



**SHUR-LOK CORPORATION TECHNICAL
SALES BULLETIN**

TSB 0001

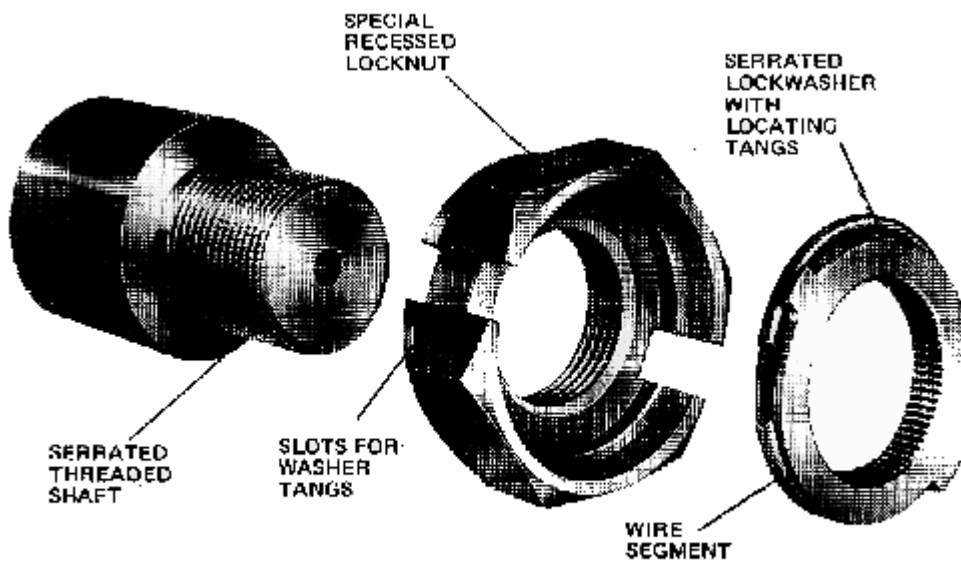
REV: NC

DATE: 6-4-96

TITLE: STA-LOK® POSITIVE LOCKING SYSTEM

STA-LOK® POSITIVE LOCKING SYSTEMS

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GENERAL DESCRIPTION OF SYSTEMS:

1.0 STA-LOK®

- 1.1 The STA-LOK® system has been developed over a number of years from the original Spring Lockwasher type to cover the needs of a wide range of applications requiring a quick, self-contained, re-usable, compact, positive locking method for threaded components.
- 1.2 Applications to date include gear-box and drive shaft bearing retention, wheel nut retention, jack body and nuts, and a number of routinely removed fully re-usable nut/bolt combinations. The method can be adapted to most combinations of nut/bolt, nut/shaft, or collar shaft types of applications.
- 1.3 The system depends essentially on registering the nut to the serrated lockwasher which in turn is registered to the bolt/shaft by means of light close pitch serrations broached on a portion of the non-working part of the thread i.e., the part in contact with the nut when fully assembled; thus the serrations do not normally affect the axial load capability of the nut.

2.0 STA-LOK® ADVANTAGES AND BENEFITS

- 2.1 Precise overload control is achieved by the large number of serrations. These give almost infinite angular positioning, thus permitting accurate torque setting for the required pre-load. Backing off or over torquing is eliminated.
- 2.2 The nut and washer assembly is highly re-usable, being easily removed without damage.
- 2.3 Since there is no keyway, stress concentrations arising from sharp non-radius corners are eliminated.
- 2.4 The nut, lockwasher and shaft are dynamically balanced due to the absence of a keyway. This means that higher shaft speeds can be used, with greater torque outputs.



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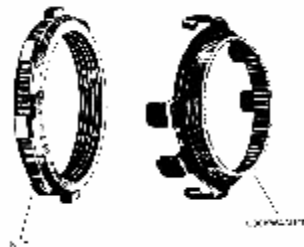
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- 2.5 The expense of keyway milling is replaced by the less costly broaching for serrations. Elimination of the keyway also allows shafts of smaller diameters or thickness to be used, with a resultant savings in weight and material.
- 2.6 The relatively low mass of the system permits rapid shaft accelerations.
- 2.7 The critical locking components are clearly visible, making visual inspection fast and positive. There is no possibility of a non-locked installation.
- 2.8 The small angular adjustment available eliminates the need for packing shims and makes the nut/washer combination highly interchangeable. It also allows for very precise positioning of the assembly.

3.0 TYPES OF STA-LOK® PRODUCT

- 3.1 To meet the varying needs of different applications there are presently two basic types of STA-LOK®, together with a number of variants developed for specific applications. All these types depend on the serrated lockwasher principle. The basic types are depicted below. The list is not exhaustive and other variations can be designed as required. If your particular requirement is not covered by the types shown, please consult Shur-Lok Corporation.



This is a low mass, good dynamically balanced system, but with low lockwasher re-usability. It is a short height system.



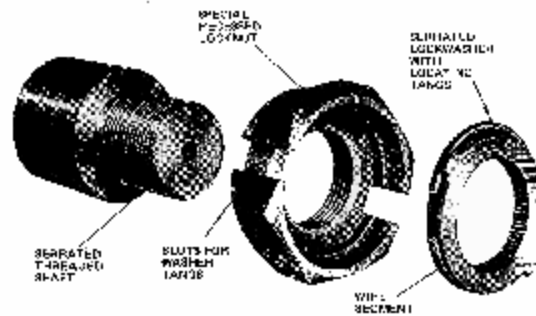
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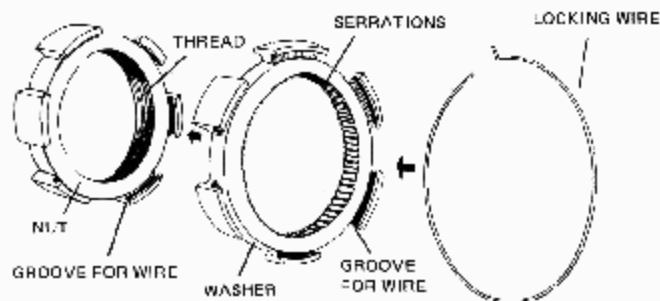
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This is a fast installation system . The circular version has good dynamic balance. This type has virtually infinite re-usability without part replacement.

3.2 Some other special types of STA-LOK® designs are shown below.



Low height for larger diameters. High dynamic balance for very high rotational speeds.



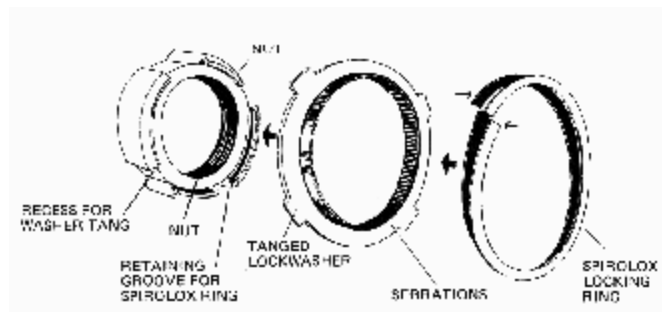
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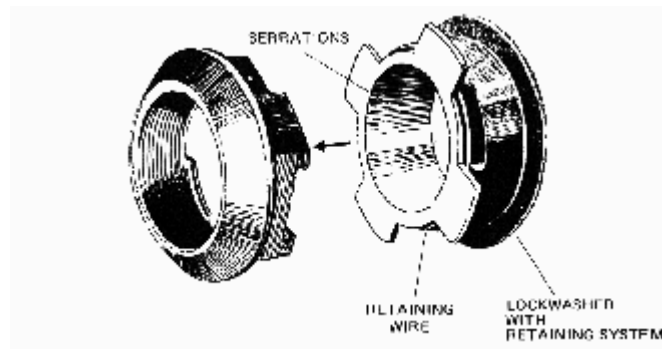
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SPIROLOX RING LOCKWASHER
Very low height and mass using a Spirolox Ring
for retention.



QUICK INSTALLATION AND REMOVAL
High speed installation and removal for vehicle hub nuts etc.



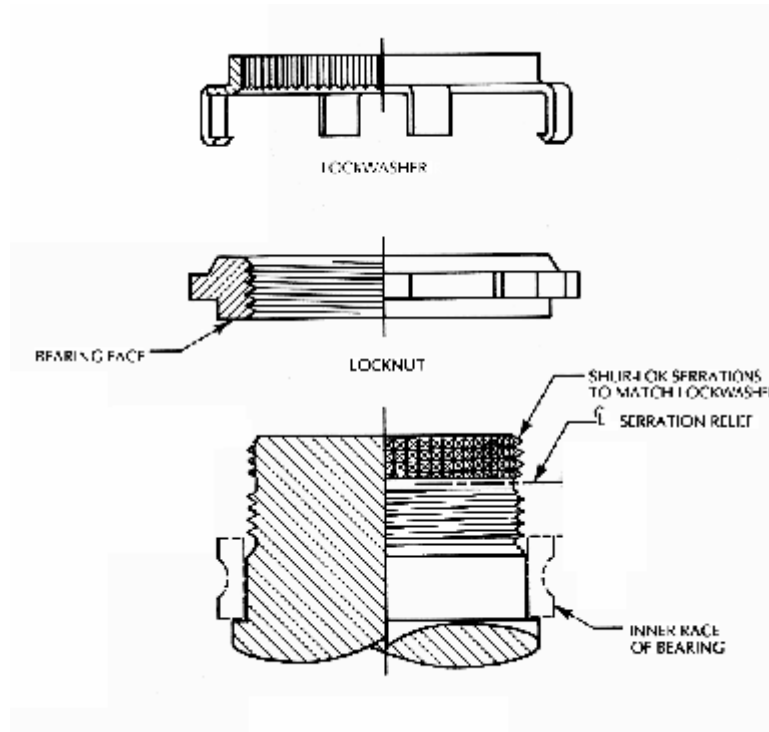
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4.0

INSTALLATION AND REMOVAL

4.1 Installation: Spring Lockwasher type:

- 4.1.1 Wrench locknut against inner race of bearing to desired torque.
- 4.1.2 Visually align lockwasher so that the four positioning tangs will straddle lugs on the locknut.
- 4.1.3 Press lockwasher over locknut until locking tangs snap in place under shoulder.



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4.2.1 Removal: Spring Lockwasher type:

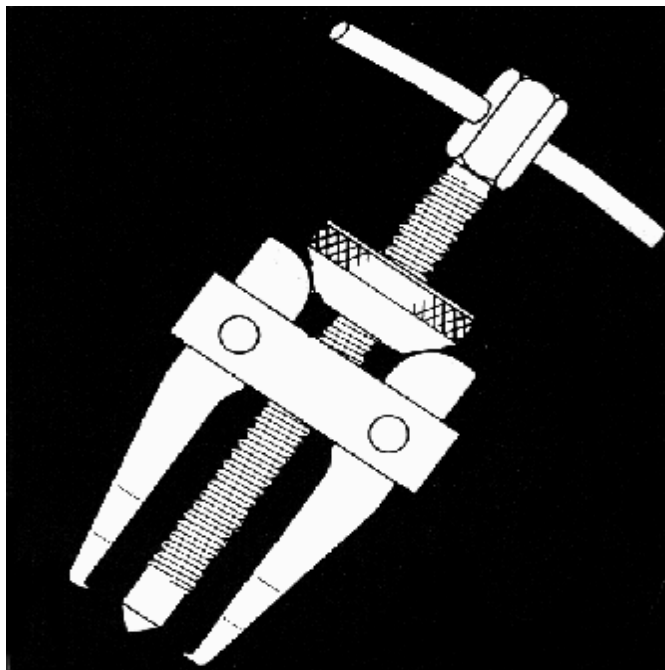
4.2.2 Insert screwdriver under lockwasher and lever off. Other methods are available for confined spaces. Consult Shur-Lok Corporation.

4.3.1 Installation: Trapped Segment Lockwasher

4.3.2 The lockwasher is installed by pushing it into the nut until the segment engages the detente. It will be found, if the segment does not engage, the lockwasher will fall out of the nut providing an immediate visual check.

4.4.1 Removal: Trapped Segment Lockwasher

4.4.2 Normal lockwasher removal is by use of a small pulling tool, but if required other methods can be catered for by modification to the basic design. For other methods consult Shur-Lok Corporation.





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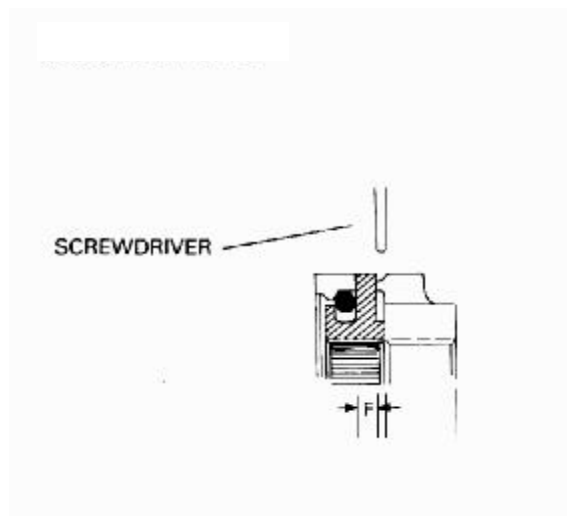
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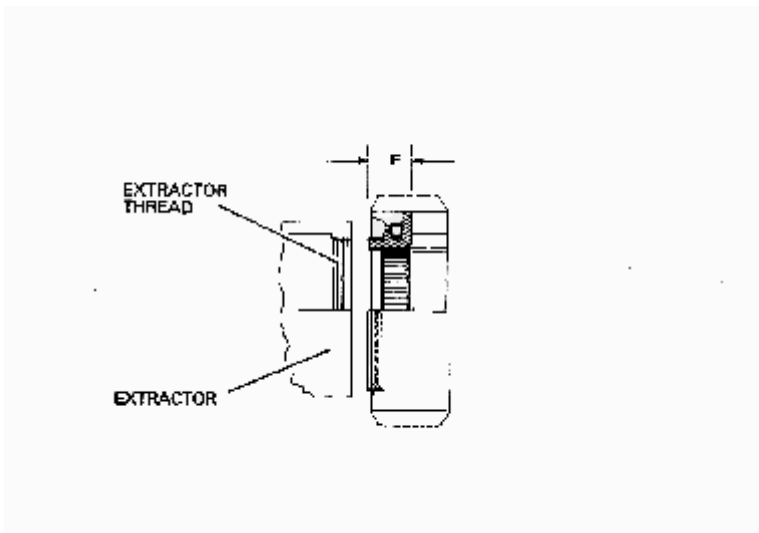
4.5.1 Alternate Removal Methods: Trapped Segment Lockwashers.

4.5.2 Screwdriver:
be used but it
length of washer
screwdriver slot.



This method can
will also increase
to allow for

4.5.3 Threaded Tube:
This method can
too increase
length of washer
(‘F’ dimension)
to accommodate
extractor thread.



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5.0 SHAFT SERRATION PREPARATION - DIE BROACH

- 5.1 In all cases, it is recommended that a Shur-Lok supplied serrating die is used in the first instance. Only if difficulty is found in using this method should alternate techniques, such as hobbing be used. In general, it will be found that problems occur only with very soft or very hard materials (generally only case hardened). The die technique will always give adequate tolerances for the locking requirement.
- 5.2 The serrating process is basically a form of broaching and will generally require power driving and die removal, lubricated with a good quality cutting fluid. On soft materials, it may be necessary to use a nut to run down the thread after serration, to remove rags and swarf (burrs). In other cases wire brushing to remove swarf is usually sufficient. Press capacity required will depend on the work piece diameter and material, but SLC experience has shown that a 15 ton press will serrate up to M170 diameter. The maximum traverse speed of the unloaded press should not exceed 3/4in/sec (20mm/second). For smaller work pieces much smaller presses can be used but it is recommended that trails be carried out on a sample piece before commencing production. The use of fly-presses is not generally recommended.
- 5.3 **Shaft Preparation for Broaching:**
- 5.3.1 In many thread cases, controlling or truncating of the major diameter is required for



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broaching (see SHAFT PREPARATION DETAIL, dimension 'T'). See table I for recommended dimensions. For sizes not listed contact Shur-Lok Corporation.

- 5.3.2 A reduced diameter (see SHAFT PREPARATION DETAIL, dimension 'D') extension in front of the thread is recommended to center the broach, and can be cutoff and removed once broaching has been completed. The reduced diameter recommended should be slightly smaller than the minor diameter of the broach die, and clearance should not exceed more than .0015 (.038mm).



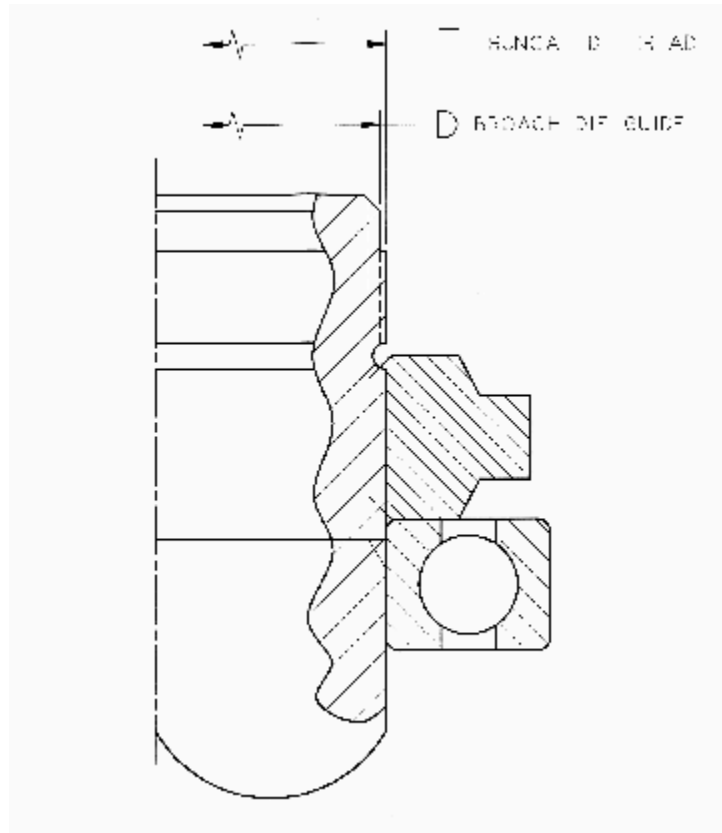
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TABLE

I:
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SHAFT
DIAMETER
(REF; THIS
DATA ALSO
SHOWN FOR
SRING
LOCKWASHE

RS SL60W(), REVISION 7 AND SL60WM(), REVISION 1 CATALOG PAGES. SOME METRIC 'T' DIMENSIONS SHOWN BELOW ARE REVISED OR ADDED FROM WHAT IS REFLECTED ON THE SL60W AND SL60WM() CATALOG PAGE AND ARE DENOTED BY .

THIS DATA IS RECOMMENDED FOR ALL STA-LOK CONFIGURATIONS EXCEPT SL40194, SK441 AND NSA5454 PRODUCT.



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NUMBER OF SERRATIONS	SAE THREAD (STANDARD BALL AND ROLLER BEARING LOCKNUTS) SEE TABLE NOTE 1	METRIC THREAD (M or MJ)	INCH THREAD (UN or UNJ)	'T' SHAFT CONTROLLED MAJOR DIA IN(mm)
19			.2500	..248-.250 (6.30-6.35)
24			.3125	.310-.312 (7.87-7.92)
		M8		.313-.315 (7.95-8.00)
29			.3750	.373-.375 (9.47-9.53)
30	.381-32	M10		.386-.391 (9.80-9.93)
34			.4375	.423-.425 (10.74-10.80)
36	.469-32	M12		.462-.467 (11.74-11.86)
39			.5000	.498-.500 (12.65-12.70)
43		M14		.549-.551 (13.95-14.00)
44			.5625	.560-.562 (14.23-14.27)
46	.586-32			.581-.586 (14.76-14.88)
49		M16	.6250	.623-.625 (15.82-15.88)
52	.664-32			.659-.664 (16.74-16.87)
54			.6875	.685-.687 (17.40-17.45)
55		M18		.703-.705 (17.86-17.91)
59			.7500	.748-.750 (19.00-19.05)
61	.781-32			.775-.780 (19.69-19.81)
62		M20		.782-.787 (19.86-20.00)



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64			.8125	.810-.812 (
69			.8750	
76	.969-32			.962-.967 (24.44-24.56)
77		M25		.978-.980 (24.84-24.89)
79			1.0000	
84			1.0625	
93	1.173-18			1.168-1.173 (29.67-29.79)
		M30		.1.178-1.180 (29.92-29.97)
99			1.2500	
104			1.3125	
108			1.3750	
109	1.376-18	M35		1.371-1.376 (34.82-34.95)
119			1.5000	
124	1.563-18	M40	1.5625	.1.560-1.562 (39.62-39.68)
129			1.6250	
139			1.7500	
140	1.767-18	M45		1.762-1.767 (44.76-44.88)
156	1.967-18	M50		1.962-1.967 (49.84-49.96)



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158			2.0000	
168			2.1250	
171	2.157-18			2.150-2.155 (54.61-54.74)
172		M55		.2.163-2.165 (54.94-55.00)
188	2.360-18	M60		2.355-2.360 (59.82-59.94)
203	2.548-18			2.543-2.548 (64.59-64.74)
		M65		.2.553-2.555 (64.85-64.90)
219	2.751-18	M70		2.746-2.751 (69.75-69.88)
228			2.8750	
233	2.933-12			2.925-2.930 (74.30-74.42)
235		M75		.2.951-2.953 (74.96-75.00)
248			3.1250	.3.110-3.112 (79.00-79.04)
250	3.137-12			3.132-3.137 (79.55-79.63)
		M80		.3.140-3.142 (79.80-79.81)
266	3.340-12	M85		3.335-3.340 (84.71-84.84)
281	3.527-12			3.522-3.527 (89.46-89.59)
282		M90		.3.541-3.543 (89.94-89.98)
297	3.730-12			3.725-3.730 (94.62-94.74)



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298		M95		.3.738-3.740 (94.94-95.00)
312	3.918-12			3.912-3.917 (99.37-99.49)
313		M100		.3.928-3.930 (99.77-99.82)
328	4.122-12			4.112-4.117 (104.44-104.57)
329		M105	4.1250	-4.123-4.125 (104.72-104.78)
331			4.1625	-4.153-4.155 (105.49-105.54)
345	4.325-12			4.320-4.325 (109.73-109.86)

NOTES: TABLE

1. NOTED SAE SIZES ARE INCLUDED ON SHUR-LOK CATALOG PAGE SL60W SERIES AND NAS1443.



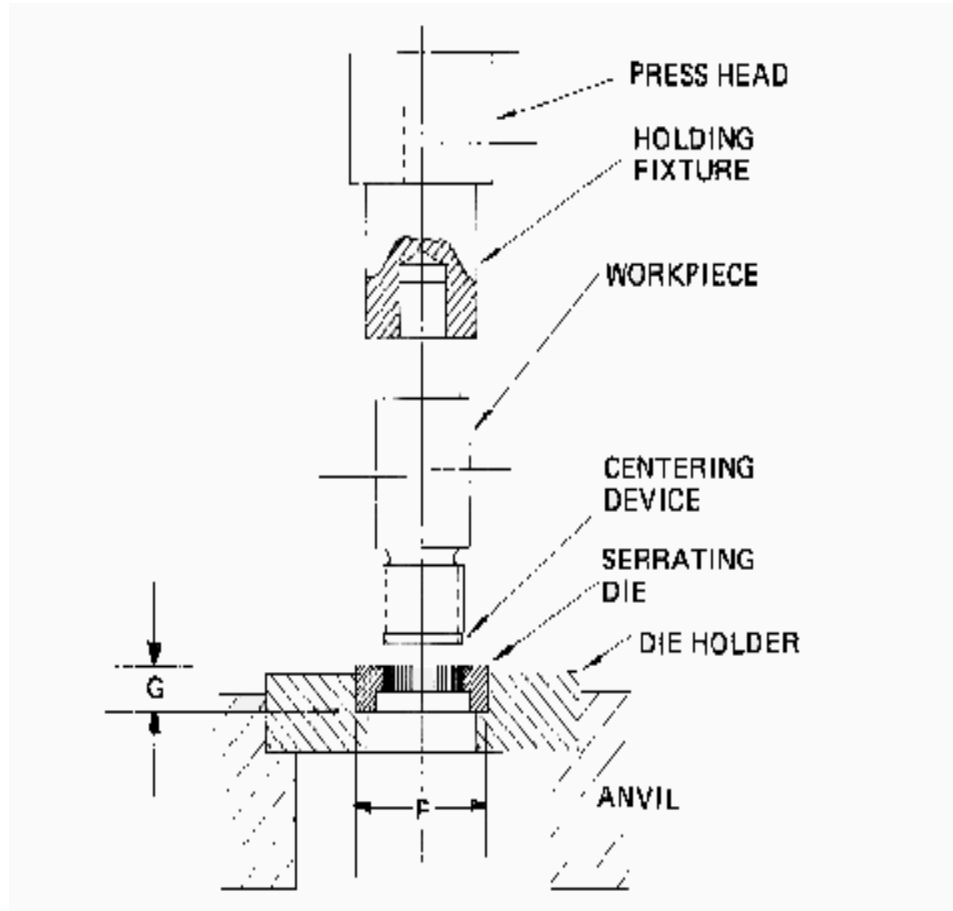
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5.3.3 **Process:** This is given in it's most basic form and can be adapted for horizontal broaching if need be, also for assisted ejection, etc. The method can also be reversed, to hold the die and traverse the work piece.

5.3.3.1 Locate die in die holder and chuck or clamp to head of press.

5.3.3.2 Mount the work piece in a holding fixture on the press bed. It is

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recommended that this fixture include a stop and, in production systems, a centering device.

5.3.3.3 If no centering device is fitted, lower press head and adjust work piece position so that it enters die guide plate centrally. Continue to lower press-head until stop is reached, or until serration dimension is reached. Reverse press to remove die from work piece.

5.3.3.4 Remove work piece and clean. Check serration with mating washer or inspection gage.

5.3.3.5 Blow out die orifice and repeat.

NOTE: Serrating must always be carried out after threading.

5.3.4 **Recommended Broach Dies for Shaft Hardness:**

Broach Die Series Part Number	Shaft Hardness (MAX)
SLT60B(*) Series	38 HRC
SL90402(*) Series	50 HRC

* Number of serration teeth (example: 233 teeth = SL90402-233 part number).

Note: As material approaches upper hardness listed above more frequent sharpening of die is required.

6.0 SHAFT SERRATION PREPARATION - OPTIONAL METHODS:

6.1 It is also possible to serrate by hobbing or gear cutting when the use of a broach die is not possible.

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6.2 If hobbing or gear cutting is required, contact Shur-Lok Engineering Department for serration geometry. The data for the individual serration (each size) geometry will be supplied under a confidential agreement.

7.0 INDUSTRY STANDARDS FOR STA-LOK® PRODUCTS:

7.1 Various industry and customer standards have been written and issued for STA-LOK® product . Listed below are a description of the more frequently used standards:

7.2 AIA Industry Standards for Spring Lockwasher Type STA-LOK®.

AIA Standard Number/ Shur-Lok Part Number	Component
NAS1443-()	Washer
SL60W() Series	
NAS1446-()	Nut
SL60N() Series	

7.3 Aerospatiale Customer Standard for Trapped Segment Lockwasher Type STA-LOK®.

Aerospatiale Part Number	Component
NSA5454-()-02	Washer
NSA5454- ()- 01	Nut



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For Nut Wrench Tooling, Washer Installation Tooling, Washer Removal Tooling and a more specific cross reference to Shur-Lok and Aerospatiale part numbers see Technical Sales Bullitin #TSB 0002.