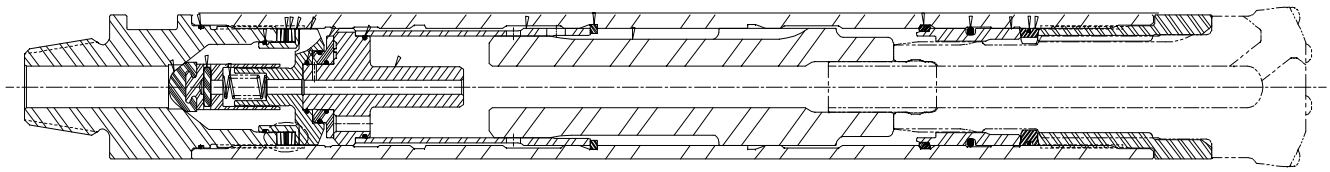
Technical Manual
For
Downhole Drills
Model: DHD CLASSIC Series

Read this technical manual before operating this equipment.

CPN 52331790

TM6217
REVISION 1

INTRODUCTION



The "DHD Classic" Series

INGERSOLL-RAND®

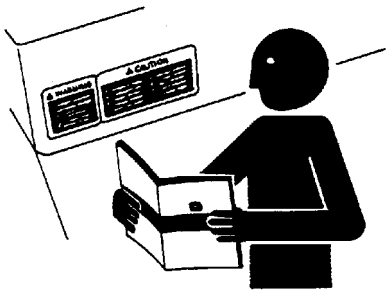
THIS PRODUCT IS COVERED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS OTHER PATENTS MAY BE PENDING.

PATENT	EXPIRATION
4,821,812	9/8/08
4,706,764	8/1/06
4,729,439	10/24/06
5,025,875	5/7/10
5,085,284	12/26/09
5,143,162	9/27/11
5,139,095	9/27/11
5,174,390	5/17/11
5,207,283	3/2/12
5,240,083	4/21/12
5,301,761	3/9/13
5,325,926	2/5/13
5,390,749	1/31/14
5,562,170	8/30/15
5,566,771	8/30/15
5,647,447	6/10/16
5,682,957	12/21/15
5,699,867	7/31/16
5,711,205	10/30/16
5.735.358	6/6/16

READ THIS MANUAL CAREFULLY to learn how to operate and service your DHD correctly. Failure to do so could result in personal injury or equipment damage. Consult your Atlas Copco Dealer if you do not understand the instructions in this manual or need additional information.

THIS MANUAL should be considered a permanent part of the DHD, and should remain with the DHD and available for reference at all times.

WARRANTY is provided as part of Atlas Copco's support program for customers who operate and maintain their equipment as described in this manual. The warranty is explained on the warranty page of this manual.



INTRODUCTION

MEASUREMENTS in this manual are given in both English and metric units, and are used to provide additional worldwide understanding. Metric units are shown between parentheses ”( )”. Use only correct replacement parts and fasteners.

The instructions, illustrations, and specifications in this manual are based on the latest information available at time of publication. Your DHD may have improvements and options not yet contained in this manual.

ABBREVIATIONS used throughout this manual.

acfm	Actual Cubic Feet per Minute
API	American Petroleum Institute
C	Celsius
dia.	Diameter
deg.	Degree
F	Fahrenheit
ft.	Feet
ft.-lb	Foot Pounds
gpm	Gallons per Minute
in.	Inches
kg	kilogram
l	Liter
lbs.	Pounds
lpm	Liters per Minute
m	Meter
mm	Millimeter
mm Hg	Millimeters of Mercury
m3/min	Cubic Meters per Minute
psi	Pounds per Square Inch
psig	Pounds per Square Inch Gauge Pressure
rpm	Revolutions per Minute
scfm	Standard Cubic Feet per Minute
⚠	Safety Alert Symbol

WARNING: This manual contains data SPECIFIC to DHD Classic Series Downhole Drills.

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WARNING: This manual contains data SPECIFIC to DHD Classic Series Downhole Drills.

SAFETY INFORMATION

BE AWARE OF SAFETY INFORMATION

This is the Safety-Alert symbol. When you see this symbol in this manual, be alert to the potential for personal injury.

Follow recommended precautions and safe operating practices.

SAFETY ALERT SYMBOL

UNDERSTAND SIGNAL WORDS

A signal word - DANGER, WARNING, or CAUTION - is used with the safety-alert symbol. DANGER identifies the most serious hazards.

DANGER, WARNING, or CAUTION safety labels are located near specific hazards.

NOTICE labels are for general information.

⚠ DANGER

(RED BACKGROUND)

DANGER IS USED TO INDICATE THE PRESENCE OF A HAZARD WHICH WILL CAUSE SEVERE PERSONAL INJURY OR DEATH IF THE WARNING IS IGNORED.

⚠ WARNING

(ORANGE BACKGROUND)

WARNING IS USED TO INDICATE THE PRESENCE OF A HAZARD WHICH CAN CAUSE SEVERE INJURY OR DEATH IF THE WARNING IS IGNORED.

⚠ CAUTION

(YELLOW BACKGROUND)

CAUTION IS USED TO INDICATE THE PRESENCE OF A HAZARD WHICH WILL OR CAN CAUSE PERSONAL INJURY, OR PROPERTY DAMAGE IF THE WARNING IS IGNORED.

NOTICE

(BLUE BACKGROUND)

Notice is used to notify people of installation, operation, or maintenance information which is important but not hazard related.

SAFETY

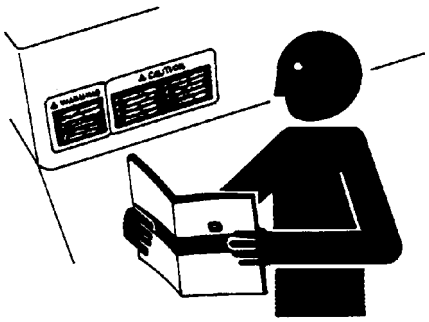
FOLLOW INSTRUCTIONS

Carefully read all safety messages in this manual and on your machine's safety labels. Keep safety labels in good condition. Replace all missing or damaged safety labels.

Replacement safety labels can be obtained at no cost from your local Ingersoll-Rand dealer or representative or by contacting the factory.

Learn how to operate the DHD and how to use the controls on the machine properly. Do not let anyone operate this DHD without proper instruction.

If you do not understand any part of this manual and need assistance, contact your local Ingersoll-Rand dealer.

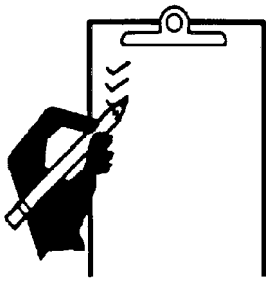


KEEP DHD IN GOOD WORKING CONDITION

Keep your DHD in proper working condition. Unauthorized modifications to the DHD may impair the function and/or safety and effect DHD life.

Make sure all safety devices, including shields are installed and functioning properly.

Visually inspect the DHD daily before using. Do not operate the DHD with loose, worn, or broken parts.



WEAR PROTECTIVE CLOTHING

Wear APPROVED safety equipment (safety shoes, safety glasses, hearing protection, hard hat, gloves, respirator, etc.) when operating or maintaining the DHD.

Wear close fitting clothing and confine long hair.

Operating equipment requires the full attention of the operator. Do not wear radio or music headphones while operating the DHD.

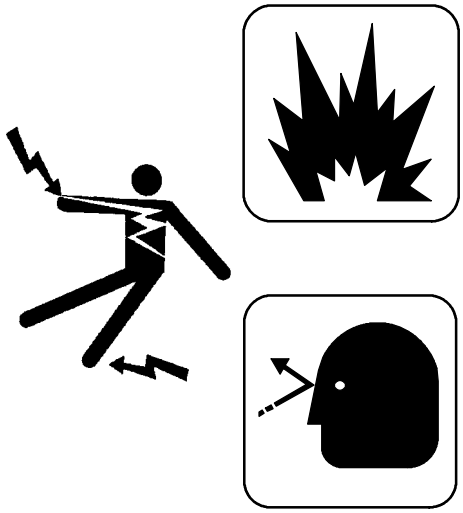
Safety Glasses | Hard Hat | Ear Protection

Electrically Insulated Gloves | Respirator | Electrically Insulated Boots

WARNING: This manual contains data SPECIFIC to DHD Classic Series Downhole Drills.

CHECK FOR UNDERGROUND UTILITY LINES

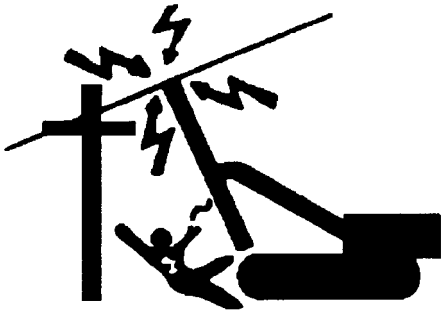
Before starting work, remember that contact with buried utilities may cause serious injury or death. Electric line contact may cause electric shock or electrocution. Gas line contact may rupture pipe causing explosion or fire. Fiber optic cables can blind you if you look into the laser light in them. Water line rupture may cause a flood and possible ground collapse. Before drilling, check with qualified sources to properly locate all buried utilities in and around drill path. Select a drill path that will not intersect buried utilities. Never launch a drill bit on a path toward electric, gas, or water lines until their location is known. If there is any doubt as to the location of the underground placement, have the utility company shut it off before starting any underground work and excavate to confirm its exact location.

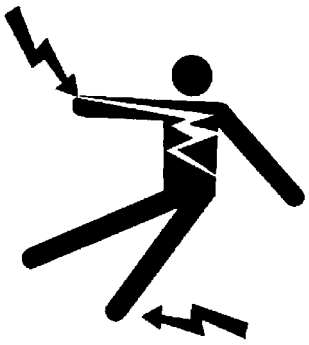


AVOID ELECTROCUTION. STAY AWAY.

Electrocution possible. Serious injury or death may result if the machine strikes an energized powerline. Take the following precautions to prevent electrocution. Also refer to the operating instructions.

- Always contact your local utility company when working in the vicinity of utilities.
- Locate underground utilities by qualified persons.
- Do not raise, lower, or move drill guide or boom near power lines.
- Always wear proper electrically insulated lineman's gloves and boots.
- Never touch metal parts on machine while standing on bare ground if machine comes in contact with a powerline.
- Always stay in cab during all drilling operations.
- Never step onto or off of a machine if an electric strike occurs.





LOOSE PARTS

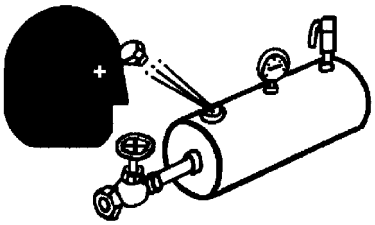
Make sure the drill rod to rotary head spindle joint is securely tightened before running the rotary head in reverse rotation. A loose connection could result in the drill rod unscrewing completely; a falling drill rod could strike personnel.

LIVE AIR

Never get under a downhole drill to examine the exhaust air; live air is dangerous. Also, part failure could cause the bit to fall out of the downhole drill which could result in bodily injury. A piece of cardboard can be inserted under the bit to check for the lubrication being carried through the downhole drill.

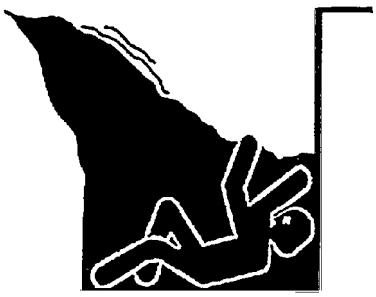
AIR PRESSURE

Make certain that the air line lubricator (or lubrication system) is capable of handling the higher air pressures associated with the downhole drill (up to 350 psi (24.13 bar) air pressure). When pressurized, an unsuitable lubricator could burst and possibly cause injury to personnel in the area.



DO NOT WORK IN TRENCH

Do not work in a trench with unstable sides which could cave in. Specific requirements for shoring or sloping trench walls are available from several sources including Federal and State O.S.H.A. offices, and appropriate governing agency. Be sure to contact suitable authorities for these requirements before working in a trench. Federal O.S.H.A. regulations can be obtained by contacting the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. State O.S.H.A. regulations are available at your local state O.S.H.A. office, and appropriate governing agency.



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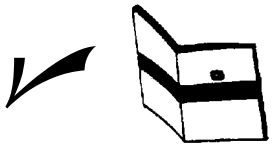
CHECK LAWS AND REGULATIONS

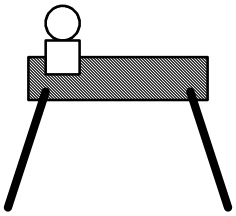
Know and obey all Federal, State, and Local, and appropriate governing agency laws and regulations that apply to your work situation.



PLACE WARNING BARRIERS AROUND WORK SITE

Set up orange cones around the work area with warning signs facing outward.

Place pedestrian and traffic barriers around the job site in accordance with Federal, State, and Local, and appropriate governing agency laws and regulations.



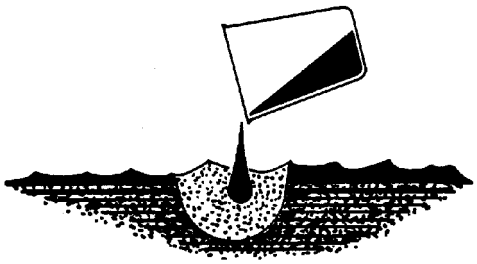
OBSERVE ENVIRONMENTAL PROTECTION REGULATIONS

Be mindful of the environment and ecology.

Before draining any fluids, find the correct way of disposing them.

Observe the relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters and batteries.

When using any solvent to clean parts, make sure that it is nonflammable, that it will not harm the skin, that it meets current O.S.H.A. standards, and appropriate governing agency, and that it is used in an area that is adequately ventilated.



WARNING: Failure to follow any of the above safety instructions or those that follow within this manual, could result in serious injury or death. This DHD is to be used only for those purposes for which it was intended as explained in this instruction manual.

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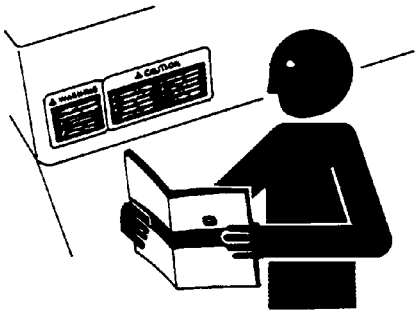
GENERAL INFORMATION

FOLLOW INSTRUCTIONS



Before operating this down-the-hole drill (DHD) for the first time, become familiar with the operation of the machine and the DHD.

Learn how to operate the machine and how to use the controls properly. Do not let anyone operate this machine without proper instruction.

If you do not understand any part of this manual and need assistance, contact your local Atlas Copco dealer.

DESCRIPTION

The DHD Classic line of down-the-hole drills is designed for use on drilling machines in conjunction with a top head or kelly drive mounting. The mounting must be capable of supplying sufficient hold down, hold back, rpm, torque, hammer lubrication, air pressure, and air volume.

DHDs achieve high productivity in hard rock applications by adding percussion to the drilling process. Rotary drilling methods use the combination of raw weight and rotation to chip and carve rock from a hole. The rotary method works fine in soft formations where adequate weight and stress can be applied to the rock to initiate fracture and chipping. However, in harder rock the rotary method cannot supply sufficient load on the bit inserts to crack the rock and produce a chip. Percussion drills overcome the rotary bit load limitation by producing a very high load during impact of the hammer. This load is sufficient to drive the cutting inserts into the rock to produce chips.

DHDs are recommended for practically any hard rock application. Depending on the size downhole drill being used, they are suitable for drilling water wells, primary blast holes in quarries, open pit mining, coal stripping operations, oil and gas exploration, and construction jobs where large volume rock excavation is required.

DHDs operate by using the position of a piston to direct supply and exhaust air to and from drive and return volumes. The drive volume ”drives” the piston toward impact and the return volume ”returns” the piston in preparation for another impact stroke.

The DHD cycle utilizes a stepped piston design that provides air pressure throughout the piston cycle. This results in a constant down force on the piston that increases the striking power of the piston over conventional drills with a non-stepped piston. The constant down force on the piston also provides fast, positive shut off when the bit is lifted off the hole bottom, limiting damage caused by “dry firing”.

DHD SETUP

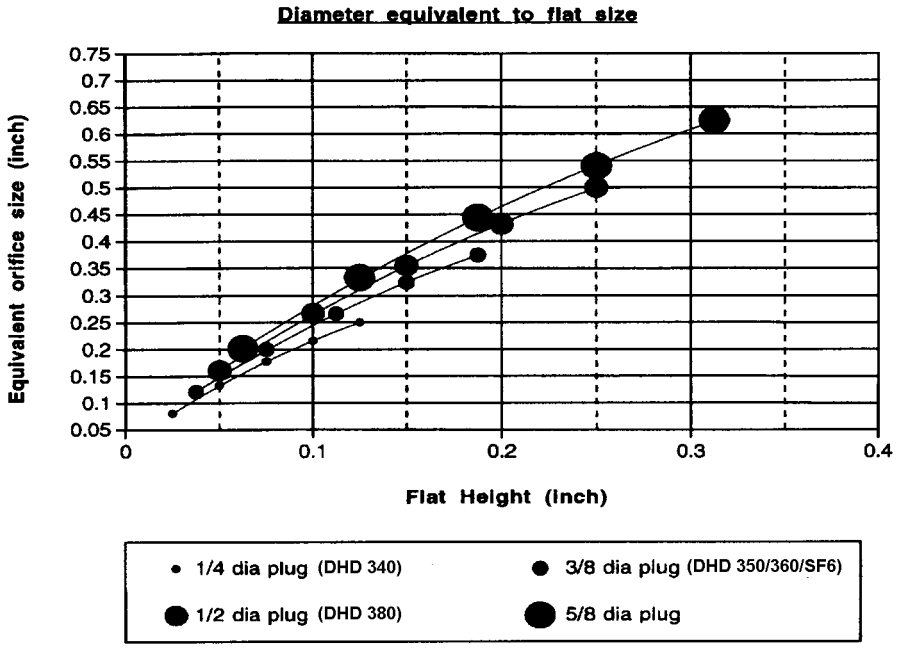
SETTING UP THE DHD

Before the DHD is used to drill it should be set up for proper air consumption and the joints should be tightened. The selection of choke size will be dependent on the hole cleaning requirements and the capacity (pressure and flow) of the compressor being used. Hammer air consumption should be set up for the best balance of power and hole cleaning. Other factors which need to be considered are depth of hole, water to be encountered and water to be injected. In some cases, where such factors are unpredictable, the proper choke size can only be selected after experience is developed.

CHOKE SELECTION SETUP

The best performance of any DHD will be achieved when a maximum volume of air can be passed through the drill with a solid choke. Under ideal conditions the pressure required to drive this volume through the drill will be within the capabilities of the compressor. When more air volume delivery is available than that required to operate the hammer at the rated compressor pressure, an alternative way of utilizing the excess volume is required. If this excess flow is not used the compressor's unloader will cycle, resulting in a loss of hammer performance.

All Atlas Copco DHDs can be modified for additional hole cleaning capacity by replacing the solid choke plug installed at the factory with a bypass choke plug (Refer to chart below). If additional hole cleaning air is needed and compressor capacity is sufficient flow can be determined from the following expression: Q=9.71 * D^2 * P, where D= hole diameter (in.); Q= flow (scfm); P= pressure (psig).



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DHD SETUP (cont'd)

BYPASS HOLES TO PASS A SPECIFIC AIR FLOW

Air Pressure psig (bar)	Hole Diameter in. (mm)				
	1/16 (1.6)	1/8 (3.2)	3/16 (4.8)	1/4 (6.4)	5/16 (7.9)
	Bypass Air scfm (m^3/min)				
200 (13.8)	8 (.23)	30 (.85)	68 (1.93)	121 (3.43)	190 (5.38)
250 (17.2)	9 (.25)	38 (1.08)	85 (2.41)	152 (4.30)	237 (6.71)
300 (20.7)	11 (.31)	46 (1.30)	102 (2.89)	182 (5.15)	284 (8.04)
350 (24.1)	13 (.37)	53 (1.50)	119 (3.37)	212 (6.00)	332 (9.40)

DHD SETUP (cont'd)

SETTING UP THE DHD (cont.)

Bailing Velocity Requirements

The need for adequate hole cleaning cannot be over emphasized. A hole that is not cleaned properly can result in poor performance, rapid wear of bits and accessories and in some cases loss of the drill and pipe down the hole. Hole cleaning is usually directly related to what is called bailing velocity or the speed of the air which is lifting cuttings from the hole.

Bailing velocity is defined as the velocity of the air in the hole annulus at atmospheric pressure. In other words, the effect of bottom hole pressure is not taken into account when computing bailing velocity. For conventional hole cleaning (no soaps or foams) bailing velocity should exceed 3000 ft./min. (914.4 m/min.). However, if possible, bailing velocity should not exceed 7000 ft./min. (2133 m/min.).

Bailing velocity can be computed by dividing the air consumption of the DHD in scfm by the annulus area in square feet. The equation following may be used:

$$\textbf{Velocity [ft./min..] (m/min.)} = \frac{\textbf{Air consumption [scfm] } (m^3/min.)}{\textbf{Annulus area [sq. ft.] (sq. m)}}$$

where:

- Air consumption is the rated delivery of the compressor or the air consumption of the drill at maximum pressure, whichever is less.
- Annulus area is the area between the hole bore and the drill rod. It can be computed as follows:
- Annulus area **[sq. ft.] =.0055 x (hole dia. [inches]^2 – rod dia. [inches]^2)**
  (sq. m) =.785 x (hole dia. [m]^2 – rod dia. [m]^2)

DHD SETUP (cont.)

BIT INSTALLATION

Bit splines should be well lubricated with rock drill oil or thread grease before the chuck is installed over the splines. Additionally, the threads on the chuck should also be well coated with thread grease before threading the chuck into the DHD. Remember to install the bit retaining ring halves before threading the chuck into the DHD.

Used Bit and Chuck

Caution must be used when installing a new bit on a used chuck or visa-versa. Some applications, usually soft rock where there is excessive bit travel within the splines, can develop uneven wear on the bit and chuck splines. When a new bit is installed in a used chuck the mating surfaces are likely to be poor. Check the condition of the chuck or bit splines when using a new bit or chuck if your application is prone to this form of spline wear.

It is also suggested that the chuck be rotated relative to the bit splines from time to time to even out the gouging and grooving which takes place due to erosive wear. This practice will extend your chuck and casing life.

MAKEUP TORQUE AND BACKHEAD CLOSURE

The DHD drills use a Belleville spring stack arrangement whereby parts are held in place under very high load.
Rotary head torque may be sufficient to close the gap between the casing and backhead but in some cases a supplementary wrench may be needed. It is extremely important that the backhead gap be closed in these drills.

THE PRESENCE OF A GAP BETWEEN THE CASING AND THE BACKHEAD WHILE DRILLING WILL INCREASE THE CHANCES FOR LOOSENING THE BACKHEAD IN THE HOLE AND POSSIBLY LOSING THE DRILL. DAMAGE TO INTERNAL PARTS IS ALSO LIKELY

In addition to at least closing the backhead gap, it is also suggested that the backhead and chuck be torqued to approximately 750 - 1000 ft.-lb per inch (40.5 - 54 N-m per mm) of hammer diameter. For example a 6 in. (152 mm) class (SF6) drill should be torqued to 4500-6000 ft.lb (6156-8208 Nm). This makeup torque insures against loosening joints in the hole and also preloads the threads sufficiently.

DRILL LUBRICATION

LUBRICATION GUIDELINES AND SPECIFICATIONS

All DHDs require oil lubrication to resist wear, galling and corrosion. Additionally, the film of oil coating all internal parts seals internal clearance paths to reduce power-robbing leakage across sealing clearances. As a general rule of thumb the oil required is proportional to the volume of air being used.

Oil also needs to be of sufficiently high quality. It is recommended that Atlas Copco Supertac rock drill oil be used. If another type of oil is used it must comply with the oil specifications shown in Figure 2 of Section 5.

For dry drilling (less than 2 gpm (7.6 lpm) of water injection) it is generally recommended that oil be injected into the drill air stream at the rate of 1/3 pint (.16 l) of oil per hour for every 100 scfm (2.8 m^3/min.) of air. For example a 900 scfm (25.5 m^3/min.) compressor delivering full flow to a DHD would require 900 ÷ 100 x 1/3 = 3 pints per hour (25.5 ÷ 2.8 x .16 = 1.6 l per hour). **For wet drilling (more than 2 gpm (7.6 lpm) it is suggested that the lubrication rate be doubled to 2/3 pint (.32 l) of oil per hour for every 100 scfm (2.8 m^3/min.) of air.** The additional oil compensates for the wash-out caused by water and the oil losses. Additional lubrication is also required when drilling with soap or foam. See the "Drilling With Foam" section for more details. (Refer to chart below.)

Air Flow scfm	**Oil Injection Rate** pints/hr (l/hr)	
	Dry Drilling	**Wet or Hydrocyclone Drilling**
150	0.5 (.2)	1.0 (.5)
250	0.8 (.4)	1.7 (.8)
350	1.2 (.6)	2.3 (1.1)
500	1.7 (.8)	3.3 (1.6)
600	2.0 (1.0)	4.0 (1.9)
750	2.5 (1.2)	5.0 (2.4)
800	2.7 (1.3)	5.3 (2.5)
900	3.0 (1.4)	6.0 (2.8)
1050	3.5 (1.7)	7.0 (3.3)
1250	4.2 (2.0)	8.3 (3.9)
1500	5.0 (2.4)	10.0 (4.7)
2000	6.7 (3.2)	13.3 (6.3)
3000	10.0 (4.7)	20.0 (9.5)

DRILL LUBRICATION (cont.)

Lubricators

There are two primary types of lubricators; a plunger oiler and a venturi oiler:

A plunger oiler normally operates from a timed plunger system which delivers a fixed ”slug” of oil into the line in timed intervals. These systems are beneficial in that the oil reservoir does not need to contain a high pressure. Plunger lubricators are also insensitive to oil viscosity and temperature. However, because of their complexity, the reliability of plunger lubricators is not as good as the venturi type. Also, because oil is delivered as ”slugs” it is not atomized and delivered to the drill internals as evenly as a venturi.

Venturi type lubricators (sometimes referred to as pig oilers) operate in a similar fashion to a gasoline carburetor. A necked down area in the venturi creates a pressure drop which draws oil into the air stream. The oil is atomized and mixed very efficiently with the air providing maximum coverage and cohesion to internal drill components. A needle valve is usually used to adjust the oil volume delivered. Disadvantages of the venturi oiler are that it requires a pressurized reservoir, which is generally small in volume. Also, the lubrication rate is dependent on oil viscosity which varies with temperature.

LUBRICATION CHECK

When oil is injected into an air stream with dry piping or hoses it takes a considerable amount of time to coat the walls of the piping so that the oil is actually delivered to the DHD. Until these surfaces are coated with an oil film very little is actually delivered to the DHD. It’s important to insure that an oil film is established before starting the DHD. It’s recommended that the drill be allowed to blow until a visible film of oil is developed on the bit blow holES.

Placing a piece of cardboard or wood beneath the blow holes gives a good indication when oil is passing through the drill. The cardboard or wood will become wet with oil when an adequate film of oil has been developed. If a drill string has not been used for some time and the oil has dried out it is suggested that a cup of oil be poured into each rod to assist in developing an oil film. After drilling with high levels of water injection it is important to note that any oil film has probably been washed off. For operators that switch from wet to dry drilling (i.e. waterwell and quarry) its important to redevelop the oil film.

DRILL LUBRICATION (cont.)

WATER INJECTION

Water injection can cause a DHD to either consume more air (hold a lower pressure) or less air (hold a higher pressure) depending on the volume of fluids injected. For example, if a DHD is lubricated with oil and water is then injected at a low rate (less than 1 gpm (3.8 lpm)), the oil film which is sealing the internal leak paths is washed out and air consumption will increase (pressure will fall).

Conversely, if water is injected at a high rate (more than 3 gpm (11.4 lpm)) the fluid level will be sufficient to seal the leak paths and restrict the flow of air through the DHD. In this case the air consumption will decrease (pressure will increase).

The pressure rise associated with water injection can sometimes exceed the maximum pressure rating of a compressor. In these cases the choke or bypass hole must be increased to reduce pressure.

The use of water, while required in most cases, does reduce component life. The following lists some of the problems that water injection can cause:

- Poor quality water can either be corrosive or can carry contamination into the drill. Premature wear or corrosion related failures can result. All water injected into a DHD should be neutral in pH and free from particulate contamination.
- Water injection reduces drill performance considerably. Water restricts the flow and resultant pressure in working chambers of the drill and reduces face cleaning which causes regrinding of cuttings.
- Water present at the impact face causes cavitation of the bit and piston and jetting or cutting of the exhaust tube. In both cases component life is reduced.

A DHD that has been operated with water injection and will be idle for more than a few days should be dried out and lubricated with oil. This can be accomplished by blowing lubricated air through the tool when drilling is finished.

DRILL OPERATION

DRILLING WITH FOAM

In certain drilling situations, it may be advantageous to use foam to improve hole cleaning and control backpressure. Use of a heavy (shaving cream consistency) foam can suspend drilled cuttings and allow them to be removed from the bore hole at bailing velocities much lower than when depending on air flow alone. Foam can also entrain and suspend formation water in instances of high water inflows, reducing backpressure on the drill.

Atlas Copco DHDs are compatible with all commonly available foaming compounds. Modern drilling foams are non-corrosive, but their effects create an environment suited to rapid corrosion of drill parts. The use of foam with a DHD requires extra care to maximize drill performance and life.

- Foam, being basically soap, breaks down rock drill oil, which can cause lubrication problems in the drill. Increase oil injection rates when drilling with foam.
- As foam passes through the drill, bubbles are created and destroyed. This action polishes the steel parts, making them more susceptible to corrosion.
- When drilling activity stops, the oil film normally present has been removed. This leaves the internal parts of the hammer without corrosion protection.

When drilling with foam is completed, all foam residues must be removed from the inside of the drill, and the parts must be coated with oil. Failure to do so will result in rapid corrosion of the internal parts and rapid wear when drilling resumes. The following procedure is recommended if the hammer is down for a day or two:

- With the drill in blow position, shut off foam delivery and blow air with a large quantity of water through the hammer for several minutes.
- Shut off the water and continue to blow lubricated air through the hammer until a good flow of oil is seen at the bit.
- For best results, clean the hammer at the end of each day.

If the hammer is to remain unused for an extended period, it is recommended that the DHD be disassembled, cleaned, oiled and reassembled before storage.

COLLARING

Collaring a drilled hole is a critical stage of the drilling process. In blast holes it can determine the quality of the top of the hole and the ability to load a charge. In foundation and well drilling it can determine the overall straightness of the completed hole. It is suggested that a drill be collared with low pressure and feed until the hole has stabilized. Just as a twist drill needs to be controlled carefully when drilling with an electric hand drill, a DHD needs to be started with care.

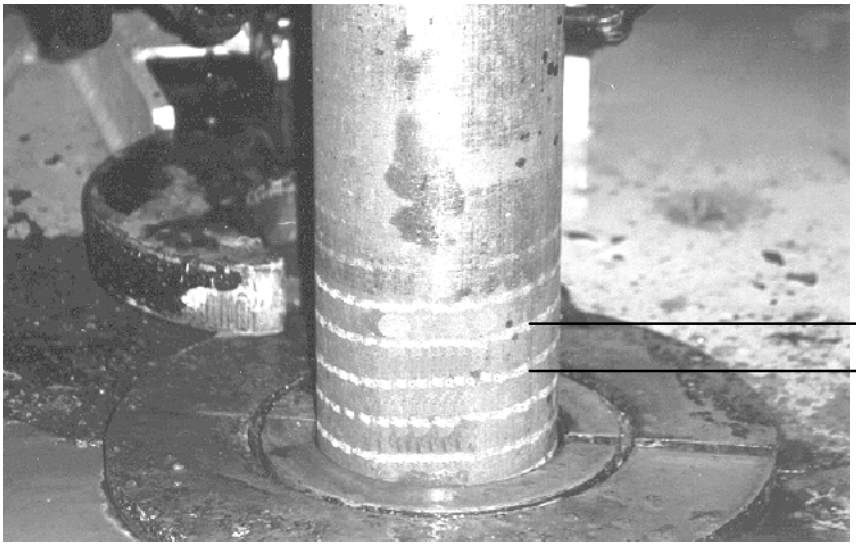
DRILL OPERATION (cont.)

ROTATION SPEED

Rotation speed directly affects the amount of angular index the bit inserts go through from one impact to the next. The optimum amount of index is dependent on variables such as blow energy (pressure), rock hardness, bit diameter, etc. The ideal rotation speed produces the best overall balance of penetration rate, bit life and smoothness of operation. It generally occurs when cuttings are their largest.

Determining the optimum rotation speed needs to be carried out in the actual application. A good rule-of-thumb is to divide 300 by the bit diameter in inches to determine RPM. This will get the rotation speed in the ”ballpark”. However, a fine-tuned rotation speed also needs to be correlated with penetration rate. It has been found that a proper rotation speed usually results in a 3/8 in.- 3/4 in. (9.5 mm - 19 mm) advance of the bit per revolution of the DHD. This measurement can normally be taken by using chalk or soapstone to scribe a spiral on the drill pipe while the drill is operating. The distance between the spirals (thread pitch) can be measured to determine if rotation speed should be increased or decreased. If the pitch is less than 3/8 in. (9.5 mm) the drill RPM should be decreased, if it is more than 3/4 in. (19mm) the drill RPM should be increased.

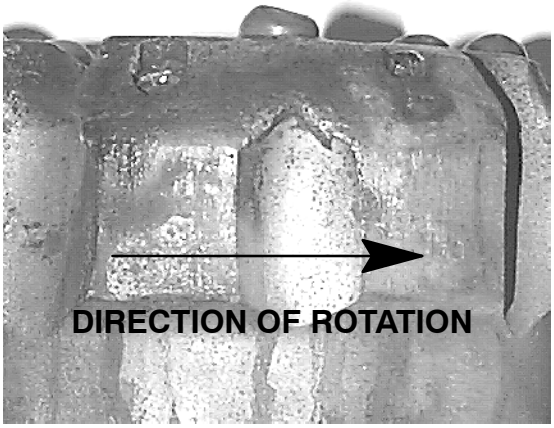
The picture following shows an example of the marks left on a drill pipe when using chalk to mark the advance of the drill.

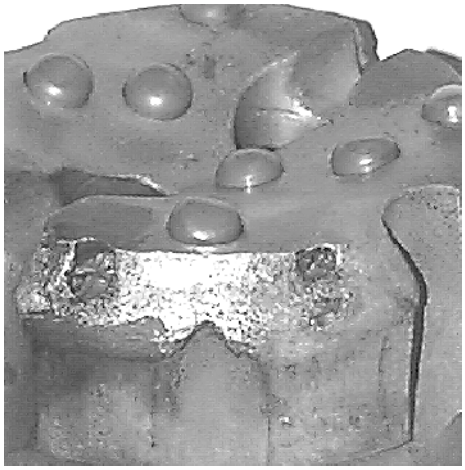


Adjust RPM to give 3/8 to 3/4 in. (9.5 to 19 mm)

DRILL OPERATION (cont.)

Another method for setting rotation speed involves observing the wear flat developed on the gage (outer) carbide. The wear flat on the should be directly on the top of the inserts. A flat which is on the leading edge of carbide (side facing the direction of rotation) indicates rotation speed is too slow. Conversely, rotating too fast will cause rapid wear of the bit and the wear flat will be on the trailing edge of the carbide.





VIEW SHOWING WEAR FLAT ON LEADING EDGE - INDICATES ROTATION TOO SLOW. NOTE THAT CARBIDE FAILURE WAS CAUSED BY THE LEADING EDGE WEAR FLAT.

DRILL OPERATION (cont.)

FEED FORCE (hold down and hold back)

The force required to feed a percussive tool properly is directly proportional to the level of output power.

As a rule of thumb, DHD's need to be fed with a force of roughly 500 lb per inch (9 kg per mm) of hammer diameter when operating at maximum power.

In many cases operators will simply adjust the feed pressure until rotation pressure starts to pulse and then back off slightly until rotation pressure becomes smooth. When a hole is first started, if the weight of the starter rod or collars is not sufficient to feed the drill then pull down will be needed. As the hole is advanced and more weight is added to the drill string, the level of pull down will need to be decreased. Eventually, the weight of the string may exceed the proper feed force and the feed system will need to be shifted to a pull-back mode.

When drilling through varying conditions such as hard and soft or voided material, every effort should be made to keep the drill fed properly. A loose running DHD can cause damage to the tool and bit in a short period of time. The feed system of a drilling rig should have a sufficiently fast response so the DHD can "catch up" with the bit when a void or soft seam is encountered.

It's equally important to avoid feeding too hard through voided and fractured material. The piston in a DHD operates within the casing with a clearance of about .003 in. (.076 mm) on each side. While the casing appears very strong and stiff, it does not take much sideways pressure to distort the casing enough to cause interference with the piston as it reciprocates. If the casing is overfed through voided ground it is likely that deflection of the casing will occur. Frictional cracks will develop on the surface of the piston if the piston rubs hard enough against the wall of the casing while being distorted. These small frictional cracks can eventually grow and break the piston.

Feed force should be reduced when drilling through voided, unconsolidated or fractured ground to avoid twisting or distorting the hammer casing.

HOLE CLEANING, FLUSHING AND DUST SUPPRESSION

As stated previously, the importance of good hole cleaning cannot be over emphasized. A hole which is not cleaned effectively will cause reduced production (penetration rate), decreased bit and accessory life and could ultimately increase the risk of losing the drill & string in the hole.

DRILL OPERATION (cont.)

DRY DRILLING

The most effective means for hole cleaning is drilling dry. Cuttings are normally lifted and cleaned from the hole very efficiently. Imagine blowing, or sweeping, dust or dirt from a floor when the floor is dry and wet....which is more effective? The same principle holds true for cleaning cuttings from a hole.

WET DRILLING

Water injection is required in many applications for dust suppression or hole cleaning. Water injection rates for dust suppression only are usually less than 1 gpm (3.785 lpm) and just sufficient to moisten fine dust. It is usually common to use minimal water injection for dust suppression in shallow blasthole applications where water intrusion into the hole is not a problem.

Heavier volumes of water injection are usually required in water well and deep-hole applications where a number of factors come into play;

- Water intrusion into the hole can develop mud rings where dry cuttings meet a seam of water entering the hole. Mud rings develop where dry cuttings stick to the wall of the hole when they hit the moist area. Water injection is needed to keep the hole wet enough to prevent these mud rings from developing. Fluid injection rates can vary from 2 - 15 gpm (7.57 - 56.775 lpm) depending of the hole size, rate of penetration and the type of material being drilled.

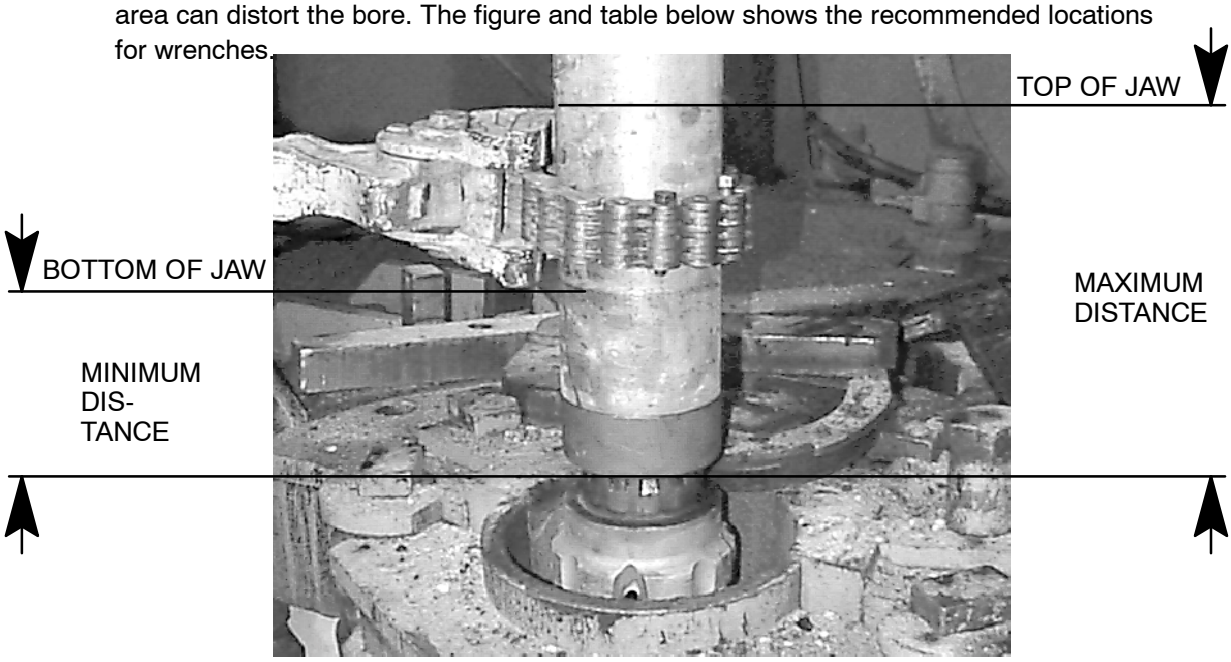
- Some materials such as those which drill fast or contain clay can sometimes require very heavy levels of water injection. These applications are unique in that they can either be drilled totally dry or totally wet....not in between. Marginal fluid injection results in making a tacky mud which sticks to the drill rods and hole wall and hinders hole cleaning. The correct level of fluid injection thins the paste so it will be cleared from the hole.

REMOVING THE DRILL BIT

Bit removal can be one of the most dangerous and frustrating tasks associated with the drilling operation. However, with the proper tools and techniques it should require no more than a few minutes and few expletives to remove a bit. The following lists pointers which will be beneficial in helping you remove a bit quickly, safely and with reduced risk to damaging DHD parts and components:

1. Use sharp tong jaws. Worn or rolled over tong jaws increase the jaw pressure and make the wrench more prone to damaging the hammer case. Many Atlas Copco hammer cases are case hardened which means sharp jaws are needed to grip through the hardened case.

2. Grip the casing in the proper location. Gripping over the threads can make thread loosening extremely difficult. Example; as the wrench tightens it exerts an inward force which can pinch the threads if they are under the wrench jaw. This only increases the torque needed to uncouple the thread. Also, do not grip the casing in an area where the bore is not supported by either the piston or bearing. Gripping over an unsupported area can distort the bore. The figure and table below shows the recommended locations for wrenches.



Chain Wrench Positions

DHD Model	Minimum distance from chuck to lower jaw	Maximum distance from chuck to upper jaw
DHD 3.5	3.3 in. (84 mm)	12.3 in. (312 mm)
DHD 340AP	6.5 in. (165 mm)	14 in. (356 mm)
DHD350RP	6.5 in. (165 mm)	17 in. (432 mm)
DHD 360/ SF6	6.5 in. (165 mm)	17 in. (432 mm)
DHD 380/ DHD 310	8 in. (203 mm)	19 in. (483 mm)
DHD 112	8 in. (203 mm)	24 in (610 mm)

BIT CHANGING (cont.)

REMOVING THE DRILL BIT (cont.)

3. Insure the bit fits properly within the bit basket. An improper fit may result in the bit slipping from the basket.

4. Never weld or hammer on the casing to loosen it. All casings are case hardened for extended service life. The hard casing surface can be cracked by welding or impacting with a sledge hammer. If a chuck or backhead is difficult to loosen, repeatedly tapping the casing at the thread location with a brass bar or hammer while torque is applied may help loosen the joint.

⚠WARNING

Insure chain wrenches or tongs are rated for the torque applied. The flying parts of chain wrenches can cause injury or death when they break!

Ingersoll-Rand

THIS CASING HAS BEEN
PRECISION HEAT TREATED

WARRANTY WILL BE VOIDED BY:

- **WELDING** ON CASING
  WILL DESTROY HEAT TREATMENT OF CASING
  CAUSING CRACKS
- **HEATING** CASING WITH A TORCH
  WILL DISTORT BORE AND RUIN HEAT TREATMENT
- **GRIPPING** WITH WRENCH ACROSS THREADS
  CAN DISTORT BORE AND START CRACKS
- **HAMMERING** ON CASING
  CAN FORM CRACKS ON OUTSIDE OF CASING

--USE SHARP TONG JAWS TO AVOID PROBLEMS--

52082013

BIT CHANGING (cont.)

REMOVING THE BIT WITH PERCUSSION ONLY

If a chuck is difficult to loosen it's sometimes helpful to use low-pressure percussion assisted with reverse rotation to free the thread. The following lists the process and cautionary notes:

⚠CAUTION

WEAR EYE PROTECTION AS THE HAMMER WILL BE CYCLING ABOVE GROUND. INSURE THAT ALL DRILL STRING JOINTS ARE TIGHT. WATCH OTHER STRING JOINTS TO INSURE THEY DO NOT LOOSEN BEFORE THE CHUCK. IF THEY DO LOOSEN, STOP THE PROCESS

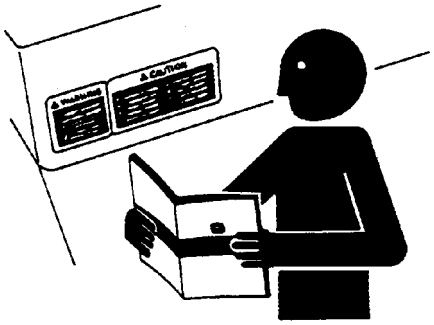
Process instructions

1. Place a piece of relatively hard polyurethane or conveyor belting in the bit break-out basket to absorb shock.
2. Remove all drill pipe so only the DHD and required adapters are attached to the rotary head.
3. Bring the drill in contact with the bit basket with a relatively light feed.
4. Bring the hammer pressure up to roughly 150 psig (10.3 bar).
5. See if the joint has loosened on its own after about 10 seconds of cycling.
6. If the joint has not loosened, "Bump" the rotation in reverse at a slow speed while the drill cycles until the joint has loosened.
7. Stop as soon as the chuck loosens, grease & air will be noticed coming from the loosened joint.

GENERAL INFORMATION

FOLLOW INSTRUCTIONS

Along with correct operational technique; proper and timely service and repair of a DHD can extent component life and reduce operational expenses considerably. The sections following describe how to disassemble, inspect, repair and reassemble all DHD's.



Depending on the degree to which you plan on servicing a DHD, a number of tools are required. The following lists the tools needed for a complete overhaul of all DHD's. A stand is required for holding the DHD and it is presumed that backhead and chuck threads have been loosened. Complete overhaul includes measuring and inspecting all clearances at seal locations and other wear points.

Tools required for DHD service and repair

Tool	DHD3.5	DHD340AP QL40	DHD350R	DHD360P SF6	DHD380	DHD112
Outside Micrometer	3-4", 2-3", 1-2"	3-4", 2-3", 1-2"	4-5", 3-4", 1-2" 1-2"	5-6", 4-5", 3-4" 2-3", 1-2"	7-8", 5-6", 4-5" 7-8", 2-3"	9-10", 8-9"
Feeler Gauges	set	set	set	set	set	set
Telescopic Bore Gauges	set up to 3"	set up to 3"	set up to 4"	set up to 5"	set up to 6"	set up to 10"
Vernier Caliper	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"
Brass (soft) Bar	3/4" dia. by 48"	1" dia. by 48"	1-1/4" dia. by 48"	1-3/4" dia. by 48"	2"dia. by 48"	
"J" Wrench	2-1/2"	2-1/2"	3-1/2"	4"	6"	9 1/4"

DHD SERVICE

In most cases a DHD will only require servicing when the casing wears out or when performance deteriorates due to internal parts wear. The level of inspection can obviously be much less if the casing only needs replacement. If the DHD has lost performance a more detailed inspection will be required.

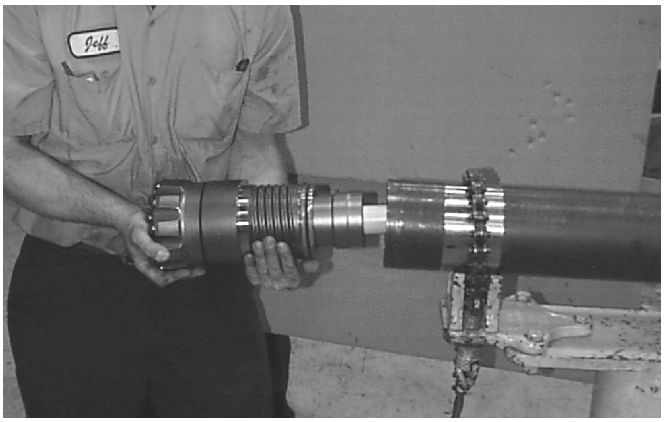
DHD DISASSEMBLY

DISASSEMBLY

The following disassembly procedure starts with the presumption that the chuck and backhead threads have been loosened. While the disassembly process is similar for all DHD Series drills there are slight distinctions from one model to another that will be noted.

1. **Mark the casing** so you can note which end is the backhead side and which is the chuck end. Once the hammer has been disassembled it's hard to tell which end is which.

2. **Loosen the chuck** along with bit and retaining rings and remove from casing.



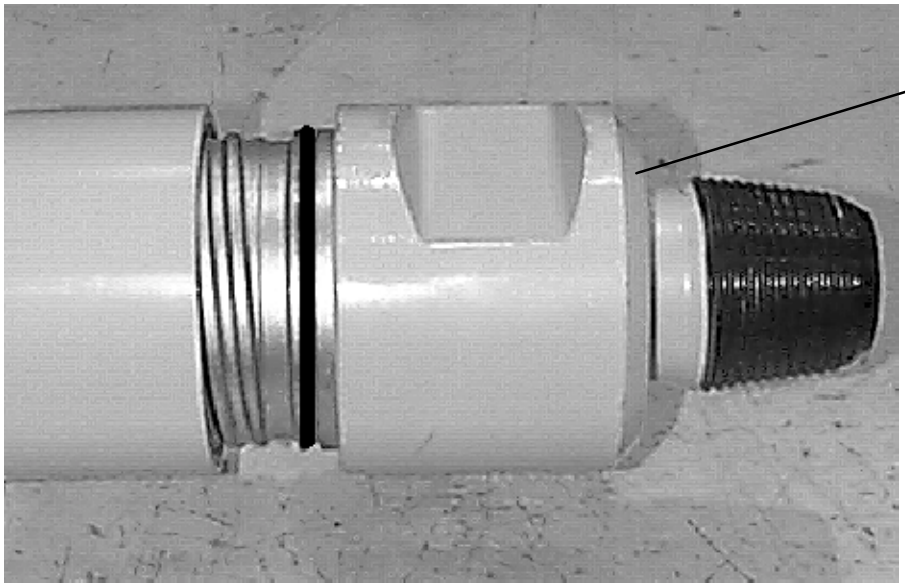
3. **Remove retaining rings** and o-ring from bit shank.

WARNING: This manual contains data SPECIFIC to DHD Classic Series Downhole Drills.

DHD DISASSEMBLY (cont.)

4. **Remove the chuck** from the bit.

5. **Remove the backhead** from the other end of the casing.



DHD DISASSEMBLY (cont.)

6. Remove the belleville springs and spacer (if used) from the casing

7. Remove the check valve and check valve spring from the top of the air distributor. It is not necessary to remove the choke plug unless it is damaged or a bypass plug is required.

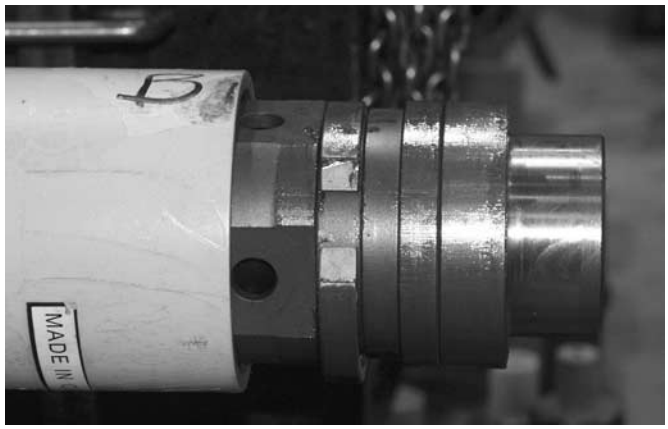
DHD DISASSEMBLY (cont.)

8. **Remove the bit bearing** (if your model DHD is furnished with one) from the hammer. The bearing can sometimes be removed by hand, but often will require the use of a bearing puller. When using a bearing puller, be sure it is in contact with the bearing and not the bearing retainer.

   For DHD360 and SF6 models: The bit bearing is held in place with a C-shaped retainer ring. Use standard retainer ring pliers to remove the retainer ring. Remove the belleville springs and wear spacer (if used). The bearing can now be removed as described above.

   For DHD310M and DHD112 models: The bit bearing is held in place by a thick section o-ring. To remove the retainer, push the bearing into the casing as far as it will go, then remove the o-ring. A screwdriver may help to start the o-ring out of its groove. The bearing can then be removed as described above.

9. Insert a brass rod through the piston bore until it makes contact with the air distributor. Push the air distributor and cylinder out of the casing. To remove the air distributor and cylinder from DHD3.5 and SF6 models push the piston toward the cylinder until it makes contact, then strike the piston struck end with a brass bar to unseat the cylinder retaining ring. The assembly can then be pushed out ot the casing



DHD DISASSEMBLY (cont.)

10. The cylinders for DHD 380, DHD 310, and DHD112 models are held inplace by a cylinder stop ring located in a groove near the center of the casing. These rings can be removed by hand. The cylinder must first be removed from the backhead end of the casing and the piston must be removed from the chuck end of the casing before the cylinder stop ring can be removed

11. Insert the brass rod in the opposite side of the casing and push the piston down until it contacts the piston retainer ring. Strike the piston with the brass rod to unseat the ring and remove it from the casing. DHD 310 and DHD 112 models use a polymer ring as a piston retainer. These can be removed by hand. It may be helpful to use a flat-bladed screwdriver to move the ring from its groove.

12. Remove the piston from the chuck end of the casing.

DHD INSPECTION

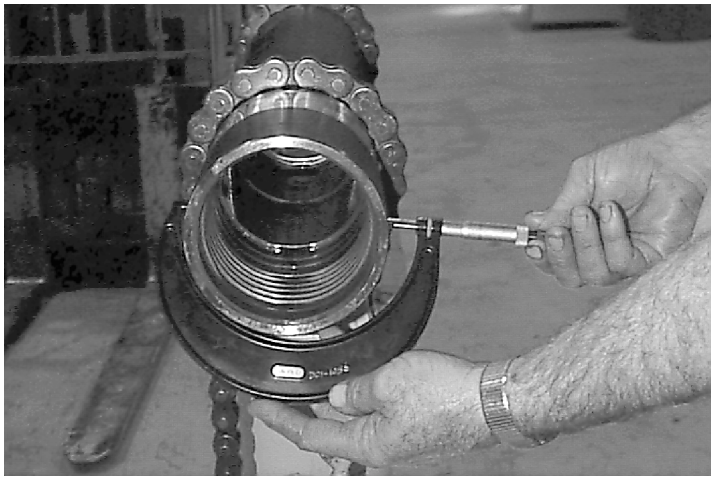
INSPECTION

When a Downhole Drill is disassembled, all parts should be inspected to determine which, if any require replacement, repair, or reversal. Refer to the specifications to find the appropriate discard point clearances. The discard point clearances listed represent an increase in clearance of 50% over the maximum as-new clearance. In some applications this clearance increase may represent too much performance loss, and in other applications additional wear (performance loss) may be acceptable.

Deterioration in drill performance is caused by the increase in clearance between parts. It is more cost effective to replace the part that decreases clearance the most at the lowest cost. Figure 6 of Section 5 tabulates the new diameters from which the wear on each part can be assessed.

1. **Casing** outside diameter should be measured roughly 2 to 3 in. (51 to 76 mm) from the end of the chuck end. Refer to the casing reverse and discard dimensions to determine if the casing should be replaced or reversed. Refer to the assembly instructions for the proper casing reversal procedure.

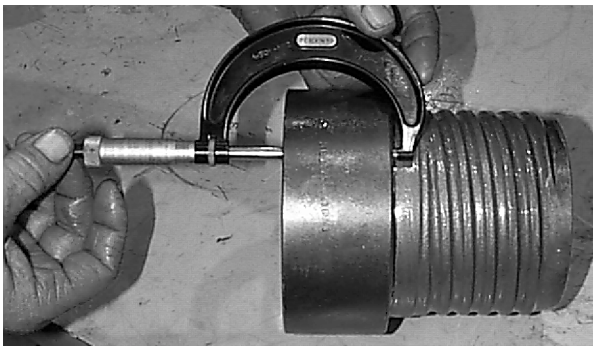
   - It is suggested that the chuck be replaced when the casing is reversed.



DHD INSPECTION (cont.)

2. **Inspect the chuck**.

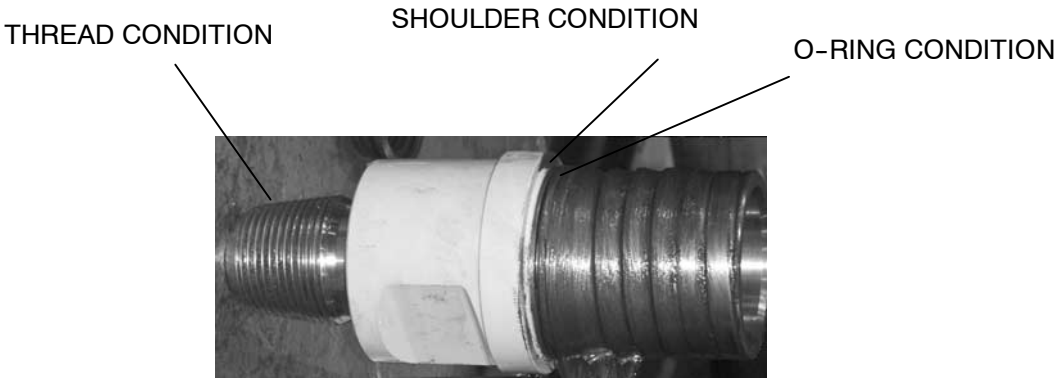
- Check the overall length of the chuck shoulder against the specifications. A short chuck shoulder can cause cycling problems, difficulty handling water, and rough operation.
- Check the chuck inside diameter. Replace if worn beyond recommended limits.
- The chuck should be replaced if spline wear is heavy or uneven.
- The chuck should be replaced if its minimum outside diameter is less that the casing discard diameter.



3.**Inspect the backhead.**

- Check the condition of the connection thread. Replace the backhead if the threads are torn, galled or damaged, or if the make-up shoulder is damaged or worn.
- Check the condition of the internal connection thread. Minor damage can be repaired by filing or lightly grinding the damaged area. Replace the backhead if the threads are badly worn, damaged or cracked.

4. **Inspect the backhead o-ring** and replace if damaged.

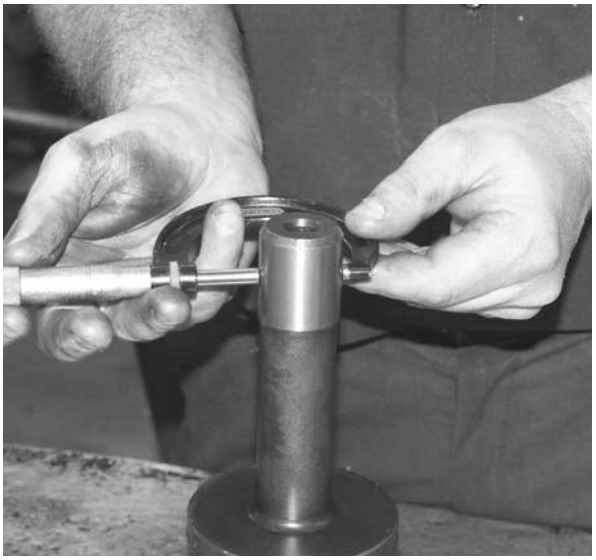


WARNING: This manual contains data SPECIFIC to DHD Classic Series Downhole Drills.

DHD INSPECTION (cont.)

5. **Inspect the check valve and spring.** Replace if cracked, torn, or if the seal is brittle.

6. **Inspect the air distributor guide** for wear, scoring, or galling. Replace if worn beyond tabulated limits. A wear pattern on one side of the guide can indicate misalignment in the drill. If this condition is observed, check other parts carefully to identify the source of the misalignment.



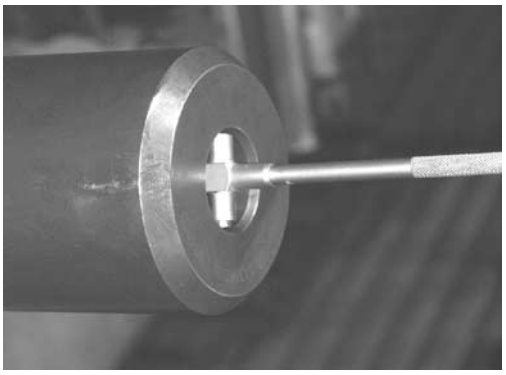
DHD INSPECTION (cont.)

8. **Inspect the bearing bore** (if applicable) just above the internal flutes for wear using a telescop ic bore gauge and micrometer. Replace the bearing if the net clearance between the bit and bearing is beyond the tabulated discard point. Replace the o-ring if it is worn or damaged.

9. **Inspect the piston** in the locations noted below. The piston usually wears faster than its mating parts, so it is likely piston wear will affect clearances the most. Record the dimensions for comparison to mating parts (cylinder and casing) to determine which part offers the most economical replacement cost.

   - Measure the tail outside diameter as shown.

   - Measure the tail bore and inspect for damage.

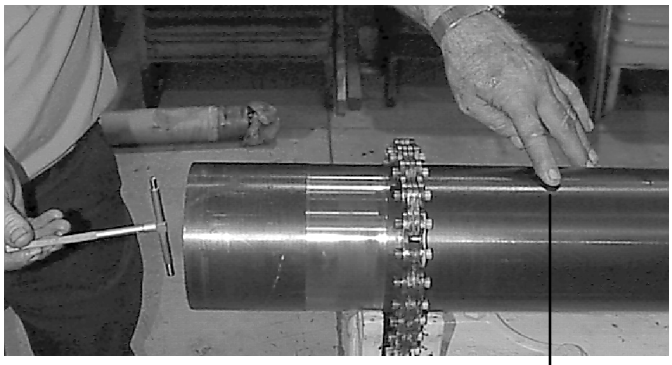


DHD INSPECTION (cont.)

- Measure the large piston diameter in the location shown. **Note:** *This is the most critical wear point on the drill, as it has the greatest influence on performance.*

10. Carefully remove any sharp edges, burrs, or nicks that have developed on the piston using a hand grinder or emery cloth. ***DO NOT OVERHEAT THE PISTON.....IT WILL CRACK IF OVERHEATED!*** If the piston striking face is heavily cavitated or pitted use a ceramic facing tool or well-cooled grinder to dress the face. A maximum of .060 in. (1.52 mm) can be removed from the piston face.

11. If the casing does not require replacement due to outside diameter wear, measure the bore diameter using a telescopic bore gage and micrometer as shown. Record the measurement for later reference. Polish any rough or galled spots in the casing bore with emery cloth. Larger areas of damage can be smoothed out using a hand grinder with flap wheel. Be careful not to remove too much material from the bore to avoid degradation of hammer performance.



MEASURE AT THIS LOCATION
(1/2" past undercut)

DHD INSPECTION (cont.)

12. Inspect the cylinder for cracks or damage. Measure the diameter of the bore and record for later reference. Scored or galled areas of the bore can be polished with emery cloth.

13. Determine the following clearances from the dimensions recorded.

- Bit to bit bearing (if applicable)
- Piston to casing
- Piston to cylinder
- Piston tail bore to guide

14. Referring to the as-new dimensions and recommended replacement clearances in Section 5, determine which parts have suffered the most wear. Replace the part(s) needed to bring the clearances back to specification. The chart below may be useful for recording and determining which clearances require service.

(continued)

DHD INSPECTION (cont.)

DHD Clearance Worksheet						
Dimensions		Measured Dimension	As new diameter from table	Actual wear	Measured clearance	Discard clearance from table
	ID	**A**	**B**	**C**	**D**	**E**
Piston to Casing					2A-1A	
Large piston OD	**1**			1B-1A		
Casing ID	**2**			2A-2B		
Piston to cylinder					4A-3A	
Small piston OD	**3**			3B-3A		
Cylinder ID	**4**			4A-4B		
Piston to guide					5A-6A	
Tail seal ID	**5**			5A-5B		
Guide OD	**6**			6B-6A		
Bit to bearing					7A-8A	
Bit bearing ID	**7**			7A-7B		
New bit tail OD	**8**			8B-8A		

DHD ASSEMBLY

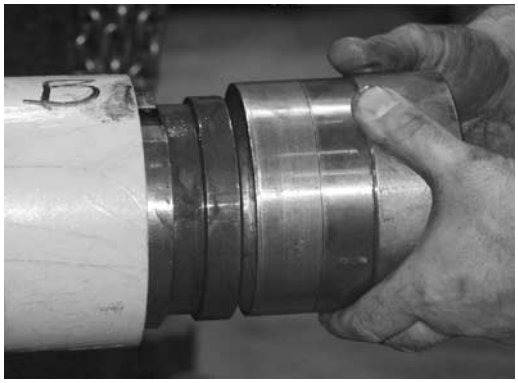
ASSEMBLY

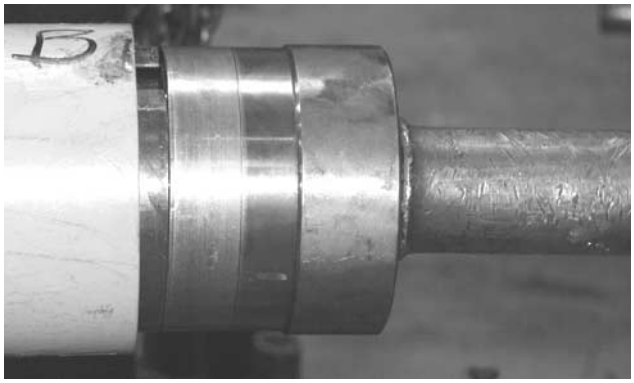
Before assembling a DHD, the parts should be prepared as follows:

- All parts should be clean and free of grit dirt and other foreign material.
- All nicks and burrs on parts should have been removed.
- All parts should be coated with rock drill oil, preferably the same type to be used while drilling.
- All damaged o-rings and seals should be replaced. Oil or lightly grease the seals to avoid cutting or tearing during assembly.
- If corrosion is common, spray casing threads with a corrosion protectant such as LPS Hardcoat. Make sure the threads are clean and dry, and that sufficient drying time is allowed.

1. Install the backhead o-ring.

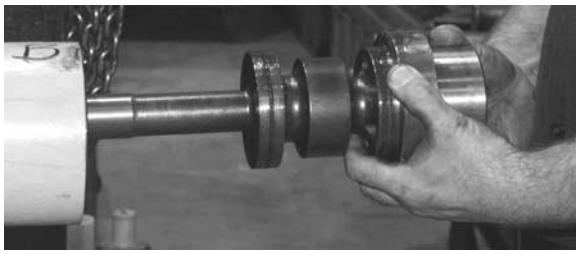
2. Install the cylinder into the backhead end of the casing. For DHD 3.5 and SF6 models, compress the cylinder retainer in the deeper groove and push it into the casing. An optional installation tool may be helpful for this process.Tap the cylinder with a brass bar to bring it to its proper position in the casing.

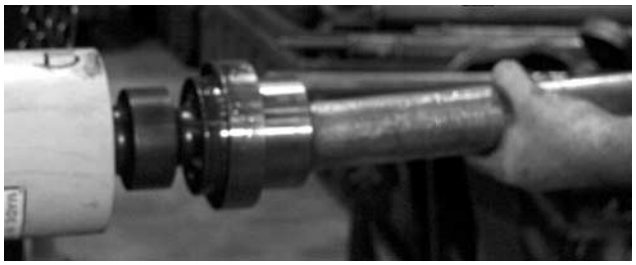




DHD ASSEMBLY (cont.)

3. Install the air distributor o-ring (if removed) and install the air distributor into the cylinder. Tap the air distributor with a brass bar to seat it in place.



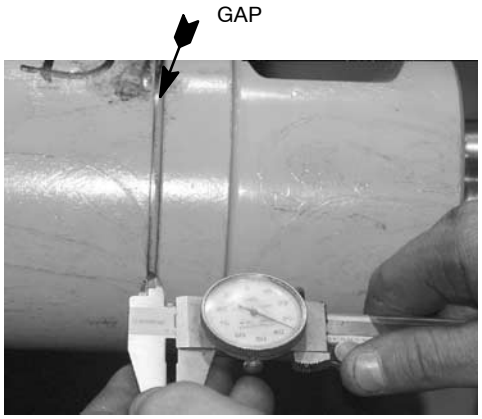


4. Install the check valve and spring insuring the valve cycles freely.

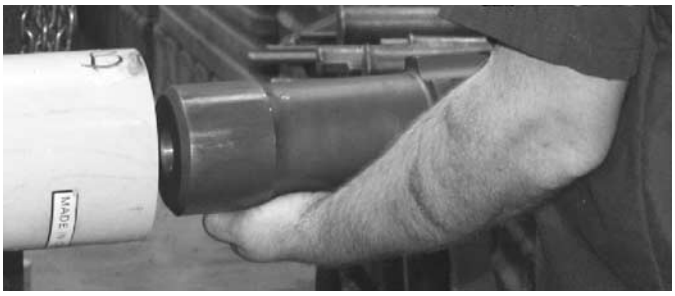
5. Arranging the belleville springs as shown, install the belleville stack and wear spacer (if used) on the air distributor.

DHD ASSEMBLY (cont.)

6. Coat the backhead threads with thread lubricant and install in the casing. When made up hand tight, there will be a gap between the backhead and casing shoulders. If there is no gap, install a wear spacer above the belleville springs. this gap must be closed by torqueing the threaded joint before drilling commences.



8. Install the piston (small end first) in the casing from the chuck end. Push the piston by hand well past the bearing retainer ring groove. If the piston does not slide freely in the bore under hand pressure, check for dirt, debris, or distorted parts that are interfering with piston action.

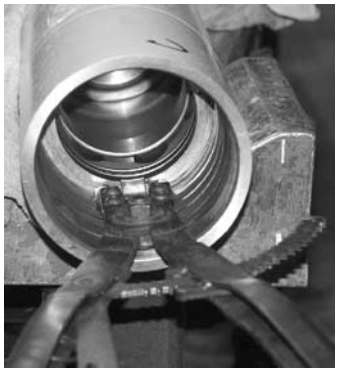


9. Install the piston retainer ring into the casing by starting it sideways, turning it to its proper orientation near the groove until it snaps into place. A brass rod will be needed to tap the ring into its place. ***Be sure to wear safety glasses as oil and grease in the groove may be expelled when the ring snaps in place.*** DHD 380 and DHD112 models use a polymer piston retaining ring. These are installed by hand. A screwdriver may be helpful to insure the ring is evenly seated in its groove.

DHD ASSEMBLY (cont.)

10 If your hammer is furnished with a bit bearing insure the bit bearing o-ring is in good condition. Slide the bearing (stepped end first) into the casing until it seats against the bearing retainer ring. The bearing may require tapping with a brass rod to keep it from binding in the casing bore. The piston may be used to seat the bearing by inserting it into the casing, large end first, and tapping the bearing in place. Heavy impact is not normally required. If the bearing is very tight, it may indicate damage to the bearing and/or casing.

11. If your hammer is furnished with a bearing retainer and/or belleville springs on the chuck end, assemble them as shown. A retaining ring pliers is required to install the retainer on DHD360 and SF6 models. A flat bladed screwdriver may be helpful for installation of the bearing retainer on DHD310M and DHD112 models.

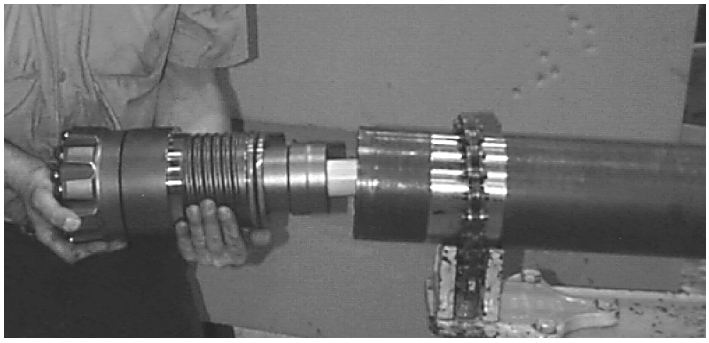


12. Coat the bit splines liberally with copper or zinc based thread compound and install the chuck on the bit.

DHD ASSEMBLY (cont.)

13. Install the bit retaining ring and o-ring onto the bit and chuck.

14. Coat the chuck threads with copper or zinc based thread compound and thread the bit, chuck, and retainer ring assembly into the casing. ***Be sure to torque the chuck to specifications before drilling.***



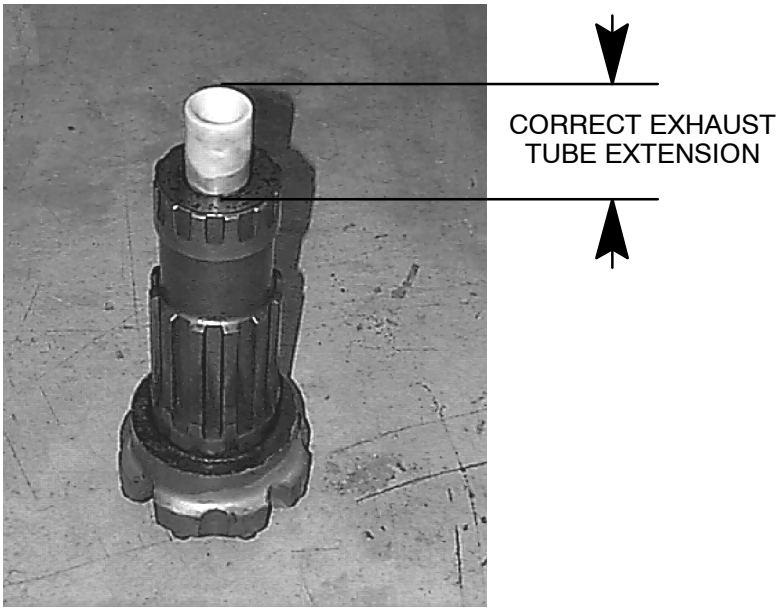
EXHAUST TUBE REPLACEMENT & INSTALLATION

Exhaust tubes (footvalves) can become damaged during handling or physically eroded while in service, the net result is that they need to be serviced from time to time.

Tube failures will generally occur due to erosion caused by the jetting of water, oil and grit which is displaced as the piston strikes the bit. This form of failure is common in waterwell applications where injection rates are high. This high velocity jet of material actually erodes away the base of the tube and can eventually cause the tube to fail. Tube erosion can be reduced by insuring water is clean and free from particulate matter and that excessive fluid injection is avoided. It's a good idea to monitor tube erosion and make replacements as needed before a hole is started to avoid a costly trip out of the hole.

Exhaust tubes can be removed by cutting off the remaining portion of the tube and prying the remaining piece out with a screwdriver. It may be useful to use a small rotary file to relieve the bore of the tube which remains in the bit. ***However, be careful not to touch the bit tube bore with the rotary file or a heat check followed by bit failure may result. The tube can also be heated slightly to soften the plastic. Avoid breathing fumes which may come from the heated plastic and also be careful not to overheat the bit.***

A new exhaust tube can be installed by driving the tube into the bit with a rubber faced mallet or with a block of wood between the hammer and tube. Do not hit the tube directly with a metal hammer or the tube may be damaged. Alternatively, the tube can be pressed into the bore using a press or even the table and feed on a drilling rig. Be careful not to over-press the tube. Refer to Section 4 for the correct exhaust tube extension.



BITS

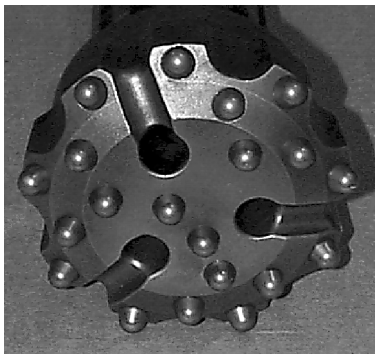
SELECTION

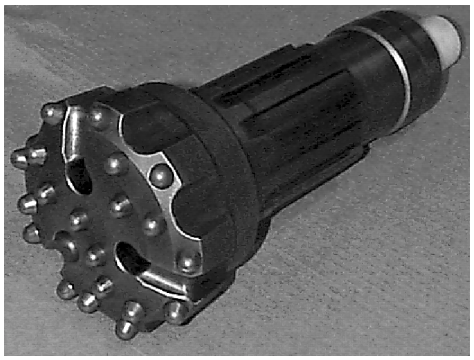
Proper selection of the correct bit type along with good service practice can reduce operating costs and improve production considerably. The sections following will assist you with the bit selection process and provide instruction for service practice.

CONVEX HEAD CONICAL TIPPED

Soft materials which are less than 15,000 psi (1033.5 bar) compressive strength. The material should also be consolidated and homogeneous with a low abrasiveness.

- Soft limestone
- Shale
- Slate

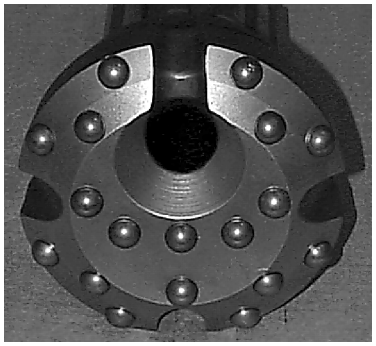


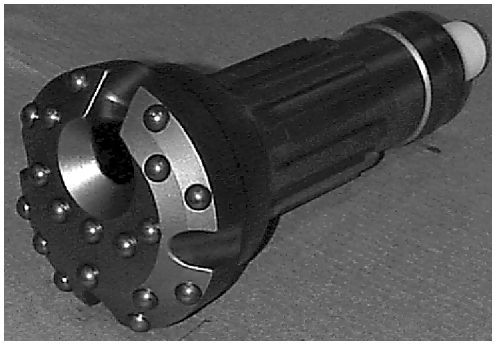


CONVEX HEAD SPHERICAL TIPPED DUROROC®

Medium hard materials which are 15,000 – 25,000 psi (1033.5 – 1722.5 bar) compressive strength. The material should be consolidated and homogenous.

- Hard limestone
- Granite
- Sandstone
- Diorite
- Schist
- Marble



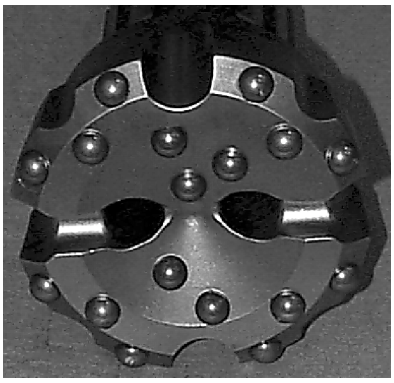


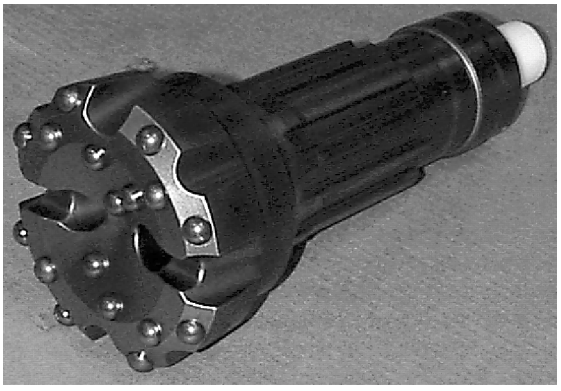
BITS (cont.)

CONCAVE FACE

Medium-soft to medium-hard materials which are 15,000 - 30,000 psi (1033.5 - 2067 bar) compressive strength. Material can be voided, fractured, unconsolidated and faulted. Face slots provide good hole cleaning in fast drilling applications.

- Hard limestone
- Granite
- Sandstone
- Diorite
- Schist
- Marble

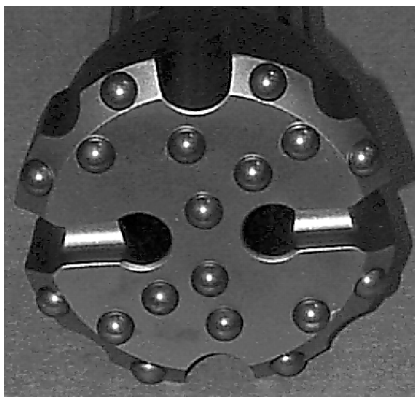


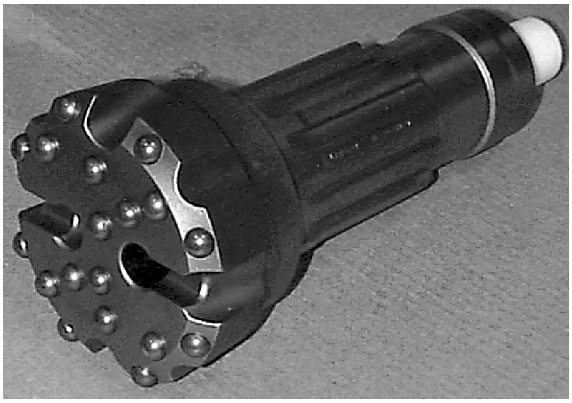


FLAT FACE

Medium-hard to hard materials which are greater than 30,000 psi (2067 bar). Materials should be consolidated but a certain level of voids and fractures are acceptable. The flat face design has the strongest head.

- Granite
- Gabbro





BITS (cont.)

SERVICE

Bits need to be sharpened and serviced just like any other cutting tool would. The following provides tips and suggestions for proper bit maintenance.

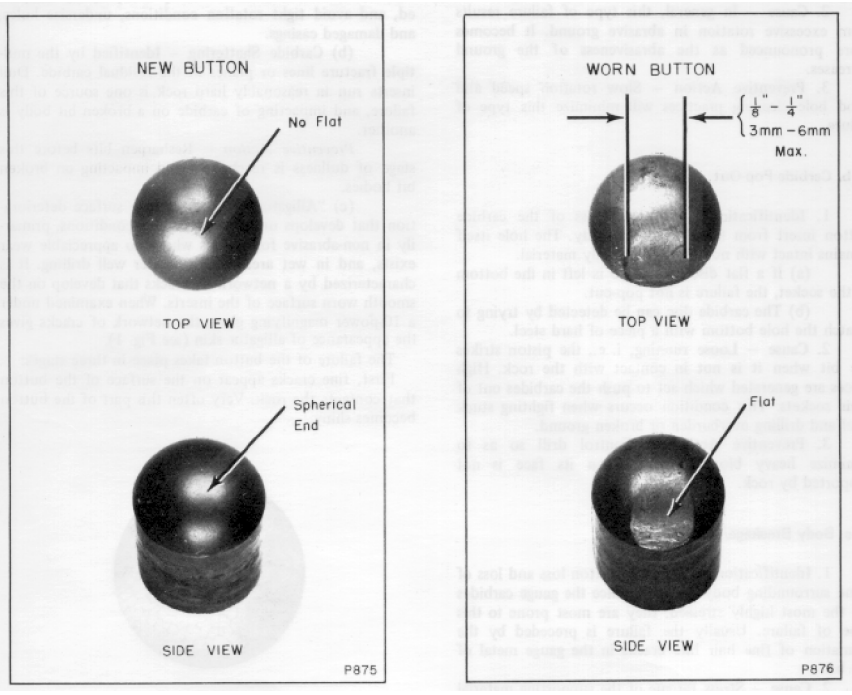
BIT SHARPENING

The sharper a bit insert is the faster you will penetrate and the longer your bit will last. The objective is to penetrate the insert into the rock so that chips can be created. A sharper insert will penetrate deeper and generate larger cuttings. Also, the stresses on a sharp insert are lower those on a dull insert. Lower stresses mean longer insert life and reduced risk of socket bottom failures. The bottom line is

Keep those inserts sharp!!

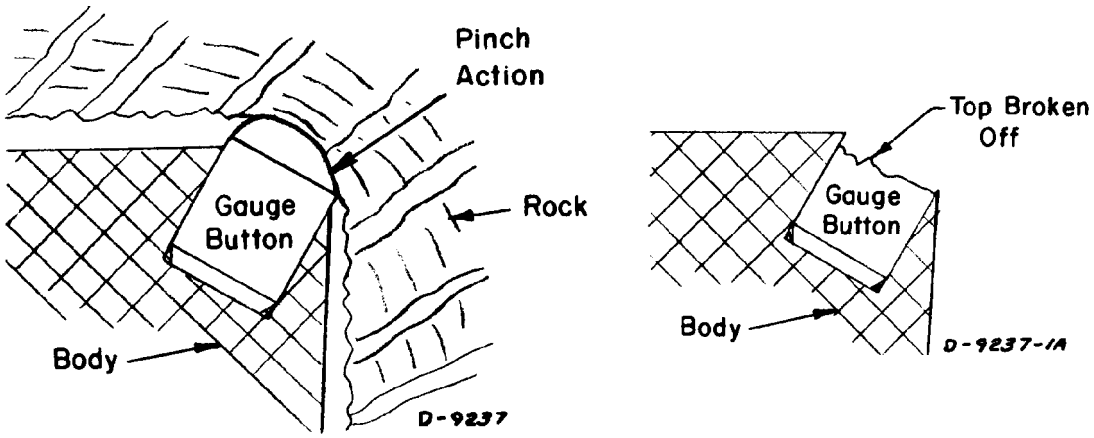
Inserts should be sharpened whenever the flat size becomes greater than 1/4 in. (6 mm). A handheld grinder or water cooled cup grinder should be used. The larger the flat becomes the longer it will take to sharpen the insert.

In many cases the carbide may wear faster than the body material. In these cases a grinder should also be used to remove body material so the carbide can be sharpened correctly. The body material may also need to be removed to expose the carbide. Use caution to avoid overheating and cracking the alloy steel bit body. While dressing up a bit body, any sharp edges or burrs should also be removed particularly around the blow holes and other places where edges may be rolled over.



BITS (cont.)

The gage of the bit also must be sharpened to insure pinching does not take place. As the figure following shows, pinching is caused by a wear flat which is on the side and not the tip of the insert. This form of wear, if not corrected, can lead to carbide fractures.



Atlas Copco offers sharpening equipment specifically designed to keep your bit in top working condition. The chart below lists the part numbers for bit grinders, grinding, cups, and button gages. Contact your Dealer for details.

Description	Part No.	Description	Part No.
Bit Grinder	52315504	Button Gauge	51914869
3/8” Spherical Cup	52315512	9/16” Spherical Cup	52315579
3/8” Ballistic Cup	52315520	9/16” Ballistic Cup	52315587
7/16” Spherical Cup	52315538	5/8” Spherical Cup	52316841
7/16” Ballistic Cup	52315546	5/8” Ballistic Cup	52316858
1/2” Spherical Cup	52315553	3/4” Spherical Cup	52316866
1/2” Ballistic Cup	52315561	3/4” Ballistic Cup	52316874

TROUBLESHOOTING

The majority of DHD operating problems can be traced to improper operation. These troubleshooting charts will help you by suggesting a probable cause and a recommended remedy.

TROUBLESHOOTING GUIDE

Problem	Cause(s)	Remedy(s)
Rough-erratic operation	1. Too much water injection.	1. Reduce level of water injection.
	2. Chuck has worn too much.	2. Inspect chuck length for correct body length. A short chuck will restrict air needed to return piston. Note that body length is the distance from the shoulder which contacts the casing to the shoulder that contacts the bit.
	3. Rotation speed too slow.	3. Increase rotation speed to get no more than 1/2 in. (12.7 mm) advance per revolution. Watch flat on carbide; if it's on the leading edge of the insert rotation's too slow.
	4. Feed too hard.	4. Set feed pressure (decrease holddown or increase holdback) just until pulsation in rotation pressure falls and pressure is steady.
	5. Worn bit bearing.	5. Replace bit bearing. Leakage past bit bearing may cause piston to lack upstroke force making cycle erratic.
	6. Worn piston exhaust tube bore or exhaust tube.	6. Inspect piston bore and exhaust tube vs. specification. Replace if needed. Leakage past this clearance can reduce piston upstroke force making cycle erratic..
Low penetration/high pressure.	1.Chuck has worn too much..	1. Inspect chuck length for correct body length. A short chuck will restrict air needed to return piston.
	2. Too much water injection.	2.Reduce level of water injection
	3. Contamination (rubber hose, etc.) jammed in hammer.	3. Remove obstruction which may be restricting the air flow.

TROUBLESHOOTING GUIDE (cont.)

Problem	Cause(s)	Remedy(s)
	4 Exhaust tube projection too long.	4. Check projection vs. specifications repair tube.
Low penetration/low pressure.	1. Lack of oil.	1. Insure lubricator is working and hammer is getting coated with oil. Check bit blow ports for oil film.
	2. Worn drill clearances.	2a. Inspect piston for wear particularly on large diameter just beneath scallops. This is the most sensitive diameter. Check other diameters; tail diameter for wear. Compare all to specification. 2b. Inspect guide diameter for wear. Compare with specification and replace if necessary. 2c. Check cylinder bore for wear. Compare to specification and replace if necessary. 2d. Check casing bore for wear. Compare to specification and reverse or replace if necessary. 2e. Check bearing bore for wear. Compare to specification and replace if necessary.
Drill running off bottom	1. Worn piston. 2. Excessive water injection. 3. Debris (cuttings, mud) between chuck & bit spline	1. Inspect large diameter of piston for wear. Leakage past the large diameter can cause the piston to cycle when off bottom. 2. Try reducing water injection level. Water inhibits the air venting process which is needed to shut the hammer off. 3. Clear debris.
Chuck hard to loosen	1. Poor gripping. 2. Conditions	1a. Don't grip over threads. 1b. Insure tong jaws are sharp. 2a. Try using breakout washer.

(Continued)

TROUBLESHOOTING GUIDE (cont.)

Problem	Cause(s)	Remedy(s)
Compressor unloading	1.Excessive water injection 2.Mud Rings	1. Reduce water injection rate. 2. Clear mud ring. Increase water injection. Consider adding foam.
Hammer won't start	1. Mud or dirt in hammer 2. Broken exhaust tube 3. Broken internal parts	1. Disassemble, clean, inspect & repair hammer. Check for proper function of check valve. 2. Replace tube. Inspect Bearing and Chuck 3. Replace broken parts.
Component failures	1. Piston cracked through large diameter.	1a. Lack of lubrication could cause frictional cracks. Check lubricator and insure oil film is developed on bit blow holes. 1b. Wrenching over wrong location distorts casing and causes frictional rubbing with piston. Apply tong wrench pressure in correct location. 1c. Fighting or getting stuck in hole heats and distorts casing bore causing frictional heat and cracks on piston. Flood tool with water when stuck. 1d. Collaring on an angle or feeding hard through voided, faulted or broken ground can cause casing to distort and rub piston causing cracks. Use light feed when going through tough conditions.
	2. Piston struck end cupping or breaking.	2a. Usually a sign of underfeeding. Increase feed until rotation pressure pulses and then back down till smooth. 2b. Cavitation from excess water injection can cause small pits in piston face. These pits turn into cracks. Avoid excessive water injection.

TROUBLESHOOTING GUIDE (cont.)

Problem	Cause(s)	Remedy(s)
	3. Cracked casing.	3a. Hammering, welding and wrenching in wrong location can fail casings; avoid these practices & use sharp tong jaws to loosen connections. 3b. Corrosion from internal undercuts and threads; use good quality (neutral pH) water and flush with oil when finished drilling. If possible, coat threaded areas undercuts and bore of casing with corrosion protector such as LPS Hardcoat. 3c. Look for beat in chuck which could allow the piston to stroke far enough to contact air distributor and overstress the casing. Replace chuck if worn more than specification. 3e. Casing has worn beyond discard point. Measure casing OD about 2 in. (50.8 mm) from chuck end. Compare to specification and replace if needed. 3f. Backhead or chuck thread loose. Be sure threaded joints are tight. Do not reverse rotate or allow hammer to cycle without rotation.
	4. Rolled over chuck	4. Underfeeding can cause the bit to rebound into shoulder of the chuck and generate a rolled up edge. Increase feed force.
	5. Cracked backhead-body.	5. Fighting from hole and pulling backhead through caved-in materials creates frictional heat. Rotate slowly and/or flood with water when stuck.
	6. Cracked backhead threaded connection.	6. Look for evidence of connection moving on contact shoulder. Connection shoulder may be worn allowing movement. Replace/repair adapter sub or rod..

(continued)

TROUBLESHOOTING GUIDE (cont.)

Problem	Cause(s)	Remedy(s)
Breaking exhaust tubes	1. Erosion.	1a. Water jetting erodes base of bit tube at striking surface. Reduce level of water injection.
		1b. Contaminants in water mix and cause abrasive blast at base of exhaust tube. Use clean water.
	2. Damage.	2a. Damaging tubes when changing bits. Be careful to thread casing onto chuck while vertical and in alignment.
		2b. Use care when transporting bits to avoid damage to tube. Keep bit in box until needed.
	3. Bit tube bore small.	3. The tube bore of a bit can become deformed and pinch the tube. Look for a rolled over edge or deformation at the top of the bit bore. Remove by grinding away lip.
Chuck loosening in hole	1. Running loose.	1a. Refer to proper feed settings (Section 1)
		1b. Avoid feathering feed in loose ground or at end of rod.
	2. Improper make up torque.	2a. Tong chuck tight before drilling.

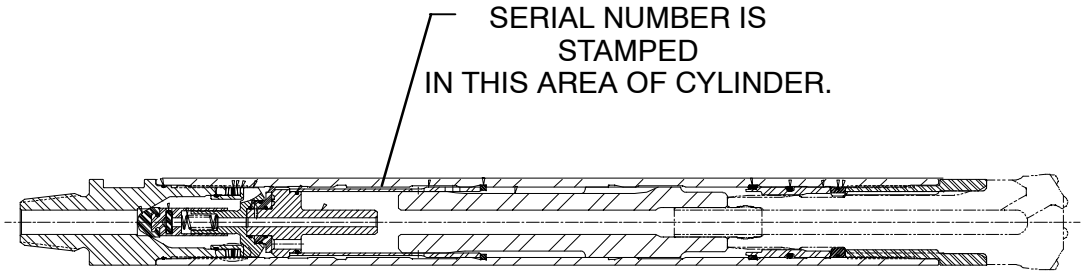
INTRODUCTION

ORDERING INSTRUCTIONS

When ordering service parts, please specify:

1. The **NAME** of each part as listed.
2. The **PART NUMBER** as listed or stamped on the part.
3. The **SERIAL NUMBER** of the equipment.

DO NOT use illustration numbers when ordering service parts. To save time, send all orders for parts to the nearest branch office or agent. *IF IT IS NECESSARY TO SEND ANY PART OF THIS EQUIPMENT TO THE FACTORY, INQUIRE AT OUR NEAREST BRANCH OFFICE OR AGENT FOR SPECIAL INSTRUCTIONS.*



NOTICE

SAVE THIS PARTS LIST. DO NOT DESTROY.

The use of repair parts other than those included within the Atlas Copco approved parts list may create hazardous conditions over which Atlas Copco has no control. Therefore lAtlas Copco cannot be held responsible for equipment in which non-approved repair parts are installed.

All information, illustrations, and specifications in this manual are based on the latest information available at the time of publication. Product improvement is a continuing goal at Atlas Copco. Design and specifications are subject to change without notice or obligation.

When the life of the machine has expired, it is recommended that the machine be disassembled, degreased and parts be separated by material so that they can be recycled.

BIT SELECTION

CPN	Symbol	Shank	Face Style	Insert Style	Exhaust tube part no.	Drive pin part no.	Gage insert Size	Gage insert Qty	Face insert Size	Face insert Qty	Total Qty
DHD3.5, TD35 bits>>>>>>>>>>											
51368280	90B3.5ES	3.5	Convex face	Spherical	51297752	n/a	0.437	8	0.437	7	15
51353605	90B3.5ESB	3.5	Convex face	Ballistic	51297752	n/a	0.437	8	0.437	7	15
51307791	93B3.5ESB	3.5	Convex face	Ballistic	51297752	n/a	0.437	8	0.437	7	15
51368272	93B3.5ES	3.5	Convex face	Spherical	51297752	n/a	0.437	8	0.437	7	15
51994929	100B3.5ESB	3.5	Flat face	Ballistic	51297752	n/a	0.437	8	0.437	8	16
51900777	100B3.5ES	3.5	Flat face	Spherical	51297752	n/a	0.437	8	0.437	8	16
52291564	100B3.5VB	3.5	Convex face	Ballistic	51297752	n/a	0.437	8	0.437	8	16
DHD4/340A bits>>>>>>>>>>											
51296572	4-1/8B34AESD	340A	Flat face	Spherical	51053726	n/a	0.563	8	0.500	8	16
51296093	4-1/8B34AESB	340A	Flat face	Ballistic	51053726	n/a	0.500	7	0.500	6	13
51296556	4-1/2B34AESD	340A	Flat face	Spherical	51053726	n/a	0.563	8	0.500	8	16
51364032	5B34AESD	340A	Flat face	Spherical	51053726	n/a	0.563	7	0.563	6	13
DHD 350R bits>>>>>>>>>>											
51060689	5-1/8B35AES	350R	Flat face	Spherical	56033467	n/a	0.625	7	0.625	7	14
51064426	5-1/4B35A	350R	Flat face	Spherical	56033467	n/a	0.625	7	0.625	7	14
52327590	5-1/4B35FY	350R	Flat face	Spherical-IMPAC	56033467	n/a	0.563	8	0.563	8	16
51060705	5-1/2B35AES	350R	Flat face	Spherical	56033467	n/a	0.625	8	0.625	7	15
51247047	5-1/2B35ADR	350R	Convex face	Spherical	56033467	n/a	0.625	8	0.625	8	16
51064467	5-1/2B35ACF	350R	Concave face	Spherical	56033467	n/a	0.563	8	0.563	8	16
52336526	5-1/2B35CXB	350R	Concave face	Spherical-ballistic	56033467	n/a	0.563	8	0.563	8	16
52138369	5-1/2B35VB	350R	Convex face	Conical	56033467	n/a	0.625	8	0.625	7	15
51249639	5-3/4B35AES	350R	Flat face	Spherical	56033467	n/a	0.625	8	0.625	10	18
51996908	5-3/4B35ADR	350R	Convex face	Spherical	56033467	n/a	0.625	8	0.625	8	16
51996890	5-3/4B35ACFES	350R	Concave face	Spherical	56033467	n/a	0.625	8	0.625	8	16
51307551	6B35ACFES	350R	Concave face	Spherical	56033467	n/a	0.625	8	0.625	8	16

WARNING: This manual contains data SPECIFIC to DHD Classic Series Down-hole Drills.

BIT SELECTION

CPN	Symbol	Shank	Face Style	Insert Style	Exhaust tube part no.	Drive pin part no.	Gage insert Size	Gage insert Qty	Face insert Size	Face insert Qty	Total Qty
	DHD 360/SF6 bits>>>>>>>>>										
51302370	6B36	360/SF6	Flat face	Spherical	51357226	n/a	0.625	8	0.625	10	18
52315140	6B36FY	360/SF6	Flat face	Spherical-IMPAC	51357226	n/a	0.625	8	0.625	10	18
50899574	6B36CF	360/SF6	Concave face	Spherical	51357226	n/a	0.625	8	0.625	8	16
52315157	6B36CY	360/SF6	Concave face	Spherical-IMPAC	51357226	n/a	0.625	8	0.625	8	16
51302388	6-1/8B36	360/SF6	Flat face	Spherical	51357226	n/a	0.625	8	0.625	10	18
52298981	6-1/8B36FY	360/SF6	Flat face	Spherical	51357226	n/a	0.625	8	0.625	10	18
51716934	6-1/8B36CFES	360/SF6	Concave face	Spherical	51357226	n/a	0.625	8	0.625	8	16
52313566	6-1/8B36CY	360/SF6	Concave face	Spherical-IMPAC	51357226	n/a	0.625	8	0.625	8	16
52308467	6.19B36CYYY	360/SF6	Dbl gage concave face	Spherical-IMPAC	51357226	n/a	0.625	8	0.625	8	16
52303021	6.25B36NNN	360/SF6	Dbl gage concave face	Spherical	51357226	n/a	0.750	8	0.625	11	19
52310364	6.25B36SSS	360/SF6	Dbl gage concave face	Spherical	51357226	n/a	0.750	8	0.625	11	19
52286168	6.25B36DYY	360/SF6	Dbl gage concave face	Spherical-PCD-IMPAC	51357226	n/a	0.750	8	0.625	11	19
52308087	6.25B36NYY	360/SF6	Dbl gage concave face	Spherical-IMPAC	51357226	n/a	0.750	8	0.625	11	19
52302502	6.25B36YYY	360/SF6	Dbl gage concave face	Spherical-IMPAC	51357226	n/a	0.750	8	0.625	11	19
52287505	6.25B36DSS	360/SF6	Dbl gage concave face	Spherical	51357226	n/a	0.750	8	0.625	11	19
52291457	6.25B36DDD	360/SF6	Dbl gage concave face	Spherical	51357226	n/a	0.750	8	0.625	11	19
52299039	6.25B36G10DYY	360/SF6	Concave face	Spherical-PCD-IMPAC	51357226	n/a	0.750	10	0.625	9	19
52323417	6.25B36G10YYY	360/SF6	Concave face	Spherical-IMPAC	51357226	n/a	0.750	10	0.625	9	19
51302404	6-1/4B36	360/SF6	Flat face	Spherical	51357226	n/a	0.625	8	0.625	10	18
52315165	6-1/4B36FY	360/SF6	Flat face	Spherical-IMPAC	51357226	n/a	0.625	8	0.625	10	18
51075661	6-1/4B36CF	360/SF6	Concave face	Spherical	51357226	n/a	0.625	8	0.625	10	18
52315173	6-1/4B36CY	360/SF6	Concave face	Spherical-IMPAC	51357226	n/a	0.625	8	0.625	10	18
52337003	6-1/4B36NY	360/SF6	Dbl gage concave face	Spherical-IMPAC	51357226	n/a	0.625	10	0.625	10	20
52297934	6-1/4B36XY	360/SF6	Flat face	Spherical-IMPAC-NO GAGE	51357226	n/a	0.625	8	0.625	9	17
52313509	6-1/4B36XYYY	360/SF6	Flat face	Spherical-IMPAC	51357226	n/a	0.625	8	0.625	9	17
52308574	6-1/4B36DY	360/SF6	Flat face	Spherical-PCD-IMPAC	51357226	n/a	0.625	8	0.625	9	17
51996759	6-3/8B36CFES	360/SF6	Concave face	Spherical	51357226	n/a	0.625	8	0.625	8	16
52317377	6-3/8B36G8YYY	360/SF6	Dbl gage concave face	Spherical-IMPAC	51357226	n/a	0.750	8	0.625	11	19
52317385	6-3/8B36G8DYY	360/SF6	Dbl gage concave face	Spherical-PCD-IMPAC	51357226	n/a	0.750	8	0.625	11	19
52308046	6-3/8B36G8NYY	360/SF6	Dbl gage concave face	Spherical-IMPAC	51357226	n/a	0.750	8	0.625	11	19
52308038	6-3/8B36G8NNN	360/SF6	Dbl gage concave face	Spherical	51357226	n/a	0.750	8	0.625	11	19
52299047	6.375B36G12DYY	360/SF6	Concave face	Spherical-PCD-IMPAC	51357226	n/a	0.750	12	0.625	11	23
52336864	6.375B36G12DDD	360/SF6	Concave face	Spherical-PCD	51357226	n/a	0.750	12	0.625	11	23
52333754	6.375B36G12YYY	360/SF6	Concave face	Spherical-IMPAC	51357226	n/a	0.750	12	0.625	11	23
52323896	6.375B36G12NYY	360/SF6	Concave face	Spherical-IMPAC	51357226	n/a	0.750	12	0.625	11	23
52328259	6.375B36G12NNN	360/SF6	Concave face	Spherical	51357226	n/a	0.750	12	0.625	11	23
52328820	6.375B36G12NBB	360/SF6	Concave face	Conical	51357226	n/a	0.750	12	0.625	11	23
52303039	6.50B36CNNN	360/SF6	Dbl gage concave face	Spherical	51357226	n/a	0.750	8	0.625	11	19
52286176	6.50B36CDYY	360/SF6	Dbl gage concave face	Spherical-PCD-IMPAC	51357226	n/a	0.750	8	0.625	11	19
52287513	6.50B36CDSS	360/SF6	Dbl gage concave face	Spherical	51357226	n/a	0.750	8	0.625	11	19
52308079	6.50B36CNYY	360/SF6	Dbl gage concave face	Spherical-IMPAC	51357226	n/a	0.750	8	0.625	11	19
52310778	6.50B36CYYY	360/SF6	Dbl gage concave face	Spherical-IMPAC	51357226	n/a	0.750	8	0.625	11	19
52316882	6.50B36CDDD	360/SF6	Dbl gage concave face	Spherical-PCD	51357226	n/a	0.750	8	0.625	11	19
52328275	6.50B36CBBB	360/SF6	Dbl gage concave face	Conical	51357226	n/a	0.750	8	0.625	11	19
52298957	6.50B36G12DYY	360/SF6	Concave face	Spherical-PCD-IMPAC	51357226	n/a	0.750	12	0.625	11	23
52302346	6.50B36G12NYY	360/SF6	Concave face	Spherical-IMPAC	51357226	n/a	0.750	12	0.625	11	23

BIT SELECTION

CPN	Symbol	Shank	Face Style	Insert Style	Exhaust tube part no.	Drive pin part no.	Gage insert Size	Gage insert Qty	Face insert Size	Face insert Qty	Total Qty
DHD 360/SF6 bits>>>>>>>>>											
52328838	6.50B36G12NBB	360/SF6	Concave face	Conical	51357226	n/a	0.750	12	0.625	11	23
52291689	6.50B36	360/SF6	Flat face	Spherical	51357226	n/a	0.625	8	0.625	11	19
52317203	6.50B36XNYY	360/SF6	Flat face	Spherical	51357226	n/a	0.625	8	0.625	11	19
51211787	6-1/2B36CFES	360/SF6	Concave face	Spherical	51357226	n/a	0.625	8	0.625	8	16
52131836	6.500B36CE	360/SF6	Concave face	Spherical	51357226	n/a	0.625	8	0.625	8	16
50764968	6-1/2B36	360/SF6	Flat face	Spherical	51357226	n/a	0.625	8	0.625	11	19
51223477	6-1/2B36DR	360/SF6	Convex face	Spherical	51357226	n/a	0.625	8	0.625	10	18
51793743	6-1/2B36CFHD	360/SF6	Concave face	Spherical	51357226	n/a	0.750	8	0.625	8	16
51065662	6-1/2B36ES	360/SF6	Flat face	Spherical	51357226	n/a	0.625	8	0.625	11	19
52310406	6-1/2B36ESX	360/SF6	Flat face	Spherical-NO GAGE	51357226	n/a	0.625	8	0.625	11	19
52292158	6-1/2B36ESY	360/SF6	Flat face	Spherical-IMPAC	51357226	n/a	0.625	8	0.625	11	19
51997443	6-1/2B36ESV	360/SF6	Flat face	Spherical	51357226	n/a	0.625	8	0.625	11	19
51711133	6-3/4B36CFES	360/SF6	Concave face	Spherical	51357226	n/a	0.625	8	0.625	10	18
51986776	6-3/4B36CEX	360/SF6	Concave face	Spherical	51357226	n/a	0.625	10	0.625	11	21
52314606	6-3/4B36CEB	360/SF6	Concave face	Spherical-Conical	51357226	n/a	0.625	10	0.625	11	21
51996916	6-3/4B36DR	360/SF6	Convex face	Spherical	51357226	n/a	0.625	8	0.625	10	18
51996924	6-3/4B36VH	360/SF6	Convex face	Spherical	51357226	n/a	0.750	9	0.625	11	20
51983633	8B36T	360/SF6	Flat face	Spherical	51357226	n/a	0.625	10	0.625	14	24
50810449	8B36	360/SF6	Flat face	Spherical	51357226	n/a	0.625	10	0.625	14	24
51777621	8-1/2B36CBR	360/SF6	Concave face	Spherical	51357226	n/a	0.750	10	0.750	20	30

WARNING: This manual contains data SPECIFIC to DHD Classic Series Down-hole Drills.

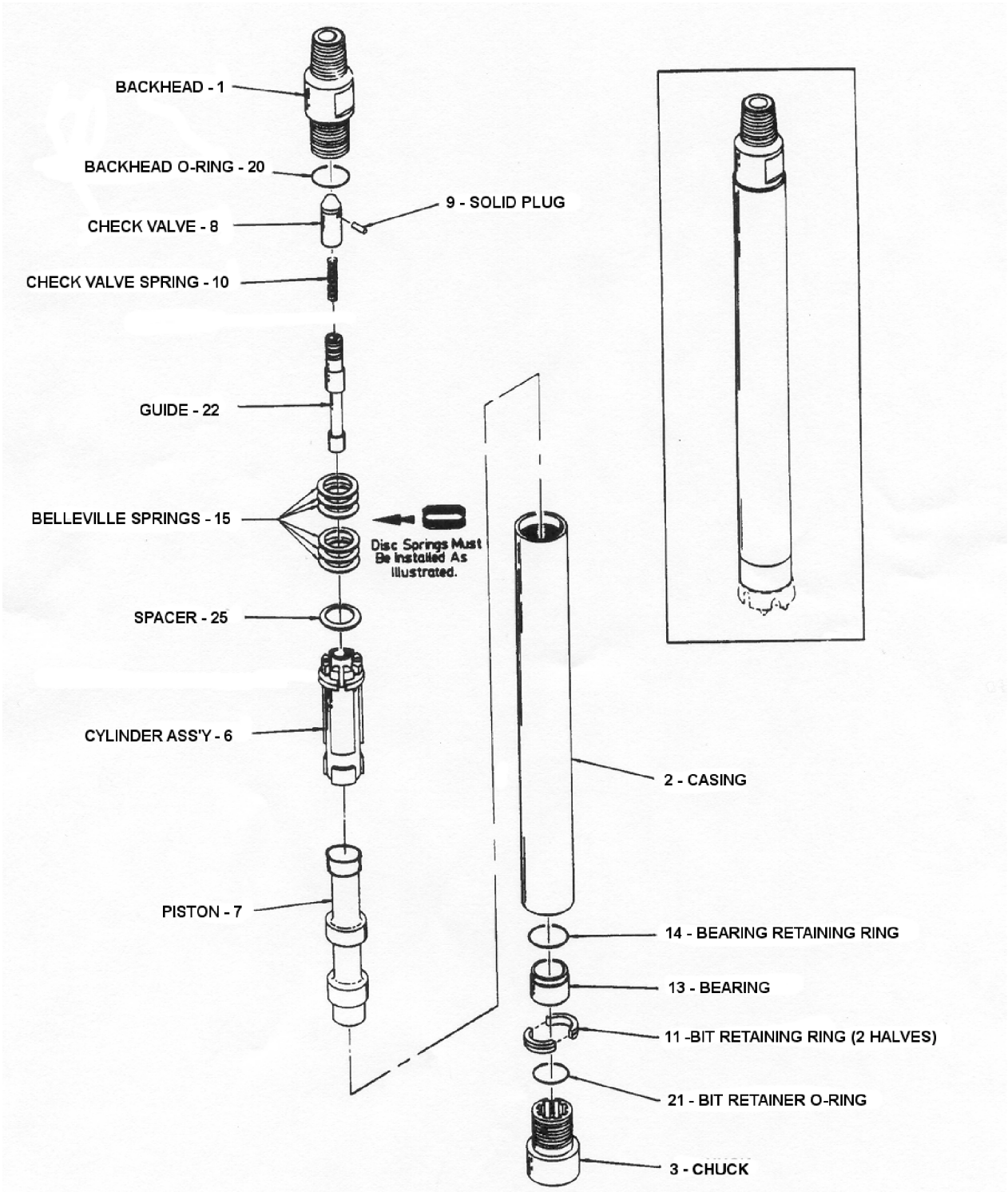
BIT SELECTION

CPN	Symbol	Shank	Face Style	Insert Style	Exhaust tube part no.	Drive pin part no.	Gage insert Size	Gage insert Qty	Face insert Size	Face insert Qty	Total Qty
	DHD 380 bits>>>>>>>>>										
51009991	7-7/8B38	380	Concave face	Spherical	56033525	n/a	0.750	14	0.625	7	21
52285608	7-7/8B38LYG10YY	380	Concave face	Spherical	56033525	n/a	0.750	10	0.750	13	23
52285764	7-7/8B38LG10DDD	380	Concave face	Spherical	56033525	n/a	0.750	10	0.750	13	23
52285665	7-7/8B38LG10DYY	380	Concave face	Spherical-PCD-IMPAC	56033525	n/a	0.750	10	0.750	13	23
52285723	7-7/8B38LG10NYY	380	Concave face	Spherical	56033525	n/a	0.750	10	0.750	13	23
52286200	7-7/8B38LG10NNN	380	Concave face	Spherical	56033525	n/a	0.750	10	0.750	13	23
50951680	8B38	380	Concave face	Spherical	56033525	n/a	0.750	8	0.750	13	21
52327988	8B38CY	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	8	0.750	12	20
52335965	8B38LG10SSS	380	Concave face	Spherical	56033525	n/a	0.750	10	0.750	13	23
52303013	8B38LG10NYY	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	10	0.750	13	23
52313145	8B38LG10NNN	380	Concave face	Spherical	56033525	n/a	0.750	10	0.750	13	23
52310810	8B38RG10NNN	380	Concave face	Spherical	56033525	n/a	0.750	10	0.750	13	23
51957439	8-1/2B38FF	380	Flat face	Spherical	56033525	n/a	0.750	10	0.750	13	23
50951706	8-1/2B38	380	Concave face	Spherical	56033525	n/a	0.750	10	0.625	16	26
52307865	8-1/2B38LG10NNN	380	Concave face	Spherical	56033525	n/a	0.750	10	0.625	16	26
50747880	8-5/8B38	380	Concave face	Spherical	56033525	n/a	0.750	10	0.625	16	26
52307857	8-5/8B38LG10NNN	380	Concave face	Spherical	56033525	n/a	0.750	10	0.625	16	26
52335973	8-5/8B38LG10SSS	380	Concave face	Spherical	56033525	n/a	0.750	10	0.625	16	26
50747906	8-3/4B38Y	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	10	0.625	16	26
52313251	8-3/4B38CG12DYY	380	Concave face	Spherical-PCD-IMPAC	56033525	n/a	0.750	12	0.750	14	26
52285624	8-3/4B38LG12YYY	380	Concave face	Spherical	56033525	n/a	0.750	12	0.750	14	26
52285814	8-3/4B38LG12DDD	380	Concave face	Spherical-PCD	56033525	n/a	0.750	12	0.750	14	26
52285681	8-3/4B38LG12DYY	380	Concave face	Spherical-PCD-IMPAC	56033525	n/a	0.750	12	0.750	14	26
52285749	8-3/4B38LG12NYY	380	Concave face	Spherical	56033525	n/a	0.750	12	0.750	14	26
52286226	8-3/4B38LG12NNN	380	Concave face	Spherical	56033525	n/a	0.750	12	0.750	14	26
52308475	8-3/4B38RG12DDD	380	Concave face	Spherical-PCD	56033525	n/a	0.750	12	0.750	14	26
52310794	8-3/4B38RG10NNN	380	Concave face	Spherical	56033525	n/a	0.750	10	0.750	14	24
52312980	8-3/4B38LG10NYY	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	10	0.750	14	24
52313137	8-3/4B38LG10NNN	380	Concave face	Spherical	56033525	n/a	0.750	10	0.750	14	24
52316908	8-3/4B38CG16NYY	380	Concave face	Spherical	56033525	n/a	0.750	16	0.750	17	33
50747922	8-7/8B38	380	Concave face	Spherical	56033525	n/a	0.750	10	0.625	16	26
52310349	8-7/8B38CY	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	10	0.625	16	26
52310489	8-7/8B38CG12YYY	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	12	0.750	14	26
52313269	8-7/8B38CG12DYY	380	Concave face	Spherical-PCD-IMPAC	56033525	n/a	0.750	12	0.750	14	26
52317211	8-7/8B38CG12DDD	380	Concave face	Spherical-PCD	56033525	n/a	0.750	12	0.750	14	26
52328804	8-7/8B38CG12NNN	380	Concave face	Spherical	56033525	n/a	0.750	12	0.750	14	26
52335981	8-7/8B38LG10SSS	380	Concave face	Spherical	56033525	n/a	0.750	10	0.750	14	24
52302625	8-7/8B38LG10NNN	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	10	0.750	14	24
52302833	8-7/8B38LG10NYY	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	10	0.750	14	24
52315488	8-7/8B38RG10NYY	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	10	0.750	14	24
52315496	8-7/8B38RG10NNN	380	Concave face	Spherical	56033525	n/a	0.750	10	0.750	14	24
52315470	8-7/8B38RG10YYY	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	10	0.750	14	24
52323805	8-7/8B38RG12NYY	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	12	0.750	14	26
52324027	8-7/8B38RG12NNN	380	Concave face	Spherical	56033525	n/a	0.750	12	0.750	14	26
52328077	8-7/8B38RG12DDD	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	12	0.750	14	26
52285640	8-7/8B38LG12YYY	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	12	0.750	14	26
52285772	8-7/8B38LG12DDD	380	Concave face	Spherical-PCD	56033525	n/a	0.750	12	0.750	14	26
52285707	8-7/8B38LG12DYY	380	Concave face	Spherical-PCD-IMPAC	56033525	n/a	0.750	12	0.750	14	26
52285756	8-7/8B38LG12NYY	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	12	0.750	14	26
52286242	8-7/8B38LG12NNN	380	Concave face	Spherical	56033525	n/a	0.750	12	0.750	14	26
52292125	9-1/2B38C	380	Concave face	Spherical	56033525	n/a	0.750	10	0.750	17	27
50951722	10B38	380	Concave face	Spherical	56033525	n/a	0.750	12	0.750	17	29
56032758	10-5/8B38	380	Concave face	Spherical	56033525	n/a	0.750	12	0.750	18	30
50973965	12B38H	380	HO	Spherical	56033525	n/a	0.750	16	0.750	18	34
52335908	12B38CBRYYY	380	Concave face	Spherical-IMPAC	56033525	n/a	0.750	15	0.750	36	51

BIT SELECTION

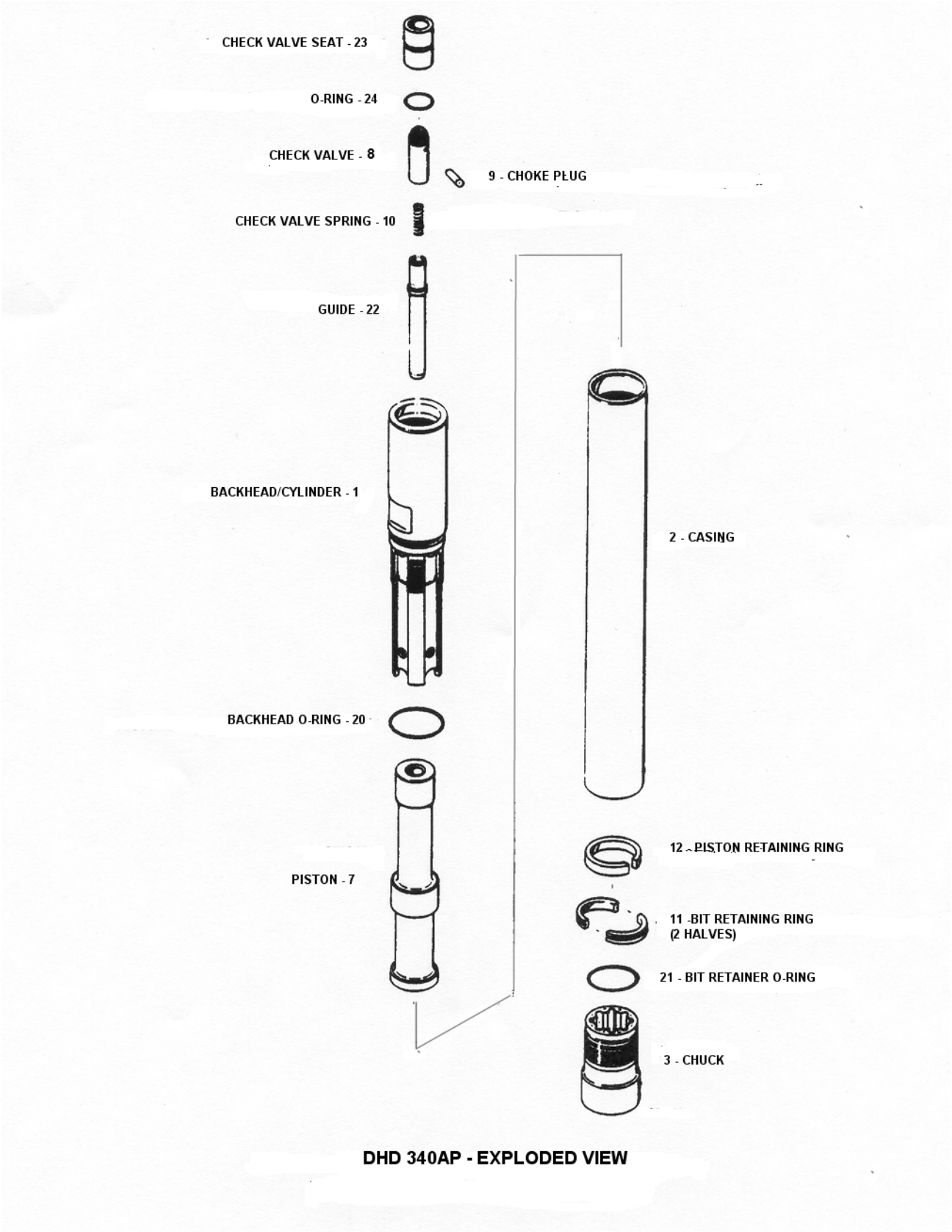
CPN	Symbol	Shank	Face Style	Insert Style	Exhaust tube part no.	Drive pin part no.	Gage insert Size	Gage insert Qty	Face insert Size	Face insert Qty	Total Qty
	Cluster drill bits>>>>>>>>>										
51609287	7-7/8B38FC	CD	Flat face	Spherical	56033525	n/a	0.750	8	0.750	14	22
51361806	9-7/8B38FW	CD	Flat face	Spherical	52127719	n/a	0.750		0.750		
51390367	9-7/8B38FC	CD	Flat face	Spherical	56033525	n/a	0.750		0.750		
52087277	10B38SI-STD	CD	Flat face	Spherical-IMPAC	52127719	n/a	0.750	20	0.750	20	40
52308111	10B38C	CD	Flat face	Spherical-IMPAC	52127719	n/a	0.750	20	0.750	20	40
52336161	10B38CXY	CD	Flat face	Spherical-IMPAC	52127719	n/a	0.750	20	0.750	20	40
52299013	10B38CRY	CD	Flat face	Spherical-IMPAC	52127719	n/a	0.750	20	0.750	12	32
52317161	10B38QRY	CD-QR	Flat face	Spherical-IMPAC	52127719	n/a	0.750	20	0.750	12	32
52303120	10B38CIY	CD	Flat face	Spherical-IMPAC	52127719	n/a	0.750	13	0.750	0	13
	DHD 310 bits>>>>>>>>>										
51612604	9-7/8B310PCG12SSS	310	Concave face	Spherical	51614188	51612620	0.750	12	0.750	17	29
52337359	9-7/8B310PCG12DYY	310	Concave face	Spherical	51614188	51612620	0.750	12	0.750	17	29
51612638	10B310PCG12SSS		Concave face	Spherical	51614188	51612620	0.750	12	0.750	17	29
51612653	10-5/8B310PCG15SSS	310	Concave face	Spherical	51614188	51612620	0.750	15	0.750	21	36
51612679	11B310PCG15SSS	310	Concave face	Spherical	51614188	51612620	0.750	15	0.750	27	42
51777316	12-1/4B310PCG15SSS	310	Concave face	Spherical	51614188	51612620	0.750	15	0.750	36	51
	DHD 112 bits>>>>>>>>>										
52094463	11B111PSSS	112	Concave face	Spherical	51915890	50794635	0.750	12	0.750	24	36
50748011	11-7/8B112PO	112	Concave face	Spherical	51915890	50794635	0.750	15	0.750	23	38
52094471	11-7/8B112P	112	Concave face	Spherical	51915890	50794635	0.750	15	0.750	23	38
50794668	12-1/4B112PO	112	Concave face	Spherical	51915890	50794635	0.750	15	0.750	24	39
52094448	12-1/4B112PY	112	Concave face	Spherical-IMPAC	51915890	50794635	0.750	15	0.750	24	39
52303054	12-1/4B112PDYY	112	Concave face	Spherical-PCD-IMPAC	51915890	50794635	0.750	15	0.750	24	39
52290483	12-1/4B112PDDD	112	Concave face	Spherical-PCD	51915890	50794635	0.750	15	0.750	24	39
52333770	12-1/4B112PBBB	112	Concave face	Conical	51915890	50794635	0.750	15	0.750	24	39
52094455	12.45B112PSSS	112	Concave face	Spherical	51915890	50794635	0.750	15	0.750	24	39
52094430	13B112PSSS	112	Concave face	Spherical	51915890	50794635	0.750	15	0.750	31	46
52094422	14B112PSSS	112	Concave face	Spherical	51915890	50794635	0.750	15	0.750	40	55
52334281	14-3/4B112PTFF	112	Concave face	Spherical-Conical	51915890	50794635	0.750	15	0.750	40	55
50794650	15B112PO	112	Concave face	Spherical	51915890	50794635	0.750	15	0.750	40	55
52094414	15B112PSSS	112	Concave face	Spherical	51915890	50794635	0.750	15	0.750	40	55
52290491	15B112PDSS	112	Concave face	Spherical	51915890	50794635	0.750	15	0.750	40	55
52084753	16-1/4B112PO	112	Concave face	Spherical	51915890	50794635	0.750	15	0.750	44	59
52094398	16-1/4B112P	112	Concave face	Spherical	51915890	50794635	0.750	15	0.750	44	59
50998020	17-1/2B112PO	112	Concave face	Spherical	51915890	50794635	0.750	18	0.750	44	62
52094406	17-1/2B112P	112	Concave face	Spherical	51915890	50794635	0.750	18	0.750	44	62
52308103	17-1/2B112PYYY	112	Concave face	Spherical-IMPAC	51915890	50794635	0.750	18	0.750	44	62
52327947	17-1/2B112PFFF	112	Concave face	Conical-tough	51915890	50794635	0.750	18	0.750	44	62
51993111	17-1/2B112PGP	112	Concave face	Spherical	51915890	50794635	0.750	18	0.750	44	62
52337219	17-3/4B112PXFFF	112	Concave face	Conical-tough	51915890	50794635	0.750	18	0.750	44	62
52096021	18-1/2B112P	112	Concave face	Spherical	51915890	50794635	0.750	18	0.750	50	68
	DHD 112S bits>>>>>>>>>										
52125242	19-1/2B112BPBRSSS	112S	Flat face	Spherical	51915890	51050854	0.750	24	0.750	84	108
51049567	20B112BPBRSSS	112S	Flat face	Spherical	51915890	51050854	0.750	24	0.750	84	108
51997344	20B112BPBRGP	112S	Flat face	Spherical	51915890	51050854	0.750	24	0.750	84	108
51997369	22B112BPBRGP	112S	Flat face	Spherical	51915890	51050854	0.750	24	0.750	93	117
51904548	22B112BPBR	112S	Flat face	Spherical	51915890	51050854	0.750	24	0.750	93	117

LUBRICANT & ROCK DRILL OIL (Furnished only when specially ordered)			
51781607	LUBRICANT, ANTI-SEIZE	8 OZ.	
51857407	LUBRICANT, DRILL PIPE	1 GAL	
51857415	LUBRICANT, DRILL PIPE	2-1/2 GAL	
51857423	LUBRICANT, DRILL PIPE	5 GAL	
52334174	SUPERTAC ROCK DRILL OIL (LIGHT)	1 GAL	
52333192	SUPERTAC ROCK DRILL OIL (LIGHT)	5 GAL	
52333200	SUPERTAC ROCK DRILL OIL (LIGHT)	55 GAL	
52334182	SUPERTAC ROCK DRILL OIL (MEDIUM)	1 GAL	
52333218	SUPERTAC ROCK DRILL OIL (MEDIUM)	5 GAL	
52333226	SUPERTAC ROCK DRILL OIL (MEDIUM)	55 GAL	
52334190	SUPERTAC ROCK DRILL OIL (HEAVY)	1 GAL	
52333234	SUPERTAC ROCK DRILL OIL (HEAVY)	5 GAL	
52333242	SUPERTAC ROCK DRILL OIL (HEAVY)	55 GAL	
52334208	SUPERTAC ROCK DRILL OIL (X-HEAVY)	1 GAL	
52333259	SUPERTAC ROCK DRILL OIL (X-HEAVY)	5 GAL	
52333267	SUPERTAC ROCK DRILL OIL (X-HEAVY)	55 GAL	

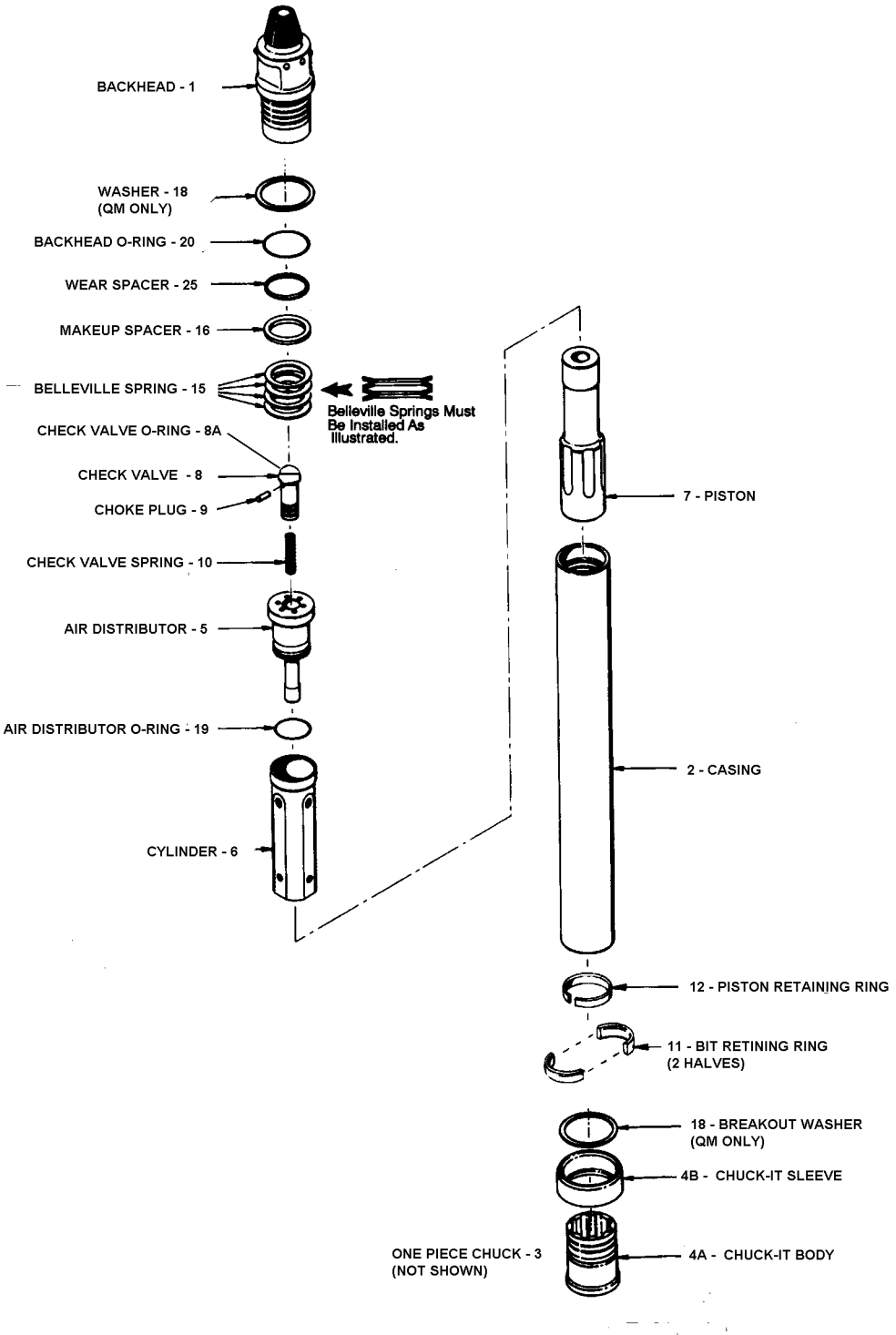


DHD 3.5 - EXPLODED VIEW

WARNING: This manual contains data SPECIFIC to DHD Classic Series Down-hole Drills.

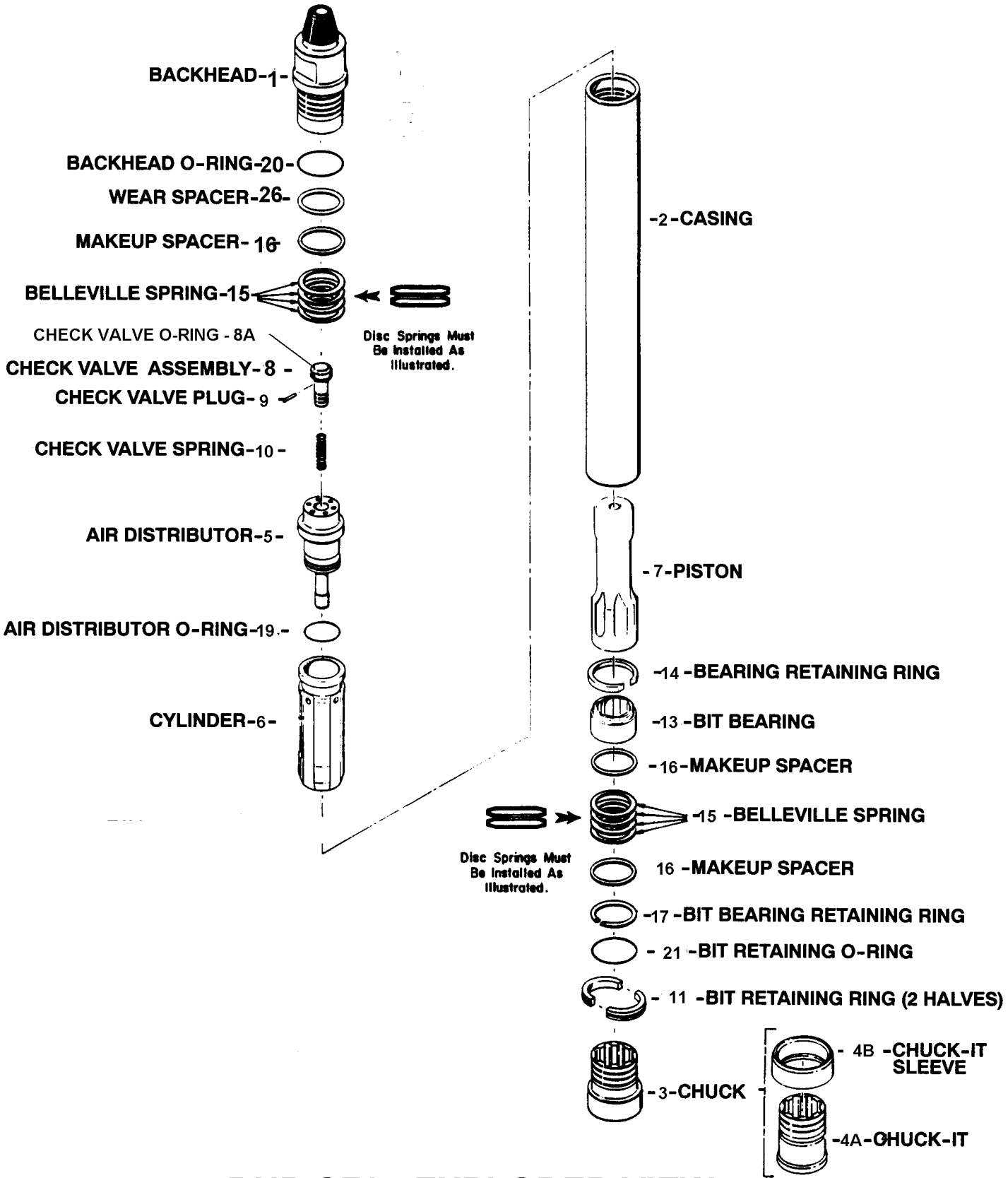


DHD 340AP - EXPLODED VIEW

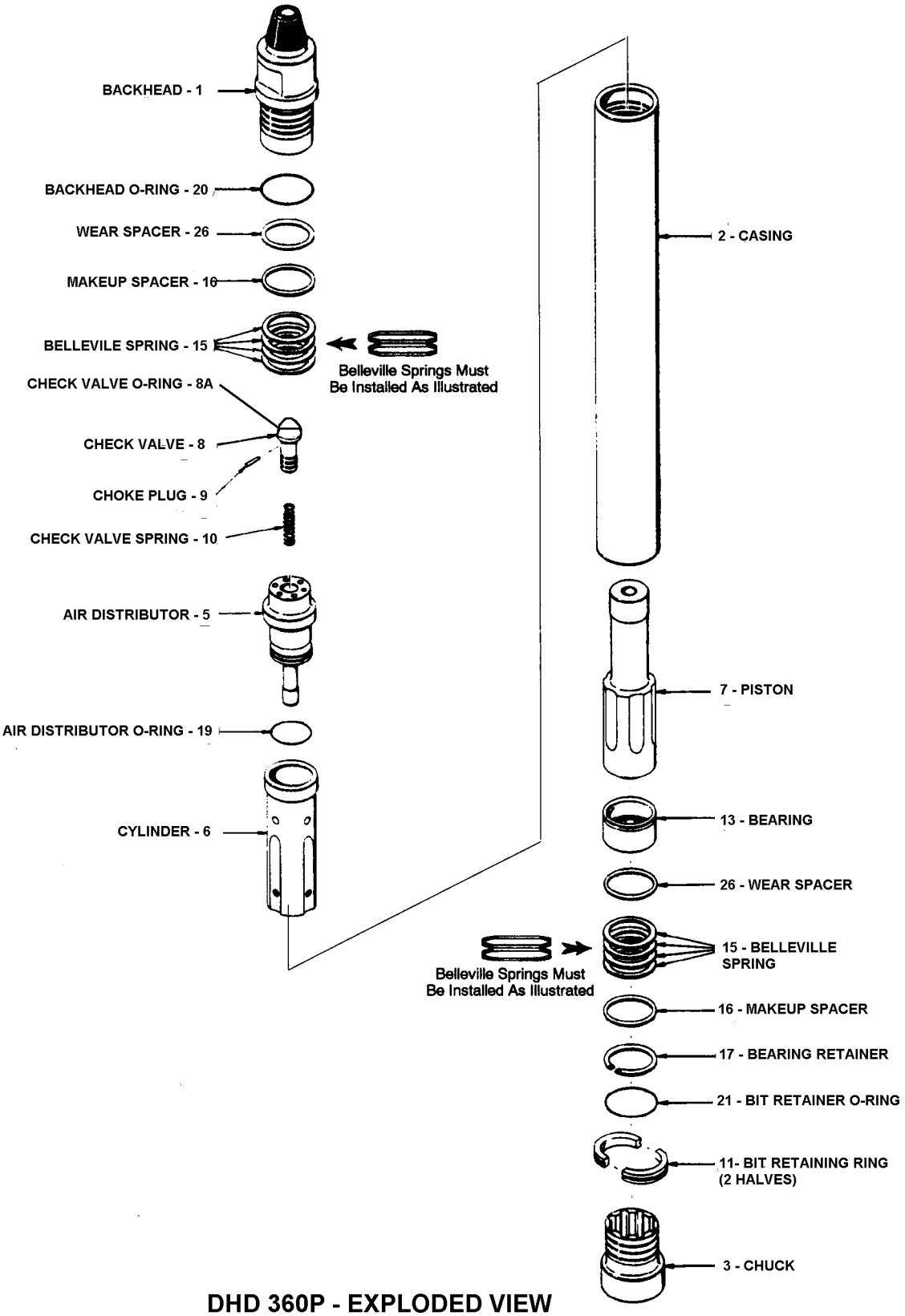


DHD 350R EXPLODED VIEW

WARNING: This manual contains data SPECIFIC to DHD Classic Series Down-hole Drills.

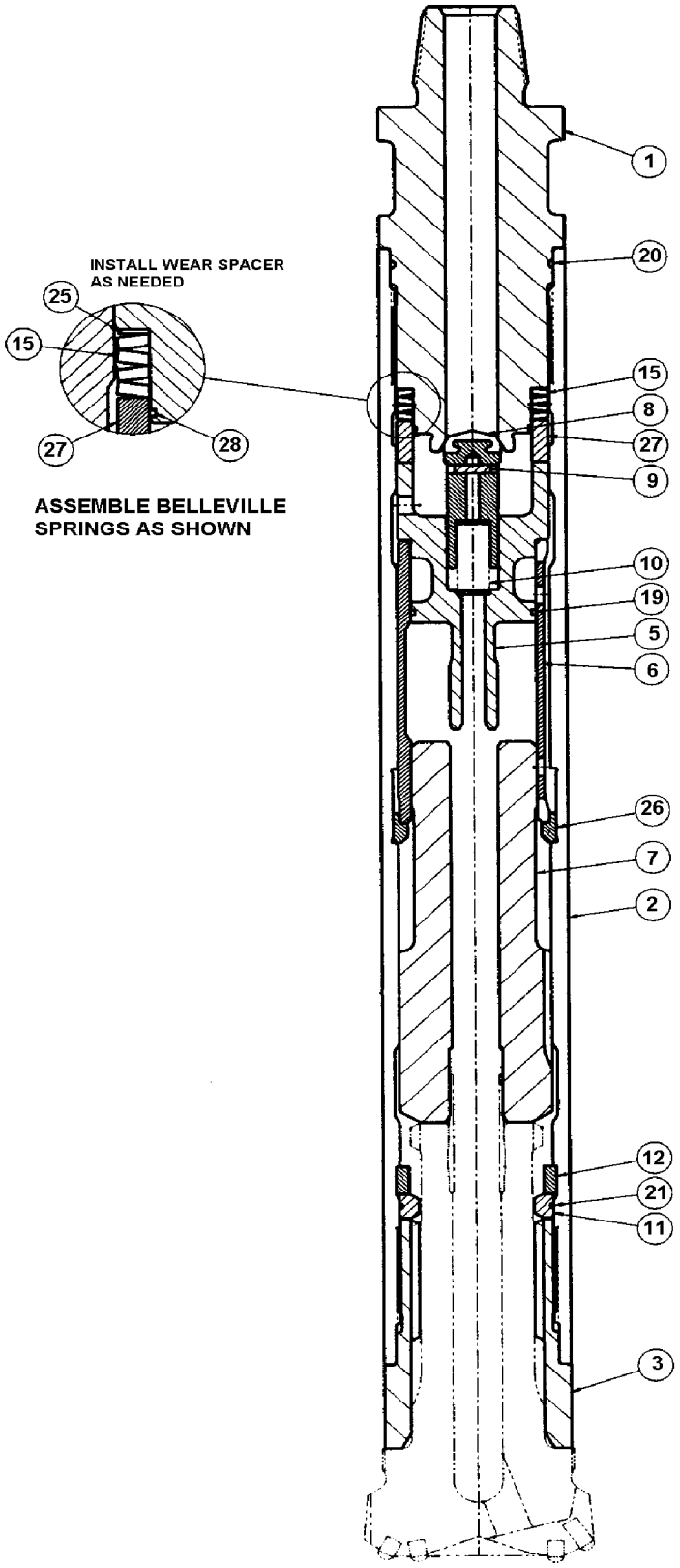


DHD SF6 - EXPLODED VIEW

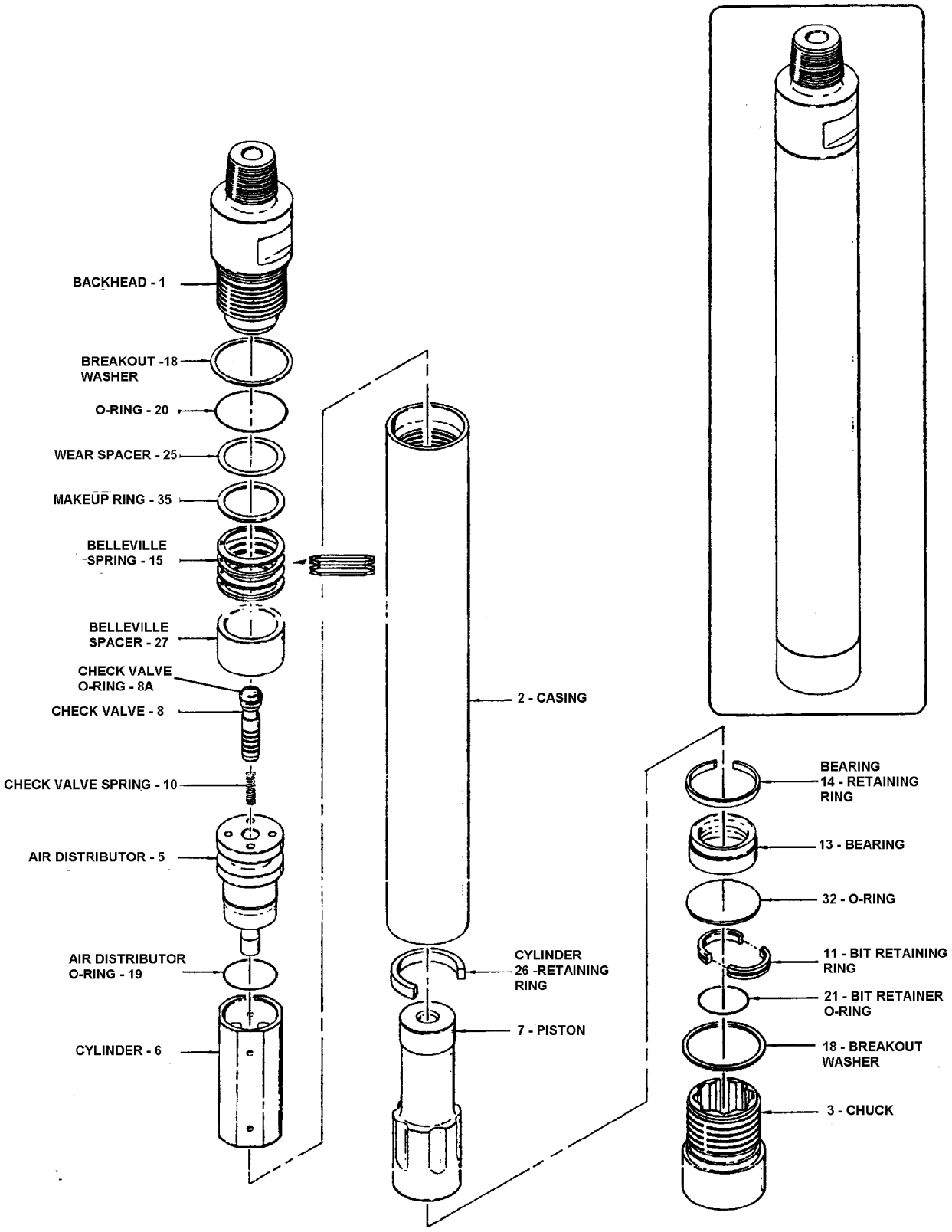


DHD 360P - EXPLODED VIEW

WARNING: This manual contains data SPECIFIC to DHD Classic Series Down-hole Drills.

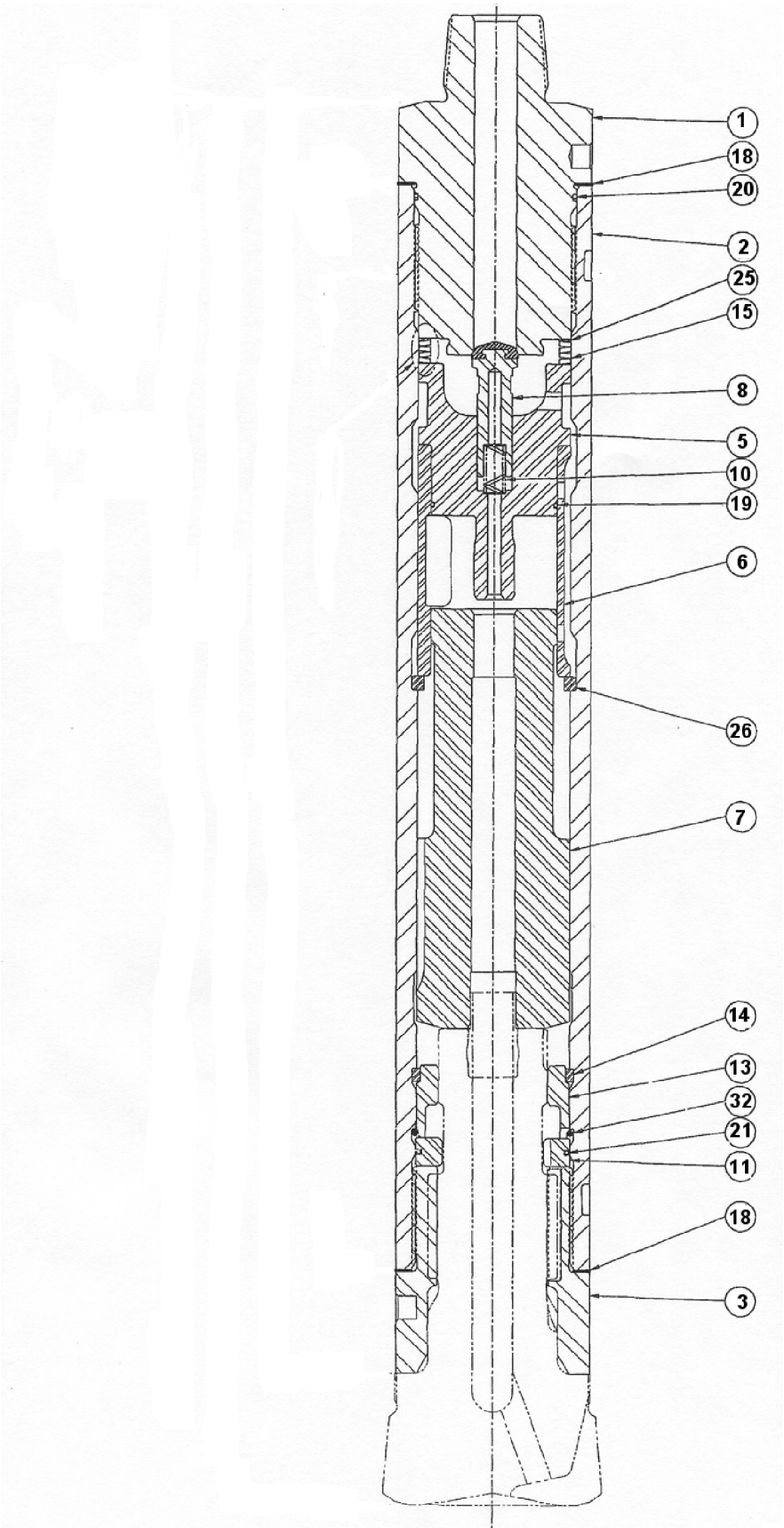


DHD 380 - SECTIONAL VIEW



DHD 310M - EXPLODED VIEW

WARNING: This manual contains data SPECIFIC to DHD Classic Series Down-hole Drills.



DHD 112 - SECTIONAL VIEW

NAME OF PART Parts indented under an item are included with that item	REF	QTY	DHD3.5P-STD 52334307	DHD340AP-STD 51783066	DHD4P-STD 51783082	DHD350RP-STD 52334315	DHD350R-OPT-A 51236198	DHD350R-OPT-B 51367076	DHD350R-OPT-C 51374767	DH5E-STD 51299592	DHD5.5QMP-STD 52334323	DHD5.5QM-OPT-A 51375384
BACKHEAD	1	1	51297877 (2-3/8 API PIN)	51364115 (2-3/8 API PIN)	←	50920404 (3-1/2 REG PIN)	51247310 (3-1/2 API BOX)	50920404 (3-1/2 REG PIN)	N/A	50920404 (3-1/2 API PIN)	51375392 (3-1/2 REG PIN)	←
CASING	2	1	52291580	50994698	51364768	51017770	←	←	←	51214104	51375376	←
CHUCK	3	1	52297926	51219657	51364271	51017762	←	N/A	51017762	←	51863918	N/A
2 PC CHUCK ASS'Y	4	ref	N/A	←	←	N/A	←	51235786	N/A	←	N/A	51235786
2 PC CHUCK BODY	4A	1	N/A	←	←	N/A	←	51233971	N/A	←	N/A	51233971
2 PC CHUCK SLEEVE	4B	1	N/A	←	←	N/A	←	51233989	N/A	←	N/A	51233989
AIR DISTRIBUTOR	5	1	N/A	←	←	50920438	←	←	←	←	←	←
CYLINDER	6	1	51354355	N/A	←	50920412	←	←	←	←	←	←
PISTON	7	1	52291572	50950823	51301315	50920420	←	←	←	51619674	50920420	←
CHECK VALVE ASS'Y	8	1	52302486	51075067	←	51075083	←	←	←	←	←	←
CHECK VALVE O-RING	8A	1	N/A	N/A	N/A	95136610	←	←	←	←	←	←
CHECK VALVE PLUG SOLID	9	1	50994755	←	←	50899137	←	←	←	←	←	←
CHECK VALVE SPRING	10	1	51997260	←	←	51033660	←	←	←	←	←	←
BIT RETAINING RING ASSEMBLY	11	1	52082823	50994714	←	51984862	←	←	←	←	←	←
PISTON RETAINING RING	12	1	N/A	50994722	←	51017754	←	←	←	←	←	←
BEARING	13	1	51233856	N/A	N/A	←	←	←	←	←	←	←
BEARING RETAINING RING	14	1	51233831	N/A	N/A	←	←	←	←	←	←	←
BELLEVILLE SPRING	15	noted	51303220 (6)	N/A	N/A	50920453 (4)	←	←	←	←	←	←
MAKEUP SPACER	16	2	N/A	N/A	N/A	50920461	←	←	←	←	←	←
SPRING RETAINER	17	1	N/A	N/A	←	←	←	←	←	←	←	←
BREAKOUT WASHER	18	2	N/A	51302602	←	51302644	N/A	←	←	←	51302644	←
O-RING, AIR DISTRIBUTOR	19	1	N/A	N/A	←	95137188	←	←	←	←	←	←
O-RING, BACKHEAD	20	1	95086575	95651956	←	95028452	←	←	←	←	←	←
O-RING, BIT RETAINER	21	1	95086229	95086278	←	N/A	←	←	←	←	←	←
GUIDE	22	1	51233815	50934918	←	N/A	←	←	←	←	←	←
SEAT	23	1	N/A	50950880	←	N/A	←	←	←	←	←	←
O-RING, SEAT	24	1	N/A	95366688	←	N/A	←	←	←	←	←	←
ACCESSORY KIT		1	N/A	N/A	N/A	50926849	←	←	←	←	←	←
WEAR SPACER (INCLUDED IN ACCESSORY KIT)	25		51303238	N/A	N/A	50251560	←	←	←	←	←	←

NAME OF PART Parts indented under an item are included with that item	REF	QTY	DHDSF6P-STD 52334331	DHDSF6-OPT-A 51074938	DHDSF6-OPT-B 51074946	DHDSF6-OPT-C 51074953	DHDSF6-OPT-D 51074961	DHDSF6-OPT-G 51250264	DHDSF6L-STD 51063030	DHDSF6MP-STD 52337904	DHDSF6M-OPT-A 51357556	DHDSF6M-OPT-B 51358265	DHDSF6M-OPT-C 51358273	DHDSF6M-OPT-D 51610160	DHDSF6M-OPT-E 52131380
BACKHEAD	1	1	50757608 (3-1/2 REG PIN)	50757566 (4 FH PIN)	50757749 (3-1/2 REG BOX)	50757756 (2-7/8 IF BOX)	50926625 (2-7/8 IF PIN)	50757608 (3-1/2 REG PIN)	←	←	51600906 (3-1/2 REG PIN CUTTING)	50757749 (3-1/2 REG BOX)	50757756 (2-7/8 IF BOX)	N/A	50757566 (4 FH PIN)
CASING	2	1	51034296	←	←	←	←	51368413	51034296	←	←	←	←	←	←
CHUCK	3	1	51996189	←	←	←	←	←	←	←	←	←	←	←	←
2 PC CHUCK ASS'Y	4	ref	N/A	←	←	←	←	←	←	←	←	←	←	←	←
2 PC CHUCK BODY	4A	1	N/A	←	←	←	←	←	←	←	←	←	←	←	←
2 PC CHUCK SLEEVE	4B	1	N/A	←	←	←	←	←	←	←	←	←	←	←	←
AIR DISTRIBUTOR	5	1	50899145	←	←	←	←	←	←	←	←	←	←	←	←
CYLINDER ASS'Y	6	1	51986792	←	←	←	←	←	←	←	←	←	←	←	←
PISTON	7	1	51354975	←	←	←	←	←	←	51250256	←	←	←	←	←
CHECK VALVE ASS'Y	8	1	51075083	←	←	←	←	←	←	←	←	←	←	←	←
CHECK VALVE O-RING	8A	1	95136610	←	←	←	←	←	←	←	←	←	←	←	←
CHECK VALVE PLUG SOLID	9	1	50899137	←	←	←	←	←	←	←	←	←	←	←	←
CHECK VALVE SPRING	10	1	51033660	←	←	←	←	←	←	←	←	←	←	←	←
BIT RETAINING RING ASSEMBLY	11	1	50757723	←	←	←	←	←	←	←	←	←	←	←	←
PISTON RETAINING RING	12	1	N/A	←	←	←	←	←	←	←	←	←	←	←	←
BEARING	13	1	51063048	←	←	←	←	←	51063063	51063048	←	←	←	←	←
BEARING RETAINING RING	14	1	51063055	←	←	←	←	←	←	←	←	←	←	←	←
BELLEVILLE SPRING	15	noted	50757707(8)	←	←	←	←	←	←	←	←	←	←	←	←
MAKEUP SPACER	16	2	50757574	←	←	←	←	←	←	←	←	←	←	←	←
SPRING RETAINER	17	1	51292233	←	←	←	←	←	←	←	←	←	←	←	←
BREAKOUT WASHER	18	2	N/A	←	←	←	←	←	←	51250272	←	←	←	←	←
O-RING, AIR DISTRIBUTOR	19	1	95137220	←	←	←	←	←	←	←	←	←	←	←	←
O-RING, BACKHEAD	20	1	95358412	←	←	←	←	←	←	←	←	←	←	←	←
O-RING, BIT RETAINER	21	1	95358073	←	←	←	←	←	←	←	←	←	←	←	←
ACCESSORY KIT			50899152	←	←	←	←	←	←	←	←	←	←	←	←
WEAR SPACER (INCLUDED IN ACCESSORY KIT)			50763739	←	←	←	←	←	←	←	←	←	←	←	←

NAME OF PART Parts indented under an item are included with that item	REF	QTY	DHD DH6P-STD 52334398	DHD DH6-OPT-D 51213684	DHD6.5QMP-STD 52334349	DHD6.5QM-OPT-B 51292324	DHD360P-STD 51945293	DHD380MP-STD 51916864	DHD380M-OPT-A 51795516	DHD380M-OPT-C 51940153	DHD380M-OPT-D 51919082	DHD380WP-STD 51940229	DHD380W-OPT-A 51940062	DHD380W-OPT-B 51942068	DHD380WHC STD 51956845	DHD8W-STD 51947901
BACKHEAD	1	1	50757608 (3-1/2 REG PIN)	50926625 (2-7/8 IF PIN)	51868495 (3-1/2 REG PIN CUTTING)	←	50757608 (3-1/2 REG PIN)	51916708 (4-1/2 REG PIN)	51795607 (4-1/2BECO)	51917524 (4-1/2 BECO PIN CUTTING)	51916708 (4-1/2 REG PIN)	←	51917516 (4-1/2 REG PIN CUTTING)	N/A	51917953 (4-1/2 REG PIN)	51916708 (4-1/2 REG PIN)
CASING	2	1	51213510	←	51863629	←	50757335	50984848	←	←	51792984	50984848	51792984	50984848	←	51947893
CHUCK	3	1	51996189	←	51996205	N/A	51996189	50984830	←	←	←	←	←	←	←	←
2 PC CHUCK ASS'Y	4	ref	N/A	←	←	51235778	N/A	←	←	←	←	←	←	←	←	←
2 PC CHUCK BODY	4A	1	N/A	←	←	51996163	N/A	←	←	←	←	←	←	←	←	←
2 PC CHUCK SLEEVE	4B	1	N/A	←	←	51222941	N/A	←	←	←	←	←	←	←	←	←
AIR DISTRIBUTOR	5	1	50899145	←	←	←	←	51795573	←	←	←	←	←	←	←	←
CYLINDER	6	1	51986792	←	←	←	50737343	51795599	←	←	←	←	←	←	←	←
PISTON	7	1	51213528	←	51354975	←	50942457	51367258	←	←	←	50951094	←	←	←	51293256
CHECK VALVE ASS'Y	8	1	51075083	←	←	←	←	52317237	←	←	←	←	←	51075109	52105749	52317237
CHECK VALVE O-RING	8A	1	95136610	←	←	←	←	95136628	←	←	←	←	←	←	←	←
CHECK VALVE PLUG SOLID	9	1	50899137	←	←	←	←	50899137	←	←	←	←	←	←	←	←
CHECK VALVE SPRING	10	1	51033660	←	←	←	←	51033678	←	←	←	←	←	←	51600773	51033678
BIT RETAINING RING ASSEMBLY	11	1	50757723	←	←	←	←	50984822	←	←	←	←	←	←	←	←
PISTON RETAINING RING	12	1	N/A	←	←	←	←	51087740	←	←	50984814	51087740	←	←	←	←
BEARING	13	1	51063063	←	51063048	←	50757715	N/A	←	←	←	←	←	←	←	←
BEARING RETAINING RING	14	1	51063055	←	←	←	N/A	N/A	←	←	←	←	←	←	←	←
BELLEVILLE SPRING	15	noted	50757707(8)	←	←	←	←	51617751 (4)	←	←	←	←	←	←	←	←
MAKEUP SPACER	16	2	50757574	←	←	←	←	N/A	←	←	←	←	←	←	←	←
SPRING RETAINER	17	1	51292233	←	←	←	←	←	←	←	←	←	←	←	←	←
BREAKOUT WASHER	18	2	N/A	←	51250272	←	N/A	←	←	←	←	←	←	←	←	←
O-RING, AIR DISTRIBUTOR	19	1	95137220	←	←	←	←	95678116	←	←	←	←	←	←	←	←
O-RING, BACKHEAD	20	1	95358412	←	←	←	←	95678124	←	←	←	←	←	←	←	←
O-RING, BIT RETAINER	21	1	95358073	←	←	←	←	95086690	←	←	←	←	←	←	←	←
WEAR SPACER (INCLUDED IN ACCESSORY KIT)	25	1	50763739	←	←	←	←	51619575	←	←	←	←	←	←	←	←
CYLINDER STOP RING	26	1	N/A	←	←	←	←	51779890	←	←	←	←	←	←	←	←
BELLEVILLE SPACER	27	1	N/A	←	←	←	←	51983112	←	←	←	←	←	←	←	←
O-RING, SPRING RETAINER	28	1	N/A	←	←	←	←	95086641	←	←	←	←	←	←	←	←
SUPPORT TUBE	29	1	N/A	←	←	←	←	←	←	←	←	←	←	←	51917946	N/A
ORIFICE TUBE	30A	1	N/A	←	←	←	←	←	←	←	←	←	←	←	51917961	N/A
ORIFICE TUBE	30B	1	N/A	←	←	←	←	←	←	←	←	←	←	←	51917979	N/A
ORIFICE TUBE	30C	1	N/A	←	←	←	←	←	←	←	←	←	←	←	51917987	N/A
ORIFICE TUBE	30D	1	N/A	←	←	←	←	←	←	←	←	←	←	←	51917995	N/A
HYDROCYCLONE WELDMENT	31	1	N/A	←	←	←	←	←	←	←	←	←	←	←	51940351	N/A
O-RING	32	1	N/A	←	←	←	←	←	←	←	←	←	←	←	95028528	N/A
O-RING	33	1	N/A	←	←	←	←	←	←	←	←	←	←	←	95086666	N/A
O-RING	34	1	N/A	←	←	←	←	←	←	←	←	←	←	←	95087029	N/A
ACCESSORY KIT		1	50899152	←	←	←	←	50978758	←	←	←	←	←	←	←	←

NAME OF PART Parts indented under an item are included with that item	REF	QTY	DHD310M-STD 51609279	DHD111W-STD 51620243	DH11-STD 51874527	DHD112W-STD 51868677	DHD112WP-STD 52336179	DHD112W-OPT-A 52338456	DHD112WS-STD 51874477	DH12-STD 51874485	DH12HC-STD 51874493	DH12SHC-STD 51874519	DH11HC-STD 51874535
BACKHEAD	1	1	51612455 (6-5/8 REG PIN)	51076958 (6-5/8 REG PIN)	←	50791805 6-5/8 REG PIN	←	NO BACKHEAD	50791805 6-5/8 REG PIN	←	51791648 (6-5/8 REG PIN)	←	51875396 (6-5/8 REG PIN)
CASING	2	1	51612463	51984169	←	51610012	←	←	←	←	←	←	51984169
CHUCK	3	1	51612539	51617710	←	51615771	←	←	51078483	51615771	←	51078483	51617710
CHUCK BEARING ASS'Y	3A	1	N/A	←	←	←	←	←	51292670	N/A	←	51292670	N/A
THRUST WASHER	3B	1	N/A	←	←	←	←	←	51307239	N/A	←	51307239	N/A
AIR DISTRIBUTOR	5	1	51612471	51874998	51793149	51874998	←	←	←	51793149	←	←	←
CYLINDER	6	1	51612497	51900652	51793164	51900652	←	←	←	51793164	←	←	←
PISTON	7	1	51612505	50926617	←	←	←	←	←	←	←	←	←
CHECK VALVE ASS'Y	8	1	52317112	52317062	←	←	←	←	←	←	52317088	←	←
CHECK VALVE O-RING	8A	1	95136669	←	←	←	←	←	←	←	←	←	←
CHECK VALVE SPRING	10	1	51033686	←	←	←	←	←	←	←	51863462	←	←
BIT RETAINING RING ASSEMBLY	11	1	51612547	51620482	←	←	←	←	←	←	←	←	←
BEARING	13	1	51942076	51941904	51915015	51941904	←	←	←	51915015	←	←	←
BEARING RETAINING RING	14	1	51863819	51863801	←	←	←	←	←	←	←	←	←
BELLEVILLE SPRING	15	noted	51612489(4)	51610004 (4)	←	←	←	←	←	←	←	←	←
BREAKOUT WASHER	18	2	51612588	51078681	←	51307239	←	←	←	←	←	←	51078681
O-RING, AIR DISTRIBUTOR	19	1	95086757	95465837	←	←	←	←	←	←	←	←	←
O-RING, BACKHEAD	20	1	95760906	95027868	←	←	←	←	←	←	←	←	←
O-RING, BIT RETAINER	21	1	95121588	95017885	←	←	←	←	←	←	←	←	←
WEAR SPACER	25	1	51617991	51610277	←	←	←	←	←	←	←	←	←
CYLINDER STOP RING	26	1	51875649	51793206	←	←	←	←	←	←	←	←	←
BELLEVILLE SPACER	27	1	51612521	N/A	←	←	←	←	←	←	←	←	←
SUPPORT TUBE	29	1	N/A	←	←	←	←	←	←	←	51793156	←	←
ORIFICE TUBE	30A	1	N/A	←	←	←	←	←	←	←	51863413	←	←
ORIFICE TUBE	30B	1	N/A	←	←	←	←	←	←	←	51863421	←	←
ORIFICE TUBE	30C	1	N/A	←	←	←	←	←	←	←	51863439	←	←
ORIFICE TUBE	30D	1	N/A	←	←	←	←	←	←	←	51863538	←	←
HYDROCYCLONE WELDMENT	31	1	N/A	←	←	←	←	←	←	←	51791978	←	←
O-RING	32	1	51942084	51941888	←	←	←	←	←	←	←	←	←
O-RING	33	1	N/A	←	←	←	←	←	←	←	95086070	←	←
O-RING	34	1	N/A	←	←	←	←	←	←	←	95087037	←	←
RING	35	1	51612596	N/A	←	←	←	←	←	←	←	←	←

ACCESSORIES FOR DHD SERIES NAME OF PART	DHD 3.5	DHD 340 DHD4	DHD350 DH5 DHD5.5QM	DHD 360	DHD DH6 DHD SF6	DHD SF6.5QM	DHD380 DH8	DHD310	DHD112- DH12	DHD111 DH11
REBUILD KIT, 2-7/8 REG PIN (includes casing, chuck, backhead)	N/A	N/A	52290962	N/A	N/A	N/A	N/A	N/A	N/A	←
REBUILD KIT, 2-7/8 IF BOX (includes casing, chuck, backhead)	N/A	N/A	N/A	N/A	52291002	N/A	N/A	N/A	N/A	←
REBUILD KIT, 3-1/2 REG PIN (includes casing, chuck, backhead)	N/A	N/A	52290947	N/A	52290970	52291036	N/A	N/A	N/A	N/A
REBUILD KIT, 3-1/2 REG BOX (includes casing, chuck, backhead)	N/A	N/A	N/A	N/A	52290996	N/A	N/A	N/A	N/A	N/A
REBUILD KIT, 3-1/2 REG PIN (includes casing, chuck-it, backhead)	N/A	N/A	N/A	N/A	N/A	52291044	N/A	N/A	N/A	N/A
BREAKOUT WASHER	N/A	51302602	51302644	51250272	←	←	51291227	N/A	51307239	←
HYDROCCYCLONE ADAPTER KIT (COMPLETE)	N/A	N/A	N/A	N/A	←	←	51956639	N/A	51791507	51913432
CASING WEAR GAGE	51372910	51372951	51293033	52291416	N/A	N/A	51372977	51711547	N/A	←
RETRIEVAL SYSTEM, COMPLETE	N/A	N/A	N/A	N/A	N/A	52335775	52099942	N/A	52116159	52337706
RETRIEVAL CHUCK	N/A	N/A	N/A	N/A	N/A	N/A	52086493	N/A	N/A	N/A
RETRIEVAL SLEEVE	N/A	N/A	N/A	N/A	N/A	N/A	52086501 (7.63 OD)	N/A	N/A	N/A
RETRIEVAL SLEEVE	N/A	N/A	N/A	N/A	N/A	N/A	52334869 (7.88 OD)	N/A	N/A	N/A
RETRIEVAL RETAINER	N/A	N/A	N/A	N/A	N/A	N/A	52086519	N/A	N/A	N/A
PIN	N/A	N/A	N/A	N/A	N/A	N/A	95651493	N/A	N/A	N/A
CYLINDER ASSEMBLY TOOL	51354322	N/A	N/A	51293199	←	←	N/A	N/A	N/A	N/A
CHUCK-IT KIT 4 SLEEVES)	N/A	N/A	N/A	51235794	←	←	N/A	N/A	N/A	N/A
QM CHUCK-IT KIT (4 SLEEVES)	N/A	N/A	51235786	N/A	N/A	51235778	N/A	N/A	N/A	N/A
DISASSEMBLY WRENCH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	51365435	←
POLE DRILL SWIVEL REBUILD KIT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	52335007	N/A
MAINTENANCE KIT - SEALS AND SPRINGS	N/A	N/A	51377091	51247302	51306983	←	51372878	N/A	N/A	N/A

DHD REQUIREMENTS

MINIMUM GUIDELINES FOR MOUNTING SPECIFICATIONS

Torque:	Roughly 500 ft-lb per inch (27 N-m per mm) maximum of bit.
Speed:	10 to 90 rpm
Hold down force:	500 lb per inch (9 kg per mm) of hammer maximum (i.e. SF6 needs 3000 lb (1360.8 kg)
Hold back force:	Dependent on hole depth and string weight. Must be capable of maintaining 500 lb per inch (226.8 kg per mm) at depth.
Operating pressure:	350 psig (24.1 bar) maximum
Volume:	150 - 200 scfm per inch (.165 - .22 m^3/min per mm) of hammer diameter.
Lubrication:	1/3 pint (.16 l) per hour per 100 scfm (2.8 m^3/min)

MINIMUM REQUIREMENTS FOR COMPRESSOR CAPACITY AND PRESSURE

The pressure and production developed by a DHD will be related to the air flow passing through the drill. The pressure and performance of a DHD is related to the SCFM (standard cubic feet per minute) delivered by the compressor. To determine what pressure a DHD will carry (without fluid injection and well oiled) you need to take into account the actual CFM (or mass flow) of air delivered by the compressor. Compressors are rated in ACFM which only equals SCFM at standard conditions of sea level and 60^0 F (16^0 C) inlet temperature. As the inlet air density either increases or decreases due to temperature and altitude changes, the SCFM delivery of a compressor will change. The pressure and performance of a DHD are related to the SCFM delivered by the compressor.

Figures 4 and 5 show the relationship of pressure and flow for all DHD's running oiled with no water injection in a shallow hole.

The Figure 1 shows compressor correction factors for typical oil flooded screw compressors. The rated delivery of a compressor must be multiplied by the correction factor to determine delivery in SCFM. The flow in SCFM should be used for determining the pressure the drill will hold referring to Figure 1.

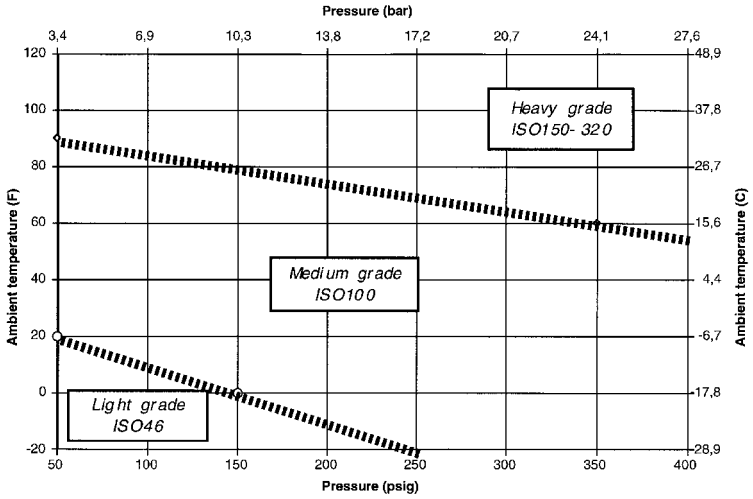
Altitude - feet (meters)	sea level 0 (0)	2,000 (609.6)	4,000 (1219.2)	6,000 (1828)	8,000 (2438.4)	10,000 (3048)
Atmospheric pressure PSIA						
(mm Hg)	14.70 (760.2)	13.66 (706.4)	12.68 (655.7)	11.77 (608.7)	10.91 (564.2)	10.10 (522.3)
Temperature F (C)						
0 (-18)	1.07	0.99	0.92	0.86	0.79	0.74
20 (-7)	1.05	0.97	0.90	0.84	0.78	0.72
40 (4)	1.02	0.95	0.88	0.82	0.76	0.70
60 (16)	1.00	0.93	0.86	0.80	0.74	0.69
80 (27)	0.98	0.91	0.85	0.78	0.73	0.67
100 (38)	0.96	0.89	0.83	0.77	0.71	0.66
120 (49)	0.94	0.88	0.81	0.76	0.70	0.65

Figure 1. Altitude Correction Multipliers

SPECIFICATIONS

Rock Drill Oil Specifications

Characteristic	Test Procedure	Below 20°F (-7°C)	20°F to 90°F (-7°C to 32°C)	Above 90°F (32°C)
Viscosity:				
SUS at 100°F (38°C)	ASTM-D2161	175 min.	450 min.	750 min.
SUS at 210°F (99°C)	ASTM-D2161	46 min.	65 min.	85 min.
cST at 104°F (40°C)	ASTM-D445	37 min.	105 min.	160 min.
cST at 212°F (100°C)	ASTM-D445	6 min.	11 min.	16 min.
Pour Point, °F (°C) max.	ASTM-D97	-10°F (-23°C)	-10°F (-23°C)	0°F (-18°C)
Flash Point, °F (°C) min.	ASTM-D92	370°F (188°C)	400°F (204°C)	450°F (232°C)
Viscosity Index, min.	ASTM-D2270	90	90	90
Steam Emulsion No. min.	ASTM-1935-65	1200	1200	1200
Consistency	. . . . .	Stringy	Stringy	Stringy
Falex Load Test lbs (kg) [min]	ASTM-D2670	2000 lbs (907 kg)	2000 lbs (907 kg)	2000 lbs (907 kg)
Timken E.P. Test lbs (kg) [min]	ASTM-D2782	30 lbs (14 kg)	30 lbs (14 kg)	30 lbs (14 kg)



Supertac Rock Drill Oil Part Numbers

Grade	1 Gallon (3.8 Liter)	5 Gallon (18.9 Liter)	55 Gallon (208 Liter)
Light	52334174	52333192	52333200
Medium	52334182	52333218	52333226
Heavy	52334190	52333234	52333242

WARNING: This manual contains data SPECIFIC to DHD Classic Series Downhole Drills.

PHYSICAL AND MAINTENANCE SPECIFICATIONS

Model	DHD3.5P-STD		DHD340AP-STD		DHD4P-STD		DHD350RP-STD		DH5E-STD		DHD5.5QMP-STD		DHDSF6P-STD		DHDSF6L-STD		DHDSF6MP-STD	
General specifications:	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**
Connection	2-3/8 API reg pin		2-3/8 API reg box		2-3/8 API reg box		3-1/2 API reg pin		3-1/2 API reg pin		3-1/2 API reg pin		3-1/2 API reg pin		3-1/2 API reg pin		3-1/2 API reg pin	
Outside diameter (in & mm)	3.13	79.4	3.63	92.2	3.63	92.2	4.53	115.1	4.53	115.1	4.88	124.0	5.38	136.7	5.38	136.7	5.38	136.7
Length w/o bit shoulder to shoulder (in &mm)	35.5	901.7	41.3	1049.0	41.3	1049.0	46.0	1168.4	46.0	1168.4	46.0	1168.4	49.4	1254.8	49.4	1254.8	49.4	1254.8
Length with bit extended (in & mm)	39.4	1000.8	45.6	1158.2	45.6	1158.2	51.0	1295.4	51.0	1295.4	51.0	1295.4	55.3	1404.6	55.3	1404.6	55.3	1404.6
Length with bit retracted (in & mm)	38.2	970.3	44.5	1130.3	44.5	1130.3	49.5	1257.3	49.5	1257.3	49.5	1257.3	53.0	1346.2	53.0	1346.2	53.0	1346.2
Weight w/o bit (lb & kg)	65	29.5	85	38.6	80	36.4	151	68.6	151	68.6	162	73.6	226	102.7	226	102.7	226	102.7
Backhead across flats (in)	1-3/4 X 2-1/2 AF		1-3/4 X 2-1/2 AF		1-3/4 X 2-1/2 AF		2 X 3-1/2 AF		2 X 3-1/2 AF		2 X 3-1/2 AF		2 X 4 AF		2 X 4 AF		2 X 4 AF	
Minimum bit size (in & mm)	3.54	89.9	4.13	104.9	4.13	104.9	5.13	130.3	5.13	130.3	5.50	139.7	6.00	152.4	6.00	152.4	6.00	152.4
Maximum bit size (in & mm)	3.93	99.8	5.00	127.0	5.00	127.0	6.00	152.4	6.00	152.4	6.00	152.4	8.50	215.9	8.50	215.9	8.50	215.9
Bore (in & mm)	2.521	64.03	2.948	74.88	2.948	74.88	3.621	91.97	3.621	91.97	3.621	91.97	4.432	112.57	4.432	112.57	4.432	112.57
Piston weight (lb & kg)	12	5.5	17.1	7.8	17.1	7.8	34	15.5	34	15.5	34	15.5	45	20.5	45	20.5	45	20.5
Stroke (in &mm)	4.00	101.6	4.00	101.6	4.00	101.6	4.00	101.6	4.00	101.6	4.00	101.6	4.00	101.6	4.00	101.6	4.00	101.6
Maximum pressure differential (psig & bar)	350.0	24.1	350.0	24.1	350.0	24.1	350.0	24.1	350.0	24.1	350.0	24.1	350.0	24.1	350.0	24.1	350.0	24.1
Maximum choke diameter (in & mm)	0.35	8.89	0.35	8.89	0.35	8.89	0.38	9.65	0.38	9.65	0.38	9.65	0.50	12.70	0.50	12.70	0.50	12.70
Make-up torque (ft-lb & N-m)	3000	4062	4000	5416	4000	5416	5000	6770	5000	6770	5000	6770	6000	8124	6000	8124	6000	8124
Air consumption:	**DHD3.5 (3")**		**DHD340AP (4")**		**DHD4P (4")**		**DHD350R (5")**		**DH5E (5")**		**DHD5.5QM (5")**		**SF6 (6")**		**SF6L (6")**		**SF6M (6")**	
100 psi/ 6,9 bar (scfm & m^3/min)	111	3.1	125	3.5	178	5.0	175	4.9	201	5.7	175	4.9	194	5.5	237	6.7	174	4.9
100 psi (bpm)	1,347	1,347	1,145	1,145	1,136	1,136	1,269	1,269	1,269	1,269	1,269	1,269	1,122	1,122	1,122	1,122	1,122	1,122
150 psi/ 10,3 bar (scfm & m^3/min)	176	5.0	199	5.6	286	8.1	283	8.0	312	8.8	283	8.0	327	9.2	383	10.8	289	8.2
150 psi (bpm)	1,486	1,486	1,335	1,335	1,382	1,382	1,380	1,380	1,380	1,380	1,380	1,380	1,301	1,301	1,301	1,301	1,301	1,301
200 psi/ 13,8 bar (scfm & m^3/min)	248	7.0	286	8.1	402	11.4	396	11.2	431	12.2	396	11.2	467	13.2	542	15.3	406	11.5
200 psi (bpm)	1,625	1,625	1,505	1,505	1,589	1,589	1,489	1,489	1,489	1,489	1,489	1,489	1,453	1,453	1,453	1,453	1,453	1,453
250 psi/ 17,2 bar (scfm & m^3/min)	328	9.3	384	10.9	524	14.8	513	14.5	559	15.8	513	14.5	611	17.3	714	20.2	527	14.9
250 psi (bpm)	1,764	1,764	1,656	1,656	1,757	1,757	1,596	1,596	1,596	1,596	1,596	1,596	1,576	1,576	1,576	1,576	1,576	1,576
300 psi/ 20,7 bar (scfm & m^3/min)	414	11.7	495	14.0	654	18.5	634	17.9	695	19.6	634	17.9	762	21.5	898	25.4	650	18.4
300 psi (bpm)	1,904	1,904	1,787	1,787	1,886	1,886	1,701	1,701	1,701	1,701	1,701	1,701	1,671	1,671	1,671	1,671	1,671	1,671
350 psi/ 24,1 bar (scfm & m^3/min)	506	14.3	618	17.5	791	22.4	760	21.5	840	23.7	760	21.5	917	25.9	1,096	31.0	777	22.0
350 psi (bpm)	2,043	2,043	1,898	1,898	1,975	1,975	1,804	1,804	1,804	1,804	1,804	1,804	1,738	1,738	1,738	1,738	1,738	1,738
Operational specifications:																		
Feed force (lbs)	1500-2000		1500-2000		1500-2000		1500-2000		1500-2500		1500-2500		1500-2500		2000-3000		2000-3000	
Rotation speed (rpm)	50-70		50-70		50-70		50-70		40-60		40-60		40-60		30-50		30-50	
Service specifications:																		
Casing discard diameter (in & mm)	2.90	73.7	3.39	86.1	3.39	86.1	4.19	106.4	4.19	106.4	4.19	106.4	5.00	127.0	5.00	127.0	5.00	127.0
Casing reverse diameter (in & mm)	n/a	n/a	3.46	n/a	n/a	n/a	4.25	108.0	4.25	108.0	4.38	111.3	5.12	130.0	5.12	130.0	5.12	130.0
Minimum chuck length (in & mm)	1.85	47.0	1.87	47.5	1.87	47.5	1.75	44.5	1.75	44.5	1.75	44.5	2.15	54.6	2.15	54.6	2.15	54.6
Max. worn piston to casing clearance (in & mm)	0.010	0.27	1.509	38.33	1.509	38.33	0.007	0.19	0.007	0.19	0.007	0.19	0.009	0.23	0.009	0.23	0.009	0.23
Min new piston large OD:	2.515	63.88	2.948	74.88	2.948	74.88	3.621	91.97	3.621	91.97	3.621	91.97	4.432	112.57	4.432	112.57	4.432	112.57
Max new casing ID:	2.522	64.06	3.954	100.43	3.954	100.43	3.626	92.10	3.626	92.10	3.626	92.10	4.438	112.73	4.438	112.73	4.438	112.73
Max. worn piston to cylinder clearance (in & mm)	0.009	0.23	0.011	0.27	0.011	0.27	0.009	0.23	0.009	0.23	0.009	0.23	0.011	0.27	0.011	0.27	0.011	0.27
Min new piston tail OD:	2.023	51.38	2.396	60.86	2.396	60.86	2.995	76.07	2.995	76.07	2.995	76.07	3.682	93.52	3.682	93.52	3.682	93.52
Max new cylinder ID:	2.029	51.54	2.403	61.04	2.403	61.04	3.001	76.23	3.001	76.23	3.001	76.23	3.689	93.70	3.689	93.70	3.689	93.70
Max. worn piston to guide clearance (in & mm)	0.021	0.53	0.011	0.27	0.011	0.27	0.013	0.34	0.013	0.34	0.013	0.34	0.015	0.38	0.015	0.38	0.015	0.38
Max new piston tail ID:	0.828	21.03	0.965	24.51	0.965	24.51	1.220	30.99	1.220	30.99	1.220	30.99	1.336	33.93	1.336	33.93	1.336	33.93
Min new guide OD:	0.814	20.68	0.958	24.33	0.958	24.33	1.211	30.76	1.211	30.76	1.211	30.76	1.326	33.68	1.326	33.68	1.326	33.68
Max. worn bit to bearing clearance (in & mm)	0.018	0.46	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.012	0.30	0.012	0.30	0.012	0.30
Max new bearing ID:	2.068	52.53	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.438	87.33	3.438	87.33	3.438	87.33
Min new bit shank OD:	2.056	52.22	2.511	63.78	2.511	63.78	3.180	80.77	3.180	80.77	3.180	80.77	3.430	87.12	3.430	87.12	3.430	87.12
Max. worn bit to chuck clearance (in & mm)	0.019	0.50	0.018	0.46	0.018	0.46	0.018	0.46	0.018	0.46	0.018	0.46	0.015	0.38	0.015	0.38	0.015	0.38
Max new chuck ID:	2.166	55.02	2.562	65.07	2.562	65.07	3.325	84.46	3.325	84.46	3.325	84.46	4.004	101.70	4.004	101.70	4.004	101.70
Min new bit shank OD:	2.153	54.69	2.550	64.77	2.550	64.77	3.313	84.15	3.313	84.15	3.313	84.15	3.994	101.45	3.994	101.45	3.994	101.45
Exhaust tube extension (in & mm):	2.32	58.93	2.19	55.63	2.19	55.63	2.5	63.50	2.50	63.50	2.50	63.50	2.00	50.80	2	50.80	2	50.80
Maximum backhead standoff:	0.122	3.10	n/a	n/a	n/a	n/a	0.296	7.52	0.296	7.52	0.296	7.52	0.166	4.22	0.166	4.22	0.166	4.22
Minimum backhead standoff:	0.058	1.47	n/a	n/a	n/a	n/a	0.076	1.93	0.076	1.93	0.076	1.93	0.101	2.57	0.101	2.57	0.101	2.57

PHYSICAL AND MAINTENANCE SPECIFICATIONS

Model	DH6P-STD		DHDSF6.5QMP-STD		DHD360P-STD		DHD380MP-STD		DHD380WP-STD		DHD380WHC-STD		DH8W-STD		DHD310M-STD		DHD111W-STD	
General specifications:	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**
Connection	3-1/2 API reg pin		3-1/2 API reg pin		3-1/2 API reg pin		4-1/2 API reg pin		4-1/2 API reg pin		4-1/2 API reg pin		4-1/2 API reg pin		6-5/8 API reg pin		6-5/8 API reg pin	
Outside diameter (in & mm)	5.38	136.7	5.75	146.1	5.38	136.7	7.13	181.1	7.13	181.1	7.13	181.1	7.13	181.1	9.00	228.6	10.00	254.0
Length w/o bit shoulder to shoulder (in &mm)	49.4	1254.8	49.4	1254.8	49.4	1254.8	56.8	1442.7	56.8	1442.7	56.8	1442.7	56.8	1442.7	64.5	1638.3	71.3	1811.0
Length with bit extended (in & mm)	55.3	1404.6	55.3	1404.6	55.3	1404.6	63.5	1612.9	63.5	1612.9	63.2	1604.0	63.2	1604.0	71.3	1811.0	80.6	2047.2
Length with bit retracted (in & mm)	53.0	1346.2	56.6	1437.6	53.0	1346.2	61.4	1559.6	61.4	1559.6	61.4	1559.6	61.4	1559.6	69.7	1770.4	78.6	1996.4
Weight w/o bit (lb & kg)	226	102.7	226	102.7	226	102.7	446	202.7	390	177.3	390	177.3	390	177.3	740	336.4	1031	468.6
Backhead across flats (in)	2 X 4 AF		2 X 4 AF		2 X 4 AF		2-1/2 X 5-7/8 AF		2-1/2 X 5-7/8 AF		2-1/2 X 5-7/8 AF		2-1/2 X 5-7/8AF		2-1/4 X 7-1/8 AF		4 X 1-5/16" Holes	
Minimum bit size (in & mm)	6.00	152.4	6.50	165.1	6.00	152.4	7.88	200.2	7.88	200.2	7.88	200.2	7.88	200.2	9.88	251.0	11.00	279.4
Maximum bit size (in & mm)	8.50	215.9	8.50	215.9	8.50	215.9	10.63	270.0	10.63	270.0	10.63	270.0	10.63	270.0	12.25	311.2	18.50	469.9
Bore (in & mm)	4.432	112.57	4.432	112.57	4.246	107.85	5.821	147.85	5.821	147.85	5.821	147.85	5.821	147.85	7.500	190.50	8.497	215.82
Piston weight (lb & kg)	45	20.5	45	20.5	43	19.5	82	37.3	82	37.3	82	37.3	82	37.3	165	75.0	250	113.6
Stroke (in &mm)	4.00	101.6	4.00	101.6	4.00	101.6	4.00	101.6	4.00	101.6	4.00	101.6	4.00	101.6	4.00	101.6	4.00	101.6
Maximum pressure differential (psig & bar)	350.0	24.1	350.0	24.1	350.0	24.1	350.0	24.1	350.0	24.1	350.0	24.1	350.0	24.1	350.0	24.1	250.0	17.2
Maximum choke diameter (in & mm)	0.50	12.70	0.50	12.70	0.50	12.70	0.53	13.46	0.53	13.46	0.53	13.46	0.53	13.46	0.75	19.05	0.88	22.35
Make-up torque (ft-lb & N-m)	6000	8124	6000	8124	6000	8124	8000	10832	8000	10832	8000	10832	8000	10832	10000	13540	12000	16248
Air consumption:	**DH6 (6")**		**SF6.5QM (6")**		**DHD360 (6")**		**DHD380M (8")**		**DHD380W (8")**		**DHD380W HC (8")**		**DH8W (8")**		**DHD310M (10")**		**DHD112W (12")**	
100 psi/ 6,9 bar (scfm & m^3/min)	364	10.3	194	5.5	195	5.5	304	8.6	345	9.7	360	10.2	401	11.3	342	9.6	570	16.1
100 psi (bpm)	1,122	1,122	1,122	1,122	1,122	1,122	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	950	950	915	915
150 psi/ 10,3 bar (scfm & m^3/min)	580	16.4	327	9.2	326	9.2	493	13.9	583	16.5	605	17.1	684	19.3	593	16.8	1,029	29.1
150 psi (bpm)	1,301	1,301	1,301	1,301	1,301	1,301	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,050	1,050	1,068	1,068
200 psi/ 13,8 bar (scfm & m^3/min)	801	22.6	467	13.2	475	13.4	672	19.0	821	23.2	851	24.0	999	28.2	842	23.8	1,529	43.2
200 psi (bpm)	1,453	1,453	1,453	1,453	1,453	1,453	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,150	1,150	1,220	1,220
250 psi/ 17,2 bar (scfm & m^3/min)	1,028	29.0	611	17.3	641	18.1	842	23.8	1,060	29.9	1,097	31.0	1,347	38.0	1,087	30.7	2,070	58.5
250 psi (bpm)	1,576	1,576	1,576	1,576	1,576	1,576	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,250	1,250	1,373	1,373
300 psi/ 20,7 bar (scfm & m^3/min)	1,260	35.6	762	21.5	825	23.3	1,003	28.3	1,299	36.7	1,344	38.0	1,727	48.8	1,330	37.6	2,651	74.9
300 psi (bpm)	1,671	1,671	1,671	1,671	1,671	1,671	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,350	1,350	1,525	1,525
350 psi/ 24,1 bar (scfm & m^3/min)	1,498	42.3	917	25.9	1,026	29.0	1,155	32.6	1,538	43.4	1,590	44.9	2,139	60.4	1,568	44.3	3,272	92.4
350 psi (bpm)	1,738	1,738	1,738	1,738	1,738	1,738	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,450	1,450	1,678	1,678
Operational specifications:																		
Feed force (lbs)	2000-3000		2000-3000		2000-3000		2000-3000		2000-3000		3000-4000		3000-4000		3000-4000		3000-4000	
Rotation speed (rpm)	30-50		30-50		30-50		30-50		30-50		20-40		20-40		20-40		20-40	
Service specifications:																		
Casing discard diameter (in & mm)	5.00	127.0	5.00	127.0	5.00	127.0	6.67	169.4	6.67	169.4	6.67	169.4	6.67	169.4	8.35	212.1	9.75	247.7
Casing reverse diameter (in & mm)	5.12	130.0	5.44	138.2	5.12	130.0	6.80	172.7	6.80	172.7	6.80	172.7	6.80	172.7	8.63	219.2	n/a	n/a
Minimum chuck length (in & mm)	2.15	54.6	2.15	54.6	2.15	54.6	3.31	84.1	3.31	84.1	3.31	84.1	3.31	84.1	3.67	93.2	5.30	134.6
Max. worn piston to casing clearance (in & mm)	0.009	0.23	0.009	0.23	0.007	0.19	0.011	0.27	0.011	0.27	0.011	0.27	0.011	0.27	0.012	0.30	0.012	0.30
Min new piston large OD:	4.432	112.57	4.432	112.57	4.246	107.85	5.821	147.85	5.821	147.85	5.821	147.85	5.821	147.85	7.500	190.50	7.500	190.50
Max new casing ID:	4.438	112.73	4.438	112.73	4.251	107.98	5.828	148.03	5.828	148.03	5.828	148.03	5.828	148.03	7.508	190.70	7.508	190.70
Max. worn piston to cylinder clearance (in & mm)	0.011	0.27	0.011	0.27	0.007	0.19	0.014	0.34	0.014	0.34	0.014	0.34	0.014	0.34	0.012	0.30	0.011	0.29
Min new piston tail OD:	3.682	93.52	3.682	93.52	3.496	88.80	4.795	121.79	4.795	121.79	4.795	121.79	4.795	121.79	6.144	156.06	6.144	156.07
Max new cylinder ID:	3.689	93.70	3.689	93.70	3.501	88.93	4.804	122.02	4.804	122.02	4.804	122.02	4.804	122.02	6.152	156.26	6.152	156.26
Max. worn piston to guide clearance (in & mm)	0.015	0.38	0.015	0.38	0.015	0.38	0.013	0.34	0.013	0.34	0.013	0.34	0.013	0.34	0.015	0.38	0.015	0.38
Max new piston tail ID:	1.336	33.93	1.336	33.93	1.336	33.93	1.833	46.56	1.833	46.56	1.833	46.56	1.833	46.56	2.128	54.05	2.128	54.05
Min new guide OD:	1.326	33.68	1.326	33.68	1.326	33.68	1.824	46.33	1.824	46.33	1.824	46.33	1.824	46.33	2.118	53.80	2.118	53.80
Max. worn bit to bearing clearance (in & mm)	0.012	0.30	0.012	0.30	0.012	0.30	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.019	0.50	0.019	0.50
Max new bearing ID:	3.438	87.33	3.438	87.33	3.438	87.33	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	5.465	138.81	5.465	138.81
Min new bit shank OD:	3.430	87.12	3.430	87.12	3.430	87.12	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	5.452	138.48	5.452	138.48
Max. worn bit to chuck clearance (in & mm)	0.015	0.38	0.015	0.38	0.015	0.38	0.022	0.57	0.022	0.57	0.022	0.57	0.022	0.57	0.021	0.53	0.024	0.61
Max new chuck ID:	4.004	101.70	4.004	101.70	4.004	101.70	5.084	129.13	5.084	129.13	5.084	129.13	5.084	129.13	6.583	167.21	7.241	183.92
Min new bit shank OD:	3.994	101.45	3.994	101.45	3.994	101.45	5.069	128.75	5.069	128.75	5.069	128.75	5.069	128.75	6.569	166.85	7.225	183.52
Exhaust tube extension (in & mm):	2	50.80	2	50.80	2	50.80	2	50.80	2	50.80	2	50.80	2	50.80	2.63	66.80	2.06	52.32
Maximum backhead standoff:	0.166	4.22	0.166	4.22	0.177	4.50	0.3	7.62	0.3	7.62	0.3	7.62	0.3	7.62	0.395	10.03	0.402	10.21
Minimum backhead standoff:	0.101	2.57	0.101	2.57	0.096	2.44	0.236	5.99	0.236	5.99	0.236	5.99	0.236	5.99	0.315	8.00	0.325	8.26

PHYSICAL AND MAINTENANCE SPECIFICATIONS

Model	DH11-STD		DHD112WP-STD		DHD112WS-STD		DH12-STD		DH12HC-STD		DH12S-STD		DH11-STD		DH11HC-STD	
General specifications:	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**	**English**	**Metric**
Connection	6-5/8 API reg pin		6-5/8 API reg pin		6-5/8 API reg pin		6-5/8 API reg pin		6-5/8 API reg pin		6-5/8 API reg pin		6-5/8 API reg pin		6-5/8 API reg pin	
Outside diameter (in & mm)	10.00	254.0	10.88	276.4	10.88	276.4	10.88	276.4	10.88	276.4	10.88	276.4	10.00	254.0	10.00	254.0
Length w/o bit shoulder to shoulder (in &mm)	71.3	1811.0	71.3	1811.0	71.3	1811.0	71.3	1811.0	71.3	1811.0	71.3	1811.0	71.3	1811.0	71.3	1811.0
Length with bit extended (in & mm)	80.6	2047.2	80.6	2047.2	80.6	2047.2	80.6	2047.2	80.6	2047.2	80.6	2047.2	80.6	2047.2	80.6	2047.2
Length with bit retracted (in & mm)	78.6	1996.4	78.6	1996.4	78.6	1996.4	78.6	1996.4	78.6	1996.4	78.6	1996.4	78.6	1996.4	78.6	1996.4
Weight w/o bit (lb & kg)	1031	468.6	1318	599.1	1487	675.9	1286	584.5	1286	584.5	1455	661.4	1237	562.3	1237	562.3
Backhead across flats (in)	4 X 1-5/16" Holes		4 X 1-5/16" Holes		4 X 1-5/16" Holes		4 X 1-5/16" Holes		4 X 1-5/16" Holes		4 X 1-5/16" Holes		4 X 1-5/16" Holes		4 X 1-5/16" Holes	
Minimum bit size (in & mm)	11.00	279.4	11.88	301.8	19.50	495.3	11.88	301.8	11.88	301.8	19.50	495.3	11.00	279.4	11.00	279.4
Maximum bit size (in & mm)	18.50	469.9	18.50	469.9	22.00	558.8	18.50	469.9	18.50	469.9	22.00	558.8	18.50	469.9	18.50	469.9
Bore (in & mm)	8.497	215.82	8.497	215.82	8.497	215.82	8.497	215.82	8.497	215.82	8.497	215.82	8.497	215.82	8.497	215.82
Piston weight (lb & kg)	250	113.6	250	113.6	250	113.6	250	113.6	250	113.6	250	113.6	250	113.6	250	113.6
Stroke (in &mm)	4.00	101.6	4.00	101.6	4.00	101.6	4.50	114.3	4.50	114.3	4.50	114.3	4.50	114.3	4.50	114.3
Maximum pressure differential (psig & bar)	250.0	17.2	250.0	17.2	250.0	17.2	250.0	17.2	250.0	17.2	250.0	17.2	250.0	17.2	250.0	17.2
Maximum choke diameter (in & mm)	0.88	22.35	0.88	22.35	0.88	22.35	0.88	22.35	0.88	22.35	0.88	22.35	0.88	22.35	0.88	22.35
Make-up torque (ft-lb & N-m)	12000	16248	12000	16248	12000	16248	12000	16248	12000	16248	12000	16248	12000	16248	12000	16248
Air consumption:	**TD90-3 (8")**		**DHD112W (12")**		**DHD112W (12")**		**DH12 (12")**		**DH12 HC (12")**		**DH12S (18")**		**DHD112W (12")**		**DH12 HC (12")**	
100 psi/ 6,9 bar (scfm & m^3/min)	217	6.1	570	16.1	570	16.1	738	20.8	753	21.3	738	20.8	570	16.1	753	21.3
100 psi (bpm)	902	902	915	915	915	915	915	915	915	915	915	915	915	915	915	915
150 psi/ 10,3 bar (scfm & m^3/min)	562	15.9	1,029	29.1	1,029	29.1	1,288	36.4	1,311	37.0	1,288	36.4	1,029	29.1	1,311	37.0
150 psi (bpm)	1,001	1,001	1,068	1,068	1,068	1,068	1,068	1,068	1,068	1,068	1,068	1,068	1,068	1,068	1,068	1,068
200 psi/ 13,8 bar (scfm & m^3/min)	907	25.6	1,529	43.2	1,529	43.2	1,813	51.2	1,843	52.1	1,813	51.2	1,529	43.2	1,843	52.1
200 psi (bpm)	1,099	1,099	1,220	1,220	1,220	1,220	1,220	1,220	1,220	1,220	1,220	1,220	1,220	1,220	1,220	1,220
250 psi/ 17,2 bar (scfm & m^3/min)	1,253	35.4	2,070	58.5	2,070	58.5	2,313	65.3	2,351	66.4	2,313	65.3	2,070	58.5	2,351	66.4
250 psi (bpm)	1,198	1,198	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373
300 psi/ 20,7 bar (scfm & m^3/min)	1,598	45.1	2,651	74.9	2,651	74.9	2,788	78.8	2,834	80.0	2,788	78.8	2,651	74.9	2,834	80.0
300 psi (bpm)	1,297	1,297	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525
350 psi/ 24,1 bar (scfm & m^3/min)	1,943	54.9	3,272	92.4	3,272	92.4	3,238	91.5	3,291	93.0	3,238	91.5	3,272	92.4	3,291	93.0
350 psi (bpm)	1,396	1,396	1,678	1,678	1,678	1,678	1,678	1,678	1,678	1,678	1,678	1,678	1,678	1,678	1,678	1,678
Operational specifications:																
Feed force (lbs)	3000-4000		3000-4000		3000-4000		3000-4000		3000-4000		3000-4000		4500-6000		4500-6000	
Rotation speed (rpm)	20-40		20-40		20-40		20-40		20-40		20-40		15-25		15-25	
Service specifications:																
Casing discard diameter (in & mm)	9.75	247.7	9.75	247.7	9.75	247.7	9.75	247.7	9.75	247.7	9.75	247.7	9.75	247.7	9.75	247.7
Casing reverse diameter (in & mm)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Minimum chuck length (in & mm)	5.30	134.6	5.30	134.6	5.30	134.6	5.30	134.6	5.30	134.6	5.30	134.6	5.30	134.6	5.30	134.6
Max. worn piston to casing clearance (in & mm)	0.012	0.30	0.012	0.30	0.012	0.30	0.012	0.30	0.012	0.30	0.012	0.30	0.012	0.30	0.012	0.30
Min new piston large OD:	7.500	190.50	7.500	190.50	7.500	190.50	7.500	190.50	7.500	190.50	7.500	190.50	7.500	190.50	7.500	190.50
Max new casing ID:	7.508	190.70	7.508	190.70	7.508	190.70	7.508	190.70	7.508	190.70	7.508	190.70	7.508	190.70	7.508	190.70
Max. worn piston to cylinder clearance (in & mm)	0.011	0.29	0.011	0.29	0.011	0.29	0.011	0.29	0.011	0.29	0.011	0.29	0.011	0.29	0.011	0.29
Min new piston tail OD:	6.144	156.07	6.144	156.07	6.144	156.07	6.144	156.07	6.144	156.07	6.144	156.07	6.144	156.07	6.144	156.07
Max new cylinder ID:	6.152	156.26	6.152	156.26	6.152	156.26	6.152	156.26	6.152	156.26	6.152	156.26	6.152	156.26	6.152	156.26
Max. worn piston to guide clearance (in & mm)	0.015	0.38	0.015	0.38	0.015	0.38	0.015	0.38	0.015	0.38	0.015	0.38	0.015	0.38	0.015	0.38
Max new piston tail ID:	2.128	54.05	2.128	54.05	2.128	54.05	2.128	54.05	2.128	54.05	2.128	54.05	2.128	54.05	2.128	54.05
Min new guide OD:	2.118	53.80	2.118	53.80	2.118	53.80	2.118	53.80	2.118	53.80	2.118	53.80	2.118	53.80	2.118	53.80
Max. worn bit to bearing clearance (in & mm)	0.019	0.50	0.019	0.50	0.019	0.50	0.019	0.50	0.019	0.50	0.019	0.50	0.019	0.50	0.019	0.50
Max new bearing ID:	5.465	138.81	5.465	138.81	5.465	138.81	5.465	138.81	5.465	138.81	5.465	138.81	5.465	138.81	5.465	138.81
Min new bit shank OD:	5.452	138.48	5.452	138.48	5.452	138.48	5.452	138.48	5.452	138.48	5.452	138.48	5.452	138.48	5.452	138.48
Max. worn bit to chuck clearance (in & mm)	0.024	0.61	0.024	0.61	0.054	1.37	0.024	0.61	0.024	0.61	0.054	1.37	0.024	0.61	0.024	0.61
Max new chuck ID:	7.241	183.92	7.241	183.92	10.782	273.86	7.241	183.92	7.241	183.92	10.782	273.86	7.241	183.92	7.241	183.92
Min new bit shank OD:	7.225	183.52	7.225	183.52	10.746	272.95	7.225	183.52	7.225	183.52	10.746	272.95	7.225	183.52	7.225	183.52
Exhaust tube extension (in & mm):	2.06	52.32	2.06	52.32	2.06	52.32	2.06	52.32	2.06	52.32	2.06	52.32	2.06	52.32	2.06	52.32
Maximum backhead standoff:	0.402	10.21	0.402	10.21	0.402	10.21	0.402	10.21	0.402	10.21	0.402	10.21	0.402	10.21	0.402	10.21
Minimum backhead standoff:	0.325	8.26	0.325	8.26	0.325	8.26	0.325	8.26	0.325	8.26	0.325	8.26	0.325	8.26	0.325	8.26

Date	Run Time (Hours)	Work Performed	Qty	Work By

SERVICE RECORDS AND NOTES

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NOTES


Atlas Copco