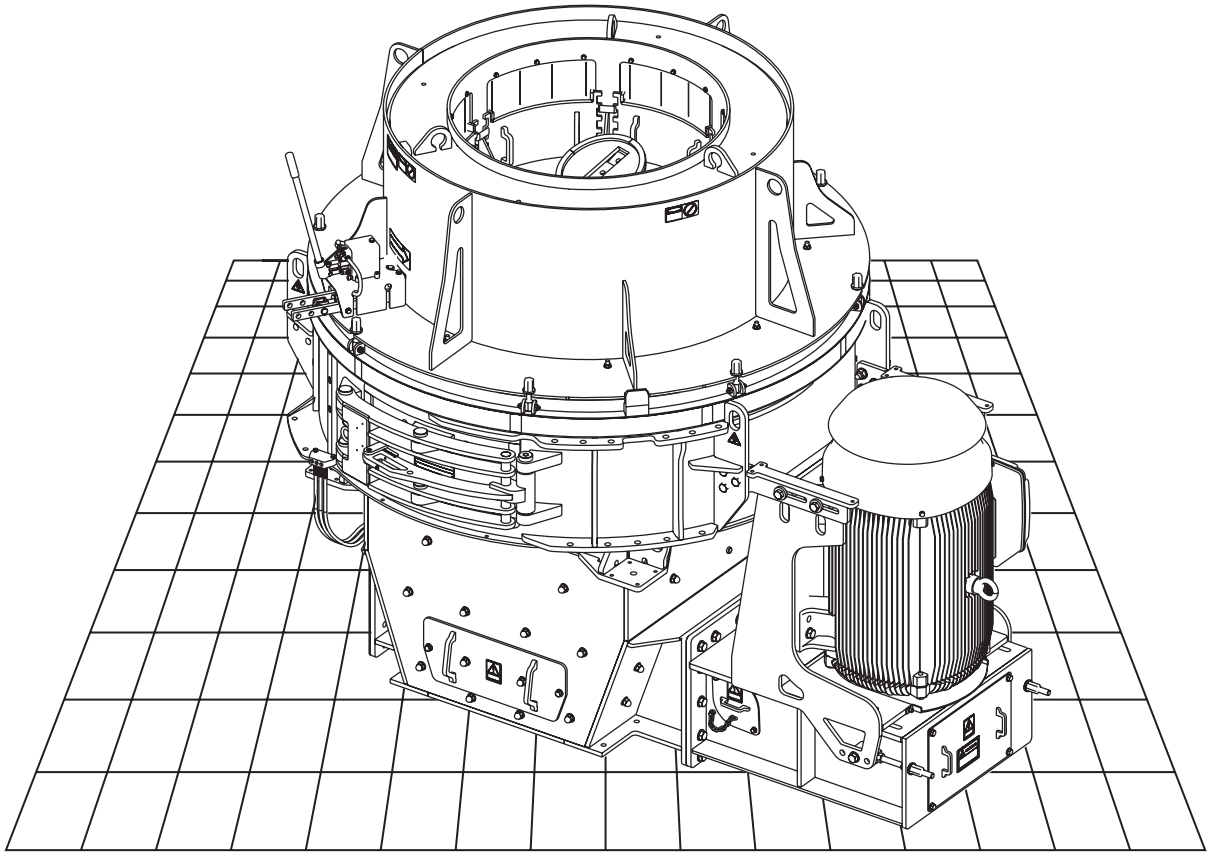
Barmac B1100 Series VSI Crusher

OPERATION & MAINTENANCE MANUAL



Suits models B9100SE, B7160SE, B7150SE, B6150SE, B5100SE, B3100SE

metso minerals

Barmac B1100 Series VSI Crusher

Manufacture and design of the Barmac B1100 Series VSI crusher is carried out under quality control systems certified to ISO 9001. Distributed worldwide under the following granted and pending patents and design applications:

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AFTER SALES CONTACTS
(PLEASE QUOTE MACHINE SERIAL NO.)

Spare Parts		Service	
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Representative:

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SAFETY DURING MAINTENANCE AND REPAIR

INTRODUCTION

SECTION 1

1.1 General

This manual, together with specific instruction manuals for individual equipment, has been prepared by Metso Minerals Crushing and Screening Business Line to increase the knowledge and awareness of all persons involved in the operation, supervision, service and maintenance of crushing and screening equipment with regard to safety and operations. A copy of this manual must be provided to and studied by each person entering the machine areas of the Crushing Plant, or otherwise involved in the operation of the Crushing Plant. It is the responsibility of the Owner to always keep this manual and other written instructions either in the Crushing Plant or its vicinity for Operator reference.

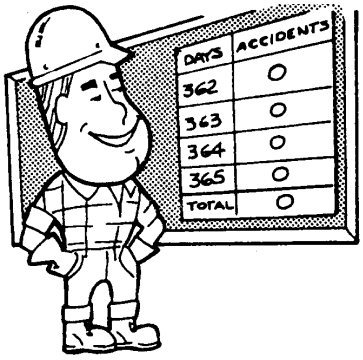
Knowledge of the machines and the potential hazards they present are essential to a safe workplace. Knowledge of and compliance with all state, provincial, and federal safety laws, safety regulations, and Crushing Plant safety procedures, warnings and instructions also are essential to a safe workplace. Failure to do so can result in serious injury or death.

When in doubt - don't! Never bypass instructions or procedures to save time. Never place foreign items, tools, rods, or any part of your body into an operating machine. Never reach over, around or beyond safety devices. Never operate a machine if safety devices are missing or disabled. Never replace an OEM safety device with a non-OEM device.

Never service equipment until all potentially moving parts are secured and power has been locked out and tagged out to prevent unexpected movement.

The Operator is responsible for using care and common sense at all times.

Remember, safety is everyone's business. You are responsible not only for your safety, but for the safety of those around you.



Please read this manual carefully. Know its contents. If you have any questions, contact your Metso Minerals representative without delay for advice. Keep in mind that there are different types of risks, hazards and injury types (see Section 2.3 *Typical risks in Crusher Plant working environment*), which are related to each other. Foresee and prevent such risks and hazards as well as resulting injuries and other consequences from occurring by all available means. Never compromise when the question is about safety!

Metso Minerals, as the machinery manufacturer and supplier, regards safety as of the utmost importance, and deems the following as essential prerequisites to the safe operation of the Crushing Plant:

- That the Owner makes available this manual, before using the machinery, to each person involved with the operation, supervision, service, or maintenance of the Crushing Plant.
- That compliance with and adherence to this manual be mandated and supervised by the Owner.
- That all personnel involved in the operation, supervision, service, or maintenance of the Crushing Plant

become familiar with the contents of this manual prior to such involvement.

- That every person involved in the operation, supervision, service, or maintenance of the Crushing Plant be properly trained and have adequate professional skills as required for the performance of the respective tasks.
- That all visitors to the Crushing Plant be properly informed of applicable safety precautions and risks, and that safety precautions be adequately maintained and in connection with any such visits, including, but not limited to, adherence to this manual.

No changes shall be made in the operation of the machinery supplied by Metso Minerals or the contents of this manual without express written approval of Metso Minerals. All operation, service, maintenance, handling, modifications, or other use of Crushing Plant equipment and/or systems is the responsibility of the Owner. Metso Minerals shall not be liable for any injury, death, damage or cost caused by any act or omission on the part of the Owner, Operator or other personnel, agents, contractors, vendors, or others. All applicable safety rules, regulations, standards, instructions, and procedures must be complied with; as must be those of this manual as well as any other instructions, specifications, and recommendations by Metso Minerals.

This manual is based upon the safety laws, rules and regulations in effect on the date hereof. The owner and operator bear sole responsibility for complying with any amendments, additions or other changes to safety law, rules or regulations arising subsequent to the date on which this manual was drafted.

Although these instructions are intended to be as comprehensive as possible, there may be hazards that cannot be anticipated, hazards associated with a particular work-site or hazards covered by special comany safety programs. The information may also not include all practices that must be observed, such as insurance requirements or governmental regulations.

If you have questions or concerns regarding safety aspects of machinery supplied by Metso Minerals, contact us before using, operating, servicing or repairing the machinery.

IMPORTANT!

Safe operation of the machine requires alertness and safety-consciousness on the part of all operating personnel. It should be operated only by knowledgeable and trained personnel.

1.2 Definitions:

"**Crushing Plant**" means a combination or part of various equipment, components, systems and parts for crushing and/or screening of rock, minerals, recycling or other crushable materials. For the purposes of this manual, the Crushing Plant means also stand-alone crushing or screening equipment as applicable. Throughout this manual, words such as "machine", "machinery", "equipment" and "crusher" are used interchangeably to refer to the Crushing Plant and its component parts.

"**Owner**" means the entities or individuals who own or lease the Crushing Plant and/or the entities or individuals who are in charge of operating and/or servicing the Crushing Plant.

"**Operator**" means the individuals who either operate the Crushing Plant or perform actual maintenance, service, repairs, supervision or any other activity on or for it.

"This manual" means, as applicable, this general safety instructions, together with any specific instructions for individual equipment, as amended from time to time, provided by or on behalf of Metso Minerals.

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GENERAL SAFETY INSTRUCTIONS

SECTION 2

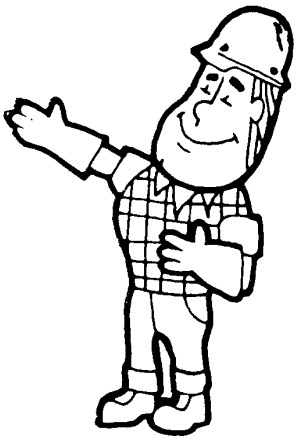
GENERAL SAFETY INSTRUCTIONS FOR A CRUSHING PLANT OR PLANT ENVIRONMENT

2.1 SAFE PRODUCTS AND THE CRUSHING PLANT

All machines require human involvement. Like any other heavy machinery, a Crushing Plant has inherent dangers that must be identified, understood and taken into account in order to avoid accidents and injuries. Metso Minerals, as machinery manufacturer and supplier, is committed to promoting safety at the Crushing Plant by providing safety devices and features, and by providing training, services, manuals and instructions.

2.2 SAFETY AND YOU

Safety is everyone's responsibility; safety is your responsibility.



Safety is the concern of all personnel. With your actions, you participate in establishing the safety of the working environment.

Metso Minerals products are designed and constructed with safety in mind. The machines incorporate high quality safety features used.

To assure safe operation, all personnel must be alert when operating or working on or around the machine. Be aware of real and potential hazards. Only properly trained personnel should operate, supervise, maintain, or service the machine.

Personnel must carefully study all aspects of the specific machine, including:

- operating instructions
- service, trouble-shooting and maintenance instructions
- automated features and motions of the machine

– specific safety features and instructions

IMPORTANT!

- If unsure of any procedure, check the operation manuals and/or contact your supervisor before proceeding.
- Follow all lockout and safety procedures before entering the machine.
- Be constantly aware of the location of each worker on or around the machine.
- Observe all safety instructions.
- Do not remove or disable any guard, safety device, sign or warning.

2.2.1 Objective

The objective of these instructions is to minimize risks and to avoid or prevent accidents and injuries. Accidents are often caused by carelessness or disregard of important instructions.

Knowledge of the machine operation and continuous safety training are necessary for a safe working environment.

Safety can be summarized in three main themes:

– MACHINE KNOWLEDGE

– SAFE OPERATION AND MAINTENANCE

– GOOD HOUSEKEEPING

2.2.2 Safety Signs, Labels And Symbols

The following symbol is used in this manual and on the machine to call attention to instructions, which will help prevent machine related injuries.

When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.

Figure 2.1 Alert Symbol

This manual uses the alert symbol, with words such as DANGER, WARNING or CAUTION, to alert you and other Crushing Plant personnel of actions or conditions that pose a potential safety hazard, with an attending risk of personal injury (including death) or property damage. The machine also displays safety signs, labels and tags at appropriate points to show safety risks that may exist.

Sign	Description
DANGER	Immediate hazards or unsafe practices that will result in severe personal injury or death.
WARNING	Hazards or unsafe practices that could result in severe personal injury or death
CAUTION	Hazards or unsafe practices that could result in minor personal injury or equipment damage

Figure 2.2 Danger, Warning, Caution Signs And Their Meaning

2.2.3 Some General Safety Instructions

1. Do not remove, cover or disable any installed safety devices, guards, warning signs or tags. They are attached to equipment to warn personnel of possible danger and prevent injury. Use OEM replacements in the event any safety devices, warning signs or tags become damaged or unreadable. Observe all instructions. Keep warnings signs and tags clean, visible and readable. (Warning signs are listed and their locations described in the machine safety instructions.)
2. Make sure that all required walkways, handrails, barriers, safety devices, and guards are in place before starting the machine. Do not use non-OEM walkways, handrails, barriers, safety devices or guards, when such items are available from OEM.
3. Keep the machine itself and the area around the machine clean and clear of obstructions. Be aware of dust, smoke or fog, which may obscure your vision.
4. Wipe up any substance, such as spilled oil, grease, water or ice, which may cause a person to slip or fall. Good housekeeping practices prevent injuries. Be a good housekeeper. Keep the machine environment and walkways clean and free from oil, grease, rags, cables, chains, buckets, rocks and other obstructions. Keep loose parts in a toolbox or return them there promptly.
5. Keep clothing and all parts of the body away from nip points and rotating or moving equipment. Be especially alert to avoid contact with parts that move intermittently.
6. Know the weight limitations of lifting devices and their loads. Never detach a lifting device from a load until the load is stable and secured from unintended movement.
7. Do not climb or stand on equipment other than in areas, which are designed for that purpose. Do not overreach.
8. Emergency-Stop buttons should be tested on a regular schedule for proper operation, as should electrical interlocks and related limit switches. Safety defects should be repaired prior to continuing operation, and thereafter tested and certified for appropriate operation by skilled personnel.
9. Personal protective equipment and safety uniforms, safety shoes, helmets, safety glasses, heavy gloves, ear protection devices etc. should be used at all times. Safety shoes should be used by all personnel entering into the Crushing Plant. Persons with loose clothing, neck ties, necklaces, unprotected long beard or long hair should not go near the machine. Wrist watches and rings can be dangerous.Rings should be removed or covered with tape. Keep your pockets free of loose objects.
10. Keep all non-operating and non-trained personnel clear of the Crushing Plant at all times. Injury or death may result if this is not done.
11. The equipment at the control panel should be handled with care. Do not place objects on the keyboard, color display or other equipment. All equipment can fail if put in contact with liquids, or excessive heat or excessive humidity. Allow good air flow around the equipment at all times. Keep magnets away from computer components, particularly hard drives and PLC cabinets.
12. A knowledgeable and properly trained Operator familiar with this manual, safety requirements, and automatic operation of the machine should be stationed at the controls whenever the machine is operating.

13. Do not consume any alcoholic beverages or other intoxicants before coming to work or while on the job. Do not operate the Crushing Plant after taking any medicines, tranquilizers or other drugs, which can impair the senses.
14. Familiarize yourself with the safety signs on the Crushing Plant. Never remove or damage any safety signs, nameplates or other safety related warnings, symbols or components. Replace them as necessary with OEM equipment.
15. Do not paint over safety signs, name plates or warnings.

WARNING:

Only qualified and properly trained operators and servicemen should operate or service the machine. Everyone else should stay clear of the machine when it is operating, or under service or maintenance!

2.2.4 Blasting

The use of the Crusher Plant's radio control device is strictly forbidden during blasting operations, as it may cause a premature explosion. Move the mobile Crushing Plant far enough away from dangerous area when blasting. Do not store or transport explosives on mobile crushing plant or screening plants.

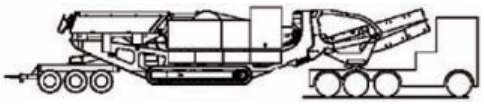
2.2.5 Portable Plants

If the Crushing Plant includes of portable equipment (i.e. crushing and screening equipment mounted on trailers), trailer footing or cribbing is extremely important for safe operation. Your machine must be on as solid and level footing as possible. If the ground is not naturally level, it must be leveled so that the unit will operate safely and effectively. The ground must support the weight of entire unit and keep it from sinking or shifting. Use heavy timber mats as needed. Trailers must be raised so that trailer wheels do not touch the ground.

Place jacks at each corner of the trailer or as near the corner as possible and to other suggested support points at mid-frame. All corner jacks must be at an equal distance from each end. Adjust each jack until the unsupported portion of the trailer beams stops vibrating or until vibrations are reduced to a minimum. Lock jacks and adjustable support legs mechanically with locking pins when applicable.

Periodically recheck trailer footing for stability.

2.2.6 Mobile Equipment Transportation



Use only appropriate transportation and lifting equipment with adequate capacity. Provide a supervisor to direct lifting operations. Follow all disassembly and assembly instructions carefully. Disconnect all external power supplies before moving any part of the equipment.Transport or hoist components and handle any parts in accordance with the instructions and advice provided. Fasten the lifting equipment only to the points meant for lifting. Use only proper means of transport with adequate transporting capacity. Fasten the load carefully. For lifting use only the fastenings shown in instructions. Secure all component parts of the equipment immediately after loading to avoid any accidental shifting. Attach required warning signs to the load.

When moving your trailer, check bridges before crossing. Make sure they will support the weight of the machine. Check clearances under bridges, for overhead lines or any overhead obstruction. Never travel with near capacity loads. Check local laws, especially on weight limitations. When travelling on the highway make sure all headlights, clearance lights and tail lights are on, as applicable. Use proper traffic warning flags and signs.

Remove all shipping brackets before re-starting the Crushing Plant. Carefully assemble all of the parts previously disassembled. Perform any start up in accordance with the instruction manual.

After the system is running, check all gauges and instruments to see that they are working correctly. Check that all controls function normally and properly. Listen for unusual noises. Shut system down immediately if any component of the system does not operate normally.

2.3 TYPICAL RISKS IN CRUSHING PLANT WORKING ENVIRONMENT

Even though every Metso Minerals machine is designed with many safety features, it is impossible to design out all safety risks. There are potential hazards, that must be recognized and avoided. Noise levels may interfere with normal discussion when the machine is operating. By their nature, Crushing Plant and auxiliary equipment can create dust. Crushing itself and some other machine processes may momentarily obstruct the view of some machine parts. In general, high levels of respirable silica and other dust in the air may expose Operator to health risks for lung disease depending upon the length and amount of exposure and type of material being crushed. In addition, there are some risks or hazards which cannot be completely guarded or avoided because of interference with machine operations. Accordingly, working on the Crushing Plant requires constant alertness by all personnel in the area. Accidents happen unexpectedly. Below are some typical hazards and types of accidents that everyone working at, on or around the Crushing Plant should be aware of.

Typical Hazards

- nips, gaps, and pinch points
- poor housekeeping
- elevated or narrow working areas
- lifting and shifting heavy loads
- cranes and mobile cranes
- sharp edges
- high-pressure hydraulic equipment
- electrical equipment
- automatic functions and unexpected start-ups
- toxic and corroding agents
- machine inertia
- hot surfaces and fires
- zinc
- conveyor belts
- dust
- noise and vibration
- improper work methods
- rotating equipment and moving components
- ejection of material from the crusher
- falling material from conveyors, and from loading, unloading and feeding operations
- crushing cavity

These typical hazards are discussed more fully in *Section 2.3.1* of this chapter. Be aware of these hazards. All personnel working on or around the machine should be properly trained in avoiding these hazards.

Typical Injury Types

- crushing
- slipping, tripping and bumping
- falling
- cutting
- entanglement
- burns and electrical shocks
- respitary organ illnesses
- asphyxiation

2.3.1 Typical Hazards

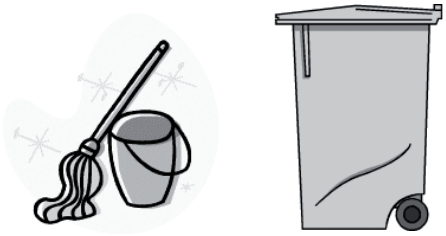
Nips, Gaps, and Pinch Points

An ingoing nip is formed by drive devices such as belt and pulley, chain and sprocket or gears. Similarly, a pinch point may be formed by rotating or moving equipment.

DANGER:

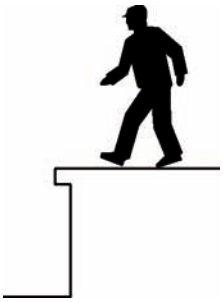
Nips and gaps are serious hazards in a Crushing Plant. They are usually guarded by nip guards, railings, or location. In all cases, extreme care must be taken to avoid nips, gaps, and pinch points or serious injury or even death may occur.

Poor Housekeeping



Promote good housekeeping. Keep machine environment, walkways, platforms etc. clean and dry and free of debris. Oily or wet machine environment, walkways, platforms, steps and hand rails are slippery. In cold weather, watch out for ice and snow. Wet spots, especially near electrical equipment, are dangerous. Return tools to their proper place after use. Even then extreme caution should be used. Follow established Crushing Plant safety procedures. Clean slippery deposits from walkways, ladders and floors. Tidiness provides a safer working environment by preventing or helping reduce tripping, slipping, fire hazards and electrical shocks.

Elevated or Narrow Working Location



Crushing Plants are tall structures. The walkways and platforms, designed to be used during machine operation, are furnished with railings to help prevent falling.

When working on an elevated surface be aware of machine movements and other activities in the area. Do not run on the walkways. Do not reach over or beyond walkway railings while the machine is running. Do not stand on railings or toe plates.

There may be narrow access routes for maintenance purposes. Do not use these routes while the machine is operating.

Do not enter any close quarters within the Crushing Plant when the machine is operating.

Lifting And Shifting Heavy Loads

- Cranes

Crushing Plants, like any other type of mechanical equipment, require regular periodic maintenance. One of the most flagrant Crushing Plant safety violations is the use of inadequate and unsafe lifting equipment. Although a Crushing Plant is a finely tuned piece of equipment, the internal parts of a Crushing Plant should be assembled and disassembled with crane facilities that have the capability of gently and slowly lifting and lowering the various parts that make up a Crushing Plant.

Do not use chain hoists (chain blocks) to assemble or disassemble a Crushing Plant. These lifting devices lack the stability and robustness required in lifting and positioning heavy components.

Do not use impact hammer boom or any other equipment which are not designed for lifting, for assembly or disassembly purposes.

Affix the load securely to its destination. Never detach a lifting device from a load until the load is stable and secured from unintended movement.

When it comes to safety, don't compromise!

IMPORTANT!

When using a crane, always operate within the rated capacity of the crane. The safe rated capacity includes weight of hook, block and any materials handling devices such as cables, slings, spreader bars, etc. Subtract the weight of all these items from the rated capacity to find the true weight of the load that can be handled safely. Always follow the crane manufacturer's operational and safety instructions.

IMPORTANT!

The weight indicated in machine plates tells the weight of standard configuration. In many cases the actual weight may differ greatly from that indicated in machine plate due to, e.g., options or ancillary equipment. Always verify the weight of the object you are lifting before attempting to lift it.

- Mobile cranes

Safe ratings are based on operating the crane on firm, level ground; outriggers must be properly extended and/or lowered whenever required. Avoid fast swings, hoists or sudden braking; these can cause overloads. Do not handle large, heavy loads in strong winds. When moving your crane, check bridges before crossing, make sure they will support the total weight in question. Check clearances under bridges for overhead electrical lines and any overhead obstruction. Be sure your hitcher is clear before starting lift. Make sure the load is securely attached.

IMPORTANT!

When using a mobile crane, always operate within the rated capacity of the machine to avoid buckling the boom or tipping.

Take the following precautions when lifting heavy loads:

- Follow all established Crushing Plant procedures.
- Follow all instructions and safety procedures recommended by the crane manufacturer.
- Plan the lifting and maintenance procedures in advance. Read and understand specific instructions for proper use of lifting equipment prior to using (e.g instructions of the machine, lifting device and local regulations).
- Clean the working environment beforehand to prevent slipping and tripping hazards.
- Make sure that the crane and other lifting devices such as chains and slings have sufficient capacity and are in good working order.
- Do not attempt to ride or sit on moving loads.
- Be sure that crane operators, riggers and other personnel have been properly trained.
- Rig the load firmly to prevent any unintened movement and assure stable and accurate positioning.
- Make sure nobody is below or on the path of the load and that the transfer routes are clear and proper protective clothing and gear are used.

Sharp Edges

Sharp edges may occur on any metal structures. Equipment damage may uncover or produce unexpected sharp edges. Sharp edges may inflict deep and serious cuts. Wear protective gloves when handling materials, parts, etc. with sharp edges. Repair or guard detected sharp edges immediately.

High-pressure Equipment - Hydraulic or Air

High pressure oil can be dangerous. Relieve all pressure before opening or removing any hydraulic or air pressure lines, valves, fittings, etc. Do not touch pressurized components since the pressure from a pin hole leak is so strong that it can easily penetrate the skin or eyes. Always exercise caution when handling hydraulic devices.

Regularly check the condition of hoses, pipes, valves and various connections. Replace them as necessary.

Before starting any maintenance work, stop all hydraulic pumps, lock out pump motors, and depressurize the system, bringing all components to a zero energy state. Remember to also depressurize the accumulators through

the bleed valve for each accumulator. Do not disconnect any hoses until the actuator has been brought to a zero energy state and properly secured.

Bleed the hydraulic system regularly to remove entrapped air that may interfere with normal expected machine operation or cause a hazard during maintenance.

WARNING!

Poorly tightened or damaged hydraulic components may inject dangerous jets of fluid. Before restarting the machine, be sure that the hydraulic system is ready for operation, and personnel are clear of affected areas.

WARNING!

Machine parts may move unintentionally and cause a risk of injury. Before restarting the machine, make sure that all personnel are clear of affected areas where machine movement may occur.

Electrical Equipment

Be especially cautious when working with or near electrical equipment. An electric shock can be fatal. Crushing Plant electrical outlets must be grounded and have ground fault interruption protection. Tools plugged into the outlets must be double insulated. Never expose electrical equipment to mechanical damage or humidity. Protect all electrical equipment from direct contact with water or high humidity.

Protect electrical devices that move as part of the machine from dirt and mechanical damage. Regularly check the operability of these devices.

DANGER:

There is a risk of an electric shock, if sufficient precautions are not taken. An electric shock can be fatal.

For maintenance work, disconnect all devices from electric and hydraulic power sources and follow Crushing Plant lockout procedures.

The lockout program, locks, tags and the blocking/restraining devices provided are designed for your protection. Your responsibility is to follow the program and use the proper equipment.

Remember:

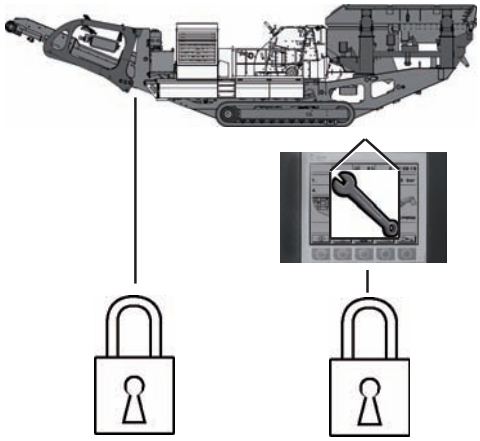
- Follow procedures.
- Stay alert.
- Do not take anything for granted.
- Verify lockout.
- Each person working on the unit must have his own lock with only 1 key.

– Tag must identify the work being done and the person(s) who locked and tagged the control.
– Locks and tags are changed with each shift that comes on.

Work to prevent injury or death. Follow proper procedures at all times!

Maintenance, repair and installation of electrical equipment must be performed only by qualified personnel who are familiar with the machinery and equipment in question.

Automatic Functions and Unexpected Start-ups



Unexpected start-ups during maintenance:

– Lock out and tag machine controls before performing maintenance or repairs to avoid unexpected start-up. Failure to properly lock out the machine can lead to injury or death. Someone may accidentally start the machine from the control room or an unexpected occurrence may activate a control. For example, a power surge may alter the logic of the control system status causing an unexpected machine movement or sequence.

WARNING:

Machine parts may move unintentionally and cause a risk of injury. Absence of safety functions may cause dangerous machine movements.

Do not tamper with limit switches or other safety devices included in the system.

DANGER:

If danger zones are not respected during machine operation or maneuvres there is a risk of serious injury or death.

Many devices operate automatically, following certain sequences which have been programmed into the logic system (i.e. programmable logic controller, microcontroller, relay system or similar). The danger zone is any area within the confines of moving machine elements, feed material or beneath any objects being lifted. Do not enter these danger zones unless the machine has been properly safeguarded according to the Crushing Plant lockout procedure and manufacturer's instructions.

Welding Equipment

Weld repairs are to be performed only by qualified personnel. Welders and welder's helpers must wear protective clothing and equipment.

Precautions must be taken when torch cutting and/or welding due to the health hazards posed by many metals. Anyone performing these types of procedures should avoid breathing the fumes. Such procedures should be done outdoors or in a well ventilated area with either a separate clean air supply provided to the mechanic or with local exhaust of fumes. Please refer to EU, OSHA, MSHA or other applicable standards as appropriate. One of the most frequently used tools around the Crushing Plant is the cutting torch. Crushing Plants which are equipped with hydraulic components and/or conveyor belts and/or v-belts should have these components depressurized and adequately covered with flame-proof material so that sparks, weld spatter, etc., cannot reach theses areas. Ruptured high pressure hydraulic lines will quickly vaporize the hydraulic fluid as it reaches the atmosphere. This vaporized fluid can quickly become a mass of flames, resulting in severe burns for personnel in the immediate area. Adequate precautions should be made to avoid contact with these components. Never perform welding or torch cutting activities in the presence of flammable materials.

WARNING:

Risk of injury. Fire may break out. Never perform welding or torch cutting activities in the presence of flammable materials.

IMPORTANT!

All maintenance personnel who use cutting and/or welding torches should be advised if there are hydraulic components in the immediate area in which they are working.

IMPORTANT!

Contact Metso Minerals or its authorized representative prior to any welding of major Crushing Plant components such as main frame, adjustment ring, bowl, etc. Performing welding on the Crushing Plant components can be detrimental. Before welding, always verify that material is weldable! Failure to do so may result in weldment failure and present a risk of injury and/or property damage.

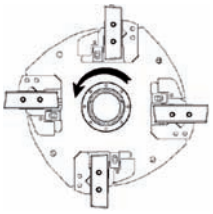
Toxic, Corroding and Irritating Agents

Before handling chemicals, carefully read the safety instructions from the supplier of the respective chemical. Hazardous chemicals may be in use. Wear protective clothing, gloves, boots, glasses, and respirator when necessary.

Refer to the MSDS (Material Safety Data Sheets) and Crushing Plant procedures for handling of these materials.

Avoid prolonged contact with fluids, such as gasoline, diesel fuel, hydraulic oil and cleaning solvents, which may cause skin irritation or other reactions.

Machine Inertia

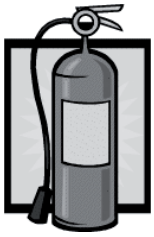


Due to the large inertial forces of the Crushing Plant and Crushing Plant components, the machine can not be stopped abruptly. This is potentially hazardous to personnel. All personnel must stay clear of rotating elements and other moving parts until the machine has come to a complete stop. Regularly inspect the structural elements to maintain safe operation.

Hot Surfaces and Fires

There are hot surfaces on Crushing Plants. Protective gloves and coveralls help protect against burns. Be aware of hydraulic system, hoses, fittings, and pipes. Regularly inspect and observe high temperature lines, and fluid lines for leaks or damage. On mobile equipment be cautious around the engine because of exhaust gases.

When in contact with hot temperatures, or when heated themselves, some hydraulic oils may ignite at around 392°F (200°C). Attention must be paid to the condition of hydraulic hoses and couplings. Remove immediately oil spills from floor, walkways, and pits. Fix all sources of oil leaks and clean up spills.



In case of a fire, the machine must be equipped with a fire extinguisher or fire extinguishing system, and marked according to the regulations. Legislation and regulations about suitable equipment may vary by country. Familiarize yourself with applicable standards. Personnel must also be trained properly to be able to use fire extinquishing equipment.

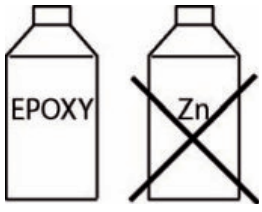
A trained person with sufficient fire extinguishing equipment must be present during welding maintenance work. Cold water on hot metal surfaces may cause a violent explosion. Monitoring after welding must be arranged as required by laws and regulations. If no other regulations apply, monitoring time is a minimum of one half hour.

Fire Hazards

- Do not smoke while refueling, or when handling fuel containers.
- Shut off engine when refueling and use extra caution if engine is hot.
- When pouring fuel into the tank, ground the funnel or spout against the filler neck to avoid static electric spark.

– Do not use gasoline or diesel fuel for cleaning parts. Good commercial, nonflammable solvents should be used.
– Do not smoke while using flammable cleaning solvents. Whenever possible, use non-flammable cleaning solvents.
– Do not let greasy, oily rags accumulate in a poorly ventilated area. Store oily rags and other combustible material in a safe place.
– Never use an open flame to check fuel, battery electrolyte or coolant levels, or to look for hydraulic leaks anywhere on the equipment. Use a flashlight. Know where fire extinguishers are kept, how they operate, and for what type of fire. Check regularly, at least monthly, to be sure they are in the working area.
– Do not weld or cause open flame in the presence of flammable materials.
– In the event of a fire, shut down the Crushing Plant, hydraulic power unit and lubrication system if this can be safely done. Warn other people in the area and commence fire fighting activities according to applicable rules. It is the responsibility of the Owner to maintain proper training and instructions in these respects.

Epoxy Versus Zinc



Many Crushing Plants require some type of backing when replacing the crushing members. Epoxy resin backing compounds have almost completely eliminated the possibility of workers being accidentally burned due to molten zinc either spilling or exploding when it comes in contact with wet surfaces. When epoxy backings are used, care should also be taken when removing the liners with a cutting torch . Do not use molten zinc as backing material. Use epoxy only according to specific instructions from the manufacturer.

Conveyor Belts

WARNING:

Do not use conveyor belts as walkways. Do not climb on them. Always stay clear of any falling or dropping materials or components. Never attempt to stand on, walk on, or step across a conveyor. Never stand below a running conveyor. Do not use loose clothing, neck ties, necklaces or other loose items when near conveyors or other moving or rotating equipment. Emergency pull cords should be used only in case of emergency -do not use them for routine stoppage of conveyor. Never attempt to service the conveyor while it is energized. Keep in mind hazardous nip points.

Crushing Plant Dust

By their nature, Crushing Plant and auxiliary equipment such as chutes, transfer stations, screens, etc. can create dust and, if not contained, the dust can escape into the air. In general, high levels of dust (particularly, respirable silica) in the air can create a hazard of lung disease, depending upon the concentrations of dust, the length of exposure, and the type of material being crushed. Dust protective devices and dust warnings may be required by OSHA, MSHA or local laws.

The Owner and Operator of the Crushing Plant must identify the material being crushed and ascertain whether respirable dust from the application poses a health hazard to personnel in the vicinity of the Crushing Plant.If the material presents such a hazard the Owner and Operator must take all necessary measures to ensure that personnel are protected from the dust. Such measures include, but are not limited to providing dust collection system, using water spray bars at the feed and discharge points, crusher transfer points and screens and providing adequate personal respiratory protection devices to workers.

Crushing with a choke level may also reduce the amount of dust issuing from the Crushing Plant itself. Because the configuration of each rock crushing installation is different, Metso Minerals recommends that the Owner and Operator consult Metso Minerals or a dust consultant about possible alternative means of dust reduction.

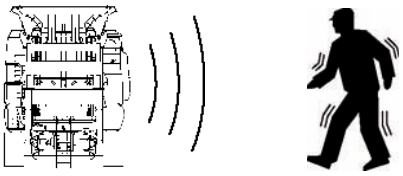
IMPORTANT!

Metso Minerals highly recommends that dust protective devices such as an appropriate respirator be worn by anyone exposed to airborne dust to prevent its inhalation.

WARNING:

Breathing dust may be hazardous to the health of anyone working at, on, or around the Crushing Plant. It can cause serious or fatal respiratory diseases including silicosis! It is the responsibility of the Owner and Operator to determine the necessity and adequacy of protective devices and warnings, to provide them, and to ensure that they are used and followed!

Noise and Vibration



- Crushing Plant Noise

Crushing Plant by its very nature is noisy and the auxiliary equipment found at, on or around the Crushing Plant such as chutes, transfer stations, screens, etc., can at times be noisier than the Crushing Plant itself. Typical Crushing Plant noise level while crushing range from 100 - 110 dB measured at 1 m (3ft) from the Crushing Plant.

Metso Minerals recommends wearing ear protection at, on and around Crushing Plant, particularly when the noise level exceeds 85dB. It is recommended that the Owner develop a signaling communication system in noisy environments to reduce the risk of accidents. Proper machine maintenance and replacement of worn parts can help reduce noise.

The most commonly applied noise reduction procedures are:

– use of isolation techniques
– equipment enclosures
– operator enclosures
– silencers

Allowable noise levels and exposure limits are regulated by various agencies such as ISO, OSHA, MSHA, etc. Refer to applicable safety regulations for permissible noise exposures, and take steps to ensure compliance with those regulations.

- Vibration

Long term exposure of Operator to vibration may result in detrimental health effects.There is an increased risk of falling on a vibrating platform. Avoid standing on a vibrating Operator's platform or walkway.

Unexpected or excessive vibrations may be a sign of wear and/or maintenance needs. Excessive vibrations associated with a portable crushing or screening plant is frequently caused by improper cribbing.

It is recommeded to regularly monitor vibration levels of machine components including, but not limited to:

– bearings
– shafts
– rollers
– structural members (including conveyor frames, walkways, platforms, hoppers, chutes, etc.)

Improper Work Methods

Improper work methods and motions may cause physical injuries. Use suitable tools, cranes or jacks for moving large and heavy objects. Overreaching and improper support for loads may lead to injuries to the back or other parts of the body. If you are unsure of proper work methods, contact your safety director or other person responsible for ensuring the safety at your work place.

When lifting equipment by hand, protect your back by lifting close to your body and using your legs without twisting. Use hoists whenever possible. Stand clear of hoisted loads and lifting cables.

Rotating Equipment and Moving Components

Rotating and moving components provide pinch points, snagging possibilities and other potential hazards. Keep clear of all moving parts until they come to a complete stop. Do not use any body part, tool or other foreign object to attempt to stop, adjust, clear, or clean any area in proximity to moving equipment such as vibrating feeder, conveyor belts, drives or other rotating parts of the crusher. Engaging in such activities can result in severe personal injury, including death.

Crushers, designed to operate within a specific RPM range for maximum efficiency, are typically checked with a tachometer. Make sure that any access openings have a protective cover in place at all times except when RPM readings are being taken. Never change sheave combinations without first consulting your Metso Minerals representative.

Ejection of Objects from the Crushing Plant

Ejected objects from the Crushing Plant may cause bodily injury. For example rock can be thrown several meters (several yards) into the air out of the crushing cavity during operation. Ejected materials may include rock, tramp metal, metal rods and work implements. Do not look into crushing cavity while crusher is in operation. Never attempt to clear jam on feeder, crushing cavity or conveyors when system is energized.

Falling Material from Conveyors, Loading, Unloading and Feeding Operations

Rocks or other objects may fall from conveyors during loading, unloading and feeding operations. Impact of falling material may cause serious bodily injury. To assure safe operation, all personnel must be alert when operating or working at or around the machine. Wear proper protective clothing (including also helmet) and protective devices. Keep all non-operating and non-trained personnel clear of the Crushing Plant at all times.

Never walk under any equipment included in loading, feeding, crushing, conveying, discharging or stockpiling material.

2.3.2 Typical Injury Types

Crushing

In general, avoid areas where you may be exposed to expected or unexpected machine movements. Crushing injuries typically occur either between two rotating or moving parts, or between a moving component and a stationary object.

Keep all body parts, clothing and tools away from areas where they may get trapped, pinched, or crushed, or otherwise come into contact with moving parts on the Crushing Plant. When moving equipment, be sure the path is clear. Horns and lights, where provided, are for your safety to alert you of moving objects. Pay attention to all such devices.

Slipping, Tripping, and Bumping

Items such as hoses, tools, etc., on walkways and Crushing Plant floors impede movement and create a tripping and slipping hazard. Good housekeeping reduces the risks considerably.

Personnel should wear safety shoes that reduce the risk of slipping and provide protection against falling objects or crushing. Hydraulic oil leaked or spilled on the floor must be cleaned up immediately.

To help avoid injury, be aware of parts positioned close to the floor level or protruding machine components, changes in elevation of platforms, walkways, and narrow access points. It is recommended that safety shoes be worn at all times. Wear safety helmets and other safety equipment as appropriate.

Falling

Use only designated access routes designed for the purpose, for example walkways and platforms. Walkways and platforms are furnished with railings designed to meet applicable standards. However, in some work phases, railings or platforms may have to be temporarily shifted aside. In those cases, special caution signs or temporary barriers must be used when working on the machine. Use personal fall protection gear , temporary barriers, interlocks, or other warning devices where appropriate. Never attempt to operate, service, or repair the Crushing Plant without first ensuring proper protection against falling. Guards that are moved aside must be installed immediately after maintenance work and before the machine is returned to operation. Never climb or stand on areas of the Crushing Plant not specifically designated for that purpose.

WARNING:

Do not operate any equipment until all guard rails and safety devices have been re-installed or returned to their proper operating condition. Failure to do this could result in serious injury or death.

KEEP THE AREA CLEAN!

Cutting

Do not reach in or enter:

- the movement paths of cutting equipment
- between moving machine components
- between moving loads and machine structures

Entanglement

To avoid entanglement, avoid wearing loose clothing that could be caught by rotating shafts, conveyors, and other moving parts .and materials. Remove neckties, necklaces, rings, and other jewelry before performing work assignments. Also protect a long beard or hair from entanglement.

Do not touch a rotating roller, sheave, pulley, idler or moving conveyor belts with any body part or work implement, as you may become entangled and pulled into a hazardous area.

Never attempt to service, repair, or troubleshoot any moving part of the Crushing Plant while it is energized or otherwise capable of movement.

WARNING:

Keep safety gates, shrouds, guards, and other protective devices in place and in good working condition at all times. Test emergency stop, electrical interlocks, and related limit switches frequently.

Burns and Electrical Shocks

Protective gloves and coveralls help protect against burns. Be cautious around and near hydraulic system hoses, fittings and pipes. Regularly inspect and repair leaking or damaged high temperature lines and fluid lines.

To avoid electrical shocks:

- Power must be shut off and locked out before any servicing or maintenance work is done. Unplug or disconnect all auxiliary motors and equipment.
- DO NOT drill blindly into beams, electrical cabinets or other enclosures.

Avoid any contact between moisture or other fluid and electrical equipment.

Impact from Ejected Materials

There are several hazards related to falling, flying or otherwise ejected materials when the Crushing Plant is being operated or serviced. For example, rock can be thrown several meters (several yards) into air out of crushing cavity during operation. Ejected materials may include rock, tramp metal, metal rods and work implements. Keep the safety grate down during the operation. Wear proper protective clothing (including helmet) and protective devices. Always use properly maintained and approved tools and work methods. Stay clear from the path of ejected materials, also during lifting, assembly and dissassembly operations.

Removal of tramp iron jammed between the crushing members is extremely dangerous. Follow the instructions in the instruction manual.

Do not look into crushing cavity while crusher is in operation.

2.4 PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING

Personal protective equipment and clothing such as foot protection, helmet, hearing protection, dust protective devices, safety glasses or other personal protective clothing and equipment should be worn at all times. All equipment should be maintained in accordance with applicable standards. Respirators, goggles, protective masks, gloves, boots, and other such equipment shall be cleaned and disinfected before being used by another employee. The Owner and Operator are responsible for ensuring that all eye, head, respiratory, and ear protection conforms to applicable standards.

IMPORTANT!

Always use right size of protective equipment.

IMPORTANT!

It is the responsibility of the Owner and Operator to determine the necessity and adequacy of protective devices and warnings, to provide them, and to ensure that they are used and followed.

2.4.1 Hearing Protection

Noise level in the machinery area may exceed 85 dB, and exposure to the machinery area in such circumstances without adequate hearing protection may lead to hearing loss. Therefore, users must be provided with appropriate hearing protection of the type and to the extent required by law.

2.4.2 Eye And Face Protection

General requirements should include:

- The Owner should ensure that personnel for the machine area use appropriate eye or face protection when exposed to eye or face hazards such as flying material, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors.
- The Owner should ensure that affected personnel use eye protection that includes side protection from flying objects.
- The Owner should ensure that affected personnel who wear prescription lenses while engaged in operations that involve possible eye hazards wear eye protection that incorporates the prescription in its design, or wear eye protection that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses or the protective lenses.

2.4.3 Respiratory Protection

Respiratory protection is required when the air contains contamination such as harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors. The primary objective is to protect the health of workers.

Respiratory protection must be provided by the Owner when such equipment is necessary to protect the health of personnel. The Owner shall provide the respiratory protection and training programs, which are applicable and suitable for the purpose intended and comply with the latest requirements and recommendations of health authorities and regulatory agencies.

IMPORTANT!

The enormous degree of convenience as well as the high safety factor involved when using plastic backing agents has made the use of molten zinc for Crushing Plant liner backing obsolete. See 2.3.1

IMPORTANT!

The area should be well ventilated. Epoxy fumes can cause nausea or eye or skin irritation.

IMPORTANT!

Breathing dust may be hazardous to the health of anyone working at, on, or around the Crushing Plant.

IMPORTANT!

Metso Minerals highly recommends that adequate dust-protective devices such as a respirator be worn by anyone exposed to airborne dust, particularly silica dust, to prevent its inhalation.

2.4.4 Foot Protection

The Owner shall ensure that affected personnel use protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects piercing the sole, and where feet are exposed to electrical or chemical hazards.

2.4.5 Head Protection

The Owner should ensure that affected personnel wear a protective helmet approved by OSHA, MSHA (or by other applicable authority) when working in areas where there is a potential for head injuries from falling objects or walking throughout areas with low head clearance.

The Owner should ensure that a protective helmet designed to reduce electrical shock hazard is worn by personnel when near exposed electrical conductors which could contact the head.

2.4.6 Hand Protection

The Owner should ensure that personnel use properly sized appropriate hand protection when hands are exposed to hazards such as those from skin absorption of harmful substances, cuts or lacerations, abrasions, punctures, chemical burns, thermal and electrical burns, and harmful temperature extremes.

2.4.7 Safety Harnesses

The Owner should ensure that any person working on elevated areas not protected by railings, or on hazardous places must wear suitable safety equipment, including safety harnesses, if there is a risk of falling. Confined spaces may also require safety harnesses.

2.4.8 Work Clothing

The Owner should ensure that personnel wear appropriate clothing to help protect against hazardous material and hot surfaces. Loose clothing can get caught in a nip, shaft, or other moving machine components.

2.4.9 Tools

The Owner should ensure that personnel use appropriate tools for the job. Use tools that are specially designed to break away or are easily released to help avoid certain accident situations such as unexpected movement at a nip point or a rotating shaft. Under no circumstances must tools be allowed to come into contact with moving parts while the Crushing Plant is energized.

When working in humid or damp environments, use hydraulic tools or electrical tools that are suitably grounded, double insulated, or have ground fault interruption circuits.

2.4.10 Safety Locks And Tags

Follow all lock-out tag procedures. Refer to appropriate standards and instructions provided by Metso Minerals.

DANGER:

For maintenance work, disconnect all devices from electric power sources. Bring all hydraulic gravity or spring loaded devices to a zero-energy state. Follow lockout procedures.

The lockout program, locks, tags and the blocking/restraining devices provided are designed for Operator's protection. Operator's responsibility is to follow the program and use the proper equipment.

Remember:

- Follow procedures.
- Stay alert.
- Do not take anything for granted.
- Verify lockout.
- Tag must identify the work being done and the person(s) who locked and tagged the control.
- Locks and tags are changed with each shift that comes on.

Work to eliminate injury and death. Follow proper procedures at all times!

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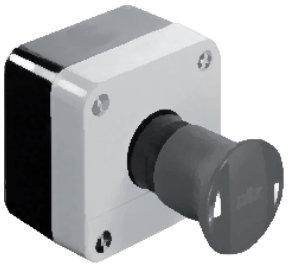
3.1 PROTECTIVE DEVICES AND ACCESSORIES FOR MACHINE SAFETY

3.1.1 Overview

The machine system has many built-in safety features. Owners and Operators should make themselves familiar with the function and purpose of each feature and make sure all of the features are enabled. Owners and Operators should never attempt to defeat, bypass or disable any safety features. If any of the features are defeated or become disabled, the machine should not be operated until corrective action is taken and all safety features are restored.

3.1.2 Emergency-Stop (E-Stop)



Use the emergency stop when injury may occur or human life is in danger from continued operation of the machine. This provides the quickest, most sure way to stop the machine. Due to the large inertial forces of the Crushing Plant and Crushing Plant parts and components, the machine can not be stopped abruptly.

Large red emergency stop buttons are typically located in control panels near the vicinity of danger points.

Emergency stops can be, and often are, in the form of pull cords that run paraller to conveyors and surround hazards.

WARNING:

On large complex systems, the E-stop may control only those components that are in the immediate area.

The location of local E-stop buttons may vary on different machines; therefore the locations of these buttons must be verified from the operating and maintenance manuals specific to the equipment and/or from proper training.

In emergency stop situations, the objective is to stop the machine as soon as possible to minimize potential injuries while maintaining the structural integrity of the machine.

CAUTION:

Emergency stop not only stops the machine but often it may initiate other protective sequences.

NOTE: It may be necessary to engage reset switches before movement can resume.

3.1.3 Safety Interlocks

A safety interlock is a device that will interrupt the supply of electricity, hydraulic oil or compressed air to an actuator or motor. A machine already in operation may need to stop quickly due to Operator error, safety violations, or an unexpected machine event. For example, a safety gate may be interlocked to stop a machine if the gate is opened while the machine is running.

Interlocks can also be used to prevent sudden unexpected movement of a machine function or component.

During operation, the logic system (i.e. programmable logic controller, microcontroller, relay system or similar device) controls the functions of the machine. Interlocks built into the system employ limit switches and other sensors to help assure proper machine operation.

THEREFORE IT IS IMPORTANT THAT INTERLOCKING ARRANGEMENTS ARE NOT REMOVED, MODIFIED OR BYPASSED, AND THAT THEY ARE CORRECTLY ADJUSTED. LIMIT SWITCHES, AND OTHER SENSORS MUST BE KEPT IN GOOD WORKING ORDER.

Electric Motors

Electric drives and motors may be controlled to stop or reduce speeds, as determined by the safety interlocks at a particular location.

Hydraulic System

Components that help protect the hydraulic system include certain valves, such as hose burst valves, pressure relief valves, counterbalance valves and pilot-controlled throttle valves as well as pressure transducers and drain valves for pressure accumulators. Metso Minerals uses these components where applicable in the hydraulic systems to minimize the potential for hazardous situations to occur.

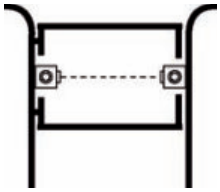
A hose break valve functions to lock up if fluid flow is discharged too rapidly from an actuating cylinder, as happens if a hose breaks and the loads react to gravity.

The pressure relief valve prevents the system pressure from rising beyond system capabilities. It helps protect the entire fluid system and any operators in the vicinity from bursting hoses and components.

The pilot-controlled throttle valve helps prevent uncontrolled actuator movements.

Pressure transducers monitor the system pressure for information or control purposes.

Safety Gates



Some safety gates are designed so that opening or closing of the gates will prevent or stop a specific machine function in that area. Hydraulic, hydraulic or electric limit interlock switches may cut off the drive or actuator power or initiate an emergency stop mode.

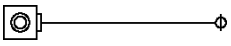
For specific operation, see later sections of this manual.

WARNING:

Safety gates must not be opened during normal machine operation. Exceptions to this rule are defined in the operating instructions.

Safety gates may also be opened for maintenance purposes when the machine has been stopped. Follow all lockout procedures.

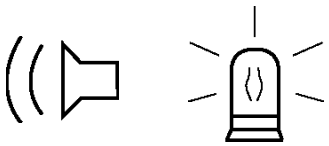
Cable Switches



Cables or ropes connected to the electrical switches can be used as interlocks also. They may stop machine function in areas where control panels cannot be closely located but where Operators may be working . Know the locations of e-stop pull cords for conveyors.

3.1.4 Additional Warning Devices

Horns and Lights



If visual contact between work places is obstructed or if communication is difficult, sound and/or light signaling devices may be used before starting the machine or a machine function. The warning device for start-up should operate so that personnel are given sufficient time to move to a safe distance from the machine. It is the responsibility of the Owner to ensure that the Crushing Plant is always equipped with required horns and lights.

Safety Signs and Labels

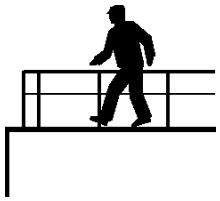
Safety signs have colors to determine the degree of hazard in particular areas. These signs must not be removed. Temporary placement of safety signs and danger tags should also be used on the control panels to warn of maintenance work and lockout situations.

Obey all warning and safety signs on the machine and in the manual.

Safety Warning Colors

Color of safety warnings are typically safety yellow.

3.1.5 Walkways, Service Platforms, Ladders And Railings



The design of walkways, ladders and railings follow standards and regulations for the application. The walkways provide access to the machine. Safe operating procedures must be followed when on walkways. Never stand, walk or climb in or on any area of the Crushing Plant not designated for such activity. If an area of the Crushing Plant must be accessed and cannot be reached by designated walkways, ladders, or platforms, then the Owner and Operator must make all necessary arrangements for safe access to the area, including but not limited to safe lifting devices and fall protection.

CAUTION:

Extreme caution must always be used on machine walkways.

3.2 TRANSPORT

Observe the following precautions before transporting the Crusher Plant:

1. Chock chassis tires securely whenever connecting or disconnecting chassis from tractor or dolly.
2. Check tire pressure. Use a protective cage or a clip-on type air chuck and remote in-line valve and gauge when inflating tires. Never exceed maximum inflation pressures of the tire or rim.
3. Check tightness of wheel lug nuts before transport and check frequently during transport.
4. Check that brake system operates correctly.
5. Observe maximum axle and tire loading capacities.
6. Protect components being transported using appropriate shipping braces and blocking material.
7. Travel may be limited to daylight hours only, depending on your specific plant and applicable state regulations.
8. Follow recommended limits on towing speed.
9. Make sure all lights are on and that they are operating correctly.
10. Use traffic warning flags, signs and lights as required.
11. Before moving the Crushing Plant, check all roadways and bridges on the route for weight limits.
12. Check clearance of bridges, overhead lines and other overhead obstructions.
13. Follow all applicable laws and regulations.

3.3 TOWING

Observe the following precautions before towing the Crusher Plant or its components:

– Check if towing is allowed for each individual equipment.

3.4 AT THE WORK-SITE

3.4.1 Precautions

Observe the following minimum precautions at the work-site:

1. Know the locations of underground and overhead powerlines and other potential hazards.
2. Select the work-site with care. The ground must be firm, level and able to support the weight of the entire plant. Make sure there is enough room for loading ramps, loaders, conveyors, etc. and for safe maneuvering of trucks and loaders.
3. Check that cribbing is secure and that plant has not shifted or settled.
4. Make sure that electrical cables are protected from wear and traffic.
5. Follow pre-operation checks and start-up procedure covered in the individual manual supplied with your specific unit equipment

3.4.2 During operation

Keep watch

Do not rely too much on automated systems. Observe Crushing Plant equipment while the system is running. Pay attention to unauthorized persons approaching the site as well as any unusual behavior of the equipment (uncommon noise, vibration, smell, reduced output, etc.).

Clearing

Crushers Plant equipment can become plugged and stall because of power failures, surges of material or other unplanned events. Clearing Crusher is potentially very hazardous. Shut down the system completely, lock and tag out all applicable controls and follow all instructions in the instruction manual of your specific crusher.

SAFETY DURING MAINTENANCE AND REPAIR

SECTION 4

4.1 GENERAL INFORMATION AND SAFETY LOCKOUTS

Detailed instructions for the operation of the machine can be found in following sections of the manual. Because each machine section may incorporate unique functions, some of which may be automated, maintenance personnel should be knowledgeable of the operation of the machine sections in order to perform the maintenance and repair work as safely as possible.

DO NOT COMPROMISE SAFETY DUE TO TIME PRESSURES.

FOLLOW ALL CRUSHING PLANT SAFETY AND FIRE PREVENTION PROCEDURES.

Before starting any repair, maintenance or troubleshooting work on the machine, ensure the following:

- If you have not been trained to perform the required repairs, maintenance or troubleshooting, or you are unsure how to safely perform the activity - STOP! Never attempt to repair, maintain or troubleshoot any aspect of the Crushing Plant unless you are thoroughly trained for the activity and understand how to perform the activity in a safe manner.
- Be sure to coordinate all repair and maintenance work with other Crushing Plant operations.
- Use lockout and warning signs to inform others that maintenance and repair work are in progress. These signs should only be removed (after all work has been completed) by the person who has placed them there.
- Transmit all knowledge of the maintenance work to the succeeding shift.
- Know the whereabouts of all personnel in, on, at and around the machine.
- Never service any machine or component without first referencing its maintenance manual.
- Before handling chemicals, refer to the MSDS (Material Safety Data Sheets) and Crushing Plant procedures for handling of these materials.

4.2 MECHANICAL SAFETY DURING MAINTENANCE AND REPAIR

4.2.1 General

DANGER:
FOLLOW ALL ESTABLISHED LOCKOUT PROCEDURES. REFER TO THE APPROPRIATE STANDARDS.

For repair, maintenance or troubleshooting work, disconnect all devices from electric, pneumatic and hydraulic power sources and follow lockout procedures.

The lockout instructions, locks, tags and the blocking/restraining devices provided are designed for your protection. Your responsibility is to follow the instructions and use the proper equipment.

Remember:

- Follow procedures
- Stay alert
- Do not take anything for granted
- Verify lockout
- Tag must identify the work being done and the person(s) who locked and tagged the control.
- Locks and tags are changed with each shift that comes on.

Work to eliminate injury and death. Follow proper procedures at all times!

IMPORTANT!

Be sure all mechanical components are brought to a zero energy state including all spring driven devices, cylinders, accumulators, drive shafts, pulleys, rollers, gears, etc., prior to entering the machine and performing the work. Never attempt to perform repair, maintenance, or troubleshooting work on or in proximity to energized mechanical components.

IMPORTANT!

Block up and support parts as necessary to prevent any unexpected motion when performing maintenance.

4.2.2 Fire Safety During Maintenance And Repair

Observe all regulations on fire safety. Sources for fires include, but are not limited to the following:

- sparks from grinding
- flames and molten metal from welding or torching
- electrical arcing
- spontaneous combustion
- smoking.

Before starting any work take the following steps to prevent a fire hazard:

- Properly dispose of rags with combustible material to avoid spontaneous combustion.
- Move flammable materials 10 m (33 ft) or more away from any fire hazard.
- Clean up all debris.
- Clean up all oil spills and leaks.
- Remove any source of flammable gases, liquids or solids.
- Use proper electrical grounding techniques for welding.
- Provide adequate fire extinguishing equipment; inspect such fire equipment regularly.
- Arrange for qualified personnel to guard against fire while welding, cutting, or heating operations are being performed, as well as a sufficient period of time after the work is completed.
- Protect yourself and others from sparks with proper personal protective equipment and clothing.

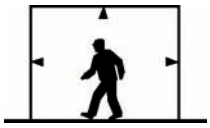
4.2.3 Preventive Maintenance

Preventive maintenance will both increase safety and be economically beneficial. It is more safe and economical to replace a worn part during a scheduled shut-down than to repair a broken device in the middle of a production cycle. A machine or device that is not in proper condition, and that has been left without regular maintenance and inspections, is a safety risk for its user. For instance, without lubrication a bearing may fail, bringing a production line down. Furthermore, the hot bearing may present a fire hazard or cause skin burns.

Some preventive maintenance suggestions for a machine include:

- observing the maintenance and lubrication instructions of the machine and equipment suppliers
- keeping the machine and surrounding area clean and orderly
- monitoring the vibration levels of the machine and to help predict bearing failures
- monitoring the power consumption of motors to help detect early failures
- repairing all leaks as soon as possible to prevent more serious conditions that eventually may occur
- monitoring the condition of pipes and tubes enclosed in ducts; repairing possible leaks

4.2.4 Confined Spaces



A confined space means a space that:

1. is large enough and so configured that a person can enter and perform assigned work; and
2. has limited or restricted means for entry or exit (for example, the crushing cavity, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and
3. is not designed for continuous employee occupancy.

Certain confined spaces may require an entry permit program to allow entry. Be sure that all applicable procedures are followed. If you have questions contact your Crushing Plant supervisor for more information.

DANGER:

Confined spaces may contain high concentrations of gases which may cause injury or death. Follow all established safety procedures.

4.3 ELECTRICAL SAFETY DURING MAINTENANCE AND REPAIR

4.3.1 General

DANGER:

Follow all established lockout procedures.

For maintenance work, disconnect all devices from electric, pneumatic and hydraulic power sources and follow lockout procedures.

The lockout instructions, locks, tags and the blocking/restraining devices provided are designed for your protection. Your responsibility is to follow the program and use the proper equipment.

Remember:

- Follow procedures
- Stay alert
- Do not take anything for granted
- Verify lockout
- Tag must identify the work being done and the person(s) who locked and tagged the control.
- Locks and tags are changed with each shift that comes on.

Work to eliminate injury and death. Follow proper procedures at all times!

Be sure all electrical components are brought to a zero energy state including capacitors and similar electrical devices.

Before maintenance work:

– Be sure all control power supplies are turned off, disconnected, and lock out procedures have been followed.
– Confirm that **ALL** power sources are disconnected. Some electrical devices may be supplied by more than one power source.
– Be aware that multiple voltage levels may exist in some junction boxes.
– Ensure that during lockout procedures, locks and signs are appropriately attached, and subsequently removed only by the person who installed them after all work is completed. Follow Crushing Plant lockout instructions for placement and removal.
– For testing and troubleshooting, clear all personnel from the machine just as though the machine were being returned to production mode. Reactivate the necessary power supplies and perform the tests. Then again disconnect all power supplies and follow lockout instructions before further maintenance work is performed.
– Be sure electrical supply voltage is disconnected before drilling into any structural frame members. Electrical cables may be inside.
– Verify that electric motors are disconnected before starting any maintenance work, thereby preventing the supply of electricity to the motor. Generally the disconnects are located in the drive control room. Each person performing maintenance work should install their lock and sign the lockout tag.

4.3.2 Electrical Fault Situations

Electrical faults may be caused by component failures such as loose or damaged wiring.

Diagnostics are provided through pilot lights, alarms, and help messages.

IMPORTANT!

Electrical connections can and do loosen due to vibration in transit and thermal expansion of the wires and lugs in operation. This is especially trua after initial delivery, break in and after major relocation. Loose connections increase current draw, which can result in false trips, intermittent circuits, and burned-out components. As part of the start-up, check and retighten as necessary all electrical connections in the elctrical enclosure. Repeat after the first forty to fifty hours of operation. This work must be performed by properly trained personnel.

IMPORTANT!

Improper phasing will damage backstops in conveyor drive reducers and may damage hydraulic system components.

4.3.3 Program Changes

WARNING:

Changes to Metso Minerals' supplied control program should be made only by Metso Minerals personnel. Faulty program code may cause the machine to behave unexpectedly. Any changes to interlock circuitry must be made with extreme caution and be reviewed and approved in writing by Metso Minerals before implementation.

An electric outlet may be supplied in the logic center and control cabinet for programming purposes only. Do not connect any electrical tools to this outlet. The tool may cause electrical disturbances in the machine control system. This could alter the machine control program and cause unpredictable machine operation.

NOTE: Do not use the logic center or control cabinet's outlet for anything other than a programming device!

4.4 HYDRAULIC SAFETY DURING MAINTENANCE AND REPAIR

DANGER:

Follow all established lockout procedures.

For maintenance work, disconnect all devices from electric, pneumatic and hydraulic power sources and follow lockout procedures.

The lockout instructions, locks, tags and the blocking/restraining devices provided are designed for your protection. Your responsibility is to follow the program and use the proper equipment.

Remember:

- Follow procedures
- Stay alert
- Do not take anything for granted
- Verify lockout
- Tag must identify the work being done and the person(s) who locked and tagged the control.
- Locks and tags are changed with each shift that comes on.

Work to eliminate injury and death. Follow proper procedures at all times!

Before proceeding with any repair, maintenance or diagnostic procedures on the hydraulic system, bring all components to a zero energy state, including cylinders,

accumulators, spring loaded hydraulic devices, circuitry between valves and actuators, etc.

- Mineral and other oils and additives can cause skin irritation. Inhaled oil mist can also cause internal irritation, headache or nausea. Avoid repeated exposure to these materials. Use appropriate personal protective equipment.
- Purge entrapped air from the hydraulic system. Entrapped air in the hydraulic system can cause erratic and unexpected movements.
- Oil mist in the work area or oil leaking onto floors and walkways will cause a serious risk of slipping. Clean up all spills and repair leaks immediately.
- Hydraulic oil temperature may be extremely high;

WARNING:

Elevated temperatures levels can be hazardous and may cause severe burns. Wait until machine cools down before doing maintenance or repair.

- A mixture of air and oil mist may explode at higher temperatures. Hydraulic oil spilled on hot machine surfaces may start a fire.
- Pressurized hydraulic hoses should not be handled with bare hands since high-pressure leaks may easily penetrate the skin. Hydraulic fluid pressure in the hoses may exceed 3000 PSI/210 bar/21MPa.

WARNING:

Risk of personal injury due to high pressure fluid jets. Do not check for pressurized leaks with bare hands. Use cardboard or other appropriate techniques.

Hydraulic hoses are subject to wear and tear. Pressurized hoses tend to straighten up, bend or twist due to reaction forces. Replace all weakened or deteriorated hoses promptly. Keep hoses properly clamped and secured to help prevent being whipped by broken hoses.

- Avoid letting dirt and other impurities into the system while doing maintenance work. Use lint free cloths for cleaning the hydraulic components system.
- When changing a cylinder, or other hydraulic device, plug all open ports and hose ends. Catch spilled oil in a suitable storage device and avoid introducing dirt into the system. Dispose of all waste fluids as presented by law.
- Tighten disconnected pipe and hose couplings immediately after reinstallation. Before finishing the work, check all parts and connections that have been serviced or repaired.
- Before starting up the pumps, make sure that maintenance work is completely finished in all work areas. When starting up the pumps, stay at a distance from the areas which were repaired.
- Before opening the main valves, make sure that there is no one working between any parts of the machine, since pressurization of the system may cause machine motion.

– Once the system is in the pressurized state, test repaired system for proper operation before putting system back into production.

Check the system for possible leaks after repair. Leaking fittings must not be tightened when under pressure. To seal threaded fittings, use appropriate sealing rings or a sealing compound suitable for hydraulics.

4.5 GENERAL MAINTENANCE WORK

The following are some of the do's and don'ts to be followed as part of normal Crushing Plant procedures

– Do not perform any maintenance on moving machinery. This includes such items as adding lubricating oil or greasing parts while the crusher is in operation.

– Never clear a jam on or in the feeder, crushing cavity or conveyors when system is energized.

– Do not put hands or feet on the release cylinders, which protect the crusher from tramp iron overloads while the crusher is in operation.

– Do check the manufacturer's recommendations for periodic maintenance procedures. These maintenance procedures are designed to not only avoid damage to the equipment but also to avoid harm to the Operator.

– Do avoid spillage around the crusher. Operator should make it a habit to keep the area immediately adjacent to the crusher free from spillage, which could cause people to trip and fall.

– Never look into the crushing cavity while crusher is in operation.

– When using a crane or other lifting device to raise or lower a load keep all personnel clear of the area.

– Never detach a lifting device from its load until the load is securely affixed at its designation, or steps have been implemented to prevent the load from unintended shifting or falling.

– Never walk, stand, crawl or lay under any load hanging from a crane or other lifting device.

SAFETY

SAFE LIFTING OF MACHINE

This decal is positioned at the points where the whole machine can be safely lifted from.

SAFETY

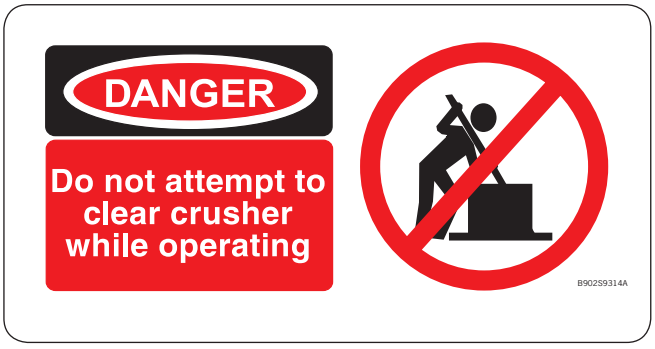
INSPECTION PROCEDURE

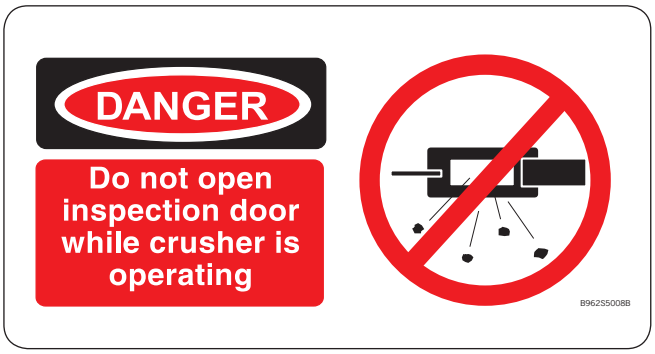
When inspecting the crusher, the following procedure must be followed:–

1. **All inspection/maintenance work must be conducted by trained and competent personnel and in line with Barmac maintenance instructions.**
2. **The crusher must be isolated using the safety interlock system (see page 5-6) before any inspection or maintenance activity is undertaken.**

NOTE: If the operation of ancillary equipment (e.g. feeders, conveyors) present any danger to this inspection or maintenance activity, these must also be isolated.

SAFETY DECALS





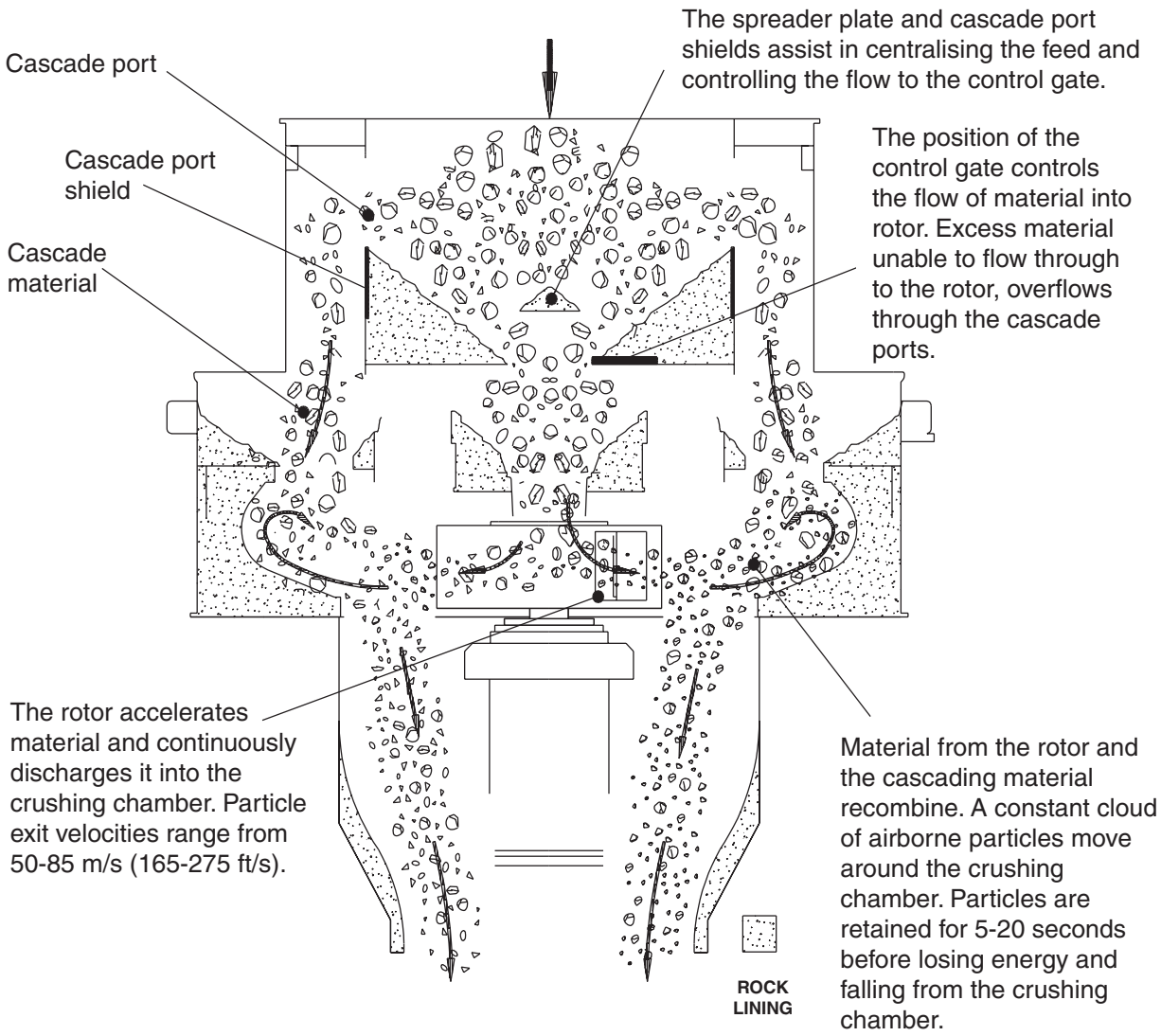
WARNING Take note of safety decals placed about the crusher. These identify specific danger areas.

Principles of Operation

The Barmac B1100 Series autogenous VSI crusher uses a rock lined rotor that acts as a high velocity dry stone pump hurling a continuous rock stream into a stone lined crushing chamber.

Material fed into the top of the machine is accelerated in the crusher's patented rock lined rotor, achieving exit velocities of up to 85 metres (275 feet) per second. The rotor continuously discharges into the crushing chamber. This process replenishes the rock lining, while at the same time maintains a rock-on-rock chain reaction of crushing and grinding.

A second stream of material in a controlled quantity can be cascaded into the crushing chamber turbulence causing a supercharging of the particle population within the chamber, improving the energy transfer. This, in combination with other variables of rotor diameter and speed and crushing chamber profile, enhances power efficiency, reduces wear, plus provides an efficient means of controlling the grinding and crushing action, to either maximise or minimise fines.



PRINCIPLES OF OPERATION

CONTROL OF CRUSHED PRODUCT SIZES

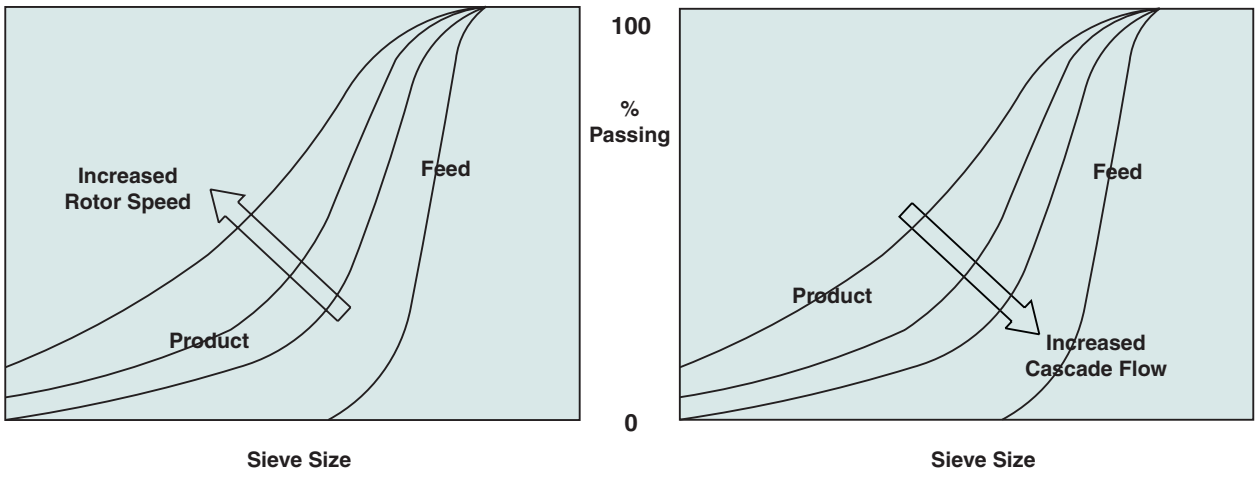
The crusher offers a number of controllable variables which affect the final product grading.

ROTOR SPEED

Increasing rotor speed increases the particles kinetic energy and increases the reduction achieved.

CASCADE

Increasing the cascade flow decreases the reduction ratio achieved whilst increasing the capacity of the crusher.

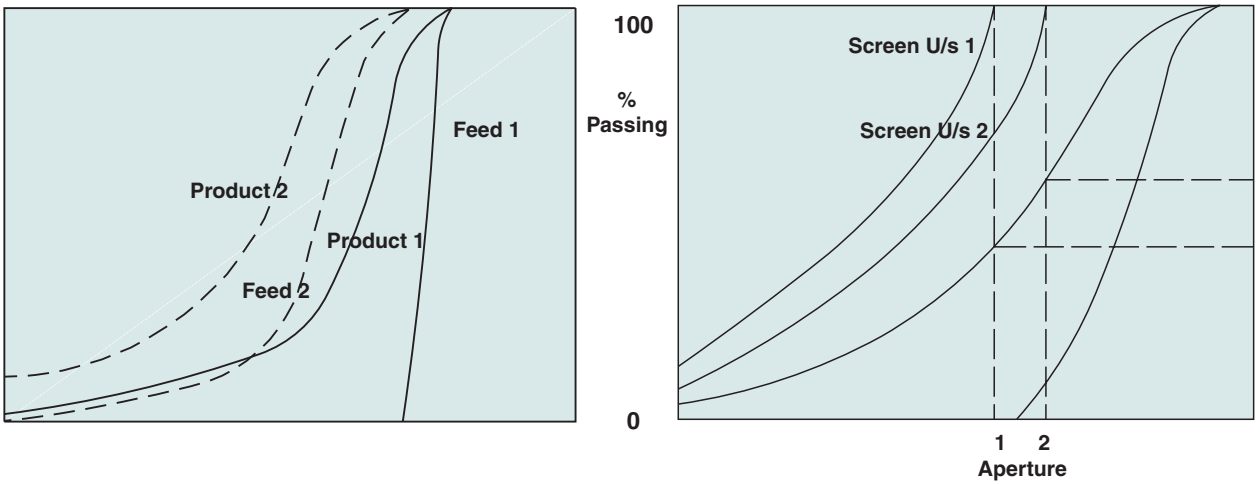


FEED GRADATION

Changing the size distribution of the feed to the crusher will affect the size distribution of the crushed product.

SCREEN APERTURE

When operating in closed circuit the final product size produced by the crusher is controlled by the screen aperture.

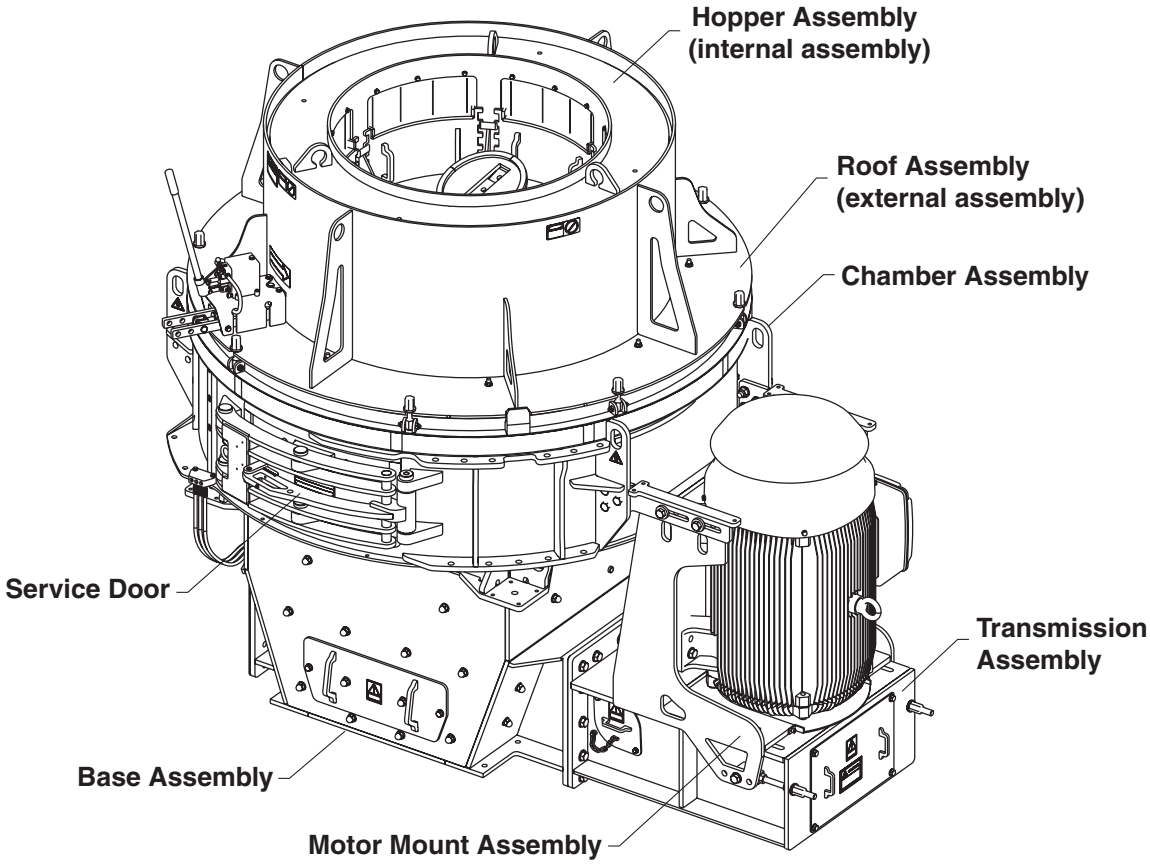


Rotor Diameter: Different rotor diameters are available for some models. Changing to a larger diameter rotor effectively increases the tip speed and the effect is similar to increasing the rotor speed with the addition that the longer grinding arm in the rotor produces more fines than a smaller diameter rotor with the same tip speed.

Component Identification

This section has been included to help you identify the various components and parts of your crusher. These terms will be used throughout the manual and parts listings that are provided.

General Description



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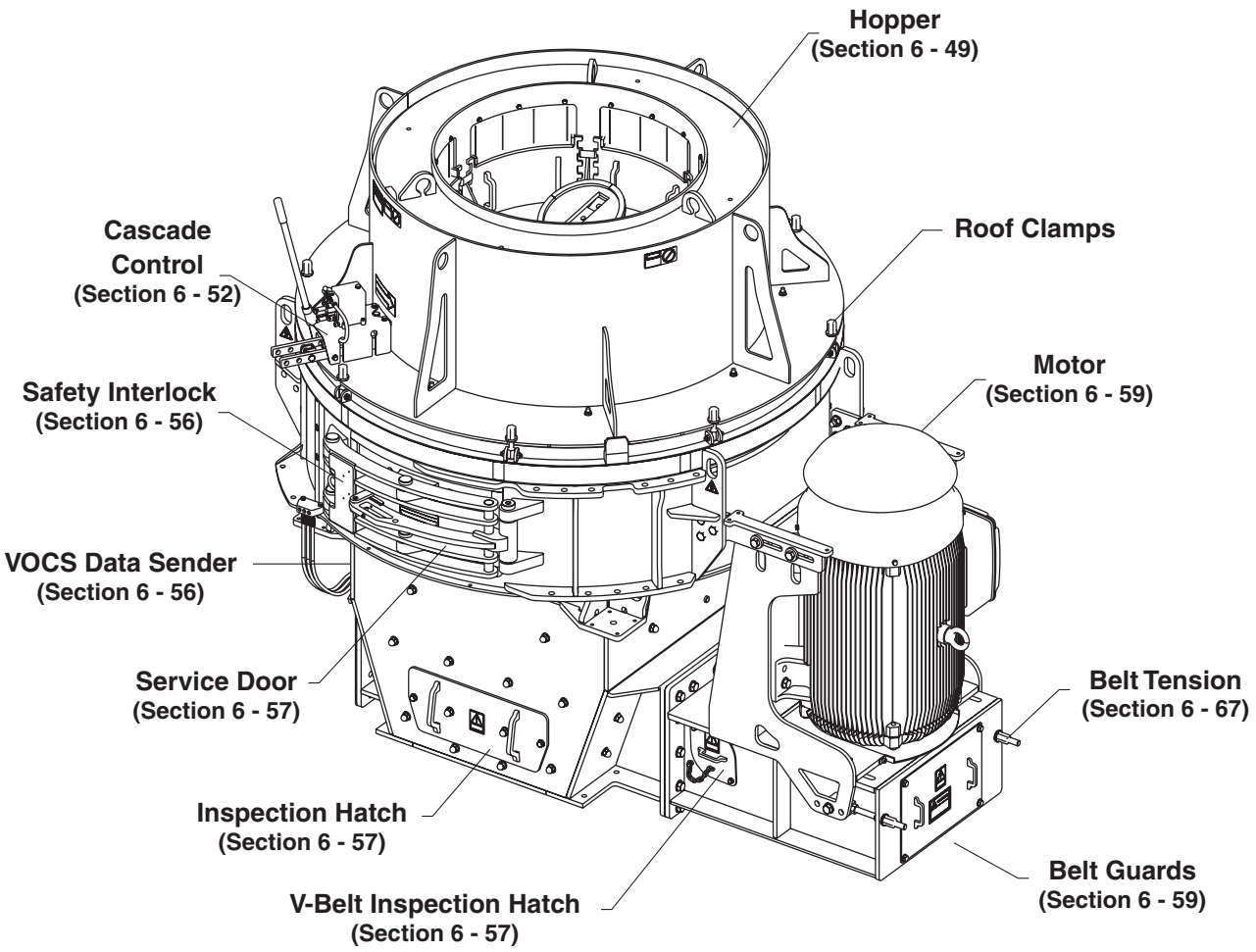
COMPONENT IDENTIFICATION

EXTERIOR OF CRUSHER

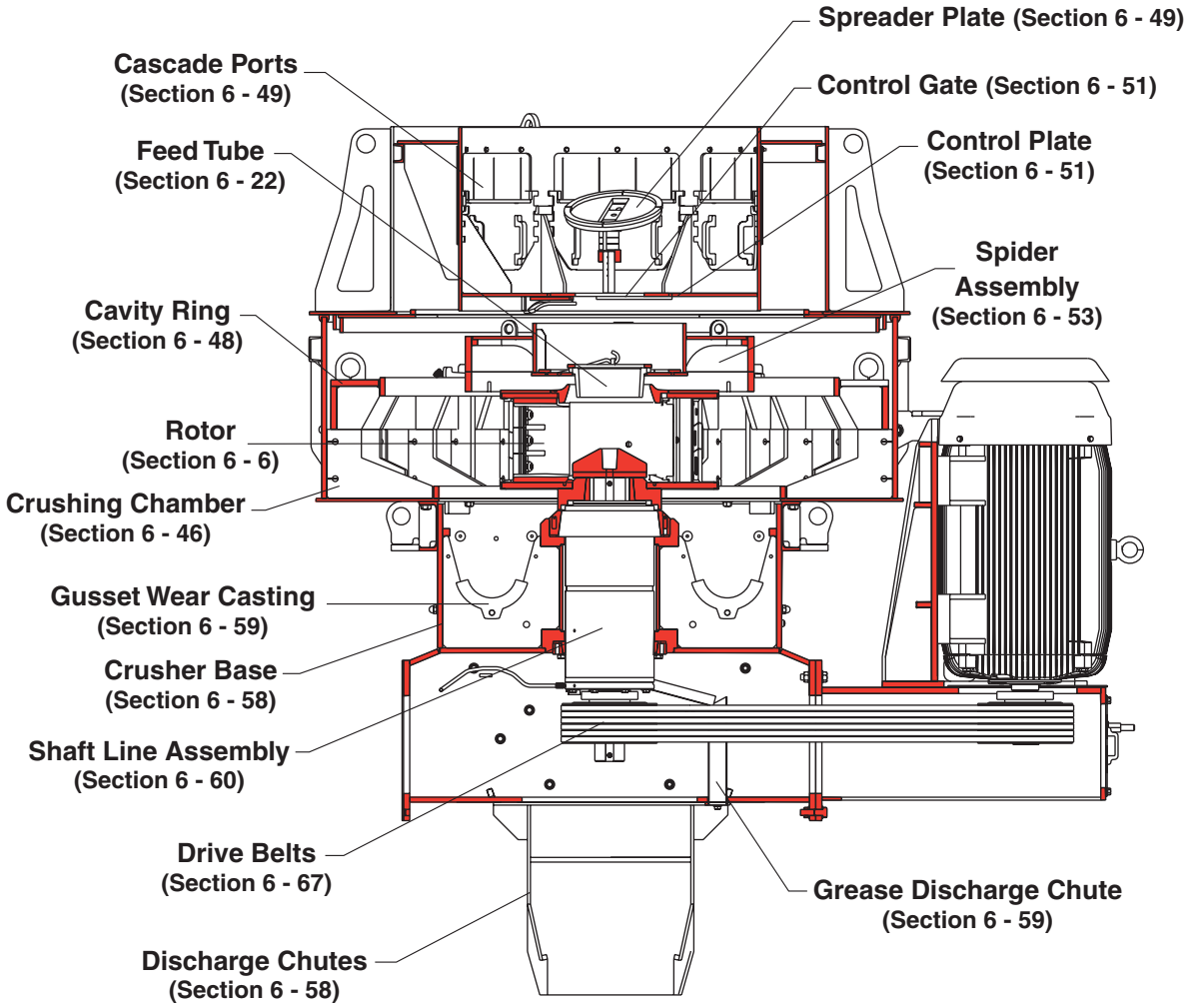
The numbers that appear in brackets refer to the section of the manual that details the inspection and service instructions for each part or component.



COMPONENT IDENTIFICATION

INTERIOR OF CRUSHER

The numbers that appear in brackets refer to the section of the manual that details the inspection and service instructions for each part or component.



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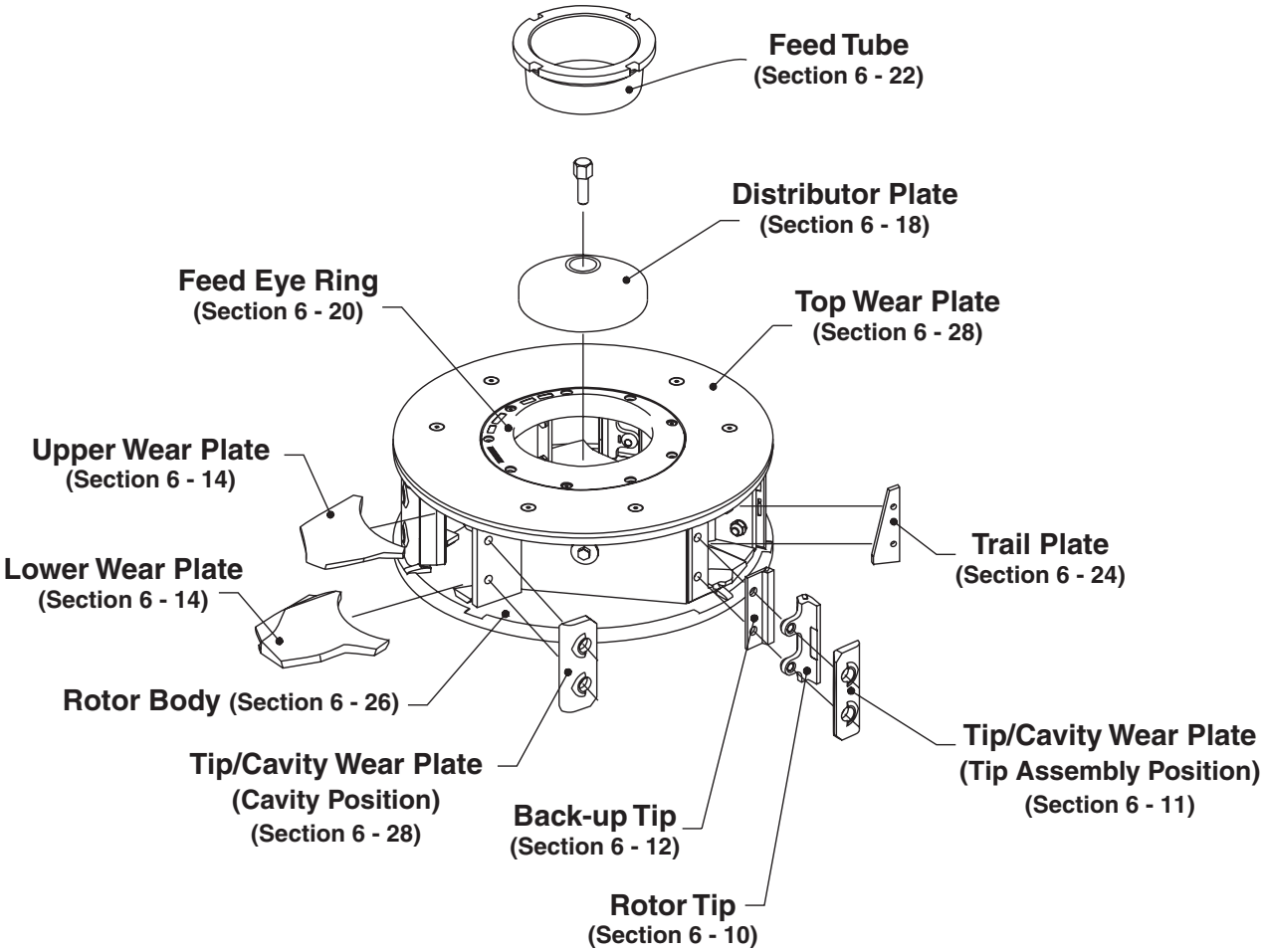
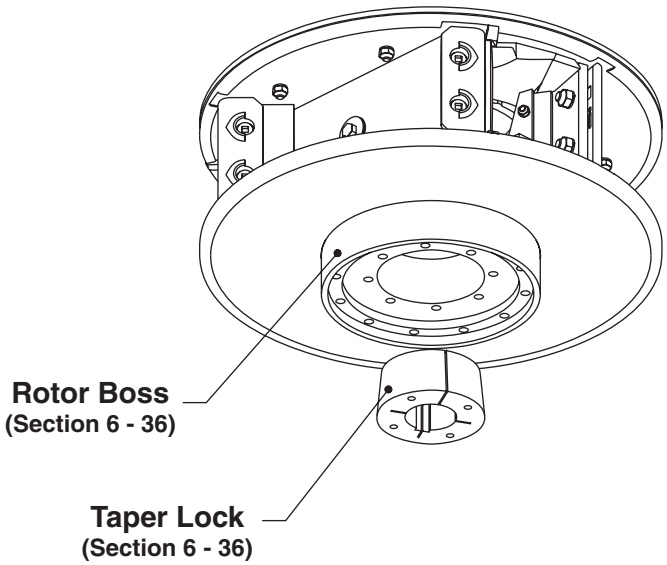
COMPONENT IDENTIFICATION

ROTOR AND WEAR PARTS

Standard

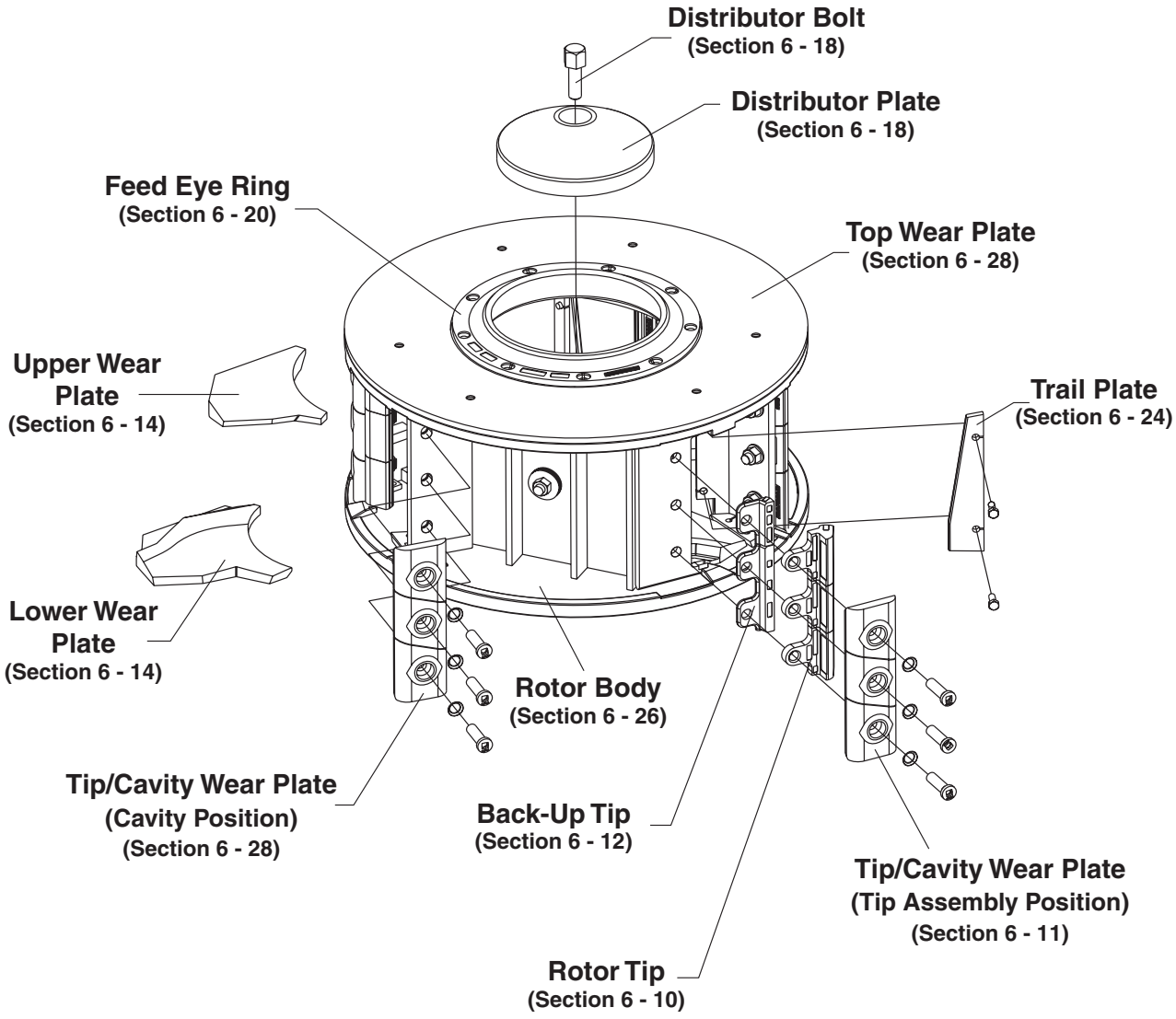




COMPONENT IDENTIFICATION

ROTOR AND WEAR PARTS

Deep

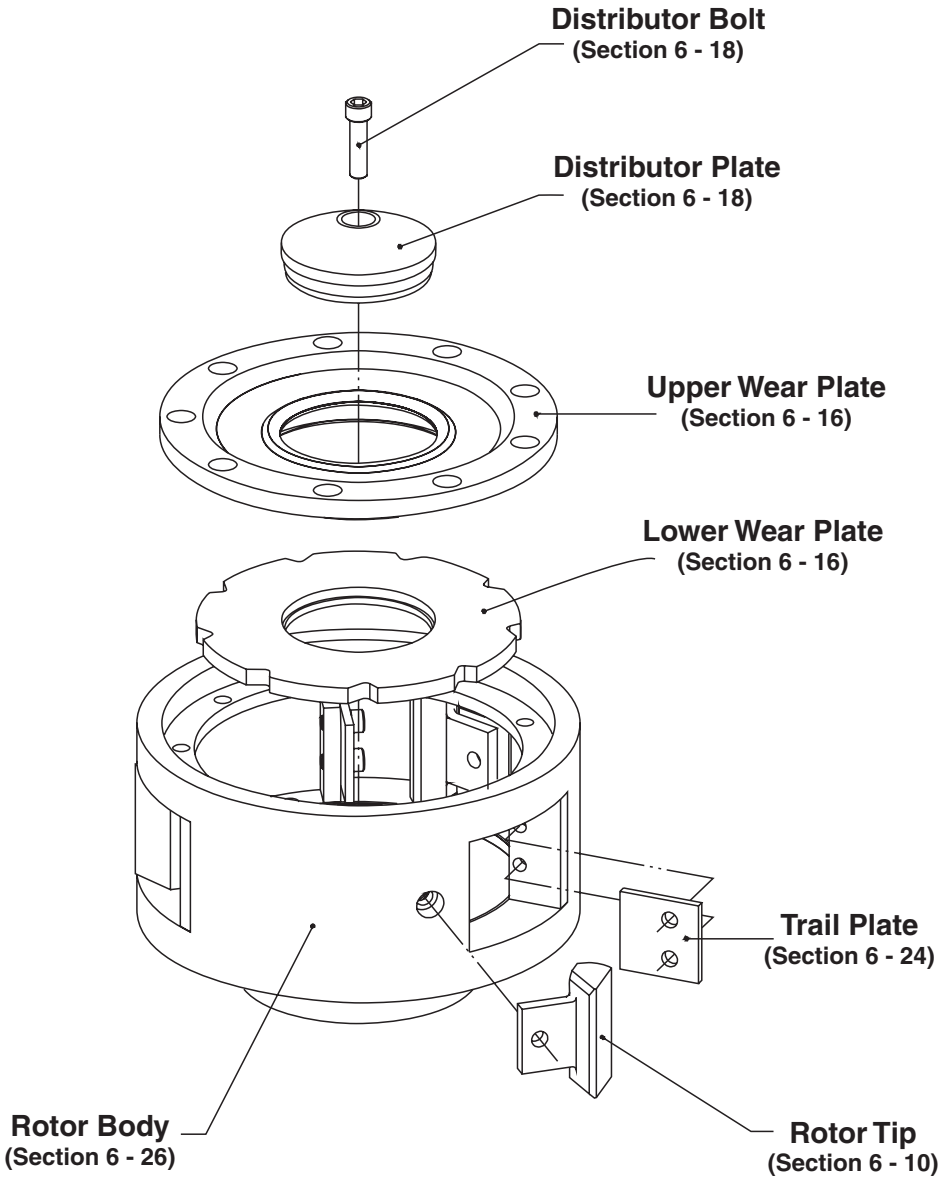


NOTE: Some deep rotors can be fitted with different rotor tip and tip/cavity wear plate options other than represented above. Please contact your Barmac representative for available options.

COMPONENT IDENTIFICATION

ROTOR AND WEAR PARTS

300mm



Start-up Procedure

This section describes the full start-up procedure, including the initial commissioning start-up. The start-up procedure should be used after a major repair such as shaft line assembly replacement or crushing chamber refurbishment has taken place.

BEFORE START-UP

1. Be completely familiar with the crusher, take the time to read this manual.
2. Have all electrical connections checked, including the operation of the vibration control system. (See Vibration Control System instruction manual).
3. Check pulley alignment and drive belt tensions. (See Belt Tensioning 6-67).
4. **Check rotor rotation – it must be counter-clockwise when viewed from above.**

   CAUTION **Severe damage to the rotor will result if the rotation is incorrect.**
5. On dual motor drive machines it is essential that the direction of both motors is correct and the same. If no electronic test equipment is available to prove this, the wedge belts must be removed and the motors started in the normal way, the direction of each motor can then be checked. When all connections are complete ensure all pvc shrouds are refitted and any unused holes are blanked off to maintain the IP rating of the enclosure.
6 Check that a safety interlock device is connected and functioning. (See Safety Interlock instruction manual).
7. Make sure all bolts in the rotor, crusher and main support frame are tightened to the correct torque. See installation book for correct torque details.
8. Loosen the transport bolts located through the rubber anti-vibration mounts by two full turns if fitted. (These bolts are marked with red paint).
9. Ensure that the feed tube assembly is centralised. (See section 6-53).
10. Check that all wear parts are correctly fitted in the rotor. (See section 6-6).
11. Remove all tools from on or within the crusher.
12. Ensure that all guards, doors, hatches and safety pins are in place.
13. Ensure grease hoses are full of grease before connection to the shaft line assembly. This includes the hoses between the shaft line assembly and the base as well as the extension hoses up to the door if fitted.

INITIAL START-UP

1. Confirm ammeter is operating accurately. (Use clip-on ammeter to check accuracy).
2. Run the crusher with rotor fitted without load for 30 minutes. Apply a single application of grease to the grease point. (See greasing procedure section 6-2).

Continued ▶

START-UP PROCEDURE

3. After 30 minutes running, stop the machine, remove belt guards and check shaft line assembly temperature. (Use a magnetic thermometer or if fitted, check thermal couples). The temperature should not exceed 70°C [160°F]. If temperature exceeds this, continue to run machine with no load for a further 30 minutes and check again. If high temperatures continue contact your service centre for advice. If temperature is within normal range (see section 4-3), replace guards.

4. Inspect rotor and cascade assembly. Ensure that all rotor parts are in place. Ensure that the feed tube is still centralised in the feed eye ring. (See section 6-53).

5 Test vibration control system. (See Vibration Control System instruction manual).

INITIAL FEEDING OF CRUSHER

1. The machine can now be run with a load. Feed material should be no larger than the maximum allowable feed size for the crusher model being commissioned.

2. Feed a small sized chip or all-in product, preferably 5mm [¼ in.] for the first half minute or so. A few cubic metres/yards of material is enough. This allows an even build-up of stone in the rotor and promotes good balance.

3. If coarse feed must be used at the start, some vibration can be expected for several hours until fines are able to work their way through the voids in the initial rotor build-up and bring the density of each rotor build-up into equilibrium.

4. When first feeding the rotor there will usually be an 'out of balance' stage for about 30-60 seconds. Do not stop the feed to the rotor at this point but feed it as much as possible until the vibration settles down.

   In normal operation there is intermittent detectable vibration about 30% of the time. This can be felt by touching the machine and is most noticeable with largest feed sizes. This is due to stone lodging by one rotor tip, causing a build-up and then being worn away. The condition is normal and no cause for concern provided the machine returns to normal running after a few seconds.

AFTER 10 MINUTES

1. Align the spreader plate under conveyor discharge so feed falls in an even curtain around the spreader. (See section 6-49). The feed should fall squarely through the control plate feed opening (i.e. not at an angle). This stabilises rotor feed. Watch for involuntary cascading through material being directed towards the cascade ports in the feed hopper. Adjust the cascade port shields if necessary. (See section 6-49).

2. Check motor power draw. If motor(s) are overloaded, reduce feed volume or adjust cascade control until load is corrected. (See section 5-2). If dual drive motors are running at different amps see belt tensioning (section 6-67).

START-UP PROCEDURE

AFTER 30 MINUTES

1. Stop machine and check build-up in rotor. For ideal build-up see rotor tuning (section 6-30).
2. Check crushing chamber build-up. (See section 6-46 for ideal build-up).
3. Make sure feed tube is in correct position in rotor, i.e. central in rotor feed hole and extending into rotor. (See section 6-53).
4. Check that rotor tip assemblies are intact and tight.
5. Check feed eye ring has not turned or lifted.
6. Check belt tensions. (See section 6-67).

AFTER 4 HOURS

1. Check build-up in rotor, crushing chamber and base.
2. Check bearing temperatures. (See below).
3. Check belt tensions.
4. Grease at the end of the shift, and perform daily inspections as listed.
5. Once the machine has settled down to normal running, adjustment of the cascade can be undertaken. (See section 5-2).

BEARING OPERATING TEMPERATURE

Normal bearing temperature is 30° to 40°C [54° to 72°F] above feed material or ambient temperature. A short duration temperature rise of approximately 10°C [18°F] can be experienced when bearings are lubricated.

The maximum permissible bearing temperature for continuous running is:

70°C [160°F] – Normal temperature service.

150°C [300°F] – High temperature service.

Operation

During operation it is important that the operator pays attention to the following:

1. **AMMETER READING** – watch for major fluctuations.

   High amps could indicate high feed rates, extreme build-up in the chamber or the base, blocked discharge chutes, incorrect cascade adjustment, mechanical or electrical problems.

   Low amps could indicate low feed rates, incorrect cascade adjustment, drive belt slippage, electrical problems.

   Unbalanced amps in a dual drive unit could indicate incorrectly tensioned drive belts, electrical or mechanical problems.

2. **NOISE LEVELS**

   Increased noise levels could indicate improper function of the crusher.

3. **VIBRATION**

   A vibration protection system protects the machine from the effects of severe vibration. With this installed the machine will be shut down and/or an alarm sounded if vibration becomes excessive. In normal operation, the crusher has a slight vibration which varies from time to time, due to the wear and replacement of rock build-up within the rotor. As rock build-up wears away it is continually replaced. Consistent or excessive vibration should always be investigated. A likely cause is breakage of a rotor tip or uneven build-up with the rotor. High pitched vibration may be caused by a poor rotor taper lock seating or a bent shaft.

   All machines must have a Vibration Protection System properly fitted and connected. Machines without a vibration protection system will not be covered by warranty.

4. **FEED CONDITIONS**

   Changes in feed conditions could require adjustment of the feed spreader plate, cascade port shields and control gate in the feed hopper. Increases in moisture content may increase build-up in the rotor, crushing chamber and base. Observing the discharge of the crusher will often warn an operator of build-up problems.

5. **DUST EMISSION**

   The crusher should not emit dust while being fed material. If the crusher is emitting dust, likely causes are insufficient feed or incorrect build-up in the crusher top or base.

OPERATION

FEED CONTROL

The aim of feed control is to govern the ratio of feed to the rotor and cascade. The reason for controlling this feed distribution is very dependent on the product requirement of the operator.

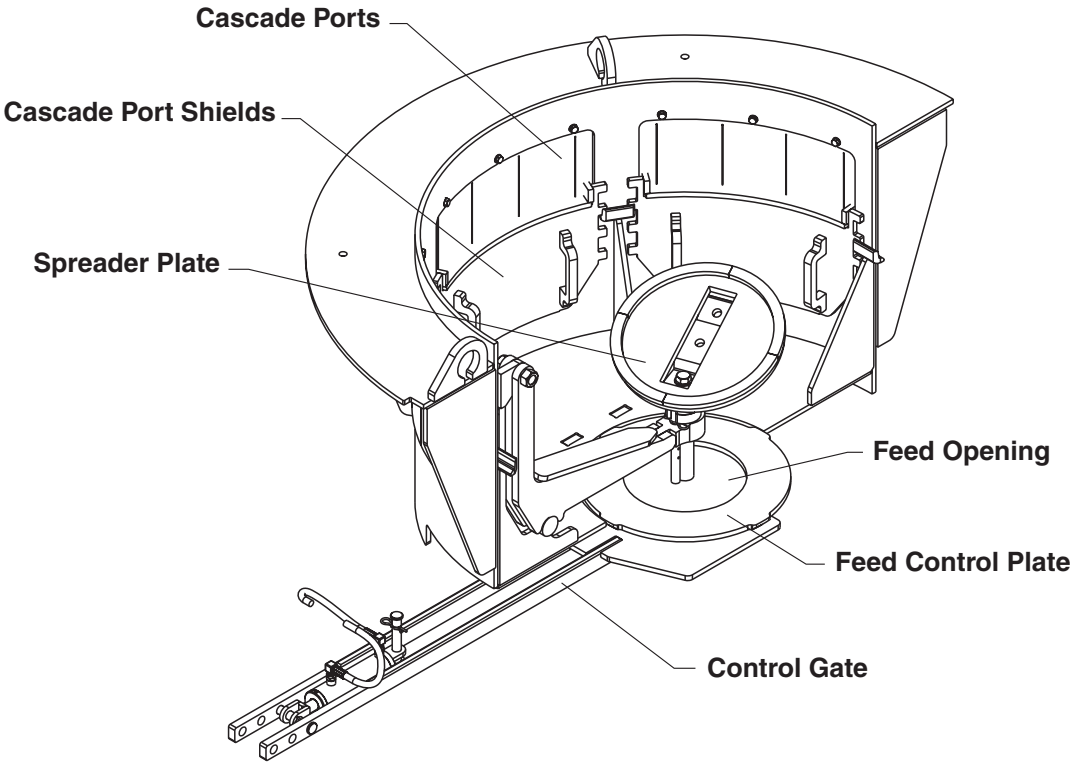
The following describes the different uses of the control:–

1. To protect the motor(s) from overload.
2. To achieve the absolute highest efficiency of crushing (reduction) by using the optimum cascade ratio and the consistent running of the motors at full capacity.
3. To maximise the production of a particular size fraction by control of the product gradation produced. Variation of the cascade ratio will allow complete control of the gradation curve.

The cascade volume is varied by adjustment of the feed opening. Coarse adjustment is made by selection of the correct feed control plate. Fine adjustment is made by movement of the control gate.

NOTE: The feed opening should not be reduced to a point where bridging of the feed opening may occur. See below.

Adjust the spreader plate so that it is positioned directly under the feed material flow. Adjust the cascade port shields so that material cascades evenly through 360°. (See section 6-49).



OPERATION

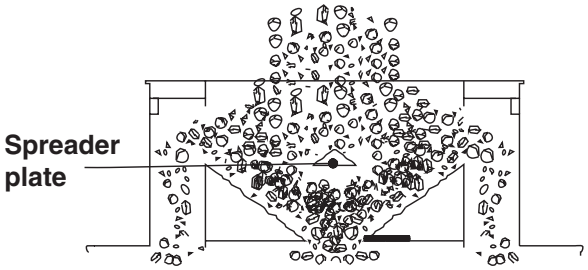
FEED CONTROL

CASCADE CONTROL

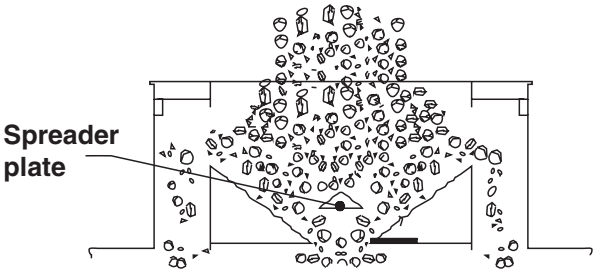
In some situations when the cascade is being used to its maximum, the flow to the rotor can be erratic (wildly fluctuating ammeter) and in extreme cases will seem to be permanently restricted (lower amps), even after some time of normal flow (normal amp reading).

This phenomenen will normally only occur when the feed hopper is full and the cascade control gate has been closed to restrict the flow of material to the rotor.

To eliminate this erratic feed or restricted flow, adjustment of the height of the feed spreader plate will be required. (See section 6-49). This simple adjustment of height provides a vortex flow (see diagram below) that eliminates the weight of material which with some feed gradations and shape combinations causes the stalling of the flow through the control gate opening.



RESTRICTED FLOW

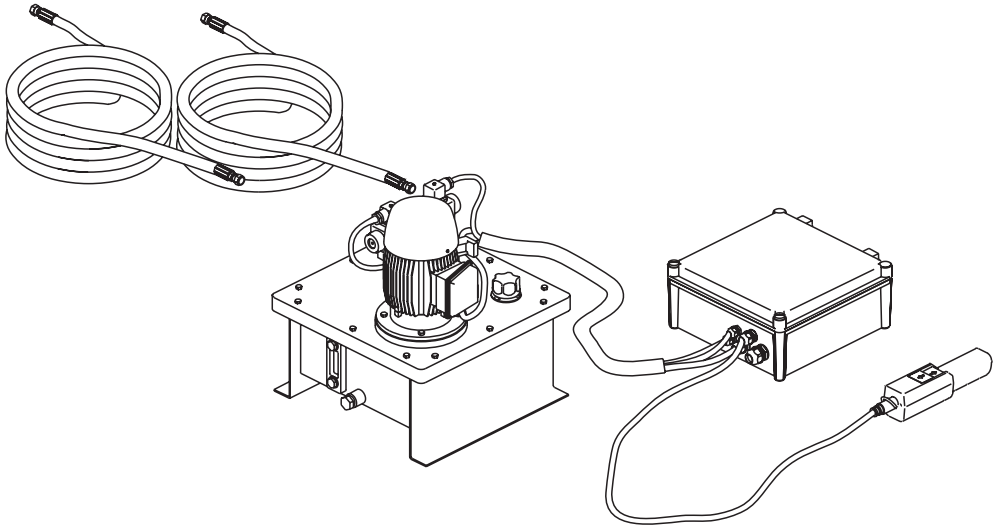


SPREADER PLATE HEIGHT ADJUSTED

OPERATION

HYDRACASCADE ELECTRIC/HYDRAULIC PUMP (Optional)

The electric/hydraulic pump is an optional device designed to operate the hydracascade hydraulic ram, thereby controlling the cascade to rotor feed in the crusher.

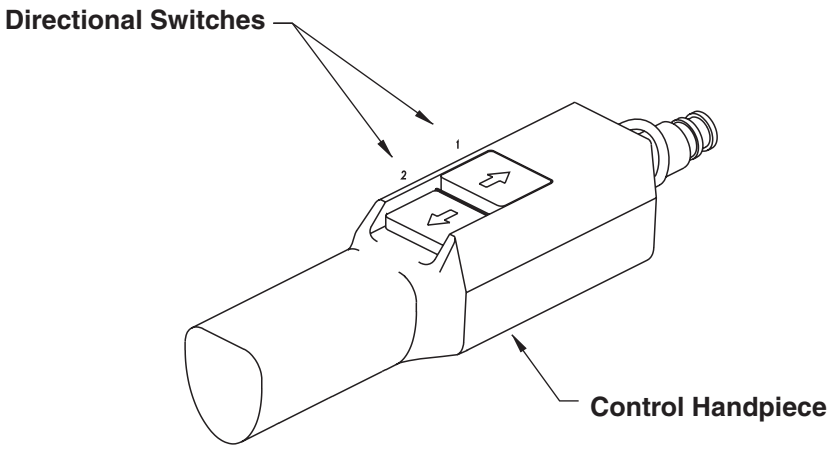


OPERATION

1. Pressing switch one will activate pump and cause fluid to flow. Direction of ram movement will depend on which way round hoses and solenoids are connected.
2. Pressing switch two will cause the fluid to flow in opposite direction to give opposite ram movement.

NOTE: 1. Motor only runs when directional switch is pressed.

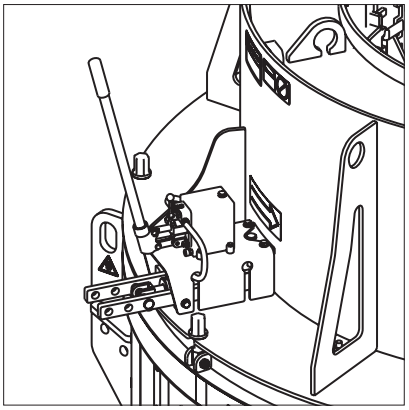
2. Both switches cannot be pressed at the same time.



- For further information See Hydracascade Electric/Hydraulic Pump Operation and Service Manual (P399).

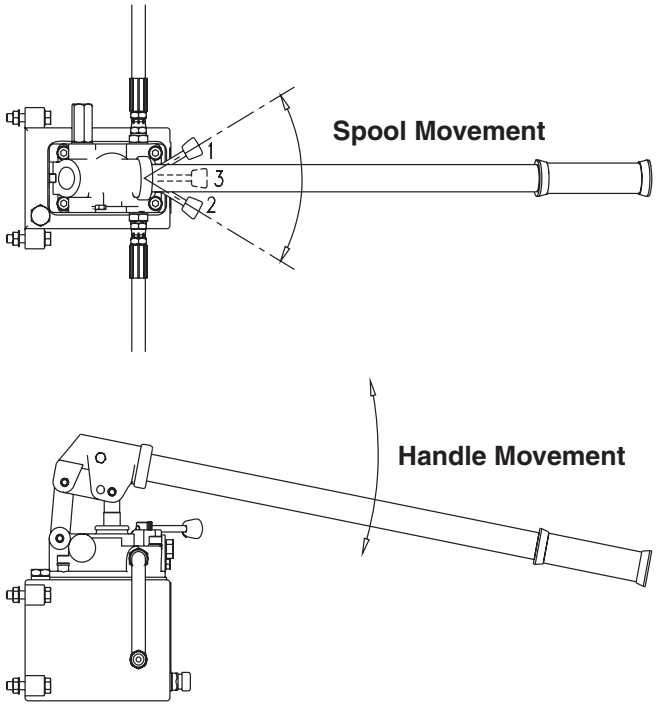
OPERATION

HYDRACASCADE HANDPUMP (Optional)



The hydraulic handpump is an optional device designed to operate the hydracascade hydraulic ram, thereby controlling the cascade to rotor feed in the crusher.

OPERATION



POSITION 1: Pumping the handle while the spool is in this position will cause the fluid to flow out of the right hand port and into the left hand port. The direction of the ram movement will depend on the fitting of the hoses.

POSITION 2: The fluid direction will be opposite in this position, which will also give the opposite ram movement.

POSITION 3: This position is off. No fluid flow will occur.

NOTE: This is a single acting pump so fluid movement will only occur with forward movements of the handle (pressure stroke).

- For further information See Hydracascade Hydraulic Handpump Operation and Service Manual (P547).

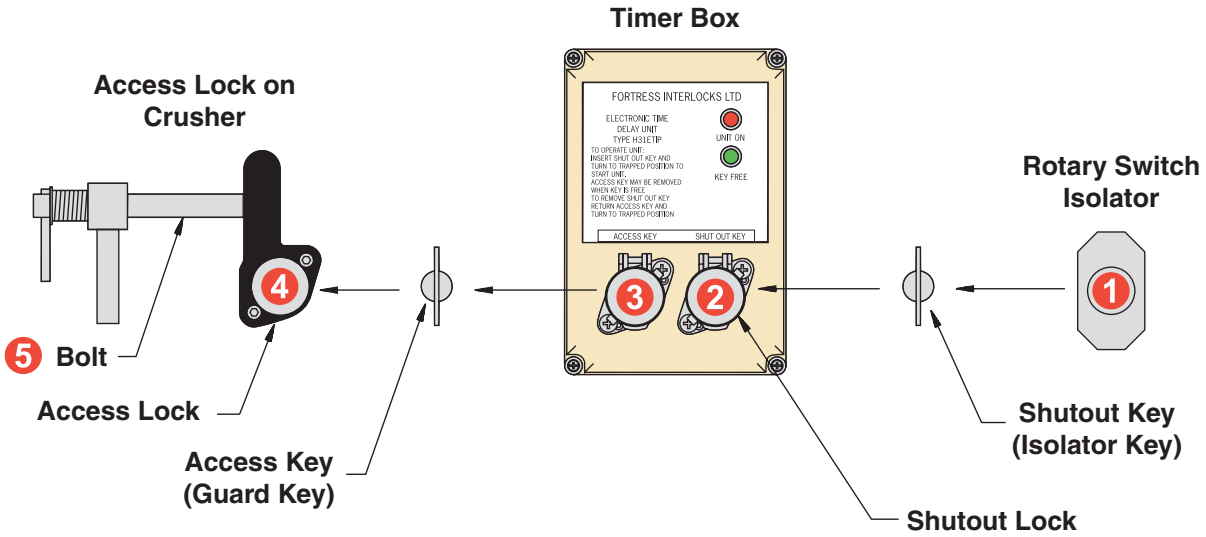
OPERATION

SAFETY INTERLOCK SYSTEM OPERATION

The Safety Interlock System is designed to prevent the crushing chamber service door or any other guards from being opened while the machine is in operation, or on shut-down, before sufficient time has elapsed to allow the rotor to stop rotating.

The interlock also prevents accidental start-up while the crusher is being serviced, or when the door is left open.

SEQUENCE OF OPERATION



❶ Turn shutout key in rotary switch and remove key.

❷ Put shutout key in shutout lock and turn.

❸ After time delay has elapsed, turn and remove access key.

⚠ CAUTION **This key must be retained by the maintenance/service engineer if access to the service door is not required.**

❹ Put access key in access lock and turn.

❺ Release bolt and open door.

To close door, engage bolt and transfer keys through reverse sequence.

(Time delay will not activate in reverse sequence).

- For further information see Safety Interlock Installation, Operation and Service Manual (P282).

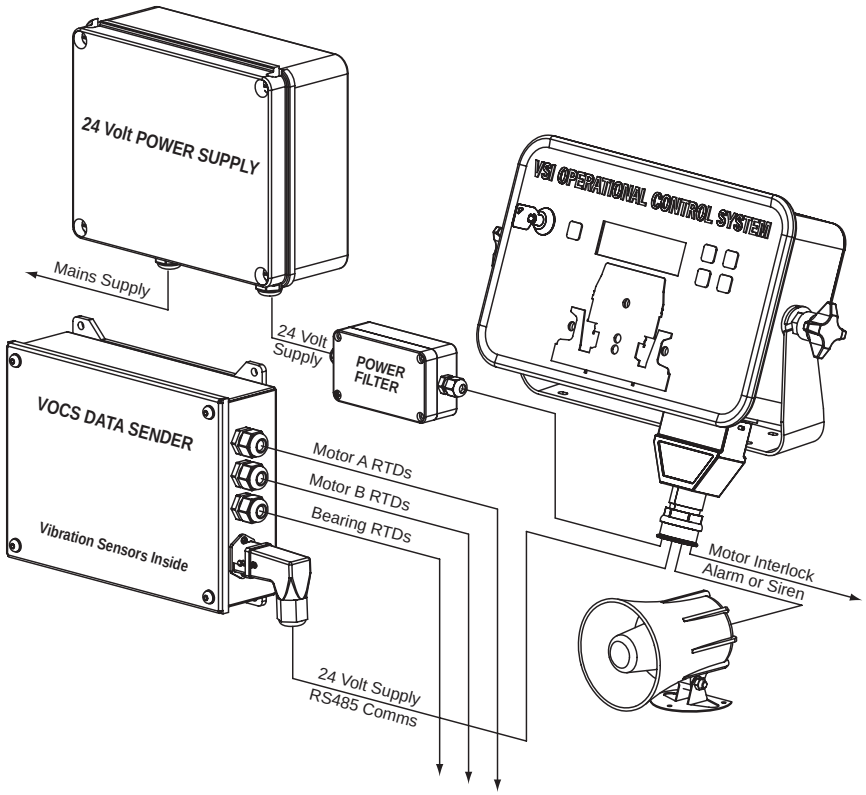
OPERATION

VSI OPERATIONAL CONTROL SYSTEM (VOCS)

The VSI Operational Control System (VOCS) has been designed to provide the operator of a Barmac Vertical Shaft Impact crusher (VSI) with constantly updated information on the operating condition of the vital mechanical components of the equipment.

The three areas monitored are:–

1. Vibration caused by an unbalanced rotor assembly.
2. Shaft line assembly running temperature.
3. Motor winding temperature.



High vibration levels can indicate damage to the rotor or cause damage to the crusher.

High bearing temperatures will damage seals, break down lubrication and ultimately destroy a shaft line assembly.

High motor winding temperatures will result in a burnt out motor or a crusher that shuts down without warning because the thermistors or starter have tripped the motor out.

In each of these areas the operator sets two values (set points). Firstly, the point at which the operator will be warned of high levels and secondly, the levels at which the crusher will be shut down.

The monitoring of these variables enables action to be taken before the crusher shuts itself down or before the bearings or rotor assembly fails, minimising down time and offering increased reliability in operation.

• For further information see VSI Operational Control System Installation, Operation and Service Manual (P611).

OPERATION

DUST CONTROL

If dust is blowing out from the bottom of the machine, this indicates that the unit is being under-fed. If the feed rate cannot be increased, close off the feed opening by adjusting the feed control plate and control gate to minimise the rush of air.

While it is not generally necessary to suppress dust within the crusher (either by dry dust collection or mist spray suppression), the turbulent activity within the crushing chamber makes it an ideal environment for the addition of small quantities of water by means of mist sprays to effectively control dust in other parts of the process plant downstream of the crusher.

However, on start-up or shut-down with no material flowing into the crusher (completing start-up of plant prior to crusher) there will be a discharge of dust caused by the crusher pumping large volumes of air.

We recommend the following:–

- Minimising the time that the crusher is running without material being fed.
- Fitting of mist sprays close to the discharge that is activated automatically from motor power on/off control so as to control the dust emission on start-up and shut-down.

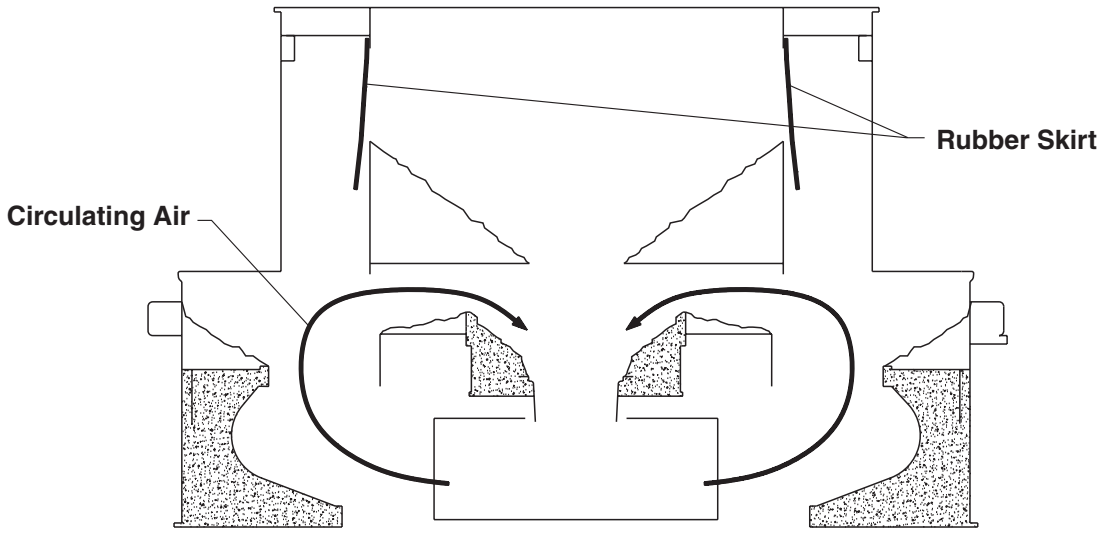


DIAGRAM OF AIR FLOW

OPERATION

ROOF LIFTER (Optional on B9100SE, B7150SE, B7160SE, B6150SE Models)

⚠WARNING

Before performing any maintenance or service work, lock out the power supply using the safety interlock system.

Before operating roof lifter ensure installation of machine is complete and all bolts are correctly tightened.

Ensure that you are familiar with the operation of the roof lifter.

Transport bolts must be fitted through anti-vibration mounts before operating roof lifter (see start-up procedure, section 4-1).

If using roof lifter on a machine with long legs and/or skid frame, the skid frame/legs MUST be bolted to concrete pad as per installation drawings.

The roof lifter has been designed to lift the roof only. All other fixtures attached to the roof must be removed before operation.

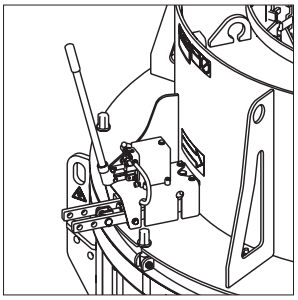
If any roof lifter parts are damaged or missing that could cause the roof lifter to be unsafe, do not use roof lifter until repairs have been made.

B9100SE - B6150SE Models

NOTE:

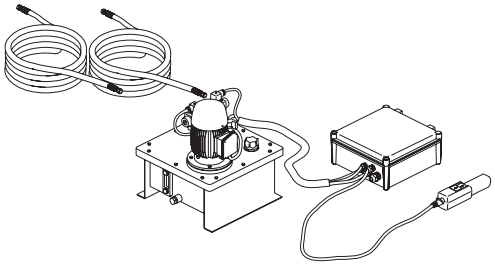
With selector valve in the rest position (spring return), the cascade gate will be in operation. B9100SE - B6150SE roof lifters are fitted with load safety valves. These safety valves will not allow the roof to be dropped, but lowered at a controlled rate.

HYDRAULIC HAND PUMP:



1. When the hand pump spool is in position 1 (see hand pump manual, P547 p. 3-1), the direction of the ram movement will depend on the fitting of the hoses.
2. When the hand pump spool is in position 2 (see hand pump manual P547 p. 3-1), the ram will move in the opposite direction.

ELECTRIC/HYDRAULIC PUMP OPERATION:



Refer to the electric/hydraulic pump manual (P399) for operation instructions.

• For further information see Roof Lifter Operation and Service Manual (P542).

Continued ▶

OPERATION

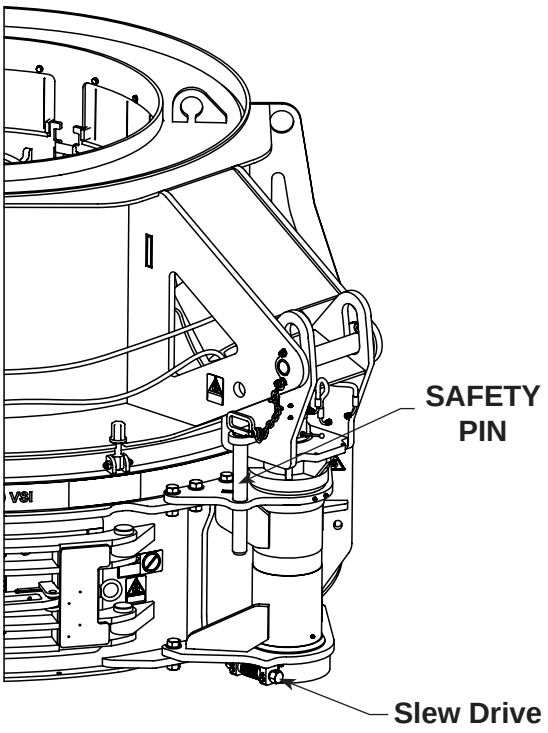
ROOF LIFTER – B9100SE - B6150SE Models

TO LIFT:

1. Shut down the crusher and lock out the power supply using the safety interlock system.
2. Remove the swing bolts holding the roof down.
3. Select the correct position of the hand pump spool to raise the roof, and fit the handle to the hand pump if not already fitted.
4. Whilst holding down the selector valve lever, pump the handle until the roof is at a sufficient height to clear the chamber and motors. FIT SAFETY PIN.
5. Fit 36mm [$1^{7}/_{16}$"] socket to slew drive and turn until roof is clear of chamber.

NOTE: If using electric/hydraulic power pack, no pumping action is required, but the selector valve lever MUST be held down while pressing the up button on the up/down remote control.

WARNING **Do not work on crusher with roof open unless safety pin is fitted.**



TO LOWER:

1. Turn slew drive until roof is aligned with chamber (locator slots on roof should align with locators on chamber).
2. Remove safety pin. Select correct position of the hand pump spool to lower the roof.
3. Whilst holding down the selector valve lever, pump the hand pump until the roof is completely closed. (The far side of the roof should close first, and then the side closest to the roof lifter).

CAUTION **Ram must be fully retracted.**

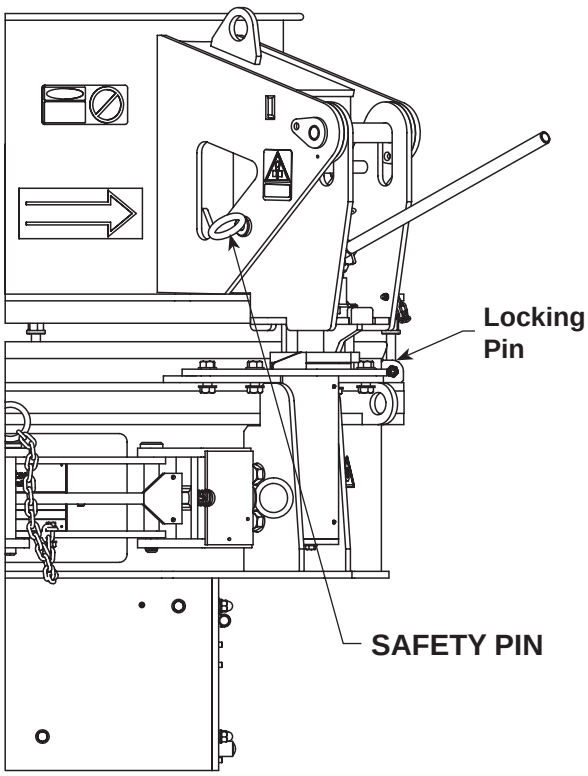
4. Tighten swingbolts to hold the roof to the chamber.
5. Re-fit safety pin to storage location on roof lifter housing.

OPERATION

ROOF LIFTER – B5100SE Model

TO LIFT:

1. Shut down the crusher and lock out the power supply using the safety interlock system.
2. Remove the swing bolts holding the roof down.
3. Screw jack release valve in fully (clockwise) using end of jack handle.
4. Fit jack handle into jack beam and pump until the roof lifter reaches the top of the slots. Keep pumping until roof is at a sufficient height to clear chamber and motors. FIT SAFETY PIN.
5. Lift roof lifter locking pin to allow roof to be turned.
6. Push roof slowly in clockwise direction (looking from top) until clear of chamber. Lock roof in the open position with roof lifter locking pin.



WARNING **Do not work on crusher with roof open unless safety pin and roof lifter locking pin are fitted.**

TO LOWER:

1. Lift roof lifter locking pin.
2. Push roof in anti-clockwise direction until aligned with chamber (locator slots on roof should align with locators on chamber). Refit roof lifter locking pin.
3. Remove safety pin. Screw the jack release valve slowly anti-clockwise to lower the roof. (The far side of the roof should lower first and then the side closest to the jack).

WARNING **Never turn release valve quickly to full open when there is a load on the jack. The load may fall uncontrolled, leading to personal injury and/or equipment damage.**

4. Tighten swing bolts holding roof to chamber.

OPERATION

AUTOMATIC LUBRICATION SYSTEM (Optional)

NOTE: The automatic lubrication system is pre-set for B9100SE models. Ensure correct settings for other models before start-up. See Automatic Lubrication Installation and Operation Manual P762 for details.

CAUTION **The autolube system has a 'power on' light on the front panel. This indicates that there is power to the system. If this is not on then the Barmac will NOT be greased and could cause major shaft line assembly failure.**

The autolube system timer will start up with the Barmac crusher when it is started. The green 'RUN' light will turn on to indicate the system is in a greasing cycle. The system will then grease to the programed specifications. Once this cycle is complete, the green 'RUN' light will turn off and wait for the next cycle.

FAULTS

If the system divider block is not receiving grease, the pump is empty of grease or there is a blockage in the system, the red 'ALARM' light will turn on and the pump will stop. This can also shut down the crusher if connected (R1 auxiliary relay). Once the fault has been rectified, the 'RESET' button can be pressed to resume normal operation. This will also initiate a greasing cycle.

MANUAL OPERATION

To grease the machine while the crusher is not operating (not recommended) the 'RESET' or 'RUN' button must be held in constantly.

CAUTION **If this reset button is continually pressed during the operation of the Barmac, there is a possibility of over-greasing, causing damage to the bearings.**

During normal operation when the Barmac is greased, there is a slight rise in bearing temperature which will be visible if the machine is fitted with a VOCS unit. This is normal and the bearing temperature will return to their normal running temperature after a few minutes.

If during a greasing cycle the pump does not receive a signal from the cycle switch, the pump will try another greasing cycle after 15 minutes and if still no signal is received after three attempts, then the red alarm light will be activated and the pump stopped. The auxiliary relay (R2) should be connected to a visible light or an audible siren that will alert the operator of the fault. It could also be connected to trip the Barmac motor if so desired.

The fault must be repaired and then the reset button pressed to clear and start the cycle.

Fault light can be caused by:

1. No grease in the pump.
2. Blockage between pump and divider block.
3. Leakage in pipe between pump and divider block.
4. Cycle switch not connected/damaged wiring.

- For further information See Automatic Lubrication System Installation and Operation Manual (P762).

OPERATION

SHUT DOWN PROCEDURE

Extended periods of running out the circuit with low feed rates to the crusher can result in undue wear to the crushing chamber and rotor body. If the crushing circuit and weather conditions permit, stop all conveyors before the crusher fully loaded. At the very least be aware of the excessive wear that takes place and minimise the run-out time.

SHUT-DOWN

1. Shut down feed device (conveyor or feeder) before the crusher.

2. Observe ammeter unload prior to disconnecting power from the crusher.

3. Time run-down time of rotor and record in the Barmac B-Series VSI Daily Log Book. Measuring the run-down time of the rotor will provide a good guide to the condition of the bearing cartridge. The commissioning records for your unit will have the rotor run-down time recorded. This will be located in the owners manual. If you cannot locate this contact your Barmac Service Engineer.

4. Prior to any servicing or maintenance ensure that the safety interlock system is activated. (See section 5-6).

Inspection and Servicing

The Barmac B1100 Series VSI is a rugged machine which is mechanically simple and extremely easy to maintain. The machine does however require ROUTINE and REGULAR inspections and attention.

The machine should not be ignored for lengthy periods, during which potentially serious damage to wear parts may remain undetected.

Long service and consistent trouble-free operation are the rewards of regular inspection.

IMPORTANT NOTE: Rotor wear parts are designed to protect the rotor body from wear. They are not involved in the crushing action of the machine. Consequently it is not possible to determine the state of wear of these parts from the product discharging from the crusher.

To ensure trouble-free operation of the crusher it is necessary to inspect the condition of the rotor wear parts and the rock build-up within the machine on a **regular basis.**

Any wear parts that are unable to complete another shift should be replaced.

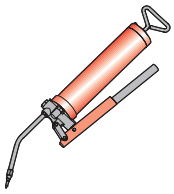
Metso Minerals recommend that you should carry out the following every 8 to 10 hours of operation:

1. **GREASE SHAFT LINE ASSEMBLY.**
2. **INSPECT EXTERIOR OF CRUSHER.**
3. **INSPECT INTERIOR OF CRUSHER.**
4. **INSPECT ROTOR**

Metso Minerals recommends the use of a Barmac B-Series VSI Daily Log Book to record inspection and replacement of parts. Service personnel will find the log book extremely helpful in assisting you to maximise the life of the wear components in your crusher.

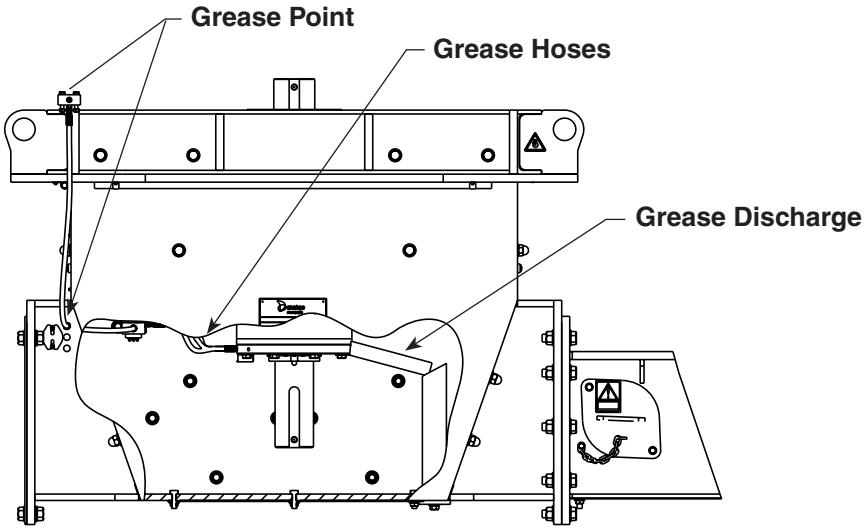
LUBRICATION

SHAFT LINE ASSEMBLY



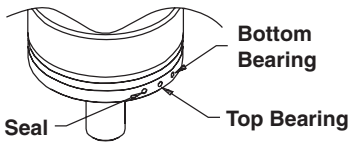
THE SHAFT LINE ASSEMBLY MUST BE GREASED EVERY 8 TO 10 HOURS OF OPERATION

The best practice is to grease the bearings when the shaft line assembly is at operating temperature while the machine is running at the end of each production shift.

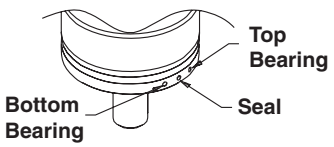


The base is fitted with a grease divider block. This takes the grease from the feeder hose and splits it into three lines, two for the bearings and one for the top seal. The divider block sends equal quantities of grease to the bearings and 1.5 times the bearing quantity to the top seal.

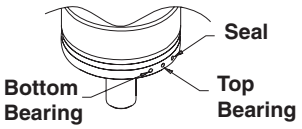
The grease points can be identified on the shaft line assembly as follows:



B9100SE, B7160SE



B7150SE, B6150SE, B5100SE



B3100SE

MANUAL LUBRICATION GREASE QUANTITIES

The following amounts are recommended for manual greasing every 8-10 hours of operation:

Model	
B3100SE	15g [0.53 oz]
B5100SE	24g [0.85 oz]
B6150SE	30g [1.06 oz]
B7150SE	45g [1.59 oz]
B7160SE	45g [1.59oz]
B9100SE	45g [1.59 oz]

LUBRICATION

SHAFT LINE ASSEMBLY

RECOMMENDED GREASE TYPES

Feed Material Temperature °C [°F]	Model	Rotor Speed (RPM)	Grease Brand and Type
-20 to 65 [-4 to 149] Normal Service Shaft Line Assembly (Low Speed)	B3100SE	3000 to 4200	Shell Alvania EP2 Mobil Mobilux EP2 BP Energrease LS-EP2 Mobil Mobilith SHC100 Arcanol L135V Castrol Optimol Longtime PD2 ✔
	B5100SE	2100 to 2800	
	B6150SE	1400 to 2000	
	B7150SE	1300 to 1700	
	B7160SE	1100 to 1400	
	B9100SE	1100 to 1400	
-20 to 65 [-4 to 149] Normal Service Shaft Line Assembly (High Speed)	B3100SE	4200 to 5300	Mobil Mobilith SHC100 Castrol Optimol Longtime PD2 ✔ Arcanol L135V Kluber Isoflex Topas NB152 ✖
	B5100SE	2800 to 3600	
	B6150SE	2000 to 2500	
	B7150SE	1700 to 2200	
	B7160SE	1400 to 1800	
	B9100SE	1400 to 1800	
60 to 100 [140 to 212] High Temp. Shaft Line Assembly (All Speeds)	B3100SE	3000 to 5300	Mobil Mobilith SHC220 ✔ Shell Stamina U2 ✖ BP Synthetic HT-XP ✖
	B5100SE	2100 to 3600	
	B6150SE	1400 to 2500	
	B7150SE	1300 to 2200	
	B7160SE	1100 to 1800	
	B9100SE	1100 to 1800	

✔ Indicates preferred grease. Shaft line assemblies are pre-lubricated with this grease type.

✖ Indicates that this type of grease is not compatible with any of the others. If this grease is used, the assembly must first be completely stripped, cleaned and reassembled to ensure maximum bearing service life.

Continued ▶

LUBRICATION

SHAFT LINE ASSEMBLY

Please note that the shaft line assembly in the crusher presents a very unique set of operating conditions for the bearings and for this reason, selection of alternative grease types is not a straight forward task. Grease properties to consider include thickener type, base oil viscosity and the inclusion of tackiness additives. Consideration must also be given to mixability of any new grease with the grease already in the shaft line assembly. Mixing (especially of different thickener types) causes unpredictable lubrication conditions and possibly premature failure of the shaft line assembly.

If you wish to use a grease that is not on the list, please consult your Barmac representative to confirm its suitability for the specific application in question. This will be determined based on your particular application It is not recommended that you use an equivalent grease as promoted by various oil companies and organisations without first consulting Metso Minerals (Matamata), New Zealand.

OPERATING TEMPERATURE

Normal bearing temperature is 30° to 40°C [54° to 72°F] above feed material or ambient temperature. A short duration temperature rise of approximately 10°C [18°F] can be experienced when bearings are lubricated.

The temperature on the outside of the shaft line assembly during continuous running should not exceeed:

***70°C [160°F] – Normal temperature service.**

150°C [300°F] – High temperature service.

***Actual bearing temperatures as indicated by VOCS may be as high as 150°C [300°F] for normal running. Refer to VOCS manual (P611) for details.**

GREASE DISCHARGE

Ensure that the grease discharge is away from the drive belts and grease hoses are undamaged.

It is also a good practice to perform a weekly inspection of the grease discharge to ensure that it is not blocked, which may lead to pressure build-up inside the shaft line assembly; breakdown of grease inside, etc.

CAUTION **Excessive build-up of grease may cause an overflow of grease onto the drive belts, causing premature failure of the drive belts.**

LUBRICATION

SHAFT LINE ASSEMBLY

AUTOMATIC LUBRICATION

If an automatic lubrication system is required, Metso Minerals recommend the Barmac "Automatic Lubrication Kit – Part No. B91AG00A". (See Automatic Lubrication System Manual P762 for more information). Other off-the-shelf systems have also proven successful, but please note the following points:

1. The total quantity of lubrication applied over an 8-10 hour operating period should not exceed the total quantity as for manual lubrication (page 6-2) over this same period.
2. The top seal plate may benefit from a more frequent/higher quantity grease application. If contamination of the top seal is known to be a problem, an increase in quantity over and above that listed in the table can safely be applied to the top seal.

NOTE: It is essential that the grease points are properly identified so that grease directed at the top seal is not mistakenly applied to the bearings.

AUTOMATIC LUBRICATION GREASE QUANTITIES

If using an automatic lubrication system, use the table below as a guide for setting grease quantities.

NOTE: The crusher must not be greased when it is not operating and must not be greased more frequently than every two hours.

MODEL	EACH BEARING		TOP SEAL	
	Minimum Interval	Maximum Interval	Minimum Interval	Maximum Interval
	Every 2 hrs	Every 8 hrs	Every 2 hrs	Every 8 hrs
B3100SE	0.8g [0.028 oz]	3.2g [0.113 oz]	1.2g [0.042 oz]	4.8g [0.169 oz]
B5100SE	1.3g [0.046 oz]	5.2g [0.183 oz]	1.8g [0.063 oz]	7.2g [0.254 oz]
B6150SE	1.6g [0.056 oz]	6.8g [0.240 oz]	2.4g [0.085 oz]	9.6g [0.339 oz]
B7150SE	2.5g [0.088 oz]	10g [0.353 oz]	3.5g [0.123 oz]	14g [0.494 oz]
B7160SE	2.5g [0.088 oz]	10g [0.353 oz]	3.5g [0.123 oz]	14g [0.494 oz]
B9100SE	2.5g [0.088 oz]	10g [0.353 oz]	3.5g [0.123 oz]	14g [0.494 oz]

ROTOR SERVICING

Please observe the correct shut-down procedures. (See section 5-13 of this manual). Prior to any internal inspection/service ensure that the safety interlock system is activated. (See section 5-6).

The rotor assembly is the main wearing component of the crusher, and regular and timely inspection of wear parts will extend the life of the rotor. If wear parts are not replaced when required, severe damage or even total destruction of the rotor body may result.

ACCESS

While wear patterns and wear rates can be observed with the rotor in place, it may be necessary or desirable to remove the rotor from the crusher to replace any worn wear parts.

In this manual we have assumed that the parts are being replaced with the rotor in the machine. The major problem with this can be the removal of the build-up of material in the rotor around the wear parts.

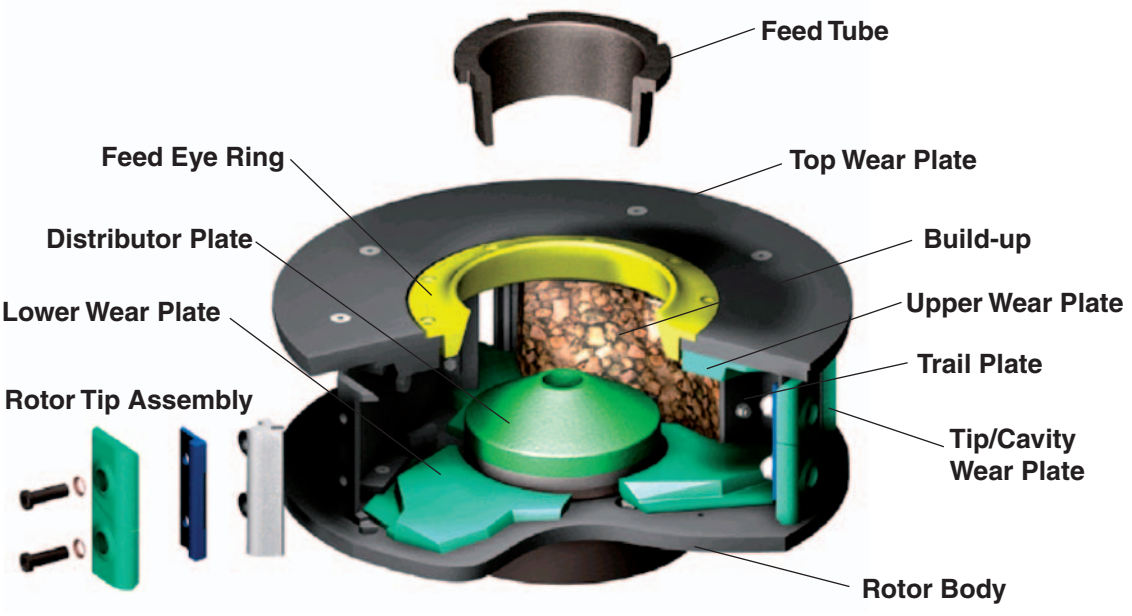
CLEANING OUT ROTOR

The most successful method of removing the build-up is by using water. If a hose pipe is available at the crusher it is quite in order to “wash out” the build-up by inserting the hose pipe into the hopper, directing the water into the rotor while the crusher is running.

⚠ CAUTION **Do not insert the hose pipe into the rotor, direct the water flow only into the rotor.**

The use of water into the rotor may scour out the build-up in the crushing chamber. This in itself is not a problem but if the feed size is at the maximum, chamber gusset wear will result until the build-up in the crushing chamber is replaced on start-up.

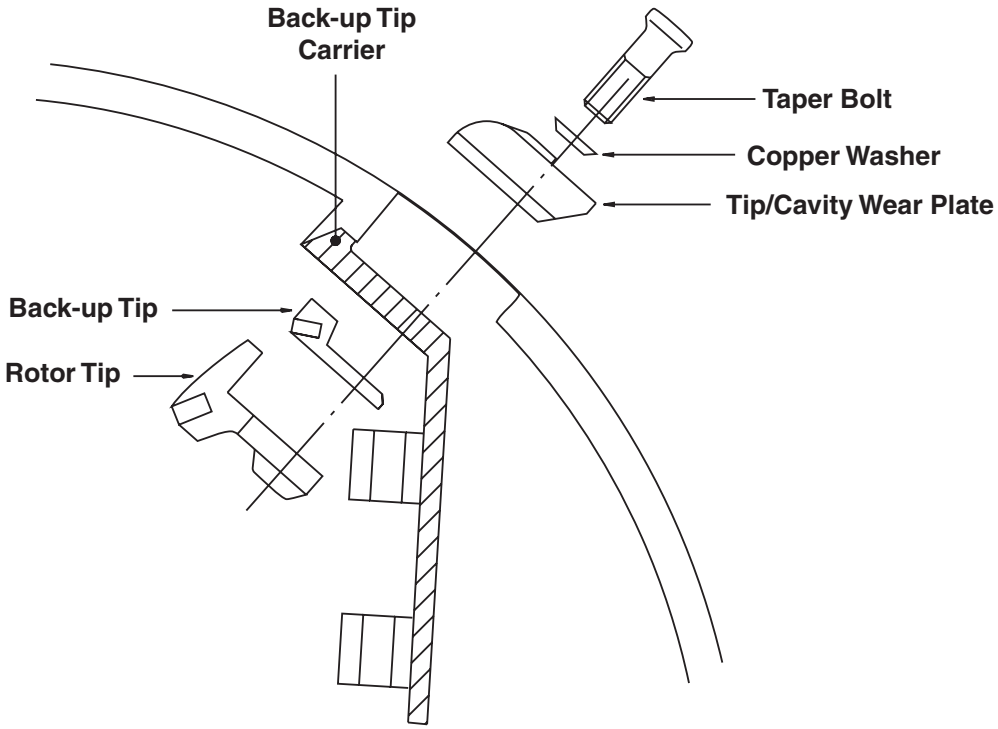
If a hose pipe is not available near the crusher it may be possible to remove build-up with a podger bar. If this is not possible or too time consuming, then it will be necessary to remove the rotor from the crusher for the removal of the upper and lower wear plates, distributor plate and feed eye ring.



ROTOR SERVICING

ROTOR TIP ASSEMBLY

Bolt-in Back-up Tip

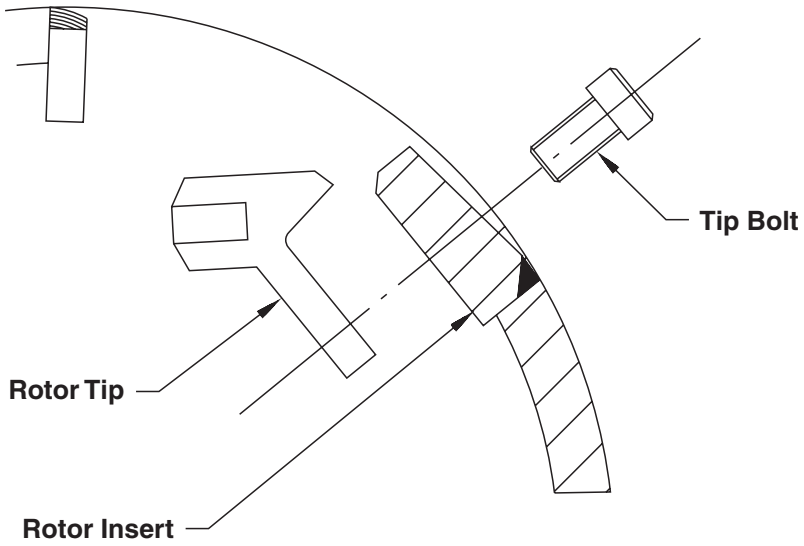


Continued ▶

ROTOR SERVICING

ROTOR TIP ASSEMBLY

300mm Rotor



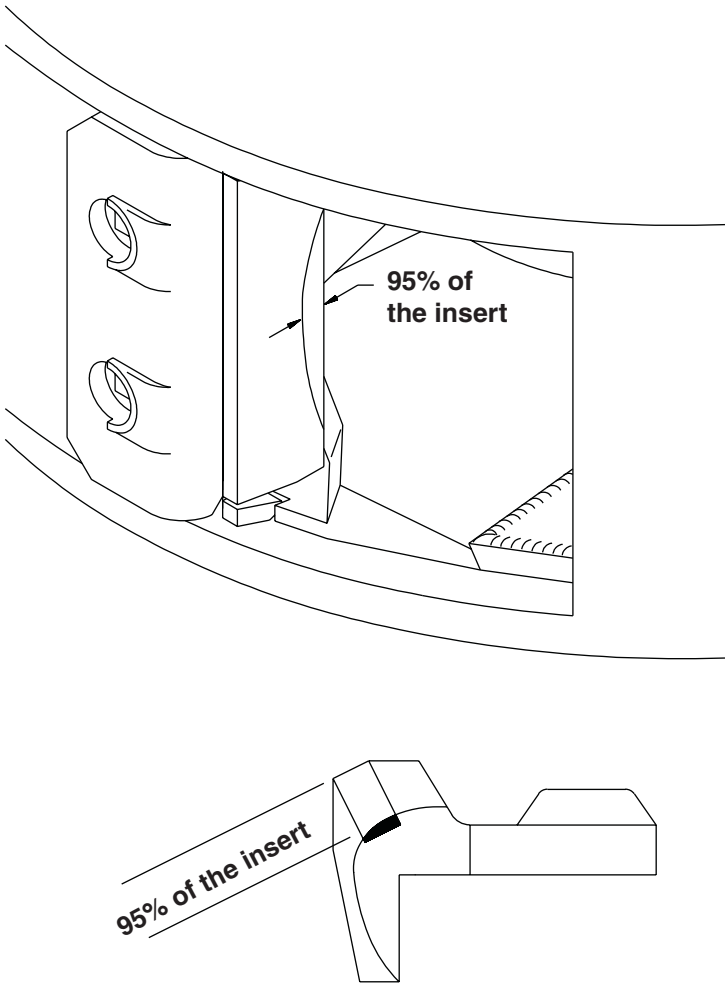
ROTOR SERVICING

ROTOR TIP ASSEMBLY

ROTOR TIPS

Rotor tips must be checked to determine the amount of wear on the inserts. Tips need to be replaced once 95% of the insert has been removed at the centre of the wear. **The back- up tip assembly will protect the rotor body from damage,** therefore a tip in this condition could be run for another shift. Experience will help the operator understand the wear performance of the tip.

Ensure that the rotor tips are tightly held and not broken, cracked or badly chipped.



This rotor tip profile has been used as an example only. Different models with different rotor designs will vary but the principles are the same.

Continued ▶

ROTOR SERVICING

ROTOR TIP ASSEMBLY

ROTOR TIPS

Normal Wear

The rotor tips are wearing normally. Replace when less than 3mm [1/8 in.] of insert remains at the centre of the wear, or if tip will not last another shift.

Cracked or Chipped Inserts

Tramp iron in feed. Remove tramp iron. Oversize feed material. Investigate cause of oversize. Reduce maximum feed size.

Off Centre Wear

The rotor tips are wearing at the top or bottom not in the centre. Trail plate angle may require altering (refer to rotor tuning section 6-30).

SELECTION OF ROTOR TIPS

A range of rotor tips are available to suit differing feed material characteristics, operating conditions and type of rotor (i.e. deep, standard). The rotor tips supplied with your machine have been carefully chosen to suit your requirements. However, changing feed material can require the re-selection of the rotor tips.

For information regarding rotor tip options, contact your Barmac representative.

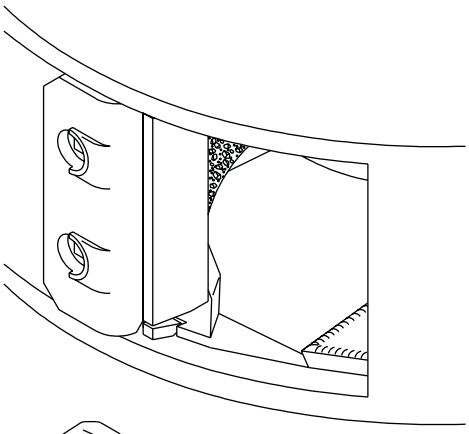
ROTOR SERVICING

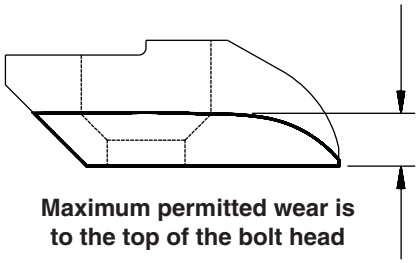
ROTOR TIP ASSEMBLY

TIP/CAVITY WEAR PLATES (Tip Assembly Position)

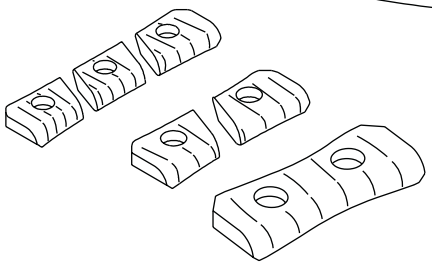
Initially, the tip/cavity wear plates may wear quickly until they reach a certain profile governed by the application. This is quite normal and should not cause concern.

Tip/cavity wear plates must be inspected for wear and be replaced when there is doubt they will last another shift, or as soon as wear appears on the top of the bolt head. Replace tip/cavity wear plates which have cracked. Check that tip/cavity wear plates are not loose.



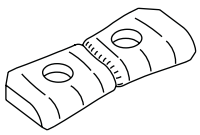


This tip/cavity wear plate profile has been used as an example only. Different rotor designs have different tip/cavity wear plates but the principles are the same.



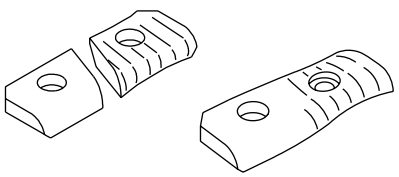
Normal Wear

The tip/cavity wear plates are wearing normally. Replace when wear just starts to show on bolt head.



Cracked Tip/Cavity Wear Plates

Caused by tramp iron, oversize feed, excess build-up with damp/sticky material or uneven mating surface. Remove tramp iron. Reduce feed size. Ensure that mating surfaces are flat, i.e. there is no spatter or grit between tip/cavity wear plate and back-up tip. (See Rotor Tip Assembly Removal/ Installation section 6-13).



Uneven Wear

Tip/cavity wear plates are wearing at the top or bottom not in the centre. Adjust trail plate angle. (See rotor tuning, section 6-30).

Uneven wear can also be caused by excessive crushing chamber build-up.

Premature top wear can be indicative of a worn cavity ring and/or cascade wear skirt.

Premature bottom wear can be indicative of excessive build-up in the base.

Continued ▶

ROTOR SERVICING

ROTOR TIP ASSEMBLY

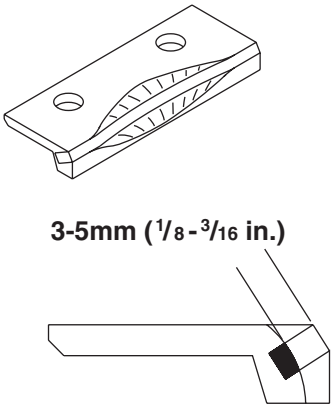
BACK-UP TIPS

In normal operation the back-up tip should be unused and in many cases is not visible (depending on rotor tip and tip/cavity wear plate style used).

Normal Wear

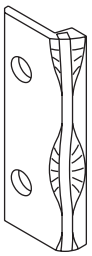
The back-up tip is only exposed to wear when the rotor tip has failed or worn out. In the event of emergency use of the back-up tips, they should be replaced once there is only 3-5 mm [1/8 - 3/16 in.] of insert remaining at the centre of the wear path.

Back-up tips should also be replaced if the insert is cracked or badly chipped.



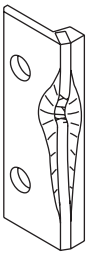
Irregular Wear

Rotor tips being left in place too long and wearing out.



Back-up Tips Breaking

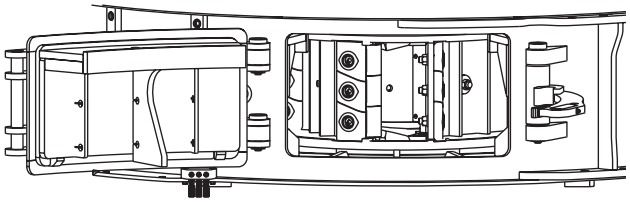
Rotor tip failed, exposing back-up tip, usually caused by tramp iron or oversize feed or having been worn too thin.



CAUTION **If the back-up tip fails or is worn out the flow of material will severely damage or even destroy the rotor body.**

ROTOR SERVICING

ACCESS: Through service door.

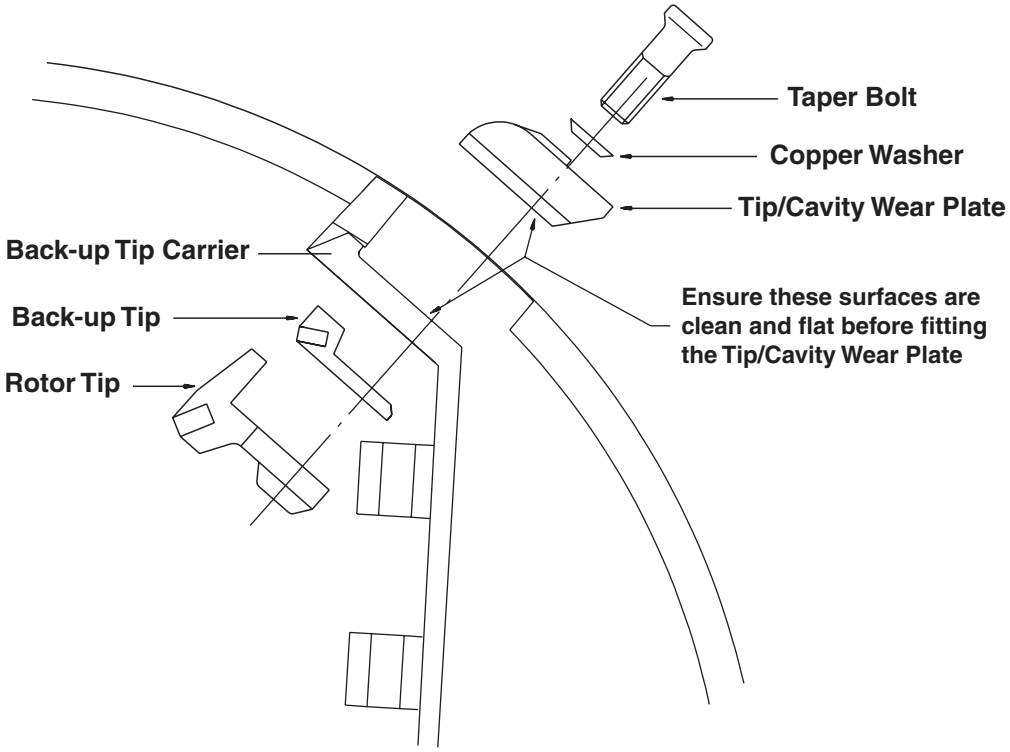


ROTOR TIP ASSEMBLY

REMOVAL/INSTALLATION

Removal

Remove taper bolts. Tap rotor tip inward to break away build-up that will hold tip and back-up tip in place. It may be necessary to use a bar to chisel away very tightly compacted build-up. If this condition persists it is advisable to wash out build-up with water. (See 6-6).



Installation

Ensure that all mating surfaces on rotor tip, tip/cavity wear plates and back up tips are free of any high spots (dirt, weld spatter, burrs).

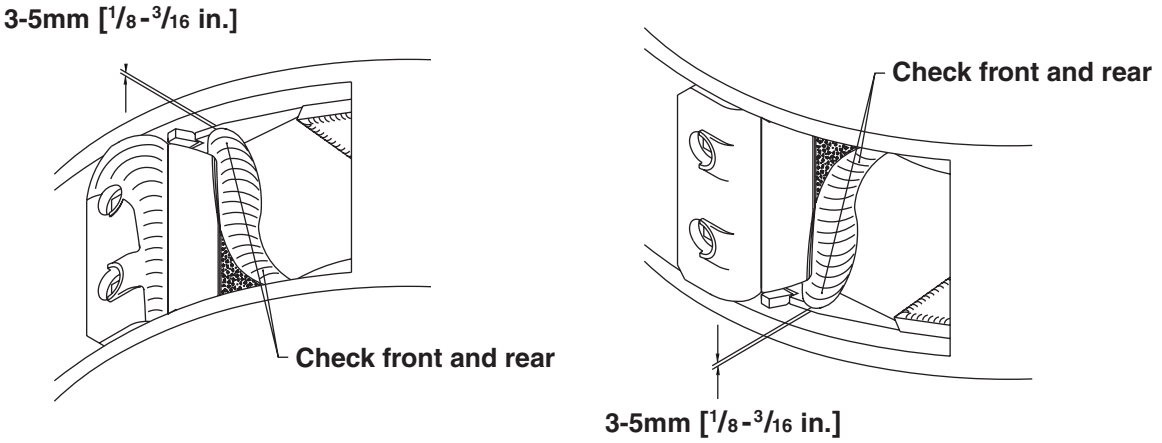
Position back up tip, rotor tip and tip/cavity wear plate in rotor port. Insert taper bolts, ensure that copper washer is in place, and tighten. (Applying anti-lock compound to thread will make removal easier). Ensure that tip assembly is pulled up tight and that there is no movement in the parts. (See bolt torque settings 6-72).

NOTE: ROTOR TIPS, TIP/CAVITY WEAR PLATES AND BACK-UP TIPS MUST BE CHANGED AS SETS. DO NOT REPLACE SINGLE PARTS OR A ROTOR OUT-OF-BALANCE CONDITION MAY RESULT.

ROTOR SERVICING

UPPER AND LOWER WEAR PLATES

Replace upper and lower wear plates when it is obvious that they will not last another shift. Replace once there is less than 3-5 mm. [1/8 - 3/16 in.] of plate remaining at the centre of the wearpath at the discharge edge or inside edge.



Upper Wear Plate

Rapid upper wear plate wear is an indication that the feed tube and feed eye ring are worn. Replace worn parts.

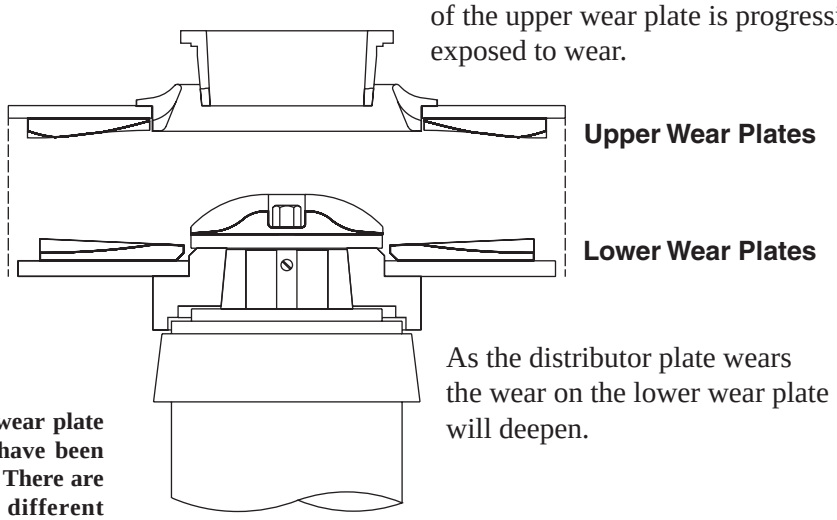
Upper wear plate wear accompanied by rotor tip top end wear is an indication that the trail plates are incorrectly shaped. Adjust trail plates as described in rotor tuning, section 6-30.

Lower Wear Plate

Lower wear plate wear accompanied by rotor tip bottom end wear is an indication that the trail plates are incorrectly shaped. Adjust trail plates as described in rotor tuning, section 6-30.

Other Influences

As the feed eye ring wears the leading edge of the upper wear plate is progressively exposed to wear.



As the distributor plate wears the wear on the lower wear plate will deepen.

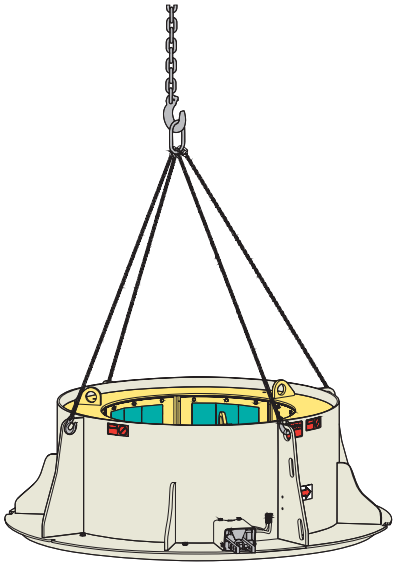
The upper and lower wear plate profiles shown above have been used as examples only. There are different profiles for different rotors, but the principle is the same.

ROTOR SERVICING

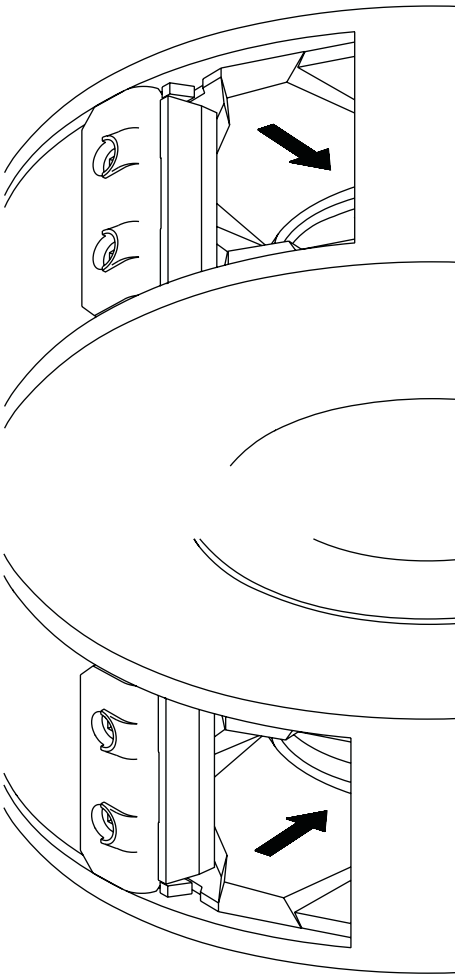
UPPER AND LOWER WEAR PLATES

REMOVAL/INSTALLATION

It is possible to remove and install the upper and lower wear plates while the rotor is in place, however it is necessary to clean out the build-up thoroughly. This can be done by using water as described in rotor servicing 6-6.



NOTE: With deep rotors fitted it is often possible to replace the upper and lower wear plates through the service door.



Removal

Upper Wear Plates

1. Remove roof and hopper in one lift.

   NOTE: The hopper may be removed from the roof first if lifting equipment being used does not have sufficient capacity to lift both assemblies together. When removing hopper assembly, remove clevis pin from hydraulic ram and slide control gate back as far as possible before lifting hopper assembly.

2. Remove rotor tips and tip carrier wear plates (6-13).
3. Remove feed eye ring (6-21).
4. Tap the wear plate towards the centre of the rotor to release it from the keepers.
5. Withdraw the plate through the feed hole.
6. Thoroughly scrub out the remaining build-up with a wire brush or hose pipe.

Lower Wear Plates

1. Remove rotor tips and tip/cavity wear plates (6-13).
2. Remove the distributor plate (6-19).
3. Tap the wear plate towards the centre of the rotor to release it from the keepers.
4. Withdraw the plate through the feed hole.
5. Thoroughly scrub out the remaining build-up with a wire brush or hose pipe.

Installation

1. Ensure mating surfaces are clean and free of snags.
2. Insert new wear plate through the feed opening and slide into place.
3. Ensure the new plates are wedged under the keepers.

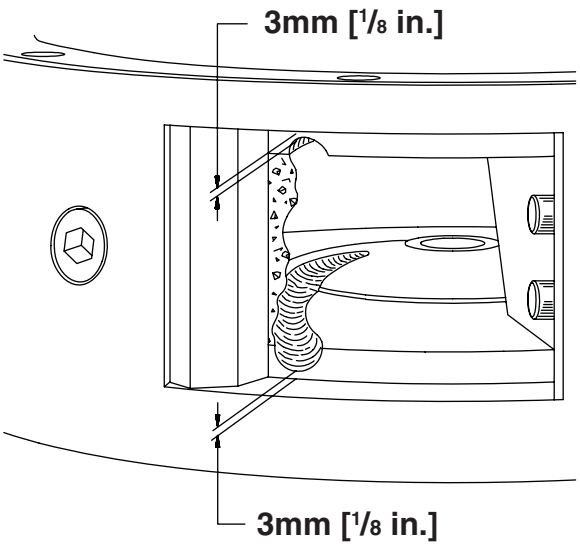
• See over for 300mm rotor instructions.

ROTOR SERVICING

300mm ROTOR UPPER AND LOWER WEAR PLATES

ADJUSTING / REPLACING UPPER WEAR PLATE

The 300mm rotor upper wear plate can be re-positioned three times for three lives before it is worn out. When worn as shown below:



1. Remove rotor from crusher.
2. Thoroughly clean wear plate and build-up in rotor, especially the bolting face of the wear plate.
3. Check the wear paths on the underside of the wear plate (fig. 1), they should be of even width, depth and position. If so, plate can be re-fitted. Uneven wear paths are caused by uneven trail plates. These should be checked. See rotor tuning 6-30.
4. Balance rotor with plates positioned so a new unworn area is next to the rotor tip.
5. Mark position of plate to rotor when balanced and remove plate.
6. When rotor body is refitted to shaft, position wear plate in correct balanced position as marked earlier, lubricate screw threads, fit aluminium taper washers and screws and torque to 30 Nm [15 lb ft].
7. If after re-starting and feeding a small amount of material, the rotor runs heavily out of balance, the wear plate is probably unbalanced and will have to be checked.

ROTOR SERVICING

300mm ROTOR UPPER AND LOWER WEAR PLATES

ADJUSTING / REPLACING LOWER WEAR PLATE

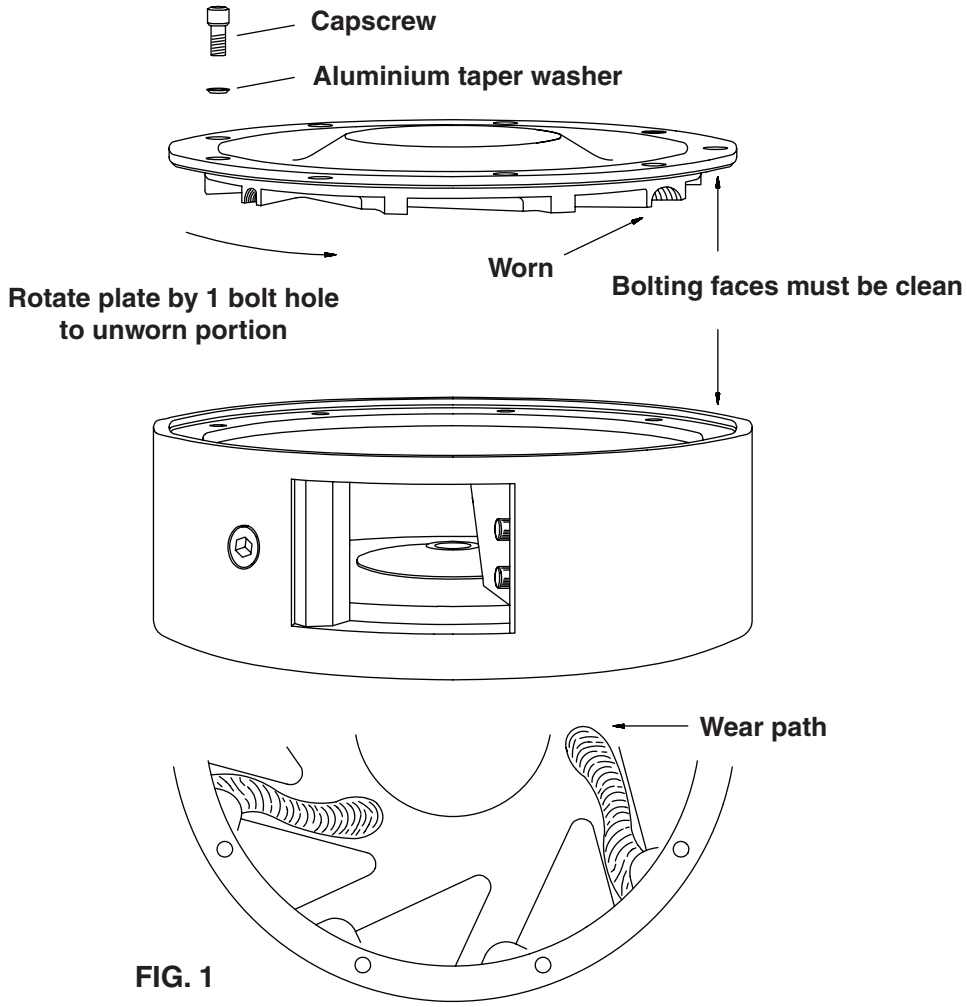


FIG. 1

As with the upper wear plate, the 300mm rotor lower wear plate can be re-positioned three times for three lives before it is worn out. To rotate or replace:

1. Remove rotor from crusher.
2. Remove upper wear plate, rotor tips and trail plates and clean out rotor (see changing upper wear plate).
3. Lift out lower wear plate and clean thoroughly. Check that wear paths on the wear plate are of even width, depth and position. If so, plate can be re-fitted. Uneven wear paths are caused by uneven trail plates. These should be checked.
4. Re-fit plate, positioned so a new unworn area is next to the rotor tip. Make sure the wear plate is sitting down flat and not resting on any grit, etc.
5. Rebalance rotor. (See section 6-39).

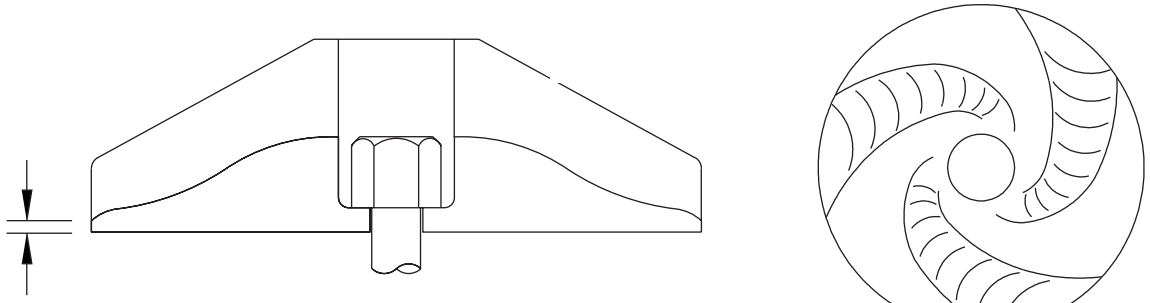
ROTOR SERVICING

DISTRIBUTOR PLATE

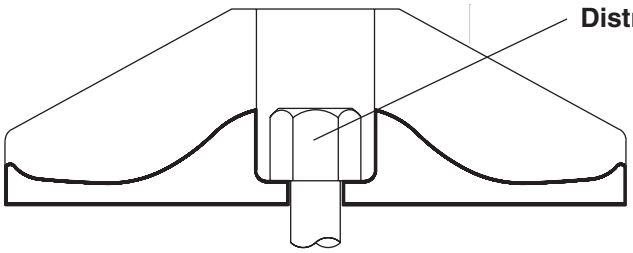
The distributor plate wears in three places, opposite each rotor port.

Turn the distributor plate 1⁄6th of a turn when partly worn to ensure maximum usage.

Replace distributor plate once the bolt head starts to wear or once there is only 3-5mm [1/8-3/16 in.] of casting left at the thinnest point.



3-5mm [1/8-3/16 in.]



Premature Wear

Generally caused by oversize feed or material dropping from a conveyor or screen chute directly onto the distributor plate.

Reduce feed size. Install or centralise spreader plate in feed hopper. Change distributor plate type.

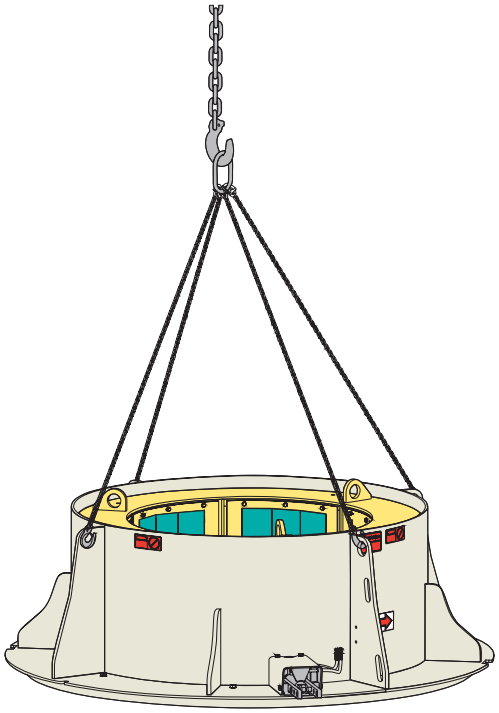
SELECTION OF DISTRIBUTOR PLATE

Different types and shapes of distributor plate are available. Please contact your Barmac dealer for more information.

ROTOR SERVICING

DISTRIBUTOR PLATE

REMOVAL/INSTALLATION



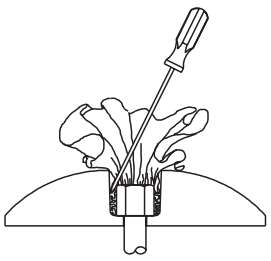
Removal

1. Remove roof and hopper in one lift.
2. Remove feed eye ring. (See 6-21).
3. Remove stones and protective rag from distributor bolt hole.
4. Remove distributor plate bolt.
5. Distributor plate lifts out.

Refitting

1. Ensure the top plate surface is clear of obstructions before fitting the distributor plate to protect the distributor plate from breakage.
2. Place distributor plate in centre of rotor. Insert distributor plate bolt and tighten. (Refer to bolt torque table section 6-72 for correct torque).
   - The use of large impact wrenches should be avoided when tightening bolt.

Reassembly is a straight reversal of removal.



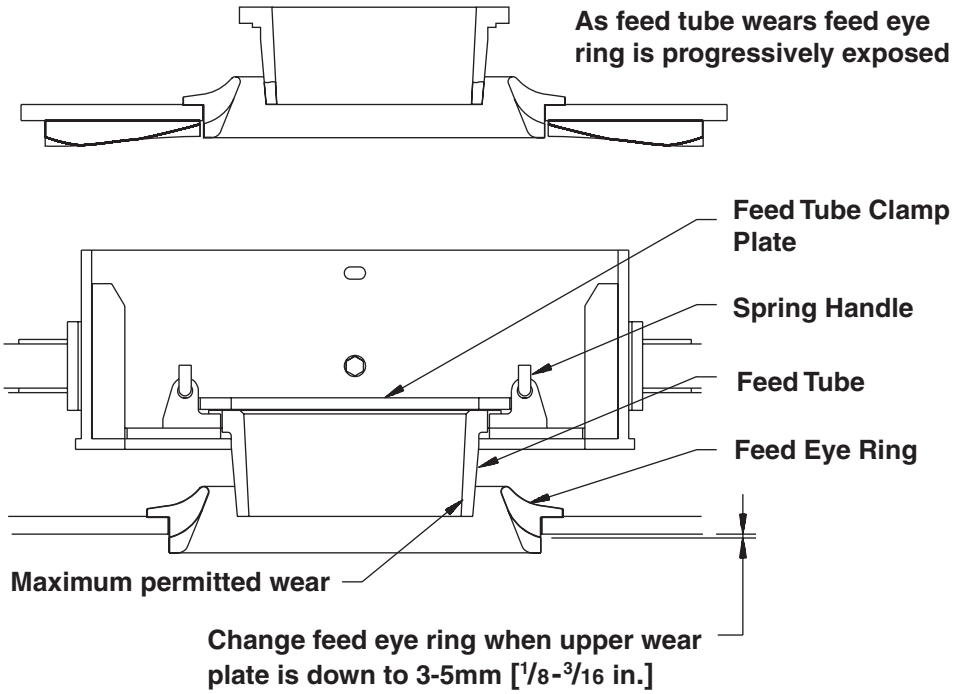
Insert a piece of rag into the distributor plate bolt hole and tamp firmly around bolt head. This will keep dirt from getting around the bolt head and will make removal much easier.

ROTOR SERVICING

FEED EYE RING

Wear on the feed eye ring is largely determined by the material flow from the feed tube. Thus as the feed tube wears the feed eye ring will be exposed to more wear.

To minimise the wear of the feed eye ring it is essential to maintain the feed tube in the correct position. (Refer to feed tube section 6-22 and 6-53).



The feed eye ring wears in three places opposite the rotor ports.

Replace the feed eye ring when the upper wear plate is worn to a thickness of 3-5mm [1/8-3/16 in.] at the inside edge.

The fixed feed eye ring cannot be rotated. A multi-life bolt-on feed eye ring is available for most models.

Premature Wear

Check feed tube is correctly positioned.

Feed Eye Ring Breakage

Material lodging between the feed tube and the feed eye ring. Check rotor build-up.

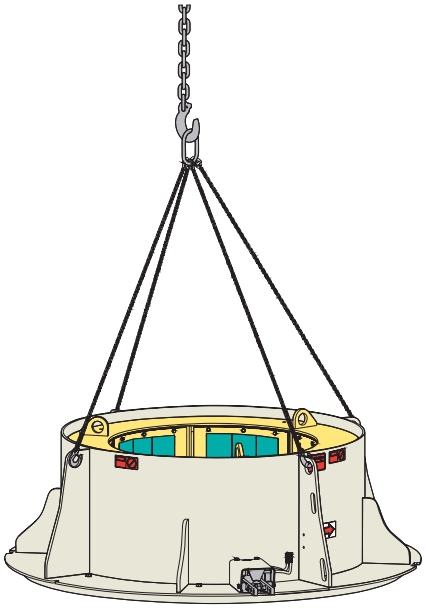
Feed Eye Ring Coming Loose

Check feed eye ring is correctly installed.

ROTOR SERVICING

FEED EYE RING

REMOVAL/INSTALLATION



Removal

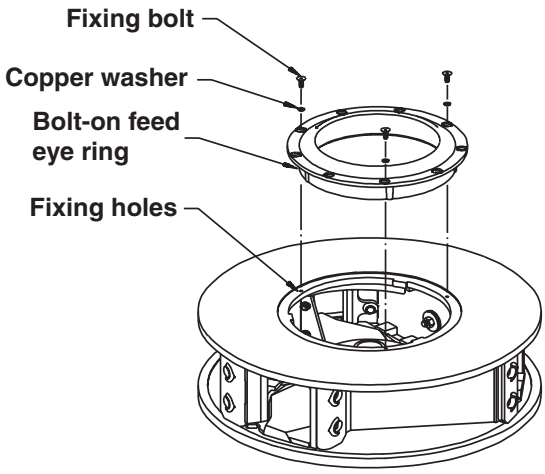
1. Remove roof and hopper in one lift.
2. With a hammer hit the top of the rotor (not the feed eye ring) above the wear plates to loosen the build-up.

3a. For fixed type feed eye ring, turn the feed eye ring counter-clockwise until the locking tabs line up with the slots in the rotor top. If material build-up stops the worn feed eye ring from turning use a soft blow hammer to tap the feed eye ring counter-clockwise.

3b. For bolt-on type feed eye ring, undo the 3 fixing bolts. If tight, tap with copper or rubber mallet which will shock feed eye ring and make the bolts easier to remove.

This feed eye ring may be turned to obtain 3 wear lives.

4. Lift the feed eye ring out.



Installation

1. Ensure mating surfaces are clean and free of snags. If refitting upper and lower wear plates ensure these are in position.
2. Position feed eye ring so locking tabs and slots line up.

3a. For fixed type feed eye ring, lower and turn clockwise to lock in place.

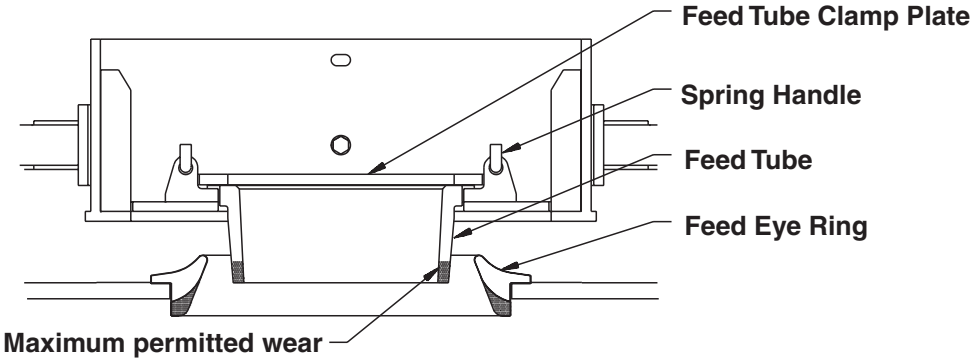
3b. For bolt-on type feed eye ring, align bolt holes in feed eye ring with tapped holes in rotor. Bolt feed eye ring to rotor, ensuring copper washers are used. Bolts should be firmly tightened by hand. Over tightening of the fixing bolts may cause breakage of the feed eye ring casting.

ROTOR SERVICING

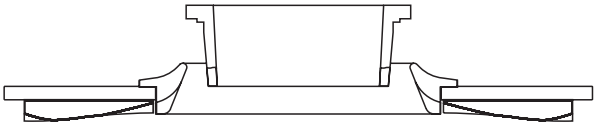
FEED TUBE

Replace feed tube just before the bottom lip is exposed above the feed eye ring.

The feed tube should wear evenly up the casting.



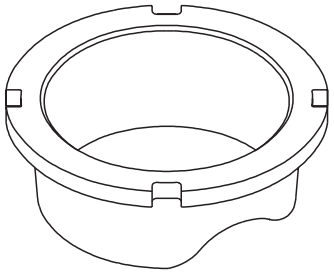
Maintaining the correct position of the feed tube in the rotor will result in increased life for the feed eye ring and upper wear plates.



Uneven Wear

Feed tube wearing on one side – feed tube not centralised.

To centralise feed tube see section 6-53.

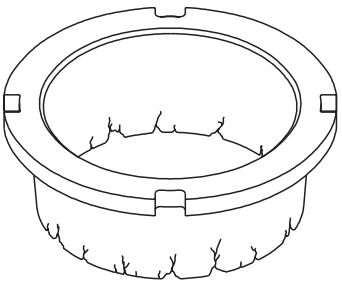


Cracking and Breakage

Feed tube cracking on bottom edge – excessive rotor build-up is rubbing on feed tube and causing overheating.

Adjust trail plates to reduce build-up.

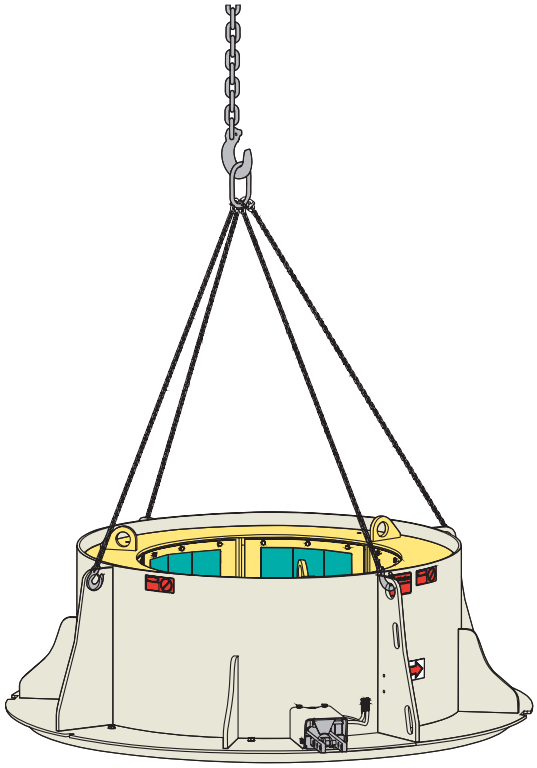
Feed tube breaks – can be caused by excessive build-up in rotor, stones wedging between feed tube and feed eye ring, feed eye ring coming loose or the feed tube coming loose (check feed tube clamp plate).



ROTOR SERVICING

FEED TUBE

REMOVAL/INSTALLATION

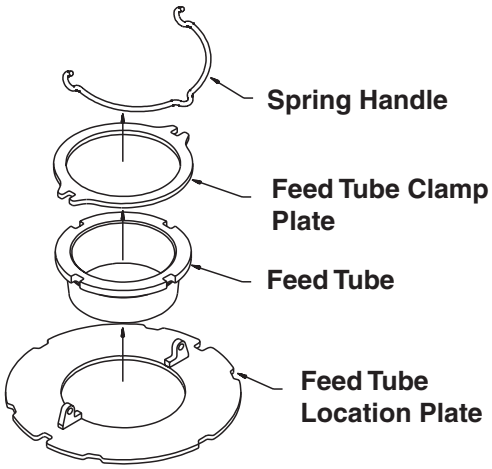


Removal

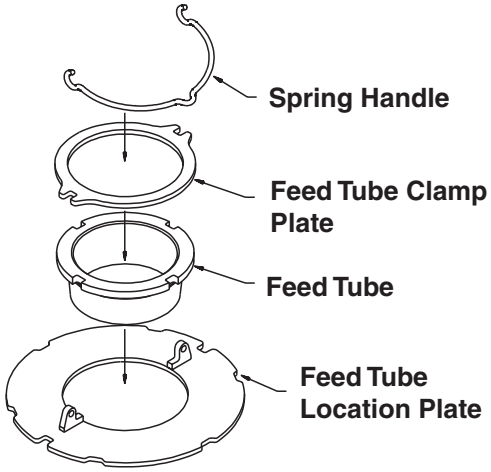
1. Remove roof and hopper in one lift.
2. Remove feed tube assembly by using spring handle (will need to remove build-up).

Dismantle

1. Remove spring handle and feed clamp plate from feed assembly.
2. Lift feed tube out.



FEED TUBE ASSEMBLY



Installation

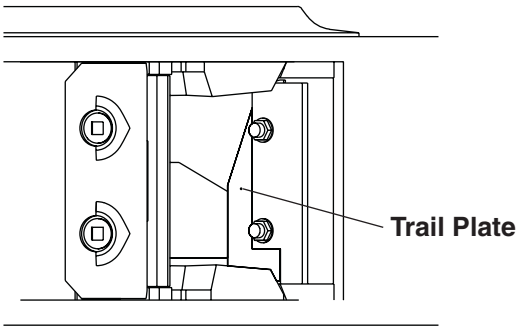
1. Lower feed tube into feed tube location plate.
2. Refit feed tube clamp plate.
3. Lock feed tube clamp plate into position with spring handle.
4. Ensure feed tube assembly holder is free from stones, etc., before refitting feed tube assembly.

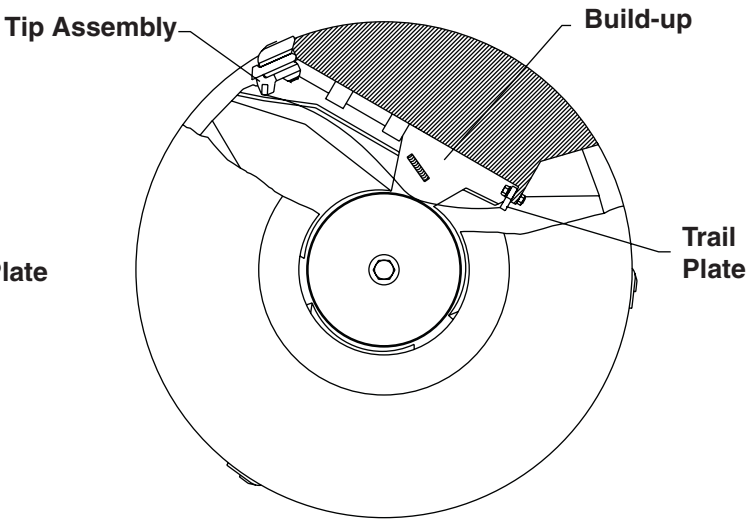
ROTOR SERVICING

TRAIL PLATES

Check trail plates for wear. Replace if badly worn or rotor build-up needs adjusting.

In some applications, trail plates are changed at the same time as the rotor tips – just to keep the stone bed profile constant. Regular change of trail plates maximises rotor tip life and is often very cost effective.





SELECTION OF TRAIL PLATES

The trail plates are the heart of the rotor. The size, position and angle of the trail plate controls the size of the rotor build-up and the flow of material through the rotor.

Incorrectly sized or shaped trail plates can result in premature wear on every rotor wear part. (See rotor tuning 6-30).

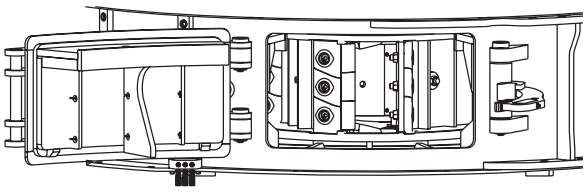
A number of trail plate profiles are available. For information regarding trail plate options, contact your Barmac representative.

CAUTION The use of different sized trail plates can create uneven build-up which may cause severe vibration. Ensure that trail plates are matched in size and shape. Differently positioned trail plates in each port may create uneven build-up which may cause vibration.

ROTOR SERVICING

TRAIL PLATE

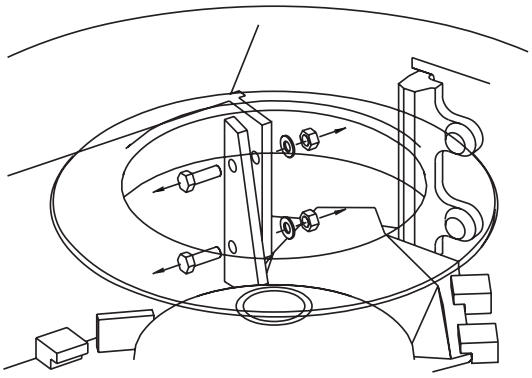
REMOVAL/INSTALLATION



Removal

Access through service door.

1. Remove trail plate retaining bolts. Bolts will be covered with build-up and will have to be knocked out with a hammer and punch. Care should be taken not to damage threads.
2. If trail plate is held in by the build-up, a sharp blow with a hammer will break away the build-up and allow the trail plate to fall free.



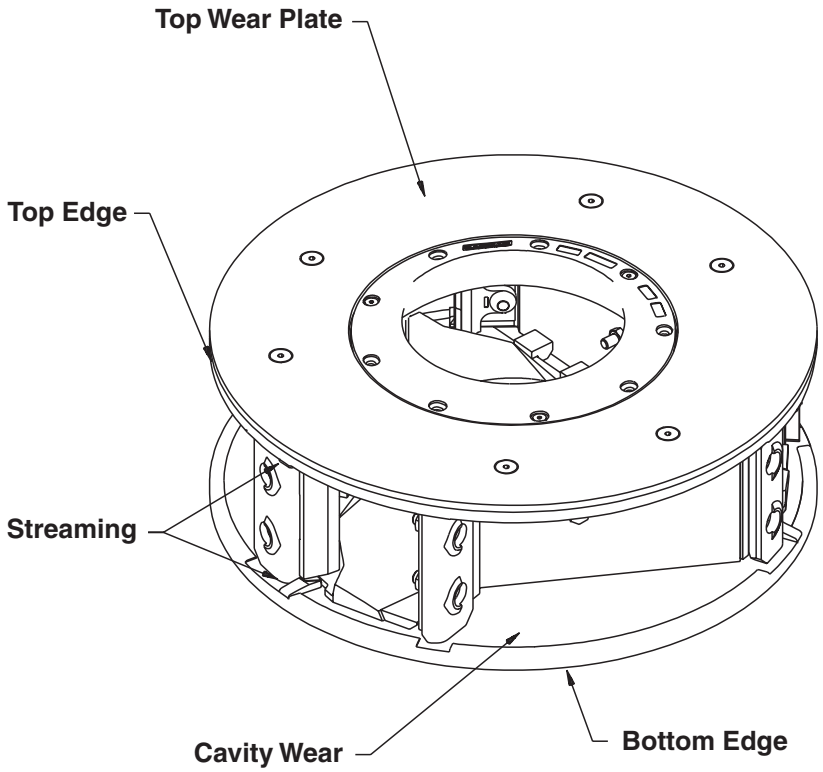
Installation

1. Clean out any remaining build-up.
2. Position trail plate and insert bolts.
3. Insert bolt from the inside of the rotor.
4. Tighten bolt with appropriate wrench.

ROTOR SERVICING

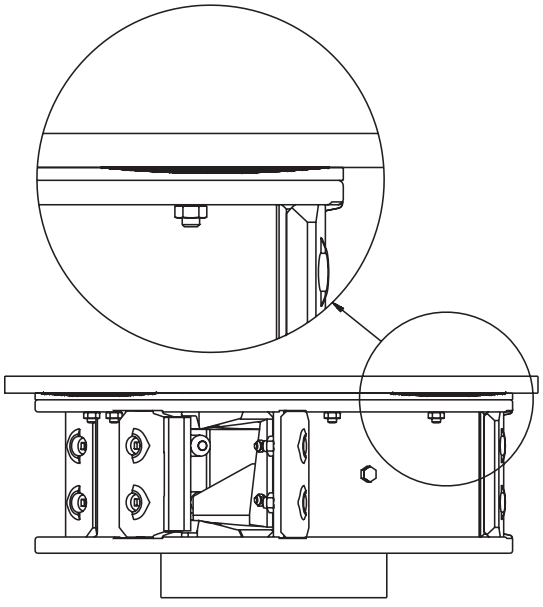
ROTOR BODY

The following areas are subject to normal wear – the comments provide a guide to causes of unusual rapid wear.



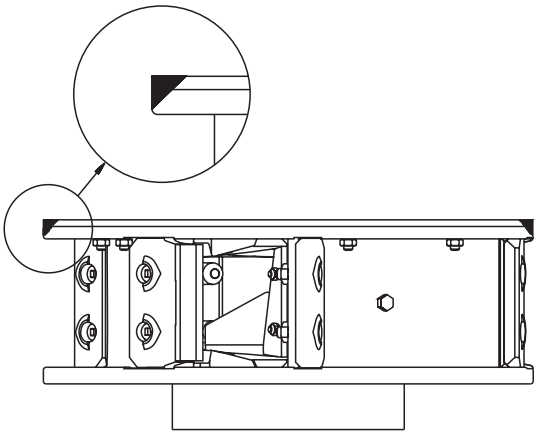
Top Wear Plate Wear

Feed tube too short and material is discharging over the top of the rotor. Replace feed tube or remove dust build-up. If the top wear plate continues to wear it may be necessary to replace the mild steel top wear plate with a more wear resistant material. Please contact your Barmac representative.



ROTOR SERVICING

ROTOR BODY

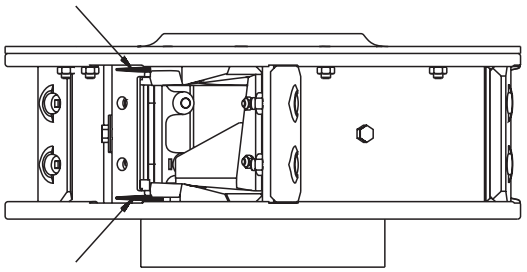


Top Edge Worn

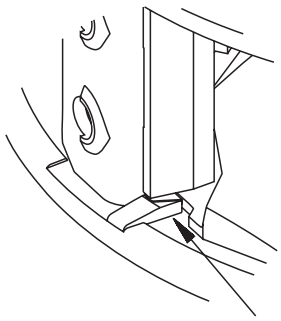
Wear skirt and/or cavity ring is worn. Replace worn parts. See section 6-48, 6-55.

Streaming Wear

This is more prevalent in wet and/or very abrasive fine applications, and is caused by dust streamlining around the tip/cavity wear plate. Effects can be reduced by sealing the gap between the top and bottom edges of the tip/cavity wear plate and the rotor with a silicone rubber or urethane sealant.

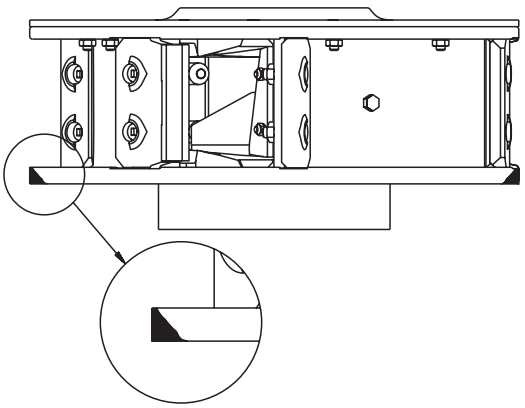


If the rotor has been in service for some time it important to check possible wear on the back-up tip holder. If the protrusions have worn, streaming wear will be more prevalent.



Bottom Edge Worn

Can be a feature of high tonnage operation or indicative of excessive build-up in the base that is rubbing on the rotor. Reduce build-up by reducing moisture content of feed or introducing water spray system. See section 6-58.

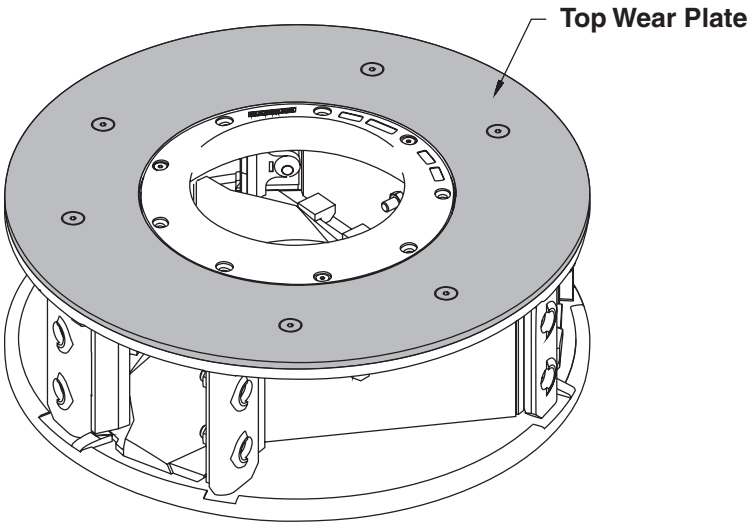


ROTOR SERVICING

ROTOR WEAR PROTECTION PLATES

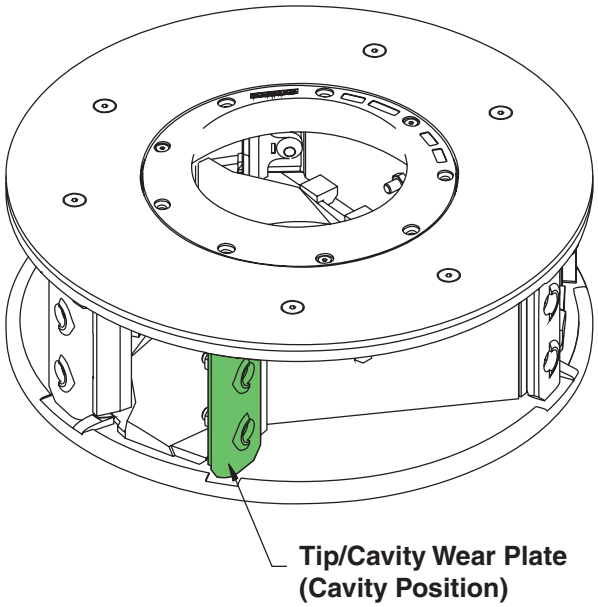
TOP WEAR PLATE

The top wear plate , although only mild steel, should not wear rapidly, but it should be inspected and replaced before the rotor body is damaged. If rapid wear occurs, wear resistant plates may be required. Contact your Barmac representative for details.



TIP/CAVITY WEAR PLATES (Cavity Position)

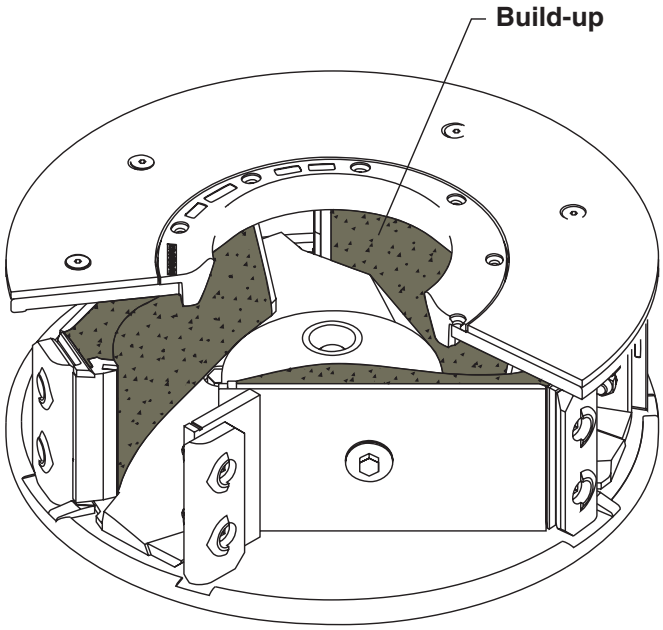
The tip/cavity wear plates should be replaced before wear progresses to the body of the rotor. Remove the bolts and nuts holding the wear plate to the rotor body and replace. Always replace all the tip/cavity wear plates with a matched set to maintain balance.



ROTOR SERVICING

ROTOR BUILD-UP

The build-up in the rotor is a deliberately retained pocket of material which forms a surface over which rock slides and generally forms the shape of a wave with the crest toward the centre of the rotor.



PRIMARY FUNCTION

The build-up in the rotor needs to protect the internal walls of the rotor and most importantly protect the rotor tip from direct wear and impact.

SECONDARY FUNCTION

The build-up in the rotor can influence the wear patterns of the wear parts in order of importance:

ROTOR TIPS

TIP/CAVITY WEAR PLATES (Tip Assembly Position)

UPPER AND LOWER WEAR PLATES

DISTRIBUTOR PLATE

FEED EYE RING

While large build-ups tend to assist in the protection of the above wear parts – particularly the rotor tips – they can greatly increase feed tube wear.

• See rotor build-up tuning section 6-30.

ROTOR SERVICING

ROTOR BUILD-UP TUNING

The success of the crusher is centred around its rotor. If the rock build-up within the rotor is ideal, then wear on the upper and lower wear plates will be even, the rotor tips fully utilised, and the lowest consumables cost per tonne of product will be achieved.

DIFFERENT MATERIAL CHARACTERISTICS

Unfortunately, the build-up characteristics are never the same for any two materials, indeed the nature of the build-up will vary with rotor speeds, rotor sizes, feed rates, feed sizes, and feed moisture.

TUNING ON SITE

A factory delivered rotor will rarely work at optimum efficiency without some degree of tuning. It is normal that some tuning will be required as each rotor is placed into service. Tuning relates to controlling the build-up of material within the rotor. This is done by altering the size, position, shape, or style of the trail plates.

PRIMARY FUNCTION

The main purpose of tuning is to ensure that the build-up within the rotor extends from the trail plate to the inserts in the rotor tip, and that the wear is centralised across the rotor tips.

Insufficient build-up will result in tip exposure. This will lead to early failure of the rotor tips through the chipping of the inserts by direct contact with the larger stones in the feed. Insufficient build-up of material will expose the supporting metal of the rotor tips. This will also lead to premature failure of the inserts by direct abrasion from the stone flow through the rotor. This can also result in the rotor tips wearing in front of the inserts which will eventually lead to their falling out of the carrier plate.

BASIC PRINCIPLES

In tuning the rotor one should try to maximise the build-up within the rotor to achieve:

- A build-up of rock within the rotor to protect the wear parts and not restrict the feedpath through the crusher.
- A build-up that clears the side and bottom of the feed tube, preventing premature feed tube wear.
- An equal flow through each rotor port, equalising the wear on the rotor tips.

ROTOR SERVICING

ROTOR BUILD-UP TUNING

The width and position of the trail plates control the amount and characteristics of the build-up in the rotor.

The following is meant only as a guide, as rotor build-up is dependent on many factors: material type, moisture content, rotor speed, etc., and trial and error will have to be employed to determine the correct trail plate position for each application.

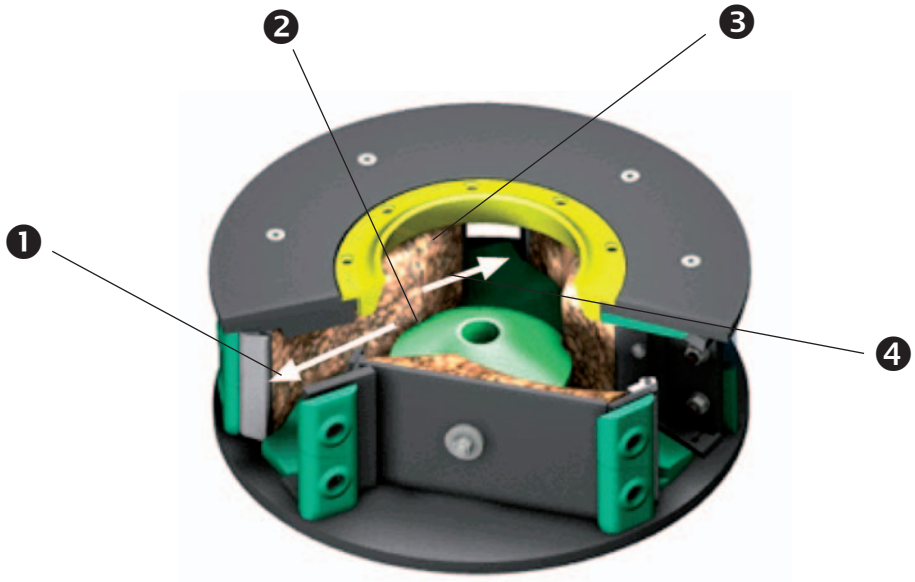
Generally –

- Wide trail plates make the material build-up deeper.
- Narrow trail plates make the material build-up shallower.
- Moving the trail plate away from the rotor tip makes the build-up deeper.
- Moving the trail plate toward the rotor tip makes the build-up shallower.

AREAS TO CONTROL

The four areas to control are:–

1. **Centralise wear over rotor tips**
2. **Build-up on distributor plate**
3. **Clearance on feed tube**
4. **Back dooring into following bed**



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ROTOR SERVICING

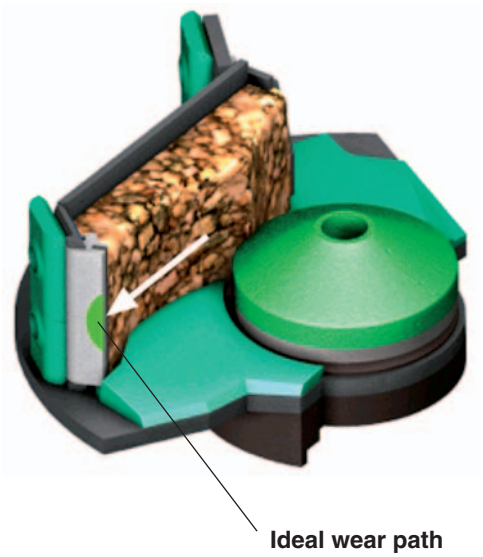
ROTOR BUILD-UP TUNING

EFFECT OF ROTOR BUILD-UP ADJUSTMENT

❶ Centralising Wear over Rotor Tips

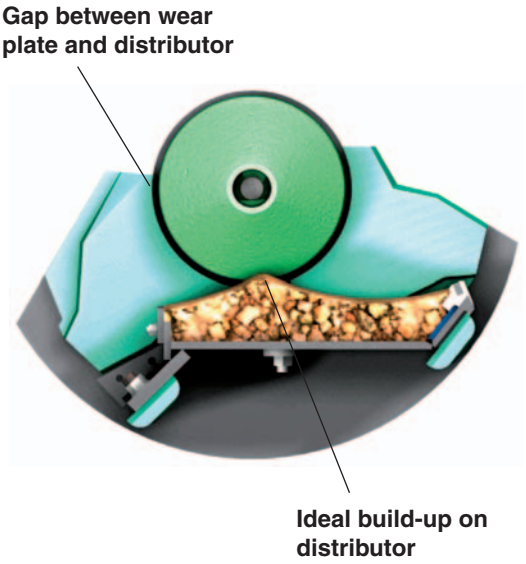
Will reduce wear on upper and lower wear plates.

For deep rotors it will reduce the wear on the top and bottom rotor tips.



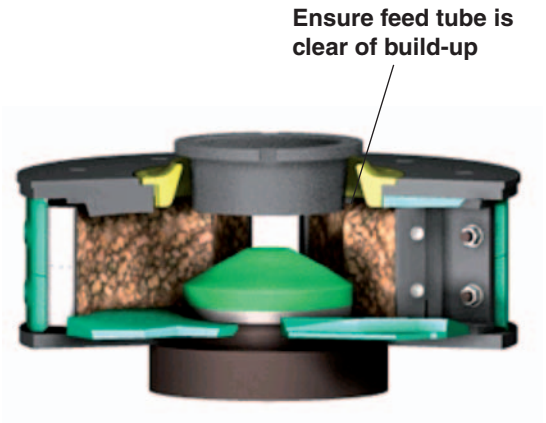
❷ Build-up on Distributor Plate

Stops fines swirling between distributor plate and wear plates which will damage rotor body.



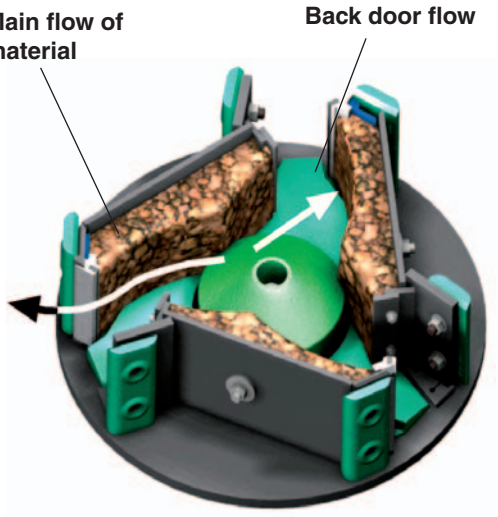
❸ Clearance on Feed Tube

Build-up rubbing on feed tube generates heat and causes the feed tube to crack.



❹ Back Dooring into Following Bed

Back dooring into following rotor tip will cause tip to crack and fail prematurely.

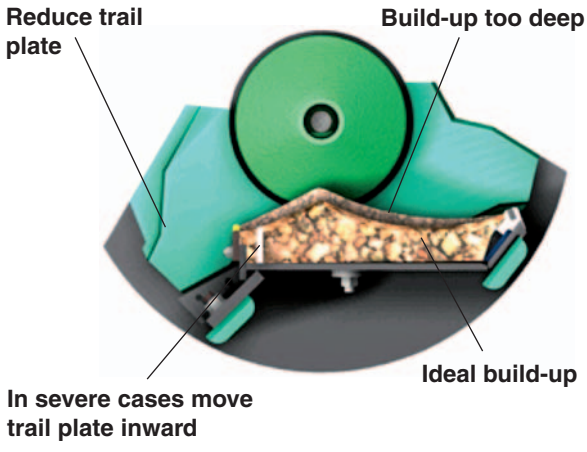


ROTOR SERVICING

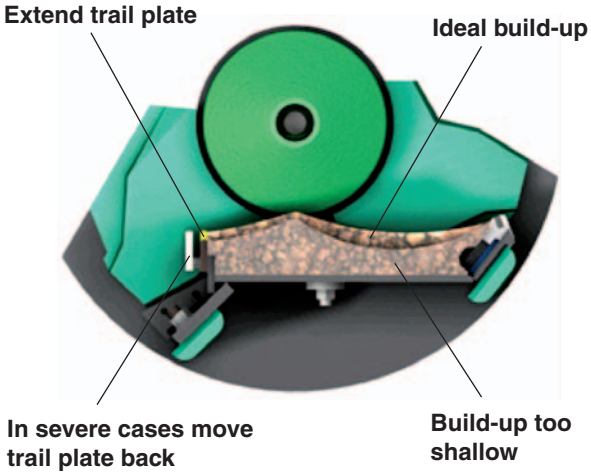
ROTOR BUILD-UP TUNING

BUILD-UP ADJUSTMENT

Trail Plate Position and Width



- Wide trail plate makes build-up deeper.
- Moving trail plate toward the rotor tip makes build-up deeper and moves peak toward the tip.



- Narrow trail plate makes material build-up shallower.
- Moving trail plate away from rotor tip makes build-up shallower and moves peak away from the tip.

Trail Plate Angle

- The angle of the trail plate controls the depth of build-up at the top of the rotor relative to the bottom height at which material exits the rotor.
- A trail plate with a wide base and narrow top will direct material more to the top of the rotor, raising wear path on rotor tips and increasing clearance around feed tube.

- A straighter trail plate will tend to direct material to the bottom of the rotor tip and reduce clearance of feed tube.

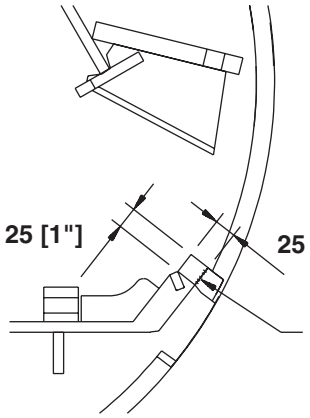
Adjustment of the trail plates should be made by cutting thin (6mm [¼"]) slices off. Large adjustments should not be made as the problem may simply move to the opposite extreme, i.e. top end tip wear may become bottom end tip wear.

ROTOR SERVICING

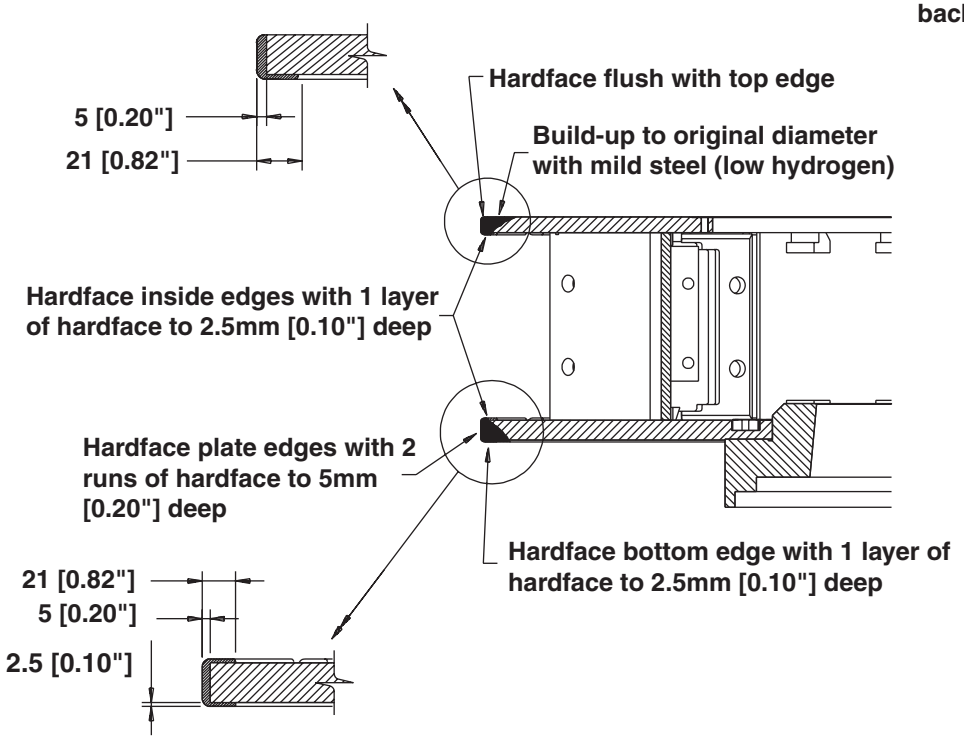
ROTOR REBUILDING

CAUTION **Do not attempt to weld on rotor while it is in the machine or arcing damage can cause premature failure of the bearings.**

1. Remove rotor (see 6-35).
2. Clean out all wear parts and build-up.
3. Do not weld on balance machine.
4. Spin rotor on balance machine to check for low spots on periphery. Mark them.
5. Build-up top edge to original diameter and roundness.
6. Build-up bottom edge to original diameter and roundness.
7. Replace top plate as required.
8. Effect any internal repairs.
9. Balance rotor.



Build-up with mild steel (low hydrogen) to size shown to a depth of 11mm [0.43"]. Hardface from outer edge of rotor to outside face of back-up tip block

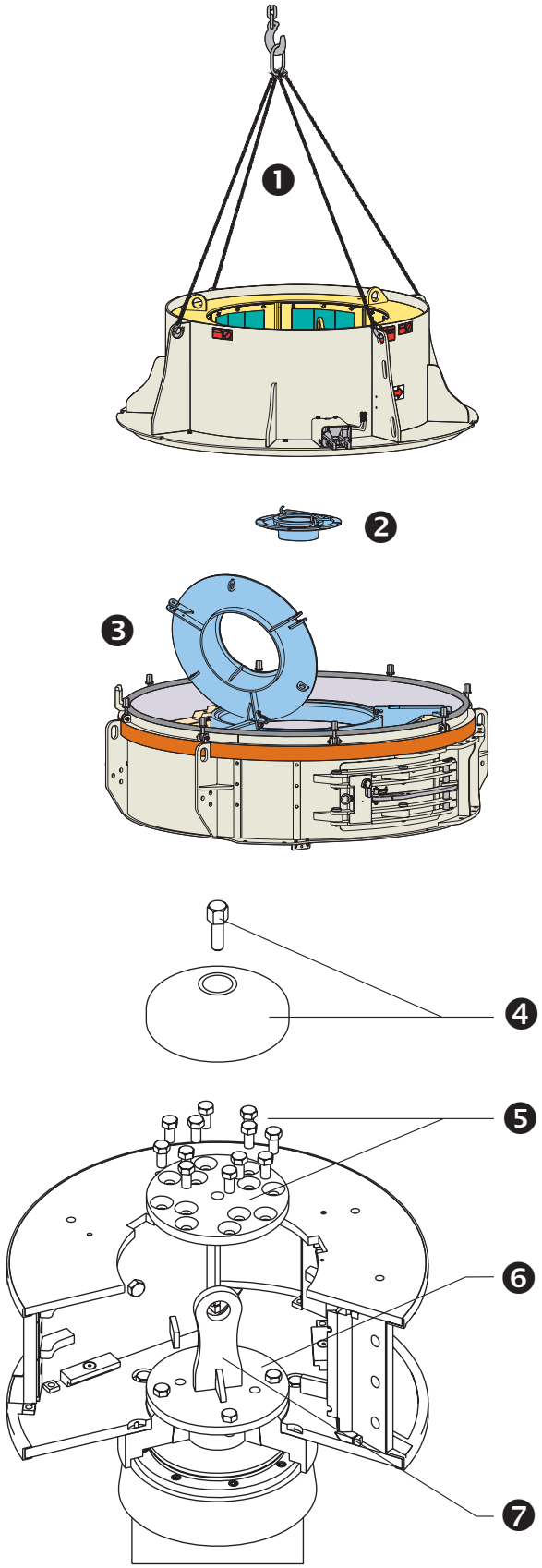


NOTE:

- Hardface wire to standard AS2576-2360-B7 or equivalent. Use either Cigweld Cobalarc Coarseclad 1.6mm or Lincoln Electric Lincore 6ø-0 7⁄64”.
- Frequent minor rebuilding is cheaper than infrequent major rebuilding work.

ROTOR SERVICING

ROTOR REMOVAL



1. Remove hopper and crusher roof in one lift.

   NOTE: The hopper may be removed from the roof first if the lifting equipment does not have sufficient capacity to lift both assemblies together. Disconnect the control gate from the hydraulic ram and slide the control gate back as far as possible. This will allow the hopper to be removed.

2. Remove feed kit.

3. Remove wedges from feed kit holder and hinge the feed kit holder out of the way.

4. Pick out material from the centre of the distributor plate and remove the rag or paper from around the distributor bolt. Remove the distributor bolt and take out the distributor plate.

   NOTE: Prevent any material falling down the threaded distributor bolt hole. Use a rag or put the distributor bolt back in.

5. Remove the top plate bolts and the top plate.

6. Attach the rotor lifting plate. Bolt down with four bolts and tighten bolts in series until fully screwed in to force rotor off taper lock.

7. Lift out rotor using rotor lifting plate

ROTOR SERVICING

ROTOR INSTALLATION

The life of the shaft line assembly is greatly reduced when the rotor is running with excessive vibration for long periods. When this vibration is extreme, there is potential for catastrophic failure, i.e. shaft breakage.

One factor which has a direct influence on the smooth running of the crusher is the fit between shaft line assembly and rotor. The correct procedure for securing a rotor to a shaft line assembly is as follows:–

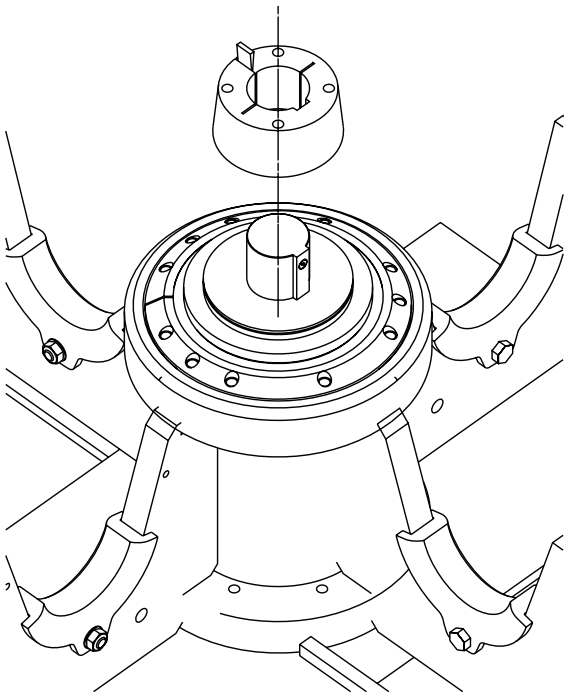
1. PREPARATION

Thoroughly clean the shaft, key, taper lock and rotor boss. Coat these surfaces with light oil or dewatering fluid and wipe down prior to assembly. Ensure the key screw is not proud of the outer face of the key.

2. TAPER LOCK FITTING

Place a small wedge or screwdriver in the split on the **TOP** of the taper lock to expand it slightly. Place the taper lock, large end downward, on the shaft so that it sits hard down on the top seal plate.

Remove the wedge or screwdriver and remove any burrs on the taper lock left behind.



NOTE: Do not expand the taper lock any more than necessary to achieve a snug sliding fit onto the shaft. Excessive expansion of the taper lock can break it.

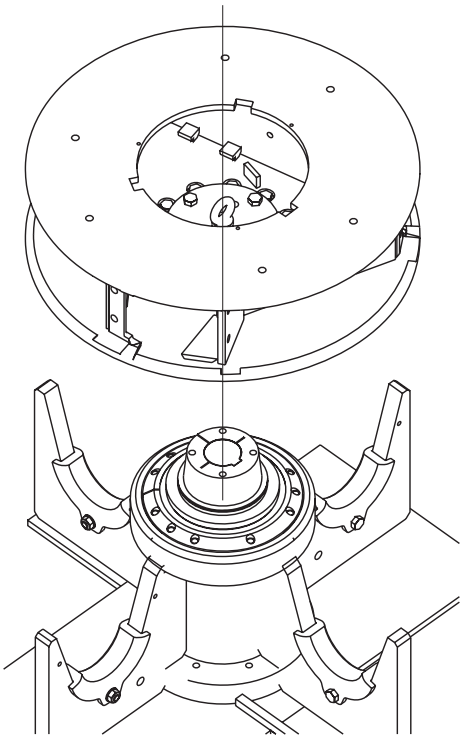
ROTOR SERVICING

ROTOR INSTALLATION

3. ROTOR TAPER CHECK

If the rotor being fitted has just been repaired and/or reconditioned around the taper area (i.e. has undergone extensive welding that may cause distortion), it is recommended that the fit between rotor and taper lock be checked prior to final fitting.

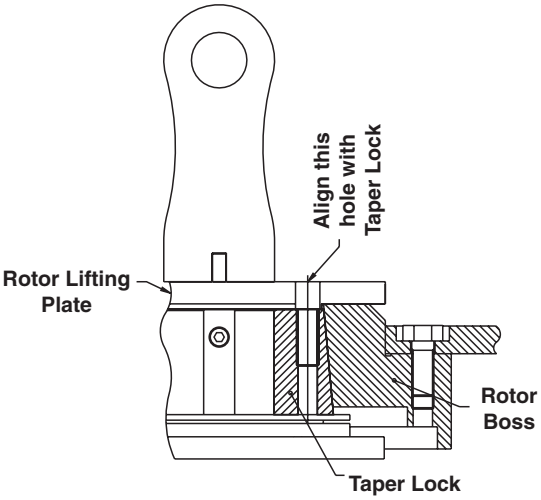
To do this, blue the bore of the rotor boss and lower onto the taper lock on the shaft. (Use the rotor lifting plate or, for the 300mm rotor, the lifting sling supplied with the crusher). Ensure the taper is properly seated under the weight of the rotor and then remove. You should see a blue mark on the taper lock indicating contact with the rotor boss. This mark should cover at least 80% of the circumference and 80% of the length of the taper. Any less contact than this will require replacement of the rotor boss. If this is not practical (e.g. the boss is welded in), consult your Barmac representative for further advice.



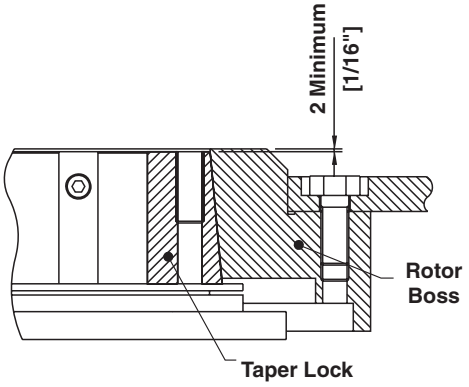
4. ROTOR FITTING

Fit the rotor lifting plate to the rotor boss and lower the rotor onto the taper lock. Before removing lifting plate, line up two spare holes in lifting plate with any holes in the taper lock.

Remove the lifting plate bolts evenly, allowing the rotor to slide onto the taper lock under its own weight. With the rotor firm on the taper lock there must be at least 2mm [1/16 in.] between the top of the taper lock and the top of the rotor boss.



NOTE: The rotor must be lowered square to the shaft onto the taper lock. Failure to do so may result in a poor mating of the tapered surfaces and hence vibration problems. Check the 2mm [1/16 in.] difference in height between the rotor boss and taper lock to ensure that the rotor has seated on the taper lock squarely.



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ROTOR SERVICING

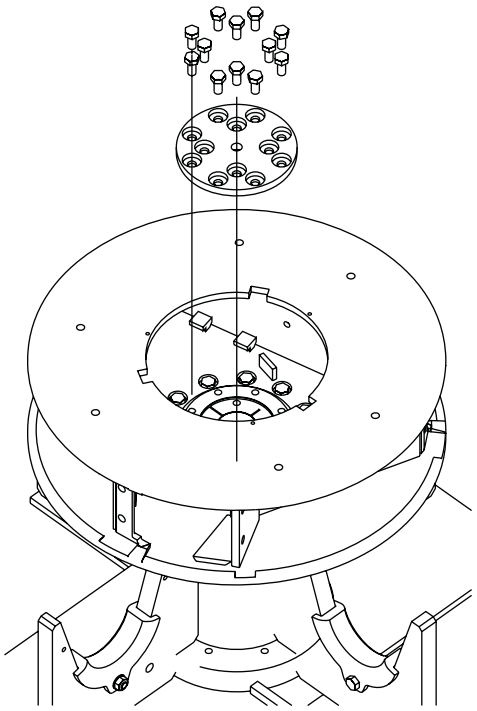
ROTOR INSTALLATION

5. SECURING BOLTS

Insert the bolts through the top plate into the taper lock and tighten evenly. This pulls the taper lock up tight on the shaft and rotor boss.

Model	Torque Nm [ft lbs]
B3100SE	34 [26]
B5100SE	60 [45]
B9100SE, B7150SE, B7160SE, B6150SE	250 [190]

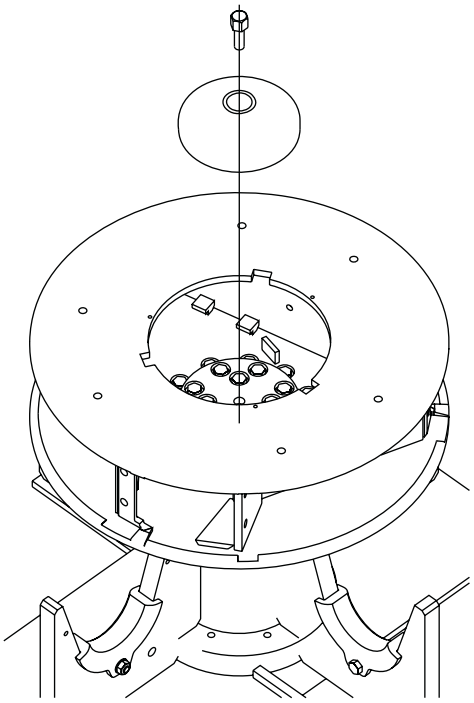
For the larger rotors, fit the additional 8 outer bolts through the top plate into the rotor boss and tighten. This fills the holes that are necessary for removal and provides positive drive between taper lock and rotor boss in addition to the friction fit of the taper. Torque to 250 Nm [190 ft lbs].



6. FINAL CHECK

Stand on top of the rotor (if possible) and try to rock it from side to side. If there is excessive movement or if you feel the rotor “settle” at all, recheck the torque on all bolts.

Note that there will be a small movement of the shaft within the bearings. This is normal. This check simply confirms that the rotor is properly seated on the taper lock.



7. DISTRIBUTOR PLATE FITTING

The distributor plate must now be fitted to protect the taper assembly. Note that the centre bolt of the distributor plate cannot be relied upon alone to secure the rotor to the shaft. (See 6-19).

ROTOR SERVICING

ROTOR BALANCING

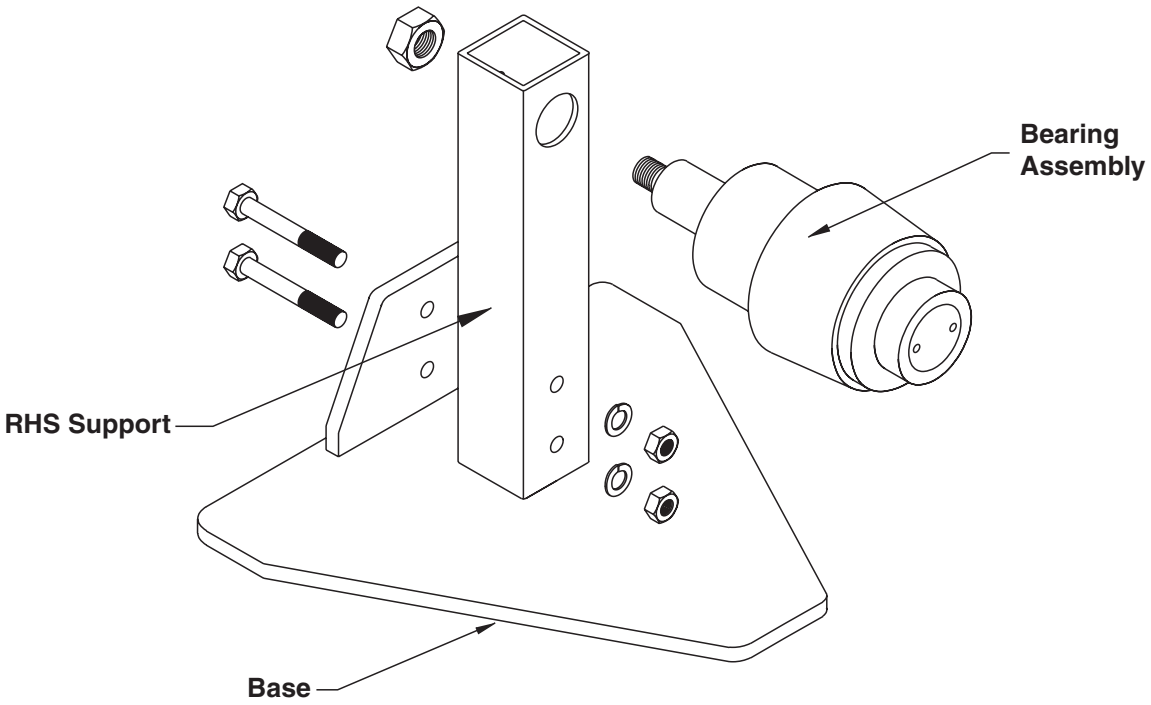
It is important that the rotor is properly balanced in order to provide the maximum trouble-free life of the shaft line assembly in the crusher. Barmac manufactured rotor balance machines are designed specifically, and only, for this job.

To get the best results from the balance machine, it must be properly set up and in good mechanical order.

ASSEMBLY – SMALL ROTOR BALANCE MACHINES (300mm and 500mm rotors only)

The bearing assembly of these machines is supplied fully assembled. All that remains is to:

1. Assemble the RHS support to the base with the bolts provided.
2. Assemble the bearing assembly to the RHS support with the nyloc nut provided.



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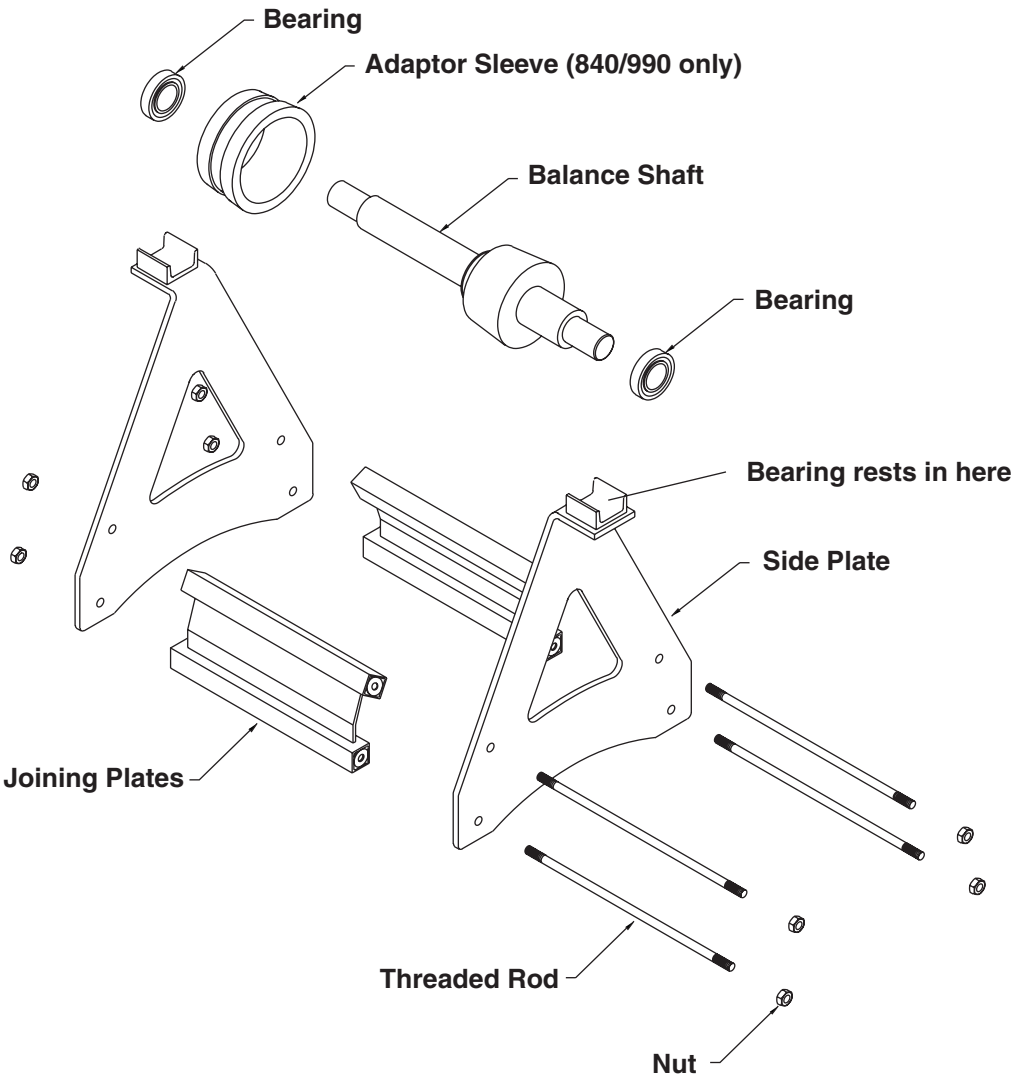
ROTOR SERVICING

ROTOR BALANCING

ASSEMBLY – LARGE ROTOR BALANCE MACHINES (690mm, 760mm, 840mm and 990mm rotors only)

These machines require full assembly as follows:

1. Assemble the two side plates of the frame with the joining plates, threaded rod and nuts supplied.
2. For 840mm and 990mm rotors only, fit the adapter sleeve to the balance shaft.
3. Clean the bearings in solvent to remove all traces of dirt, grease, oil, etc. Fit the bearings to the balance shaft and tighten the grubscrews.
4. Rest the shaft assembly on the frame. The shaft should rotate freely.



ROTOR SERVICING

ROTOR BALANCING

WHEN TO BALANCE

- The rotor must be balanced after any repair work has been carried out, e.g. hardfacing.
- In the case of 300mm rotors, the rotor must be balanced after turning or changing the upper or lower wear plates.
- It is advisable to check the balance if the vibration switch trips out repeatedly and the wear plates appear to be in good condition.

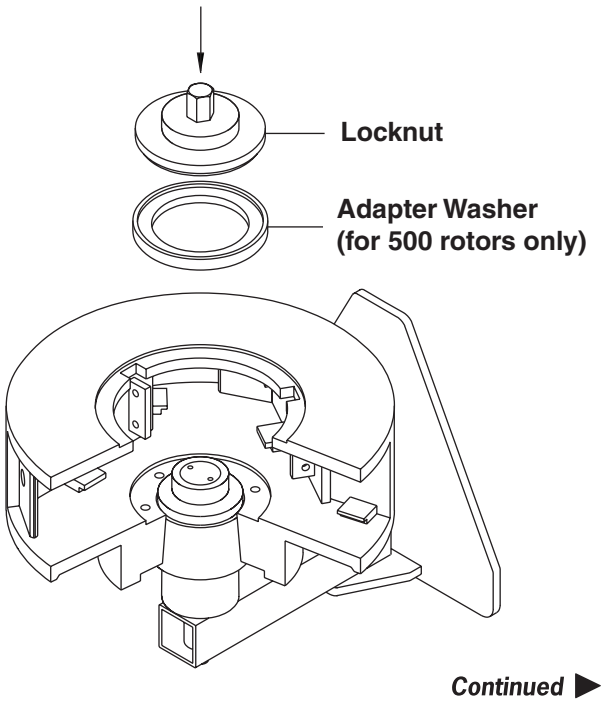
OPERATION

In all cases, remove rock build-up, dirt, old wear parts, etc. before attempting to re-balance the rotor.

- For 300mm rotors, re-fit clean wear parts in the new position ready for next period of operation.
- Make sure the taper in the rotor and on the rotor balancer are clean and free from damage.

SMALL ROTOR BALANCE MACHINES

1. Lay the rotor balance machine on its back and lower the rotor onto the taper.
2. In the case of 500mm rotors, assemble the adapter washer onto the the balancer housing.
3. Lock the rotor on with the locknut.
4. Tilt the rotor upright.
5. Make sure the balancer is level.



Continued ▶

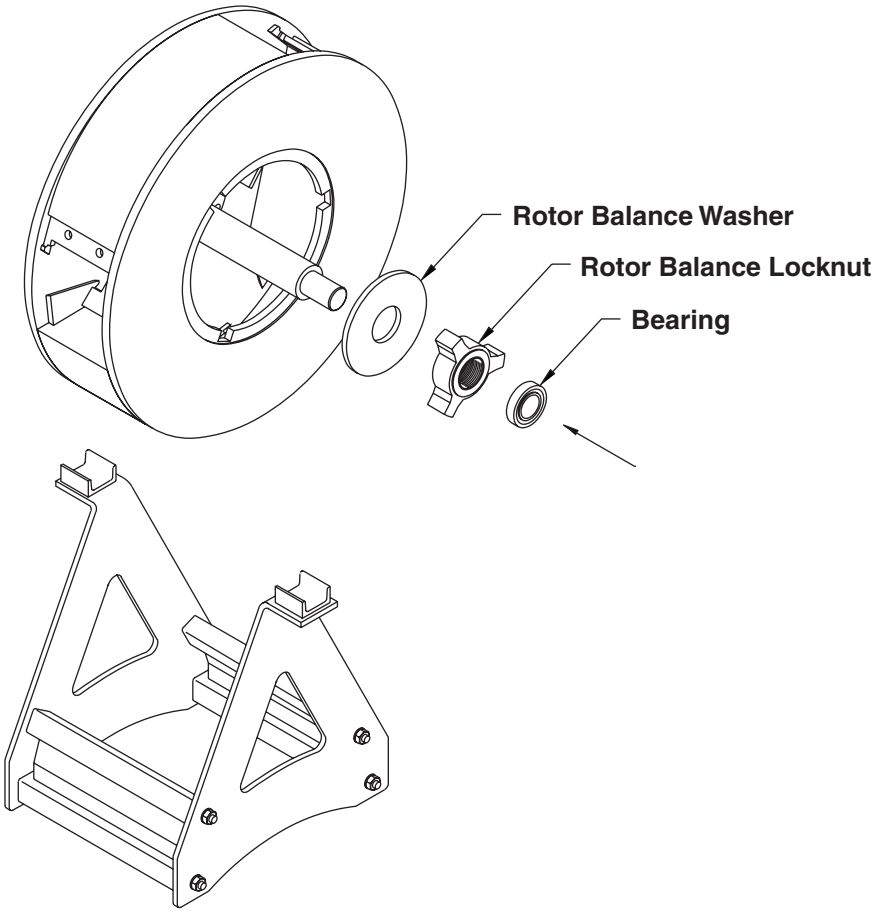
Proceed to BALANCING PROCEDURE.

ROTOR SERVICING

ROTOR BALANCING

LARGE ROTOR BALANCE MACHINES

1. Ensure the balance frame is level.
2. Remove bearing from the end of shaft that passes through the rotor.
3. Insert the balance shaft through the rotor.
4. Locate rotor on taper, ensure that the two tapers fit evenly, fit rotor balance washer and rotor balance locknut and tighten with hammer.
5. Fit bearing back onto shaft and tighten grubscrew.
6. Using suitable lifting apparatus, position the rotor and balance shaft on the support frame.



Proceed to BALANCING PROCEDURE.

ROTOR SERVICING

ROTOR BALANCING

BALANCING PROCEDURE

1. Thoroughly clean out rotor of all rock, dirt, old wear parts and any old welded on weights from a previous balance (see fig. 3). Check for perforations in the inner and outer walls.
2. Check taper in rotor boss is clean and free from damage.
3. Remove weights from previous balance and set rotor up level in rotor balancing frame.
4. Gently rotate the rotor and allow it to wind down to a stop. The heaviest point on the rotor is now at the bottom.
5. With chalk mark the blades A, B, and C (see fig. 1).
6. Add weights to the blade A (fig. 1) until blade B is at top dead centre. Each time a weight is added give the rotor a gentle push in the direction you are working and allow the rotor to settle to the new balance point. This helps overcome bearing friction.
7. When blade B has settled at Top Dead Centre, pull it around 90˚ and hold it steady there by hand (fig. 2).
8. Add weights to the blade you are holding down (B) until it doesn't try to go up or down.
9. Sometimes the blade B won't take enough weights to balance the rotor. If this is the case cut a piece of 50mm x 12mm [2 in. x ½ in.] flat bar 200mm [8 in.] long and weld it onto the B section where indicated (fig. 3). Use a small tack weld so the weight is easy to remove for the next balance. Repeat the whole balancing exercise.
10. When you think the rotor is balanced, rotate the rotor in 90˚ steps four times. If the rotor does not move from each stop, it is balanced.
11. Tighten the balance bolts.
12. Keep spare weights in a safe place.

NOTE: To check that the rotor is now properly balanced, remove one balance weight and confirm that the rotor is out-of-balance.

IF SO: Replace the weight. The rotor is now balanced.

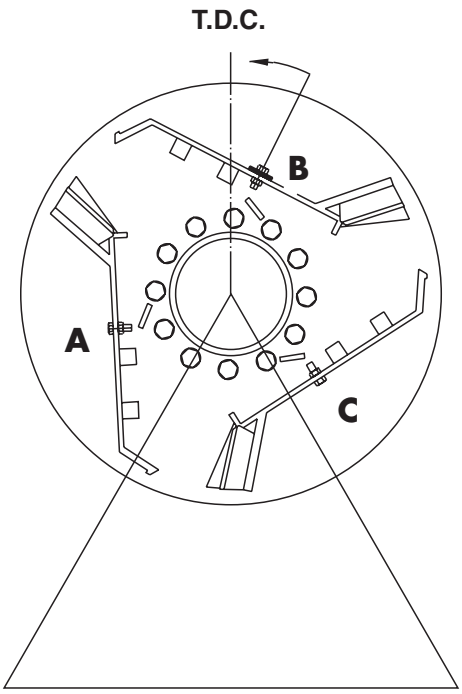
IF NOT: There may be a fault with the balance machine. The balance machine should be sensitive enough to detect an out-of-balance condition less than the effect of one balance weight.

- **Refer to Troubleshooting 6-45.**

Continued ▶

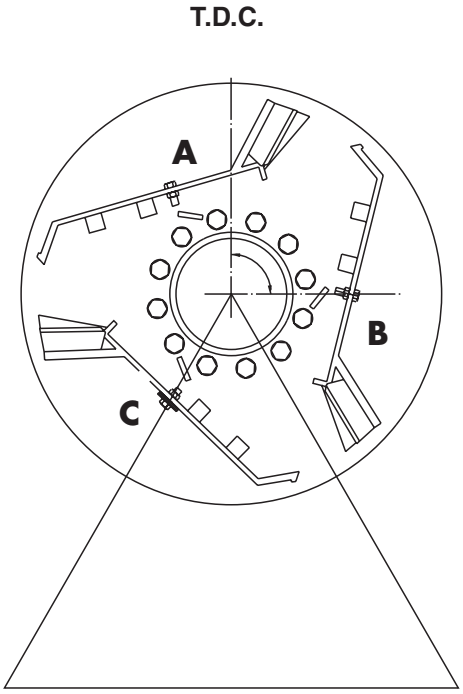
ROTOR SERVICING

ROTOR BALANCING



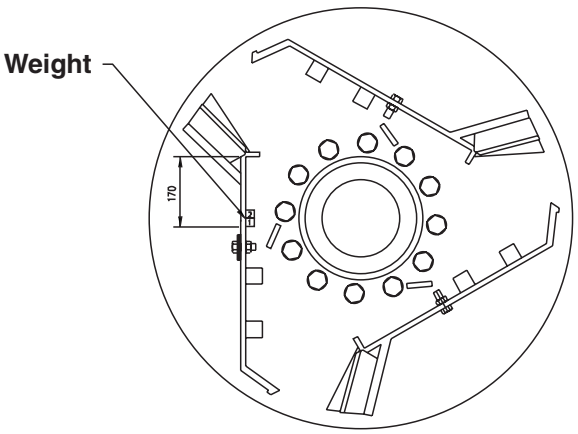
Typical rotor position after step 4. Add weights to 'A' until 'B' moves to T.D.C.

FIG. 1



Step 6: 'B' is pulled around 90° from T.D.C. Add weights to 'B' until rotor does not try to turn.

FIG. 2



Step 8: If you can't get enough weights into position B, weld flat weight inside rotor as shown and start again.

FIG. 3

ROTOR SERVICING

ROTOR BALANCING

TROUBLESHOOTING

If the rotor fails to balance properly, check the following:

- Make sure there is no loose material in the rotor that could be moving as the rotor is turned.
- Make sure the rotor balance machine is level and the bearings are totally clean.
- Make sure the tapers are in good condition.
- Make sure the bearings are not damaged or worn.

After all checks have been made, attempt to balance the rotor again from stage 1.

MAINTENANCE

The rotor balance machine is designed to give many years of trouble-free operation. However, as with any precision machinery, proper care must be taken to ensure this is the case.

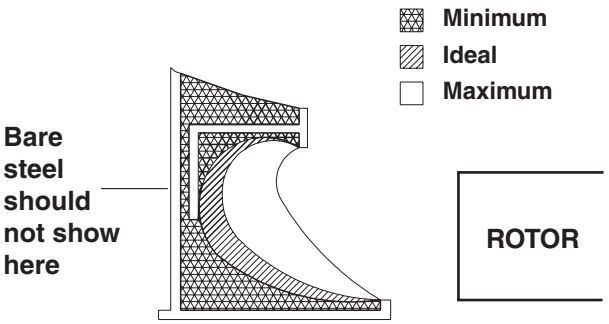
- Wrap a cloth around the taper on the balance machine when not in use.
- For the large balance machine, remove the bearings from the shaft and store in a container of light machine oil.
- Store all components in a clean environment.

CRUSHER SERVICING

CRUSHING CHAMBER

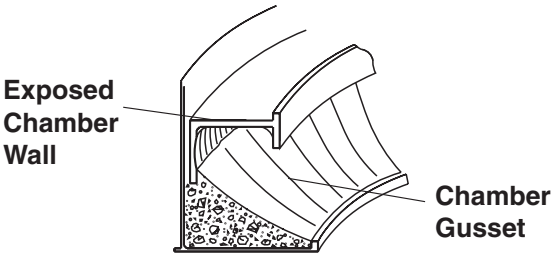
BUILD-UP

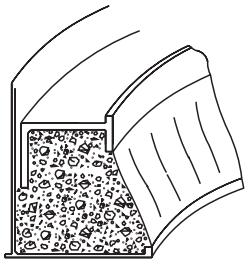
- The chamber should have a full rock lining covering all items of the structure except for the faces of the chamber gussets (see below).
- The outer wall must not be exposed.
- The feed areas must be free of fines build-up and debris.
- Build-up should not be excessive, i.e. blocking material flow routes or encroaching on moving parts.



Initially, the bottom crushing chamber gussets may protrude through the build-up. These will soon wear to their ideal level. This is quite normal.

On stopping the crusher, if the time between shutting off the feed and the rotor stopping is more than 5 minutes, air movement in the crusher may blow away much of the lighter material from the stone bed, giving the impression of insufficient build-up. In these cases, stone beds will be re-instated shortly after starting to feed material again. This can be confirmed by 'crash-stopping' the plant, to minimise the chance of air blowing material away.





Chamber Wall Exposed

Caused by bony feed, very dry feed, or rounded feed. Tuning of the gussets will assist in holding a build-up. Alternatively, the addition of fines to a rounded or bony feed and or adding some water will enable the build-up to form.

Normally a good build-up is held but occasionally it erodes – caused by running with intermittent feed or by running empty for a period of time and blowing the build-up out.

Excessive Buildup

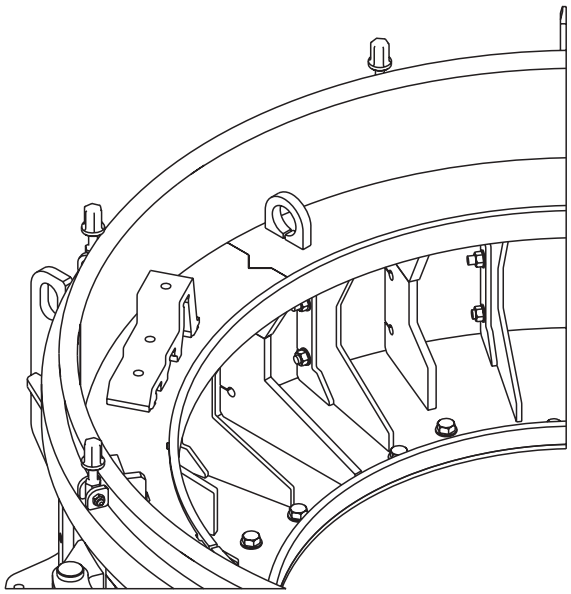
Feed moisture content too high and/or high fines content. Tuning of the gussets will assist in reducing build-up. Alternatively, remove moisture and/or reduce fines content. Where this is not practicable a water spray system may be required.

Frequent operation of the crusher running light/empty may reduce stability of the build-up and increase the likelihood of gusset and/or casing wear.

CRUSHER SERVICING

CRUSHING CHAMBER

CHAMBER GUSSETS

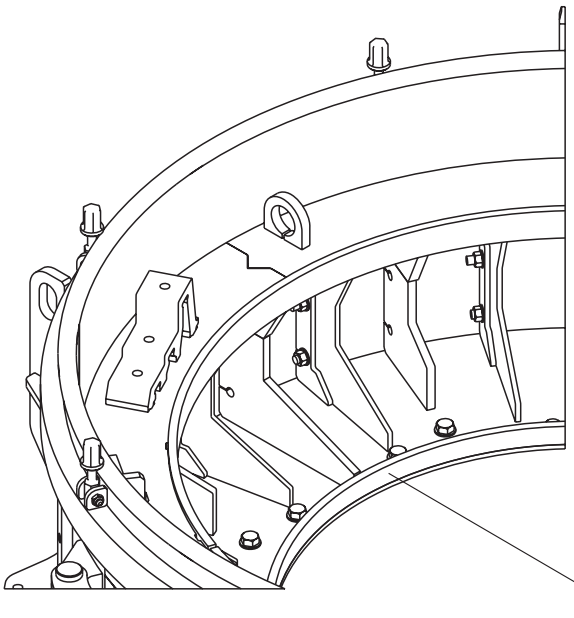


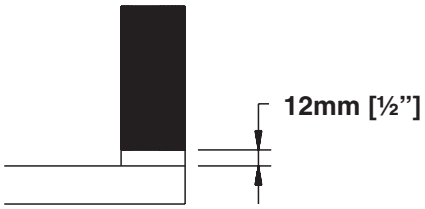
Additional chamber gussets can be added as required.

Add gussets to improve poor build-up conditions.

Gussets can be replaced when excessively worn.

TOEBOARD





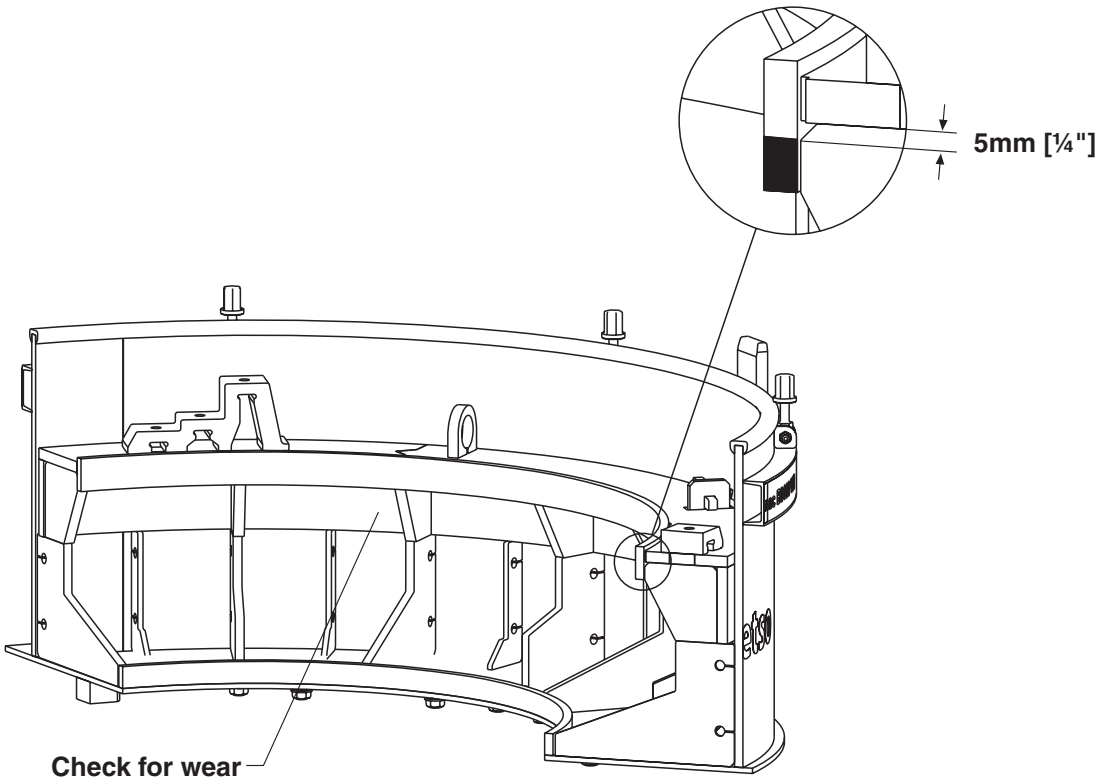
The toeboard should be replaced when 12mm [½"] remains as shown.

CRUSHER SERVICING

CRUSHING CHAMBER

CAVITY RING

The cavity ring is a secondary wear part and under normal conditions wears little but needs checking. The cavity ring should be replaced when it has worn to the level shown below.

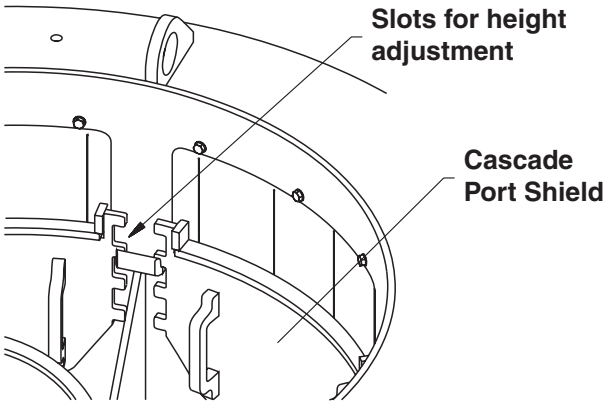


CRUSHER SERVICING

HOPPER

CASCADE PORT SHIELDS

The opening of the cascade port can be altered by moving the cascade port shield up or down. Adjust ports individually so that the cascade material passes through evenly over all ports.

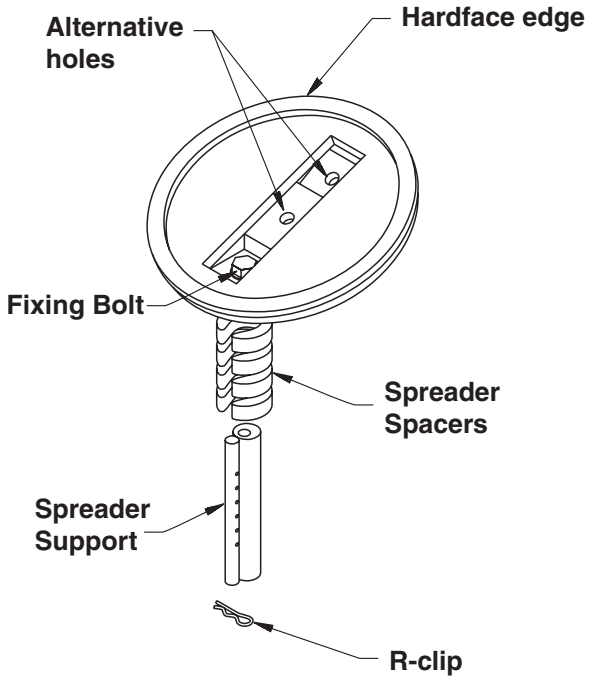


Adjusting Cascade Port Shield Height

1. Remove build-up from hopper.
2. Lift shield up vertically and out toward centre of hopper.
3. Holding shield close to wall of hopper, lift to desired height.
4. Replace shield on brackets.

SPREADER PLATE

The height and angle of the spreader plate can be adjusted to control material flow. Adjust so that feed material falls evenly off the plate and this material passes smoothly through the feed hole under the plate. Once the hardfaced edges are worn, the spreader plate will need to be replaced.



Adjusting Spreader Plate Height

1. Remove spreader plate assembly from hopper access guard.
2. Remove R-clips from spreader plate support.
3. Add or subtract spreader spacers.
4. Replace R-clips.

Adjusting Spreader Plate Angle

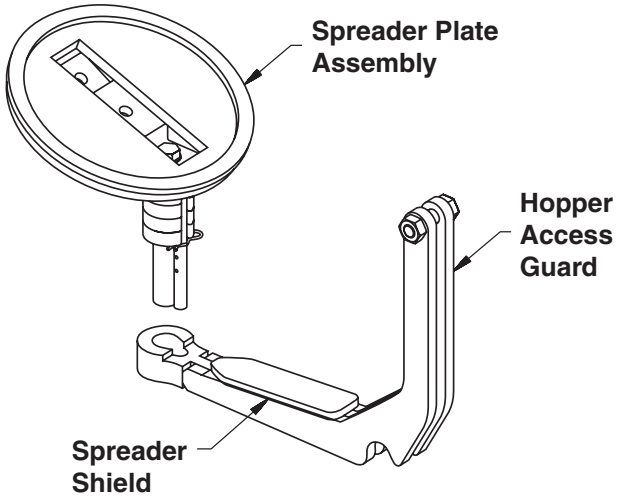
1. Remove fixing bolt.
2. Adjust plate to one of the alternative holes to change the angle.
3. Replace the fixing bolt.

CRUSHER SERVICING

HOPPER

HOPPER ACCESS GUARD

Spreader shields need replacing when hard surface is worn away.



Replacing Spreader Shields

1. Remove spreader plate assembly.
2. Remove spreader shields by grinding weld off underside.
3. Weld new spreader shields to hopper access guard.

HOPPER BODY

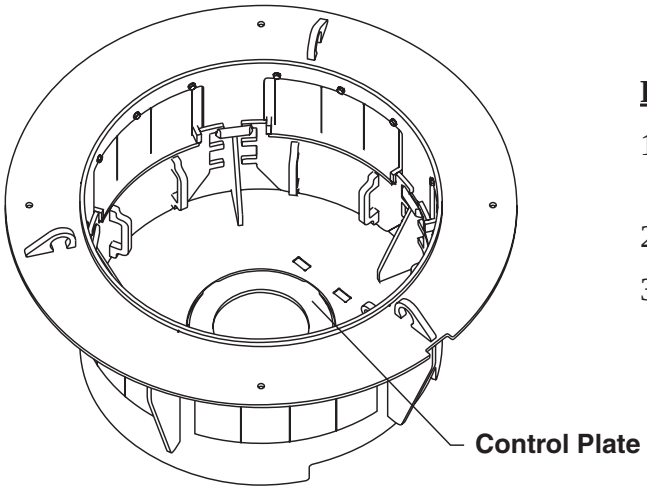
It is important to check the general condition of the hopper. Material flow from the conveyor/feeder and/or chute work may create wear in the hopper structure. Adjust flow of material to correct.

CRUSHER SERVICING

HOPPER

CONTROL PLATE

Once hardfacing is worn this plate will need replacement. Note that various opening sizes are available. Choose the size that allows the control gate to operate at the middle of its adjustment when the rotor feed is at its optimum.

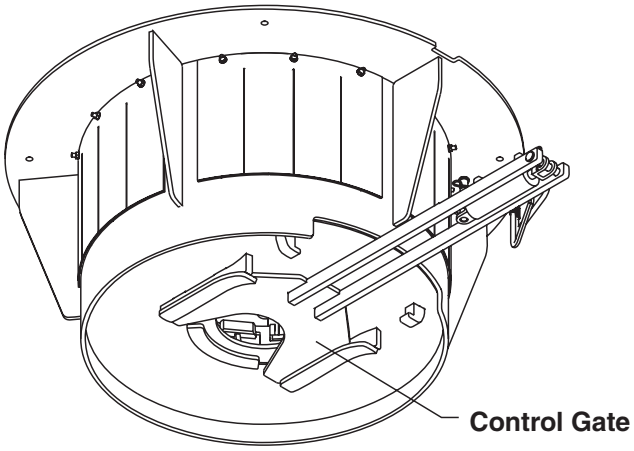


Removal

1. Remove spreader plate and hopper access guard.
2. Open control gate fully.
3. Remove control plate.

CONTROL GATE

If the edges of the control gate are excessively worn, it is necessary to replace it.



Removal

1. Remove clevis pin from hydraulic ram.
2. Slide control gate back as far as possible.
3. Remove hopper assembly using correct lifting equipment.
4. Remove control gate.

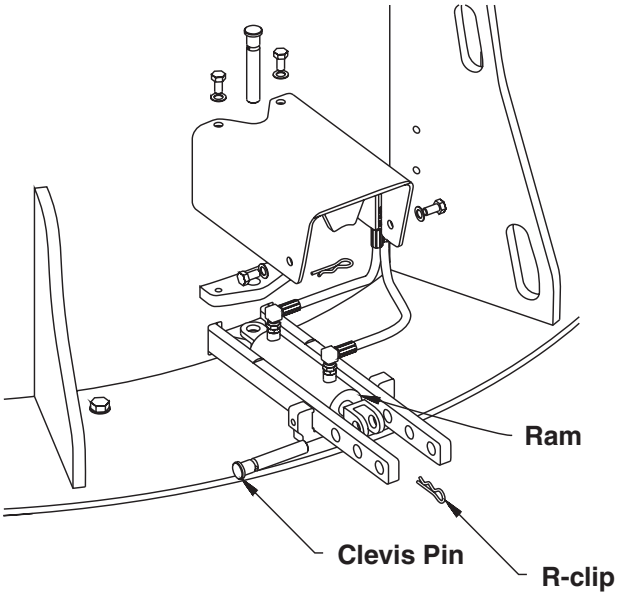
CRUSHER SERVICING

HOPPER

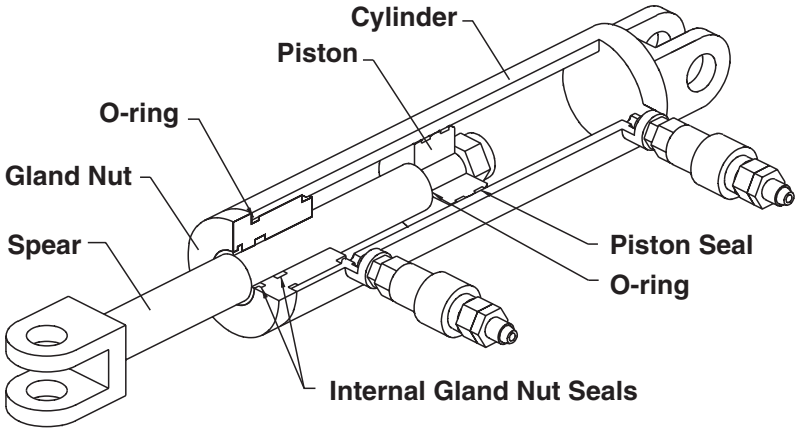
CYLINDER

Removal

1. Remove ram cover kit.
2. Remove R-clips from clevis pin at both ends of hydraulic ram.
3. Remove clevis pins.
4. Remove ram.



Servicing



Disassembly

(Refer to drawing above).

All repair work should be carried out in a clean, dust free environment.

1. Fully clean outside of cylinder prior to disassembly.
2. Remove the gland nut and slide the spear and piston assembly from the cylinder.
3. Unscrew the piston and slide the gland nut off the spear.
4. Remove all the old seals.

Assembly

(Refer to drawing above).

1. Clean all cylinder components.
2. Refit the internal seals into the gland nut.
3. Slide the gland nut over the spear.
4. Fit the o-ring onto the end of the spear and refit the piston.
5. Fit the piston seal and slide the piston into the cylinder.
6. Fit the external gland nut o-ring and refit into the cylinder.

CRUSHER SERVICING

FEED TUBE CENTRALISATION AND HEIGHT ADJUSTMENT

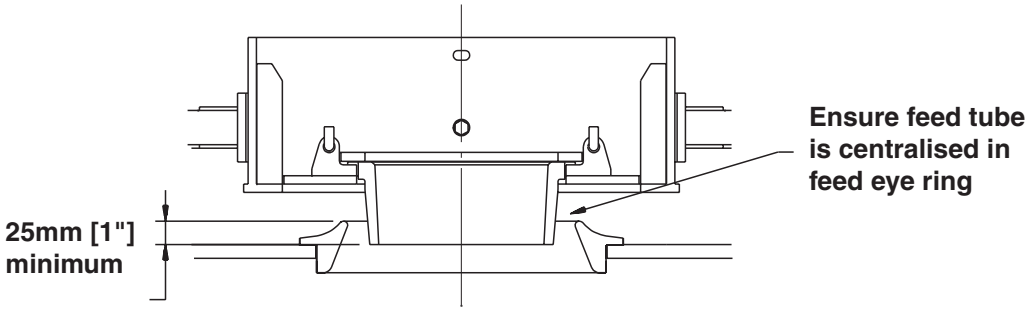
Every time the cavity ring or spider assembly is refitted to crusher, it is important to check that the feed tube is located centrally and at the correct height in the feed eye ring.

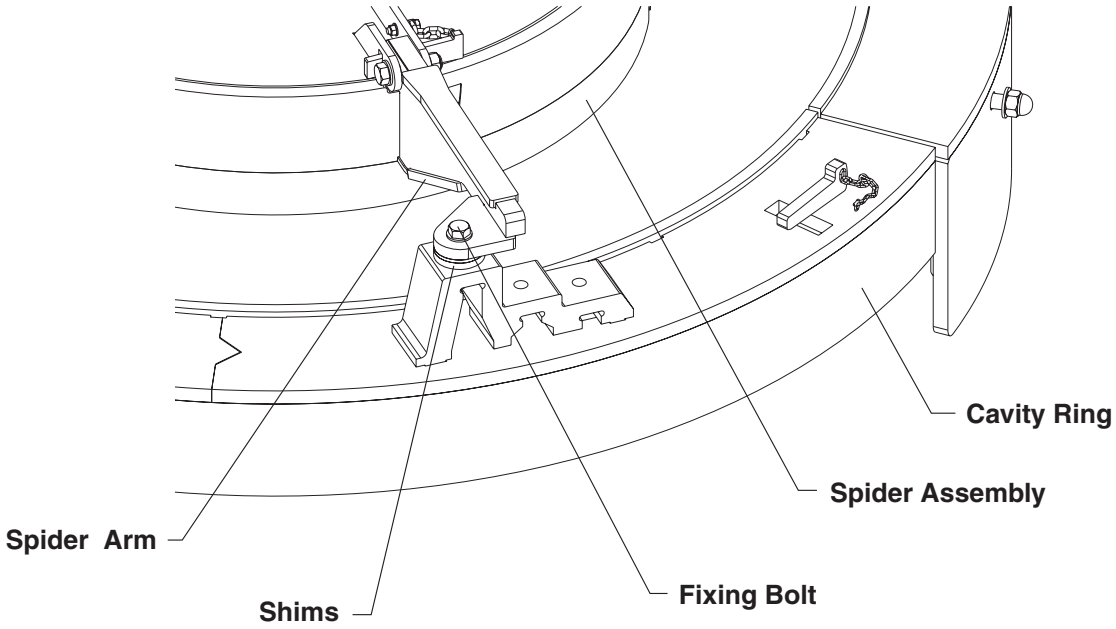
Height Adjustment

Add or remove shims from below the spider arms to set required height.

Centralisation

There is sufficient clearance in the fixing bolt holes to allow lateral movement of the spider assembly.





• See over for additional B5100SE - B3100SE adjustment.

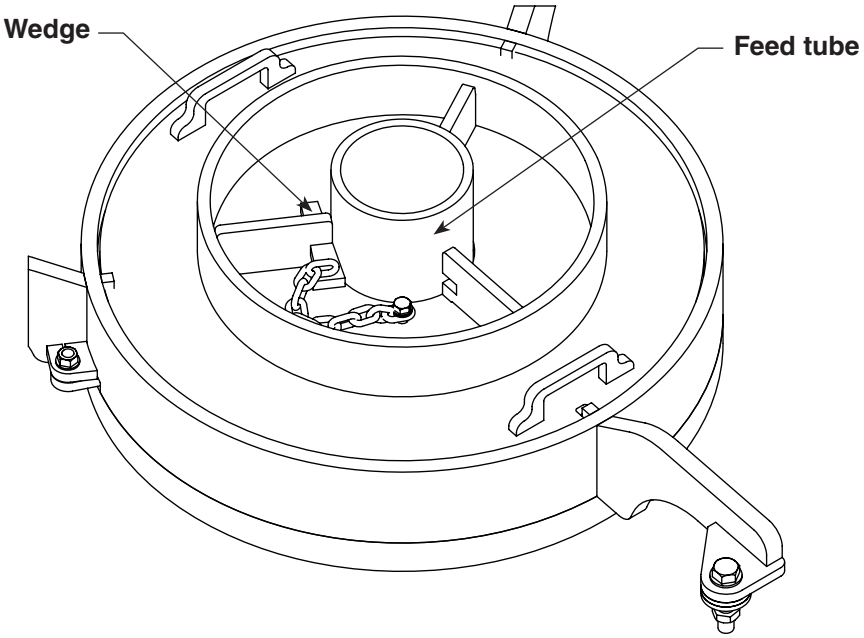
CRUSHER SERVICING

FEED TUBE CENTRALISATION AND HEIGHT ADJUSTMENT

B5100SE - B3100SE Models

Additional adjustment can be achieved on the B5100SE and B3100SE models by removing the wedge holding the feed tube in position and lifting or dropping the feed tube to the desired height.

The feed tube is then held in position by knocking the wedge back in.

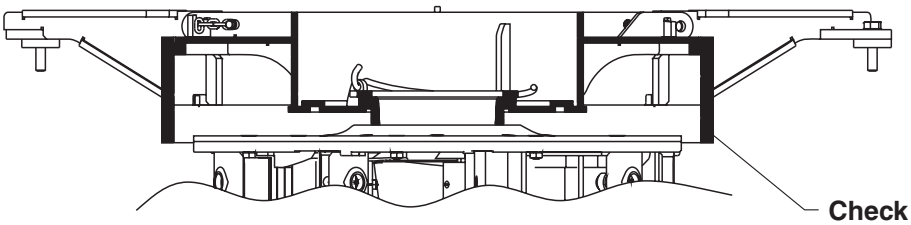


CRUSHER SERVICING

WEAR SKIRT

Like the cavity ring, this is a secondary wear part and under normal conditions wears little, but needs checking.

It should be replaced when wear on the rotor top edge increases.

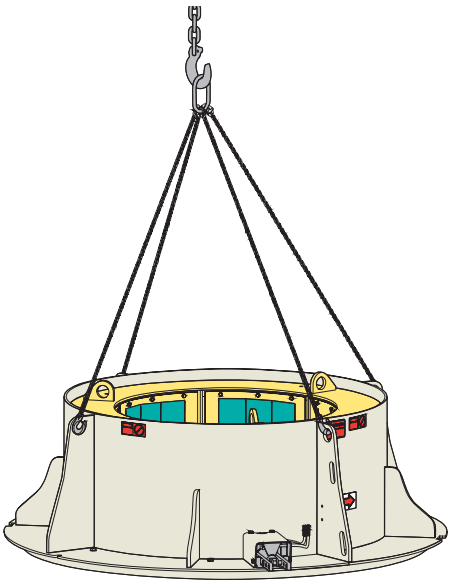


Removal

1. Remove roof and hopper in one lift.

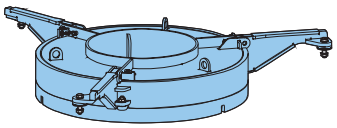
   NOTE: The hopper may be removed from the roof first if lifting equipment being used does not have sufficient capacity to lift both assemblies together. When removing hopper assembly, remove clevis pin from hydraulic ram and slide control gate back as far as possible before lifting hopper assembly.

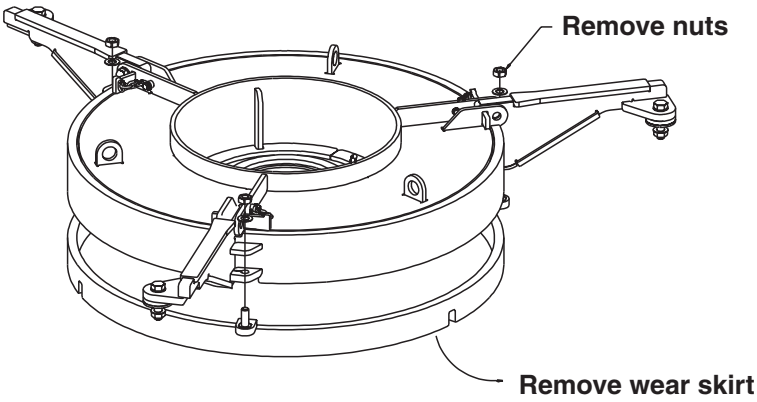
2. Lift spider assembly out of chamber.
3. Remove bolts holding wear skirt in place.
4. Remove wear skirt.

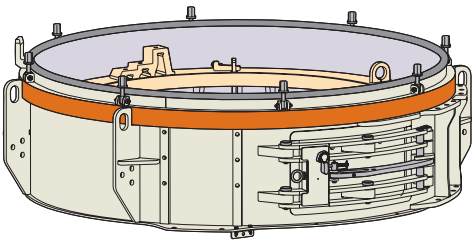


Installation

1. Bolt wear skirt into place using wear skirt bolt set.
2. Replace spider assembly.



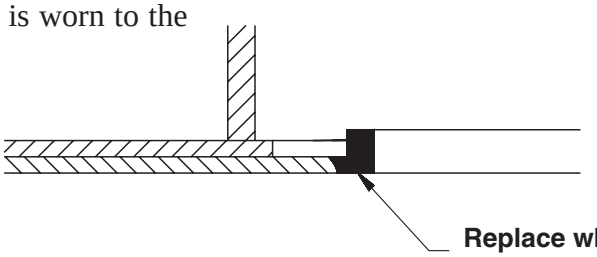




CRUSHER SERVICING

ROOF WEAR PLATE

Replace roof wear plate when it is worn to the level shown.



Removal

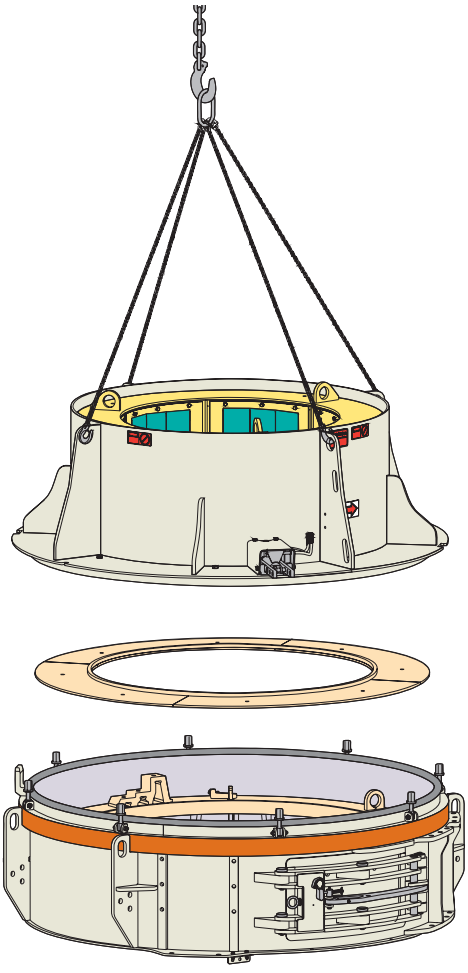
1. Remove roof and hopper in one lift.

   NOTE: The hopper may be removed from the roof first if lifting equipment being used does not have sufficient capacity to lift both assemblies together. When removing hopper assembly, remove clevis pin from hydraulic ram and slide control gate back as far as possible before lifting hopper assembly.

2. Support roof on outside edges and remove bolts holding wear plate.
3. Remove wear plate.

Installation

1. Position wear plate, aligning bolt holes in wear plate with corresponding in roof.
2. Bolt wear plate to roof.



SAFETY INTERLOCK

Regularly check that the safety interlock device is offering the operator or maintenance staff adequate protection. Refer to the separate manual supplied with the machine for additional service information.

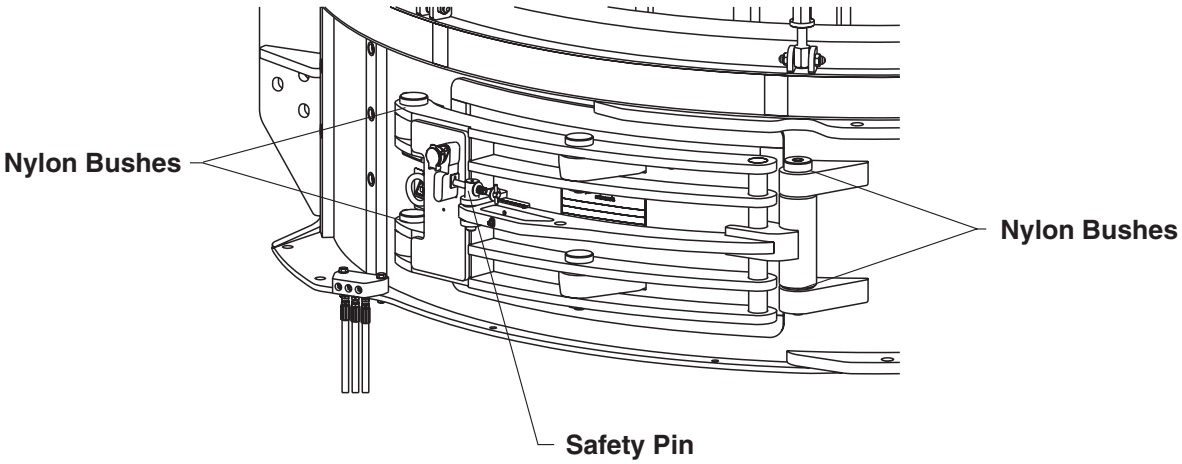
VIBRATION PROTECTION SYSTEM

It is very important to check regularly that the vibration control system is operating. For detailed information refer to the vibration protection system manual provided with the machine.

CRUSHER SERVICING

INSPECTION DOORS AND HATCHES

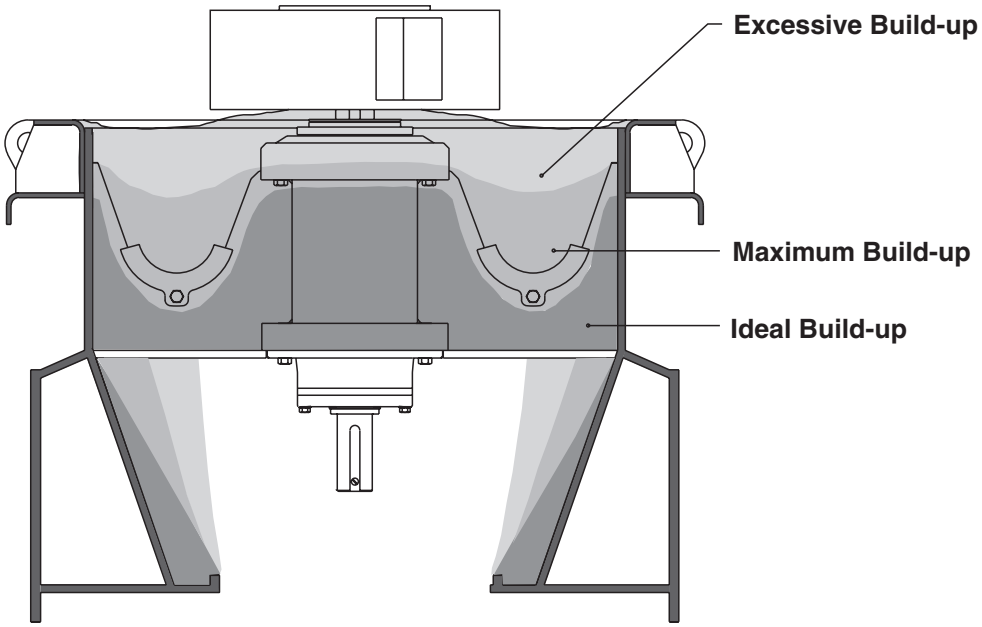
Ensure all inspection hatches, doors, guards and locks are secure. If inspection door is loose on hinges, replace nylon bushes. Ensure safety pin is in inspection door.



CRUSHER SERVICING

CRUSHER BASE

It is very important that material does not build-up under the rotor. This can cause severe wear and possibly damage bearings and/or the main shaft. Build-up should not impede flow of material to the discharge chutes.



Excessive Build-up

Excessive build-up can be caused by:
(1) Moisture content of feed too high
(2) High percentage of fine material in feed
(3) A combination of 1 and 2

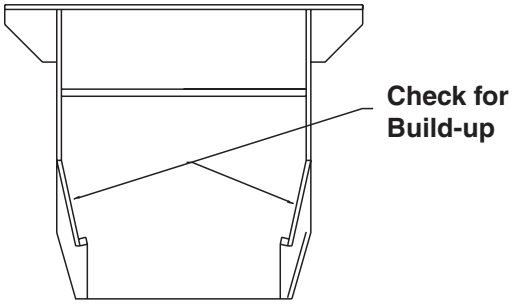
If the moisture or fines content cannot be lowered, please contact your Barmac representative for advice. This problem can be overcome by fitting a water spray system and/or low friction liners in the base of the crusher. In extreme cases air cannons are recommended. Your Barmac representative has access to recommended systems.

DISCHARGE CHUTES

Discharge chutes must be clear. In moist feed applications the discharge chutes need to be checked for possible build-up.

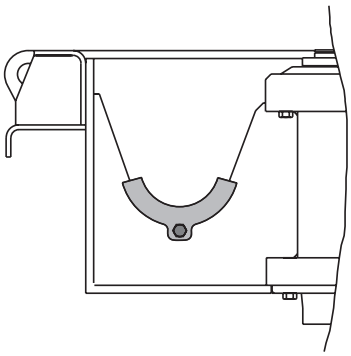
Check if the discharge chutes design restricts the flow, i.e. size or angle.

If moist material is creating a problem, consider lining with low friction material.



CRUSHER SERVICING

GUSSET WEAR CASTINGS



Check wear castings on shaft line assembly gusset. Replace as required.

GREASE DISCHARGE CHUTE

Check weekly that the grease discharge chute is not building up with grease. Clean out as required. See 6-4.

CAUTION Excessive build-up of grease may cause an overflow of grease onto the drive belts, causing premature failure of the drive belts.

BELT GUARDS

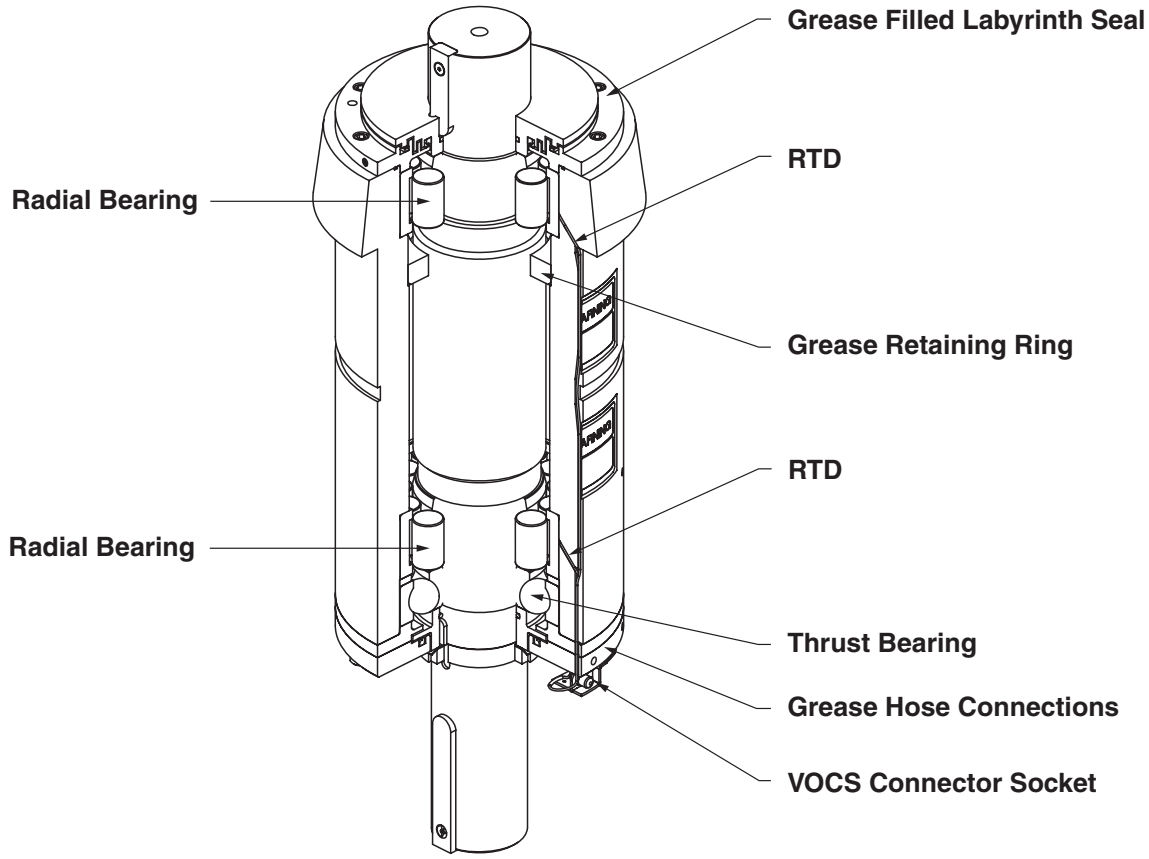
Ensure that all guards are in place and secure.

MOTORS

Check for missing bolts, bearing noise, excessive shaft float or damage and obstruction to fan cover. Grease according to motor manufacturer's instructions.

CRUSHER SERVICING

SHAFT LINE ASSEMBLY



The shaft line assembly is a grease filled, sealed bearing assembly which can be removed in one piece (shaft, bearings, seals and housing) for overhaul and inspection.

When the new shaft line assembly has run between 100 and 150 hours, begin a series of routine checks on the run down time of the rotor (time from power being cut to rotor stops turning).

A significant decrease in the run down time over a period will indicate that the bearings (crusher or motor) are deteriorating. Once the time falls below two minutes the bearings should be checked at the next routine service time.

Operators should become familiar with the sound of the bearings running. If this noise changes, especially if it begins rumbling, this will also indicate that the bearings are deteriorating.

If, when standing on top of the rotor during servicing, the shaft can be rocked from side to side with excessive float, then the radial bearings are worn.

If no-load current begins to increase slowly over a period of time, this is an indication that the crusher bearings are worn.

Upper seals should be replaced and labyrinth repacked with grease at yearly intervals.

CRUSHER SERVICING

SHAFT LINE ASSEMBLY

SEALS

Many premature shaft line assembly failures can be attributed to failure of the upper seals within the assembly. It is recommended these upper seals be inspected initially after 500 hours of operation and then at intervals of 2000 hours of operation and replaced if found to be worn or broken. This inspection/replacement can be done with the shaft line assembly installed in the base of the crusher and with the rotor removed.

Every care should be taken during inspection to ensure seals and shaft line asembly labyrinth remain free of dust.

The lower seals cannot be inspected or replaced while the assembly is installed in the base but are very unlikely to cause a premature failure of the assembly. These seals are always replaced during any repair/reconditioning process.

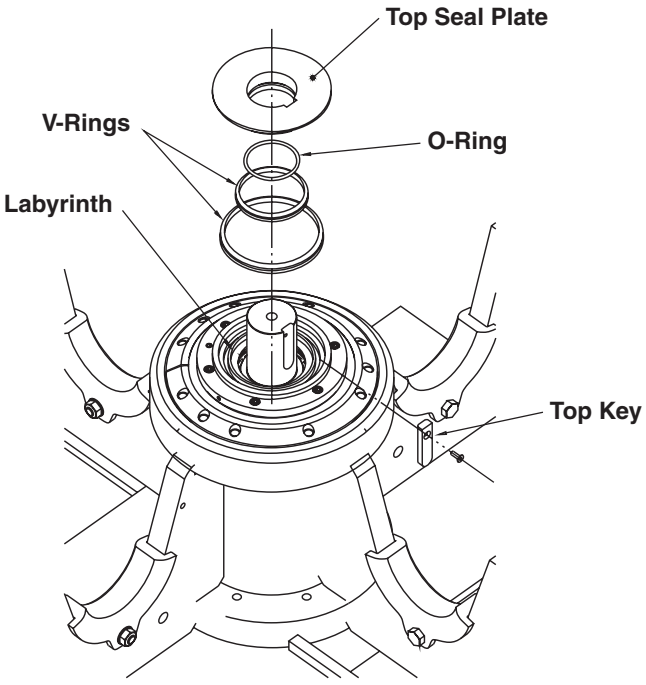
To inspect/replace upper seals:

1. Remove the top key and slide top seal plate off shaft.

2. Remove the o-ring from within the top seal plate. This is a static seal and may have a flat surface from contact against the shaft. If the seal is not broken or obviously damaged in any other way, it can be re-used.

3. Inspect the labyrinth between the bearing and the outermost seal. This should always be fully packed with clean grease. If the grease is not clean, the v-ring seals are not effective and must be replaced.

   If the labyrinth is not completely packed with grease, there could be a problem with the grease supply to the shaft line assembly (check hoses, etc) or with the lubrication schedule. (See 6-2).



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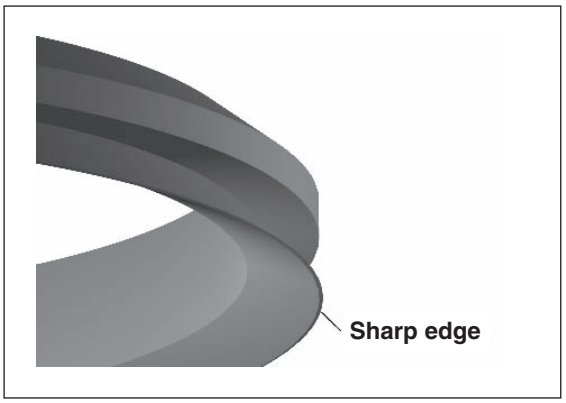
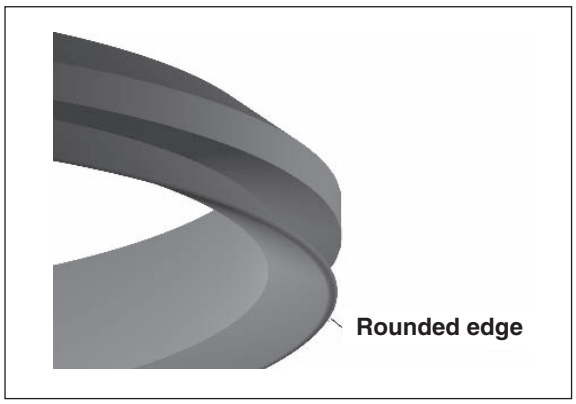
CRUSHER SERVICING

SHAFT LINE ASSEMBLY

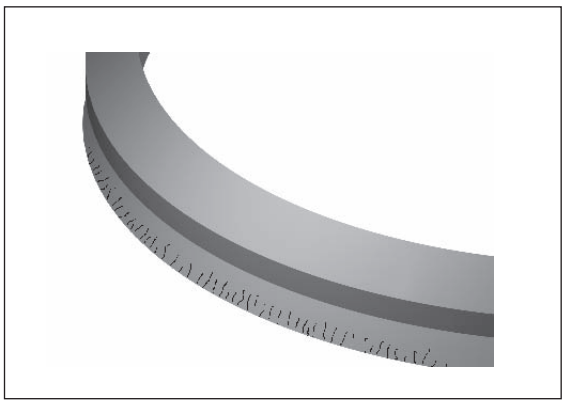
4. Remove the one or two v-ring seals (depending on the model) from the upper bearing retaining ring. These should not be worn, cracked or broken.



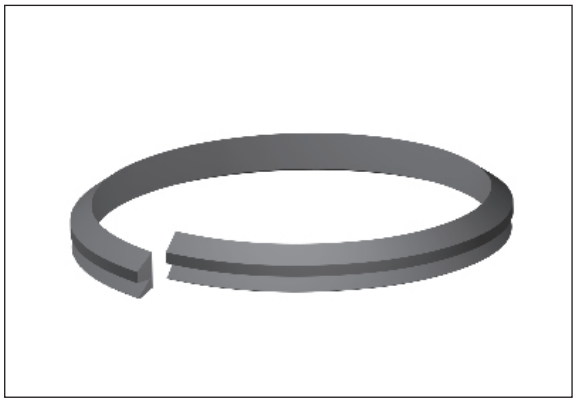
Normal Condition



Worn



Cracked



Broken

5. Refit/replace seals as necessary, pack the labyrinth with grease, refit top seal plate and key.

6. Refit the rotor and start the crusher. Apply twice the normal amount of grease to each grease point and continue with normal operation.

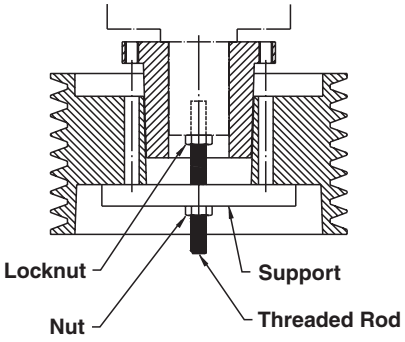
CAUTION **Do not run the crusher without rotor fitted.**

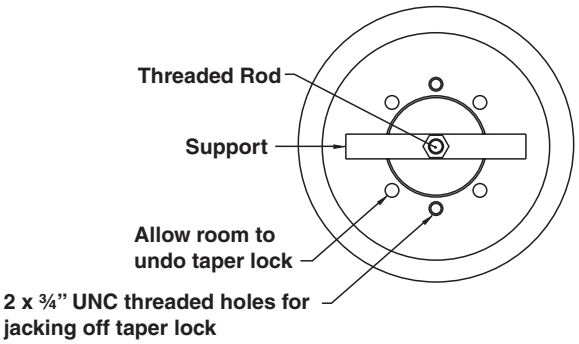
CRUSHER SERVICING

SHAFT LINE ASSEMBLY

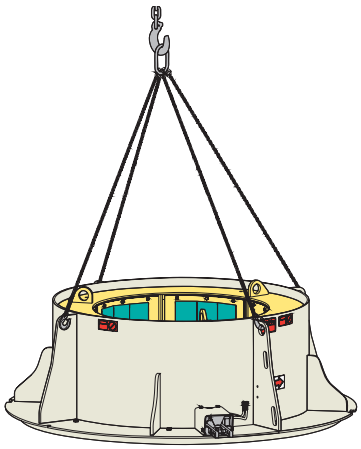
REMOVAL FROM BASE

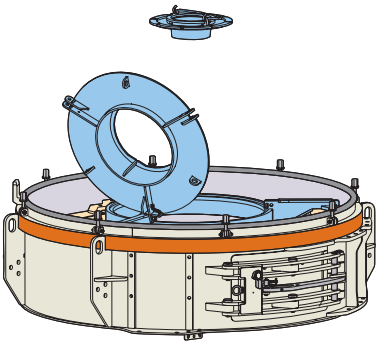
1. Remove hopper and crusher roof in one lift.
2. Remove the rotor. (See 6-35).
3. Loosen off belt tension and remove drive belts.
4. Remove crusher pulley. In larger models, use a Barmac VSI pulley lifter (contact your Barmac representative for details) or a threaded rod (in the threaded hole in shaft) and support to assist in lowering pulley.

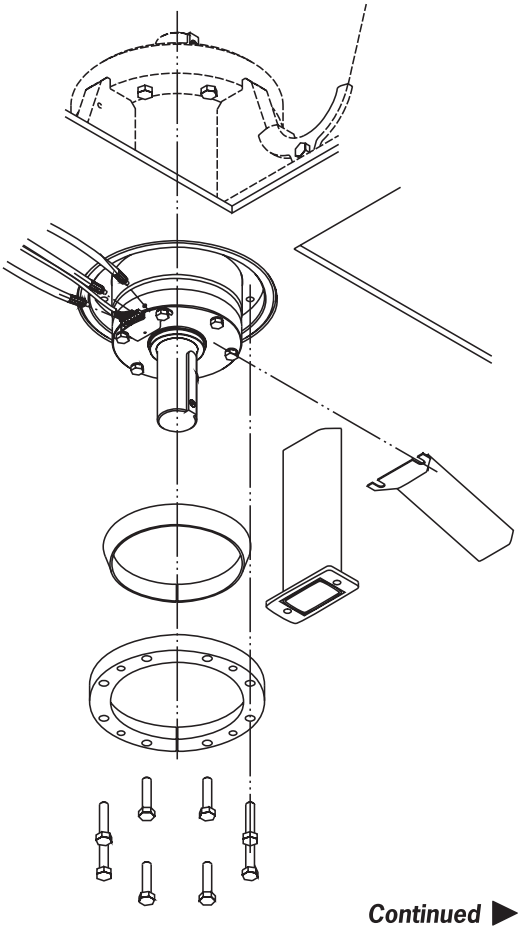




5. Remove grease hoses and grease chute.
6. Remove VOCS plug.
7. Release the bottom taper ring by removing the taper ring bolts.
8. Screw half of these back into the top of the tapped extractor holes to force the outer taper ring off.
9. Remove the bottom inner taper ring.







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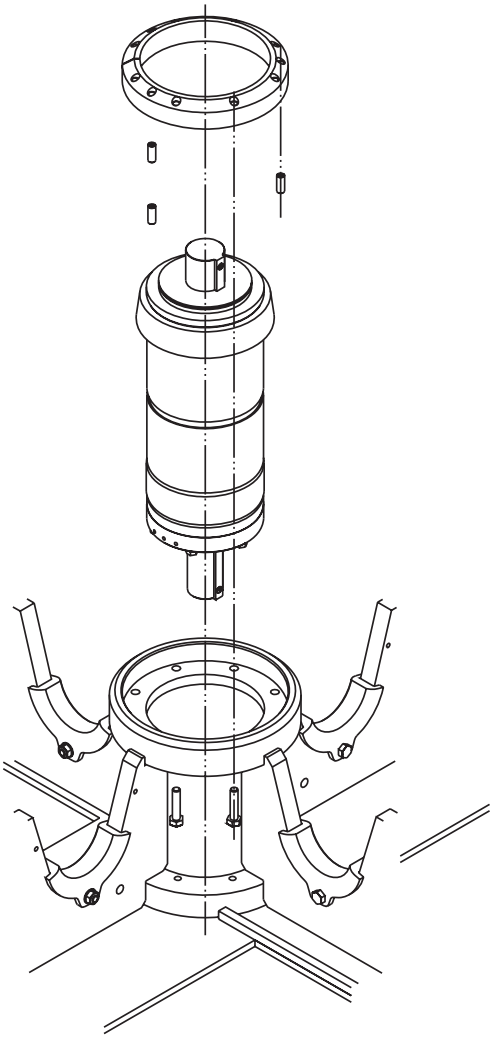
CRUSHER SERVICING

SHAFT LINE ASSEMBLY

REMOVAL FROM BASE

10. Remove the top taper ring bolts.
11. Use extractor grub screws to remove top taper ring.
12. Insert lifting eye bolt into the top of the shaft.
13. Lift out shaft line assembly.

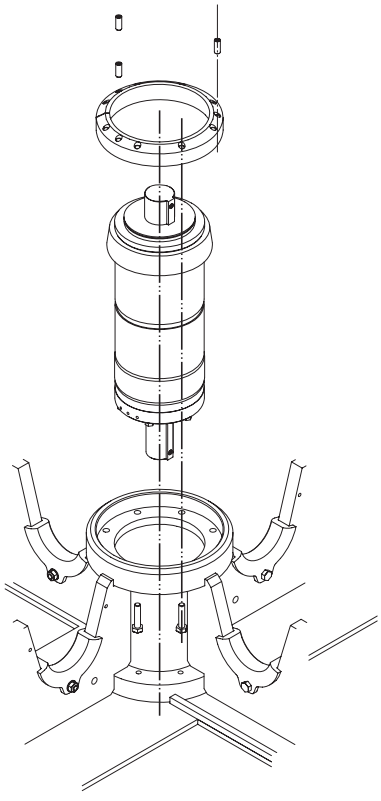


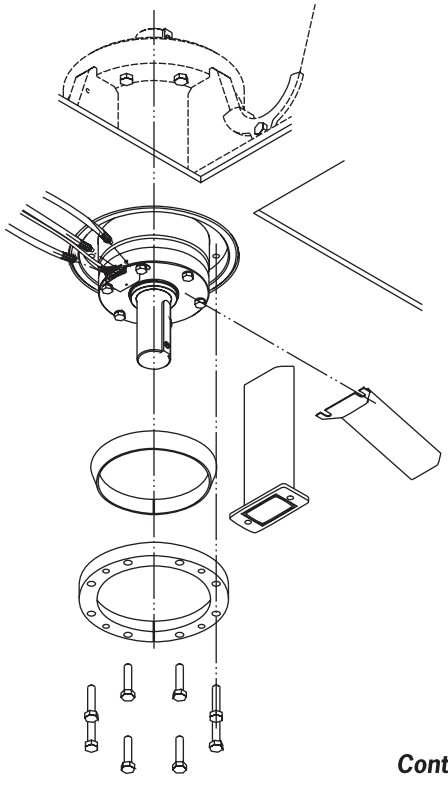
CRUSHER SERVICING

SHAFT LINE ASSEMBLY

REFITTING IN BASE

1. Remove all traces of grease, protectant, dust, etc, from machined surfaces using thinners or similar solvent.
2. Ensure all mating surfaces are free from rust, dents, scratches, etc.
3. Apply a thin layer of heavy machine oil to the mating surfaces of the shaft assembly, housing and taper rings.
4. Lower shaft line assembly into top of housing and check to see that the three plastic grommets are still in place. This will ensure the grommets are not lodged in the housing.
5. Check orientation of assembly. The grease discharge slot must align with the grease discharge chute.
6. Locate shaft line assembly centrally with top taper ring.
7. Fit bottom taper rings (inner and outer) and lightly screw in bottom taper ring bolts.
8. Fit grubscrews in until just below flush with top of taper rings and secure in place with silicone.
9. Refer to shaft line assembly bolt torque settings (6-66).





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CRUSHER SERVICING

SHAFT LINE ASSEMBLY

REFITTING IN BASE

10. Starting on top taper ring, torque down bolts top and bottom in a "star" sequence (Fig.1) in two stages. Torque bolts in order from 1 to 8. Repeat for bottom taper ring.

    Torque settings are as follows:

B5100SE, B3100SE			B9100SE, B7150SE, B7160SE, B6150SE		
Stage 1	–	15Nm (11 ft lb)	Stage 1	–	70Nm [55 ft lb]
Stage 2	–	30Nm (22 ft lb)	Stage 2	–	130Nm [100 ft lb]

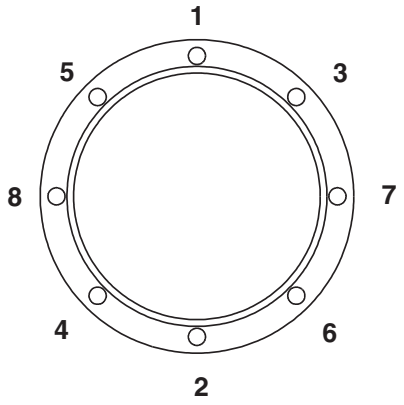


Fig.1

11. Refit grease hoses, making sure they are not twisted or blocked. See 6-2 for identification of grease points on shaft line assembly. Ensure that grease hoses are not able to fall onto drive belts during operation. **Note:** Some models have a bar to rest the grease hoses on.

12. Reconnect VOCS plug.

13. Refit pulley and drive belts.

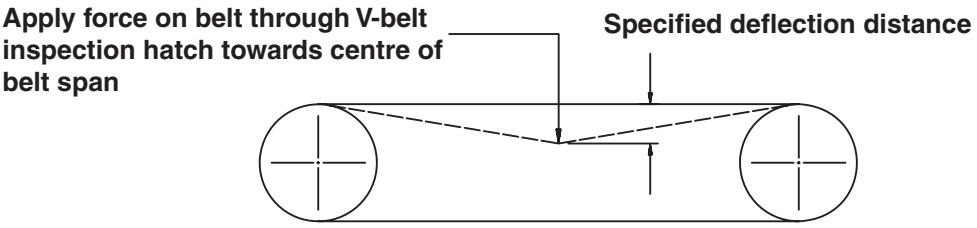
14. Refit rotor.

DRIVE BELT TENSIONING

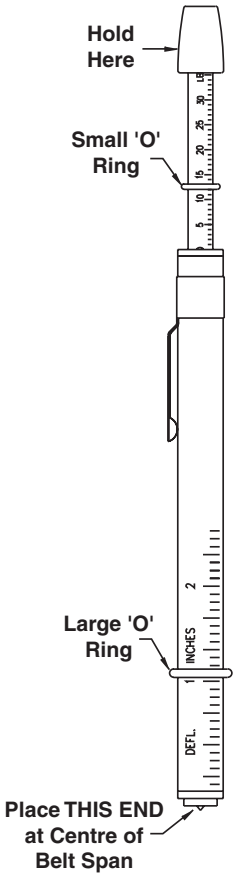
Correct tensioning is the most important factor necessary for long, satisfactory drive belt operation. Too little tension will result in slippage, causing rapid belt and pulley wear, and poor efficiency. Too much tension results in excessive strain on belts, bearings (especially motor bearings), and shafts.

MEASURING

1. Select the second belt from the bottom.
2. Measure the force required to deflect the belt the distance as set out below:



Force and deflection for each model and belt type can be found on the *Belt Tension/Deflection Chart*, 6-69.



3. For measuring the force and deflection, Metso Minerals recommend the use of a tension gauge similar to the one represented.

   Using the belt tension gauge at the centre of the belt span, follow these instructions:

   (a) Set the large 'O' ring on the designated deflection as per the *Belt Tension/Deflection Chart.*

   (b) Push the belt tension gauge against the second to bottom belt until the large 'O' ring is even with the top of the next belt. Ensure that the gauge is in the centre of the belt section, and always test the belts on the tight (or driven) side of the belts.

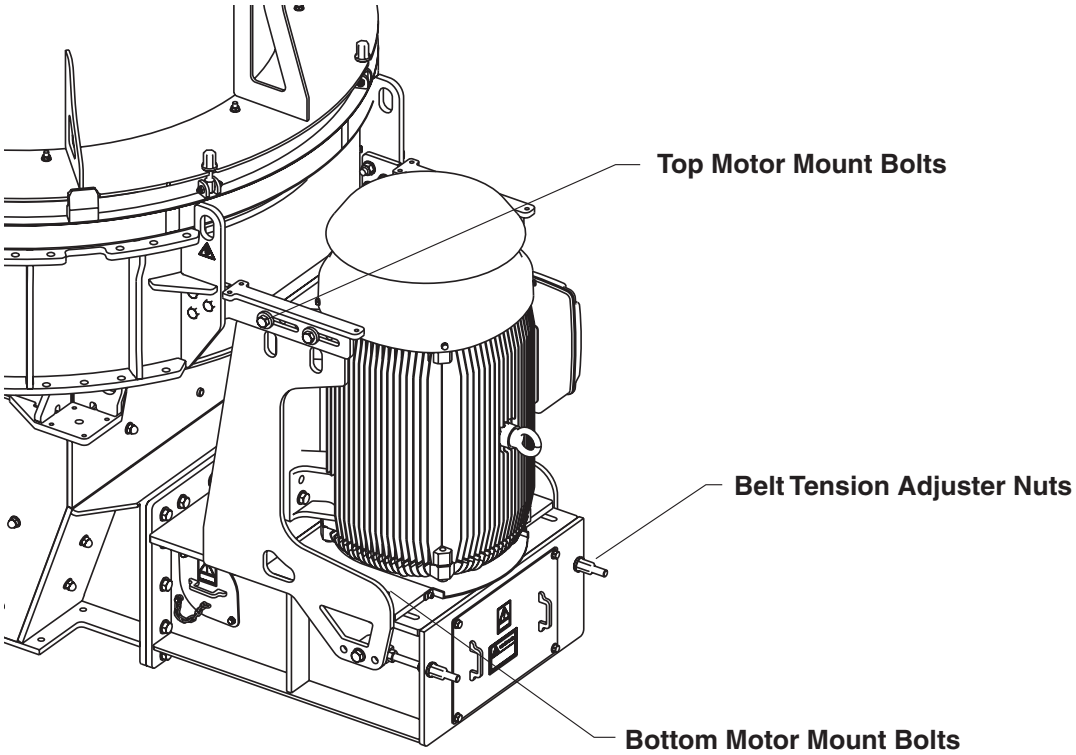
   (c) Remove the gauge and observe that the small 'O' ring has moved from its original setting at zero to the number of kg [lb] required to deflect the belt.

Continued ▶

DRIVE BELT TENSIONING

BELT ADJUSTMENT

1. Slightly loosen off top and bottom motor mount bolts.
2. Tighten (or loosen) tension by adjusting belt tension adjuster nuts.
3. Adjust belt tension as per the *Belt Tension/Deflection Chart.* (For dual drive, adjust both exactly the same).



NOTE: If motor mount top brackets are used, top bolts must be removed during adjustment.

DRIVE BELT TENSIONING

BELT TENSION/DEFELECTION CHART

Model	Initial Installation Tension kg [lb]	Normal Running Tension kg [lb]	Deflection Distance mm [in.]
B3100SE	4 [8.75]	2.5 - 3 [5.50 - 6.50]	10 [3/8]
B5100SE	10 [22.00]	8 - 9 [17.50 - 19.75]	16 [5/8]
B6150SE	11 [24.25]	8 - 9 [17.50 - 19.75]	19 [3/4]
B7150SE	16 [35.25]	12 - 14 [26.50 - 30.75]	27 [1]
B7160SE	16 [35.25]	12 - 14 [26.50 - 30.75]	27 [1]
B9100SE	16 [35.25]	12 - 14 [26.50 - 30.75]	27 [1]

NOTE: The above belt tension/defelection values relate to SP, SPX, V and VX belt sections, and have been formulated to accommodate the various centre distances that motor frame sizes or sheave diameters will provide on each model. If V-belt life, tensioned to the above values, is not satisfactory, please contact your Barmac representative.

NEW BELTS (This includes the initial commissioning of the crusher).

New belts will take a little time to settle into the grooves, and will naturally stretch in the first days of operation. To accommodate this settling in process, it is recommended that the V-belts are tensioned some 20% above the optimum. Refer to the Belt Tension/Deflection Chart under **Initial Installation Tension** column for the recommended tension for the standard deflection for new belts.

Tension Range

Belt tension should be monitored regularly (at least weekly), but does not need adjustment unless it falls outside the range indicated in the **Normal Running Tension** column

RUNNING IN NEW BELTS (This includes the initial commissioning of the crusher).

After 30 Minutes

After thirty minutes running it is recommended that the tension should be checked and retensioned to the **Initial Installation Tension** values.

After 4 Hours

Re-tension to the **Initial Installation Tension** values.

Next 5 Days

Check tension at least once daily and you should observe a "settling", requiring minimum adjustment to maintain the tension as per the **Normal Running Tension.**

Continued ▶

DRIVE BELT TENSIONING

LOOSE BELTS

In the event of there being one or two belts being looser than the others, tension the belts normally, and measure the deflection force required on the loose belt. If this is 10% or more below the low range tension, then there is a danger that the loose belt could turn, or even jump off, taking the rest of the set with it. If the belt is one of a new set, then initially add an extra 1kg [2 lb] of pressure relative to tension to that particular side of the drive, to see if the belt will "settle in" on its own. If this has not happened within 5 days or if the loose belt does not tension up to the minimum, then the loose belt must be replaced.

DUAL DRIVE

Belt Tension/Balanced Motor Amps

On dual drive machines, one motor may draw less current than the other, i.e. it appears lazy. For the motors to do equal work the belt drives must be set up with equal tension.

On dual drive machines, a small difference in belt tension between drives can make a big difference in motor amps. For example, a dual drive 185 kW [250 hp] crusher under full load with 0.5% slip in one drive and 1.0% in the other will show a current draw of 170 amps in one motor and 120 in the other – a 50 amp difference.

Adjustment

Static

Follow normal static adjustment procedure as explained above, but make special effort to adjust the two drives to exactly the same values.

Dynamic

1. With the crusher operating under load, prepare the low current motor for adjustment, ensuring that when the four motor mount bolts are loosened, the motor mount is held in place by the belt tension adjuster nuts. This is done by loosening off the two motor mount bolts that pass through the adjuster rods. (See Important Note below). Apply tension to these adjuster rods by turning the adjuster nuts approximately half a turn from hand tight.
2. Then loosen off the other two motor mount bolts. **Important Note:** Loosen only enough to permit the motor mount to be adjusted by means of the adjuster nuts. If top motor mount brackets are used, loosen and remove bolts during adjustment.
3. Turn the adjuster nuts clockwise by one turn to tighten the belts. Retighten the four motor mount bolts and observe the current drawn by both motors for ten minutes.
4. Repeat until the currents drawn by the motors are within approximately 10 amps of each other.
5. After balancing amps in this way, belt tensions should be checked as soon as possible to ensure correct balanced belt tensions. If balanced amps are achieved with unbalanced tension, the cause should be investigated.

DRIVE BELT TENSIONING

Other Causes Of Unbalanced Motor Amps

If the motors will not draw similar amps by altering belt tension, check–

1. **The motor or starter electric terminals.** Have a qualified electrician check motor or starter terminals. If dirty they will need cleaning and re-fitting.
2. **The starter has a fault.** To confirm starter fault exists, have a qualified electrician check the following:

   With the machine under load:

   (a) Read both ammeters and record amps on ammeter 1 and ammeter 2.

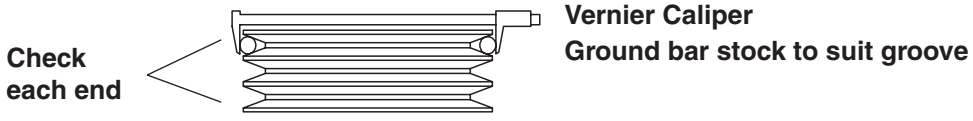
   (b) Stop the machine.

   (c) Swap motor wiring over at starter contactors.

   (d) Restart the machine. The ammeter readings should have swapped, i.e. No. 1 should read what No. 2 used to, and vice versa. If this doesn't happen, the electrician must check the function of the starter componentry.
3. **Belt alignment** – Make sure sheaves are in line using a straight edge or string line.
4. **Motors** – They should be of the same brand and type and preferably be manufactured in the same batch (check with motor manufacturer or agent). Different manufacturers and sometimes different batches of motors have different winding specifications.
5. **Belts** – The belts should be matched, i.e. all the same brand at least, and a matched set if possible.
6. **Pulleys** –

(a) Check pulley axes are parallel and grooves are properly aligned with one another – any dust build-up entering under the motor mount will cause the pulleys to be out of parallel, with higher tension on belts at one end of the pulley.

(b) Check pulley diameters. For equal power transmission, the pitch diameters of the driving pulleys must be within 0.5mm [0.02”] of each other. This can be checked by measurement as shown. Check grooves at each end of the pulley – any taper in pulley length will cause problems.



(c) If after a period of satisfactory running the motors become difficult to match, check the pulleys for wear.

BOLT TORQUE SETTINGS

BOLT TORQUE SETTINGS Nm [ft lbs]

Model	Rotor Size	Tip Assembly	Rotor Boss	Top Plate Bolts	Distributor Plate Bolt	Top Taper Ring Bolts	Bottom Taper Ring Bolts	Swing Bolts
B3100SE	300	100 [75]	77 [56.8]	34 [26]	40 [30]	30 [22]	30 [22]	74 [55]
B5100SE	500	100 [75]	190 [140]	60 [45]	40 [30]	30 [22]	30 [22]	74 [55]
B6150SE	690	130 [100]	372 [274]	250 [190]	200 [150]	130 [100]	130 [100]	144 [106]
B7150SE	840	130 [100]	372 [274]	250 [190]	200 [150]	130 [100]	130 [100]	144 [106]
B7160SE	840	130 [100]	372 [274]	250 [190]	200 [150]	130 [100]	130 [100]	144 [106]
B9100SE	840/990	130 [100]	372 [274]	250 [190]	200 [150]	130 [100]	130 [100]	144 [106]

ALL OTHER BOLT TORQUES

Bolt Size	Torque Setting
M6	9 [6.6]
M8	22 [16.2]
M10	44 [35.5]
M12	77 [56.8]
M16	190 [140]
M20	372 [274]
M24	640 [472]

NOTE: All threads must be lightly lubricated before assembly.