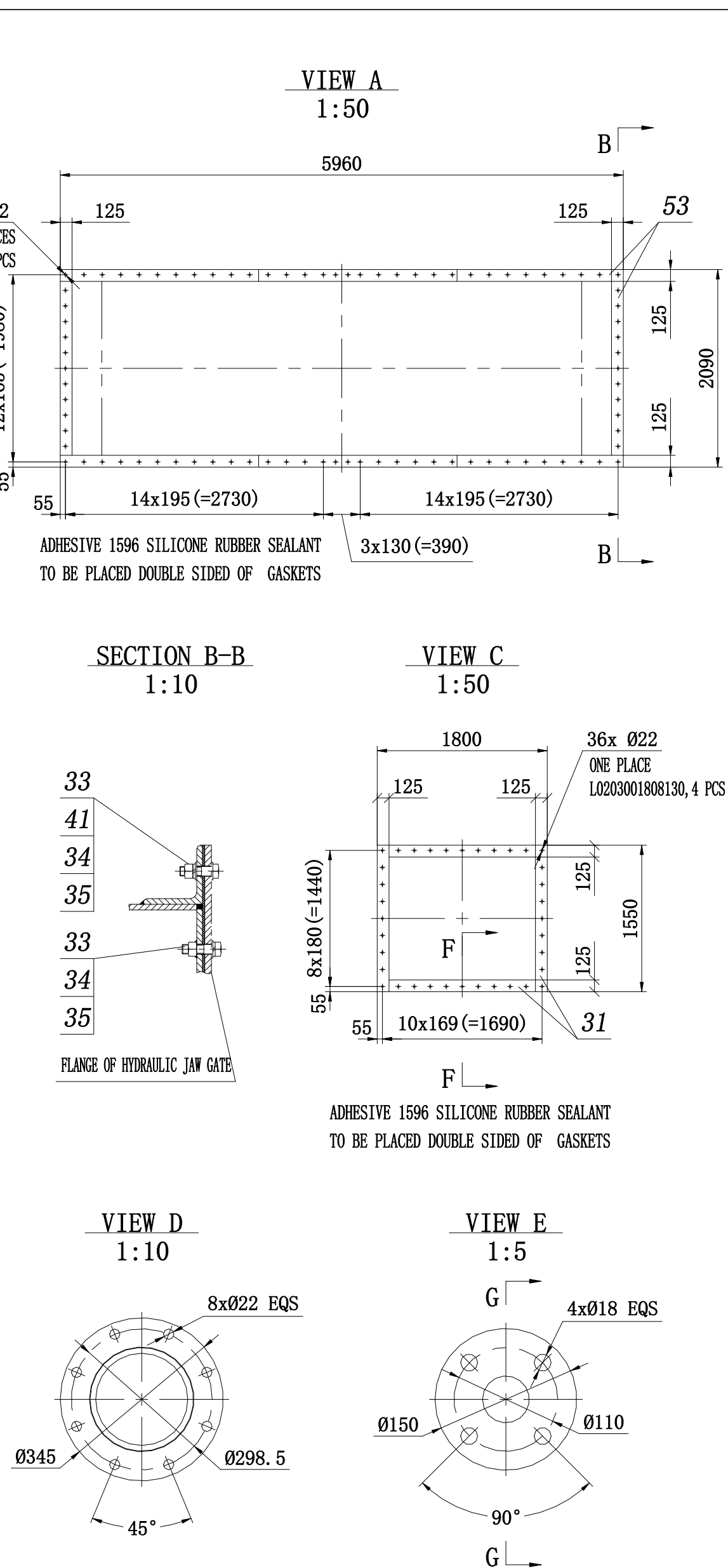
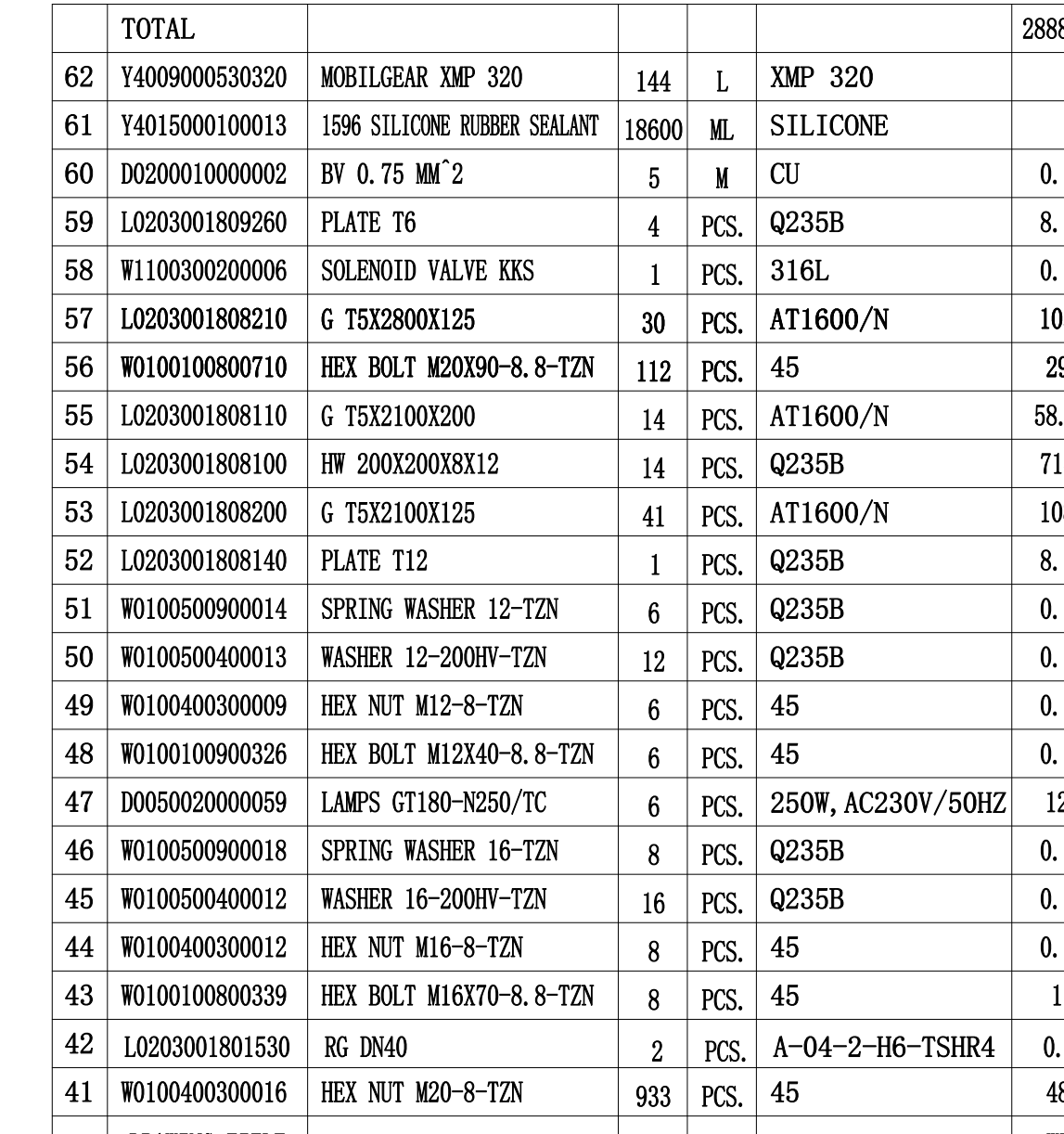
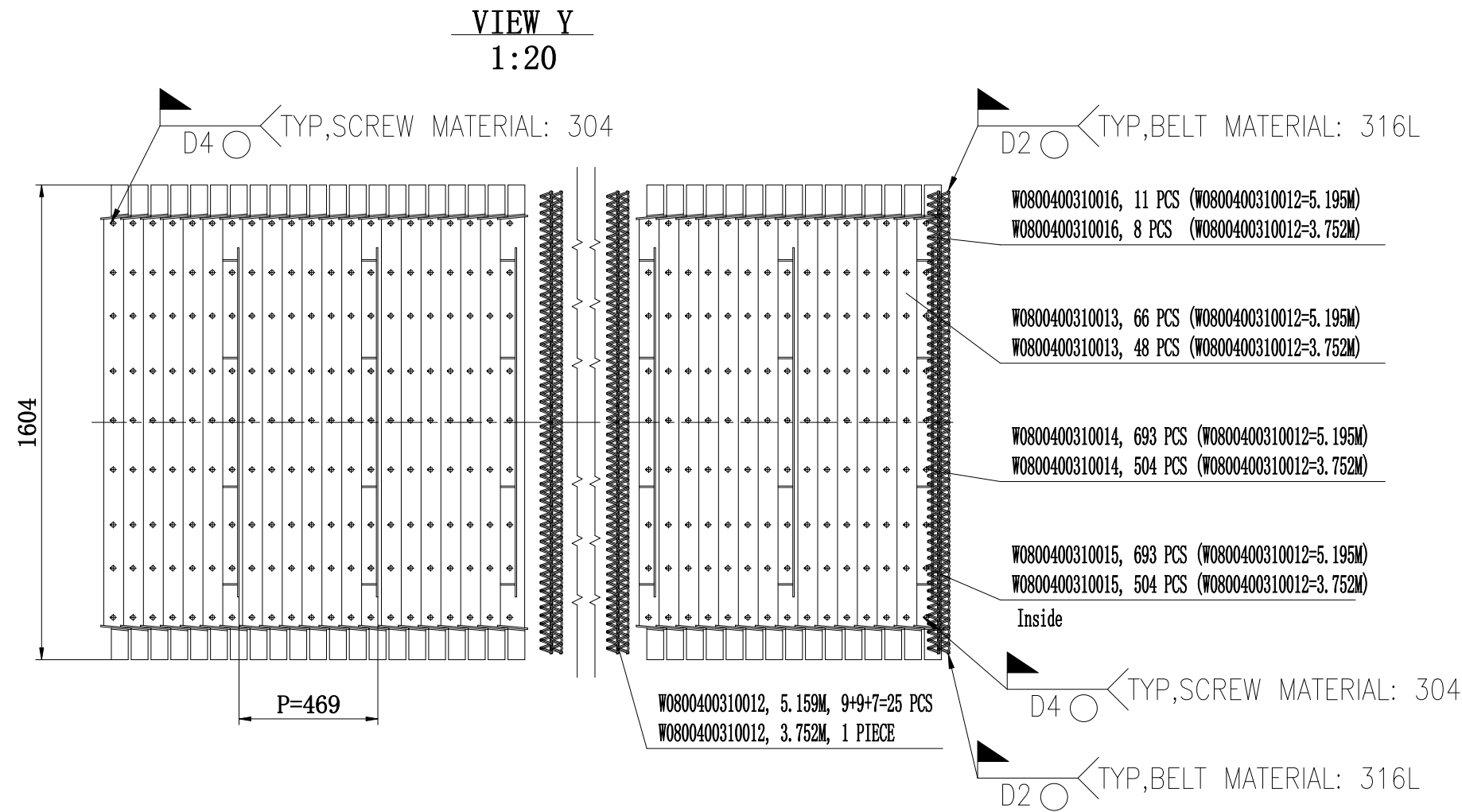
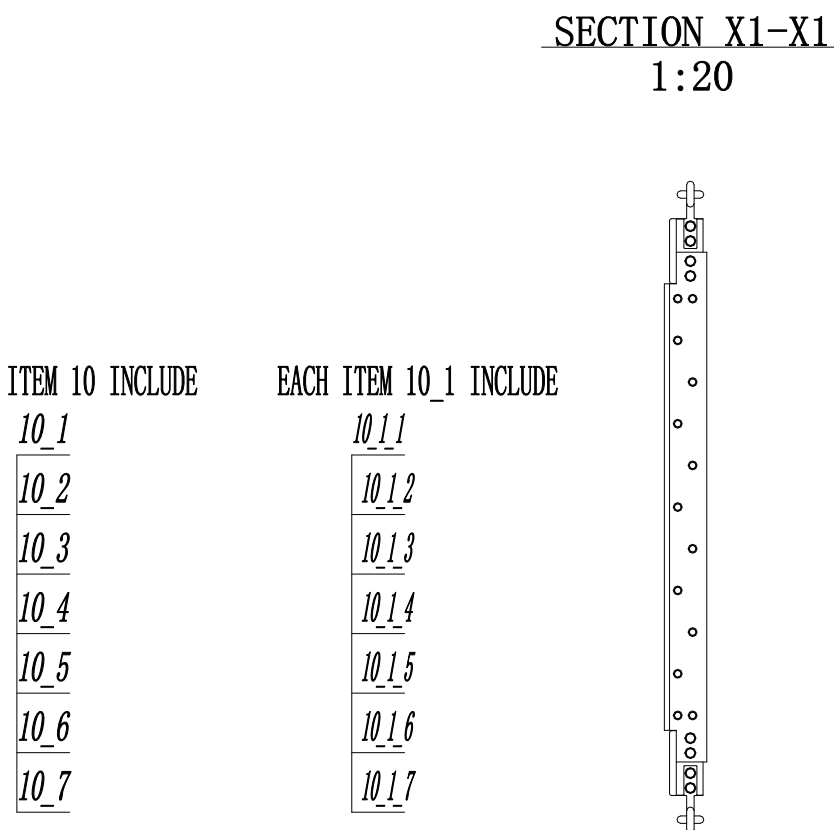
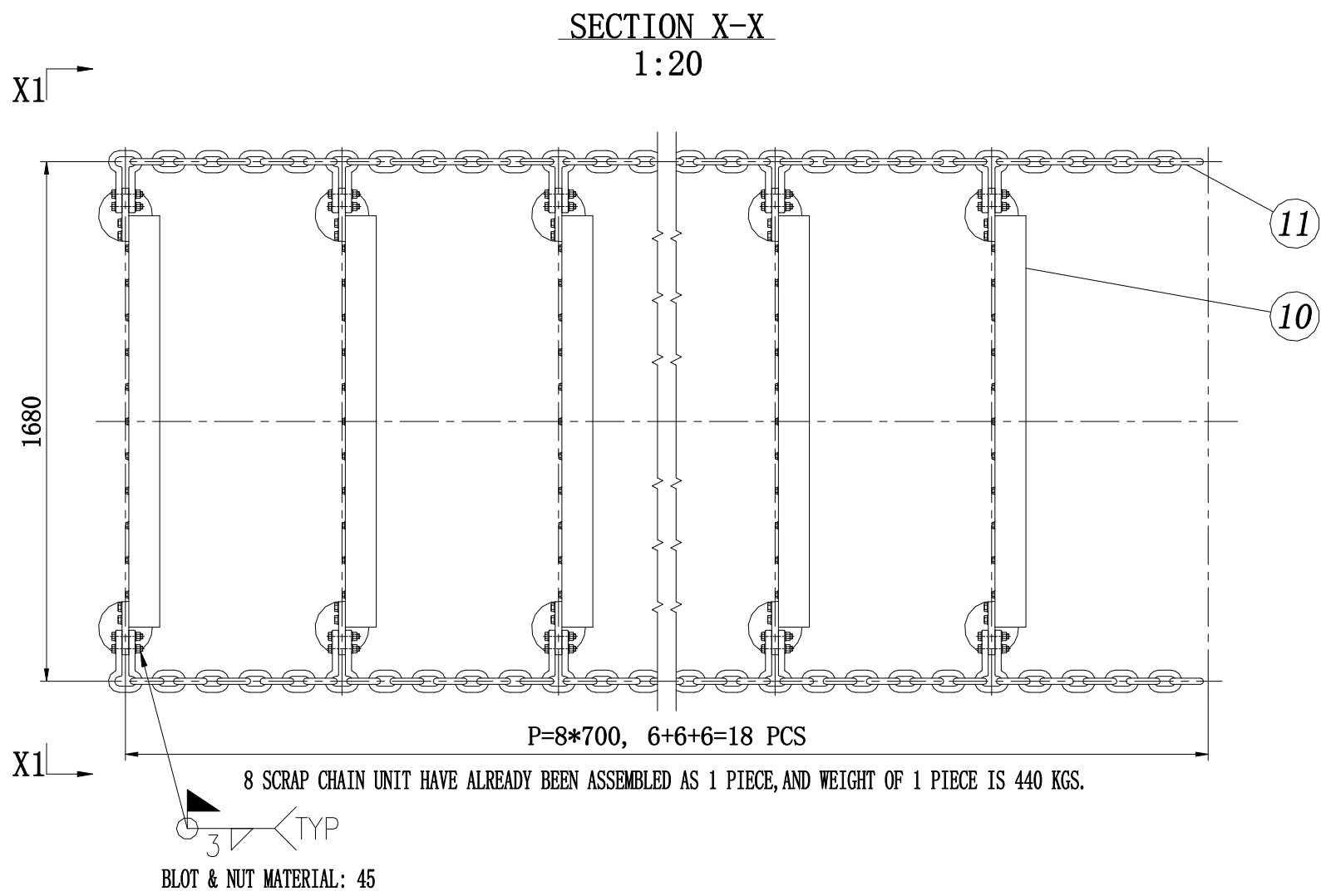




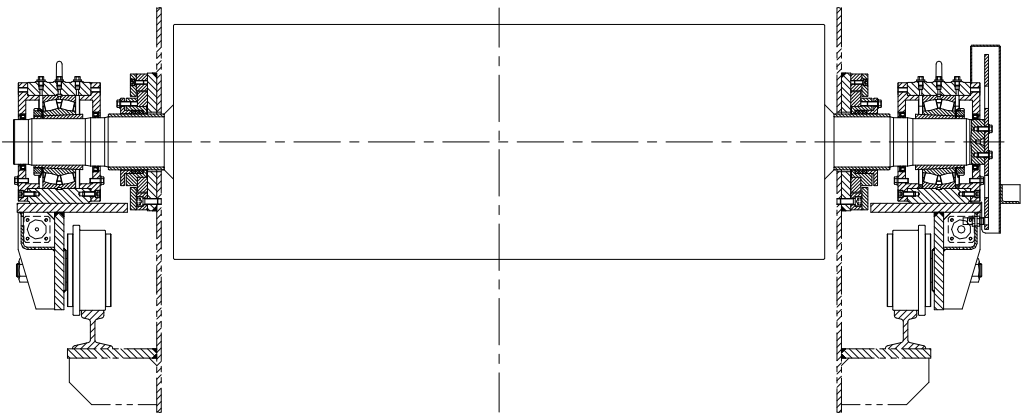
	Doelim Industrial Co., Ltd.
job No.	110180
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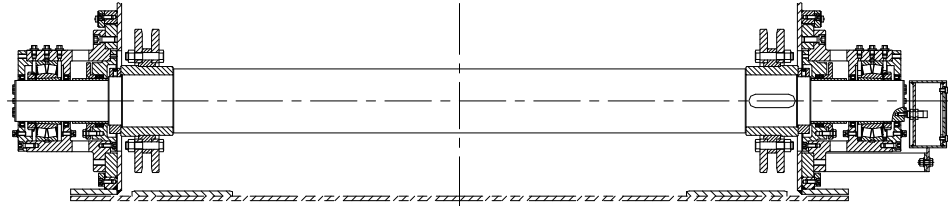
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60 PCS., TB2-WB01-201-080					
TB2-WB01-201-078					
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TB2-WB01-201-078	△	18 AUG.2016	FOR FINAL	LIU ZHONG	DOU HONGYUN
TB2-WB02-201-075	REV	DATE	DESCRIPTION	DRWN	CHKD
TB2-WB01-201-079	OWNER			OWNER'S CONSULTANT	
TB2-WB01-201-075	 VIETNAM OIL AND GAS GROUP (PVN)			 FICHTNER GmbH & Co. KG FICHTNER PV POWER PCC	
BE QUT TO TA, TB2-WB02-201-071	EPC CONTRACTOR			EPC CONTRACTOR'S CONSULTANT	
TB2-WB02-201-075	 PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)			 WorleyParsons Worned &芒芒 WORLEYPARSONS	
TB2-WB01-201-078	POWER ISLAND PACKAGE SUPPLIER			 sofitz SOFITZ CORPORATION	
TB2-WB01-201-078	PROJECT TITLE			 DAELIM DAELIM INDUSTRIAL CO., LTD.	
TB2-WB01-201-078	THAI BINH2 THERMAL POWER PLANT 2 x 600MW				
TB2-WB02-201-075	DRAWING TITLE				
TB2-WB02-201-075	ASSEMBLY DRAWING OF DRY-TYPE SLAG CONVEYOR				
TB2-WB02-201-075	ASSEMBLY, DRY-TYPE SLAG CONVEYOR				
TB2-WB02-201-075	BIP SUPPLIER	 BASCOCK & WILCOX BEIJING CO., LTD.	FUNCTION	NAME	SIGN
TB2-WB02-201-075	BIP SUB-SUPPLIER	 CEEC 广东省电力设计研究院 中国能源 GUANGDONG ELECTRIC POWER DESIGN INSTITUTE	DRWN	LIU ZHONGMEI	 18 AUG.2016
TB2-WB02-201-079			CHKD	DOU HONGYUN	 18 AUG.2016
			REVD	YANG ZUNYAO	 18 AUG.2016
			APPD	MA YI	 18 AUG.2016
REMARK	DRAWING NO.	TBD-SDC.VP101-00100-M-M12-DSU-0219		JOB NO.	110180
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				REV. NO.	△



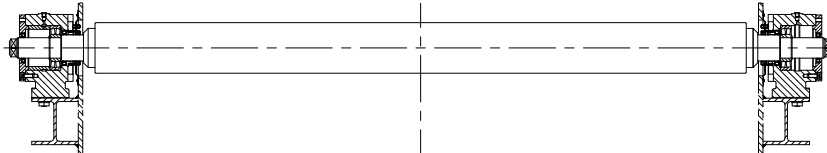
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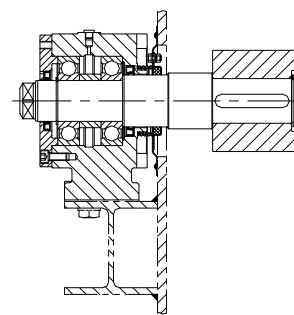
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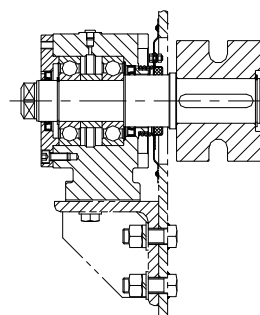
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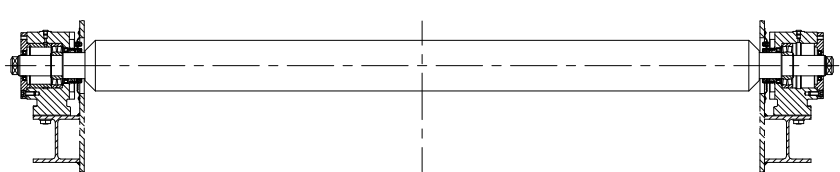
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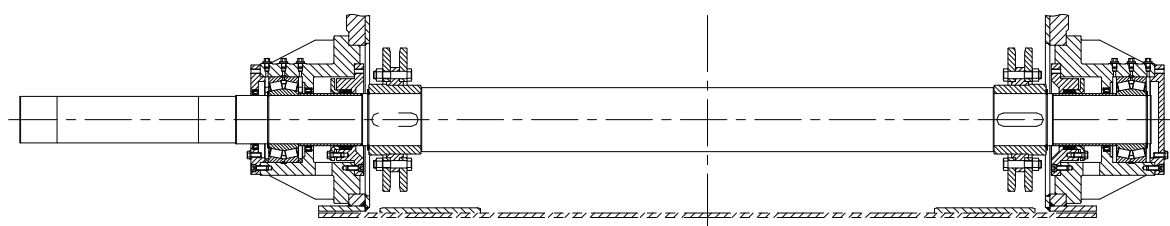
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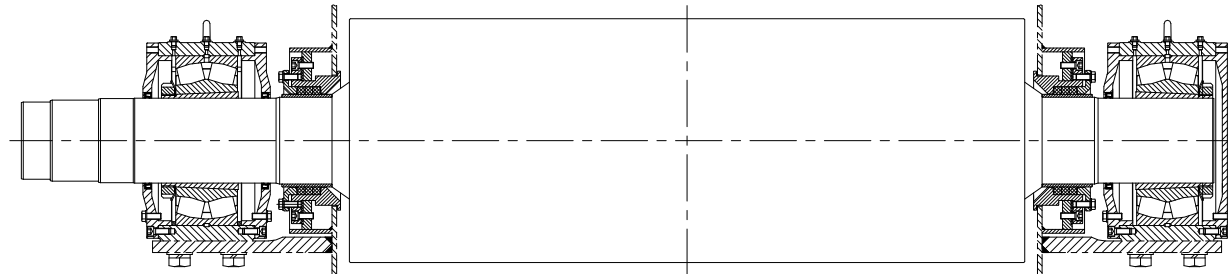
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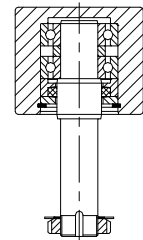
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DETAIL 9
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DETAIL 6
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NOTES:

1. ALL DIMENSIONS AND ELEVATION ARE IN MILLIMETER (MM).
2. FINISHED GRADE ELEVATION EL. +0.00M = EL. +4.5M ABOVE MEAN SEA LEVEL.
3. ALL WELDS SHALL BE IN ACCORDING TO AWS D1.1.

WHEEL SYSTEM LIST (UNIT 1)						
9	B0203001800010	MAIN ROLLER OF CONVEYING BELT	1	PCS.	ASSEMBLY	2900 NOT IN THE DELIVERY LIST
8	B0203001800090	MAIN ROLLER OF SCRAP CHAIN	1	PCS.	ASSEMBLY	880 NOT IN THE DELIVERY LIST
7	B0203001800170	ARC CONVEYING UPPER PRESS WHEEL	12	PCS.	ASSEMBLY	3180 NOT IN THE DELIVERY LIST
6	B0203001800210	GUIDE WHEEL TYPE A	100	PCS.	ASSEMBLY	320 NOT IN THE DELIVERY LIST
5	B0203001800190	SCRAP CHAIN ROLLER	166	PCS.	ASSEMBLY	7968 NOT IN THE DELIVERY LIST
4	B0203001800180	RETURN ROLLER	248	PCS.	ASSEMBLY	11408 NOT IN THE DELIVERY LIST
3	B0203001800150	CONVEYING UPPER ROLLER	159	PCS.	ASSEMBLY	27189 NOT IN THE DELIVERY LIST
2	B0203001800100	TENSION DEVICE OF SCRAP CHAIN	1	PCS.	ASSEMBLY	1096 NOT IN THE DELIVERY LIST
1	B0203001800040	TENSION DEVICE OF CONVEYING BELT	1	PCS.	ASSEMBLY	3010 NOT IN THE DELIVERY LIST

ITEM	DRAWING TITLE ITEM CODE	ITEM NAME	QUAN.	UNIT	MATERIAL	WT KG	REMARK
			Daelim Industrial Co., Ltd.				
			job No.	110180			
			A – APPROVED				
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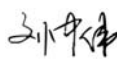
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NOTE:

	18 Aug.2016	FOR FINAL	LIU ZHENGE	DOU HONGYUN	YANG ZUNYAO	MA YI
REV	DATE	DESCRIPTION	DRWN	CHKD	REVD	APRD

OWNER		OWNER'S CONSULTANT	
VIETNAM OIL AND GAS GROUP (PVN)		FICHTNER	
EPC CONTRACTOR		EPC CONTRACTOR'S CONSULTANT	
PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)		WorleyParsons	
POWER ISLAND PACKAGE SUPPLIER		WORLEYPARSONS	

PROJECT TITLE		THAI BINH2 THERMAL POWER PLANT 2 x 600MW	
DRAWING TITLE		ASSEMBLY DRAWING OF DRY-TYPE SLAG CONVEYOR SCRAP CHAIN,STEEL BELT,WHEEL SYSTEM DETAILS	

BIP SUPPLIER		FUNCTION		NAME		SIGN		DATE	
BIP SUB-SUPPLIER		CHKD		REVD		APPD		SCALE	
DRAWING NO.		JOB NO.		SCALE		REV.NO.		FILE NAME:	

DOCUMENT SUBMISSION STATUS: FF						
NOTE:						
1	08 Jan, 2016	For Final	Liu Zhongwei	Yang Zunyao		Ma Yi
0	08 Sep, 2015	For Final	Liu Zhongwei	Yang Zunyao		Ma Yi
REV.	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	APPROVED
OWNER  VIETNAM OIL AND GAS GROUP (PVN)			OWNER'S CONSULTANT  FICHTNER  PVPOWER PCC			
EPC CONTRACTOR  PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)			EPC CONSTRUCTOR'S CONSULTANT  WorleyParsons WORLEYPARSONS			
POWERISLAND PACKAGE SUPPLIER  SOJITZ CORPORATION  DAELIM INDUSTRIAL CO., LTD.						
PROJECT TITLE THAI BINH 2 THERMAL POWER PLANT 2 x 600MW						
DRAWING / DOCUMENT TITLE Installation, Operation, Maintenance, Commission Manual For Bottom Ash System – Primary Bottom Ash Crusher						
BIP SUPPLIER:  BWBC	BIP SUB-SUPPLIER:  GEDI	FUNCTION	NAME	SIGN	DATE	
		DRWN	Liu Zhongwei		08 Jan, 2016	
		CHKD	Yang Zunyao		08 Jan, 2016	
		APPD	Ma Yi		08 Jan, 2016	
DOCUMENT No. TB2-SDC.VP101-00100-M-M12-M AN-9063			No. of page: 102		Scale: A4	Rev. 1

P.O NO.	110180-1600-101-001-A01
ITEM NO.	100
ITEM DESCRIPTION	BOILER AND BOILER BOP
DOCUMENT NO.	TB2-SDC.VP101-00100-M-M12-MAN-9063
DOCUMENT TITLE	Installation, Operation, Maintenance, Commission Manual for Bottom Ash System- Primary Bottom Ash Crusher
REV NO.	1

Daelim's Approval Status

Daelim Industrial Co., Ltd.	
Job No.	110180
	A - APPROVED
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BIP SUPPLIER: BWBC



BIP SUB-SUPPLIER: GEDI





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Instructions for Williams Single Roll Crushers	Form 620-R2
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Crusher Installation	Form 852R
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Williams #2 Hard Surface Rod	Form 769
Crusher Foundations	Form 902R

24 x 36 Single Roll Crusher – S/N 21103

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Parts List/Drawing – 24 x 36 Single Roll Crusher	43J-E-14143
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Motor Data Sheet – 50 HP [37KW] Siemens Motor	LIAZ 3250061
Dimensions – Slide Base for 280MHD Motor	280MHD
Installation and Maintenance of V-Belt Drives	VBD-IM

WILLIAMS

GENERAL SAFETY PROCEDURES FOR OPERATION OF WILLIAMS EQUIPMENT



WILLIAMS *P*ATENT CRUSHER and PULVERIZER Co., Inc.

2701 North Broadway, St. Louis, Missouri 63102 USA

Phone: (314) 621-3348 Fax: (314) 436-2639

www.williamscrusher.com

FORM 936

GENERAL SAFETY PROCEDURES FOR OPERATION OF WILLIAMS EQUIPMENT

Because each installation of Williams Equipment involves different uses and considerations it must be understood that these safety instructions are general in nature and that each specific installation must be reviewed by the owner or plant management to insure maximum safety precautions. It is the responsibility of the owner or plant management to provide complete safety instructions and procedures for the operation of all Williams equipment, which their personnel will be involved with in the performance of their duties, and to see that all the necessary precautions are followed. All personnel who will be involved in the operation or servicing of Williams equipment must be properly trained in the operation and servicing of such equipment and must be fully familiar with these general safety procedures and the safety precautions attached to the Williams equipment.

HAZARDOUS MATERIALS WARNING

OVERSIZE OR THE WRONG TYPE OF MATERIAL FED INTO A MILL CAN CAUSE SERIOUS PERSONAL INJURIES AND PROPERTY DAMAGE, INCLUDING DAMAGE TO THE EQUIPMENT ITSELF.

No explosive, flammable or similar hazardous material is to be fed into any operating Williams equipment under any circumstances.

If there is any possibility that hazardous material could be accidentally overlooked by the personnel feeding the Williams equipment, the owner must provide suitable protection such as listed below or mandated by Federal, State, or Local regulations.

- A) Inert gas atmosphere in system.
- B) Explosion vents for Williams equipment and building housing the equipment.
- C) Explosion suppression system.
- D) Operators station protected by blast panels and shielding.
- E) Water deluge system for fires.

Heat and sparks generated during the operation of some Williams equipment can cause combustible materials to ignite unless precautions are taken by the owners.

- 1) When personnel are working inside the mill or near the rotor the power to the driver shall be de-energized and locked out with an approved safety tag on the controls or starter.
- 2) Never enter or service equipment through the conveyor, feed hopper, or discharge opening.
- 3) Only the specified size and type material which the mill was designed to handle shall be fed into the mill.
- 4) The inherent ballistic action of the grinding operation can cause pieces of the material being processed to be thrown out the feed or discharge openings and injure personnel in the vicinity. It is the owner's responsibility to provide and maintain proper screens and shrouds at all the mill openings to contain the material being processed inside the hopper or mill.
- 5) All personnel in the vicinity of an operating mill must wear a hard hat and safety glasses in addition to any special clothing or protective equipment the particular installation may require.

NEVER ALLOW PERSONNEL TO STAND IN LINE WITH OR IN THE IMMEDIATE VICINITY OF THE FEED OR DISCHARGE OPENING OF A MILL WHILE MATERIAL IS BEING PROCESSED.

- 6) **NEVER OPERATE A MILL FASTER THAN THE DESIGN SPEED.**
- 7) Before starting the equipment for the first time and for normal daily operation the following precautions should be followed:
- A) Check to see that all alarm signals and emergency devices are functioning properly.
 - B) All access doors, covers, or inspections ports are closed and securely fastened in place.
 - C) Infeed conveyors or chutes cleared of all materials that could enter grinding chamber until the rotor attains operating speed.
 - D) Make a daily inspection of the rotor condition before the start of operations noting any badly worn or broken items that could fail and replace them before using the mill.
 - E) All protective covers or guards on the drive connection and flywheel or shaft end are fastened properly in place.
 - F) The mill is empty and clear of all debris or product so the rotor is free to turn without interference and the hammers can swing on their pivots.
 - G) All personnel are clear of any moving parts and positioned at their assigned operating stations.
- 8) **NORMAL OPERATING VIBRATION AND WEAR CAN CAUSE BOLTS TO LOOSEN AND ALLOW COMPONENTS TO FALL OFF THE MILL OR INTO THE ROTOR UNLESS A REGULAR REVIEW OF THE MILL IS MADE BY OPERATING PERSONNEL TO TIGHTEN ANY LOOSE BOLTS.**
- 9) Should the rotor become jammed or the feed chute plugged do not attempt to clear the chute or open the cover while the rotor is turning and the power is connected. Before any service operations on the mill, de-energize the driver and wait until all rotor movement has ceased. If entry to the rotor area is made, after the power is locked off and the rotor movement has ceased, care should be taken to secure the rotor from turning because the rotor could turn if stepped on or physically pushed thereby causing swing hammers to fall and strike the rotor, or anyone in the vicinity.

THE ABOVE LIST IS NOT INTENDED TO INCLUDE ALL PRECAUTIONS THAT CAN BE TAKEN TO INSURE SAFE OPERATION OF WILLIAMS EQUIPMENT, BUT TO SUPPLEMENT ANY EXISTING ORDINANCES, APPLICABLE REGULATIONS AND SPECIFIC SAFETY INSTRUCTIONS BY THE OWNER OR PLANT MANAGEMENT FOR THE PARTICULAR APPLICATION OF THE WILLIAMS EQUIPMENT.

THESE SAFETY INSTRUCTIONS SHOULD BE FRAMED AND POSTED IN ALL OPERATING LOCATIONS WHERE PERSONNEL ARE STATIONED.

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INSTRUCTIONS FOR ROLL CRUSHERS



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<http://www.williamscrusher.com>

FORM 620-R2

INSTRUCTIONS FOR WILLIAMS ROLL CRUSHERS

This booklet is intended to serve as a guide for installation, operation, and maintenance of your Williams Roll Crusher. Information is arranged so that, regardless of which of the several types of Williams Roll Crushers you have, this booklet may be used as the basis for your operating and maintenance procedure.

All Williams Roll Crushers, regardless of size, are assembled and run at the factory before shipment. They are mechanically sound when prepared for shipment and all but the largest sizes are shipped as an assembled unit.

INSTALLATION

The machine should be supported on concrete or steel, the setting to be strong and heavy enough to carry the vibration and weight of the Crusher and driving motor. The foundation is to be isolated from any building foundation so as not to transmit vibration into the building. The foundation is to be level and uniformly even with anchor bolts located as per specifications on Certified Williams installation prints. Bolt the Crusher assembly down solidly, shimming to make certain that it remains level in both directions. Care should be exercised when drawing up the foundation bolts so that the Crusher frame is not warped out of position due to an uneven foundation. When a Crusher and motor base are used, the entire assembly is set in its foundation in the same manner as described above. Now, flush in grouting material to give a good bearing between Crusher and foundation. Although a Williams Crusher is a heavily built machine, care must be exercised to prevent damage in handling. Whether a hoist or jack be used to lift the machine, under no circumstances, should a strain be put on the Crusher shaft. Always lift the machine by the lower frame. For more specific information, see our Form 902: Crusher Foundations.

SAFETY: It is the customer's responsibility to provide and to keep in operation - shrouds or similar safety devices - necessary to prevent material or tramp iron throw-out at the feed opening of the Crusher or feed-hopper - for the safety of all personnel. Personnel in the vicinity of the equipment when in operation should wear hard hats, goggles, and other similar safety equipment. Also see our form 936 regarding Safety Procedures.

OPERATION

STARTING THE CRUSHER: It is important that your Williams Crusher be operated at the recommended speed. Under no circumstances should any Williams Crusher be operated at a greater speed than specified by the Williams Factory, nor should the speed be lowered without factory approval. Before starting the Crusher, inspect the grinding chamber carefully and turn the Crusher by hand to be certain that it is free of all obstacles that may have found their way into the interior of the Crusher. Check direction of Rotation to see that it is the same as that indicated by the direction arrows on the sides of the Crusher, or on Williams drawings.

Also remember that when you start the Crusher, permit it to attain full speed before any materials are fed into it.

PROPER FEEDING: Material being fed into a Williams Crusher should be spread evenly over the entire feed opening and should not be conveyed into the Crusher continuously and uniformly at a feed rate not greater than that recommended by the factory. Bear in mind that surge feeding is inefficient as it tends to overload the Crusher, thereby causing the machine to use excess power. An alternate overload and underload condition of operation will average far below the results obtained by the steady feeding of the right amount of material. For some materials, automatic feeders are essential - for practically all they are beneficial.

Feed size of material should be limited to the maximum sizes recommended by the factory. Excessively large pieces of material place undue strain on the shaft and other parts of the machine. Uncrushable material such as steel and iron should be removed from the feed before it enters the crusher.

HANDLING OF PRODUCT: The Chute, Air System Belt or Screw Conveyor, etc., regardless of what conveyance system is used to remove the crusher product, must be of sufficient capacity to handle peak loads without temporary accumulations of product occurring under the machine. This is necessary to prevent the product from plugging the Crusher and shutting down its operation.

FINENESS ADJUSTMENTS: Adjustments can be made to control size of product and to compensate for wear on grinding elements.

Single Roll Crushers are adjusted by adjusting Eye Bolts through the front end spacer. These Eye Bolts, since they pull against the tension of the Spring Compression Bolt, control the clearance between the crushing roll and the crushing plate. Adjustment is simply made with a wrench.

Double Roll Crushers are adjusted by removing or adding Shims ahead of the floating roll bearing boxes. The Shims control clearance between the stationary and floating rolls. Adjustment is simply made by lifting out, or dropping in shims.

MAINTENANCE

Before performing any maintenance or service, always turn off and lock out the power and wait for the machine to stop rotating. After servicing, check the machine for loose parts or tools that were left behind. Make sure all personnel are clear before restoring power.

Lubrication: Possibly no detail is as important to the life of a machine as proper lubrication of the contact surfaces of moving parts. We advise always that you lubricate as frequently as local conditions warrant for your installation, keeping in mind that care must be exercised to prevent over-lubrication. Too much lubrication will cause a bearing to heat. Bearing operating temperatures vary with geographical location and ambient temperature at the installation. If there is any doubt about lubrication, consult a factory or a qualified lubrication expert.

Grease Lubrication: For all moving parts which have a standard grease gun fitting supplied use Socony Mobil Grease Mobilux No. 2 or its equivalent. Also see our Form 911 regarding Roller Bearings.

Oil Lubrication: For all moving parts which use oil as a lubricant, use an oil which has the following characteristics:

1. The viscosity of the oil should be between 105 SSU and 150 SSU at the operating temperature of the bearing.
2. The oil should yield a "Timken Okay Load" of 45 pounds minimum.
3. The oil should contain EP additives.

The viscosity of an oil is perhaps the most fundamental consideration in bearing applications.

Crushers with oil lubricated bearings have the bearing housings filled with a basic lubricant to protect the bearings only during transit. The bearing housings must be flushed before operating and be filled with the correct lubricant for your installation.

It should be a rule that any time grit is found in a bearing, the bearing is to be cleaned and inspected for wear and the defect which allowed grit to leak into the bearing corrected immediately. All bearing housings are designed to prevent grit from entering from the outside.

Should lubrication instructions be supplied with a bearing or machine, they naturally, take precedence over those recommended here.

REPLACEMENT PARTS: These should be ordered in anticipation of their need to prevent the possibility of a costly interruption to your production schedule. The grinding elements, particularly, should be carried in stock so as to be immediately available when needed. The grinding elements consist, primarily, of Roll Segments, Breaker Plates, Toe Plates, and Grinding Plates. A spare Bearing is also a good investment.

Don't permit the liners to wear through before replacing them. Liners protect your investment by protecting the Crusher Frame from impact and abrasion. They are furnished in all Williams Roll Crushers which are intended for heavy duty or abrasive service.

PERIODIC INSPECTIONS: Are good operating practice. At such times, Bearings, Roll Segments, Breaker Plates, Liners, and all Frame Members should be inspected carefully. Be sure all Bolts are securely tightened.

GENERAL INFORMATION: Always specify the Serial Number of your Williams Roll Crusher in all correspondence pertaining to it, and you will help us to render better service. Always specify the Serial Number when inquiring about, or ordering repair parts.

Consult us if you have a special problem related to Grinding, Shredding, Crushing, Pulverizing, Separating, or Screening. We are specialists in this field.

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- ➔ Operation
- ➔ Lubrication
- ➔ Service



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FORM 911R
REV. 2008

BEARINGS

The purpose of this manual is to provide a guide for the operation and maintenance of the roller bearing pillow blocks used on the rotors of Williams equipment. The same principles will apply for the lubrication and maintenance of all anti-friction bearings in all types of Williams equipment.

Accordingly, this manual is divided into the following parts:

I.	OPERATION AND INSPECTION	Pages 3 - 4

II.	LUBRICATION	
	a. Oil Lubrication	Pages 4 - 6
	b. Grease Lubrication	Pages 6 - 8

III.	MAINTENANCE and SERVICE	
	a. Taper bore bearings	Pages 8 - 24
	b. Straight bore bearings	Pages 24 - 29

IV.	TROUBLESHOOTING	Pages 30 - 33

SECTION I. BEARING OPERATION AND INSPECTION

A properly installed anti-friction type pillow block bearing on a piece of Williams equipment requires no adjustments during its normal service life. The bearing mountings and pillow blocks are engineered to rigidly support the bearing and keep it aligned.

When the rotor is properly installed in the shredder housing (See ASSEMBLY AND INSTALLATION) the bearings will automatically be aligned and in proper position for a long service life.

Long life of bearings is assured by maintaining proper alignment with the drive, proper belt tension, and good lubrication at all times. Incorrect alignment of flexible couplings or belt drives can produce vibration and thrust. Too much belt tension often causes overheating of bearings.

Prolonged operation of a bearing with a severe vibration problem above 5 mils (.005") will cause premature failure and expensive repairs. Excessive heat in a bearing (above 200°F) when operating will quickly destroy the effectiveness of the lubricant, and will result in premature failure of the bearing.

When either heat or excessive vibration develops, corrective action should be undertaken immediately to find the cause and remedy the problem.

The oil level gauge on the side of the bearing housing should be inspected several times each operating shift. The oil level should be at the center of the glass when the rotor is stationary and slightly below halfway when operating. A higher oil level will cause heat and churning of the oil in the bearing housing, which will contribute to oil oxidation.

Note any change or discoloration in the oil, which would indicate contamination or oxidation is taking place. If so, drain and replace the oil immediately.

Roller bearings are less sensitive to over-lubrication than ball bearings, but under-lubrication can destroy them quickly.

The bearing housing oil seals should be included in the daily inspection to insure they are functioning properly to retain the lubricant and keep foreign matter out of the bearing. Oil seals require a small amount of lubricant to prevent frictional heat and subsequent destruction when the shaft is rotating. Oil seals should permit a slight seepage of oil past the sealing surfaces to minimize seal friction and heat. If the seal leaks excessively it can easily be replaced as described in the section on BEARING MAINTENANCE.

The slingers should be tight against the face of the bearing housing to protect the oil seals, and the inside slingers should be snug against inside faces of housing and cap to help prevent oil leaks. Most problems with slingers and oil seals are the result of mishandling the rotor during installation. When properly handled and installed the oil seals will function correctly for years.

Several times an operating shift, check the bearing housing temperature to note any abnormal rise in temperature. Normal bearing operating temperatures will be in the range of 160° – 180°F, which will allow the palm of the hand placed on the top of the bearing housing to remain for approximately 2 –3 seconds. If the bearing housing is warmer than this, remedial steps should be taken to insure proper service life of the bearing.

Periodically, check to see that the bearing housing hold down bolts are tight and the stop blocks are snugly in place, especially after a severe vibration or shock. A sudden rise in vibration can often be accounted for by the loosening of bearing housing hold down bolts, which should be re-torqued.

Refer to the section on LUBRICATION for recommendations on types of oil or grease and frequency of changes or re-lubrication.

A field check on vibration can be made without instruments because a vibration level of 1 to 3 mils (.001" to .003") will allow a new nickel to stand on edge on top of the bearing housing for a few seconds. When a vibration is in the range of 3 to 5 mils (.003" to .005") at an operating speed less than 1800 RPM it is possible to stand a new nickel on edge on top of the bearing housing for 2 or 3 seconds. A vibration level more severe than this should be investigated and corrective measures taken to control the cause. This check is valid only for shredders operating without material being fed, with all the hammers free to pivot on their bolts or pins.

SECTION IIA. LUBRICATION OF BEARINGS

The importance of proper lubrication cannot be overstated in the operation of a shredder because the bearing life depends upon it. Shredder duty is among the most difficult applications for anti-friction bearings so the lubricant selection is vital to its performance. The higher speed large shredders require a circulating oil lubrication system to insure an adequate supply of oil for both cooling and lubricating the bearing.

The bearing housing is designed to provide a sump through which the rolling elements of the bearing will pass. The oil level should be no higher than the center point of the lowest rolling element which can be gauged by the center of the sight glass on the side of the bearing housing.

OILS

Oil used for shredder bearing lubrication should be a highly refined mineral oil of medium body (SAE 30 to 40) that is non-oxidizing with good de-foaming properties and contain extreme pressure (EP) additives. The viscosity of the oil should be between 105°F and 150°F SSU at the anticipated operating temperature range of 160°F to 180°F or between 500 and 750 SSU at the standard base temperature of 100°F. The oil should yield a minimum TIMKEN OK load of 45 pounds.

Oils that conform to the above specifications have been found to provide satisfactory service over the past several years in many large shredder installations. However, it is always preferable to consult a competent lubrication engineer for more specific recommendations, particularly if the conditions at the installation site are unusual.

CIRCULATING OIL SYSTEMS

When circulating oil systems are used the entry or feed is made through the center hole in the top of the housing, the drain should be made from both sides of the bottom of the housing through drain lines having inserts to maintain the proper oil level in the bearing. Lines to bearing housings should have flexible connections. Shredder bearings are given a coating of a basic lubricant at the factory to protect them from corrosion in transit and storage.

The bearing housings **MUST BE FLUSHED** before operating and filled with the correct lubricant for the installation.

High-speed shredder installations may require the oil level be lowered below center of oil sight glass to avoid heat build up due to churning. The oil level can be controlled by adjustment of the flow control valves on the lubrication circulation system or simply draining the sump on static system.

Abnormal bearing temperature may indicate faulty lubrication. Normal temperature may range from cool or warm to the touch, up to a point too hot to touch for more than a few seconds, depending on bearing size, speed and surrounding conditions. If the bearing is too hot to touch for more than a few seconds it is prudent to check the temperature by applying a thermometer at the top of the bearing housing. The bearing housing temperature is usually 10°F lower than the bearing temperature. If the bearing housing temperature is 180°F or higher, immediate steps should be taken to determine the cause and make corrections.

If the shredder is equipped with a water-cooled heat exchanger on the lubrication circulation system, make certain that clean cooling water is flowing to oil cooler. Verify the cooling water passages in the heat exchanger are not obstructed preventing proper cooling of the circulating oil.

PERIODIC LUBRICATION INSPECTION AND CHANGES

Frequency of oil changes in a static system with a bearing lubricated solely by the oil in the housing will depend on several local operating conditions.

Deterioration of oil is caused by heat, oxidation, catalytic reactions, and dirt or water contamination. Therefore, periodic oil changes must be made. The most desirable approach to the question of when to replace the oil is a continuous program of oil sampling and laboratory analysis.

After the initial two weeks of operation, the oil in the bearing housings should be changed on installations without oil circulation systems.

FLUSHING BEARING HOUSING

It is recommended that the bearing housing be thoroughly flushed out after the original oil has been drained. Fill the bearing housing to the center of the sight glass with SAE 10 straight mineral flushing oil, which should not contain additives. The shredder should be brought up to operating speed (without load) and immediately shut down. Drain off flushing oil and refill with recommended operating lubricant to proper level.

After the break-in procedure outlined above it is recommended that the oil be changed and the bearing housing flushed once a month to establish a basis for normal operating conditions. Then, depending on the condition of the oil drained from the bearing housing, the change period may be extended, but never more than every three months of operation.

In a shredder installation with an oil circulating system, test the lubricant at least every six months. If a change in the appearance is noted, check the oil immediately.

Change filters when indicating devices denote plugging of the element or when fluid analysis reveals a change is needed.

COLD WEATHER OPERATION

The heater in the circulating lubrication system reservoir is to be connected so it will operate even when the rest of the system is shut down to maintain a uniform 80°F to 90°F in the reservoir. Shredders installed in area where the ambient temperature drops below 20°F when they are shut down should have the oil circulation system operate continuously to maintain a uniform temperature on the bearings. It may be necessary to heat trace the drain lines from some outside installations to insure proper flow back to the reservoir.

SECTION IIB. GREASE LUBRICATION

The pillow block bearings on Williams’ equipment designed for grease lubrication are normally equipped with zerk type fittings unless otherwise specified.

Normal procedure when re-greasing bearing housings is to remove the drain plug and clean away any hardened grease from the opening so the old grease can be purged and any excess new grease can flow out.

The many types of grease available are of different qualities and compositions so it is necessary to select the grease carefully to insure dependable bearing service.

Bearings on Williams’ equipment designed for grease have been lubricated at the factory with a LITHIUM based grease that has a No. 2 consistency, which is suitable for normal operating conditions. For best results, re-lubricate with lithium base grease or a grease that is compatible with the original lubricant. Mixing of different greases is not recommended. If necessary to change to a different grade, make, or type of lubricant, flush bearings thoroughly before changing.

GREASE SPECIFICATIONS

A good bearing grease must have the following properties:

- 1. Freedom from chemical or mechanical active ingredients such as free lime, iron oxide, and similar minerals or solid substances.
- 2. It must not separate or change in consistency, harden, or form acid.
- 3. A melting point (dropping point) considerably higher than the operating temperatures.

A grease conforming to the following specification will provide proper lubrications for most Williams pillow block bearing applications designed for grease:

- 1. Lithium Soap Base
- 2. NLGI No. 2
- 3. Worked Penetration Range at 77°F 265/295
- 4. ASTM Dropping Point °F 380
- 5. Mineral Oil Viscosity SUS at 100°F 750
- 6. Contain Non-Corrosive, Extreme Pressure Lubricity Additives, & be Water Resistant

The lubricants listed below are typical products ONLY and should not be considered as exclusive recommendations:

**Normal Ambient Operating Temperature Range 0°F to 150°F
NLGI Grade No. 2 (with EP additives)**

METHODS OF RE-LUBRICATION

Before applying grease, the fitting on the bearing housing should be wiped clean, and the lever mechanism of the grease gun should be worked several times until trapped air is expelled and grease begins to come out of the nozzle. The drain plugs at the bottom of the cap and housing should be removed. Any dried or caked grease should be cleared from the drain area.

Grease should be applied while the machine is running. Add approximately 40 – 50 strokes of the lever from the hand-operated grease gun once a month to the grease zerk fitting on the top of the bearing housing. On some of the newer model bearing housings and housing caps there are grease zerk fittings on the sides. These zerk fittings are for lubricating the seals. Whenever the bearings are lubricated, a couple strokes of grease should be added to the seals.

(Reference Drawing # 61J-C-1955 on Page 13)

To avoid over-packing, the drain should be left open, after the gun has been disconnected, until no more grease is expelled from the drain. This is done to make sure the volume of grease has adjusted itself to the space in the housing, and to avoid overpacking. This may require anywhere from five to thirty minutes depending on the temperature and the size of the drain. Excess grease in the housing cavity will cause overheating. If grease is not expelled from the housing it may be necessary to disassemble the housing and clean the old grease out manually.

GREASING NEW BEARINGS

The bearing and housing grease reservoir should be packed with one of the greases listed above or an equivalent. Hand packing at time of assembly is generally preferable to greasing through a fitting because it is quicker and assures the proper amount of grease will be worked into all cavities of the bearing.

When hand packing, complete greasing of bearing is assured if grease is worked in at one side of the bearing until grease appears on the opposite side.

Housing reservoirs should be packed with grease to a level approximately level with the bottom of the shaft before it is pushed on the bearing. Then the bearing cap reservoir should be packed with grease

to the bottom of the shaft as it is slid into position. For a 5" bearing assembly it will take approximately two pounds (approx. 907g) of grease to hand pack the bearing, housing and cap reservoirs.

The drain plug should be left out when the new bearings are started up so any excess grease can be expelled as the surplus grease is flung off the raceways to avoid over-filling the housing.

BREAK-IN PERIOD

During the initial start-up period, after installing a new bearing, or the initial start-up of a new machine, there may be a break-in period during which the bearings will operate with above normal (160°F-180°F) temperatures. The outer race of the taper bore spherical roller bearing is common to two sets of rollers. During the assembly process, the outer race is rarely centered evenly between the two sets of rollers. When the outer race is off-center, the diametrical clearance on one side will be too tight. The reduction of the diametrical clearances on one side of the bearing will cause the bearing to heat up. This heat buildup is normal and necessary. The temperature increase of the bearing will force the outer race to move in an axial direction until it reseats itself, or the diametrical clearances are equal between the two sets of rollers.

During the break-in period, the bearing temperatures should be monitored and closely watched. If the bearing housing temperature increases above 200°F, the machine should be shut down and the bearing allowed to cool down to ambient temperature. Once the bearing has cooled off, the machine can be restarted. It is not uncommon for this process to be repeated a couple of times before the outer race has taken seat.

Once the bearing has reseated itself, the temperature will usually drop to normal operating ranges (160°F-180°F) or below.

The normal stress of shipping and handling is usually enough to cause the outer race to shift in an axial direction. As a result of this movement, abnormally high temperatures during the initial start-up of new machines are to be expected, until the outer race has re-seated itself.

SECTION IIIA. ROLLER BEARING MAINTENANCE & SERVICE

Service on all taper bore Model “O” roller bearings used in Williams’ equipment from 5” through 12” is essentially the same. The main difference is the shaft for the 5” size is not gun drilled for hydraulic connections to assist in removing and replacing the bearing.

The bearings can be removed and replaced with the rotor in the shredder frame, provided sufficient clearance is available at the ends of the shaft to remove the flywheel and coupling half (see section on FLYWHEEL MOUNTING) before loosening the bearing hold down bolts.

**CAUTION – DO NOT REMOVE NEW BEARING FROM ITS WRAPPING UNTIL
IT IS ACTUALLY READY TO MOUNT.**

BEARING HOUSING REMOVAL

Bearing housing for 5" bearings are doweled to the support pedestal with two #7 taper pins that must be removed before the housing can be moved.

Bearings 8" and larger have stop blocks with tapered keys that lock the bearing housing to the pedestal that must be removed before the housing can be moved. Unbolt the keepers that retain the tapered keys so they can be forced out of their slots by use of a hydraulic jack between their ends and the sides of the shredder frame. As the keys are removed, identify them with their slots using a marking device or paint so they will not get mixed up during reassembly.

When the ends of the bearing housings are clear and clean, scribe a match mark at each end of the bearing housing with a mating match mark on the sole plate of the pedestal. This will ensure the bearing housing is properly relocated and aligned with the rotor in the correct position when the bearing housing is reassembled.

If the bearings are to be replaced while the rotor is in the shredder, the shaft will have to be supported on blocking or suspended by a cable sling when the bearing housing is removed. (See section on ROTOR REMOVAL.)

On shredders with circulating lubrication systems, the hydraulic connections and drain lines will have to be disconnected and capped before the bearing housing can be removed. Be sure to provide a container to catch the oil from the bearing housing when the drain lines are removed. Depending on size of bearing there will be anywhere from a pint to several quarts of oil in the bearing housing.

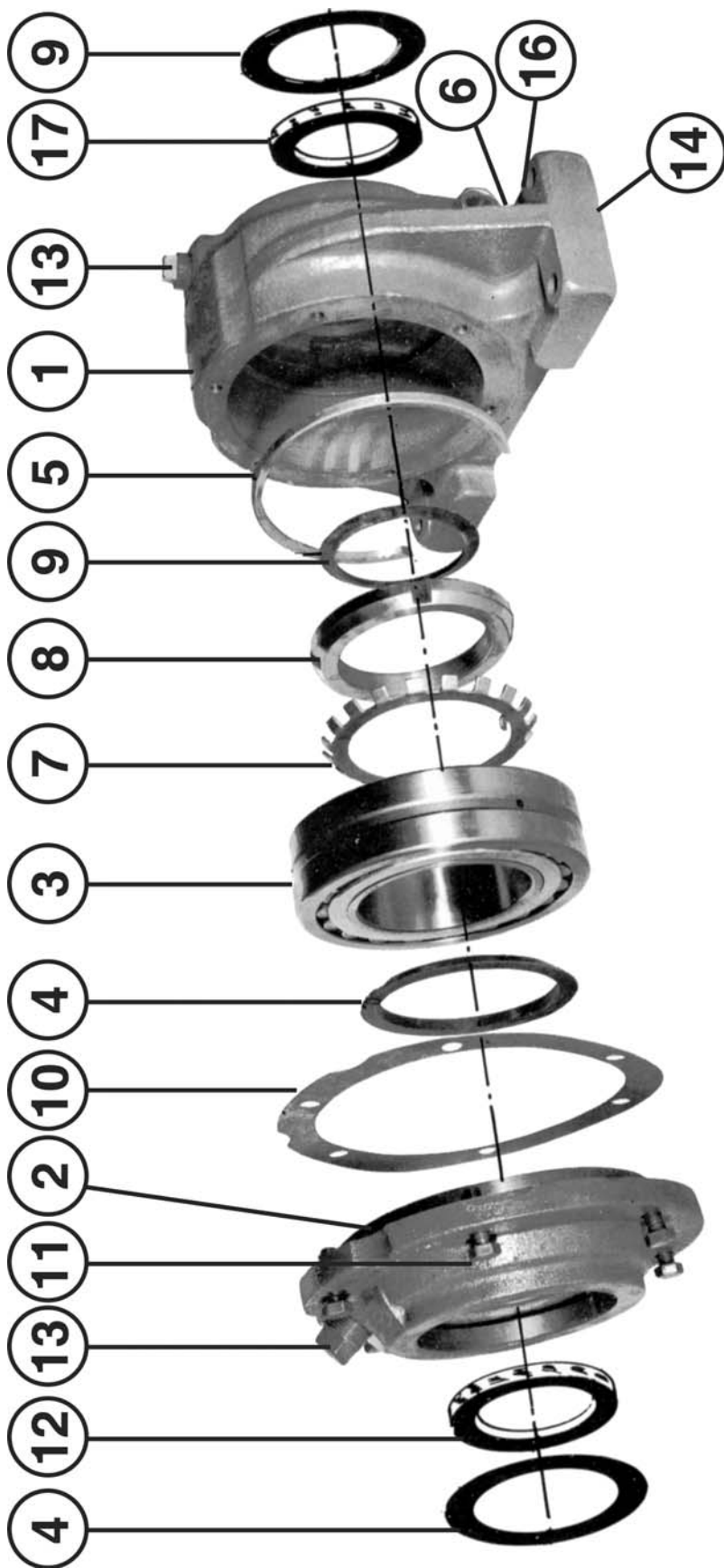
The bearing housing hold down bolts for 8" and 11" bearings have been torqued using a slugging wrench so the same procedure will be required for their removal. The hold down bolts for 12" bearing housings are 3.5" in diameter and have been tensioned while they were heated by electrical Cal-Rod units, which will have to be reconnected to heat the bolts to 350°F for removal of the nuts. (See 144-B-3906)

When the anchor bolt nuts have been loosened several turns, or about a quarter of an inch, the rotor can be raised and blocked so the bottom of the bearing housing is about an eighth of an inch above the support pedestal or sole plate, if the rotor is not to be removed from the housing for the bearing change.

ITEM NUMBER	When Ordering Repairs, Give: Part Wanted, Quantity, This Drawing Number, and Your Mill Number	PATTERN NUMBER	QUANTITY IN MACHINE
1	Pillow Block Housing	BC-286	1
2	Pillow Block Cap	BC-287	1
3	Roller Bearing		1
4	Oil Slinger, Large Bore (Should lightly rub Pillow Block Cap)		2
5	Stabilizing Ring (Used on Drive Side Only)		1
6	Oil Sight Gauge		1
7	Bearing Locknut Washer		1
8	Bearing Locknut		1
9	Oil Slinger, Small Bore (Should lightly rub Pillow Block Housing)		2
10	Gasket		1
11	Capscrews		6
12	Oil Seal, Large Bore		1
13	Inspection Port Pipe Plug		2
14	Oil Drain Plug		2
15	Oil Line Connection		1
17	Oil Seal, Small Bore		1
16	Not shown is a Thermocouple connection located opposite to the oil sight gauge (6) in bearing housing (1)		

**PARTS LIST FOR MODEL "O"
5" TAPER BORE BEARING
WITH STATIC OR CONTINUOUS OIL LUBRICATION
DRAWING NUMBER 61J-B-3051**

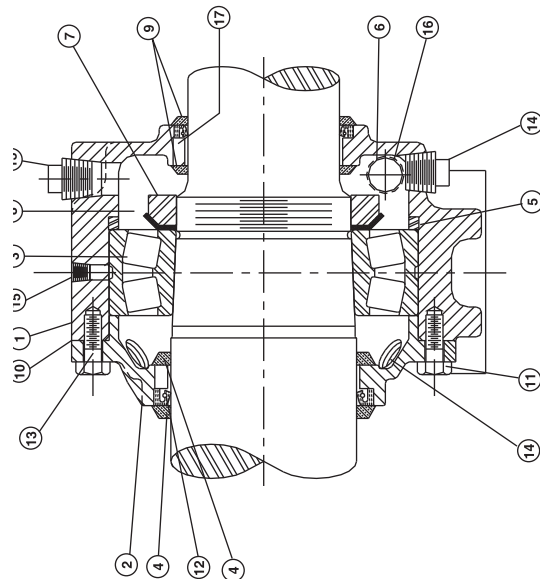




WILLIAMS
PATENT CRUSHER and PULVERIZER CO., Inc.

**PARTS LIST FOR MODEL "O"
5" TAPER BORE PILLOW BLOCK
WITH CONT. OIL LUBRICATION**

DRAWING NUMBER 61J-B-3051



NOTE: SHOULD ROTOR OR BEARINGS BE REMOVED, WHEN REASSEMBLING, ALWAYS REMOVE INSPECTION PORTS (13) AND CHECK TO SEE IF OIL SLINGERS (9) ARE CORRECTLY POSITIONED AGAINST THEIR MATING SURFACES. IF NOT, PRY INTO POSITION

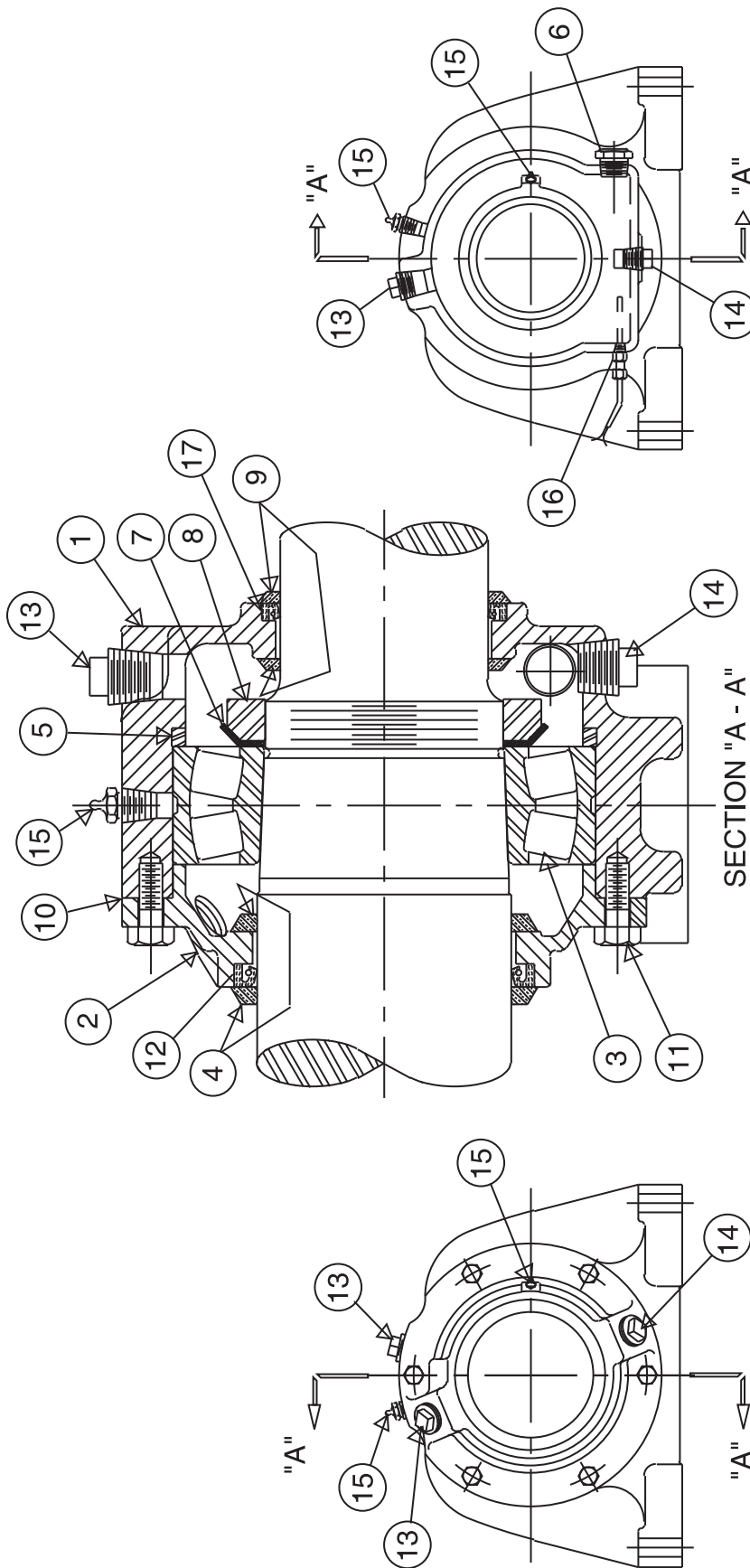
WHEN REMOUNTING BEARING -- MEASURE INTERNAL RADIAL CLEARANCE OF BEARING WITH A SHIM GAUGE -- FORCE BEARING ON SHAFT IN EASY STAGES UNTIL THE ABOVE NOTED RADIAL CLEARANCE IS REDUCED .0025 IN. TO .0035 IN.

SEE CHART ON PAGE 21.

ITEM NUMBER	When Ordering Repairs, Give: Part Wanted, Quantity, This Drawing Number, and Your Mill Number	PATTERN NUMBER	QUANTITY IN MACHINE
1	Open Pillow Block Housing		1
2	Pillow Block Cap		1
3	Roller Bearing		1
4	Oil Slinger, Large Bore (Should lightly rub Pillow Block Cap)		2
5	Stabilizing Ring (Used on Drive Side Only)		
6	Oil Sight Gauge		1
7	Bearing Locknut Washer		1
8	Bearing Locknut		1
9	Oil Slinger, Small Bore (Should lightly rub Pillow Block Housing)		2
10	Gasket		1
11	Capscrews		6
12	Oil Seal, Large Bore		1
13	Inspection Port Pipe Plug		2
14	Oil Drain Plug		2
15	Grease Zerk		3
16	Thermocouple (Optional)		
17	Oil Seal, Small Bore		1

PARTS LIST FOR MODEL "O"
5" TAPER BORE BEARING
WITH GREASE LUBRICATION
DRAWING NUMBER 61J-C-1955





WILLIAMS

PATENT CRUSHER and PULVERIZER Co., Inc.

**PARTS LIST FOR MODEL "O"
5" TAPER BORE, OPEN HOUSING
BEARING WITH GREASE
LUBRICATION**

DRAWING NUMBER 61J-C-1955

NOTE: SHOULD ROTOR OR BEARINGS BE REMOVED, WHEN REASSEMBLING, ALWAYS REMOVE INSPECTION PLUG (13) AND CHECK TO SEE IF OIL SLINGERS (4) ARE CORRECTLY POSITIONED AGAINST THEIR MATING SURFACES. IF NOT, PRY INTO CORRECT POSITION

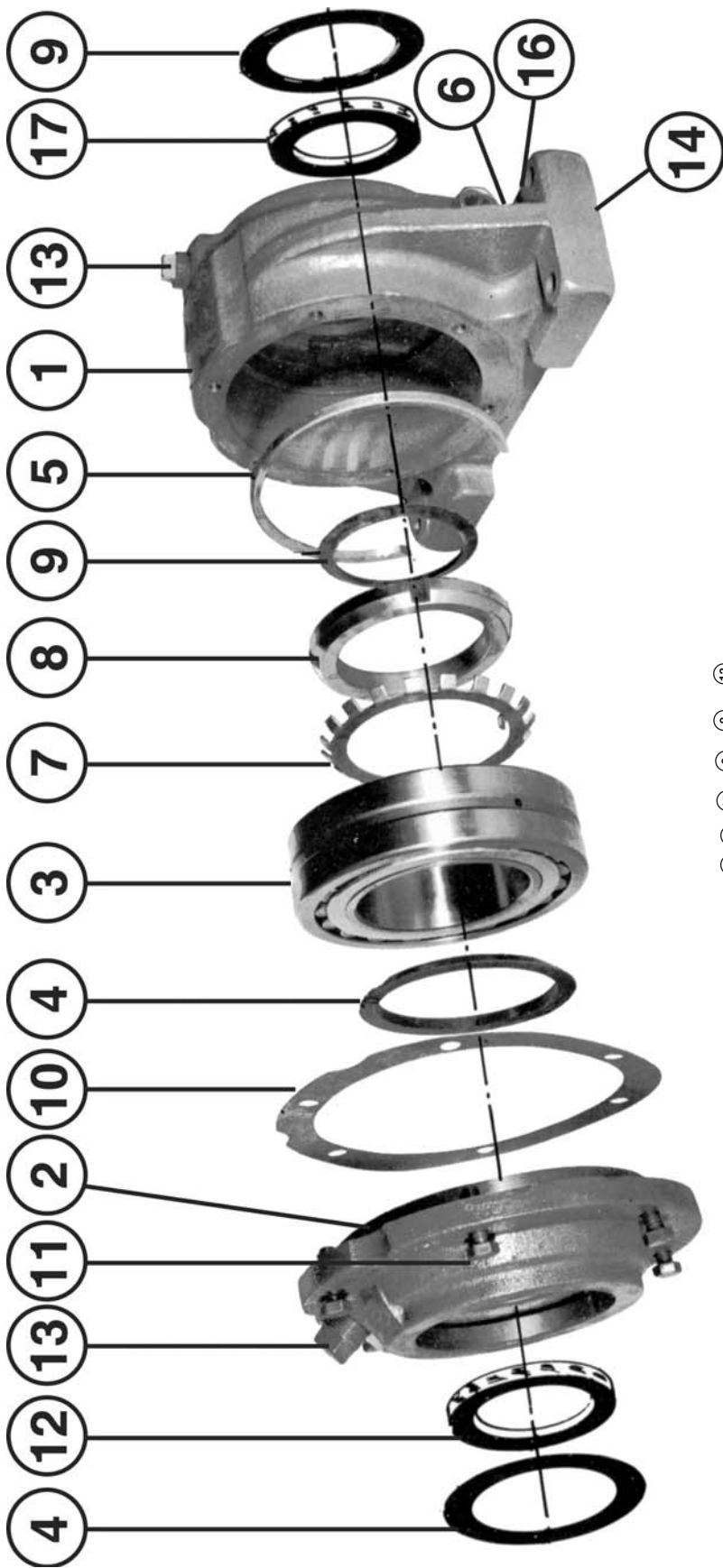
WHEN REMOUNTING BEARING -- MEASURE INTERNAL RADIAL CLEARANCE OF BEARING WITH A SHIM GAUGE -- FORCE BEARING ON SHAFT IN EASY STAGES UNTIL THE ABOVE NOTED RADIAL CLEARANCE IS REDUCED .0025 IN.

SEE CHART ON PAGE 21.

ITEM NUMBER	When Ordering Repairs, Give: Part Wanted, Quantity, This Drawing Number, and Your Mill Number	PATTERN NUMBER	QUANTITY IN MACHINE
1	Pillow Block Housing	SS-550	1
2	Pillow Block Cap	SS-551	1
3	Roller Bearing		1
4	Oil Slinger, Large Bore (Should lightly rub Pillow Block Cap)		2
5	Stabilizing Ring (Used on Drive Side Only)		1
6	Oil Sight Gauge		1
7	Bearing Locknut Washer		1
8	Bearing Locknut		1
9	Oil Slinger, Small Bore (Should lightly rub Pillow Block Housing)		2
10	Gasket		1
11	Capscrews		6
12	Oil Seal, Large Bore		1
13	Inspection Port Pipe Plug		2
14	Oil Drain Plug		2
15	Oil Line Connection		1
17	Oil Seal, Small Bore		1
16	Not shown is a Thermocouple connection located opposite to the oil sight gauge (6) in bearing housing (1)		

PARTS LIST FOR MODEL "O"
8" TAPER BORE BEARING
WITH STATIC OR CONTINUOUS OIL LUBRICATION
DRAWING NUMBER 61J-B-3052

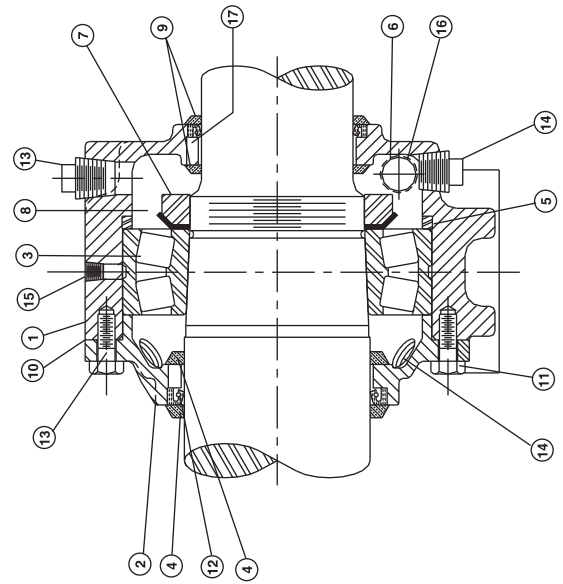




WILLIAMS
PATENT CRUSHER and PULVERIZER Co., Inc.

PARTS LIST FOR MODEL "O"
8" TAPER BORE PILLOW BLOCK
WITH CONT. OIL LUBRICATION

DRAWING NUMBER 61J-B-3052



NOTE: SHOULD ROTOR OR BEARINGS BE REMOVED, WHEN REASSEMBLING, ALWAYS REMOVE INSPECTION PORTS (13) AND CHECK TO SEE IF OIL SLINGERS (9) AND (4) ARE CORRECTLY POSITIONED AGAINST THEIR MATING SURFACES. IF NOT, PRY INTO POSITION

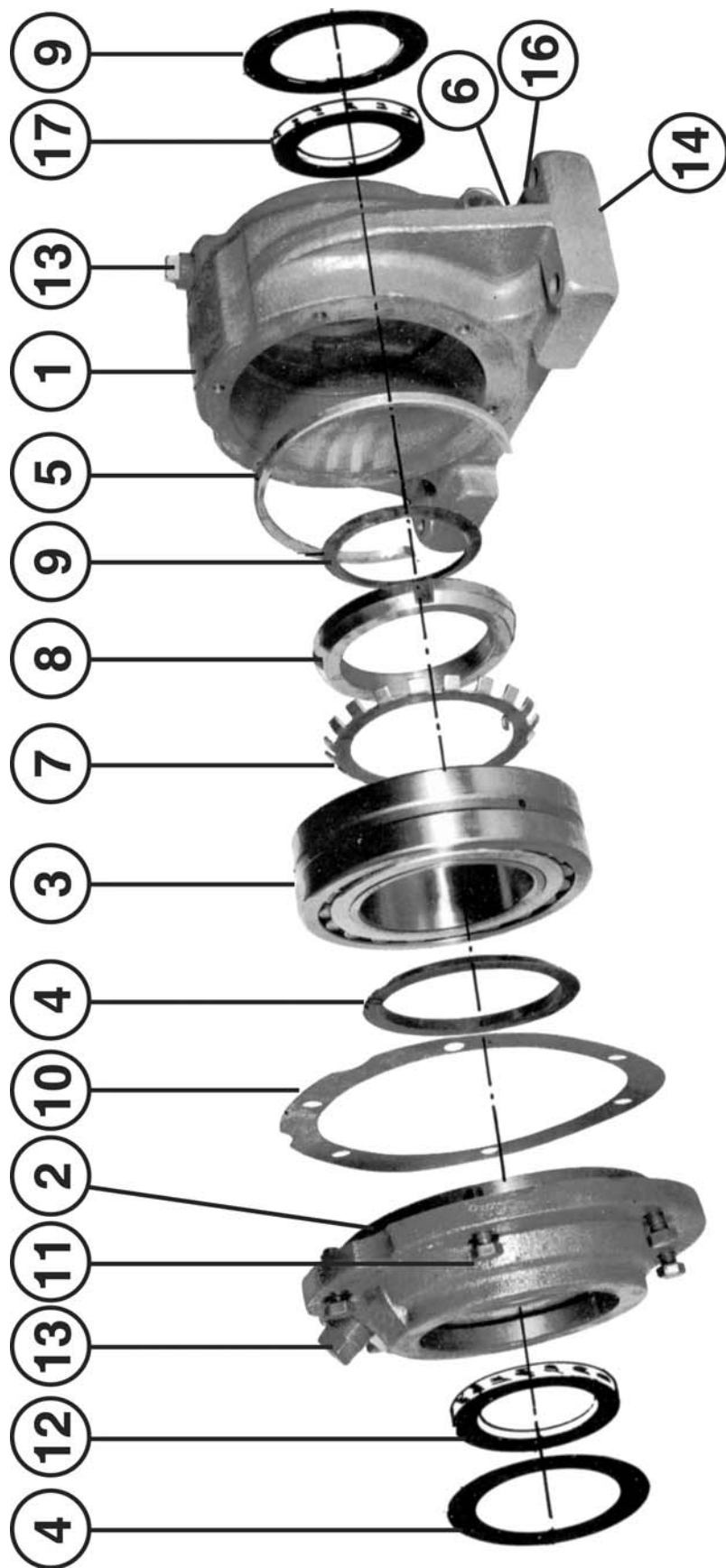
WHEN REMOUNTING BEARING -- MEASURE INTERNAL RADIAL CLEARANCE OF BEARING WITH A SHIM GAUGE -- FORCE BEARING ON SHAFT IN EASY STAGES UNTIL THE ABOVE NOTED RADIAL CLEARANCE IS REDUCED .0035 IN. TO .0050 IN.

SEE CHART ON PAGE 21.

ITEM NUMBER	When Ordering Repairs, Give: Part Wanted, Quantity, This Drawing Number, and Your Mill Number	PATTERN NUMBER	QUANTITY IN MACHINE
1	Pillow Block Housing		1
2	Pillow Block Cap		1
3	Roller Bearing		1
4	Oil Slinger, Large Bore (Should lightly rub Pillow Block Cap)		2
5	Stabilizing Ring (Used on Drive Side Only)		1
6	Oil Sight Gauge		1
7	Bearing Lockplate, Capscrews & Safety Wire		1
8	Bearing Locknut		1
9	Oil Slinger, Small Bore (Should lightly rub Pillow Block Housing)		2
10	Gasket		1
11	Capscrews		6
12	Oil Seal, Large Bore		1
13	Inspection Port Pipe Plug		2
14	Oil Drain Plug		2
15	Oil Line Connection		1
17	Oil Seal, Small Bore		1
16	Not shown is an Air Breather located on the face of the bearing housing (1)		

PARTS LIST FOR MODEL "O"
11" and 12" TAPER BORE BEARING
WITH CONTINUOUS OIL LUBRICATION
 (Note: These bearings are available only with continuous oil lubrication)
DRAWING NUMBER 61J-B-3919

WILLIAMS
PATENT CRUSHER and PULVERIZER Co., Inc.

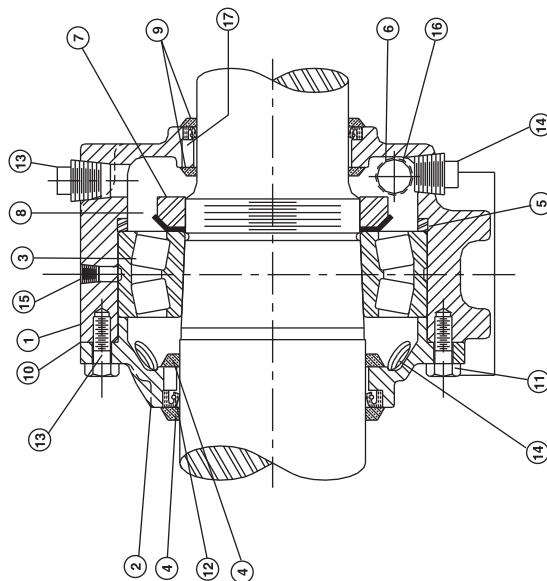


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**PARTS LIST FOR MODEL "O"
11" & 12" TAPER BORE PILLOW
BLOCK WITH CONTINUOUS OIL
LUBRICATION**

DRAWING NUMBER 61J-B-3919



NOTE: SHOULD ROTOR OR BEARINGS BE REMOVED, WHEN REASSEMBLING, ALWAYS REMOVE INSPECTION PORTS (13) AND CHECK TO SEE IF OIL SLINGERS (9) AND (4) ARE CORRECTLY POSITIONED AGAINST THEIR MATING SURFACES. IF NOT, PRY INTO POSITION

WHEN REMOUNTING BEARING -- MEASURE INTERNAL RADIAL CLEARANCE OF BEARING WITH A SHIM GAUGE -- FORCE BEARING ON SHAFT IN EASY STAGES UNTIL THE ABOVE NOTED RADIAL CLEARANCE IS REDUCED .0045 IN. TO .0065 IN. (11"), and .0050 IN. TO .0070 IN. (12").

SEE CHART ON PAGE 21.

Install a lifting eye in the tapped hole provided in the top of the bearing housing and connect it to a lifting device that will permit the housing to be moved along the shaft and clear the end without binding or interference. **CAUTION:** This eye is to lift the bearing housing only and never to lift the rotor assembly.

Complete the removal of the bearing housing hold down bolts.

Listed below are the parts drawings for the different size bearings that use similar index numbers for the assembly items that are referred to in this discussion.

PILLOW BLOCK BEARING HOUSINGS						
BEARING SIZE IN.	PARTS DRAWING	BEARING WEIGHT LBS.	HOUSING PATTERN	WEIGHT	CAP PATTERN	WEIGHT
5	61J-B-3051	22	BC286	110	BC287	22
8	61J-B-3052	122	SS550	630	SS551	90
11	61J-B-3919	265	SS646	965	SS636	160
12	61J-B-3919	408	SS825	2255	SS717	335

BEARING HOUSING DISASSEMBLY

Before proceeding with the disassembly, clean the shaft on both sides of the bearing housing of all corrosion, debris and scale until bright metal shows, then give it a coat of light oil. This will allow the slingers and oil seals to slide along the shaft without their being damaged or broken. The slingers and oil seals are molded from a compressed synthetic rubber compound that is ideal for the application, but can be damaged or broken by mishandling, such as forcing or prying with improper tools. Carefully work the larger slinger (Item 4) away from the bearing housing cap toward the rotor about four inches along the cleaned and lubricated shaft. Remove the cap screws (Item 11) holding the housing cap (Item 2) to the bearing housing, and carefully pry the cap away from the housing.

OIL SEAL REMOVAL

It should not be necessary to remove the oil seal (Item 12) from the housing cap for the cap to slide along the shaft if the shaft is smooth and clean. If the oil seal (Item 12) is to be removed for inspection or replacement, use the proper tools to pull it out of its groove in the cap or housing. A cotter key puller is an ideal tool to pry into the oil seal butt joint. Pull one end out of the groove until the fingers can grasp it. When about a fourth of the seal is clear of the groove, grasp the spring with the hooked tool and pull it from the slot in the seal to relieve the pressure on the seal lip, which should allow the seal to come out the rest of the way without too much strain. Unhook the ends of the spring and remove it from the shaft. Separate the ends of the seal sideways and it can be slipped off the shaft. Inspect the oil seals for hardness and wear which would prevent them from doing their job of retaining the lubricant and keeping foreign material and moisture out of the bearing housing. If the seal appears free of defects or grooves, set it aside for re-installation. However, it is good practice to replace the oil seals when changing a bearing.

BEARING HOUSING CAP POSITION

Slide the housing cap along the shaft until it contacts the slinger (Item 4) that had been moved previously. The larger size bearing housing caps will have to be held upright on the shaft to keep them out of the way while changing the bearing. This can be done easily by wiring the cap to the side of the shredder housing or to the sling supporting the shaft.

The inside large diameter slinger (Item 4) can remain in place if it is in good condition while the bearing is being replaced.

REMOVING HOUSING FROM BEARING

Slide the small diameter slinger (Item 9) away from the face of the bearing housing and off the end of the shaft using a lubricant to ease its travel along the shaft. Remove and inspect the oil seal (Item 17) from the end of the bearing housing using the procedure described previously.

It will be necessary to support the larger bearing housing so it can be moved axially without binding or interference and allow it to clear the end of the shaft for removal.

The inside of the bearing housing has been honed and lapped to a snug fit on the outer ring of the bearing so a pulling device or effort will be required to slide the housing off the bearing. Set the bearing housing aside where the finished machined surfaces will be protected and rest it on blocking so the bottom mounting pads will not be damaged.

Flush out any oil remaining inside the housing with solvent and make certain that the sight glass (Item 6) is cleaned, then dried thoroughly. Spray or wipe the machined surfaces of the housing with a light machine oil to protect them from rust while the bearing is being replaced.

The drive side bearing housing has a stabilizing ring (Item 5), which should also be cleaned and replaced in the housing.

The inside small diameter slinger (Item 9) is next removed from the shaft to be cleaned and inspected. If found to be in good condition, set it aside for reassembly.

BEARING REMOVAL

Straighten up the tabs of the lockwasher (Item 7) on 5" and 8" bearings, or unbolt and remove the lockplate (Item 7) on 11" and 12" bearings so the locknut (Item 8) can be loosened. Use a spanner wrench that fits the locknut to loosen it on the shaft. If a spanner wrench is not available, use a blunted bar ground to fit the locknut slots for turning the locknut. Back the locknut off a few turns until it is 1/8" to 1/4" away from the bearing face. This will keep the bearing from shooting off the end of the shaft when it is freed from the tapered mounting seat on the shaft, by the hydraulic pressure or puller.

A conventional bearing puller that contacts the inner ring will be required to remove 5" bearings from the tapered mounting seat of the shaft.

CAUTION: Do not attempt to drive the bearing off the tapered mounting because of possible damage to the critical finish of the tapered mounting surface.

HYDRAULIC REMOVAL METHOD

To remove 8" and larger bearings, connect a hydraulic pump capable of delivering 10,000 psi to the 3/8" NPT tapped hole in the end of the shaft from which the bearing is to be removed.

Slowly apply pressure with the hydraulic pump until the bearing pops free, which will sound like an explosion, but the locknut acting as a safety measure will keep it on the shaft.

Remove the locknut and slide the bearing off the shaft using a fabric sling for the larger size bearings.

Clean the tapered mounting seat and examine it for nicks and burrs or other signs of fatigue and wear. If the tapered mounting is acceptable, the shaft is ready for installing the replacement bearing.

If the large diameter slingers (Item 4) have been found satisfactory, leave them in place along with the bearing housing cap; otherwise they should be replaced at this point. Should the slingers require replacing, carefully tap them onto the shaft with a soft-faced hammer and move them up the shaft several inches so they will be out of the way.

Be sure to slide the bearing housing cap onto the shaft before mounting the inside slinger (Item 4) on the shaft.

MOUNTING TAPERED BORE SPHERICAL ROLLER BEARINGS

Cleanliness during this operation is a must, and every effort should be made to provide a moisture and dust free environment. The installer should keep hands, tools and working area clean, because the bearing is a precision unit and any foreign material will be detrimental to its operation.

Unwrap the new bearing when all the necessary preceding operations have been completed and the proper tools are on hand to complete the mounting without delay to avoid contaminating the bearing with dirt or metal particles.

Do not remove the coating of "slush" – rust preventative oil applied at the factory for protection against corrosion. This preservative is compatible with grease and oil and does not need to be removed unless a synthetic lubricant is to be used.

The distance the bearing is forced onto the tapered seat determines the fit of tapered bore spherical roller bearings. This results in a reduction of diametrical clearance (DC) in the bearing through expansion of the inner ring. It is necessary to determine the initial DC before mounting, and to check the DC reduction during mounting until the specified DC is established.

To properly determine the initial DC, the following procedure is recommended. A feeler gauge with at least 3" long blades with a smallest blade thickness of .0015" will be required.

The following table of diametrical clearances before installation and recommended reduction of clearance is provided by the bearing manufacturer.

TABLE OF DIAMETRICAL CLEARANCES

BEARING SIZE		DIAMETRICAL CLEARANCE BEFORE INSTALLATION (inches)		REDUCTION OF DIAMETRICAL CLEARANCE (inches)		MINIMUM DIAMETRICAL CLEARANCE (inches)
inch	mm	min.	max.	min.	max.	After Mounting
5	130	.0063	.0081	.0025	.0035	.0030
8	200	.0088	.0114	.0035	.0050	.0040
11	280	.0118	.0156	.0045	.0065	.0055
12	300	.0130	.0169	.0050	.0075	.0060

CHECK DIAMETRICAL CLEARANCE

Lubricate the tapered mounting seat with a light machine oil. Slide the bearing (Item 3) onto the shaft until it is resting firmly on the tapered mounting seat with the inner and outer ring faces parallel. Slide the lockwasher (Item 7) and the locknut (Item 8) onto the shaft and run them up against the face of the bearing just had tight to hold it in position. Inspect the tangs of the lockwasher removed in the disassembly for cracks or signs of fatigue and replace if necessary.

Press down firmly on the top of the outer ring and oscillate the outer ring two or three times. This “seats” the inner ring and rolling elements. Position the individual roller assemblies so that a roller is at the bottom of the inner ring – on both sides of the bearing.

Press the two bottom rollers inward and upward to assure their being in contact with the center guide flanges as well as the inner ring raceways. With the rollers in the correct position, insert a blade of the feeler gauge (see chart for size range) between two of the bottom rollers. Move it carefully under the bottom roller between the roller and outer ring raceway. **NOTE: DO NOT ROTATE BEARING WHEN PASSING FEELER BETWEEN ROLLER AND OUTER RING!** Repeat this procedure using progressively thicker feeler gauge blades until one is found that will not go through. The blade thickness that preceded the “no-go” blade is the measure of diametrical clearance (DC) before installation.

Example: A 5” (130mm) bearing is to be mounted on a tapered shaft.

- By measurement with a feeler gauge, the initial DC is .0075”
- Reference to table indicates a proper fit is obtained when DC is reduced by .0025” to .0035” or approximately .0030”.

Initial Clearance	.0075”
Reduction of DC	.0030”
Clearance after mounting	.0045”
- The locknut is tightened until the DC reaches .0045”

NOTE: Tapered bore bearings must have the proper amount of diametrical clearance before installation to provide for the required mounting reduction of DC and to compensate for any further internal reduction from abnormal temperature conditions.

MOUNTING THE BEARING

Manual Method: When the required DC reduction has been determined, tighten the locknut (Item 8) with a spanner wrench until snug. If a spanner wrench is not available, use a blunted bar ground to fit locknut slots for tightening.

Lay a soft steel or brass bar along the shaft, in contact with the locknut and strike the bar several sharp blows with a hammer at several positions around the locknut. These blows drive the inner ring of bearing further up on the tapered shaft and release the pressure on the locknut threads, allowing the nut to be tightened easier. Continue to tighten the locknut (Item 8) while periodically measuring the DC at the unloaded roller, making sure it is firmly seated against the inner race and against the guide flange. When the proper amount of DC reduction is obtained the final clearance measurement on both faces of the bearing should be recorded for future comparison or reference.

Hydraulic Mounting Method: The larger size tapered bore bearings, 8" and up, can be eased onto the tapered mounting using the hydraulic method. Connect the hydraulic pump to the end of the shaft by the 3/8" NPT fitting. Tighten the locknut (Item 8) with the lockwasher (Item 7) on 8" bearings until it is firmly against inner ring of bearing. On 11" and 12" bearings, the locknut (Item 8) should be positioned with bolt holes outward and bearing directly against the face of the bearing inner ring. Introduce 2000-3000 psi oil pressure while tightening the locknut until proper DC is obtained.

SECURING LOCKWASHER

When the recommended reduction of DC has been attained, the bearing is in its proper position on the shaft. Find a lockwasher (Item 7) tang that is nearest a slot in the locknut on 5" and 8" bearings. If slot is slightly past tang don't loosen nut, but further tighten so that the next nut slot clockwise meets a washer tang. Bend tang into the slot. The locknut (Item 8) on 11" and 12" bearings is secured by the tang of the lockplate (Item 7) inserted in a notch in the shaft, then bolted and wired to the face of the locknut. Do not loosen nut, but further tighten if necessary to allow tang to fit into notch on shaft.

ASSEMBLY OF BEARING HOUSING

Slide the small diameter inside oil slinger (Item 9) on the shaft until it is within a couple of inches of the locknut (Item 8) so it will contact the inside of the bearing housing.

Wipe the inside machined surfaces of the thoroughly cleaned bearing housing with a light machine oil. If this is the DRIVE SIDE bearing housing, it will have the stabilizing ring (Item 5) against the shoulder inside the housing.

NOTE: Only the DRIVE SIDE bearing housing has a stabilizing ring. Wipe the outside of the bearing with a light coat of machine oil to help it slide into the bearing housing.

Check to see that the housing gasket is in place on the housing cap before proceeding.

Hoist the bearing housing (Item 1) and slide it on the end of the shaft until it contacts the outer race of the bearing. Square the bearing outer race with the bore of the bearing housing so they are concentric. The bore of the bearing housing is honed to fit snug on the bearing so it will require some force to move it onto the bearing. Several light blows on the reinforcement gussets on both sides of the bearing housing will help move the housing onto the bearing without damage.

LOCATION OF HOUSING ON BEARING

The bearing housing is in the proper position on the drive side bearing when the inside shoulder with the stabilizing ring is flush against the bearing. This can be checked by removing the lubrication connection plug (Item 15) from the top of the housing to see if the lubrication groove of the bearing outer ring is centered in the hole. The outboard or "floating bearing" housing is in the correct position when the bearing is centered in the axial travel limits of the housing. This can be checked by observing through the lubrication connection hole (Item 15) if the inboard edge of the lubrication groove is centered in the opening.

NOTE: For Impact Dryer Mills or Hot Hogs where the rotors are subjected to heat, the outboard bearing may be positioned for maximum outward expansion. Maintain 1/8" minimum clearance between the bearing and the cap.

Slide the bearing cap (Item 2) into position, making certain it contacts the inner slinger (Item 4), and draw it against the bearing housing by tightening the cap screws (Item 11) equally around the cap.

Lower the rotor until the bearing housing contacts the pedestal supports or sole plate after checking to be sure the match marks on the ends of the bearing housing line up with marks on the support pedestal that were scribed prior to disassembly.

INSTALL BEARING HOUSING OIL SEALS

The RUP pattern oil seal (Item 12 & 17) is installed in the grooves in the end of the bearing housing and cap with the lip facing inward and butt joint at the top.

CAUTION: All split seals are presized for the proper bearing housing at the factory. DO NOT ATTEMPT TO ALTER THE AS-RECEIVED SIZE ON JOB SITE.

1. Separate seal ends sideways and slide it over the shaft with the lip pointing toward the mounting groove. Lubrication on the seal, shaft and mounting groove will facilitate installation. Position the butt joint at the top.
2. Lubricate the spring and install it around the shaft with hooked end connection 90° away from butt joint. Insert the spring in the lip groove of the seal, which may require a small hooked tool to handle the spring and guide it completely into the lip groove.
3. Align seal ends and start the butt joint into the groove of housing by finger pressure, then slide the fingers around the seal simultaneously in both directions with a wrapping motion to start the inner edge of seal into the groove around its entire circumference before forcing any part fully into the groove. Then gently tap (only on the outer edge of seal) until it is seated in the housing groove, with the outer edge flush with the housing face.

Slide the outside slingers (Item 4 & 9) into position on both sides of the housing until they are contacting the machined face. Open the inspection port plugs (Item 13) to see that the inside slingers are flush against the inside of the housing. If the fingers were positioned properly on the shaft, they were snug against inside of bearing housing and cap when drawn into position. If they are not flush, they can best be moved when the shaft is rotating by using a round end rod inserted through the inspection hole (Item 13) and riding against the slinger edge until it moves flush against the inside of the housing. Use care to prevent any debris entering the bearing housing when the inspection plugs are removed, and replace them promptly.

A slight leak past the oil seals when the machine is running is to be expected, and will actually be helpful in lubricating the seal lip to prevent heat and wear. If leakage is severe, check to see the seal is seated properly, or else it could have been damaged during installation. Sometimes additional lip pressure by shortening the seal spring will correct leakage.

COMPLETE MOUNTING THE BEARING HOUSING

The bearing housing hold down bolts and lubrication lines are connected along with miscellaneous other items installed in the reverse order of their removal. See section on ASSEMBLY AND INSTALLATION.

The correct procedure for installation of bearing housing hold down bolts for 12" bearings is covered in Form 895A.

SECTION IIIB. INSTALLATION, LUBRICATION & OPERATION OF STRAIGHT BORE BEARINGS

Cylinder, or straight bore bearings are mounted on their shaft with a slight interference fit. Mounting is simplified by heating the bearing in an oil bath for 20 to 30 minutes at 200° to 250°F until it has expanded sufficiently to slide easily on the shaft.

See Drawing 61J-B-2668 for exploded view of bearing assembly and the index number of the items referred to in this text. All areas inside bearing housing (Item 1) and cap (Item 2) that are not machined are thoroughly cleaned and coated with GE red Glyptol or equivalent varnish.

The large felt seal (Item 8) is inserted in the groove of the housing cap (Item 2) before the cap is slid on the shaft along with the gasket (Item 9). Make certain that the drain plug (Item 12) is installed in the housing gap.

The oil bath to heat the bearing should not be allowed to go above 250°F and the tank should have support blocks and a screen to keep the bearing away from the heat source while in the oil bath that may cause localized high temperature and reduce race hardness.

The heated bearing (Item 3) is slid on the bearing seat squarely against the shoulder. The lockwasher (Item 5) and the locknut (Item 6) are then installed to keep the bearing against the shoulder. As the bearing cools, the locknut should be tightened holding the bearing against the shoulder.

The oil bath leaves a thin film of oil on the bearing, which will prevent rust until it cools. But as soon as possible the bearing should be packed with the proper grease.

When the bearing has cooled and the locknut is fully tightened, bend a tang of the lockwasher (Item 5) into a slot of the locknut (Item 6). If slot is past the tang do not loosen the nut, but further tighten so that the next slot clockwise meets a washer tang.

The small diameter seal (Item 7) is inserted in the groove in the outside face of the bearing housing (Item 2). To minimize fretting corrosion during operation and to ease the installation on the bearing, coat the inside of the housing with a light machine oil. The drive side bearing has the stabilizing ring (Item 4) inserted in the bearing housing before it is slid on the bearing.

Make certain the outer ring of the bearing is square with the housing bore before attempting to slide it in place. If the outer ring becomes misaligned and stuck, do not force it further into the housing. Use a brass or soft steel bar and tap the outer ring until it becomes free and is realigned.

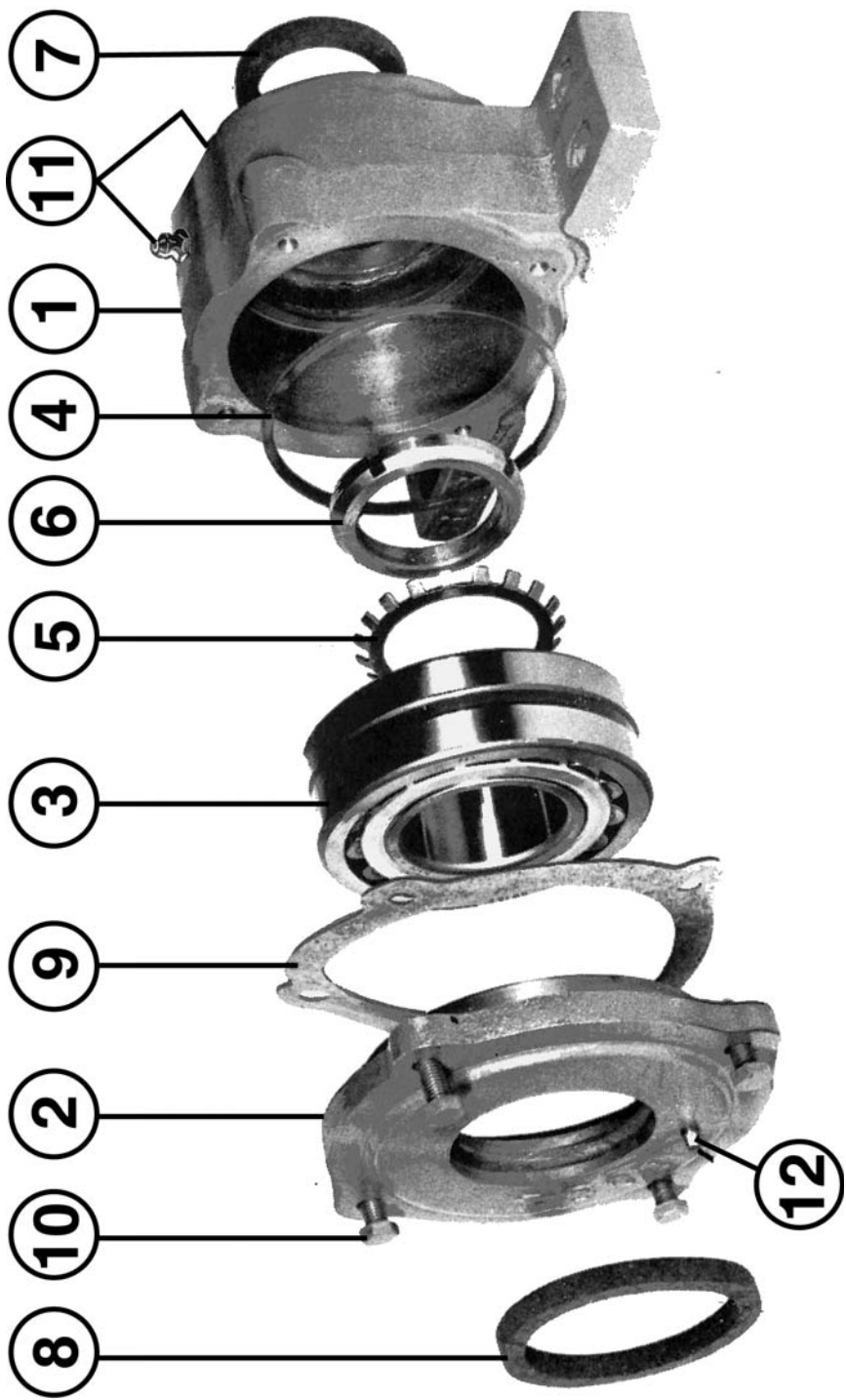
Check to see that the bearing housing is approximately one third to half full of grease when the housing cap (Item 2) is slid into place. Tighten the cap screws (Item 10) with the gasket (Item 9) in place to hold the housing cap firmly in place. The assembly is complete when the lubrication plug (Item 11) is in place on the bearing housing.

The flywheel side or outboard bearing is assembled in the same manner as above except the stabilizing ring (Item 4) is not used.

ITEM NUMBER	<u>When Ordering Repairs, Give:</u> Part Wanted, Quantity, This Drawing Number, and Your Mill Number	PATTERN NUMBER	QUANTITY IN MACHINE
1	Pillow Block Housing		1
2	Pillow Block Cap		1
3	Bearing -- Ball or Roller		1
4	Stabilizing Ring (Used on Drive Side Only)		
5	Bearing Locknut Washer		1
6	Bearing Locknut		1
7	Outside Dust Seal Ring		1
8	Inside Dust Seal Ring		1
9	Gasket		1
10	Cap Screws		
11	Lubrication Fitting (For Location, see below)		1
12	Lubrication Drain Plug		1

PARTS LIST FOR TYPE "O"
ROLLER & BALL BEARING
PILLOW BLOCKS
DRAWING NUMBER 61J-B-2668

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OPERATIONS FOR MOUNTING BEARING ASSEMBLY

BLY

- A. Slip bearing cap (2) over shaft.
- B. Slip bearing housing gasket (9) in place on cap.
- C. Press bearing (3) on shaft. Apply pressure to inner race only.
- D. Mount & tighten lock washer (5) and lock nut (6).
- E. Slip stabilizing ring (4) in housing for drive side only.
- F. Slip housing (1) over bearing & fasten cap (2) to housing.
- G. Bolt down housing to bearing pedestal.

FOR DISMANTLING - REVERSE PROCEDURE.

WILLIAMS
PATENT CRUSHER and PULVERIZER CO., Inc.

**PARTS LIST FOR TYPE "O" ROLLER
& BALL BEARING PILLOW BLOCKS**

DRAWING NUMBER 61J-B-2668

DISASSEMBLY

The removal of a bearing is the reverse of the preceding steps except a hydraulic or mechanical split ring puller is used to push the inner ring of the bearing off the shaft.

INSTALLATION

The rotor with the bearing assemblies is installed in the frame so the end disc is centered in the opening when the drive side or fixed bearing is securely bolted to its pedestal. The outboard, or flywheel side bearing housing is slid along the shaft as far as it can move in both directions and the limits of its travel is marked on the shaft. The bearing housing is then centered between these marks so the bearing can “float” in the housing when the shaft expands or contracts.

LUBRICATION

Straight bore bearing housings are designed for grease lubrication of the bearing unless specified otherwise.

The grade and type of grease used for the bearing depends on the application and temperature as well as the daily hours of operation.

An anti-friction bearing requires a comparatively small amount of lubricant, and over-lubrication will only cause trouble.

An important rule to remember is DO NOT OVER-LUBRICATE anti-friction bearings; however, lubrication must always be present in the bearing to avoid damage.

In the higher speed ranges, too much grease will cause churning and overheating that results in separation of the grease components and breakdown in lubricating values.

Normal operating temperatures are in the range of 150° to 170° F with a slight showing of grease at the seals to indicate the bearing is properly lubricated.

Many factors such as bearing size and speed and the environment determine how often the bearing should be relubricated. It is not possible to predetermine when new grease must be added because of the gradual way the lubricating value is reduced over a period of time. In establishing a greasing schedule, previous experience with similar equipment operating under comparable conditions is the best guide. Bear in mind that it is better to add small amount of grease at frequent intervals than a large amount infrequently.

The bearing size (bore diameter) and speed compared with the operating hours serve as a good estimate of the lubrication frequency or period.

The following chart lists various size mills and the suggested maximum greasing period:

MILL SIZE	MAXIMUM OPERATING SPEED	MAXIMUM GREASING INTERVAL HOURS
GP106	3600	2000
GP1512-18	3600	1200
ROCKET 10-30	3600	1200
METEOR 6-18	1800	1200
111 IMPACTOR	3600	1200
"C" SERIES	1800	300
200 IMPACTOR	1800	300
METEOR 20-24	1800	300
240 IMPACTOR	1800	150

When applying grease to the bearing housing through the fitting, make certain the fitting is wiped clean before connecting the grease gun, and the drain plug is removed from the housing cap to allow purging of the old grease. Sufficient grease should be added at each greasing to fill the bearing housing cavity from one-third to one-half full. If fill cannot be determined visually, make an estimate of the size of the cavity and measure the amount of grease expelled by a stroke of the gun.

SECTION IV. TROUBLESHOOTING

TROUBLE	OBSERVED CHARACTERISTICS	PROBABLE CAUSE	CORRECTIVE ACTION
T E M P E R A T U R E	High bearing temperature after first start	Grease redistribution	Allow machine to cool, then restart
	Continuously high during operation	Churning of lubricant	Use lower oil level or less grease, or stiffer grade of grease.
		No lubricant	Add lubricant, check seals
		Excessive axial load	Check outer ring location in housing of "floating" bearing to allow thermal expansion.
	Hottest at center of bearing housing	Bearing misaligned	Bearing outer ring should be square in housing and housing perpendicular to shaft in both directions.
		Bearing housing pinching bearing ring	Debris under bearing housing causes distortion of housing when holding bolts are drawn down, that pinches outer ring of bearing. Clean and true bearing pedestal.
		Excessive radial load	Use correct fit of inner ring on shaft for straight bore bearings. Use bearings with greater internal diametrical clearance. For preloaded paired bearings, use lighter preloads. Balance rotor.
		Raceways pitted	Pitting usually result of electrical current flow due to improper ground when welding on rotor. Replace bearing.
	Hottest at faces of bearing housing	Sliders dragging against seal	Ease slider away from face of seal a slight amount for clearance of 1/32" or less.

TROUBLE	OBSERVED CHARACTERISTICS	PROBABLE CAUSE	CORRECTIVE ACTION
E X C E S S I V E V I B R A T I O N	During acceleration or de-acceleration periods	Critical speed of machine components or feed chute	Isolate feed chute from mill, stiffen or support ducts or other components to change their criticals.
	During operation at a fixed speed	Foundation critical	May require change in operating speed of mill to avoid critical.
		Unbalanced rotating parts	Dynamically balance rotating parts. Determine if rotor or hammers are the cause of the unbalance by running rotor without hammers.
		Running at higher than rated speed	Refer to instruction manual for correct speed.
		Misalignment	Align to tolerances called for in instruction manual
		Bearing brinelled	Replace bearing, avoid excessive loading at mill or operating with unbalanced rotor.
		Machine loose on foundation	Retighten hold down bolts, but do not distort frame, which will increase vibration.
	During operation at fixed speed, but at a changing amplitude	Hammers held out of position by feed material	Reduce feed of oversize material into the mill or increase hammer size.
		Structural critical	Dynamically de-couple mill from forcing frequency by stiffening frame or isolating components that are responding to vibration from mill operation. May require changing mill speed if isolation is not practical. Condition can be positively identified by vibration analysis.
		Cover or components loose	Tighten all bolts holding accessories and covers on regular schedule.

TROUBLE	OBSERVED CHARACTERISTICS	PROBABLE CAUSE	CORRECTIVE ACTION
N O I S E	High pitch, steady tone	Excessive axial load	Correct outer ring location in housing of "floating" bearing to allow thermal expansion.
		Excessive radial load	Check internal clearance on preloaded roller bearings and increase clearance to allowable maximum
		Misalignment of bearings	Correct alignment so that bearings are square with shaft in all directions
		Lack of lubricant	Regrease or add oil as necessary. Determine cause.
		Bearing exposed to vibration while machine is idle	Carefully examine bearing for wear spots separated by distance equal to ball or roller spacing. Replace bearing. Condition known as false brinelling.
		Wrong type of grease or oil causing breakdown of lubricant	Refer to lubrication instructions for proper type of grease or oil for bearing.
		Replacement bearing selected with inadequate internal clearance for operating conditions where heat is conducted through shaft and expanding the inner ring.	Replacement bearings should have identical markings as original factory equipment.

TROUBLE	OBSERVED CHARACTERISTICS	PROBABLE CAUSE	CORRECTIVE ACTION
N O I S E	Intermittent rumbles, rattles, clicks, etc.	Too much clearance in bearing.	Adjust preload on bearing.
		Excessive wear in raceways	Replace bearing.
		Loose machine parts or bearing hold down bolts	Tighten all hold down bolts, closures and other machine components.
	Low pitched clicking	Foreign material in bearing	Flush bearing, replace oil and check seals for wear, or use better practice in handling relubrication of bearing.
	Intermittent high pitched noise or squeal	Rollers or balls skidding	Use thinner grease or oil. Possible preload of bearing not adequate. Check clearance.
	Low pitched, continuous or intermittent noise or rumble.	Rotor or shaft rubbing housing	Correct machine parts or position of cover
		Too much clearance in bearing	Check for correct preload on bearing.
		Raceways pitted	Clean all parts and replace bearing and seals. Pitting is usually result of electric current going through bearing when welding on rotor without proper ground.
		Bearing brinelled	Replace bearing and avoid overloading.
		Resonant vibration of machine or hopper	Isolate hopper from mill, stiffen or sound-deaden thin panels and large flat surfaces. Tighten all hold down bolts on mill and support structure.

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FORM 852R

CRUSHER INSTALLATION

Congratulations on your ownership of a Williams Crusher! Whether you purchased it new and specifically built for your application, or it is a previously owned crusher, it will provide years of trouble-free service if the proper installation and service procedures are followed.

It is not unusual to find one of our crushers starting a second or third career after a long, productive service life for the original owner.

The purpose of this brochure is to provide a helpful guide or checklist for the various necessary steps to insure the safe and successful installation of Williams crushing equipment.

In planning the installation of a crusher, the primary consideration must be operating safety. Proper feeding, material handling, and provisions for service are necessary operating provisions. The power of the motor and speed of the crusher rotation will be determined by the quantity and size of the product desired within the design limitations of the particular size crusher.

OPERATING CONTROLS

A uniform load on the crusher motor is the most efficient method of operation for both the crusher and its motor. This can be accomplished in several ways, but the best arrangement is by a feed control device that measures the current the motor is drawing, which in turn controls the feed equipment to maintain a selected percentage of the crusher motor full load by sequencing the feed device to regulate the material flow into the crusher.

This load control is the surest way to prevent overloading and plugging of the crusher and to protect the crusher motor from overheating and tripping the circuit breaker or causing other electrical and mechanical problems.

The electrical circuit breaker or starter to control the crusher motor should be conveniently located within sight of the crusher and clearly identified with provisions for lockout during service operations. The control circuit should have an interlock to prevent the feed device from operating when the crusher motor is not energized or running. This will prevent the crushing chamber from being filled with material that would not allow the rotor to start or plug up when the crusher motor was de-energized purposely or by overload.

When the control circuit has provisions for remote starting of the crusher, ample warning signs shall be posted near every access opening on the crusher and its inlet and outlet hoppers.

SERVICE PROVISIONS

When locating the crusher in a building or near other machinery, always allow sufficient clearance to open the crusher cover and perform necessary service operations. The hammer bolts are usually removed from the side of the crusher opposite the drive to allow sufficient clearance to withdraw the full length of the hammer bolt from the rotor. When rebuilding or replacing the hammers, which is the most frequent service operation, it is always necessary to open the crusher cover. Hammers are sometimes built up to original profile by welding while they are in position on the rotor. It is almost always necessary to use a mechanical lifting device to open the cover unless the crusher is equipped with a hydraulic cover opening system. Where mechanical equipment will be used to open the crusher cover, provisions should be made for the safe, secure attachment of the lifting devices which will allow for the movement of the cover as it lifts off or pivots open. The lifting

equipment for the cover need not to be permanently mounted, but the brackets or track it is supported by should be securely installed either on the surrounding structure or the crusher feed hopper; whichever provides for the safest opening of the crusher cover.

FEED CONVEYORS

The most common way of feeding a crusher is by a conveyor - either a belt or apron pan that dumps into a hopper above the crusher. Other alternatives are bucket elevators, vibratory pan feeders, or screw conveyors, and sometimes rotary pocket feeders are used to introduce the material into the feed hopper. Whichever feed device is used, it is important to avoid surges in loading and keep the bed of material flowing into the crusher as uniform as possible.

Feed devices such as bucket conveyors and screw conveyors are somewhat self-metering in that only a given amount of material is carried by each flight or bucket. Apron pan and belt conveyors, on the other hand, do not usually carry uniform height or width load so more careful control is necessary in the loading volume regulation with this type of material handling equipment. When material is dumped onto a conveyor either by a bucket loader or a truck, some type of height regulating or strike off device is needed to level the bed of material to a uniform height as it travels along the conveyor. This is sometimes done with two-stage conveyors, each traveling at different speeds, to spread the load or else using a surge bin to maintain an even flow into the crusher. Whichever conveyor or feed device is used, it should be freestanding or self-supported and not connected rigidly to the crusher or feed hopper to avoid vibration problems transmitted through the structure.

Normally, the infeed conveyor is on an incline for a portion of its length up to the feed hopper, which usually requires cleats or pushers attached to the belt or apron pans to elevate the bed of material without slipping. There should be no offsets or projections of the side skirts or shrouds along the conveyor that would catch or snag material on the infeed conveyor and cause blockage on the flow of material into the crusher. Where possible, the infeed conveyor should run horizontal for a few feet before it enters the feed hopper so the material will glow off the end of the conveyor more uniformly and keep the gap under the conveyor to a minimum where it exits the feed hopper. Where the conveyor enters the feed hopper, the opening should be high enough to permit the longest item going up the conveyor to pivot off the end into the crusher without jamming in the feed hopper or against the conveyor shroud.

The greater distance above the crusher rotor that the infeed conveyor introduces material into the feed hopper, the less chance there is of material being blown or thrown back down the infeed conveyor. There is, of course, a limit of how high above the rotor the conveyor entry is practical, but two out of three times the hammer circle diameter is a general rule for a minimum feed heights of most material handled by the conveyor.

Depending upon the height above the rotor where the conveyor enters the feed hopper, the conveyor should be covered or shrouded for a considerable distance back from the opening to prevent the material that is being crushed from blowing or flying down the infeed conveyor.

In most instances, a shroud two or three times the conveyor width in length extending back from the feed hopper entry with substantial curtain at the beginning of the shroud will provide sufficient emission control for most crushing operations where dust or powder is not being produced by the grinding process. Dust control will require additional precautions and very possibly a separate collecting system to eliminate the hazard or nuisance of dust because the large volume of air that is moved by the crusher rotor during operation.

It is very difficult to seal under an infeed conveyor equipped with cleats or pushers where it exits from the feed hopper, a dribble chute is often required to catch the material blown or thrown out under the conveyor and carry it to the discharge conveyor. The dribble chute should not have any offsets or constrictions that would cause the material to plug and fill up the chute. As a matter of precaution, the dribble chute should have an access door conveniently located near floor level for clean out.

Where damp material is conveyed into the crusher, it may be necessary to provide drip pans beneath the exposed return side of the conveyor.

Conveyors need lubrication and service which should be included in the installation plans to provide convenient access for maintenance of bearings and rolling members of the conveyor, as well as, the drive equipment.

FEED HOPPERS

The purpose of the feed hopper or chute is to spread the material being crushed uniformly across the full width of the rotor and to contain the crushing action inside the crusher. The feed hopper should be substantially constructed of steel plate and structural sections proportional to the size of the crusher it is to be used with and the type of material being crushed.

Whenever possible, the crusher feed hoppers should be isolated from both the crusher and its conveyor while it is supported by a separate structure independent of the crusher foundation.

Even when the hopper is isolated from the crusher, it should have sufficient stiffening and cross bracing to prevent any unsupported spans of metal from acting as a drum due to air or material flow or from vibration of the crusher transmitted through the foundation or support structure. Often, a slight vibration of the crusher can be magnified by a feed chute or hopper through its structural resonance until a serious vibration condition develops which can best be corrected by isolating the hopper. The minimum isolation for the feed hopper should be a 1/2 inch resilient pad inserted between the hopper flange and the top of the crusher frame.

The hopper should have easy access for service, designed so the segment of the hopper above the crusher cover will have a flanged section that can be unbolted from the hopper and pivoted open as part of the crusher cover. Provisions for this should be made when planning the crusher installation to allow sufficient room to fully open the cover without interference from the building or adjacent machinery. Where possible, provide a separate reinforced access door for the hopper in addition to the crusher cover opening. When material is not evenly introduced through the feed opening of the hopper, it is often necessary to provide baffles or guide chutes inside the hopper to spread the material across the full width of the rotor for equal utilization of the crusher hammers.

DISCHARGE CONVEYORS

The discharge conveyor or crushed product removal equipment should have capacity greater than the infeed conveyor plus an allowance for surges and any increase in volume due to fluffing of material being crushed.

The operating controls for the feed equipment should be interlocked with the discharge conveyor controls to prevent material from being introduced into the crusher unless the crusher and the discharge conveyor is operating.

The section of conveyor immediately under the crusher is subject to impacts from the grinding operation, so shock protection in this area is required. Belt conveyors should be provided with closely spaced impact idlers in this area. An apron pan conveyor or a vibratory conveyor is usually suitable for

service in this location under a crusher. Allow as much distance as possible beneath the crusher for the discharge conveyor to provide room for surges and to center the load on the conveyor without interfering with the crusher foundation. This is especially important when using a vibratory pan conveyor which is best installed with a downward slope away from the crusher to positively move the crushed material, which may change its density from moment to moment.

Whenever possible, the discharge equipment should carry the product away from the crusher perpendicular to the rotor so the maximum foundation support will be provided beneath the crusher bearings. The discharge conveyor should be tightly shrouded to control dust and noise emissions or reverse airflow through the crusher.

Air swept hogging or shredding operations require careful design of the discharge chute and blastgate to maintain the proper velocity and volume of air through the pneumatic conveying duct to insure that material does not accumulate in the bottom of the crusher or duct that would impede the air flow and its carrying capabilities.

Additional conveyor operating information is available in Williams Form 898.

FOUNDATIONS

The foundation of the crusher has a most significant role in the successful operation of the installation and control of vibration.

The foundation provides the mass to dampen the crusher's normal operating vibration and absorb impact shocks. The general rule for crusher foundations is to provide a reinforced concrete pedestal extending as one unit under both the crusher and its drive that weighs at least three times the equipment it will support.

The arrangement of the foundation geometry is very important to react against the forces developed by the crusher operation. The height of the foundation should never be greater than its width unless spread footing is used under the foundation to prevent rocking and distribute the weight so that the soil loading is never more than 500 pounds per square foot.

The foundation pressure on the supporting soil is very important when dealing with a dynamic condition. The soil loading should not cause an interaction of the crusher vibration with the soil's natural frequency due to its deflection that would result in foundation critical. This is especially important when moisture in the soil is involved to insure the foundation had adequate support and impose a soil loading no more than a quarter of the recommended static values for the particular type of soil under the proposed crusher foundation.

Additional information is available in Williams Form 902 - Crusher Foundations.

When the crusher is set on the foundation, make certain it is level and supported uniformly to avoid distortion of the bearing pedestals when the anchor bolts are drawn tight. Assemblies shipped from the factory that are mounted on structural base plates should be properly aligned before connecting the drive motor after they are mounted on the foundation.

Additional information is available in Williams Form 901 - Alignment.

We suggest you have your foundation plans reviewed by qualified structural engineers having expertise in dynamic loading.

WILLIAMS

CRUSHERS • PULVERIZERS • SHREDDERS • GRINDERS

OLDEST & LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD

WILLIAMS #1 BUILD UP ROD



WILLIAMS

Patent Crusher & Pulverizer Company

2701 N. Broadway, St. Louis, MO U.S.A. 63102

PHONE (314) 621-3348 FAX (314) 436-2639

<http://www.williamscrusher.com>

WILLIAMS #1 BUILD UP ROD

WARNING: Do not apply weld in an enclosed or confined area without proper ventilation – lock out electrical controls when applying build up to hammers on rotor or inside crusher.

Now you can use a high (14%) Manganese Steel rod as easily as a mild steel electrode. Williams #1 Build Up Rod gives a high buildup with X-Ray quality deposits. Check the list of features below:

FEATURES

- 1) Tough and ductile – work-hardens under heavy impact resulting in good abrasion resistance equivalent to Manganese. For heavy abrasion conditions we recommend applying Williams #2 Hard Surface Rod on top of the #1 Build Up Rod.
- 2) Excellent buildup.
- 3) Welding excellent in both vertical and horizontal positions.
- 4) A steady arc, sound deposit and easy slag removal – slag does not “pop”.
- 5) Low cost, replaces stainless for manganese-to-mild steel welds.

GENERAL DESCRIPTION

Williams #1 Build Up Rod is a composite type electrode for arc welding only. A steel core wire is utilized with the alloying elements of manganese, nickel, and chromium contained in the flux coating. The deposit is austenitic 14% manganese steel with chrome-nickel alloy content giving outstanding properties – tough and easy-to-handle.

TYPICAL APPLICATIONS

Williams #1 Build Up Rod is best suited for buildup and repair of manganese, Williams SMO and Williams “M” alloy steel parts where severe impact is present to fully utilize the work-hardening properties of the deposit. When used to build up ordinary ferrous parts, the deposited metal offers greater resistance to impact and abrasion than the base metal.

CURRENT

AC or DC, Reverse or Straight Polarity

RECOMMENDED CURRENT RANGE – AC OR DC

We recommend the use of 3/16” or 1/4” rod and such sizes can be shipped form stock.

<u>ROD</u>	<u>AMPS</u>	<u>ROD</u>	<u>AMPS</u>
5/32”	120-160	1/4”	220-300
3/16”	170-225	5/16”	270-390

PHYSICAL PROPERTIES OF WELD DEPOSIT

Brinell Hardness – as deposited – 200
Brinell Hardness – as work-hardened – 500
Nonmagnetic
Reduction of Area – 35%

Tensile Strength – 120,000 psi
Yield Strength – 75,000 psi
Elongation – 40%

TIP COLOR Silver

STANDARD MANUAL PACKAGE 50 pounds

PROCEDURE

- 1) The parent or base metal should be ground and wire-brushed to remove all cracks, oxides, and dirt. Manganese and Williams "M" alloy steel castings, even without surface defects, should be ground down below the extremely work-hardened surface which has a metal structure different from the main body of the casting.
- 2) The electrode should be deposited using a narrow weave with electrode held at about a 45° angle in the direction of welding shown in Figure 1. The width of the weave should be one to two times the electrode diameter and the arc length held quite short, with almost a "drag" technique. Welding is stopped by drawing the electrode back into the weld deposit to fill out the crater, and breaking the arc.
- 3) The arc is restruck ahead of the crater and then drawn back to where the crater begins as shown in Figure 1 so that a smooth continuous bead is obtained.
- 4) Warning...Welding should not be continued until the base metal is below 400° to 500° F for Manganese or Williams "M" alloy, 700° to 800° for Williams SMO at a point 1/2 inch from the weld. In the absence of Tempilstiks, a good rule of thumb is to determine whether one's hand can be held on the base metal 6" from the weld (for manganese of Williams "M" alloy).
- 5) Quenching the hot weld metal is unnecessary.

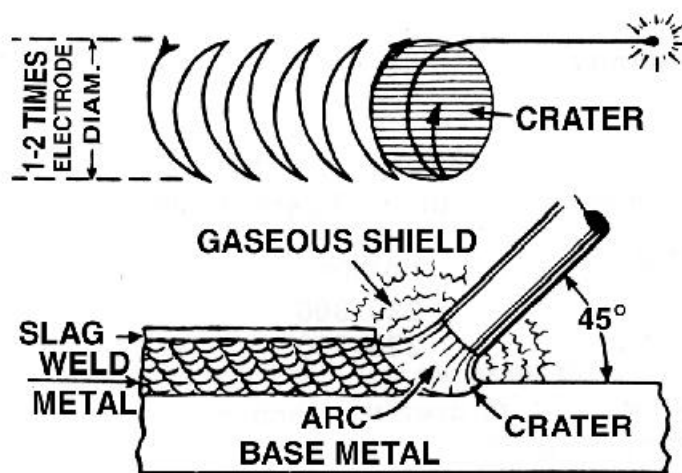


FIGURE 1



WILLIAMS

CRUSHERS • PULVERIZERS • SHREDDERS • GRINDERS

OLDEST & LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD

WILLIAMS #2 HARD SURFACE ROD



WILLIAMS

Patent Crusher & Pulverizer Company

2701 N. Broadway, St. Louis, MO U.S.A. 63102

PHONE (314) 621-3348 FAX (314) 436-2639

<http://www.williamscrusher.com>

FORM 769

WILLIAMS #2 HARD SURFACE ROD

WARNING: Do not apply weld in an enclosed or confined area without proper ventilation – lock out electrical controls when applying hard surface to hammers on rotor or inside crusher.

Williams #2 Hard Surface Rod is designed to be used on either manganese steel, Williams SMO or Williams “M” alloy. It has a high rate of deposit and an excellent bead characteristic for maximum wear life.

FEATURES

1. Fast deposition rate with high buildup.
2. Best usability for all-around hardfacing.
3. Highest alloy content at lowest cost.
4. Top performance with any power – AC or DC.
5. No slag to remove – easy multilayer buildup.

GENERAL DESCRIPTION

Williams #2 Hard Surface Rod is the answer in you are looking for a fast, easy to handle, inexpensive, all-purpose hardfacing. It is the only electrode that can come close to matching Williams #1 Build Up Rod in high speed usability for all-around hardfacing work, whether AC or DC, out of position or flat. A composite electrode with lowest price and highest alloy content in its class.

TYPICAL APPLICATIONS

Williams #2 is suitable for a wide range of hardfacing jobs whether they involve impact, abrasion, or a combination of these. Good build up of sound metal, solidly bonded to the base metal – either mild, manganese steel, Williams SMO or Williams “M” alloy – give top wear resistance in the shortest time to keep equipment on the job longer.

Do not apply hard surface deposit to over a depth of 3/16". If more metal is required use #1 Build Up Rod.

CURRENT: AC or DC, Straight or Reverse

RECOMMEND CURRENT RANGE – AC OR DC

We recommend the use of 3/16" or 1/4" rod and such sizes can be shipped from stock.

<u>Rod</u>	<u>Amps</u>	<u>Rod</u>	<u>Amps</u>
5/32"	140-200	1/4"	230-330
3/16"	180-270	5/16"	300-460

PHYSICAL PROPERTIES OF WELD DEPOSIT

Deposit Hardness Average	51 – 56	Rockwell C
	500 – 570	Brineel

TIP COLOR: Silver

STANDARD MANUAL PACKAGE: 50 pounds

PROCEDURE

1. Williams #2 can be applied in all positions. For best results all rust, scale and battered, spalled, or work-hardened sections should be removed from the base metal with a wire brush or by grinding. A short to medium arc length should be used. Either stringer beads or wide weaving passes can be made with no difficulty.
2. The electrode should be inclined at a normal angle of approximately 15° in the direction of the weld. Depending on electrode, size beads of $1/2"$ to $2"$ in width can be applied with a flat mild steel type weave. Welding is stopped by drawing the electrode back into the weld deposit to fill out the crater, and breaking the arc.

The arc is restruck ahead of the crater and then drawn back to where the crater begins as shown in Figure 1 so that a smooth continuous bead is obtained.

3. In applying these materials to heavy sections it is advisable to pre-heat to approximately 350°F except in the case of manganese steel (13%) or Williams "M" alloy steel which should never be preheated over 300°F .

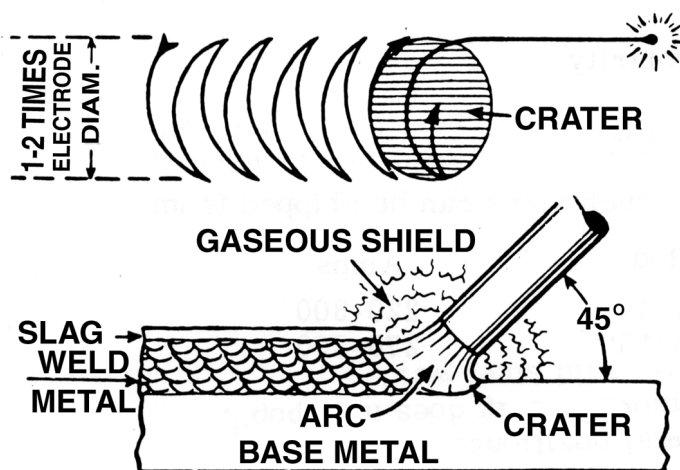


FIGURE 1

WILLIAMS

CRUSHER FOUNDATIONS



WILLIAMS *P*ATENT CRUSHER and PULVERIZER Co., Inc.

2701 North Broadway, St. Louis, Missouri 63102 USA

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FORM 902R2

FOUNDATIONS

Contrary to appearance, machinery foundations can be the most problematic component in a machine system. The motors, crushers, turbines, control panels, and ancillary meters, valves, and others appear more complex than a block of reinforced concrete or a simple arrangement of steel beams and columns between them and the earth. That may be why many machine buyers and installers find themselves in an expensive quagmire with a new machine performing out of specifications. Not enough engineering horsepower was applied to the machinery foundation design.

Machines such as steam turbines, centrifugal compressors, reciprocating compressors, fans, shredders, crushers, and others require foundations that have been designed and installed by experienced and knowledgeable engineers. The time to avoid problems is in the planning and design stage. There are the usual considerations of adequate static stiffness, stability, alignment with internal and external components, force path to earth, isolation from external influences, and isolation of the external world from machine. Then, **there is the need to avoid high vibrations.**

High level vibrations are harmful for the machine because they damage its structure and, if left uncorrected, cause breakdown. Vibrations also harm the machine surroundings by generating continuum vibrations in the soil and in buildings, propagating over long distances, and damaging buildings or other installations. Vibrations can insidiously result in damage to neighboring machinery. Moreover vibrations represent an additional soil loading at the location of the foundation, they shake the soil particles that may lead to compaction and possibly to dangerous subsidence or tilting of the machine foundation.

BASIC CONSIDERATIONS

The best foundation is provided by a poured in place reinforced concrete structure under the crusher and its driver. The foundation must have the required rigidity to sustain the alignment of machinery on it and with external ancillary devices.

A generally accepted rule-of-thumb is the foundation weight (mass) be at least three times the mass of supported machinery for centrifugal machines and four to five times for impacting (crushers) or reciprocating type of machines. The mass acts as an inertia block to stabilize the foundation. The optimum distribution of the foundation mass would be to have as much weight as possible directly under the crusher and its bearings to provide the maximum inertia damping next to the rotating equipment. The height of the foundation should never be greater than the width perpendicular to the rotor unless an integral pad or spread footing is used beneath the structure.

Whenever possible arrange the discharge from the crusher to be carried perpendicular to the rotor to allow solid support under the sides of the mill and the bearing pedestals.

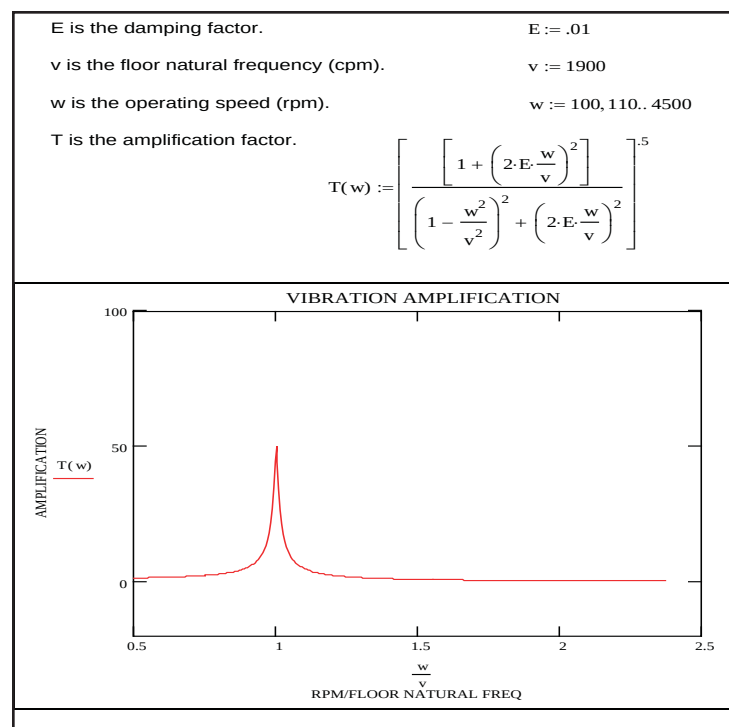
The desirability of low soil loading under a foundation subject to vibration cannot be over-emphasized. It is not safe to use conventional static soil bearing support values for dynamic loading conditions.

The foundation should rest on bedrock or solid earth, completely independent of other foundations and separated from all adjacent concrete work by shock absorbing pads between the meeting surfaces. If necessary, pilings should be placed as the initial foundation layer. The tendency to consider pilings as a panacea for foundation/soil problems should be avoided. Their use also requires specialized engineering.

Batter piling may cause piles to lose the damping expected from them. Environmental considerations are important with their use as much as without them. Machinery center of gravity should be placed over a pile groupings' center of resistance to avoid rocking in operation, which can change the natural frequencies in a short time.

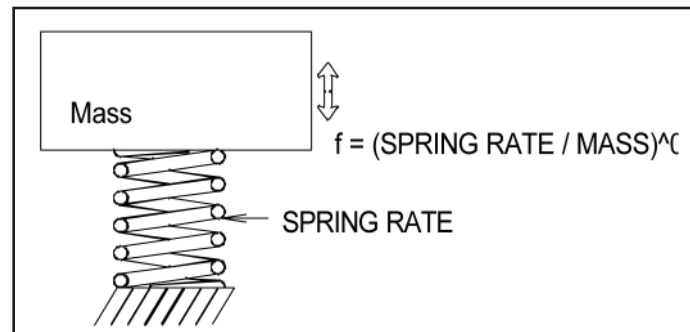
The foundation must be designed to avoid resonant vibration conditions, one of the most insidious problems because it amplifies normal vibrations and is usually expensive to cure. Engineering textbooks suggest foundation design include facility to change a foundation's properties (natural frequency , among others) after machine installation. That might include space for bracing, hollow columns to accept mass changing material, moisture control of subsoil (drainage), columnar collars for strengthening, etc.

Below is a plot showing how rapidly, as the operating frequency approaches a natural frequency, a vibration level is amplified at resonance:



Resonance arises when the foundation or one of its major components has a natural frequency¹ at or close to the machinery running frequency. The most common vibration creator in machinery is the rotor unbalance that excites the rotor and from it the surrounding elements, at the rotor's turning speed (rpm). A crusher is especially susceptible to vibration problems because its unbalance changes and can become high, at a fast rate, due to the constant uneven wear on the hammers. That wear is a natural consequence of its work.

Any natural frequency (cpm or cycles per minute) of the foundation or a major component should be 20 to 25% away from the crusher's rotating speed (rpm or revolutions per minute). For example, if the crusher's rotating speed is 900 rpm, the foundation's natural frequency should be less than $(900) - (900)(.25)$ cpm or greater than $(900) + (900)(.25)$ cpm. "Greater than" is preferred since the crusher will not have to traverse the natural frequency to get to operating speed during start.ⁱⁱ



This is a simple model to demonstrate the basic concept of natural frequency. The mass will bounce (vibrate) up and down after being pushed down and released at a rate (frequency) determined by $(\text{spring rate (lbs/in)} / \text{mass (lb-sec}^2))^{1/2}$.

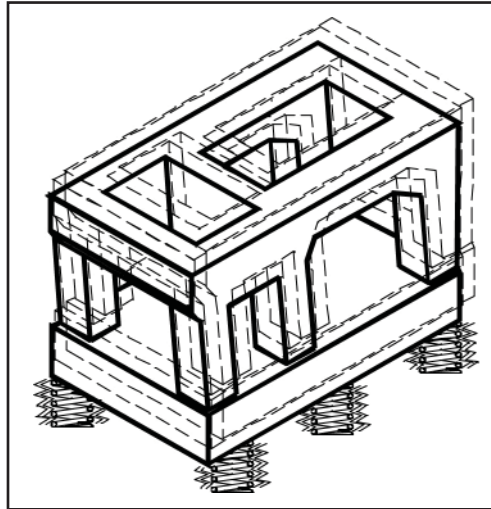
Avoiding the resonance situations requires competent engineering by all concerned. Williams Crusher Co. will supply the following information so that you can proceed with your foundation design.

- Certified drawing of machine assembly
- Functions of machine
- Weight of machine and its rotor components
- Location of center of gravity both vertically and horizontally
- Speed ranges of machine and components or frequency of unbalanced primary and secondary forces

Knowledge of the soil formation and its representative properties is required for static and dynamic analysis. The following parameters are generally required:

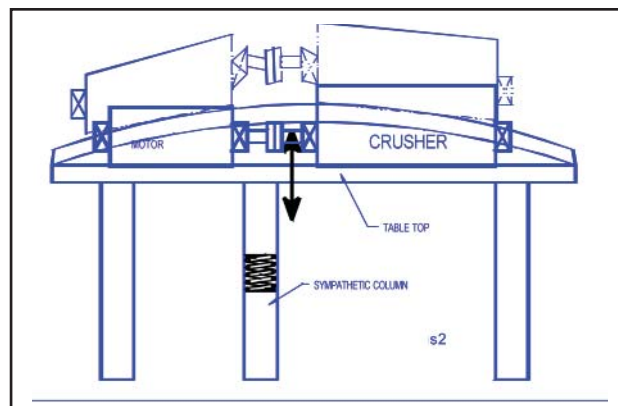
- Density of soil
- Poisson's ratio
- Shear modulus of soil at several levels of strain (or magnitude of bearing pressure)
- Coefficient of sub-grade reaction of soil, if the above parameters are not accurately known
- The foundation depth and the bearing pressure at which the above parameters are applicable
- Other information required for the static design of the footing

The soil becomes the spring for the entire machine system with the system as the mass. That translates into a situation similar to the one below. The coil springs show how the soil reacts and can form a condition of spring and mass bouncing as energetically as the small system mentioned above.

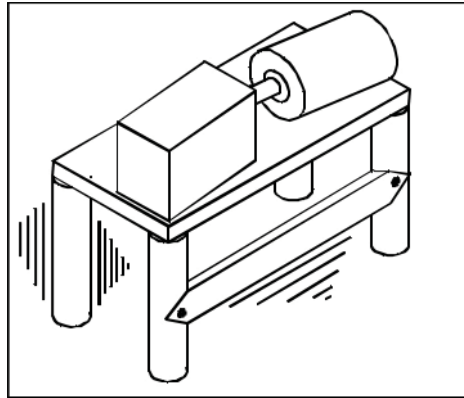


When that happens, it is usually time to start calculating the time and expense to change the mass and/or spring rates.

Vibration problems are not limited to the whole foundation and the supporting soil. Components of the foundation can have natural frequencies that will resonate with machine operating speeds. The drawing below shows the tabletop and a column beneath it vibrating together because their natural frequencies are close to the machine system operating speed.



Major components on a machine base are not the only trouble makers. A minor part can also resonate enough to cause problems to the mounted machinery and nearby personnel. The lower drawing suggests two of those.



STRUCTURAL STEEL FOUNDATIONS

If a structural steel foundation is required for any crusher installation, it should be carefully designed to avoid natural frequencies close to operating speed and its harmonics and sufficiently rigid to assure permanent alignment of the crusher and its driver. It must be designed to carry with minimum deflection the weight of the equipment, plus the loads imposed by the material handled and the dynamic forces set up from the crushing operation.

The crusher frame is to be rigidly connected to the structural foundations using shims to adjust for foundation and frame irregularities to prevent distortion of the crusher frame. The distortion can cause vibrations as problematic as vibrations from unbalance. Resilient mounting pads between the bottom flange of the crusher and the structural steel foundation are to be avoided at all times, unless they are beneath an inertia base supporting both the crusher and its driver. Vertical supports should be placed directly under the crusher bearings wherever possible. If this cannot be done, the bearing loads must be transferred properly to the nearest vertical load path.

Structural steel foundations are generally more sensitive to imbalance because more structural members are available to have natural frequencies matching the operating speed. Our crushers are dynamically balanced on a properly designed concrete foundation to 5 mils displacement or less prior to shipment from our factory. Crushers subsequently mounted on a structural steel foundation will most likely vibrate at a higher level if the steel foundation is more compliant than our balancing foundation.

All structural steel crusher foundation plans should be reviewed by a qualified structural engineer with experience and expertise in dynamic loading just as any other foundation plans.

SWING HAMMER CRUSHERS ON STRUCTURAL STEEL FOUNDATIONS

The unique characteristic of a swing hammer crusher that is different from all other rotating machinery is the starting pulse generated by hammers extending from their position of rest to a radial position on start-up. Even a perfectly weight matched set of hammers will have a significant starting pulse until they are extended to a rigid radial position. This pulse is transmitted to the support structure which responds at its natural frequency or critical and is further excited by several more heavy shocks in rapid order until the hammers are fully extended at about 200 rpm. As the crusher continues to accelerate to operating speed it rapidly passes through any foundation or structural criticals below the operating speed until it attains full speed where the vibration pattern can then be determined in a few seconds while the rotor is at a constant speed.

If the support structure is resonant at or near a multiple of the crusher operating speed the initial starting pulse is reinforced by the forcing frequency at operating speed to create a serious vibration disturbance in a non-uniform manner. This means that the vibration pattern of phase and amplitude is not the same on two consecutive starts of the crusher. This is particularly true if the critical frequency is at or near the crusher operation speed. A critical or resonant condition vibration pattern at or near operating speed is characterized by a significant increase in vibration amplitude for a very slight change in operating speed and a ninety degree or more shift in phase angle. This can best be demonstrated as the rotor coasts down from full speed and observed on the vibration analyzer meters in the filter out mode because the coast down time is considerably longer than the acceleration to full speed.

What a critical implies is that a very little force can be magnified significantly by the structures natural tendency to vibrate at or near the forcing frequency. This can be controlled sometimes by dynamic balancing to a more rigorous standard than normally required. When the crusher is mounted on a rigid or solid foundation that affords adequate damping of operating vibrations; criticals are seldom encountered. The crusher starting pulses are similar to bump test used to determine the structures natural frequencies. That test is performed by striking the structure with a sharp blow with sufficient energy to excite a vibration pulse or wave that can be measured and observed by a vibration analyzer. All structures have a natural frequency in both horizontal and vertical directions, which are influenced by their loading and sub-grade support. Steel structures have a much greater tendency to respond to vibration of equipment mounted on them because they have less inherent damping and are not normally designed to resist vibration. On the other hand concrete structures normally afford greater damping because of their lower natural frequencies due to the greater mass of concrete provided it is designed to meet nominal foundation criteria.

This is why a swing hammer crusher mounted on an elevated structural steel foundation can be easily dynamically balanced without hammers. Then when the matched weight set of hammers are installed on the rotor the vibration pattern changes dramatically where it is almost impossible to control the vibration or to see a repeat of the vibration pattern on two successive runs or starts.

The only effective answer for this situation is to provide a non-resonant foundation, which always entails considerable additional expense or to dynamically decouple the forcing frequency by changing the crusher operation speed. Options available for changing crusher speed include a different speed motor and changing to a belt drive that offers many possible speed variations by sheave combinations that permits operating the crusher out of the critical influence of the foundation.

ANCHOR BOLT LOCATIONS

Check the certified dimension drawings for the anchor bolt location and size. When anchor bolts or inserts are cast in the concrete, it is very important to construct a well braced template to accurately locate and position the anchor bolts or inserts in the foundation until the concrete has set. To compensate for small measuring errors, place a sleeve around each bolt to allow for adjustments when the concrete has set. The sleeve should have about an inch clearance around the bolt, which will require a plug at the top to keep out the concrete, and center the bolt in the sleeve.

GROUT

The crusher should be properly shimmed, leveled, aligned and grouted onto its foundation. Allow for 1 – 3 inches of grout to be placed between the crusher and its foundation. Look at your certified dimension print for depth of grout recommendation.

When new equipment is being commissioned, high vibrations often are caused by improper grouting performed by hurried construction crews. As equipment ages, many vibration problems arise that can again be traced to the foundation. Shims and hold-down bolts tend to loosen over the years, causing grout to turn to dust. Result is a condition known as “soft foot.” Grout, therefore, is one of the keys to establishing and maintaining precise alignment of rotating equipment.

Grouts can be classified as either cement- or polymer-based. Because of their low cost advantage, cement grouts often are used for large structural columns and supports. But because of their low compressive strength and even lower tensile strength, cement grouts typically are not used for heavy rotating equipment, temperatures above 250°F, or applications where lubricating oil is present.

Polymer grouts, on the other hand, are widely used for foundations of power-plant equipment. The most common polymer grout is epoxy-based – also known as “pump grout.” Epoxy grouts offer quick curing, high tensile and compressive strengths, and the ability to bond to both concrete foundation and machinery steel.

Five Star Products Inc, Fairfield, Connecticut, offers a full line of epoxy grouts for your consideration.

Grout must be placed to provide for full support under the base flanges of the mill or the structural steel bedplate provided with the mill.

BEDPLATES AND SHIMS

When the foundation design calls for a structural bedplate cast in the concrete foundation, the centerlines and elevation must be established by a survey so the crusher will be in the correct position called for on the certified dimension drawing when set on the bedplate.

To determine the necessary length the anchor bolt must project above the foundation, check the certified dimension drawings for shaft centerline elevation and its height above the foundation. Then allow for the grout or shim thickness, the crusher bottom flange thickness, the height of the nuts and washers and extra threads for draw-down.

Usual practice is to allow two to three inches of grout beneath large crushers with wide bottom flanges to facilitate placing the grout. Allow up to 3/8 inch for shims when installing a large crusher on a structural bedplate to compensate for irregularities of the wide bottom flanges and bedplate. For smaller equipment, the shim allowance can be reduced to 3/16 inch for narrower flanges. Shim packs should consist of no more than four shims, lest the pack begins to act like a spring and start vibration problems.

ⁱⁱ "Any beam, column, floor, or other material system (bearing pedestal, rotor/bearing/pedestal/foundation/earth, building/earth), having the properties of mass (weight) and elasticity is capable of making a free or natural vibration. If the system is displaced from its rest or unstrained (not stretched) configuration, elastic strain introduces internal forces and moments which oppose the strain. For brevity and by analogy with a simple mass-spring (weight hanging from a spring or a cantilevered beam or a tuning fork) system we shall refer to the effects of this elastic strain as a "restoring force." If, the system is suddenly released, the restoring force accelerated the system back toward its rest position but by the time it has arrived there it has acquired momentum and overshoots the rest position. This brings into action a restoring force in the opposite direction which resists the overshoot, brings the system momentarily to rest, and immediately accelerates it back again through the rest position, and so on. This free vibration goes on until the system is brought to rest by damping which dissipates (as heat) the energy of the free vibration.

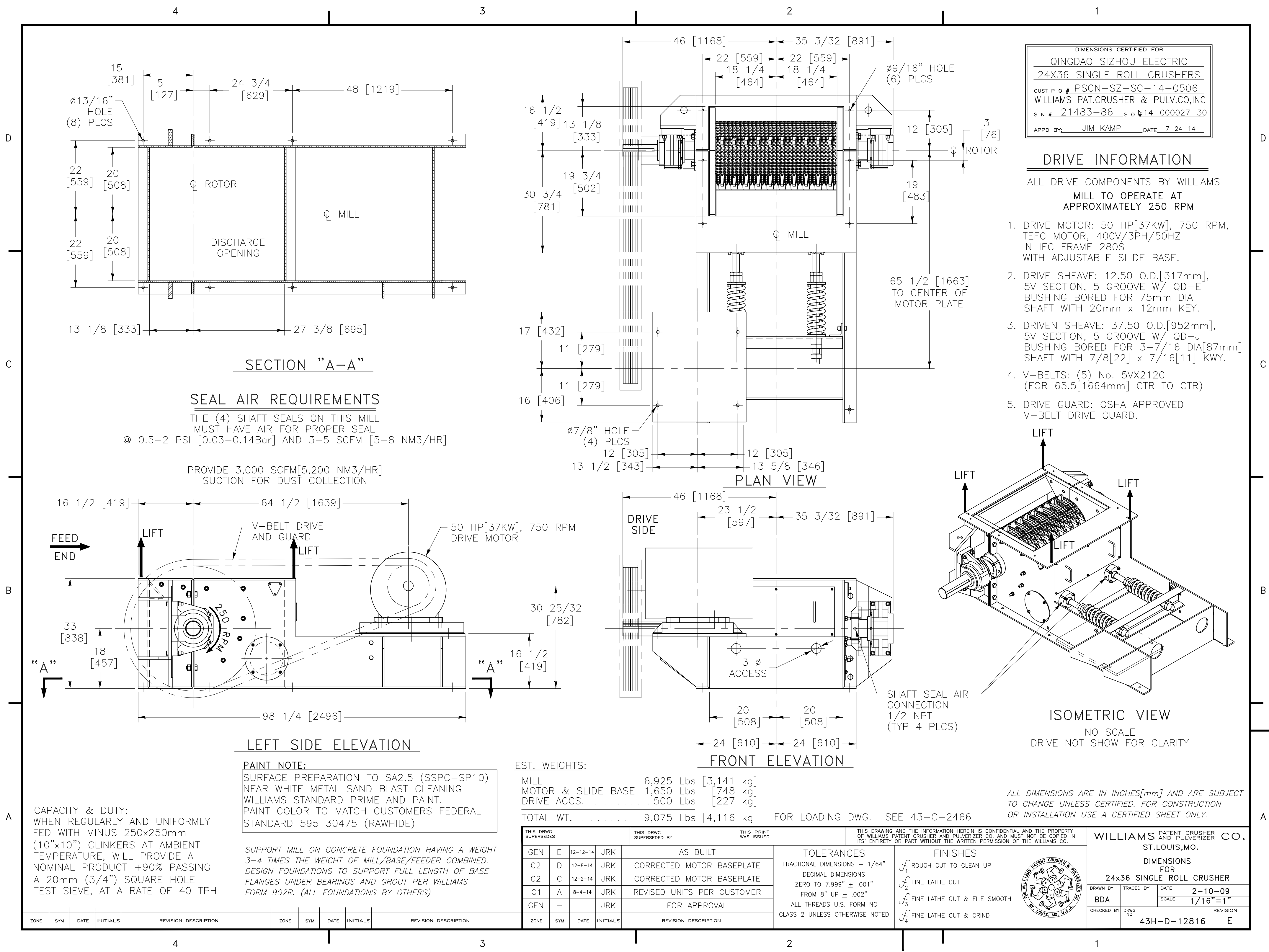
The frequency of this free vibration is the "inherent **natural frequency**."

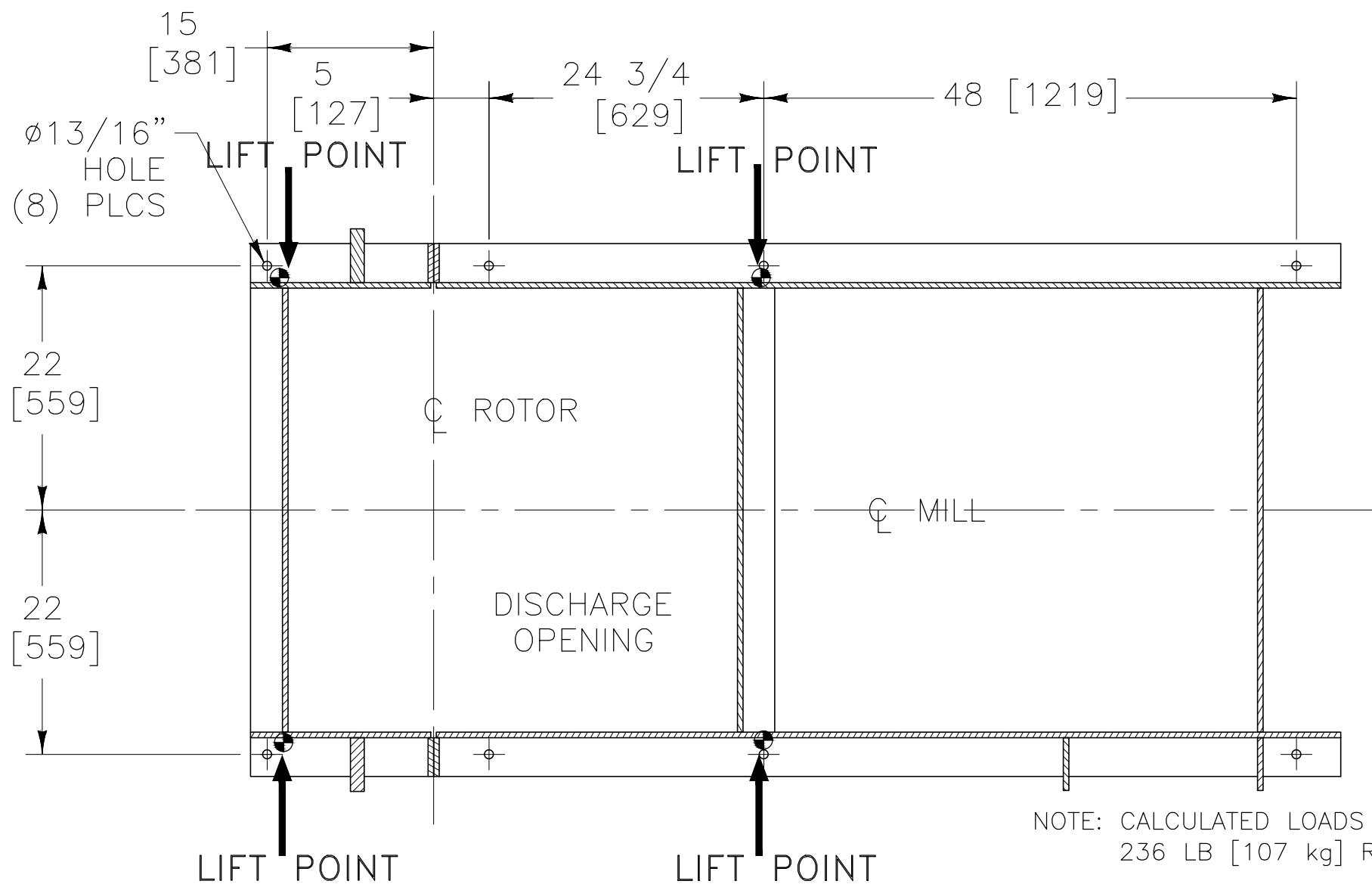
P.146, Seismic Mountings for Vibration Isolation, Macinante, Wiley Interscience, John Wiley & Sons, 1984.

"A bridge or, for that matter, any structure, is capable of vibrating with natural frequencies. If the regular footsteps of a column of soldiers were to have a frequency equal to one of the natural frequencies of a bridge which the soldiers are crossing, a vibration of dangerously large amplitude might result. Therefore, in crossing a bridge, a column of soldiers is told to break step."

P.376, University Physics, Sears and Zemansky, Addison Wesley, Reading, MA, 1962.

ⁱⁱ Decades ago resonance caused less trouble in engineering design than today, and it is precisely the higher probability of resonances that is a primary reason for this paper. Older type constructions, machines, buildings, and steel structures used thicker and more rigid parts, resulting in fairly high natural frequencies. At the same time machine speeds used to be relatively low, so that the troublesome high vibrations arising from resonance, that is, the coincidence of a speed of rotation with a natural frequency, occurred less often. With the progress of engineering techniques, structures became more slender and flexible, their natural frequencies decreased while machine speeds increased. Thus, the range of natural frequencies approached that of rotational speeds, leading more frequently to resonance and its associated high vibration levels and problems.





DIMENSIONS CERTIFIED FOR

QINGDAO SIZHOU ELECTRIC

24X36 SINGLE ROLL CRUSHERS

CUST P O # PSCN-SZ-SC-14-0506

WILLIAMS PAT.CRUSHER & PULV.CO,INC

S N # 21483-86 s o # 14-000027-30

APPD BY: JIM KAMP DATE 7-24-14

LOAD PER BOLT

MAX. LOAD = 1.6 Kip [725kg]

UPLIFT = 0.4 Kip [181kg]

MAX. SHEAR = 0.4 Kip [181kg]

NOTE: CALCULATED LOADS ARE BASED UPON COMPLETE LOSS OF A 236 LB [107 kg] ROLL SEGMENT OPERATING AT 250 RPM

MAXIMUM OVERTURNING MOMENT WOULD BE 629 FT-LBS [853 N-M] PER BOLT

MAX LOAD INCLUDES A 9075 LB [4116 kg] DEAD LOAD PLUS A 3353 LB [1521 kg] DYNAMIC LOAD

NOTE: MILL CAN BE LIFTED FROM THE FOUR (4) CORNERS OF THE TOP FLANGE. TOTAL LIFTING WEIGHT, APPROX 9,000 LBS

THIS DRWG SUPERSEDES				THIS DRWG SUPERSEDED BY				THIS PRINT WAS ISSUED				THIS DRAWING AND THE INFORMATION HEREIN IS CONFIDENTIAL AND THE PROPERTY OF WILLIAMS PATENT CRUSHER AND PULVERIZER CO. AND MUST NOT BE COPIED IN ITS' ENTIRETY OR PART WITHOUT THE WRITTEN PERMISSION OF THE WILLIAMS CO.				WILLIAMS PATENT CRUSHER AND PULVERIZER CO. ST. LOUIS, MO.											
								TOLERANCES FRACTIONAL DIMENSIONS ± 1/64" DECIMAL DIMENSIONS ZERO TO 7.999" ± .001" FROM 8" UP ± .002" ALL THREADS U.S. FORM NC CLASS 2 UNLESS OTHERWISE NOTED				FINISHES F ₁ ROUGH CUT TO CLEAN UP F ₂ FINE LATHE CUT F ₃ FINE LATHE CUT & FILE SMOOTH F ₄ FINE LATHE CUT & GRIND								LOADING DIAGRAM FOR 24 X 36 SRC							
																				DRAWN BY		TRACED BY		DATE		7-25-14	
GEN	A	10-15-14	JRK	ADDED SUGGESTED LIFT POINTS																JRK				SCALE		1"=12"	
ZONE	SYM	DATE	INITIALS	REVISION DESCRIPTION																CHECKED BY		DRWG NO		43-C-2466		REVISION	
																										A	

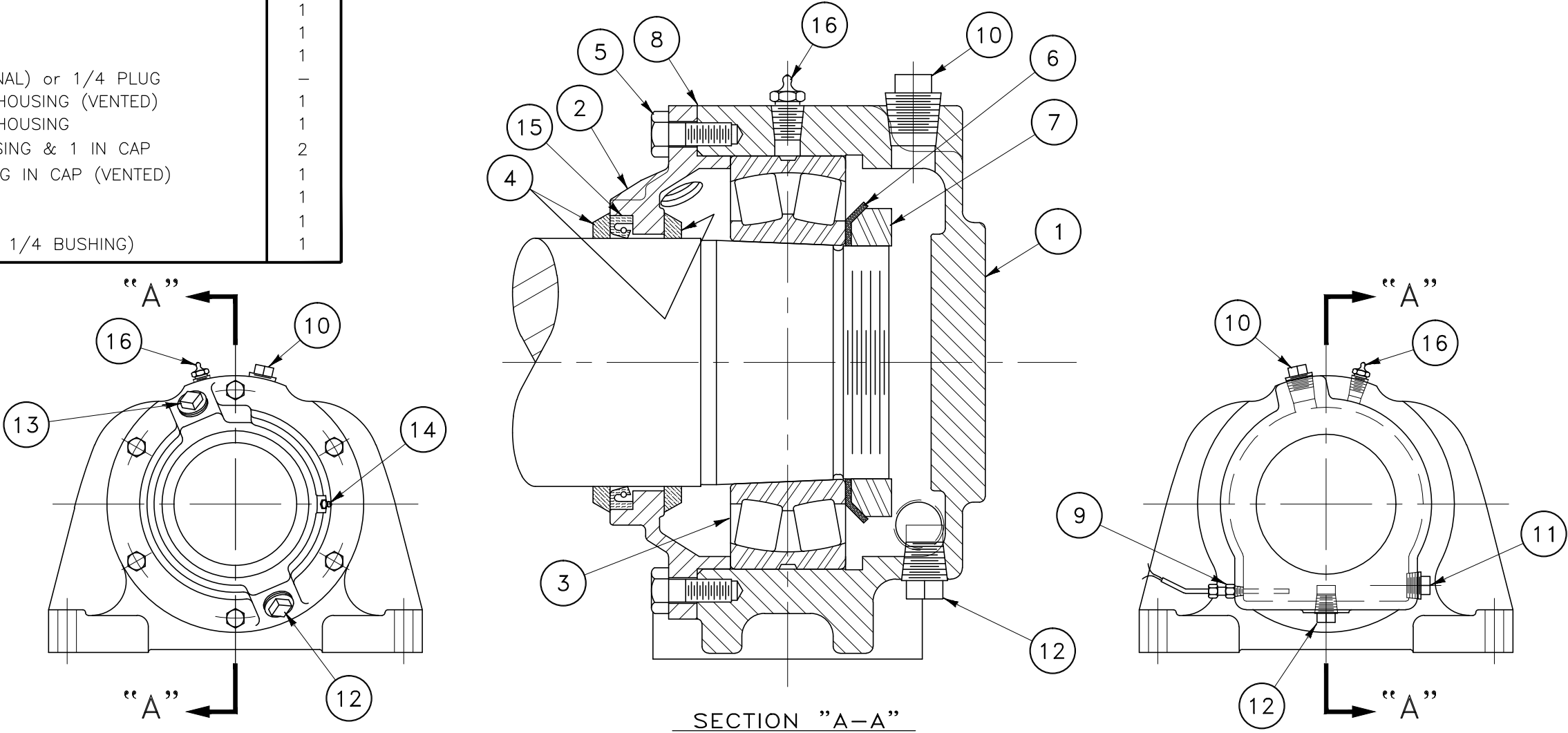
PART No.	WHEN ORDERING REPAIRS GIVE { PART WANTED, ALSO QUANTITY, THIS DRAWING NUMBER AND MACHINE SERIAL NUMBER	QUANTITY IN MACHINE
1	CLOSED PILLOW BLOCK HOUSING	1
2	PILLOW BLOCK CAP	1
3	ROLLER BEARING	1
4	OIL SLINGER (SHOULD LIGHTLY RUB PILLOW BLOCK CAP)	2
5	CAP SCREW	6
6	BEARING LOCKWASHER	1
7	BEARING LOCKNUT	1
8	GASKET	1
9	THERMOCOUPLE (OPTIONAL) or 1/4 PLUG	—
10	INSPECTION PIPE PLUG IN HOUSING (VENTED)	1
11	INSPECTION PIPE PLUG IN HOUSING	1
12	OIL DRAIN PLUG 1 IN HOUSING & 1 IN CAP	2
13	INSPECTION PORT PIPE PLUG IN CAP (VENTED)	1
14	GREASE ZERK	1
15	OIL SEAL	1
16	GREASE ZERK (WITH 1/2 x 1/4 BUSHING)	1

NOTES:

1. SHOULD ROTOR OR BEARINGS BE REMOVED, WHEN REASSEMBLING ALWAYS REMOVE INSPECTION PLUG (13) AND CHECK TO SEE IF OIL SLINGERS (4) ARE CORRECTLY POSITIONED AGAINST THEIR MATING SURFACES. IF NOT, PRY THEM INTO THEIR CORRECT POSITIONS.
2. WHEN REMOUNTING BEARINGS, MEASURE INTERNAL RADIAL CLEARANCE OF BEARING WITH SHIM GAUGE. FORCE BEARING ON SHAFT IN EASY STAGES UNTIL THE ABOVE NOTED RADIAL CLEARANCE IS REDUCED BY .0025 In.

MILL SERIAL No. 21483-86

B/M No. 61E3347 REV. _____



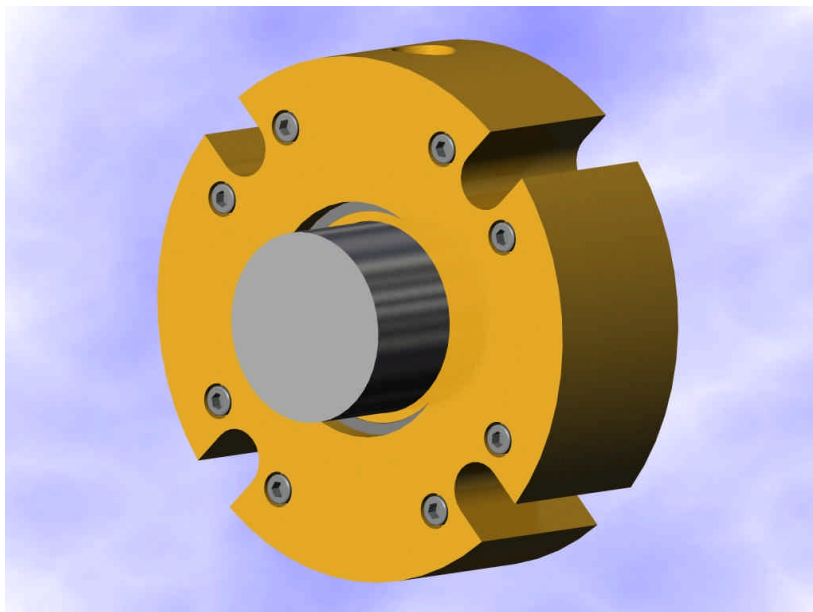
THIS DRWG SUPERSEDES				THIS DRWG SUPERSEDED BY				THIS PRINT WAS ISSUED				THIS DRAWING AND THE INFORMATION HEREIN IS CONFIDENTIAL AND THE PROPERTY OF WILLIAMS PATENT CRUSHER AND PULVERIZER CO. AND MUST NOT BE COPIED IN ITS' ENTIRETY OR PART WITHOUT THE WRITTEN PERMISSION OF THE WILLIAMS CO.				WILLIAMS PATENT CRUSHER AND PULVERIZER CO. ST. LOUIS, MO.													
								TOLERANCES FRACTIONAL DIMENSIONS ± 1/64" DECIMAL DIMENSIONS ZERO TO 7.999" ± .001" FROM 8" UP ± .002" ALL THREADS U.S. FORM NC CLASS 2 UNLESS OTHERWISE NOTED				FINISHES F ₁ ROUGH CUT TO CLEAN UP F ₂ FINE LATHE CUT F ₃ FINE LATHE CUT & FILE SMOOTH F ₄ FINE LATHE CUT & GRIND								PARTS DRAWING & LIST 5" MODEL "O" TAPER BORE CAPPED HOUSING BEARING WITH GREASE LUBRICATION									
																				DRAWN BY		TRACED BY		DATE		11-18-99			
ALL	B	12/30/10	DA																	CORRECTED CALLOUT ON ITEM 9,13,16				SCB		SCALE		3/16	
—	A	3/10	DAL																	UPDATED PARTS LIST				CHECKED BY		DRWG NO		61J-C-1954	
ZONE	SYM	DATE	INITIALS	REVISION DESCRIPTION																									

INPRO/SEAL COMPANY

**ARTICULATING AIR
MIZER PS**

DESIGN CODES 9940, 9950, 9960

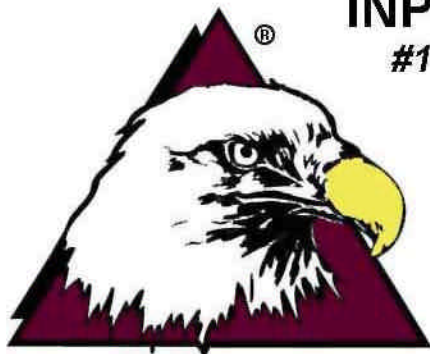
Installation instructions



PATENT PENDING

**Same Day
Shipments**

**Over 1,000,000
Installed**



INPRO/SEAL COMPANY

#1 IN BEARING ISOLATORS

4221-81st Avenue West
Rock Island, IL 61201

Ph: 309.787.4971 · 800.447.0524

Fax: 309.787.6114 · 309.787.6190

e-mail: info@inpro-seal.com

Visit us on the web: www.inpro-seal.com



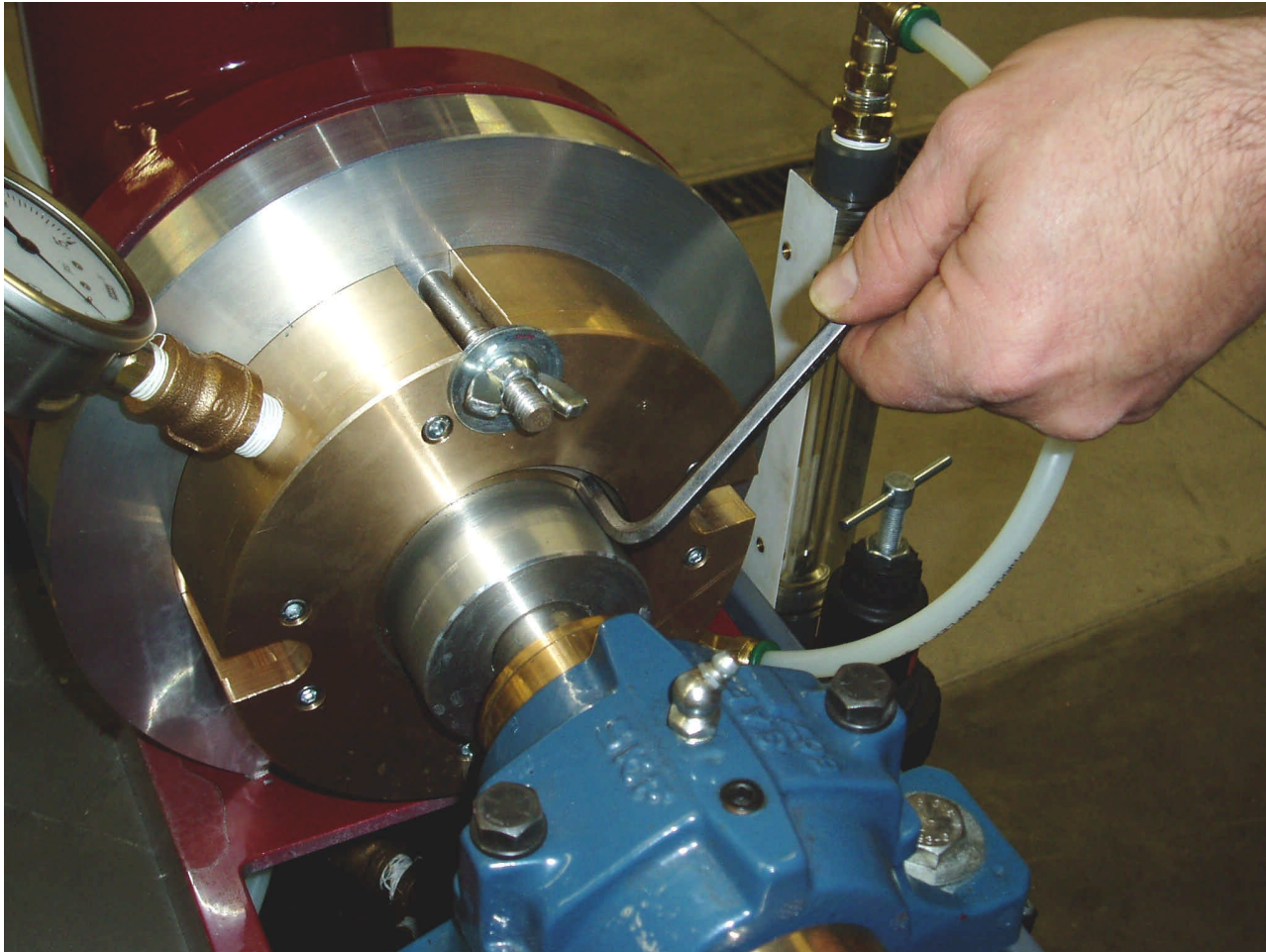
- 1. Be sure the shaft where the Inpro/Seal is to be installed is clean and free of debris.**
- 2. Lubricate the shaft and the Inpro/Seal Drive Rings with the supplied lubricant.**
- 3. Install the Inpro/Seal on the shaft with the socket head cap screws visible on the outboard face. You may use a gasket material of your choice or RTV sealant to seal the inboard face of the Inpro/Seal against the housing.**
- 4. The Inpro/Seal is designed to accommodate shaft misalignment. To maximize this feature always install the inpro/seal as centered as practical. Your seal may have been sent with a set of (3) hex keys. If so, these are sized to provide the proper shim height to align your seal. The illustration on the following page shows where to set the clearance.**
- 5. Depending on the size of your gland studs, washers may be required under the gland stud nuts to assure proper assembly.**
- 6. The Inpro/Seal model PS requires a constant supply of air for proper function. A diagram of the recommended equipment is included. You should verify that the air pressure in the seal is greater than the product pressure.**
- 7. Please contact Inpro/Seal Company or your authorized representative with any questions.**

Disassembly:

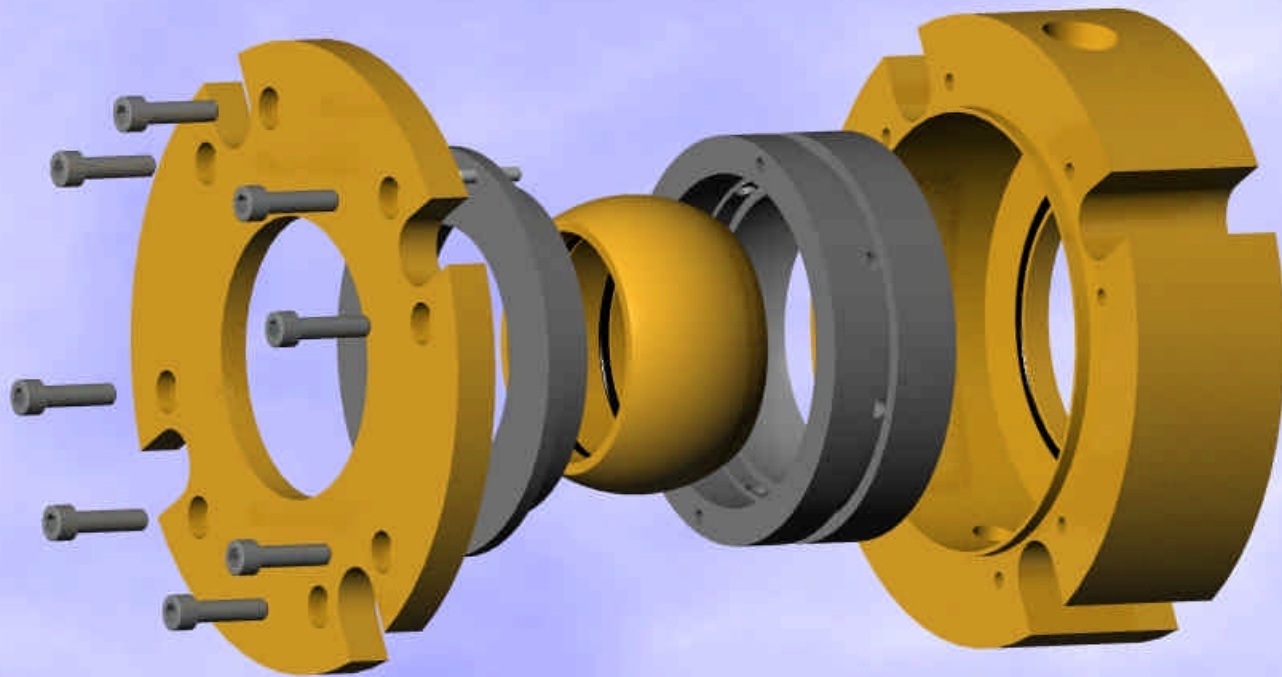
- It is not normally required to disassemble the Inpro/Seal model PS. Should the seal become contaminated with product, however, the seal may be disassembled by removing the socket head cap screws from the outboard face.**

Use the supplied hex keys to set the clearance between the outboard face of the seal and the shaft. This will center the seal prior to start-up.

When access permits use all (3) supplied keys even spaced (approximately 120° apart).



This diagram shows the Inpro/Seal model PS disassembled.



PATENT PENDING

Inpro/Seal

DynaQuip® Safety
Exhaust/Energy
lockout brass ball
valve:

Grainger Stock #
6GD08

Speedaire® 40
micron filter

Grainger Stock #
4ZL50

Speedaire® Air
Line Regulator

Grainger Stock #
4ZM20-2

Must pass a
minimum of 60
scfm.

King® 4-20
scfm Flow
Meter

Cole-Palmer #
32445-08
(Optional)

WIKA® type 213.53
2.5" 0-30 psi gage

Heeren Co. #
9692147-0002

WIKA® type 213.53
2.5" 0-30 psi gage

Heeren Co. #
9692147-0002

Air In
→

NOTE:

**AIR LINES MUST
BE 1/2" OR LARGER.**

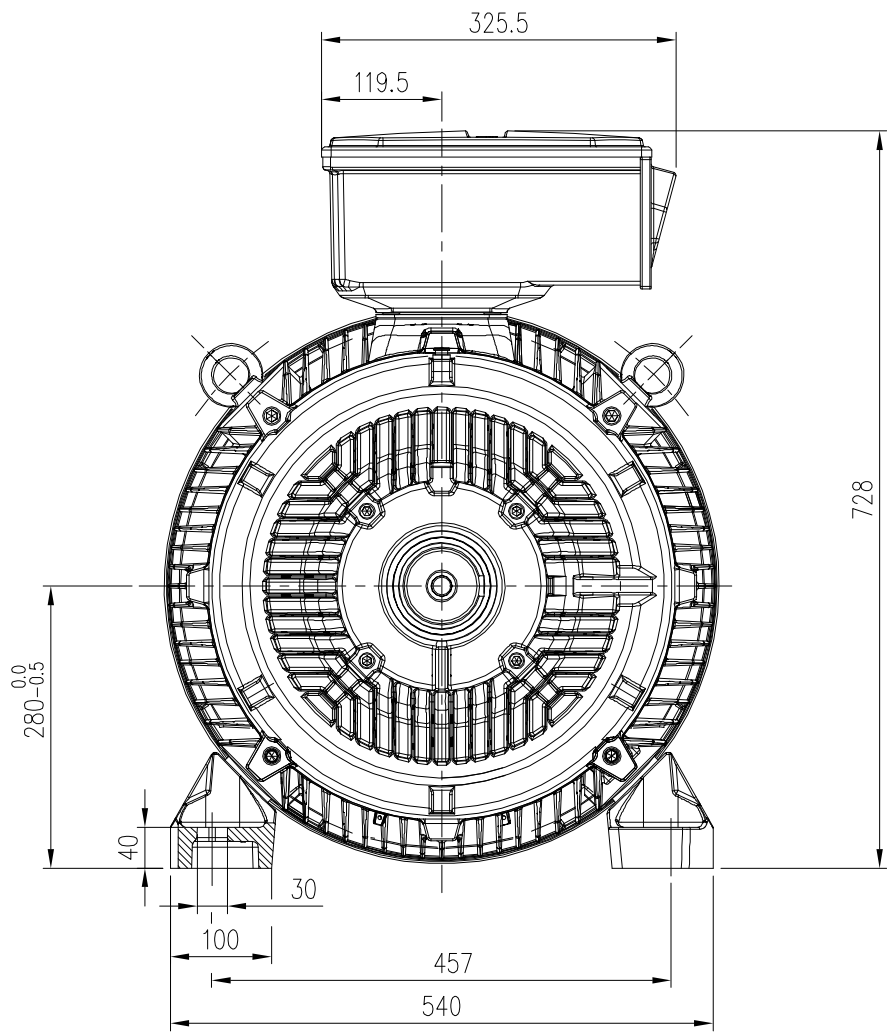
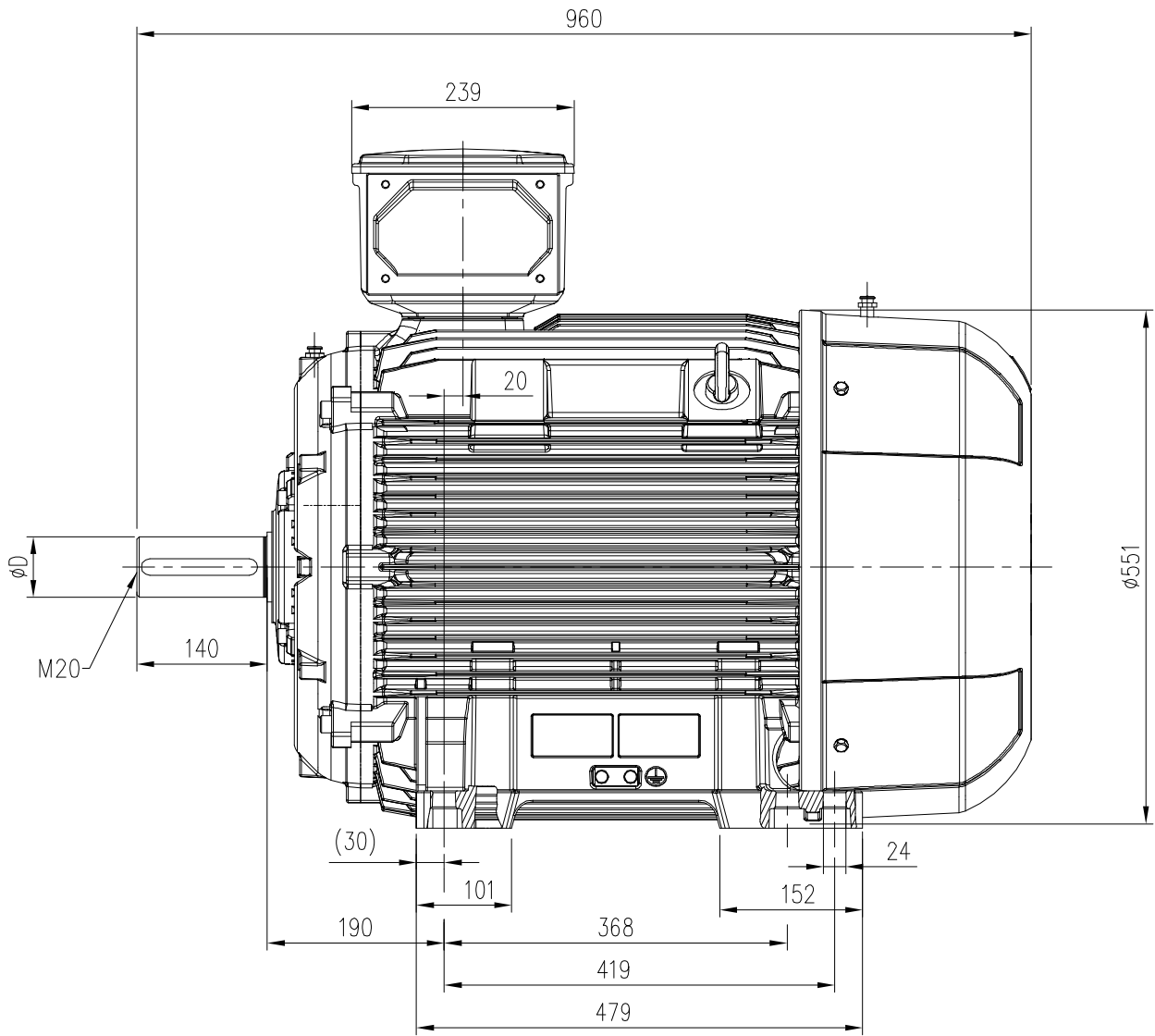
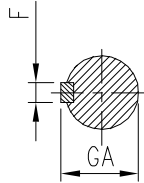
**SMALLER AIR LINES
MAY VOID WARRANTY.**

October 26, 2004

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1LE1	5x1 6x1	-2DA0	18	69	65
		-2DA2	18	69	65
		-2DB0	20	79.5	75
		-2DB2	20	79.5	75
		-2DC0	20	79.5	75
		-2DD0	20	79.5	75
		-2DC2	20	79.5	75
		-2DD2	20	79.5	75
	5x3 6x3	-2DC6	20	79.5	75
		-2DD6	20	79.5	75
		-2DA0	18	69	65
		-2DB0	20	79.5	75
		-2DC0	20	79.5	75
		-2DC2	75	79.5	75

Allgemeintoleranzen: general tolerances: Vseobecne tolerance:		
Aenderung / Revision / Zmena:		
Datum: date: Dne:	Name: name: Autor:	Datum / date / Dne: 6.10.2014
Werkstoff/Holzzeug/Modell-; Sach-Nr.: material/semi-finished part/model-; item-No.: Material/Polotovarov/Vykres Modelu:		Name / name / Autor: Rösner
Ersatz fuer: replacement for: Nahrada za:		Geprüft / checked / Prezkontrol: Bojer
NES: MHC: FST:		Abt. / dept. / Oddeleni: PD LD P MF-FRE BA
		Siemens AG

MASSBILD R53		Masse: mass: Hmotnost: kg
DIMENSION DRAWING R53		Einheit: unit: Jednotka:
ROZMĚROVÝ NÁČRTEK R53		Maßstab: scale: Meritko: 1:7.5
1LE1501_1LE1601 -2D B3		Blatt-Nr.: sheet No.: List c.: 1
5_510_82800_00_077 -		Blattzahl: total sheets: Poc. Listu: 1

Three-Phase-Inductionmotor with Squirrel Cage Rotor

Operating and Installation Data:

Rated-

-power	P_N :	37 kW	Connection	:	D
-voltage	U_N :	400 V	Class of rating	:	S1
-frequency	f_N :	50 Hz	Absolute altitude	:	<1000 m ab.s.l.
-current	I_N :	75 A	Coolant temperature	:	40 °C
-speed	n_N :	736 1/min	Therm. class (design/util.)	:	155 (F)
-torque	M_N :	480 Nm			
Power factor	$\cos\varphi$:	0,78			

Standard: IEC/EN 60034-1
Tolerances: IEC/EN 60034-1

Calculated Start-Up Data:

Motor voltage	U/U_N	1			
Locked-rotor torque	M_A/M_N	2,3			
Breakdown torque	M_K/M_N	2,4			
Locked-rotor current	I_A/I_N	5,4			

Calculated Partial Load Data:

P/P_N	1,25	1	0,75	0,5	0,25
$\cos\varphi$	0,81	0,78	0,73	0,63	0,43
η (%)	91,0	91,9	92,5	92,1	85,5

				Date	06.10.2014	Electrical Data Sheet
				Name		
				Checked	-	
				Std.		
				I DT LD P MF-FRE BA OQ		Type 1LE1501-2DD03-4AA4-Z
				SIEMENS AG		LIAZ 3250061
IND.	Text	Date	Name	187039		

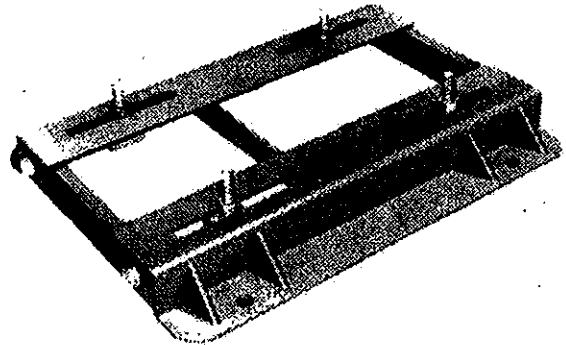
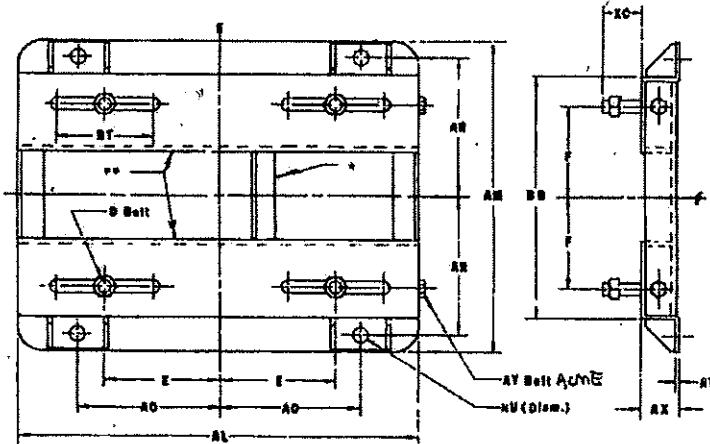


OVERLY HAULTZ COMPANY

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

NEMA

STEEL ADJUSTABLE Heavy Duty MOTOR BASES



STYLE C2HD

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

STOCK BASES

FRAME & PART NO.	AL	AM	AX	BB	E	F	AO	AR	AU	BT	AT	XC	D BOLT	ACME AY BOLT	APPROX WT. (LBS)
254C2HD	17-3/4	15-1/8	2	11	5	4-1/8	6-1/4	6-5/8	5/8	4	5/16	1 1/2	1/2x2	5/8x9	32
256C2HD	17-3/4	16-7/8	2	12-3/4	5	5	6-1/4	7-1/2	5/8	4	5/16	1 1/2	1/2x2	5/8x9	33
284C2HD	19-3/4	16-7/8	2	12-3/4	5-1/2	4-3/4	7	7-1/2	5/8	4-1/2	5/16	2	1/2x2 1/2	5/8x9	35
286C2HD	19-3/4	18-3/8	2	14-1/4	5-1/2	5-1/2	7	8-1/4	5/8	4-1/2	5/16	2	1/2x2 1/2	5/8x9	35
324C2HD	22-3/4	19-1/4	2-1/2	14-3/8	6-1/4	5-1/4	8	8-1/2	3/4	5-1/4	3/8	2 7/16	5/8x3	3/4x11	59
326C2HD	22-3/4	20-3/4	2-1/2	15-7/8	6-1/4	6	8	9-1/4	3/4	5-1/4	3/8	2 7/16	5/8x3	3/4x11	60
364C2HD	25-1/2	20-1/2	2-1/2	15-3/4	7	5-5/8	9	9-1/8	3/4	6	3/8	2 7/16	5/8x3	3/4x11	67
365C2HD	25-1/2	21-1/2	2-1/2	16-3/4	7	6-1/8	9	9-5/8	3/4	6	3/8	2 7/16	5/8x3	3/4x11	68
404C2HD	28-3/4	22-3/8	3 1/4	17-1/8	8	6-1/8	10	9-7/8	7/8	7	3/8	2 15/16	3/4x3 1/2	1" x 15	94
405C2HD	28-3/4	23-7/8	3 1/4	18-5/8	8	6-7/8	10	10-5/8	7/8	7	3/8	2 15/16	3/4x3 1/2	1" x 15	99
444C2HD	31-1/4	24-5/8	3 1/4	19-3/8	9	7-1/4	11	11	7/8	7-1/2	3/8	2 15/16	3/4x3 1/2	1" x 15	103
445C2HD	31-1/4	26-5/8	3 1/4	21-3/8	9	8-1/4	11	12	7/8	7-1/2	3/8	2 15/16	3/4x3 1/2	1" x 15	105
447C2HD	31-1/4	30-1/8	3 1/4	24-7/8	9	10	11	13-3/4	7/8	7-1/2	3/8	2 15/16	3/4x3 1/2	1" x 15	110
449C2HD	31-1/4	35-1/8	3 1/4	29-7/8	9	12-1/2	11	16-1/4	7/8	7-1/2	3/8	2 15/16	3/4x3 1/2	1" x 15	115
280MHD	31 1/4	26 5/8	3 1/4	21 3/8	9	8 1/4	11	12	7/8	7 1/2	3/8	3 3/8	M20x100	M24x15	105

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

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

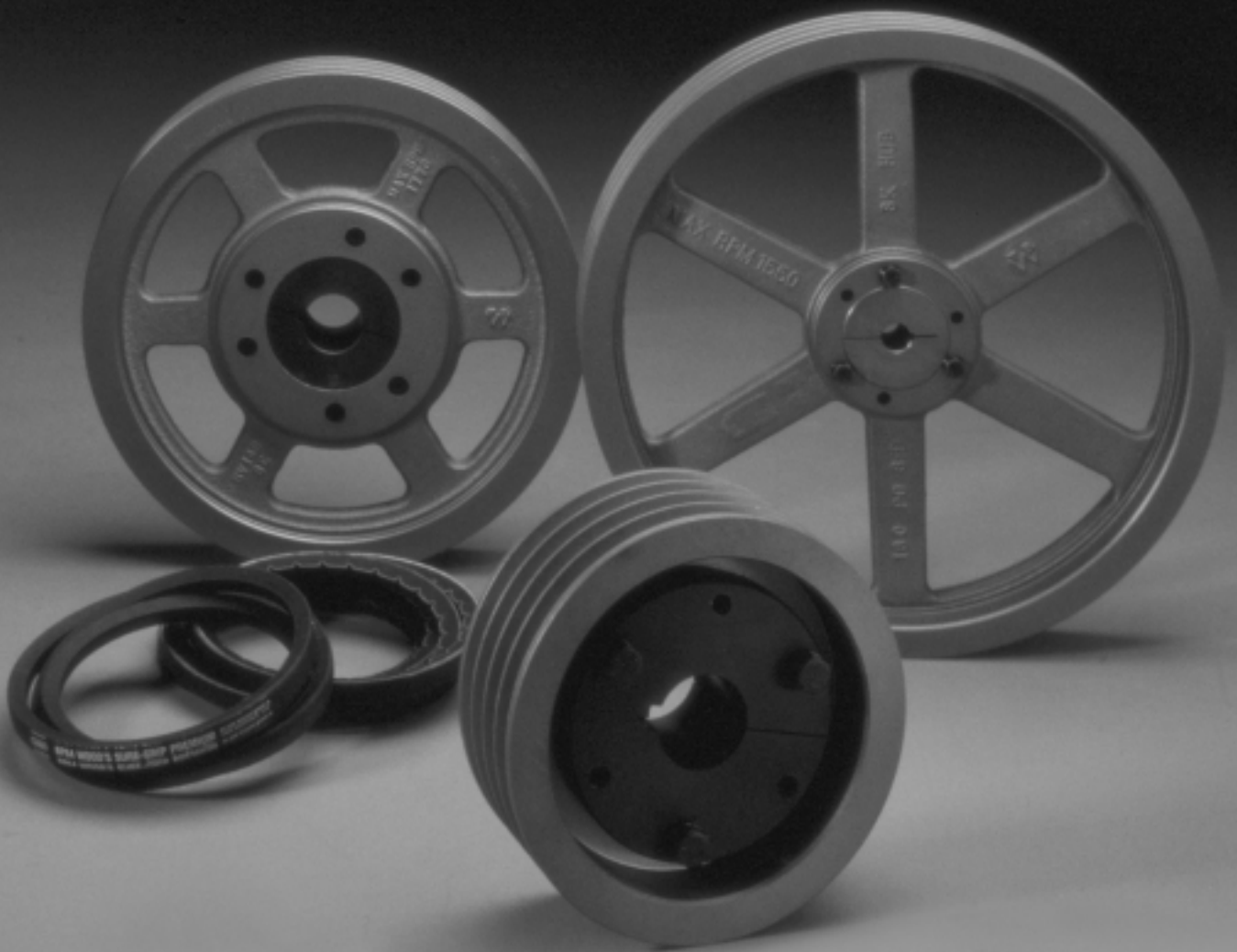
The liability of the Overly-Haultz Company to the purchaser is limited to replacement of defective materials supplied. One year from the date of our shipment all liability shall terminate. There are no warranties which extend beyond the description on the face hereof.

CERTIFIED FOR:

FRAME

BY

DATE



Installation and Maintenance of V-BELT DRIVES

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



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

Wood's offers a complete line of high capacity synchronous drives. The RPP-Plus system offers a higher horsepower capacity drive at the cost of the competition's standard rated product. Wood's also offers the aramid fiber QT Powerchain drive in 8M and 14M pitch. The QT drive is capable of high horsepower capacity in a smaller package. Both QT and RPP sprockets offer metric/inch drilling for applications which require a totally metric drive system.



Wood's has many different ways of offering variable speed for customer applications. The most basic way is through the use of one of our many belted variable speed systems. Wood's also offers many different options in the line of electronic inverters and electronic speed controls. One of the most unique ways of varying speed, however, is our HSV/HSVA hydro-static systems. The HSV system is ideal for harsh, dirty, or explosive proof environments.

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



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

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Maintain Proper Belt Tension	3

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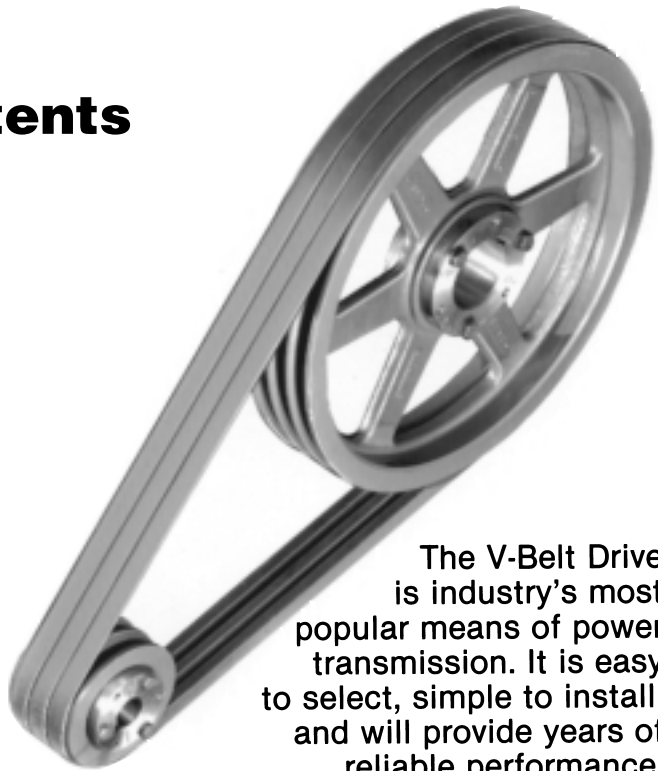
Tensioning the Drive

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6

Trouble Shooting V-Belts

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The V-Belt Drive is industry's most popular means of power transmission. It is easy to select, simple to install, and will provide years of reliable performance.

Even when misapplied, improperly installed or completely ignored, the V-Belt Drive will usually deliver some kind of performance. However, with proper installation and maintenance, many years of operating efficiency can be added to the life span of the V-Belt Drive.

It is hoped that the information contained herein will help you receive the greatest possible value from your V-belts and sheaves, will help you receive a full measure of performance from industry's dominant drive.

V-Drive Inspection and Maintenance Procedures

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

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

Inspection while running

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

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

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

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

If a set of belts is perfectly matched, all belts will have the same amount of sag. However, perfec-

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

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

Inspect sheaves often

Keep all sheave grooves smooth and uniform. Burrs and rough spots along the sheave rim can damage belts. Dust, oil and other foreign matter can lead to pitting and rust and should be avoided as much as possible. If sheave sidewalls are permitted to "dish out," as shown in the picture on page 2, the bottom "shoulder" ruins belts quickly by chewing off their bottom corners. Also, the belt's wedging action is reduced and it loses its gripping power.

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

Badly worn grooves cause one or more belts to ride lower than the rest of the belts, and the effect is the same as with mismatched belts. This is called "differential driving." The belts riding high in the grooves travel faster than the belts riding low. In a drive under proper tension, a sure sign of differential driving is when one or several belts on the tight side are slack.

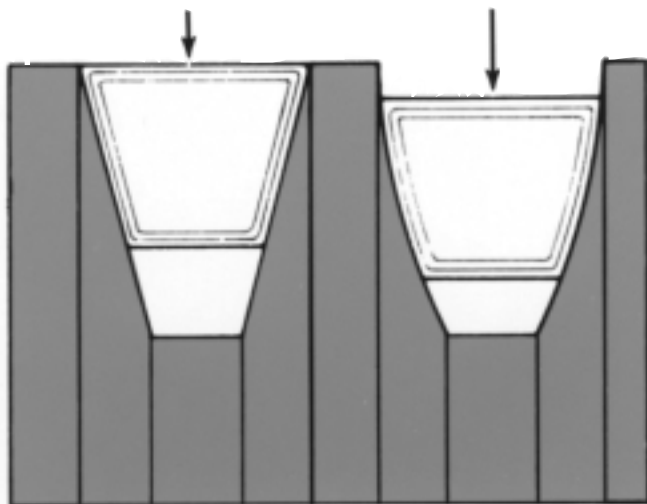
Check alignment of drive. Sheaves that are not aligned properly cause excessive belt and sheave wear. When the shafts are not parallel, belts on one side are drawn tighter and pull more than their share of the load. These overloaded belts wear out faster, reducing the service life of the entire set. If the misalignment is between the sheaves themselves, belts will enter and leave the



TB Wood's

grooves at an angle, causing excessive cover and sheave wear and premature failure. See page 10 for complete information on drive alignment.

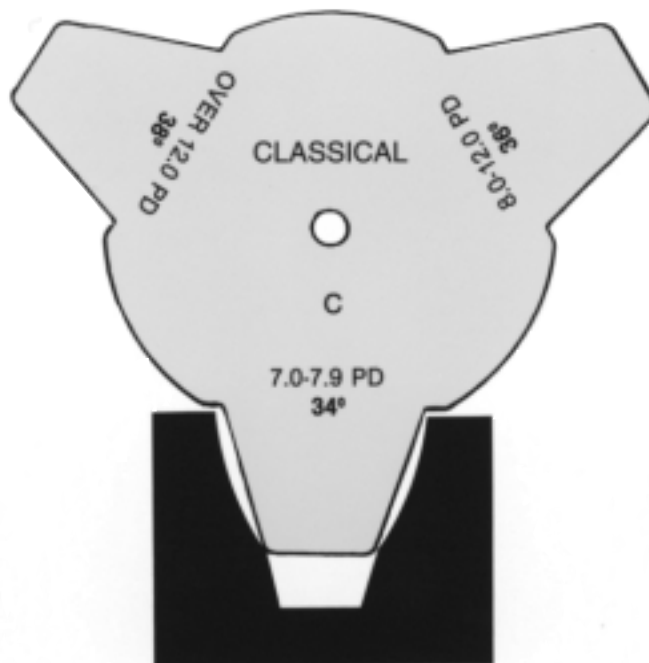
Sheave grooves must be
like this not this



Belt and sheave gages

Belt and sheave groove gage sets are available from your Wood's distributor.

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



Groove gage.

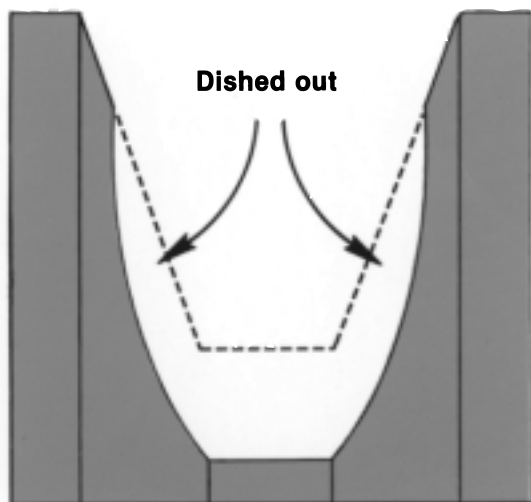
To check sheave grooves for wear, simply select the proper gage and template for the sheave diameter; then insert the gage in the groove until the rim of the gage butts against the outside diameter of the sheave flange. Worn grooves will show up as illustrated below. If more than $\frac{1}{32}$ inch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

Check belt fit

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

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

No matter which V-belt section the sheave is grooved for, the belts should never be allowed to



bottom in the groove. This will cause the belt to lose its wedging action, to slip and/or burn. Sheaves worn to the point where they allow a belt to bottom should be replaced immediately.

Keep belts clean

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

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

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

Use belt guards

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

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

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

Check for hot bearings

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

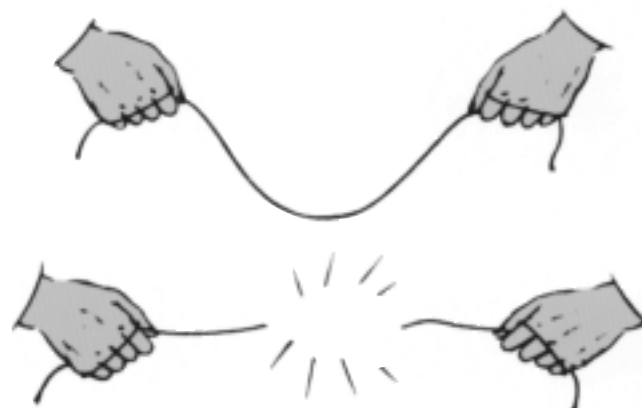
tight or too loose. Check the tension carefully using the instructions furnished.

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

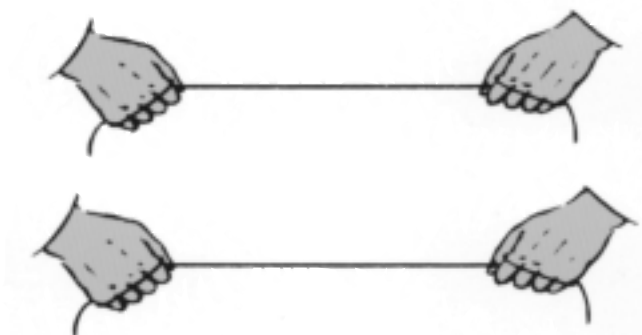
Maintain proper belt tension

Maintaining correct tension is the most important rule of V-belt care. It will give the belts 50% to 100% longer life.

Belts that are too loose will slip, causing excessive belt and sheave wear. V-belts that sag too much are snapped tight suddenly when the motor starts or when peak loads occur. That snapping action can actually break the belts, because the added stress is more than the belt was designed to take. This can be clearly demonstrated with a piece of string, as illustrated.



Loosely-held string snaps easily,
Taut string can stand strong pull.



Belt Selection

Selecting the correct belts

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

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

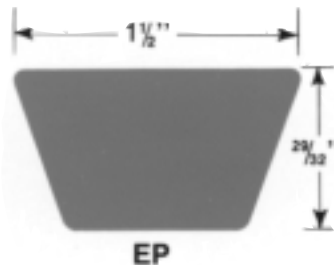
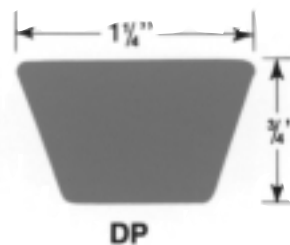
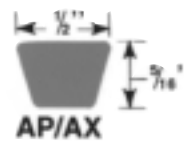
Be careful in measuring V-belts. The top widths of the B and 5V belts are very close; however, the 5V is considerably thicker, and the groove angles of the sheaves are different. Do not attempt to use these belts interchangeably. The 4L and 5L Light Duty belts are also very close in size to the A and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

The belt number C270 indicates a belt with a nominal 7/8" top width and a nominal length of 270". Its pitch length is 270.9". These should be ordered as: CP270 Classical belts. (The "P" is for Wood's Premium construction.)

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

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

Classical Belts



Narrow Belts



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

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

**Not applicable to Light Duty Belts*

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

All belts "ORS"

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

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

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

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

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

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

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

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

Explosive atmospheres

Belts on drives in hazardous atmospheres should be kept reasonably free of encrusted accumula-



TB Wood's

tions of non-conducting materials. In addition, all elements of the drive must be interconnected and grounded to earth as illustrated here.

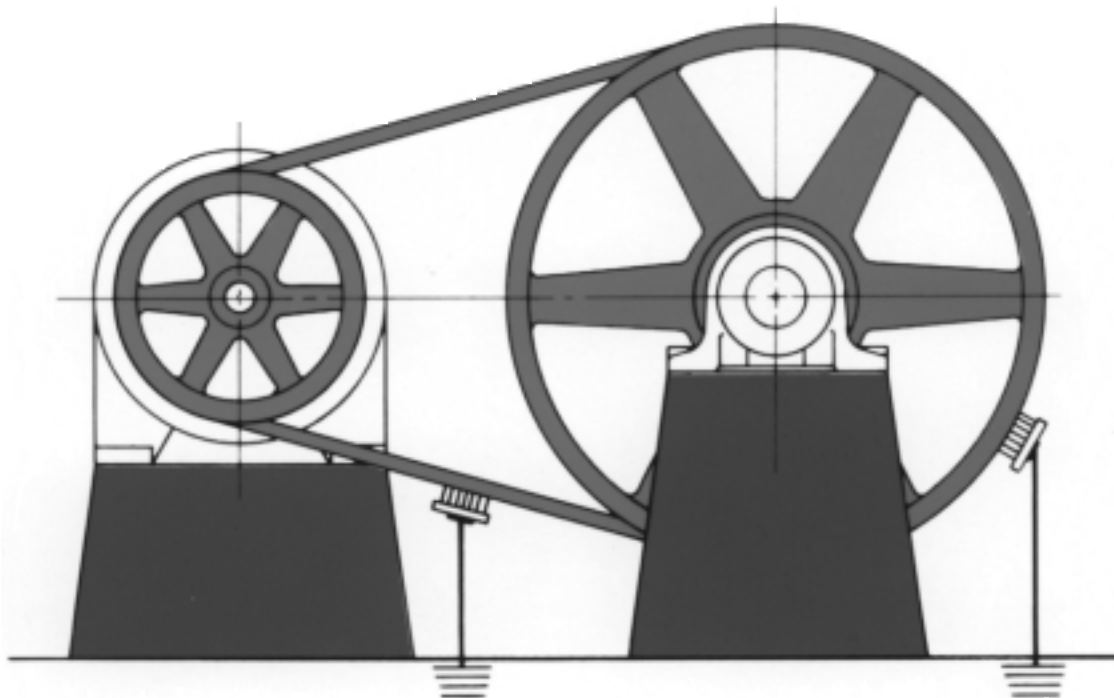
Although we know of no explosion caused by static generated by a V-belt drive, we cannot accept responsibility beyond that of furnishing belts within the above described limits.

Store belts properly

V-belts should be stored in a cool, dry place out of direct sunlight. They should be kept away from ozone-producing equipment such as arc welders and high voltage apparatus. Temperature should be below 85°F, relative humidity below 70%. If

belts are stored in piles, the piles should be kept small to avoid excessive weight which could distort the bottom belts. When belts are stored in boxes, the box size should be limited. Ideally, belts should be hung on saddle type pegs. With proper storage, belt quality will not change significantly within eight years.

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



Proper V-drive installation in explosive atmospheres

Safety Tips

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

Guard all drives properly

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

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

Check safe speed limits

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

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

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



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



Drive Installation

Sure-Grip® Sheave and Bushing Installation Instructions

Wood's Sure-Grip bushings are the most widely used, tapered, QD-type and have exceptional holding power that eliminates wobble. Standard and reverse mounting features provide greater

adaptability. Sure-Grip bushings can be used interchangeably in many of Wood's products as well as those of other manufacturers.

To Install:

IMPORTANT:

DO NOT USE LUBRICANTS IN THIS INSTALLATION

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

1. Inspect the tapered bore of the sheave and the tapered surface of the bushing. Any paint, dirt, oil, or grease **MUST** be removed.
2. Select the type of mounting (See Fig. 1 or 2) that best suits your application.
3. **STANDARD MOUNTING:** Install shaft key. (Note: If key was furnished with bushing, you must use that key.) Install bushing on clean shaft, flange end first. If bushing will not freely slide on the shaft, insert a screwdriver or similar object into the flange sawcut to act as a wedge to open the bushing's bore. **Caution: Excessive wedging will split the bushing.** If using the setscrew, tighten it just enough to prevent the bushing from sliding on the shaft. **Caution: Do not over tighten setscrew!** Slide sheave into position on bushing aligning the drilled holes in the sheave with the tapped holes in the bushing flange. (Note: Install M thru S bushings so that the two tapped holes in the sheave are located as far away as possible from the bushing's sawcut.) Loosely thread the capscrews with lockwashers into the assembly. **DO NOT USE LUBRICANT ON THE CAPSCREWS!**
4. **REVERSE MOUNTING:** With large end of the taper out, slide sheave onto shaft as far as possible. Install shaft key. (See shaft key note in #3

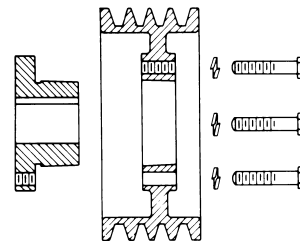


FIG. 1 Standard Mounting

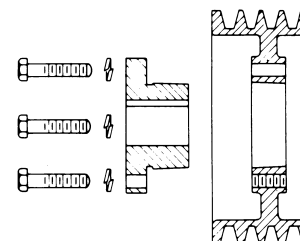


FIG. 2 Reverse Mounting

above.) Install bushing onto shaft so tapered end will mate with sheave. (See wedging note in #3 above.) If using the setscrew, tighten it enough to prevent the bushing from sliding on the shaft. **Caution: Do not over tighten setscrew!** Pull the sheave up on the bushing, aligning the drilled holes in the bushing flange with the tapped holes in the sheave. Loosely thread the capscrews with lockwashers into the assembly. **DO NOT USE LUBRICANT ON THE CAPSCREWS!**

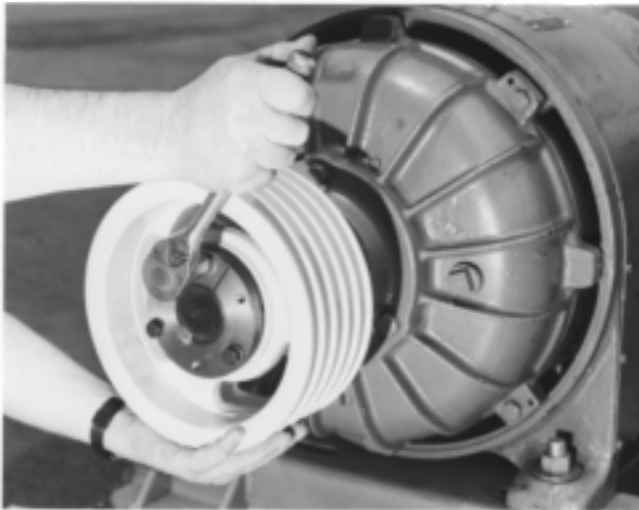
5. Using a torque wrench, tighten all capscrews evenly and progressively in rotation to the torque value in Table. There must be a gap between the bushing flange and sheave hub when installation is complete. **DO NOT OVER TORQUE! DO NOT ATTEMPT TO CLOSE GAP BETWEEN BUSHING FLANGE AND SHEAVE HUB!**

To Remove:

1. Relieve drive tension by shortening the center distance between driver and driven sheaves.
2. Lift off belts.
3. Loosen and remove cap screws. If the bushings have keyway setscrews, loosen them.
4. As shown below, insert cap screws (three in JA through J bushings, two in QT and M thru W bushings and four in S bushing) in tapped

removal holes and progressively tighten each one until mating part is loose on bushing. (Exception: If mating part is installed with cap screw heads next to motor, with insufficient room to insert screws in tapped holes, loosen cap screws and use wedge between bushing flange and mating part.)

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



Sure-Grip Bushing Screw Tightening Information

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

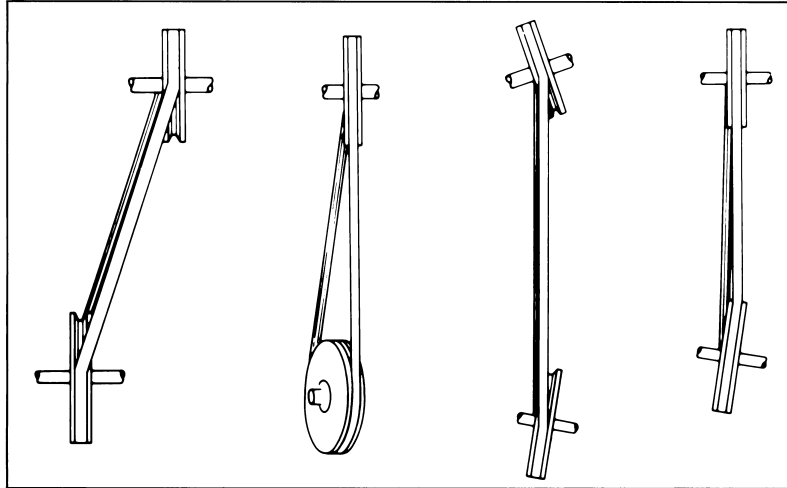
CAUTION: The tightening force on the screws is multiplied many times by the wedging action of the tapered surface. If extreme tightening force is applied, or if a lubricant is used, bursting pressures will be created in the hub of the mating part.

Check alignment

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

First, make sure that drive shafts are parallel. The most common causes of misalignment are non-parallel shafts and improperly located sheaves.

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

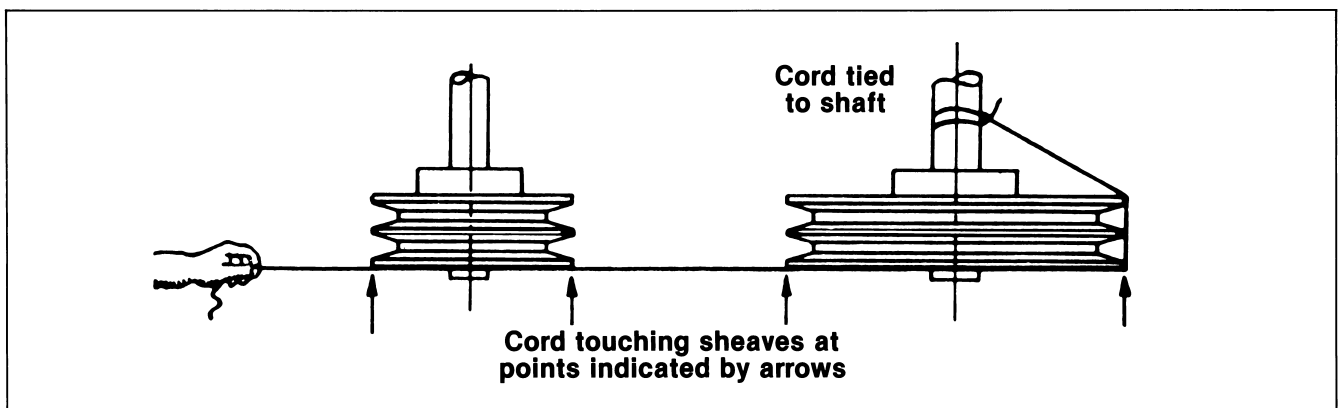


Shaft alignment can be checked by measuring the distance between the shafts at three or more locations. If the distances are equal, then the shafts will be parallel.

To check the location of the sheaves on the shafts, a straightedge or a piece of string can be used. If the sheaves are properly lined up, the string will touch them at the points indicated by the arrows in the accompanying sketch. Rotating

each sheave a half revolution will determine whether the sheave is wobbly or the drive shaft is bent. Correct any misalignment.

With sheaves aligned, tighten cap screws evenly and progressively. Apply the recommended torque to cap screws as listed in table on page 9. **NOTE:** There should be $\frac{1}{8}$ " to $\frac{1}{4}$ " gap between the mating part hub and the bushing flange. If gap is closed, the shaft is seriously undersize.



Install belts

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

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

NOTE: Never “roll” or “pry” the belts into the

sheave grooves. This can damage the belt cords and lead to belt turnover, short life or actual breakage. Moreover, it is both difficult and unsafe to install belts this way.

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

No!



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

Yes!



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

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

Narrow Belts

Belt Length	For Installation (Subtract)						For take-up (Add)
	3VX & 3V	3V Banded	5VX & 5V	5V Banded	8VX & 8V	8V Banded	All Cross Sections
250 thru 475 500 thru 710 750 thru 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
1120 thru 1250 1320 thru 1700 1800 thru 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
2120 thru 2360 2500 thru 2650 2800 thru 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
3150 thru 3550 3750 4000 thru 5000	— — —	— — —	1.2 — —	2.4 — —	2.0 2.0 2.0	4.0 4.0 4.0	4.0 4.5 5.5

Classical Belts

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

All dimensions in inches.

Tensioning V-Belt Drives

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

General method

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

Step 1: Reduce the center distance so that the belts may be placed over the sheaves and in the grooves without forcing them over the sides of the grooves. Arrange the belts so that both the top and bottom spans have about the same sag. Apply

tension to the belts by increasing the center distance until the belts are snug. See figure 1.

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

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

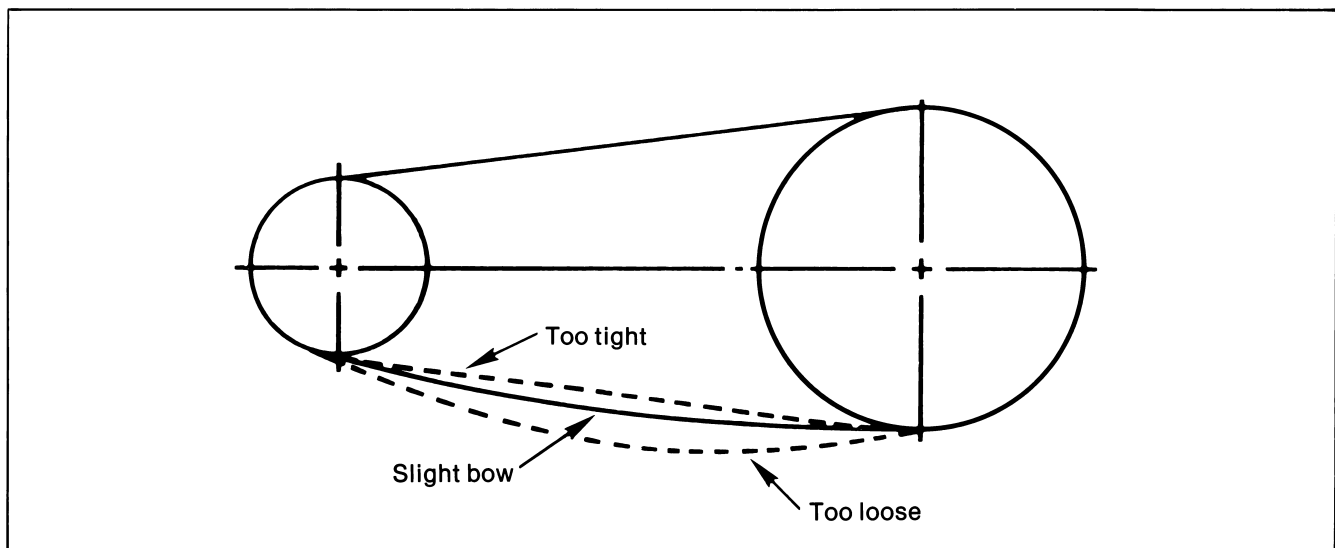


Figure 1

Force deflection method

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

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

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

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

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

- If the deflection force is below the minimum, the belts are too loose and the tension should be increased by increasing the center distance.
- If the deflection force is higher than the maximum, the belts are too tight and the tension should be decreased.

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

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

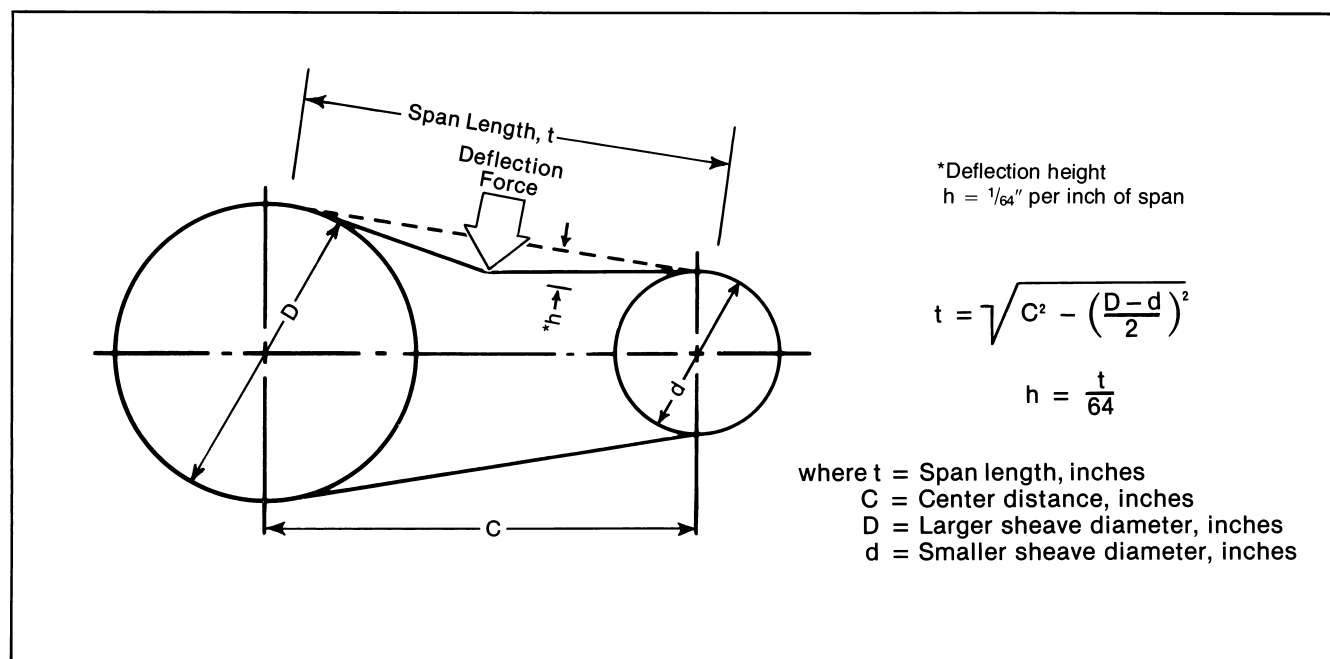


Figure 2

Table 1
Recommended Minimum Force Per Belt

Belt Section	Small Sheave		Drive Ratio			
	Speed Range	Dia.	1.0	1.5	2.0	4.0 & over
3V	1200-3600	2.65	2.0	2.4	2.6	3.0
	1200-3600	3.65	2.8	3.6	3.8	4.2
	1200-3600	4.75	3.8	4.2	4.4	4.8
	1200-3600	5.60	4.2	4.6	4.8	5.4
	1200-3600	6.90	4.6	5.0	5.2	5.6
5V	900-1800	7.1	8.5	9.5	10	11
	900-1800	9.0	10	11	12	13
	900-1800	14.0	12	13	14	15
	700-1200	21.2	14	15	16	17
8V	900-1800	12.5	18	21	23	25
	900-1800	14.0	21	23	24	28
	700-1500	17.0	24	26	28	30
	700-1200	21.2	28	30	32	34
	400-1000	24.8	31	32	34	36
3VX	1200-3600	2.20	2.2	2.5	2.7	3.0
	1200-3600	2.50	2.6	2.9	3.1	3.6
	1200-3600	3.00	3.1	3.5	3.7	4.2
	1200-3600	4.12	3.9	4.3	4.5	5.1
	1200-3600	5.30	4.6	4.9	5.1	5.7
	1200-3600	6.9	5.0	5.4	5.6	6.2
5VX	1200-3600	4.4	6.5	7.6	8.0	9.0
	1200-3600	5.2	8.0	9.0	9.5	10
	1200-3600	6.3	9.5	10	11	12
	1200-3600	7.1	10	11	12	13
	900-1800	9.0	12	13	14	15
	900-1800	14.0	14	15	16	17
AP	1800-3600	3.0	2.0	2.3	2.4	2.6
	1800-3600	4.0	2.6	2.8	3.0	3.3
	1800-3600	5.0	3.0	3.3	3.4	3.7
	1800-3600	7.0	3.5	3.7	3.8	4.3
BP	1200-1800	4.6	3.7	4.3	4.5	5.0
	1200-1800	5.0	4.1	4.6	4.8	5.6
	1200-1800	6.0	4.8	5.3	5.5	6.3
	1200-1800	8.0	5.7	6.2	6.4	7.2
CP	900-1800	7.0	6.5	7.0	8.0	9.0
	900-1800	9.0	8.0	9.0	10	11
	900-1800	12.0	10	11	12	13
	700-1500	16.0	12	13	13	14
DP	900-1500	12.0	13	15	16	17
	900-1500	15.0	16	18	19	21
	700-1200	18.0	19	21	22	24
	700-1200	22.0	22	23	24	26
AX	1800-3600	3.0	2.5	2.8	3.0	3.3
	1800-3600	4.0	3.3	3.6	3.8	4.2
	1800-3600	5.0	3.7	4.1	4.3	4.6
	1800-3600	7.0	4.3	4.6	4.8	5.3
BX	1200-1800	4.6	5.2	5.8	6.0	6.9
	1200-1800	5.0	5.4	6.0	6.3	7.1
	1200-1800	6.0	6.0	6.4	6.7	7.7
	1200-1800	8.0	6.6	7.1	7.5	8.2
CX	900-1800	7.0	10	11	12	13
	900-1800	9.0	11	12	13	14
	900-1800	12.0	12	13	13	14
	700-1500	16.0	13	14	14	15
DX	900-1500	12.0	16	18	19	20
	900-1500	15.0	19	21	22	24
	700-1200	18.0	22	24	25	27
	700-1200	22.0	25	27	28	30

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

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

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

Table 2
K Factors and Arc of Contact

$\frac{D-d}{C}$	Arc Contact Degree	Factor		$\frac{D-d}{C}$	Arc Contact Degree	Factor	
		Ac	K			Ac	K
0.000	180	1.000	24.750	0.750	136	0.879	30.411
0.025	179	0.997	24.883	0.775	134	0.874	30.688
0.050	177	0.994	25.019	0.800	133	0.869	30.975
0.075	176	0.990	25.158	0.825	131	0.864	31.270
0.100	174	0.987	25.300	0.850	130	0.858	31.576
0.125	173	0.983	25.444	0.875	128	0.852	31.892
0.150	171	0.980	25.591	0.900	127	0.847	32.219
0.175	170	0.977	25.742	0.925	125	0.841	32.558
0.200	169	0.973	25.896	0.950	123	0.835	32.909
0.225	167	0.969	26.053	0.975	122	0.829	33.273
0.250	166	0.966	26.213	1.000	120	0.823	33.652
0.275	164	0.962	26.377	1.025	118	0.816	34.045
0.300	163	0.958	26.545	1.050	117	0.810	34.454
0.325	161	0.954	26.717	1.075	115	0.803	34.879
0.350	160	0.951	26.892	1.100	113	0.796	35.323
0.375	158	0.947	27.072	1.125	112	0.789	35.786
0.400	157	0.943	27.257	1.150	110	0.782	36.270
0.425	155	0.939	27.445	1.175	108	0.774	36.777
0.450	154	0.935	27.639	1.200	106	0.767	37.307
0.475	153	0.930	27.837	1.225	104	0.759	37.864
0.500	151	0.926	28.040	1.250	103	0.751	38.448
0.525	150	0.922	28.249	1.275	101	0.742	39.064
0.550	148	0.917	28.463	1.300	99	0.734	39.713
0.575	147	0.913	28.684	1.325	97	0.725	40.398
0.600	145	0.908	28.910	1.350	95	0.716	41.123
0.625	144	0.904	29.142	1.375	93	0.706	41.892
0.650	142	0.899	29.381	1.400	91	0.697	42.709
0.675	141	0.894	29.627	1.425	89	0.687	43.580
0.700	139	0.889	29.881				
0.725	137	0.884	30.142				

MAXIMUM Deflection Force = Minimum times 1.5

INITIAL Deflection Force = Minimum times 2.0

Force deflection engineering formulas

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

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

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

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

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

$$P_{\text{Minimum}} = \frac{T_s + Y}{16}$$

$$P_{\text{Maximum}} = \frac{1.5(T_s) + Y}{16}$$

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

Explanation of Symbols

A _c	= Arc of contact - smaller sheave, degrees
C	= Center distance, inches
D	= Larger sheave pitch diameter, inches
d	= Smaller sheave pitch diameter, inches
DHP	= Design horsepower based upon the recommended application service factor
h	= Deflection height, inches (Refer. figure 2)
K	= Value from table 2 depending on $\frac{D-d}{C}$ or $K = 16.5 \frac{2.5-A_c}{A_c}$
L	= Belt length, inches
M	= Centrifugal constant table 3
N	= Number of belts or V-band ribs
P	= Deflection force, pounds
S	= Belt speed, FPM/1000
t	= Span length, inches (Refer. figure 2)
Y	= Belt constant table 3

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

$$P_{\text{Minimum}} = \frac{T_s + Y \left(\frac{t}{L} \right)}{16} \quad P_{\text{Maximum}} = \frac{1.5(T_s) + Y \left(\frac{t}{L} \right)}{16} \quad P_{\text{Initial}} = 1.33 \text{ times } P_{\text{Maximum}}$$

Table 3
Belt Constants M and Y

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

Belt elongation method

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

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

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

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

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

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

Step 4: Find a range of recommended tensions.

Lower Tension = Ts

Upper Tension = 1.5 times Ts

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

- a. From table 4, find length multipliers corresponding to the lower and upper Ts values in Step 4 above.
 - b. Multiply the slack O.C. found in Step 2 by the length multipliers to find the minimum and maximum elongated band lengths.
-

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

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

**Table 4 Belt length multipliers
for tensioning banded belts**

Ts Per Strand (lbs.)	NARROW BAND					CLASSICAL BAND					CLASSICAL COG BAND		
	CROSS SECTION												
	3V	5V		8V		BP		CP		DP	BX All Sizes	CX All Sizes	DX All Sizes
		5V1700 & under	5V1800 & over	8V1700 & under	8V1800 & over	BP144 & under	Over BP144	CP144 & under	Over CP144				
10	1.00186	1.00056	1.00001	1.00013	1.00010	1.00113	1.00141	1.00029	1.00052	1.00013	1.00082	1.00027	1.00013
12	1.00220	1.00068	1.00097	1.00016	1.00012	1.00135	1.00168	1.00035	1.00062	1.00016	1.00098	1.00032	1.00016
14	1.00254	1.00079	1.00113	1.00019	1.00014	1.00157	1.00194	1.00041	1.00072	1.00019	1.00114	1.00038	1.00019
16	1.00288	1.00090	1.00129	1.00021	1.00016	1.00178	1.00220	1.00046	1.00082	1.00021	1.00129	1.00043	1.00021
18	1.00320	1.00101	1.00144	1.00024	1.00018	1.00199	1.00246	1.00052	1.00092	1.00024	1.00145	1.00048	1.00024
20	1.00352	1.00112	1.00159	1.00027	1.00020	1.00220	1.00271	1.00058	1.00102	1.00027	1.00160	1.00054	1.00027
24	1.00414	1.00133	1.00190	1.00032	1.00024	1.00261	1.00320	1.00069	1.00122	1.00033	1.00191	1.00065	1.00032
28	1.00472	1.00155	1.00219	1.00037	1.00029	1.00301	1.00368	1.00081	1.00141	1.00038	1.00220	1.00075	1.00038
32	1.00520	1.00176	1.00249	1.00043	1.00033	1.00339	1.00414	1.00092	1.00161	1.00044	1.00250	1.00086	1.00043
36	1.00556	1.00197	1.00277	1.00048	1.00037	1.00377	1.00458	1.00104	1.00180	1.00050	1.00278	1.00097	1.00049
40	1.00588	1.00217	1.00305	1.00054	1.00042	1.00413	1.00500	1.00115	1.00199	1.00056	1.00306	1.00107	1.00054
45	1.00625	1.00243	1.00340	1.00060	1.00047	1.00458	1.00529	1.00129	1.00222	1.00063	1.00341	1.00121	1.00061
50	1.00659	1.00268	1.00374	1.00067	1.00053	1.00500	1.00553	1.00144	1.00246	1.00071	1.00374	1.00134	1.00068
55	1.00691	1.00293	1.00406	1.00074	1.00058	1.00528	1.00574	1.00158	1.00268	1.00078	1.00407	1.00147	1.00075
60	1.00722	1.00317	1.00438	1.00081	1.00064	1.00553	1.00591	1.00172	1.00291	1.00086	1.00439	1.00161	1.00081
65	1.00754	1.00341	1.00470	1.00088	1.00070	1.00576	1.00606	1.00186	1.00313	1.00094	1.00470	1.00174	1.00088
70	1.00787	1.00365	1.00500	1.00095	1.00076	1.00596	1.00620	1.00200	1.00335	1.00102	1.00500	1.00187	1.00095
75	1.00822	1.00389	1.00523	1.00101	1.00082	1.00614	1.00632	1.00214	1.00357	1.00110	1.00522	1.00200	1.00102
80	1.00861	1.00412	1.00545	1.00108	1.00088	1.00631	1.00644	1.00228	1.00378	1.00118	1.00543	1.00213	1.00109
85	1.00903	1.00434	1.00566	1.00115	1.00094	1.00646	1.00656	1.00242	1.00399	1.00127	1.00563	1.00227	1.00116
90	1.00949	1.00456	1.00586	1.00122	1.00100	1.00659	1.00668	1.00256	1.00420	1.00135	1.00581	1.00240	1.00123
95	1.01000	1.00478	1.00606	1.00129	1.00106	1.00672	1.00682	1.00270	1.00441	1.00144	1.00599	1.00253	1.00130
100	1.01056	1.00500	1.00625	1.00136	1.00113	1.00684	1.00697	1.00284	1.00461	1.00152	1.00616	1.00266	1.00137
120	1.01333	1.00561	1.00696	1.00164	1.00139	1.00727	1.00780	1.00339	1.00528	1.00188	1.00679	1.00319	1.00166
140	1.01692	1.00617	1.00765	1.00192	1.00166	1.00771	1.00912	1.00393	1.00579	1.00226	1.00736	1.00371	1.00195
160	1.02081	1.00672	1.00836	1.00220	1.00194	1.00827	1.01104	1.00447	1.00627	1.00265	1.00793	1.00423	1.00224
180	1.02385	1.00728	1.00913	1.00249	1.00223	1.00902	1.01357	1.00500	1.00675	1.00306	1.00854	1.00474	1.00253
200	1.02655	1.00707	1.01000	1.00277	1.00254	1.01000	1.01718	1.00534	1.00724	1.00349	1.00922	1.00525	1.00283
240	1.03118	1.00921	1.01213	1.00335	1.00319	1.01279	1.02268	1.00607	1.00832	1.00440	1.01090	1.00625	1.00343
280	1.03579	1.01088	1.01524	1.00395	1.00389	1.01663	1.02737	1.00692	1.00963	1.00542	1.01313	1.00724	1.00405
320	1.04070	1.01292	1.01834	1.00454	1.00461	1.02088	1.03275	1.00797	1.01124	1.00656	1.01590	1.00824	1.00468
360	1.04671	1.01562	1.02162	1.00515	1.00543	1.02423	1.03853	1.00926	1.01317	1.00771	1.01925	1.00924	1.00532
400	1.05308	1.01826	1.02526	1.00575	1.00631	1.02708	1.04393	1.01081	1.01580	1.00886	1.02229	1.01026	1.00598
450		1.02179	1.03056	1.00652	1.00744	1.03072	1.05000	1.01311	1.01877	1.01028	1.02625	1.01156	1.00683
500		1.02558	1.03643	1.00732	1.00859	1.03425		1.01610	1.02186	1.01164	1.03000	1.01292	1.00768
550		1.02927	1.04200	1.00813	1.00976	1.03781		1.01888	1.02500	1.01293	1.03354	1.01435	1.00856
600		1.03286	1.04642	1.00896	1.01094	1.04158		1.02169	1.02813	1.01413	1.03685	1.01557	1.00946
650		1.03632	1.05000	1.00982	1.01213	1.04567		1.02449	1.03123	1.01524	1.04000	1.01729	1.01037
700		1.03967		1.01071	1.01331	1.05000		1.02718	1.03426	1.01625	1.04333	1.01919	1.01130
750		1.04310		1.01163	1.01449			1.03000	1.03719	1.01718	1.04667	1.02126	1.01224
800		1.04655		1.01257	1.01571			1.03282	1.04000	1.01802	1.05000	1.02372	1.01320
850		1.05000		1.01354	1.01689			1.03563	1.04268	1.01833		1.02607	1.01418
900				1.01454	1.01887			1.03838	1.04524	1.01936		1.02840	1.01518
950				1.01561	1.01927			1.04101	1.04768	1.02044		1.03068	1.01619
1000				1.01667	1.02049			1.04345	1.05000	1.02156		1.03209	1.01717

Trouble Shooting V-Belts

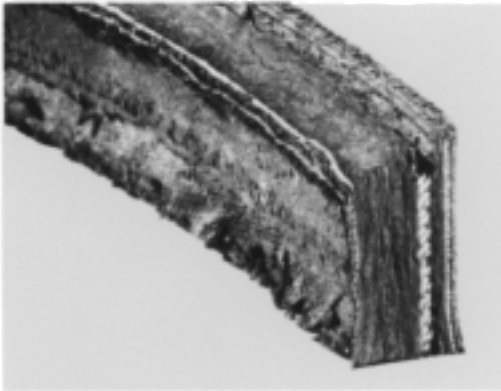
How to spot V-belt trouble

Trouble	Cause	To correct
Belt slip (sidewalls glazed)	Not enough tension.	Replace belts; apply proper tension.
Drive squeals	Shock load. Not enough arc of contact. Heavy starting load.	Apply proper tension. Increase center distance. Increase tension.
Belt turned over.	Broken cord caused by prying on sheave. Overloaded drive. Impulse loads. Misalignment of sheave and shaft. Worn sheave grooves. Flat idler sheave. Excessive belt vibration.	Replace set of belts correctly. Redesign drive. Apply proper tension. Realign drive. Replace sheaves. Align idler. Re-position on slack side of drive close to drive sheave. Check drive design. Check equipment for solid mounting. Consider use of banded belts.
Mismatched belts.	New belts installed with old belts. Sheave grooves worn unevenly; improper groove angle. Give appearance of mismatched belts. Sheave shafts not parallel. Give appearance of mismatched belts.	Replace belts in matched set only. Replace sheaves. Align drive.
Belt breaks.	Shock loads. Heavy starting loads. Belt pried over sheaves. Foreign objects in drive.	Apply proper tension; Recheck drive. Apply proper tension; Recheck drive. Use compensator starting. Replace set of belts correctly. Provide drive shroud.
Belt wears rapidly.	Sheave grooves worn. Sheave diameter too small. Mismatched belts. Drive overloaded. Belt slips. Sheaves misaligned. Oil or heat condition.	Replace sheaves. Redesign drive. Replace with matched belts. Redesign drive. Increase tension. Align sheaves. Eliminate oil. Ventilate drive.

How to diagnose V-belt failure

V-Belt Troubleshooting Checklist

BELT CONDITION



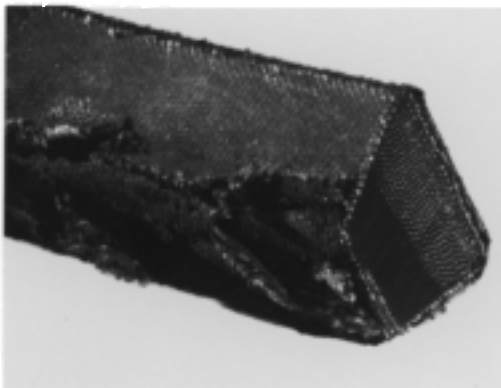
Oil Deterioration

CAUSE

Oil-softened rubber.

PREVENTION

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



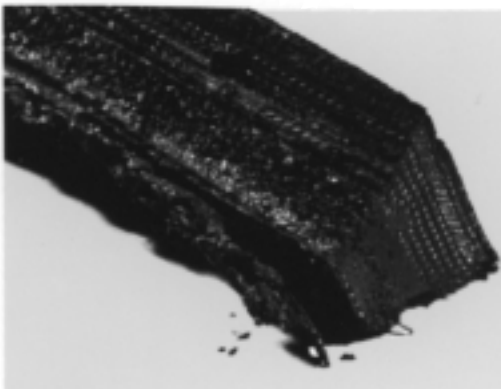
Cover Fabric Rupture

CAUSE

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

PREVENTION

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



Slip Burn

CAUSE

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

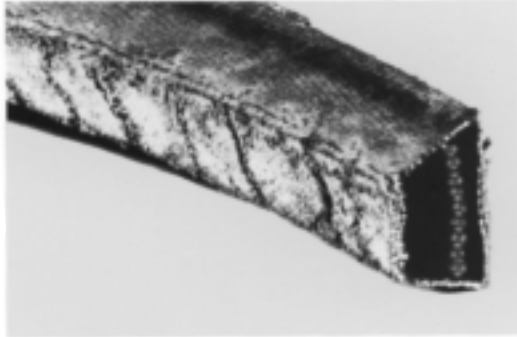
PREVENTION

Maintain proper tension on the drive.

How to diagnose V-belt failure

V-Belt Troubleshooting Checklist

BELT CONDITION



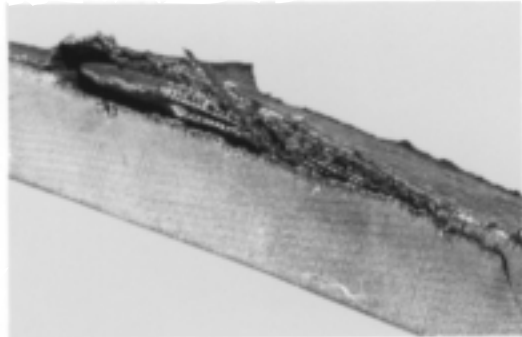
Base Cracking

CAUSE

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

PREVENTION

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



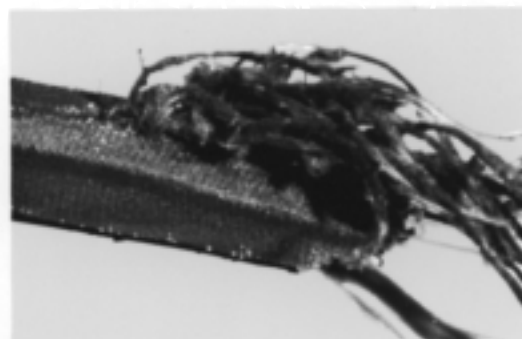
Ply Separation

CAUSE

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

PREVENTION

Redesign drive using sheaves of proper size.



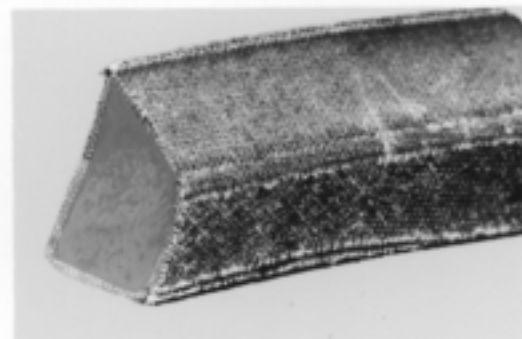
Ruptured

CAUSE

Ruptured cords in the plies.

PREVENTION

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



Worn Belt Sides

CAUSE

Misalignment. Grit or dirt. Normal wear.

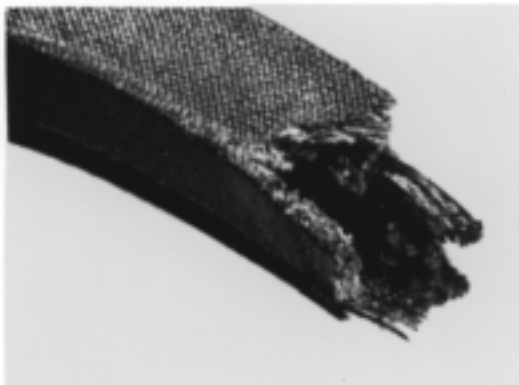
PREVENTION

Align sheaves. Replace belts as required.

How to diagnose V-belt failure

V-Belt Troubleshooting Checklist

BELT CONDITION



Snub Break

CAUSE

Cover wear indicates slip. Clean break reveals sudden snap.

PREVENTION

Maintain proper tension on the drive.



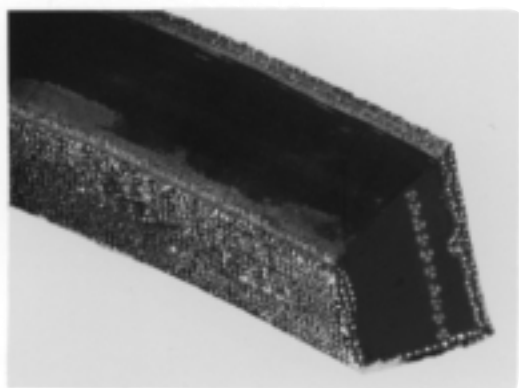
Distorted Belt

CAUSE

Breakdown of adhesion or broken cords.

PREVENTION

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



Abrasion

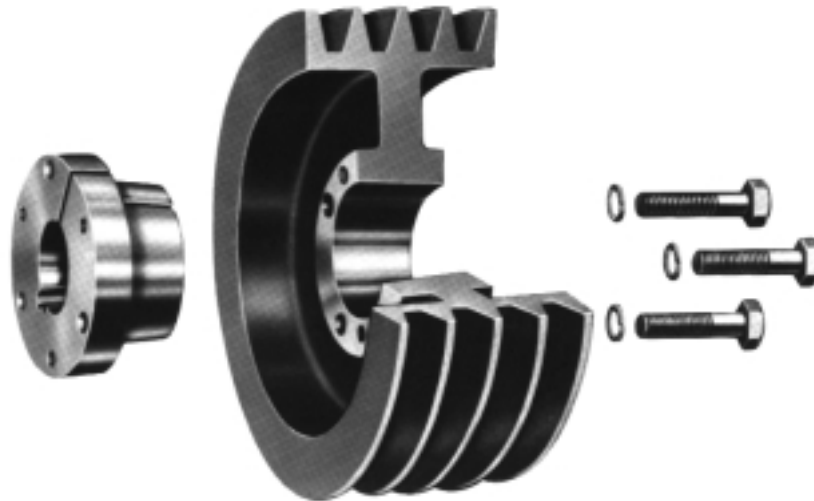
CAUSE

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

PREVENTION

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

SURE-GRIP® SHEAVE FEATURES



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

DESIGN INTEGRITY

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

FOUNDRY PROCESSES

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

MACHINING

TB Wood's Incorporated has numerous machining facilities throughout North America. Each is equipped with modern CNC equipment and capable of doing high precision machining. Statistical process controls are in place in each location, and each has been ISO-9000 certified.

SPECIFICATIONS

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

ANSI/RMA	IP-20	Classical V-Belt Sheaves
ANSI/RMA	IP-22	Narrow V-Belt Sheaves
ANSI/RMA	IP-24	Synchronous Sprockets
MPTA	QD-1	QD Bushing Guideline
MPTA	SPB	Pulley Balance
MPTA	SAS	V-Belt Sheave Arm Stress
MPTA	SF	Pulley Surface Finish



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DOCUMENT SUBMISSION STATUS: FF						
NOTE:						
1	08 Jan, 2016	For Final	Liu Zhongwei	Yang Zunyao		Ma Yi
0	08 Sep, 2015	For Final	Liu Zhongwei	Yang Zunyao		Ma Yi
REV.	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	APPROVED
OWNER  VIETNAM OIL AND GAS GROUP (PVN)			OWNER'S CONSULTANT FICHTNER GmbH & Co. KG FICHTNER  PVPOWER PCC			
EPC CONTRACTOR  PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)			EPC CONSTRUCTOR'S CONSULTANT  WorleyParsons resources & energy WORLEYPARSONS			
POWERISLAND PACKAGE SUPPLIER  SOJITZ CORPORATION DAELIM DAELIM INDUSTRIAL CO., LTD.						
PROJECT TITLE THAI BINH 2 THERMAL POWER PLANT 2 x 600MW						
DRAWING / DOCUMENT TITLE Installation, Operation, Maintenance, Commission Manual For Bottom Ash System – Secondary Bottom Ash Crusher						
BIP SUPPLIER:  BWBC	BIP SUB-SUPPLIER:  广东省电力设计研究院 中国能建 GUANGDONG ELECTRIC POWER DESIGN INSTITUTE GEDI	FUNCTION	NAME	SIGN	DATE	
		DRWN	Liu Zhongwei		08 Jan, 2016	
		CHKD	Yang Zunyao		08 Jan, 2016	
		APPD	Ma Yi		08 Jan, 2016	
DOCUMENT No. TB2-SDC.VP101-00100-M-M12-M AN-9064			No. of page: 126		Scale: A4	Rev. 1

P.O NO.	110180-1600-101-001-A01
ITEM NO.	100
ITEM DESCRIPTION	BOILER AND BOILER BOP
DOCUMENT NO.	TB2-SDC.VP101-00100-M-M12-MAN-9064
DOCUMENT TITLE	Installation, Operation, Maintenance, Commission Manual for Bottom Ash System- Secondary Bottom Ash Crusher
REV NO.	1

Daelim's Approval Status

Daelim Industrial Co., Ltd.	
Job No.	110180
	A - APPROVED
	B - APPROVED WITH COMMENTS
	C - RETURNED FOR CORRECTION
	D - REJECTED
	N - NOT APPLICABLE(REFERENCE ONLY)
SIGNED BY : _____ DATE : _____	
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S E R V I C E M A N U A L



**We are proud to present this Service Manual for your
GUNDLACH EQUIPMENT.**

As the Manual opens with Adobe Reader this page will be displayed.

There are a few guidelines to help you maneuver through this electronic version of our Service Manual.

You will find tabs or icons located on the left side of the screen. One of these tabs is labeled: Bookmarks. Click to expand. The Manuals' Table of Contents will now be listed. Selecting a Section Bookmark will take you directly to the first page in that Section. Double clicking the Section title or a single click on the plus sign + next to the title will expand the Section and show its contents and the pages outlined.

Each page listed is linked and by clicking the page description in the Table of Contents, you will be taken directly to that page. Some pages may have a link to another page in the Manual. This link is underlined in blue. If you click the link, it will take you directly to the page referenced; to return to the original page press Alt – Left Arrow. This is the previous view command. This command works one page or one view at a time, as many times as needed.

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John Brown at: (877) 486-3522 (x7916) – Toll Free
(618) 825-7916 – Direct
jbrown@terrasource.com

Thank you for choosing Gundlach

*One Freedom Drive, Belleville, Illinois 62226 USA
Phone (618) 233-7208 Fax (618) 233-6154
Toll Free 1-877- GUNDLACH*



SERVICE MANUAL

CUSTOMER:

Terrasource Global Beijing

END USER:

Longfu Power Plant

PROJECT ORDER NUMBER:

11553SQ

PURCHASE ORDER NUMBER:

2014071601

BRAND AND MACHINE TYPE:

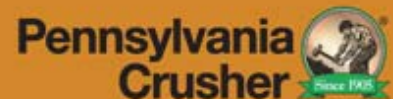
Roll Crusher

UNIT SERIAL NUMBER(S):

2040S2793 - 2794

MANUAL CREATED:

December 2014





THIS MANUAL HAS BEEN PREPARED FOR USE WITH YOUR GUNDLACH CRUSHER

MANUFACTURED BY GUNDLACH

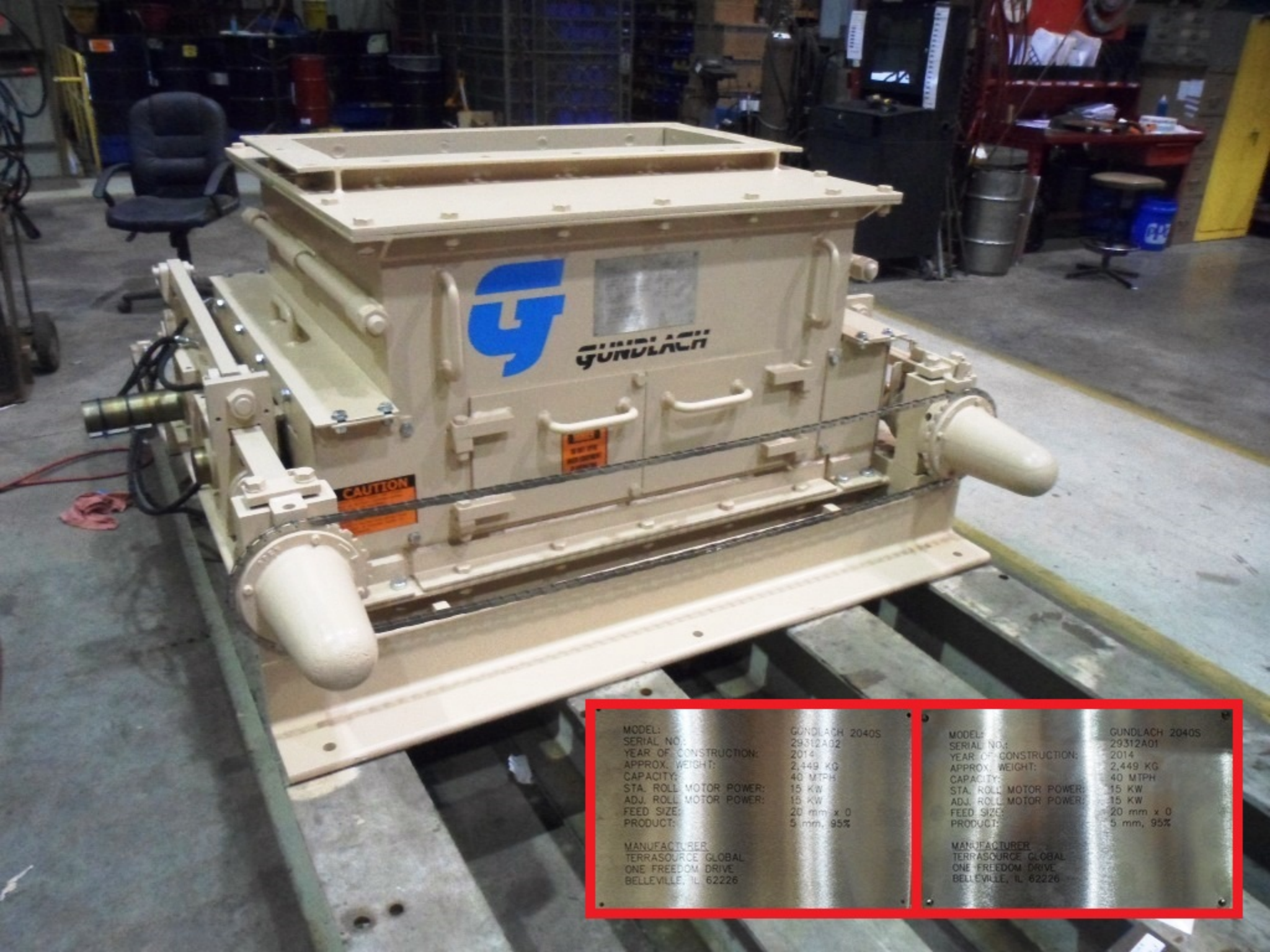
BELLEVILLE, ILLINOIS, U.S.A. 62226

SERIAL # 2040S2793 - 2794

CUSTOMER:	Longfu Power Plant
TYPE OF EQUIPMENT AND PURPOSE:	Roll Crusher
DATE OF MANUFACTURE:	November 2014
PURCHASE ORDER NUMBER:	2014071601
EQUIPMENT NUMBER:	2040S2793 - 2794
KILOWATTS/HP:	N/A
UPPER ROLL RPM:	300 RPM
LOWER ROLL RPM:	300 RPM
LEFT OR RIGHT HAND DRIVE UNIT:	Right Hand, 2 Motor Drive
REVISION NUMBER:	0
SPARE PARTS WITH ORDER:	N/A
UNIT WEIGHT:	5,400 lbs - 2,449 kg

APPLICATION DATA	
FEED:	20 mm x 0
PRODUCT:	5 mm, 95% passing square hole screen
TPH:	40 MTPH
(Capacity)	
MATERIAL:	PC Boiler Slag (Ash) - Max. Compressive Strength 80MPa

P.O. BOX 385 • BELLEVILLE, ILLINOIS 62222
ONE FREEDOM DRIVE • BELLEVILLE, ILLINOIS 62226
PHONE (618) 233-7208 • FAX (618) 233-6154
E-MAIL: BETTERCRUSHERS@GUNDLACHCRUSHERS.COM



MODEL: GUNDLACH 2040S
SERIAL NO.: 29312A02
YEAR OF CONSTRUCTION: 2014
APPROX. WEIGHT: 2,449 KG
CAPACITY: 40 MTPH
STA. ROLL MOTOR POWER: 15 KW
ADJ. ROLL MOTOR POWER: 15 KW
FEED SIZE: 20 mm x 0
PRODUCT: 5 mm, 95%

MANUFACTURER
TERRASOURCE GLOBAL
ONE FREEDOM DRIVE
BELLEVILLE, IL 62226

MODEL: GUNDLACH 2040S
SERIAL NO.: 29312A01
YEAR OF CONSTRUCTION: 2014
APPROX. WEIGHT: 2,449 KG
CAPACITY: 40 MTPH
STA. ROLL MOTOR POWER: 15 KW
ADJ. ROLL MOTOR POWER: 15 KW
FEED SIZE: 20 mm x 0
PRODUCT: 5 mm, 95%

MANUFACTURER
TERRASOURCE GLOBAL
ONE FREEDOM DRIVE
BELLEVILLE, IL 62226



QUALITY POLICY STATEMENT

- It is the policy of Gundlach Equipment Corporation to meet or exceed customer expectations in all aspects of sales, engineering, manufacturing and customer service.
- Gundlach Equipment Corporation is committed to an ongoing continuous improvement effort through employee involvement.
- In order to maintain a long-term improvement effort, Gundlach Equipment Corporation will utilize all available resources through Management and the Board of Directors, including ingenuity, research, design, development and manufacturing.

Our Goal:

- To be recognized as the world's preferred supplier of quality crushing and fine grinding equipment and services.



SAFETY INSTRUCTIONS

GUNDLACH

COMPANY PRODUCT SAFETY POLICY

Background

Supplying products that are reliable and safe for their intended use and meet the needs of our customers is a corporate responsibility of the **GUNDLACH EQUIPMENT CORPORATION**. Acceptance of this responsibility throughout the company is essential to preserve confidence of customers, retain their business, and compete successfully in the marketplace.

The intent of this policy is to emphasize the importance of continuing attention to customer needs and expectations concerning product safety (product reliability, quality and environmental effects) and to define objectives and responsibilities for the design, manufacture, testing, transportation, installation, and maintenance of products that meet or exceed appropriate standards. Personnel in all departments of the company must emphasize product safety in the daily performance of their jobs.

Policy & Objectives

It is the policy of **GUNDLACH EQUIPMENT CORPORATION** to provide products and services which perform their required function safely for their intended use.

The company will use care in the development, design and manufacture of its products, giving due regard to applicable regulatory and industry standards.

Only first class materials and components will be purchased, and careful testing and quality control procedures shall be used to assure that these objectives are met.

Specific operating procedures and instructions shall be provided with our product to guide the customer and/or user in proper care and use of the equipment.

Adopted at regular Board of Directors Meeting on August 16, 1988.



Mark Kohler, General Manager

GUNDLACH

GUNDLACH EQUIPMENT OPERATING SAFETY INSTRUCTIONS

Operator safety and the safety of others depend upon reasonable care and judgment in the operation of this Gundlach equipment. A careful operator is good insurance against an accident.

Most accidents, no matter where they occur, are caused by failure to observe and follow simple fundamental rules or precautions. For this reason, most accidents can be prevented by recognizing hazards and taking steps to avoid them before an accident occurs.

Experience has shown that regular scheduled preventative maintenance programs contribute greatly to the **SAFE** and **EFFICIENT** operation of Gundlach equipment.

We recommend that a preventative maintenance program be adopted.

Basic rules regarding safety in and around Gundlach equipment are outlined in the following list of DOs.

DO

1. DO observe all safety warning labels on machine and refer back to the manual.
2. DO install the Gundlach equipment on a structurally sound foundation.
3. DO allow the Gundlach equipment to get up to full speed before loading.
4. DO disconnect and lockout electrical power to the Gundlach equipment motor(s) before servicing the Gundlach equipment.
5. DO wear the proper safety equipment such as safety glasses, safety shoes, hard hats and ear protection at all times while near the equipment.
6. DO maintain the Gundlach equipment at regularly scheduled intervals.
7. DO keep area around the Gundlach equipment picked up and free from debris to prevent slip, trip, and fall hazards. Prior to maintenance or inspection activities, ensure the outside surfaces of the equipment are cleared of possible material buildup.
8. DO periodically check and tighten accessible bolts, nuts, and screws.
9. DO use only qualified persons for the operation and maintenance of the Gundlach equipment.
10. DO make sure the Gundlach equipment inspection doors are closed and locked before operating the Gundlach equipment.
11. DO take notice of fire exits prior to maintenance or operation of the equipment and drive components and ensure that fire exits are free from obstructions.
12. DO supply the feeding and discharge systems with adequate dust collection to prevent dust emissions at the Gundlach Equipment.

GUNDLACH

GUNDLACH EQUIPMENT OPERATING SAFETY INSTRUCTIONS

(cont.)

Operator safety and the safety of others depend upon reasonable care and judgment in the operation of this Gundlach equipment. A careful operator is good insurance against an accident.

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We recommend that a preventative maintenance program be adopted.

Basic rules regarding safety in and around Gundlach equipment are outlined in the following list of DO NOTs.

DO NOT

1. DO NOT use any smoking materials or have an open flame near the crusher and drive components for risk of explosion.
2. DO NOT remove drive guards unless the Gundlach equipment is electrically locked out.
3. DO NOT operate the crusher without the feed hopper and discharge hopper installed and properly sealed.
4. DO NOT attempt to clear the Gundlach equipment when operating. Always disconnect and electrically lockout motor(s) first.
5. DO NOT look into the crushing chamber when the Gundlach equipment is in operation.
6. DO NOT insert hands, feet or other body parts into the drive of Gundlach equipment when operating.
7. DO NOT start the Gundlach equipment while loaded, unload before starting.
8. DO NOT allow uncrushable objects to enter the Gundlach equipment.
9. DO NOT use the Gundlach equipment for any purpose other than the original specified use.
10. DO NOT operate Gundlach equipment in the wrong direction of rotation (except as described in the restart procedures).
11. DO NOT start Gundlach equipment unless the personnel in the immediate area are notified.

LOCKOUT / TAGOUT

GUNDLACH EQUIPMENT CORPORATION

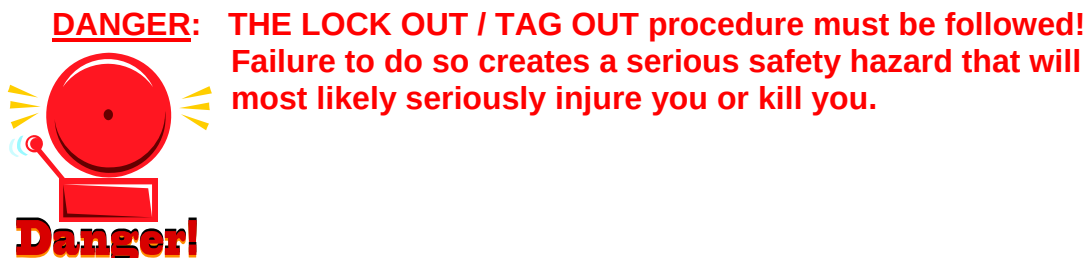
Lock Out/Tag Out Safety Information

TO USERS: Every person working on equipment should have his own locks & tags. **Lock Out** and **Tag Out** the equipment whenever maintenance work, inspect work, or any other operation is performed that would require any part of the machine to be open.

Prior to doing any of the types of work or other operations listed above, the user of this equipment is responsible for taking the following steps:

- Step 1.0** **LOCK OUT** the Electrical Control Panel with **LOCK OUT** locks. Mark the **TAG OUT** tags and install. Separate the lockout keys from the **LOCK OUT** locks during the time work is being done.
- Step 2.0** Remove all locks and tags after the work is completed and store the locks, keys, and tags for future use. No lock should be cut off.
- Step 3.0** Check to make sure all doors, covers, guards opened or removed during the work time are in place or closed.
- Step 4.0** Check to make sure tools used during the work are removed from the equipment.
- Step 5.0** Check to see that all personnel are clear of the equipment before starting equipment. Before releasing materials to the equipment, allow ten minutes running time.
- Step 6.0** Make sure equipment is set properly for product sizing.

NOTE: The owners, users, or operators of this equipment may have procedures that require additional steps to be taken when work is being done on the equipment. The instructions given here should be considered the minimum requirements for a LOCK OUT / TAG OUT procedure.



GUNDLACH

GUNDLACH EQUIPMENT OPERATING SAFETY INSTRUCTIONS

EXPLOSION WARNING!



THIS IS NOT AN EXPLOSION PROOF UNIT!

TO USERS:

If the material being processed in this machine has a risk of explosion, an explosion suppression system must be installed.



INSTALLATION INSTRUCTIONS

GUNDLACH

INSTALLATION INSTRUCTIONS STANDARD SINGLE AND DOUBLE ADJUSTABLE CRUSHERS WITH GEARBOX OR TWO MOTOR DRIVE

NOTE: Be sure to wear the proper safety equipment such as safety glasses, safety shoes, hard hats and ear protection at all times while near the equipment.

Caution: Do not perform any work or cleaning until all components have come to a complete stop and all energy sources are isolated and at a zero energy state. Observe all warning labels.

1.0 ATTACHING FEED OR DISCHARGE CHUTES

When attaching a feed or discharge chute, we recommend you bolt to the housing or base frame respectively, using the holes provided on the housing flange and the holes in the base frame. Welding to the crusher may cause distortion, resulting in failure of the moving parts. Chutes should be self-supporting units, not dependent on the crusher for support.

2.0 GEARBOX ASSEMBLY (OPTIONAL)

Before placing crusher in operation, check oil level in the gearbox (es). Check oil level by removing the plug in the top of the tee, (the oil level should be visible in the neck of tee). If oil is required, see Lubrication Section of your manual for type and quantity; do not overfill.

3.0 SECONDARY DRIVE ASSEMBLY (OPTIONAL – DOUBLE STAGE UNITS)

The Secondary Drive Assembly on some Crushers has a visible reservoir drop feed oiler for chain driven Secondary. The oiler should be filled with lubricant specified in Lubrication Section of this manual. The flow rate of the oiler, when in operation, should be one (1) drop per minute. The flow is regulated by the needle valve and friction lock on the bottom of the reservoir. A shut off toggle on the bottom of the reservoir starts or stops flow. When toggle is in up position, the oil is allowed to flow to the chain oiler.

Refer to the Lubrication and Secondary Drive Sections for information.

The Secondary Drive Assembly on some Crushers is an oil bath type for the chain driven Secondary, which requires the box to be filled with the correct lubricant and quantity. Check oil level by removing the plug in the top of the ell. Refer to the Lubrication and Secondary Drive Sections for information.

The Secondary Drive Assembly on some Crushers is driven with a Cog Style Belt. Refer to Secondary Drive Section for information.

GUNDLACH

4.0 GREASING

Your crusher has been serviced before leaving the factory and is ready for immediate installation. If the crusher is allowed to sit for three (3) months or longer, it is advisable to re-grease entire assembly. The type of lubrication and points of lubrication are specified in the Lubrication Section of this manual.

5.0 MAINTENANCE AREA

In the event of future maintenance on your crusher (changing gearbox parts, rolls, and bearings), we recommend leaving 48" (1200 mm) clear area around the front and both sides of the crusher. If it is necessary to locate other equipment in this area, we suggest bolted construction, so these items can be removed when you work on the crusher.

6.0 HOISTING

A drawing is enclosed showing the designated points to attach hook or chain. Never lift unit by handles attached to hopper. (Plate XXX for Single Stage Crushers – Plate XXX for Double Stage Crushers). Extreme care must be exercised when hoisting the crusher. If the gearbox(es) are given any bumps or sharp blows, it may cause external or internal damage, resulting in failure of the assembly.

Reminder: Look for lifting point identification safety labels and use safe lifting practices when lifting the unit and unit drive components.

7.0 V-BELT DRIVE INSTALLATION

Refer to the TB Woods installation instructions located in the Drive & Guard section of this manual.



OPERATION AND CONTROL PHILOSOPHY – ROLL CRUSHERS

STANDARD OPERATION

Standard operation refers to the “normal production” mode. It does not refer to maintenance or repair procedures. Note that start and stop (shutdown) sequences for GEC Roll Crushers involve events related to other pieces of equipment that are not supplied by GEC. It is very important that the Customer and the Customer’s Engineers understand the relationship between GEC’s Roll Crushers and the systems (supplied by Others) that are used to feed material into and discharge material from the crushers. GEC does not supply or design process control systems, but provides this Operating and Control Philosophy summary to aid the Customer and the Customer’s Engineers.

It is very desirable for a Tramp Metal Magnet and a Metal Detector to be installed as part of the Customer’s feed system and be interlocked such that the feed system is stopped if metal is detected. Metal must be removed to the greatest extent possible, to prevent it from entering the crusher and potentially causing damage to the crusher and/or a possible shutdown.

Before starting the crusher, ensure that the machine has been properly lubricated, all inspection doors are secured in the closed position, all guards are secured in place, and all personnel are located a safe distance from the machine. Additionally, do not start the crusher under a load (head) of material.

For equipment not supplied by GEC (e.g. the feed and discharge systems), follow all instructions from the manufacturer(s) of those systems regarding starting, stopping, and general operation.

Start Sequence

1. Start the product discharge system and any other downstream product handling equipment (supplied by Others). The discharge system must be running in its steady-state, normal mode of operation, prior to proceeding with the next step.
2. Depending on the number of motors used to drive the crusher, start the crusher motor(s) as follows:
 - a. For crushers with a 1-motor drive, start the motor.
 - b. For crushers with a 2-motor drive:
 - i. Start the motor connected to the “stationary” roll(s).
 - ii. After a 20 second time delay, start the motor connected to the “adjustable” roll(s).
 - c. For crushers with a 4 motor drive:
 - i. Start the motor connected to the lower stage stationary roll.
 - ii. After a 20 second time delay, start the motor connected to the lower stage adjustable roll.
 - iii. After a 20 second time delay, start the motor connected to the upper stage stationary roll.
 - iv. After a 20 second time delay, start the motor connected to the upper stage adjustable roll.
3. After a 20 second time delay, start the upstream feed system (supplied by Others) in order to begin feed of material to the crusher.



OPERATION AND CONTROL PHILOSOPHY – ROLL CRUSHERS

Note: Final adjustment of the start delay times, if needed, to be made during commissioning.

Normal Stop (Shutdown) Sequence

1. Stop the feed system. There must be no possibility of additional feed material entering the crusher, prior to proceeding with the next step. This amount of time should be determined by the Customer.
2. After a 30 second delay, stop all crusher motors. (For crushers with multiple motors, all motors may be stopped simultaneously.) Note that due to inertia, the rolls, drive components, and motors will still rotate for a significant amount of time (typically between 1 and 15 minutes) after power to the motors has been removed.
3. Allow the product discharge system sufficient time to carry away any product remaining in the system. This amount of time should be determined by the Customer, but in general, should not be less than the amount of time required for the crusher to come to a complete stop. After this period of time has passed, stop the discharge system.

Note: Final adjustment of the shutdown delay times, if needed, to be made during commissioning.

Emergency Stop (Shutdown) Sequence

1. There are essentially two options for an Emergency Stop Sequence.
 - a. *Immediately stop all crusher motors, and the feed system. Discharge system continues to run until shut down separately.*
 - i. Advantages
 1. Processed material will not buildup between the crusher and the discharge system.
 - ii. Disadvantages
 1. Unprocessed feed material may buildup between the feed system and the crusher. This material will need to be removed prior to restarting the crusher.
 2. Some product that is out of specification may enter the discharge system. (Depending on the reason for the shutdown.)
 3. A full shutdown of feed/crushing/discharge equipment is not achieved. A separate shutdown for the discharge system would be required.
 - b. *Immediately stop all crusher motors, the feed system, and the discharge system.*
 - i. Advantages
 1. A full shutdown of feed/crushing/discharge equipment is achieved.
 2. The probability of out of specification product entering the discharge system is reduced.
 - ii. Disadvantages



OPERATION AND CONTROL PHILOSOPHY – ROLL CRUSHERS

1. Unprocessed feed material may buildup between the feed system and the crusher. This material will need to be removed prior to restarting the crusher.
2. The part of the system between the crusher and the discharge system may experience a buildup of product material. This material will need to be removed prior to restarting the crusher.
2. It is the Customer's decision whether to use option 1a or 1b for an Emergency Stop Sequence.

Other Interlocks and Notes

Summary of warning and shutdown setpoints for instrumentation (if supplied)

1. Speed Sensor
 - a. Warning: 5% under nominal RPM
 - b. Shutdown: 10% under nominal RPM
2. Bearing Temperature Sensor
 - a. Warning: 160 F (72 C)
 - b. Shutdown: 180 F (83 C)
3. Auto Lubrication System Controller
 - a. Warning: When "General Fault" output is tripped
 - b. (There is no Shutdown level associated with the Auto Lubrication System Controller)

At any Warning level, the Customer's personnel should immediately investigate the cause of the warning condition.

The following conditions should trigger an Emergency Stop (Shutdown) Sequence.

1. The discharge system fails (stops carrying away product from the crusher).
2. Any of the crusher motors stop, for any reason.
3. An Emergency Stop (E-Stop) button is pressed (E-stop buttons and control system provided by Others.).
4. A speed sensor (if supplied) indicates that any roll is running 10% under nominal RPM.
5. A bearing temperature sensor (if supplied) indicates that any bearing has a temperature of 180 F (83 C) or higher.

For maintenance purposes only, the Customer may allow start-up of the Roll Crusher motors individually, without other equipment operating, and/or allow other equipment to operate without the Roll Crusher motors operating.

ALWAYS FOLLOW ALL SAFETY PROCEDURES, AND PAY SPECIAL ATTENTION WHEN OPERATING THE ROLL CRUHSER DURING "MAINTENANCE" CONDITIONS.

GUNDLACH

CRUSHER

START-UP AND OPERATION INSTRUCTIONS

Start-Up Procedure

- 1.0 Clear the inside of the crusher of any material prior to starting as the crushers must be started empty.
- 2.0 If the crusher is fed by a conveyor belt, check the belt to make sure that there is no tramp or foreign objects that could be conveyed to the crusher.
- 3.0 Check the oil levels in the secondary drive box and the gearboxes to make sure they have an adequate supply of oil, if applicable.

Refer to the lubrication section for further details.

Note: We recommend that the crusher bearing seals be lubricated every eight hours of operation under normal operating conditions and more frequently under severe conditions. The bearings should be greased once a week (or approximately 170 hours of operation) while the machine is running.

- 4.0 Check all moving parts for freedom of operation and clear any obstructions.
- 5.0 On GUNDLACH Crushers, the front rolls are adjustable either through a screw type (manual adjustment) or hydraulic cylinder (nitrogen/oil adjustment).
 - 5.1 On a screw type (manual adjustment) crusher, you adjust the rolls by inserting the adjustment rod in the holes provided in the hand wheel sprockets located just behind the adjustment screw cover on the front of the crusher. By turning the adjustment rod either clockwise or counterclockwise, you can open or close the roll.
 - 5.2 On crushers equipped with the nitrogen/oil adjustment assembly, the roll adjustment is achieved by means of a hand operated hydraulic pump and control valves located on the crusher. By pumping fluid into the hydraulic cylinder, you can open the rolls and by releasing fluid from the cylinders you can close the rolls.
 - 5.3 On some crushers, the adjustable roll is moved with a non-running adjustment. The crusher must be shut down, locked out, staged out to physically loosen belts on the bearing blocks to move the roll.
 - 5.4 Example: When fully closed, the hook tooth rolls (normally the upper rolls in the two stage crusher) will make a 2" product and the pocket tooth rolls (normally the lower rolls in a two stage crusher) will make a ¾" product. Set upper rolls to produce a product approximately three (3) times larger than the size you wish to produce from the lower rolls. (End product size.)
- 6.0 If the crusher has been sitting idle for a period of time or if it is being started for the first time, it is advisable to turn the rolls over by hand prior to starting to make sure that everything is running freely. This can be accomplished by rotating the driven sheave or flywheel. Also, bump motors and check direction of rotation of rolls.
- 7.0 Start crusher and check product size. Although the rolls have been preset, further roll adjustment might be necessary. After the rolls have been set, mark the setting on the gauge for future reference.

GUNDLACH

CRUSHER

START-UP AND OPERATION INSTRUCTIONS

Operation Instructions

- 1.0 Check the product size periodically to be sure that you are getting the desired product. Once the initial roll setting has been made, however, it is not normally necessary to readjust the rolls. Readjustment should be done when the rolls are worn sufficiently enough to change the product size or if your desired product size must be changed. Excessive roll wear is indicated when you no longer are able to obtain the design capacity.
 - 1.1 Check the flow of the feed to the crusher. It should be uniform and should be spread evenly as possible across the length of the rolls. Too much concentration of feed in one spot will cause them to wear excessively and reduce capacity.
- 2.0 Your GUNDLACH Crusher has been designed to give you a long period of service with a minimum amount of maintenance. When performing routine maintenance to the crusher, please consult your service manual for the proper procedures and possible trouble shooting suggestions. If further assistance is required from the factory, please contact the service manager at the following location and be sure to give the crusher serial number when requesting any information regarding your crusher: Service Manager

GUNDLACH

CRUSHER

UPSET CONDITION / RE-START PROCEDURES

Gundlach recommends that the crusher be started empty under normal operating conditions. If the crusher does shutdown due to power loss or other abnormal conditions and there is material in the housing, the following procedure should be followed:

- 1.0 Stop all feed material from entering the crusher.
- 2.0 Correct the cause of the abnormal condition before attempting to re-start the crusher.
- 3.0 Using the local switch, reverse the crusher motor and operate the rolls in the reverse direction for 15 seconds to dislodge any material between the rolls.
- 4.0 Allow the rolls to stop rotating, and then start the crusher motor in the forward direction. If crusher does not start, repeat the above steps.
Caution: See note below concerning motor starting.
- 5.0 If crusher still will not start, increase the distance between the rolls by operating the adjustment system and then repeat steps two and three. Refer to instructions in the Adjustment / Alignment Section of this manual for adjusting the rolls.
- 6.0 After crusher has been started, adjust rolls to the original position to obtain desired product size.

NOTE: Per NEMA MG1 standard for motors, the motor may only have 1 hot start OR 2 cold starts per hour.

GUNDLACH

CRUSHER

PROCEDURE FOR LONG TERM STORAGE EXCEEDING THREE (3) MONTHS

Units should be stored indoors - Climate controlled is preferred

1.0 **BY MANUFACTURER**

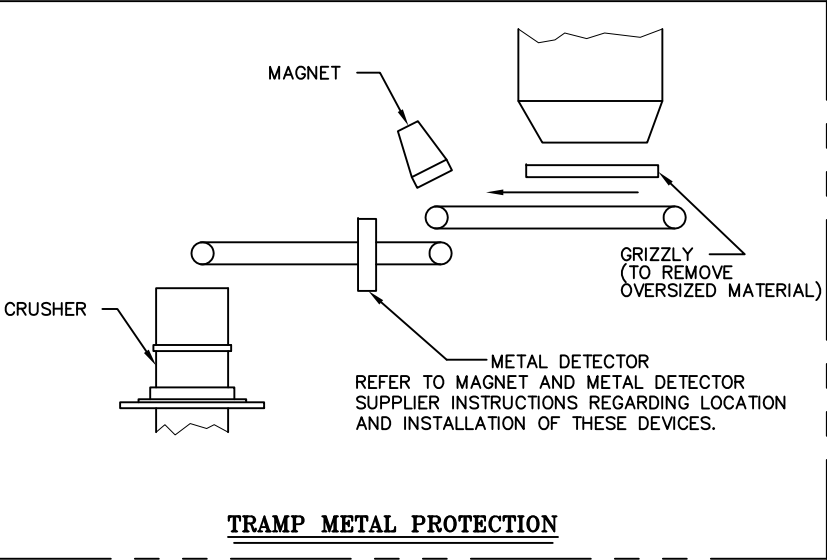
- 1.1 Pack all bearing housings full of grease.
- 1.2 Cover all unpainted surfaces with one year protective coating: Mobilarma 247 or equivalent.
- 1.3 Cover the housing with weather proof plywood.
- 1.4 On Hydraulic adjustable crushers, cover the exposed cylinder rod with one year protective coating: Mobilarma 247 or equivalent.
- 1.5 Add one quart of VCI #105* (Volatile Corrosion Inhibitor) to enclosed gearboxes and to secondary drive box (if oil bath type).

2.0 **BY CUSTOMER**

- 2.1 While the crusher is being stored or is not in operation:
 - 2.1.1 Rotate the drive shaft(s) several revolutions a minimum of once per month to distribute lubricant to the bearings, gears, and secondary drive chains to prevent possible corrosion damage.
 - 2.1.2 Check the coating on the painted and unpainted surfaces and recoat if necessary.
 - 2.1.3 Every 12 months, add one quart of VCI #105 (Volatile Corrosion Inhibitor) to the enclosed gearboxes and to the secondary drive box (if oil bath type).
- 2.2 Prior to start-up:
 - 2.2.1 Purge the bearings with new grease to remove the old grease. (Not Applicable when Taconite seals are used, See Lubrication and Bearing Sections)
 - 2.2.2 Drain the oil from the gearboxes and secondary drive boxes and fill to proper level with new oil.
 - 2.2.3 If crusher is equipped with a central manual lube system, remove grease and add new grease.
 - 2.2.4 If crusher is equipped with a pneumatic or electric greasing system, this system will not have grease in the lines or the pump. Only the bearings, seals, bushings and slides will have been greased. The entire system will need to be filled with grease and tested. The injectors will also need to be set.
 - 2.2.5 If crusher is equipped with hydraulic adjustment system, drain the hydraulic oil from the reservoir and fill to proper level with new oil. Also clean all protective coating off of the exposed cylinder rods.

*VCI #105 is a product of Daubert Chemical Company, Inc., Oak Brook, Illinois

Failure to follow long term storage procedures may cause a disallowance of certain warranty claims.

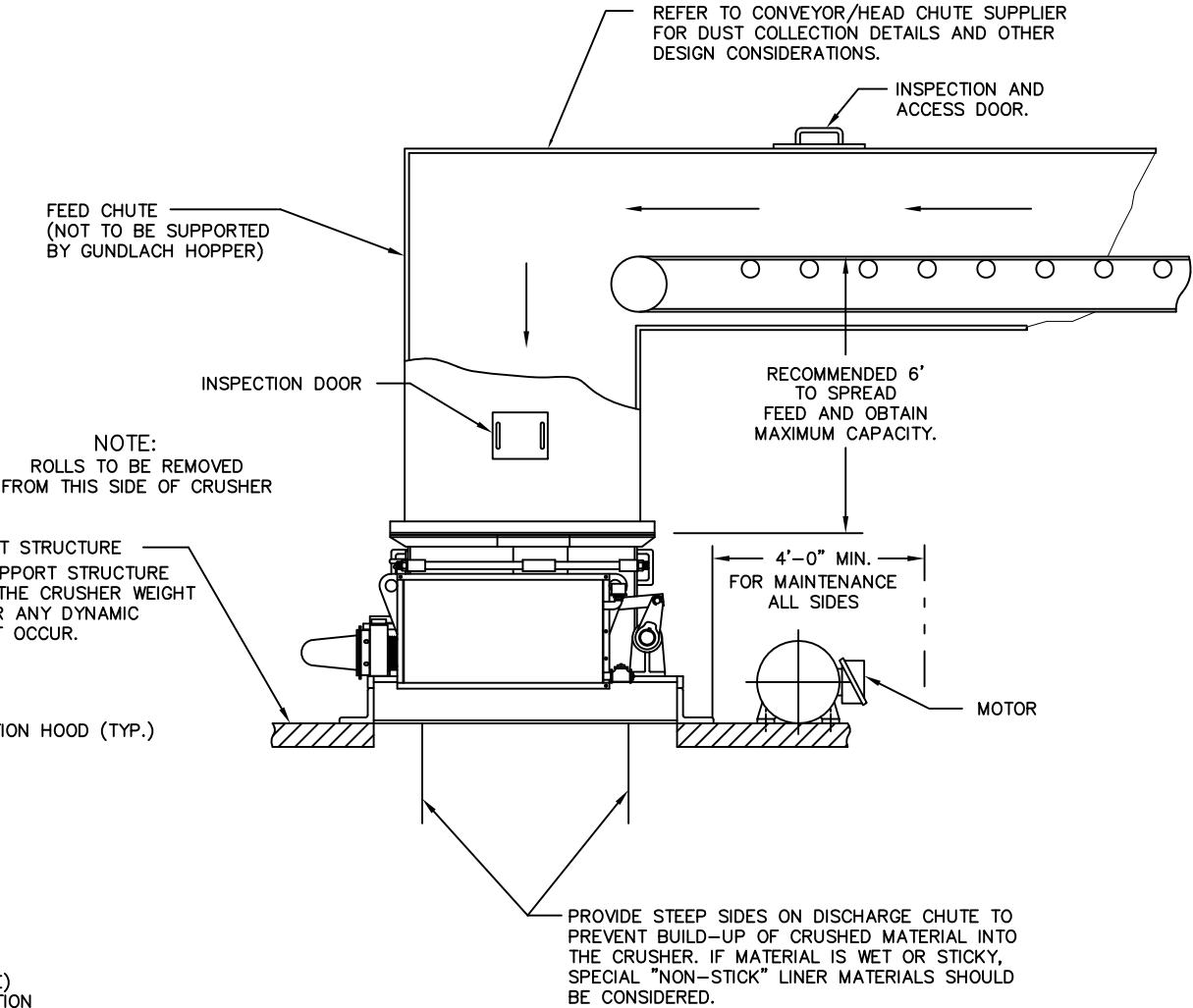
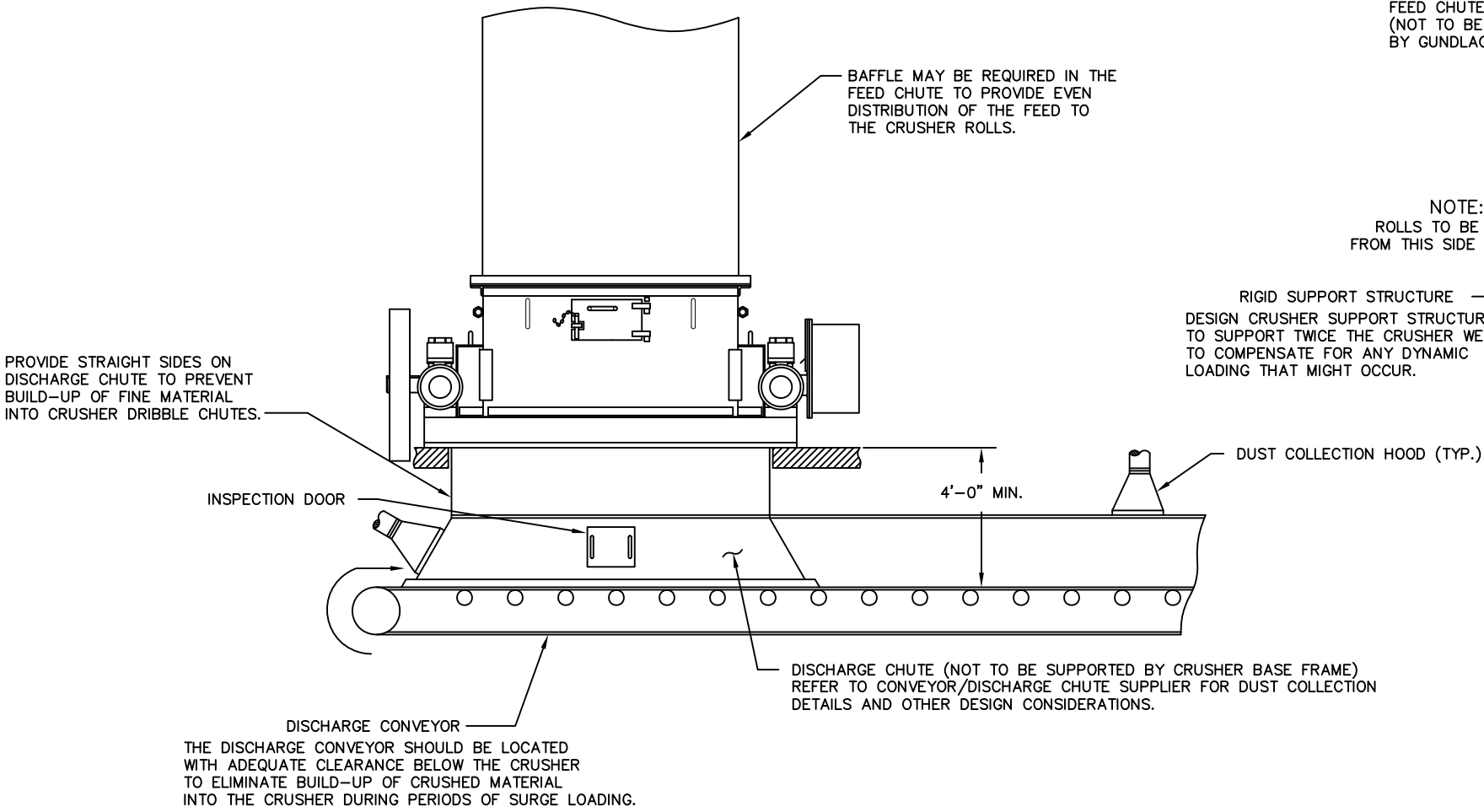
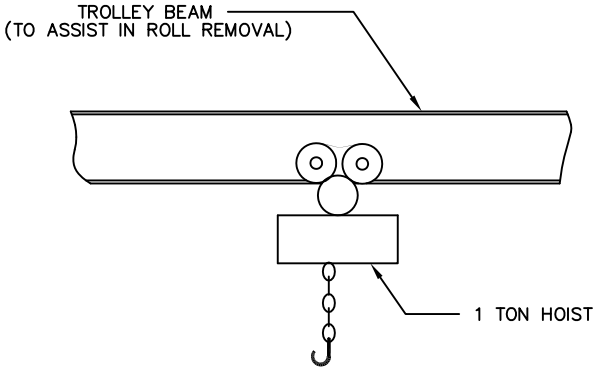


- NOTES—
- 1) THIS IS A STANDARD SUGGESTED INSTALLATION DRAWING. IT IS NOT CUSTOMIZED FOR EACH UNIT, THEREFORE SPECIFIC OPTIONS FOR A CUSTOMER'S PARTICULAR UNIT MAY NOT BE SHOWN.
- 2) THIS DRAWING IS SUPPLIED FOR REFERENCE PURPOSES ONLY. IT IS NOT SUPPLIED FOR REVIEW/APPROVAL.



© **GENERATED AIRFLOWS FOR
2000S SERIES ROLL CRUSHERS**

ROLL LENGTH IN.	SCFM	nm ³ /hr
20	500	850
30	750	1,275
40	1,000	1,700
50	1,250	2,125
60	1,500	2,550



FOR REFERENCE ONLY

Information on this drawing is proprietary and confidential

Details contained hereon shall not be used for the purpose of fabricating, machining or processing in any manner to produce a part or assembly, and the drawing cannot be reproduced without the express written permission by an authorized officer of GUNDLACH EQUIPMENT CORPORATION, Belleville, IL, U.S.A., without incurring infringement liability.

**LEFT HAND DRIVE CRUSHER SHOWN
RIGHT HAND DRIVE CRUSHER OPPOSITE**

ITEM	QTY.	PART NO.	DESCRIPTION
TOLERANCES UNLESS NOTED			
DECIMAL			
FRACTIONAL			
ANGULAR			
MATERIAL			
SCALE			
DRAWN BY G. McBRIDE			
APPROVED BY			
TITLE			
2000S CRUSHER SUGGESTED INSTALLATION			
DATE			
DRAWING NUMBER			
07-18-80			
D0-1105-00			

REVISION	DATE	BY	NEXT ASSEMBLY
ADDED GEN. AIRFLOW CHART	08-29-80	ALB	
GENERAL REVISIONS	10-07-80	WA	
REDRAWN PER SAME No.	3-16-80	GM	

CAD DWG. No.

SUPERSEDES

ITEM	LOAD	DESCRIPTION OF LOAD	FREQUENCY	DIR	LOCATION OF LOADS					
					ZONE A			ZONE B		
					X	Y	Z	X	Y	Z
I	SELF WEIGHT	SEE DRAWING NOTES	STATIC	+						
				-		2700 lbf (12.01) kN			2700 lbf (12.01) kN	
II	BELT PULL	BELT PULL AT MAXIMUM MOTOR POWER	STATIC	+			489.7 lbf (2.18) kN			489.7 lbf (2.18) kN
				-		17.1 lbf (0.08) kN	0		17.1 lbf (0.08) kN	0
III		ESTIMATED FORCE OF MATERIAL ENTERING MACHINE	300 RPM (5) Hz	+		5.1 lbf (0.02) kN			5.1 lbf (0.02) kN	
				-						
IV	NORMAL VIBRATION	MAXIMUM ESTIMATED VIBRATION DUE TO IMBALANCE DURING NORMAL OPERATION	300 RPM (5) Hz	+	3.6 lbf (0.02) kN	17.9 lbf (0.08) kN	17.9 lbf (0.08) kN	3.6 lbf (0.02) kN	17.9 lbf (0.08) kN	17.9 lbf (0.08) kN
				-	3.6 lbf (0.02) kN	17.9 lbf (0.08) kN	17.9 lbf (0.08) kN	3.6 lbf (0.02) kN	17.9 lbf (0.08) kN	17.9 lbf (0.08) kN
V	ABNORMAL VIBRATION	OCCURS WHEN UNCRUSHABLE MATERIAL ENTERS MACHINE	IMPULSE	+	14.3 lbf (0.06) kN	71.7 lbf (0.32) kN	71.7 lbf (0.32) kN	14.3 lbf (0.06) kN	71.7 lbf (0.32) kN	71.7 lbf (0.32) kN
				-	14.3 lbf (0.06) kN	71.7 lbf (0.32) kN	71.7 lbf (0.32) kN	14.3 lbf (0.06) kN	71.7 lbf (0.32) kN	71.7 lbf (0.32) kN
VI	FIRST STAGE TRAMP RELIEF	OCCURS WHEN UNCRUSHABLE MATERIAL ENTERS MACHINE	IMPULSE	+		0	1660 lbf (7.38) kN		696.4 lbf (3.1) kN	1660 lbf (7.38) kN
				-		696.4 lbf (3.1) kN	0		0	0
VII	EQUIVALENT STATIC ONLY LOAD	STATIC LOADS FOR SIMPLIFIED STRUCTURE DESIGN	STATIC	+	810 lbf (3.6) kN		1245 lbf (5.54) kN	810 lbf (3.6) kN		1245 lbf (5.54) kN
				-	810 lbf (3.6) kN	1350 lbf (6) kN	1245 lbf (5.54) kN	810 lbf (3.6) kN	1350 lbf (6) kN	1245 lbf (5.54) kN

THROUGHPUT	44 STPH (40) MTPH
MATERIAL BULK DENSITY	0.02 lbs/in3 (0.56) MT/m3
ASSUMED SUSPENSION PRESSURE	200 PSI (1379) kPa
ROLL RPM	300 RPM
MOTOR HP	20 HP (15) kW
MOTOR RUNNING TORQUE	105 lb-ft (142) Nm
MOTOR RPM	1000 RPM

LOADING COMBINATIONS

NORMAL OPERATION = I + II + III + IV

TRAMP EVENT OPERATION = I + II + III + VI

EQUIVALENT STATIC ONLY DESIGN METHOD = I + VII

EQUIVALENT STATIC-ONLY LOADS IGNORE ALL DYNAMIC AND BELT PULL LOADS. THEY ARE BASED ON SAFETY FACTORS APPLIED TO THE SELF WEIGHT AS FOLLOWS:

- X = 0.3 X SELF WEIGHT
- Y = 0.5 X SELF WEIGHT
- Z = FIRST STAGE TRAMP EVENT

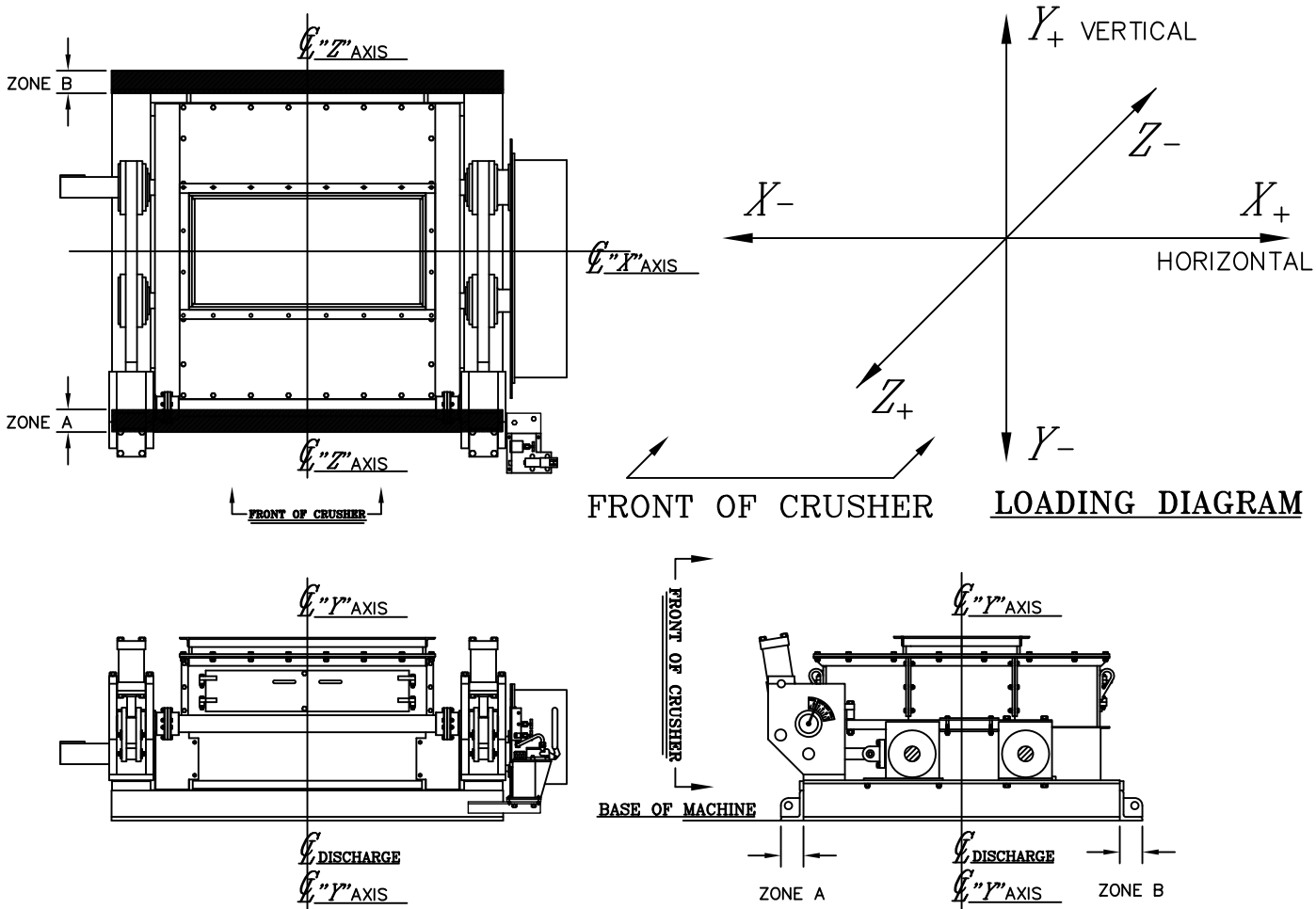
NOTES-

1. ALL LOADS ARE TRANSFERRED TO THE CUSTOMER SUPPORT STRUCTURE THROUGH THE BASE OF THE MACHINE.
2. SEE THE ANCHOR, INLET, AND DISCHARGE DRAWING FOR MORE DETAILS ON THE MACHINE BASE.
3. VIEWS ARE FOR PICTORIAL REFERENCES ONLY, AND MAY NOT SHOW ALL OPTIONS.
4. START UP LOADS WILL NOT EXCEED OPERATING LOADS.
5. TYPICAL IMBALANCE PRESENT DURING NORMAL OPERATION INCLUDE UNEVEN FEEDING, UNEVEN WEAR, AND DAMAGE TO ROLL TEETH.
6. CUSTOMER MUST BE RESPONSIBLE FOR DETERMINING LOADS DUE TO MATERIAL BACK UP ABOVE CRUSHER IF ROLLS STOP TURNING.
7. INFORMATION ON THIS DRAWING IS CONSIDERED PRELIMINARY UNLESS STAMPED AND SIGNED CERTIFIED.
8. SELF WEIGHT LOAD INFORMATION INCLUDES:

YES	NO	
☒	☐	UNIT
☒	☐	MECHANICAL DRIVES
☐	☒	GUARDS
☐	☒	MOTORS
☐	☒	COMMON BASE

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GUNDLACH EQUIPMENT CORPORATION

BELLEVILLE, IL. U.S.A.

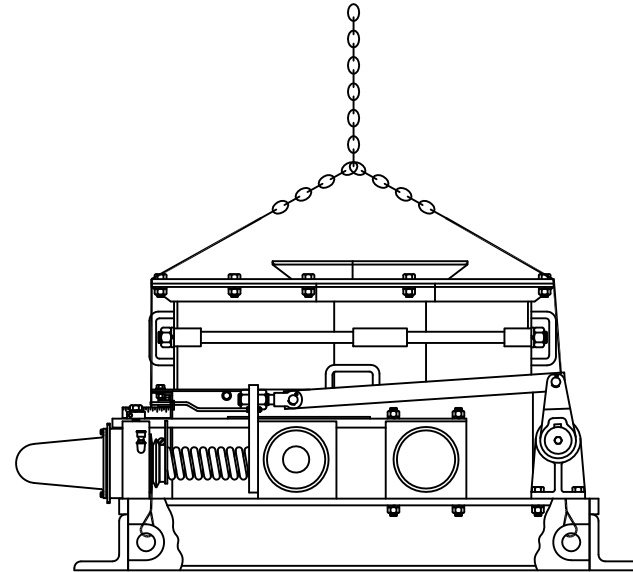
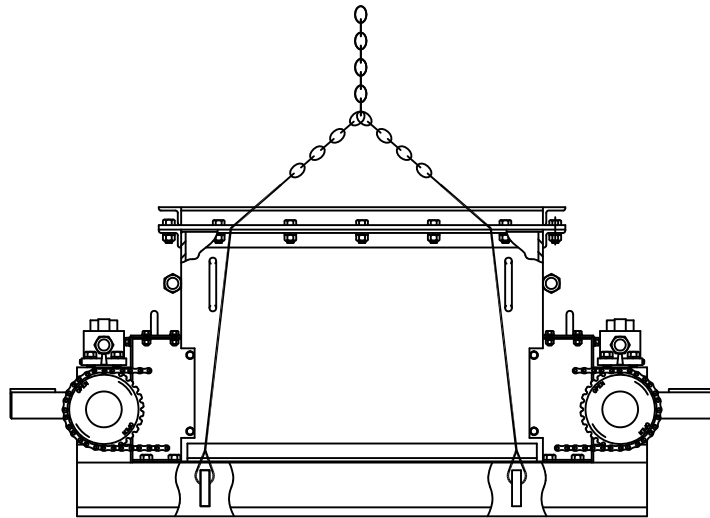
MACHINE SERIAL No. 29312A01, A02

CUSTOMER'S ORDER No. 20140716012

GEC USE ONLY	
☐	SENT FOR CUSTOMER REVIEW
☒ CERTIFIED BY GEC	
By <u>Charles Howard</u>	Date <u>AUG. 04, 2014</u>
CUSTOMER USE ONLY	
☐	APPROVED BY CUSTOMER, NO COMMENTS
☐	APPROVED BY CUSTOMER, SEE COMMENTS
☐	NOT APPROVED BY CUSTOMER, SEE COMMENTS
By _____	Date _____

ISSUED CERTIFIED.	08-04 CCS	SUPERSEDES	DATE
ISSUED FOR REVIEW.	07-14 CCS	DATE	BY
SYN.	REVISION	DATE	BY

ITEM	QTY.	PART NO.	DESCRIPTION
TOLERANCES UNLESS OTHERWISE SPECIFIED			
DECIMAL			
FRACTIONAL			
ANGULAR			
MATERIAL		SCALE	DRAWN BY MLR
		NONE	APPROVED BY PD
TITLE			
ROLL CRUSHER			
STATIC AND DYNAMIC LOADING			
DATE	DRAWING NUMBER		
06-10-14	SK2010-3059		



- 2) REFER TO GENERAL ASSEMBLY FOR^(A)
APPROXIMATE WEIGHT OF CRUSHER.
- 1) USE CHAIN OR CABLE OF SUFFICIENT
STRENGTH AS PER CRUSHER WEIGHT.

NOTES—

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○				
○				
○				
○				
(A)	REMOVED CHART AND ADDED NOTE 2	11-07	JWA	
SYM.	REVISION	DATE	BY	
	REVISION			

ITEM	QTY.	PART NO.	DESCRIPTION	
TOLERANCES (EXCEPT AS NOTED)			GUNDLACH GUNDLACH EQUIPMENT CORPORATION BELLEVILLE, IL, U.S.A.	
DECIMAL	---			
FRACTIONAL	---			
ANGULAR	---			
MATERIAL			SCALE	DRAWN BY JDT
			NONE	APPROVED BY <i>RA</i>
TITLE		2000S CRUSHER SPRING ADJ. HOISTING DRAWING (2 MTR-SPOOL PIECE)		
DATE		DRAWING NUMBER		
09-11-07		PLATE 530		



ORDERING INSTRUCTIONS

GUNDLACH

CRUSHER & CAGE PAKTOR

ORDERING INSTRUCTIONS FOR REPAIR PARTS

WHEN ORDERING REPAIR PARTS FOR YOUR GUNDLACH EQUIPMENT, PLEASE INCLUDE THE FOLLOWING INFORMATION:

-- **Crusher Serial Number** – This number can be found on the front cover of this Manual, on the housing name plate, and it's also stamped on the upper flange of the base; located on the gearbox side rear corner. (i.e. 3070D2496)

or

-- **Cage- Paktor Serial Number** – This number can be found on the front cover of this Manual, on the main cage nameplate, and it's also stamped on the base frame; located on the back corner. (i.e. 75B2C4R445)

and

- **Part Number and/or Part Name and Description**
- **Quantity Required**
- **Drawing or Plate Number where the Part is called out**

NOTE: When ordering Crusher Adjustment chains, specify type of chain and desired length; either by pitch or feet and inches.

There's an interactive form attached as a separate file to our Service Manuals. Once the Manual is open in Adobe, there is tab or paperclip labeled attachments located on the left side of the screen. This will show the attached file, **Parts Request Form**, and you will have the ability to save this file.

There are several options that can be used to forward your Parts Request. The form has "buttons" located at the bottom of the page. Once the form is filled out, these buttons allow you to either print or email the form and its contents. If you choose to use the "Print" option, the form can be faxed or mailed. The "Email" option sends the completed form directly to our Customer Service Department.

Be sure to print the **completed** form for your records if you choose the Email option.

You cannot save the completed form in Adobe Reader

GUNDLACH EQUIPMENT CORPORATION

MAIL TO:

PO Box 385
Belleville, IL. 62222

PHONE: 618-233-7208
314-436-1881

TOLL FREE (US): 1-877-GUNDLACH

SHIP TO:

1 Freedom Drive
Belleville, IL. 62226

FAX: 618-641-6974

E-MAIL: parts@gundlachcrushers.com

Ask for Customer Service Department



Customer Service Representatives

We would like to introduce you to the following Customer Service Representatives that are here to help you.



Senior Customer Service Rep (Certified) -Parts
Deb Wilburn

Toll Free Number: 877/486-3522

Parts Hotline: 618/641-6973

Fax: 618/641-6974

Email: dwilburn@gundlachcrushers.com



Senior Customer Service Rep (Certified) -Parts
Jody Jordan

Toll Free Number: 877/486-3522

Parts Hotline: 618/641-6973

Fax: 618/641-6974

Email: jjordan@gundlachcrushers.com

GUNDLACH

One Freedom Drive, Belleville, Illinois 62226 USA

Phone (618) 233-7208 - Fax (618) 233-6154

Toll Free 1-877-GUNDLACH

GUNDLACH

Service Engineers

We would like to introduce you to the following Customer Field Service Engineers that can help you with the technical aspects of your unit, including site repairs, inspection of the unit, and can supervise and assist contractors.



Service Engineer: Mark Knobeloch
Toll Free Number: 877/486-3522
Cell phone: 618/795-4033
Fax: 618/641-6974
Email: mknobeloch@terrasource.com



Service Engineer: Harold Steiding
Toll Free Number: 877/486-3522
Direct Line: 740/643-0370
Cell phone: 304/633-2476
Fax: 704/6430377
Email: hsteiding@gundlachcrushers.com

GUNDLACH

*One Freedom Drive, Belleville, Illinois 62226 USA
Phone (618) 233-7208 Fax (618) 233-6154
Toll Free 1-877-GUNDLACH*



RECOMMENDED SPARE PARTS

GUNDLACH

RECOMMENDED SPARE PARTS

2000S SERIES CRUSHERS

TWO MOTOR DRIVE

<u>DESCRIPTION</u>	<u>PART NUMBER</u>	<u>QUANTITY</u>
--------------------	--------------------	-----------------

Bearing Components

Main Bearing Unit	8100015	2
Slinger	A0-1020-0N	2

Adjustment & Alignment Assembly

Hydraulic Cylinder	2004006	1
(For Hydraulic Adjustment)		

Adjustment Chain	See Below	1
(For Manual Adjustment)		

<u>Size of Crusher</u>	<u>Part Number</u>	<u>Length of Adjustment Chain</u>
------------------------	--------------------	-----------------------------------

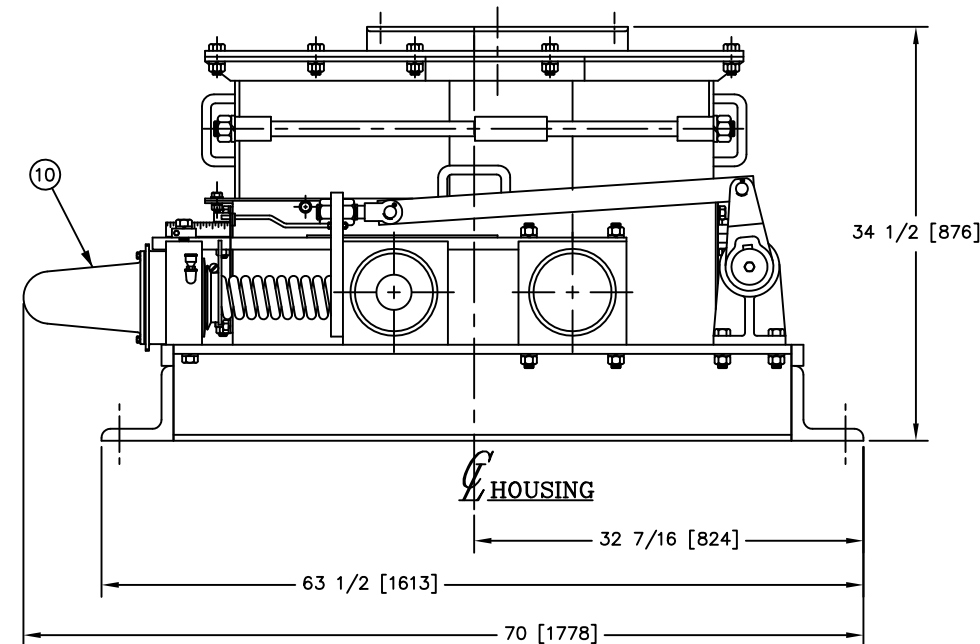
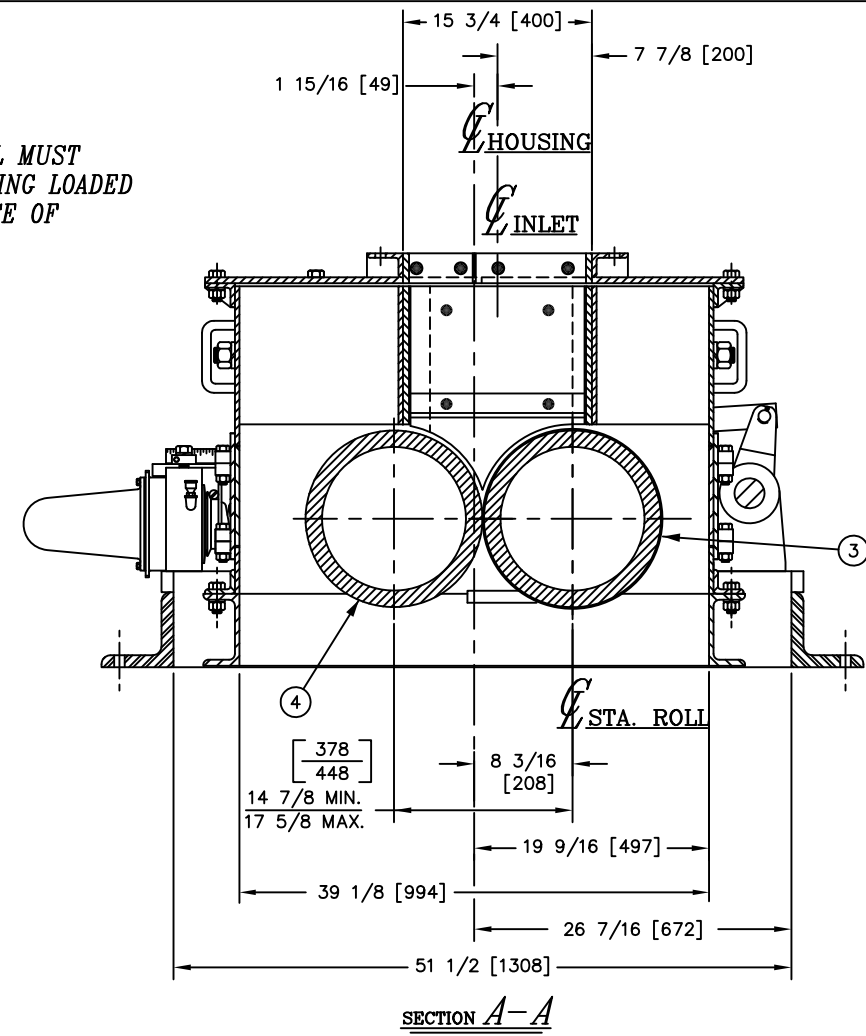
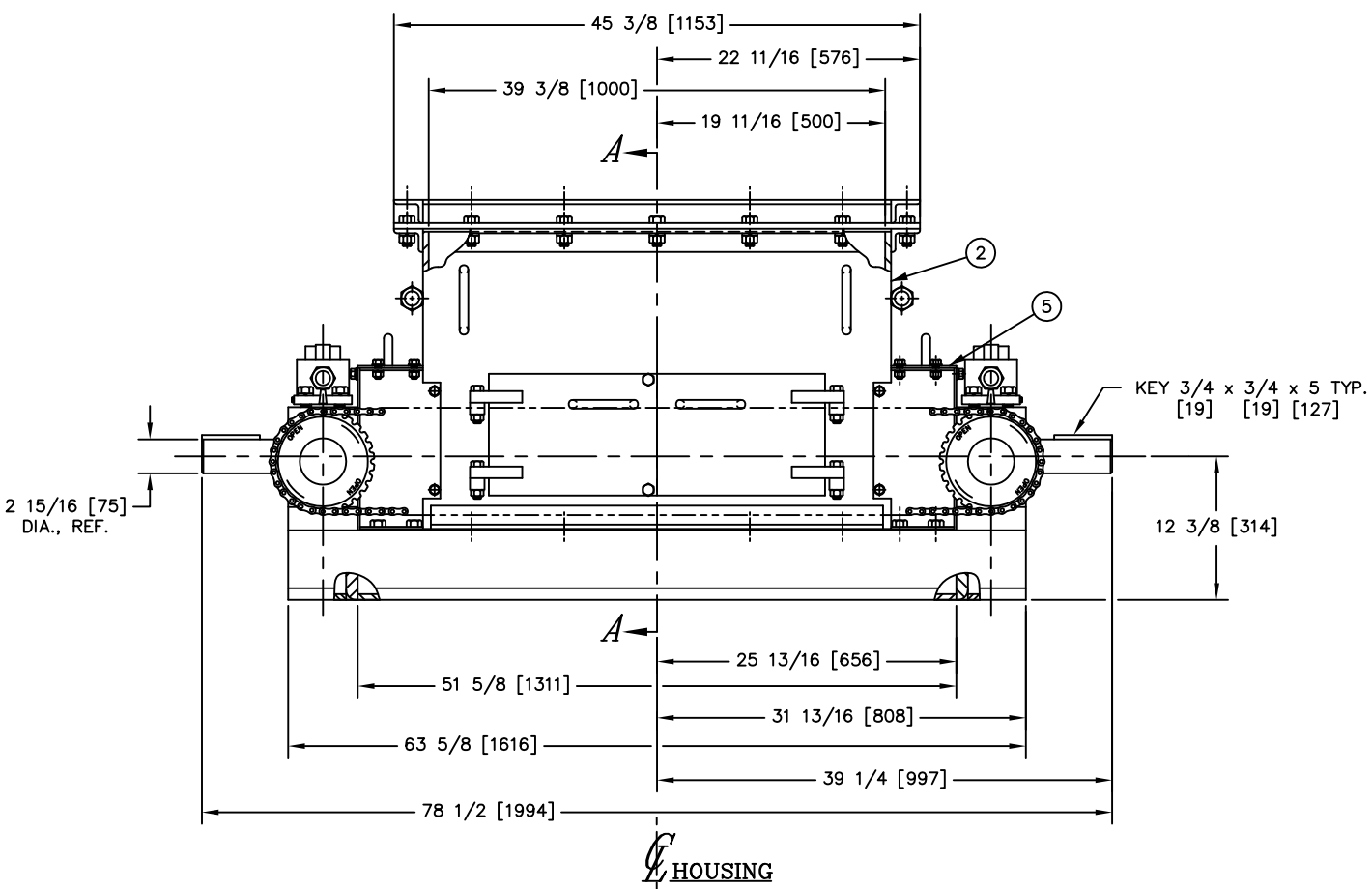
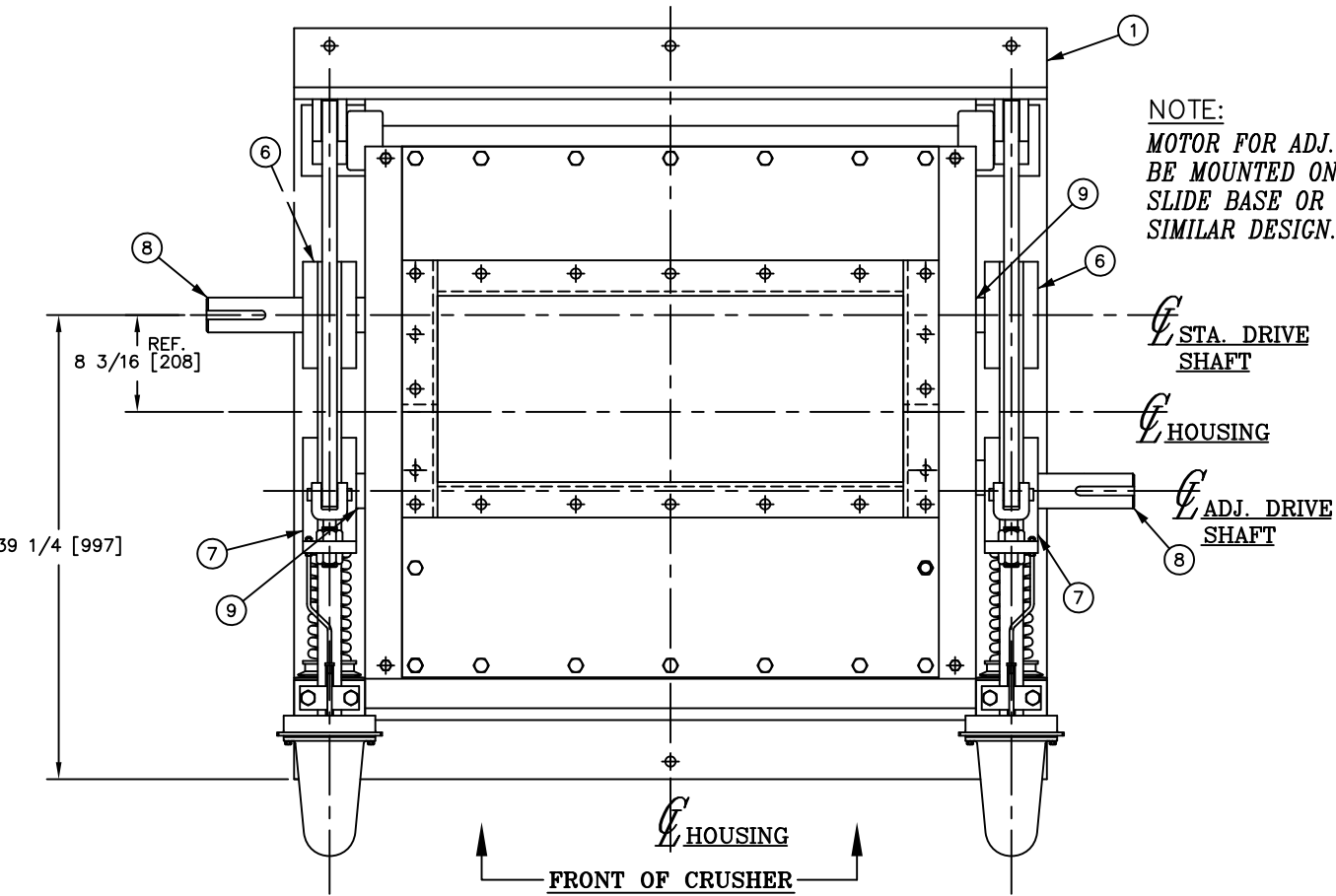
2020 [18]	59P1021	102 Pitches
2030 [27]	59P1221	122 Pitches
2040 [36]	59P1421	142 Pitches
2050 [45]	59P1621	162 Pitches
2060 [56]	59P1821	182 Pitches

Miscellaneous Parts

Roll Flange Line-up Bolt	A0-2068-0F	24
Roll Flange Nut	1M26101	24



ASSEMBLY DRAWINGS



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- NOTES—
- 1) DIMS IN BRKT'S ARE IN MMS.
 - 2) APPROX. WT. 5,400 LBS. — 2,449 KGS. DESIGN CRUSHER SUPPORT STRUCTURE TO SUPPORT TWICE THE CRUSHER WEIGHT TO COMPENSATE FOR ANY DYNAMIC LOADING THAT MAY OCCUR.
 - 3) SEE DWGS. D0-1105-00 & D0-3132-00 FOR SUGGESTED INSTALLATION & ANCHOR BOLT LOCATION.
 - 4) RIGHT-HAND DRIVE CRUSHER SHOWN
 - 5) INFORMATION ON DRAWING IS PRELIMINARY UNLESS STAMPED AND SIGNED CERTIFIED.

GUNDLACH EQUIPMENT CORPORATION

BELLEVILLE, IL. U.S.A.

MACHINE SERIAL No. 29312A01, A02

CUSTOMER'S ORDER No. 20140716012

****GEC USE ONLY****

☐ SENT FOR CUSTOMER REVIEW

☒ CERTIFIED BY GEC

By Charles Stund Date AUG. 04, 2014

****CUSTOMER USE ONLY****

☐ APPROVED BY CUSTOMER, NO COMMENTS

☐ APPROVED BY CUSTOMER, SEE COMMENTS

☐ NOT APPROVED BY CUSTOMER, SEE COMMENTS

By _____ Date _____

ITEM	QTY.	PART NO.	DESCRIPTION
10	1	D0-2079-H0	ADJ. ALIGN. ASSEMBLY
9	2	B0-1392-00	STUB SHAFT ASSEMBLY
8	2	B0-1389-00	MAIN DRIVE SHAFT
7	2	D0-0402-B0	ADJ. BEARING BLOCK ASSEMBLY
6	2	D0-0401-B0	STA. BEARING BLOCK ASSEMBLY
5	1	D0-1161-00	DRIBBLE CHUTE INSTALLATION
4	1	E204-0003-0BAD	ROLL ASSEMBLY - SMOOTH
3	1	E204-0053-000D	ROLL ASSEMBLY - HERRINGBONE
2	1	E203-0084-AACD	HOUSING ASSEMBLY
1	1	D0-1058-C0	BASE FRAME ASSEMBLY

TOLERANCES UNLESS NOTED	DECIMAL	ANGULAR	MATERIAL	ROLLS: SMOOTH & H-BONE YES COUPLING ADJ. ALIGN MANUAL	SCALE 1/8"=1"	DRAWN BY R. ALVEY
FRACTIONAL						

CAD DWG. No. CERT29312A01.dwg
DATE 08-04-08
SUPERSEDES 07-14-08
ISSUED FOR REVIEW 07-14-08
DATE 08-04-08
BY [Signature]
NEXT ASSEMBLY

TITLE 2040S CRUSHER (2040S2793)
GENERAL ASSEMBLY

DATE 09-04-07
DRAWING NUMBER D0-3360-00



LUBRICATION

GUNDLACH

ROLL CRUSHER

PREVENTATIVE MAINTENANCE

LUBRICATION

NOTE: Be sure to wear the proper safety equipment such as safety glasses, safety shoes, hard hats and ear protection at all times while near the equipment. Do not operate the crusher without feed hopper and discharge hopper installed and properly sealed.

1.0 DAILY (24 hours)

1.1 Central and automatic system.

- ▶ Check for leaks and hose damage.
- ▶ Make sure the pump reservoir has the proper level of grease and no signs of moisture.
- ▶ Check for material build up around bearings.

2.0 DAILY (24 hours)

2.1 Dual bulkhead system

- ▶ Checks for leaks or damaged hoses.
- ▶ Check for material build up around bearings.
- ▶ 4-6 pumps of EP-1 grease.
 - Except on Main Bearings where Taconite Seals are used.
 - Refer to Greasing Recommendations page.

3.0 WEEKLY (168 hours)

3.1 Automatic Lubrication System

- ▶ Cycle Lubrication Pump to verify Indicator Stem movement for each grease injector. See Lincoln Product Data pages.
- ▶ Verify the pump timer is cycling and is set per the operational data.

CAUTION: Always lockout & tagout machine if work or cleaning is performed.

GUNDLACH

RECOMMENDED LUBRICANTS

GEARBOX

BP	Energol GR-XP 150
CITGO	Citgear EP 150
CONOCO PHILLIPS	Philgear 150
GULF	EP Lube HD 150
IRVING	Gear Oil 150
MOBIL	Mobilgear 629
PENNZOIL	Super Maxol EP 150
SHELL	Omala Oil 150
TEXACO	Meropa 150
Petro - Canada	Enduratex EP 150

NITROIL ADJUSTMENT ASSEMBLY

Ambient Temperature Above 20°F (> -7°C)

BP	Energol HLP 46
CITGO	AW Hydraulic Oil 46
CONOCO PHILLIPS	Hydraulic AW 46
GULF	Harmony AWT 46
IRVING	Hydraulic 46
MOBIL	DTE 25
PENNZOIL	Pennzbell AW 46
SHELL	Tellus Plus 46
TEXACO	Rando Oil HD 46
Petro - Canada	Hydrex AW 46

Ambient Temperature Below 20°F (< -7°C)

BP	Energol HLP 32
CITGO	AW Hydraulic Oil 32
CONOCO PHILLIPS	Hydraulic AW 32
GULF	Harmony AWT 32
IRVING	Hydraulic 32
MOBIL	DTE 24
PENNZOIL	Pennzbell AW 32
SHELL	Tellus Plus 32
TEXACO	Rando Oil HD 32
Petro - Canada	Hydrex AW 32

GREASE POINTS ON BULKHEAD LINCOLN AND FARVAL SYSTEMS

Ambient Temperature Above 40°F (> 4°C)

BP	Energrease LS-EP 1
CONOCO PHILLIPS	Dynalife L-EP 1
GULF	Gulfcrown Grease No.1 EP
IRVING	Lubex EP 1
MOBIL	Mobilux EP 1
SHELL	Alvania Grease EP LF 1
TEXACO	Multifak EP 1
Petro - Canada	Precision XL EP 1

Ambient Temperature Below 40°F (< 4°C)

BP	Energrease LS-EP 0
CONOCO PHILLIPS	Dynalife L-EP 0
GULF	Gulfcrown Grease No.0 EP
IRVING	Lubex EP 0
MOBIL	Mobilux EP 0
SHELL	Alvania Grease EP LF 0
TEXACO	Multifak EP 0
Petro - Canada	Precision XL EP 1

GUNDLACH

RECOMMENDED LUBRICANTS (cont.)

SECONDARY DRIVE BOX

BP	Energol GR-XP 150
CITGO	Citgear EP 150
CONOCO PHILLIPS	Philgear 150
GULF	EP Lube HD 150
IRVING	Gear Oil 150
MOBIL	Mobilgear 629
PENNZOIL	Super Maxol EP 150
SHELL	Omala Oil 150
TEXACO	Meropa 150
Petro - Canada	Enduratex EP 150

THIS LIST OF BRAND NAMES IS FOR THE PURPOSE OF IDENTIFYING TYPES AND IS NOT TO BE CONSTRUED AS EXCLUSIVE AND NO INFERENCE IS MADE THAT ALL OF THE ABOVE PRODUCTS ARE OF THE SAME QUALITY.

NOTE:

In the event of a wet condition around the crusher, we recommend using water absorbent grease such as Shell Alvania EP 2 or Mobil Mobilux EP 2.

NOTES: _____

GUNDLACH

GREASING RECOMMENDATIONS FOR 2000D&S SERIES STANDARD CRUSHERS WITH DUAL BULKHEAD LUBRICATION SYSTEM

1.0 Number of Grease Points and Reference Drawing For the Following Crushers:

2000S Crushers (10) Grease Points

2.0 Location of Grease Points:

- 2.1 Stationary main bearings, one (1) grease point per bearing. This is Located on the slide bar on top of the bearing block.
- 2.2 Adjustable main bearings, three (3) grease points per bearing. They are located as follows:
 - A. On slide bar on top of bearing block.
 - B. On base frame under bearing block.
 - C. On side of bearing block.
- 2.3 Adjustment and alignment assembly grease point locations for the following crushers:
 - 2.3.1 2000D&S Manual Adjustment Crushers
 - 2.3.1.1 Grease cups located on thrust blocks. The grease cups should be checked periodically and the cap on the cup rotated daily to lubricate the adjustment assembly.
(Reference Drawing in Adjustment and Alignment Section)
 - 2.3.1.2 Alignment assembly, one (1) grease point per crank arm. The crank arms are located on the back side of the crusher.
 - 2.3.2 2000D&S Hydraulic Adjustment Crushers
 - 2.3.2.1 Alignment assembly, one (1) grease point per crank arm. The crank arms are located on the back side of the crusher.

3.0 Main Bearings (Reference – Drawings D0-0401-00 & D0-0402-00):

- 3.1 The bearings furnished with your crusher are spherical roller bearings, designed with a multi-labyrinth type seal to keep out dust and a moderate amount of moisture. This bearing cannot be overgreased, but we advise to grease slowly, rotating shaft until contaminated grease is expelled through the seals. After greasing a few times, you will be able to ascertain how much grease is needed per greasing, and then hold to this amount. Wipe all contaminated grease from assembly after greasing. See lubrication specification sheet for type of grease.

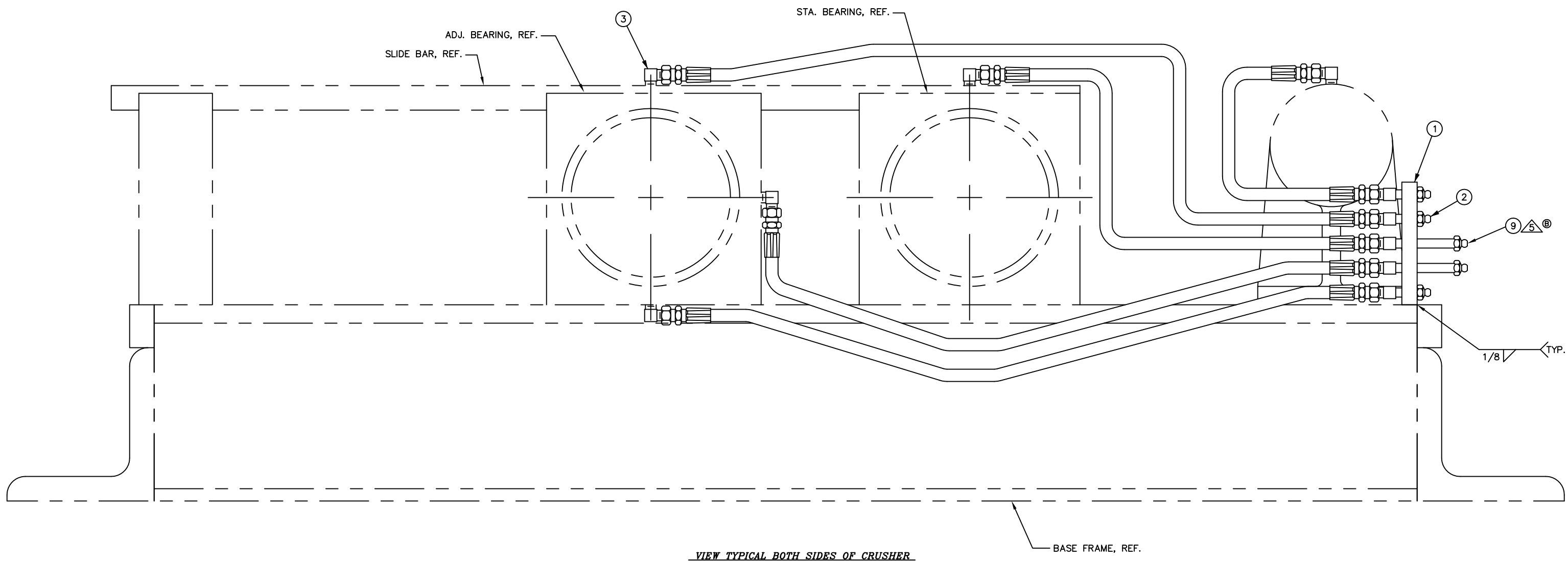
GUNDLACH

CRUSHERS

OPERATING TEMPERATURES

Note: The temperature of the feed material and the ambient temperature of the facility where the crusher is installed will affect the various components and lubricants used in the crusher. The following list describes the maximum allowed temperatures for the items indicated.

- 1.0 GEARBOXES: The maximum allowed temperature for the gearbox oil is 185° F (85° C). If the temperature of the gearbox cover is 140° F (60° C) or more, the customer should investigate the cause of the high temperature.
- 2.0 SECONDARY DRIVE: The normal operating temperatures of the oil in the secondary drive should not exceed 185° F (85° C). If the temperature of the secondary drive cover is 140° F (60° C) or more, the customer should investigate the cause of the high temperature.
- 3.0 BEARINGS: The maximum allowed temperature for the bearings is 180° F (82° C). If the bearing block surface temperature is 140° F (60° C) or more, the customer should investigate the cause of the high temperature.



⚠️ INSTALL ITEMS 9 IN PORTS FOR MAIN BEARINGS.

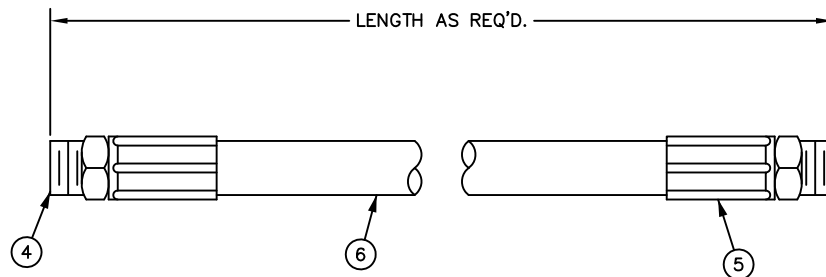
- 4) ROUTING OF LINES IS FOR PICTORIAL REPRESENTATION ONLY. ACTUAL ROUTING OF LINES IS DEPENDENT UPON CLEARANCES AVAILABLE AND ASSEMBLER'S DISCRETION. A NEAT AND CLEAN APPEARANCE IS DESIREABLE.
- 3) SYSTEM TO BE COMPLETELY PURGED WITH GREASE PRIOR TO SHIPMENT OF CRUSHER.

⚠️ ITEM NOT SHOWN ON DWG.
1) DIMS IN BRKT'S ARE IN MMS.

NOTES—

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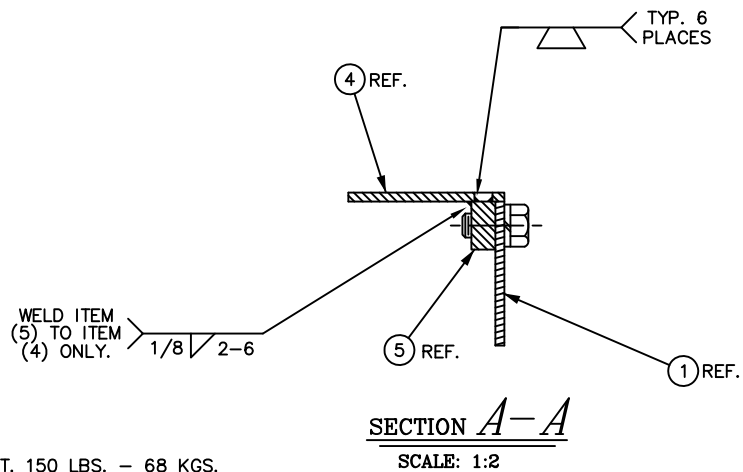
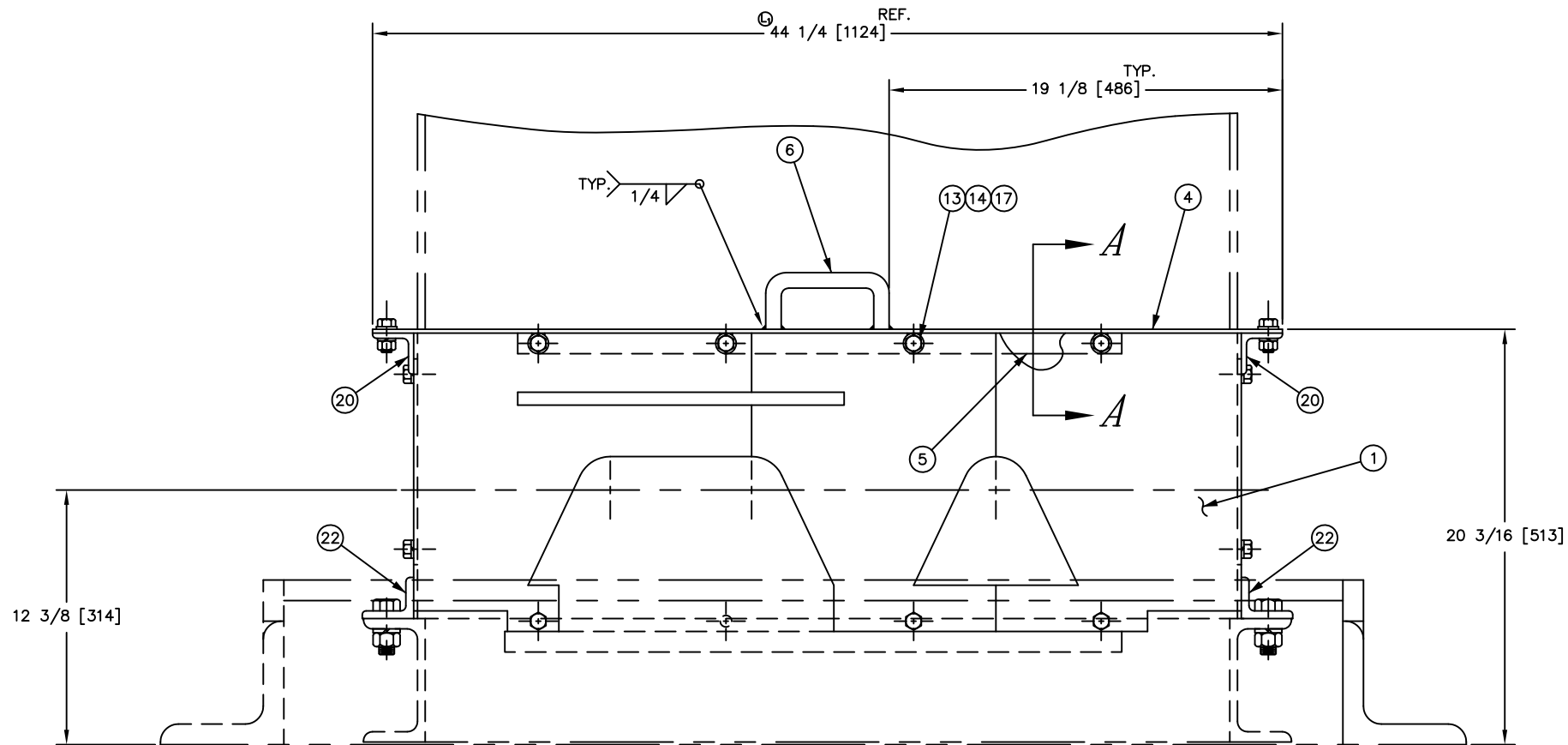
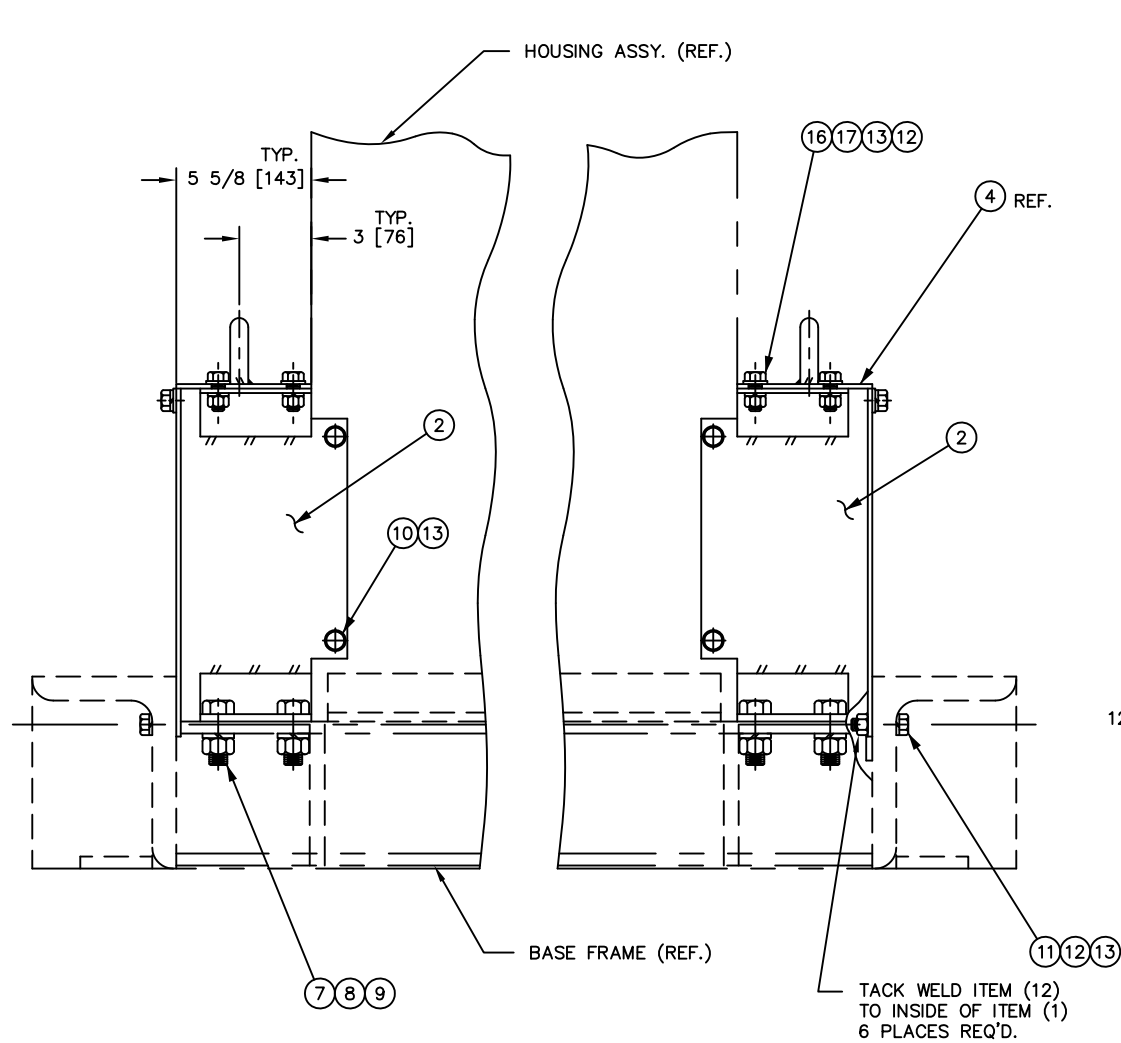
TYPICAL HOSE ASSEMBLY
SCALE: NONE

STL.	REVISION	DATE	BY	NEXT ASSEMBLY

B	5	9	4	2600179	.125 NPT x 1.75 LG-STR GRS FTG				
		8	--	-----	WELD WIRE SA 71V				
A	2	7	10	2600091	CAP - GREASE FITTING				
		6	22ft.	2300015	.250 SAE 100R2 HOSE				
C	5	20	2400316	FTG.-CRIMP ON .250 HOSE-.438 (F) JIC					
		4	20	2400154	ADAPTER - .125 MPT - .438 JIC				
3	10	2400051	90° ADPT. - .125 MPT - .125 FPT						
		2	6	2600004	GREASE FITTING - STRAIGHT				
B	1	2	A0-2510-00	BULKHEAD - 5 POINT					
		ITEM	QTY.	PART NO.	DESCRIPTION				
GUNDLACH GUNDLACH EQUIPMENT CORPORATION BELLEVILLE, IL, U.S.A.									
						TOLERANCES EXCEPT AS NOTED			
						DECIMAL			
						±.015			
						FRACTIONAL			
						±1/32			
						ANGULAR			
						±1/4°			
MATERIAL				SCALE	DRAWN BY				
				1/2"=1"	F. ERB				
				APPROVED BY	J. HANLEY				
TITLE									
2000S SERIES CRUSHER									
DUAL BULKHEAD LUBRICATION SYSTEM									
DATE				DRAWING NUMBER					
06-13-83				D0-1361-00					



DRIBBLE CHUTE & SLOT CLOSURE



ASSY P/N	ITEM 22	DESCRIPTION
D0116100	9B0420	2.50 x 2.00 x .375 ANG. x 4.625
D011610BB	9B046BB	2.50 x 2.50 x .375 ANG. x 4.625

* DETAILS ON PAGE 2 OF 2

SYMBOL	REVISION	DATE	BY	NEXT ASSEMBLY
(N)	ADDED CHART FOR ITEM 22	01-16	DWB	
(M)	LENGTH WAS 5 7/16 DEL ITEMS 21 & 23	02-17	RA	
(L)	Ø DIM WAS 44 7/8 QTY. WAS 2 Ø DIM. WAS	03-15	RA	
(K)	18 1/4 Ø DEL ITEM 3 Ø P/N WAS AA-0074-00	03-15	RA	
(J)	Ø DEL ITEM 19 Ø ADDED ITEMS 20 THRU 23			
(I)	Ø DIM WAS 12 15/16			
(H)	REMOVED ITEM 15 (1N01090)	08-05	CS	
(G)	ITEM 12 WAS QTY. 6	07-05	DWB	
(F)	REVISED & REDRAWN FOR 4th SHIFT	05-11	BT	
(E)		05-11	BT	
(D)		05-11	BT	
(C)		05-11	BT	
(B)		05-11	BT	
(A)		05-11	BT	

ITEM	QTY.	PART NO.	DESCRIPTION
23			
22	4	(N) SEE CHART	SEE CHART
21			
20	4	9B0320	2 x 2 x .250 ANG. x 4.625
19			
18	--	-----	WELD ROD E-7024
17	16	1N01060	MFW .500 DIA.
16	8	1110504	HHCS .500 NC x 1.250 LG.
15			
14	8	1110503	HHCS .500 NC x 1 LG.
13	30	1N04140	MLW .500 DIA.
12	14	1M11051	HNSF .500 NC
11	6	1110507	HHCS .500 NC x 2 LG.
10	8	1110501	HHCS .500 NC x .750 LG.
9	8	1N04180	MLW .750 DIA.
8	8	1M11081	HNSF .750 NC
7	8	1110805	HHCS .750 NC x 2
6	2	7005575	HANDLE
5	2	9A2050	BAR- .500 x 1 x 29.375
4	2	9U188A20	SHT.- .188 x 5.625 x 44.250 (N)
3			
2	4	9U188A20	SHT.- .188 x 6.937 x 13.875 (N)
1	2	9U188A20	SHT.- .188 x 14.500 x 40.500
ITEM	QTY.	PART NO.	DESCRIPTION
TOLERANCES	EXCEPT AS NOTED		
DECIMAL	±.015		
FRACTIONAL	±1/32		
ANGULAR	±1/4°		
CAD DWG. No.			
SUPERSEDES			
DATE			
TITLE			
DATE			
DRAWING NUMBER			
PAGE			

2) APPROX. WT. 150 LBS. - 68 KGS.
1) DIMS IN BRKT'S ARE IN MMS.

NOTES-

Information on this drawing is proprietary and confidential

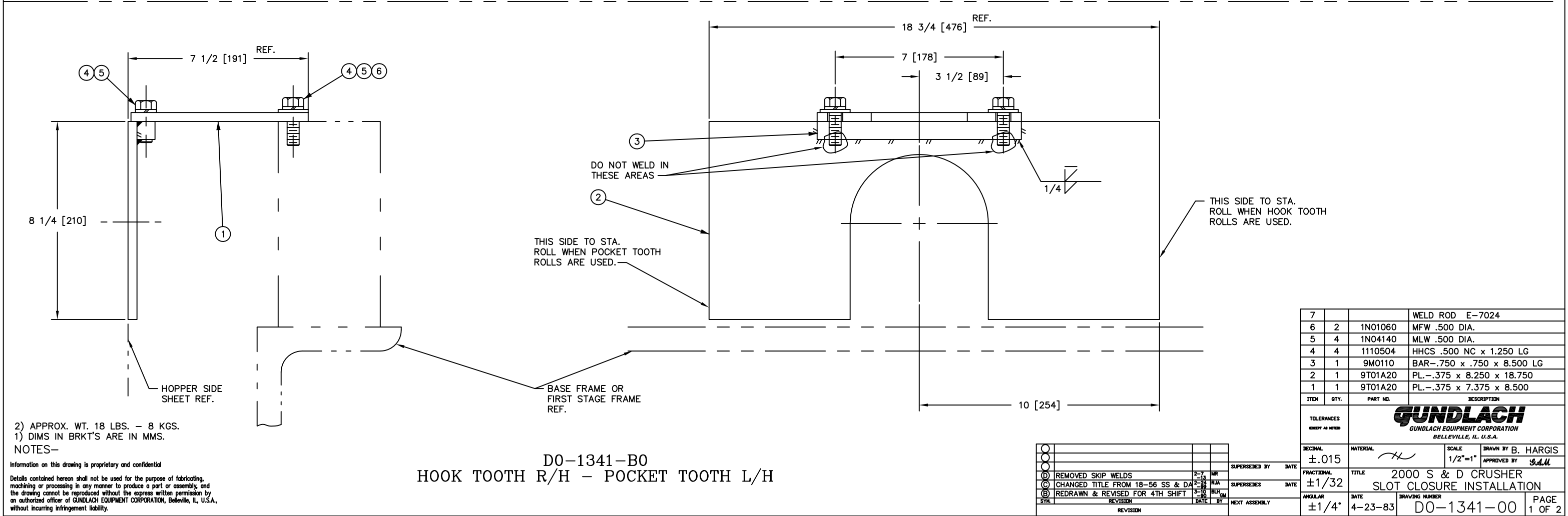
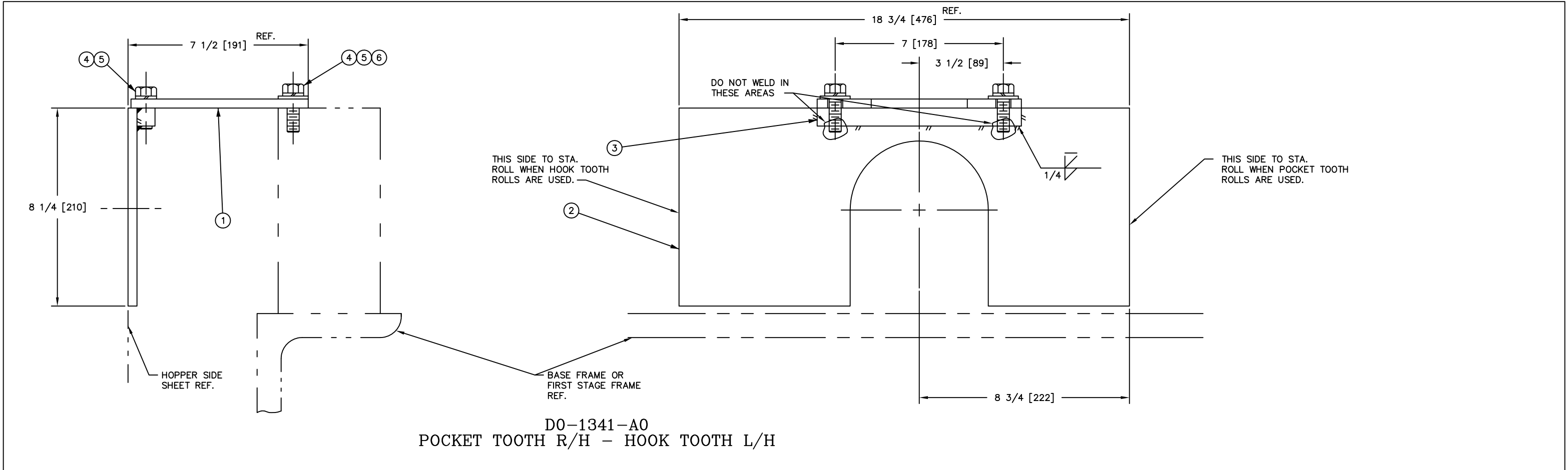
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2000S CRUSHER
DRIBBLE CHUTE - ASSEMBLY

10/22/80

D0-1161-00

1 OF 2



2) APPROX. WT. 18 LBS. - 8 KGS.
1) DIMS IN BRKT'S ARE IN MMS.
NOTES-
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REV	REVISION	DATE	BY	NEXT ASSEMBLY
1	REMOVED SKIP WELDS	2-7-83	NR	
2	CHANGED TITLE FROM 18-56 SS & DA	2-28-83	RJA	
3	REDRAWN & REVISED FOR 4TH SHIFT	3-30-83	RLH	

SUPERSEDED BY	DATE
SUPERSEDES	DATE

7			WELD ROD E-7024
6	2	1N01060	MFW .500 DIA.
5	4	1N04140	MLW .500 DIA.
4	4	1110504	HHCS .500 NC x 1.250 LG
3	1	9M0110	BAR-.750 x .750 x 8.500 LG
2	1	9T01A20	PL-.375 x 8.250 x 18.750
1	1	9T01A20	PL-.375 x 7.375 x 8.500
ITEM	QTY.	PART NO.	DESCRIPTION
TOLERANCES (EXCEPT AS NOTED)			
GUNDLACH GUNDLACH EQUIPMENT CORPORATION BELLEVILLE, IL, U.S.A.			
DECIMAL	MATERIAL	SCALE	DRAWN BY B. HARGIS
±.015		1/2"=1"	APPROVED BY <i>B.H.</i>
FRACTIONAL	TITLE		
±1/32	2000 S & D CRUSHER SLOT CLOSURE INSTALLATION		
ANGULAR	DATE	DRAWING NUMBER	PAGE
±1/4°	4-23-83	D0-1341-00	1 OF 2

GÜNDLÄCH

BEARINGS

GUNDLACH

ROLL CRUSHER

PREVENTATIVE MAINTENANCE

MAIN BEARING

NOTE: Be sure to wear the proper safety equipment such as safety glasses, safety shoes, hard hats and ear protection at all times while near the equipment. Do not operate the crusher without feed hopper and discharge hopper installed and properly sealed.

1.0 DAILY (24 hours)

- ▶ Check all accessible bolts. Especially the bolts holding the bearing stationary blocks down.
- ▶ Check bearings for excessive heat. (Temperatures above 180°F / 82°C)
- ▶ Visually check shaft for up and down movement. This could indicate a worn bearing or loose taper lock bushing.
- ▶ Check for material build up around the bearing blocks.
- ▶ Check for worn bearing sliding area.

CAUTION: Always lockout & tagout machine if work or cleaning is performed.

GUNDLACH

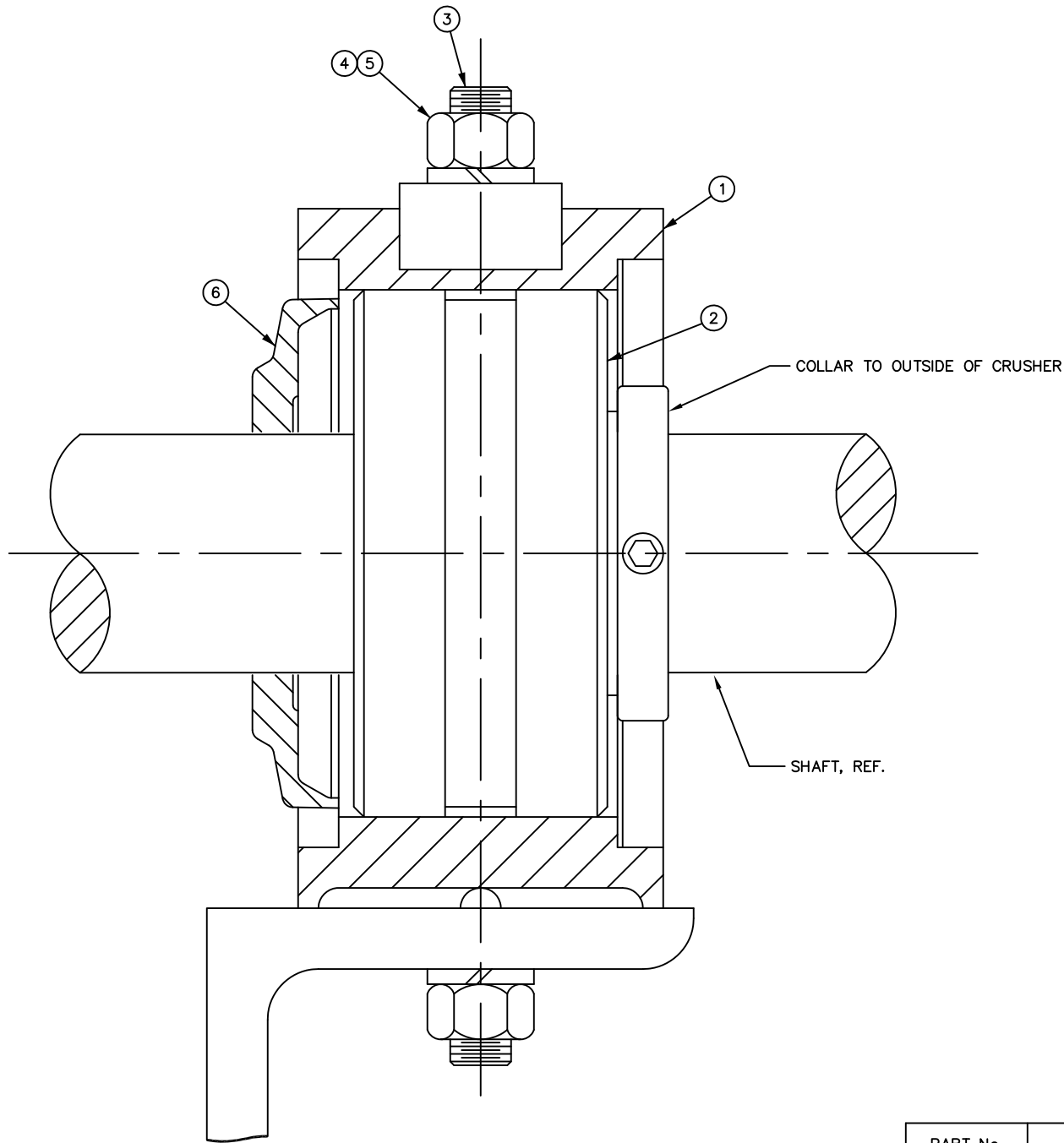
REPLACEMENT OF MAIN BEARINGS

Reference Drawing D0-0401-00 and D0-0402-00

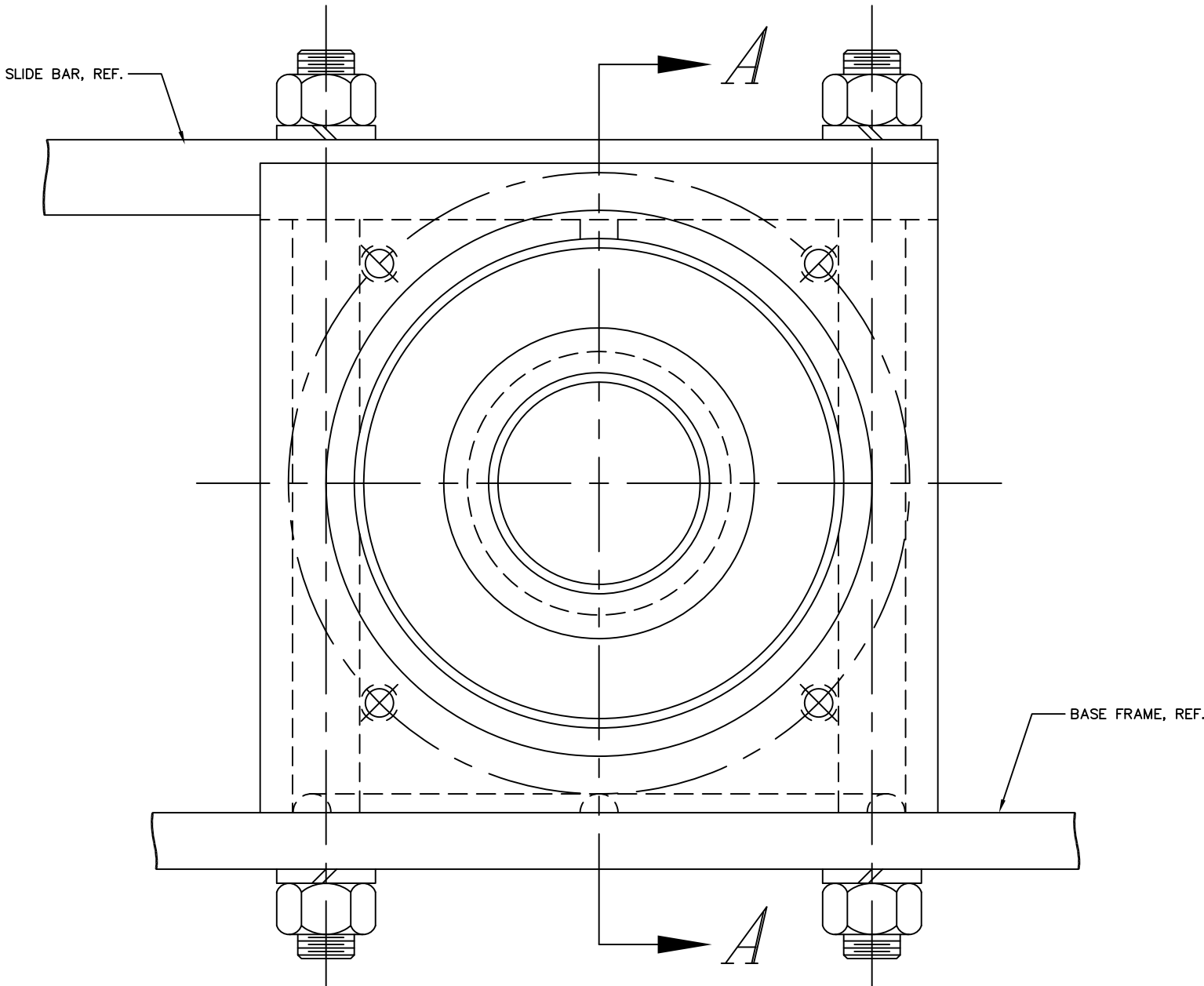
- 1.0 Remove drive components if the bearing to be changed is a drive bearing.
- 2.0 Remove the slide bar from the top of the adjustable and stationary main bearing. (Reference drawing in the Adjustment and Alignment Section)
- 3.0 If the adjustable main bearing is to be replaced, you must remove the spring retainer plate (on manual adjustment crushers) or the adapter plate (on hydraulic adjustment crushers), before the adjustable main bearing can be removed.
- 4.0 Block up rolls to remove weight from the bearings. (When replacing lower bearings, you can use roll removal rails to support rolls.)
- 5.0 Loosen setscrews on the bearing collar and slide entire bearing assembly off of shaft.
- 6.0 Press the bearing unit out of the block.
- 7.0 Before installing, check bearing housing and bearing block bore. The bearing block should be 6.4985/6.49750" (165.062 mm/165.037 mm) diameter and the bearing housing bore should be 6.500/6.499" (165.10 mm/165.07 mm) diameter. Shaft and bearing housing must be free from nicks and burrs. Coat shaft and bearing housing with a thin coat of S.A.E 30 oil. Back out collar set screws far enough to clear bearing hole. Align the grease hole in the bearing unit with the hole in the bearing block.

NOTE: The stationary bearing block has the grease hole on the top. The adjustable bearing block has the grease hole in the front.
- 8.0 Press bearing into housing. Use a soft steel tube or pipe to press against outer race of bearing cartridge to press it into the bearing block, slide bearing assembly onto shaft. If necessary to tap or press, use a hard wood block, or soft steel bar or tube against end of inner ring only. Do not strike or exert pressure on housings or seals.
- 9.0 Tighten locking collar set screws against shaft to mark their position on shaft. Loosen setscrews and slide bearing block back. Grind a flat on shaft where set screws seat. Reposition bearing block and torque set screws to 475 inch pounds. Hex key size required is ¼ inch.

NOTE: Check set screws after crusher has operated under load and re-torque set screws if necessary.



SECTION *A-A*



PART No.	DESCRIPTION	ITEM 2	ITEM 6
DO-0401-A0	BEARING ASSY. w/o SLINGER ("Z" LABYRINTH SEAL)	8100015	NOT USED
DO-0401-B0	BEARING ASSY. w/ SLINGER ("Z" LABYRINTH SEAL)	8100015	A0-1020-00
DO-0401-C0	BEARING ASSY. w/o SLINGER ("M" BUNA-N SEAL)	8100040	NOT USED
DO-0401-D0	BEARING ASSY. w/ SLINGER ("M" BUNA-N SEAL)	8100040	A0-1020-00
DO-0401-E0	BEARING ASSY. w/ STEEL SLINGER ("Z" LABYRINTH SEAL)	8100015	E206-5002-000B
DO-0401-F0	BEARING ASSY. w/ STEEL SLINGER ("M" BUNA-N SEAL)	8100040	E206-5002-000B
DO-0402-G0	BEARING ASSY. w/o SLINGER ("M" VITON SEAL)	8100055	NOT USED
DO-0402-H0	BEARING ASSY. w/ SLINGER ("M" VITON SEAL)	8100055	A0-1020-00
DO-0402-J0	BEARING ASSY. w/ STEEL SLINGER ("M" VITON SEAL)	8100055	E206-5002-000B

NOTE:
PRE-PACK BEARING SLINGER WITH GREASE AT ASSEMBLY.
APPROXIMATE WEIGHT 65 LBS-29 KGS.

REVISION	DATE	BY	NEXT ASSEMBLY
1	10-28-70	ALB	
2	10-28-70	AKR	
3	11-26-70	RA	
4	02-26-71	MH	
5	02-26-71	MH	

TOLERANCES EXCEPT AS NOTED
DECIMAL ±.015
FRACTIONAL ±1/32
ANGULAR ±1/4°

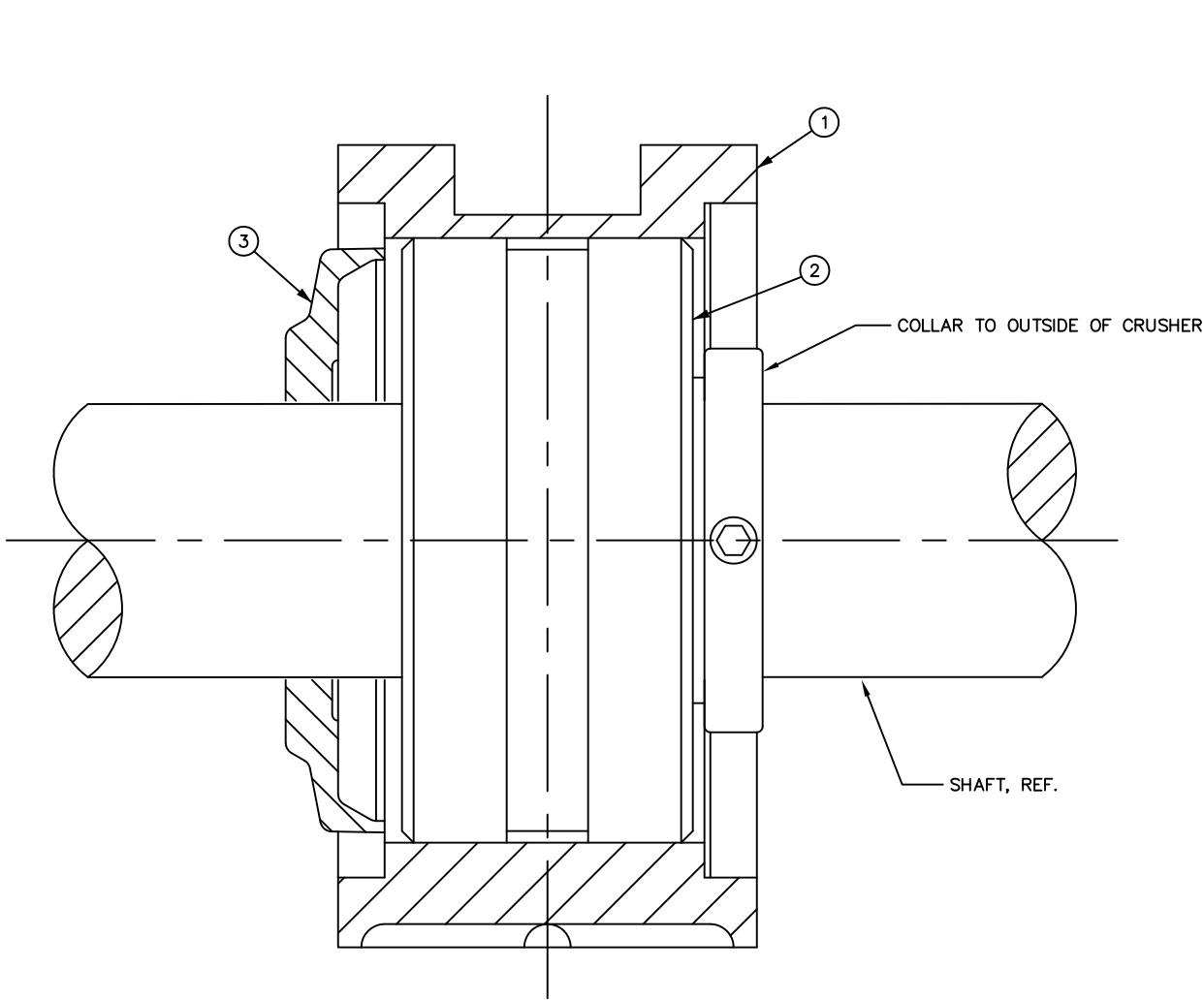
6	1	SEE CHART	SLINGER
5	4	1N04200	MLW - .875
4	4	1M11091	HNSF - .875 NC
3	2	A0-0040-00	BEARING BLOCK STUD
2	1	SEE CHART	BEARING UNIT
1	1	C0-0933-00	BEARING BLOCK
ITEM	QTY.	PART NO.	DESCRIPTION

GUNDLACH
DIVISION OF J.M.J. INDUSTRIES INC.
BELLEVILLE, IL. U.S.A.

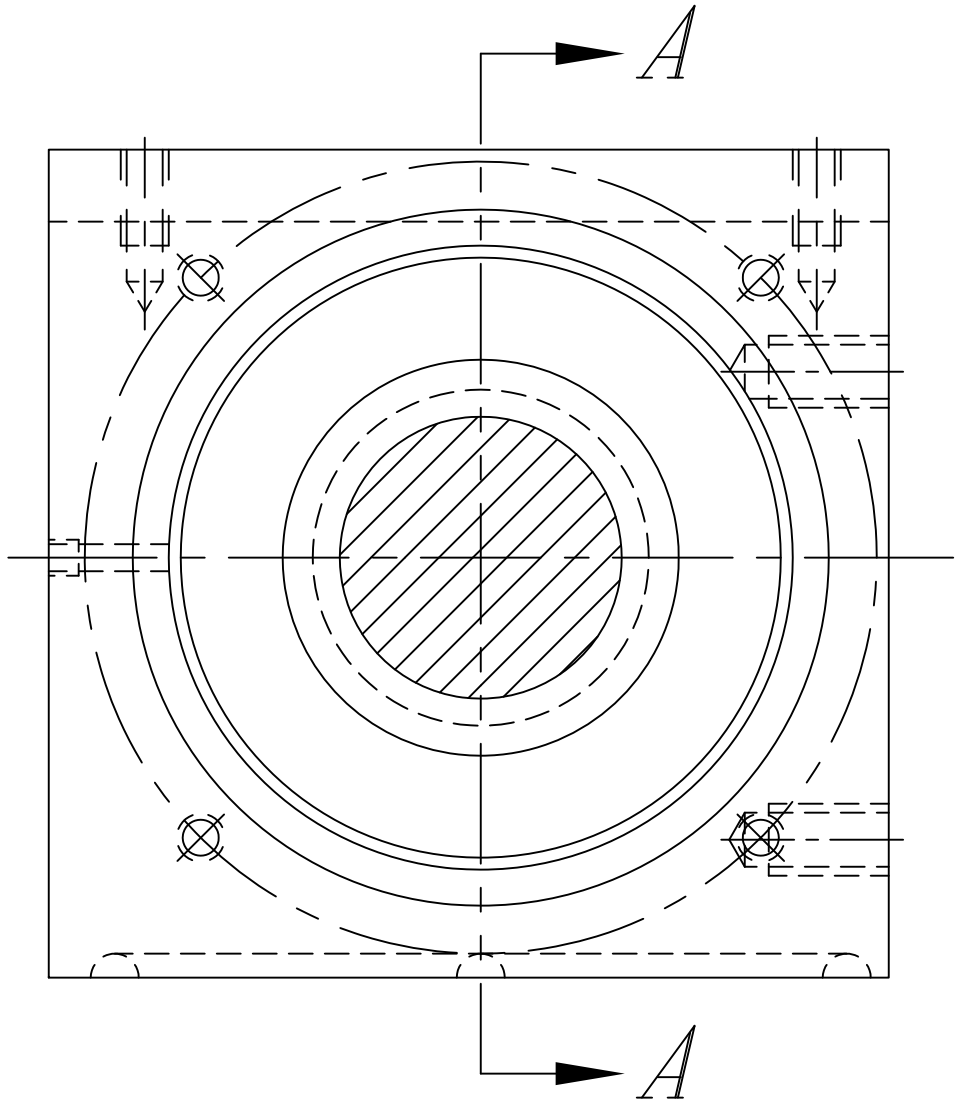
MATERIAL	SCALE 1"=1"	DRAWN BY RWH
TITLE 2000 SERIES CRUSHER BEARING BLOCK ASSEMBLY - STATIONARY	DATE 01-16-70	APPROVED BY J. KORTE
DRAWING NUMBER DO-0401-00		

Information on this drawing is proprietary and confidential

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SECTION *A-A*



PART No.	DESCRIPTION	ITEM 2	ITEM 3
DO-0402-A0	BEARING ASSY. w/o SLINGER ("Z" LABYRINTH SEAL)	8100015	NOT USED
DO-0402-B0	BEARING ASSY. w/ SLINGER ("Z" LABYRINTH SEAL)	8100015	A0-1020-00
DO-0402-C0	BEARING ASSY. w/o SLINGER ("M" BUNA-N SEAL)	8100040	NOT USED
DO-0402-D0	BEARING ASSY. w/ SLINGER ("M" BUNA-N SEAL)	8100040	A0-1020-00
DO-0402-E0	BEARING ASSY. w/ STEEL SLINGER ("Z" LABYRINTH SEAL)	8100015	E206-5002-000B
DO-0402-F0	BEARING ASSY. w/ STEEL SLINGER ("M" BUNA-N SEAL)	8100040	E206-5002-000B
DO-0402-G0	BEARING ASSY. w/o SLINGER ("M" VITON SEAL)	8100055	NOT USED
DO-0402-H0	BEARING ASSY. w/ SLINGER ("M" VITON SEAL)	8100055	A0-1020-00
DO-0402-J0	BEARING ASSY. w/ STEEL SLINGER ("M" VITON SEAL)	8100055	E206-5002-000B

NOTE:
PRE-PACK BEARING SLINGER WITH GREASE AT ASSEMBLY.
APPROXIMATE WEIGHT 62 LBS-28 KGS.

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3	1	SEE CHART	SLINGER
2	1	SEE CHART	BEARING UNIT
1	1	CO-0934-00	BEARING BLOCK
ITEM	QTY.	PART NO.	DESCRIPTION

TOLERANCES UNLESS OTHERWISE SPECIFIED	
DECIMAL	±.015
FRACTIONAL	±1/32
ANGULAR	±1/4°

GUNDLACH DIVISION OF J.M.I. INDUSTRIES INC. BELLEVILLE, IL, U.S.A.	
MATERIAL	SCALE 1"=1"
DRAWN BY RWH	
APPROVED BY J. KORTE	

TITLE 2000 SERIES CRUSHER BEARING BLOCK ASSEMBLY - ADJUSTABLE	
DATE 01-21-70	DRAWING NUMBER DO-0402-00

REVISION	DATE	BY	NEXT ASSEMBLY
1. ADDED "CO" & "HO" & "JO" AND DETAIL TO CHART	10-28-70	ALB	
2. ADDED "EO" & "FO" TO CHART	10-28-70	AKR	
3. ADDED "CO" & "DO" TO CHART	11-20-70	RA	
4. REDRAWN	01-21-70	WH	

CAD DWG. No.	SUPERSEDES	DATE



ROLL ASSEMBLY

GUNDLACH

ROLL ASSEMBLY INFORMATION

1.0 STATIONARY ROLL ROLL DESCRIPTION

Part Number

E204-0053-000D

15" Dia. - Herringbone

Hardfaced

Coupling Mounted

Roll Weight: Approx.: 950 lbs – 431 kg

2.0 ADJUSTABLE ROLL

Part Number

E204-0003-000D

14.750" Dia. - Smooth

Coupling Mounted

Roll Weight: Approx.: 895 lbs – 406 kg

GUNDLACH

ROLL CRUSHER

PREVENTATIVE MAINTENANCE

ROLLS

NOTE: Be sure to wear the proper safety equipment such as safety glasses, safety shoes, hard hats and ear protection at all times while near the equipment. Do not operate the crusher without feed hopper and discharge hopper installed and properly sealed.

1.0 DAILY (24 hours)

- ▶ Visually look at hub runout.
- ▶ Make sure feed is spread across the entire length of the rolls.
- ▶ Make sure the feed size is still as startup.
- ▶ Make sure product is to specifications.
- ▶ Visually see if material is sticking in the crusher housing. This can cause premature roll wear.

2.0 WEEKLY (168 hours)

- ▶ Check for roll wear. Worn rolls can cause reduced capacity and decreased size reduction.
- ▶ Check for uneven wear. Uneven wear is caused from a feeding problem.
- ▶ Check for missing teeth.
- ▶ Check segment bolts on rolls with segments.
- ▶ Check coupling bolts and nuts.
- ▶ Make sure rolls are parallel.
- ▶ If welding on rolls in the crusher, you should always attach the ground lead on the roll you are welding.

CAUTION: Always lockout & tagout machine if work or cleaning is performed.

GUNDLACH

ROLL MAINTENANCE

CRUSHERS

NOTE: Be sure to wear the proper safety equipment such as safety glasses, safety shoes, hardhats and ear protection at all times while near the equipment.

**Not fully applicable when using segmented rolls - consult with supplier.*

We recommend that a regularly scheduled maintenance program be established for rehardfacing of roll teeth.

- The tips of the teeth should be “retipped” as they become rounded. Retipping can be done without removing the rolls from the crusher. Access to the rolls can be obtained by removing the end sections of the housing. By establishing a regularly scheduled program for rehardfacing the teeth, they will not wear to the extent that rolls will have to be removed for reconditioning.
- It is important to maintain a good roll balance. Premature bearing failure can take place if the rolls are out of balance.

If you do not have time to maintain the rolls in the crusher, Gundlach, offers a repair program. Information is available per request, since there are many styles of rolls.

Gundlach offers roll repair / rebuilds. Not only do we offer this, if you are in need of rebuilt rolls we may have some of those available to you from our rebuilt stock.

Included in our typical roll repair

All the old teeth are removed.

- The roll drum is cleaned by grinding and/or machining
- The roll hubs are repaired or replaced if required
- The new teeth are located and welded to the drum
- Hardfacing is applied to the teeth if required
- Hardfacing is applied to the roll drum between the teeth
- The hubs are remachined
- The bolt holes are repaired as required
- The balance of the roll is checked and corrected if required

Contact: Mark Knobloch - Service Engineer - Toll Free Number: 877-486-3522

GUNDLACH

INSTRUCTIONS FOR SETTING ROLLS TO PRODUCE APPROXIMATE PLANNED PRODUCT

1.0 LOWER ROLLS

The lower rolls produce the final product from the crusher and are therefore set to produce the customer's desired product. To set these rolls, adjust the moveable roll inward as far as it will go toward the stationary roll with either your manual adjustment screw or with your Nitroil® system.

With the lower rolls closed, the body-to-body dimension (which is a rough approximation of product size) will be as follows for some example rolls.

18 Pocket Tooth Roll3/4"
4 Hook Tooth Roll2"

This will mean, for example, that with 18 pocket tooth lower rolls in a closed position, you can expect approximately a 3/4" product.

As the adjustable roll is now opened gradually from the closed position, the product size will increase accordingly.

For example:

An 18 pocket tooth roll in a closed position makes approximately a 3/4" product. If the adjustable roll is opened 1/2" from closed, the approximate product size becomes 3/4" + 1/2" or 1 1/4". Accordingly, if the roll is opened 1", the final product size becomes approximately 3/4" + 1" or 1 3/4".

These are all approximate numbers and actual testing with your material is required to find the exact setting, but these rules will obtain results very close to the product desired.

2.0 UPPER ROLLS

After the lower rolls have been set, the upper rolls must be set to produce a product that can be readily accepted by the lower rolls. The principal of product made by the upper rolls is the same as for the lower and below are listed the approximate product sizes made by various upper rolls in a closed position:

4 Hook Tooth Rolls.....2"
Chisel Tooth.....2"

A general (which may vary somewhat depending upon the material being crushed and its feed size) is to produce a product with the upper rolls that is approximately three times as big as the final product desired.

For example:

A Crusher has 4 hook tooth upper rolls and 18 pocket tooth lower rolls. The final product desired is 1 1/2". The lower rolls have been set at 3/4" back from closed. (Remember 3/4" closed + 3/4" = 1 1/2" product.) The upper rolls should produce a product approximately three times the desired final product or $3 \times 1 \frac{1}{2} = 4 \frac{1}{2}$ ". This would be accomplished by opening the upper adjustable roll approximately 2 1/2" from its closed position (i.e. 2" product closed = 2 1/2" adjustment = 4 1/2" product).

Again, remember these are all general rules and will vary somewhat in different applications; however, this procedure will obtain results close to those desired and is planned starting point.

Your Crusher has been manufactured as follows:

	<u>Design Type</u>	<u>Body-to-Body Closed Dimension</u>
Rolls	Herringbone / Smooth	0.375"

GUNDLACH

REFERENCE DRAWING ROLL REMOVAL INSTRUCTIONS 2000

REFERENCE S CRUSHERS – PLATE 300

REFERENCE D CRUSHERS – PLATE 289

- 1.0 Remove the dribble chute assembly from the crusher.
- 2.0 Remove the end section of the hopper from the side of which the rolls are to be removed.
- 3.0 If the feed chute can be removed, attach overhead hoist to both ends of roll at hubs and take up slack. Remove roll coupling bolts and remove roll from crusher. If feed chute must remain in place, use the hoist to secure roll and a hand winch to control the sideways movement of the roll. Remove as above. (See Roll Removal Rail Installation Drawing.)
- 4.0 For installation of the rolls, reverse the above procedure. Make sure when installing rolls in crusher that the notch mark on the roll hub flange is aligned with the notch mark on the shaft flanges. (See B0-1413-00 for bolt torque.)

GUNDLACH

ROLL REBUILDING PROCEDURE FOR BOTH HERRINGBONE AND DIAMOND STYLE ROLLS

- 1.0 Remove rolls from unit and grind roll body O.D. round and concentric from end to end. It is not uncommon for the center section of the roll to be worn down compared to the ends. Do not completely remove all the hardface from the roll body O.D. because this will be your pattern for rebuilding your rolls.
- 2.0 To rebuild this type of roll, a .045" diameter hardface wire is recommended in order to trace over the old hardface pattern. The Customer should consult with their welding supplier for additional details. The following typical technical data can be used as a reference for selecting a hardfacing material.

TYPICAL TECHNICAL DATA:

HARDNESS 57-62RC (Single Pass)
CURRENT DC (Electrode +/- 26%)
GAS USE 76% AR/25%/C02 OR 98% R/2%02
OPTIONAL SHIELDING GAS. (C02)

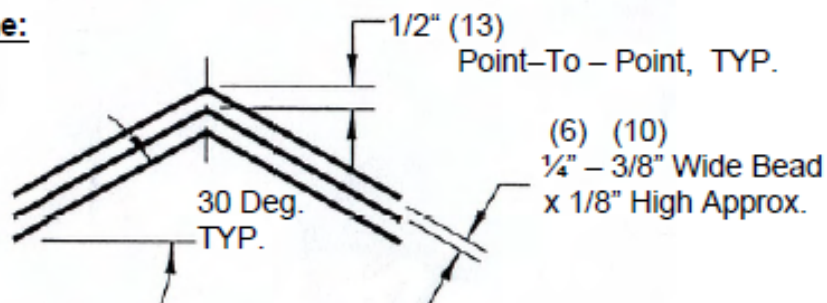
CHEMICAL COMPOSITION:

CARBON:	.60	CHROMIUM:	14.7
MANGANESE:	.50	SILICON:	.50
MOLYBDENUM:	1.0	BORON:	.8

<u>SIZE</u>	<u>AMPS</u>	<u>VOLTS</u>
5/64	350-425	27-30
1/16	300-375	27-30
.045	250-325	27-30

- 3.0 Remove all foreign and unsound material from roll body prior to rebuilding. Trace over the old hardface pattern with a steady and even movement maintaining a short arc to assure an even hardface deposit. Prevent excessive heat build up (over 600 degrees F) by alternating weld area. (See Below)

Herringbone:

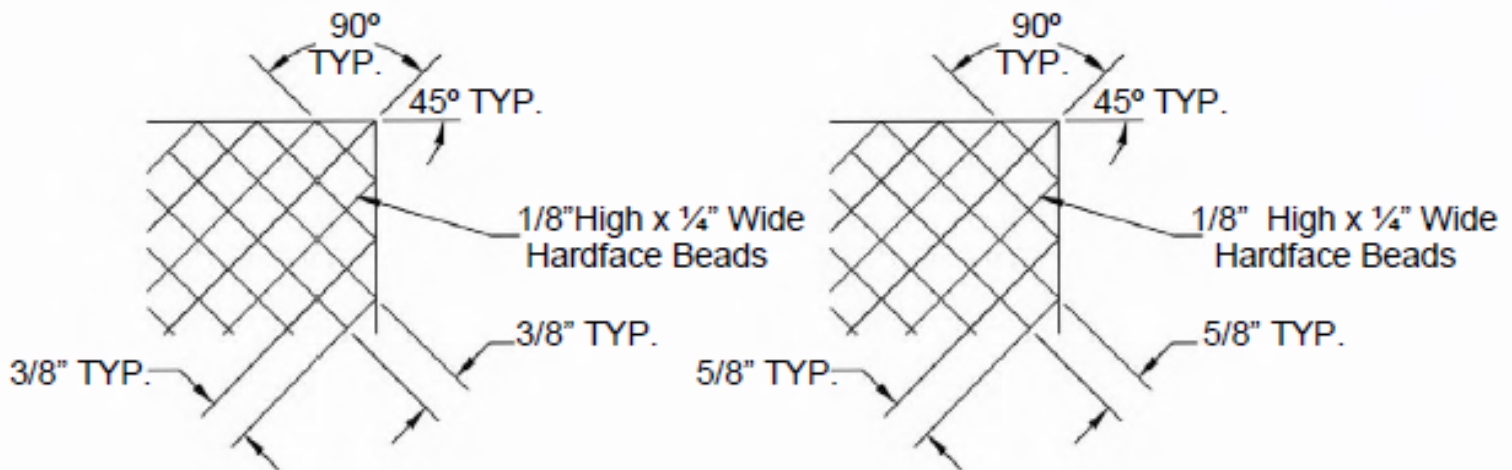


GUNDLACH

ROLL REBUILDING PROCEDURE FOR BOTH HERRINGBONE AND DIAMOND STYLE ROLLS

3/8" Diamond Pattern:

5/8" Diamond Pattern:



4.0 After roll body is rebuilt, check and clean roll O.D. Grind roll O.D., if necessary, to maintain that the roll O.D. is round and concentric. Machine hub faces – minimum clean up only - to assure rolls will run true. Check and clean all coupling bolt holes.

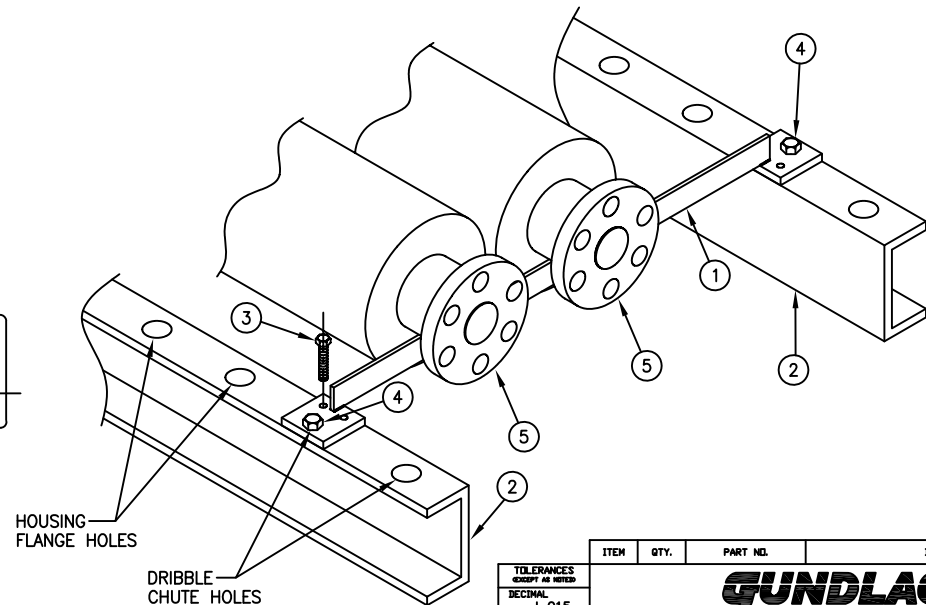
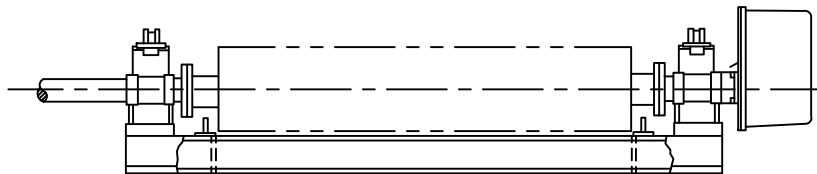
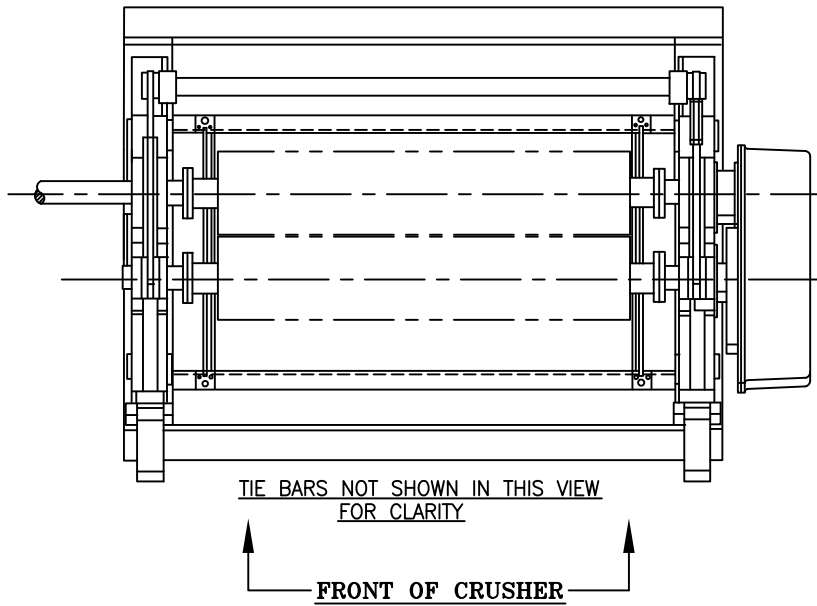
5.0 Reinstall rolls in unit, making sure the hub and shaft flange alignment marks are in line.

NOTE: Gundlach highly recommends sending the rolls into our factory for proper OEM rebuilds. You can call for information on a repair program which can save on down time.

CAUTION: If performing roll repair in the Crusher, always place welding ground lead on the roll to prevent bearing damage.

ROLL REMOVAL AND ROLL REMOVAL RAILS
INSTALLATION INSTRUCTIONS FOR 2000S CRUSHER.
THE ROLL REMOVAL RAILS ARE DESIGNED TO AID
IN THE REMOVAL OF THE ROLLS

- 1) REMOVE THE DRIBBLE CHUTE ASSY. FROM THE CRUSHER.
- 2) REMOVE THE END SECTION OF THE HOUSING FROM THE SIDE OF WHICH THE ROLLS ARE TO BE REMOVED.
- 3) REMOVE THE TOP (3) ROLL COUPLING BOLTS FROM THE SHAFT AND ROLL FLANGES ON THE STATIONARY AND ADJUSTABLE ROLLS.
- 4) ROTATE THE ROLLS SO THE LAST (3) ROLL COUPLING BOLTS ARE NOW ON TOP.
- 5) POSITION THE ROLL REMOVAL RAILS (ITEM 1) AS SHOWN ON THE HOUSING SUPPORT CHANNEL (ITEM 2).
- 6) USE (2) OF THE HOUSING BOLTS (ITEM 4) TO PIN THE ROLL REMOVAL RAIL (ITEM 1) TO THE HOUSING SUPPORT CHANNEL (ITEM 2). THE ROLL REMOVAL RAIL (ITEM 1) SHOULD BE LOCATED IN THE DRIBBLE CHUTE HOLES CLOSEST TO THE HOUSING
- 7) TIGHTEN THE SET SCREWS (ITEM 3) EQUALLY UNTIL THE ROLL REMOVAL RAILS (ITEM 1) RAISE TO TOUCH THE UNDER SIDE OF THE ROLL HUBS (ITEM 5).
- 8) REMOVE THE LAST (3) ROLL COUPLING BOLTS FROM THE SHAFT AND ROLL FLANGES ON THE STATIONARY AND ADJUSTABLE ROLLS.
- 9) ROLL THE ROLLS TO THE END OF THE ROLL REMOVAL RAIL (ITEM 1) AND REMOVE FROM THE CRUSHER.
- 10) FOR INSTALLATION OF THE ROLLS REVERSE THE ABOVE PROCEDURE. MAKE SURE WHEN INSTALLING ROLLS IN CRUSHER THAT THE NOTCH MARK ON THE ROLL HUB FLANGE IS ALIGNED WITH THE NOTCH MARK ON THE SHAFT FLANGES.



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SYN	REVISION	DATE	BY
(A)	REDRAWN CAD PER SAME No.	01-13-81	HO

TOLERANCES EXCEPT AS NOTED
DECIMAL ±.015
FRACTIONAL ±1/32
ANGULAR ±1/4°

CAD DWG. No.

SUPERSEDES

DATE

NEXT ASSEMBLY

ITEM	QTY.	PART NO.	DESCRIPTION
GUNDLACH DIVISION OF J.M.J. INDUSTRIES INC. BELLEVILLE, IL, U.S.A.			
MATERIAL		SCALE NONE	DRAWN BY D. BARNES APPROVED BY M.G.H.
TITLE 2000S CRUSHER ROLL REMOVAL RAILS - INSTALLATION			
DATE 01-13-81		DRAWING NUMBER PLATE 300	



**STUB SHAFT
&
ROLL FLANGE
COUPLING**

GUNDLACH

STUB SHAFT AND KEY LIST FOR S CRUSHERS [TWO MOTOR DRIVE] – PER PLATE #377

<u>ITEM</u>	<u>SHAFTS AND KEYS</u>	<u>18-56</u>	<u>NO. REQUIRED</u>
1.0	Short Stub	B0-1392-00	2
2.0	Main Drive Stub	B0-1389-00	2
3.0	Main Drive Key	A931DAQ1	2

Please note:

All shafts are supplied with their associated keys. However, keys can be purchased individually.



ADJUSTMENT & ALIGNMENT

GUNDLACH

ROLL CRUSHER

PREVENTATIVE MAINTENANCE

SPRING ADJUSTMENT SYSTEM

NOTE: Be sure to wear the proper safety equipment such as safety glasses, safety shoes, hard hats and ear protection at all times while near the equipment. Do not operate the crusher without feed hopper and discharge hopper installed and properly sealed.

1.0 DAILY (24 hours)

- ▶ Keep material away from the bearing block, slide bar and adjustment areas.
- ▶ Visually check spring and adjustments for damage.
- ▶ Check rolls for parallel.
- ▶ Check all accessible fasteners.
- ▶ Check alignment linkage for worn parts.
- ▶ Make sure adjustable roll is not bouncing constantly. Springs may be weak or broken.

2.0 MONTHLY

- ▶ Open and close the rolls to keep the adjustments free.

NOTE: Recheck roll gap when finished. Always adjust the crusher with the chains on to keep the rolls parallel.

- ▶ Grease the thrust block with EP-1. Do not over grease. The boot will swell and burst, causing dirt to enter the acme screw.

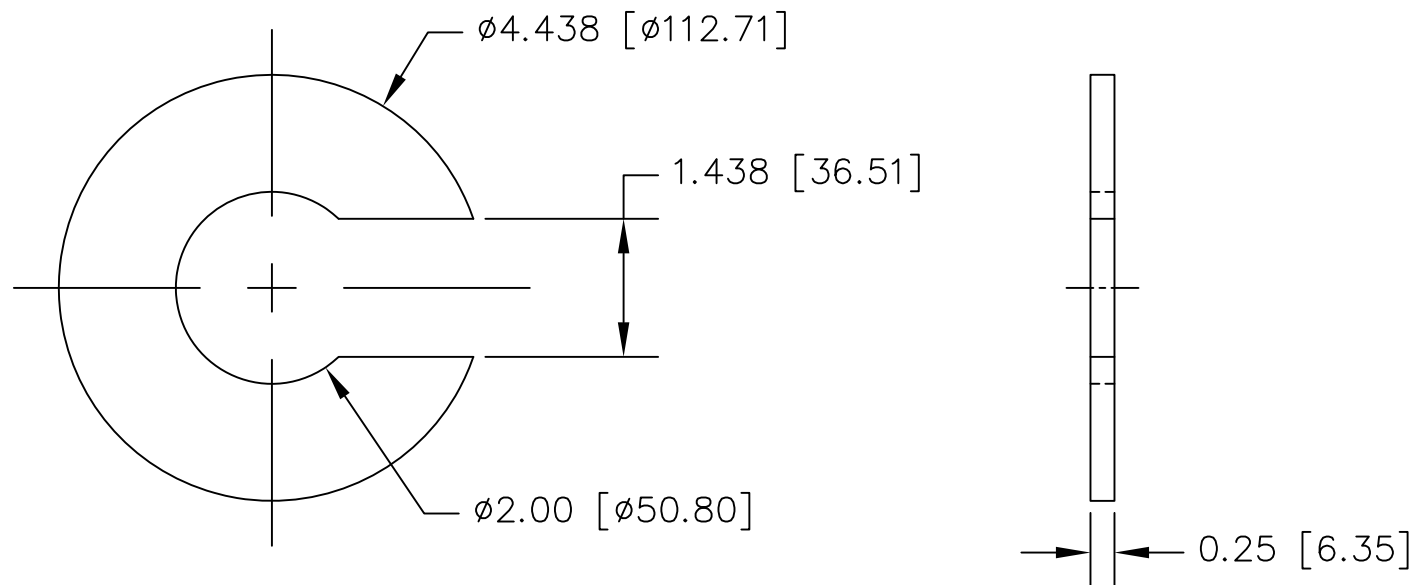
CAUTION: Always lockout & tagout machine if work or cleaning is performed.

GUNDLACH

MANUAL ADJUSTMENT AND ALIGNMENT ASSEMBLY INSTRUCTION SHEET PER MANUAL ADJUSTMENT AND ALIGNMENT ASSEMBLY DRAWING

- 1.0 The adjustment and alignment assembly requires periodic maintenance to insure movement of all parts. All adjusters should be moved through their full stroke once a month to keep adjusters free. The grease fittings (referred to in Lubrication Section). Should be lubricated every eight (8) hour shift. See specification sheet for type of lubrication required.
 - 1.1 The thrust block should be greased once a month. This will prevent over greasing.
- 2.0 To insure easy operation of the adjustment and alignment assembly, it is advisable to clean the base frame and first stage frame between the thrust block and adjustable bearing block, and between adjustable bearing block and stationary bearing block. Use a solution of coal oil or similar solvent.
- 3.0 When adjustable rolls bounce open too often and too easily, thereby producing more oversize product than desire, it is recommended that a ¼ inch (6.3 mm) thick horseshoe washer (A0-1535-00) be placed between the screw locking plate and the spring. This will add to the pre-compression of the spring.
 - 3.1 CAUTION: Do not place more than two (2) washers behind each spring and always add the same number of washers to each side.
- 4.0 To insert the horseshoe washers, the rolls will have to be closed all the way and the nuts on the 1 3/8 (34.9 mm) spring shafts will have to be loosened. Then turn the hand wheels as if to open the rolls. Now there will be room to place the washer between the screw locking plate and the spring. After the washers have been inserted, turn the hand wheels as if to close the rolls and tighten the nuts on the spring shafts, making sure that the rolls are parallel. Then check the center-to-center distance of the roll shafts on both sides of the crusher. If the rolls are not parallel, they may develop trouble in the gearbox. Example: The pocket tooth rolls should be 11 7/8" (301.6 mm) center to center, and the hook tooth rolls should be 13" (330.2 mm) center to center with the rolls fully closed.
- 5.0 Some units are equipped with a stop tube instead of a spring, when a non-relieving adjustment system is required for critical product sizing. The adjustment procedure must be done to each side of the alignment system because the chain link is not used. The method of adjustment for the roll gap is unchanged when the stop tube is used.

SYM.	REVISION	DATE	BY
(A)	WAS A-1535	7/69	RS
(B)	REDRAWN PER CURRENT STANDARDS	6/07	JDT
○	DRAWN IN CAD		
○			
○			



NOTES—

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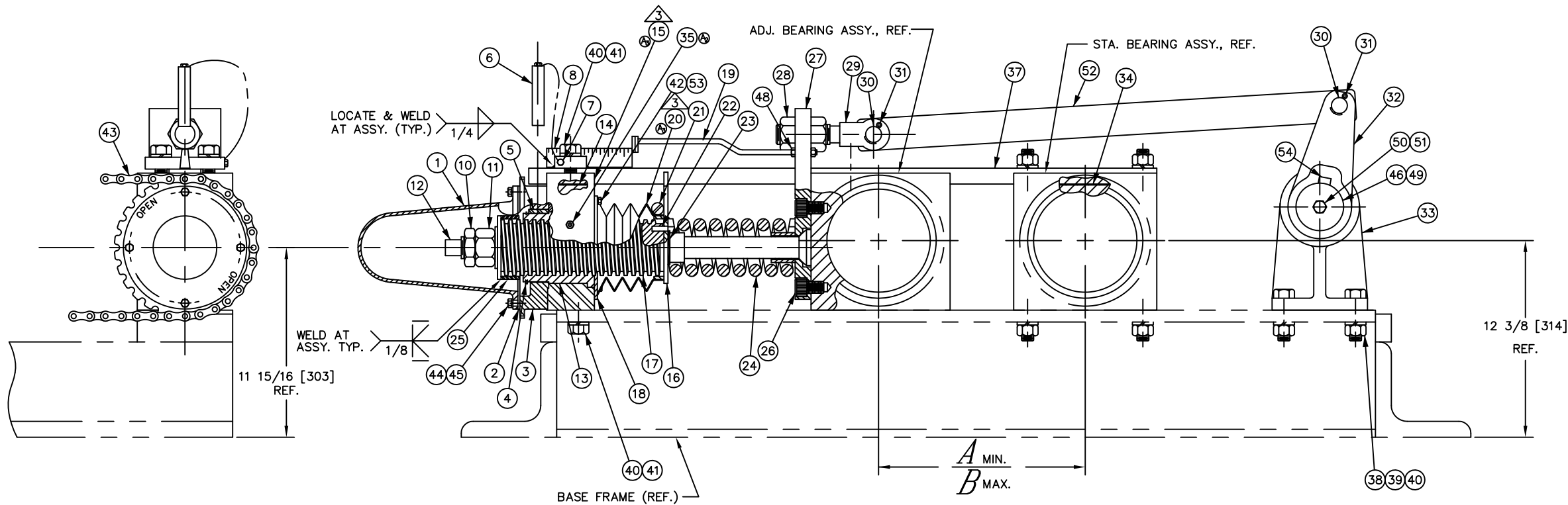
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ITEM		QTY.	PART NO.	DESCRIPTION	
TOLERANCES (EXCEPT AS NOTED)			 GUNDLACH EQUIPMENT CORPORATION BELLEVILLE, IL. U.S.A.		
DECIMAL ±.005					
FRACTIONAL ±1/32					
ANGULAR ±1°					
CAD DWG. No.		MATERIAL 1/4" x 4 1/2" x 4 1/2"		SCALE HALF	DRAWN BY L.R.
SUPERSEDES		DATE		APPROVED BY LLW	
NEXT ASSEMBLY		DATE 2-5-65		DRAWING NUMBER A0-1535-00	
TITLE HORSESHOE WASHER					

- 1) CLEAN ALL PARTS.
- 2) LUBRICATE ADJ. NUT AND ADJ. SCREW.
- 3) ASSEMBLE ADJ. NUT AND ADJ. SCREW.
- 4) PLACE ADJ. NUT AND ADJ. SCREW INTO THRUST BLOCK. INSERT ADJ. NUT KEY AND ADJ. SPROCKET. LOCK IN PLACE WITH RETAINING RING.
- 5) APPLY "HIGH TACK" SEALANT OR EQUIVALENT TO BACK OF THRUST BLOCK. FASTEN DUST BOOT TO THRUST BLOCK WITH CLAMPING RING.
- 6) FASTEN SCREW LOCKING PLATE TO THE ADJ. SCREW BY INSTALLING SCREW LOCKING PIN AND SNAP RING.
- 7) FASTEN DUST BOOT TO SCREW LOCKING PLATE USING A HOSE CLAMP.
- 8) ASSEMBLE SPRING RETAINER AND SPRING ON SPRING SHAFT. FASTEN THIS ASSEMBLY TO THE ADJ. BEARING BLOCK. INSERT THIS ASSEMBLY THROUGH THE ADJ. SCREW AND FASTEN WITH JAM NUT AND HEX NUT.
- 9) ADJUST THIS ASSEMBLY SO THE HOLES IN THE BASE FRAME OR FIRST STAGE FRAME LINE UP WITH THE HOLES IN THE THRUST BLOCK, AND INSERT CAP SCREW
- 10) TURN ADJ. SCREW IN ALL THE WAY AND SET PROPER ROLL CENTERS. TIGHTEN THE HEX AND JAM NUT.

11) FASTEN ADJ. SCREW COVER AND GASKET TO ADJ. SPROCKET.

NOTE:
ROLL SETTING GAUGE SHOULD BE SET WITH
ROLLS IN CLOSED POSITION TO INDICATE APPROX.
ROLL BODY TO BODY DIMENSION.



2) ITEM NOT SHOWN ON DRAWING.
1) DIMS IN BRKT'S ARE IN MMS.

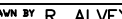
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UNIT SIZE	ASSEMBLY No.	<i>A</i>	<i>B</i>	QTY. ITEM 25	ITEM 43	ITEM 46	APPROX. WT.	
							LBS.	KGS.
20	D0-2079-A0	11 7/8	16	NOT REQ'D.	59P1021	A0-1171-E0	396	180
30	D0-2079-B0	11 7/8	16	NOT REQ'D.	59P1221	A0-1171-D0	411	186
40	D0-2079-C0	11 7/8	16	NOT REQ'D.	59P1421	A0-1171-A0	426	193
50	D0-2079-D0	11 7/8	16	NOT REQ'D.	59P1621	A0-1171-B0	441	200
60	D0-2079-E0	11 7/8	16	NOT REQ'D.	59P1821	A0-1171-C0	456	207
20	D0-2079-F0	13	16	2	59P1021	A0-1171-E0	396	180
30	D0-2079-G0	13	16	2	59P1221	A0-1171-D0	411	186
40	D0-2079-H0	13	16	2	59P1421	A0-1171-A0	426	193
50	D0-2079-J0	13	16	2	59P1621	A0-1171-B0	441	200
60	D0-2079-K0	13	16	2	59P1821	A0-1171-C0	456	207

©

B	55		WELD ROD E-7024
	54	2	A928BBC1 KEY .625 x .625 x 2.813 SQ. ENDS
	53	10	1110101 HHCS .250 NC x .500
	52	2	A0-1170-00 ALIGNMENT BAR
	51	2	1110503 HHCS .500 NC x 1 LG.
	50	2	1N04140 MLW .500 DIA.
	49	2	A0-2842-00 WASHER
	48	2	1M11021 HNSF .313 NC
	47	1	A0-0266-00 ADJUSTMENT HANDLE
	46	1	SEE CHART ALIGNMENT SHAFT
2	45	8	1N04110 MLW .313
	44	8	1110205 HHCS .313 NC x 1 LG.
	43	1	SEE CHART CHAIN ASSEMBLY
	42	10	1N04100 MLW .250 DIA.
	41	8	1110806 HHCS .750 NC x 2.250
	40	12	1N04180 MLW .750
	39	4	1M11081 HNSF .750 DIA. NC
	38	4	1110808 HHCS .750 NC x 2.750
	37	2	A0-1440-00 SLIDE BAR
	36		
A	35	2	2600004 GREASE FITTING 1/8 NPT STRAIGHT
	34	2	A0-0178-00 BEARING BLOCK SHIM
	33	2	B0-0709-00 ALIGNMENT BRACKET
	32	2	B0-2526-A0 ALIGNMENT CRANK ARM
	31	8	1S00408 CP .156 DIA. x 2.500
	30	4	A0-2046-00 PIN
	29	2	A0-1169-00 ALIGNMENT CLEVIS
	28	4	1M21121 HNSF 1.250 DIA. NF.
	27	2	A0-0187-00 SPRING RETAINER
	26	4	1311601 SHCS .750 NC x 1.250
SEE CHART	25	A0-2504-00	ADJUSTMENT SCREW SPACER
	24	2	A0-0653-00 SPRING
	23	2	1U00001 RETAINING RING
	22	2	1Q00905 SCREW LOCKING PIN
	21	2	2400006 HOSE CLAMP
	20	2	A0-1445-00 DUST BOOT
	19	1	A0-1904-00 INDICATOR ROD
	18	2	A0-1446-00 CLAMPING RING
	17	2	B0-0009-00 ADJUSTMENT SCREW
	16	2	A0-1447-00 LOCKING PLATE
3	15	2	B0-0924-00 THRUST BLOCK
	14	2	A0-0180-00 THRUST BLOCK SHIM
	13	2	A0-1291-00 ADJUSTMENT NUT
	12	2	A0-1050-00 SPRING SHAFT
	11	2	1M21131 HNSF 1.375 DIA. NF
	10	2	1M25131 JN 1.375 DIA. NF
	9	1	A0-0146-00 SLIDE BAR HOLD DOWN CLAMP
	8	1	B0-0925-00 ROLL SETTING GAUGE
	7	1	1H913091 STS. .250 TYPE F x .625 HEX HD.
	6	1	A0-1438-00 LOCKING PIN
2	5	2	A918A0D3 KEY .250 x .500 x 1.063
	4	2	1U00003 RETAINING RING
	3	2	B0-0916-00 ADJUSTMENT SPROCKET
	2	2	A0-1448-00 ADJ. SCREW COVER GASKET
	1	2	B0-0927-00 ADJUSTMENT SCREW COVER

ITEM		QTY.		PART NO.		DESCRIPTION	
TOLERANCES DECIMAL AS NOTED				 GUNDLACH GUNDLACH EQUIPMENT CORPORATION BELLEVILLE, IL. U.S.A.			
DECIMAL							
±.015							
FRACTIONAL							
±1/32				MATERIAL 			
ANGULAR							
±1/4"							
SCALE				1/4" = 1"		DRAWN BY R. ALVEY	
APPROVED BY 							
CAD DWG. No.		DATE		TITLE			
SUPERSEDES		DATE		2000 SERIES (20-60) CRUSHER			
NEXT ASSEMBLY		DATE		ADJ. ALIGN. ASSY. - MAN. (LWR) (CPLG)			
		DRAWING NUMBER		DO-2079-00			

(D)	CORRECTED ROLL SPACING ON CHART	06-26-2007	PDW
(C)	CORRECTED PICTORIAL ITEM 10 & 11, ADDED NOTE	06-26-2007	AKR
(B)	PART No. ITEM 54 WAS A928C003	06-26-2007	RA DWG
(A)	1. REMOVED ITEM 36, P/N 92040B0A,	01-18-2007	CCS
	2. ITEM 35 P/N WAS 2600007 &		
	3. ADDED NOTE 3.		
SYM.	REVISION	DATE	BY
	REVISION		

GÜNDLÄCH

HOUSING

GUNDLACH

ROLL CRUSHER

PREVENTATIVE MAINTENANCE

HOUSING

NOTE: Be sure to wear the proper safety equipment such as safety glasses, safety shoes, hard hats and ear protection at all times while near the equipment.

Do not operate the crusher without feed hopper and discharge hopper installed and properly sealed.

Do not open maintenance, inspections doors, or remove any guards until all rotating components (drive shafts, motors, etc.) have come to a complete stop.

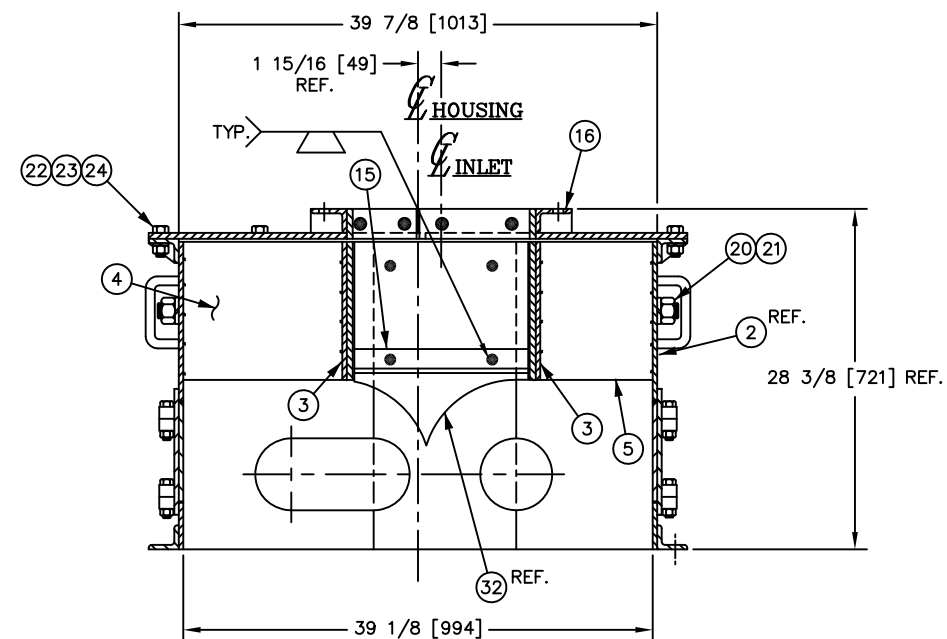
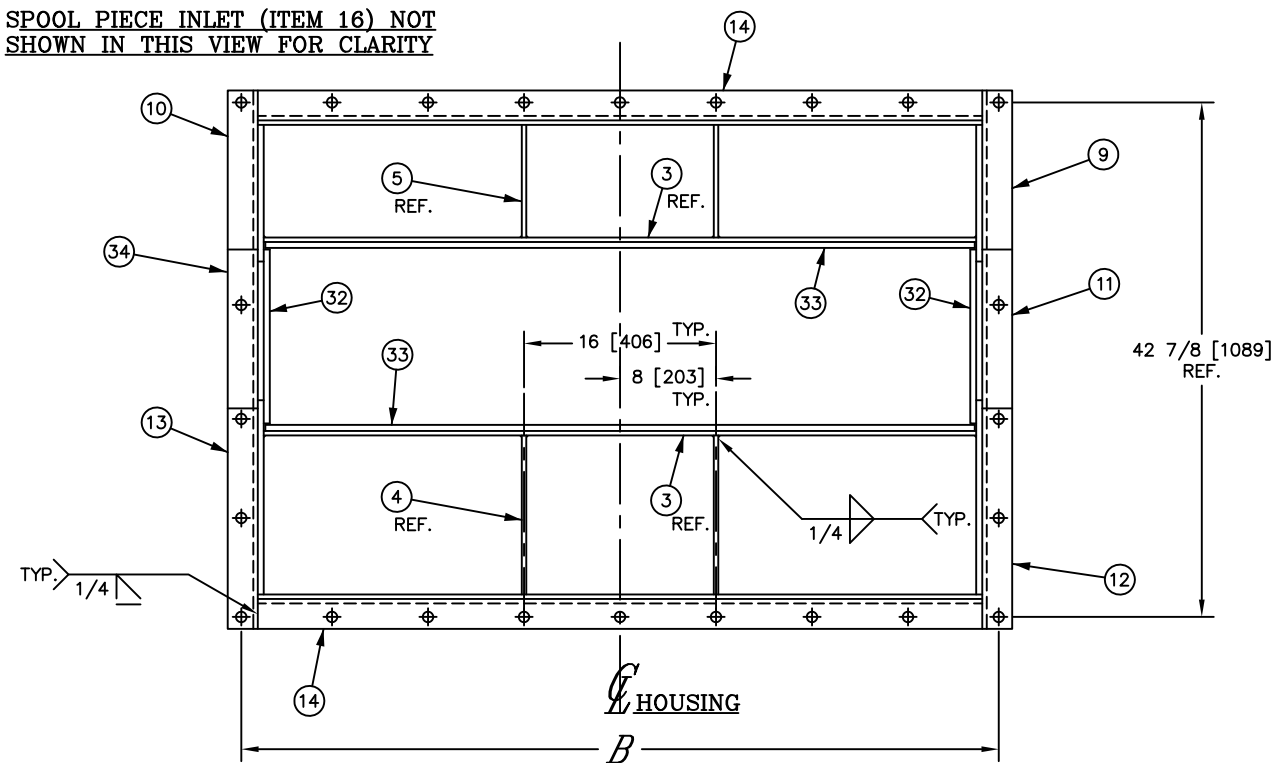
Housing is not designed to prevent explosion. This unit is not explosion proof.

1.0 WEEKLY (168 hours)

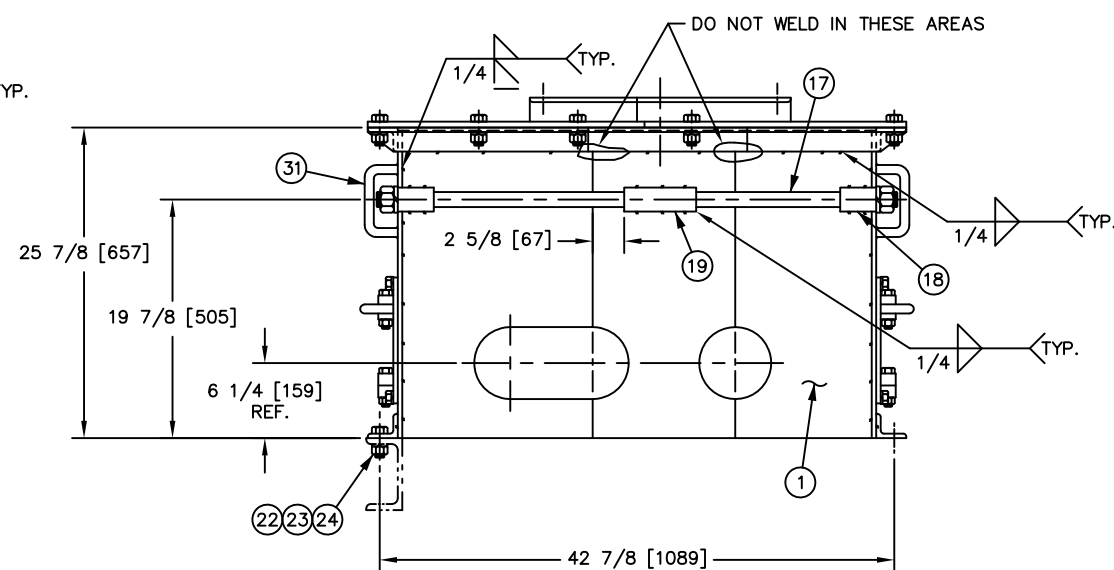
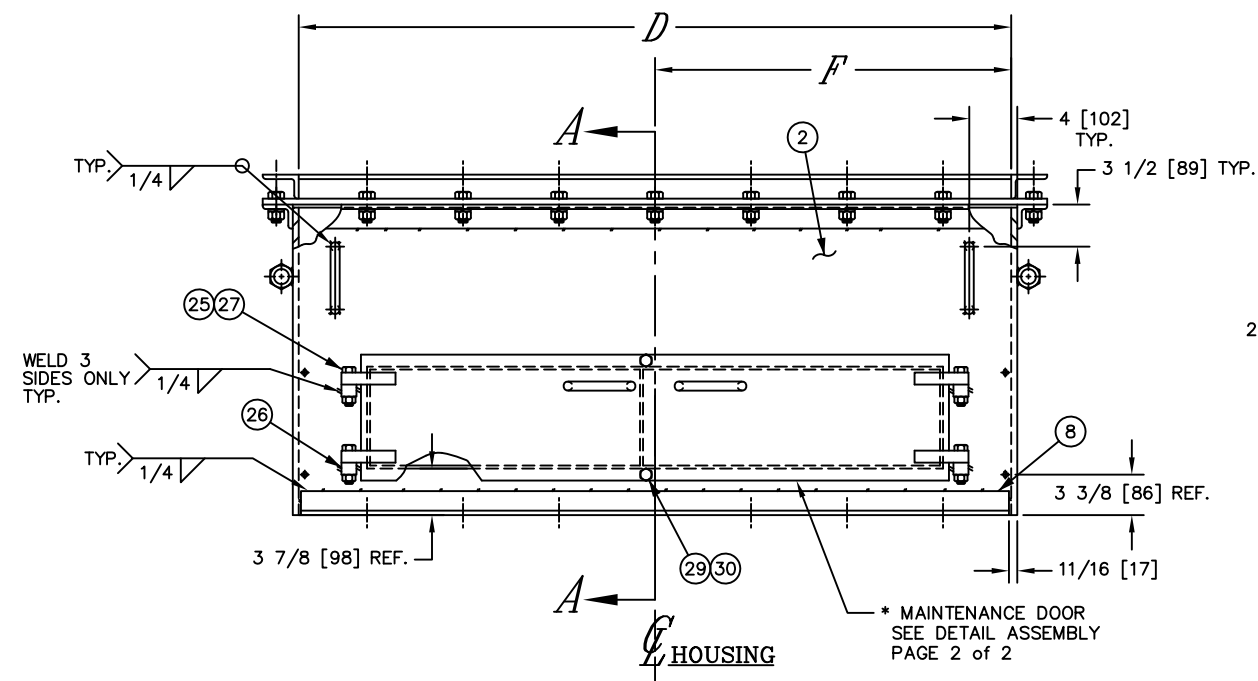
- ▶ Check wear on the slope plates and center section liners. If holes are worn in these areas, material can pass the rolls, creating oversize. Note: When fine crushing, the slope plate distance from the roll teeth should be no greater than the size you are trying to produce.
- ▶ Check slot closures for alignment. They should be tight against the housing.

CAUTION: Always lockout & tagout machine if work or cleaning is performed.

SPOOL PIECE INLET (ITEM 16) NOT
SHOWN IN THIS VIEW FOR CLARITY



SECTION A-A



SIZE	HOUSING ASSY. No.	DIM. <i>B</i>		DIM. <i>C</i>		DIM. <i>D</i>		DIM. <i>E</i>		DIM. <i>F</i>		DIM. <i>G</i>		<i>G</i>	APPROX. WT.		
		IN.	MMS.	IN.	MMS.	IN.	MMS.	IN.	MMS.	IN.	MMS.	IN.	MMS.		LBS.	KGS.	
40	E203-0084-A00D	43	1/8	1095	40 3/8	1026	39 3/8	1000	39	991	19 11/16	507	14 1/2	368	C00B	1315	596
50	E203-0084-B00D	53	1/8	1349	50 3/8	1280	49 3/8	1254	49	1245	24 11/16	627	19 1/2	495	D00B	1550	703
60	E203-0084-C00D	63	1/8	1603	60 3/8	1534	59 3/8	1508	59	1499	29 11/16	754	24 1/2	622	E00B	1785	810

3 ALL WELDS TO BE CONTINUOUS.

2) APPROX. WT. - SEE CHART.
1) DIMS IN BRKT'S ARE IN MMS.

NOTES—

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* DETAILS ON PAGE 2 OF 2

○			
○			
○			
○			
○			
○			
SYN.	REVISION	DATE	BY
REVISION			

3	35	--	--	--	-----	WELD WIRE SA 71V
*	34	1	--	1	9B0420	2.500 x 2 x .375 ANG. x 13.250
	33	2	2	2	E203-5109-000B	SCALLOP PLATE - SIDE LINER
	32	2	2	2	E203-5108- C	SLOPE SHEET LINER
	31	8	8	8	7005575	HANDLE
	30	4	4	4	1N04160	MLW .625 DIA.
	29	4	4	4	1110701	HHCS .625 NC x 1
	28	8	8	8	E403-5110-000A	HINGE
	27	8	8	8	1M13071	SLHN .625 NC (SECURITY)
	26	8	8	8	A0-2252-00	HINGE TAB
	25	8	8	8	1110709	HHCS .625 NC x 3
	24	30	34	38	1N04180	MLW .750 DIA.
	23	30	34	38	1M11081	HNSF .750 NC
<TYP.	22	30	34	38	1110805	HHCS .750 NC x 2
	21	4	4	4	1N04260	MLW 1.250 DIA.
	20	4	4	4	1M11121	HNSF 1.250 NC
	19	2	2	2	A0-2132-00	LONG COLLAR
	18	4	4	4	A0-2133-00	SHORT COLLAR
	17	2	2	2	A0-2106-A0	BAR CLASP
	16	1	1	1	E203-5068- C	SPOOL PIECE INLET
*	15	2	2	2	9B0340	2 x 2 x .375 ANG. x 14.500
*	14	2	2	2	9B0420	2.500 x 2 x .375 ANG. x C
*	13	1	1	1	9B0420	2.500 x 2 x .375 ANG. x 18.375
*	12	1	1	1	9B0420	2.500 x 2 x .375 ANG. x 18.375
*	11	1	1	1	9B0420	2.500 x 2 x .375 ANG. x 13.250
*	10	1	1	1	9B0420	2.500 x 2 x .375 ANG. x 13.250
*	9	1	1	1	9B0420	2.500 x 2 x .375 ANG. x 13.250
*	8	2	2	2	9B0420	2.500 x 2 x .375 ANG. x E
*	7	2	2	2	9T01A20	PL - .375 x 10.500 x Q
	6	2	2	2	9T01A20	PL - .375 x 10.500 x Q
	5	2	2	2	9T01A20	PL. - .375 x 9.375 x 11.500
	4	2	2	2	9T01A20	PL. - .375 x 11.500 x 13.250
	3	2	2	2	9T01A20	PL. - .375 x 11.500 x D
*	2	2	2	2	9T01A20	PL. - .375 x 25.625 x C
*	1	2	2	2	9T02A20	PL. - .500 x 25.625 x 39.375

ITEM	40	50	60	PART NO.	DESCRIPTION
	SIZE & QTY.				
TOLERANCES EXCEPT AS NOTED DECIMAL ±.015 FRACTIONAL ±1/32 ANGULAR ±1/4°				GUNDLACH GUNDLACH EQUIPMENT CORPORATION BELLEVILLE, IL, U.S.A.	
MATERIAL					
DWG. No. 300841.dwg REVISIONS				SCALE 1/8"=1" DRAWN BY R. ALVEY APPROVED BY <i>AKK</i>	
DATE		TITLE 200S (40-60) CRUSHER – HOUSING ASSEMBLY w/ MAINT. DOORS, LINERS & SPOOL PIECE INLET			
ASSEMBLY		DATE 10-10-12	DRAWING NUMBER F203-0084-000D		PAGE 1 OF 2

FOR USE WITH 15" NOMINAL DIA. ROLLS
(SMOOTH, HERRINGBONE, & PIN TOOTH)

GÜNDLÄCH

DRIVE & GUARD



CRUSHER DRIVE INFORMATION

NAME		Longfu Power Plant										
ADDRESS		Beijing, China										
PURCHASE ORDER #		2014071601					SERIAL #		2040S2793			
<u>MOTOR SPECIFICATION</u>												
BY GUNDLACH					☒		BY CUSTOMER					
ONE REQUIRED					☒		TWO REQUIRED					
<u>ADJUSTABLE (BY OTHERS)</u>												
MOTOR PART #				HP			RPM			FRAME		
SHAFT DIA.			KW			SERIAL				MFG		
VOLTS												
<u>STATIONARY (BY OTHERS)</u>												
MOTOR PART #				HP			RPM			FRAME		
SHAFT DIA.			KW			SERIAL				MFG		
VOLTS												
<u>DRIVE BELT DATA</u>												
☒		BY GUNDLACH					☒		BY CUSTOMER			
☒		ONE REQUIRED					☒		TWO REQUIRED			
<u>ADJUSTABLE</u>												
DRIVE SHEAVE PART # 4Y03085		GROOVES		3		SECT.	5V	DIA	8.5"	SHAFT DIA.	48mm	
DRIVEN SHEAVE PART # 4Y03280		GROOVES		3		SECT.	5V	DIA	28"	SHAFT DIA.	2.937"	
PART # 69FM0481		BUSHING		SF		48mm BORE IRON- DRIVE SHEAVE						
BELT PART# 435V1700		SECTION		5V		SIZE	1700	C-C	55.5	RATIO	1:3.28	
<u>STATIONARY</u>												
DRIVE SHEAVE PART # 4Y03085		GROOVES		3		SECT.	5V	DIA	8.5"	SHAFT DIA.	48mm	
DRIVEN SHEAVE PART # 4Y03280		GROOVES		3		SECT.	5V	DIA	28"	SHAFT DIA.	2.937"	
PART # 69FM0481		BUSHING		E		2.937" BORE IRON - DRIVE SHEAVE						
BELT PART# 435V1800		SECTION		5V		SIZE	1800	C-C	60.5	RATIO	1:3.28	
REMARKS:												
Manual Slide Base P/N: 3300010												
Automatic Slide Base P/N: 3300009S												
<u>BUSHING TORQUE INFORMATION:</u>												
"SF" – 30 ft lbs												
"E" – 60 ft lbs												

GUNDLACH

ROLL CRUSHER

PREVENTATIVE MAINTENANCE

MAIN DRIVE

NOTE: Be sure to wear the proper safety equipment such as safety glasses, safety shoes, hard hats and ear protection at all times while near the equipment. Do not operate the crusher without feed hopper and discharge hopper installed and properly sealed.

1.0 DAILY (24 hours)

- ▶ Check V belts for proper tension.
- ▶ Check for loose motor base bolts.
- ▶ Make sure spring loaded motor base is free of material.
- ▶ Make sure the drive guard covers all rotating components.

2.0 WEEKLY (168 hours)

- ▶ Check for worn or damaged pulley and bushing.
- ▶ Check for motor amperage to verify the crusher is not overloaded.
- ▶ Check the speed sensor for proper signal and air gap.
- ▶ Check bearing blocks, gearbox (if applicable), and secondary drive (if applicable) for excessive heat. For temperatures levels refer back to the lubrication section of this manual.

CAUTION: Always lockout & tagout machine if work or cleaning is performed.

GUNDLACH

CRUSHER GUARDS

NOTE: Be sure to wear the proper safety equipment such as safety glasses, safety shoes, hard hats and ear protection at all times while near the equipment. Do not operate the crusher without the feeding and discharge systems properly installed and sealed.

The various guards of this crusher and drive components fulfill a variety of functions

- ▶ The prevention of access which may cause bodily injury due to crushing, cutting, severing, drawing in, trapping, entanglement, or shearing.
- ▶ Containment of hazards such as the force of ejection of part of a drive component or in-process material.

Notes:

- ▶ The crusher and drive components are never to be operated without their guards properly fastened and in place.
- ▶ Do not remove any guards or perform any work or cleaning until all components have come to a complete stop and all energy sources are isolated and at a zero energy state. Observe all warning labels.

GUNDLACH

ELECTRICAL INTERLOCK OF CRUSHER DRIVES ON TWO-MOTOR DRIVE UNITS

THE CRUSHER YOU HAVE BEEN QUOTED OR HAVE PURCHASED IS POWERED BY TWO SEPARATE ELECTRIC MOTORS. THE FOLLOWING INTERLOCKS MUST BE MADE THROUGH YOUR CONTROL CIRCUITRY TO INSURE THAT YOUR CRUSHER OPERATES AT ITS OPTIMUM PERFORMANCE LEVEL.

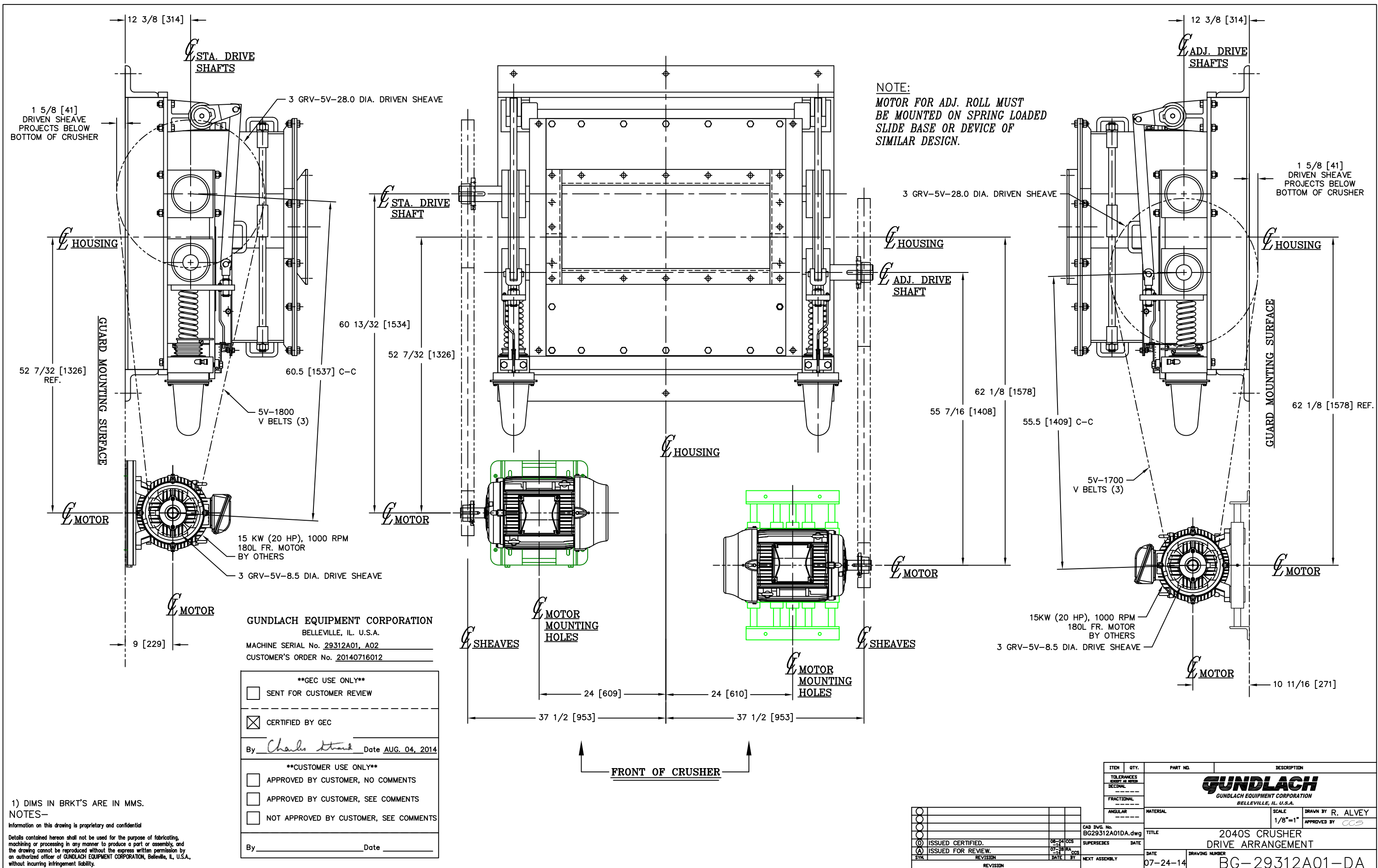
- 1.0 EACH DRIVE IS OR "SHOULD BE" FITTED WITH AN UNDERSPEED SWITCH THAT MONITOR ROLL SPEED. AT A LOSS OF 10% OF THE OPERATING ROLL SPEED, THE SPEED SWITCH WILL DISENGAGE. EACH SPEED SWITCH SHOULD BE INDIVIDUALLY INTERLOCKED WITH ITS OWN MOTOR. SET TO DE-ENERGIZE WHEN THIS UNDERSPEED CONDITION OCCURS.

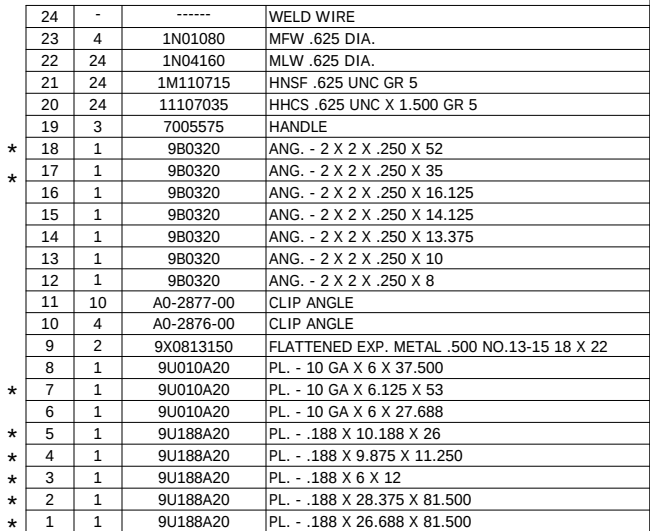
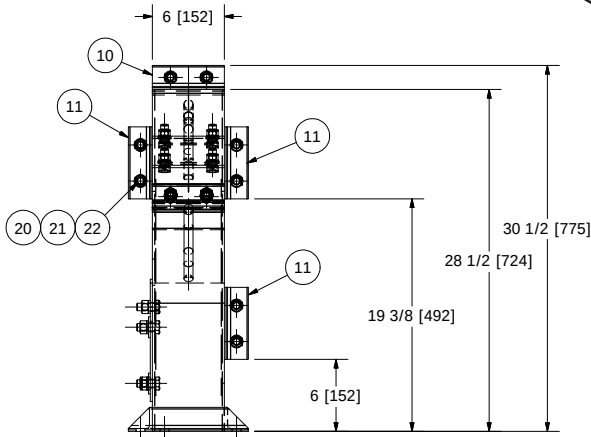
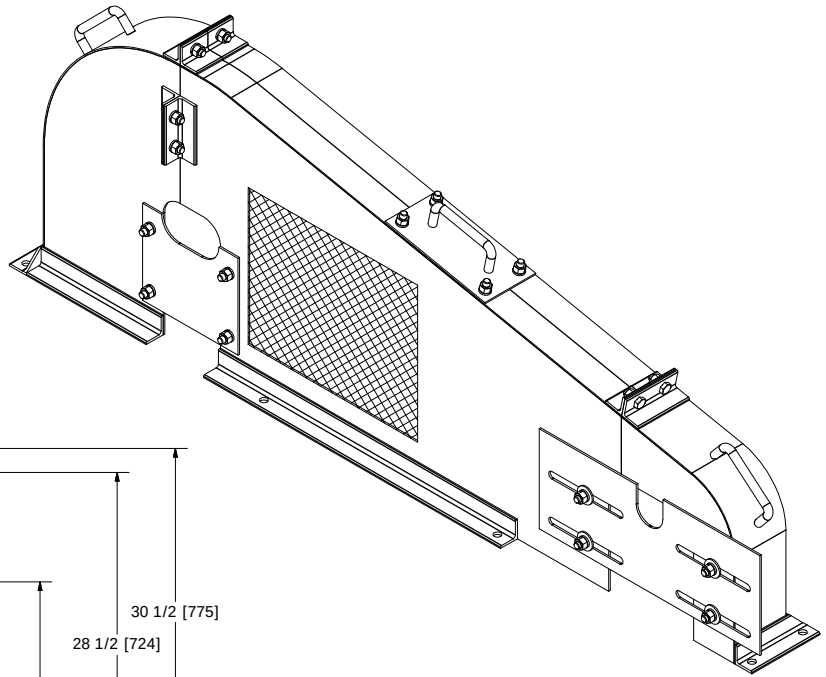
NOTE: SUCH UNDERSPEED DEVICES ARE AVAILABLE FROM GUNDLACH AS OPTIONAL EQUIPMENT.

- 2.0 IN ADDITION, THE MOTORS AND FEEDING DEVICE MUST BE INTERLOCKED IN SUCH A WAY THAT IF ONE CRUSHER MOTOR IS SHUT DOWN, BOTH THE OTHER CRUSHER MOTOR AND THE FEEDING DEVICE DRIVES ARE ALSO SHUT DOWN.

FAILURE TO DO SO COULD RESULT IN THE CRUSHER BECOMING "BURIED" OR CREATE THE POTENTIAL FOR EXTENSIVE DAMAGE TO OCCUR.

A FURTHER POINT, OPERATION OF THE CRUSHER WITH ONE MOTOR DEACTIVATED WHILE THE OTHER CRUSHER MOTOR CONTINUES TO OPERATE, WILL RESULT IN AN INABILITY OF THE MACHINE TO HANDLE THE QUOTED TONNAGE.

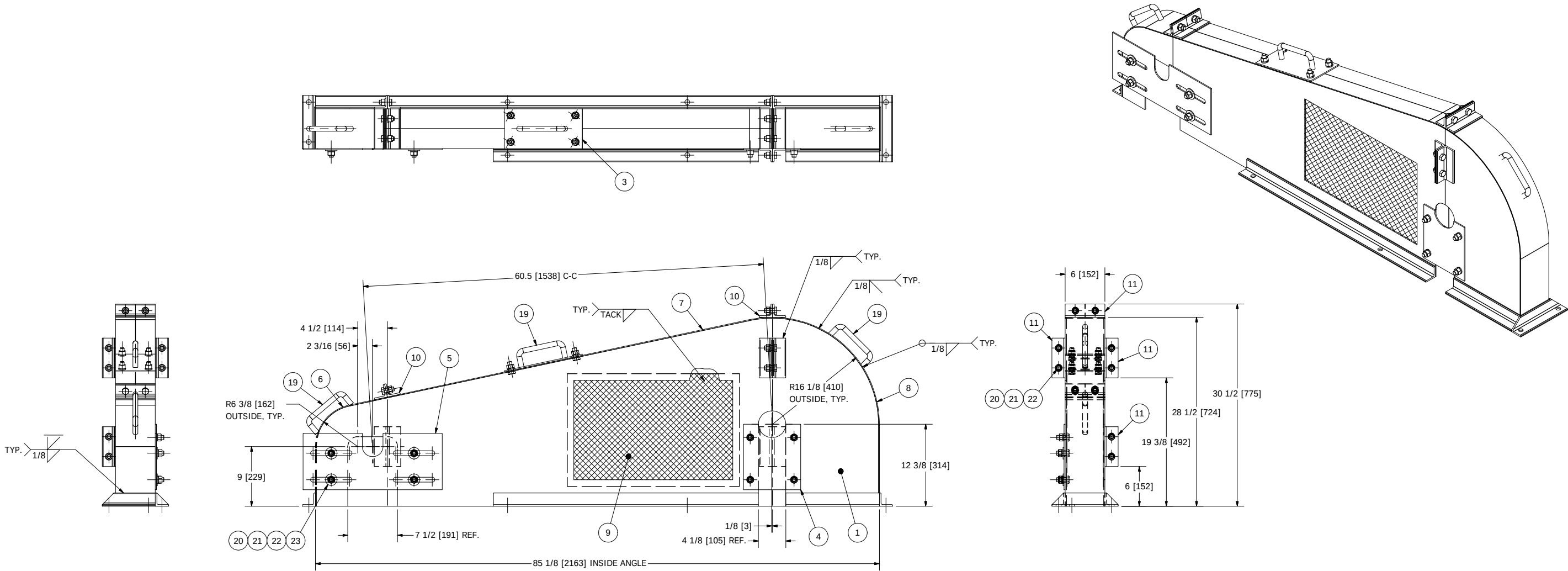




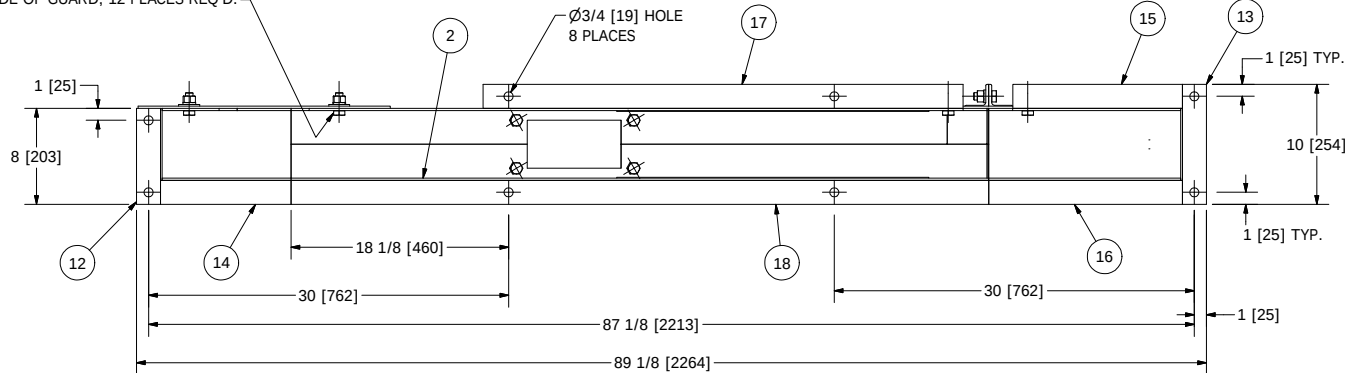
* DETAILS ON SHEET 2 OF 2

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				CAD DWG. No.	TITLE	
					DRIVE GUARD - ADJUSTABLE 2040S CRUSHER - 29312A01, A02	
☐ ISSUED CERTIFIED.	08/04/14	CCS	SUPERSEDES DATE			
☒ ISSUED FOR REVIEW.	07/28/14	BA/CCS				
DTM.	REVISION	DATE	BY	NEXT ASSEMBLY		
REVISION				7/26/2014	BG-29312A01A-00	
					INV.	SHEET 1 OF 2



NOTE:
WELD HEAD OF BOLT (ITEM 20) TO
INSIDE OF GUARD, 12 PLACES REQ'D.



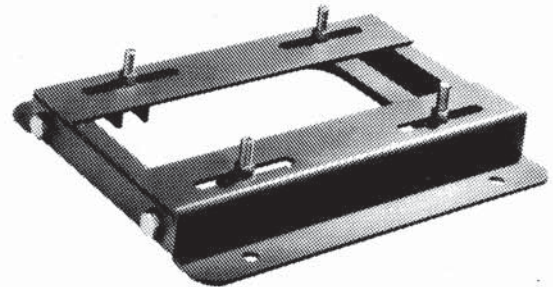
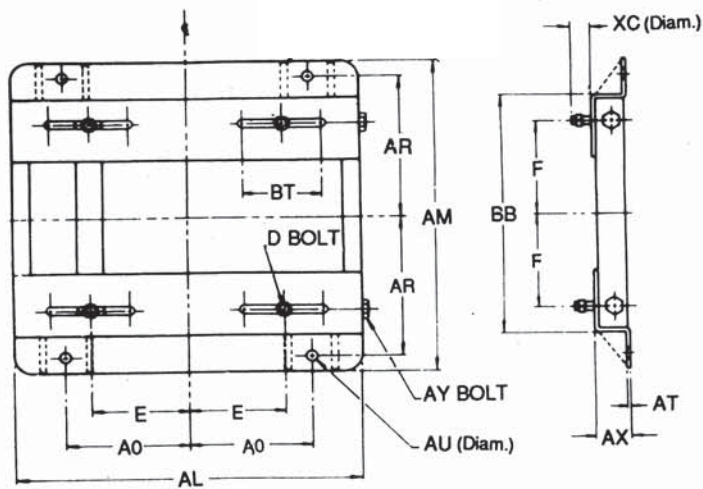
* DETAILS ON SHEET 2 OF 2

NOTES:
1) DIMENSION IN BRACKET'S ARE IN MM'S
2) APPROXIMATE WEIGHT 280 LBS. - 127 KGS
3) GUARD TO MEET APPLCABLE OSHA STANDARDS.
INTERNAL MOVING PARTS WILL BE LESS THAN 4" FROM GUARD.

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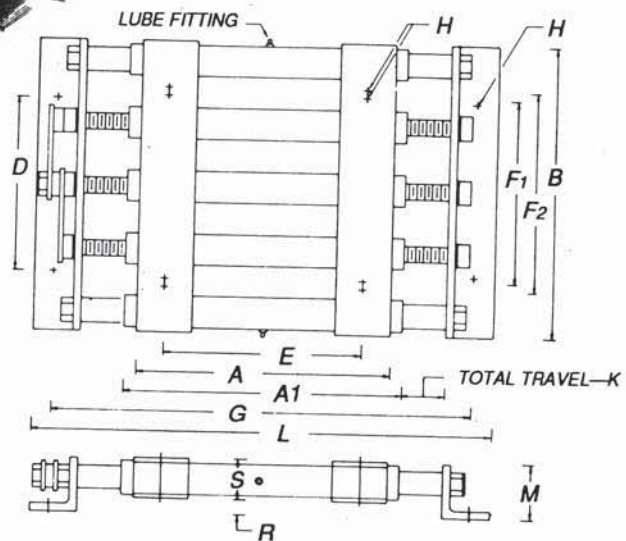
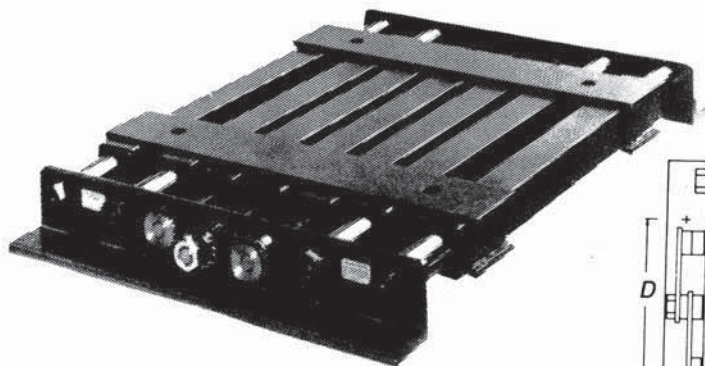
ISSUED CERTIFIED.	06/04/14	CCS	SUPERSEDES	DATE
ISSUED FOR REVIEW.	07/28/14	RAV/CCS	DATE	BY
SYN.	REVISION	DATE	BY	NEXT ASSEMBLY
REVISION				
CAD DWG. NO.				
TITLE				
DATE				
DRAWING NUMBER				
7/25/2014				
BG-29312A01S-00				
SHEET				
1 OF 2				

24	--	-----	WELD WIRE
23	4	1N01080	MFW .625 DIA.
22	24	1N04160	MLW .625 DIA.
21	24	1M110715	HNSF .625 UNC GR 5
20	24	11107035	HHCS .625 UNC X 1.500 GR 5
19	3	7005575	HANDLE
* 18	1	9B0320	ANG. - 2 X 2 X .250 X 58.125
* 17	1	9B0320	ANG. - 2 X 2 X .250 X 40
16	1	9B0320	ANG. - 2 X 2 X .250 X 16.125
15	1	9B0320	ANG. - 2 X 2 X .250 X 14.125
14	1	9B0320	ANG. - 2 X 2 X .250 X 10.875
* 13	1	9B0320	ANG. - 2 X 2 X .250 X 10
* 12	1	9B0320	ANG. - 2 X 2 X .250 X 8
11	10	A0-2877-00	CLIP ANGLE
10	4	A0-2876-00	CLIP ANGLE
9	2	9X0813150	FLATTENED EXP. METAL .500 NO.13-15 17 X 26
8	1	9U010A20	PL. - 10 GA X 6 X 37.500
* 7	1	9U010A20	PL. - 10 GA X 6.125 X 59.375
6	1	9U010A20	PL. - 10 GA. X 6 X 23.500
* 5	1	9U188A20	PL. - .188 X 8.500 X 21
* 4	1	9U188A20	PL. - .188 X 8.625 X 9.875
* 3	1	9U188A20	PL. - .188 X 6 X 12
* 2	1	9U188A20	PL. - .188 X 28.375 X 85.125
* 1	1	9U188A20	PL. - .188 X 28.375 X 85.125
ITEM	QTY	PART NO.	DESCRIPTION
TOLERANCES (EXCEPT AS NOTED)			
DECIMAL			
+/- .015			
FRACTIONAL			
+/- 1/32			
ANGULAR			
+/- 1/4°			
MATERIAL			
SCALE			
1/8"=1"			
DRAWN BY: R. ALVEY			
APPROVED BY: CCS			
GUNDLACH			
GUNDLACH EQUIPMENT CORPORATION			
BELLEVILLE, IL, U.S.A.			
TITLE			
DRIVE GUARD - STATIONARY			
2040S CRUSHER - 29312A01,A02			
DATE			
7/25/2014			
DRAWING NUMBER			
BG-29312A01S-00			
SHEET			
1 OF 2			



FRAME & PART NO.	AL	AM	AX	BB	E	F	A0	AR	AU	BT	AT	XC	D BOLT	AY BOLT	APPROX. WT. (LBS)
286B2 [inches]	19-3/4	18-3/8	2	14	5-1/2	5-1/2	7	8-1/4	5/8	4-1/2	3/16	1-5/8	1/2x2	5/8x9	22
180L [mm]	502	467	51	356	140	140	178	210	16	114	5	41	SAME	SAME	10(KGS)

****NOTE: METRIC UNITS ARE BEING SHOWN FOR CLARITY. MOTOR BASE IS BUILT USING US STANDARDS.****



				A	A ₁	B	D	E	F ₁	F ₂	G	H	K	L	M	R	S	WT.
Horizontal																		

		.286	20 HP	14	16 ¹ / ₄	17 ⁵ / ₈	10 ¹ / ₄	11	9 ¹ / ₂	11	26	9 ¹ / ₁₆	7	28 ¹ / ₄	3 ¹ / ₁₆	13 ¹ / ₁₆	27 ⁷ / ₈	90	[inches]
		180L	15 KW	356	413	448	260	279	241	279	660	14	178	718	77	21	73	41(KGS)	[mm]

NOTE: METRIC UNITS ARE BEING SHOWN FOR CLARITY. MOTOR BASE IS BUILT USING US STANDARDS.

Installation & Maintenance of V-Belt Drives



TB Wood's

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

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

In April 2007, TB Wood's was purchased by Altra Holdings, Inc. This acquisition placed TB Wood's as part of a larger company with complementary products to help grow the business.



Altra Industrial Motion

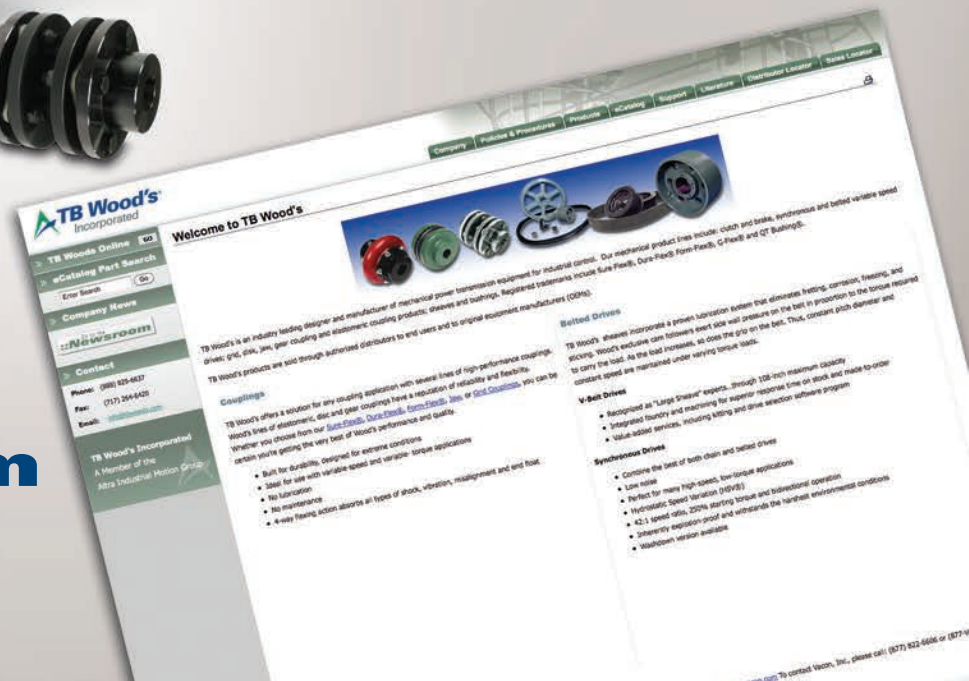
Altra is a leading multinational designer, producer and marketer of a wide range of mechanical power transmission products. We sell our products in over 70 countries throughout the world. Our products are frequently used in critical applications, such as fail-safe brakes for elevators, wheelchairs and forklifts, and in high-volume manufacturing processes, where the reliability and accuracy of our products are critical in both avoiding costly down time and enhancing the overall efficiency of manufacturing operations.

Our products are marketed under a variety of well recognized and established manufacturing brand names. These leading brands are Ameridrives, Boston Gear, Warner Electric, Formsprag Clutch, TB Wood's Incorporated, Industrial Clutch, Kilian Manufacturing, Marland Clutch, Nuttall Gear, Stieber Clutch, Twiflex Ltd, Huco Dynatork, Bibby Turboflex, Matrix International, Inertia Dynamics, Delroyd Worm Gear, Warner Linear, Wichita Clutch and Lamiflex Couplings.



Visit us on the web at

tbwoods.com



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

Inspection and Maintenance

V-Drive Inspection and Maintenance Procedures

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

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

Inspection while running

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

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

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

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

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

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

Inspect sheaves often

Keep all sheave grooves smooth and uniform. Burrs and rough spots along the sheave rim can damage belts. Dust, oil and other foreign matter can lead to pitting and rust and should be avoided as much as possible. If sheave sidewalls are permitted to "dish out," as shown in the picture on page 2, the bottom "shoulder" ruins belts quickly by chewing off their bottom corners. Also, the belt's wedging action is reduced and it loses its gripping power.

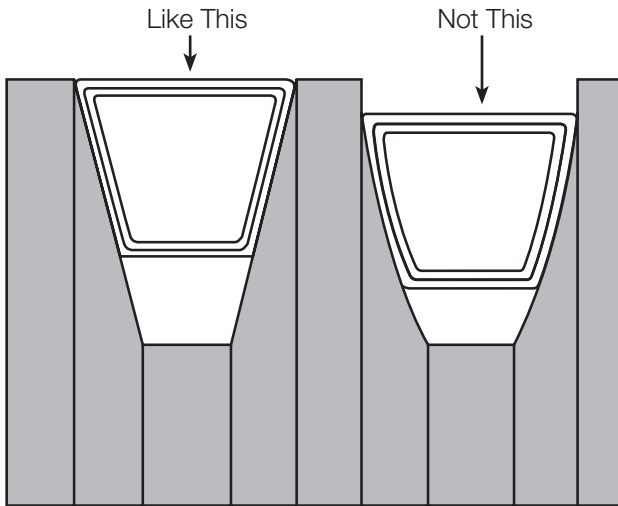
A shiny groove bottom indicates that either the sheave, the belt or both are badly worn and the belt is bottoming in the groove.

Badly worn grooves cause one or more belts to ride lower than the rest of the belts, and the effect is the same as with mismatched belts. This is called "differential driving." The belts riding high in the grooves travel faster than the belts riding low. In a drive under proper tension, a sure sign of differential driving is when one or several belts on the tight side are slack.

Check alignment of drive. Sheaves that are not aligned properly cause excessive belt and sheave wear. When the shafts are not parallel, belts on one side are drawn tighter and pull more than their share of the load. These overloaded belts wear out faster, reducing the service life of the entire set. If the misalignment is between the sheaves themselves, belts will enter and leave the groove at an angle, causing excessive wear and sheave wear and premature failure. See page 10 for complete information on drive alignment.

V-Drive Inspection and Maintenance Procedures

Sheave Grooves must be

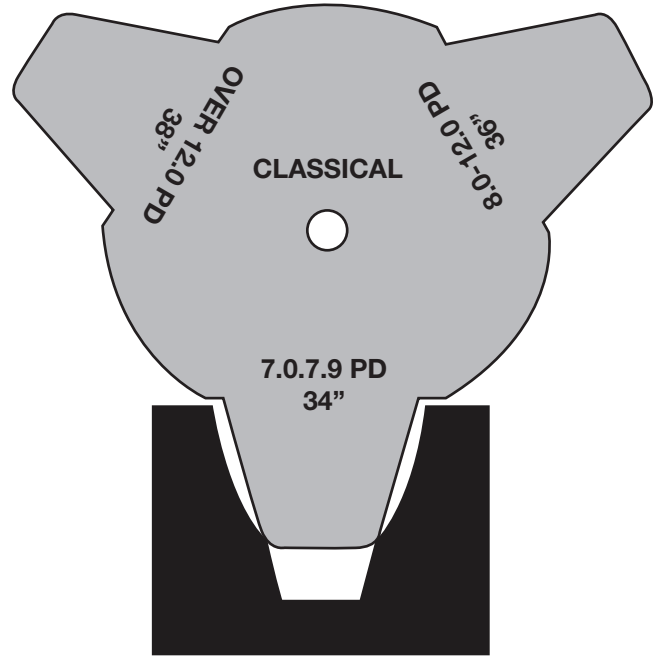
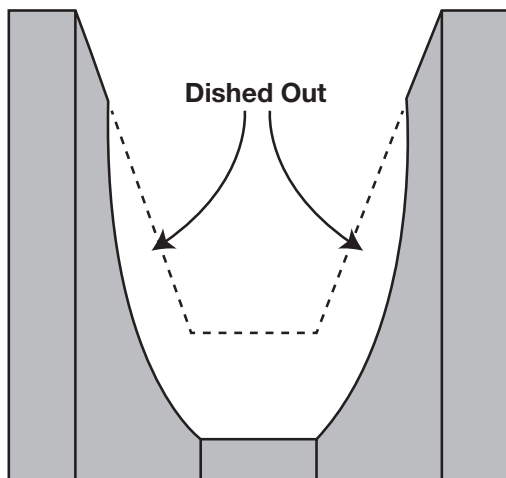


Belts and Sheave Gages

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

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

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



Groove Gage

Check Belt Fit

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

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

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

Inspection and Maintenance

V-Drive Inspection and Maintenance Procedures

Keep Belts Clean

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

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

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

Use Belt Guards

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

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

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

Check your Hot Bearings

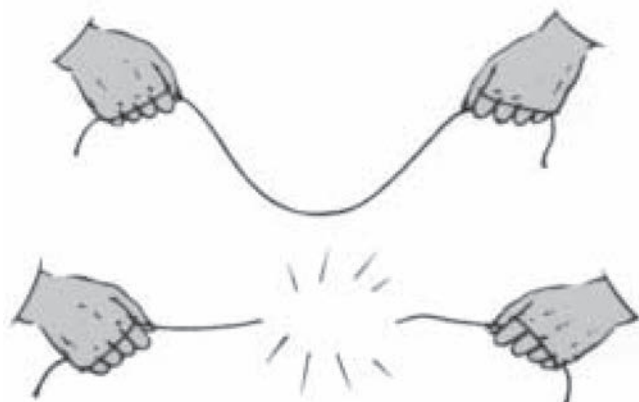
When the drive has been stopped for inspection, check the bearings to make sure they are not running hot. If they are, it could be due to improper lubrication or improper drive tension. Hot bearings can be caused by belts that are either too tight or too loose. Check the tension carefully using the instructions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

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

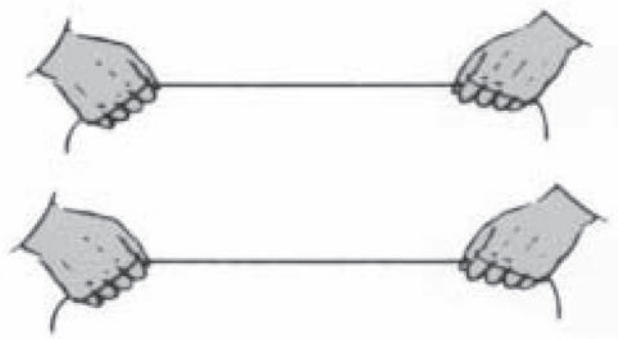
Maintain Proper Belt Tension

Maintaining correct tension is the most important rule of V-belt care. It will give the belts 50% to 100% longer life.

Belts that are too loose will slip, causing excessive belt and sheave wear. V-belts that sag too much are snapped tight suddenly when the motor start or when peak loads occur. That snapping action can actually break the belts, because the added stress is more than the belt was designed to take. This can be clearly demonstrated with a piece of string, as illustrated.



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



Selecting the Correct Belts

Selecting the Correct Belts

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

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

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

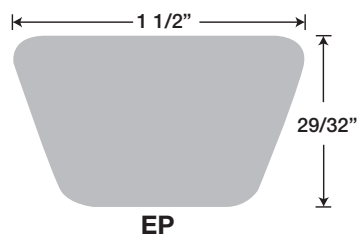
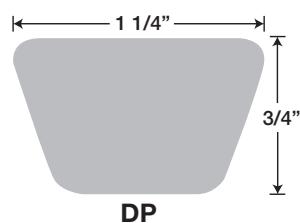
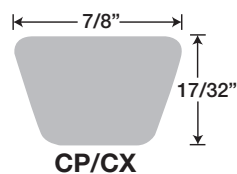
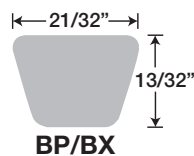
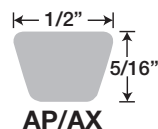
The belt number C270 indicates a belt with a nominal 7/8" top width and a nominal length of 270". Its pitch length is 270.9". These should be ordered as: CP270 Classical belts. (The "P" is for Wood's Premium construction.)

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

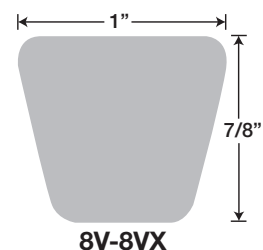
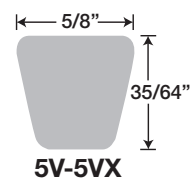
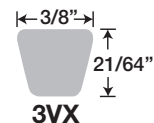
The number 4L550 indicates a Light Duty fractional horsepower belt having a nominal top width of 1/2" and a nominal outside length of 55". Light Duty belts are available for general purpose applications; specify 4L550 Light Duty. It is designed to have little or no stretch and will require few take-ups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

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

Classical Belts



Narrow Belts



Belt Selection

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

*Not applicable to Light Duty Belts

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

All Belts "ORS"

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

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

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

For maximum performance from belts in oily atmospheres, they should be guarded as much as

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

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

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

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

In the standard method of measuring a belt's electrical resistivity, two 5/8" diameter flat contacts are placed 81/2" apart on centers, moistened with water and pressed against the belt with a force of 121/2 lbs. The resistance "conductivity" between the contacts is measured with an ohmmeter operating at a potential of 500 volts and having an accuracy range from 0 to 10 megohms. Experience has demonstrated that the dissipation provided by belts having a resistance of 6 megohms or less "when new and measured as above" is satisfactory for operation in hazardous atmospheres.

Explosive Atmospheres

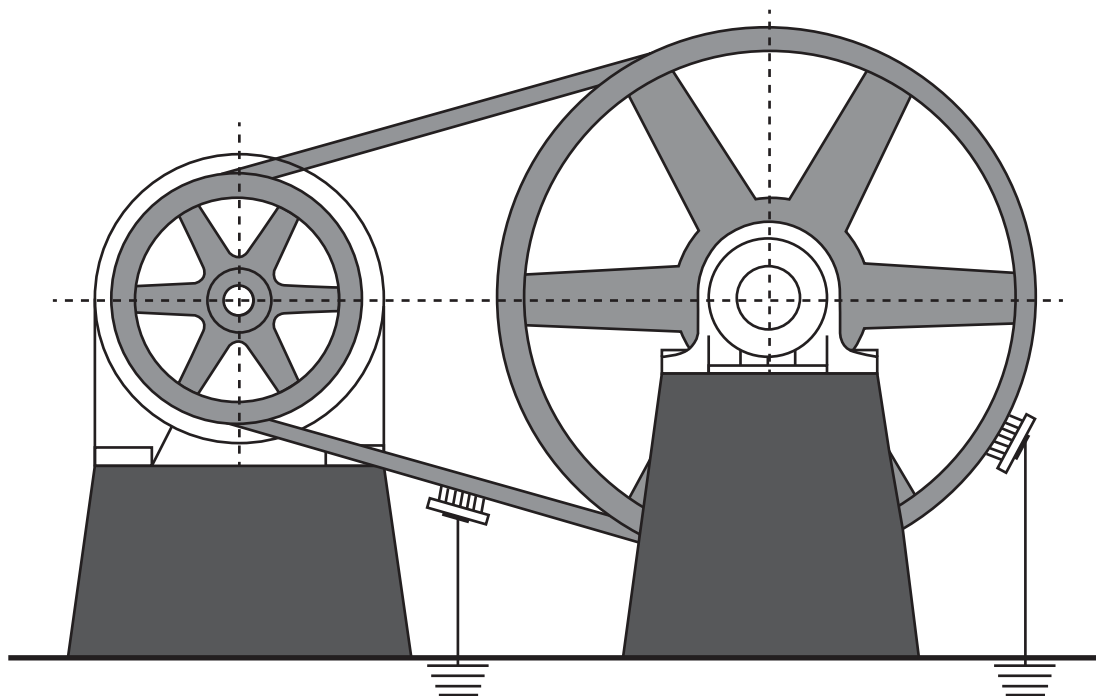
Belts on drives in hazardous atmospheres should be kept reasonably free of encrusted accumulations of non conducting materials. In addition, all elements of the drive must be interconnected and grounded to earth as illustrated below.

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

Store Belts Properly

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

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



Proper V-drive installation in explosive atmospheres

Safety Tips

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

Guard all Drives Properly

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

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

Check Safe Speed Limits

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

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

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



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



Sure-Grip® Sheaves and Brushing Installation Instructions

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

To Install:

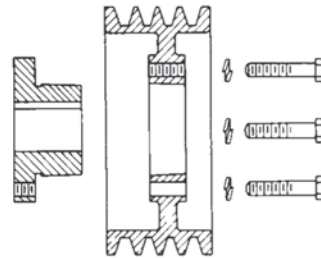
IMPORTANT: DO NOT USE LUBRICANTS IN THIS INSTALLATION

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

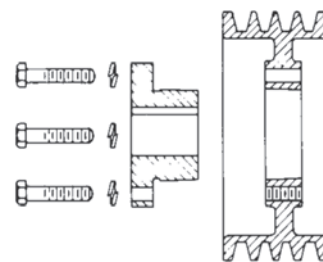
1. Inspect the tapered bore of the sheave and the tapered surface of the bushing. Any paint, dirt, oil or grease **MUST** be removed.
2. Select the type of mounting (See Fig. 1 or 2) that best suits your application.
3. **STANDARD MOUNTING:** Install shaft key. (Note: If key was furnished with bushing, you must use that key.) Install bushing on clean shaft, flange end first. If bushing will not freely slide on the shaft, insert a screwdriver or similar object into the flange sawcut to act as a wedge to open the bushing's bore. **Caution: Excessive wedging will split the bushing.** If using the setscrew, tighten it just enough to prevent the bushing from sliding on the shaft. **Caution: Do not over tighten setscrew!** Slide sheave into position on bushing aligning the drilled holes in the sheave with the tapped holes in the bushing flange. (Note: Install M thru S bushings so that the two tapped holes in the sheave are located as far away as possible from the bushing's sawcut.) Loosely thread the capscrews with lockwashers into the assembly.

DO NOT USE LUBRICANT ON THE CAPSCREWS!

4. **REVERSE MOUNTING:** With large end of the taper out, slide sheave onto shaft as far as possible. Install shaft key. (See shaft key note in #3 above.) Install bushing onto shaft so tapered end will mate with sheave. (See wedging note in #3 above.) If using the



Standard Mounting
Fig. 1



Reverse Mounting
Fig. 2

setscrew, tighten it enough to prevent the bushing from sliding on the shaft. **Caution: Do not tighten setscrew!** Pull the sheave up on the bushing, aligning the drilled holes in the bushing flange with the tapped holes in the sheave. Loosely thread the capscrews with lockwashers into the assembly.

DO NOT USE LUBRICANT ON THE CAPSCREWS!

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

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

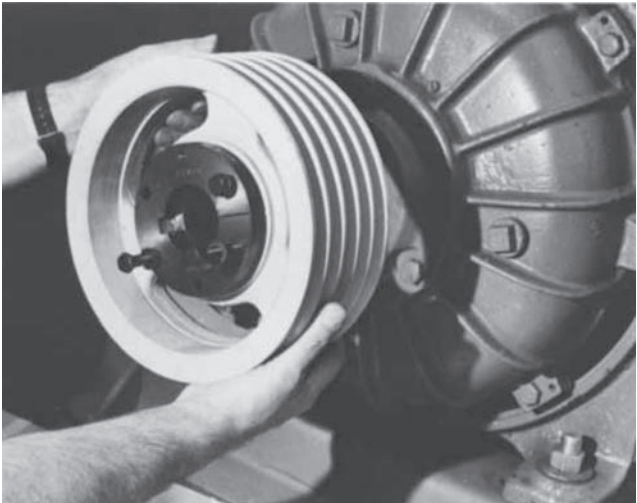
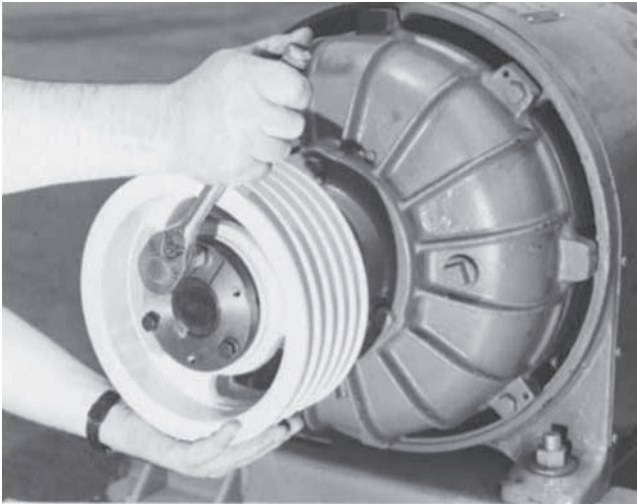
Drive Installation

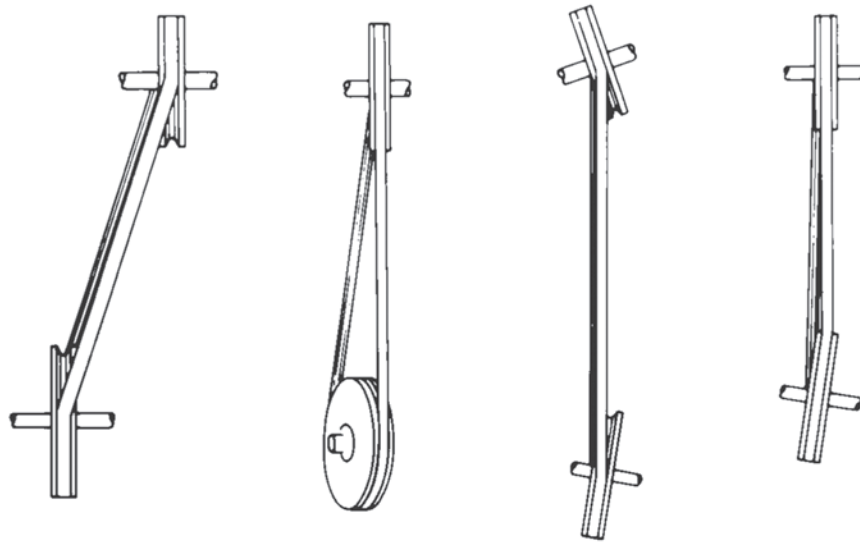
To Remove:

1. Relieve drive tension by shortening the center distance between driver and driven sheaves.
2. Lift off belts.
3. Loosen and remove cap screws. If the bushings have keyway setscrews, loosen them.
4. As shown below, insert cap screws (three in JA through J bushings, two in QT and M thru W bushings and four in S bushing) in tapped removal holes and progressively tighten each one until mating part is loose on bushing. (Exception: If mating part is installed with cap screws heads next to motor, with insufficient room to insert screws in tapped holes, loosen cap screws and use wedge between bushing flange and mating part.)
5. Remove mating part from bushing, and if necessary, bushing from shaft.

Sure-Grip Bushing Screw Tightening Information

Tapered Bushing	Size & Thread of Cap Screw	Ft.-Lbs. To Apply with Torque Wrench
QT	1/4 - 20	9
JA	No. 10 - 24	5
SH-SDS-SD	1/4 - 20	9
SK	5/16 - 18	15
SF	3/8 - 16	30
E	1/2 - 13	60
F	9/16 - 12	110
J	5/8 - 11	135
M	3/4 - 10	225
N	7/8 - 9	300
P	1 - 8	450
W	1 1/8 - 7	600
S	1 1/4 - 7	750
CAUTION: The tightening force on the screws is multiplied many times by the wedging action of the tapered surface. If extreme tightening force is applied, or if a lubricant is used, bursting pressures will be created in the hub of the mating part.		





Check Alignment

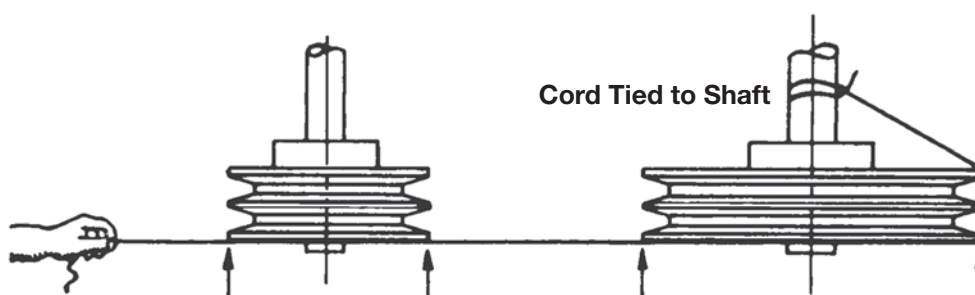
Although alignment is not as critical in V-belt drives as in others, proper alignment is essential to long belt and sheave life.

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

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

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

With sheaves aligned, tighten cap screws evenly and progressively. Apply the recommended torque to cap screws as listed in table on page 9. NOTE: There should be 1/8" to 1/4" gap between the mating part hub and the bushing flange. If the gap is closed, the shaft is seriously undersize.



Cord Touching Sheaves at Points Indicated by Arrows

Drive Installation

Install Belts

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

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

NOTE: Never “roll” or “pry” the belts into the sheave grooves. This can damage the belt cords and lead to belt turnover, short life or actual breakage. Moreover, it is both difficult and unsafe to install belts this way.

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

No!



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

Yes!



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

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

Narrow Belt

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

Classical Belts

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

Tensioning V-Belt Drives

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

General Method

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

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

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

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

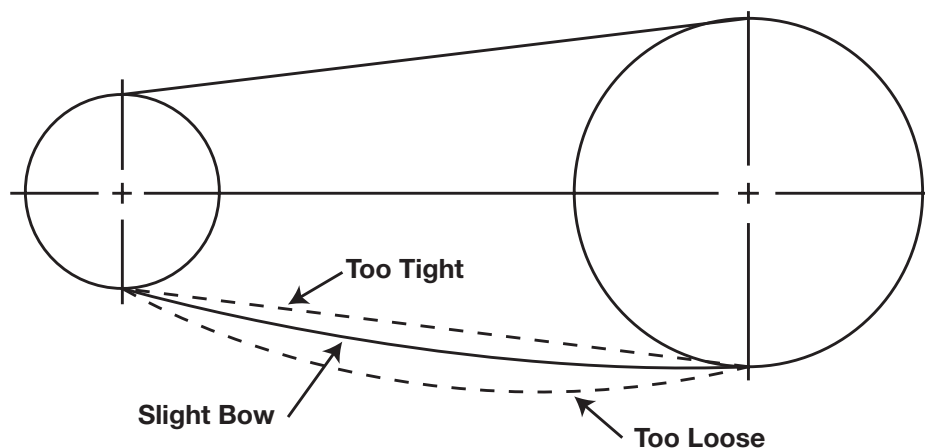


Figure 1

Tensioning the Drive

Force Deflection Method

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

Step 1: Install belts per Step 1 of General Method.

Measure span length (t) in inches as shown in figure 2, or calculate using formula.

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

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

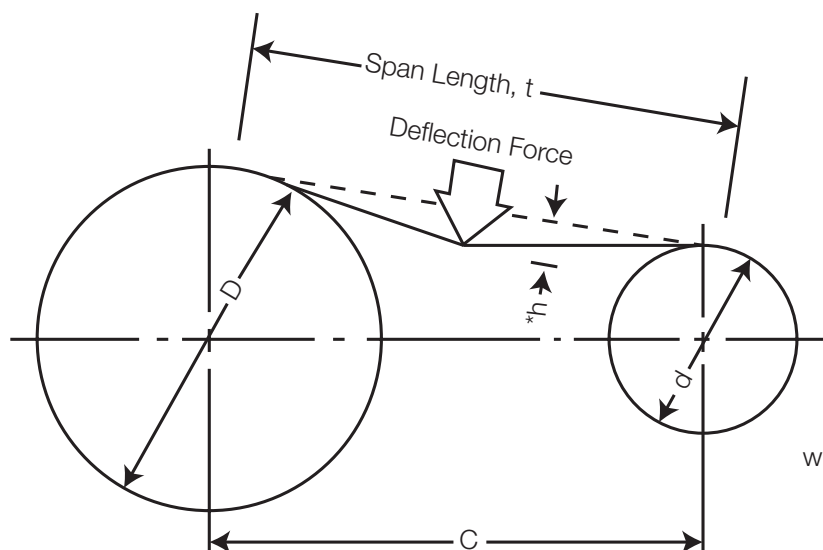
Step 4: Using a spring scale, apply a perpendicular force to any ONE of the belts at the mid point of the span as shown in figure 2. Compare this deflection force with the values found in Step 3.

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

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

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

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



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

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

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

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

Figure 2

Table 1
Recommended Minimum Force per Belt

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

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

Belt Elongation Method

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

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

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

Table 2
K Factors and Arc of Contact

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

Tensioning the Drive

Force Deflection Engineering Formulas

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

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

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

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

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

$$P_{\text{Minimum}} = \frac{T_s + Y}{16}$$

$$P_{\text{Maximum}} = \frac{1.5 (T_s) + Y}{16}$$

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

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

$$P_{\text{Minimum}} = \frac{T_s = Y \left(\frac{t}{L} \right)}{16}$$

$$P_{\text{Maximum}} = \frac{1.5 (T_s) + Y \left(\frac{t}{L} \right)}{16}$$

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

Explanation of Symbols

Ac	= Arch of contact - smaller sheave, degrees
C	= Center Distance, inches
D	= Large sheave pitch diameter, inches
d	= Smaller sheave pitch diameter, inches
DHP	= Design horsepower based upon the recommended application service factor
h	= Deflection height, inches (Refer. figure 2)
K	= Value from table 2 depending on $\frac{D - d}{C}$
	or $K = 16.5 \frac{2.5 - Ac}{Ac}$
L	= Belt length, inches
M	= Centrifugal constant table 3
N	= Number of belts or V-band ribs
P	= Deflection force, pounds
S	= Belt speed, FPM/1000
t	= Span length, inches (Refer. figure 2)
Y	= Belt constant table 3

Table 3
Belt Constants M & Y

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

Belt Elongation Method

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

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

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

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

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

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

Step 4: Find a range of recommended tensions.

Lower Tension = Ts

Upper Tension = 1.5 times Ts

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

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

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

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

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

Tensioning the Drive

Table 4
Length Multipliers for Tensioning Banded Belts

Ts PER Strand (lbs)	Narrow Band					Classical Band					Classical Cog Band		
	Cross Section												
	3V	5V		8V		BP		CP		DP	BX All Sizes	CX All Sizes	DX All Sizes
5V1700 & Under		5V1800 & Over	8V1700 & Under	8V1800 & Over	BP144 & Under	Over BP144	CP144 & Under	Over CP144					
10	1.00186	1.00056	1.00001	1.00013	1.00010	1.00113	1.00141	1.00029	1.00052	1.00013	1.00082	1.00027	1.00013
12	1.00220	1.00068	1.00097	1.00016	1.00012	1.00135	1.00168	1.00035	1.00062	1.00016	1.00098	1.00032	1.00016
14	1.00254	1.00079	1.00113	1.00019	1.00014	1.00157	1.00194	1.00041	1.00072	1.00019	1.00114	1.00038	1.00019
16	1.00288	1.00090	1.00129	1.00021	1.00016	1.00178	1.00220	1.00046	1.00082	1.00021	1.00129	1.00043	1.00021
18	1.00320	1.00101	1.00144	1.00024	1.00018	1.00199	1.00246	1.00052	1.00092	1.00024	1.00145	1.00048	1.00024
20	1.00352	1.00112	1.00159	1.00027	1.00020	1.00220	1.00271	1.00058	1.00102	1.00027	1.00160	1.00054	1.00027
24	1.00414	1.00133	1.00190	1.00032	1.00024	1.00261	1.00320	1.00069	1.00122	1.00033	1.00191	1.00065	1.00032
28	1.00472	1.00155	1.00219	1.00037	1.00029	1.00301	1.00368	1.00081	1.00141	1.00038	1.00220	1.00075	1.00038
32	1.00520	1.00176	1.00249	1.00043	1.00033	1.00339	1.00414	1.00092	1.00161	1.00044	1.00250	1.00086	1.00043
36	1.00556	1.00197	1.00277	1.00048	1.00037	1.00377	1.00458	1.00104	1.00180	1.00050	1.00278	1.00097	1.00059
40	1.00588	1.00217	1.00305	1.00054	1.00042	1.00413	1.00500	1.00115	1.00199	1.00056	1.00306	1.00107	1.00054
45	1.00625	1.00243	1.00340	1.00060	1.00047	1.00458	1.00529	1.00129	1.00222	1.00063	1.00341	1.00121	1.00061
50	1.00659	1.00268	1.00374	1.00067	1.00053	1.00500	1.00553	1.00144	1.00246	1.00071	1.00374	1.00134	1.00068
55	1.00691	1.00293	1.00406	1.00074	1.00058	1.00528	1.00574	1.00158	1.00268	1.00078	1.00407	1.00147	1.00075
60	1.00722	1.00317	1.00438	1.00081	1.00064	1.00553	1.00591	1.00172	1.00291	1.00086	1.00439	1.00161	1.00081
65	1.00754	1.00341	1.00470	1.00088	1.00070	1.00576	1.00606	1.00186	1.00313	1.00094	1.00470	1.00174	1.00088
70	1.00787	1.00365	1.00500	1.00095	1.00076	1.00596	1.00620	1.00200	1.00335	1.00102	1.00500	1.00187	1.00095
75	1.00822	1.00389	1.00523	1.00101	1.00082	1.00614	1.00632	1.00214	1.00357	1.00110	1.00522	1.00200	1.00102
80	1.00861	1.00412	1.00545	1.00108	1.00088	1.00631	1.00644	1.00228	1.00378	1.00118	1.00543	1.0213	1.00109
85	1.00903	1.00434	1.00566	1.00115	1.00094	1.00646	1.00656	1.00242	1.00399	1.00127	1.00563	1.00227	1.00116
90	1.00949	1.00456	1.00586	1.00122	1.00100	1.00659	1.00668	1.00256	1.00420	1.00135	1.00581	1.00240	1.00123
95	1.01000	1.00478	1.00606	1.00129	1.00106	1.00672	1.00682	1.00270	1.00441	1.00144	1.00599	1.00253	1.00130
100	1.01056	1.00500	1.00625	1.00136	1.00113	1.00684	1.00697	1.00284	1.00461	1.00152	1.00616	1.00266	1.00137
120	1.01333	1.00561	1.00696	1.00164	1.00139	1.00727	1.00780	1.00339	1.00528	1.00188	1.00679	1.00319	1.00166
140	1.01692	1.00617	1.00765	1.00192	1.00166	1.00771	1.00912	1.00393	1.00579	1.00226	1.00736	1.00371	1.00195
160	1.02081	1.00672	1.00836	1.00220	1.00194	1.00827	1.01104	1.00447	1.00627	1.00265	1.00793	1.00423	1.00224
180	1.02385	1.00728	1.00913	1.00249	1.00223	1.00902	1.01357	1.00500	1.00675	1.00306	1.00854	1.00474	1.00253
200	1.02655	1.00707	1.01000	1.00277	1.00254	1.01000	1.01718	1.00534	1.00724	1.00349	1.00922	1.00525	1.00283
240	1.03118	1.00921	1.01213	1.00335	1.00319	1.01279	1.02268	1.00607	1.00832	1.00440	1.01090	1.00625	1.00343
280	1.03579	1.01088	1.01524	1.00395	1.00389	1.01663	1.02737	1.00692	1.00963	1.00542	1.01313	1.00724	1.00405
320	1.04070	1.01292	1.01834	1.00454	1.00461	1.02088	1.03275 1.03853 1.04393 1.05000	1.00797	1.01124	1.00656	1.01590	1.00824	1.00468
360	1.04671	1.01562	1.02162	1.00515	1.00543	1.02423		1.00926	1.01317	1.00771	1.01925	1.00924	1.00532
400	1.05308	1.01826	1.02526	1.00575	1.00631	1.02708		1.01081	1.01580	1.00886	1.02229	1.01026	1.00598
450		1.02179	1.03056	1.00652	1.00744	1.03072		1.01311	1.01877	1.01028	1.02625	1.01156	1.00683
500		1.02558	1.03643	1.00732	1.00859	1.03425		1.01610	1.02186	1.01164	1.03000	1.01292	1.00768
550		1.02927	1.04200	1.00813	1.00976	1.03781 1.04158 1.04567 1.05000		1.01888	1.02500	1.01293	1.03354	1.01435	1.00856
600		1.03286	1.04642	1.00896	1.01094			1.02169	1.02813	1.01413	1.03685	1.01557	1.00946
650		1.03632	1.05000	1.00982	1.01213			1.02449	1.03123	1.01524	1.04000	1.01729	1.01037
700		1.03967		1.01071	1.01331			1.02718	1.03426	1.01625	1.04333	1.01919	1.01130
750		1.04310		1.01163	1.01449			1.03000	1.03719	1.01718	1.04667	1.02126	1.01224
800		0.04655 0.05000		1.01257	1.01571			1.03282	1.04000	1.01802	1.05000	1.02372	1.01320
850			1.01354	1.01689	1.03563	1.04268	1.01833	1.02607	1.01418				
900			1.01454	1.01887	1.03838	1.04524	1.01936	1.02840	1.01518				
950			1.01561	1.01927	1.04101	1.04768	1.02044	1.03068	1.01619				
1000			1.01667	1.02049	1.04345	1.05000	1.02156	1.03209	1.01717				

Trouble Shooting V-Belts

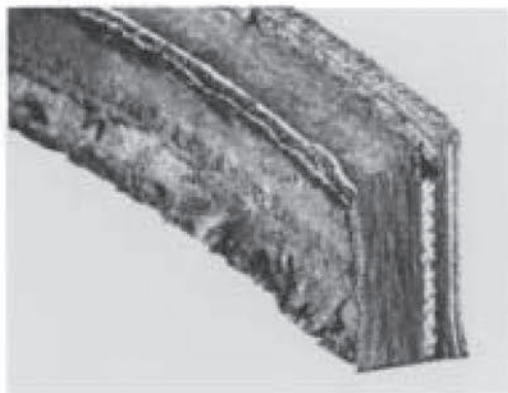
How to Spot V-Belt Trouble

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

Trouble Shooting V-Belts

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

BELT CONDITION



Oil Deterioration

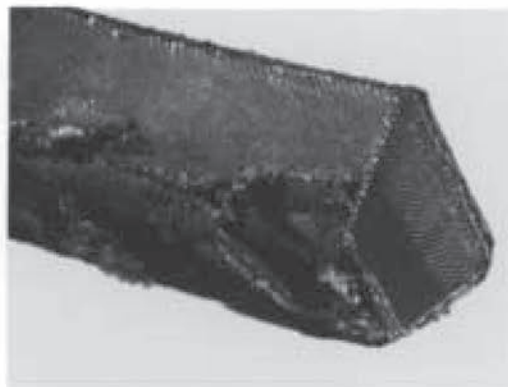
Oil Deterioration

Cause

Oil-softened rubber.

Prevention

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



Cover Fabric Rupture

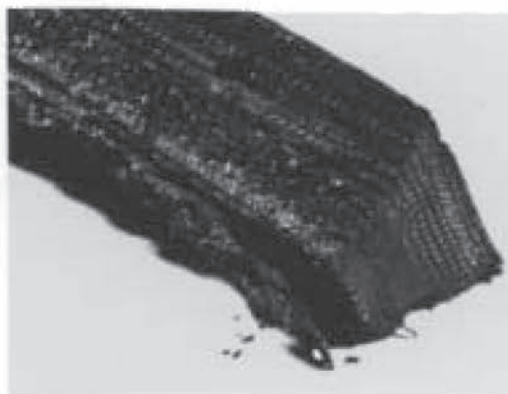
Cover Fabric Rupture

Cause

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

Prevention

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



Slip Burn

Slip Burn

Cause

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

Prevention

Maintain proper tension on the drive.

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

BELT CONDITION



Base Cracking

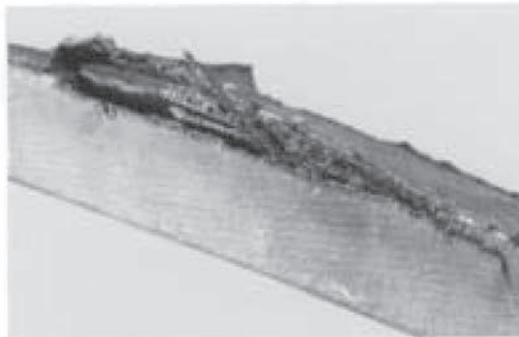
Base Cracking

Cause

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

Prevention

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



Ply Separation

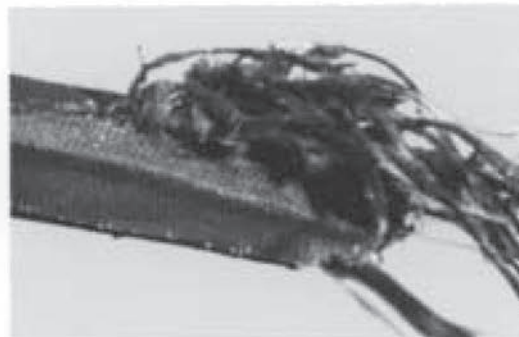
Ply Separation

Cause

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

Prevention

Redesign drive using sheaves of proper size.



Ruptured

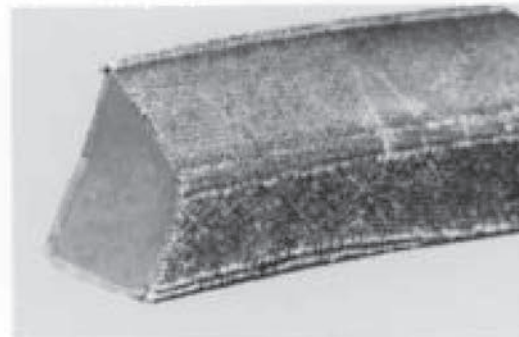
Ruptured

Cause

Ruptured cord in the plies.

Prevention

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



Worn Belt Sides

Worn Belt Sides

Cause

Misalignment. Grit or dirt. Normal wear.

Prevention

Align sheaves. Replace belts as required.

Trouble Shooting V-Belts

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

BELT CONDITION



Sub Break

Sub Break

Cause

Cover wear indicates slip. Clean break reveals sudden snap.

Prevention

Maintain proper tension on the drive.



Distorted Belt

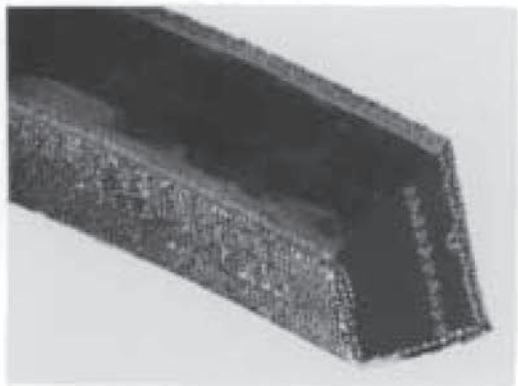
Distorted Belt

Cause

Breakdown of adhesion or broken cords.

Prevention

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



Abrasion

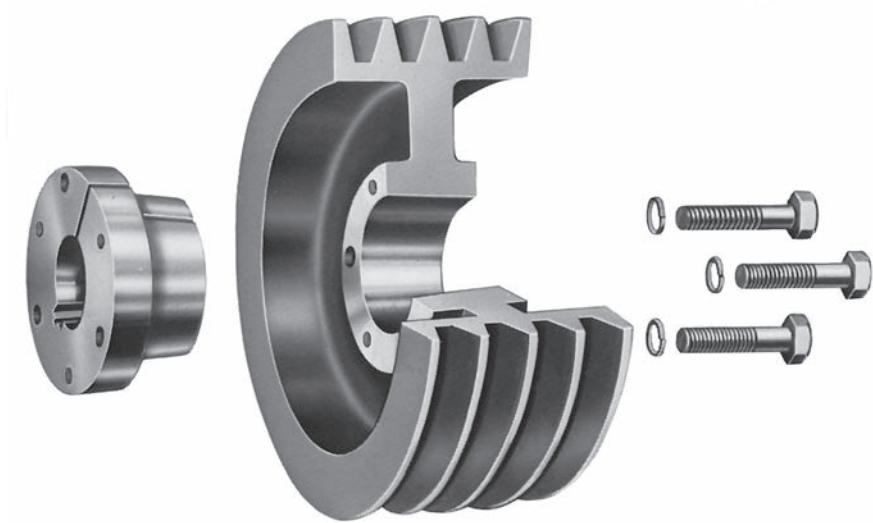
Abrasion

Cause

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

Prevention

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



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

Design Integrity

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

Foundry Process

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

Maching

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

Specification

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

ANSI/RMA	IP-20	Classical V-Belt Sheaves
ANSI/RMA	IP-22	Narrow V-Belt Sheaves
ANSI/RMA	IP-24	Synchronous Sprockets
MPTA	QD-1	QD Bushing Guideline
MPTA	SPB	Pulley Balance
MPTA	SAS	V-Belt Sheave Arm Stress
MPTA	SF	Pulley Surface Finish

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



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

Wood's offers a complete line of high capacity synchronous drives. The Synchronous Plus system offers a higher horsepower capacity drive at the cost of the competitions standard rated product. Wood's also offers the aramid fiber QT Powerchain drive in 8M and 14M pitch. The QT drive is capable of high horsepower capacity in a smaller package. Both QT and Synchronous-Plus sprockets offer metric/inch drilling for applications which require a totally metric drive system.



Wood's has many different ways of offering variable speed for customer applications. The most basic way is through the use of one of our many belted variable speed systems. Wood's also offers many different options in the line of electronic inverters and electronic speed controls. One of the most unique ways of varying speed, however, is our HSV/HSVA hydrostatic systems. The HSV system is ideal for harsh, dirty, or explosive proof environments.

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



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

The power of one, the strength of many.

Other product solutions from

Altra Industrial Motion

Our comprehensive product offering is comprised of nine major categories including electromagnetic clutches and brakes, heavy duty clutches and brakes, overrunning clutches, gearing, engineered couplings, engineered bearing assemblies, linear products and belted drives. With thousands of product solutions available, Altra provides true single source convenience while meeting specific customer requirements. Many major OEM's and end users prefer Altra products as their No.1 choice for performance and reliability.

www.altramotion.com



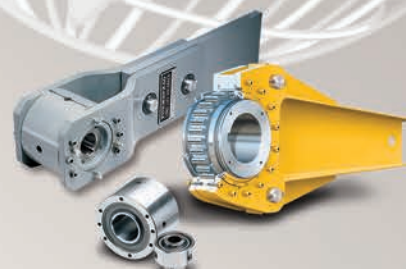
Electromagnetic Clutches and Brakes

Warner Electric
Inertia Dynamics
Matrix International



Heavy Duty Clutches and Brakes

Wichita Clutch
Twiflex Limited
Industrial Clutch



Overrunning Clutches

Formsprag Clutch
Marland Clutch
Stieber Clutch



Engineered Couplings and Universal Joints

TB Wood's
Ameridrives Couplings
Ameridrives Power Transmission
Bibby Turboflex
Lamiflex Couplings



Belted Drives and Sheaves

TB Wood's



Gearing

Boston Gear
Nuttall Gear
Delroyd Worm Gear
Bauer Gear Motor



Linear Products

Warner Linear



Engineered Bearing Assemblies

Kilian Manufacturing



Precision Couplings and Air Motors

Huco Dynatork

All Customer Service phone numbers shown in bold

Electromagnetic Clutches and Brakes

Warner Electric

Electromagnetic Clutches and Brakes

New Hartford, CT - USA
1-800-825-6544

For application assistance:
1-800-825-9050

St Barthelemy d'Anjou, France
+33 (0) 2 41 21 24 24

Precision Electric Coils and Electromagnetic Clutches and Brakes

Columbia City, IN - USA
1-260-244-6183

Matrix International

Electromagnetic Clutches and Brakes, Pressure Operated Clutches and Brakes

Brechin, Scotland
+44 (0) 1356 602000

New Hartford, CT - USA
1-800-825-6544

Inertia Dynamics

Spring Set Brakes; Power On and Wrap Spring Clutch/Brakes

New Hartford, CT - USA
1-800-800-6445

Linear Products

Warner Linear

Linear Actuators

Belvidere, IL - USA
1-800-825-6544

For application assistance:
1-800-825-9050

St Barthelemy d'Anjou, France
+33 (0) 2 41 21 24 24

Couplings

Ameridrives Couplings

Mill Spindles, Ameriflex, Amerisc

Erie, PA - USA
1-814-480-5000

Gear Couplings

San Marcos, TX - USA
1-800-458-0887

Bibby Turboflex

Disc, Gear, Grid Couplings, Overload Clutches

Dewsbury, England
+44 (0) 1924 460801

Boksburg, South Africa
+27 11 918 4270

TB Wood's

Elastomeric Couplings

Chambersburg, PA - USA
1-888-829-6637 – Press #5

For application assistance:
1-888-829-6637 – Press #7

General Purpose Disc Couplings

San Marcos, TX - USA
1-888-449-9439

Ameridrives Power Transmission

Universal Joints, Drive Shafts, Mill Gear Couplings

Green Bay, WI - USA
1-920-593-2444

Huco Dynatork

Precision Couplings and Air Motors

Hertford, England
+44 (0) 1992 501900

Chambersburg, PA - USA
1-800-829-6637

Lamiflex Couplings

Flexible Couplings, Bearing Isolators, and Coupling Guards

São Paulo, SP - Brasil
(11) 5679-6533

Heavy Duty Clutches and Brakes

Wichita Clutch

Pneumatic Clutches and Brakes

Wichita Falls, TX - USA
1-800-964-3262

Bedford, England
+44 (0) 1234 350311

Twiflex Limited

Caliper Brakes and Thrusters

Twickenham, England
+44 (0) 20 8894 1161

Industrial Clutch

Pneumatic and Oil Immersed Clutches and Brakes

Waukesha, WI - USA
1-262-547-3357

Gearing

Boston Gear

Enclosed and Open Gearing, Electrical and Mechanical P.T. Components

Charlotte, NC - USA
1-800-825-6544

For application assistance:
1-800-816-5608

Bauer Gear Motor

Geared Motors

Esslingen, Germany
+49 (711) 3518 0

Somerset, NJ - USA
1-732-469-8770

Nuttall Gear and Delroyd Worm Gear

Worm Gear and Helical Speed Reducers

Niagara Falls, NY - USA
1-716-298-4100

Overrunning Clutches

Formsprag Clutch

Overrunning Clutches and Holdbacks

Warren, MI - USA
1-800-348-0881 – Press #1

For application assistance:
1-800-348-0881 – Press #2

Marland Clutch

Roller Ramp and Sprag Type Overrunning Clutches and Backstops

South Beloit, IL - USA
1-800-216-3515

Stieber Clutch

Overrunning Clutches and Holdbacks

Heidelberg, Germany
+49 (0) 6221 30 47 0

Belted Drives and Sheaves

TB Wood's

Belted Drives

Chambersburg, PA - USA
1-888-829-6637 – Press #5

For application assistance:
1-888-829-6637 – Press #7

Engineered Bearing Assemblies

Kilian Manufacturing

Engineered Bearing Assemblies

Syracuse, NY - USA
1-315-432-0700

For information concerning our sales offices in Asia Pacific check our website
www.altramotion.com.cn



www.tbwoods.com

440 North Fifth Avenue
Chambersburg, PA 17201 - USA
888-829-6637 • 717-264-7161
Fax: 717-264-6420



TROUBLESHOOTING



TROUBLESHOOTING GUIDE ROLL CRUSHERS

1.0 GENERAL SECTION

1.1 SYMPTOM: UNIT PLUGS AND/OR STALLS

1.2 CAUSES:

- 1.2.1 MOTOR BAD OR MOTOR HEATER BLOWN.
- 1.2.2 BELTS LOOSE OR BURNED OFF.
- 1.2.3 ROLLS JAMMED WITH A NON-CRUSHABLE.
- 1.2.4 EXCEEDING RATED CAPACITY OR FEED SIZE TOO LARGE.
- 1.2.5 PLUG IN DISCHARGE AREA THAT BACKS UP INTO CRUSHER.
- 1.2.6 ON TWO STAGE (D OR DA) TYPE UNITS, SECONDARY DRIVE CHAIN OR COG BELT IS BROKEN.
- 1.2.7 GEARBOX LOCKED UP.
- 1.2.8 ON TWO STAGE (D OR DA) CRUSHER, PRODUCT FROM UPPER ROLLS TOO LARGE FOR LOWER ROLLS TO ACCEPT.
- 1.2.9 ROLLS WORN OUT. TEETH TOO WORN TO GRAB MATERIAL.
- 1.2.10 INSUFFICIENT HORSEPOWER

1.3 REMEDY:

- 1.3.1 REPLACE MOTOR OR MOTOR HEATER. BE SURE SIZING IS CORRECT.
- 1.3.2 TIGHTEN OR REPLACE BELTS.
- 1.3.3 REMOVE NON-CRUSHABLE AND CHECK CRUSHER FOR POSSIBLE DAMAGE.
- 1.3.4 REDUCE FEED RATE AND/OR FEED SIZE TO CRUSHER TO ACCEPTABLE LEVEL.
- 1.3.5 REMOVE BLOCKAGE.
- 1.3.6 REPLACE CHAIN OR COG BELT BY REMOVING SHEAVE AND CHAIN COVER.
- 1.3.7 REMOVE GEARBOX COVER. REPLACE DAMAGED GEARBOX COMPONENTS.
- 1.3.8 RE-ADJUST UPPER ROLLS TO DO MORE CRUSHING, WHICH WILL GIVE LOWER ROLLS AN ACCEPTABLE SIZE TO GRAB.
- 1.3.9 REBUILD OR REPLACE ROLLS.
- 1.3.10 INCREASE HORSEPOWER

1.4 SYMPTOM: CRUSHER WON'T MAKE PRODUCT

1.5 CAUSES:

- 1.5.1 ROLL GAP NOT ADJUSTED PROPERLY AND/OR UNEVEN ROLL GAP.
- 1.5.2 ROLL TEETH WORN OUT AND NOT CRUSHING PROPERLY.
- 1.5.3 ROLLS OUT OF TIME; BROKEN TAPER LOCK BUSHING AND SHEARED KEY IN GEARBOX, GEARS HAVE EXCESSIVE BACKLASH, OR GEARS NOT TIMED PROPERLY.
- 1.5.4 WORN OUT HOUSING SLOPE PLATES, ALLOWING OVERSIZE TO PASS BEHIND ROLL.



TROUBLESHOOTING GUIDE ROLL CRUSHERS

1.6 REMEDY:

- 1.6.1 RE-ADJUST SPRING ADJUSTMENT ASSEMBLIES OR CYLINDERS.
- 1.6.2 REPLACE OR REBUILD ROLLS. NOTE: IF WELDING WHILE ROLLS ARE IN UNIT, BE SURE TO GROUND DIRECTLY TO THE ROLLS TO PREVENT BEARING DAMAGE. SEE WELDING PROCEDURES FOR FURTHER INFORMATION.
- 1.6.3 REPLACE BROKEN TAPER LOCK BUSHING, SHEARED KEY AND REPLACE WORN GEARS. RE-TIME ROLLS.
- 1.6.4 REPLACE SLOPE PLATES.

2.0 ROLL SECTION

2.1 SYMPTOM: ROLLS WON'T GRAB FEED MATERIAL.

2.2 CAUSES:

- 2.2.1 TEETH WORN DOWN.
- 2.2.2 MATERIAL FEED SIZE ENTERING UNIT IS TOO LARGE.
- 2.2.3 IF UNIT IS A TWO STAGE (D OR DA) CRUSHER, THE ROLLS MAY NOT BE SET TO ALLOW PROPER MATERIAL REDUCTION AT EACH STAGE.

2.3 REMEDY:

- 2.3.1 REBUILD OR REPLACE ROLLS.
- 2.3.2 CHECK SCREEN OR GRIZZLY FOR DAMAGE.
- 2.3.3 RE-ADJUST ROLLS TO PROVIDE MORE CRUSHING IN UPPER STAGE, THUS ALLOWING PROPER FEED SIZE TO THE LOWER STAGE.
- 2.3.4 REDUCE FEED RATE AND/OR FEED SIZE TO CRUSHER AT ACCEPTABLE LEVEL.

3.0 GEARBOX SECTION

3.1 SYMPTOM: FAILURE, EXCESSIVE HEAT AND NOISE.

3.2 CAUSES:

- 3.2.1 LACK OF LUBRICATION.
- 3.2.2 BENT ROLL STUB SHAFT.
- 3.2.3 GEARPLATE OR IDLER BEARING FAILURE IN GEARBOX.
- 3.2.4 EXCESSIVE BACKLASH IN GEARS.
- 3.2.5 CONTAMINATION FROM MAIN BEARING FAILURE.
- 3.2.6 BROKEN TAPERLOCK BUSHING AND SHEARED KEY HAS ROLLS OUT OF TIME, CAUSING ROLLS TO HIT.
- 3.2.7 MIS-ALIGNMENT OF ADJUSTABLE ROLL.



TROUBLESHOOTING GUIDE ROLL CRUSHERS

3.3 REMEDY:

- 3.3.1 REBUILD GEARBOX, REPLACE SEALS, AND KEEP PROPER OIL LEVEL.
- 3.3.2 REPLACE ROLL STUB SHAFT.
- 3.3.3 REBUILD GEARBOX.
- 3.3.4 REPLACE GEARS AS REQUIRED.
- 3.3.5 REPLACE MAIN BEARING AND REBUILD GEARBOX.
- 3.3.6 REPLACE TAPERLOCK BUSHING AND KEY AND CHECK ROLLS FOR DAMAGE. RE-TIME ROLLS.
- 3.3.7 RE-ADJUST ROLL GAP FOR CONSISTENT ROLL GAP ACROSS FULL LENGTH.

4.0 NITROIL SYSTEM

4.1 SYMPTOM: ROLLS CLOSE WHILE CRUSHING.

4.2 CAUSES:

- 4.2.1 HYDRAULIC CONTROL VALVES ON MANIFOLD OPEN OR LEAKING.
- 4.2.2 LEAKS IN HOSE OR FITTINGS.
- 4.2.3 LEAKING NITROIL CYLINDER ROD BUSHINGS.

4.3 REMEDY:

- 4.3.1 CLOSE OR REPLACE VALVE(S).
- 4.3.2 REPLACE HOSE AND FITTINGS OR TIGHTEN AS NEEDED.
- 4.3.3 REBUILD NITROIL CYLINDER.

4.4 SYMPTOM: ROLLS OPEN WHILE CRUSHING.

4.5 CAUSES:

- 4.5.1 LEAK IN NITROGEN LINES OR FITTINGS.
- 4.5.2 NITROGEN LEAKING TO OIL SIDE OR CYLINDER PAST PISTON SEALS.
- 4.5.3 LEAK IN BLEED VALVE.
- 4.5.4 LEAK AT NITROGEN TANK REGULATOR.

4.6 REMEDY:

- 4.6.1 RE-SEAL OR REPLACE LINES/FITTINGS AS NEEDED. CHECK LINES WITH SOAPY WATER.
- 4.6.2 REBUILD NITROIL CYLINDER.
- 4.6.3 TIGHTEN OR REPLACE BLEED VALVE AND/OR CONNECTIONS.
- 4.6.4 TIGHTEN OR REPLACE NITROGEN REGULATOR.



TROUBLESHOOTING GUIDE ROLL CRUSHERS

4.7 **SYMPTOM: ROLLS KICK OR MOVE CONTINUOUSLY.**

4.8 **REMEDY:**

4.8.1 USE MORE NITROGEN PRESSURE. (NOTE: ONLY USE ENOUGH PRESSURE TO HOLD ROLLS FIXED WHILE NORMALLY CRUSHING, YET ALLOWING UN-CRUSHABLES TO PASS. MAXIMUM PRESSURE 1000 PSI (68 BARS).

5.0 ADJUSTMENT AND ALIGNMENT SECTIONS

5.1 **SYMPTOM: MANUAL SPRING ADJUST WILL NOT MOVE.**

5.2 **CAUSES:**

- 5.2.1 ADJUSTMENT ASSEMBLY RUSTED DUE TO LACK OF LUBRICATION.
- 5.2.2 RUSTED ALIGNMENT SHAFT, DUE TO LACK OF LUBRICATION.
- 5.2.3 DUST BOOT OVER THREADED SECTION DAMAGED ALLOWING CONTAMINATION.
- 5.2.4 SHEARED ADJUSTMENT SPROCKET KEY.
- 5.2.5 ADJUSTMENT CHAIN RUSTED OR MISSING.
- 5.2.6 BENT SLIDE BAR PREVENTING BEARING BLOCK FROM MOVING.
- 5.2.7 SLOT CLOSURE ATTACHED TO BEARING BLOCK JAMMED.

5.3 **REMEDY:**

- 5.3.1 DISASSEMBLE, CLEAN, RE-ASSEMBLE, LUBRICATE AND RE-ADJUST.
- 5.3.2 REMOVE SHAFT. SLIDE BRACKETS BACK, CLEAN AND RE-GREASE.
- 5.3.3 DISASSEMBLE, CLEAN, REPLACE BOOT, LUBRICATE AND RE-ASSEMBLE.
- 5.3.4 REMOVE ADJUSTMENT SPROCKET, REPLACE KEY AND RE-ASSEMBLE.
- 5.3.5 REPLACE ADJUSTMENT CHAIN. (NOTE: WHEN NEW CHAIN IS INSTALLED, BOTH ADJUSTMENT ASSEMBLIES MUST BE ADJUSTED SO THEY ARE EVEN.)
- 5.3.6 REPLACE OR STRAIGHTEN SLIDE BAR.
- 5.3.7 RE-ADJUST OR REPLACE SLOT CLOSURE.

6.0 SECONDARY DRIVE SECTION

6.1 **SYMPTOM: EXCESSIVE NOISE.**

6.2 **CAUSES:**

- 6.2.1 WORN OUT, STRETCHED OR BROKEN CHAIN.
- 6.2.2 WORN SPROCKETS.
- 6.2.3 BROKEN SPROCKET BUSHING AND/OR BOLTS.
- 6.2.4 LACK OF LUBRICATION.



TROUBLESHOOTING GUIDE ROLL CRUSHERS

6.3 REMEDY:

- 6.3.1 REPLACE ALL OF THE ABOVE ITEMS. DO NOT USE A WORN CHAIN WITH NEW SPROCKETS OR VICE-VERSA. USE NEW LUBRICATION FLUID.

7.0 BEARING SECTION

7.1 SYMPTOM: BEARING FAILURE

7.2 CAUSES:

- 7.2.1 LACK OF BEARING LUBRICATION.
- 7.2.2 BENT STUB SHAFT OR ROLL HUB.
- 7.2.3 MIS-ALIGNMENT OF ROLLS.
- 7.2.4 ROLL OUT OF BALANCE.
- 7.2.5 BEARING SET-PLUG IMPROPERLY INSTALLED CAUSING BEARING TO TURN. (NOTE: THIS TYPE IS ONLY ON SOME CRUSHERS WITH 3 15/16" (100 MM) SHAFTS WITH CARTRIDGE TYPE BEARINGS.)
- 7.2.6 MATERIAL PACKED BEHIND AND AROUND BEARING, CAUSING CONTAMINATION.
- 7.2.7 BEARING O.D. LOOSE IN BEARING BLOCK, CAUSING BOUNCING AND FALSE BRINELLING.
- 7.2.8 DAMAGED BEARING FROM WELDER GROUNDING THROUGH BEARINGS.

7.3 REMEDY:

- 7.3.1 REFER TO LUBRICATION SECTION IN MANUAL FOR GREASING RECOMMENDATIONS.
- 7.3.2 REPLACE SHAFT OR HUB.
- 7.3.3 CHECK SHAFT CENTER-TO-CENTERS AND MAKE PROPER ADJUSTMENTS BY ADJUSTING TURNBUCKLE ON ALIGNMENT ARM OR BY SHIMMING CYLINDER ON NITROIL OR BY ADJUSTING SCREW ON MANUAL ADJUST. ***THIS IS CRITICAL FOR BEST PERFORMANCE.***
- 7.3.4 MAKE SURE ROLL REBUILD AND HARDFACING IS APPLIED EVENLY.
- 7.3.5 REALIGN PLUG HOLE AND INSTALL SET PLUG USING LOCTITE.
- 7.3.6 FLUSH OUT THIS AREA AND CHECK HOUSING SLOT CLOSURES FOR PROPER OPERATION.
- 7.3.7 REPLACE BEARING BLOCK.
- 7.3.8 REPLACE BEARING AND MAKE SURE THAT WELDER GROUNDS TO HIS WORK.

GÜNDLÄCH

First in **3-D** CRUSHING

PRODUCTS

SOLUTIONS

SERVICES



Precise Product Sized for Maximum Yield

*When precise product sizing with fewer fines and maximized yield
is important, Gundlach Crushers get it right.
Every time. Every day. Day after day.*

First in 3-D CRUSHING

Gundlach designed its first single-stage, two-roll crusher in 1948, completely transforming how coal mines size product to meet market demands. This was the first crusher that in a single pass could economically break 50 mm coal to 19 mm pieces, a process that had been costly, time consuming and labor intensive.

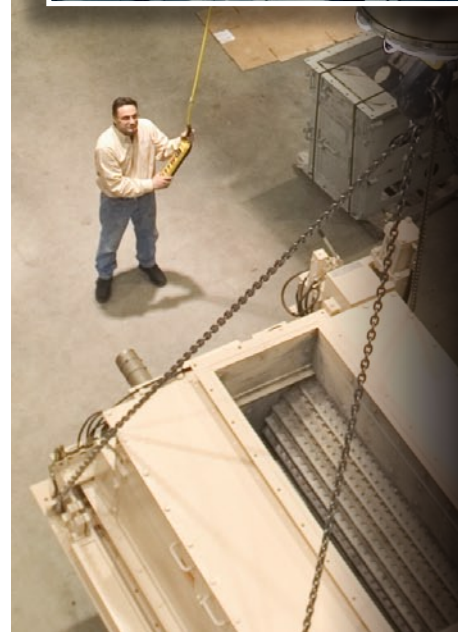
The two-roll crusher was soon followed by another breakthrough Gundlach design, the first two-stage roll crusher. For the first time, a single crusher could take run-of-mine coal and crush it to 19 mm size. To this day the Gundlach roll crusher design remains the only device to provide control over product size in all three dimensions. This 3-D crushing capability delivers higher quality product, less fines and consistently repeatable performance.

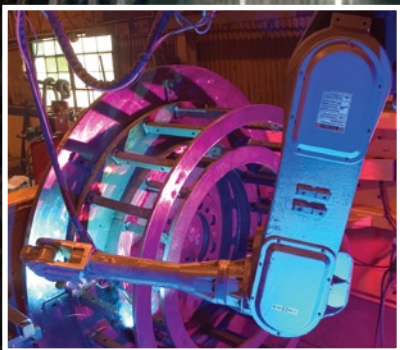
Another big change in crusher technology came with the high output demands from Western coal mines in the Powder River Basin. The two-stage, four-roll Gundlach breaker provides the high tonnage production these mines require, while producing a cubical product with less fines and the uniform sizing that power plants demand. The two-stage design eliminates the need for secondary crushing and extra handling, while reducing coal to precise, market ready product requirements.

Today, all Gundlach roll crushers and breakers are available with Gundlach's breakthrough 3-D crushing technology, with intermeshing continuous tooth roll design and positive roll timing that delivers the industry's best dimensional product control, fewer fines and elimination of over-size material.

Gundlach makes a number of different crusher types to size product to a desirable output, including roll crushers and breakers for primary and secondary crushing of product down to 10 mm, the CAGE-PAKTOR® cage mills for particle sizing below 10 mm, the NANOSIZ-R® bi-modal roll mill for 19 mm feeds to 1600-micron product, and the Accu-Grind small tonnage crusher.

In this brief overview brochure, you'll learn more about Gundlach crusher technology. We invite you to consult with our crusher application engineers to get the full story for your process needs. We think you'll see for yourself how Gundlach's application engineering, our designs for easy maintenance, our customer support and service all play a role in making Gundlach the preferred crushing solution for coal, potash, salts and lime.





A Crusher for Most Every Application

Whether you're crushing materials that are large, small, dry, wet, hot, cold, hard, soft, sticky, abrasive, or non-abrasive, Gundlach has the crusher design that can do your job best. Gundlach designs, manufactures, installs, and helps you maintain your crusher to get your job done effectively and efficiently every time – all the time.

Roll Crushers

- Crushers for Most Every Job – Single-Stage and Two-Stage Crushers for 1200 mm feeds to 6 mm product.
- Dozens of Roll Configurations – Roll designs range from 300 mm to 900 mm diameters and 500 mm to 3000 mm length.
- Most Usable Product Size – Machine configuration gives the best control of product oversize while reducing fine particle generation.
- Economical – Low horsepower-per-ton ratio means low power requirements and less operational cost.
- Easy Maintenance – Coupling mounted rolls and unique, split housing design makes roll replacement possible without disturbing drive components.
- Roll Alignment – Patented Nitroil® adjustment and relief system allows changes of product output size during operation and allows uncrushables to pass. Spring tramp relief or manual screw adjustment is also available.
- Trouble-Free Lubrication – Standard dual-bulkhead lubrication system puts all grease fittings in two convenient locations.

CAGE-PAKTOR®

- Versatile – 100 mm feeds to 2 mm product.
- Uniform Crushing – Materials with sufficient mass are crushed while already-to-size materials pass through a CAGE-PAKTOR®.
- Economical – Horsepower required is in direct proportion to work performed (so more selective crushing reduces power requirements) and operating costs.
- No Adjustments Needed – Patented striking plate prevents change of product size making adjustments for wear unnecessary.
- Compact – Unique design requires less floor space.
- Easy Maintenance – Swing-away door provides immediate access.
- Product Sizing by change of cage speed.

NANOSIZ-R®

- Bi-Modal roll mill for 19 mm feeds to 1600-micron product.
- NANOSIZ-R® is the crusher of the future.
- Compression + Shearing – NANOSIZ-R® offers a new approach to fine-grinding.
- Affordable – NANOSIZ-R® offers lower capital and energy costs than existing technologies.
- Small Footprint – NANOSIZ-R® fits in small spaces.
- Modular Design – Multiple units can be used in series to achieve greater reduction ratios.

GUNDLACH

First in 3-D CRUSHING

Accu-Grind

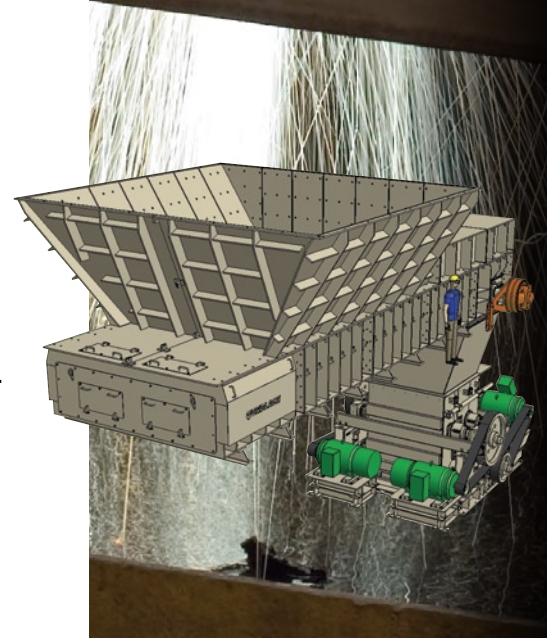
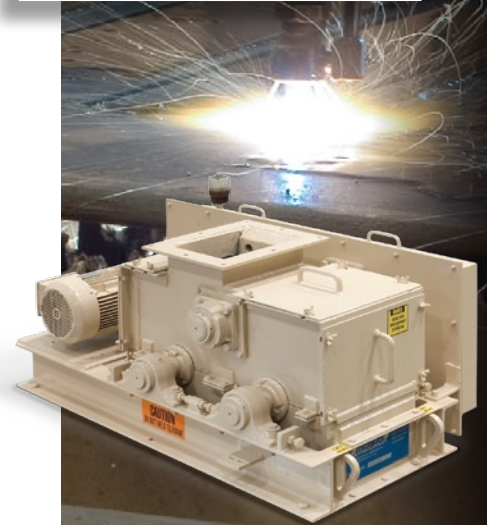
- Small Tonnage Crushing – The Accu-Grind can handle feeds up to 100 mm, reducing to 6 mm product.
- Economical – Accu-Grind requires less horsepower for operation.
- High Ratio of Reduction – Accu-Grind achieves reduction ratios up to 16:1.
- Small Footprint – The base of the Accu-Grind is less than 1.5 square meters making it well suited for small space applications.
- Ideal for Sampling – Low tonnage, low power allows continuous sampling applications.
- Trouble-Free – There are no screens to clog for simple, problem-free operation.
- Versatile – Special roll designs are available for wet applications.

Breakers

- Versatile – Two-stage breaker models up to 120" wide with 48" diameter rolls.
- Uniform Crushing – Eliminate the need for secondary crushing and extra handling.
- Economical – Horsepower required is in direct proportion to work performed (so more selective crushing reduces power requirements) and operating costs.
- High Capacity – 2,000 TPH up to 10,000 TPH with up to 24:1 reduction sizing.
- Base and Sub-Base Structure – Heavy steel fabrication, sub-base is mounted on "V" face wheels for continuous alignment.
- Nitroil® Control System – For severe crushing applications where tramp or uncrushables occur in the feed.
- Easy Maintenance – The housing assembly is fabricated in sections for fast access to upper and lower rolls, from top or center.
- Simple Drive System – The four-motor drive design allows direct energy input to each roll.

Combination Feeder-Crusher Package

- Custom Engineered – For your material input size, material hardness, total capacity requirements, haulage and conveying system needs.
- Versatile – Designed to work precisely within the widest variety of material handling settings.
- ROM Materials – Capacity ranges up to 6,000+ TPH.
- Hopper Section – Designed to accept mined materials (coal, salt, and industrial minerals) according to specific haulage equipment and production requirements.
- The Feeder – Consists of a drag-flight feeder system.
- Crushers are 40" (1.0m) wide or larger. Our large capacity feeders (90"/2.3m or 120"/3m widths) are fabricated to match up with the 5000 Series Crusher or our Breaker Series.





Coal Processing and Separating

Many different types of coal are needed to create coke. An Indiana steel mill uses an environmentally friendly system that employs Gundlach CAGE-PAKTOR® technology to crush coal to 3 mm product with strict product control. The hydrostatic drives of the CAGE-PAKTORs adjust to various product sizes and maintain uniformly sized output without stopping production.

A Canadian plant and mine uses Gundlach roll crushers to size coal to boiler feed size. After burning, bottom ash is crushed by a Gundlach single-stage crusher for sale as fill or aggregate.



Cokes

Gundlach engineers have helped many oil refineries, steel mills and others to become more efficient by designing and providing crusher solutions for different kinds of coke.

In Illinois, a Gundlach stationary petroleum coke crushing plant uses a front loader to drop green petroleum coke into a Gundlach two-stage roll crusher, which breaks 600 mm material at 300 mtp/h.

In India, Gundlach engineered and manufactured the largest mobile coke crushing plants in the world. These mobile plants use Gundlach four-roll, two-stage crushers to handle up to 1-meter lumps at 800 mtp/h and crush them to 50 mm.



Salts

A customer in Louisiana had an unreliable and dusty closed circuit screening system with their primary and reject crushers. Gundlach testing proved that a low maintenance Gundlach roll crusher could eliminate the oversize, the need for screening, and a second crusher while providing higher product yield. Sized material discharges directly to the product belt and customer specifications are met in one pass without additional screening or crushing.

Fertilizers (Potash)

Gundlach works with many different aspects of fertilizers to better control the in-range product. Gundlach has roll crushers, CAGE-PAKTORs and NANOSIZ-Rs processing nitrogen, phosphate and potash from the mine to final sizing. Throughout your system, flake, wet, agglomerated, or hot and dry, there is a Gundlach design that's just right for you.

Hot Materials

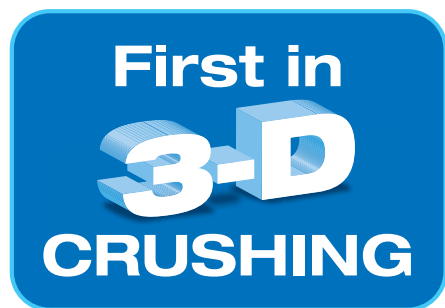
Handling high-temperature materials posed a serious and costly problem for a northern USA chemical plant. Gundlach designed a 3000 Series two-stage, four-roll crusher to reduce materials heated to 1800° Fahrenheit, an application previously thought to be impossible.

Glass

Gundlach has provided roll crushers and CAGE-PAKTORs to many major glass suppliers worldwide, for reclaim cullet, float glass, or plate glass, producing the preferred product size for best recycle efficiency.



GUNDLACH



Engineering

State-of-the-art engineering software is used to create 3-dimensional computer models of new products to verify feasibility of design and manufacturing compatibility. Gundlach engineers regularly participate with existing and potential customers to assist in defining and providing the best possible fit for new or modified installation and application of Gundlach machines.

Testing

In Gundlach's Materials Testing Center, tests are performed on materials to be crushed with full-size production equipment to verify design projections. Tests are performed by an independent third party world-leading testing service to provide complete and accurate information to ensure you're selecting the best equipment for your application.

Manufacturing

In Gundlach's modern Belleville, Illinois manufacturing plant Gundlach has complete fabricating, machining, robotic welding and crusher assembly services.

Using computer-aided design and manufacturing, Gundlach's CNC cutting and machining equipment is programmed to create consistently high quality crushing equipment and parts.

Robotic welding is used to manufacture crusher rolls and cages to exact standards and incorporates the highest quality in the rebuilding process. The level of durability, accuracy and cost reduction cannot be matched by manual systems.

Gundlach has expanded its plant to over 50,000 square feet. To handle larger equipment, a 25-ton, double girder crane is available.

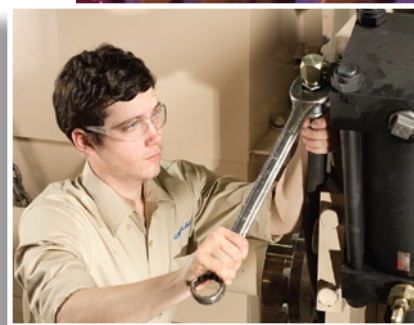
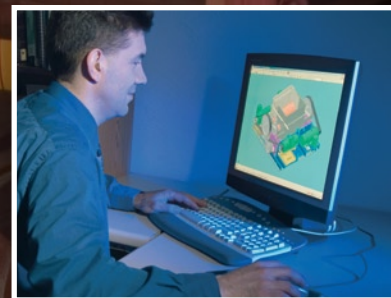
Field Service

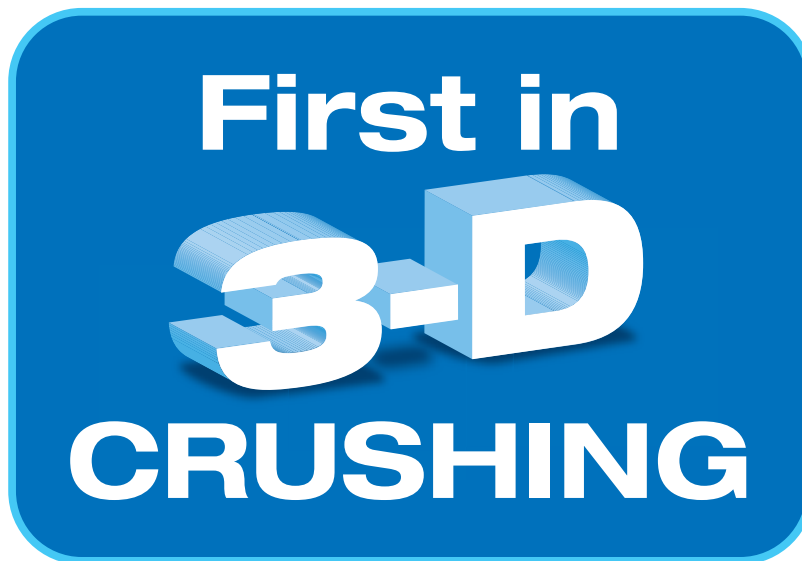
Gundlach's Field Service helps install and put crusher systems on line. Gundlach trains customers' employees to operate and maintain Gundlach products and systems. Consultants are available to regularly inspect your system and to provide upgrades or new roll configurations. Gundlach is prepared 24/7 to respond with service and spare parts to keep customers' plants up and running.

Field service programs help customers operate more efficiently and control costs. Gundlach's Roll Repair Program maintains customer roll inventories and freezes roll costs for up to three years. Gundlach re-manufactures used equipment of their manufacture and offers guaranteed refurbished crushers and rolls at tremendous savings.

International

Gundlach equipment is manufactured in the United States by Gundlach and is represented in UK, India, South Africa, Canada, Columbia, Brazil, Argentina, Chile, Czech Republic, People's Republic of China, Taiwan, Indonesia, and New Zealand.





For more information, contact your Gundlach representative today!

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