 psi CWP, tested in accordance with Manufacturers Standardization Society, flanged, bolted bonnet, OS&Y or Non-Rising, Ductile Iron body, bronze trimmed, with body and bonnet conforming to ASTM A-395 ductile iron. Packing and gaskets to be non-asbestos.

ACCEPTABLE VALVES: NIBCO F637-31 (OS&Y) or F639-31 (Non-Rising).

Globe/Angle Valves

Valves to be Class 150 and 285 psi CWP, tested in accordance with Manufacturers Standardization Society, flanged, bolted bonnet, OS&Y, Ductile Iron body, bronze trimmed, with body and bonnet conforming to ASTM A-395 Ductile Iron. Packing and gaskets to be non-asbestos.

ACCEPTABLE VALVES: Straight Globe NIBCO F738-31; Angle Globe NIBCO F838-31.

Check Valves

Valves to be Class 150 and 285 psi CWP, shall be swing-type tested in accordance with Manufacturers Standardization Society, flanged, bolted bonnet, Ductile Iron body, bronze trimmed, with body and bonnet conforming to ASTM A-395 Ductile Iron, non-asbestos gasket.

ACCEPTABLE VALVES: Swing-type NIBCO F938-31; Swing-type with outside lever and spring/weight NIBCO F938-31-BL&S (BL&W).

VALVES 2½" AND LARGER — HIGH PRESSURE STEAM/HYDROCARBON

Gate Valves

Valves to be Class 150 and 285 psi CWP, tested in accordance with Manufacturers Standardization Society, flanged, bolted bonnet, OS&Y, Ductile Iron body, 316 SS trimmed, with body and bonnet conforming to ASTM A-395 Ductile Iron. Packing and gaskets to be non-asbestos.

ACCEPTABLE VALVES: NIBCO F637-33 (31 Trim - alternative for steam applications).

Globe/Angle Valves

Valves to be Class 150 and 285 psi CWP, tested in accordance with Manufacturers Standardization Society, flanged, bolted bonnet, OS&Y, Ductile Iron body, bronze trimmed, with body and bonnet conforming to ASTM A-395 Ductile Iron. Packing and gaskets to be non-asbestos.

APPLICABLE VALVES: Straight Globe NIBCO F738-31; Angle Globe NIBCO F838-31 Bronze trim for Steam application ONLY.

Check Valves

Valves to be Class 150 and 285 psi CWP, shall be swing-type tested in accordance with Manufacturers Standardization Society, flanged, bolted bonnet, Ductile Iron body, 316 SS trimmed, with body and bonnet conforming to ASTM A-395 Ductile Iron, non-asbestos gasket.

ACCEPTABLE VALVES: Swing-type NIBCO F938-33; Swing-type with outside lever and spring/weight NIBCO F938-33-BL&S (BL&W) (31 Trim - alternative for steam applications).

GLOSSARY OF TERMS

Ductility: The ability of a material to become permanently deformed - stretched, drawn, or hammered without failure while maintaining an appreciable load.

Tensile strength: Measures in force per unit area (i.e. pounds per square inch-psi) the ultimate stress that can be withstood by a material in tension prior to failure.

Yield strength: Measures in force per unit area the stress at which a material will undergo a permanent change in shape (plastic deformation) in response to an applied force.

Elongation: Measures by percentage the amount of plastic deformation a material will exhibit in response to a force applied in tension.

Oxide penetration: The depth of material deterioration or loss displayed along the surface of a metal that is exposed to highly corrosive (oxidizing) environment.

Section 5-H

Diffusion Well Flow Indicators (FE/FIQ-711, FE/FIQ-721, FE/FIQ-731)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Propeller

CONFIGURATION SHEET
MAIN LINE FLOWMETER

MODEL MW500 / MZ500

DESCRIPTION

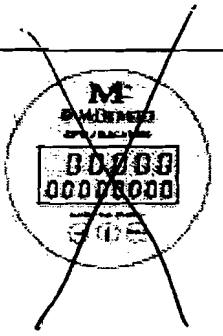
Model MW500 and MZ500 Main Line Propeller Flowmeters are manufactured to comply with the applicable provisions of the American Water Works Association Standard No. C704-92 for propeller type flowmeters. The model MW500 is designed for a maximum continuous working pressure of up to 150 psi and is fitted with AWWA Class D flanges. The model MZ500 is designed for a continuous working pressure of up to 300 psi and is fitted with ANSI B16.5 Class 300 flanges. The impeller and drive assembly are easily removed through the top flange connection. The meter flow tubes are coated with fusion-bonded epoxy for maximum corrosion protection, and integral flow straightening vanes reduce upstream flow turbulence. As with all McCrometer propeller flowmeters, standard features include a magnetically coupled drive, instantaneous flowrate indicator and straight reading, six-digit totalizer.

Impellers are manufactured of high-impact plastic, capable of retaining their shape and accuracy over the life of the meter. Each impeller is individually calibrated at the factory to accommodate the use of any standard McCrometer register. The MW500 and MZ500 can be field-serviced without the need for factory recalibration. Factory lubricated, stainless steel bearings are used to support the impeller shaft. The shielded bearing design limits the entry of materials and fluids into the bearing chamber providing maximum bearing protection.

The instantaneous flowrate indicator is standard and available in gallons per minute, cubic feet per second, liters per second and other units. The register is driven by a flexible steel cable encased within a protective vinyl liner. The register housing protects both the register and cable drive system from moisture while allowing clear reading of the flowrate indicator and totalizer.

INSTALLATION

Standard installation is horizontal mount. If the meter is to be mounted in the vertical position, please advise the factory. A straight run of full pipe the length of five diameters ahead and one diameter behind the meter is the minimum normally recommended.



The McCrometer Propeller flowmeter comes with a standard instantaneous flowrate indicator and straight-reading totalizer. An optional electronic register is also available. *Typical face plates.*

APPLICATIONS

The McCrometer propeller meter is the most widely used flowmeter for municipal and wastewater treatment applications as well as agricultural and turf irrigation measurement. Typical applications include:

- Water and wastewater management
- Center pivot systems
- Sprinkler irrigation systems
- Drip irrigation systems
- Golf course and park water management
- Gravity turnouts from underground pipelines
- Commercial nurseries

SHOWN: MODEL MW500

McCROMETER
3255 West Stetson Avenue
Hemet CA 92545-7799 USA
909-652-6811 / FAX 909-652-3078
e-mail: info@mccrometer.com
Web Site: http://www.mccrometer.com

Lit#24517-20 Rev 1.4/8-02

MAIN LINE FLOWMETER MODEL MW500 / MZ500

SPECIFICATIONS

PERFORMANCE

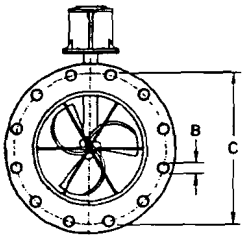
ACCURACY: ±2% of reading guaranteed throughout range.
RANGE: See dimensions chart below
HEAD LOSS: See dimensions chart below
MAXIMUM TEMPERATURE: (Standard Construction) 160°F constant
PRESSURE RATING: Model MW500: 150 psi
Model MZ500: 300 psi

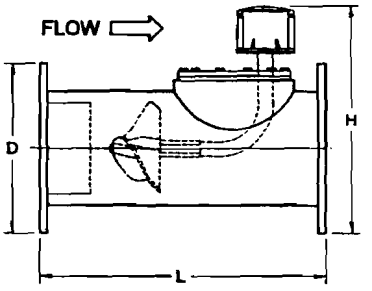
MATERIALS

BEARING ASSEMBLY: Impeller shaft is 316 stainless steel. Ball bearings are 440C stainless steel.
MAGNETS: (Permanent type) Cast or sintered Alnico
BEARING HOUSING: Brass; Stainless Steel optional
REGISTER: An instantaneous flowrate indicator and six-digit straight-reading totalizer are standard. The register is hermetically sealed within a die cast aluminum case. This protective housing includes a domed acrylic lens and hinged cover with locking hasp.
IMPELLER: Impellers are manufactured of high-impact plastic, retaining their shape and accuracy over the life of the meter. High temperature impeller is optional.

OPTIONS

- International flange standards available
- Other than standard laying lengths available
- Register extensions available
- Forward/reverse flow measurement
- All stainless steel construction
- High temperature construction
- "Over Run" bearing assembly for higher-than-normal flowrates
- Electronic propeller meter available in all sizes of this model
- A complete line of flow recording/control instrumentation
- Certified calibration test results





McCROMETER reserves the right to change design or specifications without notice.

MW500/MZ500	DIMENSIONS														
Meter and Nominal Pipe Size	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24	30	36
Maximum Flow U.S. GPM	250	250	250	600	1200	1500	1800	2500	3000	4000	5000	6000	8500	12,500	17,000
Minimum Flow. U.S. GPM	40	40	40	50	90	100	125	150	250	275	400	475	700	1200	1500
Approx. Head Loss in Inches at Max. Flow	29.50	29.50	29.50	23.00	17.00	6.75	3.75	2.75	2.00	1.75	1.50	1.25	1.00	1.00	1.00
MW500															
Approx. Shipping Weight-lbs.	36	36	43	54	115	135	197	325	465	530	744	890	1,293	1450	1650
B (inches)	3/4	3/4	3/4	3/4	7/8	7/8	1	1	1 1/8	1 1/8	1 1/4	1 1/4	1 3/8	1 3/8	1 5/8
C (inches)	4 3/4	5 1/2	6	7 1/2	9 1/2	11 3/4	14 1/4	17	18 3/4	21 1/4	22 3/4	25	29 1/2	36	42 3/4
D (inches)	6	7	7 1/2	9	11	13 1/2	16	19	21	23 1/2	25	27 1/2	32	38 3/4	46
H (inches)	11 3/4	12 1/4	12 1/2	15 1/4	16 1/4	18 1/2	21 3/4	24 1/4	25 1/4	28 1/2	29 1/4	32 1/2	36 3/4	42 3/4	49 1/4
L (inches)	14	16	16	20	22	24	26	28	42	48	54	60	60	60	60
No. of Bolts per Flange	4	4	4	8	8	8	12	12	12	16	16	20	20	28	32
MZ500															
Approx. Shipping Weight-lbs.	50	55	62	90	145	220	340	430	650	820	1,315	1,508	2,165		
B (inches)	3/4	7/8	7/8	7/8	7/8	1	1 1/8	1 1/4	1 1/4	1 3/8	1 3/8	1 3/8	1 5/8		
C (inches)	5	5 7/8	6 5/8	7 7/8	10 5/8	13	15 1/4	17 3/4	20 1/4	22 1/2	24 3/4	27	32		
D (inches)	6 1/2	7 1/2	8 1/4	10	12 1/2	15	17 1/2	20 1/2	23	25 1/2	28	30 1/2	36		
H (inches)	12	12 1/2	12 7/8	15 3/4	17	19 1/4	22 1/2	25	26 1/4	29 1/2	32 3/4	34	38 3/4		
L (inches)	20	20	20	24	26	28	30	32	42	48	54	60	60		
No. of Bolts per Flange	8	8	8	8	12	12	16	16	20	20	24	24	24		

Note: *Flanges meet ASTM-A-181 specs. Larger flowmeters on special order.*

REPRESENTED BY:

McCROMETER
3255 West Stetson Avenue
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909-652-6811 / FAX 909-652-3078
e-mail: info@mccrometer.com
Web Site: http://www.mccrometer.com

Lit#24517-20 Rev 1.4/8-02

Flowmeter Accuracy Rests On Proper Installation

Flow meters are becoming mandatory for agricultural irrigation systems in an increasing number of counties and states as stricter water management programs are implemented.

Adding flowmeters to systems designed originally without them is not difficult but requires consideration of a few important installation guidelines to assure the accuracy of the device.

Propeller flowmeters are most common in agriculture and are the subject of this article. While there are many technologies available for measuring flow, the propeller meter has cost and space advantages, especially when it is to be installed in an existing irrigation system.

Because the measuring element of this type of a flowmeter is a propeller positioned in the center of the flowstream, the pipe must be completely full and the flow of the water must not swirl. These basic conditions must be met to assure the accuracy of the flowmeter.

Upstream Disturbances

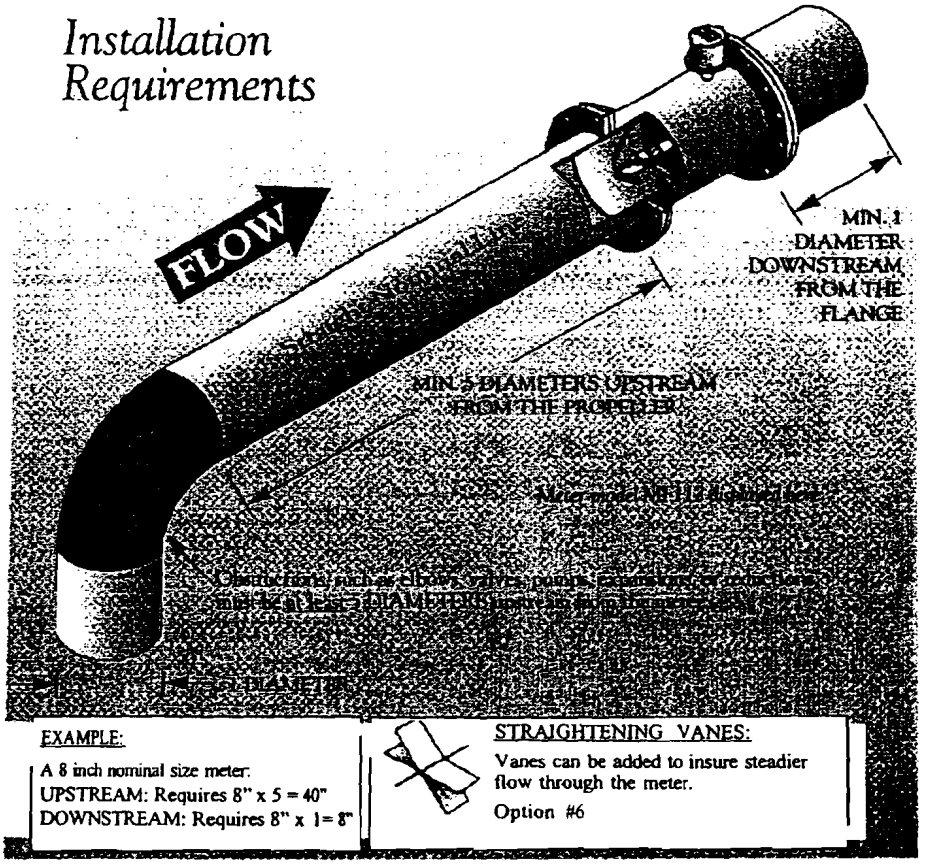
Flowmeters sense water velocity so they are vulnerable to certain upstream disturbances. Upstream obstructions, such as elbows, valves, pumps, and different sized pipe, can disturb the even flow of water through the meter. To solve these disturbances, the flowmeter should be installed downstream of obstructions on straight pipe at least five pipe diameters in length. For example, a flowmeter installed on eight-inch diameter pipe should be at least 40 inches (5 x 8") downstream of any obstruction. In addition, no obstruction should be located within one pipe diameter downstream of the flowmeter. The downstream pipe should be straight for this distance as well.

Certain conditions can cause excessive swirling of the water flow. A centrifugal sand separator or two elbows in different planes are examples. Well-developed swirls created by either of these conditions can travel up to 100 pipe diameters downstream if unobstructed.

Since most installations have less than 100 diameters to work with, straightening vanes can be placed just ahead of the meter. The vanes will break up most swirls and ensure accurate measurement. Some flowmeters include vanes as a feature.

Gravity also conditions flow. Mounting the meter vertically to take advantage of gravity flow conditioning offers some slight advantages. It is important to specify the orientation of the meter when ordering.

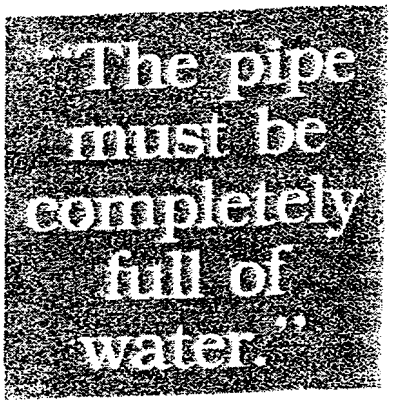
Installation Requirements



Calculate Flow Range

Naturally, a flowmeter is most accurate when used within its design specifications. One of the most important is the range of flow rates. The irrigation manager must calculate the flow rates he needs for his irrigation system in order to select the right flowmeter. The range is typically very large and is expressed as the turndown of the meter. The turndown is the ratio of the maximum flow rate to the minimum flow rate and is often 15: 1. That means the meter would remain accurate up to 15 times it's minimum flow rate. For example, a meter with a minimum flow rate of 100 gpm and a turndown of 15:1 would remain accurate up to a flow of 1,500 gpm. Meters for smaller pipes tend to have lower turndowns and a narrower range of flow rates than larger pipes.

As long as the pipe is full, flowmeters will work within a wide range of pressure. Maximum pressure is the only limitation. Standard meters have a maximum pressure tolerance of 150 psi. This should cover most agricultural applications. If not, meters are available with higher pressure ratings.



The pressure loss caused by the meter (headloss) is minimal when the pipe and meter are sized properly for the flow. The greatest headloss occurs with smaller pipe at high water velocity. By sizing pipe and flowmeter to fit the needed volume of water at a reasonable velocity, headloss is less than one psi.

Propeller flowmeters have an average accuracy of plus or minus two percent when operating within their designed flow range. This further supports the need for selecting the right flowmeter for the particular irrigation system.

Reading Flowmeters

Finally, flowmeters are available that provide totals in specific units, i.e. gallons, acre feet, acre inches, cubic feet etc. Be sure you select a flowmeter that reports and totals in the unit of measurement most appropriate in your area.

Some guidelines are helpful for reading totalizers on flowmeters. All totalizers on propeller meters have a "multiplier." For example, an eight-inch flowmeter that totalizes in gallons will have a multiplier of (X) times 100. That means that the last digit on the right of the six digit totalizer is not gallons, but hundreds of gallons. Usually two zeros are printed on the dial face to the right of the last digit to signify the multiplier.

Four-, six-, and eight-inch meters in gallons have multipliers of 100. Ten-, 12-, and 14- inch meters have multipliers of 1,000.

The same eight-inch flowmeter totalizing in acre feet will have a multiplier of .001. Now zeroes are not added to the reading but a decimal point is included after the first three digits. Usually the digits that signify fractions of acre feet are in a different color and/or X. .001 is printed below the totalizer. As the meter size goes up, the decimal point moves to the right. The person reading the meter must be careful to add the correct amount of zeroes or place the decimal point in the right place. The meter reading can be off by a factor of 10, 100, or 1000!

Flowmeters are an important tool in irrigation management and water conservation. Learn how to install them properly and read them accurately. •

Editor's Note: This article was prepared with the assistance of Glenn Voss of McCrometer in Hemet, California and appeared in "Irrigation Journal" April, 1992.

Section 5-I

Diffusion Well Air Release Valves (V-713, V-714, V-723, V-724, V-733, V-734)

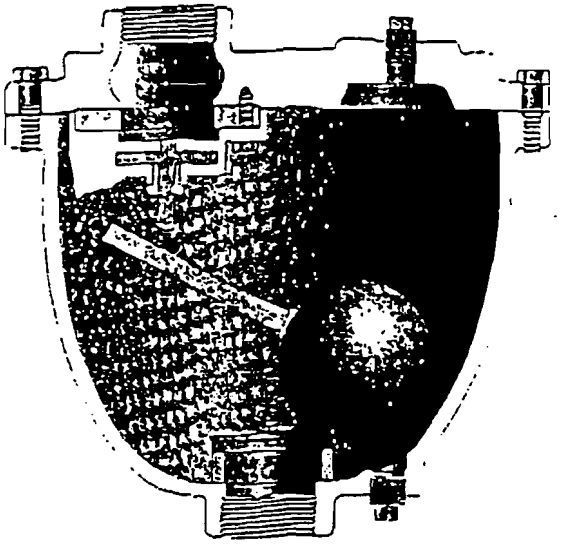
BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

CLA-VAL

V-713,723,
V-714,724,734

— SERIES — 36

Combination Air Release and Vacuum Valve



- Stainless Steel or Bronze Trim Standard
- Stainless Steel Floats Guaranteed
- Fully Ported Valves - No Restrictions
- Easily Serviced Without Removal From Pipeline
- Engineered For Drip Tight Seal At Low Pressures

The Cla-Val Series 36 Air and Vacuum Valve is a multipurpose valve that combines the operation of both the Model 34 Air Release Valve and Model 35 Air and Vacuum Valve. It functions to exhaust large quantities of air in the pipeline during the filling cycle and to admit air, as necessary, to prevent potentially dangerous vacuum from forming when being emptied either intentionally or as a result of pipeline breakage.

Installation

The Series 36 Combination Air Valve should be installed at high points at grade changes within the pipeline.

Mount the unit in the vertical position on top of the pipeline with an isolation valve installed below each valve in the event servicing is required. A vault with adequate venting and drainage should also be provided.

Purchase Specification

The combination air valve shall combine the operating features of both an air and vacuum valve and an air release valve in one housing. The air and vacuum valve portion shall automatically exhaust large quantities of air during the filling of the pipeline and automatically allow air to reenter the pipeline when the internal pressure of the pipeline approaches a negative value due to column separation, draining of the pipeline, or other emergency. The air release valve portion shall automatically release small amounts of air from the pipeline while it is under pressure.

The inlet and outlet of the valve shall have the same cross-section area. The float shall be guided by a stainless steel guide shaft and seat drip tight against a synthetic rubber seal. 4" and larger valves shall have dual guided shafts of hexagonal cross section and a protective discharge hood.

The float shall be of all stainless steel construction and capable of withstanding maximum system surge pressure without failure. The body and cover shall be concentrically located and of cast iron and the valve internal parts shall be of stainless steel or Buna-N® rubber.

The Combination Air Release and Vacuum Valve shall be Series 36 from Cla-Val., Newport Beach, CA, U.S.A.

General Specifications

Size Inlet/Outlet
1", 2", 3", 4" NPT
3" through 8"
125 lb. flange & ANSI
300 lb. flange & ANSI

Pressure Ratings (see note)
150 psi
300 psi

Temperature Range
Water to 160°F

Note: Specify when operating pressure is below 10 PSI

Materials
Body and Cover:
Cast Iron ASTM A 126, Class B

Float:
Stainless Steel

Internal Parts:
Stainless Steel or Bronze

Seal: Buna-N® Rubber

When Ordering, Please Specify

1. Model Number
2. Inlet/Outlet Size
3. Inlet Pressure Rating
4. Orifice Size

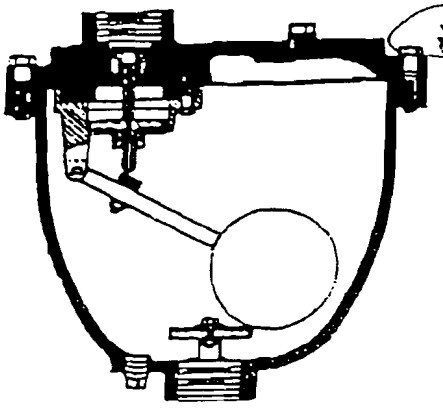
For improved control of air flow and water surges, this valve can be ordered with optional Arrestor Check accessory installed.
See E-AC Data Sheet.
Order with suffix "AC".

CLA-VAL

36 — SERIES — Sizing Guide V-713, 723, 733, 714, 724, 734

CLA-VAL

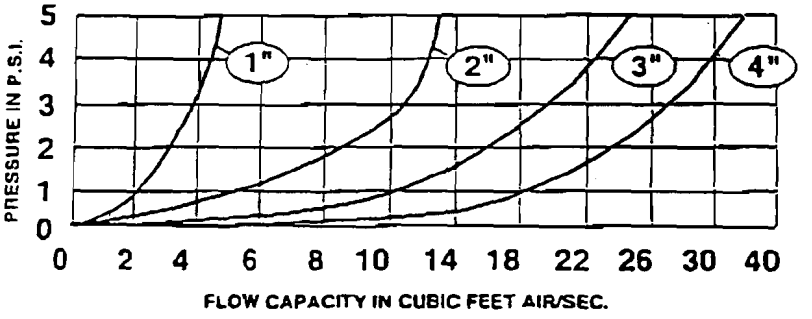
Single body Style



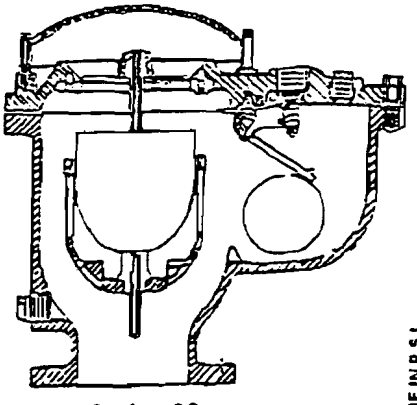
Series 36
1" through 4"

Model No.	Large Orifice Inlet x Outlet Inches	Small Orifice Diameter	Max W.P.	Height	Width	Wt. Lbs.
361-CAV564B*	1 X 1	5/64"	300 psi	10 1/2"	11 /38"	40
361-CAV564	1 X 1	5/64"	300 psi	10 1/2"	11 /38"	40
362-CAV332	2 X 2	3/32"	300 psi	13"	14"	71
364-CAV332	4 X 4	3/32"	300 psi	19"	18 1/2"	170

*Bronze trim at reduced cost

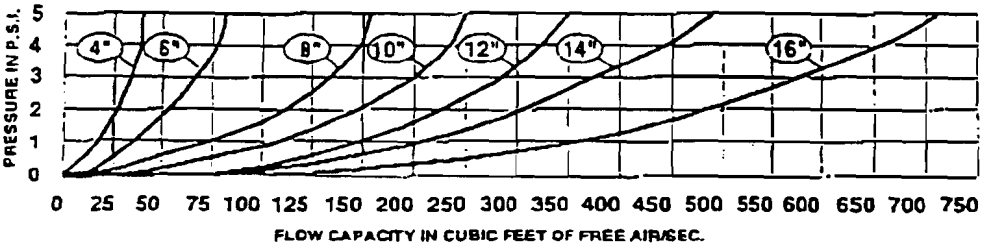


Single body Style

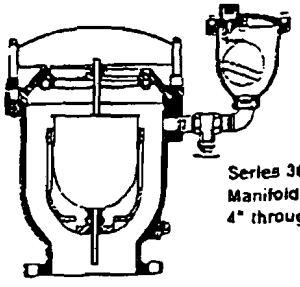


Series 36
6" through 8"

Model No.	Large Orifice Inlet x Outlet Inches	Small Orifice Diameter	Max W.P.	Height	Width	Wt. Lbs
366-CAV038	6 x 6	3/8"	150 psi	20 1/4"	21"	225
366-CAV732.3	6 x 6	7/32"	150 psi	20 1/4"	21"	225
368-CAV038	8 x 8	3/8"	350 psi	23 1/2"	25"	320
368-CAV732.3	8 x 8	7/32	350 psi	23 1/2"	25"	320



Dual body Style



Series 36 MTP Type
Manifold Design
4" through 16"

Model No. 125	Model No. 250	Large Orifice Inlet/Outlet Inches	Small Orifice Inches 125	Small Orifice Inches 250	Inches Height	Inches Width	Weight lbs. 125	Weight lbs. 250
MTP364/34.332	MTP364/34.116.3	4 x 4	3/32	1/16	21"	20"	125	132
MTP366/34.332	MTP364/34.116.3	6 x 6	3/32	1/16	21"	20"	175	195
MTP368/34.332	MTP364/34.116.3	8 x 8	3/32	1/16	21"	20"	226	255
MTP3610/34.332	MTP364/34.116.3	10 x 10	3/32	1/16	21"	20"	365	425
MTP3612/34.332	MTP364/34.116.3	12 x 12	3/32	1/16	21"	20"	560	625
MTP3614/34.332	MTP364/34.116.3	14 x 14	3/32	1/16	21"	20"	685	750
MTP3616/34.332	MTP364/34.116.3	16 x 16	3/32	1/16	21"	20"	875	985

For sizing assistance, see sizing guide or request a Cla-Val Air Valve Slide rule Calculator.

Section 5-J

Diffusion Well Butterfly Shut-Off Valves (V-712, V-722, V-732)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

200 PSI Butterfly Valves

Ductile Iron Body • Extended Neck • Geometric Drive
Molded-in Seat Liner • Lug and Wafer Style

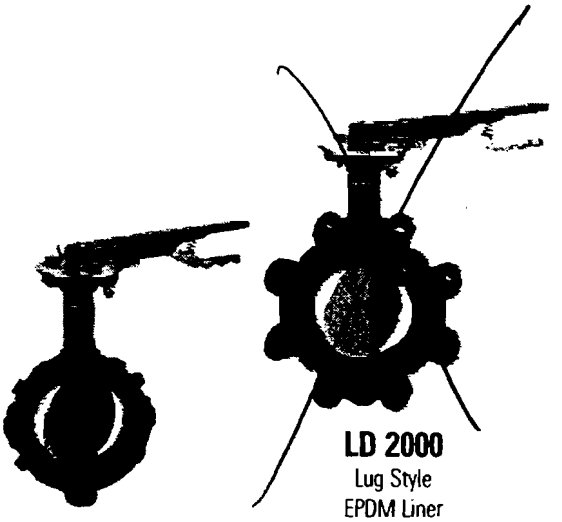
Sizes 2" through 12"

Install between Std. ANSI Class 125/150 Flanges

CONFORMS TO MSS-SP67 • MSS-SP25 • API-609

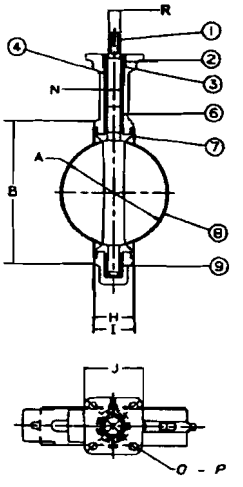
MATERIAL LIST

	PART	SPECIFICATION
1.	Stem	Stainless Steel ASTM A 582 Type 416
2.	Collar Bushing	Brass ASTM B 124
3.	Stem Seal	EPDM Rubber
4.	Body Seal	EPDM Rubber
5.	Nameplate	Aluminum
6.	Upper Bushing	Copper CDA 122
7.	Liner	EPDM Rubber
8.	Disc	Alum. Brz. ASTM B 148 Alloy 954/955
9.	Lower Bushing	Copper CDA 122
10.	Body Wafer	Ductile Iron ASTM A 536
11.	Body Lug	Ductile Iron ASTM A 536



LD 2000
Lug Style
EPDM Liner
and Aluminum
Bronze Disc

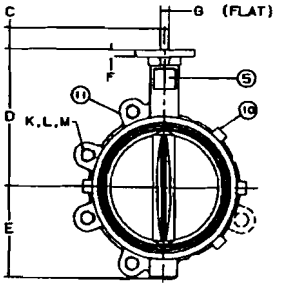
→ **WD 2000**
Wafer Style
EPDM Liner
and Aluminum
Bronze Disc



DIMENSIONS — WEIGHTS

Size In.	Size mm.	A	B	C	D	E	F	G Flat	Metal H	Rubber I	J Square	N Dia.
2	50	2.53	4.00	1.25	5.38	2.88	.38	.312	1.688	1.812	3.25	.500
2½	65	2.90	4.69	1.25	5.88	3.27	.38	.370	1.812	1.938	3.25	.562
3	80	3.15	5.12	1.25	6.12	3.40	.38	.370	1.812	1.938	3.25	.562
4	100	4.09	6.12	1.25	6.88	4.00	.38	.403	2.062	2.188	3.25	.625
5	125	5.13	7.25	1.25	7.38	4.75	.38	.496	2.188	2.312	3.25	.750
6	150	6.13	8.25	1.25	8.00	5.29	.38	.496	2.188	2.312	3.25	.750
8	200	8.13	10.41	1.25	9.25	6.50	.50	.560	2.375	2.500	3.25	.875
10	250	10.13	12.52	1.25	10.50	8.00	.50	.686	2.688	2.812	4.75	1.125
12	300	12.13	15.00	1.25	12.00	9.25	.50	.748	3.000	3.125	4.75	1.250

Size In.	Size mm.	O B.C.	P Dia.	R Dia.	Capscrew/Stud Data K No.	L Dia.	Wafer Length	Lug Length	M B.C.	Lug Weight Lbs.	Lug Weight Kg.	Wafer Weight Lbs.	Wafer Weight Kg.
2	50	3.25	.437	.437	4	5/8-11unc	4	1½	4¾	7	3.2	5.5	2.5
2½	65	3.25	.437	.500	4	5/8-11unc	4¼	1½	5½	9	4.1	7.5	3.4
3	80	3.25	.437	.500	4	5/8-11unc	4¼	1⅝	6	9.5	4.3	8	3.6
4	100	3.25	.437	.562	8	5/8-11unc	5	1⅞	7½	15	6.8	11	5.0
5	125	3.25	.437	.656	8	¾-10unc	5¼	2	8½	21	9.5	15	6.8
6	150	3.25	.437	.656	8	¾-10unc	5¼	2	9½	24	10.9	18	8.2
8	200	3.25	.437	.781	8	¾-10unc	5¾	2¼	11¾	34	15.4	28	12.7
10	250	5.00	.562	1.000	12	⅞-9unc	6¼	2¼	14¼	62	28.1	45.5	20.7
12	300	5.00	.562	1.062	12	⅞-9unc	6¾	2½	17	90	40.9	70	31.8



For actuated service where a lower torque is required use NIBCO Fig. No. WDLXXX-0 or LDLXXX-0 series, sizes 2" thru 12" only. Maximum pressure rating of 100 PSI for wet application and 50 PSI for dry application

NOT RECOMMENDED FOR STEAM SERVICE

NIBCO INC. WORLD HEADQUARTERS • 1516 MIDDLEBURY ST. • ELKHART, IN 46516-4740 • USA • PH: 1.800.234.0227
TECH SERVICES PH: 1.888.446.4226 • FAX: 1.888.336.4226 • INTERNATIONAL OFFICE PH: +1.574.295.3221 • FAX: +1.574.295.3455
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DUCTILE IRON BUTTERFLY VALVES

LD/WD 1000 AND 2000

APPLICATIONS

For use in Commercial Construction and General Utility Service:

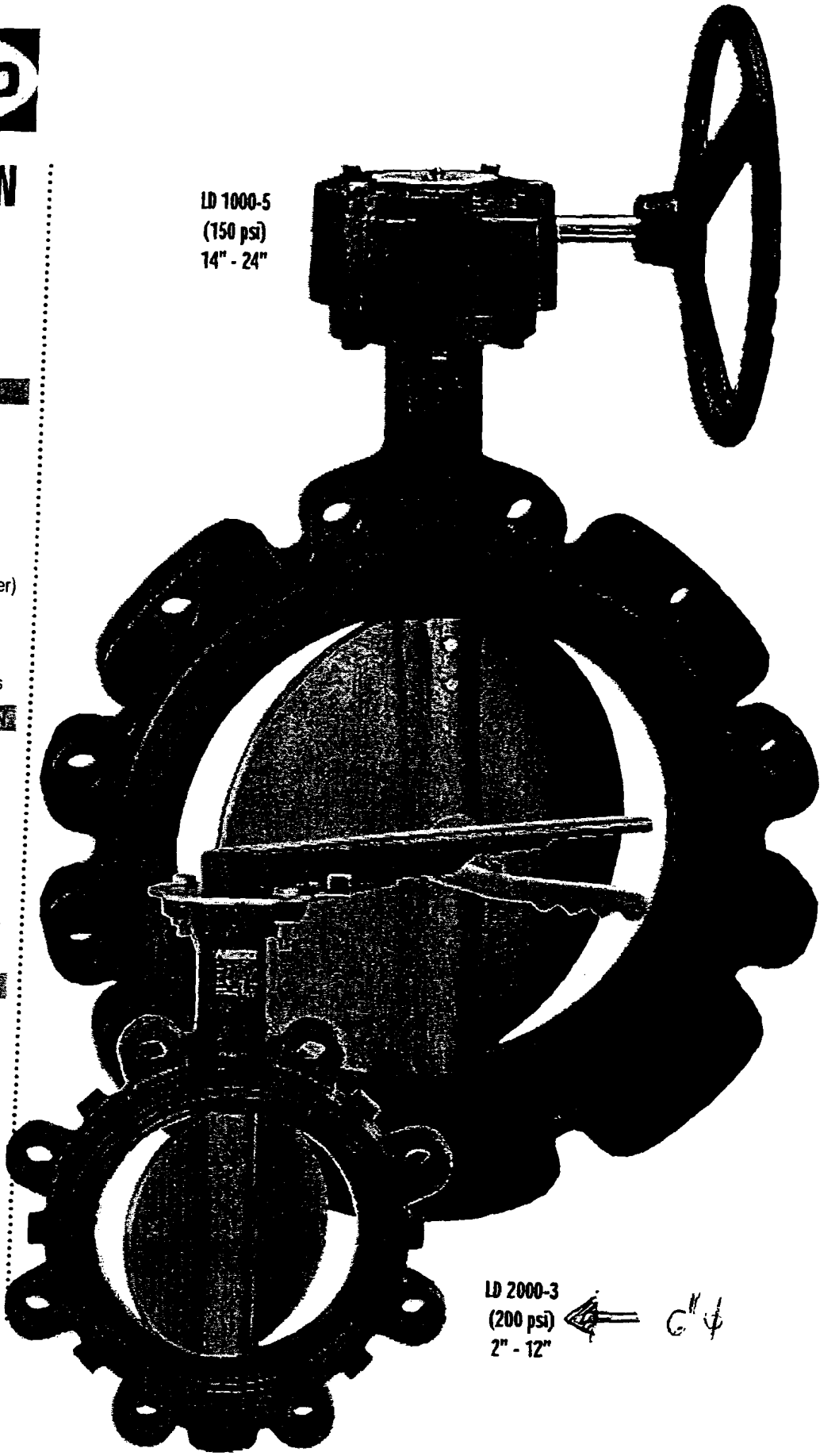
- HVAC (Condenser, Chilled Water, Hot Water Heating
- Hot and Cold Domestic Water
- Compressed Air (BUNA liner)
- Vacuum Service
- End of Line Service (Dead End)
- Modulating Control Services

MATERIALS & CONSTRUCTION

- Molded in Liner (2" - 12")
- Internal Stem/Disc Drive
- Ductile Iron Body
- Streamlined Spherical Disc
- Upper and Lower Bushings
- High Strength 416SS Stem
- Extended Neck
- Threaded Double Seal Collar Bushing (2" - 12")

DESIGN CRITERIA

- Meets or exceeds requirements of MSS SP-67.
- United States Coast Guard Approval.
- Suitable for use with ANSI Class 125 and 150 flanges.
- Pressure rating 200 psi (2"-12") and 150 psi (14"-24")
- Vacuum to 28" mercury
- Bubble tight shutoff at full pressure
- Wide choice of seat and disc combinations to suit customer application.



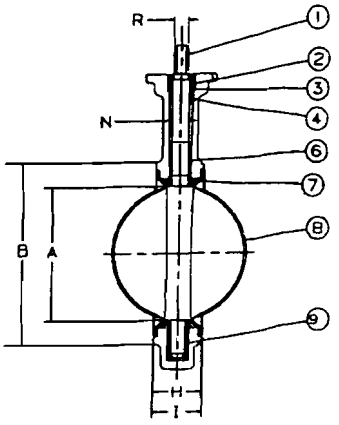
LD 1000-5
(150 psi)
14" - 24"

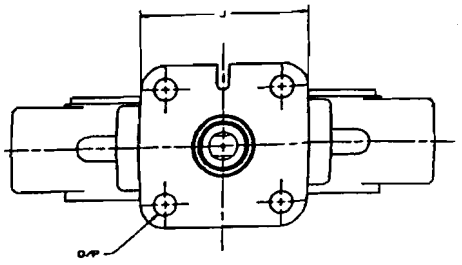
LD 2000-3
(200 psi)
2" - 12"

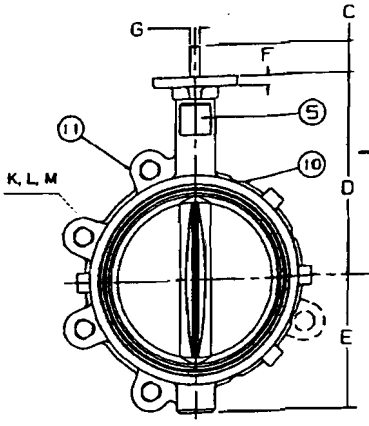
Printed in the U.S.A.

LD/WD 2000 SERIES 200 PSI

SPECIFICATIONS







LD/WD2000 SERIES Material List

PART	SPECIFICATION
1. Stem	Stainless Steel, ASTM A-582 type 416, ASTM A564 Type 17.4 PH*
2. Collar Bushing	Brass, ASTM B-124
3. Stem Seal	EPDM Ruber
4. Body Seal	EPDM Rubber
5. Nameplate	Aluminum
6. Upper Bushing	Copper CDA 122
7. Liner	EPDM Rubber, BUNA (NBR), Fluoroelastomer
8. Disc	Aluminum, Bronze, ASTM B-148 Alloy 954/955 † Ductile Iron, ASTM A395 (Plated) † Stainless Steel, ASTM A743 Grade CF8M
9. Lower Bushing	Copper CDA 122
10. Body (Wafer)	Ductile Iron, ASTM A-536
11. Body (Lug)	Ductile Iron, ASTM A-536

* Optional Stem Material

† LD 3000 Series only

LD/WD2000 SERIES Dimensions

SIZE	A	B	C	D	E	F	G Flat	METAL H	RUBBER I	J Square
2"	2.53	4.00	1.25	5.38	2.62	.38	.312	1.688	1.812	3.25
2.5"	2.90	4.75	1.25	5.88	3.12	.38	.370	1.812	1.938	3.25
3"	3.15	5.25	1.25	6.12	3.38	.38	.370	1.812	1.938	3.25
4"	4.15	6.75	1.25	6.88	4.00	.38	.403	2.062	2.188	3.25
5"	5.15	7.62	1.25	7.38	4.75	.38	.496	2.188	2.312	3.25
6"	6.15	8.62	1.25	8.00	5.25	.38	.496	2.188	2.312	3.25
8"	8.15	10.87	1.25	9.25	6.50	.50	.560	2.375	2.500	3.25
10"	10.15	13.25	1.25	10.50	8.00	.50	.686	2.688	2.812	4.75
12"	12.15	16.00	1.25	12.00	9.25	.50	.748	3.000	3.125	4.75

LD/WD2000 SERIES Dimensions

SIZE	N Dia.	O B.C.	P Dia.	R Dia.	Capscrew Data/Stud Data K No.	L Dia.	Wafer Length	Lug Length	M B.C.	Lug Approx. Net Wt. (lbs.)	Wafer Approx. Net Wt. (lbs.)
2"	.500	3.25	.437	.437	4	5/8-11unc	4	1 1/2	4 3/4	7	6
2.5"	.562	3.25	.437	.500	4	5/8-11unc	4 1/4	1 1/2	5 1/2	9	8
3"	.562	3.25	.437	.500	4	5/8-11unc	4 1/4	1 5/8	6	9 1/2	8 1/2
4"	.625	3.25	.437	.562	8	5/8-11unc	5	1 7/8	7 1/2	15	12
5"	.750	3.25	.437	.656	8	3/4-10unc	5 1/4	2	8 1/2	19	15
6"	.750	3.25	.437	.656	8	3/4-10unc	5 1/4	2	9 1/2	24	18
8"	.875	3.25	.437	.781	8	3/4-10unc	5 3/4	2 1/4	11 3/4	35	29
10"	1.125	5.00	.562	1.000	12	7/8-9unc	6 1/4	2 1/4	14 1/4	56 1/2	45 1/2
12"	1.250	5.00	.562	1.062	12	7/8-9unc	6 3/4	2 1/2	17	87	72

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SPECIFICATIONS AND TECHNICAL DATA

TORQUE is the rotary effort required to operate a valve. This turning force in a Butterfly Valve is determined by three factors. (1) Friction of the disc to seat for sealing (2) bearing friction and (3) dynamic torque.

BREAKAWAY TORQUE is the total of the torques resulting from bearing friction and seat/disc interference friction at a given pressure differential. This value is normally the highest required torque to operate a valve and is used in sizing actuators. The torques listed are valid for water and lubricating fluids at ambient temperature.

LD/WD 2000 SERIES Torque Data		
SIZE	100 PSI	200 PSI
2"	140	180
2½"	190	235
3"	250	300
4"	430	530
5"	590	760
6"	795	1,035
8"	1,850	2,350
10"	2,350	2,900
12"	3,875	5,390

LD/WD 1000 SERIES Torque Data		
SIZE	75 PSI	150 PSI
14"	3,837	4,870
16"	5,003	6,685
18"	6,567	8,958
20"	8,540	11,950
24"	13,220	18,680

NOTE: Torque data shown is for general service (clean water, ambient temperatures). For non-lubricating, high temperatures or aggressive media, consult NIBCO Technical Service. Torque listed for EPDM. When calculating torque for Buna or Fluorocarbon, multiply by 1.25

SAMPLE BUTTERFLY VALVE SPECIFICATION

Line Control Valves 2" and Larger:

BUTTERFLY VALVES: Valve shall be full lug or wafer body style. Valves to be manufactured in accordance with MSS SP-67. The valves shall be rated at least 200 psi (2" - 12") and 150 psi (14" - 36") bi-directional differential pressure. Body to have 2" extended neck for insulation and to be shock resistant ductile iron. Valves to have aluminum bronze disc and molded in or cartridge seat of EPDM rubber. Stem shall be 400 series stainless steel. Top and bottom stem bushings of dissimilar material are required with a positive stem retention mechanism. Sizes 2" to 6" shall be lever operated with 10 position throttling plate; sizes 8" and larger shall be gear operated. **Lug style valves shall be capable of providing bi-directional "Dead End Service" at full pressure without the need for a down stream blind flange.**

ACCEPTABLE VALVES:
NIBCO - LD2000 (2" - 12"), LD1000 (14" - 24") and N150235G0 (30" - 36").

Key to Butterfly Valve Figure Number System*

L	D	-	2	0	0	0	-	0
BODY TYPE	BODY MATERIAL		PRESSURE RATING	SEAT MATERIAL	DISC MATERIAL	STEM & BUSHING COMBINATIONS		OPERATING MECHANISM
						Stem / Upper & Lower / Collar		
L- Lug W- Wafer G- Grooved	D- Ductile Iron C- Cast Iron		L- Actuated 1- 150 PSI 2- 200 PSI 3- 250 PSI 4- 300 PSI	0- EPDM 1- Buna-N (Nitrile) 2- Fluoroelastomer 5- UL/FM 7- Polymid	0- Alum. Bronze 1- Ductile Iron[1] 2- CF8M 6- EPDM Coated Brass or D.I.[2] 7- Buna-N Coated Brass or D.I.[2]	0- 416 S.S. / Copper Alloy / Brass 1- 416 S.S. / 316 S.S. / Brass 2-17-4 PH / 316 S.S. / 316 S.S. 7- 416 S.S. / TFE / — 8- 316 S.S. / TFE / —		0- Bare Stem 3- L/Lock (Std.) 5- Gear op.

** This key is a guide only, it is not intended to infer that all combinations can or will be produced.*
1. Electro Nickel Plated. 2. Grooved end only.

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Section 5-K

Diffusion Well Flow Regulating Valves (V-715, V-725, V-735)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

VoV Enterprises. Inc
2063 S DELLA LANE
ANAHEIM, CA 92802-3108

Email: gwall@vovvalve.com
Web: www.vovvalve.com

O&M MANUAL
VARIABLE ORIFICE VALVE

DECEMBER 2002

ARCADIS G&M, Inc.

LOCKHEED MARTIN CORPORATION SITE GREAT NECK, NY

OPERATION OF THE VVW/ MANUAL POWER UNIT

Operation of the Variable Orifice Valve *VV* is quite straight forward and easy to understand once you have a grasp of the various component parts and their interactive relationship to each other.

The first component of the valve is a fixed ¾" thick orifice plate with a 60 degree conical section that forms the orifice. The size of the orifice is predetermined for each size valve and establishes the maximum flow of water that is possible under a particular set of conditions.

The second component of the valve that provides for the linear flow control is the piston. The piston is a cylinder with each end shaped like a cone. The free end of the piston and its position in relation to the orifice plate determines the area available for water to pass through the valve. The relationship of the orifice and the free conical portion of the piston is one that provides an area for water flow, Fig. #1. By moving the piston in relation to the orifice, the area may be decreased or increased. This action is accomplished by a hydraulic actuator (hydraulic cylinder or jack type unit) that is positioned using hydraulic fluid.

The third component is the hydraulic actuator. The unit used in the *VV* is a double acting cylinder connected to the hydraulic power unit on the surface through two small diameter hoses. The piston is attached to the shaft of the actuator, the actuator, then is the method of controlling the position of the piston and in turn the flow or Q through the valve. The pressure of the hydraulic fluid must overcome the friction between the moving parts and the friction between the seals and the cylinder or shaft, Fig #1.

The last component of the valve is the pipe section that forms the hydraulic passageway and as a means of positioning the components. The pipe section is normally installed above the well screen and below the static water level, Fig. #2.

The hydraulic power unit is manually driven pump that is controlled by a 3 position 4 way locking soleniod valve. The pump provides both the pressure and volume of hydraulic fluid to operate the hydraulic actuator.

The 3 position 4 way solenoid valve controls, Fig. # 3, the direction of movement of the hydraulic actuator by using a hydraulic valve. When the switch is moved to the center position the system hydraulically locks. This condition is maintained until the next time the hydraulic valve is moved to the open or closed position. Once the hydraulic valve is positioned the manual pump is operated until you reach the desired flow rate of the VoV.

The recommended flow meter is a mag meter for maximum accuracy and the widest possible range of flow measurement. The meter should indicate flow in GPM and a running totalizer.

When you have set the valve, move the hydraulic valve on the power unit to the center or off position.

START-UP

At initial start-up and at any subsequent time that the hydraulic hoses have been disconnected and reconnected it is necessary to purge air from the hydraulic system.

To purge the air from the system:

1. Install adapter and gauge to the Power Unit. Cap the flare fitting and operate the Power Unit to verify the pressure relief valve setting. Setting should read 4000 PSI.
2. Verify that the hydraulic hoses have a positive grade from the well head to the power unit.
3. Cycle the hydraulic pump and hydraulic actuator on the ***VoV Valve*** 3-4 times from one limit to the other limit and let the system set for 10 minutes (this allows the air to rise to the power unit). When you reach the limit of travel of the hydraulic actuator the pressure gage will increase to 4000 PSI. This indicates that the pressure relief valve is bypassing the hydraulic fluid and the limit of travel has been reached. This will normally purge the air from the system and vent the air into the hydraulic reservoir.
4. Return the system to normal operational procedure or settings.

TROUBLESHOOTING

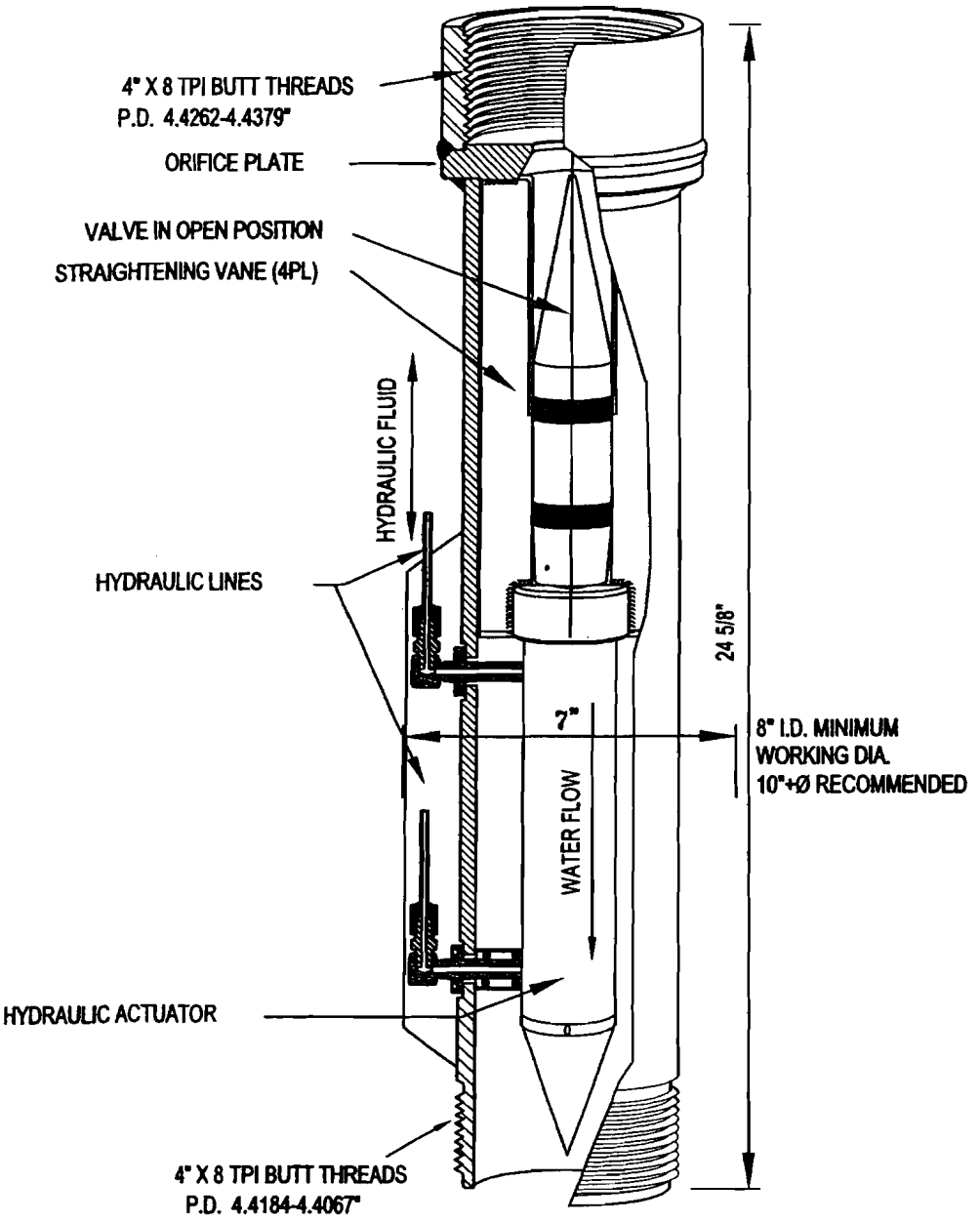
Field repair of the ***VoV Valve*** is not recommended due to the sequence of assembly and the cleanliness required during assembly. Factory repair of the valve is the preferred and the recommended option.

When the hydraulic power unit requires repair work, contact a local Authorized POWER TEAM Service Center. Due to the complexities of the settings and the specialized equipment required to set and service these units only qualified hydraulic technicians should service these units.

The following information is intended to serve as a guide in determining if a problem exists. For repair service, contact the Power Team Service Center in your area.

Problem	Possible Cause	Solution
Cylinder will not advance or retract.	Fluid level low.	Fill reservoir to proper level.
	Intake screen clogged.	Clean or replace intake screen.
		Have unit repaired by a qualified technician.
Cylinder advances and reacts erratically or hammers under load.	Air in system.	Remove air by cycling the cylinder from one extreme position to the other until the cylinder operates smoothly.
	External hydraulic leak.	Tighten leaky fitting(s). Replace damaged hoses and fittings.
	Internal hydraulic leak.	Have unit repaired by a qualified technician.
Pump fails to maintain pressure.	External hydraulic leak.	Tighten leaky fitting(s). Replace damaged hoses and fittings.
	Internal hydraulic leak.	Have unit repaired by a qualified technician.
Low fluid output.	Fluid level low.	Fill reservoir to proper level
	Pump component parts are leaking.	Test to isolate leaks.
	By-pass or relief valve malfunction.	Have power unit repaired by a qualified technician.
	Fluid intake screens on piston blocks may be clogged.	Inspect intake screens. Flush all Components of contamination. Replace damaged components.

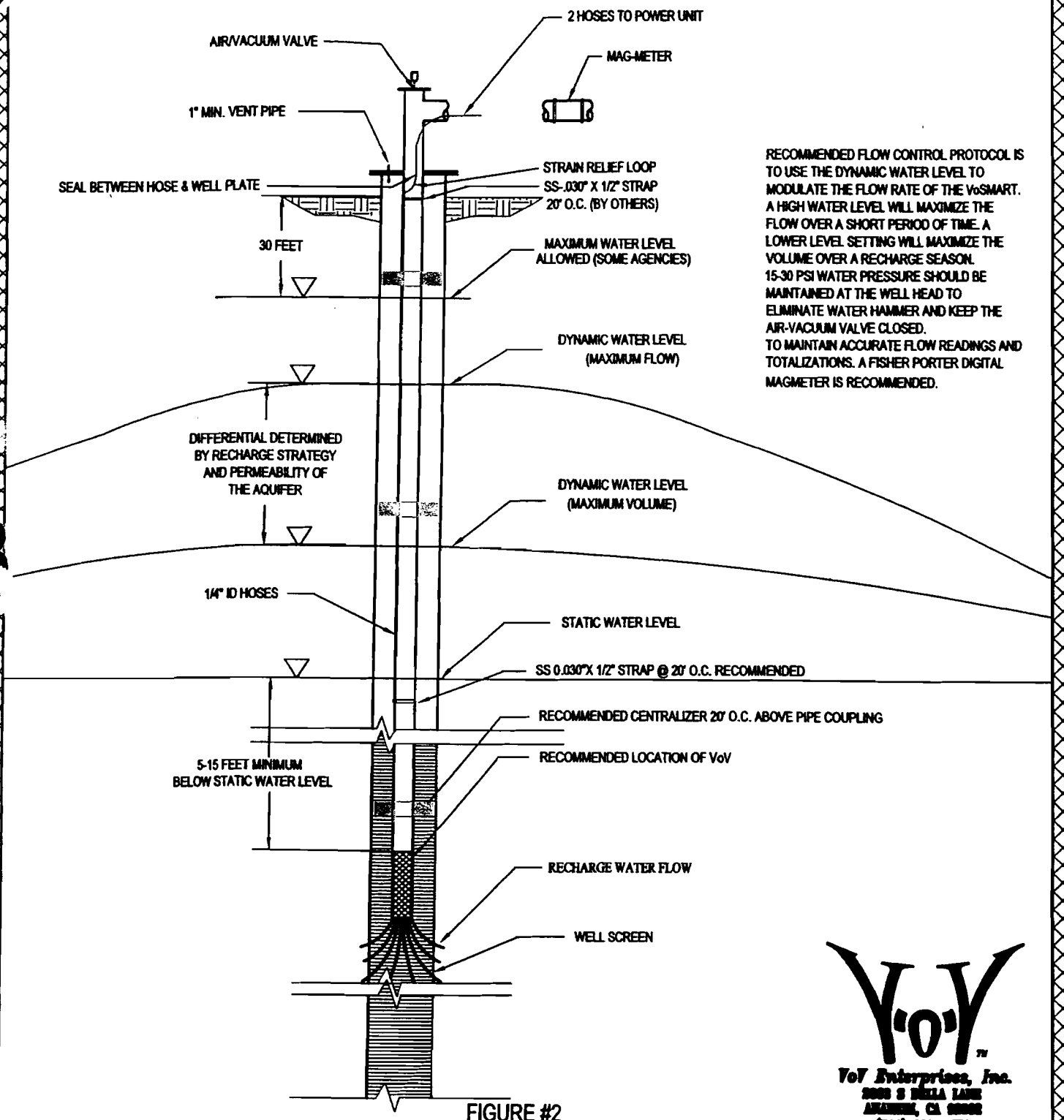
4" VARIABLE ORIFICE VALVE, W/BUTT THREADS



VoV Enterprises, Inc.
2063 S. DELLA LANE
ANAHEIM, CA 92802
(714) 636-1774

FIGURE #1

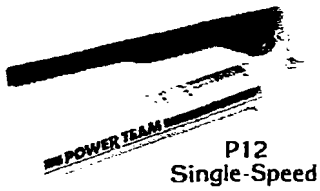
VoV INSTALLATION GUIDE



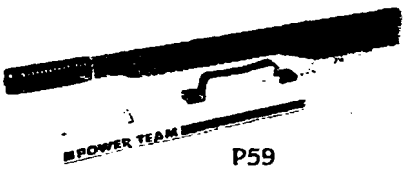
RECOMMENDED FLOW CONTROL PROTOCOL IS TO USE THE DYNAMIC WATER LEVEL TO MODULATE THE FLOW RATE OF THE VoSMART. A HIGH WATER LEVEL WILL MAXIMIZE THE FLOW OVER A SHORT PERIOD OF TIME. A LOWER LEVEL SETTING WILL MAXIMIZE THE VOLUME OVER A RECHARGE SEASON.
15-30 PSI WATER PRESSURE SHOULD BE MAINTAINED AT THE WELL HEAD TO ELIMINATE WATER HAMMER AND KEEP THE AIR-VACUUM VALVE CLOSED.
TO MAINTAIN ACCURATE FLOW READINGS AND TOTALIZATIONS. A FISHER PORTER DIGITAL MAGMETER IS RECOMMENDED.

FIGURE #2

VoV Enterprises, Inc.
2000 S BELLA LANE
ANAHEIM, CA 92802
(714) 635-1774



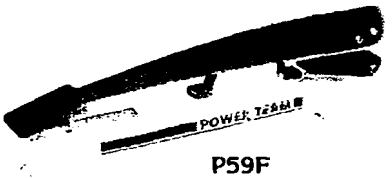
P12
Single-Speed



P59
Two-Speed

P157D/P159D
Two-Speed

NEW P19
Two-Speed



P59F
Two-Speed

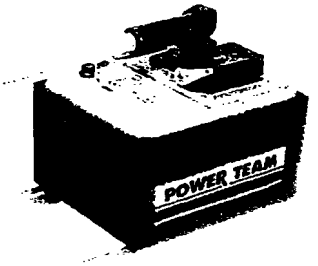
P300
Two-Speed

P23
Single-Speed
3,000 psi

P157/P159
Two-Speed

P55
Single-Speed

U.S. Patent
No.3.822.966



P460
Two-Speed

Hydraulic Hand Pumps

10,000 psi capacity.

Single or two-speed versions available for use with single or double acting cylinders.

Up to 2½ gallon reservoir capacity.

All develop up to 10,000 psi (except P23) and can operate horizontally or vertically with the pump in the down position (except 460 series). All pumps have an internal safety relief valve. Hydraulic accessories shown on pages 60 thru 70.

P12 Single-Speed Pump

For use with single-acting cylinders. Features a finger-tip control valve for instant release or pumping action. Non-vented reservoir. max. handle effort is 80 lbs.

NEW P19 Two-Speed Pump

For use with single-acting cylinders. All metal construction. max. handle effort is 90 lbs.

P23 Single-Speed Pump

For use with single-acting cylinders. Compact pump similar to P55 with a relief valve setting of 3000 psi non-vented reservoir. max. handle effort is 70 lbs.

P55 Single-Speed Pump

For use with single-acting cylinders. Features a finger-tip control valve for instant release or pumping action. All metal construction. carrying handle and large oil fill port. Non- vented reservoir. max. handle effort is 140 lbs.

P59 Two-Speed Pump

For use with single-acting cylinders. features a finger-tip control valve for instant release or pumping action. All metal construction. carrying handle and large oil fill port. Non-vented reservoir. max. handle effort is 140 lbs.

P59F 2-Speed Foot Pump

For use with single-acting cylinders. features foot or hand operated press-to-release valve. Aluminum body and lever. steel reservoir. carrying handle and large oil fill port. Non-vented reservoir. maximum lever effort is 120 lbs.

P157 & P159 Two-Speed Pumps

For use with single-acting cylinders. All metal construction. carrying handle and large oil fill port. Non-vented reservoir. max. handle effort is 130 lbs.

P157D & P159D Two-Speed Pumps

For use with double-acting cylinders. Same features as P157 & P159 except P157D & P159D have 4-way tandem center valves.

P300 Two-Speed Pump

For use with single-acting cylinders. Same as P159 except it has a large 1½ gal. reservoir with sight gauge.

P300D Two-Speed Pump

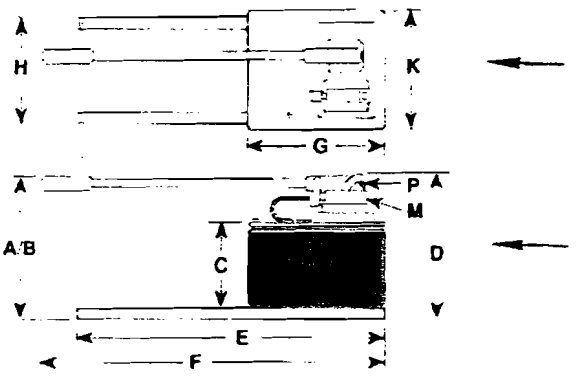
For use with double-acting cylinders. Same as P159D except it has a large 1½ gal. reservoir with sight gauge.

P460 Series Two-Speed Pumps

P460 for use with single-acting cyl. All metal construction. carrying handle and large 2½ gal. reservoir. Max. handle effort is 90 lbs.

P460D, same as P460 except for use with double-acting cylinders. Uses 4-way valve No. 9500.

FIGURE #3



DIMENSIONS (inches)

Pump No.	A	B	C	D	E	F	G	H	J	K	L	M	N	P
P12	4	—	—	4	13.6	3⅜	2⅜	—	45	⅜	3⅜	—	1⅛	—
NEW P19	5⅛	14⅝	2⅞	4⅜	13⅛	4	3⅛	11⅛	53	⅝	4	⅜ NPTF	1⅜	—
P23	6¼	13	3⅛	5⅛	13⅝	4⅛	3⅛	10⅞	38	⅜	4⅛	⅜ NPTF	1⅜	—
P55	6⅜	21	3⅛	5⅜	23	4⅛	3⅛	19⅜	38	⅝	4⅛	⅜ NPTF	1⅜	—
P59	7	21	3⅛	5	23	4⅛	3⅛	19⅛	38	⅝	4⅛	⅜ NPTF	1⅜	—
P59F	3⅛	16⅝	3⅛	6	23⅛	4⅛	3⅛	20⅛	—	⅜	4⅛	⅜ NPTF	1⅜	—
P157/ P159	7⅛	20⅛	4⅛	6⅛	22⅛	3⅛	3	19⅜	39	⅜	3⅛	⅜ NPTF	2⅛	—
P300	6⅛	21	4⅛	6⅛	22⅛	8⅛	7⅛ / 3	20 ⅜	39	⅜	3⅛	⅜ NPTF	2⅛	—
P460	11⅛	31	6⅛	11⅜	24	29⅛	11	9	80	9⅛	—	⅜ NPTF	—	⅛

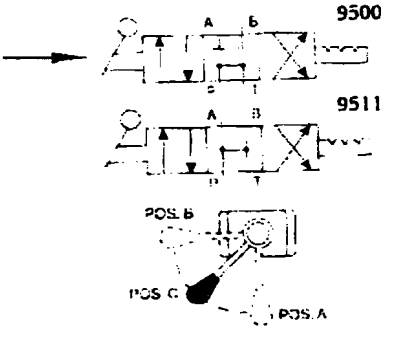
Valves for Double-Acting Cylinders, Manually Operated

9506 4-way, 3-position (tandem center) with "posi-check"

This pump-mounted, manually operated valve is designed for use with double-acting cylinders. It is a detented 4-way, 3-position tandem center valve with "advance," "hold" and "return" positions. A subplate is provided for pump mounting or it can be remote mounted with the 9510 subplate. A pressure switch and/or gauge may be added. Port size is ⅜" NPTF. Maximum operating pressure is 10,000 psi and max. flow rate is 5 gpm.

Double-Acting Cyl.	P159D	4-way				
Single-Acting Cyl.	P300	2-way				
Double-Acting Cyl.	P300D	4-way				
Single-Acting Cyl.	P460	2-way				
Double-Acting Cyl.	P460D	4-way 960				

9500 4-way, 3-position (tandem center)



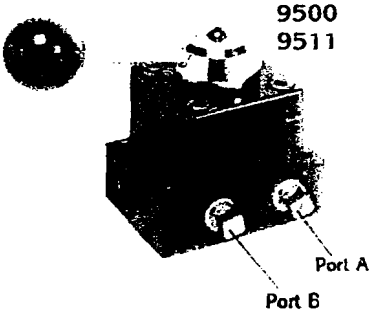


FIGURE #4

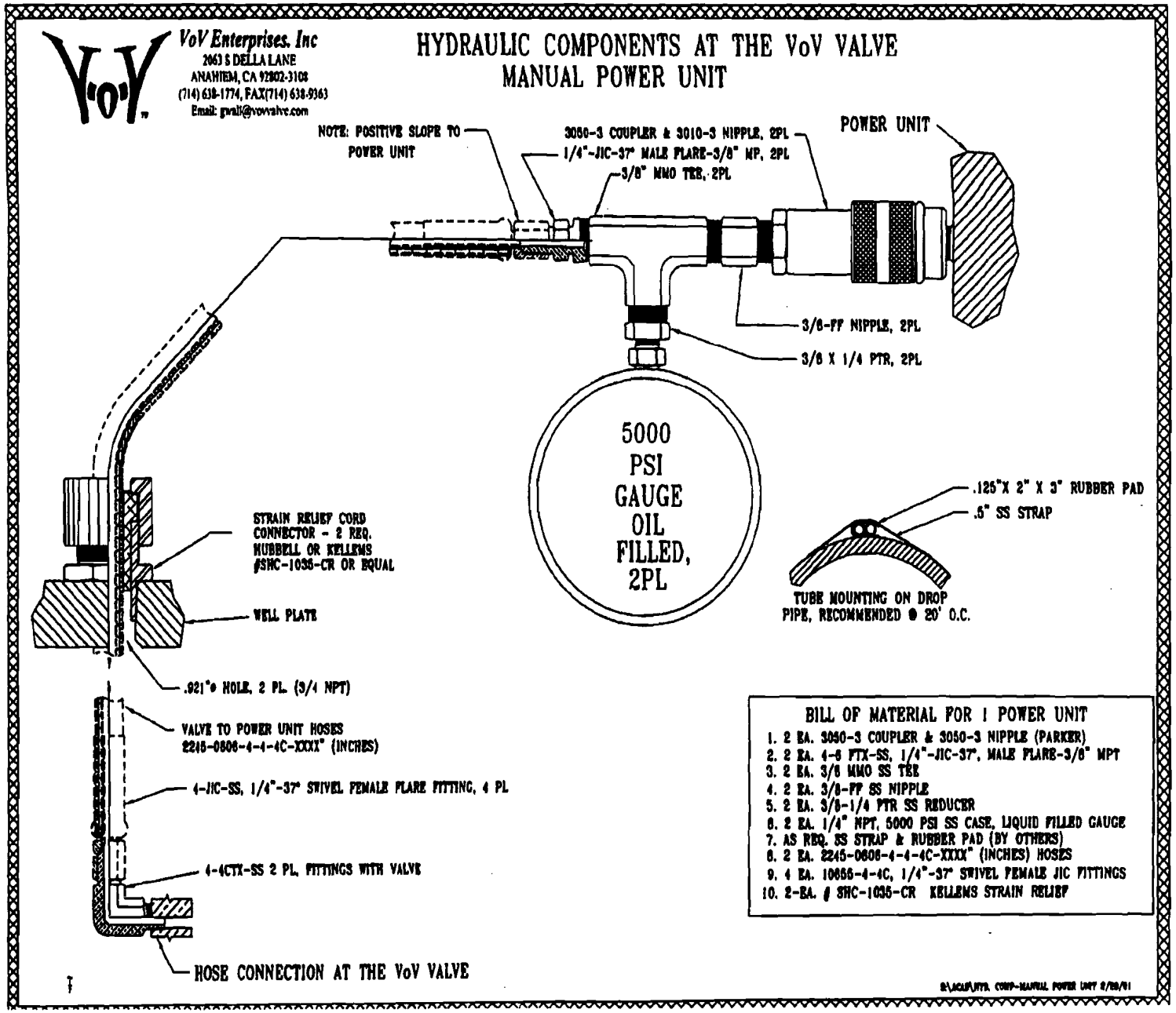
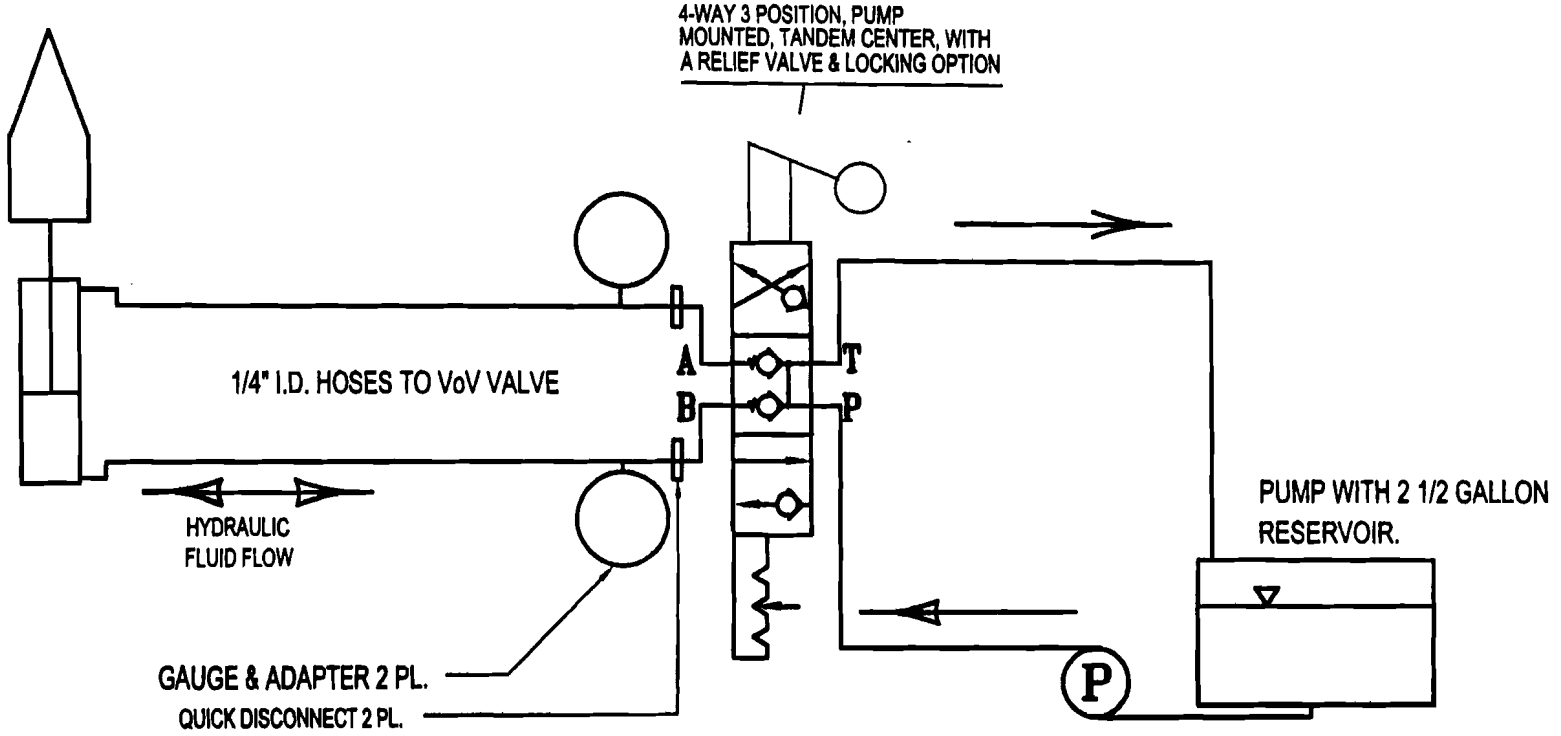

VoV Enterprises, Inc
2063 S DELLA LANE
ANAHEIM, CA 92802-3108
(714) 638-1774, FAX(714) 638-9363
Email: gwall@vovvalve.com
HYDRAULIC COMPONENTS AT THE VoV VALVE
MANUAL POWER UNIT
NOTE: POSITIVE SLOPE TO POWER UNIT
3050-3 COUPLER & 3010-3 NIPPLE, 2PL
1/4"-JIC-37° MALE FLARE-3/8" MP, 2PL
3/8" MMO TEE, 2PL
POWER UNIT
3/8-FF NIPPLE, 2PL
3/8 X 1/4 PTR, 2PL
5000 PSI GAUGE OIL FILLED, 2PL
.125"X 2" X 3" RUBBER PAD
.5" SS STRAP
TUBE MOUNTING ON DROP PIPE, RECOMMENDED @ 20' O.C.
STRAIN RELIEF CORD CONNECTOR - 2 REQ. HUBBELL OR KELLEMS #SHC-1035-CR OR EQUAL
WELL PLATE
.921"ø HOLE, 2 PL. (3/4 NPT)
VALVE TO POWER UNIT HOSES 2245-0606-4-4-4C-XXXX" (INCHES)
4-JIC-SS, 1/4"-37° SWIVEL FEMALE FLARE FITTING, 4 PL
4-4CTX-SS 2 PL, FITTINGS WITH VALVE
HOSE CONNECTION AT THE VoV VALVE
BILL OF MATERIAL FOR 1 POWER UNIT
1. 2 EA. 3050-3 COUPLER & 3050-3 NIPPLE (PARKER)
2. 2 EA. 4-6 FTX-SS, 1/4"-JIC-37°, MALE FLARE-3/8" MPT
3. 2 EA. 3/8 MMO SS TEE
4. 2 EA. 3/8-FF SS NIPPLE
5. 2 EA. 3/8-1/4 PTR SS REDUCER
6. 2 EA. 1/4" NPT, 5000 PSI SS CASE, LIQUID FILLED GAUGE
7. AS REQ. SS STRAP & RUBBER PAD (BY OTHERS)
8. 2 EA. 2245-0606-4-4-4C-XXXX" (INCHES) HOSES
9. 4 EA. 10655-4-4C, 1/4"-37° SWIVEL FEMALE JIC FITTINGS
10. 2-EA. # SHC-1035-CR KELLEMS STRAIN RELIEF

FIGURE #5

VoV Enterprises. Inc
2063 S DELLA LANE
ANAHIEM, CA 92802-3108
(714) 638-1774, FAX(714) 638-9363
Email: gwall@vovvalve.com

HYDRAULIC SCHEMATIC VoV,
HYDRAULIC POWER UNIT, MANUAL CONTROL



SPX | POWER TEAM

Form No. 102842

Operating Instructions for:

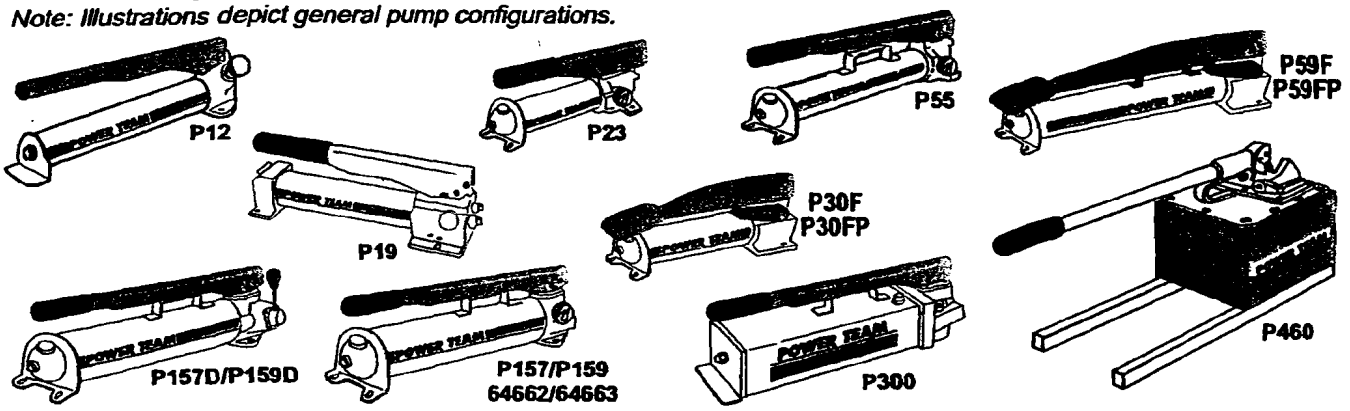
62072 (See P159)	201338-TID (See P12)	P157 SERIES
62087 (See P55)	P12 SERIES	P157D SERIES
64122 (See P55)	P19 SERIES	P159 SERIES
64215 (See P59)	P23 SERIES	P159D SERIES
64372 (See P55)	P30F SERIES	P300 SERIES
66463 (See P59)	P55 SERIES	P300D SERIES
64662 (See P157)	P59 SERIES	P460 SERIES
64663 (See P157)	P59F SERIES	YM-01 (See P19)

SINGLE-STAGE AND TWO-STAGE HYDRAULIC HAND PUMP

Max. Pressure: See Pump Data Plate

Definition: A hydraulic hand pump delivers hydraulic fluid under pressure by directly applied manual effort.

Note: Illustrations depict general pump configurations.



For Use With	Order No.	Stage	Volume & Pressure: Volume per Stroke in.³	Volume per Stroke cm³	Maximum Pressure psi	Maximum Pressure bar	Handle or Foot Lever Effort lbs.	Handle or Foot Lever Effort kg	Reservoir: Type	Oil Capacity in.³	Oil Capacity cm³	Usable Oil Capacity in.³	Usable Oil Capacity cm³	Product Weight lbs.	Product Weight kg.
Single-Acting Cylinders (Pump includes 2-Way Valve)	P12	1	0.069	1.1	10000	700	75	34.0	A	12	197	9	148	5.7	2.6
	P19	1 2	0.305 0.091	5 1.5	325 10000	22 700	8.5 98.5	3.8 44.7	B	24.4	400	20	328	6.6	3
	P23	1	0.160	2.6	3000	200	70	31.8	B	23.8	390	20.3	333	12.0	5.4
	P30F	1 2	0.216 0.054	3.5 0.9	325 10000	22 700	125	56.7	B	31	508	27	443	10.0	4.5
	P30FP	1 pop-off	0.216 0.054	3.5 0.9	325 10000	22 700	125	56.7	B	31	508	27	443	10.0	4.5
	P55	1	0.160	2.6	10000	700	145	65.8	B	55	901	45	738	15.8	7.2
	P59	1 2	0.662 0.160	10.8 2.6	325 10000	22 700	145	65.8	B	55	901	45	738	17.2	7.8
	P59F	1 2	0.550 0.130	9.0 2.1	325 10000	22 700	120	54.5	B	55	901	45	738	14.0	6.4
	P59FP	1 pop-off	0.550 0.130	9.0 2.1	325 10000	22 700	145	65.8	B	55	901	45	738	14.0	6.4
	P157	1 2	0.650 0.160	10.7 2.6	1400 10000	97 700	140	63.5	B	152	2491	137	2245	26.0	11.8
	P159	1 2	2.600 0.160	42.6 2.6	325 10000	22 700	140	63.5	B	152	2491	137	2245	26.0	11.8
	P300	1 2	2.600 0.160	42.6 2.6	325 10000	22 700	140	63.5	C	1.5 gal.	5.7 l	310	5081	55.3	25.1
	P460	1 2	7.350 0.294	120.5 4.6	325 10000	22 700	90	40.8	D	2.5 gal.	9.5 l	460	7539	54.9	24.9
Double-Acting Cylinders (Pump includes 4-Way Valve)	P157D	1 2	0.650 0.160	10.7 2.6	1400 10000	97 700	140	63.5	B	152	2491	137	2245	28.8	13.1
	P159D	1 2	2.600 0.160	42.6 2.6	325 10000	22 700	140	63.5	B	152	2491	137	2245	27.9	12.7
	P300D	1 2	2.600 0.160	42.6 2.6	325 10000	22 700	140	63.5	C	1.5 gal.	5.7 l	310	5081	57.0	25.9
	P460D	1 2	7.350 0.294	120.5 4.6	325 10000	22 700	90	40.8	D	2.5 gal.	9.5 l	460	7539	57.9	26.3

3/8 NPTF oil port(s) on all pumps

Table 1

SAFETY EXPLANATIONS

Two safety symbols are used to identify any action or lack of action that can cause personal injury. Your reading and understanding of these safety symbols is very important.

DANGER - Danger is used only when your action or lack of action will cause serious human injury or death.

WARNING - Warning is used to describe any action or lack of action where a serious injury can occur.

IMPORTANT - Important is used when action or lack of action can cause equipment failure, either immediate or over a long period of time.

Pictogram Definition

Do not remove this component. For service only. Pressure must be released.

WARNING: It is the operator's responsibility to read and understand the following safety statements,

- **Only qualified operators should install, operate, adjust, maintain, clean, repair, or transport this machinery.**
- **These components are designed for general use in normal environments. These components are not specifically designed for lifting and moving people, agri-food machinery, certain types of mobile machinery or special work environments such as: explosive, flammable or corrosive. Only the user can decide the suitability of this machinery in these conditions or extreme environments. Power Team will supply information necessary to help make these decisions.**
- **Do not use equipment if damaged, altered, or in poor condition.**
- **All safety decals must be replaced when unreadable.**

These instructions are intended for end-user application needs. Most problems with new equipment are caused by improper operation or installation. Detailed service repair instructions or parts lists can be obtained from your nearest Power Team facility.

SAFETY PRECAUTIONS

WARNING: To help prevent personal injury,

- **Before operating the pump, all hose connections must be tightened with the proper tools. Do not overtighten. Connections need only be tightened securely and leak-free. Overtightening may cause premature thread failure or high pressure fittings to split at pressures lower than their rated capacities.**
- **Should a hydraulic hose ever rupture, burst, or need to be disconnected, immediately shut off the pump and shift the control valve twice to release all pressure. Never attempt to grasp a leaking hose under pressure with your hands. The force of escaping hydraulic fluid could cause serious injury.**
- **Do not subject the hose to any potential hazard such as fire, extreme heat or cold, sharp surfaces, heavy impact. Do not allow the hose to kink, twist, curl, or bend so tightly that the fluid flow within the hose is blocked or reduced. Periodically inspect the hose for wear because any of these conditions can damage the hose and result in personal injury.**
- **Do not use the hose to move attached equipment. Stress may damage the hose and cause personal injury.**
- **Hose material and coupler seals must be compatible with the hydraulic fluid used. Hoses also must not come in contact with corrosive materials such as creosote-impregnated objects and some paints. Consult the manufacturer before painting a hose. Never paint the couplers. Hose deterioration due to corrosive materials may result in personal injury.**
- **All components in the hydraulic system must match the maximum pressure rating of the pump.**

Pump

- **Do not exceed the PSI rating noted on the pump nameplate or tamper with internal high pressure relief valve. Creating pressure beyond rated capacities may result in personal injury.**
- **Before adding hydraulic fluid, retract the system to prevent overfilling the pump reservoir. An overfill may cause personal injury due to excess reservoir pressure created when cylinders are retracted.**
- **The load must be under operator control at all times.**
- **Do not connect pump to hydraulic system powered by another pump.**

Cylinder

- **Do not exceed rated capacities of the cylinders. Excess pressure may result in personal injury.**
- **Do not set poorly-balanced or off-center loads on a cylinder. The load may tip and cause personal injury.**
- **Stay clear of lifted loads and keep others away.**
- **Extensions are not recommended for lifting applications.**

SET-UP

Hydraulic Connections

IMPORTANT: Seal all hydraulic connections with a high grade, nonhardening thread sealant. Teflon tape may also be used to seal hydraulic connections if only one layer of tape is used. Apply the tape carefully, two threads back, to prevent it from being pinched by the coupler and broken off inside the pipe end. Any loose pieces of tape could travel through the system and obstruct the flow of fluid or cause jamming of precision-fit parts.

1. Clean all areas around the fluid ports of the pump and cylinder. Clean all hose ends, couplers, and union ends. Remove thread protectors from the hydraulic fluid outlets, and connect the hose assembly. Couple hose to cylinder.
2. The use of a hydraulic pressure or tonnage gauge (not included) is strongly recommended. Remove the pipe plug from the gauge port of the valve, thread the gauge into this port and seal as noted above.

WARNING: To help prevent personal injury,

- **The gauge must have the same pressure rating as the pump and cylinder. Personal injury can result if the wrong gauge is used.**
- **Release hydraulic pressure BEFORE removing or tightening hose couplings.**

OPERATION

The P460 can be operated only in the horizontal position. All other hand pumps can be operated in a horizontal position or in a vertical position with head pointing downward.
Refer to Table 1 and your pump name plate to determine your style of pump.

IMPORTANT: Figure 1 illustrates the *normal* drop of handle effort experienced when all *(except P59)* two-stage pumps shift from low pressure stage to high pressure stage.

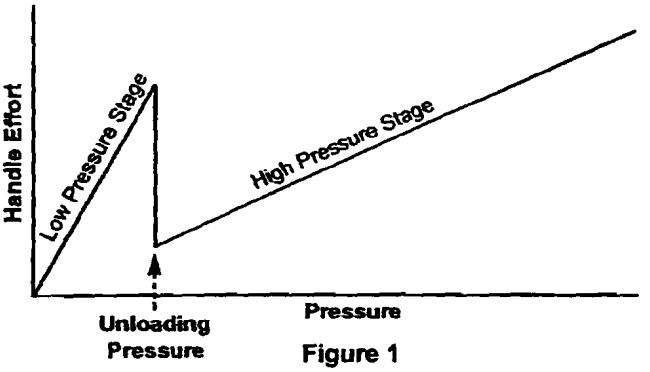


Figure 1

Two-way Valve
Pumps with a two-way valve are for use with single-acting cylinders.
1. To extend the cylinder, turn the valve knob counterclockwise to a closed (seated) position. **Note: Hand tight only!** Work the pump handle up and down to build pressure.
2. To release pressure, open the valve slowly by turning the knob clockwise to control the load.

Four-way Valve
Pumps with a three-position, four-way valve are for use with double-acting cylinders. The hose connection for extending a cylinder can be made to either port. With the handle in the forward position, the fluid is directed to the top fluid port. To maintain (hold) pressure, stop the pumping action. When the valve handle is in the center position, fluid flow is blocked to both ports.

WARNING: The operator should always release the pressure slowly.

PREVENTIVE MAINTENANCE

IMPORTANT: Any repair or servicing that requires dismantling the pump must be performed in a dirt-free environment by a qualified technician.

Note: Shaded areas reflect last revision(s) made to this form.

Lubrication

Apply lubricant regularly to all pivot and rubbing points.
Use a good grade of No. 10 motor oil or grease. Do not use dry lubricants.

Next Page

Bleeding Air From the System

Air can accumulate in the hydraulic system during the initial set-up or after prolonged use, causing the cylinder to respond slowly or in an unstable manner. To remove the air:
1. Position the cylinder at a lower level than the pump, and turn the cylinder rod end down.
2. Extend and retract the cylinder several times without putting a load on the system. Air will be released into the pump reservoir. Follow the fluid level instructions for your reservoir type to release the air from the reservoir and top off the fluid supply.

Bleeding Air From The Pump

When the pump is first put into use, or after refilling the pump's reservoir it may be necessary to bleed any trapped air from the pump. If this is not done the pump will not function properly (will not build pressure or has very spongy operation).
To bleed air from the pump, turn the pressure control knob counterclockwise (CCW) and operate the pump handle up and down approximately twenty times. Turn the pressure control knob clockwise (CW) to its full stop position. The pump should now be bled of air and ready to use.

PREVENTIVE MAINTENANCE -CONTINUED

Hydraulic Fluid Level

⚠ WARNING: Cylinder(s) must be fully retracted before checking the fluid level. Release all system pressure before breaking any hydraulic connection in the system.

Check the hydraulic fluid level in the reservoir periodically. Use a funnel with a filter to add hydraulic fluid if needed.

Refer to Table 1 for your reservoir type.

For models with Reservoir Type A: Place the pump in a vertical position with the pump head facing upward. Unscrew and remove the pump head from the reservoir. The fluid level within the reservoir should come to the fluid level mark indicated on the reservoir body decal. Before replacing the pump head, visually inspect the o-ring which seals the pump head/reservoir assembly. Replace this o-ring if it is worn or damaged. Reinstall pump head to reservoir and tighten securely. Check for leaks.

For models with Reservoir Type B: Remove the filler cap. The fluid level should come to the bottom edge of the filler hole when the pump is level and resting horizontally on its base and the cylinders are retracted (see Figure 2).

For models with Reservoir Type C: Remove the filler cap. The fluid level should be 1/2 inch (12.7 mm) from the filler hole when the pump is level and resting horizontally on its base and the cylinders are retracted.

IMPORTANT: The pump sight gauge indicates the presence of hydraulic fluid only. It does not determine correct fluid level.

For models with Reservoir Type D: Remove the filler cap. The fluid level should be 1/2 inch (12.7 mm) from the cover plate when the pump is level and resting horizontally on its base and the cylinders are retracted.

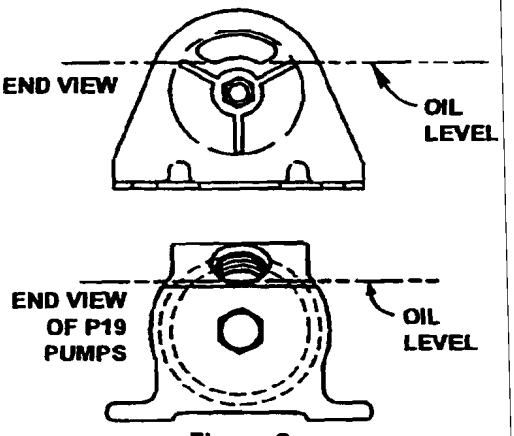


Figure 2

Draining And Flushing The Reservoir

Drain, clean and replenish the reservoir with high-grade, approved Power Team hydraulic fluid yearly or more often if necessary. The frequency of fluid change will depend upon the general working conditions, severity of use and overall cleanliness and care given the pump.

IMPORTANT: Clean the exterior of the pump first. After draining and flushing the reservoir, drain and clean the other hydraulic system components (hoses, cylinders, etc.) before connecting them to the pump again. This will help prevent contaminated fluid from entering the pump.

Refer to Table 1 for your reservoir type.

For models with Reservoir Type A:

1. Unthread and separate the pump head from the reservoir. Drain the reservoir of the used hydraulic fluid.
2. Flush out reservoir with a small amount of clean hydraulic fluid. Clean the pump intake filter.
   IMPORTANT: Removing the filter from the pump assembly could result in its breakage. Attempt to clean it as well as possible with it installed.
3. Refill the reservoir and reassemble the pump head to the reservoir. Tighten securely. Check for leaks.

For models with Reservoir Type B & C:

1. Remove the filler cap. Drain the hydraulic fluid through filler hole.
2. Remove the nut from the tie rod. Separate the reservoir from the pump body. Clean the reservoir and filter.
   IMPORTANT: Removing the filter from the pump assembly could result in its breakage. Attempt to clean it as well as possible with it installed.
3. Reassemble and fill the reservoir with Power Team hydraulic fluid. Replace the filler cap.

For models with Reservoir Type D:

1. Remove the ten screws fastening the reservoir cover to the reservoir, and lift the pump and valve assemblies off.
2. Drain all hydraulic fluid and flush reservoir with a small amount of clean hydraulic fluid.
3. Remove the pump assembly filter, rinse it clean, and reassemble.
4. Refill the reservoir with Power Team hydraulic fluid. Place the pump and valve assembly (with gasket) on the reservoir, and thread the ten screws. Tighten securely and evenly.

TROUBLESHOOTING GUIDE

WARNING: To help prevent personal injury, always release pump pressure and disconnect hoses(s) from pump before making repairs.

Refer to the appropriate pump parts list during trouble-shooting. Repairs must be performed in a dirt-free environment by qualified personnel familiar with this equipment.

PROBLEM	CAUSE	SOLUTION
Pump losing pressure	1. System components leaking 2. Directional control valve leaks or not adjusted properly 3. Fluid leaking past outlet check seat(s)	1. Repair or replace as necessary 2.* Reseat, repair, or replace directional control assembly and correctly adjust 3.* Check for dirt. Reseat pump body and/or replace poppet(s) or ball(s)
Handle rises after each stroke	1. Fluid leaking past outlet check seat(s)	1.* Check for dirt. Reseat pump body and/or replace poppet(s) or ball(s)
Pump not delivering fluid	1. Low fluid level in reservoir 2. Intake filter is dirty 3. Seats worn and not seating properly	1. Check fluid level per instructions 2. Remove reservoir and clean 3.* Repair seats or replace pump body
Pump does not reach full pressure	1. Low fluid level in reservoir 2. System components leaking 3. Directional control valve leaks or not adjusted properly 4. Improperly adjusted relief valve 5. Fluid leaking past inlet or outlet checks or high pressure piston seal damaged	1. Check fluid level per instructions 2. Repair or replace as necessary 3.* Reseat, repair, or replace directional control assembly and correctly adjust 4.* Readjust 5.* Reseat or repair inlet or outlet checks or replace high pressure piston seal
Pump handle can be pushed down (slowly) without raising the load	1. Inlet checks are not seating 2. Damaged piston assembly or piston seals leaking	1.* Check for dirt and/or reseat valve seats 2.* Replace piston assembly and/or piston seals
Pump handle operates with a spongy action	1. Air trapped in system 2. Too much fluid in reservoir	1. Position cylinder lower than pump. Extend and return cylinder several times. Follow bleeding instructions. 2. Check fluid level per instructions
Pump handle effort drops significantly after some pressure has been obtained	1. This is normal operation on most two-stage hand pumps	

*Power Team recommends these hand pump repairs be performed by an Authorized Hydraulic Service Center.

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***FAX:** 1-800-288-7031*
E-mail:
pwrteam@fluidpower.spx.com

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1-507-455-7775
***FAX:** 1-800-765-8326 or*
1-507-455-7160

International Sales:
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***FAX:** 1-507-455-7122*

For more information, Internet address: http://www.powerteam.com (or) http://www.hytec.com

SPX | POWER TEAM

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Netherlands

Telephone: 31 (45) 5678877
Fax: 31 (45) 5678878

EC Declaration of Incorporation

as defined by

European Communities Directive 89/392/EEC, Annex II(B)

MANUFACTURER'S NAME: SPX | POWER TEAM

MANUFACTURER'S ADDRESS: *2121 West Bridge Street*
Owatonna, Minnesota 55060
USA

Telephone: 507-455-7100
Fax: 507-455-7122

TYPE OF EQUIPMENT: SINGLE-STAGE and TWO-STAGE HYDRAULIC HAND PUMP.

ORDER NUMBER OR PART NUMBER: P12 Series, P19 Series, P23 Series, P30F Series, P300 & P300D Series, P157 & P157D Series, P159 & P159D Series, P460 Series, P55 Series, P59 & P59F Series.
Part numbers which start with the letter "Q" and contain the number listed above.

APPLICATION OF EC COUNCIL DIRECTIVE(S): 89/392/EEC as amended by 91/368/EEC, 93/44/EEC, and 93/68/EEC.

STANDARD(S) TO WHICH CONFORMITY IS DECLARED: EN292-1 and EN292-2.

I, the undersigned, hereby declare that the equipment specified above conforms to the above European Communities Directive(s) and Standard(s). This product is not to be put into service until the machine has been declared in conformity with the provisions of the European Communities Directive(s).

PLACE: *Owatonna, Minnesota USA*

DATE: Rev. 16 May 2000
(date / month / year)

Michael S O'Brien
(Signature)

Michael S. O'Brien
Director Quality / Technical Services

Appendix to 102842

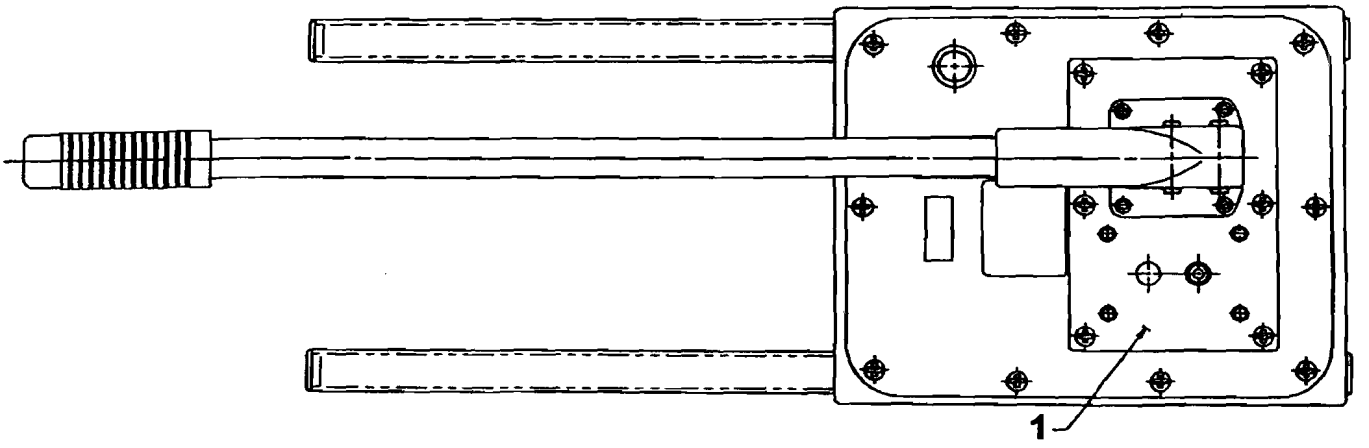
SPX Corporation
2121 West Bridge Street
Owatonna, MN 55060 USA
Phone: (507) 455-7100
Tech. Services: (800) 477-8326
Fax: (800) 765-8326
Order Entry: (800) 541-1418
Fax: (800) 288-7031

International Sales: (507) 455-7150
Fax: (507) 455-7122
Internet Address:
http://www.powerteam.com

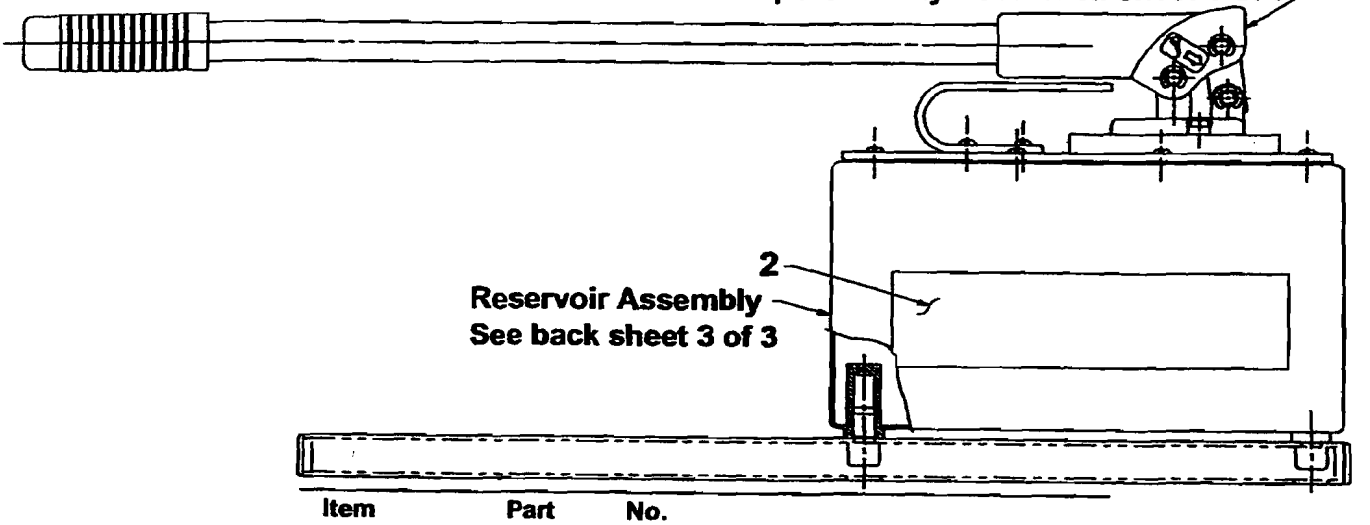
Parts List for:

P460 **P460D**
P460 Series **P460D Series**

MODEL D
TWO-STAGE HYDRAULIC HAND PUMP
GENERAL ASSEMBLY



Basic Pump Assembly - See back sheet 1 of 3



Item No.	Part No.	No. Req'd	Description
1	420295	1	Valve (3-way; For P460)
	9500	1	Valve (4-way; For P460D; See Form No. 101913)
2	309219CE	2	Trade Name Decal

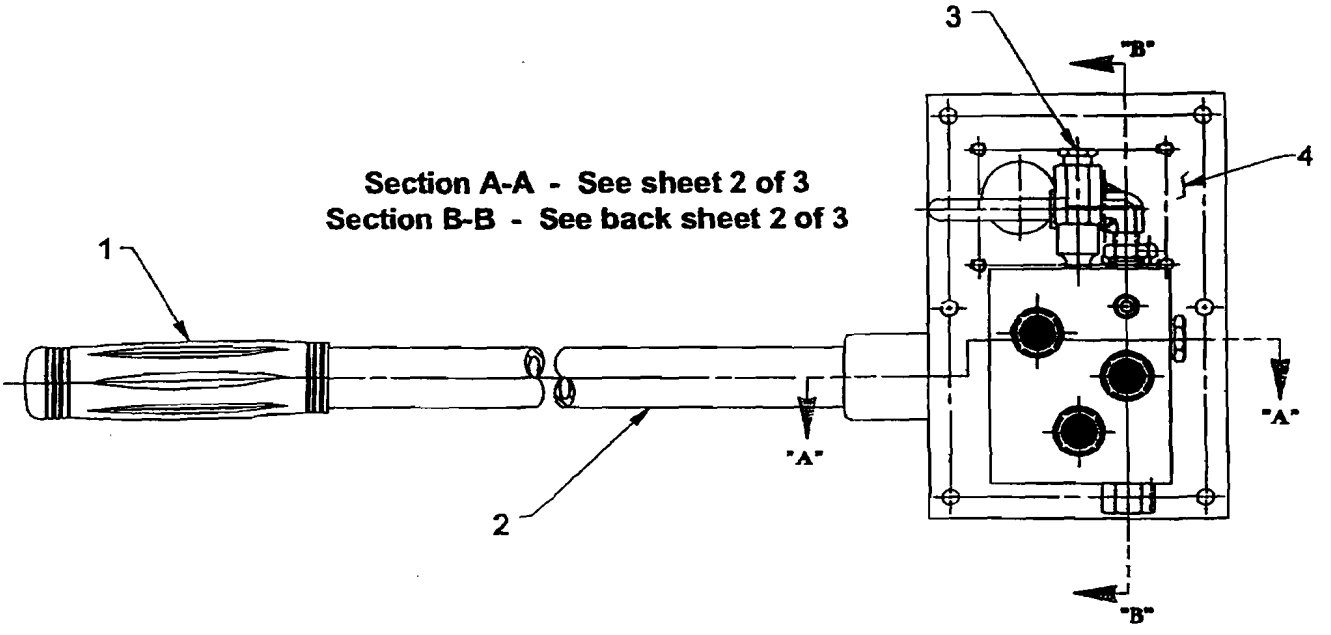
PARTS INCLUDED BUT NOT SHOWN

†205724	1	Attention Decal (Viton Seals)
•250328	1	Attention Decal (EPR Seals)
253234	1	Decal (Oil Pivot Pins)

Part numbers marked with a dagger (†) are contained in Viton Seal Repair Nit No. 300812.
Part numbers marked with a bullet (•) are contained in EPR Repair Kit No. 300813.

Litho in USA

BASIC PUMP ASSEMBLY

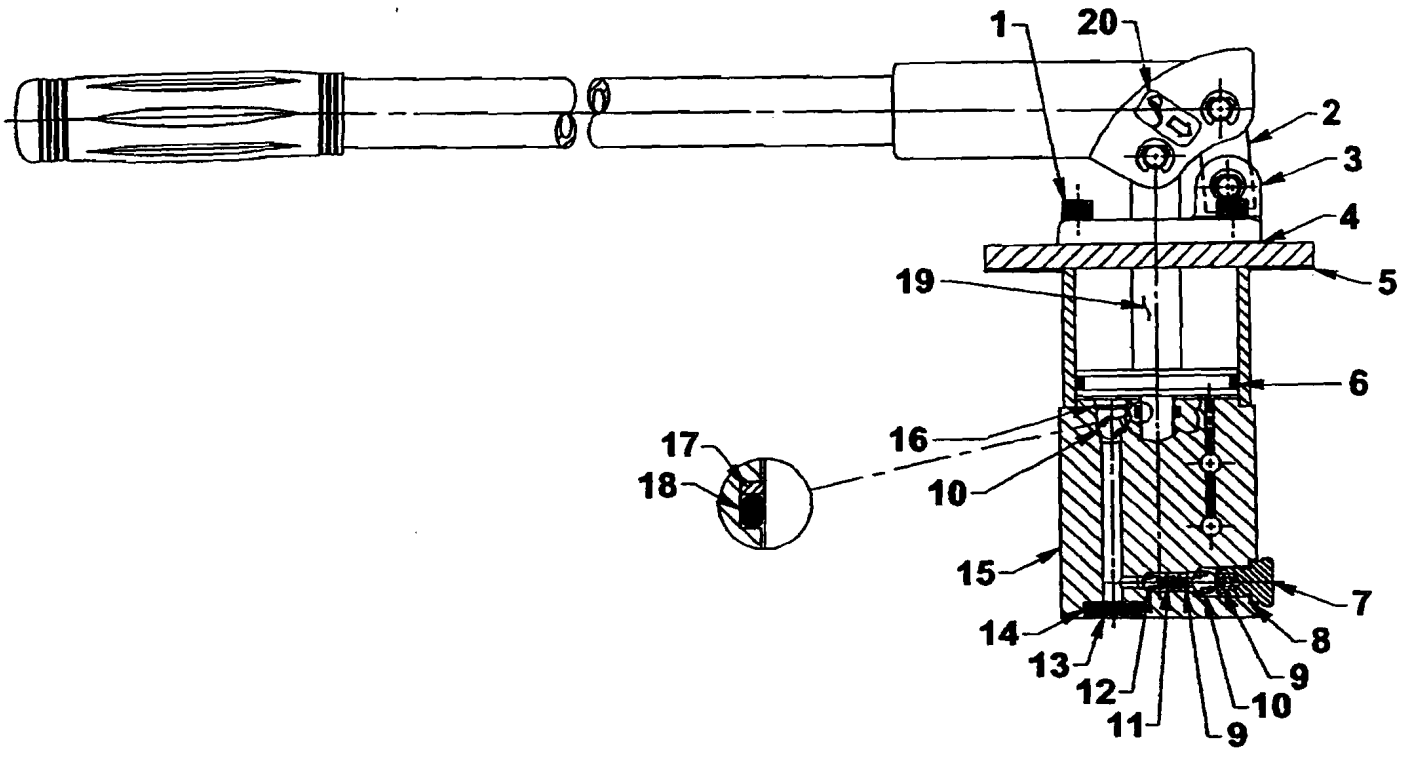


Item No.	Part No.	No. Req'd	Description
1	11390	1	Flex Grip Handle
2	30708	1	Handle
3	21278	1	Relief Valve Assembly (See note below)
4	420418GY8	1	Cover Plate

NOTE

Standard relief valves are set at 10,100/10,700 PSI.
Relief valves pre-set at special settings are available.
Refer to your pump model number or contact Power Team Technical Services.

SECTION A-A



Item No.	Part No.	No. Req'd	Description
1	250671	4	Screw (5/16-24 UNF x 3-1/2 Lg.; Torque to 240/250 in. lbs.) Note: Torque in increments of 100 in. lbs.
2	21603	1	Pivot Block
3	420978BK2	1	End Cap
4	•†*22143	1	End Cap Gasket
5	•†*30709	1	Reservoir Gasket
6	*10295	1	O-ring (2-1/2 x 2-1/4 x 1/8; Nitrile)
	†19040	1	O-ring (2-1/2 x 2-1/4 x 1/8; Viton)
	•251241	1	O-ring (2-1/2 x 2-1/4 x 1/8; EPR)
7	351952	1	Valve Screw (Torque to 480/500 in. lbs.)
8	•†*14874	1	Soft Copper Washer (.700 X 1/2 X 1/32)
9	•†*10444	1	Compression Spring (3/16 I.D. X 13/32 Lg.)

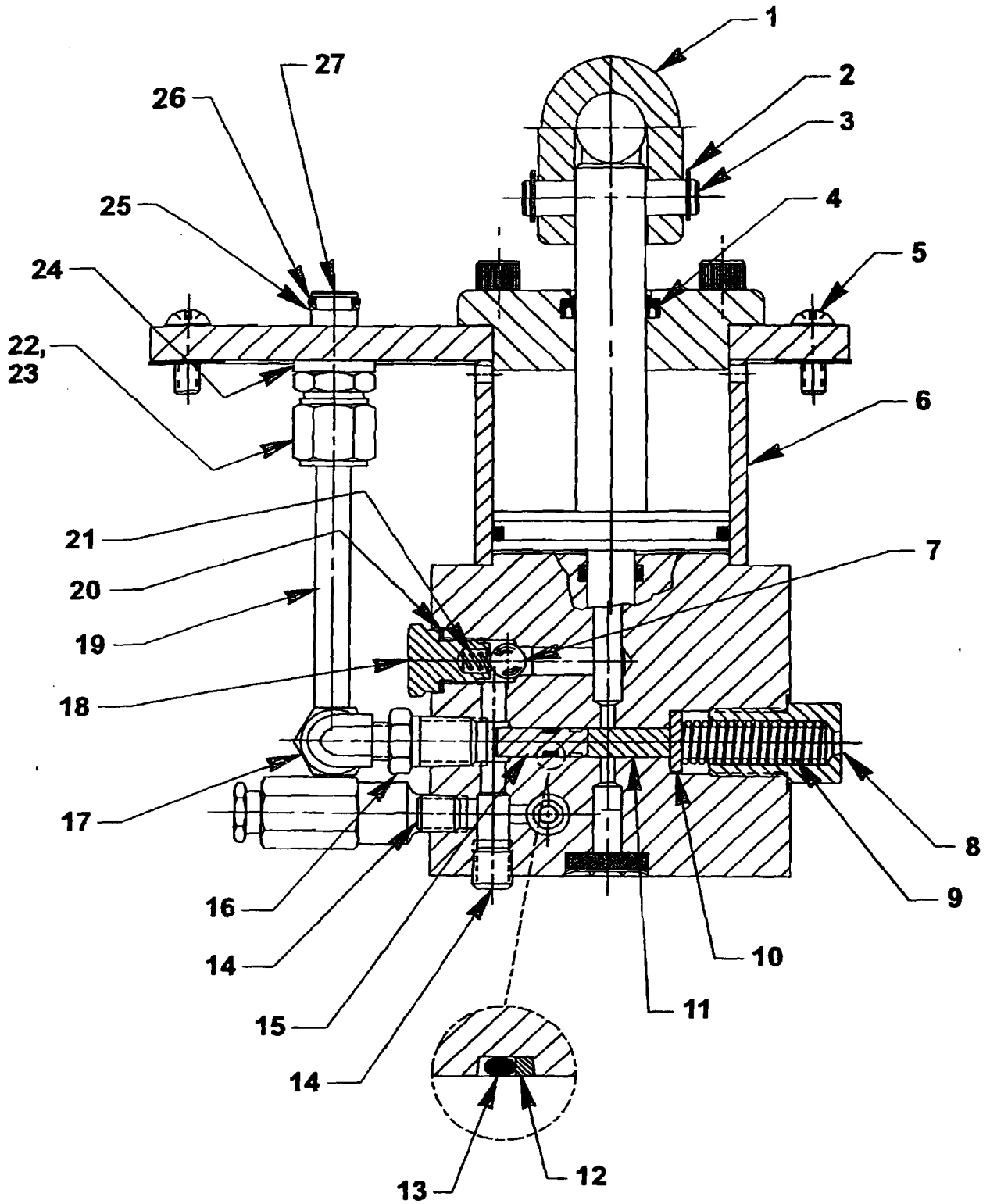
Item No.	Part No.	No. Req'd	Description
10	•†*10378	3	Steel Ball (3/8 dia.)
11	•†*211797	1	Spring (5/32 O.D. X 5/8 Lg.)
12	•†*10375	1	Steel Ball (1/4 dia.)
13	•†*214586	3	Retaining Ring (Internal)
14	•†*214578	3	Filter (Insert screen with cupped side in.)
15	64202	1	Pump Body
16	•†*250670	2	Retaining Ring
17	*12389	1	Backup Washer
	•†213987	1	Backup Washer (Assemble with concave surface towards o-ring.)
18	*11564	1	O-ring (11/16 X 1/2 X 3/32; Urethane)
	†11445	1	O-ring (11/16 X 1/2 X 3/32; Viton)
	•19406	1	O-ring (11/16 X 1/2 X 3/32; EPR)
19	253372	1	Piston Assembly
20	253234	1	Oil Pivot Pins Decal

Part numbers marked with an asterisk (*) are contained in Repair Kit No. 300811.
Part numbers marked with a dagger (†) are contained in Viton Seal Kit No. 300812.
Part numbers marked with a bullet (•) are contained in EPR Seal Kit No. 300813.

Note: Shaded areas reflect last revision(s) made to this form.

To Parts List

SECTION B-B



Item No.	Part No.	No. Req'd	Description
1	30701	1	Lever
2	11032	6	Retaining Ring
3	21609	3	Clevis Pin
4	*251728	1	Rod Wiper (Nitrile)
	†251729	1	Rod Wiper (Viton)
	•251730	1	Rod Wiper (EPR)
5	10177	6	Machine Screw (1/4-20 UNC X 3/4 Lg.)
6	350302	1	Spacer (Position of holes is to be at the top.)
7	•†*10378	1	Steel Ball (3/8 dia.)
8	308430	1	Unloading Valve Fitting
9	•†*10367	1	Compression Spring (1/2 O.D. x 2" Lg.)
10	214692	1	Disc
11	250672	1	Dowel Pin
12	•†*15174	1	Backup Ring (5/16 X 3/16 X 3/64)
13	*10265	1	O-ring (5/16 X 3/16 X 1/16; Nitrile)
	†11437	1	O-ring (5/16 X 3/16 X 1/16; Viton)
	•17714	1	O-ring (5/16 X 3/16 X 1/16; EPR)
14	10427	2	Pressure Plug
15	250658	1	Unloading Valve Piston
16	13269	1	Reducer Bushing
17	10475	1	Tube Elbow
18	305975	1	Valve Screw (Torque to 480/500 in. lbs.)
19	350340	1	Oil Line
20	14874	1	Soft Copper Washer (.700 X 1/2 X 1/32)
21	•†*10444	1	Compression Spring (3/16 I.D. X 13/32 Lg.)
22	10430	1	Tube Sleeve (3/8)
23	10431	1	Tube Nut (Torque to 40/50 ft. lbs.)
24	21484	1	Spacer
25	•†*11863	1	Backup Washer (1/2 X 3/8 X 1/16)
26	*10268	1	O-ring (1/2 X 3/8 X 1/16; Nitrile)
	†19775	1	O-ring (1/2 X 3/8 X 1/16; Viton)
	•17716	1	O-ring (1/2 X 3/8 X 1/16; EPR)
27	20787	1	Valve Connector (Torque to 20/30 ft. lbs.)

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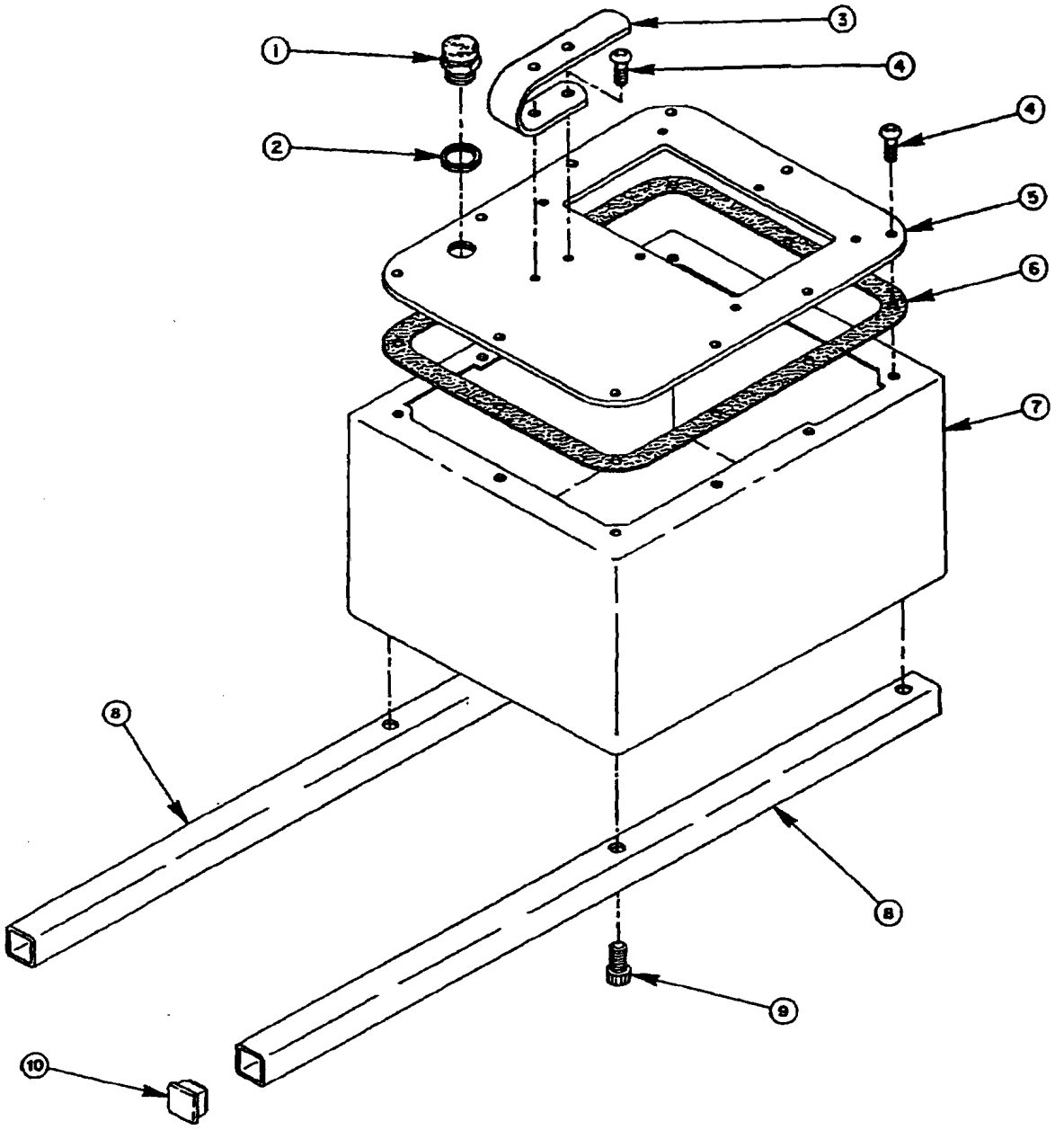
Part numbers marked with a dagger (†) are contained in Viton Seal Kit No. 300812.
Part numbers marked with a bullet (•) are contained in EPR Seal Kit No. 300813.

To Drawing

Note: Shaded areas reflect last revision(s) made to this form.

TWO GALLON RESERVOIR ASSEMBLY



Item No.	Part No.	No. Req'd	Description
1	251689	1	Filler/Vent Cap
2	*200415	1	O-ring (.81 x .62 Nitrile)
	†18999	1	O-ring (.81 x .62 Viton)
	•250157	1	O-ring (.81 x .62 EPR)
3	24066	1	Handle (Apply Permatex [or equiv.] between handle and cover plate.)
4	10177	12	Machine Screw (1/4-20 UNC x 3/4 Lg.)
5	41810WH2	1	Cover Plate

Item No.	Part No.	No. Req'd	Description
6	420484	1	Cover Gasket (Assemble gasket [with adhesive in contact with reservoir]. Apply Permatex [or equiv.] between gasket and cover plate.)
7	40063OR9	1	Reservoir
8	307569	2	Support Tube
9	213836	4	Soc. Hd. Cap Screw
10	12126	4	Plastic Tube Insert

Part numbers marked with an asterisk (*) are contained in Repair Kit No. 300811.
Part numbers marked with a dagger (†) are contained in Viton Seal Kit No. 300812.
Part numbers marked with a bullet (•) are contained in EPR Seal Kit No. 300813.

POWER TEAM
SPX Corporation
2121 West Bridge Street
Owatonna, MN 55060 USA
Phone: (507) 455-7100
Tech. Services: (800) 477-8326
Fax: (800) 765-8326
Order Entry: (800) 541-1418
Fax: (800) 288-7031
International Sales: (507) 455-7150
Fax: (507) 455-7122

OTC
SPX Corporation
655 Eisenhower Drive
Owatonna, MN 55060-0995 USA
Phone: (507) 455-7000
Tech. Services: (800) 533-6127
Fax: (800) 955-8329
Order Entry: (507) 455-1480
Fax: (800) 283-8665
International Sales: (507) 455-7223
Fax: (507) 455-7746

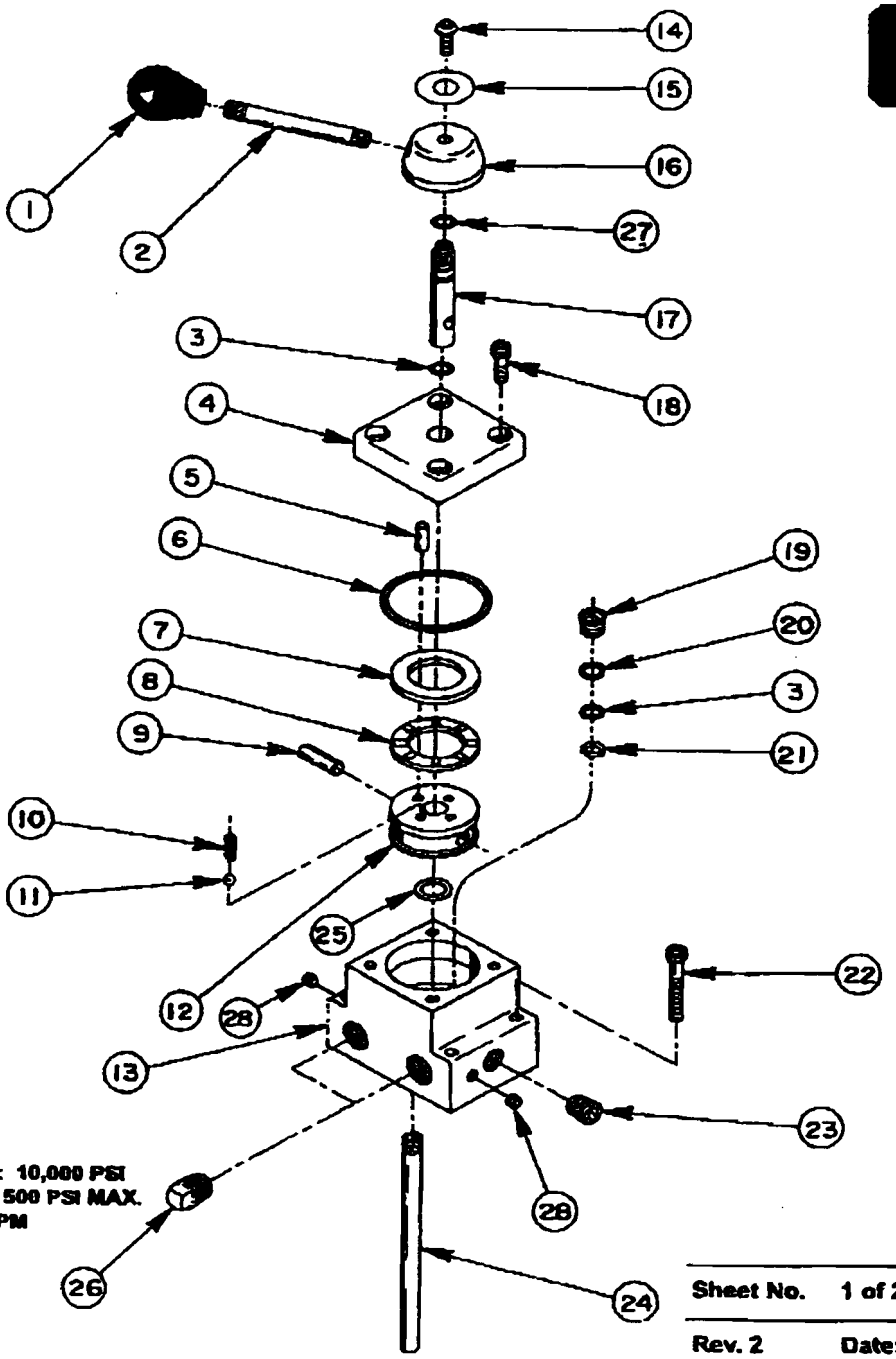
Form No. 100623

Parts List for:

9500
9501
R9500

VALVE ASSEMBLY

To Parts List



RATED PRESSURE: 10,000 PSI
CASE PRESSURE: 500 PSI MAX.
RATED FLOW: 5 GPM

Rev. 2 **Date: 13 Oct. 1998**

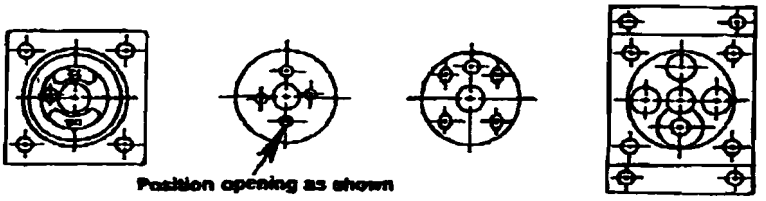
Litho in USA

Item No.	Part No.	No. Req'd	Description
1	211911	1	Plastic Knob
2	21639	1	Stud
3	*10268	4	O-ring (1/2 X 3/8 X 1/16; Nitrile)
	11439	4	O-ring (1/2 X 3/8 X 1/16; Viton)
	17716	4	O-ring (1/2 X 3/8 X 1/16; EPR)
4	61343	1	End Cap
5	211915	1	Pin
	250056	1	Pin (After 6-1-91)
6	*15892	1	O-ring (1.956 X 1.720 X .118; Nitrile)
	19097	1	O-ring (1.956 X 1.720 X .118; Viton)
	212887	1	O-ring (1.956 X 1.720 X .118; EPR)
7	11227-1	1	Thrust Bearing Washer
8	11228	1	Roller Thrust Bearing
9	16940	1	Roll Pin (5/16 dia. X 1-1/2 Lg.)
	10496	1	Roll Pin (5/16 dia. X 1" Lg.; After 6-1-91)
10	15691	1	Compression Spring (1/4 O.D. X 5/8 Lg.)
11	10375	1	Ball (1/4" Dia.)
12	471472	1	Rotor
13	61288	1	Valve Body
14	15911	1	Cap Screw (1/4-20 X 5/8 Lg.; Torque to 60/80 in. lbs.)
15	211936	1	Decal
16	46057	1	Stem End
17	46048	1	Stem
18	11013	4	Cap Screw (5/16-18 X 1" Lg.; Torque to 300/320 in. lbs.)
19	252450	3	Steel Seal
20	*11863	3	Backup Washer (1/2 X 3/8 X 1/16)
21	21975	3	Spring (.490 X .345 X .080 thk.)
22	10854	4	Cap Screw (1/4-20 UNC X 1-3/4" Lg.) Note: When using this valve on a PE30 Series pump, order (4) 12001 Screws for mounting valve to pump. OR When using this valve on a PE324-BID pump, order (4) 10855 Screws for mounting valve to pump.
23	14972	1	Pipe Plug (1/4 NPTF)
24	200609	1	Drain Tube
25	214891	1	Spacer
26	11127	2	Pipe Plug (3/8" NPTF)
27	213674	1	Shaft Seal (After 6-1-91)
28	15130	2	Pipe Plug (1/16 NPTF)

To Drawing

Part numbers marked with an asterisk (*) are contained in Repair Kit No. 300451.
Note: Alternate material seals listed for special valves factory equipped with viton or EPR seals.

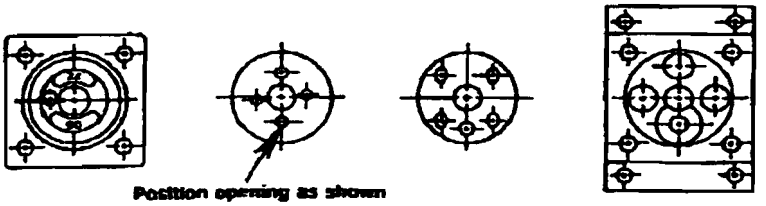
9500 & R9500
PUMP MOUNTED MANUAL DETENTED
3-Position, 4-Way Tandem Center Valve



FUNCTION
Center Position:
"A" and B" ports blocked "Pressure" Port to tank
"A" Position:
Pressure to "A" Port
"B" Port to tank
"B" Position:
Pressure to "B" Port
"A" Port to tank
NOTE: All ports open to tank during transition between valve positions.

SPECIFICATIONS

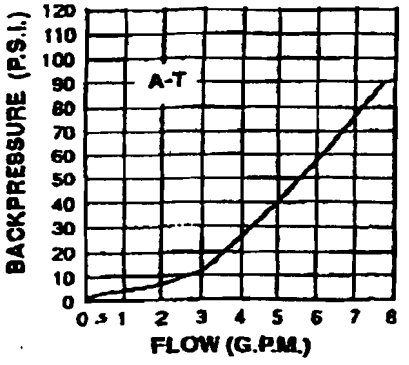
9501
PUMP MOUNTED MANUAL DETENTED
3-Position, 4-Way Closed Center Valve

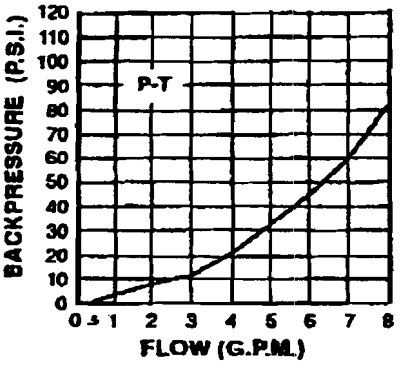


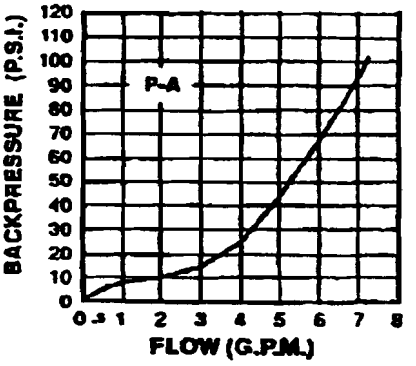
FUNCTION
Center Position:
All Ports blocked
"A" Position:
Pressure to "A" Port
"B" Port to tank
"B" Position:
Pressure to "B" Port
"A" Port to tank
NOTE: All ports open to tank during transition between valve positions.

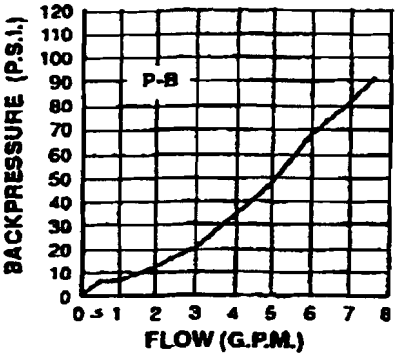
Note: Shaded areas reflect last revision(s) made to this form.

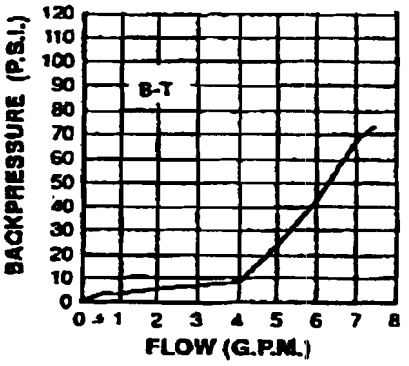
PRESSURE DROP AND FLOW CHARTS











Refer to any operating instructions included with this product for detailed information about operation, testing, disassembly, reassembly, and preventive maintenance.

Items found in this parts list have been carefully tested and selected. Therefore: Use only genuine replacement parts!

Additional questions can be directed to our Technical Services Department.

Safety Guide for Selecting and Using Hose, Fittings, and Related Accesssories

Parker Publication No. 4400-B.
Revised: February 199

⚠ **DANGER:** Failure or improper selection or improper use of hose, fittings, or related accessories can cause death, personal injury and property damage. Possible consequences of failure or improper selection or improper use of hose, fittings, or related accessories include but are not limited to:

- Fittings thrown off at high speed.
- High velocity fluid discharge.
- Explosion or burning of the conveyed fluid.
- Electrocution from high voltage electric power lines or other sources of electricity.
- Contact with suddenly moving or falling objects that are to be held in position or moved by the conveyed fluid.
- Dangerously whipping hose.
- Contact with conveyed fluids that may be hot, cold, toxic or otherwise injurious.
- Sparking or explosion caused by static electricity buildup.
- Sparking or explosion while paint or flammable liquid spraying.

Before selecting or using any Parker hose or fittings or related accessories, it is important that you read and follow the following instructions.

1.0 GENERAL INSTRUCTIONS

1.1 Scope: This safety guide provides instructions for selecting and using (including assembling, installing, and maintaining) hose (including all rubber and/or plastic products commonly called *hose* or *tubing*), fittings (including all products commonly called *fittings* or *couplings* for attachment to hose), and related accessories (including crimping and swaging machines and tooling). This safety guide is a supplement to and is to be used with, specific Parker publications for the specific hose, fittings and related accessories that are being considered for use.

1.2 Fail Safe: Hose and hose assemblies can and do fail without warning for many reasons. Design all systems and equipment in a fail-safe mode, so that failure of the hose or hose assembly will not endanger persons or property.

1.3 Distribution: Provide a copy of this safety guide to each person that is responsible for selecting or using hose and fitting products. Do not select or use hose and fittings without thoroughly reading and understanding this safety guide as well as the specific Parker publications for the products considered or selected.

1.4 User Responsibility: Due to the wide variety of operating conditions and uses for hose and fittings, Parker and its distributors do not represent or warrant that any particular hose or fitting is suitable for any specific end use system. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The user, through its own analysis and testing, is solely responsible for:

- Making the final selection of the hose and fitting.
- Assuring that the user's requirements are met and that the use presents no health or safety hazards.
- Providing all appropriate health and safety warnings on the equipment on which the hose and fittings are used.

1.5 Additional Questions: Call the appropriate Parker technical service department if you have any questions or require any additional information. See the Parker publication for the product being considered or used, for telephone numbers of the appropriate technical service department.

2.0 HOSE AND FITTING SELECTION INSTRUCTIONS

2.1 Electrical Conductivity: Certain applications require that a hose be nonconductive to prevent electrical current flow. Other applications require the hose to be sufficiently conductive to drain off static electricity. Extreme care must be exercised when selecting hose and fittings for these or any other applications in which electrical conductivity or nonconductivity is a factor. For applications that require hose to be electrically nonconductive, including but not limited to applications near high voltage electric lines, only special nonconductive hose can be used. The manufacturer of the equipment in which the nonconductive hose is to be used must be consulted to be certain that the hose and fittings that are selected are proper for the application. Do not use any Parker hose or fitting for any such application requiring nonconductive hose, including but not limited to applications near high voltage electric lines, unless (i) the application is expressly approved in the Parker technical publication for the product, (ii) the hose is both orange color and marked *nonconductive*, and (iii) the manufacturer of the equipment on which the hose is to be used specifically approves the particular Parker hose and fitting for such use.

The electrical conductivity or nonconductivity of hose and fittings is dependent upon many factors and may be susceptible to change. These factors include but are not limited to the various materials used to make the hose and the fittings, manufacturing methods (including moisture control), how the fittings contact the hose, age and amount of deterioration or damage or other changes, moisture content of the hose at any particular time and other factors.

Parker manufactures a special hose for conveying paint in airless paint spraying applications. This hose is labeled "Electrically Conductive Airless Paint Spray Hose" on its layline and on its packaging. This hose must be properly connected to Parker fittings and properly grounded in order to dissipate dangerous static charge buildup which occurs in all airless paint spraying. Do not use any other hose, even if electrically conductive, for airless paint spraying. Use of <u>any</u> other hose or failure to properly connect the hose can cause a fire or an explosion resulting in death, personal injury, and property damage.

Parker manufactures a special hose for certain compressed natural gas (CNG) applications where static electricity buildup may occur. This hose is labeled "Electrically Conductive for CNG Use" on its layline and on its packaging. This hose must be properly connected to Parker fittings and properly grounded in order to dissipate dangerous static charge buildup which occurs in, for example, high velocity CNG dispensing or transfer. Do not use any other hose, even if electrically conductive, for CNG transfer where static charge buildup may occur. Use of <u>any</u> other hose in such application or failure to properly connect this hose can cause a fire or an explosion resulting in death, personal injury, and property damage. Care must also be taken to protect against dangerous gas permeation through the hose wall. See section 2.6, Permeation, for more information.

2.2 Pressure: Hose selection must be made so that the published maximum recommended working pressure of the hose is equal to or greater than the maximum system pressure. Surge pressures in the system higher than the published maximum recommended working pressure will cause failure or shorten hose life. Do not confuse burst pressure or other pressure values for this purpose.

2.3 Suction: Hoses used for suction applications must be selected to insure that the hose will withstand the vacuum and pressure of the system. Improperly selected hose may collapse in suction applications.

2.4 Temperature: Be certain that fluid and ambient temperatures, both steady and transient, do not exceed the limitations of the hose. Care must be taken when routing hose near hot objects such as manifolds.

2.5 Fluid Compatibility: Hose selection must assure compatibility of the hose tube, cover, reinforcement, and fittings with the fluid media used. See the fluid compatibility chart in the Parker publication for the product being considered or used.

2.6 Permeation: Permeation (that is seepage through the hose) will occur from inside the hose to outside when hose is used with gases, liquid and gas fuels, and refrigerants (including but not limited to such materials as helium, fuel oil, natural gas, or Freon®). This permeation may result in high concentrations of vapors which are potentially flammable, explosive, or toxic, and in loss of fluid. Dangerous explosions, fires, and other hazards can result when using the wrong hose for such applications. The system designer must take into account the fact that this permeation will take place and must not use hose if this permeation could be hazardous. The system designer must take into account all legal, government, insurance, or any other special regulations which govern the use of fuels and refrigerants. Never use a hose even though the fluid compatibility is acceptable without considering the potential hazardous effects that can result from permeation through the hose assembly.

Permeation of moisture from outside the hose to inside the hose will also occur in hose assemblies, regardless of internal pressure. If this moisture permeation would have detrimental effects (particularly but not limited to refrigeration and air conditioning systems), incorporation of sufficient drying capacity in the system or other appropriate system safeguards should be selected and used.

Freon® is a registered trademark of the E. I. DuPont De Nemours Co. Inc.

2.7 Size: Transmission of power by means of pressurized fluid varies with pressure and rate of flow. The size of the components must be adequate to keep pressure losses to a minimum and avoid damage due to heat generation or excessive fluid velocity.

2.8 Routing: Attention must be given to optimum routing to minimize inherent problems (kinking or flow restriction due to hose collapse).

2.9 Environment: Care must be taken to ensure that the hose and fittings are either compatible with or protected from the environment (that is, surrounding conditions) to which they are exposed. Environmental conditions, including but not limited to ultraviolet radiation, sunlight, heat, ozone, moisture, water, salt water, chemicals, and air pollutants, can cause degradation and premature failure.

2.10 Mechanical Loads: External forces can significantly reduce hose life or cause failure. Mechanical loads which must be considered include excessive flexing, twisting, kinking, tensile or side loads, bend radius, and vibration. Use of swivel type fittings or adapters may be required to ensure no twist is put into the hose. Unusual applications may require special testing prior to hose selection.

2.11 **Physical Damage:** Care must be taken to protect hose from wear, snagging and cutting, which can cause premature hose failure

2.12 **Proper End Fitting:** See instruction 3.2 through 3.5 below. These recommendations may be substantiated by testing to industry standards such as SAE J517.

2.13 **Length:** When establishing a proper hose length, motion absorption, hose length changes due to pressure, and hose and machine tolerances must be considered.

2.14 **Specifications and Standards:** When selecting hose and fittings, government, industry, and Parker specifications and recommendations must be reviewed and followed as applicable.

2.15 **Hose Cleanliness:** Hose components may vary in cleanliness levels. Care must be taken to ensure that the assembly selected has an adequate level of cleanliness for the application.

2.16 **Fire Resistant Fluids:** Some fire resistant fluids require the same hose as petroleum oil. Some use a special hose, while a few fluids will not work with any hose at all. See instructions 2.5 and 1.5. The wrong hose may fail after a very short service. In addition, all liquids but pure water may burn fiercely under certain conditions, and even pure water leakage may be hazardous.

2.17 **Radiant Heat:** Hose can be heated to destruction without contact by such nearby items as hot manifolds or molten metal. The same heat source may then initiate a fire. This can occur despite the presence of cool air around the hose.

2.18 **Welding and Brazing:** When using a torch or arc welder in close proximity to hydraulic lines, the hydraulic lines should be removed or shielded with appropriate fire resistant materials. Flame or weld spatter could burn through the hose and possibly ignite escaping fluid resulting in a catastrophic failure. Heating of plated parts, including hose fittings and adapters, above 450° F (232° C) such as during welding, brazing, or soldering may emit deadly gases.

2.19 **Atomic Radiation:** Atomic radiation affects all materials used in hose assemblies. Since the long-term effects may be unknown, do not expose hose assemblies to atomic radiation.

3.0 HOSE AND FITTING ASSEMBLY AND INSTALLATION INSTRUCTIONS

3.1 **Pre-Installation Inspection:** Prior to installation, a careful examination of the hose must be performed. All components must be checked for correct style, size, catalog number and length. In addition, the hose must be examined for cleanliness, obstructions, blisters, cover looseness, or any other visible defects.

Hose and Fitting Assembly: Do not assemble a Parker fitting on a Parker hose that is not specifically listed by Parker for that fitting unless authorized in writing by the chief engineer of the appropriate Parker division. Do not assemble a Parker fitting on another manufacturer's hose or a Parker hose on another manufacturer's fitting unless (i) the chief engineer of the appropriate Parker division approves the assembly in writing, and (ii) the user verifies the assembly and the application through analysis and testing. See instruction 1.4 above.

The Parker published instructions must be followed for assembling the fittings on the hose. These instructions are provided in the Parker Fitting Catalog for the specific Parker fitting being used.

3.3 **Related Accessories:** Do not crimp or swage any Parker hose or fitting with anything but the proper listed Parker swage or crimp machine and dies and in accordance with Parker published instructions. Do not crimp or swage another manufacturer's hose fitting with a Parker crimp or swage die unless authorized in writing by the chief engineer of the appropriate Parker division.

3.4 **Parts:** Do not use any Parker hose fitting part (including but not limited to socket, shell, nipple, or insert) except with the correct Parker mating parts, in accordance with Parker published instructions, unless authorized in writing by the chief engineer of the appropriate Parker division.

3.5 **Reusable/Permanent:** Do not reuse any reusable hose product that was blown or pulled off a hose. Do not reuse a Parker permanent hose fitting (that is, crimped or swaged) or any part thereof.

3.6 **Minimum Bend Radius:** Installation of a hose at less than the minimum listed bend radius may significantly reduce the hose life. Particular attention must be given to preclude sharp bending at the hose/fitting juncture.

3.7 **Twist Angle and Orientation:** Hose installations must be such that relative motion of machine components do not produce twisting.

3.8 **Securement:** In many applications, it may be necessary to restrain, protect, or guide the hose to protect it from damage by unnecessary flexing, pressure surges, and contact with other mechanical components. Care must be taken to ensure such restraints do not introduce additional stress or wear points.

Proper Connection of Ports: Proper physical installation of the hose requires a correctly installed port connection while ensuring that no twist or torque is transferred to the hose.

3.10 **External Damage:** Proper installation is not complete without ensuring that tensile loads, side loads, kinking, flattening, potential abrasion, thread damage, or damage to sealing surfaces are corrected or eliminated. See instruction 2.10.

3.11 **System Checkout:** All air entrapment must be eliminated and the system pressurized to the maximum system pressure and checked for proper function and freedom from leaks. Personnel must stay out of potential hazardous areas while testing and using.

3.12 **Routing:** Hose should be routed in such a manner so if a failure does occur, oil mist will not come into contact with hot surfaces, open flame, or sparks, and the chance of personal injury is minimized.

4.0 HOSE AND FITTING MAINTENANCE INSTRUCTIONS:

4.1 Even with proper selection and installation, hose life may be significantly reduced without a continuing maintenance program. Frequency should be determined by the severity of the application and risk potential. A maintenance program must be established and followed by the user and must include the following as a minimum:

4.2 **Visual Inspection Hose/Fitting:** Any of the following conditions require immediate shut down and replacement of the hose assembly:

- Fitting slippage on hose.
- Damage, cut or abraded cover (any reinforcement exposed).
- Hard, stiff, heat cracked, or charred hose.
- Cracked, damaged, or badly corroded fittings.
- Leaks at fitting or in hose.
- Kinked, crushed, flattened or twisted hose.
- Blistered, soft, degraded, or loose cover.

4.3 **Visual Inspection All Other:** The following items must be tightened, repaired or replaced as required:

- Leaking port conditions.
- Remove excess dirt buildup.
- Clamps, guards, shieldss
- System fluid level, fluid type and any air entrapment.

4.4 **Functional Test:** Operate the system at maximum operating pressure and check for possible malfunctions and freedom from leaks. Personnel must avoid potential hazardous areas while testing and using.

4.5 **Replacement Intervals:** Specific replacement intervals must be considered based on previous service life, government or industry recommendations, or when failures could result in unacceptable downtime, damage, or injury risk. See instruction 1.2.

4.6 **Inspecting a Pressurized System:** Hydraulic power is accomplished by utilizing high-pressure fluids to do work. Hoses, fittings, and hose assemblies all contribute to doing work by transmitting fluids at high pressures. Fluids under pressure can be dangerous and potentially lethal and, therefore, extreme caution must be exercised when working with fluids under pressure and handling the hoses transporting the fluids. From time to time, hose assemblies will fail. Usually these failures are the result of some form of misapplication, abuse, or simply wear. When hoses fail, generally the high-pressure fluids inside escape in some sort of stream which may or may not be visible to the user. Under no circumstances should the user attempt to locate the leak by "feeling" with their hands or any other part of their body. High-pressure fluids can and will penetrate the skin and cause severe tissue damage and possibly loss of limb. Even seemingly minor hydraulic fluid injection injuries must be treated by a physician with knowledge of the tissue damaging properties of hydraulic fluid.

If a hose failure occurs, immediately shut down the equipment and leave the area until pressure has been completely released from the hose assembly. Simply shutting down the hydraulic pump may or may not eliminate the pressure in the hose assembly. Many times check valves, etc., are employed in a system and can cause pressure to remain in a hose assembly even when pumps or equipment are not operating. Tiny holes in the hose, commonly known as "pinholes," can eject small, dangerously powerful but hard to see streams of hydraulic fluid. It may take several minutes or even hours for the pressure to be relieved so that the hose assembly may be examined safely.

Once the pressure has been reduced to zero, the hose assembly may be taken off the equipment and examined. It must always be replaced if a failure has occurred. Never attempt to patch or repair a hose assembly that has failed. Consult the nearest Parker distributor or the appropriate Parker division for hose assembly replacement information.

Never touch or examine a failed hose assembly unless it is obvious that the hose no longer contains fluid under pressure. The high-pressure fluid is extremely dangerous and can cause serious and potentially fatal injury.

4.7 **Refrigerant Gases:** Special care should be taken when working with refrigeration systems. Sudden escape of refrigerant gases can cause blindness if the escaping gases contact the eye and can cause freezing or other severe injuries if it contacts any other portion of the body.

BEL-RAY

TOTAL PERFORMANCE

LUBRICANTS

DATA SHEET

24-HOUR EMERGENCY CONTACT
FOR ACCIDENTS OR SPILLS
CHEMTREC 1-800-424-9300
PRINT DATE: 10/30/97
REVISION DATE: 08/24/96

BEL-RAY
P.O. BOX 526
FARMINGDALE
N.J. 07727
(732)938-2421

SECTION 1

PRODUCT NUMBER : 6197
CHEMICAL NAME : MIXTURE
CHEMICAL FAMILY : LARGELY MINERAL OIL

PRODUCT NAME : BEL-RAY NO-TOX AW LUBE 10
HMIS RATING :

HEALTH 1
FIRE 1
REACTIVITY . . . 0

HMIS RATING SCALE	4 = EXTREME 3 = HIGH 2 = MODERATE 1 = SLIGHT 0 = INSIGNIFICANT

2 - COMPONENT INFORMATION

PROPRIETARY COMBINATION NOT TESTED AS A WHOLE FOR TOXICITY, THE CHEMICAL IDENTITIES ARE BEING WITHHELD PURSUANT TO THE TRADE SECRET EXEMPTION CONTAINED IN OSHA, 29CFR1910.1200 [1].

EXPOSURE LIMITS OF COMPONENTS

COMPONENTS	OSHA PEL	ACGIW TLU	ACGIW STEL	OTHERS
5123	5mg/M3+	5mg/M3+	10mg/M3+	-
5142	5mg/M3+	5mg/M3+	10mg/M3+	-

X - RECOMMENDED BY MANUFACTURER
+ - AS AN OIL MIST
N/E - NONE ESTABLISHED

SECTION 3 - PHYSICAL DATA

BOILING POINT : BROAD RANGE IBP > 550 F
VAPOR PRESSURE : @ 20 C < 0.01 MM HG
VAPOR DENSITY : > 10 TIMES THAT OF AIR
WATER SOLUBILITY : NEGLIGIBLE
APPEARANCE : WATER WHITE

SPEC. GRAV. : 0.86
% VOLATILE : NIL
EVAP. RATE : N/A
ODOR : ESSENTIALLY NONE
TLV : NOT ESTABLISHED

SECTION 4 - FIRE & EXPLOSION HAZARD DATA

FLASH POINT : 430 F
EXT. MEDIA : WATER FOG, CO2, DRY CHEMICAL
SPEC. FIRE FIGHTING PROC. 1: USE AIR SUPPLIED BREATHING APPARATUS FOR ENCLOSED AREAS
2:
UNUSUAL FIRE & EXT. HAZ. 1: NONE
2:

UP FLAM. LMT : 6%
LOW FLAME. LMT : 1%

SECTION 5 - HEALTH HAZARD DATA

EFFECTS OF OVER EXPOSURE

ROUTE OF ENTRY: INHALATION : IMPROBABLE SKIN: POSSIBLE INGESTION: POSSIBLE

NO ADVERSE EFFECTS KNOWN OR EXPECTED BASED ON TOXICITY, HOWEVER GOOD INDUSTRIAL HYGIENE PRACTICES ARE RECOMMENDED.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE.

UNDER NORMAL USE MEDICAL CONDITIONS GENERALLY ARE NOT AGGRAVATED BY EXPOSURE.

HEALTH HAZARDS OF COMPONENTS LISTED IN SECTION 2:

NOTE: NO COMPONENT IS DESCRIBED AS A CARCINOGEN OR POTENTIAL CARCINOGEN.
ANY PRODUCT CONTAINING A SUBSTANCE FOR WHICH OSHA HAS ESTABLISHED A PERMISSIBLE EXPOSURE LIMIT <PEL> IS CONSIDERED TO BE HAZARDOUS.

, IS AN EDIBLE MINERAL OIL THAT IS NON-TOXIC. HOWEVER, IF INHALED INTO THE LUNGS, IT CAN CAUSE LUNG DAMAGE THAT CAN LEAD TO CHEMICAL PNEUMONIA.

5142 IS CONSIDERED A NON-TOXIC MATERIAL. IT MAY BE A SLIGHT EYE IRRITANT.

EMERGENCY FIRST AID PROCEDURES:

INHALATION : - IMPROBABLE IN NORMAL USE. IF OVERCOME BY VAPORS OR OIL MIST REMOVE TO FRESH AIR.

INGESTION : - MAY BE IRRITATING TO THE GASTROINTESTINAL TRACT. SEEK MEDICAL HELP TO REMOVE RATHER THAN VOMITING, TO AVOID THE POSSIBILITY OF LUNG ENTRY, WHICH COULD BE HARMFUL.

SKIN : - WIPE AWAY EXCESS THEN WASH WITH SOAP AND WATER. SOAKED CLOTHING SHOULD BE LAUNDERED BEFORE RE-USE.

EYES : - FLUSH WITH WATER UNTIL REMOVED.

SECTION 6 - STABILITY

STABILITY	:	STABLE
INCOMPATIBILITY	:	STRONG OXIDANTS: CONCENTRATED OXYGEN & CHLORINE
POLYMERIZATION	:	NON-POLYMERIZING
THERMAL DECOMPOSITION	:	SMOKE, CO2, COMPOUNDS OF SULFUR, NITROGEN & PHOS.

SECTION 7 - SPECIAL PROTECTION PROCEDURES

VENTILATION PROCEDURE	:	IF MIST CREATES, DO NOT EXCEED ESTABLISHED TLV
GLOVES PROTECTION	:	OIL IMPERVIOUS, IF NEEDED
EYE PROTECTION	:	SAFETY GLASSES WITH EYE SHIELDS, IF NEEDED
OTHER PROTECTION	:	NONE

SECTION 8 - SPILL AND LEAK PROCEDURES

CONTAIN AND RECOVER: FOR LARGE SPILLS, VACUUM OR SHOVEL FREE FLUID INTO CONTAINERS AND APPLY OIL ABSORBING MATERIALS TO EFFECT COMPLETE CLEAN-UP.

WASTE DISPOSAL METHOD: INCINERATE IN AN APPROVED SYSTEM OR REMOVE TO A SUPERVISED LAND FILL.

SECTION 9 - SPECIAL PRECAUTIONS

STORE IN CLOSED CONTAINERS: DO NOT STORE WITH STRONG OXIDANTS SUCH AS CONCENTRATED OXYGEN AND CHLORINE.

OTHER PRECAUTIONS : "EMPTY" CONTAINERS RETAIN RESIDUE. DO NOT CUT, WELD OR EXPOSE TO SPARK OR FLAMES AS THEY MAY EXPLODE.

SECTION 10 - REGULATORY INFORMATION

SARA 311/312; 40 CFR 302: - NONE

SARA 313; 40 CFR 355 (EXTREMELY HAZARDOUS SUBSTANCES) : - NO COMPONENT LISTED

SARA 313; 40 CFR 372 (SPECIFIC CHEMICAL TOXIC LISTINGS) : - NONE.

U.S. TSCA INVENTORY: ALL COMPONENTS OF THIS MATERIAL ON THE TSCA INVENTORY.

DATE LAST PREPARED : 08/24/96
PREPARED BY THE DEPARTMENT OF REGULATORY AFFAIRS
FORMAT REVISED 10/15/98

POWER TEAM®

MARATHON LIFETIME™
WARRANTY
EFFECTIVE 4-1-84

All Power Team products and parts with the exception noted below, are warranted against defects in materials and workmanship for the life of the product or part. (The life of the product or part is defined as that point in time when it no longer functions due to normal wear.) This warranty does not cover any product or part that has been worn out, abused, heated, ground or otherwise altered, used for a purpose other than that for which it was intended, or used in a manner inconsistent with any instructions regarding its use. Chains, batteries, electric motors, gas engines, knives and cutter blades which are sold with Power Team products are not covered by this warranty. All electric motors and gas engines are separately warranted by their manufacturer under the conditions stated in their separate warranty.

Power Team's electronic products are warranted against defects in material and workmanship for one year.

To qualify for warranty consideration, return the Power Team product, freight prepaid, to a Power Team authorized repair center or to the Power Team factory. If any product or part manufactured by Power Team is found to be defective by Power Team, in its sole judgement, Power Team will, at its option, either repair or replace such defective product or part and return it via best ground transportation, freight prepaid. THIS REMEDY SHALL BE THE EXCLUSIVE REMEDY AVAILABLE FOR ANY DEFECTS IN THE PRODUCTS OR PARTS MANUFACTURED AND SOLD BY POWER TEAM OR FOR DAMAGES RESULTING FROM ANY OTHER CAUSE WHATSOEVER, INCLUDING WITHOUT LIMITATION, POWER TEAM'S NEGLIGENCE. POWER TEAM SHALL NOT, IN ANY EVENT, BE LIABLE TO ANY BUYER FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND, WHETHER FOR DEFECTIVE OR NON-CONFORMING GOODS, NEGLIGENCE, ON THE BASIS OF STRICT LIABILITY, OR FOR ANY OTHER REASON.

Power Team's warranty is expressly limited to persons who purchase Power Team's products or parts for the resale or use in the ordinary course of the buyer's business.

THIS WARRANTY IS EXCLUSIVE, AND POWER TEAM MAKES NO OTHER WARRANTY OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, WITH RESPECT TO THE PRODUCTS MANUFACTURED AND SOLD BY IT, WHETHER AS TO MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR ANY OTHER MATTER. No agent, employee or representative of Power Team has any authority to bind Power Team to any affirmation, representation, or warranty concerning Power Team products or parts, except as stated herein.

The purpose of this exclusive remedy shall be to provide the buyer with repair or replacement of products or parts manufactured by Power Team found to be defective in materials or workmanship or negligently manufactured. This exclusive remedy shall not be deemed to have failed of its essential purpose so long as Power Team is willing and able to replace said defective products or parts in the prescribed manner.

Warranty effective 4-1-84
Copies of this warranty are available from the factory upon request.

STAPDA ASSOCIATE

INDUSTRIAL DISTRIBUTORS

Service Availability

A world-wide network of Authorized Service Centers assures prompt, local parts and service access to the owner of Power Team products.

Distributor Network

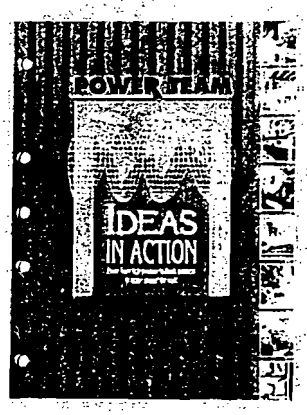
Power team considers the industrial distributor as the vital link in factory-to-customer communications and product availability. As a marketing-oriented manufacturer, Power Team is constantly seeking out industry's needs for work-saving new products and regards the industrial distributor as an important member of Power Team. Our trained force of factory representatives is at the disposal of distributor and customer alike.

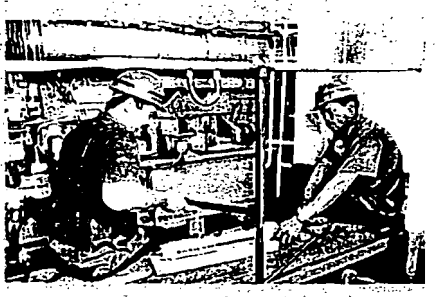
Are you a creative customer?

If you've come up with a creative new application of Power Team hydraulics to solve a unique problem, we'd like to hear about it! In fact, you could even win a $100 cash award for your entry! Just send a snapshot of the application and a brief write-up describing the problem and your solution using Power Team hydraulics. Each entry will be acknowledged and Power Team will be the sole authority in determining prize winners.

Ask for the Power Team Idea Book No. PTIB95

See creative ideas for uses of Power Team hydraulics.





Send your entry to:
Power Team
A division of SPX Corp.
2121 West Bridge St.
P.O. Box 993
Owatonna, MN 55060-0993 USA
Attn: Advertising Manager

2063 SOUTH DELLA LANE
ANAHEIM, CA 92802
TEL. 714-638-1774
FAX 714-638-9363
EMAIL: gwall@vovvalve.com
WEB: www.vovvalve.com

VoV® Enterprises, Inc.

VoV Enterprises, Inc. Warranty

EFFECTIVE 1/1/01.

WARRANTY ON THE VoVand VoSmart (V-SMART) VALVE (S) IS 1 YEAR FROM THE DATE OF RECEIPT OR INSTALLATION (RECEIPT + 6 MONTHS MAXIMUM) OF THE UNIT(S) AND COVERS MATERIALS AND WORKMANSHIP.

This warranty comprises the sole and entire warranty. Seal damage from dirt and debris along with damage due to improper handling are specifically not covered under this warranty.

To qualify for warranty consideration, return the Valve to one of our designated manufacturing facilities, freight prepaid, in **an original shipping container**. If the valve or part thereof, is found to be defective by VoV, in our sole judgement, VoV will repair or replace such defective item, part or valve and return it via best means of transportation, freight prepaid. VoV shall not be liable for any labor required to repair, remove or replace any product covered by this warranty. This warranty is void with respect to any such product which is altered or tampered with by anyone without prior consent of VoV Enterprises, Inc. VoV Industries, Inc. shall not be liable under any circumstances for damages caused by accident, misuse or abuse of the product or for failure to follow installation, maintenance or operating instructions. IN NO EVENT SHALL VoV NTERPRISES, INC. BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL, INDIRECT, PERSONAL INJURY, PROPERTY OR PUNITIVE DAMAGES. To make a claim under this warranty, the buyer must notify the factory in writing within ten (10) days of discovery of any claimed defects of workmanship, and if authorized by the factory, shall return the product in the same condition as when received by the buyer, transportation prepaid, to the factory or to such other location as directed by the factory. If said returned product is found by the factory to be defective in workmanship or materials, it shall be repaired or replaced without charge, pursuant to the terms of this warranty. This warranty excludes component parts or appurtenances not manufactured by VoV Enterprises, Inc.

No agent, employee or representative of VoV has any authority to bind VoV to any affirmation, representation or warranty concerning VoV products or parts except as stated herein.

This agreement shall be governed in all respects by the law in the state of incorporation (Nevada).

WARRANTIES AND PRODUCT LIABILITIES ON THE HYDRAULIC COMPONENTS AND POWER UNITS ARE PROVIDED THROUGH THEIR RESPECTIVE MANUFACTURERS.

VoV Enterprises, Inc
2063 S DELLA LANE
ANAHEIM, CA 92802-3108

Email: gwall@vovvalve.com
Web: www.vovvalve.com

INSTALLATION GUIDE VARIABLE ORIFICE VALVE

DECEMBER 2002

ARCADIS G&M, Inc.

LOCKHEED MARTIN CORPORATION SITE GREAT NECK, NY

2063 SOUTH DELLA LANE
ANAHEIM, CA 92802
TEL. 714-638-1774
FAX 714-638-9363
EMAIL: gwall@vovvalve.com
WEB: www.vovvalve.com

VoV® Enterprises, Inc.

VoV Valve Installation Procedure W/ Manual Power Unit Revised 2/20/01

To begin with we recommend that you verify that the following items are on or near the jobsite:

1. Control valve(s). Figure #1. See Shop Drawings for details of specific size valve.
2. Installation Drawing. Figure #2
3. Power Unit. Figure #3 & #4
4. A pair of hose assemblies (one hose should be 6" longer, identify this hose with a blue tie wrap on each end) with metal plugs installed in the SS fittings. The length to run from the valve to the Power Unit or wellhead. Figure #5
5. 2-Strain Relief Cord Grips for each hose through the well plate. Hubble # SHC-1035-CR or Grainger #5D886. Figure #5.
6. Mineral Oil SAE 10. McMaster-Carr #1499K11 (Gallon container) or 1400K15 (5 gallon container)
7. SS Straps with rubber pads for clamping the hoses to the column pipe @ 20' O.C. Figure #5 or equal.
8. Recommended Centralizer, at each coupling. By RACI. From PWM, 1-800-517-0395. Figure #7.
9. Installation sheave (pulley 2' in Diameter and 2" wide) for hose support during installation and to eliminate the possibility of kinking the hose.
10. Shop drawings.
11. Field crew that has reviewed shop drawings and installation recommendations in installing the various valves and components. (Factory supervision of installation is available during installation).

The hoses should be laid in a figure 8 pattern or if on a spool, have both ends free so that the hoses may be flushed and filled with hydraulic fluid (Mineral Oil).

A. Fill Power Unit with Mineral Oil: Figure #4.
B. Install the Power Unit Components. Torque Quick Coupler 2-3 turns past finger tight. Figure #5. Before attaching the hoses to this assembly, verify that the cap(s) are tight

(11 # feet of torque), fill the power unit with mineral oil, pump the power unit and verify that the pressure relief valve is correctly set at 4000 PSI.

C. Place the V-Smart Valve on its side with wooden blocks with stops on each side of the valve and under each end coupling of the valve (this will hold the valve in position).
D. Remove one of the caps on the male JIC fittings and attach one end of the hose to the "B" port. Torque JIC fitting to 11-12 FT./LB.
E. Attach a blue tie wrap for color-coding to the male end of the Quick Coupler, the female end of the Quick Coupler and both ends of the hose.
F. Remove the plug on the other end of the hose and verify the correct identification with the tie wrap. You may need to remove plugs on this end.
G. Pump Power Unit and flush and fill the hose with Mineral Oil, allow at least a quart of oil to waste to flush the fluid used for factory testing.
K. Attach the other end of the hose to the lower fitting of the valve (blue tie wrap).
L. Repeat I through L for the other hose to port "A" with no tie wraps.
M. Loosen the one of fittings at the valve and Pump Power Unit to bleed the air from this connection. Repeat this operation with the other fitting.
N. If the valve operates smoothly go to item "O".
O. Position the valve vertically with the hoses above the valve cycle the valve from full open to full closed. At the end of the cycle allow the valve to set for 15 minutes. This allows the air bubbles to rise above the valve. Leave the valve in the full open position to protect the seal surface of the shaft.
P. Cycle the valve from full open to full closed. Leave the valve in the full open position to protect the seal surface on the fixed section.
Q. Disconnect the Power Unit from the hoses and replace the caps and plugs for now.
R. The valve is ready to install.
S. Connect the valve to the pipe above the check valve using food grade anti-seize compound for stainless steel (SAF-T-ESE) McMaster-Carr #1494K14 or equal.
T. Attach the first section of pipe above the valve. Use anti-seize compound.
U. Repeat for each joint of pipe and attach the hose to the pipe with SS straps and 1/8" rubber pads just above each coupling. Figure # 5 or # 6.
V. Attach the wellhead assembly.
W. Feed the hoses through the well plate and install the strain relief.
X. Complete the piping.
Y. Connect the hoses to the Power Unit or Wellhead Components.
Z. *When using the wellhead components, bleed the hoses as before then attach the hoses to the wellhead components and use the bleed adapters, as you would bleed a brake cylinder.*

The Valve installation is complete; the valve may be operated manually to fully close the valve. Pump the hand pump and close the valve the pressure gage will read 1000-3000 PSI during closing and recharging. When the valve is closed the pressure gage will read ~4000 PSI (pressure relief). This completes the installation.

Congratulations You Have Done A Great Job.

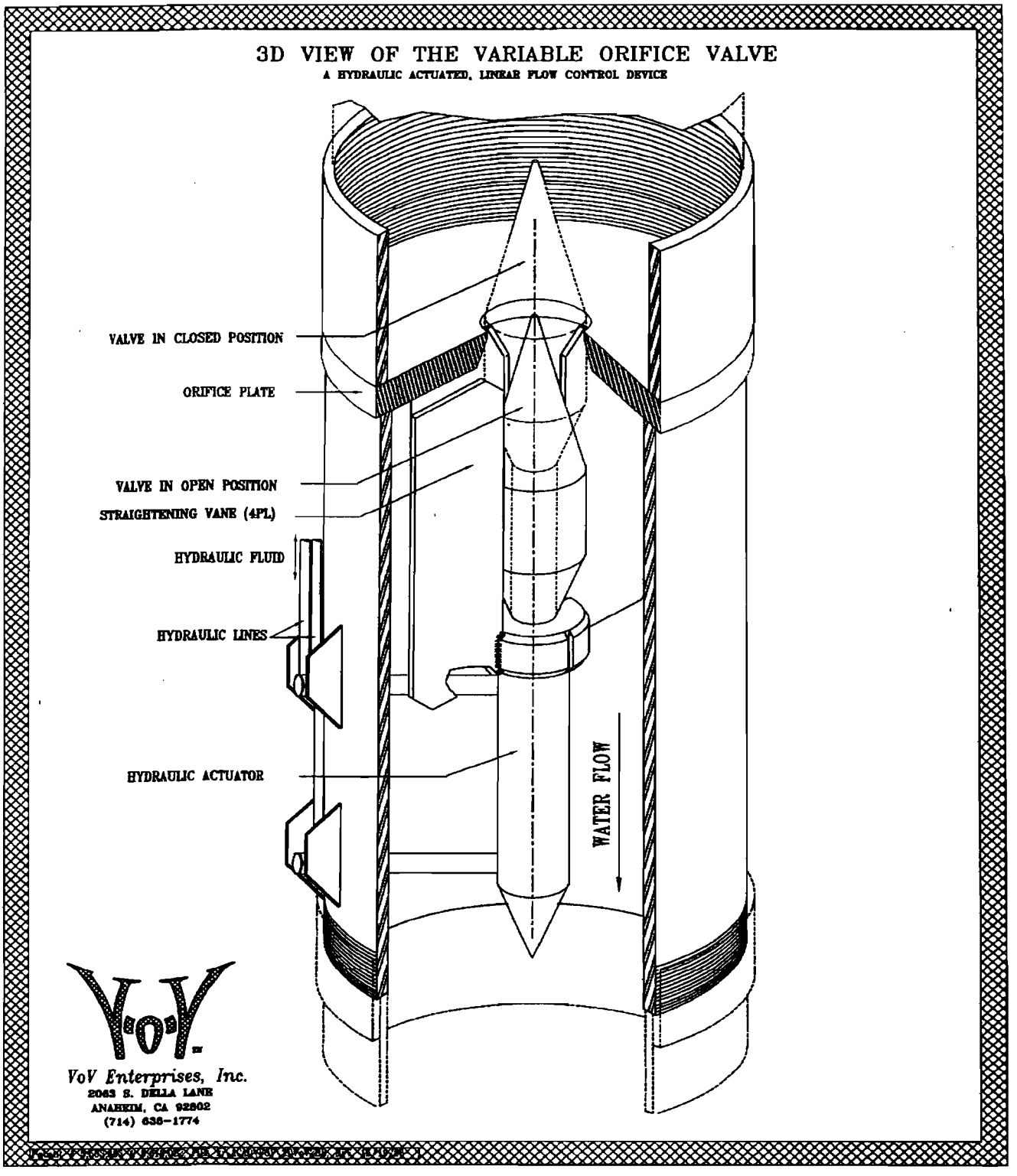

3D VIEW OF THE VARIABLE ORIFICE VALVE
A HYDRAULIC ACTUATED, LINEAR FLOW CONTROL DEVICE
VALVE IN CLOSED POSITION
ORIFICE PLATE
VALVE IN OPEN POSITION
STRAIGHTENING VANE (4PL)
HYDRAULIC FLUID
HYDRAULIC LINES
HYDRAULIC ACTUATOR
WATER FLOW
VoV Enterprises, Inc.
2063 S. DELLA LANE
ANAHEIM, CA 92802
(714) 638-1774

FIGURE #1

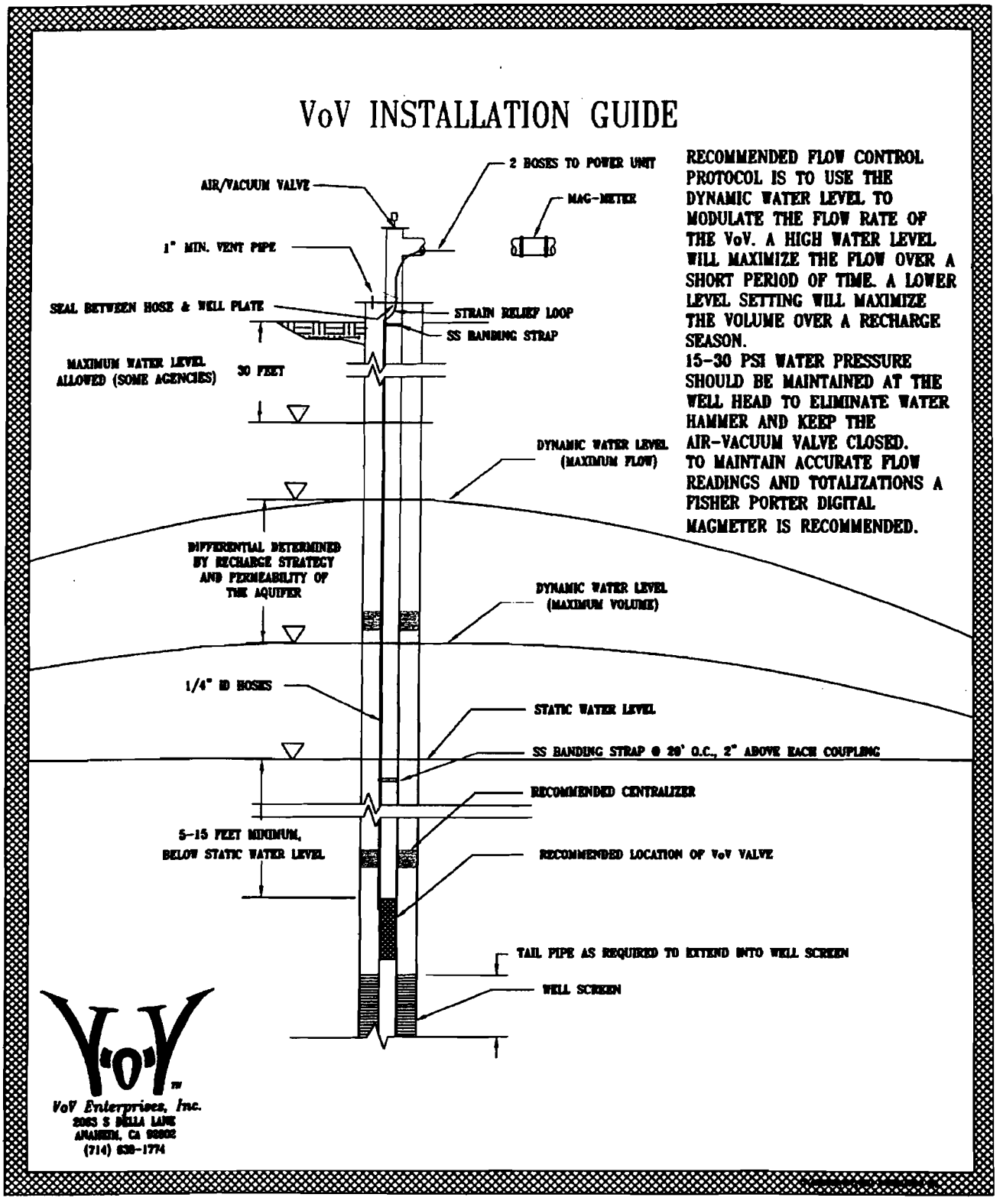
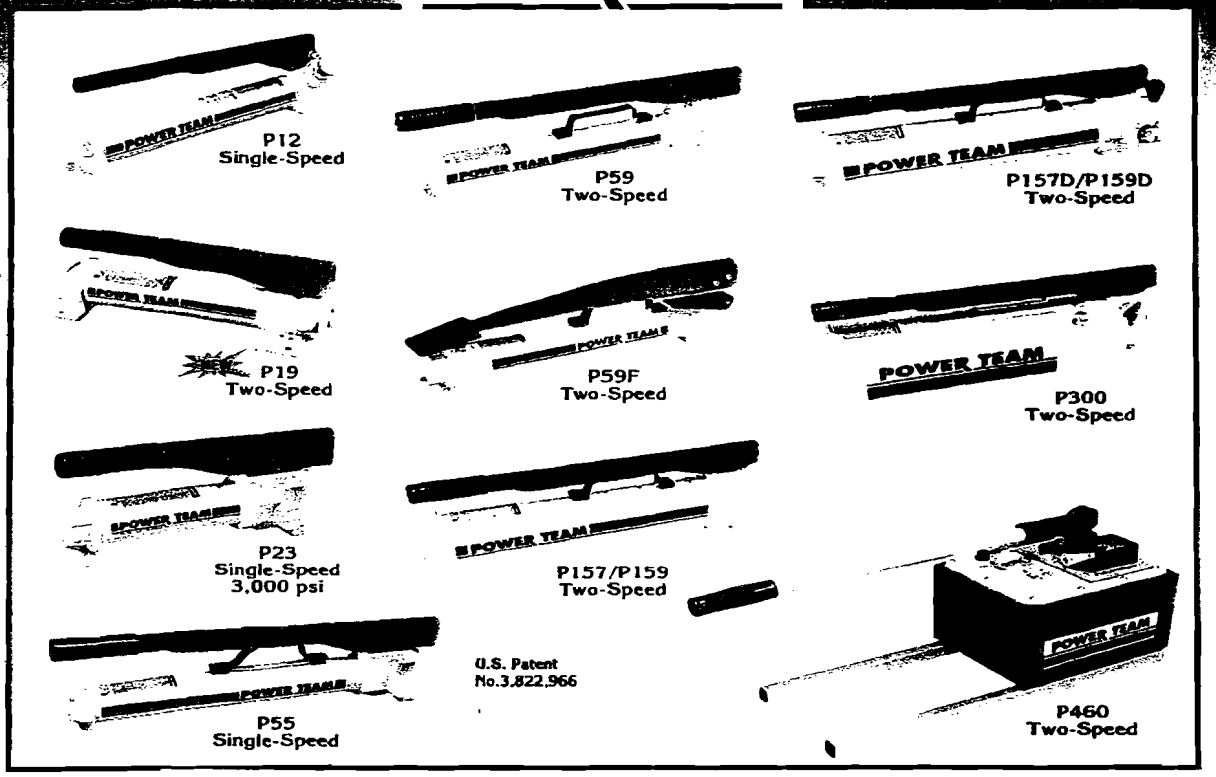

VoV INSTALLATION GUIDE
2 HOSES TO POWER UNIT
AIR/VACUUM VALVE
MAG-METER
1" MIN. VENT PIPE
SEAL BETWEEN HOSE & WELL PLATE
STRAIN RELIEF LOOP
SS BANDING STRAP
MAXIMUM WATER LEVEL ALLOWED (SOME AGENCIES)
30 FEET
DYNAMIC WATER LEVEL (MAXIMUM FLOW)
DIFFERENTIAL DETERMINED BY RECHARGE STRATEGY AND PERMEABILITY OF THE AQUIFER
DYNAMIC WATER LEVEL (MAXIMUM VOLUME)
1/4" ID HOSES
STATIC WATER LEVEL
SS BANDING STRAP @ 20' O.C., 2" ABOVE EACH COUPLING
RECOMMENDED CENTRALIZER
5-15 FEET MINIMUM, BELOW STATIC WATER LEVEL
RECOMMENDED LOCATION OF VoV VALVE
TAIL PIPE AS REQUIRED TO EXTEND INTO WELL SCREEN
WELL SCREEN
RECOMMENDED FLOW CONTROL PROTOCOL IS TO USE THE DYNAMIC WATER LEVEL TO MODULATE THE FLOW RATE OF THE VoV. A HIGH WATER LEVEL WILL MAXIMIZE THE FLOW OVER A SHORT PERIOD OF TIME. A LOWER LEVEL SETTING WILL MAXIMIZE THE VOLUME OVER A RECHARGE SEASON.
15-30 PSI WATER PRESSURE SHOULD BE MAINTAINED AT THE WELL HEAD TO ELIMINATE WATER HAMMER AND KEEP THE AIR-VACUUM VALVE CLOSED.
TO MAINTAIN ACCURATE FLOW READINGS AND TOTALIZATIONS A FISHER PORTER DIGITAL MAGMETER IS RECOMMENDED.
VoV Enterprises, Inc.
2083 S BELLA LANE
ANAHEIM, CA 92802
(714) 630-1774

FIGURE #2



Hydraulic Hand Pumps

10,000 psi capacity.

Single or two-speed versions available for use with single or double acting cylinders.

Up to 2½ gallon reservoir capacity.

All develop up to 10,000 psi (except P23) and can operate horizontally or vertically with the pump in the down position (except 460 series). All pumps have an internal safety relief valve. Hydraulic accessories shown on pages 60 thru 70.

P12 Single-Speed Pump

For use with single-acting cylinders. Features a finger-tip control valve for instant release or pumping action. Non-vented reservoir. max. handle effort is 80 lbs.

P19 Two-Speed Pump

For use with single-acting cylinders. All metal construction, max. handle effort is 90 lbs.

P23 Single-Speed Pump

For use with single-acting cylinders. Compact pump similar to P55 with a relief valve setting of 3000 psi non-vented reservoir. max. handle effort is 70 lbs.

P55 Single-Speed Pump

For use with single-acting cylinders. Features a finger-tip control valve for instant release or pumping action. All metal construction, carrying handle and large oil fill port. Non- vented reservoir, max. handle effort is 140 lbs.

P59 Two-Speed Pump

For use with single-acting cylinders. features a finger-tip control valve for instant release or pumping action. All metal construction, carrying handle and large oil fill port. Non-vented reservoir. max. handle effort is 140 lbs.

P59F 2-Speed Foot Pump

For use with single-acting cylinders. features foot or hand operated press-to-release valve. Aluminum body and lever, steel reservoir, carrying handle and large oil fill port. Non-vented reservoir, maximum lever effort is 120 lbs.

P157 & P159 Two-Speed Pumps

For use with single-acting cylinders. All metal construction, carrying handle and large oil fill port. Non-vented reservoir. max. handle effort is 130 lbs.

P157D & P159D Two-Speed Pumps

For use with double-acting cylinders. Same features as P157 & P159 except P157D & P159D have 4-way tandem center valves.

P300 Two-Speed Pump

For use with single-acting cylinders. Same as P159 except it has a large 1½ gal. reservoir with sight gauge.

P300D Two-Speed Pump

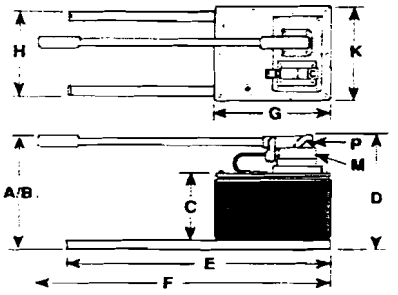
For use with double-acting cylinders. Same as P159D except it has a large 1½ gal. reservoir with sight gauge.

P460 Series Two-Speed Pumps

P460 for use with single-acting cyl. All metal construction, carrying handle and large 2½ gal. reservoir. Max. handle effort is 90 lbs.

P460D, same as P460 except for use with double-acting cylinders. Uses 4-way valve No. 9500.

FIGURE #3



DIMENSIONS (inches)

Pump No.	A	B	C	D	E	F	G	H	J	K	L	M	N	P
P12	4	—	—	4	13½	3⅜	2 3/16	—	45°	3/16	3⅜	—	1⅛	—
NEW P19	5½	14⅜	2⅜	4 3/16	13 11/16	4	3¼	11 1/16	53°	3/16	4	⅜ NPTF	1 3/32	—
P23	6¼	13	3½	5 3/16	13⅜	4½	3¼	10 9/32	38°	3/16	4⅜	⅜ NPTF	1⅜	—
P55	6½	21	3½	5 3/16	23	4½	3¼	19¾	38°	3/16	4⅜	⅜ NPTF	1⅜	—
P59	7	21	3½	5	23	4½	3¼	19¾	38°	3/16	4½	⅜ NPTF	1⅜	—
P59F	3½	16½	3½	6	23½	4½	3¼	20½	—	3/16	4½	⅜ NPTF	1 1/16	—
P157/ P159	7¾	20½	4⅜	6⅜	22½	3⅜	3	19¾	39°	7/16	3½	⅜ NPTF	2⅛	—
P300	8¼	21	4½	6⅜	22⅞	8½	7½ / 3	20 21/32	39°	3/16	3½	⅜ NPTF	2⅛	—
P460	11⅜	31	6½	11⅜	24	29¼	11	9	80°	9½	—	⅜ NPTF	—	½"

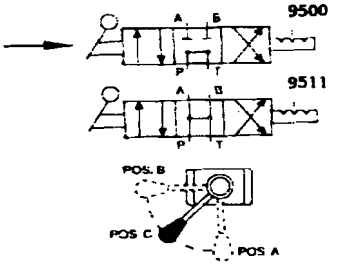
Valves for Double-Acting Cylinders, Manually Operated

9506 4-way, 3-position (tandem center) with "posi-check"

This pump-mounted, manually operated valve is designed for use with double-acting cylinders. It is a detented 4-way, 3-position tandem center valve with "advance," "hold" and "return" positions. A subplate is provided for pump mounting or it can be remote mounted with the 9510 subplate. A pressure switch and/or gauge may be added. Port size is ⅜" NPTF. Maximum operating pressure is 10,000 psi and max. flow rate is 5 gpm.

Double-Acting Cyl.	P1590	4-way	1st. 325 psi 2nd. 10,000 psi	2.60 160	152 cu. in.	137 cu. in.	⅜" NPTF	27.9
Single-Acting Cyl.	P300	2-way			1.0 cu. in.	.310 cu. in.		55.3
Double-Acting Cyl.	P300D	4-way						57.0
Single-Acting Cyl.	P460	2-way		7.35 .294	2½ cu. in.	.460 cu. in.		54.9
Double-Acting Cyl.	P460D	4-way (9500)						57.9

9500 4-way, 3-position (tandem center)



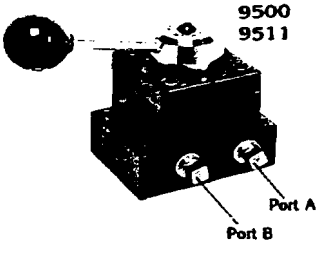
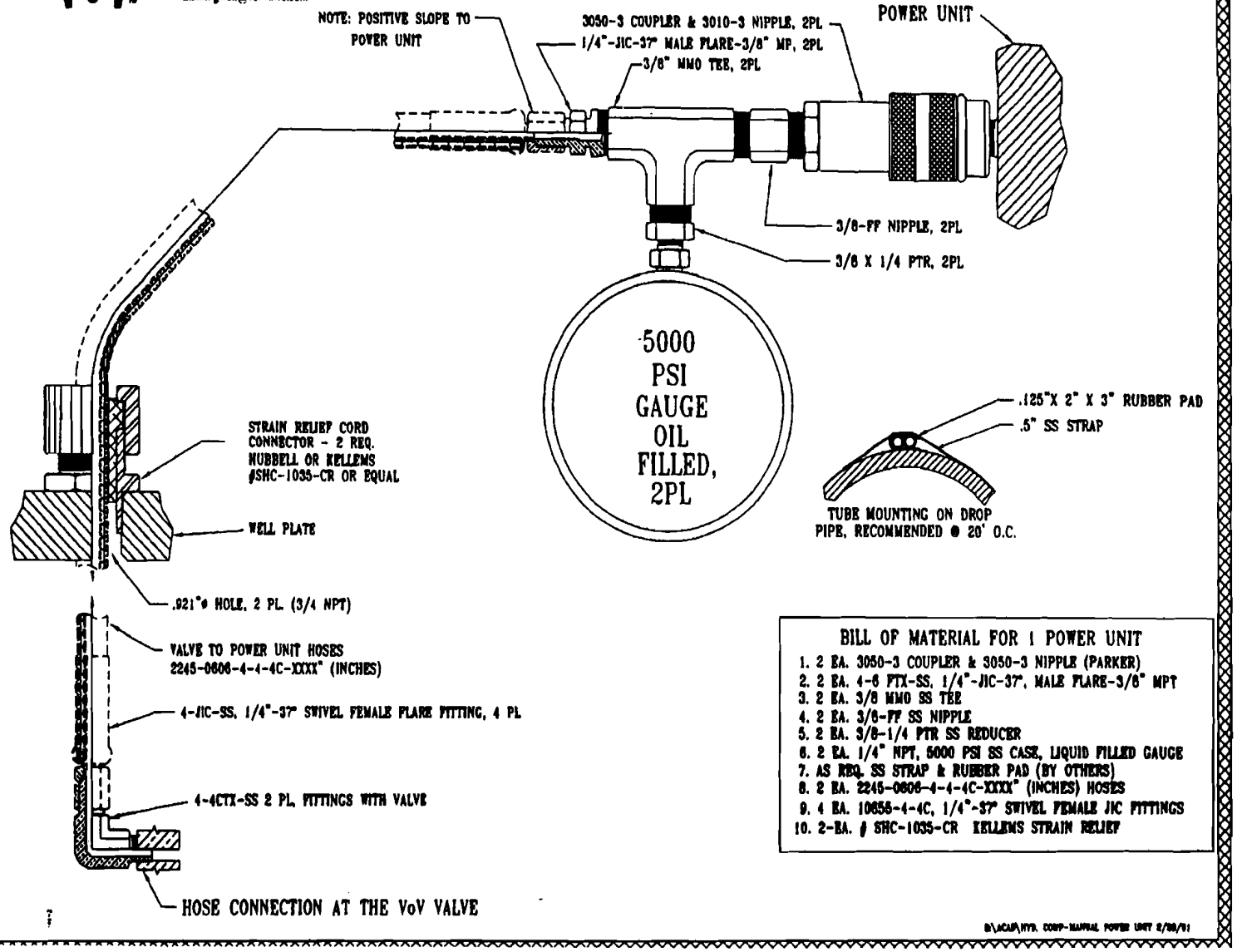


FIGURE #4

VoV Enterprises, Inc
2063 S DELLA LANE
ANAHIEM, CA 92802-3108
(714) 638-1774, FAX(714) 638-9363
Email: gwall@vovvalve.com

HYDRAULIC COMPONENTS AT THE VoV VALVE
MANUAL POWER UNIT



BILL OF MATERIAL FOR 1 POWER UNIT

1. 2 EA. 3050-3 COUPLER & 3050-3 NIPPLE (PARKER)
2. 2 EA. 4-6 FTX-SS, 1/4"-JIC-37°, MALE FLARE-3/8" MPT
3. 2 EA. 3/8 MMO SS TEE
4. 2 EA. 3/8-FF SS NIPPLE
5. 2 EA. 3/8-1/4 PTR SS REDUCER
6. 2 EA. 1/4" NPT, 5000 PSI SS CASE, LIQUID FILLED GAUGE
7. AS REQ. SS STRAP & RUBBER PAD (BY OTHERS)
8. 2 EA. 2245-0606-4-4-4C-XXXX" (INCHES) HOSES
9. 4 EA. 10655-4-4C, 1/4"-37° SWIVEL FEMALE JIC FITTINGS
10. 2-EA. # SHC-1035-CR KELLEMS STRAIN RELIEF

B:\ACAD\VVE. CORP-MANUAL POWER UNIT 2/28/01

FIGURE #5

CENTRALIZER

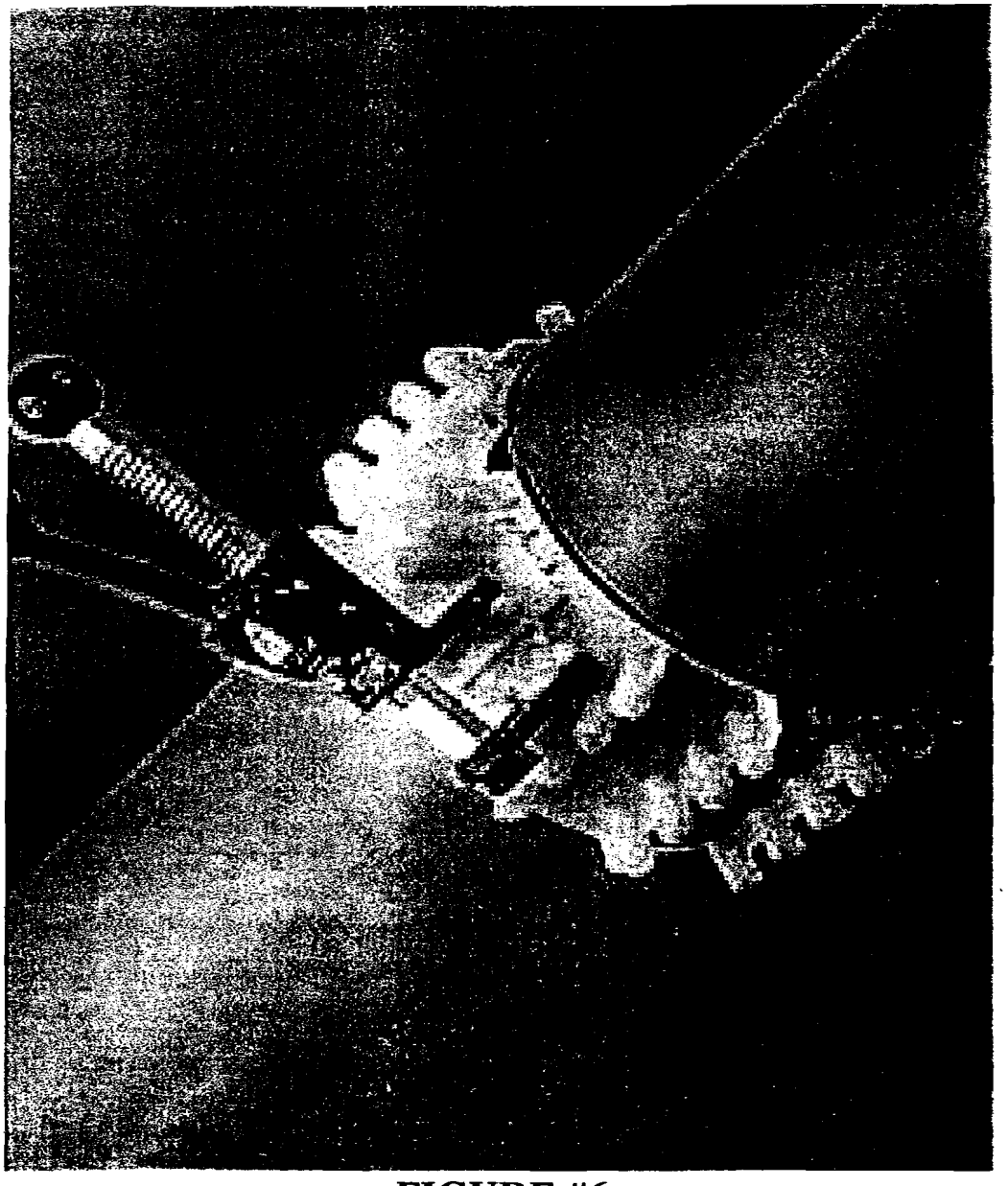
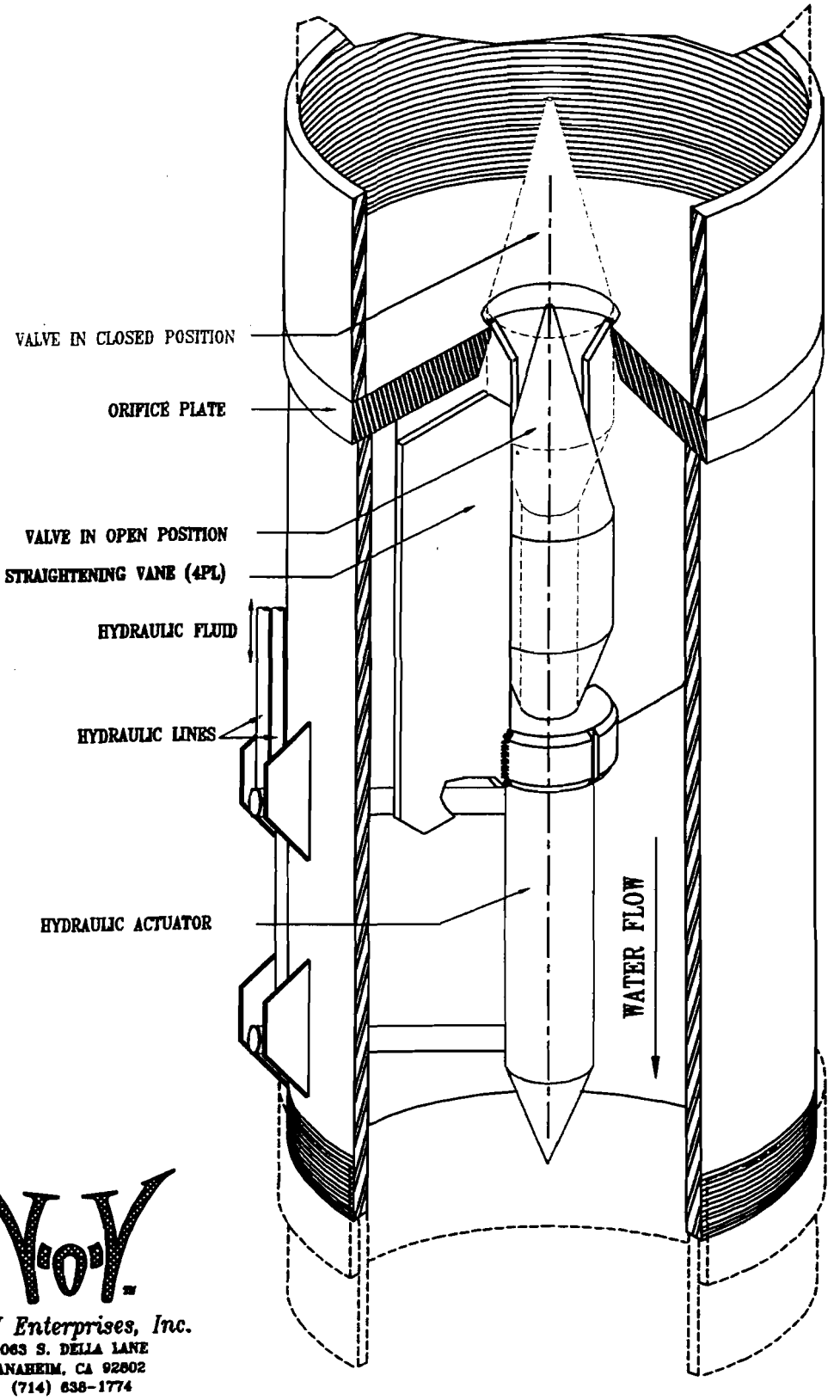


FIGURE #6

3D VIEW OF THE VARIABLE ORIFICE VALVE

A HYDRAULIC ACTUATED, LINEAR FLOW CONTROL DEVICE



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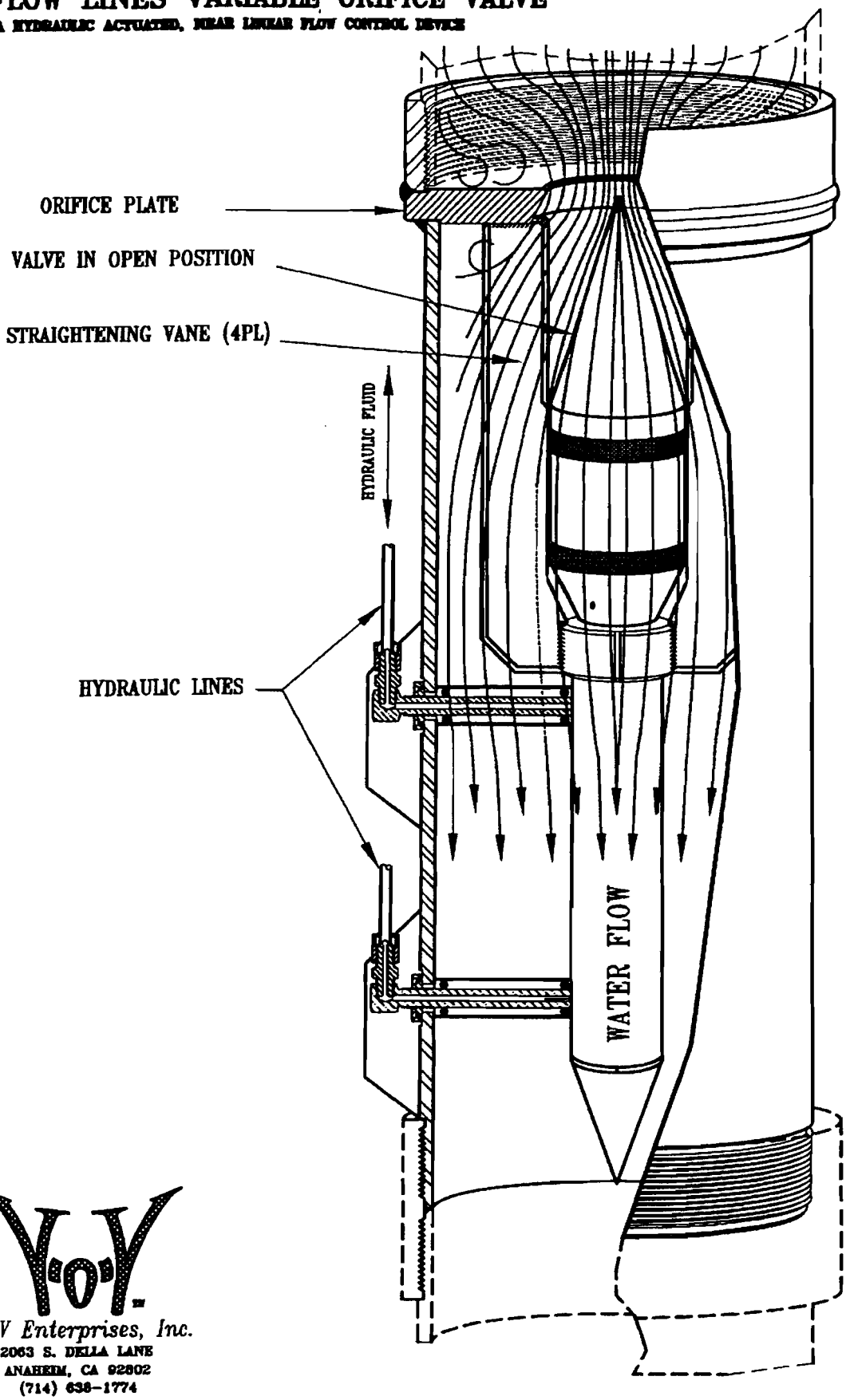
FLOW LINES VARIABLE ORIFICE VALVE

A HYDRAULIC ACTUATED, NEAR LINEAR FLOW CONTROL DEVICE



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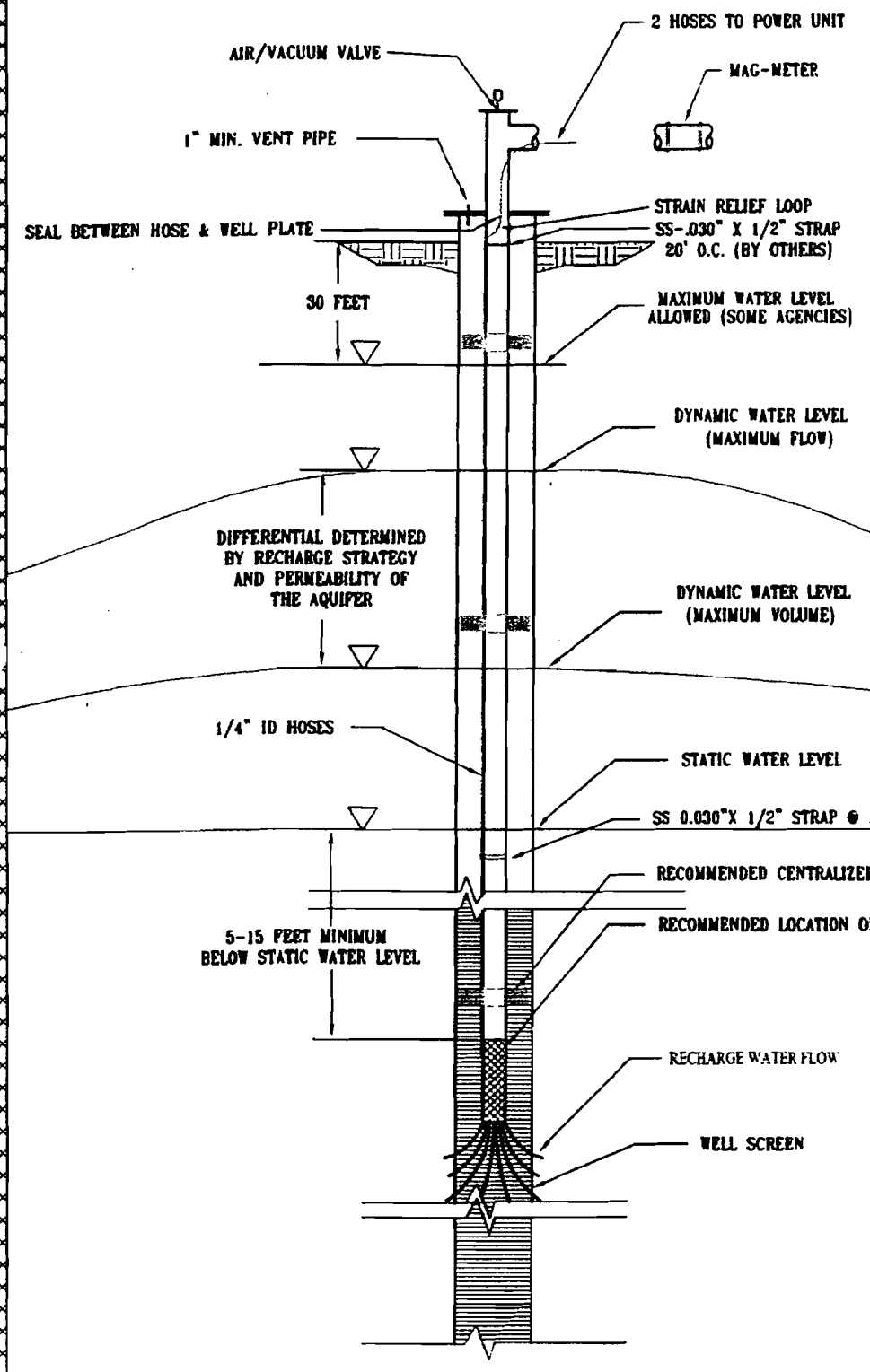
(714) 638-1774

VoV INSTALLATION GUIDE



RECOMMENDED FLOW CONTROL PROTOCOL IS TO USE THE DYNAMIC WATER LEVEL TO MODULATE THE FLOW RATE OF THE VoSMART. A HIGH WATER LEVEL WILL MAXIMIZE THE FLOW OVER A SHORT PERIOD OF TIME. A LOWER LEVEL SETTING WILL MAXIMIZE THE VOLUME OVER A RECHARGE SEASON.
15-30 PSI WATER PRESSURE SHOULD BE MAINTAINED AT THE WELL HEAD TO ELIMINATE WATER HAMMER AND KEEP THE AIR-VACUUM VALVE CLOSED.
TO MAINTAIN ACCURATE FLOW READINGS AND TOTALIZATIONS. A FISHER PORTER DIGITAL MAGMETER IS RECOMMENDED.

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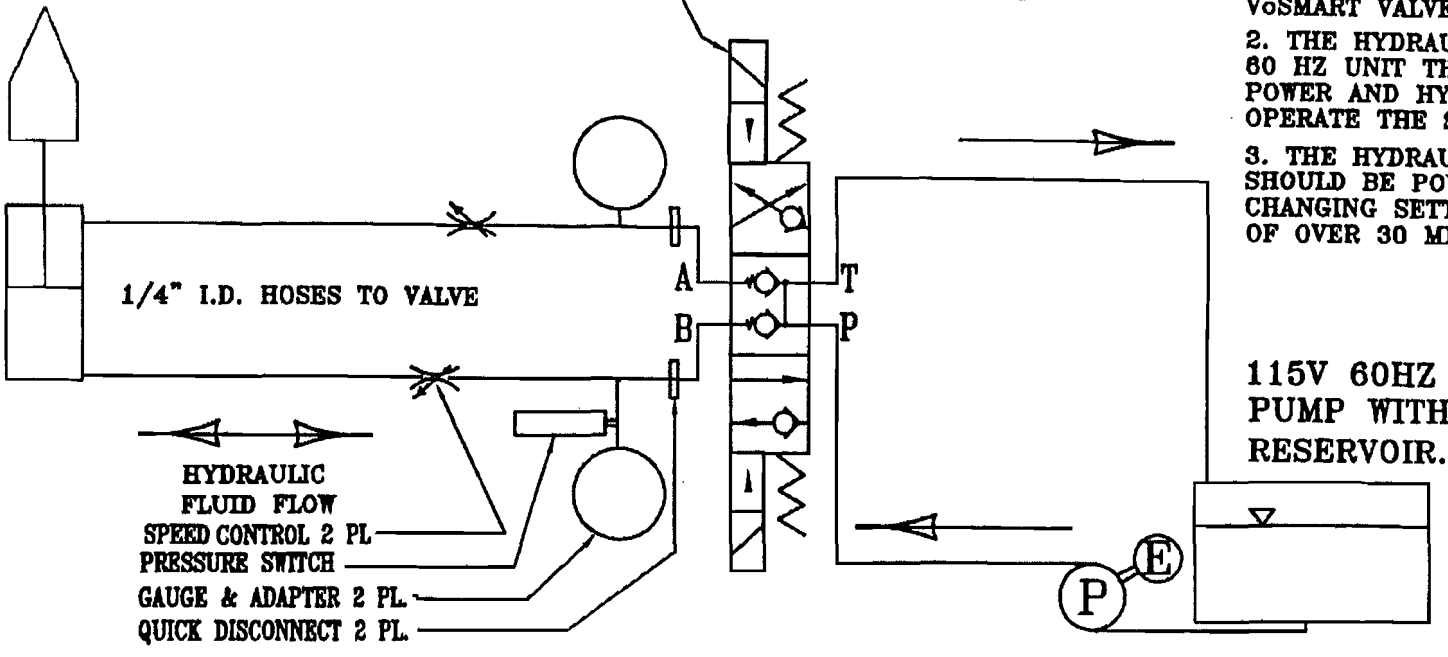
SOLENOID OPERATED, MODULAR, 4-WAY 3 POSITION, PUMP MOUNTED, TANDEM CENTER, WITH A RELIEF VALVE & LOCKING OPTION



FUNCTION OF COMPONENTS

1. THE SOLENOID VALVE IS A 4-WAY, 3 POSITION VALVE THAT ALLOWS THE OPERATOR TO STOP THE CYLINDER ANYWHERE IN THE CLOSING OR OPENING STROKE AND LOCK IN THAT POSITION, THEREBY SETTING THE DESIRED FLOW RATE OF THE VoSMART VALVE.
2. THE HYDRAULIC PUMP IS A 115V 60 HZ UNIT THAT PROVIDES THE POWER AND HYDRAULIC FLUID TO OPERATE THE SYSTEM.
3. THE HYDRAULIC POWER UNIT SHOULD BE POWERED DOWN BETWEEN CHANGING SETTINGS OF THE VALVE OF OVER 30 MINUTES.

115V 60HZ POWERED PUMP WITH 2 1/2 GALLON RESERVOIR.

HYDRAULIC SCHEMATIC, SCADA CONTROL

Z:\ACADwin\VoV\HYDRAULIC SCHEMATIC 12-19-01

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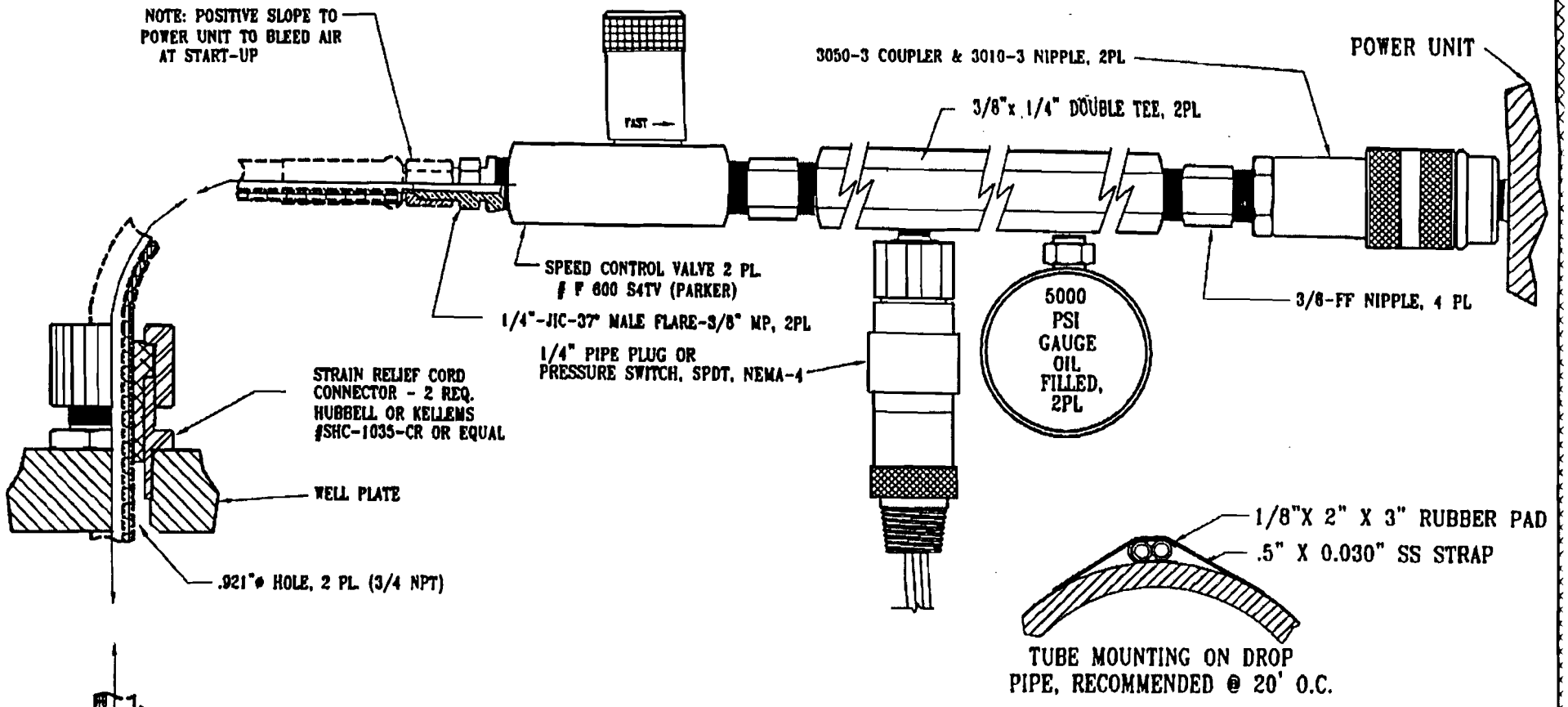
HYDRAULIC COMPONENTS AT THE VoV VALVE
POWER UNIT AT THE WELL HEAD



BILL OF MATERIAL FOR 1 POWER UNIT

1. 2 EA. 3050-3 COUPLER & 3050-3 NIPPLE (PARKER)
2. 2 EA. 4-6 FTX-SS, 1/4"-JIC-37°, MALE FLARE-3/8" MPT
3. 2 EA. 3/8"x1/4" DOUBLE TEE-SS
4. 4 EA. 3/8-FF SS NIPPLE
5. 1 EA. 4-HP-SS 1/4" PIPE PLUG-SS
6. 1 EA. PRESSURE SWITCH, SS, SPDT, NEMA-4
7. 2 EA. 1/4" NPT, 5000 PSI SS CASE, LIQUID FILLED GAUGE
8. 2 EA. SPEED CONTROL VALVE PARKER # F-600-S4TV
9. AS REQ. SS STRAP & RUBBER PAD (BY OTHERS)
10. 2 EA. 2245-0606-4-4-4C-XXXX" (INCHES) HOSES (BY OTHERS)
11. 4 EA. 10655-4-4C, 1/4"-37° SWIVEL FEMALE JIC FITTINGS (BY OTHERS)
12. 2-EA. # SHC-1035-CR KELLEMS STRAIN RELIEF (BY OTHERS)

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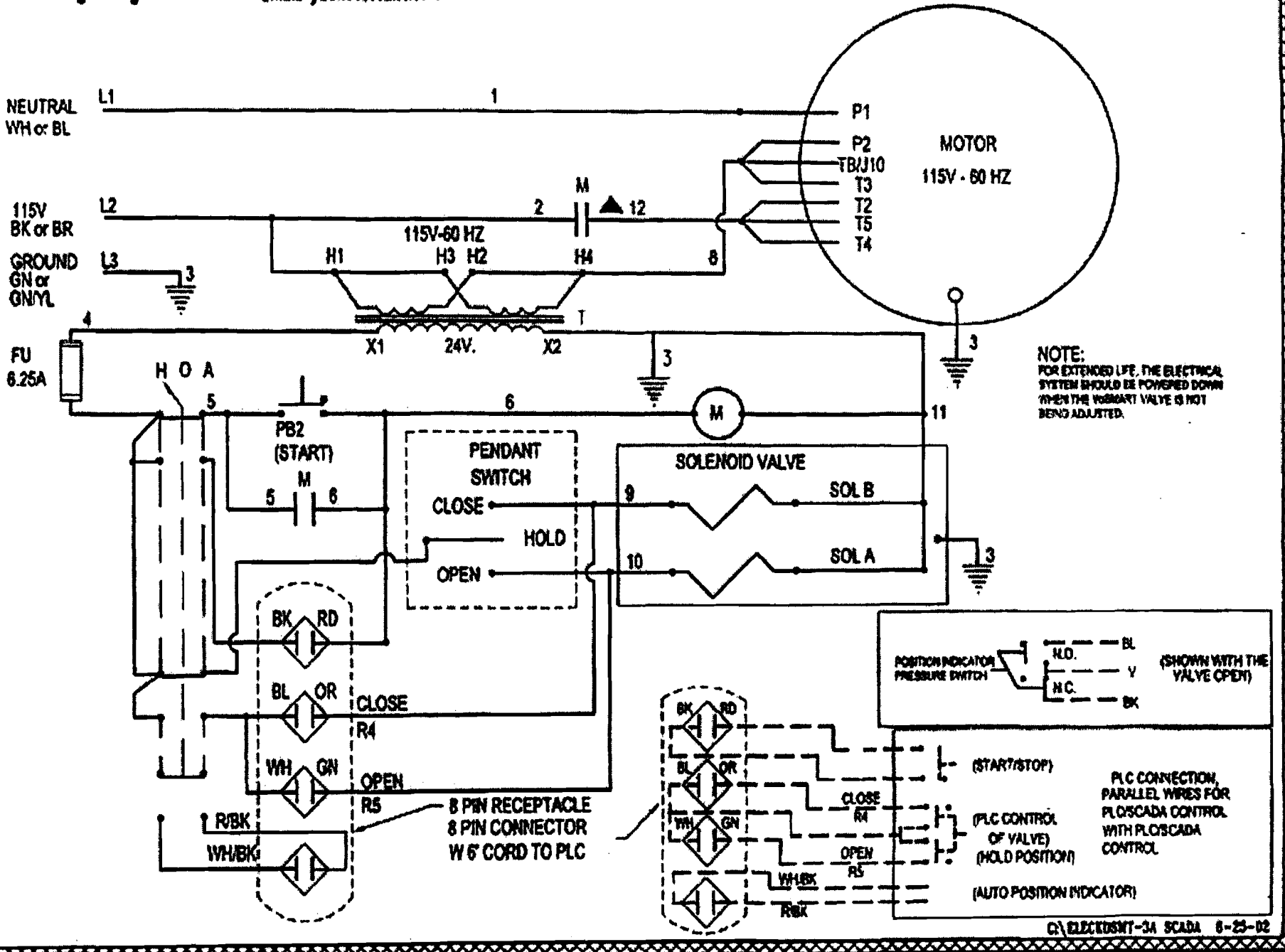
Email: pwall@vovvalve.com

ELECTRICAL SCHEMATIC-3A, SCADA CONTROL
PUMP WITH ELECTRIC HYDRAULIC VALVE

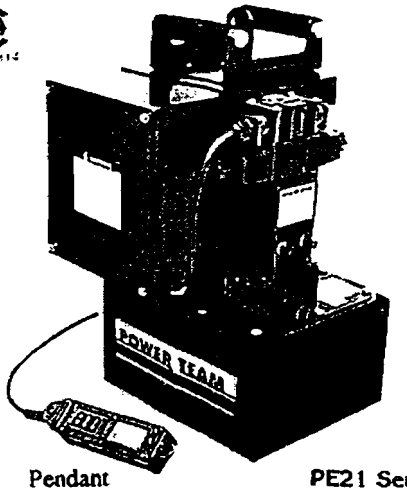


NOTE:
FOR EXTENDED LIFE, THE ELECTRICAL SYSTEM SHOULD BE POWERED DOWN WHEN THE VIBRAFT VALVE IS NOT BEING ADJUSTED.

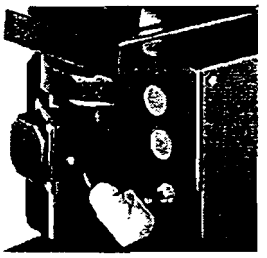
C:\ELECDSNT-3A SCADA 8-25-02

U.S. Patent No. 3,992,131

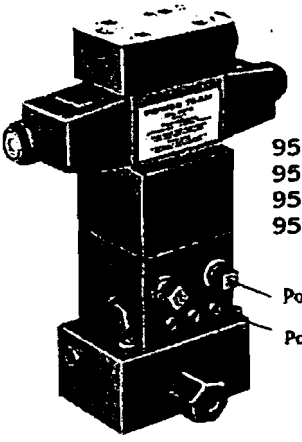
"Quiet" Pumps



Pendant Switch



PE21 Series
24 volt remote control switch with 10' cord for easy operation



Pumps

Electric/Hydraulic Pumps

2-speed, high-pressure performance pumps designed especially for heavy-duty, extended-cycle operations.

PE21 series pumps

Heavy-duty, portable, extra-quiet all metal power unit.

Electrical controls are in conformance with NEMA 12 standards.

The PE21 series pumps are designed for continuous duty, they're equipped with 1 hp single-phase motors (1725 rpm) which are totally enclosed and fan-cooled. Other features include moisture and dust resistant controls, electric motor drip cover with carry handles, and lifting lug. All models have an electrical "latch" feature to prevent unintentional restarting of the unit following an interruption in electrical service. Plus, thermal overload protection is also provided to prevent overheating. Each pump will start and operate under full load, even if voltage is reduced by 10%. Remote controls with a 10' cord, "STOP" and "START" switches, and a RUN/OFF/ JOG switch (manual valve units only) are just a few more features. A 2½ gallon steel reservoir is standard, but 5 and 10 gallon capacities are also available. Each unit comes with a "posi-check" valve for positive load holding, and an internal relief valve to limit pressure to 10,000 psi. Also included is an external relief valve which is adjustable from 1000 to 10,000 psi.

Valves

9513 4-way, 3-position (tandem center) pilot operated solenoid valve, 115 volt, 50 and 60 Hz

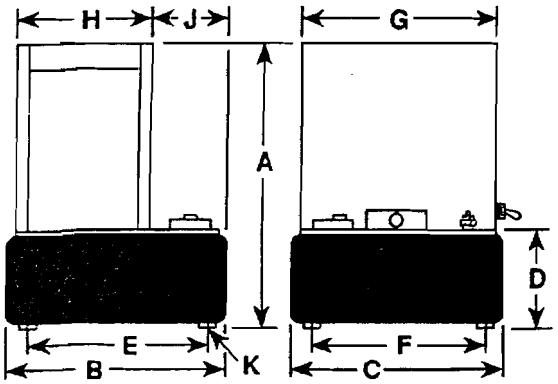
This 4-way, 3-position (tandem center) solenoid valve features "posi-check" which holds the load when shifting from the "advance" to "hold" position. This pump-mounted valve is designed for use with double-acting cylinders. A gauge may be attached if needed. Port size is ⅜" NPTF. Maximum operating pressure is 10,000 psi and maximum flow rate is 5 gpm.

NOTE: The 9513 is suitable for use with the PE17, PE21, PE30*, PE46, PE55, PE84, PE90, PE120, PE200, PE400, PQ60 and PQ120 series pumps.

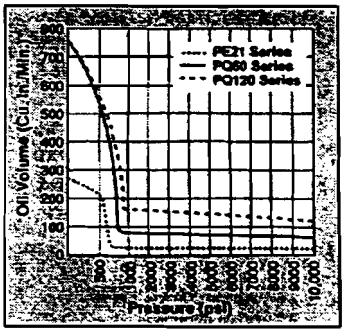
No. 9513 — 4-way, 3-position (tandem center) solenoid valve, 115 volt, 50/60 Hz.

No. 9512 — Same as 9513 except for 24 volt, 50/60 Hz systems.

"Quiet" Pumps



PERFORMANCE



SPECIFICATIONS AND DIMENSIONS

Pump No.	Max. Press. Output	rpm	dBA at Idle and 10,000 psi	Amp Draw at 10,000 psi	Oil Delivery (cu. in./min.@) 100 psi	1,000 psi	5,000 psi	10,000 psi	Dimensions (in.) A	B	C	D	E	F	G	H	J	K ***	Prod Wt. w/Oil (lbs.)
PE21 Series	10,000 psi	1,725	70 *	See Chart Below	270	29	27	22	21⅜	11½	9½	6½	10	8	14⅛	9½	3¼	½-20 UNF	98 †
PQ60 Series	10,000 psi	1,725	74/76 *		730	70	65	60	25⅛	14¼	15½	7¼	12⅛	13⁵⁄₁₆	4¹³⁄₁₆	9⁵⁄₁₆	4¹³⁄₁₆	½-20 UNF	169 **
PQ120 Series	10,000 psi	1,725	73/78 *		730	160	130	120	25⅛	14¼	15½	7¼	12⅛	13⁵⁄₁₆	4¹³⁄₁₆	9⁵⁄₁₆	4¹³⁄₁₆	½-20 UNF	164 **

* Noise level reading (dBA) measured at a 3 foot distance, all sides.

** Total weight with oil and 3-way solenoid valve. Subtract 10 lbs. to obtain weight of pump with manual valve.

*** For 2" dia. swivel casters, order (4) No. 10494.

† Shipping weight with manual valve, add 14 lbs. for pump with solenoid valve.

ORDERING INFORMATION†

See current price list for shipping weights.

For Use With:	Order No.	Type	Valve No.	Reservoir Function	Cap.	Usable	Motor
Single-Acting Cylinders	PE213	3-Way	9520*	Advance Hold Return	2 1/2 gal.	590 cu. in.	1 hp 115/230 Volt 60 Hz †† sgl. phase
	PE213S	3-Way	9599†				
Double-Acting Cylinders	PE214	4-Way	9506*				
	PE214S	4-Way	9512†				
Single-Acting Cylinders	PQ603	3-Way	9520*	Advance Hold Return	5.7 gal.	1250 cu. in.	2 hp 230 Volt 60Hz †† sgl. phase
	PQ603S	3-Way	9599†				
Double-Acting Cylinders	PQ604	4-Way	9506*				
	PQ604S	4-Way	9512†				
Single-Acting Cylinders	PQ1203	3-Way	9520*	Advance Hold Return	5.7 gal.	1250 cu. in.	3 hp 460 Volt 60Hz †† 3-phase
	PQ1203S	3-Way	9599†				
Double-Acting Cylinders	PQ1204	4-Way	9506*				
	PQ1204S	4-Way	9512†				

	Max. Amp Draw @ 10,000 psi	Max. dBA @ 10,000 psi
PE21 Series	(115V)–15 amps (230V)–7.5 amps	70
PQ60 Series	(115V)–22 amps (230V)–11 amps	76
PQ120 Series	(230V)–10.5 amps (460V)–5.3 amps	78

† Some Power Team pumps are available in special configurations not listed in this catalog. Power Team can "Assemble to Order" pumps with special seals, voltages, valves, relief valve settings, etc. For your special requirements please consult your local distributor or the Power Team factory.

* Manual valve. Pump is equipped with RUN/OFF/JOG switch for control of motor.

† Solenoid valve. Pump is equipped with a remote control switch with 10' cord.

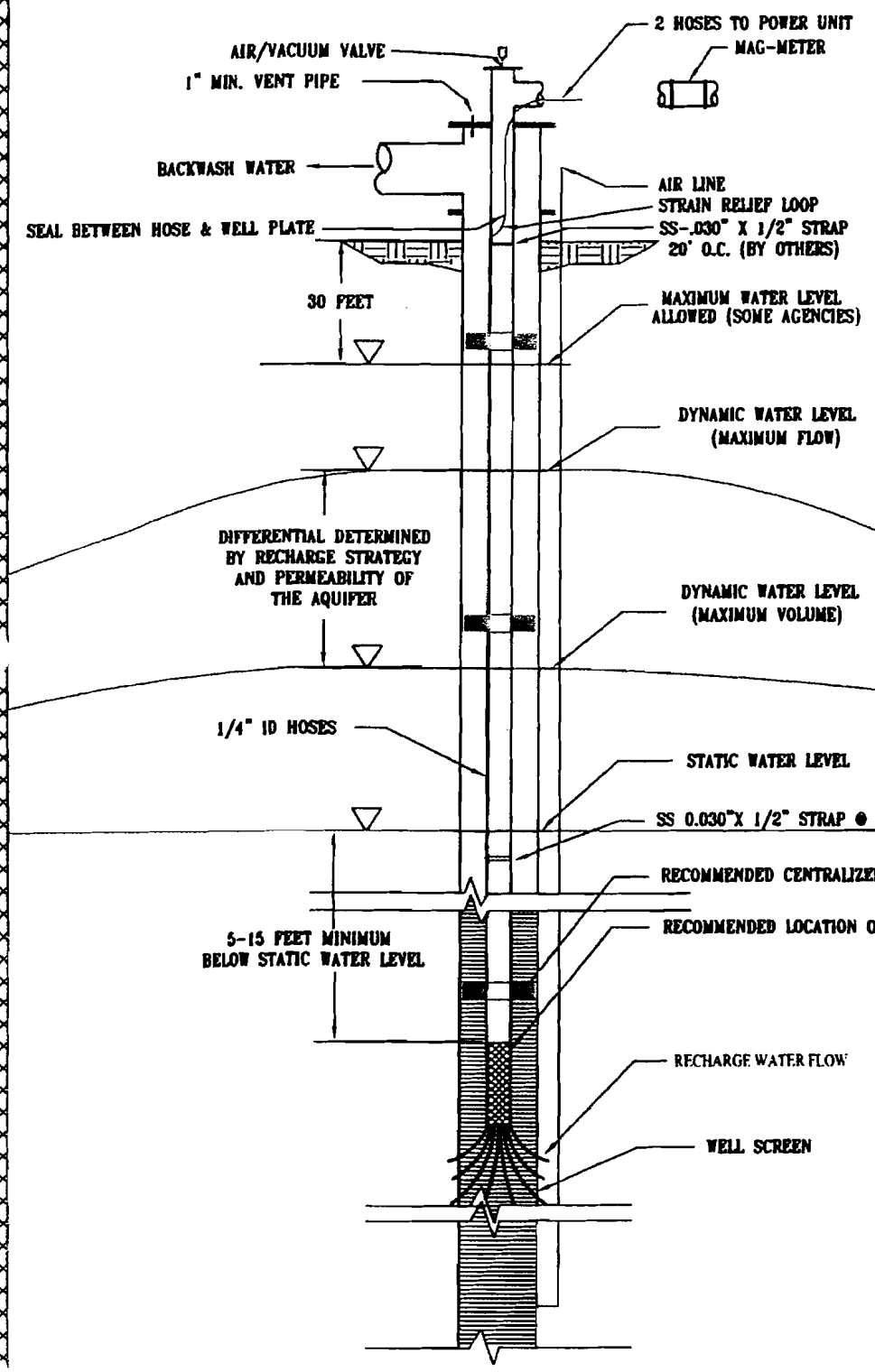
†† Prewired at factory for this voltage. PE21 series available in 230V 60Hz or 220V 50Hz please specify when ordering. Example; for 60Hz order PE213-230, for 50Hz order PE213-50-220.

PQ60 series available in 115V 60Hz or 220V 50Hz, please specify when ordering. Example: for 60Hz order PQ603-115, for 50Hz order PQ603-50-220.

PQ120 series available in 230V 60Hz or 220/380V 50Hz, please specify when ordering. Example; for 60Hz order PQ1204S-230, for 50Hz order PQ1204S-50-220 or PQ1204S-50-380.

PQ120 series also available in 575V 60Hz. Consult the Factory.

VoV INSTALLATION GUIDE
WITH AIR LIFT PUMP FOR BACKFLUSHING WELL



RECOMMENDED FLOW CONTROL PROTOCOL IS TO USE THE DYNAMIC WATER LEVEL TO MODULATE THE FLOW RATE OF THE VoSMART. A HIGH WATER LEVEL WILL MAXIMIZE THE FLOW OVER A SHORT PERIOD OF TIME. A LOWER LEVEL SETTING WILL MAXIMIZE THE VOLUME OVER A RECHARGE SEASON.
15-30 PSI WATER PRESSURE SHOULD BE MAINTAINED AT THE WELL HEAD TO ELIMINATE WATER HAMMER AND KEEP THE AIR-VACUUM VALVE CLOSED.
TO MAINTAIN ACCURATE FLOW READINGS AND TOTALIZATIONS. A FISHER PORTER DIGITAL MAGMETER IS RECOMMENDED.

VoV™
VoV Enterprises, Inc.
2963 E BELLA LANE
ANAHEIM, CA 92806
(714) 630-1774

Section 5-L

Diffusion Well Pressure Gauges (PI-711, PI-712, PI-713, PI-721, PI-722, PI-723, PI-731, PI-732, PI-733)

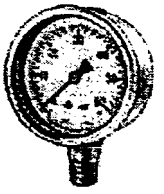
BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

General Service Pressure Gauges

For information about gauges, see page 490 .

Type 304 Stainless Steel-Case Gauges- ±2% Mid-Scale Accuracy (Grade B)

- General service bronze Bourdon pressure tube
- Connection: 1/4" NPT male brass
- Lens Material: Polycarbonate
- Temperature Range:
  Ambient: -40° to +150° F
  Process: -40° to +150° F



Bottom Connection

Available Pressure Ranges (psi)

Pressure Range	Figure Intervals	Grad. Marks
0-30	5	0.5
0-60	10	1
0-100	20	2
0-160	20	2
0-200	40	5
0-300	50	5
0-400	50	10

Pressure Range	Figure Intervals	Grad. Marks
0-600	100	10
0-1000	200	10
0-1500	200	20
0-2000	400	20
0-3000	500	50
0-5000	1000	100

To Order: Please specify pressure range in psi from the table above.

Dial Face	Bottom Conn.	Each	Center Back Conn.	Each
2 1/2"	4003K11	$25.04	4003K71	$28.64
4"	4003K61	35.03	4003K81	37.97

About Gauges

Pressure Gauges—Measure positive pressure.

General service gauges measure the pressure of noncorrosive gases and liquids such as air, water, and steam. The Bourdon pressure tube (or diaphragm) and connection are made of a copper alloy such as brass or bronze.

Corrosive service gauges measure the pressure of mild acids and bases. The Bourdon pressure tube and connection are usually Type 316 stainless steel. If you're dealing with highly corrosive media, we recommend using a gauge guard (diaphragm seal) between the medium and your gauge (see page 505).

Vacuum gauges measure pressure below atmospheric pressure (negative pressure). ***Compound gauges*** measure both positive and negative pressure. ***Differential gauges*** measure the difference between two pressures.

Temperature Range

Ambient temperature range refers to the temperature of the environment that the exterior of the gauge is exposed to.

Process temperature range refers to the temperature of the process media that the internal components of the gauge are exposed to (i.e. the Bourdon pressure tube and diaphragm).

Gauge Accuracy

Gauge accuracy is categorized by ASME (ANSI) standard B40.1. Unless indicated, gauges do not include a certificate of calibration. We offer gauges in the following ASME (ANSI) grades:

±5% Full-Scale (Grade D)—Accurate to ±5% over the entire scale. These gauges are used as indicators when minimal accuracy is required.

±2% Mid-Scale (Grade B)—Accurate to ±2% over the middle half of the scale and ±3% over the first and last quarters of the scale. Though often used in industry, they're referred to as commercial and utility equipment gauges.

±1% Mid-Scale (Grade A)—Accurate to ±1% over the middle half of the scale and ±2% over the first and last quarters of the scale.

±1% Full-Scale (Grade 1A)—Accurate to ±1% over the entire range of the scale, making them a good choice for many precision industrial applications.

±0.5% Full-Scale (Grade 2A)—Accurate to ±0.5% over the entire range of the scale. Called process gauges, they're used for measuring process pressure.

±0.25% Full-Scale (Grade 3A)—Accurate to ±0.25% over the entire scale. These are used as test gauges.

±0.1% Full-Scale (Grade 4A)—Accurate to ±0.1% over the entire range of the scale. These gauges are used as precision test instruments.

Units of Pressure

psi—Pounds per square inch ***in. of H$_2$O***—Inches of water
in. of Hg—Inches of mercury ***kPa***—Kilopascals
oz./in.^{2}—Ounces per square inch

Case Materials

In a clean, dry, noncorrosive environment, a painted-steel-case gauge is adequate. Brass is a good choice for damp areas, and stainless steel cases are better in corrosive environments. In situations that allow the use of thermoplastic, the ABS-case gauges perform very well in dry as well as damp and corrosive environments.

Dry or Glycerin-Filled

Most of the gauges we offer are "dry," containing only the gauge mechanism inside the case. These work well for most applications. In some environments, however, vibration and pressure fluctuations can cause the gauge needle to jump, making the gauge more difficult to read. Glycerin-filled gauges reduce this "pointer flutter." Gauges have an air bubble inside that allows for expansion due to temperature changes, unless noted.

Dial Face

Figure intervals refer to the distance between figures on the dial face. ***Graduation marks*** are the hash marks between the figure intervals. For example, the gauge shown at left has figure intervals of 10 psi and graduation marks of 2 psi. This means you'll find a numeral every 10 psi and hash marks at every 2 psi on the dial face.

Range Selection

Choose a gauge with a full-scale pressure range that is approximately twice the required normal operating pressure. The maximum operating pressure should not exceed 75% of the full-scale range.

Connection Styles

Gauges are available in one or more of the three styles pictured here.

Case-Mounting Styles

Flanged gauges are designed to be externally mounted. ***Panel mounting gauges*** are designed to fit into a cutout.

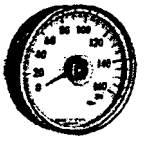
General Service Pressure Gauges

Gearless Mini ABS-Case Gauges—±5% Full-Scale Accuracy (Grade D)

- No gears or bearings to wear out
- Pressure tube transmits motion directly to pointer
- For use as indicators when minimal accuracy is required
- Miniature design is ideal for tight spaces
- Case: Black ABS thermoplastic
- General service beryllium copper Bourdon pressure tube
- Connection: ⅛" NPT male brass or ⅛" BSPT (British Standard Pipe Taper) male brass
- Lens Material: Polycarbonate
- Temperature Range:
  Ambient: -40° to +150° F
  Process: -40° to +150° F

Dial Face	Pressure Range, psi	Figure Intervals, psi	Graduation Marks, psi	CENTER BACK CONNECTION NPT Connection	Each	BSPT Connection	Each
29/32"	0- 60	10	5	38105K31	$8.82	38105K41	$9.82
29/32"	0-100	20	5	38105K32	8.82	38105K42	9.82
29/32"	0-160	40	10	38105K33	8.82	38105K43	9.82
29/32"	0-200	40	10	38105K34	8.82	38105K44	9.82
29/32"	0-300	50	25	38105K35	8.82	38105K45	9.82

Gearless ABS-Case Gauges—±2% Mid-Scale Accuracy (Grade B)

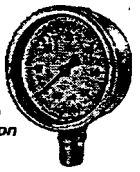


- No gears or bearings to wear out
- Pressure tube transmits motion directly to pointer
- Case: Black ABS thermoplastic
- General service beryllium copper Bourdon pressure tube
- Connection: ⅛" NPT male black ABS thermoplastic
- Lens Material: Polycarbonate
- Temperature Range:
  Ambient: -40° to +150° F
  Process: -40° to +150° F

Dial Face	Pressure Range, psi	Figure Intervals, psi	Graduation Marks, psi	Center Back Connection	Each
1½"	0- 60	10	5	3793K11	$9.33
1½"	0-100	20	2	3793K12	9.33
1½"	0-160	20	5	3793K13	9.33
1½"	0-200	20	5	3793K14	9.33
1½"	0-300	50	10	3793K15	9.33
1½"	0-400	100	20	3793K16	9.33

For information about gauges, see page 490.

Type 304 Stainless Steel-Case Gauges—±2% Mid-Scale Accuracy (Grade B)


Bottom Connection

- General service bronze Bourdon pressure tube
- Connection: ¼" NPT male brass
- Lens Material: Polycarbonate
- Temperature Range:
  Ambient: -40° to +150° F
  Process: -40° to +150° F

Available Pressure Ranges (psi)

Pressure Range	Figure Intervals	Grad. Marks	Pressure Range	Figure Intervals	Grad. Marks
0- 30	5	0.5	0- 600	100	10
0- 60	10	1	0-1000	200	10
0-100	20	2	0-1500	200	20
0-160	20	2	0-2000	400	20
0-200	40	5	0-3000	500	50
0-300	50	5	0-5000	1000	100
0-400	50	10			

To Order: Please specify pressure range in psi from the table above.

Dial Face	Bottom Conn.	Each	Center Back Conn.	Each
2½"	4003K11	$25.04	4003K71	$28.64
4"	4003K61	35.03	4003K81	37.97

Gearless Type 304 Stainless Steel-Case Gauges—±2% Mid-Scale Accuracy (Not Graded)

- No gears or bearings to wear out
- Pressure tube transmits motion directly to pointer
- General service beryllium copper Bourdon pressure tube
- Connection: ⅛" NPT male brass
- Lens Material: Polycarbonate
- Temperature Range: Ambient: -40° to +150° F, Process: -40° to +150° F

Dial Face	Pressure Range, psi	Figure Int., psi	Graduation Marks, psi	Center Back Conn.	Each
1½"	0- 60	10	2	40565K31	$5.27
1½"	0- 100	20	2	40565K32	5.27
1½"	0- 160	20	5	40565K33	5.27
1½"	0- 200	20	5	40565K34	5.27
1½"	0- 300	50	5	40565K35	5.27
1½"	0- 700	100	25	40565K36	8.97
1½"	0-1200	200	20	40565K37	8.97
1½"	0-1500	500	50	40565K38	14.47
1½"	0-2000	500	100	40565K39	14.47
1½"	0-3000	1000	100	40565K41	14.47
1½"	0-4000	1000	100	40565K42	14.47

Low Pressure Type 304 Stainless Steel-Case Gauges—±1% Full-Scale Accuracy (Grade 1A)

- Diaphragm accurately measures low pressure
- General service phosphor-bronze diaphragm
- Connection: ¼" NPT male brass
- Lens Material: Glass

Available Pressure Ranges

Pressure Range	Figure Intervals	Grad. Marks	Pressure Range	Figure Intervals	Grad. Marks
oz./in.²			*psi (cont.)*		
0- 10	1	0.1	0- 10	1	0.1
0- 15	1	0.1	*in. of H²O*		
0- 30	5	0.2	0- 10	1	0.1
0- 60	5	0.5	0- 15	1	0.1
0-100	10	1	0- 30	5	0.2
0-160	20	2	0- 60	5	0.5
psi			0-100	10	1
0- 3	0.5	0.02	0-160	20	2
0- 5	0.5	0.05	0-200	20	2

To Order: Please specify pressure range in oz./in.², psi, or in. of H_2O from table above.

Dial Face	Scale	Temp. Range, Ambient and Process	Bottom Connection	Each
4"	oz./in.²	0° to 140° F	4269K71	$78.92
4"	psi	0° to 140° F	4269K31	78.92
4"	in. of H_2O	0° to 140° F	4269K51	78.92

Glycerin-Filled Type 304 Stainless Steel-Case Gauges—±1% Mid-Scale Accuracy (Grade A)


Center Back Connection

- Refillable glycerin-filled gauges dampen needle vibration; allow for more accurate gauge readings
- Gauges have a dual scale that reads in psi and kPa
- General service phosphor-bronze Bourdon pressure tube
- Connection:
  1½" dial: ⅛" NPT male brass
  2½" dial: ¼" NPT male brass
  4" dial: ¼" NPT male brass
- Lens Material: Polycarbonate
- Temperature Range:
  Ambient: -5° to +150° F
  Process: -5° to +150° F

Available Pressure Ranges

Pressure Range, psi	Pressure Range, kPa	Figure Intervals, psi	Graduation Marks, psi
0- 15	0- 100	2	0.2
0- 30	0- 200	5	0.5
0- 60	0- 400	10	1
0- 100	0- 700	20	2
0- 160	0- 1,100	20	2
0- 200	0- 1,400	50	5
0- 300	0- 2,000	50	5
0- 400	0- 2,800	100	10
0- 600	0- 4,000	100	10
0- 1,000	0- 7,000	200	20
0- 1,500	0-10,000	200	20
0- 2,000	0-14,000	500	50
0- 3,000	0-20,000	500	50
0- 5,000	0-35,000	1,000	100
0-10,000	0-70,000	2,000	200

To Order: Please specify pressure range in psi from the table above.

Dial Face	Bottom Connection	Each	Center Back Connection	Each
1½"	3850K2★	$16.95	3850K3★	$16.95
2½"	4053K1	17.09	4053K8	17.09
4"	4053K2	33.14	4053K9	33.14

★ This dial size not offered for 0-10,000 psi pressure range.

Glycerin-Filled Type 304 Stainless Steel-Case Gauges with BSPP Threads—±1.5% Full-Scale Accuracy (Not Graded)

- Refillable glycerin-filled gauges dampen needle vibration; allow for more accurate gauge readings
- Dual scale reads in bar and psi
- General service phosphor-bronze Bourdon pressure tube
- Connection: ¼" BSPP (British Standard Pipe Parallel) male brass
- Lens Material: Acrylic

Available Pressure Ranges

Pressure Range Bar	Pressure Range psi	Figure Int. Bar	Figure Int. psi	Grad. Marks Bar	Grad. Marks psi
0- 1	0- 14	0.2	2	0.05	0.5
0- 1.6	0- 20	0.5	5	0.05	0.5
0- 2.5	0- 35	0.5	5	0.1	1
0- 4	0- 50	1	10	0.2	2
0- 6	0- 80	1	20	0.2	2
0- 10	0- 140	2	20	0.5	5
0- 16	0- 200	5	50	0.5	5
0- 25	0- 350	5	50	1	10
0- 40	0- 500	10	100	2	20
0- 60	0- 600	10	200	2	20
0-100	0-1400	20	200	5	50
0-160	0-2000	50	500	5	50
0-250	0-3500	50	500	10	100
0-400	0-5000	100	1000	20	200
0-600	0-8000	100	2000	20	200

To Order: Please specify pressure range in bar from the table above.

Dial Face	Temp. Range, Ambient and Process	Bottom Connection	Each
2½"	0° to 140° F	3548K11	$21.93

Section 6

Section 6-A

Duct Heater (DH-500)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

REZNOR® Thomas&Betts

Model Series RG, RX, RP, RPV, HRPD Outdoor Duct Furnaces

INSTALLATION FORM RZ-NA1-OUTDOOR DUCT
Obsoletes Form I-RG/RX/RP/HRPD

APPLIES TO: Installation/Operation/Service

Table of Contents

Index by Page Number

References:
Replacement Parts for Model Series RX and RPV, Form 705
Replacement Parts for Model Series RG and RP, Form 707
Gas Conversion, Form 703

FOR YOUR SAFETY

If you smell gas:
1. Open windows.
2. Don't touch electrical switches.
3. Extinguish any open flame.
4. Immediately call your gas supplier.

FOR YOUR SAFETY

The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous.

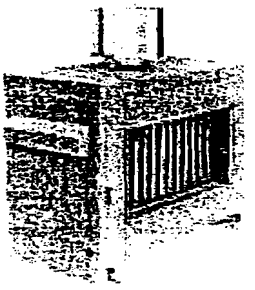
WARNING: Gas-fired appliances are not designed for use in hazardous atmospheres containing flammable vapors or combustible dust, in atmospheres containing chlorinated or halogenated hydrocarbons, or in applications with airborne silicone substances. See Hazard Levels, Page 2.

WARNING: Improper installation, adjustment, alteration, service, or maintenance can cause property damage, injury or death. Read the installation, operation, and maintenance instructions thoroughly before installing or servicing this equipment.

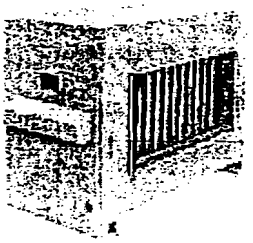
GENERAL

Installation should be done by a qualified agency in accordance with the instructions in this manual and in compliance with all codes and requirements of authorities having jurisdiction. The instructions in this manual apply to the outdoor duct furnace models listed below.

Model Designation	Characteristics		
	Vent	CFM	Thermal Efficiency
RG	Gravity	Standard	78%
RX		Standard	
HRG		High	
HRX		High	
CRG		Standard	80%
CRX		Standard	
HCRG		High	
HCRX		High	
RP	Power	Standard	
HRP		High	
HRPD		High	
RPV		Standard	
HRPV		High	



Model RG Series Duct Furnace



Model RP Series Duct Furnace

HAZARD INTENSITY LEVELS

1. DANGER: Failure to comply will result in severe personal injury or death and/or property damage.
2. WARNING: Failure to comply could result in severe personal injury or death and/or property damage.
3. CAUTION: Failure to comply could result in minor personal injury and/or property damage.

1. Installation Codes

The outdoor duct furnaces covered in this manual are design-certified by the Canadian Standards Association to ANSI Z83.8 and CSA 2.6 for use with either natural or propane gas. The type of gas for which the furnace is equipped and the correct firing rate are shown on the rating plate attached to the unit. Electrical characteristics are shown on the unit rating plate.

These units must be installed in accordance with local building codes. In the absence of local codes, in the United States, the unit must be installed in accordance with the National Fuel Gas Code (latest edition). A Canadian installation must be in accordance with the CSA B149.1 and B149.2 Installation Code for Gas Burning Appliances and Equipment. These codes are available from CSA Information Services, 1-800-463-6727. Local authorities having jurisdiction should be consulted before installation is made to verify local codes and installation procedure requirements.

WARNING: These duct furnaces are not certified or approved for use in drying or process applications. If a duct furnace is to be used in a drying or process application, contact the factory for application guidelines and manufacturer's authorization. Without factory authorization, the warranty is void, and the manufacturer disclaims any responsibility for the duct furnace and/or the application.

WARNING: To ensure safety, follow lighting instructions located on the outlet box cover. See Hazard Levels, above.

2. Warranty

Refer to limited warranty information on the warranty card in the "Owner's Envelope".

WARRANTY: Warranty is void if.....

a. Furnaces are used in atmospheres containing flammable vapors or atmospheres containing chlorinated or halogenated hydrocarbons or any contaminant (silicone, aluminium oxide, etc.) that adheres to the spark ignition flame sensing probe.
b. Wiring is not in accordance with the diagram furnished with the heater.
c. Unit is installed without proper clearances to combustible materials or without proper ventilation and air for combustion. (See Paragraphs 6 and 7.)
d. Furnace air throughput is not adjusted within the range specified on the rating plate.
e. Duct furnace is installed in a process or drying application without factory authorization. (Any use in a process or drying application voids agency certification.)

3. Uncrating and Preparation

This furnace was test operated and inspected at the factory prior to crating and was in operating condition. If the furnace has incurred any damage in shipment, document the damage with the transporting agency and immediately contact an authorized Reznor distributor. If you are an authorized Distributor, follow the FOB freight policy procedures as published by Thomas & Betts for Reznor products.

Check the rating plate for the gas specifications and electrical characteristics of the furnace to be sure that they are compatible with the gas and electric supplies at the installation site. Read this booklet and become familiar with the installation requirements of your particular furnace. If you do not have knowledge of local requirements, check with the local gas company or any other local agencies who might have requirements concerning this installation. Before beginning, make preparations for necessary supplies, tools, and manpower.

Check to see if there are any field-installed options that need to be assembled to the furnace prior to installation.

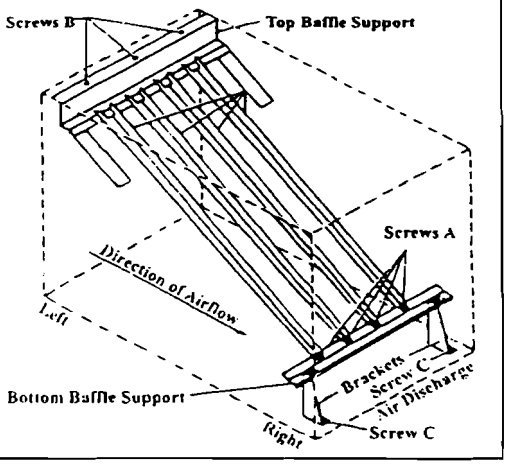
Option Parts - Some gas control options will have parts either shipped loose with the heater or shipped separately. If your unit is equipped with any of the gas control options in the table below, be sure these parts are available at the job site.

Other shipped-separate options could include a gas shutoff valve, a vertical vent terminal, a thermostat, an optional control, or a disconnect switch.

Application	Option	Shipped Separate Components
Heating – Gas Control Option	AG7	Thermostat, P/N 48033
Makeup Air – Gas Control Options	AG3, AG6, AG8, or AG13	Control Switch, P/N 29054
	AG9	Remote Temperature Selector, P/N 48042 Control Switch, P/N 29054
	AG15	Remote Temperature Selector, P/N 115848 Stage Adder Module, P/N 115849 Control Switch, P/N 29054
	AG16	Remote Temperature Selector, P/N 115848 Stage Adder Module, P/N 115849 Remote Display Module, P/N 115852 Control Switch, P/N 29054
	AG39	Remote Temperature Selector, P/N 174849

4. Instructions for Reversing Airflow by Changing Direction of Heat Exchanger Air Baffles

FIGURE 1 - Heat Exchanger Directional Air Baffles



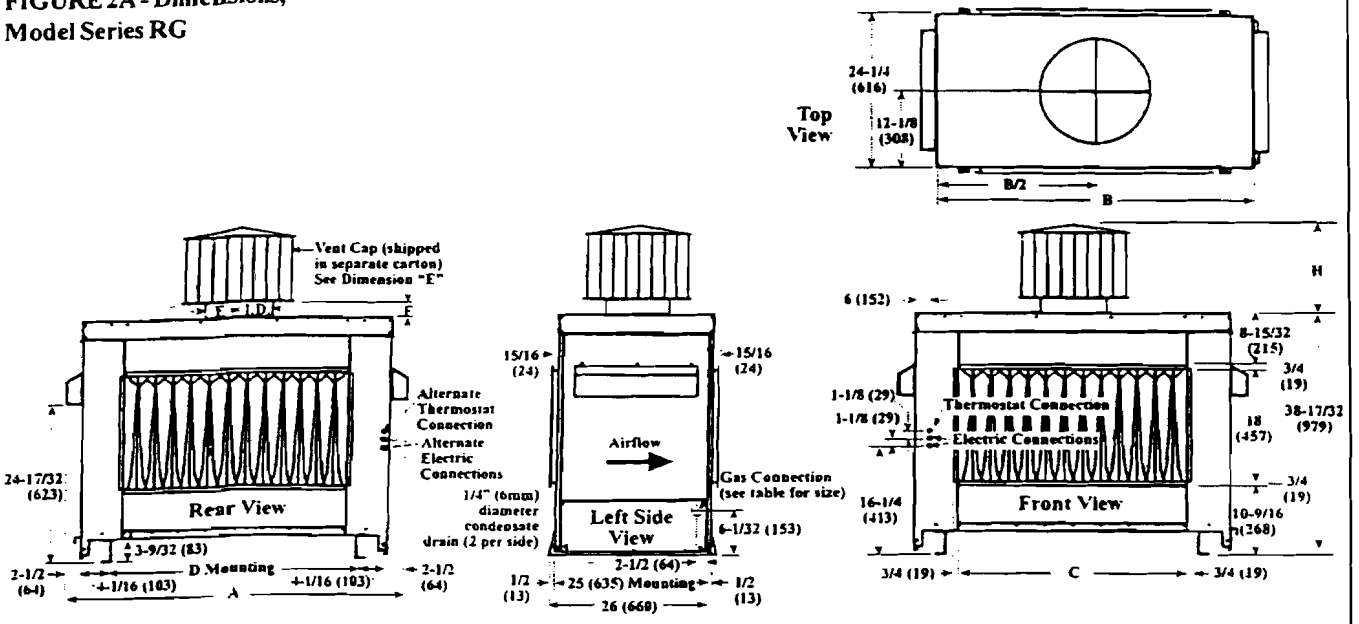
Duct furnaces (for high CFM "H" models, see NOTE below) are equipped with directional air baffles between the heater exchanger tubes. Facing the control compartment of the furnace, the standard direction of airflow is from left to right. Installations requiring direction of airflow from right to left when facing the control compartment will require repositioning of the directional air baffles at the installation site. Change the position of baffles as follows (See FIGURE 1):

1) Remove Screws "A".
2) Lift each baffle slightly and slide forward removing each individual baffle completely from the heat exchanger.
3) Remove the top baffle support. Re-use screws "B" and install the top baffle support on the opposite end of the heat exchanger.
4) Re-install the bottom baffle support and brackets on the opposite end of the heat exchanger.
5) Reverse Steps 1 and 2 -- re-installing all of the baffles.

NOTE: Models with prefix "H" are factory-built for high CFM capability and include only the top baffle support shown in FIGURE 1. To reverse air flow, move the top baffle support. The top baffle support must always be on the entering air side of the unit.

5. Dimensions

FIGURE 2A - Dimensions, Model Series RG



Model Series RG and CRG Dimensions - inches ± 1/8									
Model	Size	A	B	C	D	E	F	G	H
(H)-RG,CRG	75	33-7/16	28-1/2	12-1/2	20-5/16	6	2	3-3/32	9
(H)-RG,CRG	100	33-7/16	28-1/2	12-1/2	20-5/16	6	2	1-21/32	9
(H)-RG,CRG	125	33-7/16	28-1/2	15-1/4	20-5/16	8	2	1-21/32	11-1/2
(H)-RG,CRG	150, 175	38-15/16	34	20-3/4	25-13/16	8	2	1-21/32	11-1/2
(H)-RG,CRG	200, 225	44-7/16	39-1/2	26-1/4	31-5/16	10	3	1-21/32	15
(H)-RG,CRG	250	52-11/16	47-3/4	34-1/2	39-9/16	10	3	1-21/32	15
(H)-RG	300	52-11/16	47-3/4	34-1/2	39-9/16	12	12	1-21/32	29
(H)-CRG	300	52-11/16	47-3/4	34-1/2	39-9/16	10	3	1-21/32	15
(H)-RG,CRG	350	58-3/16	53-1/4	40	45-1/16	12	12	1-21/32	29
(H)-RG,CRG	400	63-11/16	58-3/4	45-1/2	50-9/16	12	12	1-21/32	29

Gas Connection (inches)			
Model	Size	Natural	Propane
(H)-RG,CRG	75	1/2	1/2
(H)-RG,CRG	100	1/2	1/2
(H)-RG,CRG	125	1/2	1/2
(H)-RG,CRG	150, 175	1/2	1/2
(H)-RG,CRG	200, 225	1/2	1/2
(H)-RG,CRG	250	1/2	1/2
(H)-RG	300	3/4	1/2
(H)-CRG	300	3/4	1/2
(H)-RG,CRG	350	3/4	1/2
(H)-RG,CRG	400	3/4	1/2

Model Series RG and CRG Dimensions - mm ±3									
Model	Size	A	B	C	D	E	F	G	H
(H)-RG,CRG	75	849	724	318	516	152	51	79	229
(H)-RG,CRG	100	849	724	318	516	152	51	42	229
(H)-RG,CRG	125	849	724	387	516	203	51	42	292
(H)-RG,CRG	150, 175	989	864	527	656	203	51	42	292
(H)-RG,CRG	200, 225	1129	1003	667	795	254	76	42	381
(H)-RG,CRG	250	1338	1213	876	1005	254	76	42	381
(H)-RG	300	1338	1213	876	1005	305	305	42	737
(H)-CRG	300	1338	1213	876	1005	254	76	42	381
(H)-RG,CRG	350	1351	1353	1016	1145	305	305	42	737
(H)-RG,CRG	400	1618	1492	1156	1284	305	305	42	737

5. Dimensions (cont'd)

FIGURE 2B - Dimensions, Model Series RP

Model Series RP Dimensions - inches ± 1/8 / mm ±3

(H)-RP	A	B	C	D
125	30-15/16	28-1/2	15-1/4	20-5/16
150, 175	36-7/16	34	20-3/4	25-13/16
200, 225	41-15/16	39-1/2	26-1/4	31-5/16
250	50-3/16	47-3/4	34-1/2	39-9/16
300	50-3/16	47-3/4	34-1/2	39-9/16
350	55-11/16	53-1/4	40	45-1/16
400	61-3/16	58-3/4	45-1/2	50-9/16

(H)-RP	A	B	C	D
125	786	648	387	516
150, 175	914	864	527	656
200, 225	1065	1003	667	795
250	1275	1213	876	1005
300	1275	1213	876	1005
350	1414	1353	1016	1145
400	1554	1492	1156	1284

Gas Connection (inches)		
(H)-RP	Natural	Propane
125	1/2"	1/2"
150, 175	1/2"	1/2"
200, 225	1/2"	1/2"
250	1/2"	1/2"
300	3/4"	1/2"
350	3/4"	1/2"
400	3/4"	1/2"

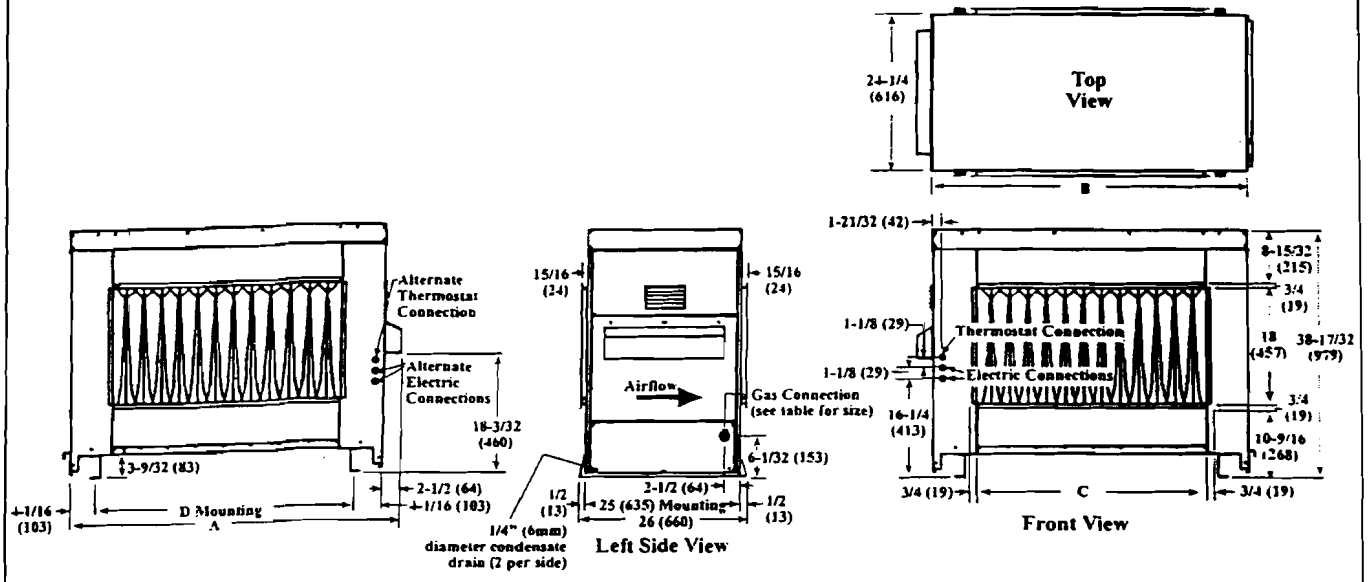


FIGURE 2C - Dimensions, Model Series HRPD

Dimensions (inches)

Size	A	B	C	D	E
250	30-15/16	28-1/2	15-1/4	20-5/16	3-3/32
300	36-7/16	34	20-3/4	25-13/16	1-21/32
350	36-7/16	34	20-3/4	25-13/16	1-21/32
400	41-15/16	39-1/2	26-1/4	31-5/16	1-21/32
500	50-3/16	47-3/4	34-1/2	39-9/16	1-21/32
600	50-3/16	47-3/4	34-1/2	39-9/16	1-21/32
700	55-11/16	53-1/4	40	45-1/16	1-21/32
800	61-3/16	58-3/4	45-1/2	50-9/16	1-21/32

Dimensions (mm)

Size	A	B	C	D	E
250	786	724	387	516	79
300	926	864	527	656	42
350	926	864	527	656	42
400	1065	1003	667	795	42
500	1275	1213	876	1005	42
600	1275	1213	876	1005	42
700	1414	1353	1016	1145	42
800	1554	1492	1156	1284	42

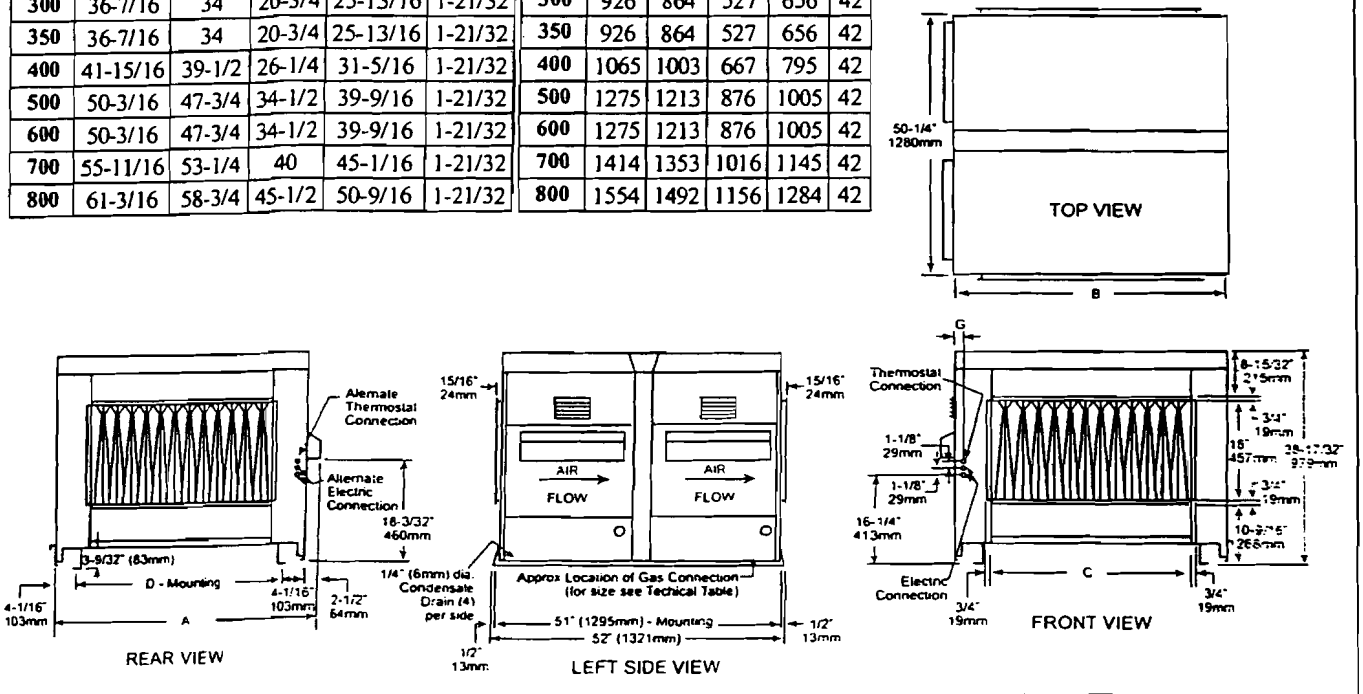


FIGURE 2D - Dimensions, Model Series RX

Model Series RX and CRX Dimensions - inches ± 1/8

Model	Size	A	B	D	E	F	H
(H)-RX,CRX	75	19-1/4	32-1/4	12-1/2	14	6	9
(H)-RX,CRX	100	19-1/4	32-1/4	12-1/2	15	6	9
(H)-RX,CRX	125	22	32-1/4	15-1/4	16-3/4	6	11-1/2
(H)-RX,CRX	150, 175	27-1/2	32-1/4	20-3/4	22-1/4	8	11-1/2
(H)-RX,CRX	200, 225	33	35-1/4	26-1/4	27-3/4	10	15
(H)-RX,CRX	250	41-1/4	35-1/4	34-1/2	36	10	15
(H)-RX	300	41-1/4	35-1/4	34-1/2	36	12	29
(H)-CRX	300	41-1/4	35-1/4	34-1/2	36	10	15
(H)-RX,CRX	350	46-3/4	35-1/4	40	41-1/2	12	29
(H)-RX,CRX	400	52-1/4	35-1/4	45-1/2	47	12	29

Model Series RX and CRX Dimensions - mm ±3

Model	Size	A	B	D	E	F	H
(H)-RX,CRX	75	489	819	318	356	152	229
(H)-RX,CRX	100	489	819	318	356	152	229
(H)-RX,CRX	125	559	819	387	425	152	292
(H)-RX,CRX	150, 175	699	819	527	565	203	292
(H)-RX,CRX	200, 225	738	895	667	705	254	381
(H)-RX,CRX	250	1048	895	876	914	254	381
(H)-RX	300	1048	895	876	914	305	737
(H)-CRX	300	1048	895	876	914	254	381
(H)-RX,CRX	350	1187	895	1016	1054	305	737
(H)-RX,CRX	400	1327	895	1156	1194	305	737

Gas Connection (inches)

Size	75	100	125	150, 175	200, 225	250	300	300	350	400
Natural	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4
Propane	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2

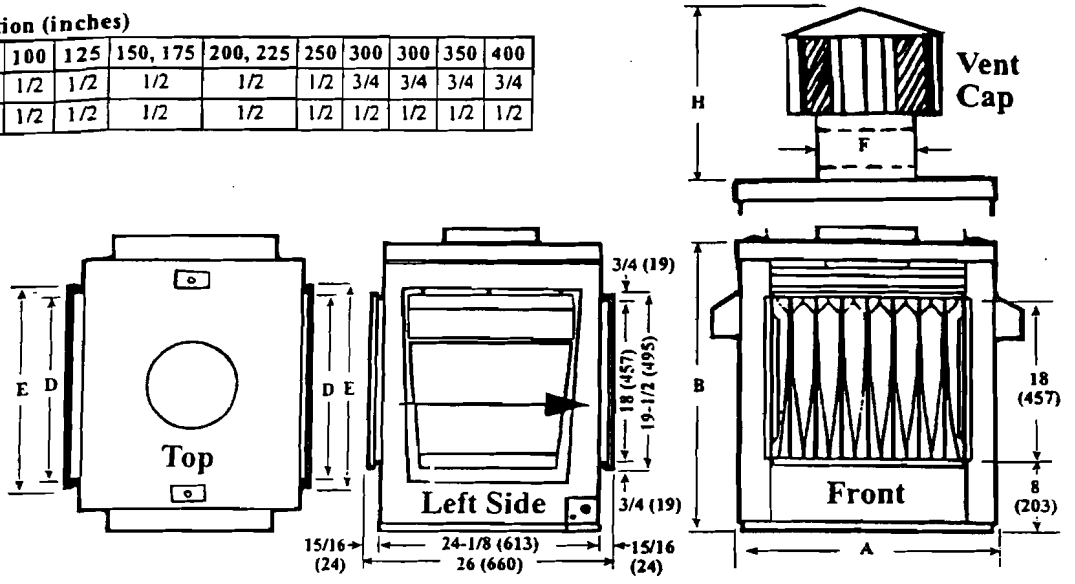


FIGURE 2E - Dimensions, Model Series RPV

Model Series RPV Dimensions - inches ± 1/8

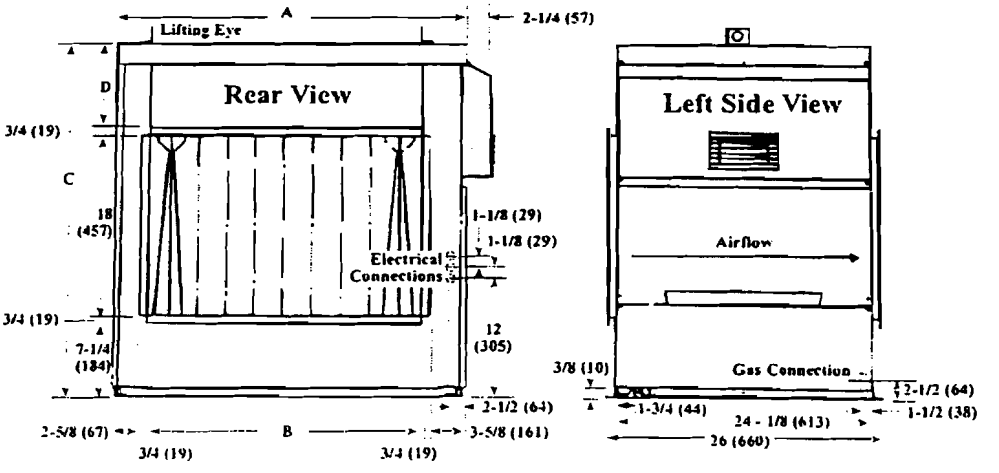
(H)-RPV	A	B	C	D
125	23	15-1/4	32-1/4	5-1/2
150, 175	28-1/2	20-3/4	32-1/4	5-1/2
200, 225	34	26-1/4	35-1/4	8-1/2
250	42-1/4	34-1/2	35-1/4	8-1/2
300	42-1/4	34-1/2	35-1/4	8-1/2
350	47-3/4	40	35-1/4	8-1/2
400	53-1/4	45-1/2	35-1/4	8-1/2

Model Series RPV Dimensions - (mm ±3)

(H)-RPV	A	B	C	D
125	584	387	819	140
150, 175	724	527	819	140
200, 225	864	667	895	216
250	1073	876	895	216
300	1073	876	(895	216
350	1213	1016	895	216
400	1353	1156	895	216

Gas Connection (inches)

(H)-RPV	Natural	Propane
125	1/2	1/2
150, 175	1/2	1/2
200, 225	1/2	1/2
250	1/2	1/2
300	3/4	1/2
350	3/4	1/2
400	3/4	1/2



6. Clearances

Clearance to combustibles is defined as the minimum distance from the heater to a surface or object that is necessary to ensure that a surface temperature of 90°F above the surrounding ambient temperature is not exceeded.

Clearance is also required to sides of furnace for service.

Required Clearances						
Models		Top	Sides*		Bottom	
			Control	Opposite	To Combustibles	To Non-Combustibles
RG, RP, HRPD Series	inches	36	Width of furnace plus 6	6	0	0
	mm	914	Width of furnace plus 152	152	0	0
RX & RPV Series	inches	36	Width of furnace plus 6	6	3	0
	mm	914	Width of furnace plus 152	152	76	0
RG & RX Series		30 ft (9M) radius from center of vent cap to obstructions such as walls, parapets or cupolas.				
* Provide clearance as shown for safety, for combustion air, and for service.						

7. Combustion Air Requirements

7A. Combustion Air Requirements for Power-Vented Model Series RP, HRPD, and RPV

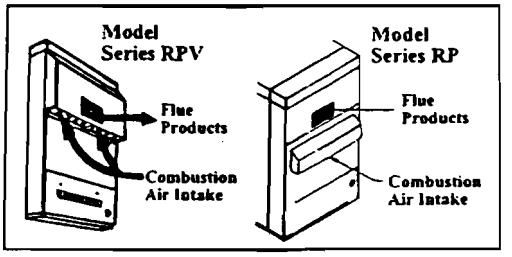


FIGURE 3 - Combustion Air Intakes, Power-Vented Models

The combustion air and flue gas openings are carefully designed screened openings located on the side of each unit just above the control access panel. Location of the flue opening directly above the air intakes discourages recirculation of combustion products. See **FIGURE 3**.

7B. Gravity-Vented Model Series RX and RG

Both Model RX and RG Series furnaces have screened combustion air intake hoods in their doors. The air intake hood on a Model RG furnace is factory installed. The air intake hood on a Model RX furnace requires field installation. Follow the instructions below to assemble the air intake hood before a Model RX Series heater is installed.

Field Installation Instructions for Combustion Air Intake Hood for Gravity-Vented - Applies to RX, HRX, CRX, HCRX Models *Only*

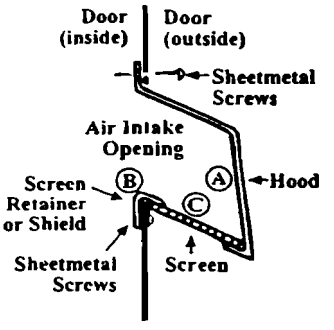
The parts shown in **FIGURE 4** may be shipped attached to the inside of one or both furnace access doors to facilitate crating, and must be removed from the inside of the doors and installed on the outside as shown in **FIGURE 4**. The hood is comprised of the parts shown in **FIGURE 4** -- (a) inlet hood, (b) a screen retainer or shield, (c) screen (Sizes 150-400).

On Sizes 75, 100 and 125, the screen retainer serves as a shield and no screen is used. Sizes 150 through 400 use the screen retainer and screen.

FIGURE 4 - Combustion Air Intake Hood, Model Series RX only

Instructions:

1) Attach (B) screen retainer or shield with sheetmetal screws (heads out).
2) Attach (A) hood at top only with sheetmetal screws (don't tighten).
3) Insert (C) screen under retainer (B) and over bottom flange of hood (A).
4) Attach (A) hood at sides with sheetmetal screws and tighten top sheetmetal screws.



7C. CHLORINE - All Models

The presence of chlorine vapors in the combustion air of gas-fired heating equipment presents a potential corrosion hazard. Chlorine will, when exposed to flame, precipitate from the compound, usually freon or degreaser vapors, and go into solution with any condensation that is present in the heat exchanger or associated parts. The result is hydrochloric acid which readily attacks all metals including 300 grade stainless steel.

Care should be taken to separate these vapors from the combustion process. This may be done by wise location of the furnace with regard to exhausters or prevailing wind direction. Remember, chlorine is heavier than air. This fact should be kept in mind when determining installation locations of heating equipment and building exhaust systems.

8. Rigging and Mounting

Weights

Before installing the furnace, check the supporting structure to be used to verify that it has sufficient load-carrying capacity to support the weight of the unit. Lifting holes are provided at each of the four corners of the mounting support rails. Use spreader bars when lifting to prevent chains or cables from damaging the cabinet. Furnaces must be level.

Approximate Net Weight - lbs										
Size	75-100	125	150	175	200	225	250	300	350	400
RG	160	196	21	212	242	242	290	290	327	354
RP	--	201	217	217	247	247	295	295	333	361
RX	161	167	181	181	247	247	305	308	337	364
RPV	--	193	203	207	271	278	339	349	368	405
Size	250	300	350	400	500	600	700	800		
HRPD	402	434	434	494	590	590	666	722		

Approximate Net Weight - kg										
Size	75-100	125	150	175	200	225	250	300	350	400
RG	73	89	96	96	110	110	132	132	148	161
RP	--	91	98	98	112	112	134	134	151	164
RX	73	76	82	82	112	112	138	140	153	165
RPV	--	88	92	94	123	126	154	158	167	184
Size	250	300	350	400	500	600	700	800		
HRPD	182	196	196	224	268	268	302	328		

Mounting Models (H) - RG, CRG, RP, HRPD - These furnaces may be placed directly on a slab or roof where support is adequate. Support rails provide required clearance from combustibles.

Mounting Models (H) - RX, CRX, RPV - These furnaces require a minimum of 3" (76mm) clearance from the bottom of the unit to a combustible surface. Available support feet, P/N 10680 (four required), or 3" (76mm) field-fabricated supports will provide adequate clearance. (See FIGURES 5A and 5B.)

FIGURE 5A - Support Feet, P/N 10680 (4 required)

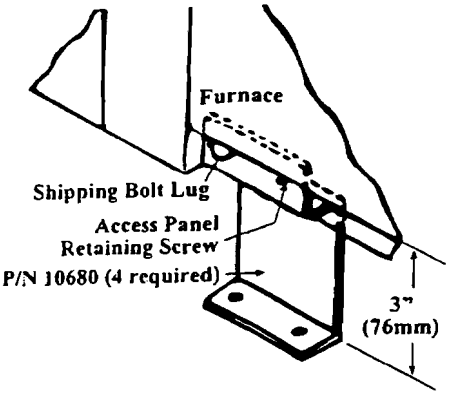
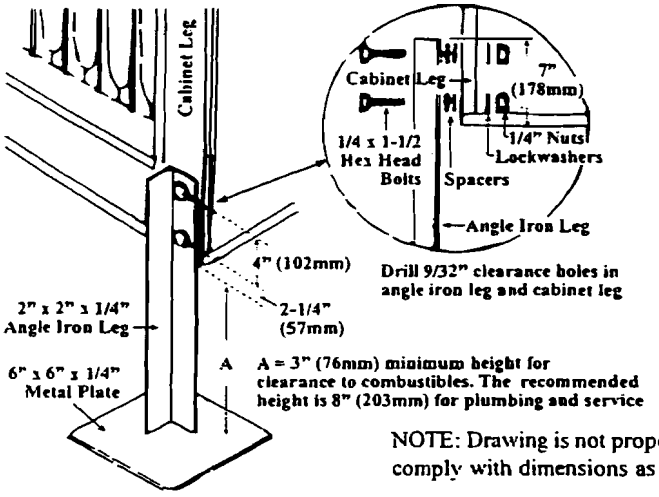


FIGURE 5B - Field-Fabricated Supports



NOTE: Drawing is not proportional; comply with dimensions as written.

9. Venting

WARNING: This gravity-vented furnace should be located on a roof or slab with at least 30-foot (9M) radius between the center of the vent cap and obstructions such as walls, parapets or cupolas. See Hazard Levels, page 2.

9A. Venting - Gravity-Vented, Outdoor Models (H)-RX, CRX, RG, CRG

The appropriate size of gravity vent cap is supplied with the furnace. The gravity vent cap requires field installation.

Size (All Models except where specified)	Vent Cap Size	Extension Required
75, 100	6" (152mm)	No
125, 150, 175	8" (203mm)	
200, 225, 250	10" (254mm)	
(H)-CRX, CRG 300	10" (254mm)	
(H)-RX, RG 300	12" (305mm)	Yes (packed inside cap)
350, 400	12" (305mm)	

9A. Venting - Gravity-Vented, Outdoor Models (H)-RX, CRX, RG, CRG (cont'd)

Vent Cap Installation Instructions:

IMPORTANT REQUIREMENT

For proper operation of the gravity vent cap, position the pre-punched holes so that the solid side panel of the cap will face the control compartment access panel side of the furnace. See FIGURE 6B.

1) Furnaces that ***do not require*** a Vent Cap Extension

Sizes 75-250 and high efficiency Size 300, align holes and attach the vent cap to the furnace flue collar with sheetmetal screws.

2) Furnaces that ***require*** a Vent Cap Extension (packed inside the vent cap) - See FIGURES 6A and 6B

Standard efficiency furnace Size 300 and all Sizes 350 and 400 require a 12" extension to raise the vent cap above the top of the furnace.

a) Remove the extension from the inside of the cap.

b) Attach the extension to the furnace flue collar --

(1) With 3/8" centerline clearance holes at the bottom, wrap extension ***around*** flue collar on the top of the furnace.

(2) Align holes in the extension with holes in the flue collar.

(3) Secure with No. 10-1/2" sheetmetal screws.

c) Attach the vent cap to the extension --

(1) Position vent cap ***into*** top of extension.

(2) Align holes and push cap into extension.

(3) Secure with No. 10-1/2" sheetmetal screws.

FIGURE 6A - Vent Cap Extension. P/N 20524

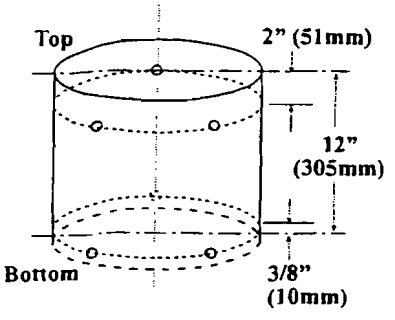
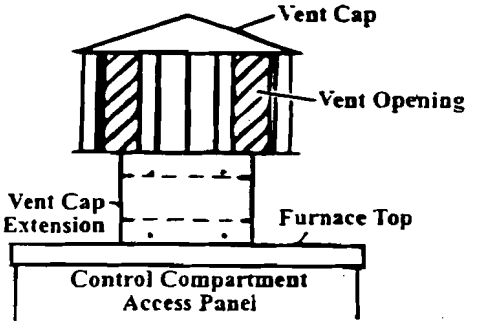


FIGURE 6B - Vent Cap Installation

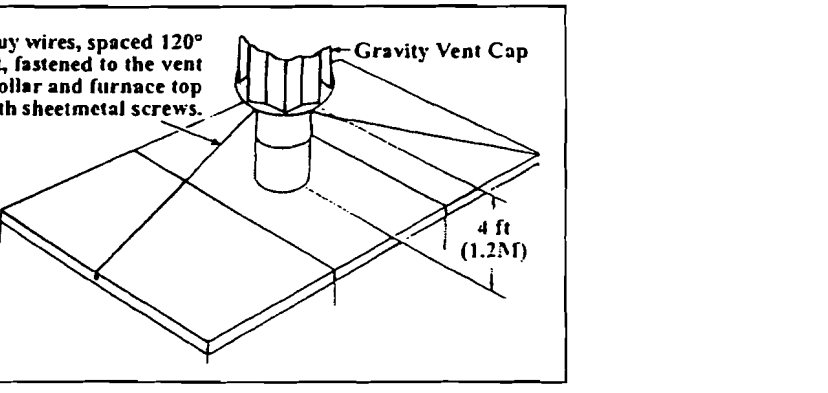


Optional 4-foot (1.2M) Stack Extension for Gravity Vent -- Model Series RX or RG with Option ZZ

Outdoor, gravity-vented furnaces that are factory-built with Option ZZ are designed to release flue gases four feet above the top of the furnace. A field-provided 4-ft (1.2M) vent extension must be installed between the top of the furnace and the bottom of the vent cap. (See FIGURE 6C).

Furnaces with Option ZZ (factory-installed restrictor plus field-provided 4-ft stack) may be installed adjacent to fresh air inlet(s) when local code requires that release of flue gases be above an adjacent fresh air inlet that is not part of the furnace.

FIGURE 6C - Optional Stack Extension applies only to Furnaces with Suffix "Z" in the Model No. (Ex: RX400-6Z)



9B. Venting - Power Vented, Outdoor Model Series (H)RP, (H)RPV, HRPD

Locate power-vented furnaces so that flue discharge is not directed at fresh air inlets.

Flue Gas and Combustion Air Openings

These screened openings are located on the side of the furnace just above the control access panel. See FIGURE 7. The positions of these openings discourages recirculation of combustion products and provides for furnace operation in all normal weather conditions.

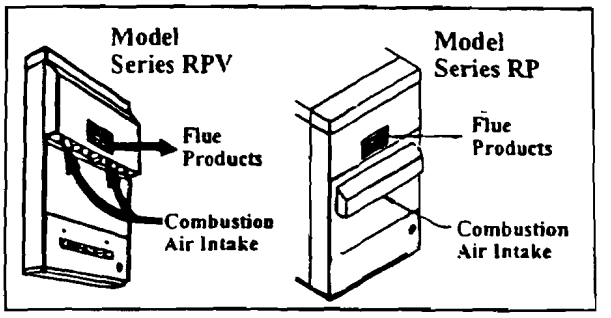


FIGURE 7 - Flue Outlet, Power-Vented Furnaces

Optional Vertical Flue Discharge (Option CC3)

These power vented furnaces are certified with four feet of vertical pipe attached as shown in FIGURES 8A and 8B. The distance is measured from the top of the unit to the bottom of the vent cap. The option package includes the 5" vent cap, the adapter assembly and the seal plate. The vent pipe and supports are field supplied.

Optional vertical vent piping provides compliance with local codes that require either 10-ft horizontal or 4-ft vertical clearance between the flue outlet and fresh air intake of the heating system and/or the building.

FIGURE 8A - Installation of Adapter for Optional Vertical Flue Discharge (Option CC3, P/N 45021)

Attach the venter seal plate and oval adapter assembly with sheetmetal screws. Use venter seal plate as drill template.

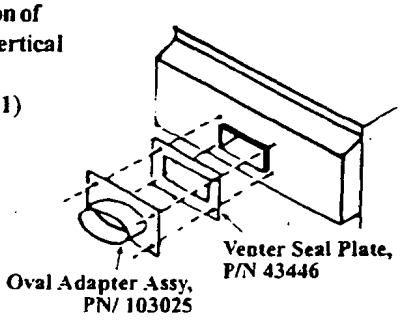
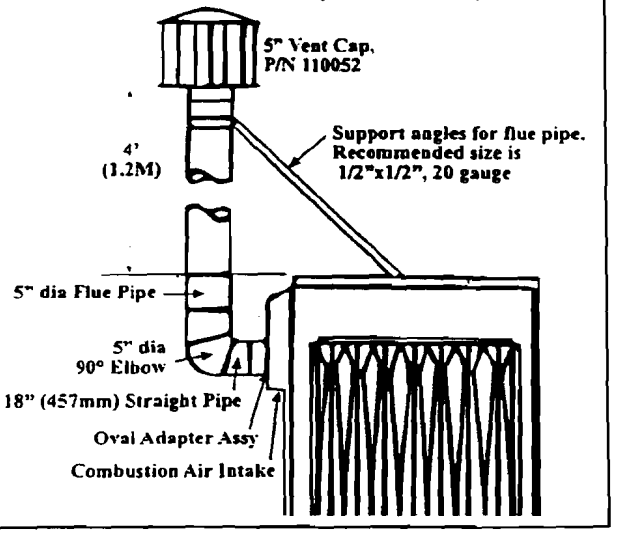


FIGURE 8B - Installation of the Vent Cap (included in the option pkg) and the field-supplied piping and supports



10. Condensate Drain

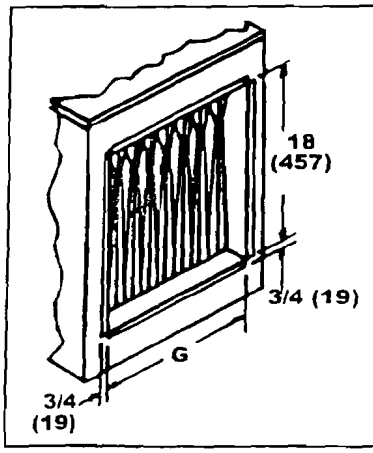
All furnace bottom panels are provided with holes to eliminate condensation.

Model Series RX - slots in all four corners

Model Series RPV - a 9/16" diameter hole in the corner

Model Series RG, RP, HRPD - holes in all four corners of each furnace

11. Duct Connections



Size	G
75, 100	12-1/2 (318)
125	15-1/4 (387)
150, 175	20-3/4 (527)
200, 225	26-1/4 (667)
250, 300	34-1/2 (876)
350	40 (1016)
400	45-1/2 (1156)

FIGURE 9 - Duct Connection Dimensions for Horizontal Discharge - inches (mm)

11. Duct Connections (cont'd)

Requirements and Suggestions for Connecting and Installing Ducts

- **Type of Ductwork** - The type of duct installation to be used depends in part on the type of construction of the roof (whether wood joist, steelbar joist, steel truss, pre-cast concrete) and the ceiling (hung, flush, etc.).
- **Ductwork Material** - Rectangular duct should be constructed of not lighter than No. 26 U.S. gauge galvanized iron or No. 24 B & S gauge aluminum.
- **Ductwork Structure** - All duct sections 24 inches (610mm) or wider, and over 48 inches (1219mm) in length, should be cross broken on top and bottom and should have standing seams or angle-iron braces. Joints should be S and drive strip, or locked.
- **Through Masonry Walls** - No warm air duct should come in contact with masonry walls. Insulate around all air duct through masonry walls with not less than 1/2" (1" recommended) of insulation.
- **Through Unheated Space** - Insulate all exposed warm air ducts passing through an unheated space with at least 1/2" (1" is recommended) of insulation.
- **Duct Supports** - Suspend all ducts securely from building members. Do not support ducts from unit duct connections.
- **Duct Sizing** - Proper sizing of the supply air ductwork is necessary to ensure a satisfactory heating installation. The recognized authority for such information is the Air Conditioning Contractors Association, 1228 17th Street N.W., Washington, D.C. 20036. A manual covering duct sizing in detail may be purchased directly from them.
- **Removable Panels** - The ducts should have removable access panels on both upstream and downstream sides of the furnace. These openings must be accessible when the furnace is in service and should be a minimum of 6" x 10" in size so smoke or reflected light may be observed inside the casing to indicate the presence of leaks in the heat exchanger. The covers for the openings must be attached in such a manner as to prevent leakage. See **FIGURE 10**.
- **Horizontal Discharge Duct Length** - A minimum horizontal duct run of 24" (610mm) is recommended before turns or branches are made in the duct system to reduce losses at the furnace outlet.
- **Supply Air Duct/Furnace Horizontal Connection** - The seal between the furnace and the duct must be mechanical. Duct connection should be made with "U" type flanges on the top and bottom of the connecting duct. Slide the duct over the flanges of the heater giving an airtight fit. Provide "U" type channels for the other side flanges to ensure tight joints. Use sheetmetal screws to fasten ducts and "U" channels to the furnace flange. See **FIGURES 10 and 11**.

CAUTION: Joints where supply air ducts attach to the furnace must be sealed securely to prevent air leakage into drafthood or burner rack area. Leakage can cause poor combustion, pilot problems, shorten heat exchanger life and cause poor performance.

FIGURE 10 - Connecting Supply Air Duct to the Furnace

(1) Flanges on the furnace (heat exchanger) turn out as shown. (2) Shape duct connection as shown -- "U" on top and bottom: "L" on sides. (3) Slide "U" channels over furnace top and bottom flanges making connection. (4) Form "U" channels to seal sides. Drill and lock with sheetmetal screws.

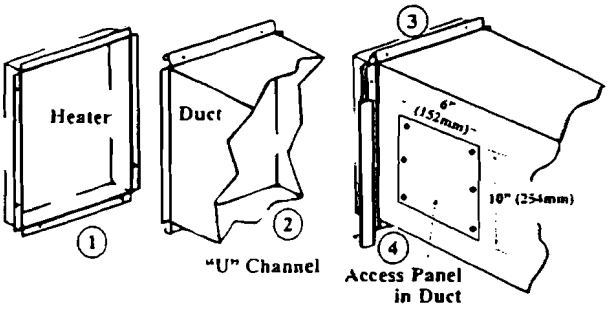
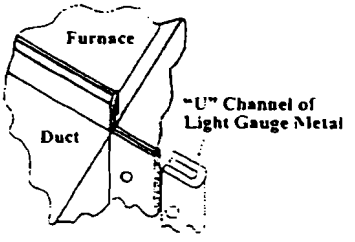


FIGURE 11 - "U" Channel Duct Connection



12. Duct Furnace Air Flow Requirements

The duct furnace must be installed on the positive pressure side of the field supplied blower. The air throughput must be within the CFM range stated on the heater rating plate. The air distribution must be even over the entire heat exchanger. Turning vanes should be used in elbows or turns in the air inlet to ensure proper air distribution (See Paragraph 14). If it is determined that the blower CFM is greater than allowed or desirable, see Paragraph 13 for instructions on determining the correct size of bypass duct required. To determine temperature rise, the inlet and outlet air temperatures should be measured at points not affected by heat radiating from the heat exchanger. The charts below show the approved temperature rise range with the required CFM and the internal pressure drop for each size of unit.

Models RP/RPV (80% thermal efficient)

Size	125		150		175		200		225		250		300		350		400	
Temp Rise	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.
50°F	1840	0.50	2210	0.38	2580	0.52	2945	0.42	3315	0.53	3685	0.40	4420	0.58	5160	0.65	5895	0.67
60°F	1535	0.33	1840	0.26	2150	0.35	2455	0.28	2765	0.36	3070	0.28	3685	0.39	4300	0.44	4915	0.45
70°F	1315	0.25	1580	0.19	1840	0.26	2105	0.22	2370	0.27	2630	0.23	3160	0.29	3685	0.31	4210	0.32
80°F	1150	0.21	1380	0.15	1610	0.19	1840	0.17	2070	0.22	2300	0.22	2765	0.25	3225	0.25	3685	0.25
90°F	1020	0.18	1225	0.12	1430	0.16	1635	0.14	1840	0.17	2045	0.21	2455	0.22	2865	0.23	3275	0.19

Models HRP/HRPV (80% thermal efficient, high CFM)

Size	125		150		175		200		225		250		300		350		400	
Temp Rise	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.
20°F	4605	1.16	5530	0.85	6450	1.19	7370	1.00	8295	1.28	9215	0.90	11060	1.26	12900	1.23	14745	1.23
30°F	3070	0.53	3685	0.39	4300	0.54	4915	0.45	5530	0.58	6140	0.41	7370	0.57	8600	0.56	9830	0.56
40°F	2300	0.28	2765	0.21	3225	0.29	3685	0.25	4145	0.31	4605	0.22	5530	0.32	6450	0.31	7370	0.31
50°F	1840	0.21	2210	0.15	2580	0.18	2945	0.16	3315	0.21	3685	0.15	4420	0.21	5160	0.19	5895	0.19
60°F	1535	0.15	1840	0.12	2150	0.15	2455	0.12	2765	0.15	3070	0.11	3685	0.15	4300	0.14	4915	0.15
75°F	1225	0.12	1475	0.11	1720	0.12	1965	0.11	2210	0.12	2455	0.08	2945	0.11	3440	0.11	3930	0.11

Models RG/RX (78% thermal efficient)

Size	75		100		125		150		175		200		225		250		300		350		400	
Temp Rise	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.
50°F	1075	0.22	1435	0.41	1795	0.47	2155	0.36	2515	0.49	2875	0.40	3235	0.50	3590	0.38	4310	0.55	5030	0.62	5750	0.64
60°F	895	0.14	1195	0.28	1495	0.32	1495	0.25	2095	0.33	2395	0.27	2695	0.34	2995	0.27	3590	0.37	4190	0.42	4790	0.43
70°F	770	0.09	1025	0.19	1280	0.24	1540	0.18	1795	0.25	2050	0.22	2310	0.26	2565	0.22	3080	0.28	3590	0.30	4105	0.31
80°F	670	0.06	895	0.14	1120	0.19	1345	0.14	1570	0.18	1795	0.16	2020	0.21	2245	0.21	2695	0.24	3145	0.24	3590	0.24
90°F	595	0.04	795	0.10	995	0.17	1195	0.11	1395	0.15	1595	0.13	1795	0.16	1995	0.19	2395	0.21	2795	0.22	3195	0.18

Models HRG/HRX (78% thermal efficient, high CFM)

Size	75		100		125		150		175		200		225		250		300		350		400	
Temp Rise	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.
20°F	2695	0.58	3590	1.03	4490	1.10	5390	0.81	6290	1.13	7185	0.95	8085	1.22	8985	0.85	10780	1.20	12580	1.17	14375	1.17
30°F	1795	0.27	2395	0.47	2995	0.50	3590	0.37	4190	0.51	4790	0.43	5390	0.55	5990	0.39	7185	0.54	8385	0.53	9585	0.53
40°F	1345	0.15	1795	0.27	2245	0.27	2695	0.19	3145	0.28	3590	0.24	4040	0.30	4490	0.21	5390	0.31	6290	0.30	7185	0.30
50°F	1075	0.11	1435	0.15	1795	0.19	2155	0.14	2515	0.17	2875	0.15	3235	0.19	3590	0.14	4310	0.19	5030	0.18	5750	0.18
60°F	895	0.09	1195	0.13	1495	0.14	1795	0.11	2095	0.14	2395	0.11	2695	0.14	2995	0.10	3590	0.14	4190	0.13	4790	0.14
75°F	715	0.09	955	0.11	1195	0.11	1435	0.10	1675	0.11	1915	0.10	2155	0.11	2395	0.07	2875	0.10	3355	0.10	3830	0.10

NOTE: Temperature rise for Models approved to Candian Standards is 20°F-50°F

Models CRG/CRX (80% thermal efficient)

Size	75		100		125		175		225		250		300		350		400	
Temp Rise	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.
50°F	1110	0.24	1330	0.34	1655	0.39	2220	0.38	2960	0.41	3330	0.32	4000	0.47	4665	0.51	5330	0.53
60°F	920	0.15	1105	0.23	1375	0.26	1845	0.26	2460	0.28	2765	0.24	3320	0.32	3875	0.35	4430	0.36
70°F	752	0.10	945	0.16	1175	0.22	1575	0.19	2105	0.22	2365	0.20	2840	0.25	3315	0.26	3785	0.26
80°F	695	0.08	835	0.12	1040	0.18	1395	0.15	1860	0.17	2090	0.20	2510	0.22	2930	0.22	3345	0.21
85°F	650	0.08	780	0.12	975	0.17	1305	0.15	1740	0.16	1960	0.20	2350	0.21	2745	0.20	3135	0.18

Models HCRG/HCRX (80% thermal efficient, high CFM)

Size	75		100		125		175		225		250		300		350		400	
Temp Rise	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.
20°F	2775	0.60	3330	0.89	4145	0.92	5555	0.84	7405	1.03	8330	0.74	10000	1.00	11665	1.03	13330	1.03
30°F	1875	0.28	2250	0.40	2800	0.41	3750	0.37	5000	0.45	5625	0.33	6750	0.47	7875	0.45	9000	0.45
40°F	1395	0.16	1670	0.22	2080	0.23	2790	0.21	3720	0.24	4185	0.19	5020	0.27	5860	0.26	6695	0.26
50°F	1110	0.13	1330	0.15	1655	0.16	2220	0.15	2960	0.16	3330	0.13	4000	0.17	4665	0.16	5330	0.17
60°F	920	0.11	1105	0.13	1375	0.13	1845	0.13	2460	0.13	2765	0.10	3320	0.13	3875	0.11	4430	0.13
70°F	790	0.10	950	0.11	1185	0.11	1585	0.11	2115	0.10	2380	0.08	2855	0.10	3330	0.10	3805	0.09

NOTE: Temperature rise for Models approved to Canadian Standards is 20°F-50°F

Model HRPD

SIZE	250		300		350		400		500		600		700		800	
Temp Rise	CFM	PD	CFM	PD	CFM	PD	CFM	PD	CFM	PD	CFM	PD	CFM	PD	CFM	PD
40°F	4630	1.97	5556	1.45	6481	2.02	7407	1.70	9259	1.53	11111	2.14	12963	2.09	14815	2.09
50°F	3704	1.26	4444	0.92	5185	1.29	5926	1.09	7407	0.98	8889	1.37	10370	1.34	11852	1.34
60°F	3086	0.88	3704	0.64	4321	0.90	4938	0.76	6173	0.68	7407	0.95	8642	0.93	9877	0.93
70°F	2646	0.64	3175	0.47	3704	0.66	4233	0.56	5291	0.50	6349	0.70	7407	0.68	8466	0.68
80°F	2315	0.49	2778	0.36	3241	0.51	3704	0.43	4630	0.38	5556	0.54	6481	0.52	7407	0.52
90°F	2058	0.39	2469	0.29	2881	0.40	3292	0.34	4115	0.30	4938	0.42	5761	0.41	6584	0.41
100°F	1852	0.32	2222	0.23	2593	0.32	2963	0.27	3704	0.24	4444	0.34	5185	0.33	5926	0.33

13. Constructing Bypass Duct

When the CFM of air throughput is greater than desirable or permissible for the unit, a bypass duct may be constructed. Follow these instructions to determine the correct size of the bypass duct.

Directions for Sizing Bypass Duct

1) From the tables in Paragraph 12. find the pressure drop (P.D.) and the allowable CFM for the furnace that is being installed.

   Example: Standard Size RP150 @ 50°F temperature rise

   P.D. .38

   CFM 2210

2) Subtract the allowable CFM from the actual CFM of the installation to determine how much air must be diverted through the bypass duct.

13. Constructing Bypass Duct (cont'd)

Directions for Sizing Bypass Duct (cont'd)

Example: Blower CFM 3000
Allowable CFM -2210
Bypass CFM 790

3) Go to the column in the Bypass CFM Chart that is closest to the pressure drop through the heater. Move down in that column until you find the CFM closest to the answer in Step 2).

Example: P.D. .40: Bypass CFM 900

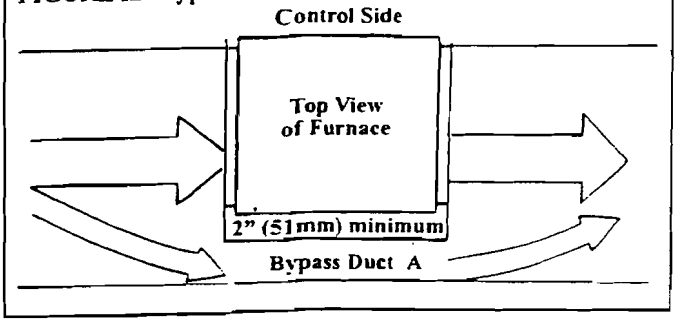
4) Move to the left column to find out the required size of the bypass duct.

Example: Bypass Duct Size is 3"

Depth of the bypass duct is 18" on both inlet and outlet ends. Bypass duct must be located on side opposite controls and 2" from the heat exchanger side panel.

NOTE: Not all capacities are covered in this chart. If your installation is not covered, the correct size may be determined by consulting the factory representative.

FIGURE 12 - Bypass Duct



Bypass CFM										
"A" Width		Pressure Drop through the Furnace								
inches	mm	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
3"	76	490	530	610	700	780	830	900	960	1010
4"	102	630	750	870	980	1090	1160	1250	1310	1400
5"	127	850	1010	1190	1300	1410	1520	1640	1730	1810
6"	152	1050	1290	1480	1650	1800	1940	2090	2200	2320
7"	178	1250	1510	1760	1960	2180	2320	2500	2650	2800
8"	203	1490	1810	2100	2350	2560	2760	2940	3110	3290
9"	229	1700	2100	2400	2700	2970	3200	3400	3600	3800
10"	254	1920	2350	2760	3090	3650	4020	4300	4550	4800

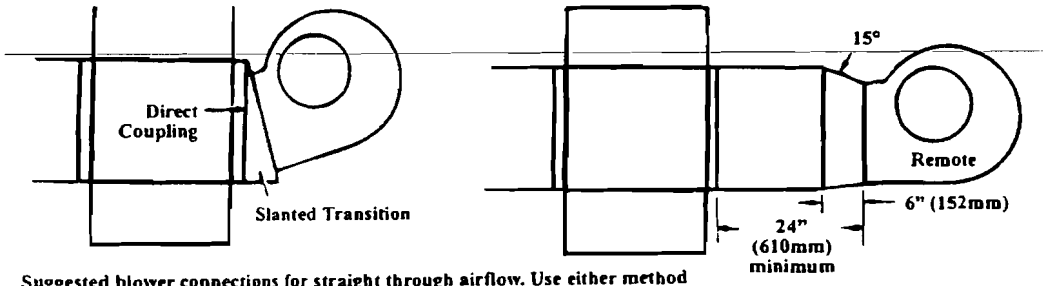
14. Duct Furnace Blower Connections

Proper arrangement of blower and duct furnace with respect to angle of approach of the duct connection and the arrangement of the discharge opening of the blower is required. Blowers should be bottom horizontal discharge when coupled to the duct furnace. When a top horizontal discharge blower is connected to the duct furnace, be sure that sufficient length of duct is provided to permit even flow of air at the end of the duct. Or, baffles may be inserted between the blower and the heater to assure an even flow of air across the heat exchanger.

WARNING: The furnace must be installed on the positive pressure side of the air-circulating blower. See Hazard Levels, page 2.

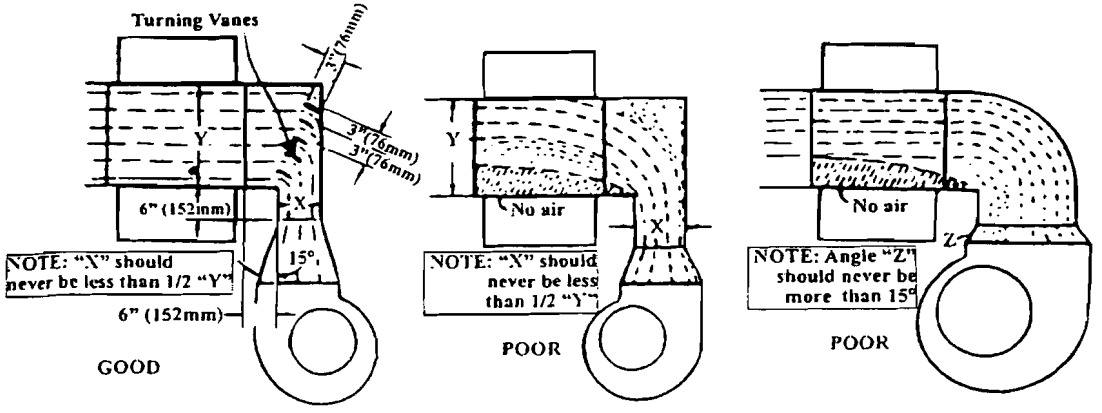
FIGURE 13

Straight Through Air

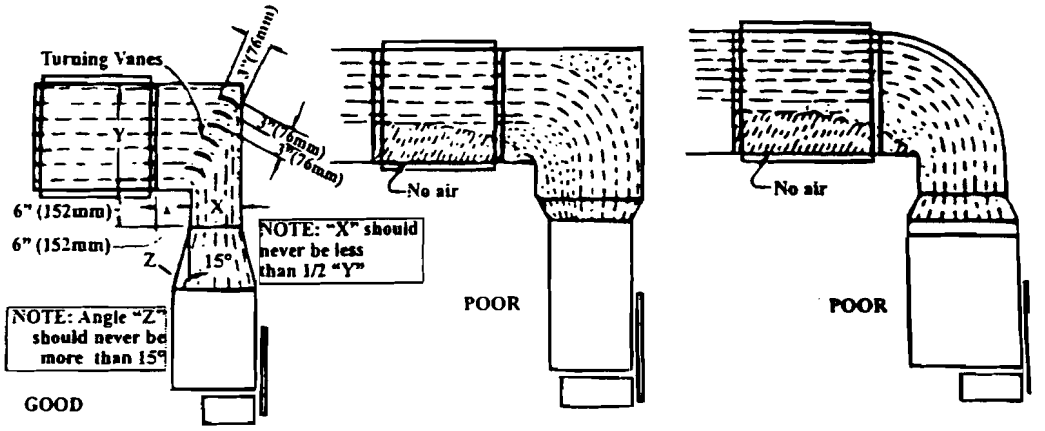


Suggested blower connections for straight through airflow. Use either method for good air coverage and efficient operation.

With Elbows Up or Down



With Elbows Right or Left



15. Gas Piping and Pressures

WARNING

This appliance is equipped for a maximum gas supply pressure of 1/2 psi, 3.4 kPa, or 14 inches water column. Supply pressure higher than 1/2 psi requires installation of an additional service regulator external to the unit.

PRESSURE TESTING SUPPLY PIPING

Test Pressures Above 1/2 PSI: Disconnect the heater and manual valve from the gas supply line which is to be tested. Cap or plug the supply line.

Test Pressures Below 1/2 PSI: Before testing, close the manual valve on the heater.

All piping must be in accordance with requirements outlined in the National Fuel Gas Code ANSI/ Z223.1a (latest edition) or CSA-B149.1 and B149.2 (See Paragraph 1). Gas supply piping installation should conform with good practice and with local codes.

Duct furnaces for natural gas are orificed for operation with gas having a heating value of 1000 (+ or - 50) BTUH per cubic ft. If the gas at the installation does not meet this specification, consult the factory for proper orificing.

Pipe joint compounds (pipe dope) shall be resistant to the action of liquefied petroleum gas or any other chemical constituents of the gas being supplied.

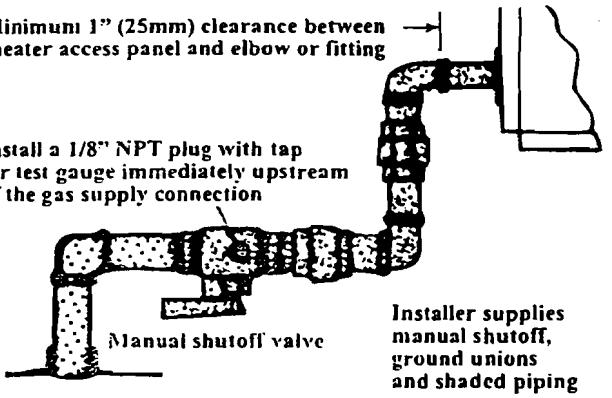
Install a ground joint union and manual shutoff valve upstream of the unit control system, as shown in **FIGURE 14**. The 1/8" plugged tapping in the shutoff valve provides connection for supply line pressure test gauge. The National Fuel Gas Code requires the installation of a trap with a minimum 3" drip leg. Local codes may require a minimum drip leg longer than 3" (typically 6").

After all connections are made, disconnect the pilot supply at the control valve and bleed the system of air. Reconnect the pilot line and leak-test all connections by brushing on a soap solution.

WARNING: All components of a gas supply system must be leak tested prior to placing equipment in service. NEVER TEST FOR LEAKS WITH AN OPEN FLAME. Failure to comply could result in personal injury, property damage or death.

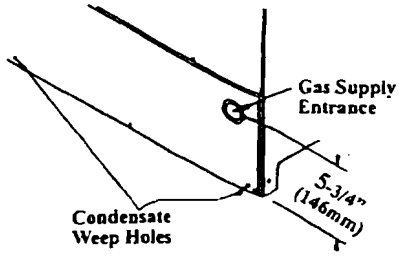
Gas Connection (Not Gas Supply Line Size) to Single-Stage Valve (see FIGURES 14-17)		
RX, RG, RP, RPV	75-250	300-400
HRPD	250-500	600-800
Natural Gas	1/2"	3/4"
Propane Gas	1/2"	1/2"

FIGURE 14- Gas Connection Requirements - All Models



15. Gas Piping and Pressures (cont'd)

FIGURE 15 - Gas Connection Location - Model Series RG, RP, and HRPD (Multiple furnaces require one connection; see FIGURE 2C for approximate location.)



Install the gas supply piping so that when the union is disconnected, the supply pipe will not interfere with the removal of the burner rack. (The burner rack slides out of the control side of the furnace.)

FIGURE 16 - Gas Connection Location - Model Series RPV

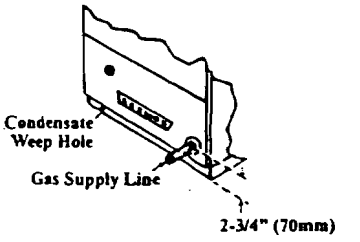
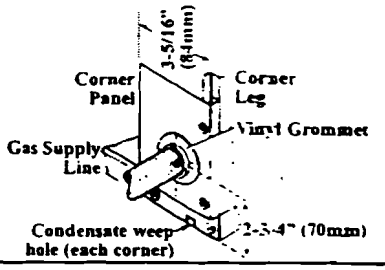


FIGURE 17 - Gas Connection Location - Model Series RX



Gas Supply Sizing

Capacity of Piping - Cubic Feet per Hour based on 0.3" w.c. Pressure Drop
Specific Gravity for Natural Gas -- 0.6 (Natural Gas -- 1000 BTU/Cubic Ft)
Specific Gravity for Propane Gas -- 1.6 (Propane Gas -- 2550 BTU/Cubic Ft)

Length of Pipe	Diameter of Pipe											
	1/2"		3/4"		1"		1-1/4"		1-1/2"		2"	
	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane
20'	92	56	190	116	350	214	730	445	1100	671	2100	1281
30'	73	45	152	93	285	174	590	360	890	543	1650	1007
40'	63	38	130	79	245	149	500	305	760	464	1450	885
50'	56	34	115	70	215	131	440	268	670	409	1270	775
60'	50	31	105	64	195	119	400	244	610	372	1105	674
70'	46	28	96	59	180	110	370	226	560	342	1050	641
80'	43	26	90	55	170	104	350	214	530	323	990	604
90'	40	24	84	51	160	98	320	195	490	299	930	567
100'	38	23	79	48	150	92	305	186	460	281	870	531
125'	34	21	72	44	130	79	275	168	410	250	780	476
150'	31	19	64	39	120	73	250	153	380	232	710	433
175'	28	17	59	36	110	67	225	137	350	214	650	397
200'	26	16	55	34	100	61	210	128	320	195	610	372

Note: When sizing supply lines, consider possibilities of future expansion and increased requirements. Refer to National Fuel Gas Code for additional information on line sizing.

Manifold or Orifice Pressure Settings

WARNING: Manifold gas pressure must never exceed 3.5" w.c. for natural gas and 10" w.c. for propane gas.

Measuring manifold gas pressure cannot be done until the heater is in operation. It is included in the steps of the "Check-Test-Start" procedure in Paragraph 28. The following warnings and instructions apply.

For Natural Gas: Manifold gas pressure is regulated by the combination valve to 3.5" w.c. Inlet pressure to the valve must be a minimum of 5" w.c. **or as noted on the rating plate** and a maximum of 14" w.c. **NOTE: Always check the rating plate for minimum gas supply pressure.** Minimum supply pressure requirements vary based on the size of the burner and the gas control option. Most units require a minimum of 5" w.c. of natural gas as stated above, but Sizes 350 and 400 with electronic modulation require a minimum of 6" w.c. natural gas supply pressure. Sizes 300 and 350 with mechanical modulation require 7" w.c.

For Propane Gas: Manifold gas pressure is regulated by the combination valve to 10" w.c. Inlet pressure to the valve must be a minimum of 11" w.c. and a maximum of 14" w.c.

Before attempting to measure or adjust manifold gas pressure, the inlet (supply) pressure must be within the specified range for the gas being used both when the heater is in operation and on standby. Incorrect inlet pressure could cause excessive manifold gas pressure immediately or at some future time.

Instructions to Check Manifold Pressure:

1) With the manual valve (on the combination valve) positioned to prevent flow to the main burners, connect a manometer to the 1/8" pipe outlet pressure tap in the valve. NOTE: A manometer (fluid-filled gauge) is recommended rather than a spring type gauge due to the difficulty of maintaining calibration of a spring type gauge.
2) Open the valve and operate the heater. Measure the gas pressure to the manifold. Normally adjustments should not be necessary to the factory preset regulator.

If adjustment is necessary, set pressure to correct settings by turning the regulator screw IN (clockwise) to increase pressure. Turn regulator screw OUT (counterclockwise) to decrease pressure.

Consult the valve manufacturer's literature provided with the furnace for more detailed information.

16. Electrical Supply and Connections

WARNING: If you turn off the power supply, turn off the gas. See Hazard Levels, page 2.

All electrical wiring and connections, including electrical grounding MUST be made in accordance with the National Electric Code ANSI/NFPA No. 70 (latest edition) or, in Canada, the Canadian Electrical Code, Part I-C.S.A. Standard C22.1. In addition, the installer should be aware of and in compliance with any local ordinances or gas company requirements that might apply.

Check the rating plate on the heater for the supply voltage and current requirements. A separate line voltage supply with fused disconnect switch should be run directly from the main electrical panel to the furnace, making connection to leads in the junction box. All external wiring must be within approved conduit and have a minimum temperature rise of 60°C. Conduit from the disconnect switch must be run so as not to interfere with the service panels of the furnace.

If the heater has field-installed options that require electrical connections, consult the instruction sheet and wiring diagram supplied in the option package.

Specific wiring diagrams that include standard and factory-installed options are included with the heater. Typical wiring diagrams are on pages 16-19.

CAUTION: If any of the original wire as supplied with the appliance must be replaced, it must be replaced with wiring material having a temperature rating of at least 105°C, except for limit control, optional bypass damper combustion air safety circuit (Option AG39 or AG40), and sensor lead wires which must be 150°C. See Hazard Levels, page 2.

Disconnect Switch

A disconnect switch is a required part of this installation. Switches are available, as options or parts, or may be purchased locally. When ordered as an optional component, the disconnect switch is shipped separately.

The disconnect switch may be fusible or non-fusible. When providing or replacing fuses in a fusible disconnect switch, use dual element time delay fuses and size to 1.25 times the maximum total input amps as stated on the unit rating plate. When installing, be careful that the conduit and switch housing are clear of furnace panels and inspection plates. Allow at least four feet (1.2M) of service room between the switch and removable panels.

Control Thermostat

A thermostat is not standard equipment but is an installation requirement. Use either an optional thermostat available with the heater or a field-supplied thermostat. Install according to the thermostat manufacturer's instructions.

A 24-volt thermostat must be used to actuate low voltage gas controls. If line voltage from the thermostat to the unit is desired, consult the factory representative.

Wiring between the thermostat and the heater must be suitable for a temperature rise of 60°C. Labeled thermostat leads are provided in the heater junction box for connection of thermostat wiring.

Thermostats should be located five feet above the floor on an inside wall, not in the path of warm or cold air currents and not in corners where air may be pocketed. Do NOT install a thermostat on cold air walls. For specific connection details, refer to instructions with the thermostat.

If more than one unit is cycled from one thermostat, separately activated relays must be substituted at unit thermostat connections.

CAUTION: Make sure the thermostat has an adequate VA rating for the total requirements. Add coil rating of all relays and match thermostat rating. See Hazard Levels, page 2.

Low voltage (24 volt) thermostats are equipped with heat anticipators which level out unit cycling for optimum temperature control. Set anticipator at full load control AMPS.

24V Controls - Maximum Amps (24V Transformer has 20VA capacity)		
Single-Stage Valve - .6	Spark Ignition System - .1	Relay Coil - .12
Two-Stage Valve - .6	Fan Control Heater - .12	
Maxitrol System - .5	Time Delay Relay Heater - .1	

Control Wiring

Field Control Wiring - Length and Gauge		
Total Wire Length	Distance from Unit to Control	Minimum Recommended Wire Gauge
150ft (46M)	75ft (23M)	#18 gauge
250ft (76M)	125ft (38M)	#16 gauge
350ft (107M)	175ft (53M)	#14 gauge

17. Limit Control

The heater is equipped with a non-adjustable high limit switch which shuts off the gas in the event of motor failure, lack of air due to dirty filters, or restrictions at the inlet or outlet of the unit. See Paragraph 28 for limit control check.

18. Fan Control

1. Blower is field-provided. The fan control on the furnace will provide the following:
   (a) A 45-second delay of blower operation to prevent the discharge of cold air.
   (b) Blower operation as long as the unit is hot.

18. Fan Control (cont'd)

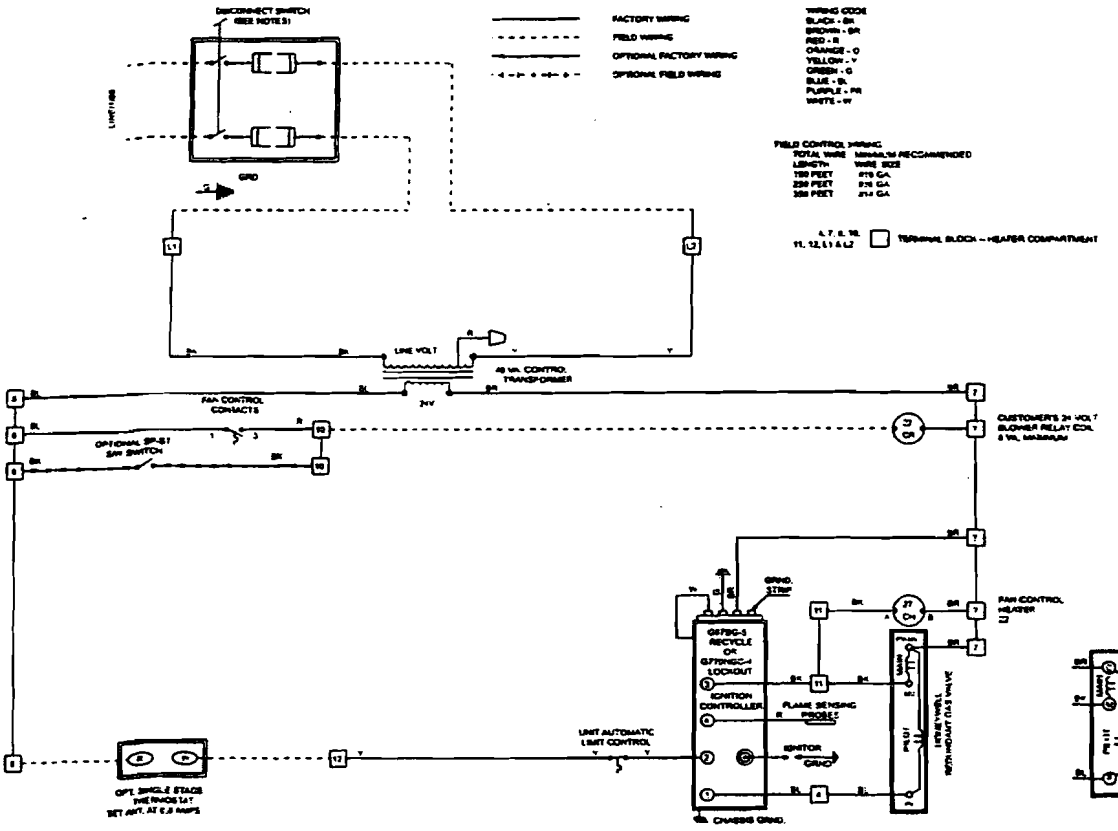
2. The fan control provides additional safety by keeping the blower in operation in the event that the gas valve fails to close when the thermostat is satisfied.
3. To be sure that the blower can continue to operate, the power supply to the furnace MUST NOT be interrupted except when servicing the unit.
4. If the customer wants the furnace off at night, the gas valve circuit SHOULD BE OPENED by a single pole switch wired in series with the thermostat. Some thermostats are provided with this feature. Multiple units controlled from a single thermostat are shut off in the same manner. For proper operation, be sure the fan control wiring is observed.

The fan control contains a built-in heater to control delay times. For proper operation, refer to the wiring diagram furnished with the furnace.

NOTE: Prior to 10/03, the fan control was optional. Check the wiring diagram on the furnace.

TYPICAL WIRING DIAGRAMS

Gravity-Vented Furnace with Standard Single-Stage Gas Valve, W. D. 106875



OPERATING SEQUENCE

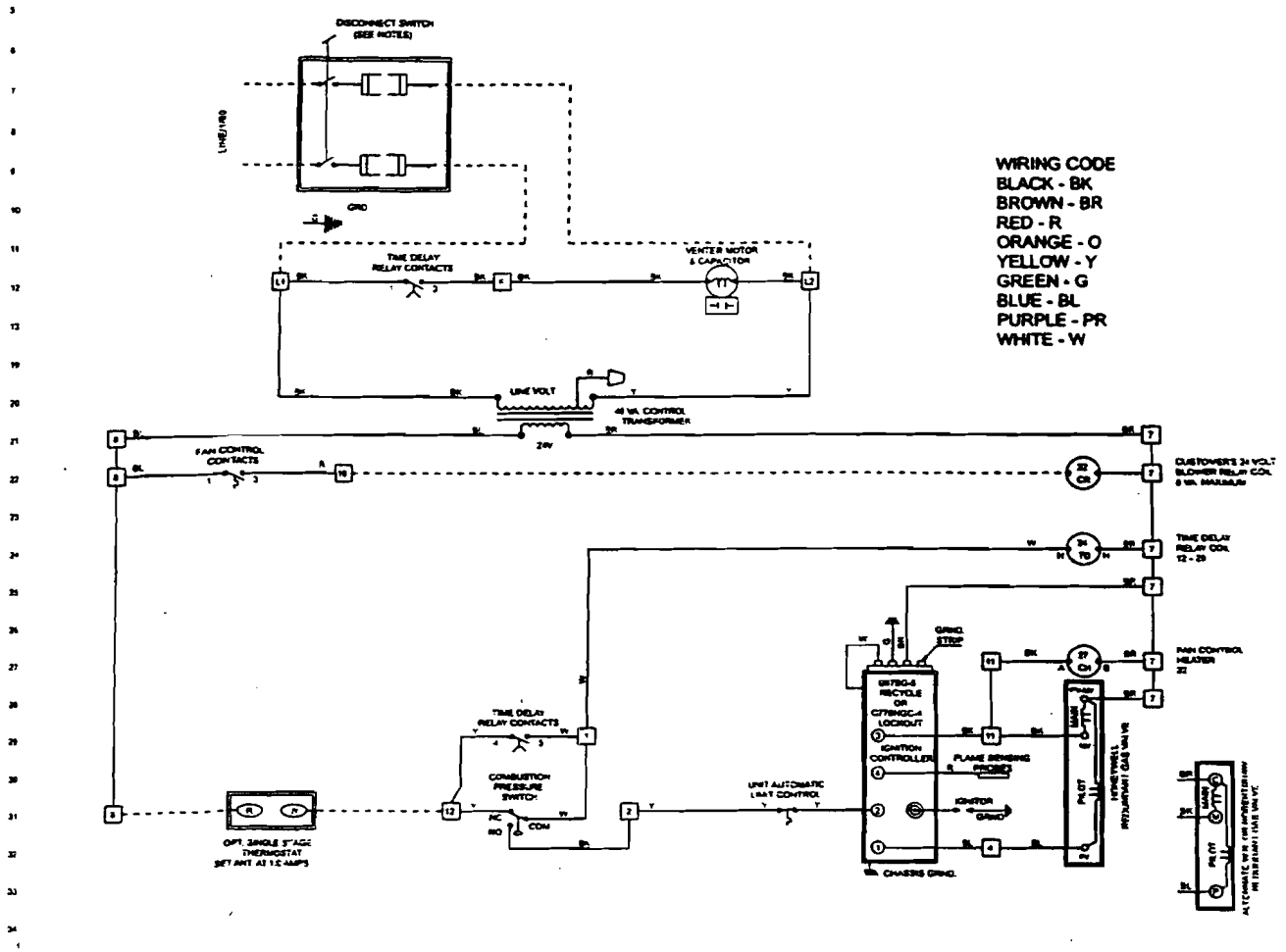
1. SET THERMOSTAT AT LOWEST SETTING.
2. TURN ON POWER, MAIN AND PILOT MANUAL GAS VALVES.
3. SET THERMOSTAT AT DESIRED TEMPERATURE.
4. THERMOSTAT CALLS FOR HEAT.
5. THE PILOT GAS VALVE AND SPARK GAP ARE ENERGIZED TO PRODUCE A PILOT FLAME ON EACH OPERATING CYCLE. THE SENSING PROBE PROVES THE PRESENCE OF THE PILOT FLAME AND ENERGIZES THE SAFETY SWITCH PORTION OF THE CONTROL. THE SWITCH ACTION DE-ENERGIZES THE SPARK GAP AND ENERGIZES THE MAIN VALVE. THE MAIN GAS IGNITES AND UNIT FIRES AT FULL RATE.
6. IF THE FLAME IS EXTINGUISHED DURING MAIN BURNER OPERATION THE SAFETY SWITCH CLOSES THE MAIN VALVE AND RECYCLES THE SPARK GAP. ON UNIT EQUIPPED WITH G770NGC-4 LOCKOUT CONTROL, IF PILOT IS NOT ESTABLISHED WITHIN 120 SECONDS (APPROX.) UNIT LOCKS OUT AND MUST BE RESET BY INTERRUPTING POWER TO CONTROL CIRCUIT (SEE LIGHTING INSTRUCTIONS).
7. THE SENSING PROBE PROVES THE PRESENCE OF THE PILOT FLAME.
   (A) DE-ENERGIZING THE IGNITOR.
   (B) ENERGIZING THE GAS VALVE.
8. SET THERMOSTAT AT LOWEST SETTING FOR SHUTDOWN.
   (A) FAN CONTROL KEEPS THE BLOWER MOTOR ON WHILE UNIT IS HOT
9. SET THE S/W SWITCH AT "ON" POSITION (CLOSED) FOR CONTINUOUS BLOWER OPERATION.

NOTES

1. THE FOLLOWING CONTROLS ARE SUPPLIED BY REZNOR FOR FIELD INSTALLATION: NONE
2. THE FOLLOWING CONTROLS ARE SUPPLIED AS OPTIONAL EQUIPMENT: S/W SWITCH AND THERMOSTAT
3. DOTTED WIRING AND THE FOLLOWING CONTROLS ARE SUPPLIED AND INSTALLED BY OTHERS: BLOWER RELAY
4. CAUTION: IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105 DEGREES C., EXCEPT FOR BLOCKED VENT SWITCH OR SENSOR LEAD WIRE WHICH MUST BE 150 DEGREES C.
5. LINE AND BLOWER MOTOR BRANCH CIRCUIT WIRE SIZES SHOULD BE OF A SIZE TO PREVENT VOLTAGE DROP BEYOND FIVE PERCENT OF SUPPLY LINE VOLTAGE.
6. USE #14 GA. WIRE FOR LINE AND MOTOR WIRING ON UNIT.
7. USE #18 GA. FOR 24 VOLT CONTROL WIRING ON UNIT.
8. WHEN PROVIDING OR REPLACING FUSES IN THE FUSIBLE DISCONNECT SWITCH USE DUAL ELEMENTS TIME DELAY FUSES AND SIZE ACCORDING TO 1.25 TIMES THE MAXIMUM TOTAL INPUT AMPS
9. DISCONNECT SWITCH IS FIELD FURNISHED OR AVAILABLE FROM FACTORY AS AN OPTION

RG SERIES AH2 OR AH3-AG1-CL1 WD # 106875 REV #2 DLE

Power-Vented Furnace with Standard Single-Stage Gas Valve, W.D. 106894



OPERATING SEQUENCE

1. SET THERMOSTAT AT LOWEST SETTING.
2. TURN ON POWER AND MANUAL GAS VALVE TO UNIT.
3. SET THERMOSTAT AT DESIRED SETTING.

(A) FIRING RATE IS CONTROLLED BY THE SINGLE STAGE THERMOSTAT.
(B) BLOWER MOTOR OPERATES FROM HEAT EXCHANGER TEMPERATURE.

FIRING SEQUENCE:

1. ON A CALL FOR HEAT BY THE THERMOSTAT.
(A) THE VENTER MOTOR IS ENERGIZED AFTER A 15 SECOND (APPROX.) TIME DELAY.
2. VENTER FLOW SWITCHES FROM N.C. TO N.O. CONTACTS ENERGIZING THE PILOT GAS VALVE AND SPARK GAP TO PRODUCE A PILOT FLAME ON EACH OPERATING CYCLE. THE SENSING PROVE PROVES THE PRESENCE OF THE PILOT FLAME, AND ENERGIZES THE SAFETY SWITCH PORTION OF THE CONTROL. THE SWITCH ACTION DE-ENERGIZES THE SPARK GAP AND ENERGIZES THE MAIN VALVE. THE MAIN GAS IGNITES AND THE UNIT FIRES AT FULL RATE.
3. IF THE FLAME IS EXTINGUISHED DURING MAIN BURNER OPERATION THE SAFETY SWITCH CLOSES THE MAIN VALVE AND RECYCLE THE SPARK GAP. ON UNIT EQUIPPED WITH G770NC-4 LOCKOUT CONTROL, IF PILOT IS NOT ESTABLISHED WITHIN 120 SECONDS (APPROX.) UNIT LOCKS OUT AND MUST BE RESET BY INTERRUPTING POWER TO CONTROL CIRCUIT (SEE LIGHTING INSTRUCTIONS).

NOTE

1. THE FOLLOWING CONTROLS ARE SUPPLIED BY REZNOR FOR FIELD INSTALLATION. NONE
2. THE FOLLOWING CONTROLS ARE SUPPLIED AS OPTIONAL EQUIPMENT: THERMOSTAT
3. DOTTED WIRING AND THE FOLLOWING CONTROLS ARE SUPPLIED AND INSTALLED BY OTHERS: BLOWER RELAY
4. CAUTION: IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105 DEGREES C., EXCEPT FOR SENSOR LEAD WIRE WHICH MUST BE 150 DEGREES C.
5. LINE AND BLOWER MOTOR BRANCH CIRCUIT WIRE SIZED SHOULD BE OF A SIZE TO PREVENT VOLTAGE DROP BEYOND FIVE PERCENT OF SUPPLY LINE VOLTAGE.
6. USE #14 GA. WIRE FOR LINE WIRING ON UNIT.
7. USE #18 GA. WIRE FOR 24 VOLT CONTROL WIRING ON UNIT.
8. ON 208/230V. UNITS THE CONTROL TRANSFORMER HAS A DUAL VOLTAGE PRIMARY. FOR 230V. UNITS USE BLACK AND YELLOW LEADS (CAP RED). FOR 208V. UNITS USE BLACK AND RED LEADS (CAP YELLOW). ON 115/460V. UNITS THE CONTROL TRANSFORMER IS A SINGLE VOLTAGE PRIMARY. FOR 115/460V. UNITS USE BLACK AND YELLOW LEADS.
9. WHEN PROVIDING OR REPLACING FUSES IN THE FUSIBLE DISCONNECT SWITCH USE DUAL ELEMENTS TIME DELAY FUSES AND SIZE ACCORDING TO 1.25 TIMES THE MAXIMUM TOTAL INPUT AMPS.
10. DISCONNECT SWITCH IS FIELD FURNISHED OR AVAILABLE FROM FACTORY AS AN OPT

106894
REV #2

——— FACTORY WIRING
- - - - - - - - - - FIELD WIRING
———o———o——— OPTIONAL FACTORY WIRING
-|-|-|-|-|-|- OPTIONAL FIELD WIRING

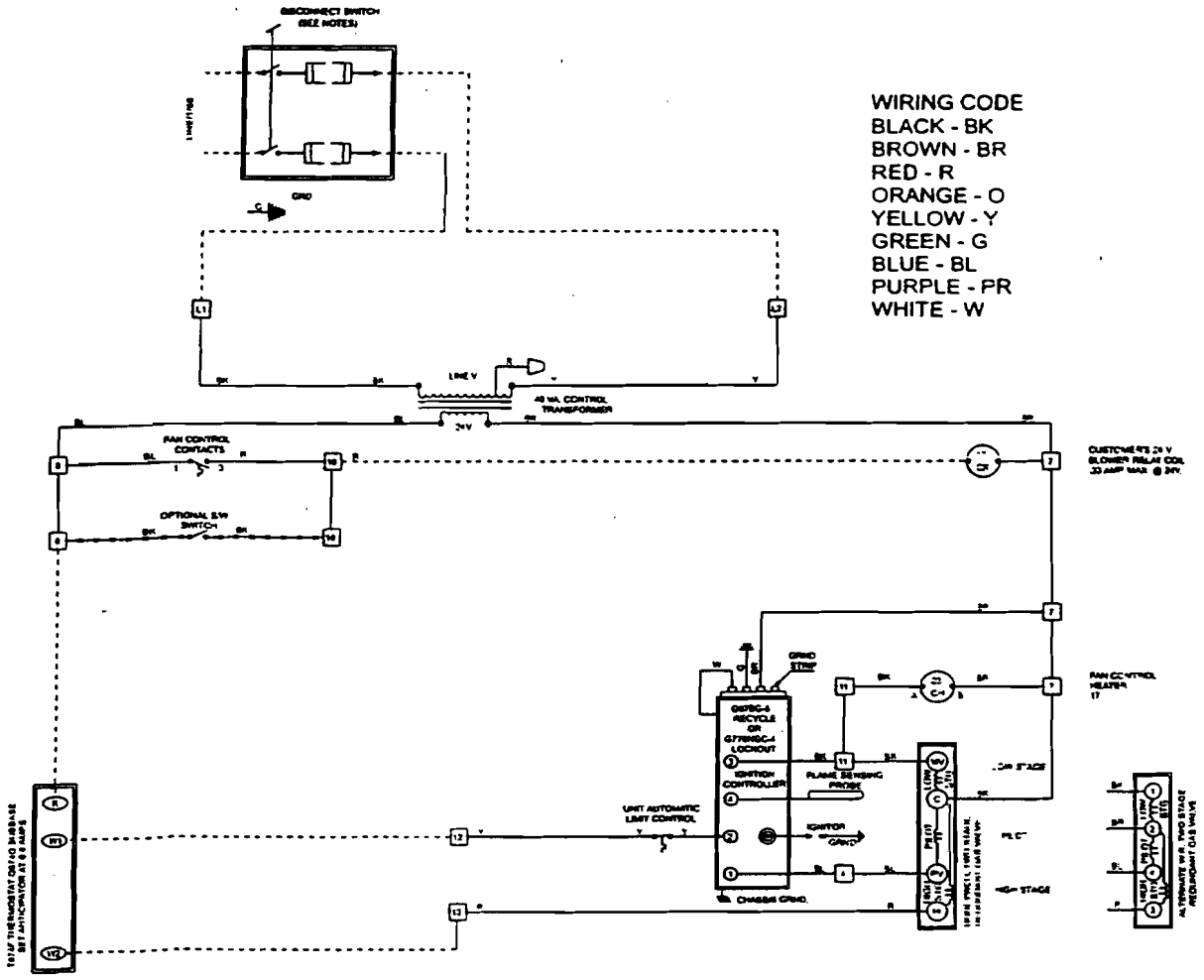
FIELD CONTROL WIRING

TOTAL WIRE LENGTH	MINIMUM RECOMMENDED WIRE SIZE
150 FEET	#18 GA.
250 FEET	#16 GA.
350 FEET	#14 GA.

1, 2, 4, 7, 8, 10, 11, 12, F, L1 & L2 ☐ TERMINAL BLOCK – HEATER COMPARTMENT

RP SERIES AH2 OR AH3-AG1-CL1 WD # 106894 REV #2 MLH

Gravity-Vented Furnace with Optional Two-Stage Gas Valve, W. D. 106877



OPERATING SEQUENCE
1. SET CONTROL SWITCH AT "OFF" POSITION.
2. TURN ON POWER AND MANUAL GAS VALVE TO UNIT.
3. SET CONTROL SWITCH AT "AUTO" POSITION.
(A) FIRING RATE IS CONTROLLED BY THE TWO STAGE THERMOSTAT.
(B) BLOWER MOTOR OPERATES FROM HEAT EXCHANGER TEMPERATURE.
4. SET CONTROL SWITCH AT "OFF" POSITION FOR SHUTDOWN.
(A) FAN CONTROL KEEPS BLOWER MOTOR ON WHILE UNIT IS HOT.

FIRING SEQUENCE:
1. ON A CALL FOR HEAT BY THE LOW STAGE OF THERMOSTAT
(A) THE PILOT GAS VALVE AND SPARK GAP ARE ENERGIZED TO PRODUCE A PILOT FLAME ON EACH OPERATING CYCLE. THE SENSING PROBE PROVES THE PRESENCE OF THE PILOT FLAME AND ENERGIZED THE SAFETY SWITCH PORTION OF THE CONTROL. THE SWITCH ACTION DE-ENERGIZES THE SPARK GAP AND ENERGIZES THE MAIN VALVE. THE MAIN GAS IGNITES AND THE UNIT FIRES AT LOW RATE.
2. ON A CALL FOR HEAT BY THE HIGH STAGE OF THERMOSTAT THE UNIT FIRES AT FULL RATE.
3. IF THE FLAME IS EXTINGUISHED DURING MAIN BURNER OPERATION THE SAFETY SWITCH CLOSES THE MAIN VALVE AND RECYCLES THE SPARK GAP. ON UNIT EQUIPPED WITH G770NGC-4 LOCKOUT CONTROL, IF PILOT IS NOT ESTABLISHED WITHIN 120 SECONDS (APPROX.) UNIT LOCKS OUT AND MUST BE RESET BY INTERRUPTING POWER TO CONTROL CIRCUIT (SEE LIGHTING INSTRUCTIONS).

NOTE
1. THE FOLLOWING CONTROLS ARE SUPPLIED BY REZNOR FOR FIELD INSTALLATION:
NONE
2. THE FOLLOWING CONTROLS ARE SUPPLIED AS OPTIONAL EQUIPMENT:
S/W SWITCH AND THERMOSTAT
3. DOTTED WIRING AND THE FOLLOWING CONTROLS ARE SUPPLIED AND INSTALLED BY OTHERS: BLOWER RELAY
4. CAUTION: IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105 DEGREES C., EXCEPT FOR SENSOR LEAD WIRE WHICH MUST BE 150 DEGREES C.
5. LINE AND BLOWER MOTOR BRANCH CIRCUIT WIRE SHOULD BE OF A SIZE TO PREVENT VOLTAGE DROP BEYOND FIVE PERCENT OF SUPPLY LINE VOLTAGE.
6. USE #14 GA. WIRE FOR LINE WIRING ON UNIT.
7. USE #18 GA. WIRE FOR 24 VOLT CONTROL WIRING ON UNIT.
8. ON 230V. UNITS THE CONTROL TRANSFORMER HAS A DUAL VOLTAGE PRIMARY. FOR 230V. UNITS USE BLACK AND YELLOW LEADS (CAP RED). ON 115/460V. UNITS THE CONTROL TRANSFORMER IS A SINGLE VOLTAGE PRIMARY. FOR 115/460V. UNITS USE BLACK AND YELLOW LEADS.
9. WHEN PROVIDING OR REPLACING FUSES IN THE FUSIBLE DISCONNECT SWITCH USE DUAL ELEMENTS TIME DELAY FUSES AND SIZE ACCORDING TO 1.25 TIMES THE MAXIMUM TOTAL INPUT AMPS.
10. DISCONNECT SWITCH IS FIELD-FURNISHED OR AVAILABLE FROM FACTORY AS AN OPTION.

106877 REV #2

FACTORY WIRING
FIELD WIRING
OPTIONAL FACTORY WIRING
OPTIONAL FIELD WIRING

FIELD WIRING	
TOTAL WIRE LENGTH	MINIMUM RECOMMENDED WIRE SIZE
150 FEET	#18 GA.
250 FEET	#16 GA.
350 FEET	#14 GA.

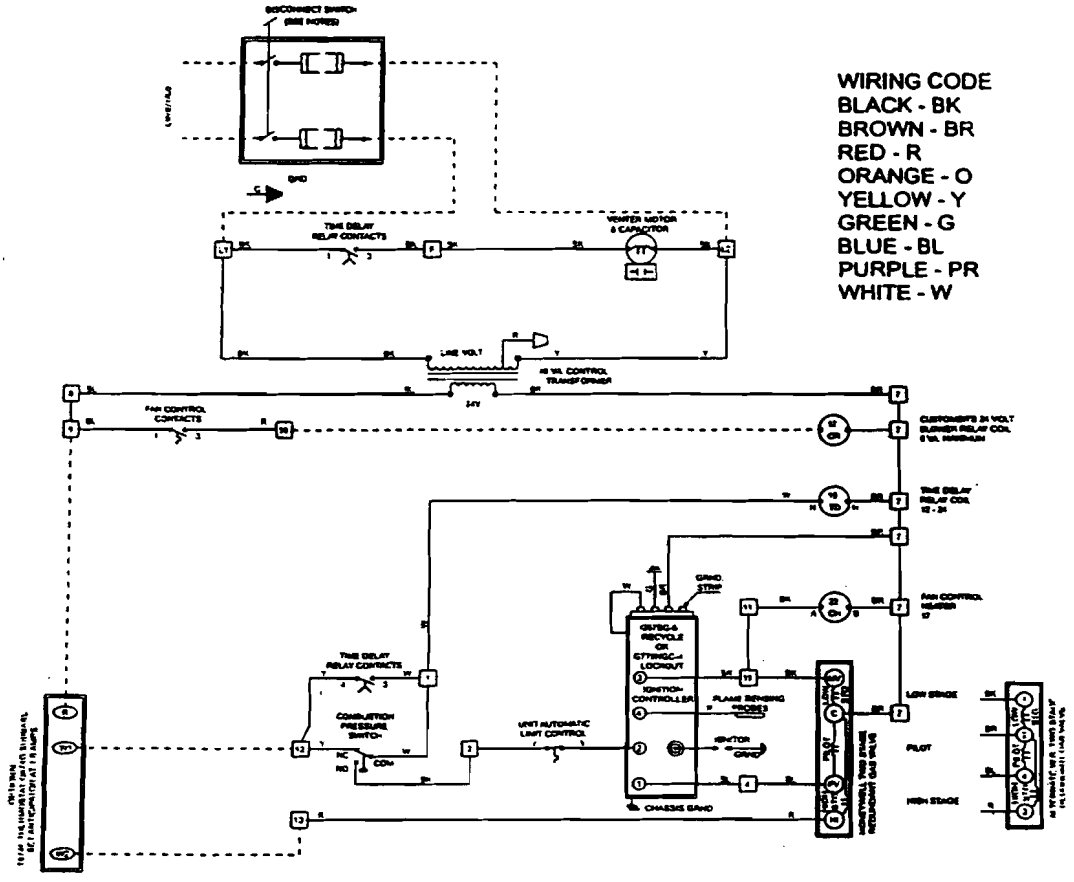
4, 7, 8, 10, 11, 12, 13, L1 & L2

TERMINAL BLOCK - HEATER COMPARTMENT

RG SERIES AH2 OR AH3-AG2-CL7 DWG. #B-106877 REV #2

MLH

Power-Vented Furnace with Optional Two-Stage Gas Valve, W. D. 106895



OPERATING SEQUENCE
1. SET THERMOSTAT SWITCH AT "OFF" POSITION.
2. TURN ON POWER, MAIN AND PILOT MANUAL GAS VALVES
3. SET THERMOSTAT SWITCH AT "AUTO" POSITION.
(A) FIRING RATE IS CONTROLLED BY THE TWO STAGE THERMOSTAT.
(B) BLOWER MOTOR OPERATES FROM HEAT EXCHANGER TEMPERATURE.
4. SET CONTROL SWITCH AT "OFF" POSITION (OPEN) FOR SHUTDOWN
(A) FAN CONTROL KEEPS THE BLOWER MOTOR ON WHILE UNIT IS HOT.

FIRING SEQUENCE:
1. ON A CALL FOR HEAT BY THE LOW STAGE OF THERMOSTAT
(A) THE VENTER MOTOR IS ENERGIZED AFTER A 15 SECOND (APPROX.) TIME DELAY.
2. VENTER FLOW SWITCH SWITCHES FROM N.C. TO N.O. CONTACTS ENERGIZING THE PILOT GAS VALVE AND SPARK GAP TO PRODUCE A PILOT FLAME ON EACH OPERATING CYCLE. THE SENSING PROBE PROVES THE PRESENCE OF THE PILOT FLAME AND ENERGIZES THE SAFETY SWITCH PORTION OF THE CONTROL. THE SWITCH ACTION DE-ENERGIZES THE SPARK GAP AND ENERGIZES THE MAIN VALVE. THE MAIN GAS IGNITES AND THE UNIT FIRES AT LOW RATE.
3. ON A CALL FOR HEAT BY THE HIGH STAGE OF THERMOSTAT, THE UNIT FIRES AT FULL RATE.
4. IF THE FLAME IS EXTINGUISHED DURING MAIN BURNER OPERATION THE SAFETY SWITCH CLOSES THE MAIN VALVE AND RECYCLES THE SPARK GAP. ON UNIT EQUIPPED WITH G770NGC-4 LOCKOUT CONTROL, IF PILOT IS NOT ESTABLISHED WITHIN 120 SECONDS (APPROX.) UNIT LOCKS OUT AND MUST BE RESET BY INTERRUPTING POWER TO CONTROL CIRCUIT (SEE LIGHTING INSTRUCTIONS).

NOTE
1. THE FOLLOWING CONTROLS ARE SUPPLIED BY REZNOR FOR FIELD INSTALLATION: NONE
2. THE FOLLOWING CONTROLS ARE SUPPLIED AS OPTIONAL EQUIPMENT: THERMOSTAT
3. DOTTED WIRING AND THE FOLLOWING CONTROLS ARE SUPPLIED AND INSTALLED BY OTHERS: BLOWER RELAY
4. CAUTION: IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105 DEGREES C., EXCEPT FOR SENSOR LEAD WIRE WHICH MUST BE 150 DEGREES C.
5. LINE AND BLOWER MOTOR BRANCH CIRCUIT WIRE SHOULD BE OF A SIZE TO PREVENT VOLTAGE DROP BEYOND FIVE PERCENT OF SUPPLY LINE VOLTAGE.
6. USE #14 GA. WIRE FOR LINE WIRING ON UNIT.
7. USE #18 GA. WIRE FOR 24 VOLT CONTROL WIRING ON UNIT.
8. ON 208/230V. UNITS THE CONTROL TRANSFORMER HAS A DUAL VOLTAGE PRIMARY. FOR 230V. UNITS USE BLACK AND YELLOW LEADS (CAP RED). FOR 208V. UNITS USE BLACK AND RED LEADS (CAP YELLOW).
ON 115/460V. UNITS THE CONTROL TRANSFORMER IS A SINGLE VOLTAGE PRIMARY. FOR 115/460V. UNITS USE BLACK AND YELLOW LEADS.
9. WHEN PROVIDING OR REPLACING FUSES IN THE FUSIBLE DISCONNECT SWITCH USE DUAL ELEMENTS TIME DELAY FUSES AND SIZE ACCORDING TO 1.25 TIMES THE MAXIMUM TOTAL INPUT AMPS.
10. DISCONNECT SWITCH IS FIELD FURNISHED OR AVAILABLE FROM FACTORY AS AN OPTION.

FACTORY WIRING
FIELD WIRING
OPTIONAL FACTORY WIRING
OPTIONAL FIELD WIRING

FIELD CONTROL WIRING

TOTAL WIRE LENGTH	MINIMUM RECOMMENDED WIRE SIZE
150 FEET	#18 GA.
250 FEET	#18 GA.
350 FEET	#14 GA.

1, 2, 4, 7, 8, 10, 11, 12, 13, F, L1 & L2 — TERMINAL BLOCK – HEATER COMPARTMENT

106895 REV #3

RP SERIES AH2 OR AH3-AG2-CL7 WD # 106895 REV #3 MLH

19. Combustion Air Proving Switch (Power-Vented)

The combustion air proving switch, which ensures that proper combustion airflow is available is a pressure switch. The switch is a single-pole, double-throw switch, which senses pressure caused by the flow of combustion air from the venter. To prevent the switch from responding to sudden temporary pressure fluctuations and to provide a prepurge, a small diameter orifice is installed in the outlet fitting of the pressure switch.

The electrical circuit of this heater is designed to check for proper switch position before each complete heat cycle. Only after checking the state of the pressure switch, and proving that combustion air is present, will the gas ignition sequence begin.

DANGER: Safe operation requires proper venting flow. Never bypass the combustion air proving switch or attempt to operate the unit without the venter running and proper flow in the vent system. Hazardous condition could result. See Hazard Levels, page 2.

20. Gas Valve

All furnaces are equipped with a 24-volt combination valve which includes the automatic electric on-off valve controlled by the room thermostat, the pressure regulator, the safety pilot valve, and the manual shutoff valve. The standard gas valve allows for single-stage control from a single-stage, 24-volt thermostat.

WARNING: The operating valve is the prime safety shutoff. All gas supply lines must be free of dirt or scale before connecting the unit to ensure positive closure. See Hazard Levels, page 2.

21. Optional 2-Stage Operation - Heating Only

The standard combination control valve is replaced with a two-stage combination gas control valve providing for low fire or high fire operation controlled by a two-stage thermostat. First stage (low fire) is factory set (not field adjustable). Both high and low stages are controlled by a Servo regulator, maintaining constant gas input under wide variations in gas supply pressure. See instructions packed with the unit for specific gas valve specifications, wiring, and operating instructions.

22. Optional 2-Stage Operation - Makeup Air Application

Two-stage makeup air units are equipped with a two-stage gas valve, but instead of control from a two-stage room thermostat, the outlet air temperature is monitored and controlled by a two-stage ductstat. When the discharge air temperature drops to the setpoint, low fire is energized. If low fire cannot satisfy the ductstat setting, high fire is energized.

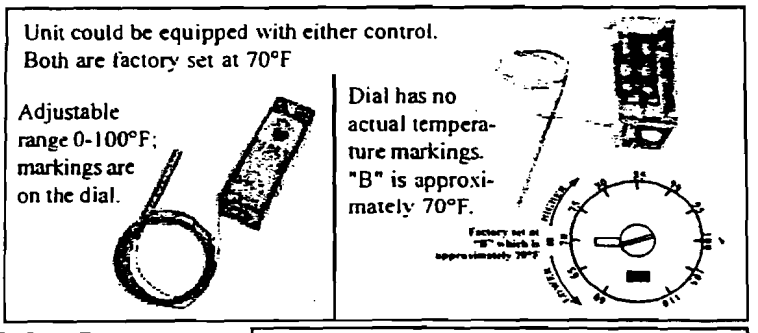
Makeup air applications are usually adjusted to discharge an outlet air temperature between 65°F and 75°F. In all applications, the allowable temperature rise of the furnace in the installation dictates the limits of the ductstat temperature setting.

Depending on the option selection, the factory-installed sensor is either field-connected by capillary tubing to the unit-mounted ductstat (**FIGURE 18**) or electrically connected to a remote electronic temperature selector (**FIGURE 19**). The remote temperature selector is available with or without a display module.

See **FIGURE 20** for a general location of the factory-installed sensor with either the factory-mounted or the remote ductstat selector option.

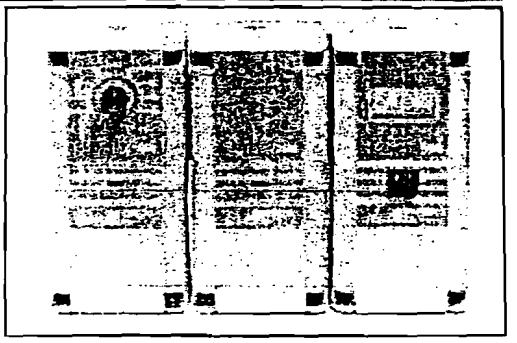
Optional Ductstat with Capillary Tubing (Option AG3) - Either of the controls illustrated in **FIGURE 18** is used with Option AG3. The control is set to 70°F and has an adjustable range with a fixed differential of 2-1/2°F. Due to different CFM settings and outside air temperatures, the average downstream outlet temperature may not match the ductstat setting exactly. After the installation is complete, adjust the setpoint of the ductstat to achieve the desired average outlet air temperature.

FIGURE 18- Ductstat Control in Option AG3



Optional Ductstat with Electronic Remote Setpoint Module (Options AG15 and AG16) - The field-installed sensing probe is field-wired to a remote temperature selector with a temperature operating range to 130°F. The remote modules and sensing probe are shipped separately for field installation. Follow the wiring diagram with the unit and the manufacturer's instructions for wiring and installation. There will be one module for selecting temperature and one-stage adder module. The digital display module is optional. See FIGURE 19.

FIGURE 19- Remote Temperature Selector, Stage-Adder Module, and Optional Display Module for Ductstat in 2-Stage Makeup Air Control Options (Option AG15 or AG16)



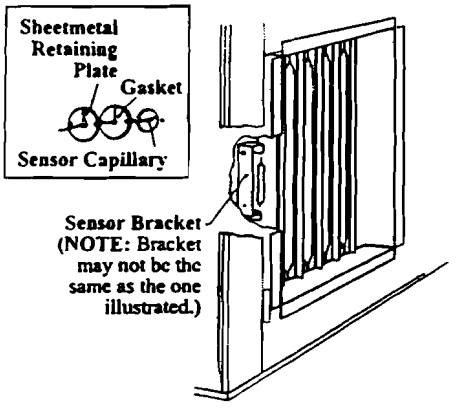
CAUTION: Be sure heat/cool selector switch is set to "heat".

23. Optional Mechanical Modulation - Makeup Air Application

The mechanical modulation valve regulates the flow of gas to the main burner, depending on the demands of the sensing bulb which is located in the airstream adjacent to the heat exchanger. Inputs are varied from 50% through 100% of full rate in direct response to the modulating control sensing element and depending on the temperature of outside air being forced through the furnace. Outlet air or return air temperature can be maintained within a range of 50°F to 100°F (Option AG6) and is adjustable at the mechanical modulating valve. Valve manufacturer's specifications and operating instructions for mechanical modulating valve may be found in the heater instruction envelope accompanying the furnace. (See FIGURE 20 for a general location of the factory-installed sensor.)

Installation NOTE: Sizes 300 and 350 with mechanical modulation require a minimum of 7" w.c. natural gas supply pressure.

FIGURE 20 - Duct Temperature Sensor Location



1. Remove access panel in ductwork adjacent to control compartment access panel.
2. Element is retained by spring clips.
3. Round gasket and metal retaining plate provide airtight seal for capillary and must be removed to remove the element.

24. Optional Electronic Modulation

The type and capability of the electronic modulation system depends on the option selected. Electronic modulation options are identified by a suffix to the Serial No. printed on the heater rating plate. AG7 is identified as MV-1; AG8 is identified as MV-3; AG9 is identified as MV-4; AG21 is identified as MV-A; AG39 is identified as MP-1; and AG40 is identified as MP-2.

Installation NOTE: Sizes 350 and 400 with electronic modulation require a minimum of 6" w.c. natural gas supply pressure.

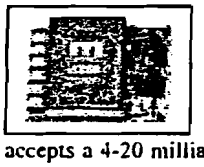
24A. Electronic Modulation between 50% and 100% Firing Rate (Options AG7, AG8, AG9)

Depending on the heat requirements as established by the thermistor sensor, the burner modulates between 100% and 50% firing. The thermistor is a resistor that is temperature sensitive in that as the surrounding temperature changes, the Ohms resistance changes through the thermistor. This change is monitored by the solid state control center (amplifier) which furnishes varying DC current to the modulating valve to adjust the gas input.

Each modulating valve is basically a regulator with electrical means of raising and lowering the discharge pressure. When no DC current is fed to this device, it functions as a gas pressure regulator, supplying 3.5" w.c. pressure to the main operating valve.

Refer to the wiring diagram supplied with the furnace for proper wiring connections. Electronic modulation for heating controlled by a specially designed room thermostat (60°-85°F) is identified as Option AG7. Electronic modulation control systems for makeup air applications controlled by a duct sensor and temperature selector (55-90°F) are identified as either Option AG8 or Option AG9. The temperature selector setting for Option AG8 is on the amplifier; Option AG9 has a remote temperature selector. Both systems are available with an override thermostat.

24B. Computer Controlled Electronic Modulation between 50% and 100% Firing Rate (Option AG21)



With this option the furnace is equipped with a Maxitrol A200 signal conditioner which operates much the same way as the amplifier above to control the regulator valve. The conditioner accepts an input signal of either 4-20 milliamps or 0-10 volts from a customer-supplied control device such as a computer. With the dip switches on the conditioner in the "on" positions, the conditioner accepts a 4-20 milliamp signal. In the "off" positions, the conditioner accepts a 0-10V signal. The conditioner converts the signal to the 0 to 20 volt DC current required to control the modulating valve. Temperature selection is through the field-supplied computer software.

24C. Electronic Modulation between 20-28% and 100% Firing Rate (U.S. Patent 6,109,255), Option AG39 - natural gas Model RP only; not available on Size 350

Depending on the size, furnaces equipped with electronic modulation Option AG39 have a 20-28% turndown ratio. The furnace will ignite at any input rate in the available range and will maintain average thermal efficiencies equal to or greater than the thermal efficiency at full fire.

24. Optional Electronic Modulation (cont'd)

24C. Electronic Modulation between 20-28% and 100% Firing Rate (U.S. Patent 6,109,255), Option AG39 (cont'd)

Model	Maximum Turndown	MBH Input Range	Inlet Pressure to Modulating Valve	Gas Supply Pressure Required
RP 125	20%	25-125	3.9" w.c.	5" w.c.
RP 150	27%	40.3-150	3.7" w.c.	5" w.c.
RP 175	23%	40.3-175	3.7" w.c.	5" w.c.
RP 200	26%	51.8-200	3.9" w.c.	5" w.c.
RP 225	23%	51.8-225	3.9" w.c.	5" w.c.
RP 250	28%	69-250	4.0" w.c.	5" w.c.
RP 300	23%	69-300	4.0" w.c.	5" w.c.
RP 400	25%	100-400	4.4" w.c.	6" w.c.

The gas train includes a single-stage gas valve, a modulating valve, and two gas pressure switches. The burner rack is equipped with one flash carryover and a regulated gas lighter tube system. The carryover lighter tube receives its gas supply through the regulator, simultaneously with the gas to the burner. Control of the system is through a Maxitrol #ES410A amplifier with a corresponding remote temperature dial (Maxitrol #ES410TD).

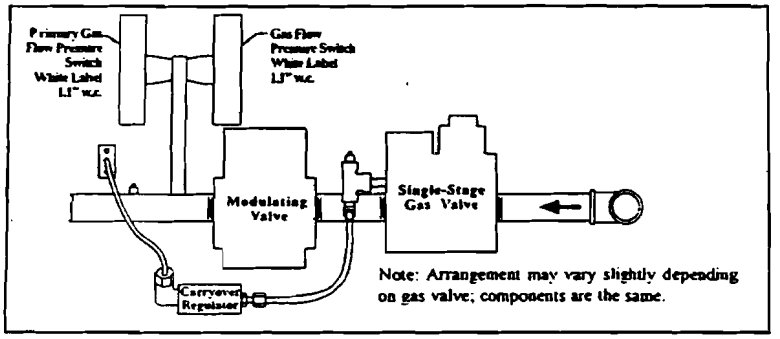


FIGURE 21 - Option AG39 Manifold Arrangement

Description of Operation of Option AG39

The gas supply (see pressure requirements in the table above) connects to the single-stage gas valve. To compensate for additional pressure loss through the modulating valve, the single-stage gas valve has a custom outlet pressure setting higher than when it is used on a standard gas manifold. The pilot tubing connects to the pilot port on the single-stage gas valve. When the valve receives a call for heat from the amplifier and pilot is established, gas flow from the single-stage valve goes to both the modulating valve and the regulated lighter tube system. When the signal from the amplifier to the modulating valve requires less-than-high fire operation, the modulating valve functions to lessen the gas flow to the burner to reduce the input rate to that required to maintain the desired temperature. When the input rate is reduced enough to decrease the gas pressure to 1.1" w.c., the primary gas pressure switch in the manifold activates the gear motor that controls the bypass damper in the venter/combustion air system. The bypass damper opens diverting some of the incoming air directly into the flue duct, reducing airflow through the burner. Safety switches monitor the position of the bypass damper. When the gas pressure increases above 1.1" w.c., the bypass damper closes.

Combustion Air Pressure Switch Setting

This uniquely designed modulation system requires combustion air pressure settings different from the standard system. The approximate settings for the combustion air proving switch at sea-level operation are:

Sizes with AG39&40	Startup Cold	Equilibrium at Full Rate	Factory Setting
125-225	-1.3"w.c.±0.2	-1.05"w.c.±0.1	-1.0"w.c.±0.2
250-400	-1.2"w.c.±0.2	-0.95"w.c.±0.1	-.75"w.c.±0.5

Sensor Location

For the convenience of the installer, the duct temperature sensor is factory installed in the cabinet leg (See FIGURE 20). Although the sensor has a mixing tube, at this distance from the discharge it does not receive a true mix, so the temperature read by the sensor will be slightly higher than the actual air entering the ductwork. The system will provide comfort level heat if the selector is set slightly lower to compensate for this reading. The offset temperature will vary with the application. If a direct correlation of these two temperatures is required, move the duct sensor to a location in the ductwork about 10-12 feet (3-3.7M) from the furnace discharge.

Wiring and Service

For wiring, consult the wiring diagram attached to the furnace. All wires in the electrical box connecting the modulation controls must have a temperature rating of 150°C.

This is a unique system which includes custom-built components and custom settings. If service is required, follow the general troubleshooting guide on page 27 and the special troubleshooting guide on page 23.

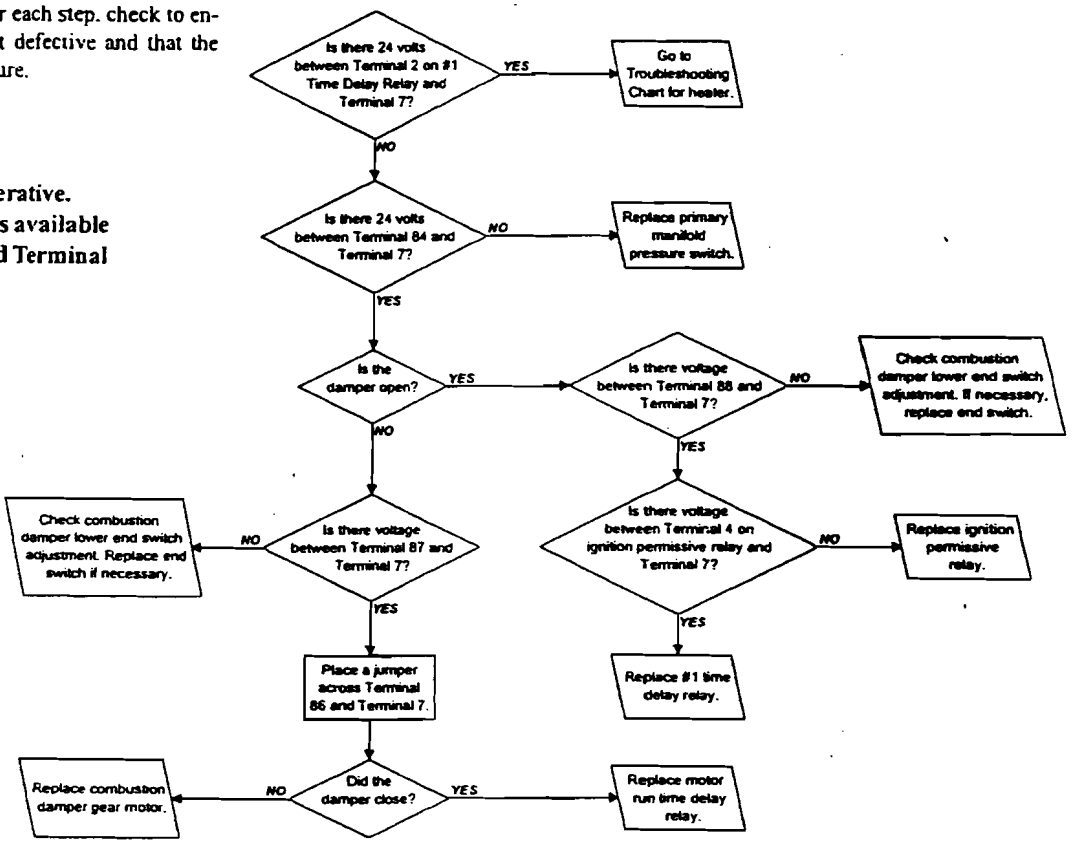
24D. Computer Controlled Electronic Modulation between 20-28% and 100% Firing Rate (U.S. Patent 6,109,255), Option AG40 - natural gas Model RP only; not available on Size 350

With this option the furnace is equipped with a Maxitrol A200 signal conditioner (see illustration in Paragraph 24B) which accepts an input signal of either 4-20 milliamps or 0-10 volts from a customer-supplied control device such as a computer. With the dip switches on the conditioner in the "on" positions, the conditioner accepts a 4-20 milliamp signal. In the "off" positions, the conditioner accepts a 0-10V signal. The conditioner converts the signal to the 0 to 20 volt DC current required to control the modulating valve. The heater functions and is equipped in the same way as described in Paragraph 24C (Option AG39) except that with computer control the temperatures are selected through the field-supplied software and there is no temperature selector or duct sensor.

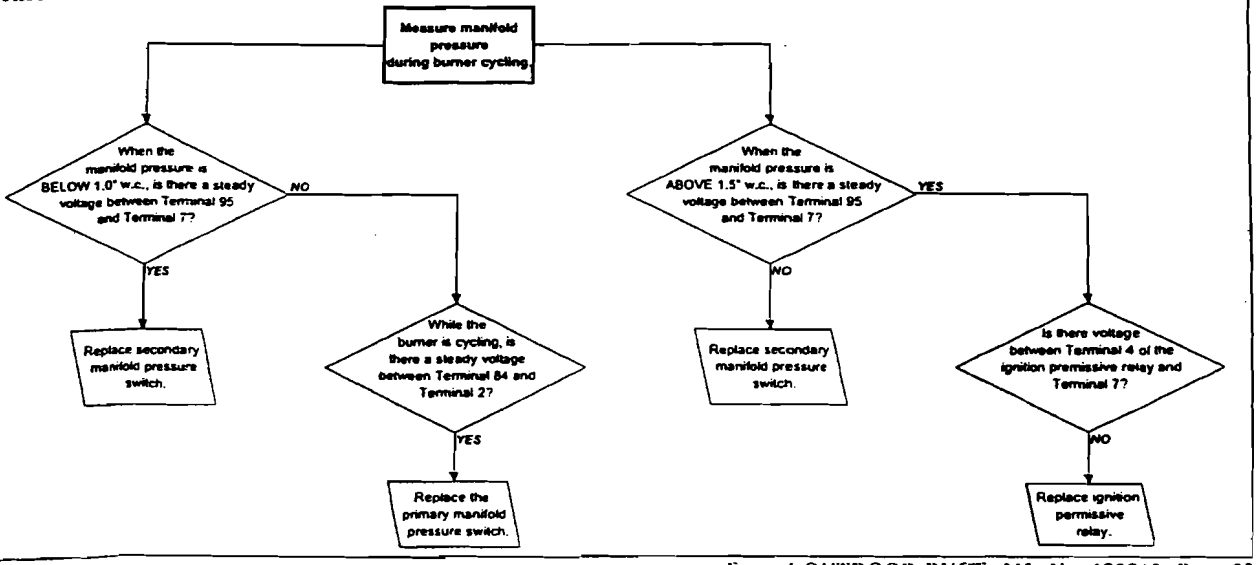
Troubleshooting Guide for Checking Bypass Combustion Air Damper Safety Circuit on Model RP with Option AG39 or Option AG40

General Instructions: For each step, check to ensure that the wiring is not defective and that the wiring connections are secure.

Symptom - Part 1:
Main burners are inoperative.
Assumes that 24 volts is available between Terminal 2 and Terminal 7.



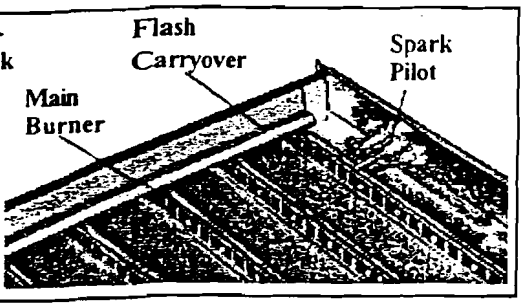
Symptom - Part 2:
Steady call for heat - burner cycles.
Assumes constant voltage between Terminals 11 and 7 and Terminals 2 and 7.



25. Pilot and Ignition Systems

The horizontal pilot is located in the control end of the burner rack and is accessible after the control compartment panel has been removed. All pilots are target type with lint-free feature. Pilot gas pressure should be the same as supply line pressure. (See Paragraph 15.) If required, adjust the pilot flame length to approximately 1-1/4" with pilot adjustment screw in control valve body.

FIGURE 22 - Burner Rack with Spark Pilot



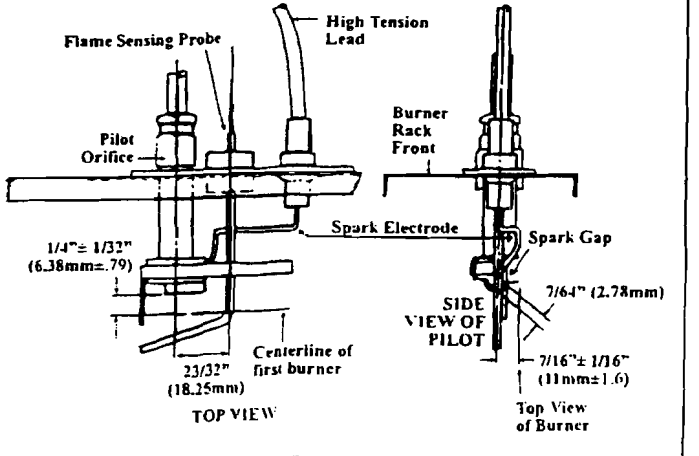
Intermittent Spark Ignition Safety Pilot Systems - There are two types of intermittent spark pilots -- one type shuts off the pilot gas flow between the cycles and the other not only shuts off the pilot gas flow between cycles but also has a lockout device that stops the gas flow to the pilot if the pilot fails to light in 120 seconds. This lockout feature requires manual reset by interruption of the thermostat circuit. Propane units installed in Canada require the spark ignition system with the lockout device. Refer to the wiring diagram supplied with the heater for pilot system identification and wiring. Spark pilot without lockout is designated as Option AH2; with lockout is Option AH3.

CAUTION: Due to high voltage on pilot spark wire and pilot electrode, do not touch when energized. See Hazard Levels, page 2.

Ignition Controller - As part of the intermittent safety pilot systems, the ignition controller provides the high voltage spark to ignite the pilot gas and also acts as the flame safety device. After ignition of the pilot gas, the ignition controller electronically senses the pilot flame. A low voltage DC electrical signal is imposed on the separate metal probe in the pilot assembly. The metal probe is electrically insulated from ground. The pilot flame acts as a conduction path to ground completing the DC circuit and proving pilot flame. With pilot flame proven, the ignition controller energizes the main gas valve. If no spark occurs, check the following:

a) Voltage between blue and white terminals (non-lockout type pilot) and Terminals 2 and 5 (lockout type pilot) on the ignition controller should be at least 20 volts and no higher than 32 volts. Refer to Troubleshooting (Paragraph 32) if no voltage is observed.
b) Short to ground in the high tension lead and/or ceramic insulator.
c) Pilot spark gap should be approximately 7/64".

FIGURE 23 - Maintain spark gap of 7/64"



NOTE: When checking for spark with the pilot burner assembly removed from the burner rack, the pilot assembly must be grounded to the heater for proper spark.

If the above conditions are normal and no spark occurs, replace the ignition controller.

If the main gas valve fails to open with a normal full size pilot flame established, check for the following:

a) Voltage between black and brown leads on the main gas valve is 20 to 32 VAC and there is no main gas flow with the built-in manual valve in FULL OPEN position -- the main valve is defective.
b) No voltage between black and brown leads on the main gas valve -- check for disconnected or shorted flame sensor lead or flame sensor probe.

When the above conditions are normal and the main gas flow is still off, the ignition controller is probably defective.

26. Burners and Carryover System

These duct furnaces have individually formed steel burners with accurately die-formed ports to give controlled flame stability without lifting or flashback with either natural or propane gas. The burners are lightweight and factory mounted in an assembly which permits them to be removed as a unit for inspection or service.

Natural gas burner racks (except when equipped with electronic modulation Option AG39 or AG40; see Paragraphs 24C and D) are equipped with two flash carryovers. Propane gas burners are equipped with one flash carryover and a regulated gas lighter tube system.

During regular service, check the main burner ports, the carryover assemblies, and the orifices for cleanliness.

27. Burner Air Adjustment

Burner air shutters are not normally required on natural gas furnaces. Air shutters are required on propane gas units and may require adjustment.

Before making any adjustments to the air shutters, allow the heater to operate for about fifteen minutes with the air shutters open. The slotted screw on the end manifold bracket moves the air shutters and adjusts all burners simultaneously. Turning the screw clockwise opens the shutters; counterclockwise closes the shutters. After the furnace has been in operation for 15 minutes, close the air shutters observing the flame for yellow-tipping. Open the shutters until the yellow disappears. A limited amount of yellow-tipping is permissible for liquefied petroleum gases. Natural gas should not display any yellow-tipping.

When making the adjustment, close the air shutters no more than is necessary to eliminate the problem condition.

DANGER: Failure to install and/or adjust air shutters according to directions could cause property damage, personal injury, and or death.

28. Check Installation and Startup

Check the installation prior to startup:

- ☐ Be certain the electrical supply matches voltage rating of the furnace. (Refer to the rating plate.)
- ☐ Check all field wiring against the wiring diagram. Be sure that wire gauges are as required for the electrical load.
- ☐ Be certain that the electrical entrances are sealed against the weather.
- ☐ Check that fuses or circuit breakers are in place and sized correctly.
- ☐ Be sure that all condensate drains are open. See Paragraph 10.
- ☐ Check clearances from combustibles. Requirements are shown in Paragraph 6.
- ☐ Check piping for leaks and proper gas line pressure. Bleed gas lines of trapped air. See Paragraph 15.
  - a) Turn manual shutoff valve to off position.
  - b) Turn gas supply on.
  - c) Observe gas meter for movement, or
  - d) Attach pressure gauge readable to .1" w.c. and after turning gas on for ten seconds. turn gas supply off. No change in pressure should occur over a three-minute period.
  - e) If either c) or d) above indicate a leak, locate leak by brushing a soapy solution on all fittings. Bubbles will appear at a leak. Repair and repeat tests.
- ☐ Power Vented Models - Check to make sure that flue discharge openings are free from obstructions.
- ☐ Gravity Vented Models - Be sure that vent cap is installed properly. If required, vent cap extension must be installed. See Paragraph 9A.

Operating Sequence – Gravity-Vented Models

1) Set the thermostat switch at its lowest setting.
2) Turn on power and main and manual gas valves.
3) Set thermostat switch at desired setting.
4) Thermostat calls for heat. The pilot gas valve and spark gap are energized to produce a pilot flame on each operating cycle. The sensing probe proves the presence of the pilot flame and energizes the safety switch portion of the control. The switch action de-energizes the spark gap and energizes the main valve. The main gas ignites and unit fires at full rate.
5) If the flame is extinguished during main burner operation, the safety switch closes the main valve and recycles the spark gap. On unit equipped with a G770NGC-4 controller which includes lockout, if the pilot is not established within 120 seconds (approximately), the unit locks out and must be reset by interrupting the power to the control circuit (See Lighting Instructions).
6) The sensing probe proves the presence of the pilot flame.
   (a) De-energizing the ignitor.
   (b) Energizing the gas valve.
7) Set the thermostat switch at lowest setting for shutdown. Fan control keeps the blower on while unit is hot.
8) Set the S/W switch at "ON" position (closed) for continuous blower operation.

Operating Sequence – Power-Vented Models

1) Set the thermostat switch at its lowest setting.
2) Turn on power, main and manual gas valves.
   (a) Firing rate is controlled by the thermostat.
   (b) Blower motor operates from heat exchanger temperature.
3) Set thermostat switch at desired setting.
4) Thermostat calls for heat
   (a) The venter motor is energized after 15-second (approximate) time delay.
   (b) Venter flow switches from N.C. to N. O. contacts, energizing the pilot gas valve and spark gap to produce a pilot flame on each operating cycle. The sensing probe proves the presence of the pilot flame and energizes the safety switch portion of the control. The switch action de-energizes the spark gap and energizes the main valve. The main gas ignites and the unit fires at full rate.
5) If the flame is extinguished during main burner operation, the safety switch closes the main valve and recycles the spark gap. On unit equipped with a G770NGC-4 controller which includes lockout control, if the pilot is not established within 120 seconds (approximately), the unit locks out and must be reset by interrupting the power to the control circuit (See Lighting Instructions).

Startup

- ☐ Turn electric and gas supply on to the furnace. Adjust the thermostat or ductstat so that a call for heat exists. Observe for complete sequencing of safety pilot and ignition.

Check installation after startup:

- ☐ With the unit in operation, measure manifold gas pressure. Manifold pressure for natural gas should be 3.5" w.c. and 10" w.c. for propane gas. See Paragraph 15.
- ☐ Turn the unit off and on, pausing two minutes between each cycle. Observe for smooth ignition. On two-stage or modulating burner systems, manipulate temperature adjustment slowly up and down to see if control is sequencing or modulating properly. Raising temperature setting drives burner on or to full fire.
- ☐ Observe burner flame at full fire. Natural gas flame should be about 1-1/2" in height with blue coloring. Propane gas flame should be approximately the same length with blue coloring. Yellow tipping may appear on propane gas. If yellow extends beyond 1/2 to 3/4", adjust air shutters. See Paragraph 27.
- ☐ Close all panels tightly. With the heater on, check limit control by completely blocking off distribution air. The limit control should open within a few minutes, shutting off the gas supply to the main burners.
- ☐ Return all instruction forms and warranty information to the "Owner's Envelope". Keep for future reference.

DANGER: The gas burner in this gas-fired equipment is designed and equipped to provide safe, complete combustion. However, if the installation does not permit the burner to receive the proper supply of combustion air, complete combustion may not occur. The result is incomplete combustion which produces carbon monoxide, a poisonous gas that can cause death. Safe operation of indirect-fired gas burning equipment requires a properly operating vent system which vents all flue products to the outside atmosphere. FAILURE TO PROVIDE PROPER VENTING WILL RESULT IN A HEALTH HAZARD WHICH COULD CAUSE SERIOUS PERSONAL INJURY OR DEATH.

Always comply with the combustion air requirements in the installation codes and instructions. Combustion air at the burner should be regulated only by manufacturer-provided equipment. NEVER RESTRICT OR OTHERWISE ALTER THE SUPPLY OF COMBUSTION AIR TO ANY HEATER.

SERVICE AND MAINTENANCE

WARNING: If you turn off the power supply, turn off the gas. See Hazard Levels, page 2.

This unit will operate with a minimum of maintenance. To ensure long life and satisfactory performance, a furnace that is operating under normal conditions should be inspected every four months. If the furnace is operating in an area where an unusual amount of dust or soot or other impurities are present in the air, more frequent inspection is recommended.

The following procedures should be carried out at least annually (See Paragraphs 29-31 for instructions).

- ☐ Clean all dirt and grease from the primary and secondary combustion air openings.
- ☐ Clean the heat exchanger both internally and externally.
- ☐ Check the pilot burner and main burners for scale, dust, or lint accumulation. Clean as needed.
- ☐ Power Vent - Check the flue products outlet; clean if needed. Gravity Vent - Check the vent cap or optional vent system; replace any parts that do not appear sound.
- ☐ Check the wiring for any damaged wire. Replace damaged wiring. (See Paragraph 16 for wiring requirements.)

CAUTION: When cleaning, wearing eye protection is recommended.

NOTE: Use only factory-authorized replacement parts.

29. Burner Rack Removal Instructions

1. Turn off the gas supply.
2. Turn off the electric supply.
3. Remove control access side panel.
4. Disconnect the pilot tubing and flame sensor lead.
5. Mark and disconnect electric valve leads.
6. Uncouple the union in the gas supply.
7. Remove sheetmetal screws in the top corners of the burner rack assembly.
8. Pull "drawer-type" burner rack out of the furnace.

To disassemble the burner rack:

1. Remove Carryover System --

   Natural Gas - remove the flash carryover system from the "manifold end" of the burner rack

   NOTE: Natural gas burner racks manufactured prior to 3/95 have a lighter tube carryover system. Break the lighter tube connection at the orifice and remove the supply tubing, the drip shield and the lighter tube.

   Propane Gas - break the lighter tube connection at the regulator and remove the lighter tube orifice supply tubing; remove the retaining screws in the drip shield and the shield; remove the retaining screws and slide out the lighter tube.
2. Pull main burners horizontally away from injection opening and lift out.
3. Remove manifold bracket screws and remove manifold.
4. Remove the main burner orifices.
5. Remove screws and lift out pilot burner.

Follow the instructions in Paragraph 30 to clean. To re-assemble and replace, reverse the above procedures being careful not to create any unsafe conditions.

CAUTION: When cleaning, wearing eye protection is recommended.

30. Cleaning Pilot and Main Burners

In the event the pilot flame is short and/or yellow, check the pilot orifice for blockage caused by lint or dust accumulation. Remove the pilot orifice and clean with air pressure. DO NOT REAM THE ORIFICE. Check and clean the aeration slot in the pilot burner.

Clean the metal sensing probe and the pilot hood with an emery cloth and wipe off the ceramic insulator. Check the spark gap; spark gap should be maintained to 7/64". After the pilot is cleaned, blow any dirt away with compressed air.

Clean main burners and burner orifices using air pressure. Use an air nozzle to blow out scale and dust accumulation from the burner ports. Alternately blow through the burner ports and the venturi. Use a fine wire to dislodge any stubborn particles in the burner ports. Do not use anything that might change the port size.

Clean the burner rack carryover systems with air pressure.

31. Cleaning the Heat Exchanger

To clean the outer surfaces (circulating air side) of the heat exchanger, gain access by removing the inspection panels in the ductwork or remove the ductwork. Depending on whether or not the furnace is designed for high CFM (Model prefix "H"), there may be directional baffles between the heat exchanger tubes. The standard furnace has baffles between the heat exchanger tubes as shown in **FIGURE 24.** (High CFM furnaces have only the top baffle support which does not need to be removed for cleaning.) To remove the baffles, remove the screws marked "A" in **FIGURE 24.** and slide each baffle forward. Use a brush and/or an air hose to remove accumulated dust and grease deposits from the heat exchanger tubes and the baffles. Re-install the baffles by sliding them into the rear slot and replacing the screw.

The inner surfaces (combustion air side) of the heat exchanger can be reached for cleaning with the burner rack removed. (See Paragraph 29.) An air hose, an 18-24" long, 1/2" diameter furnace brush (or heavy wire with steel wool securely attached), a flashlight, and a mirror are needed. Furnaces designed to provide high efficiency heating have "V" shaped baffles in the top of each heat exchanger tube. Follow the instructions below to remove the "V" baffles when cleaning the inner surfaces of the heat exchanger.

NOTE: High efficiency furnaces manufactured prior to 3/95 have a "C" prefix in their model designation. **All furnaces manufactured beginning 3/95 are designed for high efficiency and include the heat exchanger "V" baffles.**

Instructions to Remove Heat Exchanger "V" Baffles:

Gravity Vent Models (See FIGURE 25)

1) Remove the ends of the flue gas collection box. On the control side of the furnace, remove the block-off plate to gain access to the collection box end.
2) **Sizes 75-175** -- Remove one of the tube baffle retaining angles on each inside wall of the collection box. Each tube baffle angle has one screw.

   Sizes 200-400 -- Remove the flue diverter. Remove the screw at each end and slide the flue diverter out of the furnace.
3) Pull the "V" baffles out of the heat exchanger.

Power Vent Models

1) Remove the ends of the flue gas collection box. On the control side of the furnace, remove the venter assembly and the flue outlet duct to gain access to the collection box end.
2) **Sizes 125-300** -- Remove one of the tube baffle retaining angles on each inside wall of the collection box. Each tube baffle angle has one screw.

   Size 400 -- Remove the inner baffle from the flue collection box. On the control side, align the inner baffle with the slot in the collection box edge. Pull the inner baffle until it clears the heat exchanger.

Remove the screw at each end and slide the flue diverter out of the furnace.

3) Pull the "V" baffles out of the heat exchanger.

Clean the inner surfaces of the heat exchanger from beneath using the brush to "scrub" the tube walls to remove any accumulated dust, rust and/or soot. Clean the "V" tubes and re-assemble the heat exchanger and the furnace. **Check the furnace for proper operation.**

FIGURE 24 - When cleaning outer heat exchanger surface remove directional air baffles. Remove Screws "A" and slide baffles out. Clean and replace all baffles. NOTE: High CFM furnaces ("H" Models) do not have directional air baffles.

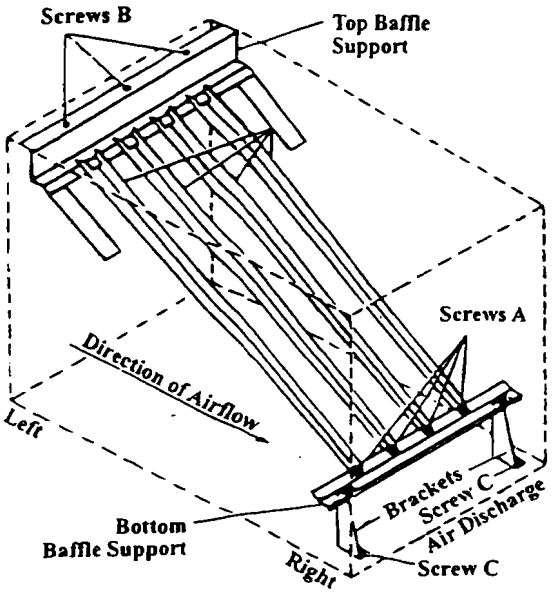
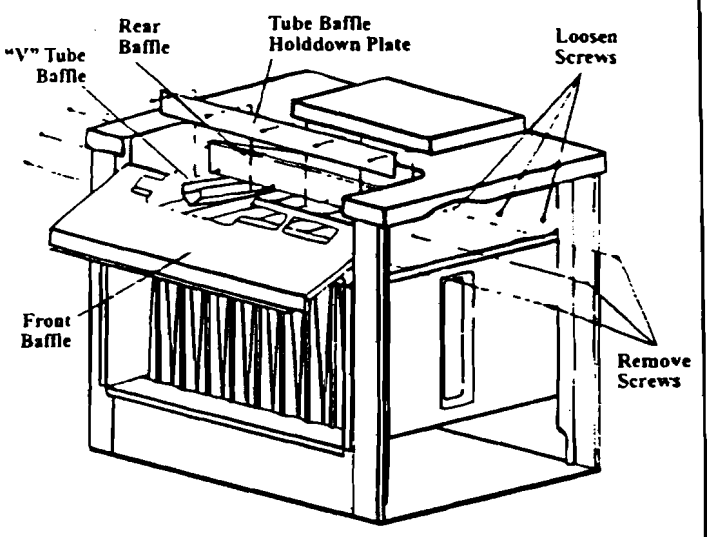


FIGURE 25 - Remove "V" Baffles to Clean Inner Surface of Heat Exchanger Tubes



32. Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Venter motor will not start (power-vented system)	1. No power to the furnace.	1. Turn on power, check supply fuses or circuit breaker.
	2. No 24-volt power to venter relay.	2. Turn up thermostat, check control transformer output. Check for loose or improper wire connections.
	3. Venter relay defective.	3. Replace.
	4. Defective motor or capacitor.	4. Replace defective part.
Pilot will not light (Venter operating on power-vented models)	1. Manual valve not open.	1. Open manual valve.
	2. Air in gas line.	2. Bleed gas line.
	3. Dirt in pilot orifice.	3. Remove and clean with compressed air or solvent (do not ream).
	4. Gas pressure too high or too low.	4. Adjust supply pressure. (See Paragraph 15).
	5. Kinked pilot tubing.	5. Replace tubing.
	6. Pilot valve does not open.	6. If 24 volt available at valve, replace valve.
	7. No spark:	7.
	a) Loose wire connections	a) Be certain all wires connections are solid.
	b) Transformer failure.	b) Be certain 24 volts is available.
	c) Incorrect spark gap.	c) Maintain spark gap at 7/64".
	d) Spark cable shorted to ground.	d) Replace worn or grounded spark cable.
	e) Spark electrode shorted to ground.	e) Replace pilot if ceramic spark electrode is cracked or grounded.
	f) Drafts affecting pilot.	f) Make sure all panels are in place and tightly secured to prevent drafts at pilot.
	g) Ignition control not grounded.	g) Make certain ignition control is grounded to furnace chassis.
	h) Faulty ignition controller.	h) If 24 volt is available to ignition controller and all other causes have been eliminated, replace ignition control.
	8. Optional lockout device interrupting control circuit by above causes.	8. Reset lockout by interrupting control at thermostat.
	9. Faulty combustion air proving	9. Replace combustion air proving switch.

(continued on page 28)

32. Troubleshooting (cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
Pilot lights, main valve will not open	1. Manual valve not open.	1. Open manual valve.
	2. Main valve not operating	2.
	a) Defective valve.	a) If 24 volt is measured at valve connections and valve remains closed, replace valve.
	b) Loose wire connections.	b) Check and tighten all wiring connections.
	3. Ignition control does not power	3.
	a) Loose wire connections.	a) Check and tighten all wiring connections.
	b) Flame sensor grounded. (Pilot lights - spark continues)	b)Be certain flame sensor lead is not grounded or insulation or ceramic is not cracked. Replace as required.
	c) Gas pressure incorrect.	c) Set supply pressure at 5" w.c. to 8" w.c. for natural gas and 11" w.c. for propane gas.
	d) Cracked ceramic at sensor.	d) Replace sensor.
	e) Faulty ignition controller.	e) See Paragraph 25. If all checks indicate no other cause, replace ignition controller. Do not attempt to repair the ignition controller. This device has no field replaceable parts.
	f) Poor microamp signal	f) Adjust pilot regulator
No heat (Heater Operating)	1. Dirty filters in blower system..	1. Clean or replace filters.
	2. Incorrect manifold pressure or	2. Check manifold pressure (See Paragraph 15).
	3. Cycling on limit control.	3.Check air throughput (See Paragraph 12).
	4. Improper thermostat location or	4. See thermostat manufacturer's instructions.
	5. Belt slipping on blower	5. Adjust belt tension
Cold air On Start-up	1. Fan control improperly wired	1. Connect as per wiring diagram.
	2. Defective fan control.	2. Replace fan control.
During Operation	3. Incorrect manifold pressure.	3. Check manifold line pressure (See Paragraph 15).
	4. Blower set for too low temperature	4. Slow down blower or increase static pressure.

FOR SERVICE OR REPAIR, FOLLOW THESE STEPS IN ORDER:

FIRST: Contact the installer.

Name _____

Address _____

_____

_____

Phone _____

SECOND: Contact the nearest distributor (See Yellow Pages). If no listing, contact Authorized Factory Representative, 1-800-695-1901 (Press 1).

THIRD: Contact: REZNOR®/Thomas & Betts Corporation
150 McKinley Avenue
Mercer, PA 16137
Phone: (724) 662-4400

Model No. _____

Unit Serial No. _____

Date of Installation _____

Thomas&Betts

(800) 695-1901; www.RezSpec.com

 Printed in the U.S.A.

MANUFACTURER OF GAS, OIL, ELECTRIC HEATING AND VENTILATING SYSTEMS

11/03 Form RZ-NA I-OUTDOOR DUCT

Section 6-B

VPGAC Treatment Vessels and Treatment Media (VG-610, VG-620, VG-630)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

June 12, 2003

Konrad Kuc
Arcadis G&M
88 Duryea Road
Melville, NY 11747

Subject: Request for Bid - Vapor Phase Treatment Units
OU-2 South IRM Groundwater Treatment System
Former MLWD Site, Great Neck, NY

Dear Konrad:

Thank you for considering TIGG Corporation for this request for bid regarding the above subject. We understand your request and feel that we are uniquely qualified to provide the type of vapor phase carbon system to meet your requirements.

This innovative response has been prepared to specifically address:

1. Minimum desired change out frequency
2. Non detect standard in primary treatment ECU
3. Lowest possible pressure drop
4. Serviceability
5. Overall cost effectiveness

Should you decide that a system based primarily on capital cost is more desirable, TIGG Corporation would be pleased to provide an alternative quote focusing on airflow and removal efficiencies.

It is our understanding that the system will consist of two vapor phase carbon adsorber units or ECUs, ducted in series arrangement but not designed for a rotating lead/lag operation. Recognizing that the second ECU will rarely be used, we have considered a different sizing and capacity for this unit. It is our intent to provide an operating lead ECU that will meet or exceed your minimum requirement of change out frequency of 3 months. We are also aware of the need to meet a non detect emission standard and will offer a design that addresses this requirement to minimize short-circuiting.

Per your request, we have attached the following information:

- Completed bid form
- Description of change out procedure with statement of confidence to meet allowable change out durations
- Applicable information related to carbon specification and equipment preliminary design information
- Statement of qualifications

Equipment
TIGG Corporation will provide both the primary and secondary ECU and the required transitional pieces from the ductwork to the ECUs.

Primary ECU
TIGG is recommending a modified Nixtox **NB20** as the primary ECU. The NB20 is approximately 8'X9'X30' with a 20,000 lb carbon fill. The inlet will be sized appropriately for the design flow rate. The air distribution is a plenum chamber, which will perform ideally for both the normal, and design operating conditions. We recommend TIGG 5CC 0612 virgin vapor phase coconut carbon

for the carbon fill. This coconut carbon is designed for use in vapor phase application, and is made from select grades of coconut shell to offer superior hardness and long life. It provides high surface area, fine pore structure, high density, and high volume activity. This combination of high activity level with a unique selection of transport and adsorption pores accommodates adsorbates of varied molecular size. This carbon also contains the high-energy adsorption pores, which are vital to attaining ultra high removal of low molecular weight volatile organic compounds.

NB20 with 20,000 lbs TIGG 5CC 0612 Virgin Coconut Shell Base Carbon

CFM	**4000**	**7000**
Velocity	19 ft/min	33 ft/min
Empty Bed Contact Time	11 seconds	6 seconds
Pressure Drop (dense packed)	4" wc	7"wc
Carbon Usage Rate (coco)	125 lbs/day	385 lbs/day
Days of Operation Before Breakthrough	160	52

Secondary ECU

Since the second bed in series is not intended to be used in a lead/lag operation, we are recommending a standard TIGG **NB15** box adsorber with a 5,000 lb carbon fill of 4mm coal base virgin vapor phase carbon. The 4mm pellet offers a low pressure drop and is a very good all purposeThe unit is 8'X9'X22 with appropriately sized inlet and outlet openings.

NB15 with 5000 lbs TIGG 5CP 4mm Virgin Coal Base Carbon

CFM	**4000**	**7000**
Velocity	24 ft/min	41 ft/min
Empty Bed Contact Time	2.7 seconds	1.5 seconds
Pressure Drop (dense packed)	1.5" wc	2"wc
Carbon Usage Rate (coco)	150 lbs/day	450 lbs/day
Days of Operation Before Breakthrough*	33	11

* This economical option of using the NB15 as the secondary ECU offers substantial protection in an emergency situation at the normal rate with 33 days of operation before breakthrough. This should provide ample time to change out the primary ECU. Under design conditions, you will have 11 days before breakthrough. Should you be operating under design conditions, up to an additional 2.5 – 3' of carbon can be added to the NB15, extending the breakthrough period by an additional 15 – 20 days.

The proposed system is designed to operate under both design and normal conditions offering a pressure drop through both units at design conditions of approximately 9" w/c. Both units will be equipped with appropriate safety railings around the top of the units, surrounding the access hatches. Both will be insulated using a spray on seamless foam insulation approximately 3" deep offering an R-value of 18. Both units will be supplied with three equally spaced air samples ports along the air stream through the media bed. Each unit will be supplied with a TIGG Breakthrough Indicator to provide an early warning of imminent contaminant breakthrough.

Catalog cut and dimension sheets of both the NB20 and NB15 are attached for your reference. Final design of the unit with be modified slightly to accommodate the specific requirements of this project (i.e. inlet and outlet size, sample ports, etc.). Sample ports will be placed on the sidewall at equal distances through the height of the carbon bed. Both units will be provided with painted safety railings and foam insulation (approximately 3" thick offering an R value of 18).

Bypass/Channeling
We understand that there is a requirement to meet a non detect emission standard for this application. As with all carbon applications, effluent is non detect until breakthrough. However we recognize the concern for potential short circuiting or channeling during operation. Channeling through a carbon bed occurs as a result of poor design of the air distribution system. Channeling can also occur if the carbon along the sidewalls of the adsorber becomes wet from condensation. Insulating the vessel will eliminate condensation on the sidewalls.

The ultimate way to avoid channeling is to design for plug flow through the adsorber vessel (ECU). With plug flow, all flow is the same across the total cross sectional area of the bed. In order to achieve equal distribution the influent air must approach 0 velocity in the plenum chamber to the maximum practical extent. TIGG will provide a transitional piece from the recommended 24" duct provided by others to a rectangular inlet on the ECU to reduce the velocity to 300 fpm (at 7000 cfm) at the entrance of the ECU. Influent air will enter the ECU's plenum chamber and traverse the length and width approaching 0 velocity, which, as stated earlier, is ideal for plug flow, creating an equal upward pressure on the carbon bed.

Additionally, one component of the carbon bed support is a 4" angle installed around the entire perimeter of the ECU. This angle will deflect air away from the sidewalls.

Ductwork to the ECU
2500 fpm is optimal velocity for air traveling in ductwork. For Design conditions, we recommend 24" influent ducting. At 7000 cfm, duct velocity will be approximately 2225 fpm. This is optimal velocity under design conditions.

Temperature and Relative Humidity
The adsorbed capacity of halogenated hydrocarbons on activated carbon, and thus the carbon use rate, is affected by relative humidity much more than for non-halogenated hydrocarbons. This is particularly true when the loading on the carbon is below 10 wt%. As can be seen in the accompanying figure for TCE, there is a large reduction in the carbon use rate when going from 100% - 50% R.H.

For most hydrocarbons, lowering the relative humidity below 50 wt% doesn't decrease the use rate that much. However, the use rate for halogenated hydrocarbons does decrease at lower humidity levels. Therefore, it is desirable to have the relative humidity as low as is practical.

Generally, the manner in which the relative humidity is reduced is by increasing the temperature. The lower humidity has a greater effect on lowering the carbon use rate than the higher temperature has on increasing the carbon use rate.

Unfortunately, the correction for relative humidity, used in the available computer programs, does not account for this anomaly. Thus, if the humidity is between 50 and 100%, the use rate can be more than that predicted by the computer. Since the RH in this application is <50%, the impact on use rate should not be as significant. However, we are proposing enough carbon in service to assure desired bed life under normal conditions.

Installation
The ECUs will be shipped to the site with the carbon already loaded. Minimal assembly of the will be required on site. TIGG Corporation will provide flexible ducting from the primary ECU to the secondary ECU. A crane will be required to offload the units and carbon

Media Change Out Procedure
Both the NB20 and the NB15 come equipped with 24.5"X42.5" access ways on the top of the units. The NB20 has 6 and the NB15 has 4. These openings allow for easy access to remove the media via vacuum and refilling. Refilling can be accomplished pneumatically or by using a boom or crane with super sacks. Our horizontal bed design also provides ease of removal and refilling compared to vertical beds.

Although no specific change out schedule or duration has been identified in your request for bid, we are confident that TIGG Corporation can meet any reasonable requirements that may apply.

Pricing
We have completed and attached the requested pricing form.

Alternate
Our pricing covers the equipment as described previously in this proposal. Per your request for bid, page 2/5, we have included a smaller secondary ECU in our initial pricing. Should Arcadis elect to have the same size units in both the primary and secondary positions, TIGG Corporation would be pleased to accommodate this request and provide two NB20 units. Upon request, we will provide any additional costs based upon equipment and media needs.

Lead Time
TIGG Corporation can meet the proposed schedule identified in your request for bid, page 3/5, item #6.

Guarantee of Performance
As long as Arcadis is guaranteeing the influent compounds and concentrations as they appear on Table 1 of the request for bid, TIGG will guarantee the effluent to be non detect in accordance with the preceding

Standard Warranty Statement
TIGG Corporation warrants that the carbon adsorption equipment sold hereunder shall be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. The warranty does not apply to problems associated with normal wear and tear, improper maintenance, negligence, misuse, or the failure to operate the system properly. For those items provided by, but not directly manufactured by TIGG, the manufacturer's warranty shall apply provided warranty coverage exceeds that which is provided by TIGG. All other warranties, either express or implied, are hereby disclaimed including but no limited to the warranty of merchantability and fitness for a particular purpose. There are not warranties made with regard to the equipment sold hereunder other than those contained in this paragraph.

This warranty is limited to the replacement and/or repair by TIGG Corporation of any part, parts or material, which in TIGG's determination are defective and does not extend to any other types of damage or loss in consequence of such defects. This warranty does not cover any charges by the Buyer for replacement of parts, adjustments or repairs, or any other work unless such charges shall be assumed or authorized in advance in writing by TIGG Corporation.

In Conclusion
All of our equipment is engineered and designed to provide the highest-level quality and long-term performance that you will require for this project. To us, this opportunity represents an important technical and commercial endeavor – one that we want to see through to its successful implementation and ongoing operation. We are committed to helping Arcadis achieve your project goals and objectives, on time and within budget. We are confident that our equipment and our professional staff will insure this success. We want to emphasize the importance of your business and this project to TIGG Corporation. Arcadis is a key customer for TIGG. As such, you will receive high priority in our organization and superior ongoing service.

I have attached the complete bid form for your review. Also attached for your reference are similar project listing, references, specification sheets, drawings, and a features/benefits of the NB15 and NB20; specification sheets of the activated carbon, and a Statement of Qualifications.

At your convenience, we would be pleased to meet with you to further discuss this application and to answer any questions you may have. Thank you for considering TIGG Corporation for this opportunity.

Sincerely,

Jim Kearns
Dir, Sales & Marketing

Table 2: Bid Sheet - Emissions Control Units, OU-2 South Groundwater Treatment System
Former Unisys Site, Great Neck, New York

Please fill out the following for your proposed ECUs:

	Primary Unit	Secondary Unit
ECU INFORMATION		
Model	NB20	NB15
Dimensions	8'x9'x30	8'x9'x22
Pressure Drop (in H_2O)	---	---
4,000 CFM	4" WL	1.5" WL
7,000 CFM	7" WL	2" WL
Change Out Frequency	---	---
Normal Conditions	160 Days	33 Days
Design Conditions	52 Days	11 Days
CAPITAL COST (5)	$101,750	
SHIPPING COST (5)	$4,000	
ADDITIONAL COSTS (6)	$750/day + expenses	
AVAILABILTY	6 week lead time	
DELIVERY TIME	4-5 days	

Please make sure the following are addressed:

1 We have indicated that the relative humidity will be 45% at a temperature of 97 degrees farenheit. Please discuss any benefits associated with changing these parameters, for example to either 40% RH or 50% RH.

2 Confirm that your units will be able to achieve the Non-detect Standard outlined in Table 1.

3 Include Specifications (weight, dimensions, inlet, outlet ducts, cut sheets, drawings, etc.)

4. We require intermediate sampling ports in the beds to help assess system performance. initially we anticipate three intermediary sampling ports per bed. Provide a recommendation for these ports.

5 Include costs for the initial media loading.

6. Include any additional costs, like site oversight, etc.

7. Propose an ECU insulation method and consider installing safety railing around the ECU access hatches. Include associated costs.

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corporation

Similar Installations

Midwest Utility, Beardstown, IL	Treatment flow rate – 45,000 cfm; system included three TIGG Model NB20 carbon adsorbers operated under vacuum conditions.
Commonwealth Edison Oak Park, IL	Treatment flow rate – 80,000 cfm; system included four TIGG Model NB20 carbon adsorbers operated under vacuum conditions.
Commonwealth Edison Oak Park, IL	Treatment flow rate – 220,000 cfm; system includes eleven TIGG Model NB20 carbon adsorbers operated under vacuum conditions
North East Utility Saratoga Springs, NY	Treatment flow rate – 18,000 cfm; system included TIGG Model NB20 carbon adsorber with blower, inlet vane damper, motor and combination motor starter, particulate filter, and all associated ductwork.
Eastern Utility Pottsville, PA	Treatment Flow rate – 25,000 cfm; system included two TIGG Model NB15 carbon adsorbers with blower, inlet vane damper, motor and combination motor starter, particulate filter and associated ductwork.
Providence Gas Providence, RI	Treatment flow rate – 30,000 cfm; system included two TIGG Model NB20 carbon adsorbers
Remediation Site Greenwich, RI	Air stripper off gas – Chlorinated compounds at 7,000 CFM. One NB20 box split to form two compartments with 10,000 lbs of virgin carbon in each adsorber.
Edwards Air Force Base	2- NB 20s with specialty activated carbon for war gases. Blower package, ducting and stack.
Shell Oil Hobbs, NM	Waste petroleum site – 40,000 cfm using complete air handling system including 2 – NB20s, Blower package, & ducting.

References

Earth Tech
100 W. Broadway
Suite 240
Long Beach, CA
Mr. Karl Eggers

BBC International
1324 West Marland Street
Hobbs, NM
Mr. Cliff Brunson

MTB
1005 South Lombard Avenue
Oak Park, IL 60304
Mr. John Bell

Great Lakes Chemical
PO Box 2200
West Lafayette, IN 47906
Mr. David McAllister

TIGG Corporation respectfully requests that you provide us with notification prior to contacting the above references.

TIGG NB 15

Features	Benefits
• High capacity vapor adsorber (8'x 22')	• High flow through single vessel
• Large amount of carbon in a single vessel (12,000 lbs.)	• Longer time on stream before carbon change-outs
• Durable construction – Most metal per CFM	• Robust construction for long life and durability
• 4 Large access doors (24"x 42")	• Easy carbon removal/replacement, bed leveling and interior maintenance
• 4 – drains	• Optimum condensate removal
• Sample ports	• Allow monitor of inlet, outlet and movement of adsorption zone through carbon bed
• 2 Couplings to accommodate TIGG breakthrough detectors	• Early warning of pending organic breakthrough
• Slip resistant surface coating and ladder	• Operator safety
• Properly designed and placed lifting lugs	• Allows lifting of adsorber even with spent carbon in place
• High solids epoxy lined	• Corrosion resistance and long life
• 2 – Large (16") inlets and outlets	• Minimal pressure drop means reduced fan H.P. and electrical consumption
• Large inlet plenum	• Reduces air velocity and allows entrained water to drop out • Avoids bed channeling for optimum carbon usage • Optimizes directional flow charges
• Porous plate bed support	• Minimal pressure drop, fan H.P. and electrical consumption
• 60 CCl_4 – 4mm High capacity pelleted carbon	• Long bed life and fewer change-outs • Minimal pressure drop reduces fan H.P. and electrical consumption
• Large outlet collection plenum	• Avoids bed channeling for optimum carbon usage • Optimizes directional flow changes

TIGG corporation

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(412)257-8520 (facsimile)
www.tigg.com
information@tigg.com

TIGG NB 20

Features	Benefits
• Largest vapor adsorber in the industry (8'x 30')	• Highest flow through single vessel
• Largest carbon capacity in a single vessel (20,000 lbs.)	• Longest time on stream before carbon change-outs
• Durable construction – Most metal per CFM	• Assured durability for long life
• 6 Large access doors (24"x 42")	• Easy carbon removal/replacement, bed leveling and interior maintenance
• 4 – drains	• Optimum condensate removal
• Sample ports	• Allow monitor of inlet, outlet and movement of adsorption zone through carbon bed
• 2 Couplings to accommodate TIGG breakthrough detectors	• Early warning of pending organic breakthrough
• Slip resistant surface coating on top of box and ladder	• Operator safety
• Robust lifting lugs	• Allows lifting of adsorber even with spent carbon in place
• High solids epoxy lined	• Increased corrosion resistance and long life
• 2 – Large (20") inlets and outlets	• Minimal pressure drop means reduced fan H.P. and electrical consumption
• Large inlet plenum	• Reduces air velocity and allows entrained water to drop out • Avoids bed channeling for optimum carbon usage • Optimizes directional flow charges
• Porous plate bed support	• Minimal pressure drop, fan H.P. and electrical consumption
• 60 CCl_4 – 4mm High capacity pelletized carbon	• Long bed life with fewer change-outs • Minimal pressure drop reduces fan H.P. and electrical consumption
• Large outlet collection plenum	• Avoids bed channeling for optimum carbon usage • Optimizes directional flow changes

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9/02

NIXTOX® BOX NB15 and NB20

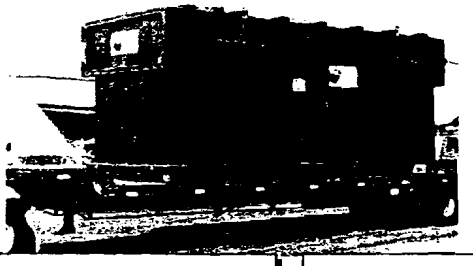
MODEL	MAXIMUM FLOW (CFM)	MAX PRESS (PSIG)	MAX TEMP (deg F)	INLET / OUTLET (IN)	DIMENSIONS L X W X H (FT)	STANDARD ADSORBENT FILL (LBS)	SHIPPING WEIGHT (EMPTY) (LBS)
NB-15	15000	1	180	16/16	22 X 8 X 9.3	12000	9000
NB-20	20000	1	180	20 /20	30 X 8 X 9.3	16000	15000

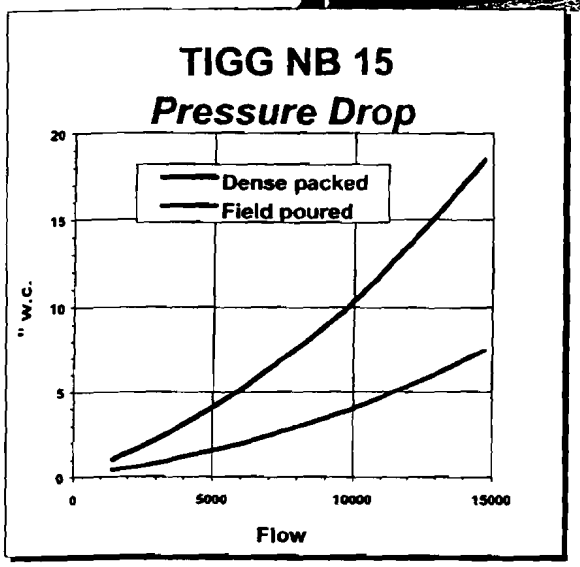
NOTES:

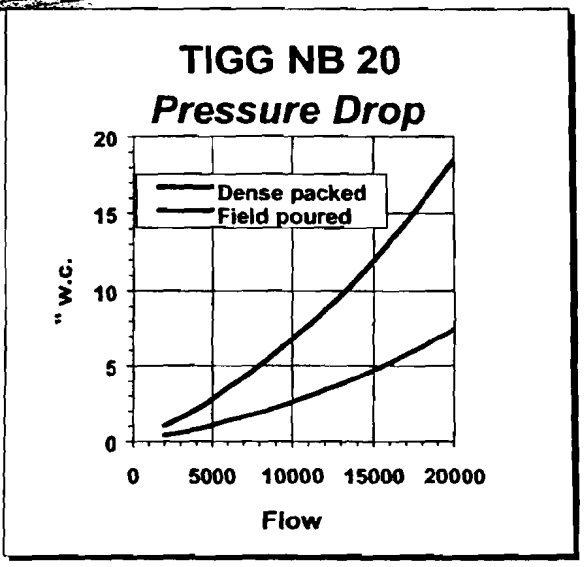
1) Do not exceed maximum flow conditions listed.
2) Dry virgin activated or reactivated carbon provided as standard adsorbent.
3) Maximum adsorbent fill is based on a bed density of 29 lb/ft^3.
4) Maximum adsorbent fill can differ based on variable bed density and alternate adsorbents.
5) Pressure drop curves are dense packed. Please contact your TIGG sales representative for more specific information.

The NIXTOX Box Series Modular Adsorbers are designed for applications with high flow rates or where more on-line adsorbent is required. Model numbers reflect nominal design flow for air and other vapors. The vessels are fabricated of carbon steel and provided with a high solids epoxy lining. The vessels are provided with lifting lugs. *Specifications and properties are subject to change without notice.*

NB20 Pictured on flatbed ready for shipment.







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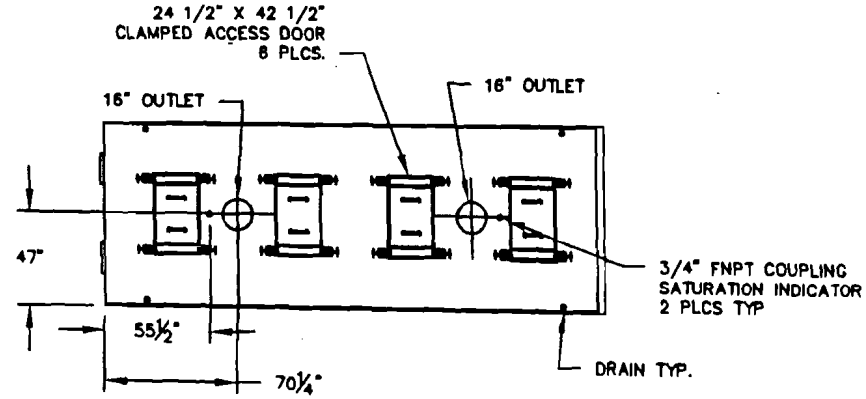
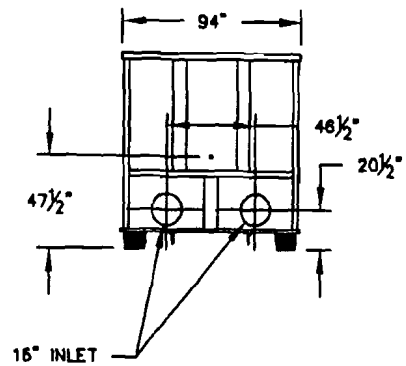
info@tigg.com

NOTES: TIGG CORPORATION RESERVES THE RIGHT TO CHANGE ANY AND ALL DIMENSIONS – AND DESIGNS.
OVERALL OUT TO OUT DIMENSIONS AND INLET/OUTLET LOCATIONS ARE FIXED.

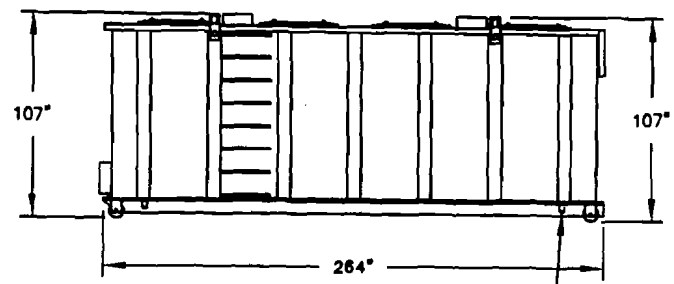
CONTAMINATED AIR SHALL ENTER UNIT THROUGH BOTH INLETS AND MUST EXIT USING BOTH OUTLETS.



TOP VIEW

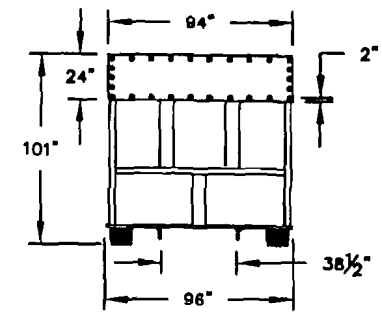


LEFT SIDE



FRONT VIEW

DRAIN 3/4"
HALF COUPLING
W/ 3/4" PLUG
4 PLCS.



RIGHT SIDE

NO.	REVISION	BY	DATE
1	REVISE STANDARDS	JB	5/22/03

VESSEL STANDARDS

VESSEL MATERIALS : CARBON STEEL	BED VOLUME STD/MAX : 413 FT^3/ 517 FT^3
LINING : HIGH SOLIDS EPOXY	STANDARD/MAX CARBON FILL : 12,000 LBS 15,000 LBS
EXTERIOR PAINT : HIGH SOLIDS EPOXY W/ URETHANE TOP COAT	SHIP WT.STD.FILL : 15,000 LBS/27,000 LBS
HEAD THICKNESS : 12 GAUGE STD.	CARBON TYPE : TIGG 5CP-4MM VAPOR PHASE
SHELL THICKNESS : 3/16"	MAX. OPERATING PRESSURE : 14" H$_2$O
INTERNALS : CARBON STEEL & POLYPROPYLENE	MAX. OPERATING TEMP. : 140F
ADSORBENT OUTLET ASSEMBLY : 24 1/2" X 42 1/2" ACCESS AND HINGED DOORS	

PROJECT

PROJ. NO.	SALES
P.O. NO.	
DRAWN BY	JB
DESIGN BY	BL
CHKD. BY	BL
DATE	05/16/02
SCALE	NTS

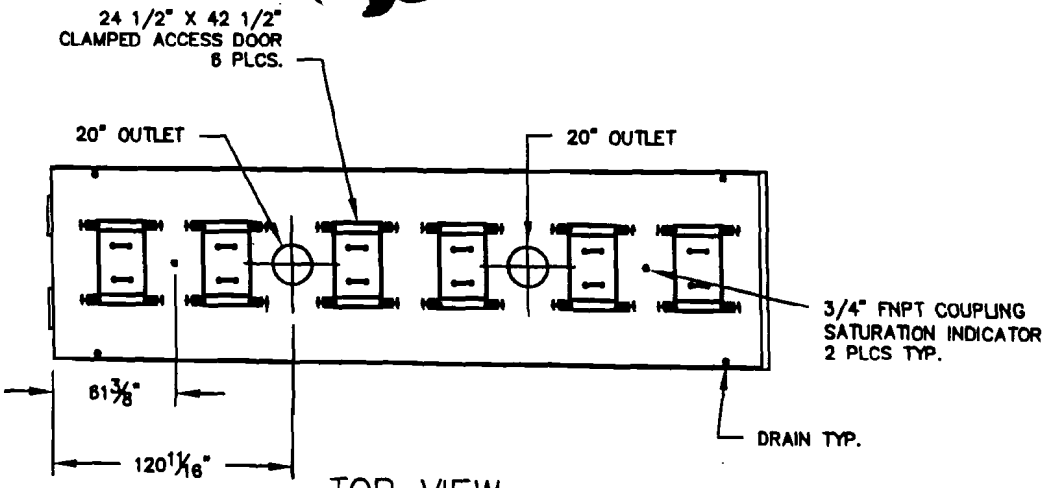
TIGG corporation

NB-15-1001

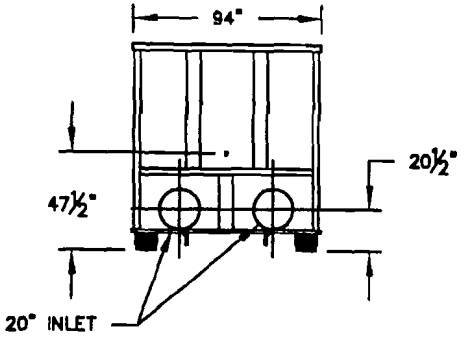
DWG. NO. NB-15-1001 REV. 1

NOTE: TIGG CORPORATION RESERVES THE RIGHT TO CHANGE ANY AND ALL DIMENSIONS– AND DESIGNS
OVERALL OUT TO OUT DIMENSIONS AND INLET/OUTLET LOCATIONS ARE FIXED.

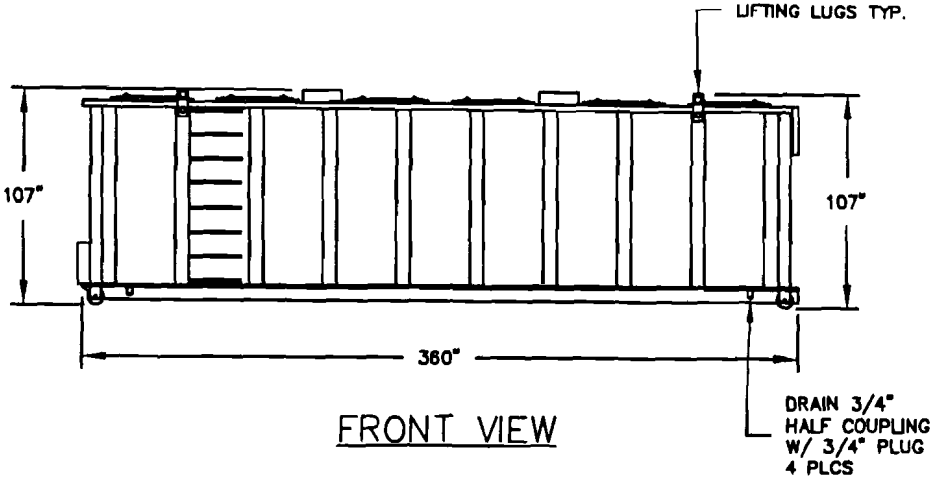
CONTAMINATED AIR SHALL ENTER UNIT THROUGH BOTH INLETS AND MUST EXIT USING BOTH OUTLETS.



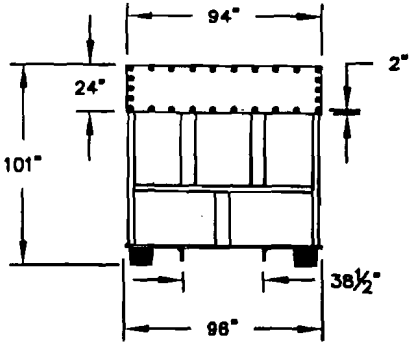
TOP VIEW



LEFT SIDE



FRONT VIEW



RIGHT SIDE

VESSEL STANDARDS

VESSEL MATERIALS : CARBON STEEL	BED VOLUME STD/MAX : 640 FT³ / 780 FT³
LINING : HIGH SOLIDS EPOXY	STD / MAX CARBON FILL : 17,000 LBS/20,000 LBS
EXTERIOR PAINT : ACRYLIC WATERBORNE PRIMER & PAINT	SHIP WT. EMPTY/MAX.FILL : 15,000 LBS/35,000 LBS
WALL THICKNESS : 12 GAUGE STD.	CARBON TYPE : TIGG 5CP–4MM VAPOR PHASE
FLOOR THICKNESS : 3/16" STD.	MAX. OPERATING PRESSURE : 14"H.O
INTERNALS : CARBON STEEL & POLYPROPYLENE	MAX. OPERATING TEMP. : 140F
ADSORBENT OUTLET ASSEMBLY : 24" X 42" ACCESS AND HINGED DOORS	

NO.	REVISION	BY	DATE
1	REVISE STANDARDS	JB	6/10/

PROJECT

PROJ. NO.	SALES
P.O. NO.	
DRAWN BY	JB
DESIGN BY	BL
CHKD. BY	BL
DATE	05/15/02
SCALE	NTS

TIGG corporation

NB–20–1001

DWG. NO. NB–20–1001 REV. 1

TIGG 5CP 4mm
VIRGIN VAPOR PHASE
ACTIVATED CARBON PELLETS

DESCRIPTION

TIGG 5CP 0406 is a pelletized activated carbon made from selected grades of bituminous coal. The combination, of a high activity level and selective transport and adsorption pores, accommodates adsorbates of varied molecular size. This carbon also contains the high energy adsorption pores which are vital to attaining ultra high removal of low molecular weight volatile organic compounds. The physical properties provide resistance to breakage and minimal pressure drop.

TYPICAL PROPERTIES

U.S Sieve, 90 wt% min	4 x 6
CCl_4 Number, min	70
Butane Number, min	27.8
Iodine Number, mg/g, min	1000
Apparent Density, (dense packing)	
g/cc	0.48
lbs/ft^3	30
Moisture - % max	2
Hardness No. - % min	97

TYPICAL APPLICATIONS

This carbon is ideally suited for use in vapor phase applications, especially steam regenerable solvent recovery systems and air/gas purification systems.

Standard packaging is in 1100 lb saks.

Wet drained activated carbon adsorbs oxygen from the air. Therefore, when workers need to enter a vessel containing wet activated carbon, they should follow confined space/low oxygen level procedures. Activated carbon dust does not present an explosion hazard.

10/02

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www.tigg.com

TIGG 5CC 0612
VIRGIN VAPOR PHASE ACTIVATED CARBON

DESCRIPTION

TIGG 5CC 0408 is a granular activated carbon made from coconut shell. The combination of high activity level with a selection of transport and adsorption pores that accommodate adsorbates of varied molecular size. This carbon also contains the high energy adsorption pores which are vital to attaining ultra high removal of low molecular weight volatile organic compounds.

TYPICAL PROPERTIES

U.S Sieve, 90 wt% min	6 x 12*
CCl_4 Number, min	50
Iodine Number, mg/g, min	900
Apparent Density, min (dense packing)	
g/cc lbs/ft^3	0.41-0.42 26
Moisture - % max (as packed)	3
Hardness No. - % min	92

***Sizes also available are 0612 & 0816.**

TYPICAL APPLICATIONS

This carbon can be used to:

- Recover solvents
- Remove VOC's from air from:
  - Tank vents
  - Air stripper offgas
  - Soil venting
  - Remediation of excavated soil

Standard packaging is in 1000 pound supersaks.

Wet drained activated carbon adsorbs oxygen from the air. Therefore, when workers need to enter a vessel containing wet activated carbon, they should follow confined space/low oxygen level procedures. Activated carbon dust does not present an explosion hazard.

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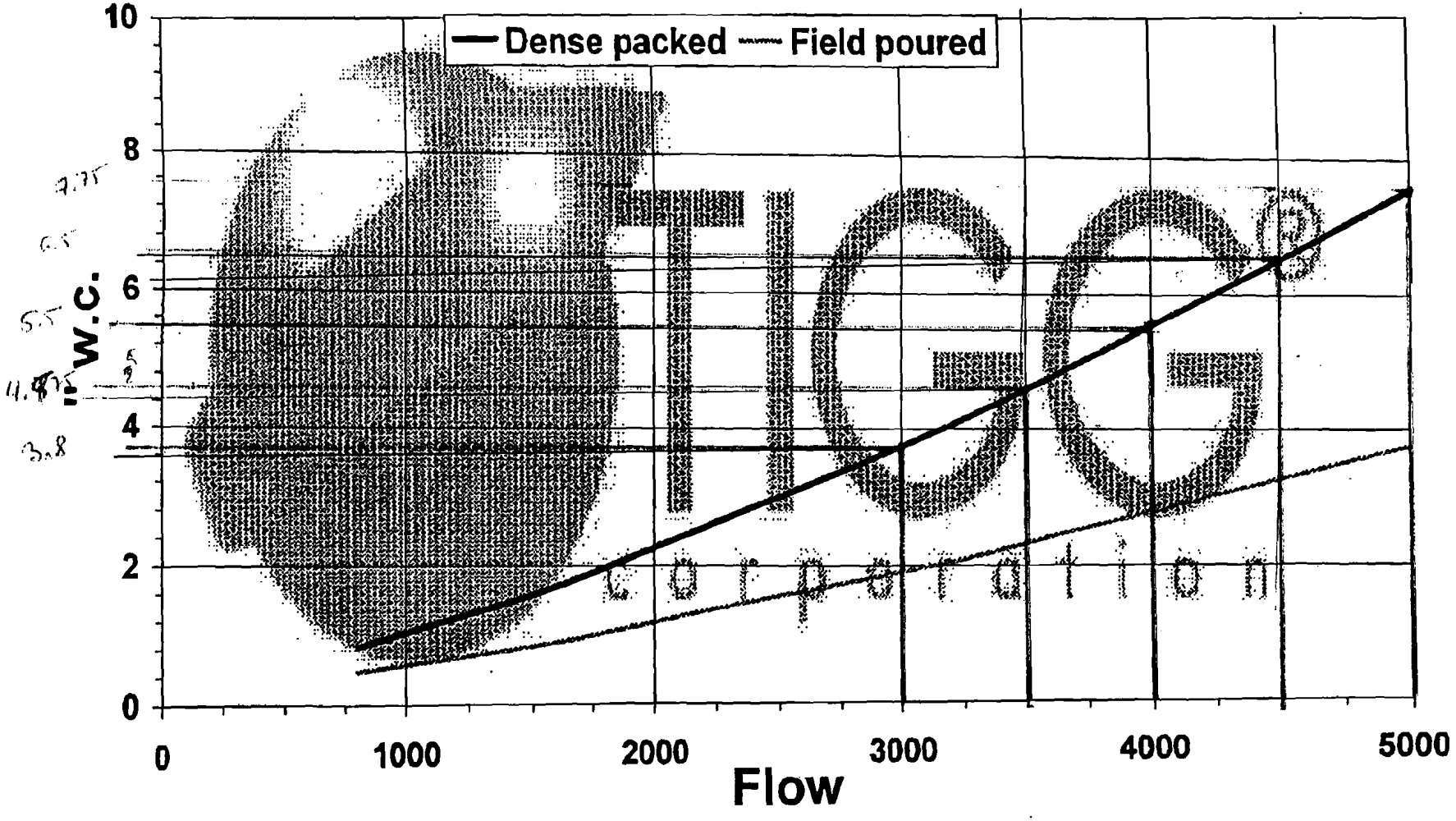
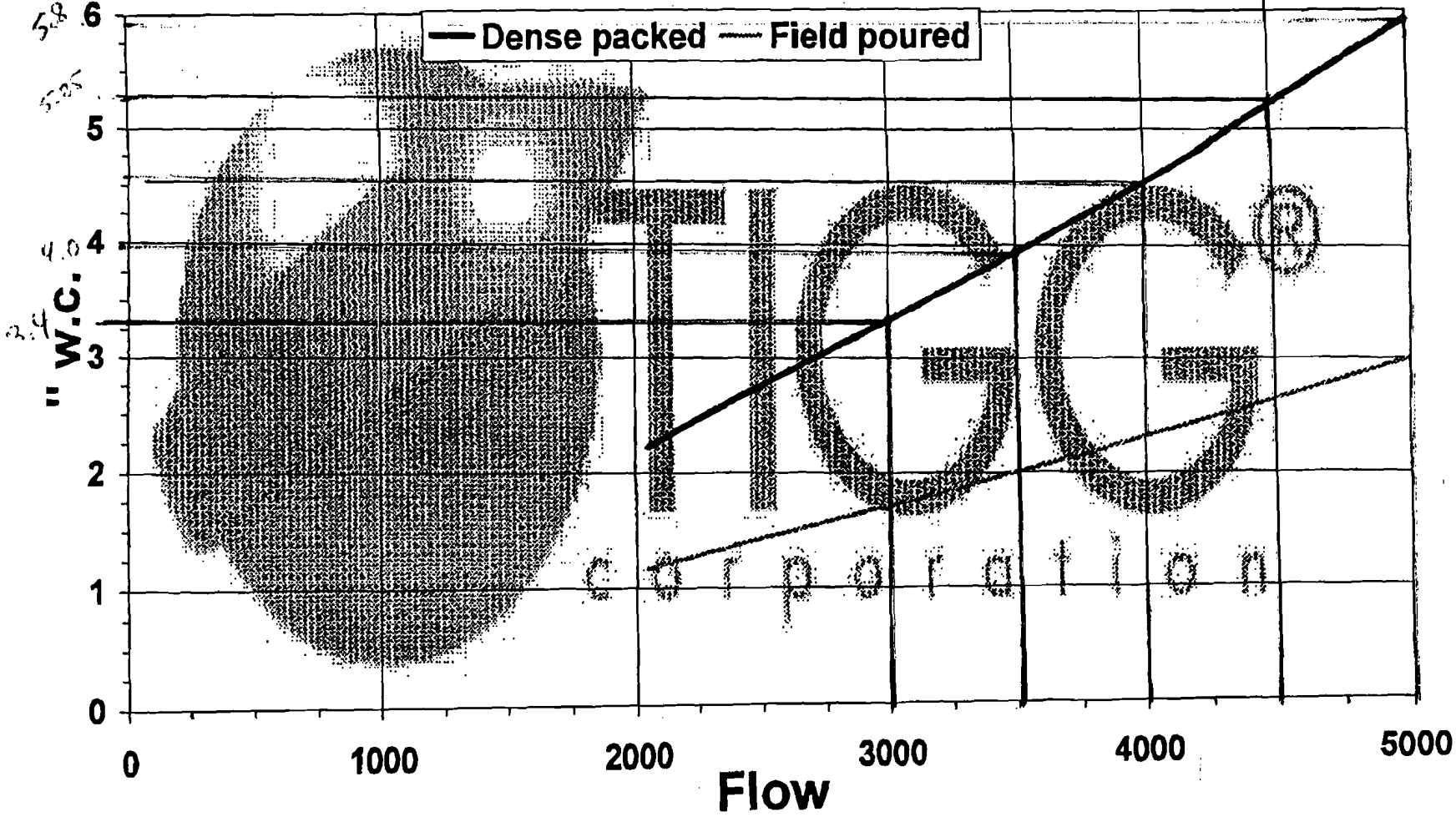
NB8



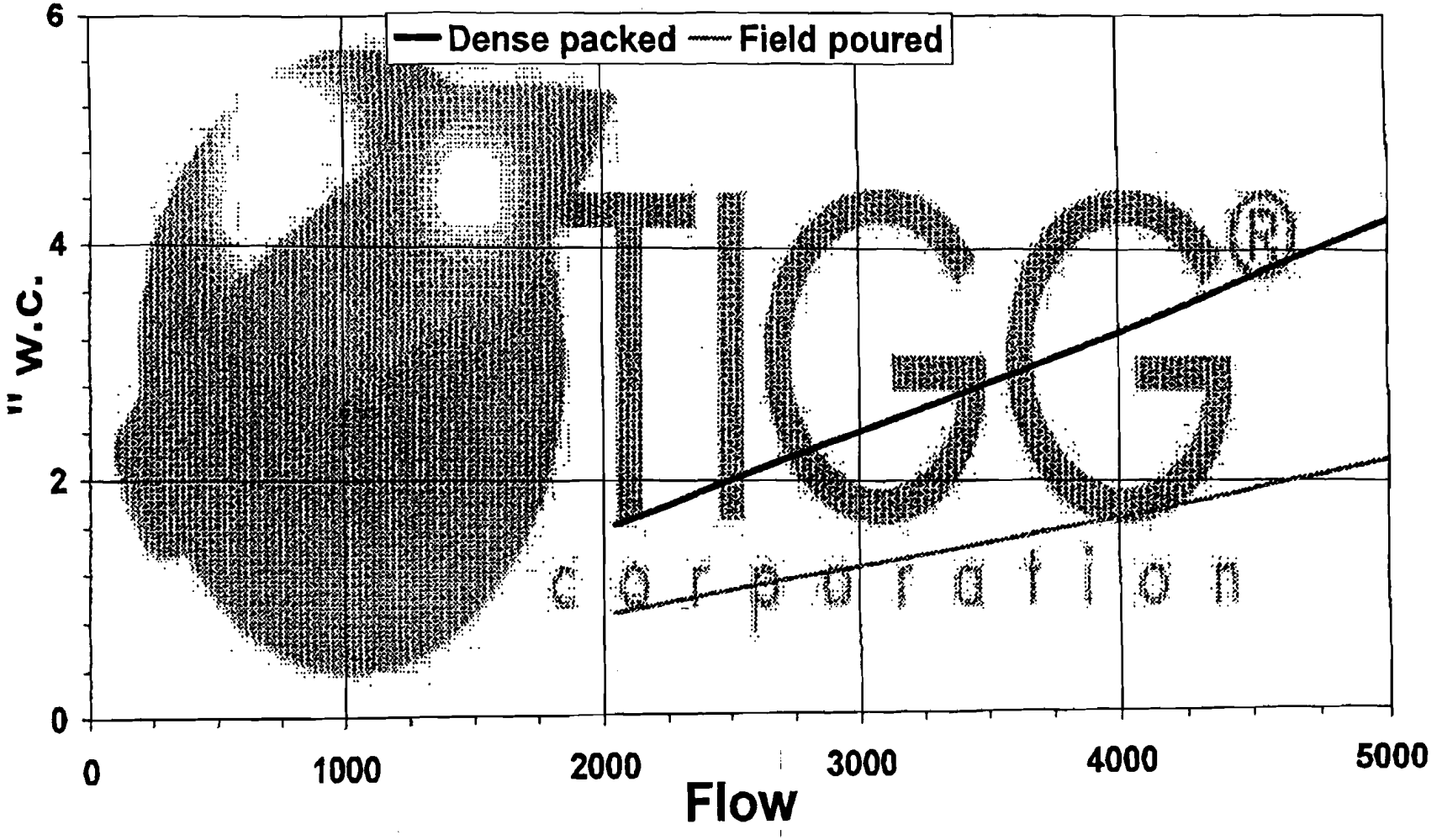
Carbon	Type	Density	MPD	Bed Depth	Media
		(lbs/cuft)	(mm)	(in)	(lbs)
TIGG 4mm	4	30	4	76	7200

NB20



Carbon	Type	Density (lbs/cuft)	MPD (mm)	Bed Depth (in)	Media (lbs)
TIGG 5CC	612	31.5	2.5	52	27983

NB20



Carbon	Type	Density (lbs/cuft)	MPD (mm)	Bed Depth (in)	Media (lbs)
TIGG 5CC	612	31.5	2.5	[illegible]	20018

RECEIVED		W.
REVIEWED	2/16/04	WS
APPROVED	2/16/04	WS

Arcadis Drawing Index

NB-8 Drawings

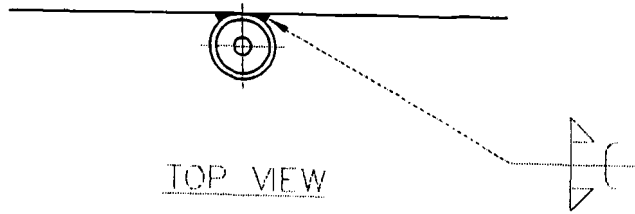
N04-1002	Plan & Elevation (Sales) (NB-8)
N04-1003	Plan & Elevation (NB-8)
N04-1004	Internals (NB-8)
N04-1005	Internal Plate Details (NB-8)
N04-1006	Floor Detail (NB-8)
N04-1007	Blast Media Drain (NB-8)
N04-1008	Structural Base (NB-8)
N04-1019	Sample Port Detail (NB-8 Details)

NB-20 Drawings

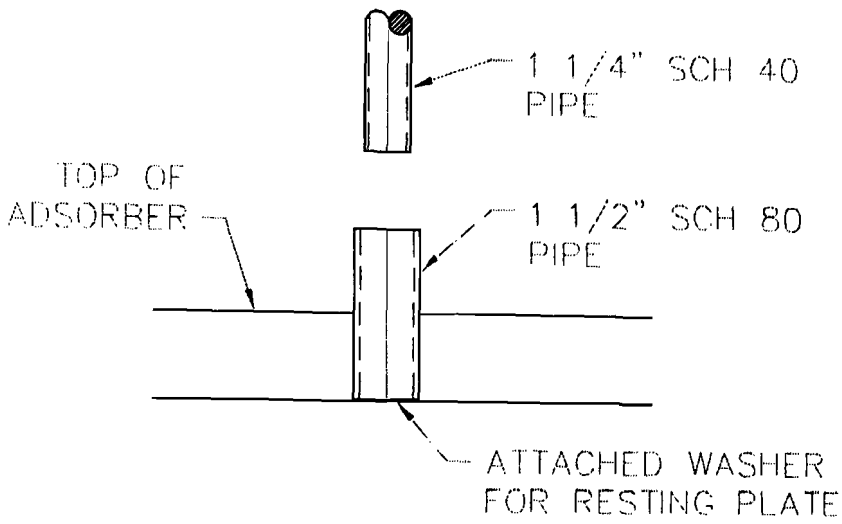
N04-1009	Plan & Elevation (Sales) (NB-20)
N04-1010	Plan & Elevation (NB-20)
N04-1011	Internals (NB-20)
N04-1012	Internal Plate Details (NB-20)
N04-1013	Floor Detail (NB-20)
N04-1014	Blast Media Drain (NB-20)
N04-1015	Structural Base (NB-20)
N04-1033	Sample Port Detail (NB-20 Details)

Detail Drawings

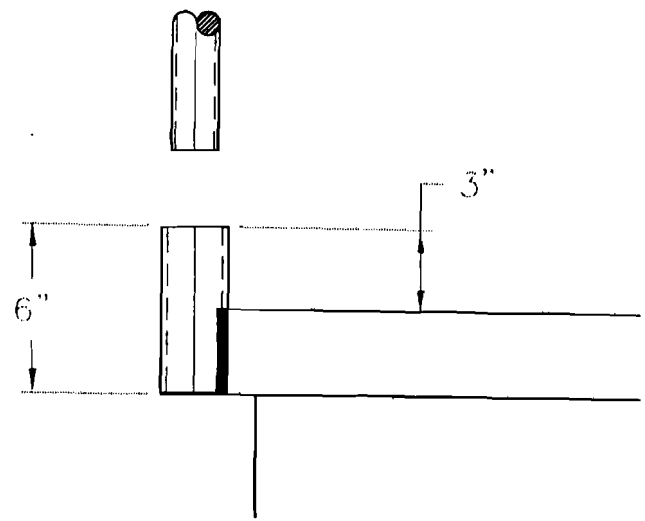
N04-1016	Inlet Flange (Details)
N04-1017	Outlet Flange (Details)
N04-1018	Lift Lug Detail (Details)
N04-1020	Drain Detail (Details)
N04-1036	Sample Probe (Details)



TOP VIEW



FRONT VIEW



SIDE VIEW

NO.	REVISION	BY	DATE

PROJECT
ARCADIS
OU-2 SOUTH IRM

PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-JK-064

DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	3/1/04
SCALE	NTS

TIGG corporation

SAFETY RAIL MOUNTING

DWG. NO. NO3-1042

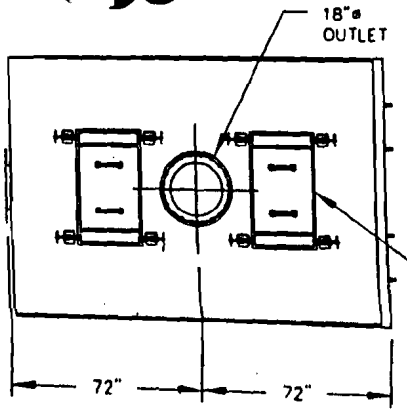
REV 0

NOTE: CONTAMINATED AIR SHALL ENTER UNIT THROUGH THE INLETS AND MUST EXIT USING BOTH OUTLETS.

PROTECTIVE COATING SYSTEM

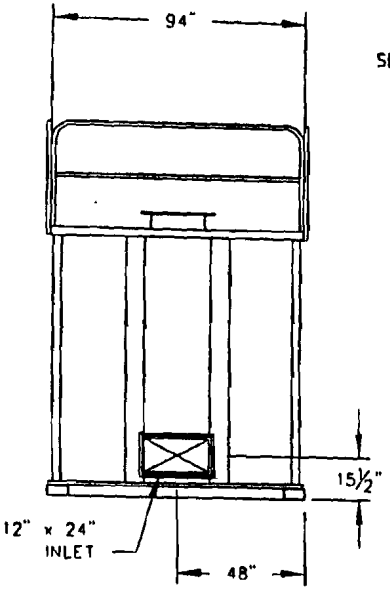
INTERIOR : SHERWIN WILLIAMS DURAPLATE 235(WHITE) DFT 7-14 MILS.

EXTERIOR : ANCHOR HIGH SOLIDS EPOXY #3950 TOP COATED WITH #4900 ANCOTHANE ACRYLIC URETHANE (BLACK)DFT 7-14 MILS.



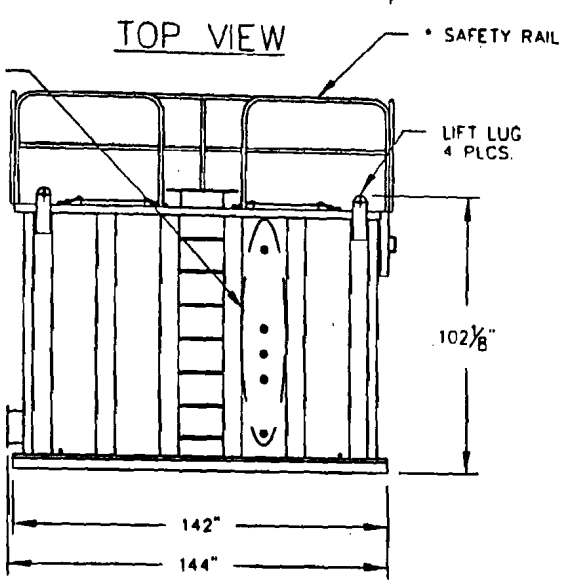
TOP VIEW

* SAFETY RAIL-
1 1/4"ø A-53 PIPE CONSTRUCTI
SHERWIN WILLIAMS SAFETY YELLO
DURA-PLATE EPOXY 235

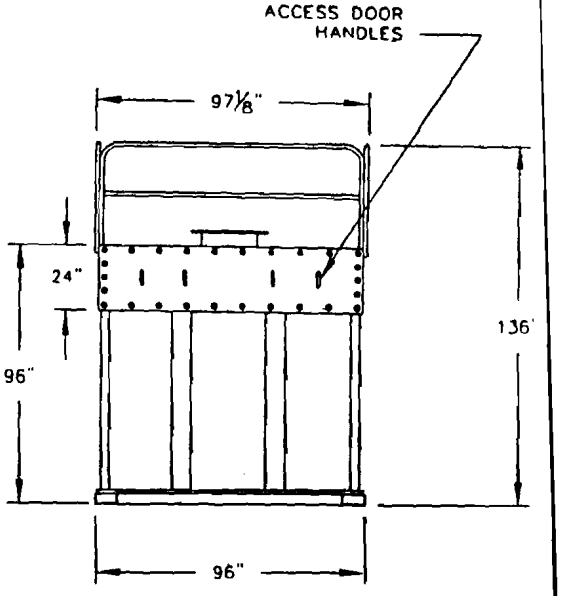


LEFT SIDE

SEE DRAWING N04-1019 FOR SAMPLE PORT SIZE & ELEVATIONS



FRONT VIEW



RIGHT SIDE

NO.	REVISION	BY	DA
3	REVISE INLET ELEVATION	JB	2/
3	SAFETY RAIL NOTES	JB	2/
2	REVISE HEIGHT OF INLET & CARBON BED	JB	1/
1	REVISE SAMPLE PORT LOCATIONS	JB	1/

VESSEL STANDARDS

VESSEL MATERIALS : CARBON STEEL A-36	BED VOLUME STD : 250 FT³
LINING : HIGH SOLIDS EPOXY	CARBON FILL : 7,200 LBS
EXTERIOR PAINT : HIGH SOLIDS EPOXY	SHIP WT. EMPTY/STD.FILL : 7,000 LBS/13,250 LBS
WALL THICKNESS : 12 GAUGE STD.	CARBON TYPE : TIGG 5CP-4MM VAPOR PHASE
FLOOR THICKNESS : 3/16" STD.	MAX. OPERATING PRESSURE : 40"H₂O
INTERNALS : CARBON STEEL & POLYETHYLENE	MAX. OPERATING TEMP. : 140F
ADSORBENT OUTLET ASSEMBLY : 24" X 42" CLAMPED ACCESS AND 86" X 16" BOLTED DOOR	

PROJECT
ARCADIS
OU-2 SOUTH IRM

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PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK
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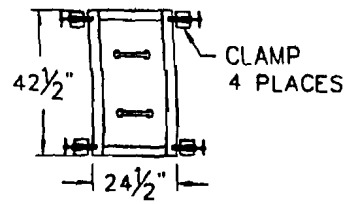
DESIGN BY	BB
CHKD. BY	BB
DATE	1/13/04
SCALE	NTS

ECU-4

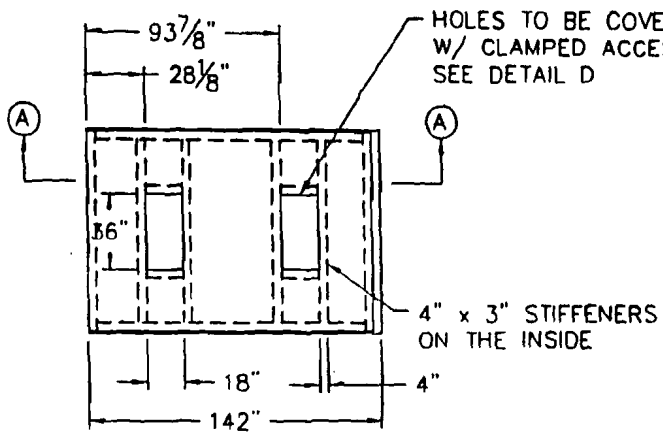
DWG. NO. N04-1002

NOTE: ALL EXTERIOR SUPPORT WELDS TO BE STITCH WELDS

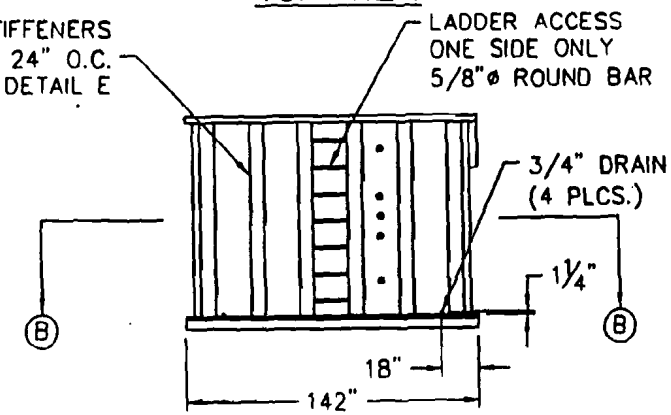
SEE DRAWING N04-1004 FOR SECTION A-A AND SECTION B-B.



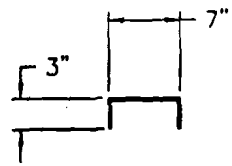
DETAIL D



TOP VIEW

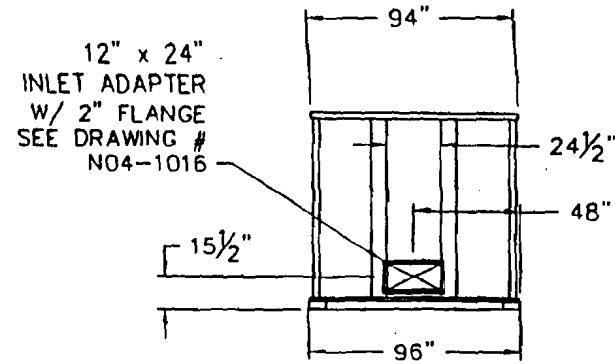


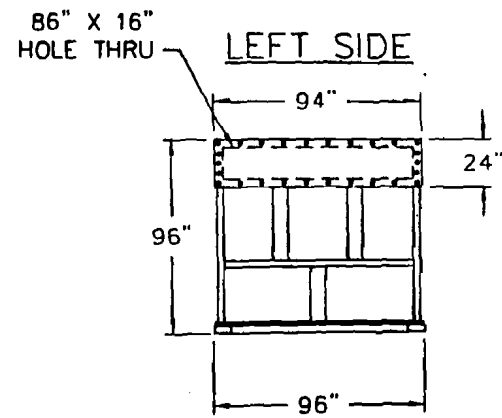
FRONT VIEW



DETAIL E

SIDE SUPPORTS
12 GA.
A-36





RIGHT SIDE

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NO.	REVISION
3	REVISE DRAIN FROM 1/2" TO 3/4" & INLET ELEVATION
2	INLET REFERENCE
1	REVISE SAMPLE PORT LOCATIONS

PROJECT	ARCADIS OU-2 SOUTH IRM
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-084-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/13/04
SCALE	NTS

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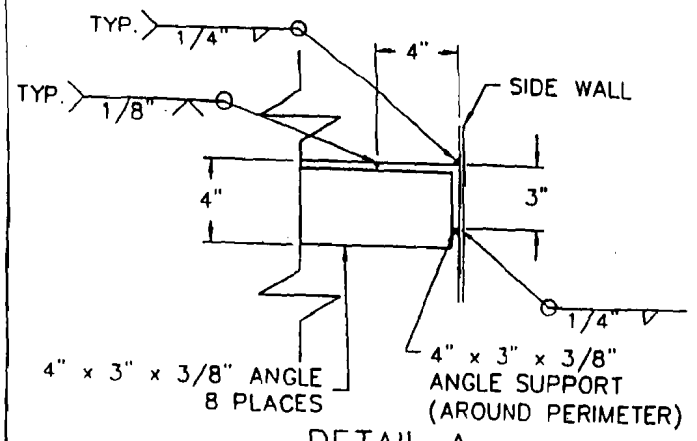
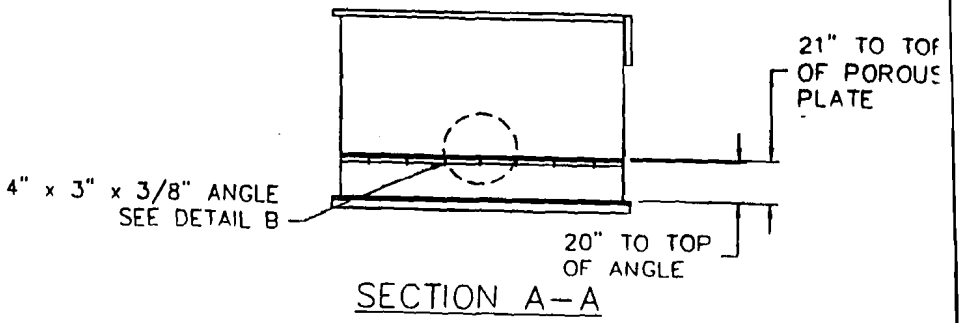
PLAN & ELEVATION

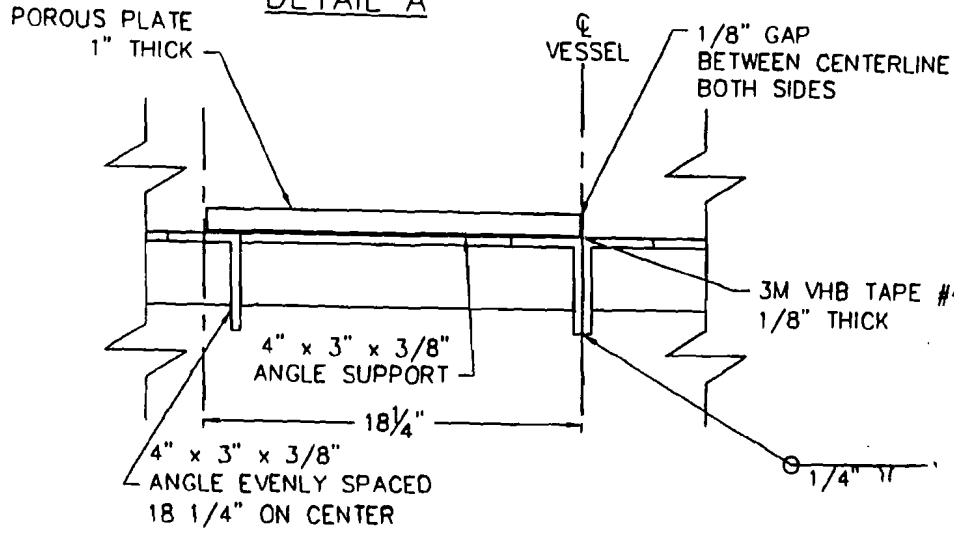
DWG. NO. N04-1003



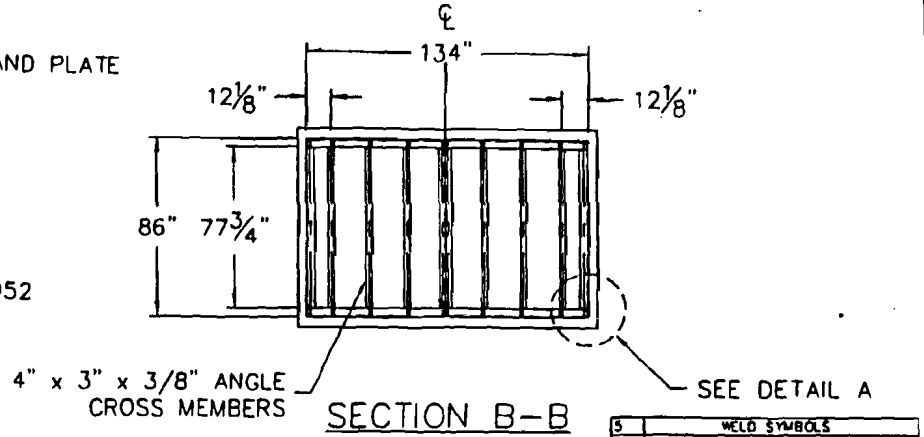
DETAIL A



SECTION A–A



DETAIL B



SECTION B–B

NOTE: INSTALL ANGLE BACK TO BACK
@ ADSORBER CENTERLINE.
INSTALL BALANCE OF ANGLES ON 18 1/4"
CENTERS FROM CENTERLINE OF BOX.
NOTE: ALL INTERIOR ANGLE IS A-36 STEEL

NO.	REVISION
5	WELD SYMBOLS
4	REVISE ANGLE SPECS. TO ORIGINAL
3	REVISE ANGLE SPECS.
2	LOWER BED HEIGHT & INLET HEIGHT
1	REVISE HEIGHT OF BED SUPPORT

PROJECT	ARCADIS OU-2 SOUTH IRM
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-084-JK
DRAWN BY	JG
DESIGN BY	BB
CHKD. BY	BB
DATE	1/13/04
SCALE	NTS

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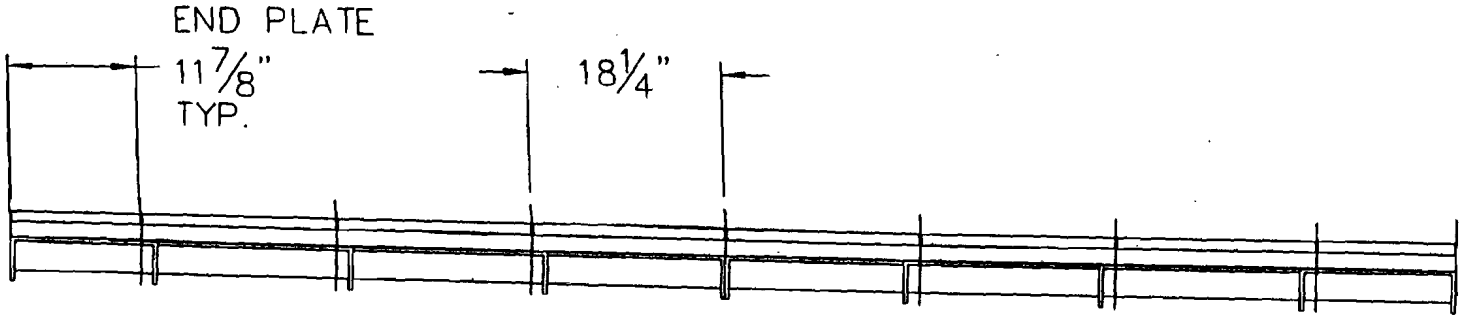
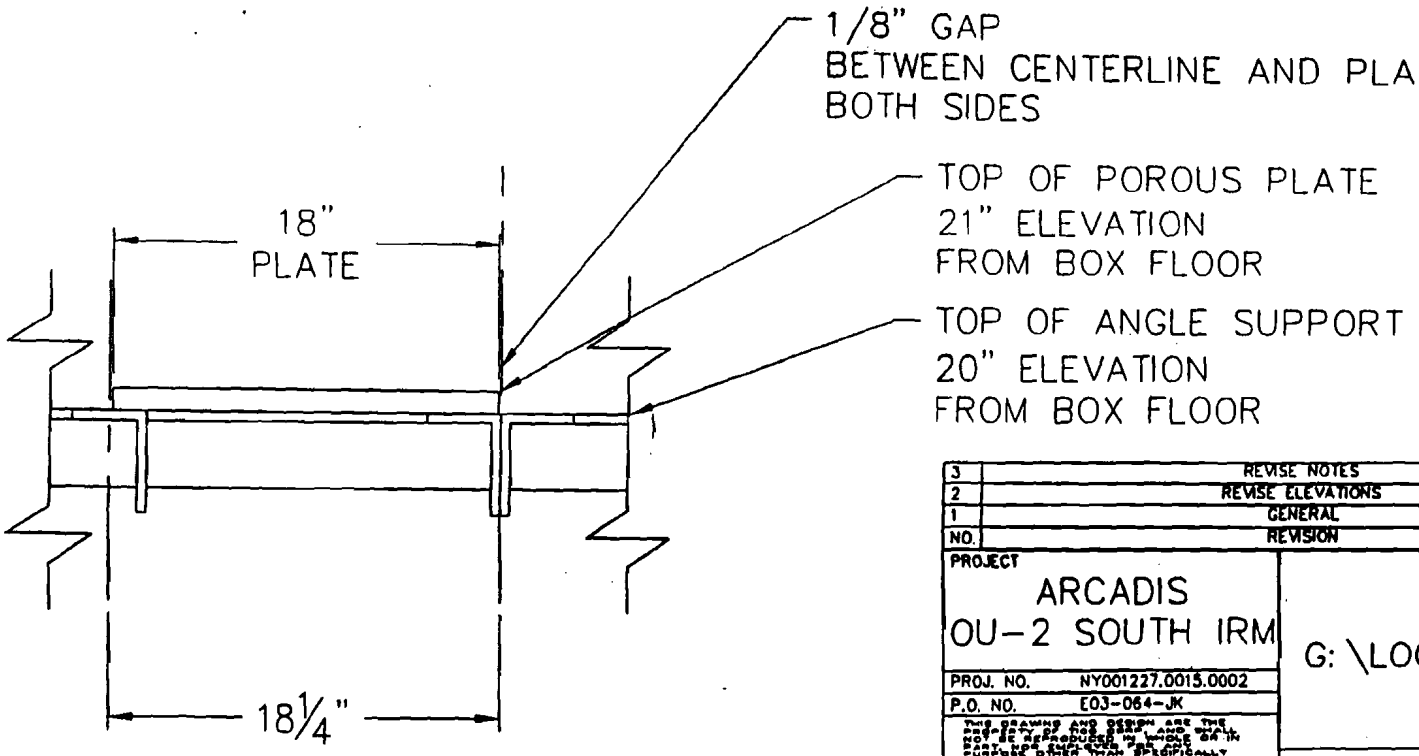
INTERNALS

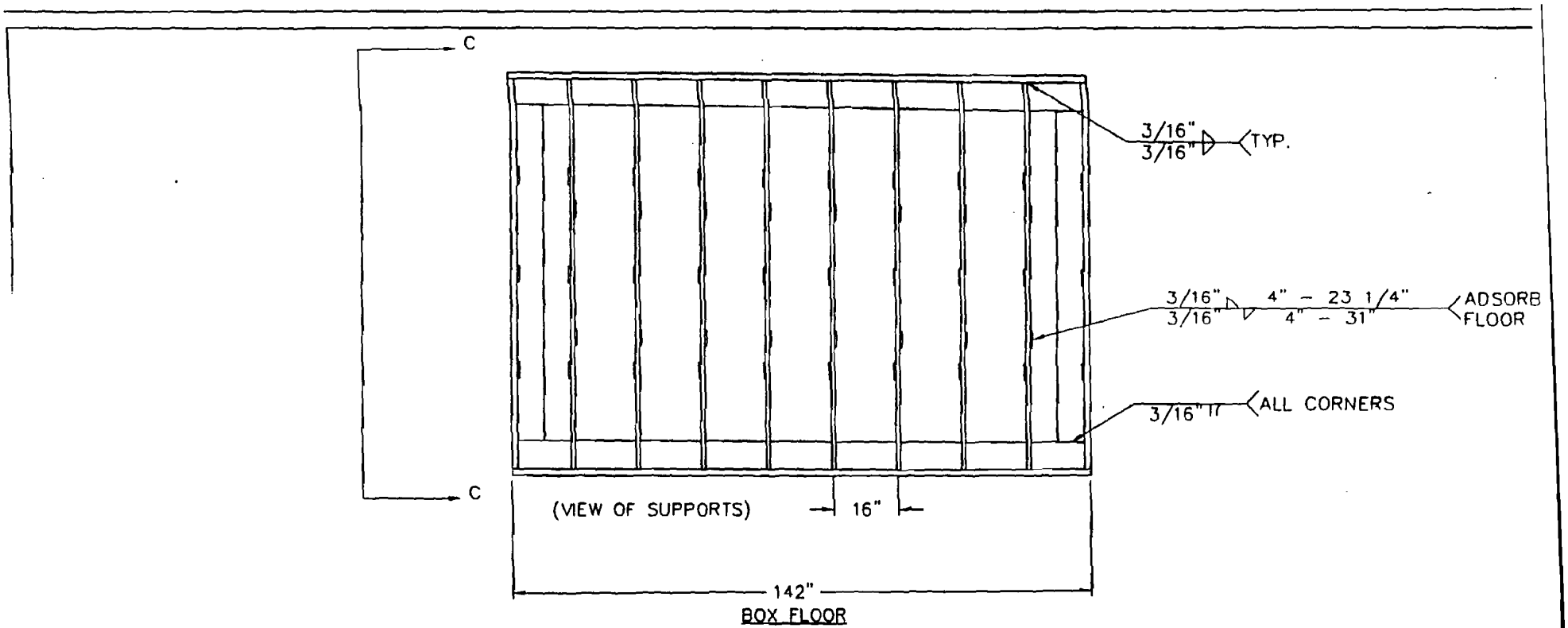
DWG. NO. N04-1004



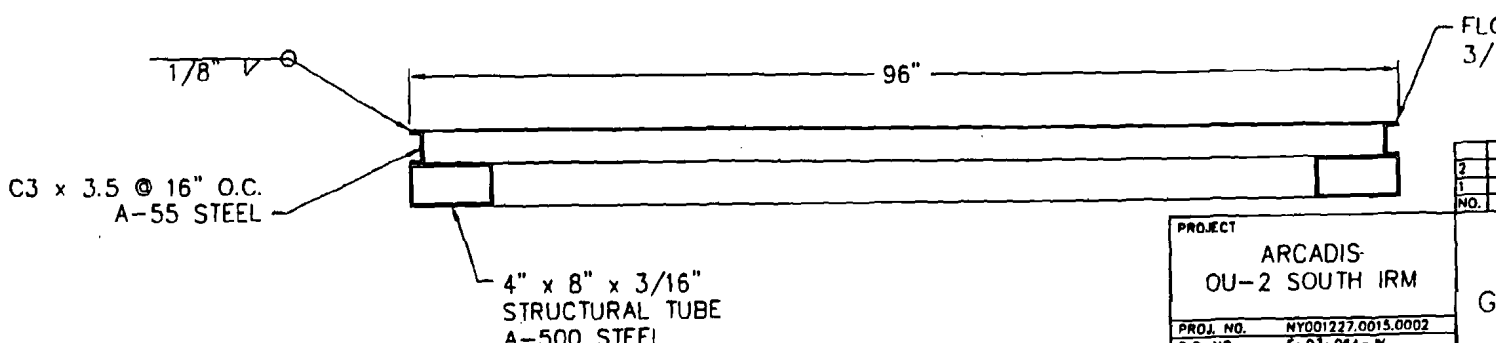


NO.	REVISION	BY
3	REVISE NOTES	JB
2	REVISE ELEVATIONS	JB
1	GENERAL	JB

PROJECT	ARCADIS OU-2 SOUTH IRM
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK
	G:\LOGO\TIGGLOGO.G
DRAWN BY	JB
DESIGN BY	BL
CHKD. BY	BL
DATE	1/12/04
SCALE	NTS
	INTERNAL PLATE DETAIL
DWG. NO.	N04-1005



BOX FLOOR



SECTION C-C

NO.	REVISION
2	WELD SYMBOLS.
1	GENERAL

PROJECT

ARCADIS
OU-2 SOUTH IRM

PROJ. NO.	NY001227.0015.0002
P.O. NO.	E-03-084-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/13/04
SCALE	NTS

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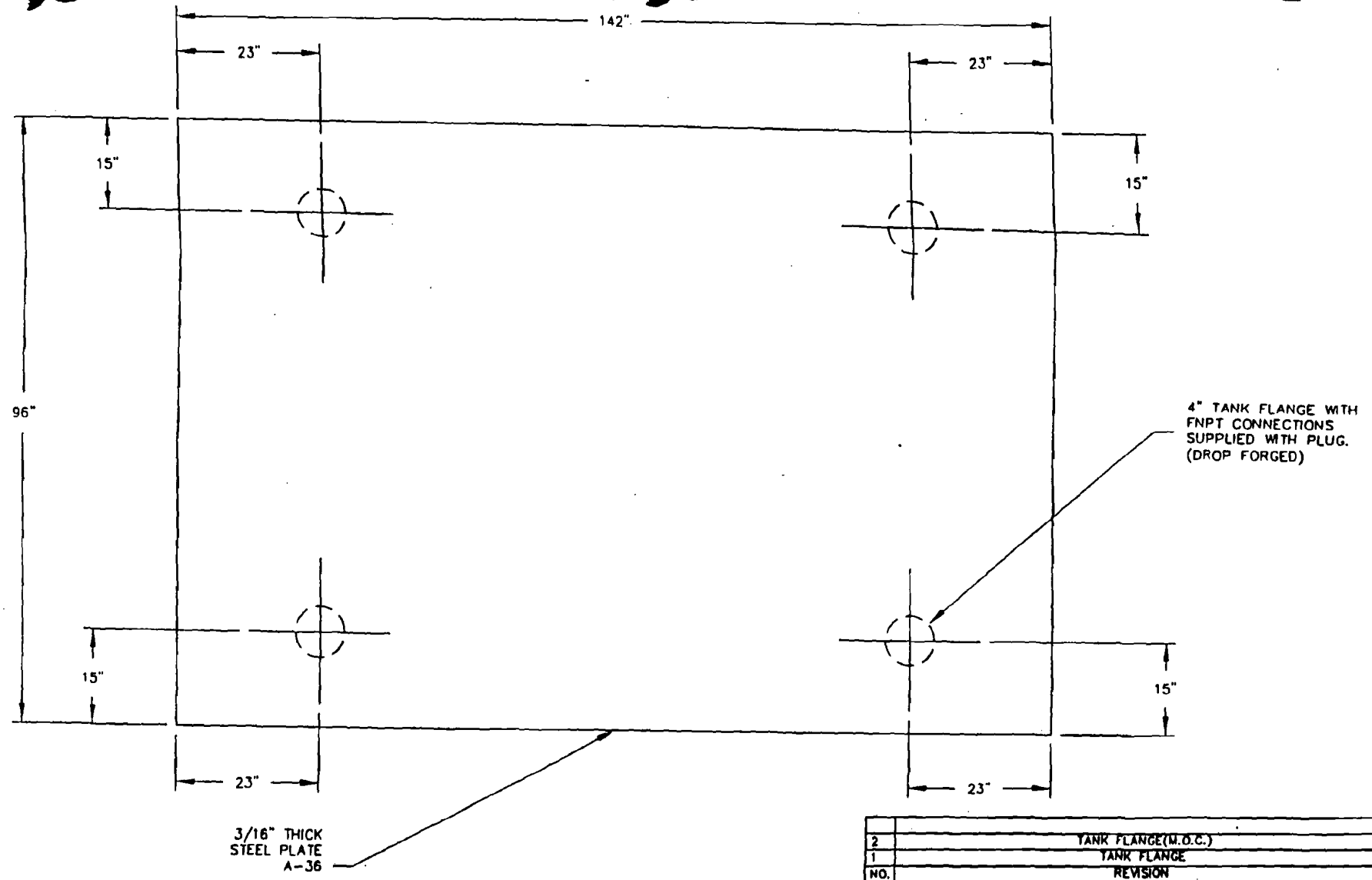
FLOOR DETAI

DWG. NO. N04-1.006



NO.	REVISION	BY	D
2	TANK FLANGE(N.O.C.)	JB	2
1	TANK FLANGE	JB	1

PROJECT

ARCADIS
OU-2 SOUTH IRM

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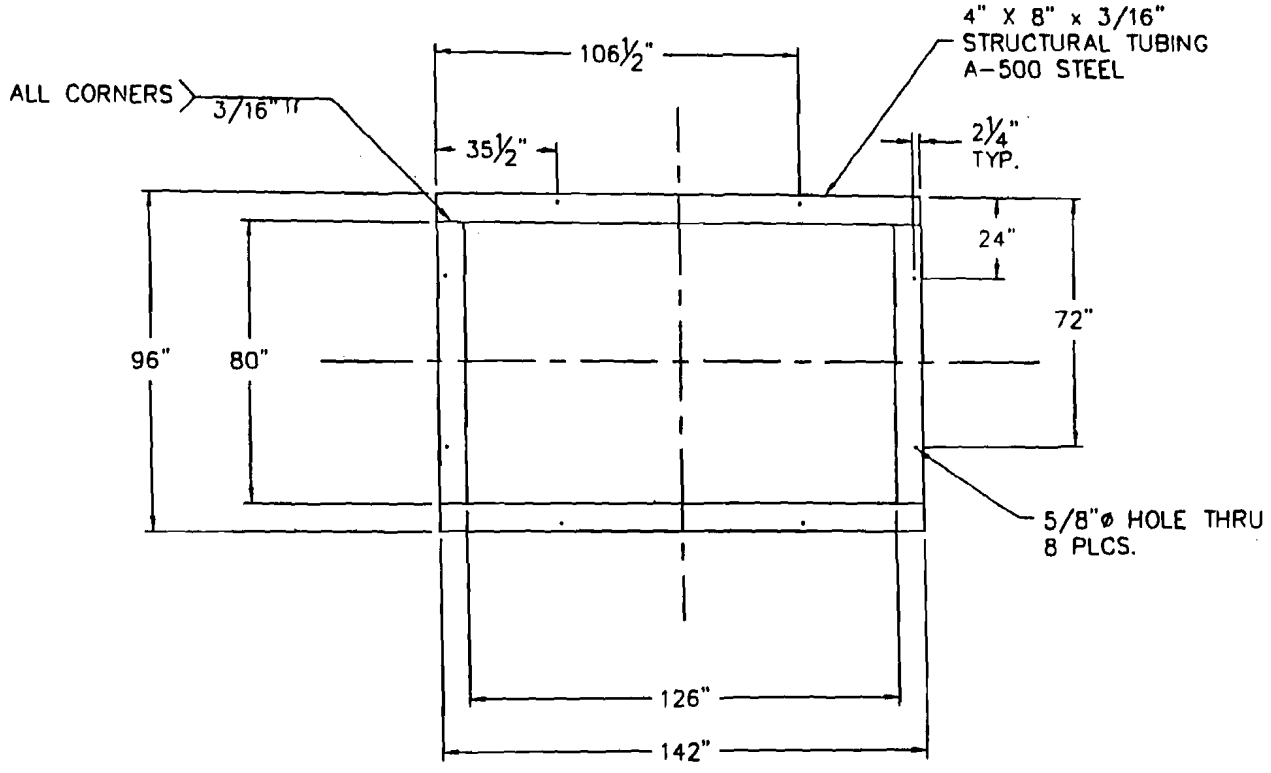
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-084-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/13/04
SCALE	NTS

BLAST MEDIA
DRAIN

DWG. NO.
N04-1007



NO.	REVISION
2	WELD SYMBOL
1	GENERAL

ARCADIS
OU-2 SOUTH IRM

PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/13/04
SCALE	NTS

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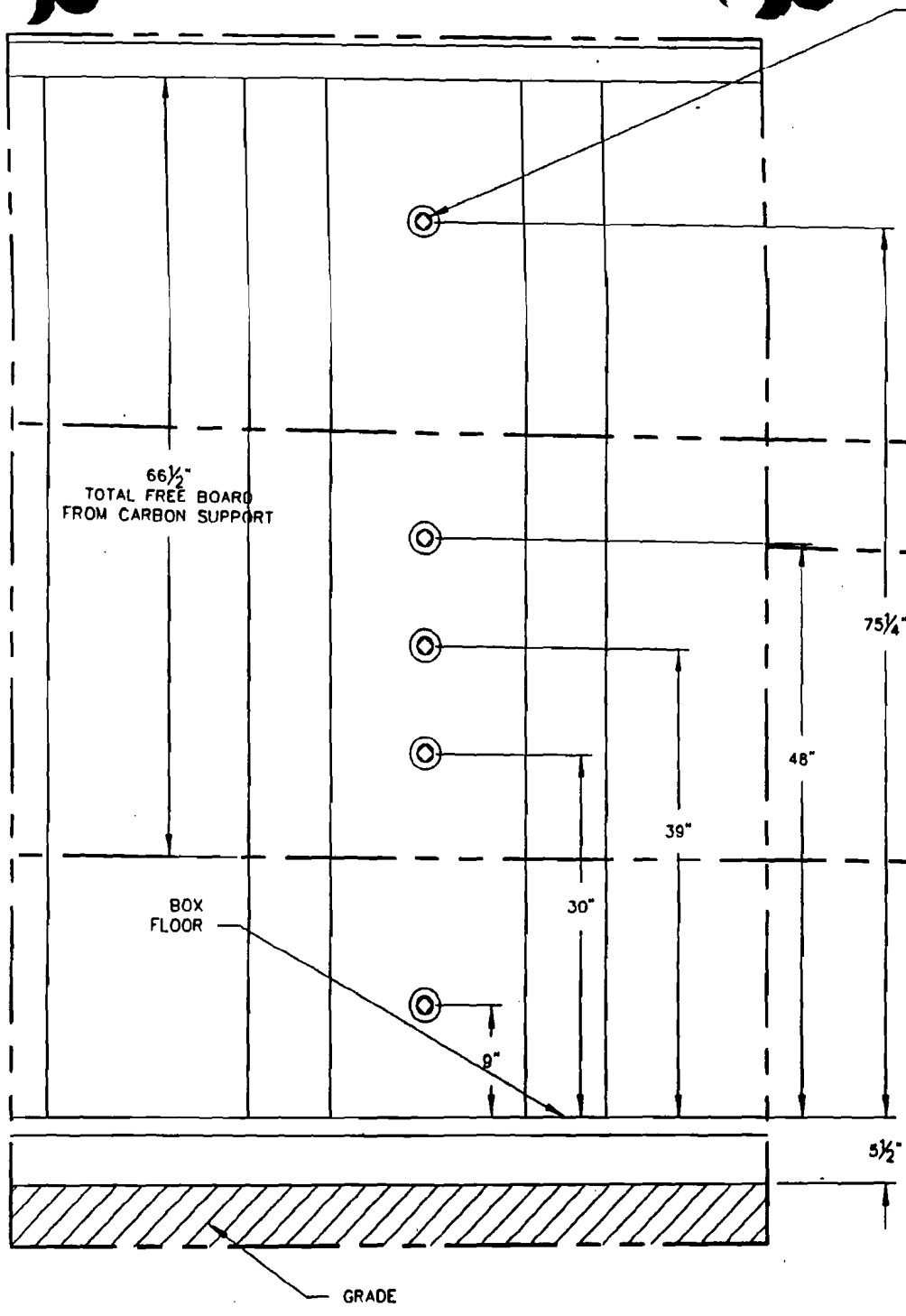
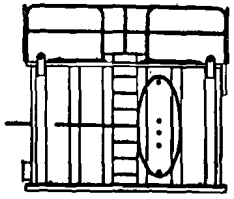
STRUCTURAL
BASE

DWG. NO. N04-1008





NB-8

NO.	REVISION	BY
3	REVISE SAMPLE PORT FROM 3/4" TO 1/2"	JB
2	SAMPLE PORT & CARBON BED ELEVATION	JB
1	REVISE FOR NB-8	JB

PROJECT
ARCADIS
OU-2 SOUTH IRM

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PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/13/04
SCALE	NTS

SAMPLE PORT DETAIL

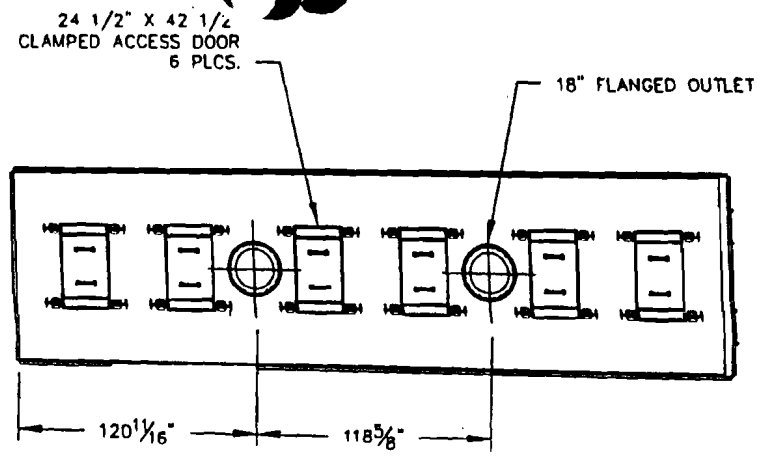
DWG. NO. N04-1019

CONTAMINATED AIR SHALL ENTER UNIT THROUGH THE INLETS AND MUST EXIT USING BOTH OUTLETS.

PROTECTIVE COATING SYSTEM

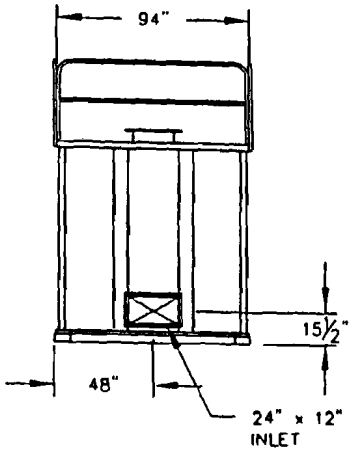
INTERIOR : SHERWIN WILLIAMS DURAPLATE 235(WHITE) DFT 7–14 MILS.

EXTERIOR : ANCHOR HIGH SOLIDS EPOXY #3950 TOP COATED WITH #4900 ANCOTHANE ACRYLIC URETHANE (BLACK)DFT 7–14 MILS.

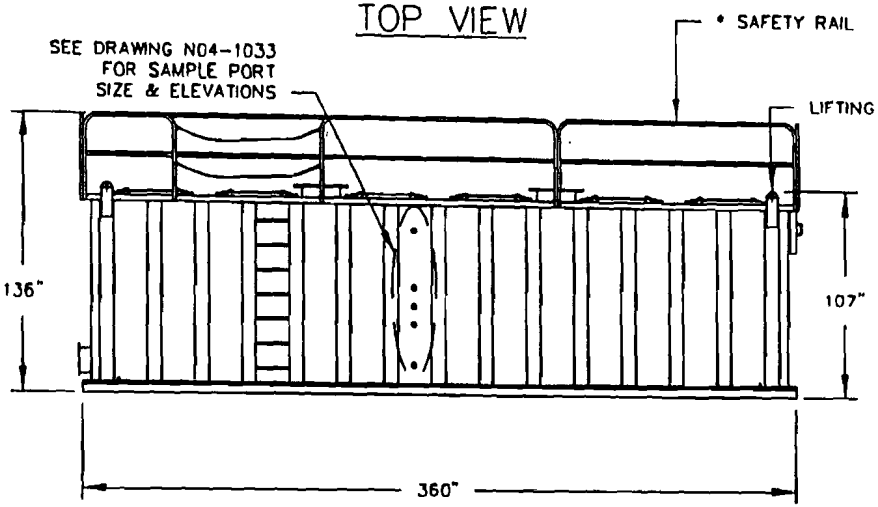


TOP VIEW

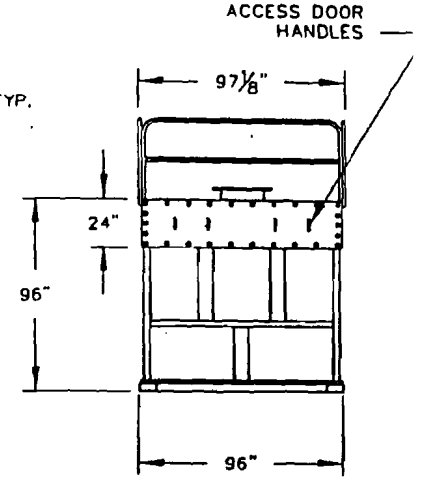
* SAFETY RAIL –
1 1/4"ø A–53 PIPE CONSTRUC
SHERWIN WILLIAMS SAFETY YEL
DURA–PLATE EPOXY 235



LEFT SIDE



FRONT VIEW



RIGHT SIDE

NO.	REVISION	BY
4	REVISE INLET ELEVATION	JB
3	SAFETY RAIL NOTES	JB
2	REVISE HEIGHT OF INLET & CARBON BED	JB
1	REVISE SAMPLE PORTS	JB

VESSEL STANDARDS

VESSEL MATERIALS : CARBON STEEL A-36	BED VOLUME STD/MAX : 640 FT³ / 780 FT³
LINING : HIGH SOLIDS EPOXY	CARBON FILL : 28,000 LBS
EXTERIOR PAINT : HIGH SOLIDS EPOXY	SHIP WT. EMPTY/MAX.FILL : 15,000 LBS/43,000 LBS
WALL THICKNESS : 12 GAUGE STD.	CARBON TYPE : TIGG 5CC 0612 VAPOR PHASE
FLOOR THICKNESS : 3/16" STD.	MAX. OPERATING PRESSURE : 40"H.O
INTERNALS : CARBON STEEL & POLYETHYLENE	MAX. OPERATING TEMP. : 140F
ADSORBENT OUTLET ASSEMBLY : 24" X 42" CLAMPED ACCESS AND 86" X 16" BOLTED DOORS	

PROJECT
ARCADIS
OU–2 SOUTH IRM

G: \LOGO\TIGGLOGO.(

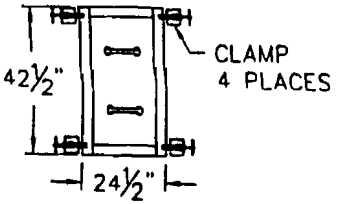
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03–064–JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/12/04
SCALE	NTS

ECU–1,2,3

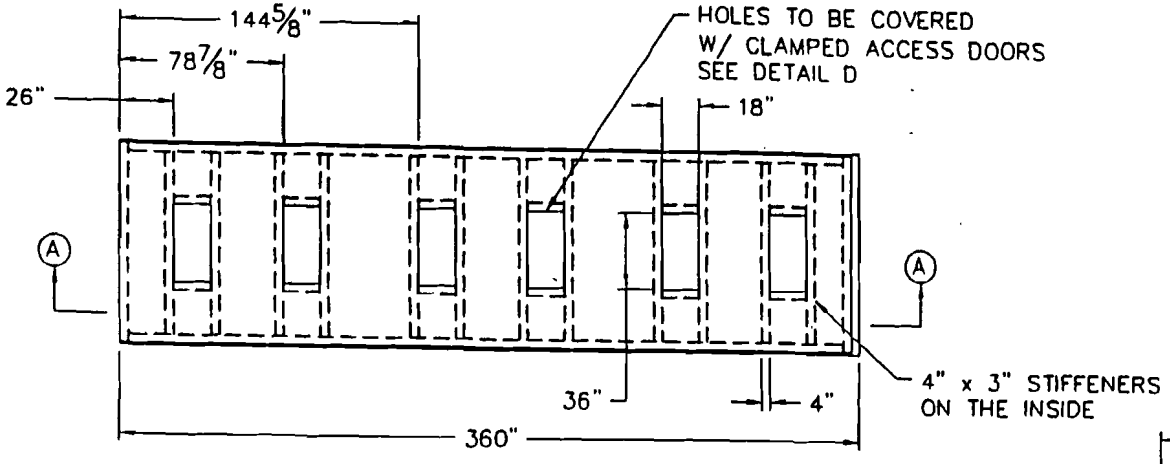
DWG. NO. N04–1009

NOTE: ALL EXTERIOR SUPPORT WELDS TO BE STITCH WELDS

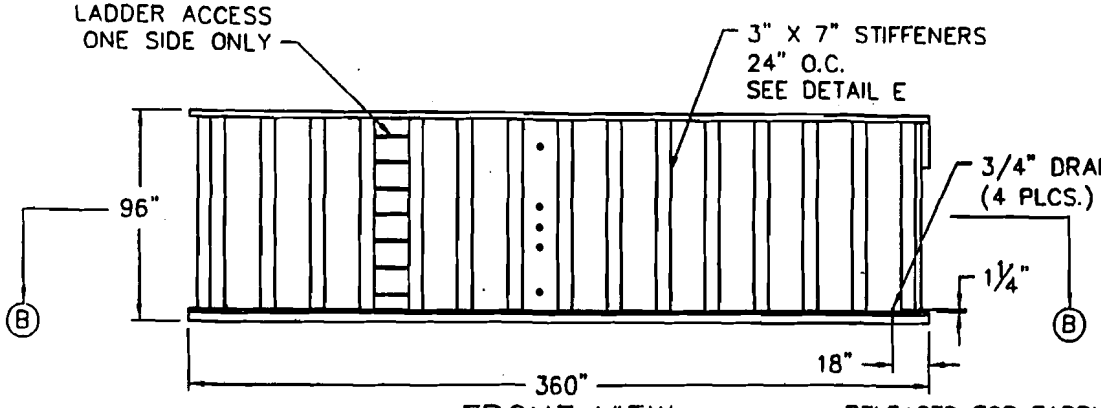
SEE DRAWING N04-1011 FOR SECTION A-A AND SECTION B-B.



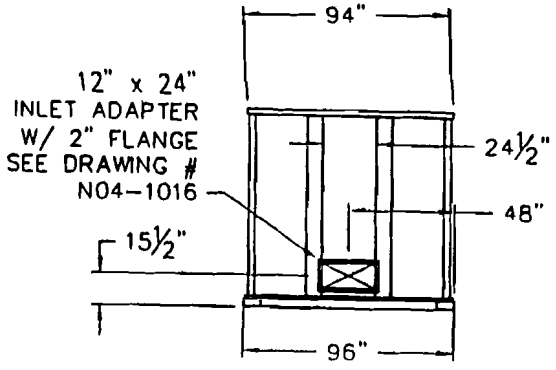
DETAIL D

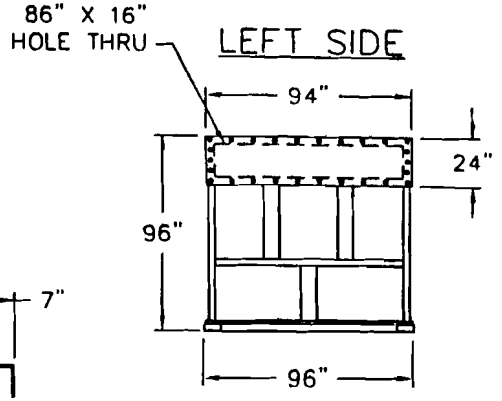


TOP VIEW

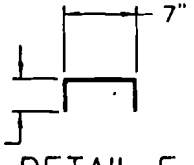


FRONT VIEW





RIGHT SIDE



DETAIL E

SIDE SUPPORT
10 GA.
A-36

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NO.	REVISION
4	REVISE DRAIN FROM 1/2" TO 3/4" & INLET ELEVATION
3	INLET REFERENCE
2	REVISE SAMPLE PORT LOCATION
1	SHOW SAMPLE PORTS

PROJECT
ARCADIS
OU-2 SOUTH IRM

PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/13/04
SCALE	NTS

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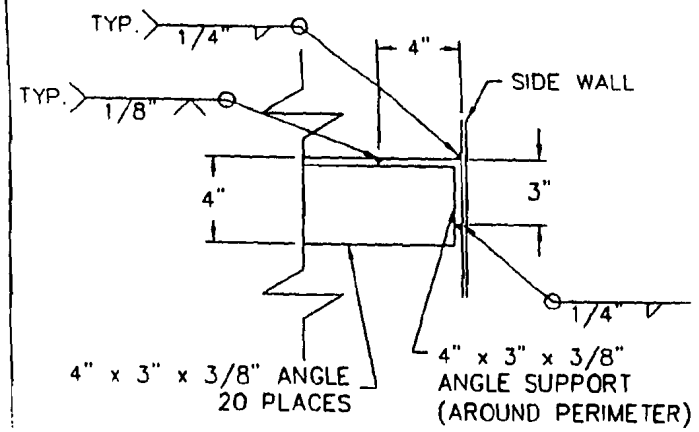
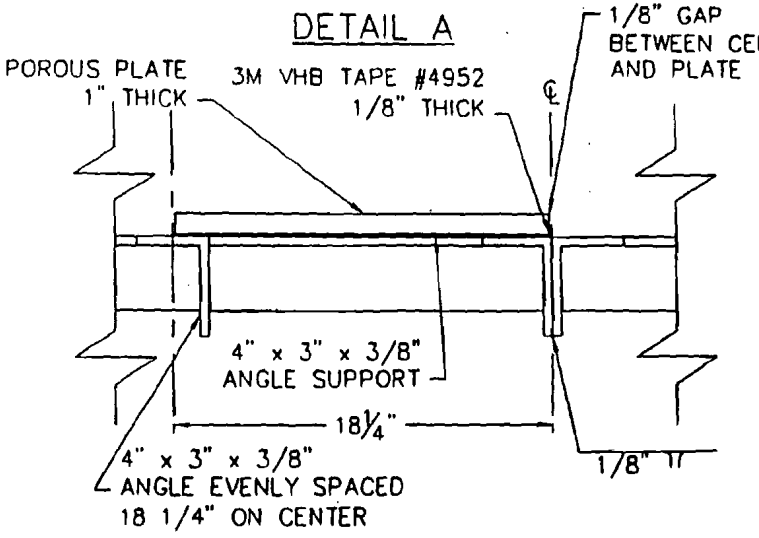
PLAN & ELEVATION

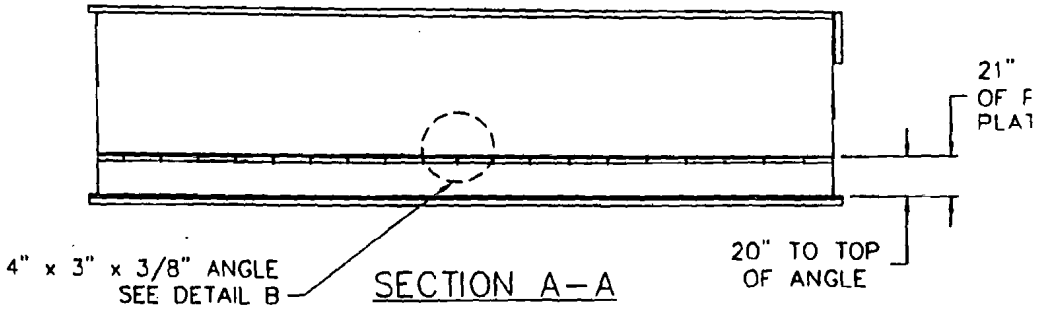
DWG. NO. N04-1010



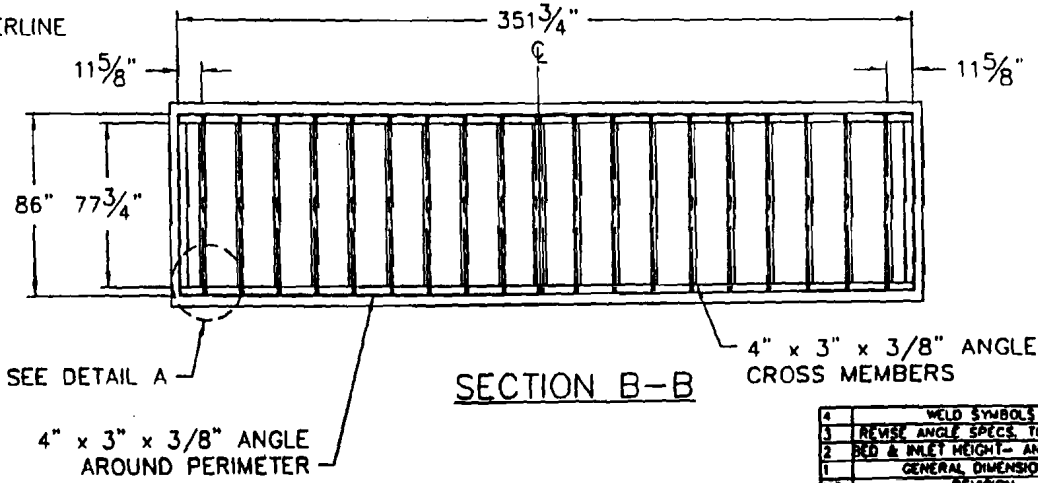
DETAIL A



DETAIL B



SECTION A–A



SECTION B–B

NOTE: INSTALL ANGLE BACK TO BACK
@ ADSORBER CENTERLINE.
INSTALL BALANCE OF ANGLES ON 18 1/4"
CENTERS FROM CENTERLINE OF BOX.
NOTE: ALL INTERIOR ANGLE IS A-36 STEEL

NO.	REVISION
4	WELD SYMBOLS
3	REVISE ANGLE SPECS. TO ORIGINAL
2	BED & INLET HEIGHT- ANGLE SPECS.
1	GENERAL DIMENSIONING

PROJECT	ARCADIS OU-2 SOUTH IRM
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/13/04
SCALE	NTS

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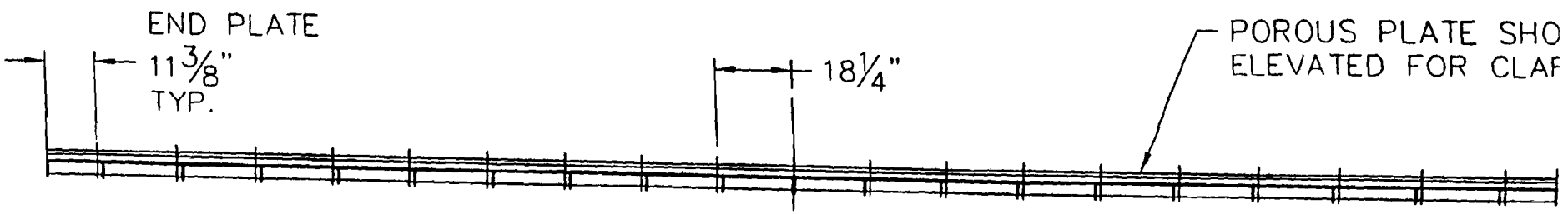
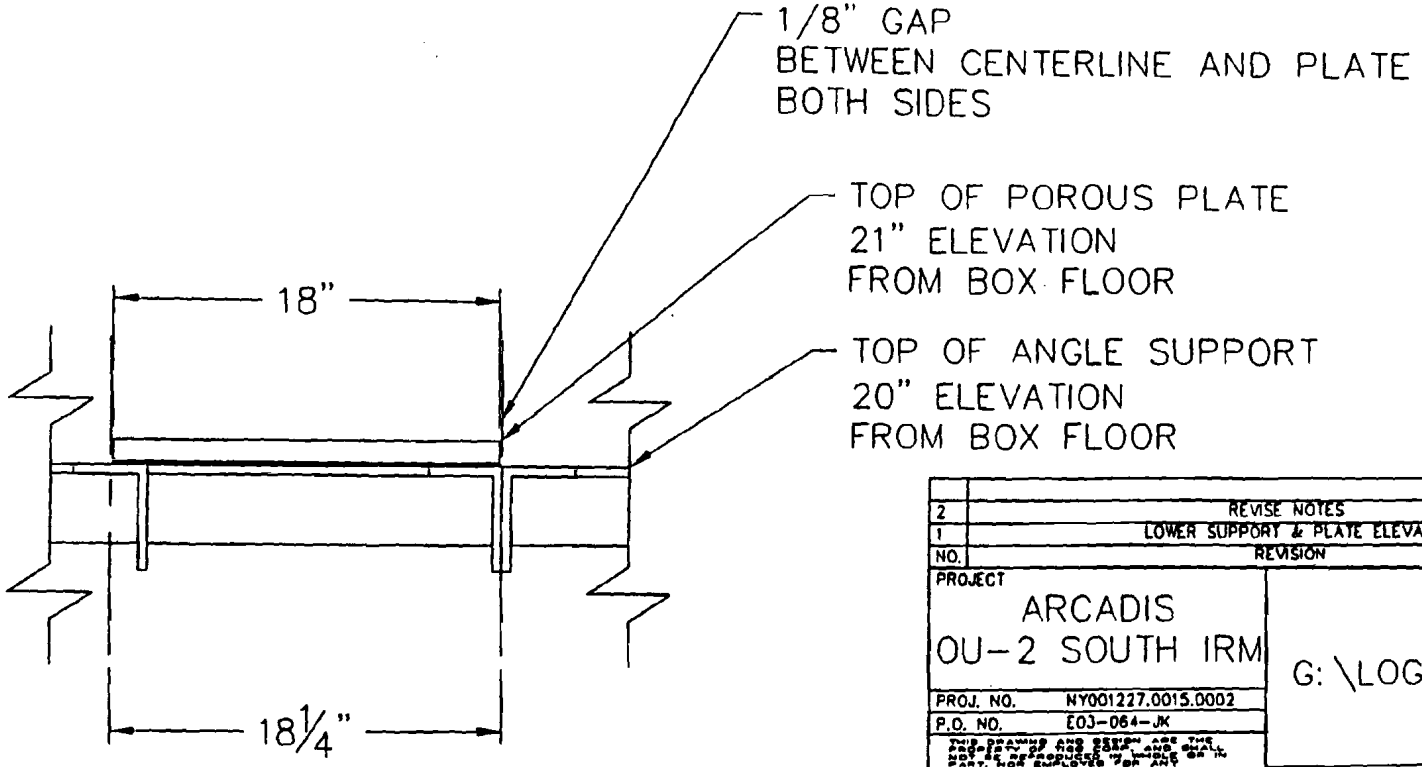
INTERNALS

DWG. NO. N04-1011





NO.	REVISION	BY
2	REVISE NOTES	JB
1	LOWER SUPPORT & PLATE ELEVATIONS	JB

PROJECT	ARCADIS OU-2 SOUTH IRM
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/8/04
SCALE	NTS

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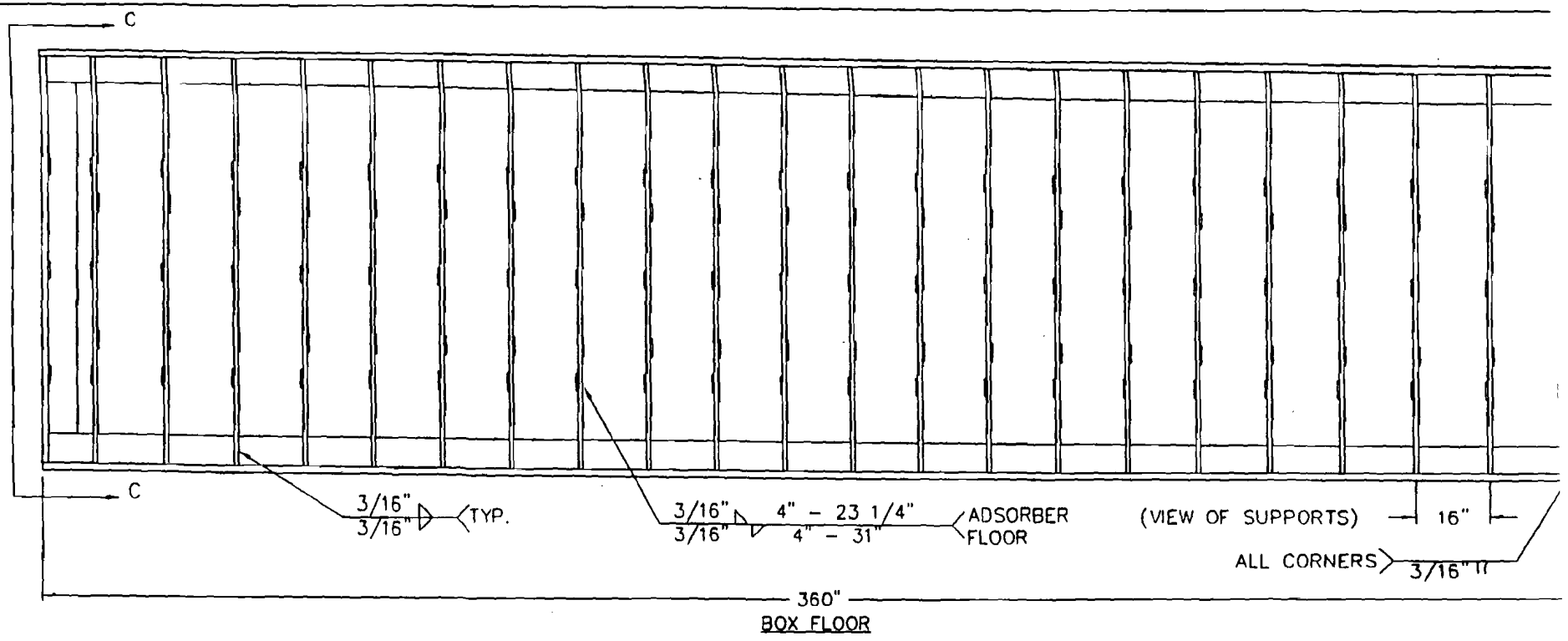
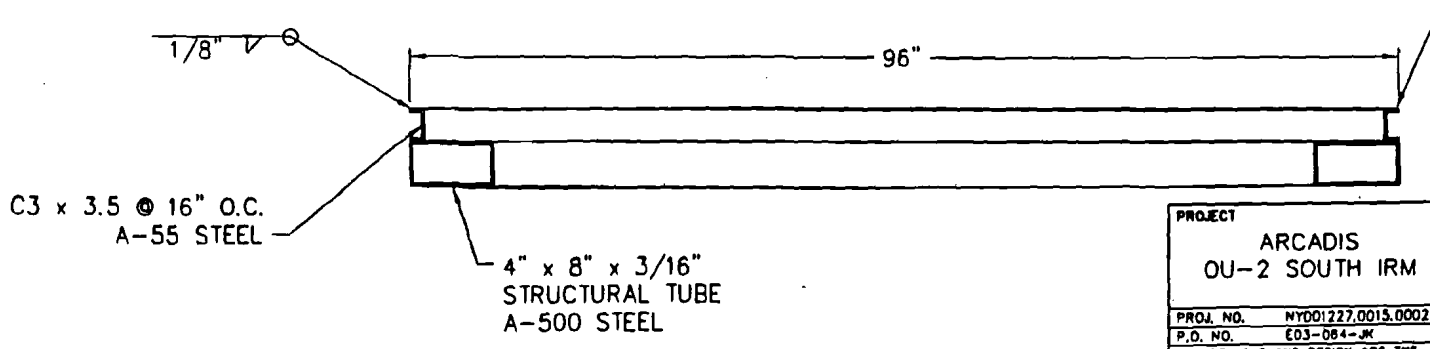
INTERNAL PLATE DETAILS

DWG. NO. N04-1012



BOX FLOOR



SECTION C-C

NO.	REVISION	
2	WELD SYMBOLS	JS
1	GENERAL DIMENSIONING	JK

PROJECT	ARCADIS OU-2 SOUTH IRM
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-084-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/13/04
SCALE	NTS

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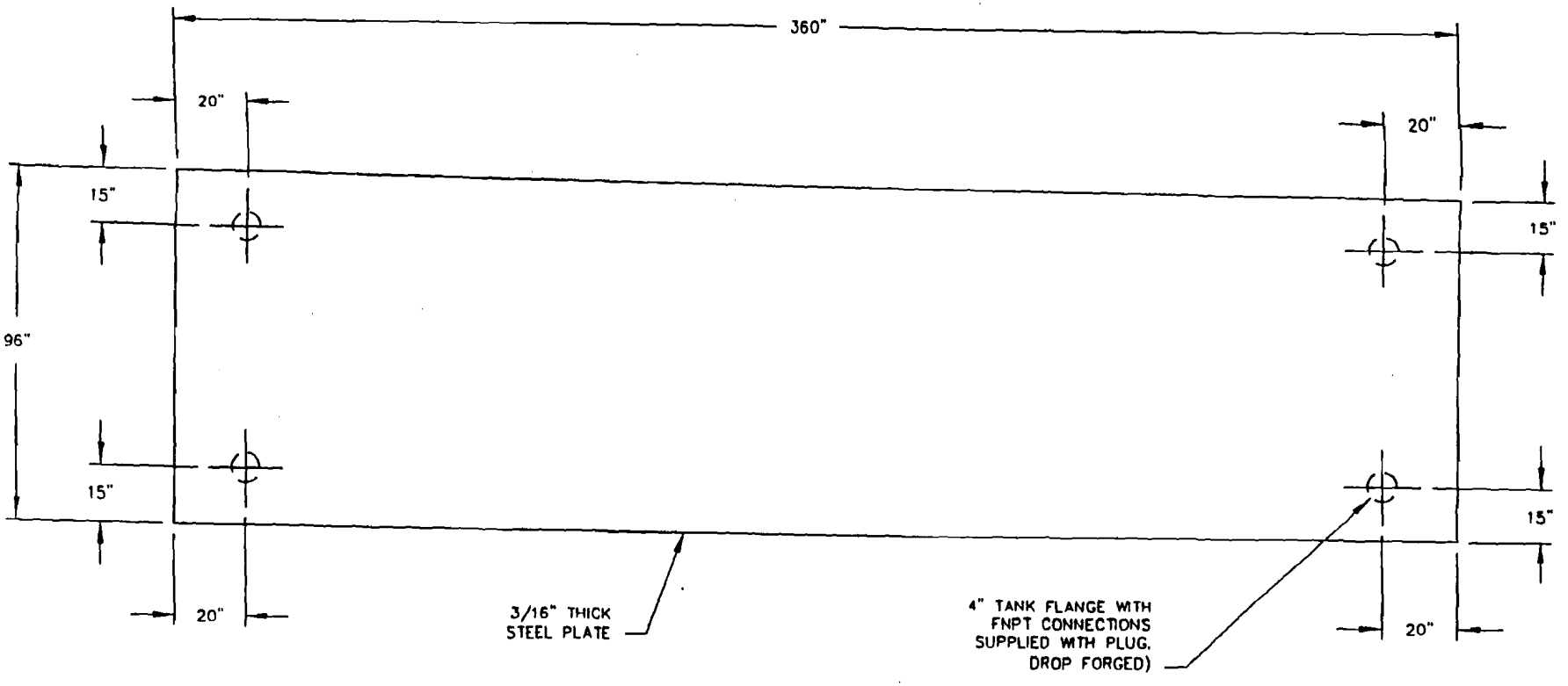
FLOOR DETAILS

DWG. NO. N04-1013



NO.	REVISION	BY	D.
2	TANK FLANGE (M.O.C.)	JB	2
1	TANK FLANGE	JB	1.

PROJECT

ARCADIS
OU-Z SOUTH IRM

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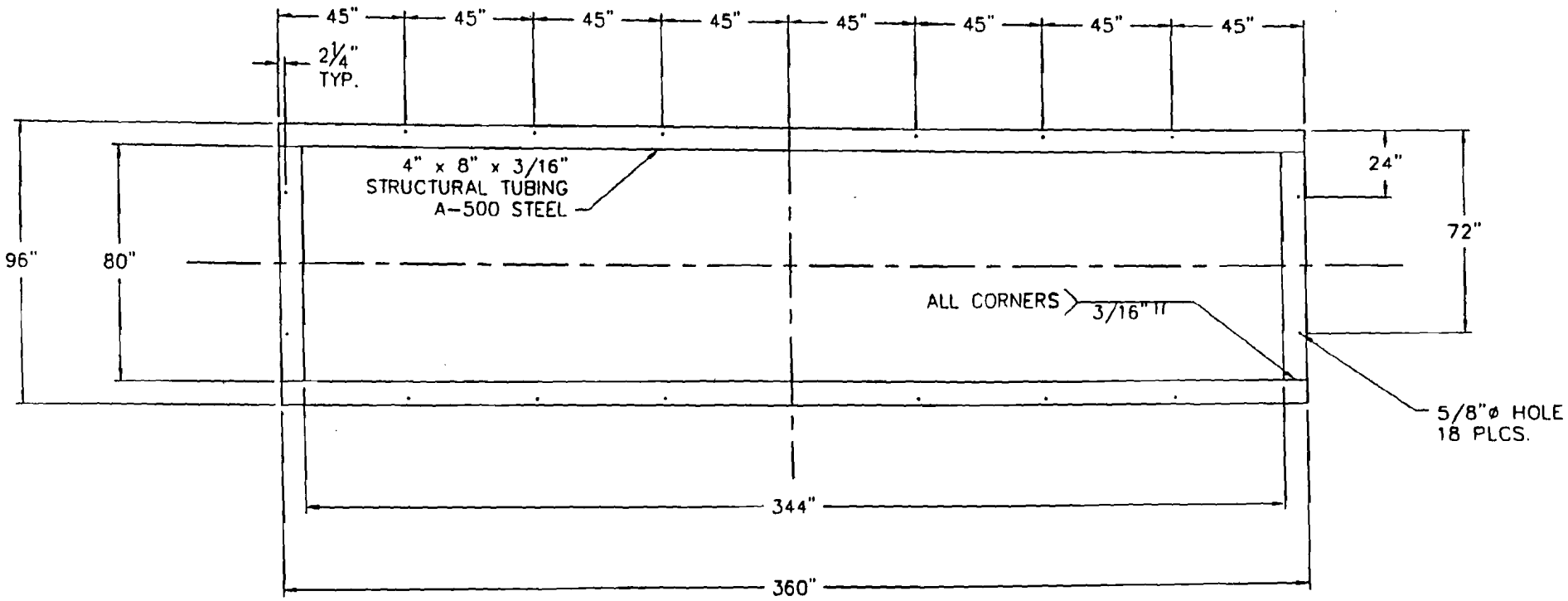
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/13/04
SCALE	NTS

BLAST MEDIA
DRAIN

DWG. NO.
N04-1014



NO.	REVISION
2	WELD SYMBOL
1	GENERAL

ARCADIS
OU-2 SOUTH IRM

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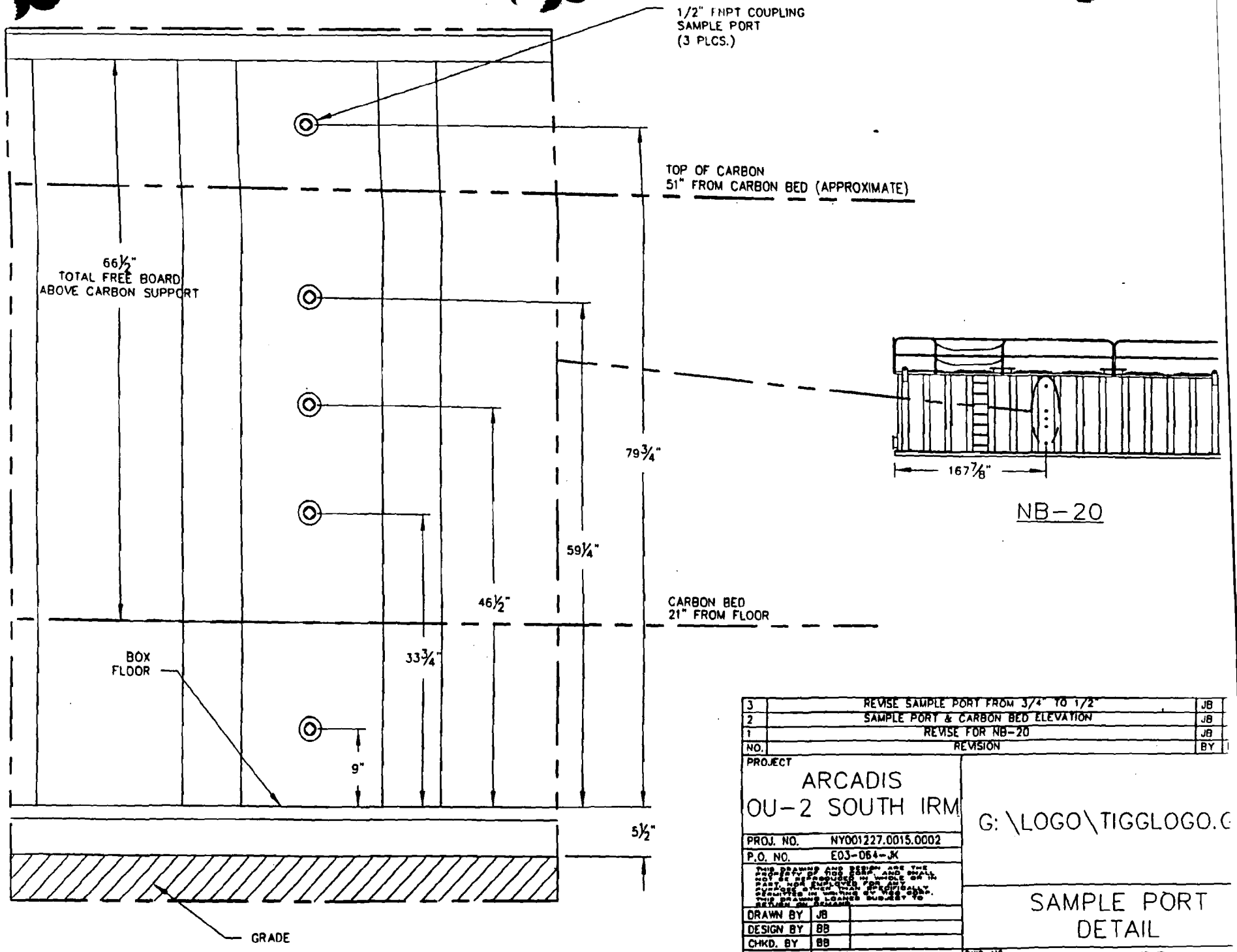
PROJ. NO.	NY001227.0015.0002
P.O. NO.	ED3-084-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	11/14/03
SCALE	NTS

STRUCTURAL BASE

DWG. NO. N04-1015



NB-20

NO.	REVISION	BY
3	REVISE SAMPLE PORT FROM 3/4" TO 1/2"	JB
2	SAMPLE PORT & CARBON BED ELEVATION	JB
1	REVISE FOR NB-20	JB

PROJECT

ARCADIS

OU-2 SOUTH IRM

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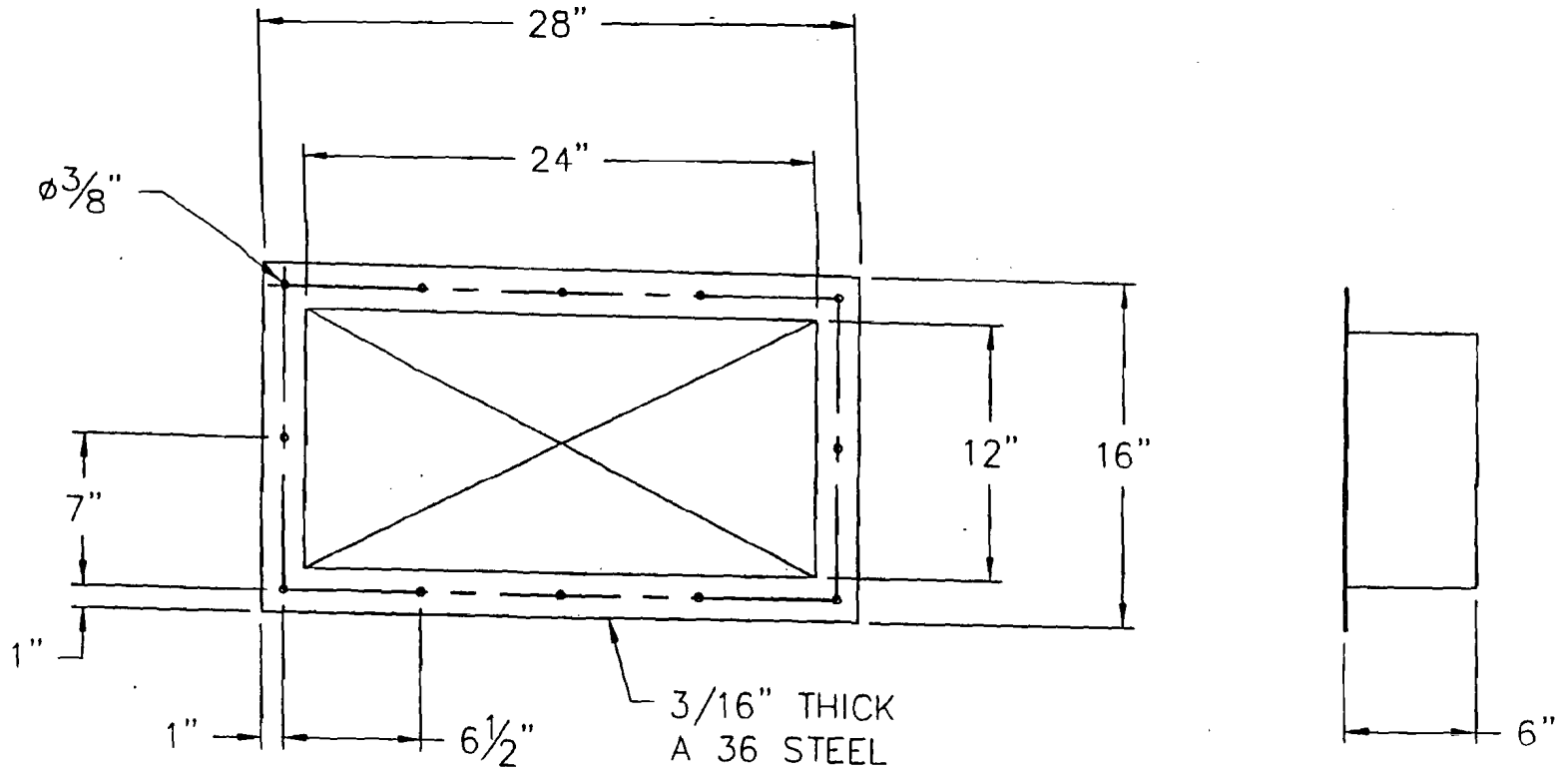
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/13/04
SCALE	NTS

SAMPLE PORT DETAIL

DWG. NO. N04-1033



INLET

NO.	REVISION	BY	D
2	CALL OUT MATERIAL	JB	2
1	HOLE DIA.	JB	2

PROJECT
ARCADIS
OU-2 SOUTH IRM

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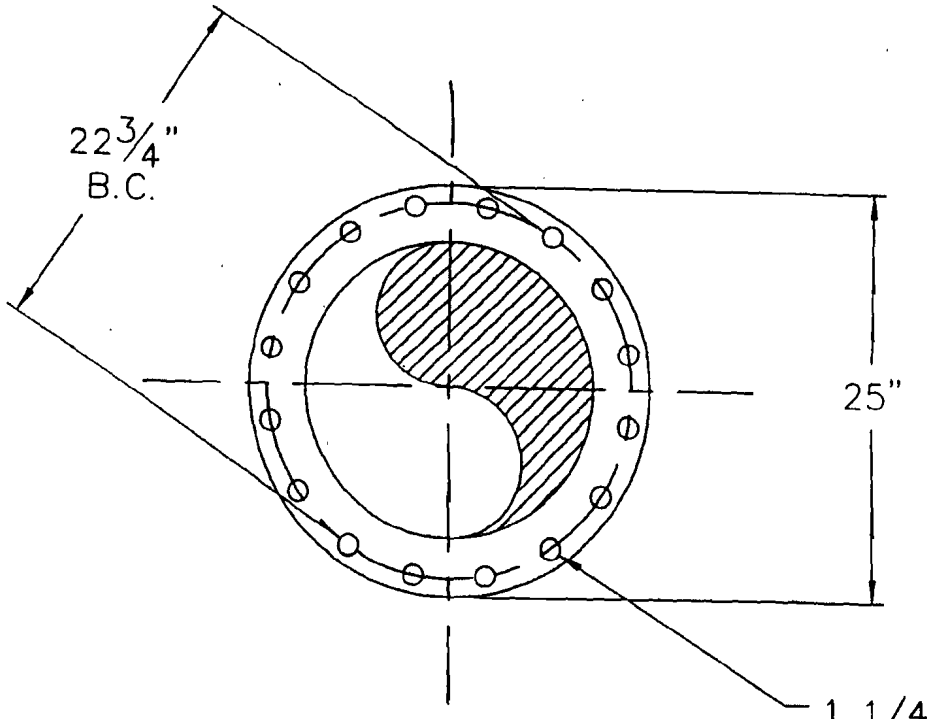
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK

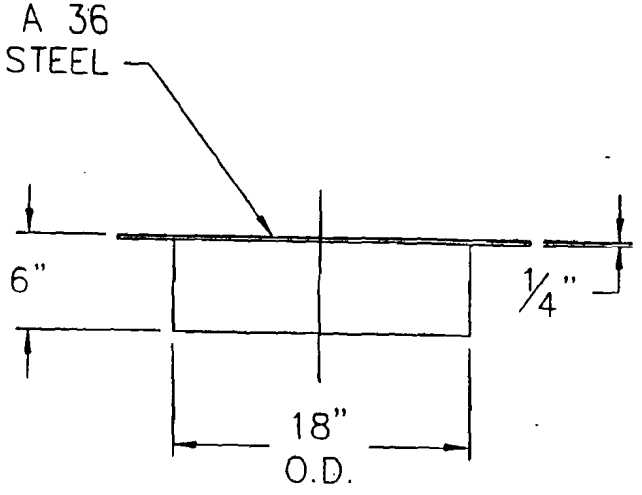
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	12/17/03
SCALE	NTS

INLET
FLANGE

DWG. NO.
N04-1016



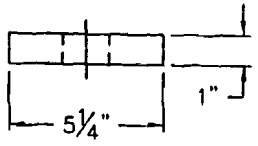
TOP VIEW



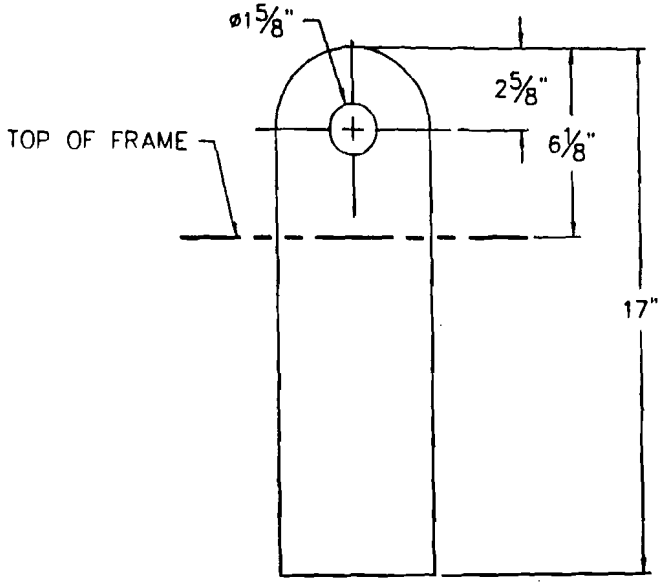
ELEVATION

NO.	REVISION	BY	D

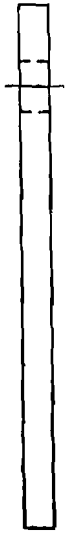
PROJECT	ARCADIS OU-2 SOUTH IRM
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-084-JK
	G:\LOGO\TIGGLOGO.G
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	12/17/03
SCALE	NTS
	OUTLET FLANGE
DWG. NO.	N04-1017



TOP



FRONT



SIDE

NO.	REVISION	BY

PROJECT	ARCADIS OU-2 SOUTH IRM
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/12/04
SCALE	NTS

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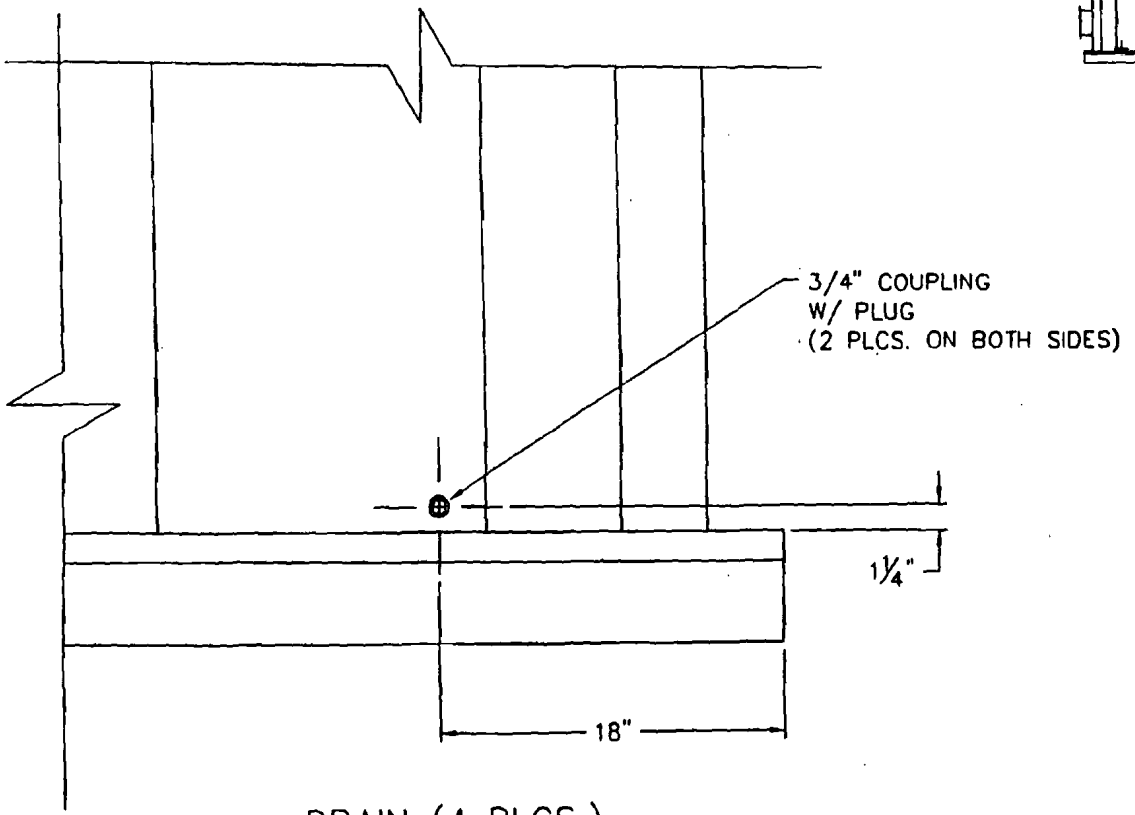
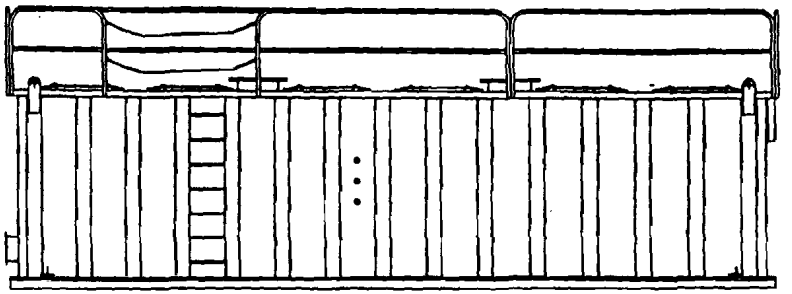
LIFTING LUG DETAIL

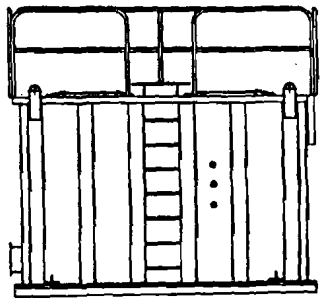
DWG. NO. N04-1018



DRAIN (4 PLCS.)



NB-20



NB-8

NO.	REVISION	
1	REVISE DRAIN FROM 1/2" TO 3/4"	JB

PROJECT	ARCADIS OU-2 SOUTH IRM
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/13/04
SCALE	NTS

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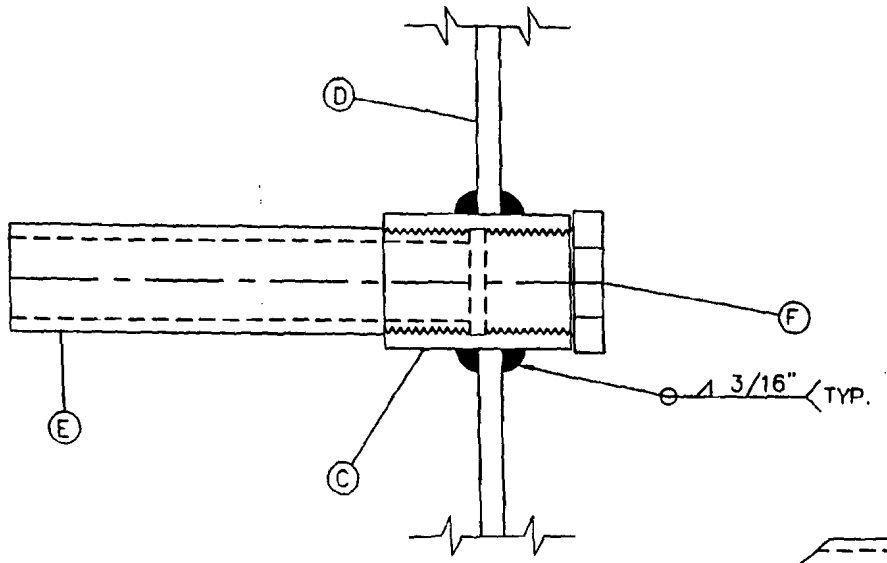
DRAIN DETAILS

DWG. NO. N04-1020

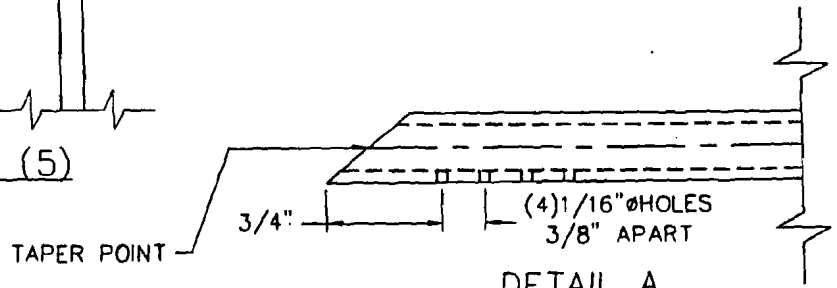
PARTS LIST

	PART	DESCRIPTION
	SAMPLE PROBE	
A	1/8" C.S. SCH. 40 PIPE	8 1/2" LONG (T.O.E.) W/ TAPERED END AND SAMPI
B	1/2" C.S. PLUG THREADED	HOLE THRU AT 7/16" DIA. FOR SAMPLE PROBE
	SAMPLE PORT	
C	1/2" C.S. COUPLING	MERCHANT COUPLING
D	VESSEL SHELL	3/16" THICK CARBON STEEL
E	1/2" C.S. SCH. 40 PIPE	3" LONG (T.O.E.)
F	1/2" C.S. PLUG THREADED	FOR SAMPLE PORTS

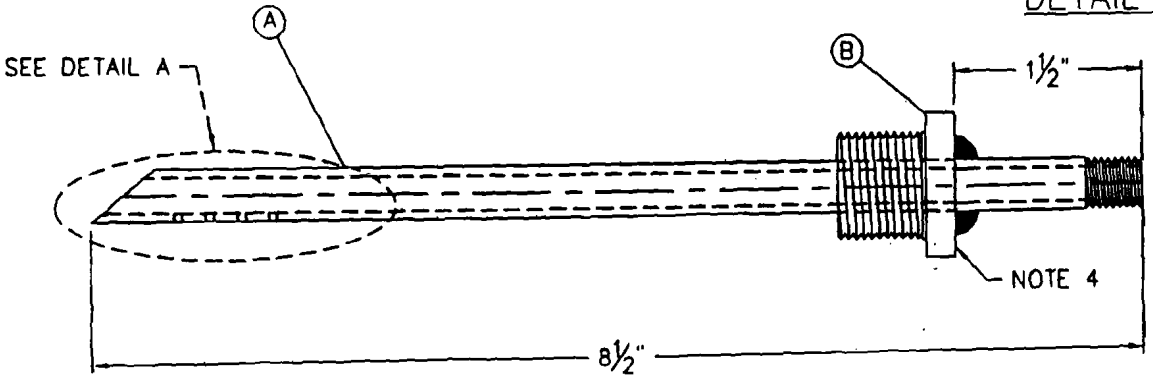
NOTES:
1. DRILL PLUG FOR PROBE, TUBE AND SEAL WELD.
2. FIVE SAMPLE PORTS REQU PER VESSEL, FURNISH (2) PI FOR EACH VESSEL.
3. THREE SAMPLE PROBE RE PER VESSEL.
4. STAMP INDICATOR LINE ON FOR HOLE ALIGNMENT.



SAMPLE PORT X (5)



DETAIL A



SAMPLE PROBE X (3)

NO.	REVISION
1	REVISE PROBE & PLUG QUANTITIES

ARCADIS
OU-2 SOUTH IRM

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PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-084-JK
DRAWN BY	JB
DESIGN BY	GFK
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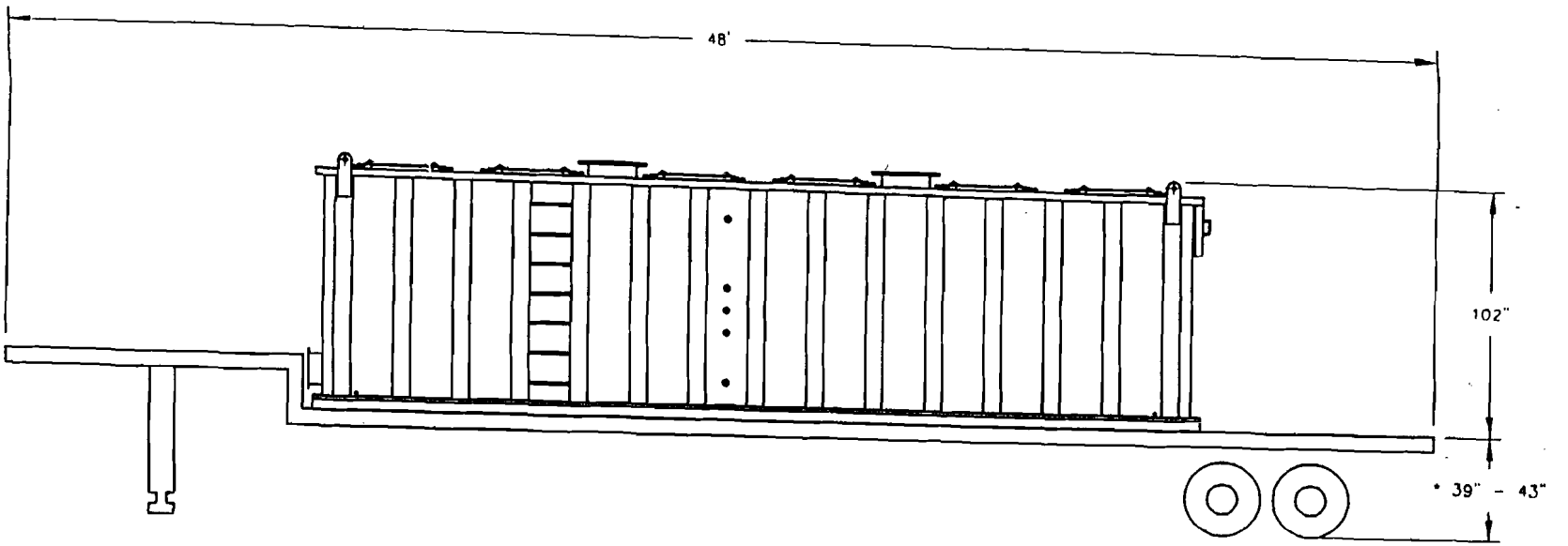
DATE	9/12/02
SCALE	NTS

VESSEL SAMPLE PO

DWG. NO. N04-1036



* TRAILER DECK HEIGHT WILL VARY FROM TRUCK TO TRUCK.

NO.	REVISION	BY	DATE

PROJECT
ARCADIS
OU-2 SOUTH IRM

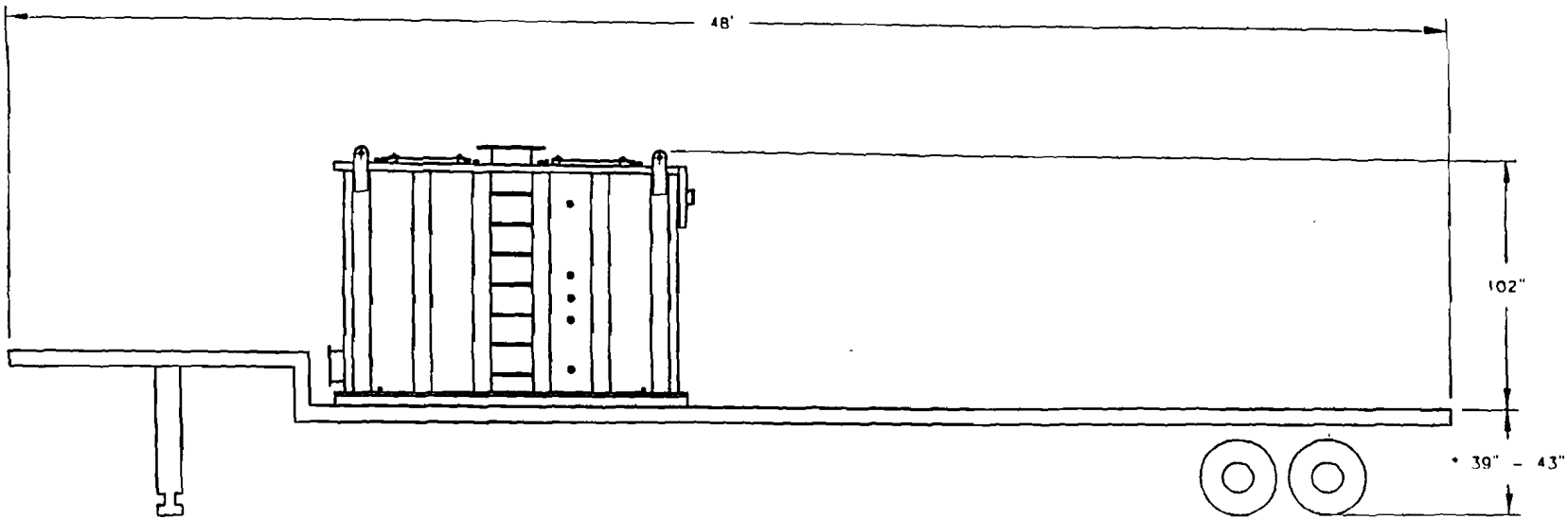
PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK

DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/12/04
SCALE	NTS

TIGG corporation

TRUCK HEIGHT

DWG. NO. N04-1039



NO.	REVISION	BY	DATE

PROJECT
ARCADIS
OU-2 SOUTH IRM

PROJ. NO.	NY001227.0015.0002
P.O. NO.	E03-064-JK
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	1/12/04
SCALE	NTS

TIGG corporation

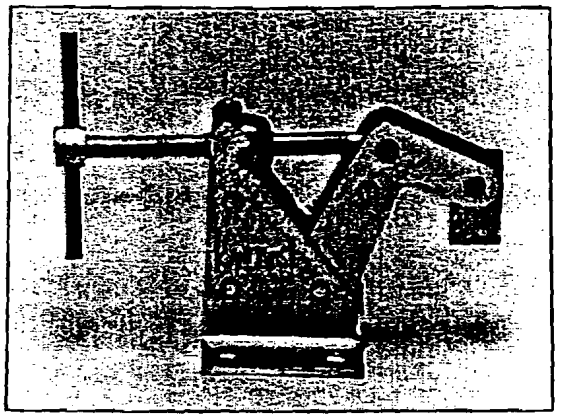
TRUCK
HEIGHT

DWG. NO. N04-1040

REV

* TRAILER DECK HEIGHT WILL VARY FROM TRUCK TO TRUCK.

NB-20 Access Door Hold down Clamps



QUICK ACTING HOLD DOWN CLAMPS

Best for drill presses and shop machines of every type.
For holding where thickness and surface are not exact from part to part.
Uses: Drill Press/Assembly
Molds/Furniture/Planners/Vertical Turrets/
Mills/Woodworking/Plastic Tooling/Fixtures of all types.

Quick Acting Clamps	
P/N	Size
411	3" F
411-2	3" FT
423	6" F
423-1	6" FT

Deep Throat Jaw Opening Clamps | 3-Jaw Clamp
Universal No-Mar Clamps | Poly Jaw No-Mar Clamps
Quick Acting Hold Down Clamps | Round Handle Clamps
Stainless Steel Clamps | Standard "T" Handle Clamps

Return to Kant-Twist Top Page

ANCHORED FOR WEAR

Ancothane Acrylic Urethane
#4900 Series

<<Back to Data Sheets

Product Profile:

General Description:

A low V.O.C. Acrylic Urethane finish (two component) providing very high gloss with excellent physical properties such as abrasion and chemical resistance, flexibility and weatherability.

Common Usage:

This product is targeted for applications such as bridges, storage tank exteriors, farm and shop equipment, and heavy machinery.

Color: White, Clear and to meet standard

Finish: High Gloss

Activator Required: Anchor #4906 Activator

Coating Systems:

Primer Coats:

Primer will be determined by service environment and job specifications. Consult your Anchor representative for specific job recommendations.

Surface Preparation:

New Work: For best performance on steel, the surface should be blasted to SSPC-SP6 or SSPC-SP10, including the removal of all mill scale. Prior to blasting, remove all flux and scab from welding and grind smooth all rough weld seams and sharp edges. Remove any grease, oil, or dirt with solvent (SSPC-SP1) or chemical cleaner before blasting. The surface should be coated within 24 hours after blasting. Apply over properly primed surface as detailed by applicable specifications.
Old Work: Substrate must be clean, dry and thoroughly degreased in accordance with SSPC-SP1 standards. All damaged areas should be repaired and existing paint should be in good condition. This coating may be applied over most old coatings in sound condition. Check the existing paint by applying on a trial patch and observe overnight for lifting, softening, or wrinkling. If this occurs, the existing paint must be removed or a compatible barrier primer must be applied first. Glossy surfaces should be sanded or brush blasted for best performance.

Technical Data:

...ness, application method and service equipment)

Drying Time:

Temperature	To Touch	To Recoat	Full Cure
75 F / 55% R.H.	4 hours	8 hours	7 Days
			(Accelerator Available, CC-150 - 4oz./ gal)

Architectural and Industrial Maintenance Category: Industrial Maintenance Coatings

Maximum Allowable V.O.C.: 3.8 lbs./gal. (450 g/l)

Actual V.O.C.: 2.9 lbs./gal. (348 g/l) when mixed with activator -varies by color

Theoretical Coverage:
915 sq. ft./ gallon @ 1 mil dry, assuming no application losses. Coverage will vary depending on the color, application technique, porosity and design of the substrate.

Packaging: A 1 gallon kit consisting of a 1 gallon container of urethane partially filled to accommodate a 1quart container of activator. When mixed, it yields 1 gallon. The 5 gallon kit consists of a 5 gallon container of urethane, partially filled to accommodate a 1 gallon container of activator. When mixed, it yields 5 gallons.

Storage Temperature:
Minimum 20 F Maximum 110F

Chemical Resistance:

Alkalis:	Excellent
Acids:	Very Good
Water:	Excellent
Solvents:	Excellent
Salt:	Excellent
Immersion:	Not recommended

Heat Resistance: 350 F Intermittent, 250 F Continuous (Dry)

Health & Safety:
Refer to the front of this manual, the product label itself, and your Anchor representative concerning a Material Safety Data Sheet for complete information on this product.

Mix Ratio: Four parts Urethane to one part #4906 Activator.

Pot Life: 2 Hours @ 77 F (Keep cool and agitated)

Application:

Coverage Rates Per Coat:

	Dry Mils	Wet Mils	Sq.Ft./Gal.
Suggested:	1.5	2.6	610
Minimum:	1.0	1.8	915
Maximum:	2.0	3.5	457

Minimum 50 F

The surface should be dry and the relative humidity should be no greater than 60%

Application Equipment:

Airless Spray

Pressure:	1200-2200 psi
Tip:	.011"-.015"

Conventional Spray

Air Pressure:	60-80 psi
Fluid Pressure:	10-20 psi
	Use pressure pot with dual regulators,.
Air Hose:	3/8 I.D. hose
Spray Gun:	Use a .070" tip, appropriate air cap and oil/water seperator.

Brush: High Quality Pure China Bristle.

Roller: Short nap mohair roller with Phenolic Core.

Cleanup: Use Anchor #T-3M MIBK solvent.

Application Considerations:
This product is moisture sensitive. Do not apply when the surface temperature is within 10 F of the dew point or when freeze, rain, or dew is forecast within 72 hours. Apply first coat as a mist or tack coat prior to subsequent finish coats as specified by job requirements.

Limited Warranty:
The technical data on this label or on other data is true and accurate to the best of our knowledge. We guarantee our products to conform to ANCHOR PAINT MFG. CO. quality control standards. Due to misuse in handling, storage, application and workmanship or variables such as weather or surface integrity that are beyond our control, Anchor Paint does not authorize any representative to make any warranty or merchantability of fitness of this product. Any liability whatsoever of Anchor Paint Mfg. Co. to the buyer or user of this product is limited to the purchaser's cost of the product itself.

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Epoxy Hi-Build
#3900 Series

<<Back to Data Sheets

Product Profile:

General Description:

This material is a high-solids polyamide cure epoxy coating that provides room temperature cured finishes. Polyamide cured epoxies combine outstanding resistance to solvents, tap water, and most forms of shock and abrasion.

Common Usage:

Excellent adhesion and flexibility are obtained over ferrous and non-ferrous metals and "green" or dry concrete floors. If desired or warranted by the service environment, can be topcoated with Ancothane #4900 polyurethane.

Color: White, Standard, and Custom colors.

Finish: High Gloss

Activator Required: Yes, #3906

Coating Systems:

Primer Coats:

For maximum protection, use Anchor #3900 Hi-Buid Epoxy primer. Consult your Anchor representative for specific job recommendations.

Surface Preparation:

Old Work: Prior to application, ensure that the substrate is free of any contaminants according to SSPC-SP1. All damaged ares should be repaired and existing paint should be in good condition. Test existing paint for lifting and if present, it must be removed or application of a barrier primer must be used. New Work: For best performance on steel, the surface should be blasted to a minimum SSPC-SP10, including the removal of all mill scale. Prior to blasting, remove all flux and scab from the welding and grind smooth all rough weld seams and sharp edges. Remove any grease, oil or dirt with solvent or chemical cleaner before blasting. The surface should be coated immediately after blasting. Concrete Floors: Old concrete floors must be tested for lifting and old paint removed if not resistant to epoxy. The surface must be cleaned of all dirt, oils, or other contaminants with a non-soapy detergent; thoroughly rinsed and dried. New floors must be cured. All floors then must be etched with 3% solution of Muriatic Acid, then thoroughly rinsed and dried.

Recommended Thickness: 2 mils dry per coat minimum. 2-4 coats recommended.

Drying Time:

Temperature	To Touch	To Recoat
75 F / 55% R.H.	3 Hours	Within 48 Hours

Cooler temperatures and higher humidity will require a longer cure time. However, very rapid cures can be obtained by force drying or baking the epoxy.

Architectural and Industrial Maintenance Category: Industrial Maintenance Coatings

Maximum Allowable V.O.C.: 3.8 lbs./gal. (450 g/l)

Conventional Spray

Air Pressure:	75-100 psi
Fluid Pressure:	10-20 psi

Brush: Recommended for small areas only. Use a high quality natural china bristle brush.

Roller: Use 3/8" or 1/2" synthetic nap roller covers

Cleanup: Clean equipment thoroughly before and immediately after using Anchor #3905.

Application Considerations:
This product can be applied by brush, roller or spray equipment. The cure time is directly affected by the substrate temperature. The coating will not cure where the substrate is below 50 F; at 70 F the cure time is approximately 7 days. Avoid applications where the relative humidity is above 85%. Apply in wet coats to avoid dusting. When spraying, use a cross hatch method, overlapping each pass 50%. On a derusted surface, the application of a dry film thickness of at least 2.0 mils is recommended.

Limited Warranty:
The technical data on this label or on other data is true and accurate to the best of our knowledge. We guarantee our products to conform to ANCHOR PAINT MFG. CO. quality control standards. Due to misuse in handling, storage, application and workmanship or variables such as weather or surface integrity that are beyond our control, Anchor Paint does not authorize any representative to make any warranty or merchantability of fitness of this product. Any liability whatsoever of Anchor Paint Mfg. Co. to the buyer or user of this product is limited to the purchaser's cost of the product itself.

<<Back to Data Sheets

THE SHERWIN-WILLIAMS COMPANY

Industrial and Marine Coatings

INDUSTRIAL & MARINE COATINGS

DURA-PLATE® 235

MULTI-PURPOSE EPOXY

PART A B67-235 SERIES COLORS
PART B B67V235 HARDENER

PRODUCT INFORMATION

Revised 12/03

PRODUCT DESCRIPTION

Dura-Plate 235 Multi-Purpose Epoxy is a modified epoxy phenalkamine, formulated specifically for immersion and atmospheric service in marine and industrial environments. Dura-Plate 235 provides exceptional performance in corrosive environment, and can be applied at temperatures as low as 0°F.

- Self-priming
- Suitable for use in USDA inspected facilities
- Low temperature application
- Surface tolerant - damp surfaces
- Provides salt water and fresh water immersion resistance
- Cures at temperatures as low as 0°F
- Approved as a primer under MIL-P-23236, Type IV, Class 2, Grade B

RECOMMENDED USES

For use over prepared steel and masonry surfaces.

- Salt water and fresh water immersion resistance
- Ballast tanks
- Offshore and marine structures
- Bilges and wet void areas
- Above- and below- water, hull areas
- Decks and superstructures
- Fabrication and new construction
- Water and waste water tanks
- Acceptable for use with cathodic protection systems.
- Water and waste water treatment facilities

Note: Not for immersion service when tinted.

PRODUCT CHARACTERISTICS

Finish: Semi-Gloss

Color: Buff, Black, Haze Gray, Red Oxide, Mill White, and a wide range of colors available

Volume Solids: 68% ± 2%, mixed
Ultra White

Weight Solids: 79% ± 2%, mixed
Ultra White

VOC (EPA Method 24): Unreduced: 272 g/L; 2.3 lb/gal
Reduced 10%: 327 g/L; 2.72 lb/gal

Mix Ratio: 4:1 by volume

Recommended Spreading Rate per coat:

Wet mils:	6.0 - 12.0
Dry mils:	4.0 - 8.0
Coverage:	136 - 272 sq ft/gal approximate

NOTE: Brush or roll application may require multiple coats to achieve maximum film thickness and uniformity of appearance.

Drying Schedule @ 6.0 mils wet @ 50% RH:

	@0°F	@40°F	@77°F	@120°F
To touch:	18 hours	3½ hours	2 hours	20 minutes
To handle:	36 hours	12 hours	3½ hours	40 minutes
To recoat minimum:	36 hours	12 hours	3½ hours	40 minutes
maximum	6 months	6 months	6 months	6 months
Cure to service:	30 days	14 days	7 days	3 days
Pot Life:	16 hours	8 hours	4 hours	1 hour
Sweat-in-time:	1 hour	30 mins	15 minutes	5 minutes

If maximum recoat time is exceeded, abrade surface before recoating. Drying time is temperature, humidity and film thickness dependent.

Shelf Life: 36 months, unopened
Store indoors at 40°F to 100°F

Flash Point: 116°F PMCC

Reducer/Clean Up: Reducer R7K104

PERFORMANCE CHARACTERISTICS

System Tested: (unless otherwise indicated)
Substrate: Steel
Surface Preparation: SSPC-SP10
2 cts. Dura-Plate 235 @ 5.0 mils dft/ct

Abrasion Resistance:
Method: ASTM D4060, CS17 wheel, 1000 cycles, 1 kg load
Result: 65 mg loss

Adhesion:
Method: ASTM D4541
Result: 850 psi

Direct Impact Resistance:
Method: ASTM D2794
Result: 10 in lb

Dry Heat Resistance:
Method: ASTM D2485
Result: 250°F

Moisture Condensation Resistance:
Method: ASTM D4585, 100°F, 2000 hours
Result: Rating 10 per ASTM D610 for rusting
Rating 10 per ASTM D714 for blistering

Pencil Hardness:
Method: ASTM D3363
Result: H

IMMERSION
(Ambient temperature)

- Salt Water ..... Recommended
- Fresh Water ..... Recommended
- Ballast Tank Mix ..... Recommended

Epoxy coatings may darken or yellow following application and curing.

continued on back

THE SHERWIN-WILLIAMS COMPANY

INDUSTRIAL & MARINE COATINGS

Industrial and Marine Coatings

DURA-PLATE® 235

MULTI-PURPOSE EPOXY

PART A	B67-235	SERIES COLORS
PART B	B67V235	HARDENER

PRODUCT INFORMATION

RECOMMENDED SYSTEMS

Steel, immersion or atmospheric service:
2 cts. Dura-Plate 235 @ 4.0 - 8.0 mils dft/ct

Steel, immersion service:
1 ct. Dura-Plate 235 @ 4.0 - 8.0 mils dft
1-2 cts. Dura-Plate UHS @ 10.0 - 12.0 mils dft/ct

Steel, immersion service:
1 ct. Dura-Plate 235 @ 4.0 - 8.0 mils dft
1-2 cts. TarGuard Coal Tar Epoxy @ 8.0 - 16.0 mils dft/ct

Steel, immersion service:
2 cts. Dura-Plate 235 @ 4.0 - 8.0 mils dft
2 cts. SeaGuard Anti-Foulant
(refer to respective data pages for coverage)

Steel, atmospheric service:
1 ct. Dura-Plate 235 @ 4.0 - 8.0 mils dft
1-2 cts. Macropoxy 646 @5.0 - 10.0 mils dft/ct

Steel, atmospheric service:
1 ct. Zinc-Clad II HS @ 3.0 - 5.0 mils dft
1-2 cts. Dura-Plate 235 @ 4.0 - 8.0 mils dft/ct

Steel, atmospheric service:
1 ct. Zinc-Clad IV @ 3.0 - 5.0 mils dft
1-2 cts. Dura-Plate 235 @ 4.0 - 8.0 mils dft/ct

Steel, atmospheric service:
1 ct. Corothane I-GalvaPac Zinc Primer @ 3.0 - 4.0 mils dft
1-2 cts. Dura-Plate 235 @ 4.0 - 8.0 mils dft/ct

Steel, atmospheric service:
1 ct. Dura-Plate 235 @ 4.0 - 8.0 mils dft
1-2 cts. Acrolon 218 HS @ 3.0 - 6.0 mils dft/ct
or Hi-Solids Polyurethane @ 3.0 - 5.0 mils dft/ct

Concrete/Masonry, immersion service:
1 ct. Kem Cati-Coat HS Epoxy Filler/Sealer @ 10 - 20 mils dft/ct, as required to fill voids and provide a continuous substrate
2 cts. Dura-Plate 235 @ 4.0 - 8.0 mils dft/ct

Galvanized, atmospheric service:
1 ct. Dura-Plate 235 @ 4.0 - 8.0 mils dft

The systems listed above are representative of the product's use. Other systems may be appropriate.

SURFACE PREPARATION

Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure good adhesion.
Refer to product Application Bulletin for detailed surface preparation information.
Minimum recommended surface preparation:

Iron & Steel:	
Atmospheric:	SSPC-SP2 or SSPC-SP12/NACE No. 5, WJ-3/SC-2
Immersion:	SSPC-SP10, 2 mil profile or SSPC-SP-12/NACE No. 5, WJ-2/SC-2
Concrete & Masonry:	
Atmospheric:	SSPC-SP13/NACE 6
Immersion:	SSPC-SP13/NACE 6-4.3.1 or 4.3.2
Galvanized, atmospheric:	SSPC-SP1

TINTING

Tint with 844 Colorants only. Mill White tints at 150%. Ultra-deep Base tints at 100%. Five minutes minimum mixing on a mechanical shaker is required for complete mixing of color.

Note: Not for immersion service when tinted.

APPLICATION CONDITIONS

Temperature:	0°F minimum, 120°F maximum (air and surface) At least 5°F above dew point

Material should be at least 40°F for optimal performance.

Relative humidity: 85% maximum

Refer to product Application Bulletin for detailed application information.

ORDERING INFORMATION

Packaging:	
Part A:	1 gallon and 4 gallons in a 5 gallon container
Part B:	1 quart and 1 gallon
Weight per gallon:	11.3 ± 0.2 lb, mixed may vary with color

SAFETY PRECAUTIONS

Refer to the MSDS sheet before use.

Published technical data and instructions are subject to change without notice. Contact your Sherwin-Williams representative for additional technical data and instructions.

THE SHERWIN-WILLIAMS COMPANY

INDUSTRIAL & MARINE COATINGS

Industrial and Marine Coatings

4.67A

DURA-PLATE® 235

MULTI-PURPOSE EPOXY

PART A B67-235 SERIES COLORS
PART B B67V235 HARDENER

APPLICATION BULLETIN

Revised 12/03

SURFACE PREPARATION

General Surface Preparation
Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure good adhesion.

Iron & Steel, Immersion Service:
Remove all oil and grease from surface by Solvent Cleaning per SSPC-SP1. Minimum surface preparation is Near White Metal Blast Cleaning per SSPC-SP10 or SSPC-SP12/NACE No. 5. For SSPC-SP10, blast clean all surfaces using a sharp, angular abrasive for optimum surface profile (2 mils). For SSPC-SP12/NACE No. 5, all surfaces to be coated shall be cleaned in accordance with WJ-2/SC-2 standards. Pre-existing profile should be approximately 2 mils. Light rust bloom is allowed. Remove all weld spatter and round all sharp edges by grinding to a minimum 1/4" radius. Prime any bare steel the same day as it is cleaned.

Iron & Steel, Atmospheric Service:
Minimum surface preparation is Hand Tool Clean per SSPC-SP2 or SSPC-SP12/NACE No. 5. For surfaces prepared by SSPC-SP2, first remove all oil and grease from surface by Solvent Cleaning per SSPC-SP1. For better performance, use Commercial Blast Cleaning per SSPC-SP6, blast clean all surfaces using a sharp, angular abrasive for optimum surface profile (2 mils). For surfaces prepared by SSPC-SP12/NACE No. 5, all surfaces shall be cleaned in accordance with WJ-3/SC-2. Pre-existing profile should be approximately 2 mils. Prime any bare steel the same day as it is cleaned.

Galvanized Steel
Allow to weather a minimum of six months prior to coating. Solvent Clean per SSPC-SP1 (recommended solvent is VM&P Naphtha). When weathering is not possible, or the surface has been treated with chromates or silicates, first Solvent Clean per SSPC-SP1 and apply a test patch. Allow paint to dry at least one week before testing adhesion. If adhesion is poor, brush blasting per SSPC-SP7 is necessary to remove these treatments. Rusty galvanizing requires a minimum of Hand Tool Cleaning per SSPC-SP2, prime the area the same day as cleaned.

Concrete/Masonry, Atmospheric Service:

New
For surface preparation, refer to SSPC-SP13/NACE 6. Surface must be clean, dry, sound, and offer sufficient profile to achieve adequate adhesion. Minimum substrate cure is 28 days at 75°F. Remove all form release agents, curing compounds, salts, efflorescence, laitance, and other foreign matter by sandblasting, shotblasting, mechanical scarification, or suitable chemical means. Refer to ASTM D4260. Rinse thoroughly to achieve a final pH between 6.0 and 10.0. Allow to dry thoroughly prior to coating.

Old
Surface preparation is done in much the same manner as new concrete; however, if the concrete is contaminated with oils, grease, chemicals, etc., they must be removed by cleaning with a strong detergent. Refer to ASTM D4258. Form release agents, hardeners, etc. must be removed by sandblasting, shotblasting, mechanical scarification, or suitable chemical means. If surface deterioration presents an unacceptably rough surface, Kem Cati-Coat HS Epoxy Filler/Sealer is recommended to patch and resurface damaged concrete.

Concrete/Masonry, Immersion Service:
For surface preparation, refer to SSPC-SP13/NACE 6, Section 4.3.1 or 4.3.2.

Always follow the industry standards listed below:
ASTM D4258 Standard Practice for Cleaning Concrete.
ASTM D4259 Standard Practice for Abrading Concrete.
ASTM D4260 Standard Practice for Etching Concrete.
ASTM F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete.
SSPC-SP13/NACE 6 Surface Preparation of Concrete

APPLICATION CONDITIONS

Temperature: 0°F minimum, 120°F maximum (air and surface)
At least 5°F above dew point
Material should be at least 40°F for optimal performance.

Relative humidity: 85% maximum

APPLICATION EQUIPMENT

The following is a guide. Changes in pressures and tip sizes may be needed for proper spray characteristics. Always purge spray equipment before use with listed reducer. Any reduction must be compatible with the existing environmental and application conditions.

Reducer/Clean Up ..... Reducer R7K104

Airless Spray
Unit ..... 30:1 Pump
Pressure ..... 2400 - 2800 psi
Hose ..... 1/4" - 3/8" ID
Tip ..... .015" - .019"
Filter ..... 60 mesh
Reduction ..... As needed, up to 10% by volume

Conventional Spray
Gun ..... DeVilbiss MBC-510
Fluid Tip ..... E
Air Nozzle 704
Atomization Pressure .. 60-65 psi
Fluid Pressure ..... 5-15 psi
Reduction ..... As needed, up to 10% by volume

Brush
Brush ..... Natural Bristle
Reduction ..... Not recommended

Roller
Cover ..... 3/8" woven with phenolic core
Reduction ..... Not recommended

If specific application equipment is listed above, equivalent equipment may be substituted.

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THE SHERWIN-WILLIAMS COMPANY

Industrial and Marine Coatings

INDUSTRIAL & MARINE COATINGS

4.67A

DURA-PLATE® 235

MULTI-PURPOSE EPOXY

PART A	B67-235	SERIES COLORS
PART B	B67V235	HARDENER

APPLICATION BULLETIN

APPLICATION PROCEDURES

Surface preparation must be completed as indicated.

Mix contents of each component thoroughly using power agitation. Make certain no pigment remains on the bottom of the can. Then combine 4 parts by volume of Part A with 1 part by volume of Part B. Thoroughly agitate the mixture with power agitation. Allow the material to sweat-in as indicated prior to application. Re-stir before using.

If reducer solvent is used, add only after both components have been thoroughly mixed, after sweat-in.

Apply paint to the recommended film thickness and spreading rate as indicated below:

Recommended Spreading Rate per coat:

Wet mils:	6.0 - 12.0
Dry mils:	4.0 - 8.0
Coverage:	136 - 272 sq ft/gal approximate

NOTE: Brush or roll application may require multiple coats to achieve maximum film thickness and uniformity of appearance.

Drying Schedule @ 6.0 mils wet @ 50% RH:

	@ 0°F	@ 40°F	@ 77°F	@ 120°F
To touch:	18 hours	3½ hours	2 hours	20 minutes
To handle:	36 hours	12 hours	3½ hours	40 minutes
To recoat:				
minimum:	36 hours	12 hours	3½ hours	40 minutes
maximum	6 months	6 months	6 months	6 months
Cure to service:	30 days	14 days	7 days	3 days
Pot Life:	16 hours	8 hours	4 hours	1 hour
Sweat-in-time:	1 hour	30 mins	15 minutes	5 minutes

If maximum recoat time is exceeded, abrade surface before recoating. Drying time is temperature, humidity and film thickness dependent.

Application of coating above maximum or below minimum recommended spreading rate may adversely affect coating performance.

PERFORMANCE TIPS

Stripe coat crevices, welds, and sharp angles to prevent early failure in these areas.

When using spray application, use a 50% overlap with each pass of the gun to avoid holidays, bare areas, and pinholes. If necessary, cross spray at a right angle

Spreading rates are calculated on volume solids and do not include an application loss factor due to surface profile, roughness or porosity of the surface, skill and technique of the applicator, method of application, various surface irregularities, material lost during mixing, spillage, overthinning, climatic conditions, and excessive film build.

Excessive reduction of material can affect film build, appearance, and adhesion.

Do not mix previously catalyzed material with new.

Do not apply the material beyond recommended pot life.

In order to avoid blockage of spray equipment, clean equipment before use or before periods of extended downtime with Reducer R7K104.

Prior to immersion service, test coating with appropriate holiday detection equipment. Set charge in accordance with manufacturer's recommendation.

Not recommended for immersion service when tinted.

Refer to Product Information sheet for additional performance characteristics and properties.

CLEAN UP INSTRUCTIONS

Clean spills and spatters immediately with Reducer R7K104. Clean tools immediately after use with Reducer R7K104. Follow manufacturer's safety recommendations when using any solvent.

SAFETY PRECAUTIONS

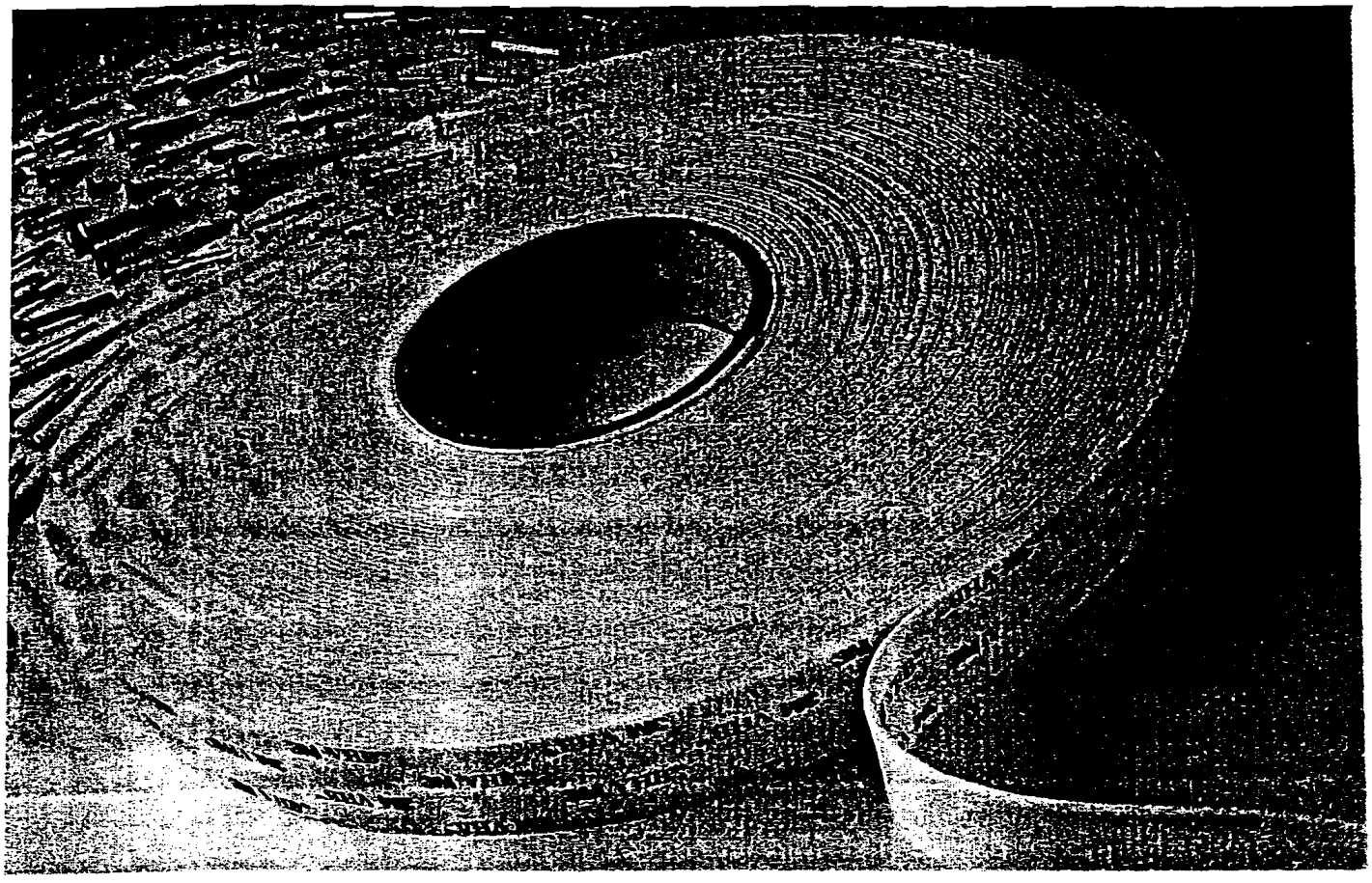
Refer to the MSDS sheet before use.

Published technical data and instructions are subject to change without notice. Contact your Sherwin-Williams representative for additional technical data and instructions.

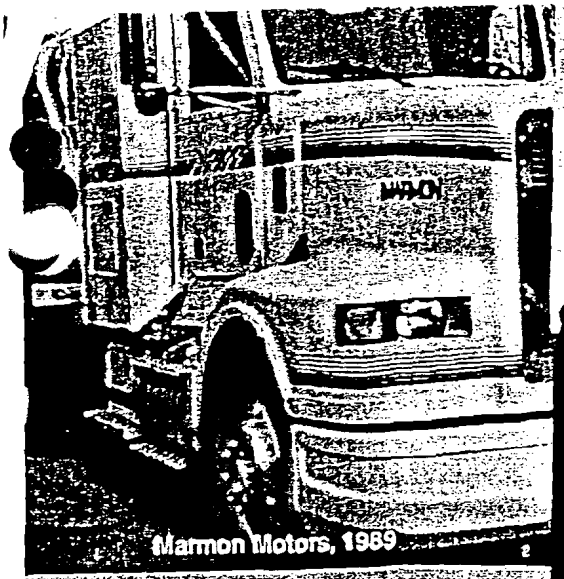
3M

VHB™ Tapes

Imagine your world without rivets, screws and welding



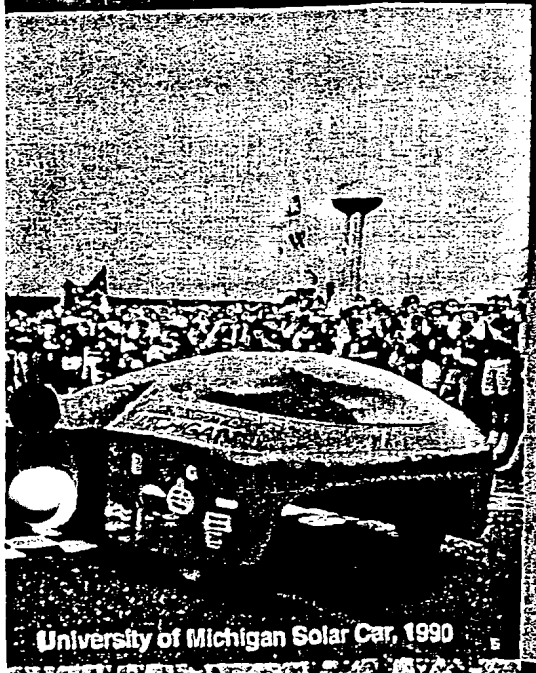
Revised



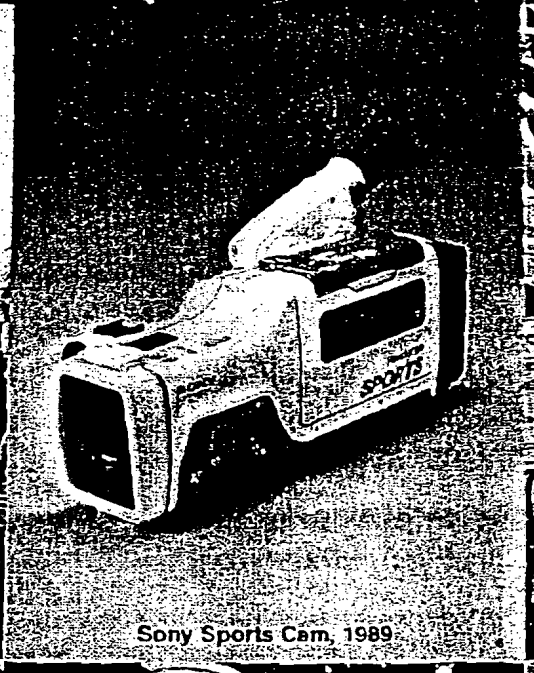
Marmon Motors, 1989

Denmark Sign, 1985

Westinghouse Sign, 1986

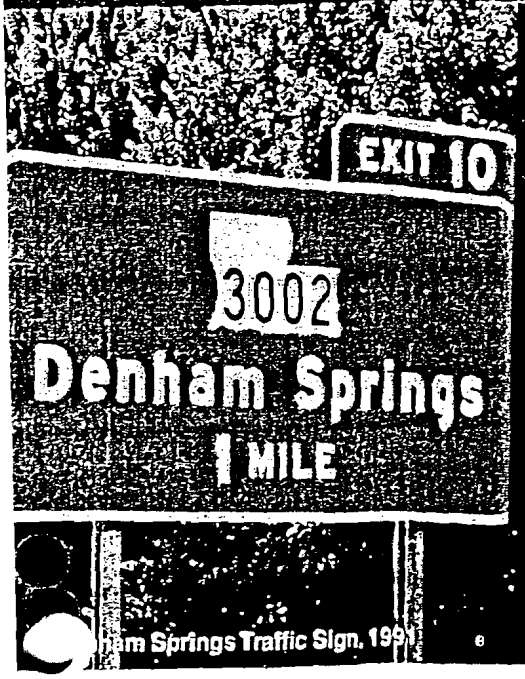


University of Michigan Solar Car, 1990

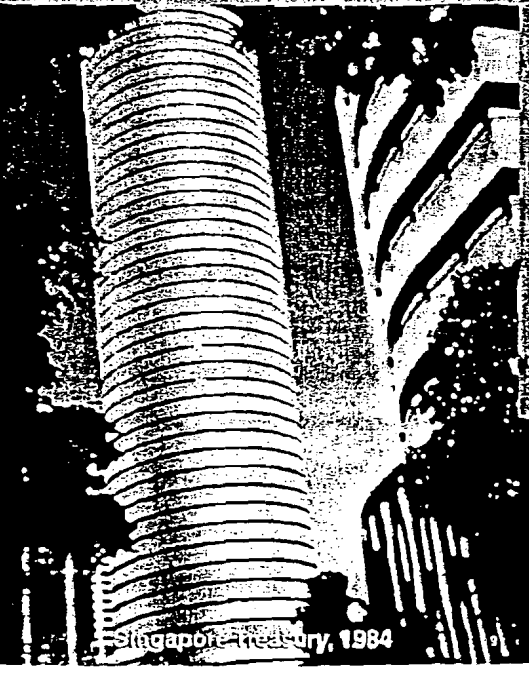


Sony Sports Cam, 1989

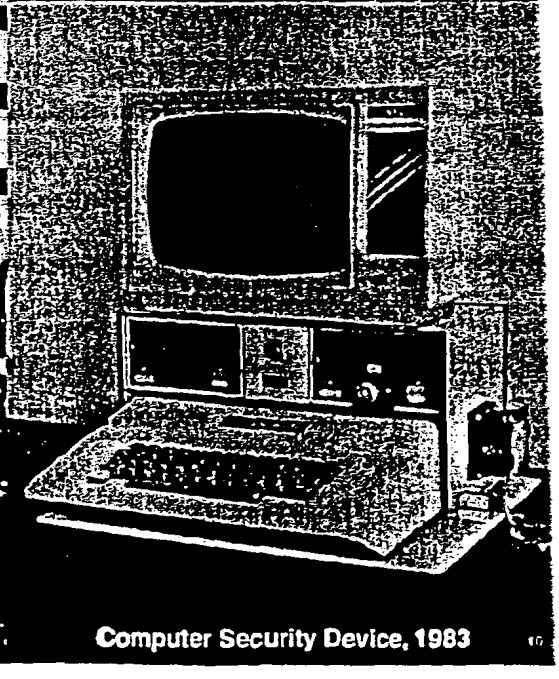
Chicago O'Hare Terminal, 1987



ham Springs Traffic Sign, 199



Singapore Treasury, 1984



Computer Security Device, 1983

For over 20 years, 3M™ VHB™ Tape has been making a name for itself among design and manufacturing engineers. Look at the nine photos (at left) and you'll see where we've been.

Now imagine where you can go in a world without rivets, screw, and welding.

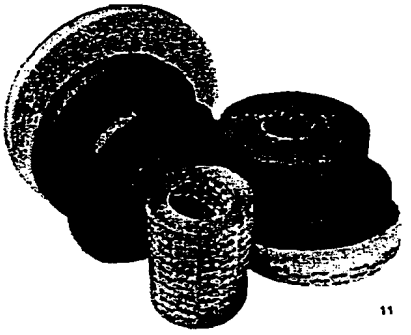
Your designs would be sleeker, seamless. Major equipment could be eliminated, labor and materials could cost less. And the finished product, overall, could be lighter, quieter and more efficient.

Best of all, you would be freed from the restraints of working with mechanical fasteners. You could design projects the way you want. You could join dissimilar materials and set new standards for strength and aesthetics.

Impossible?

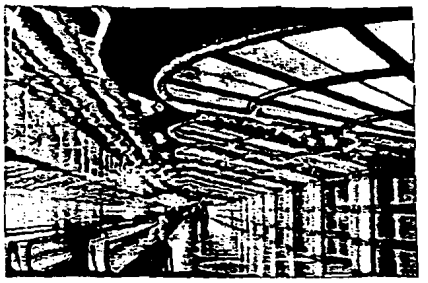
Hardly. You can dream it, design it and produce it — just the way you want — by replacing your mechanical fasteners with VHB tape.

Flexible, durable, versatile and strong. VHB tape will allow you to conceive the projects you care about ... and achieve the results you've dreamed about.



For over 20 years, design and manufacturing engineers have used 3M™ VHB™ Tape. Some of their results are featured here and on the following pages. Review them, then call us at 800-362-3550. We'll talk with you, one-on-one, about applying VHB tape to your next project.

VHB tape. It's going to change the way you work.



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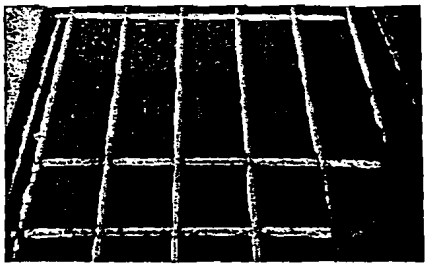
At Chicago O'Hare International Airport, 9,600 lbs. of mirror are secured to the ceiling using VHB tape in place of traditional fasteners. VHB tape is strong, sturdy and seamless.

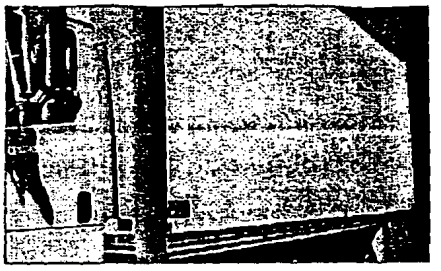
3M™ VHB™ Tape attributes:

- Fast, easy assembly
- No drilling, riveting, welding, screw fastening or clean-up
- Eliminates grinding and refinishing
- Damps vibration and noise
- Absorbs impact
- Joins dissimilar materials
- Compensates for differential thermal expansion or contractions
- Lighter, less expensive materials
- Uniform thickness
- Die-cutting available
- Resists plasticizer migration
- No investment in major equipment
- Minimal application training



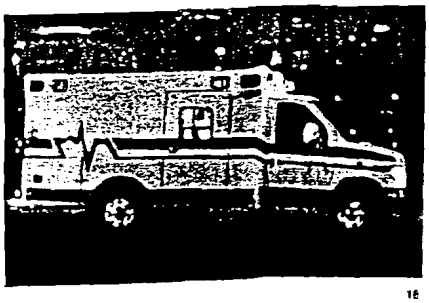
16

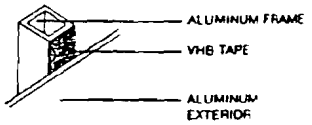
This building in St. Petersburg, Florida, has decorative copper cladding attached with VHB tape. The tape withstands heat and moisture.



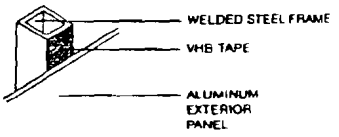
17

After hundreds of thousands of miles of jarring and bouncing, seams sealed with VHB tape remain securely locked in place. VHB tape absorbs shock, fatigue and vibration.

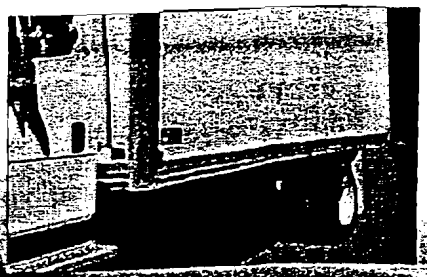


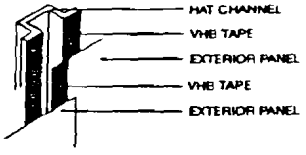


VHB tape damps vibrations and noise producing a quieter ride.



Metal surfaces are separated reducing the potential for galvanic corrosion.

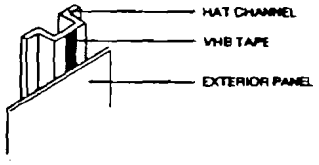




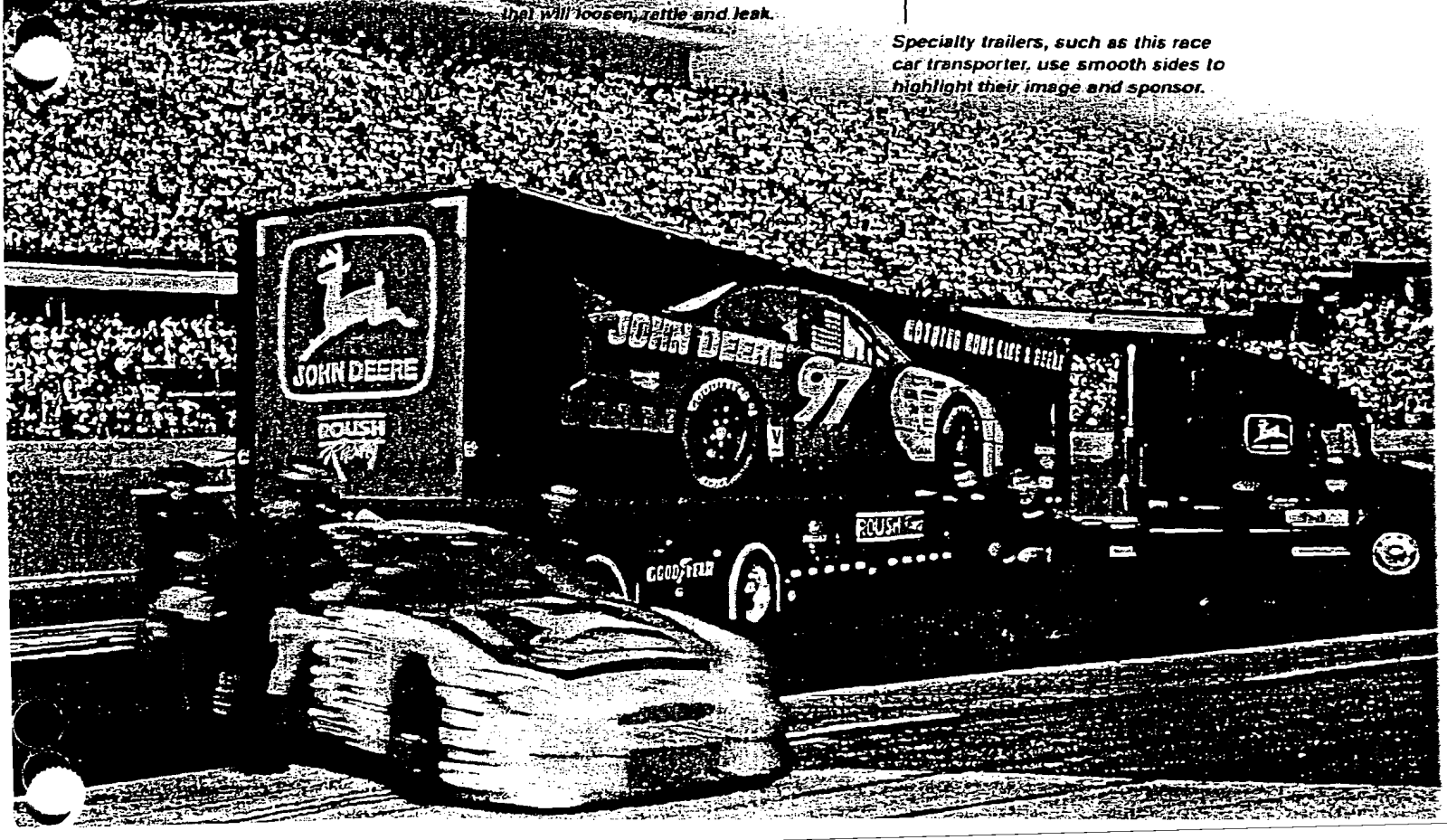
VHB tape bonds panels to the frame and seals the seam, eliminating rivets and screws that will loosen, rattle and leak.

Traditional fasteners get in the way when you add graphic film to any mode of transportation. Only by eliminating rivets, screws and welding and attaching stiffeners to panels using 3M™ VHB™ Tape can your trailers, trucks, buses and trains become seamless.

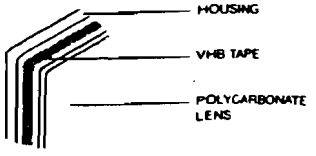
Further, every hole drilled into a vehicle for a screw or rivet provides a leak potential. VHB tape eliminates the holes — and therefore the problem — while creating a moisture seal. Commercial vehicles, which constantly battle the elements, become truly weather resistant.



Specialty trailers, such as this race car transporter, use smooth sides to highlight their image and sponsor.



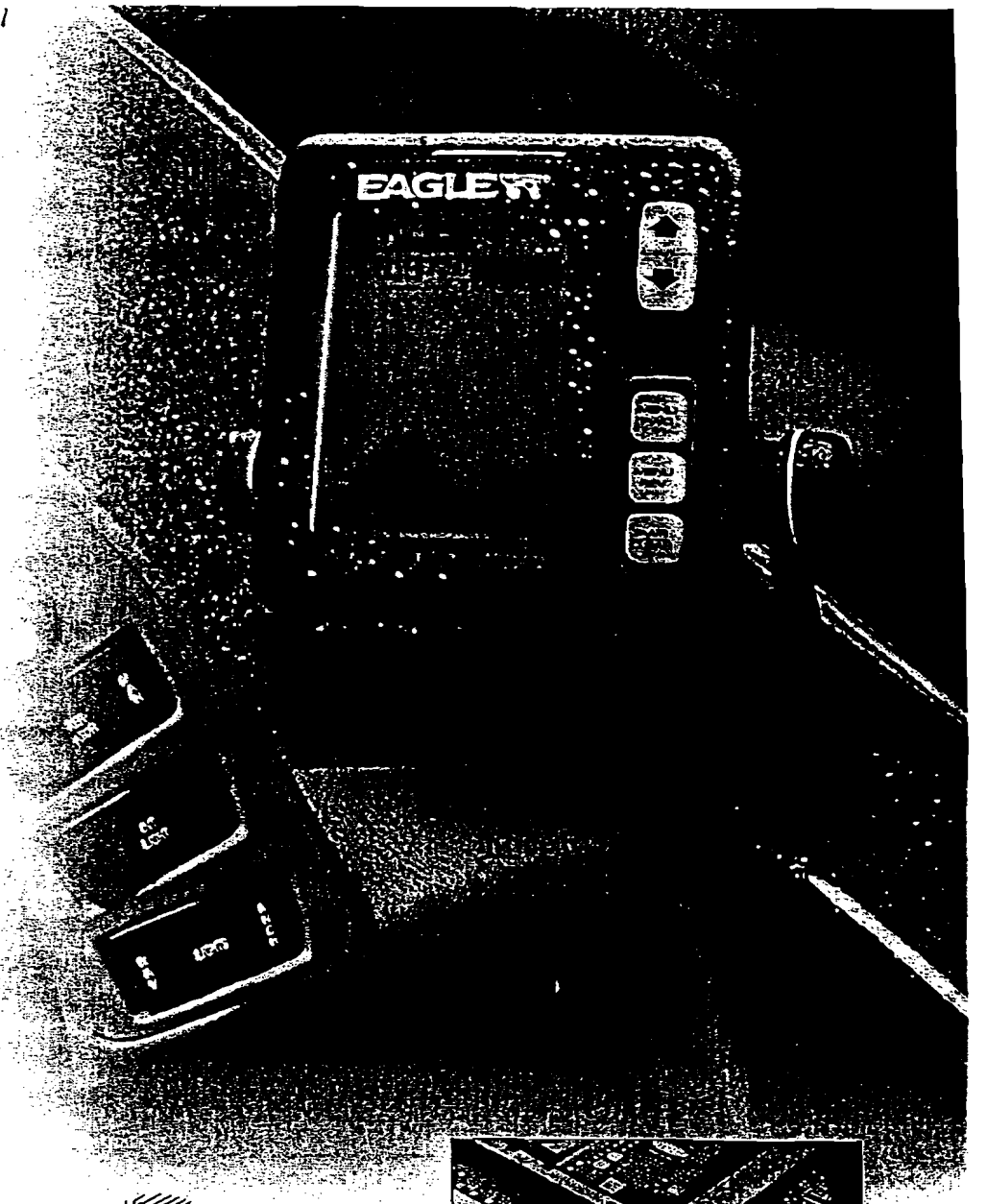
Create a rugged and resistant seal

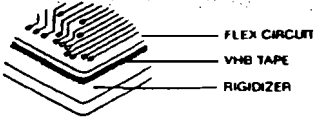


Lens bonds to housing providing a weather-tight seal in this fish finder.

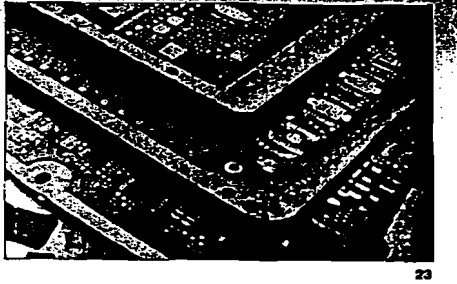
Today, electronic products are smaller, more powerful and more portable than ever before. Engineers in this industry need materials that are rugged, durable and lightweight. 3M™ VHB™ Tape rises to the occasion.

Not only does VHB tape bond, seal and absorb shock, it is also easy to apply, lightweight, and can be die-cut to fit even the smallest, most unusual shapes. Engineers say these attributes, along with a UL 746C listing, make VHB tape ideal for a wide range of electronic products.





Sheldahl Flex Circuits withstand process heat and benefit from low outgassing properties.



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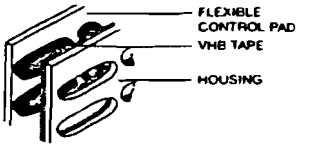
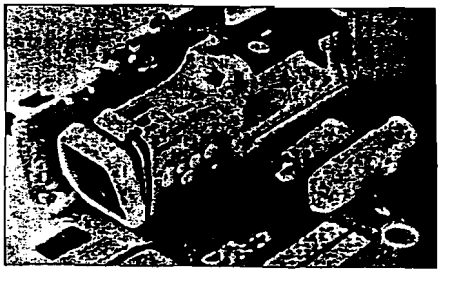


Precisely die-cut, VHB tape bonds and seals the parts in this underwater camera case.



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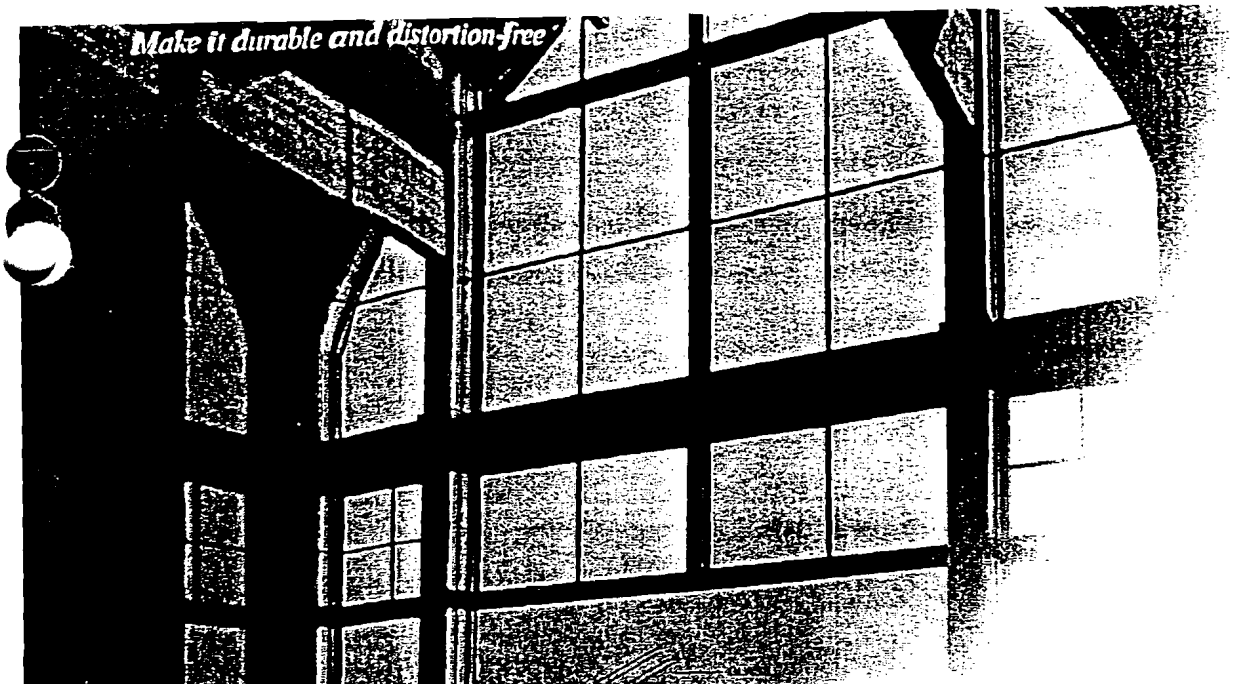

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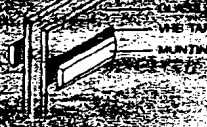
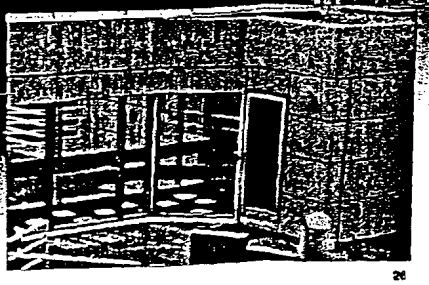
Indoors and out, 3M™ VHB™ Tape withstands even the toughest environmental elements. For 20 years, VHB tape has achieved amazing results in buildings and construction projects. Durable and strong, VHB tape fastens smoothly — keeping surfaces distortion free.

VHB tape also provides an excellent seal against moisture. Not only can it join dissimilar materials and resist differing coefficients of thermal expansion, VHB tape also forms a barrier preventing galvanic corrosion between different metals.

Quick and easy to apply, using lighter, thinner materials, VHB tape saves time and labor costs.



...bars are bonded to glass ...ompensating for differential ...icients of expansion.



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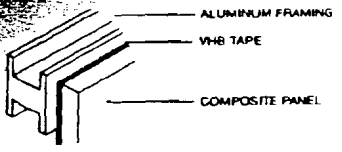
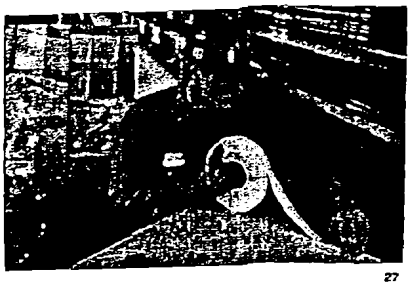


Architectural panels bond to frames eliminating all visible fasteners.



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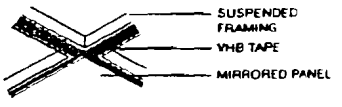
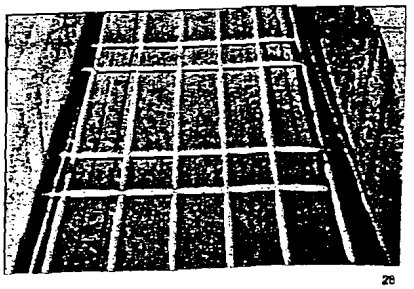


This ceiling seamlessly holds 9,600 lbs. of mirrored panels at Chicago O'Hare International Airport.



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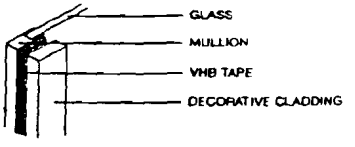
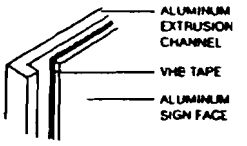


Decorative copper cladding adheres to window system creating a unique appearance.

Produce sleeker, cleaner signs

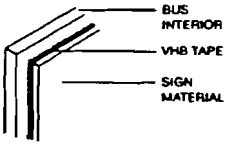
When signs are built with 3M™ VHB™ Tape, surfaces are clean and sleek, free of rivets or bolts for greater graphical impact. Lighter, easier-to-handle material can also be used without worry about pull-through or dimpling— providing greater flexibility for fresh, aesthetically pleasing signs.

And because VHB tape seals against the environment while compensating for different co-efficients of thermal expansion, your signs will be stronger, more resilient and last longer than before.



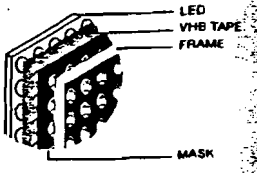
Sign face easily mounts to extrusions saving time and providing a smooth, clean finish.

29

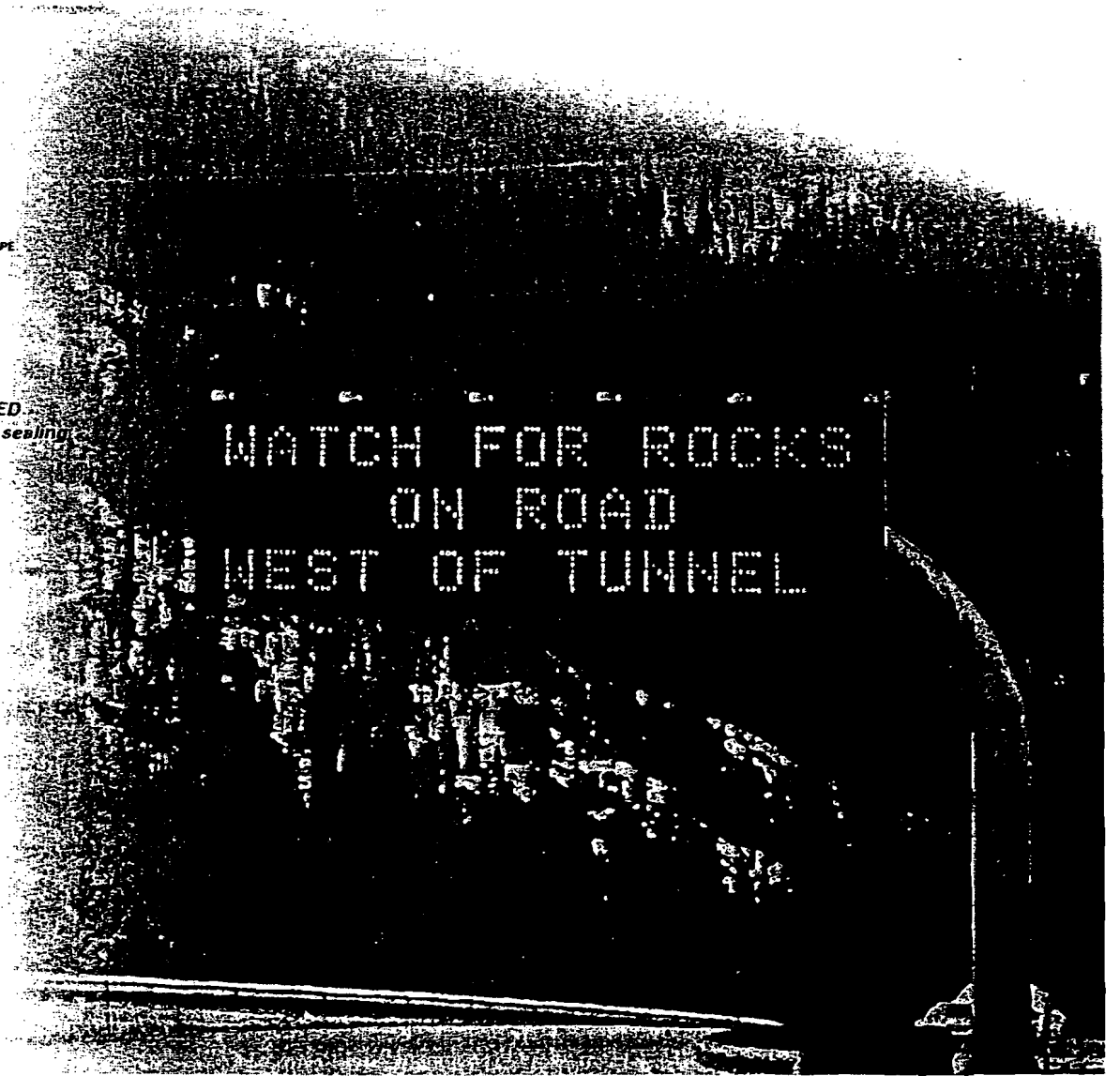


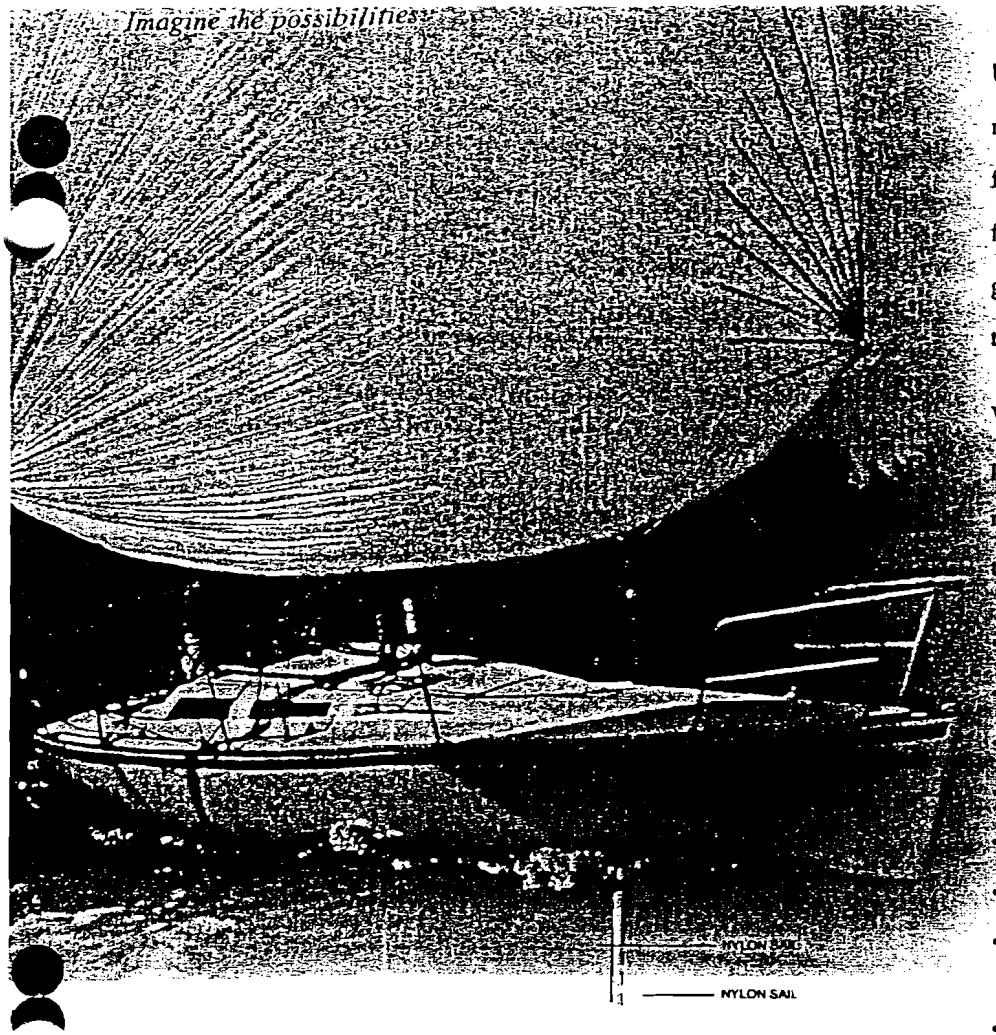
A polycarbonate overlay adheres to a polyvinyl material creating vandal-proof train signs for Globe Transportation Graphics.

30

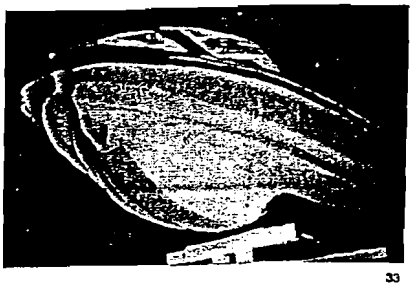


Aluminum face joins LED providing bonding and sealing in one easy step.





VHB tape, instead of stitching on sails, distributes stress and withstands harsh environmental conditions.



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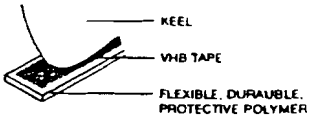
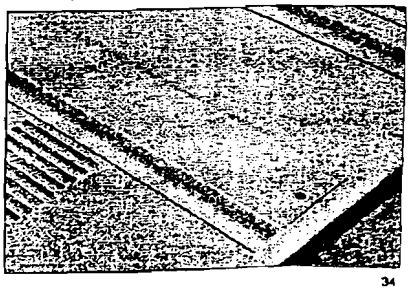


Keel Shield™ Hull Protectors use VHB tape which resists both salt and freshwater.



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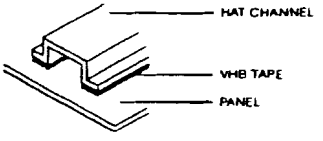

VHB tape bonds panel stiffeners to preprinted metal cabinetry. Using tape doesn't damage the finish the way mechanical fasteners can and it eliminates the need to refinish.

Until now, your projects may have been restricted by the limitations of traditional fasteners. But, proven in the marketplace for over 20 years, 3M™ VHB™ Tape gives you the freedom to create projects the way you know they should be.

When you are ready to conceive the projects you care about and achieve the results you've dreamed about, consider the attributes of VHB tape.

- Produces long-lasting strength
- Absorbs shock
- Distributes stress
- Creates an invisible bond
- Joins dissimilar materials
- Allows thinner, lighter materials
- Eliminates pull-through, dimpling, rivet heads and weld distortions
- Compensates for differential thermal expansion
- Seals against the environment
- Resists UV light
- Damps vibration and noise
- Reduces labor and material costs

For more information on VHB tape, call 800-362-3550, or visit our Web site at www.3M.com/adhesives.

	Product Number	Tape Thickness w/o liner Mils (mm)	Description	Adhesive Type	Temperature Resistance Minutes Hours	Temperature Resistance Days Weeks	Solvent Resistance	Relative Adhesion HSE	Relative Adhesion LSE	Application Ideas	Liner Type
3M™ VHB™ Conformable Tape											
				Synthetic							
3M™ VHB™ Tape	4920 4930 4940 4950 4959	5 (0.4) 25 (0.64) 45 (1.1) 80 (2.0) 120 (3.0)	White, closed-cell acrylic foam carrier. All-purpose adhesive. UL 746C.	Acrylic	300°F (149°C)	200°F (93°C) 400°F (204°C)	High	High	Low	Mount nameplates in all conditions. Bond weatherstrip signs to frames.	
	4945 4946	45 (1.1) 45 (1.1)	White, closed-cell acrylic foam carrier. Plasticizer resistant. UL 746C. Film liner version of 4945.	Acrylic	300°F (149°C)	200°F (93°C)	High	High	Med.	Bond vinyl graphics to window frames. Bond trim molding to truck and trailer skins.	B B
	4905 4910	20 (0.5) 30 (0.8)	Clear, closed-cell acrylic carrier for joining transparent material.	Acrylic	300°F (149°C)	200°F (93°C)	High	High	Low	Seal acrylic bubble dome. Attach handle to sliding glass doors. Mount back lit translucent signs. Edge-bond insulated glass.	D D
	4951	45 (1.1)	White, closed-cell acrylic foam carrier. Apply as low as 32°F (0°C).	Acrylic	300°F (149°C)	200°F (93°C)	High	High	Low	Mount panels to aluminum frames in buildings, trucks and trailers. Mount trim to portable buildings.	
	4932 4952	25 (0.64) 45 (1.1)	White, closed-cell acrylic foam carrier. Good adhesion to polypropylene and many powder paints.	Synthetic	200°F (93°C)	150°F (71°C)	High	High	High	Bond polypropylene, polyethylene and other low surface energy plastics.	
Transfer Tape	9460 PC 9469 PC 9478 PC	2.0 (0.05) 5.0 (0.13) 10 (0.25)	Clear adhesive transfer tape. High shear strength adhesive.	100 MP	300°F (260°C)	200°F (149°C)	High	High	Low	Bond stainless metal trim. Bond acrylic panels to aluminum.	

NOTE: The technical information and data provided here should be considered representative or typical only and should not be used for specification purposes. User should evaluate the 3M product to determine whether it is fit for a particular purpose and suitable for user's method of application.

Liner Types:
A – 3 mil 54# Densified Kraft Paper
B – 5 mil Clear Polyethylene Film
C – 2 mil Polyester Film
D – 5 mil Red Polyethylene Film
E – 4 mil 58# Polycoated Kraft Paper
F – 4 mil Green Polyethylene Film

Relative Adhesion:
HSE – High Surface Energy
LSE – Low Surface Energy

Additional product information or sales assistance: 1-800-362-3550.

For Additional Information

To request additional product information or to arrange for sales assistance, call toll free 1-800-362-3550 or visit www.3M.com/adhesives. Address correspondence to: 3M Industrial Adhesives and Tapes Division, Building 21-1W-10, 900 Bush Avenue, St. Paul, MN 55106. Our fax number is 651-733-9175. In Canada, call: 1-800-364-3577. In Puerto Rico, call 1-787-750-3000. In Mexico, call: 52-70-04-00.

Important Notice

The statements and technical information contained herein are based on tests and data which 3M believes to be reliable, but the accuracy or completeness of such statements and technical information is not guaranteed. User is responsible for determining whether a specific 3M™ VHB™ Tape is fit for a particular purpose and suitable for user's method of application.

Limited Warranty

3M warrants for 24 months from the date of manufacture that 3M™ VHB™ Tape will be free of defects in material and manufacture. 3M MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. This Limited Warranty does not cover damage resulting from the use or inability to use 3M™ VHB™ Tape due to misuse, workmanship in application, or application or storage not in accordance with 3M recommended procedures.

Limitation of Remedies and Liability

If the 3M™ VHB™ Tape is proved to be defective within the warranty period stated above, THE EXCLUSIVE REMEDY, AT 3M'S OPTION, SHALL BE TO REFUND THE PURCHASE PRICE OF OR TO REPAIR OR REPLACE THE DEFECTIVE 3M™ VHB™ TAPE. 3M shall not otherwise be liable for loss or damages, whether direct, indirect, special, incidental or consequential, regardless of the legal theory asserted, including, but not limited to, contract, negligence, warranty or strict liability.

3M

Industrial Business
Industrial Adhesives and Tapes Division

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(610) 374-5171 Fax: (610) 374-4990
http://www.thomasregister.com/genpore

POROUS POLY UNDERDRAIN PLATE

Since 1969 GenPore has been an innovator in the field of porous plastics. In 1984 GenPore developed Porous Poly Underdrain Plate and began manufacturing this plate as a replacement for the Alumina oxide used in various water treatment facilities. Porous Poly Underdrain plates are used in both fresh and waste water treatment filters.

Porous Poly is made of black ultra-violet resistant High Density Polyethylene resin and has a pore size in the range of 400--500 microns. It is made from a non-toxic resin that meets all the FDA specifications for food contact. In addition, the resin has been listed by NSF for use in potable water treatment systems.

Porous Poly offers the following benefits over ceramic plates:

Lightweight:	1/3 the weight of ceramic plates
Long Lengths:	Available in lengths up to 16 feet
Impact Resistant:	Plates are tough and resilient. They withstand rough handling and will not crack, shatter, or deform on impact
Easy Installation:	Plates can be field fitted by trimming with hand saws. Fewer joints are required because of long lengths. Excellent bonding to installation adhesives

Properties of Porous Poly

Property:	Value:
Weight-- 1" thick plate	3lbs. / ft^2
Bulk Density	38 – 40 lbs / ft^3
Pore Size	400 – 500 micron
Pore Volume	40% – 55%
Break Point at 70 F	700 lbs / linear foot (line load on 5.75" wide span)

(continued)

Properties of Porous Poly (continued)

Property	Value
Modulus of Rupture at 70 F	1700 lbs
Deflection Under Load at 70 F	3/32" median deflection at 500 lbs / linear foot (line load on 5.75" wide span)
Chemical Resistance at < 70 F	Unaffected by all normal concentrations of waste water treatment chemical.

Performance Characteristics

Characteristic	Value:
Air Permeability at 1" water column	100 SCFM + 25% / ft^2
Sand Retention	Retains sand > 0.45 mm in diameter

Water Permeability – 1" Porous Poly Underdrain Plate

Gravity Flow

Flow Rate (Gal./min./ft^2)	Head Loss (Inches of H_2O)
4	1/2"
5	3/4"

Backwash Flow

Flow Rate (Gal./min./ft^2)	Head Loss (Inches of H_2O)
10	1"
15	4 3/4"
20	5 3/4"

10/98

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AIR FLOW versus PRESSURE DROP CHARTS

Introduction

The flow charts presented here were generated by conducting flow tests on porous plastic discs ranging from 1/8" to 1/2" thick, 20 to 100 micron average pore size, and 40 to 50% void volume. An increase in void volume will result in a higher flow at the same pressure and average pore size. Back pressure and flow rates are essentially proportional to material thickness. These flow charts should only be used as a guide, as other factors such as surface finish and pore size distribution, can affect permability. The values on the outside of the charts are in English units, whereas the inside values are metric.

HIGH AIR FLOW VS. PRESSURE—1/8" thick material

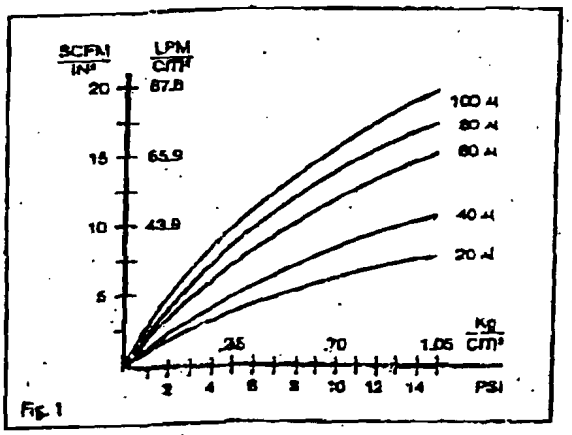

Fig. 1

LOW AIR FLOW VS. PRESSURE—1/8" thick material

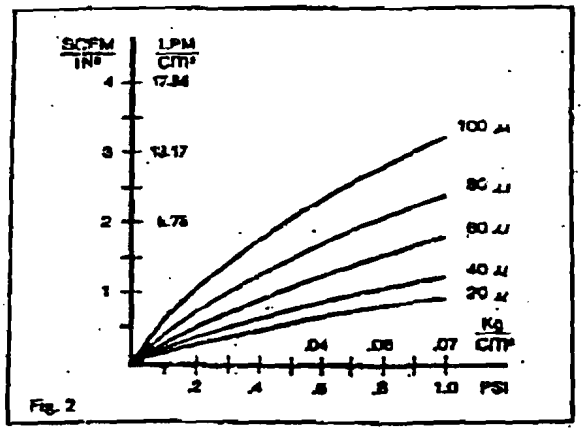

Fig. 2

Determine pressure drop through 1/8" thick 20 micron material at a flow of 5 SCFM/IN^2: Using graph in Figure 1, read down left side to 5, then across to the 20 micron curve, and down to 8 PSI. To determine the pressure drop for 3/8" material under the same flow conditions use the following equation:

$$\frac{\text{Required Thickness}}{\text{Original Thickness}} \times \text{PSI value of original Thickness} = \text{PSI of Required Thickness}$$

$$3/8" \div 1/8" \times 8 = 24 \text{ PSI}$$

Legend	PSI— pounds per square inch	µ — microns
	SCFM/IN^2— standard cubic feet of air per minute per square inch of material	GPM/IN^2— gallons per minute per square inch of material
	KG/CM^2— kilograms per square centimeter	LPM/CM^2— liters per minute per square centimeter

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POROUS POLY

PRODUCT DATA SHEET

Porous Poly is a free-sintered material which produces porous products with excellent filtration efficiency of fine solid particulates combined with exceptional flowability of liquids and gases. By controlling the particle size distribution and the sintering process, Porous Poly is manufactured with an interconnected cell structure and a specific pore size range.

The free sintering process is performed by heating the resin without pressure, until the surface of the particles soften and bond together with surrounding particles. Since the resin does not melt, the particles of Porous Poly retain their original shape and physical properties. Selection of resin bulk density and particle size distribution, plus a controlled molding cycle determines the parts physical strength and porosity. Although the polyethylene resin is naturally hydrophobic, parts can be made hydrophilic by treating the resin with either silica, ethylene glycol, or glycerin prior to sintering. A unique treatment is also available to produce a material that is "self-sealing." It stops the flow of aqueous solutions when the solution makes contact with the treated material. This "self-sealing" characteristic is employed to produce a non-mechanical shut-off valve, allowing the passage of air, but not the aqueous solution.

Since porous products are produced with tortuous paths, rather than through holes, much smaller particles than the pore diameter size can be filtered out. In addition, filtration efficiencies of 99.8 % can be achieved with filter cartridges removing 2 micron particles with only 1 mbar (0.40" water) pressure drop.

TYPICAL APPLICATIONS

Bubblers
Water Filters
Scent Reservoirs
Air Filters
Blood Serum Filters
Mufflers
Liquid Marker Tips
Wicks

KEY BENEFITS

Chemically resistant to most acids, bases, solvents and hydrocarbons.

Excellent corrosion resistance

High purity --- FDA/USDA approved resins

Elastic behavior--not brittle like ceramics

Easily machined with metal working tools.

PROPERTIES OF POROUS POLY (measured at 73° F)

Property	Units	Value
Pore size	Micrometers	10-90
Void Volume	%	25-60
Density	grams/liter	580-600
Tensile strength	psi	450 minimum
Coefficient of linear thermal expansion	inch/inch/ °F	7.2×10^{-5}
Service temp. (Max.)	°F (°C)	Continuous: 194 (90) Non-Stressed: 212 (100) Intermittent: 240 (116)
(Min.)	°F (°C)	Continuous: -269 (-425)

The physical strength of porous plastics are less than their solid counterparts, however, standard ASTM tests can still be used to develop physical strength data for a porous part. Two ASTM test methods are used to define the pore structure of a porous part. ASTM E128, Bubble Point, is a non-destructive test and only defines the upper and lower limits of the pore size range. The Mercury Porsimeter Test, ASTM C699, is a destructive test that infuses mercury into the sample by incrementally increasing pressure and measuring the volume of mercury injected at each pressure increment. This test produces significantly more data, as the volume of each pore size is determined and a graph showing the pore size distribution is printed. GPC uses the mercury porsimeter to characterize the resin blend necessary to produce a specific pore size and void volume.

FABRICATION TECHNIQUES

Porous Poly can be machined using either metal or wood cutting tools and equipment. Sharp tools and increased tool clearance are necessary for adequate chip and heat removal. It is recommended that stellite and/or carbide tipped cutting tools be used as they give cleaner cuts and extend tool life. The best surface finish is produced with higher cutting speeds but requires the use of coolant to remove heat buildup. Air cooling is usually adequate but water cooling may be necessary.

FABRICATION TECHNIQUES (continued)

Porous Poly can be welded by butt fusion or hot-gas welding. Butt fusion welding must be performed at low pressures using heated PTFE coated tools. Welding seals the pore structure producing a solid surface. Porous Poly can also be bonded together using adhesives. Two part epoxy systems penetrate the open pore structure of the material and bond to the matting component.

MATERIAL AVAILABILITY

Two standard size sheets (36"x48" and 56"x56") are available in thickness' ranging from 1/16" to 1". Many rod and tubular bar sizes are available without a tooling charge. Special sizes and complex parts can be tooled and molded to a meet customers' requirements.

4/96

Section 6-C

PPZ Treatment Vessels and Treatment Media (PP-640, PP-650)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Operating and Maintenance Manual for NB-15 & NB-20 Vapor Phase Units

---

1.0 GENERAL

Standard adsorbent is *virgin* granular or pelleted vapor phase coal based activated carbon and is normally installed prior to shipment. These units are designed to operate in the upflow mode. If the inlet organic contaminant concentrations exceed 500 ppm and the flow is less than 50 ft/min, significant heat of adsorption may be generated. Prewetting the adsorbent with water is recommended in these cases, in order to minimize the chance of ignition.

In all cases of a combustible source of air or gases, a suitable **bi-directional detonation flame arrestor** should be installed between the source and the adsorber. TIGG premounts arrestors as ordered; otherwise, carefully observe instructions included with your own arrestor.

If media other than carbon is to be used, contact a TIGG representative for any procedural changes.

2.0 SAFETY CONCERNS

WARNING: Wet drained activated carbon preferentially removes oxygen from air. In closed or partially closed containers, the oxygen concentration can reach dangerously low levels. Therefore, procedures related to entering low-oxygen spaces should be followed by workers that must enter a vessel containing wet carbon.

Activated carbon can react with oxidizing/easily-oxidized substances such as ozone, concentrated oxygen, halogens, ketones etc. to liberate heat in additon to that which is normal for physical adsorption. Regular activated carbon is not recommended with these materials, **especially in intermittent use application.**

If it is used in these applications contact a TIGG representative to discuss the necessary precautions to prevent temperature excursions. In this application **TIGG SAFE** carbon should be used.

3.0 UNLOADING & STARTUP PROCEDURES

3.1 Receiving

When a unit is delivered to the site, it should be checked thoroughly to ensure all required items have been received and the equipment is free of any shipping damage **prior to signing the bill of lading.**

3.2 Rigging

All equipment will arrive at the job site via truck. The units will arrive either with or without activated carbon, depending on the customer's request.

The unit should be carefully removed from the truck in a horizontal position by either a forklift or an overhead crane. If a crane is used it is advisable to use a properly sized spreader beam and lifting cables.

Following are weights of the units.

UNIT	Empty Wt.	Filled Wt.
NB – 15	9000	21000
NB – 20	15000	31000

Once the adsorber has been removed from the truck, it should be placed on a stable, level surface and oriented to complement the piping and blower arrangement. Four wheels are installed on the units to allow on site movement by a tow motor along a solid ground surface.

3.3 Ducting and Peripheral Equipment

Supply and discharge duct for the units, if provided, is usually installed by others. External ductwork should be connected to the units using flexible connectors and clamps. The ductwork should be properly supported to prevent excessive loading on the adsorber.

A packing list is included with the shipment.

Go To Top Of Page

4.0 STARTUP PROCEDURES

4.1 Filling the unit with Fresh Carbon

Fresh carbon will arrive on one truck in 1000-1100 pound super sacks. Upon arrival of the truck, the following steps should be taken:

1. Remove the top hatches by loosening four clamps on each hatch and placing each hatch to the side.
2. Inspect the interior of the adsorber to make sure the grating and screen are not damaged and that no holes are present.
3. Install the **Breakthrough Detector** into the ¾" FNPT fitting on top of the adsorber. if one was supplied. Remove the tape covering the diffusion ports on each end. The colored granules will change from violet to a brown color when organics(s) or other oxidizable substance reach the ports – signaling that about 70% of the carbon bed is exhausted for that compound. A low humidity level is required in the air or gas being monitored for the oxidation to occur. A sliding shield, to prevent light from prematurely changing the indicator color, is moved to view the granules.
4. Prepare to load through an end hatch.
5. Suspend a super sack above the hatch and lower it as close to one side of the hatch as possible.
6. Untie the outer bag exposing the inner chute. Untie the inner chute while clasping the inner chute. Remain holding the chute and carefully lower the chute through the hatch. Unclasp the chute and allow the carbon to discharge from the sack. When the bag is empty shake it and invert the chute into the bag. If at any time you wish to stop the flow of carbon simply re-grasp the chute up high and cinch. Re-tie the bag.
7. Continue to load super sacks through the hatch until carbon is within 1-2 feet of the opening (approximately (2) super sacks. The carbon will have formed a cone shaped pile which could have an angle of repose between 20 and 30 degrees. Push the carbon toward the sides and ends of the adsorber and then level it.
8. Repeat steps 5 through 7 for the remaining hatches.
9. Level the carbon throughout the entire bed by using a steel or aluminum straight head rake and push/pull the carbon toward and away from the sides of the adsorber until the bed of carbon is level. **Be careful to not damage the high solids epoxy liner while raking the carbon.**

4.2 Removing Spent Carbon

Spent carbon can be removed by using a vacuum source, generally supplied by a vac-truck. Upon arrival of the truck, the following steps should be taken.

1. Open the hatches and the end door.
2. The vacuum source is generally connected by a hose to a section of plastic pipe, which is inserted into one of the top openings on the adsorber. **Any metal fittings should be protected from touching the plenum and sides of the adsorber in order to prevent damage.**
3. Move the pipe around as the carbon level is lowered. The adsorber may require entry to remove any residual amounts of spent carbon. **Follow appropriate OSHA confined space entry procedures to prevent worker injury.**
4. Thoroughly inspect the interior lining and plenum material for damage once all of the carbon has been removed.
5. If the interior lining is undamaged and the plenum material intact, the adsorber can be filled in accordance with Section 4.1.

5.0 GENERAL PROCESS DESCRIPTION

5.1 Mode of Operation

The adsorber utilizes a horizontal bed of granular vapor phase activated carbon. Influent vapor enters through two duct fittings located on one end of the adsorber.

The vapors are then distributed throughout an open area in the bottom of the adsorber. Influent vapors flow upward through the carbon bed and into the headspace of the adsorber and then into a discharge duct(s).

5.2 Excessive Moisture Accumulation

If excessive moisture is present in process vapors, liquid may accumulate within the open bottom portion of the adsorber. Drain plugs are located at the four corners of the adsorber floor. The drain plugs can be removed from the bottom side of the adsorber.

Note – removal of a drain plug may expose personnel to untreated process vapor and may result in spillage of contaminated liquid. Use appropriate protection.

Go To Top Of Page

6.0 TROUBLESHOOTING

This section is intended to identify some of the more common problems which may be encountered during the operation of a vapor phase carbon system. The following discussion is not intended to be all-inclusive since situations and circumstances will vary with each individual system by virtue of design, operating philosophy etc. Therefore, this section should only be considered as a guideline for troubleshooting.

6.1 General

The problems which arise generally fall under the following categories:

- High pressure drop
- Poor adsorption and inefficient carbon usage

6.2 High Pressure Drop

High pressure drop can usually be caused by:

- Excessive moisture accumulation in the plenum and/or
- Blinding of the plenum by particulates

6.2.1 Excessive Moisture Accumulation

As discussed in Section 5.2, if excessive moisture is present in process vapors, liquid may accumulate within the bottom portion of the unit. This accumulation may restrict or completely block portions of the inlet duct connection and the open space beneath the carbon support.

Either restriction or blockage will increase inlet velocities and pressure drop through the unit. This condition may be avoided by periodically draining the inlet lines and drains on the unit.

6.2.2 Blinding the Plenum

The plenum is constructed of black porous polyethylene support medium attached to angle bracing every 18". The porous polyethylene looks like pelleted carbon bonded together. The porous polyethylene not only supports the carbon., but also provides uniform distribution of the vapor.

If the influent vapor contains an excessive amount of particulates, the particulates may build up on the underside of the screen, causing a restriction of the open area and an increase in the pressure drop. If excessive blinding occurs within the unit, an upstream filter may have to be installed to remove the particulates prior to the adsorption unit.

6.2.3 Poor Adsorption and Inefficient Carbon Usage

Poor adsorption and/or inefficient carbon usage may be caused by the following:

- Channeling – level the bed
- Carbon saturation – change the carbon
- Premature increase in the effluent concentration – check the influent concentration
- Change in types of contaminants in the influent – compare influent analyses with original
- Presence of non-adsorbable organics in effluent –compare influent analyses with original

7.0 MAINTENANCE

These units are designed to require minimum maintenance. The following items should be inspected and maintained as noted:

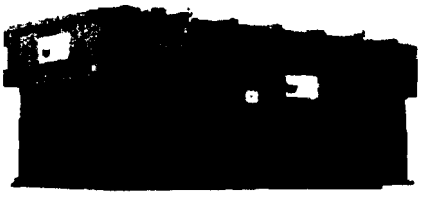
- Internal inspection of the lining and polyethylene plate should be performed each time the carbon is removed.
- Inspect all attachment hardware for damage
- Check for moisture accumulation by removing drain plugs at least every 2-3 months.
- Check inlet pressure periodically to insure proper operation.
- Inspect process connections periodically for signs of wear and/or leakage.

For reorders, replacement adsorbents or further technical information please contact

Activated Carbon Box Adsorbers

NIXTOX® NB15 AND NB20

Vapor phase activated carbon adsorption systems for air purification



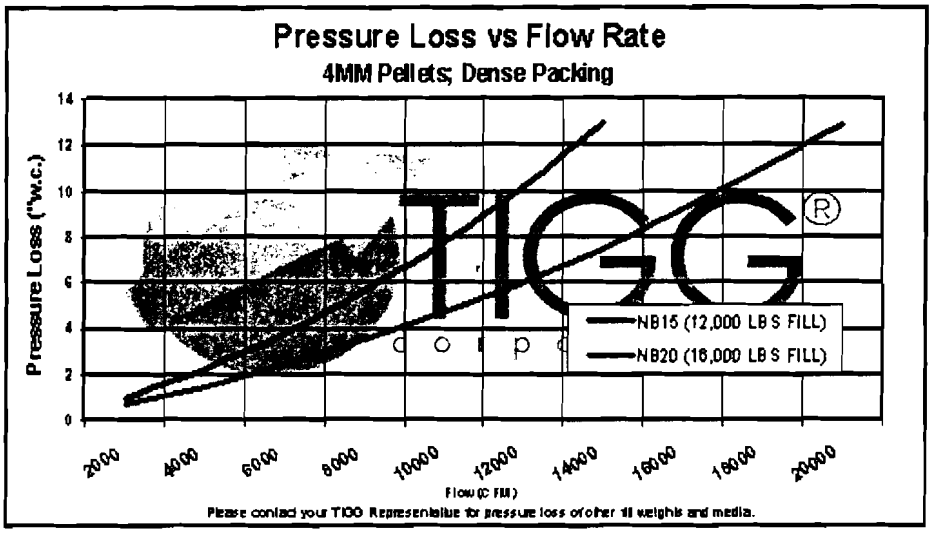
NIXTOX box series modular activated carbon box adsorbers are designed for environmental remediation and air purification applications with high flow rates. These activated carbon box adsorbers are manufactured of carbon steel providing a high solids epoxy lining which can withstand the work load of environmental remediation applications. These activated carbon box adsorbers feature a specially constructed plenum chamber which permits even flow distribution and thus efficient utilization of the ***activated carbon***. These adsorbers are provided with lifting lugs. Model numbers reflect the maximum flow for air and other vapors in environmental remediation applications. Specifications and properties are subject to change without notice. NB15 Pictured.

BOX ADSORBER MODEL PDF FILES*	NOM FLOW (CFM)	MAX PRESS (PSIG)	MAX TEMP (deg F)	INLET / OUTLET (IN)	DIMENSIONS LxWxH (FEET)	STANDARD ADSORBENT FILL (LBS) / MAX ADSORBENT FILL (LBS)	VESSEL WEIGHT (LBS)
NB-15	15000	1	180	16 / 16	22 X 8 X 9.3	12000 / 15000	9000
NB-20	20000	1	180	20 / 20	30 X 8 X 9.3	16000 / 20000	15000

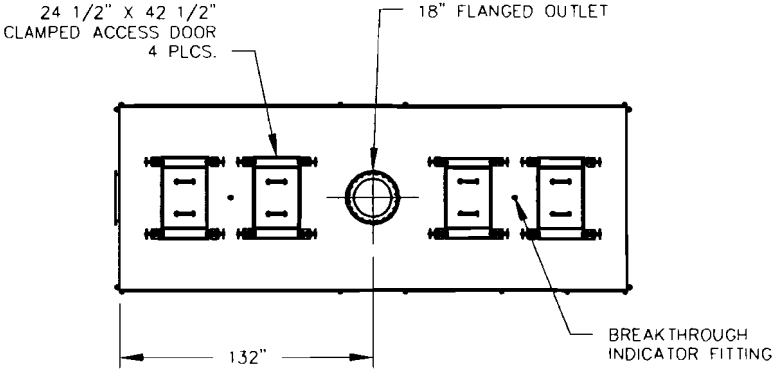
* INDICATES PDF FILE FOR DOWNLOAD

NOTES:

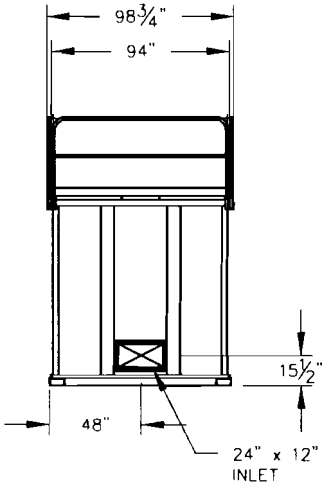
1. Nominal flow may be conservative. Desired contact time may allow higher or lower flow rates.
2. Dry virgin activated or reactivated carbon provided as standard adsorbent.
3. Adsorbent fill is based on a bed density of 27 lb/ft3
4. Adsorbent fill can differ based on variable bed density and alternate adsorbents.
5. Pressure drop curves are based on a dense packed activated carbon bed. Please contact your TIGG sales representative for more specific information.


Pressure Loss vs Flow Rate
4MM Pellets; Dense Packing
Pressure Loss ("w.c.)
14
12
10
8
6
4
2
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Flow (C FM)
NB15 (12,000 LBS FILL)
NB20 (16,000 LBS FILL)
Please contact your TIGG Representative for pressure loss of other fill weights and media.

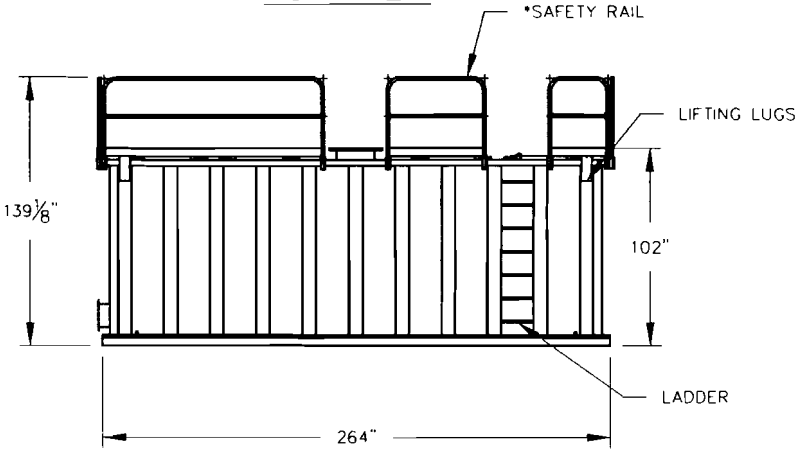
* SAFETY RAIL–
1 1/4"ø A-53 PIPE CONSTRUCTION
SHERWIN WILLIAMS SAFETY YELLOW
DURA-PLATE EPOXY 235



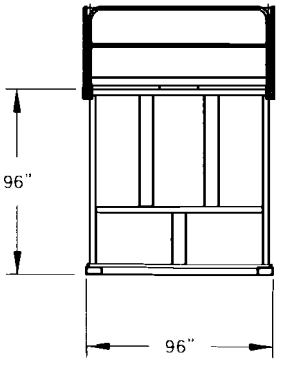
TOP VIEW



LEFT SIDE



FRONT VIEW



RIGHT SIDE

VESSEL STANDARDS

VESSEL MATERIALS : CARBON STEEL A-36	BED VOLUME STD/MAX : 413 FT³/ 517 FT³
LINING : HIGH SOLIDS EPOXY	CARBON FILL : 12,000 LBS
EXTERIOR PAINT : HIGH SOLIDS EPOXY	SHIP WT. EMPTY/MAX.FILL : 9,000 LBS/21,000 LBS
WALL THICKNESS : 12 GAUGE STD.	CARBON TYPE : TIGG 5CC 0612 VAPOR PHASE
FLOOR THICKNESS : 3/16" STD.	MAX. OPERATING PRESSURE : 40"H₂O
INTERNALS : CARBON STEEL & POLYETHYLENE	MAX. OPERATING TEMP. : 140°F
ADSORBENT OUTLET ASSEMBLY : 24" X 42" CLAMPED ACCESS AND 86" X 16" BOLTED DOORS	

NO.	REVISION	BY	DATE
2	REVISE TO SHOW SAFETY RAIL DESIGN	JB	11/1/05
1	REMOVE 86" X 16" ACCESS WAY ON LEFT SIDE	JB	10/3/05

PROJECT

BBL

PROJ. NO. E05-061-JK

P.O. NO.

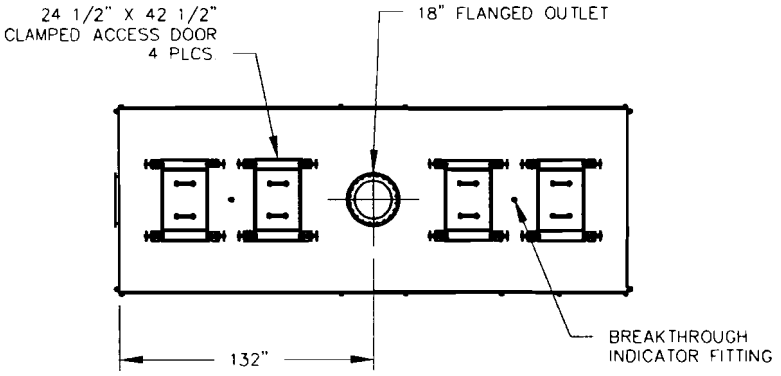
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	9/26/05
SCALE	NTS

TIGG corporation

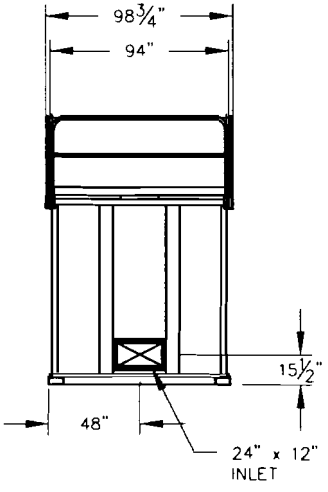
NB-15

DWG. NO. N05-1022-PZZ-2 REV. 2

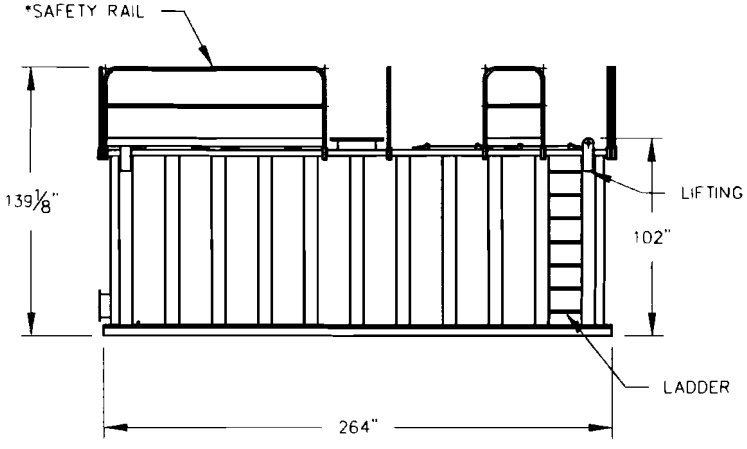
* SAFETY RAIL-
1 1/4"ø A-53 PIPE CONSTRUCTION
SHERWIN WILLIAMS SAFETY YELLOW
DURA-PLATE EPOXY 235



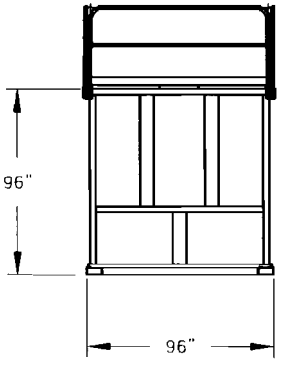
TOP VIEW



LEFT SIDE



FRONT VIEW



RIGHT SIDE

VESSEL STANDARDS

VESSEL MATERIALS : CARBON STEEL A-36	BED VOLUME STD/MAX : 413 FT³/ 517 FT³
LINING : HIGH SOLIDS EPOXY	CARBON FILL : 12,000 LBS
EXTERIOR PAINT : HIGH SOLIDS EPOXY	SHIP WT. EMPTY/MAX.FILL : 9,000 LBS/21,000 LBS
WALL THICKNESS : 12 GAUGE STD.	CARBON TYPE : TIGG 5CC 0612 VAPOR PHASE
FLOOR THICKNESS : 3/16" STD.	MAX. OPERATING PRESSURE : 40"H,O
INTERNALS : CARBON STEEL & POLYETHYLENE	MAX. OPERATING TEMP. : 140F
ADSORBENT OUTLET ASSEMBLY : 24" X 42" CLAMPED ACCESS AND 86" X 16" BOLTED DOORS	

NO.	REVISION	BY	DATE
2	MOVE LADDER AND RAIL	JB	10/28/05
1	REMOVE 86" X 16" ACCESS WAY ON LEFT SIDE	JB	10/3/05

PROJECT: BBL

PROJ. NO. E05-061-JK

P.O. NO.

DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	9/26/05
SCALE	NTS

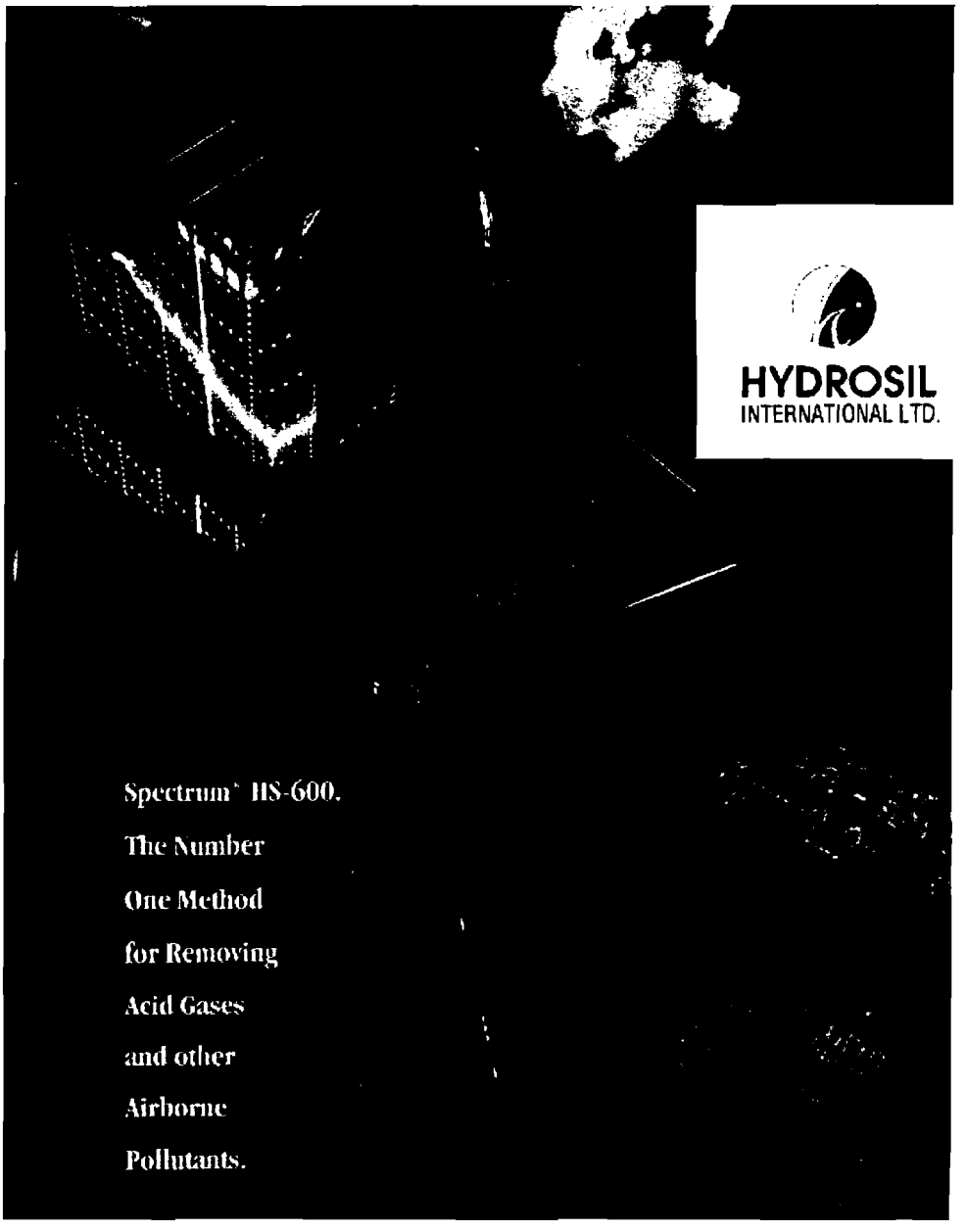
TIGG corporation

NB-15

DWG. NO. N05-1022-PZZ-1 REV. 2

Hydrosil HS-600

Spectrum HS-600 is the most effective solution for odor and corrosion control available.



Specifications on Spectrum HS-600

Hydrosil vigorously controls the production process. Data is reviewed and maintained on each batch as it is being produced through and including the moisture content of the HS-600 being delivered to our customer.

HS-600 Specifications

The potassium permanganate impregnated media shall have no less than 3.6 pounds of potassium permanganate per cubic foot a bulk density of no less than 60 pounds per cubic foot, a moisture content of 12-15% by weight and shall not dust. The media shall have an irregular particle size of 4 x 8 mesh.

The performance characteristics of the air filtration media shall meet or exceed a service life of no less than 72 hours for breakthrough of hydrogen sulfide at the following test conditions:

Media Bed Volume	76.00 cubic centimeters
Bed Configuration	2.54 cm (id) x 15.00
Flow Rate	3000 (+/- 100) ml/minute
Relative Humidity	70%
Challenge Gas	Hydrogen sulfide
Challenge Gas Concentration	10 (+/- 0.25) PPM

Competitive Information

Page 2

Hydrosil HS-600 Compared to Potassium Hydroxide Impregnated Carbon

	Hydrosil HS-600	Potassium Hydroxide Impregnated Carbon
Active Ingredient	**KMn04**	KOH
Substrate	**Zeolite**	Activated Carbon
Cation Exchange Capacity	**Yes**	No
Dusting	**Insignificant**	Moderate
Attrition	**Insignificant**	Moderate
Hardness of Substrate	**Hard**	Soft
Erosion in Air Stream	**Insignificant**	Low
Particle Size	**1/8" to 1/4"**	1/16" to 1/4"
Flammability	**No**	Yes
Bulk Density	**60#'s/ft3**	32 #'s/ft3
% of Active Ingredient	**6.0%**	5.0%
#'s of Active Ingredient (1.0 cubic foot)	**3.6 #'s (Mn04/KOH/Mn02)**	1.6 #'s (-/KOH/ -)
Moisture Content	**12 to 15%**	Not less than 12%
Disposal Cost	**Same**	Same
Possible Combustion During Startup	**None**	Yes
Color Indicator When Spent	**Yes**	No

*Chemically KMn04 produces three ingredients: Mn04, KOH, and Mn02

HS-600 Provides a significantly longer service life than potassium impregnated carbon.

- Hydrosil HS-600 has 3.6 pounds of active ingredient as compared to 1.6 pounds of active ingredient (32 pounds per cubic foot times 5.0%). Mathematically, the service life of HS-600 is 125% longer.

HS-600 is effective on a broader spectrum of gaseous pollutants

- Potassium permangante used in the Hydrosil HS-600 production process chemically produces manganese dioxide (MnO2) and manganese tetraoxide (Mn04), in addition to potassium hydroxide (KOH). Manganese dioxide/tetraoxide is effective in removing sulfur dioxide, nitrogen dioxide, chlorine dioxide and mercaptans. These chemicals are not present in potassium hydroxide impregnated carbon. Typically corrosive pollution in a plant environment is caused by a broad group of chemicals, and potassium hydroxide impregnated carbon is too focused to handle this broad spectrum.

HS-600 does not support combustion.

- Potassium hydroxide impregnated carbon will support combustion.

HS-600 provides a visual indicator when the media is spent.

- The manganese dioxide/tetraoxide produces a purple color, which evolves to a dull brown as the media is spent. Testing is the only reliable way of knowing the remaining productive service life of the media. Visual indications are useful in prioritizing the need to test.

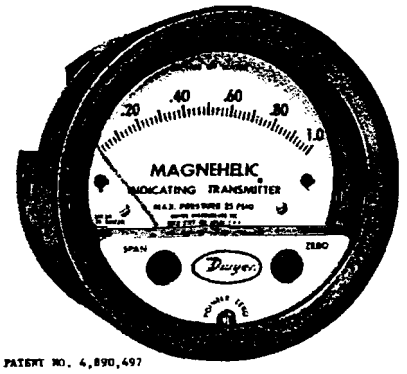
Section 6-D

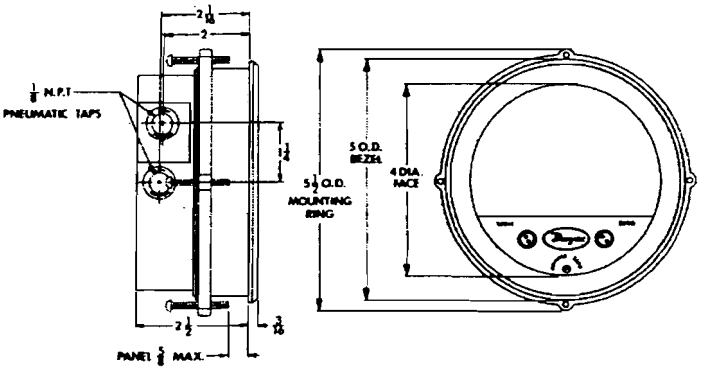
Air Stripper Effluent Air Pressure Indicating Transmitter (PIT-313)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

SERIES 605 MAGNEHELIC®
DIFFERENTIAL PRESSURE INDICATING TRANSMITTER

Specifications - Installation and Operating Instructions





The Dwyer Series 605 Magnehelic® indicating transmitter simultaneously provides local indication on a large, easily read analog scale while also converting that pressure into a standard two-wire, 4-20 mA signal for ranges from 0-0.5 to 0-50"w.c. Positive, negative or differential air and compatible gas pressure can be measured with an accuracy of ±2% of full scale. The basic mechanical components of the Series 605 Magnehelic® indicating transmitter are similar to those used in the popular, time-proven Magnehelic® differential pressure gage. However, the Series 605 models add electrical conditioning and amplification of a resistance change produced by a silicon strain gage which is cemented to the range spring. This resistance change is the result of the slight flexing which results from spring deflection as pressure is applied to the diaphragm which is directly linked to the spring. Refer to bulletin E-50 for additional information on the design, operation and construction of the Magnehelic® indicating transmitter.

SERIES 605 MODELS & RANGES

MODEL NUMBER	RANGE, INCHES W.C.	MINOR DIVS.
605-0	0-.5	.01
605-1	0-1.0	.02
605-2	0-2.0	.05
605-3	0-3.0	.10
605-6	0-6.0	.20
605-10	0-10	.20
605-20	0-20	.50
605-30	0-30	1.0
605-50	0-50	1.0
MODEL NUMBER	**RANGE, PASCALS**	**MINOR DIVS.**
605-250Pa	0-250	5
605-500Pa	0-500	10
MODEL NUMBER	**RANGE, KILO PASCALS**	**MINOR DIVS.**
605-1.5kPa	0-1.5	.05

SPECIFICATIONS

GENERAL

Maximum Pressure:	25 PSIG
Media Compatibility:	Air & noncombustible, noncorrosive gases

ELECTRICAL

Power Supply:	12.3 to 35 VDC.
Connections:	2 screw terminal block, positive and negative.
Output Signal:	4 to 20 mA DC (limited at 38 mA)
Loop Resistance:	0 to 1135 ohms $R_{Load} = \frac{V_{ps} - 12.3V}{20mA}$
Warm-up Time:	5-10 Minutes
Current Consumption:	38 mA max. DC

PERFORMANCE AT ROOM TEMPERATURE

Zero Output:	4 mA
Full Scale Span:	16 mA
Static Accuracy:	±2% Span
Span & Zero:	Adjustable to 0.05%
Repeatability:	0.5% Span
Resolution:	Infinitesimal

ENVIRONMENTAL

Operating Temperature:	20 to 120°F (dry air)
Compensated Temperature:	30 to 120°F
Thermal Errors:	±1%/50°F

MECHANICAL

Weight:	1 lb. 10 oz.
Span & Zero Adjustments:	Protected potentiometers, externally accessible.
Pressure Connections:	⅛-27 NPT female

STANDARD ACCESSORIES

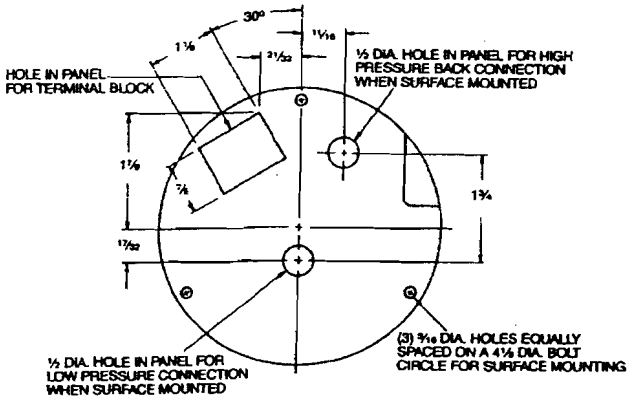
Mounting ring
Snap ring
(4) 6-32 x 1-1/4 screws (panel mtg.)
(3) 6-32 x 5/16 screws (surface mtg.)
(2) Tubing to 1/8" NPT adapters
(2) 1/8" NPT plugs
Adjustment key

INSTALLATION

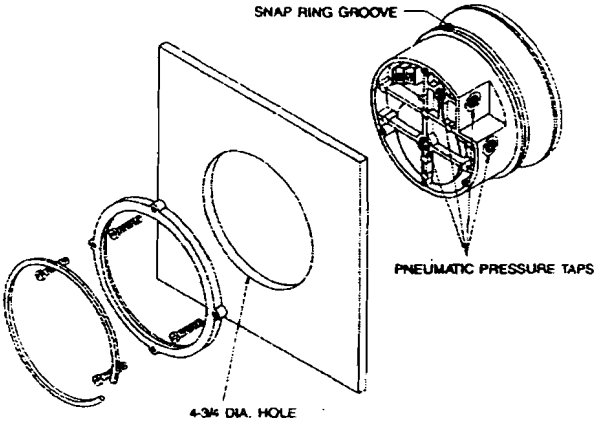
1. **LOCATION:** Select a location where the temperature of the unit will be between 20°F and 120°F. Distance from the receiver is limited only by total loop resistance. See "Electrical Connections." The tubing feeding pressure to the instrument can be run practically any length required but long lengths will increase response time slightly. Avoid surfaces with excessive vibration.

2. **POSITION:** All standard models are calibrated with the diaphragm vertical and should be used in that position for maximum accuracy. If your application requires mounting in other than a vertical position, be sure to specify this when ordering.

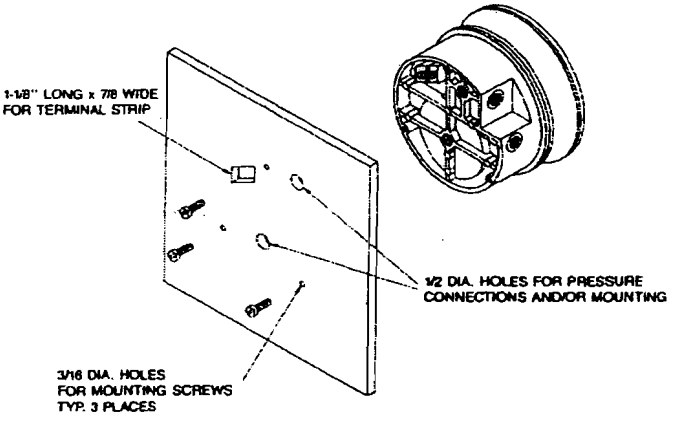
3. **PRESSURE CONNECTIONS:** For convenience, two sets of 1/8" NPT female ports are available. Plug the unused set with pipe plugs provided. Attach tubing from positive pressure source to port marked "HI" or from negative (Vacuum) source to port marked "LOW". In either case, opposite port must be vented to atmosphere. In dusty environments, we recommend use of an A-331 Filter Vent Plug to keep interior of instrument clean. For differential pressures the higher source is connected to the "HI" port and lower to the "LOW" port.



4. **MOUNTING:** The Series 605 Transmitter may be either panel mounted or surface mounted.



A. **PANEL MOUNTING:** Cut a 4¾" or 120mm dia. hole in panel and insert the complete unit from the front. Slip on the mounting ring and install the split snap ring in the groove on the bezel. Seat the mounting ring against the snap ring and thread the four screws through the tapped holes. Tighten screws against rear of panel.



B. **SURFACE MOUNTING:** Drill (3) 3/16" dia. holes for mounting screws and cut (1) 7/8" x 1-1/8" hole for access to terminal strip as shown in hole location drawing. Insert screws from rear of panel and thread into tapped holes on back of transmitter case. If rear pressure connections are to be used, make 1/2" dia. holes located as shown in hole location drawing in left column.

5. **ZEROING:** Once gage/transmitter is mounted in its final position, check to be sure pointer aligns with zero on scale, when no pressure is applied and both low and high pressure ports are vented to atmosphere. To adjust, turn small slotted screw at center-bottom of gage face. Do not move the larger black knobs labeled SPAN and ZERO. These are for use only if a calibration check shows the 4-20 mA output signal to need adjustment. See page 3 under heading OUTPUT RANGING.

ELECTRICAL CONNECTIONS

CAUTION: DO NOT EXCEED SPECIFIED SUPPLY VOLTAGE RATINGS. PERMANENT DAMAGE NOT COVERED BY WARRANTY WILL RESULT. THIS UNIT IS NOT DESIGNED FOR AC VOLTAGE OPERATION.

Electrical connections to the Series 605 Transmitter are made to the two-screw terminal strip on the rear of the case. Polarity is indicated by + and − signs stamped on side. The schematic diagram of the Series 605 transmitter is illustrated in Figure B.

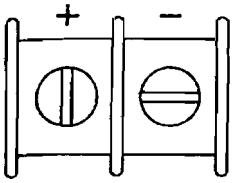


FIG. A

An external power supply delivering 12.3 to 35 VDC with a minimum current capability of 40 milliamps must be used to power the control loop in which the Series 605 transmitter is connected. Refer to Fig. B for connection of the power supply, transmitter and receiver. The range of appropriate receiver load resistances (R_L) for the power supply voltage available is given by the formula and graph in Fig. C. Shielded two wire cable is recommended for control loop wiring and the negative side of the loop may be grounded if desired. Note also that the receiver may be connected in either the negative or positive side of the loop, whichever is most convenient. Should polarity of the transmitter or receiver be inadvertantly reversed, the loop will not function properly but no damage will be done to the transmitter.

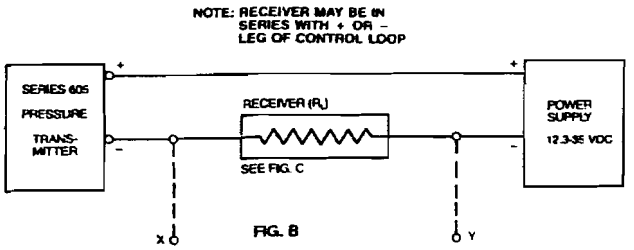


FIG. B

The maximum length of connecting wire between the transmitter and the receiver is a function of wire size and receiver resistance. That portion of the total current loop resistance represented by the resistance of the connecting wires themselves should not exceed 10% of the receiver resistance. For extremely long runs (over 1,000 feet), it is desirable to select receivers with higher resistances in order to keep the size and cost of the connecting leads as low as possible. In installations where the connecting run is no more than 100 feet, connecting lead wire as small as No. 22 Ga. can be used.

The Series 605 transmitters can be used with receivers requiring 1-5 volt input rather than 4-20 mA. If the receiver requires a 1-5 volt input, insert a 250 ohm, ½ watt resistor in series with the current loop but in parallel with the receiver input. Referring to Figure B, R_L becomes the 250 ohm resistor and points X and Y are connected to the receiver input, point X being positive (+) and point Y negative (−) or ground. The resistor should be connected at the panel end of the transmitter current loop close to the receiver input to take advantage of the immunity of the current loop to electrical noise pickup. Most electronic component distributors stock a 249 r, ½ watt, ± 1% tolerance metal film resistor which is adequate for this application.

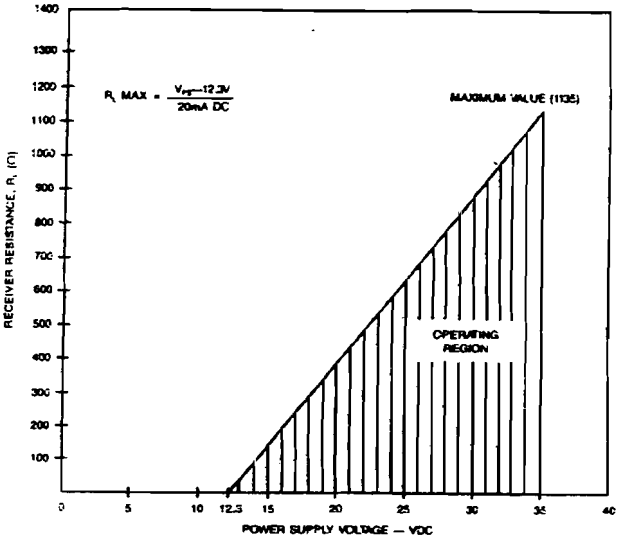


FIG. C

OUTPUT RANGING

Each Series 605 Magnehelic® indicating transmitter is factory calibrated to produce 4 mA at zero scale reading and 20 mA at full scale reading. The following procedure should be used if the pressure versus output signal relationship needs to be checked.

1. With unit connected to the companion receiver per preceding instructions, insert an accurate milliammeter with a full scale reading of approximately 30 mA in series with the current loop.
2. Vent both pressure ports to atmosphere and, if necessary, adjust pointer zero screw to align pointer with zero on scale. A controllable pressure source capable of reaching the full scale range should be connected to either high pressure port. Plug the other high pressure port and vent one or both low pressure ports to atmosphere. The instrument must be ranged in the same position in which it will be used. Standard factory calibration and ranging is done with unit vertical.
3. Apply electrical power to the system and check for proper operation by slowly increasing pressure and observing whether the loop current increases above the 4 mA zero pressure reading.
4. A spanner type key is supplied to adjust span and zero. This helps to reduce unauthorized tampering. Apply pressure until pointer aligns with full scale reading and adjust the SPAN knob for a 20 mA reading.
5. Relieve all pressure, allow a few seconds for settling and adjust the ZERO knob for a 4 mA current loop reading.
6. The SPAN and ZERO controls are slightly interactive so steps 4 & 5 should be repeated a few times until readings of 4 and 20 mA are obtained consistently.
7. Remove the milliammeter from the current loop and proceed with final installation of the transmitter and receiver.

MULTIPLE UNITS WITH COMMON POWER SUPPLY

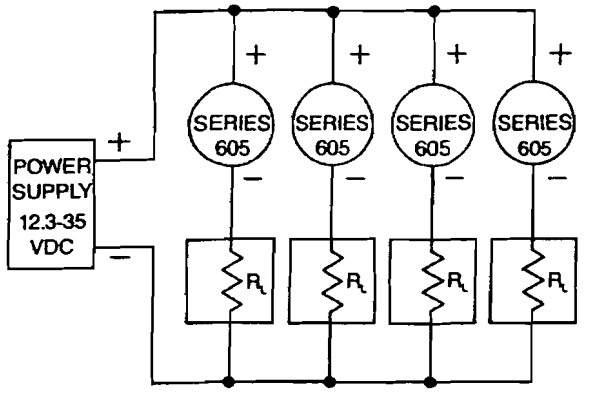


FIGURE D

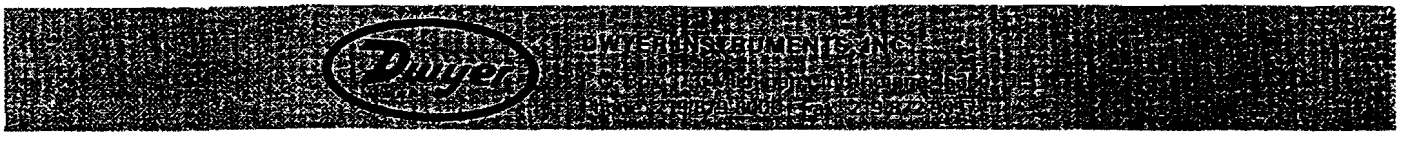
Several Series 605 transmitters can be operated with a single power supply as depicted above in Figure D. Be careful to specify a supply with sufficient capacity. The minimum current requirement at a given voltage can be calculated by multiplying the number of units x 20 mA. In the example shown this would be 4 x 20 or 80 mA minimum.

MAINTENANCE

Upon final installation of the Series 605 Transmitter and the companion receiver, including the A-701 Digital Readout, no routine maintenance is required. A periodic check of system calibration is recommended. The Series 605 Differential Pressure Transmitter is not field serviceable and should be returned to the factory if service is required. The A-701 Digital Readout should be returned to the manufacturer if service is required. Refer to the A-701 instruction sheet.

Printed in U.S.A. 10/92

FR NO. 01-440559-00



Section 6-E

Air Flow Rate Indicating Transmitters (FE/FIT-313, FE-FIT-641)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

ELDRIDGE PRODUCTS, INC.

Master-Touch™

version 3.9G

SERIES 8000MP

MICROPROCESSOR-BASED
THERMAL MASS FLOWMETERS

INSTRUCTION MANUAL

80201101 (Rev. 1.5I)

CE Compliant

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2700 Garden Road, Building A
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Table of Contents

Section A Introduction and Installation

Introduction

Your Master-Touch flowmeter includes a flow sensing element, temperature sensing element, bridge amplifier/signal output board, microprocessor circuit board, transmitter enclosure, and probe support or flow section. Depending upon your requirements, these individual pieces may be integrated into one assembly or you may have a flow transmitter with remote electronics. In either configuration, the microprocessor converts the nonlinear input signal received from the flow transmitter to linear 0–5 VDC & 4–20 mA output signals. RS232 and RS485 communication protocols support the use of *EPICommunicator* (EPICom) for monitoring and control.

Unpacking Your Instrument

Your Master-Touch thermal mass flowmeter is a precision piece of electronic flow instrumentation. Although these flowmeters are rugged, they should be inspected upon delivery to assure that no damage has taken place during transit. If upon inspection it is found that damage has occurred, notify the carrier immediately and place a claim for damaged goods. The shipping container or crate should be handled with care and carefully opened to avoid possible damage to the contents. After the container is opened the contents should be carefully removed and the individual pieces checked against the packing list. Should you discover a discrepancy, contact EPI shipping department right away. The last verification is to check that the equipment and calibration range match your purchase order specifications. If you find that a mismatch has taken place, contact the EPI sales department immediately.

Installation And Mounting

Effects of Reynolds Number in Closed Conduits

Reynolds Number (RD) defines whether laminar flow or turbulent flow are causing the flow profile within the flow conduit. Laminar flow has a RD of <2000 with a parabolic flow profile, while turbulent flow has a RD of >4000 with a more uniform (squared up) face velocity. The RD's between 2000 and 4000 are in the transition region allowing a change in profile from laminar to a turbulent face velocity profile. Turbulent flow profile is not the same as turbulence or swirl within the flow conduit. Changing Reynolds Numbers are caused by changing flow rates within the flow conduit.

Installation of Thermal Dispersion Gas Mass Flowmeters

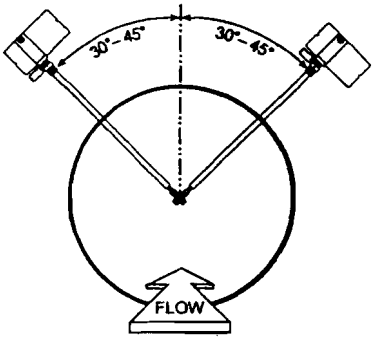
Optimum installation requires sufficient straight run to allow a uniform, non-swirling, fully-developed flow profile within the flow conduit. It is best to avoid installations which are immediately downstream of bends, abrupt cross-sectional area increases or decreases, fans, louvers, or other equipment installed in the line. These situations can cause non-uniform flow profiles and swirl which can result in signal errors. Problematic flow profiles require flow conditioning to improve meter performance. Consult the factory for additional information.

Our insertion flowmeters are now calibrated for point-of-average-flow (.243r) positioning in the process line with a fully-developed flow profile. You may need to make minor adjustments in the sensor position or utilize the C-Factor of the Master-Touch software for the most accurate flow readings due to a non-uniform flow profile in your process line. The design of our probe assembly is such that the active part of the flow sensor is always .75" from the bottom of the sensor's protective

window. Please take into account the location of the active part of the sensing element when installing the flowmeter.

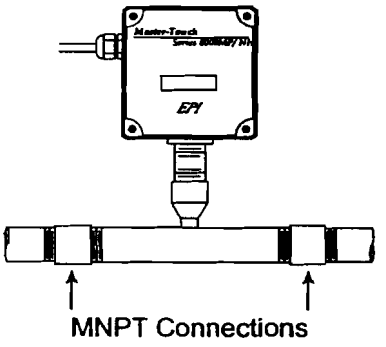
For additional information see the *Probe Insertion Guidelines* located in Section H.

The temperature parameters for the transmitter are listed in the specification section of this manual. Acceptable limits for the gas temperature and the environmental temperature limits to which the transmitter electronics may be subjected are provided.



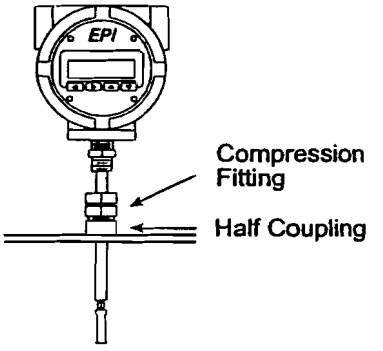
The flowmeter must be installed at a location where the gas is dry or above the dew point temperature. Installations which allow large droplets of water to condense out and come in contact with the sensing element must be avoided. EPI has developed a strategy which is usually successful in minimizing or eliminating this affect. For installations where the formation of condensing water droplets in a horizontal process line is unavoidable, the flowmeter should be mounted at an angle of 30°–45° from the vertical. This will allow any droplets which collect on the inner pipe wall and run down probe assembly to drop off before they come into contact with the sensor.

Installation of the Master-Touch flowmeter is accomplished by one of the following two methods:



Inline style flowmeters require plumbing the flowmeter in series with the flow conduit by threading, flanging, welding or by fitting in place with the use of tube fittings on sizes up to one inch O.D. Various end configurations are available for the inline style flowmeters and will determine the exact process of installation. The standard end configuration is MNPT (male national pipe thread) threaded ends for flow sections up to 3"; flow sections of 3" and larger are assembled with the appropriate size of ANSI 150lb Class flanges. Other end styles are optional.

Insertion style flowmeters require the probe support to be inserted through the flow conduit. The probe support can be held in place by a pipe nipple threaded to the user's flow conduit with a connecting pipe coupling threaded between the flowmeter probe and pipe nipple. Nipple length must be sized to allow the probe to be inserted to the proper depth in the process flow stream.



Alternately, the flowmeter is installed by the use of the proper size bored through tube fitting. The tube fitting is provided by the user or purchased as an option from EPI. Installing the tube fitting consists of preparing the flow conduit to accept the fitting by first drilling a clearance hole for the transmitter probe assembly, welding it in place, or threading it into the proper size half coupling which has been welded to the flow conduit.

The maximum pressure for insertion style flowmeters is stated in the General Specifications section of this manual. To reduce the possibility of personal injury when servicing the flowmeter, each size is rated such that the maximum force applied to the transmitter is approximately 25 pounds. Caution should be exercised if considering applying higher pressures, and AT HIGHER PRESSURES, A HOLDING DEVICE MAY BE REQUIRED TO PREVENT THE TRANSMITTER FROM BEING PROJECTED OUT OF THE PROCESS LINE WHEN REMOVING OR REPLACING THE TRANSMITTER ASSEMBLY.

Power Requirements

Power requirements for Master-Touch flowmeters with the "-DC24" option are user supplied 18 to 24 Volts DC @ 250 mA. All wiring and conduits shall be installed per the National Electrical Code requirements as appropriate for the application.

Power requirements for Master-Touch flowmeters with the "-AC115" option are 115 VAC 50/60 Hz standard, or 220 VAC 50/60 Hz with the "-AC230" option. If conduit is used to enclose the power input line, it should be suitable for the application, electrically conductive, and connected within the enclosure to the earth ground. Our recommendation on wire size is 18 Ga. stranded for all AC wiring.

Transmitter power requirements are met with the power provided by the signal processor assembly. Ten feet of two wire connection cable is provided with the flowmeter assembly. If more cable is required, the 10' length should be replaced with a two wire twisted or shielded cable. The wire should be sized for no more than 5 Ohms resistance across the loop and not less than 22 AWG. The transmitter is independent of cable length and won't suffer any signal degradation with length changes.

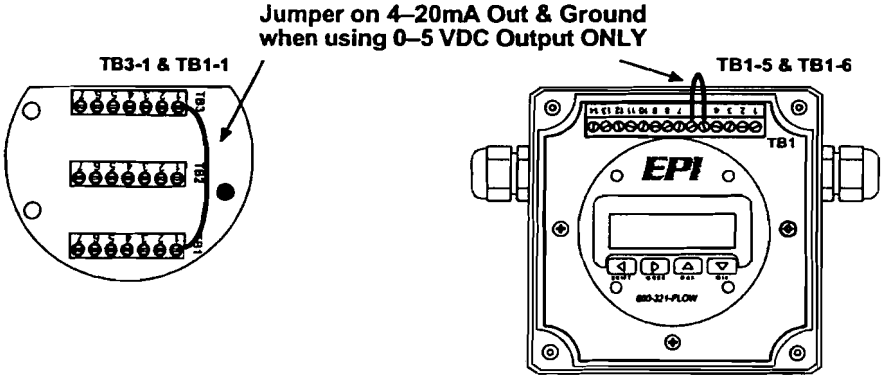
If replacing the wire connection cable, seal wiring access ports as appropriate (3/4" NPT) to maintain the transmitter enclosure rating (if required per N.E.C.).

Signal Interface

The microprocessor provides both 0–5 Volts DC and 4–20 mA flow output signals. Voltage signals should not be sent over long distances due to small currents causing voltage drops across the wire pair. If the voltage is to be sent over a distance (for example 50 feet), the wire AWG should be sized to reduce the voltage drop to acceptable levels. Knowing your load impedance is the only way this calculation may be achieved. Our 4–20 mA signal is provided to prevent this sort of signal loss. Current loops are normally not susceptible to noise and are not affected by voltage drops around the loop. However, it is important when using a current loop not to exceed the level of load resistance that the current loop may drive. Our current loop will drive a load (lead plus load resistance) of 500 ohms. When the 4–20mA current loop output is not to be used, jumper around the loop at the output signal connections (see below).

RS232 and RS485 connections are also available for direct communication via the appropriate version of the *EPICommunicator* software.

The Master-Touch Series has been tested and approved as CE Compliant.



Section G General Specifications

Linear signal output	0–5 VDC & 4–20 mA
Accuracy including linearity (Ref.: 21°C):	± (1% of Reading + (.5% + .02%/°C of Full Scale))
Repeatability	± 0.2% of Full Scale
Sensor response time (ceramic)	100 ms typical
Sensor response time (stainless)	1 second
Signal response time	Set to one second
Turn down ratio	100:1 minimum
Electronics temperature range	0–50°C (32–122°F) *Consult factory for extended range.*
Gas temperature range	0–200°C (32–392°F) *Consult factory for extended range.*
Gas temperature effect	.02% /°C
Gas pressure effect	Negligible over ±20% of absolute calibration pressure
Pressure rating maximum (*See note below*):	
MP Series	
In-line flowmeters	500 PSI Std., >500 special
Insertion O.D. .500	125 PSI Std., >125 special
" " .750	55 PSI Std., >55 special
" " 1.000	30 PSI Std., >30 special (*See note below*)
MP/NH Series	
In-line flowmeters	250 PSI Std., >250 special
Insertion O.D. .500	125 PSI Std., >125 special
" " .750	55 PSI Std., >55 special
" " 1.000	30 PSI Std., >30 special (*See note below*)
Transmitter power requirements	5 Watts or less
RAM Back-up	Lithium Battery
Flow transmitter enclosure	NEMA 4,Class 1, Div 1, Groups B, C, & D, Std.
Wetted materials:	
MP Series	
In-line & Insertion	316SS, including sensor
MP/NH Series	
In-line & Insertion	316SS, including sensor
Standard temperature & pressure (STP)	70° F & 29.92" Hg (Air .075 lb/cubic foot)
NIST traceable calibration	Standard

Insertion probe PSI is rated to limit applied force at probe to a maximum of 25 pounds. Above the listed pressure, a restraining device is required to eliminate the potential of the probe being forced out of the line during installation or removal under pressure.

Specification Notice

Specifications contained herein are subject to change without notice, EPI cannot guarantee the applicability or suitability of our products in all situations since it is impossible to anticipate or control every condition under which our products and specifications may be used.

Service Work

In the event that service work is required or calibration and recertification is required, call the factory and a return materials authorization (RMA) number will be issued for each job. All units sent in for service work shall include a RMA, work instructions and be shipped prepaid. On receipt of your flow instrumentation, we will inspect the equipment and give a price quotation for service work to be performed, if not already given.

Storage

Equipment and instrumentation shall be stored in an environmentally controlled storage shelter or warehouse when not in use. All openings shall be sealed off to prevent foreign materials from entering the instrumentation.

Limited Warranty

Eldridge Products, Inc. (EPI) warrants its products to be free from defects in materials and workmanship for one year from the date of factory shipment. If there is a defect, the purchaser must notify EPI of the defect within the warranty period. Upon receipt of the defective product, EPI will either repair or replace the defective product at its sole option and at no cost to the purchaser. EPI MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AS TO THE PRODUCTS. EPI MAKES NO WARRANTY THAT THE GOODS SOLD TO ANY PURCHASER ARE FIT FOR ANY PARTICULAR PURPOSE. FURTHERMORE, EPI MAKES NO WARRANTY OF MERCHANTABILITY WITH RESPECT TO ANY PRODUCTS SOLD TO ANY PURCHASERS. There are no other warranties that extend beyond the description on any brochure or price quote.

Limited Acceptance

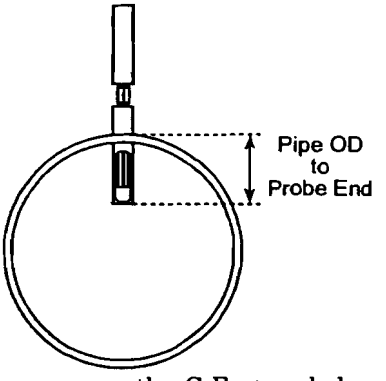
Acceptance of any offer is limited to its terms. Acceptances or confirmations that state additional or differing terms from this price quote shall be operative as acceptances, but all additional or differing terms shall be deemed material alterations within the meaning of Commercial Code Section 2207(2)(b), and notice of objection to them pursuant to Commercial Code Section 2207(2)(c) is hereby given. The laws of the State of California govern this contract and venue is Monterey County. Risk of loss passes F.O.B. EPI factory. Payment due in full in US Dollars within credit terms granted from factory shipment. Additional fees shall include interest on unpaid balances that are outstanding for more than granted credit terms, plus all collection costs and attorneys' fees incurred in collecting any outstanding balance. Any and all additional or differing terms do not become part of the contract between EPI and any purchaser.

The terms of any offer are expressly limited to the terms detailed in any product brochure or price quote. Any modification to any of the terms of this offer must be in writing and must be signed by an officer of EPI.

Section H Guidelines and Product Drawings

Probe Insertion Guidelines

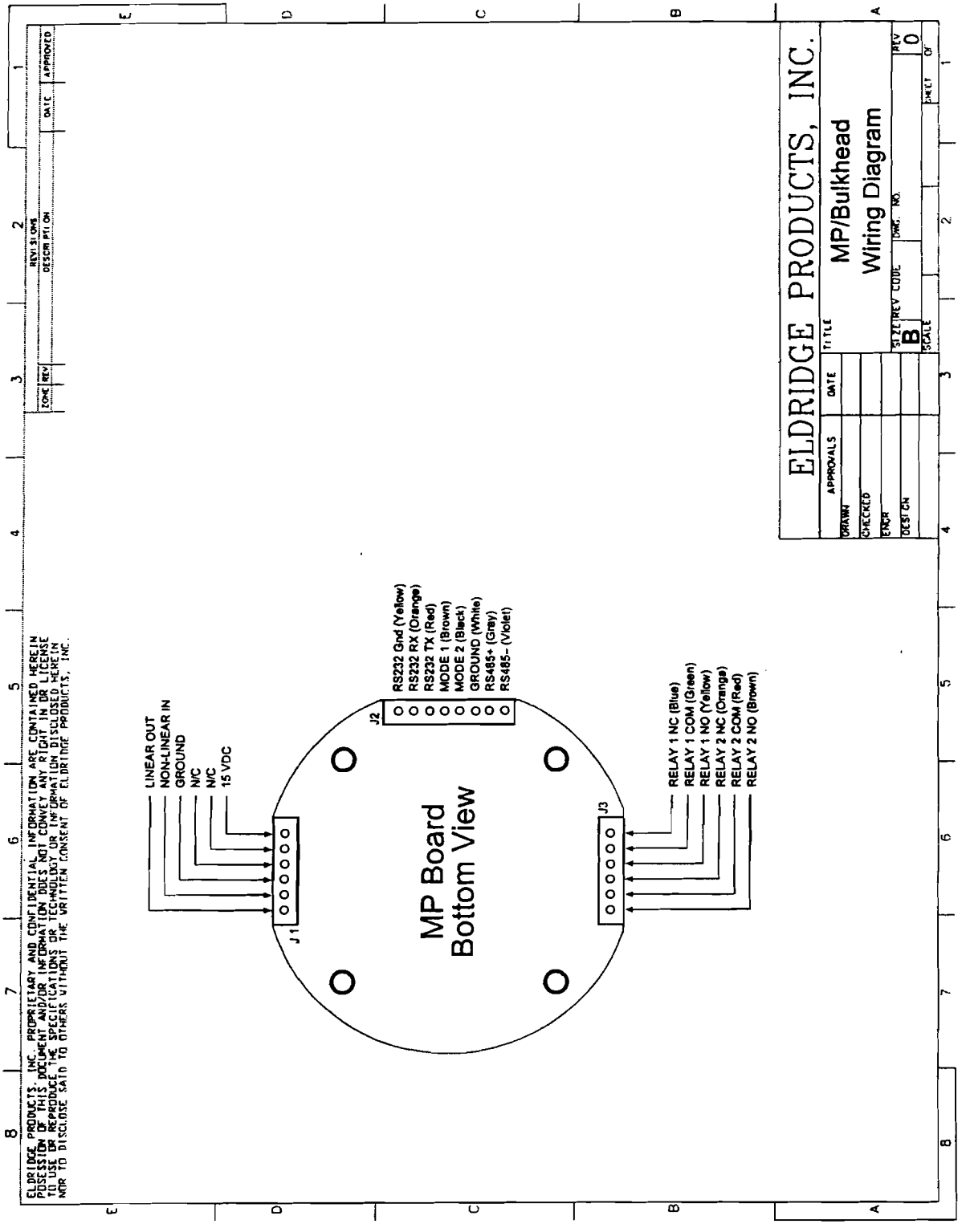
The following chart presents the C-Factor adjustments for **insertion** style Master-Touch flowmeters. To use the information properly, insert the probe assembly to the correct position in the process line according to "Pipe OD to Probe End" guidelines, and enter the C-Factor corresponding to probe OD and pipe size into the microprocessor settings (Menu 811–C-Factor). The C-Factor can be entered into the settings before or after insertion into the process line.



The calculation for the probe insertion depth (pipe OD to probe end) includes the point-of-average-flow, the 1.3" slot in the protective sensor window, and the wall thickness of each nominal pipe size, as well as a further adjustment on smaller line sizes to be sure that the slot is fully inserted through the pipe wall. The C-Factor corrects the blockage effect created by inserting the probe assembly into the pipe to the depth listed.

The information below assumes a well-developed flow profile in the process line. The actual flow profile may not conform to this standardized profile. Therefore, a further adjustment to the position or C-Factor may be required to improve the overall accuracy of the flowmeter readings. If an additional adjustment is necessary, the C-Factors below must be multiplied by the second correction to calculate the revised C-Factor. For example, if an adjustment of 0.975 must be made to the listed C-Factor for a ½" probe in a 4" line (0.868), the revised C-Factor is 0.975 x 0.868 = 0.8463.

Sch 40 Nominal Pipe Size	Inside Diameter (inches)	Wall Thickness (inches)	Cross-sectional Area (ft^2)	Pipe OD to Probe End (inches)	Menu 811 – C-Factor			
					1/2" OD Probe	3/4" OD Probe	1" OD Probe	3/8" OD PS1
2"	2.067	0.154	0.0233	**1.6**	0.858	0.856	0.854	0.550
2.5"	2.469	0.203	0.0332	**1.6**	0.795	0.793	0.792	0.567
3"	3.068	0.216	0.0513	**1.6**	0.813	0.811	0.810	0.590
4"	4.026	0.237	0.0884	**1.7**	0.868	0.866	0.864	0.762
6"	6.065	0.280	0.2006	**1.8**	0.978	0.976	0.974	1.000
8"	7.981	0.322	0.3474	**2.1**	1.000	1.000	1.000	1.000
10"	10.020	0.365	0.5476	**2.4**	1.000	1.000	1.000	1.000
12"	12.000	0.375	0.7854	**2.6**	1.000	1.000	1.000	1.000
14"	13.250	0.375	0.9575	**2.8**	1.000	1.000	1.000	1.000
16"	15.250	0.375	1.2684	**3.0**	1.000	1.000	1.000	1.000
18"	17.250	0.375	1.6230	**3.2**	1.000	1.000	1.000	1.000
20"	19.250	0.375	2.0211	**3.5**	1.000	1.000	1.000	1.000
24"	23.250	0.375	2.9483	**4.0**	1.000	1.000	1.000	1.000


ELDRIDGE PRODUCTS, INC.
MP/Bulkhead
Wiring Diagram
MP Board
Bottom View
J1
J2
J3
LINEAR OUT
NON-LINEAR IN
GROUND
N/C
N/C
15 VDC
RS232 Gnd (Yellow)
RS232 RX (Orange)
RS232 TX (Red)
MODE 1 (Brown)
MODE 2 (Black)
GROUND (White)
RS485+ (Gray)
RS485- (Violet)
RELAY 1 NC (Blue)
RELAY 1 COM (Green)
RELAY 1 NO (Yellow)
RELAY 2 NC (Orange)
RELAY 2 COM (Red)
RELAY 2 NO (Brown)
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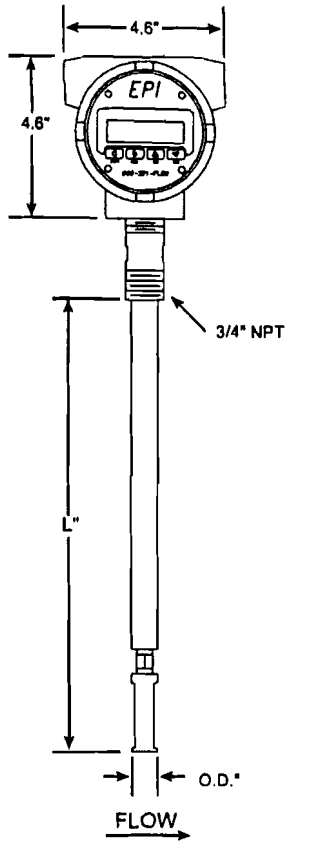
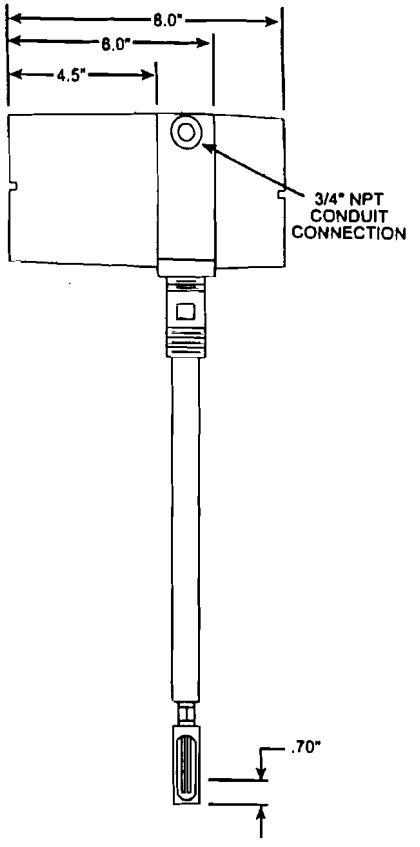
REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED





Model Number	O.D.	Length
8830MP	3/8"	to 36"
8840MP	1/2"	to 60"
8860MP	3/4"	to 84"
8880MP	1"	to 108"

ELDRIDGE PRODUCTS, INC.

APPROVALS	DATE
DRAWN	
CHECKED	
ENGR	
DESIGN	

TITLE: Series 8800MP

SIZE: B | REV CODE | DWG NO. 58500401 | REV A

SCALE | SHEET 1 OF 1

ELDRIDGE PRODUCTS, INC.
2700 Garden Road, Building A
Monterey, California 93940

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Email sales@epiflow.com
Internet www.epiflow.com

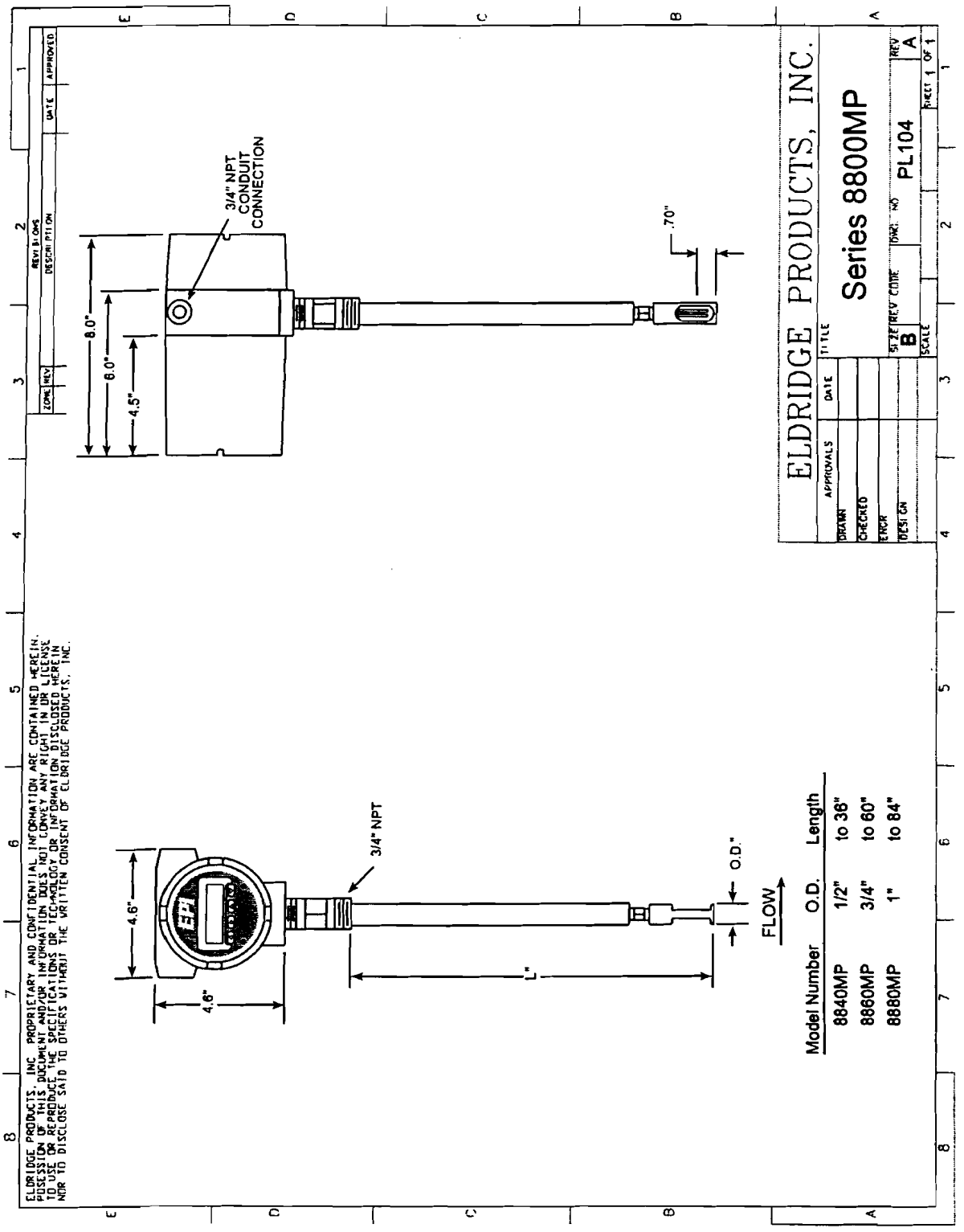
Series 8800MP

Master-Touch™ Series 8800MP flowmeters are insertion style instruments with all electronics mounted integrally on the sensor probe assembly. All input power and signal output connections are accessible through the double-sided enclosure. A variety of installation options are available, including ball valve retractor assemblies, tube to pipe compression fittings, and probe mounted flanges. Input power is supplied to the remote electronics. Consult factory for details.
This Series is CE-approved, with CSA and CENELEC approval pending.

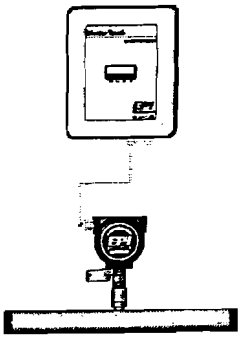
Specifications

Linear signal output	0–5 VDC & 4–20 mA
Signal Interface	RS232 & RS485
Accuracy, including linearity (Ref.: 21°C)	±[1% of Reading + (.5% + .02%/°C of Full Scale)]
Repeatability	±0.2% of Full Scale
Sensor response time	1 second
Turn down ratio	100:1 minimum
Electronics temperature range	0°–50°C (32°–122°F), extended temperature optional
Gas temperature range*	-40°–200°C (-40°–392°F), extended range available
Gas pressure effect	Negligible over ± 20% of absolute calibration pressure
Pressure rating maximum	500 PSI Std., > 500 PSI special
Input power requirement	24VDC @ 250mA 115 VAC 50/60 Hz optional 230 VAC 50/60 Hz optional
Flow Transmitter power requirements	5 watts maximum
Flow Transmitter enclosure	NEMA 4, Class 1, Div 1, Groups B, C, & D, Std.
Wetted materials	316 Stainless Steel (Hastelloy and Monel optional)
Standard temperature & pressure (STP)	70°F & 29.92" Hg (Air .075 lb./cubic foot)
NIST traceable calibration	Standard

***SSM option required for 100°–200°C (212°–392°F)**



Series 8000-8100M P



Master-Touch™ Series 8000–8100MP

Inline flowmeters with remote electronics, for hazardous locations.

Model	Pipe OD" x L"	Max SCFM
8036MP-SSS-133	1/4 x 6	3.50
8049MP-SSS-133	3/8 x 6	6.00
8059MP-SSS-133	1/2 x 7	13.0
8069MP-SSS-133	3/4 x 7	60.0
8089MP-SSS-133	1 x 8	90.0
8110MP-SSS-133	1¼ x 10	150
8112MP-SSS-133	1½ x 15	200
8116MP-SSS-133	2 x 20	350
8120MP-SSS-133	2½ x 25	500
8124MP-SSS-133	3 x 30	750
8132MP-SSS-133	4 x 40	1350

Series 8200M P

Master-Touch™ Series 8200MP

Insertion flowmeters with remote electronics, for hazardous locations.

Model	Probe OD" x L"
8240MP-SSS-133	1/2 x ≤36
8260MP-SSS-133	3/4 x ≤60
8280MP-SSS-133	1 x ≤84

Master-Touch™ Series 8600–8700MP

Inline flowmeters with integral electronics, for hazardous locations.

Model	Pipe OD" x L"	Max SCFM
8636MP-SSS-133	1/4 x 6	3.50
8649MP-SSS-133	3/8 x 6	6.00
8659MP-SSS-133	1/2 x 7	13.0
8669MP-SSS-133	3/4 x 7	60.0
8689MP-SSS-133	1 x 8	90.0
8710MP-SSS-133	1¼ x 10	150
8712MP-SSS-133	1½ x 15	200
8716MP-SSS-133	2 x 20	350
8720MP-SSS-133	2½ x 25	500
8724MP-SSS-133	3 x 30	750
8732MP-SSS-133	4 x 40	1350

Series 8600-8700M P

Master-Touch™ Series 8800MP

Insertion flowmeters with integral electronics, for hazardous locations.

Model	Probe OD" x L"
8840MP-SSS-133	1/2 x ≤36
8860MP-SSS-133	3/4 x ≤60
8880MP-SSS-133	1 x ≤84

Series 8800M P

Notes:

1) Maximum SCFM based on 15,000 SFPM. Air SCFM can be doubled to maximum of 1350 SCFM.
2) Maximum Operating Pressure = 500 PSIG
3) Flow sections 3" and larger include ANSI 150# Class flanges as standard end configuration.
4) Standard probe lengths available in 6" increments from 6" to 24" and 12" increments from 24" to maximum. BVRs require up to 12" of additional probe length.
5) Specify 24VDC, 115VAC or 230VAC input power

Eldridge Products, Inc.

The 85 page instruction manual can be found at:

http://www.epiflow.com/80201101v39G15l.pdf

Master-Touch™ Microprocessor-based Thermal Mass Flowmeters

EPI Home Page

Series 8000MP/NH Master-Touch™ Mass Flowmeters

Master-Touch™ (FAT)™ Flow Averaging Tubes Mass Flowmeters

Series 8000–8200 Mass Flowmeters

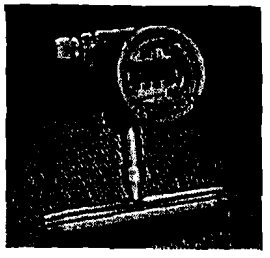
Series 8600–8800 Mass Flowmeters

Series 9000MP Multipoint Mass Flowmeters

Series 7000–7200 Mass Flow Switches

EPICommunicator

Eldridge Products, Inc. (*EPI*) released the Master-Touch™ Family of microprocessor-based thermal mass flowmeters in 1997. The powerful Master-Touch offers a broad range of new capabilities, without sacrificing the basic design elements that have earned *EPI* worldwide recognition for accurate and reliable thermal mass flow instrumentation — and all of these beneficial features are included in every Master-Touch flowmeter **at no additional cost**.



The Master-Touch thermal mass flow meter has an explosion-proof, double-sided NEMA 4 enclosure which gives you convenient access to all power supply input and sensor signal output connections. Your installation requirements can be easily accommodated by your choice of in-line or insertion models with 115VAC, 230VAC, or 24VDC configurations, and with either integral or remote displays (as shown throughout this page). The Master-Touch™ thermal mass flow meter is CE compliant

Utilizing the same proven bridge circuitry as *EPI*'s well known meters, the Master-Touch thermal mass flowmeters add a powerful microprocessor that provides **five major systems** to enhance performance:

1. Analog-to-Digital Converter to acquire data generated from sensors.
2. Curve Linearizer to transform nonlinear to linear voltages.
3. Digital-to-Analog Converter to generate output voltage from sensor data.
4. Voltage Tracking to perform real-time processing of input and output signals.
5. EEPROM to store and maintain user configurable variables.

Every Master-Touch thermal mass flowmeter supports up to **Four Separate Meter Ranges** that can include independent calibration data for different gases, flow ranges, pressures, etc. The meter ranges can be selected "on the fly" through the keypad, a PC, your DCS, or by external switching.

The Master-Touch thermal mass flow meter provides **Continuous Curve Fitting** as the microprocessor uses a polynomial curve fit to linearize data into a continuous linear output with 12-bit precision (4096 increments). The flowmeter variables may be viewed or modified, yet data

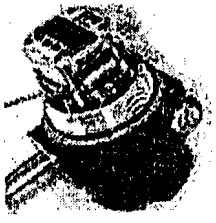
continues to be processed without interruption.

In addition to monitoring the flow rate and accumulated total flow, **Continuous Tracking and Timestamping** of high and low flow rates is included in the Run and Status Modes of the PC display and the in the Status Menu of the LCD display. These values can be easily reset as necessary.

The user can choose from a variety of **Engineering Units** while the flowmeter is in operation. All flow rate, accumulated total, alarm, and timestamp information is automatically converted into the new units.

User Input and Control of the field-adjustable, smart transmitter is available by using the four button touch keypad or via RS232 and RS485 I/O communications using *EPICommunicator* software.

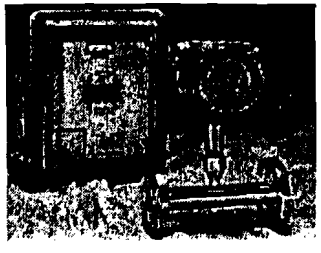
The menuing system features six operational modes:



The **Run Mode** displays the flow rate and total flow along with the selected calibration range. There is also a symbol for the status of the relay contact closures. *NOTE: You must be in the Run Mode for the meter to function normally.*

The **Meter Mode** provides easy access to change the engineering units, to select the bias factor, to offset zero, to change the pipe cross-sectional area for insertion meters, etc.

The **Utility Mode** supports such functions as changing the filtering to smooth out pulsation or unwanted flow noise and selecting up to four pre-calibrated ranges. Each of these ranges (or meters) can contain its own unique full-scale range or gas mix.

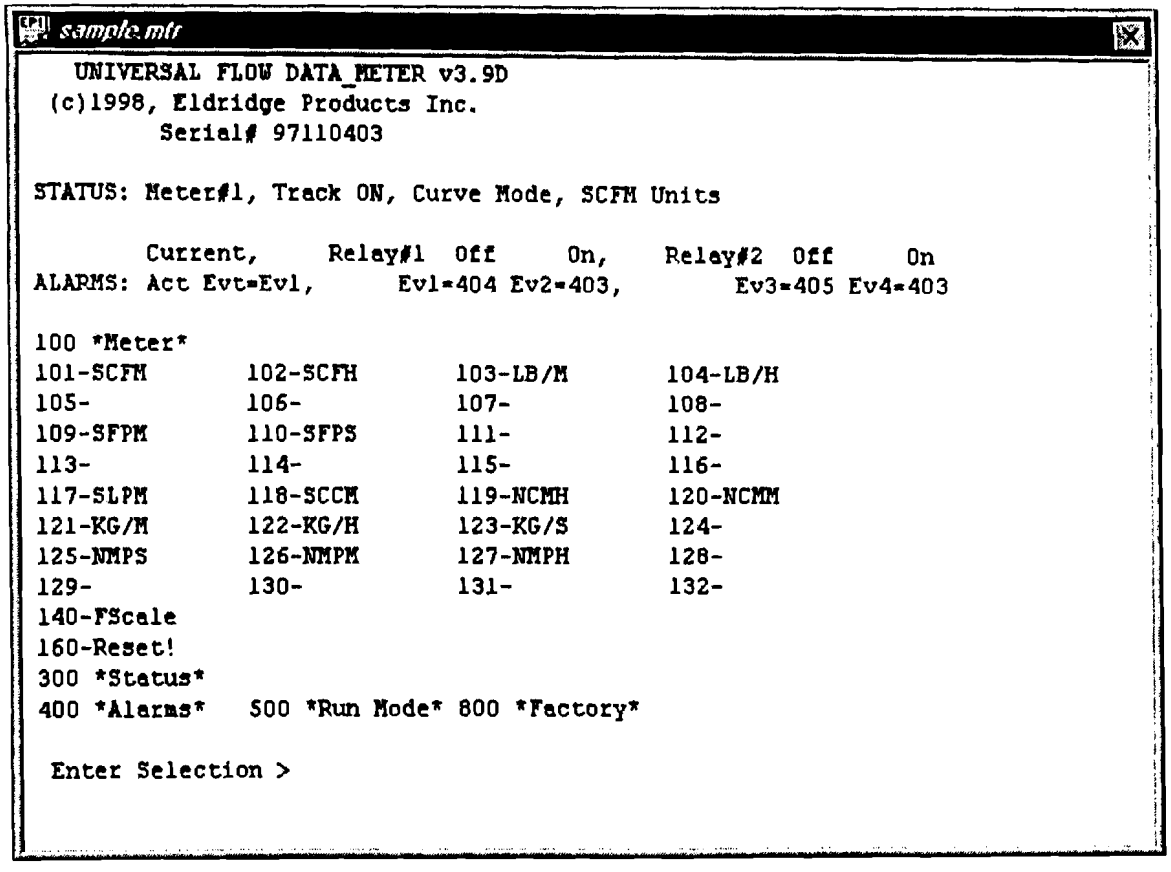


The **Status Mode** presents information about the current status of the metering operations: the active meter range (1–4), the engineering units selected, whether in normal or linear curve mode (the linear mode is only used for trouble-shooting metering problems), and tracking status. When turned on, the tracking status provides the user with the ability to freeze or restore totalizer and current readings, update the HI/LO timestamp values, zero the totalizer, and record new timestamp.

The **Alarm Mode** is utilized for flow alarms, batch counting, or timer functions. Two 1-amp relays can be configured for any combination of alarms.

The **Factory Mode** is reserved for factory configuration and variables.

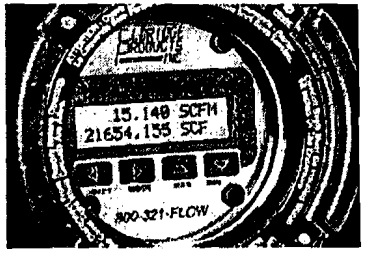
The following is a sample of the 100 *Meter* Menu information displayed on a PC terminal when connected to the Master-Touch thermal mass flowmeter via *EPICommunicator* (EPICom) software:



The following is a sample of the Run Mode information displayed on a PC terminal when connected to the Master-Touch thermal mass flow meter via EPICom software:

sample.mtr

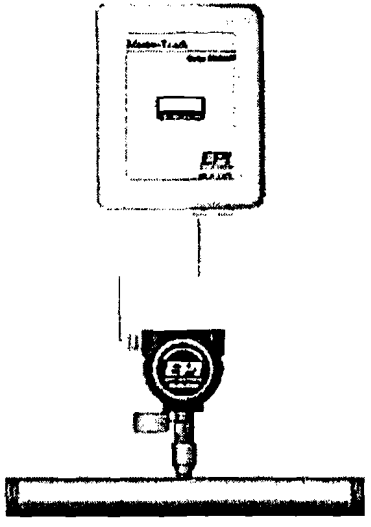
```
  UNIVERSAL FLOW DATA_METER v3.9D
(c)1998, Eldridge Products Inc.
        Serial# 97110403

STATUS: Meter#1, Track ON, Curve Mode, SCFM Units

        Current,     Relay#1  Off     On,    Relay#2  Off     On
ALARMS: Act Evt=Ev1,      Ev1=404 Ev2=403,        Ev3=405 Ev4=403

Real-Time Readout

 S - Start/Stop Tracking
 R - Refresh Display

 C - (Clear) Totalizer          09/01/98   02:34:21PM
 L - (Reset) Lo = 0         at  09/01/98   02:36:35PM
 H - (Reset) Hi = 488.4005 at   09/04/98   09:04:19AM

   Press space bar to return

     Rate          Total              High       Low
4.8840   SCFM    38633.95214  SCF   488.4005    0        R1=. R2=.
```



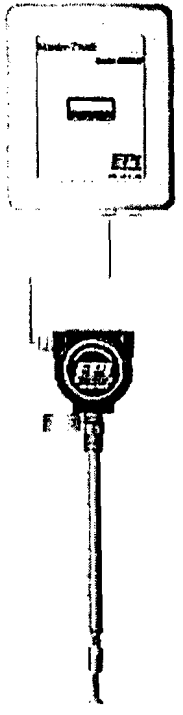
The following is sample of the Run Mode information displayed on the LCD display of the Master-Touch thermal mass flowmeter:

MASTER-TOUCH™ THERMAL MASS FLOWMETERS

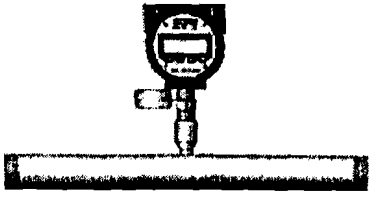
Series 8000–8100MP



Series 8200MP

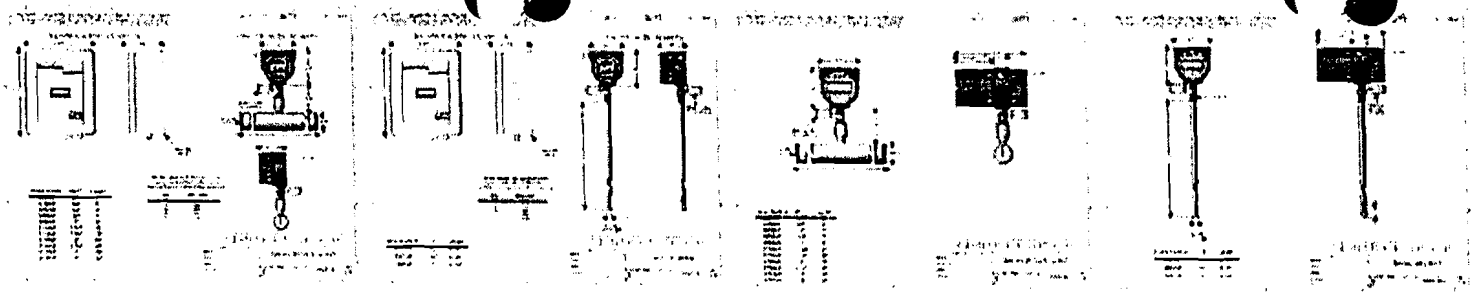


Series 8600–8700MP



Series 8800MP

Click on a picture below for larger, printable image.
For best printing, select Landscape in Page Setup menu.
Click your browser's "Back" button to return to this page.



Inline, Remote Electronics Specs8000-8100MP.pdf
Insertion, Remote Electronics Specs8200MP.pdf
Inline, Integral Electronics Specs8600-8700MP.pdf
Insertion, Integral Electronics Specs8800MP.pdf
Instruction Manual
Model Numbering

SPECIFICATION NOTICE

The specifications presented are subject to change without notice. *EPI* cannot guarantee the applicability or suitability of our products in all situations, since it is impossible to anticipate or control every condition under which our products and specifications may be used.

LIMITED WARRANTY

Eldridge Products, Inc. (EPI) warrants its products to be free from defects in materials and workmanship for one year from the date of factory shipment. If there is a defect, the purchaser must notify EPI of the defect within the warranty period. Upon receipt of the defective product, EPI will either repair or replace the defective product or refund the purchase price at its sole option. EPI MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AS TO THE PRODUCTS. EPI MAKES NO WARRANTY THAT THE GOODS SOLD TO ANY PURCHASER ARE FIT FOR ANY PARTICULAR PURPOSE. FURTHERMORE, EPI MAKES NO WARRANTY OF MERCHANTABILITY WITH RESPECT TO ANY PRODUCTS SOLD TO ANY PURCHASERS. There are no other warranties that extend beyond the description on any brochure or price quote.

Top of page

***EPI* Home Page**

Section 6-F

Air Flow Switch (FSL-642)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Ameritrol, Inc.

Manufacturer of Industrial Instrumentation

ELECTRONIC FLOW SWITCHES

Features

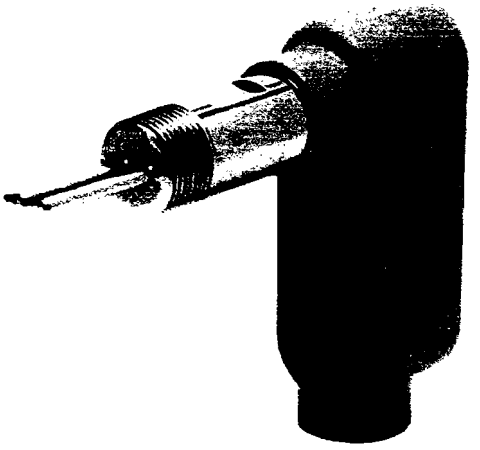
No Moving Parts

Operates in Liquids, Gases and Slurries

Can Detect Increase or Decrease of Flow

316L Stainless Steel Sensor

Lowest Cost, Designed for Industrial OEM and End Users



FM Series

Applications

Low Flow Shut Down of Pumps

Flow Indication/Verification

Pump or Valve Seal Leakage

Bearing Lubrication Flow Sensor

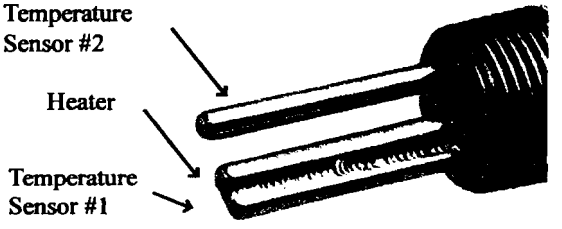
HVAC Flow Monitor

Safety Shower Flow Switch

The FM series is designed to provide an extremely reliable flow switch at a very cost effective price. This series replaces the standard explosion proof enclosure utilized in our FX series with a general purpose enclosure.

The principle of operation measures a temperature differential between a heated and a reference temperature sensor (see figure 1). The differential varies as flow across the sensor changes. This allows the flow switch to detect the increase or decrease of flow in virtually all liquids, gases and slurries. Flow ranges are shown on the back of this brochure in the set-point range chart. A conversion chart is also provided to convert volume flow to velocity.

The electronics feature a SPDT relay switch output with options for power input of 120 VAC, 24 VDC or VAC, or 240 VAC. Calibration is easily performed by adjusting a potentiometer on the circuit board.



Temperature Differential = Temperature Sensor #1 Minus Temperature Sensor #2

Part Number/Order Entry Specification

F	M	-	0	7	5	0	C	-	0	4

Process Connection

3/4" MNPT	0	7	5	0
1" MNPT	1	0	0	0

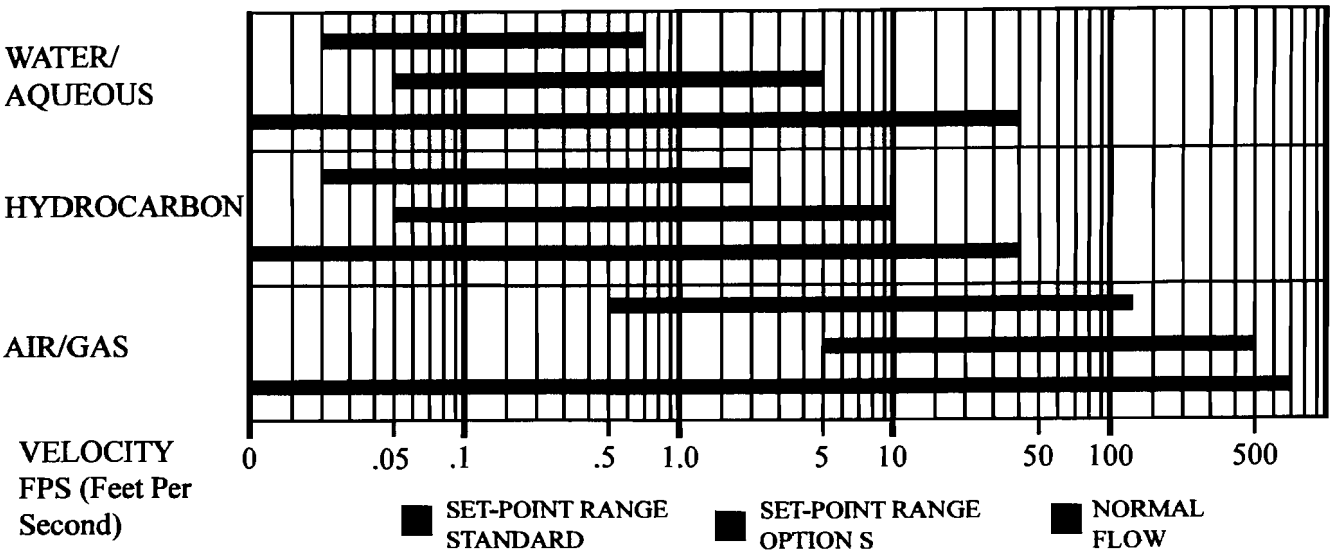
Power Input

12 VDC (10.8-18VDC)	B
117 VAC (90-135 VAC)	C
24 VDC or VAC (+/- 10%)	D
200-240 VAC	E

Probe Length

0	1	1.2" PROBE
0	2	1.8" PROBE
		SPECIAL PROBE LENGTH, SPECIFY LENGTH IN INCHES

Flow Switch Set-Point Range



Conversion Table

Volumetric (GPM or CFM) to Velocity (Feet per Second - FPS)

Line Size	1/8"	1/4"	3/8"	1/2"	3/4"	1"	1.25"	1.5"	2"	2.5"	3"	3.5"	4"	5"	6"
Liquid Multiplier	5.65	3.08	1.68	1.06	.602	.371	.215	.158	.096	.067	.0434	.0325	.0252	.0160	.0111
Air Multiplier	42.19	23.06	12.57	7.91	4.50	2.78	1.61	1.18	.716	.502	.325	.243	.188	.120	.083

Line Size	8"	10"	12"	14"	16"	18"	20"	24"
Liquid Multiplier	.0064	.00407	.00287	.00237	.00182	.00143	.00115	.000798
Air Multiplier	.0480	.0304	.0209	.0177	.0136	.0107	.00863	.00597

Examples:

1) 100 CFM in 3" Line = 100 x .325 = 32.5 FPS

2) 10 GPM in 3" Line = 10 x .0434 = .434 FPS

Specifications

Sensor Head

Material of Construction: 316L Stainless Steel Standard

Operating Temperature: -50 to 250F (-46 to 121C)

Operating Pressure: Vacuum to 4000 PSIG (275 Bar)

Response Time: From 3 Seconds

Repeatability +/- 0.5% of Range at Constant Conditions

Process Connection: 3/4" MNPT, 1" MNPT

Probe Length: 1.8", 1.2"; Option Customer Specified

Electronics

Housing: Powder Coated General Purpose

Temperature: -50 to 150F (-46 to 65C)

Power Input: 90-135 VAC, 50/60 Hz, 4 Watts
Option 24 VDC/VAC, 200-240VAC

Relay Output: SPDT 2 Amps Resistive

Electrical Connection: 1" FNPT

Shipping Weight: 4 lbs

Ameritrol, Inc.

1185L Park Center Drive
Vista CA 92081
760-727-7273 Phone
760-727-7151 Fax

1-800-910-6689
Visit our website at
www.ameritrol.com

AMERITROL, INC.

INSTALLATION

AND

OPERATION MANUAL

FM SERIES

FLOW SWITCH

FM-0750-C-04

1185D Park Center Dr. Vista CA 92081 760-727-7273

1-800-910-6689
1-760-727-7151 Fax

INSTALLATION

Install the FM Flow Switch into the process line so that the "flat" on the instrument pipe nipple is parallel to the flow. Although flow direction is not critical, it is recommended that in extremely low flow rate applications, the direction of the single tube on the sensor be upstream of the dual tubes. Note that the FM series does not have the weather proof enclosure that our FX series offers.

For mounting threaded units to process lines, it is recommended that:

A half-coupling, thread-a-let or the like be used. It is ideal for probes to extend into the line being monitored.

If a pipe Tee is used, it is recommended that the leg used to mount the flow switch be the same as the instrument size (1" MNPT typical). The standard length flow switch sensor (1.8" long) will fit in a 1-1/2" X 1-1/2" X 1" or larger Tee.

For mounting flanged units, bolt holes will straddle the process line. Probe length ("U") is specified as the distance from the face of the flange to the center of the pipe being monitored.

For liquid service, fill the process line to that the probe is surrounded by liquid.

See attached drawing for wiring details.

CALIBRATION

Power the instrument and allow 1 minute for the sensor head to reach equilibrium.

Remove the housing cover observing the safety precautions associated with the area in which the unit is mounted.

TO DETECT A DECREASE IN FLOW (FACTORY DEFAULT):

It is assumed that the user will have the relay energized at flow and will alarm (relay de-energize) on loss or decrease of flow. Please refer to attached wiring diagram for relay energization programming.

Flow product in the process line to the normal /expected rate for 1 minute.

Adjust the potentiometer (R15 on the wiring diagram) on the circuit board until the red LED changes state, as follows:

If the LED is on: Turn the potentiometer clockwise.
If the LED is off: Turn the potentiometer counterclockwise.

Typical backlash for the potentiometer is 1/8 turn.

Once the red LED on/off location is determined, turn the potentiometer in the LED "on" direction (counterclockwise), as follows:

Air Flow Switch: 4 turns
Organics/hydrocarbons Flow Switch: 2 turns
Water Flow Switch: 1 turn

TO DETECT INCREASE IN FLOW:

It is assumed that the user will have the relay energized at no flow and will alarm (relay de-energize) on increase of flow. Please refer to attached wiring diagram for relay energization programming. The relay energization switch will need to be changed from the factory default.

Flow product in the process line to the normal condition for 1 minute. If zero flow rate is normal/expected, omit this step.

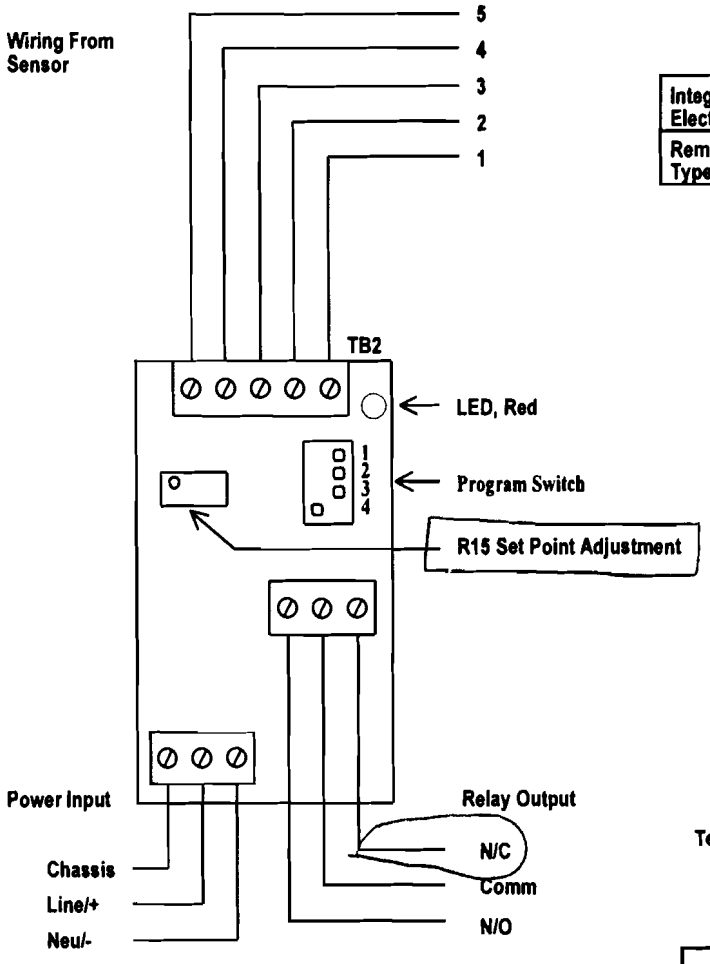
Adjust the potentiometer (R15 on the wiring diagram) on the circuit board until the red LED changes state, as follows:

If the LED is on: Turn the potentiometer counterclockwise.
If the LED is off: Turn the potentiometer clockwise.

Typical backlash for the potentiometer is 1/8 turn.

Once the red LED on/off location is determined, turn the potentiometer in the LED "on" direction (clockwise), as follows:

Air flow switch: 4 turns
Organics/hydrocarbons flow switch: 2 turns
Water flow switch: 1 turn



	Terminal Number (TB2)				
	1	2	3	4	5
Integral Electronics	Red	Red	Yel	Blk	Grn
Remote Electronics Type J Cable	White	Blue Drain	Yel	Blk	Grn

Application Settings

Program Switch	1	2	
Liquid Flow Switch	On	On	Factory Default
Air Flow Switch	Off	On	
Liquid Level Switch	Off	On	
Temperature Switch	Off	Off	

Program Switch

Off On

Relay Energization Settings

	Program Switch	3	4	
Flow Switch	Energized at Flow	On	Off	Factory Default
	Energized at No Flow	Off	On	
Level Switch	Energized when Wet	On	Off	Factory Default
	Energized when Dry	Off	On	
Temperature Switch	Energized below Set Point	On	Off	Factory Default
	Energized above Set Point	Off	On	

Ameritrol, Inc

1185L Park Center Dr. Vista CA 92081 760-727-7151 800-910-6689

Title: Flow Switch Wiring Diagram, SPDT Relay Output, M Series Board			
Size: A	Drawn by: RAL	Drawing No.: 2010	Rev: 2
Scale:	Date: 2/01	Sheet: 1 of 1	

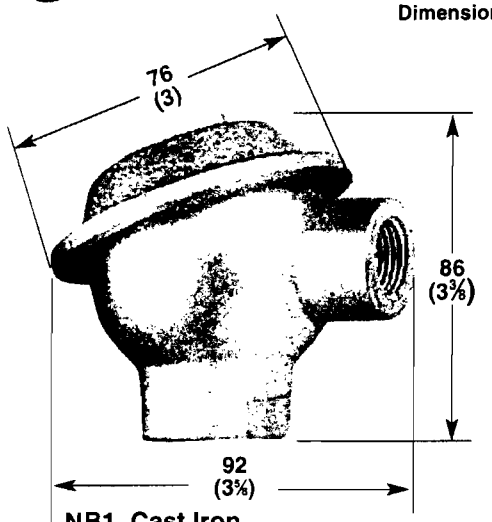
Section 6-G

Duct Heater Discharge Air Temperature Transmitter (TT-502)

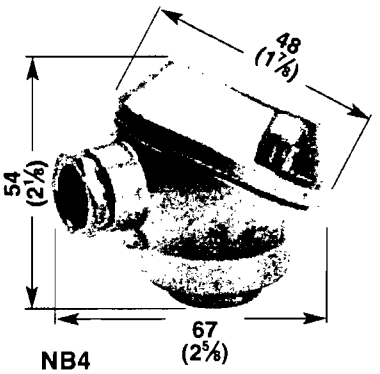
BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

NEW Thermocouple Heads

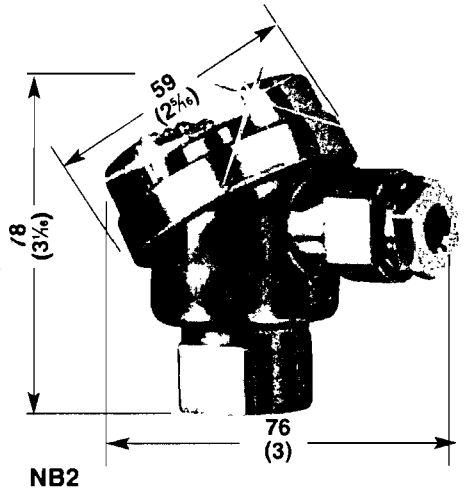
Dimensions mm (in)



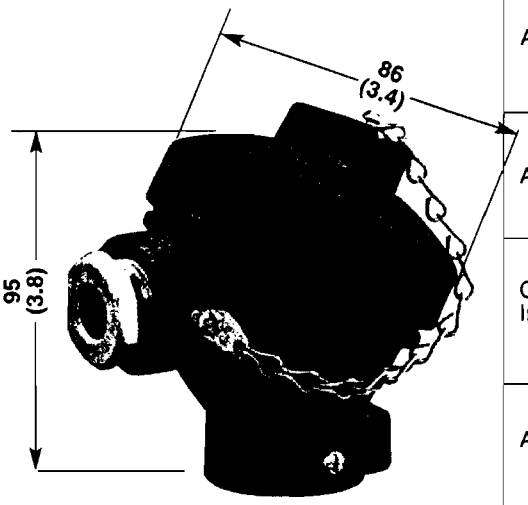
NB1 Cast Iron



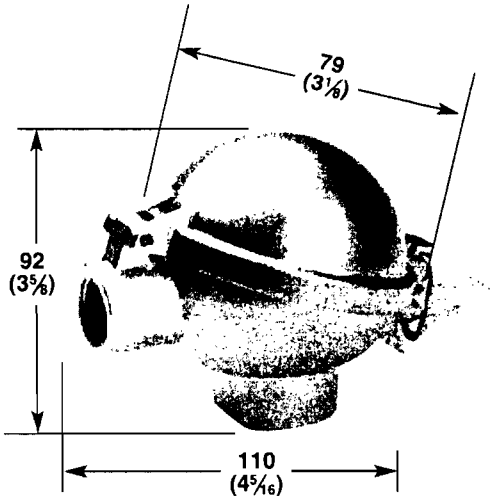
NB4
Aluminum



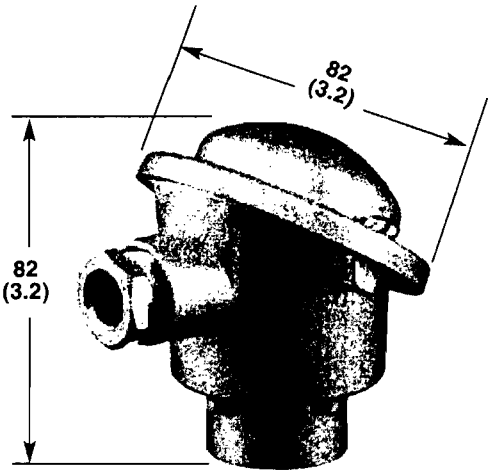
NB2
Burnished Die Cast Aluminum



NB5
Cast Iron



NB3
Aluminum



NB6
Deep Base

To Order *(Specify Model No.)*

Material	Type	Model Number	Price Each
Cast Iron	NB1	NB1-0 NB1-2 NB1-4	$23 26 28
Burnished Die Cast Aluminum	NB2	NB2-0 NB2-2 NB2-4	$23 26 28
Aluminum	NB3	NB3-0 NB3-2 NB3-4	$25 28 30
Aluminum	NB4	NB4-0 NB4-4	$23 28
Cast Iron	NB5	NB5-0 NB5-2 NB5-4	$23 26 28
Aluminum	NB6	NB6-0 NB6-2 NB6-4	$23 26 28

Ceramic
CH-83

Ceramic
CH-84

ALL MODELS AVAILABLE FOR FAST DELIVERY!

Terminals	Wt. (oz)	Threaded Openings: Protection Tube Entry	Threaded Openings: Extension Wire Entry	Features
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	22 23 24	½" NPT	½" NPT	• Rugged construction • Screw cover with inside thread • Moisture and dust resistant • Ideal for outdoor use • Standard Size
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	5 6 6½	½" NPT Standard	½" NPT w/compression fitting for ¼" to ⅜" O.D. wire	• Small and Lightweight • Good corrosion resistance • Gasketed, weather resistant • Burnished finish • Safety chain on cover • Medium Size
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	8 9¼ 9¾	½" NPT	½" NPT	• Hinge top • Lightweight Aluminum • Standard Size
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	2½ 3⅛ 3¼	M10 x1 works with ⅛" NPT	M15 x .75 w/compression fitting	• Metric • Miniature size • Good corrosion resistance • Utilizes miniature barrier strip connector (optional)
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	56 57 58	½" NPT	½" NPT w/compression fitting	• Rugged cast iron • High temperature painted finish • Safety chain on cover • Standard Size
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	8¾ 9¾ 10¾	½" NPT	½" NPT w/compression fitting	• Deep Base • Lightweight Aluminum • Standard Size

Ordering Examples:** 1.) **NB1-0** is a cast iron head with no terminal block, **$23.** 2.) **NB6-2** is a deep base aluminum head with a 2-terminal terminal block (for one thermocouple element), **$26.

Terminal Blocks for Connection Heads

(Order Separately or included with heads with -2 or -4 suffixes)

Ceramic Block with Nickel Plated Brass Terminals for NB2 Head. For Gage 14 Wire Maximum

To Order *(Specify Model No.)*

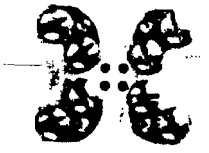
Model No.	Price	Terminals	Wt. g (oz)
CH-49	$4	2 = single	43 (1½)
CH-50	6	4 = duplex	57 (2)

Ceramic Blocks with Brass Terminals for Type NSA, NSB, NSC & NBS Connection Heads for Max. 8 Gage Wire

To Order *(Specify Model No.)*

Model No.	Price	Terminals	Wt. g (oz)
CH-47	$6	2 = single	85 (3)
CH-48	8	4 = duplex	128 (4½)

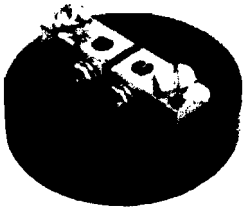
Ceramic Blocks with Brass Terminals for Type NBN, NB3, NBG, NB1, and NBB Connection Heads for Max. 14 Gage Wire



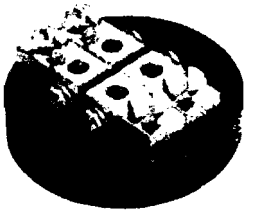
To Order *(Specify Model No.)*

Model No.*	Price	Terminals	Wt. g (oz)
CH-73	$3	2 = single	35 (1¼)
CH-74	5	4 = duplex	50 (1¾)

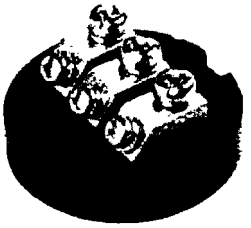
For NB1 Heads, add suffix "-NB1**" to model number; no additional charge.*



Bakelite CH-76



Bakelite CH-78



Bakelite CH-77

To Order *(Specify Model No.)*

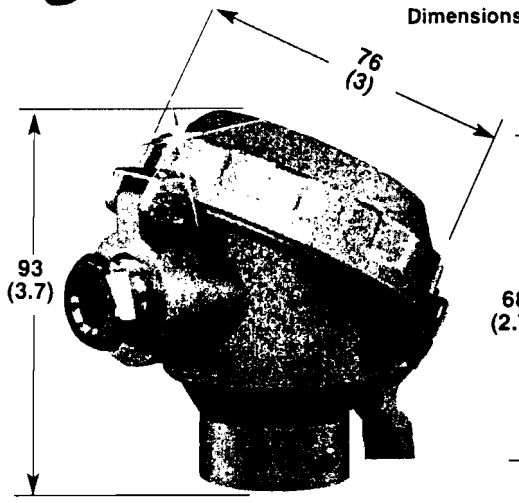
Model No.	Price	Desc.	Material	Term	Wt. g (oz)
CH-83	$4	For NB4	Ceramic	2	28 (1)
CH-84	4	For NB4	Ceramic	4	28 (1)
CH-76	4	For NBG, NB5, NB6, NB7, NB9, and NB12	Bakelite	2	77 (2½)
CH-77	4		Bakelite	3	77 (2½)
CH-78	4		Bakelite	4	77 (2½)

†These are alternatives, not standard with -2 or -4 suffixes on thermocouple heads

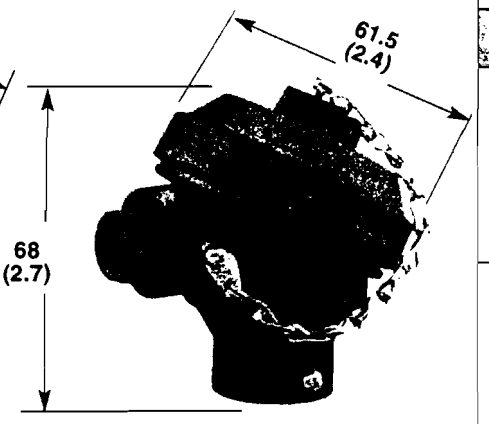
All shown smaller than actual size.

NEW Thermocouple Heads

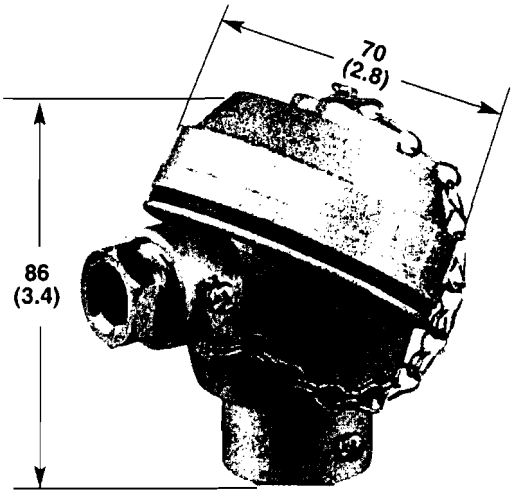
Dimensions mm (in)



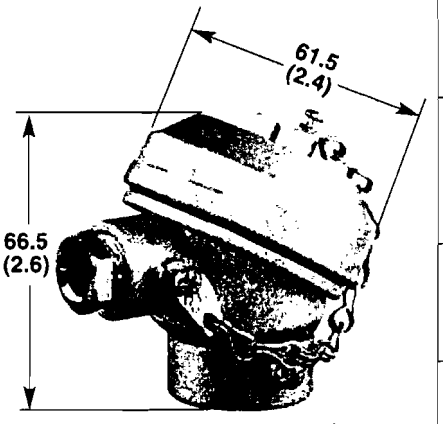
NB7 Flip Top



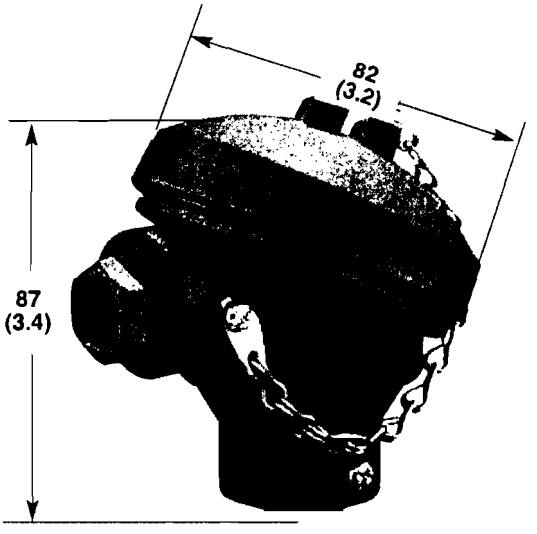
NB10 Miniature Bakelite



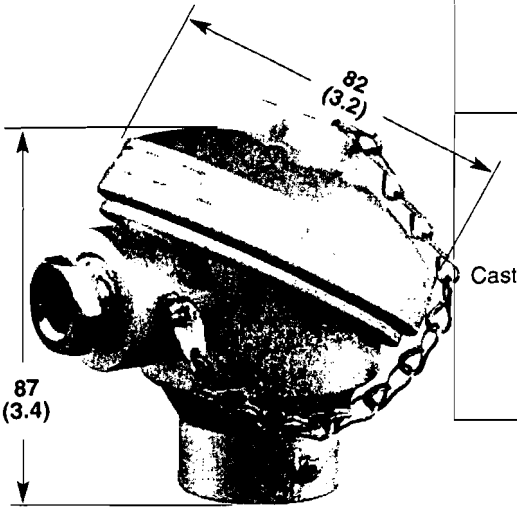
NB8 Domed Top



NB11 Miniature Aluminum



NB9 Glass Reinforced Nylon



NB12 Low Profile

To Order *(Specify Model No.)*

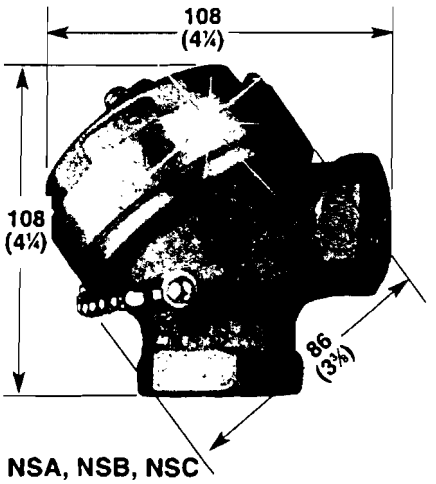
Material	Type	Model Number	Price Each
Aluminum	NB7	NB7-0 NB7-2 NB7-4	$23 26 28
Aluminum	NB8	NB8-0 NB8-2 NB8-4	$23 26 28
Glass Reinforced Nylon	NB9	NB9-0 NB9-2 NB9-4	$23 26 28
Bakelite	NB10	NB10-0 NB10-2 NB10-4	$23 26 28
Aluminum	NB11	NB11-0 NB11-2 NB11-4	$23 26 28
Aluminum	NB12	NB12-0 NB12-2 NB12-4	$23 26 28
Cast Aluminum Body and Cap	NEPA	NEPA-0 NEPA-2 NEPA-4	$85 88 91
	NEPB	NEPB-0 NEPB-2 NEPB-4	$85 88 91
Cast Iron	NSA	NSA-0 NSA-2 NSA-4	$22 25 27
	NSB	NSB-0 NSB-2 NSB-4	$22 25 27
	NSC	NSC-0 NSC-2 NSC-4	$22 25 27

ALL MODELS AVAILABLE FOR FAST DELIVERY!

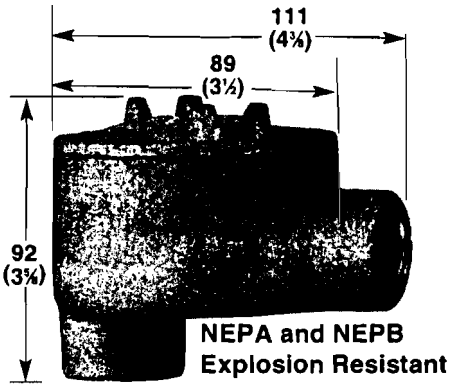
Terminals	Wt. (oz)	Threaded Openings: Protection Tube Entry	Threaded Openings: Extension Wire Entry	Features
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	8¾ 9¾ 10¾	½" NPT	½" NPT	• Lightweight Aluminum construction • Flip Top • Moisture and dust resistant • Ideal for outdoor use • Standard size
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	8 9 10	½" NPT	½" NPT w/compression fitting	• Small and Lightweight • Domed Top • Gasketed, weather resistant • Secure screw thread • Safety chain on cover • Medium size
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	5 6 7	½" NPT	½" NPT w/compression fitting	• Very lightweight construction • Safety chain on cover • Good corrosion resistance • Standard size
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	2⅞ 3⅞ 4⅞	½" NPT	½" NPT	• Ultra lightweight construction • Safety chain on cover • High temperature plastic • Miniature size
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	4⅞ 5⅞ 6⅞	½" NPT	½" NPT w/compression fitting	• Miniature size • IP 67 Sealed • Safety chain on cover • Lightweight construction • Miniature size
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	9¾ 10¾ 11¾	½" NPT	½" NPT	• Low profile • Safety chain on cover • Lightweight construction • Standard size
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	16½ 17¾ 18¼	¾" NPT	¾" NPT	• Explosion resistant head* • Rated for: Class III Class I, Group C, D Class II, Groups E, F, G • Screw cover • Moisture and dust resistant • Ideal for outdoor use • Utilizes barrier strip connector (optional)
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	21½ 22¾ 23¼	½" NPT	½" NPT	
0 = no terminal block 2 = single element 4 = duplex element max. 8 gage wire	42 46 48	½" NPT	¾" NPT	• Rugged construction • Screw cover with inside thread • Moisture and dust resistant • Ideal for outdoor use • Standard OMEGA® heavy duty head • Cover equipped with safety chain (readily removed without tools) • Standard size
0 = no terminal block 2 = single element 4 = duplex element max. 8 gage wire	40 44 46	¾" NPT	¾" NPT	
0 = no terminal block 2 = single element 4 = duplex element max. 8 gage wire	36 40 42	1" NPT	¾" NPT	

**Note:* *The use of explosion resistant heads does not imply that a complete assembly is either explosion proof or intrinsically safe. It is the user's responsibility to determine suitability of materials for an installation.*

Ordering Examples: *1.)* ***NB10-0*** *is a Bakelite head with no terminal block,* ***$23.***
2.) ***NB7-4*** *is a flip-top aluminum head with a 4-terminal terminal block (for two thermocouple element),* ***$28.***



NSA, NSB, NSC
Cast Iron

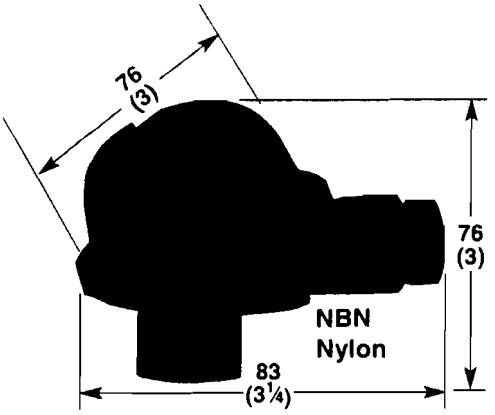


NEPA and NEPB
Explosion Resistant

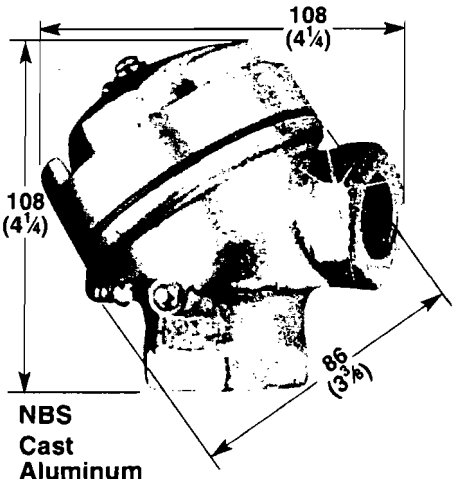
Discount Schedule	
1-10 Units . . . . . Net 11-24 Units . . . . 5% 25-100 Units . . 10%	101 and Up, Consult Sales

NEMA 4X (IP66) Rated Heads Available. Please consult our Technical Quotations Department

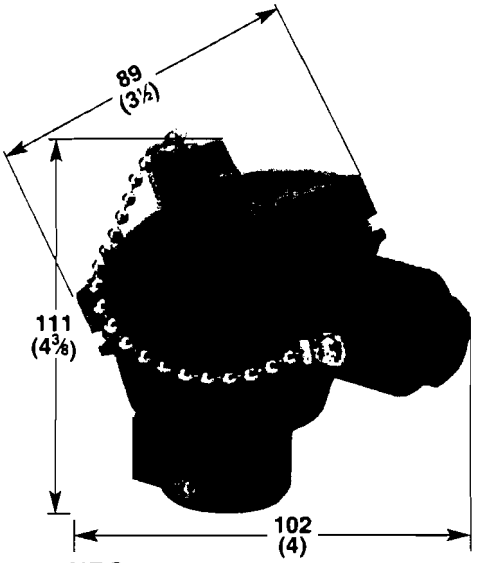
Thermocouple Heads



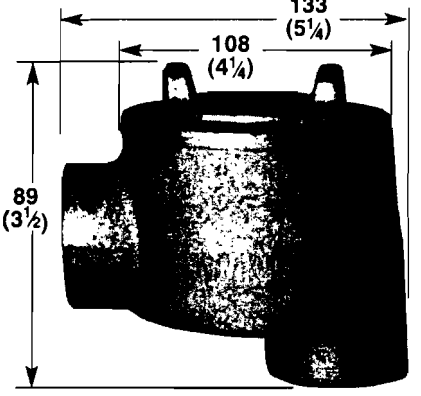
NBN
Nylon



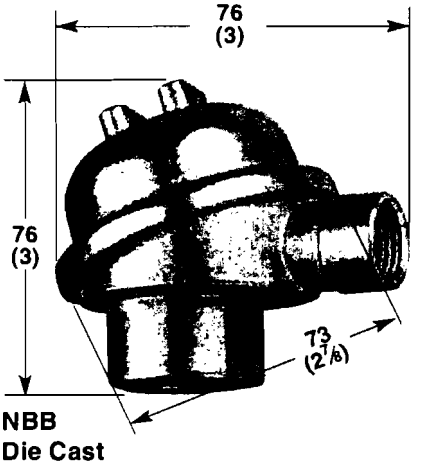
NBS
Cast
Aluminum



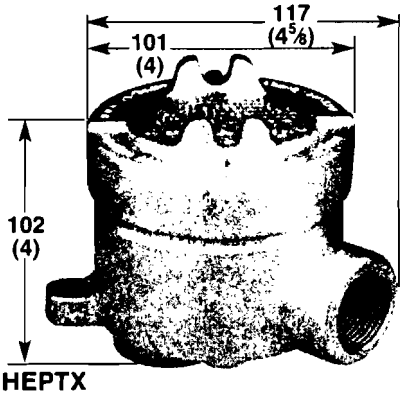
NBG
Bakelite Glass Fiber



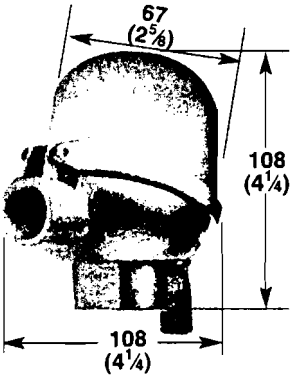
NEP-T Cast Iron
with Aluminum Cap
Explosion Resistant



NBB
Die Cast
Aluminum



HEPTX
Feraloy®
Iron Alloy



NXT
Aluminum

Dimensions mm (in)

Discount Schedule	
1-10 Units . . . . . Net 11-24 Units . . . . 5% 25-100 Units . . 10%	101 and Up, Consult Sales

To Order *(Specify Model No.)*

Material	Type	Model Number	Price Each
Nylon	NBN	**NBN-0** **NBN-2** **NBN-4**	**$19** **22** **24**
Bakelite Glass Fiber	NBG	**NBG-0** **NBG-2** **NBG-4**	**$19** **22** **24**
Die Cast Aluminum	NBB	**NBB-0** **NBB-2** **NBB-4**	**$23** **26** **29**
NBS Cast Aluminum	NBS	**NBS-0** **NBS-2** **NBS-4**	**$25** **29** **31**
Cast Iron with Aluminum Cap	NEP-T	**NEP-T0** **NEP-T2** **NEP-T4**	**$75** **77** **79**
Aluminum	NXT	**NXT-0** **NXT-2** **NXT-4**	**$27** **30** **32**
Feraloy® Iron Alloy	HEP-TX	**HEP-TX-0** **HEP-TX-2** **HEP-TX-4** **HEP-TX70**	**$80** **83** **85** **85**

Note: Barrier strips are utilized when more than four connections are required. e.g.: dual element 3-wire RTD.

Transmitter may be mounted in most heads. Transmitter may not be mounted in NB4 and only the smallest transmitters can fit the NB2 head by special order.

Check transmitter dimensions identified by individual product specifications as well as the internal dimensions for the head given in Section Z.

Ordering Example: NEP-T4**, cast iron thermocouple head with Aluminum cap, **$79.

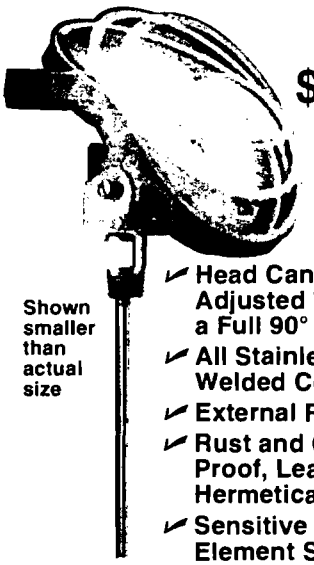
ALL MODELS AVAILABLE FOR FAST DELIVERY!

Terminals	Wt. (oz)	Threaded Openings: Protection Tube Entry	Threaded Openings: Extension Wire Entry	Features
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	3 4 5	½" NPT	Supplied with nylon bushing for plastic covered extension wire to . 0.24" to 0.40" O.D.	• Easy access to terminal block • Suitable for use in ambient temperatures to121°C (250°)°F • Moisture and dust-resistant • Ideal for chemical plant use • Excellent corrosion resistance • Very light weight • Standard size
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	6 7 8	½" NPT	½" NPT	• Noncombustible • Heat proof • Acid resistant • Alkali resistant • Standard size
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	6 7 8	½" NPT	½" NPT	• Good corrosion resistance • Lightweight • Bayonet cover readily removed without tools • Easy access to terminal block • Moisture and dust-resistant • Standard size
0 = no terminal block 2 = single element 4 = duplex element max. 8 gage wire	15 18 20	½" NPT	½" NPT	• Good corrosion resistance • Lightweight • Cover, equipped with safety chain,easily removed • Moisture and dust-resistant • Standard size
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	75 76 76	½" NPT	½" NPT	• Explosion resistant head* • Rated for Class I, Group C, D Class II, Groups E, F, G Class III • Screw cover with inside thread • Moisture and dust resistant • Ideal for outdoor use • Utilizes barrier strip connector (optional)
0 = no terminal block 2 = single element 4 = duplex element max. 14 gage wire	11 12 ¼ 12 ¾	½" NPT	½" NPT	• Tall cover with Hinge top • Ideal for big transmitters • Utilizes barrier strip connector (optional) • Medium size
0 = no terminal block 2 = single element 4 = duplex element 70 = for mounting TX70 Transmitter max. 14 gage wire	62 64 64 66	1" NPT ¾" NPT	1" NPT ¾" NPT	• Explosion resistant head for 2-wire transmitter* • Rated for: Class I, Div 1&2, Groups C, D Class II, Div 1 Groups E, F, G, Class III • Moisture/dust-resistant • Utilizes barrier strip connector (optional)

Note: The use of explosion resistant heads does not imply that a complete assembly is either explosion proof or intrinsically safe. It is the user's responsibility to determine suitability of materials for an installation.

Bi-Metal Thermometers for Head & Well Assemblies

See Page E-27 for Additional Models



Shown smaller than actual size

Model J (Shown)

$114

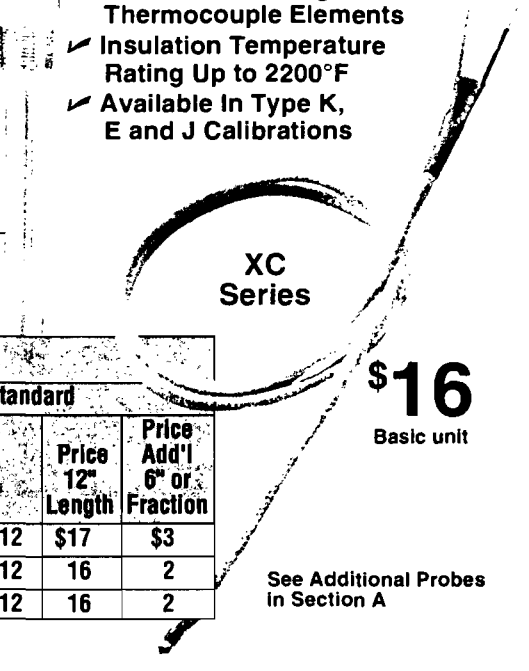
2½", 4" and 6" Lengths

- Head Can Be Tilt-Adjusted Through a Full 90° Angle
- All Stainless Steel Welded Construction
- External Recalibration
- Rust and Corrosion Proof, Leakproof, Hermetically Sealed
- Sensitive Bi-Metal Element Silicone
- Dampened for Minimum Pointer Vibration and Maximum Heat Transfer
- Accuracy – 1% of Range
- Use of Thermowell Is Recommended for Pressure Applications
- Overrange Protection – 50% Up to 500°F

Thermowells Accept: Models A, B, G, H, L, R and S

Ceramic Fiber Insulated Thermocouple Elements for Head & Well Assemblies

- Standard 12" Long Thermocouple Elements
- Insulation Temperature Rating Up to 2200°F
- Available In Type K, E and J Calibrations



XC Series

$16

Basic unit

See Additional Probes in Section A

To Order *(Specify Model No.)*

300 mm (12") Long with Insulation, Plus 13 mm (½") Stripped Ends Standard

AWG Wire Size	Type K	Price 12" Length	Price Add'l 6" or Fraction	Type E	Price 12" Length	Price Add'l 6" or Fraction	Type J	Price 12" Length	Price Add'l 6" or Fraction
14	XC-14-K-12	$17	$3	XC-14-E-12	$17	$3	XC-14-J-12	$17	$3
20	XC-20-K-12	16	2	XC-20-E-12	16	2	XC-20-J-12	16	2
24	XC-24-K-12	16	2	XC-24-E-12	16	2	XC-24-J-12	16	2

*6" = 150 mm

Ordering Example: XC-20-K-12, $16.

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BENELUX
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Amstelveen, NL
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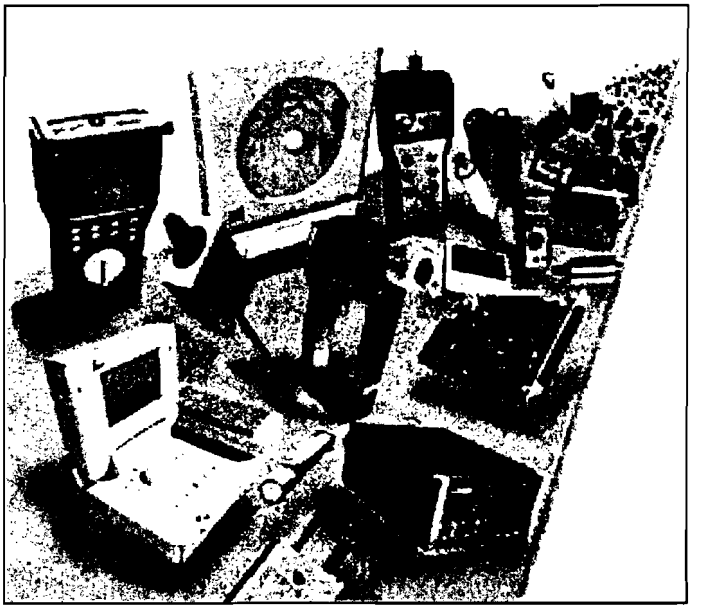

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• Temperature

Calibrators, Connectors, General Test and Measurement Instruments, Glass Bulb Thermometers, Handheld Instruments for Temperature Measurement, Ice Point References, Indicating Labels, Crayons, Cements and Lacquers, Infrared Temperature Measurement Instruments, Recorders Relative Humidity Measurement Instruments, RTD Probes, Elements and Assemblies, Temperature & Process Meters, Timers and Counters, Temperature and Process Controllers and Power Switching Devices, Thermistor Elements, Probes and Assemblies, Thermocouples Thermowells and Head and Well Assemblies, Transmitters, Wire

• Flow and Level

Air Velocity Indicators, Doppler Flowmeters, Level Measurement, Magnetic Flowmeters, Mass Flowmeters, Pitot Tubes, Pumps, Rotameters, Turbine and Paddle Wheel Flowmeters, Ultrasonic Flowmeters, Valves, Variable Area Flowmeters, Vortex Shedding Flowmeters

• pH and Conductivity

Conductivity Instrumentation, Dissolved Oxygen Instrumentation, Environmental Instrumentation, pH Electrodes and Instruments, Water and Soil Analysis Instrumentation

• Data Acquisition

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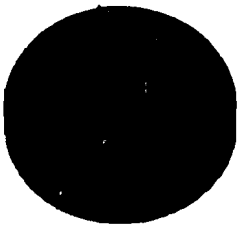
TX901, TX903

Field Rangeable Thermocouple Two-Wire Temperature Transmitters



OMEGA® Operator's Manual

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It is the policy of OMEGA to comply with all worldwide safety and EMC/EMI regulations that apply. OMEGA is constantly pursuing certification of its products to the European New Approach Directives. OMEGA will add the CE mark to every appropriate device upon certification.

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1 Introduction

1.1 General Description

The OMEGA® TX901 and TX903 transmitters are field rangeable miniature two-wire temperature transmitters that are dip switch selectable for input type and range. The transmitters accept thermocouple sensor types J, K, T, E, R or S and will produce a standard 4-20 mA output signal proportional to the millivolt signal produced by its attached input temperature sensor. Transmission of the proportional current output may be accomplished by using inexpensive copper wire. The TX901 is non-isolated (does not provide isolation between its input and the 4-20 mA output); therefore an ungrounded thermocouple junction is suggested for the TX901 to avoid possible ground loops. The TX903 is isolated (provides 500V RMS isolation between its input and the 4-20 mA output).

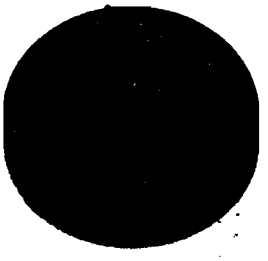


Figure 1-1 TX901, TX903 Transmitter

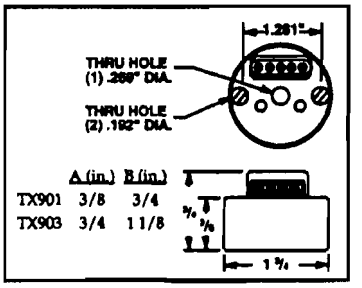


Figure 1-2 Dimensions (in Inches)

The TX901 or 903 transmitter is normally powered by an unregulated power supply as shown in Figure 1-3. The proportionally-transmitted signal begins at 4 mA, at the low end of its temperature range, and increases to 20 mA, at the high end of its temperature range.

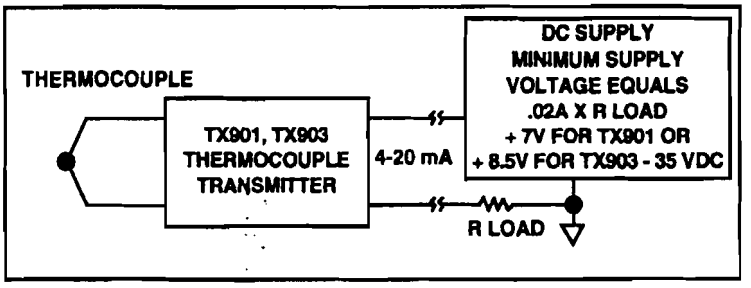


Figure 1-3 TX901, TX903 Thermocouple Transmitter

The TX901 or TX903 two-wire transmitter receives and measures signals from thermocouples and sends an output current of 4-20 mA which is directly proportional to the thermocouple millivolt input. It is designed to connect with only two copper wire leads that will supply the voltage to operate the transmitter from a power supply, and also carry the output current. The output current is then used for recording, computing or controlling.

If the TX901 or TX903 is mounted inside a protection head, the thermocouple extension wires are replaced by two copper wires that carry the 4-20 mA signal and dc voltage to operate the transmitter.

The TX901 or TX903 has reverse supply polarity protection and will operate with a wide range of supply voltages 7 to 35 Vdc (TX901), 8.5 to 35 Vdc (TX903). It has an input sensor break-protection circuit that forces the output current to go upscale when the thermocouple wire opens. The TX901 does NOT provide isolation between its input and the 4-20 mA output; therefore, an ungrounded thermocouple junction is suggested to prevent possible ground loops. The TX903 DOES provide isolation (500V RMS) between its input and the 4-20 mA output.

Note that most thermocouple transmitters with 4-20 mA outputs, including the TX901 and TX903, are proportional with respect to the thermocouple input voltage. However the relationship between temperature and millivolt for all the thermocouple types is somewhat non-linear. This leads to maximum error at approximately the midpoint of the range as shown in Figure 1-4.

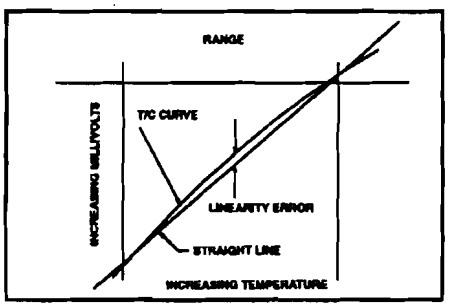


Figure 1-4 Straight Line Approximation of a Curve

1.2 Features

- 4-20 mA output
- ±0.1% full-scale accuracy (with respect to the mV input signal)
- Upscale break protection
- Low Cost

1.3 TX901, TX903 Models Available

Model Number	Description
TX901	J/K/T/E/R/S field rangeable thermocouple input transmitter, non-isolated
TX903	J/K/T/E/R/S field rangeable thermocouple input transmitter, isolated
NB1TX901-(*)	NB1 thermocouple probe, 12" L, ¼" O.D., ungrounded junction, 304SS sheath, with TX901 transmitter

Model Number	Description
NB1TX903-(*)	NB1 thermocouple probe, 12" L, ¼" O.D., ungrounded junction, 304SS sheath, with TX903 transmitter

*Insert J, K, T or E for thermocouple type. Contact OMEGA for probe/transmitter assemblies for types R or S.

For complete information on NB1 Thermocouple Probes, see the OMEGA Temperature Measurement Handbook®.

2 Unpacking Instructions

Remove the Packing List and verify that you have received all equipment, including:

- TX901 or TX903 Field Rangeable Thermocouple Temperature Transmitter
- Operator's Manual

If you have any questions about the shipment, please call the Customer Service Department.

When you receive the shipment, inspect the container and equipment for signs of damage. Note any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor damage claims unless all shipping material is saved for inspection. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

3 Installation

3.1 Mounting the TX901 or TX903

The TX901 or TX903 transmitter may be:

1. surface mounted,
2. mounted inside a protection head (refer to figure 3-1), or
3. installed into the OMEGA mounting track (part number RT) using an OMEGA mounting bracket (part number TX90-BR).
4. installed into standard 35mm DIN rail using an OMEGA DIN rail mounting adapter (part number TX-90-DIN).

Figure 3-2 shows the RT mounting track. Figure 3-3 shows the TX90-BR mounting bracket.

Figure 3-4 shows a typical installation of two transmitters using the bracket and mounting track. Figure 3-5 shows the TX90-DIN rail mounting adapter.

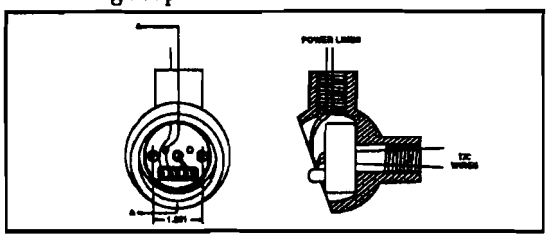


Figure 3-1 Assembly of Transmitter inside an OMEGA NB1 Protection Head (Dimensions in Inches)

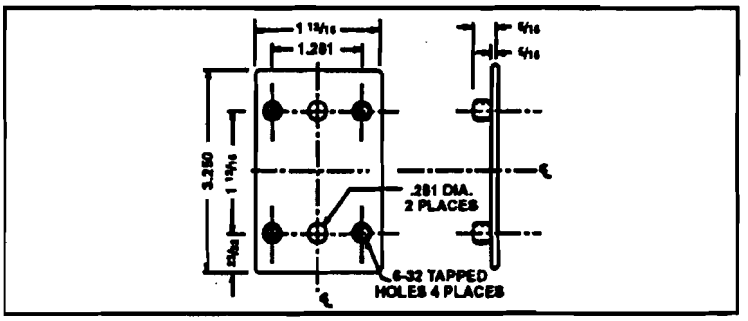
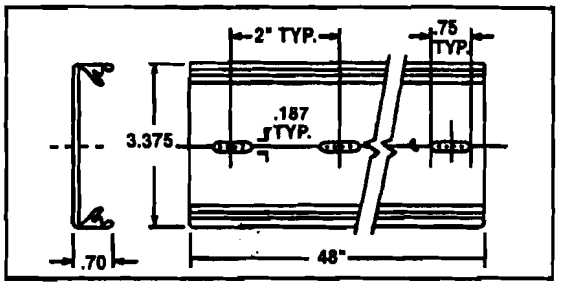


Figure 3-3 TX90-BR Mounting Bracket (in Inches)



CAUTION

Hand tighten transmitter mounting screws only. Do not overtighten.

Figure 3-2 RT Mounting Track (in Inches)

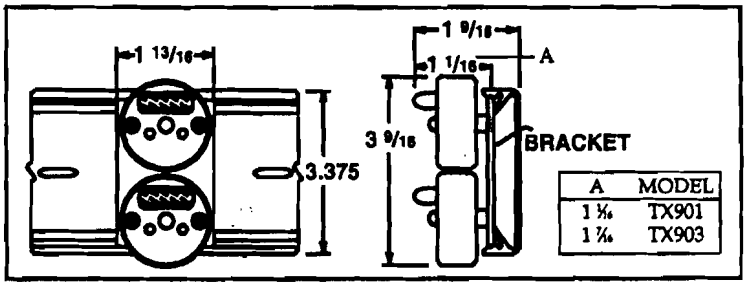


Figure 3-4 Installation with the Bracket and Track (in Inches)

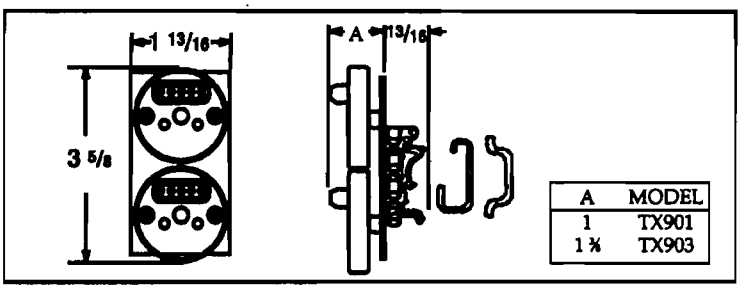


Figure 3-5 TX90-DIN DIN Rail Mounting Adapter (Dimensions in Inches)

3.2 Wiring the TX901 or TX903 (Refer to Figure 3-6)

1. Connect a dc power supply in series with the load to the (+PS) and (-PS) power terminals. Note that the load (usually a monitoring instrument) may be connected to either the (+) or (-) power lead.
2. Connect the thermocouple to the (+IN) and (-IN) input terminals.

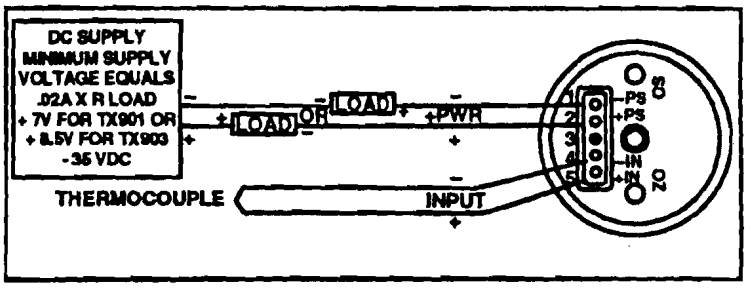


Figure 3-6 Wiring Diagram for the TX901 or TX903

4 Calibration Instructions

4.1 Equipment Required

- Precision mV source, with 0.001 mV resolution and ±0.002 mV accuracy or
- Precision DVM with ±0.002 mV accuracy and an adjustable mV source with 0.001 mV resolution
- OMEGA TRC III Ice Point Reference (or stable ice bath)
- Temperature Reference Probe (OMEGA P/N: TRP-(*))
  *Thermocouple Type: J, K, T, E, R, S

4.2 Set-Up Equipment

To prepare the ice bath:

a) Fill a glass beaker with crushed ice made from distilled water.

b) Fill the beaker with enough distilled water so that the ice just becomes slush, but not enough to float the ice.

c) Insert the reference thermocouple.

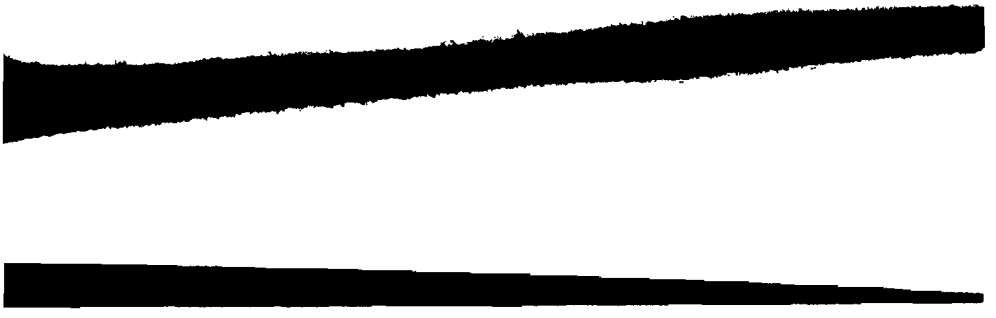
Figure 4-2 shows an alternate set-up. Here, a high precision thermocouple calibrator, such as the OMEGA Model CL511, replaces the DVM, ice bath, voltage source, etc.

4.3 Calibration Procedures (Refer to Figure 4-1)

Connect the calibration equipment according to Figure 4-1 or 4-2. The thermocouple wire (J, K, T, E, R or S) must be of the same type as required for the transmitter being calibrated. Make sure that the wiring polarities are correct. (Note that the RED thermocouple wire is NEGATIVE.)

To check or adjust the calibration:

1. Select the temperature range and thermocouple type.
   Note that the top of the range can be 4 to 64 mV above the bottom of the range. The bottom of the range is always 0 mV (or 0°C) ±25% of the millivolt span.



2. If you are calibrating using an ice bath and millivolt source, find the millivolt values in a thermocouple reference table corresponding to the top and bottom of your temperature range. For example, for type J, 60 to 200°F, the millivolt input will be .791 to 4.906 mV. Note that the zero offset of .791 mV is less than 25% of the millivolt span of 4.115 mV.

   If you are calibrating using a Thermocouple Calibrator/ Simulator the above step is not necessary. This is because the output of the calibrator is given directly in units of temperature rather than in millivolts.

3. Referencing Table 4-1 set the DIP switch positions for the required thermocouple type and input span.

4. Locate the span "S" and zero "Z" potentiometers on the transmitter.
5. Set the calibration source to the bottom of the input range and adjust the zero potentiometer for an output of 4 mA.
6. Set the calibration source to the top of the input range and adjust the zero potentiometer for an output of 20 mA.
7. Repeat steps 5 and 6 until the output readings are exactly 4,000 mA and 20,000 mA. This procedure is necessary as there is some interaction between the two potentiometers.

Table 4-1. Dip Switch Settings for the Thermocouple Types and Ranges

Millivolt Span		4/8	8/16	12/24	16/32	20/40	24/48	28/56	32/64
	SW4	ON	OFF	ON	OFF	ON	OFF	ON	OFF
SWITCH	SW5	ON	ON	OFF	OFF	ON	ON	OFF	OFF
SETTINGS	SW6	ON	ON	ON	ON	OFF	OFF	OFF	OFF
TYPE J SW1 ON	°C	0 TO 80/150	0 TO 150/290	0 TO 220/420	0 TO 290/600	0 TO 370/710	0 TO 420/760		
SW2 OFF SW3 OFF	°F	0 TO 140/270	0 TO 270/530	0 TO 400/790	0 TO 530/1050	0 TO 560/1320	0 TO 790/1390		
TYPE K SW1 OFF	°C	0 TO 100/200	0 TO 200/390	0 TO 290/580	0 TO 390/770	0 TO 480/970	0 TO 580/1180	0 TO 670/1370	
SW2 ON SW3 OFF	°F	0 TO 175/355	0 TO 355/705	0 TO 530/1045	0 TO 705/1385	0 TO 875/1740	0 TO 1045/2115	0 TO 1210/2500	
TYPE T SW1 OFF	°C	0 TO 95/175	0 TO 175/320	0 TO 250/400					
SW2 ON SW3 OFF	°F	0 TO 175/320	0 TO 320/585	0 TO 460/750					

Table 4-1. Dip Switch Settings for the Thermocouple Types and Ranges (Continued)									
TYPE E SW1 OFF	°C	0 TO 65/125	0 TO 125/235	0 TO 180/325	0 TO 235/440	0 TO 285/535	0 TO 325/635	0 TO 385/735	0 TO 435/835
SW2 OFF SW3 OFF	°F	0 TO 120/230	0 TO 230/430	0 TO 335/615	0 TO 430/795	0 TO 525/975	0 TO 615/1155	0 TO 705/1330	0 TO 795/1515
TYPE R SW1 OFF	°C	0 TO 450/800	0 TO 800/1400	0 TO 1115/1700					
SW2 OFF SW3 ON	°F	0 TO 840/1470	0 TO 1470/2540	0 TO 2025/3100					
TYPE S SW1 OFF	°C	0 TO 480/860	0 TO 860/1535	0 TO 1200/1760					
SW2 OFF SW3 ON	°F	0 TO 875/1565	0 TO 1565/2785	0 TO 2190/3210					

NOTE: Zero Adjustment is Approximately ±25% of span Centered Around 0°C.

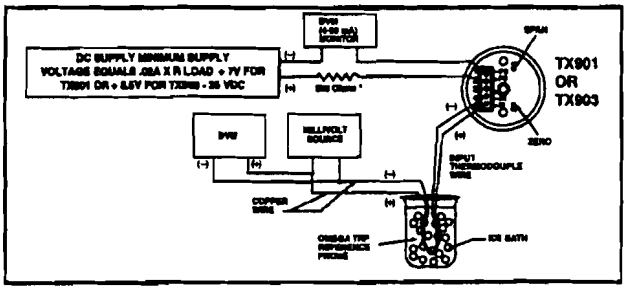


Figure 4-1 Calibration Set-Up

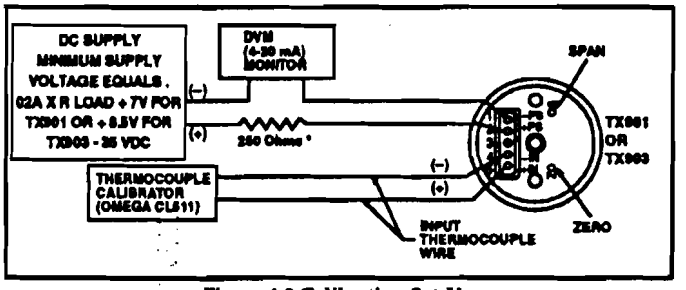


Figure 4-2 Calibration Set-Up

5 Troubleshooting Guide

Malfunction or incorrect operation may be caused by:

1. Reversed polarity:

   Check the wiring using Figure 3-6 as a guide. If the temperature of the thermocouple increases while the current magnitude decreases, the problem could be caused by reversed polarity of the:

   a) thermocouple wiring

   b) power supply leads

   c) monitor instrument

2. Loose or broken wires:

   Check each terminal connection for tightness. Move each wire back and forth and note any changes in operation.

3. Too high a load resistance in the output current loop or too low a current rating on the power supply:

   a) Measure the total resistance of each device (excluding the transmitter and power supply) in the 20 mA loop, including the resistance of the lead wires.

b) Calculate the maximum allowable loop resistance using the formula:

$$\text{Loop Resistance (maximum)} = \frac{V_{supply} - V_T}{0.020A}$$

For example, a 24V power supply would give a maximum loop resistance of: 17V/0.020A = 850 ohms for TX901.

c) Make sure the power supply is rated for at least 28 mA times the number of TX901 or TX903 transmitters being powered. For example, if the supply is powering 5 transmitter, the supply should be rated for at least 140 mA.

V_T	MODEL
7V	TX901
8.5V	TX903

6 Accessories

Model No.	Description
TX90-BR	Mounting Bracket
PSU-24B	Unregulated Power Supply, 24 Volts
TX82B	Process Loop-Powered Indicator
RT	48" Mounting Track
TX90-DIN	DIN Rail Mounting Adapter
RAIL-35-2	6.5' Section 35mm DIN Rail

General

Size:	TX901: 1.75" dia. X 0.75" high (includes terminal strip) TX903: 1.75" dia. X 1.125" high (includes terminal strip)
Span Adjustment:	4 to 64 mV
Zero Adjustment:	±25% of mV span centered around 0 mV (or °C)
Isolation (TX903 only):	500 V RMS
Power Supply Voltage Operating Range:	+7 V for TX901 and +8.5V for TX903 to +35 Vdc, 28 mA max required per transmitter

Accuracy:	±0.1% of full scale (includes effects of hysteresis, repeatability and linearity proportional to the T/C)
Frequency Response:	3dB@ 3Hz
Ambient Temperature:	-13°F to 185°F (-25°C to 85°C)
Storage Temperature Range:	-85°F to 257°F (-65°C to 125°C)
Thermal Zero Shift:	<0.01%/°F of span (span > 10 mV) <0.02%/°F of span (4-10 mV span)
Thermal Span Shift:	<0.01%/°F of span
Weight:	2.5 oz (71g)

Output

Current Output Span:	4-20 mA dc
Current Output Limits:	3 to 28 mA, typical
Maximum Loop Resistance:	(V_{supply} — +7V) for TX901 and +8.5V for TX903)/0.020A = ohms
Load Resistance Effect:	0.01% of span per 300 ohms change
Power Supply Effect:	0.002% of output span per volt

Input

Sensor:	Thermocouple
Input Break Protection:	Upscale
Impedance:	>30 MΩ
Source Current:	4 nA typical

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA ENGINEERING Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

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OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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OMEGA USA WARRANTY/DISCLAIMER

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of **61 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the **five (5) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this warranty is VOID, if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. Nevertheless, OMEGA only warrants that the parts manufactured by it will be as specified and free of defects.

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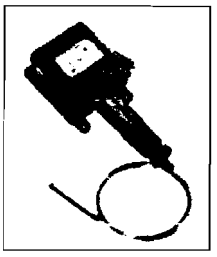
Section 6-H

Duct Heater Discharge Air Temperature Switch (TSH-503)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction



100 Series Temperature Switch

Types B100, C100, E100, F100

UNITED ELECTRIC CONTROLS

Installation and Maintenance Instructions

Please read all instructional literature carefully and thoroughly before starting. Refer to the final page for the listing of Recommended Practices, Liabilities and Warrantees.

GENERAL

Types B100 and C100 (Immersion Stem)

Temperature variations are sensed by a liquid filled sensor which expands or contracts against a bellows which in turn actuates or deactuates a snap-action switch at a predetermined set point.

Types E100 and F100 (Bulb & Capillary)

Temperature variations of a liquid filled sensing bulb are hydraulically transmitted to a bellows which either actuates or deactuates a snap-acting switch at a predetermined set point.

MAXIMUM TEMPERATURE IS THE HIGHEST TEMPERATURE TO WHICH A SENSING ELEMENT MAY BE OCCASIONALLY EXPOSED TO WITHOUT ADVERSELY AFFECTING SET POINT CALIBRATION AND REPEATABILITY. MAXIMUM TEMPERATURE LIMITS STATED IN LITERATURE AND ON NAMEPLATE MUST NEVER BE EXCEEDED, EVEN BY TEMPERATURE OVERSHOOTS IN THE SYSTEM. OCCASIONAL OPERATION OF UNIT UP TO MAX. TEMPERATURE IS ACCEPTABLE (E.G., START-UP, TESTING). CONTINUOUS OPERATION SHOULD BE RESTRICTED TO THE DESIGNATED ADJUSTABLE RANGE.

Part I - Installation

Tools Needed

Adjustable wrench
Flathead screwdriver
Hammer (for alternate wire knockouts)

MOUNTING

INSTALL UNIT WHERE SHOCK, VIBRATION AND TEMPERATURE FLUCTUATIONS ARE MINIMAL. DO NOT MOUNT UNIT IN AMBIENT TEMPERATURES EXCEEDING PUBLISHED LIMITS. 100 SERIES TEMPERATURE SWITCHES CAN BE MOUNTED IN ANY POSITION, PROVIDED THE ELECTRICAL CONDUIT IS NOT FACING UP. ORIENT UNIT SO THAT MOISTURE IS PREVENTED FROM ENTERING THE ENCLOSURE.

For remote mounting, mount the unit via the (2) 1/4" screw clearance holes on the enclosure (See Dimensions on back page.) Fully immerse the bulb and 6" capillary in the control zone. It is generally desirable to place the bulb close to the heating or cooling source in order to sense temperature fluctuations quickly. Be sure to locate the bulb so that it will not be exposed to temperatures beyond the instrument range limits.

FOR LOCAL MOUNTING, ALWAYS HOLD A WRENCH ON THE TEMPERATURE HOUSING HEX WHEN MOUNTING UNIT. DO NOT TIGHTEN BY TURNING ENCLOSURE. THIS WILL DAMAGE SENSOR AND WEAKEN SOLDERED OR WELDED JOINTS.

WIRING

DISCONNECT ALL SUPPLY CIRCUITS BEFORE WIRING UNIT. ELECTRICAL RATINGS STATED IN LITERATURE AND ON NAMEPLATE MUST NOT BE EXCEEDED. OVERLOAD ON A SWITCH CAN CAUSE FAILURE ON THE FIRST CYCLE. WIRE UNITS ACCORDING TO NATIONAL AND LOCAL ELECTRICAL CODES. MAXIMUM RECOMMENDED WIRE SIZE IS 14 AWG.

Remove the two screws retaining the cover and cover gasket. A 1/2" NPT conduit connection is located on the left side of the enclosure. Two cast-in 7/8" diameter knockouts for electrical conduit are located on the side and rear of enclosure. These can easily be knocked out by placing the blade of a screwdriver in the groove and tapping sharply with a hammer.

Connect conduit to the enclosure and wire directly to the switch terminals according to local and national electrical codes. Bring the wires up to terminals from the rear of the enclosure allowing enough slack so as not to affect switch movement when making setting adjustments. The three switch terminals are clearly labeled "common", "norm open", and "norm closed". If lead wires are supplied, color coding is as follows:

	SPDT
Common (COM)	Violet
Normally Open (NO)	Blue
Normally Closed (NC)	Black

A grounding screw and clamp (cast in symbol) is provided which meets a 35 lb. pull test. Keep the wire as short as possible to prevent interference with the plunger and, when provided, the adjustable differential switch wheel (option1519).

Part II - Adjustments

Tools Needed

3/16" open end wrench

NOTE: For set point adjustments and recalibration, immerse sensor (immersion stem or bulb and 6" of capillary) in a calibrated temperature source and stabilize unit.

Types C100 and F100

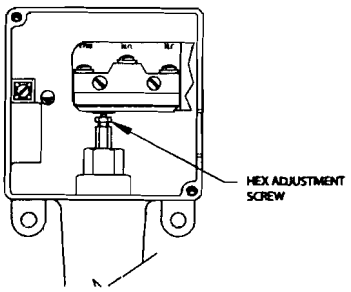
Remove cover. Switch has a hex adjustment screw inside enclosure. If switch transfer point differs from actual temperature, adjust setting. To raise the temperature setting, turn the hex towards the left (clockwise). To lower the temperature setting, turn the screw towards the right (counter-clockwise). When making adjustments, do not exceed the maximum temperature rating on nameplate.

Types B100 and E100 (with reference dial)

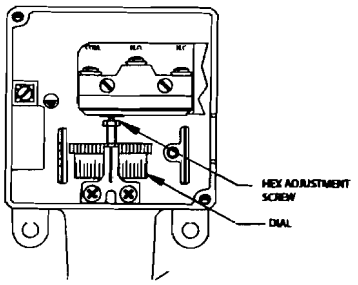
Controls are factory calibrated for maximum accuracy at the midpoint of the scale.

To re-calibrate, turn dial to desired set point. If the actual temperature and set point temperature do not agree, turn hex adjustment screw towards the left (clockwise) to raise and towards the right (counter-clockwise) to lower temperature setting.

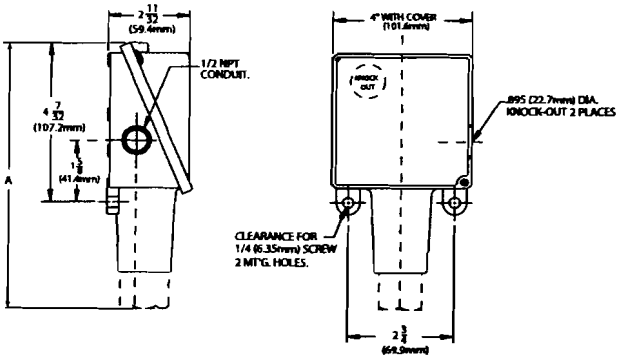
C100, F100



B100, E100

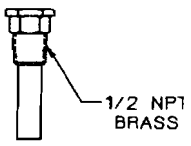


Dimensions

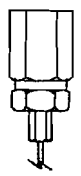


Types B100, C100, E100, F100

	Dimension A		
Models	Inches	mm	
120,121	9.38	238,2	Immersion stem
1B-8B	8.75	222,23	Bulb & capillary



Models 120-121



Models 1BC-8BC, 1BS-8BS

RECOMMENDED PRACTICES AND WARNINGS

United Electric Controls Company recommends careful consideration of the following factors when specifying and installing UE pressure and temperature units. Before installing a unit, the Installation and Maintenance instructions provided with unit must be read and understood.

- To avoid damaging unit, proof pressure and maximum temperature limits stated in literature and on nameplates must never be exceeded, even by surges in the system. Operation of the unit up to maximum temperature is acceptable on a limited basis (i.e., start-up, testing) but continuous operation must be restricted to the designated adjustable range. Excessive cycling at maximum temperature limits could reduce sensor life.
- A back-up unit is necessary for applications where damage to a primary unit could endanger life, limb or property. A high or low limit switch is necessary for applications where a dangerous runaway condition could result.
- The adjustable range must be selected so that incorrect, inadvertent or malicious setting at any range point cannot result in an unsafe system condition.
- Install unit where shock, vibration and ambient temperature fluctuations will not damage unit or affect operation. Orient unit so that moisture does not enter the enclosure via the electrical connection. When appropriate, this entry point should be sealed to prevent moisture entry.
- Unit must not be altered or modified after shipment. Consult UE if modification is necessary.
- Monitor operation to observe warning signs of possible damage to unit, such as drift in set point or faulty display. Check unit immediately.
- Preventative maintenance and periodic testing is necessary for critical applications where damage could endanger property or personnel.
- For all applications, a factory set unit should be tested before use.
- Electrical ratings stated in literature and on nameplate must not be exceeded. Overload on a switch can cause damage, even on the first cycle. Wire unit according to local and national electrical codes, using wire size recommended in installation sheet.
- Do not mount unit in ambient temp. exceeding published limits.

LIMITED WARRANTY

Seller warrants that the product hereby purchased is, upon delivery, free from defects in material and workmanship and that any such product which is found to be defective in such workmanship or material will be repaired or replaced by Seller (Ex-works, Factory, Watertown, Massachusetts. INCOTERMS); provided, however, that this warranty applies only to equipment found to be so defective within a period of 24 months from the date of manufacture by the Seller (36 months for the Spectra 12 and One Series products; 18 months for Temperature Sensors). Seller shall not be obligated under this warranty for alleged defects which examination discloses are due to tampering, misuse, neglect, improper storage, and in any case where products are disassembled by anyone other than authorized Seller's representatives. EXCEPT FOR THE LIMITED WARRANTY OF REPAIR AND REPLACEMENT STATED ABOVE, SELLER DISCLAIMS ALL WARRANTIES WHATSOEVER WITH RESPECT TO THE PRODUCT, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

LIMITATION OF SELLER'S LIABILITY

SELLER'S LIABILITY TO BUYER FOR ANY LOSS OR CLAIM, INCLUDING LIABILITY INCURRED IN CONNECTION WITH (I) BREACH OF ANY WARRANTY WHATSOEVER, EXPRESSED OR IMPLIED, (II) A BREACH OF CONTRACT, (III) A NEGLIGENT ACT OR ACTS (OR NEGLIGENT FAILURE TO ACT) COMMITTED BY SELLER, OR (IV) AN ACT FOR WHICH STRICT LIABILITY WILL BE IMPUTTED TO SELLER, IS LIMITED TO THE "LIMITED WARRANTY" OF REPAIR AND/OR REPLACEMENT AS SO STATED IN OUR WARRANTY OF PRODUCT. IN NO EVENT SHALL THE SELLER BE LIABLE FOR ANY SPECIAL, INDIRECT, CONSEQUENTIAL OR OTHER DAMAGES OF A LIKE GENERAL NATURE, INCLUDING, WITHOUT LIMITATION, LOSS OF PROFITS OR PRODUCTION, OR LOSS OR EXPENSES OF ANY NATURE INCURRED BY THE BUYER OR ANY THIRD PARTY.

UE specifications subject to change without notice.

UNITED ELECTRIC CONTROLS
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617 926-1000 Fax 617 926-2568
http://www.ueonline.com

EMC03.5M1202

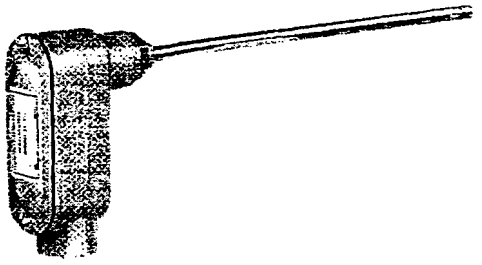
Section 6-I

Relative Humidity and Temperature Transmitters (RHT/TT-501, RHT/TT-621, RHT/TT-633)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

MODEL 657C-1 RELATIVE HUMIDITY/TEMPERATURE TRANSMITTER

Physical Data – Installation and Operating Instructions



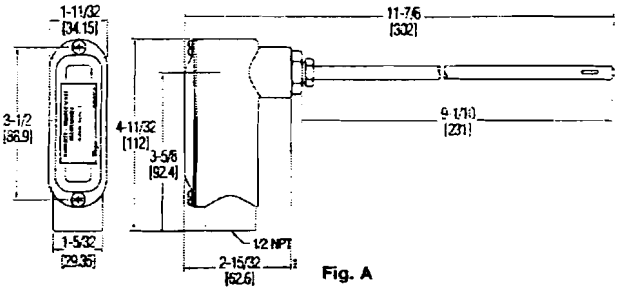


Fig. A

The Dwyer Model 657C-1 Relative Humidity/Temperature Transmitter provides two 4-20 mA channels to produce separate output signals for both relative humidity and temperature. This unit is housed in a die cast aluminum 1/2" LB conduit enclosure with internal screw terminals. A 5/16" × 9-1/10" stainless steel sensing probe extends through a side hub. Sensor can be inserted directly into ducts and secured by optional mounting kits A-158 or A-159. The A-158 kit consists of a split flange which is clamped around the probe and then attached to the duct exterior with sheet metal screws. A rubber gasket is included to seal the connection. The A-159 kit includes a bushing with 1/2" NPT male threads which is inserted through a hole in the duct. It is then secured from the duct interior with a washer and locknut. Alternatively, it can be threaded into a standard pipe flange mounted outside the duct.

The sensor employed in the 657C-1 features a state-of-the-art integrated polymer film relative humidity sensor and a thin-film platinum temperature sensor. These sensors were designed to provide high reliability and stability over years of continuous service. The relative humidity sensor uses a special polymer film which absorbs water vapor at a precisely known rate which is dependent on the relative humidity of the surrounding air. This film is deposited on a CMOS integrated circuit that measures and conditions the sensor output. The semiconductor and advanced film technology ensure long term stability and accuracy. The temperature sensor couples the highly accurate and predictable temperature characteristics of platinum with a cost effective thin-film technology.

Physical Data

Relative Humidity Range: 0-100%

Accuracy: ±2% (10-90% Rh), ±3% (0-10% and 90-100% Rh)

Operating Temperature Range: 32 to 158°F (0-70°C)

Temperature Measurement Range: 32 to 212°F (0 to 100°C)

Temperature Accuracy: ±1°F (0.5°C)

Output: 2 channels, each 4-20 mA, loop powered on Rh channel

Power Supply: 10-35 VDC

Ambient Operating Temperature Limits: 32 to 158°F (0 to 70°C)

Storage Temperature Limits: –40 to 176°F (–40 to 80°C)

Housing: Die cast aluminum with 1/2" conduit connection

Sensor Probe: 5/16" × 9-1/10" (0.8 × 25.4 cm) stainless steel

Installation

1. Location: Select a clean, dry location for the enclosure where the temperature will not exceed the limits of 32 to 158°F (0-70°C). The transmitter can be located any distance from the receiver provided the total loop resistance does not exceed the limits as explained under "Wire Type and Length."
The probe should be located where conditions are representative of the overall environment being monitored. Avoid locations where stagnation or rapidly fluctuating conditions might occur. Also avoid areas where water mist or condensation exist which could cause erroneous full scale humidity readings.

2. Position: The probe and transmitter are not position sensitive and can be mounted in any orientation required. However, if the formation of condensation within the conduit is possible, locate the Model 657C so that moisture will drain away from the enclosure.

3. Mounting: To mount the probe, use optional kits A-158 Split Flange or A-159 Duct Mounting Gland or equivalent. Be carefull to avoid excess stress on the sensing tube and/or housing which could cause the probe and housing to separate.

Electrical Connection

Caution: Do not exceed the specified supply voltage rating. Permanent damage, not covered by warranty, may result. This unit is not designed for AC voltage operation.

Receiver-Transmitter Connection – The Model 657C-1 transmitter is designed as a two-wire 4-20 mA device with two channels. The channels are common on the negative side of the current loops. Sensor excitation power is derived from the relative humidity channel, so power must always be applied to that channel. If the temperature channel is not used, it can be left disconnected. The basic two-wire connection is shown in Fig. B. Terminal 4 can be used as a tie point since it is not used internally. However, the voltage on the terminal should not exceed the 35 VDC limit. Never connect AC or voltages exceeding 35 VDC to this terminal.

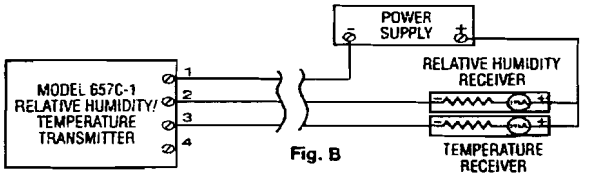


Fig. B

Power Supply – The transmitter requires a minimum of 10 and a maximum of 35 VDC at its connection for proper operation. Choose a power supply with a voltage and current rating which meets this requirement under all operating conditions. If the power supply is unregulated, make sure voltage remains within these limits under all power line conditions. Ripple on the supply should not exeed 100 mV.

Loop Resistance – The maximum allowable loop resistance depends on the power supply voltage. Maximum loop voltage drop must not reduce the transmitter voltage below the 10 VDC minimum. Maximum loop resistance can be calculated with the following equation. V_{PS} is the power supply voltage.

$$R_{max} = \frac{V_{ps} - 10.0}{20\ mA}$$

Some receivers, particularly loop powered indicators, may maintain a fixed loop voltage to power the device. This voltage drop must also be subtracted from the power supply voltage when calculating the voltage margin for the transmitter. The following equation takes this into account. V_{rec} is the receiver fixed voltage.

$$R_{max} = \frac{V_{ps} - 10.0 - V_{rec}}{20\ mA}$$

Wire Type and Length – Wire selection is often overlooked or neglected and thus can contribute to improper or intermittent operation. Although 4-20 mA current loops are relatively immune to wiring related problems, for some systems, proper wiring can be an important factor in ensuring satisfactory system operation.

Twisted conductors are usually immune to most stray electric and magnetic fields, and to some extent electromagnetic fields such as interference from RF transmitters. Avoid use of flat or ribbon cable which has no regular conductor twist. Where interference is possible, use shielded wire. The shield must not be used as one of the conductors and should be connected to ground at one end only – generally at the power supply. Similarly, the conduit should be connected to protective ground as dictated by applicable code and the signal wiring must not be connected to the conduit at more than one point or as specified by code.

The maximum length of wire connecting the transmitter and receiver is a function of wire and receiver resistances. Wire resistance is negligible in most installations with shorter runs, typically under 100 feet. Generally, wire resistance should contribute no more than 10% to total loop resistance. Where long runs are necessary or unique application conditions exist, wire resistance must be carefully considered. Use the following equations to determine maximum wire length.

For a receiver with a pure resistive load, the maximum wire length is:

$$L_{c\ max} = \frac{V_{ps} - 10V - .02R_r}{0.10R_{co}}$$

For a receiver with a voltage drop specification, the maximum wire length is:

$$L_{c\ max} = \frac{V_{ps} - 10V - V_r}{0.10R_{co}}$$

Where:

L_{Cmax} = Maximum wire length in feet
V_{ps} = Minimum power supply voltage
R_r = Receiver resistance
V_r = Receiver voltage drop
R_{co} = Wire resistance per foot from Table 1

This equation includes a 20% safety factor and accounts for the common lead carrying the current for both temperature and humidity channels.

To determine the maximum wire length, follow this procedure:

1. Determine whether the receiver is purely resistive or has a fixed voltage drop, then select the corresponding equation.
2. Determine the minimum power supply voltage that will be used. If the power supply is unregulated, use the voltage corresponding to the low-line condition.
3. Select the wire size and determine, from Table 1, the resistance per foot for that wire size. If the wire will be exposed to a wide temperature range, use the resistance corresponding to the highest expected temperature.
4. Calculate the maximum length. If the required distance is greater than the calculated value, choose a larger wire size and recalculate the maximum length.

AWG	Ohms/ft. @32°F	Ohms/ft. @68°F	Ohms/ft. @122°F	Ohms/ft. @ 167°F
16	.03983	.04495	.04833	.05256
18	.06332	.06873	.07684	.08360
20	.10069	.10928	.12218	.13291
22	.16010	.17375	.19426	.21132
24	.25459	.27628	.30886	.33596
26	.40486	.43930	.49114	.53445

Table 1 – Wire resistance for various wire sizes

Multiple Receiver Installation

An advantage of the standard 4-20 mA DC output signal used in the Model 657C-1 transmitter is the compatibility with a wide range of receivers. Devices such as the A-701, A-702 and A-705-20 digital readouts, chart recorders and other process control equipment can be easily connected and used simultaneously. It is only necessary that all devices be designed for standard 4-20 mA input, the proper polarity of input connections be observed and the combined receiver resistance or loop voltage not exceed the maximum for the current loop. If any receiver indicates a negative or downscale reading, the signal input leads are reversed

Maintenance

After final installation of the Model 657C-1 transmitter, no routine maintenance is required. These devices are not field repairable and should be returned to the factory if recalibration or other service is required. After first obtaining a Returned Goods Authorization (RGA) number, send the material, freight prepaid, to the following address. Please include a clear description of the problem plus any application information available.

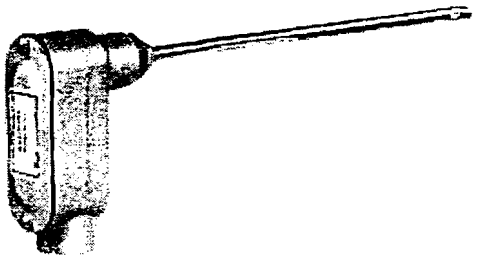
Dwyer Instruments, Inc.
Attn: Repair Department
102 Highway 212
Michigan City, IN 46360

Printed in U.S.A. 2/98 FR 02-443011-00

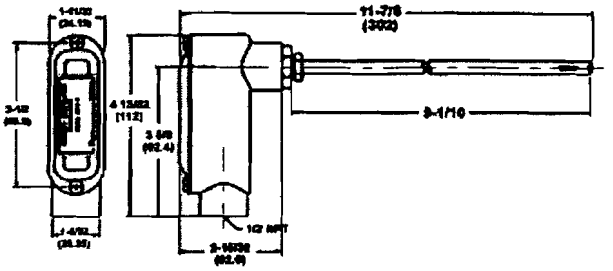
Ready to

Model 657C-1 Relative Humidity/Temperature Transmitter

Dual Channel Design for Simultaneous 4 - 20 mA Output Signals - Conduit Housing



Service Manual
Catalog Page



Dimensional Enlargement

The Model 657C-1 Transmitter features the same circuit design as the 657-1 providing two 4 - 20 mA channels to produce separate output signals for both relative humidity and temperature. However, this model is housed in a tough die cast aluminum protective conduit enclosure with gasketed cover. An internal terminal block is provided for electrical connections. The sensor employed in the 657C-1 features a state-of-the-art integrated polymer film humidity sensor and a thin-film platinum temperature sensor to assure high reliability and rock-solid stability over years of continuous service. Stainless steel probe measures 5/16" x 9 1/10" (0.8 x 23.1 cm) and can be easily mounted to most ductwork using either of the two optional kits below.

POPULAR MODELS

Model Number	Description	Price	Discount Schedule
657C-1	RH/Temperature Transmitter	$205.00	Standard

***Prices are based in US currency and may change for international customers due to and not limited to customs brokerage fees, export packing and documentation, tariffs, duty and taxes.**

Click the Model Number of the item to add the item to your shopping cart.

SPECIFICATIONS

Relative Humidity Range: 0 - 100%
Rh Accuracy: ± 2% (10 - 90% Rh), ± 3% (0 - 10% and 90 - 100% Rh)
Operating Temperature Range: 32 to 158°F (0 to 70°C)
Temperature Measurement Range: 32 to 212°F (0 to 100°C)
Temperature Accuracy: ± 1°F (0.5° C)
Output: 2 channels, each 4 - 20 mA, loop powered on Rh channel
Power Supply: 10 - 35 VDC
Ambient Operating Temperature Limits: 32 to 158°F (0 to 70°C)
Storage Temperature Limits: -40 to 176°F (-40 to 80°C)
Housing: Die cast aluminum
Conduit Connection: ½"
Sensor Probe: 5/16" x 9 1/0" (0.8 x 23.1 cm) stainless steel
Weight: 10 oz (284 gr)

ACCESSORIES

Model Number	Description	Price	Discount Schedule
A-158	Split Flange, used with Series 160 Pitot Tubes.	$8.10	Standard
A-159	Mounting Gland, used with Series 160 Pitot Tubes.	$17.25	Standard

***Prices are based in US currency and may change for international customers due to and not limited to customs brokerage fees, export packing and documentation, tariffs, duty and taxes.**

Click the Model Number of the item to add the item to your shopping cart.

VIEW YOUR SHOPPING CART

Section 6-J

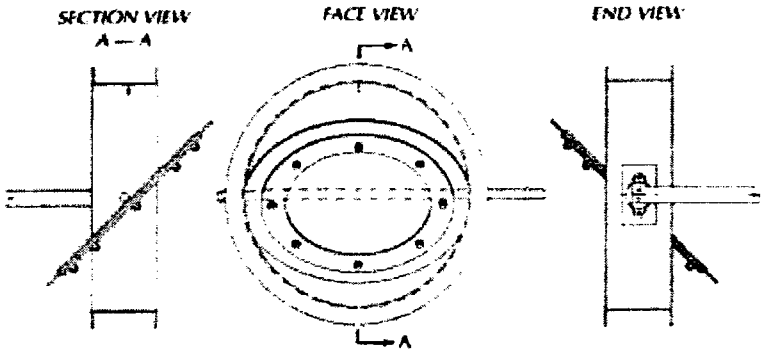
Air Flow Butterfly Shut-Off Damper and Spool Pieces (V-501, SP-601, SP-602, SP-611, SP-612, SP-621, SP-622, SP-631 through SP-634)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Round Isolation Dampers

Model VC-56ISO

The VC-56I damper is the ultimate in isolation dampers. Like the VC-560 Series with its superior construction; the VC-56I adds a full circumference seal to provide near bubble tight results at .029 scfm per lineal inch of perimeter up to 10 in. wg, and at temperatures from -40°F to 150°F.



Pioneering America's Air Control Technology

Options for VC-56I

- **"C" flange width.**
- **"D" frame depth.**
- **Material gauges/thickness for frames, sleeves, flanges and blades**
- **Axle dimensions.**
- **Manual quadrants.**
- **Lever arms.**
- **Mounting holes.**
- **Frame styles.**

STANDARD SPECIFICATIONS FOR VC-56I (mm)

Max. Temp.:	**150°F** (65°C)
Max. Face Velocity:	**4000 fpm** (20 m/s)
Frame:	**8"** (203) x **1½"** (38) x **10 Ga.** (3.42) rolled steel channel, thru **25"** (635) dia. **10"** (254) x **2"** (51) x **10 Ga.** (3.42) rolled steel channel **25 1/16"** (637) thru **36"** (914) dia. **10"** (254) x **2"** (51) x **3/16"** (4.76) thick rolled steel channel **36 1/16"** (916) thru **60"** (1524) dia.
Sleeve:	*(Used with optional frames)* **10 Ga.** (3.42) steel, thru **36"** (914) dia. **3/16"** (4.76) thick steel, **36 1/16"** (916) thru **60"** (1524) dia.
Blade:	**3/16"** (4.76) thick steel, welded to axle, thru **24"** (610) dia. **¼"** (6.35) thick steel, welded to axle, **24 1/16"** (611) thru **60"** (1524) dia.
Axle:	**¾"** (19) dia. steel full length, thru **18"** (457) dia. **1"** (25) dia. steel full length, **18 1/16"** (459) thru **28"** (711) dia. **1¼"** (32) dia. steel full length, **28 1/16"** (713) thru **40"** (1016) dia. **1½"** (38) dia. steel full length, **40 1/16"** (1018) thru **48"** (1219) dia. **1¾"** (44) dia. steel full length, **48 1/16"** (1211) thru **60"** (1524) dia.
Bearings:	Relubricable ball with neoprene O-ring stuffing boxes.
Stops:	½" (12.7) dia. steel pin.
Seals:	Full circumference neoprene seal retained by a seal ring bolted to the blade.
Finish:	One (1) coat AWV standard primer.
Actuator:	Extended shaft *(See options above)*

AWV
AMCA MEMBER
american warming
and ventilating

Certificate of Conformance

Job Name: M.L. Water District TP

Customer: Layne Christensen Company
97 Chimney Rock Rd
Bridgewater NJ 08807

Representative: Air Systems Engineering, Inc.

AWV Job No.: 208350

AWV Model No.: VC-56I(SO)-710

The (9) 18 inch diameter heavy duty round isolation dampers supplied on this project are required to meet low leakage results as follows:

(1) unit	0.009 SCFM/in of perimeter at 10 inches of water gauge or 0.509 SCFM total
(4) units	0.023 SCFM/in of perimeter at 30 inches of water gauge or 1.301 SCFM total
(4) units	0.027 SCFM/in of perimeter at 40 inches of water gauge or 1.526 SCFM total

Leakage performance was recorded as follows for a pre production unit.

- At 20 inches of water gauge; Total leakage: 0.0269 SCFM – 5.3% of allowable at 10 inches of water gauge.
- At 30 inches of water gauge; Total leakage: 0.0409 SCFM – 3.1% of allowable
- At 40 inches of water gauge; Total leakage: 0.0581 SCFM – 3.8% of allowable

The leakage results were significantly below the allowable leakage rates, therefore testing of each unit is not required.

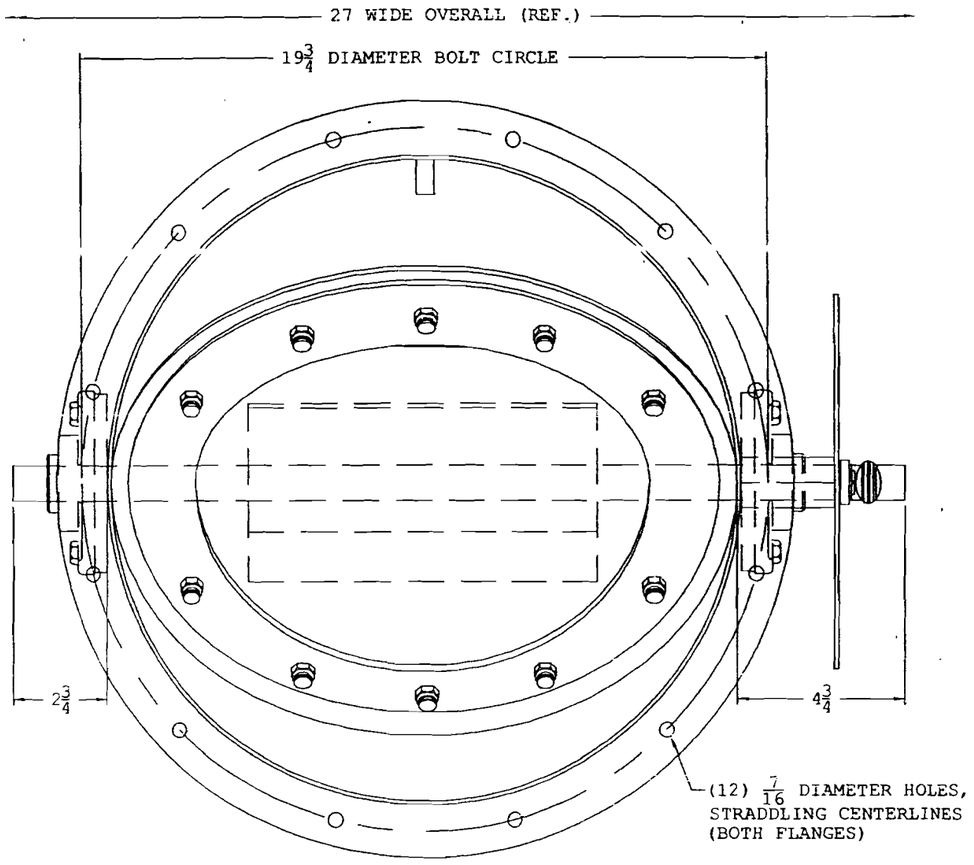
At 40 inches of water gauge, the total leakage of 0.0581 SCFM is less than the requirement at 10 inches of water gauge, thus testing at 10 inches of water gauge is not required.

Test was performed using a pressure decay method for a minimum of 5 minutes in our AMCA registered laboratory in Bradner, Ohio. Test was performed by Mr. John Lockmiller, Laboratory Manager.

William Lampkin
AWV Engineering Manager

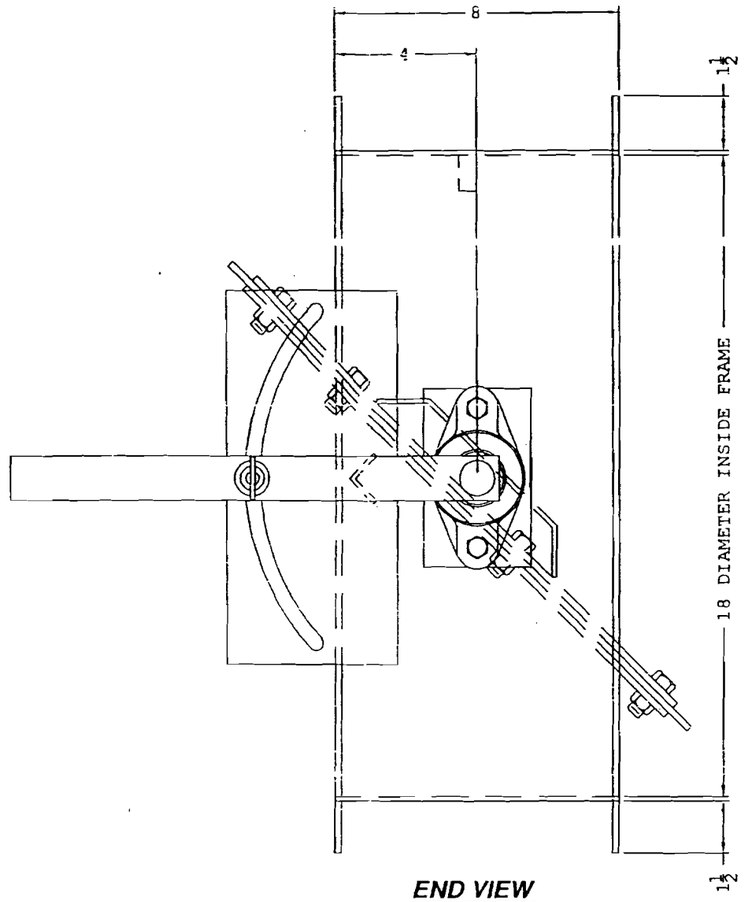
24-JUL-04
Date

7301 International Drive • Holland, OH 43528 • Phone: (419) 865-5000 • Fax: (419) 865-1375



FACE VIEW
FLOW ENTERING SIDE

FLOW



END VIEW

SPECIFICATIONS

FRAME: 8" DEEP x 10 GAUGE 304 STAINLESS STEEL SLEEVE WITH 1-1/2" x 3/16" THK. 304 STAINLESS STEEL CUT RINGS.

BLADE: 3/16" THK. 304 STAINLESS STEEL PLATE WITH 10 GAUGE 304 STAINLESS STEEL PARALLEL REINFORCING CHANNEL, ALL WELDED TO AXLE.

AXLE: 1" DIAMETER 304 STAINLESS STEEL, FULL LENGTH.

BEARINGS: RELUBRICABLE BALL WITH NEOPRENE O-RING STUFFING BOXES.

SEALS: FULL CIRCUMFERENCE NEOPRENE SEAL RETAINED BY A SEAL RING BOLTED TO THE BLADE.

STOPS: 1/2" DIAMETER 304 STAINLESS STEEL PIN.

FINISH: MILL.

ACTUATOR: HEAVY DUTY MANUAL QUADRANT, 304 STAINLESS STEEL.

NOTES

1. DESIGN CRITERIA:
   MAX. DIFF. PRESS.: 30 IN. W.G.
   MAX. TEMPERATURE: 150 DEG. F.
   MAX. VELOCITY: 4000 FPM
   EST. WEIGHT: 115 LBS.
   MAX. LEAKAGE: .023 SCFM PER INCH OF BLADE CIRCUMFERENCE AT 30 IN. W.G.
2. QUANTITY: (4) FOUR DAMPER REQUIRED AS SHOWN.
3. DAMPERS WILL BE VERTICALLY MOUNTED WITH HORIZONTAL AIRFLOW.
4. GRIND FRAME WELD SMOOTH ON INSIDE OF FRAME. CAULK SEAL BOLTS. CAULK O-RING STUFFING BOX - EACH LAYER.
5. ALL WELDING WILL BE PERFORMED IN ACCORDANCE WITH ANY STANDARD WELD DRAWINGS #10151-STD SERIES, UNLESS OTHERWISE SPECIFIED.
6. DAMPERS WILL BE CYCLE TESTED (3) THREE TIMES UNDER SHOP FLOOR CONDITIONS.
7. INLET AND OUTLET DUCTS MUST BE OF SUFFICIENT LENGTH TO CONTAIN THE BLADE IN THE FULL OPEN POSITION AND THE DUCT AND JUNCTION OF THE DAMPER MUST BE SMOOTH AND FREE OF PROTRUSIONS THAT MAY DAMAGE THE BLADE EDGE.
8. TAG: 701458, V-611, V-612, V-631 & V-632

FOR FAB

LAYNE CHRISTENSEN Co. WTD
P.O. No.: 11980701458
AIR SYSTEMS ENG., INC.
P.O. No.: AW04C48
AWV PROD. No.: 208350

STANDARD MANUFACTURING TOLERANCES UNLESS OTHERWISE SPECIFIED DWG. DIMENSIONS ARE IN INCHES.

FRACTIONS
(+ OR -) 1/16 ----- UP TO 6"
(+ OR -) 3/32 ----- 6" TO 12"
(+ OR -) 1/8 ----- 12" TO 24"
(+ OR -) 1/4 ----- ABOVE 24"
(+ OR -) 2 DEG ---- ANY SPECIFIED ANGLE
REFERENCE ----- GIVEN AS SHOP AID. DIMENSIONS MAY VARY
(+ OR -) 1/16 TRUE LOCATION ---- ALL MOUNTING HOLES

DECIMALS
DECIMAL 1 PLACE - (+ OR -) .015
2 PLACE - (+ OR -) .010
3 PLACE - (+ OR -) .005

REVISION	DATE	DRN	CK	APPD	QA

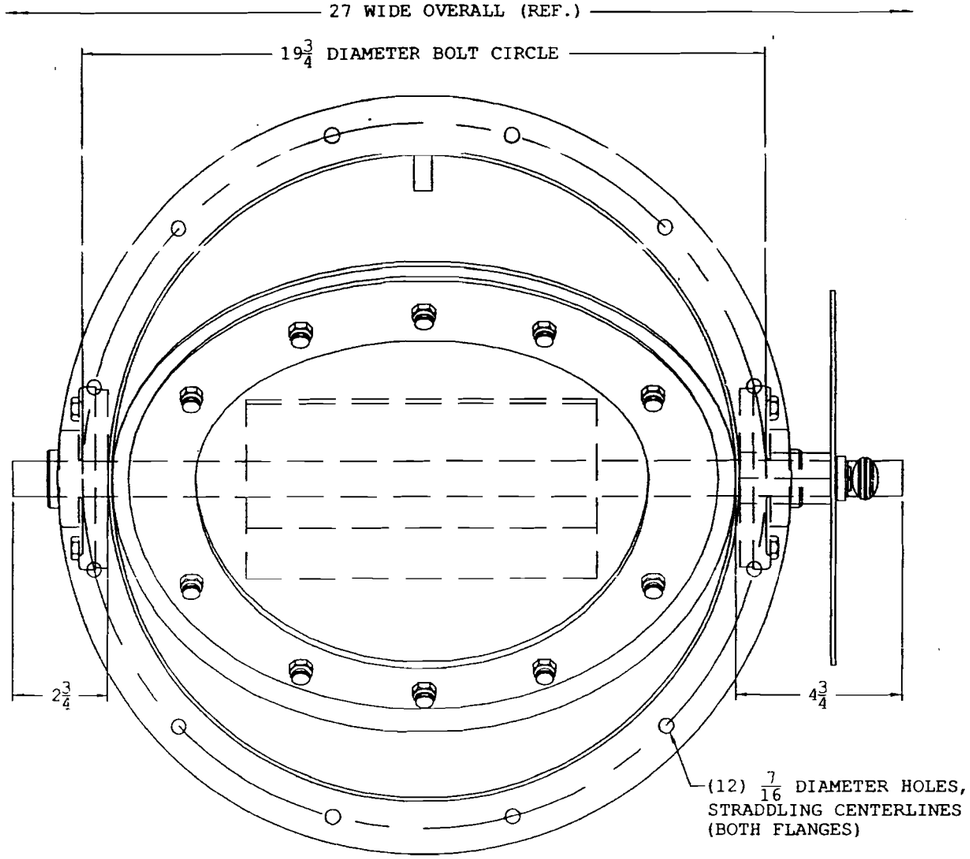
DRAWING STATUS
☒ RELEASED FOR FABRICATION
☐ HELD FOR APPROVAL
☐ AS BUILT DRAWINGS

awv american warming and ventilating
A MESTEK COMPANY
7303 INTERNATIONAL DRIVE HOLLAND, OHIO

VC-56ISO HEAVY DUTY ISOLATION DAMPER

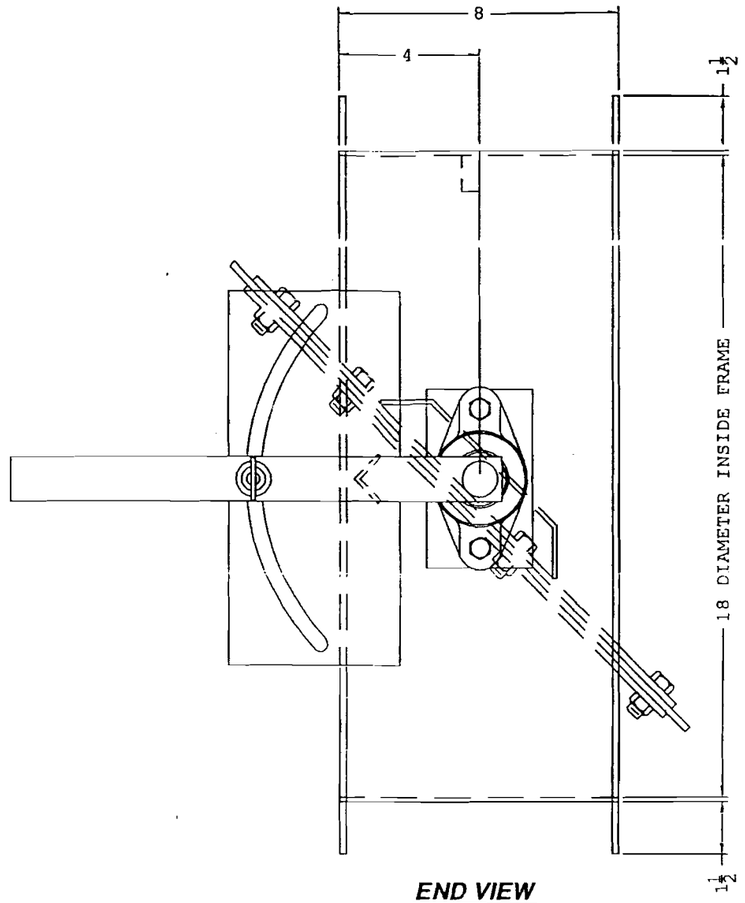
DRN. BY	SOA	DWG. NO.	REV
DATE	5-18-04	20835004-2	

ENGR. APPD BY 5/20/04 APPD BY 5/20/04 DWL Q.A.



FACE VIEW
FLOW ENTERING SIDE

FLOW



END VIEW

SPECIFICATIONS

FRAME: 8" DEEP x 10 GAUGE 304 STAINLESS STEEL SLEEVE WITH 1-1/2" x 3/16" THK. 304 STAINLESS STEEL CUT RINGS.

BLADE: 3/16" THK. 304 STAINLESS STEEL PLATE WITH 10 GAUGE 304 STAINLESS STEEL PARALLEL REINFORCING CHANNEL, ALL WELDED TO AXLE.

AXLE: 1" DIAMETER 304 STAINLESS STEEL, FULL LENGTH.

BEARINGS: RELUBRICABLE BALL WITH NEOPRENE O-RING STUFFING BOXES.

SEALS: FULL CIRCUMFERENCE NEOPRENE SEAL RETAINED BY A SEAL RING BOLTED TO THE BLADE.

STOPS: 1/2" DIAMETER 304 STAINLESS STEEL PIN.

FINISH: MILL.

ACTUATOR: HEAVY DUTY MANUAL QUADRANT, 304 STAINLESS STEEL.

NOTES

1. DESIGN CRITERIA:
   - MAX. DIFF. PRESS.: 40 IN. W.G.
   - MAX. TEMPERATURE: 150 DEG. F.
   - MAX. VELOCITY: 4000 FPM
   - EST. WEIGHT: 115 LBS.
   - MAX. LEAKAGE: .027 SCFM PER INCH OF BLADE CIRCUMFERENCE AT 40 IN. W.G.
2. QUANTITY: (4) FOUR DAMPER REQUIRED AS SHOWN.
3. DAMPERS WILL BE VERTICALLY MOUNTED WITH HORIZONTAL AIRFLOW.
4. GRIND FRAME WELD SMOOTH ON INSIDE OF FRAME. CAULK SEAL BOLTS. CAULK O-RING STUFFING BOX - EACH LAYER.
5. ALL WELDING WILL BE PERFORMED IN ACCORDANCE WITH AWV STANDARD WELD DRAWINGS #10151-STD SERIES, UNLESS OTHERWISE SPECIFIED.
6. DAMPERS WILL BE CYCLE TESTED (3) THREE TIMES UNDER SHOP FLOOR CONDITIONS.
7. INLET AND OUTLET DUCTS MUST BE OF SUFFICIENT LENGTH TO CONTAIN THE BLADE IN THE FULL OPEN POSITION AND THE DUCT AND JUNCTION OF THE DAMPER MUST BE SMOOTH AND FREE OF PROTRUSIONS THAT MAY DAMAGE THE BLADE EDGE.
8. TAG: 701458, V-601, V-602, V-621 & V-622

CERTIFIED FOR FABRICATION

A W G

LAYNE CHRISTENSEN Co. WTD
P.O. No.: 11980701458
AIR SYSTEMS ENG., INC.
P.O. No.: AW04C48
AWV PROD. No.: 208350

STANDARD MANUFACTURING TOLERANCES UNLESS OTHERWISE SPECIFIED
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FRACTIONS
(+ OR -) 1/16 ----- UP TO 3"
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(+ OR -) 1/16 TRUE LOCATION -- ALL MOUNTING HOLES

DECIMALS
DECIMAL 1 PLACE - (+ OR -) .015
2 PLACE - (+ OR -) .010
3 PLACE - (+ OR -) .005

REVISION	DATE	DRN / CK	APPD	QA

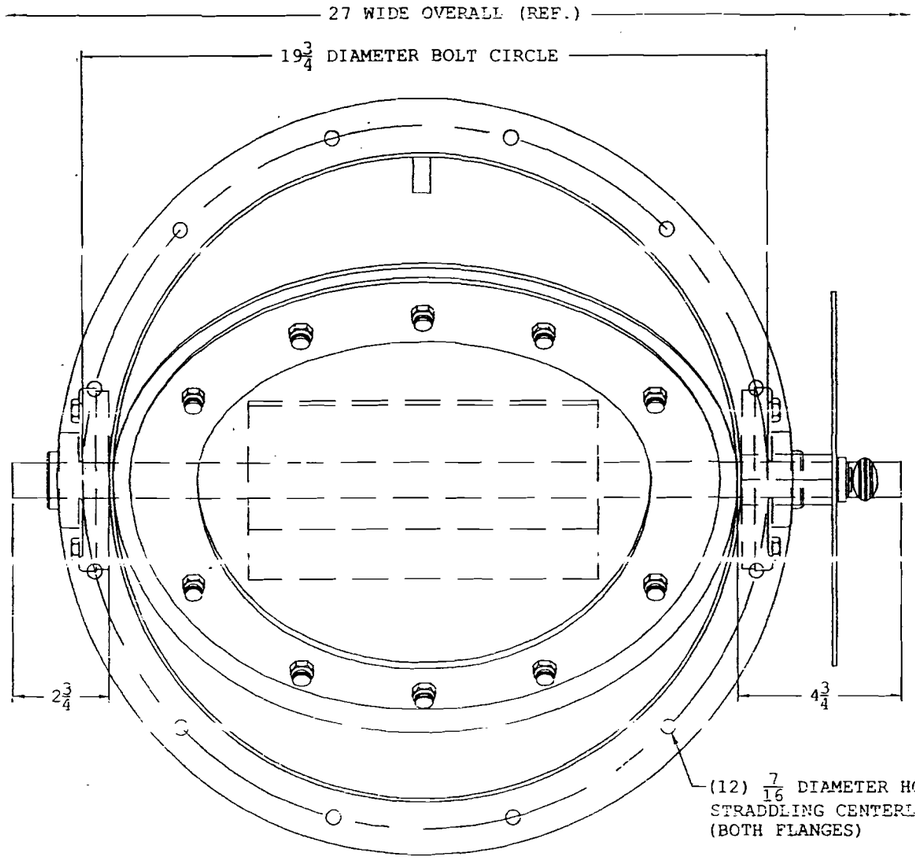
DRAWING STATUS
☒ RELEASED FOR FABRICATION
☐ HELD FOR APPROVAL
☐ AS BUILT DRAWINGS

awv american warming and ventilating
A MESTEK COMPANY
7301 INTERNATIONAL DRIVE HOLLAND, OHIO

VC-56ISO HEAVY DUTY ISOLATION DAMPER

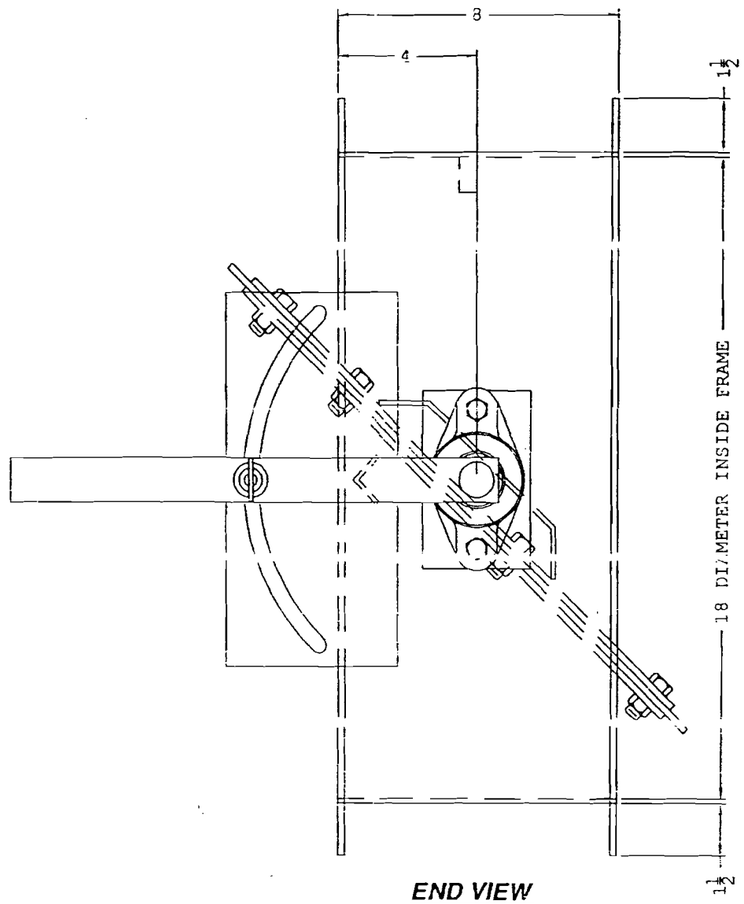
DRN. BY	APPD. BY	Q.A.
SJA	5/20/04 DWR	-
DATE 5-18-04	DWG. NO. 20835004-3	REV.

AutoCAD 208350043



FACE VIEW
FLOW ENTERING SIDE

FLOW



END VIEW

SPECIFICATIONS

FRAME: 8" DEEP x 10 GAUGE 304 STAINLESS STEEL SLEEVE WITH 1-1/2" x 3/16" THK. 304 STAINLESS STEEL CUT RINGS.

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NOTES

1. DESIGN CRITERIA:
   MAX. DIFF. PRESS.: 10 IN. W.G.
   MAX. TEMPERATURE: 150 DEG. F.
   MAX. VELOCITY: 4000 FPM
   EST. WEIGHT: 115 LBS.
   MAX. LEAKAGE: .009 SCFM PER INCH OF BLADE CIRCUMFERENCE AT 10 IN. W.G.
2. QUANTITY: (1) ONE DAMPER REQUIRED AS SHOWN.
3. DAMPER WILL BE VERTICALLY MOUNTED WITH HORIZONTAL AIRFLOW.
4. GRIND FRAME WELD SMOOTH ON INSIDE OF FRAME. CAULK SEAL BOLTS. CAULK O-RING STUFFING BOX - EACH LAYER.
5. ALL WELDING WILL BE PERFORMED IN ACCORDANCE WITH AWV STANDARD WELD DRAWINGS #10151-STD SERIES, UNLESS OTHERWISE SPECIFIED.
6. DAMPER WILL BE CYCLE TESTED (3) THREE TIMES UNDER SHOP FLOOR CONDITIONS.
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8. TAG: 701458, V-501

LAYNE CHRISTENSEN Co. WTD
P.O. No.: 11980701458
AIR SYSTEMS ENG., INC.
P.O. No.: AW04C48
AWV PROD. No.: 208350

CERTIFIED FOR FABRICATION
AWV

STANDARD MANUFACTURING TOLERANCES UNLESS OTHERWISE SPECIFIED DWG. DIMENSIONS ARE IN INCHES.

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DECIMALS
DECIMAL 1 PLACE - (+ OR -) .015
2 PLACE - (+ OR -) .010
3 PLACE - (+ OR -) .005

REVISION	DATE	DRN / CK	APPD	QA

DRAWING STATUS
☒ RELEASED FOR FABRICATION
☐ HELD FOR APPROVAL
☐ AS BUILT DRAWINGS

awv american warming and ventilating
A MESTEK COMPANY
7301 INTERNATIONAL DRIVE HOLLAND, OHIO

VC-56ISO HEAVY DUTY ISOLATION DAMPER

DRN. BY SJR	DATE 5-18-04	APPD. BY 5/20/04 DWL	Q.A. -
DWG. NO. 20835004-1			REV.

AutoCAD 20835041

Section 6-K

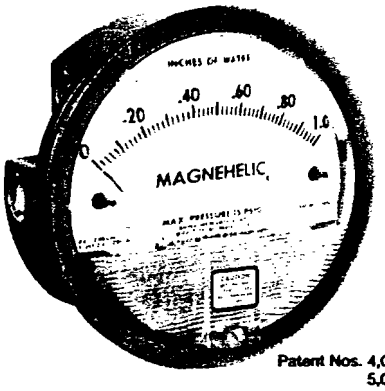
Pressure Indicators (PI-502, PI-611, PI-621, PI-631, PI-634, PI-636, PI-643, PI-651)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Dwyer®

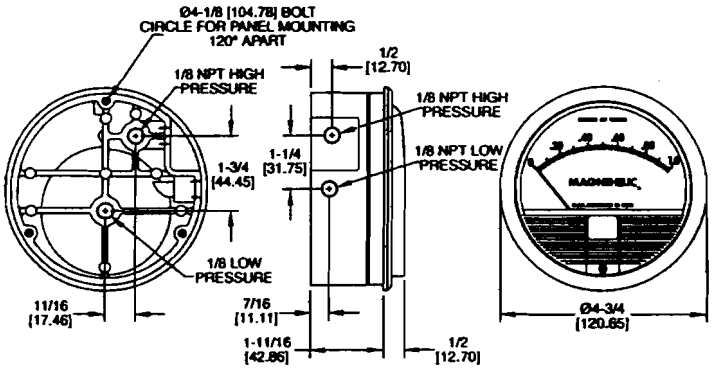
Series 2000 Magnehelic® Differential Pressure Gages

Indicate positive, negative or differential. Accurate within 2%.



Patent Nos. 4,030,365
5,012,678

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 models 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.

The Magnehelic® is the industry standard 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.

NOTE: Do Not use with Hydrogen gas. Dangerous reactions will occur.

Flush ...Surface...or Pipe Mounted

MOUNTING. A single case size is used for most models 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" 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 4⅜" 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 4⅛" 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 for all models. Because of larger case, the medium pressure and high pressure models will not fit in a portable case size. Weight 1 lb., 10 oz. Installation of the A-321 safety relief valve on standard Magnehelic® gages often provides adequate protection against infrequent overpressure.

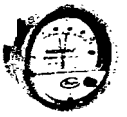
SPECIFICATIONS

Service: Air and non-combustible, compatible gases. (Natural Gas option available.)
Wetted Materials: Consult Factory.
Housing: Die cast aluminum case and bezel, with acrylic cover, Exterior finish is coated gray to withstand 168 hour salt spray corrosion test.
Accuracy: +/- 2% of full scale (±3% on - 0 and ±4% on - 00 ranges), throughout range at 70°F. (21.1°C)
Pressure Limits: -20" Hg. to 15 psig.† (-0.677 bar to 1.034 bar); MP option; 35 psig (2.41 bar), HP option; 80 psig (5.52 bar).
Overpressure: Relief plug opens at approximately 25 psig (1.72 kPa), standard gages only.
Temperature Limits: 20 to 140°F.* (-6.67 to 60°C).
Size: 4" (101.6 mm) Diameter dial face.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Process Connections: 1/8" female NPT duplicate high and low pressure taps - one pair side and one pair back.
Weight: 1 lb. 2 oz. (510g), MP & HP 2 Lb. 2 oz. (963g).
Standard Accessories: Two 1/8" NPT plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapter and three flush mounting adapters with screws. (Mounting and snap ring retainer substituted for 3 adapters in MP & HP gage accessories.)
*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

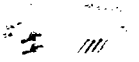
Transparent overlays
Furnished in red and green to highlight and emphasize critical pressures.

Adjustable signal flag
Integral with plastic gage cover. Available for most models except those with medium or high pressure construction. Can be ordered with gage or separate.



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.

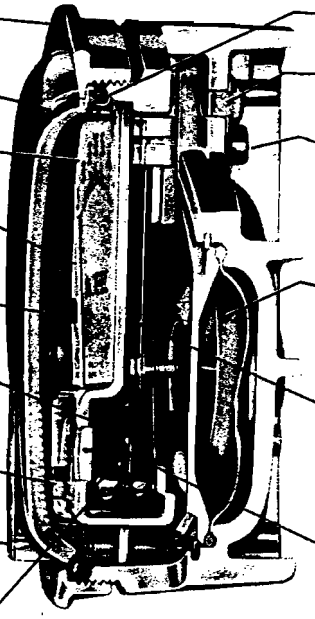
Portable units
Combine carrying case with any Magnehelic® gage of standard range,except high pressure connection. Includes 9 ft. (2.7 m) of ¼" I.D. rubber tubing, standhang bracket and terminal tube with holder.



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. (1.5 m) lengths of ¼" aluminum tubing two static pressure tips and two molded plastic vent valves, integral compression fittings on both tips and valves.

Dwyer Instruments, Inc./P.O. Box 373/Michigan City, Indiana 46361/Phone 219 879-8000/Fax 219 872-9057 • U.K. Phone (01494)-461707 • Australia Phone (02) 9756-5355

Quality design and construction features



Bezel provides flange for flush mounting in panel.

Clear 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 the helix shaft.

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

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

Jeweled 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 the plastic cover, and is 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 and iridite-dipped to withstand 168 hour salt spray corrosion test. Exterior finished in baked dark gray hammerloid. One case size is used for all standard pressure options, 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 flat spring steel. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.

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

Helix is precision made from an alloy of high magnetic permeability. Mounted in jeweled bearings, it turns freely, following the magnetic field to move the pointer across the scale.

Dual Scale English/Metric Models		
Model Number	**Range, In. W.C.**	**Range, Pa or kPa**
2000-00	0-0.5	0-125 Pa
2001D	0-1.0	0-250 Pa
20020	0-2.0	0-500 Pa
20030	0-3.0	0-700 Pa
20040	0-4.0	0-1.0 kPa
20060	0-6.0	0-1.5 kPa
20080	0-8.0	0-2.0 kPa
20100	0-10	0-2.5 kPa

SERIES 2000 MAGNEHELIC® — MODELS AND RANGES
STOCKED MODELS in bold

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.

Model Number	**Range Inches of Water**
2000-00†	0-.25
2000-0†	0-.50
2001	0-1.0
2002	0-2.0
2003	0-3.0
2004	0-4.0
2005	0-5.0
2006	0-6.0
2008	0-8.0
2010	0-10
2015	0-15
2020	0-20
2025	0-25
2030	0-30
2040	0-40
2050	0-50
2060	0-60
2080	0-80
2100	0-100
2150	0-150

Model Number	**Range Zero Center Inches of Water**
2300-0†	.25-0-.25
2301	.5-0-.5
2302	1-0-1
2304	2-0-2
2310	5-0-5
2320	10-0-10
2330	15-0-15

Model Number	**Range PSI**
2201	0-1
2202	0-2
2203	0-3
2204	0-4
2205	0-5
2210*	0-10
2215*	0-15
2220*	0-20
2230**	0-30

*MP option standard
**HP option standard

Dual Scale Air Velocity Units

Model Number	**Range in W.C.I Velocity, F.P.M.**
2000-00AV	0-.25/300-2000
2000-0AV	0-.50/500-2800
2001AV	0-1.0/500-4000
2002AV	0-2.0/1000-5600
2010AV	0-10/2000-12500

For use with pitot tube.

Model Number	**Range MM of Water**
2000-6MM†	0-6
2000-10MM	0-10
2000-25MM	0-25
2000-50MM	0-50
2000-80MM	0-80
2000-100MM	0-100
Zero Center Ranges	
2300-20MM†	10-0-10

Model Number	**Range, CM of Water**
2000-15CM	0-15
2000-20CM	0-20
2000-25CM	0-25
2000-50CM	0-50
2000-80CM	0-80
2000-100CM	0-100
2000-150CM	0-150
2000-200CM	0-200
2000-250CM	0-250
2000-300CM	0-300
Zero Center Ranges	
2300-4CM	2-0-2
2300-10CM	5-0-5
2300-30CM	15-0-15

†These ranges calibrated for vertical scale position.

Model Number	**Range, Pascals**
2000-60 Pa†	0-60
2000-125 Pa†	0-125
2000-250 Pa	0-250
2000-500 Pa	0-500
2000-750 Pa	0-750
Zero Center Ranges	
2300-250 Pa	125-0-125
2300-500 Pa	250-0-250

Model Number	**Range, Kilopascals**
2000-1 kPa	0-1
2000-1.5 kPa	0-1.5
2000-2 kPa	0-2
2000-3 kPa	0-3
2000-4 kPa	0-4
2000-5 kPa	0-5
2000-6 kPa	0-6
2000-10 kPa	0-10
2000-15 kPa	0-15
2000-20 kPa	0-20
2000-25 kPa	0-25
2000-30 kPa	0-30
Zero Center Ranges	
2300-1 kPa	.5-0-.5
2300-3 kPa	1.5-0-1.5

Accessories
A-310A, 3-Way Vent Valve
A-321, Safety Relief Valve
A-432, Portable Kit
A-605, Air Filter Kit
A-610, Pipe Mount Kit

Options — To order, add suffix: I.E. 2001-ASF
ASF (Adjustable Signal Flag)
HP (High Pressure Option)
LT (Low Temperatures to -20°F)
MP (Med. Pressure Option)
SP (Setpoint Indicator

Scale Overlays — Red, Green, Mirrored or Combination, Specify Locations

Special Purpose Ranges
Scale No. 2401 Square Root Specify Range
Scale No. 2402 Blank Scale Specify Range

Model 2000-00N, range -.05 to +.20" W.C. For room pressure monitoring

1011R01-0298P

Section 6-L

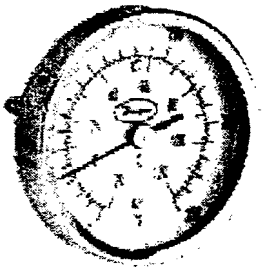
Temperature Indicators (TI-313, TI-635, TI-651)

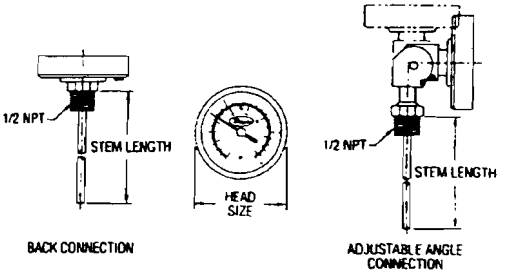
BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Series BT

Bimetal Thermometers

2", 3" or 5" Dial, Dual Scale, ±1% FS Accuracy, External Reset





Series BT Bimetal Thermometers offer accurate, reliable service even in the toughest environments. These corrosion resistant units are constructed from stainless steel and are hermetically sealed to prevent crystal fogging. The bimetal element directly drives pointer, eliminating gears and linkage. An external reset screw allows field calibration and easy-to-read aluminum dial minimizes parallax error. Choose back connection, lower connection or adjustable angle for easy viewing and installation. Adjustable models can be rotated a full 360° and tilted over a 180° arc. NOTE: When using in pressurized applications, use a suitable thermowell.

SPECIFICATIONS

Wetted Materials: 304 SS.
Accuracy: ±1% full scale.
Response Time: ≤ 40 seconds.
Temperature Limits: Head: 200°F (93°C). Stem: Not to exceed 50% over-range or 1000°F (538°C) or 800°F (427°C) continuously.
Process Connection: 1/4" NPT on 2" dial size; 1/2" NPT on 3" or 5" dial size.
Materials of Construction: 304 SS stem, glass crystal, anodized aluminum dial, Series 300 SS head, bezel, and mounting bushing.
Stem Diameter: 1/4" O.D.
Immersion Depth: Minimum 2" in liquids, 4" in gas.

STOCKED MODELS

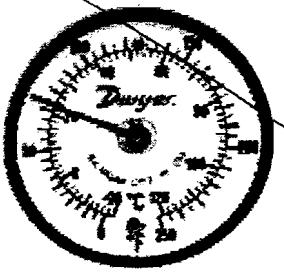
	Dial Size, Stem Length	Temperature Range, °F(°C)	Degree Div., °F(°C)
Back Connection			
BTB22551*	2", 2-½"	0/250	2
BTB2405D	2", 4"	0/250 (-20/120)	2 (2)
BTB2409D	2", 4"	200/1000 (100/550)	10 (5)
BTB32510D	3", 2½"	0/200 (-20/100)	2 (2)
BTB3255D	3", 2½"	0/250 (20/120)	2 (2)
BTB3257D	3", 2½"	50/550 (10/290)	5 (5)
BTB34010D	3", 4"	0/200 (-20/100)	2 (2)
BTB3405D	3", 4"	0/250 (-20/120)	2 (2)
BTB3407D	3", 4"	50/550 (10/290)	5 (5)
BTB3605D	3", 6"	0/250 (-20/120)	2 (2)

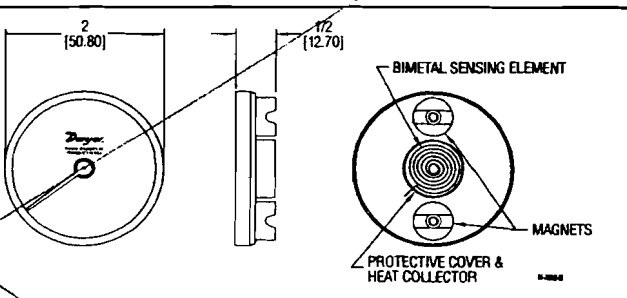
Model Number	Dial Size, Stem Length	Temperature Range, °F(°C)	Degree Div., °F(°C)
Adjustable Angle Connection			
BTA54010D	5", 4"	0/200 (-20/100)	2 (2)
BTA5405D	5", 4"	0/250 (-20/120)	2 (2)
BTA5407D	5", 4"	50/550 (10/290)	5 (5)
BTA56010D	5", 6"	0/200 (-20/100)	2 (2)
BTA5605D	5", 6"	0/250 (-20/120)	2 (2)
BTA5607D	5", 6"	50/550 (10/290)	5 (5)
Lower Connection			
BTC3255D	3", 2.5"	0/250 (-20/120)	2 (2)

Series ST

Surface Mount Thermometer

2" Dual Scale Dial, ±2% Full Scale Accuracy





Measure the temperature of boilers, air ducts, motors, bearings, furnaces or other surfaces with Series ST Surface Mount Thermometers. Dual magnet design allows easy mounting on any ferrous surface. Bi-metallic thermal sensing coil provides quick temperature measurement with ±2% full scale accuracy.

SPECIFICATIONS

Accuracy: ±2% full scale.
Sensing Element: Bimetal coil.
Response Time: Approximately one minute.
Mounting: Two Alnico® magnets on back.
Materials of Construction: Aluminum with optically clear crystal.
Head Size: 2" (5.08 cm).
Height: 1/2" (1.27 cm).
Weight: 2 oz (56.7 g).

STOCKED MODELS

Model Number	Range
ST250	0 to 250°F (-20 to 120°C)
ST500	0 to 500°F (-20 to 260°C)
ST750	0 to 750 °F (-20 to 399°C)

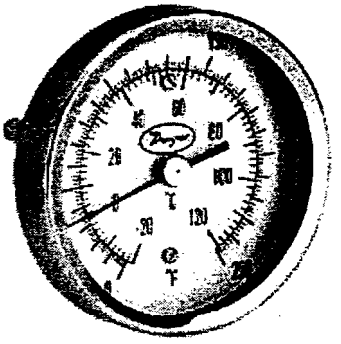
APPLICATIONS

Manifolds, platens, boilers, air ducts, furnaces, engines, motors, bearings, enclosures, cabinets, drums, plumbing, piping, refrigerators, and other ferrous surfaces.

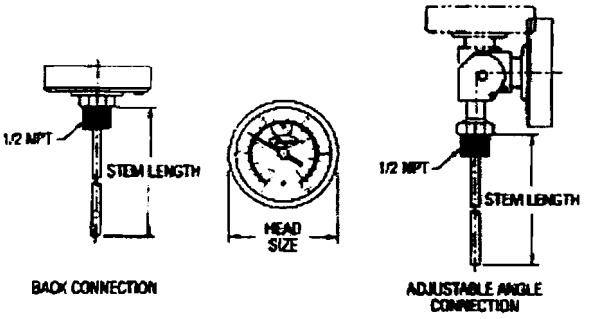
Series BT Bimetal Thermometer

2", 3", or 5" Dial, Dual Scale, ±1% FS Accuracy, External Reset

NEW MODELS!



Catalog Page



Dimensional Enlargement

Series BT Bimetal Thermometers offer accurate, reliable service even in the toughest environments. These corrosion resistant units are constructed from stainless steel and are hermetically sealed to prevent crystal fogging. The bimetal element directly drives pointer, eliminating gears and linkage. An external reset screw allows field calibration and easy-to-read aluminum dial minimizes parallax error. Choose back connection, lower connection or adjustable angle for easy viewing and installation. Adjustable models can be rotated a full 360° and tilted over a 180° arc. NOTE: When using in pressurized applications, use a suitable thermowell.

Choose a different selection (if desired), then press the ' **Display the product...**' button.

Series BT Bimetal Thermometers (Back Connection)

Display the product I have selected

POPULAR MODELS

Model Number	Dial Size Stem Length	Temp Range, °F(° C)	Degree Div., °F (°C)	Price	Discount Schedule
BTB2251*	2", 2-1/2	0/250	2	$41.50	Standard

SPECIFICATIONS

Accuracy: ±1% full scale.

Response Time: ≤40 seconds.

Maximum Head Temperature: 200°F (93°C).

Maximum Stem Temperature: Not to exceed 50% over-range or 1000°F (538° C) or 800°F (427°C) continuously.

Immersion Depth: Minimum 2" in liquids, 4" in gas.

Stem Diameter: ¼" O.D.

Materials of Construction: 304 Stainless Steel stem, glass crystal, anodized aluminum dial, Series 300 Stainless Steel head, bezel, and mounting bushing.

Process Connection:

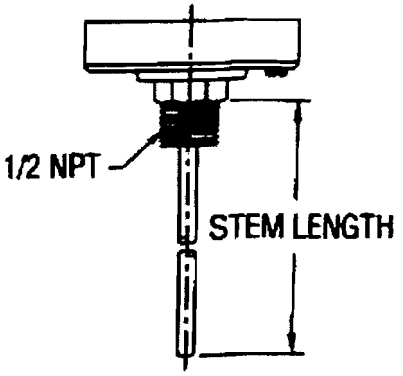
BTB2405D	2	0/250(-20/120)	2(2)	$41.50	Standard
BTB2409D	2	200/1000 (100/550)	10 (5)	$41.50	Standard
BTB32510D	3", 2-1/2	0/200 (-20/100)	2 (2)	$41.50	Standard
BTB3255D	3", 2-1/2	0/250 (-20/120)	2 (2)	$41.50	Standard
BTB3257D	3", 2-1/2	50/550 (10/290)	5 (5)	$41.50	Standard
BTB34010D	3", 4"	0/200 (-20/100)	2 (2)	$41.50	Standard
BTB3405D	3", 4"	0/250 (-20/120)	2 (2)	$41.50	Standard
BTB3407D	3", 4"	50/550 (10/290)	5 (5)	$41.50	Standard
BTB3605D	3", 6"	0/250 (-20/120)	2 (2)	$41.50	Standard

¼" NPT on 2" dial size; ½" NPT on 3" or 5" dial size.

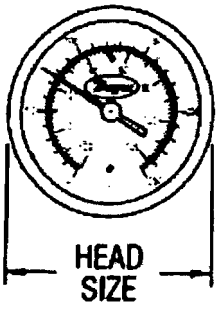
***Prices are based in US currency and may change for international customers due to and not limited to customs brokerage fees, export packing and documentation, tariffs, duty and taxes.**

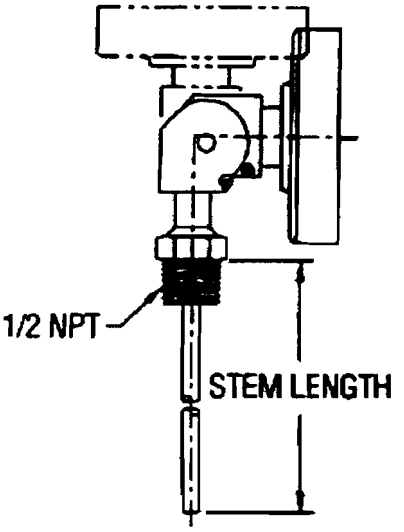
Click the **Model Number** of the item to add the item to your shopping cart.

Ⓑ Items Subject to Schedule B discounts.
*Model offered in Fahrenheit scale only.



BACK CONNECTION





ADJUSTABLE ANGLE
CONNECTION