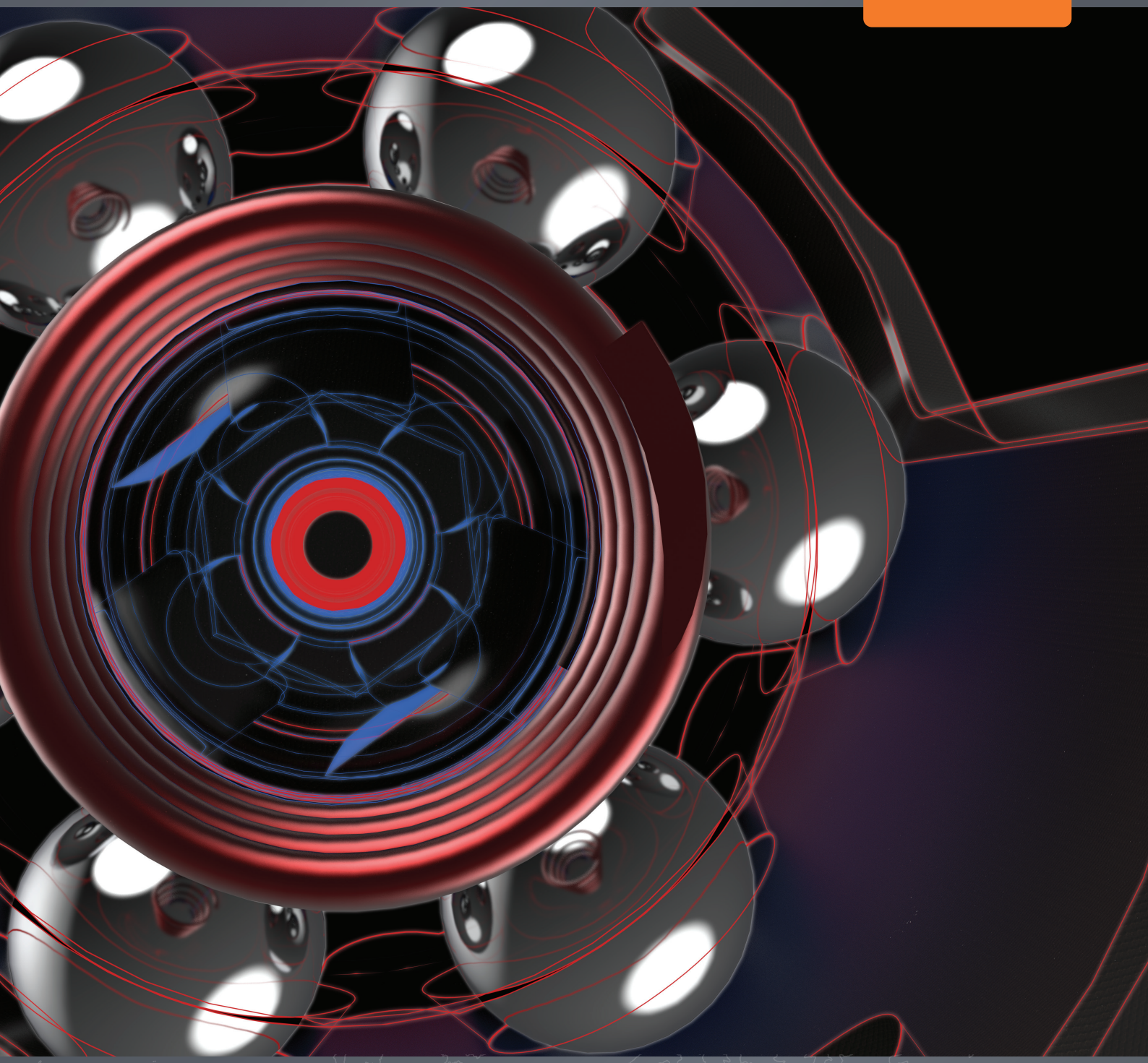
BOART LONGYEAR®



Q™ WIRELINE SYSTEMS

Operations and Service Manual

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1

GENERAL INFORMATION

1.1 INTRODUCTION

This manual shows how to get the best performance from your Q™ Wireline Core Barrel Assembly, explains preventative maintenance and how to make minor adjustments.

Boart Longyear is backed by over 100 years of experience in the design, manufacture and operation of core drilling equipment. Many of the accepted practices in use in the industry today were pioneered by Boart Longyear.

To obtain the utmost in performance and wear life:

- Read this manual carefully before attempting to use the tools.
- Use as instructed.
- Perform regular maintenance.
- Keep this manual handy for reference.

1.2 STANDARD WARRANTY

Boart Longyear makes no warranty that the products sold hereunder shall be merchantable or that such products shall be fit for any particular purpose and there are no warranties expressed or implied made by Boart Longyear except its following standard warranty.

Boart Longyear warrants each product, and accessory equipment sold by it (except items not manufactured by Boart Longyear such as power units, pumps, and other trade accessories sold with, attached to, or operated with Boart Longyear drills or other products) to be free from defects in material and workmanship under normal use and service for 90 days from date of first use, but not to exceed 6 months from the date of shipment from a Boart Longyear factory, the obligation of this warranty being limited to the replacement or repair at a Boart Longyear facility, or at a point designated by it, of such parts as shall appear to it upon inspection at such point to have been defective in material or workmanship at the time sold, providing that the part or parts claimed defective are returned to inspection point, transportation charges prepaid.

This warranty applies only to new and unused products and accessory equipment, which after shipment from the Boart Longyear factory, have not been altered, changed or repaired in any manner.

Exclusion of Liability for Consequential Damage

It is further agreed by the purchaser that in no event shall Boart Longyear be liable for increased costs, loss of profits or goodwill or any special, indirect, incidental, or consequential damages whatsoever.

1.3 ORDERING & RETURNING PARTS

Ordering Parts

The following procedure results in timely deliveries, eliminates delays, and ensures the correct replacement parts are received.

1. Note the size of the wireline system.
2. State the exact quantity required.
3. Specify the description and part number as shown in catalogue.
4. Specify the method of shipment, ie: Parcel Post, Express, Freight; for Overseas shipment, Air Freight, Air Parcel Post, or Ocean Freight.

All parts are priced F.O.B., our factory, and separate charges will be made for transportation and export packing.

Returning Parts

1. If you wish to return parts for repairs, replacement, or warranty, first reach out to your Boart Longyear representative, specifying the following:
    - Quantity
    - Part numbers
    - Wireline system
    - Reason for requesting the return
2. **DO NOT** ship parts until authorization and shipping instructions are received.
3. All parts returned must be prepaid.

2

IMPORTANT SAFETY INFORMATION

2.1 HAZARD INDICATORS

Warning and Caution indicators are located throughout the manual at specific points of interest, and are intended to alert the reader to the existence and relative degree of a hazard. These notices are given to prevent personal injury, death and/or equipment damage. These indictors must be followed to reduce the possibility of personal injury, damage to the equipment, or improper service. **ALWAYS** heed these notices, and practice common sense when performing any maintenance or repair procedure.

Safety Alert is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury and death.

Danger indicates an imminently hazardous situation which, if not avoided, could result in death.

Warning indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury or property damage.

Caution indicates a potentially hazardous situation which, if not avoided, MAY result in minor or moderate injury and property damage. It may also be used to alert against unsafe practices.

Notice is used to draw attention to detailed instructions. These notes are intended to give further important information regarding the machine and/or a step in a procedure.

2.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The following personal protective equipment are intended to make the reader aware of the various ways to keep themselves protected and prevent personal injury or death. PPE guidelines must **ALWAYS** be followed when working with or working close to equipment that could cause harm to the individual. **ALWAYS** pay attention to PPE guidelines when working.

1. Read and understand manuals.
2. Wear approved safety glasses.
3. Wear gloves.
4. Wear safety boots.
5. Wear hard hat.
6. Wear fall arrester when working at heights.
7. Wear hearing protection.

2.3 SAFETY GUIDELINES & PRECAUTIONS

Carefully read and understand all safety and operational instructions before operating this equipment. Failure to follow these instructions could result in serious personal injury or death.

Causes of un-latched tools or falling core include:

- worn parts
- broken core
- rock movement (e.g. mine blast)
- pressurized fluid or gas reservoirs
- operator error

Always Follow These Rules:

1. Keep clear of rotating equipment. **NEVER** wear any loose clothing, which could become entangled in the rods.
2. **NEVER** stand or walk with any part of your body in front of the rod string. **NEVER** look into the rod string. When working, **ALWAYS** stand to the side of an open rod string.
3. **DO NOT** open the rod string unless absolutely necessary, and then do so with extreme caution. Keep open rod string as close to the floor as possible and stand to the side.
4. When a rod string is in an inclined or 'up' hole:
    i. Plug the rod string when not in operation by attaching a water saver sub, a water swivel, or loading chamber.
    ii. Move the rods as close to the floor as possible.
    iii. If it is not possible to retrieve the inner tube or overshot, pump the rods full of water prior to plugging the rod string. If leaving the rod string unattended, attach a visible warning tag to alert the next shift or anyone approaching the drill that there is a safety hazard.
5. **NEVER** use air pressure to pump the inner tube assembly into a rod string unless the head assembly incorporates a hold-back braking device that has been inspected or tested prior to use.
6. Use only Boart Longyear replacement parts. Failure to do so could cause severe damage to the equipment or operator and may void your warranty.
7. Read and understand the Operations and Service Manuals for all drilling equipment in use. Complete all checks and adjustments as stated before starting the drill.
8. **DO NOT** alter or modify the core barrel assembly, its components, optional equipment, or accessories without prior approval from Boart Longyear. Unauthorized alteration may void the warranty, render the equipment unsafe, or result in decreased performance.
9. **DO NOT** attempt to stop the core with your hand when emptying the inner tube. The core can be sharp or heavy and cause severe injury. If it is necessary to look in an inner tube, **ALWAYS** look down, **NEVER** look up the tube.
10. **NEVER** rotate the rod string with a joint between the drill chuck and the water swivel. The joint may become loose and unscrew the rod that is not held by the chuck jaws.
11. If you do not fully understand the equipment and how it operates, **DO NOT** attempt to make adjustments or repairs.
12. When the core barrel is transported on an angle where the head assembly is lower than the bit and shell, the inner tube assembly may unlatch and slide out of the outer tube. To prevent the inner tube assembly from sliding out, it is good practice to thread a sub into the locking coupling, or remove the inner tube assembly from the outer tube.

FOR ADDITIONAL INFORMATION ON TRAINING OR START-UP, CONTACT YOUR BOART LONGYEAR REPRESENTATIVE.

OVERSHOTS & ELEVATED LOAD HAZARDS

WARNING

Inner tubes are an elevated load hazard when hoisting overhead with a surface wireline overshot, or when retracting from elevated positions in inclined drill strings with an underground wireline overshot. Regularly inspect and confirm safe working condition of wireline hoist, cable, and fittings. **ALWAYS** use recommended overshot safety features and safety devices. **ALWAYS** use Boart Longyear components and hardware. **DO NOT** interchange components or hardware from other manufacturers. A fluid bypass valve is required in underground pump-in overshots to release the hold-back brake - **DO NOT** block porting or otherwise disable the bypass valve.

INCLINED DRILLING HAZARD

WARNING

Inclined, up-hole drilling presents a risk that wireline tools or other in-hole components may fall back towards the operator at high speed, under gravity or in-hole fluid or gas pressure. Operators must **ALWAYS** stand clear of rod string openings to prevent serious injury or death. **DO NOT** remove the Water Swivel or Loading Chamber until the inner tube assembly is at the collar. **ALWAYS** maintain a column of fluid in the drill rods to reduce the chance of uncontrolled descent of wireline tools or core.

HEAD ASSEMBLY HOLDBACK BRAKE

WARNING

The head assembly hold-back brake feature is designed to improve the safety of up-hole drilling operations. The hold-back brake is **NOT** designed nor intended to be used as a fail-safe device. Failure of the hold-back brake can potentially occur due to factors such as improper maintenance or wireline overload. A fluid bypass valve is required in underground pump-in overshots to release the hold-back brake - **DO NOT** block porting or otherwise disable the bypass valve.

ADAPTER COUPLING HAZARD

WARNING

Roller Latch™ head assemblies are not compatible with core barrel adapter couplings. Verify that adapter couplings have been removed from pre-existing core barrel assemblies and drill strings. Failure to do so will prevent latch deployment and may result in product failure or injury.

PRESSURIZED INNER TUBE LINER HAZARD

WARNING

Q™3 triple tube core barrels may require the use of a pump-out piston to remove the core sample under fluid pressure. There is risk of sudden core sample expulsion under excessive fluid pressure as a result of stuck core samples or worn components. **ALWAYS** stand to the side of a pressurized inner tube. **NEVER** look into an inclined or pressurized inner tube. **ALWAYS** inspect for, and replace a worn pump-out piston or worn split tubes. Failure to do so may result in product failure or injury.

PUMP-IN SEAL HAZARD

WARNING

Head assemblies with a pump-in seal connected to the latch retracting case are not recommended for inclined holes or ground with pressurized fluid or gas zones. Boart Longyear recommends Quick Pump-In™ head assemblies which incorporate pump-in seals separate from the retracting case.

RETAINED FLUID COLUMN HAZARD

WARNING

DO NOT remove loading chambers or water saver subs without first draining any retained column of fluid. Inclined or up-hole drilling can include retention of a column of fluid by a wireline loading chamber or a water saver sub. With increasing hole depth, this fluid column quickly builds hazardous weight and hydrostatic pressure until it is safely drained. If drainage tooling and adapters are not available, use the drill rig to partially break the joint at the loading chamber or water saver sub to allow drainage, while standing clear.

PETROLEUM-BASED GREASE

WARNING

Throughout this manual, the use of grease is mentioned. It is important to note that the use of petroleum-based grease in some areas of the world is prohibited. Contact your Boart Longyear representative for recommended lubrication alternatives.

3

UNDERSTANDING THE Q™ WIRELINE SYSTEM

3.1 WIRELINE SYSTEM OVERVIEW

Genuine Q™ Wireline Systems

Genuine Q wireline systems are ideal for use in most drilling conditions and are available for application in standard DCDMA hole sizes (A, B, N, H, P).

Boart Longyear currently offers four models of the wireline core barrel system: **Q™ / Q™TK / Q™3 / Q™TT**

Q™ / Q™TK

Q / QTK wireline systems (pictured right) consist of the core barrel assembly and the overshot assembly. Both assemblies are integral to the wireline system.

The core barrel assembly is composed of the inner-tube group and outer-tube group.

The inner-tube group is composed of:

- Head assembly
- Inner-tube
- Core lifter case
- Core lifter
- Stop ring

The inner-tube group collects the core sample during the drilling process and is independent of the outer-tube group.

The outer-tube group is composed of the remainder of the core barrel components:

- Locking coupling
- Adapter coupling (*eliminated in Roller Latch™ systems*)
- Outer-tube
- Landing ring
- Inner-tube stabilizer
- Reaming Shell*
- Coring Bit*

The outer-tube group always remains at the bottom of the hole and houses the inner-tube group during the drilling process.

QTK systems are optimized to allow for a larger core sample while retaining the same hole, low fluid pressure, and robust inner and outer-tubes. Q™TK systems are offered in the A, B. and N sizes.

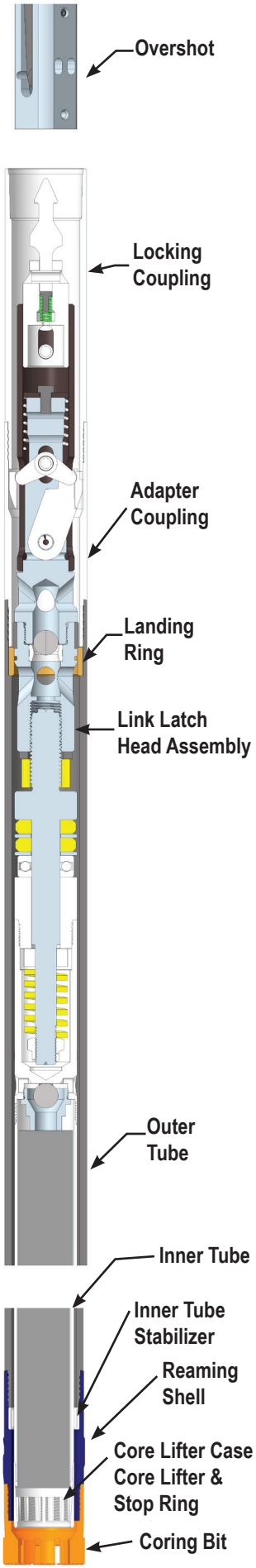
Q™3

Q3 wireline systems consist of the same groups as the Q and QTK but utilize a third tube called an inner-tube liner or split tube. The liner is placed inside the inner-tube.

Q3 systems enable integral core recovery when drilling coal, clay bearing or highly fractured formations. The liner, or split tube, retains the core sample in its received state for easier loading into sample trays or for storage and subsequent presentation to the geologist. The Q3 system is only available in surface configurations and is available in N, H and P sizes.

Q™TT

The QTT system is similar to the Q3 system but includes a specialized core lifter case and bit. These components enable change in the water flow by creating a seal which routes water flow away from the inner-tube – further improving core recovery.



* Sold Separately, refer to the Diamond Tools Catalogue for more details.

Core Barrel Configurations, Features and Options

Standard

Boart Longyear core barrel kits and inner tube groups are available in A, B, N, H and P sizes, as well as two standard lengths of 1.5M/5.0FT and 3.0M/10.0FT. These lengths refer to the inner-tube length which dictates the maximum amount of core that can be retrieved in one drilling run before the inner tube must be retrieved.

Note that optional couplings and adapters are available, for Q and QTK systems, to extend the core barrel in 1.5 M/5.0FT or 3.0M/10.0FT multiples. Also, optional inner tube couplings and extensions are available to allow for extended length reaming shells.

Full-hole

Full-hole systems are designed for operation in competent ground formations where hole accuracy is top priority. The oversized outer diameter and four-flat design keeps the core barrel system tight to the hole while allowing adequate cutting flow. This system is comprised of standard core barrel components, the full-hole induction-hardened locking coupling and the full-hole outer tube. When ordering a core barrel kit, these two optional full-hole items must be selected.

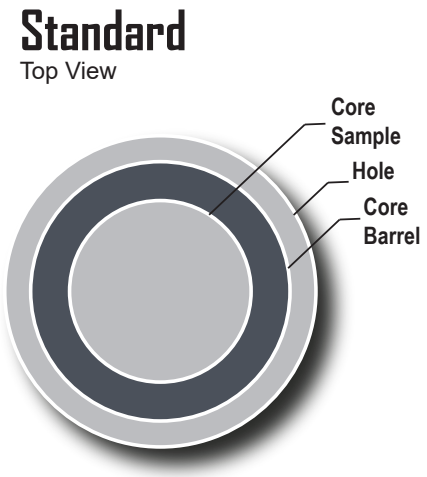
Boart Longyear A, B, N, and H size core barrel systems can be configured as full-hole wireline coring systems. This system is comprised of standard core barrel components, the full-hole locking coupling and outer-tube. When ordering a core barrel kit, these two optional full-hole items must be selected.

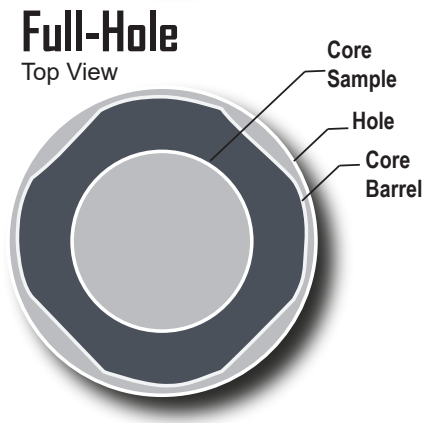
Size	Core Diameter		Hole Diameter	
	Metric (mm)	U.S. (in)	Metric (mm)	U.S. (in)
Q™ (Standard)				
BQ™	36.4	1-7/16	60.0	2-23/64
NQ™	47.6	1-7/8	75.7	2-63/64
HQ™	63.5	2-1/2	96.0	3-25/32
PQ™	85.0	3-11/32	122.6	4-53/64
Q™TK (Thin Kerf)				
AQ™TK	30.5	1-13/64	48.0	1-57/64
BQ™TK	40.7	1-39/64	60.0	2-23/64
NQ™TK**	50.6	2	75.7	2-63/64
Q™3 (Triple Tube)				
NQ™3	45.0	1-25/32	75.7	2-63/64
HQ™3	61.1	2-13/32	96.0	3-25/32
PQ™3	83.0	3-9/32	122.6	4-53/64

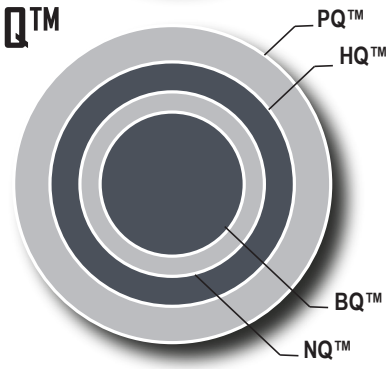
Compared to most core drilling systems, Q systems provide maximum performance, balancing drilling fluid and cuttings management with reliable inner and outer-tubes.

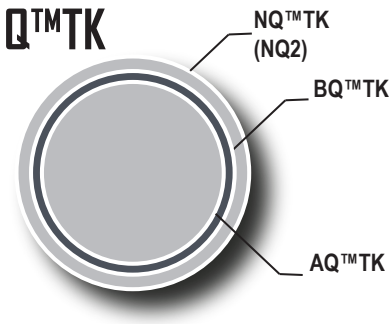
The Boart Longyear nomenclature and hole sizes are based on the globally accepted Diamond Core Drilling Manufacturers Association (DCDMA) "W" series. Also note that the DCDMA specifications were adopted into ISO3551 (1992) and British Standard BS4019 (1993) Rotary Drilling Equipment.

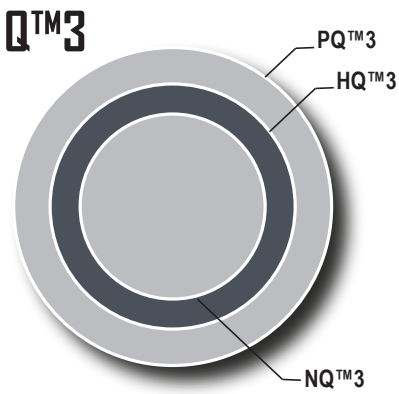
**NQ™TK are also known as NQ2











3.2 QUICK DESCENT™ ROLLER LATCH™ HEAD ASSEMBLY OVERVIEW

The revolutionary new Quick Descent Roller Latch Head Assembly combines the improved reliability and safety of Roller Latch technology with the increased productivity of Quick Descent™ technology along with additional new features.

Roller Latch™ Technology

Ultra-reliable roller technology eliminates the low strength, play, and jamming associated with traditional 'swing-out' latch mechanisms. Roller latches detent into retracted position to eliminate latch drag for increased tripping speed, particularly in W-Wall™ Rods. Roller latches overcome the detent upon landing, or alternatively can be positively driven to deployed position with fluid pressure, or with drill rotation centrifugal force. Under drilling rotation, roller latches self-lock into the locking coupling integrated latch seat to drive the head assembly, eliminating adapter couplings and locking coupling tangs. New Quick Descent Roller Latch Head Assemblies also offers built-in compatibility with Quick Descent Roller Latch Overshots, meaning no spearheads or adapters are required.

Latch Indication

Our improved pump-in valve design now comes with increased travel for better water bypass after latching and while tripping to allow for increased speed. A new rounded valve shape also allows for less wear to the indicator bushing. The 2-piece design replaces the former spring pin design and leads to longer life across all our latch indication components. This redesigned fluid control valve provides a positive latch indication signal and provides our patented 'Dry Hole Valve' functionality for lost circulation conditions in deep holes when used with optional 'Fluid Retention' valve springs and bushings.

Quick Descent™ Technology

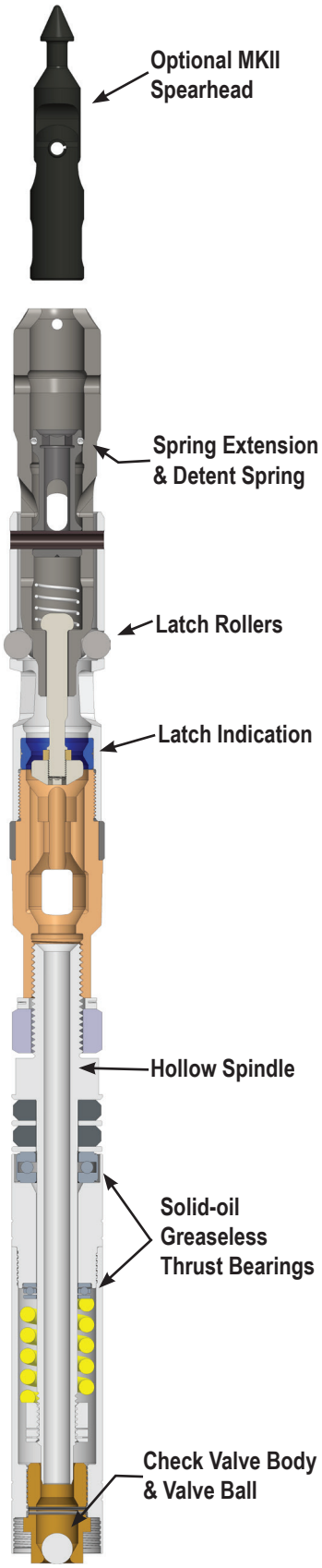
The patented design includes a tapered profile with axial grooving, a new spring extension with detent spring to secure rollers into tripping or deployed position and a hollow spindle. Additionally, a check valve body, optimized for fluid flow directly from the inner tube through the head assembly, offers dramatically reduced fluid drag for increased tripping speed and productivity; up to 50% faster tripping when combined with enlarged W-Wall rod midbodies.

Solid-oil Greaseless Thrust Bearings

A new spindle bushing houses and fully encloses the solid-oil greaseless thrust bearings, for increased load capacity and maximum bearing life at high rpm, ensuring reliable performance when pushing through difficult drilling conditions.

EZY-Lock™ Compatibility

The new Quick Descent Roller Latch Head Assembly is still compatible with lifting dog style Ezy-Lock™ overshots when the optional MKII™ Spearhead is installed.



The Quick Descent™ Roller Latch™ Head Assembly draws on three distinct design enhancements:

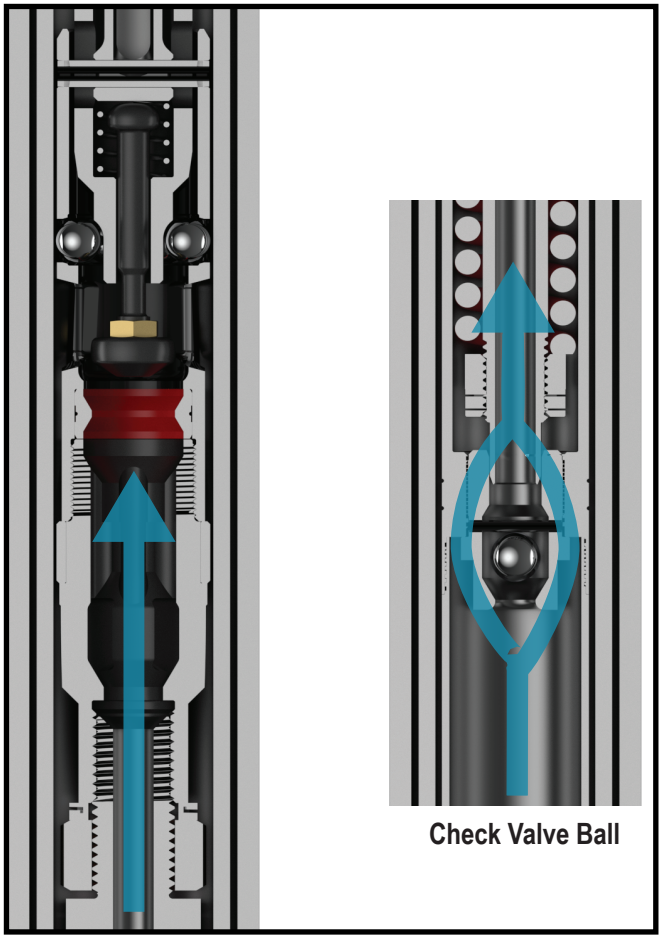
1. **Solid-oil Greaseless Thrust Bearings**
   New spindle bushings now fully enclose solid-oil greaseless thrust bearings, offering increased load capacity, maximum bearing life at high rpm and reliable performance when pushing through difficult drilling conditions.

2. **Detented Roller-Latch™**
   Boart Longyear's patented detented Roller Latch design enables smooth inner-tube travel and eliminates drag against the rod string inner-wall during descent. When retracted, the latches are completely hidden inside the upper latch body and kept in retracted position by the new spring extension with detent spring - allowing the core barrel to travel freely through the rod string.

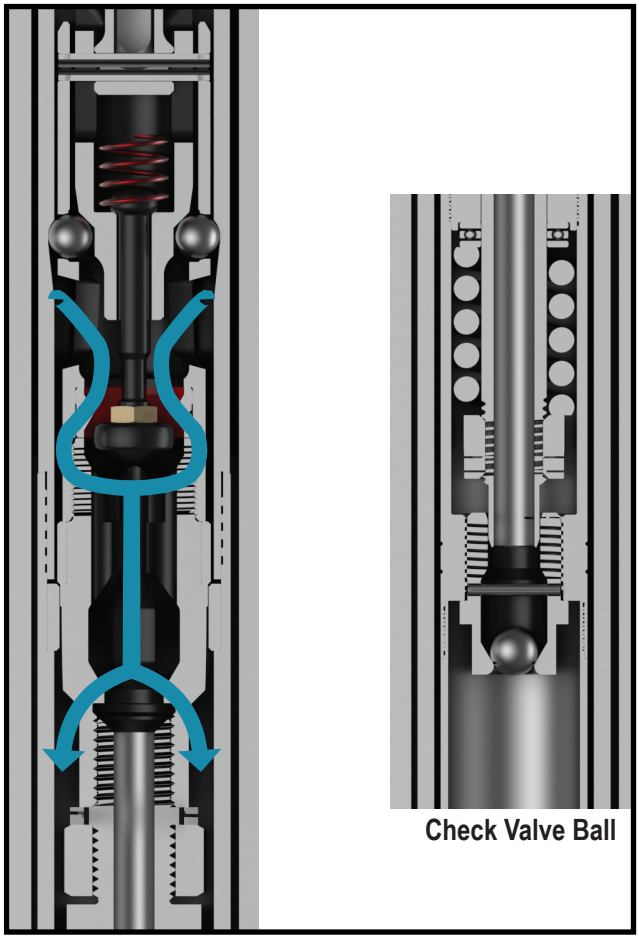
3. **Hollow Spindle**
   Our unique hollow spindle allows fluid to pass easily through the core barrel - significantly increasing drop speed. The HQ™ hollow spindle passes 2.0 L/s (31gpm) at 100kPa (15psi) compared to the standard core barrel 1.2 L/s (19 gpm) which relies on the inner tube's outer annulus for all fluid transmission.

4. **Latch Indication**
   Our improved fluid control valve design provides a positive latch indication signal. It is now equipped with longer piston travel, allowing for increased tripping speed, and a new 2-piece assembly that effectively adds longer life to all our latch indication components. This design improvement goes far beyond existing systems that only give landing feedback -- drill operators will now see a drilling fluid pressure spike when a positive latch has occurred.

Tripping Mode



Drilling Mode



3.3 QUICK PUMP-IN™ ROLLER LATCH™ HEAD ASSEMBLY OVERVIEW

The revolutionary new patented Roller Latch Head Assembly features rolling latches as a replacement for the traditional link latch mechanism. It offers greater pump-in speed, improved safety and increased productivity.

Safer Operations

The Roller Latch head assembly offers the first hold-back braking system employed in any core retrieval system. The unique design utilizes large rollers that are spring driven to a deployed position simultaneously. Only when the wireline is taut during retrieval operations will the rollers retract, allowing for a controlled descent. During a blow-back or free-fall situation, the rollers automatically engage and immediately stop the head assembly, offering added safety to drillers. An indicator groove is now found on the retracting case to indicate worn rollers or a worn brake wedge. This head assembly also incorporates Boart Longyear's MKII™ Spearhead for added strength and safety during retrieval.

Quicker Pump-In

The Roller Latch underground head assembly is optimized for fluid flow, utilizing corrosion and wear resistant components to ensure smooth and reliable functionality. It includes a fluid bypass valve that optimizes fluid flow and aids in fast retrieval. The new Roller Latch locking coupling connects the drill string directly to the outer-tube, and the latch rollers lock the head assembly with the rotating rod string. These features eliminate the need for any adapter couplings, drive key or tang.

Latch Indication

Our new pump-in valve design provides a positive latch indication signal, more piston travel (meaning increased tripping speeds), and a redesigned 2-piece valve design which increases wear life across all latch indication systems. The light up-hole bushing is now the default bushing on all head assemblies; users have the option of swapping out to standard hole bushings. The up-hole bushing prevents water from passing through during retrieval from inclined holes, eliminating drainage delays once the loading chamber is removed.

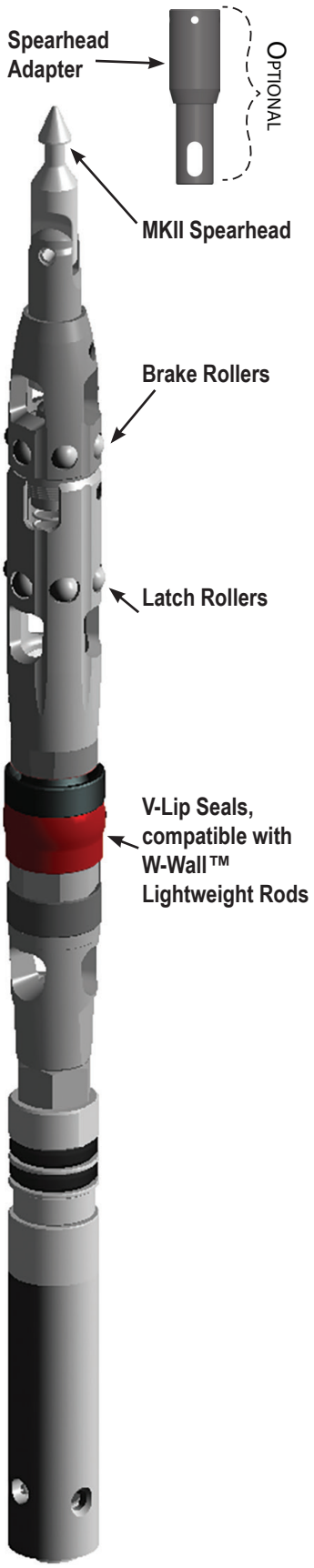
Drill Deeper with W-Wall™ Capability

The new Roller Latch Underground head assembly is equipped with variable lip pump-in seals which are compatible with Boart Longyear's advanced W-Wall™ coring rods.

For the first time, underground drillers are able to take advantage of significantly lighter W-Wall rods, leading to deeper drilling capacity and reduced driller fatigue during rod handling.

Increased Productivity

The wear-life of the latch rollers is superior to conventional latches because the rolling action eliminates drag. The Roller Latch deploys and retracts radially, without swinging out like conventional pivoting latch mechanisms. Excessive wear due to a loose-fit or slippage is eliminated as the rollers simply drop back into position upon wireline retraction.

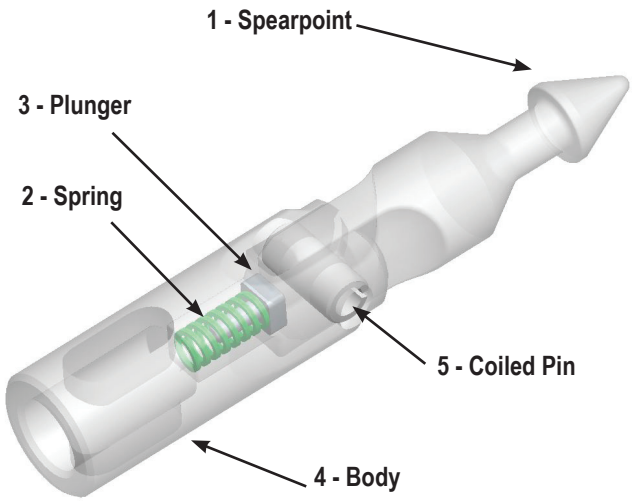


NOTE: When using Roller Latch™ overshots, install the spearhead adapter in place of the spearhead assembly.

3.4 MKII™ SPEARHEAD ASSEMBLY

Spearhead Redesign

Boart Longyear's spearhead assembly has been redesigned for safer and more efficient inner-tube assembly handling, resulting in increased productivity and precise compatibility with all Q™ wireline head assemblies. Building on the proven technology of the pivoting spearhead design, the patented MKII™ Spearhead is 70% stronger and provides the safest inner-tube handling for drillers.



Strong Platform

The new MKII Spearhead Assembly consists of a redesigned spearpoint and spearhead body for added strength and safety. It also features self-lubricating nylon to reduce wear, self-centering spearpoint with multiple detent positions, and an innovative design to eliminate pinch points. A new, heavy duty spring provides a 30% increase in detent positioning strength and is treated for consistent performance. In addition, new precision machined components cut from high quality, quench & tempered, high strength alloy steel bar replaces the inconsistent finish and performance of investment cast components.

	Roller Latch Size	AQTK	BQ/BQTK	NQ/NQTK	HQ/PQ	
	Link Latch Size	AQTK	BQ/BQTK		NQ/NQTK	HQ/PQ
	Spearhead Assembly	5008322	5008323		5008324	5008325
1	Spearpoint	5008164	5008165			
2	Spring, Heavy Duty	5007947				
3	Plunger	3547002				
4	Spearhead Body	5008167	5008168		5008169	5008170
5	Coiled Pin	5003199	5003192			

NOTE: Socket adapters are available to replace spearhead assemblies. See table below.

Spearhead Adapters

Size	Link Latch	Roller Latch	Knucklehead	Blank
	Part #	Part #	Part #	Part #
BQ / BQTK	5008056	5008799	5009999	5010228
NQ/NQTK	5008057	5008799	5009999	5010228
HQ	5008058	5008089	5010001	5010229

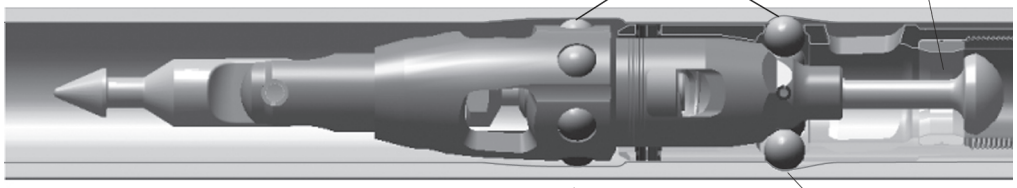
NOTICE

Roller Latch head assemblies, in the larger NQ, NQTK, HQ and PQ sizes only, use smaller spearhead bodies than those used in Link Latch head assemblies.

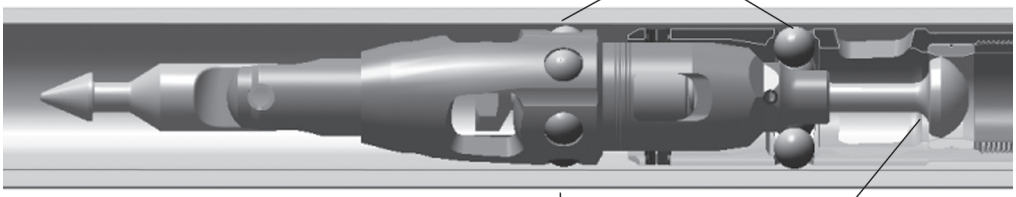
3.5 LATCH & VALVE POSITIONS - ROLLER LATCH™

Roller Latch technology employs rollers that directly retract or deploy without requiring axial clearance or movement of the head. This eliminates jamming as experienced in traditional link latch mechanisms when the core barrel is over-filled. In traditional pivoting latch systems, axial clearance and axial movement is required of the head during wireline retraction. This is no longer required with the Roller Latch system.

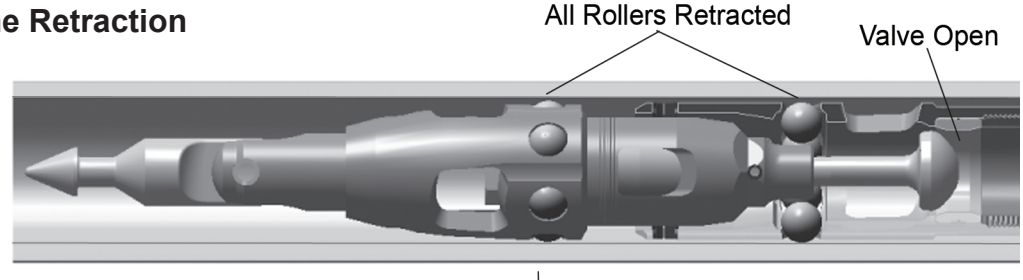
Drilling Position



Tripping In



Wireline Retraction



3.6 FLUID CONTROL

Latch Indication & Fluid Retention

Latch indicator bushings are available for both the 22mm valve in Link Latch™ head assemblies and in AQTK, BQ, and BQTK Roller Latch™ head assemblies, and the 35mm valve piston in NQ, NQTK, HQ, and PQ Roller Latch head assemblies.

Optional fluid retention bushings and springs are available for both 22mm and 35mm valve pistons when drilling in 'dry hole' or lost circulation conditions.

22mm Ball or Piston	35mm Piston	Description	Pressure Spike*
Latch Indication Valve Bushings			
3543904	N/A	Light	1 MPa (150psi)
5008628	5008819	Light Up-Hole	1 MPa (150psi)
62380	5005385	Standard Hole	2 MPa (300psi)
5008018	5007966	Standard Up-Hole	2 MPa (300psi)
3542834	5008307	Deep Hole	4 MPa (600psi)
Fluid Retention Valve Bushings			
306131	5007867	Standard	N/A
3543378	5007868	Heavy Mud	N/A
Fluid Retention Valve Springs			
104966		Light (Green)	1 MPa (150psi)
104971		Medium (Blue)	2 MPa (300psi)j
104972		Heavy (Red)	5 MPa (800psi)
103116		X-Heavy (Yellow)	7 MPa (1000 psi)

*Hydrostatic pressure will reduce the pressure spike reading by 10kPa per meter hole depth (50psi/100ft)

NOTICE

22mm Indicator Valve balls and bushings are installed in all Quick Pump-In Standard Overshots while 22mm fluid retention bushings and springs are installed in all Quick Pump-In Roller Latch Overshots by default. Fluid Retention bushings and springs reset the valve ball until the overshot has landed (see Overshot Operation - Underground).

Installation

Bushings and springs can be installed or removed without pulling the entire inner tube assembly out of the hole or changing the inner tube assembly length adjustment.

- Un-thread the upper and lower latch bodies.
- Insert the bushing into its seat in the latch body. All bushings are reversible except for the 'up-hole' style bushing which must be installed with the extended portion towards the valve piston.
- For fluid retention (optional), drop the spring into its seat in the lower latch body, below the valve piston.
- Thread the upper and lower latch bodies together, ensuring the landing shoulder remains seated.
- Check that the valve piston is in tripping position, above the indicator bushing.
- Check that the valve produces the desired latch indication pressure signal, or fluid retention pressure level, and measure the output flow from the pump, prior to lowering.
- The indication pressure spike magnitude and speed will degrade with hole depth and bushing wear. Install a 'deep hole' style indicator bushing to compensate for deep holes.

Latch Indication Valve Operation

- As the inner tube assembly descends, the valve ball or piston floats above the bushing.
- Upon landing the valve piston drops into the bushing, closing the valve, and the latches deploy.
- Fluid pressure builds and forces the valve piston to advance through the indicator bushing. See 'Latch & Valve Positions' (Section 3.5).
- This generates a pressure spike significantly higher than normal drilling fluid pressure, indicating to the operator that the inner tube assembly has both landed and latched.
- If the supply pressure relief valve (PRV) opens, or if pressure remains high and does not return to a normal lower level, then this indicates that the valve piston has not advanced and the latches have not deployed.
- When retracting with a wireline overshot, a slight tension is required to retract the valve piston back through the indicator bushing before the retracting case retracts sufficiently to allow the latches to retract.
- When retracting from a declined or down-hole, standing fluid will bypass through the valve as the inner tube assembly trips out of the hole, without overloading the wireline cable.
- When retracting from an inclined or up-hole, supply fluid flow and pressure is required to remove weight from the latches and holdback brake. However, fluid will build behind the inner tube assembly and will need to be drained after inner tube retrieval. To avoid the delay of drainage, optional up-hole bushings may be installed to prevent fluid build-up behind the inner tube.

NOTICE **A fluid supply pressure gauge wth a reset-able maximum value indicator is recommended to avoid missing the temporary spike.**

Fluid Retention & 'Dry Hole Valve' Operation

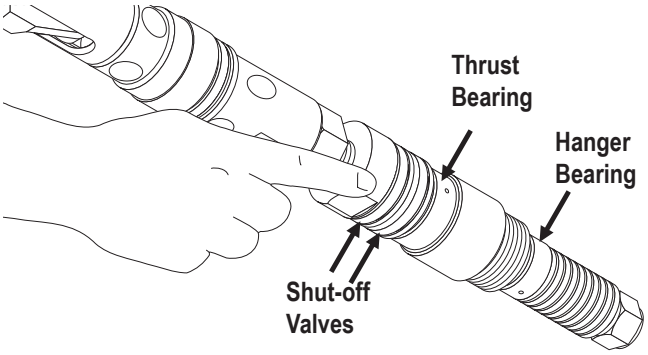
An optional valve is required to maintain a column of fluid in lost circulation conditions. Roller Latch™ heads include a valve piston, enabling 'Dry Hole Valve' operation which eases inner tube retrieval by relieving the retained column of drilling fluid and/or suction from aquifers.

- Choose a fluid retention bushing, providing a slight clearance to the valve piston head. The optional 'heavy mud' bushing has a larger clearance for thicker muds or lower pump capacity.
- Choose a fluid retention valve spring strength to develop a sustained and elevated pressure signal. Choose stronger springs to compensate for hole depth or to provide faster, stronger valve signals. Choose weaker springs to compensate for limited supply pump pressure.
- Install the fluid retention valve bushing and spring as directed above.
- As the inner tube assembly descends, the valve ball or piston floats above the bushing.
- Upon landing the valve ball or piston drops into the bushing, closing the valve.
- As supply fluid pressure builds it acts against the valve ball or piston. Fluid pressure can maintain the retracting case and latches in the deployed position by driving the valve piston through the bushing and compressing the spring.
- The bushing clearance and the strength of the spring determine the minimum fluid pressure or column of fluid required in the rods to open the valve.
- As the spring compresses, the ball or piston moves past the bushing developing fluid flow and a steady, sustained latch indication pressure signal.
- **Roller Latch™:**
  - The latches must be deployed to drop the retracting case and allow the valve piston to advance through the bushing and onto the spring. See 'Latch & Valve Positions' (Section 3.5).
  - Using a wireline overshot to pull the latch retracting case, only apply sufficient tension to retract the valve piston above the bushing. This allows the retained column of fluid to drain and any suction from aquifers to be relieved. **ONLY** after pausing to allow pressure to equalize and wireline tension to decrease, gradually resume wireline retraction to retract the latches and lift the inner tube assembly.
  - Standing fluid will bypass through the valve as the inner tube assembly trips out of the hole, without overloading the wireline cable.

Full Tube/Core Block Indicator 'Shut-Off Valves'

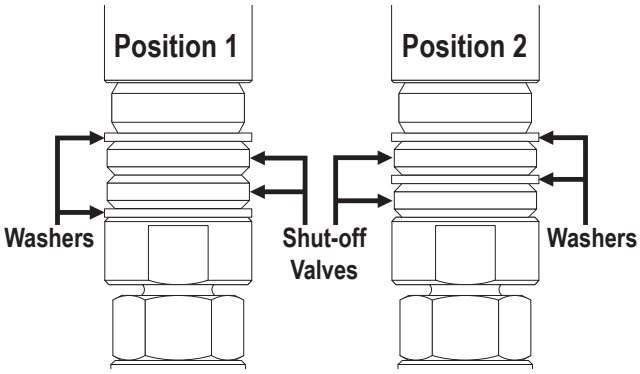
When an inner tube is full or a core block occurs, the core resists the downward drilling force. This exerts a force up through the inner tube assembly, which compresses and radially expands the shut-off valves to restrict the flow of drilling fluid. This restriction increases the fluid supply pump pressure, warning the operator that a core block has occurred.

Two polyurethane 'shut-off valves' and two steel 'valve-adjusting washers' in the head assembly can be repositioned to account for different drilling conditions.



POSITION 1: When coring soft or friable rock, reposition the steel washers so that the valves contact each other. The table below shows the approximate core block forces necessary to close the shut- off valves in this position.

POSITION 2: When coring in harder formations, reposition the steel washers to separate the two shut-off valves. The table below shows the approximate core block forces necessary to close the shut-off valves in this position.



Size	Force - Position 1	Force - Position 2
AQTK	400 lb (1.8 kN or 180 kg weight)	700 lb (3.1 kN or 310 kg weight)
BQ/BQTK	700 lb (3.1 kN or 310 kg weight)	1000lb (4.4 kN or 440 kg weight)
NQ/NQTK	1750 lb (7.7 kN or 770 kg weight)	2500 lb (11.1 kN or 1100 kg weight)
HQ/PQ	3000 lb (13.3 kN or 1300 kg weight)	5000 lb (22.2 kN or 2200 kg weight)

NOTICE

Optional rubber shut-off valves are available for lower loads and faster response when drilling in sensitive or 'soft' formations. When drilling difficult or broken ground conditions, wherein core blocks are frequent or the core sample has excessive drag in the inner tube, the shut-off valves may excessively restrict fluid supply or increase fluid pressure. Also, the gap between the bit and the core lifter case may increase, potentially allowing core fragments to become wedged in-between. In these situations, it may prove beneficial to replace the shut-off valves with an amount of solid valve-adjusting washers that provides equal thickness (for HQ heads, adjust the head assembly length to offset the mis-match in thickness). This alternate configuration ensures unrestricted fluid flow to the bit, however, the operator must rely on drill rig bit load fluctuations as a core block indication, i.e. bit load may be read indirectly on some drill rigs from drill string feed or thrust (or drill string pullback in deep holes).

Size	Shut-Off Valve Thickness	Adjusting Washer Thickness	Qty Washers to Replace Two Shut-off Valves
AQTK	1/2" (12mm)	1/8" (3mm)	8
BQ/BQTK	1/2" (12mm)	1/8" (3mm)	8
NQ/NQTK	1/2" (12mm)	1/8" (3mm)	8
HQ*	1/2" (12mm)	3/16" (4.5mm)	5 or 6
PQ**	1/2" (12mm)	1/4" (6.5mm)	4

*NOTE: for HQ heads, adjust the head assembly length (bit gap) to offset the mis-match in washer thickness and ensure that the inner tube cap turns freely without dragging on the spindle lock nut.

**NOTE: For PQ Quick Descent Roller Latch MK2 Heads, each Adjusting Washer Thickness is 0.167" (4mm).

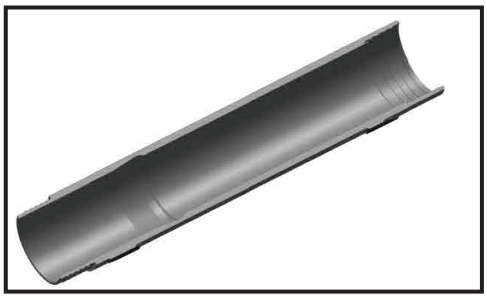
3.7 LOCKING COUPLINGS

All Boart Longyear locking couplings are made of quench and tempered alloy steel for improved wear life and strength. Both Roller Latch™ and Link Latch™ locking couplings are available in 'Full Hole' and 'Stabilized' styles. Refer to the Boart Longyear In-Hole Tools catalogue for details.

NOTICE **Roller Latch locking couplings are not compatible with Link Latch style head assemblies.**

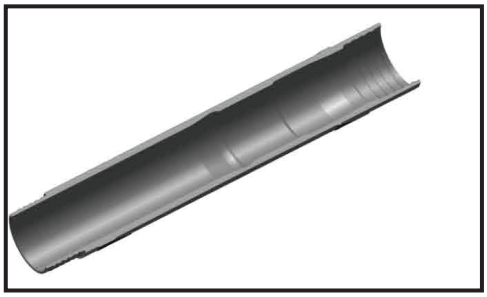
WARNING **Roller Latch head assemblies are not compatible with core barrel adapter couplings. Verify that adapter couplings have been removed from pre-existing core barrel assemblies and drill strings. Failure to do so will prevent latch deployment and may result in product failure or injury.**

Quick Descent™ Roller Latch™ Locking Couplings



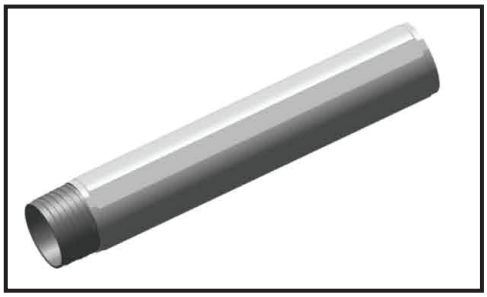
- An internal groove provides improved load capacity for Roller Latch over Link Latch.
- Not compatible with Quick Pump-In or Link Latch head assemblies.

Quick Pump-In™ Roller Latch™ Locking Couplings



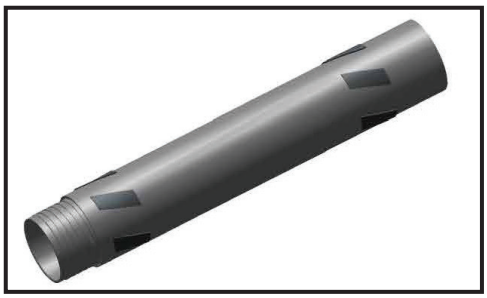
- An internal groove provides improved load capacity for Roller Latch over Link Latch.
- A ***secondary internal groove***, near the box end, provides allowance for simultaneous deployment of hold-back brake rollers.
- Not compatible with Quick Descent or Link Latch head assemblies.

Full-Hole Locking Couplings



- Induction case-hardened wear pads for wear resistance.
- Oversized, full-length wear pads are combined with four axial drilling fluid channels for improved core barrel stabilization in competent ground conditions.
- An optional feature on Link Latch locking couplings, a 'tang' latch driving feature. This is not required for Roller Latch head assemblies, which are self-locking under rotation.

Stabilized Locking Couplings



- High-density tungsten wear pads provide significantly improved wear life.
- Dual offset bands of spiral wear pads provide core barrel stabilization and improved fluid and cuttings bypass channels for use in all ground conditions.
- An optional feature on Link Latch locking couplings, a 'tang' latch driving feature. This is not required for Roller Latch head assemblies, which are self-locking under rotation.

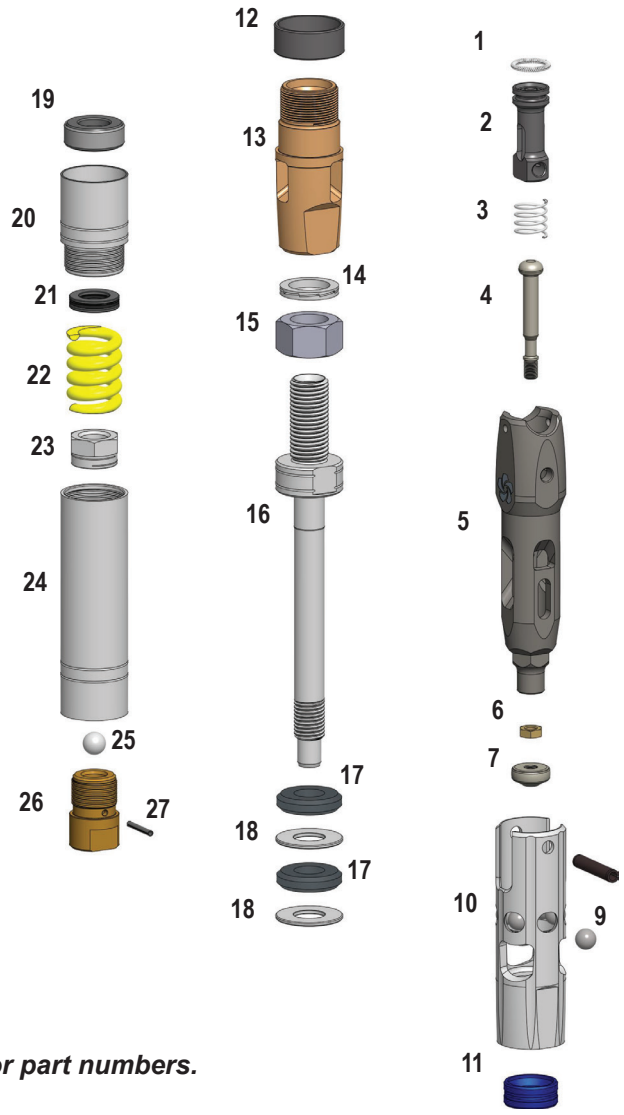
4

PREPARING THE CORE BARREL FOR USE

4.1 ASSEMBLY OF QUICK DESCENT™ ROLLER LATCH™ HEADS

NQ/NQTK/HQ/PQ

ITEM	Description	Qty
1	Detent Spring	1
2	Latch Body Extension	1
3	Latch Compression Spring	1
4	Piston Body	1
5	Retracting Case	1
6	Nut	1
7	Piston Head	1
8	Spirol Pin	1
9	Latch Roller Ball	6
10	Upper Latch Body	1
11	35mm Standard Indicator Bushing	1
12	Landing Shoulder	1
13	Lower Latch Body	1
14	Nord-Lock Washer	1
15	Hex Nut	1
16	Hollow Spindle	1
17	Hard Shut-off Valve	2
18	Valve Adjusting Washer	2
19	Solid-oil Greaseless Thrust Bearing	1
20	Spindle Bushing	1
21	Solid-oil Greaseless Thrust Bearing	1
22	Compression Spring	1
23	Lock Nut	1
24	Inner Tube Cap	1
25	Check Valve Ball	1
26	Check Valve Body	1
27	Spring Pin	1



Refer to the Boart Longyear In-Hole Tools Catalogue for part numbers.

TOOLS: Non-marking hammer/mallet, adjustable wrench, 1/4” Allen key, 5/8" or 3/4" T-handle hex key, grease gun, strap wrench, soft-jaw vice-grip.

TIME: 10 - 20 minutes

1. Ensure workspace and all components are clean and free of debris.
2. Insert the Piston Body (A) into Retracting Case (B), align the slot with the pin hole. Thread on the Jam Nut and Piston Head (C). Once assembled, tighten the Jam Nut against the Piston Head to lock. **DO NOT** tighten anything against the Piston Body. (Fig. 4.1-1)

CAUTION

Roller Latch retracting cases feature a thin, corrosion and wear resistant surface case hardening which may crack if struck or damaged by a sharp edge or tool, leading to premature component failure.

3. With Retracting Case (B) upside down, insert into Upper Latch Body (D). Raising the Retracting Case slightly, insert the Latch Rollers (E) into the fluid port one-by-one, under the Piston Head. Slowly lower the Upper Latch Body (D) until the Roller seats itself. Repeat until all Rollers are installed. (Fig. 4.1-2)
4. Install the Canted Coil Detent Spring (H) onto the extension. Drop the Spring (F) and Extension Subassembly (G) into the Retracting Case (B). Using a hex-key, align the Extension, Retracting Case, and Latch Body and pin together. (Fig. 4.1-3)
5. OPTIONAL: For Ezy-Lock Overshots, insert the Spearhead (I) and install pin into Retracting Case (B). (Fig 4.1-4)

CAUTION

Some spring pins may peel as they are driven into a hole with a sharp edge. Deburr sharp hole edges prior to pinning. Thoroughly remove any peelings formed ensuring they DO NOT interfere with assembly or jam the mechanism. Replace badly peeled pins.

Fig. 4.1-1

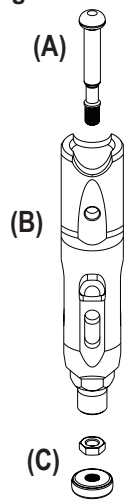


Fig. 4.1-2

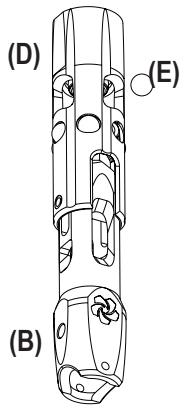


Fig 4.1-3

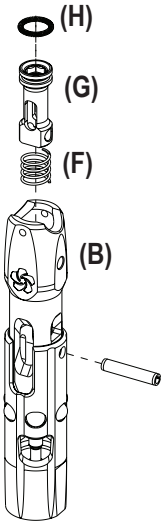
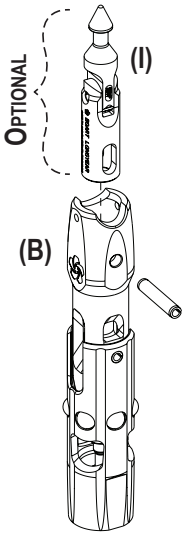


Fig 4.1-4



6. **Detent function check:**
   i. Pull the retracting case away from the upper latch body, angled down, and confirm that the head 'detents' (latch rollers are ‘trapped’ in-between the retracting case and upper latch body) and can self-maintain this position under latch spring load.
   ii. With the upper latch body angled and held down against a fixed stop or surface, the detented position of the retracting case and latches must be held under a manual or hand-applied compression load, e.g. minimum 15lb(60N).
   iii. To return to the latch deployed position, rotate the head 180deg (turn upside-down), pull the retracting case back from the upper latch body to allow the rollers to drop out of detent position, and allow the latch spring to drop the retracting case and deploy the rollers before rotating back to an up-right position.
   iv. The detent must also ‘release’ (allow latch deployment) after a short drop onto an outer tube landing ring, or onto a hard solid surface (e.g. metal bench or concrete floor). The drop height should be more than 2”(50mm) and less than 12”(300mm), drop height varies with the size of head assembly and resilience of the test surface used.
   v. Cycle the detent feature, and verify full and free movement of the retracting case, to ensure the assembly is aligned and free of debris.
7. Check that the retracting case can travel into the upper latch body and fully deploy the latch rollers by ensuring this partial assembly cannot insert into a rod or coupling without retracting the latches. Alternatively, confirm that the rollers are deployed beyond the outer diameter of the landing shoulder, e.g. by visual height comparisons on a level surface, or by diameter comparisons with the landing shoulder as a reference gauge, or by comparisons to the inner diameter of the outer tube landing ring as a reference gauge.

8. Insert Latch Indicator Bushing (J) into Upper Latch Body (D) and Landing Shoulder (K) onto Lower Latch Body (L). Manually tighten, applying adjustable wrenches to the wrench flats on each body. (Fig 4.1-5)
    i. Optionally, insert a fluid retention bushing in the upper latch body and a fluid retention spring into the lower latch body (L).
9. Install Nordlock Washer and hex nut between Lower Latch Body (L) and Hollow Spindle (M). (Fig 4.1-6)
10. Slide the shut-off valves and valve adjusting washers onto Spindle (M). Install the Thrust Bearing (N) into the enclosed Spindle Bushing (O). (Fig 4.1-7)
    i. For NQ/NQTK/HQ, slide on valve first, followed by washer, valve and washer.
    ii. For PQ, slide on washer first, followed by valve, washer, valve, and tapered washer.
11. Slide the core breaking spring onto Spindle (M). Thread on the slotted locknut until it contacts the spindle mounted components. Apply an additional 1/2 turn and **DO NOT** compress the shut-off valves. Make sure that all spindle-mounted components can freely rotate by hand. Thread the Inner Tube Cap (R) into the Spindle Bushing (O). Capture Check Valve Ball (Q) inside Check Valve (P) with Pin (S). Thread this Check Valve Subassembly into the Inner Cap. (Fig 4.1-8) .

Fig. 4.1-5

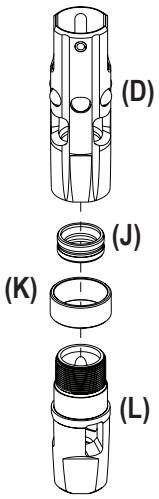


Fig. 4.1-6

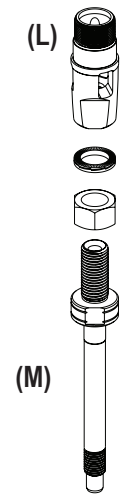


Fig. 4.1-7

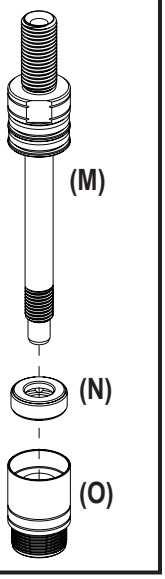
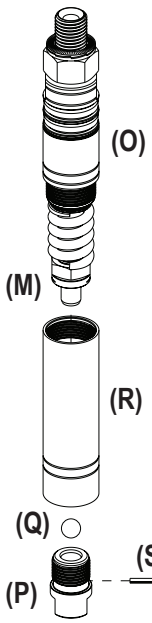


Fig. 4.1-8



CAUTION

Excessive tightening of the spindle lock nut may also create resistance to turning. Resistance to turning may cause the inner tube to spin with the rods and damage the core sample or hamper core recovery.

CAUTION

Excessive tightening of the spindle lock nut will compress the shut-off valves. The resulting expanded valve diameter will drag on the drill string, reducing tripping speeds, and restrict drilling fluid flow to the bit, reducing bit life.

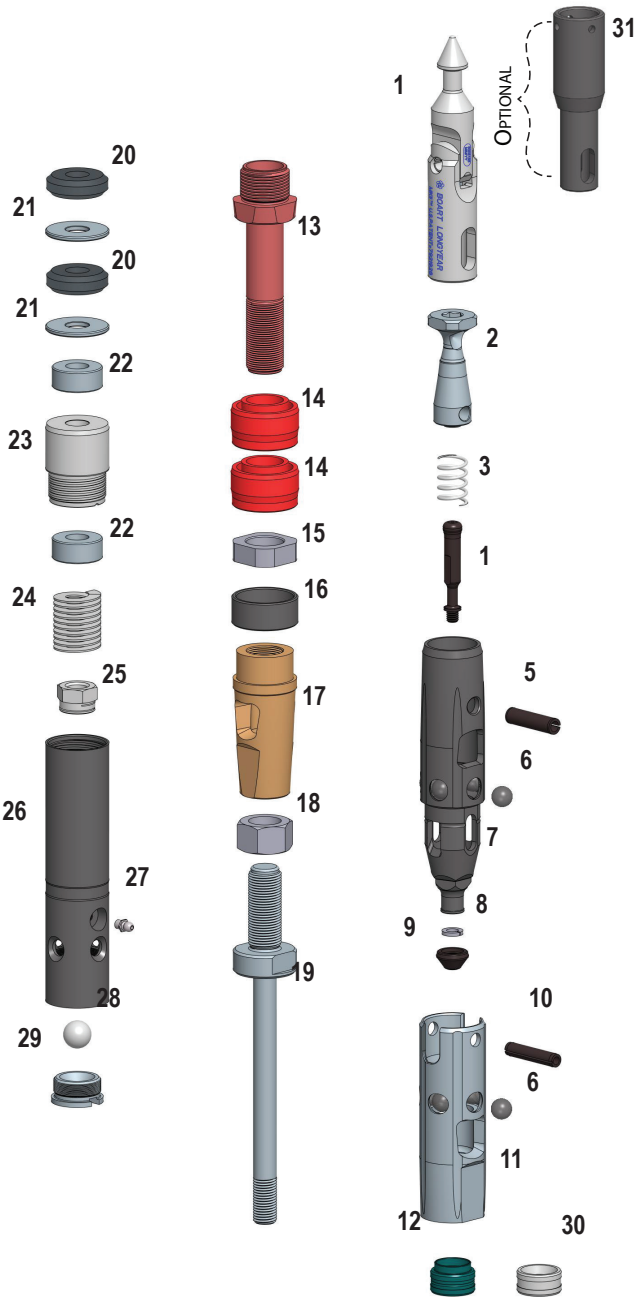
CAUTION

A loose or insufficiently tightened spindle lock nut may cause a mis-latch or prevent drilling as follows: the core lifter case can drop and seal on the bit upon landing; this will prevent fluid flow around the inner tube, and prevent the fluid control valve from opening which prevents the latches from deploying.

4.2 ASSEMBLY OF QUICK PUMP-IN™ ROLLER LATCH™ HEADS

BQU / BQTKU

ITEM	Description	Qty
1	MKII Spearhead Assembly	1
2	Brake Wedge	1
3	Latch Compression Spring	1
4	Piston Body	1
5	Spirol Pin	1
6	Latch/Brake Roller Ball	10
7	Retracting Case	1
8	Lock Washer	1
9	Piston Head	1
10	Spirol Pin	1
11	Upper Latch Body	5
12	22mm Bushing	1
13	Seat Seal	1
14	Lip Seal	2
15	Jam Nut	1
16	Landing Shoulder	1
17	Lower Body	1
18	Hex Nut	1
19	Spindle	1
20	Hard Shut-off Valve	2
21	Valve Adjusting Washer	2
22	Thrust/Hanger Bearing	2
23	Spindle Bearing	1
24	Compression Spring	1
25	Nut	1
26	Cap	1
27	Hydraulic Grease Fitting	1
28	Check Valve Ball	1
29	Check Valve Body	1
30	22mm Standard Bushing	1
31`	Spearhead Adapter (Optional)	1

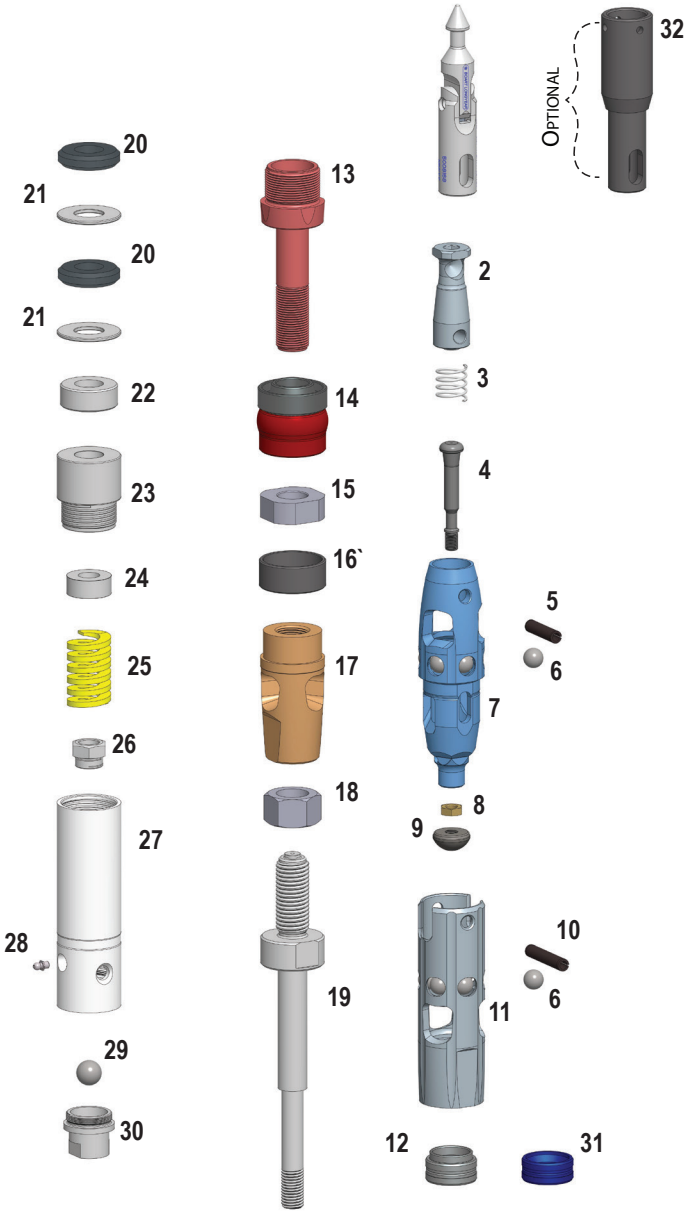


Refer to the Boart Longyear In-Hole Tools Catalogue for part numbers.

NOTE: When using Roller Latch™ overshots, install the spearhead adapter in place of the spearhead assembly.

NQU / NQTKU / HQU

ITEM	Description	Qty
1	MKII Spearhead Assembly	1
2	Brake Wedge	1
3	Latch Compression Spring	1
4	Piston Body	1
5	Spirol Pin	1
6	Latch/Brake Roller Ball	12
7	Retracting Case	1
8	Thin Hex Nut	1
9	Piston Head	1
10	Spirol Pin	1
11	Upper Latch Body	1
12	35mm Bushing	1
13	Seal Seat	1
14	V-Lip Seal	1
15	Jam Nut	1
16	Landing Shoulder	1
17	Lower Latch Body	1
18	Hex Nut	1
19	Spindle	1
20	Hard Shut-off Valve	2
21	Valve Adjusting Washer	2
22	Thrust Bearing	1
23	Spindle Bushing	1
24	Thrust Bearing	1
25	Compression Spring	1
26	Slotted Nut	1
27	Inner Tube Cap	1
28	Hydraulic Grease Fitting	1
29	Check Valve Ball	1
30	Check Valve Body	1
31	35mm Standard Bushing	1
32	Spearhead Adapter (Optional)	1



Refer to the Boart Longyear In-Hole Tools Catalogue for part numbers.

NOTE*: When using Roller Latch™ overshots, install the spearhead adapter in place of the spearhead assembly.*

TOOLS: Non-marking hammer/mallet, adjustable wrench, 1/4" Allen key, 1/2" T--handle hex-key, grease gun, strap wrench, soft-jaw vice-grip.

TIME: 10 - 20 minutes

- Once inner tube assembly is retrieved and loading chamber is removed, apply a quick manual "push & pull" action to the overshot to simultaneously remove weight, retract brake and unload inner tube from an inclined drill string.
  - » Use of a one-foot rod extension on the loading chamber will facilitate removal by allowing the overshot to be removed from the inner tube assembly.
  - » If the overshot or head assembly cannot be reached and water pressure is not available to unload the brake in inclined holes (e.g. when retrieving an inner tube assembly without wireline at the start of a hole), retract the rod string until a joint can be broken above the brake. The rod or locking coupling containing the head assembly can then be used as a handle to manage the inner tube.
  - » The brake will remain engaged until the core sample end of the inner tube assembly is tilted toward the ground, unloading weight from the brake, and allowing retrieval of the inner tube assembly using the spearhead.
- Assemble your new Roller-Latch™ head assembly as follows, taking care to apply a hand wrench to tighten all threaded components including the length adjustment hex nut against the lock washer (smaller size heads have only 5 rollers per set).

1. Ensure workspace and all components are clean and free of debris.
2. Insert Piston Body (A) into the top of the Retracting Case (B) and assemble the Washer (or Jam Nut for N, H and P sizes) (C) and valve piston head. NOTE: Once assembled, tighten the washer (or jam nut) against valve piston head (Fig 4.2-1). **DO NOT** tighten anything against the piston body (A).

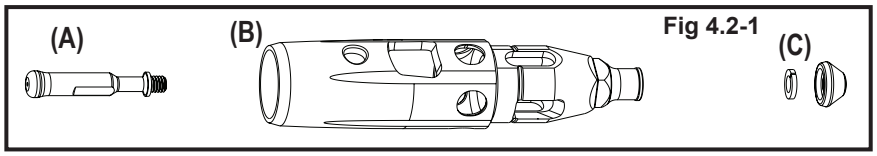


Fig 4.2-1

3. Insert Spring (D) and Brake Wedge (E) into the Retracting Case (B). (Fig 4.2-2)

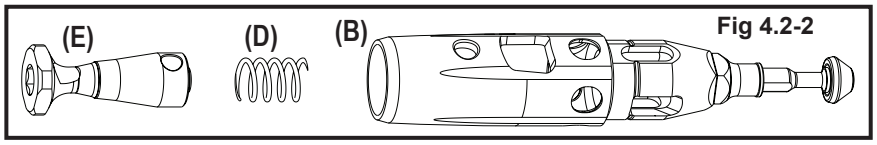


Fig 4.2-2

4. Drop in Brake Rollers (E) one-by-one through the water port on the Retracting Case (B) and into the wedge pocket and use a hex key to compress the spring and rotate to each position. Repeat until all brake rollers are installed. (Fig 4.2-3)
5. Partially insert Brake Assembly (F), drop in Latch Rollers (E) one by one, align slots, and drive in spring pin (Fig. 4.2-4)

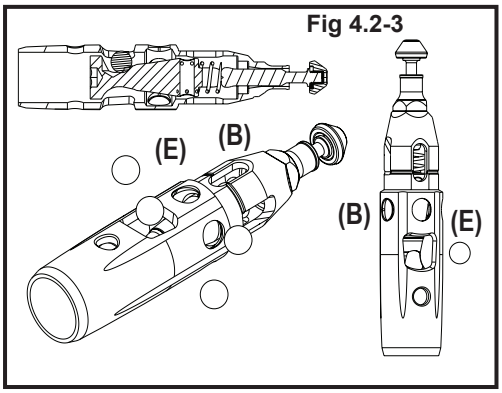


Fig 4.2-3

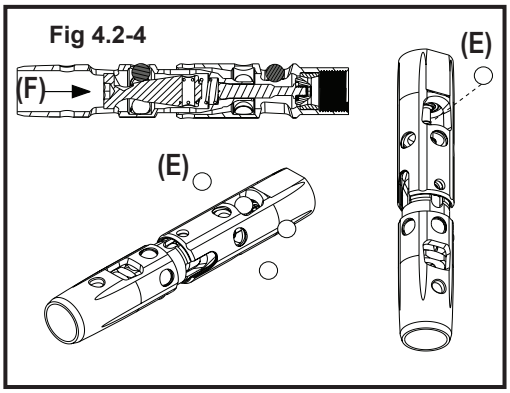


Fig 4.2-4

6. Insert up-hole style Indicator Bushing (G) and assemble Seal Seat (H), Pump-in Seals (I), Jam Nut (J), Landing Shoulder (K), Lower Latch Body (L), Hex Nut (M) and remaining standard Q™wireline components. Ensure that jam nut does not tighten against or compress the pump-in seal assembly. (Fig 4.2-5)

Fig 4.2-5

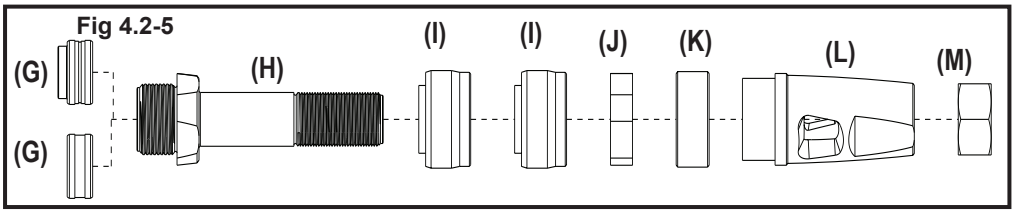
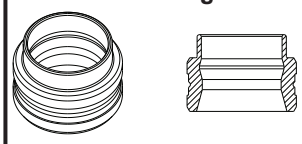


Fig 4.2-6



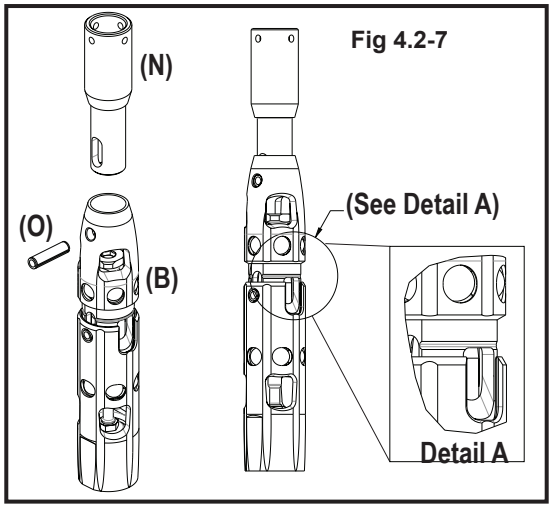
i. Alternatively, install a standard latch indicator bushing if there is very little fluid build-up behind the inner tube assembly in inclined holes. (Fig 4.2-6).

CAUTION

Before using a down-hole, verify that the up-hole bushing is not installed, as it will prevent water from passing through head assembly during retrieval.

7. Insert the optional Spearhead Adapter (N), as shown, for Quick Pump-in™ Roller Latch™ overshots, or a MKII™ spearhead assembly for standard Quick Pump-In overshots. Align slot with pin hole in the Retracting Case (B) and drive the Coiled Spring Pin (O) through. Center the pin to ensure both ends are seated and not protruding excessively. (Fig 4.2-7).

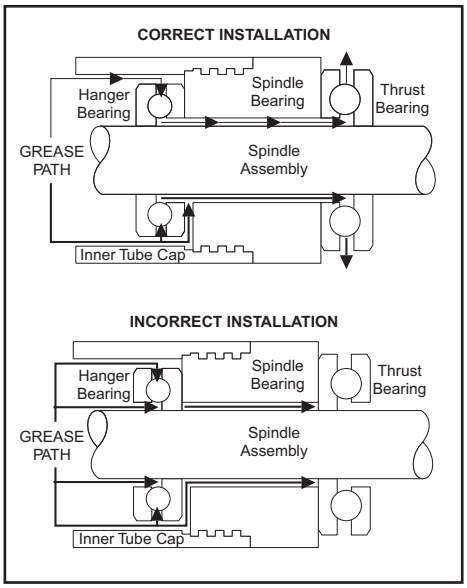
Fig 4.2-7



8. **Brake Function Test:**
   i. Insert the partial assembly, spearpoint first, into a rod or coupling.
   ii. Confirm that retraction is required to insert the brake rollers and allow the latch spring to deploy the brake rollers.
   iii. Confirm that the brake rollers wedge into a braking action, gripping the rod or coupling and preventing further insertion.
   iv. Confirm whether the wear indicator groove is visible between the upper latch body and retracting case shoulder (see 'Detail A'). Replace the brake wedge and rollers if the groove cannot be observed.
   v. Similarly, latch roller function can be checked by confirming retraction is required to insert into a rod or coupling. Alternatively, confirm the rollers are deployed beyond the outer diameter of the landing shoulder, e.g. by visual height comparisons on a level surface, or by diameter comparisons with the landing shoulder as a reference gauge, or by comparisons to the inner diameter of the outer tube landing ring as a gauge.

CAUTION

Thrust type ball bearings have races with two different inner diameters. The bearing race with the larger inside diameter must ALWAYS face the grease fitting to allow proper grease flow.



CAUTION

Excess grease pressure may cause resistance to turning, overheating and premature bearing failure. Excessive tightening of the spindle lock nut may also create resistance to turning. Resistance to turning may cause the inner tube to spin with the rods and damage the core sample or hamper core recovery.

CAUTION

Excessive tightening of the spindle lock nut will compress the shut-off valves. The resulting expanded valve diameter will drag on the drill string, reducing tripping speeds, and restrict drilling fluid flow to the bit, reducing bit life.

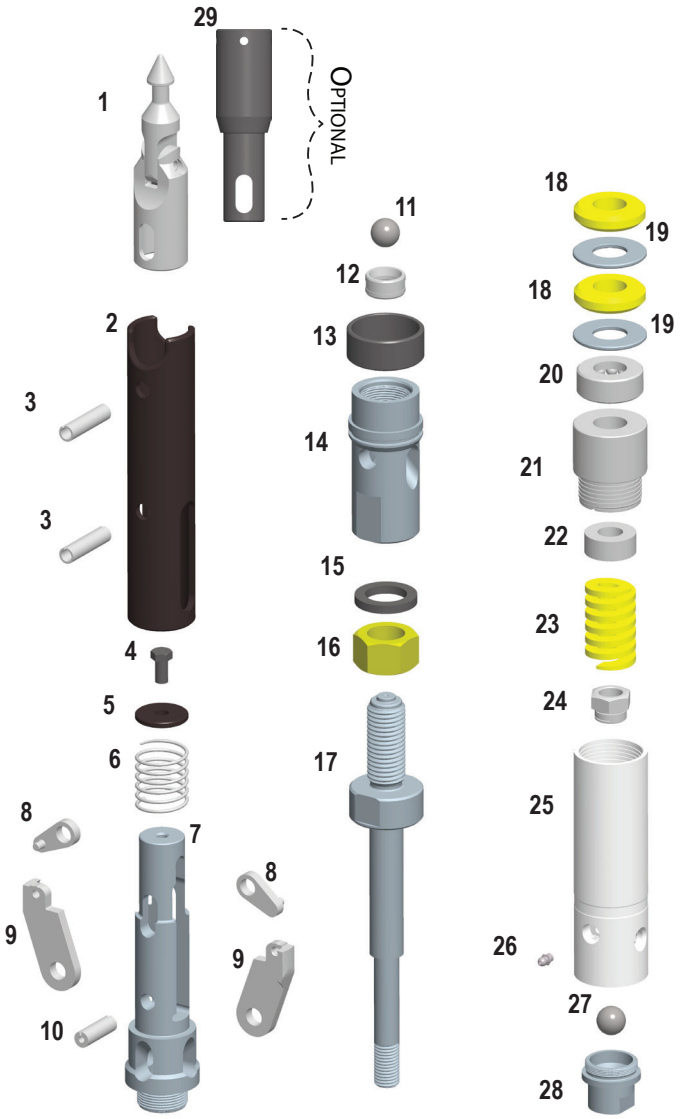
CAUTION

A loose or insufficiently tightened spindle lock nut may cause a mis-latch or prevent drilling as follows: the core lifter case can drop and seal on the bit upon landing; this will prevent fluid flow around the inner tube, and prevent the fluid control valve from opening, preventing the latches from deploying

4.3 ASSEMBLY OF LINK LATCH™ HEADS

Surface

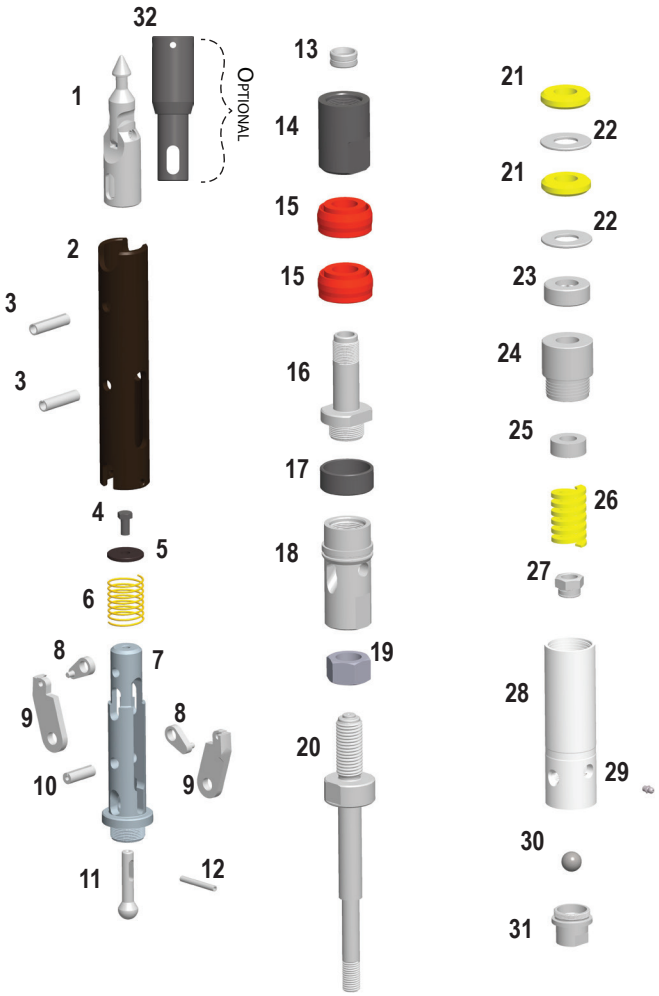
Item	Description	Qty
1	MKII Spearhead Assembly	1
2	Latch Retracting Case	1
3	Coiled Spring Pin	2
4	Nylok Bolt	1
5	Washer, Latch Spring	1
6	Latch Spring	1
7	Upper Latch Body	1
8	Link	2
9	Latch	2
10	Coiled Spring Pin	1
11	22mm Ball	1
12	Indicator Bushing, 22mm	1
13	Landing Shoulder	1
14	Lower Latch Body	1
15	Nord-Lock Washer	1
16	Hex Jam Nut	1
17	Spindle	1
18	Shut-Off Valve	2
19	Valve Adjusting Washer	2
20	Thrust Bearing	1
21	Spindle Bushing	1
22	Hanger Thrust Bearing	1
23	Core Breaking Spring	1
24	Lock Nut	1
25	Inner-Tube Cap	1
26	Grease Fitting	1
27	Check Valve Ball	1
28	Check Valve Body	1
29	Spearhead Adapter (Optional)	1



Refer to the Boart Longyear In-Hole Tools Catalogue for part numbers.

Quick Pump-In™

Item	Description	Qty
1	MKII Spearhead Assembly	1
2	Latch Retracting Case	1
3	Coiled Spring Pin	2
4	Nylok Bolt	1
5	Washer, Latch Spring	1
6	Latch Spring	1
7	Upper Latch Body	1
8	Link	2
9	Latch	2
10	Coiled Spring Pin	1
11	22mm Valve	1
12	Coiled Spring Pin	1
13	Indicator Bushing, 22mm	1
14	Latch Body Adapter	1
15	Pump-In Lip Seal	2
16	Seal Seat	1
17	Landing Shoulder	1
18	Lower Latch Body	1
19	Hex Jam Nut	1
20	Spindle	1
21	Shut-Off Valve	2
22	Valve Adjusting Washer	2
23	Thrust Bearing	1
24	Spindle Bushing	1
25	Hanger Thrust Bearing	1
26	Core Breaking Spring	1
27	Lock Nut	1
28	Inner-Tube Cap	1
29	Grease Fitting	1
30	Check Valve Ball	1
31	Check Valve Body	1
32	Spearhead Adapter (Optional)	1



Refer to the Boart Longyear In-Hole Tools Catalogue for part numbers.

TOOLS: Non-marking hammer/mallet, adjustable wrench, 1/4” socket wrench, drift tool, grease gun, strap wrench, soft-jaw vice-grip.

TIME: 10 - 20 minutes

NOTICE

DO NOT use pipe wrenches or ‘stillsons.’ Use crescent wrenches or adjustable wrenches on components with wrench flats, or strap wrenches where flats are not provided.

1. Ensure workspace and all components are clean and free of debris.
2. Insert the Spearhead Assembly (A) and align slot with pin hole in Retracting Case (B). Drive the Coiled Spring Pin (C) through and center to ensure both ends are seated and not protruding excessively. (Fig 4.3-1)
3. Insert two Latches (D) into the slot in the Upper Latch Body (E). Use a drift tool to align the holes in the latches with the hole in the Latch Body, and drive the Coiled Spring Pin through. Center the pin to ensure both ends are seated and not protruding. (Fig. 4.3-2)
4. Slide the Latch Compression Spring (F) over the Upper Latch Body (E). Retain by threading the Nylok Cap Screw (G) with Spring Retaining Washer (H). Manually wrench the cap screw to fully seat and shoulder, ensuring that the end of the spring is not wedged under the washer. (Fig. 4.3-3)
5. Swing the latches inward and slide the Retracting Case (B) over the Upper Latch Body (E), ensuring that it does not have excessive drag on the latch compression spring.(Fig. 4.3-4)
6. Swing the Latches (D) outward and insert the two mating Links (I). (Fig. 4.3-5)

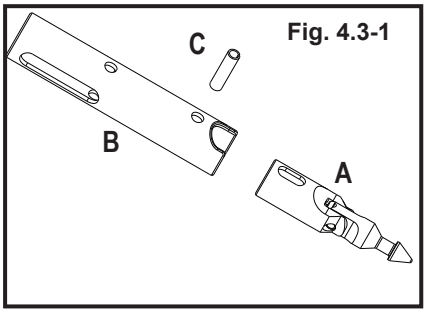


Fig. 4.3-1

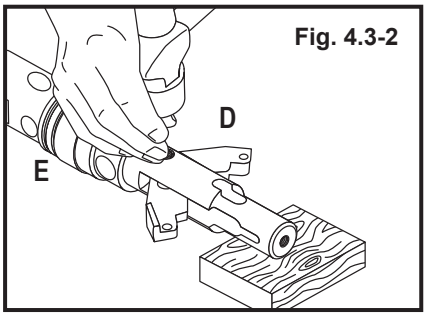


Fig. 4.3-2

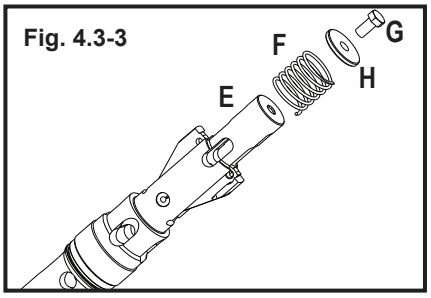


Fig. 4.3-3

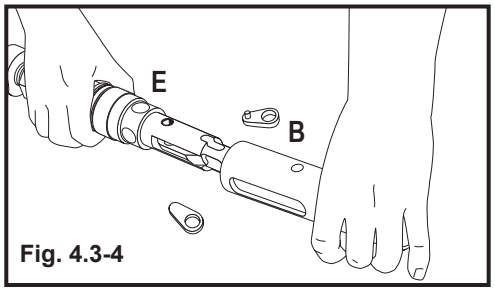


Fig. 4.3-4

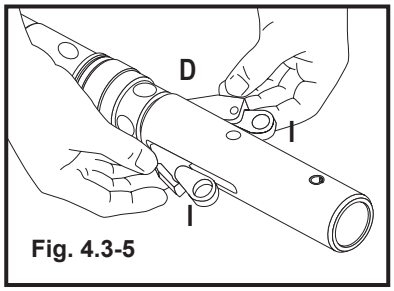


Fig. 4.3-5

7. Use a drift tool (Fig. 4.3-6) to align the holes in the links with the hole in the Retracting Case (B), and drive the Coiled Spring Pin (J) through. Center the pin to ensure both ends are seated and not protruding excessively. (Fig. 4.3-7).
   i. If assembling a Quick Pump-In Link Latch Head, skip to step 8.
   ii. If assembling a surface Link Latch head, skip to step 9.

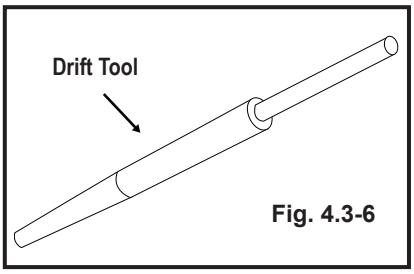


Fig. 4.3-6

8. **Quick Pump-In™ Link Latch™ Components:**
   i. Insert the Valve Piston (K) into the Upper Latch Body (L). Align the piston slot with the hole in the retracting case and drive the Coiled Spring Pin (M) through. Center the pin to ensure both ends are seated.
   ii. Drop the 22mm Indicator Bushing (N) into the Lower Latch Body (O) and tap to full seat.
   iii. Thread the latch body adapter onto the Upper Latch Body. Manually tighten.
   iv. Slide two Pump-in Lip-Seals (P) onto the Seal Seat (Q), so that the lip opening is facing towards the spearhead. Thread the seal seat onto the latch body adapter. Manually tighten. **DO NOT** tighten against or compress the pump-in seats. Lip seals must be free to rotate under light hand pressure (Fig. 4.3-8).
   v. Slide the Landing Shoulder onto the Lower Latch Body. Thread the Lower Latch Body onto the Seal Seat. Manually tighten.

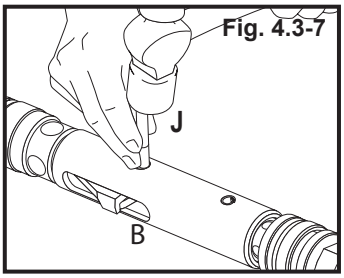


Fig. 4.3-7

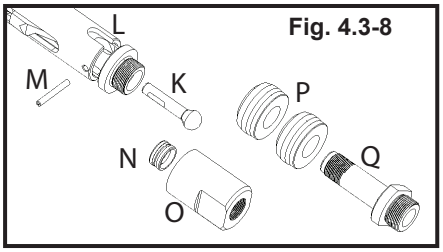


Fig. 4.3-8

9. **Surface Link Latch™ Components:**
   i. Drop the 22mm Indicator Ball (R) and Bushing (S) into the Lower Latch Body (O) and tap to fully seat. Slide the Landing Shoulder (T) onto the Lower Latch Body.
   ii. Thread the Lower Latch Body (O) onto Upper Latch Body (L), which retains the Landing Shoulder (T) externally and the Bushing (S) internally. Manually tighten, applying an adjustable wrench to the wrench flats on the Lower Latch Body and a strap wrench to the Upper Latch Body. (Fig. 4.3-9)

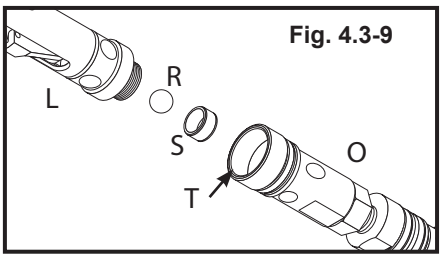


Fig. 4.3-9

10. Partially thread the spindle into the lower latch body with the jam nut. The amount of mated spindle thread determines the overall head assembly length which can be locked by tightening the jam nut against the lower latch body.
11. Slide shut-off valves and valve adjusting washers onto spindle. Refer to 'Fluid Control' (Section 3.6) for alternative configurations.
12. Slide thrust bearing, spindle bushing, and hanger bearing onto spindle. Orient the bearings with the race having the larger inner diameter facing the inner tube cap grease fitting to ensure proper grease flow. (Fig. 4.3-10)
13. Slide the core breaking spring onto the spindle. Thread on the slotted lock nut until contacting the spindle mounted components. Apply additional 1/2 turn.

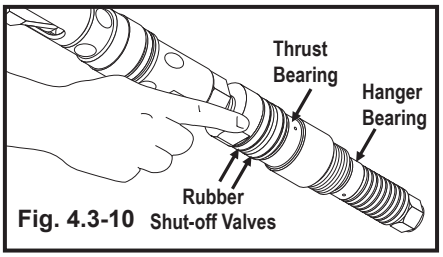


Fig. 4.3-10

14. Check all spindle-mounted components are able to freely turn under a light hand load. If difficult to turn, back off the spindle lock nut a partial turn to reduce resistance.
15. Hand pack grease onto the core breaking spring and into the inner tube cap sufficient to loosely fill assembly voids. Thread the inner tube cap onto the spindle bushing. Manually wrench tighten. Avoid the use of pipe wrenches or 'stillsons' to avoid crushing thin wall sections and creating fatigue cracks from surface jaw marks.
16. Thread the grease fitting into the inner tube cap and manually wrench tighten. Pump grease through the fitting and slowly rotate the assembly until grease weeps from the vent hole in the upper-most bearing.
17. Check that all spindle-mounted components are able to freely turn under a light hand load. If difficult to turn, un-thread the inner-tube cap and remove excess grease.
18. Insert the check valve ball and thread the check valve body into the inner tube cap to retain. Manually wrench tighten.

CAUTION

Thrust type ball bearings have races with two different inner diameters. The bearing race with the larger inside diameter must ALWAYS face the grease fitting to allow proper grease flow.

CAUTION

Excess grease pressure may cause resistance to turning, overheating and premature bearing failure. Excessive tightening of the spindle lock nut may also create resistance to turning. Resistance to turning may cause the inner tube to spin with the rods and damage the core sample or hamper core recovery.

CAUTION

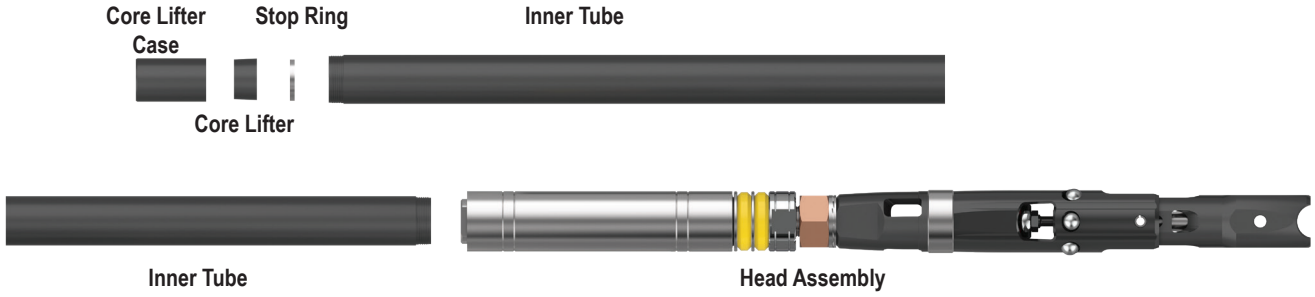
Excessive tightening of the spindle lock nut will compress the shut-off valves. The resulting expanded valve diameter will drag on the drill string, reducing tripping speeds, and restrict drilling fluid flow to the bit, reducing bit life.

CAUTION

A loose or insufficiently tightened spindle lock nut may cause a mis-latch or prevent drilling as follows: the core lifter case can drop and seal on the bit upon landing; this will prevent fluid flow around the inner tube, and prevent the fluid control valve from opening, preventing the latches from deploying.

4.4 INNER TUBE ASSEMBLY

The inner tube group consists of the head assembly, inner tube, stop ring, core lifter, and core lifter case. Refer to the Boart Longyear In-Hole Tools Catalogue for details. Assemble as follows:

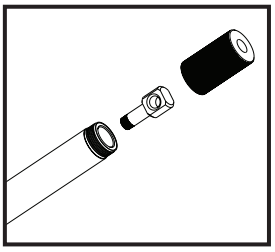


1. Apply a light coating of lithium grease to the inside of the core lifter case. Alternatively, use thread compound where acceptable.
2. Slide the core lifter into the threaded end of the core lifter case, tapered end first. The tapered surfaces of the core lifter and core lifter case act against one another to tighten the grip on the core when the core barrel is pulled back. See 'Core Breaking' (Section 6.4) for operation.
3. Snap the stop ring into the core lifter case. The stop ring provides a hardened surface for the core lifter to bear against during coring.
4. Thread the core lifter case onto one end of the inner tube. If using a stabilized reaming shell, an inner tube extension may be required, see 'Installing Bits and Shells' (on next page).
5. Thread the head assembly onto the other end of the inner tube.
6. Tighten all joints with a circular jaw, 'full-grip' style wrench. Manually applied force is sufficient, but should not exceed 70N-m (50ft-lb). **DO NOT** use pipe wrenches or 'stillsons'.

Extended Core Barrels

For extended core barrels, insert an inner tube coupling and a second inner tube between the first inner tube and the core lifter case. The inner tube coupling accounts for the increased core barrel length when adding additional outer tubes. Alternatively,'extenda' inner tubes can be added which combines a coupling and an inner tube into one length, eliminating a thread joint. Refer to the In-Hole Tools catalogue for details.

Triple Tube System -'Q3'



An optional inner tube liner or 'split tube' (split length-wise) with a pump-out system is available. Use safety loader p/n5006293 to insert when drilling coal, clay bearing, or highly fractured formations. A core ejection piston protects the core from pressurized fluid when the split tube (containing the core sample) is pumped out of the inner tube. Upon removal, one half of the split tube is lifted off to reveal the undisturbed core sample. See 'Core Removal' (Section 6.5) for operation.

NOTICE

Optional 'pump-out group' items are required to pump the core out of the inner tube, refer to In-Hole Tools catalogue. Remove the head assembly from the inner tube, insert the piston plug and thread the pump out adapter on to the inner tube. An optional hand pump and pump-out group is recommended to develop fluid pressure to drive out the piston and split tube.

WARNING

NEVER stand or pass any body part in front of an open inner tube. When applying fluid pressure, ALWAYS stand to the side of an open inner tube and NEVER look into the inner tube.

4.5 OUTER TUBE ASSEMBLY

CAUTION

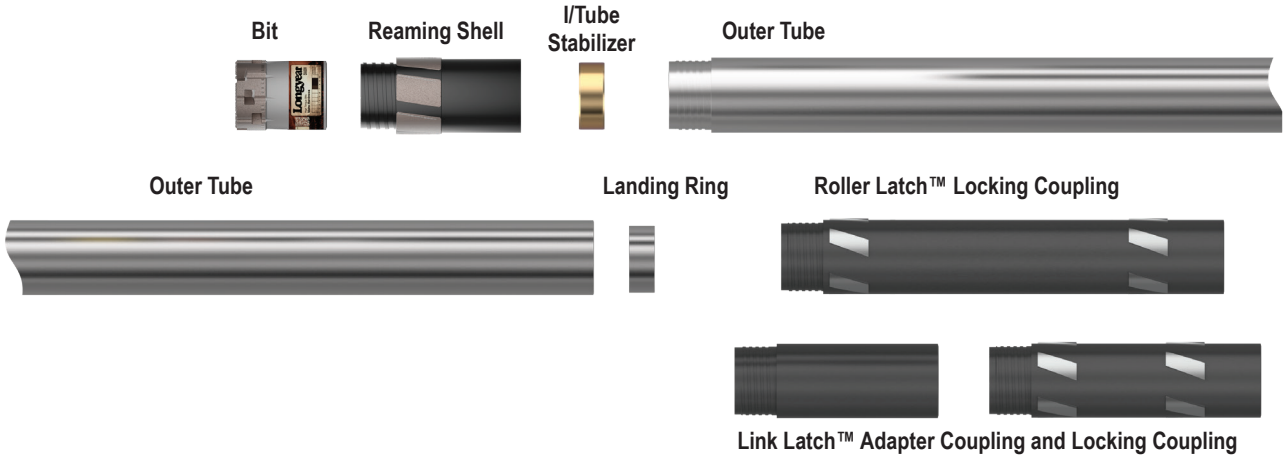
Quick Pump-In™ locking couplings (underground) include a secondary internal brake roller groove which must not be used with Quick Descent™ wireline systems to avoid mis-latches.

CAUTION

Roller Latch™ head assemblies are not compatible with core barrel adapter couplings. Verify that adapter couplings have been removed from pre-existing core barrel assemblies and drill strings. Failure to do so will prevent latch deployment and may result in product failure or injury.

The core barrel outer tube group consists of the locking couplings, landing ring, outer tube, inner tube stabilizer, reaming shell and coring bit. Refer to the Boart Longyear In-Hole Tools Catalogue for all but the reaming shell and coring bit (for those, refer to the Diamond Tools Catalogue) for more details. Assemble as follows:

1. Apply thread compound to the outside of the landing ring and the mating seat in the outer tube, and insert into the outer tube.
2. Apply thread compound and thread the locking coupling to the outer tube. For Link Latch™ systems, an adapter coupling is required in between the locking coupling and outer tube.



Link Latch™ Adapter Coupling and Locking Coupling

3. Install the inner tube stabilizer into the bore of a new reaming shell, then apply thread compound and thread onto the outer tube. See 'Installing Bits & Shells' below.
4. Tighten all joints with a circular jaw, 'full-grip' style wrench to avoid component damage. Manually applied force is sufficient if exceeding 40N-m (30ft-lb). **DO NOT** use pipe wrenches or 'stillsons' on thin walled components including bits, shells, and locking coupling bodies.

NOTICE

In PQ systems, the inner tube stabilizer is inserted into the bore of the bit.

Extended Core Barrels

If assembling an extended core barrel, insert an inner tube stabilizer into the box of the second length of outer tube and thread it to the first.

Installing Bits and Shells

1. Refer to the Boart Longyear Diamond Coring Bits & Accessories catalogue.
2. Install the inner tube stabilizer into the counter bore of a new reaming shell (into the bit in PQ systems only). This stabilizer centers the inner tube.
3. Apply thread compound and thread both the reaming shell and the bit to the outer tube.
4. If using a stabilized reaming shell, add the appropriate inner tube extension between the inner tube and the core lifter case to account for any added length. If using a stabilised reaming shell with an extended core barrel, use the appropriate extended inner tube coupling. Refer to Diamond Coring Bits & Accessories catalogue for details.
5. Wipe the inner tube assembly clean and lightly oil the outside surface. Retract the latches and insert the inner tube assembly into the outer tube assembly, ensuring the landing shoulder is firmly seated on the landing ring.
6. Suspend the assembly, or lower the bit end of the assembly sufficiently to maintain the inner tube assembly in a seated position.

7. Inspect the ‘bit gap’, the space between the inside shoulder of the bit and the end of the core lifter case (Fig. 4.5-1). The gap should measure 3 to 5 mm (1/8” to 3/16”). If the gap is not within these limits:
   - Extract the inner tube assembly.
   - Loosen the lock nut (‘jam nut’).
   - Adjust the length of mating spindle thread to attain the proper gap.
   - Re-insert the inner tube assembly.
   - Inspect the gap again.

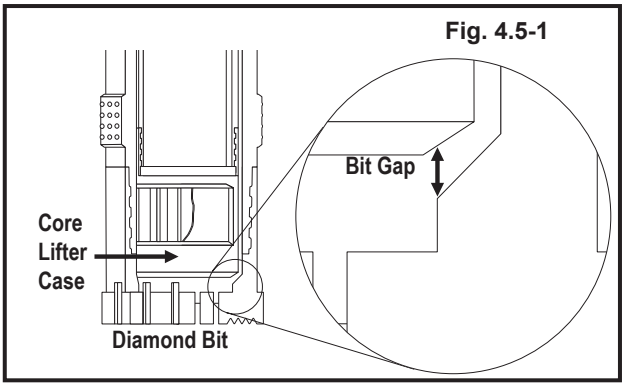


Fig. 4.5-1

8. Repeat bit gap inspection whenever a new bit or reaming shell is installed, or if any component in the inner tube assembly is replaced.

NOTICE

A bit gap that exceeds 5mm (3/16”) may cause poor recovery or short core runs. A gap less than 3 mm (1/8”) may cause high fluid pressure, restricted flow to the bit, or prevent latching of the inner tube assembly.

WARNING

When tripping the inner tube assembly into the hole, an insufficient bit gap may allow the core lifter case to seal against the bit upon landing impact. If the case seals on the bit then the valve piston cannot open, preventing latch deployment and the latch indication signal, resulting in a mis-latch.

9. Remove the bit and push upward on the core lifter case to check the axial ‘play’ or latch clearance. Movement should be slight, approximately 1 to 3 mm (1/16” to 1/8”). Excessive movement indicates worn components or a worn locking coupling latch groove.
10. When using more than one inner tube assembly, check the bit gap and latch clearance in all the assemblies used with the same outer tube assembly.
11. Tighten all thread joints using only circular jaw, ‘full grip’ style wrenches (FIg. 4.5-2). Manually applied force is sufficient if exceeding 40N-m (30ft-lb).

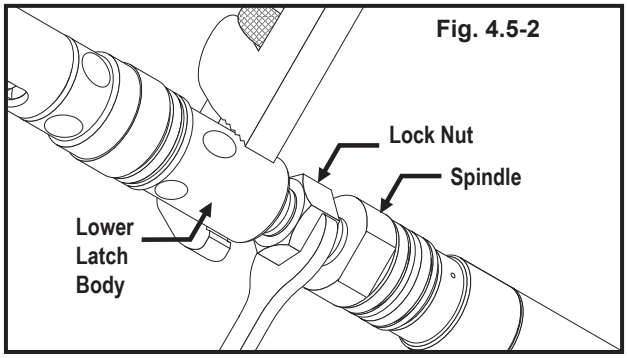


Fig. 4.5-2

4.6 STORAGE AND TRANSPORTING

When transporting or storing the core barrel, insert the inner tube assembly into the outer tube assembly. Incline the assembly to prevent accidental release of the inner tube. Pivot or ‘knuckle-over’ the spearpoint to reduce injury in the case of accidental release.

For storage, apply rust preventative and protect against excessive moisture and humidity.

5

ROLLER LATCH™ OVERSHOT ASSEMBLY

5.1 QUICK DESCENT™ (SURFACE)

TOOLS: Adjustable wrench, 3/16" Allen key, 5/16" socket wrench, grease gun, soft-jaw vice-grip

TIME: 10 - 20 Minutes

Overshot Latch Subassembly

1. Slide the Spring (A) over the Lifting Wedge (B). Insert this subassembly into the Overshot Head (C). (Fig. 5.1-1)
2. Place Release Rollers (D) one-by-one onto their respective grooves on the Overshot Head, positioning them against the raised Lifting Wedge (B). Push the Lifting Wedge down into the Overshot Head to seat all rollers at once. (Fig. 5.1-2)
3. Drop in Latch Rollers (D) one-by-one through the Roller Installation Hole on the Overshot Head (C), rotating the Lifting Wedge (B) for each position. (Fig. 5.1-3)
4. With the Safety Pin Hole on the Lifting Wedge (B) and Overshot Head (C) aligned, push the Lifting Wedge down into the Overshot Head to seat the Rollers. Seat the O-Ring inside the Overshot Head at the base of the threads and tightly thread the Nosecone (E) onto the Overshot Head (Fig. 5.1-4). **DO NOT** seat the O-ring on the nosecone threads.

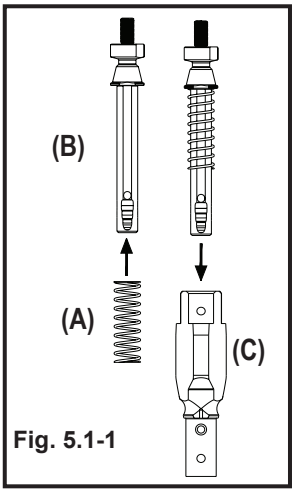


Fig. 5.1-1

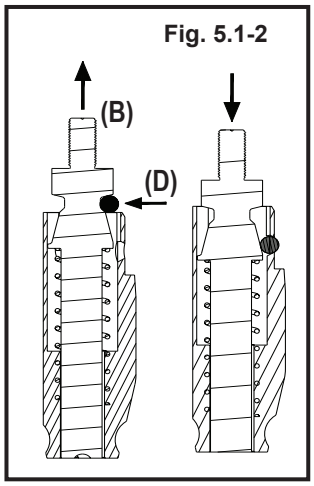


Fig. 5.1-2

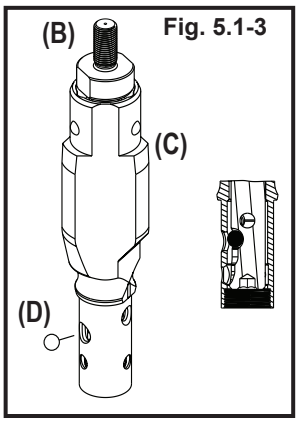


Fig. 5.1-3

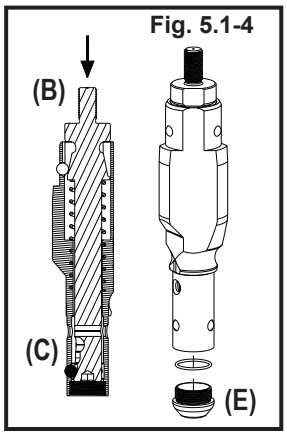


Fig. 5.1-4

Overshot Spindle Subassembly

5. Insert the Ball Joint (F), Large Roller (G) and Spring (H) into the Ball Joint Socket (I). (Fig. 5.1-5)
6. Thread the Overshot Spindle (J) into the Ball Joint Socket and the Set Screw (K) into the Overshot Spindle. Insert the Spindle Bushing (L), Hanger Bearing (M) and Slotted Lock Nut (N). Ensure the Spindle Bushing can still spin (Fig 5.1-6).

Upper Portion of Overshot Assembly

7. Add the Belleville Washer (O) to the Lifting Wedge. Thread the Overshot Spindle Subassembly (Step 6) onto the Overshot Latch Subassembly (Step 4) (Fig. 5.1-7)

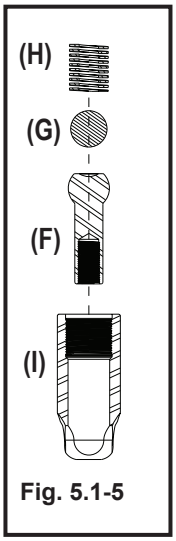


Fig. 5.1-5

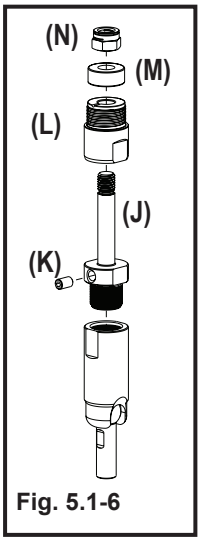


Fig. 5.1-6

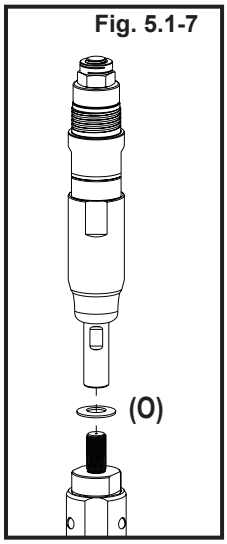


Fig. 5.1-7

Overshot Cable Swivel Subassembly

8. Slide Cable Swivel Collar (P) and Bearing (Q) over Eye Bolt (R). Thread the Castle Hex Nut (S) onto Eye Bolt and insert Cotter Pin (T). Thread a Grease Nipple (V) into the Upper Cable Swivel Body (U) and the Lower Cable Swivel Body (W). Thread the Cable Swivel Collar onto this Upper Cable Swivel Body. (Fig. 5.1-8)
9. Two Overshot configurations can be used (Fig. 5.1-9):
   i. Standard: Thread a Chaser Weight Body (X) in between the Upper Cable Swivel Body (U) and the Lower Swivel Body (W).
   ii. Short Overshot/Dry-Hole: Thread the Upper Cable Swivel Body (U) directly into the Lower Cable Swivel Body (W).

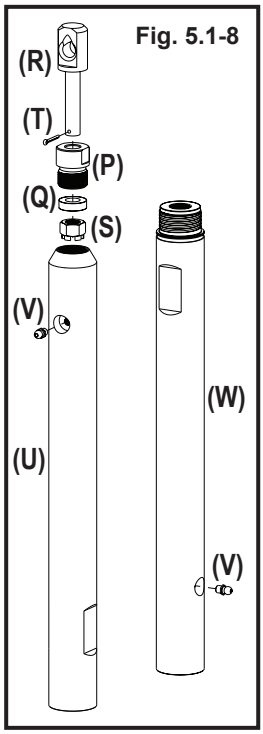


Fig. 5.1-8

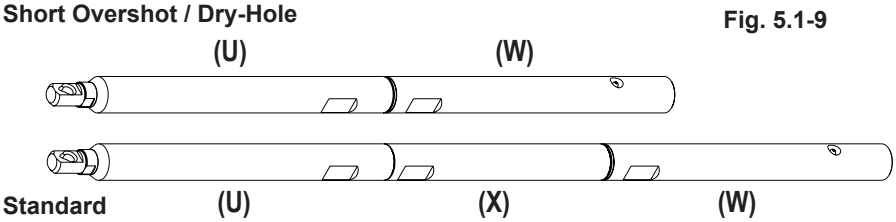


Fig. 5.1-9

Overshot Assembly

10. Attach the Cable Swivel Subassembly (Step 9) to the Upper Portion of Overshot Assembly (Step 7) (Fig 5.1-10)

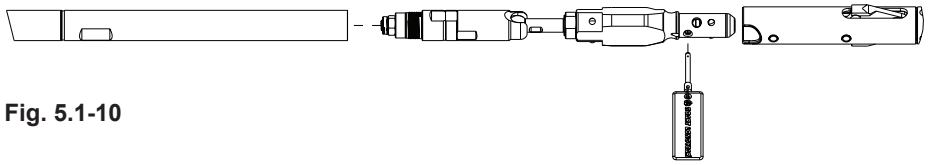


Fig. 5.1-10

5.2 QUICK PUMP-IN™ (UNDERGROUND)

TOOLS: Adjustable wrench, 3/15" Allen key, 5/16" socket wrench, grease gun, soft-jaw vice-grip.

TIME: 10 - 20 minutes

Overshot Latch Subassembly

1. Insert the Lifting Wedge (A) into Overshot Body (B). (Fig. 5.2-1)
2. Drop in Latch Rollers (C) one-by-one through the Roller Installation Hole on the Overshot Body (B). Rotate Lifting Wedge (A) and repeat for the remaining two rollers. (Fig. 5.2-2)
3. With the safety pin hole on both the Lifting Wedge (A) and the Overshot Body (B) aligned, push the Lifting Wedge into the Overshot Body to seat the rollers. (Fig. 5.2-3)
4. Insert the Latch Spring (D) into the Overshot Body (B) and thread on the Jam Nut (E), ensuring the Latch Rollers stay deployed. (Fig. 5.2-4)

Fig. 5.2-1

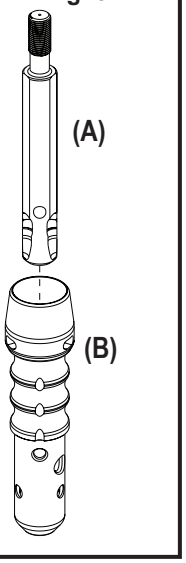


Fig. 5.2-2

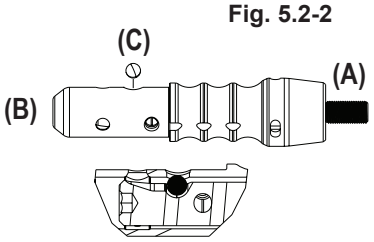
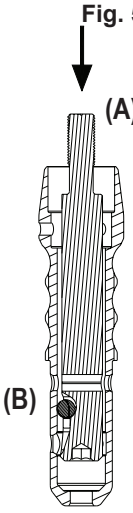


Fig. 5.2-3



Seal Seat Subassembly

5. Install Fluid Retention Spring (G), Fluid Retention Bushing (H) and 22mm Ball (I) into the Overshot Joint Adapter (F). Thread on the Seal Seat (J). (Fig. 5.2-5)

Cable Release Subassembly

6. Install Cable Release Spring (L) and Sleeve (M) onto the Cable Release Jam Nut (K). Thread the Cable Release Box (N) into the Jam Nut until the sleeve covers the Roller Seats. Pull down the sleeve to install the Cable Release Rollers (O) one-by-one. Finish threading the Cable Release Box (N) into the Jam Nut (K). Cable Release Subassembly complete. (Fig. 5.2-6)

Fig. 5.2-4

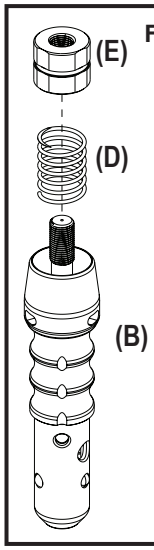


Fig. 5.2-5

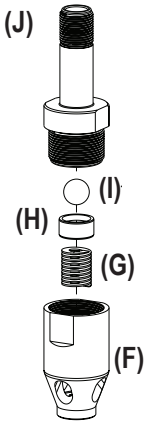
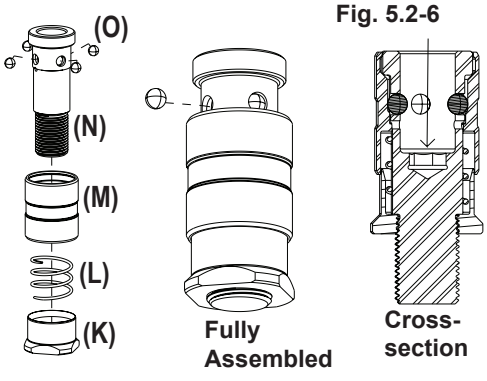


Fig. 5.2-6



7. Thread Cable Release Subassembly into the Upper Overshot Body (P) and tighten the Jam Nut against the Upper Body. Thread Grease Nipple (Q) into the Cable Swivel Body (R). Pull the Cable Swivel Release Sleeve (M) down and install the Cable Swivel Body. (Fig. 5.2-7)

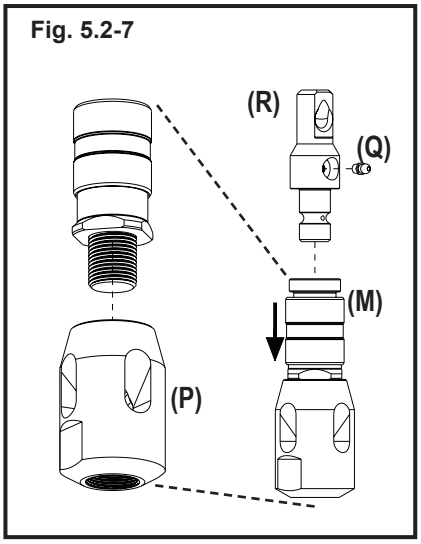


Fig. 5.2-7

Overshot Assembly

8. Thread the Overshot Latch Subassembly (from Step 4) into the Seal Subassembly (from Step 5). Tighten the Jam Nut (E) against the Joint Adapter (F). Install Seal Seat (T) and thread the Cable Release Subassembly (from Step 7) onto the Seal Seat. (Fig. 5.2-8)

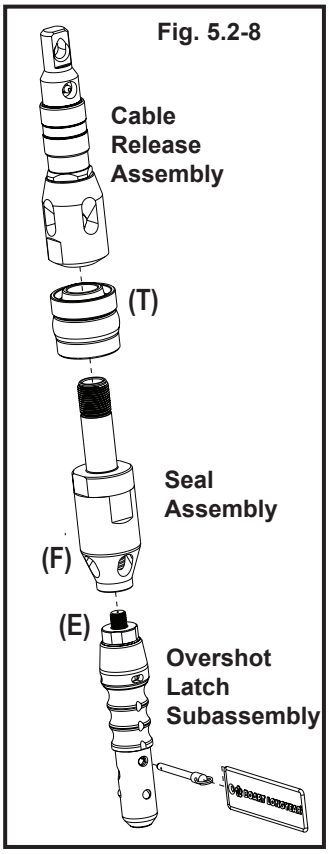


Fig. 5.2-8

6

OPERATING PROCEDURES

6.1 FINAL CHECK & LUBRICATION

1. Check that all inner tube and outer tube thread connections have been tightened, with application of thread compound, utilizing 'full-grip' stype wrenches.
2. Before drilling and before every run, pump grease into the grease fitting until it flows through the vent holes in the thrust bearing or spindle bushing. Rotate the inner tube cap assembly slowly to distribute the grease while pumping. If grease does not vent, check bearing assembly for correct orientation.
3. Check that the inner tube cap turns freely under light hand load. To free up, remove the inner tube cap and remove excess grease. If necessary, back-off the spindle lock nut with a partial counterclockwise turn.
4. **For spearheads only:** Check full movement and spring or detent resistance of the spearhead.
5. **For Roller Latch™ socket adapters only:** Visually inspect the interior groove for wear. Replace if wear is significant, or if the safety pin hole no longer lines up with the Roller Latch™ Overshot.
6. Check the landing shoulder for excessive wear on leading edge and reverse it or replace it for a fresh shoulder to avoid loss of bit gap. Similarly, check the outer tube landing ring when the drill string is pulled for bit changes, reversing, or replacing when worn.
7. Check the head assembly length adjustment by comparing to another assembly or outer tube that has been checked against the length of the outer tube in the drill string. Confirm that the adjusting nut and wedge-lock washer are tight. This will confirm that the bit gap will be correct when interchanging inner tubes. Confirm the bit gap length adjustment in the actual drill string outer tube when it is pulled for a bit change.
8. Apply lithium grease between the core lifter and core lifter case.
9. Check the pressure relief valve setting on the supply pump, typically 4200kPa (600psi).
10. Grease the wireline cable swivel bearing in the overshot, checking that the eye bolt freely turns. Check condition and operation of rollers or lifting dogs, safety features, and any secondary safety devices, e.g. Ezy-Lock twist sleeve and safety pin, shear pin (underground), etc.
11. Check for full and free movement of the latching mechanism. **For Roller Latch head assemblies**, visually inspect the roller path on the retracting case for any wear and replace if any exists.
12. Visually inspect all rollers or latches; if visibly worn or deformed in comparison to un-used rollers or latches, replace the worn part(s).
13. Before using any **Quick Pump-In™ head assembly (Roller Latch™ or Link Latch™)** in a downhole, verify that the up-hole bushing is not installed as it will prevent water from passing through the inner tube assembly during retrieval.
14. **Roller Latch™ Head Assemblies:**
    i. **Quick Descent™:**
        a. Check that there is no adapter coupling and that a Quick Descent Roller Latch locking coupling is installed before sending anything down the rod string. Failure to do so will prevent roller deployment and result in product failure or injury.
        b. For MK2 assemblies only, perform a detent function check to verify that the detent position can be maintained:
            - Check for canted coil spring condition by pulling back the retracting case and confirming spring resistance until latch rollers have reached detent position (rollers in the retracted position).
            - Confirm latch rollers maintain detent position. Replace canted coil spring if detent position cannot be maintained.
            - Check that the detent position is released with a short drop (with force if necessary) of the head assembly onto a hard surface.
            - Cycle the detent feature to verify that the assembly is free of debris and does not jam.
    ii. **Quick Pump-In™:**
        a. Check that there is no adapter coupling and that a Quick Pump-In Roller Latch locking coupling is installed before sending anything down the rod string. Failure to do so will prevent roller deployment and result in product failure or injury.

b. Perform the holdback brake test:

- Partially insert the head assembly, spearhead first, into a rod or coupling until the brake rollers are engaged on the inner diameter.
- Observe whether the wear indicator groove in-between the retracting case and the upper latch body can be ovserved. (Fig. 6.1.1)
- Replace the brake wedge and brake rollers if the groove cannot be observed.

iii. Replace the brake wedge and rollers if the groove cannot be observed. Refer to assembly section.

15. **Link Latch™ Head Assemblies:**

i. Check that there is an adapter coupling and locking coupling installed before sending anything down the rod string. Failure to do so will prevent roller deployment and result in product failure or injury.

ii. Check that the valve ball or piston is in the proper position above or behind the indicator bushing prior to each run. If an inner tube assembly is dropped with the valve ball or piston below or ahead of the bushing, then the bypass porting is blocked, and the descent rate is drastically reduced. If necessary, force the valve ball or piston back through the bushing using a tool or drift, leveraged against the body porting.

16. **Roller Latch™ Overshots:**

i. Visually inspect all rollers if visibly worn or deformed in comparison to un-used rollers.

ii. Confirm the full and free movement of the rollers on the wedges with the overshot pointing up. If any rollers get stuck or motion is not smooth, disassemble to thoroughly inspect both the lifting wedge and overshot head for any signs of wear or damage and replace either if worn.

iii. Confirm full and free movement of the wireline cable swivel. Apply grease as necessary.

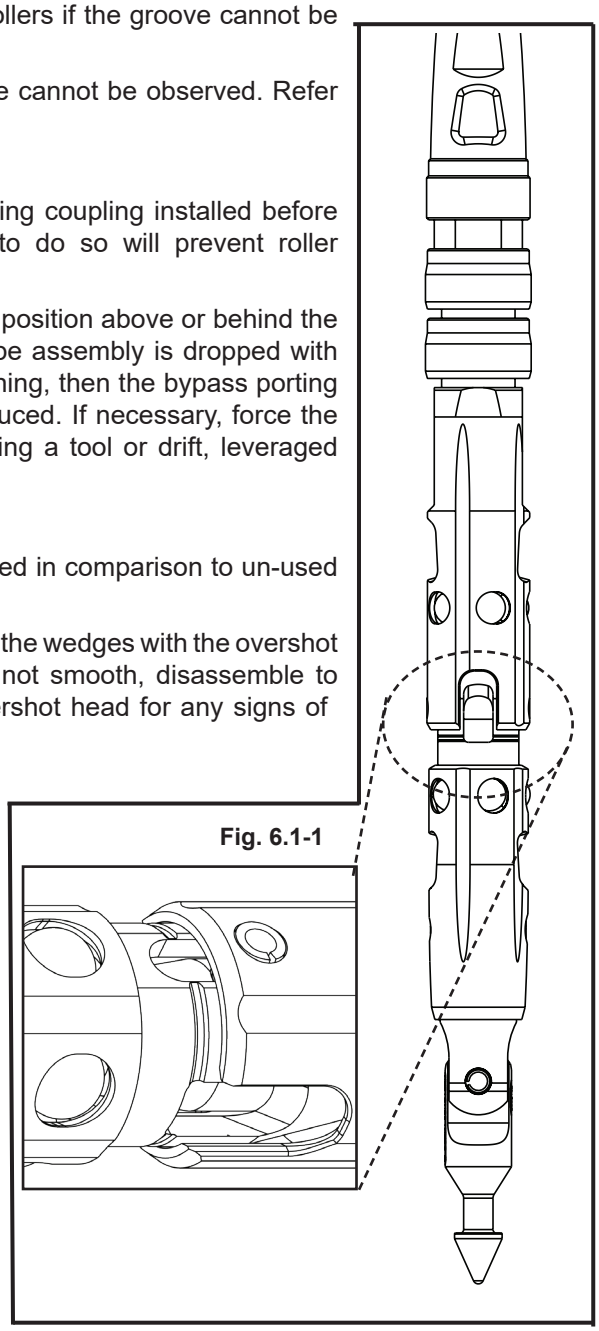


Fig. 6.1-1

iv. **Quick Descent™:**

a. Check that the overshot self-aligns and stays straight upon handling.

b. Check the pivot function on the overshot by applying a moderate amount of force to pivot the overshot in either direction. If you are not able to pivot 90° in both directions, inspect the ball joint, large roller, and spring to confirm if any parts are worn and replace if so.

c. Verify that the entire joint swivels 360° and confirm full and free movement of the spindle. Replace bearings if there is any resistance in motion.

v. **Quick Pump-In™:**

a. Check whether the wear indication groove on the overshot jam nut is fully visible.

b. Using the porting on the joint adapter, visually inspect the indicator bushing and spring and replace if worn.

c. Visually inspect the pump-in lip seals and replace if the lip outer diameter is visibly worn or undersized, or if loose when inserted into a rod or coupling in comparison to a new seal.

17. **Lifting Dog Style Overshots:**

i. Using the inspection windows in the overshot head, visually inspect the 'hooked' ends of overshot lifting dogs by comparing to a spare lifting dog and replace if visibly worn or deformed.

ii. Confirm full and free movement of the lifting dogs, Ezy-Lock™ twist sleeve (surface only), and wireline cable swivel. Apply grease as necessary.

iii. **EZY-Lock™ Overshots:**

a. Inspect threaded joints and condition of jar staff, hex nut, and wedge-lock washer. Replace any worn or damaged components, reassemble, and wrench tighten.

b. Refer to 'Ezy-Lock Maintenance' (Section 6.6) for more after service instructions.

iv. **Quick Pump-In™ Overshots:**

a. Visually inspect the indicator bushing and replace if worn. Also check that the overshot bypass valve porting is open, and a single valve ball is in position behind the indicator bushing. If the bypass valve is blocked or closed then drilling fluid cannot pass through to relieve inner tube weight, and any ground fluid pressure, from the head assembly latch mechanism or hold-back brake when drilling inclined holes. **DO NOT** retract the wireline cable from inclined holes without first applying fluid pressure.

b. Visually inspect the pump-in lip seals and replace if the lip outer diameter is visibly worn or undersized, or if loose when inserted into a rod or coupling in comparison to a new seal.

c. Visually inspect the shear pin in the cable swivel body and replace if worn.

d. Ensure that a supply fluid bypass valve arrangement is set up and convenient for the operator. This will allow the operator to open or meter the bypass when pulling the inner tube for fine control of the rate of descent, or to close the bypass while drilling.

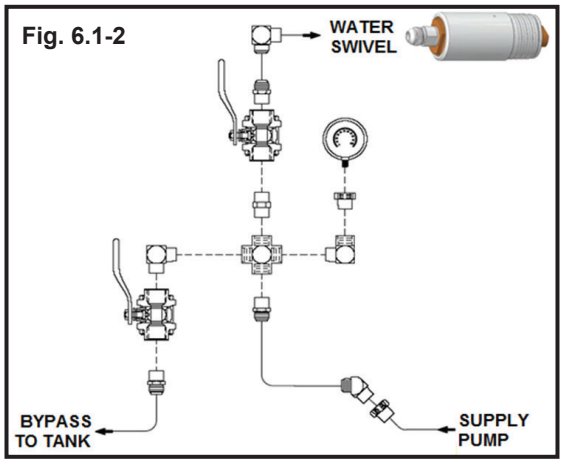


Fig. 6.1-2

6.2 INITIAL RUN

1. Coring system performance is dictated by ground conditions. Solid, competent ground or 'bedrock' may be drilled without interruption, filling the core barrel each run. Alternatively, fractured, broken rock can wedge (or ‘block’) in the core barrel and prevent penetration. Each time a core block occurs the core barrel must be emptied, reducing productivity. As a result, holes from surface are often pre-bored through overburden and cased prior to coring system application. However, an experienced coring crew may outperform an expensive rotary drill rig in overburden drilling.
2. In the tight confines of an underground application, a ‘starting barrel’ or partial drill string is often required to start or ‘collar’ a hole from the mine face. This typically consists of a standard 1.5m (5ft) outer tube coupled to a water swivel and fitted with a bit and shell, to allow drilling the first meter. A full face bit may be used to collar without an inner tube assembly. If drilled with a coring bit and without an inner tube assembly, then any core developed must be removed manually. Once the hole is of sufficient depth, a standard double-tube core barrel assembly may replace the starting barrel.
3. After the core barrel is in the hole, complete the drill string by adding a locking coupling, followed by a drill rod if space permits. Connect the water swivel.
4. Lower the drill string to within a few inches of the bottom of the hole.
5. Start the water pump and the drill, but do not advance the rod string into the hole until the water pressure rise is indicated on the pressure gauge or until water is returning from the hole. Water must be circulating around the diamond bit before core cutting begins.
6. Water pressure of 350–700kPa (50–100psi) is sufficient to start advancing a rotating rod string into the hole and to start coring. As the hole progresses, the water pressure will gradually increase.
7. Select a suitable rotation speed and penetration rate for the drilling conditions encountered. Refer to the Boart Longyear ‘Diamond Core Drilling Reference’ card.
8. Continue drilling until the inner tube fills with core, or a core block occurs.
9. Following runs will require either core barrel extensions or additional drill rods to extend the drill string sufficiently.

6.3 FLUID PRESSURE & CORE BLOCKS

1. Whenever the fluid pressure rises rapidly above normal operating pressure, or if the pressure relief valve opens, stop drilling and prepare to retrieve the inner tube assembly.

2. Occasionally during the drilling operation, the bit will ‘mud’ or ‘block’, which causes a sharp rise in fluid pressure. When this happens, retract the drill string so the bit is pulled back 15–30mm (1/2”–1”). Allow the bit to clear itself, and allow the fluid pressure to return to normal. Begin drilling, but if high fluid pressure returns, it may indicate a core block.

3. In most cases, an above normal water pressure reading indicates:
   - that either the core barrel is full of core,
   - that a core block has occurred in the bit or inner tube,
   - that the bit has been consumed.

   Refer to the Boart Longyear Diamond Products Field Manual.

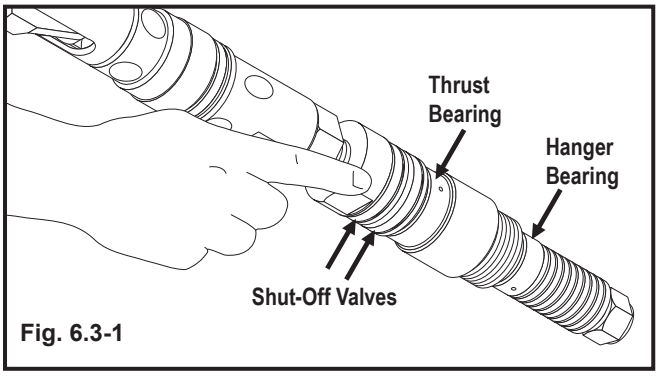


Fig. 6.3-1

4. When a core block occurs, the blocked core resists the downward drilling force. This exerts a force up through the inner tube assembly, which compresses the shut-off valves causing them to spread outward and restrict the flow of water. This restriction increases the supply fluid pressure indicating to the operator that a core block has occurred. See ‘Fluid Control’ (Section 3.6).

5. Wash the hole for several minutes before retrieving the inner tube.

6. The inner tube must be removed from the hole and inspected to avoid unnecessary damage to the bit or barrel.

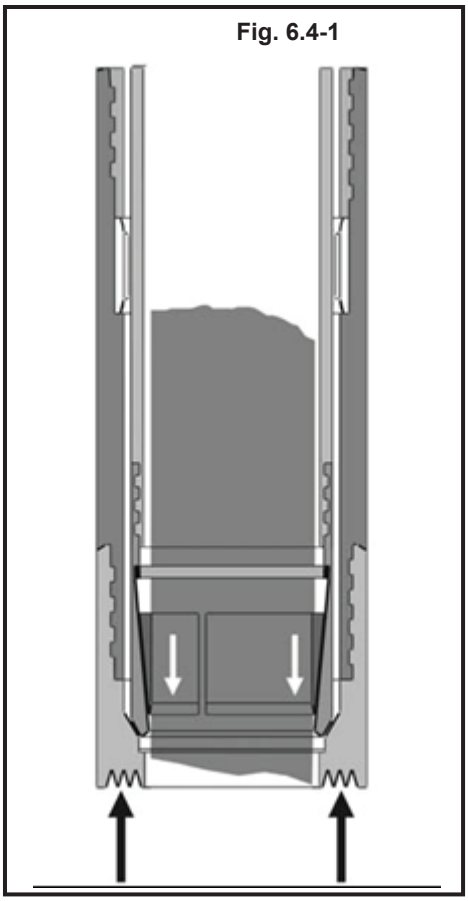
6.4 CORE BREAKING

NOTICE

Core lifters utilize the toughness of heat-treated alloy steel to withstand core breaking loads. However, the grip pattern or teeth are subject to wear as the core lifter drags over core during normal drilling operations. This may result in frequent replacement to avoid core slippage or drops. Micro-diamond coated core lifters are available to provide superior wear life and gripping action.

1. As the rod string and core barrel outer tube are pulled back, the core lifter grasps the core and increases its grip as it becomes wedged into the core lifter case, resisting pullback of the inner tube.
2. A compression spring acting between the spindle and inner tube cap assembly compresses under this resistance. This allows the head assembly to move with the outer tube while the inner tube remains stationary, until the bit contacts the stationary core lifter case.
3. The pullback load is then transferred through the bit and outer tube, protecting the inner tube assembly from overload.
4. Pullback load and spring compression increases until the core breaks below the core lifter, allowing the core sample to be retained in the inner tube for retrieval.

Fig. 6.4-1



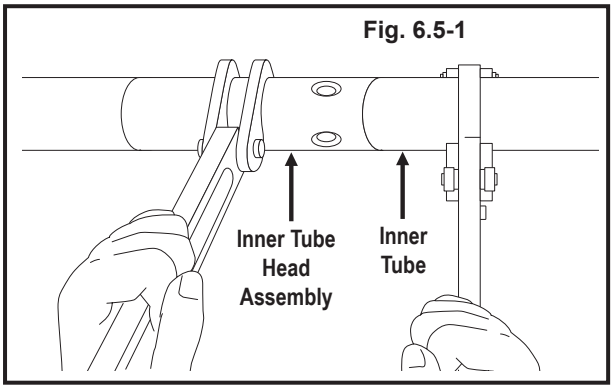
6.5 REMOVING CORE FROM THE INNER TUBE

CAUTION

When emptying the inner tube, DO NOT attempt to stop the core by hand. Core can be sharp or heavy and cause severe injury. If necessary, ALWAYS look down into an inner tube. NEVER look up an inner tube.

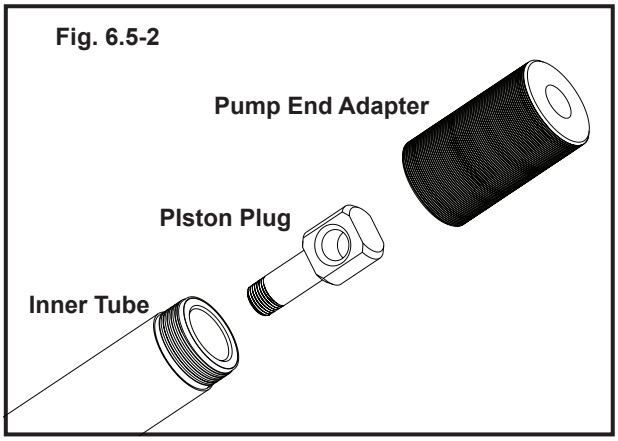
1. Un-thread the inner tube from the head assembly using full grip style wrenches. When using two inner tube assemblies, inspect and service one assembly between core runs while the other is running. (Fig. 6.5-1)

Fig. 6.5-1



2. If running a triple-tube assembly, insert the piston plug into the split tube piston. Thread the pump-out adapter onto the inner tube. (Fig. 6.5-2) Pump out the split tube and core sample. Proceed to step 4.

Fig. 6.5-2

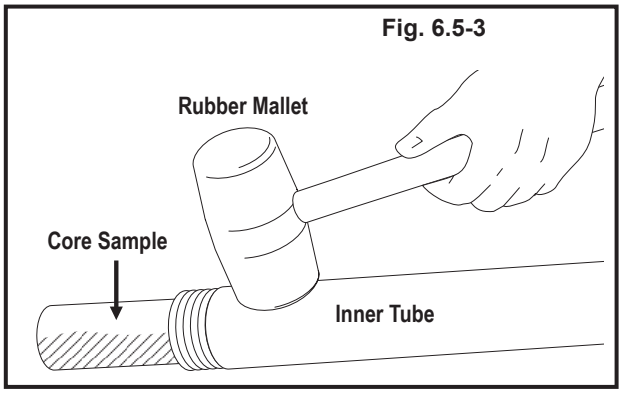


WARNING

There is risk of sudden core sample expulsion under excessive fluid pressure as a result of stuck core samples or worn components. ALWAYS stand to the side of a pressurized inner tube. NEVER look into an inclined or pressurized inner tube. ALWAYS inspect for, and replace a worn pump-out piston or worn split tubes. Failure to do so may result in product failure or injury.

3. Empty core from the inner tube. Jar the core loose from the inner tube by tapping with a rubber mallet. (Fig. 6.5-3) Place the core carefully in a box and mark as instructed by the site geologist or appropriate client representative.
4. Between each core run, check the inside of the inner tube to ensure all of the core has been removed. Flush out the inner tube with clear water to remove all chips and grit.

Fig. 6.5-3



NOTICE

Inner tubes are subject to rapid wear from tools and core samples. Avoid application of tools with hard, sharp edges. An optional interior chrome plating is recommended to resist wear. Refer to In-Hole Tools catalogue.

6.6 TRIPPING THE INNER TUBE -- SURFACE

LOADING THE INNER TUBE ASSEMBLY -- SURFACE

CAUTION

Hoist the inner tube assembly above the rod string using the wireline overshot, ensuring the Ezy-Lock™ sleeve is in the locked position, and avoiding sudden movement and side loading. The safety pin is also highly suggested to protect against accidental release. Regularly inspect and confirm safe working condition of wireline hoist, cable and fittings.

CAUTION

DO NOT drop the inner tube assembly into the rod string without ensuring the latches are in a retracted position. Since latches are normally spring driven into a deployed and locked position, the latches may impact the drill string box thread, damaging the rod, the latches, or the retracting case. Even a short drop may cause damage. Alternatively, use a loading sleeve to retain the latches in a retracted position for loading.

1. In order to insert the inner tube assembly into the rod string, the retracting case must be pulled back to retract the latches. Quick Descent™ heads include a detent position that holds the latches in a retracted position. Alternatively, an optional loading sleeve is available to temporarily hold the latches in a retracted position. Refer to the In Hole Tools catalogue.
2. In lost circulation ‘dry hole’ conditions, or where standing water is suspected to be less than 9m (30ft) in the hole, the inner tube assembly may suffer impact damage upon landing if released into the hole. In these conditions, the inner tube assembly must be lowered with the overshot. See 'Overshot Operation - Surface' (in this Section).
3. If there is more than 9m (30ft) of standing ground water in the hole, lower the inner tube assembly using the wireline overshot and release only after the latches are fully inserted into the drill rod string, past the box thread. See 'Overshot Operation - Surface' (in this Section).

TRIPPING THE INNER TUBE ASSEMBLY -- SURFACE

As hole depth increases, the tripping of the inner tube consumes the largest portion of time in the drilling cycle.

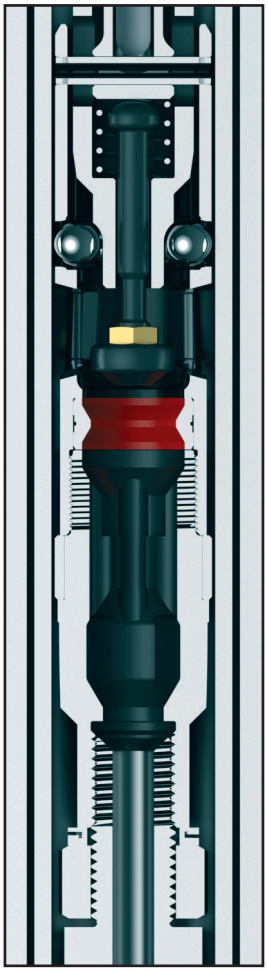
During tripping, the tight annuli around the inner tube and the head assembly create significant resistance to standing ground water. To relieve this, a check valve and bypass porting is provided to allow fluid to bypass through the inner tube and around the landing shoulder.

As the inner tube assembly descends, attach the water swivel to the drill string. Start the drilling fluid supply pump to increase descent speed while limiting flow and rotating the rod string slowly to avoid hole degradation in sensitive ground conditions.

The inner tube assembly descends approximately 0.5-1.0m/s (100-200ft/min) depending on the size of the system, the supply pump fluid flow, the fluid drag, and the friction related to the length of the inner tube and the hole angle. Additionally, deployed spring-loaded latches will drag on the rod string and further slow the inner tube. Only Quick Descent™ head assemblies offer features to address these issues and improve productivity.

Roller Latch™

Quick Descent™ Roller Latch™ heads incorporate additional features, allowing the inner tube assembly to descend quickly through standing ground water.



1. As the inner tube descends through standing ground water, the fluid control valve piston floats above the indicator bushing as fluid bypasses through the assembly.
2. In addition to landing shoulder bypass porting, the lower latch body includes interior channels which allow fluid to bypass directly from the hollow spindle and around the retained check valve ball.
3. The check valve and hollow spindle allow fluid to pass through the inner tube and the head assembly, eliminating the drag associated with flowing around the inner tube assembly. During drilling and core retrieval, the check valve ball closes and prevents fluid from entering the inner tube.
4. The valve piston will close under sufficient supply fluid flow to propel the inner tube into the hole where frictional drag has slowed descent.
5. Quick Descent inner tube assemblies, with latches in retracted detent position, will descend at up to twice the normal rate when tripping through the enlarged inner diameter of light weight W-Wall™ drill rods. Refer to the Boart Longyear Rod & Casing catalogue.

Link Latch™

Link Latch heads incorporate a check valve in the inner tube cap, allowing fluid to pass through the inner tube during tripping but not while drilling.

The landing shoulder has very little clearance to the drill rod, which limits the descent rate of the inner tube through standing fluid. To remedy this, fluid bypass porting is provided through the latch bodies allowing the inner tube assembly to descend quickly through standing ground water.

If the landing indicator ball is installed, it must be above the indicator bushing to allow bypass flow.

LATCHING THE INNER TUBE -- SURFACE

Roller Latch™

1. The impact of the head assembly landing shoulder contacting the outer tube landing ring generates a noise that is audible up to approximately 300m (1000ft). To aid in detecting this, place a wrench or tool against the rod string to amplify the sound.
2. If an indicator bushing is installed, fluid pressure will rapidly build until the valve ball or piston is driven through the interference fit with the bushing, generating a significant pressure spike visible on the supply fluid pressure gauge. The valve is then in an open position and fluid pressure will return to normal drilling pressure, strictly due to the resistance of circulation through the drill string and back to surface.
3. If a fluid retention valve bushing and spring is installed, pressure will rise to the drilling pressure determined by the strength of the fluid retention spring installed in addition to the resistance of circulation.
4. If pressure remains well above normal, or increases to the point where the supply pump pressure relief valve continually vents, this indicates that the fluid control valve is not open. This may occur because:
   - the landing shoulder may not be seated on the landing ring
   - the inner tube assembly length adjustment may be excessive
   - the latches may not have deployed
   - the hole angle may be excessive, reducing landing impact inertia. The impact inertia of the retracting case will normally overcome the detent to deploy the latch rollers, allowing the retracting case to drop, and the valve piston to deploy into the valve bushing.

   To correct, briefly apply rotation to drive the latches out by centrifugal force, or a sharp pullback 'jump' to the drill string to cause the inner tube to re-seat itself.

5. A seated and latched condition may not be possible due to conditions in the hole such as pressurized fluid or aquifers, or loose chunks of core or debris in poor ground conditions. See Troubleshooting (Section 8.1).

Link Latch™

1. The impact of the head assembly landing shoulder contacting the outer tube landing ring generates a noise that is audible up to approximately 300m (1000ft). To aid in detecting this, place a wrench or tool against the rod string to amplify the sound.
2. If an indicator bushing is installed, fluid pressure will rapidly build until the valve ball or piston is driven through the interference fit with the bushing, generating a significant pressure spike visible on the supply fluid pressure gauge. The valve is then in an open position and fluid pressure will return to normal drilling pressure, which is strictly due to the resistance of circulation through the drill string and back to surface.
3. If a fluid retention valve bushing and spring is installed, pressure will rise to the drilling pressure determined by the strength of the fluid retention spring installed in addition to the resistance of circulation.
4. If pressure remains well above normal, or increases to the point where the supply pump pressure relief valve continually vents, this indicates that the fluid control valve is not open. This may occur because:
   - the landing shoulder may not be seated on the landing ring,
   - the inner tube assembly length adjustment may be excessive,
   - the latches may be oriented such that they are blocked by the optional locking coupling tang feature.

   To correct, briefly apply a sharp rotation or pullback 'jump' to the drill string to cause the inner tube to re-seat itself.

5. A seated and latched condition may not be possible due to conditions in the hole such as pressurized fluid or aquifers, or loose chunks of core or debris in poor ground conditions. See Troubleshooting (Section 8.1).

OVERSHOT OPERATION – SURFACE

NOTICE

Boart Longyear recommends 3/16 in (4 mm) swaged wireline cable for maximum strength and durability. Galvanized and armoured cables suffer from un-raveling, kinking, and bird-nesting problems. Maintain a minimum drum to cable diameter ratio of 20:1 for maximum life and DO NOT operate with ratios below 15:1.

CAUTION

During hoisting operations, ensure the Ezy-Lock™ sleeve is in the locked position, and avoid sudden movement and side loading. The optional safety quick-pin is also recommended to protect against lifting dog failure. Regularly inspect and confirm safe working condition of wireline hoist, cable, and fittings.

Thread the wireline cable through the overshot eyebolt and terminate the cable with appropriately sized copper oval compression sleeves or ferrules applied with an appropriately sized swaging tool. Confirm the number and size of swage compressions with the tool OEM gauge, e.g. typically four compressions for a 3/16" (4mm) wireline cable. Ensure the proper swager and sleeve combination is used. Length of cable equal to the cable diameter should extend beyond the sleeve to achieve maximum holding (See arrow in figure below). All compressions must be gauged to assure maximum holding strength.

When handling an inner tube assembly above ground level suspended at any height, it becomes a raised load representing a potential safety hazard. Roller-Latch and 'Ezy-Lock' overshot incorporates safety devices to act as a back-up should excessively worn or dirty components cause the overshot lifting dogs, core barrel spearpoint or latch rollers to malfunction or fail.

ROLLER LATCH™ OPERATION

Roller Latch™ - Safety Pin Operation

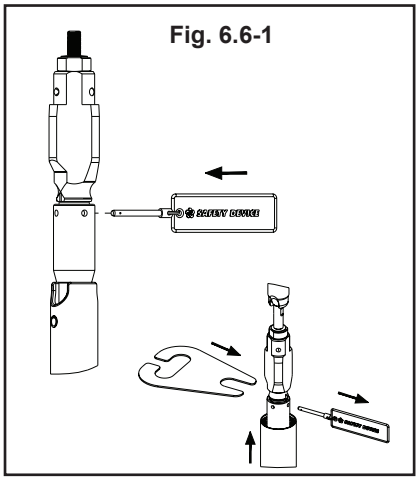


Fig. 6.6-1

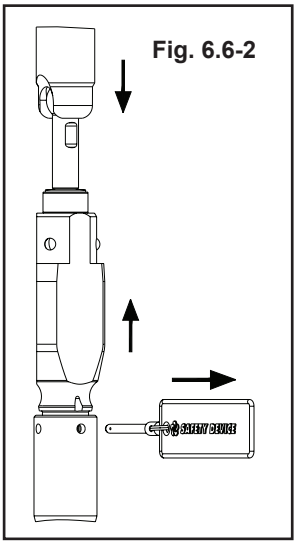


Fig. 6.6-2

1. The safety pin is a two-hand operated safety device which acts as a lock to the overshot to prevent accidental release during handling and is to **ALWAYS** be used.
2. Use of the safety pin is especially useful in operations where additives are used in the drilling fluid, or where heavy drilling muds are utilized such that debris may build up under the spearpoint or under the hooked ends of the lifting dogs or inside the overshot head.
3. The safety pin should be used when hoisting extended inner tube assemblies in large size wireline systems which may overload the rollers under accidental impact load or sudden movement.
4. Upon inner tube assembly releasing, as the Roller Latch overshot is partially lowered into the rod string, remove the safety pin, and slide the release guard in as shown (Fig. 6.6-1).
5. Upon inner tube assembly retrieval, as the Roller Latch overshot is raised out of the rod string, stop the wireline and insert the safety pin. This will lock the head assembly and overshot together to prevent accidental overshot release. The safety pin has spring-loaded detent balls which retain the pin in the overshot.
6. To disengage the overshot, remove the safety pin and use two hands to push the overshot head towards the 360° ball joint socket (Fig. 6.6-2).

Roller Latch™ - Maintenance

Regular maintenance is required for the Roller Latch mechanism to ensure the rollers properly latch onto the inner tube assembly.

1. Visually inspect the overshot for wear, verify the overshot's ability to self-center through handling and verify the latching function. These will determine what further maintenance steps you perform.
2. Unscrew the spindle subassembly from the latch subassembly at the ball joint and unscrew the weight bodies.
3. Disassemble the overshot spindle subassembly and latch subassembly separately.
4. Inspect all components for corrosion or wear, paying attention to the preliminary tests performed in Step 1 and replace as required to ensure the proper function of the overshot.

Roller Latch™- Releasing Inner Tube Assembly into Rod String

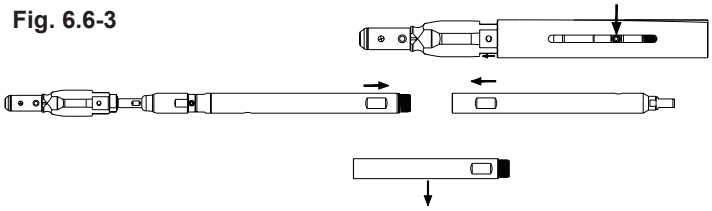
1. Push the overshot head into the spearhead adapter on the inner tube assembly.
2. Insert safety pin to prevent against accidental release during handling.
3. Lower the inner tube assembly into the rod string until head assembly and overshot are just above the opening.
4. When ready to release, remove the safety pin while simultaneously sliding on the release guard.
5. Slowly lower the overshot until the guard rests on the open rod and the weight of the overshot acting against the sliding guard will automatically release the inner tube assembly.

Roller Latch™- Releasing Inner Tube Assembly into Low Water Table or Dry Hole

When a low water table (or dry hole) exists that fluctuates or is insufficient to allow dropping the inner tube from the surface, releasing the inner tube assembly in the conventional way will very likely cause damage to the assembly. A release sleeve is to be utilized to delay the descent of the inner tube assembly in the rod string until it hits the water table or the bottom.

1. Slide the slotted release sleeve over the Roller Latch overshot, holding it in place by partially unthreading the setscrew, extending it into the slot in the release sleeve to retain the sleeve during lowering (Fig. 6.6-3).
2. Remove the chaser weight body to prevent early inner tube assembly release (Fig. 6.6-3).

Fig. 6.6-3



3. Lower the inner tube into the hole, maintaining the tension in the wireline cable.
4. When the inner tube hits the water table, or lands in the outer tube, the weight of the overshot will disengage the overshot latch rollers and unlatch the overshot from the inner tube assembly. This allows the release sleeve to slide onto the release rollers to keep them disengaged on overshot retrieval.
5. If the overshot did not release, pull the cable tight and release it quickly. This tugging motion of the overshot should move the release sleeve down over the release rollers on the overshot head.
6. Retrieve the overshot and remove the release sleeve.

Roller Latch™ - Retrieving the Inner Tube Assembly

1. Mark or paint a 2m (6ft) section of the wireline cable about 10m (30ft) above the overshot. This marker will signal the approach of the overshot when it is being retrieved from the hole.
2. Pull back the rod string until the first joint appears. Disconnect the drill rod with the water swivel attached.
3. Ensure that the safety pin is removed.
4. Lower the overshot into the rod string, maintaining a slight tension on the cable. As the overshot approaches the spearhead adapter on the inner tube assembly, reduce the descent rate.
5. When the overshot connects to the spearhead adapter, attach a moveable marker (e.g. a piece of string) on the cable, about 1m (3ft) above the point of entry, to use as a warning for the next core retrieval. Move the marker upward with each run.

6. To check that the overshot has latched, reel in the slack in the cable. With experience, the operator can detect the extra weight of the inner tube assembly.
7. Reverse and begin spooling the wireline onto the hoist drum to retrieve the inner tube assembly. As the overshot pulls on the spearpoint adapter, the retracting case retracts the latches, releasing the inner tube assembly from its latched position.
8. Slowly hoist the inner tube assembly. As the overshot approaches, the painted marker will appear.
9. Stop the hoist as the overshot exits the rod string and insert the safety pin to prevent accidental overshot release. Carefully hoist and move the core-laden inner tube to the side once the inner tube clears the rod string.
10. Lower the inner tube assembly to the floor. Disconnect the overshot from the inner tube assembly and connect it to an empty tube that has been checked and serviced. (Fig. 6.6-4)

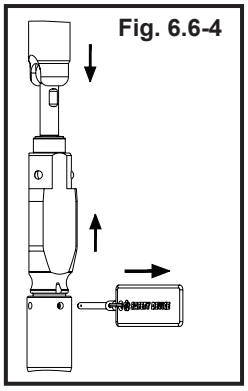


Fig. 6.6-4

Roller Latch™ - Inner Tube Assembly Fails to Release

Roller Latch head assemblies will not release under core block conditions.

1. In the event of a stuck tube, slide the release sleeve over the wireline and drop it down the hole.
2. When the sleeve reaches the overshot, it will hold the release rollers in place, forcing the latch rollers to retract and allowing the overshot to be retrieved (Fig. 6.6-5).
3. If the overshot did not release, pull the cable tight and release it quickly. This tugging motion of the overshot should move the release sleeve down over the release rollers on the overshot head.
4. Retrieve the overshot and pull the rods.

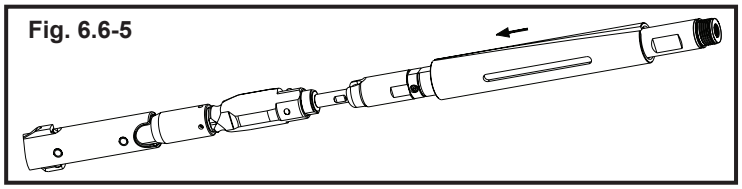


Fig. 6.6-5

NOTICE

Remove tension in the wireline to allow the full weight of the overshot to retract the release rollers and to allow the drop sleeve to slip over. If the drop sleeve doesn't make it to the release rollers, apply and release wireline tension periodically to lower the drop sleeve over the release rollers.

EZY-LOCK™ OPERATION

EZY-Lock™ - Twist Sleeve Operation

The Ezy-Lock twist sleeve is an integral, one-hand operated safety mechanism to easily lock the lifting dogs to the spearpoint and is recommended for all wireline operations.

1. As the Ezy-Lock overshot is raised out of the rod string, stop the wireline and twist the sleeve 90 degrees from the 'open' position to the 'locked' position (Fig. 6.6-6) [Note: the sleeve has spring-loaded detent positioning in 90 degree intervals]. The sleeve is spring loaded against the back of the overshot head. As the sleeve rotates into the locked position, tapered extensions of the sleeve are forced underneath the back ends of the lifting dogs. This forces the hooked ends of the lifting dogs against the neck of the spearpoint and prevents the lifting dogs from releasing the spearpoint.
2. In order to release an inner tube assembly, the Ezy-Lock sleeve must be returned to the 'open' position. Slots in the tapered extension of the sleeve align with the lifting dogs allowing them to function normally (Fig. 6.6-7).
3. Alternatively, when tripping expensive survey tools in the hole utilize the EZY-Lock sleeve to ensure the lifting dogs remain engaged to the tool spearpoint.

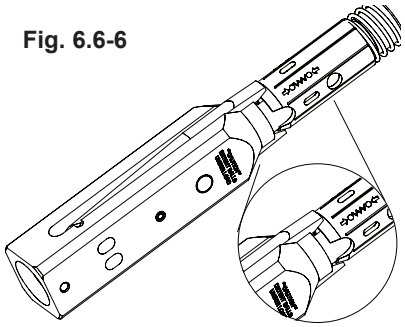


Fig. 6.6-6

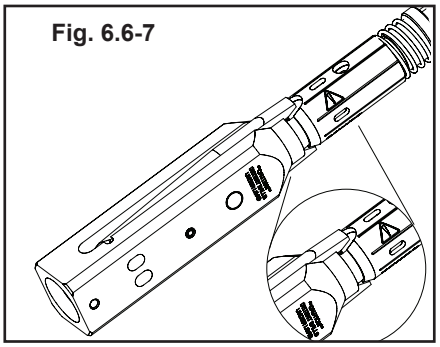


Fig. 6.6-7

EZY-Lock™ - Safety Pin Operation

1. The safety pin is a two-hand operated safety device which acts as a back-up to the lifting dogs and may be used in addition to the Ezy-Lock sleeve.
2. Use of the safety pin is recommended in operations where additives are used in the drilling fluid, or where heavy drilling muds are utilized such that debris may build up under the spearpoint or under the hooked ends of the lifting dogs.

3. The safety pin should be used when hoisting extended inner tube assemblies in large size wireline systems which may overload the lifting dogs under accidental impact load or sudden movement.
4. As the Ezy-Lock overshot is raised out of the rod string, stop the wireline and insert the safety pin into the hole in the overshot head immediately adjacent the hooked end of the lifting dogs and under the spearpoint. The safety pin has spring-loaded detent balls which retain the pin in the head. Should the lifting dogs move into a release position or fail due to wear or overload, the safety pin will retain the spearpoint (Fig. 6.6-8).
5. In order to release an inner tube assembly, remove the safety pin.

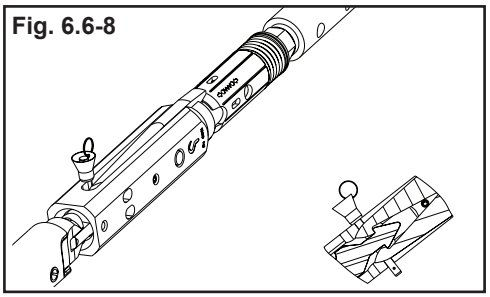


Fig. 6.6-8

WARNING **The Ezy-Lock sleeve detent balls are spring loaded and will eject at significant speed. Wear proper PPE and contain the balls as the Ezy-Lock sleeve is removed to prevent ejection.**

EZY-Lock™ - Maintenance

Regular maintenance is required for the lifting dog mechanism to ensure proper grasping of the head assembly spearpoint. Also, the Ezy-Lock sleeve must be replaced if any wear is visible on the tapered end.

1. Unscrew the jar staff from the overshot head subassembly.
2. Slowly remove the Ezy-Lock sleeve, spring, and cap, being careful to retain the spring loaded detent balls inside.
3. Disassemble the head and lifting dogs.
4. Inspect all components for corrosion and wear and replace as required to ensure proper function of both the lifting dog and Ezy-Lock sleeve.
5. To reassemble the detent balls, hold the head oriented with the detent hole horizontal. Compress the balls and spring into the detent hole with one hand and slowly advance the Ezy-Lock sleeve over the balls with the other hand.

EZY-Lock™ - Releasing Inner Tube Assembly into Rod String

1. Lower the inner tube assembly into the rod string until the head assembly and overshot are just above the opening.
2. A suitable drift or tool is recommended, inserted through head assembly porting. Slowly lower until the tool rests across the top of the rod string, taking the weight of the inner tube assembly off the overshot.
3. Twist the Ezy-Lock™ sleeve open and remove the safety quick-pin. Staying clear of the inner tube assembly, release the overshot by squeezing the lifting dogs. Carefully pull the tool out to allow inner tube descent.

EZY-Lock™ - Lowering with Slotted Release Sleeve

Where there is a low water table that fluctuates or is insufficient to allow dropping the inner tube from the surface, utilize the slotted release sleeve to lower and delay release until the inner tube hits the water table.

1. Attach the slotted release sleeve to the Ezy-Lock overshot, resting it on the back end of the lifting dogs. Adjust the grub screw to protrude through the closed slot to retain the sleeve during lowering.
2. Lower the inner tube into the hole, maintaining the wireline cable taut.
3. When the inner tube hits the water table, or lands in the outer tube, the overshot advances further onto the spearpoint. The taper on the spearhead body spreads the leading ends of the lifting dogs. This brings the opposite end of the lifting dogs inward allowing the release sleeve to drop, locking the lifting dogs open to release the inner tube (Fig 6.6-9).
4. If the overshot did not release, pull the cable tight and release it quickly. The jarring action of the overshot will force the release sleeve down over the lifting dogs.
5. Retrieve the overshot and remove the release sleeve.

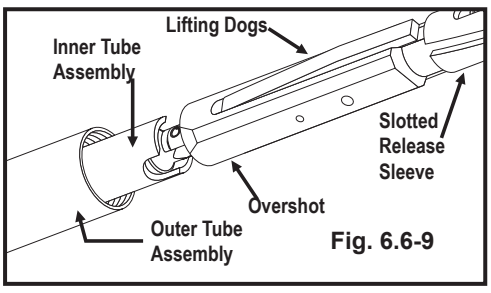


Fig. 6.6-9

EZY-Lock™ - Dry Hole Lowering

When lowering into the rod string it is possible to accidentally release the inner tube assembly, especially in angled holes, which can cause extensive damage in dry holes.

An optional 'Dry Hole Lowering Kit' is available to modify the Ezy-Lock overshot and head assembly, to eliminate accidental drops by locking the overshot to the spearhead until the latches have deployed.

With the overshot head spacer installed, and washer(s) inserted under the spearhead base, the lifting dogs cannot advance over the taper on the spearhead base to allow release (Fig. 6.6-10).

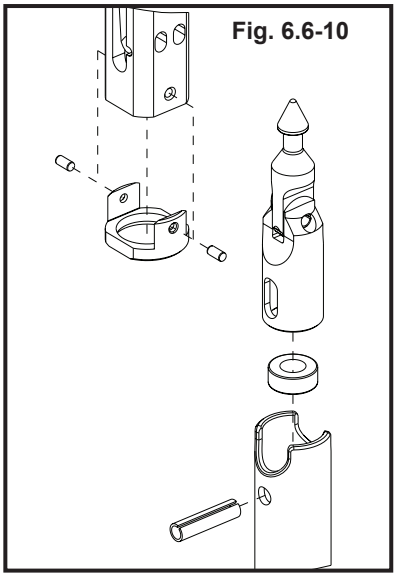


Fig. 6.6-10

EZY-Lock™ - Retrieving the Inner Tube Assembly

1. Mark or paint a 2m (6ft) section of the wireline cable about 10m (30ft) above the overshot. This marker will signal the approach of the overshot when it is being retrieved from the hole.
2. Pull back the rod string until the first joint appears. Disconnect the drill rod with the water swivel attached.
3. Ensure the Ezy-Lock sleeve is in the open position and the safety pin is removed.
4. Lower the overshot into the rod string, maintaining a slight tension on the cable. As the overshot approaches the spearhead, reduce the descent rate.
5. When the overshot connects to the spearhead, attach a moveable marker (e.g. piece of string) on the cable, about one meter above the point of entry, to use as a warning for the next core retrieval. Move the marker upward with each run.
6. To check that the overshot has latched, reel in the slack in the cable. With experience, the operator can detect the extra weight of the inner tube assembly.
7. Reverse and begin spooling the wireline onto the hoist drum to retrieve the inner tube assembly. As the overshot pulls on the spearpoint, the retracting case retracts the latches, releasing the inner tube assembly.
8. Slowly hoist the inner tube assembly. As the overshot approaches, the painted marker will appear.
9. Stop the hoist as the overshot exits the rod string. Twist the Ezy-Lock sleeve to the locked position and apply the safety pin. Carefully hoist and move the core-laden inner tube to the side once the inner tube clears the rod string.
10. Lower the inner tube assembly to the floor. Disconnect the overshot from the inner tube assembly, and connect it to an empty tube that has been checked and serviced.

EZY-Lock™ - Inner Tube Fails To Release

1. Link Latch™ head assemblies may not release (un-latch) as a result of a severe core block.
2. Pull the cable tight and release it to cause a jarring action of the overshot body, which may free the tube.
3. If the inner tube assembly does not release, use the slotted release sleeve:
    i. Slip the sleeve over the wireline cable and drop it down the hole.
    ii. The sleeve slips over the upper ends of the lifting dogs, drawing them in and spreading the lower ends away from the spearpoint, allowing release.
    iii. If the overshot fails to release, pull the cable tight and release it so the jarring action of the overshot body forces the release sleeve over the lifting dogs.
4. Retrieve the overshot and pull the rods.

6.7 TRIPPING THE INNER TUBE – UNDERGROUND

WARNING

Head assemblies with a pump-in seal connected to the latch retracting case are not recommended for inclined holes or ground with pressurized fluid or gas zones. Boart Longyear recommends Quick Pump-In™ head assemblies which incorporate pump-in seals separate from the retracting case.

WARNING

Inclined, up-hole drilling presents a risk that wireline tools or other in-hole components may fall back toward the operator at high speed, under gravity or in-hole fluid or gas pressure. Operators must stand clear of rod string openings to prevent serious injury or death. DO NOT remove the Water Swivel or Loading Chamber until the inner tube assembly is at the collar. ALWAYS maintain a column of fluid in the drill rods to reduce the chance of uncontrolled descent of wireline tools or core.

WARNING

The head assembly hold-back brake feature is designed to improve the safety of up-hole drilling operations. The holdback brake is not designed nor intended to be used as a fail-safe device. Failure of the hold-back brake can potentially occur due to factors such as improper maintenance or wireline overload. A fluid bypass valve is required in underground pump-in overshots to release the hold-back brake - DO NOT block porting or otherwise disable the bypass valve.

LOADING THE INNER TUBE ASSEMBLY – UNDERGROUND

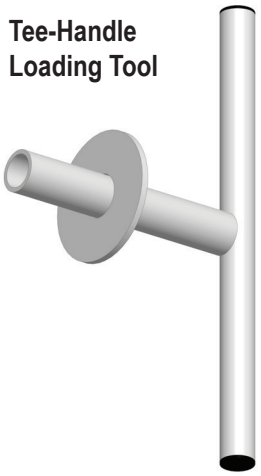
CAUTION

DO NOT force the inner tube assembly into the rod string without ensuring the latches are in a retracted position. Since latches are normally spring driven into a deployed and locked position, the latches may impact the drill string box thread, damaging the rod, the latches, or the retracting case. Alternatively, use a loading sleeve to retain the latches in a retracted position for loading.

NOTICE

Boart Longyear recommends using the new Tee Handle Loading Tool (see image right) in cooperation with the loading sleeve or a spare landing ring when loading the inner tube assembly.

Tee-Handle Loading Tool



1. Clean out any grease or debris from the pump-in lip seals to ensure they expand under fluid pressure. Also, ensure the lip is free to expand and not over-tightened by checking that the seals freely rotate on the assembly.
2. As the inner tube assembly is inserted into the rod string, the retracting case must be pulled back to retract the latches.
3. While inserting the inner tube assembly into the rod string, the retracting case can be held back while pushing the assembly in by the spearhead (the slotted spearhead bottoms out on the upper latch body to lift the assembly). Alternatively, an optional loading sleeve is available to hold the latches retracted until the inner tube assembly is inserted into the rod string.
4. **Roller Latch™**
   - i. **ALWAYS** use a Roller Latch™ Quick Pump-In™ head assembly when drilling inclined holes, allowing the holdback brake to retain the inner tube assembly against gravity or expulsion. Test the brake feature prior to use. See 'Final Check & Lubrication' (Section 6.1).
   - ii. The retracting case drives both the latch rollers and the holdback brake rollers, which must be retracted in order to insert into the rod string.
   - iii. Once fully inserted into the rod string, release the retracting case to allow the spring to engage the holdback brake and retain the inner tube in the rod string.
   - iv. In flat or declined holes, the friction and weight of the inner tube act to reduce the latch spring force and allow the holdback brake rollers to be disengaged when applying the wireline overshot to the spearpoint or spearhead adapter, to retract the retracting case.
   - v. In inclined holes, the weight on the inner tube and ground source flows add to the spring force acting on the holdback brake. The brake cannot be disengaged by wireline retraction alone since the weight above maintains brake roller engagement. See 'Inner Tube Retrieval - Underground' (in this Section).

INNER TUBE TRIPPING – UNDERGROUND

As hole depth increases, the tripping of the inner tube consumes the largest portion of time in the drilling cycle. A seal between the inner tube assembly and the inner surfaces of the rod string allows it to be pumped into the hole by the drilling fluid supply pump. A high quality seal is required to maximize inner tube speed and productivity.

When inserted into the rod string, the retracting case maintains the valve piston in a closed position, sealing on the indicator bushing. Combined with the pump-in lip seal(s), a hermetic (100%) seal is formed which translates to improved tripping rates over previous designs, as all of the supply pump flow and pressure goes into propelling the inner tube assembly.

1. Attach the water swivel.

   Note: Quick coupler connections are recommended to quickly switch the fluid supply line from the water swivel to the loading chamber, and vice versa.

2. Start the drilling fluid supply pump, adjusted for high flow and pressure.
3. As the inner tube approaches the landing ring, monitor the fluid supply pressure gauge for the latch indication pressure spike.

Roller Latch™

- Quick Pump-in™ Roller Latch™ head assemblies utilize rolling latches to provide minimum resistance and maximum pump-in rates, eliminating the heavy latch drag typical to other pump-in systems.
- Only Quick Pump-in Roller Latch head assemblies offer a variable-lip pump-in seal and latch mechanism capable of pumping through high productivity, light weight W-Wall™ drill rod strings. Quick Pump-In™ Link Latch™ systems are not compatible with W-Wall drill rod strings.

INNER TUBE LATCHING – UNDERGROUND

Only upon reaching the outer tube landing ring can the latches deploy, allowing the retracting case to drop and the valve piston to advance into the latch indicator bushing. Fluid pressure will then rapidly build until the valve ball or piston is driven through the interference fit with the bushing, generating a significant pressure spike visible on the supply fluid pressure gauge. The valve piston is then in an open position and fluid pressure will return to normal drilling pressure, which is strictly due to the resistance of circulation through the drill string and back to the drill rig.

If a spike does not occur and the pressure remains well above normal or increases to the point where the supply pump pressure-relief valve continually vents, this indicates that the pump-in valve is not open. The valve cannot open unless the latches have deployed.

This situation could arise because:

- the landing shoulder may not be seated on the landing ring
- the inner tube assembly length adjustment may be excessive
- Link Latch latch mechanisms may be oriented such that they are blocked by the optional locking coupling tang feature.

To correct:

i. Reduce fluid supply pressure and briefly apply a sharp rotation to drive the latches out by centrifugal force, OR apply a sharp pullback ‘jump’ to the drill string to cause the inner tube to re-seat itself.

ii. Slowly increase fluid pressure to avoid sealing the inner tube onto the bit.

A seated and latched condition may not be possible due to conditions in the hole such as pressurized fluid or aquifers, or loose chunks of core or debris in poor ground conditions. See 'Troubleshooting' (Section 8.1).

NOTICE

In a declined hole, where fluid does not drain from the rod string, if the Inner Tube Assembly is hung up or cannot latch, the pump-in valve will remain closed. As a result, fluid cannot circulate through the rod string and the overshot cannot be pumped in. Pull the rod string to retrieve the inner tube.

CAUTION

Quick Pump-In Roller Latch head assemblies require a unique locking coupling and are not compatible with other couplings or systems. Verify that the locking coupling incorporates a secondary internal groove allowing deployment of the holdback brake rollers.

WARNING

DO NOT lengthen inner tube assemblies or loosen head assembly core breaking springs to attempt sealing the inner tube on the bit upon landing. This poor practice will prevent fluid circulation, prevent the valve piston from deploying, and may prevent latch deployment or cause a mis-latch condition.

WATER SAVER SUBS – UNDERGROUND

When drilling with extended core barrels, a special 'water saver' adapter sub may be utilized to increase productivity by eliminating drainage and refilling of the rod string when adding drill rods to the rod string. The adapter has an internal check valve to retain drilling fluid in the rod string.

1. After loading the inner tube, attach a water saver sub prior to attaching the water swivel.
2. As the drill string advances, remove the water swivel and add a drill rod behind the water saver sub to extend the drill string without draining any fluid.
3. As hole depth increases, the hydrostatic pressure created by the weight of the retained fluid column acting on the water saver sub rapidly builds beyond the holding capability of an operator. Refer the chart below (fluid weight is approximately 1 kg/L or 8 lb/gal weight).

Fluid Column	AQTK	BQ/BQTK	NQ/NQTK	HQ
KG/100M	110	184	286	475
LB / 100FT	71	118	184	306

4. Before a full inner tube can be retrieved, the water saver sub and the rods added behind it must be carefully removed as follows:
   i. Prior to removing the water saver sub, remove any rods behind and the water swivel.
   ii. Prior to removing the water saver sub, the retained column of fluid must be drained to relieve hydrostatic pressure acting on the sub.
   iii. Thread an empty loading chamber body into the water saver sub with a side discharge hose connected and directed for drainage. Insert and thread a drainage spear into the loading chamber body. Apply a wrench to extend the spear and overcome fluid pressure, lifting the check valve ball. Drain the rod string.
   iv. Standing clear of the rod string, carefully un-thread and remove the water saver sub.
   v. Standing clear of the open rod string, and taking precautionary measures in case of a malfunctioning falling inner tube, quickly thread and tighten the loading chamber.

Fig. 6.7-1

WARNING

DO NOT remove loading chambers or water saver subs without first draining any retained column of fluid. Inclined or up-hole drilling may include retention of a column of fluid by a wireline loading chamber or a water saver sub. With increasing hole depth, this fluid column quickly builds hazardous weight and hydrostatic pressure until it is safely drained. If drainage tooling and adapters are not available, stand clear and use the drill rig to partially break the joint and retain the loading chamber or water saver sub to allow drainage.

WARNING

Suction is created when draining a retained column of drilling fluid. DO NOT use a head assembly with a pump-in seal connected to the retracting case as this will unlatch under suction. A Roller Latch™ holdback brake is recommended for inclined drilling applications.

OVERSHOT OPERATION – UNDERGROUND

Boart Longyear underground overshots combine a pump-in lip seal with a fluid bypass and landing indication valve to enable drilling in both shallow angle and inclined hole applications. Optional Fluid Retention bushings and springs provide automatic resetting of the indicator valve.

Quick Pump-In™ overshots provide significantly improved pump-in rates with pump-in lip-seals; as well as new 'V-Lip' pump-in seals in NQ™ and HQ™ sizes. The variable profile of the 'V-Lip' seal provides improved performance and, when used with the new Quick Pump-In™ Roller Latch™ head assembly, accommodates both standard wall and W-Wall™ drill rods. In addition, the valve ball and indicator bushing provides a pump-in valve, a bypass valve, and a landing indicator pressure signal. These features function as follows:

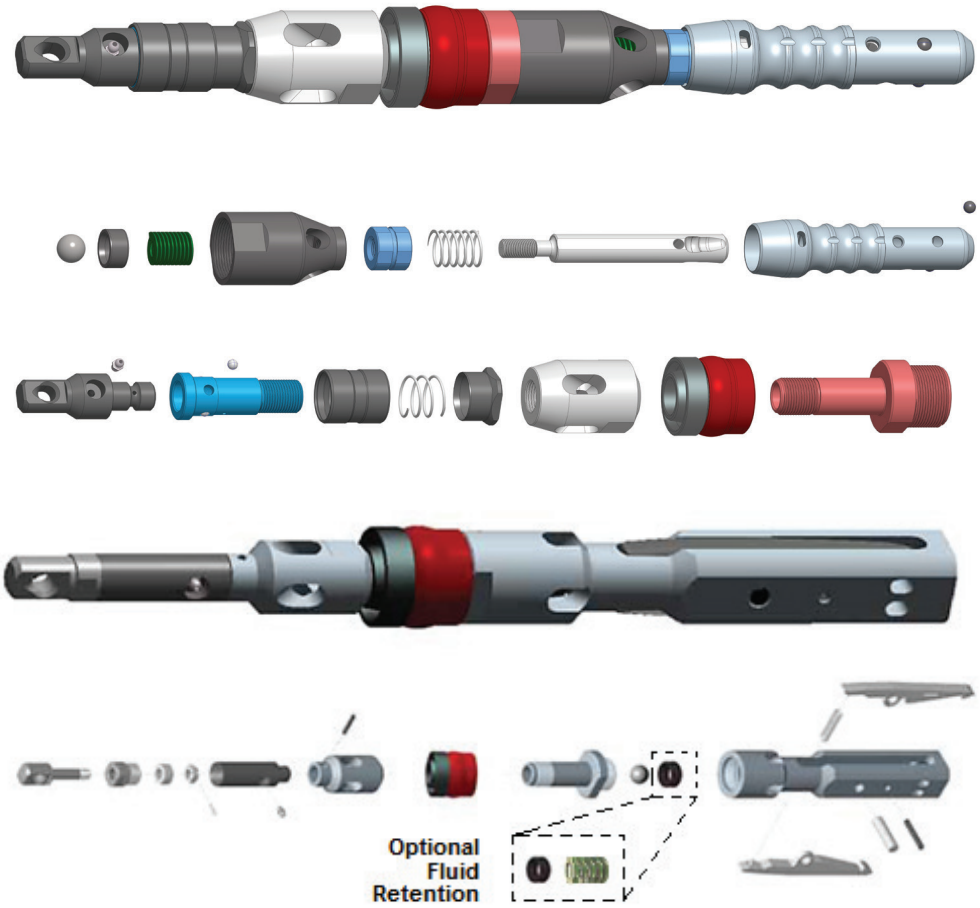
- For rapid pump-in rates, the valve ball and bushing provides a reliable pump-in seal with optional bushings for light, standard, or deep-hole pressure signals.
- When the overshot has landed, the valve ball is driven through the valve bushing causing a spike in the fluid pressure. Once the ball is forced through the bushing, fluid can flow through the valve porting.

  Optionally, to ensure that the valve ball does not prematurely pass through the bushing before landing at the spearpoint, install a Fluid Retention valve bushing and spring which resets the ball until landing.

- When drilling flat or declined holes, the valve allows fluid to bypass the overshot when retrieving from the hole. This significantly improves retraction rates and eliminates the need to refill the hole with drilling fluid.
- When drilling inclined holes, the valve allows fluid to bypass the overshot and lift the inner tube. This removes weight from the core barrel latch mechanism, allowing flawless wireline latch retraction and improved retrieval rates while preventing latch or wireline cable overload failure or premature wear.
- Upon retrieval, re-seat the valve ball by inserting a tool through the fluid ports and manually forcing the ball back through the bushing.

Roller Latch™

- The unique variable-lip pump-in seal, developed for Quick Pump-in™ Roller Latch™ head assemblies and incorporated on overshots, enables tripping through high productivity, light weight W-Wall™ drill rod strings.
- When retrieving from inclined holes with the Roller Latch head assembly, the overshot valve allows fluid to bypass and deactivate the holdback brake in the head assembly, allowing the inner tube to exit the locking coupling and improve retrieval rates while maintaining wireline cable tension during retrieval.



NOTICE

Boart Longyear recommends 3/16 in (4 mm) swaged wireline cable for maximum strength and durability. Galvanized and armoured cables suffer from un-raveling, kinking, and bird-nesting problems. Maintain a minimum drum to cable diameter ratio of 20:1 for maximum life and do not operate with ratios below 15:1.

WARNING

LIfting Dog Style Quick Pump-In overshots do not include a secondary or optional valve ball. Roller Latch Quick Pump-In overshots do not include a secondary or optional fluid retention spring. DO NOT block fluid porting and DO NOT disable the fluid bypass valve in inclined hole applications. Fluid pressure is required to ensure proper latch mechanism functionality, to deactivate the hold-back brake on the Roller Latch underground head assembly, and to avoid system overload and premature wear.

Loading Chamber

Loading chambers allow passage of the wireline attached to the overshot, into a fluid pressurized rod string. The loading chamber must be assembled prior to attaching the wireline to the overshot (Fig. 6.7-2).

1. Thread and tighten a 0.5m (2ft) drill rod onto the loading chamber as an extension. This locates a rod joint providing operator access to the overshot and head assembly during inner tube retrieval.

CAUTION

A rod extension is required to operate a Roller Latch™ head assembly in an inclined hole application. Once the loading chamber is removed, fluid pressure cannot be applied to remove the inner tube weight which acts on the holdback brake and maintains a braking condition. Wireline retraction cannot overcome a braking condition. Using a loading chamber extension will allow access to the overshot and manual unloading of the holdback brake.

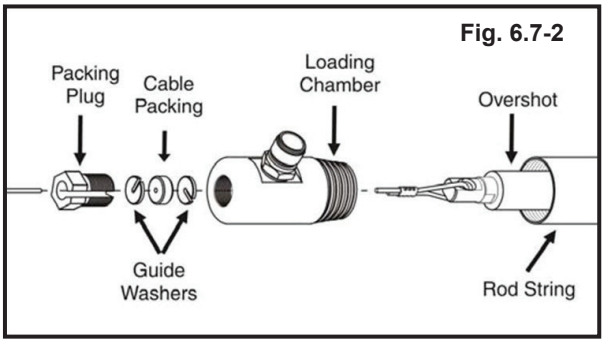


Fig. 6.7-2

2. Run the wireline cable through the appropriate sized cable packing (the rubber packing may be cut with a utility knife to slip over the cable) and the loading chamber body.
3. Slide guide washers of appropriate size over the cable both in front and behind the cable packing. Slide these components along the cable until seated in the loading chamber body.
4. Follow with the packing plug, thread into the loading chamber body, and tighten to form a seal around the wireline. The packing should be compressed and continually adjusted by the packing nut to account for wear.
5. Thread the wireline cable through the overshot eyebolt and terminate the cable with appropriately sized copper oval compression sleeves or ferrules, applied with an appropriately sized swaging tool. Confirm the number and size of swage compressions with the tool OEM gauge, e.g. typically four compressions for a 3/16”(4mm) wireline cable. Ensure the proper swager and sleeve combination is used. Length of cable equal to the cable diameter should extend beyond length of sleeve to achieve maximum holding (See arrow in figure below). All compressions must be gauged to assure maximum holding strength.

6. Align the wireline sleeves and cable with the packing plug to minimize wear during tripping.
7. After loading the overshot, thread and tighten the loading chamber and extension rod onto the rod string and attach the fluid supply line. Quick coupler connections are recommended to quickly switch the fluid supply line from the water swivel to the loading chamber. Loading chamber bodies feature a drill rod thread connection to eliminate adapter subs.

Loading the Overshot – Underground

1. Clean out any grease or debris from the pump-in lip seals to ensure they expand under fluid pressure. Also, ensure the lip is free to expand by checking that the seals freely rotate on the assembly and are not over-tightened.
2. Check that the valve ball is positioned behind the indicator bushing. If necessary, re-seat the valve ball by inserting a tool through the fluid ports and manually forcing the ball back through the bushing. ***Optionally, install a Fluid Retention Valve bushing and spring ahead of the ball to eliminate premature valve opening during pump-in. NOTE: Fluid retention is default on Roller Latch overshots.***
3. Mark or paint a 2m (6 ft) section of the wireline cable about 10m (30ft) above the overshot. This marker will signal the approach of the overshot when it is being retrieved from the hole.

Inner Tube Retrieval - Underground

1. The fluid supply pump should be set at maximum flow and pressure to attain maximum overshot velocity.

   Spearhead Only: When the lifting dogs hit the inner tube assembly spearhead, they open and attach themselves to the spearhead point.

   Spearhead Adapter Only: When the overshot reaches the inner tube assembly spearhead adapter, it will latch onto the spearhead adapter upon wireline retraction.

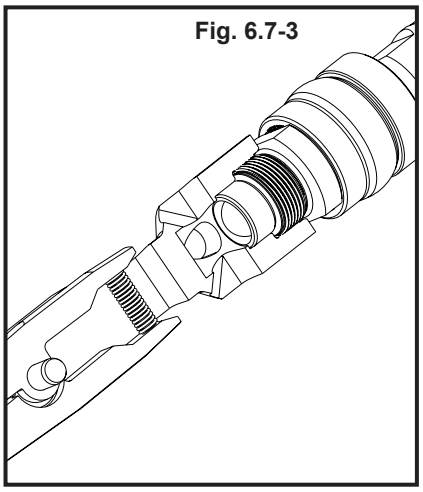


Fig. 6.7-3

2. Watch for the wireline to stop feeding into the loading chamber and monitor the fluid supply pressure gauge for the landing indication pressure spike.
3. Divert or close the supply fluid pressure valve. Tie a string or similar marker to the wireline about one meter above the point of contact. On successive runs this marker will warn the operator when the overshot is approaching the spearpoint. Move the marker upward with each run.
4. Retrieve inner tube assembly

   Flat or Declined 'Down' Holes:

   i. Begin spooling the wireline onto the hoist drum to retrieve the inner tube assembly.

   ii. As the overshot pulls on the spearpoint or spearhead adapter, the retracting case retracts the valve piston back through the indicator bushing, and retracts the latches, releasing the inner tube assembly.

   iii. With the valve piston fully retracted, the bypass porting allows the overshot to move through standing fluid.

   iv. When the wireline marker comes into view, slow down the wireline hoist. Continue slowly until the overshot contacts the loading chamber.

   v. Remove the loading chamber and extension rod. Grasp the overshot and gauge the weight to confirm the inner tube assembly is attached.

   Inclined 'Up' Holes:

   vi. **ALWAYS** apply and maintain sufficient fluid pressure to lift and remove inner tube weight from the latches and to counteract any wireline retraction resistance.

   vii. Begin spooling the wireline onto the hoist drum to retrieve the inner tube assembly.

   viii. As the overshot pulls on the spearpoint or spearhead adapter, the retracting case retracts the valve piston back through the indicator bushing, and retracts the latches, releasing the inner tube assembly.

   Roller Latch™: Maintain fluid pressure to unload the holdback brake, allowing wireline retraction of the brake rollers. If there is no retraction, then the brake is still engaged. Repeat with increased fluid pressure and slowly apply wireline tension.

   ix. Once free of the locking coupling, fluid supply pressure can be reduced slightly to improve retrieval rates while maintaining wireline tension.

   Roller Latch™: Sufficient fluid flow and pressure is required to prevent the weight of the inner tube from re-engaging the holdback brake. The holdback brake cannot be disengaged by wireline pullback alone.

   x. In larger size systems, significant fluid can build-up behind the inner tube during retraction which may then require significant drainage delay. The optional 'up-hole' style indicator bushing, recommended for inclined holes, closes the fluid bypass porting during retraction and eliminates fluid build-up.

   xi. When the wireline marker comes into view, slow down the wireline hoist. Continue slowly until the overshot contacts the loading chamber.

   xii. Remove the loading chamber and extension rod to expose the overshot. Grasp the overshot and lift the inner tube inwards slightly to gauge the weight and confirm the inner tube assembly is attached.

   Roller Latch™: Apply a quick inward push followed by an immediate pull to create sufficient inertia such that the inner tube counteracts the pullback to disengage the holdback brake. Repeat until the brake rollers are free of the rod string and remove the inner tube. If not able to manually disengage the holdback brake, break the rod containing the head assembly to remove the inner tube assembly; angle the inner tube assembly down, using inner tube weight to counteract overshot retraction and disengage the holdback brake.

WARNING

DO NOT use the wireline hoist to remove head assembly from an inclined drill string: Once water pressure is removed, the holdback brake will be deployed and maintained by inner tube weight. Use of the wireline hoist in an attempt to force the inner tube assembly out, against the holdback brake, may result in product failure or injury.

5. If the inner tube assembly is not attached, it may be hung up in the rod string. Take precautions for a falling inner tube. If fluid circulation is possible, this indicates that the inner tube assembly is still in a latched position or can be re-latched. Repeat the retrieval procedure.
6. Remove the inner tube assembly and lower to the floor.
7. Disconnect the overshot from the inner tube

   Roller Latch™ Quick Pump-In™ Overshots: Disconnect by pushing the overshot head towards the joint adapter.

   Lifting Dog Style Quick Pump-In™ Overshots: Disconnect by compressing the back ends of the lifting dogs.
8. Connect overshot to an empty inner tube assembly that has been checked and serviced.

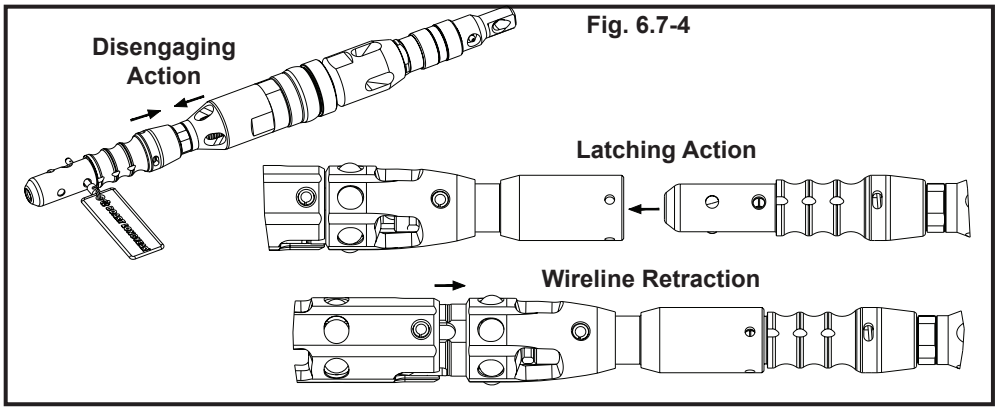


Fig. 6.7-4

Inner Tube Fails To Release - Underground

1. Link Latch™ head assemblies may not release (un-latch) as a result of a severe core block. Roller Latch™ head assemblies will release under core block conditions. See 'Troubleshooting' (Section 8.1).
2. Apply maximum fluid pressure. Pull the wireline cable tight and release it to cause a jarring action, while maintaining fluid pressure, which may free the tube.
3. For Roller Latch overshots, a cable release sleeve assembly (Fig. 6.7-5) is available to remove the wireline attached to the cable swivel eye. Assemble the sleeve assembly over the wireline and pump-in while maintaining wireline tension. When the sleeve reaches the overshot, it will slide the cable swivel release sleeve down and unlatch the cable swivel eye, allowing the wireline to be retrieved (Fig. 6.7-6).
4. For lifting dog style overshots, pull with the wireline hoist until the hoist stalls. If the inner tube still is not released, repeat this operation until the shear pin in the overshot fails. The shear pin has a failure load that is significantly less than that of standard 3/16"(4mm) wireline cable. This allows retrieval of the wireline cable prior to pulling the rod string.

   NOTE: The shear pin is a light duty coiled spring pin which has been proven to shear more consistently than a soft solid shear pin.
5. Staying clear of the open rod string, reel up the wireline cable. Taking precautions for a possible falling inner tube, carefully remove the rod string from the hole to retrieve the inner tube assembly.

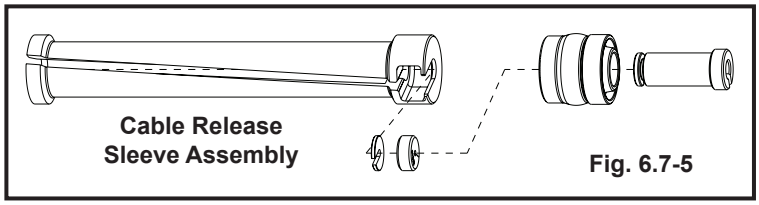


Fig. 6.7-5

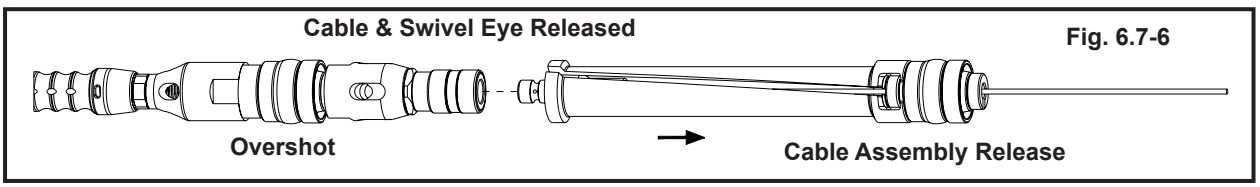


Fig. 6.7-6

7

INSPECTION & MAINTENANCE

7.1 MAINTENANCE BETWEEN CORE RUNS

Head Assembly

1. Visually inspect the length adjustment nut and wedge-lock washer and tighten if necessary.
2. Visually inspect the landing shoulder and reverse or replace if leading edge visibly worn to avoid loss of bit gap.
3. Visually inspect the shut-off valves and replace if worn or deformed due to abrasion or overload deformation.
4. **For Spearheads Only:** Visually inspect the spearpoint and replace if worn or deformed due to abrasion or overload deformation. Replace the knuckle detent spring if decreased or lack of spring resistance.

   For Roller Latch™ Socket Adapters Only: Visually inspect the interior groove for wear. Replace if wear is significant, or if the safety pin hole no longer lines up with the Roller Latch™ Overshot.
5. Check the movement of the spindle bushing. The bushing should spin freely and there should be no run-out or vertical end-play, indicating the bearings are in good condition. If there is resistance, run-out, or play, replace the bearings and spindle bushing.
6. If needed, pump grease into the grease fitting until clean grease flows out of grease relief holes or vents. Rotate the inner tube cap slowly to distribute the grease while pumping. If grease does not vent, check bearing assembly for correct orientation.
7. Check for resistance to turning inner tube cap. To remove resistance, remove inner tube cap, remove excess grease pressure, and repeat. If resistance remains, dis-assemble, clean and inspect components. Reassemble referring to the appropriate head assembly section (Chapter 4).
8. Wash the head assembly with clear water to remove drilling mud and debris.
9. Visually inspect all rollers or latches if visibly worn or deformed in comparison to un-used rollers or un-used latches and replace if there are any signs of wear.
10. Once per day, at the start of the shift, spray the head assembly with a light oil (ex. WD-40) to further remove any debris and prevent rust. This will ensure that the head assembly latching action stays smooth and does not begin jamming up over time.
11. Before using any **Quick Pump-In™ Head Assembly (Roller Latch™ or Link Latch™)** in a downhole, verify that the up-hole bushing is not installed as it will prevent water from passing through the inner tube assembly during retrieval.
12. **Roller Latch™ Head Assemblies:**
    i. Check for full and free movement of the roller latching mechanism. Visually inspect the roller path on the retracting case for any wear and replace if any wear is present.
    ii. **Quick Descent™:**
        a. Verify that a Quick Descent Roller Latch locking coupling is installed before sending any head assembly into the rod string.
        b. For MK2 assemblies only, perform a detent function check:
            - Check for canted coil spring condition by pulling back the retracting case and confirming spring resistance until latch rollers have reached detent position (rollers in the retracted position).
            - Confirm latch rollers maintain detent position. Replace canted coil spring if detent position cannot be maintained.
            - Check that the detent position is released with a short drop (with force if necessary) of the head assembly onto a hard surface.
            - Cycle the detent feature to verify that the assembly is free of debris and does not jam.

iii. **Quick Pump-In™:**

a. Verify that a Quick Pump-In™ Roller Latch™ locking coupling is installed before sending any head assembly into the rod string.

b. Perform the holdback brake test:

- Partially insert the head assembly, spearhead first, into a rod or coupling until the brake rollers are engaged on the inner diameter.
- Observe whether the wear indicator groove in-between the retracting case and the upper latch body can be observed. (Fig 7.1-1).
- Replace the brake wedge and brake rollers if the groove cannot be observed.

13. **Link Latch™ Head Assemblies:**

i. Verify that a Link Latch™ adapter coupling and locking coupling are installed before sending any head assembly into the rod string.

ii. Check for full and free movement of the latch mechanism. If necessary, manually apply a small amount of grease to the latches and latch retraction case. Repeatedly retract and deploy to distribute the grease. Replace latch spring if weak or lacking spring resistance.

iii. Check that the valve ball or piston is in the proper position above or behind the indicator bushing prior to each run. If an inner tube assemby is dropped with the valve ball or piston below or ahead of the bushing, then the bypass porting is blocked, and the descent rate is drastically reduced. If necessary, force the valve ball or piston back through the bushing using a tool or drift, leveraged against the body porting.

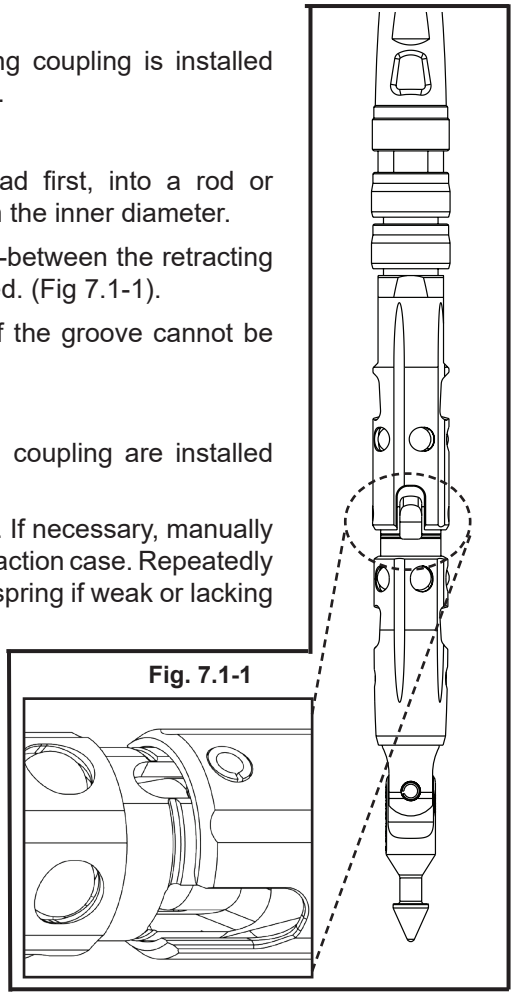


Fig. 7.1-1

Inner Tube Assembly

1. Inspect the core lifter inner diameter grip features by manual feel or dragging a thumbnail across. If the inside surface of the core lifter feels smooth, check the grip action by inserting a short section of core into the core lifter and pull it out to see if it will firmly grip the core. If the core slips, the core lifter should be replaced.

NOTICE

Core lifters utilize the toughness of heat-treated alloy steel to withstand core breaking loads. However, the grip pattern or teeth are subject to wear as the core lifter drags over core during normal drilling operations. This may result in frequent replacement to avoid core slippage or drops. Micro-diamond coated core lifters are available to provide superior wear life and gripping action.

NOTICE

The new and innovative Cold Formed™ core lifters utilize outer flutes for reduced resistance and improved gripping action. Combining the increased grip area of slotted lifters with the flexibility of fluted lifters, Cold Formed core lifters provide excellent performance in all ground conditions.

In order to replace a worn core lifter, remove the core lifter case with a full-grip inner tube wrench and remove the internal stop ring (Fig. 7.1-2). To remove the stop ring:

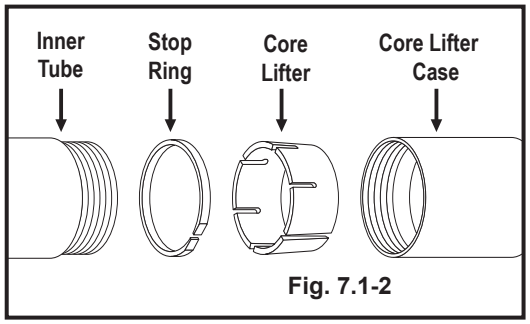


Fig. 7.1-2

i. Insert a flat tip screw-driver blade, or similar tool, under the split in the ring and pry loose from its seat in the case. Rotate the stop ring until it is at 90° with its seat and pull it out.

ii. Replace the worn core lifter.

iii. Replace the stop ring by sliding it in at the 90° position, rotate the hoop 90°, and snap it into the recess.

2. Confirm full and free axial and rotational movement of the core lifter in the core lifter case. Note that when empty and fully compressed, the core lifter will protrude from the end of the core lifter case, but this is not possible with a core sample present. If there is resistance to movement or if there is excessive axial movement, replace the stop ring and core lifter case.

3. Inspect the outer diameter of the core lifter case for excessive wear or axial cracking. If there is visible wear, this may indicate that the inner tube stabilizer is worn (See 'Outer Tube Assembly', Section 7.2). A highly polished localized wear area indicates that the rod string was rotating during core breaking procedures. This practice should be avoided as it weakens the core lifter case and may cause ‘heat check’ surface cracks which lead to axial cracking or splitting failures.

4. Apply lithium grease between the core lifter and core lifter case.
5. Check the inner tube for excessive internal wear. Interaction with core samples may form internal wear ridges which may cause core blocks. Reverse the inner tube to extend wear life (**except** NQTK male-female inner tubes which are not reversible). If wear is excessive due to ultra-hard and broken or abrasive ground conditions, consider upgrading to an internally chrome plated inner tube.

NOTICE **Inner tubes are available with optional Liquid Nitriding (surface hardening) for superior wear life.**

Lifting Dog Overshot

1. Confirm full and free movement of the lifting dogs, Ezy-Lock™ twist sleeve (surface only), and wireline cable swivel. Apply grease as necessary.
2. Using inspection windows in the overshot head, visually inspect the 'hooked' ends of overshot lifting dogs by comparing to a spare lifting dog and replace if visibly worn or deformed.
3. **Quick Pump-In™ Overshots:** Check that the overshot bypass valve porting is open and a single valve ball is in position, behind the indicator bushing, prior to each run. Check that the cable swivel body shear pin is not loose or deformed.

Roller Latch™ Overshot

1. Confirm latching function by pulling the overshot towards the swivel end, swivel joint (surface only), and wireline cable swivel. Apply grease as necessary.
2. **Quick Pump-In™ Overshots:** Check whether the wear indication groove is visible on the overshot jam nut located near the base of the overshot body. Replace overshot body or lifting wedge if groove is fully visible.
3. **Quick Descent™ Overshots:** Verify the overshot's ability to self-center visually. If the overshot has some wiggle upon handling at the ball joint, it could mean that the ball joint or spring needs to be replaced.

7.2 AFTER SERVICE MAINTENANCE

Inner Tube Assembly

1. Using Boart Longyear inner tube wrenches, remove the head assembly from the inner tube and remove the inner tube cap from the spindle bushing (Fig 7.2-1).
2. Remove grease from within the cap and from the compression spring and bearings on the spindle.
3. Inspect the thrust and hanger bearings and spindle bushings for full and free movement of races and replace if resistance. If replacement is required, bearings must be installed and oriented with the race having the larger inner diameter facing the grease fitting to ensure proper grease flow.

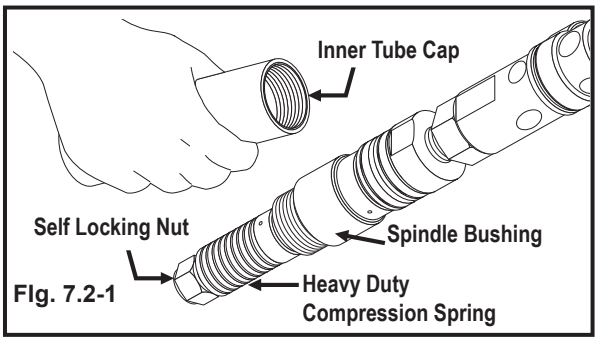


Fig. 7.2-1

NOTICE

Thrust bearing races have two different inner diameters. For correct installation, the largest inner diameter must face the grease fitting. Incorrect bearing installation can cause damage to the core sample or core lifter wear or reduce head wear life.

4. Inspect the check valve body and ball and remove caked debris or trapped water.
5. Strip the spindle shaft of all parts, keeping the bearings together as a group.
6. Replace the shut-off valves to restore pressure signals and inner tube tripping speeds. Shut-off valves degrade and visibly deform under repeated loading and extended use.
7. Check the spindle for wear and straightness. Although some wear is permissible, replace the spindle and spindle bushing if galling or wear grooves are visible.
8. Re-assemble, threading the lock nut to the spindle and partially wrench tighten so that the compression spring is only lightly pre-loaded. There should be no axial play; however the bearings must spin freely.
9. Pump grease into the grease fitting until clean grease flows out of grease relief holes or vents. Rotate the inner tube cap slowly to distribute the grease while pumping. If grease does not vent or if not freely turning, check bearing assembly for correct orientation.
10. **For Spearheads Only:** Visually inspect the spearhead assembly and replace any components if worn or deformed due to abrasion or overload deformation. Replace the knuckle detent spring if decreased or lack of spring resistance. Replace the spearhead at least every 2,500m or annually if uncertain of usage.

CAUTION

As a recommend minimum service frequency as a lifting device, replace the spearhead at least every 2,500m, or annually if uncertain of usage.

For Roller Latch™ Socket Adapters Only: Visually inspect interior groove and safety pin holes for wear and replace if wear is significant. Replace also if the safety pin hole no longer lines up with the Roller Latch overshot.

11. Un-thread the lower latch body (and for **Quick Pump-In™ Link Latch™ Head Assemblies**, also un-thread the adapter):
    i. Visually inspect the landing shoulder and reverse or replace if leading edge visibly worn or deformed, to avoid loss of bit gap.
    ii. Visually inspect the fluid control valve piston or ball and replace if visibly worn or corroded, to restore fluid control performance.
    iii. Visually inspect the indicator bushing and replace if worn to restore pressure signal performance.
    iv. If operating with an optional fluid retention bushing and spring, remove and clean for inspection. Replace if worn or corroded.
12. Visually inspect all rollers or latches if visibly worn or deformed in comparison to un-used rollers or un-used latches and replace if there are any signs or wear.

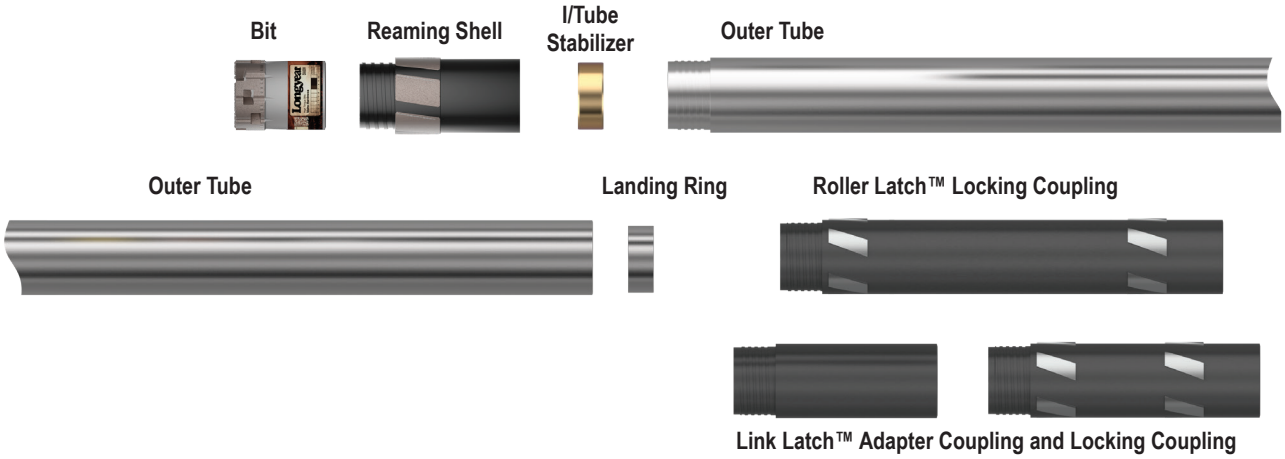
NOTICE

Roller Latch Heads: The wear witness marks formed on the retracting case and brake wedge by mating rollers is large in appearance. However, because of the spherical roller shape, the depth of the witness mark is only about ten percent of its diameter.

13. For any **Quick Pump-In™ head assembly (Roller Latch™ or Link Latch™)**, visually inspect the pump-in lip seals and replace if the lip outer diameter is visibly worn or undersized, or if loose when inserted into a rod or coupling in comparison to a new seal.

14. **Roller Latch™ Head Assemblies:**
    i. Check for full and free movement of the roller latching mechanism. Visually inspect the roller path on the retracting case for any wear and replace if so.
    ii. **Quick Descent™ MK2:** If the spring detent position cannot be maintained, visually inspect the detent spring condition to confirm if worn and replace if wear is present.
    iii. **Quick Pump-In™:** If the head assembly fails the holdback brake test (see 'Maintenance Between Core Runs' Section 7.1), replace the brake wedge and brake rollers.
15. **Link Latch™ Head Assemblies:**
    i. Check for full and free movement of the latch mechanism. If necessary, manually apply a small amount of grease to the latches and latch retraction case. Repeatedly retract and deploy to distribute the grease. Replace latch spring if decreased or lack of spring resistance.
    ii. Visually inspect latch deployment by partially inserting the head assembly into the male end of a suitable rod or coupling, until the deployed latches are against the pin end shoulder face. The distance across the outer surfaces of the latches should be at least 1.0mm (0.040") larger than the inner diameter of the rod or coupling. If suspect, or if excessive play in the mechanism, replace the retracting case and the latches (and links for Link Latch heads).
16. Attach the inner tube to the head assembly using full-grip style inner tube wrenches.
17. Check the assembly length for the correct bit gap with the outer tube assembly. Check the adjustment nut and wedge-lock washer. Adjust and tighten as necessary.
18. Set the inner tube assembly aside and service the outer tube assembly.

Outer Tube Assembly



NOTICE **In PQ systems, the inner tube stabilizer is inserted into the bore of the bit.**

1. Check the general condition of the outer tube assembly each time it is pulled from the hole. A dented or bent outer tube causes premature core blocking and vibration.
2. Remove the locking coupling (and adapter coupling if using a Link Latch head assembly) from the outer tube and inspect the condition of mating shoulders and internal grooves (or latch load bearing surfaces for Link Latch head assemblies). Drilling through heavy core blocks may cause latch dents on the locking coupling. When this damage occurs, the locking coupling needs to be replaced.
3. Remove the landing ring from the counter-bore of the outer tube. If it is tight, insert the inner tube assembly from the bit end of the outer tube. Grasp the inner tube and use the assembly as a slide hammer to jar the landing ring loose.
4. Clean both the landing ring and the outer tube counter-bore.
5. Inspect the landing ring for wear. If the landing impact edge of the landing ring is visibly worn or deformed, reverse it and reinstall. Replace if both sides are worn. Apply anti-seize compound, or grease, between the ring and the counter-bore before reinstalling.

6. Remove the reaming shell from the outer tube. The inner tube stabilizer is located in the counter-bore of the reaming shell.
7. Remove the inner tube stabilizer by carefully tapping it out of the reaming shell using a screwdriver and hammer. Clean the inner tube stabilizer and the reaming shell counter-bore.
8. Inspect the inner tube stabilizer for wear by fitting it over the inner tube O.D. If there is more than 0.7mm (0.030") clearance, the ring is worn and should be replaced.
9. Inspect the locking coupling wear pads by checking the play with a reaming shell or bit gauge. Locking coupling wear pad outer diameter gauge is approximately 0.25mm (0.010") smaller than bit gauge. Replace worn locking couplings to restore core barrel performance and hole deviation control, and to prevent outer tube wear.

NOTICE **Locking couplings with 'stabilized' wear pads, utilizing high density tungsten carbide, can provide up to three times the service life of 'full-hole' style locking couplings.**

10. Reassemble the outer tube, replacing all worn parts. Clean each threaded connection and apply thread compound to each joint.

Core Barrel Assembly

1. After the inner tube assembly and the outer tube have been serviced, clean and lightly oil the surface of the inner tube.
2. Install the inner tube assembly into the outer tube so that the landing shoulder is firmly seated on the landing ring.
3. Check the latching action of the head assembly in the outer tube assembly. The rollers or latches should snap out quickly and latch in firmly.

Overshot

1. Inspect the eye bolt, wireline cable termination and oval compression sleeves and repair if visibly worn, corroded, or in poor condition.
2. **For Roller Latch™ Overshots Only:**
   - i. Visually inspect all rollers if visibly worn or deformed in comparison to un-used rollers.
   - ii. Confirm full and free movement of the rollers on the wedges with the overshot pointing up. If any rollers get stuck or motion is not smooth, disassemble to thoroughly inpect both the lifting wedge and overshot head for any signs of wear or damage and replace either if worn.
   - iii. Confirm full and free movement of the wireline cable swivel. Apply grease as necessary.
   - iv. **Quick Descent™:**
     - a. Visually inspect the safety pin hole on the lifting wedge and overshot head and make sure they are aligned. Disassemble the wedge and inspect the roller seating for any damage and replace if worn.
     - b. Check that the nosecone is threaded on tightly with an o-ring installed against the inner shoulder of the overshot head upon re-assembly to prevent the release rollers from getting stuck.
     - c. Apply a moderate amount of force to pivot the overshot in either direction. If you are not able to pivot 90° in both directions, inspect the ball joint, large roller, and spring to confirm if any parts are worn and replace if so.
     - d. If there is a lot of wiggle upon handling in comparison to a new overshot, visually inspect the ball joint, large roller, and spring to confirm if any parts are worn and replace if so.
     - e. Verify that the entire joint swivels 360° and confirm full and free movement of the spindle. Replace bearings if there is any resistance in motion.
     - f. Inspect threaded joints and condition of the chaser weight and cable swivel bodies. Replace any worn or damaged components, reassemble, and wrench tighten.
   - v. **Quick Pump-In™:**
     - a. Observe whether the wear indication groove is visible on the overshot jam nut located near the base of the overshot body. Replace overshot body or lifting wedge if groove is fully visible.
     - b. Using the porting on the joint adapter, visually inspect the indicator bushing and spring and replace if worn.
     - c. Visually inspect the pump-in lip seals and replace if the lip outer diameter is visibly worn or undersized, or if loose when inserted into a rod or coupling in comparison to a new seal.

d. Inspect threaded joints and condition of the quick disconnect body and joint adapter. Replace any worn or damaged components, reassemble, and wrench tighten.

3. **For Lifting Dog Style Overshots Only:**

i. Confirm full and free movement of the lifting dogs, Ezy-Lock twist sleeve (surface only), and wireline cable swivel. Apply grease as necessary.

ii. Using inspection windows in overshot head, visually inspect the 'hooked' ends of overshot lifting dogs by comparing to a spare lifting dog and replace if visibly worn or deformed.

iii. **EZY-Lock™:**

a. Inspect threaded joints and condition of jar staff, hex nut, and wedge-lock washer. Replace any worn or damaged components, reassemble, and wrench tighten.

b. See 'Ezy-Lock Maintenance' (Section 6.6) for more after service instructions.

iv. **Quick Pump-In™:**

a. Visually inspect the indicator bushing and replace if worn. Also check that the overshot bypass valve porting is open, and a single valve ball is in position, behind the indicator bushing.

b. Visually inspect the shear pin in the cable swivel body and replace if worn.

c. Visually inspect the pump-in lip seals and replace if the lip outer diameter is visibly worn or undersized, or if loose when inserted into a rod or coupling in comparison to a new seal.

8

TROUBLESHOOTING

8.1 TROUBLESHOOTING

1. Problem: Fluid Pressure Too High or No Fluid Circulation (PRV opens)

Investigation:

i. Lift the rod string off the hole bottom and attempt fluid circulation under slow rotation to detect any drop in fluid supply pressure which might indicate an intermediate blockage due to hole or ground issues, such as swelling ground (e.g. clay-like), or a fully consumed bit or reaming shell.

Probable Cause	Recommended Action
i) Inner tube is full, or a core block has occurred.	See 'Fluid Pressure & Core Blocks' (Section 6.3)
ii) Roller or latches may not have deployed, the landing shoulder may not be seated on the landing ring, the inner tube assembly length adjustment may be excessive, or the latches may be oriented such that they are blocked by the optional locking coupling tang feature (Link Latch™ only), or the detent spring may be worn (Quick Descent™ Roller Latch™ MK2 only). These issues prevent the retracting case from dropping, and the fluid control valve from opening.	Briefly apply rotation to drive the rollers/latches out by centrifugal force, or a sharp pullback 'jump' to the drill string to cause the inner tube to re-seat itself. Slowly increase fluid pressure to avoid sealing the inner tube onto the bit.
iii) Bit gap is too small, therefore restricting flow, or the core lifter case may have sealed on bit preventing circulation, valve, and latch deployment.	Retrieve the inner tube assembly and inspect the head assembly referring to the maintenance sections (Chapter 7). Adjust the overall length shorter to maximize bit gap. See 'Outer Tube Assembly' (Section 7.2).
iv) Indicator bushing resistance is too high for pump or for shallow depths, or the water table may have dropped.	Retrieve the head assembly and swap the bushing out for an alternative indicator bushing with a lower pressure signal rating.
v) Fluid retention valve spring selection may be too strong.	Retrieve the head assembly and swap the spring out for an alternative spring with a lower pressure rating.
vi) The spring pin retaining the fluid control valve piston may be bent, or the head assembly may be loose or broken.	Retrieve the head assembly and repair, referring to the maintenance sections (Chapter 7).
vii) The drilling fluid or 'mud' may be too thick or viscous or may contain 'lost circulation material' that is too coarse	Thin out the drilling fluid and re-attempt.
viii) Debris or mud build-up in head assembly	Retrieve and repair referring to the maintenance sections (Chapter 7).
ix) The hole bottom may have debris or portions of loose core preventing a seated position or blocking circulation, or the hole may have intersected a zone or aquifer of pressurized fluid or gas.	Prior to retrieving the inner tube, wash the hole for several minutes under slow rotation and take precautions for sudden inner tube expulsion. Retrieve and inspect the inner tube. Clean the hole, re-seat the rod string and the inner tube.

2. Problem: Fluid Pressure Too Low or Landing Indication Signal Too Low

Probable Cause	Recommended Action
i) Fluid may be bypassing the inner tube assembly if it is not fully seated or hung up in the rod string due to bad joints or 'mud rings', or excessive drag when dropping into shallow hole angles.	Retrieve and inspect the inner tube assembly. Wash the hole and rod string for several minutes before re-attempting.
ii) Indicator bushing resistance is too low for pump or for hydrostatic pressure at depth.	Retrieve the head assembly and swap the bushing out for an alternative indicator bushing with a higher pressure signal rating.
iii) Indicator bushing or fluid retention bushing may be worn. Fluid control valve piston or ball may be worn.	Retrieve the head assembly and swap the bushing out for an alternative indicator bushing with a higher pressure signal rating.
iv) Fluid retention valve spring is too weak for hydrostatic pressure at depth, or the water table may have dropped.	Retrieve the head assembly and swap the bushing out for an alternative indicator bushing with a higher pressure signal rating.
v) Supply lines or fittings leaking, or rod string joints leaking.	Inspect and repair. If damaged rod joints are suspected, **DO NOT** lower the overshot; pull rods.

3. Problem: Difficult to Un-latch or Pull Inner Tube Assembly Off Bottom (Surface)

Probable Cause	Recommended Action
i) Wireline hoist may be giving problems.	Wireline hoist may require troubleshooting or may not have adequate lifting capacity.
ii) Locking coupling or latch mechanism may be worn or damaged.	Retrieve the head assembly and repair, referring to the maintenance sections (Chapter 7). Pull the rods to inspect the locking coupling and replace if necessary.
iii) **EZY-Lock™ Overshots:** Inner tube is full or a core block has occurred.	See 'Fluid Pressure & Core Blocks' (Section 6.3)
iv) **EZY-Lock™ Overshots:** The spring pin retaining the fluid control valve piston may be bent, or the head assembly may be loose or broken.	Retrieve the head assembly and repair, referring to the maintenance sections (Chapter 7).
v) **EZY-Lock™ Overshots:** Bit gap is too small, restricting flow, or the core lifter case may have sealed on bit preventing circulation. Alternatively, the inner tube annulus may be blocked with debris or sand.	Wait for any retained column of fluid to drain from the rods. Retrieve the inner tube assembly and inspect the head assembly referring to the maintenance sections (Chapter 7). Adjust the overall length shorter to maximize bit gap. See 'Outer Tube Assembly' (Section 7.2).

4. Problem: Difficult to Un-latch or Retrieve Inner Tube Assembly (Underground)

Probable Cause	Recommended Action
i) All issues listed above for surface applications may also apply to underground applications.	All corrective actions listed above for surface applications may also apply to underground applications.
ii) **Roller Latch™:** The overshot landing indication and fluid bypass valve may be blocked, preventing fluid flow from reaching the head assembly to lift weight of the inner tube off the holdback brake, to allow un-latching or retrieval.	Retrieve the overshot and inspect the indicator bushing area for signs of blockage.
iii) **Link Latch™:** The overshot landing indication and fluid bypass valve may be blocked, preventing fluid flow from reaching the head assembly to lift the weight of the inner tube off the latch mechanism and allow un-latching.	Retrieve the overshot and inspect the indicator bushing area for signs of blockage.

5. Problem: Very Slow Descent or Pump-In Tripping

Probable Cause	Recommended Action
i) Landing indicator valve piston or ball may be seized or was not reset above or behind the indicator bushing. Valve piston retaining spring pin may be bent. Fluid bypass porting may be blocked.	Inspect head assembly and check valve is reset, every run.
ii) Shut-off valves may be deformed or over-tightened in assembly, causing drag.	Replace valves.
iii) **Quick Descent™ Roller Latch™:** The rollers may have deployed prematurely, dragging on the rods.	Inspect the upper latch body, retracting case, detent spring and rollers for wear. Repair and confirm detent positioning is restored.
iv) **Quick Pump-In™ Roller Latch™:** The fluid seal during pump-in has failed or degraded.	Inspect the valve piston and bushing and inspect the pump-in lip seals for wear. Replace worn components and reassembly to restore performance.

6. Problem: Inner Tube Fails To Release - Surface

Probable Cause	Recommended Action
i) Link Latch™ head assemblies may not release (un-latch) because of a severe core block. Roller Latch™ head assemblies will release under core block conditions.	Refer to 'Fluid Pressure & Core Blocks' section in Chapter 6. Pull cable tight and release it to cause a jarring action of the overshot body, which may free the tube. If the inner tube assembly does not release, use the slotted release sleeve: - Slip the sleeve over the wireline cable and drop it down the hole. - The sleeve slips over the upper ends of the lifting dogs, drawing them in and spreading the lower ends away from the spearpoint, allowing release. - If the overshot fails to release, pull the cable tight and release so the jarring action of the overshot body forces the release sleeve over the lifting dogs. - Retrieve the overshot and pull the rods.

7. Problem: Inner Tube Fails to Release -- Underground

Probable Cause	Recommended Action
i) Link Latch™ head assemblies may not release (un-latch) because of a severe core block. Roller Latch™ head assemblies will release under core block conditions. **NOTE:** Whichever corrective action is followed, **ALWAYS** stay clear of the open rod string, and reel up the wireline cable. Take precautions for a possible falling inner tube and carefully remove the rod string from the hole to retrieve the inner tube assembly.	Refer to 'Fluid Pressure & Core Blocks; section in Chapter 6. Apply maximum fluid pressure. Pull the wireline cable tight and release it to cause a jarring action, while maintaining fluid pressure, which may free the tube. Pull with the wireline hoist until the hoist stalls. If the inner tube still is not released, repeat this operation until the shear pin in the overshot fails. The shear pin has a failure load that is significantly less than standard 3/16" (4mm) wireline cable. This allows retrieval of the wireline cable prior to pulling the rod string. **NOTE:** The shear pin is a light duty coiled spring pin which has been proven to shear more consistently than a solid soft pin.

8. Problem: Landing Rings Wearing Out Inner Tubes Quickly (Link Latch™ Head Assemblies)

Probable Cause	Recommended Action
i) Tanged locking coupling is not being used.	Install a tanged locking coupling, because it drives the head assembly in rotation. Consider switching to the Roller Latch™ equivalent, which locks the head assembly in rotation.
ii) The landing shoulder is worn and, on impact, sticks into the landing ring (or vice versa), causing the rods to spin around the head assembly that cannot turn.	Inspect the landing shoulder and/or the landing ring for wear and either reverse or replace if worn.
iii) Latches and latch seats on the locking coupling are worn so the latches are not contacting the locking coupling properly.	Replace any affected parts that are worn.
iv) The bearings are seized.	Inspect and replace if worn.
v) The bearings have been over greased, so grease has built up and is creating more friction and excessive pressure.	Disassemble to remove pressure caused by excess grease and re-grease if needed.
vi) Head assembly is overtightened and motion is being restricted.	Loosen head assembly and follow assembly instructions to re-tighten.
vii) Maintenance/wear issues causing resistance to rotation in the head assembly.	Retrieve head assembly and inspect thoroughly for any signs or wear and replace any worn parts.

INTELLECTUAL PROPERTY

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