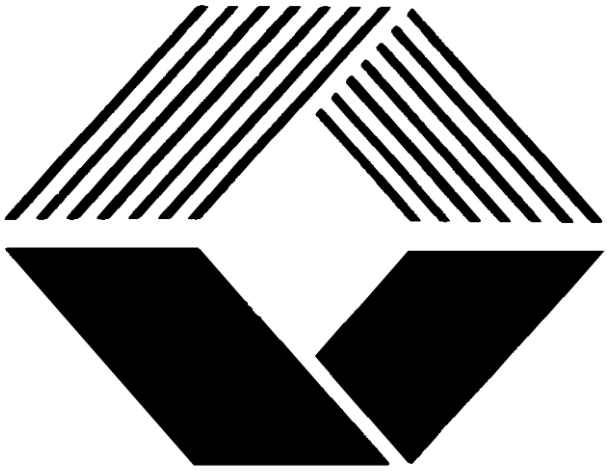
September 27, 2012

Miller Environmental

Viron Job Number: CA-44834

VHS-3636 Horizontal Scrubber and Operation and Maintenance Manual

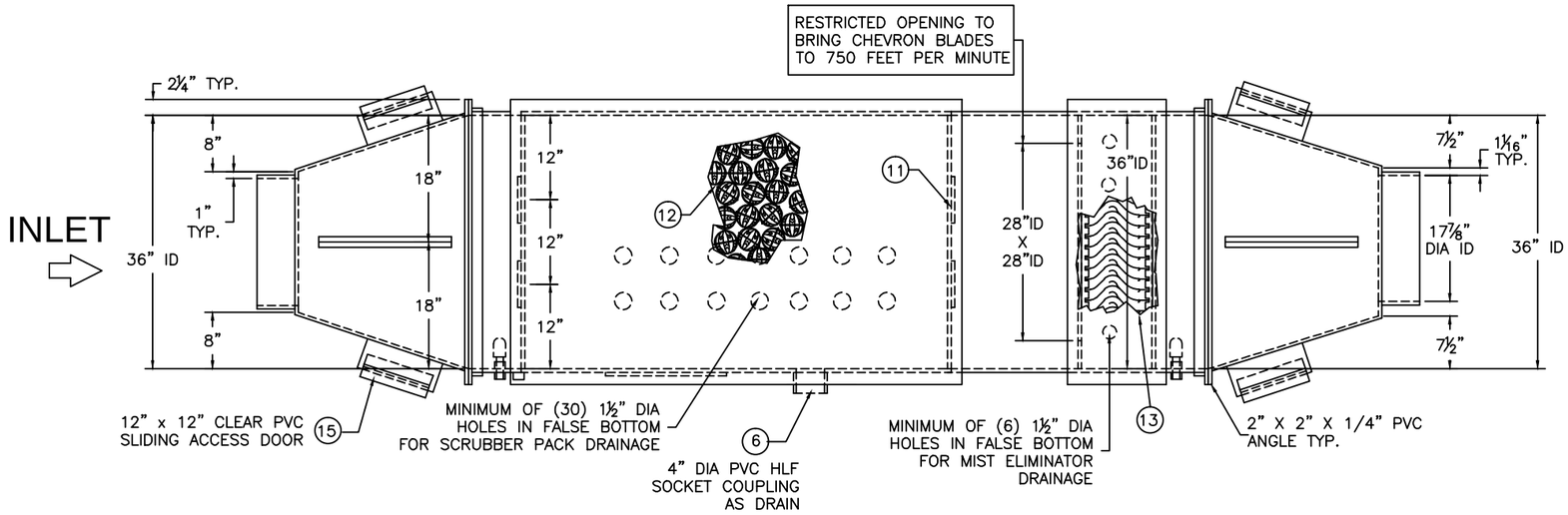
Project Manager: Tony Sovey
Cad Operator: Bill Csapos

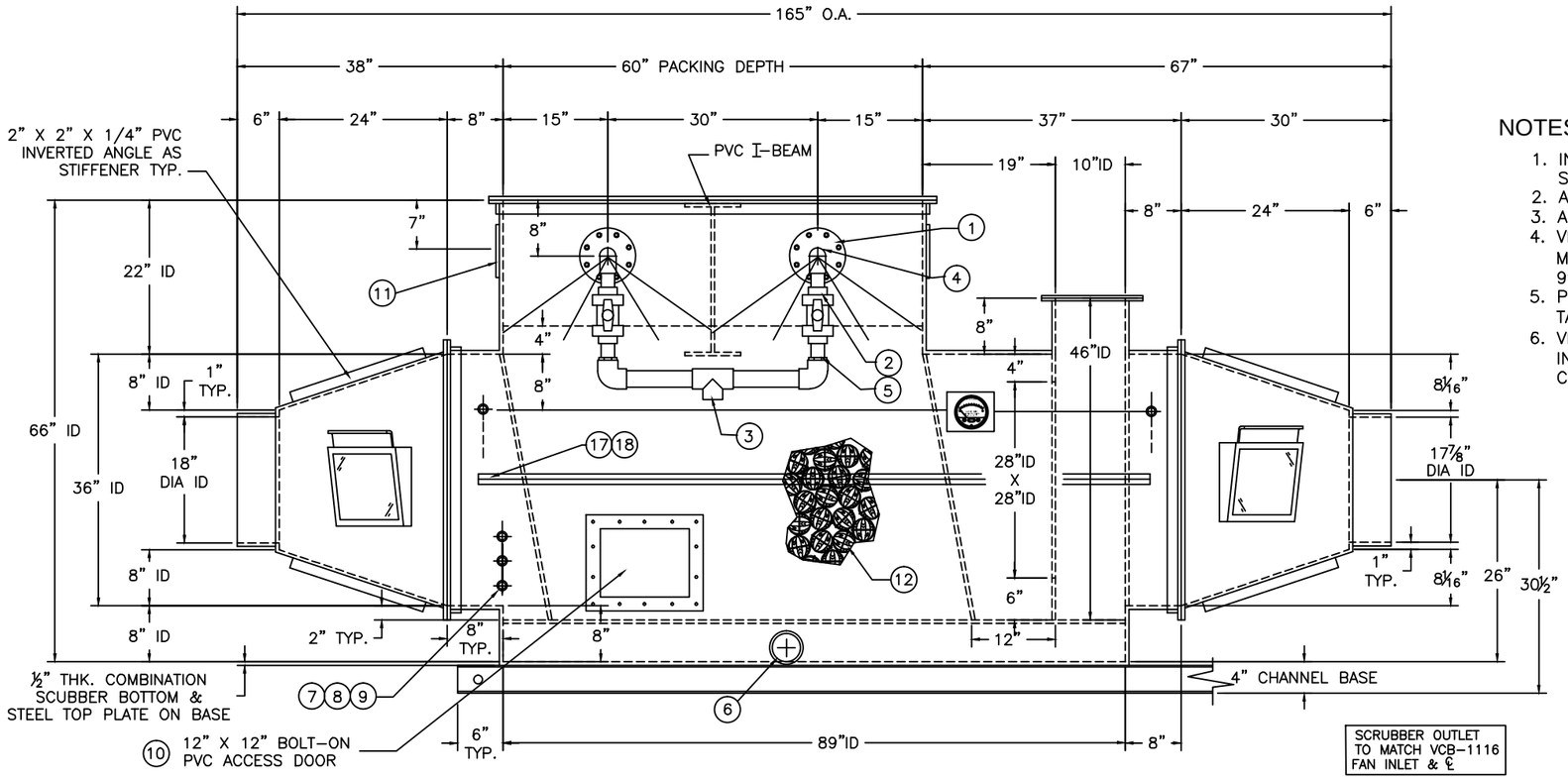


VIRON®

INTERNATIONAL
CORPORATION

989-723-8255





SCRUBBER

VIRON VHS-3636-PVC-4.0-60-R-1-F-575-3-60

4,000 CFM 60" PACKING DEPTH
REMOTE RECIRCULATION SYSTEM
55-65 GPM
MINIMUM OF .3-.4 GPM MAKE-UP WATER
OPERATING S.P.= 2" W.G.
SHIPPING WEIGHT: 1,421 LBS.
OPERATING WEIGHT: 2,358 LBS.
(1) REQUIRED

(14) SPRAY NOZZLES

BEX "YS" SERIES
MOD. NO 1/2YS120164
120 DEG SPRAY PATTERN
PVC CONSTRUCTION
(6) REQUIRED @ 5 psi

(19) MAGNEHELIC GAUGE

DWYER INSTRUMENTS
MOD. NO 2004
0-4" STATIC PRESSURE
(1) REQUIRED
MOUNTED ON SCRUBBER

NOTES:

1. INLET AND OUTLET TRANSITION TO BE SHIPPED ON SCRUBBER.
2. ALL PLUMBING TO BE SCH 80 PVC.
3. ALL HARDWARE TO BE 18-8 STAINLESS STEEL.
4. VIRON VHE-1025 PVC CHEVRON BLADE TYPE MIST ELIMINATOR WITH A REMOVALL EFFICENCY OF 99% OF 20 MICRONS AND LARGER.
5. PVC PLUMBING FROM SCRUBBER TO REMOTE TANK TO BE BY OTHERS.
6. VIRON RECOMMENDS THAT ALL MAKE-UP WATER INTO ANY UNITS HAVE LESS THAN 100 PPM OF $CaCo^3$ TO REDUCE FOULING AND EMINENCE.

OUTLET

WHITE PVC

TYPE II PVC CONSTRUCTION
3/16" MATERIAL THICKNESS
COLOR - WHITE

NO.	QTY.	DESCRIPTION
19	1	MAGNEHELIC GAUGE
18	2	1" DIA PVC 90° ELBOW
17	2	1" DIA PVC FULL THD COUPLING
16	2	1"ø POLYPROPYLENE HOSE BARBS
		MAGNEHELIC TAPS
15	4	12" X 12" CLEAR PVC SLIDING
		ACCESS DOOR
14	6	BEX SPRAY NOZZLES
13	12	VIRON VHE-1025 PVC CHEVRON
	FT²	BLADE MIST ELIMINATOR
12	53	JAEGER 2" DIA POLYPROPYLENE
	FT³	SCRUBBER PACKING
11	4	6" DIA CLEAR PVC VIEW PORT
		ACCESS DOOR
10	1	12" X 12" BOLT-ON PVC
		SCRUBBER PACK REMOVAL DOOR
9	1	1" DIA PVC HLF THD
		COUPLING AS MAKE-UP WATER
8	1	1" DIA PVC HLF THD
		COUPLING AS CAUSTIC
7	1	1" DIA PVC HLF THREADED
		COUPLING AS SAMPLE
6	1	4" DIA PVC HLF SOCKET
		COUPLING AS DRAIN
5	2	1 1/2" DIA TO 2" DIA PVC
		REDUCER BUSHING
4	2	1 1/2" DIA PVC 90 DEG ELBOW
3	1	2" DIA PVC TEE
2	2	1 1/2" DIA PVC TRUE UNION
		BALL VALVES
1	2	1 1/2" DIA PVC REMOVABLE
		SPRAY HEADER

NO.	QTY.	DESCRIPTION

TITLE	VHS-3636 PVC REMOTE SCRUBBER
USER	
	MILLER ENVIRONMENTAL CORP.
	St. JEAN BAPTISTE, MANITOBA
REP.	VIRON INT'L
DATE	JUNE 1, 12
DRAWN BY	B. CSAPOS
SCALE	N.T.S.
SHEET	1 OF 5
JOB NUMBER	CA-44834

REVISION HISTORY

REV.	DATE	BY	DESCRIPTION

VIRON®
INTERNATIONAL CORPORATION
OWOSSO, MICHIGAN
TEMPLE, TEXAS
EN VIRON MENTAL CONTROL SYSTEMS

VIRON VHS-3636 PVC REMOTE SCRUBBER

FAN

VCB-1116-BD-PVC-FRP-9-CW360-7.5-TEFC-PREM-575-3-60

4,000 CFM 4" S.P.
2,542 RPM 4.90 BHP
7 1/2 HP TEFC MOTOR (PREM. EFF.)
PVC CONSTRUCTION
WITH SOLID FRP WHEEL
CLASS II ARR. #9
FIXED SPEED DRIVE
WEIGHT: 550 LBS.
(1) REQUIRED

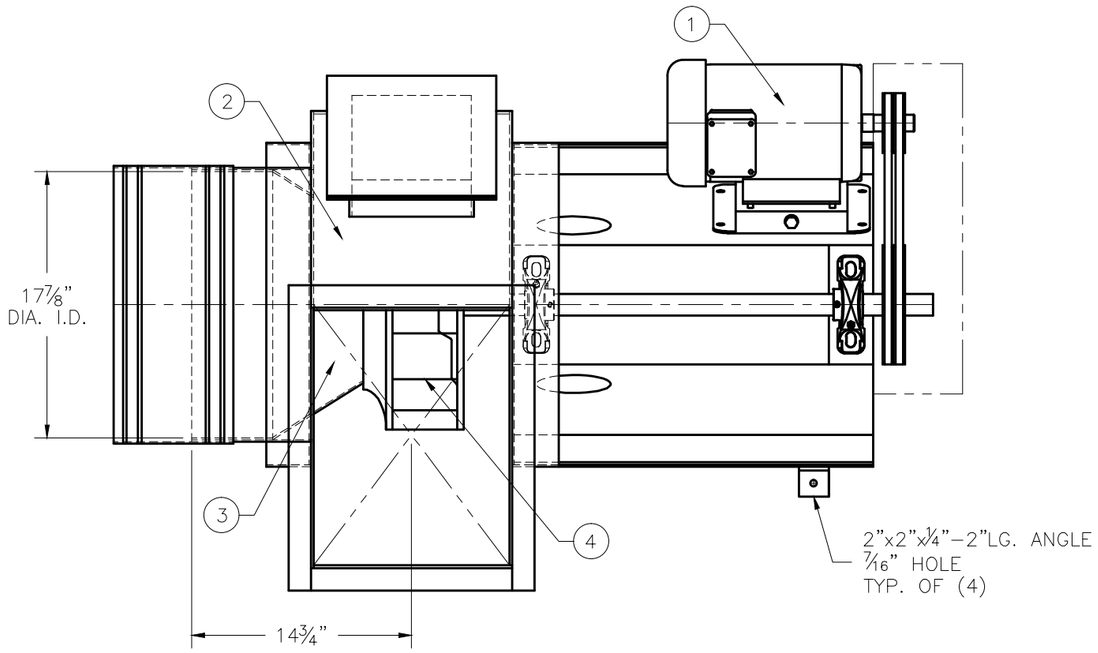
MOTOR

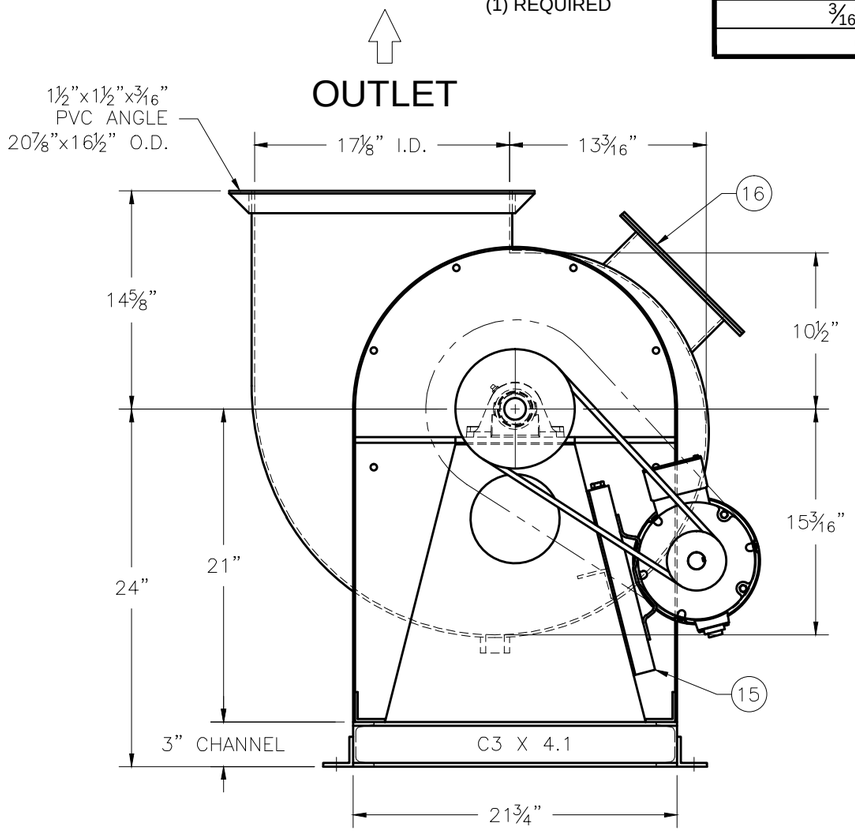
WEG OR EQUAL
MODEL NO. 00718ET3H213T
F1 JUNCTION BOX MOUNT
7 1/2 HP TEFC MOTOR
1,800 RPM
575 VOLT
3 PHASE
60 HERTZ
(1) REQUIRED

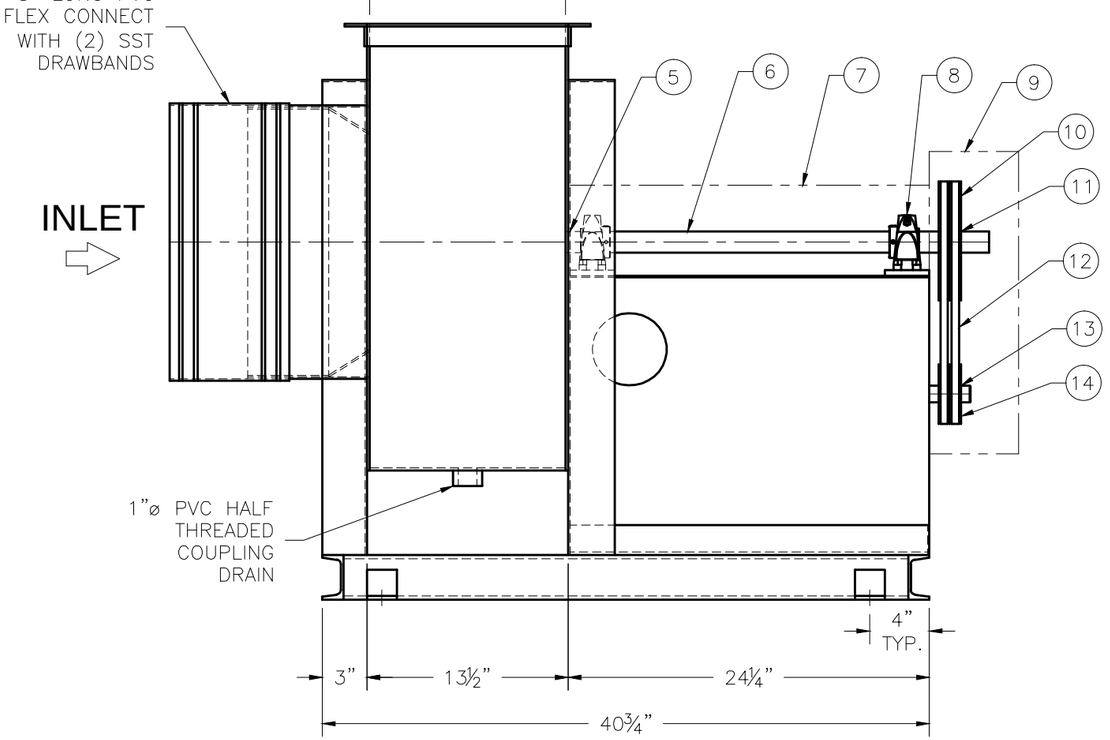
NOTES:
1. FAN TO BE CONSTRUCTED OF TYPE II WHITE PVC MATERIAL.
2. FAN TO BE ASSEMBLED TO COMMON STEEL BASE (SEE DRAWING).
3. FAN TO HAVE 575-3-60 MOTOR.

TYPE II PVC CONSTRUCTION
3/16" THICK MATERIAL
COLOR - WHITE

REVISION HISTORY			
REV	DATE	BY	DESCRIPTION







NO.	QTY.	DESCRIPTION
16	1	8"I.D. X 8"I.D. BOLT ON ACCESS DOOR
15	1	XXXT MOTOR SLIDING BASE
14	1	MOTOR SHEAVE
13	1	MOTOR BUSHING
12	–	BELT
11	1	FAN BUSHING
10	1	FAN SHEAVE
9	1	PVC BELT GUARD
8	2	1 7/16"ø FAFNIR RAS BEARING
7	1	PVC SHAFT GUARD
6	1	1 7/16"ø 1045TGP SHAFT
5	1	NEOPRENE SHAFT SEAL
4	1	16½"ø SOLID CLASS II FRP WHEEL
3	1	PVC INLET CONE
2	1	PVC HOUSING
1	1	XXHP TEFC MOTOR

TITLE	VCB–1116 PVC CENTRIFUGAL FAN
USER	MILLER ENVIRONMENTAL CORP.
REP.	VIRON INT'L
DATE	JUNE 1, 12
DRAWN BY	B. CSAPOS
SCALE	N.T.S.
SHEET	2 OF 5
JOB NUMBER	CA-44834

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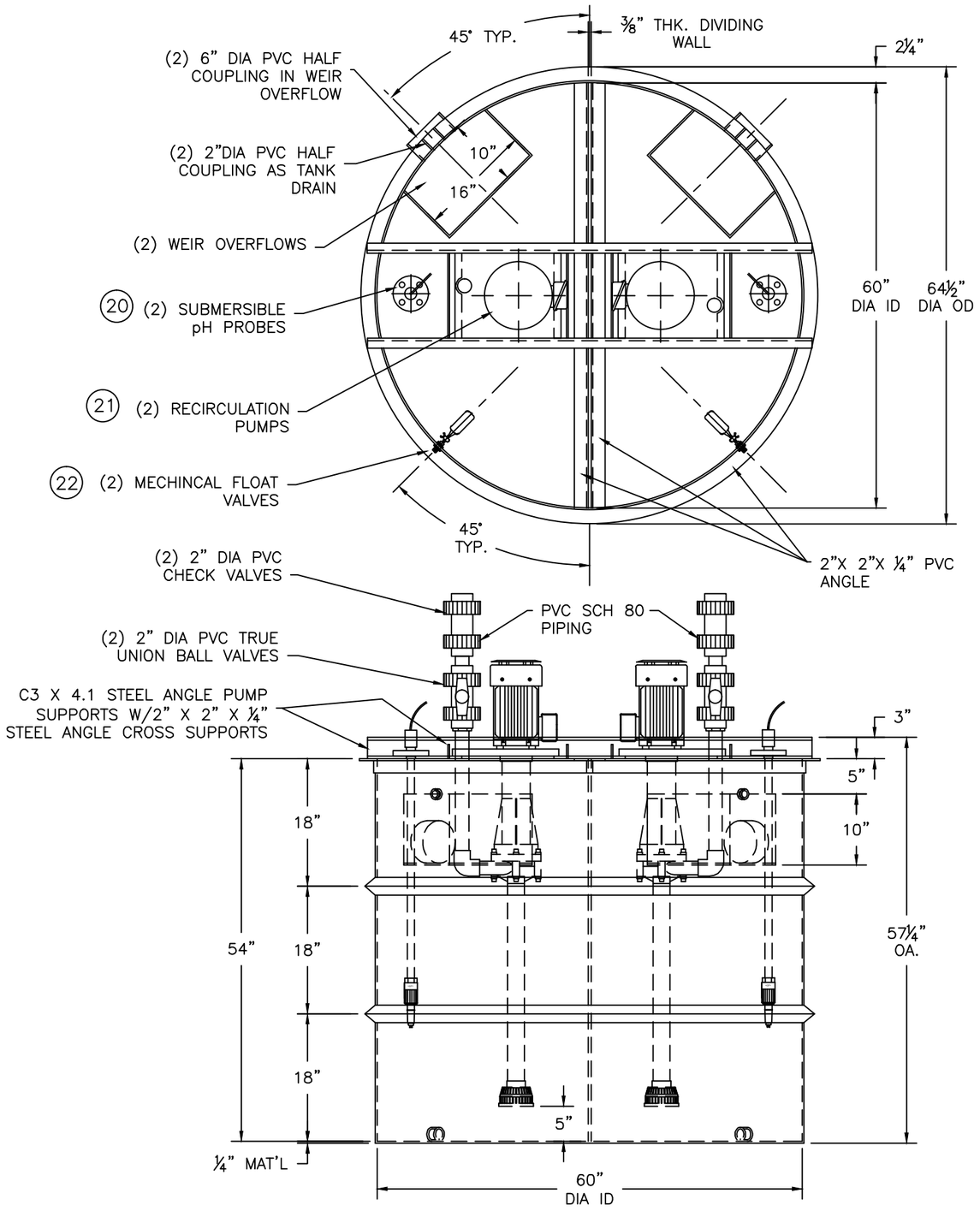
TEMPLE, TEXAS
ENVIRONMENTAL CONTROL SYSTEMS

VIRON VCB-1116 PVC CENTRIFUGAL CW360 FAN



20 pH CONTROLLER & PROBES

WALCHEM
MODEL NO. WDP410–122
120–1–60 POWER
(4) CONTROL RELAYS
(2) 4–20ma OUTPUTS
(2) SUBMERSIBLE pH PROBES
¾"ø NPT CONNECTIONS
(1) REQUIRED, SHIPPED LOOSE AND INSTALLED BY OTHERS

21 RECIRCULATION PUMP

SERFILCO, LTD.
MODEL NO. EHLX 1 1/2–3SC–D3.0–ST
3 HP
3,450 RPM
575 VOLT
3 PHASE 60Hz
CPVC CONSTRUCTION
(2) REQUIRED FOR OPERATION
(1) SHIP LOOSE FOR SPARE

22 FLOAT VALVE

KERICK VALVE, INC.
MODEL NO. MA–052
1/2" DIA. CONNECTION
POLYPROPYLENE FLOAT
PVC CONSTRUCTION
SST HARDWARE
OPER. INLET MAX. 60 psi
(2) REQUIRED

TYPE II PVC CONSTRUCTION
¼" - THICK MATERIAL
COLOR - LIGHT GRAY

(1) REQUIRED

23 CHEMICAL METERING PUMP

IWAKI/WALCHEM
MODEL NO. EWB16F1–VE
0–1 GPH OUTPUT
PVC CONSTRUCTION
⅜" DIA. CONNECTIONS
120–1–60 POWER
(2) REQUIRED, SHIPPED LOOSE AND INSTALLED BY OTHERS

VIRON PVC DIVIDED REMOTE TANK W/DIFFERENT SOLUTION EACH HALF

REVISION HISTORY			
X	X	X	X X
REV	DATE	BY	DESCRIPTION

TITLE	PVC DIVIDED REMOTE TANK
USER	MILLER ENVIRONMENTAL
REP.	VIRON INT'L
DATE	JUNE 4, 12
DRAWN BY	B. CSAPOS
SCALE	N.T.S.
SHEET	3 OF 5
JOB NUMBER	CA-44834

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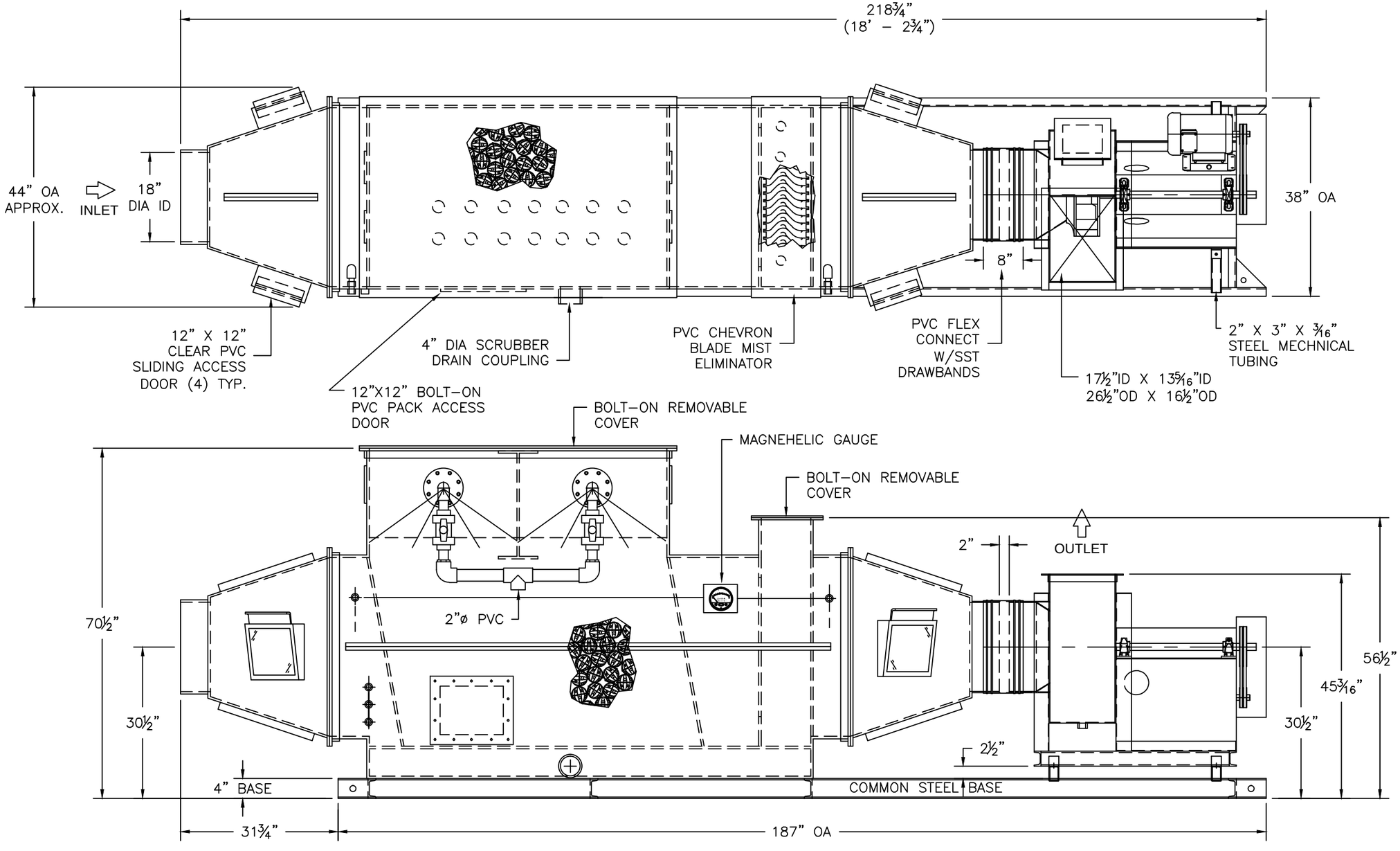
ENVIRONMENTAL CONTROL SYSTEMS



(1) REQUIRED

VIRON PVC EQUIPMENT ON A PAINTED STEEL COMMON BASE

REVISION HISTORY			
X	X	X	X X
REV	DATE	BY	DESCRIPTION

TITLE	COMMON STEEL BASE & EQUIPMENT DETAIL
USER	MILLER ENVIRONMENTAL
REP.	VIRON INT'L
DATE	JUNE 4, 12
DRAWN BY	B. CSAPOS
SCALE	N.T.S.
SHEET	4 OF 5
JOB NUMBER	CA-44834

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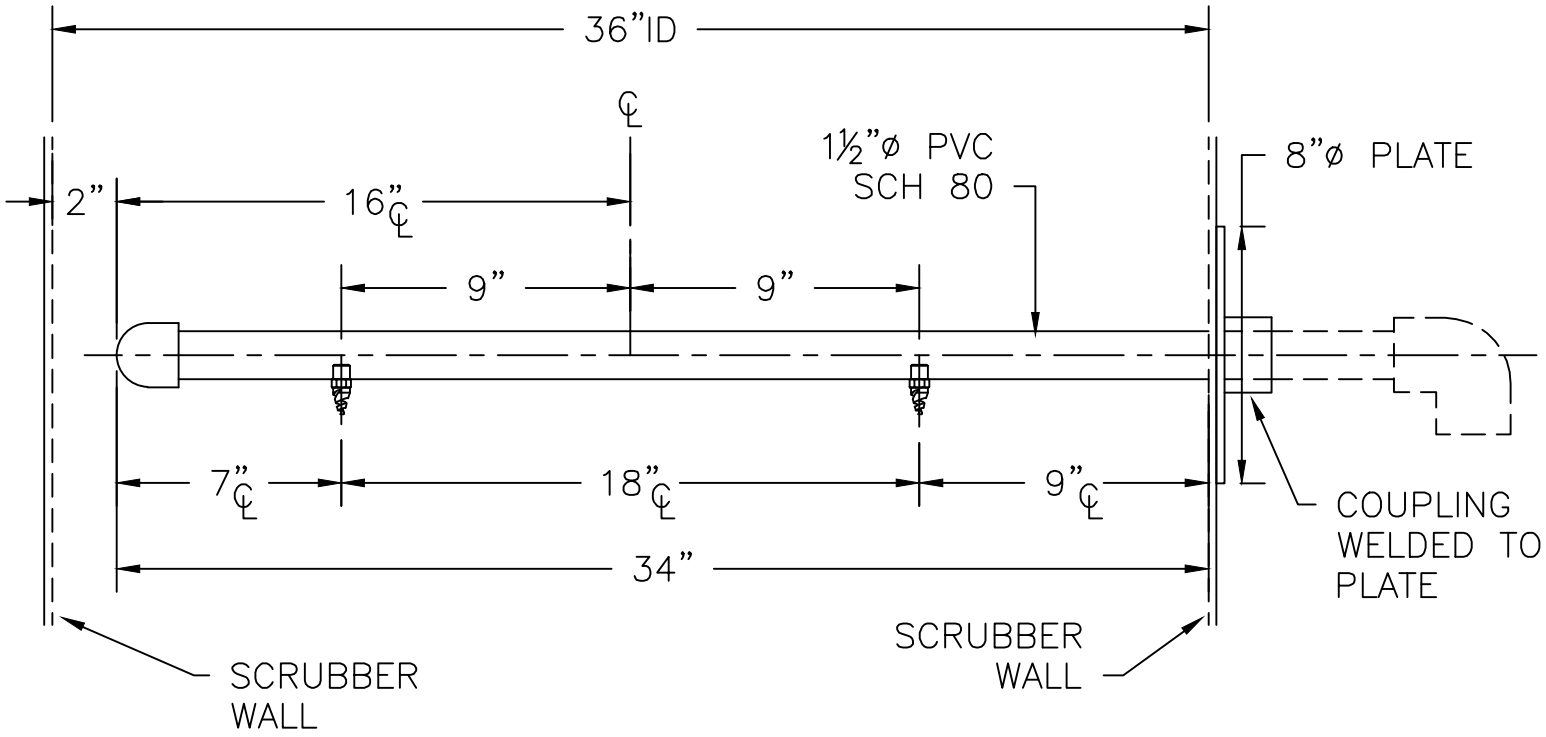
ENVIRONMENTAL CONTROL SYSTEMS



(14) SPRAY NOZZLES

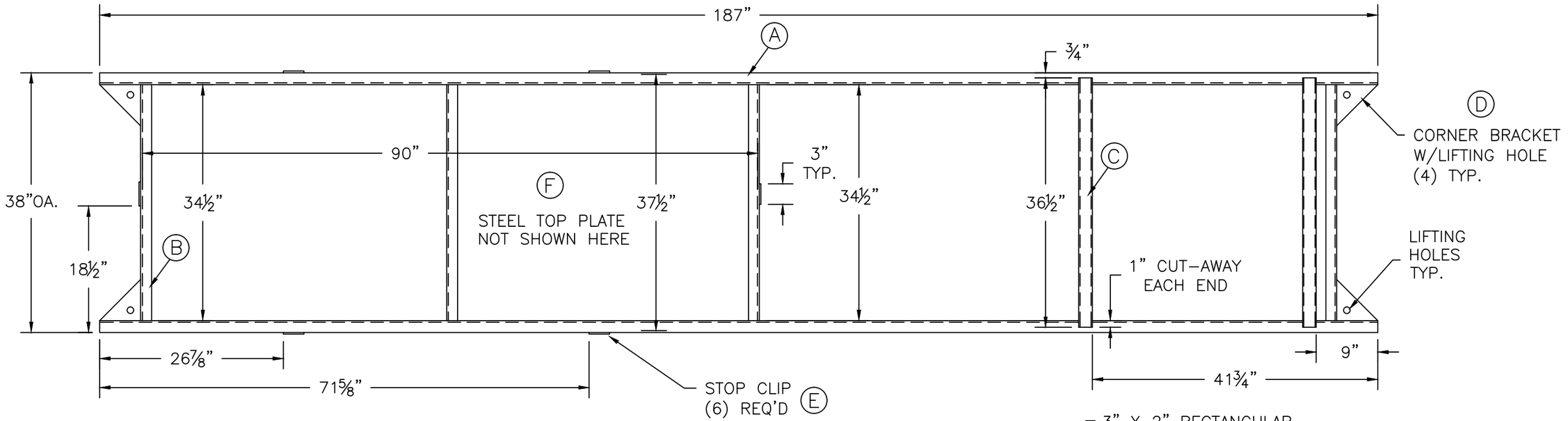
BEX "YS" SERIES
MOD. NO 1/2YS120164
120 DEG SPRAY PATTERN
PVC CONSTRUCTION
(6) REQUIRED @ 5 psi

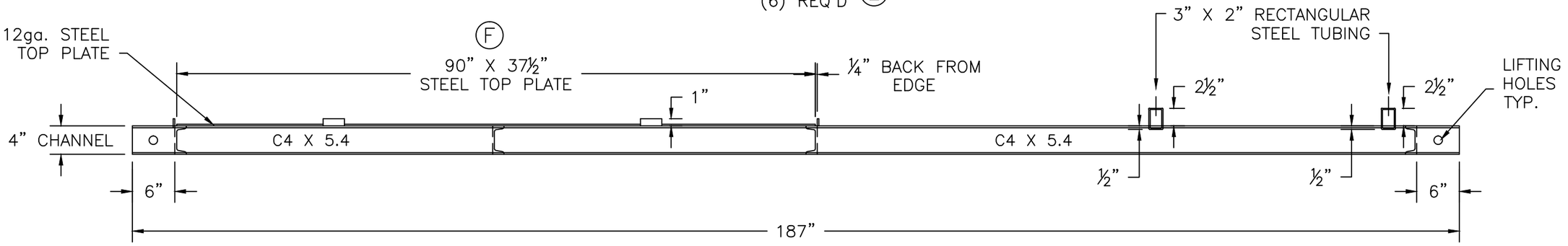
(2) QTY.
ASSEMBLIES

VIRON VHS-3636 SPRAY HEADER DETAIL

VIRON® INTERNATIONAL CORP.
OWOSSO, MICHIGAN TEMPLE, TEXAS
989-723-8255
989-723-8417 FAX EMAIL: info@vironintl.com
ENVIRONMENTAL CONTROL SYSTEMS

USER	MILLER ENVIRONMENTAL CORP.
REP.	VIRON INT'L
JOB NO.	CA-44834
DATE	6-4-12
SHEET	5 OF 5
DRAWN BY	B. CSAPOS





BILL OF MATERIALS

A = C4 X 5.4 STEEL CHANNEL, 187" LONG (2 PCS)
B = C4 X 5.4 STEEL CHANNEL, 34 1/2" LONG (4 PCS)
C = 3" X 2" X 3/16" STEEL TUBING, 36 1/2" LONG (2 PCS)
D = STEEL CORNER BRACKET, 6 X 6" X 1/4" W/1"ø HOLE (4 PCS)
E = 1 1/2" X 1 1/2" X 3" LONG STEEL STOP CLIP (6 PCS)
F = 90" X 37 1/2" X 12ga. STEEL TOP PLATE (1 PC)

NOTES:
1. STEEL BASE TO BE PAINTED WITH EPOXY PAINT.

VIRON VHS–3636 STEEL BASE DETAIL (PAINTED)

COMMON STEEL BASE (1 REQUIRED)

REVISION HISTORY			
REV	DATE	BY	DESCRIPTION
X	X	X	X X

TITLE	VHS–3636 STEEL BASE DETAIL
USER	MILLER ENVIRONMENTAL CORP.
REP.	VIRON INT'L
DATE	JUNE 18, 12
DRAWN BY	B. CSAPOS
SCALE	N.T.S.
SHEET	1 OF 1
JOB NUMBER	CA-44834

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INTERNATIONAL CORPORATION
OWOSSO, MICHIGAN
TEMPLE, TEXAS
ENVIRONMENTAL CONTROL SYSTEMS

VIRON®
HORIZONTAL SCRUBBER

PVC

Fiberglass

PolyPro

PVC/FRP Overlay

TECHNICAL BULLETIN

VIRON®
INTERNATIONAL CORPORATION

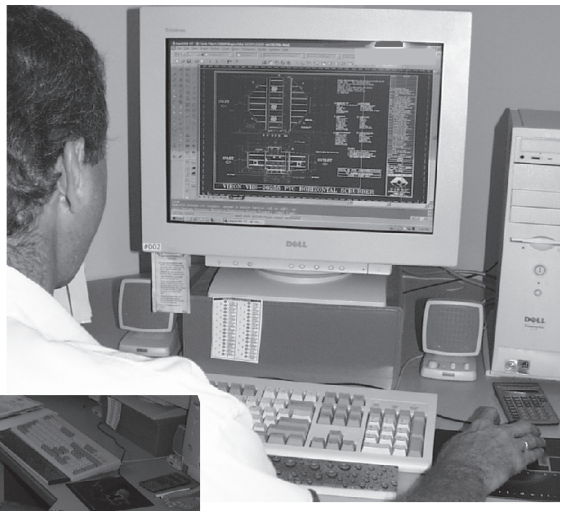
989-723-8255

Complete System Solutions for Moving Corrosive Air

www.vironintl.com

VB-1000-02

Viron® Horizontal Scrubber Engineering



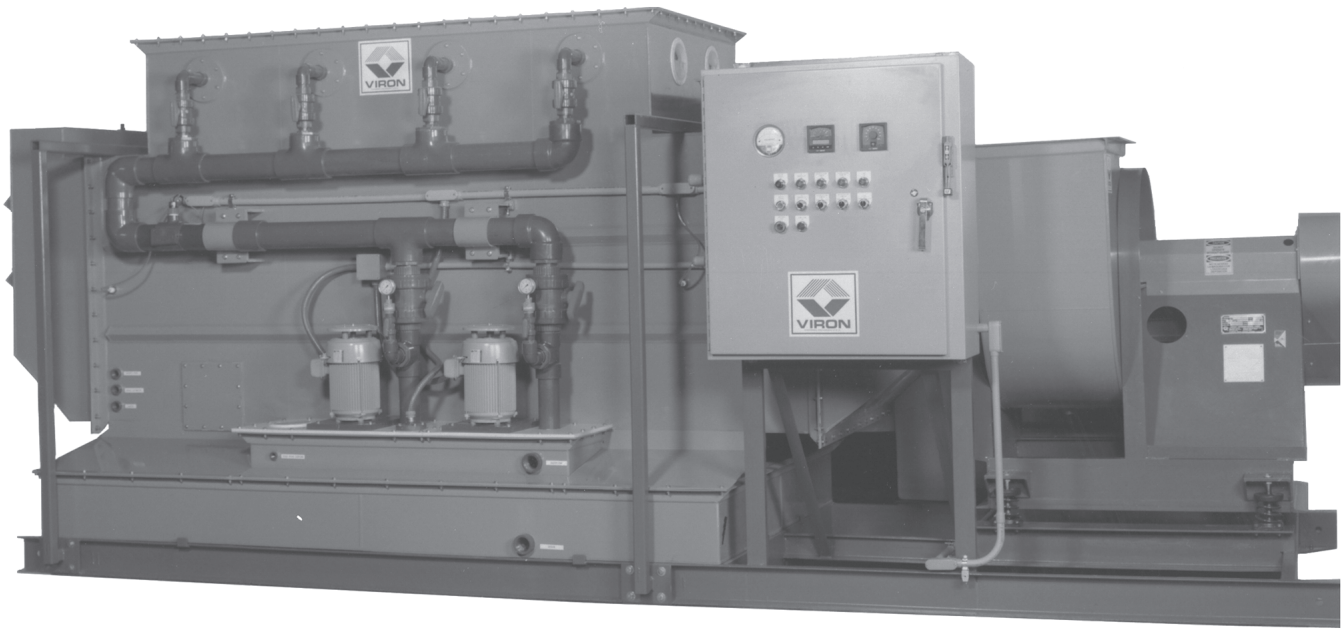
The VIRON® Engineering Department over 30 years of experience designing custom pollution control systems to meet the efficiency requirements of customer emissions. The VIRON® Engineering staff includes mechanical, chemical and electrical engineers to handle all facets of system design as well as, ensuring process compatibility.

Designers utilizing the latest in CADD software work directly with engineers and project managers in "start-to-finish" teams. This approach insures thorough, consistent ownership of each project. VIRON® Engineers have been responsible for worldwide installations of VIRON® Systems including design, on-site start-up, and personnel training.

VIRON®
INTERNATIONAL CORPORATION
FQ
"First Quality"

The VIRON® Engineering Project Team is an integral part of VIRON® International's "First Quality" FQ, quality control commitment to offering the best solution for customers in the most cost effective method. This commitment has made VIRON® International Corporation the leader in the corrosion resistant ventilation industry.

Viron® Horizontal Scrubber



Viron® Horizontal Scrubber

The VIRON® Horizontal Scrubber is used in many industrial applications. Its uses include the cleaning of fumes from plating, anodizing, steel pickling, WWTP, printed circuit board plating, semi-conductor clean rooms, and corrosive odor control units. When looking through this catalog it will become apparent that VIRON® manufactures many standard units ranging in size from 500 CFM to 100,000 CFM. Scrubbers, with capacity requirements lower than 500 CFM, are available upon request. In addition to our standard sizes, VIRON® will also, upon demand, quote and manufacture custom scrubbers. Our engineering staff is available to discuss your upcoming projects and we have been solving the toughest corrosive fume problems since 1971.

Standard Design Parameters

1. High Efficiency
2. Easy Maintenance
3. Minimum Operating Cost
4. Structural Integrity
5. First Quality "FQ" is Viron's Commitment to our customers
6. Complete System Solutions

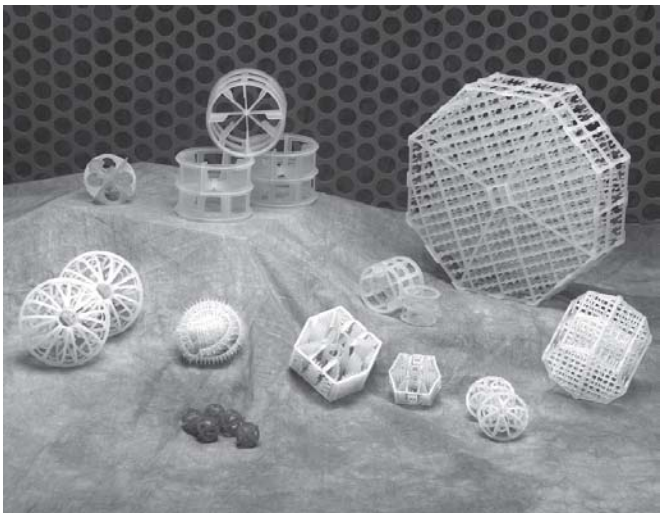
Standard Features of a Viron® Horizontal Scrubber

- **Scrubber Housing** - PVC, Polypro, or FRP - Chemical resistant FRP - vinyl ester VER 9300, or as specified. Inner corrosion barrier is reinforced with surface veil for maximum chemical resistance.
- **Packing Material** - loose fill polypro packing material- Lantec Lanpac®, Jaeger Tri-Packs® or equal. The velocity through the packing to be 400-600 FPM. The standard packing depth will range from 12" to 180". In specific applications VIRON® can increase the packing depth to accomplish higher efficiencies.
- **Mist Eliminator Packing** - PVC material as manufactured by VIRON® model #VHE-1025 or equal. The velocity through the mist eliminator will vary by type.
- **Mesh Pads** - are available in Polypro with efficiencies down to 2 GPM.
- **Spray Nozzles** - PVC or Polypro design material. Each nozzle sprays approximately 7-50 GPM at 10 psi of pump pressure.
- **Troughs** - are available.
- **Spray Header** - All spray headers are to be PVC schedule 80 pipe, sized for the appropriate flow with true union type ball valves to facilitate removal without having to shut the recirculation system down.*
- **Recirculation Pumps** - All pumps are CPVC material as standard unless otherwise specified. These pumps are sump pump type without seals and have capability to run dry for a short period of time without damage. FRP, SST, and Polypro pumps are available. Horizontal or vertical designs are available.
- **Recirculation Rate** - Most VIRON® Horizontal Scrubbers have a recirculation rate of between 2 to 15 GPM per square foot of open surface packing area. The recirculation rate of Viron's standard units is 4 GPM per square foot of open surface packing area.
- **Self-contained Recirculation Units** - The sump recirculation pump is mounted on the top of the scrubber sump which is attached to the side of the scrubber housing. The pump motor is bolted to the top of the sump keeping the motor above the highest point of liquid. The sump pump's inherent design prevents any scrubber liquid from spilling on the floor. This type of unit is used primarily in the southern climates where freezing is rare and/or where the unit is installed inside the building.
- **Remote Recirculation Units** - The recirculation pump is mounted to a separate tank which holds the recirculated water. This type of unit is used primarily in cold winter regions where freezing is customary. It may also be used when the scrubber is on the roof and the customer wishes to visually monitor the recirculation flow. Some of the advantages are: less roof weight, no freezing because remote tank is located inside of building and no scrubber heaters required.
- **Some of our many Available System Components** -
  - Fans
  - Ducts
  - Dampers
  - Specialty Scrubbers
  - Louvers & Grills
  - Y-Strainer
  - Flow Meter
  - Solenoid Valves
  - Magnehelic Gauges
  - Neutralizing Chemical Control Systems
  - pH Monitor with Probe
  - Pressure Gauges
  - Float Valves
  - Sump Heater with Controls
  - Special Lifting Lugs
  - Special Hold Down Lugs
  - Pressure Switch
  - Expansion Joints
  - Air Strippers

* As an option, Viron® can provide CPVC or Polypro piping for your recirculation needs

Viron® Column Packing Material

VIRON® uses many different kinds of packing material in its scrubbers. The type and style depend on the application and the efficiency desired. The most popular packings among our customers are the Jaeger Tri-Packs® , Lantec Lanpac® and Rauschert.



1", 2", 3.5" Packing by Jaeger Tri-Packs®, Lantec Lanpac®, and Rauschert Packing.

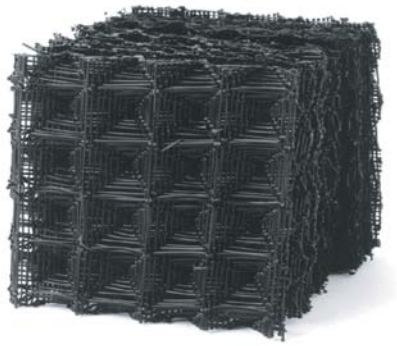
The packing is typically Polypropylene, a hollow, spherical column packing constructed of a unique network of ribs, struts and drip rods. It is most distinguished from other column packing in its unusually high ACTIVE surface area, for gas liquid contacting. The liquid used to wet the packing is from the scrubber pump recirculation system. This liquid is pumped over the packing and sprayed through nozzles to cover the entire area inside the scrubber housing. This allows the liquid to cover all of the packing area. Since packing is geometric with structural uniformity, it allows all surfaces to become wet while eliminating nesting and channeling.

The more surface area that is wet, the more active surface is available for producing higher efficiency. The packing's other advantage results from a high void area and minimal blockage. Both are critical because having a void area allows the liquid to cascade through the column with minimum effort and still be able to wet the whole packing structure. Blockage or channeling results when packing nests, causing areas to remain dry and provides open areas for contaminates to pass through. Dry areas will cause a loss of efficiency. Blockage also increases the static pressure of a column, and as static pressure increases, so do the energy requirements to move air through the column.

Viron® Mist Eliminators: Blades • Packing • Pads

Blades Available in PVC

Packing Available in Polypro, Kynar, and CPVC



Mesh Pad Available in Polypro and Kynar

Viron® Scrubber Options

Float Valve

Pressure Gauge

Metering Pump

Conductivity System Controller

Mixer

Rotameter

Level Controller

Sump Heater

Magnehelic Gauge

Basket Strainer

Check Valve

Make-Up Flowmeter

Pumps: CPVC, PP, KYNAR, SST, FRP

Pump Inlet Strainer

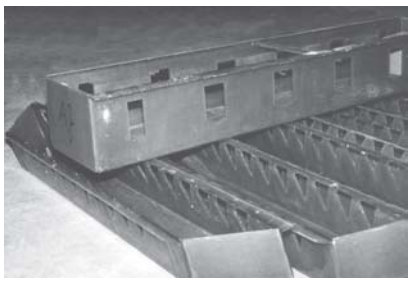
Sight Glass

Viron® Scrubber Options

Digital Flowmeter

Solenoid Valves

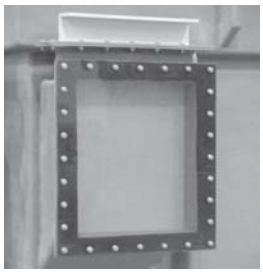
Dual Redundant Pumps



Troughs

pH System Controller

Secondary Containment-Rain Covers



Inspection Port

Manways

Chemical Day Tanks

Control Panels w/Remote Tank

Mist Eliminator-Mesh Pad

Lifting Lugs

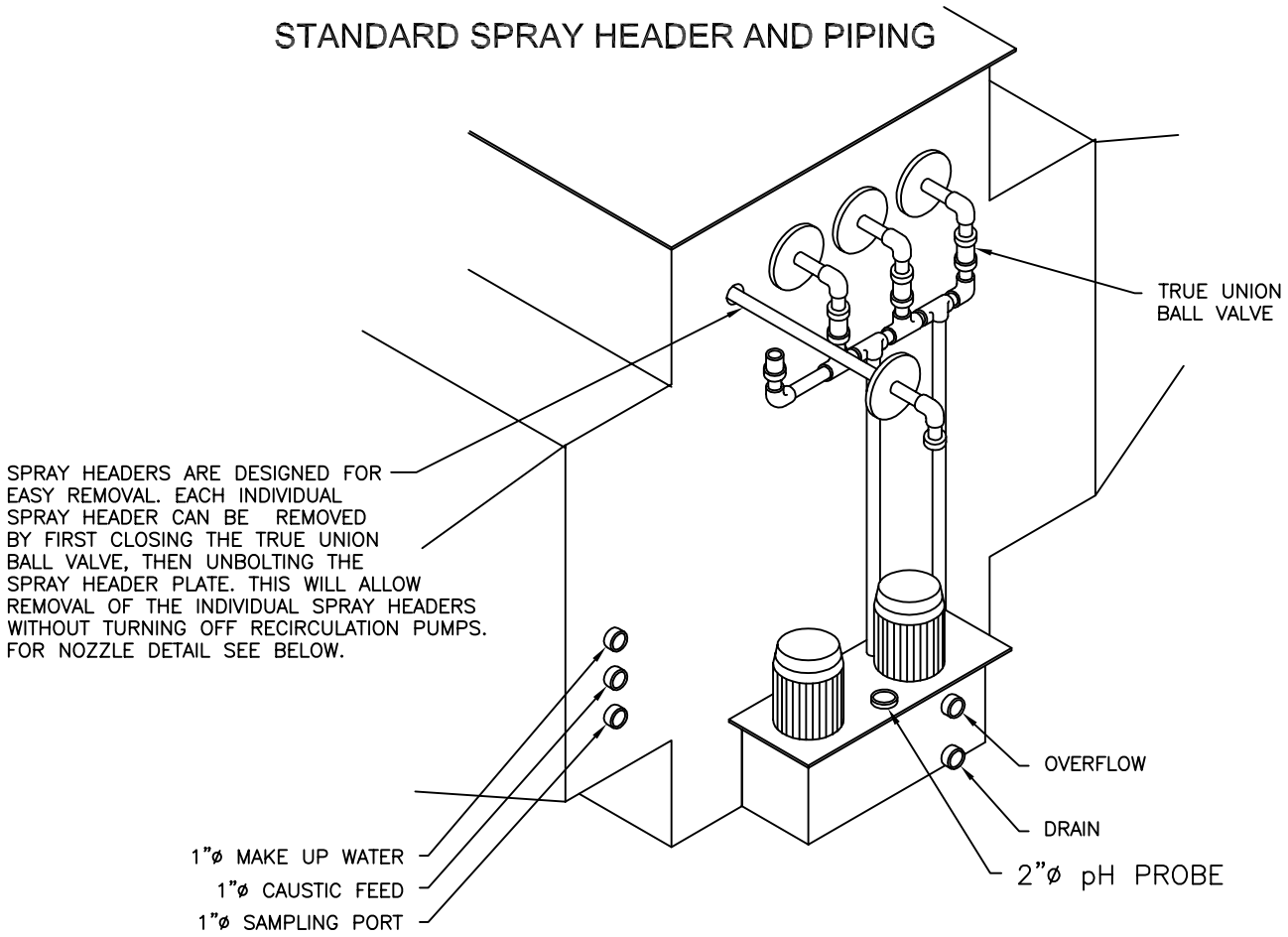
Y-Strainer

Photohelic Gauge

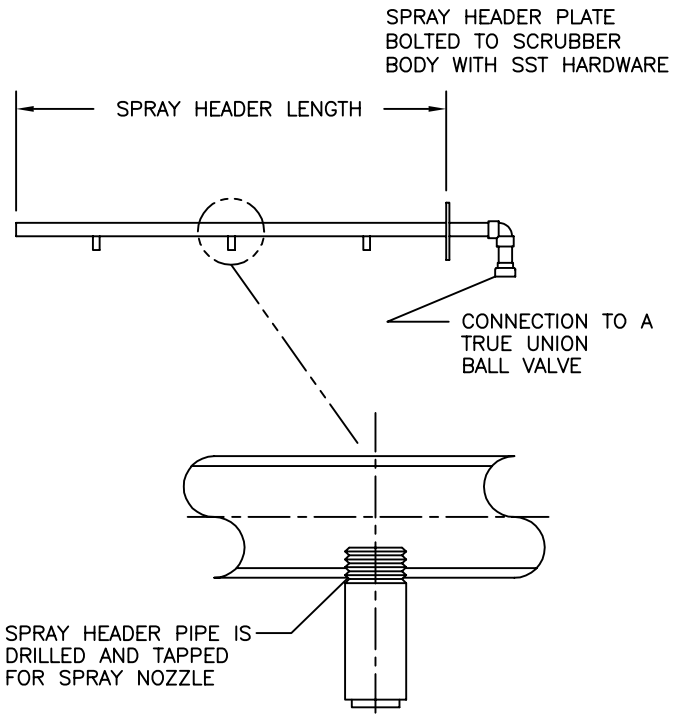
Hold Down Lugs

Viron® Spray Header Detail Illustrations

STANDARD SPRAY HEADER AND PIPING

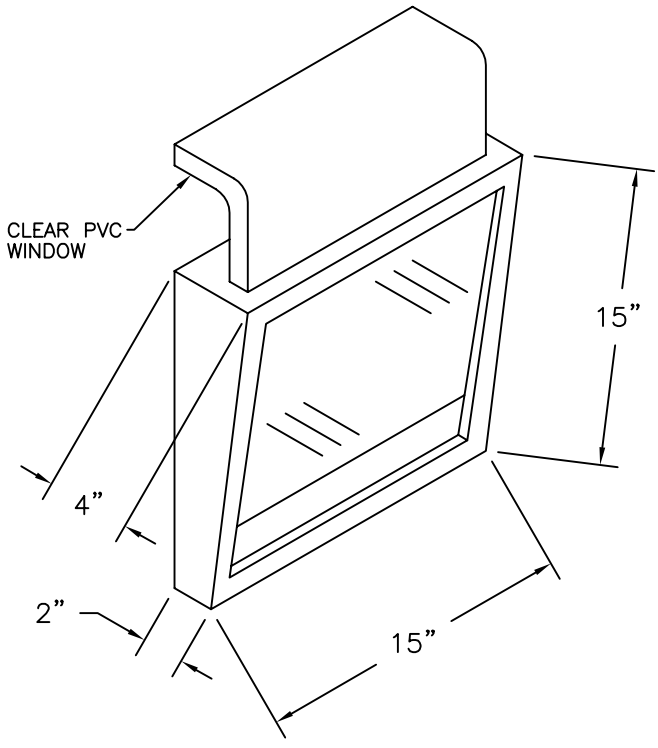


STANDARD SPRAY HEADER



NOZZLE DETAIL

STANDARD SLIDING ACCESS DOOR



Viron® Scrubber Selection Guide

Viron® Model Code: VHS- 4860- FRP- 10- 24- R- 2- C- 460- 3- 60

- Viron® Horizontal Model
- Scrubber Body Size
- Scrubber Body Material*
- CFM (thousands)
- Packing Depth
- Recirculation Code**
- Quantity of Pumps
- Pump Horse Power Code***
- Pump Motor Voltage
- Pump Motor Phase
- Pump Motor Cycle

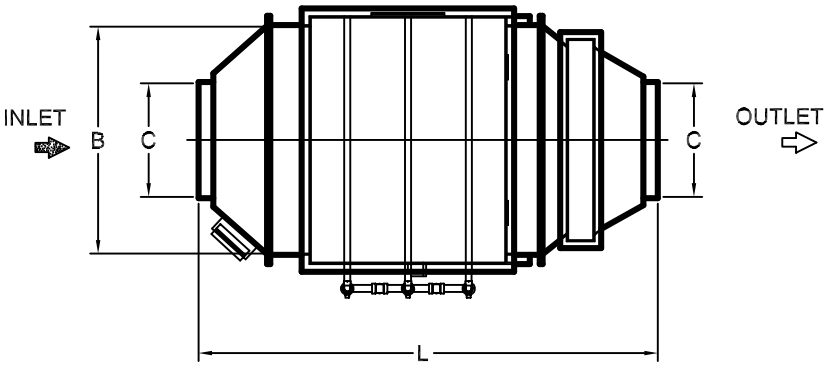
*Scrubber Body Material
FRP = Fiberglass Reinforced Plastic
PVC = Poly Vinyl Chloride
PP = Polypropylene
PVC/FRP = Poly Vinyl Chloride with FRP Overlay (Dual Laminate)

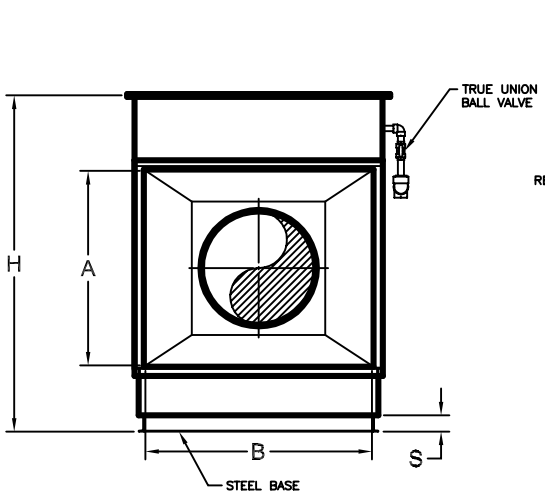
**Recirculation Code
S = Self-Contained Recirculation Units
R = Remote Recirculation Units

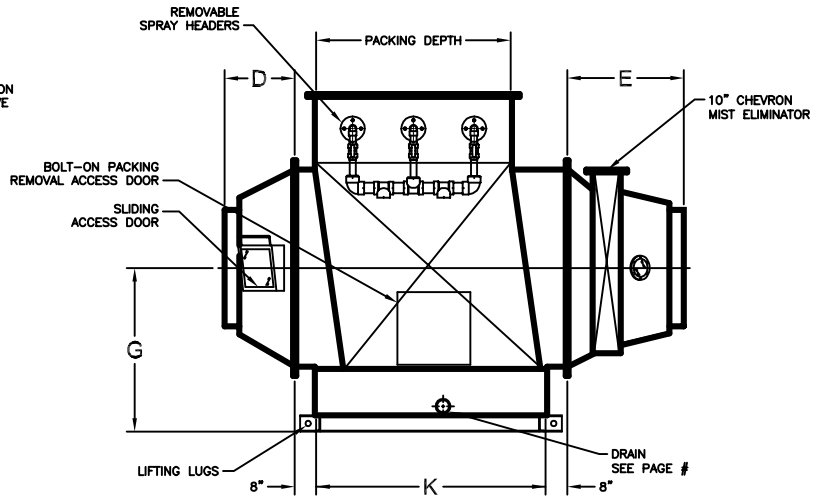
***Pump Horse Power Code

Horse Power	.5	.75	1	1.5	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100
Code Letter	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T

Viron® PVC Remote Recirculation Unit





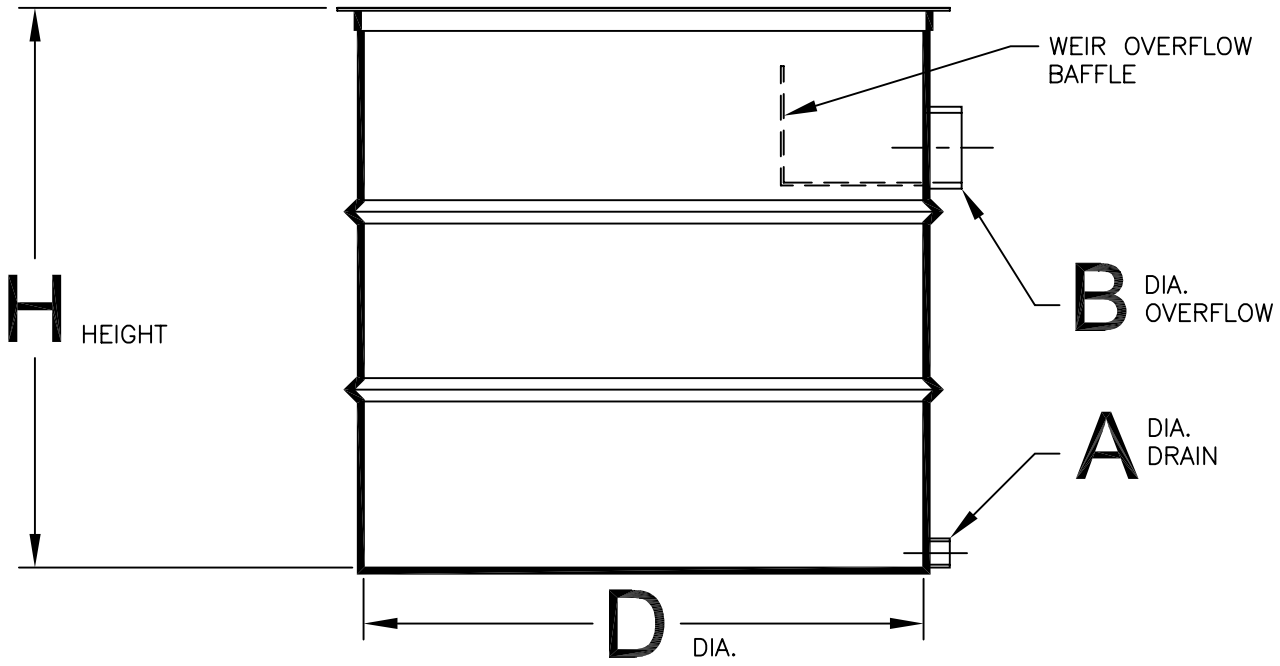


THESE DIMENSIONS ARE GUIDELINE DIMENSIONS ONLY. CERTIFIED DRAWINGS ARE SUPPLIED WITH SUBMITTAL PACKAGES.

MODEL SERIES NO.	CFM	A	B	C	D	E	G	H	K ID								L ID								S
		ID	ID	ID INLET			ID ℄ INLET	OD	12" PACK	24" PACK	36" PACK	48" PACK	60" PACK	72" PACK	96" PACK	120" PACK	12" PACK	24" PACK	36" PACK	48" PACK	60" PACK	72" PACK	96" PACK	120" PACK	BASE HEIGHT
VHS-1212	500	12	12	8	12	12	21	51	38	50	54	66	78	90	114	138	78	90	94	106	118	130	154	178	3
VHS-1224	1000	12	24	14	14	14	21	51	38	50	54	66	78	90	114	138	82	94	98	110	122	134	158	182	3
VHS-2424	2000	24	24	16	14	14	27	63	39	51	55	67	79	91	115	139	83	105	99	111	123	135	159	183	3
VHS-2436	3000	24	36	18	14	14	27	63	39	51	55	67	79	91	115	139	83	105	99	111	123	135	159	183	3
VHS-3636	4000	36	36	20	14	36	33	75	28	40	44	56	68	80	104	128	94	106	110	122	134	146	170	194	3
VHS-3642	5000	36	42	22	16	36	34	76	28	40	44	56	68	80	104	128	96	108	112	124	136	148	172	196	4
VHS-3648	6000	36	48	24	18	36	34	76	28	40	44	56	68	80	104	128	98	110	114	126	138	150	174	198	4
VHS-4848	8000	48	48	26	18	36	40	88	29	41	45	57	69	81	105	129	99	111	115	127	139	151	175	199	4
VHS-4860	10000	48	60	30	22	38	40	88	29	41	45	57	69	81	105	129	105	117	121	133	145	157	181	205	4
VHS-6060	12000	60	60	32	22	38	46	100	30	42	46	58	70	82	106	130	106	118	122	134	146	158	182	206	4
VHS-6066	14000	60	66	34	22	38	48	102	30	42	46	58	70	82	106	130	106	118	122	134	146	158	182	206	6
VHS-6672	16000	66	72	36	24	38	51	108	31	43	47	59	71	83	107	131	109	121	125	137	149	161	185	209	6
VHS-7272	18000	72	72	38	24	44	54	114	32	44	48	60	72	84	108	132	116	128	132	144	156	168	192	216	6
VHS-7278	20000	72	78	40	24	44	54	114	32	44	48	60	72	84	108	132	116	128	132	144	156	168	192	216	6
VHS-7284	22000	72	84	42	26	44	54	116	32	44	48	60	72	84	108	132	118	130	134	146	158	170	194	218	6
VHS-7494	24000	74	94	42	30	48	57	120	32	44	48	60	72	84	108	132	126	138	142	154	166	178	202	226	8
VHS-74102	26000	74	102	42	32	52	57	120	32	44	48	60	72	84	108	132	132	144	148	160	172	184	208	232	8
VHS-74108	28000	74	108	48	32	52	57	120	32	44	48	60	72	84	108	132	132	144	148	160	172	184	208	232	8
VHS-74116	30000	74	116	48	36	56	57	120	32	44	48	60	72	84	108	132	140	152	156	168	180	192	216	240	8
VHS-74136	35000	74	136	54	42	64	59	122	32	44	48	60	72	84	108	132	156	166	170	182	194	206	230	254	10
VHS-74156	40000	74	156	54	54	74	64	127	32	44	48	60	72	84	108	132	176	188	192	204	216	228	252	276	10
VHS-82158	45000	82	158	60	54	74	68	135	33	45	49	61	73	85	109	133	177	189	193	205	217	229	253	277	10
VHS-82175	50000	82	175	60	62	80	70	137	33	45	49	61	73	85	109	133	191	203	207	219	231	243	267	291	12
VHS-82193	55000	82	193	66	68	83	70	137	33	45	49	61	73	85	109	133	200	212	216	228	240	252	276	300	12
VHS-82210	60000	82	210	66	74	94	70	137	33	45	49	61	73	85	109	133	217	229	233	245	257	269	293	317	12
VHS-96210	70000	96	210	72	74	94	77	151	34	46	50	62	74	86	110	134	218	230	234	246	258	270	294	318	12
VHS-96240	80000	96	240	76	86	104	81	155	34	46	50	62	74	86	110	134	240	252	256	268	280	292	316	340	16
VHS-96270	90000	96	270	80	102	118	81	155	34	46	50	62	74	86	110	134	270	282	286	298	310	322	346	370	16
VHS-96300	100000	96	300	84	114	128	81	155	34	46	50	62	74	86	110	134	292	304	308	320	332	344	368	392	16

NOTE:
1. SCRUBBER BODY SHOWN ABOVE IS DESIGNED FOR 4 GPM/FT.^{2}
2. PUMPS AND RECIRCULATION RATE SELECTION SHOWN ABOVE ARE DESIGNED AT 4 GPM/FT.^{2}
3. PUMP SELECTION FOR 7 1/2 HP AND LOWER ARE CPVC CONSTRUCTION. 10 HP AND ABOVE ARE 316 SST CONSTRUCTION.
4. REMOTE PUMP SIZING BASED ON 60' OF HEAD.
5. VIRON CAN CHANGE THE OVERALL SIZE OF YOUR SCRUBBER TO FIT YOUR REQUIREMENTS.
6. SCRUBBER DRAIN SIZED FOR 1/4 "/FT SLOPE ON ALL HORIZONTAL RUNS.
7. SCRUBBER DIMENSIONS DO NOT SHOW ANY EXTERNAL STIFFENERS. PLEASE CONTACT FACTORY FOR O.D. DIMENSIONS.
8. DIMENSION "C" OUTLET COLLAR MAY CHANGE TO MATCH YOUR INLET DUCT SIZE OR VIRON'S FAN INLET.
9. ALL DIMENSIONS SHOWN IN INCHES.

Viron® Remote Recirculation Tank

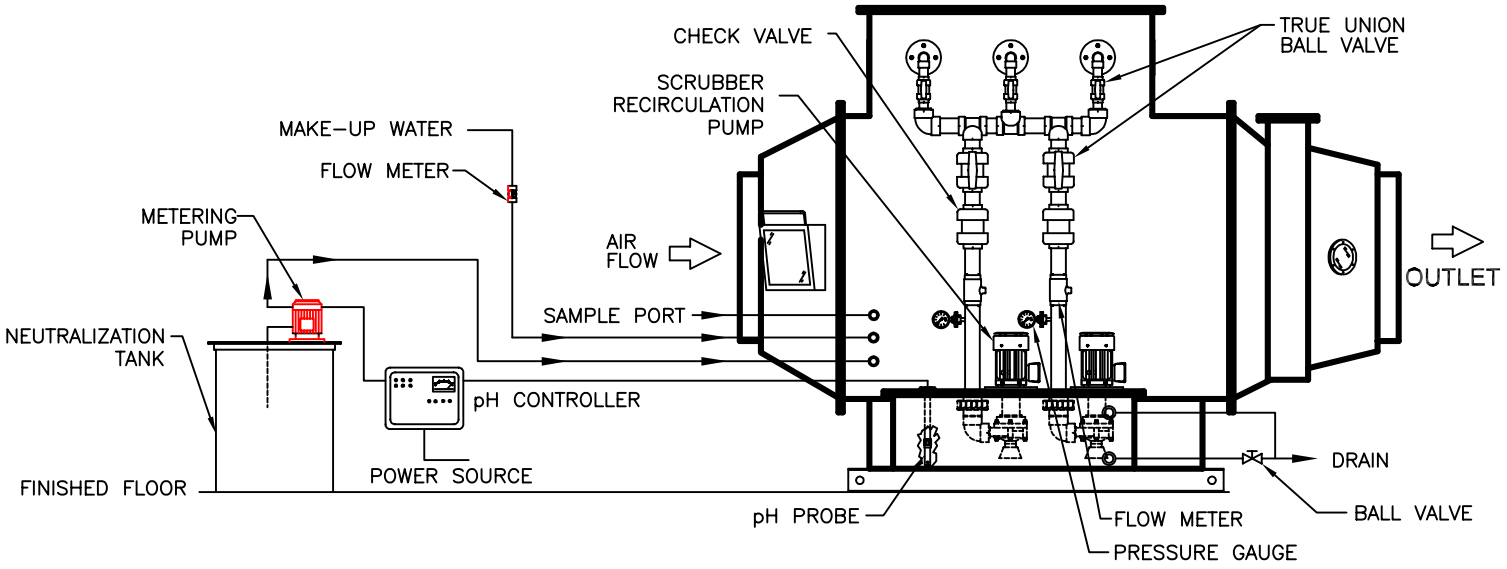


SCRUBBER RECIRCULATION RATE GPM	TANK CAPACITY	D	H	A	B	MATERIAL OF CONSTRUCTION	REMOTE SCRUBBER DRAIN
25	70	24	42	2	4	PVC	3
50	160	36	42	2	4	PVC	3
75	225	42	42	2	6	PVC	4
100	300	48	48	2	6	PVC	4
150	430	54	48	2	8	PVC	6
200	600	60	54	2	8	PVC	6
250	725	66	54	2	8	PVC	6
300	900	66	66	2	8	PVC	6
350	1050	72	66	2	8	FRP	6
400	1180	72	72	2	10	FRP	8
500	1600	84	72	2	10	FRP	8
600	1800	84	84	3	10	FRP	8
700	2100	84	96	3	10	FRP	8
800	2400	96	84	3	12	FRP	10
900	2700	96	96	3	12	FRP	10
1000	3000	96	102	3	12	FRP	10
1200	3600	108	96	3	12	FRP	10
1400	4200	120	90	3	14	FRP	12
1600	4800	120	104	3	14	FRP	12
1800	5400	120	120	3	14	FRP	12
2000	6000	120	132	3	14	FRP	12

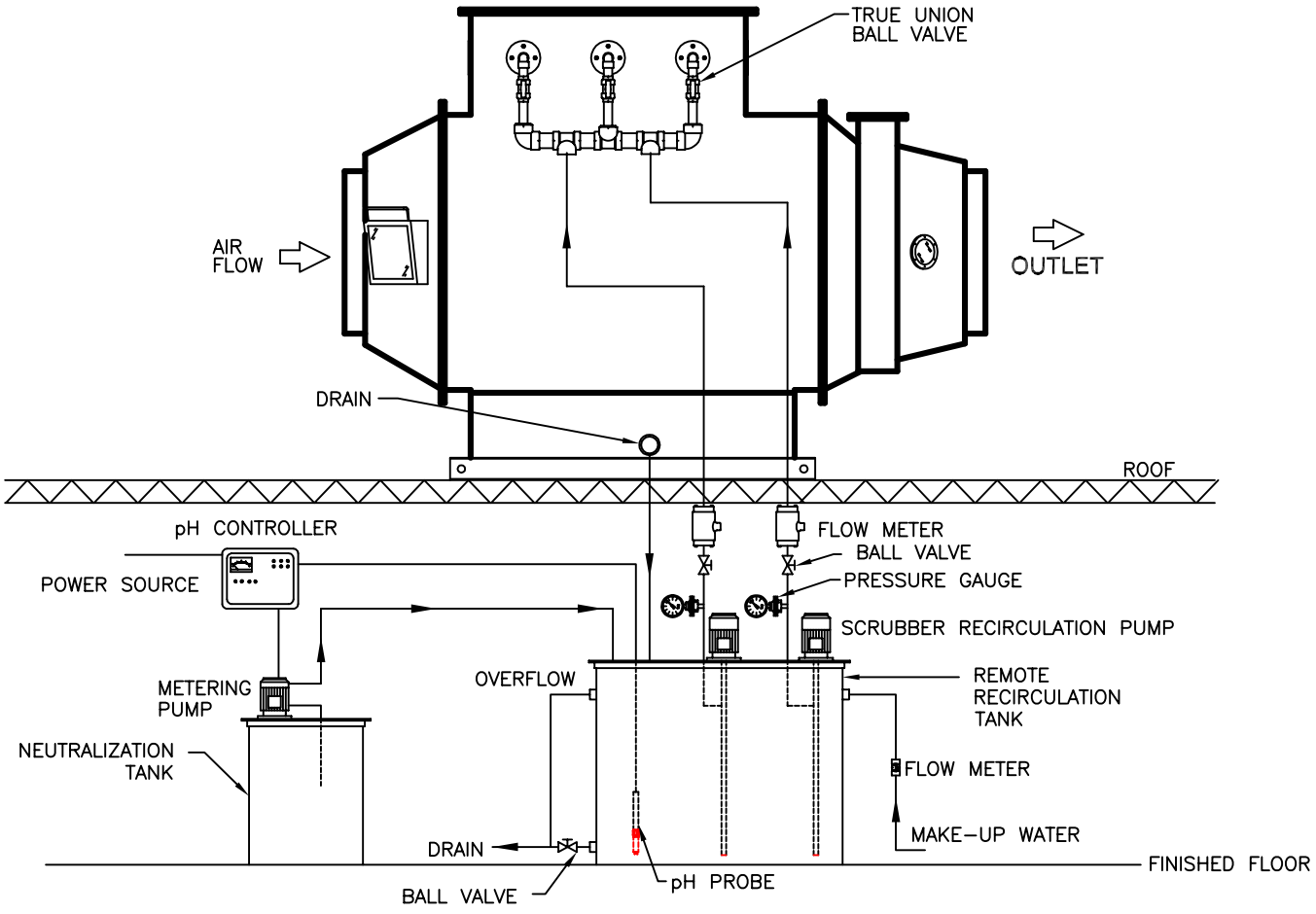
NOTE:
1. FRP NOZZLES WILL BE NPT TYPE. PVC NOZZLES WILL BE SCHEDULE 80 SOCKET TYPE.
2. SECONDARY CONTAINMENT MAY BE REQUIRED. PLEASE CONSULT FACTORY.
3. RECIRCULATION PUMPS TO BE INSTALLED ON A STEEL FRAME AND MOUNTED ON TOP OF THE TANK.
4. ALL TANKS ARE OPEN TOP.
5. CUSTOMER TO SUPPLY A SOLID, CONTINUOUSLY SUPPORTED BASE FOR THE INSTALLATION OF THE REMOTE TANK.

Viron® Neutralizing Chemical Control System Illustrations

SELF-CONTAINED RECIRCULATION FLOW DIAGRAM



REMOTE RECIRCULATION FLOW DIAGRAM



Viron® PVC Corrosion Table

This table may be used as a guide for ventilating gases and vapors from processes where chemicals shown are used.
Maximum temperatures shown.

ENVIRONMENT	Type I 70°	Type I 140°	Type II 70°	Type II 140°
ACIDS				
Acetic 20-30%	E	G	G	L
Acetic 30-60%	E	E	G	L
Benzene	U	U	U	U
Benzene Sulfonic 10%	E	E	E	E
Benzoic	E	E	E	E
Boric	E	E	E	E
Butyric 20%	G	U	L	U
Carbonic	E	E	E	E
Chloracetic	E	L	E	U
Chromic 10%	E	E	E	E
Chromic 25%	E	L	G	L
Citric	E	E	E	E
Fluoroboric	E	E	E	E
Fluorosilicic	E	E	E	E
Formic	E	U	E	U
Glucose	E	E	E	E
Hydrobromic 20%	E	E	E	G
Hydrochloric 0-25%	E	G	E	G
Hydrochloric 25-40%	E	E	E	G
Hydrocyanic	E	E	E	E
Hydrofluoric 10%	E	L	E	G
Hydrofluorosilicic 30%	E	G	G	L
Hypochlorous 20%	E	E	E	E
Lactic 28%	E	E	E	E
Maleic	E	E	E	E
Nitric 10,35,40%	E	G	G	L
Nitric 20%	E	L	G	L
Nitric (vapor) 60%	E	L	G	U
Nitrous Oxide	E	E	E	E
Oleic	E	E	E	E
Oxalic	E	E	E	G
Perchloric 10%	E	L	G	L
Phosphoric 0-25%	E	G	E	G
Phosphoric 25-75%	E	E	E	G
Phosphorus (yellow)	E	G	G	L
Picric	U	U	U	U
Silicic	E	E	E	E
Stearic	E	E	G	G
Sulfamic (see Benzene Sulfonic 10%)	E	E	E	E
Sulfuric 0-75%	E	E	E	G
Sulfuric 75-90%	E	E	L	L
Sulfuric 95%	E	G	U	U
Sulfurous	E	E	E	E
Tannic	E	E	E	E
Tartaric	E	E	E	E
ALCOHOLS				
Amyl	E	E	L	U
Benzol	U	U	U	U
Butyl	E	G	L	U
Ethyl 0-98%	E	E	E	E
Methyl	E	E	E	E
GASES AND VAPORS				
Ammonia, Dry	E	E	E	E
Ammonia, Wet	L	U	–	–
Bromine	U	U	U	U
Carbon Dioxide	E	E	E	E
Carbon Monoxide	E	E	E	E
Chlorine, Dry	G	G	G	G
Fluorine	L	U	U	U
Hydrogen	E	E	E	G
Hydrogen Sulfide	E	E	E	E
Sulfur Dioxide, Wet	G	U	L	U
Sulfur Troxide, Dry	E	E	E	G

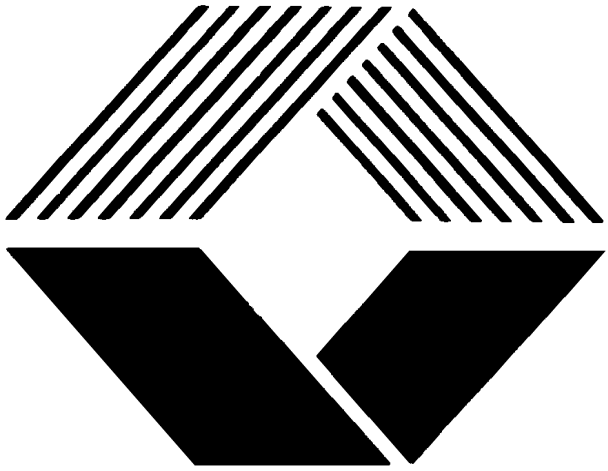
ENVIRONMENT	Type I 70°	Type I 140°	Type II 70°	Type II 140°
ALKALIES				
Ammonium Bifluoride	E	E	E	E
Ammonium Carbonate	E	E	E	E
Ammonium Fluoride 25%	E	L	U	U
Ammonium Hydroxide 28%	E	E	E	E
Barium Carbonate	E	E	E	E
Calcium Hydroxide	E	E	E	E
Magnesium Carbonate	E	E	E	E
Potassium Bicarbonate	E	E	E	E
Potassium Carbonate	E	E	E	E
Potassium Hydroxide 10, 20, 35%	E	E	E	E
Sodium Bicarbonate	E	E	E	E
Sodium Carbonate	E	E	E	E
Sodium Hydroxide 10,35%	E	E	E	E
Sodium Sulfide	E	E	E	E
Trisodium Phosphate	E	E	E	E
SALTS				
Aluminum Chloride	E	E	E	E
Aluminum Nitrate	E	E	E	E
Aluminum Sulfate	E	E	E	E
Ammonium Chloride	E	E	E	E
Ammonium Nitrate	E	E	E	E
Ammonium Persulfate	E	E	E	E
Ammonium Sulfate	E	E	E	E
Aniline	U	U	U	U
Aniline Sulfate, saturated	U	U	U	U
Antimony Trichloride	E	E	E	E
Barium Chloride	E	E	E	E
Barium Sulfide	E	E	E	E
Calcium Chlorate	E	E	E	E
Calcium Chloride	E	E	E	E
Calcium Sulfate	E	E	E	E
Copper Chloride	E	E	E	E
Copper Cyanide	E	E	E	E
Copper Fluoride 2%	E	E	E	E
Copper Sulfate	E	E	E	E
Ferric Chloride	E	E	E	E
Ferric Nitrate	E	E	E	E
Ferric Sulfate	E	E	E	G
Ferrous Chloride	E	E	E	E
Lead Acetate	E	E	E	E
Magnesium Chloride	E	E	E	E
Magnesium Hydroxide	E	E	E	E
Magnesium Sulfate	E	E	E	E
Mercuric Chloride	E	E	G	G
Mercurous Nitrate	E	E	G	G
Nickel Chloride	E	E	E	E
Nickel Nitrate	E	E	E	E
Nickel Sulfate	E	E	E	E
Potassium Chloride	E	E	E	E
Potassium Dichromate 40%	E	E	E	E
Potassium Ferricyanide	E	E	E	E
Potassium Nitrate	E	E	E	E
Potassium Permanganate 10%	E	E	G	G
Potassium Persulfate	E	E	E	E
Potassium Sulfate	E	E	E	E
Silver Nitrate	E	E	E	E
Sodium Acetate	E	E	E	E
Sodium Bisulfate	E	E	E	E
Sodium Chloride	E	E	E	E
Sodium Chlorate	E	G	G	L
Sodium Cyanide	E	E	E	E
Sodium Dichromate	E	E	E	G

ENVIRONMENT	Type I 70°	Type I 140°	Type II 70°	Type II 140°
SALTS (cont'd.)				
Sodium Ferricyanide	E	E	E	E
Sodium Fluoride	E	E	E	E
Sodium Nitrate	E	E	E	E
Sodium Nitrite	E	E	E	E
Sodium Sulfate	E	E	E	E
Sodium Sulfite	E	E	E	E
Stannic Chloride	E	E	E	E
Stannous Chloride	E	G	E	G
Zinc Chloride	E	E	E	E
Zinc Nitrate	E	E	E	E
Zinc Sulfate	E	E	E	E
SOLVENTS				
Acetone	U	U	U	U
Benzene	U	U	U	U
Carbon Bisulfide	U	U	U	U
Carbon Tetrachloride	L	U	U	U
Chlorobenzene	U	U	U	U
Ethyl Acetate	U	U	U	U
Ethyl Chloride	U	U	U	U
Ethylene Glycol	E	E	E	E
Heptane	E	G	L	U
Hexane	E	L	U	U
Methyl Ethyl Ketone	U	U	U	U
Naphtha	E	E	E	G
Trichloroethylene	U	U	U	U
Toluene	U	U	U	U
Xylene	U	U	U	U
BLEACHES				
Calcium Chlorate	E	E	E	E
Calcium Hypochlorite	E	E	E	E
Chlorine Water	E	E	E	E
Hydrogen Peroxide 30%	E	E	E	G
Hydrogen Peroxide 50%	E	E	E	L
Sodium Chlorate	E	G	G	L
Sodium Hypochlorite	E	E	E	E
OTHERS				
Aluminum Hydroxide	E	E	E	E
Ammonium Phosphate	E	E	–	–
Aqua Regia	E	L	L	U
Glycerine	E	E	E	E
Kerosene	E	E	E	E
Photographic Solutions	E	E	E	E
Tetrahydrofurane	U	U	U	U
Sodium Xylene Sulfonate	–	–	–	–
Sorbitol Solution	–	–	–	–
Urea	E	E	E	E
Urea-Ammonium-Nitrate	E	E	E	E
PLATING SOLUTIONS				
Brass	E	E	E	E
Cadmium	E	E	E	E
Chromium	E	G	G	G
Copper	E	E	E	E
Gold	E	E	E	E
Judium	E	E	E	E
Lead	E	E	E	E
Nickel	E	E	E	E
Rhodium	E	E	E	E
Silver	E	E	E	E
Tin	E	E	E	E
Zinc	E	E	E	G

KEY: E = Excellent G = Good L = Limited U = Unsuitable

Scrubber Manual

General Recommendations for Operation and Maintenance of Viron® Scrubbers



VIRON®

INTERNATIONAL CORPORATION

989–723–8255

SCRUBBER MANUAL

A. GENERAL FORMAT:

1. All VIRON scrubbers are inspected and pretested at the factory. Upon receipt of equipment, inspection is recommended. If any parts are found to be damaged, a claim should be immediately filed against the freight carrier.

2. VIRON equipment is constructed of the finest fiberglass reinforced plastic and thermoplastic materials. Care must always be taken during handling and installation to prevent damage, which may be caused by external stress or shock.

3. The scrubber should be mounted on an adequate support. When the scrubber is to be mounted on a platform, the platform should be thoroughly braced. If the scrubber is roof supported, it is suggested that a structural engineer be consulted.

4. For best results, VIRON equipment should be installed by personnel experienced with the installation of air handling equipment.

5. Temperatures of fumes at the inlet of the scrubber should never exceed 160 degrees Fahrenheit for fiberglass or 140 degrees Fahrenheit for PVC, unless the scrubber has been designed for higher temperatures. Consult the factory if in doubt.

6. Do not ignore special instructions with the equipment.

B. GENERAL INSTALLATION INSTRUCTIONS

1. Inspect equipment received to determine if damage or shifting occurred during shipment. Inspection can be made, by observing the packing face from the scrubber inlet.

2. Check all piping for breakage or damage.

3. Utilize nylon straps when lifting scrubbers from truck bed to final destination. If the lifting lugs are on the equipment be sure they are used. If there are no lifting lugs, place nylon straps around the scrubber flanges for lifting. The flanges are adequate to support the weight of the unit.

4. Large size horizontal scrubbers require the contractor or customer to install the inlet and outlet transitions. The outlet transition contains the mist eliminator and must be located on the discharge side of the scrubber.

Caulking or gasketing should be applied to the inlet and outlet flanges of the scrubber housing. The transition is then secured to the scrubber housing with mounting hardware. The smaller horizontal and vertical scrubbers have the transitions installed at the factory.

5. The scrubber should be thoroughly cleaned after installation. Spray the filter media, eliminator sections, scrubber housing, and transitions with a hose nozzle, to wash all foreign material out of the scrubber.

C. RECIRCULATION SYSTEM PLUMBING

1. Install diameter make-up water supply plumbing and valves per diagram. If scrubber was ordered with float control valve, install the plumbing per diagram 1. Check with city code concerning installation of back flow preventer.

   CAUTION: Make-up water supply must be continuously furnished to the scrubber, to maintain overflow of contaminated sump water. If the pH-sensing unit is not utilized, overflow water should be maintained at 3% of scrubber re-circulation rate.

   EXAMPLE: The scrubber re-circulation rate is 30 gallons per minute, then overflow rate is 1 gallon per minute. The float valve is used only for evaporation control. It should not be used in place of make-up control.

2. If the pH control system is to be installed, refer to the pH control package of this manual.

3. Install drainage plumbing to overflow and drain outlet per diagram 2.

4. Check all valves to insure proper position. All spray header valves should be in the open position, with handles in line with the flow. The drain valve should be closed, with the handle in line across the fluid flow.

5. Diagram 1 – Exterior make-up water plumbing optional. The scrubber is supplied with these 1” threaded inlets as shown. All plumbing valves, fittings and floats are available as optional equipment.

6. Diagram 2 – Exterior drain and overflow plumbing optional. The scrubber is supplied with a threaded overflow outlet, and a threaded drain outlet. All plumbing valves and fittings shown are available as optional equipment.

VIRON® INTERNATIONAL CORP.

OWOSSO, MICHIGAN
TEMPLE, TEXAS

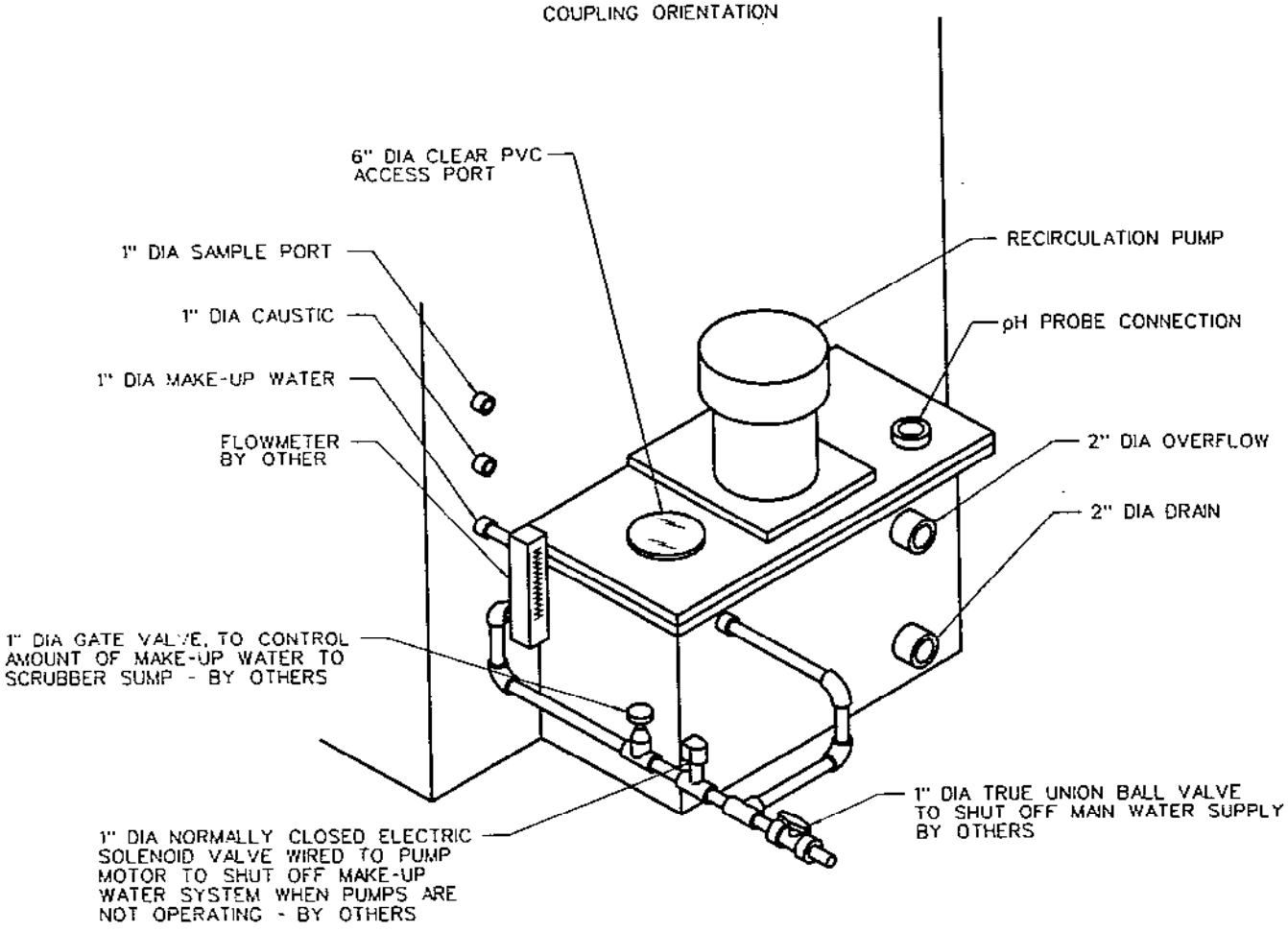
ENVIRONMENTAL CONTROL SYSTEMS

USER	
REP.	
JOB NO.	
DATE	SHEET OF
DRAWN BY	

SUGGESTED MAKE-UP WATER PLUMBING

FOR REFERENCE ONLY

SEE SCRUBBER DETAIL FOR
COUPLING ORIENTATION



VIRON® INTERNATIONAL CORP.

OWOSSO, MICHIGAN
TEMPLE, TEXAS

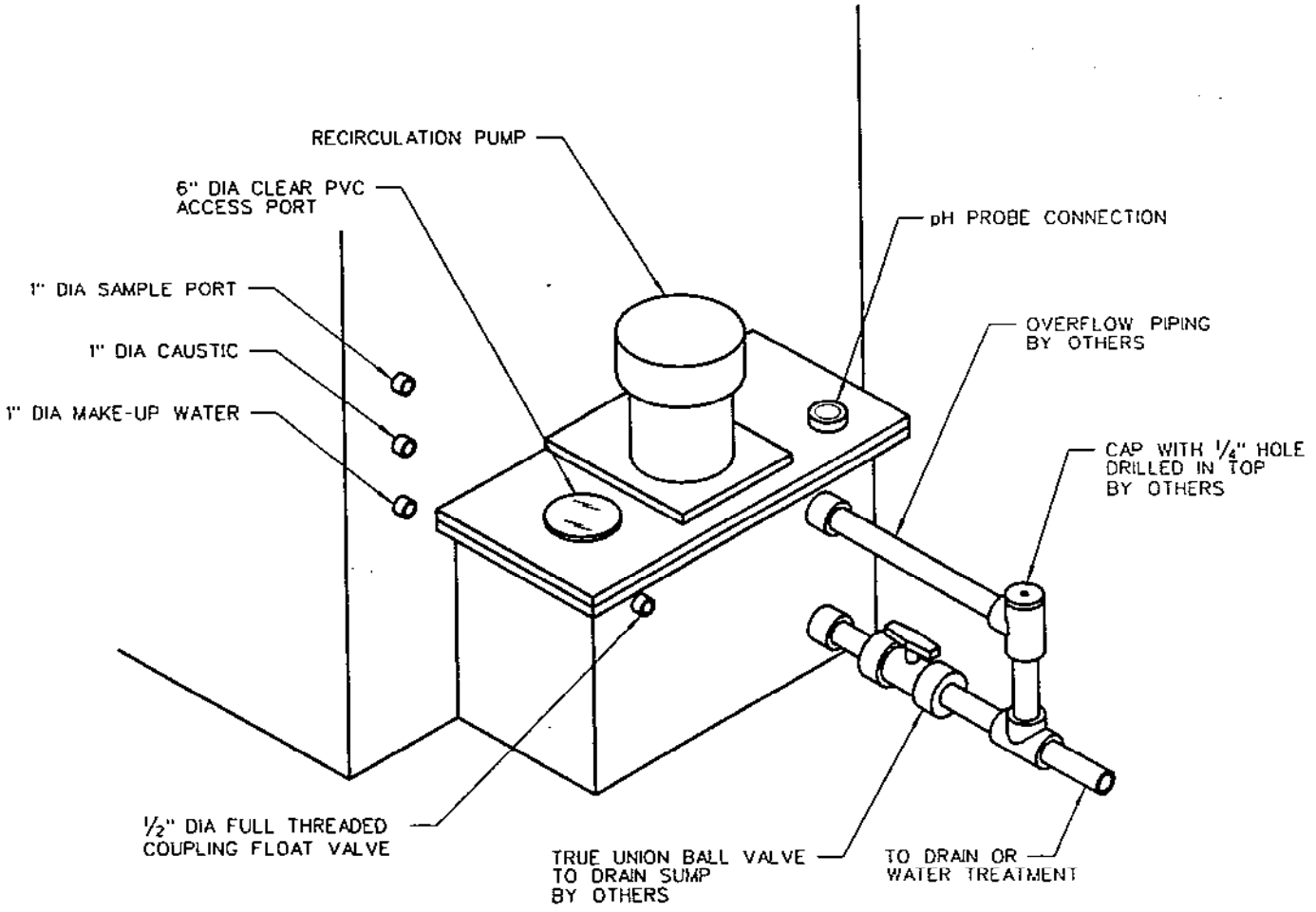
ENVIRONMENTAL CONTROL SYSTEMS

USER	
REP.	
JOB NO.	
DATE	SHEET OF
DRAWN BY	

SUGGESTED OVERFLOW-DRAIN PLUMBING

FOR REFERENCE ONLY

SEE SCRUBBER DETAIL FOR
COUPLING ORIENTATION



D. PUMPS

In most applications, sump pumps are used for re-circulation. The pumps are CPVC, polypro, or 316 stainless steel. Pumps are selected from several manufacturers, for use on air pollution control equipment. Pump maintenance instructions for pump supplied with your unit will be attached to the unit.

WARNING: Reverse rotation can cause severe damage. Check the pump rotation before filling the pump.

The motor should operate in clockwise direction when viewed from the top of the pump. (Label on motor also indicates proper rotation direction.)

PUMP MOTORS-Single Phase

These units are supplied with a single phase dual voltage motor (115/230 volts) and are always wired at the factory for the higher voltage. When changing 230 volt wiring to 115 volt wiring, follow the manufacturer's wiring instructions, which are found inside the motor junction box or on the motor nameplate. Be sure to wire the motor for clockwise rotation, as seen from the motor end of the pump. (The fan should rotate in a clockwise direction.)

PUMP MOTORS-Three Phase

All three phase dual voltage motors are wired for higher voltage (460 volts) at the factory. For 230 volt operation, follow the motor manufacturer's wiring instruction, which are found inside of the motor junction box or on the motor nameplate.

To check motor rotation:

1. Attach leads to motor and bump start the motor.

2. Inspect the motor to determine rotation.

3. If a motor is rotating in a clockwise rotation when looking at the motor fan, rotation is correct.

4. If the rotation is not correct, interchange any two leads to obtain the correct rotation.

E. GENERAL MAINTENANCE INSTRUCTIONS

Because adequate access has been engineered into the unit, a minimum amount of work is required when cleaning or servicing. See the drawing of

the unit you purchased. The horizontal and vertical scrubbers have similar features.

1. ACCESS DOORS

   Clear PVC access doors are located in areas to permit observance of spray nozzles.

2. PUMP FILTER

   Pump filters are an optional item. The filters are located on the suction side of the pump. They are polypro. Removal of the filter, from the unit access, can be achieved from the top of the sump box. The filters should be checked once a week.

3. PUMPS

   The pump (or pumps) should rarely require maintenance, because they have no seals or bearings in the fluid to wear out, and can be run dry indefinitely without harm. There are times when, due to inadvertent installation or maintenance miscalculations, removal and replacement may be required. The pump (or pumps) are mounted on a PVC or polypropylene plate which is bolted to the sump box. The pumps are plumbed to the spray piping with unions.

   To remove pump:

   a. **CAUTION:** All electrical power to the unit should be disconnected PRIOR to pump removal.

   b. Disconnect electrical wiring from pump motor.

   c. Turn off the ball valves, unscrew union nut ball valve connection pump outlet pipe to spray header piping.

   d. Remove bolts that attach pump plate to sump box.

   e. Remove pump and return to factory for repair or replacement.

   f. Reverse above steps to re-install pump (or pumps).

   g. Be sure to reconnect wiring for proper pump rotation.

      NOTE: REMEMBER TO TURN BALL VALVE ON.

Do not over-tighten bolts, screws, or union nuts on ball valves.

4. PUMP MOTOR MAINTENANCE

CLEANING AND INSPECTION

a. MOTOR: The motor should be cleaned and inspected at **regular** intervals. Operating conditions involving continuous running, hot or dusty environments, etc., require frequent attention. Check bearings when any unusual noise or vibration develops in the motor. Check bearing for roughness by removing the pump from the sump box and turning the pump impeller by hand. If the bearings bind in spots, replace the bearings.

b. INSULATION: The insulation resistance should be checked before placing the motor in service after extended storage periods, and periodically thereafter, especially when in service under severe conditions encountering high humidity. Check the insulation resistance with a megohm meter or similar instrument employing a 500 volt D.C. potential. Resistance should be at least 1.5 megohms: if it is less, the motor should be removed from service, cleaned, dried, rechecked and the winding given two coats of high grade insulating varnish to assure adequate winding protection.

F. MAINTENANCE INSTRUCTIONS FOR VHS HORIZONTAL SCRUBBER

1. MIST ELIMINATOR ACCESS

The smaller cover bolted to the rear on the housing unit allows access to the mist eliminator section. The mist eliminator profiles can be removed individually by sliding them out the top of the unit. Removal should not be attempted unless absolutely necessary, because the profile replacement can be difficult, therefore, removal of them should be attempted only when necessary.

2. SPRAY NOZZLE ACCESS

The spray headers may be individually removed to aid in the servicing of the spray nozzles. The unit does not have to be shut down to service the spray headers or nozzles.

To remove spray headers:

a. Turn off ball valve supplying the spray manifold.

b. Loosen the union nut on the outlet side of the valve to free the manifold header.

c. Remove pipe straps which affect manifold to filter media cover.

d. Remove the manifold header.

e. Loosen nozzles to remove from manifold header.

f. Reverse above steps to re-install manifold header.

NOTE: REMEMBER TO TURN BALL VALVE ON.

Do not over-tighten bolts, screws, or union nuts on ball valves.

3. FILTER MEDIA ACCESS

The top of the unit has two covers, which are bolted to the main body. The larger cover has the spray headers mounted under it. Removal of the cover will allow complete access to the packed section. The system must not be in operation while this cover is being removed. Refer to the section on “Spray Nozzle Removal” to remove the spray headers.

G. MAINTENANCE INSTRUCTIONS FOR VVS VERTICAL SCRUBBER

1. MIST ELIMINATOR ACCESS

To access the mist eliminator, remove the top outlet transition of the unit. The transition is bolted tot he housing unit and can be easily removed. The mist eliminator is in modular form, and can be lifted out by any maintenance personnel by hand. When re-install the transition, use Silicone Rubber Caulking on the flanges or plastic gasketing for proper sealing.

2. SPRAY NOZZLE ACCESS

The spray headers may be removed during the servicing of the spray nozzles. The unit does not have to be shut down to service the spray headers or nozzles.

To remove the spray headers:

a. Turn of the ball valve supplying the spray manifold.

b. Loosen the unit nut on outlet side of valve to free the manifold header.

c. Remove bolts connecting manifold flange to scrubber body.

d. Turn manifold 90 degrees and remove.

e. Loosen nozzles to remove from manifold.

f. Reverse above steps to re-install spray manifold.

NOTE: REMEMBER TO TURN BALL VALVE ON.

Do not over tighten bolts, screws, or union nuts on ball valves.

3. FILTER MEDIA ACCESS

Access door is also located in the filter media area, and is a bolted door. The door should not be open or removed during unit operation. This door is for removal of the filter media if it becomes necessary to clean it.

H. INSTALLATION AND MAINTENANCE OF pH CONTROL PACKAGE (OPTIONAL)

1. pH CONTROL PACKAGE

A pH control package can be utilized to maintain a pre-determined pH value in scrubber sump. The following list describes all of the parts required for a standard chemical feed system.

Required component parts of a pH control package are:

a. pH controller

b. 300 gallon mixing tank

c. chemical feed pump

d. mixer (agitation)

2. MIXING TANK

The chemical make-up tank for fiberglass scrubbers is made with fiberglass resin with a Nexus interior liner. The exterior color of the tank is white. The chemical make-up tank for PVC scrubbers is made of gray PVC with PVC angle girths. The make-up tank should be located as close as possible to the scrubber on self-contained units as possible, A161-62 and next to a remote re-circulation tank on remote units.

3. CHEMICAL FEED PUMP

   The pump is a model A161-62, manufactured by Liquid Metronics, Inc. Maximum capacity is 2.0 gallons per hour, maximum head is 115 feet. The pump is powered by a 115 volt, single phase, 60 cycle, 1 amp motor. This is totally enclosed to protect against splash or drip. The pump is shipped loose to be installed on the mixing tank by others. The outlet plumbing, from the pump to the scrubber unit, must be supplied by the customer.

4. MIXER

   The mixer (agitator) is a model C1-TE-PRP/44 with a 3 HP, 1,725 rpm, 115/230/1/60 voltage, automatic overload, ball bearing, and capacitor start, fan cooled motor. A 5/8" diameter x 44" long 304 SST shaft with propeller is standard. The mixer comes with two clamp mounts for mounting to the vertical surface on the tank cover. The mounts are steel with corrosion resistant paint. The mixer is to agitate the solution in the make-up tank. It should be operated as often as necessary to prevent the chemical from settling to the bottom of the tank.

5. pH CONTROLLER

   Please refer to the enclosed instructions from the manufacturer.

6. OPTIONAL SCRUBBER ACCESSORIES AVAILABLE BY VIRON

   Optional accessories available from VIRON for factory installation or outright purchase:

   a. pH indicators and controls.

   b. Liquid flow metering or monitoring equipment & gauges

   c. PVC float valves (evaporating control)

   d. Inlet gate and solenoid valves

   e. PVC or polypro pipe, fittings, valves, or external plumbing

   f. Magnehelic gauges

   g. Immersion sump heaters

h. Air quality testing equipment (pilot tube kit)

i. PVC line strainer

j. Remote sump tank and pumps

SCRUBBER START-UP

Technical Bulletin No. 1007 September 30, 1997

This bulletin is designed to be a brief overview for the start-up of your new Viron International scrubber. The following should be used as a checklist during the start-up of your scrubber.

1. Verify that the packing is up to the proper level and that the mist eliminator assembly is properly installed. Add packing material if required.

2. Fill the scrubber sump with fresh water to the scrubber overflow and check the vessel for any water leaks. Each Viron International scrubber is leak tested at the factory for a minimum of twenty-four hours prior to shipment. Repair any leaks as required.

3. Drain the scrubber to remove any dirt and foreign material that may have accumulated in the scrubber sump.

4. Bump start each recirculation pump and check for proper rotation. If the pump rotates in the wrong direction, reverse two leads for three phase pumps or see the pump's conduit box cover for single phase pumps. Never check the pump rotation with liquid in the scrubber sump.

5. Close the scrubber drain and fill the unit with fresh water to the scrubber overflow.

6. Start and operate each recirculation pump. Check each pumps amp draw. If the readings are above the ratings on the recirculation pump's nameplate, stop the recirculation pump immediately. See the scrubber trouble-shooting guide to evaluate the high amp draw.

7. Check the recirculation system plumbing for leaks and correct as required. Each Viron International scrubber is tested for these leaks prior to shipment, but fittings and valves will loosen during shipment.

8. Adjust the spray header ball valves to achieve a back pressure of 12 psi or the proper gpm reading for units with rotameters.

9. Visually check the spray nozzles for the proper 120 degree pattern. Nozzles that do not spray properly should be removed and cleaned. This is accomplished by turning the spray header's true union ball valve off and disassembling the valve at the upper union nut. Remove and clean the nozzle. Return and remount the spray header. Following these instructions will allow continued operation of the remaining spray headers.

10. If the unit is equipped with a pH or ORP controller, follow the manufacturer's procedure for start-up. Typical set points for each controller are as follows:

Controller	Neutralizer	Set Point
# pH	NaOH	8-9
* ORP	NaOCl	300-500 mV

\# for Acid Control
* for Oxidation Addition

Required set points can usually be found on Viron's approval drawings. If you have any questions as to your particular control requirement, please consult the factory.

11. Start and operate the exhaust fan. Check for proper air volume and adjust as required.

12. Adjust the make-up water valve to produce the proper flow (5% of the scrubber recirculation gpm.) This will reproduce an overflow gpm of 3% of the scrubber recirculation gpm. If the overflow gpm is greater than the 3%, throttle the make-up water valve back to achieve this flow.

13. When shutting the system down, it is imperative that the exhaust blower be completely stopped before the recirculation pump operation is halted. This insures that the airstream has been cleaned before being discharged into the atmosphere.

CAUTION: There is never to be any airflow through the scrubber when the recirculation water, make-up water, or chemical neutralization systems are not in operation.

SCRUBBER TROUBLE SHOOTING GUIDE

Technical Bulletin No. 1008 December 17, 1997

PROBLEMS	PROBABLE CAUSES/CORRECTIVE ACTION
INSUFFICIENT WATER FLOW	Check the pump(s) for proper rotation. If rotating in the wrong direction, switch the motor leads to obtain proper rotation. Verify that all true union ball valves are in the open position. Verify that all the spray nozzles are functioning properly. Clean as required. Verify that all line strainers (if equipped) are clean. Clean as required.
WATER DISCHARGING FROM UNIT	Recirculation pumps discharging too much water. Close down the ball valves until water does not exit scrubber. Exhaust fan drawing too much air through the scrubber. Verify airflow and reduce as required. Verify that the packing is at the proper level. Add packing as required.
EXCESSIVE PUMP VIBRATION	Check the pump for accumulated debris. Clean as required. Verify that the pump mounting bolts are tight. Tighten as required.

Note: For items such as pH controllers, metering pumps, etc. See the manufacturers' operation and maintenance manual for trouble shooting data.

BULLETIN: VB-1100-98
March-98

PVC AND FRP CENTRIFUGAL FANS

VCB-SERIES

VIRON®

INTERNATIONAL

PVC AND FRP CENTRIFUGAL FANS

VCB-1100 SERIES

VIRON® INTERNATIONAL is a leading manufacturer of corrosion resistant PVC and FIBERGLASS fans. Our manufacturing facilities in Michigan and Texas operate the most modern equipment and efficient manpower found in the fan industry. Our PVC and FIBER-GLASS Centrifugal Fans are produced in 20 standard sizes with wheel diameters ranging from 12" to 80", allowing our fans to produce volumes from 400 to 150,000 CFM

STANDARD DESIGN PARAMETERS:

1. High Efficiency
2. Easy Maintenance
3. Minimum Operating Cost
4. Structural Integrity

VIRON® INTERNATIONAL certifies that the VCB-1100 Series PVC and FRP Centrifugal Fans shown herein are licensed to bear the AMCA seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and comply with the requirements of the AMCA Ratings Program.

SPECIFICATIONS

PVC GENERAL SPECIFICATIONS

- Corrosion resistant PVC sheet with flame retardant additives will reduce the flame spread rating to below 25. This material is then rated for Class 1 flame spread.
- All structural parts in the airstream are PVC.
- All internal hardware is stainless steel.
- The fan housing is solid PVC sheet using premium grade corrosion resistant material.
- The fan wheel is solid fiberglass using a premium grade corrosion resistant resin. The backward incline wheel design offers efficient, low cost handling of industrial process air or gas. As an option **VIRON®** can manufacture a steel wheel with a PVC coating. The coating thickness will vary from 40 to 100 MILS depending upon the application.
- Maximum temperature limitation is 140°F on all PVC fans.

FRP GENERAL SPECIFICATIONS

- Corrosion resistant polyester resin with flame retardant additives will reduce the flame spread ratings to below 25.
- All structural parts in the airstream are fiberglass and resin.
- All internal hardware is stainless steel.
- The fan housing is solid fiberglass using premium grade corrosion resistant material.
- The fan wheel is solid fiberglass using a premium grade corrosion resistant resin. The backward incline wheel design offers efficient, low cost handling of industrial process air or gas.
- Maximum temperature limitation is 200°F on all fiberglass fans.
- Special high corrosion construction is optional on all **VIRON®** fiberglass air moving equipment.

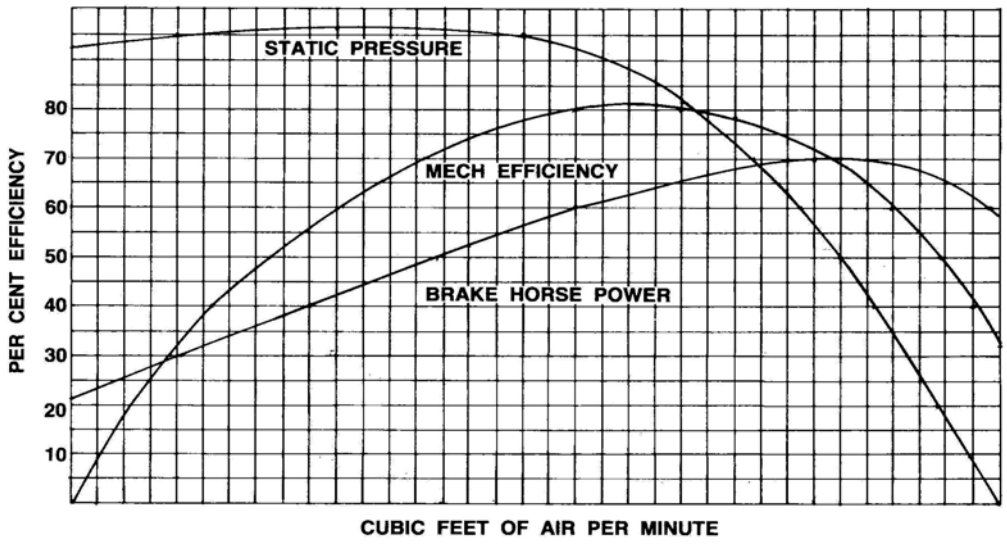
PVC AND FRP STANDARD SPECIFICATIONS

- **Size** - 12" to 80" diameter wheel, 20 convenient sizes to choose from giving you 400 to over 150,000 CFM.
- **Motor** - All motors are TEFC.
- **Belts** - All belts are industrial grade V-belt type.
- **Bearings** - All bearings are heavy duty, self aligning, ball bearing type.
- **Drain** - All fan housings have 1" drain at the lowest point of the housing.
- **Hardware** - All hardware is stainless steel.
- **Wheel** - All fan wheels are dynamically balanced.
- **Pedestal Base** - All pedestal bases are constructed of heavy gauge steel. The trapezoid design insures smooth performance and structural integrity. An epoxy protective coating is applied to all bases.

FRP BACKWARD INCLINE WHEEL

The fan wheel is solid fiberglass using a premium grade corrosion resistant resin. This design offers our customers one of the highest efficiencies and quietest operation of any fan wheel manufactured. This wheel has a non-overloading characteristic, and has been proven to save horsepower over the entire volume range.

CENTRIFUGAL FAN PERFORMANCE CURVES



TEMPERATURE AND ALTITUDE CORRECTION DATA

CORRECTION FACTOR TABLE

Air Temp. Deg. F	Altitude In Feet Above Sea Level																			
	0	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500	8000	8500	9000	10000
0°	.87	.89	.91	.92	.94	.96	.98	.99	1.01	1.03	1.05	1.06	1.09	1.10	1.13	1.15	1.17	1.19	1.22	1.26
40°	.94	.96	.98	1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.14	1.16	1.19	1.21	1.23	1.26	1.28	1.30	1.32	1.36
70°	1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.14	1.16	1.18	1.20	1.22	1.25	1.27	1.30	1.32	1.35	1.37	1.40	1.45
80°	1.02	1.04	1.06	1.08	1.10	1.12	1.14	1.16	1.19	1.21	1.23	1.26	1.28	1.30	1.33	1.36	1.38	1.41	1.43	1.48
100°	1.06	1.08	1.10	1.12	1.14	1.16	1.19	1.21	1.23	1.25	1.28	1.30	1.33	1.35	1.38	1.41	1.43	1.46	1.48	1.54
120°	1.09	1.12	1.14	1.16	1.18	1.20	1.23	1.25	1.28	1.30	1.32	1.35	1.38	1.40	1.43	1.46	1.48	1.51	1.53	1.58
140°	1.13	1.15	1.18	1.20	1.22	1.25	1.27	1.29	1.32	1.34	1.37	1.40	1.42	1.45	1.48	1.51	1.54	1.57	1.58	1.65
160°	1.17	1.19	1.22	1.24	1.26	1.29	1.31	1.34	1.36	1.39	1.42	1.44	1.47	1.50	1.53	1.56	1.59	1.62	1.64	1.70
180°	1.21	1.23	1.26	1.28	1.30	1.33	1.36	1.38	1.41	1.43	1.46	1.49	1.52	1.55	1.58	1.61	1.64	1.67	1.70	1.75
200°	1.25	1.27	1.29	1.32	1.34	1.37	1.40	1.42	1.45	1.48	1.51	1.54	1.57	1.60	1.63	1.66	1.69	1.72	1.75	1.81
250°	1.34	1.36	1.39	1.42	1.45	1.47	1.50	1.53	1.56	1.59	1.62	1.65	1.68	1.71	1.74	1.78	1.82	1.85	1.88	1.94
300°	1.43	1.46	1.49	1.52	1.55	1.58	1.61	1.64	1.67	1.70	1.74	1.77	1.80	1.84	1.87	1.91	1.94	1.98	2.00	2.08
350°	1.53	1.56	1.59	1.62	1.65	1.68	1.72	1.75	1.78	1.81	1.85	1.88	1.92	1.96	2.00	2.04	2.07	2.11	2.14	2.22
400°	1.62	1.65	1.69	1.72	1.75	1.79	1.82	1.85	1.89	1.93	1.96	2.00	2.04	2.08	2.12	2.16	2.20	2.25	2.27	2.35
450°	1.72	1.75	1.79	1.82	1.86	1.89	1.93	1.96	2.00	2.04	2.08	2.12	2.16	2.20	2.24	2.29	2.33	2.38	2.41	2.50
500°	1.81	1.85	1.88	1.92	1.96	1.99	2.03	2.07	2.11	2.15	2.19	2.23	2.28	2.32	2.36	2.41	2.46	2.51	2.54	2.62
550°	1.91	1.94	1.98	2.02	2.06	2.10	2.14	2.18	2.22	2.26	2.30	2.35	2.40	2.44	2.49	2.54	2.58	2.63	2.68	2.77
600°	2.00	2.04	2.08	2.12	2.16	2.20	2.24	2.29	2.33	2.38	2.42	2.47	2.50	2.56	2.61	2.66	2.71	2.77	2.80	2.90
650°	2.10	2.14	2.18	2.22	2.26	2.31	2.35	2.40	2.44	2.49	2.54	2.58	2.53	2.68	2.74	2.79	2.84	2.90	2.94	3.04
700°	2.19	2.23	2.27	2.32	2.36	2.41	2.46	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.86	2.91	2.97	3.03	3.06	3.18
750°	2.28	2.33	2.37	2.42	2.47	2.51	2.56	2.61	2.66	2.71	2.76	2.81	2.87	2.92	2.98	3.04	3.10	3.16	3.19	3.31
800°	2.38	2.43	2.48	2.52	2.57	2.62	2.66	2.72	2.76	2.81	2.86	2.90	2.98	3.02	3.10	3.14	3.21	3.26	3.33	3.45
850°	2.47	2.52	2.57	2.62	2.67	2.72	2.76	2.82	2.87	2.92	2.97	3.02	3.09	3.14	3.21	3.26	3.33	3.38	3.46	3.58
900°	2.57	2.62	2.67	2.72	2.76	2.83	2.88	2.93	2.98	3.03	3.08	3.14	3.21	3.26	3.34	3.39	3.47	3.52	3.60	3.73
950°	2.66	2.72	2.77	2.82	2.87	2.92	2.98	3.03	3.08	3.14	3.19	3.24	3.32	3.38	3.46	3.51	3.58	3.64	3.72	3.86
1000°	2.76	2.82	2.87	2.92	2.98	3.04	3.09	3.14	3.20	3.26	3.31	3.37	3.45	3.50	3.59	3.64	3.72	3.78	3.86	4.00

PERFORMANCE AT OTHER THAN STANDARD CONDITIONS

Any particular fan, operating at a constant speed on a fixed system when there is no internal heat exchange involved, will deliver the same volume of air but the static pressure and brake horsepower will vary with the density. The capacity tables in this catalog are based on the fan handling standard air at a density of .075 lbs. per cubic foot corresponding to 70°F, and 29.92" Hg. Barometric Pressure. Therefore, when the fan handles air or other gases at other than standard densities due to temperature, altitude, or the kind of gas, the published tables should be used in the following manner:

General Method

Step 1 Compute the equivalent static pressure in the following manner:

$$\text{Equivalent SP} = \text{Required SP} \times \frac{0.75}{\text{Actual Density}}$$

When both temperature and altitude vary from standard.

$$\text{Actual Density} = \frac{\text{Density at temp.} \times \text{density at alt.}}{.075}$$

(See chart below)

Step 2 Using the required CFM and the equivalent SP, obtain the RPM and BHP from the standard capacity table, interpolating when necessary.

Step 3 The RPM obtained is the correct value.
The BHP obtained must be corrected for the actual density as follows:

$$\text{BHP (from table)} \times \frac{\text{Actual Density}}{.075}$$

Example

To compute the changes in RPM and BHP on a VCB-1140 fan from 17,733 CFM, 1½" s.p. at sea level to operating a fan with 250°F air at 5000' altitude follow steps 1 through 3.

Step 1 $\text{Equivalent SP} = 1.5 \times \frac{.075}{.0465} = 2.42"$

$$\text{Actual Density} = \frac{.056 \times .0623}{0.075} = .0465$$

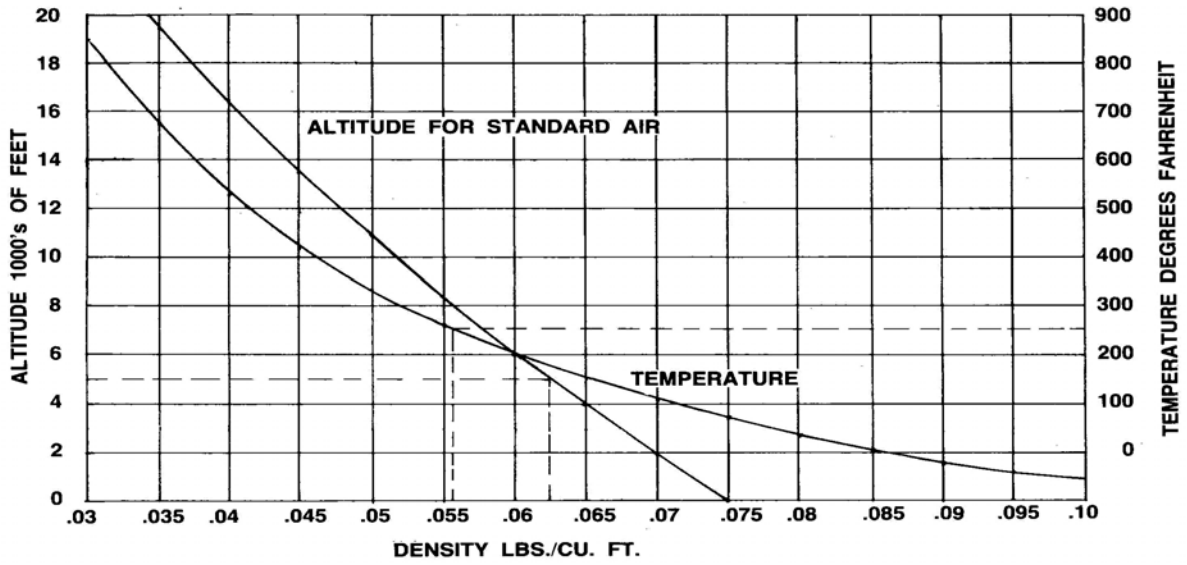
Where .056 is read from temperature curve and .0623 from altitude curve.
(See chart below)

Step 2 From capacity table on page 22, by interpolation:
RPM = 722
BHP = 9.27

Step 3 Actual RPM required = 722

$$\text{Actual BHP} = 9.27 \times \frac{.0465}{0.75} = 5.75$$

Correct performance is: 17,733 CFM, 1½ SP, 722 RPM, 5.75 BHP, when handling air at 250°F., and 5000' elevation.



SELECTION GUIDE

VIRON® MODEL CODE: **VCB 1160 BD FRP FRP 9 CW360 50 TEFC NORM 460 3 60**

VIRON® Centrifugal Fan

Series and Wheel Diameter

Drive Code

Housing Material Code

Fan Wheel Material Code

Drive Arrangement (see page 7)

Rotation and Discharge Position (see page 7)

Motor Horsepower

Motor Type Code

Motor Efficiency Code

Motor Voltage

Motor Phase

Motor Cycle

HOUSING MATERIAL CODE

Fiberglass	FRP
Polyvinyl Chloride	PVC
Polypropylene	PP

FAN WHEEL MATERIAL CODE

Fiberglass	FRP
Steel With Polyvinyl Chloride Coated	PVC
Steel With Kynar Coated	KYN
Stainless Steel	SST

DRIVE CODE

Direct Drive	DD
Belt Drive	BD

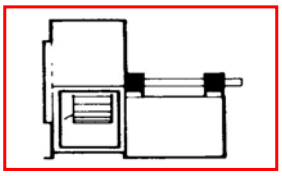
MOTOR TYPE CODE

Totally Enclosed Fan Cooled	TEFC
Open Drip Proof	OPEN
Explosion Proof	EXPL
Chemical Duty	CHEM

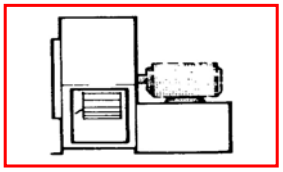
MOTOR EFFICIENCY CODE

Normal Efficiency	NORM
High Efficiency	HIGH

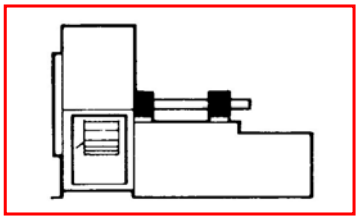
DRIVE ARRANGEMENTS FOR CENTRIFUGAL FANS



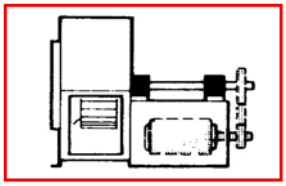
ARR.1 SWSI. For belt drive or direct connection. Impellar overhung. Two bearings on base.



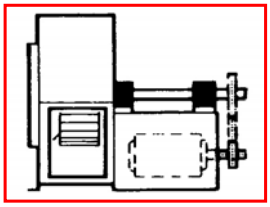
ARR. 4 SWSI. For direct drive. Impellar overhung on prime mover shaft. No bearings on fan. Prime mover base mounted or integrally directly connected.



ARR. 8 SWSI. For belt drive or direct connection. Arrangement 1 plus extended base for prime mover.

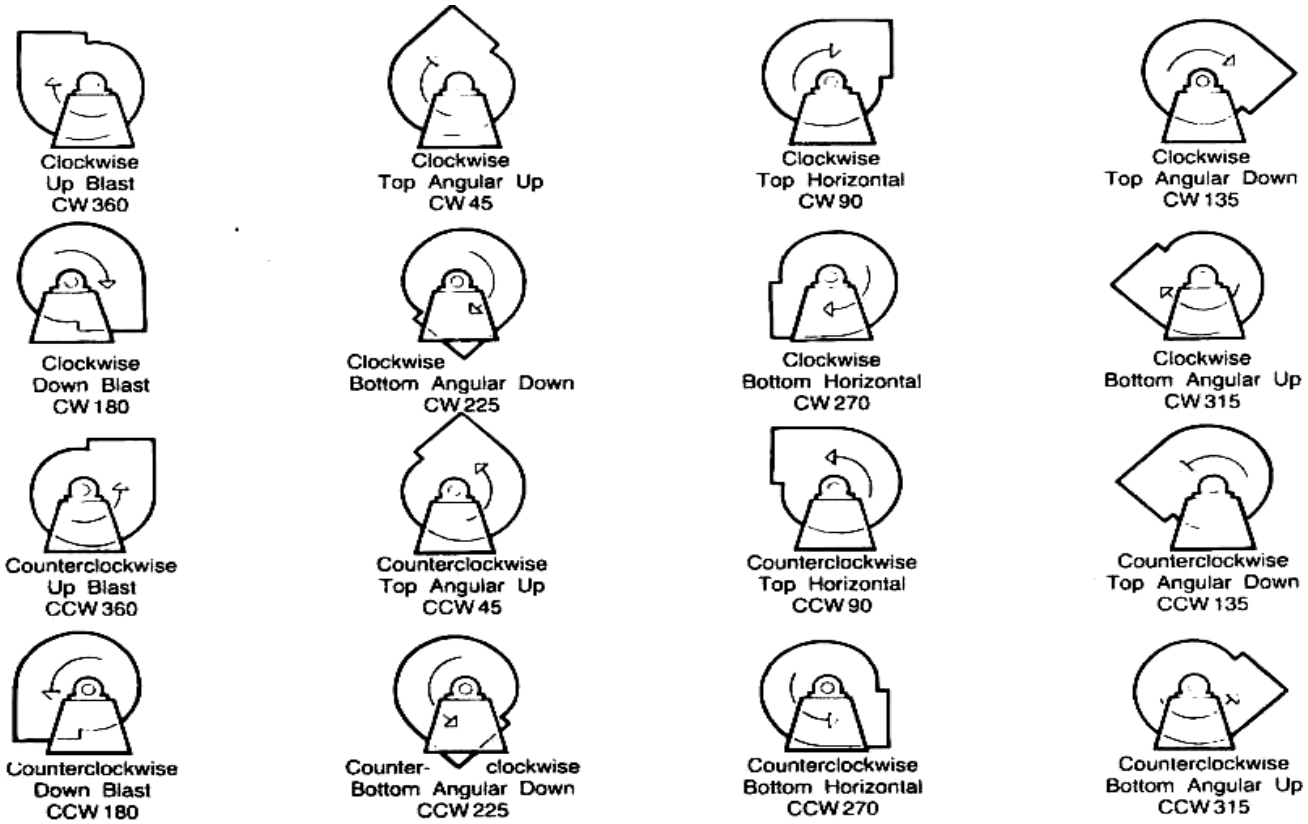


ARR. 9 SWSI. For belt drive, impellar overhung, two bearings, with prime mover outside base.



ARR. 10 SWSI. For belt drive, impellar overhung, two bearings, with prime mover inside base.

ROTATION AND DISCHARGE FOR CENTRIFUGAL FANS



NOTES:

1. Direction of rotation is determined from drive side of fan.
2. On single inlet fans, drive side is always considered as the side opposite fan inlet.

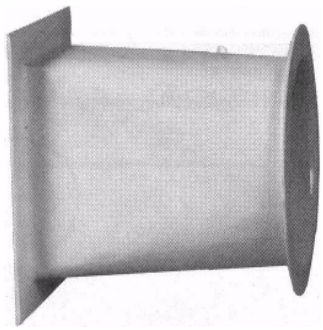
FAN ACCESSORIES

PARALLEL BLADE OUTLET DAMPER

The **VIRON**® Parallel Blade Outlet Damper is fabricated from Fiberglass Reinforced Plastic (FRP). It is designed to control the volume of corrosive fumes exiting the VCB Series fans. The linkage is placed outside the airstream for easy maintenance and long life.

COMMON STEEL BASE

All **VIRON**® VCB Series fans come standard with Common Steel Bases. This adds structural rigidity and helps distribute the weight on a more even basis. When you need to mount the fan from the Common Steel Base, the factory can supply a heavier frame to accommodate any design criteria.

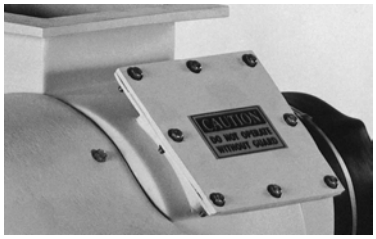


OUTLET TRANSITION

In many instances the installing contractor may want to put a stack off the fan outlet. **VIRON**® can manufacture a standard Outlet Transition to accommodate the rectangular fan outlet to a round duct stack.

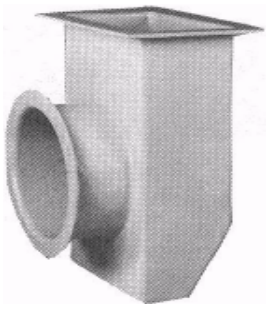
FLANGED INLET

A permanent bonded inlet flange is available for use by the installing contractor to mount an Inlet Duct or Inlet Plenum Box so a portion of the duct can be removable for future maintenance.



BOLTED CLEANOUT DOOR

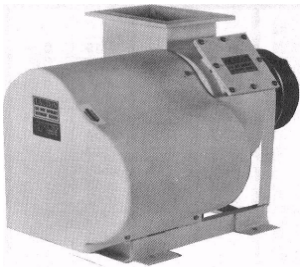
In order to properly maintain your fan you must visually inspect the fan wheel on a monthly basis, to do this **VIRON** offers a Bolted Cleanout Door. The Bolted Cleanout Door is fabricated into the rounded portion of the fan scroll. This allows your maintenance personnel to get the closest view of the fan wheel. Standard hardware is type 304 stainless steel with PVC closed cell gasket material.



INLET PLENUM BOX

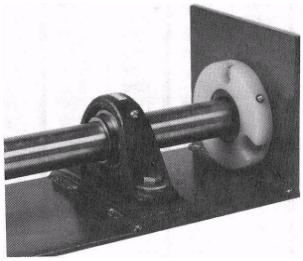
When there is not room to adequately design the inlet duct to a fan, **VIRON**® offers an Inlet Plenum Box. This Fiberglass Reinforced Plastic (FRP) fabricated box can be mounted to accommodate a duct coming from any direction, and still minimize the pressure loss associated with tight design parameters.

FAN ACCESSORIES



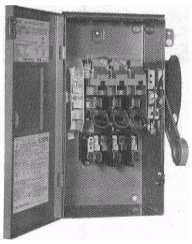
WEATHER COVER

All VCB Series Fans can be shipped with a complete weather cover. This weather cover protects the shaft, bearings, sheaves, drives, belts, and motors. It is available in all sizes.



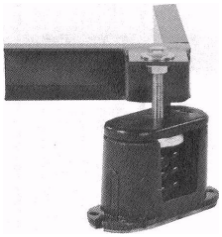
VITON SHAFT SEAL

In certain applications, it is important to keep fumes from escaping through the interface area of the shaft and the fan housing. By utilizing this positive shaft seal, you can keep fumes contained and away from your bearings which help operate your fan.



ELECTRICAL DISCONNECT SWITCH

Frequently fans are installed at remote locations. When this happens, **VIRON**® can mount an Electrical Disconnect Switch to the fan. This safety device can help insure your workers safety when periodic maintenance is required.



VIBRATION ISOLATION

A variety of different Vibration Isolation products are available for your **VIRON**® VCB Series Fans. The list of products can range from neoprene pads to 4" spring isolators with seismic restraints.

OTHER POPULAR FAN ACCESSORIES

- Adjustable V-Belt Drives
- Belt Guard
- Butterfly Stack Cap
- Class III Wheels
- Flange Inlet
- Flange Inlet Drilling
- Flex Inlet Connections
- Hinged Access Door
- Inlet Flange Gasket
- Inspection Port
- Motor Speed Controls
- Motors:
  - ODP
  - TEFC
  - High Efficiency TEFC
  - 2 Speed - 1800/900 & 1800/1200
  - Explosion Proof
  - Chemical Duty
- Outlet Flange Drilling
- Outlet Flange Gasket
- PVC Shaft Seal
- Rubber Mount Vibration Isolators
- Shaft Guard
- Special Belts
- Special Lifting Lugs
- Special Sliding Bases (for motors)
- Stainless Steel Shaft
- Starter
- Static Grounding Graphite Coating
- Teflon Shaft Seal
- Veil Interior
- Vinyl Ester Resin

VCB-1116

Wheel Diameter
16-1/2"

INLET 17-3/8" Ø I.D.
OUTLET 13-1/8" x 17-1/8" I.D.

Area 1.65 Sq. Ft.
Area 1.56 Sq. Ft.

Tip Speed = RPM X 4.32

Max BHP = .33 $\frac{RPM^3}{1000}$

Volume	Outlet	.5" s.p.		.75" s.p.		1" s.p.		1.5" s.p.		2" s.p.		2.5" s.p.		3" s.p.		3.5" s.p.	
CFM	Vol.	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
780	500	707	0.09	851	0.15	987	0.22	1217	0.38								
936	600	740	0.11	863	0.17	984	0.24	1211	0.41	1427	0.62						
1092	700	786	0.13	892	0.19	998	0.26	1204	0.42	1397	0.63	1584	0.87	1713	1.07		
1248	800	839	0.16	935	0.22	1027	0.29	1214	0.46	1390	0.65	1560	0.88	1725	1.14	1885	1.44
1404	900	895	0.20	985	0.26	1069	0.33	1232	0.50	1398	0.69	1554	0.91	1706	1.16	1854	1.44
1560	1000	952	0.24	1039	0.31	1117	0.38	1266	0.55	1414	0.74	1562	0.97	1702	1.21	1840	1.48
1716	1100	1011	0.28	1095	0.36	1170	0.44	1308	0.61	1441	0.80	1577	1.03	1711	1.27	1840	1.54
1872	1200	1070	0.33	1152	0.42	1225	0.51	1356	0.69	1480	0.88	1602	1.10	1727	1.34	1850	1.61
2028	1300	1130	0.39	1210	0.48	1281	0.58	1407	0.77	1524	0.97	1637	1.19	1750	1.43	1866	1.70
2184	1400	1192	0.45	1270	0.56	1338	0.66	1461	0.86	1573	1.07	1680	1.30	1784	1.54	1889	1.80
2340	1500	1254	0.52	1329	0.63	1397	0.74	1517	0.96	1624	1.19	1726	1.42	1826	1.66	1923	1.92
2496	1600	1318	0.60	1389	0.72	1456	0.84	1573	1.07	1678	1.31	1776	1.55	1870	1.80	1963	2.06
2652	1700	1382	0.69	1450	0.82	1516	0.94	1631	1.19	1734	1.44	1828	1.69	1919	1.95	2007	2.22
2808	1800	1447	0.79	1513	0.92	1575	1.05	1689	1.32	1790	1.58	1883	1.85	1970	2.11	2054	2.39
2964	1900	1513	0.90	1576	1.04	1636	1.17	1748	1.46	1847	1.73	1938	2.01	2023	2.29	2105	2.57
3120	2000	1580	1.02	1640	1.16	1698	1.31	1808	1.60	1905	1.89	1994	2.19	2078	2.48	2157	2.78
3276	2100	1647	1.15	1704	1.30	1760	1.45	1867	1.76	1963	2.07	2051	2.37	2133	2.68	2211	2.99
3432	2200	1714	1.29	1770	1.45	1823	1.60	1927	1.93	2022	2.25	2108	2.57	2189	2.90	2266	3.22
3588	2300	1782	1.45	1835	1.61	1887	1.77	1987	2.11	2082	2.45	2167	2.78	2246	3.12	2322	3.46
3744	2400	1850	1.61	1902	1.78	1952	1.95	2049	2.30	2141	2.65	2226	3.01	2304	3.36	2378	3.71
3900	2500	1919	1.79	1968	1.97	2017	2.15	2111	2.51	2201	2.87	2285	3.24	2362	3.61	2435	3.97
4056	2600	1988	1.99	2036	2.17	2083	2.35	2174	2.73	2261	3.11	2345	3.49	2421	3.87	2493	4.25
4212	2700	2057	2.20	2103	2.39	2149	2.58	2237	2.96	2322	3.35	2404	3.75	2480	4.15	2551	4.55
4368	2800	2126	2.42	2171	2.62	2215	2.81	2301	3.21	2383	3.62	2463	4.03	2540	4.45	2610	4.85
4680	3000	2265	2.92	2308	3.12	2349	3.33	2430	3.76	2508	4.19	2584	4.63	2658	5.07	2729	5.52
4992	3200	2406	3.48	2445	3.70	2484	3.92	2561	4.37	2635	4.83	2708	5.29	2778	5.76	2847	6.24
5304	3400	2546	4.11	2584	4.35	2621	4.58	2693	5.06	2764	5.54	2833	6.03	2901	6.53	2967	7.03
5616	3600	2687	4.82	2723	5.07	2758	5.32	2827	5.82	2895	6.33	2961	6.85	3025	7.37	3089	7.89
5928	3800	2829	5.61	2863	5.87	2896	6.13	2962	6.67	3026	7.20	3090	7.74	3152	8.29	3213	8.84
6240	4000	2971	6.48	3003	6.76	3035	7.03	3098	7.59	3159	8.15	3220	8.72	3280	9.29	3338	9.87

Volume	Outlet	4" s.p.		4.5" s.p.		5" s.p.		5.5" s.p.		6" s.p.		7" s.p.		8" s.p.		9" s.p.	
CFM	Vol.	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1716	1100	1966	1.82	2089	2.13	2211	2.47	2331	2.84	2449	3.23	2650	3.98	2751	4.40		
1872	1200	1968	1.90	2084	2.20	2199	2.52	2312	2.87	2423	3.25	2641	4.07	2854	5.00	2954	5.48
2028	1300	1981	1.99	2090	2.29	2198	2.61	2305	2.95	2410	3.31	2616	4.09	2818	4.97	3016	5.95
2184	1400	1996	2.08	2105	2.40	2207	2.71	2308	3.05	2407	3.40	2603	4.16	2795	5.01	2983	5.94
2340	1500	2021	2.20	2120	2.50	2223	2.84	2319	3.17	2413	3.52	2600	4.27	2783	5.09	2962	5.99
2496	1600	2054	2.34	2146	2.64	2239	2.96	2335	3.31	2427	3.67	2605	4.41	2779	5.21	2951	6.08
2652	1700	2094	2.50	2180	2.80	2266	3.11	2353	3.45	2442	3.81	2617	4.57	2784	5.37	2948	6.22
2808	1800	2138	2.68	2220	2.98	2301	3.29	2382	3.62	2464	3.97	2634	4.75	2795	5.55	2953	6.40
2964	1900	2184	2.87	2264	3.18	2341	3.49	2418	3.62	2495	4.17	2650	4.91	2812	5.76	2963	6.60
3120	2000	2234	3.08	2310	3.39	2385	3.71	2458	4.05	2531	4.39	2678	5.13	2827	5.94	2980	6.83
3276	2100	2286	3.30	2359	3.62	2431	3.95	2502	4.29	2572	4.64	2711	5.37	2851	6.16	2995	7.04
3432	2200	2339	3.54	2410	3.87	2480	4.20	2548	4.55	2616	4.91	2750	5.65	2883	6.43	3017	7.28
3588	2300	2394	3.80	2463	4.13	2531	4.48	2597	4.83	2662	5.19	2792	5.94	2919	6.73	3046	7.57
3744	2400	2449	4.06	2517	4.41	2583	4.77	2648	5.13	2711	5.50	2837	6.26	2960	7.06	3081	7.89
3900	2500	2505	4.34	2573	4.71	2637	5.08	2700	5.45	2762	5.82	2883	6.60	3003	7.41	3120	8.25
4056	2600	2562	4.63	2628	5.02	2692	5.40	2754	5.78	2814	6.16	2932	6.95	3048	7.78	3163	8.63
4212	2700	2619	4.94	2685	5.34	2748	5.74	2809	6.13	2868	6.53	2983	7.33	3096	8.17	3207	9.04
4368	2800	2677	5.26	2741	5.67	2804	6.08	2864	6.50	2923	6.91	3035	7.73	3145	8.58	3253	9.46
4680	3000	2794	5.96	2857	6.39	2918	6.83	2976	7.27	3034	7.71	3144	8.60	3249	9.48	3351	10.39
4992	3200	2913	6.71	2974	7.18	3033	7.65	3091	8.11	3147	8.58	3254	9.53	3357	10.46	3455	11.41
5304	3400	3031	7.53	3093	8.04	3151	8.53	3207	9.03	3262	9.52	3367	10.52	3467	11.52	3563	12.52
5616	3600	3151	8.42	3211	8.96	3270	9.50	3325	10.02	3378	10.54	3481	11.59	3579	12.65	3674	13.71
5928	3800	3272	9.39	3331	9.95	3388	10.52	3444	11.09	3497	11.64	3597	12.75	3693	13.86	3786	14.98
6240	4000	3396	10.45	3452	11.03	3508	11.62	3562	12.22	3616	12.82	3715	13.99	3809	15.15	3900	16.32

Volume	Outlet	10" s.p.		11" s.p.		12" s.p.		13" s.p.		14" s.p.		16" s.p.		18" s.p.		20" s.p.	
CFM	Vol.	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2652	1700	3110	7.14	3269	8.13	3426	9.18	3581	10.31	3734	11.51						
2808	1800	3108	7.30	3260	8.27	3411	9.30	3560	10.39	3708	11.54						
2964	1900	3112	7.50	3259	8.45	3404	9.45	3548	10.52	3690	11.65						
3120	2000	3123	7.72	3265	8.67	3405	9.66	3543	10.71	3680	11.81						
3276	2100	3140	7.98	3276	8.92	3411	9.90	3545	10.94	3676	12.02						
3432	2200	3154	8.21	3292	9.20	3423	10.18	3552	11.21	3679	12.28						
3588	2300	3175	8.47	3307	9.45	3439	10.49	3564	11.51	3688	12.58						
3744	2400	3203	8.78	3327	9.74	3453	10.76	3581	11.85	3700	12.91						
3900	2500	3237	9.13	3354	10.07	3473	11.07	3595	12.14	3718	13.27						
4056	2600	3275	9.52	3387	10.45	3500	11.43	3615	12.47	3731	13.58						
4212	2700	3316	9.93	3424	10.86	3532	11.84	3641	12.86	3752	13.95						
4368	2800	3360	10.38	3465	11.31	3569	12.29	3673	13.30	3778	14.37						
4680	3000	3452	11.32	3552	12.29	3651	13.28	3748	14.30	3845	15.35						
4992	3200	3551	12.37	3647	13.36	3741	14.38	3834	15.43	3926	16.49						
5304	3400	3656	13.52	3747	14.54	3837	15.58	3926	16.65								
5616	3600	3765	14.77	3853	15.83	3939	16.90										
5928	3800	3876	16.10	3962	17.21												

"Performance shown is for installation type B-Free inlet, Ducted outlet" "Power rating (BHP) does not include drive losses" "Performance ratings do not include the effects of appurtenances in the airstream"

All capacities based on standard air (density .075#/cu.ft.-70°F-29.92" hg. Bar) Shaded areas show Class III Wheel Design

PVC CORROSION TABLE

This table may be used as a guide for ventilating gases and vapors from processes where chemicals shown are used.
Maximum temperatures shown.

ENVIRONMENT	Type 1 70°	Type 1 140°	Type II 70°	Type II 140°
ACIDS				
Acetic 20-30%	E	G	G	L
acetic 30-60%	E	E	G	L
Benzene	U	U	U	U
Benzene Sulfonic 10%	E	E	E	E
Benzoic	E	E	E	E
Boric	E	E	E	E
Butyric 20%	G	U	L	U
Carbonic	E	E	E	E
Chloracetic	E	L	E	U
Chromic 10%	E	E	E	E
Chromic 25%	E	L	G	L
Citric	E	E	E	E
Fluoroboric	E	E	E	E
Fluorosilicic	E	E	E	E
Formic	E	U	E	U
Glucose	E	E	E	E
Hydrobromic 20%	E	E	E	G
Hydrochloric 0-25%	E	G	E	G
Hydrochloric 25-40%	E	E	E	G
Hydrocyanic	E	E	E	E
Hydrofluoric 10%	E	L	E	G
Hydrofluorosilicic 30%	E	G	G	L
Hypochlorous 20%	E	E	E	E
Lactic 28%	E	E	E	E
Maleic	E	E	E	E
Nitric 10, 35, 40%	E	G	G	L
Nitric 20%	E	L	G	L
Nitric (vapor) 60%	E	L	G	U
Nitrous Oxide	E	E	E	E
Oleic	E	E	E	E
Oxalic	E	E	E	G
Perchloric 10%	E	L	G	L
Phosphoric 0-25%	E	G	E	G
Phosphoric 25-75%	E	E	E	G
Phosphorus (yellow)	E	G	G	L
Picric	U	U	U	U
Silicic	E	E	E	E
Stearic	E	E	G	G
Sulfamic (See Benzene Sulfonic 10%)	E	E	E	E
Sulfuric 0-75%	E	E	E	G
Sulfuric 75-90%	E	E	L	L
Sulfuric 95%	E	G	U	U
Sulfurous	E	E	E	E
Tannic	E	E	E	E
Tartaric	E	E	E	E
ALCOHOLS				
Amyl	E	E	L	U
Benzol	U	U	U	U
Butyl	E	G	L	U
Ethyl 0-98%	E	E	E	E
Methyl	E	E	E	E
GASES AND VAPORS				
Ammonia, Dry	E	E	E	E
Ammonia, Wet	L	U	-	-
Bromine	U	U	U	U
Carbon Dioxide	E	E	E	E
Carbon Monoxide	E	E	E	E
Chlorine, Dry	G	G	G	G
Fluorine	L	U	U	U
Hydrogen	E	E	E	G
Hydrogen Sulfide	E	E	E	E
Sulfur Dioxide, Wet	G	U	L	U
Sulfur Trioxide, Dry	E	E	E	G

ENVIRONMENT	Type 1 70°	Type I 140°	Type II 70°	Type II 140°
ALKALIES				
Ammonium Bifluoride	E	E	E	E
Ammonium Carbonate	E	E	E	E
Ammonium Fluoride 25%	E	L	U	U
Ammonium Hydroxide 28%	E	E	E	E
Barium Carbonate	E	E	E	E
Calcium Hydroxide	E	E	E	E
Magnesium Carbonate	E	E	E	E
Potassium Bicarbonate	E	E	E	E
Potassium Carbonate	E	E	E	E
Potassium Hydroxide 10, 20, 35%	E	E	E	E
Sodium Bicarbonate	E	E	E	E
Sodium Carbonate	E	E	E	E
Sodium Hydroxide 10, 35%	E	E	E	E
Sodium Sulfide	E	E	E	E
Trisodium Phosphate	E	E	E	E
SALTS				
Aluminum Chloride	E	E	E	E
Aluminum Nitrate	E	E	E	E
Aluminum Sulfate	E	E	E	E
Ammonium Chloride	E	E	E	E
Ammonium Nitrate	E	E	E	E
Ammonium Persulfate	E	E	E	E
Ammonium Sulfate	E	E	E	E
Aniline	U	U	U	U
Aniline Sulfate, saturated	U	U	U	U
Antimony Trichloride	E	E	E	E
Barium Chloride	E	E	E	E
Barium Sulfide	E	E	E	E
Calcium Chlorate	E	E	E	E
Calcium Chloride	E	E	E	E
Calcium Sulfate	E	E	E	E
Copper Chloride	E	E	E	E
Copper Cyanide	E	E	E	E
Copper Fluoride 2%	E	E	E	E
Copper Sulfate	E	E	E	E
Ferric Chloride	E	E	E	E
Ferric Nitrate	E	E	E	E
Ferric Sulfate	E	E	E	G
Ferrous Chloride	E	E	E	E
Lead Acetate	E	E	E	E
Magnesium Chloride	E	E	E	E
Magnesium Hydroxide	E	E	E	E
Magnesium Sulfate	E	E	E	E
Mercuric Chloride	E	E	G	G
Mercurous Nitrate	E	E	G	G
Nickel Chloride	E	E	E	E
Nickel Nitrate	E	E	E	E
Nickel Sulfate	E	E	E	E
Potassium Chloride	E	E	E	E
Potassium Dichromate 40%	E	E	E	E
Potassium Ferricyanide	E	E	E	E
Potassium Nitrate	E	E	E	E
Potassium Permanganate 10%	E	E	G	G
Potassium Persulfate	E	E	E	E
Potassium Sulfate	E	E	E	E
Silver Nitrate	E	E	E	E
Sodium Acetate	E	E	E	E
Sodium Bisulfate	E	E	E	E
Sodium Chloride	E	E	E	E
Sodium Chlorate	E	G	G	L
Sodium Cyanide	E	E	E	E
Sodium Dichromate	E	E	E	G

ENVIRONMENT	Type I 70°	Type I 140°	Type II 70°	Type II 140°
SALTS (cont'd.)				
Sodium Ferricyanide	E	E	E	E
Sodium Fluoride	E	E	E	E
Sodium Nitrate	E	E	E	E
Sodium Nitrite	E	E	E	E
Sodium Sulfate	E	E	E	E
Sodium Sulfite	E	E	E	E
Stannic Chloride	E	E	E	E
Stannous Chloride	E	G	E	G
Zinc Chloride	E	E	E	E
Zinc Nitrate	E	E	E	E
Zinc Sulfate	E	E	E	E
SOLVENTS				
Acetone	U	U	U	U
Benzene	U	U	U	U
Carbon Bisulfide	U	U	U	U
Carbon Tetrachloride	L	U	U	U
Chlorobenzene	U	U	U	U
Ethyl Acetate	U	U	U	U
Ethyl Chloride	U	U	U	U
Ethylene Glycol	E	E	E	E
Heptane	E	G	L	U
Hexane	E	L	U	U
Methyl Ethyl Ketone	U	U	U	U
Naphtha	E	E	E	G
Trichloroethylene	U	U	U	U
Toluene	U	U	U	U
Xylene	U	U	U	U
BLEACHES				
Calcium Chlorate	E	E	E	E
Calcium Hypochlorite	E	E	E	E
Chlorine Water	E	E	E	E
Hydrogen Peroxide 30%	E	E	E	G
Hydrogen Peroxide 50%	E	E	E	L
Sodium Chlorate	E	G	G	L
Sodium Hypochlorite	E	E	E	E
OTHERS				
Aluminum Hydroxide	E	E	E	E
Ammonium Phosphate	E	E	-	-
Aqua Regia	E	L	L	U
Glycerine	E	E	E	E
Kerosene	E	E	E	E
Photographic Solutions	E	E	E	E
Tetrahydrofurane	U	U	U	U
Sodium Xylene Sulfonate	-	-	-	-
Sorbitol Solution	-	-	-	-
Urea	E	E	E	E
Urea-Ammonium-Nitrate	E	E	E	E
PLATING SOLUTIONS				
Brass	E	E	E	E
Cadmium	E	E	E	E
Chromium	E	G	G	G
Copper	E	E	E	E
Gold	E	E	E	E
Judium	E	E	E	E
Lead	E	E	E	E
Nickel	E	E	E	E
Rhodium	E	E	E	E
Silver	E	E	E	E
Tin	E	E	E	E
Zinc	E	E	E	G

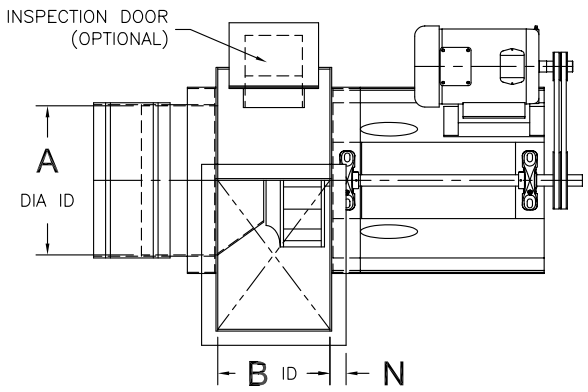
KEY: E = Excellent G = Good L = Limited U = Unsuitable

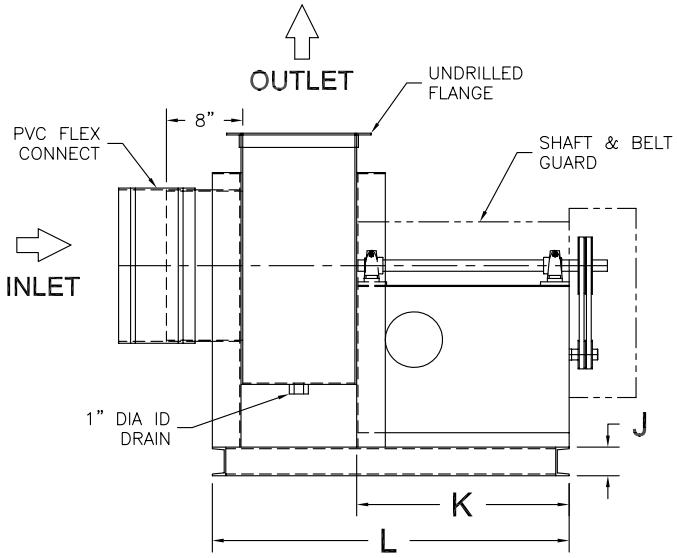
VIRON® INTERNATIONAL CORP.

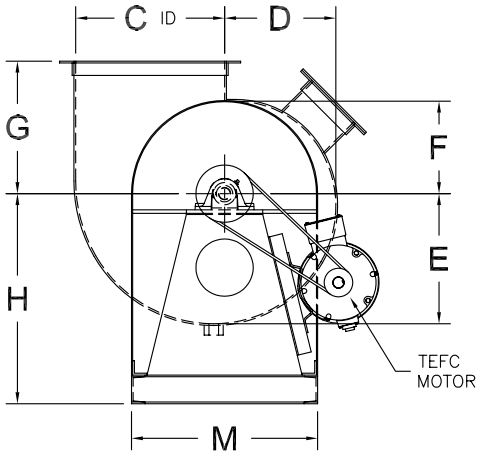
OWOSSO, MICHIGAN TEMPLE, TEXAS
989-723-8255
989-723-8417 FAX EMAIL: info@vironintl.org
ENVIRONMENTAL CONTROL SYSTEMS

CENTRIFUGAL FAN SPECIFICATIONS

MODEL NO.	
USER	
REP.	
JOB NO.	DATE
CFM	BHP
S.P.	FAN RPM
ROTATION CW360	HP TEFC MOTOR
DISCHARGE UP BLAST	MOTOR RPM
DRIVE BELT DRIVE	VOLTS
CLASS	PHASE
ARRANGEMENT 9	HERTZ
QTY. REQ'D	WEIGHT
TAG NO.	WHEEL MAT'L FRP







VCB	WHEEL ø	SHAFT ø	INLET A	OUTLET B	OUTLET C	D	E	F	G	H	J	K	L	M	N	FAN WEIGHT
1112	12¼"	1 3/16"	13 5/16"	9¾"	12¾"	9 13/16"	11⅜"	8¼"	12⅜"	19"	3"	18¼"	31⅜"	16½"	1½"	219
1113	13½"	1 3/16"	14 5/16"	10¾"	14"	10⅝"	12 5/16"	8 15/16"	12 15/16"	20"	3"	18¼"	32⅜"	17½"	1½"	267
1115	15"	1 3/16"	16¼"	11¾"	15⅝"	11⅝"	13⅝"	9 1/16"	13⅞"	22"	3"	22¼"	37⅜"	19½"	1½"	321
1116	16½"	1 7/16"	17⅝"	13⅛"	17⅛"	12⅝"	15"	10 5/16"	14 1/16"	24"	3"	24¼"	40⅝"	21½"	1½"	383
1118	18¼"	1 7/16"	19 5/16"	14½"	18 15/16"	14"	16 7/16"	11 1/16"	15½"	26"	3"	24¼"	42⅛"	23½"	1½"	462
1120	20"	1 7/16"	21 3/16"	15⅞"	20⅞"	15 5/16"	18 1/16"	12 9/16"	16 13/16"	27"	3"	26¼"	45¾"	25½"	1½"	534
1122	22¼"	2 3/16"	23 9/16"	17⅝"	23 3/16"	17 1/16"	20⅛"	14"	18¼"	30"	3"	26¼"	47½"	28½"	1½"	618
1124	24½"	2 3/16"	26 1/16"	19½"	25⅛"	18⅞"	22 5/16"	15⅜"	19 3/16"	32"	3"	26¼"	49 1/16"	31½"	2"	710
1127	27"	2 3/16"	29 1/16"	21½"	28⅛"	20⅝"	24 5/16"	16 15/16"	21 7/16"	35"	3"	27¼"	52⅛"	34¾"	2"	820
1130	30"	2 3/16"	32⅛"	23¾"	31¼"	23 1/16"	27 3/16"	19"	23 1/16"	38"	3"	27¼"	54⅜"	38½"	2"	954
1133	33"	2 7/16"	34 9/16"	26¼"	34⅜"	25 3/16"	29 1/16"	20⅝"	25¼"	41"	3"	27¼"	57⅞"	41¼"	2"	1,092
1136	36½"	2 7/16"	38¾"	29"	38"	28"	33 3/16"	12⅞"	27 5/16"	46"	4"	28¼"	61¾"	45¼"	2"	1,312
1140	40¼"	2 15/16"	43"	32"	42"	30½"	36¼"	24 15/16"	29⅞"	50"	4"	30¼"	66¾"	49⅜"	2"	1,580
1144	44½"	2 15/16"	47"	35⅜"	46½"	34 1/16"	40 3/16"	27⅞"	33"	55"	4"	32¼"	72⅛"	55⅜"	2"	1,890
1149	49"	3 3/16"	52"	39"	51⅛"	37 1/16"	44 3/16"	30 1/16"	36 5/16"	59"	4"	34¼"	78¾"	60⅞"	2"	2,230
1154	54¼"	3 3/16"	56 5/16"	43⅜"	56½"	41⅜"	48 13/16"	33 15/16"	39 9/16"	65"	4"	36¼"	84⅞"	66⅞"	2"	2,600
1160	60"	3 7/16"	62"	47¾"	62½"	45 13/16"	54"	37 9/16"	43 3/16"	71"	4"	38¼"	92½"	70⅜"	2"	3,520
1166	66"	3 15/16"	69¼"	52⅜"	68⅛"	51 7/16"	60½"	42 5/16"	48 5/16"	81"	8"	43¾"	102⅛"	80½"	2"	6,021
1173	73"	4 7/16"	76"	58"	76"	55 1/16"	66 1/16"	45 1/16"	51 15/16"	88"	8"	47⅝"	112⅛"	90⅜"	2"	7,819
1180	80¾"	4 15/16"	84"	64⅛"	84¼"	61 1/16"	72 13/16"	50 9/16"	57 1/16"	97"	8"	55⅛"	125¾"	99⅜"	2"	10,253

MOTOR HP	MOTOR WEIGHT
½	22
¾	26
1	36
1½	41
2	45
3	68
5	78
7½	126
10	138
15	244
20	269
25	396
30	433
40	517
50	579
60	747
75	833
100	1,118
125	1,238
150	1,421

1100 SERIES PVC CENTRIFUGAL FAN

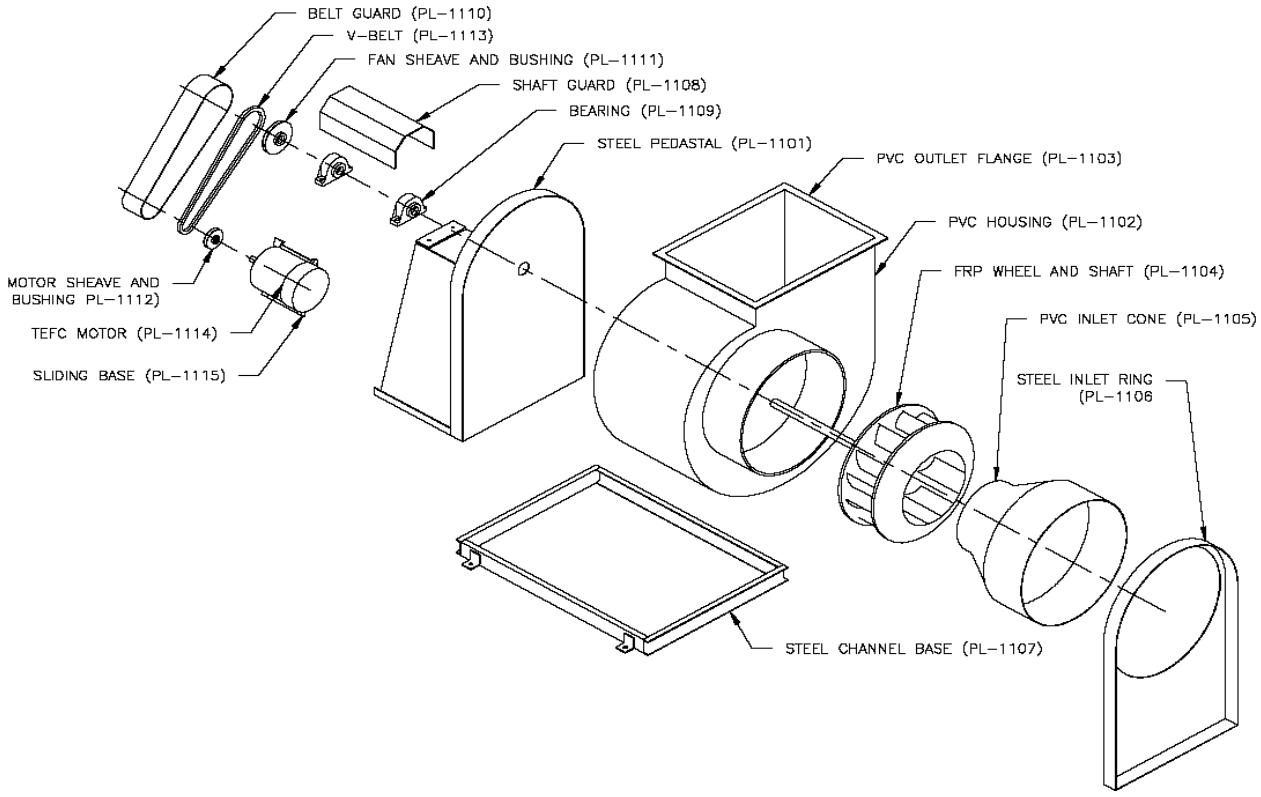
TYPICAL VIRON® APPLICATIONS

Anodizing
Batteries
Breweries
Chemical Filling Operations
Chemical Industries
Clean Rooms
Coatings
Electro-Chemical Machining
Emergency Chlorine
Etching
Fish Processing
Food Processing
Foundry
Glass
Industrial Waste Treatment
Laboratories
Medical
Metal Recovery
Metal Cleaning
Municipal Waste Treatment
Pharmaceuticals
Phosphating
Photographic
Pickling
Plastics Manufacturing
Plating
Printed Circuits
Pulp & Paper
Refining
Semiconductors
Stripping
Tank Venting
Textiles

PARTIAL CUSTOMER LIST

3M
Alcoa
Anheuser Busch
AT & T
Bendix
Boeing Aircraft
Caterpillar
Chrysler Corp.
Delco Electronics
Digital Corp.
Dow Chemical
Dupont
Eli Lilly
Federal Mogul
Ford Electronics
General Dynamics
General Electric
General Motors
GTE
Harris Semiconductor
Hewlett Packard
Hitachi
Hughes Aircraft
IBM
John Deere
Lockheed
Mortom Thiokol
Motorola
Northern Telecom
Occidental Chemical
Perkin Elmer
Pfizer Chemical
Pratt Whitney
Sandia National Lab
SEH America
Sematech
Signetics Corp.
Square D
Sundstrand Corp.
Texas Instruments
Unisys
Westinghouse Corp.

SERIES VCB-1100 PARTS LIST



PARTS LIST

PL-1101 - Steel Pedestal
PL-1102 - FRP Housing
PL-1103 - FRP Outlet Flange
**PL-1104 - FRP Wheel & Shaft*
PL-1105 - FRP Inlet Cone
PL-1106 - Steel Inlet Ring
PL-1107 - Steel Channel Base
PL-1108 - Shaft Guard

PARTS LIST (Cont.)

**PL-1109 - Bearings*
PL-1110 - Belt Guard
PL-1111 - Fan Drive
PL-1112 - Motor Drive
**PL-1113 - Belts*
PL-1114 - Motor
PL-1115 - Motor Sliding Base

**** Suggested Spare Parts***

Blower Manual

General Recommendations for Operation and Maintenance of Viron® Fans

VIRON®

INTERNATIONAL
CORPORATION

989-723-8255

VIRON® GENERAL FAN MANUAL

Introduction:

This manual is provided as a guide to the installation, operation and maintenance of Viron® International Corporation manufactured fans. Viron® fans are engineered and constructed for continuous duty in an industrial environment. They are recognized for exceptional quality, efficient performance and reliability. Each fan is thoroughly inspected and tested by trained factory personnel prior to shipment to insure the highest standards of quality and performance. It is essential that proper care be taken in the installation and operation of this unit, to guarantee a long, trouble-free operational life.

Instructions given in the body of this manual are intended to cover a variety of Viron® fan models and options. Although general in nature, this manual includes the details necessary for the proper installation, operation and maintenance of the fan.

Read and adhere to the instructions in this manual. Failure to comply with proper installation procedures may void the warranty. Retain this manual with the fan for future reference.

Safety:

Always employ a comprehensive industrial safety program when installing, maintaining and operating any industrial equipment. Viron® fans include standard safety devices including belt, shaft and bearing guards. The need for additional safety accessories, such as inlet and outlet screens, depends upon system design, fan location, accessibility and the operating procedures being employed. Proper protective safety measures should be installed to meet company standards, local codes and the requirements of the Occupational Safety and Health Act. The responsibility for selecting and providing safety accessories to meet these criteria, as well as the proper application and operation of equipment supplied by Viron® is that of the installer and user of the equipment.

Only experienced and trained personnel who are aware of the hazards associated with rotating equipment should perform handling, installation and maintenance of this equipment. Each person performing these functions should be familiar with AMCA Publication 410, “Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans.” Failure to comply with these practices could result in death or serious bodily injury.

General safety concerns with any air moving equipment include electrical hazards, moving parts, air velocity, air pressure and sound. Each can create serious safety hazards if the equipment is not properly installed, operated or maintained. To minimize the dangers associated with the operation of the fan follow these instructions as well as any additional placards attached to the unit itself. Additional labeling should also be employed in the vicinity of the fan to warn of possible machinery dangers.

Electrical Hazards. Every motor driven fan should have an independent disconnect switch to isolate the unit from the electrical supply. It should be located near the fan and must be capable of being locked by maintenance personnel while servicing the unit, in accordance with OSHA procedures. Any inspection, maintenance or repair program should include procedures to properly isolate and lock out electrical power to the fan prior to commencing work.

Moving Parts. All moving parts must be guarded to protect personnel. Never energize a fan without having all safety guards installed. Check regularly for damaged or missing guards and do not operate any fan without all of the proper guards installed. Always make certain that the unit is stopped, electrical power is locked out and the fan wheel is immobilized before putting hands into the inlet or outlet opening or near drive components. Secure or remove loose or hanging clothing while working on or around the fan. Always position body, hands, and foreign objects away from the inlet, outlet, or moving parts of the fan such as shafts, belts and pulleys.

Air pressure and velocity. In addition to the obvious dangers of rotating machinery, fans expose personnel to hazards associated with suction created at the fan inlet. Suction created by the turning fan wheel can draw materials into the fan where they become high velocity projectiles at the outlet. Further, the suction created at the fan inlet may be more significant than easily recognized. Forces are commonly generated that can overcome the strength of an individual. Inlets and outlets that are not ducted should be screened to prevent entry and discharge of solid objects. Access doors should never be opened while the fan is in operation. Bolted doors must have the bolts securely tightened to prevent accidental or unauthorized opening.

Sound. Some fans may generate sound levels that create hazardous conditions for exposed personnel. The degree of hazard can be influenced by many factors including inlet and outlet ducting, room design and fan speed. It is the responsibility of the system designer and user to determine sound levels of the system, the degree of personnel exposure, and to comply with applicable safety requirements to protect personnel from potential noise hazards.

Establish and adhere to a strict inspection and maintenance regimen to insure the fan is operating within design parameters. Do not operate the fan at speeds or temperatures exceeding design. If unsure of the design parameters relative to the fan, consult the factory before energizing the unit.

Receiving and Inspection:

Each Viron® fan is thoroughly inspected and tested at the factory prior to shipment to insure every fan meets our strict quality standards for construction and performance. All Viron® fans are packaged in accordance with the requirements of the commercial carrier and shipped F.O.B. factory. This means that upon acceptance at Viron's® facility, the carrier assumes responsibility for any subsequent damage or shortages, evident or concealed. Consequently, it is essential that each item be carefully inspected upon delivery. It is the responsibility of the receiver to inspect the Bill of Lading and packing list to verify that the proper items were delivered without shortage or damage. Any damage or shortages must be filed immediately with the carrier. Note, Viron® cannot file

a claim or accept responsibility for reimbursement or replacement for items received damaged.

Storage:

Viron® fans are prepared, packaged and shipped for immediate installation and service. If the equipment is not to be put into service immediately it is necessary to take additional precautions to insure the fan components are protected from degradation.

If the unit is to be placed in operation within two weeks of delivery, the fans may be stored outdoors and unprotected from the elements. Inline fans should have the belt tunnels covered to insure water does not collect inside the fan.

If the unit is to be stored for any period over two weeks, the fan wheel must be turned a minimum of thirty revolutions per week until the fan is placed in operation to insure that the bearings do not develop flat spots. Flat spots on the bearings will cause premature bearing failure. The fan should also be stored indoors and protected from the elements. Tarping the fan from the elements and storing outdoors is also acceptable.

Handling:

Viron® fans should be handled and installed by experienced personnel familiar with the installation of air handling equipment. Viron® fan housings are constructed of fiberglass-reinforced or thermoplastic materials. Care must be taken during handling and installation to prevent applying concentrated stresses on plastic components. Fans should be lifted using nylon straps or well-padded cables, which protect the coatings and parts from damage. Spreader bars should be used to insure that straps clear the housing during the lift. Utility sets are best lifted with straps around the steel pedestal and support base. Inline fans should be lifted using straps around the fan housing only. Never lift a fan by the shaft, motor, wheel, or flanges as a point of attachment.

Fan Installation:

Do not use backwardly inclined centrifugal fans for material handling applications or in applications where the airstream contains sticky or stringy substances.

The fan should be mounted on vibration isolators or another suitable vibration absorbent. If the fan is to be elevated on a platform above the floor, the platform must be solidly supported.

Due to sloping floors and other building constraints, the fan may need to be leveled or aligned. A high performance epoxy grout should always be used under the fan base of the steel supporting stand feet. This will ensure proper transmission of vibration to the equipment foundation.

Particular care should be taken when installing the fan to ensure that the fan base is not twisted or misaligned when anchoring the unit to the foundation. Never force the base

into alignment. Use shims, if necessary, to insure the base is level. A twisted or misaligned base will cause damage to the fan once the unit is placed into operation. As a minimum, check all of the following bolts to assure that they have not loosened during shipment.

1. Housing bolts. (Attaching the fan housing to the steel base.)
2. Bearing mounting bolts.
3. Set screws on the bearing locking collars.
4. Motor sliding base.
5. Sheave/flex coupling set screws and bolts.
6. Access door.
7. Fan hold down bolts.

Before wiring the motor, rotate the fan wheel by hand to check for free rotation and to ensure that the wheel has not shifted during installation.

All ductwork and/or stacks must be self-supported independently of the fan. It is recommended that flexible connectors be installed both on the inlet and outlet of the fan to prevent the transmission of vibration from the ductwork to the fan. If flanges are utilized, a soft sponge type gasket compatible with the chemical being exhausted should be used. Care should be taken when tightening bolts so that damage is not caused to the flanges.

The drain line must be installed using a U-trap arrangement. To ensure proper air seal and drain flow, the leg length of the U-trap must be greater than the system static pressure.

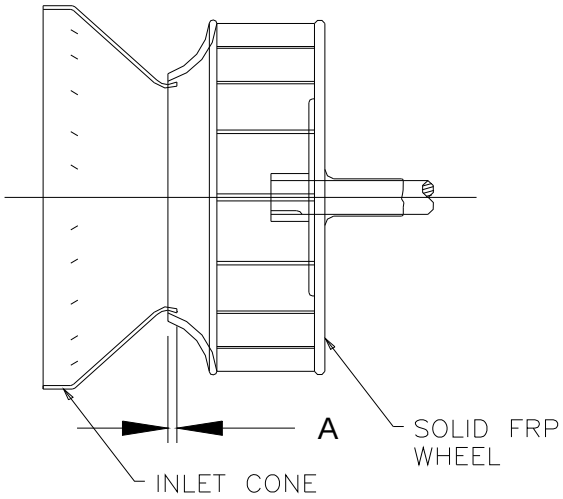
The following pre-operative instructions must be completed prior to putting the fan into service. Even if factory start-up instruction services have been contracted, these instructions should be completed prior to the field representative arrival. The field representative will not arrive equipped to make these types of adjustments.

PRE-OPERATIVE INSTRUCTIONS:

1. Turn over rotating assembly by hand to check for free rotation and any shifting of the wheel which may have occurred during shipment. If necessary, shift wheel to correct position to correct for a grinding or rubbing wheel. Be sure to maintain preset wheel/inlet cone overlap when adjusting the wheel alignment.

   NOTE: See Diagram 1 for correct wheel overlap for centrifugal fans.

Diagram # 1:



Inlet Cone/Wheel Cone Overlap

Wheel Size	12	13	15	16	18	20	22	24	27	30
A Dimension	3/8”	7/16”	7/16”	1/2"	9/16”	9/16”	5/8”	5/8”	5/8”	3/4"
Wheel Size	33	36	40	44	49	54	60	66	73	80
A Dimension	3/4"	3/4"	13/16”	15/16”	1-1/16”	1-1/8”	1-1/8”	1-5/16”	1-3/8”	1-1/2”

2. Assemble motor and drive in their proper relative positions, if not already assembled on fan. (Refer to “BELT AND SHEAVE INSTALLATION” instructions.)

3. Check belt tension and belt and sheave alignment. (Refer to “BELT AND SHEAVE INSTALLATION” instructions.)

4. Install any accessories such as belt guard or weather cover, and vibration isolating springs or pads.

5. Assure that all bolted connections are tight:

   a. Check tightness of any flanged connection bolts.
   b. Check tightness of adjustable motor base bolts.
   c. Check tightness of set screws in motor and fan pulleys sheaves. **IMPORTANT!**

OPERATION:

After all pre-operative inspection checks have been completed, the unit is ready for operation. Thoroughly review VIRON® Technical Bulletin 1107, ***Fan Start Up*** in addition to the following before placing the fan into service.

1. Connect motor in accordance with wiring diagram attached to motor. (Refer to "MOTOR INSTALLATION" Instructions.)

2. Momentarily start the blower motor to check for correct rotation as indicated by arrow on the fan outer shell. Blower wheel must rotate in the direction indicated by the arrow on the outside of the casing. If the arrow has been removed, determine the blower rotation from the drive end, or consult factory. If blower wheel rotates in opposite direction, check motor manufacturer's instructions and re-wire accordingly.

3. Check operation of the blower carefully during initial start-up. If excessive vibration is evident, shut off blower immediately, and determine the cause. Do not operate blower until the source of vibration has been eliminated.

4. Check the motor with an ammeter and compare current draw of the motor with the amperes shown on the motor nameplate. Do not operate the blower unit with the motor overloaded, as this may ruin the motor and void the motor manufacturer warranty.

5. Double check bolts and set screws after one hour of operation and again after 24 hours of operation. Re-check the belt tension and make necessary adjustments.

GENERAL MAINTENANCE GUIDELINES:

The following information is intended to give a general overview of common maintenance items requiring attention on VIRON® fans. Specific information for the parts and accessories supplied with the fan are included in separate attachments to this manual. Be sure to consult the appropriate attachments, as well as this information, when maintaining, trouble-shooting and repairing the fan.

WHEEL MAINTENANCE:

Inspect wheel for buildup at least every three months; or as required for your application. If a crust or scale buildup has begun on the wheel, fresh water with a coarse rag or a soft brush will easily remove the buildup. This step will assure the precision static and dynamic balance of the wheel will be maintained.

INSTALLING/TENSIONING V-DRIVES:

Installing Drive

Before a new set of V-belts are installed, check the condition of the sheaves. Dirty or rusty sheaves impair the drives efficiency and roughen the belts, which result in premature failure. Clean existing sheaves thoroughly before installing a new set of belts. A safe cleaning fluid, such as methyl chloroform, is recommended.

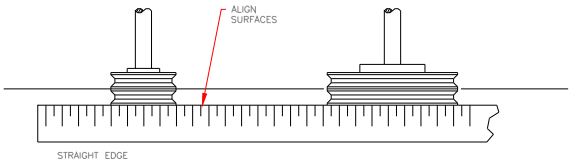
Worn grooves can be detected by feel, or by sight. If the grooves are worn excessively, the sheave should be replaced. Worn grooves can shorten belt life by as much as 50%, which in turn increases the cost of maintenance.

Make sure the bore of the sheave and the tapered cone surface of the Sure-Grip bushing are free of all foreign substances such as paint, dirt and lubricants.

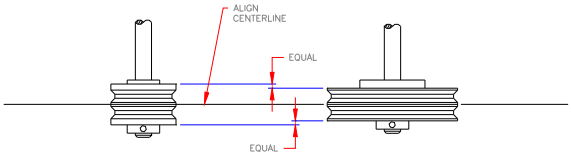
Place bushing into sheave. Loosely insert the set-screws into the assembly. Do not lubricate the set screw threads.

With key in keyseat of shaft, slide the sheave/bushing assembly to its desired position with cap set screw to the outside. (A few small sheaves may have to be installed with the set screw on the inside.) If the bushing is hard to slide onto the shaft, wedge a screwdriver blade into the saw cut to overcome the tightness.

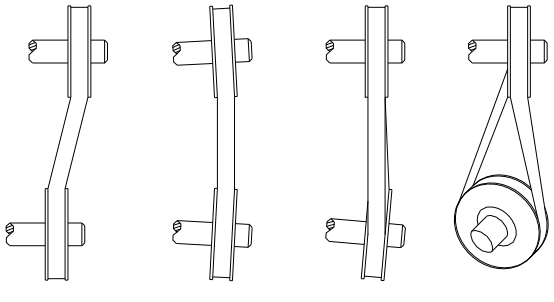
Align sheaves with a straight edge. If the sheaves are properly lined up, the straight edge will touch all points across both sheaves. Rotate each sheave a half a revolution to determine whether the sheave has been installed correctly. With the sheaves aligned, tighten the set screws.



EQUAL WIDTH PULLEYS



UNEQUAL WIDTH PULLEYS



UNACCEPTABLE SHAFT ALIGNMENTS

REMOVAL OF SHEAVES:

1. Release bolt tension, remove bolts. Loosen and remove set- screws.

2. Insert set-screws into tapered removal holes and progressively tighten each one until mating part is loose on bushing.

3. Remove mating part from bushing and, if necessary, remove bushing from shaft. If bushing will not slip off shaft, wedge screwdriver blade into saw cut to overcome tightness.

ADJUSTING VARIABLE PITCH SHEAVES:

Viron® belt driven blowers may be furnished with variable-pitch motor sheaves. Sheaves may be adjusted for lower blower speeds without concern of overloading motors. When adjusting sheaves to overcome blower speed, check motor current to be sure motor is not overloaded. Keep motor current within nameplate and service factor ratings.

The following steps should be taken to adjust the pitch diameter:

1. Release belt tension and remove belt or belts from sheave.

2. Loosen set screw and remove key holding adjustable half of the groove (decreased speed), or in for a larger pitch diameter (increased speed). Each one-half turn will change the pitch diameter one-tenth of an inch. Adjust two-groove sheaves the same amount on each groove.

3. Replace the key and tighten set-screw to lock sheave half in position.

4. Replace the belts and tighten to proper tension. If extreme amounts of adjustments have been made, it may be necessary to replace belts with another length.

BELT INSTALLATION:

1. Shorten the center distance between the driver and driver sheaves so the belts may be placed in the sheave grooves without force.

   NOTE: Never “roll” or “pry” the belts into the sheave grooves. This can damage the belt cords and lead to belt turnover, short life or actual breakage.

2. With the belts in their proper grooves, adjust the centers.

3. Operate the drive for a few minutes to seat the belts in the sheave grooves.

4. Observe the operation of the drive under its highest load condition (usually starting) a slight bowing on the slack side of the drive indicates

proper tension. Excessive bowing or slippage indicates insufficient tension. If the slack side remains taut during the peak load, the drive is too tight.

5. Check the tension on a new drive frequently during the first day, by observing the slack side span.

6. Excessive tension reduces belt and bearing life.

7. Keep the drive free of foreign material which might cause slippage or damage to belt and sheave surfaces.

8. If V-Belt slips, it is too loose. Increase the tension by moving the centers. Never apply belt dressing, as this will soften the belt and cause early failure.

   NOTE: A common cause of short belt life is unequal distribution of load among the belts on a multiple-belt drive. This unequal distribution can be caused by mismatched sets of belts or by grooves that, because of wear or machining error, are not matched. Always check for matching prior to installation.

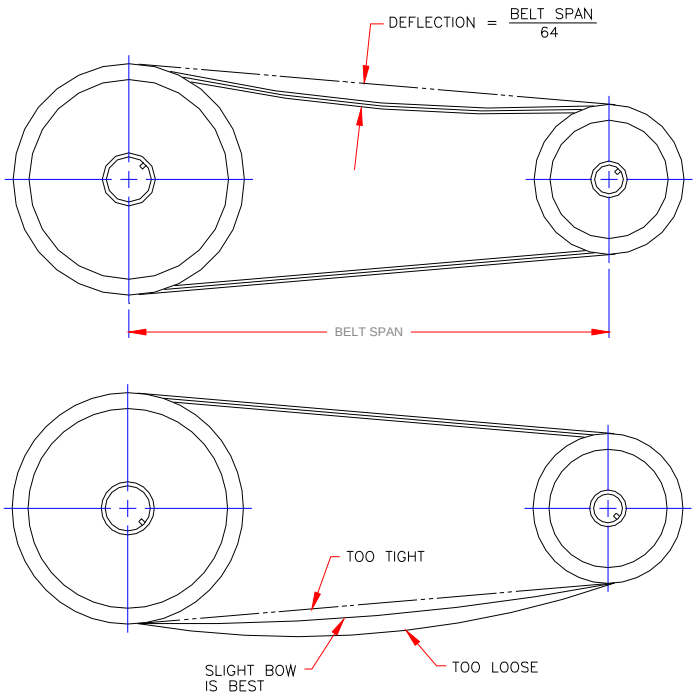
BELT MAINTENANCE:

Dirt and grease reduce belt life. Belts should be wiped with a dry cloth occasionally to remove any build-up of foreign material. If the belts have been splattered with grease and/or oil, clean them with methyl chloroform or soap and water. Inflammable cleaners, such as gasoline, are to be avoided as a matter of safety.

Under no circumstances is the use of belt dressing recommended on a V-Belt. The remedial effect is only temporary. It is much better to keep the belts and grooves of the drive clean.

MAINTAIN PROPER BELT TENSION:

Maintaining correct tension is the most important rule of V-Belt care. It will give the belts 50% to 100% longer life. Belts that are too loose; will slip, causing excessive belt and sheave wear. V-Belts that sag too much are snapped tight suddenly when the motor starts or when peak loads occur. That snapping action can actually break the belts, because the added stress is more than the belt is designed to take.



INSPECT SHEAVES OFTEN:

Keep all sheave grooves smooth and uniform. Burrs and rough spots along the sheave rim can damage belts. Dust oil and other foreign matter can lead to pitting and rust, therefore should be avoided as much as possible. A shiny groove bottom indicates that either; the sheave, belt or both are badly worn and the belt is bottoming in the groove. Badly worn grooves cause one or more belts to ride lower than the rest of the belts. The effect is the same as with mismatched belts. This is called “differential driving”. The belts riding high in the grooves travel faster than the belts riding low. In a drive under proper tension, a sure sign of differential driving is when one or several belts on the tight side are slack.

BEARINGS:

Because of the importance of bearings on any rotating machine, special attention should be given to their maintenance and replacement.

Fans that have instruction plates or tags pertaining to the bearings; should be left in place and not covered or defaced. These instructions should be read with care before bearings are serviced.

Extreme care must be taken to prevent dirt from entering the bearings during maintenance and replacement. Use only **clean** **fresh** lubricants.

1. ONE PIECE PILLOW BLOCK BEARINGS

   a. Carefully mark position of old bearing on bearing support and shaft.
   b. Support weight of wheel and shaft on blocks or with non-marring slings.
   c. Loosen set screws on locking collar, rotate each collar in the direction opposite shaft rotation until counterbored recess in bearing wide inner race releases cam on collar, and slide collars away from bearings.
   d. Smooth shaft at areas of set-screw penetration and remove bearing hold down bolts.
   e. Raise shaft slightly and remove pillow block and collar, noting arrangement of parts.

2. TO REPLACE BALLS AND RACES:

   a. Tilt balls and races assembly until parallel with base, then slide assembly from pillow block.
   b. Clean and inspect pillow block.
   c. Insert new balls and races assembly in pillow block so that the eccentric recess on inner race faces outward. Using narrow spatula, fill pillow block 1/3 full of high grade ball bearing grease (refer to “LUBRICATION” section) through shaft hole on opposite side of bearing from eccentric recess.

3. TO INSTALL NEW BEARINGS:

   a. Slip locking collar on inner race eccentric recess and slide bearing on shaft in same arrangement as noted in removal from step 1.e on previous page.
   b. Position bearing to the marks made from step 1.a on previous page.
   c. Lower shaft on bearing and loosely mounted h9olddown bolts.
   d. Align bearing with shaft for uniform radial clearance between shaft and shaft hole in bearing by turning adjustment screws or with shims.
   e. Check position from step 3.b above, then tighten holddown bolts securely.
   f. Rotate licking collar in direction of shaft rotation and against inner race cam until eccentrics engage.
   g. Slightly tighten set-screw in locking collar, then tap set screw wrench sharply in direction of shaft rotation. Tighten set-screw securely.
   h. Check wheel alignment with inlet.

4. TO INSTALL NEW BEARINGS OR TO REPLACE ROLLERS & RACES:

   a. Place parts with new rollers and races assembly in pillow block in same arrangement as noted in step 2.c on the previous page, making sure the adapter sleeve is loose in inner race.
   b. Slide parts on shaft to position marked in step 1.a on previous page. Install holddown bolts with shims and dowels in place.
   c. Position roller and race assembly of drive side bearing toward fan as far as pillow block will allow. Tighten locknut until there is barely perceptible drag when the outer race is rotated. Bend tang of lock washer in slot in lock nut. Insert stabilizing ring in bearing housing on shaft extension side of the roller and race assembly.
   d. Position roller and race assembly of opposite side bearing in center of float range. Then tighten lockout and set lock washer.
   e. Lower shaft into bearing. Fill bearing housing 1/3 full of grease as described in “LUBRICATION” instructions. Then replace pillow block cap.
   f. Check wheel alignment as shown in “ALIGNMENT” instructions. Check bearing seals to be free, both at shaft and housing.

5. BEARING LUBRICATION:

   a. Use Texaco Regal AFB2 or Mobilux Grease No. 2 or equivalent grease for ambient temperature from 20ºF to 250ºF.
   b. Add small amount of grease per bearing manufacturers lubrication schedule; smaller amounts may be required in clean atmosphere at normal temperatures.
   c. Where bearings are not equipped with grease fittings, remove lubrication plug and install suitable grease fitting.
   d. Do not over-lubricate.
   e. When adding lubricant, make sure grease and fittings are clean to prevent entrance of dirt.

6. BEARING MAINTENANCE:

   a. Establish a lubrication schedule based on periods suggested in “BEARING LUBRICATION” instructions and by motor manufacturer.
   b. Establish a preventative maintenance inspection schedule. After the first fifty (50) hours of operation, potentially damaging conditions are often signaled in advance by change in vibration and sound. A simple, regular audiovisual inspection of fan operation can lead to correction of the condition before expensive damage occurs.
   c. Where gas handled by blower contains corrosive materials, blower should be shut down regularly for inspection, cleaning and reconditioning of the interior parts.

MOTORS - GENERAL:

STORAGE: Storage of motors on equipment and component equipment prior to installation, should be protected from the weather. Keep the motor dry. If the equipment is exposed to the atmosphere, remove the breather drain plug in the end frame at both end, and cover the motor with a waterproof cover. CAUTION: Do not completely surround the motor with the protective covering. The bottom area should be checked with a megohmmeter (Megger) as given under sub-title "INSULATION".

LOCATION: For maximum motor life, motor should be located in a clean, dry, well-ventilated place easily accessible for inspection, cleaning and lubrication. The temperature of the surrounding air should not exceed 104ºF (40ºC) except for motors with nameplates indicating a higher maximum ambient temperature. Enclosed motors are equipped with condensation vents, located in the bottom center of both end frames. When the motor is exposed to the weather, or is subject to high humidity conditions, the drain plugs should be removed.

CONNECTIONS & WIRING: Check the power supply to make certain that voltage, frequency and current carrying capacity are in accord with the motor nameplate. Motors with nameplates stamped 208-230/440 volts may be operated on 208, 220 or 440 volt lines. When such a motor is operated with 208 volts at the motor terminals, the motor will deliver approximately 11% more line current at rated load as compared to operation with 220 volts at the terminals. The motor will perform satisfactory on voltage variation of ± 10%, or frequency variations of ± 5% of the nameplate rating, or a combined voltage and frequency of 10%. The preceding variation do not apply to the 208 volt rating of motors with a nameplate stamped 208-220/440 volts. Connect the motor to the power supply according to the diagram on the connection plate. Connections should be clean and tightly bolted. To reverse the direction of rotation of a three phase motor, interchange any two of the line wires to the motor leads. Two phase motors are reversed by interchanging T-1 and T-3 or T-2 and T-4.

MOTOR MAINTENANCE:

CLEANING & INSPECTION: A CLEAN motor runs COOLER. The motor should be cleaned and inspected at regular intervals. Operating conditions involving continuous running, hot, dirty or dusty surrounding, etc. require frequent attention. Inspect bearings for roughness by uncoupling the motor from driven unit, if possible; and turning shaft by hand. If bearings feel "rough" or stick in spots, replace them. Always check bearings when any unusual noise or vibration develops in motor.

INSULATION: The insulation resistance should be checked before placing motor in service after any extended storage period, and periodically thereafter especially when in service under severe conditions encountering high humidity. Check the insulation resistance with megohm meter or similar instrument employing a 500 volt d.c. potential. Resistance should be at least 1.5 megohms; if it is less, the motor should

be removed from service; cleaned, dried, rechecked and the windings given at least two coats of high-grade insulating varnish to assure adequate winding protection.

LUBRICATION: Grease-lubricated bearings, as furnished, are adequate for a long period of operation without re-lubrication. A good maintenance schedule for re-greasing will vary widely depending on motor size, speed and environment. We suggest re-lubrication intervals for motors on normal, steady running, light duty indoor loads in a relatively clean atmosphere at 104ºF (40ºC) ambient temperature or less. Fractional horsepower motors follow a similar schedule to that shown under frames 143 to 215T. Motors with no provision for lubrication are equipped with sealed bearings and require no maintenance. Motors mounted in accessible locations, are provided with extended grease lines to facilitate lubrication. They are equipped with relief fittings to prevent over-lubrication. The grease lines are filled with lubricant at the factory.

PROCEDURE FOR RE-LUBRICATION:

a. Stop Motor
b. Remove grease relief plugs in bearing housings.
c. Grease with hand-gun until new grease appears at relief hole.
d. Run motor for ten (10) minutes before replacing relief plugs.

CAUTION: DO NOT OVER LUBRICATE! This is a major cause of bearing and motor failure. Make sure no dirt, or any other contaminants are introduced when adding grease.

TYPE OF GREASE:

Lubrication with or equivalent to the following greases:

Chevron BRB-2 - Standard Oil of California
SRI-2 - Standard Oil Company
Alvania 2 - Shell Oil Company

For motors lubricated with special greases check lubrication tag on motor.

END OF SECTION

VIRON® FAN INSTALLATION INSTRUCTIONS

Technical Bulletin 1118 September 30, 1997

General

VIRON® International fans are known for their quality, efficient performance, and long life in corrosive environments. Each fan has been inspected and tested at the factory before shipment. It is essential that proper care be taken in the installation and operation of this unit to guarantee a long operational life.

Inspection

All VIRON® International fans are inspected prior to shipment, but all units should be inspected upon receipt and before any attempt is made to unload the unit from the freight carrier. First, visually inspect the fan for any signs of damage. Using the following checklist, look for any breakage and abrasion which should be very easy to recognize.

Inspection Checklist

1. Is the shipping container still intact? (Check for loose banding or damaged shipping crates.)
2. Is there any damage to the exterior of the fan? (Check the fan housing, steel base, and flanges for damage.)

Impact Damage (Fiberglass Units)

Impact damage can occur to a fiberglass unit and go undetected without a close, visual examination. This damage would appear as whitening of the surface or star shaped cracks and crazes. If any part of the fan is found to be damaged, file a claim with the freight carrier immediately. Do not operate the fan until all damage is completely repaired.

Storage

All VIRON® fans should be stored in an area protected from the weather. Fork trucks and other traffic should be directed away from the fan storage area. If the fan is to be idle more than one to two weeks, the fan wheel and motor should be rotated several revolutions at least once a week to ensure that the bearings won't freeze up. Also, the fan motor must be protected from dampness so that the motor windings are not damaged.

Handling

Do not remove the fan from the shipping container until the unit is at the point of installation. Never lift the unit by the fan housing, guards, shaft, or motor. Lifting straps should only be attached to the structural steel base. Never use chains.

Fan Leveling

Due to sloping floors and other building constraints, the fan may sometimes need to be leveled or aligned. A high performance epoxy grout should always be used

under the fan base of the steel supporting stand feet. This will ensure proper transmission of vibration to the equipment foundation.

Fan Installation

Particular care should be taken when installing the fan to ensure that the fan base is not twisted or misaligned when anchoring the unit to the foundation. Never force the base into alignment. Use shims, if necessary, to level the base. A twisted or misaligned base will cause damage to the fan once the unit is placed in operation.

Check all of the following bolts to assure that they have not loosened during shipment.

1. Housing bolts. (Attaching the fan housing to the steel base.)
2. Bearing mounting bolts.
3. Set screws on the bearing locking collars.
4. Motor sliding base.
5. Sheave set screws and bolts.
6. Access door.
7. Fan hold down bolts.

Before wiring the motor, rotate the fan wheel by hand to check for free rotation and to ensure that the wheel has not shifted during installation.

All ductwork and/or stacks must be self-supported independently of the fan. It is recommended that flexible connectors be installed both on the inlet and outlet of the fan to prevent the transmission of vibration from the ductwork to the fan. If flanges are utilized, a soft sponge type gasket compatible with the chemical being exhausted should be used. Care should be taken when tightening bolts so that damage is not caused to the flanges.

The drain line must be installed using a U-trap arrangement. To ensure proper air seal and drain flow, the leg length of the U-trap must be greater than the system static pressure.

You are now ready to perform the instructions in VIRON® Technical Bulletin 1107, *Fan Start Up*. Even if you have contracted services from the factory for start-up instruction, these start-up instructions should be completed prior to the field representative arrival. The field representative is not responsible for trouble shooting problems of any kind.

EXHAUST FAN START-UP

Technical Bulletin No. 1107 September 30, 1997

This bulletin is designed to be a brief overview for the start-up of your new VIRON® International exhaust fan. The following should be used as a checklist during the start-up of your exhaust fan:

1. Verify that the fan has not been damaged in freight or during the installation process. If damage is found, please contact the factory.

2. Insure that the main disconnect switch is locked in the "off" position.

3. Never inspect or maintain the fan with the disconnect switch on.

4. Visually inspect the duct system and fan for foreign objects that may have accumulated. Never operate the fan when objects are believed to be in the fan or duct system.

5. If spring isolators are supplied, insure that the proper clearance is maintained between the fan base and the supporting structure.

6. Remove all belt, bearing, and motor covers from the fan.

7. Inspect all fasteners for tightness. This should include motor mounts, housing mounts, bearings, and sheaves. Tighten as required.

8. Inspect the sheaves for proper alignment and the belts for proper tension.

9. Remount all guards that have been removed.

10. Turn the disconnect switch to the "on" position.

11. Bumpstart the fan motor and check for proper rotation. If the fan rotates in the wrong direction, reverse any two leads for three phase motors or see the motor's conduit box cover for single phase motors. Fan rotation is always determined from the drive end of the fan.

12. Start and operate the fan. Check the amp draw. If the readings are above the ratings shown on the motor's nameplate, stop the fan immediately. See the *Fan Trouble Shooting Guide* to evaluate the high amp draw.

13. Inspect the motor for any unusual noise or vibration. Stop the fan immediately and see the *Fan Trouble Shooting Guide* if any problems are encountered.

14. Have the CFM, static pressure, and RPM of the fan checked. Compare the results with the system specifications. Keep in mind that if the duct system is incomplete or unbalanced, your results will vary. Have the system checked once again after the duct system is completed and balanced.

15. After eight and twenty-four hours of operation, the fan should be shut down and inspected. All guards should be removed and all bolts checked for tightness. Always remember to lock the main disconnect switch in the "off" position before inspecting or maintaining the fan.

FAN TROUBLE SHOOTING GUIDE

Technical Bulletin 1117 September 29, 1997

PROBLEMS	PROBABLE CAUSES/CORRECTIVE ACTION
INSUFFICIENT AIR FLOW	Check the fan for proper rotation. If rotating in the wrong direction, switch the motor leads to obtain the proper rotation. Verify that the fan is running at the design RPM. If not, sheave the fan for the proper RPM. Check the system resistance. If higher than design, speed up the fan or open a damper. Check the motor amp draw for overloading. Poor fan inlet or outlet conditions. Please consult the factory. Check the fan wheel for damage. If damaged, replace the wheel.
EXCESSIVE AIRFLOW	Verify that the fan is running at the design RPM. If not, sheave the fan for the proper RPM. Check the system resistance. If lower than design slow down the fan or close a damper.
EXCESSIVE HORSEPOWER DRAW	Verify that the fan is not running at a higher RPM than design. IF so, sheave the fan for the proper RPM. Check the fan for proper rotation. If rotating in the wrong direction, switch the motor leads to obtain the proper rotation. Check the system resistance. If lower than design slow down the fan or close a damper.
EXCESSIVE VIBRATION	Check the fan wheel for accumulated foreign matter. Clean as required. Check the fan wheel for damage. If damaged, replace the wheel. Check the fan shaft for damage. If bent or marred, replace the shaft.

Verify that the fan wheel and sheaves are not loose on their respective shafts. Tighten as required.

Verify that the fan wheel and motor are in balance. If out of balance, return item to the manufacturer.

Check all bolts for tightness. Tighten as required.

Check the belts for proper tension and wear. Adjust or replace as required.

Check the fan bearings for wear and overheating. Replace as required.

Check the foundation for levelness and structural integrity. Level or reinforce as required.

FAN STORAGE REQUIREMENTS

Technical Bulletin No. 1134 October 20, 1994

All Viron® International Corporation fans have been tested at the factory before shipment for proper mechanical operation. It is the consignee's responsibility to insure that the fans are stored as follows:

Short Term Storage
(0 – 2 weeks)

1. The fan wheel must be turned 30 revolutions weekly to insure that the bearings do not develop a flat side.

2. The fans may be stored outside unprotected from the elements for this period of time. Inline fans should have the belt tunnels covered to insure water does not collect inside the fan.

Long Term Storage
(2 weeks or longer)

1. The fan wheel must be turned 30 revolutions weekly to insure that the bearings do not develop a flat side.

2. Viron® recommends that the fans be stored inside protected from the elements prior to installation. Tarping the fans from the elements and storing the units outside; is also acceptable.

VIRON® INTERNATIONAL CORPORATION

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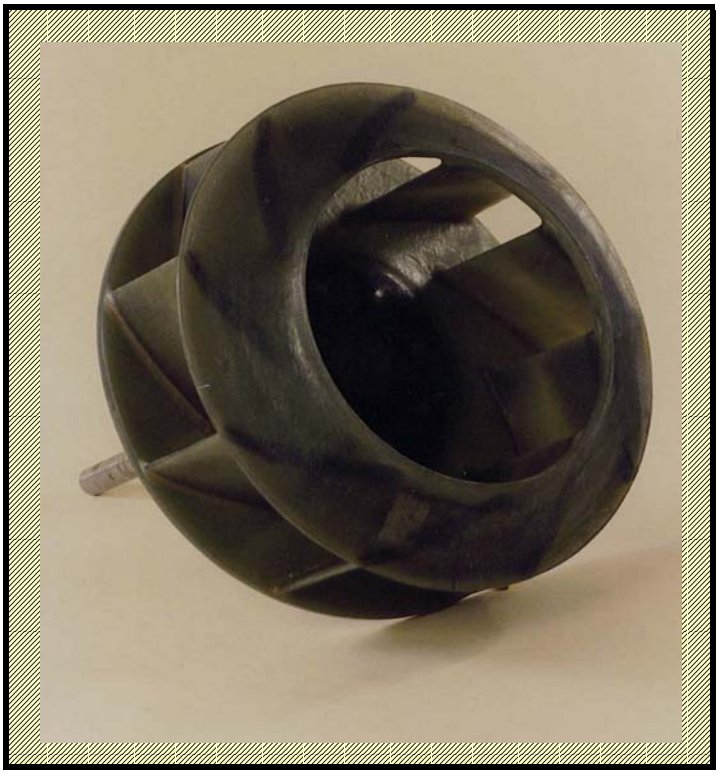


FRP WHEEL SPECIFICATIONS

The solid FRP Fan Wheel is fabricated by **VIRON®** personnel using premium grade corrosion resistant resin. Fan wheel sizes range from 12" diameter to 80" diameter. Fan shafts are secured to the wheel by the use of a taper lock bushing in the embedded hub. The portion of shaft exposed to the corrosive air stream is covered with a FRP overlay. Class II Wheels are standard, with Class III as an option. Both clockwise and counterclockwise rotations are available. All wheels are dynamically balanced, ensuring smooth vibration free operation. After initial balancing the wheel is installed and tested at its operating speed. This second test is made using actual bearings, sheaves, belts, motor, housing and steel base of the equipment purchased.

INSTRUCTIONS FOR
FAN WHEEL REPLACEMENT
PVC UNITS

REMOVING FAN WHEEL

1. **SHUT OFF** and **LOCK OUT** power source.
2. Remove SST drawbands and PVC flex connection, or unbolt inlet connections.
3. Unbolt fan base from common base; rotate 90 degrees to get at fan inlet.
4. Remove PVC “buttons” (3 or 4) on the inlet of fan, then remove SST bolts holding the inlet cone. The inlet cone should then slide out.
5. Remove Sheave/Belt and Bearing safety guards.
6. Loosen motor sliding base.
7. Remove belts.
8. Remove sheaves.
9. Unbolt and turn CCW the retaining ring on the bearings*.
10. Slide wheel out through the fan inlet.

NOTE: *In the event that the bearings cannot be removed from the shaft, customers should cut the shaft between the fan housing and the first bearing. Then the bearings can be unbolted and replaced.

RE-INSTALLING FAN WHEEL

1. Bolt on new bearings (if necessary).
2. Lightly sand wheel shaft to insure ease of installation.
3. Wheel should be put in the same location as the original.
4. Turn retaining rings on the bearings CW and lock set screws.
5. Re-install sheave and belts.
6. Re-adjust motor sliding base.
7. Bolt on all safety guards.
8. Placement of inlet cone should be equally spaced in the wheel making sure it doesn’t “rub” once centered. Re-drill holes, re-bolt, and glue PVC “button”.
9. Double check all connections, re-tighten if necessary.
10. Rotate fan back into original position and re-bolt.
11. Connect PVC flex and SST drawbands.
12. Unlock power source.
13. Start fan, and check for proper rotation.
14. Check amps and make sure they do not exceed the motor nameplate.
15. Re-check the total CFM.
16. Operate the unit for 24 hours; shut down. Re-tighten all bolts, bearings and belts.
17. Re-check the motor amps.

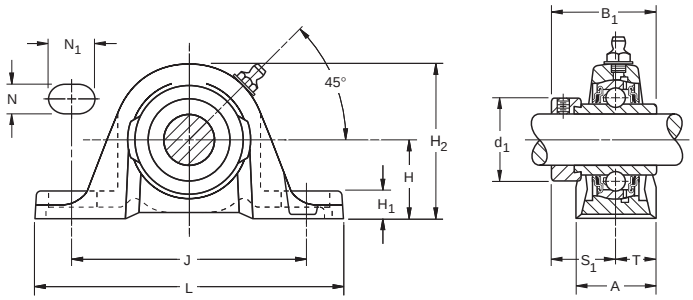
RAS,TAS, LAS Industrial Series

Fafnir RAS, TAS and LAS pillow blocks are similar in design and equal in load carrying capacity to the RAK, TAK and LAK types but have a slightly higher base to center height dimension to make them interchangeable with certain other competitive designs.

The RAS pillow block is equipped with G-KRRB (R-Seal) wide inner ring bearings, the TAS with G-KPPB (Tri-Ply Seal) wide inner ring bearings, and the LAS with the G-KLLB (Mechani-Seal) wide inner ring bearings.

Contact The Torrington Company to discuss highly corrosive applications (i.e. food processing, chemical exposure) where Fafnir TDC® bearings can be utilized.

Recommened shaft tolerances: 1/2"-1 15/16", nominal to -.0005", -.013mm; 2"-2 3/16", nominal to -.0010", -.025mm.



Bearing Data

Unit	Bearing Number	Dimensions and Load Ratings
RAS	G-KRRB	Page 154
TAS	G-KPPB	Page 165
LAS	G-KLLB	Page 162

TO ORDER, SPECIFY UNIT AND SHAFT DIAMETER. Example: RAS 1 3/16", POPULAR SIZES ARE IN BOLD

Unit	Shaft Diam.	H	H_2	B_1	J	L	A	H_1	N	N_1	d_1	S_1	T	Bolt Size	Bearing Number[1]		Collar Number	Housing Number	Unit Wt.
	in. / mm	in. / mm	in. / mm	in. / mm	in. / mm	in. / mm	in. / mm	in. / mm	in. / mm	in. / mm	in. / mm	in. / mm	in. / mm	in.	RAS	(TAS)		new / (old)	lbs / kg
RAS	1/2														**G1008KRRB**		S1008K		
RAS	5/8	1 3/16	2 7/32	1 15/32	3 5/8	4 7/8	1 3/16	15/32	7/16	7/8	1 1/8	59/64	19/32	3/8	**G1010KRRB**		S1010K	T-40238	1.00
RAS	11/16	30.16	56.4	37.3	92.1	123.8	30.2	11.9	11.1	22.2	28.6	23.4	15.1	10	**G1011KRRB**		S1011K	(T-30595)	0.454
RAS	17														**GE17KRRB**		SE17K		
RAS	3/4	1 5/16	2 17/32	1 23/32	3 25/32	5	1 1/4	17/32	7/16	25/32	1 5/16	1 3/64	5/8	3/8	**G1012KRRB**		S1012K	T-40239	1.40
RAS	20	33.34	64.3	43.7	96	127	31.8	13.5	11.1	19.8	33.3	26.6	15.9	10	**GE20KRRB**		SE20K	(T-30555)	0.635
RAS,TAS	7/8														**G1014KRRB**	**(KPPB)**	S1014K		
RAS,TAS	15/16	1 7/16	2 13/16	1 3/4	4 1/8	5 1/2	1 13/32	19/32	7/16	13/16	1 1/2	1 1/16	45/64	3/8	**G1015KRRB**	**(KPPB)**	S1015K		1.77
RAS,TAS,LAS	1	36.51	71.4	44.4	104.8	139.7	35.7	15.1	11.1	20.6	38.1	27	17.9	10	**G1100KRRB**	**(KPPB)**	S1100K	T-30365	0.803
RAS,TAS	25														**GE25KRRB**	**(KPPB)**	SE25K		
RAS,TAS	1 1/16														**G1101KRRB**	**(KPPB)**	S1101K		
RAS,TAS	1 1/8	1 11/16	3 3/32	1 29/32	4 5/8	6 3/16	1 9/16	21/32	9/16	15/16	1 3/4	1 3/16	25/32	1/2	**G1102KRRB**	**(KPPB)**	S1102K	T-40241	2.86
RAS,TAS,LAS	1 3/16	42.86	83.3	48.4	117.5	157.2	39.7	16.7	14.3	23.8	49.5	30.2	19.9	12	**G1103KRRB**	**(KPPB)**	S1103K	(T-30300)	1.297
RAS,TAS	30														**GE30KRRB**	**(KPPB)**	SE30K		
RAS,TAS	1 1/4														**G1104KRRB**	**(KPPB)**	S1104K		
RAS,TAS	1 5/16	1 7/8	3 11/16	2 1/64	5 1/8	6 9/16	1 25/32	23/32	9/16	31/32	2 1/8	1 9/32	57/64	1/2	**G1105KRRB**	**(KPPB)**	S1105K	T-40242	3.69
RAS,TAS	1 3/8	47.62	93.7	51.2	130.2	166.7	45.2	18.3	14.3	24.6	54	32.5	22.7	12	**G1106KRRB**	**(KPPB)**	S1106K	(T-30410)	1.674
RAS,TAS,LAS	1 7/16														**G1107KRRB**	**(KPPB)**	S1107K		
RAS,TAS	35														**GE35KRRB**	**(KPPB)**	SE35K		
RAS,TAS	1 1/2	1 15/16	3 15/16	2 7/32	5 3/8	7 1/16	1 7/8	3/4	9/16	1 1/32	2 3/8	1 3/8	15/16	1/2	**G1108KRRB**	**(KPPB)**	S1108KT	T-40243	4.74
RAS,TAS	1 9/16	49.21	100	56.4	136.5	179.4	47.6	19	14.3	26.2	60.3	34.9	23.8	12	**G1109KRRB**	**(KPPB)**	S1109KT	(T-30484)	2.150
RAS,TAS	40														**GE40KRRB**	**(KPPB)**	SE40K		
RAS,TAS	1 5/8														**G1110KRRB**	**(KPPB)**	S1110K		
RAS,TAS	1 11/16	2 1/8	4 3/16	2 7/32	5 7/8	7 17/32	2	3/4	9/16	1 1/8	2 1/2	1 3/8	1	1/2	**G1111KRRB**	**(KPPB)**	S1111K	T-40244	5.31
RAS,TAS	1 3/4	53.98	106.4	56.4	149.2	191.3	50.8	19	14.3	28.6	63.5	34.9	25.4	12	**G1112KRRB**	**(KPPB)**	S1112K	(T-30682)	2.409
RAS,TAS	45														**GE45KRRB**	**(KPPB)**	SE45K		
RAS,TAS	1 7/8	2 1/4	4 1/2	2 15/16	6 7/32	7 7/8	2 3/16	3/4	11/16	15/16	2 3/4	1 1/2	1 3/32	5/8	**G1114KRRB**	**(KPPB)**	S1114K	T-40245	6.62
RAS,TAS,LAS	1 15/16	57.15	114.3	62.7	158	200	55.6	19	17.5	23.8	69.8	38.1	27.8	16	**G1115KRRB**	**(KPPB)**	S1115K	(T-30706)	3.003
RAS,TAS	50														**GE50KRRB**	**(KPPB)**	SE50K		
RAS,TAS	2														**G1200KRRB**	**(KPPB)**	S1200K		
RAS,TAS	2 1/8	2 1/2	4 31/32	2 13/16	6 15/16	8 3/4	2 5/16	13/16	23/32	1 5/32	3	1 23/32	1 5/32	5/8	**G1202KRRB**	**(KPPB)**	S1202K	T-40246	8.60
RAS,TAS	2 3/16	63.5	126.2	71.4	176.2	222.3	58.7	20.6	18.3	29.4	76.2	43.7	29.4	16	**G1203KRRB**	**(KPPB)**	S1203K	(T-30738)	3.901
RAS,TAS	55														**GE55KRRB**	**(KPPB)**	SE55K		
RAS	2 1/4	2 3/4	5 15/32	3 1/16	7 13/32	9 7/16	2 3/8	15/16	23/32	1 5/32	3 5/16	1 27/32	1 3/16	5/8	**G1204KRRB**		S1204K	T-40247	12.15
RAS	2 3/8	69.85	138.9	77.8	188.1	239.7	60.3	23.8	18.3	29.4	84.1	46.8	30.2	16	**G1206KRRB**		S1206K	(T-31244)	5.511
RAS,LAS	2 7/16														**G1207KRRB**		S1207K		
RAS	60														**GE60KRRB**		SE60K		
RAS	2 15/16	3 1/4	6 15/32	3 5/8	8 1/2	10 5/8	2 3/4	1	7/8	1 1/4	4	2 5/32	1 3/8	3/4	**G1215KRRB**		S1215K	T-23423	19.90
RAS	75	82.55	164.3	92.1	215.9	269.9	69.9	25.4	22.2	31.8	101.6	54.8	34.9	20	**GE75KRRB**		SE75K		9.026

[1] Bearing number for RAS is G-KRRB. TAS uses G-KPPB, type LAS uses G-KLLB.

Note: All units have 1/8 pipe thread grease fitting except 1/2-11/16 and 3/4 units which have 1/4-28 fitting.

FAFNIR
BALL BEARING HOUSED UNITS

Mounting and Lubrication Instructions

IMPORTANT
Please read through all instructions carefully before proceeding. Failure to do so may result in premature failure and/or personal jury.

WARRANTY
Torrington will replace, free of charge, within three years of date of sale, any bearing which in its judgment has failed because of defective material or workmanship, provided it has been shown to have properly mounted,, adequately lubricated, and not subjected t abuse in operation or assembling. Such bearings must be returned to the factory, changes prepaid, and with complete information as to service. Torrington assumes no responsibility for contingent or consequential damage in any event.

TORRINGTON MAKES NO OTHER WARRANTY OR REPRESENTATION OF ANY KIND WHATSOVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MECHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

INSTALLATION

1. Ensure that the shaft is clean, free of burrs, straight, and of proper diameter. The bearing should not be mounted on a worn section of the shaft. Use of shafts with hardness greater than Rc 45 will reduce effectiveness of the locking devices. See chart for recommended shaft tolerances.

2. Align the bearing in its housing and slide the unit into position on the shaft.

3. Bolt housing tightly to its mounting supports using an appropriately sized fastener. Flat washers should be used when installing any kind of housed unit. Washers should be properly sized to bolt diameter and should not be an SAE grade, which are smaller. See chart for proper mounting torques.

4. **Eccentric locking collar bearings:** Slide collar over cammed end of inner ring. Rotate collar to engage cams and lock by tapping lightly with drift pin in the directions of shaft rotation. **For SURVIVOR bearings use a soft or non-metallic drift pin to avoid damaging the Fafnir TDC coating on the collar.** Tighten set screw to recommend torque levels as shown in the chart.

   In cases where the units are mounted vertically or where they are to assume considerable thrust loading, the unit should be placed so that the collar is forced

against the inner ring by the thrust rather than away from it. In these cases it may be advisable to spot the shaft under the set screw.

To disassemble, loosen set screw and tap collar in direction opposite shaft rotation.

5. **Set screw locking bearings:** Lock bearing to the shaft by tightening each inner ring set screw incrementally to recommended torque levels as shown in the chart. For concentric collar units, tighten each collar set screw to recommended torque levels in charts.

   To disassemble, loosen set screw.

6. **SAL/SAOL:**
   - **a.** Remove housing cover, gasket, bearing, spacer ring, endplates and packings. Use care when handling when handling gasket and packings. Slide housing and one endplate along shaft. Ensure that the overflow cup, located at the base of the pillow block, is placed on the downward side of shaft rotation. Slide bearing onto shaft and into housing, with cam side outward (facing open end of housing).
     Fixed mounting: Position bearing against housing shoulder and place spacer ring between bearing aligning ring face and housing cover shoulder face.
     Floating mounting: Position bearing in center of its floating space between housing and housing cover shoulder faces. Do **NOT** use spacer ring.
   - **b.** Follow steps three (3) and four (4) to secure bearing to shaft.
   - **c.** Replace gasket and housing cover.
   - **d.** Install packings and endplates. Tighten screws holding endplates to force packings into contact with shaft. This creates and effective seal. **NOTE: Do not overtighten packings If considerable heat develops during operation, loosen packings by loosening the screws holding endplate.**
   - **e.** **To disassemble:** Reverse the above operations to remove bearing from the shaft.

LUBRICATION

1. Bearings have been factory prelubricated with high quality grease. Bearings with contacting lip seals and shields contain a No. 2 polyurea base grease. Bearings with non-contacting labyrinth seals (suffix "KLL" in bearing part number) contain a No. 2 modified clay base grease. For **normal conditions of service** these bearings require no further lubrication.
   Normal service is considered as operation in a clean, dry environment at temperatures between –30^{o} Fahrenheit and 180^{o} Fahrenheit (-34^{o} C to 82^{o} C), and dN values (bore in mm multiplied by speed in rpm) less than 175,000.
   If service is considered abnormal due to speed, temperature, or exposure to moisture, dirt or corrosive chemicals, periodic relubrication may be advisable.

Excessive relubrication may cause high operating temperatures due to grease churning. General guidelines for relubrication are provided in the chart.

2. **SURVIVOR PT and NT:** These housed units are specifically designed for use in conditions of corrosion and contamination. The premium bearing insert is factory prelubricated with a polyrea base, high quality, type H1, food grade grease. This grease is acceptable in applications with incidental food contact.

   Periodic relubrication is advisable due to the nature of food grade greases and the corrosive environments for which these units are designed. Consult your equipment manufacturer's operating manual for relubrication cycle. Again, general guidelines are provided below.

3. **SAL/SAOL:** These pillow blocks are intended for use with oil lubrication and are equipped with a filler cup located on top of the pillow block. Each housing assembly also has an overflow cup and a pipe plug located at the base. These can be interchanged as required in order to properly locate the overflow cup should be placed on the downward side of shaft rotation. Incorrect location will cause oil to leak from the overflow cup with respect to shaft rotation. The overflow cup should be placed on the downward side of shaft rotation. Incorrect location will cause oil to leak from the overflow cup during operation. Oil should be supplied through filler cup until overflow cup is full. **NOTE: Inspect and refill only when the shaft is stationary to avoid overfilling.**

   Inspection is necessary to determine the frequency of refilling, which is based on a number of factors, including speed, temperature, and type of oil. To avoid scant lubrication, maintain oil level to the top of the overflow cup.

   In general, a high quality automotive or turbine oil with oxidation inhibitors is recommended. For normal operating conditions an SAE 30 weight oil or equivalent is adequate. Contact your local Torrington Company District Sales Office for abnormal lubrication recommendations.

Recommended Shaft Tolerance*

Shaft Size	Tolerance
1/2 - 1 15/16"	nominal to -.0005"
2 - 3 15/16"	nominal to -.0010"
above 4"	nominal to -.0015"

* These are for normal service; for heavy loads, high speeds, or vertical shaft applications, reduce the recommended shaft tolerance by half.

Recommended Setscrew Tightening Torque

Setscrew Size (in.)	Standard Steel (Torque: in.-lbs.)	Stainelss Steel (TDCF inserts) (Torque: in.-lbs.)
#10	35	23
1/4"	80	60
5/16"	155	122
3/8"	275	213
7/16"	425	340

Metric (mm)	Torque: (Nm)	
M5	4	3.1
M6	6.6	4.9
M8	15.3	11.5
M10	30	22
M22	49	37

Recommended Bolt Mounting Torque

Bolt Size (in.)	Torque (ft.-lbs.)
3/8"	27
1/2"	65
5/8"	130
3/4"	230
7/8"	573
1"	858
1 1/8"	1059

(mm)	(Nm)
M10	44
M12	77
M16	192
M20	372

General Relubrication Recommnedations*
(Greased Bearings)

Condition	Relube Interval
1. Indoor service	Not Required
2. Outdoor service	2-3 times per year
3. Severe outdoor exposure	Once a month
4. High contamination/washdown	Once a week

* Relubricate until a thin bead of fresh grease is visible at the seal lip.

SAFETY INSTRUCTIONS

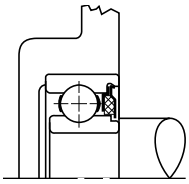
1. **This product must be properly installed and maintained to perform as intended by the manufacturer.**
2. **Before installation, consult manufacturer's recommendations.**
3. **Failure to adhere to manufacturer's recommendation may result in premature product failure and/or personal injury.**
4. **Store product in a dry and clean area.**
5. **Do not open until ready to use.**
6. **Not to be used in helicopter or nuclear applications.**

Bearing Types

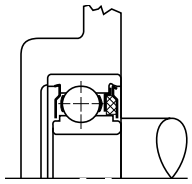
Felt Seals (T Type)

The felt seal consists of two metal plates fixed in the outer ring of the bearing which enclose a felt washer. This felt washer, which is saturated with oil before assembly in the bearing, contacts the ground outside diameter of the inner ring to provide sealing with minimum friction drag.

Bearings with felt seals are made only in the non-filling slot type and are available with one seal designated by the suffix T, one seal and one shield identified by suffix TD, and two seals suffix TT. Bores and outside diameters of these bearings are the same as standard unshielded and shielded types but overall widths are greater. As illustrated, in the T and TD types, the inner rings are offset slightly on the opposite side of the seal to permit clearance when the bearings are mounted in blind housings as illustrated.



Suffix T



Suffix TD

Rubber Seals (P Type)

Radial bearings with rubber seals having one or two seals are designated by the suffixes P and PP respectively. With the exception of the extra-small sizes, they are dimensionally interchangeable with open type and shielded bearings.

The P type design is a positive contact seal using a molded synthetic rubber. Firmly fixed to the outer ring, the seal flares outward and rides on the rabbet radius of the inner ring. The flareout of the seal against the inner rabbet radius assures constant positive contact to provide an effective barrier against the entrance of contaminants or loss of lubricants.

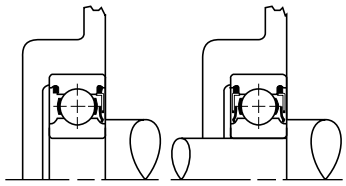
Because they interchange dimensionally with standard single row radial types, Fafnir rubber seal bearings provide a convenient compact design.

Wide-type radial rubber seal bearings (W-PP Type) designated by prefix W and suffix PP for two seals, are made with standard bores and outside diameters, but with widths the same as those as corresponding double row bearings. This design also utilizes a molded seal.

The extra width offers a larger contact area for shaft and housing and also provides additional space for displacement of grease under agitation.

These wide type rubber seal bearings are particularly well suited for use by electric motor manufacturers where their advantages have helped simplify design. A typical example of motor design simplification is illustrated.

Suffix PP



P Type **PP Type**

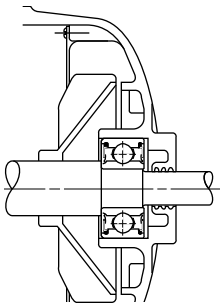
Typical Mounting Arrangements

Rubber Seals (R-Type)

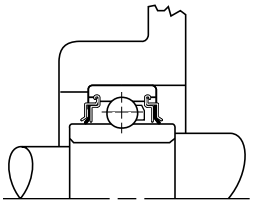
One of the most advanced sealing design introduced by Fafnir is the R-type rubber seal bearing. This is a positive contact seal of three piece construction utilizing a synthetic rubber seal retained by two steel caps. The seal flares outward and rides or wipes on the ground land of the inner ring. In this design, the rubber sealing element is completely protected by a closely-fitting outer cap or shroud, which nests tightly against the seal member following its flared out shape at the inner ring of the outside diameter. The innermost member is crimped into a groove in the outer ring and encapsulates the seal and outside shroud. Besides providing firm seal contact, the back-up plate of the seal assembly has a close clearance with the outside diameter of the inner ring thus preventing the seal from being pushed inward by external forces.

Laboratory tests have clearly established the superior performance of the shroud-type “R” seal. Along with improved lubricant retention and greater protection against contaminants, the shroud design guards the rubber seal against abrasive damage by dirt, and fiber wrap which may be prevalent in agriculture and textile applications. This seal construction is also available in standard and heavy series, wide inner ring bearings.

Electric Motor Assembly with W-PP Type Bearing



Shroud Seal suffix RR



Tri-Ply Seals

Tri-Ply, shroud seal ball bearings are designed for bearing applications involving exceptionally severe contamination or abrasion environments. They are produced in many types and sizes, both in the radial and wide inner ring designs.

Each Tri-Ply seal consists of a triple lip nitrile seal molded to a heavy metal shroud cap. All three seal lips have heavy flare-out contact with

Lubrication

LUBRICATING GREASES

DEFINITION

According to the ASTM definition, lubricating grease is a “solid to semi-fluid product of the dispersion of a thickening agent in a liquid lubricant; other ingredients imparting special properties may be included.” If this definition were laid out in the manner a chemist would use to illustrate a chemical reaction, the composition of a grease could be described by the formula below.

Fluids	+ Thickening Agents	+ Special Ingredients	= Lubricating Grease

By expanding this formula, it is possible to show the combinations possible for formulating greases to meet a wide range of operating conditions.

Fluids	+ Thickening Agents	+ Special Ingredients	= Lubricating Greases
Mineral Oils	Soaps	Oxidation Inhibitors	
Esters	Lithium, Sodium	Rust Inhibitors	
Organic	Barium, Calcium	VI Improver	
Esters	Strontium	Tackiness	
Glycols	Non-Soap (Inorganic)	Perfumes	
Silicones	Microgel (Clay)	Dyes	
	Carbon Black	Metal Deactivator	
	Silica-gel		
	Non-Soap (Organic)		
	Urea compounds		
	Terepthlamate		
	Organic Dyes		

At this time there is no known universal anti-friction bearing grease. Each individual grease has certain limiting properties and characteristics.

Synthetic lubricating fluids, such as esters, organic esters and silicones, are used with conventional thickeners or chemical additives to provide greases capable of performing over an extremely wide range of temperatures, from as low as -100°F (-73°C) to a high of 550°F (288°C).

The successful use of lubricating grease in roller bearings depends on the physical and chemical properties of the lubricant as they pertain to the bearing, its application, installation and general environmental factors. Because the choice of a lubricating grease for a particular bearing under certain service conditions is often difficult to make, our engineering department should be consulted for proper recommendations.

CHARACTERISTICS AND OPERATING ENVIRONMENTS

Table 1 lists general characteristics of prominent rolling bearing greases.

Table 1

Thickener	Typical Dropping PT F	Typical Dropping PT C	Usable** Temperature F	Usable** Temperature C	Typical Water Resistance
Sodium Soap	500 +	260 +	250	121	Poor
Lithium Soap	380	193	220	104	Good
Polyurea	460	238	300	149	Excellent
Lithium Complex Soap	500 +	260 +	325	163	Good

* The properties of a grease may vary considerably depending on the particular oil, thickener and additives used in the formulation.

** Continuous operation with no relubrication. Depending upon the formulation the service limits may vary. The usable limit can be extended significantly with relubrication.

Polyurea as a thickener for lubricating fluids is one of the most significant lubrication developments in over 30 years. Polyurea grease performance in a wide range of bearing applications is outstanding, and in a relatively short time it has gained acceptance as a factory packed lubricant for ball bearings.

Consistency

Greases may vary in consistency from semifluids, hardly thicker than a viscous oil, to solid grades almost as hard as a soft wood.

Consistency is measured by a pentrometer in which a standard weighted cone is dropped into the grease. The distance the cone penetrates (measured in millimeters in a specific time) is the penetration number.

The National Lubricating Grease Institute (N.L.G.I.) classification of grease consistency is shown below:

NLGI Grease Grades	Penetration Number
0	355-385
1	310-340
2	265-295
3	220-250
4	175-205
5	130-160
6	85-115

Grease consistency is not fixed; it normally becomes softer when sheared or “worked”. In the laboratory this “working” is accomplished by forcing a perforated plate up and down through a closed container of this grease. This “working” does not compare with the violent shearing action that takes place in a ball bearing and does not necessarily correlate with actual performance.

Low Temperatures

Starting torque in a grease lubricated ball bearing at low temperatures can be critical. Some greases may function adequately as long as the bearing is operating, but resistance to initial movement is such that the starting torque is excessive. In certain smaller machines, starting is an impossibility when very cold. Under such operating circumstances the greases containing low temperature characteristic oils are generally required.

If the operating temperature range is wide, synthetic fluid greases offer definite advantages. Greases are available to provide very low starting and running torque at temperatures as low as -100°F (173°C). In certain instances these greases perform better in this respect than oil.

An important point concerning lubricating greases is that the starting torque is not necessarily a function of either the consistency or the channeling properties of the grease. It appears to be more a function of the individual properties of the particular grease and is difficult to measure. Experience alone will indicate whether one grease is superior to another in this respect.

High Temperatures

The high temperature limit for modern grease is generally a function of the thermal and oxidation stability of the fluid and the effectiveness of the oxidation inhibitors. The graph, page E62, was prepared using military specification greases to illustrate the thermal limitations of mineral oil, ester, silicone, and flouronated ether greases. the limits as shown apply only to prelubricated bearings or to applications where relubrication is not possible. Where provisions have been made for relubrication the temperature limits may be extended providing the interval between cycles is reduced accordingly.

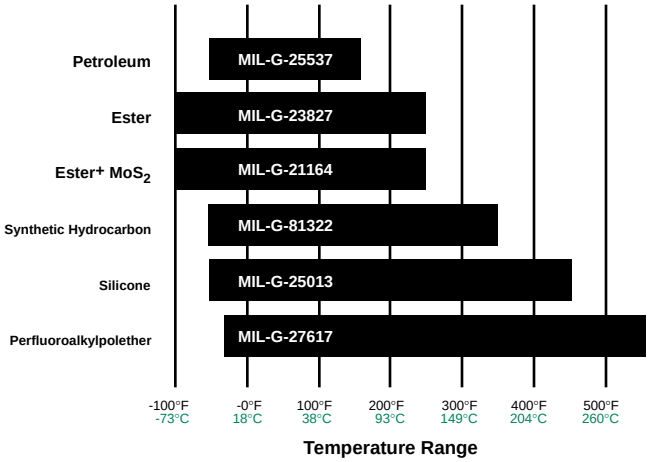
A rule of thumb, developed from years of testing grease lubricated bearings, indicates that grease life is halved for every 25°F (14°C) increase in temperature. For example, if a particular grease is providing, say 2000 hours of life at 200°F (93°C) by raising the temperature to 225°F (107°C) reduction in life to approximately 1000 hours would result. On the other hand, 4000 hours could be expected by lowering the temperature to 175°F (79°C).

It becomes obvious that the reactions started by the normal reaction of lubricant with oxygen increases rapidly at higher temperatures. The lubricants undergo a series of chemical reactions which ultimately result in the development of viscous or hard residues which interfere with the operation of the bearing.

Thermal stability, oxidation resistance, and temperature limitations must be considered when selecting greases for high temperature applications. In non-relubricatable applications highly refined mineral oils or chemically stable synthetic fluids are required as the oil component of greases for operation at temperatures above 250° F (121°C).

Lubrication

LUBRICATION GREASE TEMPERATURE RANGES



Wet Conditions

Water and moisture can be particularly conducive to bearing failure. Lubricating greases may provide a measure of protection from this contamination. Certain greases, the calcium, lithium and non-soap type, for example, are highly water resistant. However, these greases exhibit poor rut preventative characteristics unless properly inhibited.

Sodium soap greases emulsify with small amounts of moisture that may be present and prevent the moisture from coming in contact with the bearing surfaces. In certain applications this characteristic may be advantageous; however, emulsions are generally considered undesirable.

Many bearing applications require lubricants with special properties or lubricants formulated specifically for certain environments, such as :

Friction Oxidation (Fretting Corrosion)
Chemical and Solvent Resistance
Food Handling
Quiet Running
Space and/or Vacuum
Electrical Conductivity

For assistance with these or other areas requiring special lubricants, contact the Torrington engineering department.

GREASES - APPLICATIONS AND LUBRICATING METHODS

Grease lubrication is generally applicable to the following conditions, and features low to moderate speed applications within operating temperature limits of the grease:

(1) Easily confined in the housing. This is important in the food, textile and chemical industries.

(2) Bearing enclosure and seal design simplified.

(3) Improves the efficiency of external mechanical seals to give better protection to the bearing.

(4) Successfully used for integrally-sealed prelubricated ball bearings.

Advantages of prelubricated ball Bearings

Prelubricated shielded and sealed bearings are extensively used with much success on applications where:

1. Grease might be injurious to other parts of the mechanism.
2. Costs and space limitations preclude the use of a grease filled housing.
3. Housings cannot be kept free of dirt and grit, water or other contaminants.
4. Relubrication is impossible or would be a hazard to satisfactory use.

Prelubricated Torrington bearings are prepacked with greases which have chemical and mechanical stability and have demonstrated long life characteristics in rotating bearings. Greases are filtered several times to remove all harmful material and accurately metered so that each bearing receives the proper amount of grease.

GREASE LUBRICATION FOR BEARING/HOUSING ASSEMBLIES

Polyurea and lithium base greases are normally preferred for general purpose bearing lubrication and are advantageous in high moisture applications. Both greases have good water resistant characteristics. For temperature ranges of standard greases see chart below.

The grease must be carefully selected with regard to its consistency at operating temperature. It should not exhibit thickening, separation of oil, acid formation or hardening to any marked degree. It should be smooth, non-fibrous, and entirely free from chemically active ingredients. Its melting point should be considerably higher than the operating temperature.

Frictional torque is influenced by the quantity and the quality of lubricant present. Excessive quantities of grease cause churning. This results in excessive temperatures, separation of the grease components, and break down in lubrication values. On normal speed applications the housings should be kept approximately ⅓ to ½ full.

Only on low speed applications may the housing be entirely filled with grease. This method of lubrication is a safeguard against the entry of foreign matter, where sealing provisions are inadequate for exclusion of contaminants or moisture.

During periods of non-operation, it is often wise to completely fill the housings with grease to protect the bearing surfaces. Prior to subsequent operation, the excess grease should be removed and the proper level restored.

Applications utilizing grease lubrication should have a grease fitting and a vent at opposite ends of the housing near the top. A drain plug should be located near the bottom of the housing to allow purging the old grease from the bearing.

Relubricate at regular intervals to prevent damage to the bearing. Relubrication intervals are difficult to determine. If plant practice or experience with other applications is not available, consult your lubricant supplier.

STANDARD LUBRICATION - FAFNIR BALL BEARINGS

Bearing Type	Grease type	Grease Temperature Range
Radial Bearings		
(Double shielded and	Polyurea thickener	
Single and Double Sealed)	Petroleum oil	-30° to +275°F
Wide Inner Ring Bearings	Polyurea thickener	
(Contact Seal Types)	Petroleum oil	-30° to +275°F
Wide Inner Ring Bearings	Synthetic thickener	
(Labyrinth Seal Types)	Synthetic hydrocarbon fluid	-65° to +325°F
Airframe Control Bearings		
(MIL-B-7949)		
Bearing Suffix FS428	MIL-G-23827	-100° to +250°F
Bearing Suffix FS464	MIL-G-81322	-65° to +325°F
Bearing Suffix FS235	MIL-G-25537	-65° to +160°F

Note: Open type bearings and single shielded types are NOT prelubricated. They have a rust preventative coating only and must be lubricated by the customer or end-user before operation.

TECO Westinghouse

OPERATION & MAINTENANCE MANUAL FOR THREE PHASE INDUCTION MOTORS

TECO-Westinghouse Motor Company
5100 North IH-35
Round Rock, Tx. 78681

INDEX PAGE

1. INTRODUCTION

This and the following instruction address the more common situations encountered in motor installation, operation and maintenance. For the TWMC motor warranty to be and to remain in effect, the motor must be installed and operated in strict accordance with the outline drawing, motor nameplates and these instructions and must not be altered or modified in any unauthorized manner.

During the installation and operation of motors in heavy industrial applications there is a danger of live electrical parts and rotating parts. Therefore to prevent injury and/or damage the basic planning work for installation, transportation, assembly, operation, etc... needs to be done and checked by authorized and competent personnel only.

Since these instructions cannot cover every eventuality of installation, operation and maintenance, the following points should be considered and checked.

- The technical data and information on permissible use such as assembly, connection, ambient and operating conditions given in the related catalogue, operating instructions, nameplates and other production documentation.
- The general erection and safety regulations.
- The local and plant-specific specifications and requirements.
- The proper use of transport, lifting devices and tools.
- The use of personal protective equipment.

Following indications should be observed when reading these instructions.

Safety instructions are marked as follows:

Warning of electric hazards for personnel.

Warning of dangers for personnel.

ATTENTION!
Warning of damage for the motor or installation.

2. ACCEPTING, INSPECTION, STORAGE, TRANSPORTATION

Inspection upon receipt
Check to following points upon receipt:

- Are the nameplate ratings identical with what you ordered?
- Are dimensions and color in compliance with your specifications?
- Are the nameplate ratings for space heater, thermal protector, temperature detector, etc. identical with what you ordered?
- Is there any damage?
- Are all accessories and accompanying instruction manuals in good order?
- Please ensure that the arrow head indicator really indicates direction of rotation.
- If there are any specific requirements, please ensure they are in conformity with your specifications.

2.1 Storage
When motors are not in operation, the following precautionary measures should be undertaken to assure best performance.

2.2 Place
(a) High and dry, well ventilated without direct sun, dust or corrosive gas.
(b) Not located near to a boiler or freezer.
(c) Entirely free form vibration and easy for movements.
(d) Motors should be put on pallets to prevent moisture.

2.3 Moisture prevention
Since moisture can be very detrimental to electrical components, the motor temperature should be maintained about 3ºC above the dew point temperature by providing either external or internal heat. If the motor is equipped with space heaters, they should be energized at the voltage shown by the space heater nameplate attached to the motor. Incandescent light bulbs can be placed within the motor to provide heat. However, if used, they must not be allowed to come in contact with any parts of the motor because of the concentrated hot spot that could result.

2.4
Even during storage, the insulation resistance should be kept above the specified values.
(a) For measurement of insulation resistance and acceptable standard values, please refer to measures stated in 3.1.2 “Measurement of insulation resistance”.
(b) Insulation resistance test should be performed once every three months.

2.5

If the motor is not in operation for a long period (one week and above) after installation or has been in operation but stopped for a period of time, the following precautions must be taken.

(a) Protect the motor as measures stated in 2.2.3.
(b) Insulation resistance test should be performed as stated in 2.2.4.

2.6 Bearing protection

(a) If the motor has been provided with a shaft shipping brace to prevent shaft movement during transit, it must be removed before operating the motor. It is very important that this brace be re-installed exactly as it was originally, before the motor is moved form storage or any time when the motor is being transported. This prevents axial rotor movement that might damage the bearings.
(b) Motors equipped with sleeve bearings are shipped from the factory with the bearing oil reservoirs drained. In storage, the oil reservoirs should be properly filled to the center of the oil level gauge with a good grade of rust inhibiting oil. To keep the bearing journals well oiled and to prevent rusting, the motor shaft should be rotated several revolutions about every month ensuring the shaft does not come to rest in its original position. While the shaft is rotating, it should be pushed to both extremes of the endplay.
(c) Motors with anti-friction bearings are properly lubricated with the correct grade of grease at the factory and no further greasing is required in storage. The shaft should be rotated several revolutions about every month to maintain proper distribution of the grease within the bearings.
(d) Tilt-pad bearings are a type of sleeve bearing used in special design applications. Due to the nature of this bearing, a loose oil ring for delivering lubricant cannot be provided. Therefore, during the storage internal, oil must be periodically manually introduced into the pads and housing to prevent the occurrence of oxidation of the precision machined components.
    (1) Remove the pipe plug from the bearing cap located above the tilt-bearing shell.
    (2) Pour in approximately one cup of oil every month and rotate the shaft a few revolutions about every two (2) weeks.
    (3) For long periods of storage, the oil that accumulates in the housing should be removed.

ATTENTION!
Care should be taken to keep parts such as fitting surfaces, key, shaft extension and axial central hole from any collision with foreign matter. Grease should also be generously applied to prevent rusting.

2.7 Transportation

To keep the rotating parts of motors from moving, thus preventing damage and scratching during transportation, they should be held securely with a locking device. Remove all transit clamps before operating the motor. It is very important that this device be reinstalled exactly as it was originally, before the motor is moved from storage or any time when the motor is being transported. The vertical mounting type motors should be transported in the vertical position.

Do not use the hoisting hook/eyebolts to lift more that the motor itself. They are designed to support the motor only. Make sure the hoisting hook is correctly attached to the eyebolt(s)/lug(s) are fully screwed in before hoisting. Also note such parts as fan cover, ventilation box, bracket, slip-ring, etc. may have their own hoisting lugs which can only carry their own weight. Nothing extra should be attached while hoisting.
Do not twist the steel wires and make sure the eyebolts have been firmly screwed and the sling angle is correct.

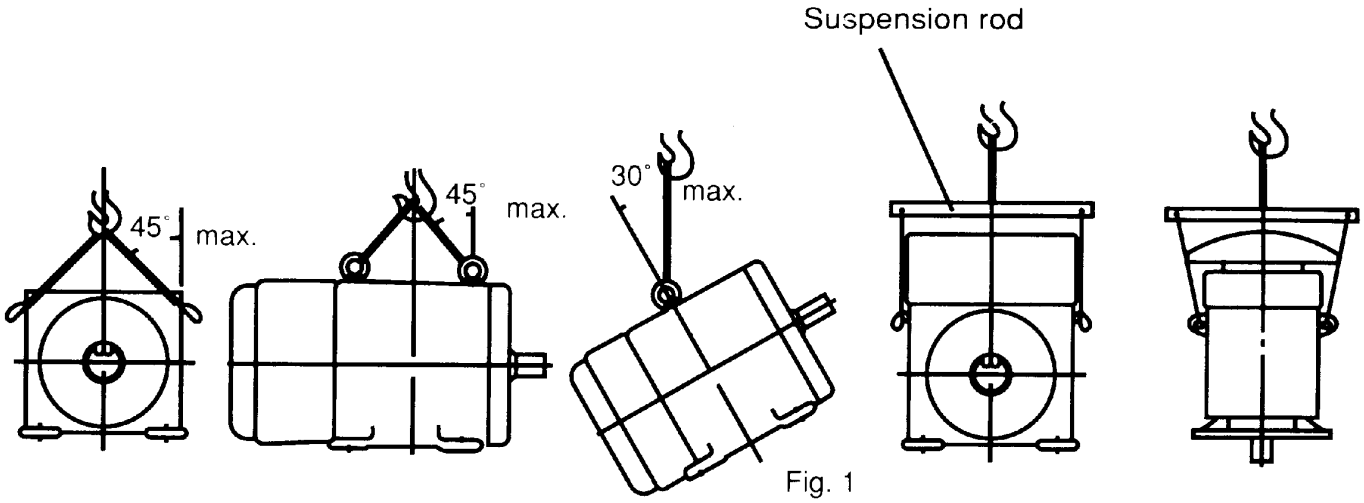


Fig. 1

3 INSTALLATION

Site and environment for motor installation
3.1.1
Standard environment and site conditions for the installation of motors are usually set as follows:

(a) Ambient temperature: -10~40ºC
(b) Humidity: Relative humidity below 90%RH for totally enclosed types, and below 80%RH for semi-enclosed types.
(c) Elevation: below 1000 meters or 3300 feet.
(d) Harmful gases, liquids, dusts, high moisture should be absent.
(e) Foundations should be strong and free of vibration.

If there are any special environmental conditions, please inform TWMC prior o ordering.

3.1.2 Ventilation and space

(a) Installation area should be well ventilated.
(b) The installation space should be large enough to facilitate heat dissipation and maintenance.

3.2 Foundation
3.2.1
Use rigid and solid sole plate or common bed as foundation.
For best motor performance, it is advisable to use a sole plate or common bed, particularly when using a shaft coupling.

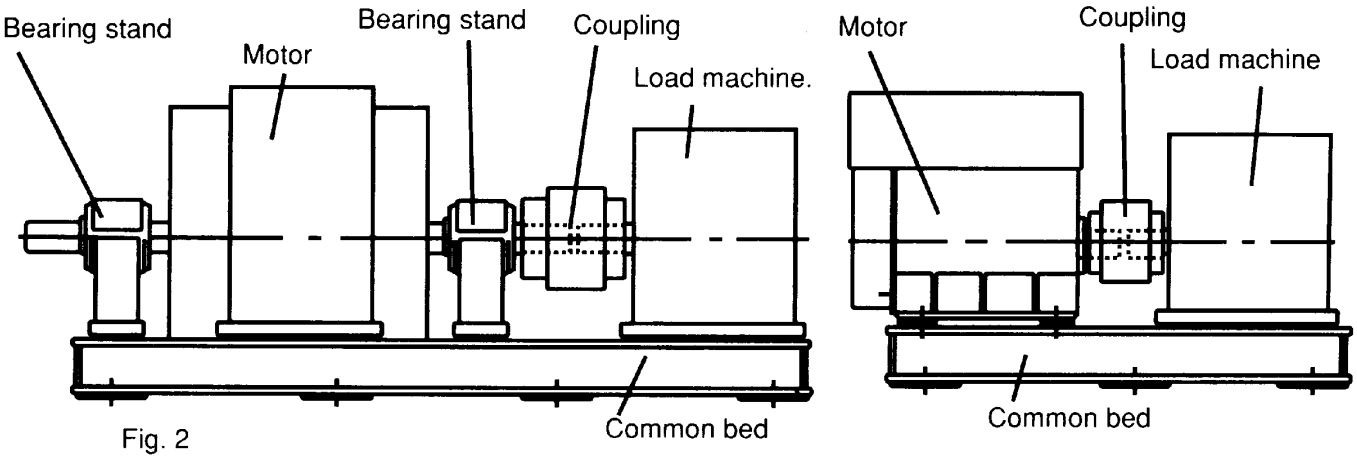


Fig. 2

3.2.2 Installation

(a) Select an appropriate foundation surface for the sole plate or common bed, which will be, considered the ultimate level.
(b) Align the position of the common bed with reference to that level.
(c) Align the level accuracy at least at four points such as bearing mounting, shaft extension etc. The accuracy should be within 0.04mm or .0015 inches
(d) Sole plate or common bed should be embedded in concrete foundation as illustrated in Fig. 3. Stiff pads should also be installed beneath the wedges, which are welded together at various spots about 400-500mm (15.75-19.70 inches) apart etc., to enable the foundation to carry evenly the weight of the whole motor.
(e) The base should be sturdy and rigid to keep it flat and level.
(f) Make sure the mortar and concrete are completely dry, and the precision of the level is acceptable, and then set the motor on the mounting foundation.
(g) Accurately install shaft couplings, belt sheaves etc., then weld the wedges solid to prevent untoward change in position.

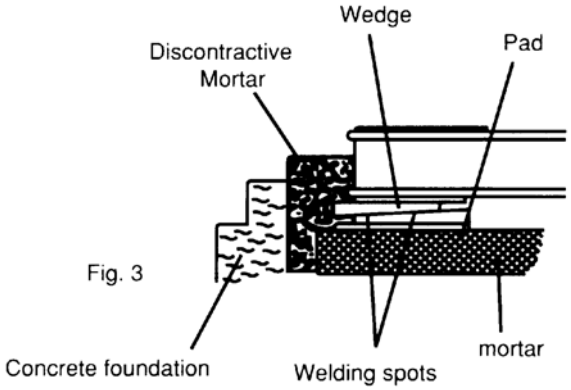


Fig. 3

3.2.3 The foundation of vertical induction motors: (Also the foundation of pump)

(a) Foundation of motor/pump must be rigid and secure to provide adequate support. There must be no vibration, twisting, misalignment etc. due to inadequate foundations.
(b) A massive concrete foundation is preferred in order to minimize vibration. Rigidity and stability are enhanced by prop plate and foundation bolt. As shown in Fig. 4.

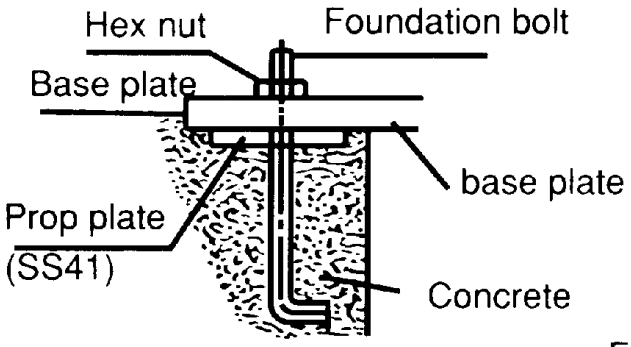


Fig. 4

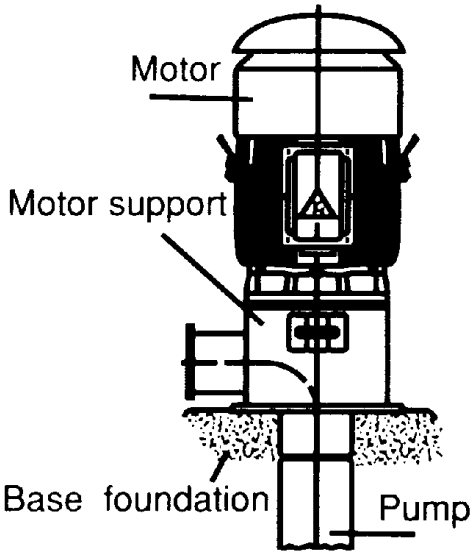


Fig. 5

3.2.4 Installation of vertical motors:

(a) All mounting surfaces must be clean and level.
(b) Foundation must be leveled at least at 4 points and guaranteed to be below 0.04mm (.0015 in.) flat and level.
(c) Make sure the mortar and concrete are completely dry, and the precision of the level is acceptable, and then set the motor on the mounting foundation.
(d) Accurately install shaft couplings.

3.3 Installation of shaft coupling

ATTENTION!
Motors must always be accurately aligned, and this applies especially where they are directly coupled.
Incorrect alignment can lead to bearing failure, vibration and even shaft fracture. As soon as bearing failure or vibration is detected, the alignment should be checked.

3.3.1

Field application of a coupling to the motor shaft should follow the procedures recommended by the coupling manufacturer. The motor shaft extension must not be subjected to either extreme heat or cold during coupling installation.

ATTENTION!
Basically, the coupling should be heated and pushed onto the shaft extension with slight axial force. Do not hammer coupling to prevent bearing damage.

3.3.2

Although the sleeve bearings are equipped with thrust faces, these are intended only to provide momentary axial restraint of rotor movement either during start-up or when operating the motor disconnected from the driven equipment. They must not be operated under a constant thrust load unless they were originally designed for this condition.

Motors with either sleeve or anti-friction bearings are suitable for connection to the driven load through a flexible coupling. Coupling solidly to the load is not acceptable. With sleeve bearings, the flexible coupling should be of the limited end float type to prevent the possibility of any end thrust from load being transmitted to the motor bearings, which could cause bearing damage. The recommended limits of end float are as follows:

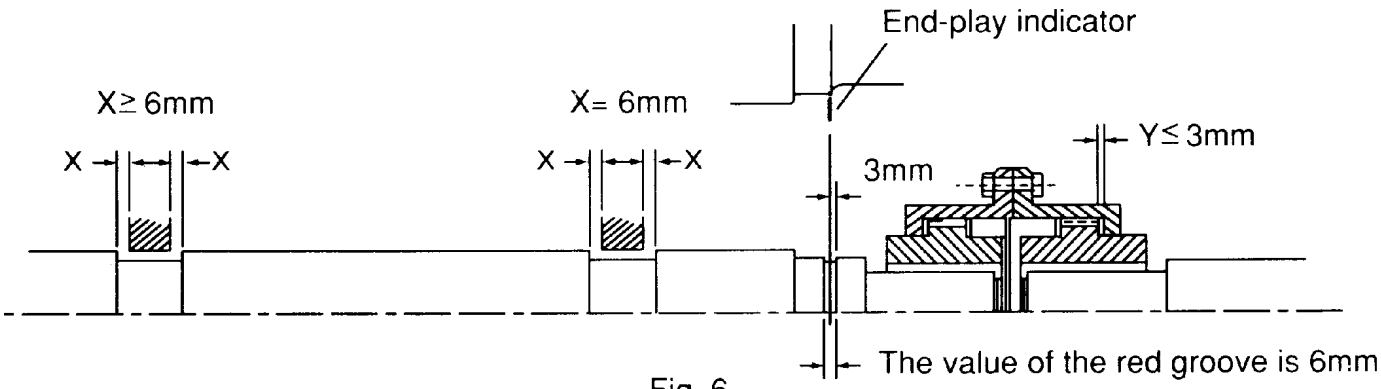


Fig. 6

(a) When the motor is in operation after installation, be sure that the end-play indicator is within the 6mm (.236 in.) of the groove on the shaft or aligned to the shaft shoulder immediately outboard of the drive-end bearing to assure there is low friction between shaft and bearing.

(b) Unless otherwise specified, the designed end-play value X of the groove for TWMC motors in general is within 6mm (.236 in.) as illustrated in Fig. 6. In essence, the endplay indicator is adjusted to point at the center of the groove or the drive-end shaft shoulder; thus X equals to 6±1mm or so, and the endplay value (Y) of the couplings should equal or be smaller than 3mm (.118 in.).

(c) If the desired value Y is grater than 3mmm (.118 in.) caused for instance by a thrust load and/or load machine with large end-play, please inform TWMC prior to entering an order.

3.3.3

In aligning the motor (and rotor) axially with the driven equipment, consideration should be given not only to the endplay indicator position but also to axial shaft expansion and increase in shaft centerline height due to thermal effects. In general, the axial shaft growth for motors can be disregarded since neither bearing is fixed and any shaft growth due to temperature increase will produce an elongation away from the coupling.

Shaft height growth (change in shaft centerline elevation) for TEFC machines can be calculated as follows:

$$\Delta=(0.0005”) \times (\text{motor foot to shaft £ dimension})$$

For non-TEFC machines, divide the number by 2.

3.3.4

It is desirable, in normal operation that the motor operates on its magnetic center, so that no axial force is exerted on the coupling.

The motor shaft and the driven shaft should be aligned within the following tolerances in both angular and parallel alignment:

Unit: mm

TIR	Range of rotating speed	Solid coupling	Flexible coupling
C	2500 rpm and above	0.03	0.03
	Below 2500 rpm	0.04	0.05
A	2500 rpm and above	0.03	0.03
	Below 2500 rpm	0.03	0.04

Angular misalignment is the amount by which the centerlines of driver and driven shafts are skewed. It can be measured using a dial indicator set up as shown in Fig. 7. The couplings are rotated together through 360 degrees so that the indicator does not measure runout of the coupling hub face. The shafts should be forced against either the in or out extreme of their end float while being rotated.

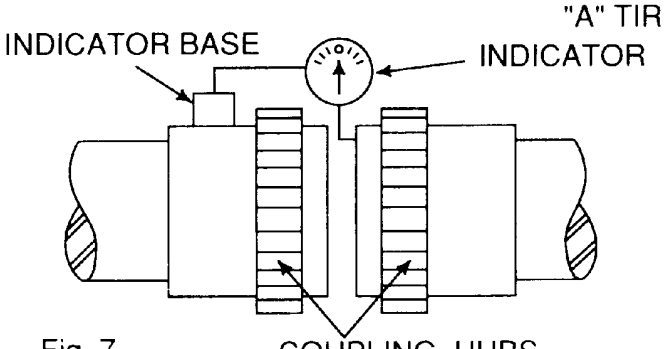


Fig. 7

TIR=Total indicator reading (by dial indicator)

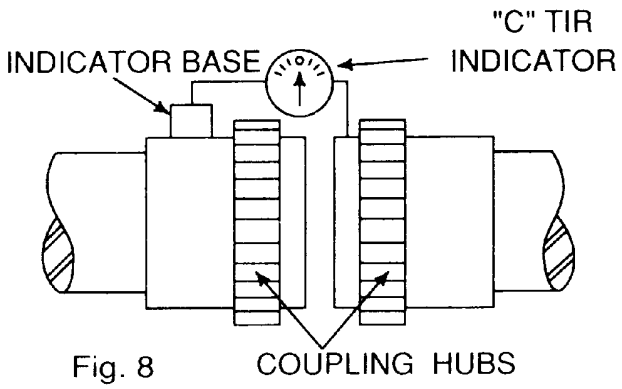


Fig. 8

Parallel misalignment is the amount by which the centerlines of the driver and driven shafts are out of parallel. It can be measured using a dial indicator set up as shown in Fig. 8. Again, the couplings are rotated together through 360 degrees so that the indicator does not measure runout of the coupling hub outside diameter.

3.3.5

After the motor has been properly aligned with the driven equipment and the hold-down bolts have been installed and tightened, for motors with fabricated frames, at least two dowel pins should be installed in two diagonally opposite motor feet.

3.3.6 Installation of shaft coupling: (Vertical hollow shaft motor only)

Bolted Coupling as shown in Fig. 9

(a) Bearings are provided to absorb some upward shaft thrust when the coupling is fitted.
(b) The coupling is fastened with bolts.
(c) This coupling type is not auto-release type.

Note: Standard high thrust motors can absorb momentary up-thrust load up to 30% of the standard down thrust load. If the up-thrust is long in duration (over 10 Seconds) and/or exceeds 30% of the standard high thrust rating, special design arrangements are required and standard motor is not suitable.

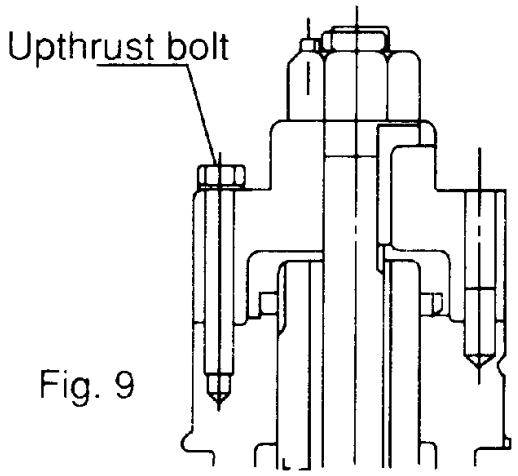


Fig. 9

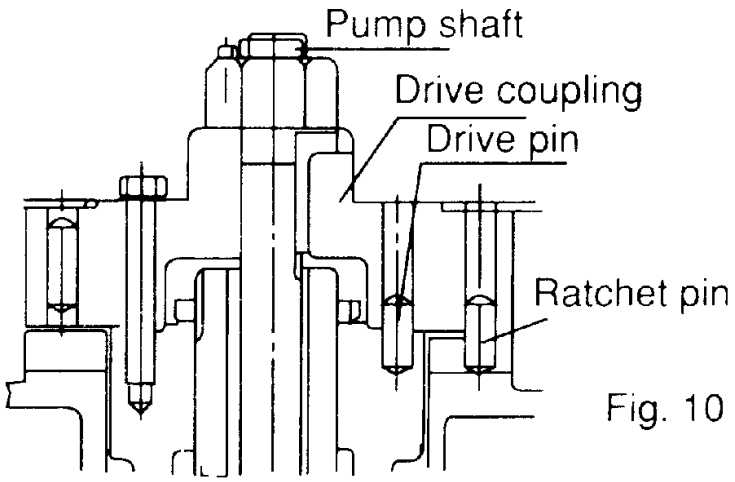


Fig. 10

3.3.7 Non-reverse ratchet/coupling, as Fig. 10 (If necessary)

The non-reverse coupling is also a bolted type and,

(a) It prevents the pump and motor from rotating in the reverse direction.
(b) It also prevents damage form over speeding and damage to pump shaft and bearings.
(c) The ratchet pins are lifted by the ratchet teeth and are held clear by centrifugal force and friction as the motor comes up to speed.
(d) When power is removed, speed decreases, and the pins fall. At the instant of reversal, a pin will catch in a ratchet tooth and prevent backward rotation.
(e) When installing the non-reverse coupling, do not use lubricant. Lubricant will interfere with proper operation. The top half of the coupling should seat solidly on the lower half and the pins should touch the bottom of the pockets between the teeth in the plate.
(f) As with the bolted coupling, the up-thrust capabilities are 30% of the standard high thrust rating for down thrust.

ATTENTION!
Do not apply non-reverse ratchets on applications in which the pump reversal time from shutdown (the instant the stop button is pressed) to zero speed is less than one second.

3.4 Installation for belt drive

In general, power transmission though direct flexible coupling is appropriate for large motors. Such motors are not suitable for belt, chain or gear connection unless specially designed for such service. However, for small and medium motors of which outputs within the ranges shown on table below, it is acceptable to use belt transmission as indicated. Beyond these ranges, do not apply belt sheaves unless specially designed.

3.4.1

The diameter ratio between conveyance sheaves should not be greater than 5 to 1 for flat belts, and 8 to 1 for V-belts. It is also advisable to limit the belt velocity to under 35m/sec (115 ft/sec) to limit belt abrasion and vibration. The smaller the outer diameter of the V-belt sheave, the greater the shaft bending stress will be. If the bending stress is in excess of the shaft fatigue stress, the shaft may break. Therefore, please inform TWMC when you have decided the size of the sheaves and the length of the belts upon ordering.

ATTENTION!
Place the sheave and belt as close as possible to the motor body (it is advisable to make x as shown in Fig. 11 equal to 0) to reduce the bending moment and improve shaft life.

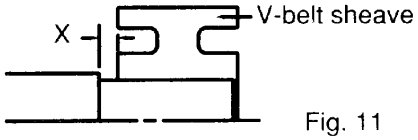


Fig. 11

3.4.2 Table of belt-sheave application for general electric motors

Output (KW/HP)			V-Belt Sheave							
			Conventional V-Belts				Narrow V-Belts			
4P	6P	8P	V-Belt Type	Number Of Belts	Min. PCD (mm)	Max Width (mm)	V-Belt Type	Number Of Belts	Min. PCD (mm)	Max Width (mm)
11/15	-	-	B	4	160	82	3V	4	125	48
-	11/15	-	B	5	170	101	3V	5	140	59
-	-	11/15	B	5	190	101	3V	6	160	69
15/20	-	-	B	5	170	101	3V	6	125	69
-	15/20	-	B	5	224	101	3V	6	160	69
-	-	15/20	C	4	224	111	5V	3	180	60
18.5/25	-	-	B	5	200	101	3V	6	140	69
-	18.5/25	-	C	4	224	111	5V	3	180	60
-	-	18.5/25	C	5	224	136	5V	4	180	78
22/30	-	-	B	5	224	101	5V	6	160	69
-	22/30	-	C	5	224	136	3V	4	180	78
-	-	22/30	C	5	250	136	5V	4	200	78
30/40	-	-	C	5	224	136	5V	4	180	78
-	30/40	-	C	5	265	136	5V	4	224	78
-	-	30/40	C	6	265	162	5V	5	224	95
37/50	-	-	C	6	224	162	5V	4	200	78
-	37/50	-	C	6	265	162	5V	4	224	78
-	-	37/50	C	7	280	187	5V	5	250	95
45/60	-	-	C	6	265	162	5V	4	224	78
-	45/60	-	C	7	280	187	5V	5	224	95
-	-	45/60	C	7	315	187	5V	6	250	113
55/75	-	-	C	7	265	187	5V	5	224	95
-	55/75	-	C	8	300	213	5V	6	250	113
-	-	55/75	D	5	355	196	5V	6	280	113
75/100	-	-	C	8	315	213	5V	6	250	113
-	75/100	-	D	6	355	233	5V	6	315	113
-	-	75/100	D	6	400	233	5V	6	355	113
-	90/120	-	D	6	400	233	5V	6	355	113
-	-	90/120	D	6	425	233	8V	4	355	124
-	110/150	-	D	7	400	270	8V	4	355	124
-	132/175	110/150	D	7	450	270	8V	4	400	124
-	160/200	132/175	D	9	450	344	8V	4	450	124

3.5 Conveyance with chain or gear

3.5.1

Make sure the loading capacity of shaft and bearings is appropriate for the size and installation position (overhung) of chain and gear. If necessary, please contact us to ensure the shaft and bearings will meet your requirements.

3.5.2
Pay close attention to ensure the parallelism of shafts.

3.5.3
The teeth of couplings should be correctly and precisely matched; the force conveyance centers should lie on the same line.

3.5.4
There should be no skip, jumping, vibration or unusual noises.

ATTENTION!
Do not hammer the conveyance devices such as couplings, belt sheaves, chain wheels, gears etc. onto the shaft. Those shaft fitments should be fitted and removed only by means of suitable devices. Heat shrinking may be a better alternative to avoid damaging bearings and components.

The exposed rotating parts should be covered to prevent accidents.

3.6 Electrical connections

All interconnecting wiring for controls and grounding should be in strict accordance with local requirements such as the USA National Electrical Code and UK IEE wiring regulations. Wiring of motor and control, overload protection and grounding should follow the instructions of connection diagrams attached to the motor.

3.6.1 Power

The rated conditions of operation for the motor are as shown on the nameplate. Within the limits, given below, of voltage and frequency variation from the nameplate values, the motor will continue to operate but with performance characteristics that may differ from those at rated conditions:

±10% of rated voltage
±5% of rated frequency
±10% combined voltage and frequency variation so long as frequency variation is no more than ±5% of rated.

Operating the motor at voltages and frequencies outside of the above limits can result in both unsatisfactory motor performance and damage to or failure of the motor.

3.6.2
The main lead box furnished with the motor has been sized to provide adequate space for the make-up of the connections between the motor lead cables and the incoming power cables.

The bolted joints between the motor lead and the power cables must be made and insulated in a workman-like manner following the best trade practices.

3.6.3
Either fabricated motors or fan cooled cast frame, motors are all provided with grounding pads or bolts.

The motor must be grounded by proper connection to the electrical system ground.

3.6.4

The rotation direction of the motor will be as shown by either a nameplate on the motor or the outline drawing. The required phase rotation of the incoming power for this motor rotation may also be stated. If either is unknown, the correct sequence can be determined in the following manner: While the motor is uncoupled from the load, start the motor and observe the direction of rotation. Allow the motor to achieve full speed before disconnecting it from the power source. Refer to the operation section of these instructions for information concerning initial start-up. If resulting rotation is incorrect, it can be reversed by interchanging any two (2) incoming cables.

3.6.5 Auxiliary devices

Auxiliary devices such as resistance temperature detectors, thermocouples, thermoguards, etc., will generally terminate on terminal blocks located in the auxiliary terminal box on the motor. Other devices may terminate in their own enclosures elsewhere on the motor. Such information can be obtained by referring to the outline drawing. Information regarding terminal designation and the connection of auxiliary devices can be obtained from auxiliary drawings or attached nameplates.

If the motor is provided with internal space heaters, the incoming voltage supplied to them must be exactly as shown by either a nameplate on the motor or the outline drawing for proper heater operation.

Caution must be exercised anytime contact is made with the incoming space heater circuit as space heater voltage is often automatically applied when the motor is shutdown.

4. OPERATION

4.1 Examination before start

4.1.1

When motors are installed in good manner, ensure the wiring is according to the diagram. Also, the following points should be noted:

(a) Make sure all wiring is correct.
(b) Ensure the sizes of cable wires are appropriate and all connections are well made for the currents they will carry.
(c) Ensure all connections are properly insulated for the voltage and temperature they will experience.
(d) Ensure the capacity of fuses, switches, magnetic switches and thermo relays etc. are appropriate and the contactors are in good condition.
(e) Make sure the frame and terminal box are grounded.
(f) Make sure that the starting method is correct.
(g) Make sure switches and starters are set at their right positions.
(h) Motor heaters must be switched off when the motor is running.

4.1.2 Measurement of insulation resistance

During and immediately after measuring, the terminals must not be touched as they may carry residual dangerous voltages. Furthermore, if power cables are connected, make sure that the power supplies are clearly disconnected and there are no moving parts.

(a) For rated voltage below 1000V, measured with a 500VDC megger.
(b) For rated voltage above 1000V, measured with a 1000VDC megger.
(c) In accordance with IEEE 43, clause 9.3, the following formula should be applied:

$$R \geq \left(\frac{\text{Rated voltage (v)}}{1000} + 1 \right) \times 10(M\Omega)$$

(d) On a new winding, where the contaminant causing low insulation resistance is generally moisture, drying the winding through the proper application of heat will normally increase the insulation resistance to an acceptable level. The following are several accepted methods for applying heat to the winding:
   (1) If the motor is equipped with space heaters, they can be energized to heat the winding.
   (2) Direct current (as from a welder) can be passed through the winding. The total current should not exceed approximately 50% of rated full load current. If the motor has only three leads, two must be connected together to form one circuit through the winding. In this case, one phase will carry the fully applied current and each of the others, one-half each. If the motor has six leads (3 mains and 3 neutrals), the three phases should be connected into one series circuit.

Ensure there is adequate guarding so live parts cannot be touched.

   (3) Heated air can either blown directly into the motor or into a temporary enclosure surrounding the motor. The source of heated air should preferably be electrical as opposed to fueled (such as kerosene) where a malfunction of the fuel burner could result in carbon entering the motor.

ATTENTION!
Caution must be exercised, when heating the motor with any source of heat other than self contained space heaters, to raise the winding temperature at a gradual rate to allow any entrapped moisture to vaporize and escape without rupturing the insulation. The entire heating cycle should extend over 15-20 hours.

Insulation resistance measurements can be made while the winding is being heated. However, they must be corrected to 40ºC for evaluation since the actual insulation resistance will decrease with increasing temperature. As an approximation for a new winding, the insulation resistance will approximately halve for each 10ºC increase in insulation temperature above the dew point temperature.

(e) Should the resistance fail to attain the specified value even after drying, careful examination should be undertaken to eliminate all other possible causes, if any.

4.1.3 Power Source

(a) Ensure the capacity of the power source is sufficient.
(b) Ensure the supply voltage and frequency ratings are identical to those on the nameplate.
(c) Voltage variation should be confined to within ±10% of the rated value and the phase to phase voltages should be balanced.

4.1.4 Bearing lubrication

(a) For sleeve bearing motors, the oil reservoir must be filled with oil to the correct level. On self-lubricated bearings, the standstill oil level will be at the center of the oil gauge. The proper oil is a rust and oxidation inhibited, turbine grade oil. Refer to the lubrication nameplate for the recommended viscosity.

(b) Motors, which are supplied with provision for flood lubrication, have an inlet orifice to meter the oil flow to the bearing. Refer to the outline drawing for these values. If the supply pressure does not match that stated on the outline, the orifice size must be adjusted to produce the specified flow rate. The drain adapter (also provided) has a weir plate fixed to the inside of the pipe to permit the establishment of the proper oil level. This weir plate must be located at the bottom of the pipe and must be parallel to the plane of the motor feet. To ensure optimum flow, the drain line should be vented to the atmosphere.

Oil inlet temperature: Normal below 50ºC
Alarm 60ºC
Trip 65ºC

(c) If the motor is in storage for over three (3) months, refilling of some new oil should be undertaken before operation to prevent bearing damage due to dry friction. The oil level should be kept at the center of the oil gauge. If necessary, drain some oil after refilling.

(d) Motors that have been designed with anti-friction bearings for use with an oil mist lubrication system have been packed at the factory with a small amount of grease for short test runs. Continuous running should not be considered unless the oil mist system is installed and operating.

(e) Grease lubricant type

(1) The bearings have been well greased at the factory before delivery. However, regreasing is required if a significant period has elapsed between manufacture and use or in storage

(2) All motors with ZZ bearings will have SHELL Alvania R3 (*Lithium base grease*). All motors with open bearings will have Polyrex EM (polyurea base grease).

4.1.5 Cooling water for the cooler on water-cooled motors

Make sure the quality, volume and inlet temperature of cooling water for the motors are normal before the machine is in operation.

Water: General tower water or industrial water.
Volume: Please see outline drawing
Inlet temperature: Normal below 30ºC
Alarm 35ºC
Trip 40ºC

ATTENTION!
Make sure all locks, which fasten the movable parts of the motors during transportation, are dismantled and the shaft can rotate freely.

ATTENTION!
Ensure there is no foreign matter or tools inside the motors before starting motors.

4.1.6
Make sure the transmission system, including belts, screws, bolts, nuts and set pins are in good condition.

The keys fitted to the shaft extensions are held by plastic tape only to prevent them from falling out during transportation or handling. The shaft key shall be removed to avoid flying out, when the motor is operated prior to the couplings etc. being fitted to the shaft extension.

4.1.7
Make sure the items above are examined. Test the motor running with or without load. Record and check according to "Maintenance" at 15-minute intervals during the first three hours of operation. Then regular examinations should take place at longer intervals. If all goes well the motor can be classified as "in good order".

4.2 Starting operation

4.2.1 Starting load
Initially run the motor unloaded prior to coupling to other machines. Unless otherwise specified, a motor usually starts with light load, which is then gradually increased, proportional to the square of the speed and at last reaches 100% load at full load speed.

4.2.2 Starting
Too frequent starts can be harmful to the motors. The following restrictions should be observed:

(a) Motor can be restarted should the initial start fail. Two starts are generally permissible when the motor is cold.
(b) Motor can be started only once when it is at normal running temperature.
(c) Should additional starts be necessary beyond the conditions stated above, the following restrictions should be noted:
    (1) Let the motor cool down for 60 minutes before restarting, fully loaded.
    (2) Let the motor cool down for 30 minutes before restarting, unloaded.
    (3) Two inching starts can be regarded as one normal start.

ATTENTION!
If the motor rotor fails to start turning within one or two seconds, shut off the power supply immediately.
Investigate thoroughly and take corrective action before attempting a restart.

Possible reasons for not starting are:
(1) Too low a voltage at the motor terminals.
(2) The load is too much for the rotor to accelerate.
(3) The load is frozen up mechanically.
(4) All electrical connections have not been made.
(5) Single-phase power has been applied.
(6) Any combination of the above.

4.2.3 Rotating direction

(a) Most TWMC motors are bi-directional. However, when some special types, such as high speed 2-Pole, certain large capacity motors, those with a non-reversing ratchet etc., should rotate in one direction, please ensure the rotation is in conformity with the directional arrow-mark shown on the attached nameplate.

(b) To reverse a bi-directional motor, cut the power and wait until the motor stops. Then interchange any two of the three phases.

4.2.4 Power source, Voltage, Current

(a) Ensure the voltage and frequency of the power source are identical to the ratings shown on the nameplate.

(b) Voltage variation should be confined to within ±10% of the rating and the three phase voltages should be in full balance

(c) Ensure the motor phase currents, when without load, are within ±5% of the average values.

4.2.5

Frequency variation should be confined to within ±5% of the rating. The aggregate variation of voltage and frequency should be confined to within ±10% of the absolute value of the ratings.

Starting time and unusual noises

ATTENTION!
Starting time is longer for the motors with large inertia. However, if starting time is longer than usual or if there is difficulty in starting, or there is abnormal noise, do not run the motor and refer to TWMC Service representative.

4.2.6 Sleeve bearing oil rings (sleeve bearing types only)

As the oil ring is used to carry lubricant to sleeve bearings, frequently check to ensure the oil ring is in motion.

4.2.7 Bearing temperature rise

Following the initial start-up, the bearing temperatures should be closely monitored. The rate of rise in bearing temperature is more indicative of impending trouble than is the actual temperature.

ATTENTION!
If the rate of rise in temperature is excessive or if the motor exhibits excessive vibration or noise, it should be shut down immediately and a thorough investigation made as to the cause before it is operated again.

If the bearing temperature rise and motor operation appear to be normal, operation should continue until the bearing temperature stabilizes.

Recommended limits on bearing temperature are as follows:

Sleeve Bearings	**Total measured temperature**
● By permanently installed detector	90ºC
● By temporary detector on top of the bearing sleeve near the oil ring	85ºC

Anti-Friction Bearings	Total measured temperature
● By permanently installed detector	100ºC
● By temporary detector measuring the outside of the bearing housing	95ºC

ATTENTION! (For sleeve bearing)

(1) It must be noted that when operating flood lubricated sleeve bearings without outside lubrication supplied, the bearing temperature must not be allowed to exceed 85ºC total temperature

(2) Under normal condition, for the self-lube bearing, the rate of temperature rise should be from 11 to 14ºC for the first ten (10) minutes after starting up and approximately 22ºC at thirty (30) minutes. The rate of bearing temperature rise is a function of the natural ventilation and operating conditions.

(3) When the rate of bearing temperature rise is less than 1ºC per half-hour, the bearing temperature is considered to be stabilized.

(4) If the total bearing temperature exceeds 95ºC, the motor should be shut down immediately.

Noise and Vibration

ATTENTION!
Any abnormal noise or vibration should be immediately investigated and corrected. Increased vibration can be indicative of a change in balance due to mechanical failure of a rotor part, a stator winding problem or a change in motor alignment.

5. MAINTENANCE

5.1 Major points in regular inspections and maintenance.

For safety, maintenance and repairs must only be carried out by properly trained personnel.

Some testing, such as insulation resistance, usually requires the motor to be stopped and isolated from power supplie(s).

Routine inspection and maintenance are usually performed by looking, listening, smelling and simple meters.

High temperature may arise under operating conditions on the motor surfaces, so that touching should be prevented or avoided. Keep away from moving and live parts. Unless deemed necessary, do not remove guards whilst assessing the motor.

Timely replacement of worn parts can assure longevity and prevent breakdown.

Routine inspection and regular inspection and maintenance are important in preventing breakdown and lengthening service life.

Owing to the varied time and circumstances, motors are used, it is difficult to set the items and periods for regular inspection and maintenance. However, as a guide it is recommended to be performed periodically according to factory maintenance program. Generally, the inspection scope determined by the following factors:

(a) Ambient temperature.
(b) Starting and stopping frequency.
(c) Troublesome parts usually affecting motor functions.
(d) Easily abraded parts.
(e) The important position of motor in the operational system of a factory should be duly recognized. Therefore, its health and wellbeing should be fully protected especially when it is operating in severe conditions.

5.2 Motor windings:

(a) Measurement of insulation resistance and standards to determine quality of insulation resistance, please refer to measures stated in 3.1.2 “Measurement of insulation resistance”.
(b) Inspection of coil-ends:
    (1) Grease and dust accumulated on coils may cause insulation deterioration and poor cooling effect.
    (2) Moisture must not accumulate. Keep coils warm when motor is not in use if moisture can be seen.
    (3) Discoloring. This is mainly caused by overheating.
(c) Ensure no untoward change of wedges from original position.
(d) Ensure the binding at the coil end is in its normal position.

5.3 Clean the interior of the motor:

(a) After a motor is in operation for some time, accumulation of dust, carbon powder and grease etc., on the inside is unavoidable, and may cause damage. Regular cleaning and examination is necessary to assure top performance.
(b) Points to note during cleaning:
    (1) If using compressed air or blower:
        (a) Compressed air should be free of moisture.
        (b) Maintain air pressure at 4 kg/cm², since high pressure can cause damage to coils.
    (2) Vacuum
        Vacuum cleaning can be used, both before and after other methods of cleaning, to remove loose dirt and debris. It is a very effective way to remove loose surface contamination from the winding without scattering. Vacuum cleaning tools should be non-metallic to avoid any damage to thee winding insulation
    (3) Wiping
        Surface contamination on the winding can be removed by wiping using a soft, lint-free wiping material. If the contamination is oily, the wiping material can be moistened (not dripping wet) with a safety type petroleum solvent. In hazardous locations, a solvent such as inhibited methyl chloroform may be used, but must be used sparingly and immediately removed. While this solvent is non-flammable under ordinary conditions, it is toxic and proper health and safety precautions should be followed while using it.

ATTENTION!
Solvents of nay type should never be used on windings provided with abrasion protection. Abrasion protection is a gray, rubber-like coating applied to the winding end-turns.

Adequate ventilation must always be provided in any area where solvents are being used to avoid the danger of fire, explosion or health hazards. In confined areas (such as pits) each operator should be provided with an airline respirator, a hose mask or a self-contained breathing apparatus. Operators should wear goggles, aprons and suitable gloves. Solvents and their vapors should never be exposed to open flames or sparks and should always be stored in approved safety containers.

(4) Keep core ducts completely clean. The difference in temperature rise could be around 10°C before and after cleaning

5.4 Clean the exterior of the motor:

(a) On open ventilated motors, screens and louvers over the inlet air openings should not be allowed to accumulate any build-up of dirt, lint, etc. that could restrict free air movement.

ATTENTION!
Screens and louvers should never be cleaned or disturbed while the motor is in operation because any dislodged dirt or debris can be drawn directly into the motor.

(b) If the motor is equipped with air filters, they should be replaced (disposable type) or cleaned and reconditioned (permanent type) at a frequency that is dictated by conditions. It is better to replace or recondition filters too often than not often enough.

(c) Totally enclosed air to air cooled and totally enclosed fan cooled motors require special cleaning considerations. The external fan must be cleaned thoroughly since any dirt build-up not removed can lead to unbalance and vibration. All of the tubes of the air-to-air heat exchanger should be cleaned using a suitable tube brush having synthetic fiber bristles (not wire of any type).

5.5 Maintenance of anti-friction bearings

5.5.1 Frequency of re-lubrication:

The life of grease varies greatly as a result of types of model, revolution speed, temperature, operational conditions etc. It is, therefore, impossible to be precise about replenishment intervals. However, for normal direct coupling transmission, the periods shown as Table 1 may be used as a guide.

Remarks:

(a) The periods shown in Table 1 should be halved where bearings are used for belt drive and/or in dirty or high ambient temperature or high humidity environments.

(b) Please refer to the lubrication nameplate, if attached to the motor.

(c) For bearing numbers outside the range of Table 1, please contact TWMC

(d) If the periods referred to in Table 1 for drive-end bearing and opposite drive-end are different, for the convenience of maintenance operation, please take the shorter one the required grease replenishment period of these bearings.

5.5.1 Kinds of grease:

All motors with ZZ bearings will have SHELL Alvania R3 (lithium base grease). All motors with open bearings will have Polyrex EM (polyurea base grease).
Certain T-frame models will utilize special grease and will be noted on the lubrication nameplate. Please us identical grease or its equivalents when maintaining lubrication schedule.

ATTENTION!
Do not mix different kinds of grease.
Mixing grease with different type of thickeners may destroy its composition and physical properties. Even if the thickeners are of the same type, possible differences in the additive may cause detrimental effects.

5.5.2 Grease quantity

The amount of grease per replenishment depends on the type, size and construction of the bearings. The maximum amount of one replenishment for each bearing is shown in Table 2.

5.5.3 Re-greasing

If re-lubrication is to be performed when the motor is running, stay clear of rotating parts.

It is advisable to re-grease when the motor is running to allow the new grease to be evenly distributed inside the bearing.
Before re-greasing, the inlet fitting should be thoroughly cleaned to prevent any accumulated dirt from being carried into the bearing with the new grease. The outlet of grease drainage should be opened to allow the proper venting of old grease.

Use a grease gun to pump grease through grease nipple into the bearings. After re-greasing, operate the motor for 10-30 minutes to allow any excess grease to vent out.

TABLE 1.

Bearing Number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM	3000 RPM	3600 RPM
62XX 63XX 72XX 73XX	6210										
	12									2000 Hrs.	
	13										
	14									1000 Hrs.	
	15										
	16									720 Hrs.	
	17							2000 Hrs.			
	18			3000 Hrs.							
	20										
	22										
	24							1500 Hrs.			
	26										
	28					2000 Hrs.		1000 Hrs.			
	30										
	32							500 Hrs.			
	34					1500 Hrs.					
	36										
	38			2000 Hrs.		1000 Hrs.					

Bearing Number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM
NU2XX NU3XX	NU214								
	15							2000 Hrs.	
	16								
	17								
	18			3000 Hrs.				1500 Hrs.	
	20								
	22							1000 Hrs.	
	24								
	26					2000 Hrs.			
	28							500 Hrs.	
	30								
	32								
	34			2000 Hrs.		1000 Hrs.			
	36								
	38	2000 Hrs.							
	40								
	44			1000 Hrs.					
	48	1000 Hrs.							

Bearing Number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM
222XX 223XX	22220							300 Hrs.	
	22								
	24			1000 Hrs.		500 Hrs.			
	26								
	28								
	30					300 Hrs.			
	32			500 Hrs.					
	34								
	36								
	38	500 Hrs.							
	40			300 Hrs.					
	44								
	48	300 Hrs.							

TABLE 2.

Bearing No.		Amount of replenishment
62XX 72XX NU2XX 2222XX	6210	30 g
	6212	40
	6213	50
	6214	50
	6215	60
	6216	60
	6217	80
	6218	80
	6220	100
	6222	120
	6224	120
	6226	140
	6228	160
	6230	180
	6232	200
	6234	250
	6236	300
	6238	350
	6240	400
	6244	450
	6248	500

Bearing No.		Amount of replenishment
63XX 73XX NU223XX 223XX	6310	40 g
	6312	60
	6313	80
	6314	80
	6315	100
	6316	100
	6317	120
	6318	120
	6320	160
	6322	220
	6324	270
	6326	300
	6328	400
	6330	450
	6332	500
	6334	600
	6336	700
	6338	800
	6340	900
	6344	900
	6348	900

*Fill new grease until it overflows and the old grease is entirely replaced.

5.5.4 Oil re-lubrication (For oil lubrication types only)

Maintain proper lubrication by checking the oil level periodically and adding oil when necessary. Because of the initial clearing action of the bearing and the expansion of the oil as it comes up to operating temperature, the oil level will be higher after the motor has been in operation for a while than it is with the motor at standstill.

Overfilling should be avoided not only because of the possibility that expansion may force the oil over the oil sleeve and on to the rotor, but also because too high an operating oil level prevents the bearing form clearing itself of excess oil. The resultant churning can cause extra loss, high temperatures, and oxidized oil. If, during operation, the oil level goes above the maximum shown on the sight gauge, drain enough oil to bring the level back within the recommended operating range. **Do not permit the operating level to fall below the minimum shown on the gauge.**

ATTENTION!
Should it ever become necessary to add excessive amount of make-up oil, investigate immediately for oil leaks.

Change the oil at regular intervals. The time between oil changes depends upon the severity of operating conditions and, hence, must be determined by the motor user. Two or three changes a year is typical, but special conditions, such as high ambient temperature, may require more frequent changes. Avoid operating the motor with oxidized oil.

Use only good grade, oxidation-corrosion-inhibited turbine oils produced by reputable oil companies.

The viscosity of the oil to be used depends upon the type and size of the bearings, its load and speed, the ambient temperature, and the amount and temperature of the cooling water (if used)). The lubrication nameplate or instructions with each motor specifies the viscosity range of oil suitable for average conditions. The usual oil viscosity range of oil suitable for average conditions. The usual oil viscosity recommendations are summarized in Table 3. Operation in ambient temperatures that are near or below freezing may require preheating the oil or the use of special oil. Whenever the motor is disassembled for general cleaning and reconditioning, the bearing housing may be washed out with a suitable cleaning solvent. Be sure that the oil-metering hole is clear, and then dry the housing thoroughly before re-assembly, and ensure all traces of cleaning solvent have been removed.

TABLE 3 Oil Viscosity**

Bearing function and location	Bearing Type	Oil Viscosity - SSU	
		@ 100°F	@ 200°F
Thrust Bearing	72XX, 73XX Angular contact ball And/or (62XX, 63XX)	150	45
	Spherical roller	300	53
	Plate (Kingsbury Type)	300	53

**Remark: When a lubrication nameplate attached to the motor, use lubrication oil it stipulates.

5.5.5 Cleaning and installation of bearings

(a) Apply the proper amount of grease to the disassembled parts of the bearing after they have been thoroughly cleaned with high quality cleaning oil. Then protect them from contamination before and during assembly.

(b) Bearing installation

ATTENTION!
Before installing the bearings, make sure that the shaft mounted parts inside the bearings are in place before installation.

Since the bearing is a high precision component, it is important to avoid ingression of dust and foreign matter, and hammering during cleaning and installation. Use extreme care and insure clean conditions during installation and assembly.

ATTENTION!
The best way for bearing installation is heat shrinking. Knocking and hammering during installation should be avoided absolutely.

The bearing should be heated in a bath of clean oil at a temperature of approximately 80°C. After warming, slide the bearings in place quickly and nimbly so that it has not shrunk before being fully in position.
Grease the bearing after the temperature returns to normal, and then reassemble the motor.

5.6 Maintenance of sleeve bearings

5.6.1 Daily inspections

(a) Ensure the volume and quality of lubrication oil are in compliance with specifications.

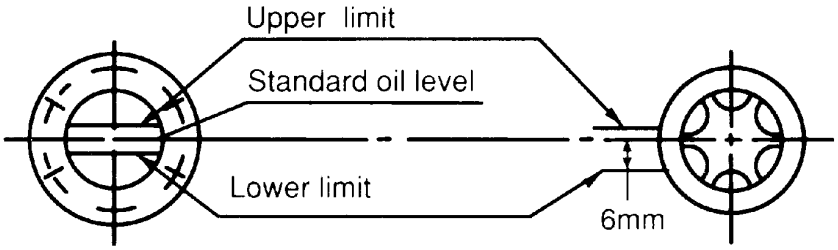


Fig. 12

(b) Ensure there is motion of the oil ring and it is not clamped.

(c) The indicator of the shaft endplay should be restricted within the specified range of the red groove of the shaft or the ±3mm (.118 in.) range of the drive-end shaft shoulder, or the bearing may be damaged.

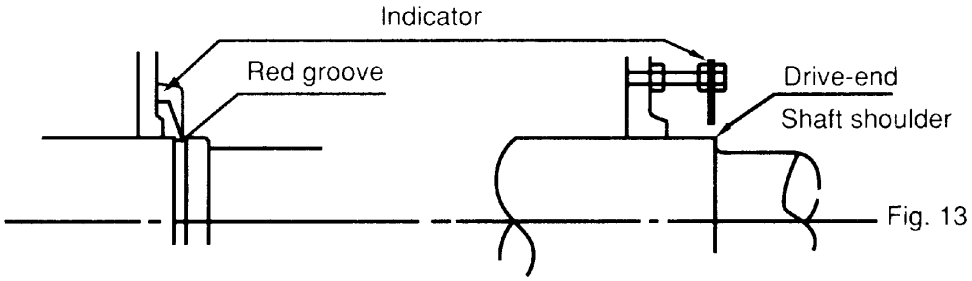


Fig. 13

5.6.2 Regular examination

(a) Periodical change of oil

The oil reservoirs of self (not flood) lubricated bearings should be drained and refilled about every six (6) months. More frequent changes may be needed on high speed (3600 rpm) motors or if severe oil discoloration or contamination occurs. In conditions where contamination does occur, it may be advisable to flush the reservoir with kerosene to remove any sediment before new oil is added. Proper care must be taken to thoroughly drain the reservoir of the flushing material before refilling with the new oil.

Refill the reservoir to the center of oil sight glass with a rust and oxidation inhibited turbine grade oil. Refer to the outline and lubrication nameplate for the correct viscosity.

(b) Quantity of lubrication oil

Please refer to the lubrication nameplate for oil quantity.

(c) Oil viscosity

(d)

ISO	Equivalents	Viscosity (SUS/100°F)
VG32	Esso Teresso 32	150
VG46	Esso Teresso 46	200
VG68	Esso Teresso 68	300

5.6.3 Disassembly

Prior to disassembling, ensure the power supplies are disconnected and there are no moving parts.

The bearing sleeve is of the spherically seated, self-aligning type. The opposite drive end bearing is normally insulated for larger motors (or when specified). On some motors, the insulation is bonded to the spherical seat of the bearing housing.

ATTENTION!
Extreme care must be exercised in removing the bearing sleeve from the insulated support to avoid damaging this insulation.

The following is the recommended procedure for removing the bearing sleeve:

(a) Remove the oil drain plug in the housing bottom and drain the oil sump.

(b) Remove all instrumentation sensors that are in contact with the bearing sleeve. These would include resistance temperature detectors, thermocouples, thermometers, etc..

(c) Remove the socket head bolts holding the bearing cap and the inner air seal. The end cover plate must also be removed if the non-drive end bearing is being disassembled. Remove the bearing cap and top half of the inner air seal. Place them on a clean, dry surface to avoid damage to the parting surfaces.

(d) Remove the top half of the bearing sleeve using suitable eyebolts in the tapped holes provided. Lift the bearing top straight up and avoid any contact with the shoulders of the shaft journals that might damage the thrust faces of the bearing. Place on a clean, dry surface taking care to prevent damage to either the parting surfaces or the locating pins that are captive n the top bearing half.

(e) Remove the screws at the partings in the oil ring and dismantle the ring by gently tapping the dowel pin ends with a soft face mallet. Remove the ring halves and immediately reassemble them to avoid any mix up l parts or damage to the surfaces at the partings.

(f) Pull up on the garter spring surrounding the floating labyrinth seal and carefully slip out the top half. Rotate the garter spring until the lock is visible. Twist counter-clockwise to disengage the lock, remove the garter spring then rotate the lower half of the seal out of the groove in the bearing housing. Note the condition of these floating labyrinth seals. If they are cracked or chipped, they must be replaced. Do not attempt to reuse a damaged seal.

(g) To remove the bottom bearing half, the shaft must be raised a slight amount to relieve pressure on the bearing. On the drive end, this can be done by jacking or lifting on the shaft extension. Protect the shaft. On the non-drive, jacing or lifting can be done using bolts threaded into the tapped holes provided in the shaft end.

(h) Roll the bottom bearing half to the top of the shaft journal and then lift it using suitable eyebolts threaded into the holes provided. Again avoid any contact with the shaft shoulders that could damage the bearing thrust faces. Place the lower bearing half on a clean, dry surface to protect the parting surfaces.

⚠ **Use extreme care when rolling out the lower bearing half. Keep the hands and fingers well clear of any position where they might be caught by the bearing half if it were accidentally released and rotated back to its bottom position. Serious personal injury could result.**

(i) Protect the shaft journal by wrapping it with clean, heavy paper or cardboard.

5.6.4 Re-assembly

Bearing re-assembly is basically a reverse of the disassembly procedures outlined above, with the following suggestions:

(a) The interior of the bearing housing should be cleaned and then flushed with clean oil or kerosene.

(b) The bearing halves and the shaft journal should be wiped clean using lint-free cloth soaked with clean oil.

(c) All parts should be carefully inspected for nicks, scratches, etc., in any contract surfaces. Such imperfections should be removed by an appropriate method such as stoning, scraping, filling, etc., followed by thorough cleaning.

(d) Before installing the floating labyrinth seal halves, observe their condition. Do not attempt to use a cracked or chipped seal. The bottom half seal has a set of drilled holes in its side face. These must be place at the bottom toward the inside of the bearing so that accumulating oil may drain back into the housing.

(e) Put a bead of Curil-T around the seal half O.D.'s on both sides adjacent to the garter spring groove. This will prevent oil by-passing the seal around its outside.

(f) Place the bottom seal half on top of the shaft and roll it into position. Install the top half and insert the garter spring pulling up on both ends to permit engaging the lock. Run a bead of Curil-T around the O.D's on both sides adjacent to the garter spring groove on this half also.

(g) Carefully reassemble the two oil ring halves. Inspect the dowel pins for burrs and straightness and make any corrections required. Do not force the ring halves together. Excessive force may alter the roundness or flatness of the oil ring which can change its oil delivery performance.

(h) Some of the pipe plugs in the housing are metric thread type. These are identified as those, which have a copper, lead, or similar material washer. If these plugs are removed,

be careful not to lose the washers. Before re-assembly, inspect the washers and replace them as required.

(i) Before installing the bearing cap, observe the position of the floating labyrinth seal. The "tab" must be on top to engage the pocket. Failure to position the seal properly will result in damage when the cap is assembled.

ATTENTION!
(1) Curil-T is the only approved compound for use in the assembly of the bearings on this motor. Other products may harden and impede the operation.
(2) During the re-assembly of the bearing parts, a thin layer of Curil-T should be applied to all gaskets and machined interface surfaces. This suggestion does not apply to the machined surfaces of the bearing liner halves.
(3) When seating the bearing shell, apply a thin layer of lube oil at the spherical surface of the liner. Slowly roll the lower bearing liner into the bearing housing making sure that the splinted surface of the liner and the housing are flush. Gradually lower the shaft onto the bearing. The weight of he shaft will help rotate the bearing liner so that the babbitt surface of the liner will match the slope of the journal. Sometimes it is required to use a rubber mallet to tap lightly on the bearing housing while slowly rolling the shaft to help this seating operation.

5.7 Maintenance of slip ring (For Wound Rotor Motors only)

Ensure motor is disconnected from power supplies and there are no accessible moving parts before maintenance operation.

5.7.1 Adjustment of carbon brush

(a) Brush pressure for normal operation:
- Electro-graphite brush…..0.2~0.25 kg/cm²

When frequent vibrations are evident or the brush is small (area below 0.5 cm²), the pressure should be greater than as shown.

(b) Adjustment of brush pressure:
The brush pressure should be adjusted to keep normal operation as it wears.
- The brush pressure may be reduced after use, so it is necessary to re-adjust. For adjustment, please turn adjusting screw, pressure adjusting pin or pressure adjusting plate as shown in Fig. 14 to obtain the correct tension (=0.23 x brush cross sectional area in cm²) ±10% kg.

(c) Brush pressure need not be adjusted if constant force spring is used as shown in Fig. 15 and Fig. 16.

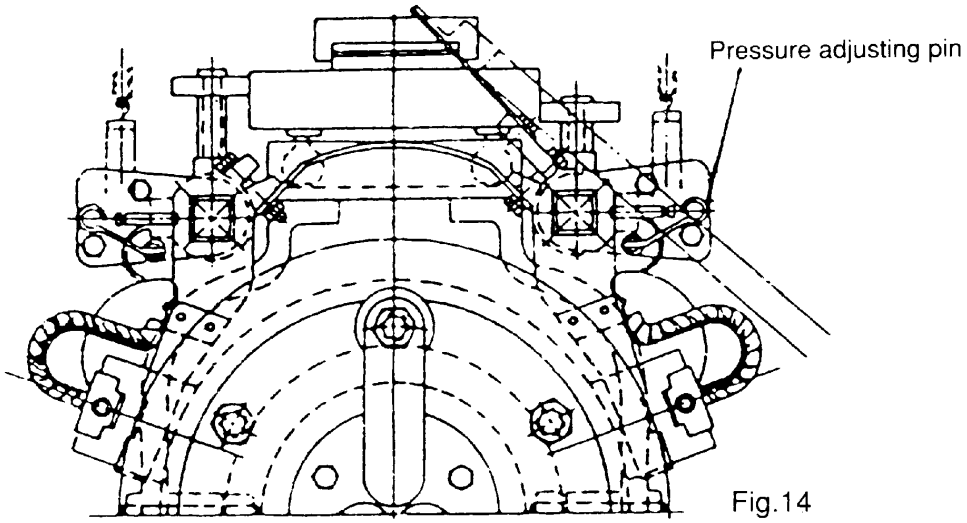


Fig.14

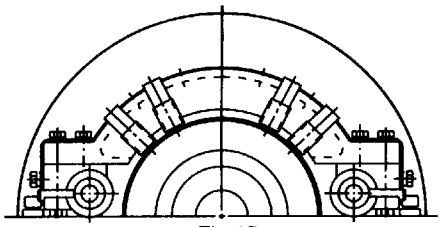


Fig.15

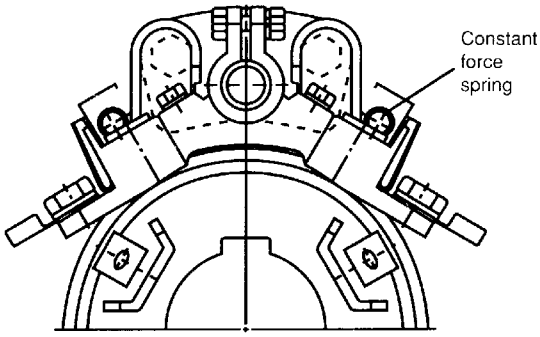


Fig.16

5.7.2 Brush replacement

The carbon brush is a part of the equipment which is easily worn away, replace it after it is worn to ½ ~ ¾ of original size.

(a) Brush material

The brush material is important to the performance of the motor. Only the most appropriate materials are chosen by TWMC, and are listed on the nameplate of the motor. It is important to know this when you replace the brush, so a recommended type is used.

(b) Dimensions

Brush, holder and gap between them, please refer to CNS 2322 C4051 or JIS C2802.

ATTENTION!
The gap between a brush and it holder is important for good performance and safety of the motor.

(c) Adjustment of new brushes (Shown in Fig. 17)

(1) Polish the new brush with a file until is assumes the appropriate contour of the slip ring which it touches.

(2) Place sand-paper (JIS R6252 No. 40…50) on the slip ring with the abrasive face of the paper against the brush to induce a closer contact by rubbing against each other.
(3) Repeat item 2 with fine sand –paper (JIS R6252 No. 100 to 200) until the contact surface between brush and slip ring exceeds 80%.
(4) Finally, clean the contaminated slip ring and brush with clean cloth or compressed air.

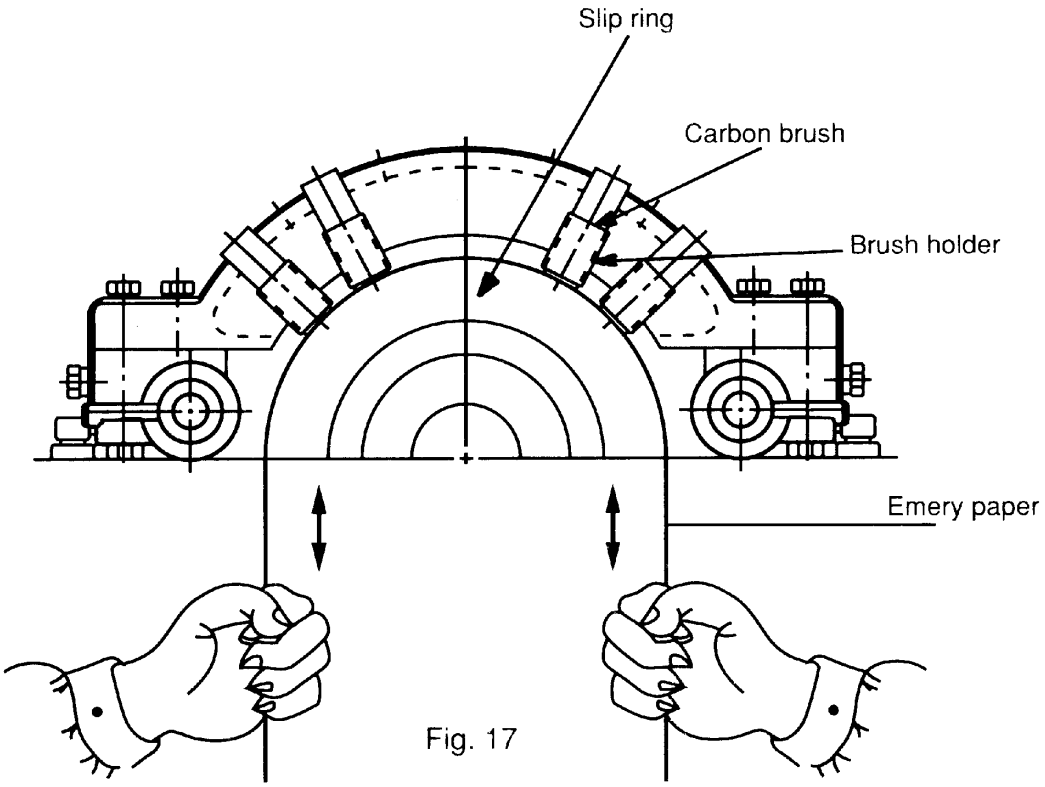


Fig. 17

5.8 Maintenance of non-reverse ratchet mechanism (For Vertical high Thrust Motor only)

5.8.1

In the pump piping system, a check valve and a stop valve should be installed in the discharge line. The check valve, placed between the pump and the stop valve, is to protect the pump from reverse flow and excessive backpressure. The stop valve is used in priming, starting and when shutting down the pump. It is advisable to close the stop valve before stopping the pump. This is especially important when the pump is operated against a high static head.

TWMC vertical high thrust motors are equipped with non-reverse ratchet (N.R.R.) mechanism only when requested by the pump manufacturer. Typical construction of the N.R.R. mechanism is shown as Fig 18 below.

The N.R.R. mechanism keeps the pump and motor from rotating in the reverse direction. Thus prevents damage from over-speeding and damage to water-lubricated pump shaft bearings

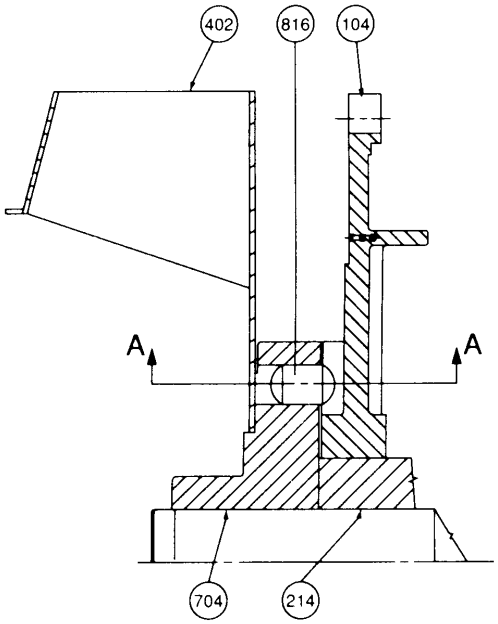
when, on shutdown, the falling water column tends to drive the pump in the reverse direction. In normal operation, the ratchet pins are lifted by the ratchet teeth and are held clear by centrifugal force and friction as the motor comes up to speed. When power is removed, the speed decreases and the pins fall. At the instant of reversal, a pin will catch in a ratchet tooth and prevent backward rotation.

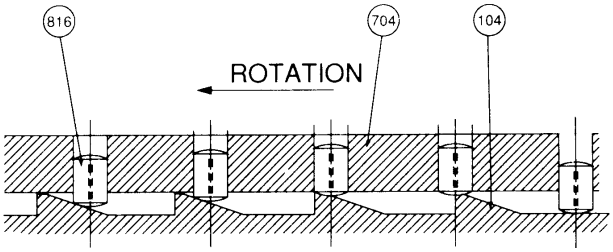
5.8.2

The service life of ratchet pins depends not only on the reverse shock load between the pin and ratchet tooth when pump stopped but also the frequency of pump starting and stopping while in service. Provided that the pins are deformed due to this reverse shock load, then the up and down motion of the ratchet pins could be sluggish or jammed and that unusual noises shall arise.

The recommended replacement period for these ratchet pins is every three (3) years. If the reverse shock load is greater than 30% of motor rated torque or the starting frequency is more than twice per day, then the replacement period should be halved.

ATTENTION!
The check valve and stop valve in the discharge line should be regularly inspected and maintained to assure the normal function of these valves. This is important to protect the pump and motor from damage and increase the service life of the N.R.R. mechanism.





SECTION A-A

ITEM	NAME
104	RATCHET
214	BEARING SEAT
402	EXTERNAL FAN
704	RATCHET PIN CARRIER
816	RATCHET PIN

Fig. 18

6. FAULT FINDING AND RECOGNITION

Kinds of Breakdown	Symptoms	Possible Causes	Remedies
Fail to start without load	Motionless and soundless	Power-off	Consult power company
		Switch-off	Switch-on
		No fuse	Install fuse
		Broken wiring	Check wiring and repair
		Broken lead	Check wiring and repair
		Broken windings	Check windings and repair
	Fuse blowing. (Automatic switch trips off, slow start with electromagnetic noise)	Short circuit of circuit switches	Check circuit switches and replace
		Incorrect wiring	Check wiring according to nameplate
		Poor contact at terminal	Lock tightly
		Windings grounded	Factory repair
		Broken windings	Factory repair
		Poor contact of circuit switches	Check and repair
		Broken wiring	Check and repair
		Poor contact of starting switches	Check and repair
		Short circuit of starting switches	Check and repair
		Incorrect connections of starting switches	Connect according to nameplate
Loading after start	Fuse blowing. Fail to restart due to trip-off of automatic switch	Insufficient capacity of fuse	Replace fuse if wiring permits
		Overload	Lighten load
		High load at low voltage	Check circuit capacity and reduce load
	Overheating motor	Overload or intermittent overload	Lighten load
		Under-voltage	Check circuit capacity and power source
		Over-voltage	Check power source
		Ventilation duct clogged	Remove the foreign matter in the duct
		Ambient temperature exceeds 40°C	Correct insulation class to B or F, or lower ambient temperature
		Friction between rotor and stator	Factory repair
		Fuse blown (Single-phase rotating)	Install the specified fuse
		Poor contact of circuit switches	Check and repair
		Poor contact of circuit starting switches	Check and repair
		Unbalance three-phase voltage	Check circuit or consult power company

Kinds of Breakdown	Symptoms	Possible Causes	Remedies
Loading after start	Speed falls sharply	Voltage drop	Check circuit and powers source
		Sudden overload	Check machine
		Single-phase rotating	Check circuit and repair
	Switch overheat	Insufficient capacity of switch	Replace switch
		High load	Lighten load
	Bearing over-heating	High belt tension	Adjust belt tension
		Slack belt tension	Adjust belt tension
		Misalignment between motor and machine shafts	Re-align
		Over speed of bearing outer-ring	Adjust bracket
		High bearing noise	Replace the damaged bearing
Noise	Electromagnetic noise induced by electricity	Occurrence from its first operation	May be normal
		Sudden sharp noise and smoking	Short circuit of windings should be repaired at the factory
	Bearing noise	Noise of low shishi or Thru-Thru	May be normal
		Kala-Kala as a result of poor lubrication	Grease
		Kulo-Kulo as a result of poor lubrication	Clean bearing and grease
		Sa-Sa or larger noise	Replace the damaged bearing
	Mechanical noise caused by machinery	Loose belt sheave	Adjust key and lock the screw
		Loose coupling or skip	Adjust the position of couplings, lock key and screw
		Loose screw on fan cover	Lock fan cover screw tightly
		Fan rubbing	Adjust fan position
		Rubbing as a result of ingression of foreign matter	Clean motor interior and ventilation ducts
		Wind noise	Noise induced by air flowing through ventilation ducts
		Induced by conveyance machine	Repair machine
Vibration	Electromagnetic vibration	Short circuit of winding	Factory repair
		Open circuit of rotor	Factory repair
	Mechanical vibration	Unbalanced rotor	Factory repair
		Unbalanced fan	Factory repair
		Broken fan blade	Replace fan
		Unsymmetric centers between belt sheaves	Align central points
		Central points of couplings do not lie on the same level	Adjust the central points of couplings to the same level
		Improper mounting installation	Lock the mounting screws
		Motor mounting bed is not strong enough	Reinforce mounting bed

Remarks:

(1) Circuit switches: These include knife switches, electromagnetic switches, fuse and other connection switches etc.

(2) Starting switches: These include Delta-Star starters, compensate starters, reactance starters, resistor starters, starting controller's etc.

Scrubber Recommended Lubrication, Maintenance, Schedule and Spare Parts List

Viron Scrubber Model Number:	**Date Shipped:**	**Viron Job No.:**
VHS-3636-PVC-4.0-60-R-1-F-575-3-60	9/26/12	CA-44834

Customer:	**Viron Representativc:**
Miller Environmental Corp	Miller Environmental
PO Box 279	1803 Hekla Ave
St. Jean Baptiste, Manitoba, ROG 2BO	Winnipeg, Manitoba R2R OK3
Canada	Canada
Purchase Order No.:	**Tag:**

MAINTENANCE REQUIREMENTS	Lube Typ	D	W	M	Q	S	A	Hours
Inspect Spray Nozzles For Clogging	N/A				X			
Inspect Packing For Build Up	N/A				X			
Inspect Mist Eliminator For Build Up	N/A				X			
Lubricate Motor Bearings	1-3					X		
Calibrate pH & Conductivity Electrodes	N/A			X				
Inspect Metering Pump	N/A					X		
Inspect Float Valve	N/A				X			
Inspect/Calibrate Level Switch	N/A				X			
Inspect Pressure Switch	N/A					X		
Inspect Pressure Gauges	N/A					X		
Inspect Solenoid Valves	N/A					X		

	LUBRICANT	MANUFACTURER		LUBRICANT	MANUFACTURER
1	Chevron BRB-2	Standard Oil Company	3	Alvania #2	Shell Oil Company
2	SRI-2	Standard Oil Company	4		

RECOMMENDED SPARE PARTS			PUMP NAMEPLATE DATA			
Part No.	Description	Qty.	**Pump Make:**	Serfilco		
VEH-1025	Mist eliminator		**Pump Model:**	EFLX-1-1/2-3SC-D3.0		
	Jaeger 2" packing material 53 Cu. Ft		**Pump HP:**	3	**Motor Enclosure:**	TEFC
1/2YS120164	Bex Spray Nozzles	6	**RPM:**	3,450	**Voltage:**	575
MA052	Kerick Float Valve		**Hertz:**	60	**Phase:**	3
EWB16F1VE	Iwaki Walchem Metering Pump	1	**Quantity:**	2		
WDP410322	pH Controller and probes	1				
2004	Magnahelic Pressure Gauge	1				
			SCRUBBER PERFORMANCE DATA			
			CFM:	4,000	**W.G.:**	2"
			Packing Depth:	60"	**GPM:**	55-65
			Packing Mfg:	Jaeger	**Mist. Elim. Mfg.:**	Viron

Fan Recommended Lubrication, Maintenance, Schedule and Spare Parts List

Viron Fan Model Number:	**Date Shipped:**	**Viron Job No.:**
VCB-1116-BD-PVC-FRP-9-CW360-7.5-TEFC-PREM-575-3-60	9/27/12	CA-44834

Customer:	**Equipment User:**
Miller Environmental PO Box 279 St Jean Baptiste, Manitoba ROG 2BO	Miller Environmental N.E. 2-3-1 EPM RM of Montcalm, MB ROG 2BO Winnipeg, Manitoba Canada

Purchase Order No.:	

MAINTENANCE REQUIREMENTS	**Lube Type**	**D**	**W**	**M**	**Q**	**S**	**A**	**Hours**
Inspect Wheel For Build Up	N/A				X			
Verify Belt Tension	N/A				X			
Inspect Sheaves	N/A				X			
Check Tightness of All Bolts	N/A						X	
Lubricate Bearings	1-3			X				
Lubricate Motor Bearings	1-3			X				

LUBRICANT TYPE		**LUBRICANT TYPE**	**MANUFACTURER**
1 Chevron BRB-2	Standard Oil Company	3 Alvania #2	Shell Oil Company
2 SRI-2	Standard Oil Company		

Recommended Parts			**MOTOR NAMEPLATE DATA**			
Part No.	**Part Name**	**Qty.**	**Motor Make:** Teco-Westinghouse			
1-7/16"	Fafnir RAS Bearings	2	**Motor Model:** EP7/545			
2B62	Motor Sheave	1	**Motor Frame** 213T		**Volts:**	575
1610 x 1-3/8"	Motor Bushing	1	**HP:**	7.5	**Phase:**	3
2B44	Fan Sheave	1	**RPM:**	1755	**Hertz:**	60
1610 x 1-7/16"	Fan Bushing	1				
			FAN PERFORMANCE DATA			
			CFM:	4,000	**CLASS:**	II
			SP:	4"	**ROTATION:**	CW360
			RPM:	2,542	**ARN:**	9
			BHP:	4.9	**SPROCKET:**	40BS60

TROUBLE SHOOTING / REPAIR SERVICE

DESIGN

If after the initial start-up and commissioning, the customer discovers that the software is at fault with a machine malfunction, Viron® International Corporation will re-design software, load to disc, and mail to customer for up-load to software device by customer free of charge.

The customer must accept total responsibility for what is required to perform all tasks to operate the system after initial start-up. (Set all parameters, make all adjustments, diagnose, and fix any mal-functions).

If the customer requests on site assistance to discover where or what the cause if for a problem detected, and is unable; or has not time to do so, a request for the customer to pay for this service will be made. This is provided that the initial start-up has been completed to the customers satis-faction.

Unless specifically requested, Viron® International Corporation does not provide on-site services on demand after initial start-up. Unless quoted, this includes maintenance, diagnostic, technical support team, and/or teaching aid.

PRODUCT

Viron® International Corporation will only guarantee parts as provided by equipment manufacturer or same. The customer is expected to inventory (in-house or local supplier) any critical components that; if fail, will cause production down time.

Viron® International Corporation does not stock any product components manufactured by others, and can only warranty per product manufacturer terms and delivery.

The guarantee is limited to the replacement of the defective part when received by Viron® International Corporation from the customer. This does not include any on-site labor or expenses for troubleshooting, removal/replacement of part and/or loss of production.

It is expected that the customer have the experience with, and understanding of, the type of scrubber controls used on the system to maintain and troubleshoot the system after initial start-up.

If the customer cannot perform all of the above functions, a limited over the phone assistance will be provided by Viron International Corporation free of charge, or if need is greater, a service contract can be provided for the customer at competitive rates for service and/or training.

Viron® International Corporation

Engineer, Testing and Field Services

Viron® International Corporation offers the following engineering services to customers in connection with Viron® International Corporation's manufactured equipment. These charges shall apply in those cases where services are not included as part of the equipment cost, but stated as breakout item. In addition, the charges will also apply where a customer in conjunction with a current or previous equipment order accepts repair work, engineering, and consultation, etc.

PRICING PER DAY		**NORMAL* SERVICE**	**EMERGENCY** SERVICE**
Service Specialist:	Start-up/Installation Assistance or Service Call	$800.00/day	$1,200.00/day
Senior Engineer:		$1,000.00/day	$1,500.00/day
PVC Field Service Technician:		$60.00/hr	$90.00/hr

Terms and Conditions

All rates apply to each workday (Monday through Friday) the technician is away from the home office. Rates do not include living (budget – $150.00 per man-day) and travel expense (air fare and car rental), which will be charged at cost plus 20%. Standard overtime charges will be billed at $150.00 per man-hour for service specialist and $250.00 per man-hour for senior engineers. Should these services be required for Saturday, rates would be 1.5 times standard; for Sundays and Holidays, the rates would be 2 times standard. Viron® International Corporation reserves the right to decline holiday work. Viron® International Corporation, if requested by the customer in writing, will contract the services of a professional chemical laboratory and independent testing firms. The charges for these services are available upon request.

If travel to and from the jobsite is required the day before or after these services, the travel time will be charged at the standard hourly rate for the specific service category, defined above.

* Rates assume a minimum of one (1) week notice for scheduling. Scheduling will occur only after receipt of a written purchase order. This purchase order must be a different number than the original order for the equipment.

** Emergency service is defined as immediate availability (within 24 hours). The rate is for a standard day (8:00am to 5:00pm). Any hours before 8:00a.m., after 5:00pm, Saturdays, Sundays, and/or holidays other than standard work days will be billed at time and a half or double time.

• LIMITED WARRANTY

VIRON® INTERNATIONAL warrants to the dealers and owners its VIRON® products and parts to be free from defects in workmanship and material under normal use and services for one (1) year after the date of shipment by VIRON to the first retail purchaser or first user: if and only if VIRON® is notified in writing of the defect within fourteen (14) days from date that the defect is discovered. Written notice of defects discovered within the final fourteen (14) days of the warranty period must be sent to VIRON® via facsimile or first class mail prior to the expiration of the warranty period otherwise this warranty shall be void. Our obligation under this warranty is expressly limited to repairing or replacing at our option, without cost at our factory any part or parts therof which shall be returned to and received by VIRON® within such warranty period with transportation charges both to and from VIRON® prepaid, and which our examination shall disclose to our satisfaction to have been defective. In the event a defect is discovered within the final seven days of the warranty period, the returned goods must be received by VIRON® at VIRON®'s facility within seven days following expiration of the warranty period. Any request for repair or replacement should be directed to VIRON® INTERNATIONAL, Owosso, MI.

If examined equipment is found not to be defective or for some other reason not to be within the warranty coverage, seller's service time expended on and off location will be charged to the purchaser. This warranty gives you specific legal rights which vary from state to state. FAILURE TO PAY THE INVOICE IN FULL WILL RESULT IN VOIDING ANY AND ALL WARRANTIES.

• LIMITATION OF WARRANTY AND LIABILITY

This warranty does not apply to such VIRON® products and parts which in the sole judgment of VIRON® have failed as a result of faulty installation or abuse, or incorrect electrical connections or alterations, made by others, or use under abnormal operating conditions or misapplication of products and parts.

This warranty does not apply to damage resulting from shipment or storage of VIRON® products. Purchaser acknowledges that VIRON® products contain rotating parts that may be damaged by the forces of nature if not installed or put to their intended use within seven (7) days of delivery. THIS WARRANTY DOES NOT COVER COMPONENT PARTS THAT CARRY A SEPARATE WARRANTY FROM THE MANUFACTURER OF THE COMPONENT PART.

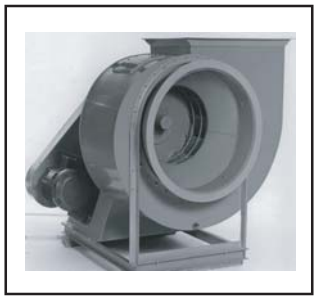
VIRON® will not approve for payment any repair made outside its factory without prior written consent of its Owosso, Michigan office. The foregoing shall constitute our sole and exclusive warranty and our sole and exclusive liability and is in lieu of all other warranties, whether written, oral, implied or statutory.

THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE PAGE HEREOF. SELLER DOES NOT WARRANT MERCHANTABILITY THAT SAID GOODS AND ARTICLES ARE OF MERCHANTABLE QUALITY, OR THAT THEY ARE FIT FOR ANY PARTICULAR PURPOSE.

The liability of any seller on any claim of any kind, including contract, warranty, tort, or negligence, for any loss or damage arising out of or connected with or resulting from the sale and purchase of products and parts covered by any VIRON® proposal, acknowledgement, order, or from the performance or breach of any contract pertaining to such sale or purchase, or from the design, manufacture, sale, delivery, resale, installation, technical direction in installation, inspection, repair, operation or use of any products or parts covered by any VIRON® proposal, acknowledgement, order or furnished by seller, shall in no case exceed the price as paid by purchaser allocable to the products or parts therof which give rise to the claim and shall terminate one year after shipment of said products and parts.

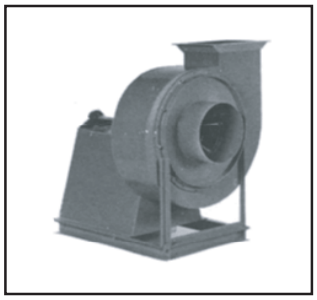
IN NO EVENT, WHETHER AS A RESULT OF BREACH OF CONTRACT, OR WARRANTY, OR TORT, OR ALLEGED NEGLIGENCE, DEFECTS, INCORRECT ADVICE OR OTHER CAUSES, SHALL SELLER BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, including but not limited to loss of profits or revenue, loss of use of the equipment or any associated equipment, cost of removal or reinstallation or any cost associated therewith, cost capital, cost of substitute equipment, facilities or services, down time cost, or claims of customers of the purchase of such damages.

VIRON® neither assumes nor authorizes any person to assume for it any other liability in connection with the sale of its products and parts. Some states do not allow the exclusion or limitation of incidental or consequential damages, so all of the above limitations or exclusions may not apply to you.



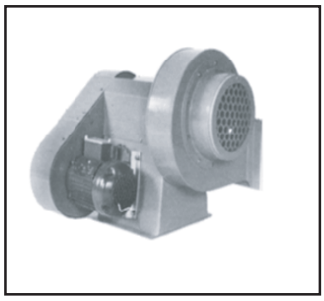
Centrifugal Fan
VCF-100

Inline Centrifugal Fan
VIF-200

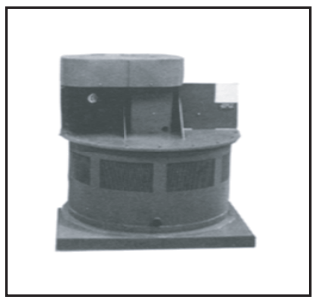


Radial Blower
VRB-600

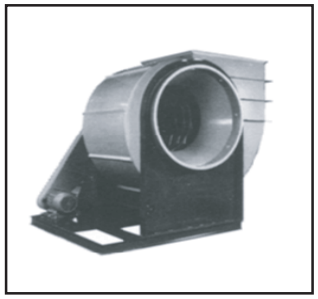
Lab Blower
VLB-700



PushBlower
VPB-800

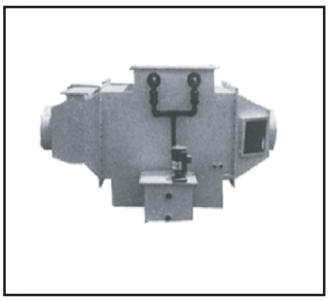


Roof Ventilator
VRV-900



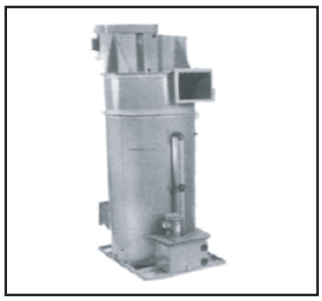
Centrifugal Fan
VCB-1100

Gravity Relief Ventilator
VGR-1300



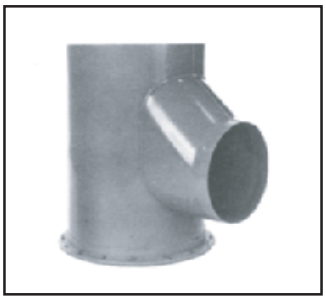
Horizontal Scrubber
VHS-Series

Vertical Scrubber
VVS-Series



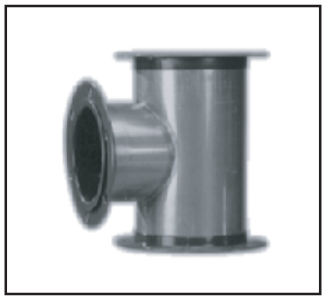
Blower-Scrubber
VBS-Series

VIRO-CHROME 9000®
VCS-Series

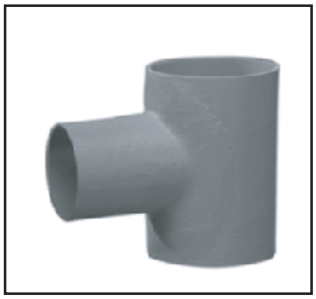


VI-A-DUC®
FM Approved PVC Duct

VIRO-DUC®
FM Approved FRP Duct



SSTEELCOAT®
FM Approved Duct



FRP Duct
ICBO Approved

VI-A-TROL®
AMCA Approved Damper

PVC & FRP
Blastgates

FRP Parallel
Blade Damper

FRP Fixed Louver

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