Metso:Outotec

Application guide

SUPERIOR® primary gyratory crusher wear parts


Maximize the
potential of your
SUPERIOR® crusher

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SUPERIOR® primary gyratory crusher

Primary gyratory crusher basic concepts

The SUPERIOR® gyratory crusher is a compressive style crusher for primary-stage applications. Its steep crushing chamber and long crushing surfaces provide exceptionally high capacity and long liner life.

A primary gyratory crusher consists of a concave surface and a conical head; both surfaces are typically lined with manganese steel. The top of the shaft attached to the crushing cone is supported centrally in the bushings, and the bottom of the shaft is positioned in an eccentric bushing.

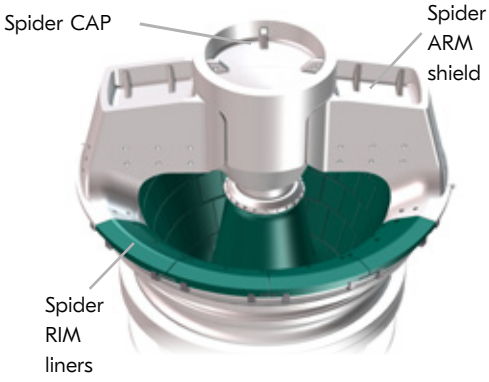
The feed material is crushed between the fixed concave surface and a movable mantle. The bigger rock material is crushed against the mantle and the concave.

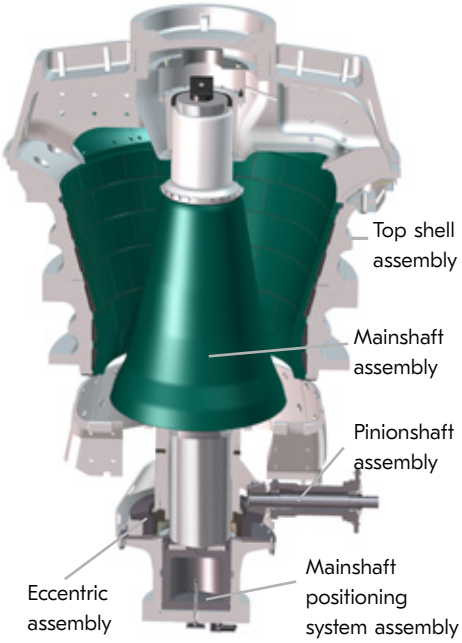
The crushing action is caused by the closing of the gap between the moving mantle liner mounted on the central vertical shaft and the fixed concave liners mounted in the top shell of the crusher. The gap is opened and closed by an eccentric assembly in the bottom shell, which causes the central vertical shaft to gyrate. The vertical shaft is free to rotate about its own axis.

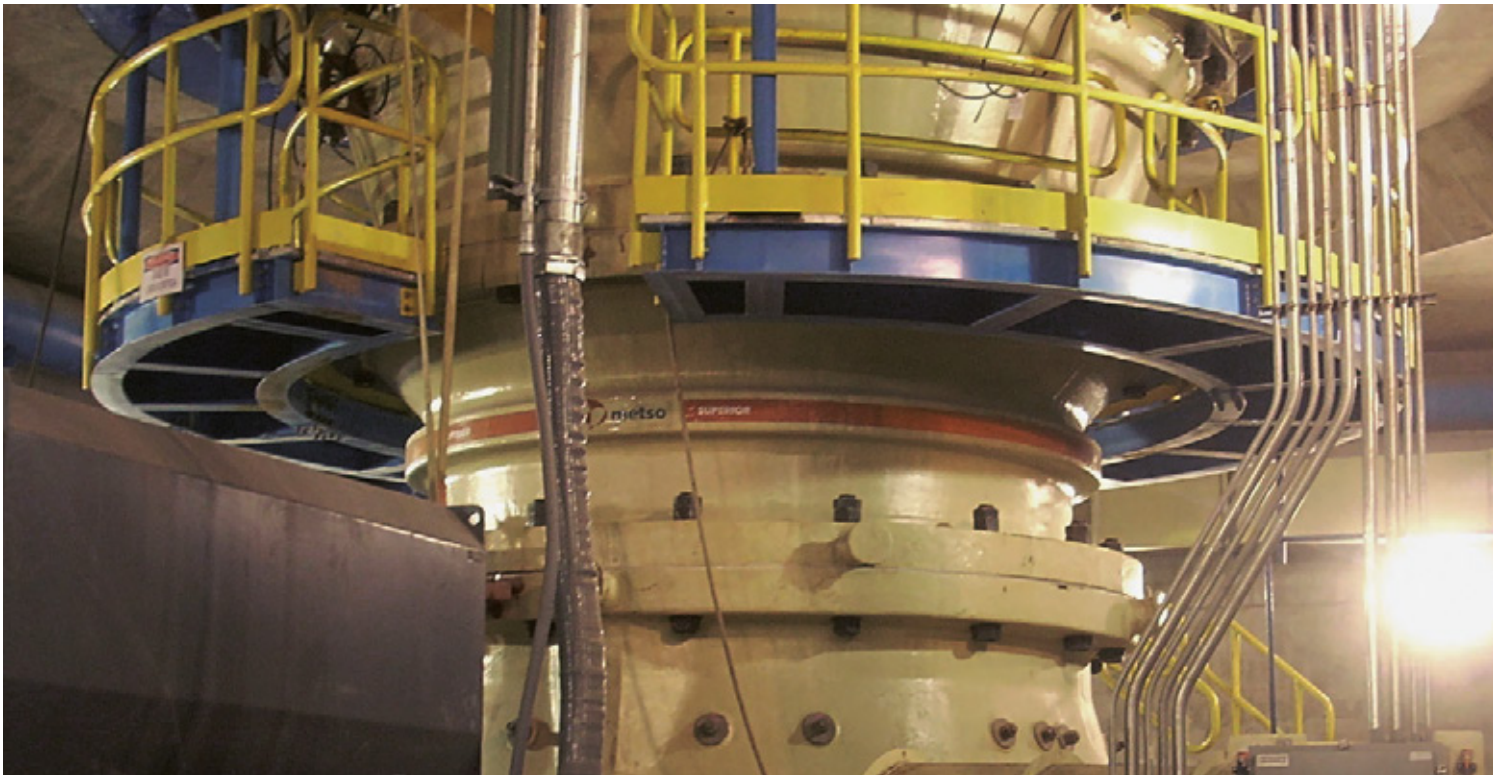
Gyratory crushers are one of the main primary crusher types used in mines and quarries. The size designation of gyratory crushers is based on the size of the feed opening and the mantle diameter.

Main features

- Steep crushing chamber and long crushing surfaces for exceptionally high capacity and maximum liner life
- Extra heavy-duty frame, integral large-diameter mainshaft assembly, and high performance bearing arrangement provide long life and reliable operation
- Accurate crushing chamber design for optimized production
- Dual counterbalance design minimizes the dynamic forces transmitted to the supporting structure
- Large-diameter mainshaft upper journal with threaded, replaceable alloy steel sleeve
- Hydraulically operated and controlled mainshaft positioning system for quick and effective adjustment of the mainshaft to compensate for liner wear
- Easy maintenance and service







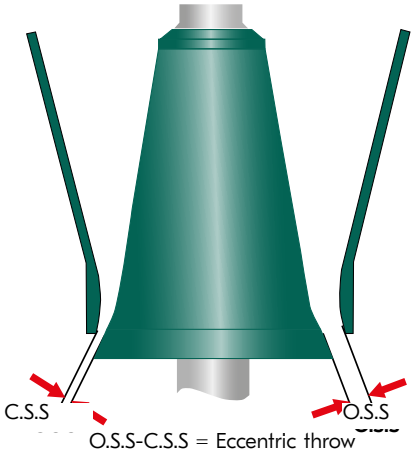
Current model sizes

Recognized as the world leader, Metso Outotec Mining and Construction Technology offers the complete range of primary gyratory crushers to meet all application requirement.

Machine size*	Feed opening mm (in)	Mantle diameter mm (in)
42-65	1065 (42)	1650 (65)
50-65	1270 (50)	1650 (65)
54-75	1370 (54)	1905 (75)
62-75	1575 (62)	1905 (75)
60-89	1525 (60)	2260 (89)
60-110	1525 (60)	2795 (110)
70-89	1778 (70)	2260 (89)

*1st number = feed opening in inches,

2nd number = mantle diameter in inches



Spider design

Metso Outotec's primary gyratory crusher range includes 4 basic head sizes (65", 75", 89" and 110"), in addition to which the Super Spider upgrade provides two additional larger feed openings. The patented U-shaped spider arms reduce twisting during crushing. Arched spider arms create a less restricted feed opening to reduce material bridging.

Open side setting

The superior gyratory crusher's discharge setting is referred to as the Open Side Setting (OSS).

This is a single pre-determined setting at which the crusher and it's crushing chamber are designed to operate. The setting cannot be operationally changed to produce different product sizes instead the setting change is made by modifying the bottom tier of the concave or the bottom mantle's diamete.

Mainshaft positioning system

The mainshaft position system is a hydraulic method of vertical adjustment to compensate wear. It consists of a pump, controlled by a push-button, and a heavy-duty hydraulic cylinder that supports and adjusts the position of mainshaft assembly.

In lowest position with a new mantle and new concaves, there is about 1" (25mm) of oil under the piston

- In highest position the minimum distance between the head nut and the spider is 1" (25mm)
- The mainshaft positioning system is only used to compensate mantle and concave wear, not to change the crusher setting. The Superior Gyratory Crusher is designed for one setting only with a given set of concaves and mantles.

How to operate a gyratory crusher

Operating a gyratory crusher within its design parameters reaps huge benefits for the end-user, most notably, maximum crusher online availability, lowest possible maintenance repair costs, improved productivity and maximized crusher life span.

In order to achieve these benefits, the following should be considered:

1. Always start the crusher correctly

- Verify that the tank oil temperature is between 86°F (30°C) and 90°F (32°C)
- Start the lube pump and circulate the oil
- Start the crusher drive motor and allow the crusher to come to full speed
- Run the crusher with no load (empty) until the return oil temperature is above 65°F (18°C)
- Start feeding the crusher

2. Ensure proper pinionshaft speed

- If the pinionshaft speed is much below the recommended RPM, the crushing performance can be adversely affected and can cause the crusher to stall
- If the pinionshaft speed is much above the recommended RPM, the crusher balance and lube oil cooling can be adversely affected

3. Monitor no-load head spin

- In most cases, no-load head spin will be 20 RPM or less. An excessively worn spider bushing can cause high no-load head spin
- Monitor head spin at normal oil temperature. Normal oil temperature is in the range of 100°F (38°C) to 115°F (46°C) with ISO VG 68 EP2 oil or 100°F (38°C) to 130°F (54°C) with ISO VG 150 EP4 oil

4. Operate within the design limits

- Volume limit:
  Each crushing chamber (mantle and concaves) has a volume limit which determines maximum throughput. A full crushing chamber is operating at its volumetric limit
- Do not exceed the maximum feed size.
  Attempting to crush oversize feed material wastes time and reduces crusher capacity. The maximum feed size should be less than 80 – 85% of the nominal feed opening. This size distribution helps prevent blockage at the spider opening and allows a well-filled crushing chamber that will evenly distribute the crushing forces
- Power limit:
  Power consumption will vary based on the crushing chamber used and the eccentric throw: increased throw = increased power draw. The power limit is exceeded if the crusher drive motor draws more power than it is rated for (the attached power must be compatible with the actual throw being used in the crusher).

***5.* Keep the overloading frequency to a minimum**

Overloads affect productivity and crusher reliability. Overloads can be caused by:

- Tramp material (steel, wood, plastic, rubber, etc.)
- High moisture content of the feed material
- Sticky feed materials
- Crusher set too tight for conditions
- Improper feed arrangement to the crusher
- Crusher fitted with the wrong style of mantle and concaves

Note: For new installations the chamber performance and wear profile must be determined for the target application in order to ensure optimal material choices and develop the most economical customer solution. Changes in ore size and ore properties also affect chamber performance so a system survey aimed at developing an optimal chamber solution may be required.

SUPERIOR® chamber

The crushing chamber, also known as the crusher cavity, is composed of a mantle and concave segments.

The Superior crushing chamber is designed for a specific open side setting (OSS) which is tailored for each individual application. The concave profiles are designed taking into account the optimal combination of nip angle, power draw, crushing force and capacity requirements. The required product output size is achieved with the design of the lower tier concaves together with mantle's lower profile (O.S.S). A reduced throw eccentric can be supplied to reduce crusher throughput and therefore allow a full chamber to be maintained which will produce a more consistent product with less oversize material. The objective is to maximize crusher productivity and to achieve best possible wear material performance.

The unique SUPERIOR crushing chamber concept provides:

- Even wear
- Greater product uniformity
- Better distribution of wear throughout the chamber — fewer service problems and lower operating cost
- Fewer liner changes — less wear costs per product ton
- Improved energy efficiency

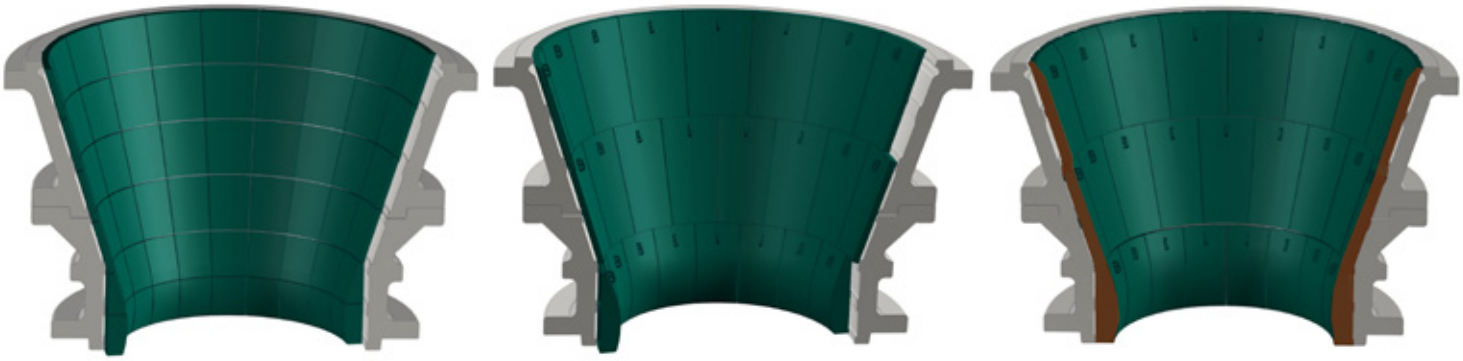
High abrasion resistance concaves

- Single or double tier concaves available in a variety of alloys
- Secured manufacturing / casting / heat treatment process
- Easy to fit. Special concaves are preassembled before delivery and equipped with v-groove for thickness monitoring and predictive maintenance.
- Cost effective. Extended wear life and application-specific liners
- No maintenance, no gouging
- No swelling — growth. Reduced down-time
- Reduced risk of fall out with locking system. Conical pins or lock bars

V-groove

Backing material

The backing material fills the void between the concaves and shells or the mantle and head to provide a solid assembly. Metso Outotec offers WF Ultra Performance backing material for long-lasting and secure installation.



Examples of single tier (left) and double tier (center) chambers. Chamber segment thickness (right) varies depending on the application

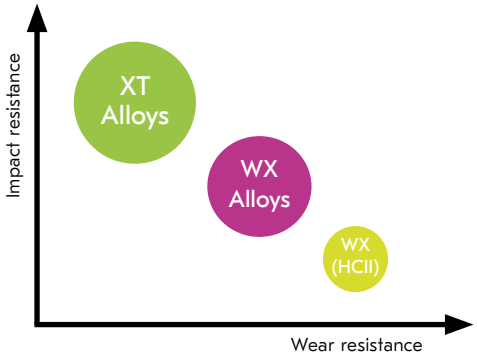
Concave segments

Metso Outotec's standard concave alloy is manganese, but depending on the feed characteristics a variety of other alloys can be chosen to achieve best cost per produced ton. The upper concave tiers must withstand high impact forces. The lower tiers require maximum abrasion resistance.

Upper intake liners
- Manganese alloys
- Low-alloy steel, impact resistant

Chamber mid liners
- High manganese alloys
- Low-alloy steel, abrasion and impact resistant

Chamber bottom liners
- Low-alloy- steel, high abrasion and impact resistant
- High-chrome special, maximum abrasion resistance



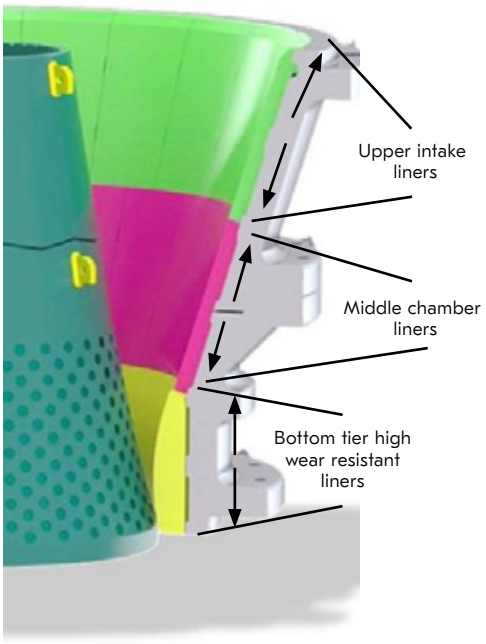
Upper intake liners (TOP)	Difficult and abrasive	Difficult and non abrasive	Medium and abrasive	Medium and non abrasive	Easy and abrasive	Easy and non abrasive
XT510 / XT525	●●	●●●	●●	●●●	●●	●●●
XT610 / XT710	●●●	●●	●●●	●●	●●●	●●
Low-alloy steel, High-chrome special	C	C	C	C	C	C

Middle chamber liners (MID)						
XT510 / XT525	●●	●●	●●	●●●	●●	●●●
XT610 / XT710	●●●	●●●	●●●	●●	●●●	●●
Low-alloy steel, High-chrome special	C	C	C	C	C	C

Bottom chamber liners (BTM)						
XT510 / XT525	●	●●●	●	●●●	●	●●●
XT710	●●	●●	●●	●●	●●	●●
Low-alloy steel, High-chrome special	●●● C	C	●●●	C	●●●	C

● Can be used ●● Good choice ●●● Recommended

C - Contact Metso Outotec representative for more information



Mantle options

Different alloys, designs and sectioned mantles can be selected to achieve the best cost per produced ton, depending on the application and the wear rate.

Choosing the correct mantle is always an application-specific process. The following mantle designs are available or will be designed to meet the customer's process requirements:

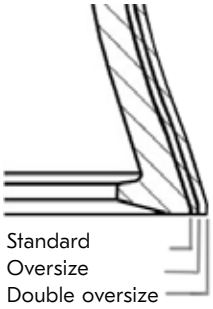
- 1, 2 and 3 piece
- Smooth, partially corrugated, fully corrugated
- Standard, oversize, double oversize #1, #2
- Matched mantles, RBD (Reduced Bottom Diameter) #1 and #2
- Special application-specific designs

Model	1 Piece	2 Piece	3 Piece
42-65	Standard	Optional	
50-65	Optional	Standard	
54-75	Standard	Optional	
62-75	Optional	Standard	
60-89	Optional	Standard	Optional
60-110		Standard	Optional
70-89		Standard	

Approximate weight of shaft (complete assembly)	
42-65	51 000 lbs. (23 130 kg.)
50-65	62 000 lbs. (28 120 kg.)
54-75	85 000 lbs. (38 560 kg.)
62-75	93 000 lbs. (42 180 kg.)
60-89	146 000 lbs. (66 220 kg.)
60-110	226 160 lbs. (102 585 kg.)
70-89	176 050 lbs. (79 855 kg)

Mantle size

For each primary gyratory model there are several basic mantle sizes: standard, undersize and oversize. Oversize mantles can be used, for example, to maintain the primary gyratory's setting during concave wear. Undersize mantles are needed if extra thick concaves are used. For perfect fitting of the mantle, the bottom skirt diameter can also be modified (see 'Matched mantles', page 9.). In addition, Metso Outotec offers fully customized designs for special applications through the chamber optimization program.



Sectioned mantles

During operation the primary gyratory's wearparts are subject to shock and impact loads in the upper chamber, abrasive wear in the bottom of the chamber and a combination of these in the middle part of the chamber. When using a 2 or 3 piece mantle, best performance can be obtained by selecting optimal material characteristics for each mantle piece according to the target application. However, 1 piece mantle is faster to change and 2 or 3 piece mantle may not be suitable for all applications.

Smooth and corrugated designs

The first choice of mantle design is either smooth or partially corrugated. Two corrugated profiles are available: partially and fully corrugated.

The smooth mantle design is an ideal choice for high abrasive applications. Depending on the application properties, the corrugated profile may provide better performance. A corrugated surface effectively removes fines from the mantle surface, provides better grip on the feed material and reduces mantle material expansion. The fully corrugated design is for special applications only.

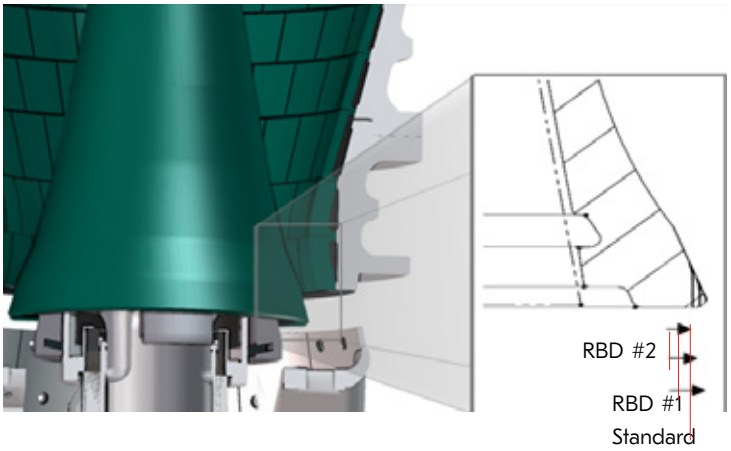
Examples of smooth (left), partially corrugated (center) and fully corrugated (right) mantle profiles.

Examples from an installation

Matched mantles
The mantle should fit easily through the smallest inner diameter of the chamber during installation or replacement. It is important to know what concaves are used in order to be able to match the mantle bottom skirt diameter.

Matched mantles are called RBD (Reduced Bottom Diameter) mantles. It is important to note that the RBD is NOT the actual mantle size. An RBD is, for example, a modification of an oversize mantle made in order to fit through the concave's smallest inner diameter.

Material selection
The first choice of material for standard mantles is the XT510. To further maximize performance and wear life, special designs and high manganese content alloy options are also available. Please consult your Metso Outotec representative for more information.



Mantle materials	Difficult and abrasive	Difficult and non abrasive	Medium and abrasive	Medium and non abrasive	Easy and abrasive	Easy and non abrasive
XT510/XT520/ XT525	●	●●●	●	●●●	●●	●●●
XT710	●●		●●	●	●●●	●●
XT750	●●● C		●●● C		C	

● Can be used ●● Good choice ●●● Recommended

C - Contact Metso Outotec representative for more information

MX mantles

Metso Outotec MX Mantle provides extra wear life in primary gyratory applications where uptime and safety are top priorities. Available in all sizes and several configurations for all primary gyratory crushers, regardless of brand.

When increased profitability matters
Maximizing production and reducing operating costs is a common target in the mining business. To reach this target, shutdowns need to be kept to a minimum.

The primary crusher is a crucial part of any size reduction process, and frequent maintenance shutdowns quickly add up as lost production time and increased costs. Not to mention the safety risks associated with each and every liner replacement.

Extended wear life increases uptime
To help minimize maintenance and maximize valuable production time, Metso Outotec has developed a solution with the potential to cut the number of mantle replacements in half. Metso Outotec MX Mantle is a hybrid mantle that typically provides up to double wear life compared to a conventional manganese mantle. In the MX mantle, the manganese steel acts as a matrix and the wear surface is covered by Metso Outotec's special wear resistant inserts in areas where it's most needed. These unique characteristics allow the mantle to maintain an optimal wear profile longer and make it extremely wear resistant. The solution is patented and exclusive to Metso Outotec.

Less maintenance, fewer risks
The long wear life and reliable performance of Metso Outotec MX Mantle can help eliminate several mantle change-outs per year, reducing parts and labor costs as well as increasing production. Long wear life also means fewer liner change-outs and a significant reduction in your maintenance work and, consequently, safer operations. All this leads to more profit and higher safety for your operation.

Sustainability - Get the full picture
Hundreds kilograms of epoxy components are used on every mantlechange out. The MX mantle are eco friendly and helps reducing the Consumption of non-recyclable materials. Metso Outotec MX mantle could double the wear life of the mantle. By increasing the wear life of the mantle, there will be a significant reduction in:

- Carbon emission
- Energy consumption
- Water
- Mold sand

We continue to optimize our own operations through our solutions and services and those of our customers. Contributing to a low-carbon society by striving to minimize impact across our entire value chain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How to change wear parts

In order to avoid damage to the liner seating surfaces, wear parts must be replaced before they are worn through. In normal conditions, approximately 50% of the liner weight is consumed when liners are worn out. It is important to keep a record of liner wear in order to assess the degree of liner wear without the need to stop the crusher operation.

Mantle installations

Always obey the safety instructions during all maintenance and lifting work.

One piece mantle

1. Trial fit the head nut onto the mainshaft sleeve's threads to ensure free running of threads.
2. Remove any burrs from the mainshaft taper that may come in contact with the backing and act as a key, preventing the mantle from moving downward when the manganese stretches. Fill any depressions with Babbittrite to match the surrounding taper.
3. Coat the mainshaft taper lightly with beeswax or a silicone mold release for epoxy backing. Heavy grease can prevent proper curing of epoxy backing.
4. Place the mainshaft in the repair bay.
5. Lower the mantle over the taper on the mainshaft and block up under the mantle so that when the head nut is in place there will be approximately 1/4" (6.4 mm) of the threads on the head nut above the threads on the mainshaft sleeve.
6. Wedge up the bottom of the mantle until the top of the mantle is tight completely around the bottom of the head nut (or combined burning ring and head nut).
7. Remove the head nut carefully and measure the gap between the mantle and mainshaft at four evenly spaced points.
8. Center the bottom of the mantle lip on the taper of the mainshaft with four small hardwood wedges, 1" (25.4 mm) wide x 1/4" (6.4 mm) thick at small end by 3/4" (19 mm) thick at large end by approximately 3" (77 mm) long.
9. Again check the contact of the mantle to the head nut.
10. Block the opening at the bottom of the mantle section before pouring any backing.
11. If epoxy backing is used, preheating of the mantle is not necessary, but will speed up the cure time.
12. Skip entire step 12 if a burning ring is being used. If no burning ring is being used, back off the head nut, making sure that the mantle does not move.

> Note: The head nut may be spaced away from the mantle and three or more parallels (or spacers) placed between the mantle and head nut with the head nut tightened against the parallels to ensure that no movement occurs. If a pouring spout is designed properly, the backing can be poured into the space between the parallels into the cavity between the mantle and mainshaft.

13. Refer to the appropriate backing instructions. Do not fill the cavity under the head nut with backing. Exceeding this level will prevent tightening the head nut.
14. After pouring is completed allow the backing to cure.
15. Apply a coat of anti-seize compound to the head nut threads and assemble it to the mainshaft. Drive head nut for a tight fit on mantle and line up the half rounds with the half rounds on the mantle. Assemble dowel pins in slots that line up. Weld pins to the head nut (only) per AWS class E70XX. If a burning ring is being used there are no half rounds to line up. Instead, after the head nut has been fully tightened down, use a Ni-Cr-Mn or stainless steel rod and weld the burning ring to the mantle.
16. Remove lifting lugs from the mantle after the mantle is assembled on the mainshaft. Do not exceed 800°F (427°C).

Two piece mantle

1. Follow steps 1 through 4, under Section " One Piece Mantle".
2. Lower the mantle sections over the taper on the mainshaft and block up under the lower mantle section. Using six hardwood shims, set a 0.375" (9.6mm) gap between mantle sections at the three closest positions (where the gaps are parallel) around the circumference. When the head nut is in place, there will be approximately 1/4" (6.4 mm) of threads on the head nut above the threads on the mainshaft sleeve.
3. Follow steps 6 through 9 under Section "One Piece Mantle."
4. Carefully remove the head nut and upper mantle section making sure not to disturb the lower mantle. Check the gap between the top of the lower mantle and the mainshaft.
5. Block the opening at the bottom of the lower mantle section before pouring any backing.
6. Reinstall the upper mantle and head nut and check that the gap between the upper mantle and head nut (or burning ring) does not exceed 25 percent of the circumference.
7. Carefully remove the head nut and upper mantle section making sure not to disturb the lower mantle.
8. If epoxy backing is used, preheating of the mantle is not necessary, but will speed up the cure time.
9. Pour a small amount of backing and check for leaks at the bottom of the mantle. Reseal as necessary. Use Babbittrite to dam the top joint of the lower mantle so that the backing material will have the same profile as the mantle. If using epoxy allow the initial pour to set for 1 hour before proceeding.
10. Finish pouring the backing to fill the cavity between the lower mantle and the mainshaft and allow the backing to cure.
11. After the backing has cured, apply a layer of Babbittrite in the top corner between the mainshaft and backing. Make sure that the Babbittrite extends out to the edge of the backing so that a barrier will be formed between each section of backing. The backing of each mantle section must be kept independent of each other to allow sections to rotate independently and allow the head nut to self-tighten.
12. Position the upper mantle section on the mainshaft and set a gap with approximately 3/8" (9.6 mm) wooden shims, between mantle sections at the three closest positions (where the gaps are parallel) around the circumference.
13. Plug space between upper and lower sections. Each section must be zinced or epoxy packed independent of the other.
14. Center and locate upper mantle section in position using hardwood shims and wedges. Align top surface of mantle with head nut; it must bear on almost the full circumference. Remove head nut; carefully shim between mantle and mainshaft.
15. Follow steps 11 through 16, under Section "One Piece Mantle.

Concave installations

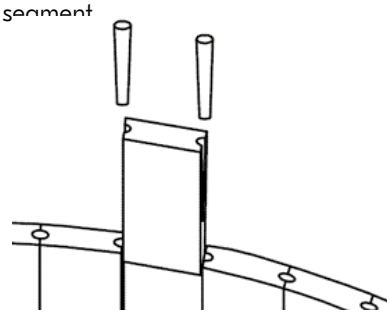
There are three different installation methods depending on the concave segment design and alloy. Important! Use safe lifting procedures, e.g. closed loop or pin and clevis arrangement, no open hooks! Always obey the safety instructions during all maintenance and lifting work.

Manganese concaves installation

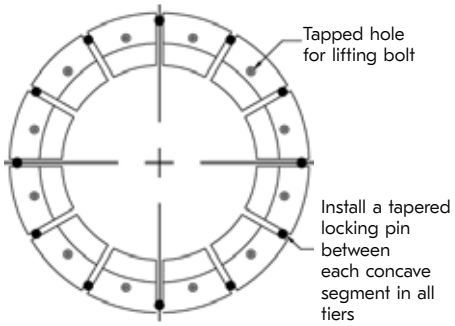
1. Thoroughly clean and dry the concave fit surfaces inside Top Shell, e.g. by wire brushing or sandblasting, to remove any scale, oil or rust on the surface.
2. If plastic type packing is used, DO NOT coat concaves or crusher shell with a parting agent or release agent of any type.
3. Check the "LAND AREAS" of the shell for gouges or high spots. Rough areas must be repaired before installation of the new concaves.
4. Check the bottom row concave support ring and replace if worn or deformed.
5. Place lower row in position and be sure each concave is resting metal-to-metal with all four (or six) corners (or pads) tight against the crusher shell. It may be necessary to shim to obtain contact with all pads. Use metal shims.
6. Before pouring backing, sprag (brace) each concave in place with 102 (4.0) x 102 (4.0) wooden props, or equal. depending on the concave size. More than one prop per concave may be needed.
7. After installing the lower row, stack several concaves from each remaining row in position to determine the vertical gap between rows required to center the locking lug on the upper row concave into the corresponding groove in the Top Shell.
8. Offset vertical joints row by row to avoid a continuous groove (raceway) from top to bottom of chamber.

Pin-style concaves

1. Follow same steps as above and addition, use tapered locking pins.
2. After setting one complete row of concaves and before pouring the backing material, a tapered locking pin should be placed between each concave segment.



1. Pins are designed so that they will tighten when they are installed.
2. Do not force the pins down further if they tighten up above the top of the concave.
3. When all the pins have been installed, they should be tapped in snugly to equalize gaps. Any portion of the pins which remain above the concaves is to be cut flush with the top of the concaves segments.



Metal to metal concaves

1. Position the concaves clockwise in numbered order.
2. Align first concave so remaining gap will be under the spider arm.
3. Tap together so there is no vertical gap between segments.
4. Use hydraulic jack before installing last concave to force concaves together.
5. If 2 or more gaps, the extra gaps to be shimmed together when forcing concaves together.
6. Shim between top shell and pads if necessary. No rockers allowed.
7. Weld retaining bar at top of concaves to hold concaves in place.
8. Shim plate kits are available from Metso Outotec.
9. Air arc off remaining shim material.
10. Hard face weld shims together the length of the crushing surface.
11. Gap recommended to be split if exceeding 40mm.
12. Larger gaps can lead to excessive washout of the shims.
13. Avoid possible horizontal steps between tiers.
14. Plaster at the edges between segments to seal up any gaps before pouring backing.
15. Once plaster has cured pour epoxy backing. Metso Outotec WF Ultra backing recommended.
16. Pour backing for one tier at a time before setting next tier.
17. Back roughly 75% of the first tier initially. After finished 100% of all concaves area backed.
18. Continue assembly with next tier using same guidelines.

Note: See the instruction manual for more information about when to change and how to change wear parts

Metso Outotec is a frontrunner in sustainable technologies, end-to-end solutions and services for the aggregates, minerals processing and metals refining industries globally. By improving our customers' energy and water efficiency, increasing their productivity, and reducing environmental risks with our product and process expertise, we are the **partner for positive change.**

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