



CEMENT RETAINER - MECHANICAL SET

4-1/2"

Manual No:
DL-840-4500-307

Revision: G

Revision Date:
01/20/2016

Authored by: B.Mathis

Approved by: D.Hushbeck

A) DESCRIPTION

The Cement Retainer is a drillable packer that provides the end user with a tool that will consistently contain well pressures at elevated temperatures and pressures. This tool is designed to be used for remedial cementing operations and light service applications. This tool permits faster removal from the well with either rotary or cable tool methods due to its compact size and the selection of high quality construction materials.

The Cement Retainer is convertible to a bridge plug with the D&L Conversation Kit, sold separately.

B) RELATED TOOLS (sold separately)

B-1) 4-1/2" Mechanical Setting Tool (P/N 52445)—refer to technical manual *DL-524-4500-308*.

C) SPECIFICATION GUIDE

CASING			TOOL OD (INCHES)	PART NUMBER
SIZE (INCHES)	WEIGHT (LBS/FT)	RECOMMENDED HOLE SIZE (INCHES)		
4-1/2	9.5 – 15.1	3.826 – 4.090	3.612	84045MS

DIFFERENTIAL PRESSURE (MAX)	TEMPERATURE (MAX)
10,000 PSI	350° F

D) PRE-INSTALLATION INSPECTION PROCEDURES

Before use, D&L recommends inspection of the tool. Ensure parts have not been damaged during shipping. Replace damaged with D&L replacement parts. Contact D&L sales for replacement part information.

E) STORAGE RECOMMENDATIONS

Store the tool, if possible, in an enclosed, temperature and humidity controlled environment. Avoid excessively high temperatures over long periods of time. Shield elastomeric parts from ultraviolet light sources. Keep tool dry and protected from condensation. Do not store in contact with or near volatile or corrosive chemicals. Do not store near ozone generating equipment or operations such as welding.

D & L OIL TOOLS
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F) HYDRAULIC FORCES ACTING ON CEMENT RETAINERS

Forces created by applied pressure to the casing and tubing act upon the stinger sub and tubing during cementing and pressure testing operations. These forces are variable and are affected by the area of the cement retainer seal bore, casing and tubing pressure changes at the Cement Retainer, tubing size and weight and fluid weight.

An increase in casing pressure at the Cement Retainer tends to lift the tubing which can cause the collet (aka slide valve) to close. The force generated by a casing pressure increase is calculated by multiplying the casing pressure increase by the outside area of the tubing minus the seal bore area of the tool.

A pressure increase in the tubing exerts a lifting force at the top of the string which will reduce the effective hook load. A pressure increase in the tubing at the Cement Retainer will tend to hold the stinger sub in the tool and keep the collet open. The net of these two forces is upward and is equal to the increase in tubing pressure multiplied by the area of the seal bore in the cement retainer. When this force is equal to the tubing weight, any additional pressure will lift the tubing and allow the collet to close.

Therefore, the minimum setting depth will depend on the applied pressure changes in the tubing and casing acting to lift the available tubing weight.

The amount of tubing and annulus pressure that can be applied are limited for any size and length of tubing. When the total of the forces is equal to the weight of the tubing in fluid, an increase in either tubing or casing pressure will raise the tubing and close the collet. However, the cementing pressure may be increased if the casing pressure is decreased and vice versa.

The snap latch feature of the stinger sub has no effect on either opening or closing the collet. The stinger sub will remain in the Cement Retainer as long as the snap-out force is not exceeded. If excess tension is pulled on tubing while pressure testing the snap-out force may be overcome and the stinger sub will be pumped out.

G) PRESSURE AFFECTED AREA GUIDE

CEMENT RETAINER SIZE (INCHES)	TUBING OD (INCHES)	TUBING PRESSURE GREATER THAN CASING PRESSURE (AT CEMENT RETAINER)		TUBING ID AREA	CASING PRESSURE GREATER THAN TUBING PRESSURE (AT CEMENT RETAINER)		TUBING PRESSURE GREATER THAN CASING PRESSURE (AT CEMENT RETAINER DUE TO SWABBING)	
		Tubing Area	Casing Area		Tubing Area	Casing Area	Tubing Area	Casing Area
4-1/2	1.660	+0.1	-0.7	-1.5	+0.1	-0.7	-0.1	+0.7
	1.900	+0.6	-1.4	-2.0	+0.6	-1.4	-0.6	+1.4
	2.063	+1.0	-1.9	-2.4	+1.0	-1.9	-1.0	+1.9
	2.375	+1.7	-3.0	-3.1	+1.7	-3.0	-1.7	+3.0
	2.875	+3.3	-5.1	-4.7	+3.3	-5.1	-3.3	+5.1

The values given in the guide are shown as positive (+) and negative (-). These values reflect the area in square inches affected by pressure change and the direction of the resulting force. A positive area in square inches affected by pressure change and the direction of the resulting force. A positive area and a pressure increase will create a force tending to keep the collet open. A negative area and a pressure increase will tend to keep the collet closed. When the net force is negative additional set-down weight must be applied to keep the collet open. Use the following to calculate the net force in determining if additional set-down weight must be applied:



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G) PRESSURE AFFECTED AREA GUIDE (cont'd)

- G-1) Multiply the change in tubing pressure at the Cement Retainer by the tubing area given for the applicable condition (ex. tubing pressure greater than casing pressure).
- G-2) Multiply the change in casing pressure at the Cement Retainer by the casing area given for the applicable condition.
- G-3) Add together the forces acting on the tubing and the casing. If the sum is negative then additional set-down weight is required.
- G-4) Multiply the tubing gage pressure by the tubing ID area.

NOTE₁: This area is always negative and tending to close the collet by lifting the tubing at the surface.

- G-5) Add together all three forces. If the sum is negative and is greater than the total hook load of the tubing then the tubing will raise and the collet will close.

NOTE₂: Since the hook load is the limiting factor, high pressures at shallow depths may not be possible.

Example:

Cement Retainer Size	4-1/2
Tubing Size	2-3/8
Max Hook-Load Before Latching Snap-Out Seal Assy into Cement Retainer	7,000 Lbs
Max Cementing Pressure	3,000 PSI
Change in Tubing Pressure at Cement Retainer (Due to Heavier Fluid Introduced During Cementing plus Cementing Pressure).....	3,500 PSI
Casing Pressure to be Applied During Cementing	1,000 PSI
3,500 PSI (Tubing Pressure) X +1.7 (Tubing Area) =	5,950 Lbs
1,000 PSI (Casing Pressure Change) X -3.0 (Casing Area) =	-3,000 Lbs
5,950 Lbs - 3,000 Lbs =	+2,950 (Force Down)
3,000 PSI (Gage Pressure) X -3.1 (Tubing ID Area) =	-9,300 Lbs
+5,950 - 3,000 - 9,300 =	-6,350 Lbs

H) REMOVAL TECHNIQUES FOR CEMENT RETAINERS

H-1) GENERAL

Drilling is the preferred method of removing Cement Retainers since drilling can usually be accomplished in less than 10 percent of the time it takes to millout the same tool. This high removal time for the milling technique is explained by the mechanics of the two methods. Drilling causes a chiseling effect, and milling has a shaving effect of the target. Further, milling yields more debris of the type that causes penetration stoppage. Drilling with a short tooth, medium hard formation rock bit is usually the best combination for cement retainer removal.

H-2) SUGGESTED DRILLING TECHNIQUE

Though the best drilling technique will vary with available equipment, a typical combination of a short tooth, medium hard formation rock bit (ADC Codes 2-1, 2-2, 2-3, 2-4, and 3-1), 75 to 120 RPM rotary speed and such drill collars as necessary for weight and bit stabilization will provide desirable results. To drill the Cement Retainer:

- Apply 5,000-7,000 lbs until top end of the mandrel is drilled (4 to 5 inches)
 - Increase weight to 2,500-3,000 lbs. per inch of bit diameter to drill out remainder
- Example:** Use 12,000-14,500 lbs for a 4-3/4" OD bit
- Drill collars should be used as required for weight and bit stabilization
 - A rotary speed of 75-125 RPM is recommended
 - A Junk Basket should be used
 - The mud viscosity and gel strength should be sufficient to remove and support the cuttings. A minimum annular velocity of 120 Ft/min is recommended



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H-2) SUGGESTED DRILLING TECHNIQUE (cont'd)

When normal circulation is to be used, place a junk basket above the bit. If reverse circulation is planned, the casing scraper or other equipment in the tubing string should have an inside fluid passage as large as the passage through the bit so cuttings will not bridge.

Variations in bit speed and bit weight should be made to help break up debris to re-establish penetration should it cease while drilling.

Penetration may be stopped by "bit tracking" which is usually caused by insufficient weight on the bit. Bit tracking occurs when bit teeth travel in the same indentation of "track" made previously by another tooth. Successive tooth impact to the same location will sometimes deepen the track until indentations equal bit tooth length, reducing the impact of teeth to the point that they will not penetrate. Drilling penetration may be re-established by raising the bit off of the tool and then lowering the bit while maintaining rotation and making rapid bit contact with extra weight.

NOTE₃: Drilling times are directly related to tool size, bit stability, drilling weight, pump rate, bit RPM, type of bit, drilling fluid, etc. The same considerations should be used when drilling Cement Retainers as would be used when drilling medium hard formations.

H-3) SUGGESTED MILLING TECHNIQUE

If equipment availability or other considerations dictate that the Cement Retainer be milled, the recommended combination is a junk type mill tool rotated at 60-150 RPM with 5,000-8,000 lbs on the mill.

Use a mud viscosity of 60 CPS and a minimum annular velocity of 120 Ft/min to assure cutting removal. When ready to begin milling operations, start rotating the mill above the target and lower it slowly onto the target. Do not apply weight in excess of recommended amount. Excessive weight can tear out chunks of the Cement Retainer and make a bailer trip necessary to remove the chunks to allow further penetration . Maintain a constant milling rate by adding weight as the tool is milled away.



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I) PARTS LIST

ITEM	QTY	DESCRIPTION	MATERIAL	PART NUMBER
1	1	MANDREL INSERT	1026	84045215
2	1	MANDREL	G-2 CAST IRON	84045210
3	2	FEMALE EXPANSION RING	DURA BAR 65-45-12	84045815
4	2	MALE EXPANSION RING	DURA BAR 65-45-12	84045810
5	1	LOWER CONE	GRAY IRON	84045420
6	1	SLIP	GRAY IRON	84045135
7	1	LOCK RING	DLMS60	84055011
8	1	UPPER CONE RING	1026	84055825
9	1	UPPER CONE	GRAY IRON	84045410
10	1	COLLET	DURA BAR 80-55-06	84055660
11	1	SEAL	1026/90 DURO NITRILE	84055520
12	1	BOTTOM SUB	GRAY IRON	84045620
13	1	ELEMENT	80 DURO NITRILE	84045512
14	1	SET SCREW 5/16-18 UNC X 1/2	STEEL	SSS031C050
15	5	ROLL PIN 3/16 X 1/2	STEEL	RP018050
16	1	KEY 3/16 X 3/16 X 1"	DLMS110	KS018X018X100
17	1	MECHANICAL SLIP KIT	-	84045115ASSY
18	1	133 O-RING	90 DURO NITRILE	90133
19	1	223 O-RING	90 DURO NITRILE	90223
20	1	SHEAR SCREW (2000#) 5/16-18 UNC X 1/2	BRASS	BSSS031C050

ASSEMBLED WEIGHT	-	34 LBS
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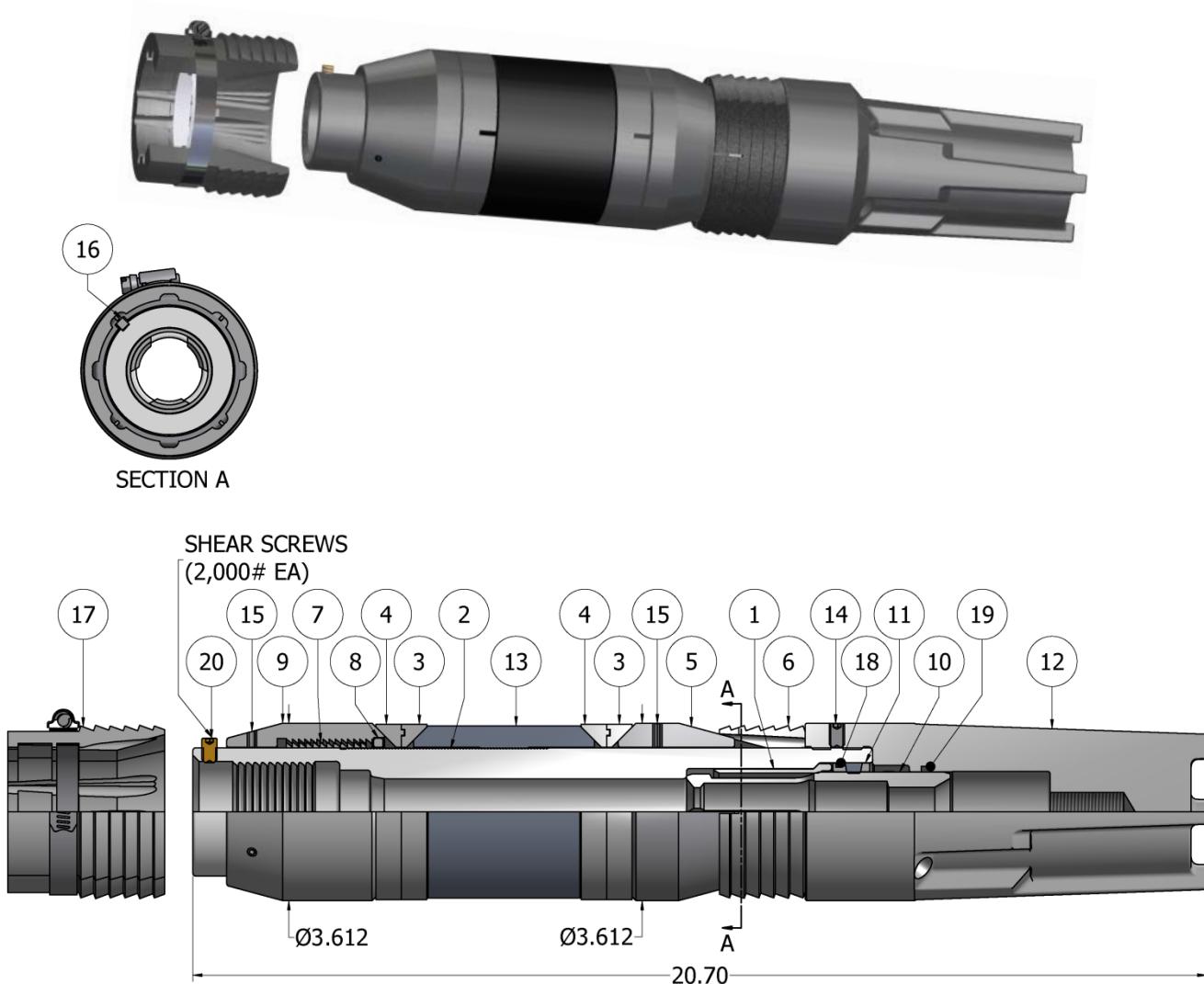
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J) TECHNICAL ILLUSTRATION



*During assembly, holes are drilled through upper cone and lower cone, and into mandrel, roll pins (15) installed, and then ground flush with upper cone and/or lower cone.



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K) REVISION HISTORY

DATE	REVISION	DESCRIPTION OF CHANGES	REVISED BY	APPROVED BY
01/20/2016	G	Rewrote manual; Created new manuals for 5", 5-1/2", 6-5/8", 7", 7-5/8", 8-5/8" sizes	J.Anderson	K.Riggs