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ULTRA MAXBIT OPERATION MANUAL

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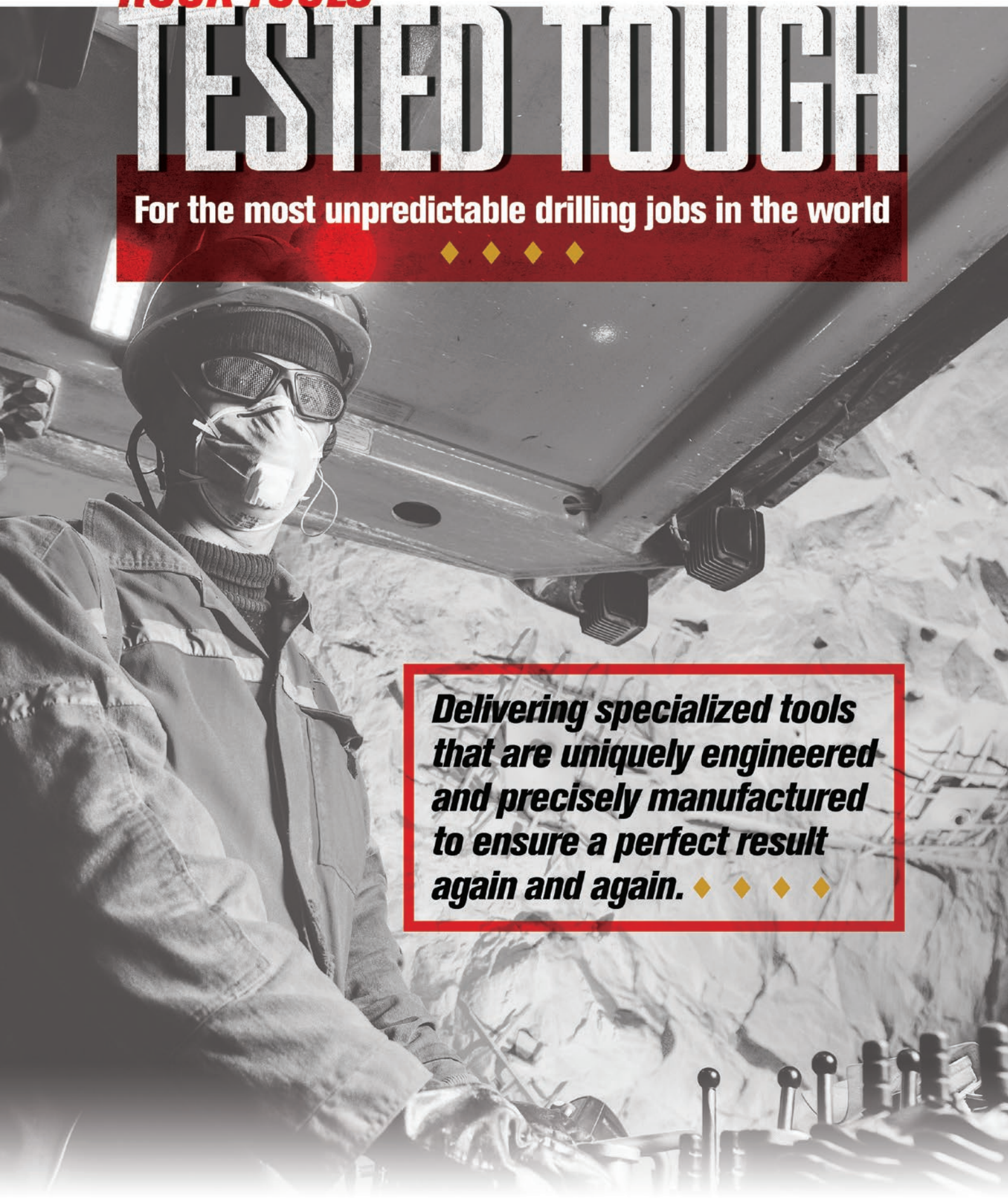

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ULTRA MAXBIT
CASING ADVANCEMENT SYSTEM

High speed and straight drilling
In a wide range of ground conditions

- **ULTRA MAXBIT** (UMB) is used for simultaneous drilling and casing in unstable ground formations.
- UMB is also applicable for wide range of ground conditions such as sand, gravel and boulders and rock.
- Easy locking system.
- The dual bit system also allows vertical, horizontal, and even inclined drilling.
- Faster penetration rates due to large bit surface area contacting formation.
- Various casing systems/models are available for any applications.

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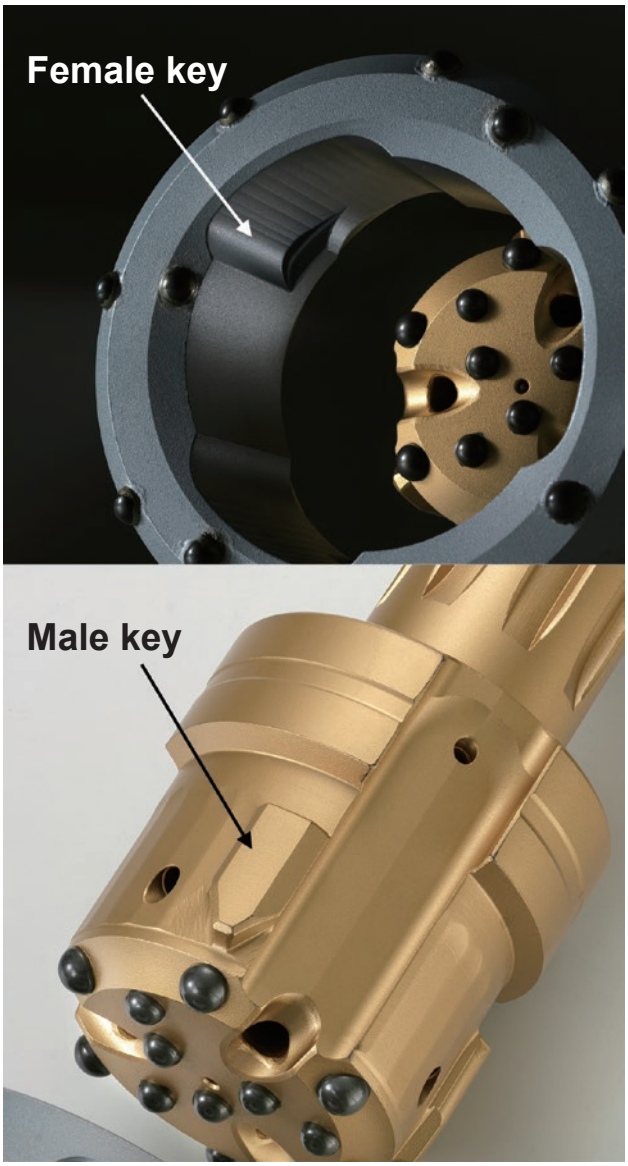
Easy and Speedy lock system



UMB EASY LOCK SYSTEM structure is consists of male key on the pilot bit and female key on the ring bit.

• Easy unlock and re-lock system when flushing to remove cuttings.

• Cuttings cannot stay in female key.

1. Drive the pilot bit through the casing pipe
2. Rotate to locked position with the ring bit.
3. READY TO DRILL
4. Finish drilling by rotating the pilot bit in opposite direction and pulling it out

Unlock and relock procedure see P.14.

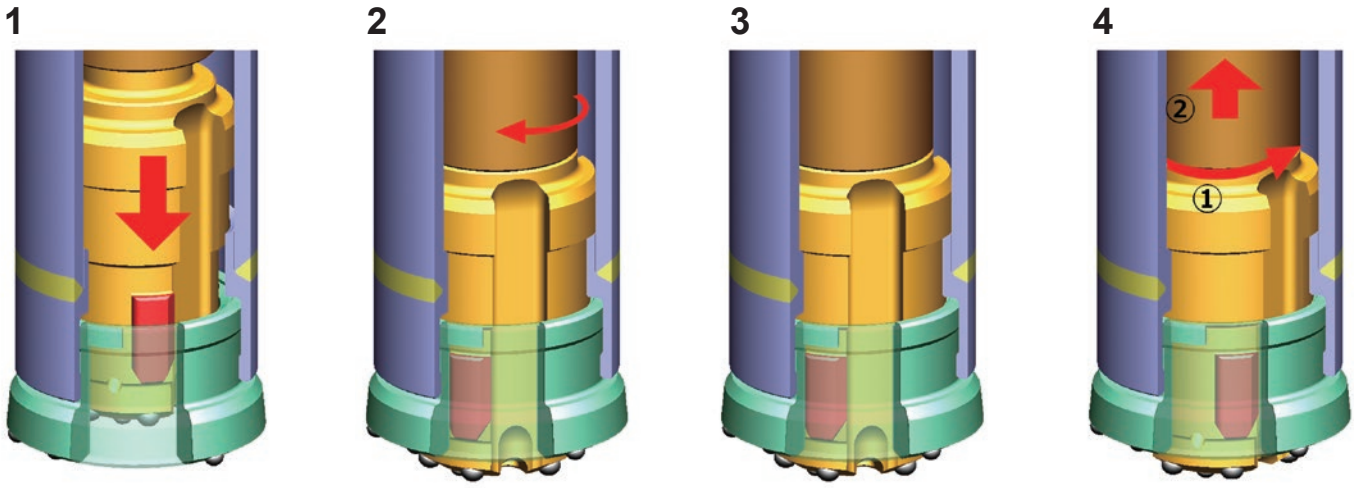


Figure 1 : Easy lock system

The dual bit system / Various casing systems and models

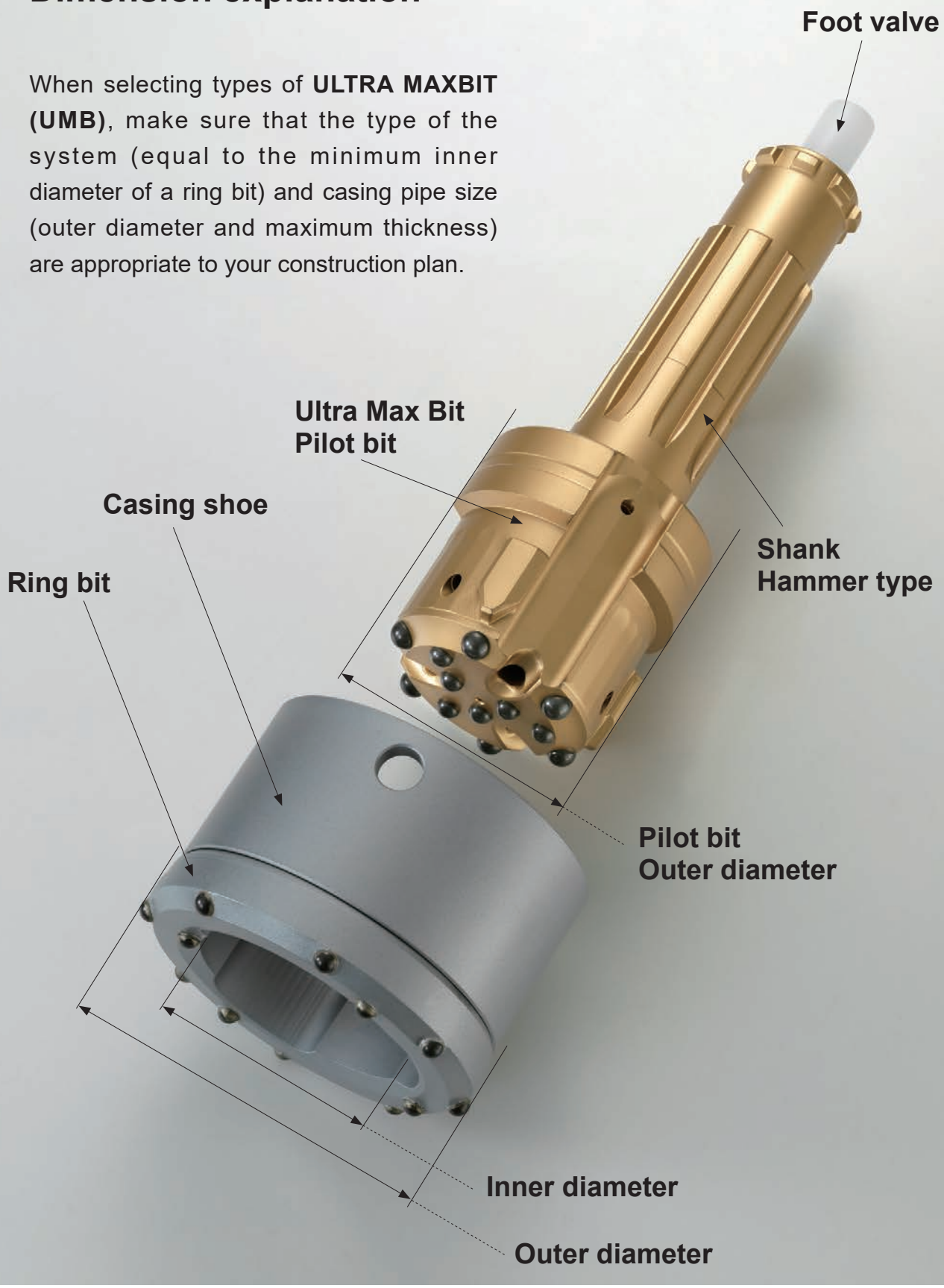
The dual bit system also allows vertical, horizontal, and even inclined drilling.
UMB is also applicable for wide range of ground conditions such as sand, gravel and boulders and rock.

Various casing systems/models
are available for any applications.

See P.4 Models and Usage

Dimension explanation

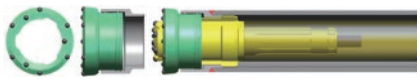
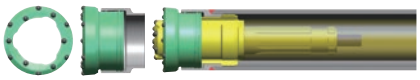
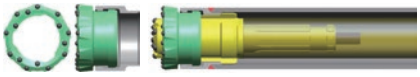
When selecting types of **ULTRA MAXBIT (UMB)**, make sure that the type of the system (equal to the minimum inner diameter of a ring bit) and casing pipe size (outer diameter and maximum thickness) are appropriate to your construction plan.



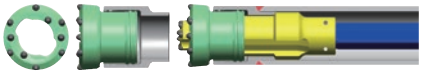
B-1. ULTRA MAXBIT CASING SYSTEM and MODELS

Various ULTRA MAXBIT casing systems/models are available for any applications. Select the most appropriate systems. In the Table1, you can see the range of casing sizes of use for each casing systems/models.

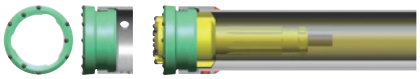
Standard DTH System

Model	connection	Suitable for	Casing Type	Application
Single Pass Model 	Thread	• Soft ground • Shallow hole	Permanent	Pilling construction
Normal Model 	Thread	• Heavy duty • Deep hole	Permanent	• Pilling construction • Water well / Geothermal
Multi Use Model  The groove makes the casing pipe pulled easily. Casing pipe and ring sets can be used repeatedly.	Inter Linked	Re-Using	Retrievable / Temporary	Anchoring, foundation

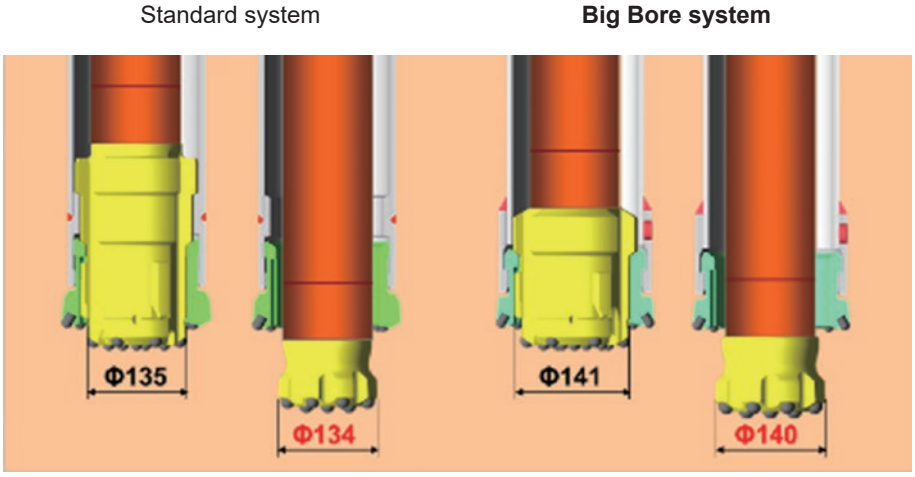
Top Hammer System

Model	connection	Suitable for	Casing Type	Application
Top Hammer Model 	Thread	Small hole tunneling	Permanent	Pilling construction

Big Bore DTH System

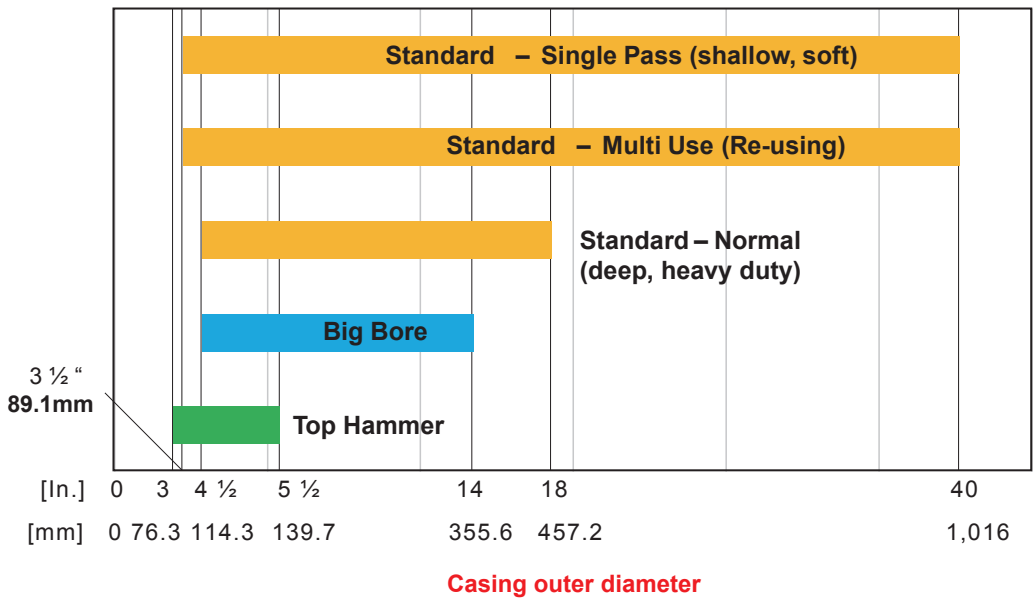
Model	connection	Suitable for	Casing Type	Application
Big Bore Model 	Inter Linked	Larger Bore Drilling	Permanent	Water well / Geothermal

ex) Casing pipe Outer Diameter : 6 5/8” (168.3 mm) Inner Diameter : 6.18” (157.3 mm)



Big Bore system has larger inner diameter. We can drill through with larger diameter DTH single bit.

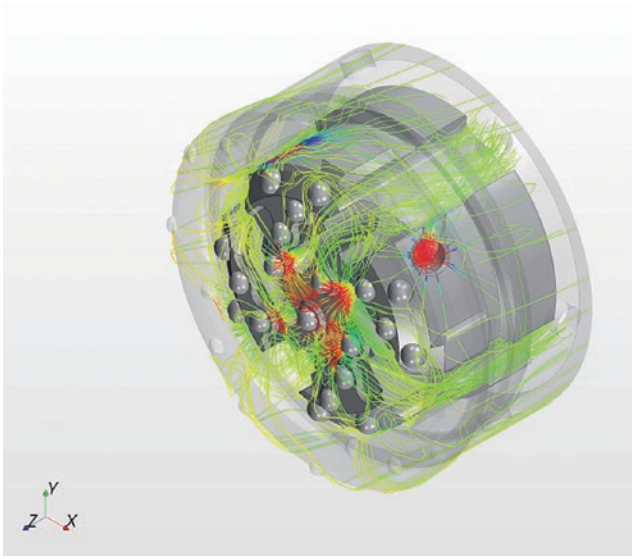
Table 1 : The range of casing sizes of use for each casing systems/models



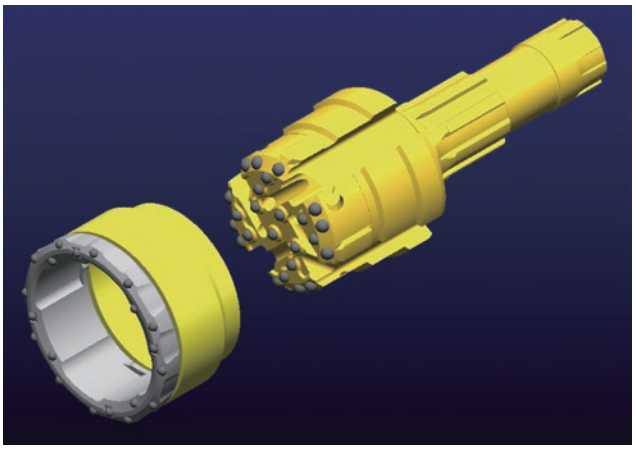
ULTRA MAXBIT VENTURI MODEL

The VENTURI MODEL has a following advantages and best solution for drilling in sensitive ground:

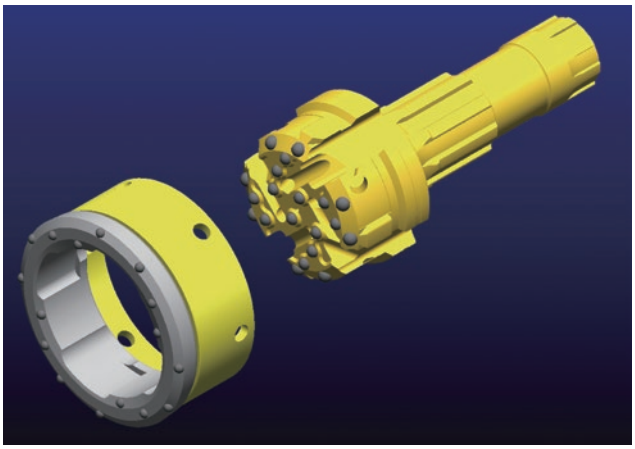
-The flushing air does not hit directly to the bottom of the borehole.
-Minimal air leakage into the formation will not enlarge the borehole.
-The reverse flushing causes a vacuum effect to remove the cuttings.
-The efficient flushing and face groove designed by CAE simulation and analysis.
-Standard system and Big Bore system are available.



Air Flushing Slimulation



Standard system



Big Bore system

B-2. Application

Permanent casing - Pilling and Underpinning/ Foundation/Horizontal drilling

Softer ground conditions require that the foundations of any type of construction must be stabilized. Drilling system consist of casing pipes drilled through the overburden to the solid bedrock and filled with concrete. Horizontal drilling is used to lead water, sewage, or cable pipes under roads, rivers and buildings. There is no need to make extensive surface cuttings that block the roads or ruin the landscape.

STEP 1: Drilling to bedrock

STEP 2: Pulling out pilot bit

STEP 3: Cementing

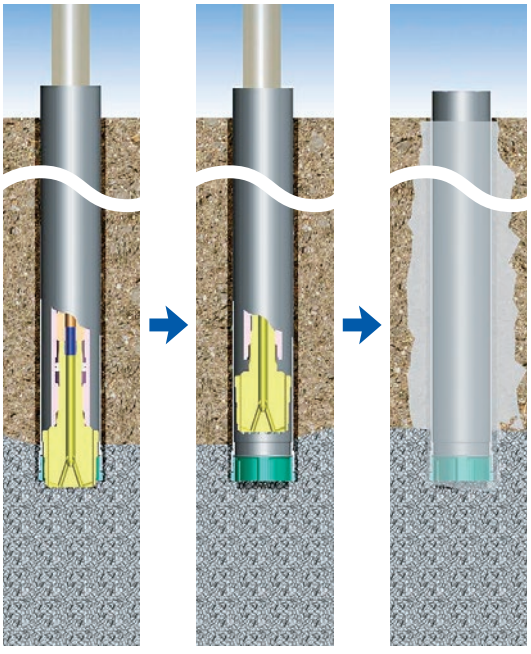


Figure 2 : Permanent casing

Recommendation

Soft ground / Shallow hole → Single pass

Heavy Duty / Deep hole → Normal

Permanent casing - Tunneling / Forepoling

Forepoling, also known as tube umbrella, is an application used to strengthen tunnel roof in broken rock conditions. Top Hammer models are used in these applications with relatively short hole requirement and the casing is left in the ground.

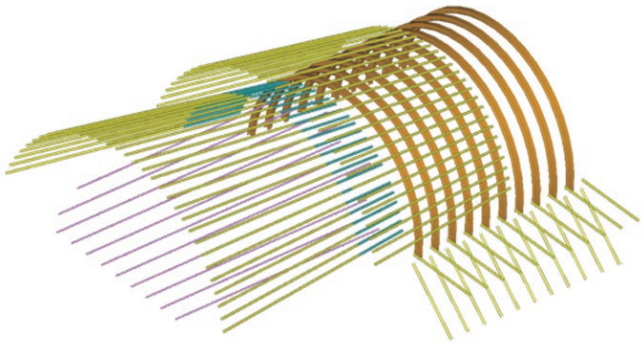


Figure 3 : Forepoling

Permanent casing drill through - Water well / Geothermal

Casing drilling is used in making water and thermal wells in broken overburden conditions.

The casing pipe is left in the ground as a protection pipe of the water or thermal well. After drilling through the overburden to the solid bedrock then drilling is continued with single Down The Hole bit.

STEP 1: Drilling to bedrock

STEP 2: Pulling out pilot bit

STEP 3: Re-drilling bedrock by single DTH bit

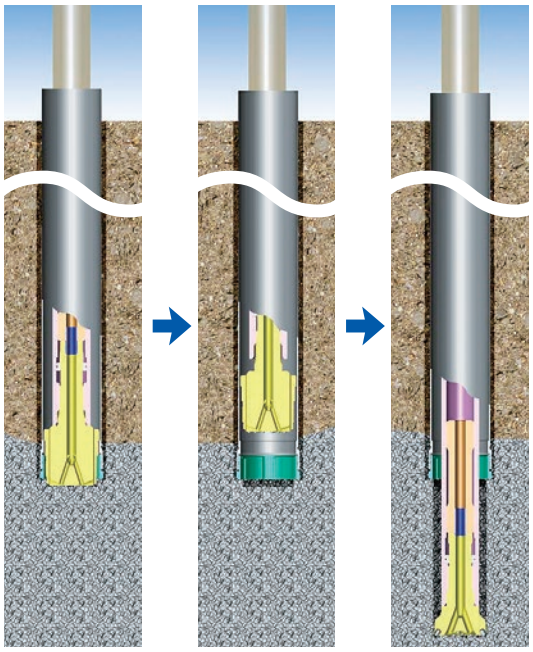


Figure 4 : Permanent casing drill through

Recommendation
Soft ground / Shallow hole → Single pass
Heavy Duty / Deep hole → Normal
For large bore drilling bedrock → Big Bore

Retrievable/Temporary casing - Anchoring, Foundation

In some overburden drilling applications the casing has to be removed from the ground. Multi-Use Model is perfect for Retrievable / Temporary casing. The groove design of Multi-Use model makes pulling the casing pipe easy. Casing pipe and ring sets can be used repeatedly.

STEP 1: Drilling to bedrock
STEP 2: Pulling out pilot bit
STEP 3: Set up structural object
STEP 4: Pulling out casing

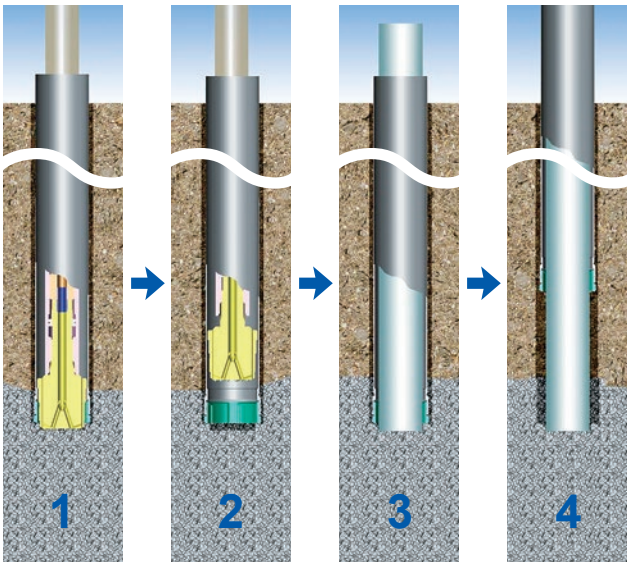


Figure 5 : Retrievable casing

C-1. Casing shoe attachment (Welding procedure)

Standard DTH / Top hammer system

1. Bevel the end of the casing to an angle of about 30 degrees.
   Be sure that all surfaces to be welded are clean and free from any dirt, contamination including moisture.
   Pre-heat the end of the casing shoe to 100 degrees (Celsius), 212 degrees (Fahrenheit).
2. Insert the casing shoe inside the casing pipe. Be sure the casing shoe is in the center of the casing pipe.
3. Temporary tack-weld the casing to centralize. Tack welding should be done diagonally.
4. When welding on the circumference, normally three passes are recommended. Take sufficient time to weld the casing using the correct welding rod.
5. After welding, use a grinder to smooth the weld. This will help while installing casing so not to drag drill cuttings into the borehole on the outside of the casing and causing drag when installing.
6. Recommendation: Plug welds or diamonds cut in the casing to strengthen the weld from casing to drive shoe. Please refer following table for plug size and the number of plugs.

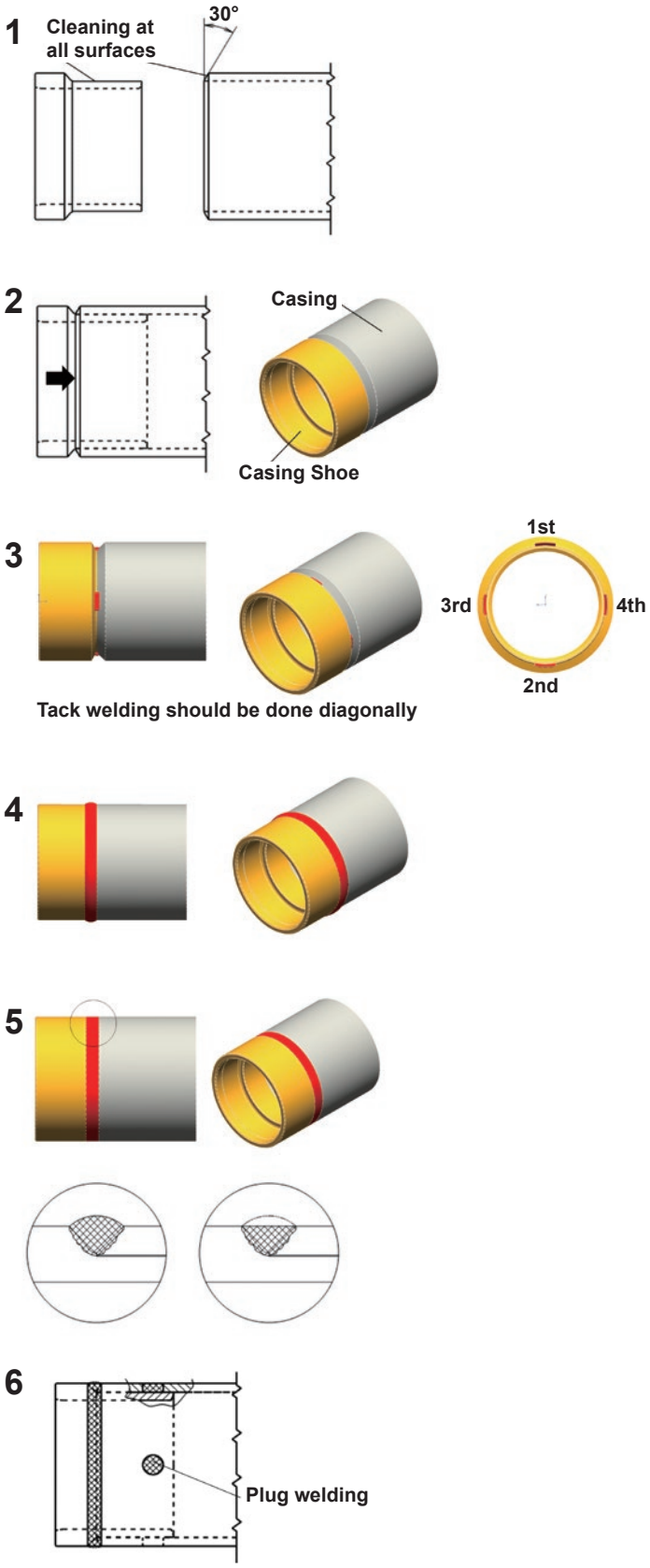


Figure 6 : Welding procedure

Big-Bore DTH system

1. Be sure that all surfaces to be welded are clean and free from any dirt, contamination including moisture.
   Pre-heat the end of the casing shoe to 100 degrees (Celsius), 212 degrees (Fahrenheit).
2. Put the ring sets (the casing shoe and the ring bit) to the casing. Be sure the casing shoe is in the center of the casing pipe and there is no gap between the ring bit and casing shoe to make the ring bit rotate smoothly. **See Figure7.**
3. Temporary tack-weld the casing to centralize. Tack welding should be done diagonally.
4. When welding on the circumference, normally three passes are recommended. Take sufficient time to weld the casing using the correct welding rod. The width (W) of the fillet weld should be duplicate of the height (H) of the fillet weld (W = 2H). **See Figure8.**
   Be sure that the ring bit can rotate smoothly (rotate by hands) after welding. **See Figure7.**
5. After welding, use a grinder to smooth the weld. This will help while installing the casing to not drag drill cuttings into the borehole on the outside of the casing and causing drag when installing.
6. Recommendation: Plug welds or diamonds cut in the casing to strengthen the weld from casing to drive shoe. Please refer following table for plug size and the number of plugs.

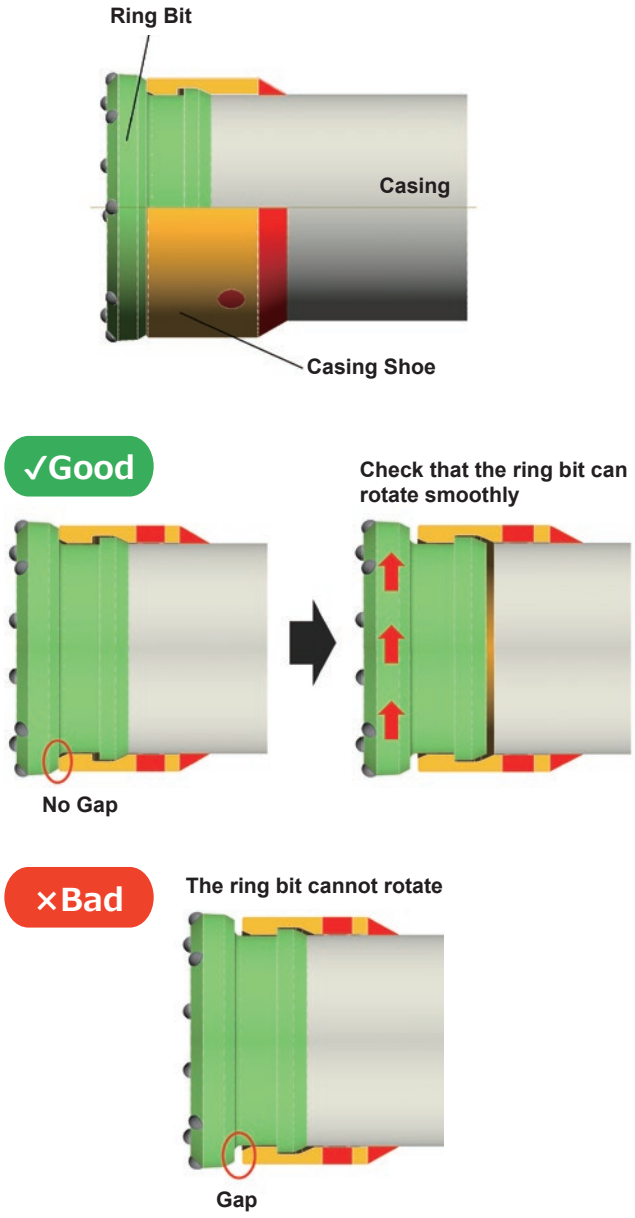


Figure 7 : Big Bore ring sets attachment and welding

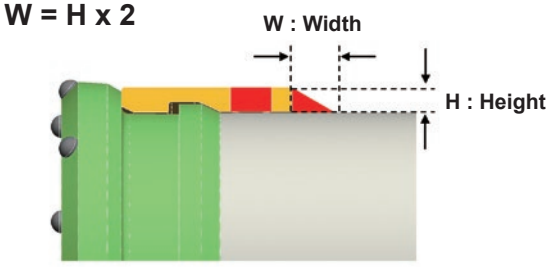


Figure 8 : Fillet welding

NOTE:

The casing shoe must be correctly welded to the casing in order to carry out a successful casing drilling operation. If the casing shoe is not welded correctly to the casing, possible premature failures could happen. Casing shoe could separate from the casing, causing hole deviation or damage to the shoulder of the pilot bit.

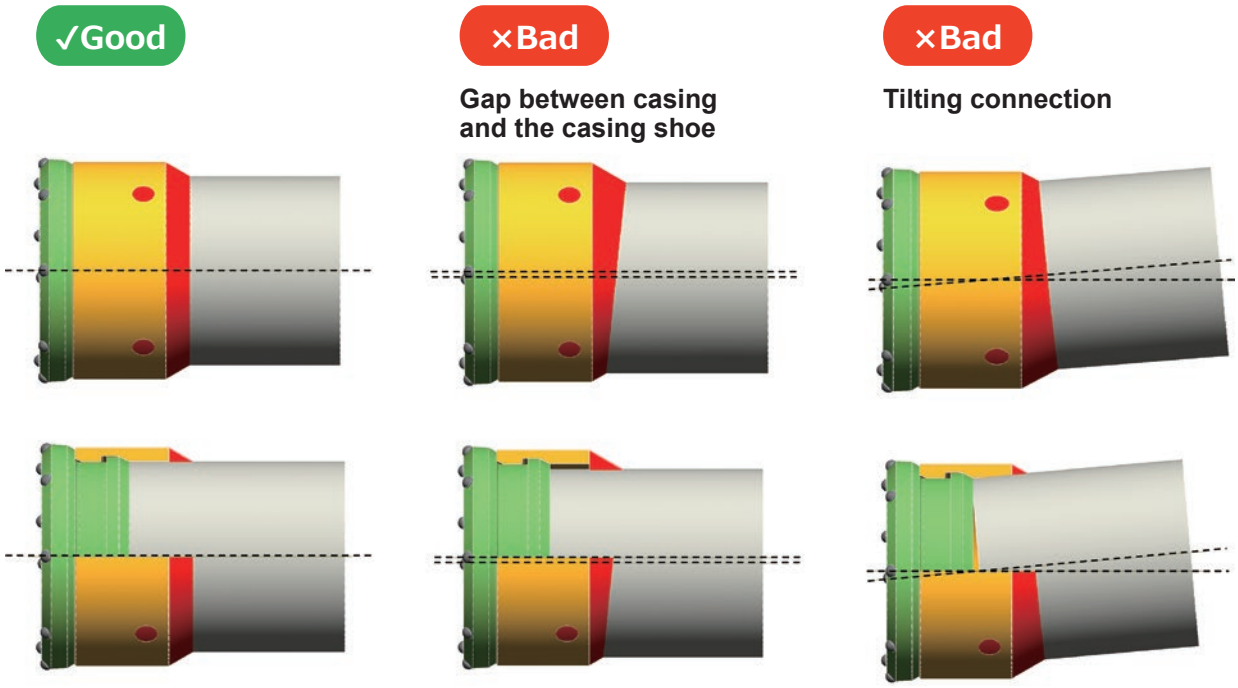


Figure 9 : Alignment for the first casing pipe and casing shoe

C-2. Ring Bit attachment -Thread connection type

Attachment of the ring bit is completed only by fitting the thread to the casing shoe which is pre-welded to the first casing pipe. Interlinked type (Multi Use Model and Big-Bore Model) is assembled in the factory and cannot be disassembled.

-DTH specification-
Most of the DTH Hammer rotate **clockwise**. The ring bit and casing shoe are fit with **Left-hand Thread**.

-Top Hammer specification-
Most of the Top Hammer rotate **counterclockwise**. The ring bit and casing shoe are fit with **Right-hand Thread**.

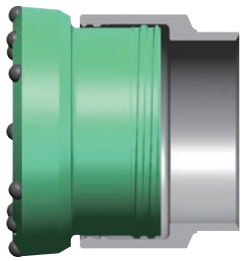


Figure 10 : Thread connection

NOTE:
1. Do not apply a grease when fitting the thread. Sand or gravel may be caught by the grease.
2. Check the nominal type of both Ring bit and casing shoe. A product with a different nominal type cannot be used.

C-3. Drill Operation

Pull down force

The moderate pull down force on pilot is 9 kg/mm (500 lbs. /inch)

Rotation speed

Always drill considering ground formations encountered as they are drilled, hard formations – slower rotation speed, softer formations rotation speed is a little faster to achieve smooth drilling and not binding.

Refer to the following figure for normal rotation speeds.

Select the range of uniform rotation during drilling.

The normal rotation speed range from 10 to 80 rpm, all depending on the device size and formation being drilled.

Higher rotation speeds will wear the bit prematurely and cause bit failure.

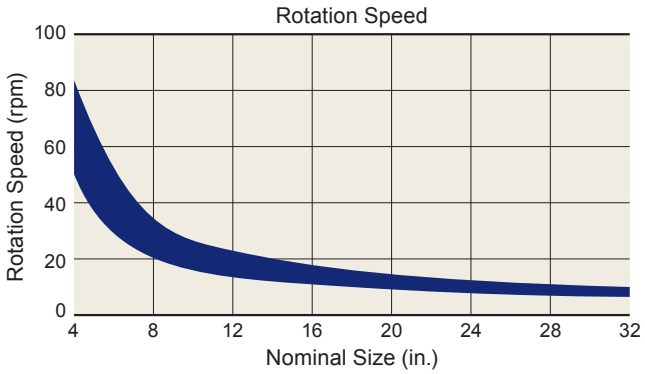


Figure 11: Rotation speed of Bit

Compressor pressure

Normal operating pressure is from 10.5 bar to 13.8 bar (150 psi to 200 psi).

Consider the depth of underground water when drilling through the layer. In case of 30 m (90 ft.) depth, add 3.1 bar (45 psi) to the air pressure.

Do not set over 21 bar (300 psi).

NOTE: In loose formation such as sand, compressor can be set to 7 bar (100 psi).

Flushing

For proper hole cleaning, verify that an adequate up-hole air velocity can be obtained. An annular velocity of 3000 feet-per-minute (1000 meter-per-minute) or more is required. Use this formula to check what the velocity will be:

$$Velocity\ (ft/min) = \frac{(183.4) \times Q\ (Ft^3/min)}{(D^2(inch) - d^2(inch))}$$

$$Velocity\ (m/min) = \frac{(1273500) \times Q\ (m^3/min)}{(D^2\ (mm) - d^2(mm))}$$

Q – Supply Air volume

D – Inside diameter of casing pipe

d – Outside diameter of the drill tube

C-4. Unlock and Relock Procedure

The ULTRA MAXBIT enables the pilot bit and ring bit to be easily unlocked (separated) and relocked (reconnect) even during drilling. This mechanism facilitates a flushing action and enhances efficiency of the subsequent drilling. Follow the procedure below to unlock or relock the pilot bit and ring bit.

Unlock procedure

1. After you have drilled to required depth. Flush the hole while lightly moving the bit up and down with the bit locked.
2. Keep the pilot bit at hole bottom.
3. Rotate (a few revolutions) slowly to unlocked position with the ring bit.
4. Raise the pilot bit.
5. Perform the flushing action while rotating the pilot bit in opposite direction.

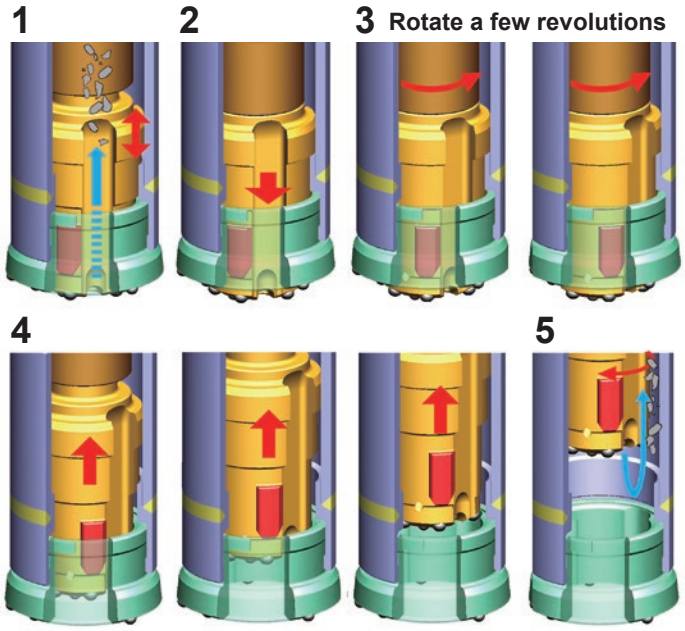


Figure 12 : Unlock procedure

NOTE:
When pulling casing pipe, use elevators on the casing.
See P.8 Temporary casing applications
Use of the pilot bit or the ring bit is NOT recommended.
There is a risk that the male key breakage due to pulling load is on the male key.

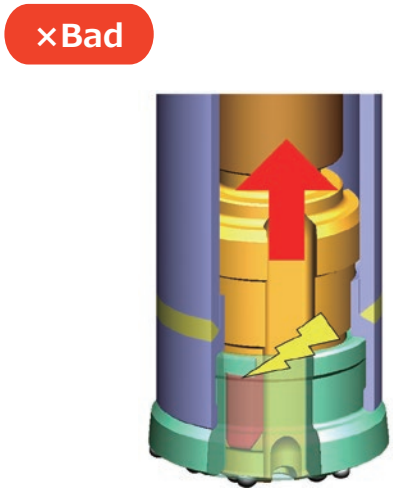


Figure 13 :
DO NOT USE the pilot bit when pulling casing pipe

Relock procedure

1. **STOP AIR SUPPLY.**
2. Lower the bit slowly by rotating the pilot bit slowly.
3. Keep the pilot bit at hole bottom. Rotate (a few revolutions) slowly to locked position with the ring bit.
4. Slowly raise the pilot bit to confirm that the pilot bit and the ring bit are locked.
5. Supply air and restart drilling.

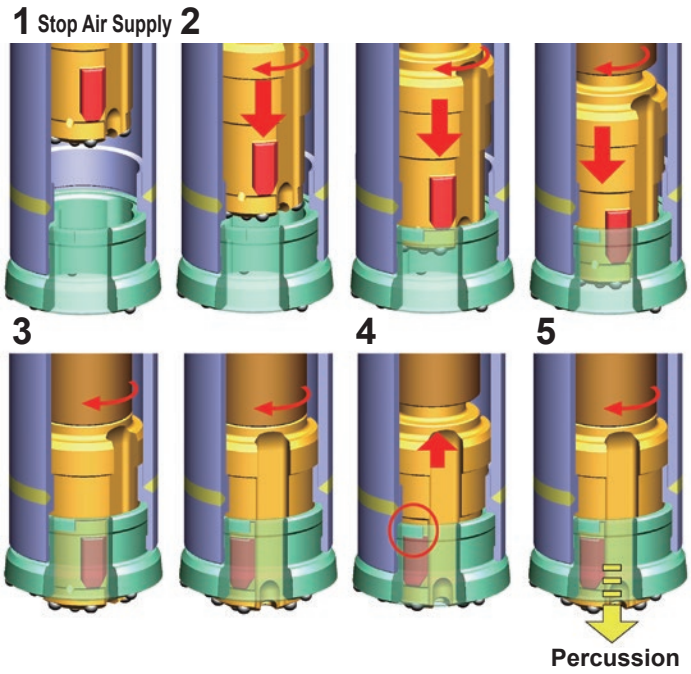


Figure 14 : Relock procedure

NOTE:
If the air supply is not stopped, the piston of DTH hammer will continue to operate and percussion will occur.
This may cause:

A. The male key of the pilot bit percussion the ring bit and push it forward.
B. The male key can be damaged.

Ensure that the air supply is stopped before lowering the bit. **See Figure15**.

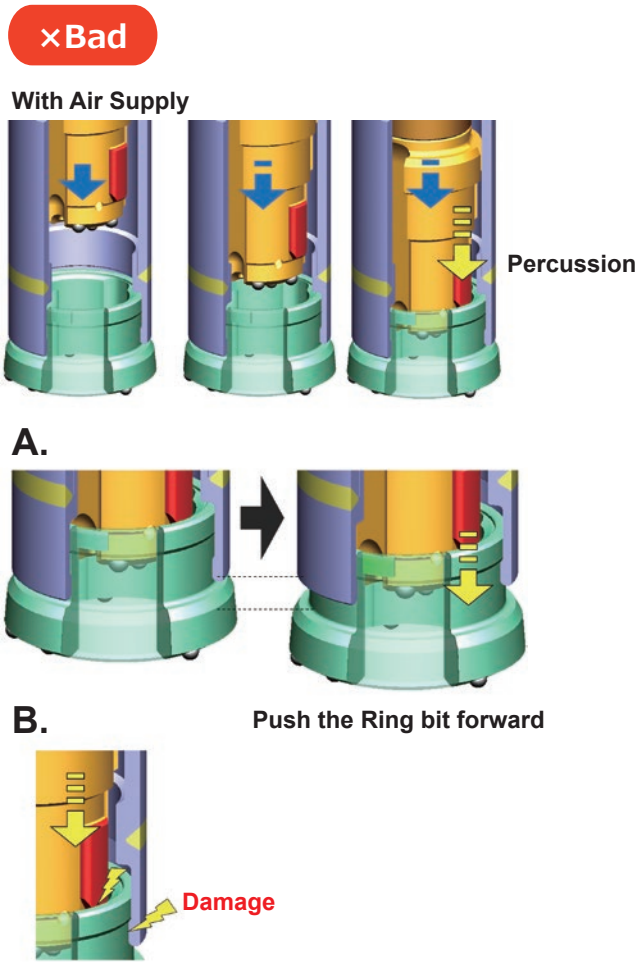


Figure 15 : Relock with Air supply

When the ring bit goes forward to the casing pipe, failure to relock can be caused (The male key may be stuck or the pilot bit cannot rotate as show in **Figure16**)

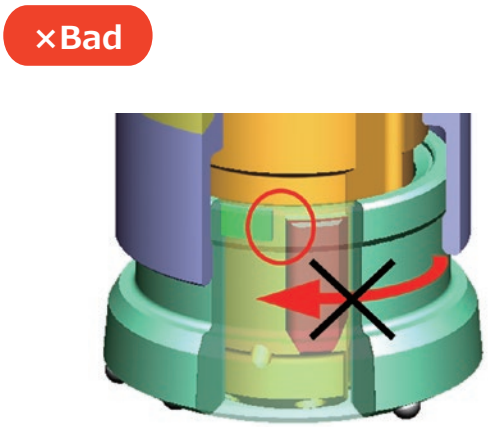


Figure 16 : Failure to relock

Carefully follow the procedure below when failure to relock is caused. **See Figure17**.

1. Lower the bit by rotating slowly to locked position.
2. Stop rotation.
3. Supply a small volume air / low percussion to move the pilot bit to the locked position.
4. Keep the pilot bit at hole bottom. Rotate (a few revolutions) slowly to the locked position with the ring bit.
5. Slowly raise the pilot bit to confirm that the pilot bit and the ring bit are locked.
6. Supply air and restart drilling.

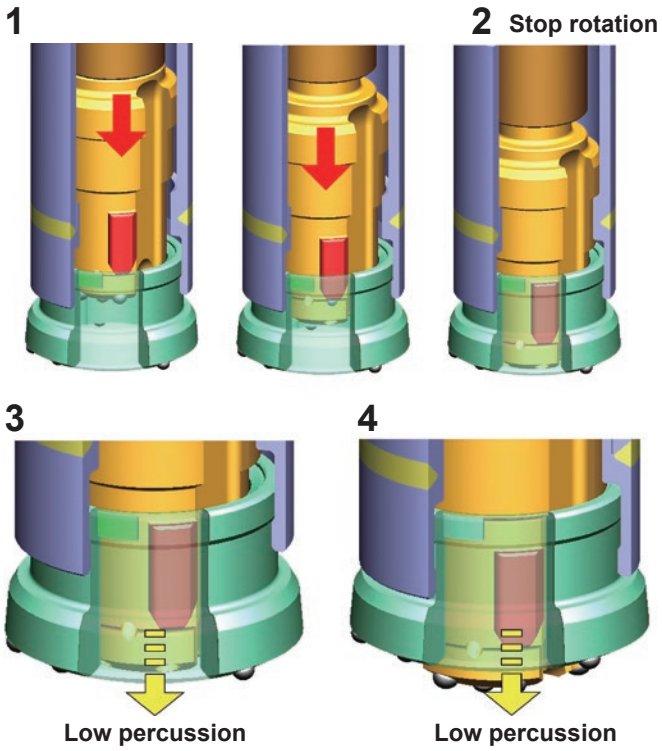


Figure 17 :
How to deal with when failure to relock caused.

D-1. Checking wear at Pilot Bit

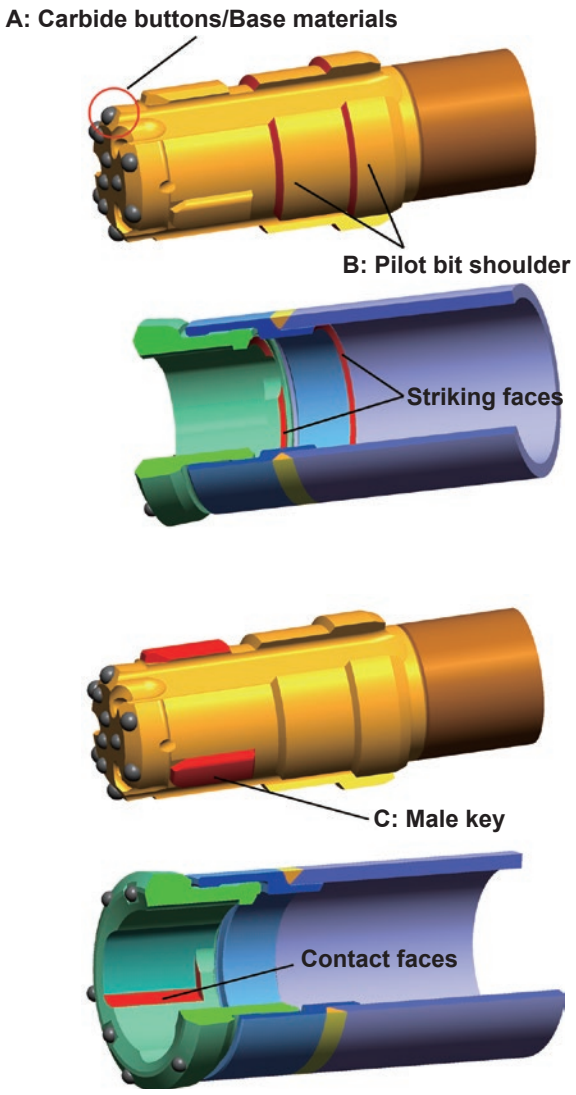


Figure 18 : Checking wear at Pilot bit

The pilot bit gives percussion/rotation/feed energy to the ring and percussion energy to the ground.
Wear on the face of the bit causes the male key to wear, and eventually the pilot bit reaches the end.
Continuously using the bit which reaches the end may cause drilling trouble.
Conducting a periodic wear check is recommended.

A: Carbide buttons and base material

1. If the wear width at the tip end is half of the chip diameter or less, regrind the tip end.
2. If the base material around the tip is worn and in a pyorrhea-like condition, then tip retention decreases and pop outs will occur.

B: Pilot bit shoulders
- give blows/percussions to the ring bit and the casing shoe

1. Use the template to check the wear. 15mm of wear width on the part to transmit the percussion energy indicates it has reached the end of its lifetime.
2. Drilling conditions and improper use of the system may cause abnormal wear of the pilot bit shoulder.
3. Remove the burr on the pilot bit shoulder with a grinder.

C: Male key
- give rotation energy to the ring bit

1. Wear of half the spline width indicates it has reached the end of its lifetime.
2. Improper locking may cause abnormal wear on the male key or make the ring bit life shorter. See locking procedure page**

D-2. Checking wear at Pilot bit shoulder

You can use the checking template to check the wear at pilot bit shoulder.
When the wear width attains 15mm it may show wear limit.
Please stop using the pilot bit and follow the build-up repair procedure.

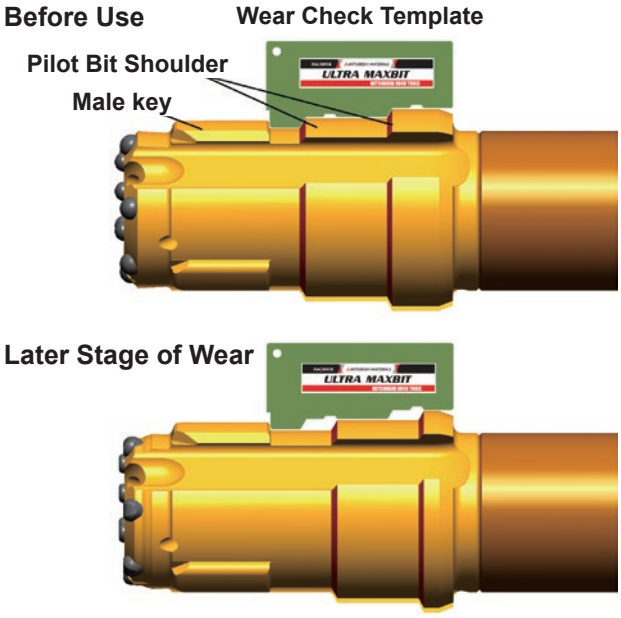


Figure 19 : Check the wear at pilot bit shoulder.

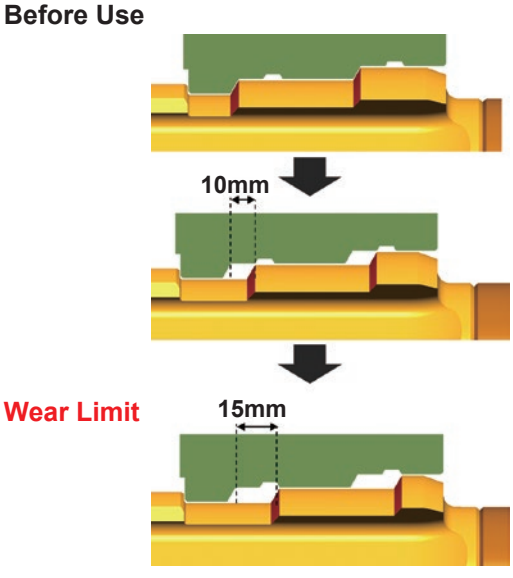


Figure 20: Check the wear width

D-3. Build-up Welding

In the case of wearing on the pilot bit shoulder, build-up welding repair is needed. Carefully follow the procedure to perform the build-up welding repair or take to a welding shop that can do this for you. Otherwise heat treatment issues will cause welding cracks.

NOTE:
Product repaired with the build-up welding cannot be guaranteed.

1. Pre-heat the base material to 200 to 300 degree Celsius, 392 to 572 degree Fahrenheit.
2. Weld the material layer on the surface of the base material.
3. Gradually cool the pilot bit. Never rapidly cool it.
4. Apply a finishing process. The angle of the device shoulder should be 30 degree.

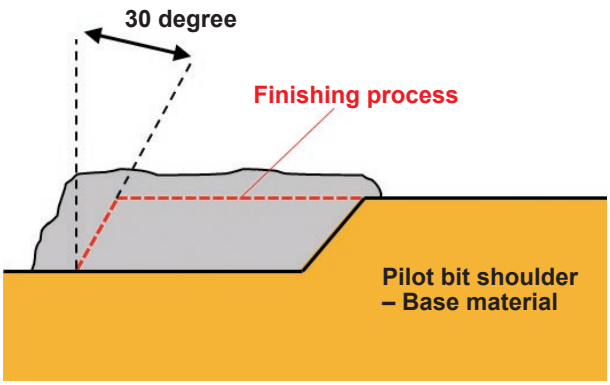


Figure 21 :
Build-up welding repair of the pilot bit shoulder (cross-section)

Apr-2021 Update

MMC RYOTEC Corporation

A Group Company of MITSUBISHI MATERIALS

JAPAN / ROCK TOOLS

MMC RYOTEC CORPORATION
TOKYO OFFICE [Overseas Oparations Center]
KFC Bldg. 7F, 1-6-1 Yokoami, Sumida-ku, Tokyo 130-0015
TEL +81-3-5819-8723
E-Mail: rocktool@mmc.co.jp

http://www.ryotec.co.jp/en/

Subsidiaries of MITSUBISHI MATERIALS CORPORATION

U.S.A. **MITSUBISHI MATERIALS U.S.A. CORPORATION**
105 Corporate Center Dr. Suite A, Mooresville,
NC 28117, U.S.A
TEL +1-980-312-3150 FAX +1-704-746-9595
E-Mail: mmusclt@mmus.com

Germany **MMC HARTMETALL GMBH**
Comeniusstr. 2,40670 Meerbusch, Germany
TEL +49-2159-9189-32 FAX +49-2159-9189-30079
E-Mail: rocktools@mmchg.de

Brazil **MMC METAL DO BRASIL LTDA.**
Rua Cincinato Braga, 340 13º andar.Bela Vista-
CEP 01333-010 São Paulo-SP., BRASIL
TEL +55-11-3262-5095 FAX +55-11-3285-4906
E-Mail: mmbr@mmbr.com.br

Mexico **MMC METAL DE MEXICO S.A. DE C.V.**
Av. La Canada No.16 Parque Industrial Bernardo Quintana
El marques, Queretaro.
TEL +52-442-221-6136 +52-442-221-6137
FAX +52-442-221-6134
E-Mail: gonzalez@mmcmex.com

Australia **MITSUBISHI MATERIALS TRADING CORPORATION PERTH BRANCH**
Suite 10, 137 Kewdale Road, Kewdale, WA 6105, Australia
TEL +61-8-6258-7200 FAX +61-8-6258-5614
E-Mail: ml-sales@mmtc.co.jp
Website: https://www.mmtc.co.jp/au/

South Korea **MITSUBISHI MATERIALS TRADING CORPORATION SEOUL BRANCH**
#1812 Samsung Cheil Bldg., 309, Teheran-ro,
Gangnam-gu, Seoul 06151, South Korea
TEL +82-2-3474-2331 FAX +82-2-527-2834
Email: mb-rocktool@mmtc.co.jp
Website: https://www.mmtc.co.jp/en/

Singapore **MITSUBISHI MATERIALS TRADING CORPORATION SINGAPORE BRANCH**
10 Anson Road, #32-09 International Plaza,
Singapore 079903
TEL +65-6221-7233 FAX +65-6325-4220
Email: mb-rocktool@mmtc.co.jp
Website: https://www.mmtc.co.jp/en/

China **MITSUBISHI MATERIALS (SHANGHAI) CORPORATION**
2101 Tower 1, Raffles City, 1133 Changning Road
Changning District, Shanghai, 200051, China
TEL :+86-(0)21-6235-0745 FAX :+86-(0)21-6235-0741
Inquiry form : http://www.mmc.sh.cn/contact-us/

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