A) DESCRIPTION

The VSI-X HT Packer, a Single-String Double-Grip Production Packer, is one of the most versatile packers on the market. This packer is a modification of the ASI-X Packer with the advantage of being able to set on electric line or hydraulically.

An On-Off Tool Stinger with a Wireline Plug installed can be attached to the top of this packer. This packer can then be lubricated in the hole and set under pressure. Once set, casing pressure can be bled off, and the tubing with an On-Off Tool Overshot can be run and latched onto the packer. The Wireline Plug can then be removed.

The VSI-X HT Packer is designed for differential pressures up to 10,000 PSI (unless noted otherwise). The HT version allows this packer to be utilized in completions where high pressure treating operations are performed and it is desirable to leave the tool in the well for production.

This packer easily converts to a mechanically set ASI-X HT Packer – just remove the shear screws and install drag blocks and drag block springs. The ASI-X HT Packer sets with 1/4 right-hand rotation, and releases with 1/4 right-hand rotation. The ASI-X HT Packer can be left in tension, compression or neutral.

NOTE$_1$: Stinger and setting equipment must be purchased separately.

NOTE$_2$: This packer requires at least a 30 second burn on the wireline setting tool to ensure a proper set. A burn time less than 30 seconds may shear the setting tool off of the packer before fully setting the packer.

B) RELATED TOOLS (sold separately)

B-1) 5-1/2” – 7-5/8” X 2-7/8” Wireline Adapter Kit (WLAK) (P/N 97156) —refer to technical manual *DL-971-5500-440*.

B-2) 2-7/8” DT-2 On/Off Tool—refer to technical manual *DL-512-2875-146*.

B-3) 2-7/8” Stinger - actual P/N varies depending on customer requirements.

C) SPECIFICATION GUIDE

CASING			TOOL		THREAD CONNECTION BOX UP / PIN DOWN	PART NUMBER
SIZE (INCHES)	WEIGHT (LBS/FT)	RECOMMENDED HOLE SIZE (INCHES)	GAGE OD (INCHES)	NOMINAL ID (INCHES)		
7	17.0 – 26.0	6.276 – 6.538	6.000	2.50	2-7/8 EUE	60172HT 60172HTH[1] 60172HTV[2]
	26.0 – 32.0	6.094 – 6.276	5.875	2.50	2-7/8 EUE	60170HT 60170HTH[1] 60170HTV[2]
	29.0 – 35.0	6.004 – 6.184	5.812	2.50	2-7/8 EUE	60171HT 60171HTH[1] 60171HTV[2]

Elastomer Trim Options: [1]HSN, [2]Viton

NOTE$_3$: Tools listed are right-hand set / right-hand release.

NOTE$_4$: Use of a Double Hook J-slot Packer is recommended when running with a pumpjack to help prevent the packer from unsetting during well production.

D & L OIL TOOLS
P.O. BOX 52220 TULSA, OK 74152
PHONE: (800) 441-3504 www.dloiltools.com

C) SPECIFICATION GUIDE (cont’d)

DIFFERENTIAL PRESSURE (MAX)	TENSILE LOAD THRU TOOL (MAX)
10,000 PSI	70,000 LBS

D) PRE-INSTALLATION INSPECTION PROCEDURES

CAUTION$_1$: D&L ships tool connections made-up **HAND TIGHT**—labeled with hand-tight tape on the tool (Fig. 1) — unless stated otherwise. Tighten/torque all connections properly before operating tool.

Fig. 1

GENERAL THREAD CONNECTION TORQUE RECOMMENDATIONS			
STUB ACME / ACME THREADS	**INTERNAL TAPERED TUBING THREADS**		**PREMIUM THREADS**
	UP TO 2-3/8”	**GREATER THAN 2-3/8”**	
600 – 800 FT-LBS	600 – 800 FT-LBS	800 – 1,200 FT-LBS	Consult thread manufacturer’s recommendations.

GENERAL SCREW TORQUE RECOMMENDATIONS									
SCREW SIZE (INCHES)	#6	#8	#10	1/4	5/16	3/8	7/16	1/2	5/8 and larger
TORQUE RANGE (INCH-POUNDS)	5 – 8	10 – 15	18 – 25	25 – 40	50 – 80	90 – 135	160 – 210	250 – 330	450 - 650

Before first use, D&L recommends disassembly and inspection of the tools unless stated otherwise. Ensure parts have not been damaged during shipping. Replace damaged parts with D&L replacement parts. Contact D&L sales for replacement part information.

Re-assemble the tool after inspection. Install parts in the correct order and orientation. Properly tighten connections.

Before re-using the tool, D&L recommends disassembly and inspection of the tool. Clean parts and ensure parts are in good working condition. Replace worn or damaged parts with D&L replacement parts.

When redressing the tool, D&L recommends replacement of all seals, elements, o-rings, shear screws, etc. Contact D&L sales for redress kit and/or other part information.

E) RELEASING PROCEDURES

The releasing procedures are the same whether the packer has been tension or compression set. Set down weight on the packer to unseat the J-pin from the tension shoulder of the J-slot. Refer to the Pressure Affected Area Guide to determine necessary set down weight on the packer. Rotate the work string 1/4 right-hand turn at the packer and pick up while holding right hand torque. Weight in addition to pipe weight may be required to pick up on packer – refer to Pressure Affected Area Guide. The internal by-pass will open, allowing pressure to equalize. After pressure is equalized, continue to pick up to release the upper slips, relax the elements and release the lower slips thus allowing the packer to be re-set or removed from the well.

CAUTION$_2$: High differential pressure below the VSI-X may cause the upper slips to wedge in tighter, requiring an extra amount of tension to release the upper slips.

F) STORAGE RECOMMENDATIONS

When preparing the tool for storage, follow the Pre-Installation Inspection Procedures. Re-assemble the tool with connections hand-tight only and in running position if applicable. Elements should be in a relaxed state—free from tension, compression and other stresses that could cause deformation.

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.

G) PRESSURE AFFECTED AREA GUIDE

When set downhole, the packer mandrel is subjected to a force created by differential pressure above or below the packer that acts on the pressure affected area (i.e., the piston effect). Depending on the tubing size and weight and the seal area of the packer the force created by differential pressure acts upwards or downwards on the packer mandrel. An upward force, designated as a negative (-) value, acts to push the packer mandrel up hole and must be accounted for to ensure that the packer remains set. A downward force, designated as a positive value, acts to push the packer mandrel down hole and must be accounted for when releasing the packer. Other factors (e.g., tubing movement due to temperature change) must be considered separately to determine all the forces acting on the packer.

PACKER SIZE (INCHES)	**TUBING SIZE** (INCHES)	**PRESSURE AFFECTED AREA** (SQ. INCHES)	
		ABOVE	**BELOW**
7 X 2-7/8	2.375	3.87 (DOWN)	-5.17 (UP)
	2.875	1.80 (DOWN)	-3.62 (UP)
	3.500	-1.33 (UP)	-1.26 (UP)

Example: Consider a 7” X 2-7/8” VSI-X Packer set on 2.375” tubing with a differential pressure of 3,000 PSI in the annulus around the tubing above the packer. What is the force acting on the seal area of the mandrel?

To calculate the force (lbs) acting on the seal area of the mandrel, refer to the Pressure Affected Area Guide for a 7” X 2-7/8” VSI-X Packer run on 2.375” tubing. In this example, the differential pressure from above the packer acts on the seal area of the packer mandrel across a pressure affected area of 3.87 in^2. Multiplying the differential pressure (3,000 PSI) by the pressure affected area (3.87 in^2) results in a force of 11,610 lbs. The piston effect on the packer mandrel is an downward force of 11,610 lbs.

H) ELASTOMER TRIM TEMPERATURE GUIDE

NITRILE (STD)			
TEMPERATURE RANGE (F°)	**DUROMETER**		
	END	**MIDDLE**	**END**
70° - 125°	80	70	80
125° - 250°	90	70	90
150° - 250°	90	80	90
250° +	Contact D&L Sales		

RUBBER TYPE	**TEMPERATURE RANGE**
NITRILE	70° - 250°F
HSN (HNBR)	70° - 300°F
VITON	100° - 350°F

I) RECOMMENDED TOOLS

I-1) HAND TOOLS

- VISE
- GLOVES
- ALLEN WRENCHES
- TAPE MEASURE
- O-RING PICK
- BAR
  - 1/2-INCH
  - 3/4-INCH
- PAINT BRUSH, 2-INCH
- PIPE WRENCH, 3-FT (2 EA)
- “CHEATER” PIPE, 4-FT LONG
- ADJUSTABLE WRENCH, 12-INCH
- CORDLESS DRILL, 18V
- SNAP RING SPREADER PLIERS
- ALIGNING PUNCH
- SCREWDRIVER SET, FLAT-TIPPED
- SOCKET SETS
  - 3/8-INCH DRIVE
  - 1/2-INCH DRIVE
- HAMMERS
  - SLEDGE
  - BALL PEEN
  - DEAD BLOW

I-2) SPECIAL TOOLS

ITEM	QTY	DESCRIPTION	PART NUMBER
T-1	1	ASSEMBLY TOOL 4-1/2” - 7-5/8” VSI-XW	AT100

J) DISASSEMBLY

J-1) Clamp spring cage (5) in vise.

J-1.1) Unscrew and remove bottom nipple (32) from J-pin bottom sub (23).

J-1.2) Unscrew and remove set screws (35) from drag block body (18). Rotate drag block retainer (21) as needed.

J-1.3) Unscrew and separate drag block body (18) from J-body (20) (**NOTE$_5$**: Left-hand threads).

NOTE$_6$: Drag block body assembly must be free to rotate.

J-1.4) Unscrew and remove shear screws (3) from J-body (20). Move drag block body (18) as needed.

J-1.5) Unscrew and remove set screws (34) from J-pin bottom sub (23). Move J-body (20) as needed.

J-1.6) Unscrew and remove J-pin bottom sub (23) from inner mandrel (2).

J-1.6.1) Remove o-ring (40) from J-pin bottom sub (23).

J-1.7) Remove J-body (20) and retaining ring (31) from inner mandrel (2).

J-1.8) Unscrew and remove rubber mandrel cap (19) from rubber mandrel (11).

NOTE$_7$: For added leverage, insert a rod through rubber retainer (15) and rubber mandrel (11) as needed.

J-1.9) Remove drag block retainer (21) from drag block body (18).

J-1.10) Wedge lower slips (17) outwards (if needed). Remove drag block body assembly and disassemble:

J-1.10.1) Remove wedges. Remove lower slips (17) and lower slip springs (25) from drag block body (18).

J-1.11) Unscrew and remove lower cone (16) from rubber retainer (15).

J-1.12) Unscrew rubber mandrel (11) from center coupling (10).

J-1.13) Remove rubber mandrel assembly and disassemble:

J-1.13.1) Remove gage ring (29), elements (13, 14), rubber spacers (12), and rubber retainer (15) from rubber mandrel (11).

J-1.14) Unscrew and remove center coupling (10) from collet upper cone (9).

J-1.14.1) Remove seal (24) and o-ring (41) from center coupling (10).

J-1.14.1.1) Remove o-ring (39) from seal (24).

J-1.15) Remove bearing bushing (30) and collet upper cone (9) from inner mandrel (2).

J-1.16) Wedge releasing slip (7) and upper slips (8) outwards (if needed). Unscrew and remove inner mandrel assembly from top sub (1).

J-1.17) Remove releasing slip (7), upper slips (8) and upper slip springs (26) from upper slip body (6).

J-1.18) Disassemble inner mandrel assembly:

J) DISASSEMBLY (cont’d)

J-1.18.1) Unscrew and remove set screws (36) from cover sleeve (28).

J-1.18.2) Remove cover sleeve (28) from inner mandrel (2).

J-1.18.3) Remove snap ring (38) from inner mandrel (2).

J-1.18.4) Remove swivel sleeve (37) and bearing rings (22) from inner mandrel (2)

J-1.19) Unscrew and remove spring cage cap (27) from spring cage (5).

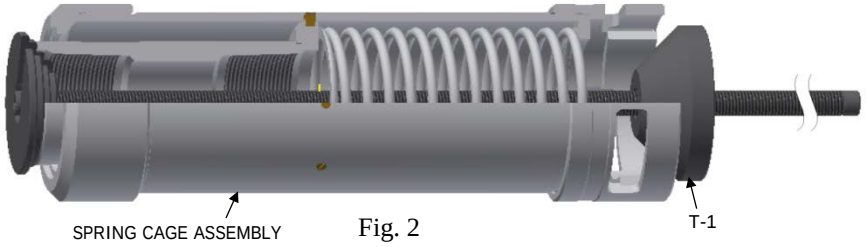


Fig. 2

J-1.20) Disassemble spring cage assembly:

J-1.20.1) Position assembly tool (T-1) hand-tight against top sub (1) and upper slip body (6) of spring cage assembly (Fig. 2).

CAUTION$_3$: Compression spring (4) is compressed with tension against spring cage assembly.

J-1.20.2)Unscrew and remove shear screws (3) from spring cage (5).

J-1.20.3) Release compression spring (4) tension by loosening assembly tool (T-1). Remove tool from assembly.

J-1.20.4) Remove top sub (1), and compression spring (4) from spring cage (5).

J-1.20.5) Unscrew and remove upper slip body (6) from spring cage (5).

J-1.20.6) Remove spring retainer ring (33) from upper slip body (6).

J-2) Remove spring cage (5) from vise.

K) ASSEMBLY

NOTE$_9$: Clean and inspect all parts. Replace all worn and damaged parts. Install parts in proper order, and orientation and tighten/torque all connections properly.

CAUTION$_5$: To ensure tool operates properly, install o-rings in o-ring grooves **NOT** thread reliefs unless stated otherwise (Fig. 3).

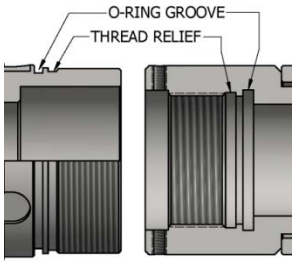


Fig. 3

K-1) Clamp spring cage (5) in vise.

K-2) Assemble spring cage assembly:

K-2.1) Install spring retainer ring (33) into upper slip body (6).

K-2.2) Screw upper slip body (6) onto spring cage (5).

K-2.3) Install compression spring (4) and top sub (1) into spring cage (5).

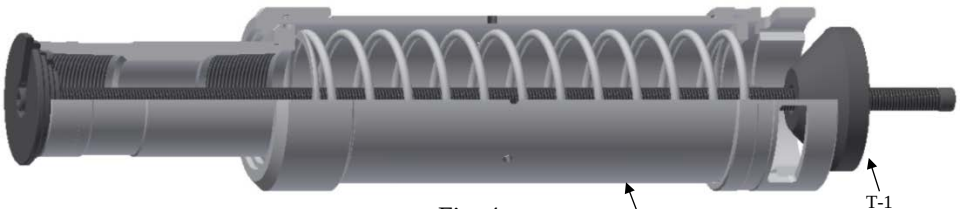


Fig. 4

K-2.4) Compress compression spring (4) with assembly tool (T-1) (Fig. 4).

K) ASSEMBLY (cont’d)

K-2.5) Align threaded holes in spring cage (5) with recessed holes in top sub (1). Screw shear screws (3) into spring cage (5). Tighten until shear screws (3) make contact with top sub (1). Back shear screws (3) out 1/4 turn.

K-2.6) Remove assembly tool (T-1) from spring cage assembly.

CAUTION$_3$: Compression spring (4) is compressed with tension against spring cage assembly.

K-2.7) Screw spring cage cap (27) onto spring cage (5).

K-2.8) Install upper slip springs (26), upper slips (8), and releasing slip (7) into upper slip body (6). Wedge releasing slip (7) and upper slips (8) outwards.

NOTE$_{11}$: Install two (2ea) springs per slip.

K-3) Assemble inner mandrel assembly and install:

K-3.1) Install bearing rings (22) and swivel sleeve (37) onto inner mandrel (2).

K-3.2) Insert snap ring (38) in groove in inner mandrel (2).

K-3.3) Install cover sleeve (28) onto inner mandrel (2).

K-3.4) Align threaded holes in cover sleeve (28) with groove in inner mandrel (2). Screw set screws (36) into cover sleeve (28).

K-3.5) Screw inner mandrel (2) into top sub (1). Remove wedges from slips.

K-4) Install collet upper cone (9) and bearing bushing (30) onto inner mandrel (2).

K-5) Install o-ring (39) in groove in seal (24).

K-6) Install seal (24) into center coupling (10).

CAUTION$_4$: Do not rip or tear o-ring during installation.

K-7) Install o-ring (41) in groove in center coupling (10).

K-8) Screw center coupling (10) onto collet upper cone (9).

NOTE$_8$: For added leverage, insert a rod through collet upper cone (9) as needed.

K-9) Assemble rubber mandrel assembly and install:

K-9.1) Install rubber retainer (15), elements (13, 14), rubber spacers (12), and gage ring (29) onto rubber mandrel (11).

K-9.2) Install rubber mandrel assembly onto inner mandrel (2). Screw rubber mandrel (11) into center coupling (10).

CAUTION$_4$: Do not rip or tear o-ring during installation.

K-10) Screw lower cone (16) into rubber retainer (15).

K-11) Assemble drag block body assembly and install:

K-11.1) Install lower slip springs (25) and lower slips (17) into drag block body (18). Wedge lower slips (17) outwards.

NOTE$_{11}$: Install two (2ea) springs per slip.

K-11.2) Install drag block body assembly onto rubber mandrel (11). Remove wedges.

K-12) Screw rubber mandrel cap (19) onto rubber mandrel (11).

NOTE$_7$: For added leverage, insert a rod through rubber retainer (15) and rubber mandrel (11) as needed.

K-13) Install drag block retainer (21) onto drag block body (18).

K-14) Install retaining ring (31) onto J-body (20).

K-15) Install J-body (20) onto inner mandrel (2).

K-16) Install o-ring (40) in groove in J-pin bottom sub (23).

K-17) Screw bottom nipple (32) into J-pin bottom sub (23).

K-18) Install J-pin bottom sub (23) into J-slots in J-body (20). Screw J-pin bottom sub (23) onto inner mandrel (2).

K) ASSEMBLY (cont’d)

K-19) Align threaded holes in J-body (20) with recessed holes in rubber mandrel cap (19). Screw shear screws (3) into J-body (20). Tighten until shear screws (3) make contact with rubber mandrel cap (19). Back shear screws (3) out 1/4 turn.

CAUTION$_4$: Do not rip or tear o-ring during installation.

NOTE$_{10}$: If needed, back off J-pin bottom sub (23). But no more than 1/8 turn (45°) should be needed.

K-20) Screw set screws (34) into J-pin bottom sub (23).

K-21) Screw drag block body (18) onto J-body (20). Align thread holes in drag block body (18) with groove in J-body (20) (**NOTE$_5$**: Left hand threads).

NOTE$_6$: Drag block body assembly must be free to rotate.

K-22) Screw set screws (35) into drag block body (18). Rotate drag block retainer (21) as needed.

K-23) Remove assembled tool from vise.

L) PARTS LIST

ITEM	QTY	DESCRIPTION	MATERIAL	26.0 - 32.0# 60170HT	29.0 - 35.0# 60171HT	17.0 - 26.0# 60172HT
1	1	TOP SUB	DLMS110	60170610HT		
2	1	INNER MANDREL	DLMS110	60370211HT		
3	16	SHEAR SCREW (2375#)	DLM360BRS	60100990		
4	1	COMPRESSION SPRING	CHROME VANADIUM	60373920		
5	1	SPRING CAGE	DLMS60	60173310		
6	1	UPPER SLIP BODY	DLMS110 / DLMS60	60073320HT	60071320HT	60073320HT
7	1	RELEASING SLIP	DLMS110	60073125	60067125	60073125
8	2	UPPER SLIP	DLMS35	60073115	60067115	60073115
9	1	COLLET UPPER CONE	DLMS110	60370411HT		
10	1	CENTER COUPLING	DLMS35	60370620		
11	1	RUBBER MANDREL	DLMS60	60370220	60371220	60370220
12	2	RUBBER SPACER	DLMS35	60270840	60271840	60272840
13	1	ELEMENT	80 DURO NITRILE	60270512		60272512
14	2	ELEMENT	90 DURO NITRILE	60270513		60272513
15	1	RUBBER RETAINER	-	60370850	60271850	60372850
16	1	LOWER CONE	DLMS110	60070420HT		
17	4	LOWER SLIP	DLMS35	60070135		
18	1	DRAG BLOCK BODY	DLMS60 / DLMS35	60070335		
19	1	RUBBER MANDREL CAP	DLMS60	60170230		

L) PARTS LIST (cont’d)

ITEM	QTY	DESCRIPTION	MATERIAL	26.0 - 32.0# 60170HT	29.0 - 35.0# 60171HT	17.0 - 26.0# 60172HT
20	1	J-BODY	DLMS60	60170340HT		
21	1	DRAG BLOCK RETAINER	DLMS60	60070910	60071910	60070910
22	2	BEARING RING	DLMS110	60370103		
23	1	J-PIN BOTTOM SUB	DLMS110	60370634HT		
24	1	BONDED SEAL	90 DURO NITRILE	60070520		
25	8	LOWER SLIP SPRING	-	7170901		
26	6	UPPER SLIP SPRING	-	7170902		
27	1	SPRING CAGE CAP	-	60173810	60171810HT	60173810
28	1	COVER SLEEVE	DLMS60	60370106		
29	1	GAGE RING	-	60270830	60271830	60272830
30	1	BEARING BUSHING	DLMS60	60170224	60370224	60170224
31	1	RETAINING RING	DLMS60	60070911		
32	1	BOTTOM NIPPLE	DLMS80	60370636		
33	1	SPRING RETAINER RING	DLMS35	60073820		
34	2	SET SCREW 1/4-20 UNC	STEEL	SSS025C037 (3/8" LONG)	SSS025C043 (7/16" LONG)	SSS025C037 (3/8" LONG)
35	3	SET SCREW 5/16-18 UNC X 1/2	STEEL	SSS031C050		
36	3	SET SCREW 5/16-18 UNC	STEEL	SSS031C031 (5/16" LONG)	SSS031C037 (3/8" LONG)	SSS031C031 (5/16" LONG)
37	1	SWIVEL SLEEVE	DLMS110	60370100		
38	1	SNAP RING	DLMS110	60370102		

L) PARTS LIST (cont’d)

ITEM	QTY	DESCRIPTION	MATERIAL	26.0 - 32.0# 60170HT	29.0 - 35.0# 60171HT	17.0 - 26.0# 60172HT
39	1	153 O-RING	90 DURO NITRILE	90153		
40	1	233 O-RING	90 DURO NITRILE	90233		
41	1	242 O-RING	90 DURO NITRILE	90242		
42	8	SHEAR SCREW (5500#) 1/2-13 UNC X 7/16	DLM360BRS	BSSSLT050C043*		

*Refer to WLAK tech manual for placement.

REDRESS KIT (RDK)		60170050HT	60171050HT	60172050HT
ASSEMBLED WEIGHT		297 LBS	293 LBS	300 LBS

L-1) ELASTOMER TRIM OPTIONS

NOTE$_{12}$: For temperature range, refer to Elastomer Trim Temperature Guide.

L-1.1) HSN

ITEM	QTY	DESCRIPTION	MATERIAL	26.0 - 32.0# 60170HTH	29.0 - 35.0# 60171HTH	17.0 - 26.0# 60172HTH
13	1	ELEMENT	80 DURO HSN	60270512H		60272512H
14	2	ELEMENT	90 DURO HSN	60270513H		60272513H
24	1	BONDED SEAL	90 DURO HSN	60070520H		
39	1	153 O-RING	90 DURO HSN	90153H		
40	1	233 O-RING	90 DURO HSN	90233H		
41	1	242 O-RING	90 DURO HSN	90242H		

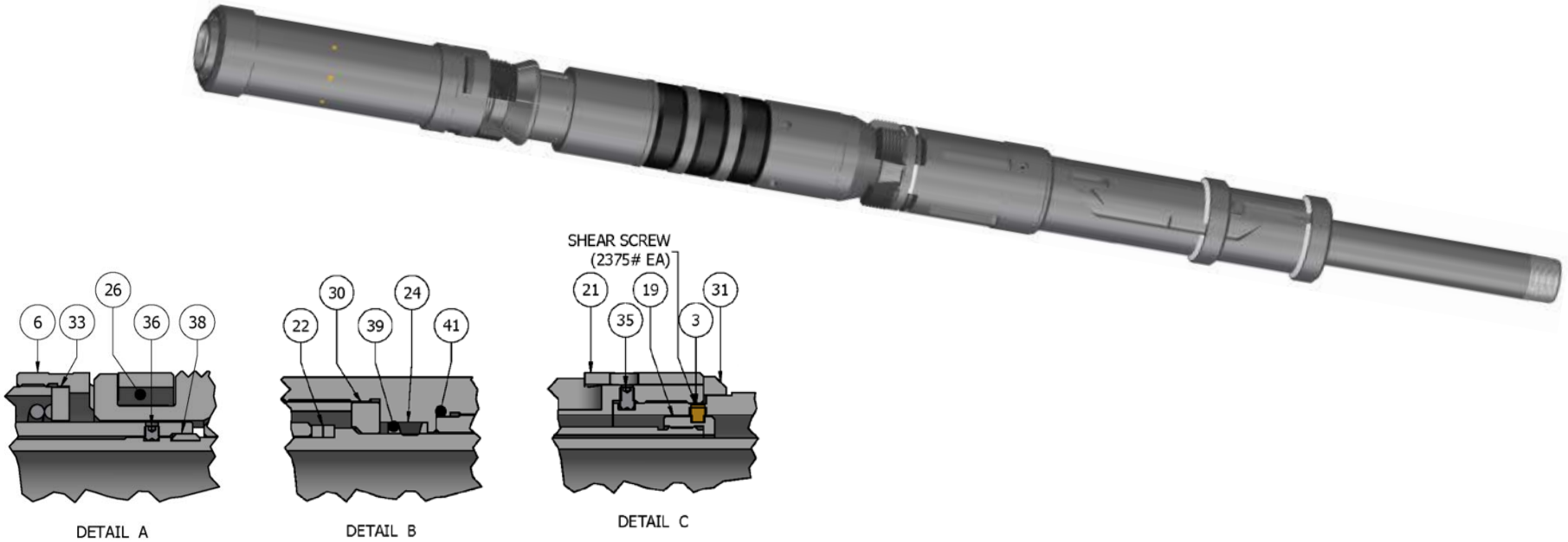
REDRESS KIT (RDK)		60170050HTH	60171050HTH	60172050HTH

L-1.2) VITON

ITEM	QTY	DESCRIPTION	MATERIAL	26.0 - 32.0# 60170HTV	29.0 - 35.0# 60171HTV	17.0 - 26.0# 60172HTV
13	1	ELEMENT	80 DURO VITON	60270512V		60272512V
14	2	ELEMENT	90 DURO VITON	60270513V		60272513V
24	1	BONDED SEAL	90 DURO VITON	60070520V		
39	1	153 O-RING	90 DURO VITON	90153V		
40	1	233 O-RING	90 DURO VITON	90233V		
41	1	242 O-RING	90 DURO VITON	90242V		

REDRESS KIT (RDK)		60170050HTV	60171050HTV	60172050HTV

M) TECHNICAL ILLUSTRATION



N) REVISION HISTORY

DATE	REVISION	DESCRIPTION OF CHANGES	REVISED BY	APPROVED BY
04/20/2016	G	Added Related Tools, Storage Recommendations; Revised Elastomer Durometer Temperatures – Nitrile (90/80/90 Duro) was 250° - 300°F, Nitrile (Contact D&L Sales) was 300°F +, Rubber Type Temperature Ranges – Nitrile was 70° - 300°F, HSN was 70° - 325°F, SSS031C031 qty 3 was 4	J.Anderson	C.Colvin
05/14/13	F	Revised 60370850 was 60170850; Removed setting kit section; Added references to WLAK tech manual *DL-971-5500-440*	J.Anderson	H.Bringham
01/03/13	E	Revised P/N 60170HT 297 lbs assembled weight was 296 lbs, P/N 60172HT 300 lbs assembled weight was 299 lbs, technical illustration; Removed emergency release instructions from releasing procedures section, AFLAS from element selection guide; Added HSN and Viton options (60172HTH, 600172HTV, 60170HTH, 60170HTV, 60171HTH, 60171HTV), recommended tools and revision history sections, P/N BSSSLT050C043; Rewrote disassembly and assembly instructions.	J.Anderson	K.Plunkett