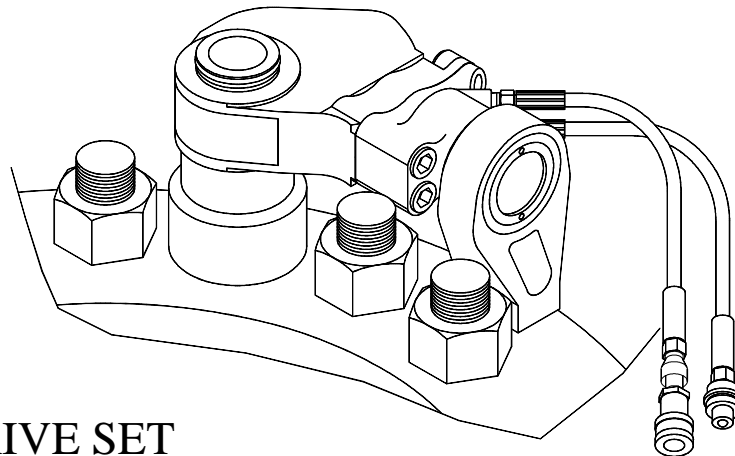


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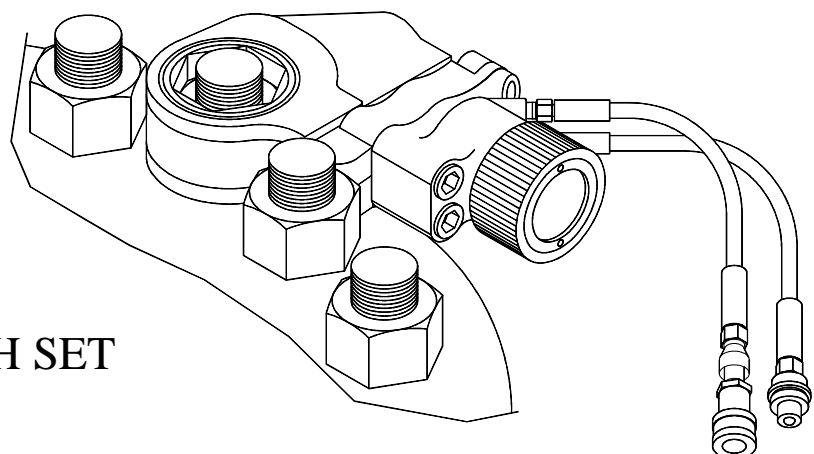


RSL[™]

OPERATION & MAINTENANCE MANUAL



SQUARE DRIVE SET



HEX WRENCH SET

SALES, PARTS, REPAIR, CALLIBRATION, SERVICE and RENTAL:

Western hemisphere: 2440 E. Pasadena Freeway, Pasadena, TX 77506, tel. 713-860-4200, toll free in USA: 1-800-895-3849

Eastern hemisphere: Bentley Road South, Darlaston, West Midlands, WS10 8LQ England, Phone: 0121 50 50 600

Optional - REPAIR and CALIBRATION: 2010 Clermont Street, Antigo, WI 54409, tel: 715-627-5519, fax: 715-627-5544, toll free in USA: 1-800-569-6807

WEB SITE: <http://www.hydratight.com>

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This tool, when used in conjunction with the specified console and hoses, conforms with the requirements for CE Marking. Contact Hydratight for a list of approved components.

SAFETY FIRST

RSL power tools enable the user to more easily accomplish bolting tasks with increased force, accuracy, and efficiency. It is due to the powered nature of the tools, with large forces generated from high pressure fluid/air and electricity applied to a variety of applications, that adherence to strict safety issues through the proper design and documented use of RSL tools. However, the user must accept the primary responsibility of safety when using RSL tools by reading, understanding, and complying with all operating instructions prior to and during operation. In a commitment to facilitate user understanding of all operating instructions, HYDRATIGHT offers (upon request) free videotapes and on-site training by a local representative. This manual and additional safety related services are designed to assist in the proper training for use and care of RSL tools and play a major role in preventing accidents and increasing safety.

The following safety related operating instructions are documented in the manual and on a Safety Tag which should always be attached to the hydraulic pump when in use:



Operator must read and understand all operating instructions prior to operations! In addition to this Manual, HYDRATIGHT offers (per request) videotapes and/or training on site by local representative.



One-person operation recommended. Only one trained & competent person should control the operation of the tool. **When two-person operation cannot be avoided** a risk assessment must be undertaken that fully address the specific application, communication, & co-ordination of the tool operation between the two users, the person **HOLDING** the wrench should control operations. (**Note: The person in control does not necessarily have the control pendant in his possession, but will give the commands to energize the console.**)



Do not use electric pump in explosive or wet environment! If electric pump is used, assure that grounding, power supply, and extension cord meet electrical code. Be aware of electrical hazards.



Keep hands and fingers clear from pinch points! Pinch points are present around reaction area and in tight spaces.



Set reaction properly! Improper reaction set-up and/or incorrect socket size will cause a concentration of stress that can make the tool, socket, or nut vulnerable to fracture. The common cause of socket breakage is cocking, a condition when socket fits over the bolt at an angle. Read this manual for examples of “how to” and “how not to” react, with and without Reaction Arm.



High hydraulic pressure hazards, 10,000 psi (690 bar)!

- Use proper tools, hoses, fittings and protective equipment.
- Keep clear of leaking hydraulic fluid.
- Never exceed the maximum working pressure. Marking on the Wrench Head indicates maximum working pressure requirements.



Wear safety glasses! Eye protection is necessary when working with or near the pressurized hydraulic system.



Do not expose hoses to damaging conditions! Hose damage may result from mechanical, thermal, or chemical abuse and may release hydraulic fluid under pressure and cause injury.



Disconnect all power supply before performing any maintenance!



Maintain equipment in good working condition! Inspect for cracks, wear, and lubricate moving parts with SWEENEY 503 lubricant. Remove damaged equipment from service.



Do not modify or subject any equipment or accessories to impact! Contact HYDRATIGHT for special tool applications or modifications. Unauthorized modification(s) may cause injury.

To avoid possibility of falling objects in elevated areas, tool must be tied off to application area and reaction arm firmly attached to tool! Reaction arm must be firmly attached with locking devise provided as part of arm (Dialock, ...) and can be further retained by safety cable. Contact Hydratight for Bulletin 116, which shows how to tie reaction arm to tool with cable.

SECTION 1

GENERAL

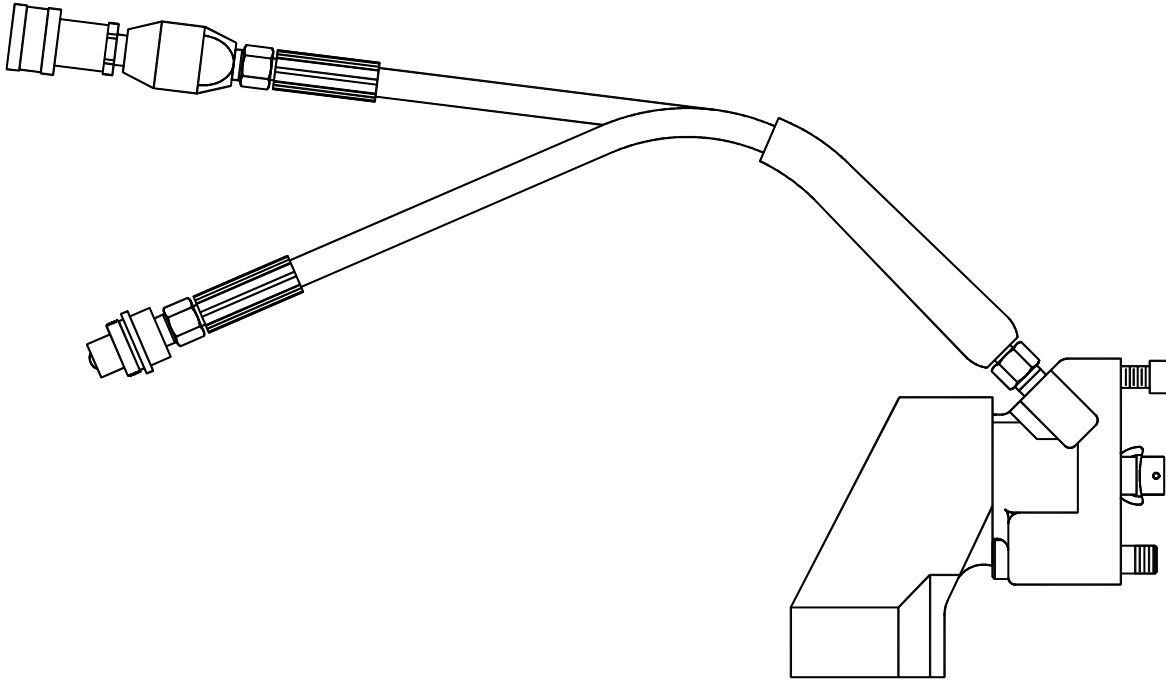


FIGURE 1-1
RSL POWER HEAD

BRIEF DESCRIPTION

Ratcheting Slim Line (RSL) Tool is operated with 10000 psi (690 bar)* hydraulic pressure and is used to apply a specific tension to studs, bolts and cap screws by applying the proper torque value for a specific bolting material, size and type of lubrication. The Tool is also used to remove the tension when loosening is necessary.

The Tool is powered by a Console (hydraulic pump). The desired tension is achieved by precisely controlling the hydraulic fluid pressure produced by the Console and controlling the frictional force exerted between the studs and nuts. The hydraulic fluid pressure produced by the Consoles is accurate to $\pm 1\%$. The friction force is controlled by applying a **lubricant** with a known coefficient of friction to the threads and mating surfaces.

RSL Tool is offered in Seven standard models:

(Example of RSL tool is shown in figure 1-1)

- RSL2 with a maximum torque output of 1408 ft-lb. (1909 N-m)
- RSL4 with a maximum torque output of 3080 ft-lb. (4176 N-m)
- RSL6 with a maximum torque output of 5303 ft-lb. (7190 N-m)
- RSL8 with a maximum torque output of 7862 ft-lb. (10660 N-m)
- RSL14 with a maximum torque output of 11154 ft-lb. (15123 N-m)
- RSL20 with a maximum torque output of 18843 ft-lb. (25514 N-m)
- RSL30 with a maximum torque output of 28002 ft-lb. (37966 N-m)



Caution! Do not modify any equipment or accessories. Contact HYDRATIGHT for special application(s) or modification(s). Unauthorized modification(s) may cause injury and damage, and will invalidate the warranty.

PREPARATION FOR OPERATION

Tools are inspected and tested at the HYDRATIGHT factory prior to shipment and should be ready for immediate use. However inspection of the Tool for damage and verification that all loose parts are included, is recommended.

* HYDRATIGHT offers full torque and limited torque RSL Wrench Heads –see marking on the housing.

SECTION 2

GENERAL OPERATING INSTRUCTIONS

GENERAL

The steps to be followed in selecting the correct Tool and Console for the Application and setting-up- the Tool are as follows:

STEP 1 Determine the torque value

1. The torque value to be used for applying tension should be the value **specified by the equipment manufacturer** whenever it is available. For convenience, chart of torque values for common sizes of ASTM A193 Grades B7 and B16 studs and lubricants are shown in Figures 2-1 and 2-2. The torque values in the charts are based upon the following:

Inch size studs are per ASTM A193, Grade B7 or B16, as applicable, with 10 UNC thread form on 3/4 inch studs, 9 UNC on 7/8 inch studs, 8 UNC on 1 inch studs, and 8 UN on 1 1/8 inch and larger studs. Inch size nuts are heavy hex per ASTM A194, Grade 2H. Metric size stud materials and thread forms are per IFI 500; Class 8.8 and nuts are per Class 9. Torque values listed in the charts will produce stud stress equal to 50% for B7 and 35% for B16 of the minimum yield strength of the specified materials, provided the threads and mating surfaces are in good condition and have been properly lubricated with the specified lubricant.

CAUTION: It the stud material, thread form, lubrication, or loading in your application is not the same as used to prepare the charts, do not use the charts. Contact Hydratight Customer Service for the bolting analysis of your application.

2. For other materials, thread forms, lubricants, or loading, contact Hydratight Customer Service to have the proper torque determined free of charge. The following information must be provided to determine the proper torque value for your application:
 - a. Stud diameter at the threads (dimension **a** in Figure 2-1).
 - b. Nut size across the flat (dimension **b** in Figure 2-1).
 - c. Stud Grade (B7, B8, B16 etc.).
 - d. Lubrication to be used on threads and mating surfaces and, if known, coefficient of friction of the lubricant.
 - e. Desired tension (percentage of the yield strength of the stud material or tensile stress in the stud.)
 - f. Threads per inch (dimension **c** in Figure 2-1) or inches per thread (dimension **d** in Figure 2-1)
 - g. Extent of threading on the stud (full length or only at the ends).
 - h. Stud solid or hollow; if hollow, inside diameter of the hole.
 - i. Nut type (regular hex, heavy hex, special turntable diameter, etc.).

If the elongation of the stud or rotation of the nut methods are used to measure the tension in the studs, the following additional information must be provided:

- a. Desired tension (elongation of the stud or rotation of the nut).
- b. If the threading is only at the ends, outside diameter of the stud between the nut faces (dimension **e** in Figure 2-1).
- c. Effective bolt length (dimension **f** in Figure 2-1).

Note: Note the type of gasket material in use, as it may have an effect upon the tension required to achieve a good seal.

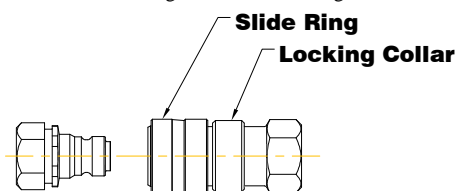
STEP 2 Select the Tool, which best meets the requirements of the application.

Note: When loosening, the Tool should be sized for torque values at least 1 1/2 and preferably 2 times of the tightening torque.

STEP 3 Select the Console, which best meets the requirements of the application.

STEP 4. Connect the air or electrical power source, as applicable, to the Console.

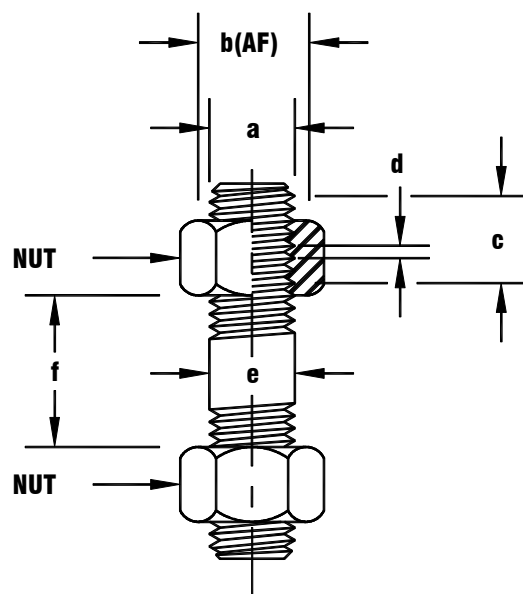
STEP 5. Connect the Twin Hoses to the Console. Each end of the hose will have one male and one female quick connect fitting. The Console will have like male/female quick connect fittings. Unscrew the locking collar on the female QD. Slide the outside slide ring back and snap the male and female together release the slide ring. Screw the locking collar back against the side ring.



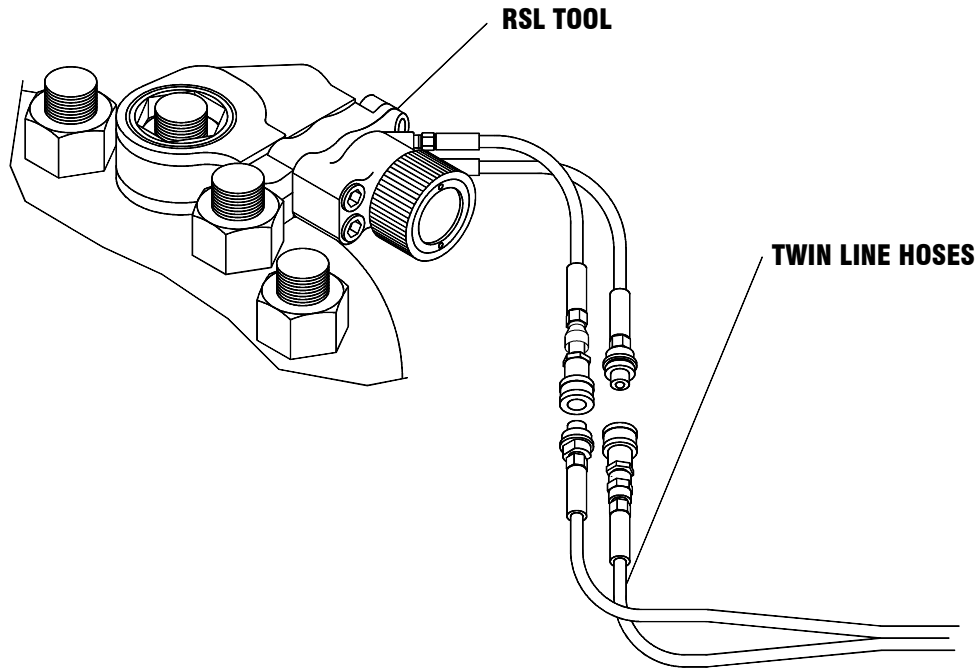
STEP 6 Connect the Twin Hoses to RSL Tool, using the Quick Connect Fittings, as shown in Figure 2-2, before setting the tool on the application. Each end of the hose will have one male and one female quick connect fitting. The RSL Tool will have like male/female quick connect fittings.

STEP 7. Set the torque value on the Console according to the instructions below for tightening or loosening, as applicable.

STEP 8. Set the Tool on the nut and operate in accordance with the instructions in Section 3 or Section 4, Tool Operating Instructions.



**FIGURE 2-1
STUD AND NUT DIMENSION**



**FIGURE 2-2
CONNECTING THE TWIN
HOSES TO RSL TOOL**

TIGHTENING

1. Mark the correct tightening sequence on the studs in a clockwise direction with chalk as per diagram. For more explanation please read ASME-PPC-1-2000 or refer to the Hydratight Joint Integrity Assurance procedures.

Criss-Cross Tightening Sequence Examples:

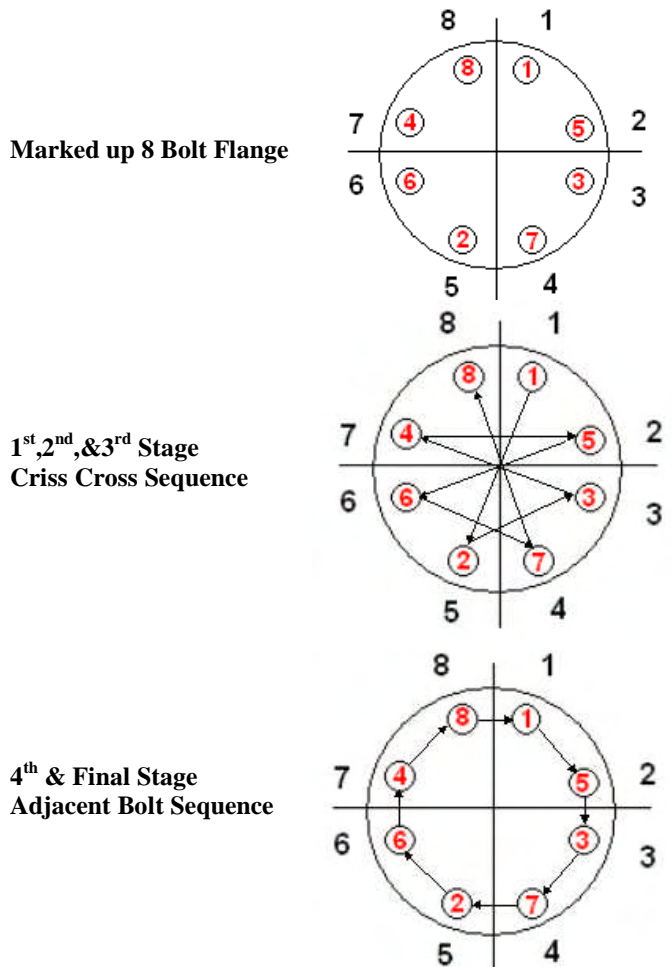
- 4 Bolt Flange 1-3-2-4
- 8 Bolt Flange 1-5-3-7-2-6-4-8
- 12 Bolt Flange 1-5-9-3-7-11-2-6-10-4-8-12
- 16 Bolt Flange 1-9-5-13-3-11-7-15-2-10-6-14-4-12-8-16
- 20 Bolt Flange 1-13-5-17-9-3-15-7-19-11-2-14-6-18-10-4-16-8-20-12
- 28 Bolt Flange 1-13-21-5-17-9-25-3-15-23-7-19-11-27-2-14-22-6-18-10-26-4-16-24-8-20-12-28
- 32 Bolt Flange 1-17-9-25-5-21-13-25-3-19-11-31-7-29-15-27-2-18-10-30-6-22-14-26-4-20-12-32-8-24-16-28

Note: Correct numbering of bolts should result in all odd numbered bolts around one side of the flange and all even numbered bolts around the other side.

- Determine the Torque Value for the stud or bolt to be tightened: -
- First tightening stage should be limited to a maximum of 30% of the final Torque setting.
- Second tightening stage should be limited to a maximum of 60% of the final Torque setting.
- Third tightening stage should be carried out at the 100% Torque setting.
- On the Fourth and Final tightening stage, change from diagonal tightening to adjacent bolt-to-bolt tightening clockwise using the 100% Torque setting and chase around flange until nuts finally stop rotating.
- Note: First, second and third stages should be tightened using the criss cross tightening sequence and the fourth stage should be tightened using the adjacent clockwise bolt to bolt sequence as shown in the diagrams above.

For more specific application based procedures please consult **Hydratight Sweeny Joint Integrity Assurance** procedures.

*HYDRATIGHT offers Manual Control Pendant (standard) and Digital Control Pendant (option).



**FIGURE 2-3
FASTENING SEQUENCE FOR CIRCULAR FLANGES**

BOLT SIZE (IN.)	MINIMUM YIELD STRENGTH (PSI)	BOLT TENSION (LBS.)	TORQUE FOR SPECIFIED LUBRICANT (FT-LBS.)							
			503 SWEENEY®	504 SWEENEY®	505 SWEENEY®	506 SWEENEY®	507 SWEENEY®	API SA2	MACHINE OIL	DRY STEEL ON STEEL
			f=.067	f=.085	f=.100	f=.110	f=.100	f=.117	f=.150	f=.200
3/4	105000	17754	104	128	147	159	147	168	209	272
7/8	105000	24495	167	204	234	254	234	268	335	435
1	105000	32129	249	304	349	379	349	400	499	649
1-1/8	105000	41873	362	442	508	553	508	584	730	953
1-1/4	105000	52905	502	615	709	772	709	816	1023	1337
1-3/8	105000	65226	675	829	958	1043	958	1103	1386	1814
1-1/2	105000	78835	878	1082	1253	1366	1253	1446	1820	2387
1-5/8	105000	93733	1124	1388	1608	1755	1608	1858	2342	3076
1-3/4	105000	109920	1411	1746	2024	2210	2024	2340	2953	3883
1-7/8	105000	127395	1744	2160	2507	2739	2507	2901	3664	4822
2	105000	146158	2100	2611	3037	3320	3037	3519	4455	5874
2-1/8	105000	166210	2529	3148	3663	4007	3663	4247	5381	7099
2-1/4	105000	187551	3011	3751	4368	4779	4368	5067	6424	8480
2-3/8	105000	210180	3552	4429	5160	5648	5160	5989	7597	10033
2-1/2	105000	234098	4154	5184	6042	6615	6042	7015	8903	11764
2-3/4	95000	258580	5024	6278	7324	8020	7324	8508	10807	14291
3	95000	310020	6545	8189	9558	10472	9558	11111	14124	18689
3-1/4	95000	366124	8346	10452	12207	13377	12207	14196	18057	23907
3-1/2	95000	426891	10451	13099	15307	16778	15307	17808	22664	30022
3-3/4	95000	492321	12880	16156	1887	20707	1887	21982	27989	37091
4	95000	562415	15658	19655	22986	25206	22986	26760	32408	41910
4-1/4	75000	503030	14850	18651	21819	23931	21819	25409	32379	42939
4-1/2	75000	565731	17654	22185	25961	28478	25961	30240	38548	51134

NOTE: 503 – MOLYBDENUM DISULFIDED BASED (FUNCTIONAL EQUIVALENT C670, MOLY – COTE G PASTE)
504 – MOLYBDENUM LEAD OXIDE & GRAPHITE BASED (FUNCTIONAL EQUIVALENT C100)
505 – COPPER & GRAPHITE BASED (FUNCTIONAL EQUIVALENT N1000)
506 – NICKEL & GRAPHITE BASED (FUNCTIONAL EQUIVALENT NICKEL EASE N5000, NEVER – SEEZ NICKEL SPECIAL)
507 – COPPER & GRAPHITE BASED (FUNCTIONAL EQUIVALENT C5A, NEVER SEEZ)

FIGURE 2-4
CHART OF TORQUE VALUES IN IMPERIAL UNITS FOR ASTM A-193 GRADE B7 WITH STUD
STRESS EQUAL TO 50% OF MINIMUM YIELD STRENGTH

ALTERNATE – STUD ELONGATION METHOD

If the stud elongation method of measuring tensioning is used, determine the torque value required to produce this amount of elongation in accordance with the instructions in Section 8, Tension, Torque and Elongation, or contact Hydratight Customer Service to have the value calculated free of charge. Then follow steps 1 through 7 above and measure the elongation of the studs. If the studs have not elongated fully, increase the torque value and continue to tighten the studs until the proper elongation is achieved. If the studs have elongated too far, loosen the studs until the proper elongation is achieved.

Caution: When elongating fasteners, care should be taken to not over elongate the fastener, stud or flange as yielding of the material may result.

LOOSENING

- Adjust the Console to 10,000 psi (690 bar)* prior to mounting the RSL Tool on the nut by turning the Torque Control Knob clockwise until it stops.
- NOTE: HYDRATIGHT offers full-torque and limited-torque versions of RSL Hex (or square) Wrench Heads as a standard. Reduced torque (and size) is for limited space applications. For limited torque wrenches, maximum operating pressures vary. Refer to the maximum torque rating stamped on the wrench housing. To avoid wrench damage, do not exceed maximum torque rating. If max. torque rating is not stamped on the housing of the wrench, the Hex (or square) Wrench Head has no torque restrictions.
- Liberal apply SWEENEY 501 penetrating oil to all the nuts in the application and let it set for a minimum of 5 minutes. Then setup the Tool on the nut to be loosened in accordance with the instructions in Section 3, Tooling Operation Instructions for RSL Tooling.

- To loosen the nut, place the RSL Tool to be used on the application in the loosening position (tool stroke extension will achieve a counter-clockwise rotation on the nut/bolt being worked). Depress and hold the Pendant Control button.

- Move the Tool to the next nut to be loosened and repeat step 3 until all the nuts have been turned 1/8 turn. For Cameron BOP Bonnet bolts, loosen the bolts in a four post pattern, for other bolt patterns, the loosening can progress from nut to nut sequentially.

Warning: If all the tension is removed from the first stud to be loosened at one time rather than loosening all the studs 1/8 turn, the tension in the remaining fastened studs will increase and may result in damage to the studs or flange.

- If the torque required to initially loosen the nuts was less than 150% of the tightening torque value, then the remaining tension may be fully removed in each nut sequentially.
- If the torque required to initially loosen the nuts was greater than 150% of the tightening torque value, repeat steps 3 and 4 on additional time for each nut so that the remaining tension may be fully removed in each nut sequentially.

BOLT SIZE (IN.)	MINIMUM YIELD STRENGTH (PSI)	BOLT TENSION (LBS.)	STUD ELONGATION (INCHES PER INCH x 10 ⁻³)	TORQUE FOR SPECIFIED LUBRICANT (FT-LBS.)							
				503 SWEENEY®	504 SWEENEY®	505 SWEENEY®	506 SWEENEY®	507 SWEENEY®	API SA2	MACHINE OIL	DRY STEEL ON STEEL
				f=.06	f=.085	f=.100	f=.110	f=.100	f=.117	f=.150	F=.200
3/4	105000	12428	1.225000	73	89	102	111	102	117	146	190
7/8	105000	17147	1.225000	117	142	164	178	164	188	234	305
1	105000	22490	1.225000	174	212	244	265	244	280	349	454
1-1/8	105000	29311	1.225000	253	309	356	387	356	408	511	667
1-1/4	105000	27034	1.225000	351	430	496	540	496	571	716	936
1-3/8	105000	45658	1.225000	472	580	670	730	670	772	970	1270
1-1/2	105000	55185	1.225000	615	758	877	956	877	1012	1274	1671
1-5/8	105000	65613	1.225000	787	972	1126	1228	1126	1300	1639	2153
1-3/4	105000	76944	1.225000	988	1222	1417	1547	1417	1638	2067	2718
1-7/8	105000	89176	1.225000	1220	1512	1755	1917	1755	2030	2565	3375
2	105000	102311	1.225000	1470	1827	2125	2324	2125	2463	3119	4112
2-1/8	105000	116347	1.225000	1770	2203	2564	2804	2564	2973	3767	4969
2-1/4	105000	131286	1.225000	2108	2626	3058	3345	3058	3547	4497	5936
2-3/8	105000	147126	1.225000	2487	3100	3612	3953	3612	4192	5317	7023
2-1/2	105000	163868	1.225000	2908	3629	4230	4630	4230	4910	6232	8234
2-3/4	95000	181000	1.108330	3517	4395	5126	5614	5126	5955	7565	10004
3	95000	217104	1.108330	4582	5732	6691	7330	6691	7777	9886	13082
3-1/4	95000	256287	1.108330	5842	7316	8544	9364	8544	9937	12640	16735
3-1/2	95000	298824	1.108330	7315	9169	10714	11745	10714	12466	15865	21015
3-3/4	95000	344625	1.108330	9016	11309	13221	14495	13221	15387	19592	25963
4	95000	393690	1.108330	10961	13758	16090	17644	16090	18732	23861	31633
4-1/4	85000	399071	0.991667	10395	13056	15273	16752	15273	17786	22665	30057

NOTE: 503 – MOLYBDENUM DISULPHIDE BASED (FUNCTIONAL EQUIVALENT C670, MOLY-COTE G PASTE)
504 – MOLYBDENUM LEAD OXIDE & GRAPHITE BASED (FUNCTIONAL EQUIVALENT C100)
505 – COPPER & GRAPHITE BASED (FUNCTIONAL EQUIVALENT N1000)
506 – NICKEL & GRAPHITE BASED (FUNCTIONAL EQUIVALENT NICKEL EASE N5000, NEVER-SEEZ NICKEL SPECIAL)
507 – COPPER & GRAPHITE BASED (FUNCTIONAL EQUIVALENT CSA, NEVER SEEZ)

**FIGURE 2-5
TORQUE VALES IN IMPERIAL UNITS FOR ASTM A193 GRADE B16 WITH STUD STRESS EQUAL TO 35%
OF MINIMUM YIELD STRENGTH**

FLANGE SIZE	STUD DIAMETER (INCHES), NUMBER OF STUDS AND BOLT CIRCLE DIAMETER (INCHES)																	
	2,000 PSI			3,000 PSI			5,000 PSI			10,000 PSI			15,000 PSI			20,000 PSI		
	DIA	NO	BCD	DIA	NO	BCD	DIA	NO	BCD	DIA	NO	BCD	DIA	NO	BCD	DIA	NO	BCD
2-1/16	5/8	8	5	7/8	8	6-1/2	7/8	8	6-1/2	3/4	8	6-1/4	7/8	8	6-7/8	1-1/8	8	9-1/16
2-9/16	3/4	18	5-7/8	1	8	7-1/2	1	8	7-1/2	7/8	8	7-1/4	1	8	7-7/8	1-1/4	8	10-5/16
3-1/16				1	8	9-1/16	1-1/8	8	9-1/16	1-3/8	8	11-5/16	1-1/8	8	9-1/16	1-3/8	8	11-5/16
3-1/8	3/4	8	6-5/8	7/8	8	7-1/2	1-1/8	8	8									
4-1/16	7/8	8	8-1/2	1-1/8	8	9-1/4	1-1/4	8	10-3/16	1-1/8	8	10-3/16	1-3/8	8	14-1/16	1-3/4	8	14-1/16
5-1/8**	1	8	10-1/2	1-1/4	8	11	1-1/2	8	11-1/2	1-1/8	8	11-13/16						
7-1/16	1	12	11-1/2	1-1/8	12	12-1/2	1-3/8	12	15-7/8	1-1/2	12	16-7/8	1-1/2	16	16-7/8	2	16	21-13/16
9	1-1/8	12	13-3/4	1-3/8	12	15-1/2	1-5/8	12	15-1/2	1-1/2	16	18-3/4	1-7/8	16	21-3/4			
11	1-1/4	16	17	1-3/8	16	18-1/2	1-7/8	12	19	1-3/4	16	22-1/4	2	20	28			
13-5/8	1-1/4	20	19-1/4	1-3/8	20	21	1-5/8	16	23-1/4	1-7/8	20	16-1/2	2-1/4	20	30-3/8			
16-3/4	1-1/2	20	23-3/4	1-5/8	20	24-1/4	1-7/8	16	26-5/8	1-7/8	24	30-9/16						
18-3/4							2	20	31-5/8	2-1/4	24	36-7/16						
20-3/4				2	20	31-5/8												
21-1/4	1-5/8	24	28-1/2	2	20	29-1/2	2	24	34-7/8	2-12	24	40-1/4						
26-3/4	1-3/4	20	37-1/2	2	24	39-3/8												

**INACTIVE IN 2,000, 3,000 & 5,000 PSI FLANGES

**FIGURE 2-6
AMERICAN PETROLEUM INSTITUTE (API) FLANGE SPECIFICATIONS**

FLANGE SIZE	STUD DIAMETER (INCHES), NUMBER OF STUDS AND BOLT CIRCLE DIAMETER (INCHES)																				
	150			300			400			600			900			1,500			2,500		
	DIA	NO	BCD	DIA	NO	BCD	DIA	NO	BCD	DIA	NO	BCD	DIA	NO	BCD	DIA	NO	BCD	DIA	NO	BCD
2	5/8	4	4-3/4	5/8	8	5	5/8	8	5	5/8	8	5	7/8	8	8-1/2	7/8	8	6-1/2	1	8	6-3/4
3	5/8	4	6	3/4	8	6-5/8	3/4	8	6-5/8	3/4	8	6-5/8	7/8	8	7-1/2	1-1/8	8	8	1-1/4	8	9
4	5/8	8	7-1/2	3/4	8	7-7/8	7/8	8	7-7/8	7/8	8	8-1/2	1-1/8	8	9-1/4	1-1/4	8	9-1/2	1-1/2	8	10-3/4
5	3/4	8	8-1/2	3/4	8	9-1/4	7/8	8	9-1/4	1	8	10-1/2	1-1/4	8	11	1-1/2	8	11-1/2	1-3/4	8	12-3/4
6	3/4	8	9-1/2	3/4	12	10-5/8	7/8	12	10-5/8	1	12	11-1/2	1-1/8	12	12-1/2	1-3/8	12	12-1/2	2	8	14-1/2
8	3/4	8	11-3/4	7/8	12	13	1	12	13	1-1/8	12	13-3/4	1-3/8	12	15-1/2	1-5/8	12	15-1/2	2	12	17-1/4
10	7/8	12	14-1/4	1	16	15-1/4	1-1/8	16	15-1/4	1-1/4	16	17	1-3/8	16	18-1/2	1-7/8	12	19	2-1/2	12	21-1/4
12	7/8	12	17	1-1/8	16	17-3/4	1-1/4	16	17-3/4	1-1/4	20	19-1/4	1-3/8	20	21	2	16	22-1/2	2-3/4	12	24-3/8
14	1	12	18-3/4	1-1/8	20	20-1/4	1-1/4	20	20-1/4	1-3/8	20	20-3/4	1-1/2	20	22	2-1/4	16	25			
16	1	16	21-1/4	1-1/4	20	22-1/2	1-3/8	20	22-1/2	1-1/2	20	23-3/4	1-5/8	20	24-1/4	2-1/2	16	27-3/4			
18	1-1/8	16	22-3/4	1-1/4	24	24-3/4	1-3/8	24	24-3/4	1-5/8	20	25-3/4	1-7/8	20	27	2-3/4	16	30-1/2			
20	1-1/8	20	25	1-1/4	24	27	1-1/2	24	27	1-5/8	24	28-1/2	2	20	29-1/2	3	16	32-3/4			
24	1-1/4	20	29-1/2	1-1/2	24	32	1-3/4	24	32	1-7/8	24	33	2-1/2	20	35-1/2	3-1/2	16	39			

**FIGURE 2-7
AMERICAN NATIONAL STANDARD (ANSI) FLANGE SPECIFICATIONS**

STUD / NUT SIZE CROSS REFERENCE

PIPE SIZE	STUD DIA (INCHES), NUMBER OF STUDS & BOLT CIRCLE DIA (INCHES)														
	150			300			400			600			900		
	DIA	NO	BCD	DIA	NO	BCD	DIA	NO	BCD	DIA	NO	BCD	DIA	NO	BCD
12	7/8	12	17	1-1/8	16	17-3/4	1-1/4	16	17-3/4	1-1/4	20	19-1/4	1-3/4	20	21
14	7/8	12	18-3/4	1-1/8	20	20-1/4	1-1/4	20	20-1/4	1-3/8	20	20-3/4	1-1/2	20	22
16	1	16	25-1/4	1-1/4	20	20-1/5	1-3/8	20	22-1/2	1-1/2	20	32-3/4	1-5/8	20	24-1/4
18	1-1/8	16	22-3/4	1-1/4	24	24-3/4	1-3/8	24	24-3/4	1-5/8	20	25-3/4	1-7/8	20	27
20	1-1/8	20	25	1-1/4	24	27	1-1/2	24	27	1-5/8	24	28-1/2	2	20	29-1/2
22	1-1/4	20	27-3/4	1-1/2	24	29-1/4	1-5/8	24	29-1/4	1-3/4	24	30-2/3			
24	1-1/4	20	29-1/2	1-1/2	24	32	1-3/4	24	32	1-7/8	24	33	2-1/2	20	35-1/5
26	1-1/4	24	31-3/4	1-5/8	28	34-1/2	1-3/4	28	34-1/2	1-7/8	28	36	2-3/4	20	37-1/2
28	1-1/4	28	34	1-5/8	28	37	1-7/8	28	37	2	28	38	3	20	40-1/4
30	1-1/4	28	36	1-3/4	28	39-1/4	2	28	39-1/4	2	28	40-1/4	3	20	42-3/4
32	1-1/2	28	38-1/2	1-7/8	28	41-1/2	2	28	41-1/2	2-1/4	28	42-1/2	3-1/4	20	45-1/2
34	1-1/2	32	40-1/2	1-7/8	28	43-1/2	2	28	43-1/2	2-1/4	28	44-1/2	3-1/2	20	48-1/2
36	1-1/2	32	42-3/4	2	32	46	2	32	46	2-1/4	28	47	3-1/2	20	50-3/4
38	1-1/2	32	45-3/4	1-1/2	32	43	1-3/4	32	44	2-1/4	28	45-3/4	3-1/2	20	50-3/4
40	1-1/2	36	47-1/4	1-5/8	32	45-1/2	1-7/8	32	46-1/4	2-1/4	32	47-3/4	3-1/2	24	52-3/4
42	1-1/2	36	49-1/2	1-5/8	32	47-1/2	1-7/8	32	48-1/4	2-1/2	28	50-1/2	3-1/2	24	54-3/4
44	1-1/2	40	51-3/4	1-3/4	32	49-3/4	2	32	50-1/2	2-1/2	32	52-1/2	3-3/4	24	67-2/3
46	1-1/2	40	53-3/4	1-7/8	28	52	2	36	52-3/4	2-1/2	32	54-3/4	4	24	60-1/2
48	1-1/2	44	56	1-7/8	32	54	2-1/4	28	55-1/4	2-3/4	32	57-1/2	4	24	62-1/2
50	1-3/4	44	58-1/4	2	32	56-1/4	2-1/4	32	57-1/2	3	28	60			
52	1-3/4	44	60-1/2	2	32	58-1/4	2-1/4	32	59-1/2	3	32	62			
54	1-3/4	44	62-3/4	2-1/4	28	61	2-1/2	28	62-1/4	3	32	64-1/4			
56	1-3/4	48	65	2-1/4	28	63	2-1/2	32	64-1/4	3-1/4	32	66-3/4			
58	1-3/4	48	67-3/4	2-1/4	32	65	2-1/2	32	66-1/4	3-1/4	32	68-3/4			
60	1-3/4	52	69-1/4	2-1/4	32	67	2-3/4	32	69	3-1/2	28	71-3/4			

**FIGURE 2-8
MANUFACTURER'S STANDARDIZATION SOCIETY
OF THE VALVE AND FITTINGS INDUSTRY, INC.**

NUT / BOLT (A/F)		STUD / BOLT SIZE OUTSIDE DIAMETER	
INCH	mm	INCH	METRIC (mm)
1-1/8 RB	30	3/4	20RB
1-1/4 H		3/4	
1-5/16 RB	34 36	7/8	20H 24RB, 22H
1-7/16 H		7/8	
1-1/2 RB 1-5/8 H	41	1 1	24H
1-11/16 B 1-13/16 H		1-1/8 1-1/8	
1-7/8 B	50	1-1/4	30H
2 H		1-1/4	
2-1/16 B	55	1-3/8	36RB
2-3/16 H		1-3/8	
2-1/4 B	60	1-1/2	36H
2-3/8 H		1-1/2	
2-9/16 H	65	1-5/8	42RB
2-5/8 B 2-3/4 H	70	1-3/4 1-3/4	42H
2-13/16 B 2-15/16 H		1-7/8 1-7/8	

NUT / BOLT (A/F)		STUD / BOLT SIZE OUTSIDE DIAMETER	
INCH	Mm	INCH	METRIC (mm)
3B 3-1/8 H	80 85	2 2	48H 56RB
3-3/8 B 3-1/2 H		2-1/4 2-1/4	
3-3/4 B 3-7/8 H	90 95	2-1/2 2-1/2	56H 64RB
4-1/8 B 4-1/4 H		2-3/4 2-3/4	
4-1/2 B	110	3	72H
4-5/8 H	115	3	80RB
4-7/8 B 5 H	120	3-1/4 3-1/4	80H
5/1/4 B		130	
5-3/8 H	135	3-1/2	90H
5-3/4 H	145	3-3/4	100RB
6 B 6-1/8 H	150	4 4	100H

KEY: R = REGULAR HEX
H = HEAVY HEX
B = BOLT OR CAP SCREW

FIGURE 2-9

PRESSURE		RSL2		RSL4		RSL6		RSL8		RSL14		RSL20		RSL30	
PSI	BAR	lbf-ft	Nm	lbf-ft	Nm	lbf-ft	Nm	lbf-ft	Nm	lbf-ft	Nm	lbf-ft	Nm	lbf-ft	Nm
1000	69	123	167	290	393	457	620	725	983	961	1303	1957	2614	2298	3116
1200	83	152	206	352	477	564	765	884	1199	1188	1611	2332	3115	2869	3890
1400	97	180	244	414	561	672	911	1043	1414	1414	1917	2708	3617	3440	4664
1600	110	209	283	476	645	780	1058	1201	1628	1641	2225	3083	4118	4012	5439
1800	124	238	323	538	729	888	1204	1360	1844	1867	2531	3458	4619	4583	6214
2000	138	267	362	600	813	995	1349	1518	2058	2094	2839	3822	5105	5154	6988
2200	152	296	401	662	898	1103	1495	1677	2274	2320	3145	4209	5622	5725	7762
2400	165	324	439	724	982	1211	1642	1836	2489	2547	3453	4584	6123	6296	8536
2600	179	353	479	786	1066	1318	1787	1994	2703	2773	3760	4959	6624	6868	9312
2800	193	382	518	848	1150	1426	1933	2153	2919	3000	4067	5334	7125	7439	10086
3000	207	411	557	910	1234	1534	2080	2311	3133	3226	4374	5710	7627	8010	10860
3200	221	439	595	972	1318	1641	2225	2470	3349	3453	4682	6085	8128	8581	11634
3400	234	468	635	1034	1402	1749	2371	2629	3564	3679	4988	6460	8629	9152	12408
3600	248	497	674	1096	1486	1857	2518	2787	3779	3906	5296	6835	9130	9724	13184
3800	262	525	712	1158	1570	1964	2663	2946	3994	4132	5602	7210	9631	10295	13958
4000	276	554	751	1220	1654	2072	2809	3104	4208	4359	5910	7586	10133	10866	14732
4200	290	583	790	1282	1738	2180	2956	3263	4424	4585	6216	7961	10634	11437	15506
4400	303	611	828	1344	1822	2288	3102	3422	4640	4812	6524	8336	11135	12008	16280
4600	317	640	868	1406	1906	2395	3247	3580	4854	5038	6831	8711	11636	12579	17055
4800	331	669	907	1468	1990	2503	3394	3739	5069	5265	7138	9087	12138	13151	17830
5000	345	697	945	1530	2074	2611	3540	3897	5284	5491	7445	9462	12639	13722	18604
5200	359	726	984	1592	2158	2718	3685	4056	5499	5718	7752	9837	13140	14293	19378
5400	372	754	1022	1654	2242	2826	3831	4215	5715	5944	8059	10212	13641	14864	20153
5600	386	783	1062	1716	2327	2934	3978	4373	5929	6171	8367	10588	14143	15435	20927
5800	400	811	1100	1778	2411	3041	4123	4532	6144	6397	8673	10963	14644	16007	21702
6000	414	840	1139	1840	2495	3149	4269	4690	6359	6624	8981	11338	15145	16578	22476
6200	427	868	1177	1902	2579	3257	4416	4849	6574	6850	9287	11713	15646	17149	23251
6400	441	897	1216	1964	2663	3364	4561	5008	6790	7077	9595	12089	16148	17720	24025
6600	455	925	1254	2026	2747	3472	4707	5166	7004	7303	9901	12464	16649	18291	24799
6800	469	954	1293	2088	2831	3580	4854	5325	7220	7530	10209	12839	17150	18863	25574
7000	483	982	1331	2150	2915	3688	5000	5483	7434	7756	10516	13214	17651	19434	26349
7200	496	1011	1371	2212	2999	3795	5145	5642	7649	7983	10823	13589	18152	20005	27123
7400	510	1039	1409	2274	3083	3903	5292	5801	7865	8209	11130	13965	18654	20576	27897
7600	524	1068	1448	2336	3167	4011	5438	5959	8079	8436	11438	14340	19155	21147	28671
7800	538	1096	1486	2398	3251	4118	5583	6118	8295	8662	11744	14715	19656	21719	29447
8000	552	1125	1525	2460	3335	4226	5730	6276	8509	8889	12052	15090	20157	22290	30221
8200	565	1153	1563	2522	3419	4334	5876	6435	8725	9115	12358	15466	20659	22861	30995
8400	579	1181	1601	2584	3503	4441	6021	6594	8940	9342	12666	15841	21160	23432	31769
8600	593	1210	1641	2646	3587	4549	6168	6752	9154	9568	12972	16216	21661	24003	32543
8800	607	1238	1678	2708	3672	4657	6314	6911	9370	9795	13280	16591	22162	24575	33319
9000	621	1266	1716	2770	3756	4764	6459	7069	9584	10021	13586	16967	22665	25146	34093
9200	634	1295	1756	2832	3840	4872	6605	7228	9800	10248	13894	17342	23165	25717	34867
9400	648	1323	1794	2894	3924	4980	6752	7387	10015	10474	14201	17717	23666	26288	35641
9600	662	1351	1832	2956	4008	5087	6897	7545	10230	10701	14508	18092	24167	26859	36415
9800	676	1380	1871	3018	4092	5195	7043	7704	10445	10927	14815	18467	24668	27431	37191
10000	689	1408	1909	3080	4176	5303	7190	7862	10659	11154	15123	18843	25170	28002	37965

1 PSI = 6.894757 kPa
1 PSI = .06894757 BAR
1 lbf-ft = 1.3558 Nm

**FIGURE 2-10
PRESSURE / TORQUE CONVERSION CHART FOR RSL TOOLS**

SECTION 3

RSL POWER HEAD WITH HEX WRENCH HEAD OPERATING INSTRUCTIONS

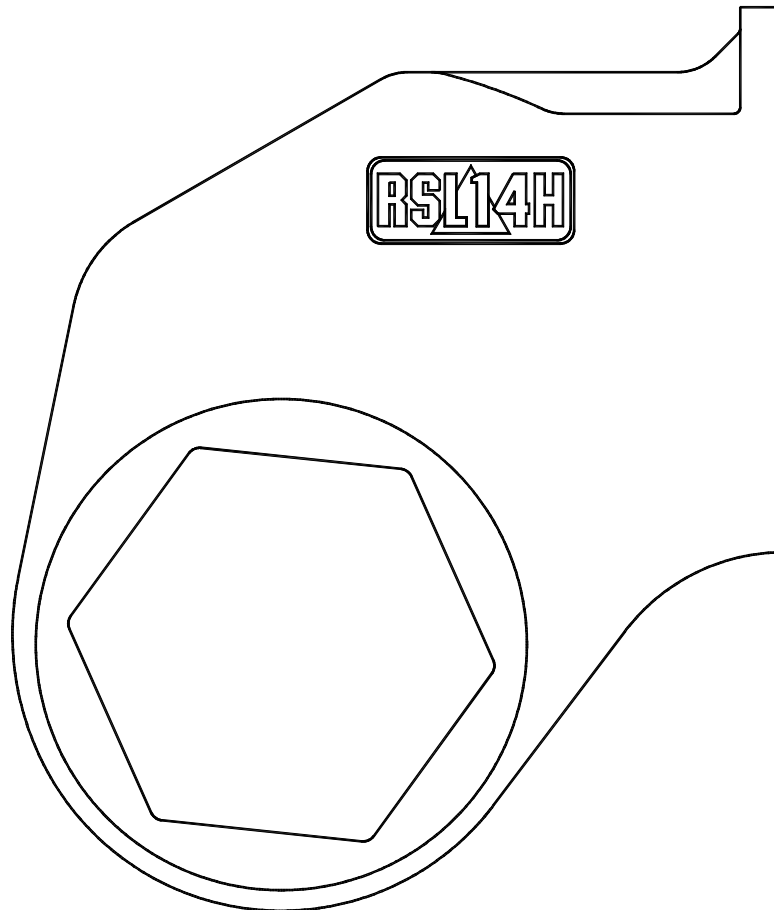


FIGURE 3-1
RSL HEX WRENCH HEADS

GENERAL

1. RSL Power Head can be used with a wide variety of interchangeable Hex Wrench Heads (Figure 3-1) for applications with limited access, reduced height, and low clearance. Hex Wrench Heads are available for all common hex nut sizes (See Figure 2-9). HYDRATIGHT offers full torque and limited torque versions of RSL Hex Wrench Heads. Reduced torque (and size) is for limited space applications. For limited torque wrenches, maximum operating pressures vary. Refer to the maximum torque rating stamped on the wrench housing. To avoid wrench damage, do not exceed maximum torque rating. If max. torque rating is not stamped on the housing of the wrench, the Hex Wrench Head has no torque restrictions.
2. RSL Power Head with Hex Wrench Heads (also called RSL Tool or Tool) can be used when:
 - a. Overhead accessibility is limited and other tooling employing standard impact sockets will not fit.
 - b. The lightest weight tool is required.
 - c. There are a limited number of nut sizes.
 - d. To eliminate any deflection that may be present when using other tools.
 - e. Quick and easy bolt-to-bolt change is required.
 - f. The smallest nose radii is required for tight bolt patterns.

ASSEMBLY OF COMPONENTS

1. Select the Hex Wrench Head to be used and assemble as shown in Figure 3-2. The wrench size (and Maximum torque rating, if limited torque wrench is selected) is marked on the side of the wrench.
2. The assembly requires user to engage the pin into the groove on Pawl Driver (fig 3-2). Ensure that pawl driver is in the retracted position before attempting assembly. After the Hex Wrench Head has been properly couple to the Power Head piston, secure assembly by tightening the two short socket head cap screws at top and two long socket head cap screws at bottom of Power Head housing. It is good practice to use lubricant (oil) and tighten those screws to a specific torque to prevent over tightening. Use this guideline for tightening, the first number is for the long bolts (RSLxx-6) and the second number is for the short bolts: RSL2 assemblies to 19/23 ft-lb., RSL4 assemblies to 35/45 ft-lb., RSL6 assemblies to 60/105 ft-lbs, RSL6A assemblies to 85/105 ft-lb., RSL8 assemblies to 170/210ft-lb., RSL14 assemblies to 90/90 ft-lb., RSL20 assemblies to 110/110 ft-lb., and RSL30 assemblies to 150/150 ft-lb. Contact Hydratight for more information.

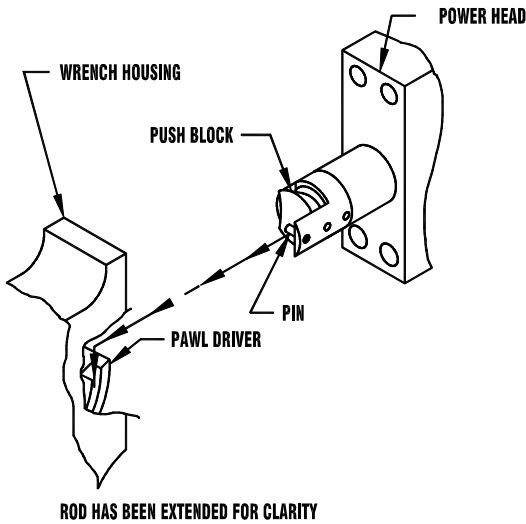


FIGURE 3-2

RSL POWER HEAD TO HEX WRENCH HEAD ASSEMBLY

SET-UP AND USE

1. Adjust the torque value on the Console in accordance with the instructions in Section 2, General Operating Instructions.
2. Place the Hex Wrench Head on the nut to be worked. For most applications, RSL tool will take reaction on its tool housing, as shown in Figure 3-3. Do not operate the Tool if reaction is taken on the spline portion of the tool, as damage to the spline will occur. Use Reaction Arm or call HYDRATIGHT for special Reaction Arm(s).
3. If application particulars require reaction on spline portion of tool, use of Reaction Arm (supplied with RSL Tool) is required. Slip the Reaction Arm over the spline portion of the Power Head until it stops against o-ring. Reaction Arm must be aligned in the same plane (in-line) as the wrench head (fir. 3-4). Rotate Dialock in any direction to the next "click" (60 degrees), to lock Reaction Arm in place.

▲ Warning: Dialock must be in locked position before using Tool!

NOTE: Reacting at sharp angle on underside of Reaction Arm as shown in fir. 3-4, may cause damage to Power Head spline and/or Reaction Arm. Contact Hydratight Customer Service or Hydratight Engineering for modification(s) required to use tool in this manner.

4. After ensuring proper reaction set-up, proceed with tightening or loosening of nuts in accordance with Section 2.

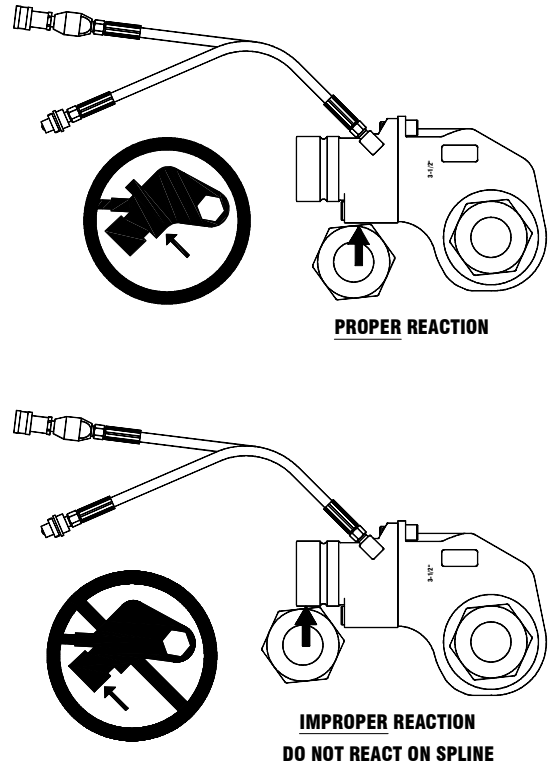
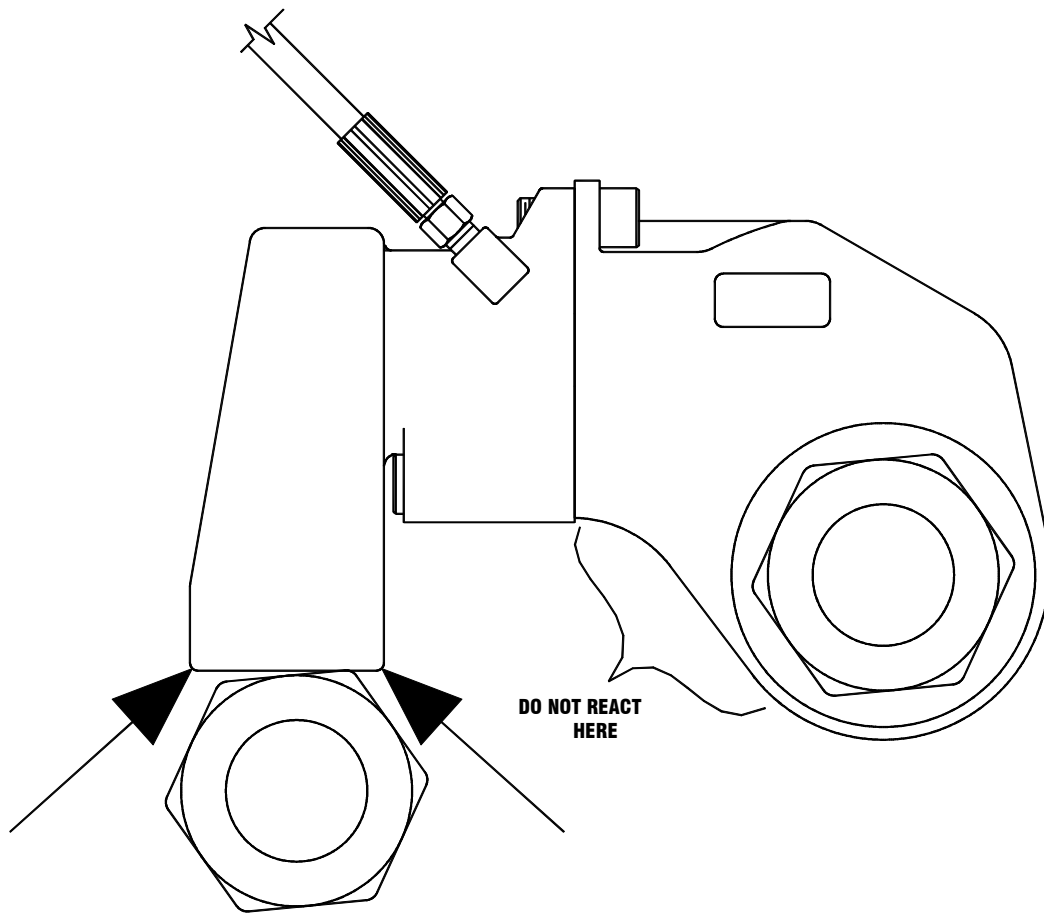


FIGURE 3-3

RSL REACTION METHODS (POWER HEAD WITH HEX WRENCH HEAD) – without Reaction Arm



DO NOT REACT AT AN ANGLE

FIGURE 3-4
USING REACTION ARM WITH RSL POWER HEAD AND HEX WRENCH HEAD
 (If Reaction Arm is used, reaction must be in-line with Hex Head as shown)

IMPROPER		PROPER
	<p>AVOID ANY ANGULAR ENGAGEMENT</p>	
	<p>NO ANGULAR ADJUSTMENT ALLOWED. IN LINE REACTION ONLY</p>	

SECTION 4

RSL POWER HEAD WITH SQUARE DRIVE WRENCH HEAD OPERATING INSTRUCTIONS

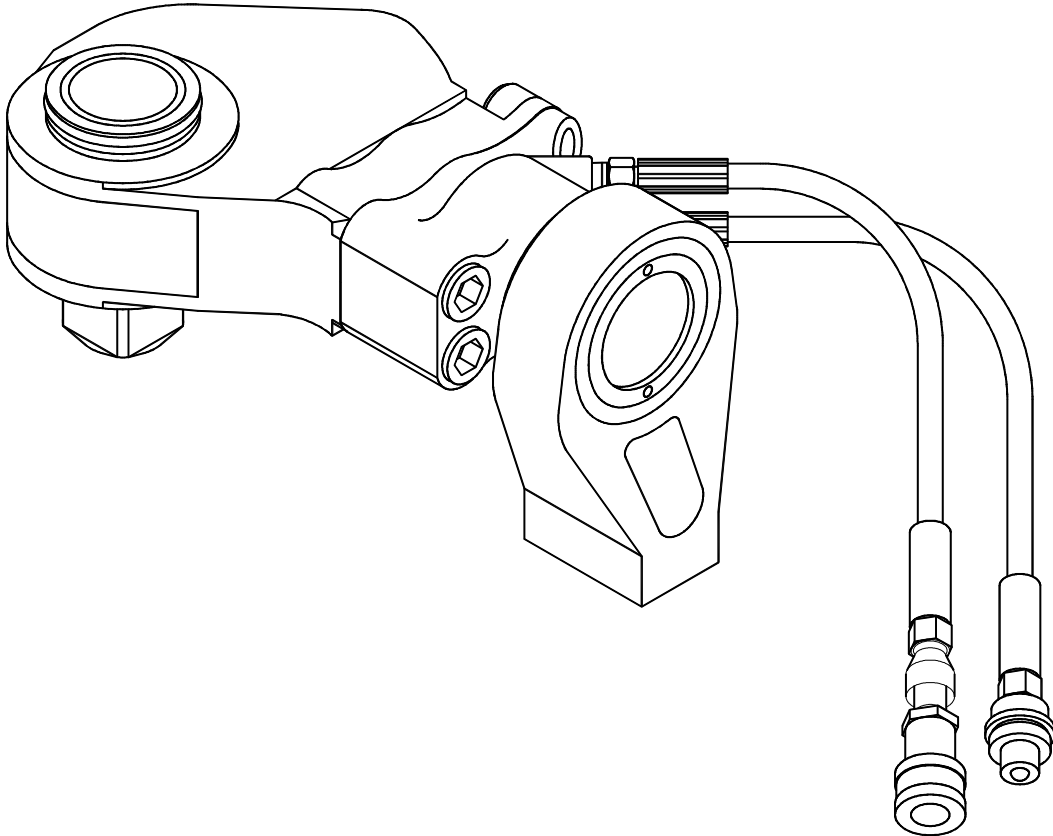


FIGURE 4-1
RSL POWER HEAD WITH SQUARE DRIVE WRENCH HEAD (RSL-SDS)

GENERAL

1. RSL Tool, as shown in Figure 4-1, can also be used with Square Drive Wrench Head. RSL Power Head, when used with a Square Drive Wrench can work a variety of applications by employing standard impact sockets.
2. RSL Power Head with Square Drive Wrench Head can be used when:
 - a. Little or no space limitations exist.
 - b. Light weight tool is required to reduce worker fatigue.
 - c. There are a large number of bolts to be fastened.
 - d. Maximum tool versatility is required – multi size applications exist with the same torque range.
3. RSL Power Head coupled with Square Drive Wrench Head is used with impact sockets with a 3/4" to 2 1/2" square drive.

RSL MODEL	SQUARE DRIVE (inches)	MAX. TORQUE OUTPUT ft-lb. (N-m)
RSL2	3/4	1408 (1909)
RSL4	1	3080 (4176)
RSL6	1-1/2	5303 (7190)
RSL8	1-1/2	7862 (10660)
RSL14	1-1/2	11154 (15123)
RSL20	2-1/2	18843 (25547)
RSL30	2-1/2	28002 (37966)

ASSEMBLY OF COMPONENTS

- The assembly requires the user to engage the pin into the groove on Pawl Driver (fig. 3-2). Ensure that the pawl driver is in the retracted position before attempting assembly. After the Hex Wrench Head has been properly coupled to the Power Head piston, secure the assembly by tightening the two short socket head cap screws at top and two long socket head cap screws at bottom of Power Head housing. It is good practice to use lubricant (oil) and tighten these screws to a specific torque to prevent over tightening. Use this guideline for tightening, the first number is for the long bolts (RSLxx-6) and the second number is for the short bolts.: RSL2 assemblies to 19/23 ft-lb., RSL4 assemblies to 35/45 ft-lb., RSL6 assemblies to 60/105 ft-lb., RSL6A assemblies to 85/105 ft-lb., RSL8 assemblies to 170/210ft-lb., RSL14 assemblies to 110/110 ft-lb., RSL20 assemblies to 90/90 ft-lb., and RSL30 assemblies to 150/150 ft-lb. Contact Hydratight for more information.

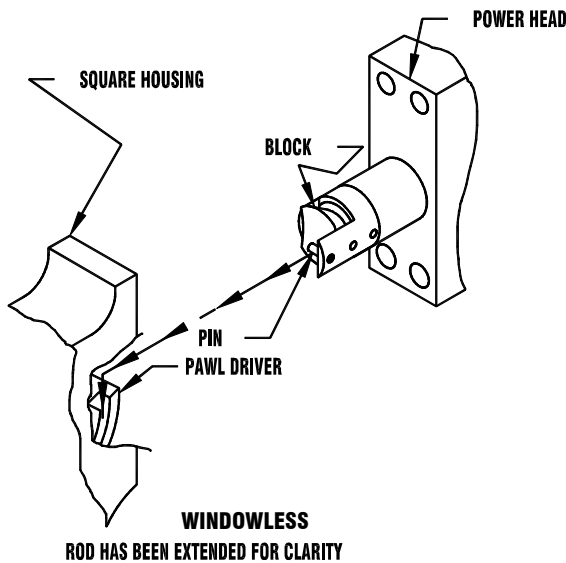


FIGURE 4-2

RSL POWER HEAD TO SQUARE DRIVE WRENCH HEAD ASSEMBLY

OPERATING RSL POWER HEAD WITH THE SQUARE DRIVE WRENCH HEAD

- When using the Square Drive Wrench Head with RSL Power Head, it is almost always necessary to use the Reaction Arm (supplied with RSL Power Head). The Reaction Arm is used to counteract the reaction forces created as RSL Tool operates. The Reaction Arm, whenever possible, should extend in the direction of the square drive. The RSL Reaction Arm is 360 degree adjustable, but the working angle should be within 90 degrees (see proper figure 4-4A and improper figure 4-4B).
- Slip the Reaction Arm over the spline portion of the Power Head until it stops against o-ring. The Reaction Arm must be aligned in the same plane (in-line) as the wrench head (fig. 3-4). Rotate the Dialock (in any direction to the next click, 60 degrees) to lock Reaction Arm in place.
- Set the reaction properly! Improper reaction set-up and/or incorrect socket size will cause a concentration of stress, making the tool, socket, or nut vulnerable to fracture. The common cause of socket breakage is **cocking**, a condition when socket fits over the bolt at an angle.



The lifting (cocking) condition may occur when the operator, having small area of Reaction Arm engaged, lifts the Tool over the flange creating an "out of square" engagement. Another lifting situation is when the Reaction Arm is set against sloped object. To check if the Tool is going to be set properly, conduct a "floor test" where a complete RSL Tool assembly (with socket to be used on application) is set on the floor. Push down at the opposite side of Square Drive (Retaining Nut) and check for a clearance under the Reaction Arm. If clearance is observed, Tool will be set properly. If there is no space under Reaction Arm, set-up will be improper. A Similar test may be performed on the actual application. **If there is no space under the Reaction Arm, ROTATE the Arm until space appears. Do not operate the Tool if the reaction is lifting the Tool as the load is applied. Injury and/or damage to the Tool may result.** Figure 4-3 and 4-4A illustrates the proper and Figure 4-4B the improper reaction methods.

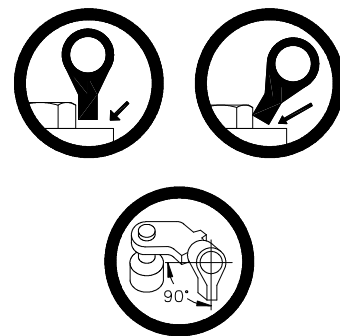
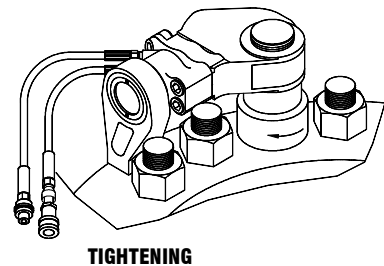
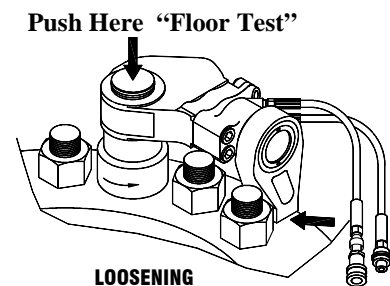


FIGURE 4-3
PROPER REACTION POINTS FOR RSL REACTION ARM WITH SQUARE DRIVE WRENCH HEAD

SET-UP AND USE

- Adjust the torque value on the Console in accordance with the instructions in Section 2, General Operating Instructions.
- Position the square drive for tightening or loosening as shown Figure 4-5. To change direction of square drive from tightening to loosening (or vice-versa):
previous style: remove o-ring around retainer bushing, remove pin, and lift retainer bushing away from tool as shown in Figure 4-5. Slide square drive out away from tool and reposition for desired operation. Secure drive key by re-assembling retainer bushing, pin and o-ring.
modified style (all models): remove Retaining Nut. Slide square drive away from tool and reposition for desired operation. Secure square drive by re-installing Retaining Nut (Figure 4-5).
- Place the desired size impact socket on the square drive and secure properly with the o-ring and pin.
- Place the RSL Power Head with the Square Drive Wrench Head and socket on the nut. Insure that the Reaction Arm is making firm contact against a stationary object (i.e. an adjacent nut, flange, or equipment housing.)
- After ensuring proper reaction, Fig. 4-3 and 4-4A (also read paragraph 3 in OPERATING RSL POWER HEAD WITH THE SQUARE DRIVE WRENCH HEAD on previous page), proceed with tightening or loosening the nuts in accordance with instructions in Section 2, General Operating Instructions, and the following additional instructions:
- Depress and hold the Manual Control Pendant* Button until the Power Head rod had made a complete stroke. Return the rod to the initial position. The operator should push against the rear of the Tool (or use other mean of holding) during this process to insure that reaction arm is in constant contact with the reaction point. Continue to work the nut in this manner until the Pawl does not engage with another tooth on the Square Driver (tool stalls). Return the rod to the initial position on additional time and attempt to further turn the nut. If the nut does not turn, the desired tension has been achieved in the stud.
- The Tool also can be operated with the Digital Control Pendant, which has its own manual.
- Tighten nuts in accordance with the instructions in Section 2, General Operating Instructions.
- Move the RSL Tool to the next stud. The RSL Power Head, Square Drive Wrench Head, socket and Reaction Arm can be moved as a unit to the next stud to be worked.

POSITIONING THE SQUARE DRIVE

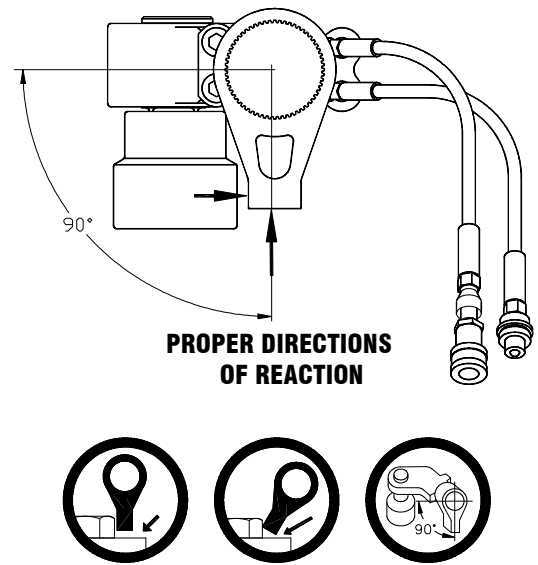
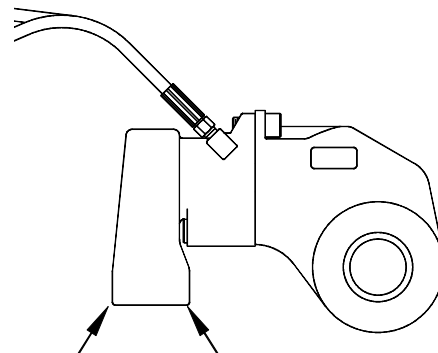


FIGURE 4-4A
PROPER REACTION POINTS FOR THE RSL REACTION
ARM WITH THE SQUARE DRIVE WRENCH HEAD



DO NOT ANCHOR
IN DIRECTION SHOWN

FIGURE 4-4B
IMPROPER REACTION POINTS/POSITIONS FOR THE
RSL REACTION ARM WITH THE SQUARE DRIVE
WRENCH HEAD

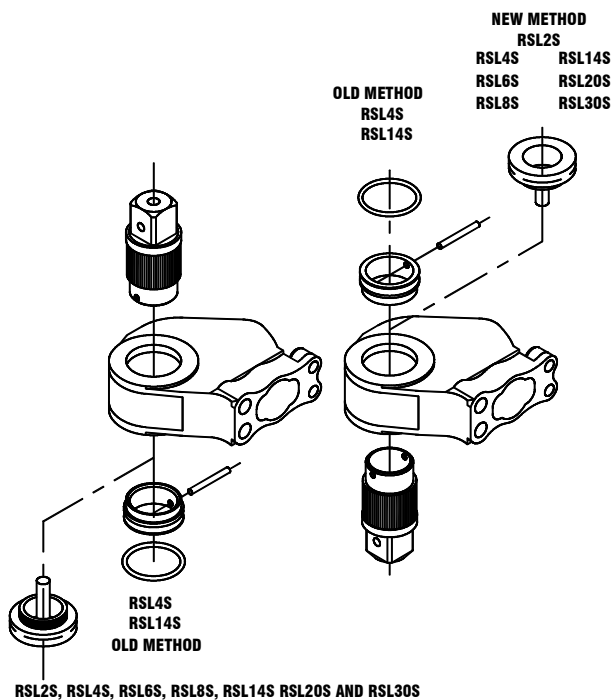


FIGURE 4-5

SECTION 5

PREVENTIVE MAINTENANCE

RSL POWER HEAD

1. Lubricate push block (and sliding surface of the Pawl Driver) periodically with SWEENEY 503 Moly Paste Lubricant. The frequency of lubrication depends on severity of use and working environment
2. Check Retractor, Block and Retractor pin for secure fit before each use.
3. Clean dirt from the Twinline Hose quick connect couplers before each use.
4. Ensure that Power Head and Wrench Head are correctly engaged and tightly coupled with socket head cap screws.
5. Cylinder seals are designed for long life. Should seals require replacement because of leaks, replace seal kit (SK):

RSL2: RSL2-SK; RSL4: RSL4-SK; RSL8: RSL8-SK; RSL14: RSL14-SK; RSL20: RSL20-SK; RSL30: RSL30-SK

- Newer models have third letter indicating model version (A, B, ...)
- RSL4 also have universal seal kit (for all models) RSL4-SKX, proper seal selection to be done on the site.

6. RSL Tool structure, including reaction spline and Reaction Arm, should be inspected regularly to determine if there are any cracks, chips, or deformities. If any irregularities are found, immediate service or replacement is required.

Disassembly (RSL2, RSL4, RSL6, RSL8, RSL14 AND RSL20) – models with Front Cap, see procedures below or use previous versions of RSL-OM for models with End Cap.

1. Install mating QD's to QD on Power Head with piston at mid stroke.
2. Remove pin joining Retractor with Piston, or 10-24 x 1.5 socket head cap screw (on RSL8). Remove push block and retractor.
3. Using spanner wrench unscrew and remove front cap.
4. Pull piston straight out (use pressure if needed).
5. Replace seals and wear rings as needed.

Assembly (RSL2, RSL4, RSL6, RSL8, RSL14 AND RSL20) – models with Front Cap, see procedures below or use previous versions of RSL-OM for models with End Cap.

1. Lubricate surfaces with hydraulic oil (especially those in contact with the seals).
2. Install front cap (with seals installed) onto rod. Slide cap on rod until it makes contact with the piston.
3. Assemble by pressing the above components into bore until front cap comes into contact with internal threads. At this point start using spanner wrench. Tighten front cap until firmly seated.
4. Tighten RSL4A and B models to 40 lbf-ft.
5. Reinstall retractor, push block and the pin, or socket head cap screw (on RSL8).

Disassembly (RSL4 with End Cap)

See Figure 5-1, on following page.

1. Install mating QD's to QD on Power Head with tool at mid stroke.
2. Remove pin that holds retractor on piston rod with a punch. Drive piston rearward until piston rests on end cap.
3. With greater force, drive piston and end cap out, (use piston to keep end cap square and perpendicular to bore).
4. Replace seals and wear rings as needed.

Assembly (RSL4 with End Cap)

1. Press piston to bottom of bore and fill with SWEENEY 509 Hydraulic Fluid to high pressure inlet hole.

2. Place end cap with new seal in bore with a press. Push end cap flush using installation tool (RSL4-IT).

Disassembly (RSL14 with End Cap)

1. Insert mating QD's in QD's on Power Head.
2. With piston in mid stroke, remove pin, which holds retractor in place on piston. With spanner wrench, remove end cap by rotating is counter-clockwise.
3. Pour out hydraulic oil from cylinder. Remove piston by pressing on its end. (Do not press on spherical radius surfaces).
4. Replace seals and/or wear ring as needed.

Assembly (RSL14 with End Cap)

1. Insert piston into cylinder all the way to end of stroke.
 2. Fill to high pressure inlet hole with hydraulic oil.
- Screw in en cap until it bottoms out.

Disassembly (RSL30)

1. Insert mating QD's in QD's on Power Head.
2. With piston in mid stroke, remove pin, which holds retractor in place on piston.
3. Remove 22 bolts (5/16-24x5/8) that hold end cap in place.
4. Remove end cap
5. Pour out hydraulic oil from cylinder. Remove piston by pressing on its end. (Do not press on spherical radius surfaces).
6. Replace seals and/or wear ring as needed.

Assembly (RSL30)

1. Insert piston into cylinder all the way to end of stroke.
 2. Fill to high pressure inlet hole with hydraulic oil.
- Replace end cap. Tighten (22) 5/16 bolts to 20 ft-lb. (dry or with only hydraulic oil for lubrication).

Assembly (on ALL RSL Power Heads)

All air should be purged from the tool head before the Power Head is returned to service.

Suggested method:

Connect the Power Head to the console. Placing the Power Head below the console and extend the cylinder to the end of the stroke. Remove the power head and connect the hoses together. Turn the console on and let run for a minute. Repeat the procedure until the rod extends and retracts smoothly.

RSL HEX AND SQUARE DRIVE WRENCH HEADS

1. All moving parts should be coated periodically with SWEENEY 503 Moly Paste Lubricant. The frequency of lubrication depends on severity of use and working environment.
2. Check housing and internal parts for cracks and wear **RSL Hex Wrench Heads**: Loosen socket head cap screws joining hex wrench head housings. Separate housing halves. Ratcheting assembly is now exposed. Pawl and hex driver teeth should be in correct alignment and precise engagement. Before assembly, all moving parts should be coated with SWEENEY 503 Moly Paste Lubricant. Hex wrench head components including Pawl, Pawl Driver, Pawl holding spring, and hex wrench head housings should be inspected regularly to determine if there are any cracks, chips, or deformities. If any irregularities are found, immediate service or replacement is required.

Preventive Maintenance Continued

RSL Square Drive Wrench Heads: Remove Square Drive from square drive housing assembly, remove ratcheting assembly away through bottom of square drive housing. Ratcheting assembly is now exposed. Pawl and square drive teeth should be in correct alignment and precise engagement. Before assembly, all moving parts should be coated with SWEENEY 503 Moly Paste Lubricant. Square Drive Wrench Head components including Square Drive, Square Driver, Pawl, Pawl Driver, pawl holding spring, and square drive wrench head housing should be inspected regularly to determine if there are any cracks, chips, or deformities. If any irregularities are found, immediate service or replacement is required.

DISASSEMBLY OF RSL4 POWER HEAD (with End Cap only - older style)

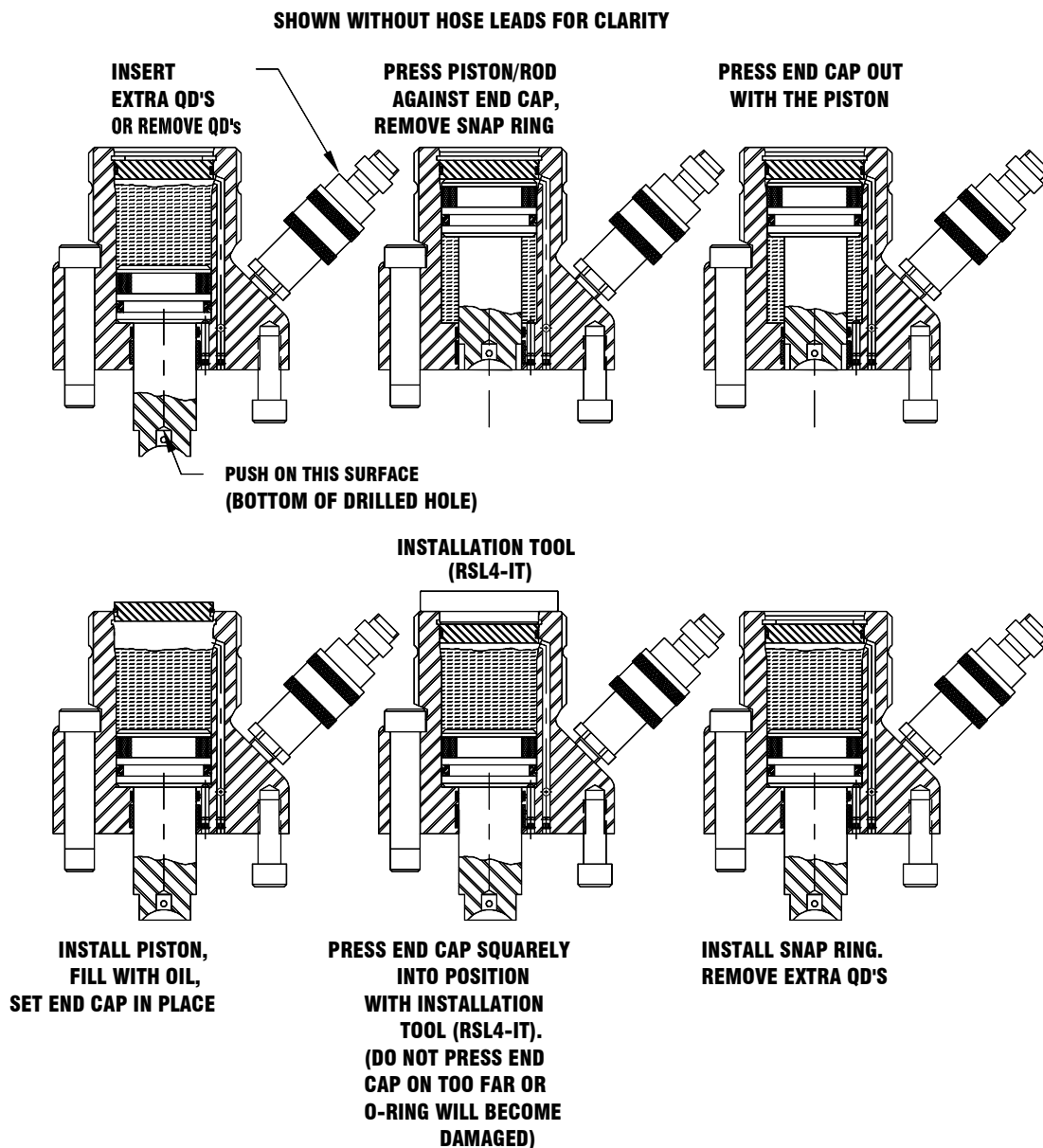


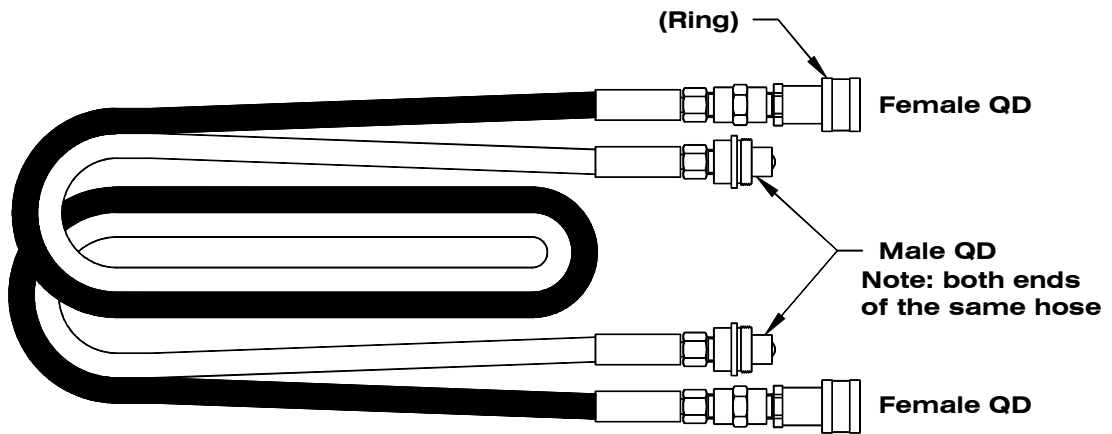
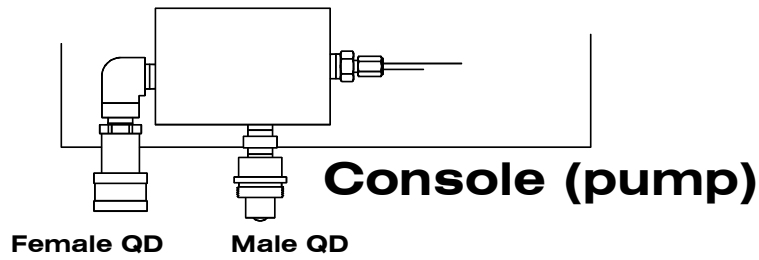
FIGURE 5-1

SECTION 6

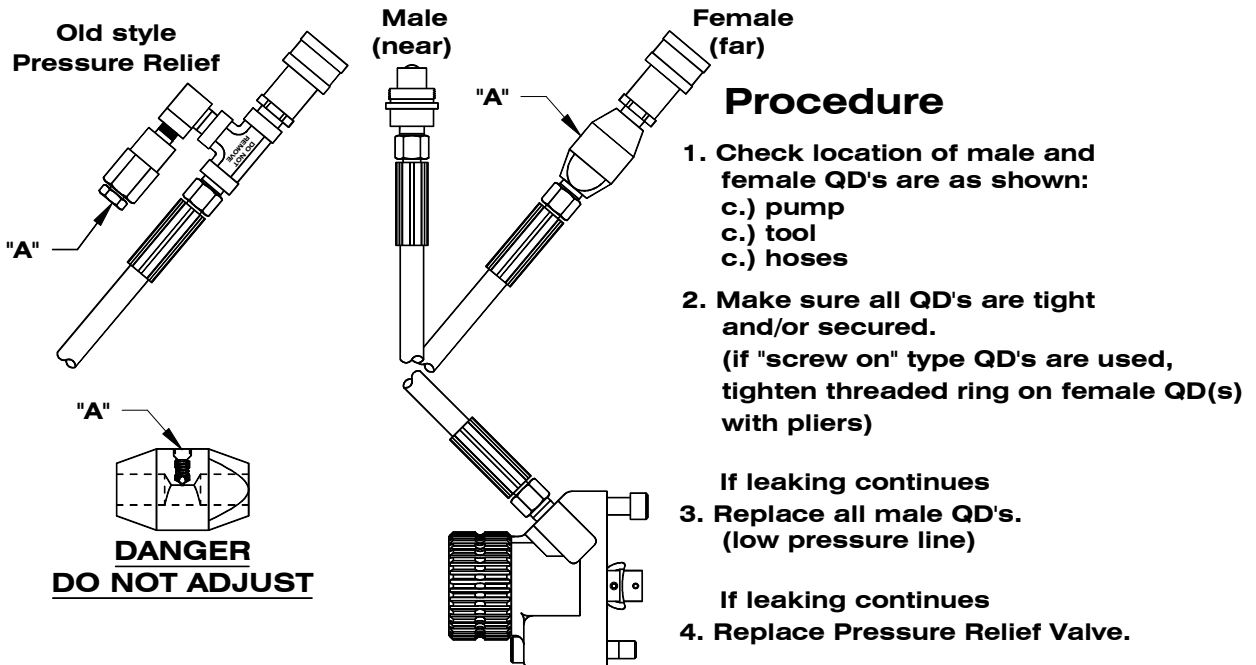
TROUBLE SHOOTING

PROBLEM	CAUSE	SOLUTION
Hydraulic fluid leaks from RSL Power Head.	Power Head Seals are worn.	Replace Power Head Seals
Power Head Rod does not extend. Torque Gauge shows hydraulic pressure, and the Console is running. or Power Head Rod does not retract. Torque gauge shows hydraulic pressure and the Console is running.	1. Hydraulic line Quick Connect Couplings are improperly connected. 2. Hydraulic line Quick Connect Couplings are worn and the Check Valves are not engaging one another. 3. Power Head Seals have flattened and hydraulic fluid is flowing by the Piston.	1. Disconnect hydraulic lines, clean Quick Connect Couplings and securely reconnect the couplings with pliers (on screw-on type couplings). 2. Replace the worn Quick Connect Couplings. 3. Change Seals.
Power Head Rod does not fully extend when Tool is not mounted on a stud.	1. Hydraulic system is low on hydraulic fluid. 2. Hoses have air in them.	1. Add additional hydraulic fluid in accordance with the applicable Console Operation and Maintenance Manual. 2. Connect hose ends together and run pump to force out air.
Power Head Rod will not extend at all, the Torque Gauge shows no hydraulic pressure and the Console is running.	1. For System Z1A Consoles, the Four-way Air Valve is sticking due to moisture or dirt in the compressed air supply or corrosion of the Four-way Air Valve. 2. For System Z1E Consoles, the Solenoid Valve is sticking.	1. Clean the Four-way Air Valve. 2. Clean the Solenoid Valve. Check line voltage.
Tool operates backwards (Advance button retracts piston rod).	Quick Connect Couplings are reversed on hoses, pump, or Power Head.	Properly install Quick Connect Couplings.
Tool does not operate even though Console is running and all connections are properly connected.	Improper Power Head to Wrench Head assembly has sheared or broken retractor pin.	Replace retractor pin, if broken, and assemble correctly.
Wrench Head operation is sluggish and/or noisy.	Insufficient lubrication on push block/pawl driver surfaces, bushing surfaces and /or ratcheting mechanism.	Disassemble, coat well with SWEENEY 503 Moly Paste Lubricant.
Nut partially returns with the Wrench (or socket) when the Power Head Rod returns to initial position.	Torsion on stud is causing the nut to return with the stud.	Properly lubricate stud and nut threads.
The nut does not rotate as many degrees as the Wrench (or socket).	1. The Tool is not level or perpendicular to the stud centerline (“out of square” engagement). 2. The corners of the nut being worked are rounded off.	1. Reposition the Tool and/or Reaction Arm so that it is level and perpendicular to the stud centerline (perform “floor test”). 2. Either replace the nut or use a smaller size Wrench or socket.

TROUBLE SHOOTING



If oil is coming out of pointed location "A" on extend cycle



**FIGURE 6-1
TROUBLE SHOOTING**

SECTION 7 PARTS LIST

When ordering replacement parts, specify the Tool Style, Model Number, Serial Number, Description of the replacement parts, and the number listed in the Parts List. All replacement parts should be ordered from Hydratight factory service (tel. 713-860-4200, 1-800-895-3849).

RSL POWER HEAD PARTS

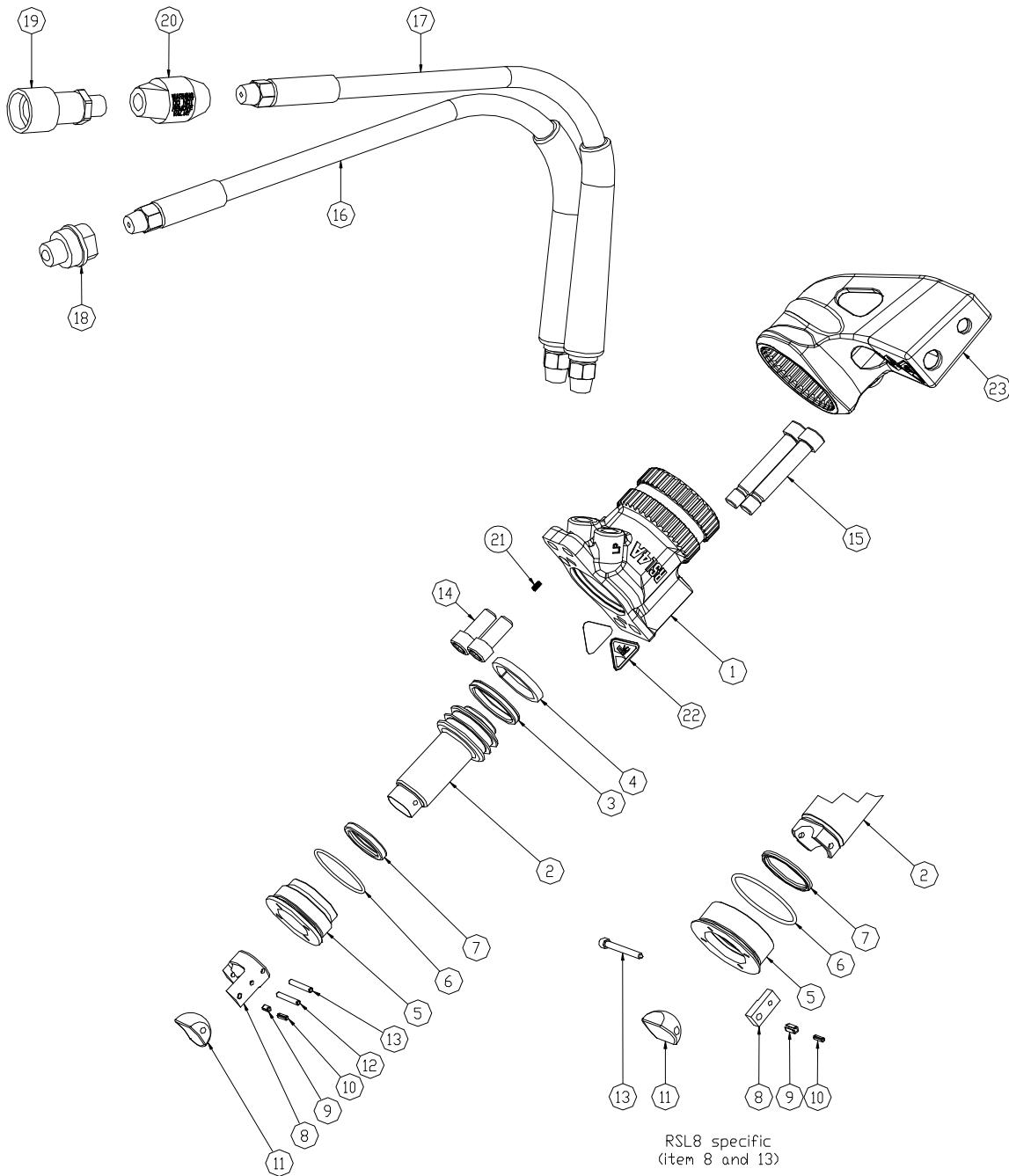


Fig 7-1

ITEM	PART NUMBER							DESCRIPTION	QTY
	RSL2B	RSL4B	RSL6A	RSL8A	RSL14B	RSL20	RSL30		
								Power Head	
1	RSL2-1A	RSL4-1A	RSL6-1A	RSL8-1A	RSL14-1A	RSL20-1	RSL30-1	Housing, Power Head	1
2	RSL2-2A	RSL4-2A	RSL6-2	RSL8-2	RSL14-2B	RSL20-2	RSL30-2	Piston	1
3	942348	942300	942355	942346	942304	942356	942327	Piston Seal	1
4	942349	942301	942354	934747	942306	942360	942328	Piston Wear Ring	1
5	RSL2-3	RSL4-3B	RSL6-3	RSL8-3	RSL14-3A	RSL20-3	N/A	Front Cap	1
6	A000282070001	A000282076001	A000282080001	A000282086001	A000282090001	A000282098001	N/A	O-Ring (Front Cap)	1
7	942272	942361	942364	942359	942367	942358	942362	Gland Seal	1
8	RSL2-5A	RSL4-5	RSL6-5	RSL8-5	RSL14-5B	RSL20-5	RSL30-5	Retractor	1
9	A000141183001	A000141183001	921152	921152	RSL14-55	921152	921152	Pin, Retractor	1
10	N/A	N/A	A000141185001	A000141185001	A000141165001	A000141185001	A000141185001	Pin, (Inner)	1
11	RSL2-4A	RSL4-4	RSL6-4	RSL8-4	RSL14-4	RSL20-4	RSL30-4	Block, Bronze	1
12	A000141192001	A000141194001	A000141198001	N/A	A000141201001	A000141203001	A000141203001	Pin, Roll	1
13	N/A	A000141194001	RSL6-55	A000151769001	A000141221001 & A000141169001	A000141203001	A000141183001	Pin, Roll (or screw) RSL14 - Pin in pin	1 2
14*	A000151813001	A000151862001	916279	916268	916268	916281	916270	Short Bolt	2
15*	RSL2-6	RSL4-6	RSL6-6A	RSL8-6	RSL14-6	RSL20-6	RSL30-6	Long Bolt	2
16	X1-192	X1-422BLK	X1-422BLK	X1-422BLK	X1-422BLK	X1-422BLK	X1-422BLK	Hose, Black	1
17	X1-192	X1-422BLU	X1-422BLU	X1-422BLU	X1-422BLU	X1-422BLU	X1-422BLU	Hose, Blue	1
18	936541	936541	936541	936541	936541	936541	936541	QD, Male	1
19	936543	936543	936543	936543	936543	936543	936543	QD, Female	1
20	X1-21	X1-21	X1-21	X1-21	X1-21	X1-21	X1-21	Relief Valve	1
21**	936633	936633	936633	936633	936633	A000371564001	936575	Plug	1
22	RSL-308	RSL-308	RSL-308	RSL-308	RSL-308	RSL-308	RSL-308	Sign, Safety	2
23	RSL2-70A	RSL4-70A	RSL6-70	RSL8-70A	RSL14-70A	RSL20-70	RSL30-710	Reaction Arm Assembly	1
24***	X1-18	X1-1	X1-15	X1-14	X1-5	X1-16	X1-6	Overlay	1
25***	N/A	N/A	RSL6-100A	RSL8-100	N/A	N/A	RSL30-100	Model Plate	1
26***	N/A	N/A	N/A	N/A	N/A	N/A	RSL30-101	Name Plate	1
27***	913007 (1/4)	913009 (5/16)	913012 (3/8)	913023 (1/2)	913021 (5/8)	913021 (5/8)	913022 (3/4)	Hex Key - for short screw	1
28***	N/A	N/A	N/A	N/A	913020 (1/2)	N/A	N/A	Hex Key – for long screw	1
29***	913001 (3/32)	913001 (3/32)	913003 (5/32)	913003 (5/32)	913005 (3/16)	913005 (3/16)	913005 (3/16)	Hex Key – for hex head	1
30***	N/A	N/A	N/A	N/A	N/A	N/A	RSL30-3	End Cap (not shown)	1
31***	N/A	N/A	N/A	N/A	N/A	N/A	942334&942335	End Cap Seal(s)	1
32***	N/A	N/A	N/A	N/A	N/A	N/A	A000151829001	End Cap Bolts	22
33***	N/A	N/A	N/A	N/A	N/A	N/A	942326	Gland Wear Ring	1

* Refer to section 3 or section 4 - paragraph "ASSEMBLY OF COMPONENTS" for recommended tightening torque.

** Tightening torque 80 lbf-ft / 108 Nm (+/- 6% of torque value).

*** Not shown.

Available:

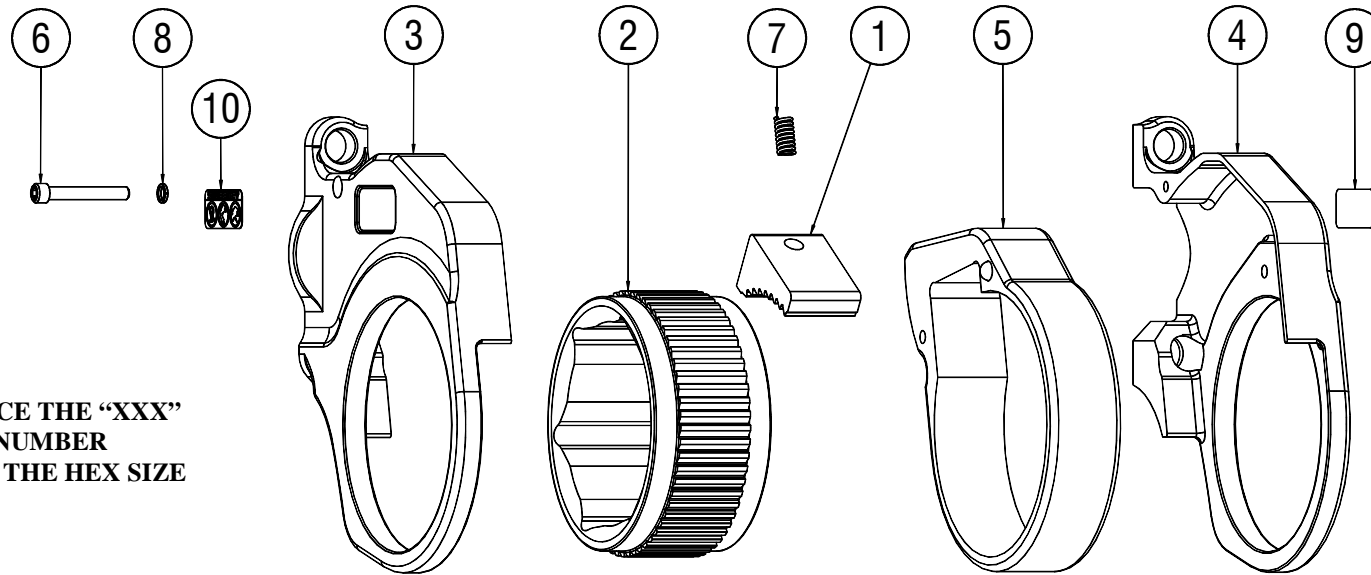
Spare Part Kit number: RSLx-SPK, for actual kit number, "x" to be replaced with model number (2, 4, 6, ...). Spare Part Kit, consists of: seal kit, OD's (male and female), long and short screws, retractor pins.

Seal Kit number: RSLx-SK, for actual part number "x" to be replaced with model number (2, 4, 6, ...).

100002813 Lubricant, 503 Molypaste (4 lb can)

For older models' parts, refer to original (older) manual or contact Pasadena facility for clarification – see front page for contact data.

RSL HEX WRENCH HEAD PARTS LIST



**NOTE: REPLACE THE “XXX”
IN THE PART NUMBER
BELOW WITH THE HEX SIZE**

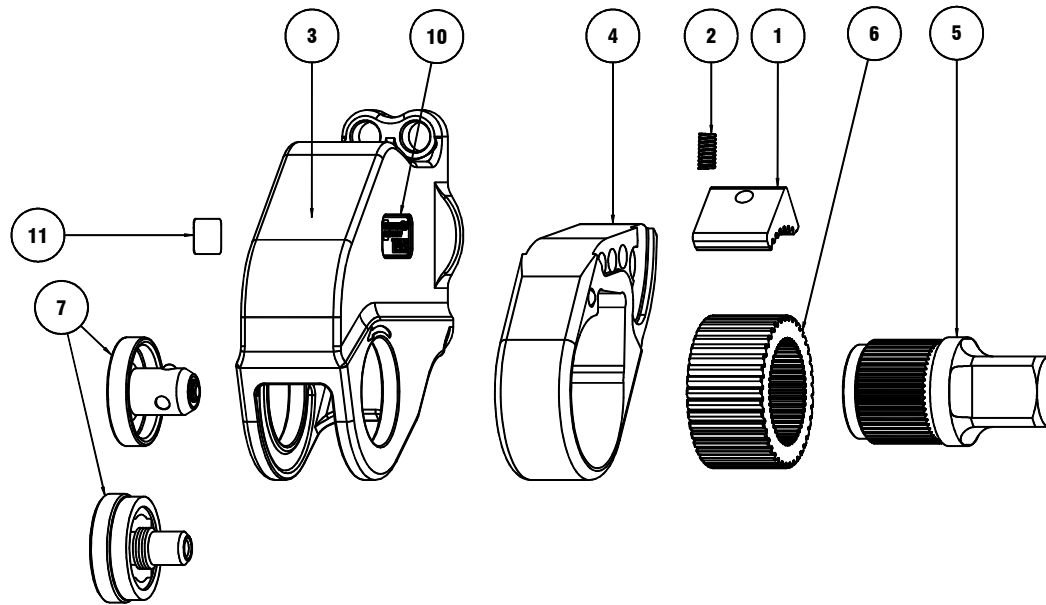
ITEM	PART NUMBER							DESCRIPTION	QTY
	RSL2H	RSL4H	RSL6H	RSL8H	RSL14H	RSL20H	RSL30H		
1	RSL2HXXX-3	RSL4HXXX-3	RSL6HXXX-3	RSL8HXXX-3	RSL14HXXX-3	RSL14HXXX-3	RSL30HXXX-3	PAWL	1
2	RSL2HXXX-4	RSL4HXXX-4	RSL6HXXX-4	RSL8HXXX-4	RSL14HXXX-4	RSL14HXXX-4	RSL30HXXX-4	HEX	1
3	RSL2HXXX-10	RSL4HXXX-10	RSL6HXXX-10	RSL8HXXX-10	RSL14HXXX-10	RSL14HXXX-10	RSL30HXXX-10	HOUSING, RIGHT SIDE	1
4	RSL2HXXX-11	RSL4HXXX-11	RSL6HXXX-11	RSL8HXXX-11	RSL14HXXX-11	RSL14HXXX-11	RSL30HXXX-11	HOUSING, LEFT SIDE	1
5	RSL2HXXX-20	RSL4HXXX-20	RSL6HXXX-20	RSL8HXXX-20	RSL14HXXX-20	RSL14HXXX-20	RSL30HXXX-20	DRIVER, PAWL SUB-ASS'Y	1
*6	A000152945001	A000152945001	A000151766001	A000151768001	A000151790001	A000151792001	A000151792001	SOC. HD CAP SCREW	1
7	950291	950250	950250	950250 (QTY 2)	950255	950263	950263	SPRING	1
8	A000261235001	A000261235001	A000261237001	A000261237001	A000261243001	A000261243001	A000261243001	WASHER	1
9	RSLH-300	RSLH-300	RSLH-300	RSLH-300	RSLH-300	RSLH-300	RSLH-300	PLATE, SAFETY	1
10	RSL2H-100	RSL4H-100	RSL6H-100	RSL8H-100	RSL14H-100	RSL20H-101	RSL30H-100	PLATE, MODEL	1

* HEX KEY SIZE 5/32 (RSL2HXXX, RSL4HXXX AND RSL8HXXX), 3/16 (RSL14HXXX, RSL20HXXX AND RSL30HXXX)

NOTE: FOR ACTUAL PART NUMBER INSERT WRENCH SIZE FOR “XXX”

**FIGURE 7-2
RSL HEX WRENCH HEAD PARTS LIST**

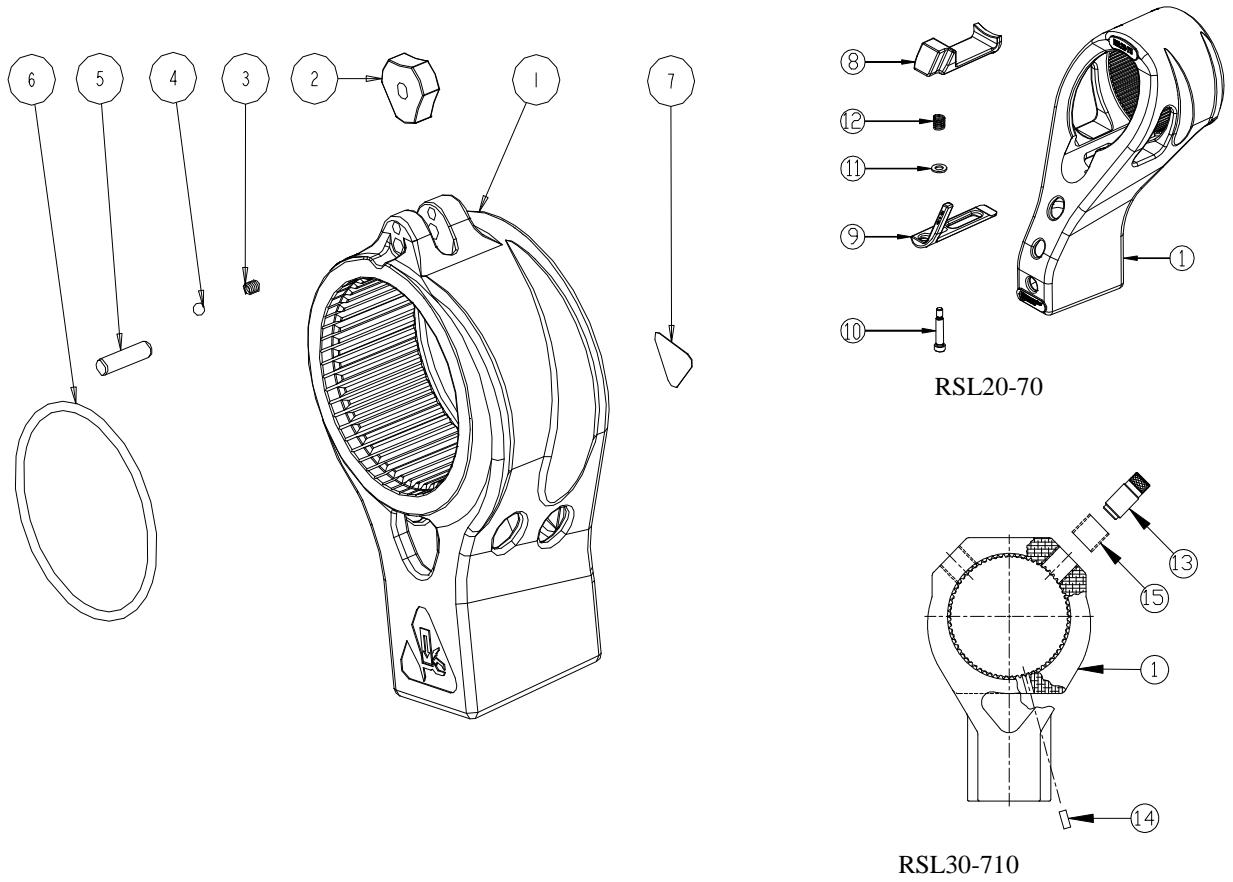
RSL Square Drive Wrench Head Parts List



ITEM	PART NUMBER							DESCRIPTION	QTY
	RSL2S	RSL4S	RSL6S	RSL8S	RSL14S	RSL20S	RSL30S		
1	RSL2S-3	RSL4S-3	RSL6S-3	RSL8S-3	RSL14S-3	RSL20S-3	RSL30S-3	PAWL	1
2	950291	950302	950250	950250 (2)	950255	950263	950263 (2)	SPRING	1 (2)
3	RSL2S-10	RSL4S-10	RSL6S-10	RSL8S-10	RSL14S-10	RSL20S-10	RSL30S-10	HOUSING	1
4	RSL2S-20	RSL4S-20	RSL6S-20	RSL8S-20	RSL14S-20	RSL20S-20	RSL30S-20	ASSEMBLY, PAWL DRIVER	1
5	TA2S-40	TA4S-40	TA6S-40	TA8S-40	TA14S-40	RSL20S-40	RSL30S-40	ASS'Y, SQUARE DRIVER	1
6	RSL2S-4	RSL4S-4	RSL6S-4	RSL8S-4	RSL14S-4	RSL20S-4	RSL30S-4	DRIVER, SQUARE	1
7	TA2S-44	TA4S-44	TA6S-44	TA6S-44	TA14S-44	RSL30S-44	RSL30S-44	RETAINER, SQUARE	1
8	N/A	NA	N/A	N/A	NA	N/A	N/A	PIN	1
9	N/A	NA	N/A	N/A	NA	N/A	N/A	O-RING	1
10	RSL2S-100	RSL4S-100	RSL6S-100	RSL8S-100	RSL14S-100	N/A	RSL30S-100	PLATE, MODEL	1
11	RSLS-300	RSLS-300	RSLS-300	RSLS-300	RSLS-300	RSLS-300	RSLS-300	SIGN, SAFETY	1

Figure 7-3
RSL Square Drive Wrench Head Parts List

RSL Reaction Arm Assembly Parts List



ITEM	PART NUMBER							DESCRIPTION	QTY
	RSL2-70A	RSL4-70A	RSL6-70	RSL8-70	RSL14-70A	RSL20-70	RSL30-710		
								Ass'y, Reaction Arm	
1	RSL2-710	RSL4-710A	RSL6-710	RSL8-710	RSL14-71A	RSL20-71	RSL30-711	Arm, reaction	1
2	RSL2-724	RSL4-724	RSL8-724	RSL8-724	RSL14-724			Diallock	1
3	950288	950288	950285	950285	950285			Spring, compression	1
4	900006	900006	900005	900005	900005			Ball	1
5	920143	A000141014001	A000141025001	A000141026001	A000141026001			Dowel pin	1
6	A000282077001	A000282157001	A000282161001	A000282163001	A000282165001			O-ring	1
7	RSL-308	RSL-308	RSL-308	RSL-308	RSL-308	RSL-308	RSL-308	Sign, safety	1
8						RSL20-72		Lever, retention	1
9						RSL20-73		Lock, retention	1
10						A000152767001		Set Screw	1
11						A000261434001		Washer	1
12						950300		Spring, compression	1
13							RSL30-712	Screw	2
14							A000141274001	Rollpin, 1/4 x 5/8" long	1
15							926085	Insert, thread	2

Figure 7-3
RSL Reaction Arm Assembly Parts List

Seal Kits

Parts List and Seal Placement Guide

General

Seals replacement requires proper procedure to disassemble and assemble Power Head. Please reference to Section 5: Preventive Maintenance.

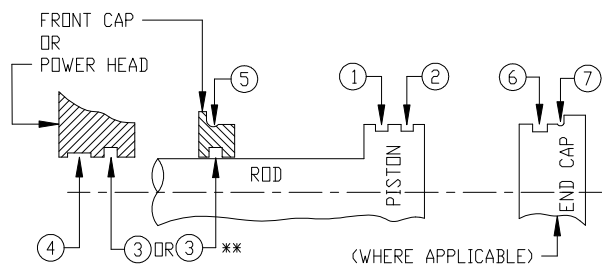
- For ease of identification, each seal is individually packed and clearly marked.
- Use table and drawing below as a seal placement guide.

Parts List

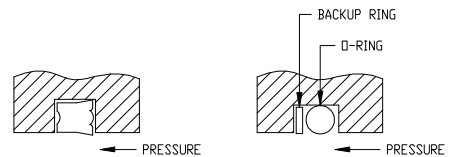
- Every Seal Kit consists all seals for all respective RSL models.
- RSL4-SKV Seal Kit consists seals made of Viton, for special, environment driven applications.

Item Number →		1	2	3	4	5	6	7
Seal Kit	RSL Model	Piston Seal	Piston Wear Ring	Rod Seal	Rod Wear Ring	Front Cap Seal	End Cap Seal (groove)	End Cap Seal (corner)
RSL2-SK	RSL2 (rev D)	942348	942349	A000282015001	n/a	A000282070001	n/a	n/a
	RSL2				n/a		n/a	
	RSL2A				n/a		n/a	
	RSL2B				942272		n/a	n/a
RSL4-SK	RSL4*	942300	942301	A000282019001	942299		942302	n/a
	RSL4A				n/a	A000282026001	n/a	n/a
	RSL4B				942361	n/a	A000282076001	n/a
RSL4-SKV	RSL4A & B	942370	942301	942371		A000282026004		
RSL6-SK	RSL6 (rev C)	942355	942354	A000282023001	n/a	A000282080001	n/a	n/a
	RSL6				n/a		n/a	
	RSL6A				942364		n/a	n/a
RSL8-SK	RSL8 (rev H)**	942346	942347	A000282026001	n/a	A000282086001	n/a	n/a
	RSL8A				942359		n/a	n/a
RSL14-SK	RSL14	942304	942306	A000282028001	942305	n/a	942303	n/a
	RSL-14A				342367	n/a	A000282090001	n/a
RSL20-SK	RSL20	942356	942360	942358	n/a	A000282098001	n/a	n/a
RSL30-SK	RSL30 (rev L)	942327	942328	A000282084001	942326	n/a	942335	942334
	RSL30					942362		

* RSL4 (with End Cap) - for proper assembly of this model, it is highly recommended to use RSL4-IT Installation Tool - sold separately, not included in this standard Seal Kit.
 ** Some older RSL8 Front Caps have been reworked and have two grooves, smaller in front and bigger in the back - use bigger groove and square seal. Do not install both seals.

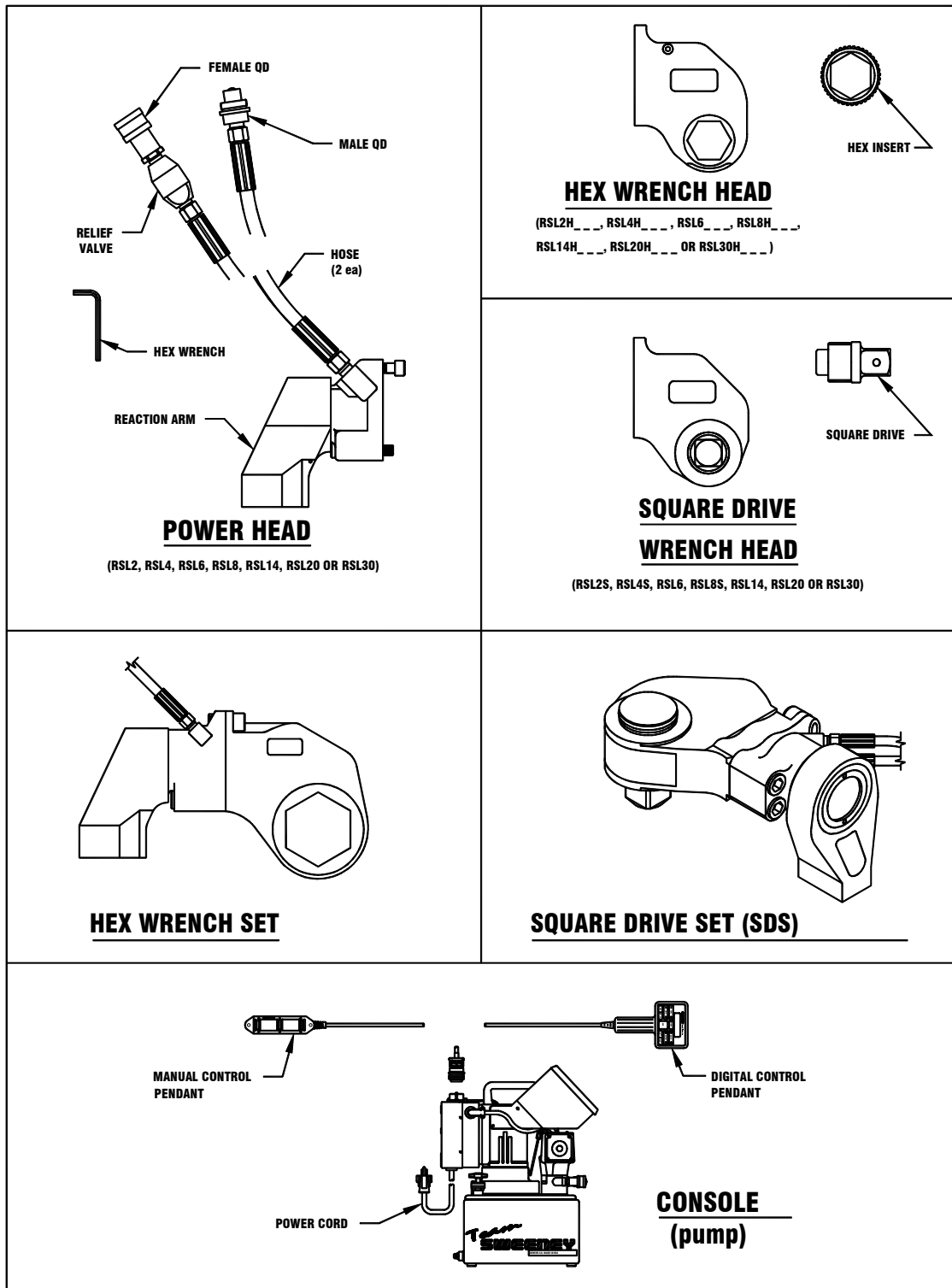


Seal placement guide



Seal type dependent installation detail (where applicable)

RSL TOOL DESCRIPTIONS



**FIGURE 8-2
GENERAL DESCRIPTIONS**

SECTION 8

TENSION, TORQUE AND ELONGATION

7. The moment arm length of the Wrench is controlled during the manufacture of the Wrench.

TENSION

1. To prevent leakage in bolted connections, it is necessary to provide an equal, evenly distributed clamping force around the entire connection. The clamping force must be greater than the anticipated loads applied to the connection. However, the tension in the studs due to the sum of the clamping force and the anticipated loads applied to the connection must be below the yield point of the stud material. The clamping force is achieved by applying a controlled tensile load to the studs by tightening the nuts. The correct tension is established by equipment manufactures, Codes or Standards depending upon the application, the tension can be expressed as the tensile stress in the studs, percentage of the yield strength of the stud material, elongation of the studs or degrees of rotation of the nut. The two ways of achieving the desired tension in the studs are applying a controlled amount of torque to the nuts or controlling the elongation of the studs.

TORQUE

1. To determine the amount of torque which must be applied to the nuts to achieve the desired tension in the studs, the frictional force between the stud and nut threads and mating surfaces must be known and controlled.
2. The required torque value is determined by using of the simplified screw jack formula by Farr which is as follows:

$$T = \frac{F}{12} \left(\frac{P}{2\pi} + \frac{RF}{\cos d} + Sf \right)$$

Where:

T = Torque value in ft-lb.

F = Required tension in the stud in pounds force.

P = Lead of the threads in inches (Figure 8-1)

R = Average mean radius from the axis of the stud out to the point where the load is applied to the thread surface in inches (Figure 8-1).

S = Mean Radius of the nut face or shoulder in inches (Figure 8-1).

$\cos d$ = cosine of 1/2 the included thread angle measured on a plane through the axis in degrees (d usually equals 30°).

f = Coefficient of friction.

3. The amount of torque to achieve the desired tension in the studs will vary widely depending upon the type of lubricant used due to the variation in coefficients of friction.
4. The coefficient of friction may be controlled through the use of a lubricant whose coefficient of friction is known.
5. To apply the required torque value to the nut the following must be controlled:
 - a) The force applied to the Wrench
 - b) The length of the moment arm of the Wrench.
6. The force applied to the Wrench is controlled by regulating and measuring the hydraulic fluid pressure produced by the Console, whose accuracy is traceable to the United States Bureau of Standards.

ELONGATION

1. The amount of elongation of the stud required to achieve the desired tension in the stud is determined by use of the following formula:

$$D = \frac{FL}{AE}$$

Where:

D = Elongation of the stud in inches.

F = Required tension in the stud in pounds force.

L = Effective bot length in inches.

A = Cross sectional area of the stud at its smallest diameter in square inches.

E = Modulus of elasticity.

2. Elongation is determined by measuring the length of the stud before and again after the tensile load is applied to the stud. If the stud was heated to accomplish the elongation, it should be allowed to cool (normally 24 hours) prior to measurement after the tensile load was applied. To accomplish elongation measurements of studs installed in blind holes, a flat-bottomed hole must be drilled along axis of the studs.
2. The amount of torque required to produce the calculation elongation can be determined by use of the simplified screw

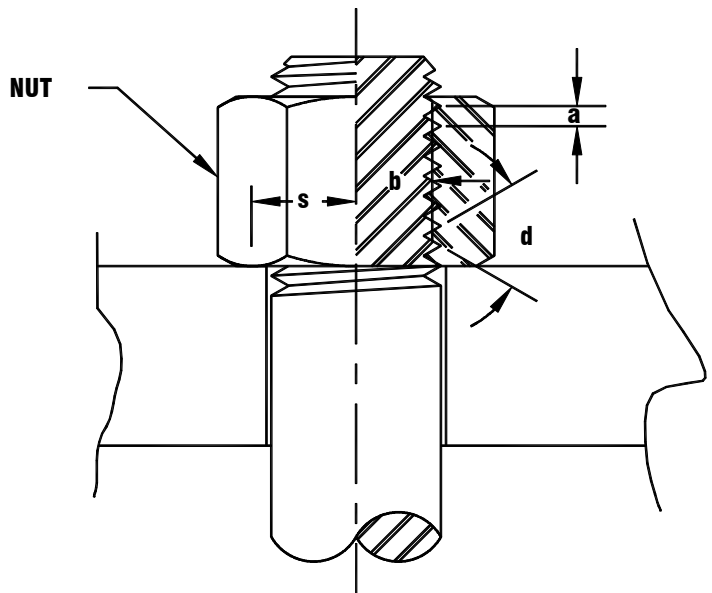


FIGURE 8-1
STUD AND NUT DIMENSIONS

NOTES

RSL TOOLS are designed to operate with either electric or air hydraulic Console (pump). This manual covers operation of the RSL Tools only. Operating instructions for the pump are covered in the separate manual provided with the pump. The tool should not be operated without Safety Tag (shown below) attached to the pump.



	WARNING
	OPERATOR MUST READ AND UNDERSTAND ALL OPERATING INSTRUCTIONS BEFORE USING EQUIPMENT
	INCORRECT REACTING WILL CAUSE HIGH STRESS ON TOOL AND SOCKET, MAY RESULT IN POSSIBLE BREAKAGE AND INJURY
	HIGH HYDRAULIC PRESSURE HAZARD USE WITH PROPER PROTECTIONS, TOOLS AND HOSES <small>690 BAR 10000 PSI</small>
	KEEP HANDS CLEAR FROM PINCH POINTS. OPERATION BY ONE PERSON IS RECOMMENDED
	DO NOT STRIKE OR MODIFY ANY EQUIPMENT

LEADING THE WAY
IN BOLTING TECHNOLOGY



RSL-STAG-REV A

INSTALL ON THE PUMP



SELECTED REACTION FIGURES

SQUARE DR. WRENCH HEADS		
	IF SOLID, SQUARE ENGAGEMENT IS NOT POSSIBLE ROTATE ARM INSTEAD OF LIFTING	
	DO NOT REACT WITHOUT CLEARANCE UNDER REACTION ARM ROTATE TO AVOID COCKING	
	AVOID ANY ANGULAR ENGAGEMENT	
	NEVER REACT IN REVERSED POSITION	

HEX WRENCH HEADS		
	AVOID ANY ANGULAR ENGAGEMENT	
	DO NOT REACT ON SPLINE	
	NO ANGULAR ADJUSTMENT ALLOWED. IN LINE REACTION ONLY	

INSTALL ON THE PUMP

SIDE 1

SIDE 2

WARRANTY

Hydratight warrants to the original purchaser only that the Product manufactured by it will be free from defects in design, materials and workmanship for three years from the date on which the Product is delivered to the original purchaser. **EXCEPT AS STATED IN THIS LIMITED WARRANTY, HYDRATIGHT DOES NOT MAKE AND DISCLAIMS ALL EXPRESS OR IMPLIED WARRANTIES INCLUDING, BUT NOT LIMITED TO, THE MERCHANTABILITY OF THE PRODUCT, ITS FITNESS FOR A PARTICULAR PURPOSE, ITS DESIGN, CONDITION OR WORKMANSHIP.** Hydratight's obligation under this warranty is limited to replacing or restoring (at Hydratight's election) any Product that is returned intact to it, or to one of its authorized service stations with transportation charges prepaid, within the warranty period, and that is disclosed, to Hydratight's satisfaction, to be defective after its examination.

The original purchaser is responsible for maintaining and replacing field serviceable items such as fuses, heater coils, filter elements and fluids. The field serviceable items are not warranted by Hydratight. This warranty shall not apply to any Product that has been repaired or altered outside of the Hydratight factory or authorized service stations, or has been subject to misuse or abuse, negligence or accident, or has been installed or used not in accordance with instructions furnished with the product by Hydratight.

HYDRATIGHT WILL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY CHARACTER AS A RESULT OF A BREACH OF ITS LIMITED WARRANTY, INCLUDING WITHOUT LIMITATION: INCONVENIENCE, TRANSPORTATION COSTS, LOSS OF PROFITS, PROPERTY DAMAGE OR LOST PRODUCTION, WHETHER SUFFERED BY THE ORIGINAL PURCHASER OR ANY THIRD PARTY. Hydratight's maximum liability under any circumstances will be the purchase price of the product paid by the original purchaser. Hydratight neither assumes nor authorizes and person to assume for it any other or greater liability in connection with the sale of its products.

Any provision in this limited warranty, including any provision limiting or excluding legal remedies or warranties or merchantability or fitness for purpose, is not applicable where expressly prohibited by local law, but only to the extent so prohibited.

Any action for breach of this warranty, regardless of the legal theory of the action, must be brought within one year after the date of breach.

Documentation of the date of delivery to the original purchaser is required with all requests for warranty. Contact Customer Service for a "Return Material Authorization" (RMA) number and shipping instructions. Products returned without an RMA number will not be accepted.