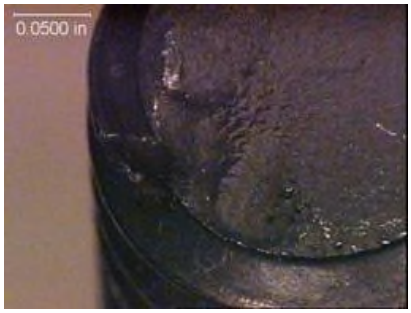
Document Title

Eliminating Screw Failures used in determining the proper techniques and machining practices used in eliminating screw and bolt failure.

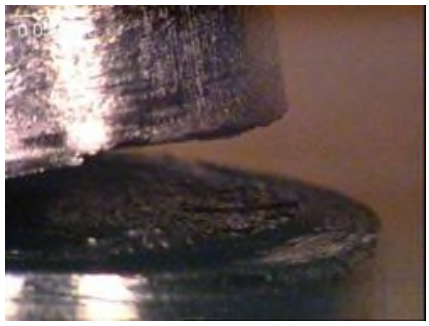
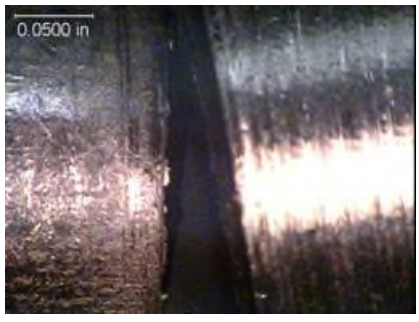
The screws must be of good quality and meet specifications as required. The following image shows a sub quality fastener with stress cracks and voids present. This creates an immediate failure mode.





The correct tap drill size must be used in order to create an "aircraft fit". When the screw is engaged 1 diameter into the thread, there should be no "wobble" or side play looseness. It is recommended that fine threads be used in hardened punches and plates that are dynamic and are constantly removed and re tightened. If the screws are retightened frequently it is a good practice to replace all screws at measured die service intervals.

Improper through hole preparation will cause screw failure at the heads as depicted in the following illustrations.

THROUGH-HOLE PREPARATION

DRILL AND COUNTERBORE SIZES FOR INCH SOCKET HEAD CAP SCREWS

Note 1

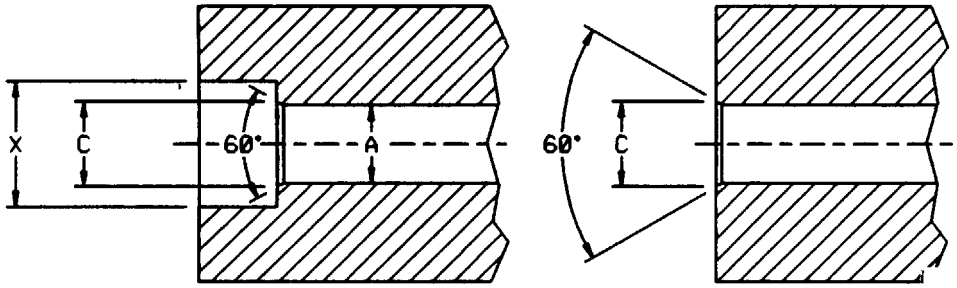
Close Fit: Normally limited to holes for those lengths of screws threaded to the head in assemblies in which: (1) only one screw is used; or (2) two or more screws are used and the mating holes are produced at assembly or by matched and coordinated tooling.

Note 2

Normal Fit: Intended for: (1) screws of relatively long length; or (2) assemblies that involve two or more screws and where the mating holes are produced by conventional tolerancing methods. It provides for the maximum allowable eccentricty of the longest standard screws and for certain deviations in the parts being fastened, such as deviations in hole straightness; angularity between the axis of the tapped hole and that of the hole for the shank; differneces in center distances of the mating holes and other deviations.

Note 3

Chamfering: It is considered good practice to chamfer or break the edges of holes that are smaller than "F" maximum in parts in which hardness approaches, equals or exceeds the screw hardness. If holes are not chamfered, the heads may not seat properly or the sharp edges may deform the fillets on the screws, making them susceptible to fatigue in applications that involve dynamic loading. The chamfers, however, should not be larger than needed to ensure that the heads seat properly or that the fillet on the screw is not deformed. Normally, the chamfers do not need to exceed "F" maximum. Chamfers exceeding these values reduce the effective bearing area and introduce the possibility of indentation when the parts fastened are softer than screws, or the possiblity of brinnelling of the heads of the screws when the parts are harder than the screws. (See "F" page 6).



nominal size	basic screw diameter	A				X	C	hole dimensions			
		drill size for hole A				counter-bore diameter	countersink diameter D Max. + 2F(Max.)	tap drill size		**body drill size	counter-bore size
		close fit		normal fit				UNRC	UNRF		
		nom.	dec.	nom.	dec.						
0	0.0600	51*	0.0670	49*	0.0730	1/8	0.074	–	3/64	#51	1/8
1	0.0730	46*	0.0810	43*	0.0890	5/32	0.087	1.5mm	#53	#46	5/32
2	0.0860	3/32	0.0937	36*	0.1065	3/16	0.102	#50	#50	3/32	3/16
3	0.0990	36*	0.1065	31*	0.1200	7/32	0.115	#47	#45	#36	7/32
4	0.1120	1/8	0.1250	29*	0.1360	7/32	0.130	#43	#42	1/8	7/32
5	0.1250	9/64	0.1406	23*	0.1540	1/4	0.145	#38	#38	9/64	1/4
6	0.1380	23*	0.1540	18*	0.1695	9/32	0.158	#36	#33	#23	9/32
8	0.1640	15*	0.1800	10	0.1935	5/16	0.188	#29	#29	#15	5/16
10	0.1900	5*	0.2055	2*	0.2210	3/8	0.218	#25	#21	#5	3/8
1/4	0.2500	17/64	0.2656	9/23	0.2812	7/16	0.278	#7	#3	17/64	7/16
5/16	0.3125	21/64	0.3281	11/32	0.3437	17/32	0.346	F	I	21/64	17/32
3/8	0.0375	25/64	0.3906	13/32	0.4062	5/8	0.415	5/16	Q	25/64	5/8
7/16	0.4375	29/64	0.4531	15/32	0.4687	23/32	0.483	U	25/64	29/64	23/32
1/2	0.5000	33/64	0.5156	17/32	0.5312	13/16	0.552	27/64	29/64	33/64	13/16
5/8	0.6250	41/64	0.6406	21/32	0.6562	1	0.689	35/64	14.5mm	41/64	1
3/4	0.7500	49/64	0.7656	25/32	0.7812	1-3/16	0.828	21/32	11/16	49/64	1-3/16
7/8	0.8750	57/64	0.8906	29/32	0.9062	1-3/8	0.963	49/64	20.5mm	57/64	1-3/8
1	1.0000	1-1/64	1.0156	1-1/32	1.0312	1-5/8	1.100	7/8	59/64	1-1/64	1-5/8
1-1/4	1.2500	1-9/32	1.2812	1-5/16	1.3125	2	1.370	1-7/64	1-11/64	1-9/32	2
1-1/2	1.5000	1-17/32	1.5312	1-9/16	1.5625	2-3/8	1.640	34mm	36mm	1-17/32	2-3/8

** Break edge of body drill hole to clear screw fillet.

DRILL AND COUNTERBORE SIZES FOR METRIC SOCKET HEAD CAP SCREWS

Note 1

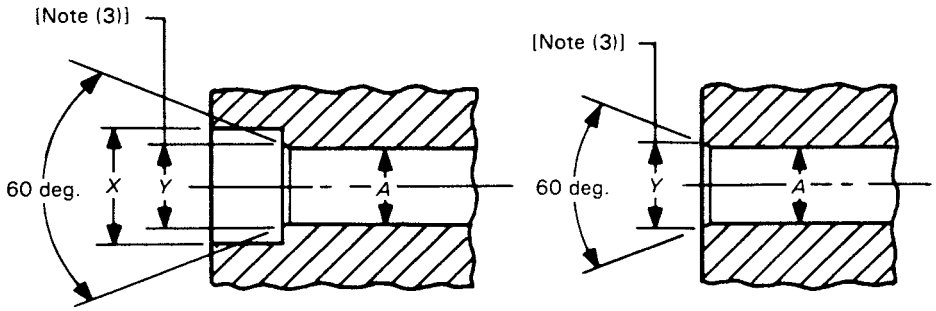
Close Fit: Normally limited to holes for those lengths of screws threaded to the head in assemblies in which: (1) only one screw is used; or (2) two or more screws are used and the mating holes are produced at assembly or by matched and coordinated tooling.

Note 2

Normal Fit: Intended for: (1) screws of relatively long length; or (2) assemblies that involve two or more screws and where the mating holes are produced by conventional tolerancing methods. It provides for the maximum allowable eccentricty of the longest standard screws and for certain deviations in the parts being fastened, such as deviations in hole straightness; angularity between the axis of the tapped hole and that of the hole for the shank; differneces in center distances of the mating holes and other deviations.

Note 3

Chamfering: It is considered good practice to chamfer or break the edges of holes that are smaller than "B" maximum in parts in which hardness approaches, equals or exceeds the screw hardness. If holes are not chamfered, the heads may not seat properly or the sharp edges may deform the fillets on the screws, making them susceptible to fatigue in applications that involve dynamic loading. The chamfers, however, should not be larger than needed to ensure that the heads seat properly or that the fillet on the screw is not deformed. Normally, the chamfers do not need to exceed "B" maximum. Chamfers exceeding these values reduce the effective bearing area and introduce the possibility of indentation when the parts fastened are softer than screws, or the possiblity of brinnelling of the heads of the screws when the parts are harder than the screws.



Nominal Size or Basic Screw Diameter	*A* Nominal Drill Size		*X*	*Y*	*B*
	Close Fit [Note (1)]	Normal Fit [Note (2)]	Counterbore Diameter	Countersink Diameter [Note (3)]	Transition Diameter, Max.
M1.6	1.80	1.95	3.50	2.0	2.0
M2	2.20	2.40	4.40	2.6	2.6
M2.5	2.70	3.00	5.40	3.1	3.1
M3	3.40	3.70	6.50	3.6	3.6
M4	4.40	4.80	8.25	4.7	4.7
M5	5.40	5.80	9.75	5.7	5.7
M6	6.40	6.80	11.25	6.8	6.8
M8	8.40	8.80	14.25	9.2	9.2
M10	10.50	10.80	17.25	11.2	11.2
M12	12.50	12.80	19.25	14.2	14.2
M14	14.50	14.75	22.25	16.2	16.2
M16	16.50	16.75	25.50	18.2	18.2
M20	20.50	20.75	31.50	22.4	22.4
M24	24.50	24.75	37.50	26.4	26.4
M30	30.75	31.75	47.50	33.4	33.4
M36	37.00	37.50	56.50	39.4	39.4
M42	43.00	44.0	66.00	45.6	45.6
M48	49.00	50.00	75.00	52.6	52.6