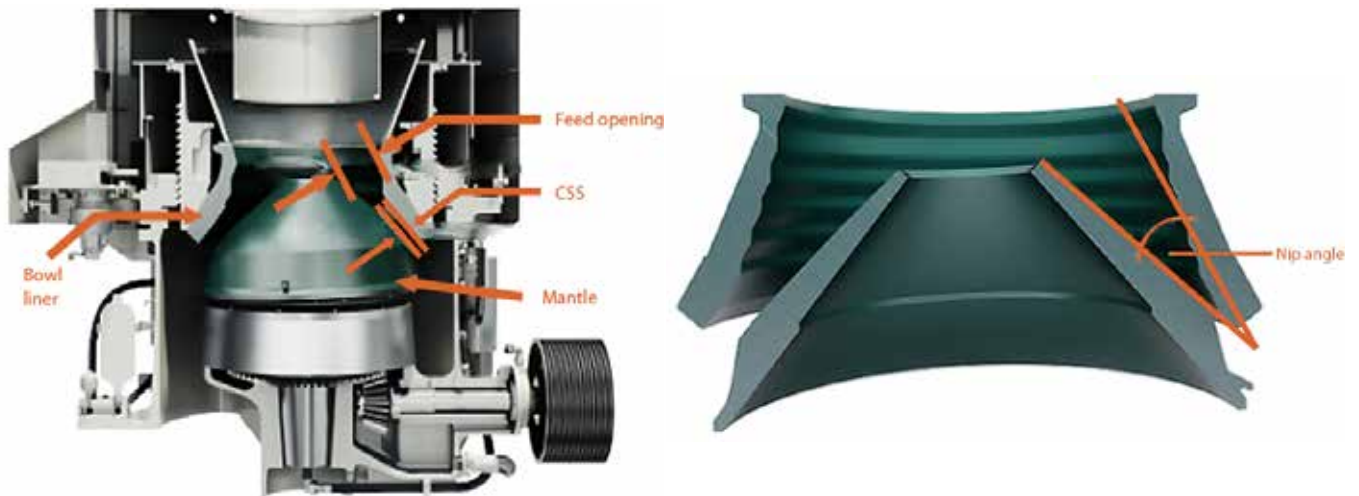


# Nordberg HP series cone crushers

## Wear parts application guide





## Wear parts application guide - Nordberg HP series cone crusher

# HP cone crusher and basic concepts

The HP cone crusher is a compressive crusher in which feed material is crushed between a fixed bowl liner and a moveable mantle. Bigger rock particles are crushed directly between the surfaces of the mantle and bowl liner. This is called single layer crushing. Smaller rock particles are crushed between other rock particles, which is termed multi-layer crushing or inter-particle comminution. Multi-layer crushing plays a significant role in the HP cavity. This improves the end product shape and reduces wear on the wear parts.

### Closed side setting (CSS)

The closed side setting defines the reduction ratio in HP cone crusher and has a significant effect on the product gradation, capacity and power draw.

The closed side setting is measured from the bottom of the mantle to the bottom of the bowl liner at their closest point during the gyrating cycle.

### Feed opening

The feed opening defines the maximum feed size for a crushing cavity. The closed side feed opening is the smallest distance between the top of the mantle and bowl liner as measured when they are at their closest to one another during their gyrating cycle.

The open side feed opening is the distance between the top of the mantle and bowl liner as measured when they are at their farthest from one another during their gyrating cycle.

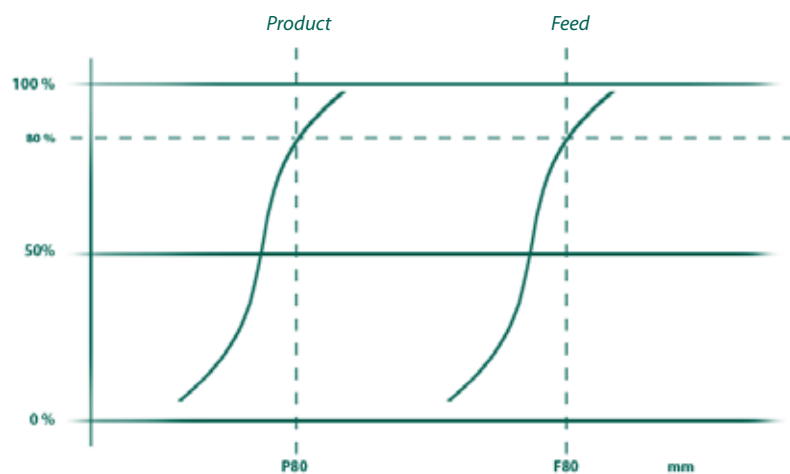
In HP standard cavities, the maximum feed size is approximately 80% of the open side feed opening. In HP Short head cavities, the maximum feed size is equal to the closed side feed opening.

### Nip angle

The nip angle is the angle between the mantle and bowl liner. Too large a nip angle reduces the capacity and increases the wear as feed material will tend to slip back upward in the cavity rather than crush. This can be observed as bouncing or boiling of the feed material.

### Reduction ratio

The reduction ratio is the ratio between the size of feed and the size of the outgoing product. It is normally measured at the 80% passing point. A typical reduction ratio in the HP standard cavity is 3-5 and in the HP short head cavity it is 2-4.







# How to operate a HP cone crusher

In order to get optimum capacity and maximum wear life of wear parts, consider the following points:

## 1. Check the feed arrangement:

- The crusher should be choke fed so that the crushing chamber is full all the time. This is important, especially in fine crushing. Choke feeding maximizes the amount of multi-layer crushing, improves the shape of the crushing cavity as it wears and improves the crushing efficiency. => Choke feed level for an HP cone crusher is 300 mm or more above the feed plate.
- The feed must be distributed evenly 360° around the crushing chamber. Uneven feed distribution may cause power and force cycles through each gyration cycle. Evenly distributed feed will result in a more steady

power and crushing force.

- Feed should not be segregated (for example finer material on one side of the cavity and coarser material on the other side of the cavity).
- Flow of the feed should be stable and continuous.
- Closed circuit crushing (where the crusher product goes to a screen and the oversize material returns to the crusher) is needed when producing high quality products.

## 2. Check the feed size and gradation:

- Oversize feed material decreases capacity and can cause abnormal wear of the liners
- Too small a feed size for the cavity increases the wear at the bottom part of the liners and may cause poor utilization of the wear parts
- Fines (0-4 mm) should be screened out before the material is fed to the crusher as the fines may cause packing which can be

seen as adjustment ring movement which is a force overload.

- Feed should be well graded with no gaps in the size distribution.

**3. Check the power draw. Crusher should operate with a steady power draw and as close to full rated power as practical, depending the circuit design and the ability to control system.**

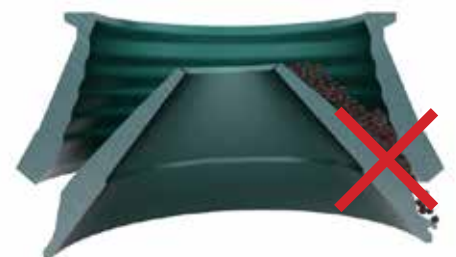
Note: Feed material characteristics such as gradation, bulk density, moisture, clay content and crushability have significant impact on crusher capacity.



Good feed material level



Too big feed material



Too small feed material



**4. Check the closed side setting. The setting should be close to the required product. The setting is too small if the adjustment ring is moving on the main frame (ring bounce).**

- Larger setting -> Product size increases
- Larger setting -> Capacity increases
- Larger setting -> Power draw decreases

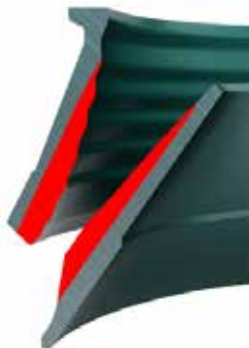
**5. Check the crusher operating speed.**

Generally, a higher speed creates a finer product gradation curve and better product shape, which is important when producing the end product in most construction applications. While operating the HP cone crusher at the lower end of its speed range will increase the cavity volumetric throughput and the product gradation curve can be altered to produce fewer fines. The allowed speed limits can be found in the Nordberg HP cone crusher instruction manual. Before changing the speed of the crusher, consult product support for further information.

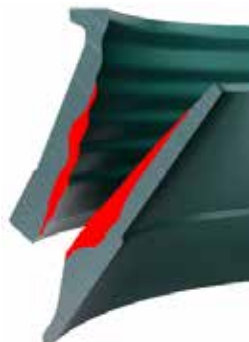
**6. Check the cavity in use.**

- Based on feed size
- Based on required end product size which determines the required setting range
- Check the crushing reduction ratio

**7. Check the wear profile of the liners: a distorted wear profile may decrease capacity, increase the liner wear rate and increase the crushing force.**



*Example of normal wear. Obtained with correct feed arrangements, feed gradation and parameters for the cavity.*



*Example of abnormal wear. Cupping has occurred.*



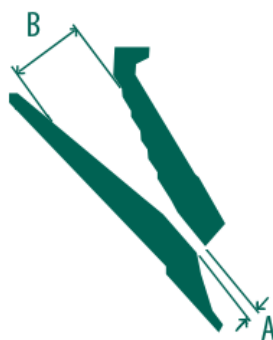
# HP cone crusher cavity selection

Each HP cone crusher has several cavity options with different feed openings and setting ranges. The correct cavity can be selected based on the feed size, setting and application.

Standard liners are typically used in secondary applications. Secondary applications don't necessarily need to be operated in closed circuit, but preferably choke fed.

Short head liners are used in tertiary or quaternary stage applications for fine crushing. Fine crushing requires choke feeding and closed circuit operation with oversize returning to the crusher.

Crusher size	Cavity	Standard		Short head	
		Minimum setting "A"	Feed opening "B"	Minimum setting "A"	Feed opening "B"
HP100	Extra fine			6 mm (0.24 in)	20 mm (0.79 in)
	Fine			9 mm (0.35 in)	50 mm (1.97 in)
	Medium			9 mm (0.35 in)	70 mm (2.76 in)
	Coarse			13 mm (0.51 in)	100 mm (3.94 in)
	Extra coarse			21 mm (0.83 in)	150 mm (5.91 in)
HP200	Extra fine			6 mm (0.24 in)	25 mm (0.98 in)
	Fine	14 mm (0.24 in)	95 mm (3.74 in)	6 mm (0.24 in)	25 mm (0.98 in)
	Medium	17 mm (0.31 in)	125 mm (4.92 in)	8 mm (0.31 in)	54 mm (2.13 in)
	Coarse	19 mm (0.39 in)	185 mm (7.28 in)	10 mm (0.39 in)	70 mm (2.99 in)
	Extra coarse				
HP300	Extra fine			6 mm (0.24 in)	25 mm (0.98 in)
	Fine	13 mm (0.51 in)	107 mm (4.21 in)	6 mm (0.24 in)	25 mm (0.98 in)
	Medium	16 mm (0.63 in)	150 mm (5.91 in)	8 mm (0.31 in)	53 mm (2.09 in)
	Coarse	20 mm (0.79 in)	211 mm (8.31 in)	10 mm (0.39 in)	77 mm (3.03 in)
	Extra coarse	23 mm (0.98 in)	233 mm (9.17 in)		
HP400	Extra fine			6 mm (0.24 in)	30 mm (1.18 in)
	Fine	14 mm (0.55 in)	111 mm (4.37 in)	6 mm (0.24 in)	40 mm (1.57 in)
	Medium	20 mm (0.70 in)	108 mm (7.80 in)	8 mm (0.31 in)	52 mm (2.05 in)
	Coarse	25 mm (0.98 in)	252 mm (9.92 in)	10 mm (0.39 in)	92 mm (3.62 in)
	Extra coarse	30 mm (1.18 in)	299 mm (11.77 in)		
HP500	Extra fine			6 mm (0.24 in)	55 mm (1.38 in)
	Fine	16 mm (0.63 in)	133 mm (5.24 in)	8 mm (0.31 in)	40 mm (1.57 in)
	Medium	20 mm (0.79 in)	204 mm (8.03 in)	10 mm (0.39 in)	57 mm (2.24 in)
	Coarse	25 mm (0.98 in)	286 mm (11.26 in)	13 mm (0.51 in)	95 mm (3.74 in)
	Extra coarse	30 mm (1.18 in)	335 mm (13.19 in)		
HP800	Extra fine			5 mm (0.20 in)	33 mm (1.30 in)
	Fine	16 mm (0.63 in)	187 mm (7.36 in)	10 mm (0.39 in)	92 mm (3.62 in)
	Medium	25 mm (0.98 in)	267 mm (10.51 in)	13 mm (0.51 in)	155 mm (6.10 in)
	Coarse	32 mm (1.26 in)	297 mm (11.69 in)		
	Extra coarse	32 mm (1.26 in)	353 mm (13.90 in)		



1. The minimum setting is that at which the crusher will operate without causing ring bounce. Depending on the crusher characteristics of the rock, this setting can change.
2. Feed opening "B" is at a minimum setting "A".
3. Maximum feed size vary from 80 to 100% of "B" depending on the machine size and material.



Examples of standard (left) and short head liners (right).

	Difficult and abrasive rock	Difficult and non abrasive rock	Medium and abrasive rock	Medium and non abrasive rock	Easy and abrasive rock	Easy and non abrasive rock
<b>SECONDARY CRUSHING</b>						
<b>HP100 - HP500</b>						
XT510			●●	●●	●●	●●●
XT710	●●●	●●●	●●●	●●●	●●●	●●●
XT720	●●●		●●●		●●●	
<b>HP800</b>						
XT510	●●●	●●●	●●●	●●●	●●●	●●●
XT710 / XT720	C	C	C	C		
<b>FINE CRUSHING</b>						
<b>HP100 - HP500</b>						
XT510			●●	●●●	●●	●●●
XT710	●●●	●●●	●●●	●●●	●●●	●●●
XT720	●●●	●●●	●●●	●●	●●●	
<b>HP800</b>						
XT510	●●●	●●●	●●●	●●●	●●●	●●●
XT710 / XT720	C	C	C	C		

● Can be used ●● Good choice ●●● Recommended C - Contact Metso representative for more information

Definitions for different rock types are presented in  
Wear and materials application guide, page 4.



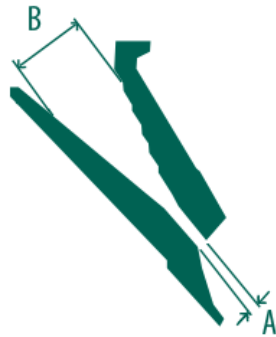
# HP3, HP4 and HP6 cone crusher cavity selection

HP3, HP4 and HP6 cone crushers have several cavity options with different feed openings and setting ranges. The correct cavity can be selected based on the feed size and setting. Liners are manufactured from XT710 material.

Crusher size	Cavity	Minimum setting "A"	Feed opening "B"
HP3	Extra fine	8 mm (0.31")	18 mm (0.78")
	Fine	11 mm (0.43")	95 mm (3.74")
	Medium	15 mm (0.59")	156 mm (6.15")
	Coarse	20 mm (0.79")	183 mm (7.20")
	Extra coarse	25 mm (0.99")	200 mm (7.89")
HP4	Extra fine	8 mm (0.31 in)	74 mm (2.91 in)
	Fine	10 mm (0.39 in)	116 mm (4.57 in)
	Medium	16 mm (0.63 in)	169 mm (6.65 in)
	Coarse	28 mm (1.10 in)	252 mm (9.92 in)
	Extra coarse	28 mm (1.10 in)	252 mm (9.92 in)
HP6	Extra fine	9 mm (0.35 in)	56 mm (2.20 in)
	Fine	12 mm (0.47 in)	112 mm (4.41 in)
	Medium	18 mm (0.71 in)	205 mm (8.07 in)
	Coarse	25 mm (0.98 in)	290 mm (11.41 in)
	Extra coarse	30 mm (1.18 in)	330 mm (12.99 in)

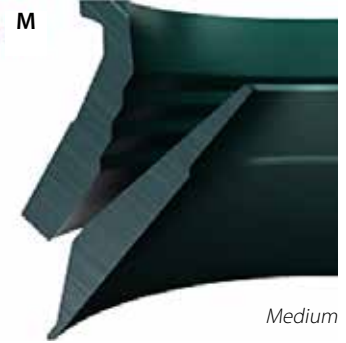
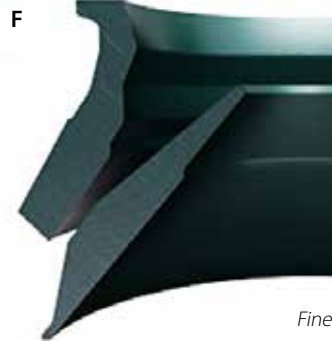
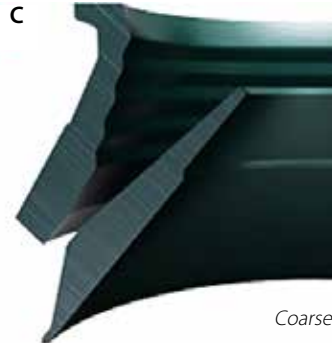
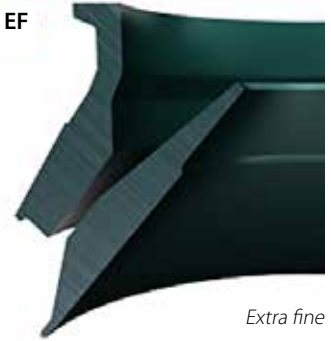
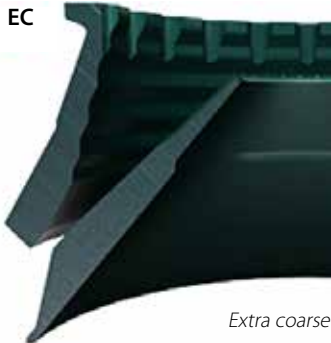
HP3 / HP4 / HP6	Difficult and abrasive rock	Difficult and non abrasive rock	Medium and abrasive rock	Medium and non abrasive rock	Easy and abrasive rock	Easy and non abrasive rock
XT710	●●●	●●●	●●●	●●●	●●●	●●●
	●●● Recommended					

*Definitions for different rock types are presented in Wear and materials application guide, page 4.*



1. Feed opening "B" is at a minimum setting "A".
2. Maximum feed size vary from 80 to 100% of "B" depending on the machine size and material.





Crusher size	Number of gear teeth required for one complete revolution	Vertical bowl travel per tooth	Setting variation per tooth	Setting for 1/4 revolution of the driver ring	"A" Approximate dimension when the liners are worn out
HP100	106	0.36 mm (0.014 in)	0.27 mm (0.011 in)	7.1 mm (0.28 in)	A = 50 + (1.59 x CSS)
HP200 long bowl	138	0.28 mm (0.011 in)	0.18 mm (0.007 in)	6.3 mm (0.25 in)	A = 50 + (1.58 x CSS)
HP200 short bowl	138	0.28 mm (0.011 in)	0.18 mm (0.007 in)	6.3 mm (0.25 in)	A = 37 + (1.58 x CSS)
HP300	156	0.33 mm (0.013 in)	0.23 mm (0.009 in)	8.73 mm (0.34 in)	A = 37 + (1.59 x CSS)
HP400	176	0.29 mm (0.011 in)	0.20 mm (0.008 in)	8.9 mm (0.352 in)	A = 26 + (1.69 x CSS)
HP500 long bowl	192	0.26 mm (0.010 in)	0.18 mm (0.007 in)	8.5 mm (0.344 in)	A = 0 + (1.59 x CSS)
HP500 short bowl	192	0.26 mm (0.010 in)	0.18 mm (0.007 in)	8.5 mm (0.335 in)	A = 75 + (1.59 x CSS)
HP800 long bowl	243	0.21 mm (0.008 in)	0.14 mm (0.006 in)	8.5 mm (0.335 in)	STD A = 79 + (1.50 x CSS) SH HD = 82 + (1.50 x CSS)
HP800 short bowl	243	0.21 mm (0.008 in)	0.14 mm (0.006 in)	8.5 mm (0.335 in)	STD A = 85 + (1.50 x CSS) SH HD = 120 + (1.50 x CSS)
HP3	138	0.28 mm (0.011 in)	0.18 mm (0.007 in)	6.3 mm (0.25 in)	A = 37 + (1.58 x CSS)
HP4	159	0.32 mm (0.013 in)	0.21 mm (0.008 in)	8.35 mm (0.329 in)	A = 50 + (1.59 x CSS)
HP6	185	0.27 mm (0.011 in)	0.17 mm (0.007 in)	7.9 mm (0.311 in)	A = 40 + (1.69 x CSS)

# When to change liners

In order to avoid damage to the liner seating surfaces of the crusher head or bowl, 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.

## See the following instructions

1. On the initial set of new liners, place a mark on the adjustment cap driver ring where the pinion tooth makes contact with a driver ring tooth when the target crusher setting has been achieved.
2. Keep an accurate record of the number of teeth used to compensate for liner wear on this set of liners.
3. After the initial set of liners have worn out, but before moving the bowl, record the total number of teeth the driver ring has moved and also paint a horizontal liner on the side

of the dust shell just below the bottom of the adjustment cap. This will be the baseline for determining how close the next liner sets are to being worn out.

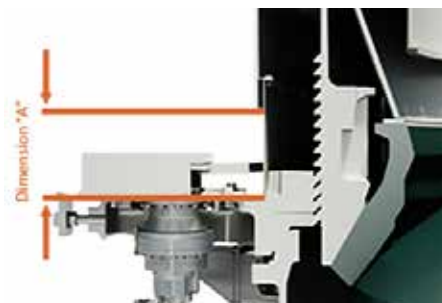
4. When a new liner set has been installed, keep a record of the number of teeth the driver ring has moved and compare this number to the total number from the initial set of liners. This will give an estimation of the liner wear. The horizontal mark painted on the dust shell will also indicate when the liners are approaching the wear limit. The approximate minimum heights of the adjustment cap (A-dimension) with worn liners are listed in the attached tables.

When changing liners and determining liner wear, follow the instructions in the related Nordberg HP cone crusher instruction manual.

Production considerations may sometimes favor changing of wear parts before they are fully utilized. Hourly capacity or product quality may decrease toward the end of the liner wear life and it may be more economical to change before the end of the liner wear life.

Typically, distorted wear profiles can cause a reduction in capacity. Other symptoms of poorly worn liners are high power draw and ring bounce. Also, the wear life can be

reduced because the wear is sometimes concentrated in a small zone rather than spread along the full cavity and the cavity may have to be replaced before they are fully worn. This results in poor utilization and a higher operating wear costs.



Caution: A is given for a good wear. Meaning similar mantle and concave wear, without distorted wear profile = correct application according to cavity selected.



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