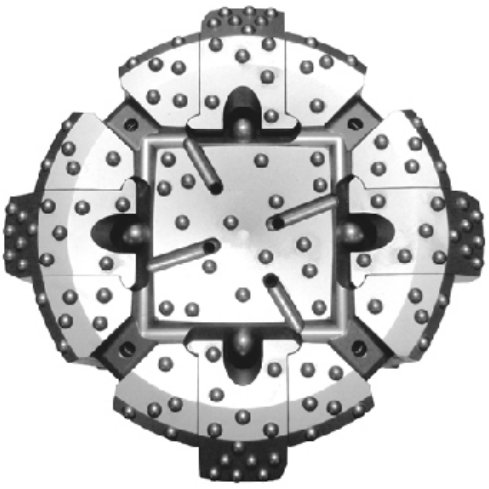
HAMMERS AND BITS

Super Jaws®

OPERATIONS MANUAL

Care & Maintenance Instructions



- **Do not discard this manual.**
- **Keep manual readily available for reference during operation or when servicing product.**
- **Before operation and maintenance, read and comprehend operations manual content.**

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Patents: 6,883,618 7,442,074 10,612,310 11,085,242 EP 3 803 032 B1 KR-101340351 EP-2029325 CN-101448608 BR-P10711711 AU2007254317 AU2007254317 WO2007/136658

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WARRANTIES AND REMEDIES

LIMITED WARRANTY

Numa warrants that the Product will be new and free from defects in material and workmanship under normal use as contemplated by this Contract for a period of six (6) months from the date of shipment.

Except for the foregoing warranty, Numa disclaims all warranties and representations wherever made, including warranties of merchantability, durability, length of service, or fitness for a particular purpose.

Any alteration or modification of the original product without the express written consent of Numa will void this warranty.

REMEDY

If, during such warranty period, Buyer promptly notifies Numa in writing of any defect and establishes that the above warranty is not met, Numa shall either repair or replace the Product or credit the customer, as it deems necessary to meet the warranty.

Such repair, replacement, or credit of Product shall constitute complete fulfillment of Numa's obligation under this warranty, and upon the expiration of the original warranty period, all of Numa's obligations hereunder shall terminate.

LIMITATION OF LIABILITY

Numa shall not be liable to Buyer whether in contract, in tort (including negligence and strict liability), under any warranty or otherwise, for any special, indirect, incidental or consequential loss or damage whatsoever, including (without limitation) loss arising from delay, cost or capital and loss of profits or revenues. The remedies set forth in this Contract are exclusive, and the total cumulative liability of Numa under this Contract or for any act or omission in connection therewith or related thereto, whether in contract, in tort (including negligence and strict liability), under any warranty or otherwise, is limited to the price paid by Buyer for the Product.

The *WARNINGS, CAUTIONS* and *NOTES* used throughout the text of this instruction book are defined as follows:

WARNING	A specific procedure or practice that must be strictly followed, or a specific condition that must be met, to prevent possible bodily harm.
CAUTION	A specific procedure or practice that must be strictly followed, or a specific condition that must be met, to prevent damage to the equipment.
NOTE	Important supplemental information.

Section I - Description

Description

The Super Jaws® Bit is an integral part of an overburden drilling system used in applications where the drilled hole may collapse when drilling with conventional methods. Super Jaws Bits allow for the advancement of a casing system through unconsolidated formations, using a DHD Hammer, and the effortless withdrawal of the Bit after the casing has been set. Applications are typically variable formations with soft layers overlying or interspersed with hard materials such as boulders or cobbles.

Super Jaws is designed to drill in all such formations by carrying the casing through the variable layers to target depth, after which the complete tool is retracted, leaving the casing in the hole permanently, or until the next operation is carried out.

The Super Jaws Bit is the most technologically advanced overburden bit design made for simultaneously installing casing from 5-1/2” (140 mm) to 42” (1067 mm) and drilling in unconsolidated rock formations of boulders and loose strata. The Super Jaws Bit has become recognized around the world for its robust construction, ease of operation and overall efficiency and has been widely accepted in the drilling industry as the most efficient means of installing casing.

Central to the design of the Super Jaws Bits are replaceable jaws that extend out further than the casing while in the drilling position. During the drilling operation, the Bit drills a hole slightly larger than the casing diameter, and utilizing an internal drive shoe, allows the Bit to drill and advance the casing simultaneously. When the desired depth is reached the Hammer and Bit are simply lifted and the Wings move to center without reverse rotation. A significant cost savings benefit of the Super Jaws® Bit is that it does not require the use of expensive carbide tipped rings that remain down the hole when drilling is complete. When the drilling is completed, the Bit is retracted and withdrawn inside the casing pipe, with the casing being left in the drilled hole.

For the standard drilling methods using the Super Jaws Bit, the air Hammer and Bit will advance the casing during drilling. Thus special drill rigs or special devices for installing the casing are not required.

However, drilling and installing casing in deep hole applications may require telescoping and or the use of fluids to minimize skin friction on the outside of the casing. Please contact your Numa representative for further information.

Examples of Super Jaws Overburden Drilling System applications may be viewed on the internet at: www.numahammers.com

Section I - Description

Features

- **High Drilling Efficiency:**
  The design of the Super Jaws Bit enables the Guide Device to perform most of the drilling directly while the expanded Bit Wings perform the reaming. This minimizes loss of hammer energy and maintains a high drilling efficiency.

- **Concentric Drilling:**
  Since Super Jaws bits expand and retract concentrically, they will drill and maintain a round hole. Unlike eccentric overburden systems, which inherently drill misshapen holes, the Super Jaws system has no tendency to wander, or to produce an offset. This feature assures a straight, round hole, equivalent to that drilled with a conventional bit. This also means that a Super Jaws system does not have to drill as large an overcut as a comparative eccentric system, saving time, energy and money.

- **Easily Retractable:**
  The Super Jaws Bit Wings are retracted when the Bit body is lifted. This ensures that they can be easily retracted even in soft soil, without hammering, levering, or excessive pull back.

- **No Reverse Rotation Required:**
  Reverse rotation is not required for retracting Super Jaws. This eliminates concerns about disconnecting hammer parts or tool joints in the hole.

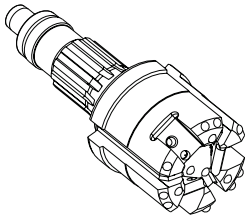
- **Smooth Discharge of Cuttings:**
  The Super Jaws Bit has a lower height and larger chip ways than many conventional overburden Bits, ensuring smooth discharge of cuttings and eliminating the regrinding of cuttings. The exhaust air discharge is located beneath and beside the Wings, to clean the pockets and reduce or eliminate material becoming trapped in the pockets.

- **Faster Penetration Rates:**
  The high mechanical strength of the Bit, concentric design, and the full face contact, enables Super Jaws Bits to maintain a higher penetration rate than any other overburden drilling system in the same formation.

Section I - Description

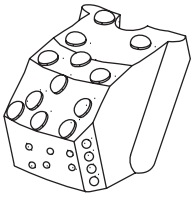
Functional Description

1. Guide Device



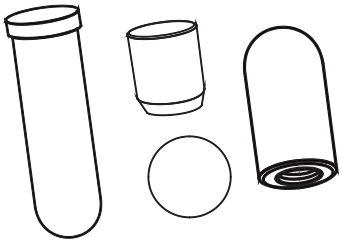
The Guide Device is the basic Bit body. It incorporates the integral Bit shank and exhaust tube. The head of the Guide Device acts as the main drilling portion of the Super Jaws Bit, drilling the hole diameter up to the internal size of the casing. It has pockets which contain the Wings, configured to allow these Wings to extend during drilling and to retract during withdrawal.

2. Wing



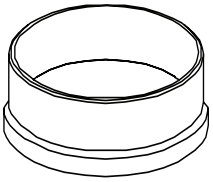
The Wings of a Super Jaws Bit are the extendable portions that move outward to cut a hole larger than the casing, and retract inwards to allow for the retracting of the Bit through the inside of the casing. They are contained in pockets in the Guide Device, and retained by one of several retention devices. Small Bits have two extendable Wings while a large Bit may have as many as five.

3. Retention Devices



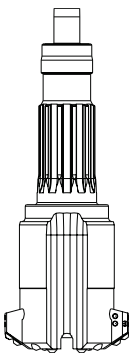
There are several types of retention devices used on Super Jaws Bits, depending on their size and configuration. Smaller sizes use a Retention Pin fitted to the bottom pocket face of the Guide Device. Larger sizes use a Retention Pin fitted through the Wing, loosely sliding in a corresponding groove in the Guide Device. On some variants the Wings are retained by the use of a Pin and Ball arrangement.

4. Drive Shoe



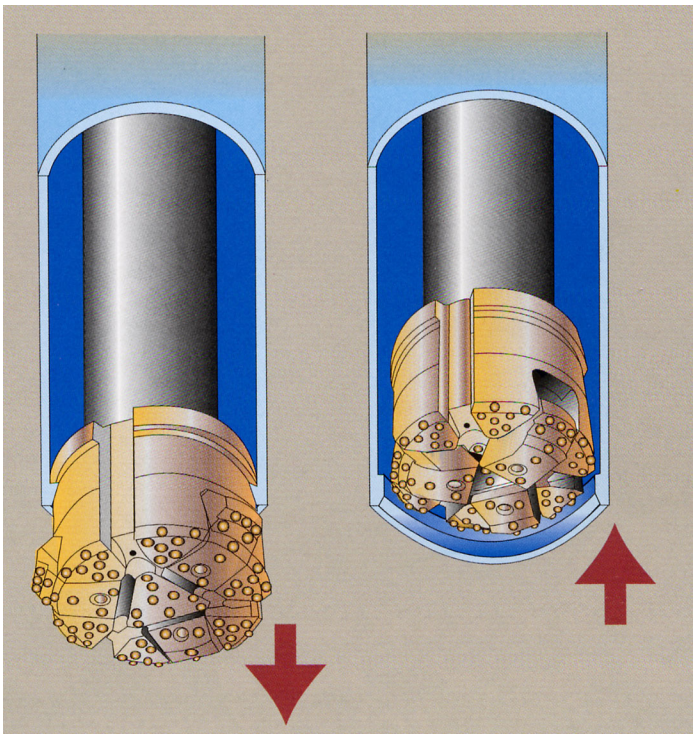
The Drive Shoe is attached to the bottom end of the casing by welding. It provides a shoulder that the lug shoulder of the Guide Device drives against to advance the casing in conjunction with the Bit. The strength and quality of the weld joint between the Drive Shoe and the casing is critical to maintaining this ability to advance the casing.

5. ND Systems

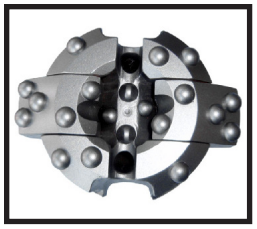


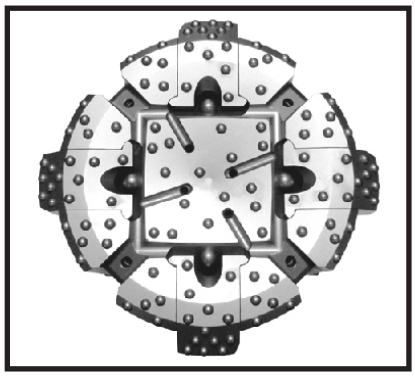
NUMA also offers Super Jaws ND systems. These bits do not have a drive shoulder and thus cannot pull down the casing with a drive shoe attached to the casing. Super Jaws ND bits must be used with dual rotary rigs, or with systems designed to use a duplex diverter.

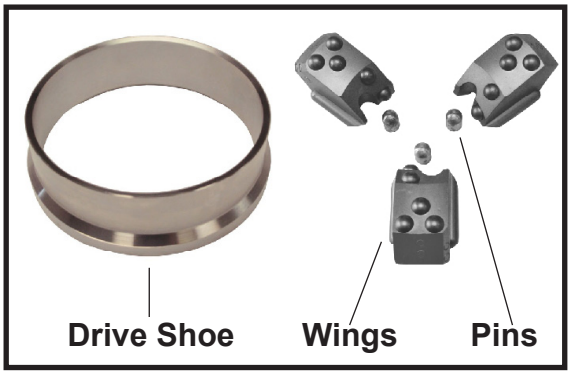
Section II - Parts Identification
Super Jaws Bits



Drilling Position ***Retract Position***







Section II - Parts Identification

Super Jaws Bit Specifications

Metric Measurement (millimeters)

System	Shank	No. of Wings	Bit Outer Diameter		Applicable Casing		Drive Shoe Inner Dia.
			Expanded	Retracted	Inner Dia.	Outer Dia.	
T115	340A	2	148.2	113.7	127.0	139.7	116.1
T140	350/QL50	2	185.5	139.6	155.2	168.3	142.0
T150	350/QL50 360/QL60	2	196.9	152.1	164.7	177.8	153.4
T165	360/QL60	2	213.1	162.8	183.0	193.7	167.0
T190	360/QL60	3	243.0	189.0	204.7	219.1	192.0
T215	380/QL80	3	263.0	211.0	225.9	244.5	215.0
T240	380/QL80	3	290.0	238.0	254.0	273.1	242.0
T280	N100	3	340.5	280.3	301.7	323.9	284.0
T315	N100/P125	3	374.2	313.0	337.0	355.6	317.0
T365	P125	4	430.2	363.3	387.4	406.4	367.0
T410	P125	4	477.9	410.3	435.0	457.2	414.0
T455	P125	3	530.2	452.2	482.6	508.0	459.0
T510	P180	4	580.5	503.0	533.4	558.8	512.0
T560	P180/QL200	4	632.9	554.0	584.2	609.6	562.0
T610	P240	4	686.6	603.0	635.0	660.4	613.0
T660	P240	4	730.9	654.0	685.8	711.2	662.0
T710	P240	4	784.3	704.0	736.6	762.0	711.2
T760	P240	4	835.0	755.0	787.4	812.8	762.0
T810	P240	4	887.3	806.0	838.2	863.6	813.0

All casing sizes are nominal.
Other sizes and shanks may be available upon request.

Section II - Parts Identification

Super Jaws Specifications

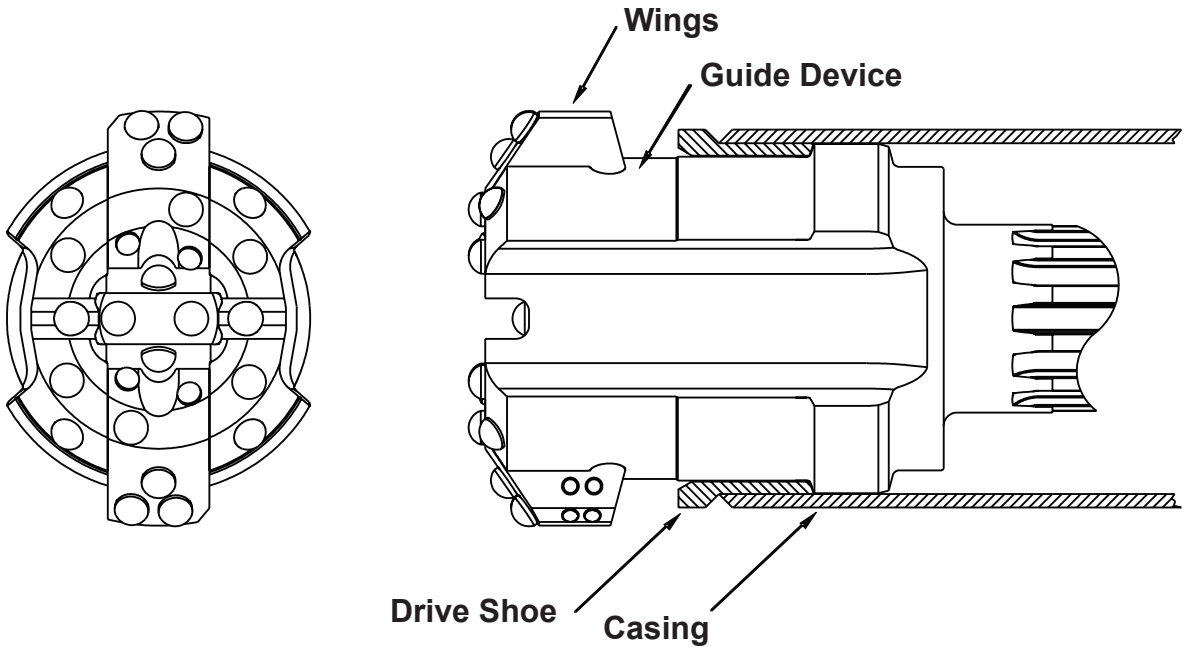
Imperial Measurement (inches)

System	Shank	No. of Wings	Bit Outer Diameter		Applicable Casing		Drive Shoe Inner Dia.
			Expanded	Retracted	Inner Dia.	Outer Dia.	
T115	340A	2	5.833	4.476	5.000	5.500	4.572
T140	350/QL50	2	7.304	5.496	6.110	6.625	5.591
T150	350/QL50 360/QL60	2	7.750	5.990	6.485	7.000	6.040
T165	360/QL60	2	8.388	6.410	7.204	7.625	6.575
T190	360/QL60	3	9.565	7.442	8.060	8.625	7.559
T215	380/QL80	3	10.353	8.308	8.894	9.625	8.465
T240	380/QL80	3	11.417	9.370	10.000	10.750	9.527
T280	N100	3	13.406	11.034	11.878	12.750	11.181
T315	N100/P125	3	14.733	12.324	13.268	14.000	12.480
T365	P125	4	16.936	14.302	15.250	16.000	14.449
T410	P125	4	18.814	16.152	17.125	18.000	16.300
T455	P125	3	20.873	17.804	19.000	20.000	18.071
T510	P180	4	22.856	19.804	21.000	22.000	20.158
T560	P180/QL200	4	24.919	21.811	23.000	24.000	22.126
T610	P240	4	27.032	23.742	25.000	26.000	24.133
T660	P240	4	28.774	25.748	27.000	28.000	26.063
T710	P240	4	30.878	27.718	29.000	30.000	28.000
T760	P240	4	32.875	29.726	31.000	32.000	30.000
T810	P240	4	34.934	31.732	33.000	34.000	32.008

All casing sizes are nominal.
Other sizes and shanks my be available upon request.

Section II - Sample Layouts

T150 Super Jaws Bit



T190 Super Jaws Bit

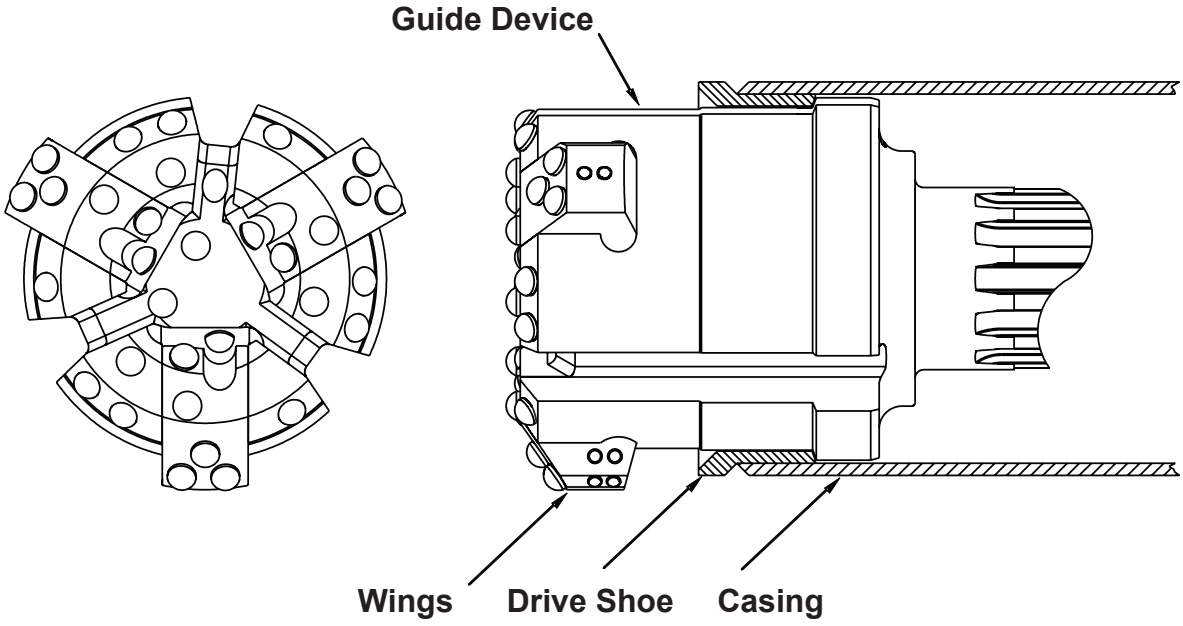
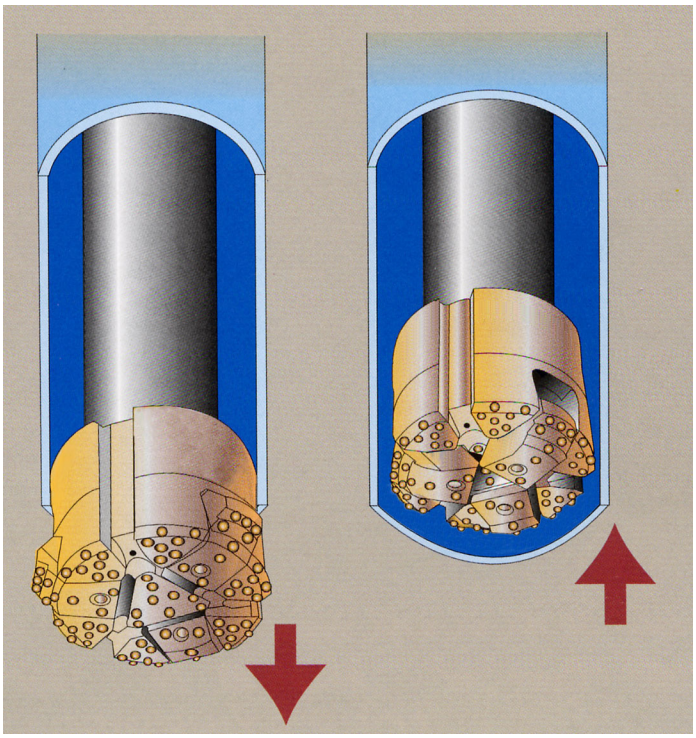
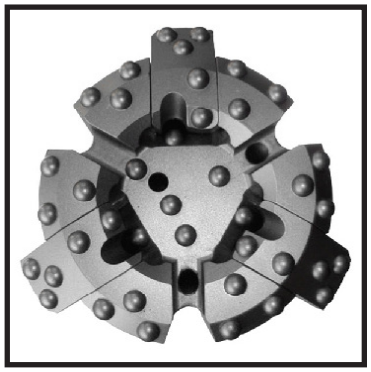


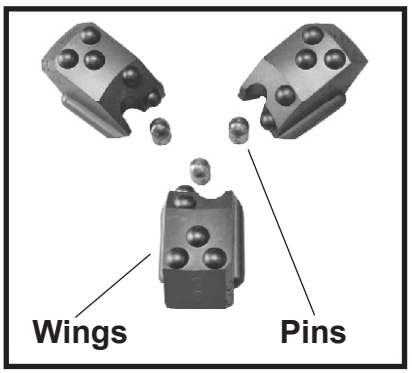
Figure 1A. Sample Layouts

Section II - Parts Identification
Super Jaws ND Bits



Drilling Position ***Retract Position***





Section II - Parts Identification

Super Jaws ND Specifications

Metric Measurement (millimeters)

System	Shank	No. of Wings	Bit Outer Diameter		Applicable Casing	
			Expanded	Retracted	Inner Dia.	Outer Dia.
T105 ND	3.5	2	139.9	104.9	108.0	130.2
T111 ND	340A	2	148.6	111.1	113.0	133.4
T115 ND	340A	2	152.7	112.8	114.3	139.7
T117 ND	340A	2	152.9	116.6	118.6	139.7
T130 ND	340A 350/QL50	2	162.9	124.5	127.0	152.4
T136 ND	350/QL50	2	170.2	133.4	135.9	158.8
T140 ND	350/QL50	2	185.5	141.0	142.9	168.3
T145 ND	350/QL50	2	193.7	146.1	148.3	177.8
T150 ND	350/QL50 360/QL60	2	196.9	149.4	152.4	177.8
T165 ND	QL50/260/QL60	2	213.0	165.1	168.3	193.7
T190 ND	360/QL60	3	243.0	191.0	193.7	219.1
T215 ND	380/QL80	3	263.0	211.0	217.6	244.5
T240 ND	380/QL80	3	289.2	240.0	242.8	273.1
T265 ND	N100	3	315.0	266.7	272.2	301.6
T292 ND	N100	3	351.0	292.1	295.3	323.9
T302 ND	N100	3	361.3	302.0	308.0	323.9
T310 ND	N100	3	368.7	310.0	339.7	339.7
T385 ND	P125/QL120	4	449.6	382.4	390.5	406.4
T432 ND	P125/QL120	4	499.5	432.0	438.2	457.2
T470 ND	P125/P180/ QL120	4	546.9	469.9	476.3	508.0
T530 ND	P180/QL200	4	612.4	533.4	539.8	558.8
T580 ND	P180/P240	4	658.6	577.9	590.6	609.6

All casing sizes are nominal.
Other sizes and shanks may be available upon request.

Section II - Parts Identification

Super Jaws ND Specifications

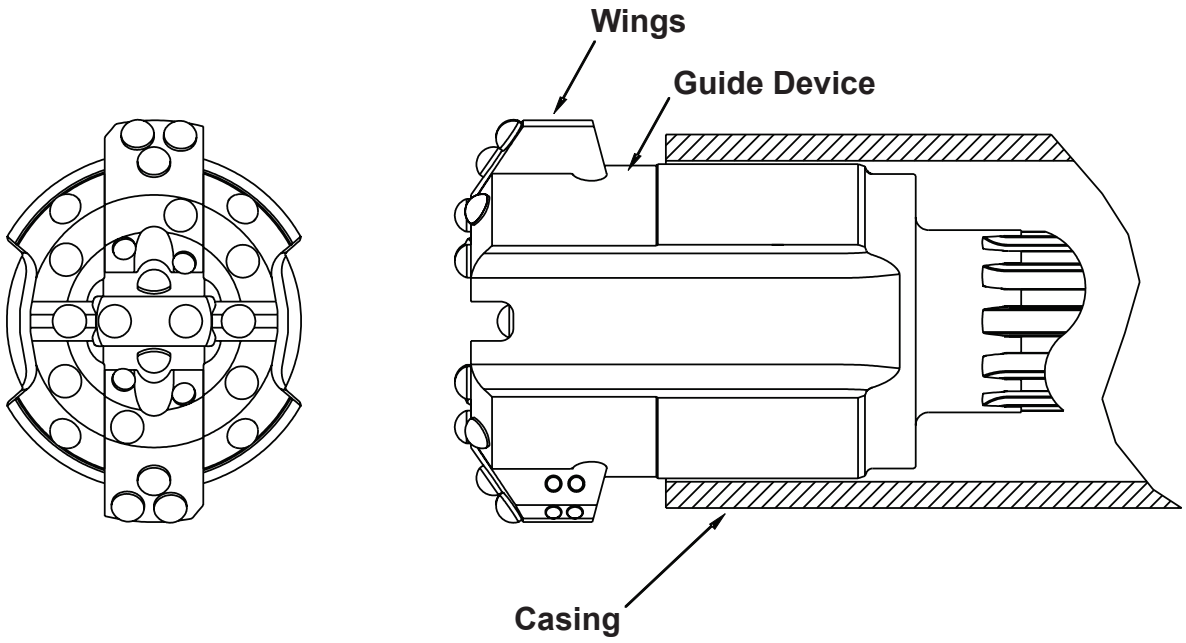
Imperial Measurement (inches)

System	Shank	No. of Wings	Bit Outer Diameter		Applicable Casing	
			Expanded	Retracted	Inner Dia.	Outer Dia.
T105 ND	3.5	2	5.509	4.130	4.250	5.125
T111 ND	340A	2	5.849	4.374	4.450	5.250
T115 ND	340A	2	6.010	4.440	4.500	5.500
T117 ND	340A	2	6.020	4.589	4.670	5.500
T130 ND	340A 350/QL50	2	6.414	4.900	5.000	6.000
T136 ND	350/QL50	2	6.699	5.250	5.350	6.250
T140 ND	350/QL50	2	7.304	5.551	5.625	6.625
T145 ND	350/QL50	2	7.625	5.750	5.840	7.000
T150 ND	350/QL50 360/QL60	2	7.750	5.880	6.000	7.000
T165 ND	QL50/360/QL60	2	8.385	6.500	6.625	7.625
T190 ND	360/QL60	3	9.567	7.520	7.625	8.625
T215 ND	380/QL80	3	10.354	8.307	8.565	9.625
T240 ND	380/QL80	3	11.385	9.449	9.560	10.750
T265 ND	N100	3	12.400	10.500	10.715	11.875
T292 ND	N100	3	13.819	11.500	11.625	12.750
T302 ND	N100	3	14.226	11.890	12.125	12.750
T310 ND	N100	3	14.517	12.205	13.375	13.375
T385 ND	P125/QL120	4	17.699	15.056	15.375	16.000
T432 ND	P125/QL120	4	19.665	17.008	17.250	18.000
T470 ND	P125/P180/ QL120	4	21.533	18.500	18.750	20.000
T530 ND	P180/QL200	4	24.112	21.000	21.250	22.000
T580 ND	P180/P240	4	25.931	22.750	23.250	24.000

All casing sizes are nominal.
Other sizes and shanks may be available upon request.

Section II - Sample Layouts

T150 ND Super Jaws Bit



T190 ND Super Jaws Bit

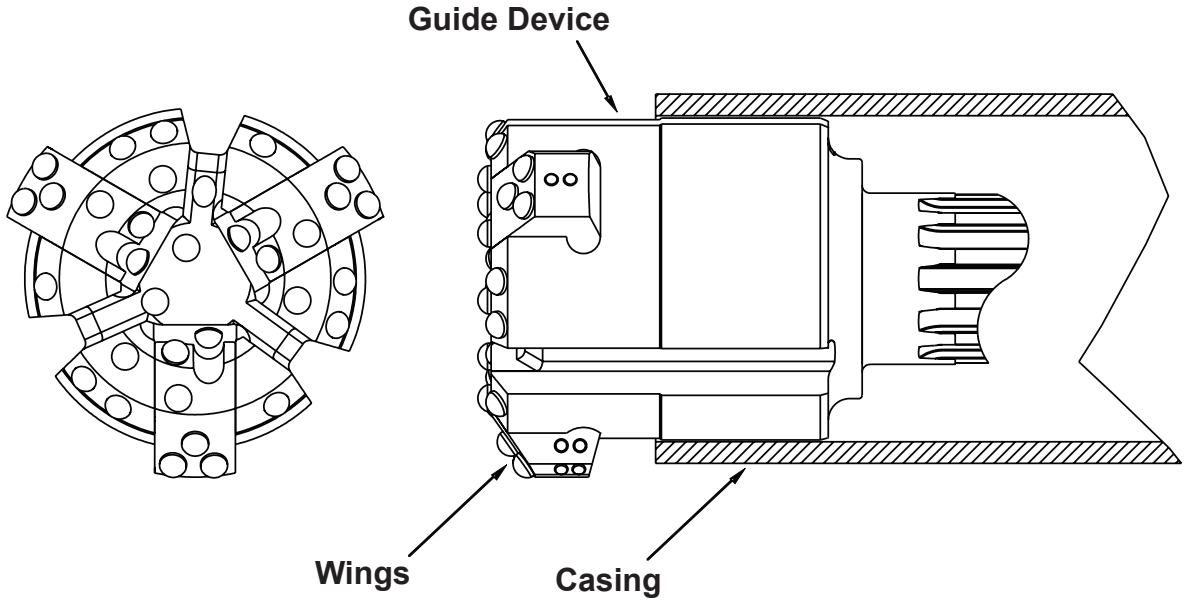


Figure 1B. Sample Layouts

Section III - Maintenance

Disassembly

The Wings in Super Jaws Bits may be disassembled from the Guide Device, either for repair or replacement. The disassembly process is dependant upon the type of retention device used in the particular Bit. There are three basic retention types.

Standard sized Super Jaws Bits use a Retention Pin fitted to the bottom pocket face of the Guide Device.

Please reference our Super Jaws Wing Replacement video on YouTube for additional information. (https://www.youtube.com/watch?v=Kpm49Dk6Qno)

Wing Disassembly for Standard Super Jaws Bits

1. Find the steel Pins located toward the center of the Bit on the inclined bottom face of the milled pocket in Guide Device. These Pins keep the Wings from falling out when they are in the retracted position. Using a hand held grinder with a grinding stone, or cut-off wheel, grind the dome down flat. **(Figure 2)**. (In many Bits, the Pin will already have a center hole in it, which is exposed by grinding off the dome of the Pin. If this is the case proceed to step #3.)

2. On smaller sized Super Jaws, use a hand held drill and drill as large a tap drill hole as possible in the center of the Pin. Thread the hole, with the appropriate sized tap. See Appendix A on page 30 for proper thread specifications depending on bit model.

3. Obtain a bolt with the same thread as tapped, approximately twice the length of the Pin. Screw the bolt into the threaded hole in the Pin. When the bolt contacts the bottom of the hole, continue to thread it inwards, jacking out the Pin. **(Figure 3)**

Alternatively

4. Using a hollow slide arm (slide hammer), screw a threaded rod into the Pin. Screw a nut on to the top end of the threaded rod, and pull out the Pin, using the hollow slide as a reverse impact device. In some cases, it may be easier to simply drill out the Pin, to a diameter as close to the Pin diameter as possible without touching the inside of the hole itself. The remaining portions of the Pin can then be pried carefully out of the hole.

> **NOTE:** Care must be taken while removing the Pins, to prevent damage to the hole itself. Damage to this hole could cause the replacement Pins to fit loosely (or not at all), when the Bit is reassembled.

5. Slide the Wings out of the Bit body. In many cases it may be easier to cut or grind the dome of the Retention Pin off completely level with the face of the Guide Device pocket.

Section III - Maintenance

This will allow the removal of the Wings, without the complete removal of the Pins, and allow easier access to the remainder of these Pins for their subsequent removal.

NOTE: Always use a new Pin (provided with spare Wing Set), when reconditioning or replacing the Wings. Be sure to install Pin **after** new, or reconditioned Wings are installed in the Bit.

Smaller Super Jaws Wings (Retention Pin in Guide Device)

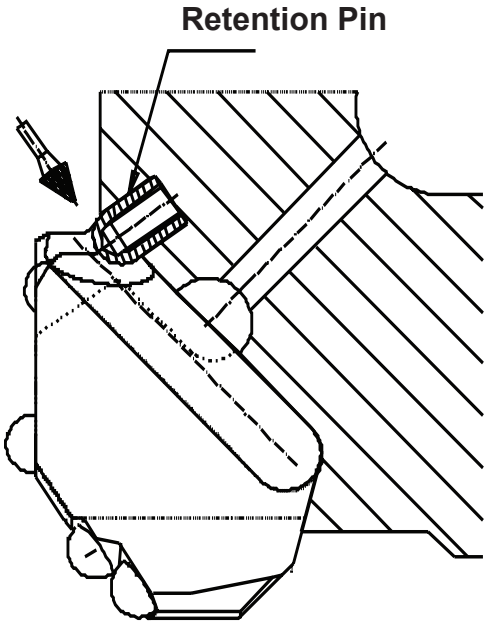


Figure 2. Cut off dome of Retention Pin

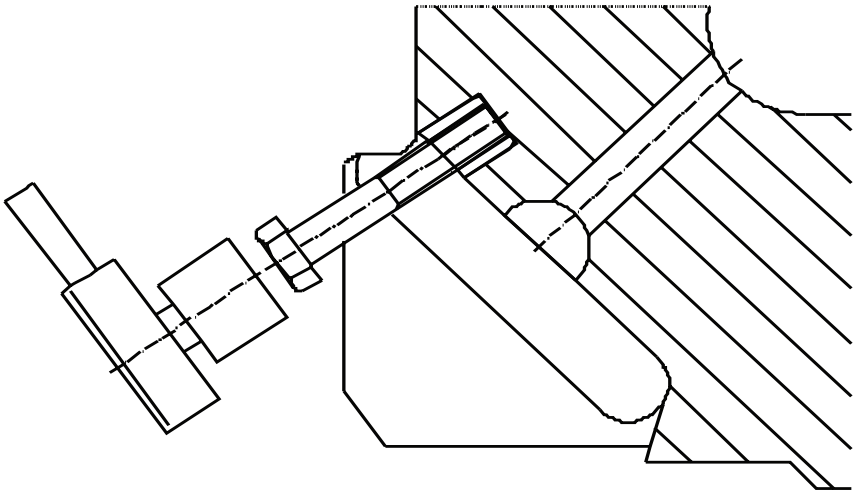


Figure 3. Jacking Pin out of Guide Device

Section III - Maintenance

Some Super Jaws use a Retention Pin fitted to the Wing, which protrudes into a loose fitting groove in the bottom face of the pocket in the Guide Device.

Wing Disassembly for Super Jaws Bits with Retention Pin in Wings

1. Locate the center of the Retention Pin in the top of each Wing. There will either be a plastic plug in a threaded hole.

2. Simply unscrew the plastic plug to expose the threaded hole. Screw a threaded rod of appropriate length into the threaded hole in the Pin. Using either a slide hammer or a hollow hydraulic cylinder pull the Retention Pin out of the Wing. On some bits, NUMA offers a custom designed pulling system, that includes a fixture pad, threaded rod and accessories, hollow hydraulic cylinder and pump. **(Figure 4)** Contact your NUMA representative or distributor for more information.

3. Using a hollow piston arm (slide hammer), screw a threaded rod into the Pin. Screw a nut on to the top end of the threaded rod, and pull out the Pin, using the hollow piston as a reverse impact device. **(Figure 5)**

4. Slide Wings out of the Bit body

Wing Disassembly for Super Jaws Bits with Pin and Ball Retention

1. Wing removal for this style Bit is the same as above (for Retention Pin in Wings). **(Figure 6)** The only difference is that instead of a one piece solid Pin, a shorter Pin and contiguous Ball is used. The Pin is fitted to the Wing and the Ball is located half in a counterbore beneath the Pin, and half in a groove in the Guide Device. **(Figure 7)**

2. Once the Pins have been removed from the Wings as described above, the Balls can be fully retracted into a counterbore in the Wings, allowing for Wing removal.

Section III - Maintenance

Super Jaws Wings with Retention Pin in Wing

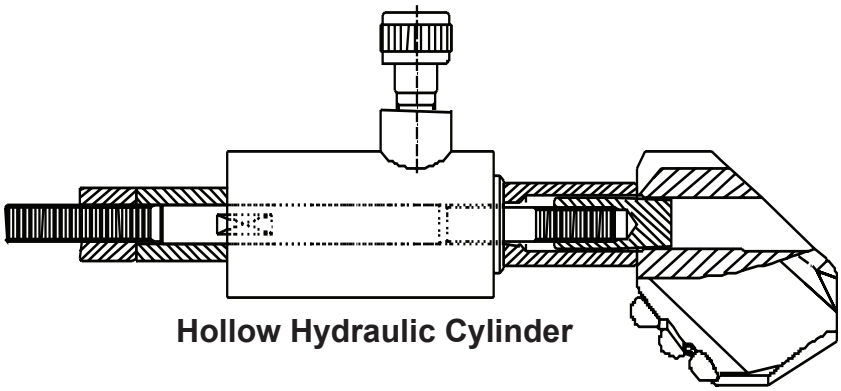


Figure 4. Retracting Pins with Hollow Hydraulic Cylinder

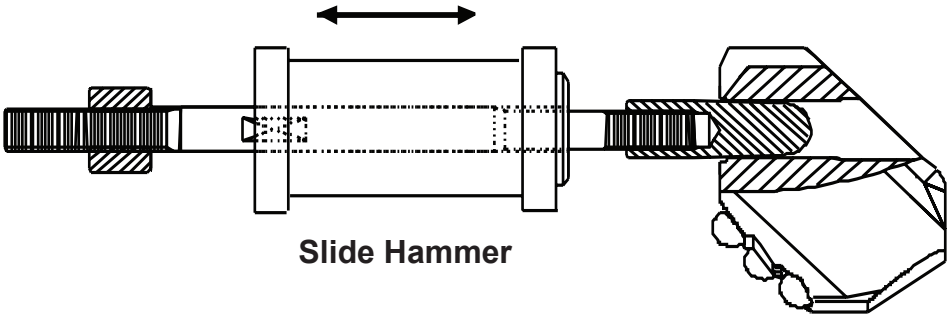
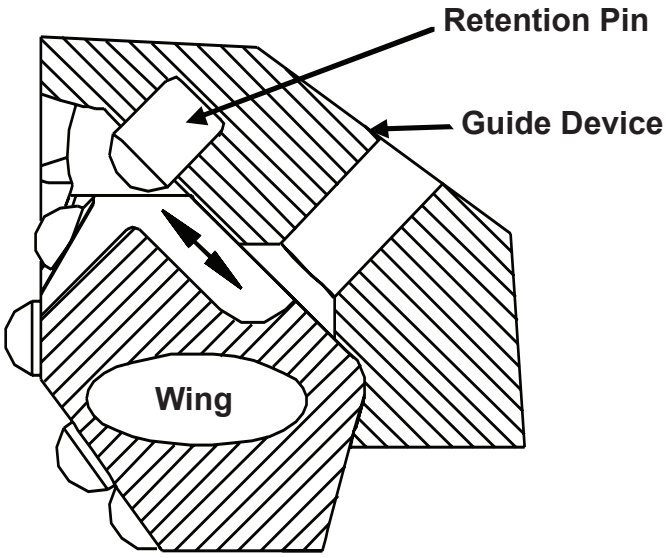


Figure 5. Retracting Pins with Slide Hammer

Section III - Maintenance

Standard Wing Retention System



Solid Pin Retention System

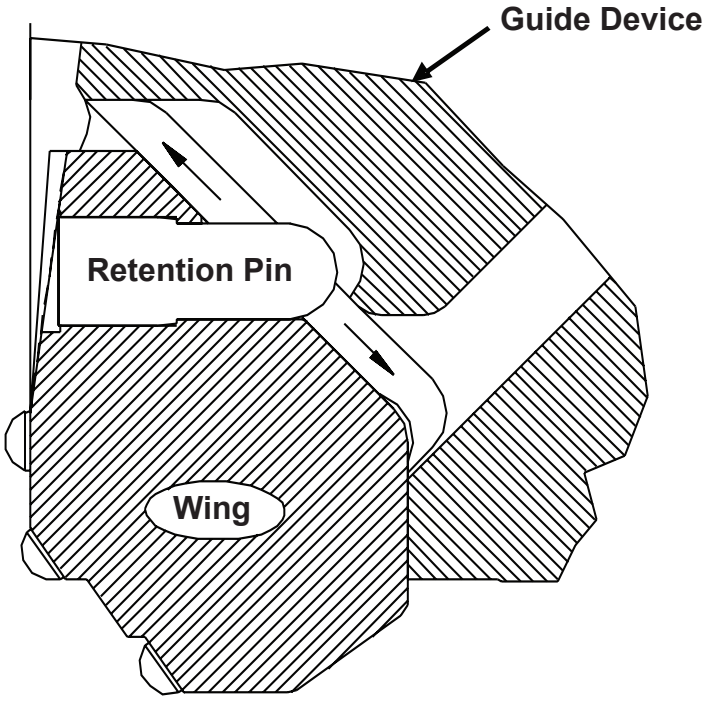


Figure 6. Retention Pin Types

Section III - Maintenance

Ball and Pin Retention System

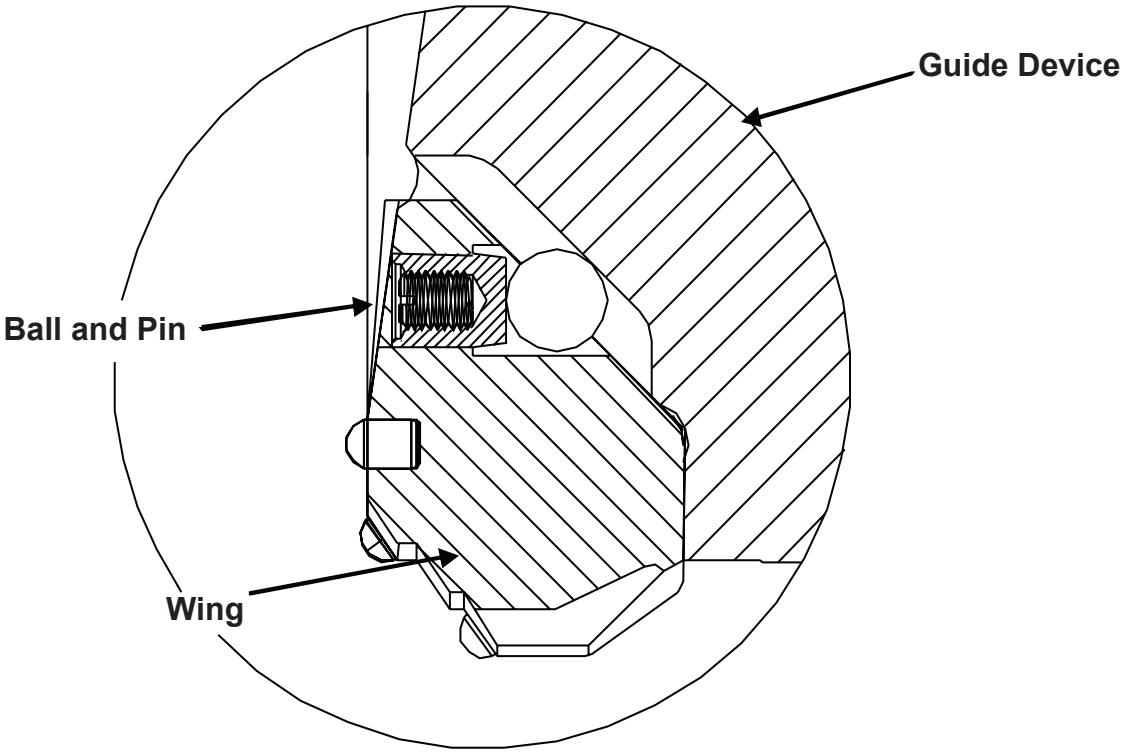


Figure 7. Ball and Pin Retention

Section III - Maintenance

Inspection

Wings

Examination of the Bit Wings will indicate if they can be refurbished. If the body wash is not excessive, but there is considerable play when installed in the Wing pocket, it may be possible to build up the sliding surfaces on the Wings and re-use them. In some cases, minor body wash on the leading edge of the Wings can be repaired.

Consult your Numa representative or distributor for welding specifications.

If the Bit has encountered rubble in the hole containing foreign material or objects, and the only damage to the Wings is broken buttons, consult your Numa representative or distributor for the cost of factory replacement of broken buttons.

Inspect the Wings for cracks around the Pin or button holes. If cracks exist, replace the Wing.

Bit Body

Inspect the shank interface with the Bit shoulder. If drilling with large quantities of water, cavitation can occur at the interface. If this exists, remove all sharp edges with a deburring tool, or grinding stone.

Inspect the striking face for indentations. If deep indentations appear, the striking face may need to be faced off to remove them. A like amount from the top of the Bit drive splines and the Bit shoulder may also have to be removed to restore the original dimensional relationship. Consult you Numa representative or distributor for the appropriate course of action.

Drive shoulder - if the Drive Shoe drive shoulder has progressed almost to the upper surface, after very extended use, it may be economical to restore the drive shoulder if the condition of the rest of the Bit justifies this work. Consult your Numa representative or distributor for the appropriate course of action.

Bit Face - If some buttons are broken but the Bit is otherwise in good condition, Numa provides a factory button replacement service.

Drive Shoe

If the casing is being pulled from the hole and reused, the Drive Shoe should be inspected after each hole for any evidence of peening over at the drive shoulder lip. Failure to monitor the drive shoulder condition could ultimately cause the Bit to bind in the Drive Shoe, thus

Section III - Maintenance

Inspection

preventing withdrawal of the tooling when the casing is at full depth. If peening over is present, this should be ground out using a small angle grinder, which takes only minutes to rectify.

Wing Body Wear

When the Wing wear approaches the condition of imminent loss, the Wing should be replaced.

Over time the leading edge of the Wings will wear to the extent that gage buttons will commence to fall out or fail through shear, and drilling performance will decrease. A rise in torque may also occur.

When the wear noticeably affects performance, the Wings should be replaced.

Allowable Wing play

As shown below, allow for play between the hammered plane and the Wing when the Wing is retracted and expanded as far as it will go in the direction of F. Then measure the play **L** with a scale. If the play L exceeds 5/16” (8 mm), replace the wing.

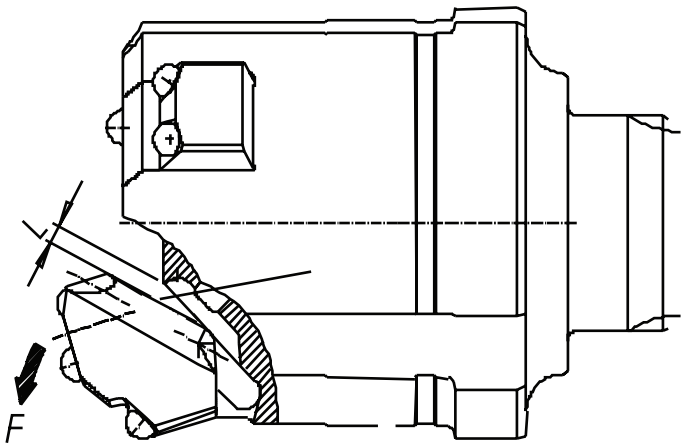


Figure 8. Allowable Wing Play

Section III - Maintenance

Button Maintenance

Bit Sharpening

In abrasive drilling conditions, the carbide buttons must be re-sharpened on a regular basis. This is particularly important for the gage buttons on the Wings, to avoid premature failure. When the flats on the gage buttons become a maximum of 1/8” (3mm) wide, or the button protrudes from the bit body by more than half of its diameter, it is time to re-sharpen.

A hand held wet grinder using a combination-grinding pin (or cup) will restore the button to the original profile quickly and at the same time remove body metal surrounding the button.

Clean and Lubricate

Prior to beginning the assembly process, the entire Super Jaws Bit should be thoroughly cleaned. Mating surfaces such as; Wing pockets, Wing sides, and Retention Pins, should be lightly lubricated with an appropriate grease or oil to facilitate easy assembly.

The entire Bit may be treated with light oil to prevent corrosion. This is especially true if the Bit is to be stored for any length of time.

Bit Assembly

Slide the new or refurbished Wings into the Guide Device body from the face side, lying them against the pocket face, and sliding them down and outwards into the pockets.

Standard Super Jaws Bits (Retention Pin in Guide Device)

With the dome side of the new Pin facing upwards, place the Pin into the groove supplied in the back face of the assembled Wing, and start it into the appropriate hole. Using a drift and a small hammer, tap the Pin into the hole. Keep the Pin as straight as possible during the insertion.

Super Jaws Bits with Retention Pin in Wings

With the Wings in place, insert the domed end of the solid Retention Pins into the hole in the Wings. Once the Pins have been started straight with the hole, hammer the Pins into place until they seat against the face in the counterbore. Large Retention Pins in Large Super Jaws, have considerable press fit. These Pins require significant force to seat them properly. The Pins should be lubricated with an appropriate grease or oil to ease the assembly. **(Figure 6)**

Section III - Maintenance

Bit Assembly

Super Jaws Bits with Pin and Ball Retention

Push the Wing upwards toward the center of the Guide Device, until the Balls can be placed into the counterbores in the bottom of the Wings. With the Balls in place, allow the Wings to fall back to their cutting position, and assemble the Pins from the top of the Wing as described in the step above. **(Figure 7)**

Section IV - Operation

Drill Operation

The Super Jaws Bit performs comparably with a conventional Bit of the same diameter. When the drilling parameters are set up correctly, in some respects drilling with a Super Jaws Bit is easier than drilling with a conventional Bit. The reason is the casing prevents hole collapse and jamming and the operator simply monitors cutting return and rotation.

In the case of a leader type rig with correct weight on Bit and uphole velocity, the operator releases the winch rope completely while drilling and may only need to lift to blow once or twice while drilling the hole to full depth. **(Figure 9)**

The one major difference between drilling with casing and drilling conventionally is that the operator cannot see the rotating drill pipe unless he leaves his seat, but he soon knows by sound, feel and casing advance if drilling is progressing normally.

Water Injection

If clay is present, it may be necessary to drill with water injection to avoid plugging the Bit. Clay may also entrap small drill cuttings and occasionally prevents easy retraction of the Bit Wings. Water flushes the tooling and allows the Hammer to run cooler. Even in the absence of clay, water injection improves the environment around the work site by removing the dust from drilling and keeping the tooling free from dirt build up.

ND Systems

Super Jaws ND systems are designed to operate without a drive shoe (page 3, #5). Subsequently ND systems must be operated on drilling rigs with dual rotary systems or another form of simultaneous casing advancement. As there is no drive shoe to prevent the Super Jaws bit from advancing beyond the lower end of the casing, it will do so unless the casing is advanced at the same rate as the bit. **This is to be avoided.** Advancing an overburden bit beyond the lower end of the casing, to the extent where the entire bit is completely beneath the casing, can prevent the bit from retracting back into the open end of the casing.

Rock Drill Oil

Always use a high quality rock drill oil. Consult the Care & Maintenance Instructions for your Hammer to determine which products are recommended. A positive displacement air line lubricator is recommended, particularly in large Hammer applications.

Down Hole Hammers

Numa Patriot® Hammers, Numa Champion® Hammers and Numa Challenger® Hammers are compatible with the Super Jaws Overburden Drill Bits.

Section IV - Operation

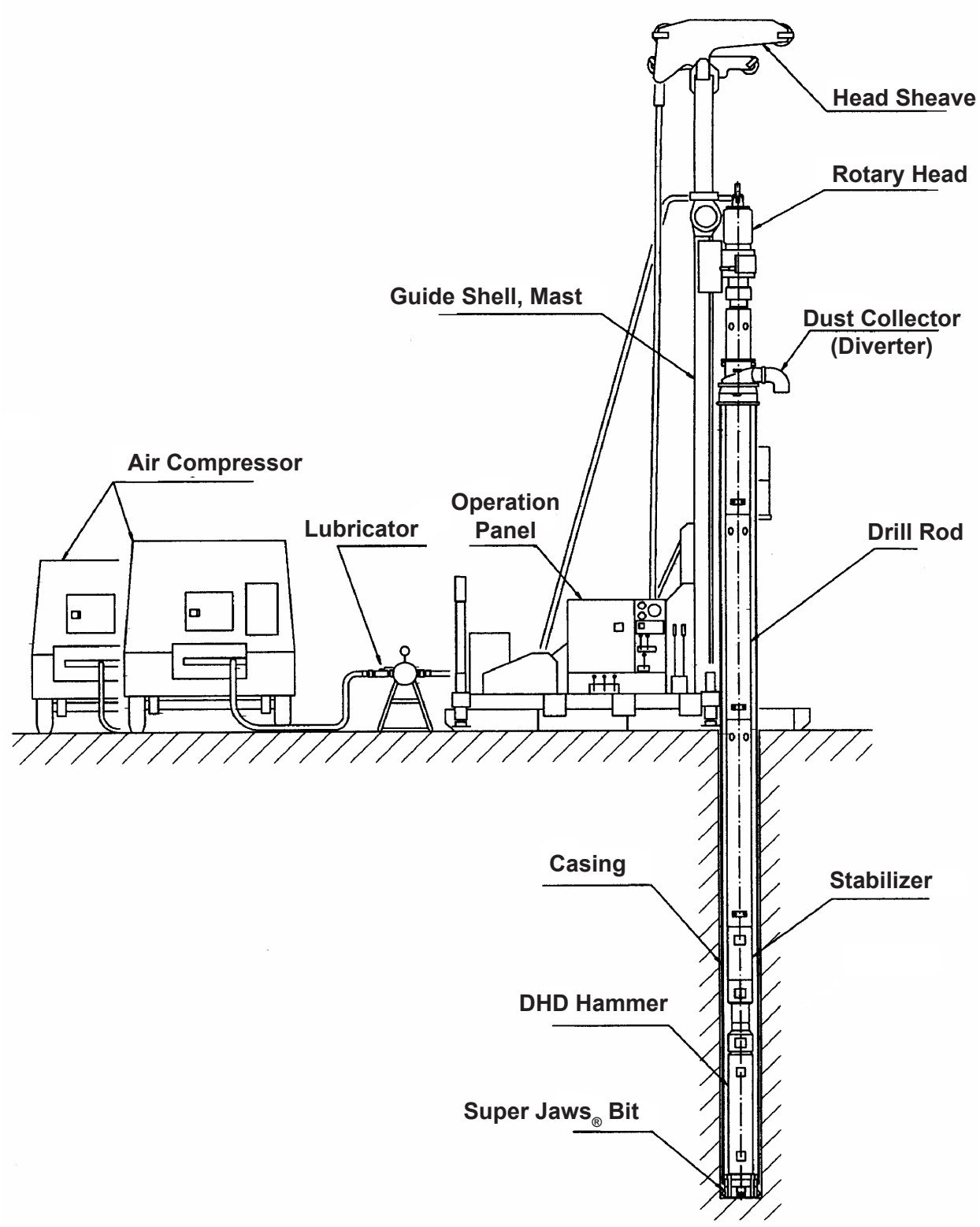


Figure 9. Typical Rig Setup

Section IV - Operation

It is recommended that when drilling through severely unconsolidated materials, the Hammer should not be operated at full pressure. The operating pressure of the Hammer can be controlled through the use of interchangeable chokes supplied with the Hammer. If in doubt, consult your Numa representative or distributor for assistance.

Refer to the appropriate Hammer Care and Maintenance Instructions Section IV, Air Consumption Charts to select the proper choke size for the air volume available.

Casing Types

Plain end casing is normally used for drilling with the Super Jaws Bit as the casing is butt welded rather than threaded and coupled. Couplings reduce the annular area and increase the friction on the outside making it difficult for the system to advance the casing.

Refer to the Super Jaws recommended casing specifications to select the proper casing diameter (see page 5).

A combined chamfer of 60 degrees on the casing ends is recommended for welding. Either one end flat and the mating end with a 60 degree chamfer or both ends with a 30 degree chamfer is recommended. **(Figures 10, 11, and 12)**

The casing should have sufficient tensile strength and be of low carbon steel for good weld strength.

Preparation

Welding of the Drive Shoe to the casing and subsequent casing weld joints is one of the most critical procedures in the installation of casings with the Super Jaws Overburden Drilling System. Poorly welded joints may separate and or fracture from impact vibration during the drilling process and may result in the loss of casing sections or tooling in the borehole.

Weld beads should not protrude excessively beyond the outside diameter of the casing. This will cause unnecessary friction on the outside of the casing, make advancement difficult and exert high stresses on the weld joints. Excessive weld should be ground off. If this becomes necessary, grinding should be done in a linear fashion rather than around the circumference. Grinding marks around the circumference can generate stress risers and weaken the weld joint.

Alignment of the casings is critical. If the casings are askew unnecessary friction will be applied to the outside of the casings and may apply bending stresses on the casing weld joints. It is recommended that a pipeline clamp is used for alignment and tack welding each section of subsequent casings.

Section IV - Operation

Before connecting the Hammer to the rotary drive, all hoses and pipe work should be flushed with compressed air from the compressor(s). As each drill pipe is added, it should be connected to the rotary drive and flushed in the same procedure, with a protector cap or cover over the lower drill pipe(s), before attaching to the bottom hole assembly. The importance of this procedure cannot be over emphasized. Entrapped dirt in hoses from manufacturing and handling, mill scale in drill pipe, cutting from machining, weld spatter etc. must be flushed from the system. Failure to do so can contaminate the Down Hole Hammer and initiate irreparable damage in a very short time.

Drive Shoes

The strength and quality of the welded joint between the Drive Shoe and the casing, determines how much force can successfully be applied to advance the casing. Several types of Drive Shoes are available for different Super Jaws systems, with the most common being the Shouldered type.

NOTE: Casing specifications (outside diameter and wall thickness) are required prior to the placement of order of a Super Jaws Bit. This will assure that the proper size has been selected.

Welding procedure for Drive Shoe Attachment

Drive shoes are to be attached to the casing end by welding. Depending on the size of the casing, several different types of Drive Shoes can be used. On casing sizes in excess of 12" (304 mm) diameter, or when the casing is to be driven deeper than 100 feet (30 m), and an inserted type of Drive Shoe is used, holes should be cut through the casing toward the inner end of the Drive Shoe and plug welded through to the Drive Shoe. These holes should be approximately 2" (50 mm) in diameter, equally spaced around the casing OD, and they should be fillet welded circumferentially. This is not necessary with externally mounted, butt welded Drive Shoes.

The Drive Shoe must be centralized inside the casing to allow for the pass through of the Bit, and to insure concentric operation. The Drive Shoe should either be a close fit to the ID of the casing, 0.040" (1 mm) maximum clearance, or the Drive Shoe may be split and clamped into the casing to fit tightly.

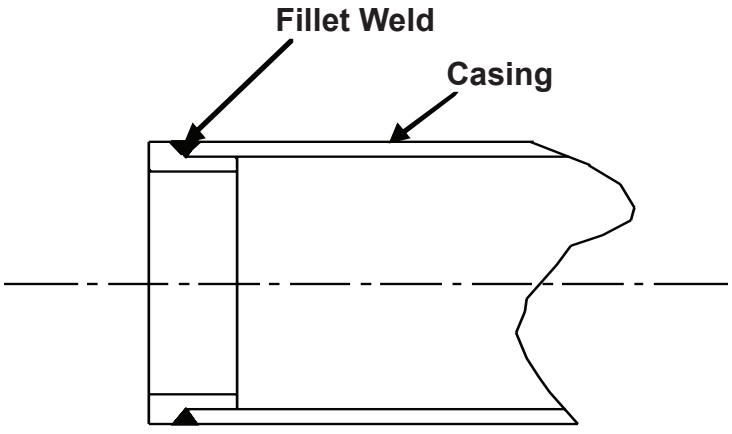


Figure 10. Shoulder Type, Drive Shoe Inserted, Fillet Weld

Section IV - Operation

Welding may be done by the MIG or SMAW methods. The Welding rod or wire should be equivalent to AWS E8018-C1 or E8018-C2. These are 80,000 psi materials with 2-1/2% to 4% Nickel for impact strength. The part to be welded should be preheated to 450 - 500 degrees F. (230 - 260 degrees C). This can be done with a torch and "temp sticks", or any reasonable temperature measurement method. The weld should be laid on in passes, until the appropriate thickness is obtained.

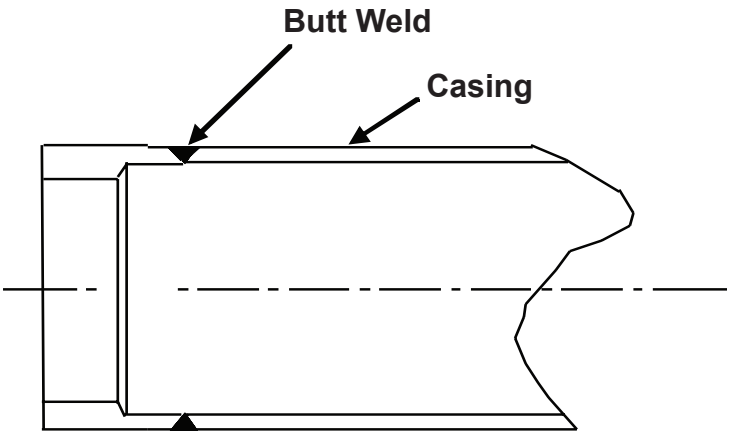


Figure 11. Shoulder Type Drive Shoe, External Butt Weld

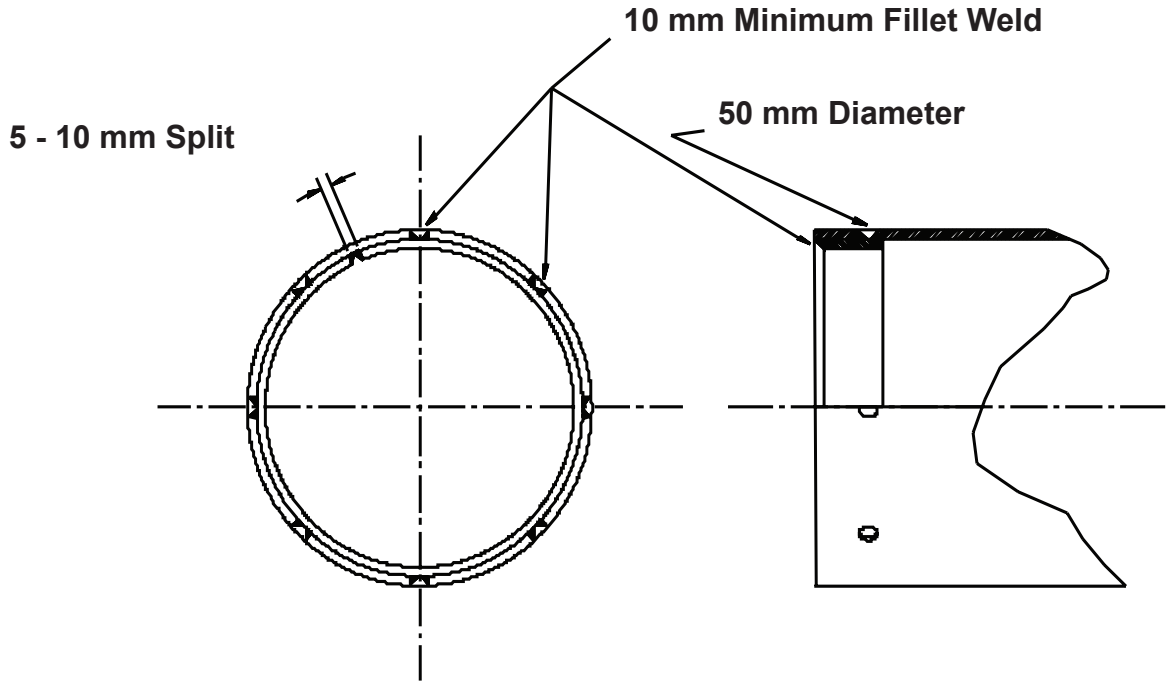


Figure 12. Straight Drive Shoe with Plug Welded Casing Holes

NOTE: When the welding is completed, the entire welded area and surrounding base material must be heated again to 450 - 500 degrees F (230 - 260 degrees C) to temper it. This eliminates metallurgical notches, untempered and untransformed byproducts. This tempering is critical to maintaining ductility and preventing cracking.

After the completion of the welding and tempering, any excess material on the ID of the Drive Shoe must be removed by hand grinding, so as not impede the Bit from passing through this diameter.

Section IV - Operation

Rotation Speed

Rotation speed has a direct effect on Bit life and overall performance. The main purpose of rotating a Down Hole Hammer and Bit is to index the carbide button inserts to fresh rock on every impact from the Hammer piston and to keep all of the threaded joints tightened. Slow rotation can result in the re-crushing of the rock, also known as regrinding, which results in rapid carbide wear. Excessive rotation speed will usually result in rapid gage carbide and Bit body wear.

> **NOTE:** Reverse rotation and impact without rotation may cause tool joints to become loose. Operating with loose tool joints may initiate damage or the possibility of lost tooling in the hole.

An operator must learn to have a feel for finding the proper rotation speed that will deliver optimum penetration without sacrificing Bit life. As a starting point an operator can use the following as a guideline:

RPM = 1/2 penetration rate per hour in feet
RPM = 1.6 X penetration rate per hour in meters

As an example, if the average penetration rate is 60 feet (18.3 m) per hour the RPM should be approximately 30.

> **NOTE:** This is only a guideline. Many factors need to be taken into account for proper rotation speed such as ground conditions, formation hardness, flushing, abrasiveness, etc.

Section IV - Operation

Drilling With The Super Jaws Overburden System

A starter rod / drill pipe may be used for ease of operation. The combined length of the first drill pipe, hammer, and Super Jaws Bit should be longer than the effective length of the first piece of casing, Drive Shoe and chip diverter assembly. This will expose the connections above the chip diverter for ease of disassembly and or making additional connections.

With the drill pipe attached to the Hammer and Super Jaws Bit, install the complete assembly into the first piece of casing. Care should be taken to be sure that the Wings pass through the Drive Shoe. The Wings may be taped in the retracted position to aid in this process if necessary. **(Figure 13)** Attach the chip diverter assembly to the top of the casing. Connect the complete assembly to the rotary drive system.

Lift the casing to expose the Wings of the Super Jaws Bit and simultaneously lower to the formation. Slight feed pressure may be required to make the Wings move to the extended / drill position. **If possible, apply friction to the casing to keep the Drive Shoe off the back side of the Wings.** Turn on the air and start rotating. Adjust feed pressure to start the drilling process. After drilling approximately 10' (3 meters) the formation usually creates enough friction on the casing to keep it off the back side of the Wings and mechanical friction should no longer be required.

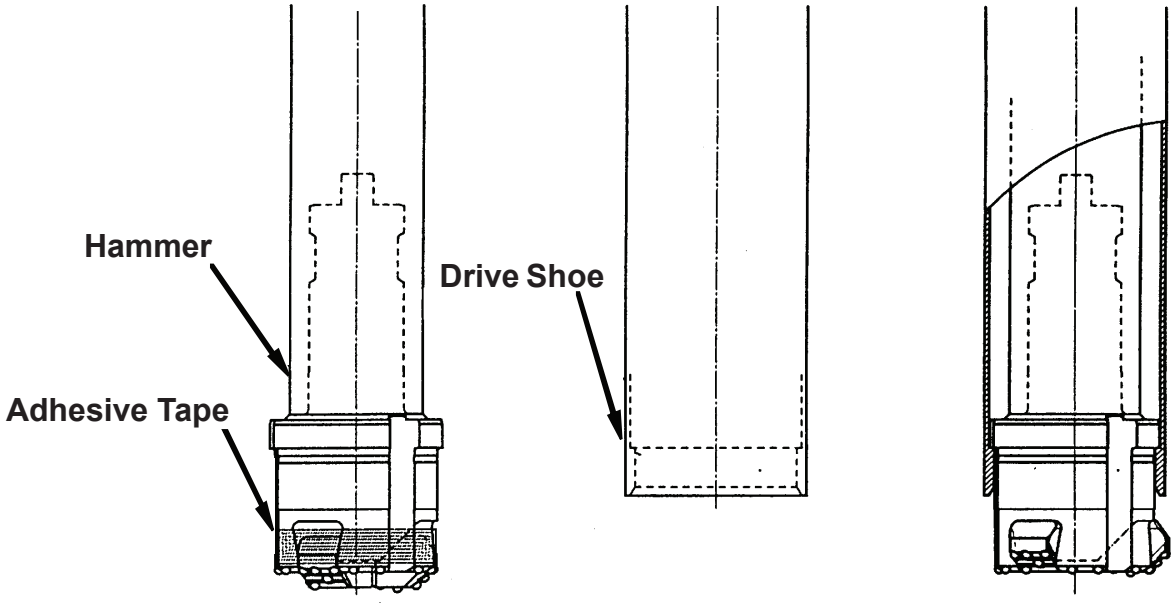


Figure 13. Insertion of Bit through Casing

Section IV - Operation

Throughout the drilling process, hole cleaning is more important than drilling speed. A slow and continuous feed will aid in an even flow of cuttings through the casing and diverter system.

> **NOTE:** Never operate the Hammer while the Wings are retracted into the Drive Shoe, otherwise the Drive Shoe or the Wings may be seriously damaged.

Drill to a position where the connections will be accessible for disassembly and the casing joint can be easily welded. Disconnect the drill pipe connection and remove the diverter.

A drill pipe must be inserted into the next piece of casing. The casing and drill pipe must be of the same length to continuously position the connections above the diverter. Install the diverter on the casing with the drill pipe sticking out the top. Both the drill pipe and casing must be lifted simultaneously, in position and attach the drill pipe to the rotary drive. (If operating in a vertical application several lifting devices are available for this purpose.) Align the casing joints. Several types of welding fixtures are available to aid with alignment. Use a level or straight edge to be sure all subsequent casings are aligned with the first installed. Repeat the procedure for subsequent lengths of casing as required.

When the desired depth is achieved remove the diverter and lift the drill string for removal. The Wings will automatically slide to the collapsed position for removal. If resistance occurs there may be material stuck in the Wing pocket not allowing the Wing to slide. Turn on air, flush with water and impact lightly on the bottom of the hole to remove the obstruction. **Do not reverse rotate.** Reverse rotation will **not** assist in collapsing the Wings.

Appendix A
Wing Retaining Pins Extraction Thread for Standard Super Jaws

System	No. of Wings	Wing Retaining Pins	
		Part Number	Extraction Thread
T150	2	012790	M10 x 1.5
T165	2	012790	M10 x 1.5
T190	3	012790	M10 x 1.5
T195	3	012790	M10 x 1.5
T215	3	012790	M10 x 1.5
T240	3	013101	M14 x 2
T280	3	013101	M14 x 2
T315	3	013101	M14 x 2
T365	4	013440	M20 x 2.5
T410	4	013440	M20 x 2.5
T455	3	013254	M24 x 3
T510	4	013254	M24 x 3
T560	4	013254	M24 x 3
T610	4	013254	M24 x 3
T660	4	013254	M24 x 3
T710	4	013254	M24 x 3
T760	4	013254	M24 x 3
T810	4	015053	M24 x 3
T860	4	015053	M24 x 3
T940	4	015053	M24 x 3

NOTE: T105 - T140 do not have a predrilled and threaded hole in the pin. A #7 Drill and 1/4" - 20 NC Tap can be used.

NOTES