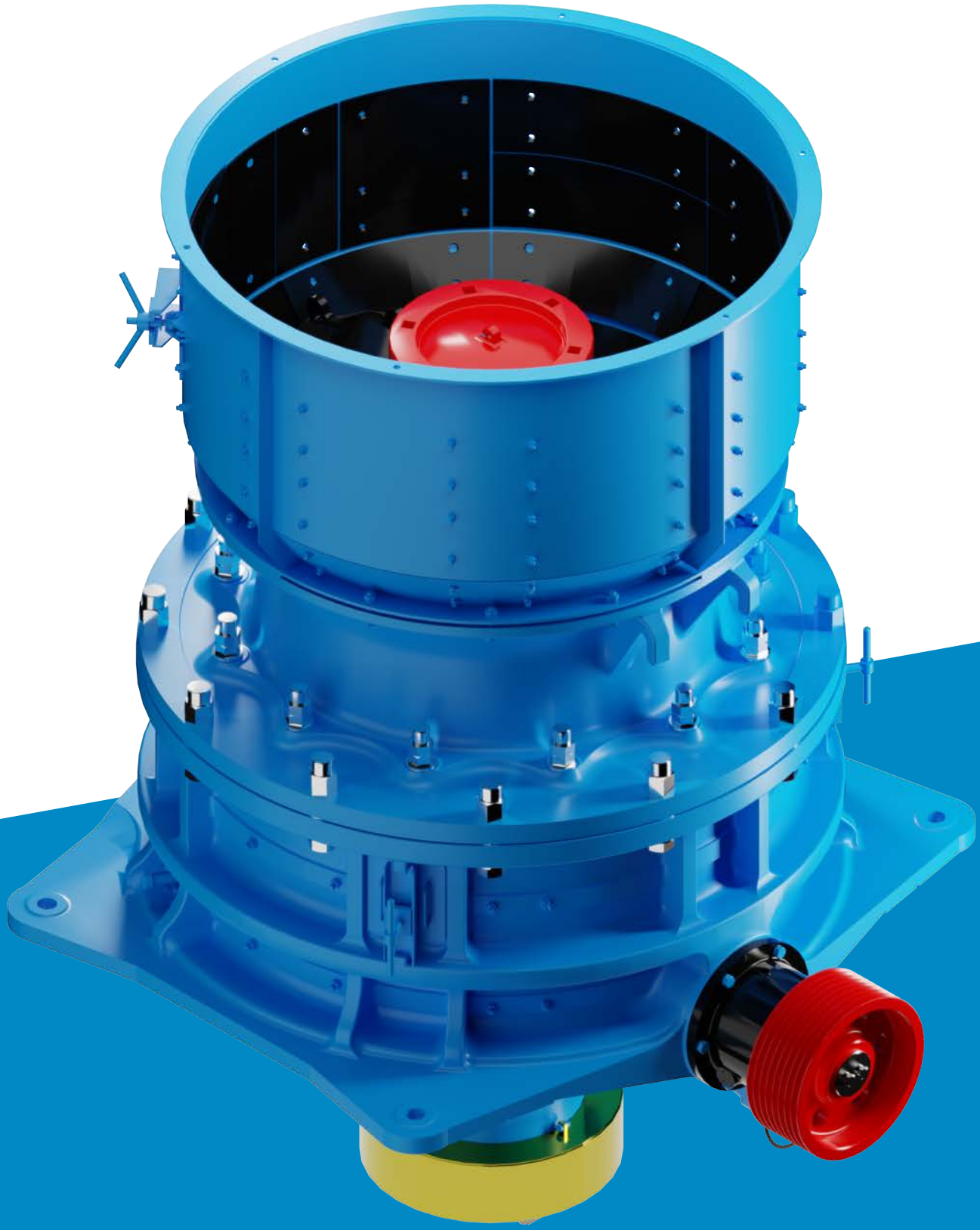
KAWASAKI CYBAS-I CONE CRUSHER

MANUAL

US / IMPERIAL

IMSV ENGINEERING



EARTHTECHNICA

KAWASAKI
CYBAS CONE CRUSHER

Preface

We wish to express our sincere appreciation for your purchasing a KAWASAKI cone or gyratory crusher.

This crusher is so designed and manufactured as to best suit your projected operation.

With its hydraulic mechanism, this crusher allows easy and prompt adjustment of discharge set and other operations. Moreover, since the whole construction allows easy checking and maintenance, we are confident that it will fully satisfy your requirements.

For this crusher to be operated at high efficiency at all times, even under different conditions, it is necessary for you to be fully acquainted with how to make adjustments and what are the key points of checking and maintenance.

Since this manual is prepared for the said purpose, we hope that you will carefully read it prior to installation and operation of this crusher.

DATA SHEET:
CLIENT DETAIL

CUSTOMER:		
IMS CONTACT NUMBER:		
IMS OFFER NUMBER:		
DATE OF ORDER:		
ADDRESS:		
SITE OF OPERATION:		
TYPE OF MACHINE:		
SERIAL NUMBER:		

DUTY SPECIFICATION

MACHINE APPLICATION:	
FEED MATERIAL TYPE:	
FEED MATERIAL BULK DENSITY:	
FEED SIZE:	
MOISTURE CONTENT:	
MASS OF CRUSHER	
CRUSHING CHAMBER SIZE:	
ECCENTRIC THROW:	
DISCHARGE SET – [CSS]:	
CAPACITY (THROUGHPUT):	
PRODUCT SIZE:	
DYNAMIC LOADS: HORIZONTAL	
DYNAMIC LOADS: VERTICAL	

DRIVE DETAILS

MOTOR SUPPLIED BY:	
RATING:	
HORIZONTAL SHAFT SPEED:	
SHAFT DIAMETER: (ELECTRIC MOTOR)	
MOTOR PULLEY:	
CRUSHER PULLEY:	
V-BELTS	

AUXILIARIES SUPPLIED

LUBRICATION AND HYDRAULIC UNIT TYPE:	
ROTARY FEEDER:	
RECOMMENDED LUBRICATION OIL:	
TYPE OF OIL COOLER:	
VORTEX BLOWER:	
CONTROL EQUIPMENT:	

SUPPLIER DETAILS

I.M.S. ENGINEERING. (Pty.) Ltd.
Spartan Service Centre

Postal Address
PO Box 8003
EDLEEN
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CONTENTS

Table of Contents:

Contents:

1. INTRODUCTION

This portion of the manual is intended to only illustrate basic safety procedures. Additional precautions may be necessary for the safe operation of a crusher.

The information contained in this manual is not intended to replace safety codes, insurance requirements, federal, state and local laws, rules and regulations.

The examples of safety features listed below must be strictly observed, as the most important thing in the running of the equipment is to ensure the safety of the operators and maintenance personnel.

Since the personnel are the key to the safe execution of operations, we hope they will carefully study the safety hints and recommendations described in the following paragraphs, and become well acquainted with the basic safety measures, so that serious accidents and machinery damage are kept to a minimum.

ALWAYS REMEMBER THAT YOU, THE OPERATING PERSONNEL, ARE THE SAFETY.

2. SAFETY PRECAUTIONS

2.1. PREVENTION

Accident prevention is better than any cure, and to assist you in this regard we draw your attention to the words "**CAUTION**" and "**WARNING**" for dangerous operations in particular.

However safe the machine may be, the operation and running must be done with the greatest possible care, and the use of good safety and working practices will not only protect the people working around you, but also yourself.

Carefully study the instruction manual and pay particular attention to all descriptions of "**CAUTION**", "**WARNING**", "**DANGER**" and "**IMPORTANT**".

Recommend to your colleagues to do the same.

2.2. SAFETY WEAR

Always be aware of safety requirements for your protection and make use of the equipment recommended. i.e. Safety helmet, safety shoes, safety goggles, gloves, ear protectors.

Do not wear loose fitting clothing. Long, loose, sleeves and jewellery are also hazardous around moving machinery. Always consider your working area and dress for your health and safety.

2.3. KNOW YOUR MACHINE.

Carefully read and study the Instruction Manual to become fully familiar with the characteristics, capacities and limits on operation and maintenance of the equipment.

2.4. HOUSEKEEPING

Housekeeping is a very important feature of safety and each and every person can play a part in keeping floor surfaces clean and free of oil grease rags and chains and any other debris. Return tools and other equipment to the stores after use.

Identify working areas and never work in an unsafe way.

THINK BEFORE YOU ACT

3. FIRE DRILL

Each person shall know what to do in the event of a fire.

Before carrying out any welding or grinding work or any form or task where heat is developed, all combustible material shall be protected and a person shall standby with an extinguisher of the type that would be appropriate.

CHECK WITH YOUR FIRE OFFICER.

4. ALCOHOLIC DRINKS - MEDICATION

- Prior to, and during your working hours, never take any kind of alcoholic drinks.
- Pay sufficient attention to administration of medicine, tranquilliser or any other substances, which may induce drowsiness or impair focus, attention and vision.

5. PRE-START CHECKS

It is important that each check must be carried out thoroughly as this will ensure that the equipment is kept in good and safe condition. Points to look for are as follows:

- Verify that all safety devices are installed in the correct positions and working as prescribed.
- Check the lubrication system for leakage and that the correct specified oil is being used. (MOST IMPORTANT).
- Check the machine visually for any defects, loose fitting parts, broken or damaged parts.
- Before starting any of the equipment make sure that nobody is working on this equipment, sound the alarm and make sure that everybody, even visitors know what the sound of this alarm(s) means and that everybody without exception knows that the consequences that ignoring the alarm(s), can be fatal.

Upon detection of any defect, report it to your supervisor. However small this defect may be, it might result in an accident now, or in the future.

6. SAFETY CHECKS UPON START UP

- Run the equipment according to "OPERATING PROCEDURE" described in the manual.
- When start up is completed check for abnormal noises, and that all the equipment is functioning as required, if any of these are not working correctly, stop the machine immediately and investigate and take the appropriate cause of action.
- Oil strainers must be checked and cleaned.
- Upon detection of any defect, small as it may be, report this to your supervisor. However small this defect may be it might result in an accident now or in the future.

7. CHECKS DURING MAINTENANCE AND NORMAL RUNNING

Besides taking great care and working safely, operators and maintenance personnel must adhere to the following procedures.

- When work is to be carried out inside or around the crusher, the main power switch must be isolated and locked out, and a sign "under repair" must be displayed.
- Each person should have his own lock and keys to implement the above safely.
- Any adjustment e.g. Cleaning, servicing, lubrication checking of belt tension must be done when crusher is at standstill and never while in motion.
- Proper tools must be used to complete any job.
- Crusher parts must be handled with care especially when fitting gears, bushes, bearings and other moving parts.
- When lifting heavy parts make sure that lifting equipment is correct and in good condition and never walk or stand underneath the part being lifted.
- When operating a crane, only a single person should give instructions.
- Do not look inside the crusher without wearing safety glasses.

8. REPLACEMENT PARTS

Replacement parts, whatever it may be, must be of identical size, type and quality with those of the parts to be replaced.

Parts must be clean and free of dirt and burrs prior to installation. Lubricate parts where applicable.

SAFETY PRECAUTIONS

9. PRESSURE VESSELS

The following important note has a direct bearing on the accumulators supplied with every Kawasaki Cone Crusher. Procedures shall be put in place by the end user so that the following is adhered to and followed according to South African law. Where the machine is used outside the borders of South Africa the regulations of that country shall apply.

IMPORTANT

PRESSURE VESSELS INSPECTION IN TERMS OF VESSELS UNDER PRESSURE REGULATIONS OF THE OHS [Occupational Health and Safety] ACT No. 85 OF 1993 AND MINERALS ACT No. 50 OF 1991 AS AMENDED.

NOTES

GENERAL POINTS REGARDING OPERATION

Contents:

GENERAL POINTS REGARDING OPERATION

1. GENERAL PRECAUTIONS

1.1 FEED MATERIAL DUMPING /FEEDING DIRECTION

The feed material should be supplied to the cybas cone crusher directly, or via a rotary feeder (if fitted) uniformly into the crushing chamber circumference so that the chamber is used effectively. The feed rate shall be adjusted so that the level of feed in the crushing chamber is in line with the top of the main shaft head nut. (Fig 2.1)

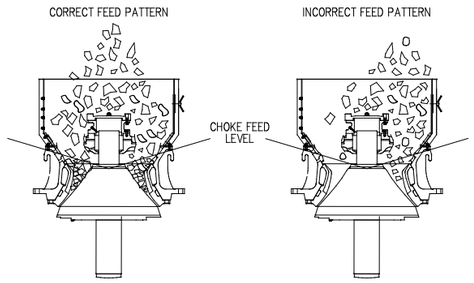


Fig 2.1

Correct distribution of feed material is achieved by altering the position of the rotary feeder, so as to ensure material is thrown evenly over the entire circumference of crushing chamber. The rotary feeder direction should be evenly alternated. (E.g. Mon c/wise, Tues ac/wise, Wed c/wise, ect.)

1.2. SIZE OF FEED MATERIAL.

Ensure that the maximum feed size is less than the width of the feed opening.

1.3 BEFORE CRUSHING BEGINS.

Make sure that the crushing chamber is empty before starting the crusher. If feed material is dumped into the crusher chamber by mistake, it should be gradually crushed and discharged using the maximum allowable CSS, (closed side setting). If this operation is impossible, remove the feed material manually from the top.

1.4 IMPORTANT POINTS TO OBSERVE.

Be sure to run the crusher in during trial operation, or after the replacement of bearings or gears. If full-load operation is done without running in, bearing seizure will occur.

Always ensure proper operation. Checks and maintenance of the crusher, lubrication equipment, hydraulic equipment, electrical equipment, and piping shall be carried out regularly.

An operation log should be compiled and recorded.

The protective interlocks must be installed according to the functional specifications. Operator access to change this specification must not be allowed.

Make sure that the recommended lubrication oil is used. Using the flow meters in the lubrication oil system, ensure that oil flow is at the specified rate.

CAUTION

IT MAY WELL BE SAID THAT THE LUBRICATION OIL TANK IS THE HEART OF THE CYBAS CONE CRUSHER AND THE LUBRICATION OIL IS THE BLOOD. SHOULD SOMETHING BE WRONG WITH THIS FUNCTION OR OIL FLOW, THE OUTER BUSH OR INNER BUSH WILL BE DAMAGED, MAKING THE CRUSHER INOPERATIVE.

Prior to starting the crusher each day, check the horizontal shaft lubrication oil to see if the oil level is at the specified level. If not, replenish the oil and run the crusher keeping the oil level in the middle between the lower limit and upper limit. (Fig 2.2)

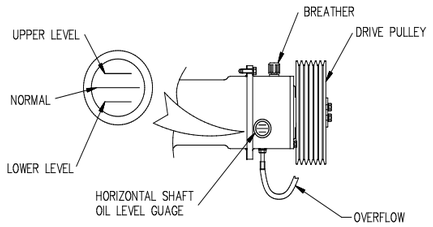


Fig. 2.2

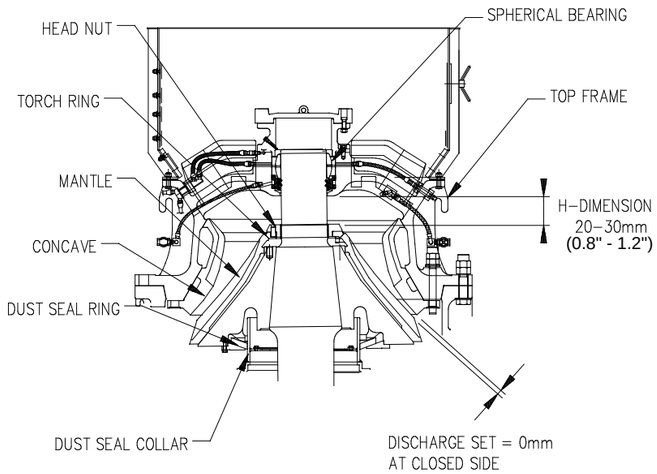


Fig. 2.3

Ensure that the spherical bearing grease dispensing system is working properly and that grease is fed to the bearing at the rate specified.

For the determination of the point of ordering and changing of the mantle and concave due to wear, the H-dimension shall be checked. This must be checked regularly and recorded. (Fig. 2.3).

The mantle and concave shall be replaced at the same time. When the distance between the head nut and the spherical bearing housing, (Dimension H), becomes 30mm at discharge set equal zero, the mantle and concave should be regarded as. worn out.

The head nut, torch ring, concave mounting bolts, nuts and washers should also be replaced at the same time as the mantle and concave.

NOTE: In some specific cases of wear pattern of the mantle and concave, the dimension "H" may not accurately indicate the service life of these parts.

When the dimension "H" reaches 50 mm, frequently check the wear condition and replace the mantle and concaves well in advance, when local wear or damage, etc. are detected.

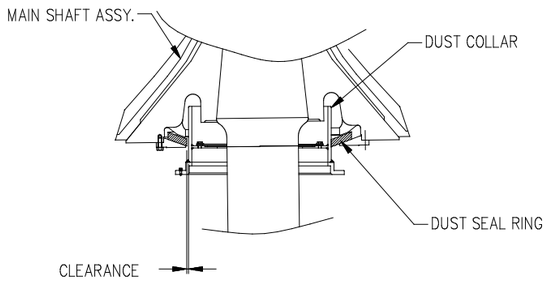


Fig. 2.4

GENERAL POINTS
REGARDING OPERATION

When the clearance between dust seal ring and dust collar has reached 3mm, a spare dust seal ring should be ordered and when it reaches 5 mm, it is time to replace the dust ring. (Fig. 2.4)

1.5 DRIVE

A motor drives the crusher via a direct drive shaft. (Fig. 2.5)

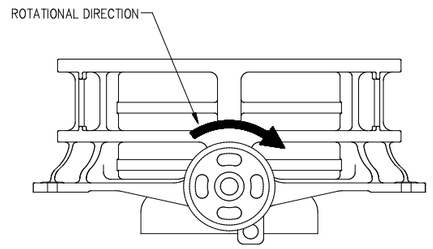


Fig. 2.5

The rotational direction of the shaft must be clockwise viewed from the motor side. This is absolutely necessary to ensure a self tightening action of the head nut and to prevent it from loosening during operation. A wrong direction of rotation will also negatively influence the flow of lubrication oil inside the crusher with the danger of damage to the bearings

2. SAFETY PRECAUTIONS.

Stop the crusher before inspecting the crushing chamber and crusher interior. The crusher shall be properly locked out following the correct procedures.

When the top frame and crushing chamber are inspected, anything that can fall from above should be removed from the feed chute before checking commences.

Since the surfaces in the crushing chamber are very slippery, extreme caution shall be exercised.

During the inspections a warning indicating crusher inspection should be displayed at the feed point or a warning light should be switched on. (Make sure there is a person at the feed point to ensure that no material is thrown in by mistake.)

If any crusher problem occurs during operation, the location of the problem will be displayed in the control room. The crusher will trip and cease operation in any one of the following cases.

- Oil shortage.
- Abnormal temperature of return oil.
- Stoppage of lubricating pumps.
- Main motor overload.

In the event of any of the above, investigate the cause thoroughly and ensure that all is normal before restarting the machine. For detailed actions, see the section on "Troubleshooting".

Contents:

CONSTRUCTION

1. OPERATING PRINCIPLE.

The paragraphs that follow contain descriptions of the major sub-assemblies of the cybas cone crusher. In order to properly understand the function of the different parts, it is necessary to have a general understanding of the basic operating principle.

1.1. CENTRES OF ROTATION AND GYRATION

The movement of the parts of the cybas cone crusher is essentially described as movement around certain centres. The eccentric sleeve assembly rotates around a centre of rotation, which is also the vertical centreline of the crusher assembly.
The centre line of the bore of the eccentric sleeve is offset from the centre of rotation and this centre line, which is also the centre line of the main shaft assembly, is termed the centre of gyration. The two centrelines intersect at a point near the top of the main shaft, which is also the centre point of the spherical bearing. This point is termed the apex of gyration but is sometimes also called the dead point, as this is the only point on the main shaft that does not move.
Movement of the main shaft assembly is twofold as it has a gyratory movement and it also may or may not rotate around its own centre line, depending on the reigning conditions in the crushing chamber.

1.2 POWER TRANSMISSION AND CRUSHING ACTION

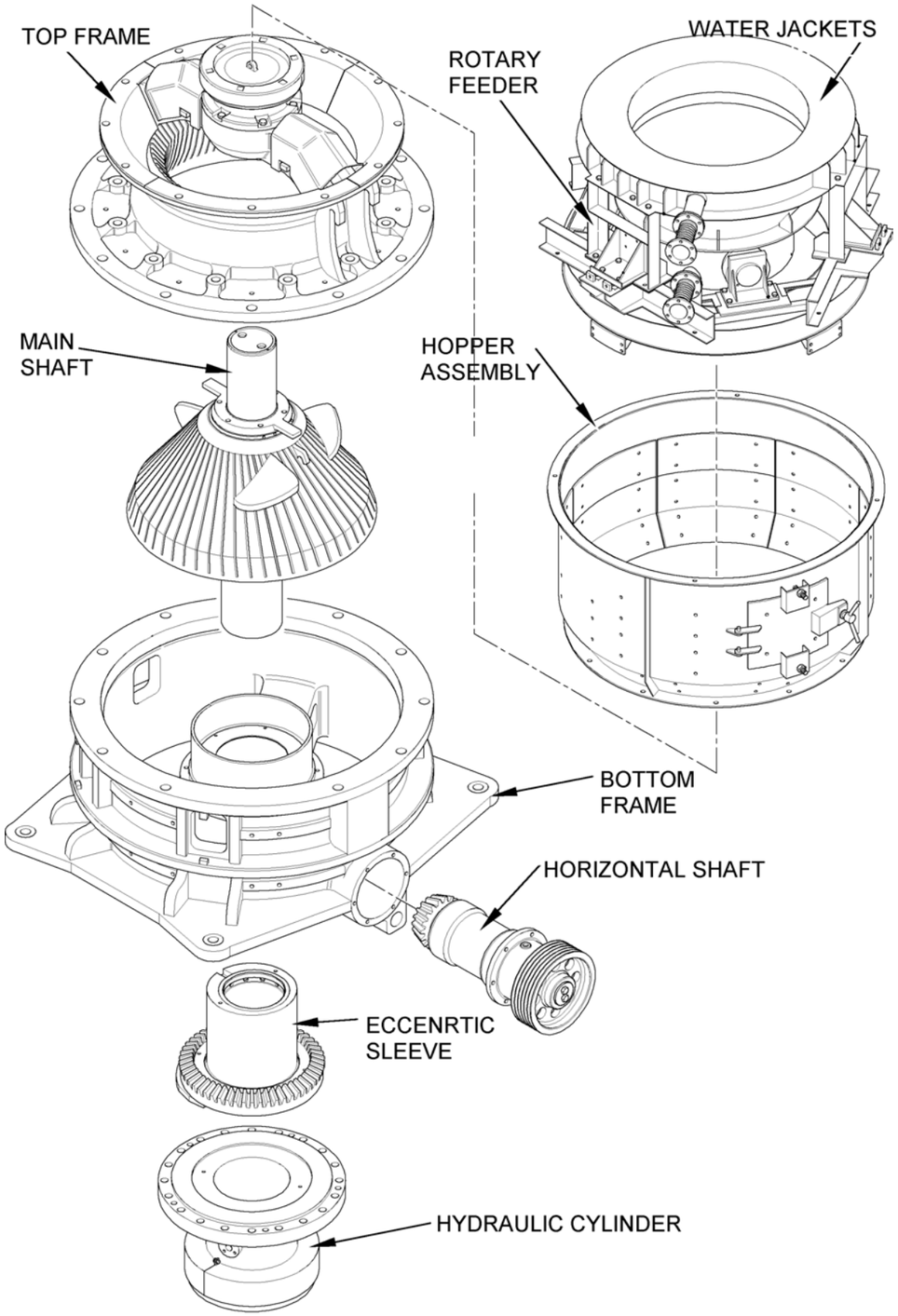
The horizontal shaft of the crusher is driven by an electric motor, either directly or via a V-belt drive mechanism. At the inner end of the horizontal shaft is a pinion which mates with a bevel gear. Through this gear set, the eccentric sleeve is forced to rotate inside the outer bush which is rigidly mounted in the crusher bottom frame.
As the eccentric sleeve rotates the main shaft assembly is forced to perform a gyratory movement. This movement causes the one side of the mantle to be closer to the concave than the opposite side at a given point in time. It is this dynamic action which causes the gap between the mantle and concave to open and close continuously at all points around the circumference of the crushing chamber.
When feed material enters the space between the mantle and concave the closing movement causes the material to be crushed through a compression action. When the mantle moves away and the opening between it and the concave increases the crushed material falls further down the crushing chamber and with the next closing cycle it is crushed again to a smaller size. This cycle is repeated until the size of the crushed material is sufficiently reduced to allow it to pass through the opening at the bottom end of the crushing chamber, which is called the discharge setting or gap. Discharge setting or gap is a variable that is set according to specific process requirements to ensure that a crusher product of the desired grain size is produced.

2. MAJOR SUB-ASSEMBLIES.

The cybas cone crusher consists of the following major sub-assemblies, which are shown in the following illustration:

Each of these sub-assemblies will be described in more detail in the following paragraphs.

NOTE: Rotary feeder & water jacket shown are optional



2.1. BOTTOM FRAME ASSEMBLY

This section describes the bottom frame and it's related sub-assemblies and parts as it is shown in the illustration. (Fig. 3.2)

1. Bottom frame
2. Dust collar
3. Inner bush
4. Eccentric sleeve
5. Bevel gear
6. Outer bush
7. Thrust bearing
8. Hydraulic cylinder
9. Plain bearing
10. Step bearing
11. Horizontal shaft assembly
12. Lubrication oil piping
13. Air piping (not shown)
14. GY Sensor
15. Air bleeder
16. Arm liners
17. Hydraulic ram assembly

The bottom frame, which is securely bolted to a suitable foundation, provides a rigid support for the remaining crusher components. The bottom frame is of a heavy duty cast steel construction and is fitted on the inside with replaceable bolted wear liners to protect it against abrasion by the material that is processed by the crusher.

The inner cylindrical section of the bottom frame is connected to the outer housing by means of three bottom frame arms. Two of these arms have the same dimensions while the third is bigger to allow the horizontal shaft assembly to be fitted inside it. Replaceable, protective cast liners are fitted over the arms to provide protection against abrasive wear.

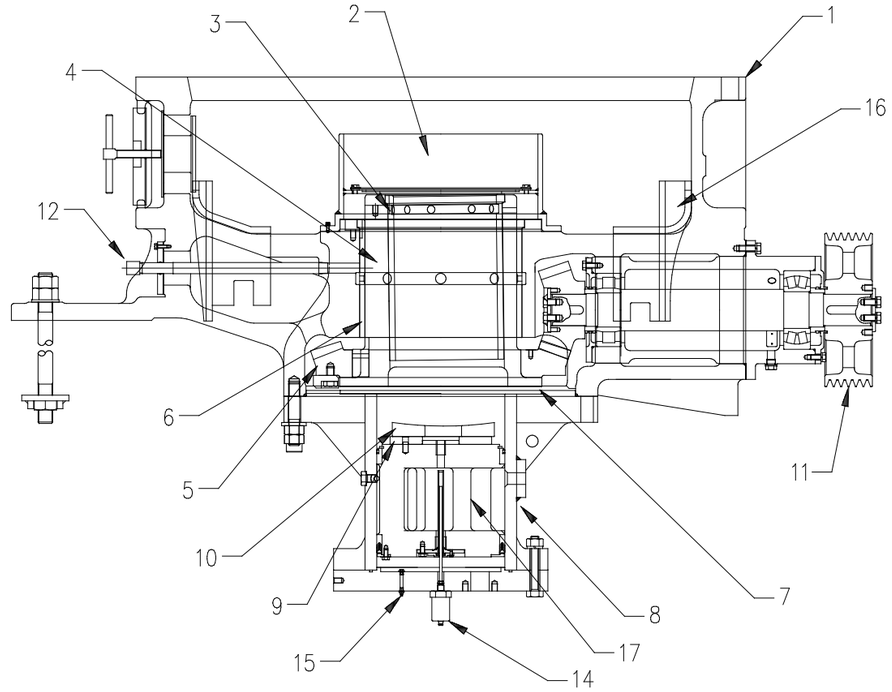


Fig. 3.2

The bronze outer bush is shrink fitted to the inner bore of the bottom frame and its function is to provide a support bearing for the eccentric assembly to run in and in doing so transmits the crushing force from the main shaft assembly to the bottom frame.
The eccentric sleeve assembly is fitted into the outer bush from below and is supported in the vertical direction by the bronze thrust bearing, which is bolted to the hydraulic cylinder.
Included in the eccentric sleeve assembly is the bronze inner bush. The bevel gear is shrink fitted to this sub-assembly.
At the top of the inner cylindrical part of the bottom frame, the dust collar assembly is located. Its function is to provide a labyrinth seal against oil splashing inside the crusher by means of the splash ring, which fits around the main shaft. It also provides a sealing surface against which the dust ring, fitted to the underside of the main shaft assembly locates. Bolted to the underside of the bottom frame is the hydraulic cylinder assembly. The function of the hydraulic cylinder is to provide support in a vertical direction to the main shaft assembly and to enable easy adjustment of the discharge setting. Furthermore through the hydraulic system to which it is connected it provides protection against overload.
Vertical support of the main shaft is through a bearing assembly made up of a bronze plain bearing and steel step bearing. The plain bearing is fitted to and supported by the ram of the hydraulic cylinder and the step bearing in turn rests on this. Part of the main shaft assembly is the main shaft step; a bronze bearing which in turn locates on top of the step bearing.
Two sets of pipe work are fitted to the bottom frame. The first is the oil piping feeding lubrication oil from the external lubrication oil pipes to the outer bush. The second is the air piping, which feeds air from the air blower to the inside of the crusher to provide a dust seal through overpressure.

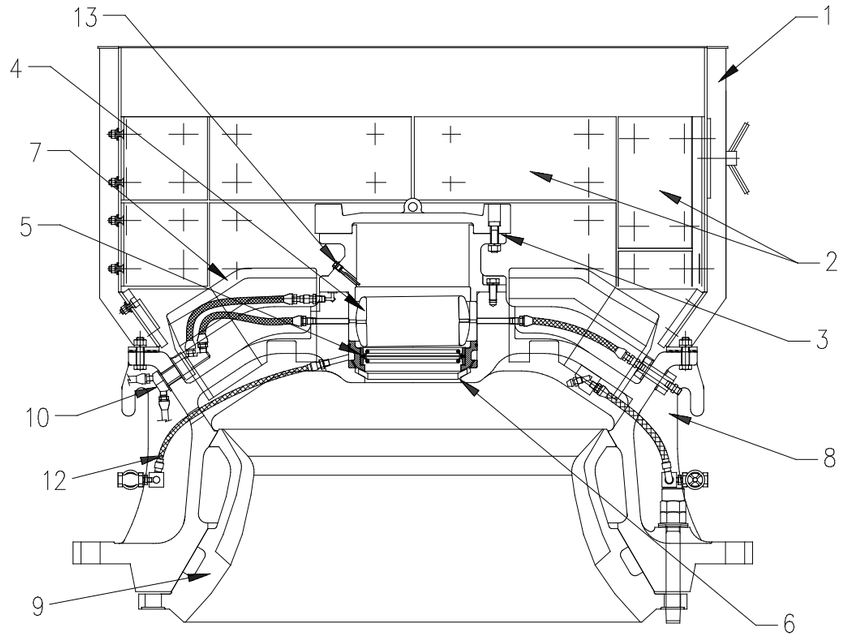


Fig. 3.3

2.2. TOP FRAME ASSEMBLY

Made out of a high quality steel casting, the top frame, like the rest of the crusher frame, is a structural component. It is bolted to the bottom frame by means of a flange connection that also includes a locating taper interface, which serves to transmit the forces created by the crushing operation.
This section describes the top frame and it's related sub-assemblies and parts as it is shown in the illustration. (Fig. 3.3)

1. Hopper
2. Hopper liners
3. Spherical bearing cap and cap cover
4. Spherical bearing
5. Oil seal assy. incl. retaining ring
6. Scraper
7. Arm liner
8. Top frame
9. Concave liner
10. Grease line
11. Rotary feeder (not shown)
12. Water spray
13. Spherical bearing grease dipstick

The spherical bearing assembly has the function of rigidly supporting the top end of the crusher main shaft in such a way that it allows both gyration and rotation of the main shaft to take place, whilst maintaining the position of the dead point at all times.
A double oil seal arrangement is contained in an oil seal holder that is located in the housing below the spherical bearing. The oil seals are kept in place by a retaining ring that is clamped in place by the spherical bearing. The double oil seal system is further enhanced by a scraper ring, which prevents dirt particles adhering to the main shaft from reaching the oil seals above the scraper ring.
The main function of the sealing arrangement is to contain the spherical bearing lubricant by preventing it from running out at the bottom and to prevent the ingress of dirt from the crushing chamber environment into the spherical bearing assembly.
Situated over the spherical bearing assembly, the cap and cap cover cast from a strong wear resistant material, protects the bearing assembly against impact and abrasion from the feed material.
The top frame arms are protected from impact and abrasion by the arm liners cast from a strong wear resistant material.
Retention of the arm liners on the arms is by means of a lug and retainer plate to prevent it being damaged by upward forces induced by the movement of large lumps prior to being nipped between the mantle and concave.
Grease pipes are fitted to feed the spherical bearing lubricant from the remotely mounted grease supply system through the one arm of the spider to the spherical bearing.
Water sprays used for the flushing of dirt and mud from the spherical bearing housing and from the exposed surface of the main shaft collar are fitted to the underside of the spider arms. Similar to the grease supply pipes a system of pipes are fitted to both the top frame arms to feed water from an external source to the water sprays. This is only fitted to a wet system crusher.
A rotary feeder (not shown) is situated on top of the hopper to facilitate the proper distribution of the feed material. Some machines are not fitted with rotary feeders.
Water jackets (not shown) are fitted to wet system machines to aid the crushing process in certain applications.
The assembly is completed by the concave liner that locates on a machined interface on the inner surface of the top frame casting. The concave liner is bolted in position.

2.3 HORIZONTAL SHAFT ASSEMBLY

This section describes the horizontal shaft assembly and it's related sub-assemblies and parts as it is shown in the illustration. (Fig. 3.4)

1. V ring seal assy.
2. Pinion
3. Inner cover
4. Roller bearing
5. Shaft

6. Horizontal shaft housing
7. Self aligning roller
8. Outer cover
9. Oil seal assy.
10. V belt pulley
11. Oil over flow

Manufactured from cast steel the cylindrical horizontal shaft housing of the horizontal shaft assembly has two machined locating journals on the outside that fit into corresponding machined areas in the bottom frame arm. The housing further has a flange towards the outside end, which is used for mounting onto the bottom frame.

Fitted into the housing is the horizontal shaft, which is supported in a bearing at each end. At the pinion end that is inside the crusher, a cylindrical roller bearing is used, while a self-aligning roller bearing is used at the other end. A pinion is fitted onto the part of the shaft that protrudes into the crusher and it meshes with the bevel gear that is fitted to the eccentric sleeve. The driving force for the crusher is applied at the other end of the horizontal shaft either by direct drive or with a suitable V-belt drive arrangement.

The horizontal shaft assembly is a sealed unit with its own separate volume of lubrication oil. At either end of the horizontal shaft assembly are V-ring type oil seals. At the inner end, there is a double seal arrangement as it must both contain the lubrication oil of the horizontal shaft assembly as well as keep out the circulating crusher lubrication oil. The opposite end has a single oil seal to contain the oil of the horizontal shaft assembly, however on this side there is a labyrinth ring keeping dirt away from the oil seal.

An oil level sight glass is fitted to the side of the horizontal shaft assembly to indicate the oil level. At the bottom of the housing an oil overflow pipe is provided. The function of this overflow is to prevent the oil level in the horizontal shaft assembly from rising above the maximum allowable level should oil be forced past the inside seal due to a defective seal. The overflow pipe is connected to the lubrication oil return pipe and thus allows the excess oil to return to the lubrication oil tank.

Between the bottom frame and the flange of the horizontal shaft housing there are asbestos

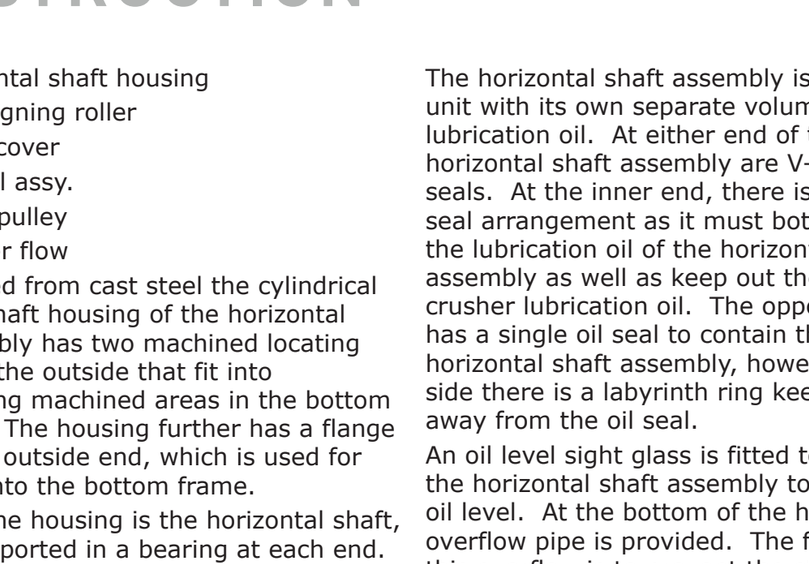


Fig. 3.4

packing which are used to adjust the bevel gear and pinion backlash by varying the thickness by adding or removing packing.

2.4. MAIN SHAFT ASSEMBLY

This section describes the main shaft assembly and it's related sub-assemblies and parts as it is shown in the illustration. (Fig. 3.5)

1. Main shaft
2. Head nut
3. Torch ring
4. Mantle liner
5. Mantle core
6. Dust ring
7. Dust ring cover

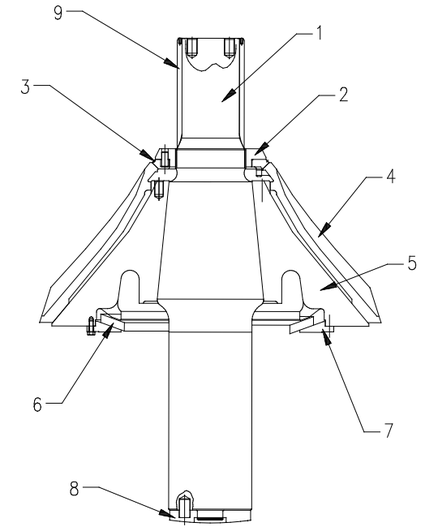


Fig. 3.5

8. Main shaft step
9. Main shaft collar

A one piece, forged, main shaft with a mantle core shirk fitted to it is used in the cybas cone crusher. The main shaft design is such that its has an exceptional fatigue life due to various specific design features.

It has fitted to the top section, which is in contact with the feed material, a special wear resistant main shaft collar that protects the shaft from any possible damage. This sleeve is also the part of the main shaft assembly that fits into the spherical bearing assembly.

The mantle has a locating taper section at the bottom and at the top it has a cylindrical journal that locates on a parallel section of the shaft/core to keep it in position. At the top it has a slight taper that matches a taper on the torch ring which acts to centre the upper mantle when the head nut is tightened. The torch ring has the further function that it can be flame cut to release the tension on the head nut when this has to be removed in order to replace the mantle liner.

Between the mantle and the mantle core is a cavity that is filled with an epoxy backing material to provide proper, even support for the mantle liners.

At the bottom of the mantle core section of the main shaft is a dust ring assembly. The dust ring is held in position by the dust ring cover. The dust ring provides a seal against dust entering the bottom frame assembly/ crusher gearbox. (See also description on bottom frame assembly)

The bottom of the main shaft is fitted with a bronze main shaft step bearing which interfaces with the step bearing of the hydraulic cylinder assembly.

Contents:

OPERATION

1. GENERAL

The Cybas cone crusher has a variety of bearings, metal parts, and gears, which are subjected to high loads, thus a running in period is required.

This section explains how to operate the crusher during trail operation after the completion of installation of the crusher and auxiliary equipment, adjustment of components, and filling with oil and grease. When bearing parts or gears are replaced, run-in must be conducted in accordance with this section before full load operation is started.

2. TRIAL OPERATION SEQUENCE

Trial operation should be done in the following sequence:

1. Preparation and general checking.
2. Flushing.
3. Hydraulic unit adjustment.
4. No-load operation.
5. Load operation (running in).
6. Commercial operation.

2.1 PREPARATION AND GENERAL CHECKING

- All bolts shall be tightened to the correct torque. (See torque tables).
- Electrical wiring must be safe.
- Check the grease at the spherical bearing is the correct quantity.
- Oil tank interiors shall be clean and free of dirt and foreign objects.
- Machine guards shall be in place.
- Drive Vee belts tension shall be correct and alignment checked.
- The horizontal shaft rotation direction must be clockwise.
- All oil strainers shall be clean.

2.2. LUBRICATION SYSTEM

- The lubrication oil tank shall be filled to the specified level.
- Run the lubrication system for at least four hours.
- Monitor oil flows, oil pressure and oil temperature.
- Check all piping for leaks.
- Monitor equipment for abnormal noise.
- Report any foreign matter in the strainers after flushing. Clean the strainers.

2.3. HYDRAULIC SYSTEM

- The hydraulic oil tank shall be filled to the specified level.
- Accumulator cylinders shall be charged to the specified pressure.
- Bleed air from hydraulic system at hydraulic cylinder and accumulators.
- Set the closed side setting (CSS) to the specified gap.

2.4. NO LOAD TRIAL OPERATION

No load operation of the equipment should be done for not longer than 30 minutes in the following sequence:

1. Set the closed side setting (CSS) to the specified gap.
2. Start the lubrication pump. Check that specified flow rates are being achieved.
3. Check that the oil is returning at the return oil strainer.
4. If all is normal, start the crusher.

Monitor the following during no load operation. Record all data.

- Check the no load power (motor current). If the no-load power is 25%, or less than the rated power of the motor, it is normal.
- Check free revolutions of the mantle. If it is <50 revolutions per minute, it is normal. (The measurement should be made when the lubrication feed oil temperature is higher than 570°F.)

- Pay attention to the gear sound.
- After stopping the crusher, check the return oil strainer. If any large metal particles that do not pass through the return oil strainer are found, it is abnormal. Such particles could be from the various bearings, (leaded-bronze), or from the gears, (steel).

2.4.1. INTERLOCK TEST

Check that the crusher shuts down due to:

- Insufficient lubrication oil flow.
- Lubrication pump stoppage.
- Return oil temperature high.
- The crusher must not start while lubrication pumps are not running. If two pumps are fitted, the two pumps may not run in tandem.
- Main motor over load. (High amps).

If the above criteria are not met, the interlock must be repaired before trail operation begins.

2.5. TRIAL OPERATION

It is important to run the crusher in slowly by gradually applying load. This must be done every time any major component is replaced, i.e. main shaft, inner bush, outer bush, main shaft step bearings, plain bearing, gears and eccentric sleeve.

The load should be applied gradually as follows:

SCHEDULE		**S** Specified closed side setting (mm)	**Q** Specified crushing rate (T/h)
PHASE:	DURATION (hrs)		
1st	4	S	Q x 0,5
	4	S	Q x 0,6
2nd	4	S	Q x 0,7
	4	S	Q x 0,8
3rd	4	S	Q x 0,9
	4	S	Q
4th	8	S	Q + 10%

At all times during the above exercise the following checks must be carried out and recorded every 1–2 hours.

- All bolts and mountings.
- Oil temperatures and flow rates. Record actual values.
- Monitor oil strainers. Record findings.
- Adjustment of charging chute and rotary feeder.
- Main motor current value less than 80% of rating? Record actual current value.
- Gas pressure of accumulator.

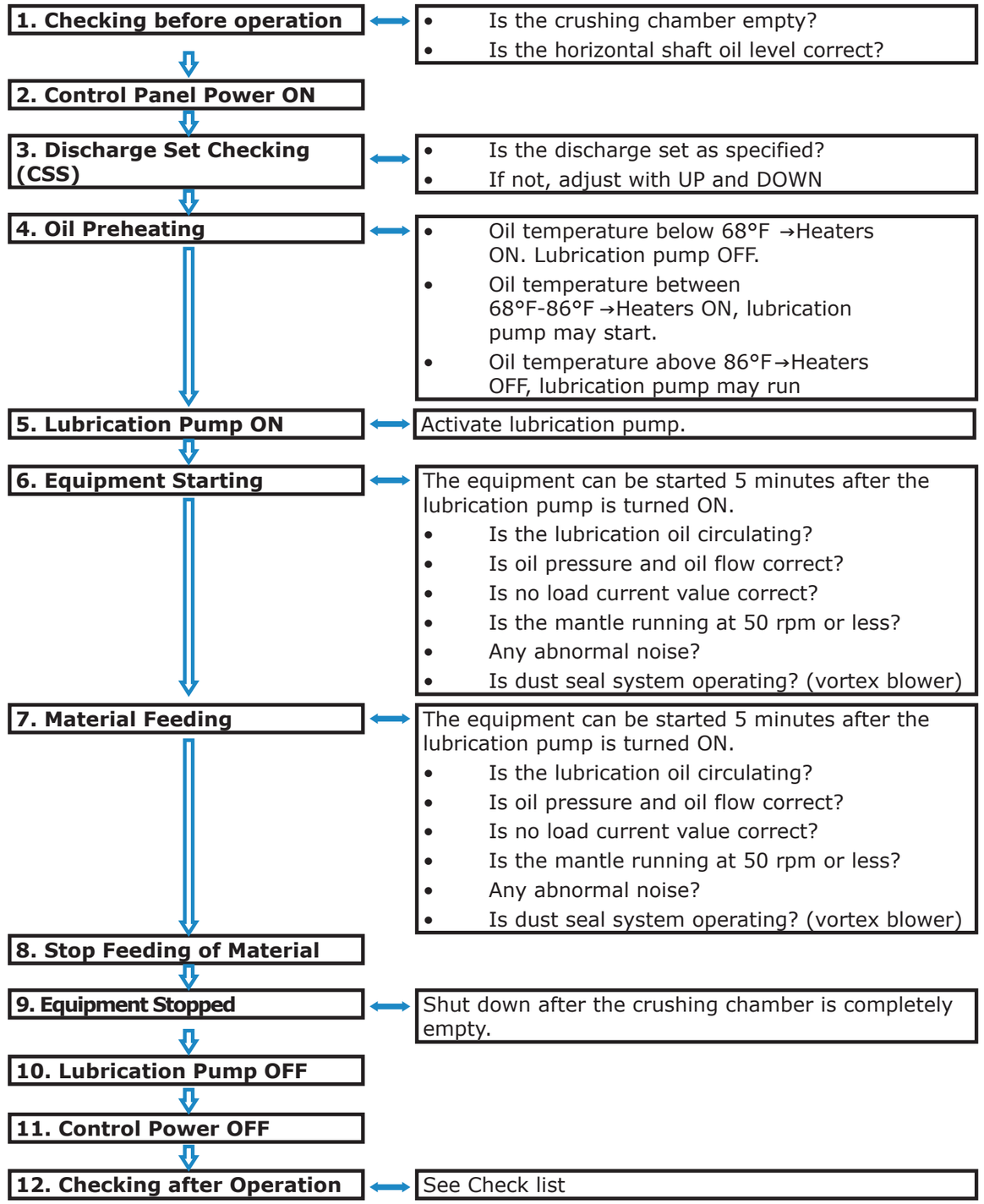
At the same time, it is important to check the noise levels of the accumulators and gear meshing.

3. COMMERCIAL OPERATION

When commercial operation is started after the run-in period, attention should be paid to the following:

- Is the feed size constant, and discharge as specified?
- Is the current value (main motor amps) within 80% of the rating?
- Is feeding done at the correct rate (choke feed) and uniformly around the circumference?
- Is the accumulator cylinder pressure within specified value?
- Are all bolts properly tight?
- Any oil leakage from hydraulic cylinder, piping, flanges, etc.?
- Any metal/foreign particles found in strainers?

OPERATION



Contents:

1. GENERAL

The Cybas Cone crusher has associated with it a number of auxiliary items, each fulfilling a certain function in support of the main function of the crusher. Proper understanding of the auxiliary equipment and its function is necessary to ensure successful operation of the crusher.

The auxiliary equipment can be grouped into the following sub-systems:

- Lubrication system
- Hydraulic system
- Set indication system
- Air blower
- Grease lubrication system

The above systems will be individually described in the paragraphs that follow.

2. LUBRICATION SYSTEM

2.1 PREPARATION AND GENERAL CHECKING

Lubrication oil is drawn from the oil tank by the pump, filtered by the oil supply strainer and delivered to the oil cooler system. Prior to the coolers, a by-pass back to the tank is provided. The purpose of this is to bleed off excess oil flow delivered by the pump, should it be required.

After being cooled, the oil is divided into two equal quantities, controlled by two gate valves situated after the flow meters, and pumped to the crusher. The flow rate in each line is indicated by the respective flow meters.

The lubrication oil entering the crusher through the hydraulic cylinder will lubricate all the bearings and the inner bush. The lubrication oil through the lower frame directly lubricates the outer bush. The oil flows merge, lubricating the gear and pinion and return to the tank through the return oil piping.

Two lubrication pumps are usually installed to provide redundancy.

CAUTION

ONLY ONE PUMP AT A TIME IS ALLOWED TO OPERATE.

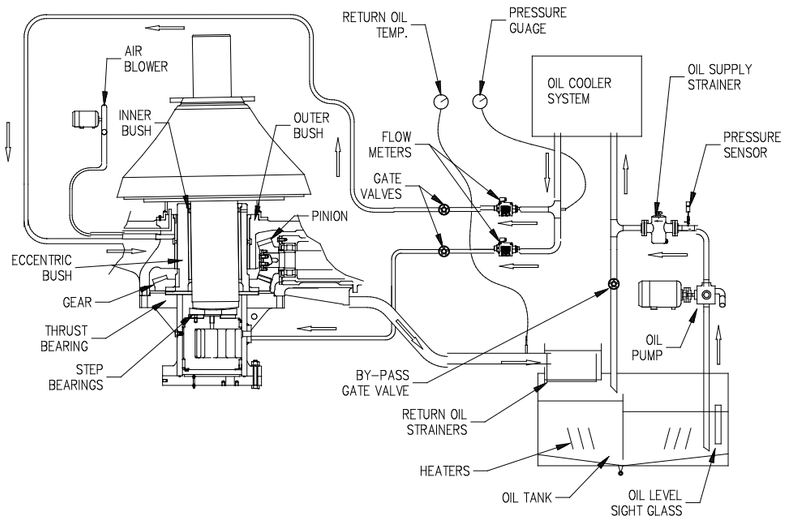


Fig. 5.1

Oil heaters are provided to heat the oil prior to starting the crusher during cold weather. The purpose of this is to ensure that the oil is at a temperature where it will have the correct viscosity to provide proper lubrication and allow the lubrication pump to operate without cavitation. Various instruments are provided to indicate temperature, pressure and level conditions, at different locations in the lubrication system. Of these some are for local indication only, while others provide either an analogue or digital interface with the plant control system for interlocking and data logging. Programmable Logic Control (PLC) or Relay Control Logic provides control of the lubrication system.

2.2 PROTECTIVE CIRCUITS

If the crusher were to be operated without efficient lubrication, the bearings would soon overheat, resulting in serious failure. To prevent this the following protective circuits are provided between the lubrication system and the crusher drive motor.

1. Circuit to prevent the main motor from starting if the lubrication pump is not operating.
2. Circuit connected to the contacts of the flow meters to stop the main motor if the required quantity of oil is not supplied, even with the lubrication pump running.
3. Circuit to stop the main motor if the lubrication pump stops due to some problem during operation.
4. Circuit activated by the contact of the return oil thermometer if the return oil temperature exceeds 140°F. This will stop the main motor.
5. Circuit to ensure that only one lubrication pump can be operated at any time. (Never both together.)

The above safety circuits (1,2,3,4 and 5) are included in the control logic. Care must be taken to ensure that the protective circuits are properly established and that they are tamper proof.

2.3 OIL FLOW

2.3.1 General

The correct oil flow must be provided to the crusher at all times. The oil flow is determined or influenced by mainly the following components of the lubrication system:

- Lubrication pump
- Strainers
- Manual control valves
- Heat exchangers (Oil coolers)

The following paragraphs contain pointers of what to look for as far as the above mentioned components are concerned

2.3.1.1 LUBRICATION PUMP

It is essential that the lubrication pumps rotate in the correct direction in order to be able to deliver the specified flow rate.

The pump relief valve pressure must be set correctly. Detail of the procedure is given elsewhere in this manual.

2.3.1.2 STRAINERS

The purpose of the strainers is to filter the oil and remove any solids that may be present. The strainers must thus be periodically cleaned to remove these solids from the strainer element as a build-up of solids will eventually clog the element and impair the flow of oil.

The strainer elements can be easily removed and shall be cleaned regularly.

2.3.1.3 MANUAL CONTROL VALVES

The system is fitted with a number of manual valves, which are used to isolate system components or are used to set the correct flow rates. Care should be taken to ensure that the valves are correctly set.

2.3.1.4 HEAT EXCHANGER

Contamination contained in the oil or physical damage to the heat exchangers could cause blockages that could hamper the oil flow. Should oil flow problems occur the heat exchangers shall be checked thoroughly to ensure that the lubrication oil can flow freely through it.

2.3.2 ADJUSTING OIL FLOW

After passing through the strainer after the lubrication oil pump, the piping branches into two and the oil in one branch returns to the tank after passing through the by-pass gate valve. If this gate valve is fully closed all the lubrication oil delivered by the pump goes to the coolers and hence to the crusher. The quantity of lubrication oil send to the crusher can thus be adjusted by changing the opening of the gate valve. From here the oil goes to the cooling system where it is cooled down.

The lubrication oil leaving the coolers is split into two pipes and passes through the flow meters. The flow meters are each fitted with a switch for control purposes. From here it enters the crusher through two delivery pipes, one into the hydraulic cylinder side (inner bush) and the other into the bottom frame (outer bush).

The ratio of the two flows can be adjusted with the two flow control gate valves and the flow rates are indicated by the flow meters. The flow rates must be adjusted with the gate valves so that it is equal to the values shown in the table that follows.

The lubrication oil entering the crusher through the two delivery pipes, returns from the crusher to the tank through one large volume pipe. The oil enters the tank through a basket type strainer with a lid that can be removed during operation so that the actual oil flow can be seen. This strainer should be cleaned at the specified intervals (see later sections of this manual) to remove any solids that may have accumulated there.

2.3.2.1 LUBRICATION OIL FLOW RATES

Values are l/min nominal flow and for oil temperature between 45°F to 115°F

Machine Model	Inner Bush [feed at bottom frame]	Outer Bush [feed at hydraulic cylinder]
Ø1000	10 gal/min	10 gal/min
Ø1200	16 gal/min	16 gal/min
Ø1350	20 gal/min	20 gal/min
Ø1500	24 gal/min	24 gal/min
Ø1650	32 gal/min	32 gal/min
Ø1800	36 gal/min	36 gal/min
Ø2100	50 gal/min	50 gal/min

2.4 LUBRICATION OIL PUMP

2.4.1 GENERAL

A positive displacement pump is used to circulate the lubrication oil. The pump can be fitted with an integrated pressure relief valve or in some cases the relief valve is fitted independently in the oil supply line.

The following paragraphs contain general precautions for the pump installation and the operation thereof.

2.4.2 PRECAUTIONS

Prior to commissioning the pump, ensure that the pipes on the suction side are properly clean. The pump will be damaged if welding slag, for example, gets sucked into the pump

- Do not conduct a test run using any liquid other than the specified oil.
- Do not run the pump in the reverse direction or run it dry, it will be damaged. To prevent reverse direction, conduct a directional check of the motor prior to fitting the coupling between the pump and the motor.
- Ensure that the connecting pipe work does not exert any forces on the pump housing.
- Ensure that the strainer is regularly cleaned.
- When the pump is replaced or pipe work is replaced or repaired, ensure proper alignment and readjustment of the pump.
- In the case of a gland type pump always ensure that the gland packing is inserted correctly as this will not only ill affect the pump operation, but will also shorten its service life.

Since the relief valve of the pump acts as a safety valve it should not actuate under normal conditions. It is not intended to be used for flow control or pressure adjustment. If the relief valve actuates continuously over time the pump will be damaged.

2.4.3 RELIEF VALVE ADJUSTMENT

The relief valves of both pumps must be set according to the following procedure and to the specified pressure.

1. Run the lubrication oil pump with the flow control gate valves and the by-pass gate valve fully closed.
2. Adjust the relief valve with the adjustment screw to an indicated pressure of 10 bar.
3. After the adjustment is completed lock the adjustment screw with the locknut and replace the cap.

The setting is complete.

2.5 FLOW METERS

2.5.1 GENERAL

It is absolutely essential to provide the proper lubrication oil quantity to the crusher under all circumstances in order to ensure sufficient lubrication and cooling of the bearings inside the crusher.

For the protection of the crusher the flow switch which is incorporated in the flow meter will immediately stop the crusher upon sensing a too low oil flow rate.

2.5.2 SET POINT ADJUSTMENT

The low flow limits for the different crusher models are given in the following table:

Machine Model	Specified Flow Rate	Low Flow Set Point
Ø1000	10 gal/min	9.2 gal/min
Ø1200	16 gal/min	14.5 gal/min
Ø1350	20 gal/min	18.5 gal/min
Ø1500	24 gal/min	22.5 gal/min
Ø1650	32 gal/min	30.5 gal/min
Ø1800	36 gal/min	34.5 gal/min
Ø2100	50 gal/min	47.5 gal/min

The set point of the switches in both flow meters must be set according to the above specification. The set point is indicated on the dial of the flow meter by a set point indicator.

2.6 THERMOMETER

The thermometer is of a contact type or a digital alarm indicator. It is provided to generate a signal that is used to stop the crusher should the return oil temperature become abnormally high due to a lack of cooling or heat build-up in the bearing assemblies.

The set point of the contact type thermometer is adjusted by using the adjusting knob. The knob is pushed in and used to hook the set indicating pointer, which is then turned to the set point.

THE SET POINT IS 140°F

2.7 COOLERS

2.7.1 GENERAL

Oil cooling is provided by one of the following:

- Refrigerated oil coolers
- Air blast coolers
- Water coolers

The control system of the coolers must be set to control the oil temp at the following values:

CONTROL:	OIL TEMP:
Cooler Fan ON	@/>95°F
Cooler fan OFF	<130°F
Alarm	@/>130°F
Main Motor Trip	@ 140°F

2.7.2 REFRIGERATED OIL COOLERS

This system consists of a refrigeration compressor driven by an electric motor, an air-cooled condensing unit and a heat exchanger through which the oil is circulated. The unit will usually be the primary method of oil cooling with an optional water cooler as a back up.
The direction of rotation of the fan motor of the air cooled condensing unit must be such that the air flow direction is from the fan through the cooler. This is important to ensure the proper airflow pattern as well as prevent the fan motor from being heated by the hot air.
It is important that the cooler fins be kept clean by using compressed air or high pressure cleaning equipment on a regular basis to blow out dust and other dirt accumulated there. Dirt on the fins reduces the heat transfer capability of the cooler and also impairs the air flow, which in turn further reduces the effectiveness of the coolers.

2.7.3 AIR BLAST COOLERS

The air blast coolers consist of a tube and fin heat exchanger through which the lubrication oil is circulated. Air is blown across the fins by an electric fan, which is activated when the lubrication oil temperature reaches a set value. The control is done through the control sequence from the central control.
The direction of rotation of the fan motor must be such that the air flow direction is from the fan through the cooler (i.e. air is blown from the fan through the cooler). This is important to ensure the proper airflow pattern as well as prevent the fan motor from being heated unnecessary by the hot air.
It is important that the cooler fins be kept clean by using compressed air or high pressure cleaning equipment on a regular basis to blow out dust and other dirt accumulated there. Dirt on the fins reduces the heat transfer capability of the cooler and also impairs the air flow, which in turn further reduces the effectiveness of the coolers.

2.7.4 WATER COOLED OIL COOLERS

x

2.8 LUBRICATION OIL HEATERS

2.8.1 GENERAL

Oil heaters are provided to heat the oil prior to starting the crusher during cold weather. The purpose of this is to ensure that the oil is at a temperature where it will have the correct viscosity to provide proper lubrication and allow the lubrication pump to operate without cavitation.

The oil heaters are in the form of W-shaped elements or pull out elements fitted to the lubrication oil tank. The elements are fitted in two sets of three elements each in the two covers situated at the front of the lubrication oil tank. Each set of three is connected in a STAR configuration and the two sets are connected in parallel to the electrical power supply.

2.8.2 SETTING AND CONTROL

The heaters are controlled automatically from the control system which switches the heaters ON and OFF as and when required. The heater ON/OFF cycle is determined by the temperature of the lubrication oil in the tank and is measured by a temperature sensor, which provides a signal to the control system.
The following control logic is used:

Oil Temperature below 68°F	Heaters ON / Lubrication oil pump OFF
Oil Temperature above 86°F	Heaters OFF
Oil Temperature above 68°F	Lubrication oil pump may run

2.9 STRAINERS

2.9.1 GENERAL

In the lubrication supply line, after the lubrication oil pumps, a metal basket type strainer, with a 100-mesh filter element, is installed.
The purpose of the strainers is to filter the oil and remove any solids that may be present. The strainers must thus be periodically cleaned to remove these solids from the strainer element as a build-up of solids will

AUXILIARY EQUIPMENT

eventually clog the element and impair the flow of oil through the strainer.
The supply line strainer can be easily removed by loosening the screw on top of the strainer bowl, removing the cover and then the element. Solids should be removed by cleaning the element with solvent.

CAUTION

THE LUBRICATION PUMP MUST BE SHUT DOWN AND THE BY-PASS GATE VALVE MUST BE FULLY OPENED BEFORE ANY MAINTENANCE IS CARRIED OUT ON THE OIL SUPPLY STRAINER. THIS IS TO AVOID ANY SPILLAGE OF OIL FROM THE OPEN STRAINER BOWL

A basket type oil strainer is also provided for the return oil.

2.9.2 INSPECTION AND CLEANING

The following guidelines are to be followed regarding inspection and cleaning of the strainers:

- Inspect and clean regularly (at least twice daily) during trail operation and after parts replacement/repair has been carried out.
- Routinely inspect and clean daily as a rule.

The oil pressure gauges will indicate high pressure in the event of the supply line strainers becoming blocked to an extent where the flow rate of oil is negatively influenced. The pressure gauges are thus used as an indication of when cleaning of the strainers become necessary.

2.10 AIR BLOWER SYSTEM

2.10.1 GENERAL

A vortex type air blower is provided to supply air for dust proofing of the crusher gearbox and bearings.
The purpose of this blower and it's related components is to provide clean air to the inside of the dust seal so that dust produced during operation of the crusher can not enter through the interface between the dust collar of the crusher and the dust ring.
The blower is fitted with an air filter to prevent dust from entering the blower and subsequently the crusher. This air filter must be cleaned on a regular basis to ensure proper functioning of the blower system.
From the blower the air passes via an air pipe into the air piping system installed inside the bottom frame of the crusher. The air is delivered to the inside of the dust seal where it creates a positive pressure and thus preventing the entry of dust.

2.10.2 ADJUSTMENT

The air volume and pressure shall be adjusted by opening/closing the pressure control valve. Use the following table as a guide for air blower system setup.

Machine Model	Air Flow Rate (CFM)	Air Flow Pressure (psi)
Ø1000	3.5 – 7	0.4 – 1.2
Ø1200	9 – 14	0.4 – 1.2
Ø1350	11 – 18	0.4 – 1.2
Ø1500	14 – 21	0.4 – 1.2
Ø1800	21 – 28	0.4 – 1.2

NOTE:

IF THIS AIR FLOW IS SET TOO HIGH IT CAN RESULT IN THE UNEVEN RETURN FLOW OF OIL BACK TO THE LUBRICATION UNIT.

3. HYDRAULIC SYSTEM

(FIG. 5.2)

3.1 GENERAL DESCRIPTION

The hydraulic system of the Cybas Cone crusher performs two main functions, which are the big advantage of this type of crusher namely;

- Adjustment of the discharge setting, (closed side setting).
- Provides a safety mechanism against possible damage caused by overload due to tramp iron entering the crushing chamber by accident.

Hydraulic oil is contained in the tank that is filled through the filler/breather. The level sight glass visually indicates the level of the hydraulic oil in the tank and a level switch provides a low-level signal to the control system, which will raise an alarm.

During the main shaft lift cycle, (UP button), the pump activates, pumping oil from the tank through a suction filter. The oil passes through a non-return valve and a pressure relief valve incorporated in the supply line. The pressure relief valve relieves pressure when the closed side setting is closed, (ZERO), or the lift cycle is interfered with due to feed material or tramp iron that is lodged in the crushing chamber. This oil will be returned to the tank. From here a solenoid opens the first outlet port of the directional control valve allowing the oil to proceed through the first check valve to the hydraulic cylinder of the crusher. When the pump is deactivated the directional control valve will close again providing protection for the pump system. Two hydraulic pumps are installed to provide redundancy, (Optional).

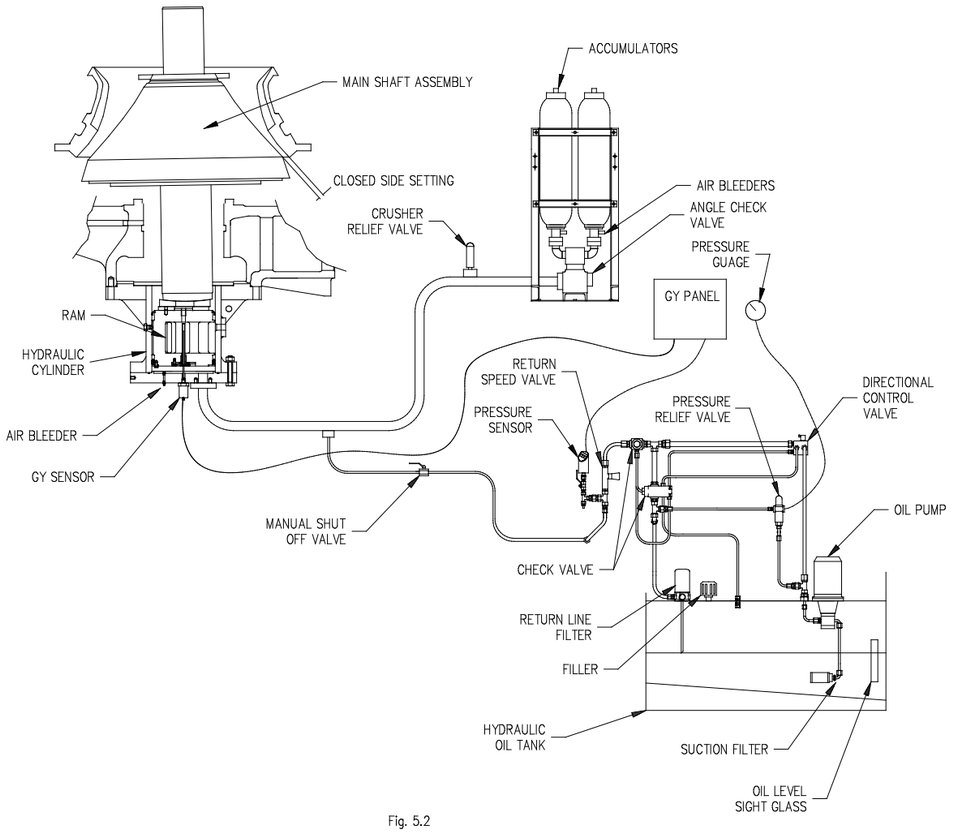


Fig. 5.2

AUXILIARY EQUIPMENT

CAUTION

ONLY ONE PUMP AT A TIME IS ALLOWED TO OPERATE.

A manual shut-off valve is fitted additional to the solenoid-operated directional control valve. This valve is left in the open position under normal operating conditions. However in the event of malfunction of the solenoid operated shut off valve it is closed to allow repair/replacement of any component in the pump system while the crusher is kept operational.

During the main shaft lowering cycle, (DOWN button), the pump will start, the solenoid will open the directional control valve and direct oil to the first and second check valves energizing the return ports and thus permitting the free flow of the hydraulic oil through an in line filter back to the tank. This takes place due to gravity and the weight of the main shaft. The return line is provided with an adjustable throttle check valve to control the return speed. The oil pumped to the check valves during this cycle is returned to the tank via a separate return line.

During crusher operation the hydraulic oil is contained in a closed system consisting of the hydraulic cylinder and a set of accumulators. Incorporated in this system is the crusher relief valve. The function of the accumulators is to absorb any pressure during the crushing operation and the relief valve is a safety measure against over loading due to uncrushable material entering the crushing chamber. Mounted under the accumulator set is an angle check valve which allows unrestricted oil flow towards the accumulators and restricted flow back to the hydraulic cylinder thus ensuring minimal damage to moving parts and bearings due to extreme pressure caused by uncrushable foreign material.

Various instruments are provided to indicate pressure conditions at different positions in the hydraulic system. A pressure gauge is fitted in the line directly after the hydraulic pump and a pressure sensor after the directional control valve. The pressure sensor transmits a signal to the GY panel as well as the control system of the crusher.

Control of the hydraulic system is provided by Programmable Logic Control (PLC) or Relay Control Logic. Field panels with UP/DOWN push buttons to raise and lower the crusher main shaft are also provided.

3.2 OPERATION AND ADJUSTMENT

Operation of the hydraulic system is simple as it basically performs the UP and DOWN functions as and when required.

As the hydraulic system is not used on a continuous basis very little adjustment or maintenance is normally required after the initial adjustment has been done after installation. When the hydraulic system is operated for the first time after installation the following steps are to be followed:

- Supply hydraulic oil to tank.
- Hydraulic pump direction check.
- Solenoid operated directional control functional check.
- Accumulator nitrogen charging.
- Set relief valve pressure (both relief valves).
- Crusher discharge set adjustment.
- Adjust the return speed of the hydraulic system. (throttle check valve adjustment)

Adjustment details pertaining to the individual components are given in the paragraphs on component description later in this section. Crusher discharge set adjustment is described in the following paragraph.

3.2.1 DECREASING DISCHARGE SET

1. Ensure that the manual shut-off valve is open.
2. Enable the UP command, which will start the hydraulic pump and open the lift valve. Hydraulic oil is now pumped to the crusher hydraulic cylinder and forces the ram upward to raise the crusher main shaft.
3. Disabling the UP command stops the pump and closes the lift valve.

3.2.2 INCREASING DISCHARGE SET

1. Ensure that the manual shut-off valve is open.
2. Enable the DOWN command, which must open the lift valve and the shut-off valve. The weight of the crusher main shaft will push the ram of the hydraulic cylinder down and force the hydraulic oil back to the tank.
3. Disabling the DOWN command closes the valves.

Components that do require adjustment and maintenance are described in more detail in the following paragraphs.

3.3 HYDRAULIC UNIT COMPONENTS.

3.3.1. LEVEL SWITCH.

SOME LUBRICATION UNITS DO NOT HAVE THIS OPTION.

The level switch is a float type that actuates the potential free contact magnetically. The switch is normally open and closes with the tank oil level above the minimum.

The switch level is adjustable by moving the probe up or down through the mounting flange and locking it in position with the lock screw at the required level.

The switch has to be positioned to fix the switching point level with the minimum allowable hydraulic oil level in the tank. This level coincides with the minimum level mark on the visual level gauge and is factory set.

3.3.2. SUCTION STRAINER.

The suction strainer is of the element type and has a screw fitting onto the hydraulic oil pump suction pipe. No maintenance is normally required but should the pump be removed or the tank inspection cover be opened it is good practice to remove the strainer element and clean it by washing with a suitable solvent.

3.3.3. RETURN LINE FILTER.

The in-line filter is of the cartridge type. A built-in relief valve is provided to allow the hydraulic oil to by-pass the strainer should the element become blocked for any reason. The cartridge must be replaced at yearly intervals.

3.3.4. CHECK VALVE

Fitted only if two pumps are provided. No maintenance is normally required.

3.3.5. PRESSURE RELIEF VALVE.

The relief valve is a directly operated valve, actuated by the pressure from the pump. The purpose of this relief valve is to protect the circuit in the event of a solenoid valve malfunction.

3.3.5.1. ADJUSTMENT OF MAIN SHAFT RETURN SPEED.

1. Make sure the hydraulic system is free of air. (see AIR VENTING OPERATION)
2. Set the throttle check valve to the middle of it's adjustment. (Approximately 5 turns out from closed.)
3. Press the down button, activating the return cycle.
4. Adjust the return speed so that the main shaft down speed is no more than 10mm/ 10seconds.

3.3.6. SOLENOID DIRECTIONAL CONTROL VALVE.

Normally no maintenance is required.

3.3.7. CRUSHER RELIEF VALVE.

When abnormally large uncrushable material (e.g. tramp iron) is fed into the crushing chamber, the crusher relief valve is actuated and hydraulic oil is led out through the valve, thereby protecting the crusher from potential damage. This hydraulic oil should be bled off into a small container so that monitoring of relief valve actuation can take place.

RELIEF VALVE	
During normal operation.	1087 psi
During exceptional conditions.	See data sheet at front of manual

CONTACT IMS ENGINEERING IF IN DOUBT

3.3.8. ACCUMULATORS

Nitrogen gas is injected into accumulator. In the normal operation, nitrogen gas pressure is higher than the hydraulic pressure in cylinder, so that the rubber bag is fully inflated

When any uncrushable material is mixed into

the feed material or when the feed amount increases temporarily and the crusher becomes overloaded, the main shaft assembly is pushed down and Hydraulic Cylinder Ram that is supporting main shaft is forced down. This makes hydraulic pressure in the hydraulic cylinder higher than the nitrogen gas pressure. As a result, the oil in the cylinder flows towards the accumulators rapidly and compresses the rubber bags.

When the foreign material is discharged, the pressure in the accumulator forces the oil back to the hydraulic cylinder and the original discharge set is restored.

3.3.9. AIR VENTING OPERATION.

1. Depress the [DOWN] push button inside the unit, and bring mantle to the widest setting.
2. Open the air bleeder of hydraulic cylinder.
3. Feed oil by depressing the [UP] push button. Close the air bleeder when no more air bubbles are present in the oil bled out through the air bleeder. At the same time, release the push button.
4. Open the air bleeder at the bottom of accumulator.
5. Same as Step 3., vent the air. Air cannot be completely vented by a venting operation performed only once. Repeat a cycle of operations several times.

3.3.10. METHOD FOR CHECKING NITROGEN GAS PRESSURE.

1. Remove valve cover and protective nut from nitrogen charging valve at the top of the accumulator.
2. Connect three-way charging valve to charging port (Dynamic valve).
3. Lightly turn the opening/closing handle of three-way charging valve to right until it contacts the stopper. The reading of gauge valve then shows the gas pressure in accumulator.
4. If gas pressure is high, reduce it to specified pressure by opening and closing relief valve of the charging apparatus. If gas pressure is low, charge the gas to a specified pressure.

ACCUMULATORS NITROGEN GAS PRESSURE	
During no-load test operation and running-in	435~580 psi
During full load operation (commercial operation)	580~725 psi
Max	797 psi
During exceptional conditions.	See data sheet at front of manual.

CONTACT IMS ENGINEERING IF IN DOUBT

4. SET INDICATING SYSTEM.

(SET IS DEFINED AS CLOSED SIDE SETTING)

4.1. DESCRIPTION

The vertical position of the crusher main shaft assembly relative to the stationary crusher frame is an important variable that is used to adjust and operate the crusher to it's full capability. This variable is measured by instruments fitted to the crusher, which serve to provide signals proportional to the actual main shaft position. The vertical position signals are calibrated and then used to indicate two variables namely discharge setting and remaining liner life. This device, called a GY SENSOR, directly indicates the vertical position of the hydraulic cylinder ram.

The GY system uses a linear position transducer (GY sensor) fitted to the hydraulic cylinder at the bottom of the crusher. The sensor is mounted in the bottom plate of the hydraulic cylinder and is thus stationary. A rod shaped extension of the sensor protrudes into the ram of the hydraulic cylinder and has sufficient length to measure over the total stroke of the ram.

Fitted to the ram is a circular shaped magnet that moves with the ram. It is the position of this magnet relative to the rod of the sensor that, through the principle of magnetic

induction, provides an electrical signal that is proportional to the ram position. This signal is supplied to the GY sensor controller where it is processed into a format that can be used to drive the different display units.

The GY system consists of the following main components:

- GY sensor
- Magnet
- GY controller

The converted signal is used to drive instruments that display two parameters, namely "ACTUAL GAP" and "LINER WEAR". These displays are duplicated with one set in a local panel (mounted close to the crusher) and the other set as part of the central control display unit.

5. GREASE LUBRICATION OF SPHERICAL BEARING

The upper support of the main shaft in the top frame of the cybas cone crusher is by means of a spherical bearing. This bearing is not connected to the oil lubrication system but has it's own grease lubrication system. This system is normally a manual system, which means that greasing does not take place automatically but has to be replenished on a regular basis by the operator/ maintenance personnel.

An optional automatic greasing system could be fitted if required by the end user.

5.1. MANUAL GREASING SYSTEM

This system consists of a manually operated grease pump which is connected to the spherical bearing by a flexible grease hose outside of the spider housing and further by another flexible grease hose inside the top frame housing. The flexible hoses are connected via a T-block, which is mounted on the outside of the top frame housing.

A pump action handle operates the grease pump and grease is forced out under pressure. With each full downward stroke a measured quantity of grease is supplied to the spider bearing via the flexible hoses and the T-block.

5.1.1. REQUIRED QUANTITY

Grease should be replenished at a rate of 20 cc/day.

One stroke of the handle supplies 10 cc

NOTE:

It is recommended that grease pump delivery rate be checked as the above may vary from pump to pump.

5.2. AUTOMATIC GREASING SYSTEM

This is an option that can be fitted at the request of the end user.

The automatic greasing system for the top frame spherical bearing consists of a constant displacement pump driven by an electric motor. Grease feed to the pump is directly from a tank mounted on top of the pump. The pump is connected to the spherical bearing in a similar manner as the manual grease pump. A low-level switch is provided to raise an alarm when the grease level is low in the grease tank.

Where the automatic system is used the manual grease pump is also still installed to provide a backup system should the automatic system malfunction for any reason.

Control of the grease volume supplied to the spherical bearing by the automatic greasing system, is effected by running the constant displacement pump for specified time intervals. The controller could be local to the grease pump unit or a central plant control (PLC) could be utilised for this function, depending on customer preference.

The controller must be programmed to operate the grease pump for the proper time periods to feed grease to the spherical bearing. Depending on the capacity of the pump used the actual intervals are determined. For example it may be chosen to run the pump for a longer period every 5 hours instead of a short period every hour.

CAUTION

THE AUTOMATIC GREASING SYSTEM IS A REPLENISHMENT TOOL. REFILLING OF THE SPHERICAL BEARING SHOULD BE DONE MANUALLY.

6. SPHERICAL BEARING SEALING CONDITION

[WHERE APPLICABLE]

Air pressure and water flow conditions to main shaft scraper.

Compressed air and water is supplied to the main shaft scraper. This is to ensure that dirt does not enter the spherical bearing chamber. The compressed air is set at 43 psi, with the switching point at 36.5 psi. The water flow rate should always exceed 3 gal/min. If one of the above two switches are unhealthy the feed to the crusher should stop.

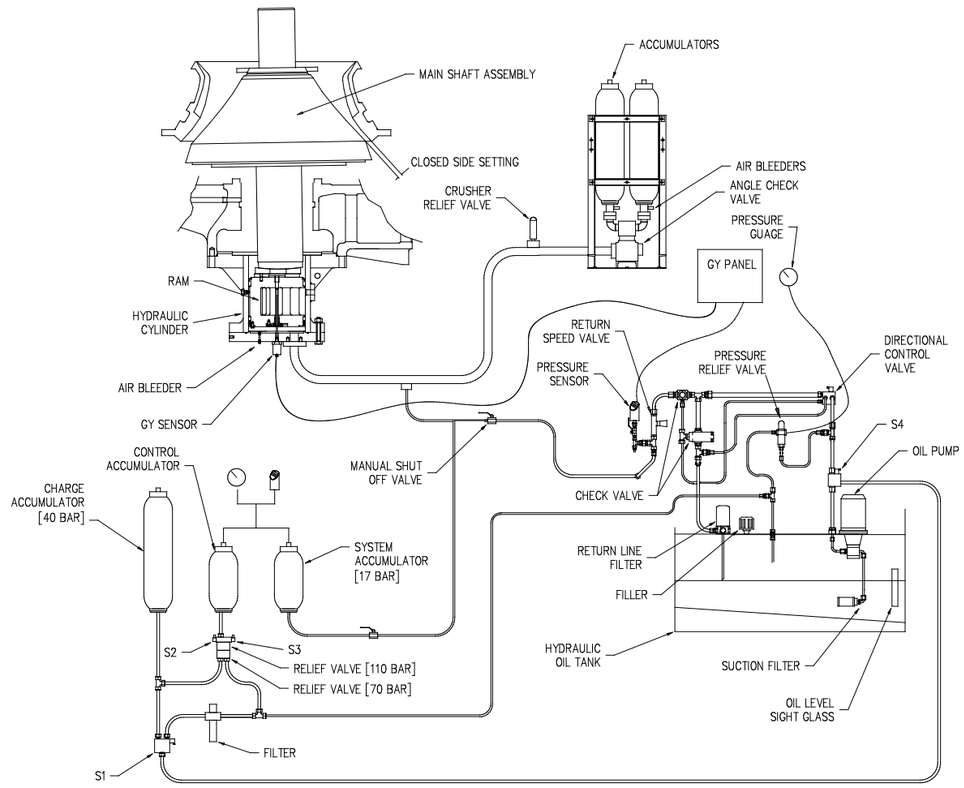


Fig. 5.3

NOTES:

AUXILIARY EQUIPMENT

Contents:

PARTS REPLACEMENT

1. GENERAL

This section describes the procedures for changing each of the replaceable parts including wearing parts such as mantle and concave.

After replacement of INNER BUSHING, OUTER BUSHING, GEARS, MAIN SHAFT, or BEARINGS, a RUNNING IN PERIOD and LOAD SEQUENCE must be performed, as shown in Section 4.

NOTE:
THE NEW MANTLE AND CONCAVE SHOULD BE REPLACED AS A PAIR.

NOTE:
REPLACE BOTH THE GEAR AND PINION AS A MATCHED PAIR.

NOTE:
REPLACE THE MAIN SHAFT STEP AND STEP BEARING AS A MATCHED PAIR.

CAUTION

WHEN CHANGING CERTAIN PARTS, PERSONNEL ARE REQUESTED TO CARRY OUT THE WORK WITH GREAT CARE.

IMPORTANT

SAFE WORKING PRACTICES SHOULD BE ADHERED TO AT ALL TIMES.

WARNING

DO NOT PERFORM MAINTENANCE ON MOVING MACHINERY.

FOLLOW THE SHUT DOWN PROCEDURES AS ADDRESSED IN THE FUNCTION SPECIFICATION FOR YOUR PARTICULAR MACHINE

CARRY OUT THE LOCKOUT PROCEDURE ACCORDING TO YOUR PLANT REGULATIONS.

PARTS REPLACEMENT

2. DETERMINATION OF THE LIFE OF WEARING PARTS

2.1 CRUSHER LINERS

Liner-Top Frame, Liner-Top Frame Arm, Hopper Liner, Liner-Bottom Frame, Liner-Bottom Frame Arm, and Liner-Horizontal Shaft. Visually check each of these liners and if any sign of extreme wear is apparent their working life shall be determined as over and replacement of these worn parts must take place immediately.

2.2 CAP COVER

If there is no more protrusion on the circumference of the cap cover, the life of the cap cover is determined as having expired. (Fig. 6.1.1)

Replace the bolts as required.

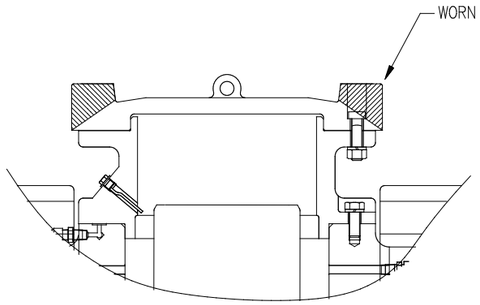


Fig 6.1.1

2.3 MANTLE AND CONCAVE

The mantle and concave should be replaced when the distance between the head nut of the main shaft and the underside of the spherical bearing housing, (Dimension H), is 30 mm and the discharge is set at zero. (Fig 6.1.2). The mantle and concave shall be replaced together at the same time.

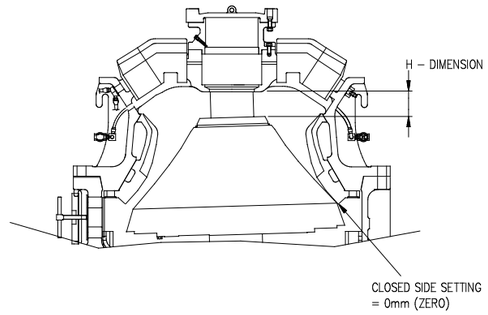


Fig. 6.1.2

2.4 DUST RING

If the clearance between dust seal collar and dust seal ring, (Dimension T) or the clearance between dust seal cover and dust seal ring, (Dimension S) is 5 mm or more, the dust seal ring shall be replaced. (Fig. 6.1.3)

Note: In the case of the T dimension, the measurement is 5 mm on the diameter.

MEASURING PROCEDURES:
Dimension T:- Insert a feeler gauge.
Dimension S:- Measure the depth difference of the dust ring with a depth gauge.

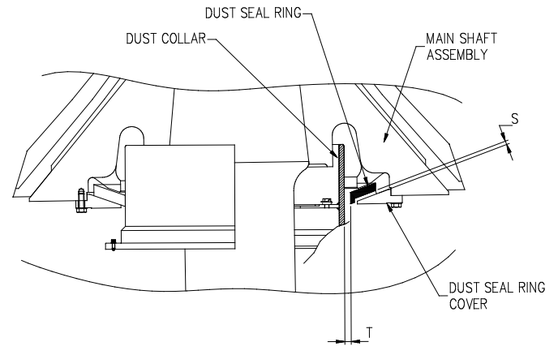


Fig. 6.1.3

2.5 MAIN SHAFT STEP

If the clearance (Dimension A) between the end face of the main shaft step and the retainer has become 0.08 or less, the main shaft step shall be replaced. (Fig. 6.1.4). The main shaft step bearing and the step bearing shall be replaced as a matched pair.

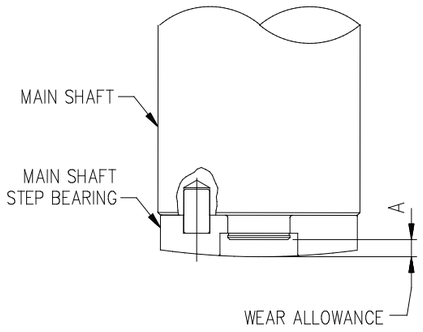


Fig. 6.1.4

Measurement is made with depth vernier or depth micrometer.

2.6 SPHERICAL BEARING

The spherical bearing consists of an inner and outer ring. When the sum total of the clearance between main shaft and inner ring (A+B) or (C+D) is more than as shown in the table below, the spherical bearing should be replaced. (Fig. 6.1.5).

MACHINE SIZE	WEAR LIMITS (inch)
Ø 1000	0.106
Ø 1200	0.114
Ø 1350	0.118
Ø 1500	0.126
Ø 1650	0.129
Ø 1800	0.134

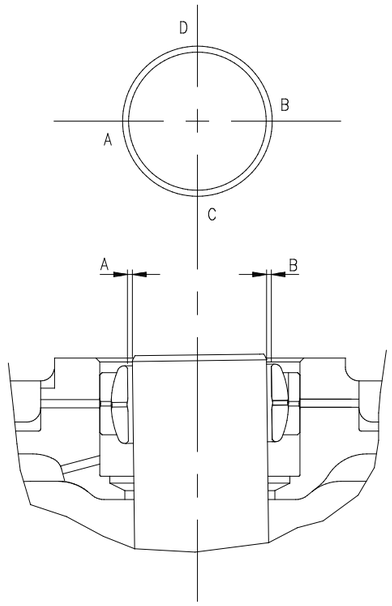


Fig. 6.1.5

3. Replacement of Liners

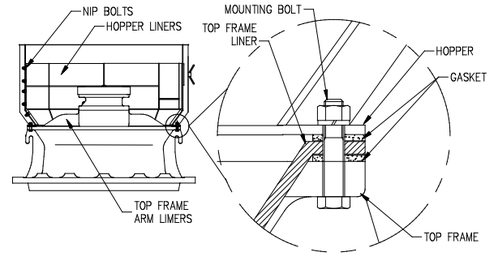


Fig. 6.2.1

3.1 HOPPER LINER

1. Remove the nip bolts and nuts.
2. Remove the liner that has become worn
3. Replace with new liner, nip bolts and nuts. Re-tighten.

3.2 TOP FRAME LINER

The top frame liner is clamped between the top frame and the feed hopper.

1. Unbolt the hopper.
2. Remove gaskets and clean faces.
3. Remove the liner that has worn and replace with a new liner.
4. Align the position of the top frame hole with that of the liner hole.
5. Replace new gaskets, (silicon sealant will be required to fill gaps between liners).
6. Fit the hopper and bolt to the top frame.

3.3 TOP FRAME ARM LINER

NOTE:

The top frame has a lug on each side of it's arms around which the top frame arm liners fit. A plate is then welded to the liner on the under side of the lug, thus preventing lifting of the liner during operation.

1. Cut the retaining plates lose.
2. Remove the worn liners.
3. Fit a new liner.
4. Weld new retainer plates into position.

CAUTION

DO NOT WELD DIRECTLY ONTO THE TOP FRAME.

3.4 BOTTOM FRAME ARM LINERS

The set includes two arm liners and one horizontal shaft arm liner. The procedure is the same as top frame arm liners.

NOTE:

THESE LINERS CAN ONLY BE REPLACED WITH THE TOP FRAME REMOVED. IT IS RECOMMENDED TO PLAN ACCORDINGLY

3.5 TOP FRAME CAP COVER (Fig. 6.2.2.)

1. Remove the square headed bolts and nuts.
2. Remove the cap cover.
3. Check the gasket and replace if necessary.
4. Fit the new cap cover.
5. Replace the square headed bolts and nuts.

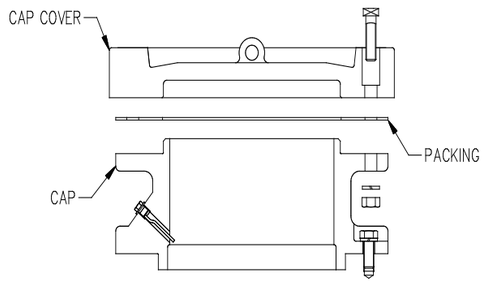


Fig. 6.2.2

4. MANTLE AND CONCAVE.

NOTE:
THE NEW MANTLE AND CONCAVE SHOULD BE REPLACED AS A PAIR.

4.1 PREPARATION PRIOR TO REMOVAL

1. Completely remove the dust from the exterior and interior of the crusher. (When the main shaft is removed the lubrication oil is exposed to the atmosphere.)
2. Lower the mantle all the way down, (i.e. open crusher to maximum gap).
3. Move feeder away from crusher.
4. Disconnect pipe work and electrical cables from rotary feed distributor and remove. (If fitted).
5. Loosen and remove rotary feeder / hopper assembly from top frame.
6. Remove top frame liners.

4.2 REPLACEMENT OF CONCAVE

4.2.1 CONCAVE REMOVAL

1. Loosen all top / bottom frame mounting bolts and remove the top frame. (Fig. 6.3.1)

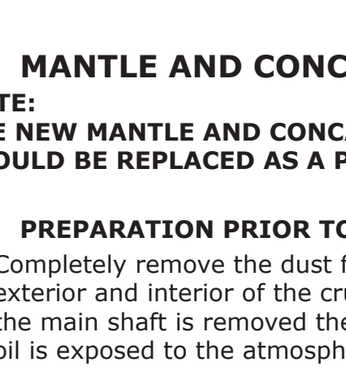


Fig. 6.3.1

2. Place the top frame on 2 wooden blocks having a height more than the length of the concave mounting bolts. (Fig. 6.3.2)

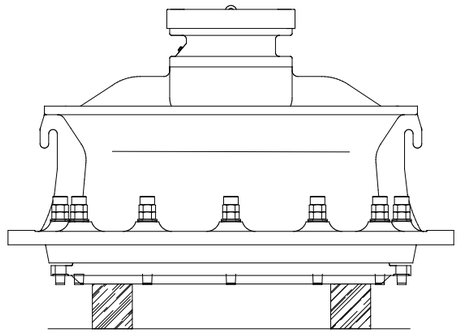


Fig. 6.3.2

3. Disconnect the concave mounting bolts and lift the top frame slowly upwards. The concave should remain on the wooden blocks. If the concave remains fast, lift the top frame above the blocks by about 0.4" - 0.8" and strike the concave with a large hammer. (Fig. 6.3.3)

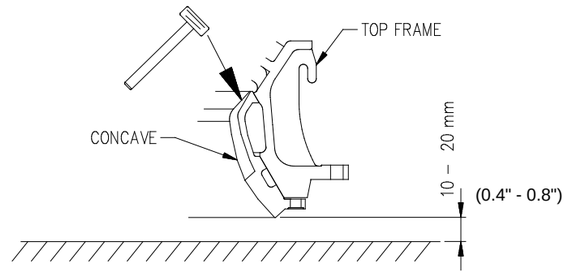


Fig. 6.3.3

WARNING

EYE PROTECTION SHOULD BE WORN.

4.2.2 FITMENT OF NEW CONCAVE

1. After removing the rust and dirt off the inside of the top frame, and the anti corrosive protection from the new mantle. Apply a thin layer of grease to all mating surfaces.
2. Place the new concave on the wooden blocks and lower the top frame onto the new concave while aligning the hole positions for the concave mounting bolts.

3. Insert and tighten concave mounting bolts, making sure that the bolt's square head is correctly positioned in the recess of the top frame. It is recommended that new conical spring washers be used. (Fig. 6.3.4)

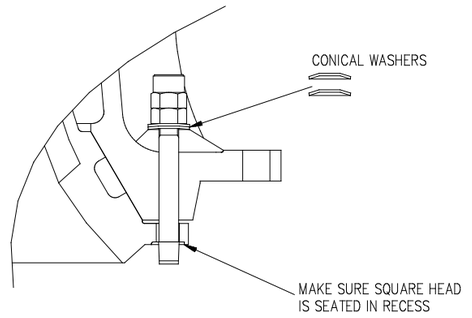


Fig. 6.3.4

4. Measure the clearance between top frame and concave and tighten the bolt so that the clearance is even throughout the entire periphery. Tighten the side with smallest clearance first. (Fig. 6.3.5).

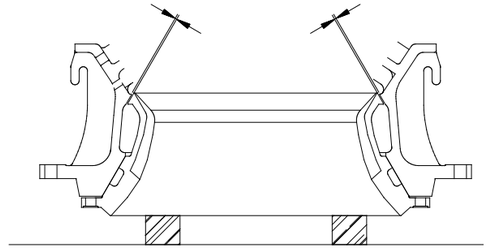


Fig. 6.3.5

5. Torque the bolts evenly according to torque tables.

4.3 REPLACEMENT OF MANTLE

4.3.1 MANTLE REMOVAL

1. Remove Rotary Feed Distributor (if fitted) Hopper and Top Frame Housing. The mantle and shaft assembly can now be lifted out of the crusher using two eye-bolts, which can be screwed into the top of the shaft. (Two eye-bolts must be used to prevent uneven lifting of mantle, reducing the risk of possible damage to Inner Bushing and Main Shaft Step Bearing.)
2. A suitable frame should be made to sit the mantle and shaft in, so it can be transported safely and for easy handling. (Dimensions can be acquired from IMS Eng. if required.) When loaded in the frame the Main Shaft Step Bearing should be removed and stored safely to prevent damage.
3. The inner bush should be inspected and any dirt should be removed. The bush should be cleaned and covered with a piece of sheet metal or wood of the appropriate size to prevent contamination.
4. Transport the mantle and shaft to the workshops.
5. Inspection of the dust ring seal and cover must be carried out. If damage to seal is evident it must be replaced.
6. If a pit is available, the mantle and shaft can be removed from the frame and lowered into the pit so that the mantle rests on the sides, (two supports may be required if the pit is to wide). Removal of the mantle is made easier using this technique. If no pit is available the mantle can be removed, while using the transport frame for support.
7. Remove the two rubber caps. (Fig. 6.3.6)
8. Jack the two dowel pins out with the aid of threaded rod. If difficulty is experienced with this procedure then take the necessary steps to prevent damage to the main shaft, before removing the two pins by gas cutting.

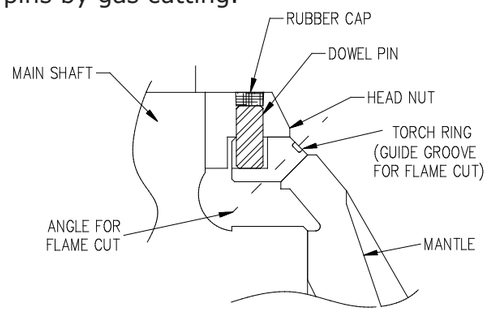


Fig. 6.3.6

9. Cut through the torch ring using the groove as a guide

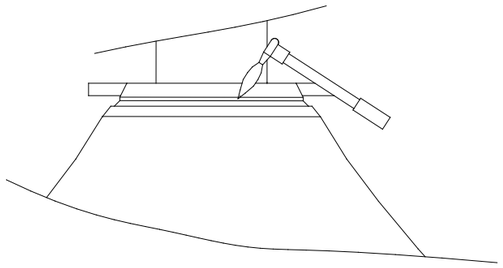


Fig. 6.3.7

10. Weld lugs for striking to the head nut. Weld lifting hooks to the upper part of the mantle. (Fig 6.3.8)

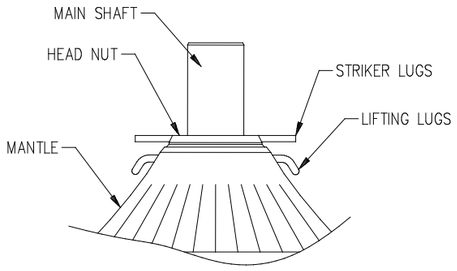


Fig. 6.3.8

11. While striking the striker lugs with large hammers, loosen and remove the head nut. The head nut has a right hand thread. (Fig. 6.3.9)

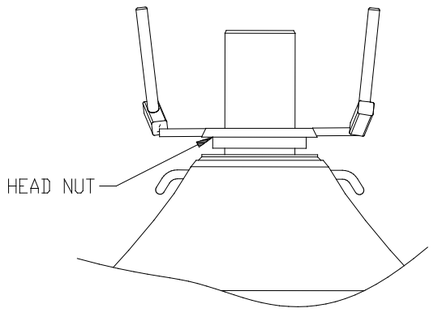


Fig. 6.3.9

12. Lift the worn mantle off the shaft using slings and the lifting hooks.

CAUTION

DURING LIFTING, DO NOT ALLOW THE MANTLE TO KNOCK AGAINST THE MAIN SHAFT

13. Clean all surfaces of the mantle core and shaft. All score marks, scratches and burrs must be removed from the main shaft by polishing.

4.3.2 FITMENT OF NEW MANTLE

1. Cover up the lifting holes of mantle core, to prevent entry of Backing material. Clean the mantle core mating surfaces and apply a thin layer of grease or oil evenly. (Fig. 6.3.10)

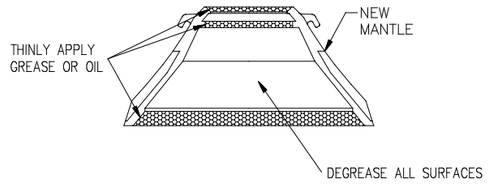


Fig. 6.3.10

2. Fit a new torch ring to the new mantle to make sure that sufficient movement is achieved to take up any misalignment of the head nut. Use an angle grinder on the mantle to widen or deepen the slots.
3. Prepare the mantle for fitment.
4. Lift the mantle and fit it to the main shaft. Fit the torch ring and head nut and tighten into position. Measure the bottom clearance to establish whether mantle fits evenly on the core. Remove the head nut and torch ring.
5. Protect the main shaft thread with cardboard or other means to prevent backing material from attaching to it.
6. Prepare and pour the backing material according to the manufactures instructions. (Fig. 6.3.11) The following table gives an indication as to the amount of backing material the respective machines may use. It is always a good idea to have at least 1 container extra before the pouring operation commences

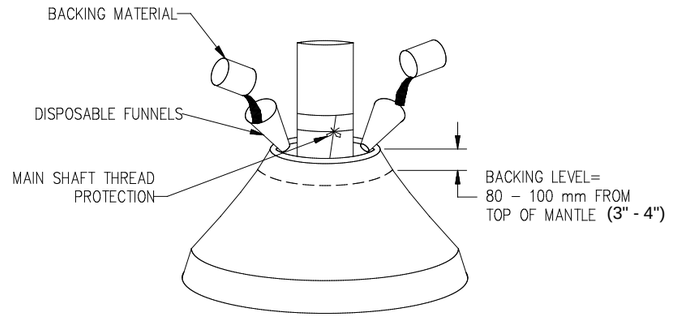
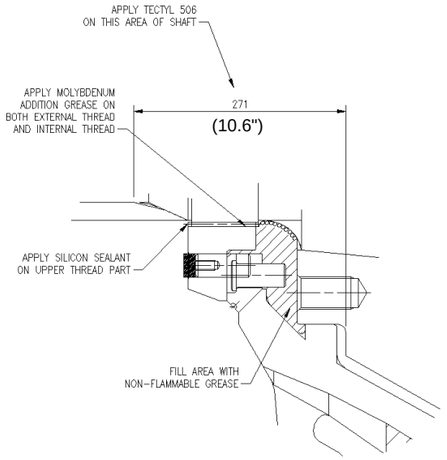


Fig. 6.3.11

MACHINE SIZE	BACKING MATERIAL
Ø 1000	66 lbs
Ø 1200	88 lbs
Ø 1350	132 lbs
Ø 1500	154 lbs
Ø 1650	176 lbs
Ø 1800	198 lbs



7. Apply Tectyl 506 to the shaft as shown in the above figure
8. Grease both the head nut thread and the shaft thread.
9. Refit the torch ring and head nut. Tighten the head nut until locking pin holes align with slots of torch ring. Seal the upper area of the thread with Silicone.
10. Fit two dowel pins and cover holes with rubber caps.
11. Fit one of the grease nipples to the head nut and leave the other grease port open.
12. Pump non-flammable grease into the cavity until it escapes from the opposite open hole
13. Once done, plug both grease holes with supplied plugs.
14. Cut the strike arms off the head nut.

4.3.3 REASSEMBLY OF CRUSHER

1. Clean bottom side of main shaft assembly and clean and prepare dust seal and dust seal cover. Pre-fit the dust seal ring over dust collar to confirm correct inner diameter of dust seal before fitting it to the main shaft assembly. Apply adequate amount of grease on the bottom of the main shaft assembly and on dust seal. Fit the dust seal and dust seal cover, insuring that lock plates are fitted and bolts tightened. Lock the lock plates.
2. Prepare and clean main shaft step and parallel pin. Make sure that dowel fits into the hole at the bottom of the shaft. Measure length of dowel protruding from shaft to assure that it is the correct length. Heat main shaft step bearing slightly, i.e. 100 - 120°F, and fit onto shaft and fit circlip.

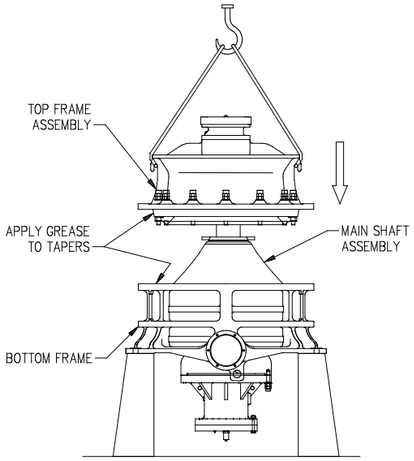


Fig. 6.3.12

3. Ensure that no objects and/or dirt have entered the inner bush cavity and that the step bearing is in position. Main shaft assembly is now ready for installation.

CAUTION

ANY DAMAGE DONE TO ANY OF THE BEARING SURFACES COULD RESULT IN CRUSHER FAILURE

4. Apply a layer of gear oil onto bottom end of shaft and on outside wall of dust collar. Remove temporary cover from dust collar. Lower main shaft assembly slowly into inner bush. Make sure to align splash ring until shaft has entered it. Lower main shaft assembly until dust seal is approximately 0.2 from dust collar. Align dust seal to dust collar by hand through the inspection covers on side of bottom frame. Lower shaft assembly slowly until main shaft step rests firmly on step bearing. Unhook from crane. Remove eye bolts from main shaft.
5. Attach two suitable slings to lifting lugs on side of top frame and lift frame assuring that it hangs horizontally. Clean machined tapers of top and bottom frames thoroughly assuring to remove all high spots and or paint if any. Apply a layer of gear oil or grease on the taper of bottom frame and position top frame over bottom frame. (Fig. 6.3.12). Position spacer washers onto bolt holes on the bottom frame. Lower top frame slowly onto bottom frame until scraper ring housing and shaft end are approximately 10 mm apart. Align scraper ring, (spherical bearing housing), to top end of the shaft and slowly lower top frame over shaft while aligning bolt holes of top and bottom frame. Insert bolts with washers and tighten evenly while checking clearance between top and bottom frame with a taper gauge until it rests firmly on spacer washers. Tighten all bolts to the required torque. (Fig. 6.3.13)

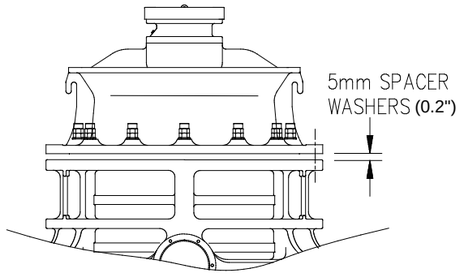


Fig. 6.3.13

6. Torque the bolts evenly according to torque tables.
7. Refit the top frame liners, hopper gasket, hopper, rotary feeder and feeder.
8. Re-tighten all fasteners and re-torque all concave bolts and top frame mounting bolts after 2 hours, after one day and again after one week of operation.

NOTE:

THE MANTLE CAN BE CHANGED IN POSITION WITHOUT THE SHAFT ASSEMBLY BEING REMOVED. THIS IS NOT RECOMMENDED UNLESS IT IS ABSOLUTELY NECESSARY. PLEASE CONTACT IMS Eng. FOR INFORMATION BEFORE ATTEMPTING THIS CHANGE.

5. SPHERICAL BEARING

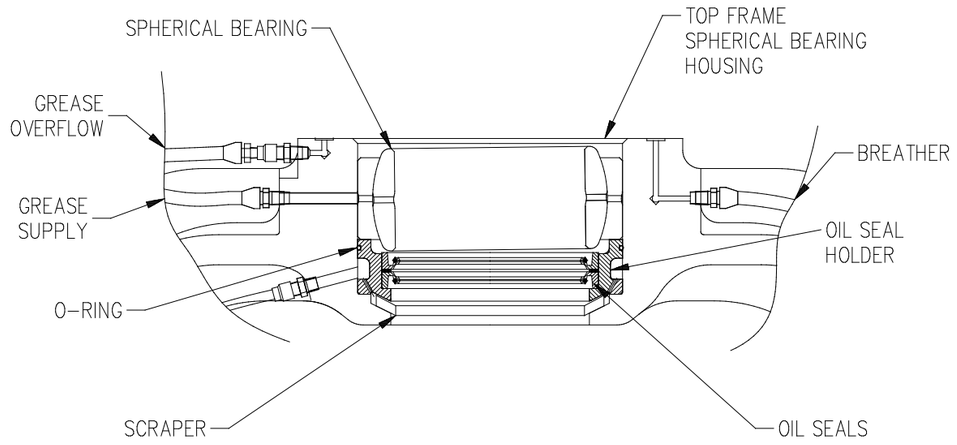


Fig. 6.4.1

5.1 SPHERICAL BEARING REMOVAL

1. The spherical bearing should be checked when replacing the mantle and concave and if found to be worn it should be replaced.
2. Place the top frame on the blocks. The sequence of steps for removing the top frame is same as described in the previous section. (REPLACEMENT OF MANTLE AND CONCAVE).
3. Remove the top frame cap and cap cover to expose the spherical bearing. (Fig. 6.4.1) Clean all grease and dirt out of spherical bearing housing with safety solvent or equivalent.

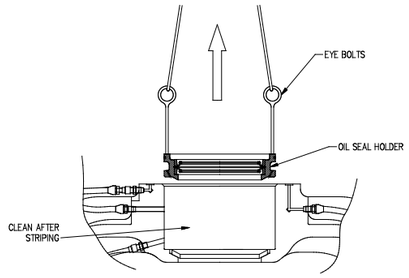


Fig. 6.4.3

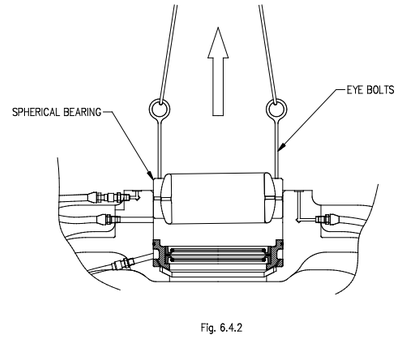


Fig. 6.4.2

4. Fit eye-bolts to the spherical bearing and withdraw it while keeping it horizontal. When difficulty is experienced extracting the spherical bearing, slowly and evenly warm the spherical bearing housing by means of a burner. (Fig.6.4.2)
5. Remove the oil seal clamp ring, oil seal holder and the scraper seal. Clean the housing thoroughly. (Fig. 6.4.3).
6. Remove the old oil seal, clean the oil seal holder and retaining ring and place new oil seals in position. Check the condition of the "O" rings and replace with new if necessary. (Fig. 6.4.4)

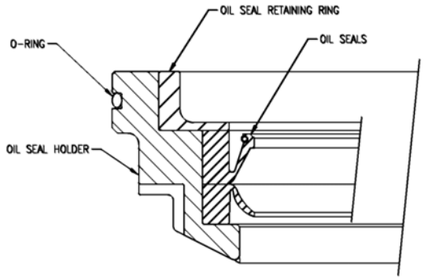


Fig. 6.4.4

5.2 FITMENT OF SPHERICAL BEARING

1. Check all grease lines and water hoses for fracture or blockage and repair where necessary.
2. Insert a new scraper seal and the oil seal holder.
3. Insert the new spherical bearing.
4. After fitting the spherical bearing, use a wooden drift and a hammer and strike the outer ring of the bearing to ensure that the bearing is properly seated in the housing. (Fig. 6.4.5)

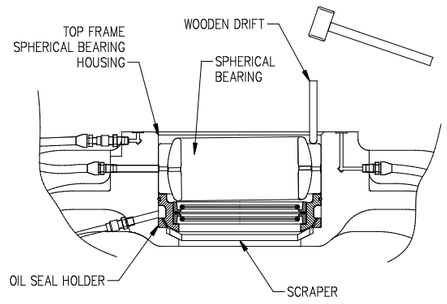


Fig. 6.4.5

5. Replace the cap and cap cover using a new "O" ring and gasket. Torque the bolts evenly according to the torque tables.(Fig. 6.4.6)

NOTE:
REMEMBER THE DOWEL PIN

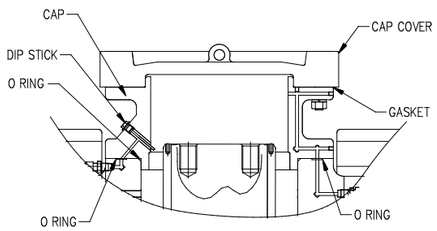
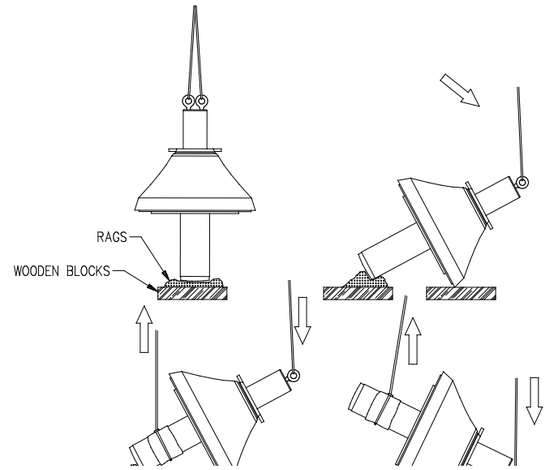


Fig. 6.4.6

6. Reassemble the top frame onto the crusher.

6. DUST RING



1. Measure the gap between dust seal ring and dust collar. Decide whether to carry out replacement of dust ring simultaneously with the replacement of mantle and concave. (See Para. 2.4)
2. Remove the main shaft assembly. (See Para. 4.3)
3. Place the main shaft in such a way so as to expose the dust ring and dust ring cover. (Fig. 6.5.1)

CAUTION

EXTREME CARE SHOULD BE EXERCISED DURING THE OPERATION

4. Flatten the locking washers, remove the bolts and remove the dust ring cover using jacking bolts.

CAUTION

HANDLE THE DUST RING WITH CARE, AS IT IS HEAVY

5. Remove the dust seal.
6. Grease the new dust ring lightly, clean the inside of the mantle core and fit the dust ring.
7. Replace the dust ring cover and bolt into position. Torque the bolts as per torque tables. Bend the lock washers into place preventing the mounting bolts from coming loose. (Fig. 6.5.2).
8. Reassemble crusher.

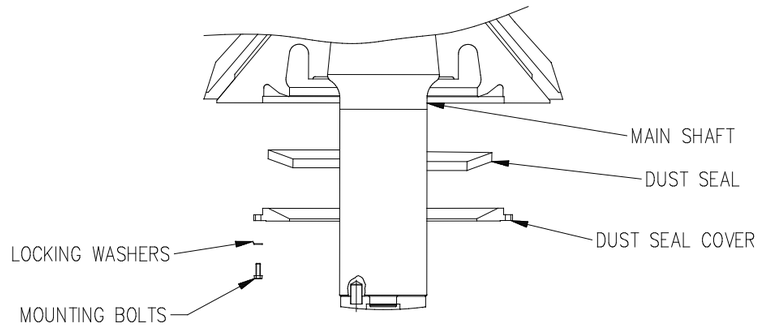


Fig. 6.5.2

7. HYDRAULIC RAM "V" PACKING

CAUTION

Prior to disassembling the hydraulic piping, transfer the weight load of the crushing head onto the bottom frame arm and horizontal shaft so that the weight of the crushing head is not exerted on the cylinder.

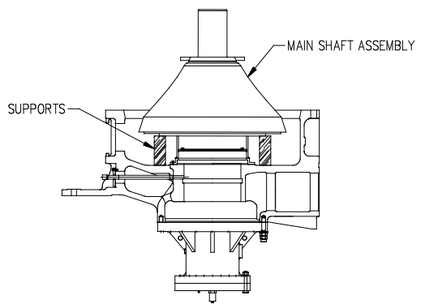


Fig 6.6.1

7.1 "V" PACKING REMOVAL

1. Raise the crushing head to a position about 0 to 0.4 from the top of dust seal collar, ensuring that the dust seal stays in contact with the dust collar.
2. Insert wooden blocks between the bottom frame arms and the crushing head making sure that it is in a stable condition. (Fig. 6.6.1).
3. Lower the ram of the hydraulic cylinder to the lowest limit and disassemble the piping and GY sensor assembly. Discharge the remaining oil by opening the bleeder at the bottom of the hydraulic cylinder.
4. Disconnect three bolts equally spaced around the cylinder bottom plate, insert threaded rod through these holes and tighten to the upper cylinder flange and bottom plate with nuts. Remove all the mounting bolts of the cylinder bottom plate. (Fig. 6.6.2)

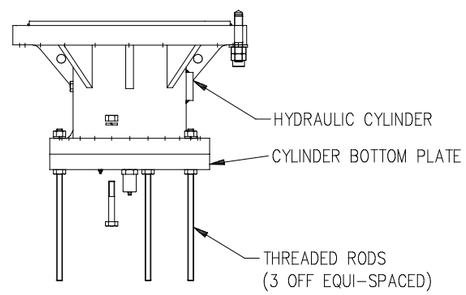


Fig 6.6.2

5. Loosen the lower nuts of the threaded rods and lower the bottom plate. (Fig. 6.6.3)
6. Remove the hexagonal bolts from the ram and the remove the Clamp "V" packing, shims, convex adapter and "V" packing. (Fig. 6.6.4)

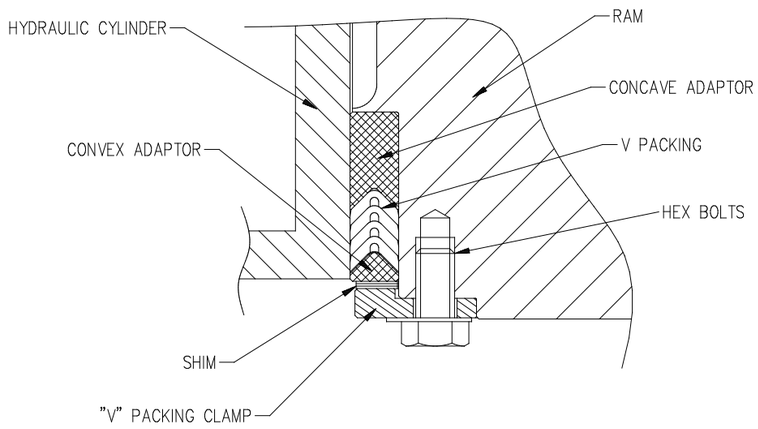


Fig. 6.6.4

PARTS REPLACEMENT

7.2 REASSEMBLY OF "V" PACKING

1. Clean inside the V-packing mounting area thoroughly.

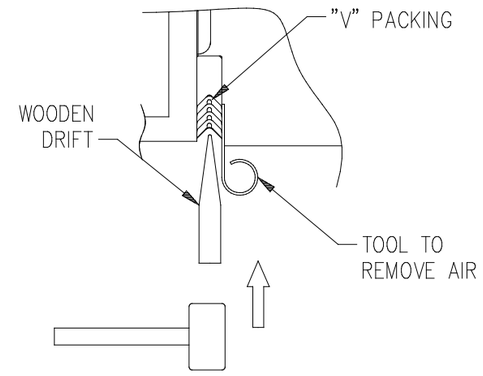


Fig. 6.6.5

2. Apply a layer of oil to the V-packing and insert it into bore of cylinder. Insert a thin wire of ± 0.07 – 0.1 diameter between packing inner bore and ram to allow the air to escape while V-packing is pushed down. Use a flat chisel with rounded tip, or other suitable object, and hammer to knock V-packing down until it is completely bottomed before the next one is inserted. (Fig. 6.6.5)
3. After the fitting of all four V-packings is completed, install the convex adapter. Measure from flange of cylinder to convex adapter and compare with measurement of V-packing clamp step to establish appropriate shim size to achieve the correct interference fit of V-packing rings i.e. 0,012 – 0,024.
4. To ascertain what size shim must be fitted to achieve the correct interference first clean and fit the convex adapter. Measure at four equidistant points, from the bottom of the hydraulic ram to the convex adapter. These measurements must not vary by more than 0.008. If the variation is greater, then re-check fitting of "V" packing and convex adapter.
5. Using these four measurements find the average

$$\frac{M1 + M2 + M3 + M4}{4} = T$$

$$SHIM\ MAX = (T - t_1) + 0{,}024$$

$$SHIM\ MIN = (T - t_1) + 0{,}012$$

where t_1 = Height of V-packing clamp step.
The ideal shim thickness is the mean of these two values

$$\therefore t2 = \frac{SHIM\ MAX + SHIM\ MIN}{2}$$

6. Fit shims and clamp plate and tighten bolts. Lock the lock washers.
7. Reassemble in reverse sequence of disassembly.

8. INNER BUSH

The life of the inner bushing used in a normal operation is 3 to 5 years, but when it is used in an operation with high oil temperature or when foreign substances are present in the oil, the inner bush life will be drastically reduced.

8.1 INNER BUSH REMOVAL

1. Remove the top frame and the main shaft.
2. Remove the dust collar. (Fig. 6.7.1)

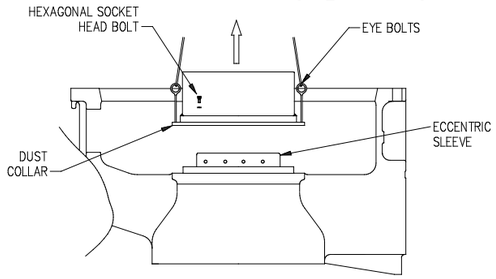


Fig. 6.7.1

CAUTION

WHEN LIFTING THE DUST COLLAR HANDLE IT CAREFULLY SINCE THE CENTRE OR GRAVITY IS HIGH

3. Clean the eccentric sleeve and its periphery and remove the key.
4. Withdrawal of the inner bush will depend on its condition, and may have to be cooled with dry ice.
5. If due to the burning effect on the inner bushing it may have contracted. Then it can easily be removed using a chain block. If it is difficult to withdraw and too much force is being applied, the eccentric sleeve can damage the gear. Only after it has been cooled with dry ice and shrunk enough, can removal take place.
6. Seal the bottom of the eccentric sleeve with a sheet of thick paper or equivalent.
7. Place lumps of dry ice in a net and insert the net into the inner bush. Hang it from above. Insulate the top and bottom of the bush with wood and rags. (Fig. 6.7.2).

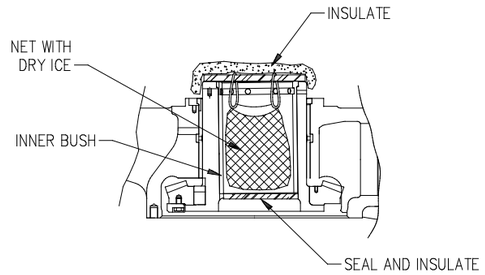


Fig. 6.7.2

8. When 3 to 4 hours have passed, remove the cover and the remains of the dry ice. Fix eye-bolts to the inner bushing and remove it. (Fig. 6.7.3)

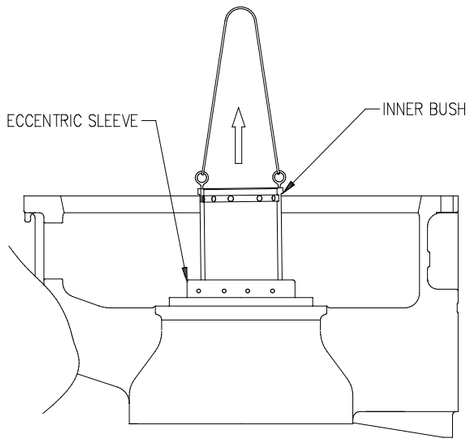


Fig. 6.7.3

9. If this can not be achieved then the bush can only be removed by splitting it along it's length with an angle grinder. As this is not easily done and a lot of waste matter is generated which must be prevented from entering the lubrication system, all efforts to remove the bush must be maximized before this type of removal is recommended.
10. Remove the thick paper from the bottom of the eccentric sleeve. Clean the inside of the eccentric sleeve and make any necessary repairs.
11. Thinly apply a lubricant to eccentric sleeve and place a cover on top, so that dust is prevented from entering.

8.2 FITMENT OF NEW INNER BUSH

1. Check the inner bush and especially check if there is any casting fin around the lower part of it. Remove any burrs and sharp edges. (Fig. 6.7.4)

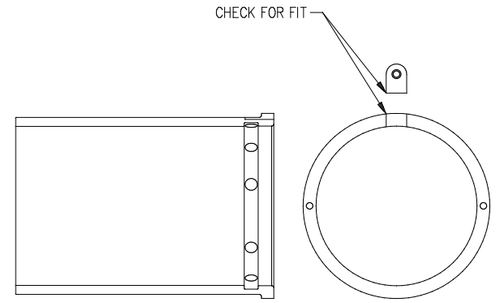


Fig. 6.7.4

2. Wipe the interior and exterior until 100% clean and dry.
3. Place the inner bush into a wooden box or similar and cool it with dry ice. (Fig. 6.7.5). The quantity of dry ice to be used and the cooling hours are the same as for removal.

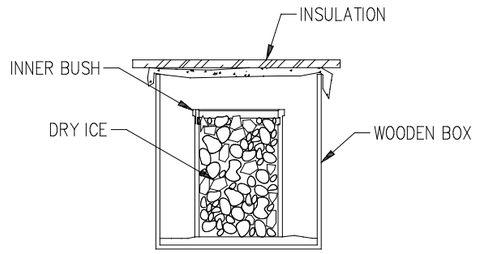


Fig. 6.7.5

4. Make sure that the key fits in the key-ways.
5. Suspend the well-cooled inner bush above the eccentric sleeve and wipe the exterior with dry waste, lower the inner bush into the eccentric sleeve while lining up the key position.
6. When the inner bush has been perfectly inserted into the eccentric sleeve, fit the key.
7. Wait for bush return to ambient temperature. Re assemble the crusher in the same sequence of main shaft and top frame.

NOTE:
RUNNING IN SEQUENCE MUST BE FOLLOWED.

Use the following table as a guide for the dry ice quantities.

CRUSHER	DRY ICE (lbs)	PERIOD (hours)
Ø1000	88	2
Ø1200	132	2
Ø1350	176	2,5
Ø1500	220	2,5
Ø1650	330	3
Ø1800	420	3,5

9. OUTER BUSH

9.1 OUTER BUSH REMOVAL

1. Remove the top frame, main shaft and dust seal collar.
2. Lower the hydraulic cylinder to the lowest limit at the control panel and drain off remaining hydraulic oil by removing the air bleeder.
3. Remove the hydraulic piping, lubricating piping and GY sensor from the cylinder. Put waste into the parts that have been removed to prevent contamination from taking place.
4. Remove five mounting studs from hydraulic cylinder at positions equi-distant around the circumference. Insert extra long threaded rod into the holes and tighten them into position. Tighten nuts (B) up against plate. Remove the remaining nuts (A) from hydraulic cylinder. (Fig. 6.8.1).

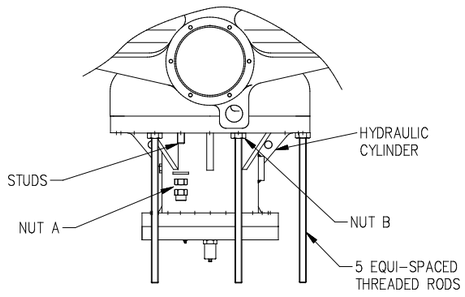


Fig. 6.8.1

5. Evenly loosen nuts (B) at five places. Until the distance between bottom frame and cylinder is 80 to 100mm. Temporarily remove and replace the long studs in sequence, fixing the special washer with nut (C) to each stud as shown. (This is to prevent the eccentric bush assembly from moving out). (Fig. 6.8.2)

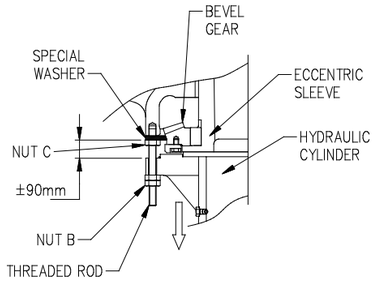


Fig. 6.8.2

6. Loosen the nuts (B) evenly, whilst checking to verify that the bevel gear is perfectly supported by the special washers.
7. Prepare a stand onto which the hydraulic cylinder can be placed and then removed.
8. Evenly lower the cylinder onto the stand and remove it. (Fig. 6.8.3)

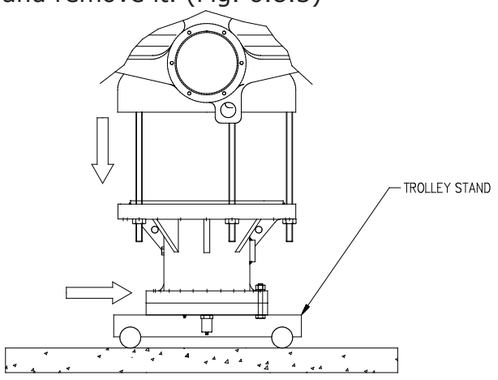


Fig. 6.8.3

9. Remove extra long studs in sequence and replace with bolts. (Fig. 6.8.4)

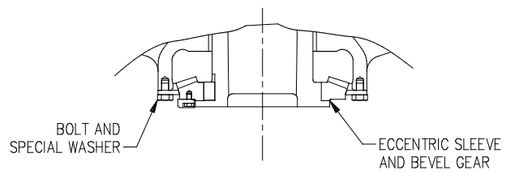


Fig. 6.8.4

10. Depending on the condition of outer bush, the eccentric sleeve may now be removed.
11. Fit two eyebolts into the top part of the eccentric sleeve as shown in the following drawing and put the sling under tension,

so as to take the initial weight of the eccentric sleeve which will help in the removal of the bolts and special washers. (Fig. 6.8.5)

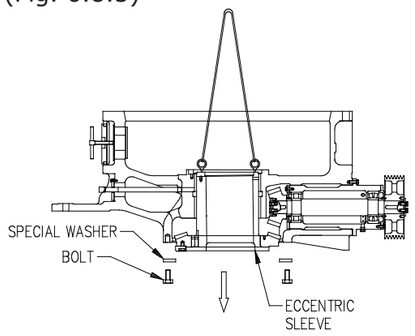


Fig. 6.8.5

12. Provide a stand on which to place the eccentric sleeve, then gently lower the eccentric sleeve onto the stand. (Fig. 6.8.6).

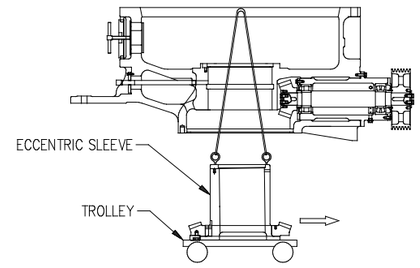


Fig. 6.8.6

13. Where the eccentric sleeve does not lower; under its own weight, strike eccentric sleeve from above with a heavy mallet, lowering, the crane a little at a time. In the case when the outer bushing has seized due to burning and the eccentric sleeve cannot be lowered by the procedure used above, press it out from above with a hydraulic jack and a beam while lowering the crane to compensate. A sling of a sufficient length must be used so as not to interfere with the beam. (Fig. 6.8.7)

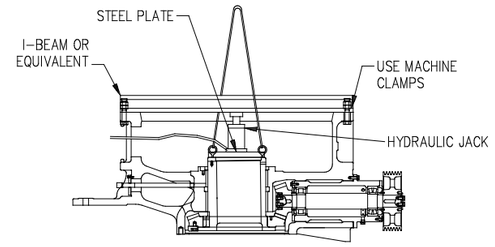


Fig. 6.8.7

14. Withdrawal of the outer bush is the same as for the inner bush depending on its condition. It is either withdrawn as it is, or after being cooled with dry ice. In most cases when the eccentric sleeve has to be pushed out forcibly, the outer bush can then be removed by means of a chain block or equivalent. (Fig. 6.8.8).

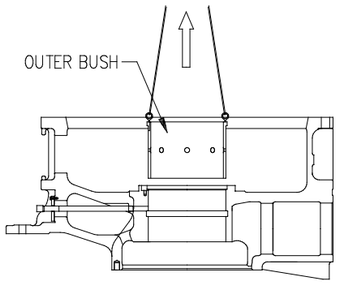


Fig. 6.8.8

15. If the outer bush is stuck, cool the outer bush with dry ice. (Fig. 6.8.9)

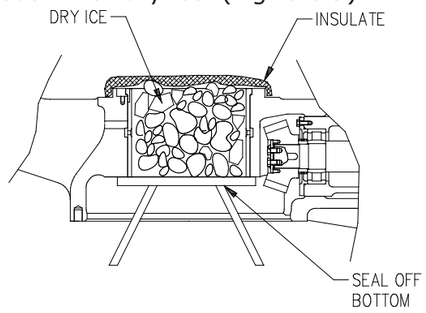


Fig. 6.8.9

16. After withdrawing the outer bush, clean the inside of the bottom frame and make any necessary repairs. Thinly apply a lubricant to the surfaces.

9.1.1 ALTERNATIVE METHOD OF REMOVAL

When circumstances and/or situation does not allow the removal of the hydraulic cylinder and eccentric bush assembly as described in the text above then an alternate method must be used.

1. Follow steps 1 to 3 for outer bush removal (9.1 above).
2. Remove all piping and drives connected to the bottom frame.
3. Loosen the bottom frame mounting bolts.
4. Lift the bottom frame from it's mounting and place it on a suitable stand such as the traveling stand.
5. Proceed with steps 6 to 16 for outer bush removal.

9.2 FITMENT OF NEW OUTER BUSH

NOTE:
THE FITMENT OF THE OUTER BUSH IS THE SAME PROCEDURE AS THE INNER BUSH.

1. Check the outer bush and especially check if there is any casting fin around the lower part of it. Remove all sharp edges and burrs.
2. Wipe the interior and exterior until it is 100% clean and dry.
3. Put the outer bush into a wooden box or similar and cool it with dry ice. (The quantity of dry ice and the cooling hours are the same as for removal.)
4. Check the fit of the key to be used, position the key in the bottom frame.
5. Suspend the well-cooled outer bush above the bottom frame. Wipe the exterior with dry waste and place the outer bush into the bottom frame while lining up the key position. Replace the key.
6. Replace the eccentric sleeve in the reverse sequence of disassembly. Pay attention to the interlocking between the gear and pinion.
7. Refit the cylinder and connect the lubrication and hydraulic piping.
8. Refit the GY sensor.
9. Reassemble crusher.
10. Vent the air from the hydraulic system.

WARNING

RUNNING SEQUENCE MUST BE FOLLOWED

Use the following table as a guide for the dry ice quantities.

CRUSHER	DRY ICE (lbs)	PERIOD (hours)
Ø 1000	88	2
Ø 1200	132	2
Ø 1350	176	2,5
Ø 1500	220	2,5
Ø 1650	330	3
Ø 1800	420	3,5

10 GEAR AND PINION

NOTE:
REPLACE BOTH THE GEAR AND PINION AS A MATCHED PAIR.

10.1. REPLACEMENT OF GEAR.

10.1.1. GEAR REMOVAL.

1. To remove the eccentric sleeve, gear assembly, follow the same procedure as for the replacement of the outer bush. Remove the top frame, main shaft and hydraulic cylinder. Remove the eccentric sleeve assembly.
2. To minimize handling and thus minimize risk of damage to the eccentric sleeve place the eccentric sleeve on two sleepers. (Fig 6.9.1).

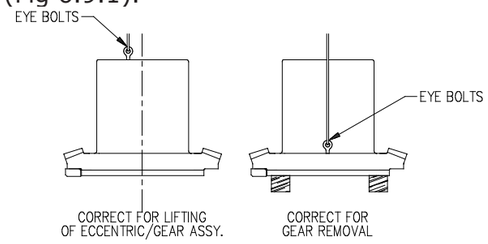


Fig. 6.9.1

3. Fix a sling to the gear and heat the gear around the circumference with propane burners or similar.

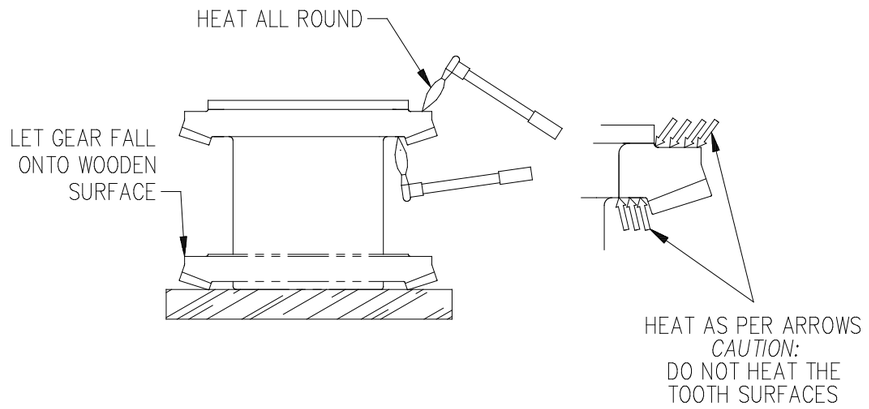


Fig. 6.9.2

NOTE:
DO NOT HEAT THE TOOTHED PART OF THE GEAR.

4. Lift the gear when it is considered that the gear will move. Hit the underside of gear evenly with a mallet and remove the gear slowly so as not to damage the eccentric sleeve. If the gear cannot be removed in this way, then the eccentric sleeve assembly will have to be turned over. Caution should be exercised when turning the eccentric sleeve over and always think safety first. Preventive measures should be taken to stop any damage to the eccentric sleeve assembly.
5. While supporting the gear, heat the whole circumference of the gear uniformly with a propane burner or similar, and remove gear with caution.(Fig. 6.9.2).
6. Remove the counterweight if the new gear has been supplied without.
7. Turn the eccentric sleeve back to original position.

10.1.2 FITMENT OF NEW GEAR

1. Clean and inspect gear and make sure that all sharp edges are removed. Measure inner bore of gear and outer diameter of eccentric bush flange to confirm correct interference fit.
2. Prepare key and make sure it fits into both key-ways. Fit the key to the eccentric sleeve. (Fig. 6.9.3).

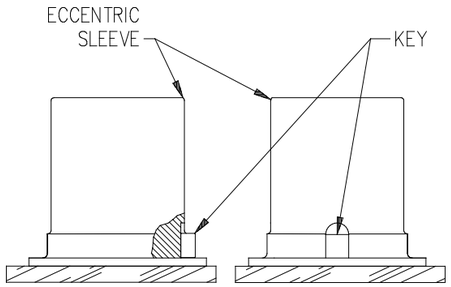


Fig. 6.9.3

3. Fit counter balance weights onto the back of the gear and lock bolt heads by welding. Assure not to attach the earth cable of the welding machine directly onto the gear, but by means of a magnetic stand or attach it to counter weights.
4. Position the eccentric sleeve at least 100 mm above floor level and making sure that it is level. The supports underneath the sleeve must not extrude past the outer diameter of the sleeve. This will ensure that the counter weights will not interfere and prevent the gear from going down all the way over the bush.
5. Heat the gear by means of a propane burner or equivalent. Re-measure the bore and when sufficient expansion has taken place, lower it over the eccentric sleeve and align the key way with the key.

NOTE:
DO NOT HEAT THE TOOTHED SURFACE IF DIRECT FLAME IS BEING USED.

6. Check to ensure the gear is fitted correctly. (Fig. 6.9.4).
7. Clamp it down firmly until cooled down. (Fig. 6.9.5).

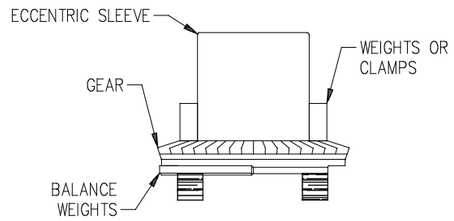


Fig. 6.9.5

8. Reassemble the crusher after the gear has cooled down completely.

10.2 REPLACEMENT OF PINION

NOTE:
REPLACEMENT OF PINION SHOULD BE PERFORMED SIMULTANEOUSLY WITH REPLACEMENT OF GEAR.

10.2.1. PINION REMOVAL.

1. Remove the crusher drive arrangement. (V-belts or direct drive)
2. Remove any piping that may be routed in such a way that it will hamper the removal of the horizontal shaft assembly. (Fig.6.9.6).

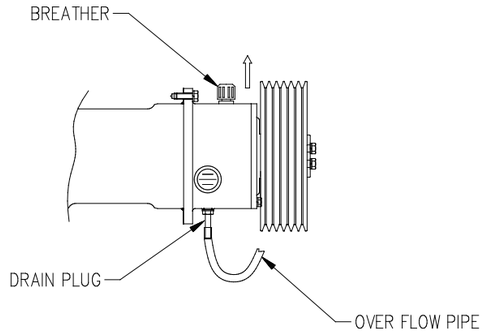


Fig. 6.9.6

3. Drain the horizontal shaft lubrication oil by removing the over flow pipe and drain plug.
4. Remove the horizontal shaft assembly retaining bolts and fit the jacking bolts to extract the horizontal shaft assembly. (Fig. 6.9.7).

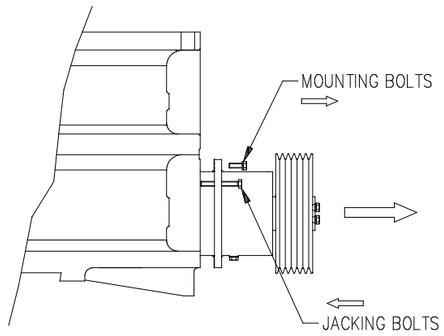


Fig. 6.9.7

5. Once the shaft assembly is extracted far enough for the locating diameters to disengage, suspend the assembly using eye-bolts and slings. Whilst keeping the assembly level and stable, remove from bottom frame.(Fig. 6.9.8).

Fig. 6.9.8

6. Place horizontal shaft assembly on wooden "V" blocks and remove the mounting bolts, lock plate and retaining plate. (Fig. 6.9.9).

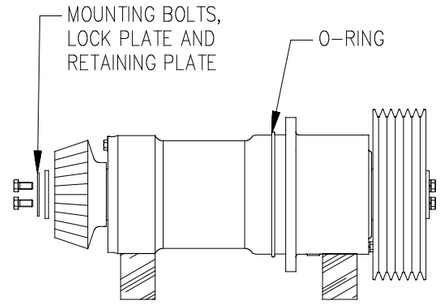


Fig. 6.9.9

7. Heat the circumference of the pinion and withdraw the pinion by means of hydraulic jack and puller. (Fig. 6.9.10).

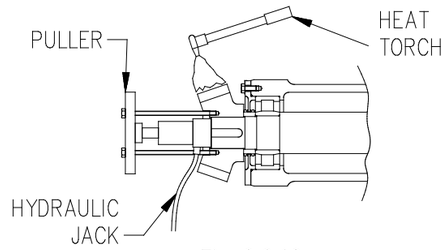


Fig. 6.9.10

8. It is recommended to replace both of the "V" ring type seals whilst the shaft is disassembled.

10.2.2 FITMENT OF NEW PINION

1. Using an oil-stone, deburr the new pinion and check the shaft and key are not damaged.
2. Verify the pinion and shaft diameters as well as the width of the key-way and key.
3. Heat the pinion to 150°C using an oven or a suitable oil.
4. Place the horizontal shaft in a vertical position to fit the pinion.

IMPORTANT
CHECK THAT THE V-RING IS FITTED

5. After verifying the inner diameter of the heated pulley fit it over the shaft. Fit and tighten the retaining plate.
6. After allowing the pinion to cool down re-tighten the retaining plate bolts and lock with the lock plate.

7. When reassembling the horizontal shaft into the bottom frame, make sure that pinion and gear mesh correctly. Backlash must be checked and reset according to specification

10.3 BACKLASH CHECK

A simple test can be carried out when checking and setting pinion backlash. (Fig. 6.9.11)

1. Set-up a magnetic base and clock gauge on the horizontal shaft.
2. Set the gauge to read on a flat surface parallel to the center line of the horizontal shaft assembly at the radius specified in the table below.
3. Rotate the shaft backwards and forwards and take a reading from the gauge.
4. Insert or remove packing as required. (Remove packing for less backlash).

TIP:

When assembling the horizontal shaft assembly into the bottom frame, use more packings rather than less as it will be easier to remove them than to insert more during backlash checking.

Table of Blacklash VALUES

MACHINE SIZE	BACKLASH = X (inch)	@RADIUS = Y (inch
Ø1000	0.05 – 0.06	4.72
Ø1200	0.06 – 0.07	5.03
Ø1350	0.07 – 0.08	6.02
Ø1500	0.08 – 0.09	6.59
Ø1650	0.09 – 0.11	7.73
Ø1800	0.10 – 0.12	8.86
Ø2100	0.11 – 0.14	9.98

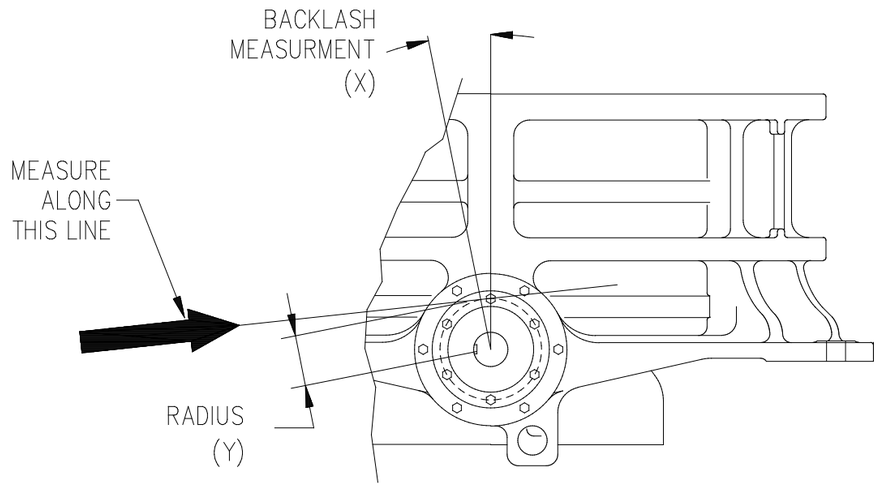


Fig. 6.9.11

PARTS REPLACEMENT

11 HORIZONTAL SHAFT BEARING

The steps required to replace the horizontal shaft bearings are the same as those for **REPLACEMENT OF PINION** in addition to the following steps.

NOTE:

If the pinion is to be re-used, it has to be heated using oil (150°C). Direct heating with a burner will destroy the surface properties, thus shortening its life.

1. Remove the covers and collars on both the pinion side and the drive side. (Fig. 6.10.1).

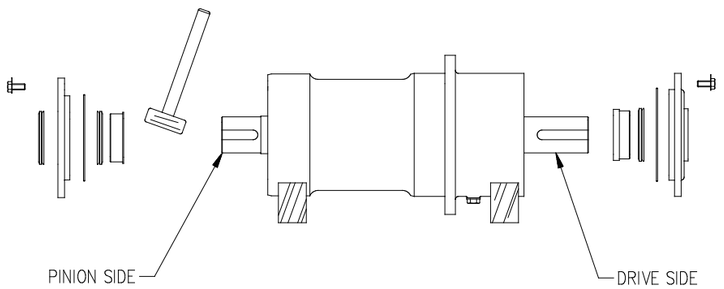


Fig. 6.10.1

2. Remove the horizontal shaft by hitting it on the pinion side with a large hammer, whilst taking care to protect the shaft from impact marks. (Use a copper hammer or mallet)
3. The outer race of the bearing on the pinion side as well as its rollers will remain inside the horizontal shaft sleeve and the inner race will remain on the shaft. If this bearing has to be replaced the inner race must be heated to remove it from the shaft and the outer race and rollers must be knocked out of the horizontal shaft sleeve. (Fig. 6.10.2)
4. Fitting the new pinion side roller bearing requires the inner race to be heated with a bearing heater to 248°F prior to fitting it onto the shaft. Insert the outer ring and roller of the new roller bearing into the sleeve.
5. The spherical roller bearing on the drive side of the horizontal shaft is retained by a lock nut and lock washer which have to be removed before the bearing can be pulled off with a puller.
6. Fitting the new drive side spherical roller bearing requires the bearing to be heated with a bearing heater to 248°F prior to

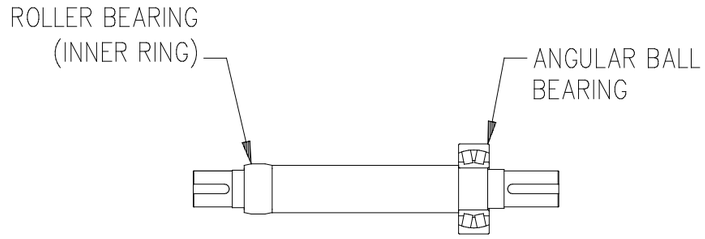


Fig. 6.10.2

fitting it onto the shaft and securing it with the lock nut and lock washer.

7. Install the shaft into the sleeve, pinion side first. (Fig. 6.10.3)

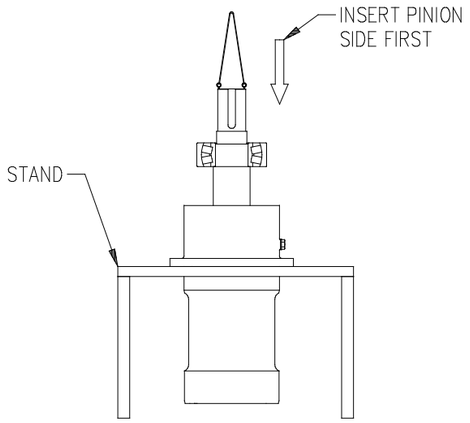


Fig. 6.10.3

8. Fit V-ring and collar over shaft on drive side and slide it down into position. Measure out the difference between V-ring and cover-sealing face to establish the correct press fit between V-ring and end cover-sealing face i.e. 0.06 – 0.12 interference. Fit end cover with O-ring.
9. Fit V-ring and collar on pinion side in the same manner and fit end cover with O-ring. Fit second V-ring on outside of end cover.
10. Fit pinion as described in previous section.
11. Assembly horizontal shaft assembly into bottom frame as described in previous section

12. MAIN SHAFT STEP

1. Remove the main shaft.
2. The main shaft step bearing and step bearing should be replaced as a pair. The plain bearing only when it is worn past its limit. A running in sequence should take place if main shaft step and step bearing are replaced but not if the plain bearing is replaced. Please consult IMS Eng if these bearings are replaced.
3. Remove the circlip from underneath the main shaft step bearing and remove bearing, refit new bearing and refit circlip. Heat the bearing with removal and refitting, 40 to 50°C if necessary. (Fig. 6.11.1).
4. Both the step and plain bearings can be lifted through the inner bush by screwing rods into the holes in these bearings. Take care not to damage the inner bush.
5. These bearings have a long life span and these changes will be done infrequently. If these changes are done in conjunction with a mantle and concave change, time will be saved.

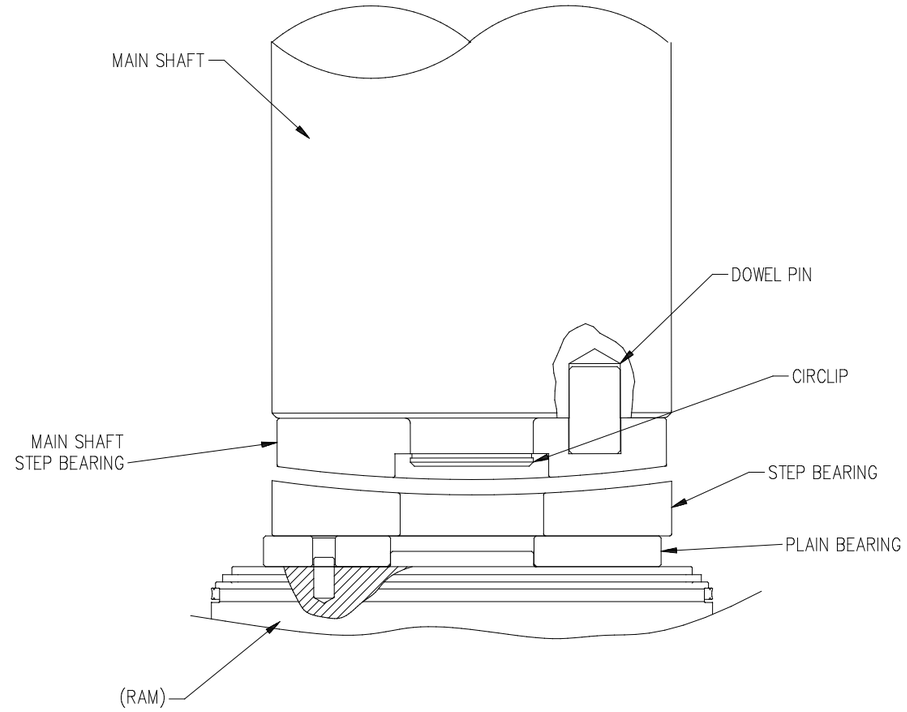


Fig. 6.11.1

13. MAIN SHAFT COLLAR

13.1 MAIN SHAFT COLLAR REMOVAL

1. Remove the main shaft from the crusher and secure into a stand.
2. Prepare for the collar removal as per the following drawing. (Fig. 6.12.1)
3. Heat the main shaft collar evenly using a burner between 392-572°F. This should be done within two to three minutes so that heat transfer to the shaft does not take place. Do not overheat.
4. Start jacking the collar off when the main shaft collar reaches about 212°F.
5. Continue jacking and heating until the collar has been removed. Use spacers if the jack does not have enough stroke.

PRECAUTIONS:

- Welding should be done by a qualified person to avoid tool breakage due to weld failure during the removal process.
- Work as quickly and safely as possible to avoid heat transfer to the shaft. This will cause the collar to stick due to shaft expansion.
- At all times avoid unnecessary force which could cause damage to the main shaft.

13.2 FITMENT OF NEW COLLAR

1. Remove any burrs and sharp edges that may have been generated during the removal process. Clean surface thoroughly
2. Clean the new main shaft collar and remove rust-prevention agent.

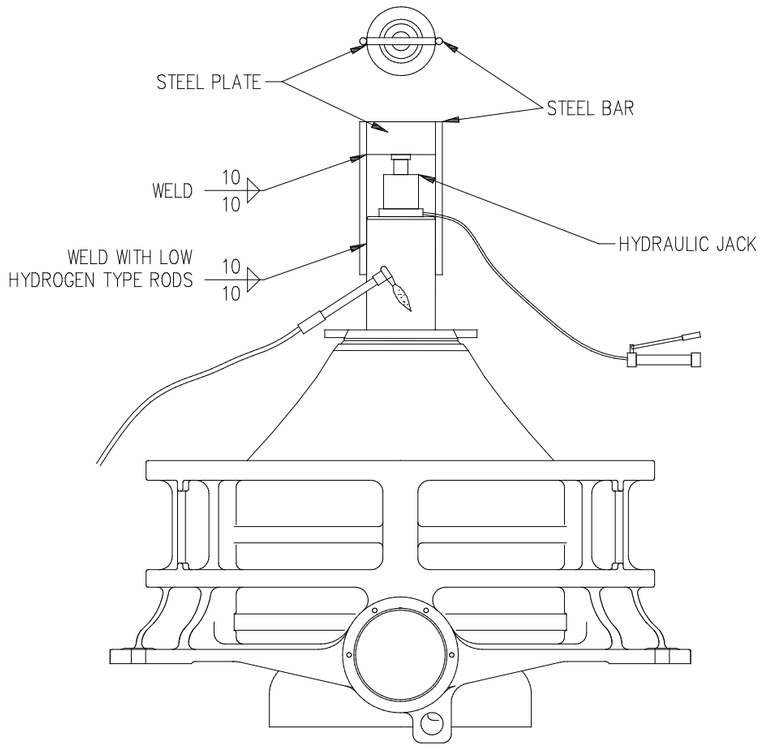


Fig. 6.12.1

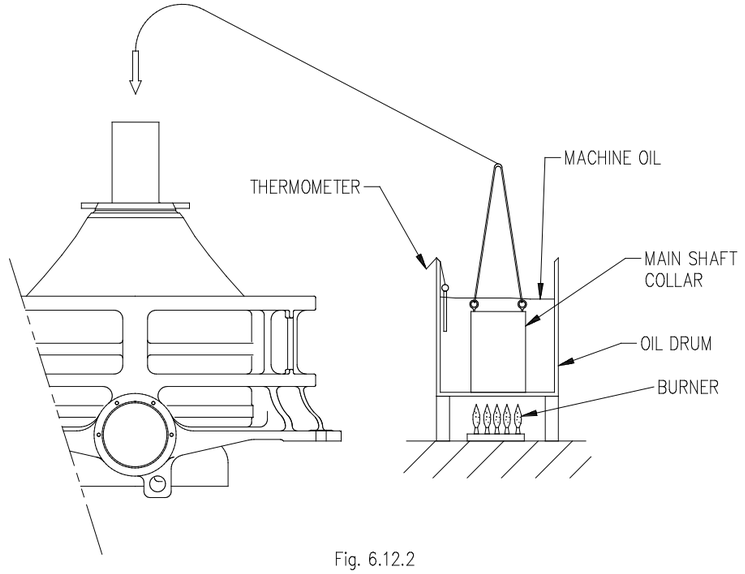


Fig. 6.12.2

3. Put the new main shaft collar in the oil drum filled with heating oil and heat it. Hold the temperature at 248- 300°F for more than 30 minutes. Don't heat the oil over 300°F since it may reach flash point. (Fig. 6.12.2)
4. Remove from the oil and wipe the inside of the collar clean. Fit the collar quickly to the main shaft before the collar cools down.
5. Re-Assemble the crusher.

14. BOLT TORQUES FOR KAWASAKI CRUSHERS

14.1 GENERAL

The information contained in the following paragraphs is based on the following assumptions:

- The bolts and nuts are new and clean.
- Are according to the crusher specification.
- The bolts and nuts are lightly oiled.

NOTE:
It is recommended that all fasteners are coated with a reputable anti seize lubricant before the torque operation commences.

14.2. TORQUE SEQUENCE FOR TOP FRAME

The basic sequence is as follows:

1. Set the top frame horizontally and parallel to the bottom frame.
2. Tighten the bolts in the sequence shown in (Fig. 6.13.1) so that the clearance reduces by ⅓ Δt.. Use a taper gauge to check the clearance.

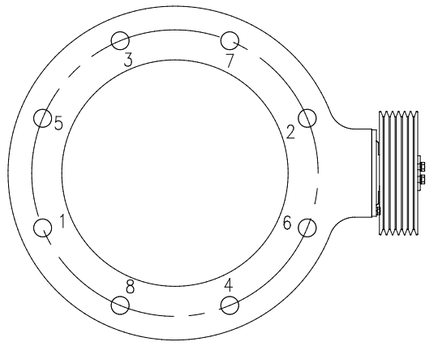


Fig. 6.13.1

3. Tighten the bolts again in the same sequence to reduce the clearance by a further ⅓ Δt. (Fig. 6.13.2).
4. Tighten the bolts a third time in the same sequence until the top frame squeezes against the spacers. Ensure that the spacer play is taken up completely.
5. Torque the bolts to the specified value.

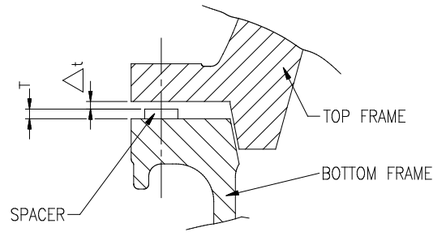


Fig. 6.13.2

14.3 TORQUE TABLES

The number in the illustration (Fig. 6.13.3), corresponds to the table number in the tables below.
If an anti seize lubricant is used, the torque valve must be reduced by 15 to 20%.

IMPORTANT

1. ALWAYS TORQUE BOLTS IN A SEQUENCE TO ENSURE UNIFORMITY OF FITMENT.
2. IF ONE OR MORE BOLTS BECOME LOOSE OR BREAK DURING OPERATION, FIRST LOOSEN THE SET OF BOLTS, REPLACE WHERE NECESSARY AND RE-TORQUE AS IN 1 ABOVE.

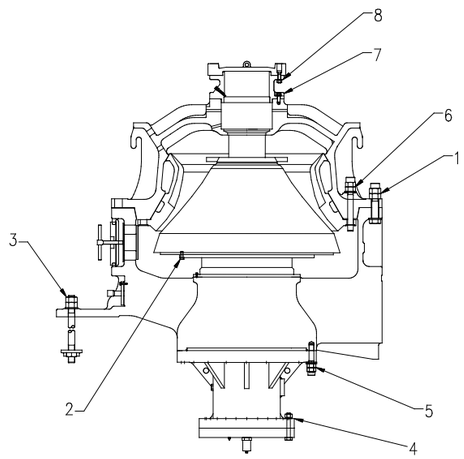


Fig. 6.13.3

PARTS REPLACEMENT

1. TOP TO BOTTOM FRAME BOLT		
MACHINE TYPE	BOLT DIAMETER	TORQUE VALUE
Ø 800	M30 x 2	845 lb-ft 1147 N·m
Ø 1000	M36 x 3	1135 lb-ft 1540 N·m
Ø 1200	M42 x 3	1851 lb-ft 2510 N·m
Ø 1350	M48 x 3	2813 lb-ft 3815 N·m
Ø 1500	M56 x 4	3945 lb-ft 5349 N·m
Ø 1650	M64 x 4	5060 lb-ft 6860 N·m
Ø 1800	M64 x 4	6567 lb-ft 8904 N·m

3. FOUNDATION BOLT		
MACHINE TYPE	BOLT DIAMETER	TORQUE VALUE
Ø 800	M30	845 lb-ft 1147 N·m
Ø 1000	M36	1135 lb-ft 1834 N·m
Ø 1200	M42	1851 lb-ft 2353 N·m
Ø 1350	M48	2813 lb-ft 3815 N·m
Ø 1500	M56 x 4	3945 lb-ft 3648 N·m
Ø 1650	M64	5060 lb-ft 4207 N·m
Ø 1800	M64	6567 lb-ft 4207 N·m

2. DUST RING COVER MOUNTING		
MACHINE TYPE	BOLT DIAMETER	TORQUE VALUE
Ø 800	M16	46 lb-ft 62 N·m
Ø 1000	M16	45 lb-ft 62 N·m
Ø 1200	M16	45 lb-ft 62 N·m
Ø 1350	M20	90 lb-ft 122 N·m
Ø 1500	M20	90 lb-ft 122 N·m
Ø 1650	M24	173 lb-ft 235 N·m
Ø 1800	M24	173 lb-ft 235 N·m

4. CYLINDER BOTTOM PLATE BOLT		
MACHINE TYPE	BOLT DIAMETER	TORQUE VALUE
Ø 800	M24 x 2	554 lb-ft 751 N·m
Ø 1000	M30 x 2	897 lb-ft 1216 N·m
Ø 1200	M30 x 2	897 lb-ft 1216 N·m
Ø 1350	M36 x 3	1938 lb-ft 2628 N·m
Ø 1500	M36 x 3	1938 2628 N·m
Ø 1650	M42 x 3	2451 lb-ft 3324 N·m
Ø 1800	M48 x 3	3725 lb-ft 5050 N·m

5. CYLINDER MOUNTING		
MACHINE TYPE	BOLT DIAMETER	TORQUE VALUE
Ø 800	M22 x 2	399 lb-ft 542 N·m
Ø 1000	M24 x 2	442 lb-ft 601 N·m
Ø 1200	M30 x 2	896 lb-ft 1216 N·m
Ø 1350	M36 x 3	1936 lb-ft 2628 N·m
Ø 1500	M42 x 3	2450 lb-ft 3324 N·m
Ø 1650	M48 x 3	3715 lb-ft 5050 N·m
Ø 1800	M56 x 4	5767 lb-ft 7826 N·m

6. CONCAVE MOUNTING BOLTS		
MACHINE TYPE	BOLT DIAMETER	TORQUE VALUE
Ø 800	M24 x 2	419 lb-ft 568 N·m
Ø 1000	M30 x 2	677 lb-ft 919 N·m
Ø 1200	M36 x 3	1134 lb-ft 1540 N·m
Ø 1350	M42 x 3	1849 lb-ft 2510 N·m
Ø 1500	M48 x 3	2811 lb-ft 3815 N·m
Ø 1650	M56	4148 lb-ft 5629 N·m
Ø 1800	M56 x 4	4357 lb-ft 5913 N·m

7. FOUNDATION BOLT		
MACHINE TYPE	BOLT DIAMETER	TORQUE VALUE
Ø 800	M16	121 lb-ft 165 N·m
Ø 1000	M20	237 lb-ft 322 N·m
Ø 1200	M20	237 lb-ft 322 N·m
Ø 1350	M20	237 lb-ft 322 N·m
Ø 1500	M24	173 lb-ft 235 N·m
Ø 1650	M24	173 lb-ft 235 N·m
Ø 1800	M24	173 lb-ft 235 N·m

8. CAP COVER BOLTS		
MACHINE TYPE	BOLT DIAMETER	TORQUE VALUE
Ø 800	Shared by cap	Shared by cap
Ø 1000	M16	121 lb-ft 87 N·m
Ø 1200	M16	121 lb-ft 87 N·m
Ø 1350	M16	121 lb-ft 87 N·m
Ø 1500	M24	121 lb-ft 235 N·m
Ø 1650	M24	121 lb-ft 235 N·m
Ø 1800	M24	121 lb-ft 235 N·m

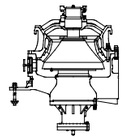
PARTS REPLACEMENT

NOTES:

TROUBLE SHOOTING

Contents:

TROUBLE SHOOTING



CRUSHER

PROBLEM	PROBABLE CAUSE	CHECKS	REMEDY
1. **Crusher does not start.**	Main motor does not start.	Check the electric system of main motor.	Make necessary repairs.
	When interlock circuit is actuated.	Check oil pump is rotating. • Actuation of flow switch due to lack of lubrication oil. • Check if the thermo-switch of lubrication return oil is working correctly.	• Reset and start oil pump. • Check the condition of relief valve, lubrication pump, flow switches and gate valves and replace if necessary. • After checking, replace faulty parts, or reset.
	Feed material in crushing chamber.	Visually, check from above.	• Bring the crushing head down to its lowest position. • Crush the feed material by moving the crushing head up and down while inching the crusher. • Attempt to remove material and tramp iron by opening the discharge set. • Attempt to remove feed material and tramp iron from above.
	Tramp iron in crushing chamber	Visually check from above	When tramp iron or the like is present, cut it out using Oxy/acetylene, or discharge it by loosening top frame. EXTREME CAUTION MUST BE EXERCISED.
	Horizontal shaft bearing is damaged.	• Check temperature of horizontal shaft bearing assembly. • Drain horizontal shaft lubrication oil and check for the presence of metallic particles	Disassemble, inspect and repair / replace bearing.

PROBLEM	PROBABLE CAUSE	CHECKS	REMEDY
	Outer eccentric bush seized.	• Check for high temperature of lubrication return oil. • Check whether metal particles are present in the strainers. • Check whether there is a rising trend of the no-load current.	Disassemble, repair / replace outer eccentric bush.
2. During no-load operation, mantle rotates too fast.	Inner eccentric bush seized	• Check for high temperature of lubrication return oil. • Check if metal particles are present in the strainers of lubrication unit.	1. Mantle rotation during no-load operation is too fast (50 rpm or more), but if raw stone can be crushed, feed slowly and observe the condition. 2. If the problem cannot be remedied by above, halt the operation for a while, feed 2 or 3 lumps of stone and carry out inching operation of motor. If the problem persists, seizure of inner bushing is likely. Disassemble, inspect repair / replace. NOTE: Running in procedure must be followed.

PROBLEM	PROBABLE CAUSE	CHECKS	REMEDY
3. Crusher stops during operation.	Actuation of interlock circuit.	Check oil pump is rotating. • Actuation of flow switch due to lack of lubrication oil. • Check if the thermo-switch of lubrication return oil is working correctly.	• Reset and start the oil pump. • Check the condition of relief valve, lubrication pump, flow switches and gate valves and replace if necessary • After checking, replace faulty parts, or reset.
	Actuation of overload relay of main motor due to overload.	Check the current value during operation of main motor.	Reset and operate to conform with the specification.
	Tramp iron.	Check up and down movement of crushing head.	• Attempt to remove feed material and tramp iron by opening the discharge set. • Attempt to remove feed material and tramp iron from above. • Loosen the set bolts of top and bottom frames to make top frame loose. After that, bring down the mantle and discharge tramp iron.
	Horizontal shaft bearing is damaged.	• Check temperature of horizontal shaft bearing assembly. • Drain horizontal shaft lubrication oil and check for the presence of metallic particles	Disassemble, inspect repair / replace bearing.
	Outer eccentric bush seized.	• Check for high temperature of lubrication return oil. • Check whether metal particles are present in the strainers. • Check whether there is a rising trend of the no-load current.	Disassemble, inspect, repair / replace outer eccentric bush.

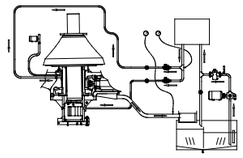
PROBLEM	PROBABLE CAUSE	CHECKS	REMEDY
4. Occurrences of abnormal noises			
❑ **Abnormal noise is heard near the spherical bearing. It is often accompanied by abnormal vibration. (Tat-tat-tat....).**	Spherical bearing is overloaded because lumps larger than specified are fed.	Check feed size.	Adjust the pre-processing so that the feed size is in accordance with the specification.
	Spherical bearing is worn.	Measure the clearances.	If the bearing wear is greater than the limit specified, replace.
❑ **Abnormal noise is heard near the horizontal shaft bearing. It is accompanied by heating. (Crunching or grating noise)**	Bearing is worn.	Measure the temperature of the bearing. 70°C Max. Drain the oil through the drain plug and check for the presence of metallic or dust particles.	Disassemble, inspect, repair / replace the bearing.
	Oil shortage	Check if the oil level is correct.	Fill with specified oil to the correct level.
❑ **Metallic sound is heard together with crushing sound. (Clanging sound)**	Head Nut and mantle are loose.	Check if the rotational direction of the horizontal shaft is correct.	Correct the rotational direction.
		Check if the knock pin is broken.	Remove the broken knock pin and replace.
		Check if the backing material inside the mantle is missing. Also check the clearance between the main shaft and inner bush.	Disassemble the mantle, inject new backing material tighten with the head nut.
❑ **Unusual sound is emitted from around concave.**	Set bolts of concave are loose.	Check set bolts.	Re-tighten if necessary.

TROUBLE SHOOTING

PROBLEM	PROBABLE CAUSE	CHECKS	REMEDY
❑ **Gear meshing noise is loud. (Ding-Dong)**	Too much backlash.	Check the backlash	Adjust the backlash
	Loosening of pinion and holder plate.	Disassemble and check the horizontal shaft assembly.	After disassembling and checking, re-tighten the bolts.
	Oil temperature is too low.	Check the oil temperature with a thermometer.	Heat the lubricating oil with the heater. Normal operation should be done at 30°C or higher.
❑ **Abnormal noise is heard from step bearing in hydraulic cylinder. Periodic sound with same frequency as main shaft revolutions. Relatively light sound. (Rap, Rap).**	Contact between step bearing and ram head	Check if metallic particles are present in the return strainer.	If the noise gradually increases, disassemble, inspect, repair / replace.
	Spherical surface of the main shaft step bearing is deformed and the center of motion of the step bearing has shifted.	Compare the sound cycle with the main shaft revolutions	If the noise gradually increases, disassemble, inspect, repair / replace.
5. Discharge set widens.	Oil leaks from hydraulic piping.	Carefully check flange assembly and the parts, which are likely to have contact with feed material.	Where oil leaks from flange assembly are evident, replace "O" rings. Provide a protector for the part that is likely to have contact with feed material.
	V-packing is worn or damaged in ram assembly.	Check oil level gauge of lubricating oil tank whether oil level has increased.	After disassembling, replace V-packing.
	Air in hydraulic piping.	When the crusher is loaded, setting deviates by more than 2 ~ 3 mm.	Vent the air through bleeder attached to the lower part of hydraulic cylinder and the lower part of balance cylinder.

PROBLEM	PROBABLE CAUSE	CHECKS	REMEDY
6. A large quantity of metallic particles (bronze lead and gear steel) is present on the return strainer of the lubrication unit. ❑ **Probably seizure of inner or outer eccentric bush or both if bronze lead is present.**	Overload	Check the current value of main motor	Correct the feed size, feed quantity and discharge set, in conformance with the specification.
	Deterioration of lubrication oil.	Compare the colour, foaming, and odour of lubrication oil with that of new oil.	Change oil every 4-6 months.
	Lubricating oil insufficient.	Check the indication of flow meter.	Restore flow
❑ **Gear is worn out or broken if gear steel is present.**	Insufficient cooling of lubrication oil.	Check temperature of feed oil.	• Lower the cooling waters temperature or increase water quantity. • Clean coolers inside and outside to restore efficiency
	Faulty interlock circuit.	Check interlock circuit.	Repair interlock circuit.
7. Product size is too large.	The discharge set does not conform to the specification.	Carry out manual measurement of closed side setting.	Adjust the discharge set.
	Uneven wear of concave.	Measure the profiles of the concave and mantle.	Change feed distribution.

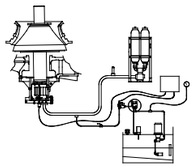
PROBLEM	PROBABLE CAUSE	CHECKS	REMEDY
8. Discharge set can not be adjusted.	Feed material or tramp iron remains in crushing chamber.	Check the crushing chamber from the top.	Remove raw stones or tramp iron.
	Inner eccentric bush seized.	• Check for high temperature of lubrication return oil. • Check if metal particles are present in the strainers of the lubrication unit.	• Mantle rotation during no-load operation is too fast (50 rpm or more), but if raw stone can be crushed, feed slowly and observe the condition. • If the problem cannot be remedied by above, halt the operation for a while, feed 2 or 3 lumps of stone and carry out inching operation of motor. If the above fails, seizure of inner bushing is likely. Disassemble, inspect, repair / replace. NOTE: Running in procedure must be followed.
	The procedure for adjusting discharge set is not followed correctly.	See procedure.	Reset.
	Leakage from hydraulic piping system.	Carefully check flange assembly and the parts that are likely to have contact with feed material.	1. Where oil leaks from flange assembly are evident, replace "O" rings. 2. Provide a protector for the part which is likely to have contact with feed material
9. Mantle and concave are cracked.	Mantle and concave have reached their wear limit.	Check the clearance between head nut and lower part of spherical bearing housing. ("H" dimension.)	Replace mantle and concave.
	Tramp iron.	Check the surfaces of mantle and concave for marks / indentations.	Provide a magnetic separator/ metal detector on feed conveyor.



LUBRICATION SYSTEM.

PROBLEM	PROBABLE CAUSE	CHECKS	REMEDY
1. Lubrication oil does not circulate.	Pump rotates in reverse direction.	Check the rotational direction.	Change the rotational direction.
	Oil strainer on feed side is blocked	• Take readings at flow meters. • Discharge pressure is higher than set value (10 bar).	Clean strainer.
	Air gains entry through suction side.	• Check oil level in oil tank. • Check piping and seals.	• Replenish oil tank. • Replace or repair pipework. • Replace packing.
	Gear pump is worn.	• Discharge pressure drops. • Take readings at flow meters. • Operation sound increases.	Replace pump.
2. Operation of pump noisy	Oil temperature is too low.	Check oil temperature in tank (30°C - 35°C).	Activate the oil heater.
	Pump relief valve is actuated due to blocking-up of oil strainer.	Check discharge pressure gauge.	Clean oil strainer.
	Air gains entry through suction side.	• Check if noise is emitted from around relief value. • Check pressure gauge and pointer of flow meter for deflection.	Inspect repair / replace piping and or seals
	Air bubbles are present in oil.	Check if oil quality has deteriorated.	Change oil if necessary.
	Misalignment of pump and motor.	Check coupling.	Correct misalignment.
	Wear of gear and bearing of pump.	• Listen to the operation sound. • Heat build up in bearing assembly.	Inspect repair / replace pump.

PROBLEM	PROBABLE CAUSE	CHECKS	REMEDY
3. Dust enters into lubrication oil.	Dust ring has worn out.	Check the degree of wear. (Max 5m/m.)	Replace dust ring as soon as possible.
	Air blower is faulty.	• Check electrical circuit. • Check mechanical condition of blower. • Check blower air filter. • Check blowerair supply rate.	• Restore circuit. • Replace blower parts. • Replace blower. • Clean filter. • Replace filter element. • Adjust flow rate.
4. Large fluctuation of pointer of flow meter (± over 10l/min)	Suction of air due to shortage of oil in oil tank.	Check oil level with the oil level gauge.	Replenish to the specified level.
	Clogging of strainer	Check discharge pressure with the pressure gauge. Compare pressure with that for normal operation.	Clean strainer.
	Life of gear pump exceeded.	Compare flow rate as when new	If the discharge is under 90% of when new, replace pump.
	Pipe work damaged.	Check pipe work.	Check and tighten the connections of pipes and hoses.
5. High return oil temperature. (55˚C or above)	Insufficient cooling of lubrication oil.	Check temperature of oil leaving cooler. (Both air/oil and water / oil coolers).	Increase cooling water flow. When using circulating water, cool the water with a cooling tower, or similar device.
	Scale on inside of cooler (water side).	Check fouling after removing bonnets on both sides of cooler.	Disassemble and clean.
	Excessively high set value of thermostat for the oil heater, or an oil heater always on due to failure or thermostat.	Measured value should be 35˚C or below. Check with thermometer.	Check setting. Replace the thermostat if faulty.
	Dirty air/oil coolers due to dust on core.	• Visual inspection. • Check temperature difference between oil inlet and oil outlet and compare with normal condition.	Clean coolers with compressed air or wash with high-pressure water jet.
	Over load in crusher.	Check whether load exceeds rated value or not.	Adjust the discharge set and feed rate to specification, maintain the current within the specified range for the motor.



HYDRAULIC SYSTEM.

PROBLEM	PROBABLE CAUSE	CHECKS	REMEDY
1. The mantle does not elevate when the button is pressed.	The pump rotates in reverse.	Check rotational direction.	Correct the rotation.
	The stop valve is closed.	Check the stop valve in hydraulic unit.	Open the stop valve.
	There is no oil in the hydraulic tank (Suction of air)	Check the oil level in hydraulic tank.	Fill oil tank to the specified volume. Vent the air through the air bleeder on the underside of hydraulic cylinder and at the lower part of the accumulators.
	The set pressure of the relief valve is low.	Is the pressure when elevating the mantle higher than normal?	• Adjust the pressure to obtain the specified value by adjusting the relief value screw. • Disassemble, inspect, repair / replace.
	Hydraulic cylinder ram or inner eccentric bush seized	• Check for high temperature of lubrication return oil. • Check if metal particles are present in the strainers of lubrication unit.	1. Mantle rotation during no-load operation is too fast (50 rpm or more), but if raw stone can be crushed, feed slowly and observe the condition. 2. If the problem cannot be remedied by above, halt the operation for a while, feed 2 or 3 lumps of stone and carry out inching operation of motor. If the problem persists, seizure of inner bushing is likely. Disassemble, inspect repair / replace. NOTE: Running in procedure must be followed.
	Material left in crusher.	Visually, check from above.	• Bring the crushing head down to its lowest position. • Dislodge feed material by moving the crushing head up and down. • “Inch” the crusher to discharge feed material. • Remove feed material from above.
	Tramp iron in crusher	Visually check from above	When tramp iron or the like is present, cut it out using Oxy/acetylene, or discharge it by loosening top frame. EXTREME CAUTION MUST BE EXERCISED

PROBLEM	PROBABLE CAUSE	CHECKS	REMEDY
2. The oil level of the tank rises during operation (At the same time, the discharge set widens, and the particle size of the product increases.)	Failure of lift/shut off valve.	Check for level rise at oil level gauge.	Inspect, repair / replace the valve.
3. The mantle does not lower or lowers slowly	The stop valve is closed.	Check the stop valve.	Open the stop valve.
	Hydraulic cylinder ram or inner eccentric bush seized.	The lowering speed of the mantle is slower than normal.	Replace the bush.
	Failure of solenoid valve.	Check lowering speed using indicator or by visual observation.	Check the wiring, if correct replace the solenoid valve.
4. The slow return check valve becomes hot. ❑ **Accumulators actuating too often.**	Nitrogen gas pressure of accumulator is low.	Check by means of 3-way valve.	Replenish nitrogen gas to the prescribed pressure.
	Feeding of raw stone is not uniform.	Visually check through feed opening.	Reset rotary feed chute.
	Raw stone feed rate is too high.	Measure the capacity on product conveyor.	Correct the capacity so as to conform to the specifications.
	Discharge set is too small.	Check discharge set or carry out actual measurement.	Correct the discharge setting so as to conform to the specification.
	Due to high content of fine grains and high content of moisture, packing occurs in crushing chamber.	Check for cause of packing on supply conveyor.	Remove fine material before crushing.
5. Pump discharge pressure does not rise.	Air gains entry on suction side.	• Check piping and seals. • Check oil level in oil tank.	• Replace piping and or seals. • Fill oil tank to specified level.
	Hydraulic pump rotates in reverse direction.	Check the rotational direction of pump.	Change the rotational direction.

TROUBLE SHOOTING

PROBLEM	PROBABLE CAUSE	CHECKS	REMEDY
	The set pressure of lift valve is too low.	Close the stop valve of hydraulic system, activate the hydraulic pump, and check discharge pressure.	Set the relief valve
6. Solenoid valve does not work.	Disconnected or inadequate contact.	Using a tester: • Check for current • Check the contacts in operation panel.	• Repair the wiring. • Replace contactor.
	Seizure of solenoid in solenoid valve.	Push the spool directly with a thin rod from the end of the solenoid of lift valve, and activate the hydraulic oil pump and check whether crushing head can move up and down.	Replace solenoid valve or solenoid.
7. During operation, product size becomes suddenly coarse, and during no-load operation of machine, the discharge set becomes narrower (or zero in the extreme case).	Bladder in accumulator is damaged and nitrogen gas has entered into hydraulic system.	Check the gas pressure in the accumulators.	Replace the bladder of accumulator.
		Check for air in the hydraulic cylinder and the accumulator.	Vent the air through air bleeder attached to the lower part of hydraulic cylinder and the lower part of accumulator.

OIL AND GREASE CHANGING FREQUENCY AND PROCEDURE

Contents:

1 GENERAL

This section describes the lubrication and hydraulic oils and grease renewal frequencies and procedures. In the case of this crusher, normal running depends on the state of lubrication. If the crusher runs without supplying the required quantity or without using proper oil, it will lead to accidents and/or seizure of inner and outer bushes, spherical bearings, ect.

Since lubrication oil and grease inevitably deteriorates over time, it shall be changed on a regular basis.

A table of oils and greases appear at the end of this section.

IMPORTANT

In certain applications and environmental conditions it may be necessary to use a lubrication oil of less or more viscosity. Refer to the data sheet at the front of this manual for information on your machine. If in doubt, consult with IMS Engineering.

2. HORIZONTAL SHAFT (LUBRICATION OIL)

(Fig 8.1)

2.1 REPLACEMENT FREQUENCY

Change oil after the initial 3 months or 800 hours. From the second time onward, the oil shall be replaced every 6 months or at 1500 hour intervals.

NOTE:
Initial change refers to the change at the time of delivery or the first change after replacement of inner and outer bushings, etc.

2.2 PROCEDURE FOR REPLACEMENT

1. Discharge the oil by removing the plug and rubber overflow pipe. Drain the oil.
2. Replace drain plug and overflow.
3. Remove the air breather of horizontal shaft and replenish the oil up to the normal level.

3. SPHERICAL BEARING (GREASE)

(Fig. 8.2)

3.1 REPLACEMENT FREQUENCY

Replenish grease daily and replace the whole amount once a year.

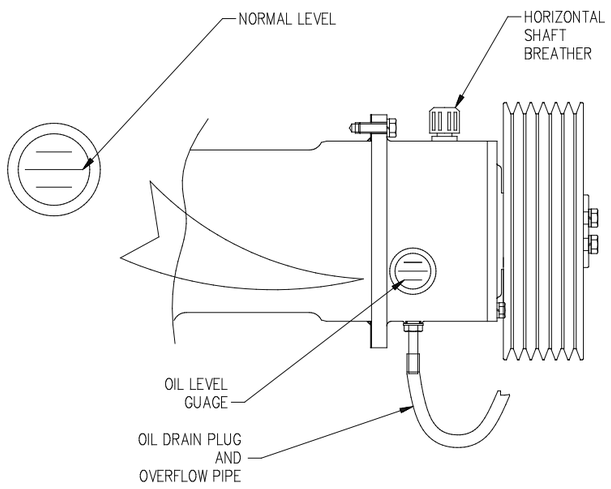


Fig. 8.1

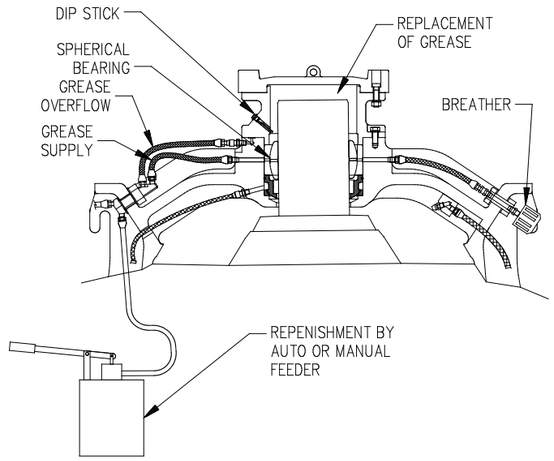


Fig. 8.2

3.2 PROCEDURE FOR REPLACEMENT

The spherical bearing grease should be replenished daily by automatic feeder or manual feeder. The feeder system should be checked at regular intervals.

Replacement of the grease should be planned for during a maintenance shut down and in this way save time, i.e. while replacing the mantle and concave liners.

IMPORTANT

THOROUGHLY CLEAN ALL COMPONENTS BEFORE REASSEMBLY.

NOTE:
SOME MACHINES ARE NOT FITTED WITH BREATHER AND OVERFLOW HOSES, BUT THE PROCEDURE REMAINS THE SAME.

4. LUBRICATION AND HYDRAULIC UNIT

(Fig. 8.3)

4.1 REPLACEMENT FREQUENCY

1. Change lubrication oil after the initial 3 months or 800 hours. After the second time onward, change the oil every 6 months or at 1500 hours intervals.
   NOTE:
   Initial change refers to the change at the time of delivery or the first change after replacement of inner and outer bushings, etc.
2. Change the hydraulic oil once a year or every 3000 hours.

4.2 PROCEDURE FOR REPLACEMENT

1. Drain the old oil through the oil draining valves.
2. Ensure that the tank is properly clean by removing the inspection cover(s) and cleaning thoroughly
3. Fill the lubrication oil tank through the filler/breather or the through the return strainer box.
4. Fill the hydraulic oil tank through the filler/breather.

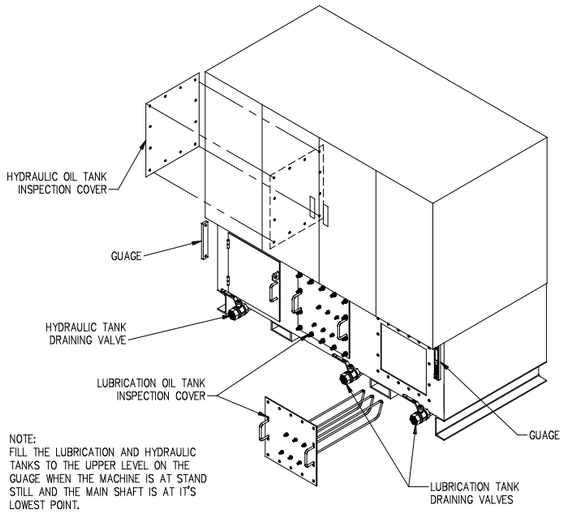


Fig. 8.3

5. TABLE OF LUBRICANTS AND HYDRAULIC OILS

5.1 MANUFACTURER EQUIVALENTS

The alternate listed below is for environmental conditions where an oil of less viscosity is required. (see the Data Sheet at the front of the manual)

	ENGEN	SHELL	MOBIL	BP	CASTROL
LUBRICATION OIL	GENGEAR 150	SHELL OMALA 150	MOBIL GEAR 629	BP ENERGOL GR-XP 150	ALPHA SP 150
ALTERNATE	GENGEAR 100	SHELL OMALA 100	MOBIL GEAR 627	BP ENERGOL GR-XP 100	ALPHA SP 100
HORIZONTAL SHAFT OIL	GENGEAR 150	SHELL OMALA 150	MOBIL GEAR 629	BP ENERGOL GR-XP 150	ALPHA SP 150
ALTERNATE	GENGEAR 100	SHELL OMALA 100	MOBIL GEAR 627	BP ENERGOL GR-XP 100	ALPHA SP 100
HYDRAULIC OIL	TURBINE 68	TURBO 68	MOBIL DTE HEAVY MEDIUM	BP HLP 68	PERFECTO T68
SPHERICAL BEARING GREASE	GENLITE 0	SHELL ALVANIA WR 0	MOBILUX EP 0	BP ENERGREASE MM-EP 0	LONGTIME PD 0

OIL AND GREASE CHANGING FREQUENCY AND PROCEDURE

5.2 CAPACITIES:

	LOCATION			
MACHINE TYPE	**HORIZONTAL SHAFT**	**LUBRICATION OIL TANK**	**HYDRAULIC OIL TANK**	**SPHERICAL BEARING**
Ø 800	Approx. 0.3 gal	80 gal	8.5 gal	0.5 gal
Ø 1000	Approx. 0.75 gal	132 gal	15 gal	1.6 gal
Ø 1200	Approx. 1 gal	132 gal	15 gal	1.6 gal
Ø 1350	Approx. 1.3 gal	158 gal	24 gal	2.4 gal
Ø 1500	Approx. 1.6 gal	158 gal	24 gal	3.2 gal
Ø 1800	Approx. 4 gal	211 gal	47 gal	5 gal

OIL AND GREASE CHANGING FREQUENCY AND PROCEDURE

NOTES:

CRUSHER CHECK LISTS

Contents:

NOTE

The following important note has a direct bearing on the accumulators supplied with every Kawasaki Cone Crusher. Procedures shall be put in place by the end user so that the following is adhered to and followed according to South African law. Where the machine is used outside the borders of South Africa the regulations of that country shall apply.

PRESSURE VESSELS INSPECTION IN TERMS OF VESSELS UNDER PRESSURE REGULATIONS OF THE OHS [Occupational Health and Safety] ACT No. 85 OF 1993 AND MINERALS ACT No. 50 OF 1991 AS AMENDED.

CRUSHER CHECK LISTS.

NOTE

ALL FASTENERS SHOULD BE RE-TORQUED DURING TEST OPERATION AND 50 HOURS AFTER ANY MAINTENANCE HAS TAKEN PLACE.

IMPORTANT

1. ALWAYS TORQUE BOLTS IN A SEQUENCE TO ENSURE UNIFORMITY OF FITMENT.
2. IF ONE OR MORE BOLTS BECOME LOOSE OR BREAK DURING OPERATION, FIRST LOOSEN THE SET OF BOLTS, REPLACE WHERE NECESSARY AND RE-TORQUE AS IN 1 ABOVE.

1. DAILY CHECKS

1.1 CRUSHER

	Check	Check Procedure	Corrective Action
CD 1	State of feed material	Is feed evenly distributed around circumference.	Check all wheels and recentre the rotary feeder.
CD 2	Is discharge gap set according to specification.	Gap readout or manually measure physical gap.	Adjust.
CD 3	Is mantle revolutions abnormally fast. i.e. Should be less than 50 rpm.	Visually check through top opening. (Lube oil must be more than 30°C.)	Rotation of main shaft is faster than before, but if feed material is charged and rotation stops, making it possible to crush, the cause may be either viscous resistance due to low temperature of lubricating oil or light seizure of inner bushing. 1. If oil temperature is low, heat oil and wait and see if rotational speed drops. 2. If no change is observed despite step 1 being taken, slowly charge feed material and observe. 3. If feed material cannot be nipped in, stop the motor at once, charge 2 or 3 lumps and turn the motor on and off. If rotation stops, charge feed material slowly and observe the result. 4. If rotation does not stop despite step 3 being taken, disassemble immediately and after checking the state of seizure of inner bushing, repair or replace it. **(The manufacturer must be informed of this problem as soon as possible.)**

	Check	Check Procedure	Corrective Action
CD 4	Oil level in the horizontal shaft.	Oil level must be between the limits indicated on sight glass at side of horizontal shaft.	Replenish if necessary.
CD 5	Oil leakage at horizontal shaft.	Visual signs of oil around shaft and pulley.	1. Reduce oil level if it is high and monitor. 2. Replace oil seal if damaged.
CD 6	Monitor sound, vibration and temperature of horizontal shaft during operation.	Make use of a stethoscope, temperature gauge and hand touch to monitor and compare to previous readings.	1. Check oil level. 2. If a condition worsens, check for metal particles in the oil. 3. Remove the assembly from crusher, check and replace damaged components.
CD 7	Concave and concave bolts.	Listen to the crushing sound. Visually check concave and bolts. Hand feel the concave fasteners.	Tighten loose fasteners.
CD 8	Gear meshing sound. (During operation)	Monitor the sound and be aware of changes.	1. Check the lubrication oil flow rate and temperature. 2. Check and adjust gear backlash.
CD 9	All frame mounting bolts and foundation bolts.	Check for wear and loosening.	Re-torque and replace if necessary.
CD 10	Drive mountings and couplings.	Visually check for loosening of bolts	Re-tighten and check alignment.

CRUSHER CHECK LISTS

1.2 LUBRICATION UNIT

	Check	Check Procedure	Corrective Action
LD 1	Lubrication oil supply strainers.	Remove strainer basket and check for foreign particles. Monitor the amount daily.	Clean and replace the basket
LD 2	Return oil strainer.	Check for clogging. Monitor metal particles daily.	Remove strainer and wash.
LD 3	Supply oil flow rate.	1. Check the flow meters that rate lies between the limits. 2. Check if the pump relief valve is actuating.	1. Adjust flow by manipulating the valves. 2. Replace flow meter if defective. 3. Clear strainer and pipes for clogging. 4. Replace oil pump if defective.
LD 4	Feed oil temperature.	Temperature gauge in lube unit.	Ensure cooling systems are clean and in proper working order.
LD 5	Return oil flow rate.	Monitor the flow at the return strainer and compare to the normal.	1. Check and repair any leaks in the piping. 2. Check that supply flow is correct.
LD 6	Feed pressure.	Monitor pressure gauge.	Clean supply strainers.
LD 7	Return oil temperature.	Check the return oil temperature gauge.(is temperature excessively high)	1. Is lubrication oil level correct. 2. Is supply rate correct. 3. Are the cooling systems operative. 4. Check and replace the heater thermostat if necessary. 5. Is the crusher being over loaded. 6. Seizure of inner or outer bush may be taking place.
LD 8	Oil level.	Monitor oil level gauge on side of tank. **Note: A dropping oil level is usually a sign of oil leaks.**	Replenish if necessary.

	Check	Check Procedure	Corrective Action
LD 9	Air blast coolers.	1. Check if there is a drop in oil temperature after the cooler. 2. Check that cooler interlocks are functional.	1. Blow or wash dust from cooler fins. 2. Confirm set points.
LD 10	Lubrication oil pump	Visual and audible monitoring of oil leaking and abnormal noise.	1. Is oil temperature correct. 2. Tighten or replace gland. 3. Re-tighten suction pipe. 4. Disassemble and refurbish. 5. Replace the pump.
LD 11	Oil heater and thermostat.	1. Check that oil level is above heater element. 2. Check that thermostat interlocks are functional.	1. Replenish oil. 2. Confirm set points.
LD 12	Vortex blower.	Check that blower is functional and that over pressure is correct.	Adjust by opening or closing the relief gate valve.
LD 13	Contamination of oil.	Compare with new oil.	Check transparency, presence of solids and moisture content. (Use following table as guide line)

	Appearance	Smell	State	Corrective action
1	Transparent and not discoloured.	Good	Good	Use as it is.
2	Transparent but light colour.	Good	Different type of oil is mixed in with the lube oil.	Check viscosity, if within specification, use as is.
3	Colour is milky white.	Good	Air bubbles and moisture is present.	Separate moisture from oil (send to manufacturer), or replace with new oil.
4	Colour is dark brown.	Bad	Deteriorated by oxidation.	Replace oil
5	Transparent, but small foreign particles are present.	Good	Foreign particles are due to wear and tear of crusher components.	Use after filtration, or replace with new oil. Repair worn parts.

CRUSHER CHECK LISTS

1.3 HYDRAULIC SYSTEM

	Check	Check Procedure	Corrective Action
HD 1	Discharge gap setting.	Compare GY sensor setting against hydraulic oil tank level indicator.	Carry out calibration and reset discharge gap.
HD 2	Accumulators.	1. Check for correct pressure 2. Visual check for oil leaks in hydraulic line. 3. Listen for abnormal noise during operation.	1. Reset to correct pressure. 2. Repair any oil leaks immediately. 3. Ascertain the source of the abnormal noise and repair if necessary.
HD 3	Hydraulic pump.	1. Listen for abnormal noise during operation. 2. Test that discharge pressure is sufficient.	1. Check that relief valve setting is correct. 2. Repair or replace
HD 4	Pressure gauge.	Verify that pressure indicates zero during shutdown.	Replace.
HD 5	Relief valve.	Monitor the flow at the return strainer and compare to the normal.	1. Reset. 2. Replace.
HD 6	Oil level.	Monitor oil level gauge on side of tank. **Note: A dropping oil level is usually a sign of oil leaks.**	Replenish if necessary.
HD 7	Lift valve.	Check operation by lifting and lowering the mantle. (Mantle movement must be smooth and steady)	1. Open shut off valve 2. Repair any leaks. 3. Reset relief valve at 20 bar. 4. Replace the lift valve.
HD 8	Shutoff valve.	1. Check for leaks during crusher operation. 2. Check that crusher maintains discharge gap before and after operation.	Repair or replace.

2. WEEKLY CHECKS

2.1 CRUSHER

	Check	Check Procedure	Corrective Action
CW 1	Rotary feeder.	Visually check all wheels for wear and alignment.	1. Repair. 2. Replace.
CW 2	Oil seal and scraper at spherical bearing housing.	Visually check for signs of oil or grease of abnormal proportions.	Replace seals and scrapers.
CW 3	Accumulation of dust at the dust collar flange and bottom frame arm liners.	Is the accumulation of dust affecting the operation of the dust seal and/or interfering with the dust seal cover mounting bolts.	Remove all deposits and clean.
CW 4	Oil leaks and mounting bolts at dust collar flange	Visual and monitor lube oil level	Tighten bolts to specified torque and/or replace seal.
CW 5	Oil leaks from hydraulic cylinder lubrication inlet	Visual and monitor lube oil level	Tighten bolts to specified torque and/or replace seal.
CW 6	Oil leaks and mounting bolts at hydraulic cylinder bottom flange	Visual and monitor hydraulic oil level	Tighten bolts to specified torque and/or replace seal.
CW 7	Oil leaks and mounting bolts at hydraulic cylinder top flange	Visual and monitor hydraulic oil level	Tighten bolts to specified torque and/or replace seal.
CW 8	Oil leaks from hydraulic cylinder	Monitor oil levels - i.e. more than 3mm per day.	Check whether oil is leaking from hydraulic piping (In particular, check for any damage to piping caused by falling of feed material). If there is no problem, the cause may be the wear of the V packing in the hydraulic cylinder. Replace the V packing.
CW 9	Dust-ring cover mounting bolts.	Visually check for wear and tightness.	Replace if necessary and retorque.
CW 10	Water spray system	1. Check all pipes for leaks. 2. Check water jackets for leaks. 3. Check piping and nozzles under the top frame arms.	1. Repair. 2. Replace.
CW 11	Spherical bearing.	1. Remove dipstick and visually check for correct level and contamination. 2. Visually check all grease lines and feed rates.	1. Replenish grease if level is low. 2. Replace grease if contaminated. 3. Replace pipes if damaged.

CRUSHER CHECK LISTS

3. MONTHLY CHECKS

3.1 CRUSHER

	Check	Check Procedure	Corrective Action
CM 1	Top frame cap cover.	1. Visually check for abnormal wear. 2. Measure frill height.	Replace when frill height reaches the bolt head. (see also Part Replacement section)
CM 2	Wear of liners.	Visually check that liner is not worn through.	Repair or plan to replace during next disassembly..
CM 3	Wear of mantle and concave.	Visually check for cracks and record the H-dimension.	Replace when the value exceeds wear specification. (see also Part Replacement section)
CM 4	Wear of dust ring.	Measure for wear.	Replace when the value exceeds wear specification. (see also Part Replacement section)
CM 5	Head nut, head nut protector and torch ring.	Check for excessive wear and looseness.	(See Part Replacement section)
CM 6	Horizontal shaft lubrication oil.	Level and contamination.	Replenish or replace. **Note: Lube oil must be replaced after first 3 months of operation and there after every 6 months.**

4. QUARTERLY CHECKS

4.1 CRUSHER

	Check	Check Procedure	Corrective Action
C3M 1	Wear of spherical bearing.	Calculate the sum of the measured clearances between main shaft and inner and outer races.	Replace when the value exceeds wear specification. (see also Part Replacement section)

4.2 LUBRICATION AND HYDRAULIC

	Check	Check Procedure	Corrective Action
L3M 1	Lubrication oil.	Send oil samples for analysis.	Replace if necessary. Note: Lube oil must be replaced after first 3 months of operation and there after every 6 months

5. CHECKS DURING DISASSEMBLY

5.1 CRUSHER

	Check	Check Procedure	Corrective Action
CR 1	Top frame arm and rim liner retaining mechanisms.	Visually check for excessive wear and failure.	Replace if necessary.
CR 2	Outer bushing.	1. Check for discolouring, excessive wear indications (seizure) and cracks. 2. Measure clearance to eccentric sleeve 3. Measure bush and compare to spec.	Replace if necessary.
CR 3	Inner bushing.	1. Check for discolouring, excessive wear indications (seizure) and cracks. 2. Measure clearance to main shaft. 3. Measure bush and compare to spec.	Replace if necessary.
CR 4	All liners.	Excessive wear.	Replace if necessary.
CR 5	Gear and pinion.	1. Meshing sound. 2. Wear on contacting faces. 3. Backlash.	Replace if necessary.
CR 6	Eccentric sleeve.	Visually check condition of sliding surfaces	1. Repair with fine water paper and oil stone. 2. Replace if necessary.
CR 7	Main shaft step.	1. Visually check for scoring. 2. Measure for wear limit. (see also Part Replacement section)	Replace if necessary.
CR 8	Thrust bearing	Visually check for scoring.	Repair or replace if necessary.
CR 9	GY sensor protection.	Check for wear and damage.	Replace if necessary.
CR 10	Vee ring on pinion side of horizontal shaft.	Check for leaks.	Replace if necessary.

CRUSHER CHECK LISTS

	Check	Check Procedure	Corrective Action
CR 11	Main shaft sleeve.	1. Visually check for excessive wear. 2. Measure and compare to spec.	Replace if necessary.
CR 12	Main shaft.	1. Visually check for excessive wear. 2. Measure and compare to spec. 3. Measure the wear deformation under the load carrying surfaces under the mantle.	1. Remove all blemishes and scratches from bearing surfaces. 2. If the wear deformation is more than 4mm, re-machining must take place.
CR 13	Rotary feeder tyres and bearings.	Strip, clean and check all bearings and bearing housings. Check tyres for excessive wear.	1. Regrease and reassemble. 2. Repair and/or replace defective parts.

5.2 LUBRICATION AND HYDRAULIC

	Check	Check Procedure	Corrective Action
LHR 1	Piping.	Visually check all piping and piping protection.	Replace when the value exceeds wear specification. (see also Part Replacement section)
LHR 2	Relief valve	Check that relief action takes place at specified pressure.	1. Recalibrate. 2. Replace if necessary.

NOTES:

CRUSHER CHECK LISTS

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TECHNICAL BULLETINS AND MODIFICATION RECORDS

Contents:

DOCUMENT TITLE OR REF. NO.	REMARKS

TECHNICAL BULLETINS AND MODIFICATION RECORDS

NOTES:

TECHNICAL BULLETINS AND MODIFICATION RECORDS

TECHNICAL BULLETINS AND MODIFICATION RECORDS

TECHNICAL BULLETINS AND MODIFICATION RECORDS

TECHNICAL BULLETINS AND MODIFICATION RECORDS

CRUSHER CONTROL DIAGRAMS

Contents:

CRUSHER CONTROL DIAGRAMS