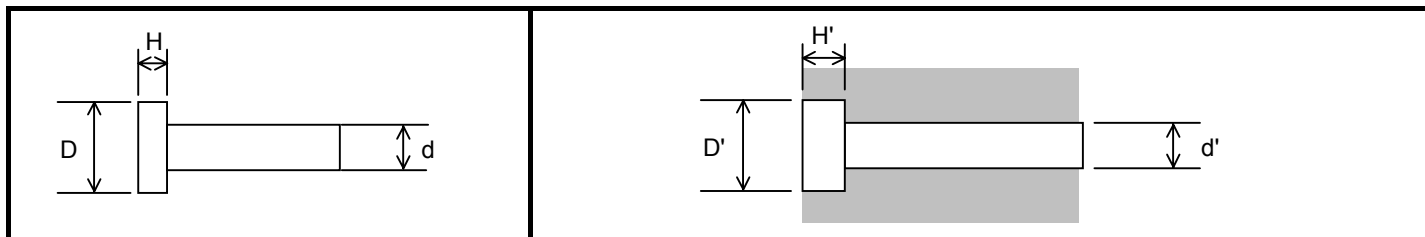


INCH STANDARD COUNTERBORE

REV. F 06/02/2005



SCREW SIZE	SCREW DIA. d	CAP HEAD DIA. (MAX) D	CAP HEAD HEIGHT (MAX) H	SOCKET SIZE	CLEARANCE DIA. (CLOSE) d'		C'BORE DIA. (CLOSE) D'	CLEARANCE DIA. (FREE) d'		C'BORE DIA. (FREE) D'	C'BORE DEPTH H'	SCREW SIZE
# 2	0.086	0.140	0.086	5/64	3/32	0.094	0.156	#36	0.107	0.161	0.105	# 2
# 4	0.112	0.183	0.112	3/32	1/8	0.125	0.204	#27	0.144	0.220	0.135	# 4
# 6	0.138	0.226	0.138	7/64	#23	0.154	0.246	#18	0.170	0.262	0.165	# 6
# 8	0.164	0.270	0.164	9/64	#15	0.180	0.290	#10	0.194	0.306	0.190	# 8
# 10	0.190	0.313	0.190	5/32	#5	0.206	0.332	#2	0.221	0.348	0.215	# 10
1/4	0.250	0.375	0.250	3/16	17/64	0.266	0.400	9/32	0.281	0.416	0.275	1/4
5/16	0.313	0.469	0.313	1/4	21/64	0.328	0.493	11/32	0.344	0.509	0.340	5/16
3/8	0.375	0.563	0.375	5/16	25/64	0.391	0.590	13/32	0.406	0.606	0.405	3/8
7/16	0.438	0.656	0.438	3/8	29/64	0.453	0.681	15/32	0.469	0.697	0.470	7/16
1/2	0.500	0.750	0.500	3/8	33/64	0.516	0.775	17/32	0.531	0.791	0.535	1/2
5/8	0.625	0.938	0.625	1/2	41/64	0.641	0.963	21/32	0.656	1.000	0.665	5/8
3/4	0.750	1.125	0.750	5/8	49/64	0.766	1.151	25/32	0.781	1.171	0.790	3/4
7/8	0.875	1.313	0.875	3/4	57/64	0.891	1.340	29/32	0.906	1.359	0.915	7/8
1	1.000	1.500	1.000	3/4	1-1/64	1.016	1.528	1-1/32	1.031	1.546	1.045	1

TOLERANCES +/-		
	FREE	CLOSE
CLEARANCE DIAMETER	0.005	0.005
COUNTERBORE DIAMETER	0.010	0.005
COUNTERBORE DEPTH	0.010	0.010

FREE SHOULD BE USED UNLESS CLOSE IS REQUIRED

BOLT TORQUE

Rev B 12/9/03

"DRY" BOLT TIGHTENING TORQUE

"DRY" IS LIGHT MACHINE OIL, GENERALLY AS DELIVERED IN THE BOX
USE "LUBRICATED" VALUES FOR WET LOCKTITE COVERED BOLTS

GRADE 12.9			GRADE 10.9			GRADE 8.8		
	N-M	FT-LBS		N-M	FT-LBS		N-M	FT-LBS
M4	4.6	3.358	M4	2.7	1.971	M4		
M5	9.5	6.935	M5	5.5	4.015	M5		
M6	16	11.7	M6	13	9.5	M6	9.5	6.9
M8	39	28.5	M8	32	23.4	M8	23	16.8
M10	77	56.2	M10	64	46.7	M10	46	33.6
M12	135	98.6	M12	110	80.3	M12	80	58.4
M16	330	240.9	M16	275	200.8	M16	195	142.4
M20	660	481.8	M20	550	401.5	M20	390	284.7
M24	1130	830	M24	900	660	M24	715	520
M30	2250	1660	M30	1800	1330	M30	1415	1040

"LUBRICATED" BOLT TIGHTENING TORQUE

"LUBRICATED" IS ANTISIEZE OF SIMILAR
USE FOR WET LOCKTITE COVERED BOLTS

GRADE 12.9			GRADE 10.9			GRADE 8.8		
	N-M	FT-LBS		N-M	FT-LBS		N-M	FT-LBS
M4	3.68	2.6864	M4	2.16	1.5768	M4		
M5	7.6	5.548	M5	4.4	3.212	M5		
M6	12.8	9.3	M6	10.4	7.6	M6	7.6	5.5
M8	31.2	22.8	M8	25.6	18.7	M8	18.4	13.4
M10	61.6	45.0	M10	51.2	37.4	M10	36.8	26.9
M12	108	78.8	M12	88	64.2	M12	64	46.7
M16	264	192.7	M16	220	160.6	M16	156	113.9
M20	528	385.4	M20	440	321.2	M20	312	227.8
M24	904	664	M24	720	528	M24	572	416
M30	1800	1328	M30	1440	1064	M30	1132	832

NOTES:

METRIC SCREW CLASS IS INDICATED ON THE HEAD OF THE FASTENER OR ON THE BOX DEPENDING ON FASTENER SIZE -- 12.9, 10.9 OR 8.8

- BLACK SOCKET HEAD CAP SCREWS ARE GENERALLY GRADE 12.9
- BLACK BUTTON HEAD, HEX HEAD AND COUNTERSINK (FLAT HEAD) BOLTS ARE GENERALLY 10.9
- NON-BLACK FASTENERS (ZINC, SS OR CHROMATE) ARE GENERALLY LOWER GRADE.

WRENCH FLATS

REV. C 9/1/04



SAE

NOMINAL	MAX.	MIN.
3/8	0.378	0.372
7/16	0.440	0.434
1/2	0.504	0.498
9/16	0.566	0.559
5/8	0.629	0.621
11/16	0.692	0.684
3/4	0.755	0.745
13/16	0.818	0.808
7/8	0.880	0.870
15/16	0.944	0.932
1	1.006	0.992

METRIC

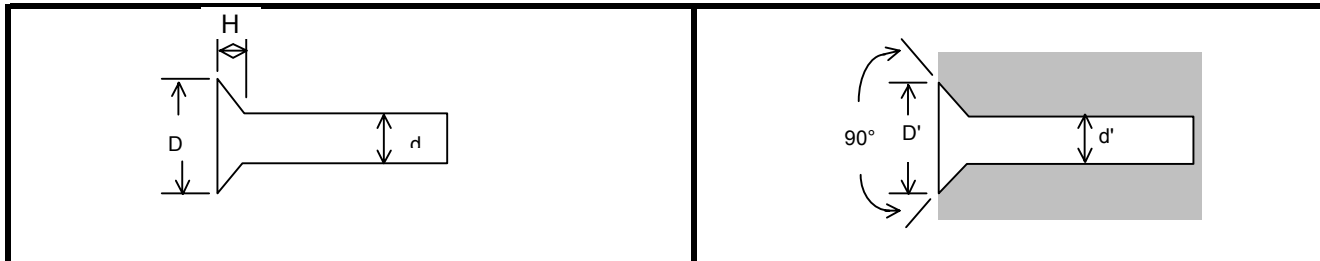
NOMINAL	MAX.	MIN.	MAX.	MIN.
MM	MM	MM	IN	IN
4	3.95	3.75	0.156	0.148
5	4.95	4.75	0.195	0.187
6	5.95	5.75	0.234	0.226
8	7.95	7.75	0.313	0.305
9	8.95	8.80	0.352	0.346
10	9.90	9.75	0.390	0.384
11	10.90	10.75	0.429	0.423
12	11.85	11.70	0.467	0.461
13	12.85	12.65	0.506	0.498
14	13.85	13.65	0.545	0.537
15	14.85	14.65	0.585	0.577
16	15.90	15.70	0.626	0.618
17	16.90	16.70	0.665	0.657
18	17.90	17.70	0.705	0.697
19	18.90	18.70	0.744	0.736
20	19.80	19.60	0.780	0.772
21	20.80	20.55	0.819	0.809
22	21.80	21.55	0.858	0.848
23	22.80	22.50	0.898	0.886
24	23.80	23.50	0.937	0.925
25	24.80	24.45	0.976	0.963
26	25.80	25.45	1.016	1.002

Metric notes:

Metric tools are generally close to the nominal dimension +/- a tolerance,
Metric wrench flats on parts must be made under the nominal size.

METRIC COUNTERSINK

REV. H 06/02/2005



SCREW SIZE	SCREW DIA. d	FLAT HEAD DIA. D (max)		FLAT HEAD HEIGHT H (max)		SOCKET SIZE	COUNTERSINK DIAMETER D'		CLEARANCE DIA. d' CLOSE		SCREW SIZE
	in	mm	in	mm	in		mm	in	mm	in	
M 2	0.079	4.2	0.165	1.1	0.043	1.3 mm	4.7	0.185	2.2	0.087	M 2
M 2.5	0.098	5.2	0.207	1.4	0.054	1.5 mm	5.8	0.227	2.7	0.106	M 2.5
M 3	0.118	6.4	0.252	1.7	0.067	2 mm	6.9	0.272	3.5	0.138	M 3
M 4	0.157	8.6	0.339	2.3	0.091	2.5 mm	9.4	0.369	4.5	0.177	M 4
M 5	0.197	10.6	0.417	2.8	0.110	3 mm	11.6	0.457	5.5	0.217	M 5
M 6	0.236	12.6	0.496	3.3	0.130	4 mm	13.9	0.546	6.50	0.256	M 6
M 8	0.315	16.8	0.661	4.4	0.173	5 mm	18.3	0.721	8.5	0.335	M 8
M 10	0.394	21.0	0.827	5.5	0.217	6 mm	22.8	0.897	10.5	0.413	M 10
M 12	0.472	25.0	0.984	6.5	0.256	8 mm	27.0	1.064	12.5	0.492	M 12
M 14	0.551	28.0	1.102	7.0	0.276	10 mm	30.4	1.197	14.5	0.571	M 14

COUNTERSINK DIAMETERS ARE BASED ON THE THEORETICAL MAXIMUM HEAD DIAMETER AT A DEPTH OF .005 TO .015 AND AN ANGLE OF 90 DEGREES. ACTUAL DEPTH MAY VARY DEPENDING ON ACTUAL HEAD DIAMETER AND ANGLE
 COUNTERSINK DIAMETER TOLERANCES ARE +/- .010
 COUNTERSINK ANGLE TOLERANCES ARE +/- 2 DEGREES

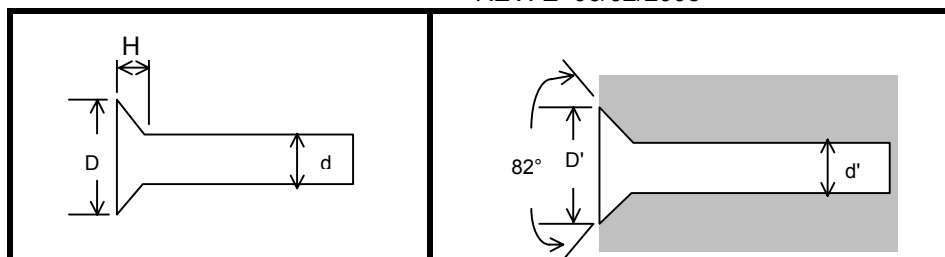
THREAD PITCHES SHOULD ALWAYS BE SPECIFIED, BUT WHEN METRIC THREADS ARE SPECIFIED WITHOUT A PITCH, THE FOLLOWING PITCHES ARE TO BE USED:

M 2	X .40	M 5	X .80	M 12	X 1.75	M 24	X 3.0
M 2.5	X .45	M 6	X 1.0	M 14	X 2.0	M 30	X 3.5
M 3	X .50	M 8	X 1.25	M 16	X 2.0		
M 4	X .70	M 10	X 1.5	M 20	X 2.5		

Printed copies of Electroimpact standards are for reference only and are not subject to revision control.

INCH STANDARD COUNTERSINK

REV. E 06/02/2005

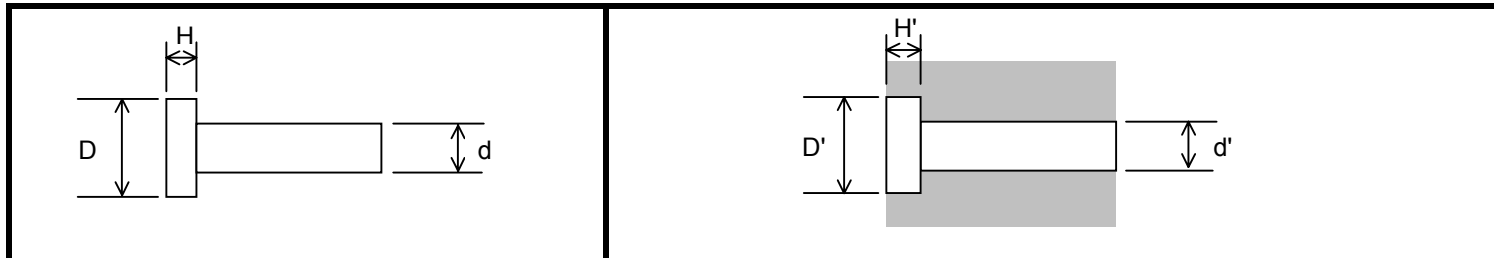


SCREW SIZE	SCREW DIA. d	FLAT HEAD DIA. D (max)	FLAT HEAD HEIGHT H (max)	SOCKET SIZE	C'SINK DIA. D'	CLEARANCE DIA. d' CLOSE	SCREW SIZE	
# 2	0.086	0.197	0.064	0.050	0.214	3/32	0.094	# 2
# 4	0.112	0.255	0.083	1/16	0.272	1/8	0.125	# 4
# 6	0.138	0.307	0.097	5/64	0.324	#23	0.154	# 6
# 8	0.164	0.359	0.112	3/32	0.376	#15	0.180	# 8
# 10	0.190	0.411	0.127	1/8	0.428	#5	0.206	# 10
1/4	0.250	0.531	0.161	5/32	0.548	17/64	0.266	1/4
5/16	0.313	0.656	0.198	3/16	0.673	21/64	0.328	5/16
3/8	0.375	0.781	0.234	7/32	0.798	25/64	0.391	3/8
7/16	0.438	0.844	0.234	1/4	0.861	29/64	0.453	7/16
1/2	0.500	0.938	0.251	5/16	0.955	33/64	0.516	1/2
5/8	0.625	1.188	0.324	3/8	1.205	41/64	0.641	5/8
3/4	0.750	1.438	0.396	1/2	1.455	49/64	0.766	3/4
7/8	0.875	1.688	0.468	9/16	1.705	57/64	0.891	7/8
1	1.000	1.938	0.540	5/8	1.955	1-1/64	1.016	1

COUNTERSINK DIAMETERS ARE BASED ON THE THEORETICAL MAXIMUM HEAD DIAMETER AT A DEPTH OF .005 TO .015 AND AN ANGLE OF 82 DEGREES. ACTUAL DEPTH MAY VARY DEPENDING ON ACTUAL HEAD DIAMETER AND ANGLE
 COUNTERSINK DIAMETER TOLERANCES ARE +/- .010
 COUNTERSINK ANGLE TOLERANCES ARE +/- 2 DEGREES
 FREE SHOULD BE USED UNLESS CLOSE IS REQUIRED

METRIC COUNTERBORE

REV. H 06/02/2005



SCREW SIZE	SCREW DIA. d		CAP HEAD DIA. (MAX) D		CAP HEAD HEIGHT (MAX) H		SOCKET SIZE	CLEARANCE DIA. (CLOSE) d'		C'BORE DIA. (CLOSE) D'		CLEARANCE DIA. (FREE) d'		C'BORE DIA. (FREE) D'		C'BORE DEPTH H'		SCREW SIZE
	in	mm	in	mm	in	mm		mm	in	mm	in	mm	in	mm	in	mm	in	
M 2	0.079	3.8	0.150	2.0	0.079	1.5 mm	2.2	0.087	4.0	0.157	2.50	0.098	4.30	0.169	2.5	0.098	M 2	
M 2.5	0.098	4.5	0.177	2.5	0.098	2.0 mm	2.7	0.106	4.7	0.185	3.00	0.118	5.00	0.197	3.0	0.118	M 2.5	
M 3	0.118	5.5	0.217	3.0	0.118	2.5 mm	3.5	0.138	6.0	0.236	3.75	0.148	6.25	0.246	3.5	0.138	M 3	
M 4	0.157	7.0	0.276	4.0	0.157	3.0 mm	4.5	0.177	7.5	0.295	4.90	0.193	7.90	0.311	4.5	0.177	M 4	
M 5	0.197	8.5	0.335	5.0	0.197	4.0 mm	5.5	0.217	9.0	0.354	5.90	0.232	9.40	0.370	5.5	0.217	M 5	
M 6	0.236	10.0	0.394	6.0	0.236	5.0 mm	6.5	0.256	10.5	0.413	7.00	0.276	11.00	0.433	7.0	0.276	M 6	
M 8	0.315	13.0	0.512	8.0	0.315	6.0 mm	8.5	0.335	13.5	0.531	9.20	0.362	14.20	0.559	9.0	0.354	M 8	
M 10	0.394	16.0	0.630	10.0	0.394	8.0 mm	10.5	0.413	16.5	0.650	11.40	0.449	17.40	0.685	11.0	0.433	M 10	
M 12	0.472	18.0	0.709	12.0	0.472	10.0 mm	12.5	0.492	18.5	0.728	13.50	0.531	19.50	0.768	13.0	0.512	M 12	
M 14	0.551	21.0	0.827	14.0	0.551	7.000	14.5	0.571	21.5	0.846	15.70	0.618	22.70	0.894	15.0	0.591	M 14	
M 16	0.630	24.0	0.945	16.0	0.630	14.0 mm	17.0	0.669	25.0	0.984	18.00	0.709	26.00	1.024	18.0	0.709	M 16	
M 20	0.787	30.0	1.181	20.0	0.787	17.0 mm	21.0	0.827	31.0	1.220	22.50	0.886	32.50	1.280	22.0	0.866	M 20	
M 24	0.945	36.0	1.417	24.0	0.945	19.0 mm	25.0	0.984	37.0	1.457	26.70	1.051	38.70	1.524	26.0	1.024	M 24	
M 30	1.181	45.0	1.772	30.0	1.181	22.0 mm	31.0	1.220	46.0	1.811	33.00	1.299	48.00	1.890	32.0	1.260	M 30	

NOTE: " FREE SIZES " AND M2.0 AND M2.5
ARE NOT McMASTER CARR STANDARD CUTTING TOOLS
 FREE SHOULD BE USED UNLESS CLOSE IS REQUIRED

THREAD PITCHES SHOULD ALWAYS BE SPECIFIED,
 BUT WHEN METRIC THREADS ARE SPECIFIED WITHOUT A PITCH,
 THE FOLLOWING PITCHES ARE TO BE USED:

TOLERANCES +/-		
	FREE	CLOSE
CLEARANCE DIAMETER	0.005	0.005
COUNTERBORE DIAMETER	0.010	0.005
COUNTERBORE DEPTH	0.010	0.010

M 2	X .40		M 6	X 1.0		M 16	X 2.0
M 2.5	X .45		M 8	X 1.25		M 20	X 2.5
M 3	X .50		M 10	X 1.5		M 24	X 3.0
M 4	X .70		M 12	X 1.75		M 30	X 3.5
M 5	X .80		M 14	X 2.0			

Internal Thread Minor Diameter Limits

Rev A 6/24/04

Inch

Metric

Class 2B

Class 6H

Thread	Min	Max
4-40	0.094	0.085
4-48	0.089	0.097
6-32	0.104	0.114
8-32	0.130	0.139
10-24	0.145	0.156
10-32	0.156	0.164
1/4-20	0.196	0.207
1/4-28	0.211	0.220
5/16-18	0.252	0.265
5/16-24	0.267	0.277
3/8-16	0.307	0.321
3/8-24	0.330	0.340
7/16-14	0.360	0.376
7/16-20	0.383	0.395
1/2-13	0.417	0.434
1/2-20	0.446	0.457
5/8-11	0.527	0.546
5/8-18	0.565	0.578
3/4-10	0.642	0.663
3/4-16	0.682	0.696
1-8	0.865	0.890
1-12	0.910	0.928

Thread	Metric		Inch	
	Min	Max	Min	Max
M 2 X .40	1.57	1.68	0.062	0.066
M 2.5 X .45	2.01	2.14	0.079	0.084
M 3 X .50	2.46	2.64	0.097	0.104
M 4 X .70	3.24	3.47	0.128	0.136
M 5 X .80	4.13	4.38	0.163	0.173
M 6 X 1.0	4.92	5.15	0.194	0.203
M 8 X 1.25	6.65	6.91	0.262	0.272
M 10 X 1.5	8.38	8.68	0.330	0.342
M 12 X 1.75	10.11	10.44	0.398	0.411
M 14 X 2.0	11.84	12.21	0.466	0.481
M 16 X 2.0	13.84	14.21	0.545	0.559
M 20 X 2.5	17.29	17.74	0.681	0.699
M 24 X 3.0	20.75	21.25	0.817	0.837
M 30 X 3.5	26.21	26.77	1.032	1.054

Other metric threads start
on page 1645 in Machinery's Handbook

Other unified threads start
on page 1544 in Machinery's Handbook

Copied from Machinery's Handbook and is for reference only

For metric threads where the pitch is not called out on the drawing,
see the countersink/counterbore standards