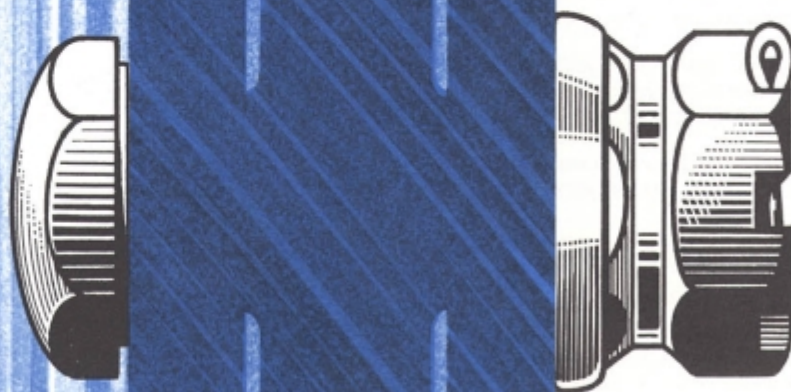
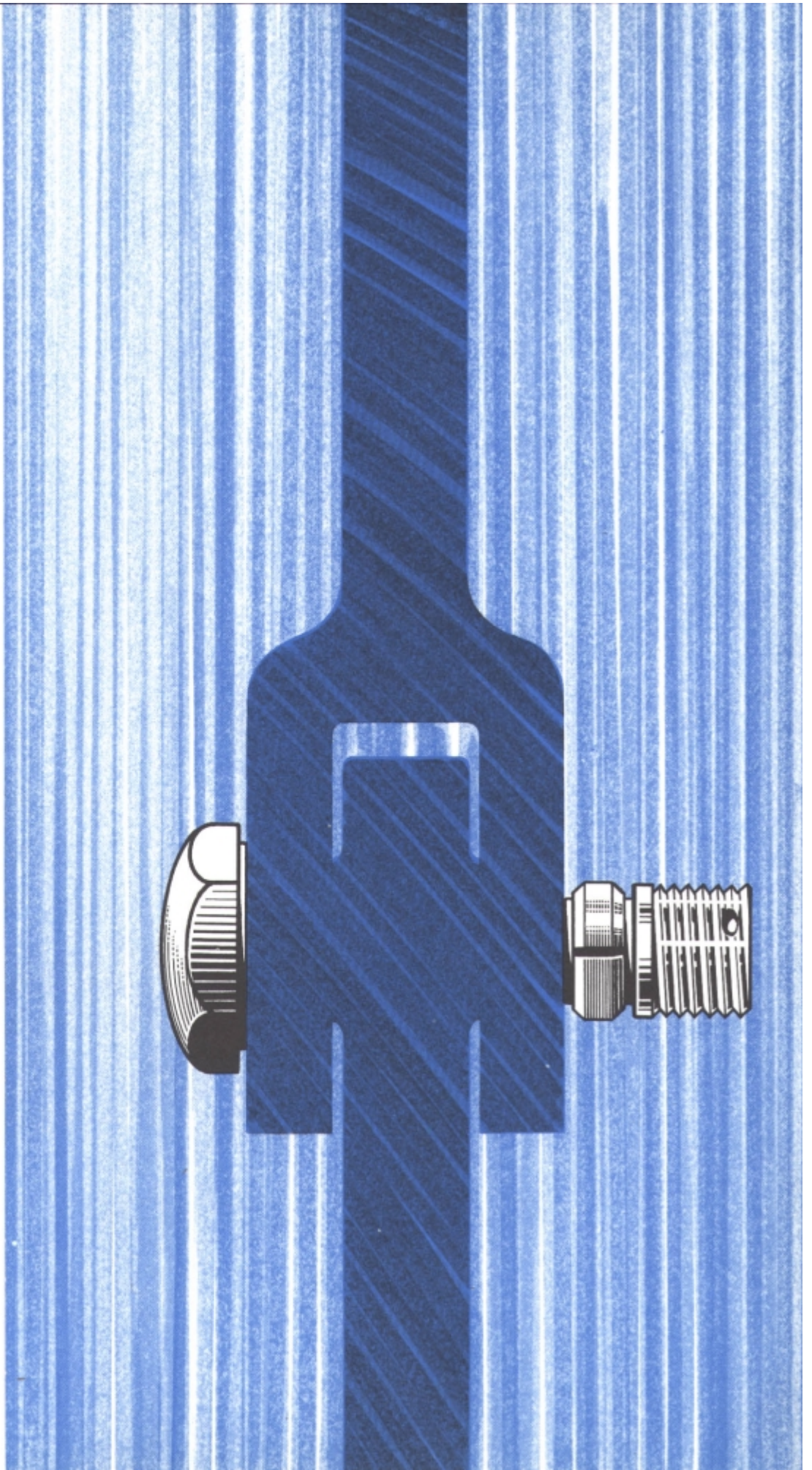


**SPS**

**Self-  
Retaining  
Bolt  
System\***









# Self- Retaining Bolt System\*

**Provides a simple,  
reliable backup device  
for critical shear joints**

**Quick and easy to install**

**Bolt alone exceeds  
vibration requirements  
of MIL-E-5272**

**Principle is  
adaptable to any  
SPS shear bolt**

**Qualified per  
MIL-B-83050 (USAF)**

**Uses standard  
MS-21244 nut**

\*Pat. applied for





*"Cotter key was omitted, resulting in loss of throttle control."*

*"Nut and cotter key were omitted from stabilator rod in shifter assembly."*

*"A nut and bolt holding an engine control rod . . . were not wired together after being replaced."*

*"Bolt connecting lateral cyclic control rod to bell crank was lost."*

*"Nut and bolt were lost because of lack of cotter key in elevator boost parallelogram linkage."*

**INSTALLATION  
IS AS  
SIMPLE  
AS THIS . . .**

These quotations are not imaginary. They were extracted from recent reports in the aerospace press. And in at least two documented instances, loss of aircraft (and life) resulted.

In short, Murphy's law again. If it *can* be installed incorrectly or incompletely, it eventually *will be*.

Of course, it is also possible for a cotter pin to fail of itself, permitting the nut to vibrate loose and the bolt to fall out.

Either way, this is the possibility that the SPS self-retaining bolt system is designed to protect against—in original design or in retrofit.\*

True, there are other systems designed to provide the same sort of protection. But none comes close to being as simple or as reliable.

#### **ADVANTAGES OVER BALL-RETAINED SYSTEM**

Comparison of the SPS self-retaining bolt system with the MS 18115 ball-retained system is admittedly "apples vs. oranges" in certain areas. The SPS system—utilizing a *solid* bolt—is obviously going to have greater shear strength. And you may not actually need that strength. Still, a comparison seems valid (see chart at right).

#### **CUTS INSTALLATION AND MAINTENANCE COSTS**

Compared to other "self-retaining" bolts, the SPS system is simplicity itself. There is really only one auxiliary part—the foolproof, circular spring around the shank. No special tools are needed for assembly. Nor do you need three hands to accomplish the job.

The SPS system utilizes a *solid* bolt. Its mechanical properties are not degraded by the self-retaining feature. It's a stronger bolt and is less susceptible to corrosion than are ball-retained types.

#### **TYPE OF SYSTEM**

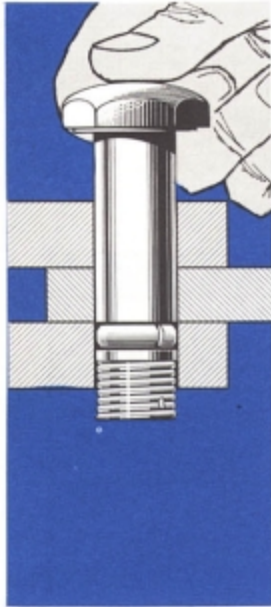
##### **SPS SYSTEM**



##### **BALL RETAINED (Positive Lock)**

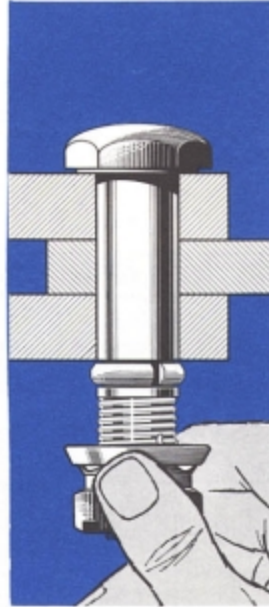


\*The U.S. Air Force, for one, has initiated "an impedance type" self-retaining bolt system retrofit program on several of its major aircraft.



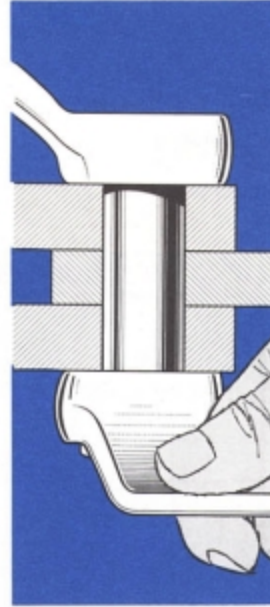
#### 1. Push the bolt home

Finger pressure is all you need. Beveled spring cannot hang up inside joint, snaps back (audibly) to original OD as it clears hole.



#### 2. Spin the nut on

MS 21244 nut provides necessary counterbore to seat over spring without compressing it. No worry about nut jamming against retaining elements.



#### 3. Tighten with standard wrenches

No pin to depress, no special tools needed. System is easily removed for maintenance and is reusable.



#### 4. Insert the cotter pin

System is still fail-safe, however, even if pin is omitted or nut lost.

### AREAS OF COMPARISON

Ease of assembly	Applicable bolt specifications	Minimum tensile strength, lb. (bolt and nut)		Minimum double shear, lb. (bolt)	Vibration resistance per MIL-B-23964A	Assembly reliability
Bolt need only be pushed through assembly.	MIL-B-83050	#10	2,892	5,380	Meets requirements	Once snap is heard, bolt is seated.
		¼	5,340	9,300		
		⅝	8,590	14,600		
		¾	12,430	22,850		
		½	26,700	41,515		
Pin must be held in while bolt is inserted and nut applied.	MIL-B-23964	#10	1,100	4,250	Meets requirements	Pin may be released prematurely and balls expand before bolt is seated.
		¼	2,040	7,360		
		⅝	3,250	11,500		
		¾	—	—		
		½	9,250	29,400		

## REMOVAL AND WEAR TESTS

Removal force test apparatus used in laboratory evaluation of SPS self-retaining bolt performance. Similar setup, minus push-pull gage, was used for wear tests.



**BOLT REMOVAL TEST AFTER CORROSION\***

Spec. No.	Bolt size	Hole A ± .0002 steel	Max. removal force, lbs. Hole A	Removal force, lbs. Test results, Hole A	Hole B ± .0002 steel	Min. removal force, lbs. Hole B	Removal force, lbs. Test results Hole B
1	10-32	.1895	14	11.7	.1920	3	7.3
2				12.0			8.7
3				11.0			7.5
1	¼-28	.2495	17	15.5	.2520	5	8.3
2				15.3			7.2
3				17.0			7.9

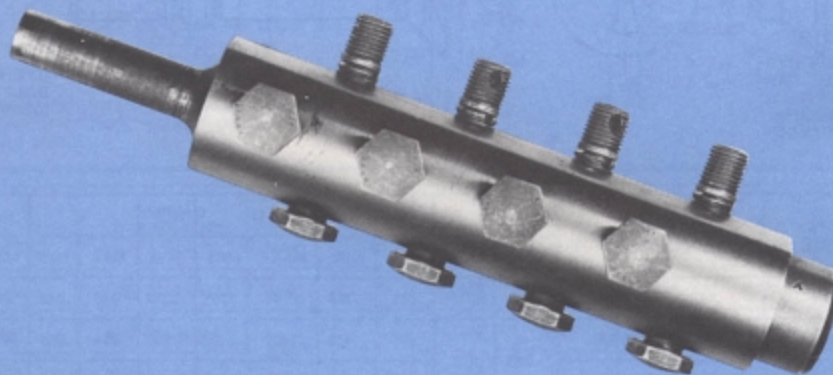
\*Per para. 4.5.5., MIL-B-83050

**BOLT WEAR TEST AFTER DUST\***

Spec. No.	Bolt size	Hole B Alum. ± .0005	Min. removal force, lbs. after 100 cycles	Removal force, lbs. Test results	Hole wear
1	10-32	.1900	2	14.4	.0001
2				17.7	.0001
3				10.9	.0001
1	¼-28	.2500	4	14.5	.0001
2				14.3	.0001
3				17.6	none

\*Per para. 4.5.10, MIL-B-83050A





#### VIBRATION AND ENVIRONMENTAL TEST

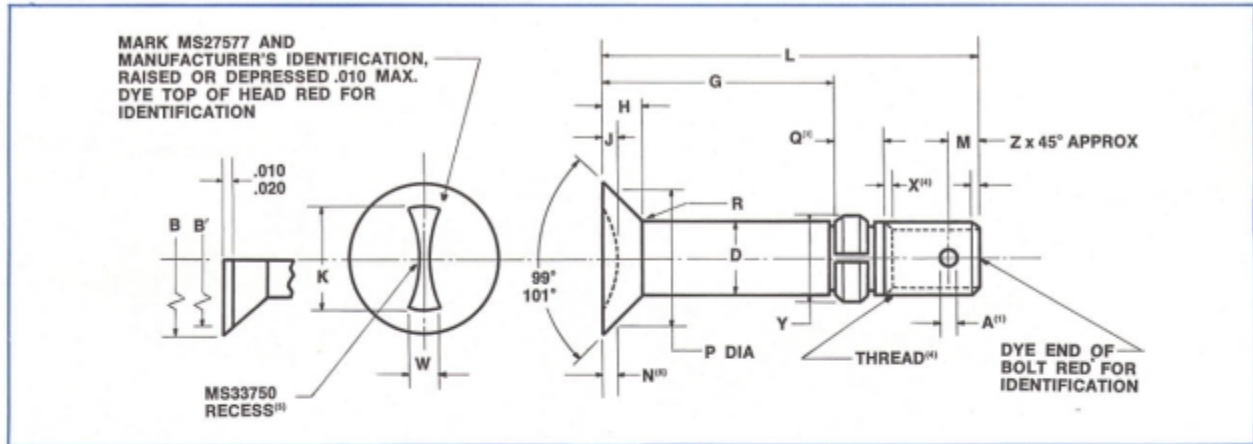
Arbor and sleeve rig used in vibration tests specified in MIL-B-83050. "The retaining element of the self-retaining bolt shall be the only factor which restrains the bolt from coming off the arbor and sleeve" (para. 4.5.14.2).

#### VIBRATION AND ENVIRONMENTAL TEST\*

TEST	SPECIMEN NUMBER	BOLT SIZE	RESULTS
Vibration #1—Par. 4,5,14	1-8	10-32	Passed
	1-8	¼-28	Passed
Vibration #2—Par. 4,5,14,4	1-5	10-32	Passed
	1-5	¼-28	Passed
Dust test—Par. 4,5,10	1-4	10-32	Passed
	1-4	¼-28	Passed

\*Per MIL-B-83050

# MS 27577 (USAF)



FIRST DASH NO.	NOMINAL DIAMETER	THREAD (4) DESIGNATION	A(1)		B	B'	D		H(2)	J		K		M	RECESS NO. (5)
			MAX	MIN			MAX	MIN		MAX	MIN	MAX	MIN		
—3	.190	.190-32UNJF-3A	.080	.070	.385	.328	.1894	.1885	.080	.045	.042	.305	.295	.098	3
—4	.250	.250-28UNJF-3A	.086	.076	.507	.449	.2492	.2483	.106	.054	.051	.422	.410	.105	4
—5	.3125	.3125-24UNJF-3A			.635	.577	.3117	.3108	.133	.064	.061	.490	.478	.120	5
—6	.375	.375-24UNJF-3A	.116	.106	.762	.704	.3742	.3733	.160	.088	.084	.639	.629	.120	6
—7	.4375	.4375-20UNJF-3A			.890	.832	.4367	.4358	.188	.100	.097	.715	.702	.125	7
—8	.500	.500-20UNJF-3A			1.017	.959	.4991	.4982	.215	.105	.101	.766	.750	.125	8
—9	.5625	.5625-18UNJF-3A	.151	.141	1.145	1.087	.5616	.5607	.242	.118	.114	.877	.864	.130	9

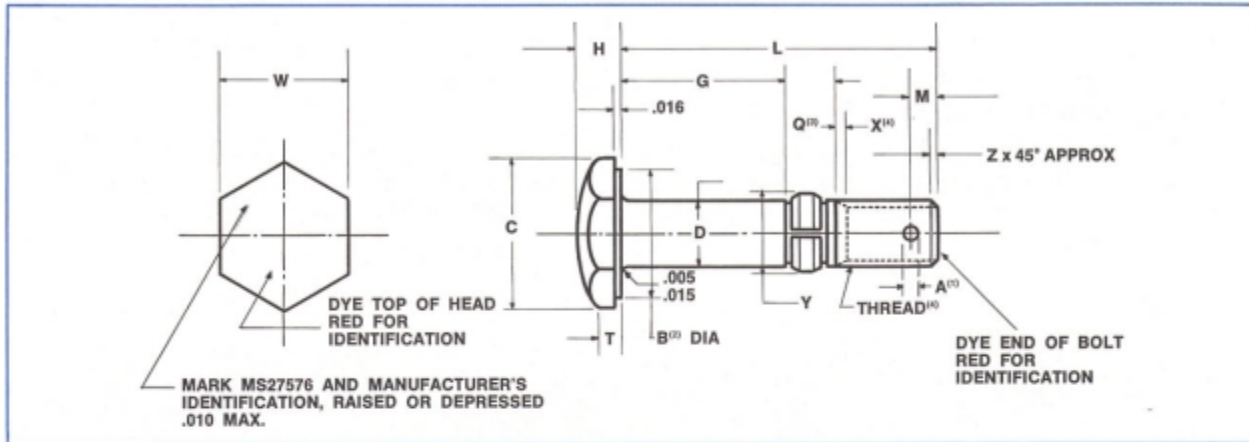
			Head Protrusion (1)																RECESS NO. (5)
FIRST DASH NO.	NOMINAL DIAMETER	THREAD (4) DESIGNATION	N		P		Q		R		W		Y		Z				
			MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN			
—3	.190	.190-32UNJF-3A	.0290	.0253	.3147	.3143	.120	.074	.020	.015	.110	.106	.225	.196	.041	.021	3		
—4	.250	.250-28UNJF-3A	.0342	.0316	.4245	.4241	.120	.105			.134	.130	.294	.256			4		
—5	.3125	.3125-24UNJF-3A	.0395	.0370	.5389	.5385	.151	.120	.030	.020	.160	.156	.330	.320	.057	.037	5		
—6	.375	.375-24UNJF-3A	.0450	.0426	.6532	.6528	.166	.120			.198	.194	.445	.332			6		
—7	.4375	.4375-20UNJF-3A	.0503	.0481	.7676	.7672	.197	.120			.224	.219	.514	.450			7		
—8	.500	.500-20UNJF-3A	.0557	.0537	.8820	.8816	.229	.120			.256	.252	.599	.510			8		
—9	.5625	.5625-18UNJF-3A	.0611	.0592	.9964	.9960	.260	.120			.300	.296	.671	.582	.072	.052	9		

1. Cotter pin hole shall be within .010 inch of bolt diameter centerline and shall be perpendicular to bolt shank axis within  $\pm 2^\circ$ . Counter-sink to deburr.
2. Reference dimensions and requirements are for design information and are not manufacturing and inspection requirements.
3. Retaining elements shall be located within the limits of Q dimension.
4. Thread: In accordance with MIL-S-8879 except that incomplete

- thread length (X) shall be a maximum of  $1\frac{1}{2}$  and a minimum of  $\frac{1}{2}$  thread pitches in length and major dia. to be 0.001 below min. shank dia.
5. Recess shall conform to MS33750 and be concentric within .006 TIR of shank diameter.
6. Reference NAS518 and NAS519 for flush gaging details.
7. The concentricity of the thread PD in relation to the shank shall be within .006 TIR.



## MS 27576 (USAF)



FIRST DASH NO.	NOMINAL DIAMETER	THREAD DESIGNATION (4)	A(1)		B	C	D		H		M
			MAX	MIN			MAX	MIN	MAX	MIN	
—3	.190	.190-32UNJF-3A	.080	.070	.359	.413	.1894	.1885	.110	.095	.096
—4	.250	.250-28UNJF-3A	.086	.076	.422	.488	.2492	.2483	.141	.126	.105
—5	.3125	.3125-24UNJF-3A			.484	.557	.3117	.3108	.172	.157	.120
—6	.375	.375-24UNJF-3A	.116	.106	.546	.628	.3742	.3733	.204	.189	.120
—7	.4375	.4375-20UNJF-3A			.609	.698	.4367	.4358	.235	.220	.125
—8	.500	.500-20UNJF-3A			.734	.840	.4991	.4982	.266	.251	.125
—9	.5625	.5625-18UNJF-3A	.151	.141	.859	.910	.5616	.5607	.297	.282	.130

FIRST DASH NO.	NOMINAL DIAMETER	THREAD DESIGNATION (4)	Q		T		W		Y		Z	
			MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
—3	.190	.190-32UNJF-3A	.120	.074	.083	.063	.376	.367	.225	.196	.041	.021
—4	.250	.250-28UNJF-3A	.120	.105	.104	.084	.439	.430	.291	.256		
—5	.3125	.3125-24UNJF-3A	.151	.120	.125	.105	.502	.492	.380	.320	.057	.037
—6	.375	.375-24UNJF-3A	.166	.120	.146	.126	.564	.553	.445	.382		
—7	.4375	.4375-20UNJF-3A	.197	.120	.166	.146	.627	.617	.514	.450		
—8	.500	.500-20UNJF-3A	.229	.120	.188	.168	.752	.741	.599	.510	.072	.052
—9	.5625	.5625-18UNJF-3A	.260	.120	.208	.188	.877	.865	.671	.582		

1. Cotter pin hole shall be within .010 inch of bolt diameter centerline and shall be perpendicular to bolt shank axis within  $\pm 2^\circ$ . Counter-sink to deburr.

2. Radius relief or chamfer to "B" dia.

3. Retaining elements shall be located within the limits of Q dimension.

4. Thread: In accordance with MIL-S-8879 except that incomplete thread length (X) shall be a maximum of  $1\frac{1}{2}$  and a minimum of  $\frac{1}{2}$  thread pitches in length and major dia. to be 0.001 below min. shank dia.

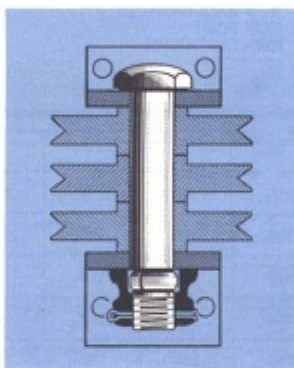
5. The concentricity of the thread PD in relation to the shank shall be within .006 TIR.

## WHERE TO USE SPS SELF-RETAINING BOLTS

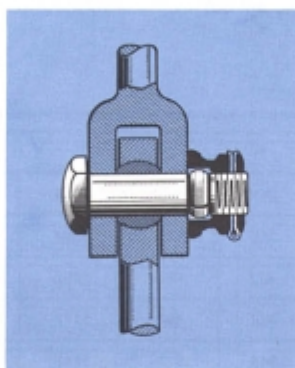
Use them wherever you *must* have a reliable, fail-safe shear fastener—in control linkages, engine control mechanisms, fuel controls, bell crank systems, and

other dynamic joint assemblies. Tests show conclusively that the spring will keep the bolt in place even if the cotter pin and nut are omitted or lost.

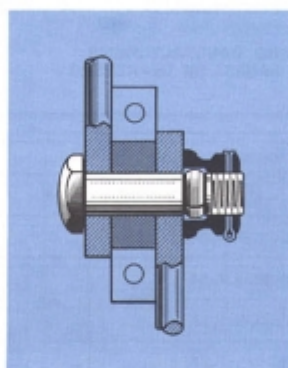
Single and multiple pulleys



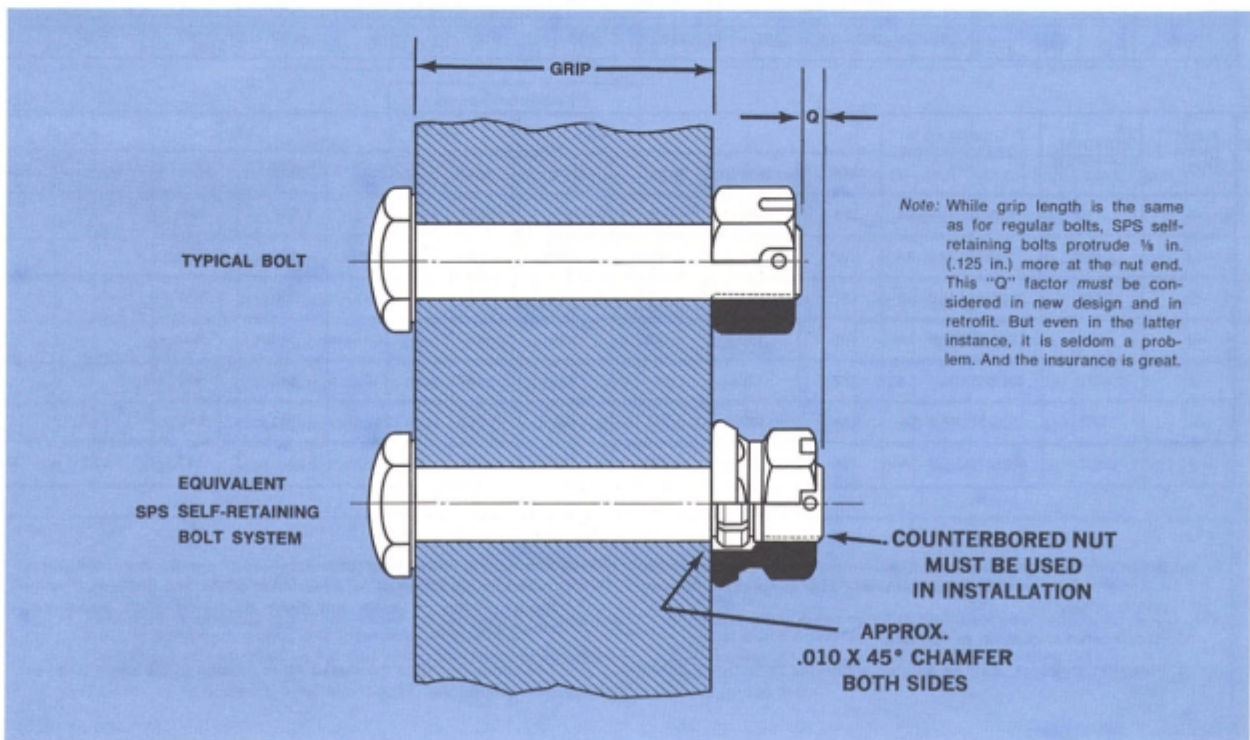
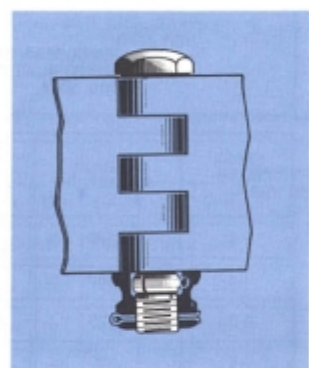
Clevis joints



Pivot pins



Hinges





The SPS self-retaining feature can be adapted to *any* type of shear bolt—hex head, flush head, 12-point, patent recess. You are not limited to one style of head.



#### How to order

SPS self-retaining bolts are available in sizes #10 through  $\frac{1}{2}$  in. Larger sizes available, information on request. The self-retaining concept can be adapted to any shear bolt specified by the customer. To order a self-retaining bolt,

simply order the bolt you are now using and add -SR to the end of the part number. Or order by MS number (see drawings on page 6 and 7). If matching MS 21244 nuts are desired, so specify. We do not supply cotter pins.



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