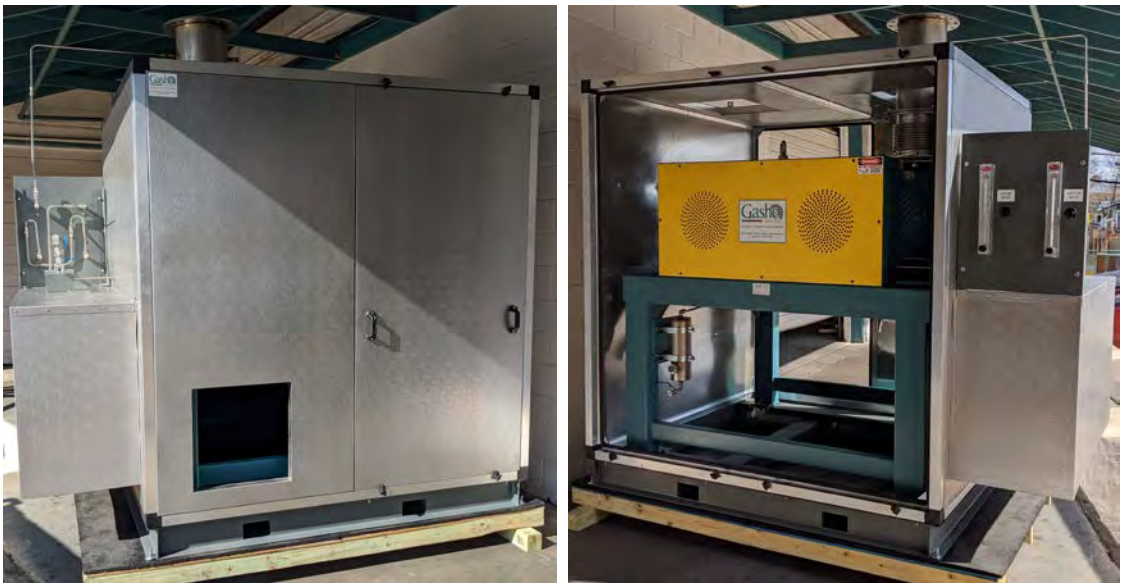
Gasho
SINCE 1982
The Leader in Blower & Vacuum Solutions

460 West Gay Street
West Chester, PA 19380



CALORIS ENGINEERING

8649 Commerce DRive
Easton, MD 21601

Purchase Order # 004025

Gasho Custom Package utilizing Tuthill Model 7021 PD Blower And 150HP Motor with Enclosure, Patch Plate for Running Discharge Pipe out Back of the Cabinet

JG19L-3414

March 13, 2020

Gasho
SINCE 1982
The Leader in Blower & Vacuum Solutions
460 West Gay Street
West Chester, PA 19380

Start-Up Check List for Positive Displacement Blower

We suggest that these start-up procedures be followed in sequence:

- During initial installation
- After any shutdown period
- After maintenance work has been performed.
- After blower has been moved to a new location

1. **Read entire Installation, Operation & Maintenance Manual before operation.**

2. Lift blower assembly by frame only.

3. Base must be shimmed to floor, before final bolt down. Failure to do so can stress the blower which can result in blower failure.

4. A flexible coupling must be used between silencers and process piping**. No** weight bearing load should be placed on piping of blower. All piping must be supported.

5. Check the unit for proper lubrication. Proper oil level cannot be over-emphasized. Refer to Lubrication Section. Blower maybe shipped dry.

6. Check Drive Alignment
   For Direct Drive: Check coupling and shaft alignment
   For Sheave Drive: Check for proper belt alignment and tension

7. **Warning**: Disconnect Power
   Turn drive shaft by hand to be certain blower does not bind.

8. "Bump" the unit with the motor to ensure proper directional rotation and to be certain it turns freely and smoothly.

9. Start the unit and operate it for 30 minutes with no load.

10. Apply the load, observe the operation of the unit for one hour. After first hour shut down unit and check belt tension and oil levels. Check the unit frequently during the first day of operation

11. If minor malfunctions occur, discontinue operation and refer to the Troubleshooting Section.

12. If blower is to be shutdown for any period of time, please operate using inlet to atmosphere for approximately 20 minutes to help dry out internals. This will prevent rusting and binding of rotors and internals.

PREVENTATIVE MAINTENANCE

A good maintenance program will add years of service to your blower.

A newly installed blower should be checked frequently during the first month of operation, especially lubrication. Check oil level in both the drive end and gear end of the blower and add oil as needed. Complete oil changes are recommended every 1000 operating hours, or more frequently depending on the type of oil and oil operating temperature.

The following is recommended as a minimum maintenance program.

DAILY MAINTENANCE

1. Check and maintain oil level, and add oil as necessary.
2. Check for unusual noise or vibration (See Troubleshooting on page 8)

WEEKLY MAINTENANCE

1. Clean all air filters. A clogged air filter can seriously affect the efficiency of the blower and cause overheating and oil usage.
2. Check relief valve to assure it is operating properly

MONTHLY MAINTENANCE

1. Inspect the entire system for leaks.
2. Inspect condition of oil and change if necessary (see page 6)

3 Check drive belt tension and tighten if necessary.

START-UP CHECKLIST

We recommend that these startup procedures be followed in sequence and checked (P) off in the boxes provided in any of the following cases:

- During initial installation
- After any shutdown period
- After maintenance work has been performed
- After blower has been moved to a new location

				Date Checked

				1. Check the unit for proper lubrication. Proper oil level cannot be over-emphasized. Refer to Lubrication Section.
				2. Check Alignment. For Direct Drive: Check coupling and shaft alignment. For Belt Drive: Check for proper belt alignment and tension.
				3. Turn the rotors by hand to be certain they do not bind.

WARNING: Disconnect power. Make certain power is off and locked out before touching any rotating element of the blower, motor or drive components.

				4. "Bump" the unit with the motor a few times to check rotation and to be certain it turns freely and smoothly.
				5. Start the unit and operate it for 30 minutes at no load. During this time. feel the cylinder for hot spots. If minor hot spots occur, refer to the Troubleshooting Section (page 8).
				6. Apply the load and observe the operation of the unit for one hour. Check the unit frequently during the first day of operation.
				7. If minor malfunctions occur, discontinue operation and refer to the Troubleshooting Section (page 8).

Caloris
JG19L-3414
150HP Motor
2025 Kg/hr 1.01 - 1.75 bar.a

Description	Date	Revision
Quote		
191015JG.1		

Item	Qty.	Supplier	Description	Gasho Part Number	Misc ID	Weight
1	1	Tuthill Blowers	PD Blower	BLW-7021-G1L4CK2HA	Cast Iron/DI Rotors, 12" Flg	1450
1.01	1	Tuthill Blowers	Plugged Rotors	-		
1.02	1	Tuthill Blowers	Kalrez 'O' Rings	-		
1.04	1	Tuthill Blowers	Vented to drain	-		
1.05	1	Tuthill Blowers	Cooling Coils	-		
1.06		Tuthill Blowers	Oil Fill, MD One	-		
2	1	Gasho	Base		custom	750
3	1		Belt Guard	BG-52X24X8-0000		40
4	1	T. B. Woods	V-belt Drive, 2365rpm, 29.4"C.D.	V-BELT DRIVE		109
4.01	1	T. B. Woods	DriveR Sheave	5V12.5X6-F		
4.02	1	T. B. Woods	DriveR Bushing	Fx3 3/8		
4.03	1	T. B. Woods	DriveN Sheave	5V9.25X6-E		
4.03	1	T. B. Woods	DriveN Bushing	Ex2 3/8		
4.04	6	T. B. Woods	V Belts	5VX930		
5	1	World Wide	150 Hp, Hi-E Motor	MTF-150-445-3735	TEFC, 575/3/60	1856
6	1	Overly Hautz	Slide base	SB-445C2HD-0000		75
7	1	Gasho	Inlet Spool Piece	-	20"L x 10" dia	65
7.1	1	Spraying Systems	Full jet spray nozzel	-	0.34 gpm 140 C	1
8	2	DME	12" x 10" reducing Flanged Flex.	-	10" Long	100
9	1	Gasho	Condensate Collection Vessel	-		12
9.1	1	Duravalve	1/4" SS ball valve	VBL-0.25-6T-0202		2
9.2	1	McMaster	Oil Sight Glass	P-MC-6490T17	Type 303 S/S, 1-1/2 NPT Male, 2" Hex	1
10	1	Acoustic Group	Sound Enclosure, mineral wool	-	20dba reduction	600
10.1	1	Acoustic Group	Enclosure Fan	-	115V/1PH/60HZ	84
11	1	Gasho	Sub Base	-		450
11.1	1	Gasho	Vibration Mat	GVM-4.0X6.0-0000		90
			Water injection system			25
20	1	Granzow	Solenoid, 1/2" 316SS, N.C.	-	WITH CONNECTOR	2
21	1	Duravalve	1/2" SS ball valve	-		1
22	1	Mcmaster Carr	1/2" SS Strainer	-	40 Micron	1
23	1	PIC	2-1/2" SS Gauge	-	0 - 100#	1
24	1	Duravalve	1/4" SS ball valve	-		1
25.1	1	Swagelok	3/8" Needle Valve	-		1
25.2	1	Swagelok	1/2" Needle Valve	-		1
26.1	1	Dwyer Instruments	Flow meter for H2O Injection	-	.2-2.2 gpm	2
26.2	1	Dwyer Instruments	Flow meter for Blower Cooling Coils	-	.4-4 gpm	2
27.1	1	Swagelok	Check Valve, 3/8"	-		1
27.2	1	Swagelok	Check Valve, 1/2"	-		1
28	1	Baillie	27" H x 21" W Panel, 1/8" thick	-		6
29.1	1	Lee	Nameplate, 3" X 2"		INJECTION WATER	
29.2	1	Lee	Nameplate, 3" X 2"		COOLING WATER	
					Weight	5730

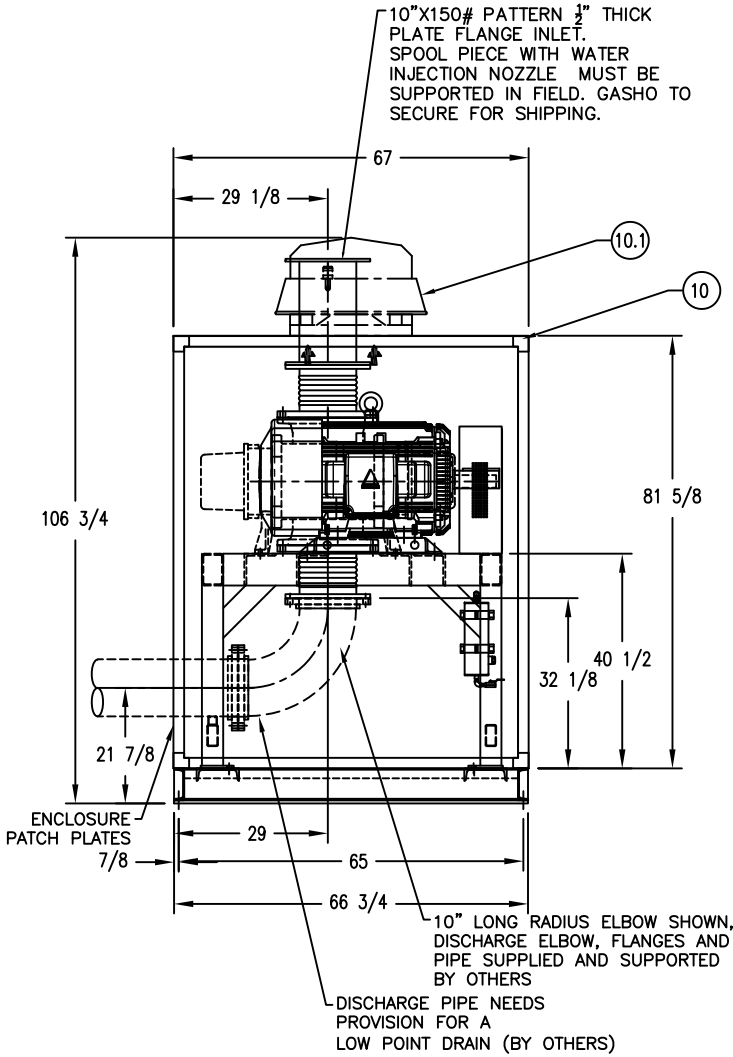
Gasho SINCE 1982
The Leader in Blower & Vacuum Solutions

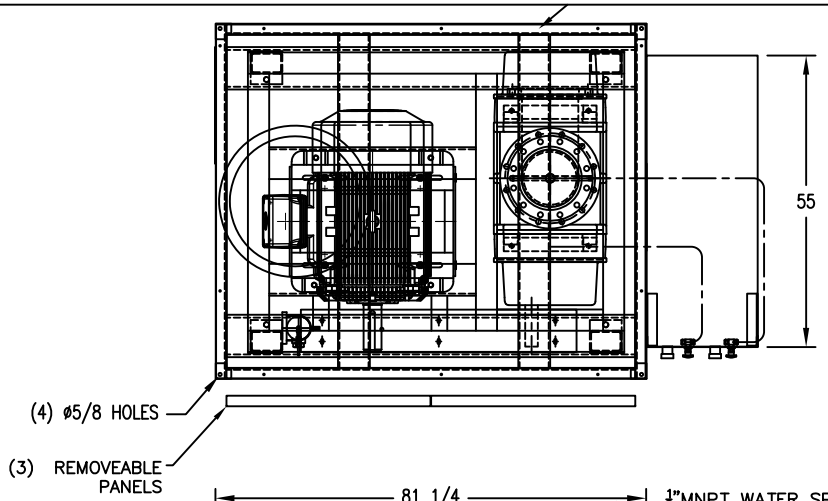
Caloris
Blower Package
JG19L-3416
Recommended Spare Parts List

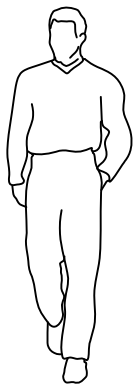
Date
3/13/2020
Pricing valid
for 60 days

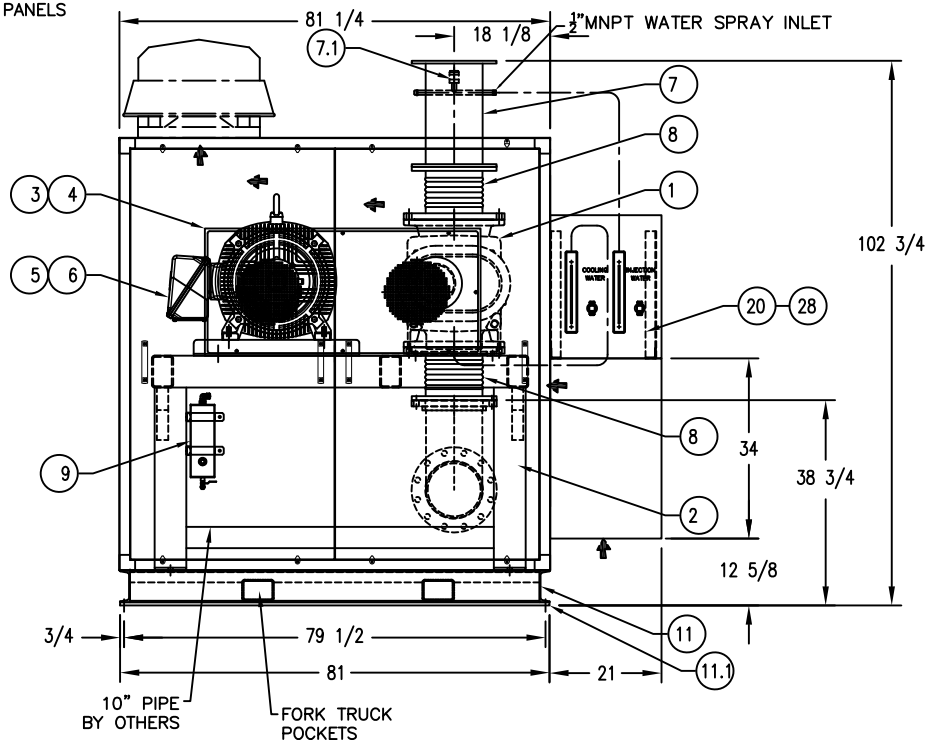
Qty.	Supplier	Description	Gasho Part Number	List Price EA
1	Gasho Inc.	MD ONE Oil - 1 Gallon	LUB-TT-SO-01G-0016	$75.00
1	Gasho Inc.	MD ONE Oil - 1 Quart	LUB-TT-SO-01Q-0016	$24.00
1	Gasho Inc.	Spare V Belts - Set of 6	VB-5VX930-0000	$322.00

NOTES:
1. CUSTOMER PIPING IS 316 SS AND NEEDS TO BE INDEPENDENTLY SUPPORTED IN FIELD.
2. TOLERANCE ± 3/4"
3. (DIM) ARE CRITICAL DIMENSIONS
4. ENCLOSURE HAS MINERAL WOOL SOUND ABSORBING MATERIAL FOR 20Dba NOISE REDUCTION.
5. NO INSTRUMENTATION HAS BEEN REQUESTED OR QUOTED. THE CUSTOMER IS RESPONSIBLE FOR INSTALLING ADEQUATE SAFEGUARDS FOR THE SAFE OPERATION OF THE PACKAGE. GASHO CAN RECOMMEND AND SUPPLY INSTRUMENTATION IF REQUESTED
6. GASHO DID NOT QUOTE ANY DISCHARGE PIPING COMPONENTS PAST THE FLANGED FLEXIBLE CONNECT (ITEM 8). GASHO WILL BE HAPPY TO INSTALL CUSTOMER SUPPLIED PIPING SO ENCLOSURE PATCH PLATES AND LOCAL PIPE SUPPORT CAN BE PLACED. GASHO CAN SUPPLY DISCHARGE PIPING IF REQUESTED.







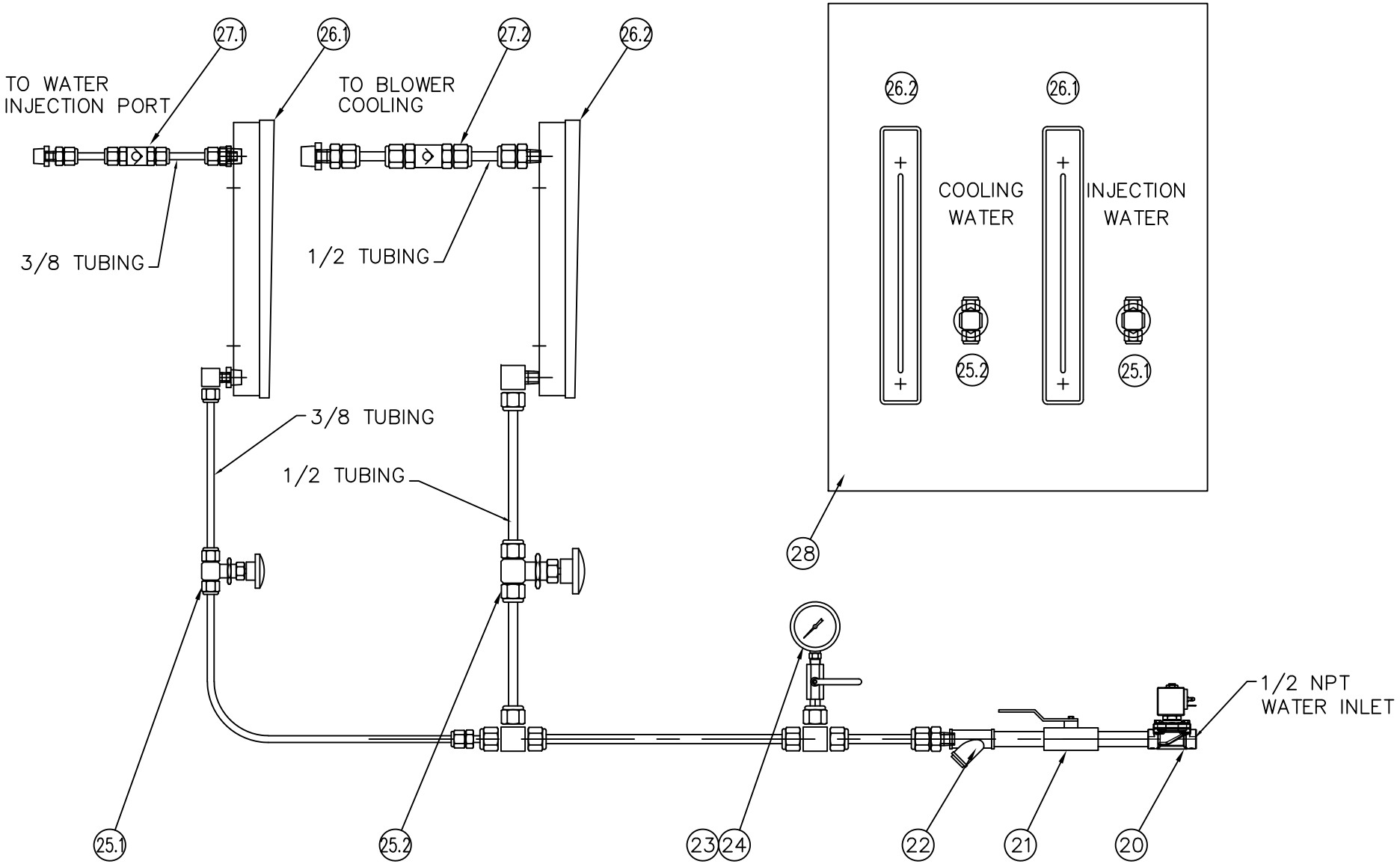


			DRAWN BY: JJH	DATE 12/12/19
			APPROVED BY:	DATE
			DIMENSIONS IN INCHES	
			SCALE NA	
			TOLERANCE ±3/4"	ANGULAR TOLERANCE
			MATERIAL	WEIGHT 6500
A	1/14 2020	CHANGE DISCHARGE PIPE	SHEET 1 OF 2	
REV.	DATE	DESCRIPTION		

J.E.GASHO & Assoc., Inc.
460 W. GAY ST.
WEST CHESTER, PENNSYLVANIA 19380

BLOWER PACKAGE
7021-G1L4CK2HA
150HP, ENCLOSURE

JG19-K-3414 | A



NOTES:
1. CUSTOMER PIPING IS 316 SS AND NEEDS TO BE INDEPENDENTLY SUPPORTED
2. TOLERANCE ± 1/2"
3. (DIM) ARE CRITICAL DIMENSIONS
4. ENCLOSURE HAS MINERAL WOOL SOUND ABSORBING MATERIAL FOR 20Dba NOISE REDUCTION.
5. NO INSTRUMENTATION HAS BEEN REQUESTED OR QUOTED. THE CUSTOMER IS RESPONSIBLE FOR INSTALLING ADEQUATE SAFEGUARDS FOR THE SAFE OPERATION OF THE PACKAGE. GASHO CAN RECOMMEND AND SUPPLY INSTRUMENTATION IF REQUESTED
6. GASHO DID NOT QUOTE ANY DISCHARGE PIPING COMPONENTS PAST THE FLANGED FLEXIBLE CONNECT (ITEM 8). GASHO WILL BE HAPPY TO INSTALL CUSTOMER SUPPLIED PIPING SO ENCLOSURE PATCH PLATES AND LOCAL PIPE SUPPORT CAN BE PLACED. GASHO CAN SUPPLY DISCHARGE PIPING IF REQUESTED.

REV.	DATE	DESCRIPTION

DRAWN BY: JJH — DATE: 12/12/19
APPROVED BY: — DATE:
DIMENSIONS IN INCHES
SCALE: NA
TOLERANCE: ±1/2" — ANGULAR TOLERANCE
MATERIAL — WEIGHT
SHEET 2 OF 2

J.E.GASHO & Assoc., Inc.
460 W. GAY ST.
WEST CHESTER, PENNSYLVANIA 19380

BLOWER PACKAGE
7021-G1L4CK2HA
150HP, ENCLOSURE

JG19-K-3414 | —

Tuthill

Performance Datasheet

Customer	:	Quote number	: 1048663
Customer reference	:	Size	: 7021 PD Plus
Item	: Caloris - 2025 Kg/hr 10-2 water vapor	Based on curve number	: 4-7021
Application	:	Date last saved	: 04 Oct 2019 11:47 AM
Material	: Cast Iron		

Operating Conditions

Standard conditions :

(14.70 psi.a , 21.11 deg C , 0.00 %)

Condition	1	
System inlet volume flow	2,042.5	CFM
Flow at standard conditions , dry	-	SCFM
Mass flow	2,025.0	kg/h
System inlet temperature	103.0	deg C
System inlet pressure	1.01	bar.a
Inlet pressure loss		psi
Product inlet pressure	1.01	bar.a
Product discharge pressure	1.75	bar.a
Discharge pressure loss		psi
System discharge pressure [p2]	1.75	bar.a
Product differential pressure	10.65	psi
System differential pressure [dp]	10.65	psi
Actual system discharge volume	1,300.9	CFM

Site Conditions

Atmospheric pressure	14.70	psi.a
Elevation above sea level	0.00	ft
Ambient temperature	20.00	deg C
Relative humidity	-	%
Frequency	60	Hz
Set inlet to ambient site conditions	No	

Gas Data

Type of gas	Gas	
Molecular weight (MW)	18.02	
Specific gravity	0.622	
Specific heat (Cp)	0.4564	Btu/(lb.deg F)
Ratio of specific heat (k)	1.32	

Performance

Actual inlet volumetric flow	2,042.5	CFM
Power, shaft [Ps]	135	hp
Inertial power	20.00	hp
Torque	5.83	hp/100 rpm
% of max torque	71.71	%
Quantity of units operating	1	
Speed	2315	rpm
% of max speed	77.17	%
Noise (with inlet and discharge silencers)	101	dB
Efficiency, volumetric [#,v]	72.67	%
Temperature rise	66.60	deg F
Discharge temperature	140.0	deg C
% of max temperature rise	23.37	%
% of max pressure rise	42.58	%

Gas constituents

Condition 1: Water Vapor H_2O (100.00%) | Mole or volume %

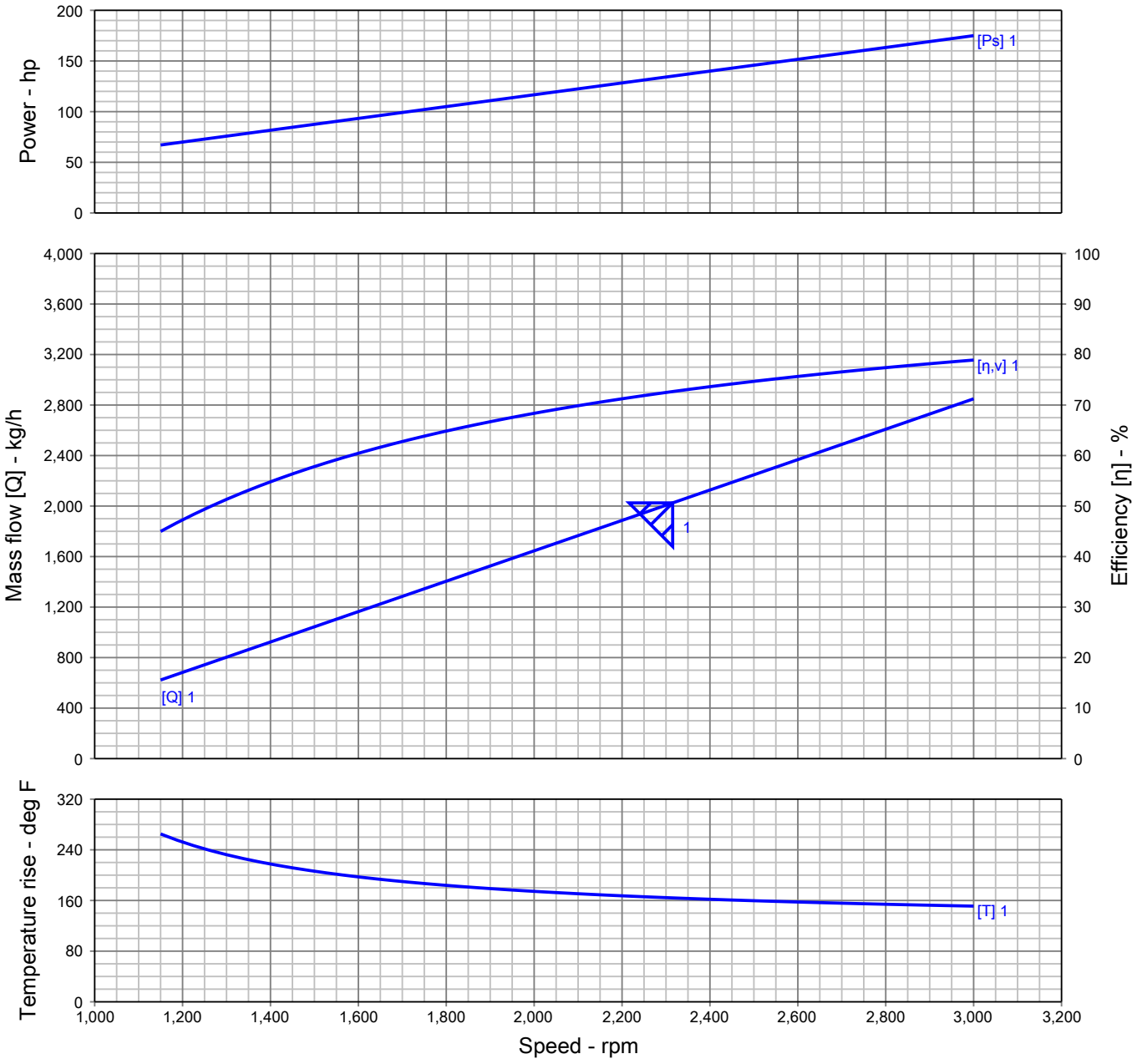
Liquid Injection (Enter a target discharge temperature)

Liquid	Water (H2O)	Temperature of injected liquid	21.10 deg C
Required liquid injection flow	0.34 USgpm	Remaining liquid injection flow	- USgpm

Tuthill

Performance Datasheet

Customer	:	Quote number	: 1048663
Customer reference	:	Size	: 7021 PD Plus
Item	: Caloris - 2025 Kg/hr 10-2 water vapor	Based on curve number	: 4-7021
Application	:	Date last saved	: 04 Oct 2019 11:47 AM
Material	: Cast Iron		



JE Gasho · 460 West Gay Street · West Chester, PA 19380-2851
phone: (610) 692-5650 · fax: (610) 692-5837 · gasho.org

PD Plus

Model 7000 Heavy Duty

Bi-directional Rotation
Series Options:
Horizontal Air Flow
Vertical Air Flow
Horizontal Flow, Single Envelope Gas Service
Vertical Flow, Single Envelope Gas Service
Horizontal Flow, Double Envelope Gas Service
Vertical Flow, Double Envelope Gas Service

Model Size	Max. Press. PSI	Max. Vac. (in. Hg)	Nominal Min. RPM @ Max. Disch. Press.	Nominal Max. RPM @ Max. Disch. Press.	Displ. CFR
7010	18	17	1700	3000	.593
7013	18	17	1650	3000	.752
7017	15	15	1150	3000	.983
7021	15	15	1150	3000	1.214
7026	12	15	1150	3000	1.503

Model 7000 PD PLUS heavy duty industrial blowers are designed for high performance applications, up to 18 PSIG pressure boost or 17" Hg dry vacuum (24" Hg water injected).

Vertical & Horizontal Air Flow

This series has wide application in pneumatic conveying, wastewater treatment, and the general process industry where high pressure, high volume air is required. Seal areas are vented to atmosphere to relieve process pressure against the internal lip seals, and to provide oil-free air.

Vertical & Horizontal Single Envelope Gas Service

This series is utilized in such applications as closed loop pneumatic conveying, fuel or process gas handling, or elevated pressure applications up to 100 PSIG discharge. Vent openings are tapped and plugged to prevent gas leakage. These fittings can also accept an inert gas purge for positive containment of the process gas.

Vertical & Horizontal Double Envelope Gas Service

This series is built to laboratory standards where virtually complete sealing is required. In addition to the features shown on the single envelope series, the drive shaft is mechanically sealed and the oil sumps are plugged to provide an even higher degree of leakage protection.

Optional Cooling Coils

7000 PD PLUS models can include cooling coils to provide cooling of lubricating oil with less than 1 GPM cooling water for high performance applications where external lubrication is not desired or practical.

Flexibility by Design

Detachable mounting feet allow field conversion from horizontal to vertical flow, or vice versa without additional components.

Maximum Efficiency

Model 7000 PD PLUS models include extended tip rotor profile for increased displacement and operating efficiency versus any other blower in its class.

Extra Capacity Oil Sumps

Oversized end covers for the largest oil capacity of any blower in its class. End covers also include external ribbing for applications where cooling water is not available. Oil drain plugs are O-ring sealed for protection against leakage.

Material Specifications:

Housing: Cast iron
End Plates: Cast iron
End Covers: Cast iron
Rotors: Ductile iron
Shafts: Ductile iron cast integrally with rotor
Bearings: Rotors - Double row ball
Drive shaft - Cylindrical roller
Drive Shaft: SAE 4140 forged alloy steel
Gears: Heat treated alloy steel, helical cut
Seals: Standard - Lip and labyrinth type on rotor shafts; lip seal on the drive shaft
Single Envelope Gas Service - Mechanical and labyrinth type on rotor shafts; lip seal on drive shaft
Double Envelope Gas Service - Same as Single Envelope series plus mechanical sealing on drive shaft
Lubrication: Oil splash system, both ends

For elevated pressure applications, single and double envelope gas service series are available with high pressure sealing and testing to allow discharge pressures as high as 100 PSIG (18 PSI nominal maximum pressure boost)*

* Blowers operating with a discharge pressure above 20 PSIG require mechanical rotor shaft sealing; above 25 PSIG requires hydrostatic testing and special high pressure seal leakage testing.

Optional Lubrication Systems

All 7000 PD PLUS models are available with integral pressure lubrication to provide positive bearing lubrication and filtration of lubricant for extreme applications. Optional lubrication can be specified.

Special Materials

Ductile Iron*
Stainless Steel**
Carbon Steel***

Special Coatings

Bi-Protec® (Nickel/Armoloy®)

*7010, 7017, 7021 & 7026 only
**7013 & 7017 only, ***7013 only

All blowers are factory tested to meet ISO 9001 registered quality standards.

Performance Tables

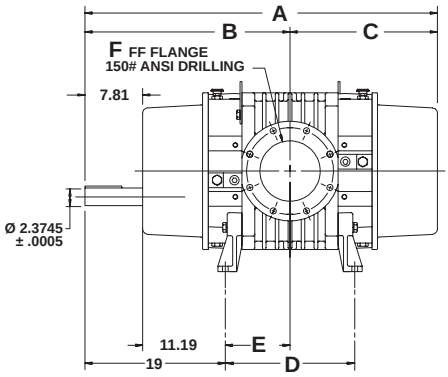
In conjunction with our program of continuous testing and design upgrading, all specifications are subject to change without notice.
All data are approximate. Request a quotation for your specific application.

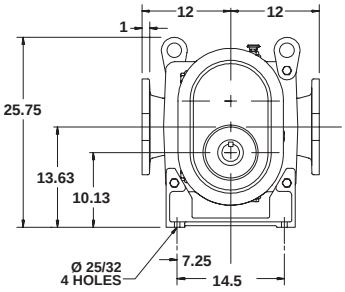
Pressure (14.70 PSIA and 70° F Inlet)

BLOWER MODEL	SPEED	2 PSIG		5 PSIG		8 PSIG		10 PSIG		12 PSIG		15 PSIG		18 PSIG		Max. Vacuum		
	(RPM)	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	" Hg	CFM	BHP
7010	1200	586	8.5	513	18	460	27	430	33	403	40	367	49			15	370	25
	1750	912	13	839	26	786	40	756	49	730	58	693	71	660	85	16	672	39
	2400	1297	17	1224	36	1172	54	1142	67	1115	79	1079	98	1046	116	17	1032	57
	3000	1653	21	1580	45	1527	68	1498	83	1471	99	1434	122	1402	145	17	1388	71
7013	1200	749	10	660	22	596	34	560	42	527	50	483	61			15	486	31
	1750	1163	15	1074	32	1010	49	974	61	941	72	897	89	857	107	16	871	49
	2400	1652	20	1563	44	1499	68	1462	83	1430	99	1385	123	1345	146	17	1329	70
	3000	2103	26	2014	55	1950	85	1914	104	1881	124	1837	153	1797	183	17	1780	88
7017	1200	985	13	872	28	790	44	744	54	703	64	647	79			15	651	40
	1750	1526	18	1413	41	1331	63	1285	78	1244	93	1187	116			16	1155	62
	2400	2165	25	2051	56	1970	87	1924	108	1882	128	1826	159			17	1754	91
	3000	2754	32	2641	70	2560	109	2514	134	2472	160	2416	199			17	2344	113
7021	1200	1225	15	1090	34	993	53	939	66	889	79	822	98			15	827	49
	1750	1893	22	1758	50	1661	78	1606	96	1557	115	1490	142			15	1495	72
	2400	2682	30	2547	68	2450	106	2395	132	2346	157	2279	195			15	2284	98
	3000	3410	38	3276	85	3178	133	3124	165	3074	196	3007	244			15	3012	123
7026	1200	1527	18	1367	42	1251	65	1186	81	1127	97					14	1101	56
	1750	2354	26	2193	61	2078	95	2012	118	1953	141					15	1879	88
	2400	3331	36	3170	83	3055	131	2989	162	2930	193					15	2856	121
	3000	4233	45	4072	104	3956	163	3891	202	3832	242					15	3758	151

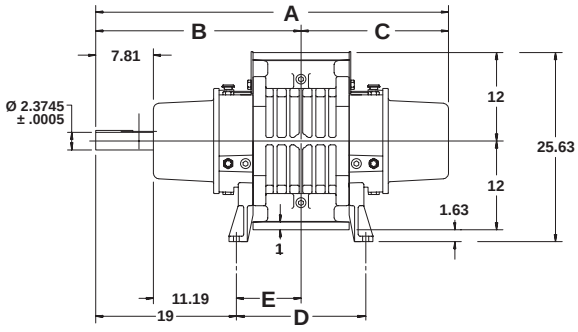
Dimensions

Horizontal Flow

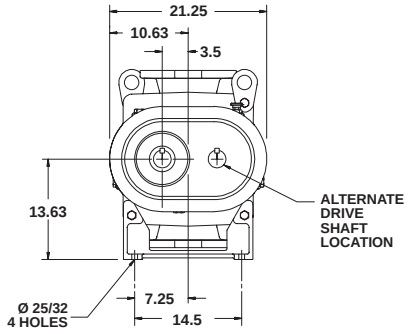




Vertical Flow



MODEL	A	B	C	D	E	F	NET WT. (lbs.)*
7010	44.94	26.38	18.56	7.38	14.75	6 FLG	1125
7013	47.69	27.75	19.94	8.75	17.50	8 FLG	1230
7017	51.69	29.75	21.94	10.75	21.50	10 FLG	1365
7021	55.69	31.75	23.94	12.75	25.50	12 FLG	1525
7026	60.69	34.75	26.44	15.25	30.50	12 FLG	1690



Values are approximate and should not be used for construction.
Certain dimensions for double envelope gas-service differ slightly from those shown above.
Certified prints are available through your local Tuthill Vacuum & Blower Systems Sales Professional.

*Approximate shipping weight.

Your Local Tuthill Vacuum Blower Systems Sales Professional:

Tuthill
PUMP YOUR HEART INTO IT

Tuthill Vacuum & Blower Systems
4840 West Kearney Street
Springfield, Missouri USA 65803-8702
o 417.865.8715 800.825.6937 **f** 417.865.2950
tuthillvacuumblower.com

ISO 9001

Tuthill

M-D Pneumatics™
Rotary Positive Displacement Blower

Manual 2007 0911 ENG

WARNING: Do Not Operate Before Reading Manual

PD Plus©
OPERATOR'S MANUAL

Models

7010	7021
7013	7026
7017	

17/19 Series - Horizontal Air Flow
46/86 Series - Vertical Air Flow
55/57 Series - Horizontal Flow, Single Envelope Gastight
81/82 Series - Vertical Flow, Single Envelope Gastight
64/66 Series - Horizontal Flow, Double Envelope Gastight
67/69 Series - Vertical Flow, Double Envelope Gastight

Operator's Manual: Tuthill PD Plus© Rotary Positive Displacement Blower

TABLE OF CONTENTS

1. INTRODUCTION

CONGRATULATIONS on your purchase of a new **PD PLUS® Rotary Positive Displacement Blower** from **Tuthill Vacuum & Blower Systems**. Please examine the blower for shipping damage, and if any damage is found, report it immediately to the carrier. If the blower is to be installed at a later date make sure it is stored in a clean, dry location and rotated regularly. Make sure covers are kept on all openings. If blower is stored outdoors be sure to protect it from weather and corrosion.

PD PLUS blowers are built to exacting standards and if properly installed and maintained will provide many years of reliable service. We urge you to take time to read and follow every step of these instructions when installing and maintaining your blower. We have tried to make these instructions as straightforward as possible. We realize getting any new piece of equipment up and running in as little time as possible is imperative to production.

NOTE
Record the blower model and serial numbers of your machine in the OPERATING DATA form on the inside back cover of this manual. You will save time and expense by including this reference identificati n on any replacement part orders, or if you require service or application assistance.

1.1 APPLICABLE DOCUMENTATION

The applicable documents associated with this manual are:
- 2006/42/CE – Machinery Directive
- EN 1012-1:1996 - Compressors and vacuum pumps - Safety Requirements - Part 1: Compressors

1.2 SCOPE OF MANUAL

The scope of this manual and the Declaration of Incorporation includes the bare shaft rotary positive displacement blower.

2. CONVENTIONS AND DATA PLATE

2.1 GRAPHIC CONVENTIONS IN THIS MANUAL

This manual is the result of a risk assessment according to the applicable documents referenced in section 1.1. The following are hazard levels are referenced within this manual:

DANGER
Indicates an immediate hazardous situation which, if not avoided, will result in death or serious injury.

WARNING
Indicates that a physical injury or damage to health or property, if not avoided, could occur.

CAUTION
Indicates that a potential hazard may occur which, if not avoided, could result in minor or moderate injury.

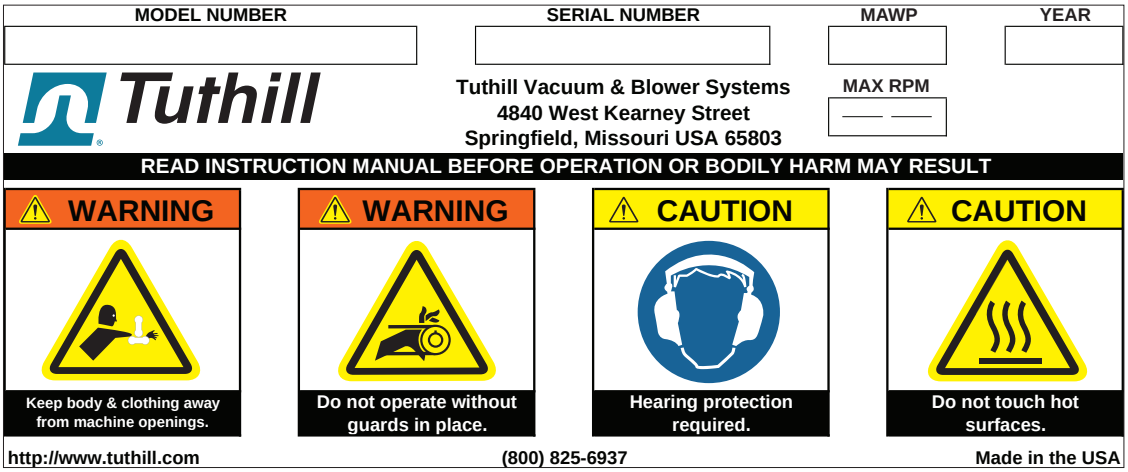
NOTE

Indicates a statement of information which, if not avoided, could cause damage to the product.

CAUTION

Read manual before operation or bodily harm may result. Attention should be given to the safety related sections of this manual.

2.2 DATA PLATE



General Operation and Symbols on Data Plate - The following information is contained on the data plate:

WARNING

Keep body & clothing away from machine.

During operation, keep body and clothing away from inlet and outlet of the blower.

WARNING

Do not operate without guards in place.

CAUTION

Hearing protection is required while the blower is in operation. Noise levels may reach as high as 81 dBA.

CAUTION

Do not touch hot surfaces.

The upper limit of the blower operation is 400° F (205° C). Do not touch the blower while it is in operation and assure blower is cool when not in operation.

MODEL NUMBER: This identifies the specific model of the blow .

SERIAL NUMBER: Each blower has a unique serial number. This number is to be used with any service issues and with any contact with the manufacturer.

YEAR: This states the year that the blower was manufactured.

MAWP: This states the maximum allowable working pressure (MAWP) of the blower casing. This is NOT the allowable maximum pressure differential. When determining the pressure differential, the inlet pressure shall be taken into account to assure that the MAWP is not exceeded.

The standard MAWP is per Table 2. The MAWP shall not be exceeded unless specific factory testing of the pressure containing components of the blower has been performed.

Contact the factory for testing and documentation if this pressure is to be exceeded.

3. LIFTING

WARNING
The blower must be handled using an appropriate device such as a fork truck or appropriate lifting device. See Table 1 for approximate weights. Care should be taken to assure blower does not over-turn during handling and installation.

4. DESCRIPTION

NOTE
Refer to specific data sheets for flow capacities and vacuum capacitie

NOTE
Refer to diagrams in this manual for proper rotation and orientation in inlet and discharge.

Tuthill Vacuum & Blower Systems model 7000 rotary lobe blowers are positive displacement type units, whose pumping capacity is determined by size, operating speed, and differential pressure conditions. Blowers employ rotors rotating in opposite directions within a housing closed at the ends by end plates.

Effective sealing of the inlet to the discharge is accomplished through the use of very small operating clearances. The resulting absence of moving contact eliminates the need for any internal lubrication.

Clearances between the rotors during rotation are maintained by a pair of accurately machined helical timing gears, mounted on the two shafts extended outside the air chamber. The intermeshing rotary lobes are designed to rotate and trap air or gas between each rotor and the housing. As the rotor lobes rotate past the edge of the suction port, the trapped air or gas is essentially at suction pressure and temperature. Since the blower is a constant volume device, the trapped air remains at suction pressure until the leading rotor lobe opens into the discharge port. The close clearances between the rotors inhibit back slippage of the trapped volume from between the rotors and the trapped volume is forced into the discharge piping. Compression occurs not internal to the blower, but by the amount of restriction, either downstream of the blower discharge port, or upstream of the blower inlet port.

Figure 1 illustrates that the air moves not between the rotors but between the rotors and the side of the housing. Also, the machine is bi-directional, meaning that the direction of rotation of the blower can make either side the inlet or discharge. See also the *Flow Direction by Rotation* section below.

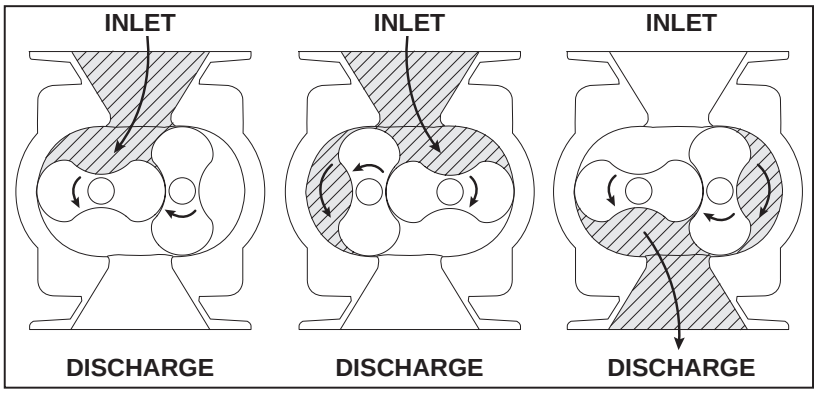


Figure 1 - Illustration of general operation principle

No attempt should ever be made to control capacity by means of a throttle valve in the intake or discharge piping. This will increase the power load on the drive system, increase operating temperatures, and can overload and/or seriously damage the blower. Likewise, if a possibility exists that flow to the blower inlet may be cut off during normal operation of a process, then an adequate vacuum relief valve must be installed near the blower. A pressure type relief valve in the discharge line near the blower is also strongly recommended for protection against cutoff or blocking in this line. Check valves should also be used on every blower when more than one blower is connected to a discharge line. This is for both safety and operating conditions.

When a belt drive is employed, blower speed, if necessary, can usually be adjusted to obtain desired capacity by changing the diameter of one or both sheaves, or by using a vari-speed motor pulley. In a direct coupled arrangement, a variable speed motor or transmission is required, or excess air or gas may be blown off through a manually controlled unloading valve and silencer. Gas units can use bypasses, but some applications may require additional cooling. If there is a large volume of high pressure air or gas downstream of the blower, a check valve in the piping downstream of the blower will protect the blower from overspeeding in a backward direction upon shutdown.

Consult your Tuthill Vacuum & Blower Systems sales professional if questions arise.

4.1 FLOW BY DIRECTION

WARNING

Refer to diagrams in this manual for proper rotation and orientation in inlet and discharge.

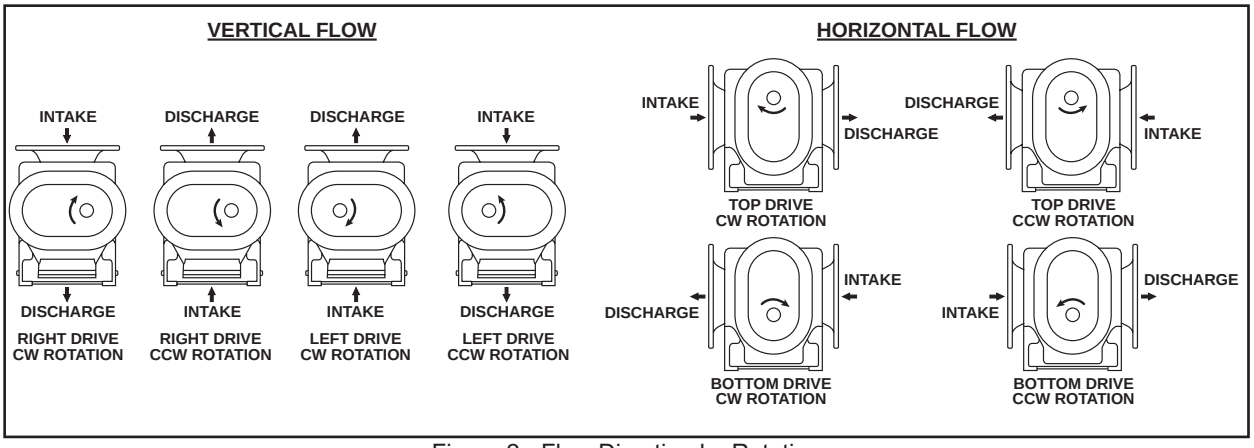


Figure 2 - Flow Direction by Rotation

4.2 SPECIFICATIONS

TABLE 1A — SPECIFICATIONS (SUMP OIL LUBRICATION)

MODEL	APPROXIMATE OIL CAPACITY QUARTS / *LITERS*		PORT SIZE IN / *MM*	MAX RPM	APPROXIMATE WEIGHT LBS. / *KG*	
	VERTICAL FLOW 46/81/67	HORIZONTAL FLOW 17/57/64			VERTICAL FLOW 46/81/67	HORIZONTAL FLOW 17/57/64
7010	8.0 / *7.5*	5.0 / *4.75*	6 / *150*	3000	—	1120 / *510*
7013	8.0 / *7.5*	5.0 / *4.75*	8 / *200*	3000	1255 / *570*	—
7017	8.0 / *7.5*	5.0 / *4.75*	10 / *250*	3000	—	1390 / *635*
7021	8.0 / *7.5*	5.0 / *4.75*	12 / *300*	3000	1530 / *695*	1530 / *695*
7026	8.0 / *7.5*	5.0 / *4.75*	12 / *300*	3000	1695 / *770*	1695 / *770*

TABLE 1B — SPECIFICATIONS (INTEGRAL LUBRICATION)

MODEL	APPROXIMATE OIL CAPACITY QUARTS / *LITERS*		PORT SIZE IN / *MM*	MAX RPM	APPROXIMATE WEIGHT LBS. / *KG*	
	VERTICAL FLOW 86/82/69	HORIZONTAL FLOW 19/55/66			VERTICAL FLOW 86/82/69	HORIZONTAL FLOW 19/55/66
7010	15 / *14.2*	12 / *11.4*	6 / *150*	3000	—	1120 / *510*
7013	15 / *14.2*	12 / *11.4*	8 / *200*	3000	1255 / *570*	—
7017	15 / *14.2*	12 / *11.4*	10 / *250*	3000	—	1390 / *635*
7021	15 / *14.2*	12 / *11.4*	12 / *300*	3000	1530 / *695*	1530 / *695*
7026	15 / *14.2*	12 / *11.4*	12 / *300*	3000	1695 / *770*	1695 / *770*

TABLE 2 — MAXIMUM OPERATING LIMITS

MODEL	MAXIMUM RPM	MAXIMUM PRESSURE DIFFERENTIAL psi / *mbar*	MAXIMUM VACUUM in. Hg / mbar	MAXIMUM TEMPERATURE RISE °F / *°C*	MAWP psi / *bar*
7010	3000	18 / *1241*	17 / *575*	300 / *166*	100 / *6.9*
7013	3000	18 / *1241*	17 / *575*	300 / *166*	
7017	3000	15 / *1034*	15 / *507*	300 / *166*	
7021	3000	15 / *1034*	15 / *507*	280 / *155*	
7026	3000	12 / *827*	15 / *507*	220 / *122*	

WARNING

The maximum pressure differential is based on the difference between the inlet pressure and the outlet pressure. The maximum pressure differential shall not be exceeded. Exceeding the maximum pressure differential will cause serious damage to the equipment and could cause bodily injury.

WARNING

The maximum allowable working pressure (MAWP) is based on the absolute pressure of the blower housing and is NOT the maximum allowable pressure differential. Exceeding the MAWP will cause serious damage to the equipment and could cause bodily injury.

To permit continued satisfactory performance, a blower must be operated within certain approved limiting conditions. The manufacturer's warranty is, of course, also contingent on such operation. Maximum limits for pressure, temperature and speed are specified here for various blower sizes when operated under the standard atmospheric conditions. Do not exceed any one of these limits.

NOTE

Specially ordered blowers with nonstandard construction, or with rotor end clearances greater than shown within the *Assembly Clearances* table, will not have the operating limits specified here. Contact your Tuthill Vacuum & Blower Systems sales representative for specific information

NOTE

Special attention must be paid when a blower has a higher than standard ambient suction temperature. Special recommendations for operating parameters and/or additional cooling may be recommended. Consult the factory or local representative for appropriate information.

5. INSTALLATION

5.1 GENERAL

DANGER

The blower is not intended to be used with explosive products or in explosive environments. The blower is not intended to be used in applications that include hazardous and toxic gases. Consult the factory for support.

DANGER

It is the responsibility of the installer to assure that proper guarding is in place and compliant with all applicable regulatory requirements.

WARNING

The bare shaft blower can generate excessive noise. Methods to reduce the noise levels by installing inlet and outlet silencers will be required. Even with inlet and outlet silencers, hearing protection will be required.

WARNING

Customers are warned to provide adequate protection, warning and safety equipment necessary to protect personnel against hazards in the installation and operation of this equipment in the system or facility.

WARNING

The standard MAWP is per Table 2. The MAWP shall not be exceeded unless specific factory testing of the pressure containing components of the blower has been performed.

WARNING

Table 2 states the maximum operating speed in RPM (rotations per minute) and maximum temperature. Do not exceed these limits. The installation of the blower shall take these critical operating parameters into account and adequate control features implemented.

WARNING

Upon completion of the installation, and before applying power, rotate the drive shaft by hand. It must move freely. If it does not, look for uneven mounting, piping strain, excessive belt tension or coupling misalignment or any other cause of binding. If blower is removed and still does not move freely, check inside the blower housing for foreign material.

NOTE
Remove the protective covers from the shaft and inspect for damage.

Carefully check to ensure that no transit damage has been sustained. If damage has occurred from shipment a claim must be filed with the carrier immediately; preserve the shipping container for inspection by the carrier.

NOTE
In the event that your unit sustains damage while being shipped to your facility, do not return it to the factory without first obtaining shipping instructions from us.

Protective covers and plugs should not be removed until the connection is being made. Mount the blower on a flat, level surface. We recommend a baseplate that is a rigid, solidly supported, and structurally sound. Shim under the legs where necessary so that each leg of the blower supports an equal share of the blower weight. This is necessary to prevent eventual twisting of the blower. Make sure feet rest evenly on the mounting surface before fastening down. Twisting or cramping the blower in mounting will cause rotor contact and binding during operation, resulting in a condition called “soft foot”. (See the *Soft Foot* section of this manual for further details and preventative measures.)

A unit that is factory mounted on a base, should not require the above adjustments. However, since the assembly can become twisted in shipping or installation, checking for soft foot should be done after installation of the base. Shims may be needed for alignment. Loosen the foot hold-down screws to check foot contact with the mounting surface. The base should be mounted on a solid foundation or heavy flooring, using shims as necessary at bolting points to prevent warping the assembly. (Also refer to the *Foundation* section.)

Transmission of small operating vibrations to a support structure may be objectionable in some cases. Use of vibration isolators or vibration absorbing materials can be effective in overcoming this problem. To avoid casing distortion, the treatment used should be applied under the common motor/blower base or mounting plate, rather than directly under the feet alone.

Piping should be accurately squared with the blower and supported independently. Stress imparted from incorrectly aligned piping or mounting will create problems with bearing and seal life, possibly leading to premature internal contact. The blower should sit stress free and evenly on its supporting surface. Care should be taken to evenly tighten the mounting bolts to not impart undue stress into the blower. Stress can be checked in a free state with feeler stock or verified on a previously installed blower with the aid of a dial indicator. Less than .002” (.05 mm) spring or gap should be found.

Use only clean new pipe and make certain it is free of scale, cuttings, weld beads, dirt, or any other foreign material. To guard against damage to the blower, insure that an inlet filter is used. Make provisions to clean the filter of collected debris after a few hours of operation and periodically thereafter. (See the *Piping Connections* section for additional details.)

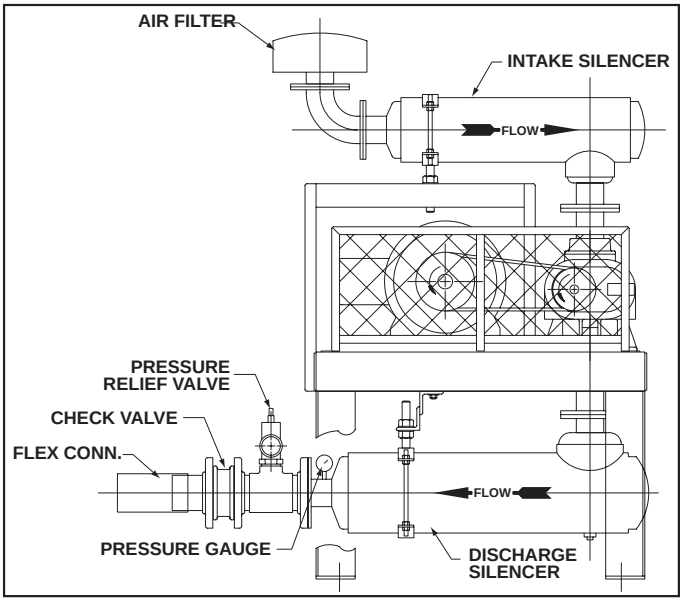


Figure 3 - Typical Blower Installation

Figure 3 shows a typical complete installation of blower and accessories. Note the absence of throttle or shut-off valves in either discharge or intake piping. If it is possible for air flow to be cut off in either of these lines, make provisions to add a pressure and/or vacuum relief valve. In some installations, it may be desirable to use only an inlet silencer-cleaner supported directly from the blower connection. Weight of accessories and piping must be kept to a minimum to prevent blower casing distortion. Weights in excess of 10% of blower weight should be supported independently of blower and connected with a flexible hose or connectors. (The approximate weight of your unit is included within the *Specifications* table.)

A blower may be driven by direct-coupling to the driver or by V-belt drive, to obtain other speeds within approved range. (See the *Motor Drives* section for more information.)

Blowers from Tuthill Vacuum & Blower Systems are internally and externally treated after factory assembly and testing to protect against rusting in normal atmospheric conditions prior to installation. The maximum period of internal protection is considered to be up to 6 months under average conditions, provided closing plugs and seals are not removed. Protection against chemical or salt water atmosphere is not provided. Avoid opening the blower until ready to begin installation, as protection will be quickly lost due to evaporation. (For recommended preparations for long term storage (longer than 6 months), please see the *Long Term Storage* section in this manual.)

5.1.1 LOCATION

Install your blower in a room or outdoor area that supplies adequate space and lighting for routine maintenance. Indoor installation areas should be well ventilated and kept as cool as possible, because operating the unit at elevated temperatures can result in nuisance overload or temperature shutdowns. An unprotected outdoor installation is only satisfactory when correct lubrication for expected temperatures is provided, as per the *Recommended Lubricants* section in this manual.

5.1.2 FOUNDATION

Your blower does not need a special foundation, however it does require a solid, level floor and adequate frame support. Bolt the blower system to the floor and seal any cracks

5.1.3 BLOWER AIR INTAKE

To minimize maintenance, supply your blower with the cleanest air possible. It is important that the air does not contain any flammable or toxic gases, as the blower will concentrate these gases. This could result in damage to the unit and surrounding property, lead to personal injury or death. Do not block or restrict the opening or the blower and/or motor may overheat and fail.

Do not use blowers on explosive or hazardous gases. Each size blower has limits on pressure differential, running speed, and discharge temperature. These limits must not be exceeded. Consult Table 2 for details pertaining to the allowable performance criteria.

If it is necessary to take air from a remote source, such as in a vacuum application, the piping should be at least the same diameter of the blower inlet. For distances greater than 20 feet (6 m) the pipe diameter should be enlarged to reduce inlet restriction. Excessive restriction will reduce the efficiency of the blower and elevate its discharge temperature. The piping used should also be corrosion resistant, and free of scale and dirt. The inlet should be covered to keep out precipitation, insects, and small animals. Vacuum kits are available.

5.1.4 SOFT FOOT

Soft foot is a condition in which one of the blower feet does not sit flat on the base. Usually, this is due to irregularities in the surface to which the blower is mounted. When you tighten the bolt on the foot, the blower will distort slightly, but enough to cause problems with bearing and seal life, and premature internal contact between the rotors and the housing.

1. Place blower on base.
2. Check each foot for gaps between foot and base (soft foot), shim as necessary to fill gap within .002" (.05 mm) Below are shown the two most common types of soft foot conditions. If either type is present, and measures more than .003" (.076 mm), the blower may fail prematurely.
3. Tighten all bolts.
4. Mount a dial indicator on base contacting one foot at 12 o'clock position.
5. Loosen bolt on that foot. Observe indicator travel and add shims as needed to reduce "spring" to less than .002" (.05 mm). Repeat steps 4 and 5 on remaining feet.

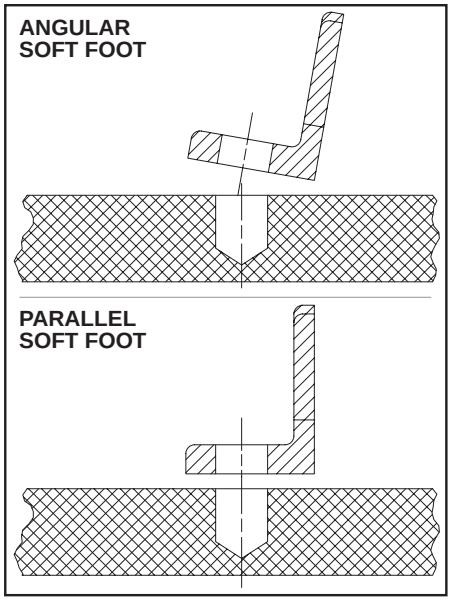


Figure 4 - Illustrations of Soft Foot

5.2 SAFETY

Tuthill Vacuum & Blower Systems recommends the use of relief valves to protect against excessive pressure or vacuum conditions. These valves should be tested at initial start-up to be sure they are properly adjusted to relieve at or below the maximum pressure differential rating of the blower.

DANGER

It is the responsibility of the installer to assure that proper guarding is in place and compliant with all applicable regulatory requirements.

DANGER

Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. The blower should never be run with the inlet or discharge piping removed. If it becomes necessary to inspect the rotating parts of the blower or to change V-belts, be absolutely sure that all power to the motor controls has been shut off, the motor controls are locked out, and properly tagged before proceeding.

DANGER

Assure that properly sized vacuum breaks/relief valves are used on the inlet side of the blower. Also assure that properly sized pressure relief valves are used on the outlet of the blower. The sizing shall be such to assure that the proper flow can be achieved without exceeding the rated vacuum and pressure ratings.

DANGER

Blower housing and associated piping or accessories may become hot enough to cause major skin burns on contact.

WARNING

Use lock out/tag out procedures to disable the electrical energy source before any service or work is done on the blower.

WARNING

Avoid extended exposure in close proximity to machinery with high intensity noise levels. Wear adequate ear protection.

NOTE

Use proper care and good procedures in handling, lifting, installing, operating, and maintaining the equipment.

5.3 LUBRICATION

Every booster from Tuthill Vacuum & Blower Systems is factory tested, oil drained and shipped dry to its installation point. Both independent oil reservoirs must be filled to the proper level before operation. Oil reservoirs are under vacuum.

Shaft bearings at the gear end of the booster are splash lubricated by one or both gears dipping into an oil reservoir formed in the gear end plate and cover. Shaft bearings at the drive end of the booster are lubricated by a slinger assembly dipping into an oil reservoir. Before starting the booster, fill oil sumps as shown below within the *Filling Procedure* section.

Add oil to the booster in the quantity shown within the *Specifications* Table. The oil level must be maintained within the notched area of the sight glass. See Figure 5 and Figure 6. Lower drive units have “bull’s eye” type oil level gauges. Maintain oil levels at the center of the glass.

WARNING

Never attempt to change or add lubrication while the booster is running. Failure to heed this warning could result in damage to the equipment or personal injury. Oil must be checked when the booster is NOT running.

WARNING

Properly dispose of the spent lubricants. Refer to the manufacturer of the lubricant and any regulations to assure proper and safe disposal.

WARNING

Do not start the booster until you are sure oil has been put in the gear housing and rear cover. Operation of the booster without proper lubrication will cause the booster to fail and void the warranty.

NOTE

Assure oil is compatible with copper/yellow metals (if equipped with cooling coils).

NOTE
Refer to Table 1 for oil capacities.

5.3.1 FILLING PROCEDURE

See Figures 5 and 6. Recommended lubricants are shown on page 35.

1. Remove fill plugs or breathers from both gear end and drive end plates.
2. SLOWLY pour oil through fill until oil appears in the oil sight glass. Bring oil level to center of sight glass.
3. Verify oil level is at proper level in BOTH gear end and drive end sight glasses.
4. Replace fill plugs or breathers that were removed in step 1.

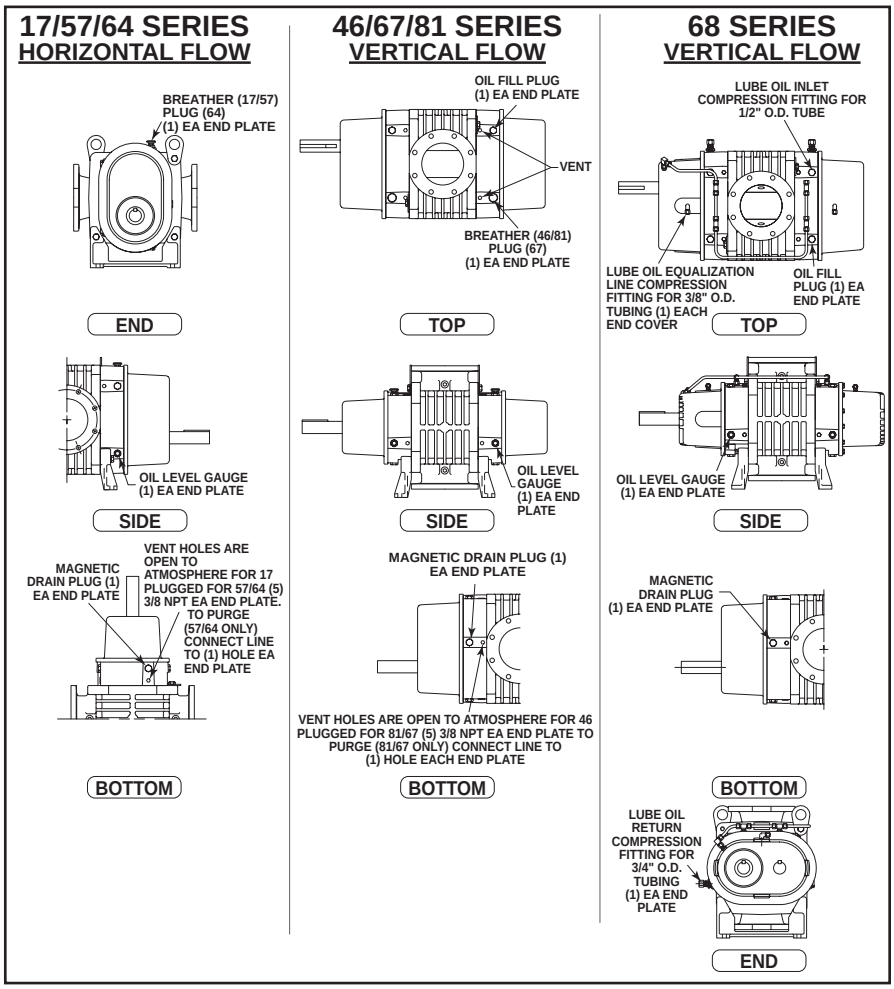


Figure 5 - Location of oil fill, drain, level gauges on blowers with Splash Lubrication

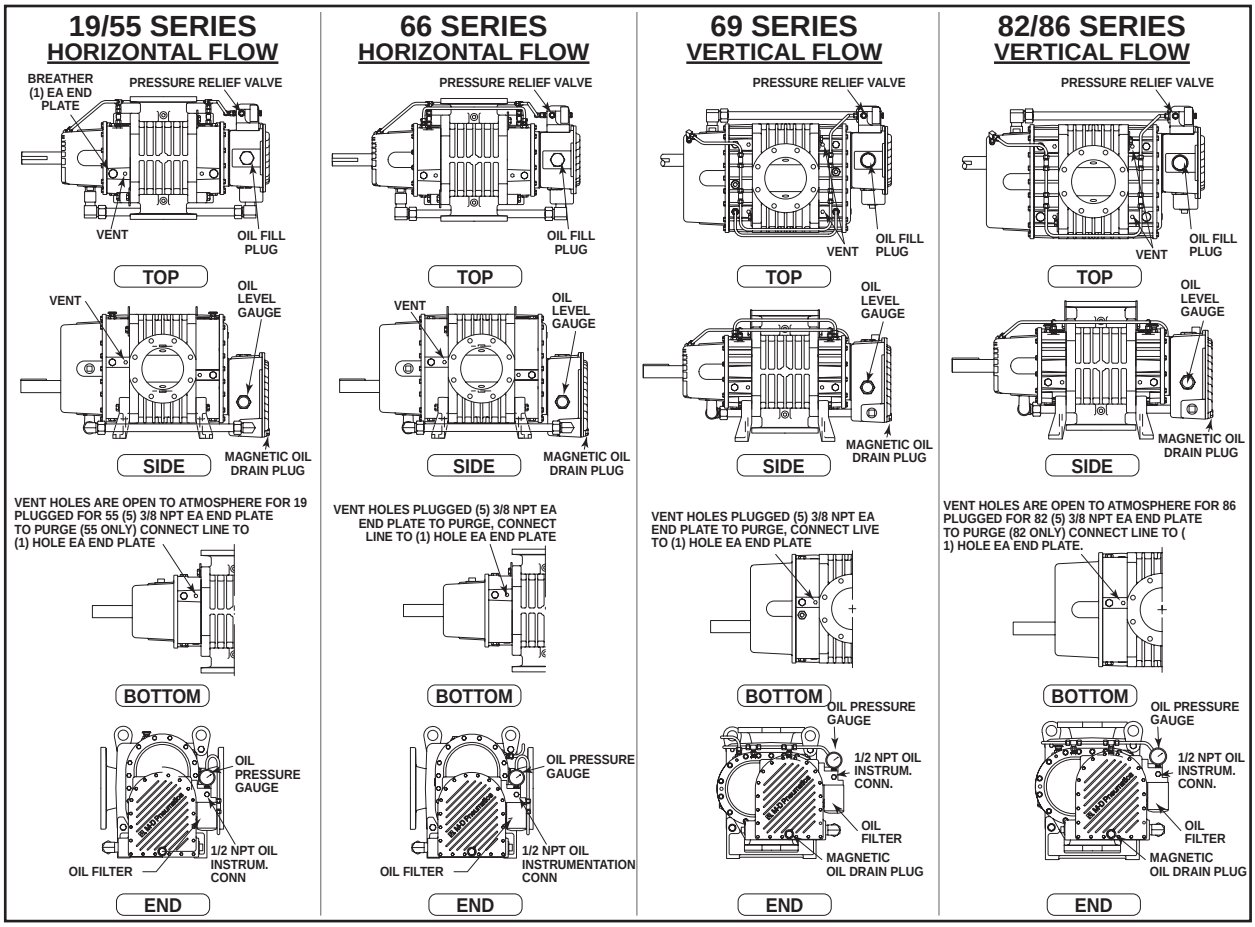


Figure 6 - Location of oil fill, drain, level gauges and cooling connections on blowers with Integral Lubrication

5.3.2 FREQUENTLY ASKED QUESTIONS REGARDING LUBRICATION

What is the functional detriment if the "wrong oil" is used?

The lubricant is selected based on bearing and gear speed, and operating temperature. Too light of a lubricant increases wear by not separating the sliding surfaces and it will not remove the heat adequately. If the lubricant is too thick, the drag in the bearings is increased causing them to run hotter. Since it is thicker, it will not flow as readily into the gears and it will reduce the available backlash. Lubricants at our conditions are incompressible.

What is the functional detriment if the oil is not serviced?

If the lubricant is not serviced at the proper interval the shearing action in the bearing and the gears will begin to take their toll and the lubricant will thicken, making matters worse. The unit will run hotter and the wear on running surfaces will increase. Generally, the lubricant will appear dirtier, this is actually material rubbed off the unit's components. The discoloration comes from overheating the additive package. An indicator of the breakdown of a lubricant is the increase in the TAN (Total Acid Number), and a change in the base viscosity of ten percent.

Several things are happening as the lubricant goes through the unit. First, it is absorbing frictional energy in the form of heat. This heat has to be dissipated through either surface contact with cooler materials, or in a rest volume of lubricant. While reducing the friction, the lubricant is also going through a shearing process and the molecular structure is broken down.

The result is that the lubricant will begin to thicken because of the shorter molecular chains and the drop out of additive packages. The thickened lubricant will cause more drag, increasing the friction and heat, and further degrading the lubricant.

Operation of the booster (environment, run time, speed, and pressure) has a direct effect on duty cycles. Our published cycles are based on worst-case conditions.

5.3.3 HAZARDS ASSOCIATED WITH BREAKDOWN OR IGNITION OF LUBRICATION

DANGER

There is a risk associated with the lubrication media breaking down and resulting in a hazardous fluid or vapor. There may also be a hazard associated with the ignition of the lubrication media. Refer to the lubrication manufacture's applicable instruction for safety precautions.

5.3.4 LUBRICATION (SPLASH - 90/91 SERIES)

WARNING

For connecting water, remove only the 1" NPT plugs with the 5/8" allen heads. Use of any other connection for water will cause serious damage to unit.

Before starting the unit, fill oil reservoirs as instructed below

1. Remove fill plugs or breathers from gear (drive) end and free (non-drive) end plates
2. Pour oil through fill hole until oil appears in sight glass. Slowly bring oil up to center of glass. Repeat for both end plates. Each oil sump must be filled independentl .
3. Re-seal plugs and reinstall in end plates.
4. Oil levels should be checked frequently. Unit must be shut down to properly check oil levels.

5.3.5 LUBRICATION (INTEGRAL PRESSURE - 31/33 SERIES)

1. Before starting the unit, fill reservoirs as instructed below:
2. Remove oil fill plug.
3. Pour oil through fill hole until oil appears in sight glass.
4. The front and back oil reservoirs are connected together; however, it will take some time for the oil to travel to the front of the machine. Allow several minutes for this to occur.
5. Bring oil level up to the center of the sight glass. Again, allow time for equalization of oil level between the back and the front of the machine.
6. Reinstall fill plug.

5.3.6 OIL FILTER

Change the oil filter element with every oil change. Filters (P/N 70248) are available from Tuthill Vacuum and Blower Systems in Springfield, Missouri, or from any authorized distributor or service center.

5.3.7 OIL PRESSURE ADJUSTMENT

Figure 7 - Oil Pressure Adjustment Hex Cap

The oil pressure on each unit has been preset at the factory during the load testing. Generally the oil pressure should not require adjustment once the unit is installed and in operation. Some adjustment may be require due to the speed and oil temperature.

To adjust the unit to the proper oil pressure remove the hex cap shown in the image to the right. Loosen the lock nut and turn the set screw clockwise to increase the pressure or counterclockwise to decrease the pressure. Tighten lock nut and replace cap before reading oil pressure. Always allow unit to reach operating temperature before adjusting the oil pressure to the proper range. Set the oil pressure to 15 PSIG (103 kPa).

5.4 PIPING CONNECTIONS

WARNING

Pipe loading on the blower should be negligible as pipe loading can cause distortion of the blower. Use proper supports and pipe hangers to assure that there is no loading.

NOTE

Remove the protective covers from the inlet and outlet ports and inspect for dirt and foreign material.

Inlet and outlet connections on all blowers are large enough to handle maximum volume with minimum friction loss. Maintain same diameter piping. Silencers must not be supported by the blower. Stress loads and bending moments must be avoided.

Be certain all piping is clean internally before connecting to the blower. We recommend placing a 16-mesh wire screen backed with hardware cloth at or near the inlet connections for the first 50 hours of use until the system is clean. Make provisions to clean the screen after a few hours of operation and completely discard it once the system is clean, as it will eventually deteriorate and small pieces going into the blower can cause serious damage. A horizontal or vertical air flow piping configuration is easily achieved by rearranging the mounting feet position.

5.4.1 HAZARDS ASSOCIATED WITH HAZARDOUS PROCESS FLUIDS

DANGER

It shall be the responsibility of the installer to ensure that piping is adequate, sealing between pipe joints is adequate for the process fluids and proper process and pressure protection devices are in place. It is also the responsibility of the installer to assure that process gasses are not vented in a manner that would be hazardous.

Refer to the manufacturer of the process media to assure that proper safety precautions are in place.

5.4.2 BLOCKAGE OR RESTRICTION

WARNING

Damage to the blower could occur if there is blockage in the inlet or outlet ports or piping. Care should be taken when installing the blower to assure that there are no foreign objects or restrictions in the ports or piping.

5.4.3 HAZARDS ASSOCIATED WITH HAZARDOUS PROCESS FLUIDS

DANGER

It shall be the responsibility of the installer to ensure that piping is adequate, sealing between pipe joints is adequate for the process fluids and proper process and pressure protection devices are in place. It is also the responsibility of the installer to assure that process gasses are not vented in a manner that would be hazardous.

Refer to the manufacturer of the process media to assure that proper safety precautions are in place.

5.4.4 BLOCKAGE OR RESTRICTION

WARNING

Damage to the blower could occur if there is blockage in the inlet or outlet ports or piping. Care should be taken when installing the blower to assure that there are no foreign objects or restrictions in the ports or piping.

5.5 COOLING COILS (OPTIONAL)

CAUTION

If the blower is to be located outdoors or in a building where the temperature surrounding the blower or the water supply and return piping can fall below 35° F (2° C), then care must be taken to ensure that the water (or other cooling liquid) does not freeze and cause damage.Cooling coils must be drained of liquid during downtime unless a recirculating unit using a glycol mixture has been installed.

NOTE

Water cooled endplates are discontinued. Consult factory for connection details.

NOTE

Units are never shipped from the manufacturer with liquid in the end plates or cooling coils.

Blowers supplied with cooling coils are identified by the letter located in the tenth position of the complete blower model number.

Tuthill Vacuum & Blower Systems recommends water cooling for blowers in applications where the blower operates with discharge temperatures of 250° F (120° C) for periods of 4 hours or greater per day. The use of water cooling reduces oil temperature and improves oil viscosity for better lubrication. Generally, a water flow or 0.5-1.0 GPM (1.9-3.8 L/min) is sufficient to maintain oil temperatures of 150° F (65° C) or below. Do not allow water pressure to exceed 75 PSIG (510 kPa g).

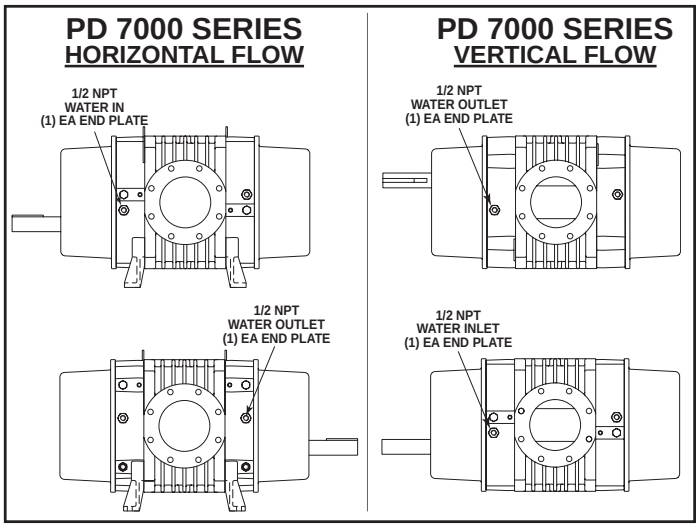


Figure 8 - Optional of cooling connections on blowers with cooling coils

5.6 COOLING WATER CONNECTIONS AND SPECIFICATIONS — COOLING COILS (OPTIONAL)

WARNING

The cooling water pressure shall not exceed 75 psig (5.17 bar g)

5.7 MOTOR DRIVES

Two drive connections commonly used are direct drive and V-belt drive.

5.7.1 DIRECT COUPLED

When installing the motor directly to the blower, align shafts to coupling in accordance with the coupling manufacturer's instructions. Blowers shipped with motor directly coupled and mounted on a common base have been aligned prior to shipment and normally no further alignment is necessary. However, alignment should be checked and adjustments made if necessary prior to starting the unit.

Coupling halves must correctly fit the blower and drive shafts so that only light tapping is required to install each half. The two shafts must be accurately aligned, A direct coupled blower and motor must be aligned with the two shafts not having more than .005" (13 mm) T.I.R. (Total Indicator Reading). Face must be aligned within .002"(.05 mm) .

Proper gap between coupling halves must be established according to coupling manufacturers instructions with the motor armature. This will minimize the change for end thrust on the blower shaft. All direct coupled base mounted units must be re-aligned and greased after field installation.

5.7.2 V-BELTS

If the motor and blower are V-belt connected, the sheaves on both motor and blower shafts, should be as close to the shaft bearings as possible. Blower Sheave is not more than 1/4" (6.5 mm) from the blower drive end cover. The drive sheave is as close to the driver bearing as possible. Care should be taken when installing sheaves on the blower and motor shafts. The face of the should be accurately in line to minimize belt wear.

Adjust the belt tension to the to the manufactures specifications using a belt tension tester. New belts should be checked for proper tension after 24 hours of run time. When manufacturer data is not available industry guidelines are 1/64 inch deflection for each inch of span at 8 to 10 pounds of force in the center of the belt.

Insufficient tensioning is often indicated by slipping (squealing) at start up. Belt dressing should not be used on V-belts. Sheaves and V-belts should remain free of oil and grease. Tension should be removed from belts if the drive is to be inactive for an extended period of time. For more specific information consult the drive manufacturer. In a V-belt drive, the blower sheave must fit its shaft accurately, run true, and be mounted as close to the bearing housing as possible to minimize bearing loads.

A tight or driving fit will force the drive shaft out of its normal position and cause internal damage. A loose fit will result in shaft damage or breaking. The motor sheave must also fit correctly and be properly aligned with the blower sheave.

Adjust motor position on its sliding base so that belt tension is in accordance with drive manufacturer's instructions. Avoid excessive belt tension at all times. Recheck tension after the first ten hours of operation and periodically thereafter to avoid slippage and loss of blower speed.

Check blower after installation and before applying power by rotating the drive shaft by hand. If it does not rotate freely, look for uneven mounting, piping strain, excessive belt tension, or coupling misalignment. Check blower at this time to insure oil was added to the reservoirs.

5.7.3 SETTING V-BELT TENSION

Proper belt tension is essential to long blower life. The following diagrams and procedures are provided to aid in field adjusting V-belts (when blower is so equipped) for maximum performance. A visual inspection of the V-belt drive should yield the appearance shown in Figure 9.

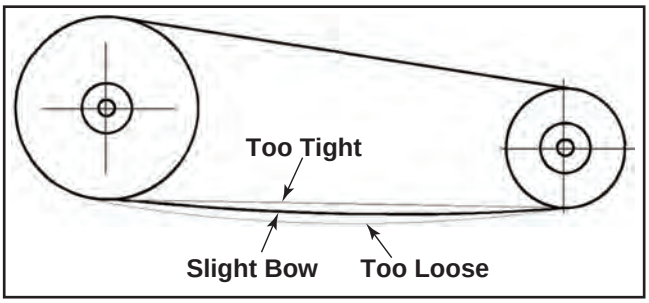


Figure 9 - General appearance of a V-Belt drive

Factors outside the control of the belt tensioning system used on an individual blower package assembly may contribute to decreased belt life, such as environmental factors, and quality of the belts installed. This can cause wear of the belts beyond the ability of the tensioning system to compensate.

As such, it is recommended to check belt tension monthly and make any manual adjustments found necessary.

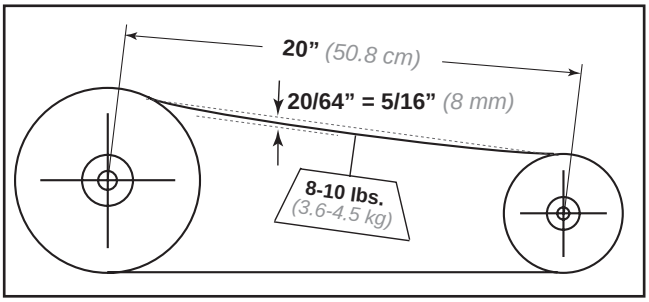


Figure 10 - Setting of proper tension for a V-Belt drive

1. Turn off and lock out power.
2. Remove the fasteners from the belt guard (if equipped)
3. Remove the belt guard.
4. Check and adjust the belt tension as necessary. It should be 1/64" deflection per inch of span (0.157 mm) deflection per centimeter of span) between sheaves, with 8-10 lbs. (3.6-4.5 kg) force applied at center point of the top section of belt.
5. Install the belt guard, making sure that all drive components are free of contact with the guard.
6. Install belt guard fasteners removed in step 2.
7. Unlock the power and start your blower.
8. Resume normal operation.

5.7.4 V-BELT TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	SOLUTION
Belts slip (sidewalls glazed)	Not enough tension	Replace belts; apply proper tension
Drive squeals	Shock load	Apply proper tension
	Not enough arc of contact	Increase center distance
	Heavy starting load	Increase belt tension
Belt(s) turned over	Broken cord caused by prying on sheave	Replace set of belts and install correctly
	Overloaded drive	Redesign drive
	Impulse loads	Apply proper tension
	Misalignment of sheave and shaft	Realign drive
	Worn sheave grooves	Replace sheaves
	Excessive belt vibration	Check drive design Check equipment for solid mounting Consider use of banded belts
Mismatched belts	New belts installed with old belts	Replace belts in matched sets only
Breakage of belt(s)	Shock loads	Apply proper tension; recheck drive
	Heavy starting loads	Apply proper tension; recheck drive Use compensator starting
	Belt pried over sheaves	Replace set of belts correctly
	Foreign objects in drives	Provide drive guard
Rapid belt wear	Sheave grooves worn	Replace sheaves
	Sheave diameter too small	Redesign drive
	Mismatched belts	Replace with matched belts
	Drive overloaded	Redesign drive
	Belt slips	Increase tension
	Sheaves misaligned	Align sheaves
	Oil or heat condition	Eliminate oil. Ventilate drive.

5.8 SPECIAL INSTRUCTIONS FOR EXTERNAL LUBE SYSTEMS

Blowers furnished with external lube tanks are designated with a suffix number after the model numbe .

1. The external lube tank is equipped with an oil filter which has a replaceable element.
2. Each tank has an oil pressure relief valve which is set at the factory between 12 and 15 PSIG and normally requires no adjustment. If an adjustment becomes necessary, remove the cap and adjust the screw. Clockwise will increase pressure, and counterclockwise will reduce pressure.
3. Oil tank should be on a level surface with return connections of tank below the blower return connections (2 inch [51 mm] drop per foot approximately). Each end of blower shall have separate return hose lines (3/4” [19 mm] I.D. minimum) not over six feet from farthest blower.
4. The oil supply hose and connections must be kept free of dirt and foreign material durlng installation to prevent clogging of blower oil supply restrictors (.055” [1.4 mm] diameter).
5. Make sure motor pump wiring connection is for correct rotation as indicated by arrow on motor.
6. Tanks equipped with heat exchangers should have water flow direction counter to oil flo . Water flow rate approximately .25 to 1.0 GPM (1.0-4.0 L/min) dependent upon blower operating condition (sump temperature should not exceed 250°F [120° C] maximum).

WARNING

Fill both ends of blower with oil to the proper level, then operate oil supply system, and be sure oil is returnlng from both blower return hoses prior to starting blower.

5.9 MOTOR AND ELECTRICAL CONNECTIONS

WARNING

The motor and connections shall be protected to assure that product and environmental condensation does not come in contact with the electrical connections.

NOTE

It is the responsibility of the installer to assure that the motor is in compliance with the latest edition of IEC 60204-1 and all electrical connections performed per IEC 60204-1, this includes over current protection.

Wire the motor and other electrical devices such as solenoid valves and temperature switch to the proper voltage and amperage as indicated on the nameplate of each component being wired. Turn the blower by hand after wiring is completed to determine that there are no obstructions and if the blower turns freely; then momentarily start the blower to check the direction of rotation. Figure 2 shows direction of air flow in relation to rotor rotation. The air flow direction can be reversed by reversing the appropriate motor leads

6. OPERATION

6.1 GENERAL

DANGER

The blower is not intended to be used with explosive products or in explosive environments. The blower is not intended to be used in applications that include hazardous and toxic gases. Consult the factory for support.

WARNING

Do not operate without guards in place.

WARNING

Maximum operating speed: Table 2 states the maximum operating speed in RPM (rotations per minute), the maximum pressure differential, maximum vacuum and maximum temperature rise. Do not exceed these limits.

Before starting the blower for the first time under power, recheck the installation thoroughly to reduce the likelihood of troubles. Use the following check list as a guide, but also consider any other special conditions in your installation.

1. Be certain no bolts, rags, or dirt have been left in blower.
2. Be certain that inlet piping is free of debris. If an open outdoor air intake is used, be sure the opening is clean and protected by an inlet filte . This also applies to indoor use.
3. If installation is not recent, check blower leveling, drive alignment, belt tension, and tightness of all mounting bolts.
4. Be certain the proper volume of oil is in the oil reservoir chambers.
5. Be certain the driving motor is properly lubricated, and that it is connected through suitable electrical overload devices.
6. With electrical power off and locked out to prevent accidental starting, rotate blower shaft several times by hand to make sure blower is rotating freely. Unevenness or tight spots is an indication of a problem that should be corrected before progressing.
7. Check motor rotation by momentarily pushing the start button and check flow direction of the blower. Reverse the motor connections if flow is in the wrong direction

Initial operation should be carried out under “no load” conditions by opening all valves and venting the discharge to atmosphere, if possible. Then start motor briefl , listen for unusual noises, and check that the blower coasts freely to a stop. If no problem appears, repeat this check, and let the motor run a little longer. If any questions exist, investigate before proceeding further.

Assuming all tests are satisfactory, the blower will now be ready for continuous full load operation. During the first several days, make periodic checks to determine that all conditions remain acceptable and steady. These checks may be particularly important if the blower is part of a process system where conditions may vary. At the first opportunity, stop the blower and clean or remove inlet filte . Also, recheck leveling, coupling alignment or belt tension, and mountlng bolts for tightness.

6.2 START-UP CHECKLIST

We recommend that these startup procedures be followed in sequence and checked off (☑) in the boxes provided in any of the following cases:

- During initial installation
- After any shutdown period
- After maintenance work has been performed
- After blower has been moved to a new location

DATES CHECKED:				

☐☐☐☐ Check the unit for proper lubrication. Proper oil level cannot be over-emphasized. Refer to the *Lubrication* section. Please see *Recommended Lubricants* for information on acceptable lubricants for your product.

☐☐☐☐ Check V-belt drive for proper belt alignment and tension.

☐☐☐☐ Carefully turn the rotors by hand to be certain they do not bind.

WARNING

Disconnect power. Make certain power is off and locked out before touching any rotating element of the blower, motor, or drive components.

☐☐☐☐ “Bump” the unit with the motor to check rotation (counter-clockwise [CCW] when facing shaft) and to be certain it turns freely and smoothly.

☐☐☐☐ Start the unit and operate it for 30 minutes at no load. During this time, feel the cylinder for hot spots. If minor hot spots occur, refer to the *Troubleshooting* chart.

☐☐☐☐ Apply the load and observe the operation of the unit for one hour.

☐☐☐☐ If minor malfunctions occur, discontinue operation and refer to the *Troubleshooting* chart.

6.3 OPERATING

The upper temperature limit for blower operation is 400° F (205° C) measured in the exhaust gas stream with a low mass thermocouple. When this temperature limit switch is installed, as the temperature exceeds the predetermined temperature, the blower motor will stop and cannot be restarted until the temperature drops below the trip setting of the temperature switch.

DANGER

The blower is not intended to be used with explosive products or in explosive environments. The blower is not intended to be used in applications that include hazardous and toxic gases. Consult the factory for support.

WARNING

Physical harm may occur if human body parts are in contact or exposed to the process vacuum. Assure that all connections are protected from human contact.

WARNING

If rated vacuum or pressure levels are exceeded, process fluids will migrate to other parts of the blower and system.

CAUTION

Do not touch hot surfaces.

The upper limit of the blower operation is 400° F (205° C). Do not touch the blower while it is in operation and assure blower is cool when not in operation.

CAUTION

Use of a thermowell insulates the thermocouple. Invalid and delayed readings will result. This can result in ineffective protection devices.

NOTE

The upper temperature limits are not intended for continuous operation. Consult with factory for detailed information assistance.

6.4 STOPPING

CAUTION

Do not stop the blower if there are high outlet pressures in the outlet piping. Unload the outlet piping prior to shutting down the blower.

Stop the blower by turning off the motor. Isolate the blower from the vacuum system and vent the blower to atmosphere. Turn off the cooling water, if water cooled. Stop the backing pump. Refer to component instruction manual.

6.5 METHANE GAS APPLICATIONS

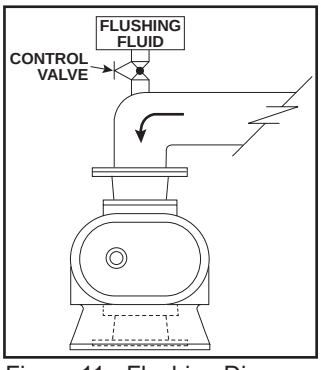


Figure 11 - Flushing Diagram

Instructions for injecting fuel oil, kerosene, and lube oil into blowers sludged by methane digester (sewage) gas: Some sewage gases will adhere to the rotors in a gas blower. If enough sludge from the gas being pumped builds up on the rotors, it destroys the clearances between the rotors. The build-up can cause the blower to clatter and eventually freeze up when the rotors no longer have clearance to turn. This can be easily prevented by periodically flushing the blower with a mixture of 75% kerosene or fuel oil and 25% lubricating oil. The kerosene or fuel oil dissolves the sludge buildup and the lubricating oil coats the rotors to slow the build-up. The mixture should be injected on the inlet side through a valve set to feed a gallon of mixture in 15-20 minutes. On units regularly flushed, once a week is sufficient. If the unit is dirty, it should be flushed daily until the hard build-up is removed then put on a weekly cycle. In very dirty gas installations, the cycle must be varied to meet the demand.

6.6 WATER INJECTED BLOWERS

Water injected into the inlet of a blower operating on vacuum service will cool the blower. The water absorbs the heat of compression as it passes through the unit along with the air/gas being compressed. A blower cooled in this manner can operate safely at higher vacuums or higher inlet temperatures than a normally uncooled unit.

The amount of water required depends on the inlet air/gas temperature, inlet vacuum, water temperature, and the maximum discharge temperature desired. Check with the factory or sales representative for additional guidance.

6.6.1 OPERATION

1. Check oil level in sight glass of blower and assure all fittings are tight
2. Check the water injection system to assure water is available.
3. Operate the blower dry for a few minutes at no load to check correct rotation and smooth operation.
4. Turn water on and adjust flow as recommended for the individual blower. Assure water discharges freely from the outlet piping.
5. Apply vacuum and observe operation at the desired inlet condition.

6.6.2 SHUTDOWN

1. The blower can be shutdown for brief periods by relieving the inlet vacuum, shutting the water off, and then stopping the unit.
2. Rusting during a slightly longer shutdown period can be avoided by operating the blower under a partial vacuum without the water injection, allowing the blower to heat within safe limits. The heat will tend to drive off residual moisture.
3. For extended shutdown, oil may be injected into the inlet of the heated blower just prior to shutting the blower down. The oil will provide a protective coating on the internals. Insure that the water is completely shut off after shutdown.
4. Special coatings or platings are available to minimize rusting or corrosion in applications where units can remain wet.

Vertical flow units with two-lobed, plugged rotors should always be used. Always orient system such that the blower intake is at the top and discharge at the bottom.

CAUTION

Water injection can cause lime build-up on rotors. Check water supply for hardness. The use of water softeners, other chemicals, or distilled water may be necessary to prevent or remove this build-up. However, due to the wide variations in mineral content, pH, and chemical content of water that can be injected, Tuthill Vacuum & Blower Systems cannot be responsible for damage which may result should this build-up occur. Units should be inspected regularly to determine any problems.

NOTE

For liquid injection other than water, consult the factory.

6.7 RECOMMENDED SHUTDOWN PROCEDURE TO MINIMIZE RISK OF FREEZING OR CORROSION

When high humidity or moisture is present in an air piping system, condensation of water can occur after the blower is shut down and the blower begins to cool. This creates an environment favorable to corrosion of the iron internal surfaces, or in cold weather, the formation of ice. Either of these conditions can close the operating clearances, causing the blower to fail upon future start-up.

The following shutdown procedure outlined below minimizes the risk of moisture condensation, corrosion and freezing.

NOTE

Care must be taken so as not to overload or overheat the blower during this procedure.

1. Isolate the blower from the moist system piping, allowing the blower to intake atmospheric air. Operate the blower under a slight load allowing the blower to heat within safe limits. The heat generated by the blower will quickly evaporate residual moisture.
2. For carpet cleaning applications, after the work is completed, simply allow the blower to run a few (3-5) minutes with the suction hose and wand attached. The suction hose and wand will provide enough load to the blower to evaporate the moisture quickly.
3. For extended shutdown, inject a small amount of a light lubricating oil such as 3-in-One® or a spray lubricant such as WD-40® into the inlet of the blower just prior to shutdown. *(3-in-One and WD-40 are registered trademarks of WD-40 Company.)* The lubricant will provide an excellent protective coating on the internal surfaces. If using a spray lubricant, exercise care to prevent the applicator tube from getting sucked into the blower. The applicator tube will damage the blower, most likely to the point that repair would be required.
4. If the blower is being taken out of commission for an extended period of time, please also refer to the *"Long Term Storage"* section of this manual.

7. MAINTENANCE

7.1 GENERAL

Regular inspection of your blower and its installation, along with complete checks on operating conditions will pay dividends in added life and usefulness. Also, service the drive per manufacturer's instructions and lubricate the coupling or check belt drive tension. By use of thermometers and gauges, make sure that blower operating temperature and pressure remain within allowed limits.

DANGER

The blower and parts may contain hazardous media. Assure that pump and parts are evacuated of hazardous media prior to servicing.

CAUTION

The electrical service must be isolated and de-energized prior to maintenance. Apply appropriate procedures to assure electrical supply is de-energized and cannot be inadvertently energized during maintenance.

Assure piping and product is isolated prior to maintenance of blower. Apply appropriate procedures to assure piping and product is isolated and that inadvertent opening of valves cannot occur during maintenance.

CAUTION

During routine maintenance, inspect and assure that guards are in place and secure.

Particular attention should be paid to lubrication of timing gears and bearings in accordance with comments under the *Lubrication* section.

When a blower is taken out of service, it may require internal protection against rusting or corrosion. The need for such protection must be a matter of judgment based on existing conditions as well as length of down time. Under atmospheric conditions producing rapid corrosion, the blower should be protected immediately. Refer to the *Long Term Storage* section for more details.

7.2 REGULAR MAINTENANCE

A good maintenance program will add years of service to your blower.

A newly installed blower should be checked frequently during the first month of operation, especially lubrication. With blower at rest, check oil level in both the gear (drive) end and free (non-drive) end of the blower and add oil as needed. Complete oil changes are recommended every 1000-1200 operating hours, or more frequently depending on the type of oil and operating temperature. Also change the oil more frequently if pumping corrosive vapors or where excessive operating temperatures are encountered. The following is recommended as a minimum maintenance program.

DAILY	WEEKLY	MONTHLY
1. Check and maintain oil level, and add oil as necessary. 2. Check for unusual noise or vibration (See *Troubleshooting*)	1. Clean all air filters. A clogged air filter can seriously affect the efficiency of the blower and cause overheating and oil usage. 2. Check relief valve to assure it is operating properly.	1. Inspect the entire system for leaks. 2. Inspect condition of oil and change if necessary. 3. Check drive belt tension and tighten if necessary.

NOTE

Oil levels should be checked every 24 hours of operation.

Proper oil drain schedules require oil be changed before the contaminant load becomes so great that the lubricating function of the oil is impaired or heavy disposition of suspended contaminants occurs. To check the condition of the oil, drain a sampling into a clean container and check for the presence of water or solids. Slight discoloration of the oil should not necessitate an oil change.

7.3 SPARE PARTS

Should adjustments or replacement eventually be needed, these can often be performed locally as described in this book after obtaining required parts. Personnel should have a good background of mechanical experience and be thoroughly familiar with the procedures outlined in this manual. Major repairs not covered in this book should be referred to the nearest Tuthill Vacuum & Blower Systems service representative.

When ordering parts, give all blower nameplate information, as well as the item number and parts description as per the parts lists and assembly drawings for your particular model. Repair kits are available for all models. These kits contain all of the seals, bearings, O-rings, locks, and special retaining screws necessary for an overhaul. For your convenience when ordering parts, we suggest you complete the *Operating Data Form* included on the inside, back cover of this manual.

In developing a stock of spare parts, consider the following:

- The degree of importance in maintaining the blower in a “ready” condition
- The time lag in parts procurement
- Cost
- Shelf life (seals and O-rings)

Contact Tuthill Vacuum & Blower Systems Service Department for any assistance in selecting spare parts. Telephone: (417) 865-8715 — Toll Free (48 contiguous states): (800) 825-6937 — Fax: (417) 865-2950

7.4 FACTORY SERVICE & REPAIR

With proper care, Tuthill Vacuum & Blower Systems blowers will give years of reliable service. The parts are machined to very close tolerances and require special tools by mechanics who are skilled at this work.

Should major repairs become necessary, contact the factory for the authorized service location nearest you. Units which are still under warranty must be returned to the factory, freight prepaid, for service.

Tuthill Vacuum & Blower Systems
ATTN: Inside Service Manager
4840 West Kearney Street
Springfield, MO 65803-870

NOTE

Current regulations require Material Safety Data Sheet to be completed and forwarded to Tuthill Corporation on any unit being returned for any reason which has been handling or involved with hazardous gases or materials. This is for the protection of the employees of Tuthill Corporation who are required to perform service on this equipment. Failure to do so will result in service delays.

NOTE

When returning a blower to the factory for repair, under warranty, please note the factory will not accept any unit that arrives without authorization. Contact the Service Department for return authorization.

7.5 LONG TERM STORAGE

Any time the blower will be stored for an extended period of time, you should take make sure that it is protected from corrosion by following these steps:

1. Spray the interior (lobes, housing and end plates) with rust preventative. This should be repeated as conditions dictate and at least on a yearly basis.
2. Fill both end covers completely full of oil.
3. Firmly attach a very prominent tag stating that the end covers are full of oil and must be drained and refilled to proper levels prior to startup
4. Apply a rust preventative grease to the drive shaft.
5. Spray all exposed surfaces, including the inlet and discharge flanges, with rust preventative
6. Seal inlet, discharge and vent openings. It is not recommended that the unit be set in place, piped to the system, and allowed to remain idle for a prolonged amount of time. If any component is left open to the atmosphere, the rust preventative will escape and lose its effectiveness.
7. During storage, ensure that the blower does not experience excessive vibration.
8. Attach a desiccant bag to either of the covers to prevent condensation from occurring inside the blower. Make sure any desiccant bag (or bags) is so attached to the covers that they will be removed before startup of the blower.
9. Store the blower in an air conditioned and heated building if at all possible. At least insure as dry conditions as possible.
10. If possible, rotate the drive shaft by hand at least monthly in order to prevent seals from setting in one position.

NOTE

When returning a blower to the factory for repair, under warranty, please note the factory will not accept any unit that arrives without authorization. Contact the Service Department for return authorization.

8. DISASSEMBLY AND REASSEMBLY

8.1 DISASSEMBLY OF BLOWER

WARNING

Before performing any repair or replacement, disconnect and lock out power.

1. Remove unit from installation and drain lubricant from both ends by removing magnetic drain plugs (31). Mark end plates, covers and housing so they can be reassembled in their original position. **On 17/46 and 57/81 series only**, skip step 2 and proceed to step 3.
2. **On 64/67 series blowers only**, remove three socket head screws (111) and dust plate (82). Requires 1/8" hex head (Allen) wrench. Using same wrench, loosen three set screws (90) and remove seal retainer (89).
3. Remove four socket head screws (93). Requires 5/32" hex head (Allen) wrench. Place two of the screws in tapped jacking holes and remove seal housing (91). Tap out seal and discard O-rings.
4. Remove gear cover cap screws (26) and gear cover (6) by placing two of the screws in the tapped jacking holes provided on the cover flange. Support cover with lift straps or other suitable means while removing. The jackscrews will provide the force necessary to break the seal between cover and end plate.
5. Temporarily secure end plate to housing with two screws (26) and some flat washers. Remove four nylok screws (66) from drive shaft (45). A light tap with a mallet will break it loose from the drive gear. **On 17/46 and 57/81 series only**, skip step 6 and proceed to step 7.
6. **On 64/67 series blowers**, remove mating ring of mechanical seal (54).
7. Remove inner bearing race with gear puller or press.
8. Bend back lock tabs and remove cap screws (29), lock (59), washers (25) and spring pins (68).
9. Position timing gears (8) so both timing marks are matched. See Figure 12. Rotate drive gear clockwise approximately three teeth and mark a matching reference line on each gear as shown in Figure 13. This gear position is necessary so rotors will clear and not jam. Using a gear puller with a live center or a centering adapter, large enough so it will not jam into threaded hole, pull driven gear, while keeping matched reference line marks aligned. Use a slight rocking motion to insure rotors have not jammed. Should jamming occur, release pressure and tap gear back on until it rotates freely. Pull mating gear.

CAUTION

Never attempt to pull gear when rotors are jammed. Rotor keyway damage will result.

10. Repeat procedure used in No. 4 to remove free end cover (7). Remove rotor shaft screws as was done in No. 6 and also oil slinger (20). Remove cap screws (30) and oil retainer rings (14). Place ½" eye bolt into top of end plate on 17/57/64 series, or both sides of end plate on 46/67/81 series, in holes provided for lifting.
11. Make up four pieces of threaded rod ½"-13 UNC approximately 9" long with double nuts or a single welded nut to turn rods. On the opposite ends remove about ½" of threads as this end will mushroom slightly when jacking end plate. This will prevent threads from jamming when removing rods.

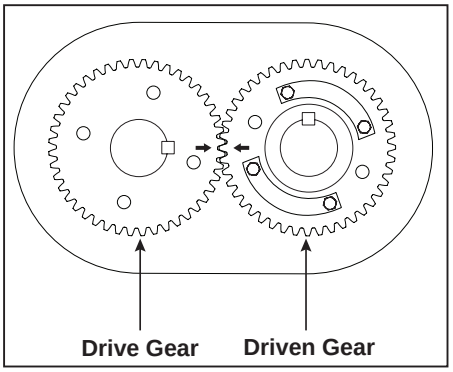


Figure 12 - Timing Marks Matched

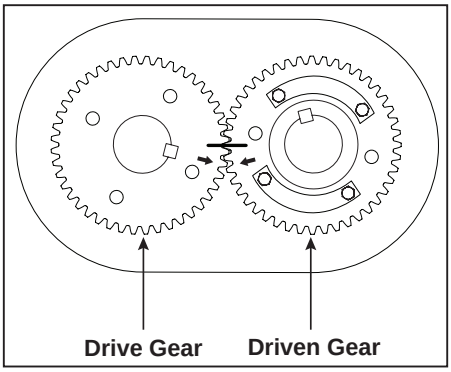


Figure 13 - Timing Marks Advanced 3 Teeth (Reference Marks Aligned)

Run in equally to remove end plate. Tap out roller bearings (10). Note that each bearing on this end has two identical spacers (57), one on each side of bearing. Tap out seals (54) or (12). Also remove the labyrinth seals (51), as they should be replaced with each overhaul. On 57/81 and 64/67 series, discard O-ring (75) and retain O-ring spacers (74) for reassembly.

12. Remove cap screws (30) and bearing retainer rings (14) from drive end of unit. Remove rotors (1). To remove the rotors from the end plate will require either a two-jaw gear puller with jaws inserted in the oil feed slots of the bearing bore, or a bar-type puller using the tapped holes around the bearing bore.

CAUTION

If rotors are side by side, position the lobes vertically when removing. If they are one on top of the other, remove top rotor first in a vertical position. Then position bottom rotor vertically and remove.

13. Support end plate with eyebolts and lift strap. Remove temporary cap screws and tap end plate from housing (3). Remove bearings and seals.
14. Clean and inspect parts for damage and wear. Replace all O-rings, seals and bearings at each overhaul.

NOTE

If end plates, housing or end covers are not being reassembled in their original position or some new parts are being used, it will be necessary to clean all paint or rust build-up from the mating surfaces to insure a good seal. Failure to do so could result in excessive end clearances and air or oil leaks.

8.2 ASSEMBLY OF 7000 BLOWER

The assembly procedure is generally the same for all series, but where there are differences, notations are made. Dowel pins are used to locate end plates, housing and end covers in their proper locations relative to each other. Be sure they are in place. An O-ring lubricant should be used on all O-rings.

It is recommended that the gear end rotor shaft bearings be purchased from Tuthill Vacuum & Blower Systems, as they are specially ground to locate the rotors with correct end clearance relative to the gear end plate.

NOTE

Make sure all parts are clean and free of any nicks or burrs caused by disassembly. Blowers incorporating lip seals will require all sleeves or seal journals to be polished to remove any nicks and scratches. Failure to polish seal journals will result in seal leakage or damage. Refer to page 34 for seal pressing tools as well as other assembly tools required.

NOTE

When rebuilding the model 7000 blowers and depending on the series designation, it may be necessary to reseal the joints between the rotor housing, end plates, and end covers. The following sealers are recommended and are available for purchase from Tuthill Vacuum & Blower Systems:

Dow Corning - RTV 737 General Electric - N-SIL

8.2.1 PREPARATION OF END PLATES FOR ASSEMBLY

1. Press the labyrinth seals (51) into seal bores with the lips toward the oil side.

NOTE

For lip seal units put a light coat of silicon in the seal bore of end plate. Install lip seal open side facing up.

8.2.2 MECHANICAL SEAL UNITS

2. Install O-ring spacers (74) with grooves up. Install O-rings (75) making sure they are fully seated in their grooves. Apply a thin coat of sealer to O. D. of seal (54) and press into seal bore. Make sure seals are fully seated without deforming. Clean seal carbon with soft tissue and cleaning agent (acetone).

8.2.3 GEAR END ASSEMBLY

3. Place free end plate on suitable blocking with rotor side up. Stand rotors (1) into each bore with gear end shafts up and keyways facing in the direction shown in Figure 14.
4. Install the gear end plate (4) over the rotor shafts and coming to rest on top of the rotor lobes, being careful not to damage the seals. Recheck the location of the oil sight glass in relation to the drive rotor before proceeding with the assembly.
   17/46 series only: Skip step 5 and proceed to step 6
5. **57/81 and 64/67 series only:** Inspect lapped surface of seal mating ring to be sure it is perfectly clean. Use a soft tissue and cleaning agent if necessary. Place a few drops of lubricating oil on its surface and lubricate the O-ring. Install on rotor shaft with lapped surface down. Slot must line up with pin (300) in rotor shaft. Gently press with fingers to insure compression is taking place and mating ring is not hung up for any reason. Top of mating ring should sit flush with rotor shoulder when fully seated.

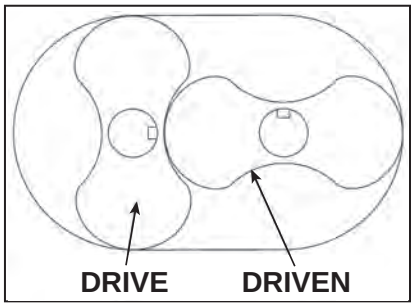


Figure 14 - Keyways

CAUTION

Gear end bearings have flush ground faces and should be installed with manufacturer numbers up (toward gear). If no numbers appear on either side, look for a black dot (acid mark) on the inner race. Install with dot up (toward gear). Do not use bearings that have not been flush ground to within .001" (.025 mm) Coat the rotor shafts with an anti-seize lubricant and press the bearings (9) on the shafts. The bearing manufacturer numbers and/or an acid dot (inner race) should be up or toward the gears. Use the tool shown on page 34 along with a length of 3/4 - 10 × 6" threaded rod, washer (25) and nut. The use of a hydraulic ram with a hollow center is also recommended. In this case the threaded rod will have to be made longer.

6. Install bearing retainer plates (14) and secure with cap screws (30).
7. Check clearance between the face of the end plate and rotor lobes. Refer to the *Assembly Clearances* table on page 34 for correct gear end clearances. If clearances are not within specifications, recheck parts to find cause of improper clearances before proceeding. Install keys (24) in rotor shaft keyways.
8. Lubricate shafts and keys and press drive gear (right hand helix) on drive rotor. To install driven gear, align reference marks as shown on page 28. Tap gear with mallet to start then press the gear until seated.

NOTE

All timing gears must be used in sets as they are matched and serially numbered.

9. Install roll pins (68), washers (25), lock tabs (59) and shaft bolts (29). Bend over lock tabs.

NOTE

These bolts are structural bolts, not standard cap screws. Therefore they have a larger body diameter and this centers the washers and slinger. Do not replace with standard cap screws.

10. Remove the gear end assembly from the free end plate and turn over so the gears are facing down on a solid surface. Place some wood blocking on each side for support.
11. **57/81 and 64/67 series:** Place a small bead of an RTV silicone type sealer around the periphery of the housing (3) bores, but inside the bolt pattern. Encircle the dowel pins. Install rotor housing and temporarily secure to end plate with two cap screws (26) and some flat washers. Check clearances between end of lobes and housing using a flat bar and feeler gauges or a depth micrometer. Refer to exploded view for free end clearances.
12. **57/81 and 64/67 series:** Put sealer on rotor housing, same as above.
    All series: Install free end plate and secure in same manner.
13. **57/81 and 64/67 series:** Install seal mating rings as was done in Step 4.
    All series: Install one bearing spacer (57) on each shaft. Lubricate shafts and install roller bearings with inner race flange outward. See Figure 15

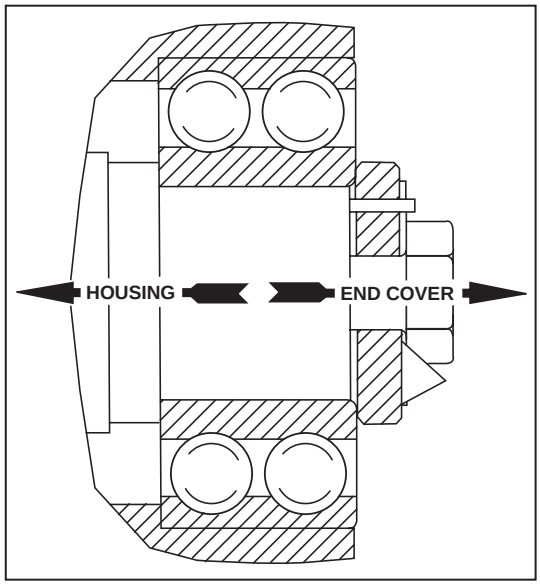


Figure 15 - Roller Bearings Illustration

14. Install oil retainer rings (14) and cap screws (30). Install roll pin (68) washers (25), oil slinger (20) (on drive rotor), lock tabs (59) and bolts (29). Bend over tabs.
15. Install mounting feet (304) with machined surface against housing and secure with lockwashers (80) and cap screws (307). Install lifting lugs (195) with cap screws (196).

8.2.4 ADJUSTING ROTOR INTERLOBE CLEARANCE

16. The driven gear is made of two pieces. The outer gear shell is fastened to the inner hub with four cap screws and located with two dowel pins. A laminated shim, made up of .003” (.076 mm) laminations, separates the hub and the shell. By removing or adding shim laminations, the gear shell is moved axially relative to the inner hub. Being a helical gear, it rotates as it is moved in or out and the driven rotor turns with it, thus changing the clearance between rotor lobes. Changing the shim thickness .014” (.36 mm) will change the rotor lobe clearance .005” (.13 mm).

    EXAMPLE: Referring to Figure 16, check the clearance at AA (right hand reading) and BB (left hand reading). If AA reading is .017” (.43 mm) and BB reading is .004” (.10 mm), by removing.018” (.46 mm) shims, the readings should then read AA .011” (.28 mm) and BB .010” (.25 mm).

    To determine the amount of shim to add or remove, subtract the smaller reading from the larger and multiply the result by 1.4. (.017” [.43 mm] -.004” [.10 mm] = .013” [.33 mm] × 1.4 = .018” [.46 mm]) If the right side reading is higher than the left side, remove shim. If the right side reading is lower, add shim.

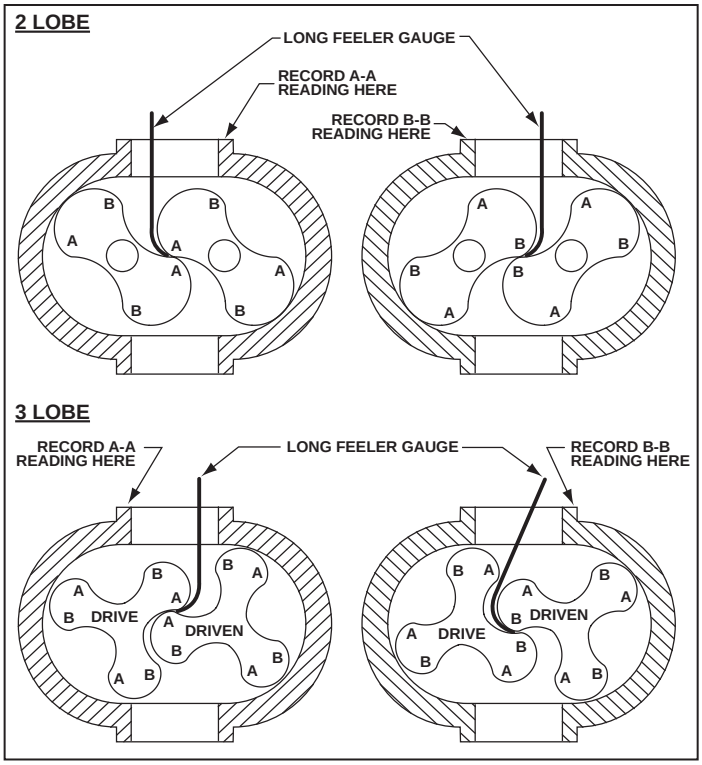


Figure 16 - Checking Rotor Interlobe Clearance

The final readings should be within .002” (.05 mm) of each other.
When removing gear shell from driven gear, it is not necessary to remove gear lock bolt. Make sure bolt locks are in place because the dowel pins must come off with the gear shell.

17. Install inner race of drive shaft roller bearing (50) onto drive shaft. Flange side must be inboard. See special tool drawings. Install outer race with rollers into cover bore flush with inside boss. Install oil slingers (395) back to back on drive shaft flange. Make sure both mating surfaces are clean and free of burrs-then mount drive shaft to gear and secure with-nylok cap screws (29). Check drive shaft runout at seal journal. Do not exceed .003” (.08 mm) T.I.R.
18. Remove temporary cap screws from gear end of housing and place bead of silicone around the periphery of the end plate. Encircle the dowel pins. Install cover (6) and cap screws (26). The use of two ½”-13 threaded rods as guide screws is recommended.

8.2.5 DRIVE SHAFT SEAL ASSEMBLY

19. **17/46 and 57/81 series:** Press drive shaft lip seal (13) into seal housing (91). This is a double lip seal; pack with grease. Install O-ring (92) and assemble to cover with hex cap screws.
    64/67 series:
    a. Install O-ring (75) into seal housing (91) and press in stator portion of mechanical seal (54). See special tool drawing. Clean face of carbon and mating ring with soft tissue and acetone. Install O-ring (92).
    b. Lubricate O-ring in ID of mating ring and carefully slide onto drive shaft with slot up and seat against shoulder. Do not use any tools. Lapped surface should be facing outward.
    c. Install seal housing (91) into cover bore and secure with four hex head screws (93).
    d. With set screws (90) in place install mating ring retainer (89) (flange facing outward) while aligning pin (300) with slot in mating ring. Secure to shaft with set screws.
20. Install free end cover (7) same as gear end.

9. TROUBLESHOOTING

Although Tuthill Vacuum & Blower Systems blowers are well designed and manufactured, problems may occur due to normal wear and the need for readjustment. The chart below lists symptoms that may occur along with probable causes and remedies.

SYMPTOM	PROBABLE CAUSE	REMEDIES
Loss of oil	Gear housing not tightened properly.	Tighten gear housing bolts.
	Lip seal failure.	Disassemble and replace lip seal.
	Insufficient sealant.	Remove gear housing and replace sealant. See the *Disassembly* section.
	Loose drain plug.	Tighten drain plug.
Excessive bearing or gear wear	Improper lubrication.	Correct oil level. Replace dirty oil. See the *Lubrication* section.
	Excessive belt tension.	Check belt manufacturer's specifications for tension and adjust accordingly.
	Coupling misalignment.	Check carefully, realign if necessary.
Lack of volume	Slipping belts.	Check belt manufacturer's specifications for tension and adjust accordingly.
	Worn lobe clearances.	Check for proper clearances. See the *Assembly Clearances* section.
	Speed too low.	Increase blower speed within limits.
	Obstruction in piping.	Check system to assure an open flow path.
Knocking	Unit out of time.	Re-time.
	Distortion due to improper mounting or pipe strains.	Check mounting alignment and relieve pipe strains.
	Excessive pressure differential.	Reduce to manufacturer's recommended pressure. Examine relief valve and reset if necessary.
	Worn gears.	Replace timing gears. See the *Disassembly* section.
Excessive blower temperature	Too much or too little oil in gear reservoir.	Check oil level. See the *Lubrication* section.
	Too low operating speed.	Increase blower speed within limits.
	Clogged filter or silencer.	Remove cause of obstruction.
	Excessive pressure differential.	Reduce pressure differential across the blower.
	Elevated inlet temperature.	Reduce inlet temperature.
	Worn lobe clearances.	Check for proper clearances. See the *Assembly Clearances* section.
Rotor end or tip drag	Insufficient assembled clearances.	Correct clearances. See the *Assembly Clearances* section.
	Case or frame distortion.	Check mounting and pipe strain.
	Excessive operating pressure.	Reduce pressure differential.
	Excessive operating temperature.	Reduce pressure differential or reduce inlet temperature.
Vibration	Belt or coupling misalignment.	Check carefully, realign if necessary.
	Lobes rubbing.	Check cylinder for hot spots, then check for lobe contact at these points. Correct clearances. See the *Assembly Clearances* section.
	Worn bearings or gears.	Check condition of gears and bearings; replace if necessary.
	Unbalanced or rubbing lobes.	Possible buildup on casing or lobes, or inside lobes. Remove buildup and restore clearances.
	Driver or blower loose.	Check mounting and tighten if necessary.
	Piping resonance.	Check pipe supports, check resonance of nearby equipment, check foundation.

10. ASSEMBLY CLEARANCES

Values shown in inches and *millimeters*.

MODEL	GEAR END	FREE END	INTERLOBE	TIP-DOWEL	TIP-PORT
7010	.006 - .009 *.15 - .23*	.013 - .019 *.33 - .48*	.010 - .014 *.25 - .36*	.008 - .012 *.20 - .30*	.015 - .019 *.38 - .48*
7013	.006 - .009 *.15 - .23*	.016 - .022 *.41 - .56*	.010 - .014 *.25 - .36*	.008 - .012 *.20 - .30*	.015 - .019 *.38 - .48*
7017	.006 - .009 *.15 - .23*	.021 - .027 *.53 - .69*	.010 - .014 *.25 - .36*	.008 - .012 *.20 - .30*	.015 - .019 *.38 - .48*
7021	.006 - .009 *.15 - .23*	.026 - .032 *.68 - .81*	.010 - .014 *.25 - .36*	.008 - .012 *.20 - .30*	.015 - .019 *.38 - .48*
7026	.006 - .009 *.15 - .23*	.031 - .037 *.79 - .94*	.010 - .014 *.25 - .36*	.008 - .012 *.20 - .30*	.015 - .019 *.38 - .48*

11. TORQUE CHART

Data shown represents “wet” torque values, in foot-pounds (ft.-lbs) and *Newton-meters (N-m)*.

PART DESCRIPTION	TORQUE
CAP SCREW 10-32UNF	4 *5*
CAP SCREW 1/4”-20UNC GR5	8 *10*
CAP SCREW 5/16”-18UNC GR5	15 *20*
CAP SCREW 3/8”-16UNC GR5	33 *45*
CAP SCREW 1/2”13UNC GR5	78 *106*
CAP SCREW 5/8”14UNC GR5	123 *167*
CAP SCREW 3/4”-10UNC GR5	260 *350*

12. RECOMMENDED LUBRICANTS

RECOMMENDED MINERAL BASED LUBRICANTS				
AMBIENT TEMPERATURE	**SHELL**	**CITGO**	**CHEVRON**	**EXXONMOBIL**
0° to 32° F *(-18° to 0° C)*	TELLUS® S2 M 68 (ISO 68)	A/W 68 (ISO 68)	RANDO HD 68 (ISO 68)	DTE HEAVY MEDIUM (ISO 68)
32° to 90° F *(0° to 32° C)*	TELLUS® S2 M 100 (ISO 100)	A/W 100 (ISO 100)	RANDO HD 100 (ISO 100)	DTE HEAVY (ISO 100)
90° to 120° F* *(32° to 50° C)*	—	A/W 150 (ISO 150)	RANDO HD 150 (ISO 150)	DTE EXTRA HEAVY (ISO 150)

RECOMMENDED SYNTHETIC BASED LUBRICANTS**			
AMBIENT TEMPERATURE	**TUTHILL**	**EXXONMOBIL**	**SHELL**
0° to 32° F *(-18° to 0° C)*	**PneuLube™** (ISO 100)	SHC 626 (ISO 68)	MORLINA® S4 B 68 (ISO 68)
32° to 90° F *(0° to 32° C)*		SHC 627 (ISO 100)	MORLINA® S4 B 100 (ISO 100)
90° to 120° F* *(32° to 50° C)*		SHC 629 (ISO 150)	MORLINA® S4 B 150 (ISO 150)

RECOMMENDED MINERAL BASED, FOOD GRADE LUBRICANTS		
AMBIENT TEMPERATURE	**Lubricant meeting U.S. FDA regulation 21 CFR 178.3570 governing petroleum products which may have incidental contact with food, and USDA H1 requirements**	**Lubricant meeting U.S. FDA regulations 21 CFR 172.878 and 178.3620(a) for direct and indirect food contact**
0° to 32° F *(-18° to 0° C)*	CITGO CLARION® A/W 68 (ISO 68)	CITGO CLARION® 350 FOOD GRADE (ISO 68)
32° to 90° F *(0° to 32° C)*	CITGO CLARION® A/W 100 (ISO 100)	CONSULT FACTORY
90° to 120° F* *(32° to 50° C)*	CONSULT FACTORY	CONSULT FACTORY

RECOMMENDED SYNTHETIC BASED, FOOD GRADE LUBRICANTS		
AMBIENT TEMPERATURE	**Lubricant meeting U.S. FDA regulation 21 CFR 178.3570 governing petroleum products which may have incidental contact with food, and USDA H1 requirements**	**Lubricant meeting U.S. FDA regulations 21 CFR 172.878 and 178.3620(a) for direct and indirect food contact**
0° to 32° F *(-18° to 0° C)*	**PneuLube™ FG** (ISO 100)	CONSULT FACTORY
32° to 90° F *(0° to 32° C)*		
90° to 120° F* *(32° to 50° C)*		

RECOMMENDED LUBRICANTS FOR M-D VACUUM BOOSTERS (90/91, 92/93, 96, 31/33 AND 35/37 SERIES)
REQUIREMENTS
• Suitable for high vacuum service • 100 cSt @ 40° C • Vapor pressure of 1 micron or less @ 70° F (21° C) • Straight mineral (no additives) or PAO synthetic oil

RECOMMENDED GREASE FOR COMPETITOR® PLUS BLOWERS:	
TUTHILL	**CITGO**
Tuthill PneuLube™ NLGI #2 premium grade, petroleum base lithium grease.	**For food grade requirements**: Use Citgo Clarion® Food Grade HTEP grease, NLGI No. 2 grade. It meets all requirements of FDA Regulation 21 CFR 178.3570 (the former USDA H-1 approval requirements) for lubricants having incidental contact with food.

* For higher ambient temperatures, please consult the factory.

** Blowers used in oxygen-enriched service should use only Castrol Brayco 1726 Plus non-flammable, PFPE synthetic lubricant. Blowers used in hydrogen service should use only PneuLube synthetic oil. Tuthill Vacuum & Blower Systems cannot accept responsibility for damage to seals, O-rings and gaskets caused by use of synthetic lubricants not recommended by Tuthill Vacuum and Blower Systems.

13. BEARING AND SEAL PRESSING TOOLS

FIGURE 17 —
LAB SEAL PRESSING TOOL

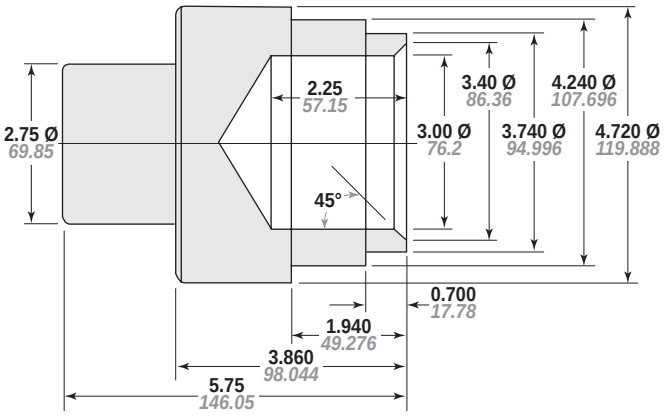


FIGURE 18 —
MECHANICAL & LIP SEAL TOOL

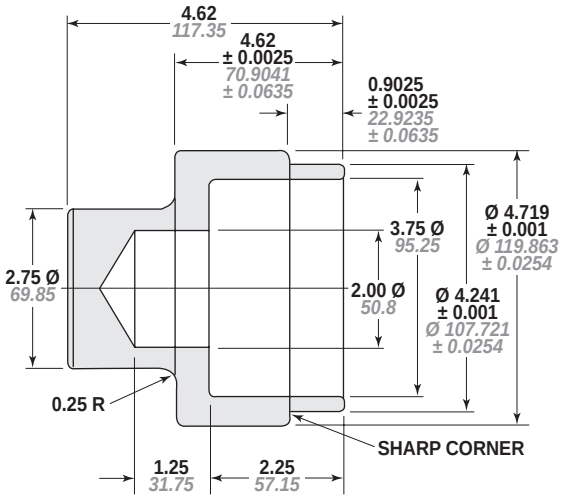


FIGURE 19 —
SEAL INSTALLATION TOOL

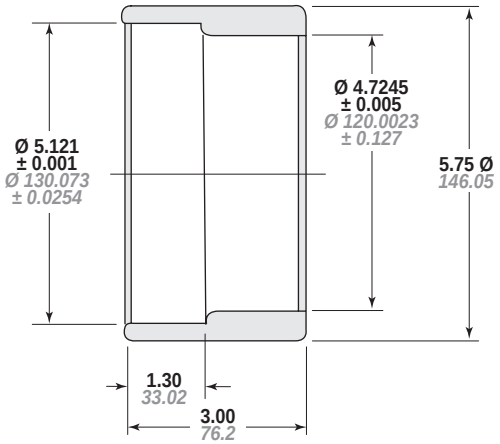


FIGURE 20 —
BEARING PRESSING TOOL

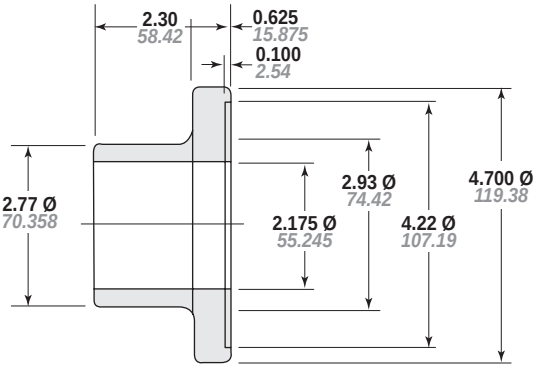
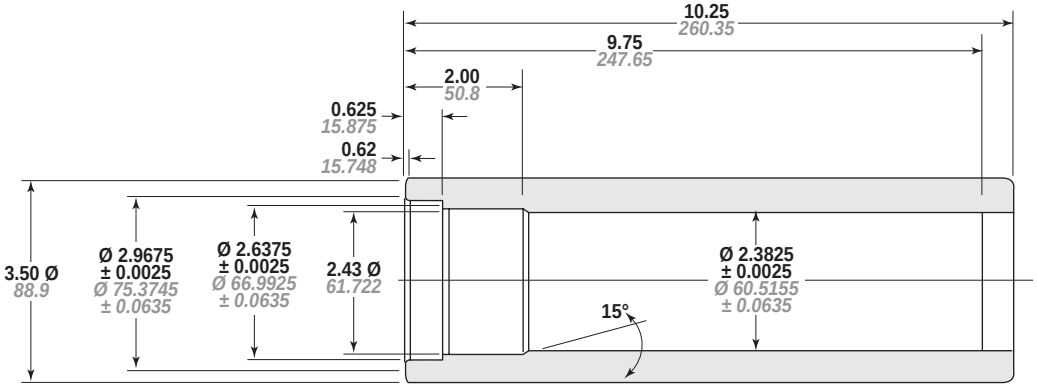


FIGURE 21 —
DRIVE SHAFT BEARING INNER RACE PRESSING TOOL



NOTE:
All dimensions are shown in Inches and *millimeters*.

TOLERANCES (Unless otherwise noted)
.XX = ± 0.01 .XXX = ± 0.003
.XX = ± 0.254 .XXX = ± 0.0762

MATERIAL:
MILD STEEL

PARTS LIST FOR MODEL 7000 SERIES - 17/46

ITEM NO.	PART DESCRIPTION	17 / 46 QTY
1	ROTOR	2
3	HOUSING	1
4	END PLATE	2
6	DRIVE END COVER	1
7	FREE END COVER	1
8	TIMING GEAR SET	1
9	BEARING, DRIVE END	2
10	BEARING, FREE END	2
12	LIP SEAL, VITON	4
13	LIP SEAL, VITON	1
14	RETAINER	2
15	RETAINER	2
20	OIL SLINGER	1
22	DOWEL PIN	8
23	DRIVE SHAFT KEY	1
24	GEAR KEY	2
25	ROTOR SHAFT WASHER	4
26	CAP SCREW	36
29	BOLT	4
30	CAP SCREW	16
31	MAGNETIC PIPE PLUG	2
37	BREATHER	2
42	NAMEPLATE	1
45	DRIVE SHAFT	1
50	BEARING	1
51	LAB SEAL	4
59	ROTOR LOCKING TAB	4
66	CAP SCREW	4
68	DOWEL PIN	4
70	SIGHT GAUGE WINDOW	2
80	LOCK WASHER	4
85	PIPE PLUG	14
91	NOSE PIECE LIP SEAL	1
92	O-RING, VITON	1
93	CAP SCREW	4
100	STRAIGHT THREAD ADAPTOR	2
109	PLUG	12 / 0
195	LIFTING LUG	2
196	CAP SCREW	2
199	O-RING, VITON	2
304	MOUNTING FOOT	2
307	CAP SCREW	4
339	PLUG	4
395	OIL SLINGER	2

NOTES:

- QUANTITIES SHOWN ARE MAXIMUM VALUES; QUANTITIES MAY VARY BETWEEN BLOWER

PARTS KITS ARE AVAILABLE, AS FOLLOWS:

17/46 — P/N 77051

PARTS LIST FOR MODEL 7000 SERIES - 57/81

ITEM NO.	PART DESCRIPTION	57 / 81 QTY
1	ROTOR	2
3	HOUSING	1
4	END PLATE	2
6	DRIVE END COVER	1
7	FREE END COVER	1
8	TIMING GEAR SET	1
9	BEARING, DRIVE END	2
10	BEARING, FREE END	2
13	LIP SEAL, VITON	1
14	RETAINER	2
15	RETAINER	2
20	OIL SLINGER	1
22	DOWEL PIN	8
23	DRIVE SHAFT KEY	1
24	GEAR KEY	2
25	ROTOR SHAFT WASHER	4
26	CAP SCREW	36
29	BOLT	4
30	CAP SCREW	16
31	MAGNETIC PIPE PLUG	2
37	BREATHER	2
42	NAMEPLATE	1
45	DRIVE SHAFT	1
50	BEARING	1
51	LAB SEAL	4
54	MECHANICAL SEAL	4
59	ROTOR LOCKING TAB	4
66	CAP SCREW	4
68	DOWEL PIN	4
70	SIGHT GAUGE WINDOW	2
74	SEALING RING	4
75	O-RING, VITON	4
80	LOCK WASHER	4
85	PIPE PLUG	14
91	NOSE PIECE LIP SEAL	1
92	O-RING, VITON	1
93	CAP SCREW	4
100	STRAIGHT THREAD ADAPTOR	2
109	PLUG	4 / —
121	PLUG	10 / —
195	LIFTING LUG	2
196	CAP SCREW	2
199	O-RING, VITON	2
300	ROLL PIN	4
304	MOUNTING FOOT	2
307	CAP SCREW	4
339	PLUG	4
395	OIL SLINGER	2

NOTES:

- QUANTITIES SHOWN ARE MAXIMUM VALUES; QUANTITIES MAY VARY BETWEEN BLOWER

PARTS KITS ARE AVAILABLE, AS FOLLOWS:

57/81 — P/N 77069

PARTS LIST FOR MODEL 7000 SERIES - 64/67

ITEM NO.	PART DESCRIPTION	64 / 67 QTY
1	ROTOR	2
3	HOUSING	1
4	END PLATE	2
6	DRIVE END COVER	1
7	FREE END COVER	1
8	TIMING GEAR SET	1
9	BEARING, DRIVE END	2
10	BEARING, FREE END	2
13	LIP SEAL, VITON	1
14	RETAINER	2
15	RETAINER	2
20	OIL SLINGER	1
22	DOWEL PIN	8
23	DRIVE SHAFT KEY	1
24	GEAR KEY	2
25	ROTOR SHAFT WASHER	4
26	CAP SCREW	36
29	BOLT	4
30	CAP SCREW	16
31	MAGNETIC PIPE PLUG	2
42	NAMEPLATE	1
45	DRIVE SHAFT	1
50	BEARING	1
51	LAB SEAL	4
54	MECHANICAL SEAL	5
59	ROTOR LOCKING TAB	4
66	CAP SCREW	4
68	DOWEL PIN	4
70	SIGHT GAUGE WINDOW	2
74	SEALING RING	4
75	O-RING, VITON	5
80	LOCK WASHER	4
85	PIPE PLUG	14
89	MECHANICAL SEAL LOCK RING	1
90	SET SCREW	3
91	NOSE PIECE LIP SEAL	1
92	O-RING, VITON	1
93	CAP SCREW	4
98	PLUG	4
109	PLUG	12 / —
121	PLUG	10 / —
195	LIFTING LUG	2
196	CAP SCREW	2
199	O-RING, VITON	2
300	ROLL PIN	5
304	MOUNTING FOOT	2
307	CAP SCREW	4
339	PLUG	6
395	OIL SLINGER	2

NOTES:

- QUANTITIES SHOWN ARE MAXIMUM VALUES; QUANTITIES MAY VARY BETWEEN BLOWER

PARTS KITS ARE AVAILABLE, AS FOLLOWS:

64/67 — P/N 77052

PARTS LIST FOR MODEL 7000 SERIES - 19/86

ITEM NO.	PART DESCRIPTION	19 / 86 QTY
1	ROTOR	2
3	HOUSING	1
4	END PLATE	2
6	DRIVE END COVER	1
7	FREE END COVER	1
8	TIMING GEAR SET	1
9	BEARING, DRIVE END	2
10	BEARING, FREE END	1
10	BEARING	1
12	LIP SEAL, VITON	4
13	LIP SEAL, VITON	1
14	RETAINER	3
15	RETAINER	1
20	OIL SLINGER	1
22	DOWEL PIN	8
23	DRIVE SHAFT KEY	1
24	GEAR KEY	2
25	ROTOR SHAFT WASHER	3
26	CAP SCREW	36
29	BOLT	3
30	CAP SCREW	16
31	MAGNETIC PIPE PLUG	1
37	BREATHER	2
42	NAMEPLATE	1
45	DRIVE SHAFT	1
50	BEARING	1
51	LAB SEAL	4
57	ROTOR SPACER	1
59	ROTOR LOCKING TAB	3
66	CAP SCREW	4
67	BEARING SPACER	1
68	DOWEL PIN	3
69	CAP SCREW	4
80	LOCK WASHER	4
91	NOSE PIECE LIP SEAL	1
92	O-RING, VITON	1
93	CAP SCREW	4
100	ADAPTOR	2
101	ST ELBOW	1
102	PIPE TBE	1
106	PIPE COUPLING	1
109	PIPE PLUG	14
110	CAP SCREW	3
121	PIPE PLUG	4 / 8
122	SET SCREW	2
124	OIL FILTER, SPIN ON	1
125	PUMP MOUNTING BRACKET	1 / 4
135	UNION, TEE, TUBE	4
136	LOCK WASHER	4
144	OIL PUMP	1
147	TUBE, AL	1 / —

ITEM NO.	PART DESCRIPTION	19 / 86 QTY
155	TUBE ELBOW	2
161	TUBE, AL	2 / —
162	TUBE, AL	1 / —
163	TUBE ELBOW	1
165	TUBE CONNECTOR	1
172	REDUCING BUSHING	1
174	PIPE PLUG	1
179	TUBE, AL	1 / —
187	TUBE	1
188	TUBE ELBOW, UNION	4 / 2
195	LIFTING LUG	2
196	CAP SCREW	2
212	CAP SCREW	2
226	FLAT WASHER	2
235	MALE TUBE ADAPTOR	5
236	TUBE, AL	2 / —
262	GAUGE, 30 HG - 30 PIS, LIQUID FILLED	1
265	BY-PASS RELIEF VALVE	1
270	OIL FILTER ADAPTER	1
271	PIPE PLUG	2
294	MALE TUBE ADAPTOR	1
302	O-RING, VITON	2
304	MOUNTING FOOT	2
306	SLEEVE	1
307	CAP SCREW	4
322	CAP SCREW	4
325	O-RING, VITON	1
329	PLUG	1
336	ORIFICE FITTING	5
337	KEY	2
339	PLUG	8
349	PIPE	1
350	CAP SCREW	36
351	PIPE	4
354	REDUCER BUSHING	5
360	OIL FILTER THREADED TUBE	1
369	TUBE	1
395	OIL SLINGER	2
446	OIL PUMP COVER	1
449	ROTOR SPROCKET ADAPTER	1
450A	CHAIN, ROLLER	1
450B	CHAIN LINK CONNECTOR, NO. 35	1
451	SPROCKET, NO. 35	1
452	SPROCKET, NO. 35	1
458	PUMP HOUSING	1
459	OIL GAUGE, BULLSEYE	1
479	TUBE, AL	— / 1

NOTES:

- QUANTITIES SHOWN ARE MAXIMUM VALUES; QUANTITIES MAY VARY BETWEEN BLOWER

PARTS KITS ARE AVAILABLE, AS FOLLOWS:

19/86 — P/N 77110

PARTS LIST FOR MODEL 7000 SERIES - 82

ITEM NO.	PART DESCRIPTION	QTY
1	ROTOR	2
3	HOUSING	1
4	END PLATE	2
6	DRIVE END COVER	1
7	FREE END COVER	1
8	TIMING GEAR SET	1
9	BEARING, DRIVE END	2
10	BEARING, FREE END	1
10	BEARING	1
13	LIP SEAL, VITON	1
14	RETAINER	3
15	RETAINER	1
20	OIL SLINGER	1
22	DOWEL PIN	8
23	DRIVE SHAFT KEY	1
24	GEAR KEY	2
25	ROTOR SHAFT WASHER	3
26	CAP SCREW	36
29	BOLT	3
30	CAP SCREW	16
31	MAGNETIC PIPE PLUG	1
37	BREATHER	2
42	NAMEPLATE	1
45	DRIVE SHAFT	1
50	BEARING	1
51	LAB SEAL	4
54	MECHANICAL SEAL	4
57	ROTOR SPACER	1
59	ROTOR LOCKING TAB	3
66	CAP SCREW	4
67	BEARING SPACER	1
68	DOWEL PIN	3
69	CAP SCREW	4
74	SEALING RING	4
75	O-RING, VITON	4
80	LOCK WASHER	4
91	NOSE PIECE LIP SEAL	1
92	O-RING, VITON	1
93	CAP SCREW	4
100	ADAPTOR	2
101	ST ELBOW	1
102	PIPE TBE	1
106	PIPE COUPLING	1
109	PIPE PLUG	14
110	CAP SCREW	3
121	PIPE PLUG	10
122	SET SCREW	2
124	OIL FILTER, SPIN ON	1
125	PUMP MOUNTING BRACKET	1
135	UNION, TEE, TUBE	4

ITEM NO.	PART DESCRIPTION	QTY
136	LOCK WASHER	4
144	OIL PUMP	1
155	TUBE ELBOW	2
163	TUBE ELBOW	2
172	REDUCING BUSHING	1
174	PIPE PLUG	1
187	TUBE	1
188	TUBE ELBOW, UNION	2
195	LIFTING LUG	2
196	CAP SCREW	2
212	CAP SCREW	2
226	FLAT WASHER	2
235	MALE TUBE ADAPTOR	5
262	GAUGE, 30 HG - 30 PIS, LIQUID FILLED	1
265	BY-PASS RELIEF VALVE	1
270	OIL FILTER ADAPTER	1
271	PIPE PLUG	2
294	MALE TUBE ADAPTOR	1
300	ROLL PIN	4
302	O-RING, VITON	2
304	MOUNTING FOOT	2
306	SLEEVE	1
307	CAP SCREW	4
322	CAP SCREW	4
325	O-RING, VITON	1
329	PLUG	1
336	ORIFICE FITTING	5
337	KEY	2
339	PLUG	8
349	PIPE	1
350	CAP SCREW	36
351	PIPE	4
354	REDUCER BUSHING	5
360	OIL FILTER THREADED TUBE	1
369	TUBE	1
395	OIL SLINGER	2
446	OIL PUMP COVER	1
449	ROTOR SPROCKET ADAPTER	1
450A	CHAIN, ROLLER	1
450B	CHAIN LINK CONNECTOR, NO. 35	1
451	SPROCKET, NO. 35	1
452	SPROCKET, NO. 35	1
458	PUMP HOUSING	1
459	OIL GAUGE, BULLSEYE	1
479	TUBE, AL	1

NOTES:

- QUANTITIES SHOWN ARE MAXIMUM VALUES; QUANTITIES MAY VARY BETWEEN BLOWER

PARTS KITS ARE AVAILABLE, AS FOLLOWS:

82 — P/N 77111

PARTS LIST FOR MODEL 7000 SERIES - 66/69

ITEM NO.	PART DESCRIPTION	66 / 69 QTY
1	ROTOR	2
3	HOUSING	1
4	END PLATE	2
6	DRIVE END COVER	1
7	FREE END COVER	1
8	TIMING GEAR SET	1
9	BEARING, DRIVE END	2
10	BEARING, FREE END	1
10	BEARING	1
13	LIP SEAL, VITON	1
14	RETAINER	3
15	RETAINER	1
20	OIL SLINGER	1
22	DOWEL PIN	8
23	DRIVE SHAFT KEY	1
24	GEAR KEY	2
25	ROTOR SHAFT WASHER	3
26	CAP SCREW	36
29	BOLT	3
30	CAP SCREW	16
31	MAGNETIC PIPE PLUG	1
42	NAMEPLATE	1
45	DRIVE SHAFT	1
50	BEARING	1
51	LAB SEAL	4
54	MECHANICAL SEAL	5
57	ROTOR SPACER	1
59	ROTOR LOCKING TAB	3
66	CAP SCREW	4
67	BEARING SPACER	1
68	DOWEL PIN	3
69	CAP SCREW	4
74	SEALING RING	4
75	O-RING, VITON	5
80	LOCK WASHER	4
89	MECHANICAL SEAL LOCK RING	1
90	SET SCREW	3
91	NOSE PIECE LIP SEAL	1
92	O-RING, VITON	1
93	CAP SCREW	4
101	ST ELBOW	1
102	PIPE TBE	1
106	PIPE COUPLING	1
109	PIPE PLUG	14 / 12
110	CAP SCREW	3
121	PIPE PLUG	4 / 10
122	SET SCREW	2
124	OIL FILTER, SPIN ON	1
125	PUMP MOUNTING BRACKET	1
135	UNION, TEE, TUBE	4
136	LOCK WASHER	4
144	OIL PUMP	1
147	TUBE, AL	1 / —
155	TUBE ELBOW	2
161	TUBE, AL	2 / —
162	TUBE, AL	1 / —
163	TUBE ELBOW	1
165	TUBE CONNECTOR	1
172	REDUCING BUSHING	1
174	PIPE PLUG	1
178	TUBE ADAPTOR	2
179	TUBE, AL	1 / —
187	TUBE	1
188	TUBE ELBOW, UNION	4 / 2
195	LIFTING LUG	2
196	CAP SCREW	2
212	CAP SCREW	2
226	FLAT WASHER	2
235	MALE TUBE ADAPTOR	5
236	TUBE, AL	2 / —
262	GAUGE, 30 HG - 30 PIS, LIQUID FILLED	1
265	BY-PASS RELIEF VALVE	1
270	OIL FILTER ADAPTER	1
271	PIPE PLUG	2
294	MALE TUBE ADAPTOR	1
300	ROLL PIN	5
302	O-RING, VITON	2
304	MOUNTING FOOT	2
306	SLEEVE	1
307	CAP SCREW	4
322	CAP SCREW	4
325	O-RING, VITON	1
329	PLUG	1
336	ORIFICE FITTING	5
337	KEY	2
339	PLUG	8
349	PIPE	1
350	CAP SCREW	36
351	PIPE	4
354	REDUCER BUSHING	5
355	TUBE, AL	1 / —
360	OIL FILTER THREADED TUBE	1
369	TUBE	1
395	OIL SLINGER	2
446	OIL PUMP COVER	1
449	ROTOR SPROCKET ADAPTER	1
450A	CHAIN, ROLLER	1
450B	CHAIN LINK CONNECTOR, NO. 35	1
451	SPROCKET, NO. 35	1
452	SPROCKET, NO. 35	1
458	PUMP HOUSING	1
459	OIL GAUGE, BULLSEYE	1
479	TUBE, AL	— / 1

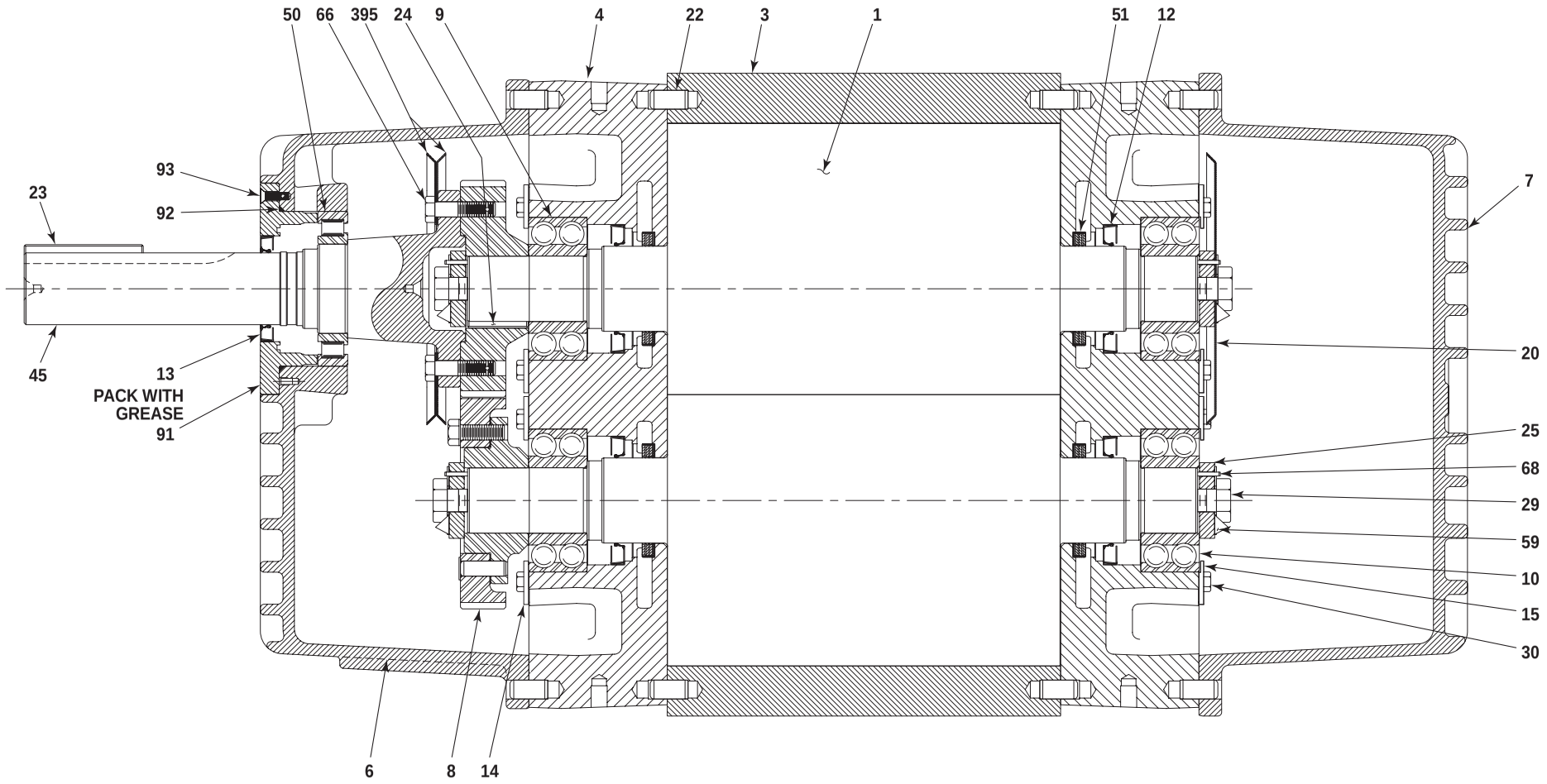
NOTES:

- QUANTITIES SHOWN ARE MAXIMUM VALUES; QUANTITIES MAY VARY BETWEEN BLOWER

PARTS KITS ARE AVAILABLE, AS FOLLOWS:

66/69 — P/N 77101

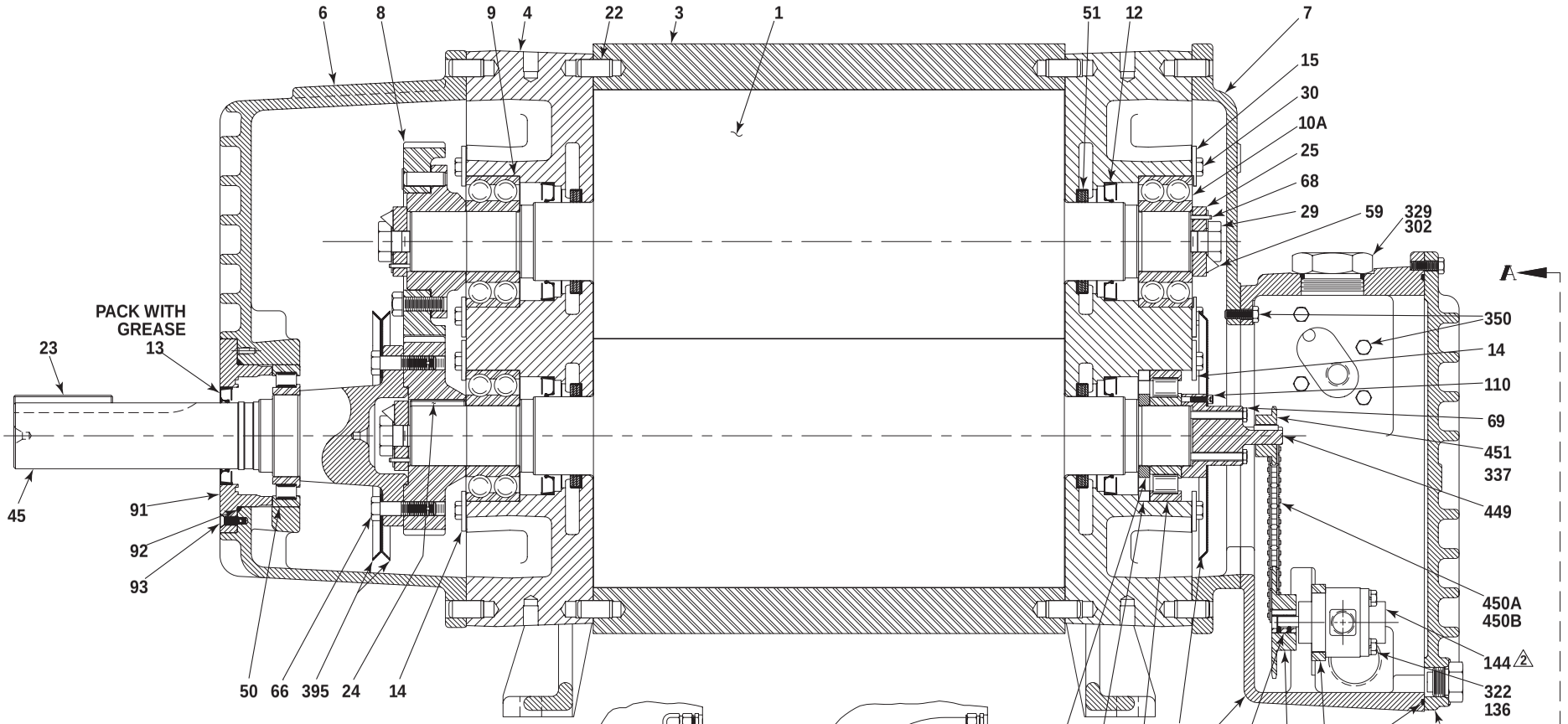
ASSEMBLY DRAWINGS FOR MODEL 7000-17/46 — CUTAWAY VIEW



7013 SHOWN

NOTE: USE SEALANT BETWEEN
END COVERS, END PLATES & HOUSING

ASSEMBLY DRAWINGS FOR MODEL 7000-19/86 — CUTAWAY VIEW



ORIFICE ASSEMBLY
4 PLACES ON EACH END PLATE
1 PLACE ON DRIVE END COVER

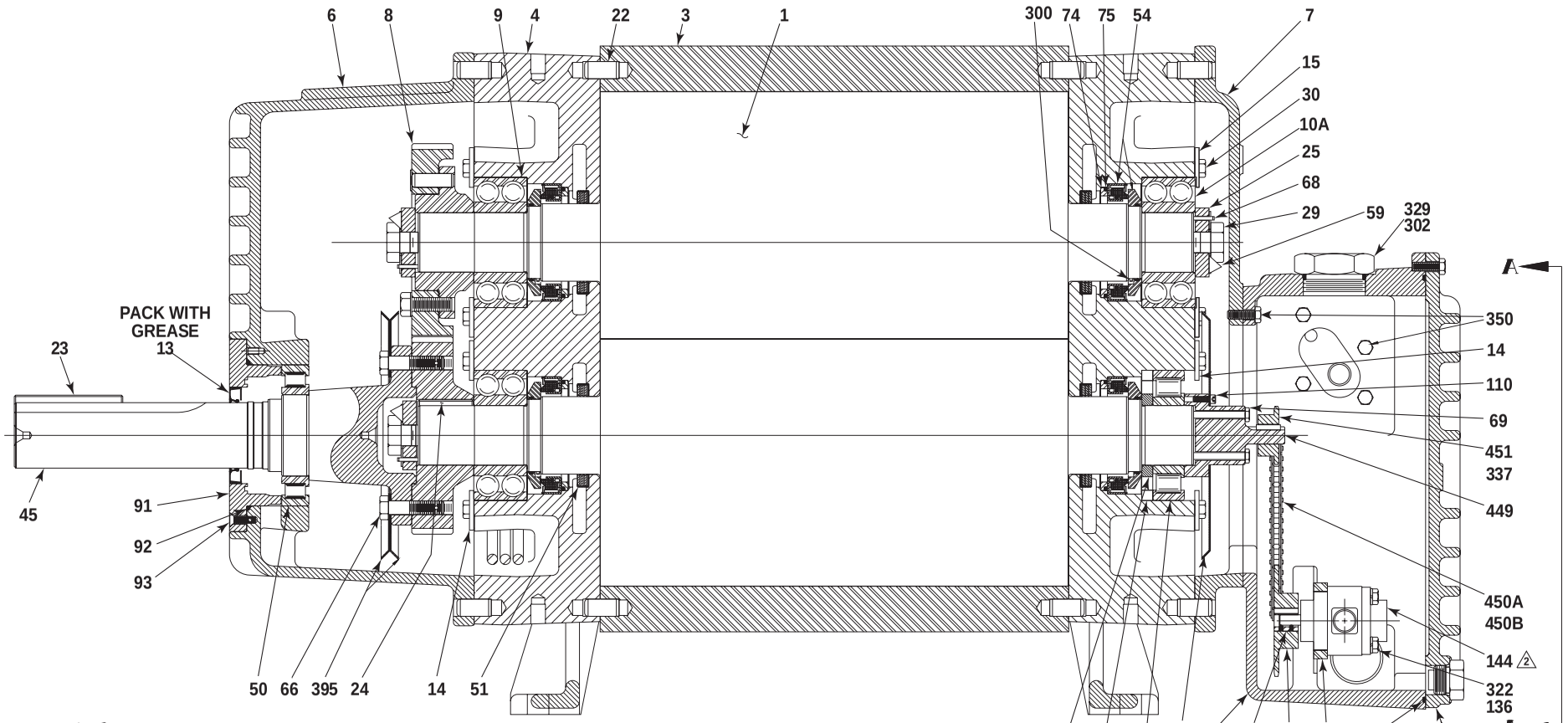
7013 SHOWN

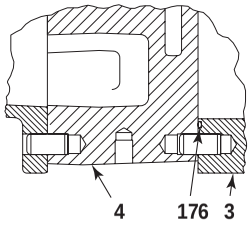
NOTES:

USE SEALANT BETWEEN END COVERS, END PLATES, HOUSING, PUMP HOUSING AND OIL FILTER ADAPTER

2 INSTALL ITEM 144 OIL PUMP WITH SUCTION OF PUMP (MARKED WITH "S") ON SIDE OF BLOWER OPPOSITE ITEM 187 OIL DRAIN LINE.

ASSEMBLY DRAWINGS FOR MODEL 7000-55/82 — CUTAWAY VIEW

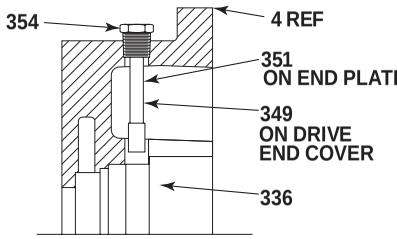




OPTIONAL O-RING ARRANGEMENT

FOR UNITS WITH O-RING SEALING

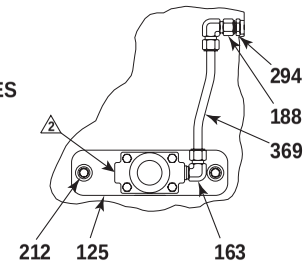
TYP FOR BOTH ENDS



ORIFICE ASSEMBLY

4 PLACES ON EACH END PLATE

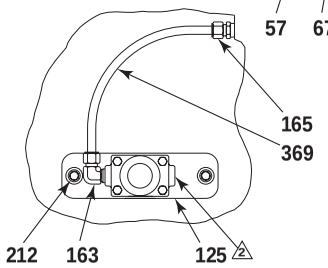
1 PLACE ON DRIVE END COVER



VIEW A-A

(COVER REMOVED)

82 SERIES



VIEW A-A

(COVER REMOVED)

82 SERIES

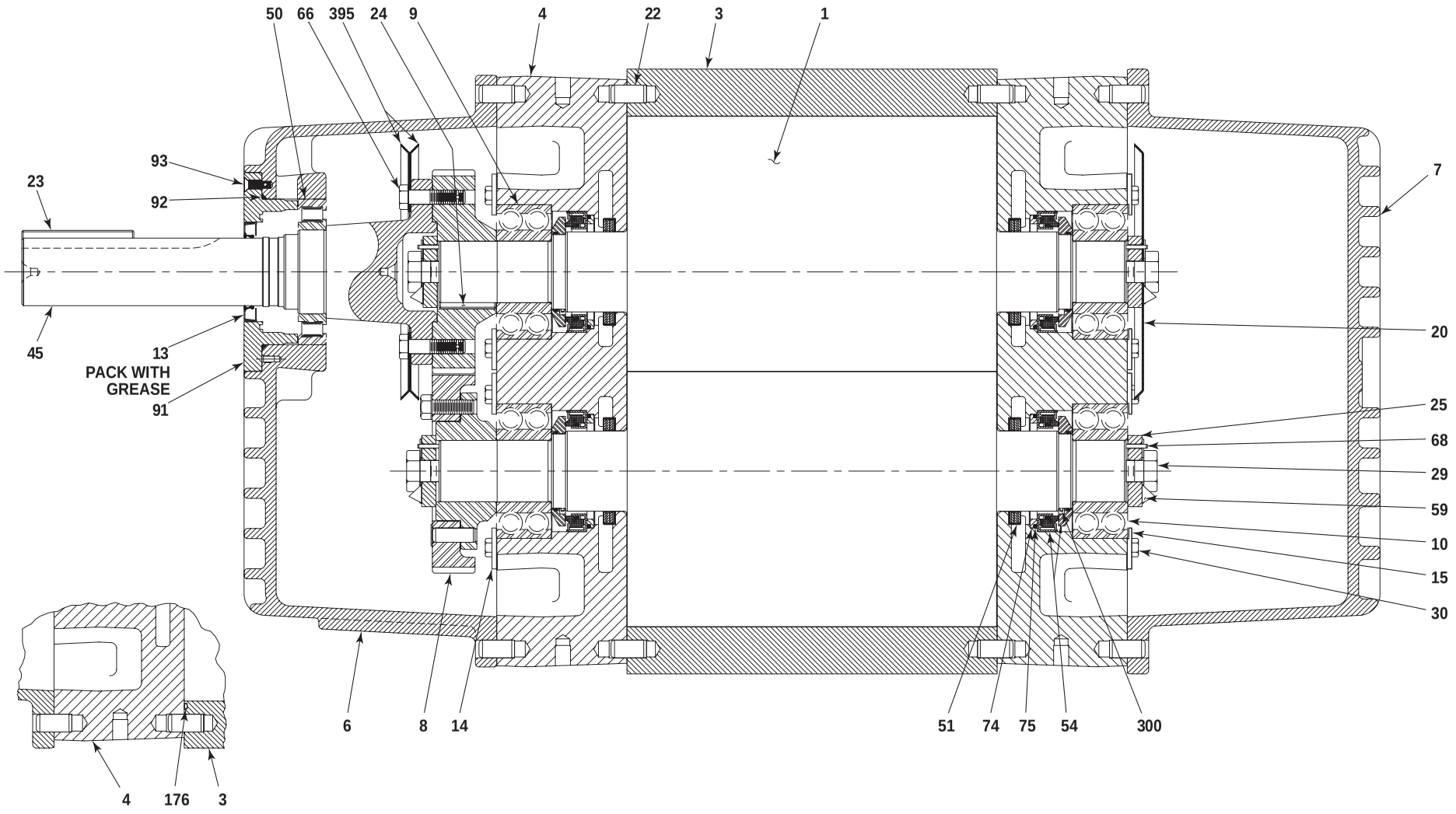
7013 SHOWN

NOTES:

USE SEALANT BETWEEN END COVERS, END PLATES, HOUSING, PUMP HOUSING AND OIL FILTER ADAPTER

2 INSTALL ITEM 144 OIL PUMP WITH SUCTION OF PUMP (MARKED WITH "S") ON SIDE OF BLOWER OPPOSITE ITEM 187 OIL DRAIN LINE.

ASSEMBLY DRAWINGS FOR MODEL 7000-57/81 — CUTAWAY VIEW

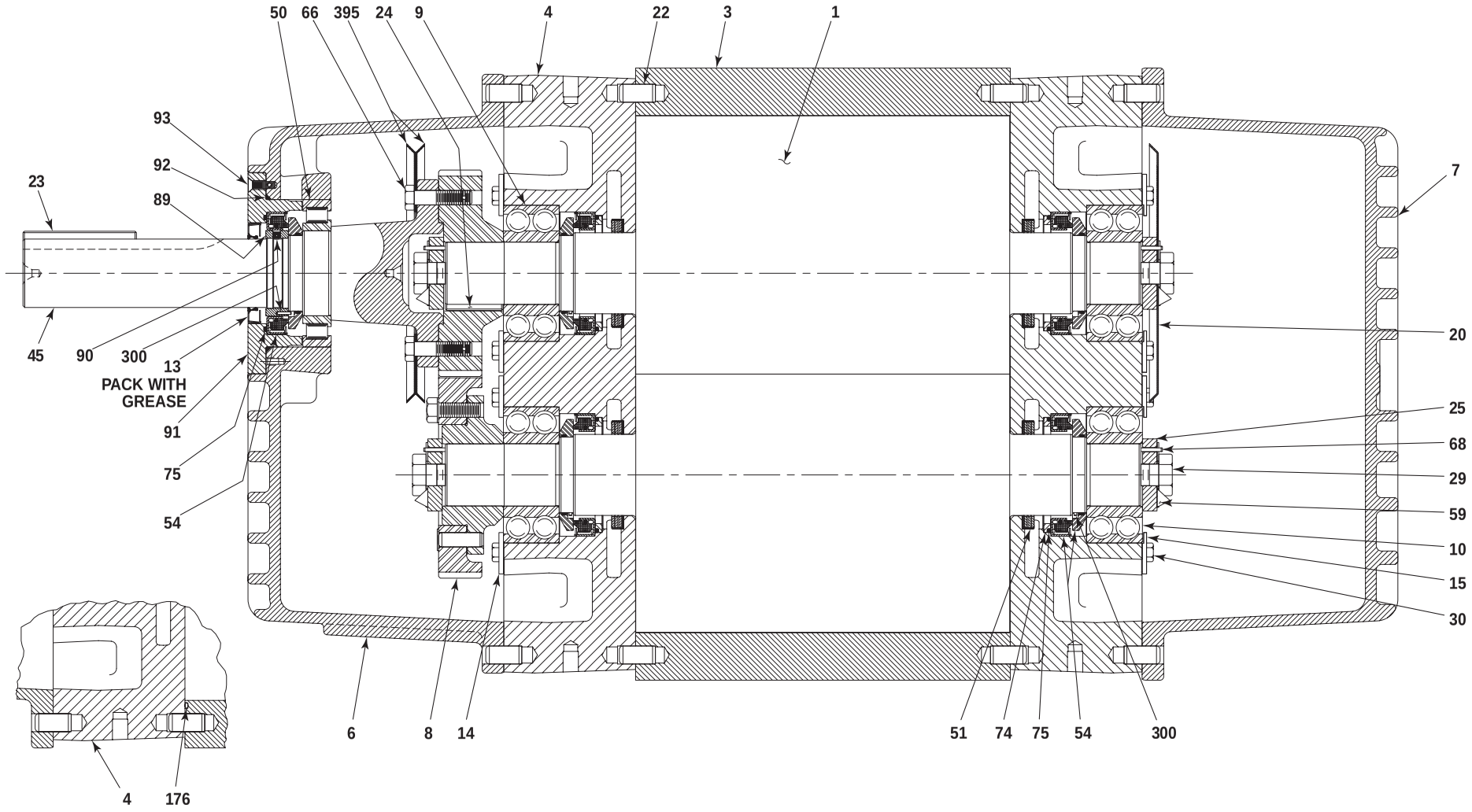


OPTIONAL O-RING
ARRANGEMENT
FOR UNITS WITH
O-RING SEALING
TYP FOR BOTH ENDS

7013 SHOWN

NOTE: USE SEALANT BETWEEN
END COVERS, END PLATES & HOUSING

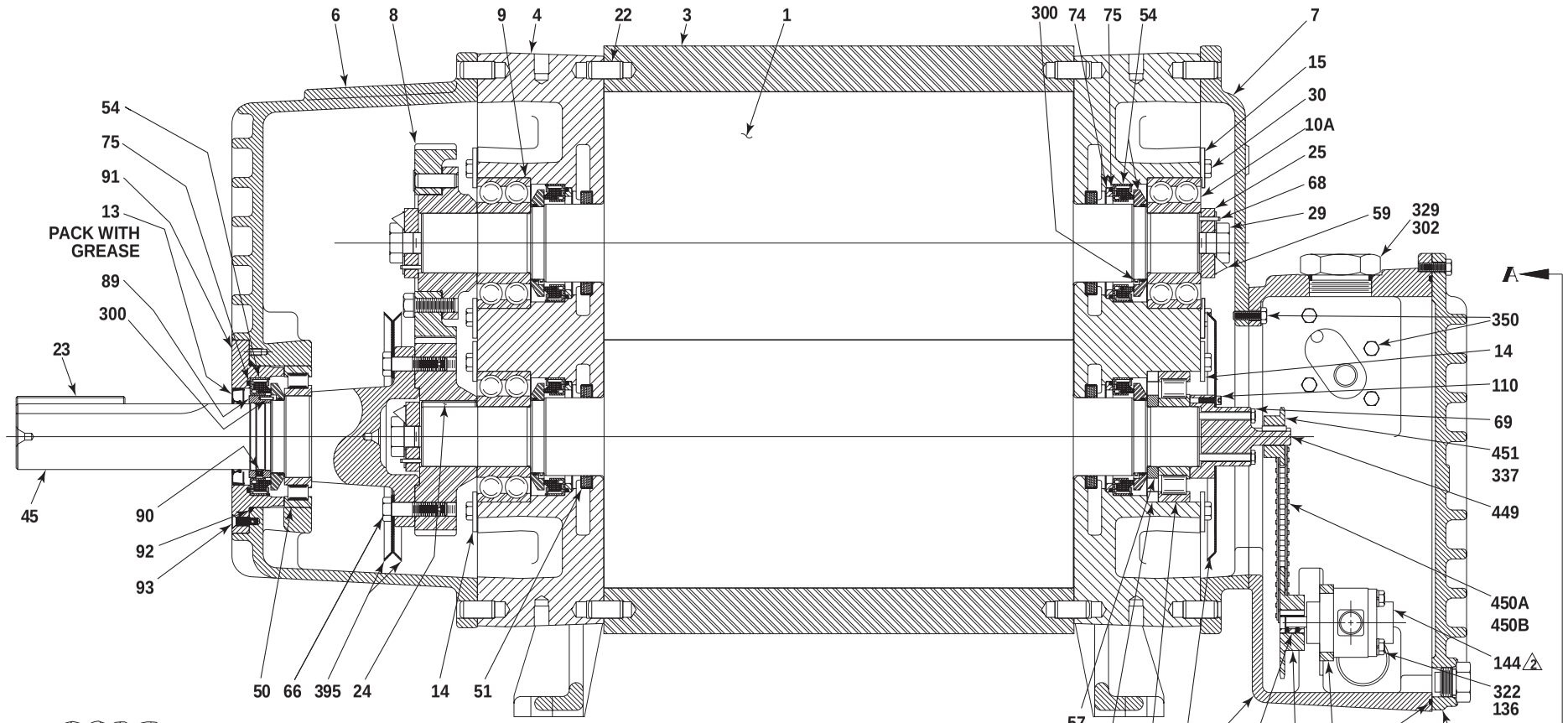
ASSEMBLY DRAWINGS FOR MODEL 7000-64/67 — CUTAWAY VIEW

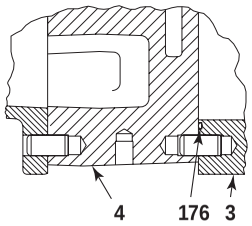


7013 SHOWN

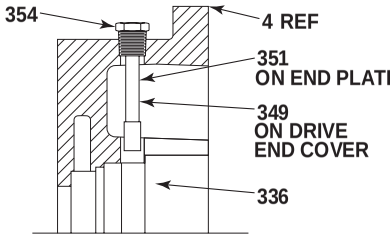
NOTE: USE SEALANT BETWEEN END COVERS, END PLATES & HOUSING

ASSEMBLY DRAWINGS FOR MODEL 7000-66/69 — CUTAWAY VIEW

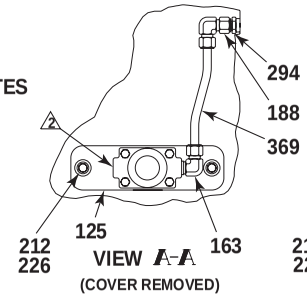




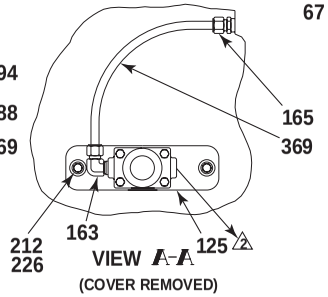
OPTIONAL O-RING ARRANGEMENT
FOR UNITS WITH O-RING SEALING
TYP FOR BOTH ENDS



ORIFICE ASSEMBLY
4 PLACES ON EACH END PLATE
1 PLACE ON DRIVE END COVER



(COVER REMOVED)
69 SERIES



(COVER REMOVED)
66 SERIES

7013 SHOWN

NOTES:

USE SEALANT BETWEEN END COVERS, END PLATES, HOUSING, PUMP HOUSING AND OIL FILTER ADAPTER

2 INSTALL ITEM 144 OIL PUMP WITH SUCTION OF PUMP (MARKED WITH "S") ON SIDE OF BLOWER OPPOSITE ITEM 187 OIL DRAIN LINE.

CE

DECLARATION OF INCORPORATION

Herewith we declare that the items detailed below are in conformity with the provisions of the Machinery Directive 2006/42/EC.

Information on the items detailed are compiled per the Machinery Directive 2006/42/EC, Annex VII, part A and are the responsibility of the person listed below.

The items detailed below must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the provisions of the relevant directive(s).

Other directives and standards that apply to this Declaration of Incorporation:

EN 1012-1: 1996 - Compressors and vacuum pumps - Safety requirements - Part 1: Compressors

The scope of the Declaration of Incorporation is for bare shaft Rotary Positive Displacement (PD Plus®) Blowers

Model 7000

17/19 – Horizontal Air Flow

46/86 – Vertical Air Flow

57/55 – Horizontal Flow, Single Envelope Gastight

81/82 – Vertical Flow, Single Envelope Gastight

64/66 – Horizontal Flow, Double Envelope Gastight

67/69 – Vertical Flow, Double Envelope Gastight

The person authorized to compile the technical file is Xavier Lambert, Tuthill Corporation, Parc Industriel Wavre Nord-Avenue Vesale 30, B-1300 Wavre Belgium.

David L. Schardt

David Schardt
VP of Engineering & Product Development

Tuthill

Tuthill Vacuum & Blower Systems
4840 West Kearney Street
P.O. Box 2877
Springfield, MO US 65801-0877

WARRANTY – BLOWER PRODUCTS

Subject to the terms and conditions hereinafter set forth and set forth in General Terms of Sale, Tuthill Vacuum & Blower Systems (the Seller) warrants products and parts of its manufacture, when shipped, and its work (including installation and start-up) when performed, will be of good quality and will be free from defects in material and workmanship. This warranty applies only to Seller's equipment, under use and service in accordance with seller's written instructions, recommendations and ratings for installation, operating, maintenance and service of products, for a period as stated in the table below. Because of varying conditions of installation and operation, all guarantees of performance are subject to plus or minus 5% variation. (Non-standard materials are subject to a plus or minus 10% variation)

PRODUCT TYPE	TYPE OF APPLICATION	
	ATMOSPHERIC AIR OR PROCESS AIR WITHOUT LIQUIDS PRESENT	PROCESS GASES OTHER THAN AIR, OR ANY LIQUID INJECTED APPLICATION
New *(Qx™ models only)*	30 months from date of shipment, or 24 months after initial startup date, whichever occurs first.	Consult Factory
New *(all other models)*	24 months from date of shipment, or 18 months after initial startup date, whichever occurs first	18 months from date of shipment, or 12 months after initial startup date, whichever occurs first
Repair	12 months from date of shipment, or remaining warranty period, whichever is greater	12 months from date of shipment, or remaining warranty period, whichever is greater

THIS WARRANTY EXTENDS ONLY TO BUYER AND/OR ORIGINAL END USER, AND IN NO EVENT SHALL THE SELLER BE LIABLE FOR PROPERTY DAMAGE SUSTAINED BY A PERSON DESIGNATED BY THE LAW OF ANY JURISDICTION AS A THIRD PARTY BENEFICIARY OF THIS WARRANTY OR ANY OTHER WARRANTY HELD TO SURVIVE SELLER'S DISCLAIMER.

All accessories furnished by Seller but manufactured by others bear only that manufacturer's standard warranty.

All claims for defective products, parts, or work under this warranty must be made in writing immediately upon discovery and, in any event within one (1) year from date of shipment of the applicable item and all claims for defective work must be made in writing immediately upon discovery and in any event within one (1) year from date of completion thereof by Seller. Unless done with prior written consent of Seller, any repairs, alterations or disassembly of Seller's equipment shall void warranty. Installation and transportation costs are not included and defective items must be held for Seller's inspection and returned to Seller's Ex-works point upon request.

THERE ARE NO WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS OF PURPOSE.

After Buyer's submission of a claim as provided above and its approval, Seller shall at its option either repair or replace its product, part, or work at the original Ex-works point of shipment, or refund an equitable portion of the purchase price.

The products and parts sold hereunder are not warranted for operation with erosive or corrosive material or those which may lead to build up of material within the product supplied, nor those which are incompatible with the materials of construction. The Buyer shall have no claim whatsoever and no product or part shall be deemed to be defective by reason of failure to resist erosive or corrosive action nor for problems resulting from build-up of material within the unit nor for problems due to incompatibility with the materials of construction.

Any improper use, operation beyond capacity, substitution of parts not approved by Seller, or any alteration or repair by others in such manner as in Seller's judgment affects the product materially and adversely shall void this warranty.

No employee or representative of Seller other than an Officer of the Company is authorized to change this warranty in any way or grant any other warranty. Any such change by an Officer of the Company must be in writing.

The foregoing is Seller's only obligation and Buyer's only remedy for breach of warranty, and except for gross negligence, willful misconduct and remedies permitted under the General Terms of Sale in the sections on CONTRACT PERFORMANCE, INSPECTION AND ACCEPTANCE and the PATENTS Clause hereof, the foregoing is BUYER'S ONLY REMEDY HEREUNDER BY WAY OF BREACH OF CONTRACT, TORT OR OTHERWISE, WITHOUT REGARD TO WHETHER ANY DEFECT WAS DISCOVERED OR LATENT AT THE TIME OF DELIVERY OF THE PRODUCT OR WORK. In no event shall Buyer be entitled to incidental or consequential damages. Any action for breach of this agreement must commence within one (1) year after the cause of action has occurred.

May 2008

OPERATING DATA FORM / PRODUCT REGISTRATION

It is to the user's advantage to have the requested data filled in below and available in the event a problem should develop in the blower or the system. This information is also helpful when ordering spare parts.

Model No. _____ V-Belt Size _____ Length _____

Serial No. _____ Type of Lubrication _____

Startup Date _____ _____

Pump RPM _____ Operating Vacuum _____

Pump Sheave Diameter _____ Any other Special Accessories Supplied or in use:

Motor Sheave Diameter _____ _____

Motor RPM _____ HP _____ _____

NOTES: _____

_____

_____

_____

IMPORTANT

All blowers manufactured by Tuthill Vacuum & Blower Systems are date coded at time of shipment. In order to assure you of the full benefits of the product warranty, please complete, tear out and return the product registration card, or register online at **tuthillvacuumblower.com**.

For Service & Repair, Technical Support, or Product Sales contact:

Tuthill Vacuum & Blower Systems
4840 West Kearney Street
Springfield, Missouri USA 65803-8702
O 417.865.8715 800.825.6937 F 417.865.2950
tuthillvacuumblower.com

Tuthill
PUMP YOUR HEART INTO IT

TUTHILL LUBRICANTS

POSITIVE DISPLACEMENT BLOWERS & BOOSTERS

TUTHILL LUBRICANTS

POSITIVE DISPLACEMENT BLOWERS & BOOSTERS

Tuthill positive displacement blowers and boosters are known worldwide for superior quality and performance. Tuthill's MD full synthetic lubricants are specifically formulated for use in Tuthill's high-performing blowers and boosters and is the only lubricant recommended. MD lubricants ensure the highest quality of operation, allowing you to achieve a longer life over mineral oil or semi-synthetic lubricants due to its specific formulation, especially in high temperature conditions. Improper lubrication is one of the main causes of blower and booster failures. Don't take a chance using anything other than MD lubricants by Tuthill.

BENEFITS

- Positive displacement blowers and boosters can often operate at temperatures near 300°F. These extreme operating temperatures require a full synthetic lubricant that is blended from synthetic hydrocarbon polyalphaolefin (PAO) to ensure maximum performance and product life.
- PAOs have greater thermal oxidative stability and a high viscosity index, allowing for greater film strength at higher temperatures and decreased viscosities at low temperatures for minimal friction and better lubrication.
- This PAO synthetic base fluid allows oil to demulsify water in high humidity and water conditions by easily separating water from the fluid. MD full synthetic lubricants provide better rust and corrosion protection for increased equipment life and has the highest 1A rating for copper corrosion under ASTM D130.
- MD full synthetic lubricants contain a formulation of anti-wear and anti-foaming additives that are specifically designed to prolong the life of Tuthill blowers and boosters.
- MD full synthetic lubricants can last up to 5 times longer than mineral oil and twice as long as many semi-synthetic lubricants, meaning fewer oil change intervals, reduced down time, and greater cost savings.
- MD full synthetic lubricants have an average oil life of 8,000-hours at temperatures up to 220°F. Mineral oils oxidize at temperatures as low as 160°F, resulting in an oil life of 1,500-hours.
- MD lubricants have a low coefficient of dynamic friction that substantially reduces power consumption by minimizing gear and bearing friction, resulting in improved efficiency.

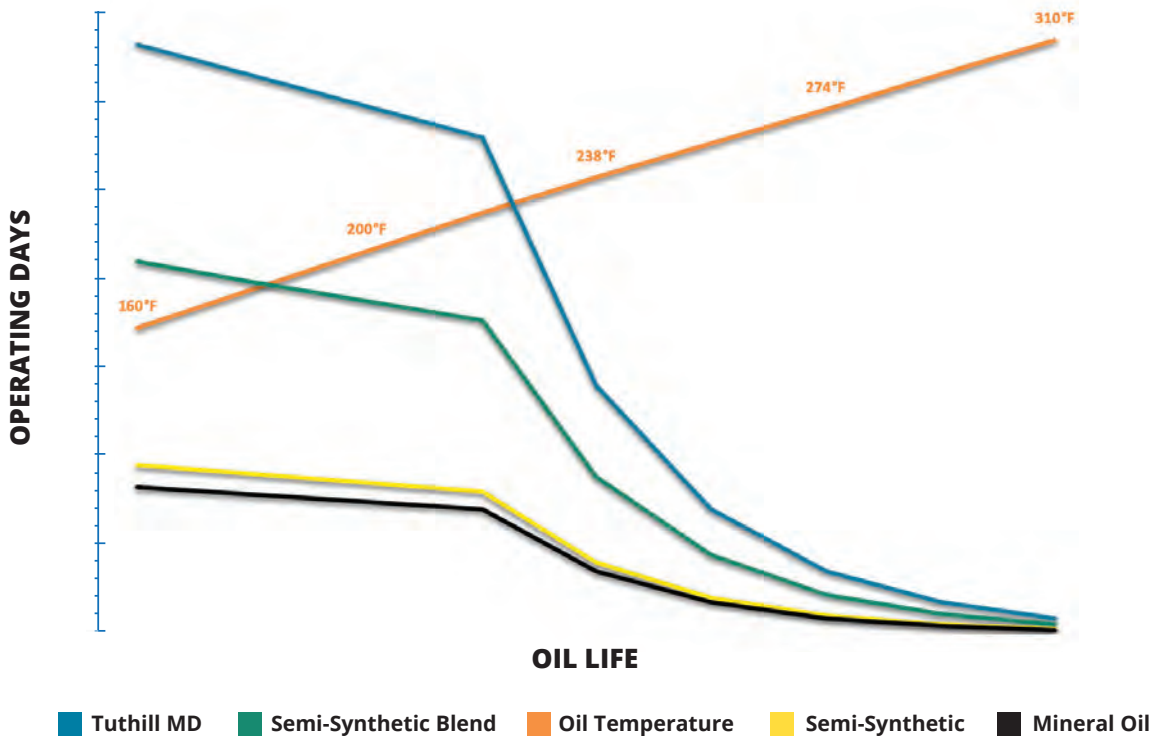
NOT ALL LUBRICANTS PERFORM THE SAME

Blowers and boosters can often operate at high temperatures. The lubricant can equal that of the discharge temperature. Oil life drops by half for every 18°F above 220°F. This is why it is important to use MD lubricants that are formulated to extend oil life, even at high temperatures.

MD LUBRICANTS VS. SEMI-SYNTHETIC & MINERAL OIL

MD LUBRICANTS	SEMI-SYNTHETICS & MINERAL OILS
Contains tailored list of additives for specific product application	Mineral oils do not contain any additional additives that protect the seals, bearings, or gears. Semi-Synthetics may only contain a small amount of additional additives
Higher oxidation resistance, improving lubricity	Lower oxidation resistance, increasing risk of sludge formation
Protects from oxidation at 220°F	Semi-synthetics begins to oxidize at 180°F and mineral oil start oxidizing at only 160°F
PAO based fluids provide higher anti-wear properties resulting in increased product life	Lack of anti-wear properties results in decreased product life
Up to a 30% reduction in cost of oil change intervals over the life of the product	Reduced oil life results in increased oil change intervals and higher overall maintenance cost
Environmentally friendly due to fewer oil changes	Increased disposal costs due to increased oil change intervals

OIL TEMPERATURE VS. OIL LIFE



COST SAVINGS OF USING MD ONE VS SEMI-SYNTHETIC AND MINERAL OIL

MD full synthetic lubricants not only better protect your product from premature failure but you will also save money in reoccurring maintenance costs. The example below shows an initial fill of MD One oil in a Tuthill PD Plus 5511 blower. In 8,000 hours of run time, using a mineral oil or semi-synthetics can cost you up to 3 times the expense.

TUTHILL 5511 BLOWER	MD ONE	SEMI-SYNTHETIC	MINERAL OIL
INITIAL FILL OF OIL (1 GALLON)	$75	$60	$35
LUBE CHANGE INTERVAL	8,000 hrs	4,000 hrs	1,500 hrs
COST OF REPLACEMENT OIL	$0	$60	$140
LABOR ($50/CHANGE)	$50	$100	$250
TOTAL COST	**$125**	**$200**	**$425**

Savings will vary based on individual operating conditions.

MD ONE

MD ONE is a great all-purpose, full synthetic lubricant suited for most blower and booster applications, working well in low or high ambient conditions. It is formulated using synthesized hydrocarbon fluid and select additives to enhance oxidation resistance and provide maximum protection against wear, rust corrosion, and foaming.

MD PLUS

MD PLUS full synthetic lubricant provides significantly better thermal and oxidation stability at higher temperatures. Compared to mineral oil, MD PLUS contains specific additives that reduce oxidation, protect against breakdown of the lubricant, and greatly prolong the life of the oil.

MD MAX

MD MAX full synthetic lubricant provides the highest protection against maximum operating temperatures for blower and booster applications. The viscosity and the additive formulation of MD MAX creates an additional layer of protection for the gears, bearings, and seals to increase durability and maintain adequate endurance in extreme operating conditions.

MD FG (FOOD GRADE)

MD FG is a full synthetic lubricant that is approved by the CFIA and the USDA for H-1 applications that is compliant with FDA 21 CFR 178.3570 requirements. In addition, the MD FG is Halal Certified by the Islamic Food and Nutrition Council of America. MD FG oil is fortified with oxidation inhibitors, corrosion inhibitors, and anti-wear additives to enhance the superior qualities offered by the synthetic hydrocarbon base stock.

MD LITHIUM GREASE

MD LITHIUM GREASE is a multi-purpose grease that is recommended for use in select CP Series blower models. This grease is shear stable with extreme pressure characteristics and outperforms conventional greases. It satisfies nearly all grease requirements found in industrial blower applications.

TUTHILL LUBRICATION RECOMMENDATION

The selection of the correct lubricant is an important decision. The application and operating conditions must be taken into consideration to achieve maximum performance and life of the product. Determination of lubricant should not be decided solely on ambient temperature. Tuthill provides a recommendation tool for its MD lubricants based on discharge temperature, inlet temperature, RPM, and model to better safeguard that you are selecting the right lubricant. The chart below is for informational guidance only. Contact Tuthill or a Tuthill Representative for assistance in choosing the best lubricant for your specific application and operating conditions.

DISCHARGE TEMPERATURE (°F)

RPM	150	170	190	210	230	250	270	290	310	330	350
1150	MD ONE	MD ONE	MD PLUS	MD PLUS	MD PLUS	MD MAX	MD MAX	MD MAX	MD MAX	MD MAX	MD MAX
1395	MD ONE	MD ONE	MD PLUS	MD PLUS	MD PLUS	MD MAX	MD MAX	MD MAX	MD MAX	MD MAX	MD MAX
1640	MD ONE	MD ONE	MD PLUS	MD PLUS	MD PLUS	MD MAX	MD MAX	MD MAX	MD MAX	MD MAX	MD MAX
1885	MD ONE	MD ONE	MD ONE	MD PLUS	MD PLUS	MD PLUS	MD PLUS	MD MAX	MD MAX	MD MAX	MD MAX
2130	MD ONE	MD ONE	MD ONE	MD PLUS	MD PLUS	MD PLUS	MD PLUS	MD MAX	MD MAX	MD MAX	MD MAX
2375	MD ONE	MD ONE	MD ONE	MD PLUS	MD PLUS	MD PLUS	MD PLUS	MD MAX	MD MAX	MD MAX	MD MAX
2620	MD ONE	MD ONE	MD ONE	MD PLUS	MD PLUS	MD PLUS	MD PLUS	MD MAX	MD MAX	MD MAX	MD MAX
2865	MD ONE	MD ONE	MD ONE	MD PLUS	MD PLUS	MD PLUS	MD PLUS	MD MAX	MD MAX	MD MAX	MD MAX
3110	MD ONE	MD ONE	MD ONE	MD ONE	MD PLUS	MD PLUS	MD PLUS	MD MAX	MD MAX	MD MAX	MD MAX
3355	MD ONE	MD ONE	MD ONE	MD ONE	MD PLUS	MD PLUS	MD PLUS	MD MAX	MD MAX	MD MAX	MD MAX
3600	MD ONE	MD ONE	MD ONE	MD ONE	MD PLUS	MD PLUS	MD PLUS	MD MAX	MD MAX	MD MAX	MD MAX

MD BLOWER & BOOSTER LUBRICANTS SPECIFICATIONS:

PRODUCTS	MD ONE	MD PLUS	MD MAX	MD FG
VISCOSITY INDEX	150	154	157	141
@40°C, CST	99.1	231.7	340.9	99.3
@100°C, CST	14.4	27.6	37.2	13.9
FLASH POINT °F (°C)	510 (266)	480 (249)	491 (255)	515 (268)
POUR POINT °F (°C)	-44 (-43)	-49 (-45)	-54 (-48)	-60 (-51)

ORDERING MADE EASY

Tuthill lubricants are available in a variety of convenient quantities and sizes. Contact your local Tuthill Distributor or order at **tvbsinquiries@tuthill.com.**

	QUART	GALLON	5 GALLON	55 GALLON BARREL	CASE - 12 QUARTS
MD ONE	16444-MD1-Q	16444-MD1-G	16444-MD1-5G	16444-MD1-B	16444-MD1-Q-C
MD PLUS	16444-MD2-Q	16444-MD2-G	16444-MD2-5G	16444-MD2-B	16444-MD2-Q-C
MD MAX	16444-MD3-Q	16444-MD3-G	16444-MD3-5G	16444-MD3-B	16444-MD3-Q-C
MD FG	16444-MD1-Q-FG	16444-MD1-G-FG	16444-MD1-5G-FG	16444-MD1-B-FG	16444-MD1-Q-C-FG

OIL ANALYSIS

Anticipate complications and avoid downtime by using Tuthill's Oil Sampling Program that provides a comprehensive laboratory analysis of the physical and chemical characteristics of your oil over a select period of time. The analysis is designed to determine lubricant deterioration, suggest a frequency for lubricant renewal, and detect any mechanical complications prior to disrepair. These benefits can be realized through creation of your own trend analysis over a series of 3-4 samples.

Each oil sample kit contains supplies to collect four different oil samples. The provided packaging material makes sending your oil sample to the laboratory easy. You will receive timely results which will enable you to make prompt maintenance decisions regarding your equipment and oil. Purchase your Tuthill oil analysis kit by ordering part number 19266.

If you have any questions or concerns regarding your analysis, you may contact us at:

tvbsinquiries@tuthill.com

Tuthill
PUMP YOUR HEART INTO IT

CONTACT US

TUTHILL SPRINGFIELD
4840 W. KEARNEY STREET
SPRINGFIELD, MO 65803
TEL: (800) 825-6937
TVBSINQUIRIES@TUTHILL.COM

MEMBER OF CAGI Compressed Air & Gas Institute

ISO 9001

MADE IN USA

FOR A COMPLETE LISTING OF SALES OFFICES AND LOCAL SALES REPRESENTATIVES VISIT: TUTHILLVACUUMBLOWER.COM

THE HEART IS THE ORIGINAL PUMP

All of us are born with a pump inside – our hearts. At Tuthill, we don't just make pumps, meters, and vacuum systems & blowers, we make an invitation for the original pump – the heart – to come alive.

We've always been a company with heart. From our beginnings as a brick maker, we made the bricks that made Chicago. As the horses hauled clay from the quarry, it was too much for their hearts to bear. So Tuthill created an oil pump to power a truck, an innovation that saved horses and led to our first manufactured pump – made from the heart.

Today, we pump our hearts into everything we do: every cut, drill, and cycle, and everything we bring to you. We invite you to join us and find what makes your heart beat a little faster. Because when we all come alive, the world comes along. Learn more at tuthill.com

TH-135 12/19

TB Wood's Incorporated

Phone: (888) 829-6637
Fax: (717) 264-6420
Email: mechanical@tbwoods.com
www.tbwoods.com

TB WOOD'S INC. IS NOT LIABLE FOR DESIGN OR PRICING ERRORS.

Prepared By:	Jeff HAMMOND	**Prepared For:**	CALORIS
Company:	JE Gasho	**Company:**	
Address Line 1:	460 W Gay ST	**Address Line 1:**	
Address Line 2:	West Chester PA 19380	**Address Line 2:**	
Address Line 3:		**Address Line 3:**	
Phone:	610-692-5650	**Phone:**	
Email:	jhammond@gasho.org	**Email:**	
Drive Name:	3414	**Date Created:**	12/9/2019 9:01:50 AM **ID:** 251113-1

CAUTION: This solution is calculated exclusively using TB WOOD'S products. Substitution of alternate components and/or material may result in failure.

Bill of Materials

	Description	Part Number	Quantity	Weight (lbs)
DR Sheave	5V12.5X6-F	5V1256	1	54
DN Sheave	5V9.25X6-E	5V9256	1	30
Belt(s)	5VX930	5VX930	6	6.6
DR Bushing	Fx3 3/8	F338	1	10.6
DN Bushing	Ex2 3/8	E238	1	8.1
			10	109

Application Details

	Input	Actual	% Change	Comments
Service Factor	1.50	1.45	-3.3%	
Input Power (HP)	150.0			NEMA Motor Specs. DO Apply (444T)
Design Power (HP)	225.0	217.4	-3.4%	Actual face width is 4.44 in.
				Actual DriveR O.D. is 12.50 in.
DR RPM	1750.0			
DR Shaft (in)	3.375			
Nominal DR torque (in·lb)		5402		
				Actual DriveN O.D. is 9.25 in.
DN RPM	2315.0	2364.9	2.2%	
DN Shaft (in)	2.375			
Nominal DN torque (in·lb)		3998		
Speed Ratio	0.76	0.74	-2.6%	
Belt Speed (FPM)		5727		
Min. Arc of Contact		173.7°		
Center Distance (in)	30	29.37	-2.1%	Center distance adjustments allowances
		28.37	-3.4%	-1.0 adjustment for installation (in)
		30.87	5.1%	+1.5 adjustment for tensioning (in)
Belt Tension (per strand)				Dynamic hubloads generated
Deflection (in)		0.46		
Force (min lbs)		12.96	produces	1923 lbs hubload
Force (max lbs)		19.04	produces	3087 lbs hubload
Sonic Tension				
Minimum Frequency	52.75 Hz			
Maximum Frequency	64.61 Hz			

feedback@tbwoods.com

ALTRA INDUSTRIAL MOTION

Installation & Maintenance of V-Belt Drives

TB Wood's®
Altra Industrial Motion

TB Wood's

TB Wood's is an industry leading designer and manufacturer of mechanical power transmission equipment for industrial control. Our mechanical product lines include: clutch and brake, synchronous and belted variable speed drives; grid, disc, jaw, gear coupling and elastomeric coupling products; sheaves and bushings. Registered trademarks include Sure-Flex Plus®, Dura-Flex®, G-Flex®, and Sure-Grip®.

TB Wood's was founded in 1857 and began as a foundry producing wood burning stoves. Our company's tradition of product innovation started early. TB Wood's entered the power transmission industry at the turn of the century with the introduction of flat belted drives and line shafting.

VISIT US ON THE WEB AT
TBWOODS.COM

Altra Industrial Motion

Altra is a leading global designer and manufacturer of quality power transmission and motion control products utilized on a wide variety of industrial drivetrain applications. Altra clutches and brakes, couplings, gearing and PT component product lines are marketed under the industries most well known manufacturing brands. Each brand is committed to the guiding principles of operational excellence, continuous improvement and customer satisfaction. Highly-engineered Altra solutions are sold in over 70 countries and utilized in a variety of major industrial markets, including food processing, material handling, packaging machinery, mining, energy, automotive, primary metals, turf and garden and many others.

Altra's leading brands include **Ameridrives**, **Bauer** Gear Motor, **Bibby** Turboflex, **Boston** Gear, **Delroyd** Worm Gear, **Formsprag** Clutch, **Guardian** Couplings, **Huco**, **Industrial** Clutch, **Inertia** Dynamics, **Kilian**, **Lamiflex** Couplings, **Marland** Clutch, **Matrix**, **Nuttall** Gear, **Stieber**, **Stromag**, **Svendborg** Brakes, **TB Wood's**, **Twiflex**, **Warner** Electric, **Warner** Linear and **Wichita** Clutch.

VISIT US ON THE WEB AT **ALTRAMOTION.COM**

Contents

The V-Belt Drive is industry's most popular means of power transmission. It is easy to select, simple to install, and will provide years of reliable performance. Even when misapplied, improperly installed or completely ignored, the V-Belt Drive will usually deliver some kind of performance. However, with proper installation and maintenance, many years of operating efficiency can be added to the life span of the V-Belt Drive. It is hoped that the information contained herein will help you receive the greatest possible value from your V-Belts and Sheaves, and will help you receive a full measure of performance from industry's dominant drive.

Inspection and Maintenance

V-Drive Inspection and Maintenance Procedures

Well designed and properly installed V-belt drives are without question the most reliable, trouble free means of power transmission available In general, except for an occasional retensioning, they will run year in and year out without maintenance.

However, some do require periodic inspection and maintenance, both while the drive is running and while it is stationary.

Inspection while running
A noisy V-belt drive is like a person with a fever. Both need attention.

V-drive noise can be caused by the slapping of belts against the drive guard or other obstruction. Check for an improperly installed guard, loose belts or excessive vibration. Squealing of belts as a drive is started or while it is running is usually caused by a poorly tensioned drive and/or by a build-up of foreign material in the sheave grooves. But it can also be caused by oil or grease between the belt and the sheave groove.

If necessary, remove the belt guard and watch the drive while it is running under load. **(Caution: Observe only; stand clear of the running drive!)** Much can be learned by watching the action of the slack side of the drive. Each variation in the driven load causes a corresponding change in the tension of the slack side of the belt. During across-the-line starts or suddenly applied loads while running, the sag on the slack side of the drive will increase. If the sag under these conditions is excessive, tension should be increased.

Any vibration in a system will cause the slack side of the belts to dance up and down. Excessive vibration will also induce a vibration in the tight side of the drive. The cause of the vibration should be determined and corrected.

If a set of belts is perfectly matched, all belts will have the same amount of sag. However, perfection is a rare thing and there will usually exist some difference in sag from belt to belt. It is more important to look at the tight side of the drive to be sure that all of the belts are running tight. If one or more belts are running loose, the drive needs to be retensioned, or the belts replaced with a matched set.

The above conditions could also be caused by uneven wear of the grooves in the sheave. These should be checked with sheave groove gages.

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 and should be avoided as much as possible. If sheave sidewalls are permitted to "dish out," as shown in the picture on page 3, the bottom "shoulder" ruins belts quickly by chewing off their bottom corners. Also, the belt's wedging action is reduced and it loses its gripping power.

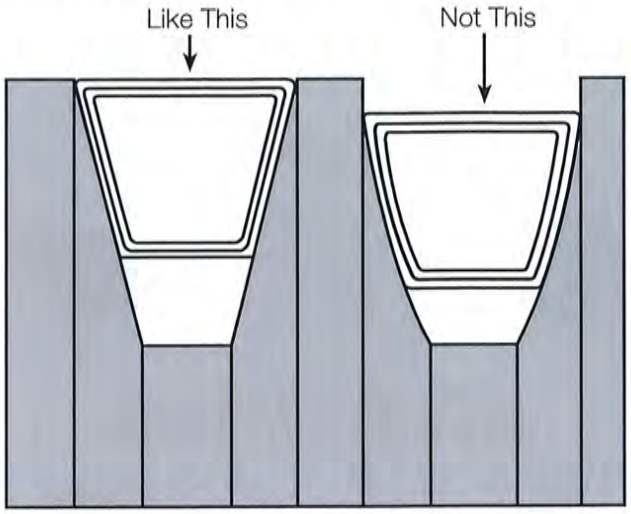
A shiny groove bottom indicates that either the sheave, the belt or both are badly worn and the belt is bottoming in the groove.

Badly worn grooves cause one or more belts to ride lower than the rest of the belts, and 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.

Check alignment of drive. Sheaves that are not aligned properly cause excessive belt and sheave wear. When the shafts are not parallel, belts on one side are drawn tighter and pull more than their share of the load. These overloaded belts wear out faster, reducing the service life of the entire set. If the misalignment is between the sheaves themselves, belts will enter and leave the groove at an angle, causing excessive cover and sheave wear and premature failure. See page 11 for complete information on drive alignment.

V-Drive Inspection and Maintenance Procedures

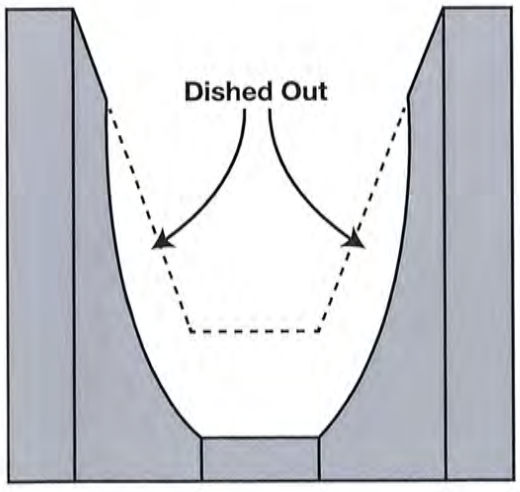
Sheave Grooves must be

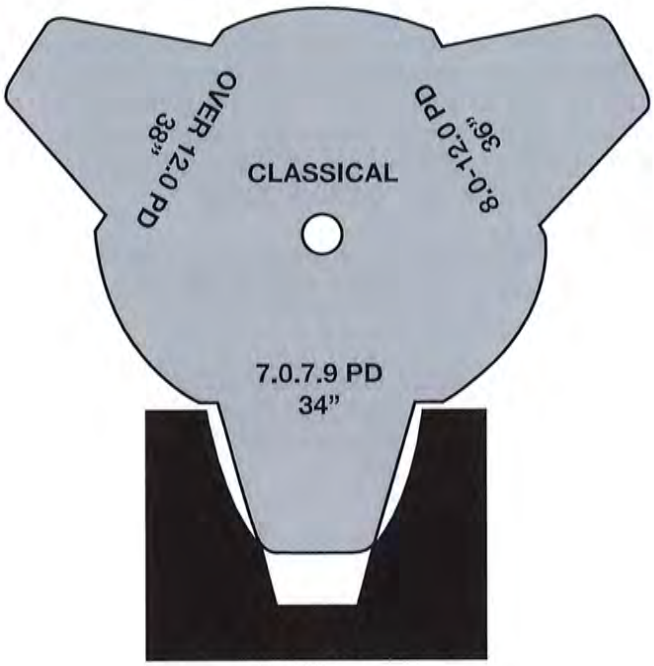


Belts and Sheave Gages
Belts and sheave groove gage sets are available from your TB Wood's distributor.

You can use them to determine the proper belt section by trying the old belt in the various gages until a proper fit is obtained. The cross section of the Classical or Narrow belt can be read from the gage.

To check sheave grooves for wear, simply select the proper gage and template for the sheave diameter; then insert the gage in the groove until the rim of the gage butts against the outside diameter of the sheave flange. Worn grooves will show up as illustrated below. If more than 1/32 inch of wear can be seen, poor V-belt life may be expected.





Groove Gage

Check Belt Fit
Classical V-belts should ride in standard sheave grooves so that the top surface of the belt is just above the highest point of the sheave. In A-B combination grooves, an A section belt will ride slightly low in the groove, while a B belt will be in the normal position. In special deep groove sheaves, belts will ride below the top of the sheave.

Narrow belts are purposely designed so that the top of the belt will ride above the O.D. of the sheave. The tensile cords are located in the belt so that they ride almost at the O.D. of the sheave. This simplifies sheave identification and drive calculations.

No matter which V-belt section the sheave is grooved for, the belts should never be allowed to bottom in the groove. This will cause the belt to lose it wedging action, to slip and/or burn. Sheaves worn to the point where they allow a belt to bottom should be replaced immediately.

Inspection and Maintenance

V-Drive Inspection and Maintenance Procedures

Keep Belts Clean
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.

Although all TB Wood's V-belts are of oil resistant construction, an occasional cleaning will help to prolong their life.

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.

Use Belt Guards
Belt guards protect personnel and the drive itself. They should definitely be used in abrasive atmospheres to protect the drive from sand, metal chips and other foreign matter. But they should be ventilated to avoid excessive heat.

Check them periodically for damage and for loose or missing mounting bolts. These could cause the belts to come in contact with the guard and cause failure.

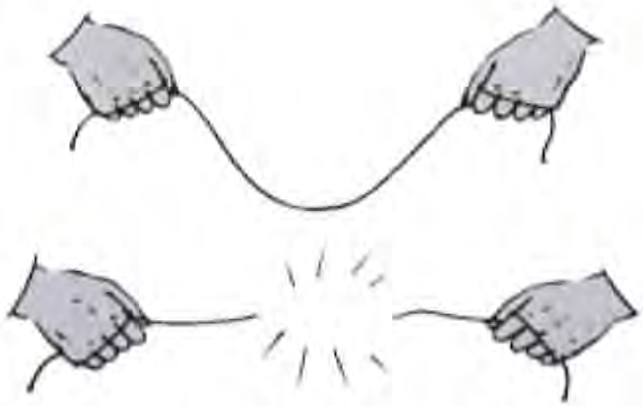
Guards alone will generally protect belts from abrasion. But where abrasive materials are common — in rock processing machinery, grinders, foundries, etc. — drives should be inspected frequently for excessive belt and groove wear.

Check your Hot Bearings
When the drive has been stopped for inspection, check the bearings to make sure they are not running hot. If they are, it could be due to improper lubrication or improper drive tension. Hot bearings can be caused by belts that are either too tight or too loose. Check the tension carefully using the instructions furnished.

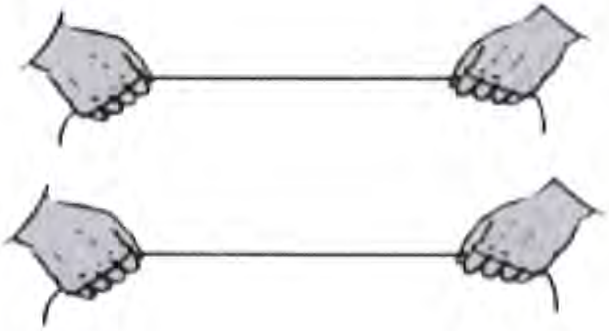
If the belts are slipping on your drive, retension the drive. Never use belt dressing to correct slipping belts.

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 start or when peak loads occur. That snapping action can actually break the belts, because the added stress is more than the belt was designed to take. This can be clearly demonstrated with a piece of string, as illustrated.



Loosley-held string snaps easily, taut string can stand a strong pull.



Selecting the Correct Belts

Selecting the Correct Belts

All the work and experience that goes into designing a V-belt drive is wasted if the specified belts are not used or the number of belts is changed. Over-belting is wasteful. Under-belting is even more expensive in the long run, because overloaded belts wear out faster.

V-belts are identified for size according to industry standards. A combination of letters and numbers indicates the width across the top of the belt (often referred to as "cross section") and the belt length. Classical belts come in five widths: A, B, C, D, and E; while Narrow belts are made in three widths: 3V, 5V, and 8V. In addition, there are the Light Duty 2L, 3L, 4L, and 5L belts. If you are not sure which to use, measure the top width of the old belts carefully, or use TB Wood's gages described previously.

Be careful in measuring V-belts. The top widths of the B and 5V belts are very close; however, the 5V is considerably thicker, and the groove angles of the sheaves are different. Do not attempt to use these belts interchangeably. The 4L and 5L Light Duty belts are also very close in size to the A and B belts. But again, groove angles may be different. Light Duty belts should not be used on heavy-duty drives.

The belt number C270 indicates a belt with a nominal 7/8" top width and a nominal length of 270". Its pitch length is 270.9". These should be ordered as: CP270 Classical belts.

The number 5VX1250 indicates a narrow belt with a nominal 5/8" top width and an effective outside length of 125". These belts should be ordered as follows: 5VX1250 Narrow belts. (The "X" identifies cogged construction belts.)

The number 4L550 indicates a Light Duty fractional horsepower belt having a nominal top width of 1/2" and a nominal outside length of 55". Light Duty belts are available for general purpose applications; specify 4L550 Light Duty. It is designed to have little or no stretch and will require few take-ups during its life.

To assure maximum V-belt life, follow the minimum recommended pitch and sheave diameters for belts established by Mechanical Power Transmission Association and Association of Rubber Products Manufacturers standards.

Belt Selection

Classical Belt Selection	Minimum* Pitch Diameter
A	3.0"
AX	2.2"
B	5.4"
BX	4.0"
C	9.0"
CX	6.8"
D	13.0"

*Not applicable to Light Duty Belts

Narrow Belt Selection	Minimum Sheave Diameter
3V	2.65"
3VX	2.2"
5V	7.1"
5VX	4.4"
8V	12.5"

All Belts "ORS"

At one time it was necessary to order special belts for various types of environments. All TB Wood's belts are of "ORS" construction, meaning they are heat resistant, oil resistant and static conducting.

By heat resistant, we mean these belts will operate well in ambient temperatures up to 140°F. They may be operated at higher temperatures, but there would be a reduction in service life. In general, short belts develop higher internal temperatures than long belts. They are usually subjected to more flexures per minute and are frequently found on totally-enclosed drives where there is little or no air circulation.

Oil resistance is a matter of degree. It varies with the amount of contact with oil, whether it is continuous or intermittent immersion, exposure to an atmospheric mist or an occasional spattering. A great many chemicals, particularly petroleum derivatives, can cause deterioration. All Narrow, Classical and Light Duty belts will withstand nominal exposure to oil and grease, but they are not 100% oilproof.

For maximum performance from belts in oily atmospheres, they should be guarded as much as practical against excessive amounts of oil and should be periodically cleaned with methyl chloroform. Oil and grease on belts and sheaves will tend to lubricate the drive and reduce the traction of the belt, even though they may not actually harm the belts themselves. However, since the friction factor is reduced, belts must be operated at abnormal tensions, and their life is shortened.

Belt failure caused by oil is obvious and easy to detect. The most apparent sign is the build-up of a black, soft substance that can be wiped off when the belt is rubbed. Another sign is a softening and swelling of the belt to the point where it no longer fits the sheave groove properly.

Like oil resistance, resistance to ozone is a matter of degree. Narrow, Classical and Light Duty belts are resistant to normal amounts of ozone in the atmosphere. However, high concentrations such as found around arc welding equipment can cause rubber to harden and crack. It is because of ozone that belts should never be stored in direct sunlight.

Belts intended for operation in potentially dangerous atmospheres are constructed with a relatively low electrical resistance characteristic and referred to as "static conducting". All Narrow, Classical and Light Duty belts meet the following requirements.

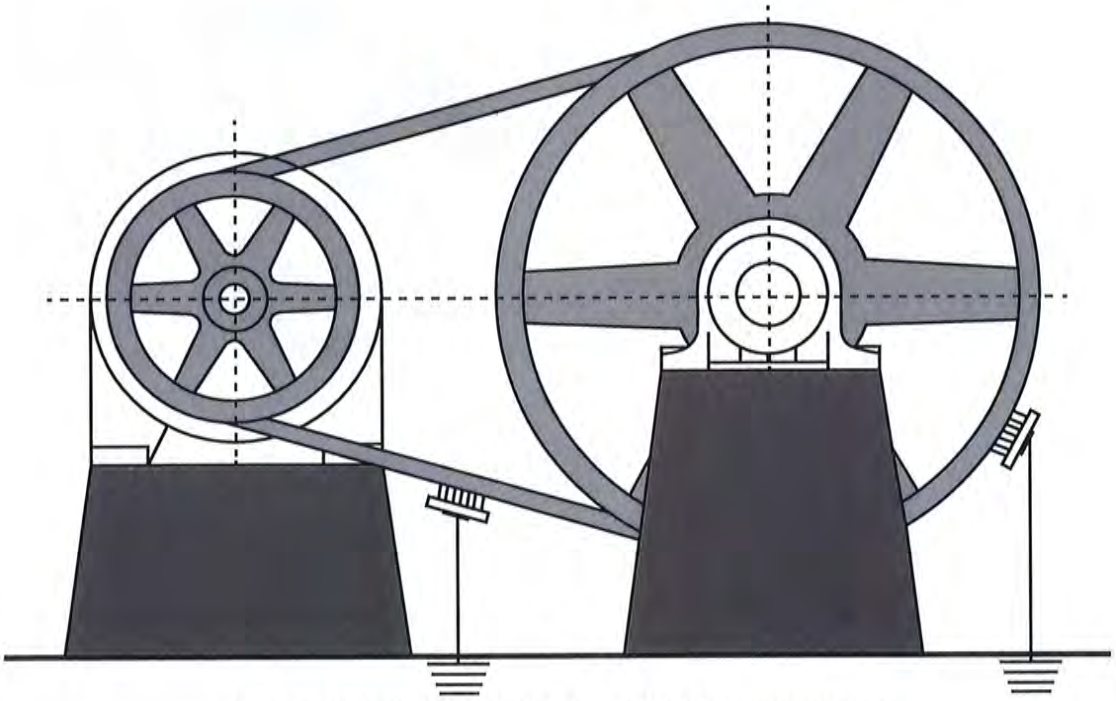
In the standard method of measuring a belt's electrical resistivity, two 5/8" diameter flat contacts are placed 8-1/2" apart on centers, moistened with water and pressed against the belt with a force of 12-1/2 lbs. The resistance "conductivity" between the contacts is measured with an ohmmeter operating at a potential of 500 volts and having an accuracy range from 0 to 10 megohms. Experience has demonstrated that the dissipation provided by belts having a resistance of 6 megohms or less "when new and measured as above" is satisfactory for operation in hazardous atmospheres.

Explosive Atmospheres
Belts on drives in hazardous atmospheres should be kept reasonably free of encrusted accumulations of non conducting materials. In addition, all elements of the drive must be interconnected and grounded to earth as illustrated below.

Although we know of no explosion caused by static generated by a V-belt drive, we cannot accept responsibility beyond that of furnishing belts within the above described limits.

Store Belts Properly
V-belts should be stored in a cool, dry place out of direct sunlight. They should be kept away from ozone producing equipment such as arc welders and high voltage apparatus. Temperature should be below 85°F, relative humidity below 70%. If belts are stored in piles, the piles should be kept small to avoid excessive weight which could distort the bottom belts. When belts are stored in boxes, the box size should be limited. Ideally, belts should be hung on saddle type pegs. With proper storage, belt quality will not change significantly within eight years.

Assuming good storage practices, a decrease in service life of approximately 10% per year of storage beyond eight years can be expected. From a norm of eight years storage life at 85°, it is estimated that the storage limit should be reduced by half for each 15° increase in temperature. A significant increase in humidity may cause a fungus to form on belts, but any effect on the performance on the belt would be very slight.



Proper V-drive installation in explosive atmospheres

Safety Tips

No matter where rotating machines are located or by what means they are driven, there is always a chance of personal injury unless they are installed and operated under safe conditions. It is with this thought uppermost in our minds that this manual is written.

Guard all Drives Properly

All regulating agencies such as OSHA, State Departments of Labor and Industry, insurance firms and other safety authorities either recommend or insist on drive guards. We, also, strongly recommend that every V-belt drive be completely guarded. Do not be lulled into a sense of security by a temporary or makeshift guard.

Of course, provision can and should be made for proper ventilation and inspection by the use of grills, inspection doors and removable panels. But the guard should have no gap where workers can reach inside and become caught in the drive. Besides being a safety asset, a good guard helps make maintenance easier by protecting the drive from weather and foreign objects.

Check Safe Speed Limits

Safe speed limits for sheaves manufactured by TB Wood's Incorporated have been established by a rigorous burst testing program. The limit for cast iron sheaves has been established at 6500 fpm; the maximum speed in rpm corresponding to 6500 fpm is either cast or stamped on each sheave.

Before installing the drive, this safe speed limit should be checked against the speed of the shaft on which it is being installed. Operating sheaves above recommended speeds could result in serious damage to equipment and/or serious personal injury.

Safe speed is cast into the arm of TB Wood's sheaves.

Burst testing. Results of centrifugal force are clearly shown in these broken "D"-groove sheaves. The pattern of breakage is typical. The rim breaks away from the arms, arms break from hub and the hub shatters through its bolt holes. With the force in several hundred thousand pounds, it all happens in a split second.

Sure-Grip® Sheaves and Brushing Installation Instructions

TB Wood's Sure-Grip bushings are the most widely used, tapered, QD-type and have exceptional holding power that eliminates wobble. Standard and reverse mounting features provide greater adaptability. Sure-Grip bushings can be used interchangeably in many of TB Wood's products as well as those of other manufacturers.

To Install:

IMPORTANT: DO NOT USE LUBRICANTS IN THIS INSTALLATION

Before beginning, make sure the correct size and quantity of parts are available for the installation. The bushing has been manufactured to accept a setscrew over the key and its use is optional. It is packaged with the hardware on sizes SH to M and loosely installed in the bushing on sizes N to S.

1. Inspect the tapered bore of the sheave and the tapered surface of the bushing. Any paint, dirt, oil or grease MUST be removed.

2. Select the type of mounting (See Fig. 1 or 2) that best suits your application.

3. STANDARD MOUNTING: Install shaft key. (Note: If key was furnished with bushing, you must use that key.) Install bushing on clean shaft, flange end first. If bushing will not freely slide on the shaft, insert a screwdriver or similar object into the flange sawcut to act as a wedge to open the bushing's bore. **Caution: Excessive wedging will split the bushing**. If using the setscrew, tighten it just enough to prevent the bushing from sliding on the shaft. **Caution: Do not over tighten setscrew!** Slide sheave into position on bushing aligning the drilled holes in the sheave with the tapped holes in the bushing flange. (Note: Install M thru S bushings so that the two tapped holes in the sheave are located as far away as possible from the bushing's sawcut.) Loosely thread the capscrews with lockwashers into the assembly.

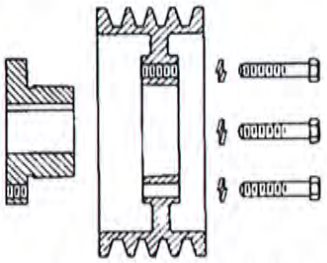
   DO NOT USE LUBRICANT ON THE CAPSCREWS!

4. REVERSE MOUNTING: With large end of the taper out, slide sheave onto shaft as far as possible. Install shaft key. (See shaft key note in #3 above.) Install bushing onto shaft so tapered end will mate with sheave. (See wedging note in #3 above.) If using the setscrew, tighten it enough to prevent the bushing from sliding on the shaft. **Caution: Do not over tighten setscrew!** Pull the sheave up on the bushing, aligning the drilled holes in the bushing flange with the tapped holes in the sheave. Loosely thread the capscrews with lockwashers into the assembly.

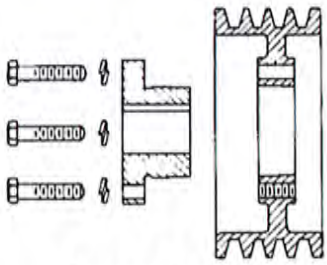
   DO NOT USE LUBRICANT ON THE CAPSCREWS!

5. Using a torque wrench, tighten all capscrews evenly and progressively in rotation to the torque value in Table. There must be a gap between the bushing flange and sheave hub when installation is complete.

   DO NOT OVER TORQUE! DO NOT ATTEMPT TO CLOSE GAP BETWEEN BUSHING FLANGE AND SHEAVE HUB!



Standard Mounting
Fig. 1



Reverse Mounting
Fig. 2

Drive Installation

To Remove:

1. Relieve drive tension by shortening the center distance between driver and driven sheaves.

2. Lift off belts.

3. Loosen and remove cap screws. If the bushings have keyway setscrews, loosen them.

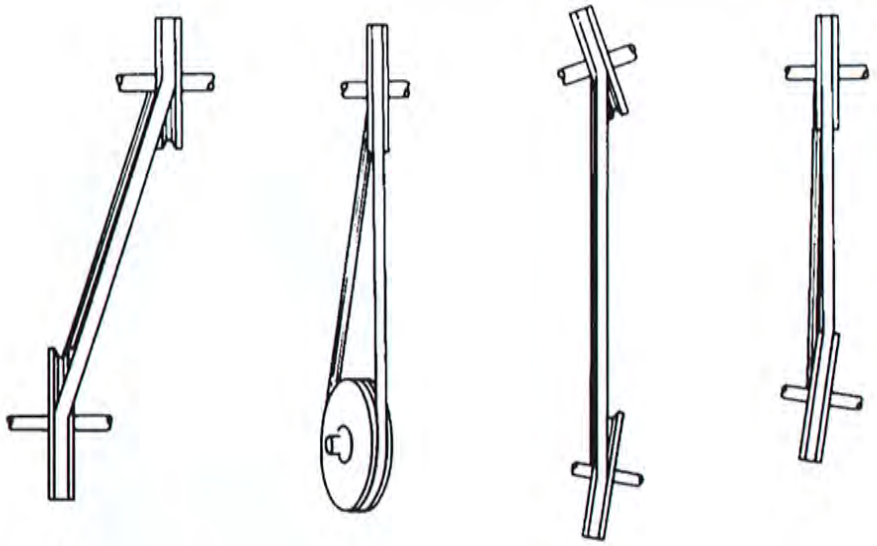
4. As shown below, insert cap screws (three in JA through J bushings, two in QT and M thru W bushings and four in S bushing) in tapped removal holes and progressively tighten each one until mating part is loose on bushing. (Exception: If mating part is installed with cap screws heads next to motor, with insufficient room to insert screws in tapped holes, loosen cap screws and use wedge between bushing flange and mating part.)

5. Remove mating part from bushing, and if necessary, bushing from shaft.

Sure-Grip Bushing Screw Tightening Information

Tapered Bushing	Size & Thread of Cap Screw	Ft.-Lbs. To Apply with Torque Wrench
QT	1/4 - 20	9
JA	No. 10 - 24	5
SH-SDS-SD	1/4 - 20	9
SK	5/16 - 18	15
SF	3/8 - 16	30
E	1/2 - 13	60
F	9/16 - 12	110
J	5/8 - 11	135
M	3/4 - 10	225
N	7/8 - 9	300
P	1 - 8	450
W	1 1/8 - 7	600
S	1 1/4 - 7	750

CAUTION: The tightening force on the screws is multiplied many times by the wedging action of the tapered surface. If extreme tightening force is applied, or if a lubricant is used, bursting pressures will be created in the hub of the mating part.



Check Alignment

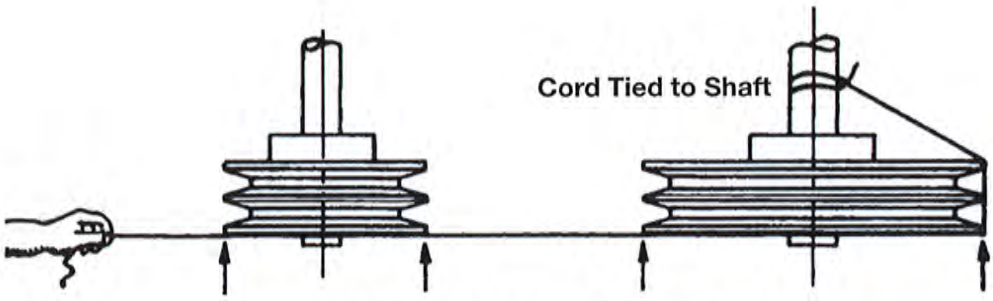
Although alignment is not as critical in V-belt drives as in others, proper alignment is essential to long belt and sheave life.

First, make sure that drive shafts are parallel. The most common causes of misalignment are non-parallel shafts and improperly located sheaves. Where shafts are not parallel, belts on one side are drawn tighter and pull more than their share of the load. As a result, these belts wear out faster, requiring the entire set to be replaced before it has given maximum service. If misalignment is in the sheave, belts will enter and leave the grooves at an angle, causing excessive belt cover and sheave wear.

Shaft alignment can be checked by measuring the distance between the shafts at three or more locations. If the distances are equal, then the shafts will be parallel.

To check the location of the sheaves on the shafts, a straightedge or a piece of string can be used. If the sheaves are properly lined up, the string will touch them at the points indicated by the arrows in the accompanying sketch. Rotating each sheave a half revolution will determine whether the sheave is wobbly or the drive shaft is bent. Correct any misalignment.

With sheaves aligned, tighten cap screws evenly and progressively. Apply the recommended torque to cap screws as listed in table on page 10. NOTE: There should be 1/8" to 1/4" gap between the mating part hub and the bushing flange. If the gap is closed, the shaft is seriously undersize.



Cord Touching Sheaves at Points Indicated by Arrows

Drive Installation

Install Belts

Shorten the center distance between the driven and the driver sheave so the belts can be put on without the use of force.

While the belts are still loose on the drive, rotate the drive until all the slack is on one side. Then increase the center distance until the belts are snug. The drive is now ready for tensioning.

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. Moreover, it is both difficult and unsafe to install belts this way.

Keep takeup rails, motor base or other means of center distance adjustment free of dirt, rust and grit. Lubricate adjusting screws and slide rails from time to time.

No!

When belts are forced into the sheave with a screwdriver or other wedge, the outer fabric is often ruptured and cords broken.

Yes!

It is well worth the time to move the driver unit forward so V-belts can be slipped easily into the sheave groove without damage.

Center Distance Allowance for Installation and Take-Up (Inches)

Narrow Belt

Belt Length	For Installation (Subtract)						For Take-Up (Add)
	3VX & 3V	3V Banded	5VX & 5V	5V Banded	8VX & 8V	8V Banded	All Cross Sections
250 thru 475	0.5	1.2	-	-	-	-	1.0
500 thru 710	0.8	1.4	1.0	-	2.1	-	1.2
750 thru 1060	0.8	1.4	1.0	1.5	2.1	3.4	1.5
1120 thru 1250	0.8	1.4	1.0	1.5	2.1	3.4	1.8
1320 thru 1700	0.8	1.4	1.0	1.5	2.1	3.4	2.2
1800 thru 20000	-	-	1.0	1.8	2.1	3.6	2.5
2120 thru 2360	-	-	1.2	1.8	2.4	3.6	3.0
2500 thru 2650	-	-	1.2	1.8	2.4	3.6	3.2
2800 thru 3000	-	-	1.2	1.8	2.4	3.6	3.5
3150 thru 3550	-	-	1.2	2.0	2.4	4.0	4.0
3750	-	-	-	2.0	-	4.0	4.5
4000 thru 5000	-	-	-	2.0	-	4.0	5.5

Classical Belts

Belt Length Designation	For Installation (Subtract)							For Take-Up (Add)
	AX & AP	BX & BP	BX & BP Banded	CX & CP	CX & CP Banded	DX & DP	DX & DP Banded	All Cross Sections
21 thru 35	0.8	1.0	1.5	-	-	-	-	1.0
36 thru 55	0.8	1.0	1.5	1.5	2.0	-	-	1.5
56 thru 85	0.8	1.2	1.6	1.5	2.0	-	-	2.0
86 thru 112	1.0	1.2	1.6	1.5	2.0	-	-	2.5
116 thru 144	1.0	1.3	1.8	1.5	2.1	2.0	2.9	3.0
148 thru 180	-	1.3	1.8	2.0	2.2	2.0	3.0	3.5
191 thru 210	-	1.5	1.9	2.0	2.3	2.0	3.2	4.0
225 thru 240	-	1.5	2.0	2.0	2.5	2.5	3.2	4.5
255 thru 300	-	1.5	2.2	2.0	2.5	2.5	3.5	5.0
315 thru 390	-	-	-	2.0	2.7	2.5	3.6	6.0
420 and Over	-	-	-	2.5	2.9	3.0	4.1	1.5% of belt length

Tensioning V-Belt Drives

Without exception, the most important factor in the successful operation of a V-belt drive is proper belt-tensioning. To achieve the long, trouble free service associated with V-belt drives, belt tension must be sufficient to overcome slipping under maximum peak load. This could be either at start or during the work cycle. The amount of peak load will vary depending upon the character of the driven machine or drive system. To increase total tension, merely increase the center distance. Before attempting to tension any drive it is imperative that the sheaves be properly installed and aligned. If a V-belt slips it is too loose. Add to the tension by increasing the center distance. Never apply belt dressing as this will damage the belt and cause early failure.

General Method

The general method for tensioning V-belts should satisfy most drive requirements.

Step 1: Reduce the center distance so that the belts may be placed over the sheaves and in the grooves without forcing them over the sides of the grooves. Arrange the belts so that both the top and bottom spans have about the same sag. Apply tension to the belts by increasing the center distance until the belts are snug. See figure 1.

Step 2: Operate the drive a few minutes to seat the belts in the sheave grooves. Observe the operation of the drive under its highest load condition (usually starting). A slight bowing of the slack side of the drive indicates proper tension. If the slack side remains taut during the peak load, the drive is too tight. Excessive bowing or slippage indicates insufficient tension. If the belts squeal as the motor comes on or at some subsequent peak load, they are not tight enough to deliver the torque demanded by the drive machine. The drive should be stopped and the belts tightened.

Step 3: Check the tension on a new drive frequently during the first day by observing the slack side span. After a few days of operation the belts will seat themselves in the sheave grooves and it may become necessary to readjust so that the drive again shows a slight bow in the slack.

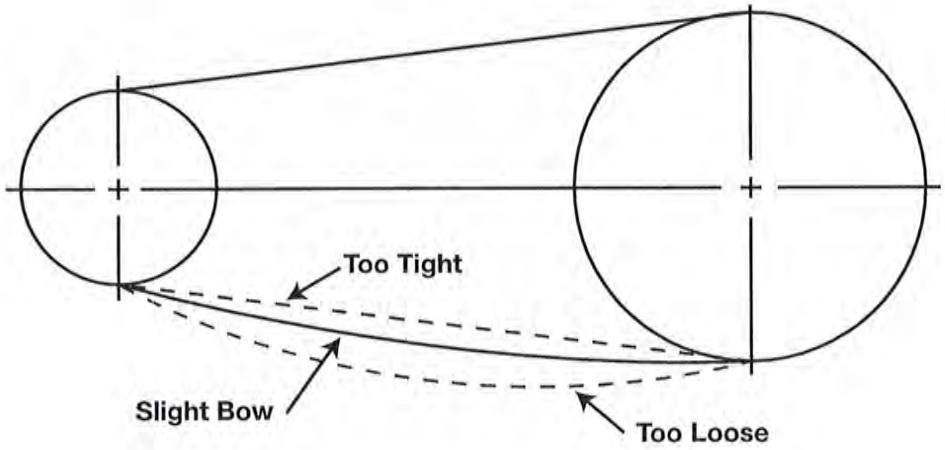


Figure 1

Tensioning the Drive

Force Deflection Method

This method should be used only for tensioning drives on which the grade of belt, rated belt capacity, service factor, design horsepower, etc. are known.

Step 1: Install belts per Step 1 of General Method. Measure span length (t) in inches as shown in figure 2, or calculate using formula.

Step 2: From figure 2 the deflection height (h) is always 1/64" per inch of span length (t). For example, a 32" span length would require a deflection of 32/64" or 1/2".

Step 3: Determine the minimum, maximum, and initial recommended pounds force using table 1 or calculate based on the required Static Strand Tension (Ts). Note: The initial recommended force is used only for installing new belts which have not seated themselves into the sheave grooves and where initial belt stretch has not taken place.

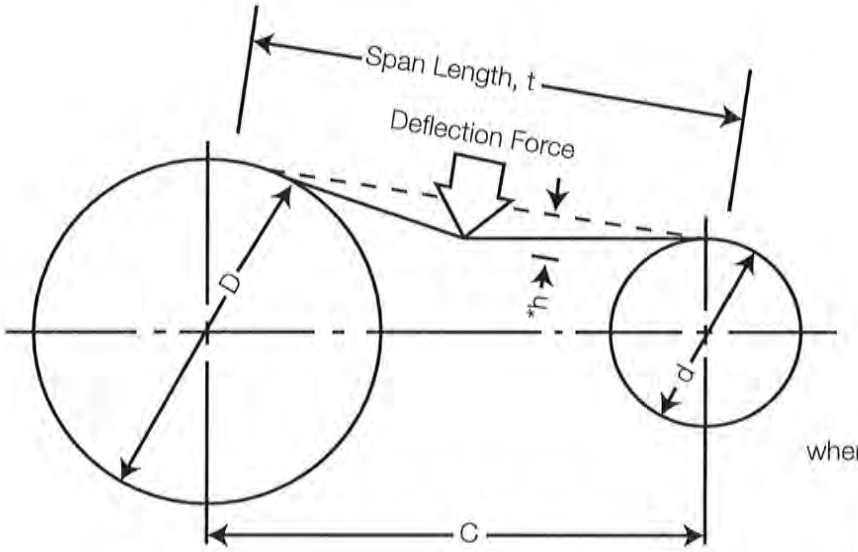
Step 4: Using a spring scale, apply a perpendicular force to any ONE of the belts at the mid point of the span as shown in figure 2. Compare this deflection force with the values found in Step 3.

a. If the deflection force is below the minimum, the belts are too loose and the tension should be increased by increasing the center distance.

b. If the deflection force is higher than the maximum, the belts are too tight and the tension should be decreased.

When new V-belts are installed on a drive the INITIAL tension will drop rapidly during the first few hours. Check tension frequently during the first 24 hours of operation. Subsequent retensioning should fall between the minimum and maximum force.

To determine the deflection distance from normal position, use a straightedge or stretch a cord from sheave to sheave to use as a reference line. On multiple-belt drives an adjacent undeflected belt can be used as a reference.



* Deflection height
h = 1/64" per inch of span

$$t = \sqrt{C^2 - \left(\frac{D - d}{2}\right)^2}$$

$$h = \frac{t}{64}$$

where t = Span length, inches
C = Center Distance, inches
D = Larger sheave diameter, inches
d = Smaller sheave diameter, inches

Figure 2

Table 1
Recommended Minimum Force per Belt

Belt Selection	Small Sheave		Drive Ratio			
	Speed Range	Dia.	1.0	1.5	2.0	4.0 & Over
3V	1200-3600	2.65	2.0	2.4	2.6	3.0
	1200-3600	3.65	2.8	3.6	3.8	4.2
	1200-3600	4.75	3.8	4.2	4.4	4.8
	1200-3600	5.60	4.2	4.6	4.8	5.4
	1200-3600	6.90	4.6	5.0	5.2	5.6
5V	900-1800	7.1	8.5	9.5	10.0	11.0
	900-1800	9.0	10.0	11.0	12.0	13.0
	900-1800	14.0	12.0	13.0	14.0	15.0
	700-1200	21.2	14.0	15.0	16.0	17.0
8V	900-1800	12.5	18.0	21.0	23.0	25.0
	900-1800	14.0	21.0	23.0	24.0	28.0
	700-1500	17.0	24.0	26.0	28.0	30.0
	700-1200	21.2	28.0	30.0	32.0	34.0
	400-1000	24.8	31.0	32.0	34.0	36.0
3VX	1200-3600	2.20	2.2	2.5	2.7	3.0
	1200-3600	2.50	2.6	2.9	3.1	3.6
	1200-3600	3.00	3.1	3.5	3.7	4.2
	1200-3600	4.12	3.9	4.3	4.5	5.1
	1200-3600	5.30	4.6	4.9	5.1	5.7
	1200-3600	6.9	5.0	5.4	5.6	6.2
5VX	1200-3600	4.4	6.5	7.6	8.0	9.0
	1200-3600	5.2	8.0	9.0	9.5	10.0
	1200-3600	6.3	9.5	10.0	11.0	12.0
	1200-3600	7.1	10.0	11.0	12.0	13.0
	900-1800	9.0	12.0	13.0	14.0	15.0
	900-1800	14.0	14.0	15.0	16.0	17.0
AP	1800-3600	3.0	2.0	2.3	2.4	2.6
	1800-3600	4.0	2.6	2.8	3.0	3.3
	1800-3600	5.0	3.0	3.3	3.4	3.7
	1800-3600	7.0	3.5	3.7	3.8	4.3
BP	1200-1800	4.6	3.7	4.3	4.5	5.0
	1200-1800	5.0	4.1	4.6	4.8	5.6
	1200-1800	6.0	4.8	5.3	5.5	6.3
	1200-1800	8.0	5.7	6.2	6.4	7.2
CP	900-1800	7.0	6.5	7.0	8.0	9.0
	900-1800	9.0	8.0	9.0	10.0	11.0
	900-1800	12.0	10.0	11.0	12.0	13.0
	700-1500	16.0	12.0	13.0	13.0	14.0
DP	900-1500	12.0	13.0	15.0	16.0	17.0
	900-1500	15.0	16.0	18.0	19.0	21.0
	700-1200	18.0	19.0	21.0	22.0	24.0
	700-1200	22.0	22.0	23.0	24.0	26.0
AX	1800-3600	3.0	2.5	2.8	3.0	3.3
	1800-3600	4.0	3.3	3.6	3.8	4.2
	1800-3600	5.0	3.7	4.1	4.3	4.6
	1800-3600	7.0	4.3	4.6	4.8	5.3
BX	1200-1800	4.6	5.2	5.8	6.0	6.9
	1200-1800	5.0	5.4	6.0	6.3	7.1
	1200-1800	6.0	6.0	6.4	6.7	7.7
	1200-1800	8.0	6.6	7.1	7.5	8.2
CX	900-1800	7.0	10.0	11.0	12.0	13.0
	900-1800	9.0	11.0	12.0	13.0	14.0
	900-1800	12.0	12.0	13.0	13.0	14.0
	700-1500	16.0	13.0	14.0	14.0	15.0
DX	900-1500	12.0	16.0	18.0	19.0	20.0
	900-1500	15.0	19.0	21.0	22.0	24.0
	700-1200	18.0	22.0	24.0	25.0	27.0
	700-1200	22.0	25.0	27.0	28.0	30.0

MAXIMUM Deflection Force = Minimum times 1.5
INITIAL Deflection Force = Minimum time 2.0

Belt Elongation Method

Minimum deflection force values shown in Table 1 are based on assumed average static tensions for drives having multiple belts or more than one V-band, thus eliminating calculations. (For drives using only one belt or one V-band, deflection force must be determined by use of engineering formulas.)

Find the minimum recommended deflection force for the belt section and type based upon the small sheave diameter, speed and drive ratio. For intermediate sheave diameters and/or drive ratio combinations the minimum deflection force may be interpolated.

For Narrow Band, Classical Band and Classical Cog Band belts multiply the minimum deflection force from Table 1 by the number of belts in the band. Where larger values make use of the Force Deflection Method impractical, use the Elongation Method to tension V-bands.

Table 2
K Factors and Arc of Contact

D-d / C	Arc Contact Degree	Factor Ac	Factor K	D-d / C	Arc Contact Degree	Factor Ac	Factor K
0.000	180	1.000	24.750	0.750	136	0.879	30.411
0.025	179	0.997	24.883	0.775	134	0.874	30.388
0.050	177	0.994	25.019	0.800	133	0.869	30.975
0.075	176	0.990	25.158	0.825	131	0.864	31.270
0.100	174	0.987	25.300	0.850	130	0.858	31.576
0.125	173	0.983	25.444	0.875	128	0.852	31.892
0.150	171	0.980	25.591	0.900	127	0.847	32.219
0.175	170	0.977	25.742	0.925	125	0.841	32.558
0.200	169	0.973	25.896	0.950	123	0.835	32.909
0.225	167	0.969	26.053	0.975	122	0.829	33.273
0.250	166	0.966	26.213	1.000	120	0.823	33.652
0.275	164	0.962	26.377	1.025	118	0.816	34.045
0.300	163	0.958	26.545	1.050	117	0.810	34.454
0.325	161	0.954	26.717	1.075	115	0.803	34.879
0.350	160	0.951	26.892	1.100	113	0.796	35.323
0.375	158	0.947	27.072	1.125	112	0.789	35.786
0.400	157	0.943	27.257	1.150	110	0.782	36.270
0.425	155	0.939	27.445	1.175	108	0.774	36.777
0.450	154	0.935	27.639	1.200	106	0.767	37.307
0.475	153	0.930	27.837	1.225	104	0.759	37.864
0.500	151	0.926	28.040	1.250	103	0.751	38.448
0.525	150	0.922	28.249	1.275	101	0.742	39.064
0.550	148	0.917	28.463	1.300	99	0.734	39.713
0.575	147	0.913	28.684	1.325	97	0.725	40.398
0.600	145	0.908	28.910	1.350	95	0.716	41.123
0.625	144	0.904	29.142	1.375	93	0.706	41.892
0.650	142	0.899	29.381	1.400	91	0.697	42.709
0.675	141	0.894	29.627	1.425	89	0.687	43.580
0.700	139	0.889	29.881				
0.725	137	0.884	30.142				

Tensioning the Drive

Force Deflection Engineering Formulas

For a more precise method, or where a V-drive combination is not within specified limits, table 1, use the following engineering formulas to determine force deflection values.

Step 1: Determine Span Length (t) and Deflection Height (h). Reference figure 2.

Step 2: Calculate the Static Strand Tension (Ts).

$$Ts = \frac{K \times DHP}{N \times S} + \frac{MS^2}{2}$$

Step 3: Calculate the recommended Deflection Forces (P) for drives using multiple belts or more than one V-band.

$$P_{Minimum} = \frac{Ts + Y}{16}$$

$$P_{Maximum} = \frac{1.5\,(Ts) + Y}{16}$$

$$P_{Initial} = 1.33 \text{ times } P_{maximum}$$

Note: For drives using only one belt or one V-band, and at least one shaft free to rotate, use the following to determine the recommended Deflection Forces (P).

$$P_{Minimum} = \frac{Ts = Y\,(\frac{t}{L})}{16} \qquad P_{Maximum} = \frac{1.5\,(Ts) + Y\,(\frac{t}{L})}{16} \qquad P_{Initial} = 1.33 \text{ times } P_{maximum}$$

Explanation of Symbols

- Ac = Arc of contact - smaller sheave, degrees
- C = Center Distance, inches
- D = Large sheave pitch diameter, inches
- d = Smaller sheave pitch diameter, inches
- DHP = Design horsepower based upon the recommended application service factor
- h = Deflection height, inches (Refer. figure 2)
- K = Value from table 2 depending on $\frac{D - d}{C}$

  or $K = 16.5 \frac{2.5 - Ac}{Ac}$
- L = Belt length, inches
- M = Centrifugal constant table 3
- N = Number of belts or V-band ribs
- P = Deflection force, pounds
- S = Belt speed, FPM/1000
- t = Span length, inches (Refer. figure 2)
- Y = Belt constant table 3

Table 3
Belt Constants M & Y

Factors	Narrow			Narrow Cog		Classical					Classical Cog			
	3V	4V	8V	3VX	5VX	AP	BP	CP	DP	EP	AX	BX	CX	DX
M Single Belts	.46	1.23	3.28	.39	1.08	.66	1.08	1.98	3.74	5.85	.61	1.00	1.78	3.97
M V-Band	.51	1.32	3.80	-	-	-	1.40	2.33	4.29	6.26	-	1.28	2.10	4.56
Y	4.0	12.00	22.00	7.0	20.0	6.0	9.0	16.0	30.00	45.00	7.0	10.00	28.00	82.00

Belt Elongation Method

This method is recommended for V-band drives where larger deflecting forces make the use of previously described methods impractical.

Elongation is related to the tension causing it; thus, tape measured V-band lengths, both slack and tight, can be used to obtain proper V-band tension.

Step 1: Decrease the center distance until the V-band(s) can be easily slipped into the sheave grooves. Forcing the belts on can damage the load-carrying cords and cause premature belt failure.

Step 2: With the V-band(s) still on the drive at NO tension, measure the outside circumference (slack O.C.) of the bands. Note: If retensioning a used drive, decrease the center distance until there is no tension on the band(s), then measure the outside circumference (slack O.C.) of the band(s).

Step 3: Determine the required Static Tension (Ts) per individual rib strand using the following formula.

$$Ts = \frac{K \times DHP}{N \times S} + \frac{MS^2}{2}$$

Step 4: Find a range of recommended tensions.
Lower Tension = Ts
Upper Tension = 1.5 times Ts

Step 5: Calculate minimum and maximum elongated band lengths for use in tensioning the drive.

a. From table 4, find length multipliers corresponding to the lower and upper Ts values in Step 4 above.

b. Multiply the slack O.C. found in Step 2 by the length multipliers to find the minimum and maximum elongated band lengths.

Step 6: Increase the drive center distance until a tape measurement of the band(s) O.C. is between the two values calculated for elongated band length in Step 5b.

Step 7: Retension as required. New V-bands may lose tension rapidly during the run-in period and will probably require retensioning. V-bands that have been on a drive for some time may also require retensioning due to tension decay from normal use and wear.

Table 4
Length Multipliers for Tensioning Banded Belts

Ts PER Strand (lbs)	Narrow Band					Classical Band					Classical Cog Band		
	Cross Section												
	3V	5V		8V		BP		CP		DP	BX All Sizes	CX All Sizes	DX All Sizes
		5V1700 & Under	5V1800 & Over	8V1700 & Under	8V1800 & Over	BP144 & Under	Over BP144	CP144 & Under	Over CP144				
10	1.00186	1.00056	1.00001	1.00013	1.00010	1.00113	1.00141	1.00029	1.00052	1.00013	1.00082	1.00027	1.00013
12	1.00220	1.00068	1.00097	1.00016	1.00012	1.00135	1.00168	1.00035	1.00062	1.00016	1.00098	1.00032	1.00016
14	1.00254	1.00079	1.00113	1.00019	1.00014	1.00157	1.00194	1.00041	1.00072	1.00019	1.00114	1.00038	1.00019
16	1.00288	1.00090	1.00129	1.00021	1.00016	1.00178	1.00220	1.00046	1.00082	1.00021	1.00129	1.00043	1.00021
18	1.00320	1.00101	1.00144	1.00024	1.00018	1.00199	1.00246	1.00052	1.00092	1.00024	1.00145	1.00048	1.00024
20	1.00352	1.00112	1.00159	1.00027	1.00020	1.00220	1.00271	1.00058	1.00102	1.00027	1.00160	1.00054	1.00027
24	1.00414	1.00133	1.00190	1.00032	1.00024	1.00261	1.00320	1.00069	1.00122	1.00033	1.00191	1.00065	1.00032
28	1.00472	1.00155	1.00219	1.00037	1.00029	1.00301	1.00368	1.00081	1.00141	1.00038	1.00220	1.00075	1.00038
32	1.00520	1.00176	1.00249	1.00043	1.00033	1.00339	1.00414	1.00092	1.00161	1.00044	1.00250	1.00086	1.00043
36	1.00556	1.00197	1.00277	1.00048	1.00037	1.00377	1.00458	1.00104	1.00180	1.00050	1.00278	1.00097	1.00059
40	1.00588	1.00217	1.00305	1.00054	1.00042	1.00413	1.00500	1.00115	1.00199	1.00056	1.00306	1.00107	1.00054
45	1.00625	1.00243	1.00340	1.0060	1.00047	1.00458	1.00529	1.00129	1.00222	1.00063	1.00341	1.00121	1.00061
50	1.00659	1.00268	1.00374	1.00067	1.00053	1.00500	1.00553	1.00144	1.00246	1.00071	1.00374	1.00134	1.00068
55	1.00691	1.00293	1.00406	1.00074	1.00058	1.00528	1.00574	1.00158	1.00268	1.00078	1.00407	1.00147	1.00075
60	1.00722	1.00317	1.00438	1.00081	1.00064	1.00553	1.00591	1.00172	1.00291	1.00086	1.00439	1.00161	1.00081
65	1.00754	1.00341	1.00470	1.00088	1.00070	1.00576	1.00606	1.00186	1.00313	1.00094	1.00470	1.00174	1.00088
70	1.00787	1.00365	1.00500	1.00095	1.00076	1.00596	1.00620	1.00200	1.00335	1.00102	1.00500	1.00187	1.00095
75	1.00822	1.00389	1.00523	1.00101	1.00082	1.00614	1.00632	1.00214	1.00357	1.00110	1.00522	1.00200	1.00102
80	1.00861	1.00412	1.00545	1.00108	1.00088	1.00631	1.00644	1.00228	1.00378	1.00118	1.00543	1.0213	1.00109
85	1.00903	1.00434	1.00566	1.00115	1.00094	1.00646	1.00656	1.00242	1.00399	1.00127	1.00563	1.00227	1.00116
90	1.00949	1.00456	1.00586	1.00122	1.00100	1.00659	1.00668	1.00256	1.00420	1.00135	1.00581	1.00240	1.00123
95	1.01000	1.00478	1.00606	1.00129	1.00106	1.00672	1.00682	1.00270	1.00441	1.00144	1.00599	1.00253	1.00130
100	1.01056	1.00500	1.00625	1.00136	1.00113	1.00684	1.00697	1.00284	1.00461	1.00152	1.00616	1.00266	1.00137
120	1.01333	1.00561	1.00696	1.00164	1.00139	1.00727	1.00780	1.00339	1.00528	1.00188	1.00679	1.00319	1.00166
140	1.01692	1.00617	1.00765	1.00192	1.00166	1.00771	1.00912	1.00393	1.00579	1.00226	1.00736	1.00371	1.00195
160	1.02081	1.00672	1.00836	1.00220	1.00194	1.00827	1.01104	1.00447	1.00627	1.00265	1.00793	1.00423	1.00224
180	1.02385	1.00728	1.00913	1.00249	1.00223	1.00902	1.01357	1.00500	1.00675	1.00306	1.00854	1.00474	1.00253
200	1.02655	1.00707	1.01000	1.00277	1.00254	1.01000	1.01718	1.00534	1.00724	1.00349	1.00922	1.00525	1.00283
240	1.03118	1.00921	1.01213	1.00335	1.00319	1.01279	1.02268	1.00607	1.00832	1.00440	1.01090	1.00625	1.00343
280	1.03579	1.01088	1.01524	1.00395	1.00389	1.01663	1.02737	1.00692	1.00963	1.00542	1.01313	1.00724	1.00405
320	1.04070	1.01292	1.01834	1.00454	1.00461	1.02088	1.03275	1.00797	1.01124	1.00656	1.01590	1.00824	1.00468
360	1.04671	1.01562	1.02162	1.00515	1.00543	1.02423	1.03853	1.00926	1.01317	1.00771	1.01925	1.00924	1.00532
400	1.05308	1.01826	1.02526	1.00575	1.00631	1.02708	1.04393	1.01081	1.01580	1.00886	1.02229	1.01026	1.00598
450		1.02179	1.03056	1.00652	1.00744	1.03072	1.05000	1.01311	1.01877	1.01028	1.02625	1.01156	1.00683
500		1.02558	1.03643	1.00732	1.00859	1.03425		1.01610	1.02186	1.01164	1.03000	1.01292	1.00768
550		1.02927	1.04200	1.00813	1.00976	1.03781		1.01888	1.02500	1.01293	1.03354	1.01435	1.00856
600		1.03286	1.04642	1.00896	1.01094	1.04158		1.02169	1.02813	1.01413	1.03685	1.01557	1.00946
650		1.03632	1.05000	1.00982	1.01213	1.04567		1.02449	1.03123	1.01524	1.04000	1.01729	1.01037
700		1.03967		1.01071	1.01331	1.05000		1.02718	1.03426	1.01625	1.04333	1.01919	1.01130
750		1.04310		1.01163	1.01449			1.03000	1.03719	1.01718	1.04667	1.02126	1.01224
800		0.04655		1.01257	1.01571			1.03282	1.04000	1.01802		1.02372	1.01320
850		0.05000		1.01354	1.01689			1.03563	1.04268	1.01833		1.02607	1.01418
900				1.01454	1.01887			1.03838	1.04524	1.01936	1.05000	1.02840	1.01518
950				1.01561	1.01927			1.04101	1.04768	1.02044		1.03068	1.01619
1000				1.01667	1.02049			1.04345	1.05000	1.02156		1.03209	1.01717

Trouble Shooting V-Belts

How to Spot V-Belt Trouble

Trouble	Cause	To Correct
Belt Slip (Sidewalls Glazed)	Not enough tension.	Replace belts; apply proper tension.
Drive Squeals	Shock load	Apply proper tension.
	Not enough arch of contact.	Increase center distance.
	Heavy starting load.	Increase tension.
Belt Turned Over	Broken cord caused by prying sheave.	Replace set of belts correctly.
	Overloaded drive.	Redesign drive.
	Impulse loads.	Apply proper tension.
	Misalignment of sheave and shaft.	Realign drive.
	Worn sheave grooves.	Replace sheaves.
	Flat idler sheave.	Align idler: Reposition on slack of the drive close to drive sheave.
	Excessive belt vibration.	Check drive design. Check equipment for solid mounting. Consider use of band belts.
Mismatched Belts	New belts installed with old belts.	Replace in matched set only.
	Sheaves grooves worn unevenly. Improper groove angle. Give appearance of mismatched belts.	Replace sheaves.
	Sheave shafts not parallel. Give appearance of mismatched belts.	Align Drive.
Belt Breaks	Shock loads.	Apply proper tension; Recheck drive.
	Heavy starting loads.	Apply proper tension; Recheck drive. Use compensator starting.
	Belt pried over sheaves.	Replace set of belts correctly.
	Foreign objects in drive.	Provide drive shroud.
Belt wears rapidly	Sheave grooves worn.	Replace sheaves.
	Sheave diameter too small.	Redesign drive.
	Mismatched belts.	Replace with matched belts.
	Drive overload.	Redesign drive.
	Belt slips.	Increase tension.
	Sheaves misaligned.	Align sheaves.
	Oil or hear condition.	Eliminate oil. Ventilate drive.

Trouble Shooting V-Belts

How to Diagnose V-Belt Failure | V-belt troubleshooting checklist

BELT CONDITION

Oil Deterioration

Oil Deterioration

Cause
Oil-softened rubber.

Prevention
Splash guards will protect drives against oil. Although Classical belts are oil resisting excessive oil can cause some deterioration.

Cover Fabric Rupture

Cover Fabric Rupture

Cause
Cover fabric ruptured when belt was pried over sheave during installation.

Prevention
Proper installation of belts by moving motor so belts do not have to be pried into the grooves.

Slip Burn

Slip Burn

Cause
Belts too loose. Belt didn't move, friction against sheave burned rubber. When belt finally grabbed, it snapped.

Prevention
Maintain proper tension on the drive.

How to Diagnose V-Belt Failure | V-belt troubleshooting checklist

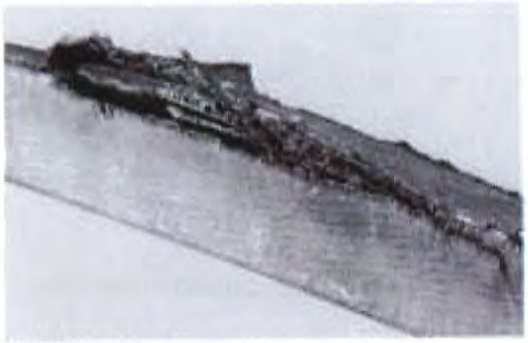
BELT CONDITION

Base Cracking

Base Cracking

Cause
Severe back-bend idlers. Improper storage. Excessive ambient operating temperature.

Prevention
Check storage conditions. If back-bend idler cannot be avoided, install idler of larger diameter. Avoid ambient temperature over 140°.



Ply Separation

Ply Separation

Cause
Split along pitch line indicating belt ran over too small a sheave.

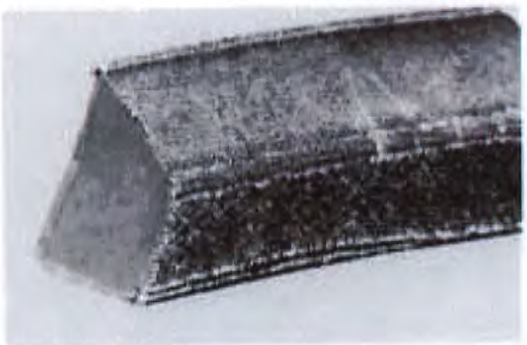
Prevention
Redesign drive using sheaves of proper size.

Ruptured

Ruptured

Cause
Ruptured cord in the plies.

Prevention
Check for rocks or tools falling into sheave grooves. Check tension. Belts loose enough to twist in groove can rupture cords.



Worn Belt Sides

Worn Belt Sides

Cause
Misalignment. Grit or dirt. Normal wear.

Prevention
Align sheaves. Replace belts as required.

Trouble Shooting V-Belts

How to Diagnose V-Belt Failure | V-belt troubleshooting checklist

BELT CONDITION

Sub Break

Sub Break

Cause
Cover wear indicates slip. Clean break reveals sudden snap.

Prevention
Maintain proper tension on the drive.

Distorted Belt

Distorted Belt

Cause
Breakdown of adhesion or broken cords.

Prevention
Do not pry belts on drives. Check sheaves for recommended diameters.

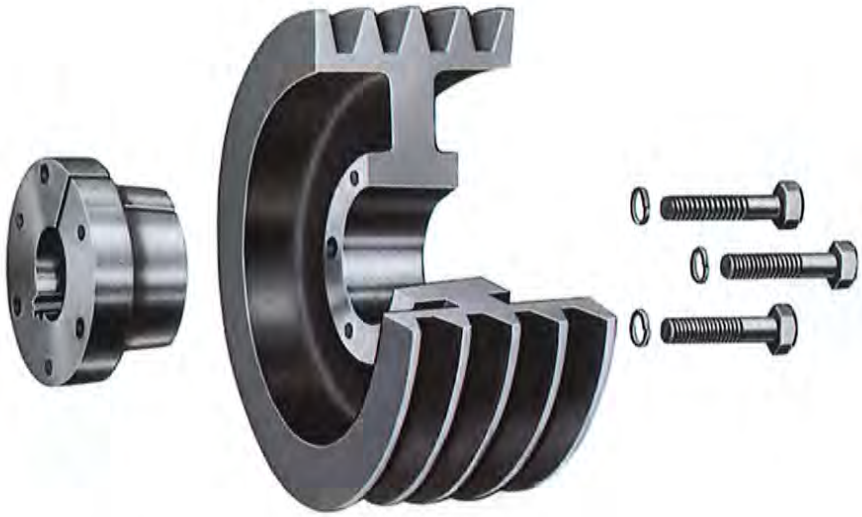
Abrasion

Abrasion

Cause
Foreign material and rust in sheaves wore away sidewalls, letting belt drop to bottom of groove.

Prevention
Dust guards help protect against abrasion. Tension must be maintained in dusty atmospheres.

Sure-Grip® Sheave Features



TB Wood's sheaves are constructed of fine grain, high tensile cast iron, and have been carefully engineered to assure maximum performance over a long life span. Behind each sheave is one of the most extensive engineering design and testing programs in the industry.

Design Integrity

TB Wood's Incorporated has been a leading supplier of cast iron pulleys, v-belt sheaves, synchronous belt sprockets and Sure-Grip mounting bushings since the inception of these products. We are committed to the continual improvement of our standard products and special or MTO products through design, materials and quality enhancements. For example, new product designs are typically computer generated and then verified using finite element analysis before CAD drawings are made. This enables TB Wood's to quickly and accurately quote on any special needs, and to relay the tool paths for new designs quickly from engineering to the shop floor.

Foundry Process

TB Wood's Incorporated has a modern state-of-the art foundry in Chambersburg, PA where cast iron and ductile iron castings are produced. This captive foundry operation not only gives TB Wood's the control needed to obtain standard high quality castings as they are required, but also enables them to produce any special requirements in a minimal amount of time.

Maching

TB Wood's Incorporated has numerous machining facilities throughout North America. Each is equipped with modern CNC equipment and capable of doing high precision machining. Statistical process controls are in place in each location, and each has been ISO- 9001 certified.

Specification

TB Wood's products are manufactured to conform to or exceed recognized industry standard specifications. The following is a listing of some of these specs.

ANSI/ARPM	IP-20	Classical V-Belt Sheaves
ANSI/ARPM	IP-22	Narrow V-Belt Sheaves
ANSI/ARPM	IP-24	Synchronous Sprockets
MPTA	B6i	QD Bushing Guideline
MPTA	B2c	Pulley Balance
MPTA	B8i	V-Belt Sheave Arm Stress
MPTA	B4c	Pulley Surface Finish

Quality Products and the Support to Back Them Up - TB Wood's

V-Belt sheaves of close grain, high-tensile cast iron are machined to provide safe, vibration-free operation at speeds up to 6500 FPM. Made to order sheaves of ductile iron material can be provided for speeds up to 10,000 FPM. V-Belt drives are only the beginning of what TB Wood's can do.

TB Wood's offers a complete line of high capacity synchronous drives. The Synchonous Plus system offers a higher horsepower capacity drive at the cost of the competition's standard rated product. TB Wood's also offers the carbon-fiber QT Powerchain II Carbon drive system in 8mm and 14mm pitch. The QTPC II Carbon drive is capable of high horsepower capacity in a smaller package.

TB Wood's has many different ways of offering variable speed for customer applications. The most basic way is through the use of one of our many belted variable speed systems. One of the most unique ways of varying speed, however, is our HSV hydrostatic system. The HSV system is ideal for harsh, dirty, or explosion proof environments (ATEX certified).

TB Wood's Elastomeric coupling line offers something for every application. TB Wood's Jaw couplings offer a full compliment of spider materials and bore options. Our Sure-Flex Plus line offers 4-way flexing action, and many different flange and sleeve options to meet your needs. The Dura-Flex coupling is designed and patented with improvements over other similar type coupling that provide for the maximum possible service life.

TB Wood's line of steel couplings offers both gear and disc coupling options. TB Wood's Form-Flex disc couplings offer zero-backlash and eliminate the need for lubrication. Our gear couplings are available in all the standard, spacer, and special options common to the industry. In both disc and gear lines we welcome the challenge of the "special" coupling.

The Power Of One, The Strength Of Many.

OTHER PRODUCT SOLUTIONS FROM

ALTRA INDUSTRIAL MOTION **WWW.ALTRAMOTION.COM**

Our comprehensive product offerings include various types of clutches and brakes, overrunning clutches, engineered bearing assemblies, gearing and gear motors along with linear products, belted drives, couplings and limit switches. With thousands of product solutions available, Altra provides true single source convenience while meeting specific customer requirements. Many major OEMs and end users prefer Altra products as their No. 1 choice for performance and reliability.

ELECTRIC CLUTCHES AND BRAKES

Inertia Dynamics
Matrix
Stromag
Warner Electric

HEAVY DUTY CLUTCHES AND BRAKES

Industrial Clutch
Stromag
Svendborg Brakes
Twiflex
Wichita Clutch

OVERRUNNING CLUTCHES

Formsprag Clutch
Marland Clutch
Stieber

ENGINEERED COUPLINGS AND UNIVERSAL JOINTS

Ameridrives
Bibby Turboflex
Guardian Couplings
Huco
Lamiflex Couplings
Stromag
TB Wood's

GEAR DRIVES

Bauer Gear Motor
Boston Gear
Delroyd Worm Gear
Nuttall Gear

GEAR MOTORS

Bauer Gear Motor

POWER TRANSMISSION COMPONENTS

LINEAR ACTUATORS AND CONTROLS

Warner Linear

ENGINEERED BEARING ASSEMBLIES

Kilian

AIR MOTORS

Huco

BELTED DRIVES AND SHEAVES

TB Wood's

GEARED CAM LIMIT SWITCHES

Stromag

TB Wood's Facilities

North America

USA

440 North Fifth Avenue
Chambersburg, PA 17201 - USA
888-829-6637 * 717-264-7161
Belted Drives and Elastomeric Couplings

Customer Service
1-888-829-6637 (Press #5)

For Application Support
1-888-829-6637 (Press #7)

2000 Clovis Barker Road
San Marcos, TX 78666 - USA
1-888-449-9439
General Purpose Disc Couplings

Customer Service
1-888-449-9439

4970 Joule St
Reno, NV 89502 - USA
775-857-1800

Canada

9779 45 Ave NW
Edmonton, AB T6E 5V8 - Canada
+1 780-439-7979

6305 Danville Road
Mississauga, ON L5T 2H7 - Canada
1-800-829-6631

1073 Rue Bégin
Saint-Laurent, QC H4R 1V8 - Canada
+1 514-332-4812

Mexico

Comisión Federal de Electricidad 850,
Industrial San Luis,
San Luis, S.L.P., 78395 - Mexico
+52 444 137 1500

Europe

Merchant Drive, Hertford
Hertfordshire SG13 7BL - England
+44(0)1992 501900
Elastomeric Couplings

The Brands of Altra Industrial Motion

Couplings

Ameridrives
www.ameridrives.com

Bibby Turboflex
www.bibbyturboflex.com

Guardian Couplings
www.guardiancouplings.com

Huco
www.huco.com

Lamiflex Couplings
www.lamiflexcouplings.com

Stromag
www.stromag.com

TB Wood's
www.tbwoods.com

Geared Cam Limit Switches

Stromag
www.stromag.com

Electric Clutches & Brakes

Inertia Dynamics
www.idicb.com

Matrix
www.matrix-international.com

Stromag
www.stromag.com

Warner Electric
www.warnerelectric.com

Linear Products

Warner Linear
www.warnerlinear.com

Engineered Bearing Assemblies

Kilian
www.kilianbearings.com

Heavy Duty Clutches & Brakes

Industrial Clutch
www.indclutch.com

Twiflex
www.twiflex.com

Stromag
www.stromag.com

Svendborg Brakes
www.svendborg-brakes.com

Wichita Clutch
www.wichitaclutch.com

Belted Drives

TB Wood's
www.tbwoods.com

Gearing

Bauer Gear Motor
www.bauergears.com

Boston Gear
www.bostongear.com

Delroyd Worm Gear
www.delroyd.com

Nuttall Gear
www.nuttallgear.com

Overrunning Clutches

Formsprag Clutch
www.formsprag.com

Marland Clutch
www.marland.com

Stieber
www.stieberclutch.com

TB Wood's®
Altra Industrial Motion

HYUNDAI HEAVY INDUSTRIES CO.,LTD.

WORLDWIDE Electric Corp

AC INDUCTION MOTOR DATA SHEET
CROWN TRITON™ MOTORS

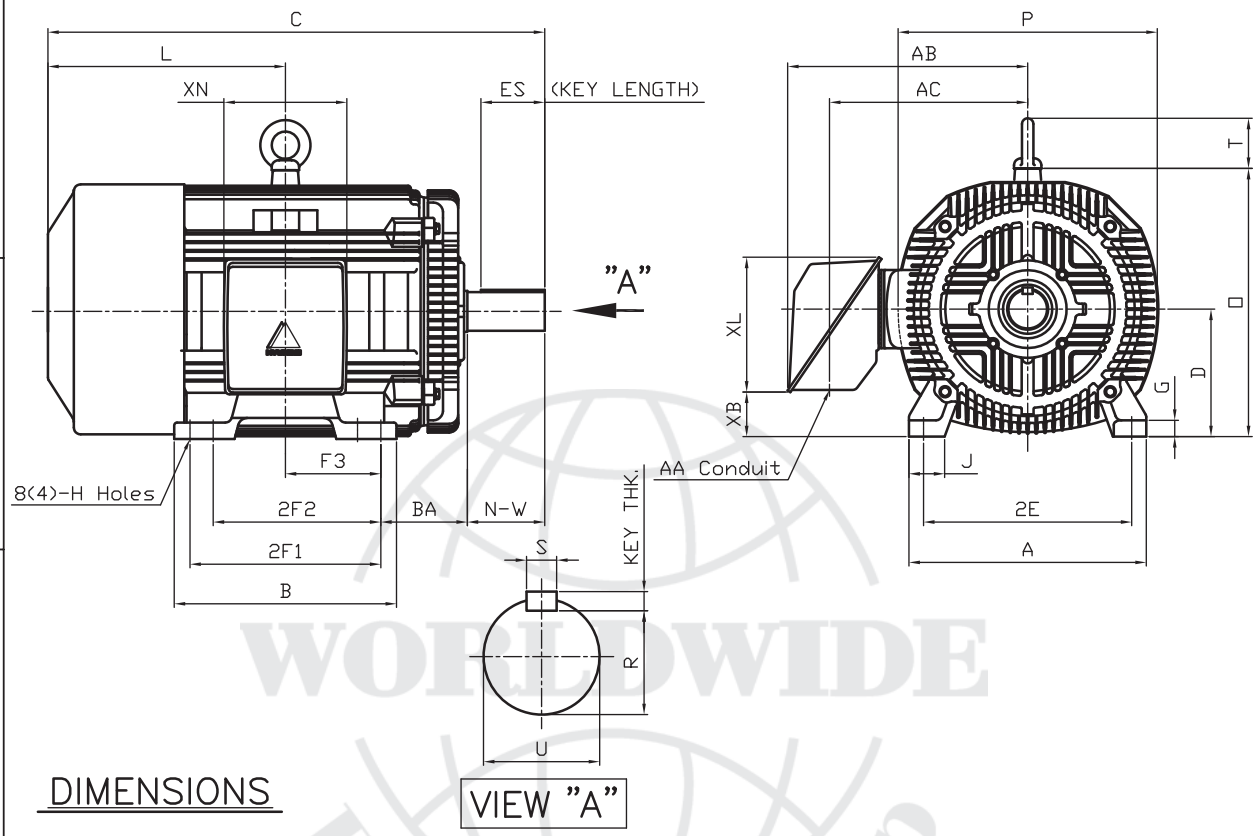
MODEL NUMBER	**HHI150-18-575-445T**		
HORSEPOWER	**150**		
RPM / POLES	**1800 / 4**		
VOLTAGE / PHASE	**575 V / 3**		
FRAME	**445T**		
ENCLOSURE / DEGREE OF PROTECTION	**TEFC / IP55**		
FREQUENCY	**60 HZ**		
FULL LOAD SPEED	**1785 RPM**		
SERVICE FACTOR	**1.15 SF at 40° C / 1.0 SF at 65° C**		
INSULATION CLASS	**F Class N Varnish**		
FULL LOAD AMPS; 575	**131.0 A**		
LOCKED ROTOR CURRENT (% Full Load)	**700 %**		
NEMA CODE LETTER	**G**		
EFFICIENCY / POWER FACTOR	LOAD	EFF.	P.F.
	100 %	**95.8 %**	**88.0 %**
	75 %	**95.9 %**	**86.2 %**
	50 %	**95.0 %**	**80.6 %**
DUTY CYCLE	**S1 / Continuous**		
TORQUE	FULL LOAD	LRT	BDT
	434.2 lb.ft.	**140 %**	**220 %**
NEMA DESIGN	**B**		
MOMENT OF INERTIA	LOAD (Max.)		MOTOR
	1855.724 lb.ft.^{2}		**67.430 lb.ft.^{2}**
SOUND PRESSURE LEVEL (No Load 1 M From Motor)	**85 dB(A)**		
NUMBER OF STARTS (Hot / Cold)	**2 Hot / 3 Cold**		
MAX. AMBIENT TEMPERATURE	**40° C at 1.15 SF / 65° C at 1.0 SF**		
MAX. ELEVATION	**3300 Ft. Above Sea Level**		
TEMPERATURE RISE (At Full Load)	**80° C**		
DRIVE-END BEARING	**NU318**		
OPPOSITE DRIVE-END BEARING	**6316C3**		
GREASE TYPE	**Mobil Polyrex EM**		
MOUNTING	**F1 (F2 Suitable), W6, W8, B3, V5, V6**		
ROTATION	**Bi-Directional**		
APPROXIMATE WEIGHT	**1700 lbs.**		
AREA CLASSIFICATION	**Class I, Division 2, Groups A, B, C, D**		
INVERTER RATING	**10:1 CT / 20:1 VT - Meets NEMA MG1 Part 31**		
SPECIFICATION - In Accordance With	**NEMA, CSA**		

C US CSA EEV 109973 ee CC 038A CE ABS TYPE APPROVED PRODUCT

REVISED 01/11/17

HYUNDAI HEAVY INDUSTRIES CO., LTD.	TEFC THREE PHASE INDUCTION MOTOR	TYPE	LP, JP Cast iron frame

FRAME SIZE	OUTPUT(HP)	POLES	Hz	TIME RATING
445T			60	CONT



DIMENSIONS

VIEW "A"

MOUNTING									CONDUIT BOX						APPROX. WGT.(LB)
A	B	2E	2F1	2F2	F3	G	J	H	AA	AB	AC	XB	XL	XN	
20.51	19.21	18.00	16.50	(14.50)	8.248	1.42	3.07	0.81	3.00	21.26	18.03	3.83	11.65	10.63	1640

OVERALL							SHAFT					KEY	BEARING	
BA	C	D	L	O	P	T	U	N-W	KEYWAY R	KEYWAY ES	KEYWAY S	THK.	DRIVE END	OPP. DRIVE END
7.50	45.21	11.00	20.96	23.19	22.40	4.33	3.375	8.50	2.880	6.93	0.875	0.875	6318C3 or NU318	6316C3

NOTE

1. Dimension "D" tolerance : +0.00inch – 0.03inch (143T–365T) ; +0.000inch – 0.06inch (404T–449T)
2. Dimension "U" tolerance : +0.000inch – 0.005inch (143T–215T), +0.000inch – 0.001inch (254T–449T)
3. Dimension "R" tolerance : +0.000inch – 0.015inch

Q'TY	DESCRIPTION	MATERIAL	DIMENSION	WEIGHT	PART NO.	REMARK	NO.

APPD BY	K.J. Kang	UNIT	INCH	SUBJECT	445T
Q.P CHK		SCALE	N/S		CAD PROJ 명 \ FILE 명
CHKD BY		PROJEC'N	3 각법(3rd Angle)	TITLE	MMSTDMTR\A1118AA
DSND BY	N.D.Lee	DATE	2011.01.12		OUTLINE

HYUNDAI HEAVY INDUSTRIES CO., LTD.	REF. NO	A1118AA	Sheet No. of
	DWG NO	350A1118AA	Revision No. 0

HYUNDAI HEAVY INDUSTRIES CO.,LTD.

PERFORMANCE CURVE

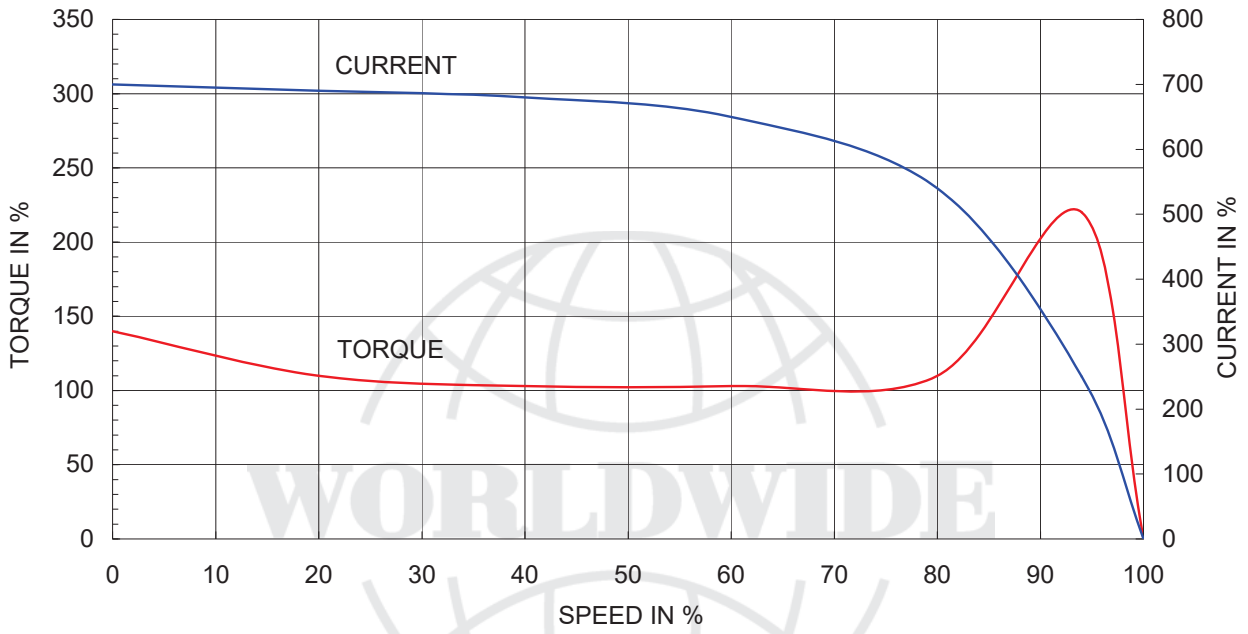
CURVE NO.

P-PLP445SR04

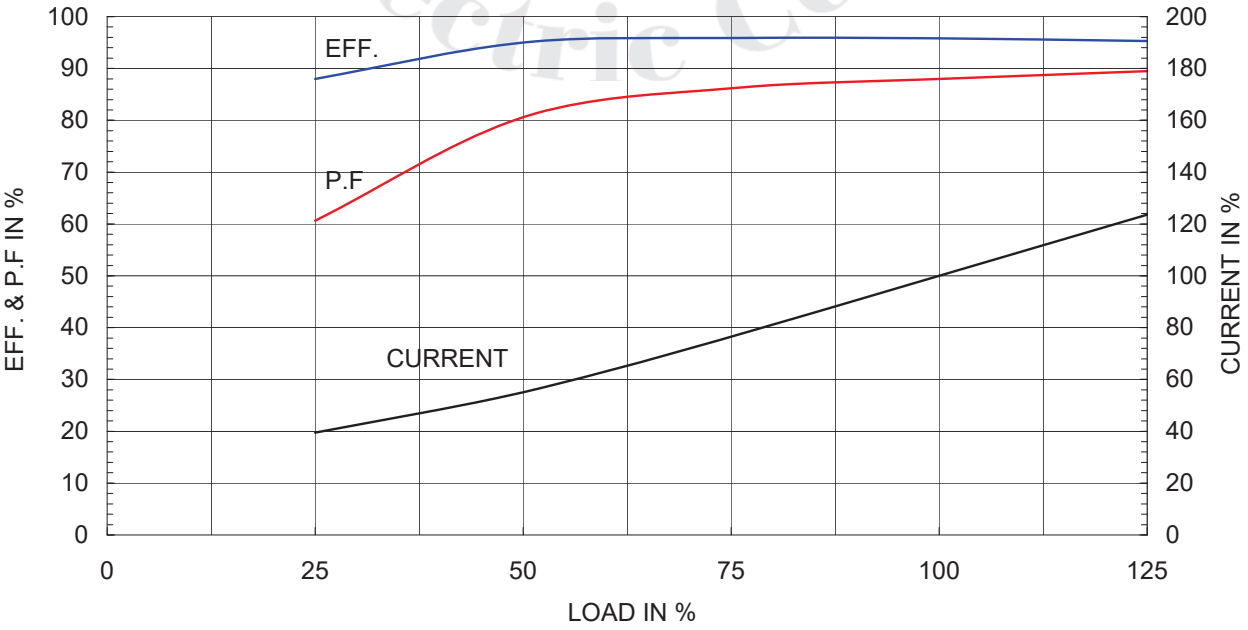
Type :	PLP				
Full Load Torque :	434.2	lb.ft			
Motor moment of Inertia (J) :	67.430	lb.ft ^{2}			
Load moment of Inertia (J) :	1855.724	lb.ft ^{2}			

110 kW	150 HP	60 Hz		
4 P	Rated Speed :	1785 RPM		
Rated Voltage	575V	460V		
Full Load Current	131.0A	163.8A		

SPEED VS TORQUE & CURRENT CURVE



OUTPUT VS EFF., P.F & CURRENT CURVE



Installation and Maintenance Manual

(Short version)

WorldWide Electric EP/PEWWE Motors

This operation manual includes important information for the installation, assembly, operation and maintenance of WorldWide Electric Low Voltage Motors. Please read this manual carefully before you start using this product. Please contact WorldWide Electric's customer service department at 1-800-808-2131 if you have any questions regarding this information. Failure to follow the instructions outlined in this manual may result in loss of your right to fulfilment of any claim under limited product warranty and potentially may cause injury to personnel, equipment and/or property, including loss of life. WorldWide Electric Corporation assumes no liability for injury to persons or damage to equipment or property resulting from non-observance of these operating instructions. In such cases, any liability for defects is excluded.

WorldWide Electric Corporation
Phone: 1-800-808-2131
Fax: 1-800-711-1616
www.worldwideelectric.net

Revised 12/01/17

Table of Contents

Intro

This manual will include procedures for the safe and proper transportation, installation, connection, operation and maintenance of the WorldWide Electric low voltage motors. Read these instructions carefully before attempting to install, operate or service the motors and retain for future reference.

Safety precautions must be observed to protect personnel from possible injury which can be caused by improper handling of the motor, including high voltages, hot surfaces and rotating parts. If at any time there are additional questions or concerns, please contact your WorldWide Electric customer service associate at 1-800-808-2131.

Receiving

1. Check the motor nameplate data (HP, RPM, voltage, frame size, enclosure, etc.) and confirm that it corresponds to your requirements.

2. Check for any damage that could have been caused by transportation. Make sure that there are no loose parts on the motor or inside the fan cover.

3. If a shaft clamp or other shipping braces (painted yellow) are installed on the motor for transport, remove these and retain for future use.

4. Turn the shaft by hand to ensure that it rotates freely and smoothly. Listen for any sounds of mechanical resistance or impact. If any are present, please check with your local representative.

CAUTION: If the motor is supplied with eyebolts for lifting purposes, make certain that these are tightened securely. Use these for lifting the motor only. Do not use these for lifting any equipment mounted to the motor. Note that the direction of lift should not exceed 15 degrees from the shank of the eyebolt.

Warnings

1. High Voltage, hot surfaces and rotating parts of electrical machinery can cause serious or fatal injury to persons and property. Only properly trained, qualified personnel should perform installation, operation and maintenance on the equipment and this should be done in accordance with NEMA MG-2, National Electrical Code, CSA C22-100 (C.E.C), IEC 364 (prEN50110-01), and all local and utility regulations and safety standards.

2. When preparing to service the motor, all power sources to the motor and accessory devices must be de-energized and disconnected. All rotating parts of the equipment must be at a standstill. Follow all regulations in locking out the power source to prevent accidental reconnection.

3. Before the motor is re-energized, make sure that all safety guards are in place and that the shaft key is fully captive or removed.

4. When working near machinery, high noise levels and proper ear protection must be used. Refer to local and national safety regulations.

5. The motor should be grounded properly to protect against injury to personnel. Refer to NEC, CSA, and local utility regulations for correct method of doing this. Note that grounding cables must be securely fastened to be effective and that lugs must be crimped to the cable using a proper crimping tool.

6. The repair of explosion proof motors should only be made by an authorized service center that is certified by Underwriters Laboratories (UL), Canadian Standards Association (CSA) or any other appropriate agency. Failure to comply with this will violate the hazardous duty certifications of the motor. The use of a non-explosion proof motor in hazardous areas is strictly prohibited. Contact WorldWide Electric or your local authorized representative for assistance.

Storage

1. When motor is not in operation, the following precautionary measures must be undertaken to ensure that motor life is not reduced:

   - The location should be dry, without direct sunlight, well ventilated and free of dust or corrosive gas.
   - The motor should not be stored near a heat or cold source (i.e. boiler / freezer).
   - The storage area should be free of vibration.
   - The motor should be easily accessible.

2. Specific precautions should be taken to prevent the entrance of moisture, dust or dirt.

3. Before commissioning, the motor's insulation should be tested with a 500VDC megger. If the resistance value of the insulation is less than 1MΩ, the windings must be dried prior to energizing.

Location

1. Open drip proof motors (IEC protection ≤ IP23) are intended for use in a well ventilated area where the atmosphere is reasonably free of dirt, moisture, corrosive agents, and is not intended for use outdoors.

2. Totally enclosed motors (IEC protection ≥ IP44) are intended for use where they are exposed to dirt, moisture, dust and most outdoor conditions. Standard enclosed motors require special features in environments where there is extremely fine abrasive dust or corrosive chemicals present, or in outdoor applications where weather protection should be considered.

3. Explosion proof motors are intended for use in hazardous areas classified by UL, National Electrical Code (NEC), CSA, and IEC79 (EN 50 014 and EN 50 018).

4. Standard motors are suitable for use in ambient temperatures between -20°C (-40°C with low temperature grease) to +40°C, and at elevations at or below 1,000 meters (3,300 feet) above sea level.

Mounting

1. Make certain that the underside of the motor feet and/or the flange are clean and free of dirt. If necessary, wipe with clean cloth using a non-abrasive cleaning solution. Remove any masking materials or any rust inhibitive coating from the mounting surfaces and the shaft.

2. Motors must be mounted securely on a firm and flat base or onto a rigid flange capable of supporting the entire motor weight. The mounting bolts must be tightened evenly to a minimum of the torque specified in (*TABLE 1*) to prevent a change in alignment and the resulting damage to equipment. These values are for medium carbon steel bolts (identified by 3 radial lines at 120° on the bolt head ANSI Grade 5). For low carbon steel bolts (ANSI Grade 2) use 50% of this torque.

   TABLE 1

Bolt Size		Recommended Torque	
Inch	Metric	Ft.Lb.	N-M
1/4″	M6	7-11	9-15
5/16″	M8	14-21	19-28
3/8″	M10	25-37	34-50
1/2″	M12	60-90	81-122
5/8″	M16	120-180	163-244
3/4"	M20	210-320	285-433

3. All ball bearing motors (frame up to and including NEMA 326T) can be mounted in all positions shown in NEMA MG1-4.03 provided that the mounting surface is stable, solid and the drain holes are located properly. For recommendations for other applications please contact WorldWide Electric.

4. When using a direct coupling, align motor shaft to drive shaft as accurately as possible. Although a flexible coupling is designed to transmit power with some angular and parallel misalignment, this will affect the life of the motor bearings.

5. If bolted-on bases are removed from totally enclosed motors, the integrity of the enclosure must be maintained by resealing the bolt holes using shorter bolts. Do not reuse the original bolts as these will be too long and will interfere in the proper operation of the motor.

Mounting (Continued)

6. Remove drain plugs from the endshield or frame on totally enclosed motors. It is critical that the motor be mounted with these at the lowest point of the frame. If the motor is to be mounted with the feet in any position except down, these must be relocated to the appropriate position. Contact a WorldWide Electric representative for assistance.

7. The use of pulleys, sheaves, sprockets or gears on motor shafts is defined in NEMA MG1-14.07. The application of V-belt sheave dimensions on AC motors is shown in NEMA MG1-14.41. The pitch diameter must not be less than indicated in (TABLE 2) and the maximum sheave width must not exceed:

   - (N-W) for Narrow Type (3V, 5V, 8V) sheaves
   - 2x (N –W)- ¼" for Conventional Type (A, B, C, D, E) sheaves
   - (N-W) is the usable shaft length (IEC designation is dim. E)

8. For sheave ratios greater than 5:1 and center distances less than the diameter of the large sheave, please contact WorldWide Electric Corporation.

9. Mount the pulley or half coupling to the motor shaft using a non-impact method. Do not hammer on the motor shaft as this will cause brinelling of the bearings, leading to premature failure of the motor.

10. The motor is balanced using a half key. Therefore, the motor pulley or half coupling should be balanced with a half key.

11. After mounting the coupling or the belt and pulleys, a guard must be placed over all of the moving parts to protect against accidental contact and injury.

12. Do not over tension the belts as this will lead to excessive overhung load on the motor bearing, causing a significant reduction in bearing life and premature failure of the motor.

13. Make certain that there is an adequate space around the motor for ventilation. If using a belt pulley, the ventilation opening at the rim of the pulley is essential for the motor's cooling. All ventilation openings must not be obstructed and any wall or divider should be mounted a minimum of 1" (25mm) away from the motor.

Mounting (Continued)

TABLE 2 – Belted Application Guidelines

These guidelines were created to help users get the longest service and reliability from WorldWide Electric and Hyundai Electric Motors. Refer to NEMA MG1-14.47 for additional information.

Suggestions for minimizing bearing loads:

1. Use the largest possible sheave (see minimum sheave size in the table below, being careful not to exceed the rim speed suggested by the sheave manufacturer.
2. Use the fewest number of belts (see maximum number of recommended belts in the table below).
3. Keep sheaves as close to the bearing as possible.
4. Do not over-tension belts (see deflection values in the table below).

Sheave Sizing

HP	1200 RPM				1800 RPM			
	Min. Sheave Diameter (in.)	Belt Type	Max. Belts	Deflection (lbs.)	Min. Sheave Diameter (in.)	Belt Type	Max. Belts	Deflection (lbs.)
1	2.4	3VX	1	4	2.2	3VX	1	3.1
1.5	2.4	3VX	2	3.1	2.4	3VX	2	2.1
2	2.4	3VX	3	2.8	2.4	3VX	2	2.9
3	3	3VX	2	2.9	2.4	3VX	3	2.9
5	3	3VX	3	4	3	3VX	3	3.7
7.5	3.8	3VX	4	4.7	3	3VX	4	4.1
10	4.4	3VX	4	5.4	3.8	3VX	4	4.3
15	4.4	3VX	5	5.4	4.4	3VX	4	5.4
20	5.2	3VX	6	6	4.4	3VX	6	4.8
25	6	3VX	7	5.6	4.4	3VX	7	5.2
30	6.8	3VX	7	6	5.2	3VX	7	5.3
40	6.8	5VX	4	12	6	3VX	7	6
50	8.2	5VX	4	14.5	6.8	3VX	8	6
60	8.2	5VX	5	14	7.4	5VX	4	13.5
75	10	5VX	5	14.5	8.6	5VX	4	14.5
100	10	5VX	6	16	8.6	5VX	6	13
125	12	5V	7	14	10.5	5VX	6	13
150	13.2	5V	7	15.5	10.5	5VX	7	13.5
200	15	5V	8	16	13.2	5VX	8	13
250	15	8V	6	28	14	5VX	9	14
300	16	8V	7	27	14	5V/8V	11/7	14/24
350	16.5	8V	7	30	14.5	5V/8V	12/7	14/26
400	17.5	8V	8	29	15	5V/8V	13/8	15/26
450	18	8V	8	32	16	5V/8V	14/9	15/25
500	18.5	8V	9	31	16.5	8V	15/9	15/27
600	---	---	---	---	17.5	8V	11	26

Power Supply and Connections

1. The wiring of the motor and control, as well as the grounding and overload protection, must be performed in accordance with National Electrical Code, CSA C22-100(C.E.C) and all local and utility regulations and safety standards. Installation should be done only by properly trained and qualified personnel.

2. The power supply must agree with the nameplate voltage and frequency. The permissible variation on the power supply is:

   - *For NEMA rated motors:*
     Rated voltage: ± 10%
     Rated frequency: ± 5%
     Combined: ± 10% (with frequency component not to exceed ±5%)

   - *For IEC rated motors (per IEC 34-1, EN60034-1):*
     Rated voltage: ± 5%
     Rated frequency: ± 2%

3. Thermally protected motors will have 2 wires in the main terminal box identified as "P1" and "P2". These should be connected to the motor starter or control circuit according to the connection diagram found inside the terminal box.

CAUTION: All explosion proof motors are equipped with thermostats. These must be connected to the motor control in order to maintain the factory warranty and for the installation to comply with CSA, UL, NFPA, WCB and other governing regulations for T4 temperature code.

4. Dual voltage motors can be hooked up for the desired voltage as shown in the connection diagram inside the conduit box.

5. The main terminal box supplied with the motor has been sized to provide adequate space for the connections between the motor leads and the incoming power cables. These connections must be made and insulated in a workmanlike manner following the best trade practices and in strict adherence to local regulations.

Power Supply and Connections (Continued)

6. Before closing the terminal box, make certain that the opening around the incoming power cables and any other opening is completely sealed and a proper cable gland is in place. When installing the terminal box cover to the base, install the gasket provided and ensure that the components fit together properly. Any modifications done to the terminal box must allow it to maintain the same enclosure as that of the motor and the original box.

7. For the motors equipped with a mechanical brake, check that the brake operates properly prior to commissioning the motor.

8. Standard connections for three-phase motors are shown in Diagrams (A-D). Use appropriately sized cable connectors when making the connections, and ensure that these are tight and insulated properly before applying power. To change the direction of rotation, interchange any of two of the incoming power leads.

Connection Diagrams

CAUTION: If rotation must be changed, ALLOW THE MOTOR TO STOP COMPLETELY.

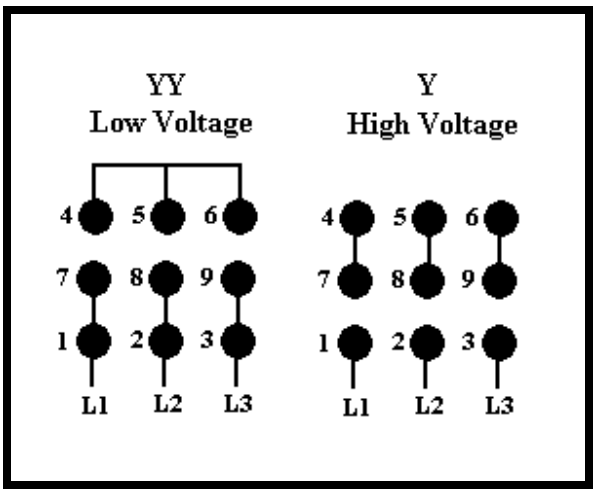
A. Frames 143T through 184T, and 210T, 6-pole are 9-Lead, 208-230/460 Volt, Wye wound.

B. Frames 210T, 2, 4-pole and 250T, 2, 4, 6-pole are 9-Lead, 208-230/460 Volt, Delta wound.

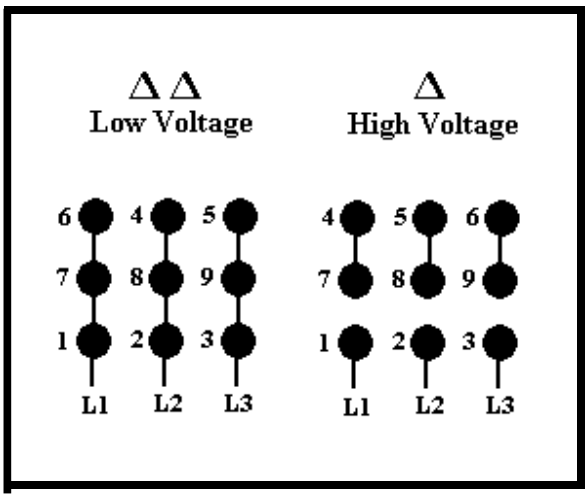
C. Frames 280T through 447T are12-Lead, 208-230/460 Volt, Wye/Delta wound.

D. Frames 449T are 6-Lead, 460 Volt, Wye-Delta wound.

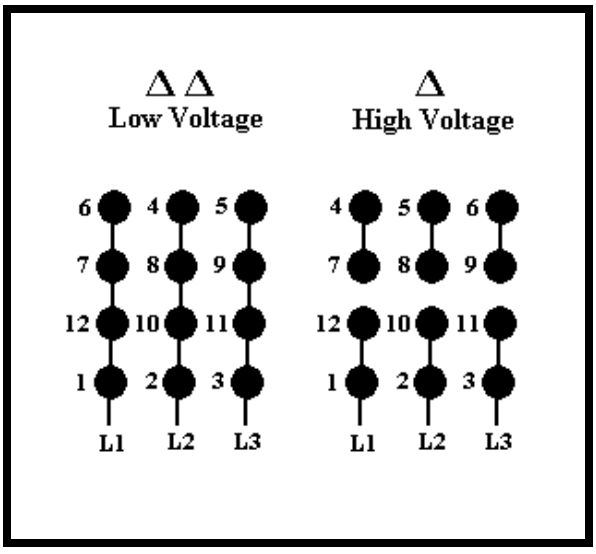
9-Lead, 208-230/460 Volt



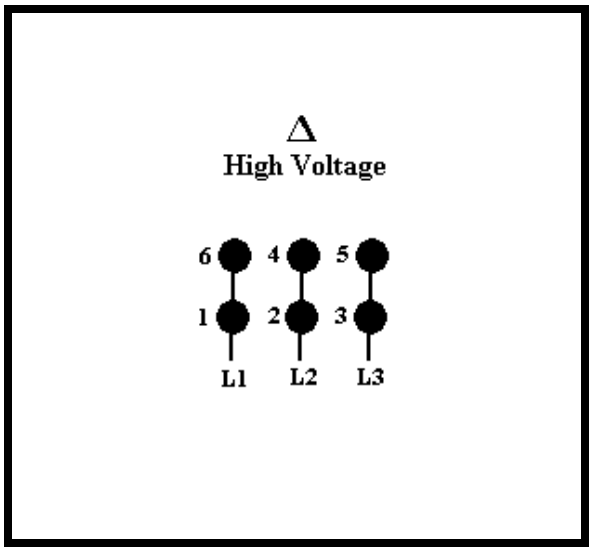
9-Lead, 208-230/460 Volt



12-Lead, 208-230/460 Volt



6-Lead, 460 Volt



Connection Diagrams (Continued)

Lead Wire Information (EP Factories)

Frame Size	EP	
	Lead Size	Lead Length
143T	16 AWG	9-1/2″
145T	16 AWG	9-1/2″
182T	16 AWG	9-1/2″
184T	16 AWG	9-1/2″
213T	14 AWG	9-1/2″
215T	14 AWG	9-1/2″
254T	12 AWG	9-1/2″
256T	12 AWG	9-1/2″
284T	10 AWG	10-5/8″
286T	10 AWG	10-5/8″
324T	8 AWG	13″
326T	8 AWG	13″
364T	6 AWG	13″
365T	6 AWG	13″
404T	4 AWG	13-3/4″
405T	4 AWG	13-3/4″
444T	3 AWG	13-3/4″
445T	3 AWG	13-3/4″
445/7T	3 AWG	13-3/4″
449T	1 AWG	14″

Testing

If the motors have been in storage for an extensive period of time or have been subjected to adverse moisture conditions, it is best to check the insulation resistance of the stator winding with a megohmmeter. If resistance is lower than 1 megohm, the windings should be dried in one of the following ways:

1. Bake in oven at temperature below 194°F until insulation resistance remains constant for a minimum of 30 minutes.

2. Enclose the motor with a canvas or similar covering, leaving an opening at the top for moisture to escape. Insert a heater or lamps into this enclosure, taking care not to place these devices in a way that creates hot spots in the motor windings. Leave the heating devices in the enclosure until the insulation resistance remains constant for a minimum of 30 minutes.

3. With the rotor locked, apply low voltage (approximately 10% of nameplate voltage) and gradually increase current through windings until temperature measured with thermometer reaches 85°C (184°F). Do not exceed this temperature. Maintain this temperature until the insulation resistance remains constant for a minimum of 30 minutes. Turn the shaft manually to check for any deterioration in the bearings on the motor. Depending on the length and conditions of the storage it may be necessary to regrease or change rusted bearings.

4. Depending on the length and condition of storage, it may be necessary to regrease or change rusted bearings.

Start-Up

1. Start the motor with the load disconnected (make sure key is removed from motor shaft). Check direction of rotation. Interchange any two leads of a three-phase motor to change the direction of rotation.

NOTICE: All electric motors are recommended to be installed by a certified electrician.

2. Connect the load and operate for an initial period of at least one hour. Check for any unusual noise, vibration or hot spots. These items should also be checked periodically as a part of a maintenance schedule even after a successful start-up. Acceptable vibration levels at no load condition are defined in:

   - *NEMA MG1-7:*
     2-6 pole: 0.15in/s peak
     8 pole: 0.12in/s peak

3. Check the operating current against the nameplate current. Be careful not to exceed the value of the nameplate amperes under continuous load. Motors with a service factor greater than 1.0 can be operated continuously with the current not exceeding the nameplate value multiplied by the service factor, however, the life span of the insulation system may be reduced.

4. When operating 208-230/460 voltage motors at 200 volts, the slip of the motor will increase by approximately 30%, and the torques will be reduced (20% to 30%). Before starting the unit, make certain the motor will start and accelerate the load without injurious heating and adequate torque. Contact WorldWide Electric for assistance.

Lubrication

1. Motors 210 frame and below contain pre-lubricated, double shielded/sealed ball bearings which are adequately greased for life at the factory and do not require relubrication.

2. Motors 250 frame and above will have open type or single shielded/sealed ball bearings with provisions for grease nipples and discharge plugs on the motor to allow grease to be inserted into the bearing cavity in more severe condition applications. Motors are shipped with grease for initial running and do not need additional lubrication except in certain instances (i.e. storage in excess of 3 months or in the presence of construction dust). In order to provide the maximum bearing life, refer to (*LUBRICATION SCHEDULE*) for guidelines. Note that excessive or too frequent lubrication may damage the motor.

3. Make certain that the fittings are clean and free from dirt. Using a low pressure grease gun, pump in the recommended amount of grease until new grease appears at grease discharge point.

4. Use MOBIL POLYREX-EM grease or equivalent polyurea based grease with the same thermal and viscosity properties, unless a special grease is specified on the nameplate. Failure to maintain grease compatibility will shorten bearing life significantly.

5. Regreasing of the bearings should be performed with the motor running. This will ensure an even dispersion of the grease in the bearing and cavity. After regreasing, continue to run the motor for ten to thirty minutes.

NOTICE: Please refer the lubrication schedules (pages 18-20).

Lubrication (Continued)

Lubrication Schedule

HP	RPM	Frame	DE Bearing					ODE Bearing				
			Size	Make-Up Amount (g)	Make-Up Months	Exchanging Amount (g)	Exchanging Months	Size	Make-Up Amount (g)	Make-Up Months	Exchanging Amount (g)	Exchanging Months
1	3600	143T	6205ZC3	9	3	14	6	6204ZC3	8	3	12	6
	1800	143T	6205ZC3	9	6	14	12	6204ZC3	8	6	12	12
	1200	145T	6205ZC3	9	6	14	12	6204ZC3	8	6	12	12
1.5	3600	143T	6205ZC3	9	3	14	6	6204ZC3	8	3	12	6
	1800	145T	6205ZC3	9	6	14	12	6204ZC3	8	6	12	12
	1200	182T	6206ZC3	10	6	15	12	6206ZC3	10	6	15	12
2	3600	145T	6205ZC3	9	3	14	6	6204ZC3	8	3	12	6
	1800	145T	6205ZC3	9	6	14	12	6204ZC3	8	6	12	12
	1200	184T	6206ZC3	10	6	15	12	6206ZC3	10	6	15	12
3	3600	182T	6206ZC3	10	3	15	6	6206ZC3	10	3	15	6
	1800	182T	6206ZC3	10	6	15	12	6206ZC3	10	6	15	12
	1200	213T	6307ZC3	15	6	30	12	6307ZC3	15	6	30	12
5	3600	184T	6206ZC3	10	3	15	6	6206ZC3	10	3	15	6
	1800	184T	6206ZC3	10	6	15	12	6206ZC3	10	6	15	12
	1200	215T	6307ZC3	15	6	30	12	6307ZC3	15	6	30	12
7.5	3600	213T	6307ZC3	15	3	30	6	6307ZC3	15	3	30	6
	1800	213T	6307ZC3	15	6	30	12	6307ZC3	15	6	30	12
	1200	254T	6309ZC3	20	6	60	12	6309ZC3	20	6	60	12
10	3600	215T	6307ZC3	15	3	30	6	6307ZC3	15	3	30	6
	1800	215T	6307ZC3	15	6	30	12	6307ZC3	15	6	30	12
	1200	256T	6309ZC3	20	6	60	12	6309ZC3	20	6	60	12
15	3600	254T	6309ZC3	20	3	60	6	6309ZC3	20	3	60	6
	1800	254T	6309ZC3	20	6	60	12	6309ZC3	20	6	60	12
	1200	284T	6310ZC3	25	6	80	12	6310ZC3	25	6	80	12
20	3600	256T	6309ZC3	20	3	60	6	6309ZC3	20	3	60	6
	1800	256T	6309ZC3	20	6	60	12	6309ZC3	20	6	60	12
	1200	286T	6310ZC3	25	6	80	12	6310ZC3	25	6	80	12
25	3600	284TS	6310ZC3	25	3	80	6	6310ZC3	25	3	80	6
	1800	284T	6310ZC3	25	6	80	12	6310ZC3	25	6	80	12
	1200	324T	6313ZC3	23	6	100	12	6211ZC3	25	6	80	12
30	3600	286TS	6310ZC3	25	3	80	6	6310ZC3	25	3	80	6
	1800	286T	6310ZC3	25	6	80	12	6310ZC3	25	6	80	12
	1200	326T	6313ZC3	23	6	100	12	6211ZC3	25	6	80	12
40	3600	324TS	6313ZC3	23	3	100	6	6211ZC3	25	3	80	6
	1800	324T	6313ZC3	23	6	100	12	6211ZC3	25	6	80	12
	1200	364T	6314C3	26	6	150	12	6213C3	14	6	80	12
50	3600	326TS	6313ZC3	23	3	100	6	6211ZC3	25	3	80	6
	1800	326T	6313ZC3	23	6	100	12	6211ZC3	25	6	80	12
	1200	365T	6314C3	26	6	150	12	6213C3	14	6	80	12
60	3600	364TS	6213C3	14	3	80	6	6213C3	14	3	80	6
	1800	364T	6314C3	26	6	150	12	6213C3	14	6	80	12
	1200	404T	6316C3	33	6	180	12	6313C3	23	6	100	12
75	3600	365TS	6213C3	14	3	80	6	6213C3	14	3	80	6
	1800	365T	6314C3	26	6	150	12	6213C3	14	6	80	12
	1200	405T	6316C3	33	6	180	12	6313C3	23	6	100	12
100	3600	405TS	6313C3	23	3	100	6	6313C3	23	3	100	6
	1800	405T	6316C3	33	6	180	12	6313C3	23	6	100	12
	1200	444T	6318C3	41	6	240	12	6316C3	33	6	180	12

Lubrication (Continued)

Lubrication Schedule

HP	RPM	Frame	DE Bearing					ODE Bearing				
			Size	Make-Up Amount (g)	Make-Up Months	Exchanging Amount (g)	Exchanging Months	Size	Make-Up Amount (g)	Make-Up Months	Exchanging Amount (g)	Exchanging Months
125	**3600**	**444TS**	6314C3	26	3	150	6	6314C3	26	3	150	6
	1800	**444T**	6318C3	41	6	240	12	6316C3	33	6	180	12
	1200	**445T**	6318C3	41	6	240	12	6316C3	33	6	180	12
150	**3600**	**445TS**	6314C3	26	3	150	6	6314C3	26	3	150	6
	1800	**445T**	6318C3	41	6	240	12	6316C3	33	6	180	12
	1200	**447T**	6318C3	41	6	240	12	6316C3	33	6	180	12
200	**3600**	**447TS**	6314C3	26	3	150	6	6314C3	26	3	150	6
	1800	**447T**	6318C3	41	6	240	12	6316C3	33	6	180	12
	1200	**449T**	6318C3	41	6	240	12	6316C3	33	6	180	12
250	**3600**	**449TS**	6314C3	26	3	150	6	6314C3	26	3	150	6
	1800	**449T**	6318C3	41	6	240	12	6316C3	33	6	180	12
	1200	**L449T**	6322C3	100	4	334	8	6318C3	41	6	240	12

Service

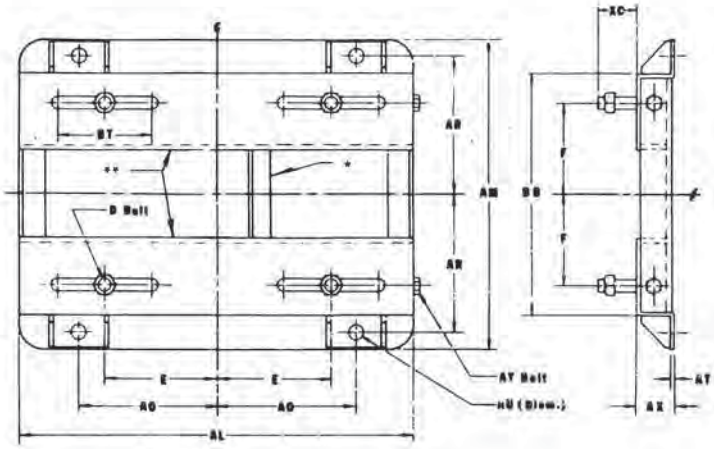
WorldWide Electric motors should only be serviced by properly trained and qualified personnel using the proper tools, equipment and genuine WorldWide Electric replacement parts. For further information, please contact WorldWide Electric. When ordering spare or replacement parts please specify complete nameplate information such as model number, serial number, HP, RPM, voltage, frame size, enclosure, etc.

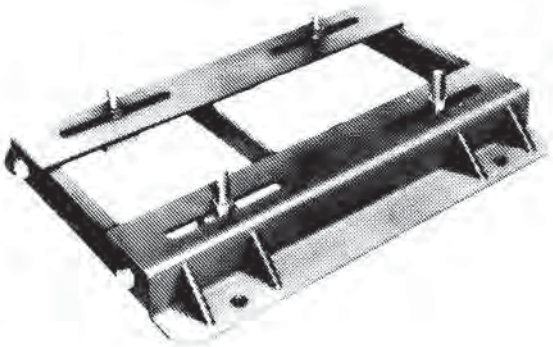
WARNING: Make sure all guards are in place and stay clear of all moving parts.

OVERLY HAUTZ COMPANY
PO BOX 837 215 SOUTH WEST STREET LEBANON, OHIO 45036-0873
PHONE 513.932.0025 FAX 513.932.1688 WWW.OVERLYHAUTZ.COM

NEMA

STEEL ADJUSTABLE Heavy Duty MOTOR BASES





STYLE C2HD

* Cross piece on 250, 280, 320, 360 style C2HD bases only.
** Turn-down flanges on 400, 440, style C2HD bases only.

STOCK BASES

FRAME & PART NO.	AL	AM	AX	BB	E	F	AO	AR	AU	BT	AT	XC	D BOLT	AY BOLT	APPROX WT. (LBS)
254C2HD	17-3/4	15-1/8	2	11	5	4-1/8	6-1/4	6-5/8	5/8	4	5/16	1-1/4	1/2x1-3/4	5/8x9	32
256C2HD	17-3/4	16-7/8	2	12-3/4	5	5	6-1/4	7-1/2	5/8	4	5/16	1-1/4	1/2x1-3/4	5/8x9	33
284C2HD	19-3/4	16-7/8	2	12-3/4	5-1/2	4-3/4	7	7-1/2	5/8	4-1/2	5/16	1-1/2	1/2x2	5/8x9	35
286C2HD	19-3/4	18-3/8	2	14-1/4	5-1/2	5-1/2	7	8-1/4	5/8	4-1/2	5/16	1-1/2	1/2x2	5/8x9	35
324C2HD	22-3/4	19-1/4	2-1/2	14-3/8	6-1/4	5-1/4	8	8-1/2	3/4	5-1/4	3/8	1-15/16	5/8x2-1/2	3/4x11	59
326C2HD	22-3/4	20-3/4	2-1/2	15-7/8	6-1/4	6	8	9-1/4	3/4	5-1/4	3/8	1-15/16	5/8x2-1/2	3/4x11	60
364C2HD	25-1/2	20-1/2	2-1/2	15-3/4	7	5-5/8	9	9-1/8	3/4	6	3/8	1-15/16	5/8x2-1/2	3/4x11	67
365C2HD	25-1/2	21-1/2	2-1/2	16-3/4	7	6-1/8	9	9-5/8	3/4	6	3/8	1-15/16	5/8x2-1/2	3/4x11	68
404C2HD	28-3/4	22-3/8	3	17-1/8	8	6-1/8	10	9-7/8	7/8	7	3/8	2-7/16	3/4x3	3/4x14	94
405C2HD	28-3/4	23-7/8	3	18-5/8	8	6-7/8	10	10-5/8	7/8	7	3/8	2-7/16	3/4x3	3/4x14	99
444C2HD	31-1/4	24-5/8	3	19-3/8	9	7-1/4	11	11	7/8	7-1/2	3/8	2-7/16	3/4x3	3/4x14	103
445C2HD	31-1/4	26-5/8	3	21-3/8	9	8-1/4	11	12	7/8	7-1/2	3/8	2-7/16	3/4x3	3/4x14	105
447C2HD	31-1/4	30-1/8	3	24-7/8	9	10	11	13-3/4	7/8	7-1/2	3/8	2-7/16	3/4x3	3/4x14	110
449C2HD	31-1/4	35-1/8	3	29-7/8	9	12-1/2	11	16-1/4	7/8	7-1/2	3/8	2-7/16	3/4x3	3/4x14	115

DIMENSIONS ARE IN INCHES: Bases are furnished with one coat of corrosion-resistant gray primer and zinc plated nuts and bolts.

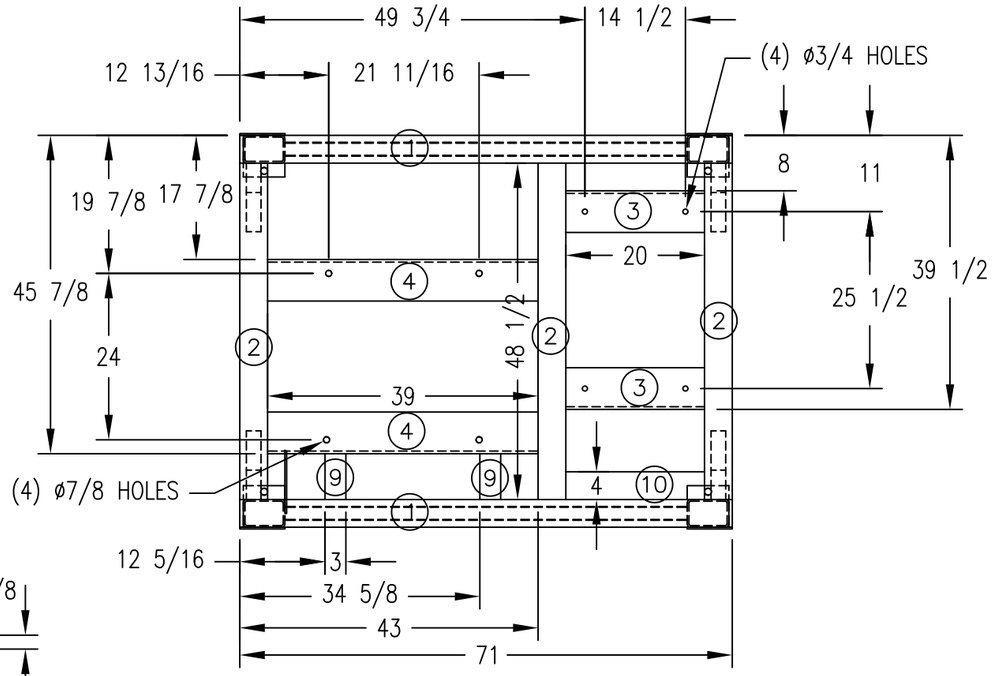
Bases listed may also be used if the motor frame is succeeded by S, T, U, US or any letter combination as long as the motor complies with N.E.M.A.

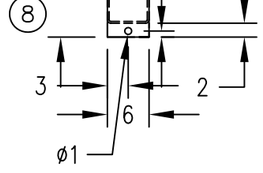
The liability of the Overly-Hautz Company to the purchaser is limited to replacement of defective materials supplied. One year from the date of our shipment all liability shall terminate. There are no warranties which extend beyond the description on the face hereof.

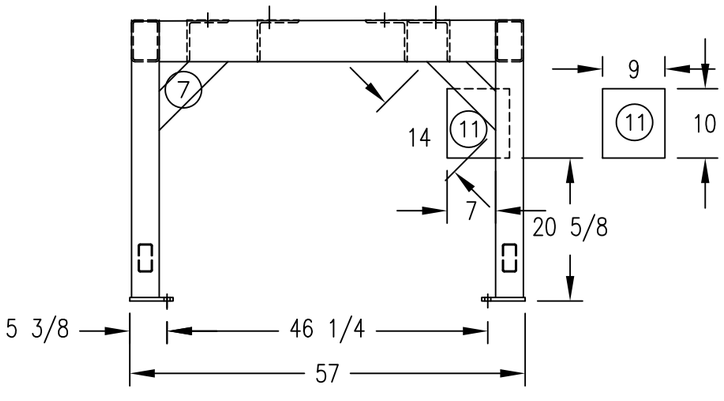
CERTIFIED FOR: _____

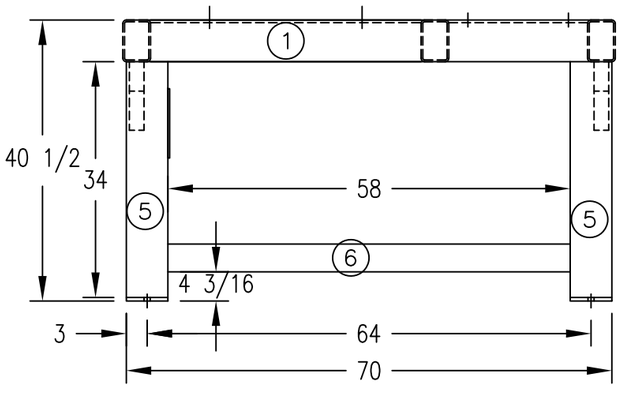
FRAME _____ BY _____ DATE _____

ITEM	QTY	SIZE	DESCRIPTION
1	2	6 X 4 X 3/16 WALL X 71 LG	RECT TUBE
2	3	6 X 4 X 3/16 WALL X 48.5 LG	RECT TUBE
3	2	6 X 6 X 3/8 X 20 LG	ANGLE
4	2	6 X 6 X 3/8 X 39 LG	ANGLE
5	4	6 X 4 X 3/16 WALL X 34	RECT TUBE
6	2	2 X 4 X 3/16 WALL X 58 LG	RECT TUBE
7	4	2 X 4 X 3/16 WALL X 14 LG	RECT TUBE
8	4	1/2 X 6 X 6-1/4	PLATE
9	2	1/4 X 3 X 6-5/8 LG	PLATE
10	1	1/4 X 4 X 20 LONG	PLATE
11	1	1/4 X 9 X 10 LONG	PLATE









NOTES:
1. MATERIAL C/S.
2. FINISH – MAKE READY FOR PAINT
3. ALL CONTINUOUS WELDS
4. TOLERANCES .X=.03" .XX=.01
.XXX=.005" 1/X=1/16" ANGULAR = ±1/4°
(INCL IMPLIED 90°) (DIM) ARE CRITICAL
5. FIRST USED 3414

REV.	DATE	DESCRIPTION

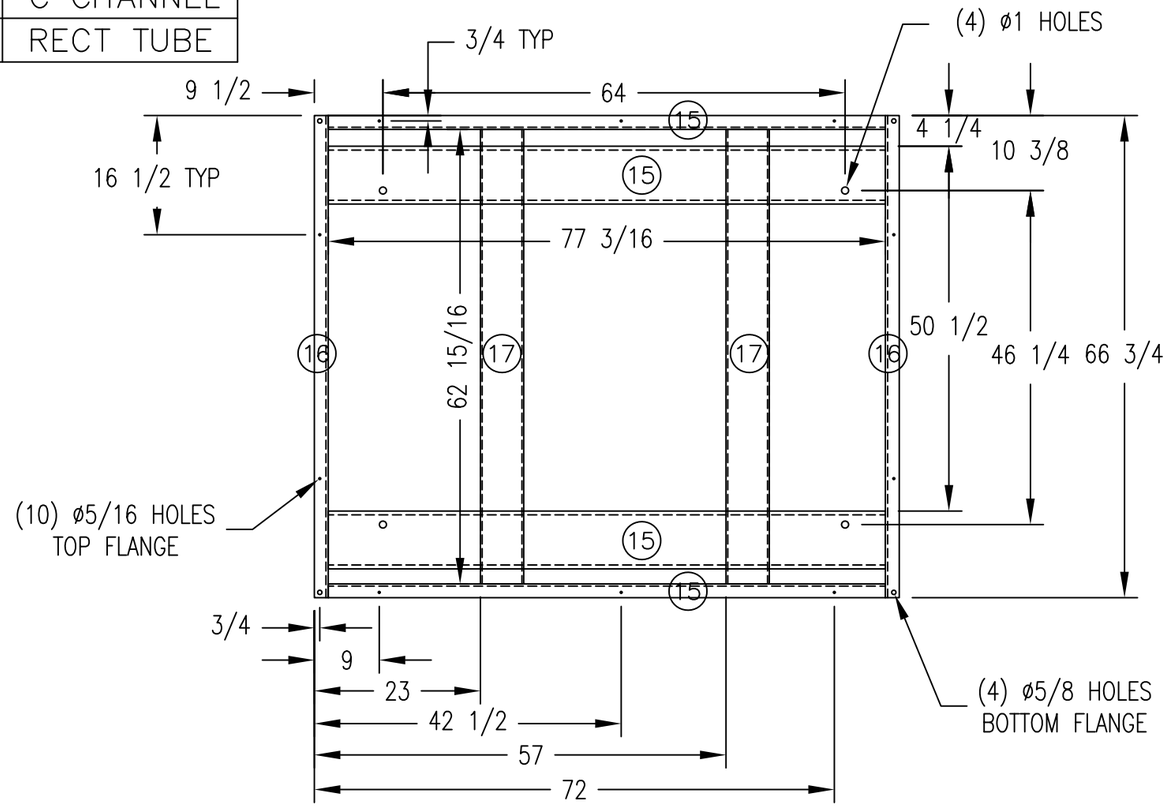
DRAWN BY: JJH	DATE 1/16/20
APPROVED BY:	DATE
DIMENSIONS IN INCHES	
SCALE NA	
TOLERANCE SEE NOTE	ANGULAR TOLERANCE
MATERIAL	WEIGHT
SHEET 1 OF 6	

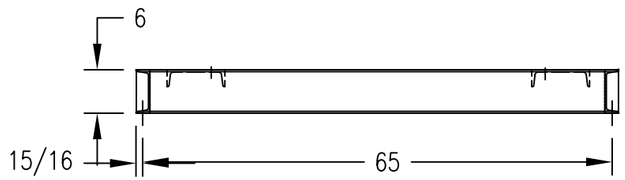
J.E.GASHO & Assoc., Inc.
460 W. GAY ST.
WEST CHESTER, PENNSYLVANIA 19380

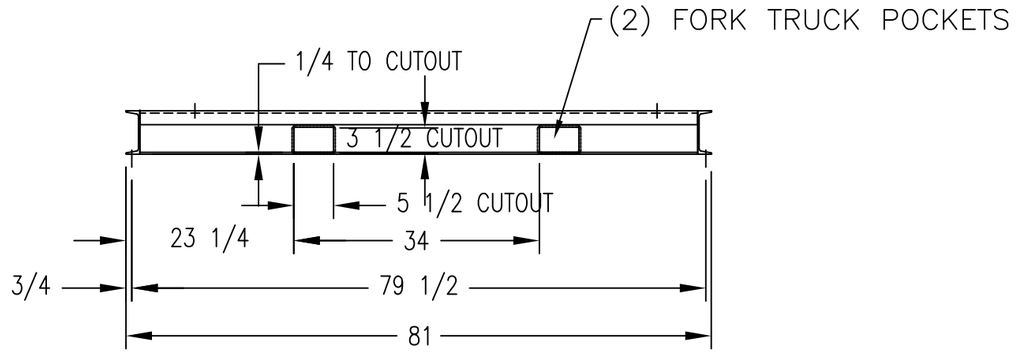
BLOWER BASE FRAME FOR 7021 WITH 150HP MOTOR

1100-C-9664 | –

ITEM	QTY	SIZE	DESCRIPTION
15	4	6" X 8.2# X 77–3/16 LG	C CHANNEL
16	2	6" X 8.2# X 66–3/4 LG	C CHANNEL
17	2	6 X 4 X 3/16 WALL X 62–15/16 LG	RECT TUBE







NOTES:
1. MATERIAL C/S.
2. FINISH – MAKE READY FOR PAINT
3. ALL CONTINUOUS WELDS
4. TOLERANCES .X=.03" .XX=.01
.XXX=.005" 1/X=1/16" ANGULAR = ±1/4°
(INCL IMPLIED 90°) (DIM) ARE CRITICAL
5. FIRST USED 3414

REV.	DATE	DESCRIPTION

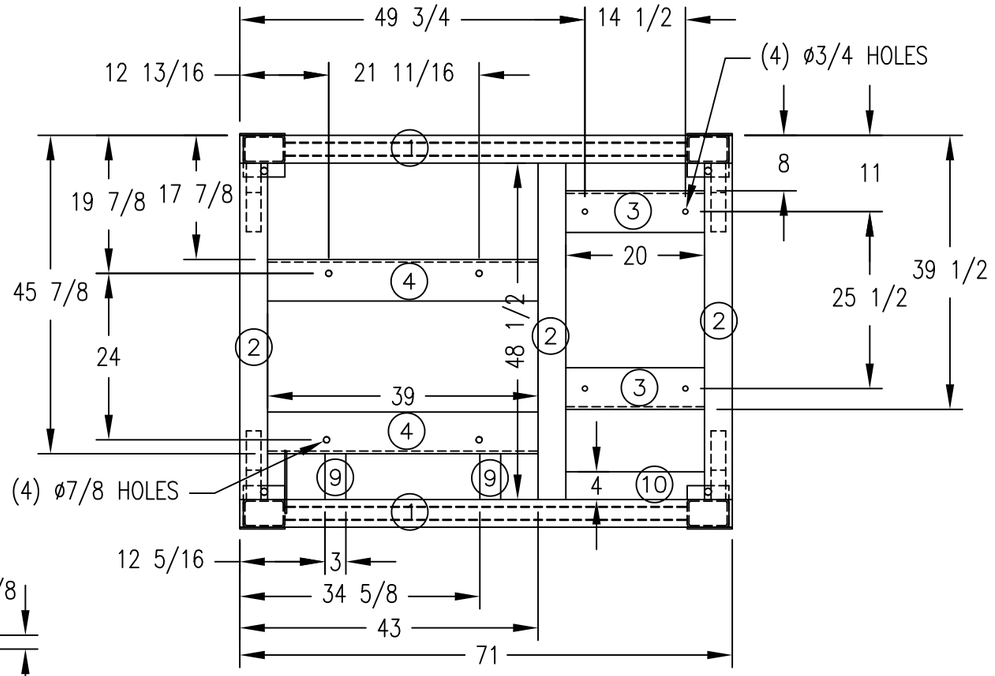
DRAWN BY: JJH	DATE 1/16/20
APPROVED BY:	DATE
DIMENSIONS IN INCHES	
SCALE NA	
TOLERANCE SEE NOTE	ANGULAR TOLERANCE
MATERIAL	WEIGHT
SHEET 2 OF 6	

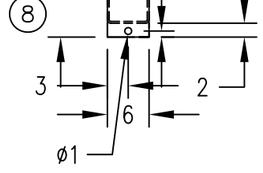
J.E.GASHO & Assoc., Inc.
460 W. GAY ST.
WEST CHESTER, PENNSYLVANIA 19380

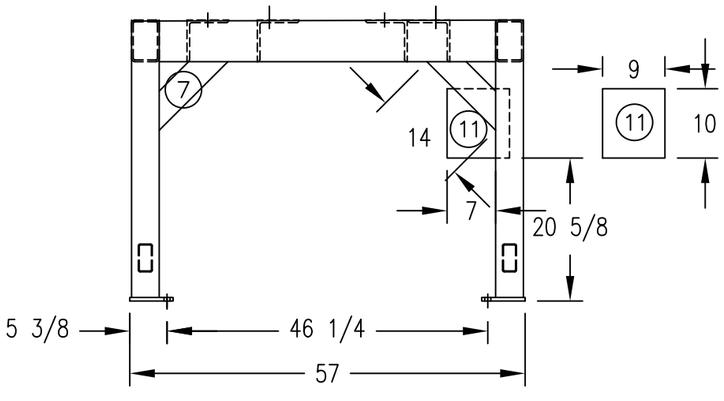
ENCLOSURE SUB– BASE
FRAME FOR 7021
WITH 150HP MOTOR

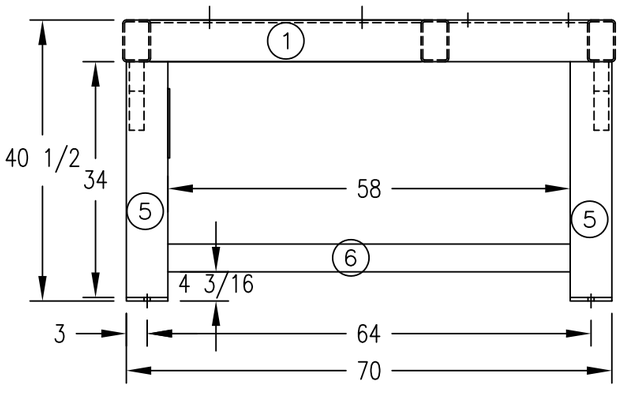
1100–C– 9664 | –

ITEM	QTY	SIZE	DESCRIPTION
1	2	6 X 4 X 3/16 WALL X 71 LG	RECT TUBE
2	3	6 X 4 X 3/16 WALL X 48.5 LG	RECT TUBE
3	2	6 X 6 X 3/8 X 20 LG	ANGLE
4	2	6 X 6 X 3/8 X 39 LG	ANGLE
5	4	6 X 4 X 3/16 WALL X 34	RECT TUBE
6	2	2 X 4 X 3/16 WALL X 58 LG	RECT TUBE
7	4	2 X 4 X 3/16 WALL X 14 LG	RECT TUBE
8	4	1/2 X 6 X 6-1/4	PLATE
9	2	1/4 X 3 X 6-5/8 LG	PLATE
10	1	1/4 X 4 X 20 LONG	PLATE
11	1	1/4 X 9 X 10 LONG	PLATE









NOTES:
1. MATERIAL C/S.
2. FINISH – MAKE READY FOR PAINT
3. ALL CONTINUOUS WELDS
4. TOLERANCES .X=.03" .XX=.01
.XXX=.005" 1/X=1/16" ANGULAR = ±1/4°
(INCL IMPLIED 90°) (DIM) ARE CRITICAL
5. FIRST USED 3414

REV.	DATE	DESCRIPTION

DRAWN BY: JJH	DATE 1/16/20
APPROVED BY:	DATE
DIMENSIONS IN INCHES	
SCALE NA	
TOLERANCE SEE NOTE	ANGULAR TOLERANCE
MATERIAL	WEIGHT
SHEET 1 OF 6	

J.E.GASHO & Assoc., Inc.
460 W. GAY ST.
WEST CHESTER, PENNSYLVANIA 19380

BLOWER BASE FRAME FOR 7021 WITH 150HP MOTOR

1100-C-9664 | –

OVERVIEW

Our full cone nozzles are available in several styles.

Standard Nozzles: Traditional threaded nozzles made of metal and, in some cases, Kynar® or polypropylene.

Quick-Connect Nozzles: Consisting of a nozzle body and spray tip, quick-connect nozzles can reduce maintenance time and lower costs. The spray tips can be removed for cleaning and/or replacement while the nozzle body remains on the pipe or spray header. We offer two lines of quick-connect nozzles:

- **QuickJet® Nozzles:**
  - A quick 1/4 turn of the wrist removes spray tips without tools.
  - Integral seal that remains attached to the spray tip to prevent accidental misplacement.
  - Available in metal, ProMax® (a chemically-coupled, glass-reinforced engineering grade of polypropylene) and Kynar materials. (See Section K, Special Purpose Spray Nozzles).
- **UniJet® Nozzles:**
  - Simply unscrew the retainer cap and remove the spray tip by hand. Then install the new spray tip and tighten the retainer cap to secure the spray tip in place.
  - Available in metal material.

Many of our nozzles are available in quick-connect versions. Watch for the QuickJet, Quick FullJet® and UniJet designations on the following pages. These nozzles are available with a wide variety of body types, mounting options, adapters, plugs, strainers, check valves, plates, fittings and more. See Section L, Accessories, for complete information.

QuickJet

Female body

Male body

Spray tip with seal

UniJet

Female body

Male body

Spray tip

Tip retainer

FULL CONE SPRAY NOZZLES TABLE OF CONTENTS

Optimization Tips

- Reduce operating costs and maintenance downtime by using quick-connect nozzles. Nozzle bodies remain on the header – only spray tips are replaced.
- Use strainers to reduce nozzle clogging and ensure optimum performance.
- Use adjustable ball connections for quick, precise nozzle orientation.
- Evaluate your specific spraying application and implement a regular nozzle maintenance plan.

  Maintenance essentials include:

  – Visual inspection of spray pattern. In full cone nozzles, watch for heavy streaks in the center of the spray. As wear occurs, more liquid flows to the center of the spray pattern.

  – Monitor flow rate and pressure to detect changes resulting from orifice or vane wear.
- Be sure to use the best type of full cone nozzle for your application.

  – Standard full cone nozzles provide a uniform, round and full spray pattern consisting of medium- to large-sized drops.

  – Spiral full cone nozzles produce relatively coarse drops in a full cone pattern with minimal flow obstruction.

  – Spray coverage is more uniform in standard full cone nozzles while spiral type full cone nozzles produce high flow rates in a compact nozzle size.
- In addition to washing and rinsing, full cone nozzles are often used for drop disbursement in chemical reactions, metal cooling, dust suppression and fire protection. Drop size and coverage can be critical in these applications. Ask for drop size data in addition to general performance data.

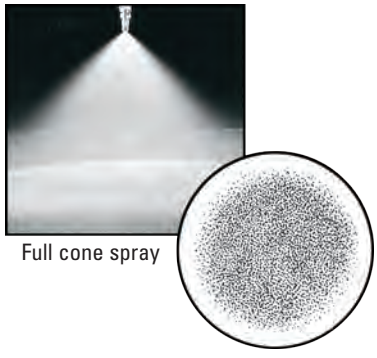
ProMax® QuickJet® Nozzles with Replaceable Tips

QPPA nozzle body

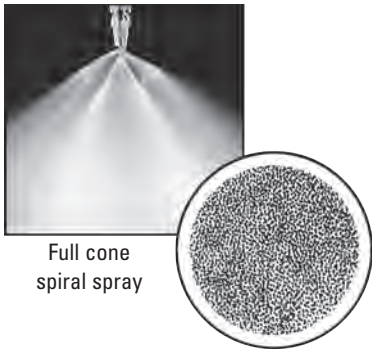
Optional external O-ring
(CP7717-2/17-VI)

Spray tip

Spray Pattern Inspection



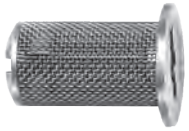
Full cone spray



Full cone
spiral spray

Adjustable Ball Connections

Strainers



Features and Benefits

- Solid cone-shaped spray pattern with round impact area.
- Uniform distribution over a wide range of flow rates and pressures.
- Medium- to large-sized drops.
- Unique vane design with large flow passages provides superior control and uniform distribution.
- Removable caps and vanes for easy inspection and cleaning on most models.
- Removable vane has location marks for proper positioning after cleaning.
- Set screws in some models secure the vane in the nozzle to prevent dislocation caused by vibration.
- Polypropylene material option offers exceptional chemical and corrosion resistance and resists caking and buildup.
- Wall-mounted options for installation on room exterior, vessel or pipeline.
- For installations with space limitations, right-angle mounting options allow for mounting at a 90° angle.

G

Removable cap and vane
1/8" to 1/2" NPT or BSPT (F)

GG

Removable cap and vane
1/8" to 1/2" NPT or BSPT (M)

H

One-piece body
3/4" to 1" NPT or BSPT (F)

H

Removable vane/cast body
1-1/4" to 8" NPT or BSPT (F)

H

Removable vane/Polypropylene
1-1/2" to 2" NPT or BSPT (F)
Maximum temperature rating is
150°F (66°C)

HF

Removable vane/cast body
4" to 10" flange connection

HH

One-piece body
1/8" to 1" NPT or BSPT (M)

GD

Wall-mounted
Removable cap and vane
1/8" to 1/2" NPT or BSPT (F)

HD

Wall-mounted
One-piece body
3/4" to 3" NPT or BSPT (F)

GGD

Wall-mounted
Removable cap and vane
1/8" to 1/2" NPT or BSPT (M)

GA

Angle type
Removable cap and vane
1/8" to 1/2" NPT or BSPT (F)

GGA

Angle type
Removable cap and vane
1/8" to 1/2" NPT or BSPT (M)

Optimization Tips

• See page B2 for optimization tips.

Applications

- Cooling coke, primary metals and other materials
- Creation/dispersion of drops in chemical reaction processing
- Dust control
- Fire suppression/prevention
- Foam break-up, aeration, deaeration
- Gas scrubbing, washing, cooling
- Washing/rinsing

Ordering Info

STANDARD SPRAY NOZZLE				
1/4	G	–	SS	10
Inlet Conn.	Nozzle Type		Material Code	Capacity Size

FLANGE CONNECTION				
10	HF	–	SS	1200
Inlet Conn.	Nozzle Type		Material Code	Capacity Size

BSPT connections require the addition of a "B" prior to the inlet connection.

See Also

- Accessories
  - Adjustable ball fittings
  - Check valves
  - Pressure gauges
  - Pressure regulators
  - Pressure relief valves
  - Solenoid valves
  - Split-eyelet connectors
  - Strainers
- FullJet Maximum Free Passage spray nozzles for applications prone to clogging
- SpiralJet® spray nozzles for maximum liquid throughput
- Kynar® FullJet spray nozzles for integrated circuit and PCB manufacturing, washing and rinsing, cooling and more (See Section K, Special Purpose Spray Nozzles)
- Kynar Quick FullJet spray nozzles for strippers, etchers, developers (See Section K, Special Purpose Spray Nozzles)

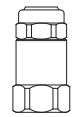
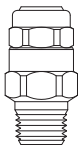
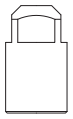
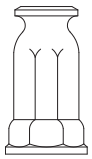
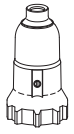
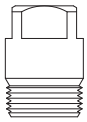
Performance Data

*At the stated pressure in psi.

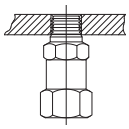
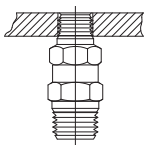
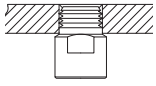
Inlet Conn. (in.)	Nozzle Type: Standard Type G	GG	H	HH	Wall Mounted GD	HD	GGD	Angle GA	GGA	Capacity Size	Orifice Dia. Nom. (in.)	Max. Free Passage Dia. (in.)	Capacity (gallons per minute)* 5	7	10	20	30	40	60	80	100	150	Spray Angle (°)* 7	20	80
1/8	●	●		●	●		●			1	.031	.025	.07	.08	.10	.14	.17	.19	.23	.26	.29	.35	–	58	53
	●	●		●						1.5	.047	.025	.11	.13	.15	.21	.25	.28	.34	.39	.43	.52	52	65	59
	●	●		●	●		●	●	●	2	.047	.040	.15	.17	.20	.28	.33	.38	.46	.52	.58	.70	43	50	46
	●	●		●	●		●	●	●	3	.063	.040	.22	.25	.30	.41	.50	.57	.68	.78	.87	1.0	52	65	59
	●	●		●	●		●	●	●	3.5	.063	.050	.25	.30	.35	.48	.58	.66	.80	.91	1.0	1.2	43	50	46
								●	●	3.9	.078	.040	.28	.33	.39	.54	.65	.74	.89	1.0	1.1	1.4	77	84	79
	●	●		●	●		●	●	●	5	.078	.050	.36	.42	.50	.69	.83	.95	1.1	1.3	1.4	1.7	52	65	59
								●	●	6.1	.094	.050	.44	.52	.61	.84	1.0	1.2	1.4	1.6	1.8	2.1	69	74	68
1/4	●	●		●	●		●	●	●	6.5	.094	.063	.47	.55	.65	.89	1.1	1.2	1.5	1.7	1.9	2.3	45	50	46
	●	●		●	●		●	●	●	10	.109	.063	.73	.85	1.0	1.4	1.7	1.9	2.3	2.6	2.9	3.5	58	67	61
								●	●	12.5	.125	.063	.91	1.1	1.3	1.7	2.1	2.4	2.9	3.3	3.6	4.3	69	74	68
3/8	●	●		●	●		●	●	●	9.5	.109	.094	.69	.81	.95	1.3	1.6	1.8	2.2	2.5	2.7	3.3	45	50	46
	●	●		●	●		●	●	●	15	.141	.094	1.1	1.3	1.5	2.1	2.5	2.8	3.4	3.9	4.3	5.2	64	67	61
								●	●	20	.156	.109	1.5	1.7	2.0	2.8	3.3	3.8	4.6	5.2	5.8	7.0	76	80	73
	●	●		●				●	●	22	.188	.109	1.6	1.9	2.2	3.0	3.6	4.2	5.0	5.7	6.3	7.6	87	90	82
1/2	●	●			●		●	●	●	16	.141	.125	1.2	1.4	1.6	2.2	2.7	3.0	3.6	4.2	4.6	5.6	48	50	46
	●	●		●	●		●	●	●	25	.188	.125	1.8	2.1	2.5	3.4	4.1	4.7	5.7	6.5	7.2	8.7	64	67	61
	●	●						●	●	32	.203	.141	2.3	2.7	3.2	4.4	5.3	6.1	7.3	8.3	9.2	11.1	72	75	68
	●	●		●				●	●	40	.250	.141	2.9	3.4	4.0	5.5	6.6	7.6	9.1	10.4	11.5	13.9	88	91	83
								●	●	50	.266	.156	3.6	4.2	5.0	6.9	8.3	9.5	11.4	13.0	14.4	17.4	91	94	86
3/4			●	●		●				2.5	.188	.172	2.1	2.5	2.9	4.1	4.9	5.6	6.7	7.7	8.5	10.2	48	50	46
			●	●		●				4.0	.250	.172	3.4	4.0	4.7	6.5	7.8	8.9	10.7	12.3	13.6	16.4	67	70	63
			●	●		●				7.0	.375	.203	6.0	7.0	8.2	11.3	13.7	15.6	18.8	21	24	29	89	92	84
1			●	●		●				4.2	.234	.219	3.6	4.2	4.9	6.8	8.2	9.4	11.3	12.9	14.3	17.2	48	50	46
			●	●		●				7.0	.328	.219	6.0	7.0	8.2	11.3	13.7	15.6	18.8	21	24	29	67	68	62
			●	●						8.0	.375	.219	6.9	8.0	9.4	13.0	15.6	17.8	21	25	27	33	72	81	82
			●	●						10	.469	.219	8.6	10.0	11.8	16.2	19.5	22	27	31	34	41	78	90	94
			●	●						12	.469	.250	10.3	12.0	14.1	19.4	23	27	32	37	41	49	89	92	84

Maximum Free Passage Diameter is the maximum diameter as listed of foreign matter that can pass through the nozzle without clogging.

Dimensions and Weights

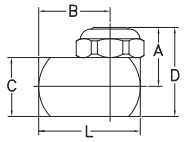
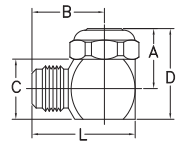
Standard	Nozzle Type	Inlet Conn. (in.)	Length (in.)	Dia. (in.)	Hex. (in.)	Net Weight (oz.)
	G (F)	1/8	1-7/32	–	9/16	1
		1/4	1-15/32	–	11/16	1-1/2
		3/8	1-13/16	–	13/16	2-1/2
		1/2	2-1/4	–	1	6
	GG (M)	1/8	1-9/32	–	9/16	3/4
		1/4	1-9/16	–	11/16	1-1/2
		3/8	1-27/32	–	13/16	2-1/2
		1/2	2-7/32	–	1	6
	H Bar Stock (F)	3/4	2-3/16	1-1/4	–	7-1/4
		1	2-3/4	1-1/2	–	13
	H Cast (F)	1-1/4	3-7/16	2-1/16	–	20
		1-1/2	4-1/16	2-5/16	–	28
		2	5-7/16	3	–	60
		2-1/2	6-7/8	3-7/16	–	76
		3	7-23/32	4-1/8	–	96
		4	9-7/8	5-7/16	–	18 lbs.
		5	12-1/4	6-3/4 oct.	–	38 lbs.
		6	14-3/8	8 oct.	–	53 lbs.
		8	18-1/2	9-1/2 oct.	–	92 lbs.
	H Polypropylene (F)	1-1/2	4-1/16	2-11/32	–	2-1/4
		2	5-9/32	2-13/16	–	3-3/4
	HF (Flange)	4	8-1/8	9	–	27 lbs.
		5	10-9/16	10	–	36 lbs.
		6	12-5/8	11	–	49 lbs.
		8	16-5/8	13-1/2	–	106 lbs.
		10	20-3/4	16	–	173 lbs.
	HH (M)	1/8	7/8	1/2	–	1/2
		1/4	29/32	17/32	–	1/2
		3/8	9/10	21/32	–	1
		1/2	1-2/5	13/16	–	1-1/2
		3/4	1-19/32	1-1/16	–	3-1/2
		1	2-3/32	1-5/16	–	7

Based on largest/heaviest version of each type.

Wall-Mounted	Nozzle Type	Inlet Conn. (in.)	Length (in.)	Dia. (in.)	Hex. (in.)	Net Weight (oz.)
	GD (F)	1/8	1-25/64	–	9/16	1
		1/4	1-39/64	–	11/16	1-1/2
		3/8	1-13/16	–	13/16	2-1/2
		1/2	1-13/64	–	1	4-3/4
	GGD (M)	1/8	1-29/64	–	9/16	1
		1/4	1-45/64	–	11/16	1-1/2
		3/8	1-27/32	–	13/16	2-1/2
		1/2	2-11/64	–	1	4-1/2
	HD (F)	3/4	2-1/8	1-1/4	–	6
		1	2-11/16	1-1/2	–	14
		1-1/4	3-3/8	1-7/8	–	24
		1-1/2	4-1/16	2-1/4	–	40
		2	5-1/16	2-3/4	–	72
		2-1/2	6-1/4	3-1/4	–	7 lbs.
		3	7-5/16	4	–	12-3/4 lbs.

Based on largest/heaviest version of each type.

Dimensions and Weights

Angle Type	Nozzle Type	Inlet Conn. (in.)	A (in.)	B (in.)	C (in. sq.)	D (in.)	L (in.)	Net Weight (oz.)
	GA (F)	1/8	11/16	5/8	9/16	31/32	29/32	1-1/2
		1/4	7/8	25/32	11/16	1-7/32	1-5/32	2
		3/8	1	7/8	13/16	1-7/16	1-9/32	3-1/4
		1/2	1-17/32	1-1/16	1	2-1/32	1-9/16	6-1/4
	GGA (M)	1/8	11/16	21/32	9/16	31/32	15/16	1-1/2
		1/4	7/8	13/16	11/16	1-1/4	1-5/32	2
		3/8	1	29/32	13/16	1-7/16	1-5/16	3-1/4
		1/2	1-17/32	1-1/8	1	2-1/32	1-5/8	6-1/4

Based on largest/heaviest version of each type.

Materials

Material	Material Code	Nozzle Type									
		G	GG	H	HF	HH	GD	HD	GGD	GA	GGA
Bar Stock:											
Brass	(none)	●	●	●		●	●	●	●	●	●
Mild Steel	I	●	●	●		●	●	●	●	●	●
303 Stainless Steel	SS	●	●	●		●	●	●	●	●	●
316 Stainless Steel	316SS	●	●	●		●					
Polypropylene†	PP			●							
Polyvinyl Chloride	PVC	●	●	●		●					
Cast:											
Brass	(none)			●	●						
Cast Iron	I			●	●						
316 Stainless Steel	SS			●	●						

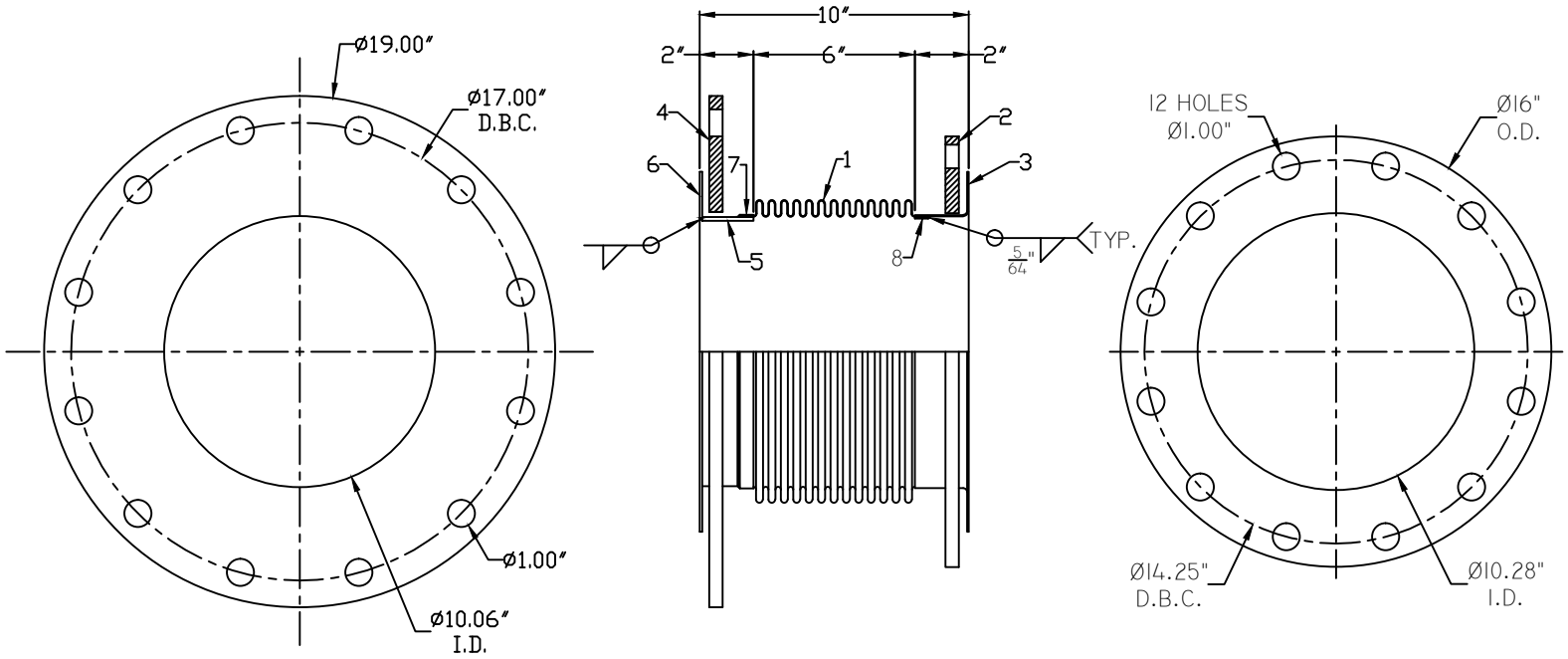
†Polypropylene is only available for H with 1-1/2" and 2" inlet connections.

Some models are available in Kynar®. Other materials available upon request.

See Section K, Special Purpose Spray Nozzles for more details or contact your local representative.

ALL DIMENSIONS ARE IN INCHES

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
0	INITIAL RELEASE	01-21-2020	J.K.



ITEM	QTY	DESCRIPTION	MATERIAL	MTR
1	1	BELLOWS, 10" I.D. X 2 PLY .012" THK.	A 240 T-316	
2	1	FLANGE, FIXED, 10" -125/150# X 1/2" THK.	A 36	
3	1	VANSTONE STUB, 10" TUBE BOS. X .050" THK.	A 240 T-316	
4	1	FLANGE, FLOATING, 12" X 10" REDUCING ANSI X 1/2" THK.	A 36	
5	1	TUBE, 10" O.D. X .135" THK.	A 269 T-316	
6	1	RING, 12.68" O.D. X 9.94" I.D. X 12 GA.	A 240 T-316	
7	1	EXTERNAL BAND, 1/2" WIDE X .062" THK.	A 240 T-316	
8	1	INTERNAL BAND, 1/2" WIDE X .062" THK.	A 240 T-316	

GENERAL NOTES:

1. DESIGN AND FABRICATE IN ACCORDANCE WITH THE EJMA STANDARDS.
   (EXPANSION JOINT MANUFACTURE'S ASSOCIATION).
2. WELDING SHALL BE IN ACCORDANCE WITH ASME SECTION IX.
3. COMPLETED ASSEMBLY SHALL BE CLEAN AND FREE OF ALL LOOSE FOREIGN MATTER.
4. SHIPPING BARS SHALL BE EQUALLY SPACED, PAINTED YELLOW AND TAGGED:
   "REMOVE AFTER INSTALLATION."

DESIGN SPECIFICATIONS			
DESIGN PRESS:	5 PSIG.	NON-CONCURRENT MOVEMENTS	
MAX. DESIGN TEMP:	1,000°F	COMPRESSION:	.3"
MEDIA:	--	EXTENSION:	0"
CYCLE LIFE:	50,000	LATERAL OFFSET:	0"
TEST:	NONE	ANGULAR:	0°
TEST PRESS.	--	AXIAL SPRING RATE:	44 LBS/IN
ASSY WEIGHT:	-- LBS. APPROX.	LATERAL SPRING RATE:	100 LBS/IN

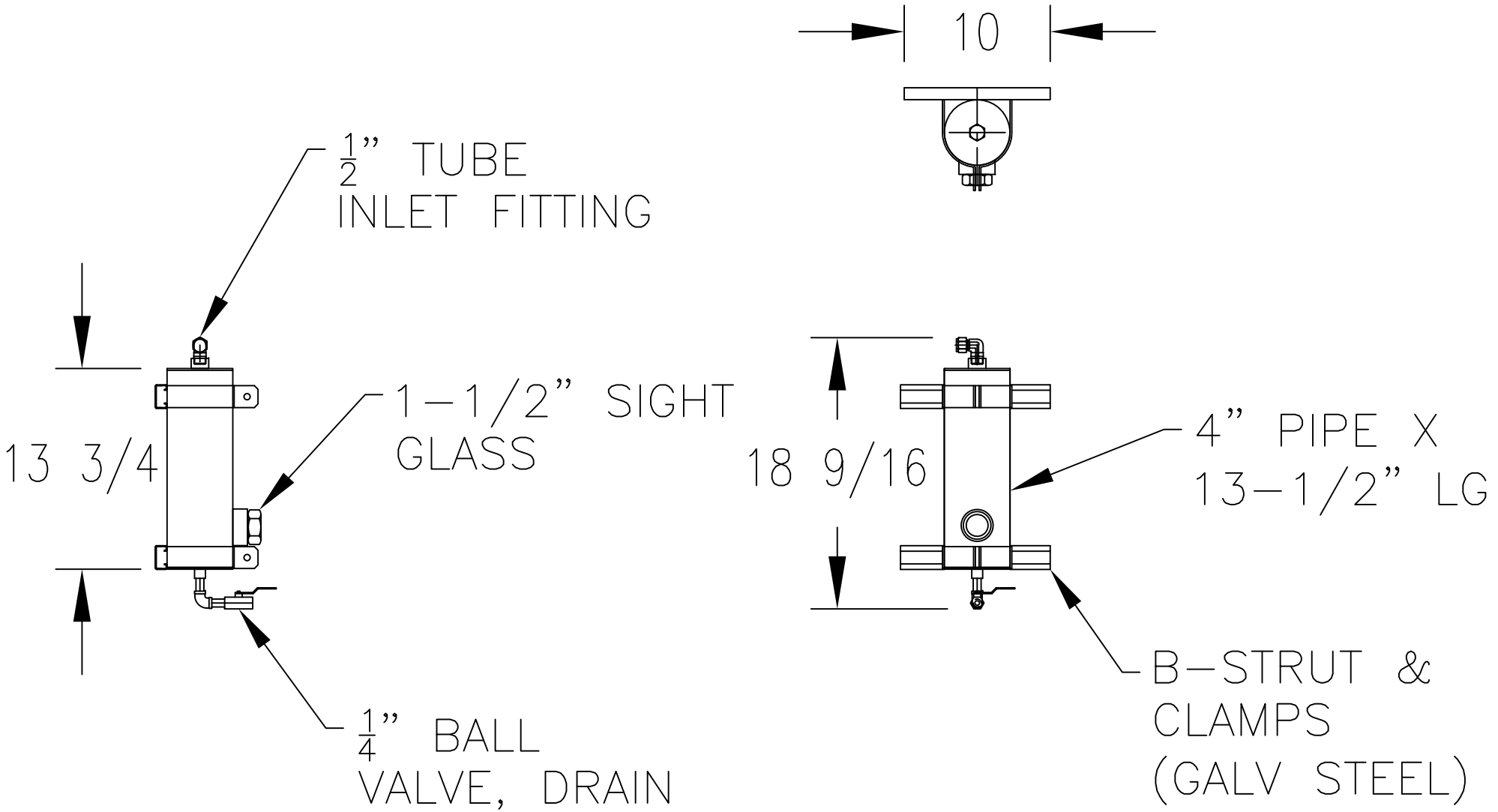
TOLERANCES: UNLESS OTHERWISE SPECIFIED, TOLERANCES ARE AS FOLLOWS: EXP. JOINTS: OAL. ± 1/8" UP THRU 36" ± 1/4" 36" THRU 144" ± 3/8" OVER 144" HOSE ASSY. OAL. ±1/8" PER FT.

OUT OF ROUNDNESS. MEASURED DIFFERENCE BETWEEN MAJOR & MINOR DIA: 1% MAX.

DESIGNED BY: J.K.
DRAWN BY: L.V.
CHECKED BY:
SALESMAN:
QC:
THIRD ANGLE PROJECTION
FRACTIONS: ±1/8" DEC. .XX: ±.03" DEC. .XXX: ±.010" ANGLE: ± 2° DIAMETRICAL: ±5% OF O.D.

DME
14001 MARQUARDT AVE.
SANTA FE SPRINGS, CA 90670
TEL: 562-921-0644 FAX: 562-802-7489

DESCRIPTION: 10" DIAMETER EXPANSION JOINT
ORIG. DATE: 01-21-2020
CURR. DATE: 01-21-2020
CUSTOMER: J.E. GASHO & ASSOCIATES, INC.
SHEET: 1 OF 1
JOB NUMBER: P2263
REV: 0
DWG NO: 1000-22995
SCALE: NTS



NOTES:
1. MATERIAL 304 SS.
2. FINISH – NONE
3. ALL CONTINUOUS WELDS TO ASME B31.3
4. TOLERANCES .X=.03" .XX=.01
.XXX=.005" 1/X=1/16" ANGULAR = ±1/4°
(INCL IMPLIED 90°) (DIM) ARE CRITICAL
5. FIRST USED

REV.	DATE	DESCRIPTION

DRAWN BY: JJH	DATE 11/11/19
APPROVED BY:	DATE
DIMENSIONS IN INCHES	
SCALE NA	
TOLERANCE ±1/2"	ANGULAR TOLERANCE
MATERIAL 304 SS	WEIGHT
SHEET 1 OF 1	

J.E.GASHO & Assoc., Inc.
460 W. GAY ST.
WEST CHESTER, PENNSYLVANIA 19380

VENT TO DRAIN
CONDENSATE CONTAINER
ø4"

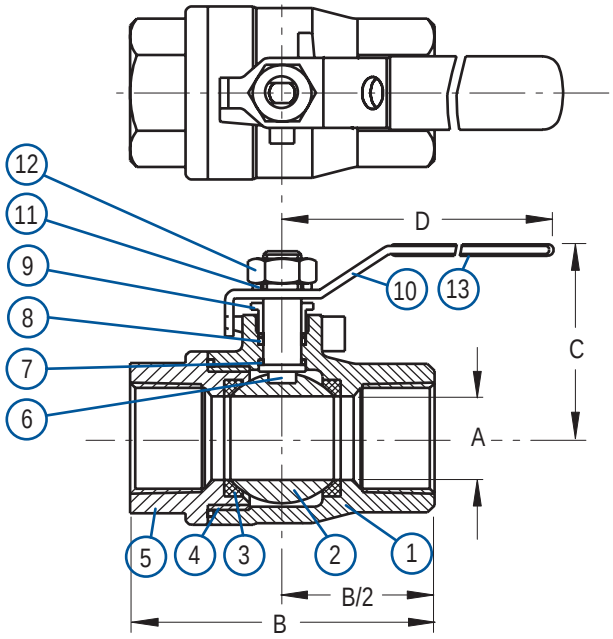
1100-C-9659 | –

DURAVALVE MODEL D210 BALL VALVE

2-PIECE FULL PORT 316 STAINLESS STEEL 1000 PSI

FEATURES AND SPECIFICATIONS

- 1/4" to 2" Sizes
- Adjustable Vee Style Stem Packing
- NTP Threaded Ends to ANSI B2.1
- Internal Entry Blow-Out Proof Stem
- Pressure Rating: 1000 PSI Maximum
- Temperature Range: -20° F – 450° F
- Meets WW-V-35 Design Specifications



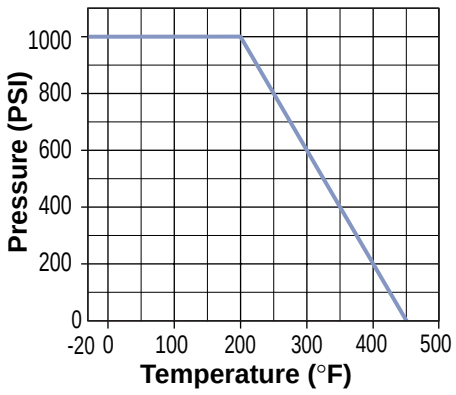
MATERIALS OF CONSTRUCTION

Item	Description	Material	Qty.
1.	Body	CF8M	1
2.	Ball	CF8M	1
3.	Seat	RTFE	2
4.	End Gasket	PTFE	1
5.	End Cap	CF8M	1
6.	Stem	316 SS	1
7.	Thrust Washer	RTFE	1
8.	Stem Packing	PTFE	1
9.	Gland Nut	304 SS	1
10.	Handle	304 SS	1
11.	Washer	304 SS	1
12.	Nut	304 SS	1
13.	Handle Sleeve	Vinyl	1

DIMENSIONS IN INCHES

Valve Size	Part Number	A	B	C	D	Weight Lbs.	C_V	Torque In.- Lb.
1/4	20200A	.47	2.09	1.81	3.62	.46	7	40
3/8	20200B	.47	2.09	1.81	3.62	.46	9	40
1/2	20200C	.59	2.48	1.93	3.62	.68	11	60
3/4	20200D	.79	2.91	2.24	4.57	1.15	24	80
1	20200E	.98	3.39	2.60	5.63	1.85	45	120
1-1/4	20200F	1.26	3.90	2.80	5.63	2.82	90	240
1-1/2	20200G	1.50	4.25	3.19	6.97	4.19	125	420
2	20200H	1.97	5.20	3.50	6.97	6.66	190	560

PRESSURE/TEMPERATURE CURVE



DuraValve, Inc.

847-616-0430 • 800-776-1260 • FAX 847-616-0432 • www.duravalve.com

Type 303 Stainless Steel Sight

6490T17

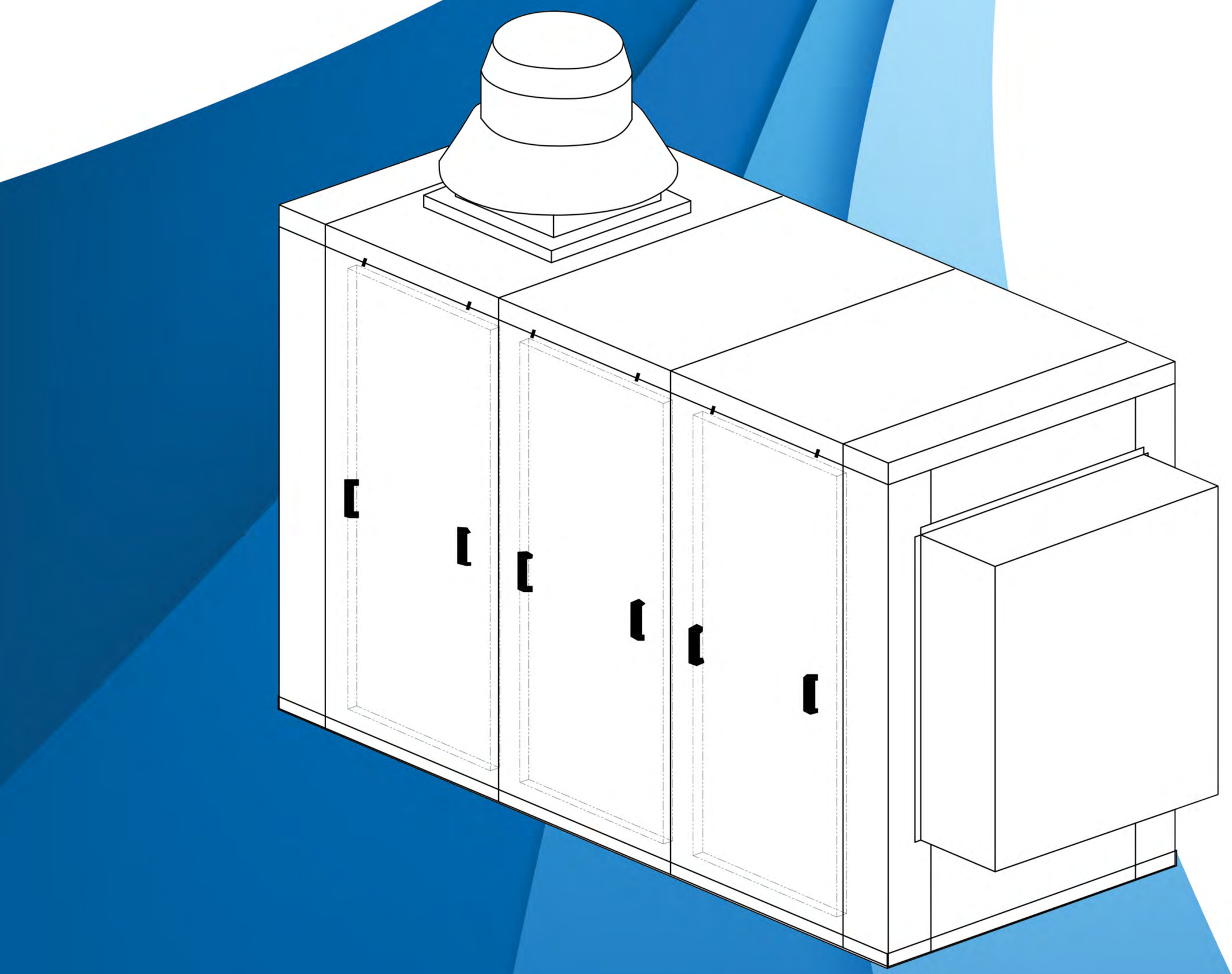
without Reflector, 1-1/2 NPT Male, 2" Hex

Pipe Size	1 1/2
Window Diameter	1 1/2"
Hex Size	2"
Maximum psi @ 70° F	50
Additional Specifications	For Clear Liquid Type 303 Stainless Steel—Temp. Range is 0° to 225° F NPT Male Connection

See inside tanks, gear cases, bearing housings, and mixers.

Type 303 stainless steel sights are for use with hydraulic oil, diesel fuel, and water. Seal is Buna-N. They are more corrosion resistant than brass and steel sights.

APPLIED
ACOUSTICAL
GROUP



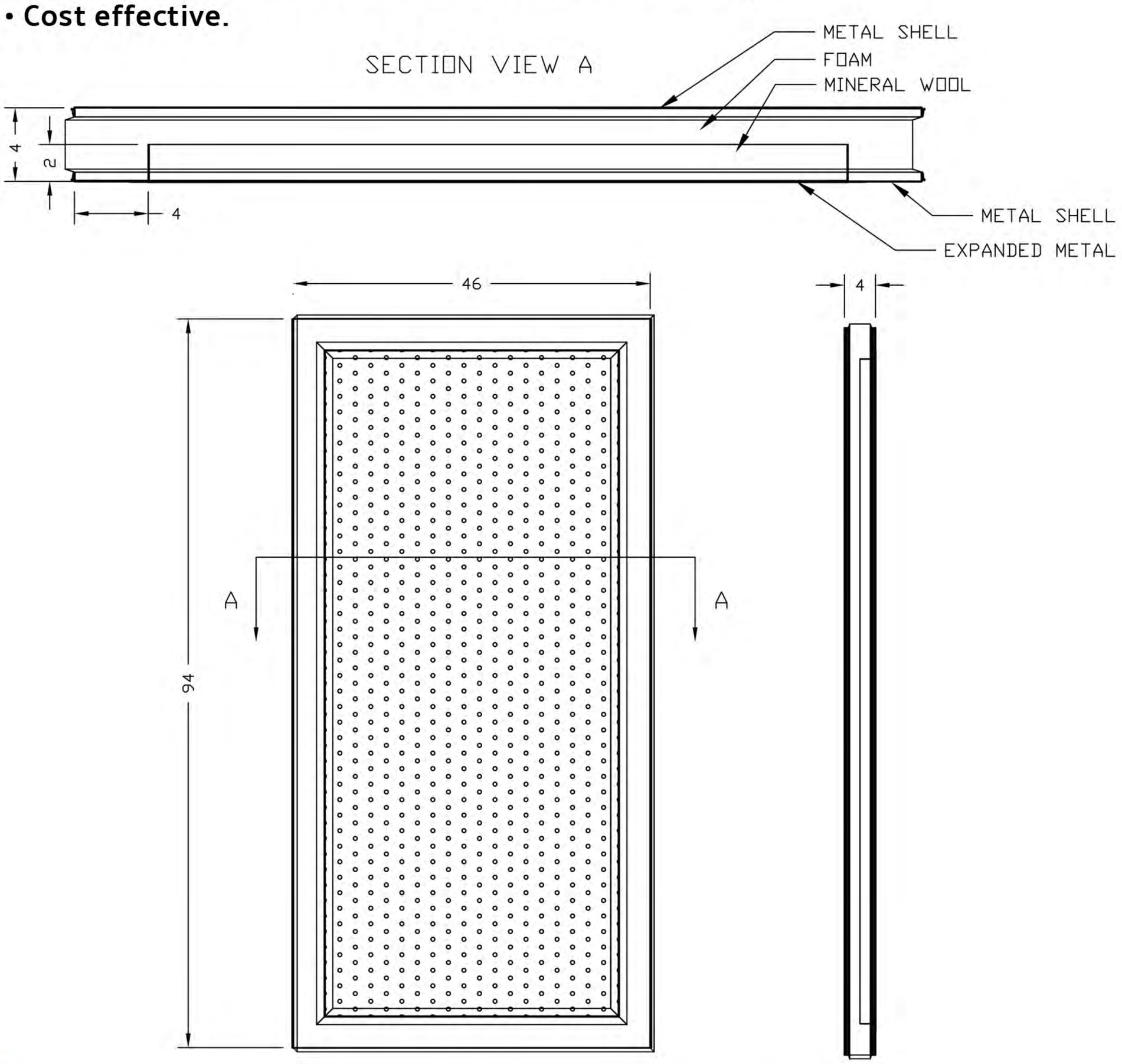
ACOUSTICAL ENCLOSURE PRODUCT GUIDE

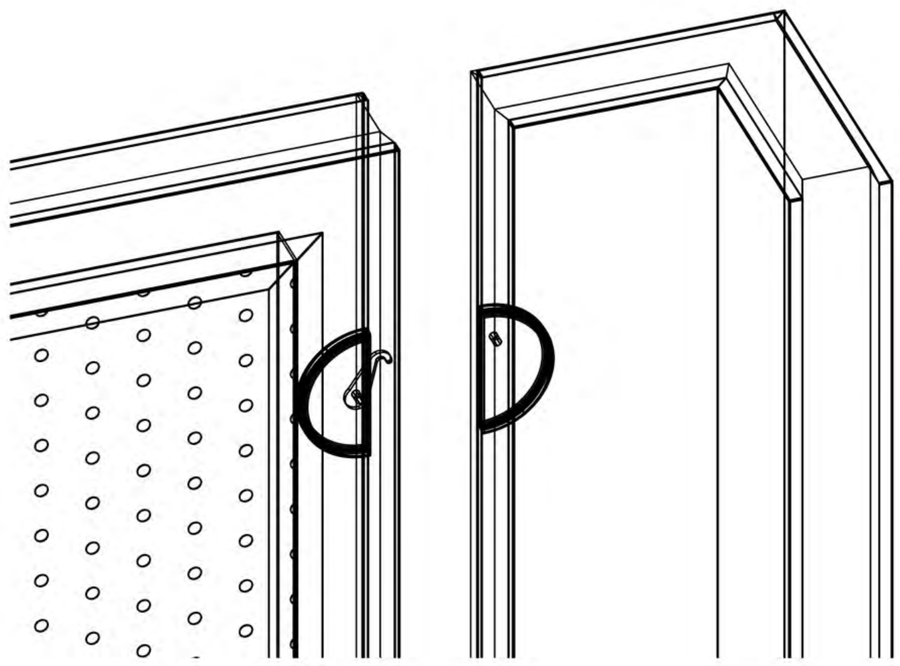
-PATENT PENDING-

“Controlling your environment so you can control your process”

Benefits:

- AAG enclosures are the easiest sound enclosures to install on the market.
- Lead time is 4-6 weeks from drawings approval.
- Our standard galvalume outer shell lasts almost 9.3x longer than the industry standard galvanized panel construction.
- “Screwless assembly”- Due to our formed-in-place panel locking system, our panels do not need hundreds of screws to assemble, making these units even more appealing to a customer that may need to move or take down the units multiple times.
- Manufactured in the USA in an ISO certified facility.
- Cost effective.





Base Model Features:

- STC rating of 30.
- NRC rating of .90.
- 2.54 lbs psf.
- Removable panels.
- Closed cell urethane foam combined with a layer of 4lb/psf density mineral wool.
- 10 year panel warranty.
- Embossed Galvalume finish. On average lasts 9.3x longer than galvanized.
- 20 year rust-through warranty on galvalume finish.
- Forced air ventilation system.
- Installation drawings.
- “Formed-in-place” panel locking mechanism.
- The prefabricated urethane foamed panels shall be supplied with Class 1 fire hazard classification according to UL 723 (ASTM-E-84), as tested by Underwriters Laboratories Inc. Panels shall have a flame spread rating of 25 or less.
- The panels are provided with PVC gaskets which are “formed-in-place” on both interior and exterior sides of the panels. The gaskets are impervious to all stains, greases, mildews, etc. They ensure an airtight seal and also eliminate the need for seam caulking.

Other Finish Options: Powder coated, Stainless Steel, aluminum, embossed galvalume (standard). 16-26 guage steel thickness.

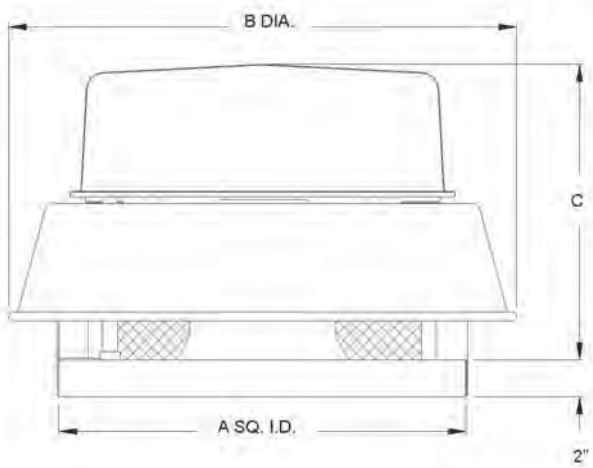
Type CRDA

Direct Drive Centrifugal Power Roof Ventilator

ILG INDUSTRIES

AMERICAN COOLAIR CORPORATION

Accessories



- Non-overloading aluminum wheel computer balanced
- Force ventilated motor compartment isolated from the airstream
- Vibration isolators on drive frame
- Weatherproof spun aluminum housing
- NEMA Standard frame size motors
- Overlapping wheel/inlet venturi
- 1/2" galvanized mesh birdscreen
- Factory mounted and wired disconnect device
- UL Listed for Standard 705 (most models)

A	B	C
23	28 5/8	16 1/2

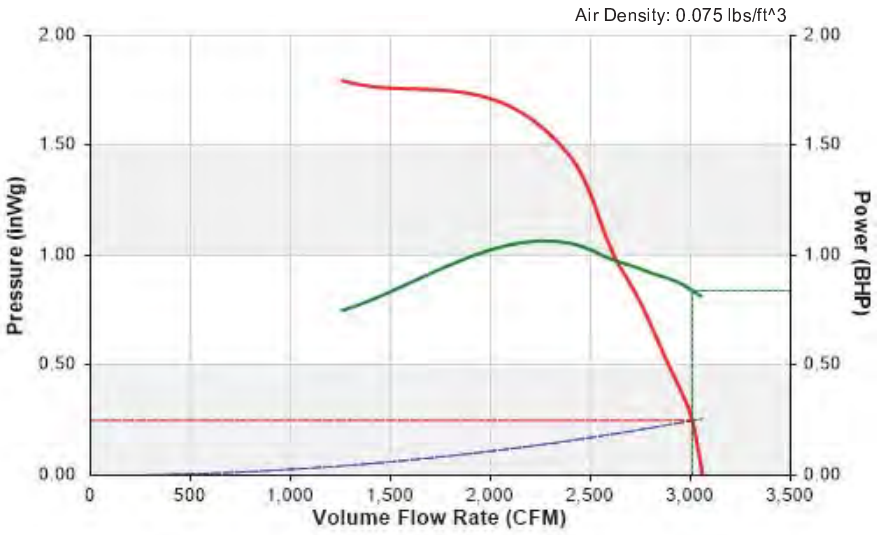
Dimensions in inches unless otherwise noted

Weight: 84 lbs. Tip Speed: 6,493 ft/min Outlet Velocity: 1,019 ft/min

Qty	Fan Data					Motor Data					Accessories
	Model No.	CFM	inWg	RPM	BHP	MHP	RPM	Voltage/Ph	Hz	Encl.	
1	CRDA15K15D1151	3,008	0.250	1,550	0.842	3/4	1,550	115V 1PH	60	OPEN	

Sones	LwA	dba @ 5'	dba @ 10'	dba @ 20'	Octave Band Sound Power (LwA)							
					63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
21	83	72	66	60	80	93	88	78	70	69	69	58

American Coolair Corporation certifies that the Type CRDA units 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 AMCA Publication 311 and comply with the requirements of the AMCA certified Ratings Program.



AMCA Licensed for Sound and Air Performance
Performance ratings do not include the effects of appurtenances (accessories).
Performance shown is for Installation Type 'A' : Free inlet, Free outlet
The sound ratings shown are loudness values in hemispherical sones at 1.5 m (5 ft.) in a hemispherical free field calculated per AMCA Standard 301.
Values shown are for Installation Type 'A' : Free inlet hemispherical sone levels
Sound ratings apply to sones only.

Notes:

Project: R&M Unit Pricing **Engineer:** _____

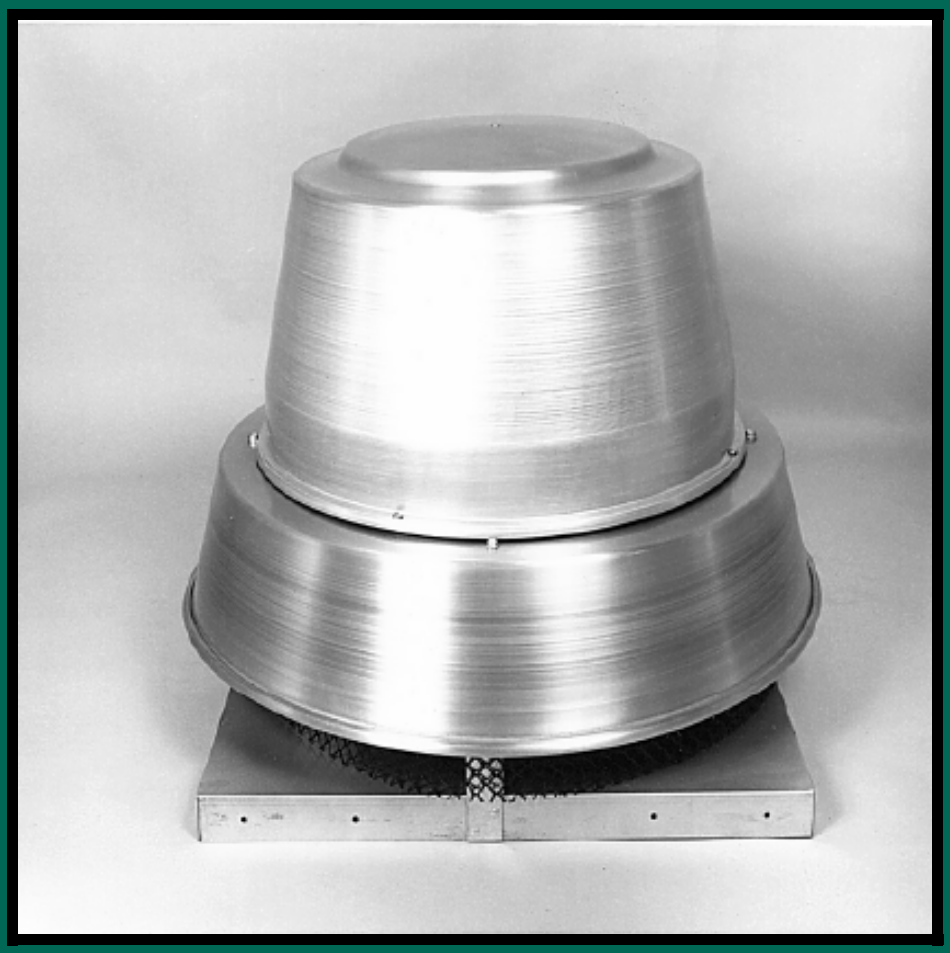
Location: _____ **Contractor:** _____

Submitted By: _____ **Date** 10/17/2017

Approved By: _____ **Date** _____

ILG INDUSTRIES

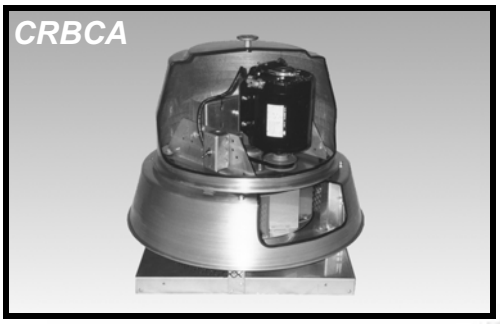
AMERICAN COOLAIR CORPORATION



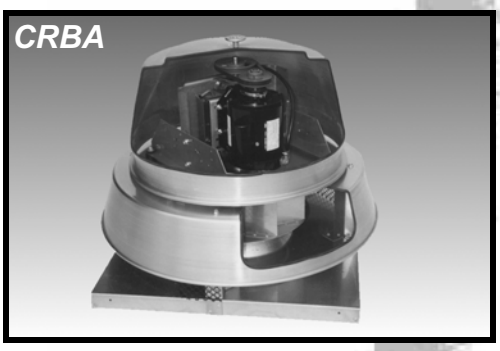
Centrifugal Power Roof Ventilators

TYPE CRBCA - BELT DRIVE
TYPE CRBA - BELT DRIVE
TYPE CRDA - DIRECT DRIVE

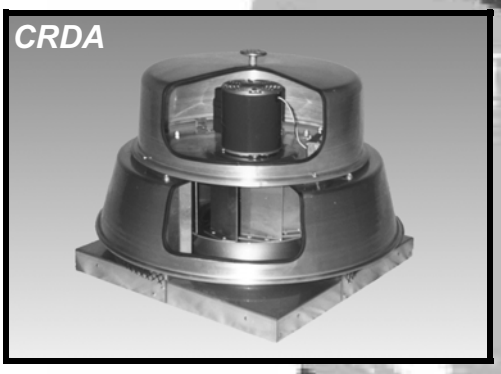
TABLE OF CONTENTS



Sizes 06 to 24
Flow rates from
185 to 10,3280 CFM
and 2" Static Pressure



Sizes 06 to 52
Flow rates from
185 to 43,962 CFM
and 2" Static Pressure



Sizes 06 to 20
Flow rates from
162 to 5,730 CFM
and 1" Static Pressure

BELT DRIVE FANS

CRBCA and CRBA

DIRECT DRIVE FANS

CRDA

STANDARD FEATURES

CRBCA, CRBA and CRDA Units

Weather-resistant aluminum motor compartment cover removes easily for access to motor and drives.

Out-of-airstream open motors are isolated for protection from exhaust airstream.

Aluminum centrifugal wheel is non-overloading, backward inclined design with state-of-the-art computerized balance.

Overlapping wheel and deep-spun venturi minimize noise and air turbulence, increasing efficiency.

Wheel balance weights are permanently affixed to assure vibration-free operation.

Wheel backplate fins cool the motor compartment, extending motor life.

Birdscreen is 1/2" galvanized mesh

AMCA Seal assures certified rating of air and sound performance.

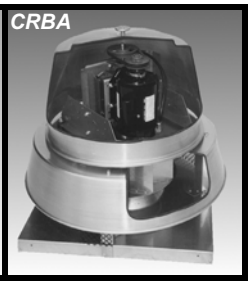
UL Listed for Standard 705.

CRBCA and CRBA

Factory-wired disconnect switch is an available option.

Belt drive with adjustable motor pulley for flexibility to match operating requirements.

Hinged motor bracket with tensioning bolt(s) facilitates maintenance of belt tension.

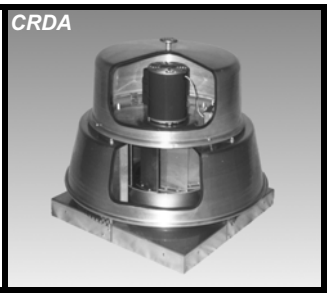


CRDA

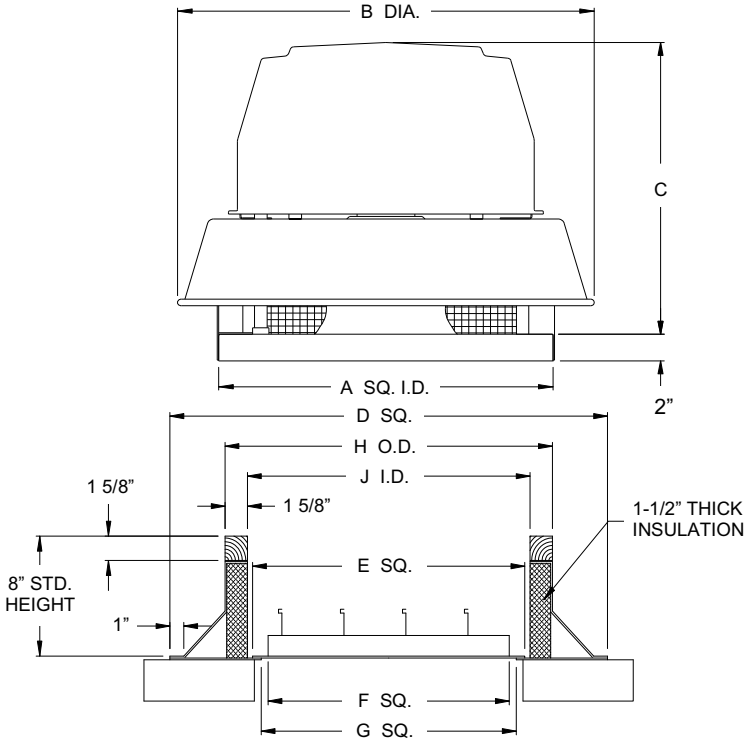
Factory-wired disconnect device for standard motors.

Direct-drive assembly reduces maintenance and operating costs.

Variable speed control available on some models.



CRBCA, CRBA and CRDA Ventilator, Roof Curb and Damper Dimensions



Unit	Ventilator Dimensions			Roof Curb and Damper Dimensions					
	A	B	C	D	E	F	G	H	J
CRBA & CRBCA 06, 08, 10	18	23 1/8	20 1/2	24 1/2	12 1/2	10	11 1/4	16 1/2	13 1/4
CRDA 06, 08, 10	18	23 1/8	12	24 1/2	12 1/2	10	11 1/4	16 1/2	13 1/4
CRBA & CRBCA 12, 13, 15 CRDA 12J17, 13K17 & 15L17	23	28 5/8	22 1/2	29 1/2	17 1/2	15	16 1/4	21 1/2	18 1/4
CRDA 12E10, 12J16, 13F11, 13J15, 15H10 & 15K15	23	28 5/8	16 1/2	29 1/2	17 1/2	15	16 1/4	21 1/2	18 1/4
CRBA, CRBCA & CRDA 16, 18, 20	30	35 1/2	24 5/8	36 1/2	24 1/2	22	23 1/4	28 1/2	25 1/4
CRBA & CRBCA 24	34	42 3/4	32 1/2	40 1/2	28 1/2	26	27 1/4	32 1/2	29 1/4
CRBA 30	40	50 1/4	36 3/4	46 1/2	34 1/2	32	33 1/4	38 1/2	35 1/4
CRBA 36	46	61 3/4	44 1/4	52 1/2	40 1/2	38	39 1/4	44 1/2	41 1/4
CRBA 44	56	71 1/4	49	62 1/2	50 1/2	48	49 1/4	54 1/2	51 1/4
CRBA 52	65	83 3/4	55 1/2	71 1/2	59 1/2	57	58 1/4	63 1/2	60 1/4

Dimensions in inches

CRDA
Direct Drive Centrifugal Power Roof Ventilators

Applications

The CRDA units are quiet, dependable power roof ventilators recommended for a wide range of general exhaust applications where low and medium ranges of air volume and pressure are specified. Applications include virtually all types of light manufacturing, commercial and institutional buildings such as shopping centers, hospitals, schools, hotels, office and apartment buildings, warehouses, airports, bus terminals and many others.

CRDA units are specified where a roof-mounted location is desired to eliminate interference with other equipment or activities in the building. They permit the direct upward venting of air. CRDA units may be used with or without ducts.

The advantages of a CRDA direct-drive over a belt-drive roof ventilator include lower maintenance requirements, reduced risk of lower performance levels as a result of loosened belts, and lower operating costs.

Construction

CRDA models feature a housing of durable spun aluminum for optimum weather protection. The overlapping deep-spun venturi minimizes air turbulence and increases efficiency.

The aluminum centrifugal wheel is a non-overloading, backward-inclined type, selected for low noise levels. Backplate fins draw cool air through the motor compartment.

The wheel is secured to the machined aluminum hub, and computer balanced on state-of-the-art equipment. The hub features a line bore, which eliminates the need for bushings. Neoprene vibration isolators to reduce noise and wear, 1/2" galvanized mesh birdscreen and factory wired disconnect device are all standard features.

Drive Mechanism

CRDA models have all the advantages of a direct drive assembly. There are no belts, bearings or pulleys to consume power or require maintenance.

Motors

The standard motor for most CRDA models is open drip-proof construction and located out of the airstream. Totally enclosed, energy efficient, two-speed and explosion-proof motors may also be available. All motor brands are recognized and serviced nationwide. Motor enclosure may affect UL Listing.

c UL us LISTED

UL705 - E39944

Type CRDA ventilators are Listed by Underwriters Laboratory Inc. to US and Canadian safety standards.

AMCA CERTIFIED RATINGS SOUND AND AIR PERFORMANCE
AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.

American Coolair Corporation, ILG Industries certifies that the Type CRDA PRVs 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 AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.

Guide Specifications

Power Roof Ventilators shall be of the CRDA centrifugal type as manufactured by ILG Industries of American Coolair Corporation (individual models to be listed in fan schedule). Units shall meet UL Standard 705 and shall bear the AMCA Certified Ratings Seal for air and sound performance. Base and venturi inlet shall be one piece heavy gauge spun galvanized steel, with wheel and venturi overlapping for efficient operation. Motor compartment cover shall be heavy gauge spun aluminum construction and easily removable for access to motor and drive.

Drive mechanism shall be of the direct-drive design. The line bore hub shall be mounted onto the backplate of the centrifugal wheel. The centrifugal wheel shall be heavy gauge aluminum with backward-inclined, non-overloading blades and be computer balanced.

Motor shall be open construction, NEMA design B. Optional variable speed control on some models allows for field adjustment and system balance. Motor shall be mounted with the shaft down to allow easy access to the electrical terminal board/circuit box.

Backdraft damper, epoxy coating, roof curb and other accessories shall be listed in the fan schedule.)

CRDA15 - CRDA 20 Performance Data

CRDA15 CFM at Static Pressure																RPM RANGE OF SELECTED MODELS			RPM
0.00		.125		.250		.375		.500		.625		.750		1.00		CRDA15H11	CRDA15K15	CRDA15L17*	
BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	1/3 HP	3/4 HP	1 HP	
1,089		930																	550
0.04	2.4	0.04	1.9																
1,286		1,169		1,015															650
0.06	3.9	0.07	3.2	0.08	3.1														
1,484		1,391		1,250		1,088													750
0.09	5.2	0.10	4.5	0.11	4.3	0.12	4.3												
1,682		1,609		1,493		1,378		1,194											850
0.13	6.8	0.15	6.2	0.16	5.9	0.17	5.8	0.18	5.7										
1,880		1,824		1,722		1,604		1,517		1,334									950
0.19	8.6	0.20	8.0	0.21	7.6	0.23	7.5	0.24	7.3	0.25	7.2								
2,177		2,134		2,053		1,966		1,860		1,785		1,677							1100
0.29	11.9	0.30	11.4	0.32	10.9	0.33	10.7	0.35	10.5	0.36	10.4	0.38	10.2						
2,276		2,237		2,163		2,079		1,984		1,897		1,824							1150
0.33	13.1	0.34	12.6	0.36	12.2	0.38	11.9	0.39	11.7	0.41	11.6	0.43	11.4						
2,474		2,439		2,379		2,301		2,224		2,128		2,056		1,868					1250
0.42	15.6	0.44	15.1	0.46	14.7	0.48	14.4	0.49	14.2	0.51	14.1	0.53	13.9	0.56	13.5				
2,672		2,641		2,593		2,521		2,450		2,375		2,284		2,161					1350
0.53	17.8	0.55	17.4	0.57	17.0	0.59	16.8	0.61	16.5	0.63	16.4	0.65	16.2	0.68	15.8				
2,820		2,791		2,750		2,685		2,617		2,549		2,471		2,333					1425
0.63	20	0.64	19.2	0.66	18.9	0.69	18.6	0.71	18.4	0.72	18.1	0.75	17.7	0.79	17.2				
2,969		2,941		2,904		2,847		2,782		2,718		2,652		2,501					1550
0.73	21	0.75	21	0.77	20	0.79	20	0.82	20	0.83	20	0.85	19.3	0.90	18.8				
3,414		3,391		3,363		3,325		3,273		3,216		3,160		3,046					1725
1.11	26	1.13	26	1.15	25	1.18	25	1.21	24	1.24	24	1.25	24	1.30	24				

CRDA16 CFM at Static Pressure																RPM OF SELECTED MODELS			RPM
0.00		.125		.250		.375		.500		.625		.750		1.00		CRDA16J8*	CRDA16L11*	CRDA16N17*	
BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	1/2 HP	1 HP	2 HP	
2439		2321		2178		2018		1854		1621									825
0.22	8.3	0.24	7.6	0.26	7.2	0.27	6.9	0.28	6.2	0.28	5.9								
3429		3349		3262		3165		3057		2942		2830		2595					1160
0.60	16.8	0.64	15.8	0.67	15.2	0.69	14.9	0.72	14.4	0.74	14.1	0.76	14.0	0.79	12.2				
5173		5121		5067		5012		4954		4894		4830		4693					1750
2.08	31	2.12	30	2.17	29	2.22	29	2.26	28	2.31	28	2.35	28	2.43	27				

CRDA18 CFM at Static Pressure																RPM OF SELECTED MODELS		RPM
0.00		.125		.250		.375		.500		.625		.750		1.00		CRDA18J8*	CRDA18L11*	
BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	1/2 HP	1 HP	
3,095		2,995		2,824		2,666		2,482		2,233		1,915						825
0.31	11.7	0.33	10.8	0.36	10.5	0.38	9.7	0.40	9.6	0.41	8.9	0.40	8.5					
4,352		4,291		4,208		4,084		3,966		3,856		3,740		3,476				1160
0.86	23	0.89	22	0.93	21	0.97	21	1.01	21	1.04	21	1.06	19.3	1.10	19.9			

CRDA20 CFM at Static Pressure																RPM OF SELECTED MODEL	RPM
0.00		.125		.250		.375		.500		.625		.750		1.00		CRDA20M11*	
BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	1-1/2 HP	
5,730		5,621		5,506		5,382		5,255		5,130		5,007		4,754			1160
1.45	34	1.49	28	1.54	25	1.59	24	1.64	24	1.67	24	1.68	23	1.73	22		

Performance shown is for Type A: free inlet, free outlet. Performance ratings do not include the effects of appurtenances (accessories).
The sound ratings shown are loudness values in hemispherical sones at 1.5 m (5 ft) in a hemispherical free field calculated per AMCA Standard 301.
Values shown are for Installation Type A: free inlet hemispherical sone levels.
* - These models are not compatible with variable speed control.
AMCA Certified Ratings apply to the CRDA Roof Ventilator constant speed fans and not variable speed fans.

Installation

Most models are shipped fully assembled and ready for installation. Always inspect equipment for transit damage before accepting delivery to assure a valid claim. Special handling and storage procedures are required if unit is to remain idle for a long time prior to installation.

Placement

All belt-driven units must be accessibly installed for maintenance and servicing of belts, bearings, motors and pulleys. Horizontal operation only is recommended to assure satisfactory damper operation.

Mounting

Satisfactory operation of roof ventilators requires mounting on adequately designed and constructed roof curbs. Prefabricated curbs for convenience in installation are available from ILG. Install with base of unit horizontal. Provide adequate caulking, flashing or other weatherproofing means.

Inspection

Check centrifugal wheel for free rotation.
Check belt for proper tension (CRBCA & CRBA).
Check bearings for proper and secure locking to drive shaft (CRBA).
Check motor and fan sheave faces for proper alignment (CRBCA & CRBA).
Check circuit phase, voltage and wiring connection against that shown on motor nameplate.
Check direction of fan rotation for proper air flow.
After one week of operation, check belt for proper tension (CRBCA & CRBA).

Maintenance

Units should be checked monthly for the first two or three months and periodically thereafter. Units should be cleaned periodically and checked for eroded parts which should be replaced to avoid structural damage and possible failure. Proper lubrication is the most important maintenance requirement. CRBA units should be lubricated as necessary based on usage and operating conditions. "C-Drive" bearings on all CRBCA units are permanently sealed and require **no** lubrication. Motor bearings should be lubricated according to the motor manufacturer's instructions.

Adjustment of Variable Pitch Pulley and Belt (CRBCA & CRBA)

Variable pitch pulley may be adjusted within catalog RPM range to alter performance without motor overload. Pulley alignment and belt tension should be adjusted if necessary. Inspection every 6 to 12 months is recommended.

Options & Accessories

Prefabricated Roof Curbs

Insulated roof curbs with weather-resistant continuous welded construction are available for convenience in installation for both insulated and non-insulated roof decks.

Special Motors

Two-speed, totally enclosed, energy efficient and explosion-proof motors for hazardous locations may be available for many models. Motor requirements may affect UL Listing.

Backdraft Dampers

Gravity or motor operated backdraft dampers are available. They are aluminum construction and designed for installation in prefabricated roof curbs.

Safety Disconnects

Safety disconnects cut power to motor for servicing of unit. A disconnect device is standard on all CRDA units and an option for CRBA and CRBCA units. It may be shipped loose for field installation or factory mounted and wired.

Protective Coatings

Fan units are not recommended for exhausting air of a corrosive nature. However, special protective coatings are available where units may be exposed to corrosive exterior conditions. Parts requiring painting are processed through the American Coolair five-stage pretreatment system prior to the application of any coatings to insure maximum finish adhesion. These parts use a thermosetting epoxy powder paint with an average thickness of 3 mils and baked at 400°F to a smooth, hard continuous finish. Consult your ILG Industries representative for available coatings.

Roof Handle

Aluminum handle facilitates removal of roof.

WARNING **CAUTION**

DO NOT INSTALL FAN WITH MOVING PARTS WITHIN 8 FEET OF FLOOR OR GRADE LEVEL WITHOUT A GUARD THAT COMPLIES WITH OSHA REGULATIONS. **DO NOT** USE UNLESS ELECTRICAL WIRING COMPLIES WITH ALL APPLICABLE CODES. **DO NOT** WIRE WITHOUT PROVIDING FOR A POWER SOURCE DISCONNECT AT THE FAN ITSELF. **DO NOT** SERVICE EXCEPT BY A QUALIFIED MAINTENANCE TECHNICIAN AND ONLY AFTER DISCONNECTING THE POWER SOURCE. FAILURE TO OBSERVE THESE PRECAUTIONS CAN RESULT IN SERIOUS INJURY OR DEATH.

To convert air performance (CFM and SP) and power (BHP) to metric units, multiply CFM x .000472 to obtain cubic meters per second (m_3/s). Multiply SP x 248.36 to obtain pascals (Pa). Multiply BHP x .7457 to obtain kilowatts (kW).

Example: 3904 CFM x .000472 = 1.8427 m^3/s
0.125 SP x 24.36 = 31.05 Pa
0.886 BHP x .7457 = 0.661 kW

CRBCA Specification Checklist

General exhaust units for low to medium air volumes in commercial, institutional and light manufacturing buildings. Centrifugal design with advantages of compact, attractive appearance, quiet operation and performance against higher static pressures. Variable pitch belt drive allows for speed adjustment. Hinged motor bracket with a belt tensioning bolt. Weatherproof heavy duty aluminum housing and motor compartment cover resist corrosion and maintain appearance. Deep-spun, overlapping, one-piece venturi minimizes noise, reduces air turbulence and improves efficiency. "C-Drive" design provides a calculated L10 bearing life in excess of 1,000,000 hours with its unique radial loading elimination design. Aluminum centrifugal wheel is quiet, non-overloading, backward-inclined design and is computer balanced. Standard open drip-proof motor is out of the airstream for protection. The motor's electrical connection terminal board is up for easy and convenient electrical connection and servicing. Positively cooled motor compartment with forced air ventilation system extends motor life. UL Label (UL 705) for general ventilation. Conduit raceway for ease in connecting to power supply. AMCA Seal assures certified rating of air and sound performance. Birdscreen prevents entry of birds or other potentially damaging objects. Heavy duty neoprene isolators eliminate metal-to-metal contact, reducing vibration and sound.

CRBA Specification Checklist

Units provide general exhaust of low, medium and high air volumes in commercial, institutional and light manufacturing buildings. Centrifugal design has advantages of compact, attractive appearance, quiet operation and performance against higher static pressures. Variable pitch belt drive allows for speed adjustment. Hinged motor bracket with belt tensioning bolt(s). Weatherproof heavy duty aluminum housing and motor compartment cover resist corrosion and maintain appearance. Deep-spun, overlapping, one-piece venturi minimizes noise, reduces air turbulence and improves efficiency. Centrifugal wheel is quiet, non-overloading, backward-inclined design and is computer balanced. Standard open drip-proof motor is out of the airstream for protection. The motor is mounted with the shaft up for convenient access to the variable pitch cast iron motor pulley. Motor compartment is cooled by a forced air ventilation system, extending motor life. UL Label (UL 705) for general ventilation. Conduit raceway allows for ease in connecting to power supply. AMCA Seal assures certified rating of air and sound performance. Birdscreen prevents entry of birds or other potentially damaging objects. Heavy duty neoprene isolators eliminate metal-to-metal contact, reducing vibration and sound. Heavy duty pillow-block bearings with cast iron housing are self-aligning and relubricable.

CRDA Specification Checklist

General exhaust units for low to medium air volumes in commercial, institutional and light manufacturing buildings. Centrifugal design with advantages of compact, attractive appearance, quiet operation and performance against higher static pressures. Spun aluminum housing for durable weather protection and attractive appearance. Direct-drive advantages of minimal maintenance and operating costs. Deep-spun, overlapping, one piece venturi minimizes noise, reduces air turbulence and improves efficiency. Aluminum centrifugal wheel is quiet, non-overloading, backward-inclined design and is computer balanced. Standard open motor is out of the airstream for protection. The motor's electrical connection terminal board is up for easy and convenient electrical connection and servicing. Positively cooled motor compartment with forced air ventilation system extends motor life. UL Label (UL 705) for general ventilation. Safety disconnect device enables cut-off of power to unit for servicing. Birdscreen prevents entry of birds or other potentially damaging objects. Factory run and tested prior to shipment for dependable operation. AMCA Seal assures certified rating of air and sound performance.

Limited Warranty

In the sale of its products, American Coolair Corporation agrees to correct, by repairs or replacement, any defects in workmanship or material that may develop under proper and normal use during the period of one year from the date of shipment from the factory. Any product or part proving, upon American Coolair's examination, to be defective during limited warranty period will be repaired or replaced, at American Coolair's option, f.o.b. factory, without charge.

Deterioration or wear caused by chemicals, abrasive action or excessive heat shall not constitute defects.

Motors are guaranteed only to the extent of the manufacturer's warranty.

American Coolair's limited warranty does not apply to any of its products or parts that have been subject to accidental damage, misuse by the user, unauthorized alterations, improper installation or electrical wiring, or lack of proper lubrication or other service requirements as established by American Coolair.

Repairs or replacements provided under the above terms shall constitute fulfillment of all American Coolair's obligations with respect to limited warranty.

THE LIMITED WARRANTY STATED HEREIN IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, STATUTORY OR IMPLIED, INCLUDING WITHOUT LIMITATION THAT OF MERCHANTABILITY AND FITNESS.

NO LIABILITY FOR REINSTALLATION COST OR FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY NATURE IS ASSUMED OR SHALL BE IMPOSED UPON AMERICAN COOLAIR.

ILG INDUSTRIES

AMERICAN COOLAIR CORPORATION

REPRESENTED BY:

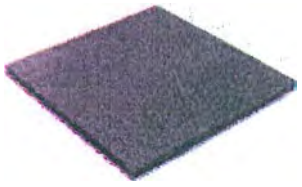
JACKSONVILLE, FLORIDA 32203-2300 ~ P.O. BOX 2300 ~ (904) 389 3646 ~ FAX (904) 387 3449 ~ E-MAIL – info@coolair.com ~ WEBSITE - coolair.com

VANE AXIAL FANS ~ TUBE AXIAL FANS ~ PROPELLER FANS ~ POWER ROOF VENTILATORS ~ CENTRIFUGAL VENTILATORS

MEMBER OF AMCA

Form No. 725-15-4 (December, 2008)

ROYAL MAT RUBBER MAT, 61” X 52”X 5/8” Thick



Mat | Brand : Royal Mat | Length : 61”. | Width : 52”. | Materlal :Rubber | Warranty: 10 Years

DETAIL DESCRIPTION

- Diamond plate top for maximum skid resistance Unique grooved bottom specifically
- Vulcanized for maximum strength and long life
- Full 10 Year warranty

TECHNICAL SPECIFICATIONS

Brand: Royal Mat
Length: 61”
Width: 52”
Material: Rubber
Warranty: 10 Years

Water Injection System

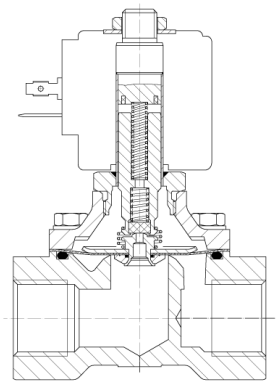
GRANZOW® INC.

Series H
SOLENOID VALVE

Model

H5B11-00Y

2-way, internally piloted, normally closed solenoid valve, with assisted lift



3/4"	5/8"	2.80	120 VAC	8 watts	0–200 psi
Pipe Size (Inch)	Orifice Size (Inch)	Flow Factor (CV)	Voltage (AC)	Wattage (W)	Pressure Range (PSI)

NBR + PA*	14°–195° F	Conduit DIN	Air, Inert gas, Water
Sealing Material	Temperature Range	Connector Supplied	Medium Examples

**PA = polyamide*

Materials of Construction

Body:	**Brass**
Armature Tube:	**Stainless Steel 300**
Fixed Core:	**Stainless Steel 400**
Plunger:	**Stainless Steel 400**
Spring:	**Stainless Steel 300**
Shading Ring:	**Copper**
Orifice:	**Brass**
Pipe Threading:	**NPT**

Electrical Specifications

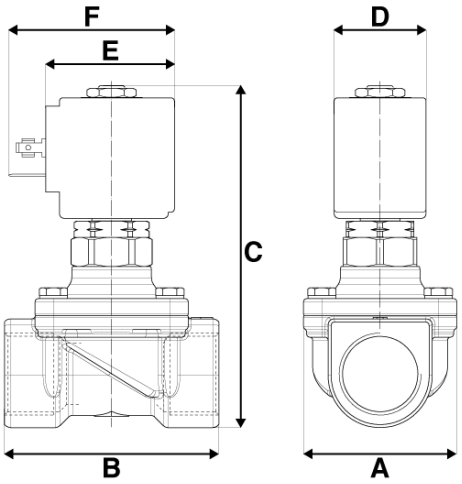
Rating:	**NEMA 4**
Inrush VA:	**25.0**
Holding VA:	**14.5**

Spare Part Numbers

Armature Tube:	**Not Available**
Repair Kit:	**RK-H0Y2**
Coil/Connector:	**C-B11**

Valve Dimensions

Valve Width **(A)** :	**1 31/32"**
Valve Length **(B)** :	**2 3/4"**
Valve Height **(C)** :	**3 15/16"**
Coil Width **(D)** :	**1 3/16"**
Coil Length **(E)** :	**1 21/32"**
Coil Length **(F)** :	**2 1/8"**



Note: *Valve is pictured above with a sample coil, which may not reflect the exact specifications of this particular part number.*

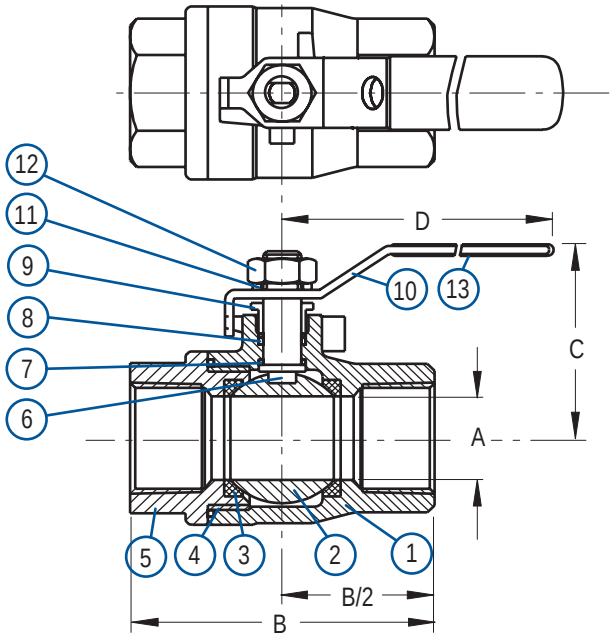
Granzow, Inc.• 2300 Crownpoint Executive Drive, Charlotte, NC 28227-6702 • Phone (704) 845-2300 • Fax (704) 845-2301

DURAVALVE MODEL D210 BALL VALVE

2-PIECE FULL PORT 316 STAINLESS STEEL 1000 PSI

FEATURES AND SPECIFICATIONS

- 1/4" to 2" Sizes
- Adjustable Vee Style Stem Packing
- NTP Threaded Ends to ANSI B2.1
- Internal Entry Blow-Out Proof Stem
- Pressure Rating: 1000 PSI Maximum
- Temperature Range: -20° F – 450° F
- Meets WW-V-35 Design Specifications



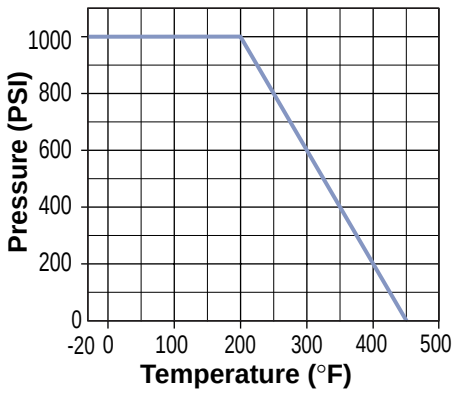
MATERIALS OF CONSTRUCTION

Item	Description	Material	Qty.
1.	Body	CF8M	1
2.	Ball	CF8M	1
3.	Seat	RTFE	2
4.	End Gasket	PTFE	1
5.	End Cap	CF8M	1
6.	Stem	316 SS	1
7.	Thrust Washer	RTFE	1
8.	Stem Packing	PTFE	1
9.	Gland Nut	304 SS	1
10.	Handle	304 SS	1
11.	Washer	304 SS	1
12.	Nut	304 SS	1
13.	Handle Sleeve	Vinyl	1

DIMENSIONS IN INCHES

Valve Size	Part Number	A	B	C	D	Weight Lbs.	C_V	Torque In.- Lb.
1/4	20200A	.47	2.09	1.81	3.62	.46	7	40
3/8	20200B	.47	2.09	1.81	3.62	.46	9	40
1/2	20200C	.59	2.48	1.93	3.62	.68	11	60
3/4	20200D	.79	2.91	2.24	4.57	1.15	24	80
1	20200E	.98	3.39	2.60	5.63	1.85	45	120
1-1/4	20200F	1.26	3.90	2.80	5.63	2.82	90	240
1-1/2	20200G	1.50	4.25	3.19	6.97	4.19	125	420
2	20200H	1.97	5.20	3.50	6.97	6.66	190	560

PRESSURE/TEMPERATURE CURVE



DuraValve, Inc.
847-616-0430 • 800-776-1260 • FAX 847-616-0432 • www.duravalve.com

McMASTER-CARR®

Medium-Pressure Stainless Steel Y-Strainer

with Mesh and Perforated Screen, 1/2 NPT

4745K53

For Use With	Diesel Fuel, Inert Gas, Natural Gas, Oil, Steam, Water
For Reducing	Particles
Strainer Type	Y
Connection Type	Pipe
Pipe Connection Type	Threaded
Pipe Size	1/2
Thread Type	NPT
Gender	Female
Maximum Pressure	1,400 psi @ 70° F
Maximum Steam Pressure	600 psi @ 1125° F
Temperature Range	35° to 1125° F
Length	3 7/8"
Height	3 1/2"
Plug Pipe Size	1/2
Material	316 Stainless Steel
Screen Material	304 Stainless Steel
Screen Construction	Mesh, Perforated
Screen Top OD	7/8"
Screen Bottom OD	1 1/8"
Screen Length	2 3/8"
Features	Threaded Drain with Plug
Related Product	Replacement Screens

316 stainless steel gives these strainers excellent corrosion resistance. Use them in medium-pressure applications to capture debris in your pipeline and protect sensitive equipment. Strainers have a threaded drain with a plug that provides access to the screen without disconnecting your line.

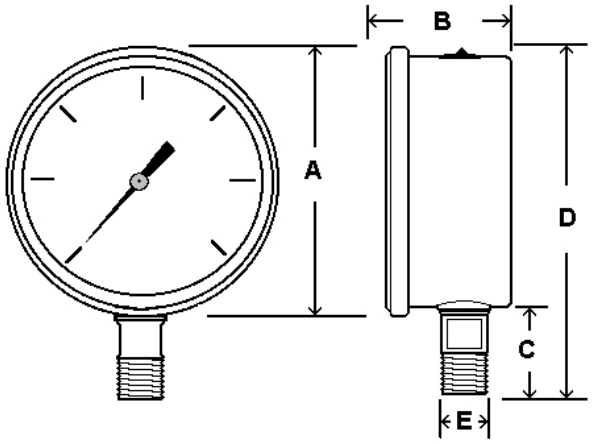
301LFW ALL STAINLESS LOWER MOUNT

Heavy duty, all stainless steel gauge with welded case-to-stem connection
Stainless steel case and bezel, 316 stainless steel internals
Glycerine filled for added durability in applications where vibration or pulsation is present

SPECIFICATIONS

Dial	1 ½" (40 mm), 2" (50 mm), 2 ½" (63 mm), 4" (100 mm) See page 37, 6" (150 mm) - See 6001 page 53
Case	Stainless steel, glycerine filled (available dry Welded case-to-stem connection
Wetted Parts	316 stainless steel
Bezel	Stainless steel, fixe
Lens	Polycarbonate
Pointer	Black aluminum
Connection	Lower mount 1 ½" dial = ⅛" NPT 2" dial = ⅛" or ¼" NPT 2 ½" dial = ¼" NPT
Scale	Standard: psi/BAR (x 100 = kPa)
Accuracy	3-2-3% of span 1 ½" & 2" ASME B40.1 Grade B 2-1-2% of span 2 ½" ASME B40.1 Grade A
Ambient Temp	Glycerine Filled = 30° F to 160° F Dry = -30° F to 180° F

Design meets or exceeds ASME B40.100 pressure gauge standard.



Dial	Unit	A	B	C	D	E
1 ½"	In.	1.84"	1.03"	0.73"	2.32"	⅛" NPT
	mm	47	26	19	59	
2"	In.	2.25"	1.15"	0.91"	2.93"	⅛"or ¼" NPT
	mm	57	30	23	75	
2 ½"	In.	2.70"	1.39"	1"	3.61"	¼" NPT
	mm	69	35	25	92	

AVAILABLE OPTIONS*

- Certificate of Accuracy, NIST traceable
- Custom Dial
- Liquid Fill Options, see page 176
- Anti-Vibration Movement, see page 109
- Dry, Fillable Case
- Glass Lens
- Cleaned for Oxygen Service (dry only)
- Special Connection Size
- Protective Rubber Cover, see page 121
- Single Scale
- Max/Min Pointer, see page 122

*Lead times/minimums may apply

APPROXIMATE SHIPPING WEIGHTS/ BOX QUANTITIES

Dial Size	Est. Unit Weight	Box Qty
1 ½"	0.20 lbs (0.10 kg)	100
2"	0.40 lbs (0.18 kg)	100
2 ½"	0.55 lbs (0.24 kg)	90

Integral Bonnet Needle Valves

Part No.

SS-1RS6

Part Description

Stainless Steel Integral Bonnet Needle Valve, 0.73 Cv, 3/8 in. Swagelok Tube Fitting, Regulating Stem

Specifications

General	
Body Material	316 Stainless Steel
Cleaning Process	Standard Cleaning and Packaging (SC-10)
Connection 1 Size	3/8 in.
Connection 1 Type	Swagelok® Tube Fitting
Connection 2 Size	3/8 in.
Connection 2 Type	Swagelok® Tube Fitting
eClass (4.1)	37010203
eClass (5.1.4)	37010201
eClass (6.0)	37010203
eClass (6.1)	37010203
Flow Pattern	Straight (2-way)
Handle Color	Black
Handle Style	Phenolic Knob
Lubricant	Perf. Polyether/Tung. Disulfide (WL7)
Max Temperature with Pressure Rating	450°F @ 3435 PSIG /232°C @ 236 BAR
Orifice	0.250 in
Packing	PFA
Room Temperature Pressure Rating	5000 PSIG @ 100°F /344 BAR @ 37°C
Stem Tip Material	316 Stainless Steel
Stem Type	Regulating
UNSPSC (10.0)	40141602
UNSPSC (11.0501)	40141602
UNSPSC (13.0601)	40141602
UNSPSC (15.1)	40141602
UNSPSC (17.1001)	40141600
UNSPSC (4.03)	40141602
UNSPSC (PGE)	401416AL
UNSPSC (SEQIRUS)	M4170
UNSPSC (SWG01)	40141602

Integral Bonnet Needle Valves

Part No.

SS-1RS8

Part Description

Stainless Steel Integral Bonnet Needle Valve, 0.73 Cv, 1/2 in. Swagelok Tube Fitting, Regulating Stem

Specifications

General	
Body Material	316 Stainless Steel
Cleaning Process	Standard Cleaning and Packaging (SC-10)
Connection 1 Size	1/2 in.
Connection 1 Type	Swagelok® Tube Fitting
Connection 2 Size	1/2 in.
Connection 2 Type	Swagelok® Tube Fitting
eClass (4.1)	37010203
eClass (5.1.4)	37010201
eClass (6.0)	37010203
eClass (6.1)	37010203
Flow Pattern	Straight (2-way)
Handle Color	Black
Handle Style	Phenolic Knob
Lubricant	Perf. Polyether/Tung. Disulfide (WL7)
Max Temperature with Pressure Rating	450°F @ 3435 PSIG /232°C @ 236 BAR
Orifice	0.250 in
Packing	PFA
Room Temperature Pressure Rating	5000 PSIG @ 100°F /344 BAR @ 37°C
Stem Tip Material	316 Stainless Steel
Stem Type	Regulating
UNSPSC (10.0)	40141602
UNSPSC (11.0501)	40141602
UNSPSC (13.0601)	40141602
UNSPSC (15.1)	40141602
UNSPSC (17.1001)	40141600
UNSPSC (4.03)	40141602
UNSPSC (PGE)	401416AL
UNSPSC (SEQIRUS)	M4170
UNSPSC (SWG01)	40141602

Dwyer

SERIES RM

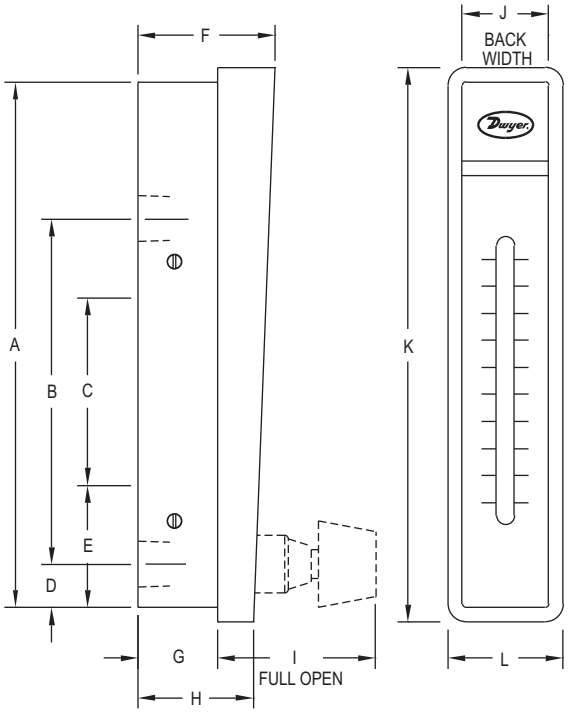
RATE-MASTER® POLYCARBONATE FLOWMETERS

2″, 5″ or 10″ Scale, Interchangeable Bodies

Model RMC
10″ scale, 15-3/8″ high

Model RMB-SSV
5″ scale, 8-3/4″ high

Model RMA-TMV
2″ scale, 4-13/16″ high



DIMENSIONS - FLOWMETER			
	Model RMA	**Model RMB**	**Model RMC**
A	4-9/16 [115.90]	8-1/2 [215.90]	15-1/8 [384.20]
B	3 [76.20]	6-7/16 [163.50]	12-1/4 [311.20]
	1/8 NPT conn.	1/4 NPT conn.	1/2 NPT conn.
C	1-5/8 [41.28]	3-15/16 [100.00]	8-3/4 [222.30]
	10-32 mtg. holes	1/4-20 mtg. holes	3/8-24 mtg. holes
D	3/8 [9.525]	5/8 [15.88]	1 [25.40]
E	1-1/16 [26.99]	1-7/8 [47.63]	2-3/4 [69.85]
F	1-3/16 [30.16]	1-3/4 [44.45]	2-1/2 [63.50]
G	11/16 [17.46]	1 [25.40]	1-7/16 [36.51]
H	61/64 [24.21]	1-7/16 [36.51]	1-31/32 [50.00]
I	1-3/8 [34.92]	1-13/16 [46.04]	2-1/2 [63.50]
J	3/4 [19.05]	1-1/4 [31.75]	2 [50.80]
K	4-13/16 [122.20]	8-3/4 [222.30]	15-3/8 [390.50]
L	1 [25.40]	1-1/2 [38.10]	2-1/4 [57.15]

The **Series RM Rate-Master® Polycarbonate Flowmeters** are a line of general use, direct reading precision flowmeters suitable for both gas and liquid applications. This Series consists of 2″ (51 mm), 5″ (127 mm) and 10″ (254 mm) scales that can be panel or surface mounted with optional precision metering valves. Within a given Series, the Rate-Master® flowmeter bodies can be instantly interchanged, allowing the piping to remain undisturbed, interchangeability of the ranges, and easy cleaning.

FEATURES/BENEFITS

- Direct reading scales eliminate the need for troublesome conversions
- Stainless steel backbone absorbs piping torque reducing installation damage and cost
- Shatter-proof polycarbonate allows for long operation life
- Precision injection molding around a precision tapered pin enables high repeatability
- Increased reading accuracy with special integral flow guides that stabilize float movement
- Scale graduations on both side of the indicating tube allow for instantaneous flow reading saving time

APPLICATIONS

- Medical equipment
- Air samplers
- Gas analyzers
- Pollution monitors
- Chemical injectors
- Cabinet purging

SPECIFICATIONS

Service: Compatible gases and liquids.
Wetted Materials: Body: Polycarbonate; O-ring: Neoprene and Buna-N; Metal parts: SS (except for optional brass valve); Float: SS, black glass, aluminum, K monel, tungsten carbide depending on range.
Temperature Limit: 130°F (54°C).
Pressure Limit: 100 psi (6.9 bar).
Accuracy: RMA: 4%; RMB: 3%; RMC: 2% of FS.
Process Connection: RMA: 1/8″; RMB: 1/4″; RMC: 1/2″ female NPT.
Weight: RMA: 4 oz (113.4 g); RMB: 13 oz (368.5 g); RMC: 39 oz (1105.6 g).
Agency Approvals: Meets the technical requirements of EU Directive 2011/65/EU (RoHS II).

CAUTION: Dwyer® Rate-Master® flowmeters are designed to provide satisfactory long term service when used with air, water, or other compatible media. Refer to factory for information on questionable gases or liquids. Caustic solutions, anti-freeze (ethylene glycol) and aromatic solvents should definitely not be used.

Dwyer

SERIES RM

RATE-MASTER® POLYCARBONATE FLOWMETERS

Gas Flow from 0.05 to 1800 SCFH, Water Flow to 10 GPM

RANGE CHART - RMA 2˝ SCALE - POPULAR RANGES			
Range No.	**SCFH Air**	**Range No.**	**LPM Air**
1	.05 to .4	26	.5 to 5
2	.1 to 1	21	1 to 10
3	.2 to 2	22	2 to 25
4	.5 to 5	23	5 to 50
5	1 to 10	24	5 to 70
6	2 to 20	25	10 to 100
7	5 to 50	**Range No.**	**CC/Min. Water**
8	10 to 100	32	5 to 50
9	15 to 150	33	10 to 110
10	20 to 200	34	20 to 300
Range No.	**CC/Min. Air**	**Range No.**	**GPH Water**
151*	5 to 50	42	1 to 11
150*	10 to 100	43	2 to 24
11	30 to 240	44	4 to 34
12	50 to 500	45	5 to 50
13	100 to 1000		
14	200 to 2500		
*Accuracy ±8%			

RANGE CHART - RMB 5˝ SCALE - POPULAR RANGES			
Range No.	**SCFH Air**	**Range No.**	**SCFH & LPM Air**
49*	0.5 to 5	50D	1.2 to 10/0.6 to 5
50	1 to 10	51D	2 to 20/1 to 9.5
51	3 to 20	52D	4 to 50/2 to 23
52	4 to 50	53D	10 to 100/5 to 50
53	10 to 100	54D	20 to 200/10 to 95
54	20 to 200	**Range No.**	**GPH & LPM Water**
55	40 to 400	82D	1 to 12/0.06 to 0.76
56	50 to 500	83D	1 to 20/0.065 to 1.25
57	60 to 600	85D	10 to 100/0.8 to 6.2
Range No.	**GPH Water**		
82	1 to 12		
83	1 to 20		
84	4 to 40		
85	10 to 100		
*Accuracy ±5%			

RANGE CHART - RMC 10˝ SCALE - POPULAR RANGES			
Range No.	**SCFH Air**	**Range No.**	**GPH Water**
101	5 to 50	134	2 to 20
102	10 to 100	135	8 to 90
103	20 to 200	**Range No.**	**GPM Water**
104	40 to 400	141	.1 to 1
105	60 to 600	142	.2 to 2.2
106	100 to 1000	143	.4 to 4
107	120 to 1200	144	.8 to 7
108	200 to 1800	145	1.2 to 10
Range No.	**SCFM Air**		
121	1 to 10		
122	2 to 20		
123	4 to 30		

MODEL CHART	
Model	**Description**
RMA-X	Standard RMA
RMA-X-BV+	RMA with brass valve
RMA-X-SSV+	RMA with stainless steel valve
RMA-X-TMV*+	RMA with top mounted valve
RMB-X	Standard RMB
RMB-X-BV+	RMB with brass valve
RMB-X-SSV+	RMB with stainless steel valve
RMC-X	Standard RMC
RMC-X-BV+	RMC with brass valve
RMC-X-SSV+	RMC with stainless steel valve
How To Order: Series-Range No.(“X”)-Valve-Option **Example:** RMA-2-SSV (Series RMA with .1-1 SCFH air range & stainless steel valve)	
*Provide same precision construction but for vacuum applications. +Valve is designed for flow adjustment only, not intended to be used as an open/shut-off valve.	

OPTIONS	
To order add suffix:	**Description**
-NIST	NIST traceable calibration certificate
-APF	Adjustable pointer flag for Series RMA
-BPF	Adjustable pointer flag for Series RMB
-CPF	Adjustable pointer flag for Series RMC
Note: Special ranges, scales, mounting arrangements, etc., are available on special order, or in OEM quantities.	

Adjustable pointer flags
Red lined pointer flags provide quick visual reference to a required flow level. Of clear plastic, they snap into place inside bezel and slide to desired level.

ACCESSORIES	
Model	**Description**
RKA	Regulator kit for Series RMA
RK-RMB	Regulator kit for Series RMB

Regulator kits
Available as optional extras for both Rate-Master® Flowmeters and Visi-Float® Flowmeters models. This view shows Model VFA Visi-Float® flowmeter with integrally connected constant differential pressure regulator. Recommended for use where inlet air pressure fluctuates widely and constant flow is required. The regulator maintains a constant pressure differential of approximately 3 ±.15 psig. Supply pressure must be at least 3 psig above the flowmeter discharge to operate. The standard regulator may be used with any Dwyer Series RM or VF flowmeter up to 200 scfh. For higher flow rates consult the factory.

USA: California Proposition 65
⚠WARNING: Cancer and Reproductive Harm - www.P65Warnings.ca.gov

Poppet Check Valves

Part No.

SS-CHS6-1/3

Part Description

Stainless Steel Poppet 6000 psig (413 bar) Check Valve, 3/8 in. Swagelok Tube Fitting, 1/3 psig (0.03 bar)

Specifications

General	
Backup Ring Material	PTFE
Body Material	316 Stainless Steel
Cleaning Process	Standard Cleaning and Packaging (SC-10)
Connection 1 Size	3/8 in.
Connection 1 Type	Swagelok® Tube Fitting
Connection 2 Size	3/8 in.
Connection 2 Type	Swagelok® Tube Fitting
Cracking Pressure	1/3 psi (0.03 bar, 0.003 MPa)
eClass (4.1)	37010801
eClass (5.1.4)	27300400
eClass (6.0)	27300601
eClass (6.1)	27300601
Feature	O-rings: Fluorocarbon FKM
Lubricant	Christo-lube MCG 111 (WL8)
Max Temperature Pressure Rating	400°F @ 4280 PSIG /204°C @ 294 BAR
Room Temperature Pressure Rating	6000 PSIG @ 100°F /413 BAR @ 37°C
Seal Material	Fluorocarbon FKM
Spring Coating	None
Surface Finish	Standard
Testing	No Optional Testing
UNSPSC (10.0)	40141641
UNSPSC (11.0501)	40141641
UNSPSC (13.0601)	40141641
UNSPSC (15.1)	40141641
UNSPSC (17.1001)	40141600
UNSPSC (4.03)	40141601
UNSPSC (PGE)	401416AL
UNSPSC (SEQIRUS)	M4170
UNSPSC (SWG01)	40141641

Poppet Check Valves

Part No.

SS-CHS8-1/3

Part Description

Stainless Steel Poppet 6000 psig (413 bar) Check Valve, 1/2 in. Swagelok Tube Fitting, 1/3 psig (0.03 bar)

Specifications

General	
Backup Ring Material	PTFE
Body Material	316 Stainless Steel
Cleaning Process	Standard Cleaning and Packaging (SC-10)
Connection 1 Size	1/2 in.
Connection 1 Type	Swagelok® Tube Fitting
Connection 2 Size	1/2 in.
Connection 2 Type	Swagelok® Tube Fitting
Cracking Pressure	1/3 psi (0.03 bar, 0.003 MPa)
eClass (4.1)	37010801
eClass (5.1.4)	27300400
eClass (6.0)	27300601
eClass (6.1)	27300601
Feature	O-rings: Fluorocarbon FKM
Lubricant	Christo-lube MCG 111 (WL8)
Max Temperature Pressure Rating	400°F @ 4280 PSIG /204°C @ 294 BAR
Room Temperature Pressure Rating	6000 PSIG @ 100°F /413 BAR @ 37°C
Seal Material	Fluorocarbon FKM
Spring Coating	None
Surface Finish	Standard
Testing	No Optional Testing
UNSPSC (10.0)	40141641
UNSPSC (11.0501)	40141641
UNSPSC (13.0601)	40141641
UNSPSC (15.1)	40141641
UNSPSC (17.1001)	40141600
UNSPSC (4.03)	40141601
UNSPSC (PGE)	401416AL
UNSPSC (SEQIRUS)	M4170
UNSPSC (SWG01)	40141641

Gasho Warranty Policy

Warranty policy for J.E.Gasho & Assoc., Inc. **blower packages and systems:**

J.E.Gasho & Assoc., Inc. (hereafter referred to as the Company) warrants that the products hereunder shall be free of defects in material and workmanship and conform to the specifications given in connection with the sale of the product.

Blowers and Systems: 1 year warranty from date of shipment, or 1 year from date that operation begins provided the blowers or pumps are operated during the full warranty period as per the instructions given in the operation and maintenance manual.

The replacement of maintenance items including, but not limited to oil, seals, bearings, filters, vanes in rotary vane pumps, etc., made in connection with normal maintenance service are not covered under this warranty.

No warranty shall apply to products that have been misused or neglected, which includes operation in excessive ambient temperatures, dirty environments or the pumping of corrosive, erosive or explosive liquids or gasses or for problems caused by a build-up of material on the internal parts of the product.

Under this warranty the purchaser is entitled to the repair or replacement (whichever Gasho elects) of any part or parts of the product which do not conform to specifications. This warranty shall be void unless said nonconformance is discovered before the expiration of this warranty. For repairs, the Company has to be notified in writing, a return authorization has to be obtained and the nonconforming part or parts need to be returned to the Company, transport charges prepaid, within thirty (30) days of discovery. Repairs shall be made at the Company's facility without charge, except for return transport charges. Replacement parts provided under the terms of this warranty, are warranted for the remainder of the warranty period applicable to the product in which they are installed, as if such parts were original components of that product.

No allowance will be granted for repairs or alterations made by the purchaser without the Company's written consent.

In lieu of the foregoing remedy, the company may (if the Company so elects), redesign and/or replace the product or refund the full purchase price thereof.

If purchaser disassembles the product for any reason without the written consent of the Company, this warranty shall be void.

Limitation of liability for J.E.Gasho & Assoc., Inc. blower packages and systems:

The Company's obligations are limited to repair, redesign, replacement or refund of the purchase price, at the Company's option. In no event shall the purchaser be entitled to recover incidental, special or consequential damages arising out of any defect, failure or malfunction of the product.

With regards to major components purchased and installed on packages, the expressed warranty of the manufacturer of that equipment shall apply.