

**MOTION DECOUPLED HYDRAULIC DELIVERY SYSTEM
(MDHDS)
ASSEMBLY AND DEPLOYMENT PROCEDURES**

Prepared for the
University of Texas

by

Pettigrew Engineering, PLLC
Tom Pettigrew, PE
President

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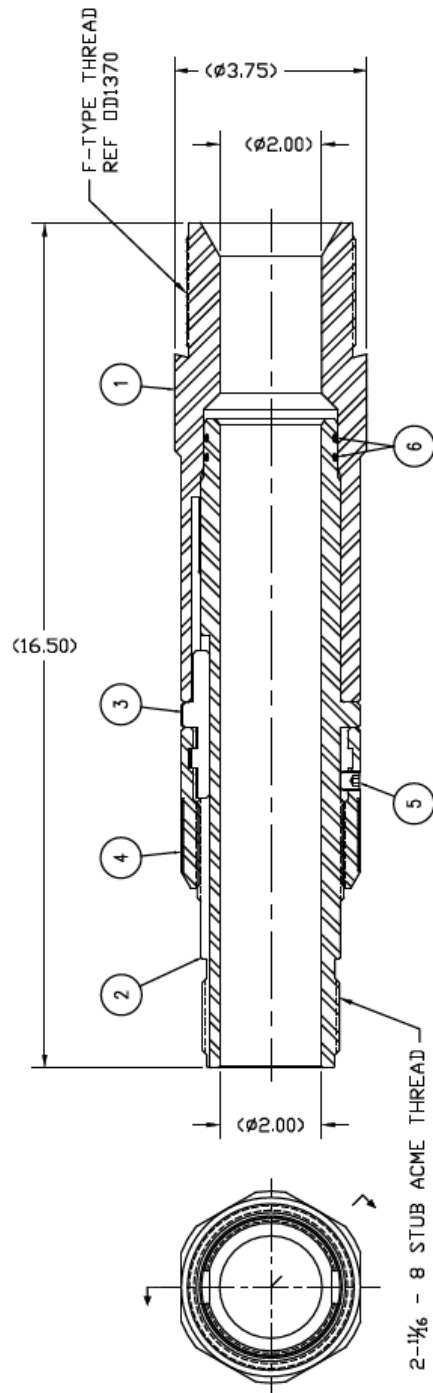
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Section I: MDHDS ASSEMBLY PROCEDURE

Note: The term "light grease" used throughout these procedures refers to Lubrimatec® White Lithium grease or equivalent.

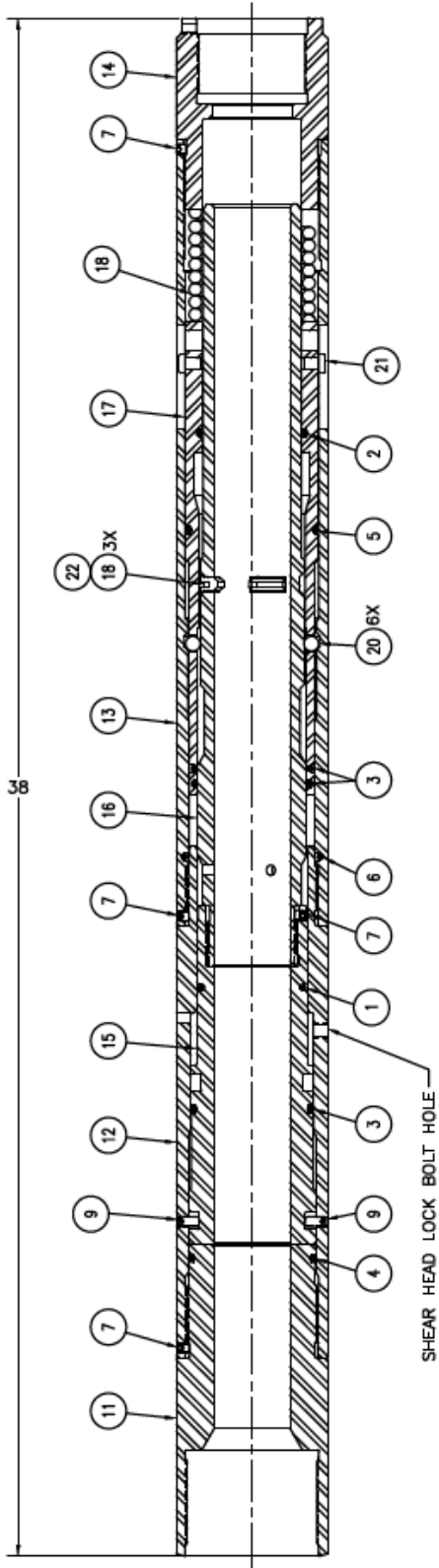
1.0 Big Bore Quick Release Assembly 172969-100



BILL OF MATERIAL			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	172969-101	FEMALE QUICK RELEASE
2	1	172969-102	MALE QUICK RELEASE
3	2	172969-103	DOG, QUICK RELEASE
4	1	172969-104	NUT, QUICK RELEASE
5	1	OD6775	SET SCREW, 3/8-16UNC x 3/8" LG.
6	2	OD2143	O-RING, 2-143, BUNA-N, 70 DURO

FIGURE 1: BIG BORE QUICK RELEASE ASSEMBLY 172969-100

- 1.1 Apply light grease on all contact surfaces and o-ring grooves of 1 ea. Male Quick Release 172969-102 and install 2 ea. O-rings 2-143.
- 1.2 Apply light grease on all surfaces of 2 ea. Dogs 172969-103 and inside of 1 ea. Nut 172969-104.
- 1.3 Install Dogs in Nut spaced 180 degree apart.
- 1.4 Slide Nut over Male Quick Release with Dogs positioned in slots, then thread Nut onto Male Quick Release.
- 1.5 Apply light grease on inside of 1 ea. Female Quick Release 172969-101 and Install Male Quick Release, rotate clockwise to lock.
- 1.6 Thread Nut all the way down on Male Quick Release, locking assembly together.



BILL OF MATERIAL			DESCRIPTION
ITEM	QTY	PART NUMBER	
1	1	0D2229	O-RING, 2-229, NITRILE, 70 DURO
2	1	0D2230	O-RING, 2-230, NITRILE, 70 DURO
3	3	0D2232	O-RING, 2-232, NITRILE, 70 DURO
4	1	0D2233	O-RING, 2-233, NITRILE, 70 DURO
5	1	0D2234	O-RING, 2-234, NITRILE, 70 DURO
6	1	0D2235	O-RING, 2-235, BUNA-N, 70 DURO
7	4	0D6060	SET SCREW, 1/4-20UNC x 1/4" LG. SS
9	1	0D6063	SET SCREW, 1/4-20UNC x 1/2" LG. BRASS
11	1	172969-201	TOP CONNECTION
12	1	172969-202	SHEAR SCREW HOUSING
13	1	172969-203	LATCH BODY
14	1	172969-204	BOTTOM CONNECTION
15	1	172969-205	SHEAR SCREW HEAD
16	1	172969-206	DOG BODY
17	1	172969-207	PISTON
18	3	172969-208	LATCH DOG
19	1	172969-323	LATCH SPRING
20	6	MC#9642K49	BALL BEARING, 3/8" SS
21	2		SOC HD CAP SCREW, 3/16 - 18UNC X 1 LG, LOW HD, STL
22	1	0D2141	O-RING, 2-141, BUNA N, 70 DURO

FIGURE 2: MDHDS LATCH ASSEMBLY 172969-200

- 2.1 Apply light grease on thread of 1 ea. Dog Body 172969-206 and place in vice.
- 2.2 Apply light grease on thread of 1 ea. Shear Screw Head 172969-205 and make up to Dog Body.

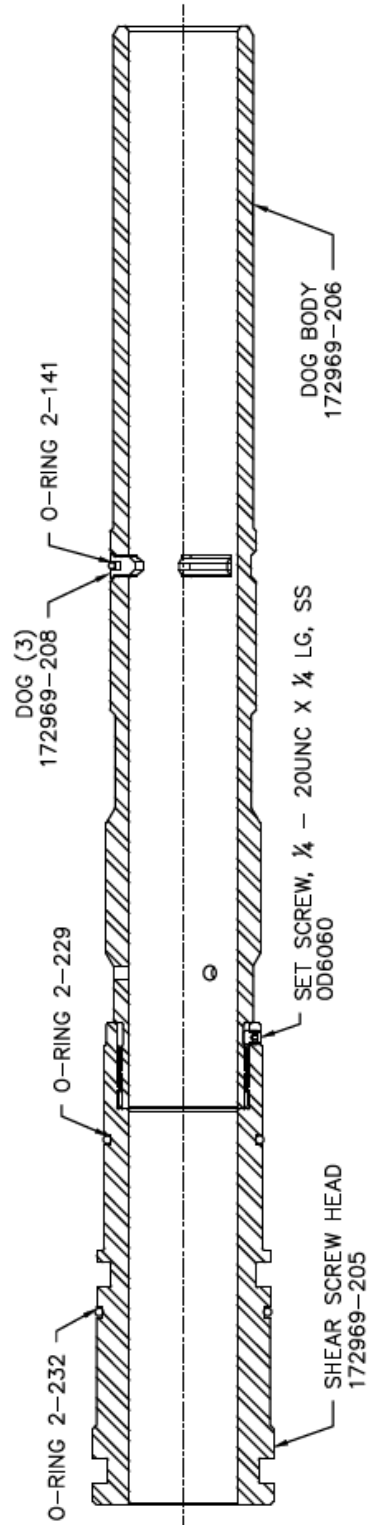


FIGURE 3: SHEAR SCREW HEAD - DOG BODY SUBASSEMBLY

- 2.3 Install 1 ea. Locking Screw OD6060 (1/4 – 20UNC x 1/4 lg, SS) in Shear Screw Head.
- 2.4 Apply light grease on all surfaces of 3 each Latch Dogs 172969-208 and install in Dog Body.
- 2.5 Install 1 ea. O-Ring 2-141 over Latch Dogs to hold in place.
- 2.6 Remove subassembly from vice.
- 2.7 Install 1 ea. O-Ring 2-232 and 1 ea. O-Ring 2-228 on Shear Screw Head.
- 2.8 Apply light grease on entire outside and inside surfaces of subassembly.
- 2.9 Apply light grease to threads, o-ring groove, and entire ID of 1 ea. Latch Body 172969-203 and place in vice.

2.10 Install 1 ea. O-Ring 2-235 in Latch Body.

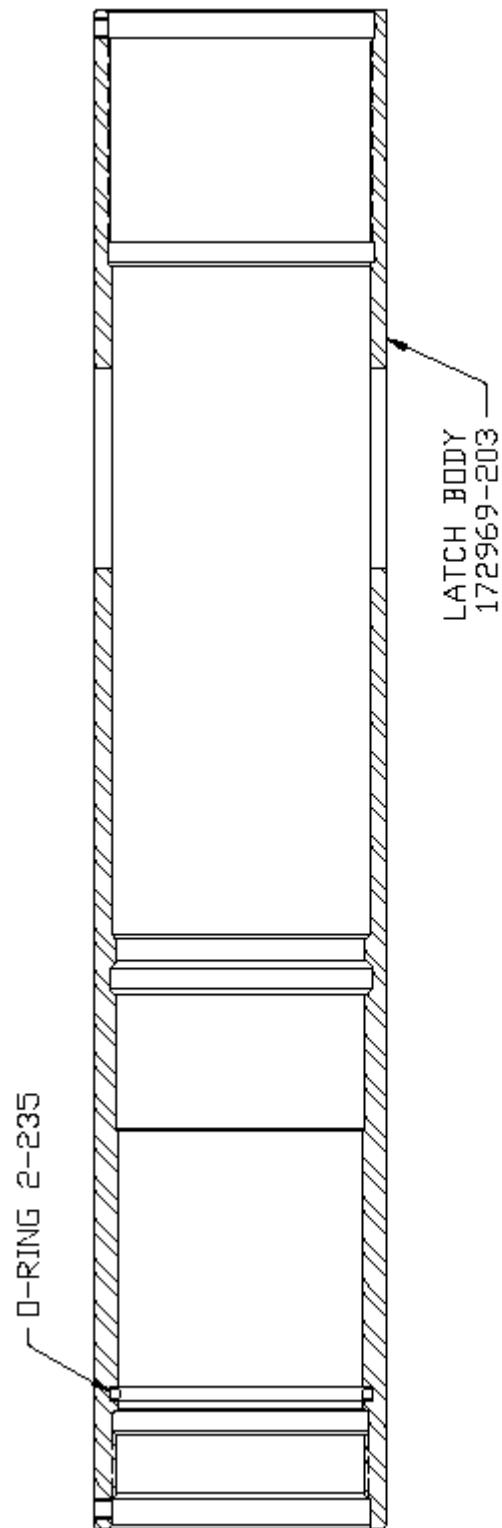


FIGURE 4: LATCH BODY

- 2.11 Apply light grease to the inside and outside surfaces of 1 ea. 172969-207 Piston.
- 2.12 Install 2 ea. O-Ring 2-232, 1 ea. O-Ring 2-234, and 1 ea. O-ring 2-230 on Piston.
- 2.13 Fill the Piston Lock Ball retaining holes with light grease.
- 2.14 Insert Piston into Latch Body while aligning Spring Compression Tool Dog Bolt holes with Latch Body slots.

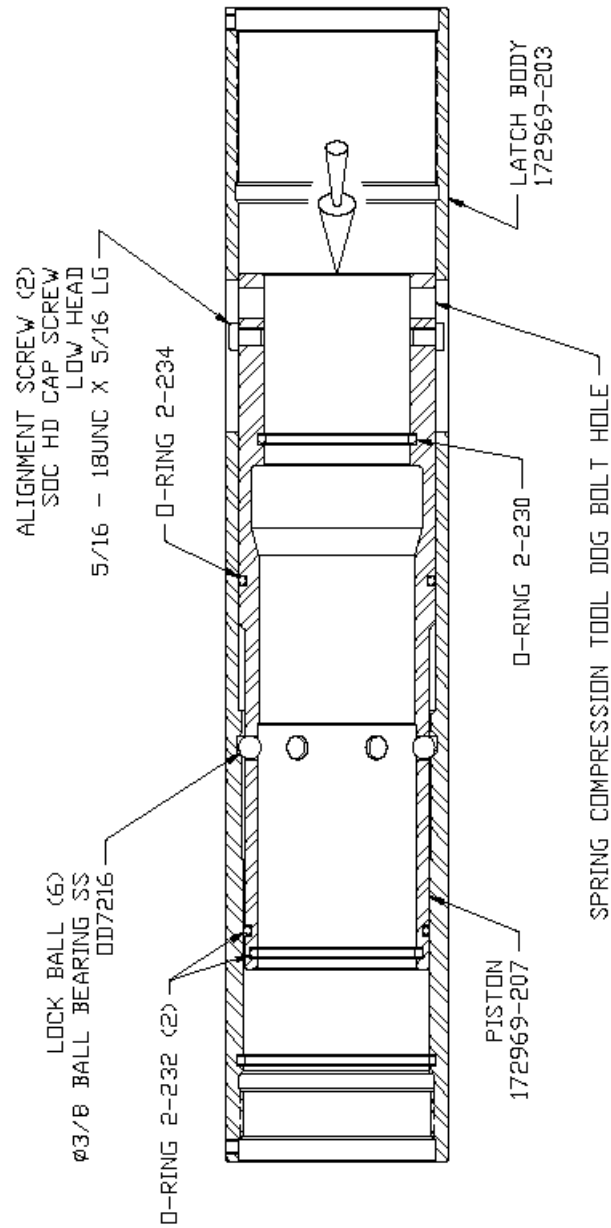


FIGURE 5A: PISTON INSTALLATION

- 2.15 Drive the Piston into the Latch Body until the Spring Compression Tool Dog Bolt holes are fully exposed at the bottom of the Latch Body slots.
- 2.16 Install 2 ea. Piston Alignment Screws (Socket Head Cap Screw, 5/16 – 18UNC X 5/16 lg) through Latch Body slots into Piston.
- 2.17 Install 6 ea. Lock Balls OD7216 (3/8 Ball Bearing SS) in the Piston Lock Ball retaining holes.

Note: Be sure the Lock Balls are positioned in the bottom of the Latch Body Lock Ball Groove. Reaching inside and feel the position of the Lock Balls, relative to the Piston inside diameter, while moving the Piston in and out slightly. By doing so, one can feel the Lock Balls move in and out of the Latch Body Lock Ball groove.

- 2.18 Apply light grease to thread of 1 ea. Shear Screw Housing 172969-202 and make up to Latch Body.

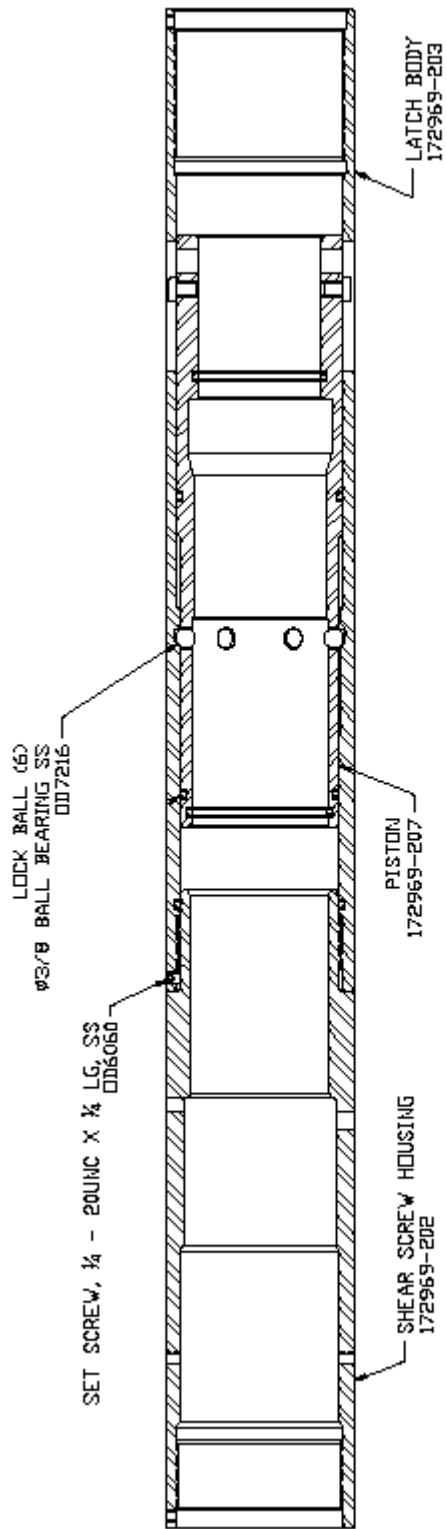


FIGURE 5B: SHEAR SCREW HOUSING - LATCH BODY SUBASSEMBLY

- 2.19 Install 1 ea. Locking Screw OD6060 (1/4 – 20UNC x 1/4 lg, SS) in Latch Body.
- 2.20 Apply light grease to inside surface of subassembly.

2.21 Install the Shear Screw Head/Dog Body Subassembly in Latch Body Subassembly.

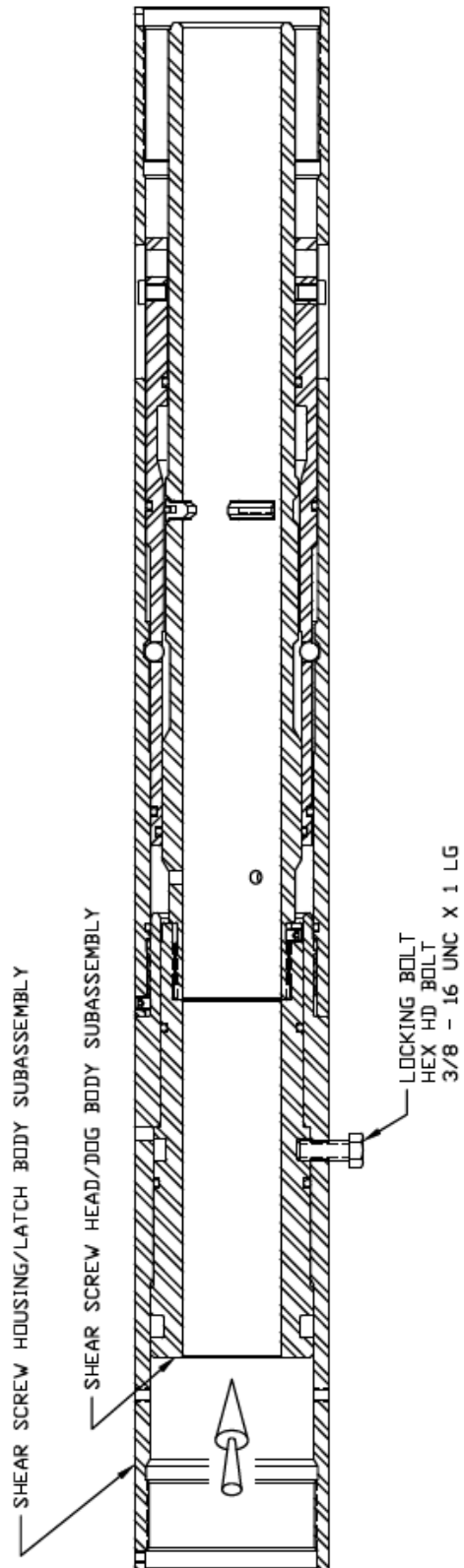


FIGURE 6: SHEAR SCREW HEAD/DOG BODY SUBASSEMBLY INSTALLATION

2.22 Drive the Shear Screw Head/Dog Body Subassembly down until the Shear Screw Head shoulders on the Shear Screw Housing.

2.23 Install 1 ea. Shear Screw Head Lock Bolt (3/8 – 16UNC X 1 lg Hex Head Bolt).

Note: Do not remove the shear head lock bolt until the Inner Rod Subassembly has been installed and the latch is set to lock the Inner Rod Subassembly in place.

2.24 Apply light grease to thread and o-ring groove of 1 ea. Top Connection 172969-201 and install 1 ea. O-Ring 2-233 OD2233.

2.25 Make up the Top Connection to the Shear Screw Housing.

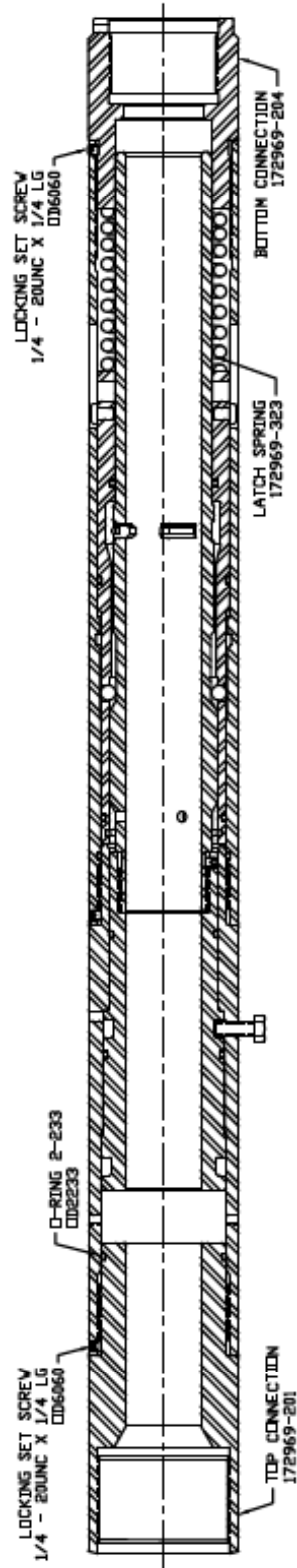


FIGURE 7: LATCH TOP AND BOTTOM CONNECTION INSTALLATION

- 2.26 Install 1 ea. Locking Screw OD6060 (1/4 – 20UNC X 1/4 lg) in Shear Screw Housing.
- 2.27 Using a punch, inserted perpendicular in the Piston Spring Compression Dog Bolt Holes, and a hammer, drive the Piston towards the Shear Screw Housing until it shoulders.
- 2.28 Apply light grease on 1 ea. Latch Spring 172969-323 and install in Latch Body.
- 2.29 Apply light grease to threads of 1 ea. Latch Bottom Connection 172969-204 and make up to Latch Body.
- 2.30 Install 1 ea. Locking Set Screw OD6060 (1/4 – 20UNC X 1/4 lg) in Latch Body.

2.31 Make up 1 ea. Spacer Sub, Big Bore Quick Release, to Bottom Connection.

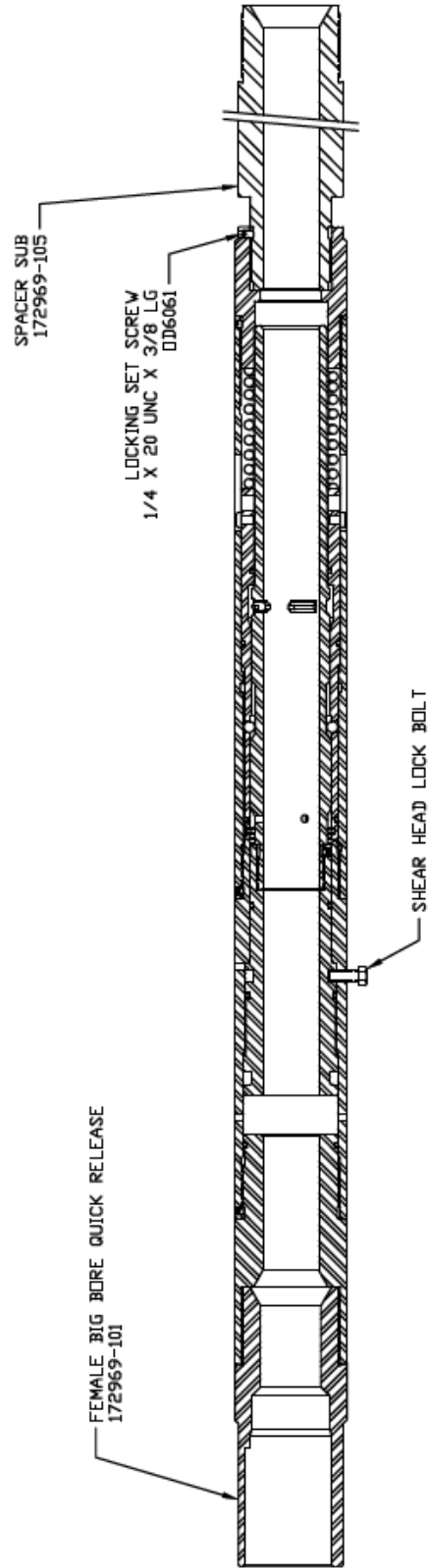


FIGURE 8: LATCH ASSEMBLY FINAL ASSEMBLY

- 2.32 Install 1 ea. Locking Screw OD6061 (1/4 – 20UNC x 3/8 lg) in Bottom Connection.
- 2.33 Make up 1 ea. Female Big Bore Quick Release to Top Connection.

3.0 MDHDS Outer Barrel Subassembly

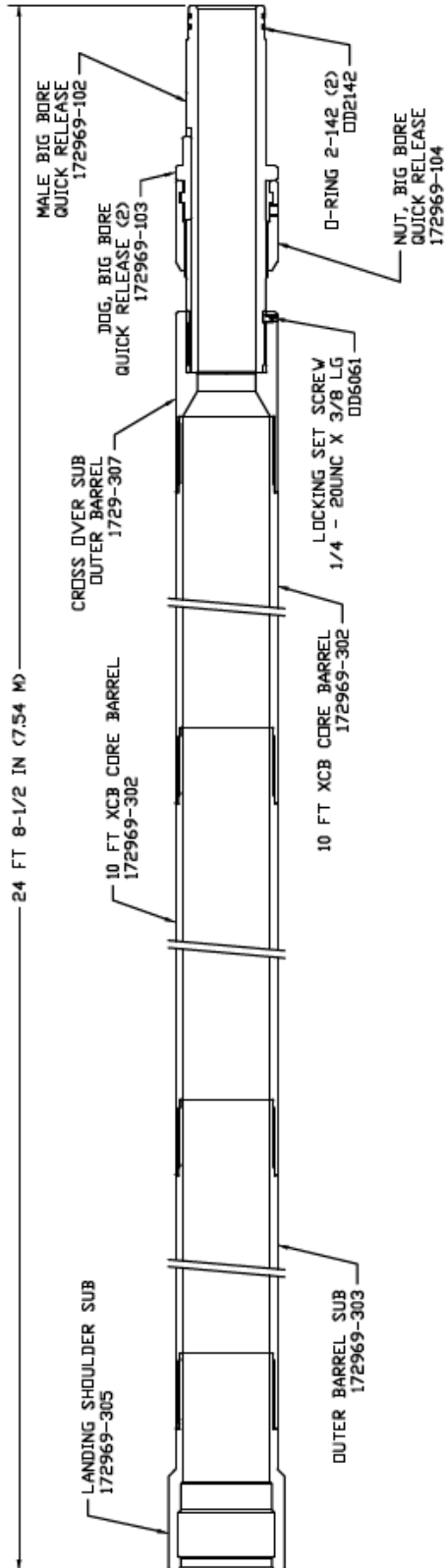


FIGURE 9: OUTER BARREL SUBASSEMBLY

3.1 Apply liquid Teflon® thread compound to pin thread of 2 ea. 10 ft XCB Core Barrels 172969-302 and make up together.

3.2 Apply liquid Teflon® thread compound to pin thread of 1 ea. Outer Barrel Sub 172969-303 and make up to the XCB core barrels.

Note: The Core Barrels and Outer Barrel Sub can be assembled in any order.

3.3 Apply liquid Teflon® thread compound to pin thread of 1 ea. Landing Shoulder Sub 172969-305 and make up to the top of Outer Core Barrel Subassembly.

3.4 Make up 1 ea. Outer Barrel Cross Over Sub 172969-307 to bottom of Outer Core Barrel Subassembly.

3.5 Apply light grease to Outer Barrel Cross Over Sub box thread and make up 1 ea. Big Bore Male Quick Release Subassembly 172969-102 to Outer Core Barrel Subassembly.

3.6 Install 1 ea. Locking Screw OD6061 (1/4 – 20UNC X 3/8 lg) in Outer Barrel Cross Over Sub.

3.7 Make up Latch Assembly to Outer Barrel Subassembly via Big Bore Quick Release.

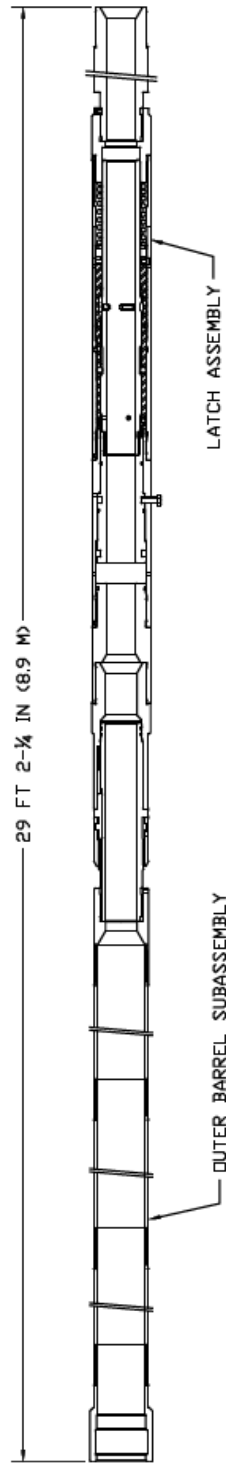


FIGURE 10: OUTER BARREL ASSEMBLY

3.8 DO NOT remove Shear Screw Head Locking Bolt.

4.0 Inner Rod Subassembly

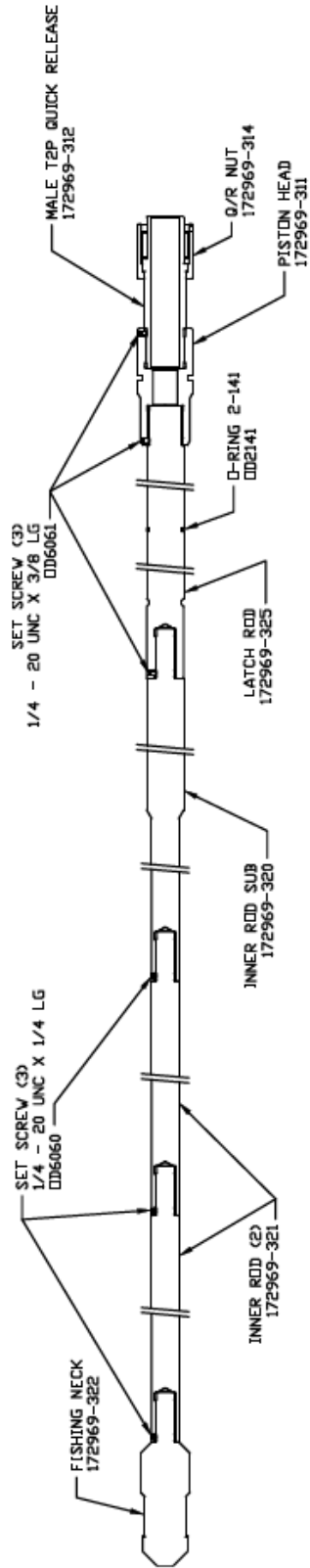


FIGURE 11: INNER ROD SUBASSEMBLY

- 4.1 Apply light grease to threads of 1 ea. Inner Rod Sub 172969-320 and place in vice.
- 4.2 Apply light grease to threads of 1 ea. Latch Rod 172969-325 and make up to Inner Rod Sub.
- 4.3 Install 1 ea. Locking Screw OD6061 (1/4 – 20 UNC x 3/8 lg) in Latch Rod.
- 4.4 Apply light grease to Latch Rod o-ring groove and install 1 ea. O-Ring 2-141 OD2141.
- 4.5 Apply light grease to threads of 1 ea. Piston Head 172969-311 and make up to Latch Rod.
- 4.6 Install 1 ea. Locking Screw OD6061 (1/4 – 20 UNC x 3/8 lg) in Piston Head.
- 4.7 Apply light grease to thread of 1 ea. Male T2P Quick Release 172969-312.
- 4.8 Install 1 ea. Nut, Quick Release 172969-314 on Male T2P Quick Release and make up to Inner Rod Subassembly.
- 4.9 Install 1 ea. Locking Screw OD6061 (1/4 – 20 UNC x 3/8 lg) in Piston Head.
- 4.10 Apply light grease to threads of 2 each Inner Rods 10 ft 172969-321 and make up to Inner Rod Sub.
- 4.11 Install 2 ea. Locking Screw 1/4 – 20 UNC x 1/4 lg OD6060 in Inner Rod Sub and Inner Rod.
- 4.12 Remove Inner Rod Subassembly from vice.
- 4.13 Place Outer Barrel Subassembly in vice.

- 4.14 Slide Inner Rod Subassembly inside Outer Barrel Subassembly from bottom (latch) end, leading with Inner Rod end.

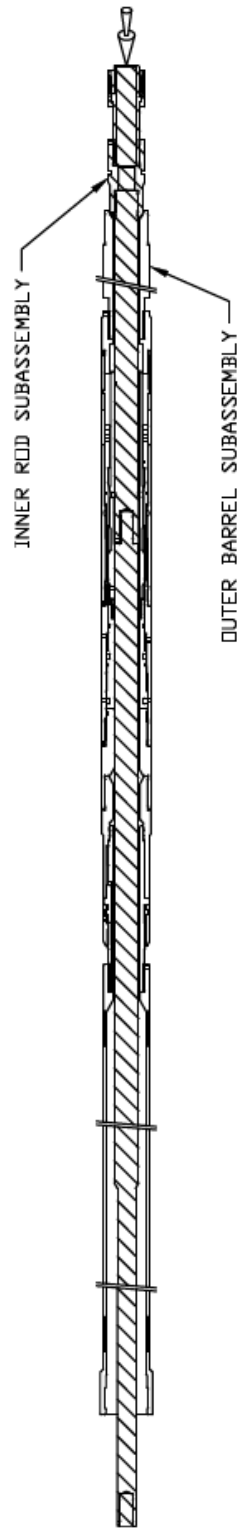


FIGURE 12: OUTER BARREL - INNER ROD SUBASSEMBLY

4.15 Apply light grease to thread of 1 ea. RS Fishing Neck 17969-322 and make up to of Inner Rod Subassembly.

5.0 Latch Inner Rod Subassembly to Outer Barrel Subassembly

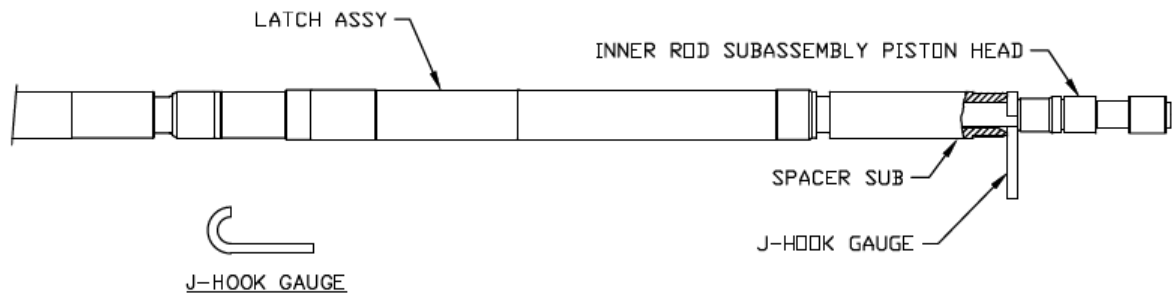


FIGURE 13: J-HOOK GAUGE INSTALLATION

- 5.1 Pull Inner Rod Subassembly out bottom of Outer Barrel Subassembly ~6 in (15 cm).
- 5.2 Place J-Hook Gauge on Inner Rod Subassembly between Piston Head and Spacer Sub.
- 5.3 Push Inner Rod Subassembly into MDHDS until Piston Head shoulders on J-Hook Gauge and J-Hook Gauge shoulders on Spacer Sub.

5.4 Install Spring Compression Tool.

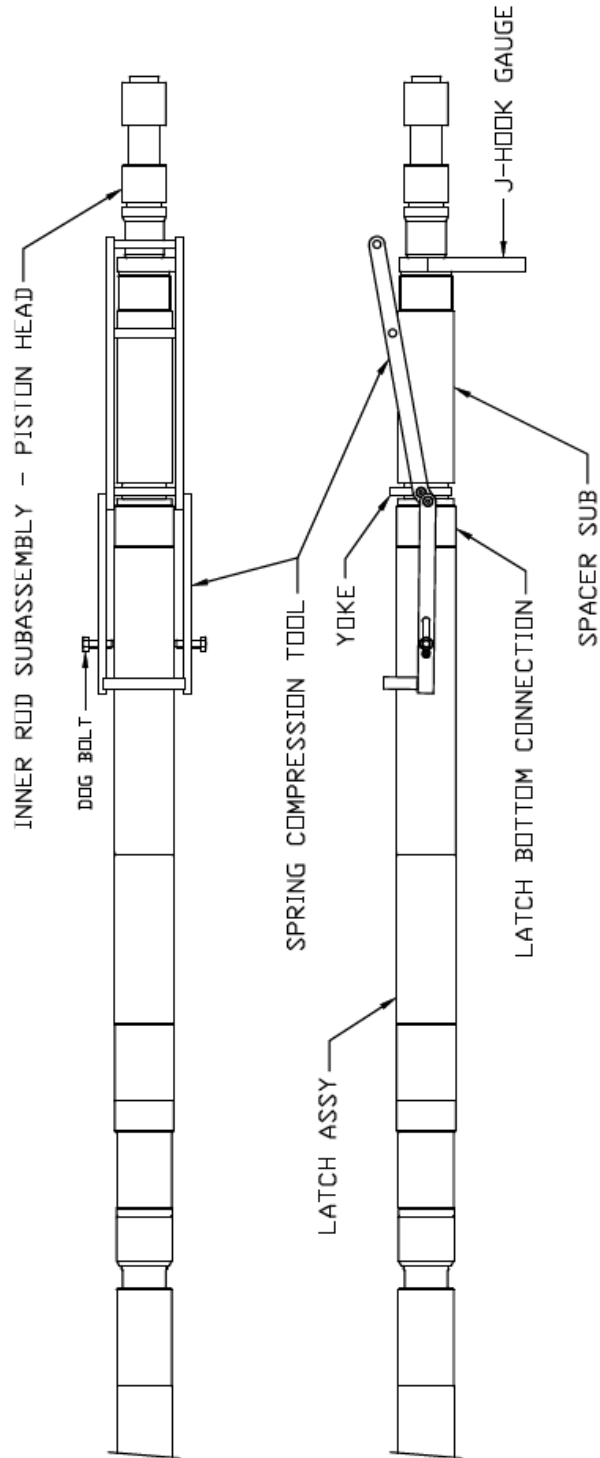


FIGURE 14: SPRING COMPRESSION TOOL INSTALLATION

Note: Snug Dog Bolts, DO NOT torque up.

5.5 Install Spring Compression Tool Spacer 172969-421 (attached to Spring Compression Tool).

Note: Spacer must be positioned between the spring compression tool handle arms so that the handle can pivot without interference from the spacer. Spacer may need to be hammered into place.

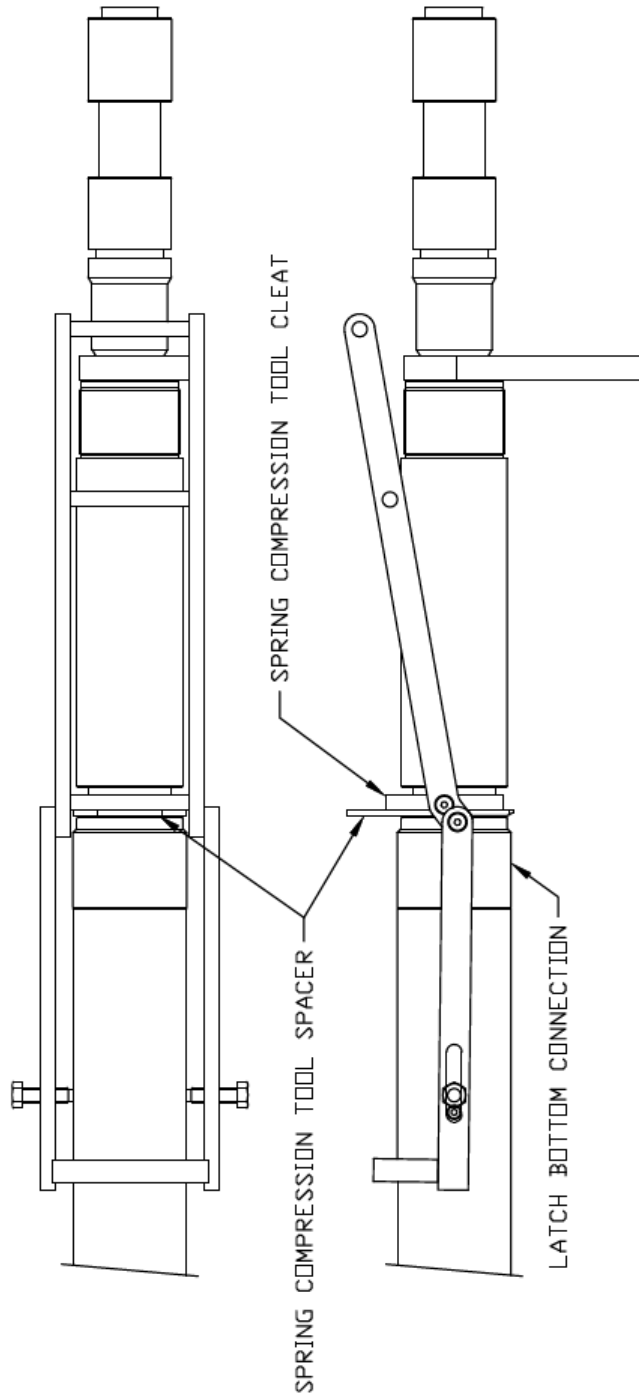


FIGURE 15: SPRING COMPRESSION TOOL SPACER INSTALLATION

5.6 Compress Latch Piston Spring by pivoting Spring Compression Tool Handle.

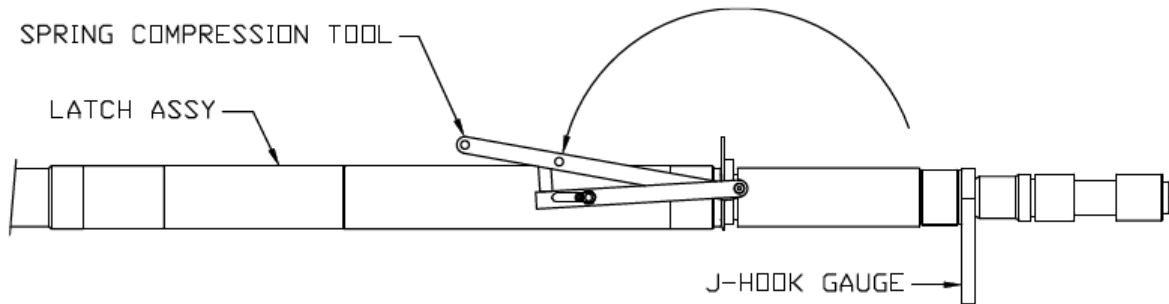


FIGURE 16: LATCH PISTON SPRING COMPRESSION

Note: **DO NOT FORCE THE SPRING COMPRESSION TOOL HANDLE** while rotating it to compress the latch spring. **If ANY resistance is felt, STOP.** Remove the J-Hook Gauge and using a plastic sledge hammer, bump the inner rod subassembly further into the outer barrel subassembly slowly, aligning the latch rod dog groove with the latch dogs, until the spring compression tool handle can be easily rotated. When the spring compression tool handle is pivoted, the piston is pulled over top of the latch dogs. The latch rod latch dog groove must be aligned with the latch dogs so as they can drop down into the groove, allowing the piston to pass over.

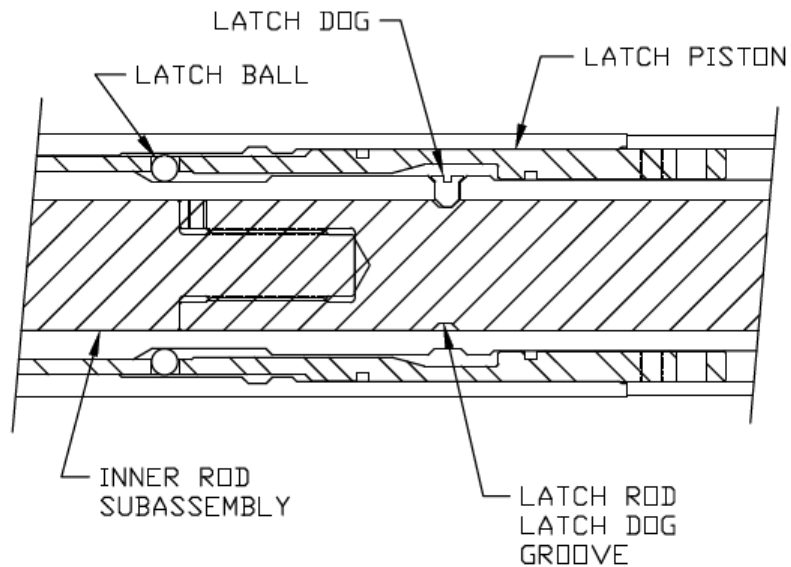


FIGURE 17: LATCH DOG POSITIONING DURING SETTING

- 5.7 Remove J-Hook Gauge from Inner Barrel Subassembly.
- 5.8 Remove the Shear Head Lock Screw.
- 5.9 Push Inner Barrel Subassembly into MDHDS until Piston Head shoulders on Spacer Sub.

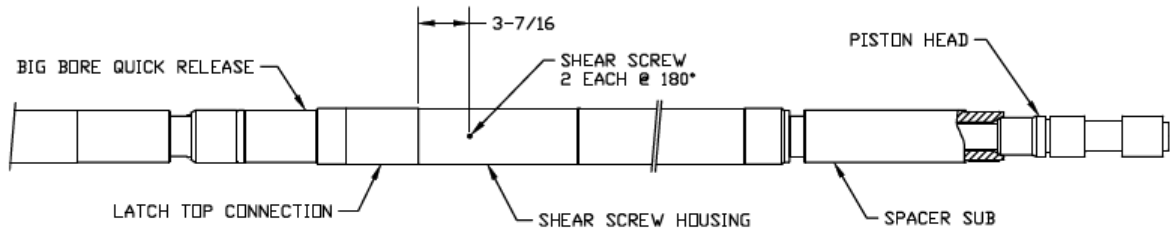


FIGURE 18: POSITIONING LATCH ROD WITH LATCH DOGS

- 5.10 Install 2 each Shear Screws OD6063 (Set Screw, 1/4 – 20 UNC x 1/2 lg, brass) in the Shear Screw Housing.
- 5.11 Remove Spring Compression Tool.
- 5.12 Make up 1 ea. Flapper Guide Tube 17969-301 to Spacer Sub.

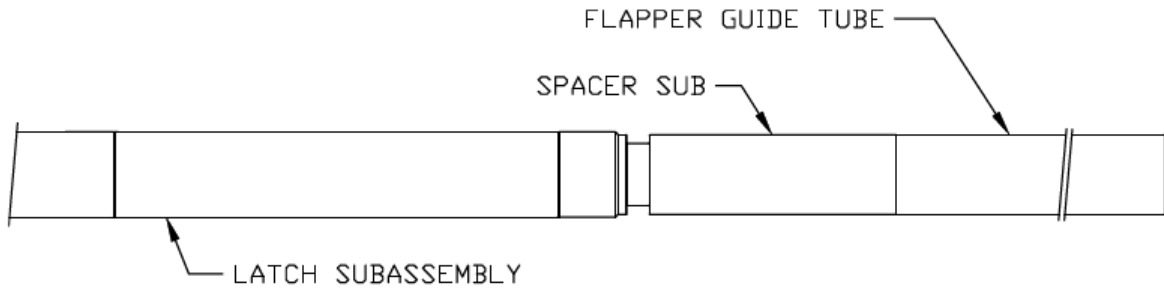


FIGURE 19: FLAPPER GUIDE TUBE INSTALLATION

- 5.13 Install MDHDS Locking Clamp 17969-418.
- 5.14 Install MDHDS Lifting Clamp 17969-403.

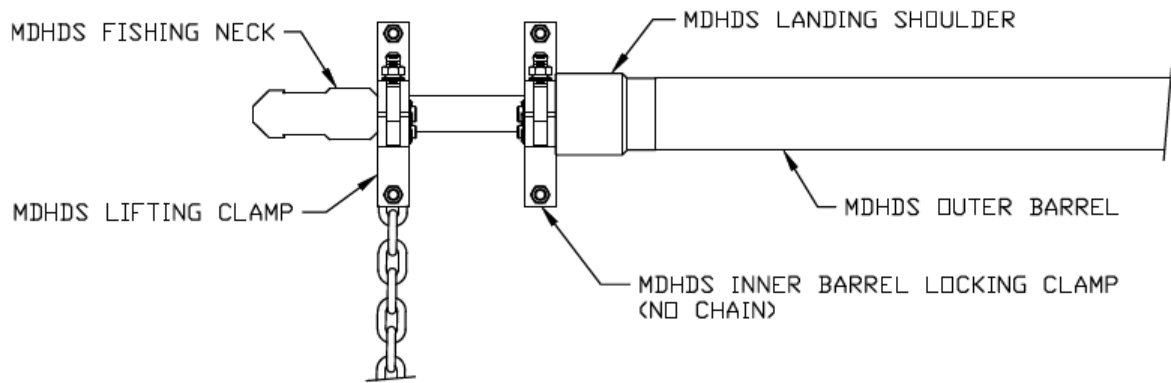


FIGURE 20: CLAMP INSTALLATION

- 5.15 Place MDHDS in shuck.

Section II: MDHDS DISASSEMBLY PROCEDURE

1.0 Unlatch MDHDS Latch

- 1.1 Remove Flapper Guide Tube.
- 1.2 Remove Shear Screws.

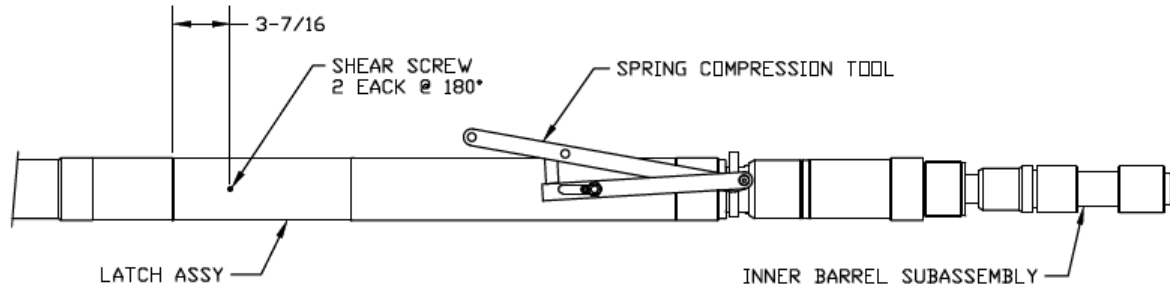


FIGURE21: REMOVING SHEAR SCREWS

- 1.3 Install Spring Compression Tool in the compressed spring configuration.
- 1.4 Pull the Inner Barrel Subassembly out of the Outer Barrel Subassembly from the bottom approximately 1-1/4" until it shoulders.
- 1.5 Uncompress the Latch Spring by rotating the Spring Compression Tool handle.
- 1.6 Remove the Inner Barrel Subassembly from the Outer Barrel Subassembly.

2.0 MDHDS Disassembly

- 2.1 Disassemble the MDHDS Inner and Outer Barrel Subassemblies in reverse order of the assembly, down to the Latch Subassembly.

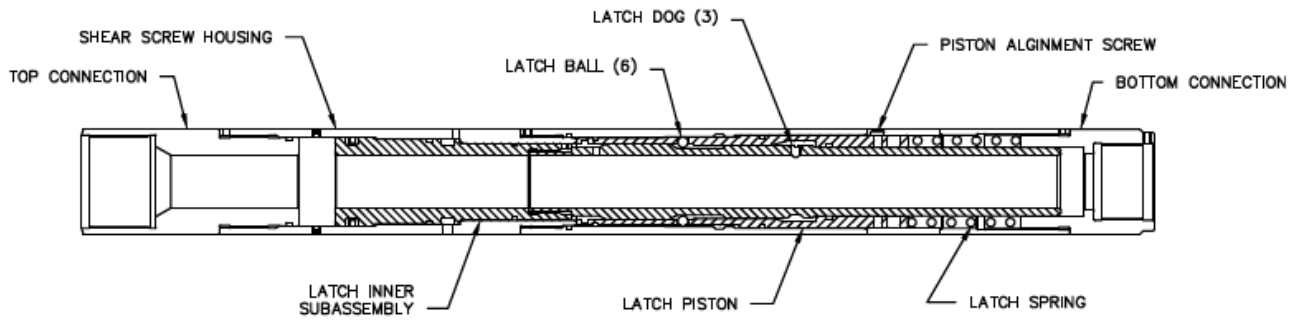


FIGURE 22: LATCH SUBASSEMBLY

- 2.2 Remove Bottom Connection, Latch Spring, Piston Alignment Screw (2), and Top Connection.

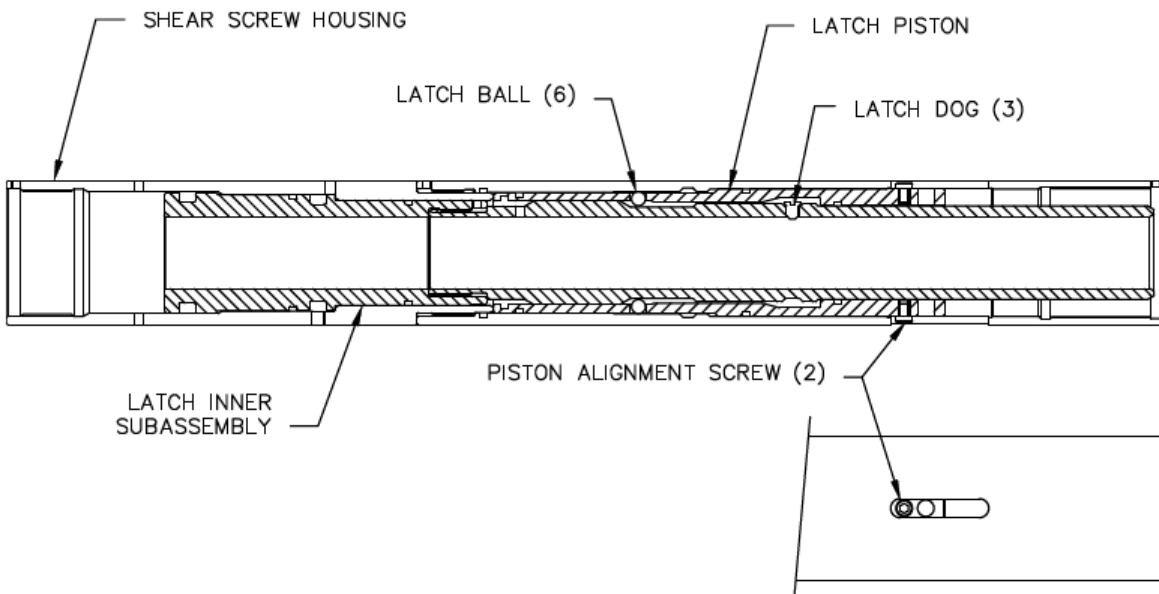


FIGURE 23: LATCH SUBASSEMBLY

- 2.3 Using a hammer and punch, accessing the piston through the Latch Body slots, drive the Piston downward until the Spring Compression Tool Dog Bolt holes are at the bottom of the Latch Body Window (~1-9/32").

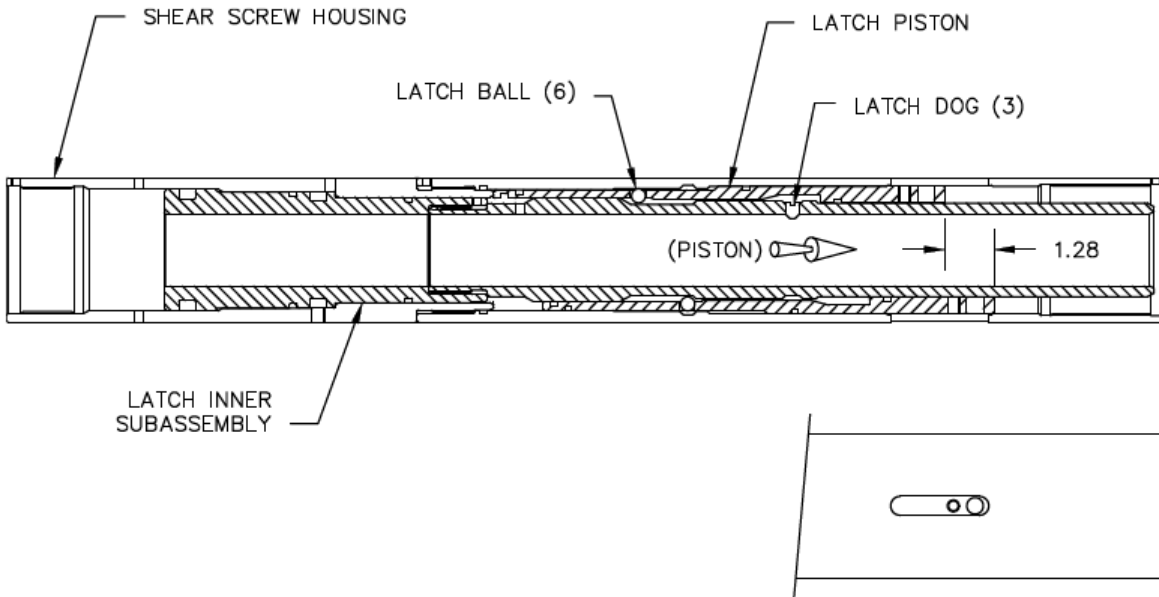


FIGURE 24: PISTON UNLATCH

- 2.4 Using a hammer and long bar, drive Latch Inner Subassembly out of the top of the Shear Screw Housing.

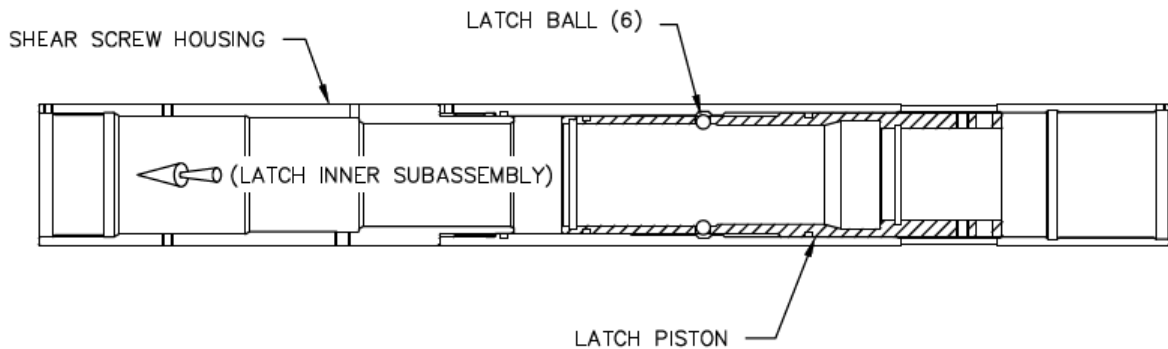


FIGURE 25: LATCH INNER SUBASSEMBLY REMOVAL

- 2.5 Remove the Shear Screw Housing.
- 2.6 Remove the Latch Piston by bumping the bottom end of the Latch Body on a wood surface.

Section III: MDHDS with T2P and ERS Deployment Procedure

Note: The following procedures describe a generic MDHDS deployment with the T2P probe.
Assumptions: a) the MFTM, ERS, MDHDS, and T2P are already assembled and bench tested, b) the MDHDS is already latched when picked up.

1.0 Prepare Logging Line

- 1.1 Connect MFTM/ERS subassembly to logging line and test.
- 1.2 Hang MFTM/ERS subassembly off at rig floor.

2.0 Prepare MDHDS

- 2.1 Lay out MDHDS on rig floor (similar to a standard core barrel).
- 2.2 Remove Flapper Guide Tube.
- 2.3 Install Inner Barrel Locking Clamp (if not installed).

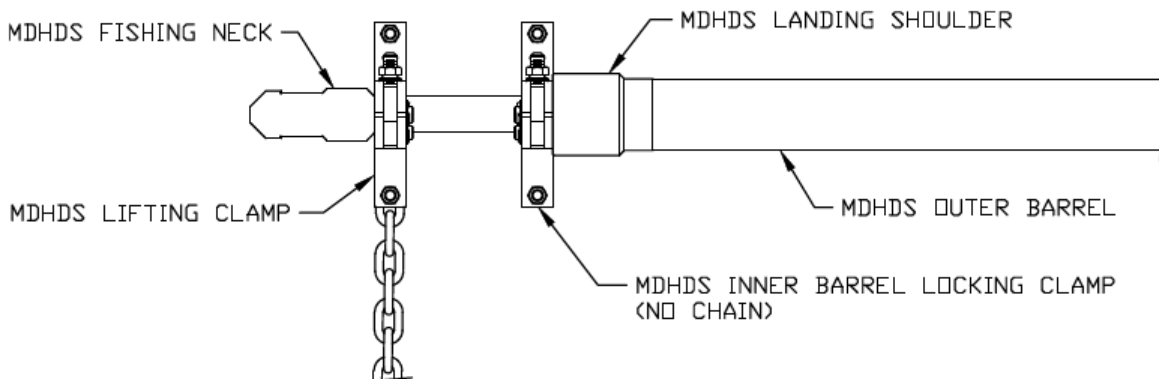


FIGURE 26: CLAMP INSTALLATION

- 2.4 Install MDHDS Lifting Clamp below Inner Barrel fishing neck (if not installed).

3.0 Attach T2P to MDHDS

- 3.1 Make up T2P to MDHDS via T2P Quick Release.
- 3.2 Install Piston Ring (4 segments) on Piston Head.

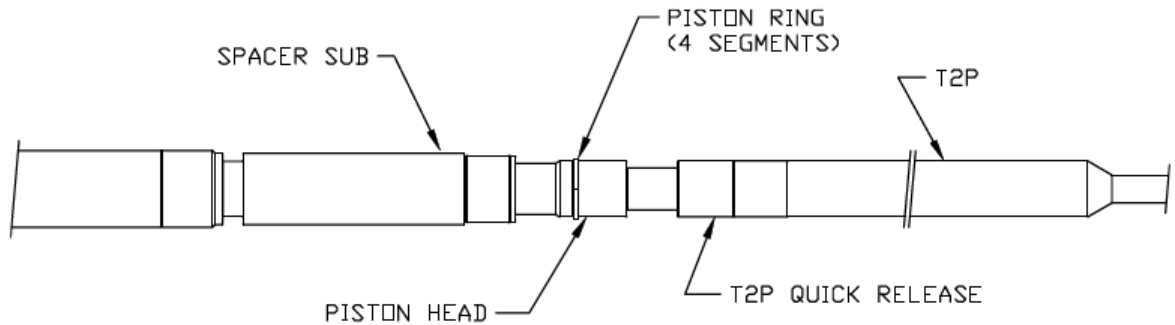


FIGURE 27: T2P INSTALLATION

- 3.3 Remove T2P probe tip water housing prior to installing flapper tube.
- 3.4 Slide Flapper Guide Tube over T2P and make up to Spacer Sub.

Note: To prevent damage to the probe tip, do not allow the Flapper Guide Tube to rest on the probe.

4.0 Attach MFTM/ERS to MDHDS

- 4.1 Using a tugger and MDHDS Lifting Clamp, pick up MDHDS/T2P.
- 4.2 Lower MDHDS/T2P into drill pipe, landing on drill pipe.
- 4.3 Remove tugger.
- 4.4 Stab MFTM/ERS subassembly through heave compensator yoke and top drive.
- 4.5 Lower ERS and latch onto MDHDS fishing neck.
- 4.6 Using logging line, raise MDHDS assembly and remove MDHDS Lifting Clamp and Locking Clamp.

5.0 Run-In-the-Hole

- 5.1 Lower MDHDS assembly down drill string to 1/3 water depth.

- 5.2 Hold for one minute for hydrostatic pressure check.
- Note: Disengage pump and do not rotate drill string during hydrostatic pressure check.
- 5.3 Lower MDHDS to 2/3 water depth.
- 5.4 Hold for one minute for hydrostatic pressure check.
- Note: Disengage pump and do not rotate drill string during hydrostatic pressure check.
- 5.5 Lower MDHDS to mud line.
- 5.6 Hold for one minute for hydrostatic pressure check.
- Note: Disengage pump and do not rotate drill string during hydrostatic pressure check.
- 5.7 Position bit 1.5 m off hole bottom.
- 5.8 Disengage pump and stop rotation of drill string.
- 5.9 Land MDHDS assembly in BHA.
- 5.10 Activate ERS to open, releasing it from MDHDS fishing neck.
- 5.11 Raise ERS 3 m above MDHDS fishing neck.
- 6.0 Insert Probe Into Formation
- 6.1 Close wireline BOP.
- 6.2 Engage pump, pressure drill string 1,000 psi to 1,200 psi and hold for one minute.
- Note: Reference "Appendix D: Drill String Pressure During MDHDS Unlatch Plot" for typical drill string pressure vs. pump strokes vs. latch movement responses.
- 6.3 Bleed off all drill string pressure at rig floor manifold, wait one minute for stand pipe pressure to drop to 5 or 6 psi.
- 6.4 Close manifold bleed valve and engage pump.
- 6.5 Pump into drill string at ~10 spm until circulation is established, or a maximum pressure of 1,400 psi is reached.
- Note: 1,400 psi equates to an 10,000 lb load on the T2P tip.
- 6.6 Raise bit 2 m, to the +/- 2 m heave compensating position, while pumping.
- Note At this point, the Outer Barrel Subassembly, which is landed in the BHA, is free to move up and down 2 m, relative to the Inner Rod Subassembly and the hole bottom, without encountering any stops.

- 6.7 Wait 20 to 30 minutes, or at the discretion of the scientists, to collect data, while circulating at ~10 spm.

Note: Do not rotate the drill string while data are collected. Scientist may request that circulation be stopped during data collection, because circulation pressures the bottom of the borehole, impacting the pressure measurements.

7.0 Retrieve MDHDS

- 7.1 Activate ERS to close it.
- 7.2 Lower ERS and latch onto MDHDS fishing neck.
- 7.3 Disengage pump.
- 7.4 Raise logging line, taking weight of the entire MDHDS (~900 lb).
- 7.5 Establish circulation and rotation of the drill string after MDHDS clears the seal bore drill collar.

8.0 Recover MDHDS

- 8.1 Raise MDHDS to mud line.
- 8.2 Hold for one minute for hydrostatic pressure check.
- Note: Disengage pump and do not rotate drill string during hydrostatic pressure check.
- 8.3 Raise MDHDS to ~2/3 water depth.
- 8.4 Hold for one minute for hydrostatic pressure check.
- Note: Disengage pump and do not rotate drill string during hydrostatic pressure check.
- 8.5 Raise MDHDS to ~1/3 water depth.
- 8.6 Hold for one minute for hydrostatic pressure check.
- Note: Disengage pump and do not rotate drill string during hydrostatic pressure check.
- 8.7 Pull out of hole with MDHDS to rig floor.
- 8.8 Break drill string.

- 8.9 Install MDHDS Inner Barrel Locking Clamp on inner barrel immediately above outer barrel landing shoulder.

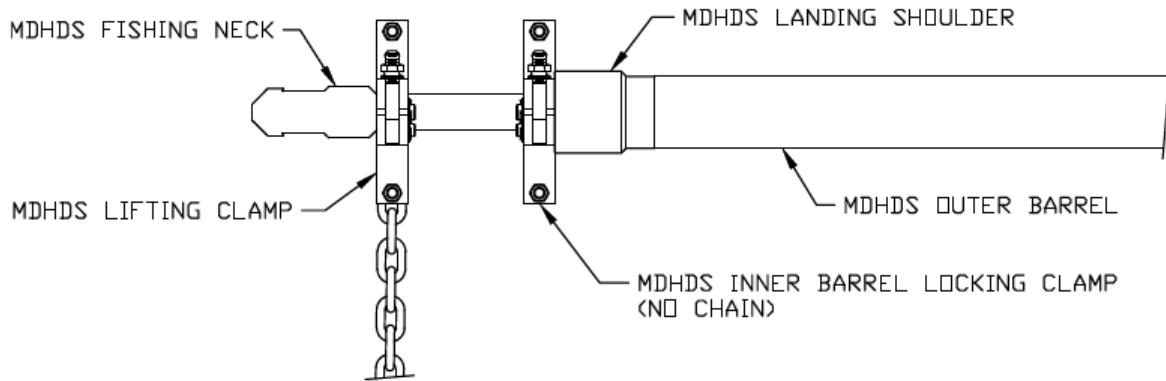


FIGURE 28: CLAMP INSTALLATION

- 8.10 Install MDHDS Lifting Clamp on MDHDS Inner Barrel immediately below fishing neck.
- 8.11 Land MDHDS on drill pipe.
- 8.12 Manually open ERS and release from MDHDS fishing neck.
- 8.13 Remove MFTM/ERS from drill string and hang off at rig floor.
- 8.14 Using a tugger and MDHDS lifting clamp, pull MDHDS out of drill pipe and lay out (similar to a standard core barrel).
- 8.15 Remove Flapper Guide Tube.

Note: To prevent damage to the probe tip, keep the flapper guide tube level with the probe while removing it. Do not allow the flapper guide tube to rest on the probe.

- 8.16 Install water housing on probe tip.
- 8.17 Break T2P Quick Release.
- 8.18 Give T2P to technicians for data down load.

9.0 Reset MDHDS Latch

- 9.1 Remove MDHDS Locking Clamp.
- 9.2 Pull Inner Barrel Subassembly out bottom of MDHDS ~6 in (15 cm).
- 9.3 Place J-Hook Gauge on Inner Barrel Subassembly between Piston Head and Female Big Bore Quick Release.

- 9.4 Push Inner Barrel Subassembly into MDHDS until Piston Head shoulders on J-Hook Gauge and J-Hook Gauge shoulders on Female Big Bore Quick Release.

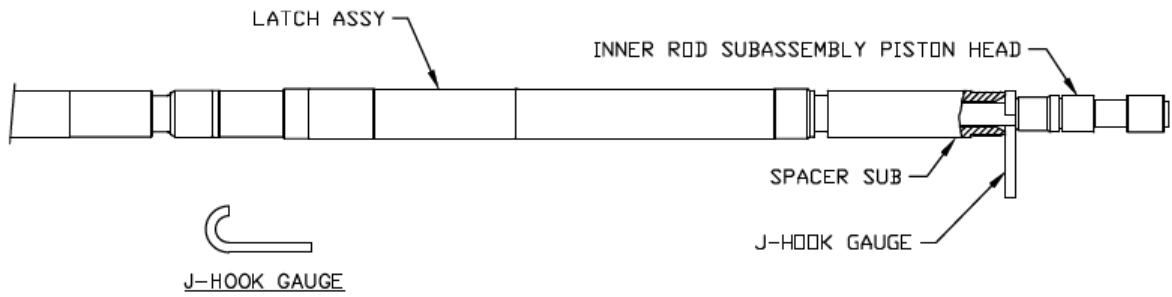


FIGURE 29: J-HOOK GAUGE INSTALLATION

- 9.5 Install Spring Compression Tool.

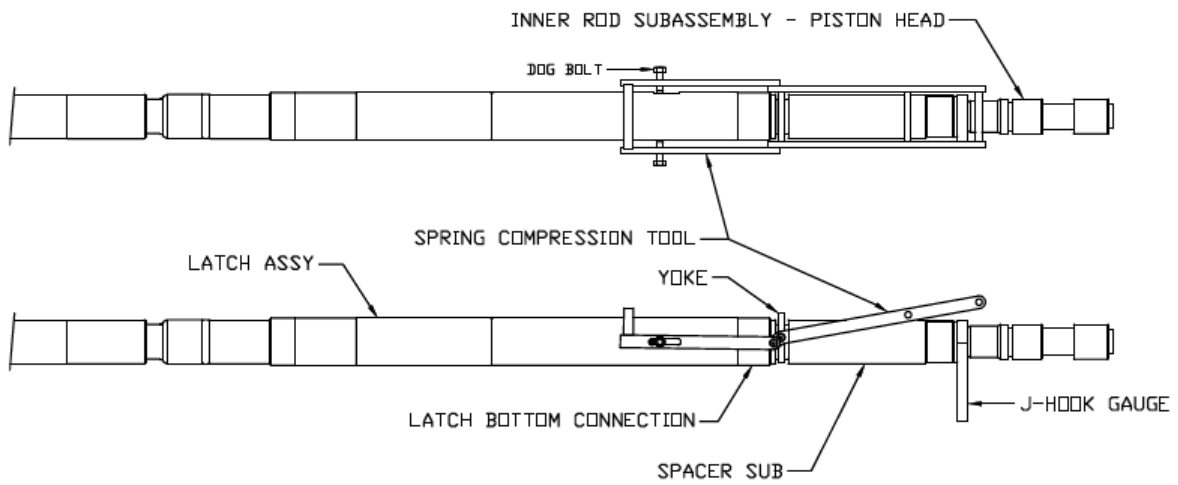


FIGURE 30: SPRING COMPRESSION TOOL INSTALLATION

9.6 Compress Latch Piston Spring.

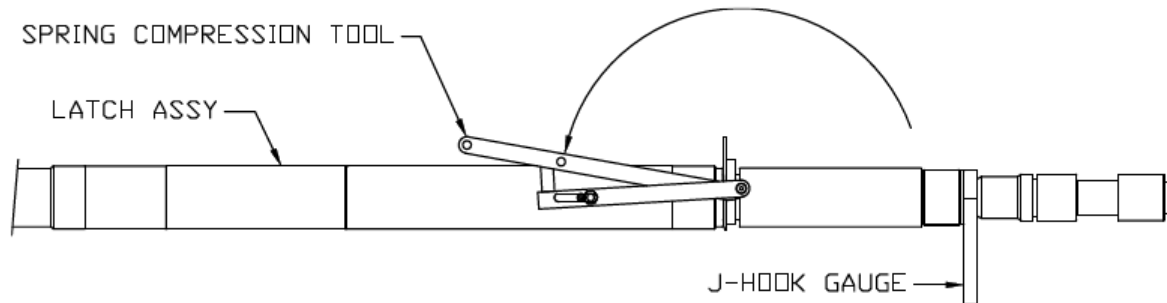


FIGURE 31: LATCH PISTON SPRING COMPRESSION

Note: **DO NOT FORCE THE SPRING COMPRESSION TOOL HANDLE** while rotating it to compress the latch spring. **If ANY resistance is felt, STOP.** Remove the J-Hook Gauge and using a plastic sledge hammer, bump the inner rod subassembly further into the outer barrel subassembly slowly, aligning the latch rod dog groove with the latch dogs, until the spring compression tool handle can be easily rotated. When the spring compression tool handle is pivoted, the piston is pulled over top of the latch dogs. The latch rod latch dog groove must be aligned with the latch dogs so as they can drop down into the groove, allowing the piston to pass over.

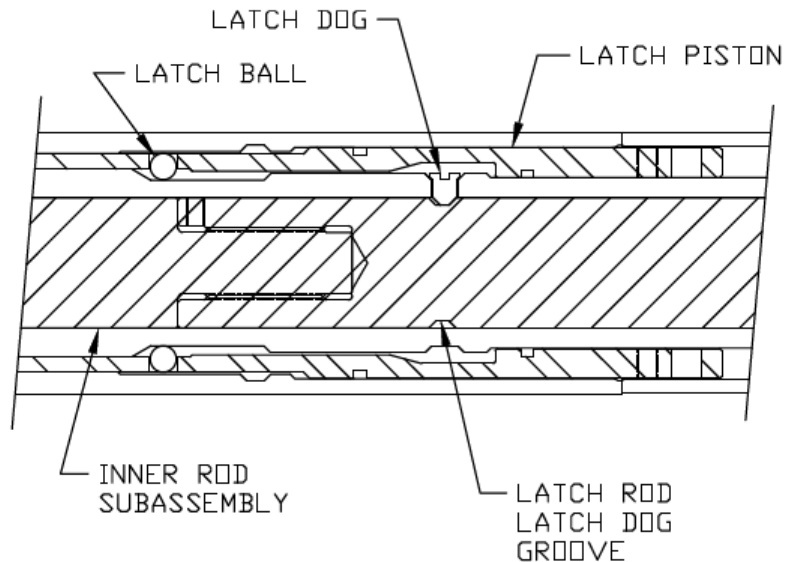


FIGURE 32: LATCH DOG POSITIONING DURING SETTING

- 9.7 Remove J-Hook Gauge from Inner Barrel Subassembly.
- 9.8 Push Inner Barrel Subassembly into MDHDS until Piston Head shoulders on Female Big Bore Quick Release.
- 9.9 Remove shear screw nubbin's from Shear Screw Body by backing out.

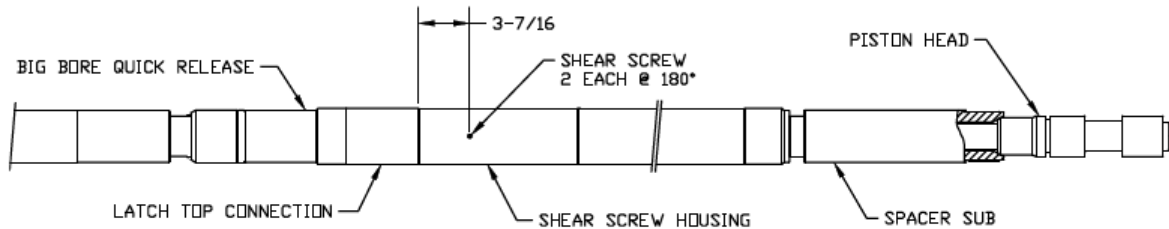


FIGURE 33: POSITIONING LATCH ROD WITH LATCH DOGS

- 9.10 Install 2 each Shear Screws (1/2 – 20UNC x 1/2 long brass set screws).

Note: The sheared part of the shear screw remaining inside the MDHDS may be positioned directly below the shear screw hole. If this is the case, use a small punch and hammer to move the shear screw nubbin's out from under the shear screw hole. The sheared portion of the shear screws remain trapped in the Shear Screw Head shear screw groove and thus do not need to be removed after each deployment.

- 9.11 Remove Spring Compression Tool.
- 9.12 Install Flapper Guide Tube.
- 9.13 Install Inner Barrel Locking Clamp.
- 9.14 Place MDHDS in working shuck.

Section IV: MDHDS System with SET(P) Deployment Procedure

Note: The following procedures describe a generic MDHDS deployment with the SET(P) probe.
Assumptions: a) the MFTM, ERS, MDHDS, and SET(P) are already assembled and bench tested,
b) the MDHDS is already latched when picked up.

1.0 Prepare Logging Line

- 1.1 Connect MFTM/ERS subassembly to logging line and test.
- 1.2 Hang MFTM/ERS subassembly off at rig floor.

2.0 Prepare MDHDS

- 2.1 Lay out MDHDS on rig floor (similar to a standard core barrel).
- 2.2 Remove Flapper Guide Tube.
- 2.3 Install Thread Protector Set 172969-402 in place of the Flapper Guide tube.
- 2.4 Install Inner Barrel Locking Clamp (if not installed).

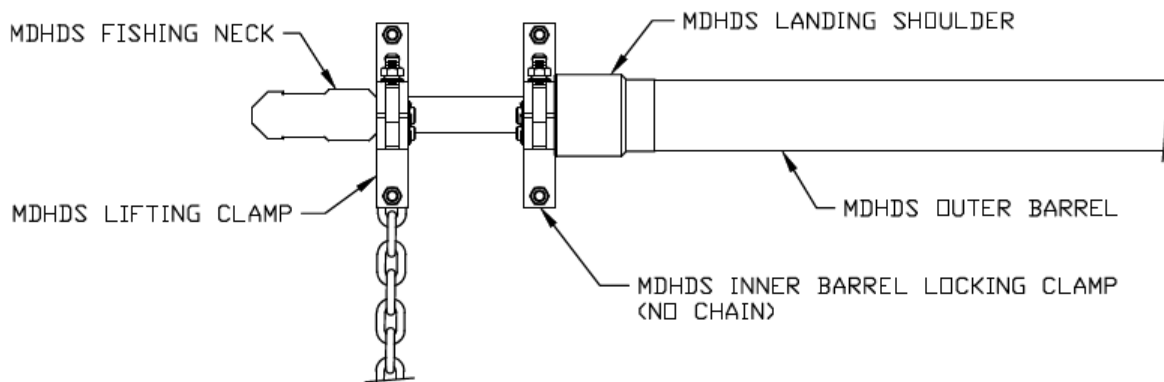


FIGURE 34: CLAMP INSTALLATION

- 2.5 Install MDHDS Lifting Clamp below Inner Barrel fishing neck (if not installed).

3.0 Load SET(P) in drill pipe

- 3.1 Attach core barrel clamp to SET(P).
- 3.2 Pick up SET(P), load in drill string and land on drill pipe.

4.0 Attach MFTM/ERS to MDHDS

- 4.1 Using a tugger and MDHDS Lifting Clamp, pick up MDHDS.
- 4.2 Lower MDHDS and connect to SET(P) via quick release.
- 4.3 Pick up SET(P) and remove core barrel clamp.
- 4.4 Lower MFTM/ERS/SET(P) and land MDHDS lifting clamp on drill pipe.
- 4.5 Stab MFTM/ERS subassembly through heave compensator yoke and top drive.
- 4.6 Lower MFTM/ERS and latch onto MDHDS fishing neck.
- 4.7 Raise MFTM/ERS/MDHDS/SET(P) and remove MDHDS Lifting Clamp and Locking Clamp.

5.0 Run-In-the-Hole

- 5.1 Lower MDHDS assembly down drill string to 1/3 water depth.
- 5.2 Hold for one minute for hydrostatic pressure check.

Note: Disengage pump and do not rotate drill string during hydrostatic pressure check.
- 5.3 Lower MDHDS assembly to 2/3 water depth.
- 5.4 Hold for one minute for hydrostatic pressure check.

Note: Disengage pump and do not rotate drill string during hydrostatic pressure check.
- 5.5 Lower MDHDS assembly to mud line.
- 5.6 Hold for one minute for hydrostatic pressure check.

Note: Disengage pump and do not rotate drill string during hydrostatic pressure check.
- 5.7 Position bit 1.5 m off hole bottom.
- 5.8 Disengage pump, do not rotate drill string.
- 5.9 Land MDHDS assembly in BHA.
- 5.10 Activate ERS to open, releasing it from MDHDS fishing neck.
- 5.11 Raise ERS 3 m above MDHDS fishing neck.

6.0 Insert Probe Into Formation

- 6.1 Close wireline BOP.

- 6.2 Engage pump, pressure drill string 2,000 psi to 2,500 psi and hold for one minute.
- Note: Reference "Appendix D: Drill String Pressure During MDHDS Unlatch Plot" for typical drill string pressure vs. pump strokes vs. latch movement responses.
- 6.3 Bleed off all drill string pressure at rig floor manifold, wait until stand pipe pressure drops to 5 or 6 psi.
- 6.5 Close manifold bleed valve and pump into drill string at ~10 spm until circulation is established, or a maximum pressure of 1,600 psi is reached.
- Note: 2,000 psi equates to a 5,000 lb load on the SET(P).
- 6.6 Raise bit 2 m while continuing to circulate.
- 6.7 Wait 20 to 30 minutes, or at the discretion of the scientists, to collect data, while circulating at ~10 spm.
- Note: Do not rotate the drill string while data are collected. Scientist may request that circulation be stopped during data collection, because circulation pressures the bottom of the borehole, impacting the pressure measurements.

7.0 Retrieve MDHDS Assembly

- 7.1 Activate ERS to close it.
- 7.2 Lower ERS and latch onto MDHDS fishing neck.
- 7.3 Increase circulation rate to 20 spm for 1 min.
- 7.4 Disengage pump.
- 7.5 Raise logging line, taking weight of the entire MDHDS assembly (~900 lb).
- 7.6 Establish circulation and drill string rotation after MDHDS clears the seal bore drill collar.

8.0 Recover MDHDS Assembly

- 8.1 Raise MDHDS assembly to mud line.
- 8.2 Hold for one minute for hydrostatic pressure check.
- Note: Disengage pump and do not rotate drill string during hydrostatic pressure check.
- 8.3 Raise MDHDS assembly to ~2/3 water depth.
- 8.4 Hold for one minute for hydrostatic pressure check.
- Note: Disengage pump and do not rotate drill string during hydrostatic pressure check.
- 8.5 Raise MDHDS assembly to ~1/3 water depth.

8.6 Hold for one minute for hydrostatic pressure check.

Note: Disengage pump and do not rotate drill string during hydrostatic pressure check.

8.7 Pull out of hole with MDHDS assembly to rig floor.

8.8 Break drill string.

8.9 Install MDHDS Inner Barrel Locking Clamp on inner barrel immediately above outer barrel landing shoulder.

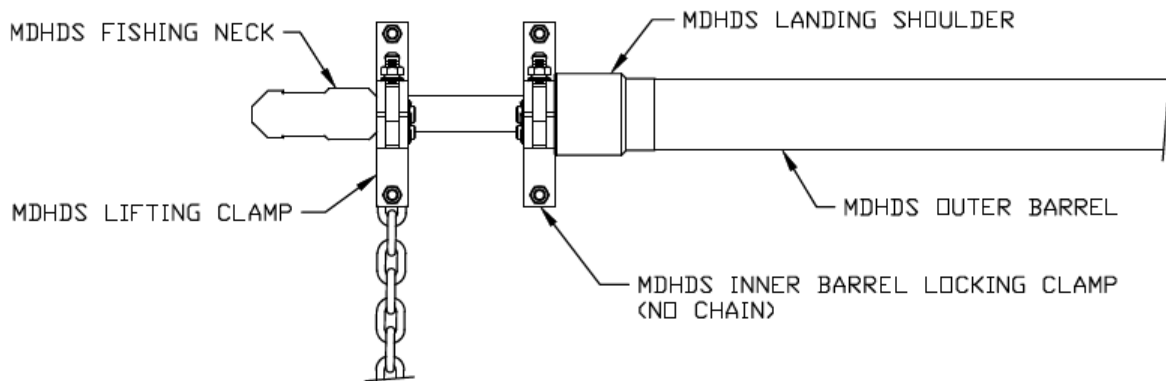


FIGURE 35: CLAMP INSTALLATION

8.10 Install MDHDS Lifting Clamp on MDHDS Inner Barrel immediately below fishing neck.

8.11 Land MDHDS assembly on drill pipe.

8.12 Manually open ERS and release from MDHDS fishing neck.

8.13 Remove MFTM/ERS from drill string and hang off at rig floor.

8.14 Using a tugger and MDHDS lifting clamp, raise MDHDS assembly to SET(P).

8.15 Install core barrel clamp on SET(P)

8.16 Land SET(P) on drill pipe.

8.17 Break SET(P) quick release.

8.18 Lay out MDHDS on rig floor (similar to a standard core barrel).

8.19 Lay out SET(P).

9.0 Reset MDHDS Latch

9.1 Remove MDHDS Locking Clamp.

- 9.2 Pull Inner Barrel Subassembly out bottom of MDHDS 6 in (15 cm).
- 9.3 Place J-Hook Gauge on Inner Barrel Subassembly between Piston Head and Female Big Bore Quick Release.
- 9.4 Push Inner Barrel Subassembly into MDHDS until Piston Head shoulders on J-Hook Gauge and J-Hook Gauge shoulders on Female Big Bore Quick Release.

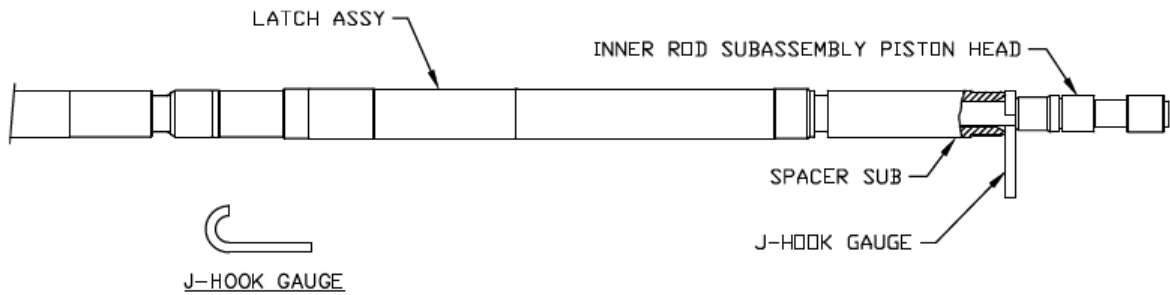


FIGURE 36: J-HOOK GAUGE INSTALLATION

- 9.5 Install Spring Compression Tool.

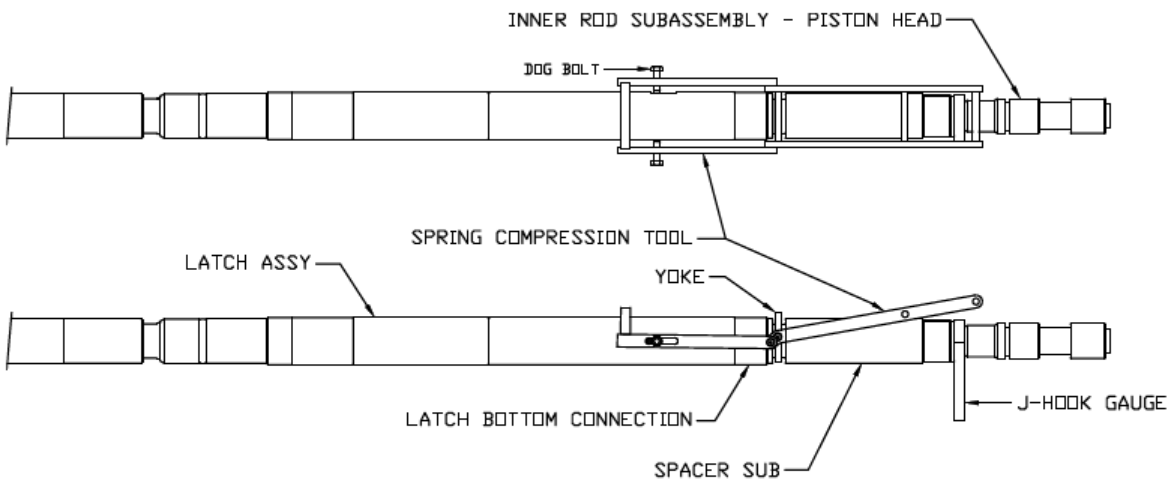


FIGURE 37: SPRING COMPRESSION TOOL INSTALLATION

9.6 Compress Latch Piston Spring.

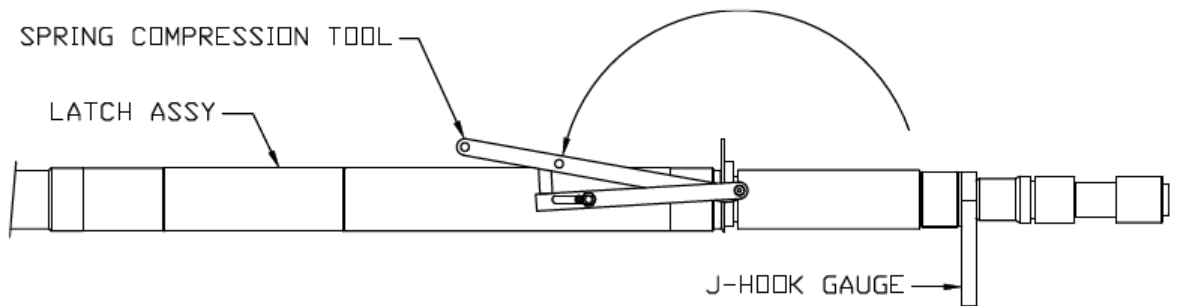


FIGURE 38: LATCH PISTON SPRING COMPRESSION

Note: **DO NOT FORCE THE SPRING COMPRESSION TOOL HANDLE** while rotating it to compress the latch spring. **If ANY resistance is felt, STOP.** Remove the J-Hook Gauge and using a plastic sledge hammer, bump the inner rod subassembly further into the outer barrel subassembly slowly, aligning the latch rod dog groove with the latch dogs, until the spring compression tool handle can be easily rotated. When the spring compression tool handle is pivoted, the piston is pulled over top of the latch dogs. The latch rod latch dog groove must be aligned with the latch dogs so as they can drop down into the groove, allowing the piston to pass over.

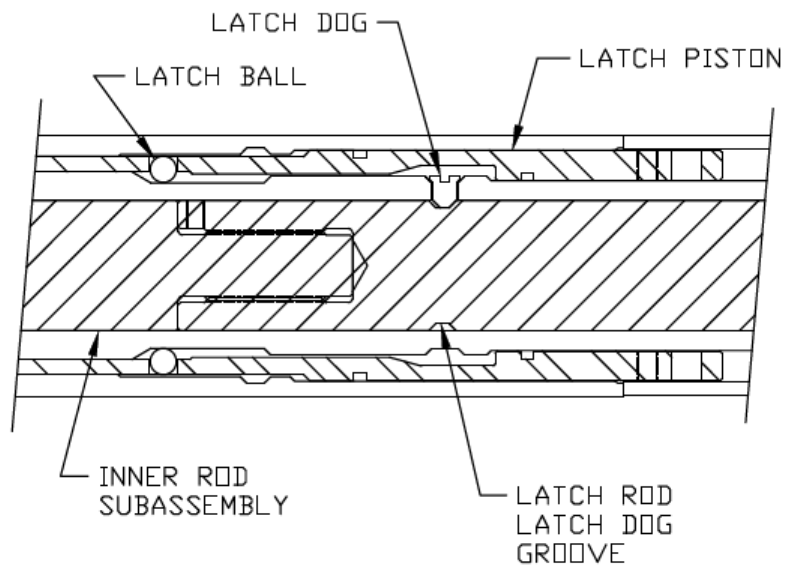


FIGURE 39: LATCH DOG POSITIONING DURING SETTING

- 9.7 Remove J-Hook Gauge from Inner Barrel Subassembly.
- 9.8 Push Inner Barrel Subassembly into MDHDS until Piston Head shoulders on Female Big Bore Quick Release.
- 9.9 Remove shear screw nubbin's from Shear Screw Body by backing out.

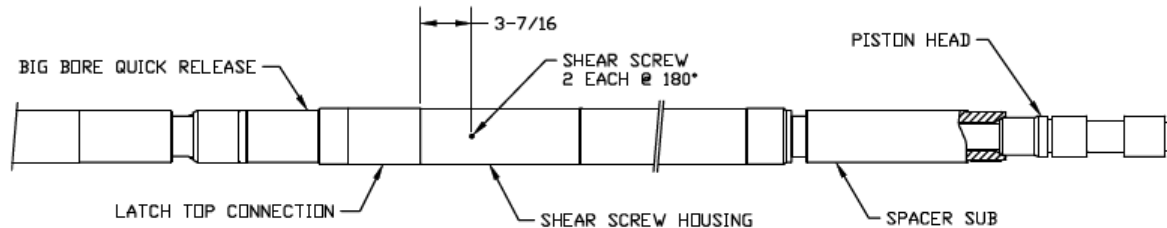


FIGURE 33: POSITIONING LATCH ROD WITH LATCH DOGS

- 9.10 Install 2 each Shear Screws (1/2 – 20UNC x 1/2 long brass set screws).

Note: The sheared part of the shear screw remaining inside the MDHDS may be positioned directly below the shear screw hole. If this is the case, use a small punch and hammer to move the shear screw nubbin's out from under the shear screw hole. The sheared portion of the shear screws remain trapped in the Shear Screw Head shear screw groove and thus do not need to be removed after each deployment.

- 9.11 Remove Spring Compression Tool.
- 9.12 Install Flapper Guide Tube.
- 9.13 Place MDHDS in working shuck.

Section V: MDHDS Deployment on Coring Wireline

1.0 MDHDS Sinker Bar Assembly

- 1.1 Make up 1 ea. GS Cup OT2574, 1 ea. 3" RS Running Tool, and a minimum length of 4.8 m of sinker bar.

Note: The maximum allowable OD of the sinker bar is 2-3/4".

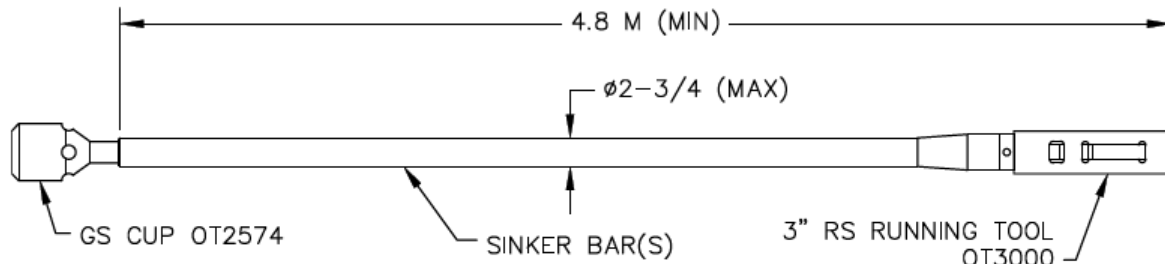


FIGURE 41: RS RUNNING TOOL CONFIGURATION

2.0 MDHDS Sinker Bar Deployment

- 2.1 Make up the MDHDS Sinker Bar Assembly to the coring wireline sinker bar assembly via the GS Cup.
- 2.2 Deploy the MDHDS on the coring wireline the same as described for deploying it on the logging line.
- 2.2 Rather than disconnecting from the MDHDS and picking up 3 m, leave the coring wireline attached to the MDHDS and slack off the coring wireline 3 m.
- 2.3 Recover the MDHDS on the coring wireline the same as described for recovering it on the logging line.

Section VI: Deployment Trouble Shooting

1.0 Probe Stuck in Formation

- 1.1 Lower bit 1 m (2.5 m off bottom).
- 1.2 Circulate at a high rate for 5 min, DO NOT exceed 750 psi over normal circulating pressure.

Note: Monitor logging line tension.

- 1.3 Slow pump to ~10 spm.
- 1.4 Pull maximum allowable with logging line.
- 1.5 If no joy, apply 1,500 to 2,000 lb of tension on logging line and hold.
- 1.6 Pick up drill string, applying a maximum over pull of 30,000 lb, or probe comes free.

Note: If probe comes free, logging line tension should drop off to ~900 lb (the weight of the MDHDS).

- 1.7 If no joy, continue raising the drill string until over pull drops to zero.

Note: If logging line tension drops to ~900 lb, the complete MDHDS should be in the BHA and recoverable with the logging line.

If logging line tension drops to zero, the MDHDS inner barrel has probably parted at one of the retractor tube connections and is lost in the hole, along with the probe.

- 1.8 Recover logging line.
- 1.9 If entire MDHDS is recovered, lay it out and inspect.
- 1.10 If nothing, or just the MDHDS fishing neck is recovered, rig up a 4" GS Pulling Tool on the coring wireline sinker bar.
- 1.11 Run in the hole with the 4" GS and latch onto the MDHDS outer barrel subassembly.

Note: There is a 4" GS profile inside the MDHDS outer barrel landing shoulder at the top of the outer barrel subassembly.

- 1.12 Recover MDHDS on wireline.
- 1.13 If no joy, RIH with fishing spear to catch a 3.0" ID.
- 1.14 Last resort . . . trip the drill string!

2.0 ERS Will Not Relatch

- 2.1 Open and close ERS, be sure it is in closed, "relatch", configuration.

2.2 Circulate at a high rate for 1 min.

Note: Monitor logging line tension, DO NOT pump the MFTM/ERS off the logging line.

2.3 Slow pump to ~10 spm.

2.4 Lower ERS, latch onto MDHDS.

2.5 If no joy, lower bit 1 m (2.5 m off bottom).

2.6 Lower ERS, latch onto MDHDS.

2.7 If no joy, lower the bit 1 m (1.5 m off bottom).

2.8 Lower ERS, latch onto MDHDS.

2.9 If no joy, raise ERS 30 m.

2.10 Circulate at a high rate for 1 min.

Note: Monitor logging line tension, DO NOT pump the MFTM/ERS off the logging line.

2.11 Slow pump to ~10 spm.

2.12 Lower ERS, latch onto MDHDS.

2.13 If no joy, POOH with MFTM/ERS

MDHDS Recovery Option 1

2.14 Rig up a 3" RS Running Tool with 3+ m of small diameter sinker bar on the coring wireline.

Note: The RS running tool and sinker bar must reach down inside the MDHDS outer barrel subassembly, ID = 3.0", ~1.5 m to latch onto the MDHDS fishing neck.

2.15 RIH with 3" RS running tool and latch onto MDHDS and POOH.

2.16 If no joy, rig up 4" GS Pulling Tool to coring wireline.

2.17 RIH with 4" GS pulling tool and latch onto MDHDS outer barrel subassembly.

2.18 POOH with MDHDS.

Note: The MDHDS inner barrel subassembly will be scoped out when recovered.

2.19 Install a standard core barrel clamp under the MDHDS landing shoulder.

2.20 Release the 4" GS pulling tool and lay it and the sinker bar out.

2.21 Using a tugger, pull the MDHDS into the derrick until the first joint in the MDHDS inner barrel below the MDHDS latch subassembly is accessible.

- 2.22 Install an MDHDS lifting clamp on the MDHDS inner barrel below the exposed joint.
- 2.23 Land the MDHDS lifting clamp on the drill pipe.
 - Note: CAUTION, continue to support the outer barrel subassembly with the tugger. Otherwise it will drop down onto the lifting clamp.
- 2.24 Break the exposed inner barrel joint.
- 2.25 Lay out the MDHDS, careful not to damage the inner barrel extending out of the bottom of the outer barrel.
- 2.26 Lay out the inner barrel and probe.

MDHDS Recovery Option 2

- 2.27 Skip running the RS Running Tool and go straight to the GS Pulling Tool.
 - Note: If the MDHDS is recovered using the RS running tool, it will not be necessary to break the inner barrel subassembly at the rig floor during recovery. However, if the ERS could not latch onto the MDHDS fishing neck, the RS running tool may not be able to either.

Appendix A

MDHDS Deployment Space Out Drawings

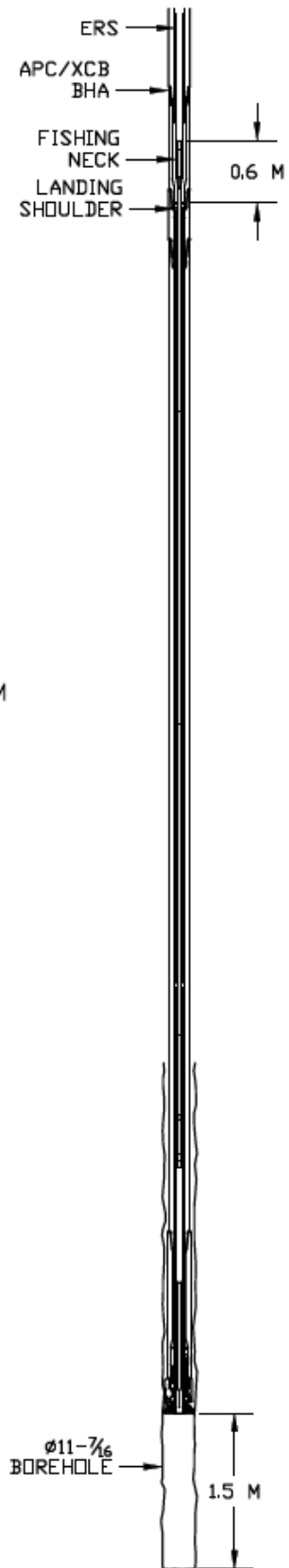


FIGURE 1

MDHDS/T2P LANDED IN BHA

BHA POSITIONED 1.5 M OFF BOTTOM

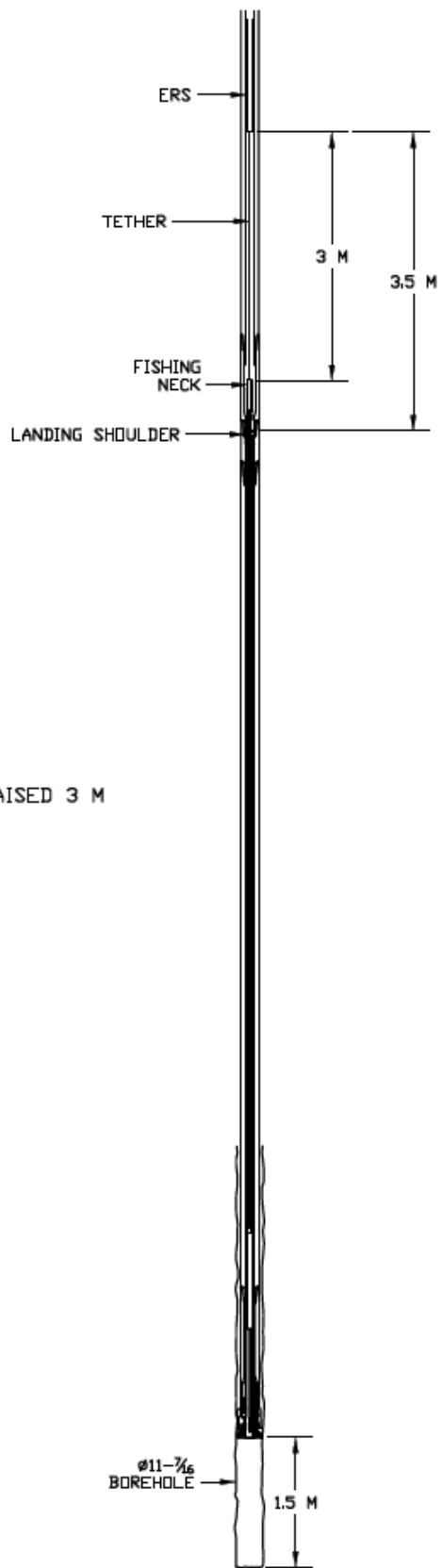


FIGURE 2
ERS RELEASED AND RAISED 3 M

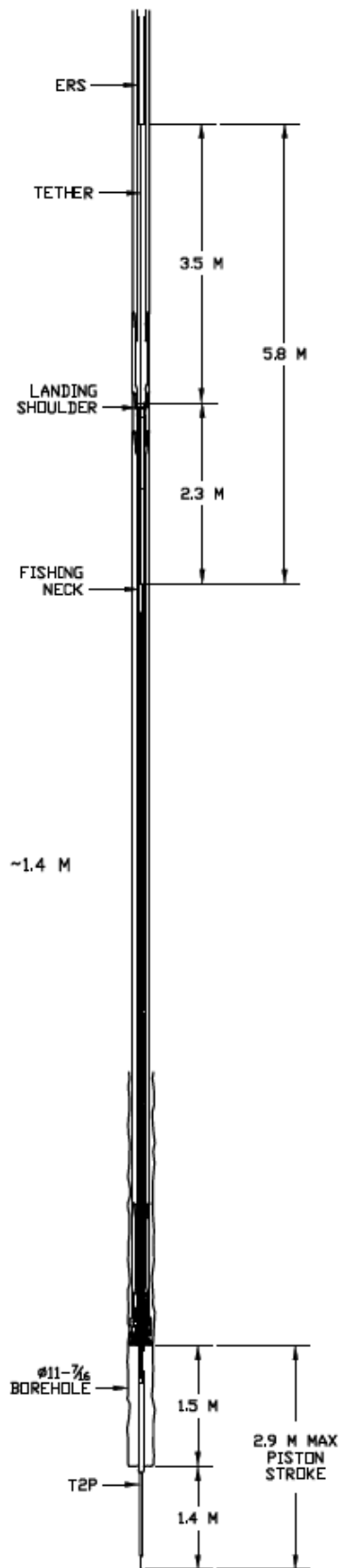


FIGURE 3
 MDHDS LATCH RELEASED
 T2P PUMPED INTO FORMATION
 MAXIMUM PISTON STROKE = 2.9 M
 T2P MAXIMUM PENETRATION INTO FORMATION ~1.4 M

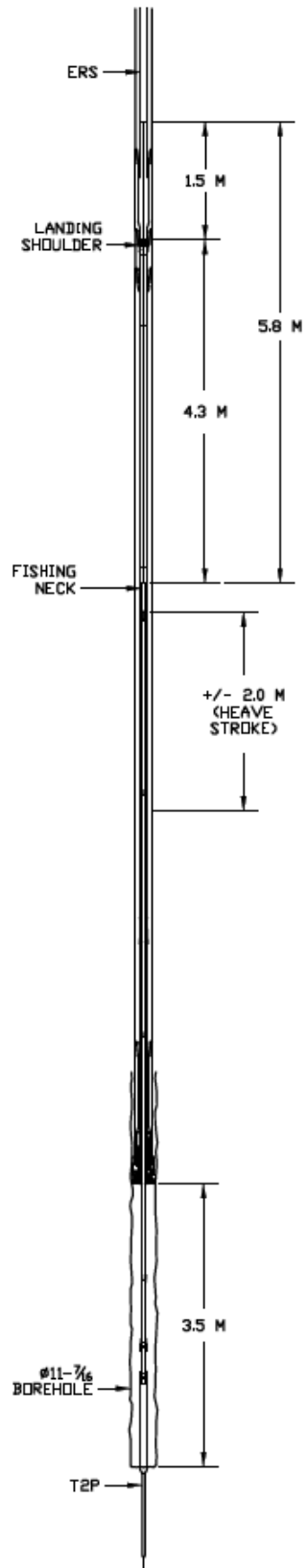


FIGURE 4
 BHA RAISED 2 M, TO +/- 2 M HEAVE
 COMPENSATION MID-STROKE POSITION
 BIT 3.5 M TOTAL OFF HOLE BOTTOM

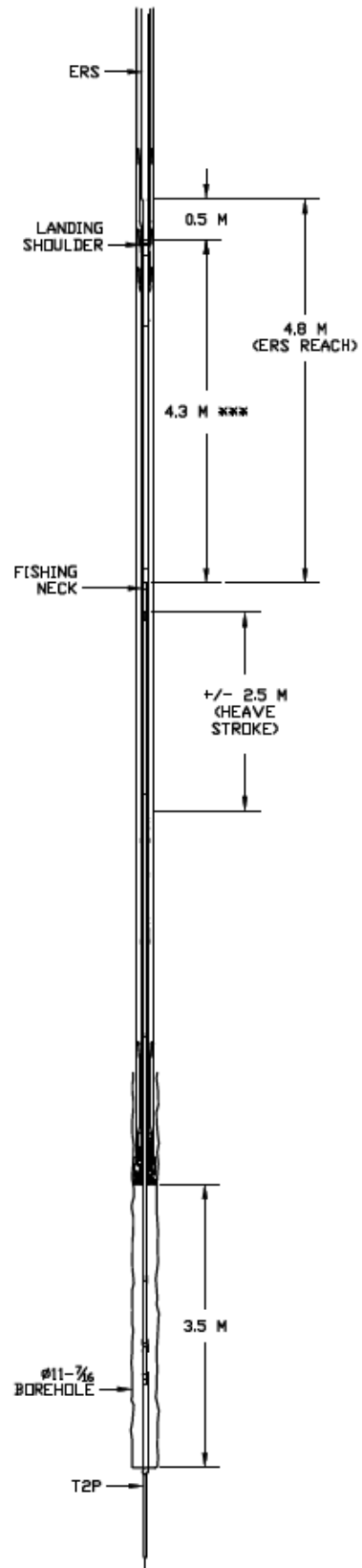


FIGURE 5

ERS LOWERED 5.8 M TO LATCH ONTO MDHDS FISHING NECK

ERS REACH = 4.8 M ***

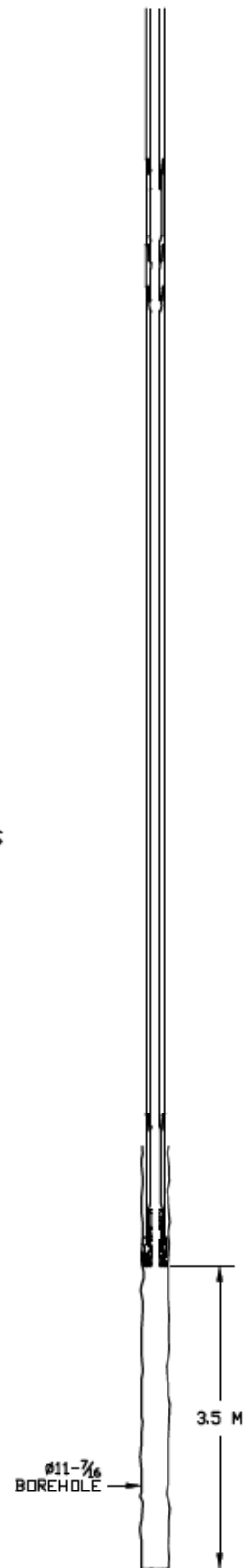
BIT 3.5 M TOTAL OFF HOLE BOTTOM

FIGURE 6

POOH ERS ON LOGGING LINE

ESTABLISH CIRCULATION WHEN MDHDS
CLEARS BHA

BIT 3.5 M TOTAL OFF HOLE BOTTOM



Appendix B

MDHDS Parts List

|

172969-001 MDHDS (172969-000) Parts and Drawings List

Revision: 11 12 October 2012

Item	Qty	Part Number	Description	Notes / Where Used
1	1	OD2141	O-Ring, 2-141, Nitrile, 70 Duro	1 ea Latch Rod 172969-325
2	4	OD2142	O-Ring, 2-142, Nitrile, 70 Duro	2x 2 ea Male Big Bore Q/R 172969-102
3	1	OD2222	O-Ring, 2-222, Nitrile, 70 Duro	1 ea Dog Body 172960-310
4	1	OD22229	O-Ring, 2-229, Nitrile, 70 Duro	1 ea Latch Shear Screw Head 172969-205
5	1	OD22230	O-Ring, 2-230, Nitrile, 70 Duro	1 ea Latch Piston 172969-207
6	3	OD22232	O-Ring, 2-232, Nitrile, 70 Duro	1 ea Latch Shear Screw Head 172969-205 2 ea Latch Piston 172969-207
7	1	OD22233	O-Ring, 2-233, Nitrile, 70 Duro	1 ea Latch Top Connection 172969-201
8	1	OD22234	O-Ring, 2-234, Nitrile, 70 Duro	1 ea Latch Piston 172969-207
9	1	OD22235	O-Ring, 2-235, Nitrile, 70 Duro	1 ea Latch Body 172969-203
10	9	OD6060	Set Screw, 1/4-20 UNC x 1/4 lg, SS	1 ea Latch Shear Screw Housing 172969-202 2 ea Latch Body 172969-203 1 ea Latch Shear Screw Head 172969-205 3 ea Inner Rod Subassembly 172969-324
11	6	OD6061	Set Screw, 1/4-20 UNC x 3/8 lg, SS	1 ea Latch Bottom Connection 172969-204 1 ea Outer Barrel Cross Over Sub 172969-307 1 ea Piston Head 172969-311 3 ea Inner Rod Subassembly 172969-324 2 ea Latch Assembly 172969-200
12	2	OD6063	Set Screw, 1/4-20 UNC x 1/2 lg, Brass	1 ea Quick Release Nut 172969-104
13	2	OD6775	Set Screw, 3/8-16 UNC x 3/8 lg, SS	6 ea Latch Assembly 172969-200 (MC# 9529K19)
14	6	OD7216	Ball Bearing, 3/8 Dia, SS	2 ea Latch Assembly 172969-200
15	2	----	Low Hd Soc Hd Cap Screw, 5/16 -18 UNC x 3/8 lg	
16	----	172969-000	MDHDS Assembly	
17	----	172969-001	Parts List, MDHDS Assembly	MDHDS Assembly 172969-000
18	----	172969-100	Quick Release Assembly, MDHDS Big Bore	2 ea MDHDS Assembly 172969-000
19	1	172969-101	Female Quick Release, MDHDS Big Bore	1 ea Q/R Assy, Big Bore 172969-100
20	1	172969-102	Male Quick Release, MDHDS Big Bore	1 ea Q/R Assy, Big Bore 172969-100
21	2	172969-103	Dog, Quick Release, MDHDS Big Bore	2 ea Q/R Assy, Big Bore 172969-100
22	1	172969-104	Nut, Quick Release, MDHDS Big Bore	1 ea Q/R Assy, Big Bore 172969-100
23	1	172969-105	Spacer Sub, Big Bore Quick Release	1 ea Latch Assembly 172969-200
24	----	172969-200	Latch Assembly, MDHDS	1 ea MDHDS Assembly 172969-000
25	1	172969-201	Top Connection, MDHDS Latch	1 ea Latch Assembly 172969-200
26	1	172969-202	Shear Screw Housing, MDHDS Latch	1 ea Latch Assembly 172969-200
27	1	172969-203	Latch Body, MDHDS Latch	1 ea Latch Assembly 172969-200
28	1	172969-204	Bottom Connection, MDHDS Latch	1 ea Latch Assembly 172969-200

172969-001 MDHDS (172969-000) Parts and Drawings List

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29	1	172969-205	Shear Screw Head, MDHDS Latch	1 ea Latch Assembly 172969-200
30	1	172969-206	Dog Housing, MDHDS Latch	1 ea Latch Assembly 172969-200
31	1	172969-207	Piston, MDHDS Latch	1 ea Latch Assembly 172969-200
32	3	172969-208	Dog, MDHDS Latch	3 ea Latch Assembly 172969-200
33	1	172969-301	Flapper Guide Tube	1 ea MDHDS Assembly 172969-000
34	2	172969-302	Outer Barrel	2 ea MDHDS Assembly 172969-000
35	1	172969-303	Outer Spacer Barrel	1 ea MDHDS Assembly 172969-000
36	----	172969-304	1.75 F-Type Thread	Machining Information
37	1	172969-305	Landing Shoulder	1 ea MDHDS Assembly 172969-000
38	1	172969-307	Outer Barrel Cross Over Sub	1 ea MDHDS Assembly 172969-000
39	1	172969-311	Piston Head	1 ea Inner Rod Subassembly 172969-324
40	1	172969-312	T2P Male Quick Release	1 ea T2P Quick Release Assy 172969-316
41	1	172969-313	T2P Female Quick Release	1 ea T2P Quick Release Assy 172969-316
42	1	172969-314	T2P Quick Release Nut	1 ea T2P Quick Release Assy 172969-316
43	1	172969-315	Piston Ring (4 ea 1/4 sections)	1 ea Inner Rod Subassembly 172969-324
44	----	172969-316	T2P Quick Release Assembly	1 ea Inner Rod Subassembly 172969-324
45	1	172969-320	Sub, Inner Rod	1 ea Inner Rod Subassembly 172969-324
46	2	172969-321	Inner Rod, 10 ft	1 ea Inner Rod Subassembly 172969-324
47	1	172969-322	RS Fishing Neck	1 ea Inner Rod Subassembly 172969-324
48	1	172969-323	Latch Spring	1 ea Latch Assembly 172969-200
49	----	172969-324	Subassembly, Inner Rod	1 ea MDHDS Assembly 172969-000
50	1	172969-325	Latch Rod	1 ea Inner Rod Subassembly 172969-324
51	----	172969-326	Subassembly, Outer Barrel	1 ea Inner Rod Subassembly 172969-324

172969-001 MDHDS (172969-000) Parts and Drawings List

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Ancillaries				
Item	Qty	Part Number	Description	Notes / Where Used
1	----	172969-317	SET(P) Cross Over Sub	1 ea Inner Rod Subassembly 172969-324
2	----	172969-400	Latch Top Test Cap	
3	----	172969-401	Latch Bottom Test Cap	
4	1	172969-402	Thread Protector, SET/SETP	
5	----	172969-403	Assembly, MDHDS Lifting Clamp	
6	1	OD7106	Spring Pin, 1/8 Dia x 3/4 lg, SS	1 ea Assy, Lifting Clamp 172969-403
7	2	OD7171	Cotter Pin, 1/8 Dia x 1 Lg, SS	2 ea Assy, Lifting Clamp 172969-403
8	2	OD7244	Bolt, Hex HD, 9/16 - 12 UNF x 2-1/2 LG	2 ea Assy, Lifting Clamp 172969-403
9	2	OD7246	Lock Nut, Hex, 9-1/6 - 12 UNF	2 ea Assy, Lifting Clamp 172969-403
10	1	OD7305	Flat Washer, Nom 5/8	1 ea Assy, Lifting Clamp 172969-403
11	1	OD7307	Flat Washer, Nom 3/4	1 ea Assy, Lifting Clamp 172969-403
12	1	OP3618	Hinge Pin	1 ea Assy, Lifting Clamp 172969-403
13	1	OP3620	Latch Pin	1 ea Assy, Lifting Clamp 172969-403
14	1	OP3622	Latch Bolt	1 ea Assy, Lifting Clamp 172969-403
15	1	OP3624	Flat Flanged Nut, 5/8 - 11 UNC, S/I	1 ea Assy, Lifting Clamp 172969-403
16	1	OP3626	Lift Chain	1 ea Assy, Lifting Clamp 172969-403
17	1	OP3627	Sling Link	1 ea Assy, Lifting Clamp 172969-403
18	1	172969-404	Clamp Body "A", MDHDS Lifting Clamp	1 ea Assy, Lifting Clamp 172969-403
19	1	172969-405	Clamp Body "B", MDHDS Lifting Clamp	1 ea Assy, Lifting Clamp 172969-403
20	----	172969-406	Top Storage Cap	For storage in shack
21	----	172969-407	Bottom Storage Cap	For storage in shack
22	----	172969-413	Assembly, Spring Compression Tool	1 ea MDHDS Assembly 172969-000
23	4	----	Shoulder Screw, 3/8 Dia x 1/4 lg x 5/16 - 18 UNC	4 ea Assy, Spring Compression Tool 172969-413 (MC# 91259A615)
24	2	172969-408	Spring Comp Tool Link	2 ea Assy, Spring Comp Tool 172969-413
25	2	172969-409	Spring Comp Tool Arm	2 ea Assy, Spring Comp Tool 172969-413
26	1	172969-410	Spring Comp Tool Cleat	1 ea Assy, Spring Comp Tool 172969-413
27	2	172969-411	Spring Comp Tool Handle	2 ea Assy, Spring Comp Tool 172969-413
28	1	172969-412	Weldment, Spring Comp Tool Handle	1 ea Assy, Spring Comp Tool 172969-413
29	1	172969-415	Brace	1 ea Link Weldment 172969-416
30	1	172969-416	Link Weldment	1 ea Assy, Spring Comp Tool 172969-413
31	2	172969-417	Dog Bolt	2 ea Assy, Spring Comp Tool 172969-413
32	----	172969-414	Reset J-Hook Gauge	Service Tool

172969-001 MDHDS (172969-000) Parts and Drawings List

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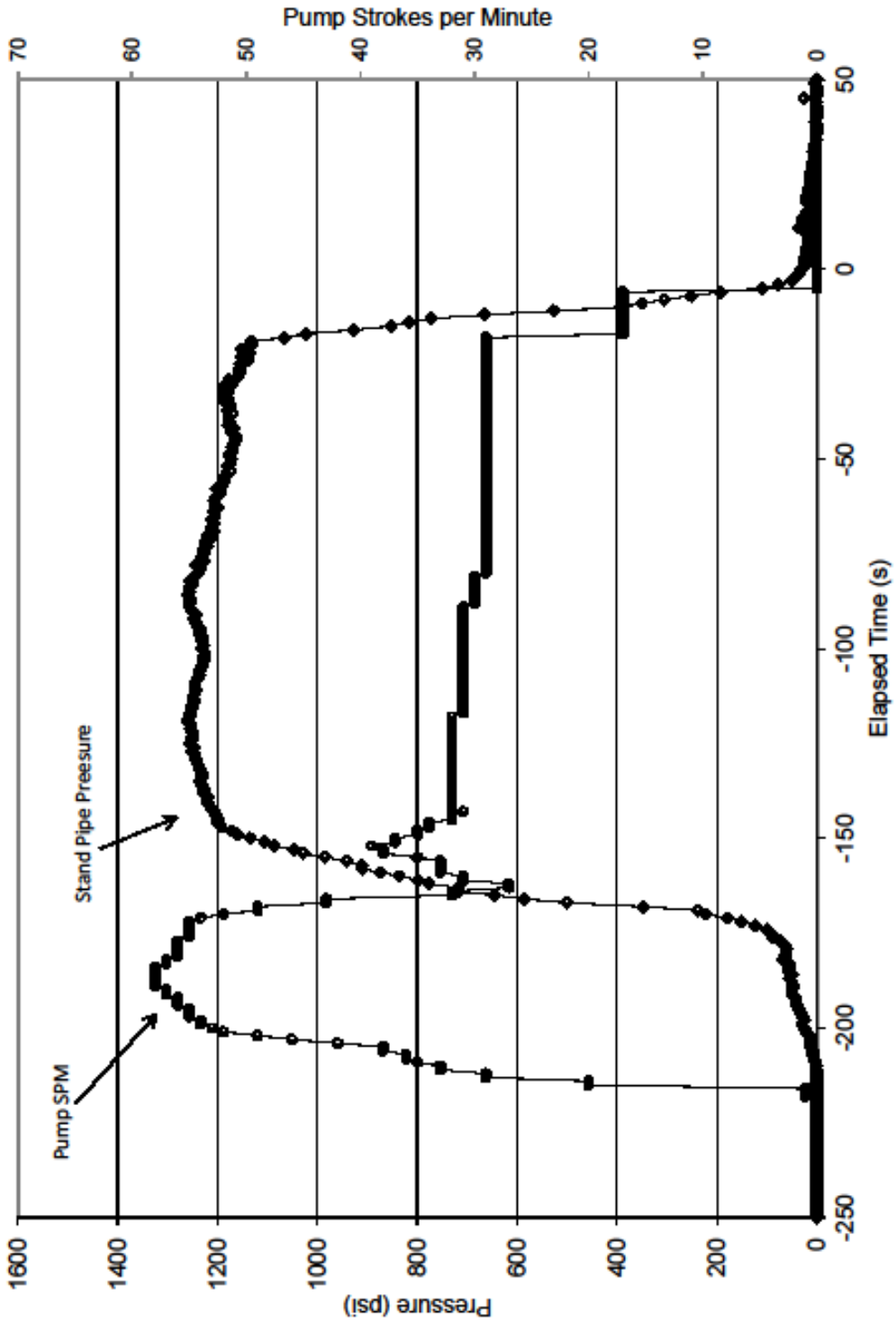
33	----	172969-418	Locking Clamp Assembly	1 ea MDHDS Assembly 172969-000
34	1	OD7106	Spring Pin, 1/8 Dia x 3/4 lg, SS	1 ea Assy, Locking Clamp Assy 172969-418
35	2	OD7171	Cotter Pin, 1/8 Dia x 1 Lg, SS	2 ea Assy, Locking Clamp Assy 172969-418
36	1	OD7305	Flat Washer, Norm 5/8	1 ea Assy, Locking Clamp Assy 172969-418
37	1	OD7307	Flat Washer, Norm 3/4	1 ea Assy, Locking Clamp Assy 172969-418
38	1	OP3618	Hinge Pin	1 ea Assy, Locking Clamp Assy 172969-418
39	1	OP3620	Latch Pin	1 ea Assy, Locking Clamp Assy 172969-418
40	1	OP3622	Latch Bolt	1 ea Assy, Locking Clamp Assy 172969-418
41	1	OP3624	Flat Flanged Nut, 5/8 - 11 UNC, Stl	1 ea Assy, Locking Clamp Assy 172969-418
42	1	172969-404	Clamp Body "A", MDHDS Lifting Clamp	1 ea Assy, Locking Clamp Assy 172969-418
43	1	172969-405	Clamp Body "B", MDHDS Lifting Clamp	1 ea Assy, Locking Clamp Assy 172969-418
44	----	172969-419	Thread Protector, Box, Inner Barrel	Service Tool
45	----	172969-420	Thread Protector, Pin, Inner Barrel	Service Tool
46	1	172969-421	Spacer, Spring Compression Tool	1 ea Assy, Spring Comp Tool 172969-413
47	1	----	Bolt, Hex HD, 3/8 - 16 UNC x 1 LG	Assembly and handling aid

Appendix C
MDHDS Drawings

(see electronic files)

Appendix D

Drill String Pressure During MDHDS Unlatch Plot



DRILL STRING PRESSURE DURING MDHDS UNLATCH PLOT

The plot shows the pump strokes versus drill string pressure during unlocking of the MDHDS latch. Initially, the pump is brought on line and as the drill string pressure begins to increase sharply, the pump strokes are reduced. At this point in the unlocking process, the drill string pressure is increased to ~1,200 psi and held. The MDHDS does not completely blank off the drill string. Thus, some pumping may be required to maintain the drill string pressure for a dwell time of 1 min to 2 min. During this dwell period, the MDHDS shear screw head shears the shear screws and is pumped down relative to the latch. This action UNLOCKS the latch. However, the drill string pressure prevents the MDHDS piston from moving upward and unlatching the MDHDS inner rod subassembly. After the dwell period, the pump is shut off and the drill string pressure is bled off at the rig floor. Note, leave the rig floor bleed off valve open until ALL pressure is bled off and the stand pipe is drained. Once the drill string pressure has been bled off, the piston spring will push the piston up, unlatching the inner rod subassembly. When the pump is engaged once again, the inner rod assembly will be pumped out of the outer barrel subassembly and into the formation.

Appendix E

MDHDS Suggested Spare Parts List

The following parts list is of suggested spare parts to accompany the MDHDS for deployment at sea. It is also suggested that a minimum of two complete MDHDS assemblies be sent for deployment at sea.

MDHDS Suggested Spares Parts List

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Item	Qty	Part Number	Description	Notes / Where Used
1	25	OD2141	O-Ring, 2-141, Nitrile, 70 Duro	1 ea Latch Rod 172969-325
2	25	OD2142	O-Ring, 2-142, Nitrile, 70 Duro	2x 2 ea Male Big Bore Q/R 172969-102
3	25	OD2222	O-Ring, 2-222, Nitrile, 70 Duro	1 ea Dog Body 172960-310
4	25	OD22229	O-Ring, 2-229, Nitrile, 70 Duro	1 ea Latch Shear Screw Head 172969-205
5	25	OD22230	O-Ring, 2-230, Nitrile, 70 Duro	1 ea Latch Piston 172969-207
6	75	OD22232	O-Ring, 2-232, Nitrile, 70 Duro	1 ea Latch Shear Screw Head 172969-205 2 ea Latch Piston 172969-207
7	25	OD22233	O-Ring, 2-233, Nitrile, 70 Duro	1 ea Latch Top Connection 172969-201
8	25	OD22234	O-Ring, 2-234, Nitrile, 70 Duro	1 ea Latch Piston 172969-207
9	25	OD22235	O-Ring, 2-235, Nitrile, 70 Duro	1 ea Latch Body 172969-203
10	50	OD6060	Set Screw, 1/4-20 UNC x 1/4 lg, SS	1 ea Latch Shear Screw Housing 172969-202 2 ea Latch Body 172969-203 1 ea Latch Shear Screw Head 172969-205 3 ea Inner Rod Subassembly 172969-324
11	50	OD6061	Set Screw, 1/4-20 UNC x 3/8 lg, SS	1 ea Latch Bottom Connection 172969-204 1 ea Outer Barrel Cross Over Sub 172969-307 1 ea Piston Head 172969-311 3 ea Inner Rod Subassembly 172969-324 2 ea Latch Assembly 172969-200
12	100	OD6063	Set Screw, 1/4-20 UNC x 1/2 lg, Brass	2 ea Latch Assembly 172969-200
13	0	OD6775	Set Screw, 3/8-16 UNC x 3/8 lg, SS	1 ea Quick Release Nut 172969-104
14	30	OD7216	Ball Bearing, 3/8 Dia, SS	6 ea Latch Assembly 172969-200 (MC# 9529K19)
15	12	----	Low Hd Soc Hd Cap Screw, 5/16 -18 UNC x 3/8 lg	2 ea Latch Assembly 172969-200
16	----	172969-000	MDHDS Assembly	
17	----	172969-001	Parts List, MDHDS Assembly	MDHDS Assembly 172969-000
18	----	172969-100	Quick Release Assembly, MDHDS Big Bore	2 ea MDHDS Assembly 172969-000
19	1	172969-101	Female Quick Release, MDHDS Big Bore	1 ea Q/R Assy, Big Bore 172969-100
20	1	172969-102	Male Quick Release, MDHDS Big Bore	1 ea Q/R Assy, Big Bore 172969-100
21	2	172969-103	Dog, Quick Release, MDHDS Big Bore	2 ea Q/R Assy, Big Bore 172969-100
22	1	172969-104	Nut, Quick Release, MDHDS Big Bore	1 ea Q/R Assy, Big Bore 172969-100
23	0	172969-105	Spacer Sub, Big Bore Quick Release	1 ea Latch Assembly 172969-200
24	----	172969-200	Latch Assembly, MDHDS	1 ea MDHDS Assembly 172969-000
25	0	172969-201	Top Connection, MDHDS Latch	1 ea Latch Assembly 172969-200
26	0	172969-202	Shear Screw Housing, MDHDS Latch	1 ea Latch Assembly 172969-200
27	0	172969-203	Latch Body, MDHDS Latch	1 ea Latch Assembly 172969-200
28	0	172969-204	Bottom Connection, MDHDS Latch	1 ea Latch Assembly 172969-200

MDHDS Suggested Spares Parts List

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29	0	172969-205	Shear Screw Head, MDHDS Latch	1 ea Latch Assembly 172969-200
30	2	172969-206	Dog Housing, MDHDS Latch	1 ea Latch Assembly 172969-200
31	0	172969-207	Piston, MDHDS Latch	1 ea Latch Assembly 172969-200
32	18	172969-208	Dog, MDHDS Latch	3 ea Latch Assembly 172969-200
33	0	172969-301	Flapper Guide Tube	1 ea MDHDS Assembly 172969-000
34	0	172969-302	Outer Barrel	2 ea MDHDS Assembly 172969-000
35	0	172969-303	Outer Spacer Barrel	1 ea MDHDS Assembly 172969-000
36	----	172969-304	1.75 F-Type Thread	Machining Information
37	0	172969-305	Landing Shoulder	1 ea MDHDS Assembly 172969-000
38	0	172969-307	Outer Barrel Cross Over Sub	1 ea MDHDS Assembly 172969-000
39	0	172969-311	Piston Head	1 ea Inner Rod Subassembly 172969-324
40	1	172969-312	T2P Male Quick Release	1 ea T2P Quick Release Assy 172969-316
41	1	172969-313	T2P Female Quick Release	1 ea T2P Quick Release Assy 172969-316
42	2	172969-314	T2P Quick Release Nut	1 ea T2P Quick Release Assy 172969-316
43	50	172969-315	Piston Ring (4 ea 1/4 sections)	1 ea Inner Rod Subassembly 172969-324
44	----	172969-316	T2P Quick Release Assembly	1 ea Inner Rod Subassembly 172969-324
45	1	172969-320	Sub, Inner Rod	1 ea Inner Rod Subassembly 172969-324
46	2	172969-321	Inner Rod, 10 ft	1 ea Inner Rod Subassembly 172969-324
47	1	172969-322	RS Fishing Neck	1 ea Inner Rod Subassembly 172969-324
48	1	172969-323	Latch Spring	1 ea Latch Assembly 172969-200
49	----	172969-324	Subassembly, Inner Rod	1 ea MDHDS Assembly 172969-000
50	2	172969-325	Latch Rod	1 ea Inner Rod Subassembly 172969-324
51	----	172969-326	Subassembly, Outer Barrel	1 ea Inner Rod Subassembly 172969-324

MDHDS Suggested Spares Parts List

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Ancillaries				
Item	Qty	Part Number	Description	Notes / Where Used
1	2	172969-317	SET(P) Cross Over Sub	1 ea Inner Rod Subassembly 172969-324
2	----	172969-400	Latch Top Test Cap	
3	----	172969-401	Latch Bottom Test Cap	
4	2	172969-402	Thread Protector, SET/SETP	
5	4	172969-403	Assembly, MDHDS Lifting Clamp	
6	----	OD7106	Spring Pin, 1/8 Dia x 3/4 lg, SS	1 ea Assy, Lifting Clamp 172969-403
7	----	OD7171	Cotter Pin, 1/8 Dia x 1 Lg, SS	2 ea Assy, Lifting Clamp 172969-403
8	----	OD7244	Bolt, Hex HD, 9/16 - 12 UNF x 2-1/2 LG	2 ea Assy, Lifting Clamp 172969-403
9	----	OD7246	Lock Nut, Hex, 9-1/6 - 12 UNF	2 ea Assy, Lifting Clamp 172969-403
10	----	OD7305	Flat Washer, Norm 5/8	1 ea Assy, Lifting Clamp 172969-403
11	----	OD7307	Flat Washer, Norm 3/4	1 ea Assy, Lifting Clamp 172969-403
12	----	OP3618	Hinge Pin	1 ea Assy, Lifting Clamp 172969-403
13	----	OP3620	Latch Pin	1 ea Assy, Lifting Clamp 172969-403
14	----	OP3622	Latch Bolt	1 ea Assy, Lifting Clamp 172969-403
15	----	OP3624	Flat Flanged Nut, 5/8 - 11 UNC, S/I	1 ea Assy, Lifting Clamp 172969-403
16	----	OP3626	Lift Chain	1 ea Assy, Lifting Clamp 172969-403
17	----	OP3627	Sling Link	1 ea Assy, Lifting Clamp 172969-403
18	----	172969-404	Clamp Body "A", MDHDS Lifting Clamp	1 ea Assy, Lifting Clamp 172969-403
19	----	172969-405	Clamp Body "B", MDHDS Lifting Clamp	1 ea Assy, Lifting Clamp 172969-403
20	2	172969-406	Top Storage Cap	For storage in shack
21	2	172969-407	Bottom Storage Cap	For storage in shack
22	2	172969-413	Assembly, Spring Compression Tool	1 ea MDHDS Assembly 172969-000
23	4	----	Shoulder Screw, 3/8 Dia x 1/4 lg x 5/16 - 18 UNC	4 ea Assy, Spring Compression Tool 172969-413 (MC# 91259A615)
24	----	172969-408	Spring Comp Tool Link	2 ea Assy, Spring Comp Tool 172969-413
25	----	172969-409	Spring Comp Tool Arm	2 ea Assy, Spring Comp Tool 172969-413
26	----	172969-410	Spring Comp Tool Cleat	1 ea Assy, Spring Comp Tool 172969-413
27	----	172969-411	Spring Comp Tool Handle	2 ea Assy, Spring Comp Tool 172969-413
28	----	172969-412	Weldment, Spring Comp Tool Handle	1 ea Assy, Spring Comp Tool 172969-413
29	----	172969-415	Brace	1 ea Link Weldment 172969-416
30	----	172969-416	Link Weldment	1 ea Assy, Spring Comp Tool 172969-413
31	8	172969-417	Dog Bolt	2 ea Assy, Spring Comp Tool 172969-413
32	2	172969-414	Reset J-Hook Gauge	Service Tool

MDHDS Suggested Spares Parts List

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33	2	172969-418	Locking Clamp Assembly	1 ea MDHDS Assembly 172969-000
34	---	OD7106	Spring Pin, 1/8 Dia x 3/4 lg, SS	1 ea Assy, Locking Clamp Assy 172969-418
35	---	OD7171	Cotter Pin, 1/8 Dia x 1 Lg, SS	2 ea Assy, Locking Clamp Assy 172969-418
36	---	OD7305	Flat Washer, Norm 5/8	1 ea Assy, Locking Clamp Assy 172969-418
37	---	OD7307	Flat Washer, Norm 3/4	1 ea Assy, Locking Clamp Assy 172969-418
38	---	OP3618	Hinge Pin	1 ea Assy, Locking Clamp Assy 172969-418
39	---	OP3620	Latch Pin	1 ea Assy, Locking Clamp Assy 172969-418
40	---	OP3622	Latch Bolt	1 ea Assy, Locking Clamp Assy 172969-418
41	---	OP3624	Flat Flanged Nut, 5/8 - 11 UNC, Stl	1 ea Assy, Locking Clamp Assy 172969-418
42	---	172969-404	Clamp Body "A", MDHDS Lifting Clamp	1 ea Assy, Locking Clamp Assy 172969-418
43	---	172969-405	Clamp Body "B", MDHDS Lifting Clamp	1 ea Assy, Locking Clamp Assy 172969-418
44	---	172969-419	Thread Protector, Box, Inner Barrel	Service Tool
45	---	172969-420	Thread Protector, Pin, Inner Barrel	Service Tool
46	2	172969-421	Spacer, Spring Compression Tool	1 ea Assy, Spring Comp Tool 172969-413
47	6	----	Bolt, Hex HD, 3/8 - 16 UNC x 1 LG	Assembly and handling aid

NOTES:

1) It is recommended that 2 complete tools in addition to the spares listed be shipped for deployment.

