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Customer: Propak Systems Ltd.

AXH Job: 206491

Ref: P501185

Model: 72VVF

Tag: STN-2-GS-Cooler

End User: TransCanada

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AXH air-coolers

401 East Lowry Road, Claremore, Oklahoma 74017 (918) 283-9200 Fax (918) 283-9229 www.axh.com

INTRODUCTION

This manual has been prepared for the purpose of providing general information and recommendations for the operation and maintenance of your air-cooled heat exchanger in order to ensure that it will continue to provide you maximum performance in future years under a variety of operating conditions.

Normal maintenance items and light repairs as outlined can be achieved with basic mechanics tools. These include adjusting v-belt tension, checking and adjusting fan blade pitch angle, lubrication of bearings, setting of vibration switches and the periodic cleaning of fin tubes, both externally and internally. For more specific and detailed information please refer to the individual manufacturer's maintenance instructions for the specific item or component in questions (i.e. motors, fans, bearings, and controls). The Table of Contents indicates the appropriate section where this information is contained.

Naturally, prudent judgment should always be exercised when repairing, replacing or particularly modifying any original parts to make certain that they are equivalent to the original design. *AXH aircoolers* stocks most standard parts and components and are available within a 24-hour emergency basis if necessary.

RECEIPT OF EQUIPMENT & SITING

Upon arrival at site, the cooler should be inspected thoroughly by receiving personnel. Damage in transit could be the result of dropping or being struck by heavy objects or equipment. Observe the sub-skid, flanges, plenum side panels and coil sections for any apparent physical damage. Dents, bent flanges, crushed fins, damaged controls are among other items that should be described on the bill of lading document and presented by the carrier. Prompt reporting will expedite filing of claims and will expedite resolution and compensation from the responsible party.

Installation of the cooler(s) is the responsibility of the purchaser or contractor who must ensure that the cooler intake areas are free from obstructions and provide adequate airflow. Spacing of air coolers should be adequate to avoid hot air re-circulation (and the effects of other coolers). The impact of grouping coolers closely together may be compensated for by either elevating and/or separating them.

The cooler is normally completely shop assembled and no field assembly at the job-site is required. However, occasionally optional or special accessories may require disassembly to meet transportation height or width limitations. In the event some assembly of the unit is required, the appropriate assembly instructions will accompany the shipment. The packing list should be checked carefully to see that all parts shipped with the cooler are on hand. These parts may be shipped separately, secured to the skid base (if so designed) or inside the plenum area.

UNLOADING & HANDLING COOLERS

Spreader bars should be used for lifting when the cooler width is over eight (8) feet. The cooler is normally supplied with multiple lifting points to be used for offloading from carrier. Lifting by any other point may cause damage to the cooler. Following are some recommended ways of lifting. Please refer to the illustration below that resembles the type of **AXH air-coolers** cooler to be handled and use it as a guide on how to unload and handle the cooler properly. (See unit name plate for unit type i.e. EF, VI, FF, ZF, etc.)







PRIOR TO RUN-IN & START UP

HYDROSTATIC TEST

AXH air-coolers tube bundles (sections) are hydrostatically tested to the ASME minimum of 1.3 times the design pressure. Higher test pressure may be required per customer's specifications (Reference the Q.A Documentation section of the data manual for test reports). To ensure that no damage has been done during shipment and/or installation, it is good practice to hydro test the entire system, including piping, heat exchangers, pumps, etc., prior to start up.

BEARINGS

Check bearings for lubrication. <u>Caution</u>: DO NOT OVER GREASE. The manufacturer has greased the bearings and no additional grease is necessary at start up. Remote lubrication lines, when provided, should be loosened at the bearing end, and checked to be sure they are filled with grease from the fitting end. This will ensure that the lube lines are full of grease and free of air and any debris. During high-speed operation too much grease will cause over-heating. When dust and water are present bearings should contain as much grease as the operating speed will permit since a full bearing with very slight leakage is the best protection against the entrance of foreign material. Under normal conditions refer to the following table as a general guideline, although certain conditions may require a change of lubrication periods other than those described. Bearing mounting bolts and set screws should be checked for tightness. See bearing manufacturer recommended lubrication chart for recommended maintenance schedule and type of grease.

FANS

Check fan blade bolts and hub bushing set screws for tightness. Rotate fan by hand to ensure that shaft, speed reducer, and driver turn freely. The fan blades should be checked for adequate tip clearance and blade pitch angle. To measure this, first move all blades past a fixed point on the inside of the fan ring and observe which blade has the least amount of clearance at that point. Then move the blade selected 360 degrees to the point of minimum clearance. Refer to the section on fans. If the fan is found not to be centered in the fan ring, slight adjustment of the tip clearance can be made by loosening the fan shaft bearing bolts and moving the complete fan and fan shaft assembly until it is centered in the fan ring. To check the fan blade angle, use a level bubble protractor (this can be obtained from AXH air-coolers). Loosen the nuts on the bolts and place the protractor on the angle setting mark or the clevis. Refer to fan manufactures information for proper location and AXH air-coolers parts list for design angle. Using a mallet, tap on the shank end of the blade to adjust the angle. Tighten fan blade bolts to the proper torque (refer to manufactures maintenance instructions) making sure to tighten evenly. Recheck blade angle. Occasionally coolers may be equipped with an auto-variable type fan. These fans have blade angles controlled by varying the air supply pressure. Air pressure should be applied to the fan before starting to check for proper operation. Before starting, any electric motor should be "bumped" to check for proper direction of fan rotation and air flow. This will also ensure that the motor is in proper working order.

LOUVERS/SHUTTERS

Check all mounting brackets and bolts for tightness. To ensure that the linkage is adjusted properly on manually operated louvers, operate blades from a fully open to a fully closed position. On automatic louvers with air motors (optional) air should be applied to actuator to check for proper linkage adjustment, free operation, and sufficient air supply. For further information on air motors see attached manufacture maintenance instructions.

CAUTION: DO NOT WALK ON LOUVERS OR USE THEM AS A LADDER

V-BELT DRIVES

Check V-Belt tension in accordance with V-Belt tensioning section of this manual.

GEAR BOX

When supplied, check gearbox for oil. Gears are shipped without oil and must be filled and serviced in accordance with the instructions contained later in this operating manual.

VIBRATION SWITCH (OPTIONAL)

For Murphy switches, after the switch has been installed, adjust it by turning the adjustment screw in a clockwise direction until the starting torque does not trip the vibration switch. For other brands see the specific manufacture's information.

PROCESS START-UP

The process start-up should be conducted in a manner that will minimize thermal shock of the tube bundles. Over cooling of fluids during periods of low ambient temperature and/or low heat load duty should also be avoided, especially during start up.

HEADER ACCESS PLUGS

Header plugs opposite each tube are installed at room temperature. To correct any minor leaking, it may be necessary to tighten the plugs when the bundle is at operating temperature. WARNING: <u>DO NOT</u> tighten plugs while bundle is under pressure. If any plugs are removed, the soft iron gasket (shoulder plugs only) should always be replaced. Replacement gaskets are in stock and may be ordered from *AXH air-coolers*. When installing the plugs, a thread lubricant and/or anti-galling compound should be used.

LONG TERM MAINTENANCE

FIN CLEANING

Fins should be kept free of dirt and lint. Bug and lint screens are an available option that will greatly assist in keeping tube bundles clean. Fin tubes can be cleaned by directing compressed air perpendicular to the tubes in a direction OPPOSITE to the normal airflow. Caution should be when using steam or chemicals to clean fins. DO NOT clean or spray water when the section/bundle is hot.

TUBE CLEANING

The internal cleaning of tubes can be done in several different ways:

1. **Mechanical Cleaning -** This consists of using a drill, (or wire brushes), on long rods, and rotating them with air or electric motors. This is normally followed by a treated water or chemical wash or air purge.

2. **Chemical Cleaning** - This consists of circulating chemical solutions through the tubes. The solution should contain inhibitors to avoid corrosion of the tube walls.

3. **High Pressure Water Sprays** - This consists of placing a high-pressure water jet head at the end of hollow rods and pushing through the individual tubes.

NOTE: The last two processes will not work on tubes that have been "plugged" with sealing pins.

LEAKING TUBES

Tube leaks are generally of two types: 1) leaks through the tube wall itself, and more commonly 2) leaks in the tube end attachment in the header (tube sheet). In the first case it is desirable to plug both ends of the tube. Only a limited number of tubes can be sealed off in this manner before performance is adversely affected and will vary with each specific application. When cooling performance falls below acceptable limits, the tube bundle may be re-tubed. If leaks develop in the tube end attachment at the tube sheet, rerolling of the tube may be necessary. Care must be taken in selecting the proper tube expander for the tube size (diameter) and gauge of tube to be rolled. When rolling a tube, excess or "over-rolling" must be avoided. Consult the factory for further information on taper sealing pins to plug the tubes and tube roller sizes.

INSTRUCTIONS FOR USING TAPER PINS FOR SEALING TUBES

- 1.) Remove header access plug from one end of leaking tube (do not switch plugs in holes) and replace with new gaskets whenever possible.
- 2.) Insert taper sealing pin through plug hole into tube and tap lightly with hammer until seated firmly, but not too tight to be removed.
- 3.) Measure plug to determine the depth it was originally screwed into header plug sheet. (Dimension A)
- 4.) Measure the distance that the taper pin protrudes from the header plug sheet in "seated" position. (Dimension B)
- 3.) Add the distance measured in Steps 3 and 4 and subtract 1/8". This will be the length which should be cut off the large end of the taper sealing pin. (A+B-1/8" = Dimension C)
- 4.) Remove the taper pin from the end of the tube.
- 5.) Cut off the large end of the taper pin to the length calculated in Step 5. CAUTION: Do not cut the pin too short.
- 6.) Re-insert the taper sealing pin in the tube and drive securely into place.
- 7.) Lubricate the access plug and replace it in plug sheet and run in tightly. The plug should now seat tightly and hold taper pin in place.
- 8.) Repeat operation on other end of tube.
- 9.) Hydro-test section to insure proper pressure seal without leaks.

NOTE: If the access plug that was removed does not seal properly, replace it along with the gasket if it is a shoulder type plug.



INSPECTION

TUBES

Tubes should be inspected for internal and external corrosion and/or erosion periodically. This depends on the severity and type of service and atmosphere that the tubes are operating in. Inspection of the tubes should be performed every six months to one-year intervals. Tube wall thickness can be checked externally using an ultrasonic technique.

FANS

Fans should be inspected for wear or loose bolts (cracks, pitting and corrosion) on all surfaces. These inspections should be performed every six months. In addition to surface inspections, all bolts and nuts must be checked for proper torque. (See the fan section of the manual).

BEARINGS

In addition to checking bearings as recommended by the manufacture, the mounting bolts should be checked for proper torque and alignment. These checks should be done at least every six months.

STRUCTURE

A general inspection of the structure should be performed every six months to a year. This inspection should include checks for corrosion, damaged members, sheeting guards and for loose bolts.

HEADERS

Headers should be inspected for corrosion periodically. This corrosion should not be allowed to proceed past the stated corrosion allowance as stated on the individual job specification data sheet.

RECOMMENDED SPARE PARTS

We suggest that one each of the parts that are identified as recommended spare parts on the Table of Contents page, be kept in stock or be readily available. The down time caused by waiting for delivery of a replacement part may cost far more in lost production or service than the cost of the item itself.

Spare parts orders should be specified in accordance with the parts list description and always include the corresponding *AXH air-coolers*' model and job number.

WARRANTY

AXH air-coolers warrants that the equipment it *manufactures* is free of defects in material and workmanship, when operated in accordance with conditions stated, for a period of one (1) year after start-up not to exceed eighteen (18) months from shipment. Such warranty shall not apply to any equipment that has been altered or repaired by other than the Company's personnel. The Company's obligation under this warranty is limited, however, to repairing or, if in the Company's judgment it seems more appropriate, to furnishing without charge,

F.O.B. the Company's factory, a similar part to replace any part which after examination shall, to its own satisfaction be determined to have been defective at the time it was shipped. This warranty applies only if the Company received an immediate written notice upon discovery of such defect. The Company makes no warranties covering deterioration or failure due to corrosion, erosion or fouling or due to improper installation or operation. EXCEPT AS SPECIFICALLY STATED ABOVE, AXH AIR-COOLERS HEREBY DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, WHETHER OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR OTHERWISE.

LIMITATION OF LIABILITY

The remedies set forth herein are exclusive. AXH air-coolers shall not be liable, in excess of the purchase price of the equipment, for any damages, whether in contract, in tort or on any other basis, sustained by the customer or any other person arising from or related to the delivery, use or failure of the equipment or for any delay, special, incidental, consequential, indirect or commercial damages whether due to lost profits or otherwise resulting from the delivery, use or failure of the equipment. If it is ever necessary to contact our plant for service or replacement parts, it is essential that our job number and other identifying data be obtained from the metal nameplate attached to the cooler, or the nameplate attached to the tube bundle header box, which also contains the design pressure, temperature, and serial number.





LONG-TERM STORAGE

RECOMMENDED LONG-TERM STORAGE PREPARATION

- 1. Blind flange all nozzles and plug all coupling. Install a pressure gauge and shut-off valve (coupling, or tap blind flange) and charge each tube bundle with 5 10 psig of dry nitrogen.
- 2. Coat drive end of fan shaft and idler shaft with grease and wrap securely with water resistant material.
- 3. Charge bearings with grease, 100% fill. Check bearing manufacturer's manual for storage requirements.

ON-SITE REQUIREMENTS

- 1. Periodically check grease in fan and idler bearings and charge if required.
- 2. Periodically rotate fans and idler shafts.
- 3. AXH air-coolers recommends storing units inside if possible or under cover to protect against adverse weather conditions such as but not limited to salt spray and blowing sand or dust. If protected storage is not available, the fan intake and tube bundle discharge should be completely covered and sealed with weather resistant material. Plywood may be suitable.
- 4. Remove and store per manufacturer's recommendations, motors, v-belts, temperature controllers, motor starters, air motors, gear drives, temperature switches, vibration switches and all other controls.
- 5. For outdoor storage; bearings, shafts and fans should be removed, packed separately and stored indoors.

****If applicable, please use the following procedure****

Overcoating Sherwin-Williams Macropoxy 646 Epoxy - Clean the surface of all foreign material in accordance with SSPC-SP1. Remove any loose or suspect material using hand or power tool cleaning per SSPC-SP2/3. Spot prime any bare areas with suitable/compatible universal primer. For best results, the surface should be abraded to create an anchor profile. Macropoxy 646 is generally compatible with most Industrial finishes. It is up to the user to confirm compatibility by reviewing overcoat data sheet and material test if desired. For more information or questions, please contact a Sherwin-Williams Protective & Marine Coatings Representative or Kevin Tillman @ 918-264-5819 <u>kevin.tillman@sherwin.com</u>.



		BILL OF MATERIAL			
MARK	QTY	DESCRIPTION	WIDTH	LENGTH	WEIGHT
165	1	SHAFT MATL 2-3/16" RND CD1045 TG&P BAR		2'-6"	32
167	2	KEYSTOCK – 1/2" SQUARE		3"	1
					33

DATE: 10/29/2020

JOB NUMBER

206491

SHEET REV. NO.

0

SHD

NO. OF UNITS: 206491

LOCATION: ~

DESCRIPTION: SHAFTING DETAILS

72–VVF





AXH air-coolers 401 E. Lowry Road, Claremore, Oklahoma 74017 (918) 283-9200 Fax (918) 283- 9229 www.axh.com Job number: 206491A Customer: AIR-X-CANADA Quantity: 1.00 Model: 72-VV

Parts List

Note: Quantity Shown is for One Unit Only

Re	evision	Engineer	Date	Description
	0	сс	10/26/2020	Initiate Parts list
	1	сс	11/03/2020	Revised Fan Diameter
	QUAN	TITY		DESCRIPTION OF PARTS
**	1.00	FAN		EA FAN
		Mak Blad Clas Serie Diar No. Rota Ang Bore Key Mod	e: Moore le Tips: VT s: 10,000 HD *Standard es: 24 neter: 72" Blades: 4 ttion: Left Hand le: 15° e: 2-3/16" way: 1/2" lel: 1024/073-U0-A/24L-	d Cord* -VT-3-6.00-4
**	1.00	SHAFT	-FAN	EA FAN SHAFT PER DWG
**	2.00	BR-TAF-2	2.1875-PB	EA #037583 Dodge TAF Bearing 2.1875 Pillow Block
**	1.00	1.00 Electric-Motor		EA Item for Attatched Notes
		Mak Hors RPM V/P/ Fran Encl Shaf Mou Spec	re: sepower: 10 4: 1800 (HZ: 575/3/60 ne: 215T osure: TEFC ft: Horizontal unting: F-1 cial Notes: Single windi	ing, variable torque, VFD compatable. (CSA)
	1.00	SB-215T		EA Slide Base 215T frame motor
**	1.00	V-Belt-Dr	ive-Assembly	EA V-BELT DRIVE ASSEMBLY



AXH air-coolers 401 E. Lowry Road, Claremore, Oklahoma 74017 (918) 283-9200 Fax (918) 283- 9229 www.axh.com Job number: 206491A Customer: AIR-X-CANADA Quantity: 1.00 Model: 72-VV

Parts List

Note: Quantity Shown is for One Unit Only

Revision	Engineer	Date	Description
0	сс	10/26/2020	Initiate Parts list
1	сс	11/03/2020	Revised Fan Diameter

QUANTITY

DESCRIPTION OF PARTS

Motor SheaveO.D.: 4.12No. of Grooves: 4Belt Pitch: 3VBushing Style: SHBore: 1.375Keyway: 5/16 X 5/32Fan SheaveO.D.: 14.00No. of Grooves: 4Belt Pitch: 3VBushing Style: SKBore: 2.1875Keyway: 1/2 X 3/16*V-BeltsType: 3VX630Center Distance: 16.620H.P. Each: 4.4341 Banded Set of 4 Belts Per Drive.TensioningNew Tension (lbf): 49.4 to 53.0New Force (lbf): 3.3 to 3.6Old Tension(lbf): 42.4 to 45.9Old Force(lbf): 2.9 to 3.1Deflection (in): 0.248(All Values given per rib/strand)			
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New Tension (lbf): 49.4 to 53.0 New Force (lbf): 3.3 to 3.6 Old Tension(lbf): 42.4 to 45.9 Old Force(lbf): 2.9 to 3.1 Deflection (in): 0.248 (All Values given per rib/strand)	Tensioning		
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Old Tension(lbf): 42.4 to 45.9 Old Force(lbf): 2.9 to 3.1 Deflection (in): 0.248 (All Values given per rib/strand)	New Force (lbf): 3.3 to 3.6		
Old Force(lbf): 2.9 to 3.1 Deflection (in): 0.248 (All Values given per rib/strand)	Old Tension(lbf): 42.4 to 45.9		
Deflection (in): 0.248 (All Values given per rib/strand)	Old Force(lbf): 2.9 to 3.1		
(All Values given per rib/strand)	Deflection (in): 0.248		
	(All Values given per rib/strand)		

, P					1				
		YH ain-	coole	ne	401 E. Low	ry Road	Phone (918) 283-9200	Proposal / Job No.	206491B
		лп ап-	COUIE		Claremore, 0	OK 74017	Fax (918) 283-9229	Date	10/23/2020
		air.y.li	mited		info@ax	h com	www.axh.com	Paga	1 of 1
1	Durahaaar				Liltimoto Lio	or		raye	1011
2	Purchaser	PROPAR STSTEINS LI	D.		Dostination	ei			
2	# Unito	1	Madal	70\/\/E	Destination				
3	# Units		Draft			Et			Ect 11/t 6 000 LB
4	Assembly	FACINAGED				τ, Γι Ν	OLL DIVAVING		L31 W1 0,000 LD
_	0	= 0.47			NICAL DESIG	IN			
5	Service	EJW	AUX-W	/					
6 7	FIOW	159GPM	26GPN	1					
/	Fiulu Tomp In (Out °	50%GLY	50%GL	120.0					
0	Dropouro DSI	F 190.07164	.4 148.77	130.0					
9 10	Pressure, PSI	61	2.0						
11	Heat Load BTH	UP 1000032	2160/)					
12		155	210942	-					
12	Overall Rate 11	45.5	131.5						
14	Eouling Eactor	0.0005	0.0005						
14	Surface Tube / 3	0.0003 Total Sci Et 271/4315	68 / 10	89					
16	Sections #	1 - COMBI	VED 1-CO						
17	Design Temp °F	Max / Min 300 / -20	300 / -2	20					
18	MWP / Test Pres	s PSIG 14* / 75	14* / 7	5					
19	Pass Arrangeme	ent CROSSEL	OW CROS	SELOW					
20	# Tube Rows	4	4	51 2011					
21	# Tube Passes	4	4						
22	Tubes, OD x BWG	5/8X16	5/8X16						
23	Material	SA214 STE	EL SA214	STEEL					
24	# Per Section / L	enath. Ft 214 / 8	54 / 8						
25	Turbulators	g ,							
26	Accelerators								
27	Fins, Type	HI-EFF	HI-EFF						
28	Material	AL	AL						
29	Nozzles, Rating / T	ype 150RF	CPLG						
30	Material	SA105	SA105						
31	#-Inlets / Size In	(1) 4	(1) 2						
32	#-Outlets / Size I	n (1) 4	(1) 2						
33	Headers, Type	REC TUBE	REC T	UBE					
34	Material	A500	A500						
35	Corrosion Allow,	In							
36	Grooved Tubesh	eet SGL	SGL						
37	Plugs, Type	TAPER	TAPEF	R					
38	Plugs Material	STEEL	STEEL						
39	PWHT								
40	ASME Code & N	at'l Board							
41	CRN								
42	Add'l Specs & Opti	ions							
43	API								
44	Louvers								
45	Hail Screen								
46	Inspection / NDT								
	AIR-SIDE PE	ERFORMANCE	F	AN DATA		D	RIVER DATA	STRUC	TURAL
47	Ambient Air Temp, I	n °F 100	Fan(s)	(1) MOORE-	10K VT S24	Туре		Guards	FAN / DRIVE
48	Elevation, Ft	2500	Blade Material		ALUMINUM \	/-BELT D	RIVE BY (1) 10HP,		CORE
49	Air Flow, SCFM	38447	HP / Fan		6.9	1800RPM	, 575/60/3, TEFC,		
50	Outlet Air Temp, °F	150.3	Dia, In / # Blades		72 / 4 \	/FD CON	IP.MOTOR (CSA)		
51	Min Air Temp, °F	-20	RPM		511				
52			Tipspeed, FPM		9632				
53	Est. Noise Data:	81 dBA @ 1m, 60 dBA @ 15m	Pitch, Deg		15				
54	Additional Info.	*-BUILT TO STANDA	RD 150# DESIGN	BUT DESIGI	NATED 14# T	O AVOID	THE NEED FOR PR	OVINCIAL REGISTRA	TION
55	<u> </u>								
56									
57	<u> </u>								
58									
59									
	NDT Legend	FX= 100% X-Ray c	of all header seam	& nozzle butt	t welds with U	I of attac	hment welds.		
		SX= Spot X-Ray of	1 long seam & 1	end closure, p	per header.	E	BX= 100% X-Ray of a	ll nozzle butt welds.	
	1	UI = 100% UI of a	ill header seam ar	nd nozzle atta	ichment welds		H = Hardness testing.		



24/2020

AXH AIR COOLERS OC CERTIFICS

FINAL IN PROCESS



INSPECTION CHECKLIST

CUSTOMER:	PROPAK SYSTEMS LTD.					
JOB / MODEL NUMBER:	206491 / 72VVF					
UNIT:						
		PROD.	LEAD	Q.C.	CUST.	
NOZZLE ARRANGEMENT AND FL	ANGE FACING	FOEU X	Bc)	they x		L
RUST PREVENTION OF NOZZLE F.	ACES	8C X	L			
RUST PREVENTION OF SHAFTS		8C 3 X	Ľ			L
DIMENSIONAL INSPECTION OF S	UBCOLUMNS	L				L
DIMENSIONAL INSPECTION OF B	ASE HOLES	EU X 4-24-20	L	11-25 X		L
TORQUING OF FAN HUB & BLAD	ES	EU X 11-74-20	Be			Ĺ
CHECK FAN BLADE CLEARANCE A	ND PITCH	EU X 11-24-20	B<	17-25 X		L
PARAFLEX CPLG, FAN BUSHING, A	AND BEARINGS SECURED	EU X 11-24-20	BC	X PARS X		L
BEARINGS GREASED		BC X 12-3		12-1 X		L
IDLER ALIGNMENT			L			
ELECTRIC MOTOR / SHEAVE ALIG	NMENT	EV X	Be x	Pos X		L
MANUAL AND/OR AIR MOTORS			L			L
SHUTTERS OPERATE CORRECTLY,	PICTURES TAKEN	L	L	L		L
SIDE FLAP INSTALLATION (FRONT (BACK HE	HEADER END) ADER END)	*	_ L			
FINAL FINISH AVG. MIL.		SP X 12-3-20	V.D X 12-3-70	P2-3 X		L
CLEANING OF GALVANIZED PART	S AS REQUIRED	BC X 12-3	Ĩ.			
HAIL GUARD, FAN GUARD, AND/	OR BUGSCREENS	BC X 12-3 X		L		
UNIT / MISC NAMEPLATE INSPEC	TION & ATTACHMENT	BC X 12-3 X	BA X	P. X		L
TEST FIT OF LADDERS / PLATFORM	MS, PICTURES TAKEN		L			
DUAL CHAMBER SURGE TANK (F	PER JOB INSTRUCTIONS)	BC X 13-3	L	R-3 X	L	
VIBRATION SWITCH					L	
ELECTRIC MOTOR VERIFICATION		EU X 1/224-30	Be X	Rux		
RUN TEST AND VIBRATION CHECH	K		TUKE	R-1-20		1
VERIFY WEIGHT		x		L	L	L
RELEASE FOR SHIPMENT			Cm X 12-3	20 X	L.	L
OMMENTS:						



MATERIAL TRACEABILITY RECORD

JOB NO. 206491

PIPES PLATES 7	UBES BY Jomes Q DATE 11-10-20	CUSTOMER
MTL. P.O. NO. SECTION NO.	MATERIAL DESCRIPTION	HEAT OR CERTIFICATION NO.
A	1.45cH 40 5AIDGB 218 2pcs.	MC3689
EJWAUXW	3.	¢,
	1. 2.	
	3.	
	1.	
	2.	
	3.	
	1. ,	
	2.	
	3.	
	1.	
	2.	
	3.	

NOTE: ALL MATERIAL OF SAME DESCRIPTION IN A SECTION MUST BE OF SAME HEAT NO.

AXH air-coolers • 401 E Lowery Road • Claremore, OK 74017 • (918) 283-9200

USS3.184 / MC3689 / 4.0A106STDD / 4 STD A106B SMLS PIPE

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Distriction MAX Tope and the state		-		(IN ACC	CERT	UNTH ISO	TEST 10474/E	REPOR N10204/E	11 01N50049	"type 3.1'	Ē	SERI	ON JA	4 0 0 1 4 6 1 4 6	121298 0326278	н 0
Constraint Constraint <thconstraint< th=""> Constraint Constra</thconstraint<>	DRID633 (A/N LU	IIPPERS NO.	-	073163	1UMBER		N/A	VEHICLE LT							
яска бятакложно акр LINE STRE AFT 51. 46TH БЛТТОК МАКОВ 447.1 6 (BADE B / XATK AJOL -18 SELES AFPALICABLE REQUIREMENENTS OF NACE REQUOY/IGO 17945-2015 ED AND NACE BRED.7/150 15156-2 2015 ED 20 DEGREES AFPALICABLE REQUIREMENENTS OF NACE REQUOY/IGO 17945-2015 ED AND NACE BRED.7/150 15156-2 2015 ED The IZD/Z ENDE B/C, MALLICABLE REQUIREMENENTS OF NACE REQUOY/IGO 17945-2015 ED AND NACE BRED.7/150 15156-2 2015 ED REMEM. AS-ROLLED MAL IZD/Z ENDE B/C, MAL-ROLLED MAL IZD/Z ENDE B/C, MAL-ROLLED MAL IZD/Z ENDE B/C, MAL IZD/Z ENDE B/C, MAL IZD/Z ENDE B/C, MAL IZD/Z ENDE B/C, MAL IZD/Z ENDE MAL IZD/Z ENDE MAL IZD/Z ENDE MAL IZD/Z MAL IZD/Z											045 72 72	S.S. IRFIE IRFIE	SEAMLI SEAMLI LD TU LD, AI	NDOR ESS T BULAR ROAD C 350	JBULAR OPERAT	SNOT
SINCE STANDARDA LITE AFT AT AT ATTENDE AVER BLITTON BAYER 410-18 SUCH ATTANAD LITE AFT AT AT ATTANATION DATED 4/1/18 GRADE BYS2-2015 BD AND RACE BYS2-2015 BD AND RACE BYS ATTA-CANTER BY 20 DEGREES APPLICABLE REQUIREMENTER OF NACE MOLOJATED 1795-2015 BD AND RACE BYS2-2015 BD AND RACE						SPECIFICAT	D ON AND G	RADE								
WITTER LOTION Contractions Contractions Contractions Matter JOI Section Sectin Section Secting Section Sectin Section Section Secti	SMLS STANDARI Grade B/C, AS 30 degree app) AND LINE FII ITM A53-18 GRA LLICABLE REQUI	PR APT 5 NDE 9, 7 CREMENTS	LL 46TE ISME SN	L EDITIC	ON DAT 17 GRA 103/IS	80 4/ DE 8/ 0 179	1/18 C. AS 45-20	GRADE ME SA	B/X42 53-201 AND N	R R N 7 GRA	DR Q DE B R0175	PSL-2, REG M	, ASTI ILL C(L5156.	A A106-	18 81
WUTDAL BUDDING CODE: AG-ROLLED OD: COD: C									P P	77	219	10				
RepoliCie Test value VEL Det value Det value <thdet th="" value<=""> <thdet th="" value<=""> <th< td=""><td>MATERAL AS-ROI</td><td>TED</td><td></td><td></td><td></td><td>0.D.: 4.</td><td>T) 005</td><td>14.30</td><td>6</td><td></td><td>in trees</td><td>ALL: 2</td><td>37 (6</td><td>010</td><td></td><td>in (man)</td></th<></thdet></thdet>	MATERAL AS-ROI	TED				0.D.: 4.	T) 005	14.30	6		in trees	ALL: 2	37 (6	010		in (man)
Definition Territy L/D Tot S0 Nor. No. S1 Definition Tot S1 Definition Definition <thdefinition< th=""> <thdefinition< th=""> <</thdefinition<></thdefinition<>					YIELD		Ed %	TENSI	3	H.	ELONG		HARDNE	881	MON HYDRO	DWELLISE
NC3689 STRITP/L/B AR T/1.800 S7.000 S5.000 S0.000 M. S5.00 S	PRODUCT IDENTIFICATION	TEST TYPE/ ORIENTATION	COND	GAUGE	tent. A M		2		H	1	24 MJ	-	SCALE:		FSI	
MC3689 STATP/L/B AR 1.5 57,000 50 75,000 0.68 41.6 2660 5 MC3691 STATP/L/B AR 1.5 55,500 50 77,000 0.68 42.1 2660 5 MC3691 STATP/L/B AR 1.5 55,500 50 75,000 0.77 39.2 2660 5 MC3691 STATP/L/B AR 1.5 53,500 50 76,000 0.77 39.2 2660 5 MC3691 STATP/L/B AR TRAVE MI-MERMANEA MI-MERMANEA MI-MERMANEA 2660 5 2660 5 2660 5 2660 5 2660 5 2660 5 2660 5 2660 5 2660 5 2660 5 2660 5 2660 5 2660 5 2660 25 2660 27 13 2650 2660 27 13 2650 26 26 26				NI	MAX: 71.	800		IN: 70	000	MAX	NIM	25,0	MUN		2660	υ.
MC3 691 STRIP/L/B AR 1.5 55,500 .50 75,500 0.71 43.5 2660 5 MC3 691 STRIP/L/B AR 1.5 55,500 .50 75,500 0.71 43.5 2660 5 MC3 691 STRIP/L/B AR 1.5 53,500 .50 75,500 0.71 43.5 2660 5 2660 5 2660 5 2660 5 2660 5 2660 5 2660 5 2660 5 2660 5 2660 5 26 20 26 20 26 20 26 26 26 27 23	MC3689 MC3689	STRIP/L/B STRIP/L/B	A.	н. 1.5	51	000	00	6L 77	000	0.72		44.6			2660	ю. -
MC3 691 STRITP/L/B AR 1.5 53,500 50 76,500 0.70 39.2 4000 0	MC3691	STRIP/L/B	AR	ыр 		500	105	78	000	12.0		1 1			0000	4
Ledend: L-LONIMUMAL T-TRANSVERSE OT-QUENCIA AR-AFROLED B. 8.00V W. WELD U-UPSET WINGRALIZES RR-AFROLED RAFROLED B. 8.00V WWELD Demonstration TYPE C MN P S NINGRALIZES MR-AFROLED B. 400V WWELD Demonstration TYPE C MN P S NINGRALIZES MR-AFROLED B. 400V WWELD MR-AFROLED MR-	MC3 69 1	STRIP/L/B	Ак *	1.5 END OF	53	STHU STHU	. 50 HEET	++ 76	200	0.70		1 N 1 N				n
PRODUCT TYPE C MM P S SI CU M V B T CB CO CL MAX MC3 689 HKAT 19 93 005 001 77 123 005 002 003 003 003 303 37 39 MC3 689 HKAT 19 93 005 001 27 123 005 003 003 303 303 303 39 39 MC3 689 HKAT 20 95 006 004 24 123 005 003 003 003 303 39 39 MC3 691 FROD 20 95 006 004 24 123 005 003 001 003 003 39 39 MC3 691 FROD 20 95 006 004 24 123 055 06 02 031 000 001 000	LEGEND: L-LO	NGTUDINAL SET	T - TRANSVER	<u>*</u>	at : que BR - stre	uch & Teup SS RELIEVE	ened	2	t-AB ROLL	CD ANNUAL	1.0	Ago		A	- WELD	
DEFINATION TYPE MAX MAX MC3689 HEAT 19 93 005 001 7 13 43 MC3689 HEAT 19 93 005 001 07 02 001 001 37 MC3689 FROD 20 95 006 001 27 02 027 002 001 03 031 001 39 39 MC3691 FROD 20 95 006 004 24 13 05 05 030 001 001 39 39 MC3691 FROD 20 95 006 004 24 13 05 05 031 000 001 39 39 MC3691 FROD 20 95 006 004 24 12 055 06 02 031 000 001 39 38 MC3691 FROD 7 00 000	ANT NOVED		C	4	10	cn	NI CH	NIC	AL	N V	B	=	69	-	-	i i i i i i i i i i i i i i i i i i i
MC3689 HEAT 12 05 06 02 022 002 003 <td>DENTIFICATION</td> <td>TYPE</td> <td>1</td> <td>1</td> <td>11</td> <td>1</td> <td>/</td> <td></td> <td>1</td> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td>MA</td>	DENTIFICATION	TYPE	1	1	11	1	/		1		1					MA
MC3689 PROD 20 95 00 001 23 03 001 03	MC3 68 9	HEAT	19/ 9	3 4005	TE 200	133	50	02 90	029	00	9002	003	: 500		-	.37
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C.E. IS BASED ON THE FOLLOWING EQUATION(S): C+EDT/6+CR/5+MO/5+V/5+N1/15+CU/15 (BUROPEAN CBV) DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT. ELEMENTS REPORTED IN MASS FRACTION (%)	MC3 691	PROD	0 +	900 S	004 24 D 73	THIS THIS	0 2 HEET	0 7		0	1000	0 0 0 0 0 0			-	0100 17171 111
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DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT. ELEMENTS REPORTED IN MASS FRACTION (%)	C.E. IS BASED ON THE	FOLLOWING EQUATION(S)	100 C+20	4/6+CR	5/0W+5/	+7/5+R	11/12+		S (BUR	OPEAN	CEV)				-	
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		D D D D D D D D D D D D D D D D D D D	TINUICALET) BY INCL	EFT MARG	IN, VERTI	ICAL DO		LE OR DE	CIMAL PI	DINT. ELE	MENTS	REPORT	ED IN M/	NSS FRACT	(%) NOL

2/5/2m

USS3184 / MC3689 / 4.0A106STDD / 4 STD A106B SMLS PIPE

District			EH BAR	ta NO.	34	D. NUMBER	-						10000	7 09/2	
Million Data Data <thdata< th=""> Data Data <</thdata<>	DR10633 01	N/A			10P316	32	-								
PRODUCT Information FLAT Band DEAD CONSTRUCTION (Construction) FLAT DEAD CONSTRUCTION (Construction) FLAT DEAD CONSTRUCTION FLAT STRUCT WC35631 OX OX + EXEN O DEAD - <td< td=""><td>ND: AB-ROLLED</td><td></td><td></td><td></td><td></td><td>ab: 4.5(</td><td>00 (114.</td><td>300)</td><td></td><td>in the second</td><td>WALL: 0.23</td><td>7 6.</td><td>(610</td><td></td><td>2</td></td<>	ND: AB-ROLLED					ab: 4.5(00 (114.	300)		in the second	WALL: 0.23	7 6.	(610		2
Informations for a large of the									CHARPY V	MOTCH DA	PACT TESTING				
MC3639 QK MC3 WC3631 QK ** KND QF DA/A, TEL 8 BEERT ** WC3631 QK ** KND QF DA/A, TEL 8 BEERT ** WC3631 QK ** KND QF DA/A, TEL 8 BEERT ** WC3631 QK ** WL WL WL MC1 ULLENDIN T.T.NANEREE #.000 WL WL ADD T TATRIO INSTERNA WL WL WL ULLENDIN TATRIO INSTERNA WL WL WL WL ULLENDIN T TATRIO INSTERNA WL WL WL ULLENDIN T T T T T T ULLENDIN T T T </td <td>DEMTWICATION</td> <td>IN</td> <td>QN28</td> <td></td> <td>COLLAPSE</td> <td>80</td> <td></td> <td>10 10</td> <td></td> <td>Ŀ</td> <td></td> <td>DNY</td> <td>-</td> <td>MILINA</td> <td>12</td>	DEMTWICATION	IN	QN28		COLLAPSE	80		10 10		Ŀ		DNY	-	MILINA	12
WC3691 OX OX NC3691 OX WC3691 OX					_		DBC	-				ļ			
CEDID L.LONGTUDIMAL T.TAUNUENDAL S. 600° W. MELL TETTING INDEGENERING INDEGENERING MERCANNIAL TETTING INDEGENERING MERCANNIAL M. MELL M. MELLANDAL TLENGTH MELL TETTING INDEGENERING MERCANNIAL TETTING INDEGENERING MERCANNIAL M. MELLANDAL TLLENGTH MELL TLENGTH MELL M. M. MELLANDAL M. M	MC3 6 9 1 WC3 6 9 1	N N		:	VC 40 CNS	THE T	geser .								
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Tert/Inspection Test/Inspection Test/Inspection ULL LENGTH MER X 00 0.010 X 10.0/10.05 XOTES ULL LENGTH MER X 0 0.010 X 10.0/10.05 XOTES ULL LENGTH MER X 0 0.010 X 10.0/10.05 XOTES ULL LENGTH MER X 0 0.010 X 10.0/10.05 XOTES ULL LENGTH MER X 0 0.000 X 1.0.0/10.05 XOTES ULL LENGTH MER X 0 0.000 X 1.0.0/10.05 XOTES ULL LENGTH MER X 0 0.000 X 1.0.0/10.05 XOTES ULL LENGTH MER X X 0.000 X 1.0.0/10.05 XOTES X 0.000 ULL LENGTH MER X X 0.000 X 1.0.0/10.05 XOTES X 0.000 ULL LENGTH MER X X 0.000 X 1.0.0/10.05 XOTES X 0.000 ULL LENGTH MER X X 0.000 X 1.0.0/10.05 XOTES X 0.000 ULL LENGTH MERT X X 0.000 X 1.0.000 X 1.0.0/10.05 XOTES X 0.000 ULL LENGTH MERT X X 0.000 X 1.0.000 X 1.0.000 X 1.0.000 ULL LENGTH MERT X X 0.000 X 1.0.000 X 1.0.000 X 1.0.000 ULL LENGTH MERT X X 0.000 X 1.0.000 X 1.0.000 X 1.0.000					F	ESTING / INGPECTA	CH INFORMAT	NO					Į		L
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MATERIAL TRACEABILITY RECORD

JOB NO. 206441

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NOTE: ALL MATERIAL OF SAME DESCRIPTION IN A SECTION MUST BE OF SAME HEAT NO.

AXH air-coolers • 401 E Lowery Road • Claremore, OK 74017 • (918) 283-9200



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Nate: 04/27/2020 Tony Stuble	full Quality Manager	201 S. Woodland Dr. Sand Springe OK 7406



HYDROSTATIC TEST REPORT

MANUFACTURED FOR _	PROPAK SYSTEMS LTD			
AXH JOB NUMBER	206491			
VESSEL TESTED	206	491.1.2 EJW/AUX-W	7	
TEST PRESSURE	75 / 75	PSI		
HYDRO TEST HELD FOR	1	HR.		

THIS REPORT IS TO CERTIFY THAT THE AFOREMENTIONED **VESSEL (OR) VESSELS WERE HYDROSTATIC TESTED IN ACCORDANCE WITH ASME SECTION VIII DIV 1.**

CUSTOMER WITNESS

QUALITY CONTROL REPRESENTATIVE

____ DATE ____/2020

ACCEPTED BY



HYDROSTATIC TEST REPORT

MANUFACTURED FOR _	PROPAK SYSTEMS LTD		
AXH JOB NUMBER		206491	
VESSEL TESTED	206491 SURGE TANK		
TEST PRESSURE	25	PSI	
HYDRO TEST HELD FOR	AS NEEDED	HR.	

THIS REPORT IS TO CERTIFY THAT THE AFOREMENTIONED VESSEL (OR) VESSELS WERE HYDROSTATIC TESTED IN ACCORDANCE WITH ASME SECTION VIII DIV 1.

CUSTOMER WITNESS

QUALITY CONTROL REPRESENTATIVE DATE 11/16/2020 ACCEPTED BY





CLASS 10000 FANS OWNERS MANUAL

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1.0 CLASS 10000 FANS OWNER'S MANUAL **1.2 INSPECTION** 2.0 INSTALLATION 2.2 INSTALL MANUAL HUB AND AIR SEAL **2.3 AUTOMATIC HUB AND AIR SEAL** 2.4 INSTALL PNEUMATIC TUBING 2.5 INSTALL AND ADJUST BLADES 2.6 START-UP PROCEDURES **3.0 MAINTENANCE 3.1 PERIODIC INSPECTION 3.2 ANNUAL INSPECTION 3.3 VIBRATION AND UNBALANCE 3.3.5 THROAT FLUTTER 3.4 WARRANTY 3.3.6 FIELD BALANCING 3.5 MANUAL FAN PARTS LIST 3.6 AUTOMATIC FANS PARTS LIST 4.0 OPERATION 4.2 BLADE OVERLOAD 4.3 CAUSES OF IMPROPER BLADE LOADING 4.4 CHECKING BLADE LOAD** 4.4.1 SAMPLE GRAPH OF BLADE ANGLE IN DEGREES **4.5 DAMAGING OPERATING CONDITIONS 4.5.3 OBSTRUCTIONS**

1.0 CLASS 10000 FANS OWNER'S MANUAL

1.1 ABOUT THIS MANUAL

Moore is as interested, as are its customers, that Moore fans operate at top efficiency for many, many years. This manual has been written to achieve that result and is based on more than 75 years of experience as a manufacturer of axial flow fans.

Moore fans represent the highest degree of axial fan development and are in all respects, regardless of price, the finest obtainable for their intended purpose. As for any fine equipment, certain precautions are necessary and certain abuses must be avoided in order to insure the best performance over the longest period of time If you have any questions regarding the installation or operation of your Moore fan(s), please contact the Company for assistance.

1.2 INSPECTION

All Moore units are carefully balanced, inspected and

packed at the factory. If any damage is evident before or after unpacking, the delivering carrier should be promptly notified so that an inspection may be made by the claims adjustor. It is the responsibility of the consignee to file damage claims with the carrier. Although Moore will not be responsible for shipping damage, it is requested that any damage, even of a minor nature, be reported to the factory at once.

1.3 IDENTIFY YOUR FAN'S FEATURES

The installation instructions which follow will include some steps for installing fans with features not provided on your unit(s). Section 2 Getting Started should be read carefully before installation begins. Moore fans have several unique features. Those unfamiliar with these units should read the short summary of these important features on the last page of this manual.

2.0 INSTALLATION **2.1 GETTING STARTED**

2.1.1 FAN IDENTIFICATION

Every fan, or group of identical fans, is assigned a Job Number. This number will be found on the Order Information Sheet showing fan specifications. A copy is attached to this 2.1.2 PLANNING THE INSTALLATION manual. If non-identical fans are shipped together, a Job Number will be included for each Job Number.

The Job Number is written in semi-permanent ink on each blade, hub and air seal. All fan parts bearing the same Job Number are entirely interchangeable. (Blades of the same Series and Diameter are also interchangeable between Job Numbers.)

Fan components covered by more than one Job Number may be crated together. The Job Number that is written found here, please contact Moore. on each part, however, will make sorting simple.

Serial Number. This Serial Number is embossed on a permanent metal tag and attached to each fan hub. The Fan Information Sheet provided for each Job Number lists all of the individual Serial Numbers of the identical fans covered by that Job Number so that, in future years, reference to the fan specifications vertical mounting and need to be mentally rotated for horizontal provided will identify the characteristics of each individual fan.

numbers of all fans produced for at least forty years in order to and the rotation direction.

provide proper maintenance advice and information on spare parts and replacements.

The sequence given for the installation may be is assigned to each fan or group and a set of Information Sheets changed if the conditions warrant. For example, the air seal may be installed on the hub before the hub is installed on the drive shaft. (In fact, for inverted fans, it is necessary to install the air seal first.) The installation should be planned before beginning so that the steps required are taken in the most convenient order. The Moore Fans LLC website, www.moorefans.com, includes a full range of installation videos. If you need information not

Class 10000 fans are suitable for horizontal or vertical Each individual fan produced by Moore is assigned a mounting, for electric motor or engine drive and may be designed for clockwise (right hand) or counterclockwise (left hand) rotation. Note: Automatic fans can only be installed for horizontal applications. (Vertical shaft)

Some drawings illustrating the installation assume mounting. Be sure to refer to the dimensional drawing(s) Moore keeps records indexed by serial and job provided. These will illustrate the proper orientation of the fan

2.2 INSTALL MANUAL HUB AND AIR SEAL



Hub Only Without Air Seal

Hub installation instructions

Moore Class 10000 hubs are shipped with Moore Hi-Torque (HT) Aluminum Bushings. The following paragraph details the installation procedure for these hubs.

Lubrication:

If the bushing was pre-installed in the hub at the factory, no further lubrication is required prior to installation.

If the bushing was not installed in the hub at the factory, it is imperative to apply high quality grease to the following surfaces:

1. The cap screw threads

2. The underside of the cap screw heads

3. The bushing taper / hub bore

DO NOT apply lubricant between the bushing bore and the shaft.

Bushing TYPE	Bushing OD	Allen Head Bolt	Hex Key Size	Required Torque
Т	3"	12 mm	10 mm	50 ft-lb (6.9 m-kg)
U	4"	12 mm	10 mm	50 ft-lb (6.9 m-kg)
W	5.5"	16 mm	14 mm	90 ft-lb (12.5 m-kg)
Ζ	7"	16 mm	14 mm	135 ft-lb (18.7 m-kg)

AIR SEAL INSTALLATION ON HUB





Installation:

Install the bushing in the hub by aligning the threaded holes on the I.D. of the hub with the slots on the OD of the bushing with the cap screws captured between the bushing and the hub. Insert the bushing in the hub. Using a hex key wrench, sequentially tighten the socket head cap screws until the bushing is almost fully engaged in the hub. Leave slight play between the bushing and hub to facilitate installation on the shaft. Place the hub/bushing on the shaft. (Preferably cap screw heads will be towards free end of shaft.) Insert the key, and tighten the setscrew to secure the hub and key to the shaft. Now begin sequentially tightening the socket head cap screws (approximately 2-3 turns per cap screw initially) to firmly engage the bushing in the hub and seat the bushing on the shaft. Once the bushing/hub is firmly seated on the shaft, continue tightening the cap screws sequentially until the specified torque, shown in the table, is reached. DO NOT over-tighten cap screws as this could cause damage to the hub.

Caution:

If bushing is expected to see frequent oscillating loads (Greater than 50% of nominal expected Static Torque), Fan should be operated for approximately 15 minutes and then re-torque bushing cap screws.

To install the air seal:

Locate the air seal installation hardware in the plastic bag taped to one of the hub tubes. Install the air seal studs on the appropriate side of the hub tube. Finger tighten.

Place one resilient washer on each stud as shown in the drawings at left. Place the air seal onto the studs and install the remaining hardware, following the sequence shown in the drawings. Do not lubricate this end of the studs.

Note that the diameter of the resilient washers, before they are compressed, is slightly less than the diameter of the aluminum washer. Tighten each nut until the resilient washer's diameter is the same as the aluminum washer. Do not overtighten. Over-tightness exists when the resilient washer has expanded in diameter larger than the diameter of the aluminum washer.

Note: Some air seals are provided with more mounting holes than may be required. This is done intentionally to make the air seals more interchangeable between units. For example, an air seal with 8 mounting holes can be used with either a 4-blade or an 8-blade unit.

TMC-704 Rev M-8/1 MOORE FANS LLC, MARCELINE MO 64658 PHONE (660) 376-3575 FAX (660)376-2909 EMAIL info@moorefans.com

Page 3



AUTOMATIC FAN ONLY WITHOUT AIR SEAL

IF BUSHING IS NOT PRE-INSTALLED INTO HUB

Install the bushing in the hub by aligning the threaded holes on the I.D. of the hub with the slots on the OD of the bushing with the cap screws captured between the bushing and the hub. Insert the bushing in the hub. Using a hex key wrench, sequentially tighten the socket head cap screws until the bushing is almost fully engaged in the hub. Leave slight play between the bushing and hub to facilitate installation on the shaft.

IF BUSHING IS PRE-INSTALLED INTO HUB

Place the hub/bushing on the shaft. Insert the key, and tighten the setscrew to secure the hub and key to the shaft. Now begin sequentially tightening the socket head cap screws (approximately 2-3 turns per cap screw initially) to firmly engage the bushing in the hub and seat the bushing on the shaft. Once the bushing/hub is firmly seated on the shaft, continue tightening the cap screws sequentially until the specified torque, shown in the following table, is reached. DO NOT over-tighten cap screws as this could cause damage to the hub.

To install **air seal** locate the air seal installation hardware in the plastic bag taped to one of the hub tubes. Remove the protective plastic caps from the bolts or studs. Place one aluminum washer and one resilient washer on each bolt or stud as shown in the drawings. Lower the air seal onto the bolts or studs and install the remaining hardware, follow the sequence shown in the drawings. Do not lubricate the end of the bolts or studs.

Note that the diameter of the resilient washers before they are compressed, is slightly less that the diameter of the aluminum washers. Tighten each nut until the resilient washer's diameter is the same as the aluminum washer. Do not over-tighten. The nut is over-tightened when the resilient washer has expanded in diameter larger than the diameter of the aluminum washer.



FAN SERIES	BUSHING TYPE	BUSHING OD	ALLEN HEAD BOLT	HEX KEY SIZE	REQUIRED TORQUE
24	Т	3"	12 mm	10 mm	50 ft-lb (6.9 m-kg)
30-72	U	4"	12 mm	10 mm	50 ft-lb (6.9 m-kg)
30-72	W	5.5"	16 mm	14 mm	90 ft-lb (12.5 m-kg)



AIR SEAL INSTALLED ON AUTOMATIC HUB WITH POSITIONER



AIR SEAL INSTALLATION ON AUTOMATIC HUB

558 PHONE (660) 376-3575 EMAIL info@moorefans.com

2.4 INSTALL PNEUMATIC TUBING 2.4.1 AUTOMATIC HUB WITH STANDARD POSITIONER

Connect the special flexible hoses provided to the instrument port "A" and the supply port "B" shown in the drawing. Use the elbow provided on one hose so that the hoses will be parallel. Support the positioner while tightening all fittings to prevent rotary union damage.

The flexible hoses supplied must be used and a slight amount of slack should be left when connecting to rigid piping to relieve any abnormal loading of the rotary union internal bearings and seal.

The ends of the hoses must be capped if not coupled to the system piping immediately. The flexible hoses provided terminate in 1/4" N.P.T. male fittings.



2.4.2 FOR POSITIONER WITH FAIL LOCKED IN LAST POSITION

When a fan is specified to fail locked in last position, pressure is retained in the actuator chamber if the system pressure falls abruptly. This retained pressure prevents the blade angle from changing when a failure occurs in the system supply pressure.

Connect hoses "A" to the instrument port as described in 2.4.1. Hose "B", which is normally connected to the supply port is to be connected to the fitting labeled "source air supply". The flexible hoses

provided must be used and a little slack must be left in them to prevent damage to the bearing or seal in the rotary union.

When the system is charged, normal pressure at the valve keeps it in the open position and flow occurs in either direction between the positioner and the supply actuator. If the system pressure fails, the valve automatically closes, retaining pressure in the actuator.



Note:

After installing hub onto bushing: Check the hub and positioner for run out. Maximum run out of positioner in the horizontal direction is $\pm 1/8''$ (3mm) If outside the tolerance adjust the bushing nuts slightly to level the fan hub.



BEFORE INSTALLING BLADES....

Check to see that the hub is level. If the drive shaft is not truly horizontal (or vertical), causing the hub to be cocked, it will be difficult to adjust blade angles accurately. Eccentric rotation of the fan can also cause serious vibration problems.

If misalignment, vibration or unbalance in the system is present, it will be more easily identified and corrected at this time.

Moore fan blades are carefully balanced to the same moment at the factory. Any Class 10000 blade of the same series and diameter may be installed on any hub furnished on the job. They are completely interchangeable.

Moore Class 10000 Heavy Duty Fans are designed for engine drive and other applications with the more severe requirements of this service. Proper installation, with particular attention to tightening nuts to the specified torque, is essential to maintain the design integrity of these units.

Install one blade: Clean any dirt or grease from the rod end and the surfaces of the resilient mounts. Align the rod end hole with the holes in the resilient mounts and insert the blade mounting bolt first through the resilient mount with the recess to accept the bolt head, then through the rod end hole and screw the bolt into the second resilient mount lightly. A 3/4" drive torque wrench with a short extension may be used. The blade mounting bolt is supplied from the factory with grease on the threads and conical face. Do NOT clean the grease from the bolt.

Complete the installation of one blade by holding the

blade so that the blade extends straight out from the hub tube. Holding the blade in this position, tighten the bolt using a torque wrench set to 200 ft-lb (28 m-kg) making sure the rod end and the resilient mounts seat.

After installing the first blade, manually rotate the fan while moving the blade tip in and out to be sure the blade clears the ring or throat at all points. When the blade is held in alignment with the blade tube (that is, straight outward from the hub), it should clear the fan ring by a distance adequate to provide for any relative motion between the fan wheel and the ring. Excess clearance between the blade tips and the ring, however, should be avoided to prevent backflow which seriously reduces fan efficiency. If clearance is excessive, the diameter may be adjusted at this time. See Section 2.5.2.

Install the rest of the blades so that they are identical with the first blade. A variation in the blade tip elevation is normal in the stop position. Torque all bolts to 200 ft-lbs (28 m-kg). If blades are installed properly, they will return to their undisturbed position if the tips are pressed in the axial direction with moderate force (10 to 20 lb).

2.5.2 ADJUST BLADE ANGLE

change in blade angle is sometimes necessary, however, to manual. Section 4.4 "Checking Blade Load" provides a simple adjust to actual site conditions. Failure to adjust the blade angle method of determining the maximum

Hubs are shipped from the factory with the rod end set when required may result in blade overload. The causes of for the blade angle indicated by the design performance. A improper blade loading are explained in Section 4.3 of this

blade angle allowable in terms of static pressure vs blade angle. Please refer to these sections before increasing blade angle.

To adjust, loosen the Clamp Nut just enough to allow the blade to be turned. Place a inclinometer on the flat surface of the mounts end as shown in the illustration at right. Turn the blade until the desired angle is achieved.. Make a permanent record of the final angle selected and take care that all blades on the fan are set at the same angle. A typical adjustment may be $+/-3^{\circ}$. The maximum recommended blade angle is 30°.

Retighten the Clamp Nut to 18 ft-lbs (2.5 m-kg) for Manual and 50 ft-lb (7 m-kg) for the Automatic while holding the blade in this position. <u>Recheck each blade angle</u> before tightening.

WARNING: The fan is designed to consume the horsepower stated on the Fan Specification Sheet. The engine drive typically produces far more power than the fan can absorb. Too great an increase in blade angle can cause serious blade overload which will stall the blades. In this condition, the fan will actually deliver less air and blade life may be shortened. Blade load considerations are discussed in Section 4.0 Operation in this manual.



ASS 10000 AUTOMATIC HUB DETAIL NOTE: CLAMP DIFFERENCES

2.5.3 ADJUST DIAMETER IF REQUIRED

particular ring. To do so, loosen the clamp nut so that the rod automatic. end can be rotated in the hub tube. One complete revolution will increase or decrease the radius of the fan by .059" (1.5 mm). mm). At least 1.0" (25 mm) of rod end threads must remain in Take care that the rod end is returned to exactly the factory-set the tube. angle unless it is intended that the blade loading be changed as discussed in the previous section. A match mark may be made at tips is $+1.0^{\circ}$ & -5° . a point on the threads and the tube before turning to assure that exactly one revolution is made. Tighten the clamp nut to 18 ft- outward adjustment.

At times it may be necessary to adjust the fan diameter to suit a lbs (2.5m-kg) for manual and 50 ft-lbs (6.9m-kg) for the

*Maximum adjustment possible is about +/- 0.75" (19

*Maximum adjustment possible on blades with ATEX

*The Series 18 has .25" inward adjustment and no

2.6 START-UP PROCEDURES

nuts to see if they are tightened. Take care not to exceed the of the blades should return to their original position at the same stated torque limits.

Manually rotate the fan while checking each blade for proper clearance.

Start the fan and watch it in operation. All blades should move to the same operating position, indicating that the blade angles are properly set and that all blades are equally loaded. If vibration or unbalance is evident, see Section 3.3.

After the fan has been operating for several minutes, than the specified horsepower.

Before starting the fan, manually check all bolts or stop the fan and observe the blades as the fan comes to rest. All rate.

> Inspect the inner surface of the fan ring and the blade tips for any indication of scoring.

> The horsepower given on the Fan Specifications is the calculated horsepower (at the fan shaft) that is required for the specified performance. Consult the factory or the fan curve before increasing the blade angle for the fan to consume more

3.0 MAINTENANCE 3.1 PERIODIC INSPECTION

3.1.1 PURPOSE

Fan failure is most likely the result of destructive repetitive stress acting over a period of time. These on the fan ring, or it may be the result of long-term fatigue stresses may be caused by mechanical abuse, e.g. rough due to continued operation under conditions of vibration gears or drive shaft imbalance, or by aerodynamic abuse or unbalance as discussed in Section 3.3 which follows. such as blade overload or abnormal flow conditions. Skin cracking can also be caused by continued operation Fortunately, these stresses manifest themselves in typical under overload conditions as discussed in Section 4.3 ways that may easily be detected on inspection if one Causes of Blade Overload. knows what to look for. The purpose of this section of this manual is to describe the symptoms of potentially been improperly installed. See Section 2.2. Check to be damaging mechanical problems and how they can be sure the resilient washers are present and the nuts properly corrected. Aerodynamic abuses are covered in Section 4.0 tightened. Operation.

3.1.2 FREOUENCY OF INSPECTION

The frequency of inspection varies widely in accordance with the severity of service and a suitable the fan or the fan striking some obstacle. Minor dents may inspection schedule should be developed with experience sometimes be repaired by drilling a small hole in the over time. During the first week of operation, at least one center of the dent and pulling outward on the blade skin. inspection should be made. At these initial inspections, in Blades may be ordered from the factory for replacement. addition to the items listed below, check all nuts for If there is any evidence of this type of damage, the hub tightness to make certain that all were tightened properly should be carefully inspected as discussed in Section 3.1.6 at installation. Take care not to exceed the stated torque which follows. limits. Following the first week, it is probable that inspections of the fan need be made no more frequently as the blade material on Moore fans works well with than inspection of the drive.

3.1.3 BLADE ANGLE AND RUNNING POSITION

Turn off the unit and watch the blade tips. A looseness in the clamp bolt will permit a blade to flatten in conditions, please contact the factory. angle. This usually can be detected by looking at the tips of the blades while the fan is slowing down. At the same 3.1.5 HUB INSPECTION time, before the unit comes to a complete stop, watch the same operating position. If one or more blades is at a caused that is not readily apparent. Check the hub for any all of the blades are at a different position than at the last cannot be replaced in the field on manual fans and a new inspection, investigate further. This condition may be hub should be ordered. caused by a damaged resilient mount, requiring blade replacement.

3.1.4 CRACKS, DENTS AND CORROSION

Skin cracking may be caused by the tips dragging

Cracking in air seals can occur if the airseal has

The fatigue strength of materials, whether metal or plastic, may be lowered by long-term exposure to water.

Dents in blades are caused by objects falling into

The Type 5052 aluminum, a marine alloy, used either fresh or sea water. Waters that are acid, alkaline, or contain copper salts, however, should be avoided for all aluminum alloys. If you have questions regarding the suitability of the fan materials under certain water

If damage to the fan has occurred, the hub should track of the blade tips to see that all blades move to the be carefully inspected since subtle damage may have been substantially different position than the other blades, or if sign of bending or twisting of the hub tubes. Hub tubes

As with any industrial equipment, before entry into fan chamber, strict adherence to ALL Lock-out / Tag-out procedures is well advised!
3.2 ANNUAL INSPECTION

3.2.1 CLEAN BLADES IF INDICATED

A smooth blade surface is essential for efficient fan performance. If an incrustation forms on the blades it should be removed. Use steel wool as an abrasive along with a mild detergent or a very mild form of solvent. Lye must not be used because it attacks aluminum readily.

3.2.2 CHECK SYSTEM PRESSURE

Radiator sections may be effected by the accumulation of dust and dirt in some atmospheres. (Cottonwood seeds are particularly troubling.) These accumulations may significantly increase the static pressure. Adjust the blade angle if necessary as described in Section 4.4 Checking Blade Load.

3.2.3 CLOSE INSPECTION

The yearly inspection should be a very thorough one. All nuts and bolts should be checked and careful scrutiny given to all highly stressed areas.

Inspect the resilient mounts as follows: With the fan turned off, grasp each blade and feel for looseness at the mount. If in doubt, the blade should be removed and the mount assembly visually inspected. Wear is indicated by a fretting effect and the resilient mount material will show signs of extruding from the cavity. If these indications are not apparent, replace the blade and continue normal operations.

Inspect the blade tips for any signs of cracking and the fan ring for any scoring that might indicate that the blades have been striking or rubbing against the fan ring.

3.3 VIBRATION AND UNBALANCE

3.3.1 GENERAL

It is always possible that the minute unbalances of the various components may combine to provide a noticeable lack of balance. This rarely occurs, since it is unlikely that all unbalanced components will become assembled with their heavy sides in the same direction. Nevertheless, if unbalance is noted, the various components should be rotated into different positions to see if this might cure the unbalanced condition.

If vibration or unbalance occur, either at the time of installation or later during the operation of the unit, its cause **3.3.3 BELT DRIVE UNITS** may be determined by following the directions below.

3.3.2 FAN UNBALANCE

Vibration is most likely to be caused by the fan if the blades are not set at the same angle. If the blades are properly set, the fan is the least likely cause of vibration. All fan components are balanced to within ±0.2 ft-lbs.

If the fan is in an unbalanced condition, the frequency of vibration of the structure will be that of the RPM of the fan 3.3.4 ROUGH GEARS and is quite low. In the case of large fans, the frequency is often low enough to be mentally counted along with the rotation of the fan. A vibration of 500 RPM or less will be felt as a weave in the structure rather than a vibration. Below 400 RPM, the vibration a frequency meter.

Before assuming fan unbalance, check for loose bearing seats or bearings journaling the shaft on which the fan is mounted. This condition will cause the shaft to rotate eccentrically, throwing the weight of the fan off center, resulting shaft accelerates and decelerates with each pinion tooth in unbalance of the frequency of the fan RPM.

determined to be unbalanced, field balancing may be accomplished as described below in Section 3.3.6.

shaft and its supporting bearings by fan unbalance are negligible. vibration is at least as serious as that caused by bad bearings.

A rotating centrifugal load of 100 pounds, due to unbalance, No piece of rotating equipment is perfectly balanced. would be extremely objectionable and possibly even damage the structure on which the drive was mounted. By contrast, it would be unlikely that the drive shaft of a fan, of perhaps 25 HP, would be supported on bearings rated less than 2000 or 3000 pounds radial load. For higher horsepower, the bearing capacity would be correspondingly increased. From this it is evident that speed reducer or drive shaft bearing failure could never be caused by moderate or even objectionable fan unbalance.

The more common causes of vibration in belt drive units are not the drives themselves but the result of shafts that are too flexible or non-rigid supporting members. Vibration can be caused by misalignment of the sheaves or poorly adjusted belt tension. Consult the manufacturer of the drives for information. The quickest way to identify the cause of vibration in belt drive units is to operate the fan with the blades removed.

Continued operation on rough gears and bearings is almost certain to develop cracks in the blade skins. Rough gears may be of two types:

1. Rough or failed bearings in the drives or gears will may be mentally counted and above that point may be read with result in a high frequency vibration being transmitted into the fan where some areas of the skin will respond to the frequencies applied. Cracks will appear in the blade skin and eventually, in some areas, the skin may actually fall away.

2. The other type of rough gear occurs when the output engagement. With a six tooth pinion and a motor speed of 1800 After all checks have been made and the fan is still RPM, or 30 cycles per second, this gear misalignment impresses upon the fan a vibrating frequency of $30 \ge 6 = 180$ cycles per second. If the engagement of teeth is also included, the It should be noted that the loads imposed on the drive frequency is 360 cycles per second. This type of high frequency

3.3.5 THROAT FLUTTER

will develop a reduced pressure area (or suction) on the fan work. If the vibration ceases under this condition, it is certain throat or ring at the tip of the blade. This suction tends to draw that throat flutter is present when the blades are loaded. the throat toward the tip of each blade, which means that a four blade fan would tend to draw the throat into something 3.3.6 FIELD BALANCING approaching a square while a six blade fan would draw it into something resembling a hexagon, etc. Since the fan is rotating, structural change or by installing one new blade on an old fan the effect on the throat is that of continually drawing it into a where the existing blades had changed in weight in the course of rotating polygon. The resulting throat flutter is frequently operation. mistaken for fan unbalance.

that flutter will not exist. A weak or flexible throat, particularly when used with a fan of a low number of blades, will be greatly affected by this type of vibration. Throat flutter is easily detected due to the fact that it is invariably of a frequency of the fan RPM times the number of blades on the fan.

Throat flutter will cause no damage to the fan so long as the throat does not disintegrate and fall into the fan blades. It may be eliminated by stiffening or bracing the throat.

If in doubt that throat flutter is the cause of vibration, Any fan that is effectively moving air at the tips of the blades reduce the angle of the blades until the fan is doing little or no

Unbalance in older fans may develop because of some

Use wire to attach a small weight in succession to each A substantial throat or ring will be sufficiently rigid of the air seal studs until the best location for the weight is found. The weight should then be increased or decreased until the best balance is achieved. The permanent weight may then be secured to the stud or hub tube, whichever is the most convenient for the type and shape of weight to be used. One or more pieces of metal shaped like a washer could be placed over the stud, on the hub tube, behind the stud, or over the threaded portion of the rod end. Aluminum or stainless weights should be used and weights should not be attached to the blade skin.

3.4 WARRANTY

purchaser for resale, that the fans manufactured and sold by shipping damage, or if repairs or part replacements have been Seller to Buyer under this Agreement will be free from all made or attempted without Seller's prior written authorization. defects in material and workmanship under ordinary use for a SELLER SHALL NOT BE LIABLE IN ANY EVENT FOR ANY INCIDENTAL OR period of two (2) years from the date of shipment or one (1) year CONSEQUENTIAL DAMAGES FOR BREACH OF THIS OR ANY WARRANTY. from the date the fan is installed on a customer's premises, THIS WARRANTY IS IN LIEU OF ALL OTHER GUARANTEES OR EXPRESSED whichever occurs first. This warranty period shall apply only if Seller receives written notice of any defect within the warranty period. Upon receipt of such notice, Seller, at its option, may require Buyer to return the fan at Buyer's cost to Seller for inspection by Seller. If the fan is found to be defective on inspection by Seller, as a sole and exclusive remedy, Seller will, at its option, either repair or replace the fan. This warranty shall

MOORE FANS LLC (the Seller) warrants only to Buyer, as its not apply to damage on account of misuse, neglect or accident or WARRANTIES AND ALL IMPLIED WARRANTIES, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE. DUE TO THE VARIETY OF CONDITIONS UNDER WHICH THE FANS MAY BE USED, RISKS OF RESULTS OBTAINED FROM USE OF THE FANS, WHETHER USED ALONE OR IN COMBINATION WITH OTHER PRODUCTS, IS ENTIRELY BUYER'S. THE ABOVE LIMITATIONS ON DAMAGE AND EXCLUSION OR LIMITATION OF IMPLIED WARRANTIES ARE NOT APPLICABLE TO THE EXTENT PROHIBITED BY STATE LAW.

3.5 MANUAL FAN PARTS LIST

				NOT TO SCALE: SOME DIMENSIONS AND ANGLES HAVE BEEN EXAGGERATED FOR CLARITY
		1.000		
	10	DWG. NO.	SHOP PART NO.	DESCRIPTION
		1	2883	ROD END CLASS 10000 HEAVY DUTY
M		1	4269	ROD END CLASS 10000 STANDARD DUTY
	2002	1	7791	SERIES 18 ROD END CLASS 10000
		4	2886	24 MM ALUMINUM BLADE MOUNTING BOLT
13		5	3028	8 MM x 50 mm SS CLAMP BOLT
		6	3029	8 MM SS CLAMP NUT
	THE REAL	7	3081	SS LOCK WASHER
		8	3073	ROD END CLAMP
		9	52	5/8" RESILIENT WASHER
(14)		9	6865	SERIES 18 RESILIENT WASHER
		10	169	16 MM ALUMINUM NUT
1		10	7783	SERIES 18 ALUMINUM NUT
1/.		11	151	5/8" ALUMINUM FLAT WASHER
Ut		11	7365	SERIES 18 ALUMINUM FLAT WASHER
		12	3033	16 MM AIR SEAL STUD
		12	7782	SERIES 18 AIR SEAL STUD
FT		13	4698	12 MM HEX BOLT FOR T BUSHING (2)
1 6		13	4153	12 MM HEX BOLT FOR U BUSHING (4)
		13	4154	16 MM HEX BOLT FOR W BUSHING (4)
		13	4159	16 MM HEX BOLT FOR Z BUSHING (8)
		14		T BUSHING (3")
		14		U BUSHING (4")

14

14

W BUSHING (5.5") Z BUSHING (7")

3.6 AUTOMATIC FANS PARTS LIST

	FOR HU	DETAIL AA JB WITH POSITIONER			
(1)≺			8) (1) SEE DI	etail aa (10)	(15) (16)
	000 000				
<u>ITEM</u>	PART #	DESCRIPTION	ITEM	PART #	DESCRIPTION
1	2624	CSP UNION ASSEMBLY (WITH POSITIONER)	22		RETURN SPRING
2	1625	10 mm STAINLESS STEEL NUT (3)	23	4515	16 mm x 32 mm ALUMINUM ANCHOR TEE BOLT (4 per BLADE)
3	733	3/8" SEALED WASHER (3)	24		12 mm HEX BOLT FOR T BUSHING (2)
4	771	10 mm x 30 mm STAINLESS STEEL BOLT (6)			12 mm HEX BOLT FOR U BUSHING (4)
5	179	3/8" FIBER WASHER (6)	25	1.50	16 mm HEX BOLT FOR W BUSHING (4)
6	162	UNION PLATE	25	152	5/8" ALUMINUM LOCK WASHER (4 per BLADE)
7	163	UNION PLATE GASKET	20	1550	18 mm x 302 mm ALUMINUM HUB STUD
8	159	STAINLESS STEEL STOP STUD (3)	27	10	
9	257	12" STANDARD NEOPRENE AIR HOSE ASSEMBLY WITH 1/4" NPT EXTERNAL THREADS BOTH ENDS	28	10/	16 mm x /0 mm ALUMINUM BOLT
10	21	POSITIONER	29	109	10 mm ALUMINUM NUT
11	210	1/4" BRASS STREET ELBOW	30	4209	KUD END
12	344	5/8-18 LH LOCKNUT	31		AUTOMATIC FAN BUSHING ADAPTER
15	1532	18 mm ALUMINUM NUT	32		PISTON STRUT ASSEMBLY WITH HARDWARE
16	164	3/4" ALUMINUM FLAT WASHER	33		PISTON PLATE
17	52	5/8" RESILIENT WASHER	34		AUTOMATIC HUB PLATE
18	2886	24 mm ALUMINUM CLEVIS/BLADE BOLT	35		T BUSHING (3")
10	644	ROD END CLAMP			U BUSHING (4")
17	044				W BUSHING (5.5")
20			36		HUB TUBE ASSEMBLY WITH HARDWARE
21		RETURN SPRING SHIM	37		CYLINDER PLATE

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4.0 OPERATION 4.1 AERODYNAMIC ABUSE

4.1.1 ABOUT THIS SECTION

abuse described on the preceding pages are destructive for all be expected to vary more than plus or minus 50%. Fan design types of operating equipment. It is less well recognized that — based on such assumptions is entirely reasonable and, with for fans — aerodynamic stresses are an even more serious proper drives and installation conditions, has proven highly hazard. This section deals with the causes of destructive successful. aerodynamic stresses and how they can be avoided.

Although this information is given primarily for the 4.1.3 ABNORMAL CONDITIONS benefit of operators of Moore equipment, it may be applied to fans of any manufacture.

Unlike smaller fans, which are typically furnished complete with their surroundings, the large fan wheel is supplied as an unprotected component of the system and is installed in innumerable types of surroundings. Not only do the types and conditions of the drives for these fan wheels vary widely, but the entrance and exit conditions and the enclosure for the wheel assume a myriad of possible combinations. In designing his product, the manufacturer of fan wheels must anticipate the operating conditions based upon his knowledge of what is reasonable and customary for the industry. He may over-design for abnormal stresses only until the practical limit is reached to avoid excessive weight, cost and inefficiency.

4.1.2 NORMAL OPERATING CONDITIONS

The fan manufacturer assumes a fairly reasonable atmosphere for the operation of his product, including the following:

- The fan selection will be reasonably in line with the performance the unit is expected to maintain, with an adequate blade area for the pressure required at the given RPM. Blades will not be loaded beyond their capacity to maintain air flow.
- A fan ring will be provided that is round, rigid and of a depth at least sufficient to cover the tips of the blades. Tip clearances will be uniform and controlled.
- The approach air will represent a relatively uniform and axial flow with, of course, some unavoidable turbulence expected. Adequate open area will be provided at the inlet of the fan.
- Major obstructions will not be present at either the inlet or discharge of the fan.
- The RPM of the fan will be within the design limits.
- The relative direction and velocity of approaching air to the blades will be fairly constant and protection will be provided from extreme wind conditions.

It is widely acknowledged that the kinds of mechanical Under such conditions, the unit stresses in the blades would not

Abnormal operating conditions result in destructive repetitive stresses that can seriously shorten fan life. The aerodynamic abuses discussed in this section can cause repeated flexing of the fan blades and hub. Violent displacement of the resiliently mounted Moore fan blades may occur - a greater displacement than would occur in rigidly mounted blades. The resilient mounting, of course, minimizes the structural unit stresses which would be transmitted to the root of the blade and into the hub and drive. Although Moore units may be expected to resist greater stress than units of conventional design, such repetitive stresses may exceed the capability of the resilient mounts to absorb them. If so, fatigue of the mounts and metal may develop, adjusting linkages may wear, and ultimate failure becomes a possibility.

Some of the abuses set out in the following text are far less important than others. All of them may occur in varying degrees.

Specifically, abuse due to serious repetitive stresses can lead to mount failure and, if carried to extremes, can require blade replacement. In units of other manufacture with rigidly mounted blades, repetitive stresses of this type may lead to blade breakage, probably near the root or at the point of attachment to the hub where stresses are highest, or may lead to failure of the hub itself. The resilient mount design, unique with Moore fans, dampens these vibrational forces and results in a fan that is far less vulnerable to failure from these conditions than other units with rigidly mounted blades. Even so, extreme conditions can cause damage.

A well-designed fan can be expected to operate for many years without trouble under normal operation as described above. The extreme repetitive stresses described below, however, will certainly reduce the life of the fan, causing failure many years sooner than would occur if the fan were operated as intended. Fortunately, these destructive conditions are readily observable to someone who is knowledgeable about them, and they can be corrected with reasonable effort and expense once they are observed.

4.2 BLADE OVERLOAD

Of all the aerodynamic abuses to be avoided in the resulting in a severe vibration throughout the aircraft as operation of a fan, the most important is that of the flow alternately makes and breaks. Anyone who has overloading the fan blades. Blade overload occurs because experienced a stall in an airplane will be familiar with this of insufficient blade area: In other words, when there is an violent phenomenon. inadequacy in the number of blades on the fan selected.

pressure that each blade will produce at a given RPM with than downward, the convex side of the blade being the good efficiency. This pressure is called 100% blade load. lower surface rather than the upper surface as in the case When blade load exceeds 110%, the fan will not only of an airplane. The result of blade overload is identical: operate at lower efficiency, it may be subject to structural When blade load exceeds that allowable, a violent damage as well.

the pressure to be produced by one blade determines the second. number of blades required for the anticipated performance. Whenever information is available, The consider that the available number of blades are set at too Moore Company checks the selection. Even so, steep an angle to be able to move air at the axial velocity underestimation of the pressure requirements by the which is necessary to maintain a smooth flow over the system designer, or changes in the operating conditions convex surface. In other words, to move air at the velocity over time, may result in overload conditions.

concern? We are all aware of the fact that an airplane have to be maintained for an air flow corresponding to this traveling at a given speed can carry only a certain load. If angle is greater than the total pressure capability of the the speed of the airplane is decreased or the load given number of blades at this RPM. Such a condition can increased, stalling flow over the wing will occur. In the only be corrected by decreasing the blade angle until case of an airplane, approximately two-thirds of the lift smooth flow is obtained or by increasing the number of provided by the wing is the result of the air flow over the blades and the total pressure potential of the fan until the top or convex portion of the wing. Lift is provided as a fan's pressure potential equals the pressure necessary to reaction to the flow of air being accelerated and deflected move the specified quantity of air through the system. downward as it passes over the wing. A negative pressure area is thus formed on the top surface of the wing which flow, or blade overload, will significantly shorten the life tends to lift it upward.

clings to the surface of the wing, little turbulence is chart under Section 4.4 Checking Blade Load which present. When the load is increased, or the speed follows. Note that although air flow remains constant or decreased, the angle of the wing to the air stream must be decreases, horsepower continues to increase with increased to a point where the air flow breaks away from increased blade angle. the upper surface of the wing. This is known as stalling or burbling flow, since the air, instead of clinging to the installation, can only absorb forty horsepower, for wing, breaks away near the leading edge and leaves what example, the blades may be pitched up to consume fifty might be called a turbulent void above the upper wing horsepower without any increase in air delivery, and surface, nullifying the accelerated flow which was possibly with a decrease. As a result, the extra ten responsible for the greater part of the lift of the wing.

of its lift. Flow, however, will re-establish briefly and blades so that blade load will amount to slightly less than break again, the cycle being repeated continuously, 100% of full blade load.

A fan blade is no different than an airplane wing The Moore system of rating is based upon the except that the air usually is being deflected upward rather vibration will take place in the blade as the laminar, or In selecting a fan, the total pressure divided by uniform, flow makes and breaks perhaps many times a

Another way of looking at this problem is to necessary for this blade angle, plus overcoming the static Why is a blade overload condition of such resistance of the system, the total pressure which would

Continued operation under conditions of stalling of the fan. Operation under these conditions will also So long as air flow over the wing is smooth and reduce efficiency to a ridiculously low figure. See the

In conclusion, if a given fan, in a given horsepower is totally wasted -- perhaps worse than When this occurs, the wing loses a large portion wasted. It is good practice to select a sufficient number of



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4.3 CAUSES OF IMPROPER BLADE LOADING

4.3.1 VARIATION FROM PREDICTED CONDITIONS

cooling towers undoubtedly do their best to accurately of the fan blade toward the hub then must produce a state the calculated static resistance of the system, a higher pressure to compensate for the portion near the tip. number of factors may cause the actual conditions to vary from the design conditions. When a variation occurs, it area between the tip of the blade and the fan ring. Air that may be found, upon testing, that the static pressure for a has been pumped by the fan will return downward through given volume through the system is higher than this unswept area at a velocity greater than that at which it anticipated. In this case, the number of blades provided passed through the fan in the desired direction. This may be inadequate to meet the performance. On the other condition adds even further to the requirements of the hand, the static pressure may have been overestimated and portion of the blade which is doing the work and excess blade area provided, resulting in a fan with efficiency will be greatly reduced. unutilized capacity operating at low efficiency.

selected to move the anticipated volume of air and the fan in this example might be considered an effective 10-ft number of blades is selected to maintain the total fan. It would have to deliver sufficient air to satisfy the anticipated pressure required to move this volume at a performance requirements of the installation, plus the given RPM. If the static pressure turns out do be higher amount of air which is returning in the void between the than predicted, the fan may then be operating in an tips and the throat. Under such circumstances, excessive overload condition. If the RPM cannot be increased, the blade loading could occur even though the required only solution to this condition is to reduce the blade angle system pressure is not achieved. until the fan can carry the then reduced volume at the originally anticipated pressure. Since reducing the 4.3.3 POOR ENTRANCE CONDITIONS volume, while holding the total pressure as originally anticipated, can only reduce the horsepower, it is then directions, increasing in velocity as it nears the opening, impossible to consume the horsepower originally intended then accelerating rapidly as it enters. The air approaching without overloading the fan. This is one of a number of from the side must be turned through 900 to enter a ring reasons for providing some safety factor in blade loading whose entrance terminates in a flat plate. If the inlet end at the time of original fan selection.

excessive number of blades may be specified in the turned through 1800. The inertia of the approaching air interest of making a conservative selection. If the static pressure has been overstated, the theoretical number of the desired flow. It consequently swoops toward the blades will be greater than needed. This theoretical center, leaving the outer area of the fan with reduced flow number of blades is usually a fractional number and the or even reverse flow near the ring. actual number of blades used must, of course, be the next larger integer, resulting in some "safety factor" in the to that previously described for excessive tip clearance in selection. If, in addition, a blade or two is added as a that the effective diameter has been reduced and excessive "safety factor" or in anticipation of increased future blade loading could occur even though the required requirements, it may be impossible to meet the original system pressure is not achieved. Efficiency will be greatly performance requirement efficiently. The only way to reduced. provide the original performance and draw no more than the original horsepower is to flatten the blade angle. There **4.3.4 EXCESSIVE DEFLECTION** is a limit, however, in how far the blade angle may be reduced before further reduction will decrease airflow dependent upon the square of the velocity of the blades without a further reduction in horsepower. For belt drive relative to the air. If the air could be moved into the fan in units, the most practical solution to this problem is to an axial direction and passed through the fan into the reduce the RPM of the fan.

4.3.2 EXCESSIVE TIP CLEARANCE

blade, air from the high pressure surface of the blade will also deflect the air in the direction of rotation of the fan. flow around the tip and nullify the negative pressure on The air when rotated with the fan is moving with the underside of the blade for some distance in from the

tip. For a fan of, say, 12-ft diameter, the last 12 to 18 inches of the blade could be producing no pressure Although those who design air coolers and whatever and performing no useful function. The balance

Excessive tip clearance also leaves an unswept

With the loss of a foot at the tips of the blades, Inadequate Blade Area: The blade angle is plus the back flow between the tips and the ring, the 12-ft

Air will approach the fan from all possible of the ring projects some distance out, with approach **Excessive Blade Area:** Occasionally, an possible from all directions, a portion of the air must be prevents it from turning sharply and advancing parallel to

The effect of poor entrance conditions is similar

The pressure which the fan can achieve is discharge without changing direction, the relative velocity of the blades to the air stream would be the true velocity of the blades at any point. This, of course, is not the case. Unless the fan ring is very close to the tip of the For the blades to accomplish work upon the air, they must a certain velocity in the same direction as the rotation of allowable pressure capability of the fan, even though it does the fan, which reduces the relative velocity between the not reach the full rated pressure. fan blades and the air by some portion of this rotational velocity.

Moore fans are designed in contemplation of a maximum deflection of 60° at the hub, decreasing to a very small value at the tip. This deflection is considered in the determination of the pressure which may be provided by each blade over its full length. If fans are selected, or if conditions exist, which cause the deflection to exceed 60° at the hub, the velocity of the blades relative to the air is less than anticipated and the blades will not provide the rated pressure. The test below, however, will show the full

4.3.5 CONCLUSION

As can be seen by the various points discussed in this section, there are a number of complex factors which tend to cause fans to be operated in a condition of improper blade loading which can shorten fan life or lower efficiency. When blade angles are set to consume the specified horsepower (at the fan shaft), the resulting performance should be very close to the specified performance. If this is not the case and the problem cannot be identified or corrected, please contact Moore for assistance.

4.4 CHECKING BLADE LOAD

4.3.3 would apply and the fan could be overloaded even though blade angle until the blade loading reaches maximum, at which the total pressure indicated by the test was within the allowable point it will level off. blade loading.

detecting blade overload, or determining maximum allowable static pressure curve may merely stay level or may drop off blade angle, is set out below. The equipment needed is a wrench, a torque wrench, a protractor and a draft gauge (or manometer).

All fans are shipped with the blade angle set for the anticipated performance requirements furnished to The Moore Company by the purchaser. This blade angle is called out on the Fan Specification Sheet. This angle refers to the angle measured at the location shown in Section 2.3.3. Hubs are shipped with the rod ends set at this angle.

To start the test, adjust the blades to an angle of approximately half that called out on the specifications or measured on the units. Connect the draft gauge to as quiescent a spot in the plenum as possible, preferably in the corner of the plenum and either ahead of or following the fan, depending upon whether the application is induced or forced draft. Since the figures obtained are purely relative, it is not necessary that accurate static pressure readings be obtained, but rather that the readings taken represent a consistent series of pressures at the point of reading chosen.

Start the fan and record on the chart provided the blade by one or two degrees and repeat the performance, recording blank chart is also provided for your use. again these readings. Keep increasing the angle and following

One method of checking blade load is to run a this procedure until the motor is fully loaded, in which case the complete field test on the fan. Although laborious, this method fan is able to consume full rated fan horsepower without will provide ample proof so long as neither excessive tip overload OR until the curve which will have started on a definite clearance nor poor entrance conditions are present. If either are slope begins to approach the horizontal. It will be noted that the present, however, the conditions set out above under Section static pressure will be consistently increasing with increased

Subsequent increases in blade angle may have quite A better, more convenient and simpler method of different effects, depending on the individual installation. The sharply. In rare cases, it may level off and again start rising as the fan begins operating as a centrifugal blower.

> Typical examples are shown in dotted lines on the chart opposite. Operation beyond the first point of leveling, or in the area of the dotted lines, is indicative of blade overload. Note that power consumption load will continue to increase even though the fan has passed into overload condition. The maximum blade angle allowable is that which produces a static pressure about 5% below the point where the curve becomes level. This represents a safe loading, and the blades may be set and left at this angle regardless of the location on the chart, assuming the motor is not overloaded.

> The point so selected will also approximate the point of the most efficient operation of the fan. Due to possible error in static pressure predictions, or in readings which are intended only to be relative, as well as other variables, the final blade setting chosen may fall below or above the specified static pressure.

A typical performance chart is shown opposite for a angle and he static pressure indicated. Advance the blade angle fan capable of a higher blade loading than originally specified. A



4.4.1 SAMPLE GRAPH OF BLADE ANGLE IN DEGREES

anything may happen, as indicated by the dotted extensions into increased performance. the shaded overload area. Note that the final selected blade angle

Note in the chart above that static pressure (and air flow) has is 5% below the point where the static pressure curve becomes reached its maximum at an 11 degree blade setting and blade level. The horsepower curve has been added to illustrate the point overload is beginning. With further increase in blade angle, that in an overload condition, horsepower will increase without



BLADE ANGLE IN DEGREES BLANK CHART FOR CUSTOMER USE

4.5 DAMAGING OPERATING CONDITIONS

4.5.1 GENERAL

and unloading is detrimental to fan performance, both in terms quite high. It is necessary for the fan to pick up this air and direct of efficiency and structural durability. Normal obstructions, of it inward. In a strong wind, the angle of air moving through the course, must be expected in the air stream. There are certain fan may be increased more than 45°. conditions, however, which may be avoided by reasonable attention to the points briefly discussed in this section. Additional information on the importance of inlet and discharge conditions can be found in Moore's General Catalog.

Ideally, air should approach a fan in an axial direction and at a uniform velocity over the area of the fan. Air approaching a fan at an angle tends to increase the relative velocity of the blades to the air on one side of the fan and decrease the relative velocity on the other side. This means that the fan blade during one-half of its revolution is picking up a heavier air load due to the higher relative velocity and, through the other half of its revolution, a lower air load as it goes "down wind". The net result is a repetitive loading and unloading of the blades at each revolution of the fan. This condition can be quite serious if the velocities are high and the angle of approach deviates considerably from axial.

4.5.2 WIND

With a vertically mounted fan blowing outward into the wind and surrounded by a short fan ring or stack, high winds may cause some concern. The farther the ring extends beyond the fan, the less effect would be expected from wind. It is a fact, however, that wind across the face of the ring will affect the direction of air flow well down into the ring. In the case of a fan tip speed (VB) of 10,000 feet per minute (114 miles per hour) installed near the outlet of the ring, the direction from axial of with a horizontal component of wind velocity (VW) of 20 miles the fan discharge may be increased by as much as 45° under high per hour. Note that the velocity (VR) of the fan blade relative to wind conditions.

In the case of a fan blowing inward in a short ring, the square of this velocity, or 2.05.

THE EFFECT OF AIR LOAD ON HUB AND DRIVE

Moore fan blades are attached to the hub by a pivot. As the fan rotates, centrifugal force causes the blades to rise (as do the blades of a helicopter). The air load (FA) is uniform over application of the force on the blade (RF). This moment will be the blade, but there is a point (shown on the blade in the drawing from 2 to 4 times as great as that produced by the Moore fan below) where, if the total load were applied at that point, the under the same conditions. effect would be the same. The resultant of the air load (FA), assumed in this example to be downward, and the horizontal



centrifugal force (FC) is the force on the blade (FB). The blade automatically positions itself in the direction of this force with bending moment due to the air load at the point of attachment of the result that the force is translated inward to the pivot point, as the blades to the hub since this is usually the structurally weakest illustrated by the dotted line. The effect of this arrangement is area of the fan. The moment due to the air load at this point is exactly as if the total air load (FA) were applied at the pivot the load (FA) times the distance (D). For the Moore fan, this point rather than at the point outward on the blade. The moment is zero since the blades are attached at the pivot point. A maximum bending moment applied to the shaft by the air load is more complete discussion of the Moore fan design can be found equal to the load (FA) multiplied by the distance from the fan in The Moore Company's General Catalog. centerline to the pivot point (RP).

condition is even more critical. In such an installation, the air on Any condition which causes repeated blade loading the inlet side of the fan has a horizontal velocity which may be



The illustration above assumes a fan operating with a the air varies by a factor of 1.43. The blade load varies as the

In conventional fans with rigidly attached blades, the bending moment at the shaft due to the air load is equal to the load (FA) multiplied by the distance from the fan centerline to the point of



Also of concern with the conventional fan is the

obvious that operation under such conditions will impose direction should be avoided. tremendous repetitive loadings on the fan blades.

In areas of unusually high wind velocities, it may be 4.5.4 UNEVEN TIP CLEARANCE advisable to shield the fan in some manner.

4.5.3 OBSTRUCTIONS

Obstructions of one type or another in the air stream, ahead of or behind the fan, are to be expected. In fact, it would be virtually impossible to eliminate all obstructions. Structural supporting members, foundations and the like, need not be of serious concern although all obstructions, even small ones, will increase the static pressure and must be taken into consideration by the system designer in specifying the fan performance.

should be twice the net area of the fan (fan area minus hub area). repetitive vibration. Every effort should be made to keep the tip In other words, the air approaching the inlet of the fan should clearance to a minimum and to have this clearance as constant as have no more than half the velocity of the air passing through the possible around the entire ring. fan. This area should be distributed reasonably uniformly. It

In this rather common wind condition, then, it can be would be unwise to attempt to operate a fan with one-half or one seen that the blade load on the side where the blade is going -third of the fan area completely blanked off. Such a condition against the wind will be double the load on the side where the would cause stalling of the fan blade through one-half the blade is going with the wind. In a 40 mile per hour wind, the revolution but create a condition of overload in the half which blade load would vary by a factor greater than 4. In a 60 mile per was not blocked off. Excessive vibration would result. Any hour wind, the load would vary by a factor of more than 10! It is condition which forces the air to approach the fan in a non-axial

Where fan rings are out of round or not centered with the fan, the tip clearance of each blade will vary as it makes a revolution. If tip clearance is tight at one point and excessive at another, proper flow will establish itself at the tight point, loading the blade to the very tip, while at the loose point the air will flow from the high pressure side of the blade through the opening between the blade tip and the ring and nullify the negative pressure on the under side of the blade. This will unload the blade near the tip within the area of excessive tip clearance. Under this condition, the blade will load and unload near the tip The total free area from which the fan can draw air one or more times per revolution, resulting in an undesirable





Type E/DOUBLE-INTERLOCK/Type K/TAF

These four product lines have (many common features and benefits that are shown on this page. Unique features for each product are shown on the following pages.

The common components used by all four lines include:

- Bearings
- Seals
- Locking collars
- Bore range

• Factory assembled, adjusted

General Features:

- and pre-lubricated
- Case hardened rollers and races
- Easy installation and maintenance
- 65 degree set screw angle Springlok collar/flingers— More holding power than 90 or 120 degree
- Single rubber lip contacting seals





Exclusive Sealing Designs and Features

Rolling Elements Never Exposed to Contaminants

- Exclusive "R" Seal features a combination metal shield and positive land riding contacting lip seal. Keeps contaminants out, lubricants in.
- E-TECT Seal option gives extra protection with a combination face rubbing seal in addition to the "R" Seal System. (See page B5–58)
- TIMKEN[™] tapered roller bearing inserts allow for combination radial and thrust loads.
- Lip design conforms to cones. Permits grease to purge.
- Close fit oversized collars act as flingers for added protection in dusty or damp environments.



Standard "R" Seal System



E-TECT Seal System

B5–2





Type E

DODGE Type E One Bearing, One Seal For Dusty or Damp Environments



The Original DODGE Type E **Bearing, Only Better**

- Provides added protection against • contamination
- Completely assembled, factory adjusted • and properly lubricated - shaft ready
- Stocked in all configurations •
- Extra protection—E-TECT seal option
- Stainless end covers available up to 3", 75mm bore

- "E" stands for economy
- Type E allows easy upgrade from ball bearings
- Interchangeable mounting dimensions with ball bearings
- Moderate price premium vs. ball bearings
- Steel housed pillow blocks available in selected sizes.





DODGE DOUBLE-INTERLOCK COMBINES DURABILITY WITH MOUNTING FLEXIBILITY

Heavy Duty Housing Construction Has Proven Performance

- Offers tapered roller bearing durability in a variety of mounting styles
- Extra protection E-TECT Seal Option
- Special clearances and greases available
- Self aligning
- Factory assembled, adjusted and lubricated shaft ready





B-1 unit

 $1-3/_{16}$ up to 5"

Flanges

1-3/16 - 5''

DODGE



Pillow block 1-³/₁₆ - 7"



S-1 unit 1-³/₁₆ up to 7"



D unit $1-^{3}/_{16}$ up to 5"

DODGE TYPE K FITS WHERE COMPETITORS WON'T

Tapered Roller Bearings With Reduced Length Thru Bore

- Reduces length thru bore design in a variety of mounting styles
- Single collar design saves space and installation time
- Allows bearing to be closer to the load for reduced shaft design
- Self-aligning
- Factory assembled, adjusted and lubricated shaft ready
- Same housing as DOUBLE-INTERLOCK



S-1 & B-1 units 1-³/₁₆ - 3-¹⁵/₁₆"



Pillow block Expansion & non-expansion $1-{}^{3}/_{16} - 3-{}^{15}/_{16}$ "



Wide-slot take-up frame $1^{-3}/_{8}$ - 3"





Flange Expansion and Non-expansion $1^{-3}/_{16} - 3^{-15}/_{16}$ "



Top angle take-ups $1^{3}/_{4} - 3^{15}/_{16}''$







TAF

TAF IS A COST SAVING ALTERNATIVE TO SAF Spherical Bearings

Mounts Fast, Stays Cleaner And Extends Service Life

- Shaft ready mounts six times faster than SAF
- Interchangeable with SAF style pillow blocks
- Self-aligning, factory assembled, adjusted and lubricated
- Available in 1-7/16" up to 7" shaft diameters
- Equipped with expansion or non-expansion housing
- E-TECT seal option available up to 7"
- Optional Smart Housings accomodate speed, vibration and temperature sensor kits



TAF Is Interchangeable With SAF Mounting Dimensions



TAF Self-alignment provided by spherically machined housing.



SAF Self-alignment provided by insert, limited by seal interference.







Type K/DOUBLE-INTERLOCK/TAF

DODGE BEARINGS SAVE YOU TIME AND MONEY

Compare These DODGE TAF, Type K & DOUBLE-INTERLOCK Bearing Advantages Against Standard SAF Pillow Blocks

Standard SAF

- Four prices
- Up to six packages
- Open bearing
- Feeler gauge required
- Grease required

DODGE TAF, Type K and DOUBLE-INTERLOCK

- One price
- Sealed bearing
- Factory adjusted
- Factory lubricated
- Shaft ready





Compare Standard SAF and DODGE Sealing Designs

STANDARD SAF

- Seals ride independently of bearing
- Less than 1° static misalignment
- Sealing effectiveness decreases as misalignment increases
- Seals distort when misalignment occurs



DODGE TAF, TYPE K, DOUBLE-INTERLOCK

- Inner unit carries seal
- Up to 5° static misalignment
- Seal and bearing ride together in inner unit
- Seals maintain contact on cones even with misalignment





Type E, Type K, DOUBLE-INTERLOCK and TAF mounted bearings are all general purpose high capacity tapered roller bearings capable of handling any combination of radial and thrust load within the capacity of the bearing.

All of these bearings are mounted to the shaft by means of set screw collars having 65 degree set screw spacing for optimum clamping force. The Type E, DOUBLE-IN-TERLOCK, and TAF mounted bearings have a locking collar at each end of their extended inner races. Type K has a single locking collar. The tapered roller bearings for these mounted bearings all have case carburized inner races (cones), outer races (cups), and rollers.

Bearings are preassembled, prelubricated and factory adjusted. They are normally equipped with land riding contact type seals with a metal deflector guard. The standard housing material for most of these mounted bearings is ASTM A48 Class 30 Iron having a minimum tensile strength of 30,000 psi. The outer housing for the Type K and DOUBLE-INTERLOCK flange bearings thru 4" bore size utilize housings made of ductile iron (ASTM A536 Grade 65-45-12) with 65,000 psi tensile strength. Type E pillow blocks are also available with cast steel housing having a tensile strength of 70,000 psi for 2 bolt base thru 3-1/2" bore size and 4 bolt base from 3-15/16" thru 5" bore size on an assembled or order basis.

The Type K, DOUBLE-INTERLOCK pillow blocks and flange bearings plus the TAF pillow blocks all have split outer housings used with completely assembled, lubricated and adjusted inner units simplifying replacement of the bearing in the pillow block or flange bearing. All Type E mounted bearings, Type K take up units and all D units, S-1 units, and B-1 units have solid one piece housings.



SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
TYPE E PAGE B5-11/B5-22	TYPE K PAGE 85-11/85-34	DOUBLE-INTERLOCK	TAF PAGE B5-11/B5-52
			TAGE DS=11/DS=32





There are two ways to specify DODGE Bearings. Most of the product offering have part numbers with listings shown throughout this catalog. Use of part numbers ensures accurate order processing.

When part numbers are not shown, the product may be specified by description or part name. This method is used when ordering units that include modifications or options. To order by description, use the nomenclature key shown on page B5–10 and add any special instructions to the end of the description for options not covered by the nomenclature.

SPECIAL BEARING REQUIREMENTS AND SPECIAL LUBRICANTS

DODGE Bearings are factory adjusted and pre-lubricated. For applications where extreme ambient temperatures, high speeds or high loads are expected, a variety of specialty lubricants and adjustments are available. Standard grease provided is Shell Alvania #2 up to 5", 125mm bore. Above 5" bore Mobil Mobilux #2EP is standard. High temperature greases available include Moluballoy 896 HT and Mobilith SHC460. Other special lubricatns are available upon request. Special lubricant options usually involve set-up charges and premiums. To order, specify type of lubricant required at the end of the product name or after the standard part number.

Example:

F4B-E-207 except with Mobilith SHC 460 grease and .012 to .015 lateral end play

or

023106 except with Mobilith SHC 460 grease and .012 to .015 lateral end play

OTHER SPECIAL REQUIREMENTS NOT LISTED

For applications requiring modifications not listed, we encourage you to contact out Application Engineering Department for Bearings at 864-297-4800.

FEATURES/BENEFITS	SPECIFICATIONS	NOMENCLATURE	SELECTION
PAGE B5-2	PAGE B5-7	PAGE B5-10	PAGE B5-11

HOW TO ORDER





TAF Smart Stock Selections *

STEP 1: Pick an S1 unit

Shaft Size	Series	Standard Housing Part Numbers If you are monitoring speed only	Drilled Housing Part Numbers For temperature and/or vibration
		Part #	Part #
207	515	037548	053067
215	517	037550	053628
317	520	037551	067350
315	522	037552	054960
407	526	037553	067352
415	528	037554	067353
515	534	042630	067357
615	538	042634	067234

STEP 2: Pick an S1 unit

Shaft Size	S1 Unit
207	055805
215	055806
307	055807
315	049235
407	055915
415	055840
515	067356
615	067323

DC prox and prox cover.

When speed only will be monitored, select the standard housing.

When vibration, and/or temperature will be monitored, select the drilled housing.

All housing part numbers shown are 4 bolt base, non expansion.



Smart S-1 units feature:

Embedded thermocouple drilled and tapped holes for prox covers Special locking collar with prox targets

STEP 3: The sensor choices

			AND/OR OR
Shaft Size	Housing Series	Part Number	
207	515	067340	
215	517	067342	
307	520	067343	
315	522	067344	
407	516	067345	
415	528	067346	
515	534	067347	1
615	538	067348	1

*Contact Dodge for sizes not shown

TAF Sensor Kits	Part Number
AC Prox	055943
DC Prox	055948
Thermocouple Transmitter	055931
EZLINK	063636
Cable Connector Kit	063694

If you want to monitor speed through EZLINK,, you'll also need to order a

For speed monitoring, use AC prox and prox cover.

cable connector kit, the DC prox, and a prox cover.

For **temperature** monitoring, use thermocouple transmitter. For **speed**, **temperature** and **vibration** monitoring, use EZLINK.

SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
TYPE E	TYPE K	DOUBLE-INTERLOCK	TAF
PAGE B5-11/B5-22	PAGE B5-11/B5-34	PAGE B5-11/B5-44	PAGE B5-11/B5-52

OR

NOMENCLATURE





Type E, Type K, DOUBLE–INTERLOCK and TAF NOMENCLATURE



SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
TYPE E	TYPE K	DOUBLE-INTERLOCK	TAF
PAGE B5-11/B5-22	PAGE B5-11/B5-34	PAGE B5-11/B5-44	PAGE B5-11/B5-52

SELECTION





Type E, Type K, DOUBLE–INTERLOCK And TAF Tapered Roller Bearings

DODGE Type E, K, DI and TAF Double Row Tapered Roller Bearings have the capacity to carry heavy radial loads and combined radial and thrust loads. The maximum recommended load which can be applied is limited by various components in the system such as bearing, housing, shaft, shaft attachment, speed and life requirements as listed in this catalog. DODGE tapered roller bearings have been applied successfully even when these limits have been exceeded under controlled operating conditions. Contact DODGE Application Engineering (864) 297-4800 for applications which exceed the recommendations of this catalog.

 ${\sf L_{10}}$ Hours Life --- The life which may be expected from at least 90% of a given group of bearings operating under identical conditions.

L10 =
$$\left(\frac{C_{90}}{P}\right)^{10/3} x \left(\frac{1,500,000}{RPM}\right)$$

Where: C_{90} = Dynamic Capacity (Table 1, pg.B5–14), lbs. P = Equivalent Radial Load, lbs.

GENERAL

Heavy Service --- For heavy shock loads, frequent shock loads, or severe vibrations, add up to 50% (according to severity of conditions) to the Equivalent Radial Load. Consult DODGE Application Engineering for additional selection assistance.

Thrust load values shown in the table below are recommended as a guide for general applications that will give adequate L_{10} life for pillow blocks. The maximum thrust load should not exceed values shown on Table 3. Where substantial radial load is also present, it is advisable to calculate actual L_{10} life to assure that it meets the requirements. The effectiveness of the shaft attachment to carry thrust load depends on proper tightening of the setscrews, shaft tolerance and shaft deflections. Therefore, it is advisable to use auxiliary thrust carrying devices such as shaft shoulder, snap ring or a thrust collar to locate the bearing under thrust loads heavier than shown below, or where extreme reliability is desired.

RPM RANGE		20-200	201-2000	over 2000
RECOMMENDED	E, DI, TAF	C ₉₀ /4	C ₉₀ /8	C ₉₀ /12
THRUST LOAD	К	C ₉₀ /5	C ₉₀ /8	C ₉₀ /12

The shaft tolerances recommended below are adequate for normal radial and radial/thrust load applications. The radial load is limited by the attachment to the shaft (see Table 1). Where the applied radial load (F_R) exceeds this limit (maximum allowable slip fit radial load), a snug-tolight press fit of the shaft is required. Since the allowable load, especially at a low speed, is very large, the shaft should be checked to assure adequate shaft strength.

The magnitude and direction of both the thrust and radial load must be taken into account when selecting a housing. When pillow blocks are utilized, heavy loads should be directed through the base. Where uplift loads are involved, see Tables 6, 7, and, pg.B5–19 for maximum values. Where a load pulls the housing away from the mounting base, both the hold-down bolts and housing must be of adequate strength. Auxiliary load carrying devices such as shear bars are advisable for side or end loading of pillow blocks and radial load for flange units.

SHAFT SIZE	TOLERANCE, INCHES
UP TO 1-1/2"	+.00000005 "
1-5/8 TO 4	+.000001″
4-7/6 TO 6	+.0000015 "
6-7/16-8″	+.000002 "

NOTE: The L₁₀ life calculated using the above formula is subject to life adjustment factors in accordance with ABMA standards described on page B14–45.

			SELECTION/DIMENSIONS
PAGE B5-8	PAGE B5–15	PAGE B5-17	TYPE E, METRIC PAGE B5–61/B5–68

SELECTION





Type E, Type K, DOUBLE–INTERLOCK And TAF Tapered Roller Bearings

SELECTING BEARINGS SUPPORTING RA-DIAL LOADS ONLY

- 1. Define L₁₀ Life Hours desired.
- Establish bearing radial load, F_R (F_R = P for Pure Radial Load Conditions). The DODGE program BEST™* can be used to find application loads.
- 3. Establish RPM.

Using the easy selection Table 2, pg. B5–15 find, under the RPM column, the equivalent radial load that equals or is higher than the application radial load for the desired life. The shaft size on the far left will be the minimum shaft size that you can use for your application. If the desired life is different than the values shown on the chart, use alternate Method A shown below.

Example:	1. L ₁₀ Life = 30,000 Hours
	2. Radial load = 3800 lbs.
	3. RPM = 1.000

At the intersection of the 1,000 RPM column and the 30,000 hours L_{10} life row, the equivalent radial load of 3910 lbs. exceeds the 3800 lbs. radial load for shaft sizes 2-11/16''-3''. A bearing with bore ranging from 2-11/16'' to 3'' may be used for this application.

ALTERNATE METHOD A ---SELECTING A BEARING FOR AN L10 LIFE VALUE NOT SHOWN IN THE EASY SELEC-TION CHART.

The L_{10} life equation can be rearranged so that the bearing dynamic capacity C_{90} is identified in terms of L_{10} , RPM and P.

$$C_{_{90}} = \left(\frac{L_{_{10}} x \text{ RPM}}{1,500,000}\right)^{0.3} x \text{ P}$$

(P = F_R for Pure Radial Load Conditions)

Since the L₁₀, RPM, and P are known, solve for C₉₀. Select from the dynamic capacity column on Table 1, pg.B5–14 the C₉₀ value equal to or greater than the C₉₀ value just calculated. The bore size on the far left represents the bore size selection. Check that the application RPM does not exceed the MAX. RPM on Table 1. Also check that the radial load does not exceed the Maximum Allowable Slip Fit Radial Load shown on Table 1. If it does, a line to line to light press fit of shaft is required. When selecting an L₁₀ life of less than 30,000 hours, particular attention must be paid to shaft deflection and proper lubricant selection.

SELECTING BEARINGS SUPPORTING COM-BINATION RADIAL AND THRUST LOADS

When a bearing supports both a radial load and a thrust load, the loading on the two rows is shared unequally depending on the ratio of thrust to radial load. The use of the X (radial factor) and Y (thrust factor) from Table 1 converts the applied thrust load and radial loads to an equivalent radial load having the same effect on the life of the bearing as a radial load of this magnitude.

The equivalent radial load $P = XF_R + YF_A$

Where: P= Equivalent radial load, lbs.

F_R= Radial load, lbs.(see Table 1 for allowable slip fit maximum)

- F_A = Thrust (axial) load, lbs.
- e = Thrust load to radial load factor (Table 1)
- X = Radial load factor (Table 1)
- Y= Thrust load factor (Table 1)

To find X and Y, calculate F_A/F_R and compare to **e** for the selected bore size. Determine X and Y from Table 1, pg. B5–14 depending on whether F_A/F_R is equal to or less than **e**, or F_A/F_R is greater than **e**. Substitute all known values into the equivalent radial load equation. P (equivalent radial load) can be used in the life formula to determine L_{10} , or it can be compared to the allowable equivalent radial load ratings for the speed and hours life desired in the easy selection Table 2, pg. B5–15.

*The DODGE Bearing Evaluation and Selection Technique (BEST) is a menu driven computer program that calculates bearing loads, fatigue life and operating temperature for a two bearing shaft system based on user supplied input parameters. To order, call (864) 287-4800.

SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
TYPE E PAGE B5-11/B5-22	TYPE K PAGE B5-11/B5-34	DOUBLE-INTERLOCK	TAF PAGE B5-11/B5-52
THEE BO TH/BO EE	THE BUILDE OF	THE BUTTIES H	TAGE DO TI/DO DE





SELECTING BEARINGS SUPPORTING ONLY THRUST LOADS

Tapered Roller Bearings perform extremely well under pure thrust load applications. Use $P = YF_A$ for the equivalent radial load. The value of Y is obtained from Table 1, pg. B5–14 for $F_A/F_R > e$. Substitute Y and F_A into the equivalent load equation. P (equivalent radial load) can be used in the life formula to determine L_{10} or it can be compared to the allowable equivalent radial load ratings for the speed and hours life desired in the easy selection Table 2, pg. B5–15.

LUBRICATION

DODGE E, K, DI, and TAF tapered roller bearings up to 5" bore are lubricated at the factory with Shell Alvania #2 grease. Above 5" bore they are lubricated with Mobil Mobi-

lux #2EP. Shell Alvania #2 and Mobil Mobilux #2EP greases are superior industrial greases using a lithium hydroxystearate thickener and highly refined base oil. These greases will adequately handle low and medium speeds with low and medium loads at normal temperatures as defined on Table 5, pg.B5–18. For very low and high speeds, for heavy loads and for low and high temperatures, special greases must be used. Contact DODGE Application Engineering (864) 297-4800. DODGE engineers will recommend bearings and lubricants for the above unusual conditions. DODGE also has the expertise to custom design and build special bearings for your needs. The only maintenance requirement for DODGE Tapered Roller Bearings is periodic relubrication at regular intervals as outlined in the appropriate instruction manuals.

RELUBRICATION SCHEDULE

Hours	SUGGESTED LUBRICATION PERIOD IN WEEKS									
Run per	1 to 250	251 to	501 to	751 to	1001 to	1501 to	2001 to	2501 to		
Day	RPM	500 RPM	750 RPM	1000 RPM	1500 RPM	2000 RPM	2500 RPM	3000 RPM		
8	12	12	10	7	5	4	3	2		
16	12	7	5	4	2	2	2	1		
24	10	5	3	2	1	1	1	1		

High Speed Operation --- In the higher speed ranges too much grease will cause overheating. The amount of grease that the bearing will take for particular high speed application can only be determined by experience --- see "Operating Temperature" below. If excess grease in the bearing caused overheating, it will be necessary to remove grease fitting (also drain plug when furnished) to permit excess grease to escape. When establishing a relubrication schedule, note that a small amount of grease at frequent intervals is preferable to a large amount at infrequent intervals.

Operation in Presence of Dust, Water or Corrosive Vapors --- Under these conditions the bearing should contain as much grease as speed will permit, since a full bearing with consequent slight leakage is the best protection against entrance of foreign material. In the higher speed ranges too much grease will cause overheating --see "High Speed Operation". In the lower speed ranges, it is advisable to add extra grease to a new bearing before putting into operation. Bearings should be greased as often as necessary (daily if required) to maintain a slight leakage at the seals.

INSTALLATION AND MAINTENANCE

In nearly all applications good design practice requires two bearings supporting the shaft. In cases where three or more bearings are installed, unless precautions are taken to line the bearings up, both vertically and horizontally, it is possible to induce heavy loads. In the case of two bearings, alignment is not as critical, especially with DODGE K, DI, and TAF Tapered Roller Bearings. K, DI, and TAF bearings are designed to allow as much as 2° to 7° of static misalignment depending on bore size. To ensure good alignment, mounting surfaces must be checked for flatness and must lie in the same plane. When tightening base bolts and cap bolts, each bolt should be alternately tightened in incremental torgue values until full torque is achieved to prevent the angular shifting of the pillow block that occurs when one bolt is tightened to its full torque. Shimming may be required to minimize misalignment.

FEATURES/BENEFITS	SPECIFICATIONS PAGE B5-7	HOW TO ORDER	SELECTION/DIMENSIONS TYPE E, METRIC
		TAGE DO-0	PAGE B5–61/B5–68



TABLE 1 - E, K, DI, AND TAF TAPERED ROLLER BEARINGS RADIAL AND THRUST FACTORS

SHAFT SIZE	е	F _A /F	F _A /F _R ≤e		F _A /F _R >e		DYNAMIC CAPACITY C ₉₀ *		MAXIMUM RPM	MAXIMUM ALL SLIP FIT R LOAD, F _R *	LOWABLE ADIAL *, LBS
		X	Y	Х	Y	LBS.	NEWTONS	R-SEAL	E-TECT	E,DI,&TAF	К
1-3/16 1-1/4	.49	.87	1.77	.70	2.14	2,980	13,260	4,490	3,100	3,100	2,100
1-3/8 1-7/16	.46	.87	1.89	.70	2.28	4,760	21,180	3,820	2,675	5,000	3,300
1-1/2 1 5/8 1-11/16	.44	.87	1.96	.70	2.37	6,140	27,320	3,320	2,325	6,400	4,300
1-3/4 1-7/8 1-15/16 2	.33	.87	2.64	.70	3.18	8,070	35,908	3,050	2,135	8,400	5,600
2-3/16	.36	.87	2.38	.70	2.87	8,550	38,044	2,730	1,900	8,900	5,900
2-1/4 2-7/16 2-1/2	.40	.87	2.17	.70	2.63	9,090	40,447	2,420	1,700	9,500	6,300
2-11/16 2-3/4 2-15/16 3	.46	.87	1.87	.70	2.26	9,600	42,716	2,060	1,440	10,000	6,700
3-3/16 3-1/4 3-7/16 3-1/2	.50	.87	1.71	.70	2.07	15,300	68,078	1,640	1,145	16,000	10,500
3-15/16 4	.49	.87	1.77	.70	2.14	21,000	93,440	1,530	1,070	22,000	14,600
4-7/16 4-1/2	.53	.87	1.63	.70	1.97	25,800	114,799	1,360	950	27,000	
4-15/16 5	.47	.87	1.83	.70	2.21	35,500	157,959	1,200	840	35,000	
5-7/16 5-15/16 6	.49	.87	1.76	.70	2.12	40,700	181,097	915	640	42,400	
6-7/16 6-1/2 6-15/16 7	.54	.87	1.61	.70	1.95	69,200	307,910	790	550	72,000	

Comparing Spherical To Taper Roller Bearings: The dynamic capacity C (spherical) and C90 (taper) are not to the same base. To compare basic dynamic capacities, multiply C x .259 and compare to C90.

* $\rm C_{90}$ – Dynamic capacity based on a rated life of 90 million revolutions or 3000 hours at 500 RPM.

** If load exceeds maximum allowable slip fit radial load, (F_R), line-to-line, to light press fit of shaft required. Application up to maximum slip fit radial load may be applied if recommended shaft tolerances are used.

SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
TYPE E PAGE B5-11/B5-22	TYPE K PAGE B5-11/B5-34	DOUBLE-INTERLOCK PAGE B5-11/B5-44	TAF PAGE B5-11/B5-52
	· · · · · · · · · · · · · · · · · · ·	·//a= Be · · ·/Be · ·	





TABLE 2 - EASY SELECTION TABLE TYPE E, K, DI, AND TAF

Shaft	L10		Allowable Equivalent Radial Load Rating (Lbs.) at Various Revolutions Per Minute													
Size	Life	50	100	150	250	500	750	1000	1250	1500	1750	2000	2500	2700	3000	3500
	10,000	4145	3365	2980	2555	2075	1840	1685	1575	1495	1425	1370	1280	1250	1215	1160
1-3/16	30,000	2980	2420	2145	1840	1495	1320	1215	1135	1075	1025	985	920	900	870	835
1-1/4	40,000	2735	2220	1965	1685	1370	1215	1110	1010	985	940	905	845	825	800	765
	60,000	2420	1965	1740	1495	1215	1075	985	920	870	835	800	750	730	710	675
	100,000	2075	1685	1495	1280	1040	920	845	790	750	715	685	640	625	610	580
	10,000	6620	5375	4760	4085	3315	2935	2695	2520	2385	2275	2190	2045	2000	1935	1850
1-3/8	30,000	4760	3865	3425	2935	2385	2110	1935	1810	1715	1640	1575	1470	1440	1395	1330
1-7/16	40,000	4365	3545	3140	2695	2190	1935	1775	1660	1575	1500	1445	1350	1320	1280	1220
	60,000	3865	3140	2780	2385	1935	1715	1575	1470	1395	1330	1280	1195	1170	1130	1080
	100,000	3315	2695	2385	2045	1660	1470	1350	1260	1195	1140	1095	1025	1000	970	925
	10,000	8535	6935	6140	5265	4280	3790	3475	3250	3075	2940	2820	2640	2580	2500	
1-1/2	30,000	6140	4985	4415	3790	3075	2725	2500	2335	2215	2115	2030	1900	1855	1795	
1-5/8	40,000	5630	4575	4050	3475	2820	2500	2290	2145	2030	1940	1860	1740	1700	1650	
1-11/16	60,000	4985	4050	3585	3075	2500	2215	2030	1900	1795	1715	1650	1540	1505	1460	
	100,000	4280	3475	3075	2640	2145	1900	1740	1630	1540	1470	1415	1325	1290	1250	
	10,000	11220	9115	8070	6925	5625	4980	4565	4270	4045	3860	3710	3470	3390	3285	
1-3/4	30,000	8070	6555	5805	4980	4045	3580	3285	3070	2910	2775	2670	2495	2440	2360	
1-7/8	40,000	7400	6010	5325	4565	3710	3285	3015	2820	2670	2545	2445	2290	2235	2165	
1-15/16	60,000	6555	5325	4715	4045	3285	2910	2670	2495	2360	2255	2165	2025	1980	1920	
2	100,000	5625	4565	4045	3470	2820	2495	2290	2140	2025	1935	1860	1740	1700	1645	
	10,000	11885	9655	8550	7335	5960	5275	4840	4525	4285	4090	3930	3675	2590		
	30,000	8550	6945	6150	5275	4285	3795	3480	3255	3080	2940	2825	2645	2585		
2-3/16	40,000	7845	6370	5640	4840	3930	3480	3190	2985	2825	2700	2595	2425	2370		
	60,000	6945	5640	4995	4285	3480	3080	2825	2645	2505	2390	2295	2145	2100		
	100,000	5960	4840	4285	3675	2985	2645	2425	2270	2145	2050	1970	1840	1800		
	10,000	12640	10265	9090	7800	6335	5610	5145	4810	4555	4350	4180	3910			
2-1/4	30,000	9090	7385	6535	5610	4555	4035	3700	3460	3275	3130	3005	2810			
2-7/16	40,000	8340	6770	5995	5145	4180	3700	3395	3175	3005	2870	2755	2580			
2-1/2	60,000	7385	5995	5310	4555	3700	3275	3005	2810	2660	2540	2440	2285			
	100,000	6335	5145	4555	3910	3175	2810	2580	2410	2285	2180	2095	1960			

For maximum RPM see Table 1 on page B5–14.

In the shaded area, E, DI, and TAF mounted units require a line-to-line to light press fit of shaft.

In the boxed area, Type K mounted units require a line-to-line to light press fit of shaft.

NOMENCLATURE PAGE B5-10	EASY SELECTION TYPE E, METRIC PAGE B5-64	SELECTION/DIMENSIONS TYPE E, METRIC PAGE B5-61/B5-68	ENGINEERING/TECHNICAL PAGE B5-17
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TABLE 2 (continued) - EASY SELECTION TABLE TYPE E, K, DI, AND TAF

Shaft	L10	Allowable Equivalent Radial Load Rating (Lbs.) at Various Revolutions Per Minute														
Size	Life	50	100	150	250	500	750	1000	1250	1500	1750	2000	2500	2700	3000	3500
	10,000	13345	10840	9600	8235	6690	5925	5435	5080	4810	4595	4415				
2-11/16	30,000	9600	7795	6905	5925	4810	4260	3910	3655	3460	3305	3175				
2-3/4	40.000	8805	7150	6335	5435	4415	3910	3585	3350	3175	3030	2910				
3	60,000	7795	6335	5610	4810	3910	3460	3175	2970	2810	2685	2580				
Ŭ	100,000	6690	5435	4810	4125	3350	2970	2725	2545	2410	2300	2210				
	10,000	21370	17280	15300	13125	10665	9440	8660	8100	7670	7320					
3-3/16	30,000	15300	12425	11005	9440	7670	6790	7230	5825	5515	5625					
3-1/4 3-7/16	40.000	14035	11400	10095	8660	7035	5230	5715	5345	5060	4830					
3-1/2	60,000	12425	10095	8940	7670	6230	5515	5060	4730	4480	4275					
0 1/2	100,000	10660	8660	7670	6580	5345	4730	4340	4060	3845	3670					
	10,000	29200	23715	21000	18015	14635	12955	11885	11115	10525						
	30,000	21000	17055	15105	12955	10525	9320	8550	7995	7570						
3-15/16	40.000	19265	15645	13855	11885	9655	8550	7840	7335	6945						
4	60,000	17055	13855	12270	10525	8550	7570	6945	6495	6150						
	100,000	14635	11885	10525	9030	7335	6495	5955	5570	5275						
	10,000	35870	29135	25800	22135	17980	15920	14605	13655							
	30,000	25800	20955	18555	15920	12930	11450	10500	9820							
4-7/16	40,000	23665	19225	17020	14605	11860	10500	9635	9010							
4-1/2	60,000	20955	17020	15070	12930	10500	9300	8530	7980							
	100,000	17980	14605	12930	11095	9010	7980	7320	6845							
	10,000	49360	40090	35500	30455	24740	21905	20095	18790							
	30,000	35500	28835	25530	21905	17790	15755	14450	13515							
4-15/16	40,000	32565	26450	23420	20095	16320	14550	13255	12400							
5	60,000	28835	23420	20740	17790	14450	12795	11740	10980							
	100,000	24740	20095	17790	15265	12400	10980	10070	9420							
	10,000	56590	45965	40700	34915	28360	25115	23035								
5-7/16	30,000	40700	33060	29270	25115	20400	18060	16570								
5-15/16	40,000	37335	30325	26850	23035	18710	16570	15200								
6	60,000	33060	26850	23775	20400	16570	14670	13455								
	100,000	28360	23035	20400	17500	14215	12585	11545								
	10,000	96215	78150	69200	59365	48220	42700									
6-7/16	30,000	69200	56205	49770	42700	34680	30710									
6-1/2	40.000	63480	51560	45655	39170	31815	28170									
7	60,000	56205	45655	40425	34680	28170	24945									
<u> </u>	100,000	48220	39170	34680	29755	24170	21400									

For maximum RPM see Table 1 on page B5–14.

In the shaded area, E, DI, and TAF mounted units require a line-to-line to light press fit of shaft. **In the boxed area**, Type K mounted units require a line-to-line to light press fit of shaft.

FEATURES/BENEFITS	SPECIFICATIONS	HOW TO ORDER	
PAGE B5-2	PAGE B5-7	PAGE B5-8	





TABLE 3 - PERMISSIBLE THRUST LOAD, LBS. *

SHAFT SIZE	*	E	K/	DI	TAF			
INCHES	2-Bolt	4-Bolt	2-Bolt	4-Bolt	2-Bolt	4-Bolt		
1-3/16	2000		2000					
1-1/4	2000		2000					
1-3/8	2590		2100					
1-7/16	2590		2100		2100			
1-1/2	2590		2100					
1-5/8	2590		2100					
1-11/16	2590		2100		2100			
1-3/4	3454		2900					
1-7/8	3454		2900					
1-15/16	3454		2900		2900			
2	3454		2900					
2-3/16	3454		2900		2900			
2-1/4	3454	3454	3454	3454				
2-7/16	3454	3454	3454	3454	3454	3454		
2-1/2	3454	3454	3454	3454	3454	3454		
2-11/16	5181	5181	5181	5181	5181			
2-3/4	5181	5181	5181	5181	5181			
2-15/16	5181	5181	5181	5181	5181	5181		
3	5181	5181	5181	5181	5181	5181		
3-3/16	5181	5181	5181	5181				
3-1/4	5181	5181	5181	5181				
3-7/16	5181	5181	5181	5181	5181	5181		
3-1/2	5181	5181	5181	5181	5181	5181		
3-15/16		6908		6908		6908		
4		6908		6908		6908		
4-7/16		6908		6908		6908		
4-1/2		6908		6908		6908		
4-15/16		6908		6908		6908		
5		6908		6908		6908		
5-7/16		8635		8635		8635		
5-15/16		8635		8635		8635		
6		8635		8635		8635		
6-7/16		8635		12282		12282		
6-1/2		8635		12282		12282		
6-15/16		8635		12282		12282		
7		8635		12282		12282		

Note: The limits above apply to set screw shaft mounting or pillow block over turning force. Under heavy thrust loads it is always wise to use shear bars. At all times the L10 life of the bearing should be checked for proper selection and life requirements. For thrust loads larger than listed or heavy thrus loading on other style housing, contact DODGE Engineering for recommendation.

* Does not include Piloted Flange.

SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
TYPE E	TYPE K	DOUBLE-INTERLOCK	TAF
PAGE B5-11/B5-22	PAGE B5-11/B5-34	PAGE B5-11/B5-44	PAGE B5-11/B5-52





TABLE 4 - K, DI, AND TAF MAXIMUM AXIAL EXPANSION (INCHES)

Bore Size (INCHES)	Type K DOUBLE-INTERLOCK		TAF
	Pillow Block	Flange	
1-3/16 - 1-1/4	.252		
1-3/8 - 1-7/16	.188	.187	.188
1-1/2 - 1-11/16	.188	.187	.188
1-3/4 - 2	.562	.187	.562
2-3/16	.562	.138	.562
2-1/4 - 2-1/2	.562	.312	.562
2-11/16 - 3	.562	.312	.562
3-3/16 - 3-1/2	.562	.312	.562
3-15/16 - 4	.674	.312	.674
4-7/16 - 4-1/2	.674	.812	.674
4-15/16 - 5	.674	.812	.674
5-7/16 - 6	.500		.875
6-7/16 - 7	.500		.875

TABLE 5 - DEFINITION OF OPERATING CONDITIONS FOR TAPERED ROLLER BEARINGS

LOW SPEED	UP TO 20% OF MAX. RPM (TABLE 1)
MEDIUM SPEED	OVER 20% TO 80% OF MAX. RPM
HIGH SPEED	OVER 80% OF MAX. RPM
LIGHT LOAD	UP TO 30% OF C ₉₀ (TABLE 1)
NORMAL LOAD	OVER 30% TO 70% OF C ₉₀
HEAVY LOAD	OVER 70% OF C ₉₀
LOW TEMPERATURE	–100°F TO 20°F
MEDIUM TEMPERATURE	OVER 20°F TO 200°F
HIGH TEMPERATURE	OVER 200°F TO 300°F
VERY HIGH TEMPERATURE	OVER 300°F TO 450°F

HOW TO ORDER	FEATURES/BENEFITS	SPECIFICATIONS	
PAGE B5-8	PAGE B5-2	PAGE B5-7	





TABLE 6 - HOUSING RATINGS - TYPE E (SOLID HOUSING)

SHAFT	MAXIMUM RECOMMENDED HOUS- ING CAP LOADS, LBS.	
SIZE (INCHES)	GRAY IRON 180°	
1-3/16 - 1-1/4	1,600	
1-3/8 - 1-7/16	3,150	
1-1/2 - 1-11/16	3,000	
1-3/4 - 2	5,150	
2-3/16	3,500	
2-1/4 - 2-1/2	6,550	
2-11/16 - 3	7,000	
3-3/16 - 3-1/2	15,700	
3-15/16 - 4	16,250	
4-7/16 - 4-1/2	21,000	
4-15/16 - 5	22,860	
5-7/16 - 6	43,600	
6-7/16 - 7	46,000	

*When utilizing heavy cap loads on pillow block housings, the installation must adhere to the following procedures.

- 1) The pillow block base bolts must be of Grade 8 strength with hardened washers and properly tightened to the mounting structure.
- 2) The use of stop bars (shear strips) against pillow block where side loads are encountered.
- 3) In all cases where loads are heavy, the L10 life of the bearing should be checked for proper selection and life requirements.

SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
TYPE E	TYPE K	DOUBLE-INTERLOCK	TAF
PAGE B5-11/B5-22	PAGE B5–11/B5–34	PAGE B5–11/B5–44	PAGE B5-11/B5-52

SELECTION



Type E, Type K, DOUBLE-INTERLOCK and TAF



TABLE 7 HOUSING RATINGS TYPE K AND DI HOUSING (SPLIT HOUSING)

SHAFT SIZE	MAXIMUM RECOMMENDED HOUS- ING CAP LOADS, LBS.
(INCHES)	180°
1-3/16 - 1-1/4	4,300
1-3/8 - 1-7/16	5,060
1-1/2 - 1-11/16	5,940
1-3/4 - 2	8,660
2-3/16	10,100
2-1/4 - 2-1/2	10,100
2-11/16 - 3	11,220
3-3/16 - 3-1/2	16,170
3-15/16 - 4	19,580
4-7/16 - 4-1/2	20,130
4-15/16 - 5	24530
5-7/16 - 6	35,200
6-7/16 - 7	56,000

TABLE 8 HOUSING RATINGS TAF (SPLIT HOUSING)

SHAFT SIZE	MAXIMUM RECOMMENDED HOUS ING CAP LOADS, LBS.	
(INCHES)	180°	
1-7/16	4,600	
1-11/16	5,400	
1-15/16	7,875	
2-3/16	9,200	
2-7/16 - 2-1/2	9,220	
2-15/16 - 3	10,200	
3-7/16 - 3-1/2	14,700	
3-15/16 - 4	17,800	
4-7/16 - 4-1/2	18,300	
4-15/16 - 5	22,300	
5-7/16 - 6	30,000	
6-7/16 - 6-1/2	30,000	
6-15/16 - 7	48.000	

*When utilizing heavy cap loads on pillow block housings, the installation must adhere to the following procedures.

1) The pillow block base bolts must be of Grade 8 strength with hardened washers and properly tightened to the mounting structure.

2) The use of stop bars (shear strips) against pillow block where side loads are encountered.

3) In all cases where loads are heavy, the L10 life of the bearing should be checked for proper selection and life requirements.

SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
TYPE E	TYPE K	DOUBLE-INTERLOCK	TAF
PAGE B5-11/B5-22	PAGE B5-11/B5-34	PAGE B5-11/B5-44	PAGE B5-11/B5-52







MOUNTED BEARINGS

APPLICATION DATA SHEET

Instructions: Complete all applicable information and mail or Fax to DODGE at P.O. Box 499, Greenville, SC 29620, Attn: Engineering, Fax 864-281-2317

	DIST. USER	OEM		
Company			ate	
Address				
Name	Phone		Fax	
Type of Equipment (sketch drive o	n separate sheet <u>)</u>			
Service Conditions:				
Shaft Speed: Normal		Maxii	num	
Loads: Radial	Thrust		Shock (f	requency)
Shaft Size	Shaft Toler	ance (specif	y if not commercial)	
Duty Cycle: Hours/Day	Days/Weel	<u>د</u>	Weeks/Y	/ear
Environment:				
Ambient Temperature: Su	mmer	°F	Winter	ە
External Heat: Source of I	-leat			
Temperature	°F Di	stance from	Bearing	
Air: Clean	Contaminated		Contamination Ty	pe
Gas: Clean	Contaminated		Contamination Ty	pe
Liquid: Type		Conc	entration	
Other: (include washdowr	ns)			
Experience: (If applicable)				
Type of Bearing Currently U	Jsed:			
Life Realized		Туре	of Failure	
Other Pertinent Data:				
L-10 Hours Rqu:	ing Lloight			
Dimensional Restrictions: Center				
Bolt Pa	ttern			
Other				
FEATURES/BENEFITS PAGE B5-2	SPECIFICATIONS PAGE B5-7	н	OW TO ORDER PAGE B5-8	NOMENCLATURE PAGE B5-10





Type E Pillow Block – Inch

2-BOLT BASE





1-3/16" THRU 3" CONSTRUCTION



3-3/16" THRU 3-1/2" CONSTRUCTION

HOW TO ORDER	NOMENCLATURE	SELECTION	EASY SELECTION
PAGE B5–8	PAGE B5-10	PAGE B5-11	PAGE B5-15





Type E Pillow Block – Inch

2-BOLT BASE

GRAY IRON				
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)	
1-3/16	023000	P2B-E-103R	4	
1-1/4	023001	P2B-E-104R	4	
1-3/8	023002	P2B-E-106R	7	
1-7/16	023003	P2B-E-107R	7	
1-1/2	023004	P2B-E-108R	10	
1-5/8	023005	P2B-E-110R	10	
1-11/16	023006	P2B-E-111R	10	
1-3/4	023007	P2B-E-112R	12	
1-7/8	023008	P2B-E-114R	12	
1-15/16	023009	P2B-E-115R	12	
2	023010	P2B-E-200R	12	
2-3/16	023011	P2B-E-203R	15	
2-1/4	023012	P2B-E-204R	21	
2-7/16	023013	P2B-E-207R	20	
2-1/2	023014	P2B-E-208R	20	
2-11/16	023015	P2B-E-211R	29	
2-3/4	023016	P2B-E-212R	28	
2-15/16	023017	P2B-E-215R	27	
3	023018	P2B-E-300R	27	
3-3/16	023019	P2B-E-303R	48	
3-1/4	023020	P2B-E-304R	47	
3-7/16	023021	P2B-E-307R	46	
3-1/2	023022	P2B-E-308R	45	

	CAST STEEL							
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS					
1-3/16	023047+	SP2B-E-103R	4					
1-1/4	023048+	SP2B-E-104R	4					
1-3/8	023049+	SP2B-E-106R	7					
1-7/16	023050+	SP2B-E-107R	7					
1-1/2	023051+	SP2B-E-108R	10					
1-5/8	023052+	SP2B-E-110R	10					
1-11/16	023053+	SP2B-E-111R	10					
1-3/4	023054+	SP2B-E-112R	11					
1-7/8	023055+	SP2B-E-114R	11					
1-15/16	023056+	SP2B-E-115R	11					
2	023057+	SP2B-E-200R	11					
2-3/16	023058+	SP2B-E-203R	14					
2-1/4	023059+	SP2B-E-204R	19					
2-7/16	023060	SP2B-E-207R	19					
2-1/2	023061+	SP2B-E-208R	19					
2-11/16	023062+	SP2B-E-211R	26					
2-3/4	023063+	SP2B-E-212R	26					
2-15/16	023064	SP2B-E-215R	26					
3	023065+	SP2B-E-300R	26					
3-3/16	023066+	SP2B-E-303R	44					
3-1/4	023067+	SP2B-E-304R	44					
3-7/16	023068	SP2B-E-307R	44					
3-1/2	023069+	SP2B-E-308R	44					

Consult DODGE For Sizes Not Listed+ Non-stock -- Consult DODGE For Delivery

Consult DODGE For Sizes Not Listed.+ Non-stock -- Consult DODGE For Delivery

SHAFT SIZE (Inches)	А	В	С	D MIN	D MAX	F BOLT DIA	G	н	J	J1	L	М
1-3/16 1-1/4	2-3/4	6	1-7/8	4-3/4	4-13/16	3/8	19/32	7/8	3	3-9/32	2-1/4	1-1/2
1-3/8 1-7/16	3	7-3/8	2-1/8	5-5/8	5-7/8	1/2	3/4	1-1/8	3-3/4	4	2-3/4	1-7/8
1-1/2 1-5/8 1-11/16	3-3/8	7-7/8	2-3/8	6-1/8	6-3/8	1/2	3/4	1-1/4	4-1/4	4-15/32	3-3/16	2-1/8
1-3/4 1-7/8 1-15/16 2	3-1/2	8-7/8	2-1/2	6-7/8	7-1/8	5/8	7/8	1-5/16	4-1/2	4-11/16	3-7/16	2-1/4
2-3/16	3-3/4	9-5/8	2-5/8	7-5/8	7-7/8	5/8	7/8	1-1/2	5	5-11/64	3-3/4	2-1/2
2-1/4 2-7/16 2-1/2	4	10-1/2	2-7/8	8-3/8	8-5/8	5/8	7/8	1-5/8	5-1/2	5-5/8	4-1/16	2-3/4
2-11/16 2-3/4 2-15/16 3	4-1/2	12	3	9-5/16	9-11/16	3/4	1	1-7/8	6-1/4	6-11/32	4-23/32	3-1/8
3-3/16 3-1/4 3-7/16 3-1/2	5	14	3-1/2	10-13/16	11-3/16	7/8	1-3/16	2-1/4	7-1/2	7-1/2	5-17/32	3-3/4

Pre-Dowel Hole Locations For Precision Positioning - See Page B9-30 - B9-31

SPECIFICATION	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
PAGE B5-11/B5-7	TYPE K PAGE 85-11/85-34	DOUBLE-INTERLOCK	TAF PAGE B5-11/B5-52





Type E Pillow Block – Inch

4-BOLT BASE





5-7/16" THRU 7" CONSTRUCTION

* 5-7/_16" THRU 7" - 45°

ENGINEERING/TECHNICAL PAGE B5–17 ACCESSORIES/MODIFICATION PAGE B5–58	SELECTION / E-TECT SEALS PAGE B5-68	EASY SELECTION PAGE B5-15
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Type E Pillow Blocks – Inch

4-BOLT BASE

	1				
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)		SHAF SIZE INCHES
2-1/4	023023	P4B-E-204R	20		2-1/4
2-7/16	023024	P4B-E-207R	20		2-7/16
2-1/2	023025	P4B-E-208R	19		2-1/2
2-11/16	023026	P4B-E-211R	30	1	2-11/16
2-3/4	023027	P4B-E-212R	28		2-3/4
2-15/16	023028	P4B-E-215R	28		2-15/16
3	023029+	P4B-E-300R	28		3
3-3/16	023030+	P4B-E-303R	47	1	3-3/16
3-1/4	023031	P4B-E-304R	47		3-1/4
3-7/16	023032	P4B-E-307R	46		3-7/16
3-1/2	023033	P4B-E-308R	45		3-1/2
3-15/16	023690	P4B-E-315R	69		3-15/16
4	023691	P4B-E-400R	69		4
4-7/16	023692	P4B-E-407R	85		4-7/16
4-1/2	023693	P4B-E-408R	85		4-1/2
4-15/16	023694	P4B-E-415R	134		4-15/16
5	023695	P4B-E-500R	133		5
5-7/16	023040	P4B-E-507R	230	1	5-7/16
5-15/16	023041	P4B-E-515R	250		5-15/16
6	023042	P4B-E-600R	245		6
6-7/16	023043+	P4B-E-607R	356]	6-7/16
6-1/2	023044	P4B-E-608R	350		6-1/2
6-15/16	023045	P4B-E-615R	340		6-15/16
7	023046+	P4B-E-700R	335		7

CAST STEEL							
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)				
2-1/4							
2-7/16							
2-1/2							
2-11/16							
2-3/4							
2-15/16							
3							
3-3/16							
3-1/4							
3-7/16							
3-1/2							
3-15/16	023070	SP4B-E-315R	65				
4	023071	SP4B-E-400R	65				
4-7/16	023072	SP4B-E-407R	81				
4-1/2	023073	SP4B-E-408R	81				
4-15/16	023074	SP4B-E-415R	132				
5	023075	SP4B-E-500R	132				
5-7/16							
5-15/16							
6							
6-7/16							
6-1/2							
6-15/16							
7							

Consult DODGE For Sizes Not Listed. + Non-stock -- Consult DODGE For Delivery # Consult DODGE For Sizes Not Listed. + Non-stock -- Consult DODGE For Delivery

SHAFT SIZE INCHES	А	В	C*	D MIN	D MAX	E	F Bolt Dia	G	н	J	J1	L	М
2-1/4 2-7/16 2-1/2	4	10-1/2	3-1/2	8-5/16	8-11/16	1-7/8	5/8	7/8	1-5/8	5-1/2	5-5/8	4-1/16	2-3/4
2-11/16 2-3/4 2-15/16 3	4-1/2	12	4	9-3/16	9-13/16	2-1/8	5/8	1	1-7/8	6-1/4	6-11/3	4-23/32	3-1/8
3-3/16 3-1/4 3-7/16 3-1/2	5	13-1/2	4-1/2	10-3/4	11-1/4	2-3/8	3/4	1-3/16	2-1/4	7-1/2	7-1/2	5-17/32	3-3/4
3-15/16 4	6-1/4	15-1/4	4-1/2	12-1/4	12-3/4	2-1/4	3/4	1-1/8	2-7/16	8-1/2	8-7/16	6	4-1/4
4-7/16 4-1/2	6-3/4	16-5/8	4-5/8	13-1/4	13-3/4	2-1/2	3/4	1-1/8	2-3/4	9-3/8	9-9/32	6-7/16	4-3/4
4-15/16 5	7-1/4	18-1/2	5-1/8	15-1/4	15-3/4	2-7/8	7/8	1-1/4	3	10-7/8	10-11/16	7-7/16	5-1/2
5-7/16 5-15/16 6	9	22	6-1/4	17-3/8	19-1/8	3-3/4	1	2	3-1/4	13-3/16		9-3/8	6-11/16
6-7/16 6-1/2 6-15/16 7	10-1/2	26	7-1/8	21-1/4	23-1/4	4-5/8	1	2	3-11/16	14-15/16		11-3/8	7-1/2

Pre-Dowel Hole Locations For Precision Positioning - See Page B9-30 - B9-31

SPECIFICATIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	
PAGE B5-7	TYPE K	DOUBLE-INTERLOCK	TAF	
	PAGE B5–11/B5–34	PAGE B5–11/B5–44	PAGE B5-11/B5-52	





Type E Flange Bearing – Inch

4-BOLT FLANGE



1-3/16" THRU 3" CONSTRUCTION

 $3\text{-}^3\!/_{16}''$ THRU $4\text{-}^1\!/_2''$ CONSTRUCTION

HOW TO ORDER	NOMENCLATURE	SELECTION	EASY SELECTION
PAGE B5-8	PAGE B5-10	PAGE B5-11	PAGE B5-15




Type E Flange Bearing – Inch

4-BOLT FLANGE

	GRAY IRON					
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)			
1-3/16	023093	F4B-E-103R	4			
1-1/4	023094	F4B-E-104R	4			
1-3/8	023095	F4B-E-106R	7			
1-7/16	023096	F4B-E-107R	7			
1-1/2	023097	F4B-E-108R	11			
1-5/8	023098	F4B-E-110R	11			
1-11/16	023099	F4B-E-111R	11			
1-3/4	023100	F4B-E-112R	12			
1-7/8	023101	F4B-E-114R	12			
1-15/16	023102	F4B-E-115R	12			
2	023103	F4B-E-200R	12			
2-3/16	023104	F4B-E-203R	15			
2-1/4	023105	F4B-E-204R	21			
2-7/16	023106	F4B-E-207R	20			
2-1/2	023107	F4B-E-208R	19			
2-11/16	023108	F4B-E-211R	28			
2-3/4	023109	F4B-E-212R	28			
2-15/16	023110	F4B-E-215R	27			
3	023111	F4B-E-300R	26			
3-3/16	023112	F4B-E-303R	52			
3-1/4	023113+	F4B-E-304R	51			
3-7/16	023114	F4B-E-307R	50			
3-1/2	023115	F4B-E-308R	50			
3-15/16	023116	F4B-E-315R	75			
4	023117	F4B-E-400R	75			
4-7/16	023118	F4B-E-407R	90			
4-1/2	023119+	F4B-E-408R	90			

Consult DODGE For Sizes Not Listed. Non-stock -- Consult DODGE For Delivery #

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SHAFT SIZE INCHES	Α	В	с	D	E	F BOLT	н	J	L
1-3/16 1-1/4	2-13/16	3-3/4	2-11/32	2-7/8	1/16	3/8	1	2-15/16	2-1/4
1-3/8 1-7/16	3-1/16	4-5/8	2-19/32	3-1/2	1/16	1/2	1-1/16	3-1/2	2-3/4
1-1/2 1-5/8 1-11/16	3-1/2	5-3/8	2-31/32	4-1/8	1/8	1/2	1-3/16	4-3/16	3-3/16
1-3/4 1-7/8 1-15/16 2	3-5/8	5-5/8	3-3/32	4-3/8	1/8	1/2	1-3/16	4-7/16	3-7/16
2-3/16	3-7/8	6-1/4	3-9/32	4-7/8	1/8	5/8	1-3/8	4-7/8	3-3/4
2-1/4 2-7/16 2-1/2	4-3/16	6-7/8	3-9/16	5-3/8	3/16	5/8	1-1/2	5-5/16	4-1/16
2-11/16 2-3/4 2-15/16 3	4-11/16	7-3/4	3-15/16	6	3/16	3/4	1-5/8	6	4-23/32
3-3/16 3-1/4 3-7/16 3-1/2	5-1/4	9-1/4	4-1/2	7	1/4	3/4	1-7/8	7-1/4	5-17/32
3-15/16 4	6-1/2	10-1/4	5-5/8	7-3/4	1/4	7/8	2-1/8	8-1/4	6-1/8
4-7/16 4-1/2	7-3/32	10-7/8	5-15/16	8-3/4	11/32	7/8	2-7/16	8-3/4	6-7/16

	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
	TYPE K	DOUBLE-INTERLOCK	TAF
TAGE DS-0	PAGE B5–11/B5–34	PAGE B5–11/B5–44	PAGE B5-11/B5-52





Type E Piloted Flange



MODIFICATIONS/ACCESSORIES END CLOSURES PAGE B5-58	NOMENCLATURE PAGE B5-10	FEATURES/BENEFITS PAGE B5-2	SPECIFICATIONS PAGE B5-7
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Type E Piloted Flange

	GRAY	' IRON	
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)
1-3/16	023120	FC-E-103R	5
1-1/4	023121	FC-E-104R	5
1-3/8	023122	FC-E-106R	7
1-7/16	023123	FC-E-107R	6
1-1/2	023124	FC-E-108R	10
1-5/8	023125	FC-E-110R	9
1-11/16	023126	FC-E-111R	9
1-3/4	023127	FC-E-112R	11
1-7/8	023128	FC-E-114R	10
1-15/16	023129	FC-E-115R	10
2	023130	FC-E-200R	10
2-3/16	023131	FC-E-203R	14
2-1/4	023132	FC-E-204R	18
2-7/16	023133	FC-E-207R	18
2-1/2	023134	FC-E-208R	17
2-11/16	023135	FC-E-211R	27
2-3/4	023136	FC-E-212R	27
2-15/16	023137	FC-E-215R	25
3	023138	FC-E-300R	25
3-3/16	023139+	FC-E-303R	44
3-1/4	023140+	FC-E-304R	44
3-7/16	023141	FC-E-307R	43
3-1/2	023142	FC-E-308R	42
3-15/16	023143	FC-E-315R	59
4	023144	FC-E-400R	58
4-7/16	023145	FC-E-407R	110
4-1/2	023146	FC-E-408R	110
4-15/16	023147	FC-E-415R	130
5	023148	FC-E-500R	130

#

Consult DODGE For Sizes Not Listed. Non-stock -- Consult DODGE For Delivery

SHAFT SIZE INCHES	А	в	с	D	E	F BOLT#	G	н	K**	L	м
1-3/16 1-1/4	2-3/4	5	2-7/32	4-1/8	3/4	3/8	1-5/16	7/16	3-3/8	2-1/4	27/32
1-3/8 1-7/16	3	5-1/4	2-15/32	4-3/8	7/8	3/8	1-1/2	1/2	3-5/8	2-3/4	1-1/32
1-1/2 1-5/8 1-11/16	3-3/8	6-1/8	2-25/32	5-1/8	1-1/16	7/16	1-9/16	1/2	4-1/4	3-3/16	1-1/32
1-3/4 1-7/8 1-15/16 2	3-1/2	6-3/8	2-29/32	5-3/8	1-3/16	7/16	1-9/16	9/16	4-1/2	3-7/16	1-1/32
2-3/16	3-3/4	7-1/8	3-3/32	6	1-3/16	1/2	1-11/16	9/16	5	3-3/4	1-3/32
2-1/4 2-7/16 2-1/2	4	7-5/8	3-5/16	6-1/2	1-5/16	1/2	1-13/16	5/8	5-1/2	4-1/16	1-3/16
2-11/16 2-3/4 2-15/16 3	4-1/2	8-3/4	3-11/16	7-1/2	1-1/2	5/8	2	3/4	6-3/8	4-23/32	1-1/4
3-3/16 3-1/4 3-7/16 3-1/2	5	10-1/4	4-3/16	8-5/8	1-1/4	3/4	2-7/16	15/16	7-3/8	5-17/32	1-11/16
3-15/16 4	6-1/4	10-7/8	4-1/2	9-3/8	1-1/2	3/4	2-11/16	1	8-1/8	6-1/8	1-13/16
4-7/16 4-1/2	6-3/4	13-1/2	4-5/8	11-3/4	1-1/2	3/4##	3	1	10-1/4	6-7/16	1-15/16
4-15/16 5	7-1/4	14-3/4	5-1/16	12-3/4	1-3/4	7/8##	2-31/32	1-1/4	11	7-7/16	1-7/8
# (4) Equally S Unless Otherw	Spaced * 1- ³ /- /ise Noted	₁₆ To 3- ¹ / ₂ - Oi	ne Collar 3- ^{15/} 16 To	5″ - Two Colla	irs	## (6) Bol ** +.000 -	ts Equally Spa .002	ced			

		1.000 1002	
	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
PAGE B5-8		DOUBLE-INTERLOCK	
	PAGE 85-11/85-34	PAGE 85-11/85-44	PAGE B5-11/B5-52





Type E Wide Slot Take-Up Unit - Inch



1-3/8" THRU 3" CONSTRUCTION

NOMENCLATURE	SELECTION	EASY SELECTION	ENGINEERING/TECHNICAL
PAGE B5-10	PAGE B5-11	PAGE B5-15	PAGE B5-17
FAGE DS-10	FAGE DS-11	FAGE D5-15	FAGE DS-17





Type E Wide Slot Take–Up Unit – Inch

	GRAY IRON					
SHAFT SIZE # Inches	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)	FRAME		
1-3/8	023076+	WSTU-E-106R	8	CP308		
1-7/10	023077	WSTU-E-107R	8			
1-1/2	023078	WSTUE 1100	10	CD 400		
1-5/8	023079+	WSTU-E-111R	10	CP400		
1-3/4	023081+	WSTU-E-112R	12			
1-7/8	023082+	WSTU-E-114R	12	CR400		
1-15/16	023083	WSTU-E-115R	12	0F400		
2	023084	WSTU-E-200R	12			
2-3/16	023085	WSTU-E-203R	16	CP408		
2-1/4	023086+	WSTU-E-204R	21			
2-7/16	023087	WSTU-E-207R	21	CP502		
2-1/2	023088+	WSTU-E-208R	21			
2-11/16	023089+	WSTU-E-211R	30			
2-3/4	023090+	WSTU-E-212R	30	CD515		
2-15/16	023091	WSTU-E-215R	30	0-315		
3	023092+	WSTU-E-300R	30			

Consult DODGE For Sizes Not Listed.

+ Non-stock -- Consult DODGE For Delivery

SHAFT SIZE INCHES	Α	В	С	D	E	F SCREW DIA	G	н	J	к	L	м	N	т
1-3/8 1-7/16	3	5-3/32	17/32	2-3/4	3-7/32	3/4	11/16	5/8	2-7/16	1-7/16	2-3/4	3-1/2	4-1/8	2-1/16
1-1/2 1-5/8 1-11/16	3-3/8	6	11/16	3-1/4	3-13/16	1	15/16	3/4	3-5/16	1-15/16	3-3/16	4	4-3/4	2-5/16
1-3/4 1-7/8 1-15/16 2	3-1/2	6-5/16	11/16	3-3/4	3-15/16	1	15/16	3/4	3-5/16	1-15/16	3-7/16	4	4-3/4	2-7/16
2-3/16	3-3/4	7-1/8	13/16	3-3/4	4-5/8	1-1/8	1	1–1/4	3-7/8	2-1/4	3-3/4	4-1/2	5-1/4	2-9/16
2-1/4 2-7/16 2-1/2	4	7-13/16	1-1/16	4-1/2	5-1/16	1-1/2	1-1/16	1-1/4	4-1/4	2-1/2	4-1/16	5-1/8	6	2-3/4
2-11/16 2-3/4 2-15/16 3	4-1/2	9-1/8	1-13/16	4-3/4	5-7/8	1-1/2	1-3/8	1-1/2	4-7/8	2-3/4	4-23/32	5-15/16	6-3/4	3

MODIFICATIONS/ACCESSORIES	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
END CLOSURES	TYPE K PAGE B5-11/B5-34	DOUBLE-INTERLOCK PAGE B5-11/B5-44	TAF PAGE B5-11/B5-52
PAGE B5–58	PAGE B5-11/B5-34	PAGE 85-11/85-44	PAGE B5-11/B5-5





Type E TP Take–Up Bearing – Inch





1-3/4" THRU 3" CONSTRUCTION



3-3/16" THRU 4" CONSTRUCTION

EASY SELECTION PAGE B5-15FEATURES/BENEFITS PAGE B5-2SPECIFICATIONS PAGE B5-7HOW TO ORDER PAGE B5-7PAGE B5-15PAGE B5-2PAGE B5-7PAGE B5-8	EASY SELECTION	FEATURES/BENEFITS	SPECIFICATIONS	HOW TO ORDER
	PAGE B5-15	PAGE B5-2	PAGE B5-7	PAGE B5-8





Type E TP Take–Up Bearing – Inch

GRAY IRON							
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)				
1-3/4	023149+	TP-E-112R	14				
1-7/8	023150+	TP-E-114R	14				
1-15/16	023151	TP-E-115R	14				
2	023152+	TP-E-200R	14				
2-3/16	023153	TP-E-203R	16				
2-1/4	023154+	TP-E-204R	21				
2-7/16	023155	TP-E-207R	21				
2-1/2	023156+	TP-E-208R	21				
2-11/16	023157+	TP-E-211R	29				
2-3/4	023158+	TP-E-212R	29				
2-15/16	023159	TP-E-215R	29				
3	023160+	TP-E-300R	29				
3-3/16	023161+	TP-E-303R	43				
3-1/4	023162+	TP-E-304R	43				
3-7/16	023163	TP-E-307R	42				
3-1/2	023164+	TP-E-308R	42				
3-15/16	023165	TP-E-315R	62				
4	023166+	TP-E-400R	62				

Consult DODGE For Sizes Not Listed. Non-stock -- Consult DODGE For Delivery #

+

SHAFT SIZE INCHES	FRAME SIZE REF.	А	L	N&R
1-3/4 1-7/8 1-15/16 2	TP10 TP10 TP10 TP10	3-1/2	3-7/16	1-3/4
2-3/16	TP20	3-3/4	3-3/4	1-7/8
2-1/4 2-7/16 2-1/2	TP30 TP30 TP30	4	4-1/16	2
2-11/16 2-3/4 2-15/16 3	TP40 TP40 TP40 TP40	4-1/2	4-23/32	2-1/4
3-3/16 3-1/4 3-7/16 3-1/2	TP50 TP50 TP50 TP50	5	5-7/16	2-1/2
3-15/16 4	TP60 TP60	6-1/4	5-15/16	3-1/8

NOMENCLATURE PAGE B5-10	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS		
	TYPE K	DOUBLE-INTERLOCK	TAF		
	PAGE B5-11/B5-34	PAGE B5-11/B5-44	PAGE B5-11/B5-52		





Type K Pillow Blocks

2 & 4 BOLT BASE-INCH*





NON-EXP

1-3/16" THRU 3" CONSTRUCTION



* 1-3/16 THRU 3-1/2 (2 BOLT BASE)

* 3-15/16 (4 BOLT BASE)

FEATURES/BENEFITS PAGE B5-2 PAGE B5-7 SPECIFICATIONS PAGE B5-7	HOW TO ORDER PAGE B5-8	NOMENCLATURE PAGE B5-10
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Type K Pillow Blocks

2 & 4 BOLT BASE-INCH

GRAY IRON* NON-EXPANSION								
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)					
1-3/16	023167	P2B-K-103R	9					
1-1/4	023168	P2B-K-104R	9					
1-7/16	023170	P2B-K-107R	11					
1-1/2	023171	P2B-K-108R	15					
1-5/8	023172+	P2B-K-110R	14					
1-11/16	023173	P2B-K-111R	14					
1-3/4	023174	P2B-K-112R	20					
1-15/16	023175	P2B-K-115R	19					
2	023176	P2B-K-200R	19					
2-3/16	023177	P2B-K-203R	24					
2-1/4	023178	P2B-K-204R	28					
2-7/16	023179	P2B-K-207R	28					
2-1/2	023180	P2B-K-208R	28					
2-11/16	023181	P2B-K-211R	40					
2-3/4	023182	P2B-K-212R	40					
2-15/16	023183	P2B-K-215R	39					
3	023184	P2B-K-300R	39					
3-7/16	023186+	P2B-K-307R	67					
3-1/2	023187	P2B-K-308R	66					
3-15/16	023188	P4B-K-315R	106					

GRAY IRON EXPANSION								
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)					
1-3/16	023189	P2B-K-103RE	9					
1-1/4	023190+	P2B-K-104RE	9					
1-7/16	023192	P2B-K-107RE	11					
1-1/2	023193	P2B-K-108RE	15					
1-5/8	023194+	P2B-K-110RE	14					
1-11/16	023195	P2B-K-111RE	14					
1-3/4	023196+	P2B-K-112RE	20					
1-15/16	023197	P2B-K-115RE	19					
2	023198	P2B-K-200RE	19					
2-3/16	023199	P2B-K-203RE	24					
2-1/4	023200	P2B-K-204RE	28					
2-7/16	023201	P2B-K-207RE	28					
2-1/2	023202	P2B-K-208RE	28					
2-11/16	023203	P2B-K-211RE	40					
2-3/4	023204+	P2B-K-212RE	40					
2-15/16	023205	P2B-K-215RE	39					
3	023206	P2B-K-300RE	39					
3-7/16	023208	P2B-K-307RE	67					
3-1/2	023209+	P2B-K-308RE	66					
3-15/16▲	023210	P4B-K-315RE	106					

* Furnished Unless Otherwise Specified

Consult DODGE For Sizes Not Listed

+ Non-stock -- Consult DODGE For Delivery

Consult DODGE For Sizes Not Listed.

+ Non-stock -- Consult DODGE For Delivery

SHAFT	•	Б	^)	F	^								EVDt
INCHES	A	В		MIN.	MAX.	DIA	G	п	J	L	IVI	Р	n i	3	EXP"
1-3/16 1-1/4	2-9/32	7-1/2	1-7/8	6	6-3/8	3/8	11/16	1	4-17/32	2-1/4	2-1/8	5	1	1-3/8	3/32
1-3/8 1-7/16	2-35/64	8	2-3/16	6-1/4	6-5/8	1/2	3/4	1-1/4	5-15/64	2-3/4	2-3/8	5-33/64	1-1/32	1-1/2	3/32
1-1/2 1-5/8 1-11/16	2-53/64	9	2-3/8	6-7/8	7-5/8	1/2	1	1-3/8	5-3/4	3-3/16	2-5/8	5-13/16	1-9/16	1-11/16	3/32
1-3/4 1-15/16 2	2-61/64	10	2-17/32	7-3/8	8-7/16	5/8	1-19/64	1-1/2	6-17/64	3-7/16	2-7/8	6-23/64	1-13/64	1-3/4	9/32
2-3/16	3-5/32	11	2-21/32	8-1/16	9-1/4	5/8	1-21/64	1-1/2	6-33/64	3-3/4	3	6-61/64	1-1/4	1-7/8	9/32
2-1/4 2-7/16 2-1/2	3-11/32	12	2-13/16	9-1/4	10-1/4	5/8	1-17/64	1-3/4	7-1/32	4-1/16	3-1/4	7-3/8	1-5/16	2	9/32
2-11/16 2-3/4 2-15/16 3	3-25/32	13-7/16	2-15/16	9-7/8	11-1/2	3/4	1-11/16	2	7-59/64	4-23/32	3-3/4	8-5/16	1-7/16	2-1/4	9/32
3-3/16 3-7/16 3-1/2	4-17/64	16	3-7/16	12-13/16	13-13/16	7/8	1-1/2	2-1/4	9-27/64	5-7/16	4-1/2	10-3/32	1-11/16	2-1/2	9/32
3-15/16 ▲	5-13/32	17-7/16	4-3/4	13-1/8	14-3/4	3/4	1-45/64	2-3/4	10-27/64	5-15/16	5	10-45/64	2-1/8	3-1/8	11/32

*Exp-total Expansion Divided Equally On Both Sides Of Bearing (Expansion Bearings Only)

4 Bolt Base (See Page B5-34 For Bolts Spacing)

Dowel Hole Locations For Precision Positioning - See Page B9-30 - B9-31

		SELECTION/DIMENSIONS		
DOUBLE-IN PAGE B5	NTERLOCK TAF	1/B5_52		
١,	/B5–22 PAGE B5	/B5-22 PAGE B5-11/B5-44 PAGE B5-11		





Type K Flange Bearing – Inch



EASY SELECTION	ENGINEERING/TECHNICAL	SELECTION	
PAGE B5-15	PAGE B5-17	PAGE B5-11	





Type K Flange Bearing – Inch

DUCTILE IRON - NON-EXPANSION*								
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)					
1-1/4	023212+	F4B-K-104R	6					
1-7/16	023214	F4B-K-107R	7					
1-1/2	023215	F4B-K-108R	12					
1-15/16 2	023219 023220	F4B-K-115R F4B-K-200R	14 14					
2-3/16	023221	F4B-K-203R	17					
2-7/16 2-1/2	023223 023224+	F4B-K-207R F4B-K-208R	20 20					
2-15/16	023227	F4B-K-215R	24					
3	023228+	F4B-K-300R	24					
3-7/16 3-15/16	023230 023232	F4B-K-307R F4B-K-315R	45 72					

* Furnished Unless Otherwise Specified

Consult DODGE For Sizes Not Listed.

+ Non-stock -- Consult DODGE For Delivery

DUCTILE IRON - EXPANSION								
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)					
1-1/4	023234+	F4B-K-104RE	6					
1-7/16	023236	F4B-K-107RE	7					
1-1/2	023237	F4B-K-108RE	12					
1-15/16 2	023241 023242	F4B-K-115RE F4B-K-200RE	14 14					
2-3/16	023243	F4B-K-203RE	17					
2-7/16 2-1/2	023245 023246+	F4B-K-207RE F4B-K-208RE	20 20					
2-15/16 3	023249 023250+	F4B-K-215RE F4B-K-300RE	24 24					
3-7/16 3-15/16	023252 023254	F4B-K-307RE F4B-K-315RE	45 72					

Consult DODGE For Sizes Not Listed

+ Non-stock -- Consult DODGE For Delivery

SHAFT SIZE INCHES	А	в	с	D	E	F Bolt Dia.	G	н	J	L	EXP*
1-3/16 1-1/4	2-9/16	5-3/16	2-1/8	5-21/32	3/16	3/8	5-1/4	7/16	4	2-1/4	
1-3/8 1-7/16	2-11/16	5-3/4	2-1/8	6-1/4	5/32	1/2	5-3/4	1/2	4-27/64	2-3/4	3/16
1-1/2 1-5/8 1-11/16	3	6-1/8	2-7/16	6-3/4	5/32	1/2	6-3/4	1/2	4-25/32	3-3/16	3/16
1-3/4 1-15/16 2	3-1/8	6-7/8	2-9/16	7-1/2	5/32	5/8	7-1/4	9/16	5-5/16	3-7/16	3/16
2-3/16	3-5/16	7-3/16	2-23/32	8	5/32	5/8	7-13/16	9/16	5-21/32	3-3/4	3/16
2-1/4 2-7/16 2-1/2	3-9/16	7-5/8	2-59/64	8-1/2	3/16	5/8	8-9/16	5/8	6	4-1/16	5/16
2-11/16 2-3/4 2-15/16 3	4	8-7/8	3-11/32	9-3/4	1/4	3/4	9-1/2	11/16	6-57/64	4-23/32	5/16
3-3/16 3-7/16 3-1/2	4-1/2	10-1/4	3-23/32	11-1/2	1/4	7/8	11-3/8	3/4	8-1/8	5-17/32	5/16
3-15/16	5-1/2	11-7/16	4-5/8	13	1/8	1	12-7/8	13/16	9-3/16	6-1/8	5/16

All Dimensions Shown In Inches.

*Exp Total Expansion Divided Equally On Both Sides Of Bearing (Expansion Bearings Only)

	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
PAGE B5-2		DOUBLE-INTERLOCK	
	PAGE 85-11/85-22	PAGE B5-11/B5-44	PAGE B5-11/B5-52





Type K Units – Inch



 $\begin{array}{c} \textbf{S-1 UNIT} \\ \textbf{1-}^{3}/\textbf{16}^{''} \ \textbf{THRU 3}^{''} \ \textbf{CONSTRUCTION} \end{array}$



B-1 UNIT 3-³/₁₆" THRU 3-¹⁵/₁₆" CONSTRUCTION

SPECIFICATIONS	HOW TO ORDER	NOMENCLATURE	SELECTION
PAGE B5-7		PAGE B5-10	PAGE B5-11
TAGE 53-1	TAGE 55-6	TAGE BS-10	TAGE BS-11





Type K Units – Inch

TYPE S-1 UNITS GRAY IRON					
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)		
1-3/16	023271	S1U-K-103R	3		
1-1/4	023272+	S1U-K-104R	3		
1-3/8	023273+	S1U-K-106R	4		
1-7/16	023274	S1U-K-107R	4		
1-1/2	023275	S1U-K-108R	5		
1-5/8	023276+	S1U-K-110R	5		
1-11/16	023277	S1U-K-111R	5		
1-3/4	023278+	S1U-K-112R	7		
1-15/16	023279	S1U-K-115R	7		
2	023280	S1U-K-200R	7		
2-3/16	023281	S1U-K-203R	9		
2-1/4	023282+	S1U-K-204R	11		
2-7/16	023283	S1U-K-207R	11		
2-1/2	023284+	S1U-K-208R	11		
2-11/16	023285+	S1U-K-211R	15		
2-3/4	023286+	S1U-K-212R	15		
2-15/16	023287	S1U-K-215R	15		
3	023288	S1U-K-300R	15		
3-3/16	023289+	S1U-K-303R	28		
3-7/16	023290	S1U-K-307R	28		
3-1/2	023291+	S1U-K-308R	28		
3-15/16	023292	S1U-K-315R	40		

TYPE B-1 UNITS GRAY IRON					
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)		
1-3/16		B1U-K-103R	3		
1-1/4		B1U-K-104R	3		
1-3/8	023293+	B1U-K-106R	4		
1-7/16	023294+	B1U-K-107R	4		
1-1/2	023295+	B1U-K-108R	5		
1-5/8	023296+	B1U-K-110R	5		
1-11/16	023297+	B1U-K-111R	5		
1-3/4	023298+	B1U-K-112R	7		
1-15/16	023299+	B1U-K-115R	7		
2	023300+	B1U-K-200R	7		
2-3/16	023301+	B1U-K-203R	9		
2-1/4	023302+	B1U-K-204R	11		
2-7/16	023303+	B1U-K-207R	11		
2-1/2	023304+	B1U-K-208R	11		
2-11/16	023305+	B1U-K-211R	15		
2-3/4	023306+	B1U-K-212R	15		
2-15/16	023307+	B1U-K-215R	15		
3	023308+	B1U-K-300R	15		
3-3/16	023309+	B1U-K-303R	28		
3-7/16	023310+	B1U-K-307R	28		
3-1/2	023311+	B1U-K-308R	28		
3-15/16	023312+	B1U-K-315R	40		

Consult DODGE For Sizes Not Listed.

ed. # Consult DODGE For Sizes Not Listed.

Non-stock -- Consult DODGE For Delivery Non-stock -- Consult DODGE For Delivery SHAFT Ε% SIZE Α в С D * MACHINE CAST н J K ** L М R S INCHES SIDE SIDE 1-3/16 2.813 2-5/16 1-7/8 1-1/32 ----2.88 7/16 ----3.125 2-1/42-1/32 1 1-3/8 1-1/4 1-3/8 2-17/32 2-1/16 1-5/32 3-7/16 3.25 3.31 11/16 2-5/8 3.625 2-3/42-5/8 1-1/32 1-1/2 1-7/16 1-1/2 1-5/8 2-27/32 2-5/16 1-3/16 3-15/16 3.75 3.82 11/16 2-7/8 4.125 3-3/16 2-13/16 1-5/32 1-11/16 1-11/16 1-3/4 1-15/16 2-31/32 2-7/16 1 - 1/24-1/4 4.125 4.18 11/16 3 4.562 3-7/16 3-1/16 1-13/64 1-3/4 2 2-3/16 3-5/32 2-9/16 1-9/16 4-5/8 4.50 4.63 11/16 3-1/4 5.000 3-3/4 3-1/4 1-1/4 1-7/8 2-1/4 2-7/16 3-3/8 2-3/4 1-7/16 5 4.812 4.87 11/16 3-7/16 5.186 4-1/16 3-3/8 1-5/16 2 2-1/2 2-11/16 2-3/4 3-3/4 3 1-7/8 5-7/8 5.563 5.63 11/16 3-7/8 6.061 4-23/32 3-13/16 1-7/16 2-1/42-15/16 3 3-3/16 3-7/16 4-1/4 3-1/2 2 7-1/8 6.813 6.88 11/164-1/2 7.373 5-17/32 4-1/2 1-11/16 2-1/2 3-1/2 7.50 3-15/16 5-3/8 4-1/2 2-3/8 7-7/8 7.438 15/16 5-1/2 7.997 6-1/8 5-5/32 2-1/8 3-1/8

* +.000 - .002"

** +.000 - .001 SIZES 1-³/₁₆ THRU 3"

± .0005" SIZES 3-3/16 THRU 3-15/16" ALL DIMENSIONS SHOWN IN INCHES % Machine side of unit is on collar side only.

EASY SELECTION
PAGE B5-15SELECTION/DIMENSIONS
TYPE E
PAGE B5-11/B5-22SELECTION/DIMENSIONS
DOUBLE-INTERLOCK
PAGE B5-11/B5-44SELECTION/DIMENSIONS
TAF
PAGE B5-11/B5-52





Type K Wide Slot Take–Up Unit – Inch



1-3/8" THRU 3" CONSTRUCTION

ENGINEERING/TECHNICAL	EASY SELECTION	FEATURES/BENEFITS	
PAGE B5-17	PAGE B5-15	PAGE B5-2	





Type K Wide Slot Take–Up Unit – Inch

GRAY IRON					
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)	CP FRAME SIZE	
1-7/16	023256+	WSTU-K-107R	8	CP308	
1-15/16	023261	WSTU-K-115R	11	CP400	
2-3/16	023263	WSTU-K-203R	15	CP408	
2-7/16	023265	WSTU-K-207R	20	CDE02	
2-1/2	023266	WSTU-K-208R	20	07302	
2-15/16	023269	WSTU-K-215R	28	CDE15	
3	023270	WSTU-K-300R	28	0-313	

Consult DODGE For Sizes Not Listed.

+ Non-stock -- Consult DODGE For Delivery

SHAFT SIZE Inches	A	в	С	D	E	F SCREW DIA	G	н	J	к	L	м	Ν	R	S	т
1-7/16	2-17/32	5-3/32	17/32	2-3/4	3-7/32	3/4	11/16	5/8	2-7/16	1-7/16	2-3/4	3-1/2	4-1/8	1-1/32	1-1/2	2-1/16
1-15/16	2-31/32	6-5/16	11/16	3-3/4	3-15/16	1	15/16	3/4	3-5/16	1-15/16	3-7/16	4	4-3/4	1-13/64	1-3/4	2-7/16
2-3/16	3-5/32	7-1/8	13/16	3-3/4	4-5/8	1-1/8	1	1–1/4	3-7/8	2-1/4	3-3/4	4-1/2	5-1/4	1-1/4	1-7/8	2-9/16
2-7/16 2-1/2	3-3/8	7-13/16	1-1/16	4-1/2	5-1/16	1-1/2	1-1/16	1-1/4	4-1/4	2-1/2	4-1/16	5-1/8	6	1-5/16	2	2-3/4
2-15/16 3	3-3/4	9-1/8	1-13/16	4-3/4	5-7/8	1-1/2	1-3/8	1-1/2	4-7/8	2-3/4	4-23/32	5-15/16	6-3/4	1-7/16	2-1/4	3

SPECIFICATIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
PAGE B5-7	TYPE E PAGE B5–11/B5–22	DOUBLE-INTERLOCK PAGE B5–11/B5–44	TAF PAGE B5-11/B5-52





Type K TP Take–Up Bearing – Inch









3-³/₁₆" THRU 3-¹⁵/₁₆" INTERNAL CONSTRUCTION

HOW TO ORDER	NOMENCLATURE	SELECTION	EASY SELECTION
PAGE B5-8	PAGE B5-10	PAGE B5-11	PAGE B5-15





Type K TP Take–Up Bearing – Inch

GRAY IRON					
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)		
1-15/16	023314	TP-K-115R	13		
2-3/16	023316	TP-K-203R	16		
2-7/16	023318	TP-K-207R	20		
2-15/16	023322	TP-K-215R	27		
3-7/16	023325	TP-K-307R	40		
3-15/16	023327	TP-K-315R	59		

Consult DODGE For Sizes Not Listed.

+ Non-stock -- Consult DODGE For Delivery

SHAFT SIZE INCHES	FRAME SIZE REF.	А	L	N	R
1-15/16	TP10	3-1/32	3-7/16	1-3/4	1-7/32
2-3/16	TP20	3-3/16	3-3/4	1-7/8	1-1/4
2-7/16	TP30	3-1/2	4-1/16	2	1-5/16
2-15/16	TP40	3-3/4	4-23/32	2-1/4	1-7/16
3-7/16	TP50	4-9/32	5-7/16	2-13/32	1-25/32
3-15/16	TP60	5-1/2	5-15/16	3-1/8	2-1/8

	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
PAGE B5-17	TYPE E	DOUBLE-INTERLOCK	TAF
	PAGE B5–11/B5–22	PAGE B5–11/B5–44	PAGE B5–11/B5–52



DOUBLE-INTERLOCK Pillow Block – Inch 2-BOLT BASE





1-3/16" THRU 3" CONSTRUCTION



3-3/16" THRU 3-1/2" CONSTRUCTION

ENGINEERING/TECHNICAL	EASY SELECTION	FEATURES/BENEFITS	SPECIFICATIONS
PAGE B5-17	PAGE B5–15	PAGE B5-2	PAGE B5-7





DOUBLE-INTERLOCK Pillow Block – Inch

2-BOLT BASE

GRAY IRON NON-EXPANSION*						
SHAFT SIZE INCHES#	SHAFT SIZE SYMBOL	PILLOW BLOCK P/N	HOUSING P/N	UNIT P/N	PIL. BLK. WT.,APRX LBS	
1-1/4	104	023329	056130	023508	9	
1-3/8	106	023330	056132	023509	11	
1-7/16	107	023331	056132	023510	11	
1-1/2	108	023332	056134	023511	15	
1-5/8	110	023333	056134	023512	15	
1-11/16	111	023334	056134	023513	15	
1-3/4	112	023335	056136	023514	18	
1-15/16	115	023337	056136	023516	17	
2	200	023338	056136	023517	17	
2-3/16	203	023339	056138	023518	25	
2-1/4	204	023340	056140	023519	29	
2-7/16	207	023341	056140	023520	26	
2-1/2	208	023342	056140	023521	26	
2-11/16	211	023343	056142	023522	41	
2-3/4	212	023344	056142	023523	41	
2-15/16	215	023345	056142	023524	40	
3	300	023346	056142	023525	40	
3-3/16	303	023347	056144	023526	67	
3-7/16	307	023349	056144	023528	66	
3-1/2	308	023350	056144	023529	66	

	GRAY IRON EXPANSION						
SHAFT SIZE INCHES#	SHAFT SIZE SYMBOL	PILLOW BLOCK P/N	HOUSING P/N	UNIT P/N	PIL. BLK. WT.,APRX LBS		
1-1/4	104	023376	056100	023508	9		
1-3/8	106	023377	056102	023509	11		
1-7/16	107	023378	056102	023510	11		
1-1/2	108	023379	056104	023511	15		
1-5/8	110	023380	056104	023512	15		
1-11/16	111	023381	056104	023513	15		
1-3/4	112	023382	056106	023514	18		
1-15/16	115	023384	056106	023516	17		
2	200	023385	056106	023517	17		
2-3/16	203	023386	056108	023518	22		
2-1/4	204	023387	056110	023519	29		
2-7/16	207	023388	056110	023520	26		
2-1/2	208	023389	056110	023521	26		
2-11/16	211	023390	056112	023522	42		
2-3/4	212	023391	056112	023523	42		
2-15/16	215	023392	056112	023524	41		
3	300	023393	056112	023525	41		
3-3/16	303	023394	056114	023526	69		
3-7/16	307	023396	056114	023528	68		
3-1/2	308	023397	056114	023529	68		

Description = P2b-di-207r For 2-7/16" Size # Consult DODGE For Sizes Not Listed. * Furnished Unless Otherwise Specified Description = P2b-di-207re For 2-7/16" Size # Consult DODGE For Sizes Not Listed.

SHAFT	•	в	•	[)	F	^	ц				D	EVD*
INCHES	A	Б	C	MIN.	MAX.	DIA.	G	п	J	L	IVI	Р	LAF
1-1/4	2-3/4	7-1/2	1-7/8	6	6-3/8	3/8	43/64	1	4-17/32	2-1/4	2-1/8	5	3/32
1-3/8 1-7/16	3	8	2-11/64	6-1/4	6-5/8	1/2	3/4	1-1/4	5-15/64	2-3/4	2-3/8	5-33/64	3/32
1-1/2 1-5/8 1-11/16	3-3/8	9	2-3/8	6-7/8	7-5/8	1/2	1	1-3/8	5-3/4	3-3/16	2-5/8	5-15/16	3/32
1-3/4 1-15/16 2	3-1/2	10	2-17/32	7-3/8	8-7/16	5/8	1-19/64	1-1/2	6-17/64	3-7/16	2-7/8	6-23/64	9/32
2-3/16	3-3/4	11	2-21/32	8-3/4	9-1/4	5/8	1-21/64	1-1/2	6-33/34	3-3/4	3	6-16/64	9/32
2-1/4 2-7/16 2-1/2	4	12	2-13/16	9-17/64	10-1/4	5/8	1-17/64	1-3/4	7-1/32	4-1/16	3-1/4	7-3/8	9/32
2-11/16 2-3/4 2-15/16 3	4-1/2	13-7/16	2-15/16	9-7/8	11-1/2	3/4	1-11/16	2	7-59/64	4-23/32	3-3/4	8-5/16	9/32
3-3/16 3-7/16 3-1/2	5	16	3-7/16	12-13/16	13-13/16	7/8	1-1/2	2-1/4	9-27/64	5-7/16	4-1/2	10-3/32	9/32

*EXP - Total Expansion Divided Equally On Both Sides Of Bearing (Expansion Bearings Only)

Dowel Hole Locations For Precision Positioning - See Page B9-30 - B9-31

	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
	TYPE E	TYPE K	TAF
PAGE D3-8	PAGE B5-11/B5-22	PAGE B5-11/B5-34	PAGE B5-11/B5-52



	-		
NOMENCLATURE	SELECTION	EASY SELECTION	ENGINEERING/TECHNICAL
PAGE B5-10	PAGE B5-11	PAGE B5-15	PAGE B5-17







4-BOLT BASE



3-3/16" THRU 5" CONSTRUCTION





DODGE



SELECTION/DIMENSIONS

DOUBLE-INTERLOCK Pillow Block – Inch







DOUBLE-INTERLOCK Pillow Block – Inch

4-BOLT BASE

	GRAY IRON NON EXPANSION*						
SHAFT SIZE INCHES#	SHAFT SIZE SYMBOL	PILLOW BLOCK P/N	HSG ASSEM P/N	UNIT P/N	PIL. BLK. WT.,APRX LBS		
2-7/16	207	023352	060745	023520	28		
2-1/2	208	023353	060745	023521	28		
2-11/16	211	023354	060747	023522	38		
2-15/16	215	023356	060747	023524	38		
3	300	023357	060747	023525	38		
3-7/16	307	023360	060749	023528	69		
3-1/2	308	023361	060749	023529	69		
3-15/16	315	023362	060751	023530	109		
4	400	023363	060751	023531	109		
4-7/16	407	023364	060753	023532	139		
4-1/2	408	023365	060753	023533	135		
4-15/16	415	023366	060755	023534	183		
5	500	023367	060755	023535	181		
5-7/16	507	023368	060579	023536	310		
5-15/16	515	023369	060579	023537	299		

	GRAY IRON EXPANSION						
SHAFT SIZE INCHES#	SHAFT SIZE SYMBOL	PILLOW BLOCK P/N	HSG ASSEM P/N	UNIT P/N	PIL. BLK. WT.,APRX LBS		
2-7/16	207	023399	060746	023520	28		
2-1/2	208	023400	060746	023521	28		
2-11/16	211	023401	060748	023522	38		
2-15/16	215	023403	060748	023524	38		
3	300	023404	060748	023525	38		
3-7/16	307	023407	060750	023528	69		
3-1/2	308	023408	060750	023529	69		
3-15/16	315	023409	060752	023530	110		
4	400	023410	060752	023531	110		
4-7/16	407	023411	060754	023532	139		
4-1/2	408	023412	060754	023533	135		
4-15/16	415	023413	060756	023534	181		
5	500	023414	060756	023535	179		
5-7/16	507	023415	060578	023536	310		
5-15/16	515	023416	060578	023537	299		

+ Furnished Unless Otherwise Specified

Description = P4b-di-207r For $2-^7/_{16}$ " Size # Consult DODGE For Sizes Not Listed.

Description = P4b-di-207re For $2-7/_{16}$ " Size # Consult DODGE For Sizes Not Listed.

SHAFT A B		в			D		F	G	u			м	р	EVD*
INCHES	A	В	C	MIN.	MAX		DIA	G	п	J	L	IVI	F	EXP
2-7/16 2-1/2	4	12	3-3/8	9-17/64	10-1/4	1-3/4	1/2	1-1/16	1-3/4	7-1/32	4-1/16	3-1/4	7-3/8	9/32
2-11/16 2-15/16 3	4-1/2	13-7/16	3-3/4	9-7/8	11-1/2	1-7/8	5/8	1-9/16	2	7-7/8	4-23/32	3-3/4	8-5/16	9/32
3-7/16 3-1/2	5	16	4	12-13/16	13-13/16	2	3/4	1-29/64	2-1/4	9-7/16	5-17/32	4-1/2	10-3/32	9/32
3-15/16 4	6-1/4	17-7/16	4-15/32	13-1/8	14-3/4	2	3/4	1-45/64	2-3/4	10-5/16	6-1/8	5	10-45/64	11/32
4-7/16 4-1/2	6-3/4	19	4-5/8	14-3/8	16-1/4	2-1/4	3/4	1-13/16	3	11-9/16	6-7/16	5-3/4	12-29/64	11/32
4-15/16 5	7-1/4	20-1/2	5-1/8	15-1/2	18-1/16	2-1/2	7/8	2-9/32	3-1/4	12-23/32	7-7/16	6-1/4	13-29/64	11/32
5-7/16 5-15/16	9	23-11/16	6-1/4	19	20-5/8	3	1	1-15/16	3-1/2	14-29/64	9-3/8	7-1/8	15-1/8	1/2

*EXP - Total Expansion Divided Equally On Both Sides Of Bearing (Expansion Bearings Only) Dowel Hole Locations For Precision Positioning – See Page B9–30 – B9–31

SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	/
	OLLEO HON, DIMLINOIONO	OLLEOTION, DIMLINOIONO	
TYPE E	TYPE K	ΤΔF	
		17 M	
PAGE B5_11/B5_22	PAGE B5_11/B5_34	PAGE B5_11/B5_52	



DOUBLE-INTERLOCK Flange Bearing – Inch



1-3/16" THRU 4" EXTERNAL CONSTRUCTION



1-3/16" THRU 3" INTERNAL CONSTRUCTION



4-7/16" THRU 5" EXTERNAL CONSTRUCTION



 $3\text{-}^3/_{16}{}''$ THRU 5" INTERNAL CONSTRUCTION OF UNIT

4-⁷/₁₆", 4-¹/₂", 4-¹⁵/₁₆" & 5" NON-EXPANSION HOUSINGS USE THE D UNIT

3-3/16" THRU 4" NON-EXPANSION & 3-3/16" THRU 5" EXPANSION HOUSINGS USE THE S-1 UNIT

EASY SELECTION	FEATURES/BENEFITS	SPECIFICATIONS	HOW TO ORDER
PAGE B5-15	PAGE B5-2	PAGE B5-7	PAGE B5-8





DOUBLE-INTERLOCK Flange Bearing – Inch

	DUCTILE IRON NON-EXPANSION*						
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)				
1-7/16	023425	F4B-DI-107R	9				
1-15/16 2	023431 023432	F4B-DI-115R F4B-DI-200R	15 15				
2-3/16	023433	F4B-DI-203R	19				
2-7/16 2-1/2	023435 023436+	F4B-DI-207R F4B-DI-208R	22 22				
2-15/16 3	023439 023440+	F4B-DI-215R F4B-DI-300R	32 31				
3-7/16	023443	F4B-DI-307R	53				
3-15/16	023445	F4B-DI-315R	82				
4-7/16◇ 4-1/2◇	023447+ 023448+	F4B-DI-407R F4B-DI-408R	158 158				
4-15/16◇	023449	F4B-DI-415R	220				

DUCTILE IRON EXPANSION SHAFT WEIGHT PART PART SIZE I BS NUMBER NAME INCHES # (APPROX) 1-7/16 023454 F4B-DI-107RE 9 1-15/16 023460 F4B-DI-115RE 15 2 023461 F4B-DI-200RE 15 2-3/16 023462 F4B-DI-203RE 19 2-7/16 023464 F4B-DI-207RE 22 2-1/2 023465+ F4B-DI-208RE 22 2-15/16 023468 F4B-DI-215RE 32 3 023469+ F4B-DI-300RE 31 023472 F4B-DI-307RE 3-7/16 53 3-15/16 023474+ F4B-DI-315RE 82 4-7/16◇ 023476+ F4B-DI-407RE 158 4-1/2◇ 023477+ F4B-DI-408RE 158 4-15/16◇ 023478 F4B-DI-415RE 220

Consult DODGE For Sizes Not Listed.

Non-stock -- Consult DODGE For Delivery

 \diamond 4⁷/₁₆" - 5" Housings Are Made Of Cast Iron

\diamond	4′/ ₁₆ ″ - 5′	' Housings Are	e Made Of Ca	st Iron	
+	NON-SLOCK		ODGE FOI DE	livery	

Furnished Unless Otherwise Specified

Consult DODGE For Sizes Not Listed.

#

SHAFT SIZE INCHES	Α	В	с	D	E	F Bolt Dia.	G	н	J	L
1-7/16	3	5-3/4	2-1/8	6-1/4	5/16	1/2	5-3/4	1/2	4-27/64	2-3/4
1-15/16 2	3-1/2	6-7/8	2-9/16	7-1/2	3/8	5/8	7-1/4	9/16	5-5/16	3-7/16
2-3/16	3-3/4	7-3/16	2-23/32	8	7/16	5/8	7-13/16	9/16	5-21/32	3-3/4
2-7/16 2-1/2	4	7-5/8	2-15/16	8-1/2	7/16	5/8	8-9/16	5/8	6	4-1/16
2-15/16 3	4-1/2	8-7/8	3-11/32	9-3/4	1/2	3/4	9-1/2	11/16	6-57/64	4-23/32
3-7/16	5	10-1/4	3-23/32	11-1/2	1/2	7/8	11-3/8	3/4	8-1/8	5-17/32
3-15/16	6-1/4	11-7/16	4-5/8	13	3/4	1	12-7/8	13/16	9-3/16	6-1/8
4-7/16 4-1/2	6-3/4	17-3/4	4-5/8	15	1-1/16	1		1	10-5/8	6-7/16
4-15/16	7-1/4	19	5	16	1-1/8	1-1/8		1-1/8	11-5/16	7-7/16

	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
PAGE B5-10	TYPE E PAGE B5–11/B5–22	TYPE K PAGE B5-11/B5-34	TAF PAGE B5–11/B5–52





DOUBLE-INTERLOCK Units - Inch



S-1 units can be mounted in a cylindrical bore to accommodate lineal shaft expansion or in a spherical groove to act as an anchor bearing. They are the same quality units which provide the statically selfaligning feature for the DOUBLE-INTERLOCK expansion flange bearings and 1- $^3/_{16}$ " to 4" non-expansion flange bearings.



D UNIT

D units require a spherical seat and serve as nonexpansion bearings. It is the static self-aligning unit which was formerly used in DOUBLE-INTERLOCK non-expansion flange bearing and pillow blocks thru 5 bore size prior to '78. They are also currently in $4^{-7}/_{16}$ " to 5" flange bearings



B-1 UNIT

B-1 Units can only be used in a cylindrical bore and are often mounted in machines where bored holes can be provided. B-1 units can be used either as a non-expansion or expansion bearing by providing a suitable means of locating the unit axially. B-1 Units will handle slight misalignment requirements. Shaft must be supported by another unit or bearing. For mounting in rotating wheels, the Type C B-1 unit is preferred or consult the factory.

SHAFT					E									
SIZE INCHES	Α	В	С	D	MACH. SIDE	CAST SIDE	н	J	к	L	м	N	Р	S
1-3/16 1-1/4	2-3/4	1-7/8	11/32	3	2.813	2.88	**	2.32	3.125●	2-1/4	2.03			
1-3/8 1-7/6	3	2-1/16	1-5/32	3-7/16	3.250	3.31	11/16	2.54	3.625●	2-3/4	2.64	2-7/8	3-5/8	3.844●
1-1/2 1-5/8 1-11/16	3-3/8	2-5/16	1-3/16	3-15/16	3.750	3.82	11/16	2.79	4.125●	3-3/16	2.89	3-1/8	4-3/32	4.344●
1-3/4 1-7/8 1-15/16 2	3-1/2	2-7/16	1-1/2	4-1/4	4.125	4.18	11/16	2.95	4.562●	3-7/16	3.10	3-1/4	4-7/16	4.656●
2-3/16	3-3/4	2-9/16	1-9/16	45/8	4.500	4.63	11/16	3.13	5.000●	3-3/4	3.32	3-7/16	4-23/32	5.000●
2-1/4 2-7/16 2-1/2	4	2-3/4	1-7/16	5	4.812	4.88	11/16	3.32	5.186•	4-1/16	3.41	3-37/64	5-5/32	5.437●
2-11/16 2-3/4 2-15/16 3	4-1/2	3	1-7/8	5-7/8	5.563	5.63	11/16	3.76	6.061•	4-23/32	3.85	4	5-13/16	6.094•
3-3/16 3-1/4 3-7/16 3-1/2	5	3-1/2	2	7-1/8	6.813	6.88	11/16	4.38	7.373#	5-17/32	4.51	4-11/16	7-7/32	7.500s
3-15/16 4	6-1/4	4-1/2	2-3/8	7-7/8	7.438	7.50	*	5.48	7.997#	6-1/8	5.16	5-1/8	8-1/8	8.375s
4-7/16 41/2	6-3/4	4-5/8	2-3/8	8-3/4	8.313	8.38	*	5.91	8.872#	6-7/16	5.60	5-1/2	8-7/8	9.125s
415/16 5	7-1/4	5-1/8	2-7/8	10-1/8	9.563	9.63	*	6.60	10.184#	7-7/16	6.26	6-3/16	10-1/4	10.500s
5-7/16 5-15/16 6	9	6-1/16	2-7/8		11.188	11.19	15/16		11.874 ∧	9-3/8	7.10			
6-7/16 6-1/2 6-15/16 7	10-1/2	7-1/8	3		13.250	13.25	15/16		14.248 ∧	11-3/8	8.29			

* 11/16" DIA ON D UNITS; 5/16" ON S-1 UNITS AND 3/4 HEX ON B-1 UNITS

** 11/16" DIA ON B-1 UNITS; 7/16" DIA ON S-1 UNITS

• +.000 TO .001" σ +.000 TO -.002"

#±.0005″

^+.000 TO -.003"

MODIFICATION/ACCESSORIES	SELECTION	EASY SELECTION	ENGINEERING/TECHNICAL
PAGE B5–9	PAGE B5-11	PAGE B5–15	PAGE B5-17





DOUBLE-INTERLOCK Units-inch

"S-1" UNITS GRAY IRON 1- ³ ∕ ₁₆ ″ thru 3″							
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)				
1-3/16	023507	S1U-DI-103R	3				
1-1/4	023508+	S1U-DI-104R	4				
1-3/8	023509+	S1U-DI-106R	5				
1-7/16	023510	S1U-DI-107R	5				
1-1/2	023511+	S1U-DI-108R	7				
1-5/8	023512	S1U-DI-110R	7				
1-11/16	023513	S1U-DI-111R	7				
1-3/4	023514	S1U-DI-112R	8				
1-7/8	023515+	S1U-DI-114R	8				
1-15/16	023516	S1U-DI-115R	8				
2	023517	S1U-DI-200R	8				
2-3/16	023518	S1U-DI-203R	10				
2-1/4	023519+	S1U-DI-204R	12				
2-7/16	023520	S1U-DI-207R	11				
2-1/2	023521	S1U-DI-208R	11				
2-11/16	023522	S1U-DI-211R	18				
2-3/4	023523+	S1U-DI-212R	17				
2-15/16	023524	S1U-DI-215R	17				
3	023525	S1U-DI-300R	17				

Consult DODGE For Sizes Not Listed.

+ Non-stock -- Consult DODGE For Delivery

"D" UNITS GRAY IRON						
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)			
1-3/16		DU-DI-103R				
1-1/4		DU-DI-104R				
1-3/8	023480+	DU-DI-106R	5			
1-7/16	023481	DU-DI-107R	5			
1-1/2	023482	DU-DI-108R	8			
1-5/8	023483+	DU-DI-110R	7			
1-11/16	023484	DU-DI-111R	7			
1-3/4	023485	DU-DI-112R	8			
1-7/8	023486+	DU-DI-114R	8			
1-15/16	023487	DU-DI-115R	8			
2	023488	DU-DI-200R	8			
2-3/16	023489	DU-DI-203R	9			
2-1/4	023490+	DU-DI-204R	12			
2-7/16	023491	DU-DI-207R	12			
2-1/2	023492	DU-DI-208R	12			
2-11/16	023493	DU-DI-211R	18			
2-3/4	023494	DU-DI-212R	17			
2-15/16	023495	DU-DI-215R	16			
3	023496	DU-DI-300R	16			
3-3/16	023497	DU-DI-303R	32			
3-1/4	023498+	DU-DI-304R	31			
3-7/16	023499	DU-DI-307R	30			
3-1/2	023500	DU-DI-308R	29			
3-15/16	023501	DU-DI-315R	46			
4	023502	DU-DI-400R	43			
4-7/16	023503	DU-DI-407R	57			
4 1/2	023504+	DU-DI-408R	64			
4-15/16	023505	DU-DI-415R	85			
5	023506+	DU-DI-500R	85			

Consult DODGE For Sizes Not Listed.

+ Non-stock -- Consult DODGE For Delivery

"S-1" UNITS GRAY IRON 3- ³ / ₁₆ ″ thru 7″						
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)			
3-3/16	023526	S1U-DI-303R	34			
3-1/4	023527+	S1U-DI-304R	31			
3-7/16	023528	S1U-DI-307R	31			
3-1/2	023529+	S1U-DI-308R	31			
3-15/16	023530	S1U-DI-315R	43			
4	023531	S1U-DI-400R	43			
4-7/16	023532	S1U-DI-407R	57			
4 1/2	023533+	S1U-DI-408R	64			
4-15/16	023534	S1U-DI-415R	82			
5	023535+	S1U-DI-500R	82			
5-7/16	023536	S1U-DI-507R	159			
5-15/16	023537	S1U-DI-515R	135			
6	023538	S1U-DI-600R	128			
6-7/16	023539	S1U-DI-607R	187			
6-1/2	023540	S1U-DI-608R	182			
6-15/16	023541	S1U-DI-615R	180			
7	023542	S1U-DI-700R	178			
# Consult DOD	GE Eor Sizes No	t Listad				

Consult DODGE For Sizes Not Listed.
+ Non-stock -- Consult DODGE For Delivery

"B-1" UNITS GRAY IRON						
SHAFT SIZE INCHES #	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)			
1-3/16	023543	BIU-DI-103R	3			
1-3/8	023545	BIU-DI-106R	5			
1-7/16	023546	BIU-DI-107R	5			
1-1/2	023547	BIU-DI-108R	6			
1-5/8	023548+	BIU-DI-110R	6			
1-3/4	023550	BIU-DI-112R	8			
1-15/16	023552	BIU-DI-115R	8			
2	023553	BIU-DI-200R	7			
2-3/16	023554	BIU-DI-203R	9			
2-7/16	023556	BIU-DI-207R	12			
2-1/2	023557	BIU-DI-208R	11			
2-11/16	023558+	BIU-DI-211R	17			
2-3/4	023559+	BIU-DI-212R	17			
2-15/16	023560	BIU-DI-215R	17			
3	023561	BIU-DI-300R	17			
3-7/16	023564	BIU-DI-307R	30			
3-1/2	023565	BIU-DI-308R	30			
3-15/16	023566	BIU-DI-315R	45			
4	023567	BIU-DI-400R	44			
4-7/16	023568	BIU-DI-407R	58			
4 1/2	023569	BIU-DI-408R	64			
4-15/16	023570	BIU-DI-415R	87			
5	023571	BIU-DI-500R	86			

Consult DODGE For Sizes Not Listed.

+ Non-stock -- Consult DODGE For Delivery

SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	
TYPE E	TYPE K	DOUBLE-INTERLOCK	
PAGE B5–11/B5–22	PAGE B5–11/B5–34	PAGE B5–11/B5–44	





TAF Pillow Block – Inch

2-BOLT BASE



FEATURES/BENEFITS	SPECIFICATIONS	HOW TO ORDER	NOMENCLATURE
PAGE B5-2	PAGE B5-7	PAGE B5-8	PAGE B5-10





TAF Pillow Block – Inch

2-BOLT BASE

	GRAY IRON NON-EXPANSION +								
SHAFT SIZE INCHES #	SHAFT SIZE SYMBOL	SAF HOUSING NUMBER	PILLOW BLOCK P/N	HSG ASSEM. P/N	UNIT P/N	PIL. BLK. WT. APRX LBS			
1-7/16	107	509	037580	037540	037632	12			
1-11/16	111	510	037581	037541	037633	15			
1-15/16	115	511	037582	037542	037634	17			
2-3/16	203	513	037583	037543	037635	25			
2-7/16	207	515	037584	037544	037636	30			
2-1/2	208	515	037585	037544	037637	30			
2-11/16	211	516	037586	037545	037638	38			
2-3/4	212	516	037587	037545	037639	38			
2-15/16	215	517	037588	037546	037640	45			
3	300	517	037589	037546	037641	44			
3-7/16	307	520	037590	037547	037642	71			
3-1/2	308	520	037591	037547	037643	70			

⁺ Furnished Unless Otherwise Specified.
Description = P2b-taf-207re For 2-⁷/₁₆" Size
Consult DODGE For Sizes Not Shown

GRAY IRON EXPANSION								
SHAFT SIZE INCHES #	SHAFT SIZE SYMBOL	SAF HOUSING NUMBER	PILLOW BLOCK P/N	HSG ASSEM. P/N	UNIT P/N	PIL. BLK. WT. APRX LBS		
1-7/16	107	509	037592	037555	037632	12		
1-11/16	111	510	037593	037556	037633	15		
1-15/16	115	511	037594	037557	037634	17		
2-3/16	203	513	037595	037558	037635	25		
2-7/16	207	515	037596	037559	037636	30		
2-1/2	208	515	037597	037559	037637	30		
2-11/16	211	516	037598	037560	037638	38		
2-3/4	212	516	037599	037560	037639	38		
2-15/16	215	517	037600	037561	037640	45		
3	300	517	037601	037561	037641	44		
3-7/16	307	520	037602	037562	037642	71		
3-1/2	308	520	037603	037562	037643	70		

Description = P2b-taf-207re For 2-⁷/₁₆" Size # Consult DODGE For Sizes Not Shown

SHAFT	SAF	•	в	6	D		F	G	ы			м	р	
INCHES	SERIES	A	В	C	MIN.	MAX.	DIA	G	п	J	L	IVI	F	EVL
1-7/16	509	3	8-1/4	2-3/16	6-1/4	7	1/2	15/16	7/8	5-7/64	2-3/4	2-1/4	5-33/64	3/32
1-11/16	510	3-3/8	8-1/4	2-3/8	6-1/2	7	1/2	7/8	1-1/32	5-5/8	3-3/16	2-1/2	5-13/16	3/32
1-15/16	511	3-1/2	9-5/8	2-3/4	7-3/8	8-1/4	5/8	1-13/64	1-1/32	6-9/64	3-7/16	2-3/4	6-23/64	9/32
2-3/16	513	3-3/4	11	3-1/4	8-21/32	9-1/2	5/8	1-7/16	1-1/32	6-33/64	3-3/4	3	6-61/64	9/32
2-7/16	515	4	11-1/8	3_1/8	8-5/8	0-5/8	5/8	1-17/64	1-1//	7-1/32	4-1/16	3-1/4	7-3/8	0/32
2-1/2	515	Ŧ	11-1/8	3-1/8	8-5/8	9-5/6	5/6	1-17/04	1-1/4	7-1/32	4-1/10	5-1/4	7-5/8	9/32
2-11/16	516	1-1/2	12-10/32	3-1/2	9-7/8	11	3/4	1-7/16	1-1/4	7-43/64	1-23/32	3-1/2	8-5/16	0/32
2-3/4	510	4-1/2	12-19/02	0-1/2	3-1/0		5/4	1-7/10	1-1/4	7-40/04	4-20/02	0-1/2	0-3/10	3/02
2-15/16	517	4 1/2	12 10/22	2 1/2	0.7/9	-1-1	3/4	1 7/16	1 1/4	7 50/64	1 22/22	3 3/4	9 5/16	0/32
3	517	4-1/2	12-19/32	3-1/2	9-7/0		3/4	1-7/10	1-1/4	7-59/04	4-23/32	3-3/4	8-5/10	9/32
3-7/16	520	5	14 1/4	4 11/22	11 12/16	12 1/9	7/9	1 01/20	1 01/20	0.27/64	5 5/16	4 1/2	10 3/32	0/32
3-1/2	520	5	14-1/4	4-11/32	11-13/10	13-1/6	1/0	1-21/32	1-21/32	9-27/04	0-0/10	4-1/2	10-3/32	9/32

*EXP Total Expansion Divided Equally On Both Sides Of Bearing (Expansion Bearing Only).

Dowel Hole Locations For Precision Positioning - See Page B9-30 - B9-31

EASY SELECTION PAGE B5-15	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
	TYPE E PAGE B5-11/B5-22	TYPE K PAGE B5-11/B5-34	DOUBLE-INTERLOCK PAGE B5-11/B5-44
		TROLE BO TH/BO OT	





TAF Pillow Block – Inch

4-BOLT BASE-INCH





2-7/16" THRU 3" CONSTRUCTION

3-7/16" THRU 5" CONSTRUCTION

5-7/16" THRU 7" CONSTRUCTION





TAF Pillow Block – Inch

4-BOLT BASE-INCH

GRAY IRON NON-EXPANSION +								
SHAFT SIZE INCHES #	SHAFT SIZE SYMBOL	SAF HOUSING NUMBER	PILLOW BLOCK P/N	HSG ASSEM. P/N	UNIT P/N	PIL. BLK. WT. APRX LBS		
2-7/16	207	515	037604	037548	037636	30		
2-1/2	208	515	037605	037548	037637	30		
2-11/16	211	516	037606	037549	037638	38		
2-3/4	212	516	037607	037549	037639	38		
2-15/16	215	517	037608	037550	037640	45		
3	300	517	037609	037550	037641	44		
3-7/16	307	520	037610	037551	037642	71		
3-1/2	308	520	037611	037551	037643	70		
3-15/16	315	522	037612	037552	037644	110		
4	400	522	037613	037552	037645	110		
4-7/16	407	526	037614	037553	037646	140		
4-1/2	408	526	037615	037553	037647	140		
4-15/16	415	528	037616	037554	037648	180		
5	500	528	037617	037554	037649	180		
5-7/16	507	532	023584	042628	023610	300		
5-15/16	515	534	023585	042630	023611	300		
6	600	534	023586	042630	023612	300		
6-7/16	607	536	023587	042632	023613	510		
6-1/2	608	536	023588	042632	023614	510		
6-15/16	615	538	023589	042634	023615	520		
7	700	538	023590	042634	023616	520		

GRAY IRON EXPANSION									
SHAFT SIZE INCHES #	SHAFT SIZE SYMBOL	SAF HOUSING NUMBER	PILLOW BLOCK P/N	HSG ASSEM. P/N	UNIT P/N	PIL. BLK. WT. APRX LBS			
2-7/16	207	515	037618	037563	037636	30			
2-1/2	208	515	037619	037563	037637	30			
2-11/16	211	516	037620	037564	037638	38			
2-3/4	212	516	037621	037564	037639	38			
2-15/16	215	517	037622	037565	037640	45			
3	300	517	037623	037565	037641	44			
3-7/16	307	520	037624	037566	037642	71			
3-1/2	308	520	037625	037566	037643	70			
3-15/16	315	522	037626	037567	037644	110			
4	400	522	037627	037567	037645	110			
4-7/16	407	526	037628	037568	037646	140			
4-1/2	408	526	037629	037568	037647	140			
4-15/16	415	528	037630	037569	037648	180			
5	500	528	037631	037569	037649	180			
5-7/16	507	532	023603*	042627*	023610	300			
5-15/16	515	534	023604*	042629*	023611	300			
6	600	534	023605*	042629*	023612	300			
6-7/16	607	536	023606*	042631*	023613	510			
6-1/2	608	536	023607*	042631*	023614	510			
6-15/16	615	538	023608*	042633*	023615	520			
7	700	538	023609*	042633*	023616	520			

+ Furnished Unless Otherwise Specified Description = P4b-taf-207r For 2-7/16" Size Pillow Block # Consult DODGE For Sizes Not Shown

Consult DODGE For Sizes Not Shown

Description = P4b-taf-207re For 2-7/16" Size Pillow Block # Consult DODGE For Sizes Not Shown

SHAFT	SAF	•	B	C	D		E	F BOLT	G	ц			M	D	EVD*
SIZE	SERIES	~	В	U	MIN.	MAX.	Ē	DIA	G	п	5	L	IVI	F	LAF
2-7/16 2-1/2	515	4	11-1/8	3-1/8	8-5/8	9-5/8	1-7/8	1/2	1-1/8	1-1/4	7-1/32	4-1/16	3-1/4	7-3/8	9/32
2-11/16 2-3/4	516	4-1/2	12-19/32	3-1/2	9-7/8	11	2-1/8	5/8	1-21/64	1	7-43/64	4-23/32	3-1/2	8-5/16	9/32
2-15/16 3	517	4-1/2	12-19/32	3-1/2	9-7/8	11	2-1/8	5/8	1-21/64	1-1/4	7-59/64	4-23/32	3-3/4	8-5/16	9/32
3-7/16 3-1/2	520	5	14-1/4	4-11/32	11-13/16	13-1/8	2-3/8	3/4	1-5/8	1-21/32	9-27/64	5-5/16	4-1/2	10-3/32	9/32
3-15/16 4	522	6-1/4	16-1/2	4-3/4	12-19/32	14-1/2	2-3/4	3/4	1-53/64	1-25/32	10-23/64	5-15/16	4-15/16	10-45/64	11/32
4-7/16 4-1/2	526	6-3/4	18-3/8	5-1/8	14-1/2	16	3-1/4	7/8	1-3/4	2-1/16	11-53/64	6-13/32	6	12-29/64	11/32
4-15/16 5	528	7-1/4	19-45/64	5-7/8	15-5/8	17-3/8	3-3/8	1	2	2-1/16	12-37/64	7-13/32	6	13-23/64	11/32
5-7/16	532	9	21– 21/32	6-1/4	17-5/8	19–1/4	3-3/4	1	1 59/64	2-11/32	14	9-3/8	6-11/16	15 1/8	7/8
5-15/16 6	534	9	24-3/4	6 3/4	19	21-9/16	4-1/4	1	2 27/64	2-7/8	14-3/8	9-3/8	7-1/16	15 1/8	7/8
6-7/16 6-1/2	536	10-1/2	26-3/4	7-1/8	21	23-5/8	4-5/8	1	2 7/16	3	16-1/32	11-3/8	7-1/2	18-5/16	7/8
6-15/16 7	538	10-1/2	28	7-1/2	21 5/8	24 3/8	4-1/2	1-1/4	2 3/4	3-1/8	16-3/8	11-3/8	7-7/8	18-5/16	7/8

*EXP - Total Expansion Divided Equally On Both Sides Of Bearing (Expansion Bearings Only) Dowel Hole Locations For Precision Positioning – See Page B9–30 – B9–31

	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
PAGE B5–15			DOUBLE-INTERLOCK
	FAGE DS-11/DS-22	FAGE DO-11/DO-04	FAGE DO-11/DO-44





TAF Units – Inch



S-1 UNIT 1-7/16" THRU 3" CONSTRUCTION



S-1 UNIT 3-³/₁₆" THRU 5" CONSTRUCTION



 $\begin{array}{c} \textbf{S-1 UNIT} \\ \textbf{5-7/}_{16}" \text{ THRU 7" CONSTRUCTION} \end{array}$

EASY SELECTION		MODIFICATION/ACCESSORIES	FEATURES/BENEEITS
PAGE B5–15	PAGE B5-17	PAGE B5-17	PAGE B5-2





TAF Units – Inch

"S-1" UNITS - GRAY IRON							
SHAFT SIZE # INCHES	PART NUMBER	PART NAME	WEIGHT LBS (APPROX)				
1-7/16	037632	S1U509-TAF-107	5				
1-11/16	037633	S1U510-TAF-111	7				
1-15/16	037634	S1U511-TAF-115	8				
2-3/16	037635	S1U513-TAF-203	9				
2-7/16	037636	S1U515-TAF-207	11				
2- 1/2	037637	S1U515-TAF-208	11				
2-11/16	037638	S1U517-TAF-211	18				
2-3/4	037639+	S1U517-TAF-212	17				
2-15/16	037640	S1U517-TAF-215	17				
3	037641	S1U517-TAF-300	17				
3-7/16	037642	S1U520-TAF-307	31				
3-1/2	037643+	S1U520-TAF-307	31				
3-15/16	037644	S1U522-TAF-315	43				
4	037645	S1U522-TAF-400	43				
4-7/16	037646	S1U526-TAF-407	57				
4-1/2	037647+	S1U526-TAF-408	68				
4-15/16	037648	S1U528-TAF-415	82				
5	037649+	S1U528-TAF-500	82				
5-7/16	023610	S1U-TAF-507R	155				
5-15/16	023611	S1U-TAF-515R	143				
6	023612	S1U-TAF-600R	138				
6-7/16	023613	S1U-TAF-607R	187				
6-1/2	023614	S1U-TAF-608R	182				
6-15/16	023615	S1U-TAF-615R	180				
7	023616	S1U-TAF-700R	178				

NOTE: TAF inserts below 5–7/16" are not interchangeable with TAF–XT housings. For TAF–XT housings, with shafts of 5" or less, order Double Interlock S–1 units on Page B5–51

SHAFT				E					
SIZE INCHES	Α	В	С	MACH. SIDE	CAST SIDE	н	к	L	М
1-7/16	3	2-1/16	1-5/32	3.250	3.31	11/16	3.595•	2-3/4	2.62
1-11/16	3-3/8	2-5/16	1-3/16	3.750	3.81	11/16	4.095•	3-3/16	2.87
1-15/16	3-1/2	2-7/16	1-1/2	4.125	4.18	11/16	4.502•	3-7/16	3.07
2-3/16	3-3/4	2-9/16	1-9/16	4.500	4.56	11/16	4.940•	3-3/4	3.29
2-7/16 2- 1/2	4	2-3/4	1-7/16	4.812	4.88	11/16	5.156•	4-1/16	3.39
2-15/16 3	4-1/2	3	1-7/8	5.563	5.63	11/16	6.001•	4-23/32	3.82
3-7/16 3-1/2	5	3-1/2	2-3/16	6.813	6.88	11/16	7.313*	5-7/16	4.48
3-15/16 4	6-1/4	4-1/2	2-19/32	7.438	7.50	15/16	7.937*	5-15/16	5.13
4-7/16 4-1/2	6-3/4	4-5/8	2-9/16	8.313	8.38	15/16	8.812*	6-13/32	5.57
4-15/16 5	7-1/4	5-1/8	3-1/8	9.563	9.63	15/16	10.124*	7-13/32	6.23
5-7/16 5-15/16 6	9	5-7/8	2-9/16	11.190	11.19	3/4	11.563^	9-3/8	6.94
6-7/16 6-1/2 6-15/16 7	10-1/2	7-1/8	3	13.250	13.25	3/4	13.748^	11-3/8	8.04

# Consult DODGE For Si	zes Not Listed +	+ Non-stock Consult DODGE For Delivery				
SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS				
TYPE E (metric)	TYPE E	DOUBLE-INTERLOCK				
PAGE B5-61/B5-68	PAGE B5-11/B5-22	PAGE B5-11/B5-44				





Type E / Type K / DOUBLE INTERLOCK / TAF E-TECT SEAL KITSS

SHAFT SIZE	KIT PART
INCHES	NUMBER
1-3/16 TO 1-1/4	037650
1-3/8 TO 1-7/16	037651
1-1/2 TO 1-11/16	037652
1-3/4 TO 2	037653
2-3/16	037654
2-1/4 TO 2-1/2	037655
2-11/16 TO 3	037656
3-3/16 TO 3-1/2	037657
3-15/16 TO 4	037658
4-7/16 TO 4-1/2	037659
4-15/16 TO 5	037660
5-7/16 TO 6	037673**
6-7/16 TO 7	037674**



** Kit For 5-⁷/₁₆-7" Consists Of A Modified V-ring Seal. This Seal Can Only Be Used With Bearings Produced After September 1995.
Limiting Speed 70% Of Catalog Rating



1-3/16 THRU 5″

5-7/16 THRU 7"

SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	SELECTION/DIMENSIONS
TYPE E	TYPE K	DOUBLE-INTERLOCK	TAF
PAGE B5-11/B5-22	PAGE B5-11/B5-34	PAGE B5-11/B5-44	PAGE B5-11/B5-52





Type E TYPE E END CLOSURE KITS-INCH

SHAFT	I/IT+	"A" DIMENSION (INCH)				
SIZE Δ Inches	SIZE A PART NO.	PILLOW BLOCK	FLANGE	PILOT FLANGE	WS TAKE-UP	TP TAKE-UP
1-3/16 TO 1-1/4	023795	1-9/16	2-31/32	1-15/32		
1-3/8 TO 1-7/16	023796	1-11/32	3-7/32	1-21/32	1-21/32	
1-1/2 TO 1-11/16	023797	1-57/64	3-43/64	1-47/64	1-55/64	
1-3/4 TO 2	023798	1-61/64	3-51/64	1-47/64	1-59/64	1-63/64
2-3/16	023799	2-3/32	4-1/16	1-7/8	2-1/16	2-1/16
2-1/4 TO 2-1/2	023800	2-1/4	4-3/8	2	2-3/16	2-5/16
2-11/16 TO 3	023801	2-7/16	4-7/8	2-3/16	2-7/16	2-7/16

 Δ - Consult DODGE For Sizes Not Listed. * - Kit Includes End Closure And Special Collar.



ENGINEERING/TECHNICAL	EASY SELECTION	SELECTION	HOW TO ORDER
PAGE B5-17	PAGE B5-15	PAGE B5-11	PAGE B5-8
			1



Type K, DOUBLE-INTERLOCK and TAF End Closures



K, D-I & TAF



K & D-I

SHAFT	DADTe	"A" DIMENSION		
SIZE INCHES	NUMBER	PILLOW BLOCK	FLANGE BEARING	
1-3/8 TO 1-7/16	037681	1-21/32	2-27/32	
1-1/2 TO 1-11/16	037682	1-55/64	3-11/64	
1-3/4 TO 2	037683	1-59/64	3-19/64	
2-3/16	037684	2-1/16	3-1/2	
2-1/4 TO 2-1/2	037685	2-3/16	3-3/4	
2-11/16 TO 3	037686	2-7/16	4-3/16	
3-3/16 TO 3-1/2	037687	2-11/16	4-15/16	
3-5/16 TO 4	037688	3-5/16	5-13/16	
4-7/16 TO 4-1/2	037689	3-9/16	5-7/8	
4-15/16 TO 5	037690	3-13/16	6-5/16	

END CLOSURE MOUNTS ON MACHINED OD SIDE OF S-1 UNIT

ENGINEERING/TECHNICAL	EASY SELECTION	SELECTION	HOW TO ORDER
PAGE B5-17	PAGE B5-15	PAGE B5-11	PAGE B5-8
			1

SELECTION





Type E - Metric

SELECTION

METRIC TYPE E TAPERED ROLLER BEAR-INGS

DODGE Type E Double Row Tapered Roller Bearings

have the capacity to carry heavy radial loads, thrust loads, and combined radial and thrust loads. The maximum recommended load which can be applied is limited by various components in the system such as bearing, housing, shaft, shaft attachment, speed and life requirements as listed in this catalog. DODGE Unitized Type E Roller Bearings have been applied successfully even when these limits have been exceeded under controlled operating conditions. Contact DODGE Application Engineering (864-297-4800) for applications which exceed the recommendations of this catalog.

L10 Life, Hours -- The fatigue life which may be expected from at least 90% of a given group of bearings operating under identical conditions.

L10 Life, Hours =
$$\left(\frac{C_{90}}{P}\right)^{10/3} X \frac{1,500,000}{RPM}$$

Where: C_{90} = Dynamic Capacity (Table 9), kN P = Equivalent Radial Load, kN (See Equation 1 On Page B5–63 for definition of P)

GENERAL

Heavy Service -- For heavy shock loads, frequent shock loads, or severe vibrations, increase the Equivalent Radial Load up to 50% (according to severity of conditions) to obtain a Modified Equivalent Radial Load. Consult Application Engineering at 864-297-4800 for additional selection assistance. Thrust load values shown in the table below are recommended as a guide for general applications that will give adequate L10 life. With substantial radial loads also present, it is advisable to calculate actual L10 life to assure the bearing meets requirements.

RPM RANGE	20-200	201-2000	over 2000
RECOMMENDED THRUST LOAD	C ₉₀ /4	C ₉₀ /8	C ₉₀ /12

The shaft tolerances recommended below are adequate for the conditions outlined in this catalog. Since the allowable load, especially at a low speed, is very large, the shaft should be checked to assure adequate shaft strength.

The magnitude and direction of both the thrust and radial load must be taken into account when selecting a shaft size. Heavy loads should be directed through the base. Where uplift loads are involved see Table 12 for maximum values. Where a load pulls the housing away from the mounting base, both the hold-down bolts and housing must be of adequate strength. Auxiliary load carrying devices such as shear bars are advisable for side or end loading of plummer blocks.

SHAFT TOLERANCES

SHAFT SIZE	TOLERANCE
Up to 35mm	+.000013mm
40 to 100mm	+.000025mm
100-150mm	+.000038mm
160-180mm	+.000051mm

FEATURES/BENEFITS	SPECIFICATIONS	NOMENCLATURE	EASY SELECTION (metric)
PAGE B5-2	PAGE B5-7	PAGE B5-10	PAGE B5-64

SELECTION





Type E-Metric

SELECTING BEARINGS SUPPORTING RA-DIAL LOADS ONLY

- 1. Define the desired L10 Life, in Hours
- 2. Establish bearing radial load, FR, kN
- 3. Establish RPM.
- FR = P for Pure Radial Load Conditions.

P=Equivalent radial load, kN

(The Dodge program $\mathsf{BEST} \bullet$ can be used to find application loads.)

Using the easy selection Table 10, Page B5–64 under the RPM column find the equivalent load that equals or is higher than the application radial load for the desired life. The shaft size on the far left will be the minimum shaft size that you can use for your application. If the desired life is different than the values shown on the chart, use alternate Method A shown below.

Example: L10 Life = 30,000 Hours Radial load = 18 kN RPM = 1000

At the intersection of the 1000 RPM column and at the 30,000 hours L10 life row, the equivalent radial load of

25 kN exceeds the 18kN application radial load for shaft sizes 80, 85, and 90. Therefore, an 80, 85, or 90mm E bearing can be used to meet the application conditions of the above example:

ALTERNATE METHOD A --SELECTING A BEARING FOR AN L10 LIFE VALUE NOT SHOWN IN THE EASY SELECTION CHART.

The L10 life equation can be rearranged so that the bearing dynamic capacity C90 is identified in terms of L10, RPM and P.

$$C_{_{90}} = \left(\frac{L10 \text{ X RPM}}{1,500,000}\right)^{0.3} \text{ X P}$$

(P = F_R for Pure Radial Load Conditions)

Since the L10, RPM, and P are known, solve for C90. Select from the dynamic capacity column on Table 9 the C90 value equal to or greater than the C90 value just calculated. The bore size on the far left represents the minimum shaft size selection. Check that the application RPM does not exceed the MAX. RPM on Table 9. When selecting a L10 life of less than 30,000 hours particular attention must be paid to shaft deflection and proper lubricant selection.

 The DODGE Bearing Evaluation and Selection Technique (BEST) is a menu driven computer program that calculates bearing loads, fatigue life, and operating temperature for a two bearing shaft system based on user supplied input parameters.

DIMENSIONS TYPE E (metric)	SELECTION/DIMENSIONS	
PAGE B5–68	PAGE B5-11/B5-22	




Type E-Metric

SELECTING BEARINGS SUPPORTING BOTH RADIAL AND THRUST LOADS

When a bearing supports both a radial load and a thrust load, the loading on the two rows is shared unequally depending on the ratio of thrust to radial load. The use of the X (radial factor) and Y (thrust factor) from Table 9 convert the applied thrust load and radial loads to an equivalent radial load having the same effect on the life of the bearing as a radial load of this magnitude.

The equivalent radial load P = XFR + YFA (Equation 1)

Where:

- P = Equivalent radial load, kN
- FR = Radial load, kN
- FA = Thrust (axial) load, kN
- e = Thrust load to radial load factor (Table 9)

X = Radial load factor (Table 9)

Y = Thrust load factor (Table 9)

Calculate FA/FR and compare to **e** for the selected bore size. Determine X and Y from Table 9 depending on whether FA/FR is equal to or less than **e**, or FA/FR greater than **e**. Substitute all known values into the equivalent radial load equation. P (equivalent radial load) can be used in the life formula to determine L10 life in hours or compared to the allowable equivalent radial load ratings for the speed and hours life desired in the easy selection table.

SELECTING BEARINGS SUPPORTING ONLY THRUST LOADS

Type E tapered roller bearings are well suited to carry pure thrust loads. Follow the same selection procedure used above "Selecting Bearings Supporting Both Radial and Thrust Loads" except the equation P = XFR + YFAreduces to P = YFA. (XFR is equal to zero)

TABLE 9 – RADIAL AND THRUST FACTORS FOR TYPE E TAPERED ROLLER BEARINGS (METRIC)

SHAFT SIZE	е	FA/F	R≤e	FA/F	R>e	DYNAMIC CAPACITY C ₉₀ *	MAXIMUM	MAXIMUM SLIP FIT RADIAL
(MM)		Х	Y	X	Y	kNEWTONS	RPM	LOAD, (FR)k N**
35	.46	.87	1.89	.70	2.28	21.2	3,820	22.2
40	.44	.87	1.96	.70	2.37	27.3	3,320	28.5
45,50	.33	.87	2.64	.70	3.18	35.9	3,050	37.4
55	.35	.87	2.38	.70	2.87	38.0	2,730	39.6
60,65	.40	.87	2.17	.70	2.63	40.4	2,420	42.2
70,75	.45	.87	1.87	.70	2.26	42.7	2,060	44.5
80,85,90	.50	.87	1.71	.70	2.07	68.1	1,640	71.2
100	.49	.87	1.77	.70	2.14	93.4	1,530	98.0
110,115	.53	.87	1.63	.70	1.97	114.8	1,360	120.0
125	.47	.87	1.83	.70	2.21	157.9	1,200	164.6
135,140,150	.49	.87	1.76	.70	2.12	181.1	915	188.6
160,170,180	.54	.87	1.61	.70	1.95	307.9	790	320.2

COMPARING SPHERICAL TO TAPER ROLLER BEARING

The dynamic capacity C (spherical) and C₉₀ (taper) are not to the same base. To compare basic dynamic capacities, multiply C x .259 and compare to C₉₀.

To select and then compare, use the complete selection procedure for each type bearing and then compare.

* C90----Dynamic capacity based on a rated life of 90 million revolutions or 3000 hours at 500 RPM.

If load exceeds maximum allowable slip fit radial load (FR), line to line, to-light press fit of shaft required. Application loads up to maximum slip fit radial load may be applied if recommended shaft tolerances are used.

FEATURES/BENEFITS	SPECIFICATIONS	SELECTION (metric)	DIMENSIONS (metric)
PAGE B5-2	PAGE B5-7	PAGE B5-61	PAGE B5-68



Type E – Metric

TABLE 10 – EASY SELECTION TABLE FOR TYPE E, DOUBLE ROW TAPERED ROLLER BEAR-INGS (METRIC)

SHAFT	L10		ALLC	WABLE	EQUIV	ALENT I	RADIAL	LOAD R	ATING	(kN) AT v	VARIOU	S REVO	LUTION	S PER I	INUTE	
SIZE, MM	LIFE, HRS.	50	100	150	250	500	750	1000	1250	1500	1750	2000	2500	2700	3000	3500
	10000	30	25	20	20	15	15	10	10	10	10	10	10	10	10	10
	30000	20	15	15	15	10	10	10	10	5	5	5	5	5	5	5
35	40000	20	15	15	10	10	10	5	5	5	5	5	5	5	5	5
	60000	15	15	10	10	10	5	5	5	5	5	5	5	5	5	5
	100000	15	10	10	10	5	5	5	5	5	5	5	5	5	5	5
	10000	35	30	25	25	20	15	15	15	15	15	10	10	10	10	10
	30000	25	20	20	15	15	10	10	10	10	10	10	10	10	5	5
40	40000	25	20	20	15	10	10	10	10	10	10	10	5	5	5	5
	60000	20	20	15	15	10	10	10	10	5	5	5	5	5	5	5
	100000	20	15	15	10	10	10	5	5	5	5	5	5	5	5	5
	10000	55	45	40	35	25	25	20	20	20	20	20	15	15	15	
45	30000	40	30	30	25	20	15	15	15	15	15	15	10	10	10	
50	40000	35	30	25	20	20	15	15	15	15	10	10	10	10	10	
	60000	30	25	25	20	15	15	15	10	10	10	10	10	10	10	
	100000	25	20	20	15	15	10	10	10	10	10	10	10	10	10	
	10000	50	40	40	30	25	25	20	20	20	20	15	15	15	15	
	30000	40	30	25	25	20	15	15	15	15	15	10	10	10	10	
55	40000	35	30	25	20	15	15	15	15	10	10	10	10	10	10	
	60000	30	25	20	20	15	15	10	10	10	10	10	10	10	10	
	100000	25	20	20	15	15	10	10	10	10	10	10	10	10	5	
	10000	55	45	40	35	30	25	20	20	20	20	20	15			
60	30000	40	30	30	25	20	15	15	15	15	15	15	10			
65	40000	35	30	25	20	20	15	15	15	15	10	10	10			
	60000	30	25	25	20	15	15	15	10	10	10	10	10			
	100000	30	20	20	15	15	10	10	10	10	10	10	10			
	10000	60	50	40	35	30	25	25	20	20	20	20				
70	30000	40	35	30	25	20	20	15	15	15	15	15				
75	40000	40	30	30	25	20	15	15	15	15	15	10				
	60000	35	30	25	20	15	15	15	15	10	10	10				
	100000	30	25	20	20	15	15	10	10	10	10	10				
	10000	95	75	70	60	45	40	40	35	35	30					
80	30000	70	55	50	40	35	30	25	25	25	25					
85	40000	60	50	45	40	30	25	25	25	20	20					
90	60000	55	45	40	35	25	25	20	20	20	20					
	100000	45	40	35	30	25	20	20	20	15	15					
	10000	130	105	95	80	65	55	50	50	45						
	30000	95	75	65	55	45	40	40	35	35						
100	40000	85	70	60	50	40	40	35	30	30						
	60000	75	60	55	45	40	35	30	30	25						
	100000	65	50	45	40	30	30	25	25	25						

For Maximum Rpm See Table 1 On Page B5–14. In The Shaded Area E, DI & TAF Mounted Units Require Line-To-Line To Light Press Fit To Shaft.

SELECTION/DIMENSIONS E (metric) PAGE B5-61/B5-68	SELECTION/DIMENSIONS TYPE E (INCH) PAGE B5-12	SPECIFICATIONS PAGE B5-7	
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Type E – Metric

TABLE 10 – EASY SELECTION TABLE FOR TYPE E, DOUBLE ROW TAPERED ROLLER BEAR-INGS (METRIC) (CONT.)

SHAFT	L10	ALLOWABLE EQUIVALENT RADIAL LOAD RATING (KN) AT VARIOUS REVOLUTIONS PER MINI						MINUTE								
SIZE, MM	HRS.	50	100	150	250	500	750	1000	1250	1500	1750	2000	2500	2700	3000	3500
	10000	160	130	115	100	80	70	65	60							
110	30000	115	95	80	70	55	50	45	45							
115	40000	105	85	75	65	50	45	40	40							
	60000	95	75	65	55	45	40	35	35							
	100000	80	65	55	50	40	35	30	30							
	10000	220	180	155	135	110	95	90	85							
	30000	155	130	115	95	80	70	65	60							
125	40000	145	115	105	90	70	65	60	55							
	60000	130	105	90	80	65	55	50	50							
	100000	110	90	80	65	55	50	45	40							
	10000	250	205	180	155	125	110	100								
135	30000	180	145	130	110	90	80	75								
140	40000	165	135	120	100	85	75	65								
150	60000	145	120	105	90	75	65	60								
	100000	125	100	90	75	65	55	50								
	10000	430	345	305	265	215	190									
160	30000	305	250	220	190	155	135									
170	40000	280	230	205	175	140	125									
180	60000	250	205	180	155	125	110									
	100000	215	175	155	130	105	95									

For Maximum Rpm See Table 1 On Page B5–14. In The Shaded Area E, DI & TAF Mounted Units Require Line-To-Line To Light Press Fit To Shaft.

FEATURES/BENEFITS	HOW TO ORDER	NOMENCLATURE	SELECTION (metric)
PAGE B5-2	PAGE B5–8	PAGE B5-10	PAGE B5-61





Туре Е

LUBRICATION

DODGE Type E Metric Tapered Roller Bearings are lubricated at the factory with Shell Alvania #2 grease up to 125mm and with Mobilux #2 EP above 125mm. Shell Alvania #2 and Mobilux #2EP grease are superior industrial greases using a lithium hydroxystearate thickener and highly refined base oil. These greases will adequately handle low and medium speeds with low and medium loads at normal temperatures as defined on Table 13. For very low and high speeds, for heavy loads and for low and high temperatures, special greases must be used. Contact DODGE Application Engineering (864) 297-4800. DODGE engineers will recommend bearings and lubricants for the unusual conditions. DODGE also has the expertise to custom design and build special bearings for your needs.

High Speed Operation --- In the higher speed ranges too much grease will cause overheating. The amount of grease that the bearing will take for particular high speed application can only be determined by experience. If excess grease in the bearing caused overheating, it will be necessary to remove grease fitting (also drain plug when furnished) to permit excess grease to escape. When establishing a relubrication schedule, note that a small amount of grease at frequent intervals is preferable to a large amount at infrequent intervals.

Operation in Presence of Dust, Water or Corrosive

Vapors --- Under these conditions the bearing should contain as much grease as speed will permit, since a full bearing with consequent slight leakage is the best protection against entrance of foreign material. In the higher speed ranges too much grease will cause overheating --see "High Speed Operation". In the lower speed ranges, it is advisable to add extra grease to a new bearing before putting into operation. Bearings should be greased as often as necessary (daily if required) to maintain a slight leakage at the seals.

INSTALLATION AND MAINTENANCE

In nearly all applications good design practice requires two bearings supporting the shaft. In cases where three or more bearings are installed, unless precautions are taken to line the bearings up, both vertically and horizontally, it is possible to induce heavy loads. To ensure good alignment, mounting surfaces must be checked for flatness and must lie in the same plane. When tightening base bolts and cap bolts, each bolt should be alternately tightened in incremental torque values until full torque is achieved to prevent the angular shifting of the pillow block that occurs when one bolt is tightened to its full torque. Shimming may be required to minimize misalignment.

Hours	SUGGESTED LUBRICATION PERIOD IN WEEKS							
Run per Day	1 to 250 RPM	251 to 500 RPM	501 to 750 RPM	751 to 1000 RPM	1001 to 1500 RPM	1501 to 2000 RPM	2001 to 2500 RPM	2501 to 3000 RPM
8	12	12	10	7	5	4	3	2
16	12	7	5	4	2	2	2	1
24	10	5	3	2	1	1	1	1

TABLE 11 – RELUBRICATION SCHEDULE

FEATURES/BENEFITS	HOW TO ORDER	NOMENCLATURE	SELECTION (metric)
PAGE B5-2	PAGE B5–8	PAGE B5-10	PAGE B5-61





Type E – Metric



TABLE 12 – TYPE E HOUSING RATINGS, GRAY IRON

BORE SIZE	MAXIMUM HOUSING CAP LOADS, kN
ММ	P180
35	14
40	13
45, 50	23
55	16
60, 65	29
70, 75	31
80, 85, 90	70
100	72
110, 115	93
125	116
135, 140, 150	194
160, 170, 180	204

TABLE 13 - DEFINITION OF OPERATING CONDITIONS FOR TAPERED ROLLER BEARINGS

LOW SPEED	UP TO 20% OF MAX. RPM (TABLE 9)
MEDIUM SPEED	OVER 20% TO 80% OF MAX. RPM
HIGH SPEED	OVER 80% OF MAX. RPM
LIGHT LOAD	UP TO 30% OF C ₉₀ (TABLE 9)
NORMAL LOAD	OVER 30% TO 70% OF C ₉₀
HEAVY LOAD	OVER 70% OF C ₉₀
LOW TEMPERATURE	-75°C TO - 10°C
MEDIUM TEMPERATURE	ABOVE - 10°C TO 100°C
HIGH TEMPERATURE	ABOVE 100°C TO 150°C
VERY HIGH TEMPERATURE	ABOVE 150°C TO 230°C

SELECTION/DIMENSIONS	SELECTION/DIMENSIONS	
E (inch) PAGE B5–11/B5–22	TAF (inch) PAGE B5–11/B5–52	

SELECTION/ DIMENSIONS



Type E – Plummer Block – Metric

2 & 4 BOLT BASE



FEATURES/BENEFITS	SELECTION (metric)	EASY SELECTION (metric)	ENGINEERING/TECH (metric)
PAGE B5-2	PAGE B5–61	PAGE B5-64	PAGE B5-66





Type E – Plummer Block – Metric

TYPE E PLUMMER BLOCKS, 2-BOLT BASE

SHAFT SIZE (mm)	Α	В	с	D Min.	D Max.	F Bolts	G	н	J	L	Μ
35mm	76.2	187	54	142.8	149.2	M12	19	29	100	70	47.6
40mm	85.7	181	60	155.5	161.9	M12	19	32	112	81	54
45mm 50mm	88.9	22.5	64	174.6	181	M16	22	33	119	87	57.2
55mm	92.3	244	67	193.7	200	M16	22	38	130	95	63.5
60mm 65mm	101.6	267	73	212.7	219	M16	22	41	142	103	69.9
70mm 75mm	114.3	305	76	236.5	246	M20	27	48	161	120	79.4
80mm 85mm 90mm	127	356	89	274.6	284.2	M24	30	57	191	140	95.3

TYPE E PLUMMER BLOCKS, 4-BOLT BASE

SHAFT SIZE (mm)	Α	в	с	D Min.	D Max.	E	F Bolts	G	н	J	L	М
100mm	158.8	387	114	311.2	323.9	57.2	M20	28	62	216	156	108
110mm 115mm	171.5	422	117	336.6	349.3	63.5	M20	28	70	238	164	120.7
125mm	184.2	470	130	387.4	400	73	M24	32	76	276	189	139.7
135mm 140mm 150mm	228.6	559	159	441.3	485.8	95.3	M24	51	83	335	238	169.9
160mm 170mm 180mm	266.7	660	181	539.8	590.6	117.5	M24	51	94	379	289	190.5

TYPE E PLUMMER BLOCKS, 2-BOLT

SHAFT SIZE (mm)	PART NUMBER	PART NAME	WEIGHT LBS. (APPROX.)
35mm	023620	P2B-E-035MR	7
40mm	023621	P2B-E-040MR	10
45mm	023622	P2B-E-045MR	12
50mm	023623	P2B-E-050MR	12
55mm	023624	P2B-E-055MR	15
60mm	023625	P2B-E-060MR	20
65mm	023626	P2B-E-065MR	20
70mm	023627	P2B-E-070MR	29
75mm	023628	P2B-E-075MR	27
80mm	023629	P2B-E-080MR	49
85mm	023630	P2B-E-085MR	47
90mm	023631	P2B-E-090MR	45

TYPE E PLUMMER BLOCKS, 4-BOLT

SHAFT SIZE (mm)	PART NUMBER	PART NAME	WEIGHT LBS. (APPROX.)
100mm	023632	P4B-E-100MR	69
110mm	023633	P4B-E-110MR	85
115mm	023634	P4B-E-115MR	91
125mm	023635	P4B-E-125MR	136
135mm	023636	P4B-E-135MR	245
140mm	023637	P4B-E-140MR	240
150mm	023638	P4B-E-150MR	235
160mm	023639	P4B-E-160MR	355
170mm	023640	P4B-E-170MR	345
180mm	023641	P4B-E-180MR	345

FEATURES/BENEFITS	SELECTION (metric)	EASY SELECTION (metric)	ENGINEERING/TECH (metric)
PAGE B5-2	PAGE B5–61	PAGE B5–64	PAGE B5-66





		Issued Date	3/23/2020		Transmit #		
ΤΥΡΙ					ISSUED REV		
	FL RPM	Frame	Voltage	Hz	Phase	FL Amps	
	1760	215T	575	60	3	10.2	
s	S.F.	Duty	NEMA Nom. Eff.	NEMA Design	kVA Code	Ambient (°C)	
	1.15	CONT	91.7	В	Н	40 C	
	Ampe	eres	Efficiency	(%)	Power Fa	ctor (%)	
	10.	1	91.4		80.4		
	8.0)	90.9		76.	5	

Model: 0104SDSC41A-P

HP	kW	Pole	FL RPM	Frame	Voltage	Hz	Phase	FL Amps
10	7.5	4	1760	215T	575	60	3	10.2
Enclosure	IP	Ins. Class	S.F.	Duty	NEMA Nom. Eff.	NEMA Design	kVA Code	Ambient (°C)
TEFC	55	F	1.15	CONT	91.7	В	Н	40 C
						1		
Load	HP	kW	Ampe	eres	Efficiency	/ (%)	Power Fa	actor (%)
Full Load	10	7.5	10.	.1	91.4		80	.4
¾ Load	7.50	5.6	8.0	0	90.9		76	.5
1/2 Load	5.00	3.7	6.2	2	88.8		67	.5
¼ Load	2.50	1.9	4.9	9	81.6		46	.7
No Load			4.5	5			6.	1
Locked Rotor			62	1			45	.6
			Torque	9				Rotor wk ²
Full La	oad	Locke	d Rotor	- Pi	ıll Up	Brea	ak Down	Inertia
(lb-f	t)	(%	FLT)	(%	FLT)	(9	6 FLT)	(lb-ft ²)
29.8		(,0	60	()0	225	()	330	1.34
Safe Stall	Time(s)	Sound						
Cold	Hot	Pressure	Bearings*		Approx. Mc	otor Weight		
25	45				ui)	- 3 /		
35	15	-	630922	203	6309220	3	203	
Motor Options: Product Family:EQP GI Mounting:Footed,Shaft:	obal SD T Shaft	, par((5).						
Customer								
Customer PO								
Sales Order								
Project #								
Tag:								
All characteristics are av	verage expected val	ues.						
		TOSHIBA INTE	RNATIONAL CO	RPORATION ·	HOUSTON, TEX	AS U.S.A.		
Engineering	BMa	mmen		Doc. Written By	D. Suarez		Doc.# / Rev	MPCF-1119 / 0
Engr. Date	11/18	8/2019		Doc. Approved By	M. Campt	bell	Doc. Issued	6/8/2011



HP

10

Enclosure TEFC

Locked Rotor

Amps

64

400

320

(%) anbio 160

80

망

Model: 0104SDSC41A-P

kW

7.5 IP

55 Rotor wk²

Inertia

(lb-ft²)

1.34

		Issued By	dschoed	k	Issued Rev	
		issued by				
S	PEED TORQ	UE/CURREN [®]	T CURVE			
Pole	FL RPM	Frame	Voltage	Hz	Phase	FL Amps
4 Is. Class	1760 S.F.	215T Duty	575 NEMA	60 NEMA	3 kVA Code	10.2 Ambient
F	1 15	CONT	91 7	Design	Н	(°C)
I	1.10	CONT	Torque	В		40.0
ull Load (lb-ft)	Locked (%	Rotor)	Pull U (%)	р	Break I (%	Down)
29.8	260)	225		330)
-			\times		4	20 Cur
					23	ent (%)
		_				40

Synchronous Speed (%)

Torque Current

Customer		wk ² Load Inertia (lb-ft ²)	-
Customer PO		Load Type	-
Sales Order		Voltage (%)	100
Project #		Accel. Time	-

Tag:

All characteristics are average expected values.

	TOSHIBA INTERNATIONAL CORPORATION · HOUSTON, TEXAS U.S.A.									
Engineering	BMammen	Doc. Written By	D. Suarez	Doc.#/Rev	MPCF-1121 / 0					
Engr. Date	11/18/2019	Doc. Approved By	M. Campbell	Doc. Issued	6/8/2011					





Certificate of Compliance

Certificate: 2637147 (262373)

Project: 70038180

Master Contract: 153942

Date Issued: 2015-09-17

Issued to: Toshiba International Corporation 13131 West Little York Rd. Houston, Texas 77041 USA Attention: Matthew Fisher

The products listed below are eligible to bear the CSA Mark shown



Issued by:

Domeníc Somma D. Somma, C.E.T.

PRODUCTS

CLASS - C422801 - MOTORS AND GENERATORS-For Hazardous Locations

For details related to rating, size, configuration, etc. reference should be made to the CSA Certification Record or the descriptive report.

PART A - CLASS I DIVISION 2: SINUSOIDAL

Class I, Division 2 - Groups A, B, C, and D:

Three Phase Motors Squirrel Cage Induction; Random Wound; 600V maximum; 50 or 60 Hz; 2, 4, 6, or 8 Pole; Class F or H; 40 C ambient max.; non-protected; Type IKH, IKKH, IK, IKK, TKKH, TIKH, TIKK, or TIK; Form ending in a '1'; up to 1.15 S.F. Sinusoidal as follows:

Max HP	Enclosure	Frames (NEMA)	Space Heaters	T-Code (1.0 S.F.)	T-Code (1.15 S.F.)
25	ODPG	140 - 250	Х	T3C	T3
5	ODP	140 - 180	Х	T4A	T4A
100	ODP	210 - 400	Х	T3C	Т3
201	ODP	210 - 400		T3C	Т3

Open Motors (ODPG/ODP/DP)



Master Contract: 153942 Date Issued: 2015-09-17

500	ODP	440 - 500/5000	Х	Т3	Т3
800	ODP	440 - 500/5000		T2C	T2C
800	ODP	580/5800	Х	T3	T3

Totally Enclosed Motors (TEBC/TEFC/TEAO/TENV)

Max HP	Enclosure	Frames (NEMA)	Space Heaters	T-Code (1.0 S.F.)	T-Code (1.15 S.F.)
5	TEFC/TEAO/TEBC	140 - 180	Х	T4A	T4A
100	TEFC/TEAO/TEBC	210 - 400	Х	T3C	T3
200	TEFC/TEAO/TEBC	440	Х	T3C	T3
350	TEFC/TEAO/TEBC	440	Х	T3	T2D
500	TEFC/TEAO/TEBC	500/5000	Х	T3	T3
800	TEFC/TEAO/TEBC	580/5800	Х	T3	T3
200	TENV	140 - 5800	Х	T3	T3

<u>Note</u>: Motors may be marked for a higher maximum surface temperature as needed to satisfy customer requirements.

Additional applicable coverage notes are shown under Part C.

PART B – CLASS I DIVISION 2: INVERTER DUTY

Class I, Division 2 - Groups A, B, C, and D:

Three Phase Motors Squirrel Cage Induction; Random Wound; 600V maximum; 50 or 60 Hz; 2, 4, 6, or 8 Pole; Class F or H; 40 C ambient max.; non-protected; Type IKH, IKKH, IK, IKK, TKKH, TIKH, TIKK, or TIK; Form ending in a '1'; up to 1.0 S.F. Inverter Duty as follows:

		Framos	Space Heaters		Inve	Inverter Duty - 1.0 S.F.		
Max HP	Enclosure	(NEMA)		T-Code	Variable Torque	Constant Torque	Constant HP	
25	ODPG	140 - 250	Х	Т3	1 – 60 Hz	6 – 60 Hz	60 - 90 Hz	
5	ODP	140 - 180	Х	T3A	1-60 Hz	6-60 Hz	60 - 90 Hz	
100	ODP	210 - 400	Х	T3A	1-60 Hz	30-60 Hz	60 - 90 Hz	
150	ODP	210 - 400		T3A	$1-60 \ Hz$	30-60 Hz	60-90 Hz	
500	ODP	440 - 500/5000	Х	T3	$1-60 \mathrm{Hz}$	30-60 Hz	60-90 Hz	
650	ODP	440 - 500/5000		T3	1-60 Hz	30-60 Hz	60 – 90 Hz	
800	ODP	580/5800	Х	T3	1-60 Hz	30-60 Hz	60 – 90 Hz	
Totally Enclosed Motors (TEFC/TEBC/TEAO/TENV)								
Max HP	Enclosure	Frames	Snace	T-Code	Inver	ter Duty - 1.0	SE	

Open Motors (ODPG/ODP/DP)



Certificate: 2637147 **Project:** 70038180

Master Contract: 153942 Date Issued: 2015-09-17

		(NEMA)	Heaters		Variable	Constant	Constant
					Torque	Torque	HP
5	TEFC/TEAO/TEBC	140 - 180	Х	T4	$1-60 \ Hz$	$6-60 \mathrm{Hz}$	$60-90 \ Hz$
100	TEFC/TEAO/TEBC	210 - 400	Х	T3	$1-60 \ Hz$	$6-60 \ Hz$	$60-90 \ Hz$
350	TEFC/TEAO/TEBC	440	Х	T3	$1-60 \ Hz$	$6-60 \mathrm{Hz}$	$60-90 \ Hz$
400	TEFC/TEAO/TEBC	500/5000	Х	T2D	$1-60 \ Hz$	$6-60 \mathrm{Hz}$	$60-90 \ Hz$
500		500/5000	v	T2C	$1-60 \ Hz$	$20-60 \ Hz$	$60-90 \mathrm{Hz}$
500	TEFC/TEAO/TEBC	300/3000	Λ	T3	$1-60 \ Hz$		$60-90 \ Hz$
600	TEFC/TEAO/TEBC	580/5800	Х	T2C	$1-60 \ Hz$	$6-60 \mathrm{Hz}$	$60-90 \mathrm{Hz}$
800	TEFC/TEAO/TEBC	580/5800	Х	T3B	1-60 Hz	20-60 Hz	60 – 90 Hz
200	TENV	140 - 5800	Х	T3	1-60 Hz	6-60 Hz	60 – 90 Hz

<u>Note</u>: Motors may be marked for a higher maximum surface temperature as needed to satisfy customer requirements.

Additional applicable coverage notes are shown under Part C.

PART C – CLASS II & III DIVISION 2

Class II, Division 2 - Groups F and G; Class III Division 2:

Three Phase Squirrel Cage Induction Motors; Random Wound; 600V maximum; 50 or 60 Hz; 2, 4, 6, or 8 Pole; Class F or H; non-protected; Type TIKH; Form beginning in an 'E' or 'F' and ending in a '1'; up to 1.15 S.F. Sinusoidal and 1.0 Inverter Duty as follows:

Max	Fnelosure	Frames	T Code	Inv	verter Duty - 1.0 S.F.	
HP	Eliciosule	(NEMA)	1-Coue	Variable Torque	Constant Torque	Constant HP
200	TEFC/TEAO	440	T3B			

Notes:

Applicable to Parts A, B, and C

- I. (a) Single or multi-speed.
 - (b) Horizontal or vertical.
 - (c) Foot, footless, or flange mounted.
 - (d) Motors supplied without terminal boxes are Certified as components only of other Certified equipment where the suitability of the combination is determined by the Canadian Standards Association.
 - (e) The "H" in type designates Premium Efficiency Design. Construction remains unchanged.
 - (f) TEFC can include TEAO using construction without fans.



- (g) TEFC can include TENV using construction without fans. TENV are de-rated to maximum 200HP.
- (h) Maximum horsepower coverage of motors listed in the tables above may be increased by a factor of 1.15 for <u>sine wave</u> only, so long as the nameplate marking for sine wave shows 1.0 S.F. or less (e.g. 800 HP TEFC motor may be rated for 920 HP sine wave as long as the NP S.F. rating shows as 1.0 only and not 1.15).
- (i) All space heaters may be marked with the same T-Codes as the motor. The manufacturer is not required to mark the T-Code at 80% of the auto ignition temperature since representative samples have already been tested at the T-Codes listed in the tables.
- (j) Includes option to use the equivalent Zone system markings as covered under the Markings section below.
- (k) An 'X' symbol denotes an approved coverage while a '----' denotes that no coverage is approved.
- (1) Any totally enclosed derivative may be equipped with a blower external to the stator frame to increase cooling airflow over the motor. No temperature code change is required.
- (m) Higher ambients (up to a maximum of 60°C) are allowed as long as the manufacturer ensures the motor winding rise meets the new winding temperature limits using adjustment formulas from NEMA MG-1 and winding adjustment equations covered under the Annexes of the CSA Expansion Project. Motors must also be marked with a higher T-Code than listed in the tables above with adjustments following the example below:

Example: 800 HP TEFC at 1.15 S.F. entering an environment with a 50°C ambient Current Approval: T3 (200°C) $200^{\circ}C + (50^{\circ}C - 40^{\circ}C) = 210^{\circ}C$

[(Current T-Code Approval) + (New Ambient – Std. Ambient) = New Temperature] The New Temperature then needs to be rounded up to the next highest temperature code and you get your final temperature code. In this scenario, 210° C is bumped up to T2D (215° C). The TEFC in this example would then be good to mark for a T2D (215° C) environment.

 (n) The Inverter Duty coverage as shown in the tables above are equivalent and may be substituted with the following verbiage on the NP as follows (these ratios may be used for 50 Hz applications as well):

Example: 10:1 for 50 Hz Base would be equivalent to 5 - 50 Hz.



- (o) For sine wave applications, motors may be marked with a higher service factor than shown in the sections above as long as the product of the nameplate HP and service factor do not exceed the product of the maximum HP and service factor as displayed in the coverage charts above.
- II. Motors supplied with accessories shall be certified and suitable for the hazardous location area classification.
- III. Enclosure Types

ODPG - Open Drip Proof Guarded ODP - Open Drip Proof TEFC - Totally Enclosed Fan Cooled TEAO - Totally Enclosed Air Over TENV - Totally Enclosed Non-Ventilated TEBC – Totally Enclosed Blower-Cooled

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APPLICABLE REQUIREMENTS

CAN/CSA-C22.2 No. 0-10	-	General Requirements
CAN/CSA-C22.2 No. 25-1966	-	Enclosures for Use in Class II, Groups E, F and G Hazardous
Locations (Guidance)		
CAN/CSA-C22.2 No. 145-M1986	-	Motors and Generators for Use in Hazardous Locations
(Guidance)		
CAN/CSA-C22.2 No100-14	-	Motors and Generators
CAN/CSA-C22.2 No CAN3-C235-1983	-	Preferred Voltage Levels for AC Systems 0 to 50,000V
CAN/CSA-C22.1-12	-	Canadian Electrical Code Part I

MARKINGS

III. MARKINGS

The manufacturer is required to apply the following markings:

- Products shall be marked with the markings specified by the particular product standard.
- Products certified for Canada shall have all Caution and Warning markings in both English and French.

Additional bilingual markings not covered by the product standard(s) may be required by the Authorities Having Jurisdiction. It is the responsibility of the manufacturer to provide and apply these additional markings, where applicable, in accordance with the requirements of those authorities.

The products listed are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US (indicating that products have been manufactured to the requirements of both Canadian and U.S. Standards) or with adjacent indicator 'US' for US only or without either indicator for Canada only.



The following markings shall be permanently marked on a metal nameplate(s) or on a certified adhesive label(s) (Refer to Figs 1 and 2 [Figures 1 & 2 are no longer required for display of Hazardous Location markings. All Hazardous Location designations may now instead be made on the main motor NP]):

- Manufacturer's name or trademark;
- Motor type designation;
- Hazardous locations designation (May optionally marked with the addition of Zone markings (i.e. Class I, Zone 2, Groups IIC, IIB and IIA;
- Complete electrical ratings: e.g.: Voltage, Horsepower, Current, Freq., RPM, Insulation Class, No. of Phase(s)/Service Factor if greater than 1.0;
- Maximum Ambient Temperature;
- Maximum Operating Temperature or Temp. Code;
- Enclosure type (eg: ODP, TEFC, WP etc.);
- Type of Temp. Limiting Device (if supplied) with Voltage Rating;
- "CAUTION TO REDUCE THE RISK OF FIRE OR EXPLOSION DO NOT INSTALL THIS MOTOR WHERE THE FOLLOWING OPERATING TEMPERATURE EXCEEDS THE IGNITION TEMPERATURE OF THE HAZARDOUS ATMOSPHERES" or equivalent with a French translation (may be marked in the Instruction Manual);
- Motors provided with a terminal box shall have the following cautionary verbiage:
 "CAUTION KEEP COVER TIGHT WHILE CIRCUIT ARE ALIVE" or equivalent and French translation (may be marked in the Instruction Manual);
- Motors provided with space heaters shall be provided with a separate nameplate with the following markings:
 - i. Max surface temp. at service ambient.
 - ii. Volts, Hz, phase, watts and wiring diagram of heater leads.
 - iii. The word "Heater".
- Serial No. or Date Code;
- CSA Mark
- In addition to the marking above, inverter-duty machines shall be permanently marked with the following:
- (a) Machine Application (e.g. 'Inverter Duty' or equivalent);
- (b) Speed range over which the machine is designed to operate;
- (c) Type(s) of torque application for which the machine is designed e.g. Variable Torque (VT) 10:1,

Constant Torque (CT) 2:1, or equivalent;

- (d) type(s) of inverter with which the machine is intended to be used: VPWM, VSI or CSI
- (e) Abbreviations may be used as necessary (examples shown above).
- (g) For Sine Wave applications "Motors may be marked with a higher service factor than shown above as long as the product of the nameplate Horse Power and service factor do not exceed the product of the maximum Horse Power and service factor displayed in the coverage charts above"



Supplement to Certificate of Compliance

Certificate: 2637147 (262373)

Master Contract: 153942

The products listed, including the latest revision described below, are eligible to be marked in accordance with the referenced Certificate.

		Troduct Certification History
Project	Date	Description
70038180	2015-09-17	Update existing report 2637147 (LR39610-11)
70032112	2015-07-23	To cover the addition of modification shops to the report.
2637147	2014-09-09	Update to Report LR39610-11 to cover Inverter duty Frames 184/405/5011/L449/5811 (Remove all Form Wound motors to separate report)

Product Certification History

TOSHIBA A Quality Product

for World Energy

INSTRUCTIONS: Installation and Maintenance For 50 & 60 Hertz Motors

Toshiba World Energy Motors Polyphase motors

- Frames 143T through 507UZ
 Dripproof
- Frames 143T through N587UZ
 Totally-Enclosed Fan-Cooled
- Frames 143T through 447TZ Explosion- Proof.

STORAGE

- Store motor in a clean, dry and cover completely with (Leave opening for ventilation)
- (2) Motor must be thoroughly dry before applying power.
- (3) Every six months, give winding a megger test. A minimum of 10 megohms are recommended.
- (4) Also, every six months, rotate shaft and add grease as needed



ODP Frames 143T-256T



TEFC Frames 143T-256T





ODP Frames 404T-507UZ



TEFC Frames 444T-N587UZ



XP Frames 404T-447TZ

shaft and add grease as needed. XP Frames 143T-256T READ CAREFULLY BEFORE INSTALLING AND STARTING RECEIVING"

- (1) Check nameplate
- (2) Check whether any damage has occurred during transportation. (Motors are normally shipped F.O.B. factory. Freight claims must be submitted by the consignee to the carrier.)
- (3) When supplied -Be sure to remove bearing lock plate before start-up.
- (4) Turn shaft by hand to check that it turns freely.

LOCATION

- (1) All motors should be located in an area where ventilation is not restricted and affects the operation of the motor.
- (2) Dripproof Motors are designed for installation in a well ventilated place where the atmosphere is reasonably free of dirt and moisture.
- (3) Totally enclosed motors may be installed where dirt, moisture (not running water) and corrosion are present, or in outdoor locations.
- (4) Explosion Proof motors are designed and built for hazardous duty.
- Listed by U L for Class 1, Group D; and Class 11, Groups E, F and G. Also listed by C S A.

MOUNTING

- (1) Mount motor securely on a firm, flat base. All ball and roller bearing normal thrust motors may be mounted in any position.
- (2) Align motor accurately, using a flexible coupling if possible. For drive recommendations consult with drive or equipment manufacturer, or Toshiba. See additional information on pages 3 and 4.
- (3) V-belt Sheave Pitch Diameters should not be less than the following Table 1, values (NEMA recommended values).
- (4) Tighten belts only enough to prevent slippage. Belt speed should not exceed 5000 ft. per min.
- (5) Motors must not be subjected to vibration exceeding 0.5 G force.
- (Motors should not be mounted to shaker screens)

POWER SUPPLY & CONNECTIONS

- (1) Nameplate voltage and frequency should agree with power supply. Motor will operate satisfactorily on line voltage within 10% of nameplate value; or frequency within 5%; combined ariation not to exceed 10%. 230 Volt motors can be used on 208-volt network systems, but with slightly modified performance characteristics.
- (2) Dual voltage and single voltage motors can be connected for the desired voltage by following connection diagram shown on nameplate. Alternate starting connections are shown in the conduit box or connection diagrams on pages 5 and 6.
- (3) Explosion Proof motors have Temperature Limiting Devices in the motor enclosure to prevent excessive external surface temperature of the motor in accordance with U L standards. Terminals of thermal protectors (P1, P2) should be connected to the motor control equipment.
- (4) Wiring of motor and control, overload protection and grounding should be in accordance with National Electrical Code and local building codes.
- (5) Disconnect motor from power supply before opening conduit box or working on motor.
- (6) Megger test before energizing. A minimum of 10 megohms are recommended.

					V-belt Sheave (inches)			
		Horsepower at		Conve	entional	Nai Nai	row	
Frame No.		Speed Range		A, B, C, D and E		3V, 5V and 8V		
	2 Pole	4 Pole	6 Pole	Min. Pitch Diameter	Max Width*	Min. Outside Diameter	Max Width**	
143T	1 ¹ / ₂	1	³ / ₄	2.2	4.250	2.2	2.250	
145	2-3	1 ¹ / ₂ - 2	1	2.4	4.250	2.4	2.250	
182T	3	3	1 ¹ / ₂	2.4	5.250	2.4	2.750	
182T	5	-	-	2.6	5.250	2.4	2.750	
184T	-	-	2	2.4	5.250	2.4	2.750	
184T	5	-	_	2.6	5.250	2.4	2.750	
184T	7 ¹ / ₂	5	Ι	3.0	5.250	3.0	2.750	
213T	7 ¹ / ₂ - 10	7 ¹ / ₂	3	3.0	6.500	3.0	3.750	
215T	10	-	5	3.0	6.500	3.0	3.750	
215T	15	10	-	3.8	6.500	3.8	3.750	
254T	15	-	$7^{1}/_{2}$	3.8	7.750	3.8	4.000	
254T	20	15	Ι	4.4	7.750	4.4	4.000	
256T	20 - 25	-	10	4.4	7.750	4.4	4.000	
256T	-	20	-	4.6	7.750	4.4	4.000	
284T	-	-	15	4.6	9.000	4.4	4.250	
284T	-	25	-	5.0	9.000	4.4	4.250	
286T	-	30	20	5.4	9.000	5.2	4.250	
324T	-	40	25	6.0	10.250	6.0	5.250	
326T	-	50	30	6.8	10.250	6.8	5.250	
36 4 T	-	-	40	6.8	11.500	6.8	5.250	
364T	-	60	Ι	7.4	11.500	7.4	5.250	
365T	-	-	50	8.2	11.500	8.2	5.500	
365T	-	75	Ι	9.0	11.500	8.6	5.500	
404T	-	-	60	9.0	14.250	8.0	7.250	
404T	-	100	I	10.0	14.250	8.6	7.250	
405T	-	-	75	10.0	14.250	10.0	7.250	
405T	-	100	-	10.0	14.250	8.6	7.250	
405T	-	125		11.5	14.250	id.5	7.250	
444T	-	-	100	11.0	16.750	10.0	8.500	
444T	-	125	-	11.0	16.750	9.5	8.500	
444T	-	150	-	-	-	10.5	8.500	
445T	-	-	125	12.5	16.75.0	12.0	8.500	
445T	-	150	_	-	-	10.5	8.500	
445T		200	_	-	-	13.2	8.500	

Table 1. V-belt Sheave Pitch Diameters (MG 1 -14.42)

* Max sheave width - 2 (N-W)-1/4".

**Max. sheave width = N-W.

Sheave ratios greater than 8:1 and center-to-center distance less than the diameter of the large sheave should be referred to the company. Sheaves must be mounted close to the shaft shoulder.

Fig. 1SHAFT EXTENSION LOADS DUE TO TRANSMISSION OF POWER



Fig. 2SHAFT EXTENSION LOADS DUE TO TRANSMISSION OF POWER



ALIGNMENT PROCEDURES

MOTOR LEVELING & COUPLING ALIGNMENT

When the base has been adjusted, leveled, and grouted, the correct motor leveling and coupling alignment are obtained with the aid of shims between the motor and the base. To give the motor proper support, it is important that the base and shims extend under the motor.

RIGID COUPLING

Extreme care must be taken to obtain correct alignment when using rigid couplings. Circular concentric peripheral surfaces of the two coupling halves must indicate correct alignment within 0.0005 in. to 0.001 in. when the two coupling halves are rotated together. The separation between the faces of the two coupling halves must also be maintained within the same tolerance.

The alignment may be checked by utilizing a dial indicator as shown in Fig. 3 or with the aid of a straight-edge and thickness gauge or feelers as shown in Fig. 4.

The preferred method of checking alignment is with the dial indicator. Bolt the indicator to one of the coupling halves and indicate the position of the dial button on ihe opposite coupling half with a chalk mark. Set the indicator dial to zero at the first position and then rotate both halves of the coupling to a new position where a check reading is to be made. All readings must be made with the dial button located at the chalk mark, and not less than six different sets of readings should be taken. A variation in the dial reading at different positions of coupling rotation will indicate whether the machine has to be raised, lowered, or moved to one side or another to obtain alignment of the circular concentric peripheral surfaces of the two coupling halves within the specified tolerance.

In addition to the above check, a check of the separation of the coupling faces must be made to establish correct alignment. The separation between the faces of the coupling may be checked with a dial indicator fastened

to one coupling half and a reference surface fastened to the other coupling half. Mark the location of the dial button on the reference surface and make all readings with the indicator in this position. Set the dial of the indicator to zero for the first reading and use this as the reference. Be sure to rotate both halves of the coupling the same amount, aligning the button of the indicator and the mark on the reference surface for each of six readings. A variation of the readings at different positions will indicate how the machine has to be adjusted to obtain correct alignment. After each adjustment of the motor, repeat the above procedure to be certain that correct alignment and leveling have been obtained.

FLEXIBLE COUPLING

Units coupled through flexible couplings should be aligned as accurately as possible. As a suggested limit, the two halves should indicate correct alignment within 0.002 in. on both the circular concentric peripheral surfaces and the separation between faces. Although most flexible couplings will withstand greater misalignment than rigid couplings, extreme misalignment can cause vibration possibly resulting in failure of motor bearings and/or shaft.

If the method shown in Fig. 4 is used to check alignment of the machines, correct alignment exists -- if the peripheries of the coupling halves are true circles of the same diameter and if the faces are flat -- when the separation between the faces is held to within the specified tolerance at all points and a straight-edge lies squarely across the rims at any point. Non-parallel faces will be indicated by a variation in separation of the coupling halves as they are rotated, and a difference in height of the coupling halves will be indicated by the straight-edge and feeler gauge test.

When the coupling halves have been correctly aligned with the motor feet bolted in position, place temporary bolts in two coupling holes for clamping the halves together. Then, ream for a light drive fit through bolt halves for regular coupling bolts.





Fig. 3. The preferred method of measuring coupling alignment is with a dial indicator.

- A. Clamp the dial indicator to the coupling as indicated above to measure the circular concentric peripheral surfaces of the coupling halves for parallel alignment.
- B. Clamping a reference surface to the opposite coupling half allows the dial indicator to be used for measuring the separation of the coupling halves for axial alignment as shown below.



BALANCE (DIRECT COUPLED UNITS)

TOSHIBA motors are balanced at the factory to standard NEMA commercial tolerances. However, if direct coupling units have been disassembled in the field, an apparent unbalance may occur if the units are not reassembled with the shafts in the same **Fig. 4.** The straight-edge or thickness gauge or feeler gauge is an alternative method of measuring coupling adjustment.

- A. Use a straight-edge and thickness gauge or feeler gauge to check the alignment of the circular concentric peripheral surfaces of the coupling halves as shown above.
- B. The separation between the faces of the coupling halves can be measured as shown below.



Rigid Coupling tolerances 0.0005 in. to 0.001 in. Flexible Coupling tolerance: 0.0015 in.

relative position as they were originally. Should this occur, disconnect the coupling halves and rotate one shaft 900 with respect to the other shaft. Re-connect the coupling and run the unit.

If the unbalance has not disappeared, repeat the above procedure until it does.

CONNECTION DIAGRAMS

A. Wye-connected Dual Voltage (low/high voltage)

_(9 L(eads	s)	
POL	E	ODP	TEFC & EXP
2P		1 ½ HP-7 ½HP	1 1/2 HP-5HP
4P	·	1HP-5HP	1HP-5HP
6P		¾ HP-5HP	¾ HP-5HP
8P		¾ HP-5HP	³ / ₄ HP-5HP

A-1 Across the Line Starting

LOW VOLTAGE	HIGH VOLTAGE
T4 - T5 - T6	T4 T5 T6
T7 T8 T9	T7 T8 T9
T1 T2 T3	T1 T2 T3

B. Delta-connected Dual Voltage

(12 Leads)

• • •	,	
POLE	ODP	TEFC & EXP
2 P	10HP-250HP	7½HP-150HP
4 P	7½HP-200HP	7½HP-150HP
6 P	7½HP-125HP	7½HP-125HP
8 P	7½HP-100HP	7½HP-100HP

B-1 Across the Line Starting

LOW VOLTAGE			HIGH VOLTAGE		
T4	Tg	T6	T <u>4</u> T9 – T6		
T8	T5	T 7	T8 – T5 T7		
тіо	τiι	T12	T10 T11 T12		
T2	тз	τ <u>΄</u> 1	T2 T3 T1		
ر ا	. N	Ē			

B-2 575 Volt Connection (see Note 1)



B-3 Wye Start Delta Run



	Start	Run
M,	Close	Close
M ₂	Open	Close
S	Close	Open

B-4 Part Winding Starting (see Note 2)



Close

M₂ should be energized within 2 seconds after M, is energized.

NOTES:

Open

M,

- 230/460 Volt Motors can be used on 575 Volt network in accordance with B-2 connection.
- 2. 4 pole and 6 pole motors are satisfactory for Part Winding starting at low voltage.

C. Delta-connected Single Voltage (6 Leads)

POLE	ODP	TEFC & EXP
2 P	300HP-350HP	200HP-300HP
8 P	125HP-250HP	125HP-250HP

C-1 Across the Line Starting

T1 T6	T2 T4 	T3 ' T5
	LINE	

C-2 Wye Start Delta Run



	Start	Run
M,	Close	Close
M ₂	Open	Close
S	Close	Open

CONNECTION DIAGRAMS CONT.

D. Delta-connected Single Voltage

1	12	Leads)
		=0000

	==00000	
POLE	ODP	TEFC & EXP
2 P	400HP-600HP	
4 P	250HP-400HP	200HP-400HP
6 P	150HP-300HP	150HP-300HP

D-1 Across the Line Starting

TA	то	TE	
14	13		
T'8	T'S	τ̈́7	
ĩ	ĩ	1	
T10	T11	T12	
1	1	1	
T2	T3	T1	
	1	1	
	LINE	-	

D-2 Wye Start Delta Run



	Start	Run
Μ,	Close	Close
M ₂	Open	Close
S	Close	Open

D-3 Part Winding Starting (4 pole and 6 pole motors)



	Start	Run
Μ,	Close	Close
M₂	Ореп	Close

should be M₂ energized within 2 seconds after M, is energized.

E. Wye-connected 575 Volt Motors

- 1	3	Leads)	
	υ.	LCUUJI	

	Eduad,	
POLE	ODP	TEFC & EXP
2 P	1½HP-7½HP	1½HP-5HP
4 P	1HP-5HP	1HP-5HP
6 P	%HP-5HP	¾HP−5HP
8 P	¾HP-5HP	%HP-5HP

E-1 Across the Line Starting



F. Delta-connected 575 Volt Motors

POLE	ODP	TEFC & EXP
2 P	10HP-500HP	7½HP-300HP
4 P	7½HP-400HP	7½HP-400HP
6 P	7½HP-300HP	7½HP-300HP
8 P	7½HP-250HP	7%HP-250HP

F-1 Across the Line Starting

T 1	T2	Т3
T6	ו 14	і Т5
	1	~
	LINC	

F-2 Wye Start Delta Run

L1



		Start	Run
_ T1	Μ,	Close	Close
- T2	M ₂	Open	Close
_ T2	S	Close	Open
_ T4			
<u>ੇ</u> ⊺5			

G. Delta-connected 575 Volt Motors

(12 Leads)	
POLE	ODP
2 P	60 0 HP

G-1 Across the Line Starting

T4	T9	T6
т'8	тs	T 7
тіо	тіі	TI2
T2	13	
ΪĻ		1
	LINE	

G-2 Wye Start Delta Run



	Start	Run
Μ,	Close	Close
M ₂	Орел	Close
S	Close	Open

WARNINGS

Motors built F-1 Assembly will be standard counter clockwise rotation facing non drive end of motor. Motors built F-2 Assembly will have clockwise rotation facing non drive end of motor. With the exception of low voltage TEFC 400T through N587UZ Frame motors, whose rotation will remain counter clockwise.

WARNING

BEFORE STARTING MOTOR, REMOVE ALL UNUSED SHAFT KEYS AND LOOSE ROTATING PARTS TO PREVENT THEM FROM FLYING OFF.

CAUTION: Check direction of motor rotation before coupling motor to load.

WARNING

ROTATING PARTS, SUCH AS COUPLINGS, PULLEYS, EXTERNAL FANS, AND UNUSED SHAFT EXTENSIONS, SHOULD BE PERMA-NENTLY GUARDED AGAINST ACCIDENTAL CONTACT WITH HANDS OR CLOTHING. THIS IS PARTICULARLY IMPORTANT WHERE THE PARTS HAVE SURFACE IRREGULARITIES SUCH AS KEYS, KEYWAYS OR SET SCREWS.

WARNING

WHEN A LIFTING MEANS IS PROVIDED FOR HANDLING THE MOTOR OR GEN-ERATOR, IT SHOULD <u>NOT</u> BE USED TO LIFT THE MOTOR OR GENERATOR PLUS ADDITIONAL EQUIPMENT SUCH AS GEARS, PUMPS, COMPRESSORS, OR OTHER DRIVEN EQUIPMENT.

THE FRAMES AND OTHER METAL EXTERIORS OF MOTORS AND GENERATORS (EXCEPT FOR INSULATED PEDESTAL BEARINGS) USUALLY SHOULD BE GROUNDED TO LIMIT THEIR POTENTIAL TO GROUND IN THE EVENT OF ACCIDENTAL CONNECTION OR CONTACT BETWEEN LIVE ELECTRICAL PARTS AND THE METAL EXTERIORS.

WARNING

WHEN CAREFUL CONSIDERATION OF THE HA-ZARDS INVOLVED IN A PARTICULAR APPLICA-TION INDICATE THE MACHINE FRAMES SHOULD NOT BE GROUNDED OR WHEN UNUSUAL OPERATING CONDITIONS DICTATE THAT A GROUNDED FRAME CANNOT BE USED, THE INSTALLER SHOULD MAKE SURE THE MACHINE IS PERMANENTLY AND EFFECTIVELY INSULATED FROM GROUND. IN THOSE INSTALLATIONS WHERE THE MACHINE FRAME IS INSULATED FROM GROUND, IT IS RECOMMENDED THAT APPROPRIATE WARNING LABELS OR SIGNS BE PLACED ON OR IN THE AREA OF THE EQUIPMENT BY THE INSTALLER.

WARNING FOR EXPLOSION-PROOF MOTOR

Disconnect power before working on motor driven equipment. This motor is equipped with an automatic temperature-limiting device. The National Electrical Code and Underwriter's Laboratories require connection of leads P1 and P2 into the control circuit of a manual reset starter per following diagram.

KLIXON TYPE	AC VOLT	VOLT AMP RATING
9700K	120-600V	720 VA



MAINTENANCE

1 INSPECTION

Inspect motor at regular intervals. Keep motor clean and vent openings clear.

2. LUBRICATION

- Frames 143T thru 256T are furnished with double sealed or shielded ball bearings, prelubricated prior to installation. Grease fittings are not supplied and bearings are designed for average 100,000 hours operation under standard conditions. (See table 2 below.) a)
- Frames 284T thru N587UZ are furnished with double shielded or open ball or roller bearings. (Depending on HP size and/or speed.) It is b) necessary to relubricate anti-friction bearing motors periodically. (See table 2 below.) These motors are supplied with provision for greasing and have been lubricated prior to test, however before start-up it is recommended to apply approximately 30 grams (1 oz.) of grease because of possible settling of grease during storage and handling. However, oil leakage around bearing caps indicate overpacking and excess grease should be purged out by operating motor temporarily with relief open.

Table 2. Frequency	of Relubrication
--------------------	------------------

Speed Range	Frame Range	Standard Duty	Severe Duty
1200	143T-256T	*5 Years	* 3 Years
2 Pole	284TS-286TS	12 Mos.	4 Mos.
	324TS- N587USS	9 Mos.	3 Mos.
4 Pole	143T-256T	*7 Years	* 3 Years
	284T-326T	4 Years	1.5 Years
	364T-365T	2.5 Years	10 Mos.
	404T-447TZ	2 Years	8 Mos.
	505US-N587UZ	1.5 Years	6 Mos.
6 Pole & Slower	143T-256T	*7 Years	3 Years
	284T-326T	4 Years	1.5 Years
	364T-447TZ	3 Years	1 Year
	505US-N587UZ	2 Years	8 Mos.

* The above table shows typical regreasing schedules to be used unless otherwise specified by the motors grease nameplate.

INSTRUCTIONS FOR LUBRICATING 3.

Toshiba motors (284T-N587UZ) are furnished with grease fittings. Before greasing, be sure fittings are clean and free from dirt. Remove grease relief plug or plate and using a low pressure grease gun, pump in the required grease. Do not overgrease. Relubrication intervals are specified in Table 2 above. After relubricating, allow motor to run for 10 minutes before replacing relief hardware.

4. RECOMMENDED GREASES FOR STANDARD APPLICATIONS

Use the following greases listed for the given temperature range, unless otherwise shown by the motors grease nameplate.

5. RECOMMENDED GREASES FOR SPECIAL APPLICATIONS

The following greases are recommended for special applications only and should be used only for motors specifically built for such conditions.

MIN. AMBIENT TEMP. -60°C BEACON 325 EXXON CORP.

MAX. AMBIENT TEMP. 90°C **DOW CORNING 44** DOW CORNING CORP. EXXON LINIREX S2 EXXON CORP

SHELL DOLIUM R SHELL OIL CO WARNING: In general it is not recommended to mix greases of different brands.

The mixing of different types of thickeners may destroy the composition and physical properties of the grease. In the event that a different grease is required by the end user, the following steps can be taken. Using the instructions for lubrication, open grease outlet and purge the system as much as possible of the old or unwanted grease. Repeat this same operation after 1 week of TOSHIBA/HOUSTON service. Consult Engineering for further recommendations on grease compatibility.

WARRANTY

Generally, TOSHIBA will correct at it's option, by repair or replacement (f.o.b. a TOSHIBA-AUTHORIZED SERVICE SHOP), any defect in material and workmanship when properly used for a period of one year after installation or 18 months after shipment, whichever comes first. TOSHIBA is not responsible for apparatus returned without proper authorization and identification, improper handling or storage, misapplication of the motor or the driven equipment, defects in the driven equipment or device, or improper circuit protection. The amount of liability shall not exceed the purchase price of the product. In no event shall TOSHIBA have any liability for commercial loss, claims for labor, removal and installation charges or consequential damages of any type. It is expressly agreed that Buyer's remedies expressed in this paragraph are Buyer's exclusive remedies.

RENEWAL PARTS

- Use only genuine TOSHIBA renewal parts. 1.
- When ordering, specify complete information (at least Model Number and Serial Number) of the motor. Specify quantity and describe 2. part.
- For information and service refer to the nearest TOSHIBA INTERNATIONAL CORPORATION office. 3

WARNING

EXPLOSION-PROOF MOTORS are constructed to comply with the UL Label Service Procedure Manual. Repairs of EXPLOSION PROOF MOTORS must be made by the manufacturer or U L listed service center to maintain the U L Listing.

FOR FURTHER INFORMATION CONTACT TOSHIBA INTERNATIONAL CORPORATION Industrial Equipment Division 13131 W. LITTLE YORK RD., P.O. BOX 40906, HOUSTON, TEXAS 77041

SERVICE CONDITIONS

CHEVRON SRI CHEVRON

EXXON UNIREX #2

EXXON POLYREX

STANDARD DUTY	Eight hours per day, light to normal loading, clean condition free from dust.
SEVERE DUTY	Twenty-four hours per day, or light to normal shock loading vibration, exposure to dirt or dusty conditions. For very severe conditions where the motor is subject to high vibration or heavy shock loading and vibration use 1/3 of the value shown in the severe duty table.

Remarkit is recommended to change bearings after the time shown in Table 2.

OPERATING AMBIENT TEMP. -30*C to 50*C

EXXON CORP.

EXXON CORP.



BELT DRIVE

Preventive Maintenance + Safety

Safety, installation, storage, handling, and troubleshooting.

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Warning! Be Safe! Gates belt drive systems are very reliable when used safely and within Gates application recommendations. However, there are specific **USES THAT MUST BE AVOIDED** due to the risk of serious injury or death. These prohibited misuses include:

Primary In-Flight Aircraft Systems

Do not use Gates belts, pulleys or sprockets on aircraft, propeller or rotor drive systems or in-flight accessory drives. Gates belt drive systems are not intended for aircraft use.

Lift Systems

Do not use Gates belts, pulleys or sprockets in applications that depend solely upon the belt to raise/lower, support or sustain a mass without an independent safety backup system. For applications requiring special "Lift" or "Proof" type chains with minimum tensile strength or certified/test tensile strength requirements, be advised that because Gates belts have different drive design procedures from metal chains, the tensile strength of a belt when compared to the tensile strength of a chain should only be a part of the design process. Diligent analysis with the customer's participation should be sued when considering any such application.

Braking Systems

Do not use Gates belts, pulleys or sprockets in applications that depend solely upon the belt to slow or stop a mass, or to act as a brake without an independent safety backup system. Gates belt drive systems are not intended to function as a braking device in "emergency stop" systems.

DRIVE DESIGN SOFTWARE

Drive design software can be found at www.gates.com/drivedesign. This software assists designers in quickly selecting optimum drive solutions.



SOURCES OF DRIVE PROBLEMS

Improper Belt or Pulley Installation

- Rolling or prying on belts
- Misalignment
- Incorrect tension
- Improper handling of belts
- Mis-matched belts and/or pulley used
- Idler not taking tension up correctly
- Guard interference



- Sub-minimal diameters
- Under-designed drive
- Over-designed drive
- Excessive rim speed
- Incorrect belt type

Improper Belt Storage or Handling

- Temperature
- High Humidity
- Storing for too long
- Too near ozone generating equipment
- Exposed to sunlight

Environmental Factors

• Dust

- Dust
 Debris
- Water/humidity
- Oil/grease
- Heat/cold
- Rust

Improper Drive Maintenance

- No retensioning
- Not replacing worn sheave
- Not cleaning guards
- Not checking for weak bracketry & drive components
- Not checking alignment

Defective Drive Components

- Check for worn pulleys or sheaves
- Check for cracked or weakened bracketry
- Check for weak mounting brackets
- Check for worn belts
- Check for nonfunctioning idlers
- Check for damaged guards



PREVENTIVE MAINTENANCE

Why have a preventive maintenance program?

When compared to the constant lubrication problems associated with chain drives, or the mechanical problems and high costs associated with gear drives, belts are the most cost-effective, reliable means of power transmission.

However, optimum belt drive performance requires proper maintenance. The potential for long service life is built into every Gates belt. When coupled with a regularly scheduled maintenance program, belt drives will run relatively trouble-free for a long time.



Power should be shut off and controls locked before inspecting



Belt drive should have adequate guard



Carefully inspect all belts * **Note** - If belt looks bad, it probably is

Important to your business

An effective preventive maintenance program saves time and money. Inspecting and replacing belts and faulty drive components <u>before</u> they fail will reduce costly downtime and production delays.

What is a good belt maintenance program?

A comprehensive, effective program of preventive maintenance consists of several elements:

- Maintaining a safe working environment.
- Regularly scheduled belt drive inspections.
- Proper belt installation procedures.
- Belt drive performance evaluations.
- Belt product knowledge.
- Belt storage and handling.
- Troubleshooting.



SAFETY

Maintaining A Safe Working Environment

It is common sense to establish a safe working environment in and around belt drives. The following precautions will make belt drive inspection and maintenance easier and safer



Power should be shut off and controls locked before inspecting

Maintain Safe Access to Drives

Always maintain safe access to the belt drives. Keep area around drives free of clutter, debris and other obstructions. Floors should be clean and free of oil and debris to insure good footing and balance while working on machinery.



Don't clutter area around belt drive

Drive Guards

Always keep drives properly guarded. Every belt drive must be guarded when in operation. Guard must be designed and installed according to OSHA standards.



A properly guarded belt drive

A Properly Guarded Belt Drive

A properly designed guard has the following features:

- Completely encloses drive.
- Grills or vents for good ventilation.
- Accessible inspection door or panels.
- Can easily be removed and replaced if damaged.
- Where necessary, should protect the drive from weather, debris and damage.

Follow these precautions to make your preventive maintenance easier.

Wear Proper Clothing

Never wear loose or bulky clothes, such as neckties, exposed shirttails, loose sleeves or loose lab coats around belt drives. Remove jewelry and tie up or restrain long hair. Wear gloves while inspecting sheaves or sprockets to avoid being cut by nicks, burrs or sharply worn pulley edges. Wear safety glasses to avoid eye injuries. Don't be foolish! Wear proper clothing. Always wear proper personal protective equipment, including gloves, eye & ear protection, steel toe shoes, and a hard hat.



No loose or bulky clothing. This technician's bulky lab coat is a hazard near moving components



Simple Drive Inspection

Begin preventive maintenance with a periodic drive inspection as a normal part of your maintenance rounds. Look and listen for any unusual vibration or sound while observing the guarded drive in operation. A well designed and maintained drive will operate smoothly and quietly.

Inspect guard for looseness or damage. Keep it free of debris or dust and grime buildup on either the inside or the outside of the guard. Any accumulation of material on the guard acts as insulation and could cause drives to run hotter.

The effect of temperature on belt life is important. For example, an internal temperature increase of 18°F (or approximately 36°F rise in ambient drive temperature) may cut belt life in half. Beware of hot surfaces and the potential for injury.

Also look for oil or grease dripping from guard. This may indicate over-lubricated bearings. If this material gets on rubber belts, they may swell and become distorted, leading to early belt failure.

It's a good idea to check motor mounts for proper tightness. Check take-up slots or rails to see that they are clean and lightly lubricated.

How Often To Inspect

The following factors influence how often to inspect a drive.

- Critical nature of equipment
- Drive operating cycle
- Accessibility of equipment
- Drive operating speed
- Environmental factors
- Temperature extremes in environment

Experience with specific equipment is the best guide to how often to inspect belt drives. Drives operating at high speeds, heavy loads, frequent stop/start conditions and at temperature extremes or operating on critical equipment require frequent inspection.

When To Perform Preventive Maintenance

To help establish a preventive maintenance schedule, keep the following in mind.

Critical Drives

A quick visual and noise inspection may be needed every one to two weeks.

Normal Drives

With most drives, a quick visual and noise inspection can be performed once a month.

Complete Inspection

A drive shutdown for a thorough inspection of belts, sheaves or sprockets and other drive components may be required every three to six months.

Remember, a well-designed industrial belt drive is capable of operating for several years when properly maintained and used under normal conditions.

Follow the Preventive Maintenance Procedure on the following page when performing detailed maintenance during equipment shutdowns.



DRIVE SHUTDOWN & THOROUGH INSPECTION

Preventive Maintenance Check List

By following these steps, belt drives can be maintained efficiently and safely.

- Always turn off the power to the drive. Lock the control box and tag it with a warning sign "Down For Maintenance. Do Not Turn Power On."
 Make sure the power is turned off for the correct drive. Never have contact with a belt drive unless the system is tagged and locked out.
- 2. Test to make sure correct circuit has been turned off.
- **3.** Place all machine components in a safe (neutral) position. Make sure that moving components are locked down or are in a safe position. Make sure that fans cannot unexpectedly freewheel.
- **4.** Beware of pinch points. Keep hands and fingers clear, especially where belts enter sheaves and sprockets.
- **5.** Remove guard and inspect for damage. Check for signs of wear or rubbing against drive components. Clean and realign guard to prevent rubbing if necessary.
- 6. Inspect belt for wear or damage. Replace as needed.
- 7. Inspect sheaves or sprockets for wear and misalignment. Replace if worn.



Turn off power, lock controls and tag

- **8.** Inspect other drive components such as bearings, shafts, motor mounts and take-up rails.
- **9.** Inspect static conductive grounding system (if used) and replace components as needed.
- **10.** Check belt tension and adjust as needed.
- **11.** Recheck sheave or sprocket alignment.
- **12.** Reinstall belt guard.
- **13.** Turn power back on and restart drive. Look and listen for anything unusual.



DRIVE SHUTDOWN & THOROUGH INSPECTION

Preventive Maintenance Procedure

Once the power is off, locked and tagged, and the machine components are in safe positions, remove the guard and begin the inspection.

How to Inspect a Belt

Observing signs of unusual belt wear or damage will help troubleshoot possible drive problems.

Mark or note a point on the belt, or on one of the belts in a multiple V-belt drive. Wearing gloves, work around the belt(s), checking for cracks, frayed spots, cuts, or unusual wear patterns. Beware of pinch points. Keep hands and fingers clear, especially where belts enter sheaves and sprockets.



Begin by inspecting the belt

Check the belt for exposure to excessive heat. Excessive heat can come from a hot environment or from belt slip that generates heat. A typical maximum environmental temperature for a properly maintained V-belt is 160°F to 180°F. The maximum environmental temperature for a properly maintained synchronous belt is 185°F.

Rubber belts that are running hot, or running in a hot environment will harden and develop cracks from the bottom of the belt upwards.

Refer to the PROBLEM/SOLUTION SUMMARY TABLE for other symptoms.

Belts should be replaced if there are obvious signs of cracking, fraying, unusual wear or loss of teeth.

How to Check Alignment

While the drive is shut down, it is a good idea to check the sheaves or sprockets for proper alignment.

To check alignment, use a straight edge, string, or Gates EZ Align® laser alignment tool.





Using a straight edge to check alignment

Using a string to check alignment





Using EZ Align[®] laser



Using EZ Align[®] laser alignment tool, showing reflected laser on emitter



Using EZ Align[®] laser alignment tool showing laser line on target

If using a straight edge (or string), line the straight edge along the outside face of both sheaves or sprockets as shown in the photo. If the drive is properly aligned, the straight edge or string will contact each sheave or sprocket evenly. The straight edge or string (pulled tight) should touch the two outer edges of each sheave or pulley for a total of four points of contact. Misalignment of sprockets and shafts will show up as a gap between the outside face of the sheave or sprocket and the straight edge. Check for tilting or shaft misalignment by using a bubble level. For proper alignment, the bubble should be in the same position as measured on each shaft.



DRIVE SHUTDOWN & THOROUGH INSPECTION

If using the Gates EZ Align[®] laser alignment tool, follow the detailed instructions included with the tool. The EZ Align laser alignment tool makes it very quick and easy to check alignment of shafts, sheaves and sprockets. EZ Align is available with a red laser, or a green laser for outdoor or brighter environment use.





There are three possible causes and solutions of sheave or sprocket misalignment:

- 1. Angular Misalignment: The motor shafts and driven machine shafts are not parallel.
 - a. Correct alignment by adjusting the motor shaft into alignment with the driveN shaft.
- 2. Parallel Misalignment: Sheaves or sprockets are not properly located on the shafts.
 - a. Loosen and reposition one or both sheaves or sprockets until properly aligned.
- 3. Sheaves or sprockets are tilted on the shaft due to incorrect bushing installation.
 - a. Rotate drive by hand and look for excessive wobble. Beware of pinch points. Keep hands and fingers clear, especially where belts enter sheaves and sprockets. If wobble is observed, remove and reinstall sheave or sprocket. Follow the bushing installation procedures explained in the INSTALLATION section. Further check alignment by using one of the previously mentioned methods.

Misalignment on V-belt drives should be less than 1/2° or 1/10" per foot of center distance. Misalignment for synchronous, Polyflex®, or Micro-V® belts should be less than 1/4° or 1/16" per foot of center distance.

When a synchronous belt drive has been aligned (following the procedure discussed above in the "How to Check Alignment" section), do not continue to adjust alignment in an attempt to make the synchronous belt ride in the center of the sprocket's face width. Synchronous belts, while neutral tracking, will tend to ride in contact with a flange on one side of the sprockets. Synchronous belts on drives that are properly aligned will lightly contact the flanges. Synchronous belts on misaligned drives will ride hard against the flanges and generate additional noise. Attempting to adjust a synchronous belt drive's alignment to force the belt to ride in the center of the sprocket's face width will typically result in misalignment.

Guard Inspection

Check the guard for wear or possible damage. Don't overlook wear on the inside of the guard. Check for any areas that may be contacting the belt. Clean the guard to prevent it from becoming blocked and closed to ventilation. Clean off any grease or oil that may have spilled onto the guard from over-lubricated bearings.

Check Other Drive Components

It is always a good idea to examine bearings for proper lubrication. Check the motor base bolts and adjustment screws to make sure they are not loose. If loose, tighten to the recommended torque value. Make sure that adjustment screws are free of debris, dirt, or rust.

Check Belt Tension

Following the drive component inspection, the final step is to check belt tension. Rotate the drive two or three revolutions by hand and check the belt tension. If necessary, retension the belt and make a final alignment check.

If V-belts are undertensioned, they can slip. Slippage generates heat and will result in cracking and belt failure.

If synchronous belts are undertensioned, they can jump teeth or ratchet. Ratcheting will damage the belt and result in premature belt failure.

If belts are overtensioned, belt and bearing life can be reduced.

The proper way to check belt tension is to use a tension tester. Gates has a variety of tension testers, ranging from the simple spring scale type tester to the sophisticated Sonic Tension Meter.


DRIVE SHUTDOWN & THOROUGH INSPECTION

Measuring Belt Tension

The spring scale type tester measures how much force is required to deflect the belt a specified distance at the center of its span. This is the force deflection method of tensioning belts.

The Sonic Tension Meter measures the vibration of the belt span and instantly converts the vibration frequency into belt static tension. This is the span vibration method of tensioning belts.



For more information, refer to the Troubleshooting Tools section.

Force Deflection Tension Method

The force deflection tension method does not directly measure belt span tension or static tension. The deflection force is a calculated value that is based on the amount of static tension required in the belt. Static tension is the tension force that is actually in the belt, while deflection force is simply a measurement to check how much static tension is in the belt. The tension testers used for the force deflection tension method are available in one, two, or five barrel configurations. The one barrel tension tester can measure up to 30 lb. of force; the two barrel tension tester can measure up to 66 lb. of force; and the five barrel tension tester can measure up to 165 lb. of force. Add the force readings from each barrel to determine the total force being measured. 1. Measure span length (t). Span length is the distance from where the belt exits one pulley to where it enters the next pulley.



- 2. Position the lower of the two O-Rings using either of these methods:
 - a. On the scale reading "Deflection Inches", set the O-Ring to show a deflection equal to 1/64" per inch of span length (t).
 - b. On the scale reading "Inches of Span Length", set
 O-Ring to show a deflection equal to the inches of measured span length (t).
- 3. At the center of the span (t), apply force using the appropriately sized Gates tension testers. Apply the force perpendicular to the span. If the belt is a wide synchronous belt or a PowerBand belt, place a piece of steel or angle iron across the belt width and deflect the entire width of the belt evenly. Deflect the belt until the bottom edge of the lower O-Ring is at the correct deflection distance. If multiple individual V-belts are used on the drive, the deflection distance can be measured against an adjacent belt. For drives with only one belt, use a straightedge or string pulled tight across the sheaves, sprockets, or top of the belt to establish a reference line. When the belt is deflected to measure tension, measure the deflection distance by measuring from the belt to the straight edge or string reference line.





DRIVE SHUTDOWN & THOROUGH INSPECTION

- 4. Find the amount of deflection force on the upper scale of the tension tester. The sliding rubber O-Ring slides up the scale as the tool compresses and stays up for a reading of the deflection force. Read at the bottom edge of the ring. Remember to slide the O-Ring down before using again.
- 5. Installation tension forces should ideally be calculated for each specific drive. The tension calculations are included in all Gates drive design manuals. Additionally, the Gates drive design and selection computer program, Design Flex® Pro[™] can be used to quickly calculate the proper installation tensions. Design Flex® Pro[™] and Design Flex Web® are available at www.gates.com/ <u>drivedesign</u>.

If installation tension values for a specific V-belt drive are not available, the tables shown can be used to determine generic tension values based on the V-belt cross section. As synchronous belt drives are more sensitive to proper belt tensioning, there are no similar quick reference tension tables for them.

Compare the deflection force with the range of forces recommended. If less than the minimum recommended deflection force, the belts are too loose and should be tightened. If more than the maximum recommended deflection force, the belts are too tight and should be loosened.

Recommended Deflection Force Per Belt For Super HC [®] V-Belts, Super HC [®] PowerBand [®] Belts Super HC [®] Molded Notch V-Belts or Super HC [®] Molded Notch PowerBand [®] Belts					
V-Belt Cross	Small Sheave Diameter	Small Sheave RPM	Speed Ratio	Recom Deflection	mended Force (Lbs.)
Section	(in)	Range	Range	Minimum	Maximum
3V	2.65 - 2.80 3.00 - 3.15 3.35 - 3.65 4.12 - 5.00 5.30 - 6.90	1200-3600 1200-3600 1200-3600 900-3600 900-3600	2.00 to 4.00	3.0 3.3 3.7 4.4 4.8	4.3 4.8 5.4 6.4 7.1
3VX	2.20 2.35 - 2.50 2.65 - 2.80 3.00 - 3.15 3.35 - 3.65 4.12 - 5.00 5.30 - 6.90	1200-3600 1200-3600 1200-3600 1200-3600 1200-3600 900-3600 900-3600	2.00 to 4.00	2.8 3.2 3.5 3.8 4.1 4.8 5.8	4.1 4.7 5.1 5.5 6.0 7.1 8.6
5VX	4.40 - 4.65 4.90 - 5.50 5.90 - 6.70 7.10 - 8.00 8.50 - 10.90 11.80 - 16.00	1200-3600 1200-3600 1200-3600 600-1800 600-1800 400-1200	2.00 to 4.00	9.0 10.0 11.0 13.0 14.0 15.0	13.0 15.0 17.0 19.0 20.0 23.0
5V	7.10 - 8.00 8.50 - 10.90 11.80 - 16.00	600-1800 600-1800 400-1200	2.00 to 4.00	11.0 13.0 14.0	16.0 18.0 21.0
8V	12.50 - 17.00 18.00 - 24.00	600-1200 400-900	2.00 to 4.00	28.0 32.0	41.0 48.0

Hi-Power [®] II V-Belts, Hi-Power II PowerBand Belts or Tri-Power [®] Molded Notch V-Belts							
				Recommended Deflection Force (Lbs.			bs.)
V-Belt Cross	Small Sheave Diameter	Small Sheave RPM	Speed Batio	Hi-Pov	Hi-Power [®] II		ower 1 Notch
Section	(in)	Range	Range	Min.	Max.	Min.	Max.
A AX	3.0 3.2 3.4 - 3.6 3.8 - 4.2 4.6 - 7.0	1750 to 3600	2.00 to 4.00	2.7 2.9 3.3 3.8 4.9	3.8 4.2 4.8 5.5 7.1	3.8 3.9 4.1 4.3 4.9	5.4 5.6 5.9 6.3 7.1
B BX	4.6 5.0 - 5.2 5.4 - 5.6 6.0 - 6.8 7.4 - 9.4	1160 to 1800	2.00 to 4.00	5.1 5.8 6.2 7.1 8.1	7.4 8.5 9.1 10. 12.0	7.1 7.3 7.4 7.7 7.9	10.0 11.0 11.0 11.0 12.0
C CX	7.0 7.5 8.0 - 8.5 9.0 - 10.5 11.0 - 16.0	870 to 1800	2.00 to 4.00	9.1 9.7 11.0 12.0 14.0	13.0 14.0 16.0 18.0 21.0	12.0 12.0 13.0 13.0 13.0	18.0 18.0 18.0 18.0 18.0 18.0
D	12.0 - 13.0 13.5 - 15.5 16.0 - 20.0	690 to 1200	2.00 to 4.00	19.0 21.0 24.0	27.0 30.0 36.0		

Recommended Deflection Force Per Belt For



Recommended Deflection Force Per Belt For Metric-Power V-Belts							
V-Belt Small Shear		Sheave	Small Sheave	Speed	Recommended Deflection Force (Lbs.)		
Cross Section	Diam (ii	neter n)	RPM Ratio Range Range		Minimum	Maximum	
	2.20	2.64	1200-3600		3.2	4.5	
SPZ		2.80	1200-3600		3.6	5.0	
	2.95	3.15	1200-3600	2.00 to 4.00	4.1	5.9	
	3.35	3.74	1200-3600		4.5	6.8	
	3.94	4.92	900-3600		5.4	7.7	
	5.20	7.09	900-3600		5.9	8.6	
	3.15	3.74	1200-3600	0.00	5.4	7.3	
SPA	3.94	4.92	900-3600	2.00 to	6.4	9.5	
0.7.1	5.20	7.87	600-1800	4.00	8.6	12.7	
	8.35	9.84	600-1800		9.1	13.6	
	4.41	5.91	1200-3600	2.00	10.4	16.3	
SPB	6.30	7.87	600-1800	to	13.2	20.0	
	8.35	11.02	600-1800	4.00	16.3	22.7	
	11.81	15.75	400-1200		17.2	26.3	
	7.09	9.29	600-1800	2.00	18.1	27.2	
SPC	9.84	13.98	400-1200	to 4.00	23.1	34.0	
	14.76	20.87	400-900	4.00	27.2	40.8	
		2.20	1200-3600		3.2	5.0	
	2.36	2.48	1200-3600		3.6	5.9	
	2.64	2.80	1200-3600	2.00 to 4.00	4.1	6.4	
XPZ	2.95	3.15	1200-3600		4.5	6.8	
	3.35	3.74	1200-3600	4.00	5.0	7.3	
	3.94	4.92	900-3600		5.9	8.6	
	5.20	7.09	900-3600	0.00	7.3	10.9	
ХРА	3.15	4.92	900-3600	2.00 to	8.2	17.7	
	5.20	/.8/	900-3600	4.00	10.0	14.1	
	4.41	4.65	1200-3600		10.9	16.3	
	4.92	5.51	1200-3600	2.00	12.2	18.6	
XPB	5.91	6.69	1200-3600	to	13.6	21.3	
	7.09	7.87	600-1800	4.00	16.3	24.0	
	8.35	11.02	600-1800		17.2	24.9	
	11.81	15.75	400-1200		18.6	29.0	
VDO	7.09	9.29	600-1800	2.00	22.7	34.0	
XPC	9.84	13.98	400-1200	to 4.00	29.5	43.1	
	14.70	20.87	400-700		30.3	47.7	
	2.25	2.20	1200-3600		2.8	4.1	
	2.55	2.30	1200-3600		3.5	4.7	
107	2.05	2.00	1200-3000	2.00	3.5	5.1	
107	3.00	3.45	1200-3600	4.00	6.1	5.5	
	6.12	5.00	900-3600		4.1	7.1	
	5.30	4 90	900-3600		5.8	8.4	
	3.50	3.00	/00-0000		3.8	5.6	
		3.20	4050	0.00	3.9	5.4	
13X	3 / 0	3.40	1750 to	2.00 to	/. 1	5.0	
10/	3.80	4 20	3600	4.00	4.1	6.3	
	4.60	7.00			4.9	7 1	
		4,60			7.1	10.0	
	5.00	5.20	1140	2.00	7.3	11.0	
17X	5.40	5.60	to	z.uu to	7.4	11.0	
	6.00	6.80	1800	4.00	7.7	11.0	
	7.40	9.40			7.9	12.0	

Span Vibration Method

The Gates Sonic Tension Meter can be used with all Gates belts. The Sonic Tension Meter measures the vibration in the belt span, and converts that measurement into a reading of the actual static tension in the belt. To use the Sonic Tension Meter, you will need to enter the belt unit weight, belt width for synchronous belts or number of ribs or strands for V-belts, and the span length. To measure the span vibration, press the "Measure" key on the meter, tap the belt span to vibrate the belt, and hold the microphone approximately 3/8" to 1/2" away from the back of the belt. The Sonic Tension Meter will display the static tension, and can also display the vibration frequency.

Since the span vibration method is intended to be a very accurate method of measuring actual tension in a belt, it is important that the proper recommended tension is <u>calculated</u> for the specific belt drive. Procedures for calculating belt tension are included in each of the appropriate Gates drive design manuals. To determine the belt tension recommended for specific drive applications, refer to the appropriate belt drive design manual, download the Gates belt drive selection program DesignFlex® Pro™ at <u>www.gates.com/drivedesign</u>, or dowload the PT Toolkit mobile app at <u>www.gates.com/</u> <u>pttoolkit</u>. Alternatively, Gates Power Transmission Product Application engineers can be contacted at ptpasupport@gates.com or (303) 744-5800.

On-the-go belt tensioning information is available in our PT Toolkit mobile app. Download today.





The adjusted belt weights for use with the Gates Sonic Tension Meter are shown in the following table.

Belt Product Family	Belt Cross Section	Belt Type	Adjusted Belt Weight (grams/meter)
	3VX	Single	53
	5VX	Single	140
	8VX	Single	383
	3V	Single	72
	5V	Single	200
Super HC [®] V-Belts	8V	Single	510
	3VX	PowerBand®	65
	5VX	PowerBand®	157
	3V	PowerBand®	96
	5V	PowerBand®	241
	8V	PowerBand®	579
	5VXP	Single	163
Super HC [®] XP™ V-Belts	5VXP	PowerBand®	
	5VP	Single	217
	8VP	Single	528
	AP	Single	114
	BP	Single	174
	CP	Single	323
	SPBP	Single	208
Predator® V-Belts	SBCP	Single	375
	3VP	PowerBand®	89
	5VP	PowerBand®	217
	8VP	PowerBand®	528
	BP	PowerBand®	212
	CP	PowerBand®	232
		Single	70
	BY	Single	136
	CY.	Single	214
Tri-Power® V-Belts		DowerBand®	100
		PowerBand®	142
		PowerBand®	103
	<u>ل</u> م	Fower Ballu-	201
	A	Single	95
	В	Single	168
		Single	2/5
	U F	Single	553
HI Power® II V-Belts	E	Single	965
	A	PowerBand®	151
	В	PowerBand®	200
	C	PowerBand®	342
	D	PowerBand [®]	663
	AA	Single	125
Hi Power® II Dubl-V Belts	BB	Single	194
	00	Single	354
	DD	Single	750
	Н	Single	5.3
	J	Single	7.0
Micro-V [®] Belts	К	Single	18
	L	Single	29
	М	Single	109
	XPZ	Single	51
	XPA	Single	87
Matria Dovis-TMV/ Dalta	XPB	Single	156
Metric Power'" V-Belts	XPC	Single	249
Lengths S 3000mm	10X	Single	44
	13X	Single	82
	17X	Single	138



DRIVE SHUTDOWN & THOROUGH INSPECTION

Belt Product Family	Belt Cross Section	Belt Type	Adjusted Belt Weight (grams/meter)
	SPZ	Single	72
	SPA	Single	115
Metric Power™ V-Belts	SPB	Single	186
Lengths ≤ 3000mm	SPC	Single	337
	13X	Single	77
	17X	Single	138
	2L	Single	19
Truflov® V Polto	3L	Single	38
Hullex V-Dells	4L	Single	66
	5L	Single	108
	3L	Single	45
PoweRated® V-Belts	4∟	Single	71
	5L	Single	119
	3M	Single	3.5
	5M	Single	9.9
	7M	Single	24
Polyflex® V-Belts	11M	Single	49
	3M	JB®	5.2
_	5M	JB®	11
_	7M	JB®	30
	11M	JB®	64
	MXL	Synchronous	1.3
	XL	Synchronous	2.4
PowerGrip® Timing Belts	L	Synchronous	3.2
	Н	Synchronous	3.9
	XH	Synchronous	11.3
	XXH	Synchronous	14.9
	XL	Synchronous	1.9
PowerGrip® Timing Twin Power® Belts	L	Synchronous	3.2
	H	Synchronous	4.6
	3M	Synchronous	2.4
	5M	Synchronous	3.9
PowerGrip® HTD® Belts	8M	Synchronous	6.2
	14M	Synchronous	9.9
	20M	Synchronous	12.8
	3M	Synchronous	2.1
PowerGrip® HTD® Twin Power® Belts	MC	Synchronous	4.6
-	8M	Synchronous	1.2
	214	Synchronous	12.3
	214	Synchronous	1.4
DowerCrip® CT®2 Polts	5M	Synchronous	2.0
Poweronp- on-2 Bells	MIC	Synchronous	4.1
	0M	Synchronous	0.4
	2M	Synchronous	2.0
	5M	Synchronous	2.0
PowerGrip® GT®2 Twin Power® Belts	JM QM	Synchronous	4.1
	01∾ 1.4 M	Synchronous	11 /
	2M	Synchronous	1 /
	3M	Synchronous	2.8
PowerGrin® GT®3 Relts	5M	Synchronous	<u> </u>
	8M	Synchronous	5.8
	14M	Synchronous	9 7
	5M	Synchronous	3.0
Poly Chain® GT®2,	8M	Synchronous	<u> </u>
Poly Chain [®] GT [®] Carbon [™] and	14M	Synchronous	7.9
Poly Chain [®] Carbon™ Volt™ Belts	19M	Synchronous	10.5
	1.7.151	0,	



How to Install Belts

When a belt is being installed, the same basic steps must be followed, regardless of whether the belt is a V-belt or a synchronous belt.

Preparation

- Confirm that the power is off, locked, and tagged. Never work on a belt drive until this important step is completed. Wear proper safety equipment (hardhat, gloves, safety glasses, steel toe shoes).
- 2. Remove belt guard and place away from drive so that it does not interfere with working on the drive.

Removal

3. Loosen motor mounting bolts or adjusting screws.



4. Move the motor in until the belt is slack and can be removed easily without prying. Never pry off a belt, as the sheave or sprocket can be damaged. Prying off belts also adds the risk of injury.



5. Remove old belt.

Inspection

- 6. Inspect the old belt for any unusual wear. Excessive or unusual wear may indicate problems with the drive design or past maintenance procedures. Refer to the Problem/Solution Summary Table in the Belt Performance and Troubleshooting section for guidelines in matching belt appearance to possible problem causes.
- 7. Inspect the sheaves or sprockets for unusual or excessive wear. Belt life will be reduced if the sheaves or sprockets are worn. Wear gloves for protection from nicks or sharp surfaces.

<u>For V-belt sheaves</u>: Inspect grooves for wear and nicks. Use Gates sheave gauges to determine if the grooves are worn. Place the proper sheave gauge into the sheave groove and check for wear. If more than 1/32" of wear can be seen between the gauge and groove side wall, the sheaves are worn and should be replaced. A light source such as a flashlight may be used to backlight the gauge.



Do not be misled by "shiny" grooves. Grooves that are "shiny" are often polished because of heavy wear.

Inspect the sheave grooves for rust or pitting. If rusted or pitted surfaces are found, the sheave should be replaced.

For Synchronous sprockets: Inspect sprocket grooves for unusual or excessive wear. Check for excessive wear by both visually inspecting the grooves and by running your finger along the sprocket grooves. If you can feel or see noticeable wear, the sprockets are worn and should be replaced.



Do not be misled by "shiny" grooves. Grooves that are "shiny" are often polished because of heavy wear.

Inspect the sprocket grooves for rust or pitting. If rusted or pitted surfaces are found, the sprocket should be replaced.

Check the sprocket flanges and make sure that they are not loose or bent. Bent flanges can interfere with the belt and cause premature belt wear and failure.

8. If necessary, clean sheave and sprocket grooves by wiping the surface with a rag slightly dampened with a light, non-volatile solvent. Do not sand or scrape the grooves to remove debris.

Installation

- If necessary, install new sheaves or sprockets. Refer to page 14 for detailed instructions for installing QD or Taper-Lock[®] bushings.
- Check the sheave or sprocket alignment. In order to achieve optimum belt life, it is important that the drive's sheaves or sprockets be aligned properly. Use a straightedge or Gates EZ Align® laser alignment tool. Adjust the sheave or sprocket position as necessary.
- 11. Install the new belt or set of belts.

Replace all belts on multiple V-belt drives. Never replace a single belt or a portion of a multiple belt drive. Always use belts from the same manufacturer on a multiple belt drive. If a new belt is used with old belts, the load will not be shared evenly between the belts on a multiple V-belt drive. Mixing new and old belts very possibly could lead to premature belt failure and uneven sheave wear.

When installing the belt, make sure that there is clearance to slip the belt over the sheave or sprocket. Do not pry or use force to install the belt. Do not roll the belt onto the drive.

- 12. Adjust the motor base adjustment screws to take up the center distance on the belt drive until the belts are tight.
- 13. Check belt tension, using a tension gauge or Sonic Tension Meter. Adjust the belt drive's center distance until the correct tension is measured.

On multiple belt drives, some belts may appear to hang unevenly when installed. It is normal for belts within RMA length and matching tolerances to have noticeable differences in the distance the belt span sags. This is called the "catenary effect". Catenary effect is a curve made by a cord of uniform weight suspended between two points.

Follow the recommended run-in and retensioning procedure to minimize the visible difference in belt sag.

- 14. Rotate the belt drive by hand for a few revolutions. Re-check the belt tension and adjust as necessary.
- 15. Re-check the drive alignment and adjust as necessary.

Completion

- 16. Secure motor mounting bolts to the correct torque.
- 17. Re-check the belt tension and adjust as necessary. Tightening the motor mounting bolts may have changed the belt tension.
- 18. Replace the belt guard.
- 19. Start the drive, looking and listening for any unusual noise or vibration. If possible, shut down the drive and check the bearings and motor for unusual heat. If the motor or bearings are hot, the belt tension may be too high, or bearings may not be properly lubricated. Temperatures can be checked with an infrared pyrometer.

V-Belt Run-In Procedure

20. A run-in procedure is recommended for all V-belt drives so that the optimum belt life can be achieved. A run-in consists of starting the drive and letting it run under full load for up to 24 hours. If a 24 hour run-in is not possible, let the belt drive run overnight, to the next shift, or at least a few hours. After the belts have run-in, stop the belt drive and check the belt tension. Running the belts under full load for an extended period of time will seat the V-belts into the sheave grooves.

V-belt tension will drop after the initial run-in and seating process. This is normal. Adjust the belt tension as necessary.

Since tension in V-belts will drop after the initial runin and seating process, failure to check and retension the belt will result in low belt tension and belt slippage. This slippage will result in premature belt failure.



How to Install Taper-Lock $^{\scriptscriptstyle \otimes}$ and QD $^{\scriptscriptstyle \otimes}$ Bushed Sheaves and Sprockets

It is important that new or replacement sheaves or sprockets be properly installed. Most sheaves or sprockets are attached to a shaft with a tapered bushing that fits a mating tapered bore in the sheave or sprocket. Bushings come in several different bore size diameters. This allows for a reduction in the parts inventory required in your plant because one bushing size with multiple bore sizes can be used with a number of different sizes of sheaves or sprockets.

There are two styles of bushings: Taper-Lock[®] and QD[®]. Installation and removal instructions for each style are noted below.

Taper-Lock® Type Sprocket Installation and Removal



To Install Taper-Lock® Type Hardware

- 1. Clean the shaft, bushing bore, tapered bushing barrel and the sprocket hub bore of all oil, paint and dirt (Note: Lubricants are not to be applied to bushings or sprockets). Remove any burrs with a file or emery cloth.
- 2. Insert bushing into sprocket hub matching hole patterns, not threaded holes. Tightening holes ("O" in diagram above) will be threaded on the sprocket hub side only. Removal holes ("O" in diagram above) will be threaded on the bushing side only. Thread screws into the installation or "O" holes.
- 3. LIGHTLY oil the set screws and thread them into the half-threaded holes indicatad in the diagram above. (Note: Do not lubricate the bushing taper, hub taper, bushing bore, or the shaft. Doing so could result in sprocket breakage.)
- 4. With the key in the shaft keyway "□", position the assembly onto the shaft at the desired location. Allow for small axial sprocket movement on bushing during tightening. (Note: When mounting sprockets on vertical shafts, precautions must be taken to prevent the sprocket/bushing from falling during the tightening).

- 5. Alternately torque screws to the recommended torque level specified in the table below. *Note: Using worn hex key wrenches may damage screw heads preventing proper tightening torque and removal.*
- 6. Check the alignment and sprocket axial runout (wobble), and correct as necessary.

Bushina		Bolts	Torque V	Vrench
Style	Qty.	Size	lb-ft	lb-in
1008	2	1/4-20 x 1/2	4.6	55
1108	2	1/4-20 x 1/2	4.6	55
1210	2	3/8-16 x 5/8	14.6	175
1610	2	3/8-16 x 5/8	14.6	175
2012	2	7/16-14 x 7/8	23.3	280
2517	2	1/2-13 x 1	35.8	430
3020	2	5/8-11 x 1 1/4	66.7	800
3525	3	1/2-13 x 1 1/2	83.3	1000
4030	3	5/8-11 x 1 3/4	141.7	1700
4535	3	3/4-10 x 2	204.2	2450
5040	3	7/8-9 x 2 1/4	258.3	3100
6050	3	1 1/4-7 x 3 1/2	651.7	7820
7060	4	1 1/4-7 x 3 1/2	651.7	7820

Taper-Lock® Bolt Torque

7. To increase and ensure bushing gripping force, firmly tap the bushing face using a drift or punch *(do not hit bushing face directly with hammer)*, then re-torque screws to the recommended torque level.

Note: Do not continue tightening screws further after target torque has been reached as bushing over insertion and hub fracture may occur.

8. Recheck all screw torque values after the initial drive run-in, and periodically thereafter. Repeat steps 5 through 7 if loose.

To Remove TL Type Hardware

- 1. Release belt tension and lift belt off of sprockets (*Note: Do not pry or roll belts off*).
- 2. Loosen and remove screws securing sprockets to bushings.
- 3. Insert screws into removal holes ("●").
- 4. Alternately tighten screw or screws in small but equal increments until sprockets disengage from bushings.
- 5. Remove sprockets and bushings from shafts as necessary.



QD Type Hardware Installation and Removal

To Install QD Type Hardware

- 1. Clean the shaft, bushing bore, tapered bushing barrel and the sheave hub bore of all oil, paint and dirt (Note: Lubricants are not to be applied to bushings or sheaves). Remove any burrs with a file or emery cloth.
- 2. Determine the type of mounting that will be used:





Conventional Mounting



- 3. Conventional Mounting:
 - A. Insert key into the shaft keyway (*Note: If key is furnished with bushing, it is special and must be used*).
 - B. Insert a screw driver blade (or similar) into the bushing flange saw cut to enlarge bore slightly *(Caution: Excessive enlargement can split bushing).*
 - C. Slide bushing onto shaft with the flange side towards the equipment. Position bushing and tighten set screw to prevent sliding on shaft.
 - D. Place sheave onto bushing and insert cap screws. Align drilled holes in sheave hub with tapped holes in bushing flange. (Note: Install M thru S bushings so that the two tapped removal holes in sheave hubs are located far away from bushing saw cuts). Finger-tighten the screws.
- 4. Reverse Mounting:
 - A. Insert key into the shaft keyway (*Note: If key is furnished with bushing, it is special and must be used*).
 - B. Place sheave onto shaft without bushing.
 - C. Insert a screw driver blade (or similar) into the bushing flange saw cut to enlarge bore slightly *(Caution: Excessive enlargement can split bushing).*
 - D. Slide bushing onto shaft with flange facing outward, away from equipment. Position bushing and tighten the set screw enough to prevent sliding on shaft.
 - E. Place sheave onto the bushing and insert cap screws. Align drilled holes in bushing flange with

tapped holes in sheave hub (Note: Install M thru S bushings so that the two tapped removal holes in sheave hubs are located far away from bushing saw cuts). Finger-tighten the screws.

5. When positioned to the desired location, secure the first sheave/bushing assembly to the shaft by tightening the bushing cap screws. Allow for small axial sheave movement on bushing during tightening. Using a torque wrench, tighten the cap screws evenly in an alternating pattern until the recommended torque level in the following table is reached. (Note: When mounting sprockets on vertical shafts, precautions must be taken to prevent the sheave/ bushing from falling during the tightening).

Note: Do not continue tightening cap screws further after target torque has been reached as bushing over insertion and hub fracture may occur. The gap between the bushing flange and sheave hub is intentional and necessary.

Bushing	Bolts		Torque W	/rench
Style	Qty.	Size	lb-ft	lb-in
Н	2	1/4 x 3/4	7.9	95
AL	3	10-24 x 1	4.5	54
SH & SDS	3	1/4-20 x 1 3/8	9.0	108
SD	3	1/4-20 x 1 7/8	9.0	108
SK	3	5/16-18 x 2	15.0	180
SF	3	3/8-16 x 2	30.0	360
E	3	1/2-13 x 2 3/4	60.0	720
F	3	9/16-12 x 3 5/8	75.0	900
J	3	5/8-11 x 4 1/2	135.0	1620
М	4	3/4-10 x 6 3/4	225.0	2700
Ν	4	7/8-9 x 8	300.0	3600
W	4	1 1/8-7 x 11 1/2	600.0	7200
S	5	1 1/4-7 x 15 1/2	750.0	9000
Р	4	1-8 x 9 1/2	450.0	5400

QD Bolt Torque

To Remove QD Type Hardware

- 1. Release belt tension and lift belts off of sheaves (*Note: Do not pry or roll belts off*).
- 2. Loosen and remove cap screws securing sheaves to bushings. If applicable, loosen keyway set screws.
- 3. Insert cap screws into the tapped removal holes adjacent the drilled holes.
- 4. Alternately tighten cap screws in small but equal increments until sheaves disengage from bushings. (Note: Uneven or excessive pressure on cap screws can break bushing flanges making removal extremely difficult)
- 5. Remove sheaves and bushings from shafts as necessary.



Storage Recommendations

Proper preventive maintenance should not be limited to the actual belt drive operating on equipment, but should also include following proper storage procedures. In order to retain their serviceability and dimensions, proper storage procedures must be followed for all belt types. Quite often premature belt failures can be traced to improper belt storage procedures that damaged the belt before it was installed on the drive. By following a few common sense steps, these types of belt failures can be avoided.

General Guidelines

Recommended

Belts should be stored in a cool and dry environment with no direct sunlight. Ideally, less than 85° F and 70% relative humidity.

Store on shelves or in boxes or containers. If the belt is packaged in a box, like Poly Chain® GT® Carbon™ belts, store the belt in its individual box.

V-belts may be stored by hanging on a wall rack if they are hung on a saddle or diameter at least as large as the minimum diameter sheave recommended for the belt cross section.

When the belts are stored, they must not be bent to diameters smaller than the minimum recommended sheave or sprocket diameter for that cross section. (see Technical Information section) Belts should not be stored with back bends that are less than 1.3 times the minimum recommended sheave or sprocket diameter for that cross section.

If stored in containers, make sure that the belt is not distorted when in the container. Limit the contents in a container so that the belts at the bottom of the container are not damaged by the weight of the rest of the belts in the container.

Not Recommended

Belts should not be stored near windows, which may expose the belts to direct sunlight or moisture.

Belts should not be stored near heaters, radiators, or in the direct airflow of heating devices.

Belts should not be stored near any devices that generate ozone. Ozone generating devices include transformers and electric motors.

Belts should not be stored where they are exposed to solvents or chemicals in the atmosphere.

Do not store belts on the floor unless they are in a protective container. Floor locations are exposed to traffic that may damage the belts. Do not crimp belts during handling or while stored.

Belts are crimped by bending them to a diameter smaller than the minimum recommended diameter sheave or sprocket for that cross section. Do not use ties or tape to pull belt spans tightly together near the "end" of the belt. This will crimp the belt and cause premature belt failure. Do not hang on a small diameter pin that suspends all of the belt weight and bends the belt to a diameter smaller than the minimum recommended sheave or sprocket diameter. Improper storage will damage the tensile cord and the belt will fail prematurely. Handle belts carefully when removing from storage and going to the application. Do not inadvertently crimp or damage the belts by careless handling.

Storage Methods

<u>V-Belts</u>

V-belts can be coiled in loops for storage purposes. Each coil results in a number of loops. One coil results in three loops, two coils results in five loops, etc. The maximum number of coils that can be used depends on the belt length. If coiling a belt for storage, consult the table on the next page and follow the limits shown.



BELT STORAGE AND HANDLING

Belt Cross Section	Belt Length (in)	Belt Length (mm)	Number of Coils	Number of Loops
3L, 4L, 5L, A, AX,	Under 60	Under 1500	0	1
AA, B, BX, 3V,	60 up to 120	1500 up to 3000	1	3
3VX, 9R, 13R, 13C,	120 up to 180	3000 up to 4600	2	5
13CX, 13D, 16R,	180 and over	4600 and over	3	7
16C, 16CX, 9N				
	Under 75	Under 1900	0	1
BB, C, CX, 5V,	75 up to 144	1900 up to 3700	1	3
5VX, 16D, 22C, 22CX, 15N	144 up to 240	3700 up to 6000	2	5
	240 and over	6000 and over	3	7
	Under 120	Under 3000	0	1
	120 up to 240	3000 up to 6100	1	3
CC, D, 22D, 32C	240 up to 330	6100 up to 8400	2	5
	330 up to 420	8400 up to 10,600	3	7
	420 and over	10,600 and over	4	9
	Under 180	Under 4600	0	1
	180 up to 270	4600 up to 6900	1	3
8V, 8VX, 25N	270 up to 390	6900 up to 9900	2	5
	390 up to 480	9900 up to 12,200	3	7
	Over 480	12,200 and over	4	9

PowerBand[®] V-Belts, Synchronous Belts, Micro-V[®] Belts

Poly Chain[®] GT[®] Carbon[™] belts are shipped in individual boxes. Poly Chain[®] GT[®] Carbon[™] belts should be stored in the box in which it was shipped.

These belts may be stored by hanging on a wall rack if they are hung on a saddle or diameter at least as large as the minimum diameter sheave or sprocket recommended for the belt cross section, and the belts are not distorted.

PowerBand® V-belts, Synchronous belts, and Micro-V® belts up to 120 inches (3000 mm) may be stored in a nested configuration. Nests are formed by laying a belt on its side on a flat surface and placing as many belts inside the first belt as possible without undue force. When nests are formed, do not bend the belts to a diameter that is smaller than the minimum recommended sheave or sprocket diameter. Nests may be stacked without damaging the belts if they are tight and stacked with each nest rotated 180° from the nest below.

PowerBand® V-belts and Micro-V® belts over 120 inches (3000 mm) may be rolled up and tied for shipment. These individual rolls may be stacked for easy storage. When the belts are rolled, they must not be bent to a diameter that is smaller than the minimum diameter recommended for the cross section.

Variable Speed V-Belts

Variable speed belts have a thicker cross section and are more sensitive to distortion than other V-belts. Do not hang variable speed belts from pins, racks, or saddles. Store variable speed belts on their edge on shelves. Variable speed belts that are in sleeves may be stacked, taking care to avoid distorting the belts at the bottom of the stack.

Storage Effects

In order to retain their serviceability and dimensions, proper storage procedures must be followed for all belt types. Quite often premature belt failures can be traced to improper belt storage procedures that damaged the belt before it was installed on the drive.

Belts may be stored up to six years if properly stored at temperatures less than 85°F and relative humidity less than 70%.

If the storage temperature is higher than 85° F, the storage limit for normal service performance is reduced by one half for each 15°F increase in temperature. Belts should never be stored at temperatures above 115°F.

At relative humidity levels above 70%, fungus or mildew may form on stored belts. This has minimal affect on belt performance, but should be avoided.

When equipment is stored for prolonged periods of time (over six months), the belt tension should be relaxed so that the belt does not take a set, and the storage environment should meet the 85°F and 70% or less relative humidity condition. If this is not possible, belts should be removed and stored separately in a proper environment.



BELT IDENTIFICATION

When preventive maintenance inspections indicate that belts need replacing, it is important to install the correct belts.

Consequently, it is important to identify the various types and sizes of belts available, and then quickly be able to specify the correct replacement. The information on the following pages will help identify the belt types used in industry. Gates makes a belt to fit nearly any application.



*Also available in Predator® belt construction.

**Also available in XP™ belt construction.





Synchronous Belts

All synchronous belts are identified in a similar manner, in either English or metric units. Belts are measured by:

1. Pitch: Distance in inches or millimeters between two adjacent tooth centers as measured on the belt pitch line.



Also available in static conductive Poly Chain Carbon Volt™ construction

PowerGrip® GT®3 Belts



- **2. Pitch Length:** Total length (circumference) in inches or millimeters as measured along the pitch line. It is equal to the pitch multiplied by the number of teeth in the belt.
- 3. Width: Denoted in inches or millimeters.



*Also available in TruMotion® belt construction

**Static conductive to ISO 9563 industry standard



Twin Power® PowerGrip® GT®2 Belts

3M 3mm Pitch

5M 5mm Pitch



8M 8mm Pitch



14M 14mm Pitch





BELT IDENTIFICATION

Synchro-Power® Polyurethane Belts



BELT TYPES

Narrow Section V-Belts

These high capacity belts are used to substantially reduce drive costs and decrease space requirements. This V-belt handles the complete range of drive horsepower recommended with three narrow cross sections instead of the five regular cross sections needed for classical heavyduty belts. Specified by 3V, 5V or 8V cross sections. Specify Gates Super HC[®] V-belts.



Classical Section V-Belts

These are the original belts used in heavy duty applications. They are specified by cross section and standard length. The size is designated as A, B, C, D or E. The easiest way to select a replacement is by finding the belt number on the worn belt. If not legible, measure the belts outside circumference with a flexible tape, preferably while it is still on the drive.

Then, order the Gates **Hi-Power® ll** V-belt which has the next shorter standard length. For example: For an "A" section belt with a 28.0" O.C., order an A26 replacement belt.



Banded and Bandless Belts

Banded belts, also called wrapped or covered belts, have a fabric cover. Un-notched and generally with concave sidewalls, banded belts have rounded bottom corners and arched tops.

Bandless belts have no fabric cover, straight cut-edge sidewalls, and special molded notches. The notches reduce bending stress which allows belts to run on smaller diameter sheaves than comparable non-notched banded belts.

Gates offers these two types in both the classical and narrow sections. In the classical section, Gates **Tri-Power**[®] molded notch is available in AX, BX and CX cross sections. Its length is specified by the same standard belt number as other classical section belts.

Gates also offers **Super HC® Molded Notch** V-belts in 3VX, 5VX and 8VX sizes.

In both cases, an "X" is used in the belt number to designate a molded notch construction. For example: An AX26 is a bandless, molded notch classical section belt. A 5VX1400 is a narrow section, bandless, molded notch belt with a 140" O.C.



Note: The revolutionary Gates belt construction is used in the notched belts.



BELT TYPES

Light Duty Belts

These are used on light duty fractional horsepower drives and are designed for use with backside idlers. **Gates Truflex**[®] and **PoweRated**[®] V-belts are offered in this category and are specified by cross section and outside circumference. **Truflex**[®] is recommended for the lower lighter duty range. **PoweRated**[®], a special belt designed for clutching, heavier shock-load and backside idler drives, is recognized by its green color. Reinforced with an aramid fiber tensile (pound for pound stronger than steel). **PoweRated**[®] can interchange with **Truflex**[®], but **Truflex**[®]



Synchronous Belts

These belts are also known as timing or positive drive belts and are used where driveN shaft speeds must be synchronized to the rotation of the driveR shafts. They can also be used to eliminate noise and maintenance problems caused by chain drives.

Synchronous belts, such as **Gates Poly Chain® GT® CarbonTM**, can be used in high horsepower drives, drives where space is severely limited and where there is limited take up.

Synchronous drives are extremely efficient – as much as 98% with properly maintained **Poly Chain® GT® Carbon™** or **PowerGrip® GT®3** systems. By contrast, chain drives are in the 91-98% efficiency range, while V-belts average in the 93-98% range.

Distinctive tooth profiles (shapes) identify synchronous belts. Various sizes and constructions are available to meet a wide range of applications. The three important dimensions of a synchronous belt are pitch, width and pitch length. Tooth profiles must also be identified.

Belt Pitch - Distance in inches or millimeters between two adjacent tooth centers as measured on the belt's pitch line.

Belt Pitch Length - Circumference in inches or millimeters as measured along the pitch line.

Width - Top width in inches or millimeters.

Tooth Profile - See the Belt Identification section for the easiest way to identify tooth profile.

Synchronous belts run on sprockets, which are specified by the following:

Pitch - Distance between groove centers, measured on the sprocket pitch circle. The pitch circle coincides with the pitch line of the mating belt.



Number of Sprocket Grooves

Width - Face width.

Note: The sprocket's pitch diameter is always greater than its outside diameter.

Note: PowerGrip[®] GT[®]3 belts must be used with PowerGrip[®] GT[®]2 sprockets for new designs.

Note: 8 and 14 mm pitch PowerGrip[®] GT[®]3 belts can be used as replacement belts for competitive curvilinear tooth profiles. See page 32.

Example: 14mm-170mm width – substitute a PowerGrip[®] GT[®]3-14mm-115 without any performance loss. Refer to page 32 for crossover information.



BELT TYPES

Polyflex® JB® V-Belts

Polyflex[®] is a unique belt with a distinctive 60° belt angle and ribbed top specifically designed for long life in small diameter sheave drives. **Polyflex**[®] **JB**[®] is ideal for compact drives, drives with high speed ratios, and drives requiring especially smooth operation.

The "JB" refers to the belt's configuration: two, three or five belts joined together to provide extra stability and improved performance. This joined belt style should be used instead of matched single belts whenever possible.

Polyflex[®] **JB**[®] belts are ideal for these applications:

- Milling, grinding or drilling machines
- Lathes
- Machine spindle drives
- Centrifuges
- Blowers
- High speed compressors

Polyflex® JB® belts are specified by Top Width and Effective Length

Multi-Speed Belts

(Variable Speed Drives)

Multi-Speed belts have a distinct shape. Multi-Speed belt top widths are usually greater than their thicknesses. This permits a greater range of speed ratios than standard belts. Usually cogged or notched on the underside, **Multi-Speed** belts are specified for equipment which require changes in driveN speed during operation.

Multi-Speed belts are specified by Top Width, Outside Circumference, and the required Groove Angle. The groove angle can be measured from the drive pulleys.



Micro-V[®] or V-Ribbed Belts

Gates Micro-V® belts outperform other V-ribbed belts because the tips of the "V" are truncated (shorter). This shorter profile gives the new **Micro-V belts** increased flexibility, reduced heat buildup and allows them to operate at extra high speeds on smaller diameter sheaves.

Additional advantages of the truncated tips are: (1) the belt does not bottom in the sheave, therefore providing a higher degree of wedging and (2) the belt can better tolerate debris in the sheave groove. They are extremely smooth running and highly resistant to oil, heat and other adverse conditions.

Three cross sections are available for industrial applications: J, L and M.







BELT STYLES

Spliced and Linked Belting

Used on drives with little or no take-up, or as an emergency belt replacement.

Belting is sold on reels in standard V-belt cross sections. **Easy-Splice V-belting** ends are spliced with fasteners that require special assembly tools. Always use the correct fasteners with the correct belt type and cross section.

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PowerBand® Belts

PowerBand belts were developed by Gates for drives subjected to pulsating loads, shock loads or extreme vibrations where single belts could flip over on the pulleys. A high-strength tie band permanently joins two or more belts to provide lateral rigidity. This keeps the belts running in a straight line in the pulley grooves. PowerBand[®] construction is offered with **Gates Hi-Power[®] II, Super HC[®]** and **Super HC[®] Molded Notch Belts**.

Predator® V-Belts

Gates Predator® V-belts are available in single, or multilayered **PowerBand®** construction that adds strength, durability, shear and tear resistance and lateral rigidity to handle the toughest shock-loaded applications.

PREDATOR®



Nu-T-Link®, a high performance, linked belt, is also available for use as emergency belting, and for drives where conditions are detrimental to rubber belts.



Primary features of **Predator**[®] V-belts:

- Aramid tensile cords for extraordinary strength, durability and virtually zero stretch.
- Chloroprene rubber compounds for superb oil and heat resistance.
- Specially-treated extra tough cover withstands slip and shear forces at peak loads without generating excessive heat. It also fends off penetration by foreign materials.
- Gates curves that compensate for effects that occur when belts bend around a sheave for uniform loading and maximum life.
- Matched by request to maximize power absorption and belt life.





BELT STYLES

Round Endless Belts

Recommended for replacing leather belting on serpentine or quarter-turn drives. They are specified by **Diameter** and **Inside Length**.

If your current drive has leather or round endless belting, you should consider a new drive design. V-belt drives offer many advantages in performance, even on serpentine or quarter-turn drives.

Also available in Heavy-Duty PowerRound® construction



PowerBack® V-Belts

PowerBack® belts are "B" section V-belts with a flat back surface. The flat back surface makes PowerBack® belts ideal for driving roll-to-roll conveyor applications.



Power Curve® V-Belts

Power Curve[®] belts are "B" section V-belts offering increased flexibility for demanding power turn conveyor applications. The belts "bend" around corners and drive the rollers in most conveyor applications.





BELT STYLES

Dubl-V Belts

A special version of Gates Hi-Power® II for serpentine drives where power is transmitted by both the top and bottom of the belt. Dubl-V belts are specified by A, B, C or D cross sections, and by Effective Length.



Static Conductive Belts

Static discharge can pose a hazard on belt drives that operate in potentially explosive environments. Static discharge can also interfere with radios, electronic instruments, or controls used in a facility. While uncommon, static discharge can also cause bearing pitting if the discharge occurs through the bearing. Static conductivity is a required belt characteristic in these cases in order to prevent static discharge.

V-belts are generally manufactured to be static conductive in accordance with the ARPM (Association for Rubber Products Manufacturers - Formerly RMA) IP 3-3 bulletin, but it is important to confirm with the belt manufacturer that a specific belt product or product line is static conductive.

Gates Hi-Power[®] II, Tri-Power[®], Super HC[®], Super HC[®] Molded Notch, Metric Power[™], Micro-V[®], Truflex[®] V-belts are all static conductive when new as defined by ARPM Bulletin IP 3-3. 8m, 14m Poly Chain[®] Carbon[™] Volt[®] and 8m, 14m PowerGrip[®] GT3[®] belts are conductive as defined by ISO 9563.

PowerGrip[®] GT[®]2^{*} in 2mm, 3mm, 5mm pitches, PowerGrip[®] Timing, Poly Chain[®] GT[®], Poly Chain[®] GT[®]2, Poly Chain[®] GT[®] Carbon[™], Polyflex[®], Polyflex[®] JB[®], PoweRated[®], and Predator[®] belts are not considered to be static conductive.

PowerGrip® GT®3* in 2mm, 3mm, 5mm pitches and PowerGrip® Timing belts can be manufactured in a static conductive construction on a made-to-order basis. When a belt is used in a hazardous environment, additional protection must be employed to assure that there are no accidental static spark discharges. The portion of the belt that contacts the sheave or sprocket must be conductive to ensure that static charge is conducted into the drive hardware. V-belts must have a static conductive sidewall in contact with a conductive sheave. Synchronous belts must have a static conductive tooth surface in contact with a conductive sprocket.

Unusual or excessive debris or contaminant on the belt contact surface or sheave or sprocket grooves should be cleaned and removed. Banded V-belts (V-belts with a fabric bandply on the driving surface) should be inspected for bandply wear. If the fabric bandply on the belt sidewall has worn away, the belts should be replaced immediately. Bandless V-belts do not have to be replaced if wear is evident on the belt sidewall. If there is any question about the belt's physical condition and its static conductivity characteristics, replace the belt.

Any belt drive system, whether it uses a synchronous belt or V-belt, that operates in a potentially hazardous environment must be properly grounded. A continuous conductive path to ground is necessary to bleed off the static charge. This path includes a static conductive belt, a conductive sheave or sprocket, a conductive bushing, a conductive shaft, conductive bearings, and the ground. As an additional measure of protection, a static-conductive brush or similar device should be employed to bleed off any residual static buildup that might remain around the belt.

* NOTE: 8mm pitch PGGT2 and PGGT3 belts at 12mm wide are NOT static conductive.



BELT DRIVE PERFORMANCE

To provide proper maintenance, you must understand the nature of the belt drives in your plant. You know the expected belt service life on each drive, and you are aware of the capabilities and limitations of this equipment.

On occasion, however, it is necessary to give some thought to belt service life, especially when belt service life is below the expected performance level and the situation must be improved.

Upgrade Drive Performance

A belt drive can sometimes be upgraded to improve performance. The first step is to see if simple improvements can be made at minimal costs. This involves checking the drive design for adequate capacity using the appropriate drive design manual or Gates Design Flex[®] Pro[™] drive design software.

If further improvement is needed, the next step is to upgrade the drive to a higher performance belt system.

Here are examples of minor changes that could improve performance.

- Increase sheave or sprocket diameters
- Increase the number of belts, or use wider belt
- Add vibration dampening to system
- Improve guard ventilation to reduce operating temperature
- Use at least the correct, minimum recommended pulley diameters on inside and backside idlers
- Use premium belts rather than general purpose types
- Replace sheaves or sprockets when they are worn
- Keep sheaves or sprockets properly aligned
- Place idler on span with lowest tension
- Re-tension newly installed belts after a 4 to 24 hour run-in period
- Review proper belt installation and maintenance procedures

Gates Corporation is the recognized industry leader in product innovation and belt drive technology. New products and applications are continually made available to Gates customers. Here are examples of advanced Gates belt innovations.

Advanced Gates Belt Drive Products & Solutions

- Poly Chain[®] GT[®] Carbon[™] positive drive (synchronous) belts
- Poly Chain[®] GT[®] Carbon[™] Volt[®] positive drive (synchronous) belts
- PowerGrip® GT®3
- Polyflex® JB® belts
- PoweRated[®] light-duty V-Belts
- Super HC[®] Molded Notch V-Belts
- Super HC[®] XP[™] (Notched Premium) V-Belts
- Predator[®] Single & PowerBand[®] belts
- Power Curve® V-Belts
- PowerBack® V-Belts
- Stainless steel sprockets & bushings (stock)
- Gates Design Flex[®] Pro[™] Software
- Gates Design Flex® Mobile Online
- Gates Design IQ™ Software

Your local Gates distributor or representative can work with you to upgrade your existing drives and reduce your maintenance and down time costs.

Or, you may have a problem or excessive maintenance costs with a non-belt drive, such as gear or chain. Again, your local Gates distributor or representative can offer you excellent advice as to whether or not a belt drive could solve the problem and reduce your maintenance costs.



BELT DRIVE PERFORMANCE

In most cases, synchonous belt drives that are using non-Gates curvilinear belts can be changed to a Gates PowerGrip[®] GT[®]3 belt to reduce width. Use the table below to identify product types that can be converted, and what widths are recommended.

PowerGrip[®] GT[®]3 – 8 & 14mm belts can be used to replace other non-Gates curvilinear belts in the next smallest width.

Company	Product Trade Name	Profile	Nomenclature	Belt-Pitch
Bando	Syncro-Link [®] – HT	H [†]	1600-8M-20-H	8 & 14MM
Dodge	HT100	GT	1600-8M-20	8 & 14MM
Gates	HTD®	HTD	1600-8M-20	8 & 14MM
Jason	HTB®	H [†]	1600-8M-20	8 & 14MM
Browning	HPT®	RPP	1600-14M-20	8* & 14MM
Goodyear	HPPD™	RPP	1600-14M-20	8* & 14MM
Dayco/Carlisle	RPP®/RPP Plus®	RPP	1600-14M-20	8* & 14MM
Dodge	HT150	GT	1600-14M-20	8 & 14MM
T.B. Wood's	RPP [®] /RPP Plus [®]	RPP	1600-14M-20	8* & 14MM

Competitors' Width	PowerGrip GT3 – Width
8MM – Pitch	8MM – Pitch
20	20
30	20
50	30
85	50

Competitors' Width	PowerGrip GT3 – Width
14MM – Pitch	14MM – Pitch
40	40
55	40
85	55
115	85

* Replacement only on sprockets with fewer than 50 grooves

[†] See Association of Rubber Products Manufacturers bulletin IP-27 (1997) for H type tooth profile specification information

For example, a competitor's belt in 14mm pitch, 85mm wide, can be replaced with a narrower 55mm Gates PowerGrip® GT®3 belt.

Reference <u>www.gates.com/interchange</u> for electronic interchange information.



NOISE

V-belt, synchronous belt, roller chain, and gear drives will all generate noise while transmitting power. Each type of system has its own characteristic sound. V-belt drives tend to be the quietest belt drives, and synchronous belt drives are much quieter than roller chain drives. When noise is an issue, there are several design and maintenance tips that should be followed to achieve the quietest possible belt drive.

Noise: Decibel and Frequency

Noise is an unwanted or unpleasant sound that can be described with two criteria – frequency and decibel (dBA) levels. Frequency is measured in Hertz.

The human ear is capable of distinguishing frequencies typically from 20 to 20,000 Hertz. The human ear generally does not perceive frequencies higher than 20,000 Hertz.

The noise level or intensity of noise is measured in terms of decibels (dBA). The decibel has become the basic unit of measure since it is an objective measurement that approximately corresponds to the subjective measurement made by the human ear. Since sound is composed of several distinct and measurable parts and the human ear doesn't differentiate between these parts, measuring scales that approximate the human ear's reaction have been adopted. Three scales – A, B, and C are used to duplicate the ear's response over the scale's ranges. The A scale is most commonly used in industry because of its adoption as the standard in OSHA regulations.

Noise described in decibels (dBA) is generally perceived as the loudness or intensity of the noise.

While the human ear can distinguish frequencies from 20 to 20,000 Hertz, the ear is most sensitive in the range of normal speech – 500 to 2000 Hertz. As a consequence, this range is the most common concern for noise control. Frequency is most closely related to what the ear hears as pitch. High frequency sounds are perceived as whining or piercing, while low frequency sounds are perceived as rumbling.

The combination of decibel and frequency describes the overall level of loudness to the human ear. One without the other does not adequately describe the loudness potential of the noise. For example, an 85 dBA noise at 3000 Hertz is going to be perceived as much louder than an 85 dBA noise at 500 Hertz.

For comparison, some typical noise levels and their sources are listed below.

Normal Speech	60 dBA
Busy Office	80 dBA
Textile Weaving Plant	90 dBA
Canning Plant	100 dBA
Heavy City Traffic	100 dBA
Punch Press	110 dBA
Air Raid Siren	130 dBA
Jet Engine	160 dBA

Reducing Noise

Following proper installation and maintenance procedures, as well as some simple design alternatives can reduce belt drive noise.

Belt Drive Tension and Alignment

Properly tensioning and aligning a belt drive will allow the belt drive to perform at its quietest level.

Improperly tensioned V-belt drives can slip and squeal. Improper tension in synchronous belt drives can affect how the belt fits in the sprocket grooves. Proper tension minimizes tooth to groove interference, and thereby reduces belt noise. Check to make sure that the drive is properly tensioned by using Gates tension measurement gauges.

Misaligned V-belt drives will be noisier than properly aligned drives since interference is created at the belt's entry point into the sheave. Misaligned synchronous belt drives tend to be much noisier than properly aligned drives due to the even greater amount of interference that is created between the belt teeth and the sprocket grooves. Misaligned synchronous belt drives may cause belt tracking that forces the edge of the belt to ride hard against a sprocket flange. Misalignment causing belt contact with a flange will generate noise that is easily detected. Follow the guidelines discussed in the installation section of this manual for checking and correcting alignment.



Noise Barriers and Absorbers

Sometimes, even properly aligned and tensioned belt drives may be too noisy for a work environment. When this occurs, steps can be taken to modify the drive guard to reduce the noise level.

Noise barriers are used to block and reflect noise. Noise barriers do not absorb or deaden the noise; they block the noise and generally reflect most of the noise back towards its point of origin. Good noise barriers are dense, and should not vibrate. A sheet metal belt guard is a noise barrier. The more complete the enclosure is, the more effective it is as a noise barrier. Noise barrier belt guards can be as sophisticated as a completely enclosed case, or as simple as sheet metal covering the front of the guard to prevent direct sound transmission.

Noise absorbers are used to reduce noise reflections and to dissipate noise energy. Noise absorbers should be used in combination with a noise barrier. Noise absorbers are commonly referred to as acoustic insulation. Acoustic insulation (the noise absorber) is used inside of belt guards (the noise barrier) where necessary. A large variety of acoustic insulation manufacturers are available to provide different products for the appropriate situation.

A combination of noise barrier (solid belt guard) and noise absorber (acoustic insulation) will provide the largest reduction in belt drive noise. While the noise reduction cannot be predicted, field experience has shown that noise levels have been reduced by 10 to 20 dBA when using complete belt guards with acoustic insulation.



SPROCKET CORROSION PREVENTION

Poly Chain® GT® Carbon™ belt drives are excellent replacements for roller chain drives. Poly Chain® GT® Carbon™ belt drives offer significant maintenance savings and performance advantages over roller chain drives on applications that operate in corrosive environments. Synchronous belt drives also provide energy savings compared to V-belt drives. Some of these applications may also operate in corrosive environments.

Corrosive Environments

Many applications in the food and beverage industry are located in areas that require periodic wash down. Unless a drive is completely shielded and protected from wash down, rust and corrosion will be rapidly apparent in these types of environments.

Applications that are located in environments that have high humidity or moisture content will also develop sprocket and bushing corrosion. Examples of these types of environments are pulp processing applications and cooling tower applications that pass moist air over the belt drive.

Effects of Corrosion

Corrosion will attack the sprocket grooves, building up rust deposits. The corrosion will increase over time, building up in the sprocket grooves and non-driving surfaces (flanges, sprocket faces, bushing face).



Sprockets with corrosion in the grooves will rapidly wear the belt's teeth. Sprockets with corroded grooves will wear through the abrasion resistant tooth fabric, resulting in tooth shear and premature belt failure.



SPROCKET CORROSION PREVENTION

Preventing Corrosion

Sprocket corrosion can be prevented by using Gates stainless steel Poly Chain® GT®2 sprockets and bushings. Sprockets can also be electroless nickel plated. Both solutions will eliminate corrosion as a cause of failure on belt drives located in these damaging environments.

The sprocket shown below has been electroless nickel plated. Compare the grooves to the unprotected corroded sprocket shown on page 35.



The photo below illustrates the difference in wear between belts running on properly plated sprockets and those running on corroded sprockets. The wear on the belt running on corroded sprockets is severe and will result in a greatly shortened belt life.





TROUBLESHOOTING GUIDE

When troubleshooting a drive problem, the goal is to identify the cause(s), then take appropriate corrective action. The following steps should be followed to help with this process.

- 1. Describe the drive problem as accurately as possible. Use Step 1 as a guide. Use this step as a guide in the troubleshooting process.
- **2.** Go through the list of "Drive Symptoms". Check those symptoms that are observed and record them, as well as observations of anything unusual about the drive.
- **3.** Go through the "Problem/Solution Summary Table". List the probable cause(s) and corrective action. Also, review the list of observations.
- **4.** After identifying probable causes and corrective action, review and implement.

What to Do When All Else Fails

If the problem still exists after all troubleshooting efforts have been exhausted, contact the local Gates distributor. If the local distributor cannot solve the problem, a qualified Gates representative can be contacted. Save the failed belt(s) for further inspection.

Gates Power Transmission Product Application engineers are also available at ptpasupport@gates.com or (303) 744-5800 to answer additional drive design and troubleshooting questions.



Step 1

Describe the problem

- What is wrong?
- When did it happen?
- How often does it happen?
- What is the drive application?
- Have the machine operations or output changed?
- What kind of belt(s) are being used?
- What are the expectations for belt performance in this application?

Step 2

Identify symptoms and record observations of anything unusual.

V-Belt Drive Symptoms

Check List

(Check those that are observed)

• Premature Belt Failure

□ Broken belt(s)

 \Box Belt(s) fail to carry load (slip). No visible reason

□ Edge cord failure

□ Belt delamination or undercord separation

• Severe or Abnormal Belt Wear

- □ Wear on belt top surface
- \Box Wear on top corners of belt
- □ Wear on belt sidewall
- \Box Wear on belt bottom corners
- \Box Wear on bottom surface of belt
- \Box Undercord cracking
- \Box Burn or hardening on bottom or sidewall
- \Box Belt surface flaking, sticky or swollen
- □ Belt stretch
- $\hfill\square$ Extensive hardening of belt exterior



TROUBLESHOOTING GUIDE

V-Belt Drive Symptoms Checklist-cont.

• Problems with PowerBand® Belts

- \Box Tie-band separation
- \Box Top of tie-band frayed, worn or damaged
- \Box Band comes off drive
- \Box One or more ribs run outside of pulley

• V-Belt Turns Over or Jumps off Sheave

- □ Single belt
- \Box One or more belts in a set
- \Box Joined or banded belts

• Problems with Belt Take-Up

- □ Single belt
- □ Multiple belts stretch unequally
- □ All belts stretch equally
- \Box Belts do not match

• V-Belt Noise

- □ Squeal or "chirp"
- □ Slapping noise
- □ Rubbing sound
- □ Grinding
- □ Unusually loud drive

• Unusual Vibration

- \Box Belts flopping
- \Box Excessive vibration in drive system

• Problem With Sheaves

 \Box Broken or damaged

 \Box Severe, rapid groove wear

• Problems With Drive Components

- □ Bent or broken shafts
- \Box Hot bearings

Gate

Synchronous Drive Symptoms Checklist

- Belt Problems
 - 🗆 Unusual noise
 - \Box Tension loss
 - \Box Excessive belt edge wear
 - \Box Tensile break
 - □ Cracking
 - □ Premature tooth wear
 - 🗆 Tooth shear
 - □ Belt ratcheting
 - \Box Land area worn

• Sprocket Problems

- \Box Flange failure
- 🗆 Unusual wear
- □ Rusted or corroded

• Performance Problems

- □ Incorrect driveN speeds
- □ Belt tracking problems
- □ Excessive temperature: bearings, housings, shafts, etc.
- \Box Shafts out of sync
- \Box Vibration

V-Belt Drive Symptoms

Premature Belt Failure

Symptoms	Probable Cause	Corrective Action
Broken belt(s)	 Under-designed drive Belt rolled or pried onto sheave 	 Redesign, using Gates manual. Use drive take-up when installing.
	3. Object falling into drive	 Provide adequate guard or drive protection.
	4. Severe shock load	4. Redesign to accommodate shock load.
Belts fail to carry load, no	1. Underdesigned drive	1. Redesign, using Gates manual.
visible reason	2. Damaged tensile member	2. Follow correct installation procedure.
	3. Worn sheave grooves	 Check for groove wear; replace as needed.
	4. Center distance movement	4. Check drive for center distance movement during operation.
Edge cord failure	1. Pulley misalignment	1. Check alignment and correct.
	2. Damaged tensile member	2. Follow correct installation procedure.
Belt de-lamination or undercord separation	1. Too small sheaves	 Check drive design, replace with larger sheaves.
	2. Use of too small backside idler	2. Increase backside idler to acceptable diameter

NOTE: Belt Failure Analysis poster #12975 available. Contact your Gates Representative.



PROBLEM/SOLUTION SUMMARY TABLE

Severe or Abnormal V-Belt Wear

Symptoms	Probable Cause	Corrective Action
Wear on top surface of belt	 Rubbing against guard Idler malfunction 	 Replace or repair guard. Replace idler.
Wear on top corner of belt	1. Belt-to-sheave fit incorrect (belt too small for groove)	1. Use correct belt-to-sheave combination.
	1. Belt slip	1. Retention until slipping stops.
Wear on belt sidewalls	2. Misalignment	2. Realign sheaves.
	3. Worn sheaves	3. Replace sheaves.
	4. Incorrect belt	4. Replace with correct belt size.
Wear on bottom corner of belt	1. Belt-to-sheave fit incorrect	1. Use correct belt-to-sheave combination.
	2. Worn sheaves	2. Replace sheaves.
Wear on bottom surface of belt	1. Belt bottoming on sheave groove	1. Use correct belt/sheave match.
A CONTRACT OF CONTRACT	2. Worn sheaves	2. Replace sheaves.
	3. Debris in sheaves	3. Clean sheaves.
Undercord cracking	1. Sheave diameter too small	 Use larger diameter sheaves. Retention
	3. Backside idler too small	 Use larger diameter backside idler.
	4. Improper storage	 Don't coil belt too tightly, kink or bend. Avoid heat and direct sunlight.



Severe or Abnormal V-Belt Wear-cont.

Symptoms	Probable Cause	Corrective Action
Undercord or sidewall burn or hardening	 Belt slipping Worn sheaves Underdesigned drive Shaft movement 	 Retension until slipping stops. Replace sheaves. Refer to Gates drive manual. Check for center distance changes.
Belt surface hard or stiff	1. Hot drive environment	1. Improve ventilation to drive.
Belt surface flaking, sticky or swollen	1. Oil or chemical contamination	 Do not use belt dressing. Eliminate sources of oil, grease or chemical contamination.
A THE THE PARTY	at the second second	



Problems With PowerBand® Belts

Symptoms	Probable Cause	Corrective Action
Tie band separation	1. Worn sheaves 2. Improper groove spacing	 Replace sheaves. Use standard groove sheaves.
Top of tie band frayed or worn	 Interference with guard Backside idler malfunction or damaged 	1. Check guard. 2. Replace or repair backside idler
PowerBand® belt comes off drive repeatedly	1. Debris in sheaves 2. Misalignment	 Clean grooves. Use single belts to prevent debris from being trapped in grooves. Realign drive.
PowerBand® belt comes off drive repeatedly	 Debris in sheaves Misalignment 	 Clean grooves. Use single be prevent debris from being tra in grooves. Realign drive.



Problems With PowerBand® Belts-cont.

Symptoms	Probable Cause	Corrective Action
One or more "ribs" runs out of	1. Misalignment	1. Realign drive.
pulley	2. Undertensioned	2. Retension.



V-Belts Turn Over or Come Off Drive

Symptoms	Probable Cause	Corrective Action
Involves single or multiple belts	1. Shock loading or vibration	 Check drive design. Use Gates PowerBand[®] belts or Power Cable[®] belts.
A REAL PROPERTY AND A REAL	2. Foreign material in grooves	2. Shield grooves and drive.
Service and the service of the servi	3. Misaligned sheaves	3. Realign the sheaves.
	4. Worn sheave grooves	4. Replace sheaves.
	5. Damaged tensile member	 Use correct installation and belt storage procedure.
	6. Incorrectly placed flat idler	 Carefully align flat idler on slack side of drive as close as possible to driveR sheaves.
	7. Mismatched belt set	 Replace with Gates matched belts. <u>Do not mix old and new</u> <u>belts.</u>
	8. Poor drive design	 Check for center distance stability and vibration dampening.

Problems with V-Belt Take-Up

Symptoms	Probable Cause	Corrective Action
Multiple belts stretch unequally	1. Misaligned drive	1. Realign and retension drive.
	2. Debris in sheaves	2. Clean sheaves.
	 Broken tensile member or cord damaged 	3. Replace all belts, install properly.
	4. Mismatched belt set	4. Install Gates matched belt set.
Single belt, or where all belts stretch evenly	1. Insufficient take-up allowance	 Check take-up. Use allowance specified in Gates design manuals.
	Grossly overloaded or under designed drive	2. Redesign drive.
	3. Broken tensile members	3. Replace belt, install properly.
Belts do not match	1. Not all belts are from the same manufacturer	1. Use Gates belts.



V-Belt Noise

Symptoms	Probable Cause	Corrective Action
Belt squeals or chirps	1. Belt slip 2. Contamination	 Retension. Clean belts and sheaves.
Slapping Sound	 Loose belts Mismatched set Misalignment 	 Retension. Install matched belt set. Realign pulleys so all belts share load equally.
Rubbing sound	1. Guard interference	1. Repair, replace or redesign guard.
Grinding sound	1. Damaged bearings	1. Replace, align & lubricate.
Unusually loud drive	1. Incorrect belt	 Use correct belt size. Use correct belt tooth profile for sprockets on synchronous drive.
	2. Incorrect Tension	2. Check tension and adjust.
	3. Worn sheaves	3. Replace sheaves.
	4. Debris in sheaves	 Clean sheaves, improve shielding, remove rust, paint, or remove dirt

from grooves.

Unusual Vibration

Symptoms	Probable Cause	Corrective Action
Belts flopping	 Loose belts (under tensioned) Mismatched belts Pulley misalignment 	 Retension. Install Gates matched belts. Align pulley
Unusual or excessive vibration	1. Incorrect belt	1. Use correct belt cross section in pulley. Use correct tooth profile and nitch in sprocket
	2. Poor machine or equipment design	 Check structure and brackets for adequate strength.
	3. Pulley out of round	3. Replace with non-defective pulley.
	4. Loose drive components	4. Check machine components and guards, motor mounts, motor pads, bushings, brackets and framework for stability, adequate design strength, proper maintenance and proper installation.
Problems With Sheaves		
Symptoms	Probable Cause	Corrective Action
Broken or damaged sheave	1. Incorrect sheave installation	1. Do not tighten bushing bolts beyond recommended torque values
	2. Foreign objects falling into drive	2 Use adequate drive guard
	3. Excessive rim speeds	 Keep pulley rim speeds below maximum recommended value.
	4. Incorrect belt installation	4. Do not pry belts onto pulleys.
Severe Groove Wear	1. Excessive belt tension	1. Retension, check drive design.
	2. Sand, debris or contamination	 Clean and shield drive as well as possible.
	3. Wrong belt	3. Make sure belt and sheave combination is correct.



Problem With Other Drive Components

Symptoms	Probable Cause	Corrective Action
Bent or broken shaft	1. Extreme belt overtension	1. Retension.
	2. Overdesigned drive*	Check drive design, may need to use smaller or fewer belts.
	3. Accidental damage	3. Redesign drive guard.
	4. Machine design error	4. Check machine design.
	 Accidental damage to guard or poor guard design 	5. Repair, redesign for durability.
	6. Pulley mounted too far away from outboard bearing	6. Move pulley closer to bearing.
Hot Bearings	 Worn grooves - belts bottoming and won't transmit power until overtensioned* 	 Replace sheaves. Tension drive properly.
	2. Improper tension	2. Retension.
	 Motor manufacturer's sheave diameter recommendation not followed 	3. Redesign using drive design manual.
	4. Bearing underdesigned	4. Check bearing design.
	5. Bearing not properly maintained	5. Align and lubricate bearing.
	6. Sheaves too far out on shaft	 Place sheaves as close as possible to bearings. Remove obstructions
	7. Belt Slippage	7. Retension.

* Using too many belts, or belts that are too large, can severely stress motor or driveN shafts. This can happen when load requirements are reduced on a drive, but the belts are not redesigned accordingly. This can also happen when a drive is greatly overdesigned. Forces created from belt tensioning are too great for the shafts.

Synchronous Drive Symptoms

Synchronous Belt Problems

Symptoms	Probable Cause	Corrective Action
Unusual noise	1. Misaligned drive	1. Correct alignment.
	2. Too low or high tension	2. Adjust to recommended value.
	3. Backside idler	3. Use inside idler.
	4. Worn sprocket	4. Replace.
	5. Bent guide flange	5. Replace.
	6. Belt speed too high	6. Redesign drive.
	7. Incorrect belt profile for sprocket	7. Use proper belt/sprocket combination.
	8. Subminimal diameter	 Redesign drive using larger diameters.
	9. Excessive load	 Redesign drive for increased capacity.

NOTE: Belt Failure Analysis poster #12975 available. Contact your Gates Representative.
Synchronous Belt Problems-cont.

Symptoms	Probable Cause	Corrective Action		
Tension Loss	1. Weak support structure	1. Reinforce structure.		
	2. Excessive sprocket wear	2. Use alternate sprocket material.		
	3. Fixed (non-adjustable) centers	 Use inside idler for belt adjustment. 		
	4. Excessive debris	4. Remove debris, check guard.		
	5. Excessive load	5. Redesign drive for increased capacity.		
	6. Subminimal diameter	6. Redesign drive using larger diameters.		
	 Belt, sprocket or shafts running too hot 	7. Check for conductive heat transfer from prime mover.		
	8. Unusual belt degradation	8. Reduce ambient drive temperature to 185°F maximum.		
Excessive Belt Edge Wear	1. Damage due to handling	1. Follow proper handling instructions.		
	2. Flange damage	2. Repair flange or replace sprocket.		
	3. Belt too wide	3. Use proper width sprocket.		
	4. Belt tension too low	 Adjust tension to recommended value. 		
	5. Rough flange surface finish	 Replace or repair flange (to eliminate abrasive surface). 		
	6. Improper tracking	6. Correct alignment.		
	7. Belt hitting drive guard or bracketry	7. Remove obstruction or use inside idler.		
	8. Misalignment	8. Realign drive.		
Tensile Break	1. Excessive shock load	1. Redesign drive for increased capacity.		
a provide and	2. Subminimal diameter	2. Redesign drive using larger diameters.		
E	 Improper belt handling and storage prior to installation (crimping) 	 Follow proper storage and handling procedures. 		
any course	4. Debris or foreign object in drive	4. Remove objects and check guard.		
	5. Extreme sprocket run-out	5. Replace sprocket.		
Belt Cracking	1. Subminimal diameter	 Redesign drive using larger diameter. 		
	2. Backside idler	 Use inside idler or increase diameter of backside idler. 		
	3. Extreme low temperature at start-up.	3. Pre-heat drive environment.		
	 Extended exposure to harsh chemicals 	4. Protect drive.		
	5. Cocked bushing/sprocket assembly	5. Install bushing per instructions.		
Premature Tooth Wear	1. Too low or high belt tension	1. Adjust to recommended value.		
	 Belt running partly off unflanged sprocket 	2. Correct alignment.		
	3. Misaligned drive	3. Correct alignment.		
	4. Incorrect belt profile for sprocket	4. Use proper belt/sprocket		
	· · ·	combination.		
	5. Worn sprocket	5. Replace.		
	6. Rough sprocket teeth	6. Replace sprocket.		



PROBLEM/SOLUTION SUMMARY TABLE

Synchronous Belt Problems-cont.

Symptoms	Probable Cause	Corrective Action		
Premature Tooth Wear-cont.	7. Damaged sprocket	7. Replace.		
	specification	8. Replace.		
	 Belt hitting drive bracketry or other structure 	9. Remove obstruction or use idler.		
	10. Excessive load	10. Redesign drive for increased capacity.		
	11. Insufficient hardness of sprocket material	11. Use a more wear-resistant sprocket.		
	12. Excessive debris	12. Remove debris, check guard.		
	 Cocked bushing/sprocket assembly 	13. Install bushing per instructions.		
Tooth Shear	1. Excessive shock loads	1. Redesign drive for increased capacity.		
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	2. Less than 6 teeth-in-mesh	2. Redesign drive.		
前非常に登りまた時がある。	Extreme sprocket run-out	3. Replace sprocket.		
(4. Worn sprocket	4. Replace.		
1. 网络新闻家 化合金	5. Backside idler	5. Use inside idler.		
·····································	 Incorrect belt profile for the sprocket 	 Use proper belt/sprocket combination. 		
	7. Misaligned drive	7. Realign.		
	8. Belt undertensioned	 Adjust tension to recommended value. 		
Belt Ratcheting	1. Drive is undertensioned	1. Adjust tension to recommended value.		
	2. Excessive shock loads	 Redesign drive for increased capacity. 		
	3. Drive framework not rigid	3. Reinforce system.		
Land Area Worn	1. Excessive tension	1. Adjust tension to recommended value.		
	2. Excessive sprocket wear	 Check sprocket condition. Replace if necessary. 		

Synchronous Sprocket Problems

Symptoms	Probable Cause	Corrective Action			
Flange Failure	1. Belt forcing flange off	 Correct alignment or properly secure flange to sprocket. 			
Unusual Sprocket Wear	 Sprocket has too little wear resistance (i.e. plastic, aluminum, soft metals) 	1. Use alternate sprocket material.			
	2. Misaligned drive	2. Correct alignment.			
	3. Excessive debris	3. Remove debris, check guard.			
	4. Excessive load	 Redesign drive for increased capacity. 			
	5. Belt tension too low or high	5. Adjust tension to recommended value.			
	6. Incorrect belt profile	 Use proper belt/sprocket combination. 			



Synchronous Sprocket Problems-cont.

Symptoms	Probable Cause	Corrective Action		
Rust and Corrosion	 Rust caused by high moisture conditions in the production area, 	 Replace cast iron sprockets with nickel plated or stainless steel 		
	or by the use of water-based cleaning solutions.	sprockets and use stainless steel bushings.		

Performance Problems

Symptoms	Probable Cause	Corrective Action		
Incorrect driveN speed	1. Design error	 Use correct driveR/driveN sprocket size for desired speed ratio. 		
Belt Tracking	 Belt running partly off unflanged sprocket 	1. Correct alignment.		
	2. Centers exceed 8 times small sprocket diameter	 Correct parallel alignment to set belt to track on both sprockets. Flange both sprockets. 		
	3. Excessive belt edge wear	3. Correct alignment.		
Excessive Temperature (Belt, Bearing, Housing, Shafts, etc.)	1. Misaligned drive 2. Too low or high belt tension	 Correct alignment. Adjust tension to recommended value. 		
	3. Incorrect belt profile	 Use proper belt/sprocket combination. 		
Shafts Out of Sync	1. Design error 2. Incorrect belt	 Use correct sprocket sizes. Use correct belt with correct tooth profile for grooves. 		
Vibration	 Incorrect belt profile for the sprocket 	 Use proper belt/sprocket combination. 		
	2. Too low or high belt tension	 Adjust tension to recommended value. 		
	3. Bushing or key loose	3. Check and reinstall per instructions.		

NOTE: Belt Failure Analysis poster #12975 available. Contact your Gates Representative.



MAINTENANCE TOOLS

The tools available to help troubleshoot drive problems range from the surprisingly simple to complicated. Following is a list of tools that can be used to effectively diagnose a problem. While Gates does not sell all of the items discussed in this section, the items are readily available from industrial instrumentation outlets throughout the United States.

Eyes, Ears & Nose

When troubleshooting a belt drive problem, stand back and observe the drive while it is in operation and at rest. Is there a warm rubber smell? Is there anything unusual about the way the belt travels around the drive? Is the drive frame flexing under load? Are there chirping, squealing or grinding noises? Is there an accumulation of dust or debris beneath the drive which might interfere with the belts?

Squirt Bottle With Soapy Water

When a belt drive is excessively noisy, the belt is often incorrectly blamed. It is easy to eliminate the belt as the problem by spraying it with soapy water while it is running. If the noise goes away, or decreases, then the belt is part of the problem. If the same noise is still present, the problem is likely due to other drive components.

String

Variation in drive center distance, often caused by weak supporting structure, can cause problems from vibration to short belt life. To determine if center distance variation exists, turn off the drive and tightly tie a piece of string from the driveR to the driveN shaft. Start up the drive and note if the string stretches almost to the point of breaking, or goes slack. If either is the case, the problem could be center distance variation.

It is particularly important to observe the string right at drive start up when the loads are highest. String can also be used to check pulley alignment.

Belt & Sheave Groove Gauges

If a belt-to-sheave groove mismatch is suspected, English and metric belt and sheave groove gauges can be used to check dimensions. These also are handy for identifying a belt cross section for replacements and

for checking sheave grooves for wear.

These gauges are available from Gates distributors.

English Gauge: Product No. 7401-0014 Metric Gauge: Product No. 7401-0013



While V-belts can be somewhat forgiving of misalignment, this condition can still affect V-belt performance. Even slight misalignment can cause major problems on a synchronous drive. Use a long straight edge, made of wood, metal or any rigid material, to quickly check drive alignment. Simply lay the straight edge across the pulley faces and note the points of contact (or lack of contact).

Design Flex[®] Pro[™] and Design IQ[™] Software

Gates design suite of engineering programs include interactive support software and a user friendly interface for rapid data retrieval and smooth design work.

Both programs are available at <u>www.gates.com/</u> <u>drivedesign</u>.

NOTE: In some cases redesign of the drive is necessary. Gates Design Flex[®] Pro[™] drive design software provides a quick, accurate and flexible method of correctly redesigning problem drives.

On-the-go belt tensioning information is available in our PT Toolkit mobile app. Download today.





MAINTENANCE TOOLS









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Belt Tension Testers

Improper belt tension, either too high or too low, can cause belt drive problems. An "experienced" thumb may be okay for ordinary drives, but for critical drives, Gates recommends using a tension gauge. Proper tension and installation can extend belt life and reduce costly downtime.

Several types of tension gauges are available.

A. Tension Tester (Product No. 7401-0076)

Maximum deflection force: 30 lbs. For use with all small V-belt and Synchronous drives, including PowerBand® and Poly Chain® GT® Carbon™ belt drives.

B. Double Barrel Tension Tester (Product No. 7401-0075)

Maximum deflection force: 66 lbs. For use with all multiple V-belt and large Synchronous drives, including PowerBand[®] and Poly Chain[®] GT[®] Carbon[™] belt drives.

C. 5-Barrel Tension Tester (Product No. 7401-0079)

Maximum deflection force: 165 lbs. for use with multiple V-belt and large Synchronous drives.

D. Krikit Gauge (Product No. 7401-0071)

For use with Automotive V-belts up to and including 7/8" top width. **Krikit II**

(Product No. 7401-0072)

For use with Automotive V-ribbed belts up to 8 ribs in width.

E. Sonic Tension Meter Model 508C (Product No. 7420-0508)

For extremely accurate belt tension measuring, the Gates Sonic Tension Meter is an electronic device that measures the natural frequency of a free stationary belt span and instantly computes the static belt tension based upon the belt span length, belt width and belt type.

Features:

- Can be used for synchronous and V-belts.
- Uses sound waves instead of force/deflection.
- Results are repeatable with any operator.
- Portable, lightweight and easy to use.
- Fast. Calculates tension in seconds.
- Can be used in almost any environment.
- Model 508C runs on two AAA batteries.



Accessories:

- F. Flexible Sensor (Product No. 7420-0205)
- G. Optional Inductive Sensor (Product No. 7420-0212)
- H. Replacement Magnets for Inductive Sensor (Prod. No. 7420-1212, set of 10)
- I. EZ Align[®] Laser Alignment Tool (Product No. 7420-1000 - Red Laser) (Product No. 7420-3000 - Green Laser)
- Compact design
- Laser projects a line
- Mirror reflects laser line, making it easy to align shafts
- Laser line is very easy to read on targets
- Includes a hard foam filled plastic carrying case
- Green laser is ideal for outdoor or bright environment use



MAINTENANCE TOOLS

Dial Indicator

Improperly mounted sheaves or out-of-round pulleys are sometimes the root of vibration or more severe problems. This device can be used to measure side-to-side sheave wobble or diameter variation by holding it up to the sheave sidewall or top of the belt inside the pulley groove, respectively. IMPORTANT: Always turn off the machine before using the dial indicator. Rotate the drive by hand to make your measurements.



Infrared Pyrometer

The pyrometer accurately measures external belt temperatures and environmental temperatures.



Noise Meter

Use a noise meter to measure environmental and belt drive noise.



Strobe Tachometer

It is not always possible to see what is happening to a drive while it is in operation. This instrument visually stops the action to get a better idea of the dynamic forces affecting the drive. The strobe tachometer is best used after initial diagnosis of the problem because it helps pinpoint the cause. It will help identify such things as single or dual mode belt span vibration and frame flexure.





TECHNICAL INFORMATION

Table No. 1

Heavy-Duty V-Belt Section, Sheave Diameters and Standard Groove Angles

Belt Section	Sheave Datum Diameter (D.D.) (in)	Standard Groove Angle (± 0.20°)
A, AX	Up to 5.40	34
A, AX	Over 5.40	38
B, BX	Up to 7.00	34
B, BX	Over 7.00	38
C, CX	Up to 7.99	34
C, CX	8.00 to 12.00	36
C, CX	Over 12.00	38
D	Up to 12.99	34
D	13.00 to 17.00	36
D	Over 17.00	38
E	Up to 24.00	36
E	Over 24.00	38
3V, 3VX	Up to 3.49	36
3V, 3VX	3.50 to 6.00	38
3V, 3VX	6.00 to 12.00	40
3V, 3VX	Over 12.00	42
5V, 5VX	Up to 9.99	38
5V, 5VX	10.00 to 16.00	40
5V, 5VX	Over 16.00	42
8V	Up to 15.99	38
8V	16.00 to 22.40	40
8V	Over 22.40	42

Table No. 2

Maximum Allowable Outside Diameters For Cast Iron Pulleys

Maximum Shaft Speed (RPM)	Maximum Allowable Pulley Diameter (in)
600	41.40
870	28.50
1,160	21.40
1,400	17.70
1,600	15.50
1,750	14.20
2,000	12.40
2,400	10.30
2,800	8.80
3,000	8.30
3,450	7.20
4,000	6.20
4,500	5.50
5,000	5.00
7,500	3.31
10,000	2.48

Table No. 3

	Shaft Diameter (in)			Wie (dth ^w k in)*	Dep +0.01 (oth ^h k 5-0.000 in)
Up Through Over 7/16 Over 9/16 Over 7/8	7/16 (0.44) (0.44) To and Incl. (0.56) To and Incl. (0.88) To and Incl.	9/16 7/8 1 1/4	(0.56) (0.88) (1.25)	3/32 1/8 3/16 1/4	2 (0.094) (0.125) 6 (0.188) (0.250)	3/64 1/16 3/32 1/8	(0.047) (0.062) (0.094) (0.125)
Over 1 1/4	(1.25) To and Incl.	1 3/8	(1.38)	5/16	(0.312)	5/32	(0.156)
Over 1 3/8	(1.38) To and Incl.	1 3/4	(1.75)	3/8	(0.375)	3/16	(0.188)
Over 1 3/4	(1.75) To and Incl.	2 1/4	(2.25)	1/2	(0.500)	1/4	(0.250)
Over 2 1/4	(2.25) To and Incl.	2 3/4	(2.75)	5/8	(0.625)	5/16	(0.312)
Over 2 3/4	(2.75) To and Incl.	3 1/4	(3.25)	3/4	(0.750)	3/8	(0.375)
Over 3 1/4	(3.25) To and Incl.	3 3/4	(3.75)	7/8	(0.875)	7/16	(0.438)
Over 3 3/4	(3.75) To and Incl.	4 1/2	(4.50)	1	(1.000)	1/2	(0.500)
Over 4 1/2	(4.50) To and Incl.	5 1/2	(5.50)	1 1/4	(1.250)	5/8	(0.625)
Over 5 1/2	(5.50) To and Incl.	6 1/2	(6.50)	1 1/2	(1.500)	3/4	(0.750)
Over 6 1/2	(6.50) To and Incl.	7 1/2	(7.50)	1 3/4	(1.750)	3/4	(0.750)
Over 7 1/2	(7.50) To and Incl.	9	(9.00)	2	(2.000)	3/4	(0.750)
Over 9	(9.00) To and Incl.	11	(11.00)	2 1/2	(2.500)	7/8	(0.875)
Over 11	(11.00) To and Incl.	13	(13.00)	3	(3.000)	1	(1.000)

*Tolerance on Width, "k for widths up through 1/2" (0.500)+0.002-0.000 For widths over 1/2" (0.500) through 1" (1.000)+0.003-0.000 For widths over 1" (1.000)+0.004-0.000

Standard Shaft and Bushing Keyseat Dimensions





Electric Motor Frames and Minimum Sheave and Sprocket Diameters

The National Electric Manufacturers Association (NEMA) publishes recommendations for the minimum diameter of sheaves to be used on General Purpose electric motors. Purpose of the recommendations is to prevent the use of too small sheaves, which can result in shaft or bearing damage because belt pull goes up as sheave diameter goes down.

The NEMA Standard MG-1-14.42, November 1978 shows minimum recommended sheave diameters as a function of frame number. The table below lists the NEMA frame assignments and minimum diameter recommendations according to the 1964 rerating program.

		Ha	Synchronous Belts			
Motor Frame Code	Shaft Diameter (in)	3600 (3450)	1800 (1750)	1200 (1160)	900 (870)	Minimum Pitch Diameter (in)
143T	0.875	1-1/2	1	3/4	1/2	2.0
145T	0.875	2 - 3	1-1/2 - 2	1	3/4	2.2
182T	1.125	3	3	1-1/2	1	2.2
182T	1.125	5	—	_	_	2.4
184T	1.125	—	—	2	1-1/2	2.2
184T	1.125	5	—	_	_	2.2
184T	1.125	7-1/2	5	_	_	2.7
213T	1.375	7-1/2-10	7-1/2	3	2	2.7
215T	1.375	10	—	5	3	2.7
215T	1.375	15	10	_	_	3.4
254T	1.625	15	_	7-1/2	5	3.4
254T	1.625	20	15	_	_	4.0
256T	1.625	20-25	_	10	7-1/2	4.0
256T	1.625	_	20	_	_	4.0
284T	1.875	-	_	15	10	4.0
284T	1.875	_	25	_	_	4.0
286T	1.875	—	30	20	15	4.7
324T	2.125	_	40	25	20	5.4
326T	2.125	-	50	30	25	6.1
364T	2.375	-	_	40	30	6.1
364T	2.375	—	60	_	_	6.7
365T	2.375	-	_	50	40	7.4
365T	2.375	_	75	_	_	7.7
404T	2.875	_	_	60	_	7.2
404T	2.875	_	—	_	50	7.6
404T	2.875	_	100	_	_	7.7
405T	2.875	_	—	75	60	9.0
405T	2.875	_	100	_	_	7.7
405T	2.875	_	125	_	_	9.5
444T	3.375	—	—	100	-	9.0
444T	3.375	_	—	_	75	8.6
444T	3.375		125	-		9.5
444T	3.375	_	150	_	_	9.5
445T	3.375	-	_	125	-	10.8
445T	3.375		_	-	100	10.8
445T	3.375		150	-	-	10.8
445T	3.375		200	-	-	11.9

Table No. 4

For other than the General Purpose AC motors (for example, DC motors, Definite Purpose motors, motors with special bearings or motors that are larger than those covered by the NEMA standard), consult the motor manufacturer for minimum sheave diameter recommendations. It is helpful to the manufacturer to include details of the application with your inquiry.



Minimum Recommended Sprocket Outside Diameters for General Purpose Electric Motors

Data in the white area are from NEMA Standard MG-1-14-42. June 1972. Figures in black area are from MG-1-43, January 1968. The gray area is a composite of electric motor manufacturer data. They are generally conservative and specific motors and bearings may permit the use of a smaller motor sprocket. Consult the motor manufacturer.

NOTE: For a given horsepower and speed, the total belt pull is related to the motor sprocket size. As the size **decreases**, the total belt pull **increases**. Therefore, to limit the resultant load on motor and shaft bearings, NEMA lists minimum sprocket sizes for the various motors. The sprocket on the motor (DriveR sprocket) should be at least this large.

	Motor RPM (60 Cycle and 50 Cycle Electric Motors)						
Motor	575	690	870	1160	1750	3450	Motor
Horsepower	485•	575•	725•	950•	1425•	2850•	Horsepower
1/2 3/4 1 1-1/2	- 2.7 2.7	- 2.3 2.7	2.0 2.2 2.2 2.2 2.2	2.0 2.2 2.2	- 2.0 2.2	2.0	1/2 3/4 1 1-1/2
2	3.4	2.7	2.7	2.2	2.2	2.2	2
3	4.1	3.4	2.7	2.7	2.2	2.2	3
5	4.1	4.1	3.4	2.7	2.7	2.2	5
7-1/2	4.7	4.1	4.0	3.4	2.7	2.7	7-1/2
10	5.4	4.7	4.0	4.0	3.4	2.7	10
15	6.1	5.4	4.7	4.0	4.0	3.4	15
20	7.4	6.1	5.4	4.7	4.0	4.0	20
25	8.1	7.4	6.1	5.4	4.0	4.0	25
30 40 50 60	9.0 9.0 9.9 10.8	8.1 9.0 9.9 9.9	6.1 7.4 7.6 9.0	6.1 6.1 7.4 7.2	4.7 5.4 6.1 6.7	- - -	30 40 50 60
75 100 125 150	12.6 16.2 18.0 19.8	11.7 13.5 16.2 18.0	8.6 10.8 13.5 16.2	9.0 9.0 10.8 11.7	7.7 7.7 9.5# 9.5	- - -	75 100 125 150
200	19.8	19.8	19.8	-	11.9	-	200
250	19.8	19.8	-	-	-	-	250
300	24.3	24.3	-	-	-	-	300

These RPM are for 50 cycle electric motors. # Use 8.6 for Frame Number 444 T only

NEMA Minimum V-Belt Sheave Diameters

Table No. 6

Table No. 5

Minimum Recommended Sheave Outside Diameters for General **Purpose Electric Motors** Super HC[®] V-Belts, Super HC PowerBand[®] Belts, Polyflex[®] JB[®] Belts

Minimum Recommended Sheave Datum Diameters for General **Purpose Electric Motors** Hi-Power® II V-Belts, Hi-Power II PowerBand Belts

Table No. 7

	T Olynex 3D Dens.							
Motor	Moto	r RPM (60	cycle and !	50 cycle El	ectric Mote	ors)	Motor	
Horse-	575	690	870	1160	1750	3450	Horse-	
power	485*	575*	725*	950*	1425*	2850	power	
1/2	-	_	2.2	-	-	_	1/2	
3/4	_	_	2.4	2.2	_	—	3/4	
	3.0	2.5	2.4	2.4	2.2	-	1 1/2	
- 1 1/2	3.0	3.0	2.4	2.4	2.4	2.2	1 1/2	
	3.8	3.0	3.0	2.4	2.4	2.4	2	
5	4.5	4.5	3.8	3.0	3.0	2.4	5	
7 1/2	5.2	4.5	4.4	3.8	3.0	3.0	7 1/2	
10	6.0	5.2	4.4	4.4	3.8	3.0	10	
15	6.8	6.0	5.2	4.4	4.4	3.8	15	
20	8.2	6.8	6.0	5.2	4.4	4.4	20	
25	9.0	8.Z	6.8	6.0	4.4	4.4	25	
30	10.0	9.0	6.8	6.8	5.2	—	30	
40	10.0	10.0	8.Z	0.8	6.U 4.9	_	40	
60	12.0	11.0	10.0	8.0	74		60	
75	14.0	13.0	9.5	10.0	8.6	_	75	
100	18.0	15.0	12.0	10.0	8.6	_	100	
125	20.0	18.0	15.0	12.0	10.5#	—	125	
150	22.0	20.0	18.0	13.0	10.5	_	150	
200	22.0	22.0	22.0	-	13.2	_	200	
250	22.0	22.0	-	-	-	—	250	
300	27.0	Z7.U	-	-	-	_	300	

*These RPM are for 50 cycle electric motors. # 9.5 for Frame Number 444T.

	or Tri-Power [®] Molded Notch V-Belts.							
Motor	Moto	r RPM (60	cycle and	50 cycle El	ectric Mot	ors)	Motor	
Horse-	575	690	870	1160	1750	3450	Horse-	
power	485*	575*	725*	950*	1425*	2850	power	
1/2	2.5	2.5	2.2	_	-	-	1/2	
3/4	3.0	2.5	2.4	2.2	_	-	3/4	
1 1/2	3.0	2.5	2.4	2.4	2.2	22	1 1/2	
2	3.0	3.0	2.4	2.4	2.4	2.2	2	
3	4.5	3.8	3.0	3.0	2.4	2.4	3	
5	4.5	4.5	3.8	3.0	3.0	2.6	5	
7 1/2	5.2	4.5	4.4	3.8	3.0	3.0	7 1/2	
10	6.0	5.2	4.6	4.4	3.8	3.0	10	
15	6.8	6.0	5.4	4.6	4.4	3.8	15	
20	8.2	6.8 0.2	6.U 7 0	5.4	4.6	4.4	20	
20	7.0	0.2	0.0	0.0	5.0	4.4	20	
30		9.0 10.0	6.8 8.2	6.8	5.Z	_	30 70	
50	11.0	10.0	9.0	8.2	6.8		50	
60	12.0	11.0	10.0	9.0	7.4	_	60	
75	14.0	13.0	10.5	10.0	9.0	_	75	
100	18.0	15.0	12.5	11.0	10.0	-	100	
125	20.0	18.0	15.0	12.5	11.5†	-	125	
100	<u> </u>	20.0	18.0	13.0			000	
200	22.0	22.0	22.0	-	-	-	200	
300	27.0	27.0	_				200	
L 300	27.0	27.0					000	

Data in Tables 5, 6 and 7 are from NEMA Standard MG-1-14.42, MG-1-14.43, MG-1-14.45 and a composite of electic motor manufacturers data. They are generally conservative and specific motors may permit the use of smaller motor sheaves or sprockets. Consult the motor manufacturer.



Minimum Recommended Sheave Diameter By Belt Cross Section

Minimum Recommended Sprocket Sizes By Belt Cross Section

Table No. 8

|--|

Belt Cross	Min Recommended Datum Diameter					
Section	(Standard Groove) (in)					
Classical V-Belts						
AX	2.20					
Α	3.00					
BX	4.00					
В	5.40					
СХ	6.80					
С	9.00					
D	13.00					
E	21.00					
Belt Cross Section	Min Recommended Outside Diameter (Standard Groove) (in)					
Narrov	v V-Belts					
3VX	2.20					
3V	2.65					
5VX	4.40					
5V	7.10					
8V	12.50					
Light Du	ty V-Belts					
2L	0.8					
3L	1.5					
4L	2.5					
5L	3.5					
Micro-	V ₀ Belts					
J	0.8					
L	3.00					
М	7.00					
Polyflex₀ JB₀ Belts						
3M	0.67					
5M	1.04					
7M	1.67					
11M	2.64					
<u> </u>						

Belt Pitch	Min Recommended Sprocket Size (No. of Teeth)					
PowerGrip _® Timing						
MXL	12					
XL	12					
L	12					
Н	14					
XH	18					
XXH	18					
Power	Gripo HTDo					
3M	12					
5M	14					
8M	22					
14M	28					
20M	34					
Power	Grip® GT®2					
2M	12					
3M	16					
5M	18					
8M	22					
14M	28					
Poly Chaine	» GT₀ Carbon™					
8M	22					
14M	28					
Synchro-Pow	er₀ Polyurethane					
MXL	10					
XL	10					
L	10					
Н	14					
T2.5	12					
Τ5	10					
T10	16					
T20	15					
AT5	12					
AT10	18					
AT20	18					
5mm HTD	10					
8mm HTD	16					
14mm HTD	28					



Minimum Recommended Idler Diameters By Belt Cross Section

Belt Cross Section	Minimum Grooved Inside (grooves)	Min. O.D. Flat Inside Idler (in)	Min. O.D. Flat Backside Idler (in)
Classical A	3.00	2.25	4.25
В	5.400	3.75	6.00
С	9.00	5.75	8.50
D	13.00	7.50	13.50
E	21.00	19.00	27.30
AX	2.20		4.25
BX	4.00		6.00
CX	7.00		8.50
AA	3.00	2.25	
BB	5.40	3.75	
CC	9.00	5.75	
Super HC 3V	2.65		4.25
5V	7.10		10.00
8V	12.50		17.50
3VX	2.20		4.25
5VX	4.40		10.00
Predator CP	9.00	5.75	8.50
3VP	2.65		4.25
5VP	7.10		8.50
8VP	12.50		17.50

Belt Cross Section	Minimum Grooved Inside (grooves)	Min. O.D. Flat Inside Idler (in)	Min. O.D. Flat Backside Idler (in)
MXL PowerGrip Timing	12	1.00	0.50
XL PowerGrip Timing	12	2.50	1.00
L PowerGrip Timing	10	4.75	1.60
H PowerGrip Timing	14	6.38	2.88
XH PowerGrip Timing	18	11.00	6.38
XXH PowerGrip Timing	18	15.75	9.25
2M PowerGrip GT3	12	1.00	0.50
3M PowerGrip GT3 + HTD	12	1.50	0.75
5M PowerGrip GT3 + HTD	14	2.50	1.25
8M PowerGrip GT3 + HTD	22	4.00	2.80
14M PowerGrip GT3 + HTD	28	7.00	6.50
20M PowerGrip HTD	34	10.00	11.00
5M Poly Chain GT Carbon	16	2.50	1.88
8M Poly Chain GT Carbon	25	4.00	3.00
14M Poly Chain GT Carbon	28	7.00	6.50

Table No. 10



Minimum Center Distance Allowances for Belt Installation and Takeup

		Minimum Center Distance Allowance for Initial Tensioning and Subsequent Takeup (in)					
Number	3V.	/3VX	5V/	/5VX	8V		All Cross Sections
	Super HC [®] V-Beits	Super HC [®] PowerBand [®] Belt*	Super HC [®] V-Belts	Super HC [®] PowerBand [®] Belt*	Super HC [®] V-Belts	Super HC [®] PowerBand [®] Belt*	All Types
Up To and Incl. 475 Over 475 To and Incl. 710 Over 710 To and Incl. 1060	0.5 0.8 0.8	1.2 1.4 1.4	1.0 1.0	2.1 2.1	1.5	3.4	1.0 1.2 1.5
Over 1060 To and Incl. 1250 Over 1250 To and Incl. 1700 Over 1700 To and Incl. 2000	0.8 0.8	1.4 1.4	1.0 1.0 1.0	2.1 2.1 2.1	1.5 1.5 1.8	3.4 3.4 3.6	1.8 2.2 2.5
Over 2000 To and Incl. 2360 Over 2360 To and Incl. 2650 Over 2650 To and Incl. 3000			1.2 1.2 1.2	2.4 2.4 2.4	1.8 1.8 1.8	3.6 3.6 3.6	3.0 3.2 3.5
Over 3000 To and Incl. 3550 Over 3550 To and Incl. 3750 Over 3750 To and Incl. 5000 Over 5000 To and Incl. 6000			1.2	2.4	2.0 2.0 2.0 2.0	4.0 4.0 4.0 4.0	4.0 4.5 5.5 6.0

Table No. 11

*Also use these figures for individual Super HC V-Belts in deep groove sheaves.

Minimum Center Distance Allowances for Belt Installation and Takeup

Table No. 12

	Minimum Center Distance Allowance for Installation (in)								Minimum Center Distance Allowance for Initial Tensioning and Subsequent Takeup (in)		
V-Belt		A		В		C	I)	E		All Cross Sections
Number	Hi-Power II and Tri-Power® Molded Notch V-Belts	Hi-Power II PowerBand Belt*	Hi-Power II and Tri-Power [®] Molded Notch V-Belts	Hi-Power II PowerBand Belt*	Hi-Power II and Tri-Power [®] Molded Notch V-Belts	Hi-Power II PowerBand Belt*	Hi-Power II and Tri-Power® Molded Notch V-Belts	Hi-Power II PowerBand Belt*	Hi-Power II V-Belts	Hi-Power II PowerBand Belt*	All Types
Up To and Incl. 35 Over 35 To and Incl. 55 Over 55 To and Incl. 85	0.75 0.75 0.75	1.20 1.20 1.30	1.00 1.00 1.25	1.50 1.50 1.60	1.50 1.50	2.00 2.00					1.00 1.50 2.00
Over 85 To and Incl. 112 Over 112 To and Incl. 144 Over 144 To and Incl. 180	1.00 1.00	1.30 1.50	1.25 1.25 1.25	1.60 1.80 1.80	1.50 1.50 2.00	2.00 2.10 2.20	2.00 2.00	2.90 3.00	2.50	3.40	2.50 3.00 3.50
Over 180 To and Incl. 210 Over 210 To and Incl. 240 Over 240 To and Incl. 300			1.50 1.50 1.50	1.90 2.00 2.20	2.00 2.00 2.00	2.30 2.50 2.50	2.00 2.50 2.50	3.20 3.20 3.50	2.50 2.50 3.00	3.50 3.60 3.90	4.00 4.50 5.00
Over 300 To and Incl. 390 Over 390					2.00 2.50	2.70 2.90	2.50 3.00	3.60 4.10	3.00 3.50	4.00 4.40	6.00 1.5% of belt length

*Also use these figures for individual Hi-Power II and Tri-Power Molded Notch V-Belts in deep groove sheaves.



INSTALLATION AND TENSIONING ALLOWANCES

Table	No	. 13
Micro-	V® I	Belts

V-Belt Number	Minim	Minimum Center Distance Allowance For Initial Tensioning and Subsequent Takeup (in)		
Standard Effective Length (in)	J	L	м	All Cross Sections
Up through 20.0 20.1 through 40.0 40.1 through 60.0 60.1 through 80.0 80.1 through 100.0	0.4 0.5 0.6 0.7 0.8	 0.9 1.0 1.2	 1.5	0.3 0.5 0.7 0.9 1.1
100.1 through 120.0 120.1 through 160.0 160.1 through 200.0 200.1 through 240.0 240.1 through 300.0	- - - - -	1.2 1.4 — —	1.6 1.7 1.8 1.9 2.2	1.3 1.7 2.2 2.6 3.3
300.1 through 360.0 60.1 through 370.0		_	2.5 2.7	3.9 4.6

Table No. 14 Polyflex[®] JB[®] Belts

V-Belt Number		Minimum f	Minimum Center Distance Allowance For Initial Tensioning and Subsequent Takeup (in)		
Standard Effective Length (in)	3M	5M	7M	11M	All Cross Sections
180-300	.18	0.4	_	_	0.2
307-750	.28	0.6	0.6	1.0	0.6
750-1090	_	0.9	0.9	1.2	1.1
1120-1500	_	1.1	1.1	1.4	1.4
1550-1900	_	_	1.1	1.5	1.4
1950-2300	-	_	1.5	1.9	1.8

Table No. 15

Belt Length (mm) (in)	Standard Installation Allowance (Flanged Sprockets Removed for Installation) (mm) (in)	Tensioning Allowance (Any Drive) (mm) (in)
Up to 40	1.8 0.07	0.8 0.03
Over 1000 to 1780 70	2.8 0.11	0.8 0.03
Over 1780 to 2540	3.3 0.13	1.0 0.04
Over 2540 to 3300	4.1 0.16	1.0 0.04
Over 3300 to 4600	5.3 0.21	1.3 0.05



Center Distance Allowance For Installation and Tensioning

Table No. 16

Additional Center Distance Allowance for Installation Over Flanged Sprocket*

(Add to Installation Allowance in Above Table)

Belt Pitch (mm) (in)	One Sprocket Flanged (mm) (in)	Both Sprockets Flanged (mm) (in)
8mm	21.8 0.86	33.3 1.31
14mm	31.2 1.23	50.0 1.97

* For drives that require installation of the belt over one sprocket at a time, use the value for both sprockets flanged — even if only one sprocket is flanged.

Table No. 17

Beit Pitch (mm) (in)	Standard Installation Allowance (Flanged Sprockets Removed for Installation) (mm) (in)	Tensioning Allowance (Any Drive) (mm) (in)
Up to 125 5	0.5 0.02	0.5 0.02
Over 1 25 to 2 50 10	0.8 0.03	0.8 0.03
Over $\frac{250}{10}$ to $\frac{500}{20}$	1.0 0.04	0.8 0.03
Over 500 to 1000 40	1.8 0.07	0.8 0.03
Over 40 to 70	2.8 0.10	0.8 0.04
Over 1780 to 2540 100	3.3 0.13	1.0 0.04
Over $\frac{2540}{100}$ to $\frac{3300}{130}$	4.1 0.16	1.3 0.05
Over $\frac{3300}{130}$ to $\frac{4600}{180}$	4.8 0.19	1.3 0.05
Over $\frac{4600}{180}$ to $\frac{6900}{270}$	5.6 0.22	1.3 0.05

Power Grip GT[®]3 and HTD Center Distance Allowance for Installation and Tensioning

Table No. 18

Belt Pitch (mm) (in)	One Sprocket Flanged (mm) (in)	Both Sprockets Flanged (mm) (in)
5mm	13.5 0.53	19.1 0.75
8mm	21.8 0.86	33.3 1.31
14mm	31.2 1.23	50.0 1.97
20mm	47.0 1.85	77.5 3.05

* For drives that require installation of the belt over one sprocket at a time, use the value for "Both Sprockets Flanged".

Additional Center Distance Allowance for Installation Over Flanged Sprockets*

(Add to Installation Allowance in Above Table)

Power Grip® Timing Belts Center Distance Allowance for Installation and Tensioning

Table No. 19

Belt Length (in)	Standard Installation Allowance (Flanged Pulleys Removed for Installation) (in)	Tensioning Allowance (Any Drive) (in)
3.6 to 5.0	.02	.02
Over 5.0 to 10.0	.03	.03
Over 10.0 to 20.0	.04	.03
Over 20.0 to 40.0	.05	.04
Over 40.0 to 60.0	.07	.05
Over 60.0 to 180.0	.12"	.08"

Table No. 20

Additional Center Distance Allowance for Installation Over Flanged Pulleys*

(Add to Installation Allowance in Above Table)

Belt Pitch (in)	Small Pulley Flanged (in)	Both Pulleys Flanged (in)
0.080" (MXL)	.33	.49
0.200" (XL)	.46	.71
0.375" (L)	.64	.85
0.500" (H)	.64	.96
0.875" (XH)	1.14	1.92
1.250" (XXH)	1.53	2.65

* For drives that require installation of the belt over one sprocket at a time, use the value for both pulleys flanged — even if only one pulley is flanged.

Table No. 21

Estimating Belt Length from Drive Dimensions

(2 Pulleys)

Belt Length = $2C + 1.57 (D + d) +$	$\frac{(D-d)^2}{4C}$
Where: C = Shaft Center Distance	
a.) For Super HC^{\otimes} :	Belt Length = Belt Outside Diameter D = 0.D. of Larger Pulley d = 0.D. of Smaller Pulley
b.) For Hi-Power [®] II and Tri-Power [®] Molded Notch:	Belt Length = Datum Length D = Datum Diameter of Larger Pulley d = Datum Diameter of Smaller Pulley
c.) For Synchronous Belts:	Belt Length = Pitch Length D = Pitch Diameter of Larger Sprocket d = Pitch Diameter of Smaller Sprocket



IDLER HARDWARE

Flat Idler Pulley



Flat Idler Pulley

		Use With	Synchonous Belt	Use		Face		_			_			
Part No.	Product No.	Pitch	Width	With V-Belt	Outside Dia. (in)	Width (in)	A (in)	B (in)	C (in)	D (in)	E (in)	Thread Size	Bearing No.	Weight (lb)
4.25x1.25-IDL-FLAT	7723-4125	8mm, L, H	Up to 21mm (0.85")	1-2 Strand 3V/3VX, 1 Strand A/AX	4.25	1.25	1.13	1.13	.64	1.30	3.75	3/4-16	6304	5.20
4.25x1.25-IDL-FLAT	7723-4200	8mm, L, H	Up to 38mm (1.5")	3-4 Strand 3V/3VX, 2 Strand A/AX	4.25	2.00	1.50	1.13	.63	1.32	4.50	3/4-16	6306	7.50
4.25x1.25-IDL-FLAT	7723-4300	8mm, L, H	Up to 62mm (2.4")	5-6 Strand 3V/3VX, 3 Strand A/AX	4.25	3.00	1.50	1.13	.75	1.32	5.63	3/4-16	6306	10.60
4.25x1.25-IDL-FLAT	7723-4400	8mm, L, H	Up to 85mm (3.3")	8 Strand 3V/3VX, 4 Strand A/AX	4.25	4.00	1.50	1.13	.75	1.32	6.63	3/4-16	6306	13.60
6.50x1.75-IDL-FLAT	7723-6175	14mm	Up to 20mm	1 Strand B/BX	6.50	1.75	2.00	1.50	1.04	1.96	5.69	1-14	6308	17.10
6.50x2.75-IDL-FLAT	7723-6275	14mm	Up to 55mm	2-3 Strand B/BX	6.50	2.75	2.00	1.50	.13	2.10	5.69	1-14	6308	23.00
6.50x4.25-IDL-FLAT	7723-6425	14mm	Up to 90mm	4-5 Strand B/BX	6.50	4.25	2.38	1.50	.13	1.98	7.06	1-14	6308	33.00
6.50x5.75-IDL-FLAT	7723-6575	14mm	Up to 125mm	6 Strand B/BX	6.50	5.75	2.38	1.50	.99	1.98	9.31	1-14	6308	45.00
6.50x7.50-IDL-FLAT	7723-6750	14mm	Up to 170mm	8 Strand B/BX	6.50	7.50	2.38	1.50	1.00	1.98	11.19	1-14	6308	57.01

Idler Bushings



Idler Bushings

Part No.	Product No.	Style	Size	D (in)	L (in)	M (in)	Thread Size	Bearing No.	Weight (lb)
20-IDLR-BUSH(SK)	7720-1120	20	SK	2.81	1.94	1.44	3/4-16	6304	11.00
30-IDLR-BUSH(SF)	7720-1130	20	SF	3.13	2.08	2.13	1-14	6206	8.60
40-IDLR-BUSH(E)	7720-1140	20	E	3.83	2.75	2.19	1-14	6306	8.62
1610-IDLR-BUSH	7720-2610	20	1610	2.25	1.00	1.38	5/8-18	6003	1.30
2012-IDLR-BUSH	7720-2012	20	2012	2.75	1.25	1.56	3/4-16	6204	2.30
2517-IDLR-BUSH	7720-2517	20	2517	3.38	1.75	1.56	3/4-16	6304	3.90



IDLER HARDWARE

Idler Sprockets



Poly Chain[®] GT[®] Carbon[™] Idler Sprocket

Part No.	Product No.	Use With	Belt Width (in)	Number of Teeth	Pitch Diameter (in)	B (in)	C (in)	D (in)	E (in)	F Threads (in)	G (in)	H (in)	J (in)	Bearing No.	Weight (lb)
12-IDL-SPRK	7720-1500	8mm Pitch	12	32	3.208	1.25	.50	.85	1.56	3/4-16	.94	2.75	—	6304	3.80
20-IDL-SPRK	7720-1600	14mm Pitch	20	30	5.263	2.55	1.00	1.36	2.25	1-14	1.00	4.38	_	6308	12.55
21-IDL-SPRK	7720-1510	8mm Pitch	21	32	3.208	1.25	.50	1.24	1.56	3/4-16	.56	2.75	_	6304	3.88
36-IDL-SPRK	7720-1520	8mm Pitch	36	36	3.609	1.91	.75	1.86	1.63	3/4-16	-	_	_	6306	5.14
37-IDL-SPRK	7720-1610	14mm Pitch	37	30	5.236	2.55	1.00	2.06	2.25	1-14	.25	4.38	_	6308	13.46
62-IDL-SPRK	7720-1530	8mm Pitch	62	36	3.609	1.91	.75	2.91	1.63	3/4-16	.69	3.13	_	6306	9.69
68-IDL-SPRK	7720-1620	14mm Pitch	68	34	5.965	3.38	.56	3.33	2.25	1-14	1.00	4.88	4.34	6310	26.03
90-IDL-SPRK	7720-1640	14mm Pitch	90	34	5.965	3.38	.31	4.20	2.25	1-14	1.00	4.88	4.34	6310	32.18
125-IDL-SPRK	7720-1630	14mm Pitch	125	34	5.965	3.38	.19	5.63	2.25	1-14	1.09	4.88	4.34	6310	36.45



IDLER HARDWARE

Flat Idler Pulley



Idler Brackets

Part No.	Product No.	Use With	A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	H (in)	J (in)	M Threads (in)	N (in)	P (in)	Q (in)	Weight (lb)
5-IDL-BRAK	7720-1005	1610-IDL-BUSH	4.62	3.50	1.75	2.00	2.06	3.06	.38	1.63	.62	5/8-18	1.16	1.77	1.94	2.80
10-IDL-BRAK	7720-1010	8mm Pitch Idler Sprockets 4.25" OD Flat Idler Pulleys, 2012-IDL-BUSH, 2517-IDL-BUSH, 20-IDL-BUSH (SK)	4.63	3.50	1.75	2.00	2.06	3.06	.38	1.50	.63	3/4-16	1.00	1.88	1.75	3.40
20-IDL-BRAK	7720-1020	14mm Pitch Idler Sprockets, 6.50" OD Flat Idler Pulleys, 30-IDL-BUSH (SF), 40-IDL-BUSH (E)	6.94	5.25	2.63	5.00	3.00	4.56	.63	2.38	1.00	1-14	1.63	2.94	2.75	11.20

Nickel Plated Idler Brackets

Part No.	Product No.	Use With	A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	H (in)	J (in)	M Threads (in)	N (in)	P (in)	Q (in)	Weight (lb)
NP-10-IDL-BRACKET	7720-1011	8mm Pitch Idler Sprockets 2012-IDL-BUSH, 2517-IDL-BUSH, 20-IDL-BUSH (SK)	4.63	3.50	1.75	2.00	2.06	3.06	.38	1.50	.56	3/4-16	1.00	1.88	1.75	3.40
NP-20-IDL-BRACKET	7720-1021	14mm Pitch Idler Sprockets, 30-IDL-BUSH (SF), 40-IDL-BUSH (E)	6.94	5.25	2.63	5.00	3.00	4.56	.63	2.38	1.00	1-14	1.63	2.94	2.75	11.20



DRIVE SURVEY WORKSHEET

High Speed Drive Survey and Energy Savings Worksheet

CUSTOMER INFORMATION		
Distributor		
Customer		
DRIVE INFORMATION		
I.D. of Drive (location, number, etc.)		
Description of DriveN Equipment		
Manufacturer of DriveN Equipmen	nt	
Horsepower Rating of Motor	DriveN HP Load (Peak)	(Normal)
Motor Frame Size	Motor Shaft Dia	DriveN Shaft Dia
Speed:		
DriveR RPM	RPM Measured wit	th Contact or Strobe Tachometer □ Yes □ No
DriveN RPM	RPM Measured wit	h Contact or Strobe Tachometer 🗆 Yes 🛛 No
Speed Ratio	_ Speed Up	or Speed Down
Center Distance: Minimum	Nominal	Maximum
Existing Drive Components: Driv	veR	_ DriveN
Belts	Belt Manufactu	ırer
Ambient Conditions:		
Temperature	Moisture	Oil, etc
Abrasives		Shock Load
Static Conductivity Required?	🗆 Yes 🔲 No	
Maximum Sprocket Diameter (OD) and Width Limitations (for guard cle	earance):
DriveR: Max. OD	Max. Width DriveN: Ma	x. OD Max. Width
Guard Description		
Motor Mount:		
Double Screw Base? 🛛 Yes	□ No Motor Mounted on She	eet Metal? 🗆 Yes 🗆 No
Adequate Structure? 🛛 Yes	□ No Floating/Pivot Motor B	ase? 🗆 Yes 🗆 No
Start Up Load:		
%Motor Rating at Start Up	AC Inverter? □ Yes □ No	Soft Start? 🗆 Yes 🗆 No
Duty Cycle:		
Number of Starts/Stops	times per	[hour, day, week, etc.]
ENERGY SAVINGS INFORMATION		
Energy Cost per KW-Hour		
Hours of Operation: Hours	per Day Days per Week	Weeks per Year



Low Speed Drive Design Information Sheet

For Drive Selections with Shaft Speeds Less Than 500 rpm

Distributor:	Drive Layout
Customer:	(check one)
Drive Identification (location, number, etc.)	
	Motor Reducer Belt
DriveR Information:	Drive Driven
Motor Nameplate Data	
Rated Horsepower = Rated RPM = Efficiency =	
Rated Voltage = Rated Amps = Rated Torque =	
Actual Motor Load =	
Motor Type: AC D DC Gear Motor	I
	DriveN
Output Speed: Constant 🔲 Variable 🔲	
Deducer Information.	
	Polt Drivo en Dodvoc-
Reducer Type (worm, right angle helical, cycloidal, etc):	Output Shaft
Reducer Efficiency = Output RPM = Reducer Ratio =	
Rated Input HP/Torque = Rated Output HP/Torque =	
Existing Drive Information:	
Drive Type: Chain V-Belt Synchronous Belt	
If chain, type; 2/#60. #80, etc Lubed Lubed Unlubed	
Current Drive Service Life =	
DriveR Sprocket/Sheave = (teeth/OD) DriveR Shaft Diameter =	
	Motor Belt Drive
DriveN Sprocket/Sheave = (teeth/OD) DriveN Shaft Diameter =	Reducer Driven
Center Distance = +	
Type of Center Distance Adjustment	
Idler used: Yes No No Inside Backside	Motor
DriveN Information:	
Type of Equipment: Actual Horsepower Required =	
DriveN RPM =	Reducer DriveN
Hours/Day = Days/Week = Weeks/Year =	┛┎╝└
	mhaaaaahhaaaaah
Special Requirements:	
Space Limitations:	
Maximum DriveR Dia. = Maximim DriveN Dia =	
Maximum DriveR Width = Maximum DriveN Width =	
Environmental Conditions:	
Temperature Range = Belt Conductivity Required	Belt Drive on Reducer
Oil Mist U Oil Splash U Moisture L Abrasives L	



Gates Design IQ Data Worksheet

Account:	Conta	Contact: Title:											
						Phone: E-mail:			Fax:				
				Δ	pplication	Summary	/						
General Description: Product Type: Prototype Schedule:							Production Volume: Production Time Schedule:						
					Design Par	ameters							
DriveR: Motor Type & Description: Nominal Motor Torque / Power Output: Max / Peak Motor Torque/Power Output: Motor Stall Torque (If applicable):					(Servo, Stepper, DC, AC, etc.) Reversing: (Y/N) rpm: rpm: Driver Rotation:(CW / CCW / Rev)								
DriveN's / Idlers: (Specify appropriate units for each field:							in. mm / hp. kw / lb-ft. lb-in. N-m. etc.)						
Description	x	Y	Pulley Diameter	Pitch	Sprocket Grooves	Inside/ Outside	rpm	Load (driven)	Units	C #	onditions % Time	Shaft Diameter	
Driver													
Note: For comp	olex driv	e layouts	use addition	nal pag	es as needeo	b				_			
Drive Sketch							Idler Details					ocition	
				Slot Movement:			X	Y		X	Y		
						·							
					Spring:								
								Pivot Point		Movem		ent Angle	
					Pivoting Mo	ng movement: X		X	Y		Min Deg	Max Deg	
				Spring: Pivot Arm Radius:				(in/mm):					
					L								
Product Docian I	ifo		Pa	S S	pecial Req	uirements	S ma/Davr			Цa	ure/Veer:		
Pulley Materials:	.ne:	Prototv	ре ве	at Lite:		Hou	Produ	Iction		HO	uis/rear:		
Belt Construction	Consid	lerations:											
Temperature:Moisture: Special Requirements:			isture:	Oil: Static Dissipation:					At	Abrasives:			

Page ____ Of ____



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Gates warrants that its power transmission products will be free from defects in materials and workmanship for the life of the product. If the product does not meet this standard, Gates will repair or replace the product free of charge!

<u>Please note that this warranty is customer's exclusive remedy and does not apply in the event</u> of misuse or abuse of the product. Gates disclaims all other warranties (express or implied) including the implied warranties of fitness for a particular purpose and merchantability.

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BELT DRIVE Preventive Maintenance + Safety

PROPER INSTALLATION + PREVENTIVE MAINTENANCE PROCEDURES

improve workplace safety, reduce downtime, and increase production.

The majority of mechanical power transmission drive problems are attributed to improper component maintenance and installation. This thorough textbook provides in depth guidance to avoid these issues to improve drive performance. Ideal for facility personnel responsible for power transmission equipment, the Gates Belt Drive Preventive Maintenance Manual covers the following topics:

- Sources of Drive Problems
- Preventive Maintenance
- Safety
- Drive Inspection
- Installation
- Storage + Handling
- Belt Types + Identification
- Sprocket Corrosion Prevention
- Troubleshooting

GATES CORPORATION powers progress by providing quality products and expert support to help you increase production, avoid downtime, decrease maintenance, and manage energy costs. Gates invented the V-belt in 1917, and continues to lead the industry with product innovations and unmatched engineering support to improve power transmission efficiency, reliability, and economy.

Gates offers onsite Preventive Maintenance training. To schedule training or to learn more, contact an authorized Gates distributor.



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Experience, Reliability, Integrity....AXH air-coolers.

AXH air-coolers

represents more than 50 years of leadership experience in the air-cooled heat exchanger industry encompassing the entire spectrum of air-coolers from initial thermal application and mechanical engineering, through design drafting, project management and after market support. To meet the growing market demands and customer expectations, in early 2005 AXH air-coolers underwent the first of a continuing series of major expansions in both physical facilities and personnel.

Experience

AXH air-coolers' offers an unparalleled level of experience and technical expertise throughout the entire organization. AXH's complex consists of (6) plants, which total 553,500 sq. ft., are located on 67 acres outside of Tulsa adjacent to Route 66 in Claremore, Oklahoma, in which Plant 1 is the largest single manufacturing facility in the air-cooled industry.

Reliability

Having manufactured tens of thousands of air-coolers for the natural gas compression, process and power generation industries AXH has established an unmatched reputation for meeting "on time" delivery commitments backed by the highest level of quality assurance and customer support in the industry.

Integrity

AXH air-cooler's goal and commitment is to consistently provide customers with the highest quality air-cooler products with uncompromised support and reliability on a competitive basis resulting in exceptional long term value.





Corporate and Sales Office





Plant 1 is 204,000 Square Feet and located on 12 acres outside Tulsa and adjacent to Route 66 in Claremore, Oklahoma



2014-2015 Expansion Plants 3, 4, 5 and 6



AXH Complex - Plants 1, 3, 4, 5, 6 - (Plant 2 is located 6 miles South)





Plant #1 - Structure Assembly Bay, 40-Ton Lift Capacity



Plant #6 - 15,000 SF Central Parts Warehouse





Plant #1 - Structure Dept, with 10 and 20-Ton Cranes

Facilities and Equipment



Plant #1 - Industry's Largest Radiography Vault, 20'X70'



Plant #1 - (7) Sub-Arc Stations



Plant #1 - (82) ASME Code Header Stations



Plant #1 - 5-Axis CNC Pipe Beveler 20" ID Capacity



Plant #1 - 105' (3) Bridge, High Definition CNC Plasma Table





Plant #1 - Dual Robotic Flange To Pipe Welding Cells



Plant #1 - One of Five, CNC Horizontal Bridge Mills



Plant #1 - Plate & Structural Bead Blast. 12' Press Brake and Custom Plate Roll



Plant #4 - Assembly Bays 1 and 2 with 10, 20 and 30 Ton Cranes
Facilities and Equipment



Plant #4 - 30x75 and 34x75 Twin Paint Rooms



Plant #2 - Finning Operation



Plant #2 - (10) Finning Machines



Plant #2 - 72,000 SF on 13 Acres-Acoustical Test Site



Plant #5 - 1000 GPM Fully Automated Oil Flushing System

7



The Most Respected and Prevalent Engine Driven Cooler Design, Proven in Tens of Thousands of Natural Gas Compression Installations Worldwide

Advantages

- · Inherently more efficient Forced draft design
- Ideally suited for multiple services including engine utility cooling along with oil and multistages of gas compression
- High vertical discharge air velocity results in the cooler being less affected by wind direction or adjacent equipment and minimizes hot air recirculation
- Sloped sections result in greater cooling capacity in a smaller footprint or skid area
- Elimination of "top-heaviness" with a true center of gravity means greater safety, stability, and ease of handling
- Improved safety with excellent visual inspection and access to critical moving parts





Model 168EF - Marcelus Area





Internal Electric Motor Drive



Model 168 EF - MAG Fan



Model 96EF with SS Sections and Warm Air Recirculation



Enclosed Slide Idler with Dual Taper Roller Bearings



AXH Air-Coolers' Type FF is a Forced Draft, Multiple-Fan, Vertical Discharge Design With a Lower Profile that is Ideal for Large Horsepower Applications While Providing Similar Features at a Cost that is Comparable to Large Single Fan Vertical Discharge Cooler.

Advantages

- Combined engine, compressor, and multiple-stage gas cooling in a single multiple fan unit
- · Forced draft design is inherently more efficient
- · Narrow transportation width and lower profile
- Section design facilitates piping
- Single, fan-shaft drive
- Improved safety with excellent visual inspection and access to critical moving parts



Model 132FF2



Model 120FF





Model 108FF2 Skid Mounted





The Induced Draft Type VI Complements AXH Air-Coolers' Line of Vertical Discharge Coolers

Advantages

- Offers combined engine, compressor, and multiple-stage gas cooling in a single unit
- Vertical discharge hot air velocity results in the cooler being less affected by wind directions or adjacent equipment
- Excellent accessibility to sections
- Superior air-flow control offers improved process temperature control



Induced Draft Design



Model 144VI

- 6





Model 168VI including Pipe Spools Supplied



(3) Model 60VI's with Full Warm Air Recirculation



(3) Model 72VI's







AXH Air-Coolers' Most Economical Cooler Design and a Superior Alternative to a "Radiator" Advantages

- Available as either a Forced or Induced draft design with horizontal air flow
- Can accommodate multiple cooling services
 in a single fan unit
- Round tube, box header construction with ASME code designs
- Small installation footprint
- Easy access to sections and drive
- Excellent for visual inspection and access to moving parts



Patented Obround Header



Model 108VVF





Special Applications



(2) Model 144EF's with Warm Air Recirculation



(2) Model 42-2ZF with Evaporative Inlet Cooling



(2) Trailer Mounted Model 96EF's



Model 120ZI (Induced Draft)



Model 156-2ZI - Induced Draft/Internal MAG Fan and Internal Drives



Horizontal Designs Provide Flexibility in Remote Installation for Large HP Gas Compression, Process or Power Generation Cooling

Advantages

- The horizontal Type ZF coolers offer flexibility that can accommodate multiple cooling services in a common horizontal cooler
- Self-contained design eliminates field assembly and reduces transportation and field installation costs
- Forced or Induced draft configurations
- Available with single or multiple fans
- Accommodates various type drive options
- Excellent access for inspection and for component parts
- Optional temperature control includes VFD drive, louvers, winterization, warm air recirculation systems





Model 120ZF



Model 132ZF - SS Section - 850F Service

Model 132-2ZF







Model 204-2ZF (18'x62') - Weight 132,000 lbs



(9) Model 132FF3 and (9) Model 144-2ZF (Algeria Installation)



(4) Model 144-2ZF's



(2) Model-84ZF on Generator Sets



Model 60H







(5) Model 108ZF





(16) - Model 18VVS SS Section

Model 156-3ZF - Offshore Gulf of Mexico



Special Applications



(3) Model 132-2ZF, Two Fan with Winterization



Model 96-2ZF with Sub Structure



Slab Headers







AXH air-coolers

401 Lowry Road, Claremore, Oklahoma 74017 (918) 283-9200 Fax (918) 283-9229 www.axh.com