FH™ 3500 HYDRAULIC SETTING TOOL

The Alpha 3500 FH™ Hydraulic Setting Tool is designed to run and set the Alpha FH™ One-Trip Cement Retainer then squeeze or spot cement in one trip. It is recommended for deviated. No rotation is required; simply run tool to the predetermined setting depth, drop ball, then pressure up either the drill pipe, tubing or coil tubing to shear release. The 3500 FH™ Hydraulic Setting Tool sets the FH™ Cement Retainer, unlocks the ball seat, closes the circulation ports, opens the bypass And compensates setting travel automatically.

Applications:
Designed to run and set the Alpha FH™ One-Trip Cement Retainer then squeeze or spot cement in one-trip. It is recommended for deviated wells where conditions are not suitable for rotating or wireline set cement retainers.

Features:
• One-trip system
• Simple operation and easy clean up makes it ideal for applications on drill pipe, tubing or coil tubing
• No rotation required

TOOL O.D.	PART NUMBER	TOP CONNECTION	MAX. STROKE LENGTH	SETTING AREA	MAX. APPLIED PRESSURE
3.500	019-3500-200	2-⅜" API Regular Box	10.5”	11.84 in^2	5,000 psi

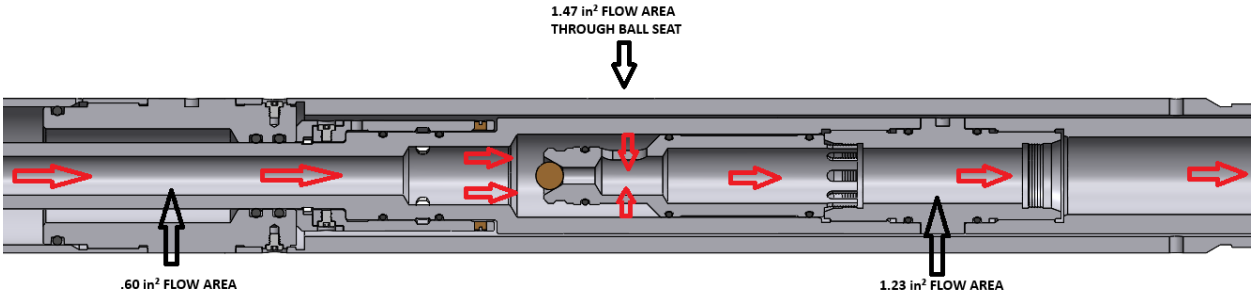
CEMENT RETAINERS
Utilizing the Alpha FH™ Cement Retainer with the 3500 FH Setting Tool, the Retainer can be run, set and squeezed through in one-trip using the Alpha FH™ Hydraulic Setting Tool. No rotation is required. The sliding sleeve valve located inside the cement retainer is controlled by picking up 2 inches to close and setting down weight to open then squeeze. Cement can also be placed on top of the cement retainer. The 3500 FH™ Setting Tool is compatible with the following Alpha FH™ Cement Retainers:

Part Number	Setting Sleeve Part Number
005-3593-500	019-3593-247
005-4312-500	019-4312-247

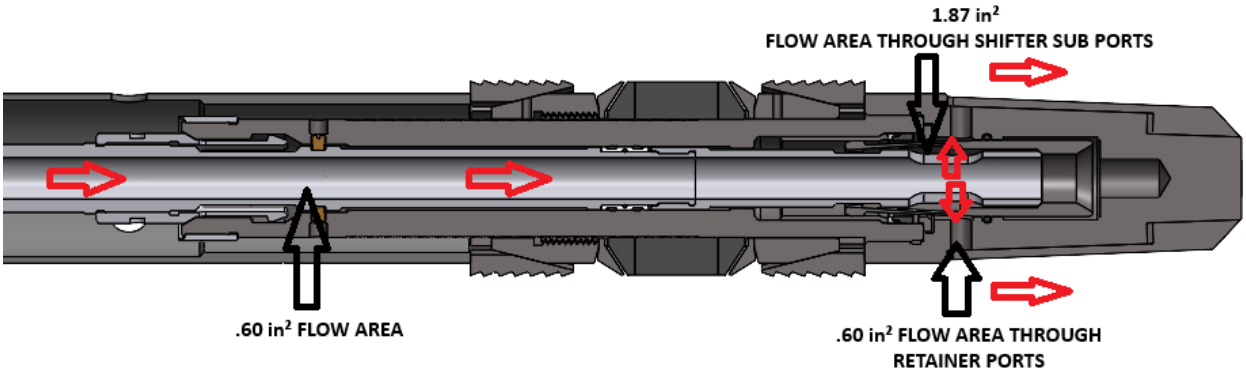
HOW THE 3500 FH™ SETTING TOOL WORKS

The ball lands on the ball seat which diverts the well fluid into the two hydraulic setting chambers (11.84 in^2 total piston area). The workstring is pressurized to establish differential pressure at the tool. That pressure is held for 5 minutes to allow the cement retainer packing system to conform to the tubing ID. The pressure in the workstring is then increased in order to shear the Shear Screws that connect to the cement retainer (this fully sets the cement retainer and disconnects the Setting Tool from the Cement Retainer). The FH™ Hydraulic Setting Tool continues to stroke and at the end of its 10.5" stroke it unlocks the ball seat by shearing the shear screws which positions an undercut over the ball seat locks. These locks are tapered so they cannot enter the cement flow path. The ball seat is now free to move downward, close circulation ports and latch into the tandem sub. The ball seat latch keeps the ball seat from moving upward during the reverse circulation process which keeps the flow path the same as the ID of the Hydraulic Setting Tool.

FLOW PATH AROUND BALL SEAT



FLOW PATH AROUND CEMENT RETAINER



Min. Flow Area	Max. Recommended Flow Rate
.60 in^2	2 BPM

The stinger remains pinned to in the cement retainer body (8,000 lbs), unaffected by the setting force because the stroke compensation sleeve moves independently from the stinger. The squeeze operation should be performed then apply overpull to remove stinger from cement retainer. See the operational illustration on next page:

RUN IN POSITION VALVE OPEN	DROP BALL & PRESSURE WORKSTRING ANCHOR RETAINER	INCREASE PRESSURE OPEN BYPASS	PULL TENSION & RELEASE RETAINER

RETAINER AND SETTING TOOL ASSEMBLY

The installation of the 3593 and the 4312 FH™ Cement Retainers onto the 3500™ FH Setting Tool are the same, with the exception of the Setting Sleeve utilized.

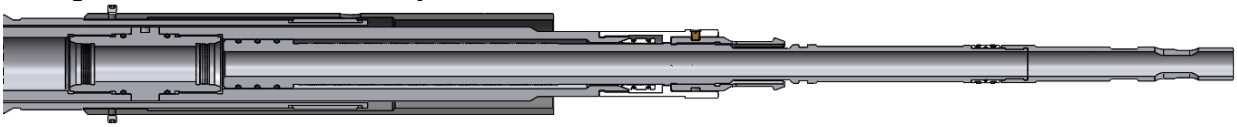
ASSEMBLY PROCEDURE FOR 3593 & 4312 RETAINERS

REQUIRED PARTS FOR ASSEMBLY OF 3593 FH™ RETAINER & 3500 FH™ SETTING TOOL	
PART NAME	**PART NUMBER**
SETTING SLEEVE	019-3593-247
5/16-18 x ¼" LONG SET SCREWS (2)	

REQUIRED PARTS FOR ASSEMBLY OF 4312 FH™ RETAINER & 3500 FH™ SETTING TOOL	
PART NAME	**PART NUMBER**
SETTING SLEEVE	019-4312-247
5/16-18 x ⅜" LONG SET SCREWS (2)	

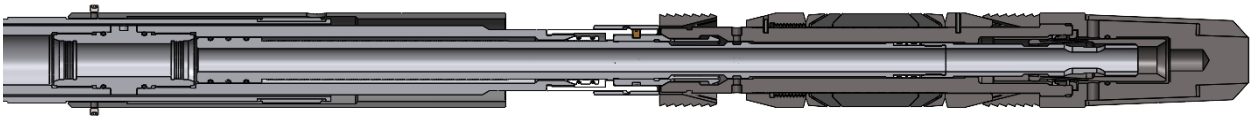
Reference Field Assembly Illustrations on the next page. Since the Retainer is so small, it is recommended that the Retainer is assembled to the Setting Tool off the rig floor in a vice or on stands.

STEP 1: Thread the Setting Sleeve onto the upper threaded section of the Adjuster Sleeve until the Setting Sleeve shoulders on the Adjuster Sleeve.

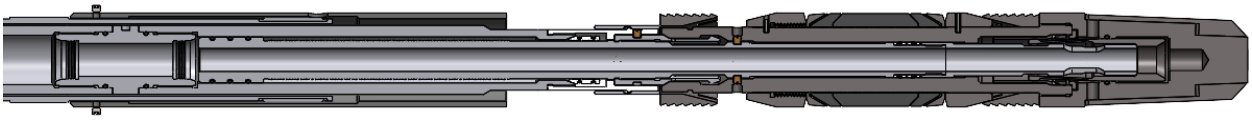


STEP 2: Grease to all parts from the to the stinger on the seal down.

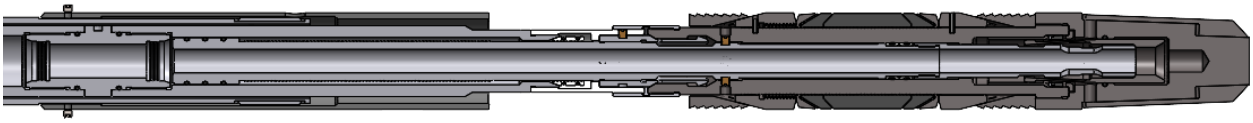
STEP 3: Install the setting tool into the seal bore of the Retainer until the Retainer shoulders onto the Setting Tool (a mallet may be required to fold the Sliding Valve of the Retainer inward as well as collapsing the Latch into the Retainer). Thread the Shear Ring on the Retainer onto the Latch Housing until the Body of the Retainer shoulder into the Latch. This should align tapped holes in the Body of the Retainer with the groove on the Stroke Compensation Piston.



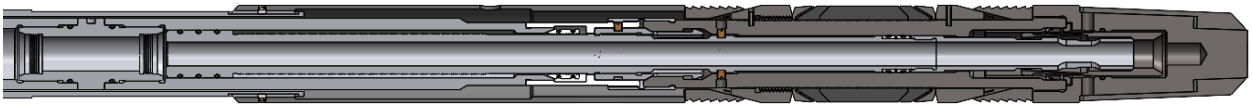
STEP 5: Install the four Brass Shear Screws included with the Retainer into the corresponding tapped holes of the Body of the Retainer and bottom the Screws put on the Stroke Compensation Piston, then back off ¼ turn.



STEP 6: Slide the Upper Slip down onto the Upper Cone and reinstall the Shear Ring.



STEP 7: Thread the Setting Sleeve down until it touches Upper Slip of the Retainer. Back the Setting Sleeve off slightly to align the closest slot in Adjuster Sleeve with the tapped holes in the Setting Sleeve and install two 5/16-18 x ¼ long socket head set screws hand tight. ***NOTE: THE TOP SLIP MUST BE FREE TO ROTATE***.



RUNNING PROCEDURES

RUNNING GUIDELINES

1. Use a casing scraper before running any equipment in the well to remove scale and other materials from the casing wall. Any tool that is expected to grip the casing wall has to first reach the casing wall.
2. Circulate the well to clean the well of debris and junk.
3. Drift the casing ID 80-100 feet below setting depth with a full OD gage ring and junk basket to ensure no restrictions or debris exist.
4. Use the correct FH™ Sleeve Valve Cement Retainer for the temperature, pressure, casing size, casing weight and environment.
5. Casing should have 100% cement bond before running the cement retainer in the well.
6. Never set the retainer in a casing collar or a location where milling has occurred.
7. Always set the retainer in static well conditions (no fluid or gas movement).
8. When perforating, the cement retainer should be protected with a minimum of ten feet of cement dumped directly on top of the retainer. Cement should be given sufficient time to harden before perforating.
9. Perforating should not be done closer than fifty feet of cement retainer without putting a minimum of 10 feet of hard cement on top of retainer.

OPERATION PROCEDURE

1. Use tubing/casing scraper before running any equipment in the well to remove scale and other materials from the tubing/casing wall.

NOTE: Skipping this step may cause the cement retainer to not properly grip the tubing/casing wall.

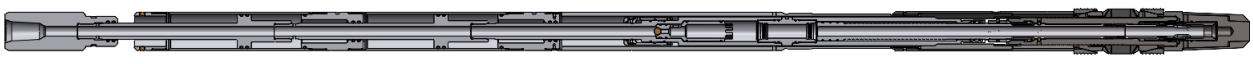
2. Circulate well to clean well of debris and junk.
3. Drift tubing/casing ID 80-100 feet below setting depth with full OD gage ring and junk basket to ensure no restrictions or debris exist.
4. Use the correct Alpha FH™ SVCR for the temperature, pressure, tubing size, tubing weight and environment.
5. Run the Alpha FH Hydraulic Setting Tool & Cement Retainer several feet below the setting depth.

NOTE: The FH HST circulation ports located below the Ball Seat and that the stinger is holding the cement retainer valve in the open position will allow the workstring to fill while running in the hole.

6. Pick up slowly to setting depth to remove slack from tubing string.
7. Drop the provided ⅝” diameter Brass Ball and slowly pump down until the Ball has seated.

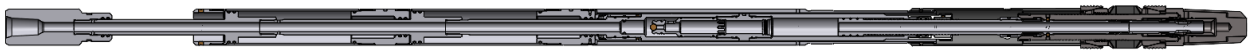
NOTE: A pressure increase will be observed upon seating the Ball.

8. Slowly pressure the workstring to establish a 1,000 *psi* differential pressure inside the workstring “at the tool” to begin the setting sequence.



9. Continue pressuring workstring to establish a 1,500 *psi* differential pressure inside the workstring "at the tool" to anchor the cement retainer against the casing wall and hold the pressure for 5 minutes.
10. Continue pressuring workstring to establish a 2,200 *psi* differential pressure inside the workstring "at the tool" to complete the set (weight indicator will drop off). The Ball Seat will unlock (the pressure will bleed off on its own).

NOTE: It is not recommended to pick up out of cement retainer prior to squeezing due to double flapper safety valve may cause HST to become hydraulically locked and prevent re-entry in cement retainer.



11. Set down weight is required on the Cement Retainer to perform a maximum 5,000 *psi* squeeze operation, apply the corresponding set down weight per chart below and start squeeze operation.

Squeeze Pressure (*psi*)	Set Down Weight Required (*lbs*)
1,000	1,430
2,000	2,860
3,000	4,290
4,000	5,725
5,000	7,160

TROUBLESHOOTING

If the 3500 FH™ Setting Tool does not unlock Ball Seat by hydraulic pressure as in Step 10: Pressure workstring to establish a 2,200 *psi* (3,000 *psi* max.) differential pressure inside the tubing "at the tool" to unlock Ball Seat.

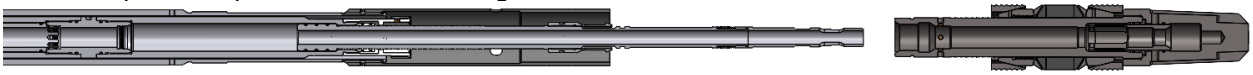
If unsuccessful, then bleed off pressure and reverse circulate capacity of the tubing (+10 BBL) to remove debris that may be inside the tubing and tool. Circulate Ball back to the Ball Seat and attempt pressuring tubing again to 3,000 *psi* max. Note: The Ball Seat cannot be pumped out until the setting stroke has been completed. Carefully remove workstring from well.

If the FH™ Setting Tool still does not unlock Ball Seat does not disconnect from CR

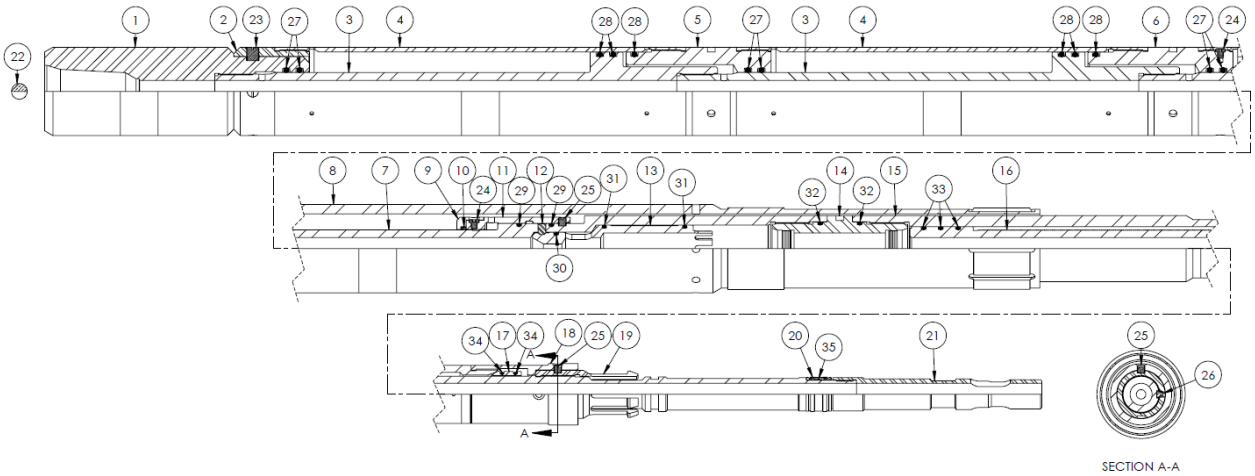
Pull 8,000 pounds over tubing weight and pressure workstring to establish a 2,500 *psi* (3,000 *psi* max) differential pressure inside the tubing "at the tool" to release from cement retainer.

If unsuccessful, then bleed off pressure, return tubing to the neutral point and reverse circulate capacity of the tubing (+10 BBL) to remove debris that may be inside the tubing and tool. Circulate Ball back to the Ball Seat and attempt pressuring tubing again to 3,000 *psi* max. Note: The Ball Seat cannot be pumped out until the setting stroke has been completed.

12. Pick up 10,000 pounds to release stinger from Cement Retainer



3500 FH™ SETTING TOOL PARTS LIST



ITEM NO.	PART NUMBER	PART NAME	QTY.
1	019-3500-220	TOP SUB	1
2	019-3500-221	CYLINDER CAP	1
3	019-3500-223	PISTON	2
4	019-3500-222	CYLINDER	2
5	019-3500-224	UPPER CONNECTOR	1
6	019-3500-225	LOWER CONNECTOR	1
7	019-3500-227	BALL SEAT HOUSING	1
8	019-3500-226	ADJUSTER SLEEVE	1
9	019-3500-231	LOCK RETAINER NUT	1
10	019-3500-232	SNAP RING	1
11	019-3500-230	LOCK RETAINER	1
12	019-3500-229	BALL SEAT LOCK	2
13	019-3500-228	BALL SEAT	1
14	019-3500-242	TANDEM SUB	1
15	019-3500-243	STROKE COMPENSATING	1
16	019-3500-244	STINGER/ STROKE	1
17	019-3500-241	STINGER LATCH	1
18	019-3500-240	LATCH HOUSING	1

ITEM NO.	PART NUMBER	PART NAME	QTY.
19	019-3500-250	SNAP LATCH	1
20	016-3500-033	MOLDED SEAL	1
21	017-3593-034	SHIFTER SUB	1
22	019-3500-236	.625 BRASS BALL	1
23	062-4500-128	SHEAR SCREW	4
24	250L20X250	1/4-20 X 250 LOW SHCS	4
25	062-4500-127	SHEAR SCREW	3
26	250S20X250	1/4 -20 X .25 SET SCREW	1
27	000-325-N090	325 O-RING	6
28	000-335N-090	335 O-RING	6
29	000-224-090	224 O-RING	2
30	000-215N-090	215 O-RING	1
31	000-223N-090	223 O-RING	2
32	000-225N-090	225 O-RING	2
33	000-222N-090	222 O-RING	3
34	000-129N-090	129 O-RING	2
35	000-024N-090	024 O-RING	1

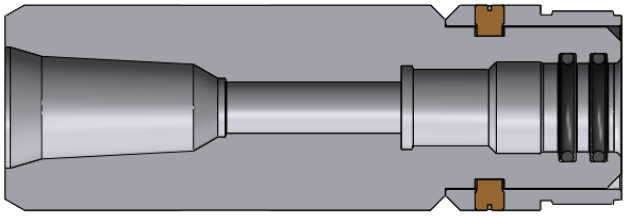
ASSEMBLY INSTRUCTIONS FOR 3500 FH™ SETTING TOOL

Anti-galling compound should be used on all threads. Lithium grease or equivalent should be used on all O-rings and sealing surfaces. To avoid damage to parts, use a soft jaw vise and strap wrenches when tightening connections. Wrench on knurled areas or utilize spanner holes. File away wrench marks.

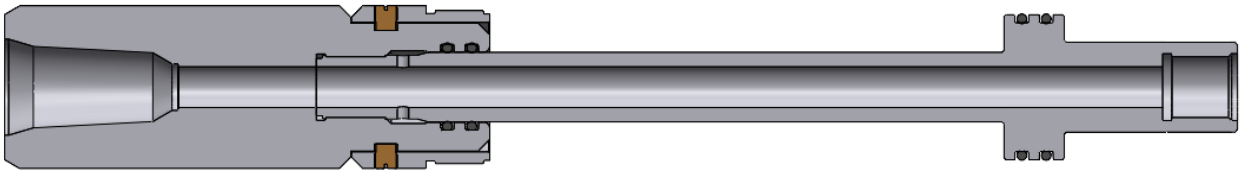
NOTES:

- Spanner wrench tight means hand tight then striking spanner handle with rubber mallet two or three times.
- Wrench tight means putting your weight on the end of a 36" pipe wrench.
- Screwdriver tight means hand tight with a medium blade 6" long screwdriver.

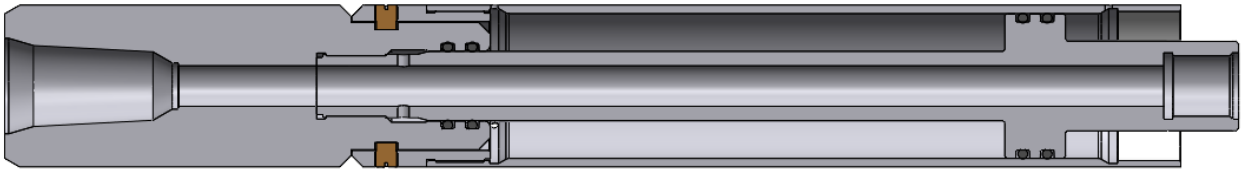
1. Place the Top Sub (item 1) in vise at box connection.
2. Install (2) 325 O-Rings (item 27) into the Top Sub.
3. Slide the Cylinder Cap (item 2) on the Top Sub (item 1) then align holes. Install four (4) Brass Shear Screws (item 23) into the Cylinder Cap (item 3) screwdriver tight then back-off 1/4 turn.



4. Install (2) 335 O-Rings (item 28) onto the Piston.
5. Screw the Piston (item 3) into the Top Sub (item 1) wrench tight. Lubricate entire Cylinder I.D. with grease.



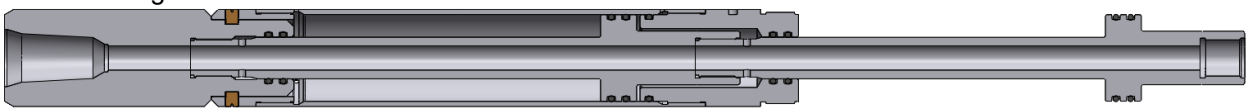
6. Slide the Cylinder (item 4) over the Piston (item 3) and screw the Cylinder onto the Cylinder Cap (item 2) wrench tight.



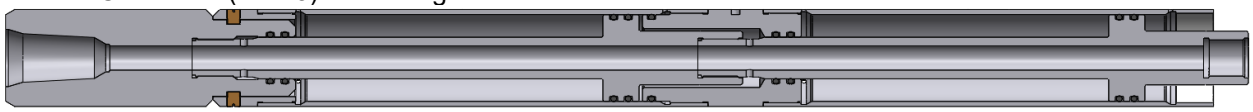
7. Install (1) 335 O-Ring (item 28) onto the Upper Connector (item 5).
8. Install (2) 325 O-Rings (item 27) into the Upper Connector (item 5).
9. Thread the Upper Connector (item 5) into the Cylinder (item 4) wrench tight.

10. Install (2) 335 O-Rings (item 28) onto the Piston (item 3).

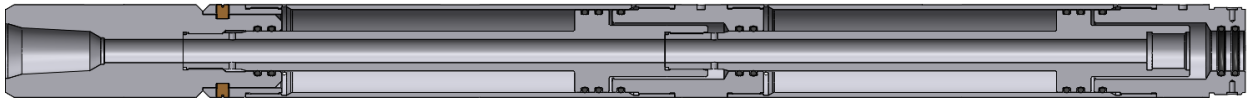
11. Screw the second Piston (item 3) into the first Piston wrench tight. Lubricate entire Cylinder I.D. with grease.



12. Slide the Cylinder (item 4) over the second Piston (item 3) and screw the Cylinder onto the Upper Connector (item 5) wrench tight.

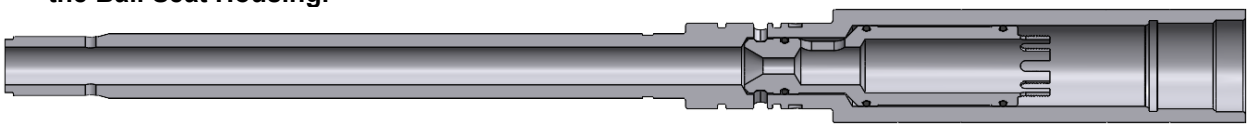


13. Install (1) 335 O-Ring (item 28) onto the Lower Connector (item 6).
14. Install (2) 325 O-Rings (item 27) into the Lower Connector (item 6).
15. Thread the Lower Connector (item 6) into the Cylinder (item 4) wrench tight.

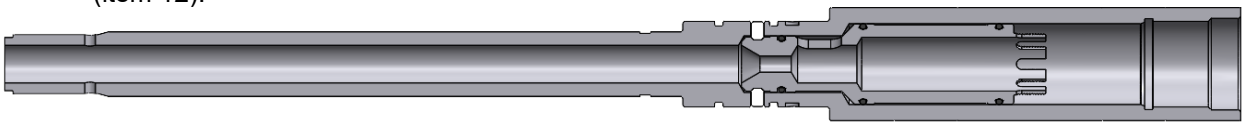


16. Remove this sub-assembly from the vise and set aside.
17. Install (1) 215 O-Ring (item 30) onto the Ball Seat (item 13).
18. Install (2) 223 O-Rings (item 31) onto the Ball Seat (item 12).
19. Slide the Ball Seat inside the Ball Seat Housing (item 7) as far as possible by hand, then with the aid of a 1/2" diameter x 36" long steel rod push the Ball Seat in place with a rubber mallet.

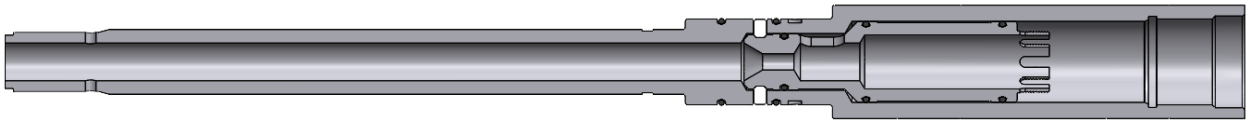
NOTE: The Ball Seat is in place when the Ball Seat groove can be viewed through windows in the Ball Seat Housing.



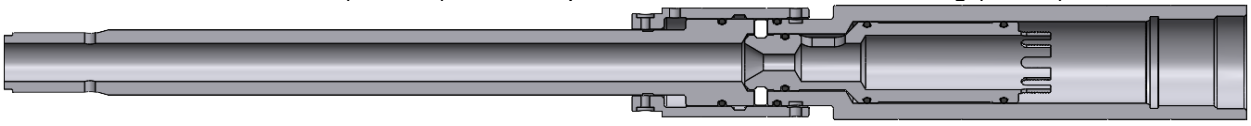
20. Pack the windows of the Ball Seat Housing (item 7) with grease and install (2) Ball Seat Locks (item 12).



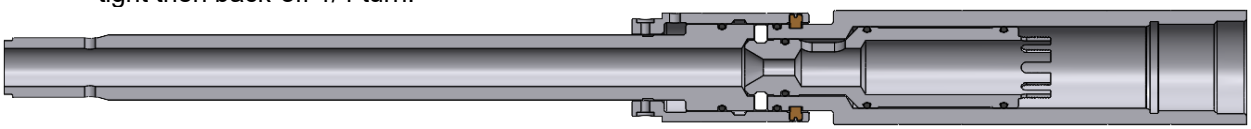
21. Install (2) 224 O-Rings (item 29) onto the Ball Seat Housing (item 7).



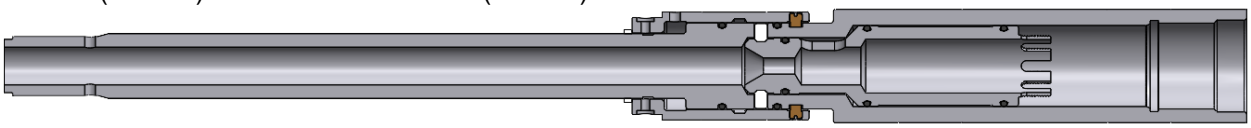
22. Slide the Lock Retainer (item 11) over the Ball Seat Housing (item 7) and align the tapped holes in the Lock Retainer (item 11) with the spot faces in the Ball Seat Housing (item 7).



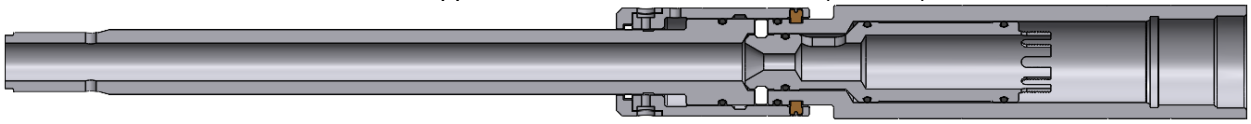
23. Install (2) Shear Screws (item 25) into the tapped holes in the Lock Retainer (item 11) screwdriver tight then back-off 1/4 turn.



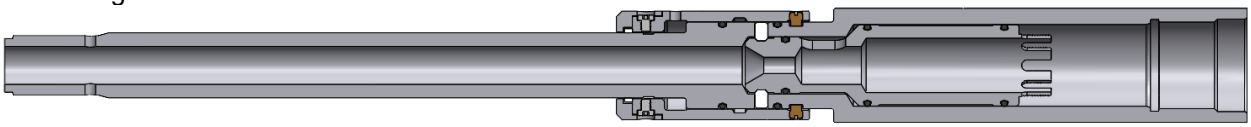
24. Slide the Snap Ring (item 10) over the Ball Seat Housing (item 7) and shoulder the Snap Ring (item 10) with the Lock Retainer (item 11).



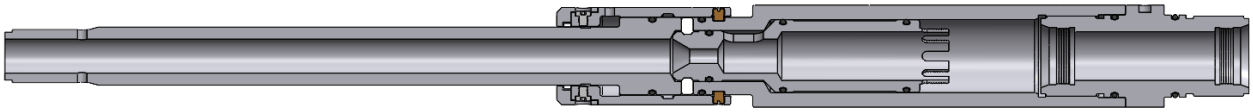
25. Slide the Lock Retainer Nut (item 9) over the Ball Seat Housing (item 7) and align the holes in the Lock Retainer Nut with the tapped holes in the Lock Retainer (item 11).



26. Install (2) ¼-20 x ¼" long Cap Screws (item 24) into the Lock Retainer (item 11) Allen Wrench tight.

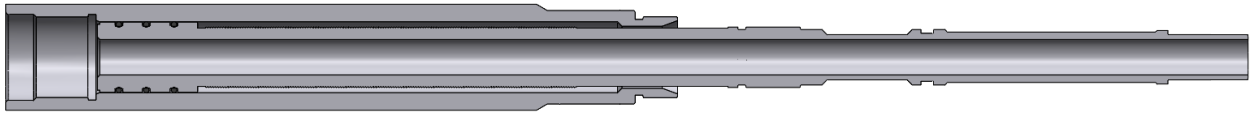


27. Install (2) 225 O-Rings (item 32) onto the Tandem Sub (item 14).
28. Thread the Tandem Sub (item 14) into the Ball Seat Housing (item 7).

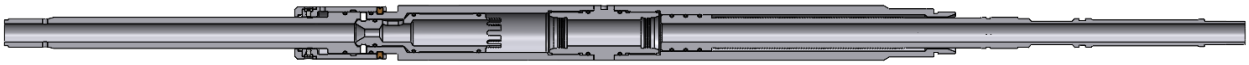


29. Install (3) 222 O-Rings (item 33) onto the Stroke Compensation Piston (item 16).

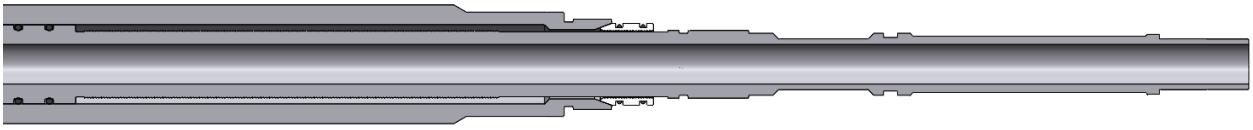
30. Slide the Stroke Compensation Piston (item 16) inside the Stroke Compensation Housing (item 15) as far as possible by hand, then with the aid of a rod push the Piston in place with a rubber mallet until the end align with the edge of the thread on the Stroke Compensation Housing (item 15).



31. Thread the Stroke Compensation Housing (item 23) onto the Tandem Sub (item 21) wrench tight.

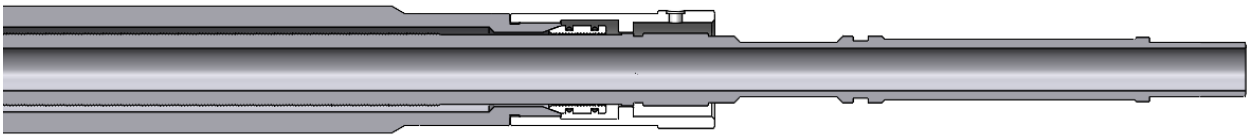


32. Install the Latch segments (item 17) over Stinger/Stroke Compensation Piston (item 16) with tapered end of Latch positioned toward Stroke Compensation Housing (item 15). Utilize (2) 129 O-Rings (item 34) in the grooves of the to hold the Stinger Latch segments in place.

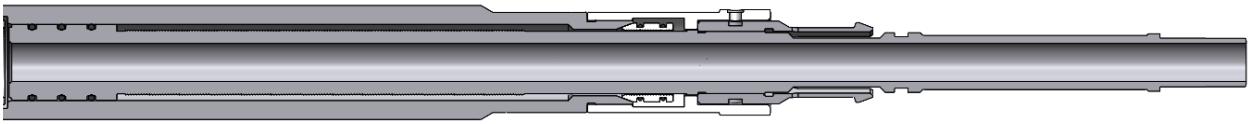


NOTE: ***Saw cuts should remain the same width.***

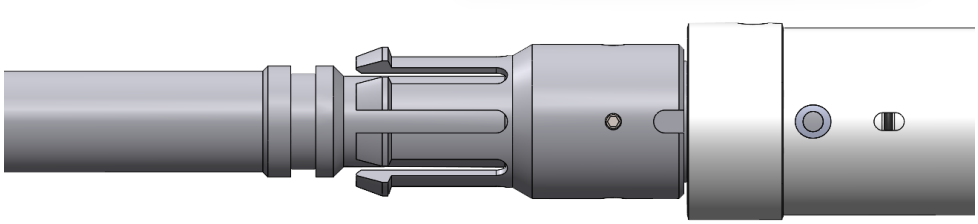
33. Slide the Latch Housing (item 18) over Stinger/Stroke Compensation Piston (item 16) to temporarily shoulder on the Stroke Compensation Housing (item 15).



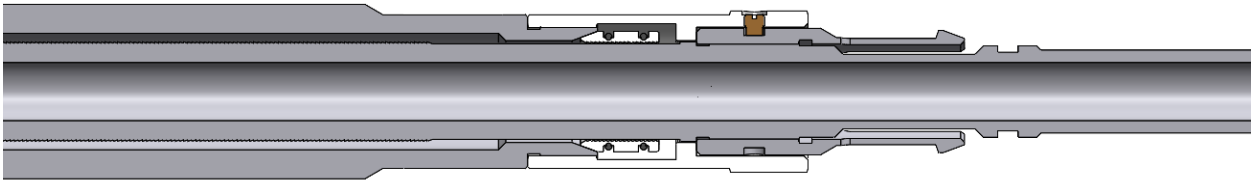
34. Thread the Latch (item 19) onto the Stinger/Stroke Compensation Piston (item 16) until the tapped hole in the Latch aligns with the spot face Latch Housing.



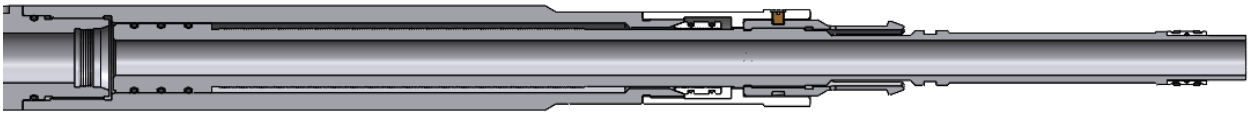
35. Move Compensating Piston down to install Set Screw (item 26) then slide up to align hole for shear screw.



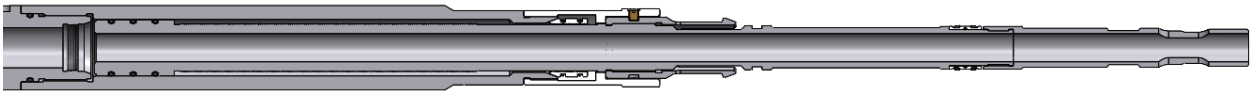
36. Slide the welded lugs in the Latch Housing (item 18) into the corresponding pockets of the Latch (item 19) and install a Brass Shear Screw (item 25) into the corresponding tapped hole in the Latch Housing screwdriver tight then back-off 1/4 turn.



37. Install (1) 024 O-ring (item 35) into the Stinger Molded Seal (item 20).
38. Slide the Stinger Molded Seal (item 20) onto the Stinger/Stroke Compensation Piston (item 16) until it bottoms out.



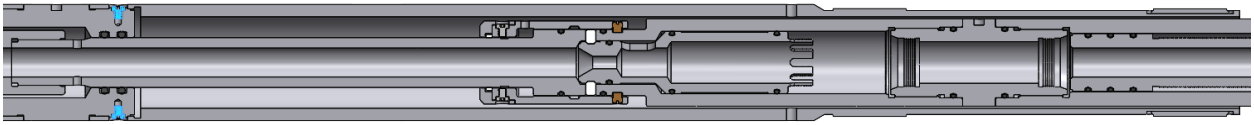
39. Thread the Shifter Sub (item 21) onto the Stinger/Stroke Compensation Piston (item 16) wrench tight.



40. Pick up the Upper portion of the setting tool that was previously assembled and thread the Ball Seat Housing Ball Seat Housing (item 7) into the Piston (item 3) wrench tight.

41. Slide Adjuster Sleeve (item 8) over Stinger and thread the Adjuster Sleeve onto Lower Connector (item 6) wrench tight.

42. Install (2) ¼-20 x ¼" long Cap Screws (item 24) into the Adjuster Sleeve (item 8) Allen Wrench tight.



DISASSEMBLY OF THE 3500 FH™ SETTING TOOL (AFTER RUNNING THE TOOL)

1. Drain all well fluids from Hydraulic Setting Tool and dispose of properly.
2. Place the Setting Tool in a pipe vise and vise onto the Top Sub (item 1).
3. Push the Outer components of the tool as far back as possible by hammering the Setting Sleeve towards the Top Sub (item 1) with a dead blow hammer or mallet. Use caution as to ensure not to damage the Setting Sleeve.
4. Fully remove the (2) 5/16-18 x ¼ long socket head set screws in the Setting Sleeve.
5. Unthread the Setting Sleeve from the Adjuster Sleeve (item 8) and fully remove.
6. Unthread the Shifter Sub (item 21) from the Stroke Compensation Piston (item 16) and fully remove.
7. Remove and discard the Molded Seal (item 20) and 024 O-Ring (item 35) from the Stroke Compensation Piston (item 16).
8. Fully remove the ¼-20 x ¼ long socket head set screws (item 26) from the Latch (item 19).
9. Unthread the Latch (item 19) from the Stroke Compensation Piston (item 16) and fully remove.
10. Remove and discard the remaining half of the Shear Ring from the Latch Housing (item 18).
11. Remove and discard the remaining portion of the Brass Shear Screw (item 25) from the Latch Housing (item 18).
12. Unthread the Latch Housing (item 18) from the Stroke Compensation Housing (item 15) and fully remove.
13. Remove and discard the (2) 129 O-Rings (item 34) from the Stinger Latch Segments (item 17).
14. Fully remove the three segments of the Stinger Latch (item 17) from the Stroke Compensating Piston (item 16).
    NOTE: ENSURE TO KEEP ALL THREE SEGMENTS TOGETHER
15. Remove the (2) ¼-20 x ¼" long Cap Screws (item 24) from the Lower Connector (item 6).
16. Unthread the Adjuster Sleeve (item 8) from the Lower Connector (item 6) and fully remove.
17. Unthread the Stroke Compensation Housing (item 15) from the Tandem Sub (item 14) and fully remove.
18. Push the Stroke Compensating Piston (item 16) out of the Stroke Compensation Housing (item 15). Remove and discard the (3) 222 O-Rings (item 33) then set both parts aside.
19. Unthread the Tandem Sub (item 14) from the Ball Seat Housing (item 7) and fully remove.
20. The Ball Seat (item 13) will come out with Tandem Sub (item 14). The Ball Seat (item 13) will need to be pushed out with a mallet and rod.
21. Remove and discard the (2) 225 O-Rings (item 32) from the Tandem Sub (item 14) and the (2) 223 O-Rings (item 31) as well as the (1) 215 O-Ring (item 30) from the Ball Seat (item 13).
22. Unthread the Lower Connector (item 6) from the Cylinder (item 4) and use a mallet to push the Lower Connector (item 6) far enough to expose the knurled section of the lower Piston (item 3).
23. While holding back up on the knurled section of the lower Piston (item 3), unthread the Ball Seat Housing (item 7) from the Piston (item 3).

24. Remove the Lower Connector (item 6) from the Ball Seat Housing (item 7).
25. Remove and discard the (2) 325 O-Rings (item 27) & the (1) 335 O-Ring (item 28) from the Lower Connector (item 6).
26. Remove the (2) ¼-20 x ¼" long Cap Screws (item 24) from the Lock Retainer (item 11).
27. Remove the Lock Retainer Nut (item 9) from Lock Retainer (item 11).
28. Remove the Snap Ring (item 10) from the groove on the Ball Seat Housing (item 7).
29. Remove the Lock Retainer (item 11) from over the Ball Seat Housing (item 7).
30. Remove and discard the remaining portions of the Brass Shear Screw (item 25) from the Lock Retainer (item 11).
31. Remove the (2) Ball Seat Locks (item 12) from the Ball Seat Housing (item 7).
32. Remove and discard the (2) 224 O-Rings (item 29) from the Ball Seat Housing (item 7).
33. Unthread the lower Cylinder (item 4) from the Upper Connector and fully remove.
34. Unthread the Upper Connector (item 5) from the upper Cylinder (item 4) and use a mallet to push the Upper Connector (item 5) far enough to expose the knurled section of the upper Piston (item 3).
35. While holding back up on the knurled section of the upper Piston (item 3), unthread the lower Piston (item 3) from the upper Piston (item 4).
36. Remove the Upper Connector (item 5) from the lower Piston (item 3).
37. Remove and discard the (2) 325 O-Rings (item 27) & the (1) 335 O-Ring (item 28) from the Upper Connector (item 5).
38. Remove and discard the (2) 335 O-Rings (item 28) from the lower Piston (item 3).
39. Unthread the upper Cylinder (item 4) from the Cylinder Cap (item 2) and fully remove.
40. Unthread the upper Piston (item 3) from the Top Sub (item 1).
41. Remove and discard the (2) 335 O-Rings (item 28) from the upper Piston (item 3)
42. Remove the Cylinder Cap (item 2) from over the Top Sub (item 1).
43. Remove and discard the remaining portion of the Brass Shear Screws (item 25) from the Latch Housing (item 18).
44. Remove and discard the (2) 325 O-Rings (item 27) from the Top Sub (item 1).

REDRESS KIT
(AFTER DISASSEMBLY THE TOOL)

Required Part for Redress Kit (019-3500-215)		
PART NAME	**PART NUMBER**	**QTY.**
Bronze Ball 0.625	019-3500-236	1
Shear Screw	062-4500-128	4
Shear Screw	062-4500-127	3
325 O-ring	000-325N-090	6
335 O-ring	000-335N-090	6
224 O-ring	000-224N-090	2
215 O-ring	000-215N-090	1
225 O-ring	000-225N-090	2
222 O-ring	000-222N-090	3
129 O-ring	000-129N-090	2
024 O-ring	000-024N-090	1
223 O-ring	000-223N-090	2

3500 FH™ HYDRAULIC SETTING TOOL
DIMENSIONAL DATA

MAX. O.D.	3.500 *in*
OVERALL LENGTH	111.63 *in*
MIN. I.D.	.875 *in*
SEAL DIA.	1.35 *in*