



# Tools Reference

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## INCH/METRIC DRILL-TAP-WIRE EQUIVALENTS TABLE

Inches	Metric (mm)	Twist Drill	B&S Wire	U.S. Plate	Tap Drill	Clearance Hole	Inches	Metric (mm)	Twist Drill	B&S Wire	U.S. Plate	Tap Drill	Clearance Hole	Inches	Metric (mm)	Twist Drill	B&S Wire	U.S. Plate	Tap Drill	Clearance Hole	Inches	Metric (mm)	Twist Drill	B&S Wire	U.S. Plate	Tap Drill	Clearance Hole
.0003936	.100						.03196	.8118			20			.0995	2.5273	#39					.209	5.3086	#4				
.001	.0254						.032	.8128	#67					.1	2.5400						.2125984	5.4000	5.40mm				
.002	.0508						.033	.8382	#66					.1003937	2.5500	2.55mm					.213	5.4102	#3				
.003	.0762						.0334646	.8500	.85mm			1.0mm		.1015	2.5781	#38					.2165354	5.5000	5.50mm				
.003145	.0799		40				.034	.8636						.1019	2.5883		10				.21875	5.5562	7/32		5		
.003531	.0897		39				.034375	.8731						.1023622	2.6000	2.60mm					.2204724	5.6000	5.60mm				
.003965	.1007		38				.035	.8890	#65			00-90		.104	2.6416	#37					.221	5.6134	#2				
.004	.1016						.0035433	.9000	.90mm					.1043397	2.6500	2.65mm					.2244095	5.7000	5.70mm				
.004453	.1131		37				.03589	.9116		19				.1062992	2.7000	2.70mm					.228	5.7912	#1				
.005	.1270		36				.036	.9144	#64					.1065	2.7051	#36					.2283465	5.8000	5.80mm				
.005614	.1426		35				.037	.9398	#63					.1082677	2.7500	2.75mm					.2294	5.8268		3			
.0059	.1499		#97				.0374016	.9500	.95mm					.109375	2.7781	1/64			12		.2322834	5.9000	5.90mm				
.006	.1524						.0375	.9525	.0			20		.11	2.7940	#35					.234	5.9436	A				
.00625	.1587			38			.038	.9625	#62					.1102362	2.8000	2.80mm					.234375	5.9531	11/64		4		
.0063	.1600		#96				.039	.9606	#61					.111	2.8194	#34					.2362204	6.0000	6.00mm				
.006304	.1601		34				.0393701	1.0000	1.00mm			1.2mm		.112	2.8448						.238	6.0452	B				
.0066406	.1687			37			.04	1.0160	#60					.1122047	2.8500	2.85mm					.2401574	6.1000	6.10mm				6.0mm
.0067	.1702		#95				.0403	1.0236		18				.113	2.8702	#33					.242	6.1468	C				
.007	.1720						.041	1.0414	#59					.1141732	2.9000	2.90mm					.246	6.2484	D				
.0070312	.1786			36			.0413386	1.0500	1.05mm					.1144	2.9058		9				.25	6.3500	1/4-E	3			1/4-20
.00708	.1798		33				.042	1.0668	#58					.116	2.9464	#32					.2559055	6.5000	6.50mm				
.0071	.1803		#94				.043	1.0922	#57					.1161417	2.950	2.95mm					.257	6.5278	F			5/16-18	1/4-20
.0075	.1905		#93				.0433971	1.1000	1.10mm					.1181102	3.000	3.00mm					.2756	6.5430		2			
.0078125	.1948		1/128		35		.04375	1.1112				19		.12	3.0480	#31					.261	6.6294	G				
.0078740	.2000		20mm				.044	1.1176						.1279528	3.2500	3.25mm					.265625	6.7462	17/64		2		
.0079	.2007		#92				.0444444	1.1289						.1285	3.2639	#30	8				.266	6.7564	H				
.00795	.2019		32				.04526	1.1496		17				.1299213	3.3000	3.30mm					.272	6.9088	I				
.008	.2032						.0452756	1.1500	1.15mm			1.4mm		.13	3.3020						.2755906	7.0000	7.00mm				
.0083	.2108		#91				.0465	1.1811	#56					.1318898	3.3500	3.35mm					.277	7.0358	J				
.0085937	.2183			34			.046875	1.1906	3/64			0-80		.1338583	3.4000	3.40mm					.281	7.1374	K				
.0097	.2210		#90				.0472441	1.2000	1.20mm					.1358268	3.4500	3.45mm					.28125	7.1437	9/32		1		
.008928	.2261		31				.0492126	1.2500	1.25mm			1.6mm		.136	3.4544	#29			8-32		.2893	7.3482					
.009	.2286						.049261	1.2512						.1377726	3.4994						.29	7.3660	L				
.0091	.2231		#89				.05	1.2700			18			.1377953	3.5000	3.50mm					.295	7.4930	M				
.009375	.2381			33			.05082	1.2908		16				.138	3.5052						.2952756	7.5000	7.50mm				
.0095	.2413		#88				.0511811	1.300	1.30mm			1.7mm	1.2mm	.14	3.5560					.296875	7.5387	19/64					
.0098425	.2500		25mm				.052	1.3208	#55					.1405	3.5687	#28					.302	7.6708	N				
.01	.2540		#87				.0531469	1.35	1.35mm					.140625	5.5719	9/64			10		.3125	7.9375	5/16		0		3/8-16
.01003	.2548		30				.055	1.3970	#54					.1417323	3.6000	3.60mm					.3149606	8.000	8.00mm				
.0101562	.2580			32			.0551181	1.4000	1.4mm					.144	3.6576	#27					.316	8.0264	O				5/16-18
.0105	.2667		#86				.05625	1.4287			17			.1443	3.6652		7				.323	8.2042	P				
.0109375	.2778		31				.05707	1.4496		15				.1456693	3.7000	3.70mm					.3249	8.2525		0			
.0111	.2819		#85				.0570866	1.4500	1.45mm			1.8mm		.147	3.7338	#26					.328125	8.3347	21/64				
.01126	.2860		29				.0590551	1.5000	1.50mm					.1495	3.7973	#25					.332	8.4328	Q				
.011481	.2916						.0595	1.5113	#53			1-72		.1496063	3.8000	3.80mm					.339	8.6106	R				
.0115	.2921		#84				.06	1.5240						.15	3.8100						.34375	8.7312	11/32		2/0		
.011811	.3000		.30mm				.0610236	1.550	1.55mm					.152	3.8608	#24					.348	8.8392	S				
.012	.3048		#83				.0625	1.5875	1/16		16			.1535433	3.9000	3.90mm					.3543307	9.000	9.00mm				
.0125	.3175		#82		30		.0629921	1.6000	1.60mm			2.00		.154	3.9116	#23					.358	9.0932	T				
.01264	.3210		28				.063	1.6002						.15625	3.9687	5/32			9		.359375	9.1281	23/64				
.013	.3302		#81				.0635	1.6129	#52					.157	3.9878	#22					.3648	9.2659		2/0			
.0135	.0000		#80				.06408	1.6276		14				.1574803	4.0000	4.00mm					.368	9.3472	U				
.0137795	.3500		.35mm				.0649606	1.6500	1.65mm					.159	4.0386	#21					.375	9.5250	V		3/0		
.0140625	.3572			29			.0669291	1.7000	1.70mm			1.6mm		.16	4.0640						.377	9.5758	W				
.01419	.3604		27				.067	1.17018	#51					.161	4.0894	#20				10-32	.386	9.8044	W				3/8-16
.0145	.3683		#79				.068976	1.7000	1.75mm			2.2mm		.1614173	4.1000	4.10mm					.390625	9.9219	25/64				
.015	.3810						.07	1.7780	#50			2-56		.162	4.1148		6				.393701	10.0000	10.00mm				
.015625	.3969		1/64		28	0000-160	.0703125	1.7859			15			.164	4.1656						.397	10.0838	X				
.0157480	.4000		.40mm				.0708661	1.8000	1.80mm					.1653543	4.2000	4.20mm					.404	10.2616	Y				
.01594	.4049		26				.07196	1.8278		13				.166	4.2164	#19					.40625	10.3187	13/32		4/0		
.016	.4064		#78				.072	1.8288						.1692913	4.3000	4.30mm					.4096	10.4038		3/0			
.0171875	.4366			27			.0728346	1.8500	1.85mm			1.8mm		.1695	4.3053	#18					.413	10.4902	Z				
.0177165	.4500		.45mm				.073	1.8542	#49					.17	4.3280						.4218745	10.7156	27/64				1/2-13
.0179	.4547		25				.0748031	1.9000	1.90mm					.171875	4.3656	11/64			8		.433071	11.0000	11.00mm				
.018	.4572		#77				.075	1.9050						.173	4.3942	#17					.4375	11.1125	7/16		5/0		
.01875	.4762			26			.076	1.9304	#48			1-72		.1732283	4.4												

### CONVERSION FACTORS

Multiply	By	To Obtain	Multiply	By	To Obtain
Centimeters	.03281	Feet	Liters	1.000	Kilograms of water
Centimeters	.3937	Inches	Liters	2.113	Pints (liquid)
Centimeters	.01	Meters	Liters	1.057	Quarts (liquid)
Centimeters	393.7	Mils	Meters	100	Centimeters
Cubic Inches	16.39	Cubic centimeters	Meters	3.281	Feet
Cubic Inches	5.787x10 <sup>-4</sup>	Cubic feet	Meters	39.37	Inches
Cubic Inches	1.639x10 <sup>-5</sup>	Cubic meters	Meters	.001	Kilometers
Cubic Inches	2.143x10 <sup>-5</sup>	Cubic yards	Meters	6.214x10 <sup>-4</sup>	Miles
Cubic Inches	.004329	Gallons	Meters	5.396x10 <sup>-4</sup>	Miles (nautical)
Cubic Inches	.01639	Liters	Meters	1000	Millimeters
Degrees (Celsius)	(°Cx9/5)+32	Degrees (Fahrenheit)	Meters	1.094	Yards
Degrees (Celsius)	°C+273.15	Degrees (Kelvin)	Milliliters	.001	Liters
Degrees (Fahrenheit)	(°F-32)x5/9	Degrees (Celsius)	Millimeters	.1	Centimeters
Degrees (Fahrenheit)	°F+459.67	Degrees (Rankine)	Millimeters	.03937	Inches
Degrees (Kelvin)	°K-273.15	Degrees (Celsius)	Millimeters	.003281	Feet
Feet	30.48	Centimeters	Millimeters	39.37	Mils
Feet	12	Inches	Ounces	16	Drams
Feet	3.048x10 <sup>-4</sup>	Kilometers	Ounces	437.5	Grains
Feet	.3048	Meters	Ounces	28.349527	Grams
Feet	1.894x10 <sup>-4</sup>	Miles	Ounces	.9115	Ounces (troy)
Feet	1.645x10 <sup>-4</sup>	Miles (nautical)	Ounces	.0625	Pounds
Feet	304.8	Millimeters	Ounces	2.790x10 <sup>-3</sup>	Tons (long)
Feet	.3333	Yards	Ounces	2.835x10 <sup>-3</sup>	Tons (metric)
Gallons	3785	Cubic centimeters	Ounces (fluid)	1.805	Cubic inches
Gallons	.1337	Cubic feet	Ounces (fluid)	.02957	Liters
Gallons	231.0	Cubic inches	Pints (dry)	33.60	Cu. Inches
Gallons	.003785	Cubic meters	Pints (liquid)	473.2	Cu. centimeters
Gallons	.004951	Cubic yards	Pints (liquid)	.01671	Cu. feet
Gallons	.83267	Gallons (Imperial)	Pints (liquid)	28.87	Cu. inches
Gallons	3.785	Liters	Pints (liquid)	6.189x10 <sup>-4</sup>	Cu. yards
Gallons	8	Pints (liquid)	Pints (liquid)	.125	Gallons
Gallons	8.3453	Pounds of water	Pints (liquid)	.4732	Liters
Gallons	4	Quarts (liquid)	Pints (liquid)	.5	Quarts (liquid)
Grams	.001	Kilograms	Pounds	453.59237	Grams
Grams	1000	Milligrams	Pounds	.45359237	Kilograms
Grams	.03527	Ounces	Pounds	16	Ounces
Grams	.03215	Ounces (troy)	Pounds	32.17	Poundals
Grams	.002205	Pounds	Pounds	.0005	Tons
Inches	2.54	Centimeters	Pounds/cubic foot	.01602	Grams/cu. centimeter
Inches	.0254	Meters	Pounds/cubic foot	16.02	Kilograms/cu. meter
Inches	25.4	Millimeters	Pounds/cubic foot	5.787x10 <sup>-4</sup>	Pounds/cu.inch
Inches	1,000	Mils	Pounds/cubic inch	27.68	Grams/cu. centimeter
Inches	.02778	Yards	Pounds/cubic inch	27,680	Kilograms/cu. meter
Kilograms	1000	Grams	Pounds/cubic inch	1728	Pounds/cu. foot
Kilograms	70.93	Poundals	Pounds/foot	1.488	Kilograms/meter
Kilograms	2.205	Pounds	Pounds/inch	178.6	Grams/centimeter
Kilograms	.001102	Tons	Quarts (dry)	67.20	Cubic inches
Kilometers	100,000	Centimeters	Quarts (dry)	1.164	Quarts (liquid)
Kilometers	3281	Feet	Quarts (liquid)	946.4	Cubic centimeters
Kilometers	1000	Meters	Quarts (liquid)	.03342	Cubic feet
Kilometers	.6214	Miles	Quarts (liquid)	57.75	Cubic inches
Kilometers	1094	Yards	Quarts (liquid)	9.464x10 <sup>-4</sup>	Cubic meters
Liters	1000	Cubic centimeters	Quarts (liquid)	.25	Gallons
Liters	.03531	Cubic feet	Quarts (liquid)	.9463	Liters
Liters	61.02	Cubic inches	Quarts (liquid)	.8594	Quarts (dry)
Liters	.001	Cubic meters	Square inches	6.452	Square centimeters
Liters	.001308	Cubic yards	Square inches	.006944	Square feet
Liters	.2642	Gallons	Square inches	645.2	Square millimeters

### AISI/SAE NUMBERING SYSTEM FOR CARBON AND ALLOY STEEL

Type	10 18		12L14	
	Carbon content (Hundredths of a %)		L denotes leaded steels B denotes boron steels	
Carbon Steels	10XX	Plain Carbon, Mn 1.00% max		
	11XX	Resulfurized Free Machining		
	12XX	Resulfurized/Rephosphorized Free Machining		
Manganese Steels	15XX	Plain Carbon, Mn 1.00-1.65%		
	13XX	Mn 1.75%		
Nickel Steels	23XX	Ni 3.50%		
	25XX	Ni 5.00%		
Nickel-Chromium Steels	31XX	Ni 1.25%, Cr .65-.80%		
	32XX	Ni 1.75%, Cr 1.07%		
	33XX	Ni 3.50%, Cr 1.50-1.57%		
	34XX	Ni 3.00%, Cr .77%		
Molybdenum Steels	40XX	Mo .20-.25%		
	44XX	Mo .40-.52%		
Chromium-Molybdenum Steels	41XX	Cr .50-.95%, Mo .12-.30%		
Nickel-Chromium-Molybdenum Steels	43XX	Ni 1.82%, Cr .50-.80%, Mo .25%		
	47XX	Ni 1.05%, Cr .45%, Mo .20-.35%		
Nickel-Molybdenum Steels	46XX	Ni .85-1.82%, Mo .20-.25%		
	48XX	Ni 3.50%, Mo .25%		
Chromium Steels	50XX	Cr .27-.65%		
	51XX	Cr .80-1.05%		
	50XXX	Cr .50%, C 1.00% min		
	51XXX	Cr 1.02%, C 1.00% min		
	52XXX	Cr 1.45%, C 1.00% min		
Chromium-Vanadium Steels	61XX	Cr .60-.95%, V .10-.15%		
Tungsten-Chromium Steels	72XX	W 1.75%, Cr .75%		
Nickel-Chromium-Molybdenum Steels	81XX	Ni .30%, Cr .40%, Mo .12%		
	86XX	Ni .55%, Cr .50%, Mo .20%		
	87XX	Ni .55%, Cr .50%, Mo .25%		
	88XX	Ni .55%, Cr .50%, Mo .35%		
Silicon-Manganese Steels	92XX	Si 1.40-2.00%, Mn .65-.85%, Cr 0-.65%		
Nickel-Chromium-Molybdenum Steels	93XX	Ni 3.25%, Cr 1.20%, Mo .12%		
	94XX	Ni .45%, Cr .40%, Mo .12%		
	97XX	Ni .55%, Cr .20%, Mo .20%		
	98XX	Ni 1.00%, Cr .80%, Mo .25%		

### FOR STAINLESS STEELS

AISI	SAE	Stainless Steels	
2XX	302XX	Chromium-Manganese-Nickel Steels	Austenitic 1
3XX	303XX	Chromium-Nickel Steels	Austenitic 1
4XX	514XX	Chromium Steels	See Note 2
5XX	515XX	Chromium Steels	Heat Resisting

NOTE 1: Austenitic Steels are not capable of heat treatment but are available in varied harnesses.

NOTE 2: ANSI 4XX (SAE 514XX) Chromium Steels are either ferritic (not heat treatable) or martensitic (heat treatable) both have magnetic properties.

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4/5 BLADE	27003 0	27	88CM	31116 0	40	144MM	44148 5	85	308	30266 3	50
5/6/55 DRILL	21014 2	27	88P	31114 6	40	145	44150 8	85	310	32072 8	50
5B	21009 8	27	90	41058 0	81	146	N/A	32,56,83	311ME	32075 9	50
6	21010 4	27	92	41062 7	80	147	01470 2	32,56,83	320	N/A	128
6 BLADE	21013 5	27	93	41065 8	81	151	14008 1	11	321	22391 3	128
7	21015 9	43	94A	41074 0	80	152	14022 7	11	329	03290 4	36
11	21024 1	27	94B	41077 1	80	153	14019 7	10	341	22389 0	96
11B	27024 5	27	94C	41080 1	80	154ST	14018 0	13	342	22390 6	96
13	22006 6	53	94D	41083 2	80	155	14009 8	11	354	22189 6	95
14	22009 7	53	100-1/2	11012 1	11	157	14015 9	11	355	22332 6	96
15	N/A	53	100-1/4	11003 9	11	159	01590 7	17	360	42021 3	95
16ME	22015 8	54	100-3/4	11015 2	11	160R	31200 6	42	366	42027 5	96
17	22018 9	55	100-3/8	11018 3	11	161R*	31203 7	42	367	42030 5	96
18	22024 0	55	100-5/16	11006 0	11	162R	31209 9	42	367-100	42031 2	96
19	22027 1	55	100-5/8	11021 3	11	163	31212 9	42	368	42033 6	96
20	22036 3	54	100-7/16	11024 4	11	164	31215 0	42	369	42036 7	96
21	22041 7	54	100-7/8	11022 0	11	165	01650 8	42	369-100	42038 1	96
22	22042 4	29	101-1/2	11013 8	NCL	166	31218 1	42	370-1	42041 1	97
23	22046 2	29	101-1/4	11020 6	NCL	167	01670 6	42	370-10	42059 6	97
24	22011 0	29	101-3/8	11019 0	NCL	175	31325 6	43	370-12	42061 9	97
29	22148 3	31	101-5/8	11025 1	NCL	177-1	31236 5	43	370-16	42064 0	97
30	22165 0	51,55	101-7/16	11023 7	NCL	177-2	31240 2	43	370-2	42044 2	97
31A	23024 9	28	102	44103 4	57,86	177-4	31244 0	43	370-24	42067 1	97
31B	23030 0	28	103	10301 7	57,86	177-8	31242 6	43	370-3	42047 3	97
31C	23033 1	28	107	10700 8	56,84	180	22158 2	19	370-4	42050 3	97
32	00052 2 *A	26	108	10800 5	56,84	182	22159 9	19	370-6	42053 4	97
34ST	23041 6	28	109	10900 2	58,86	183	01830 4	18	370-8	42056 5	97
36/37	23059 1	22	110	22075 2	13	184	22160 5	NCL	372A	42073 2	97
55	21012 8	27	111	22076 9	13	185	01850 2	18	372B	42076 3	97
55 BLADE	27015 3	27	114	01140 4	13	186	01860 1	17	372C	42079 4	97
64	41030 6	106	115	01150 3	10	188	22161 2	19	372D	42082 4	97
69	41036 8	106	115B	11500 3	10	189	18900 4	15	372E	42085 5	97
72	41039 9	106	117	01170 1	9	190	22155 1	18	374A	42093 0	97
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74B	31024 8	39	118BG	01180 0	9	193	22157 5	18	374D	42105 0	97
74C	31026 2	39	119	31173 3	9	195-1/2	23047 8	28	375	42108 1	97
74D	31028 6	39	119BG	01194 7	9	195-3/4	23050 8	28	376A	42111 1	96
75A	31034 7	39	120	12003 8	6	195-5/8	23053 9	28	376AB	37600 8	96
75B	31036 1	39	123R	12009 0	7	196	23054 6	12	376B	42114 2	96
75C	31038 5	39	124	01240 1	7	201	00201 3	20	376C	42117 3	96
75D	31040 8	39	125	12015 1	8	226	31306 5	52	376D	42120 3	96
75E	31042 2	39	126	12017 5	6	226T	31309 6	52	377	42122 7	97
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76A*	31052 1	39	129X	12032 8	7	250	25001 8	95	379	42123 4	95
76B*	31054 5	39	130	13003 7	11	251	31321 8	53	380A	31400 0	41
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76D*	31058 3	39	132ME	44136 2	85	255MM	31326 3	53	383NX	42208 8	94
76E*	31060 6	39	133	13300 7	8	260	31329 4	43	384N	42210 1	94
77	31062 0	38	134	22077 6	12	262	31331 7	43	386	42219 4	94
78	31066 8	38	135	01350 7	8	263	31334 8	43	388	42214 9	81
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81	31092 7	40	139C	13015 0	15	291	22154 4	28	400	42217 0	82
81P	31094 1	40	139D	13023 5	15	292	22149 0	28	401AA	42240 8	82
83	31098 9	40	139ST	13017 4	15	293	22150 6	28	401XX	42263 7	82
83P	31100 9	40	140	13019 8	14	300/1•	32036 0	49	403	42266 8	82
84	31102 3	40	140L	13022 8	NCL	300ME•	32042 1	49	408	42271 2	82
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416	42297 2	82	616	32096 4	46	846DB	N/A	M12	1271C	43799 0	103
417	42300 9	82	634	32108 4	46	847	43009 0	110	1271E	43804 1	103
423-3	42249 1	82	641	32112 1	51	848	00021 8 *A	25	1271G	43810 2	103
423-3C	42251 4	82	666	22415 6	74	849	00051 5 *A	24	1271H	43813 3	103
423-7	42257 6	82	666CD	22415 7	M8	849DB	N/A	M12	1271I	43816 4	103
425	42258 3	82	676	32111 4	46	851-100	43023 6	98	1271J	43819 5	103
444	31586 1	55	678MED	32114 5	46	852-100	43030 4	98	1271K	43821 8	103
450-10	31592 2	41	690	22200 8	74	852-5	43027 4	98	1271L	43822 5	103
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450-8	31604 2	41	713	22170 4	71	859	22062 2	10	1271P	43831 7	103
452-10	31607 3	41	714	35018 3	54	862	24500 7	109	1271Q	43833 1	103
452-12	31610 3	41	715	35015 2	53	864	43067 0	10,101	1271ST	43849 2	103
452-4	31615 8	41	721	42574 4	NCL	864B	43070 0	10,101	1276	31286 0	47
452-6	31618 9	41	722	N/A	85	866	43069 4	99	1280A	43856 0	103
452-8	31621 9	41	723ME	42577 5	NCL	867-100	43055 7	99	1280B	43859 1	103
454-10	31624 0	41	729	42581 2	85	868	24501 4	109	1280C	43862 1	103
454-12	31627 1	41	729ME	42594 2	85	888	25099 5	23	1280D	43865 2	103
454-4	31636 3	41	735	22412 5	62	889	25111 4	NCL	1280E	43868 3	103
454-6	31639 4	41	735DB	22412 6	M10	890	43666 5	81,107	1280F	43870 6	103
454-8	31641 7	41	741	22394 4	65	901	41059 7	104	1280G	43872 0	103
473	04730 4	107	741DB	22394 5	M10	902	41061 0	104	1280H	43874 4	103
478	42321 4	106	744	74401 2	75	903	41064 1	105	1280I	43876 8	103
481	00481 9	12	744CD	00744 6	75,M8	904	41066 5	105	1280J	43878 2	103
482	42324 5	12	744CS	74401 6	NCL	905	41067 2	105	1280K	43880 5	103
482A	42327 6	12	744DB	74400 6	75,M10	906	41069 6	105	1280L	43882 9	103
482B	42330 6	12	744DBC	74400 9	NCL	907	00907 4	105	1280M	43884 3	103
484	48401 7	12	750	22129 2	70	908	00908 1	105	1280N	43886 7	103
520	N/A	33	790-12	42618 5	80	924	25115 2	22	1280-O	43888 1	103
523	23093 5	33	790-5	42612 3	80	934	00934 0	104	1280P	43890 4	103
524	23095 9	33	790-8	42615 4	80	938	00938 8	104	1280ST	43896 6	103
527	42339 9	88	800-10*	42627 7	80	950-3	43731 0	88	1286	30995 2	39
532	42400 6	88	800-12*	42630 7	80	950-5	43734 1	88	1290	43898 0	100
533	42403 7	88	800-16*	42633 8	80	950-7	43735 8	88	1293	43900 0	100
536	42409 9	88	800-24*	42636 9	80	1050	43750 1	88	1390	01390 3	15
537	42412 9	88	800-32*	42639 0	80	1102	01102 2	14	1391	01391 0	NCL
538	42414 3	87	800-8*	42624 6	80	1121	01121 3	14	1392	01392 7	15
548	42437 2	87	800NP	42641 3	80	1122	01122 0	14	1393	01393 4	15
553	42456 3	87	803	24009 5	29	1131	01131 2	14	1395	01395 8	15
554	42462 4	87	806	24018 7	29	1132	01132 9	14	1399	01399 6	19
555	42465 5	90	807	42664 2	76	1133	01133 6	14	1436	14360 0	56,84
557	42468 6	90	807SX*	42667 3	76	1181/91B	18191 6	NCL	1471	01471 9	16
557RMF	42481 5	90	807X*	42670 3	76	1191	01191 6	9	1472	01472 6	16
558	42471 6	90	808	42688 8	76	1191BG	11910 0	9	1473	01473 3	16
560	42473 0	90	809	24024 8	34	1192	01192 3	NCL	1478	01478 3	32,56,83
560RMF	42484 6	90	811	24030 9	32	1201ME	32162 6	46	1482	01482 5	17
565	42509 6	87	812	24036 1	32	1203ME	32168 8	47	1483	01483 2	17
570	42477 8	90	812-CA	22193 3	32	1209	01209 8	8	1484	01484 9	17
572	57200 4	90	814	24039 2	34	1210	32171 8	47	1491	01491 7	17
577	42480 8	90	817	24044 6	34	1216	32174 9	47	1492	01492 4	17
580	58001 6	89	818	24047 7	34	1240	12401 2	7	1493	01493 1	17
580CD	00580 0	M8	820	24050 7	32	1241	32181 7	51	1494	01494 8	17
582	05820 1	89	825	24070 5	23	1242	32182 4	51	1545	01545 7	13
589	58900 2	110	829	24100 9	31	1249	01249 4	NCL	1566	01566 2	20
600-0*	42515 7	75	832	22124 7	51	1251	32180 0	47	1567	01567 9	NCL
600-1*	42518 8	75	833	08330 2	30	1259	01259 3	9	1569	01569 3	NCL
600-2*	42521 8	75	836	08360 9	30	1260-0	41100 6	102	1809	01809 0	20
600-3*	42524 9	75	837	24116 0	30	1260-2	41101 3	102	1841	01841 0	NCL
600-4*	42527 0	75	837CP	24116 4	NCL	1260-4	41102 0	102	1842	01842 7	NCL
600-5*	42530 0	75	839	42698 7	110	1261-0	41103 7	102	1850	43960 4	81
601	00601 1	74	840	24120 7	23	1261-2	41104 4	102	1881	01881 6	19
601CD	00601 2	M9	841	00031 7 *A	24	1261-4	41105 1	102	1882	01882 3	19
602	06020 4	74	841DB	N/A	M12	1265	41106 8	102	1883	01883 0	19
602CD	06020 5	M9	842	24126 9	31	1266	41107 5	102	1901	43974 1	99
608	42561 4	75	843/1	24132 0	31	1267	41108 2	102	1902	43976 5	99
609	06090 7	74	844	43008 3	NCL	1268	41109 9	102	1903	43978 9	99



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1914	01914 1	99	80075	80075 6	77	713009	71390 2	NCL	D11VG	N/A	M4
1914CD	01914 2	99,M9	80078	80078 7	77	713009B	71309 4	72	D12SS	N/A	M4
1915	43984 0	98	83510	81022 9	67	713010B	71301 8	72	D12UTS	N/A	M5
1920	43988 8	99	83516	80123 6	67	713015	71306 3	72	D12UTSTS	N/A	M5
1921	43990 1	99	83525	81024 3	67	713015B	71305 6	72	D14UTSS	N/A	M5
1922	43992 5	99	84101	81021 2	65	713020	71303 2	72	D15EI	N/A	M6
1923	43994 9	99	86014	86014 9	98,M11	713020B	71302 5	72	D22WDC	N/A	M4
1924	43996 3	99	86014/24	N/A	NCL	714125B	71412 1	73	D28HBE	N/A	M2
3601	36010 6	95	511031B	51103 4	72	714140B	71414 5	73	D32E	N/A	M3
7200	25300 2	31	511047B	51104 1	72	714156B	71415 2	73	D397	31434 2	M11
7902	79020 0	111,M11	511062B	51106 5	72	715156B	71515 9	73	D42HBE	N/A	M2
8071	42673 4	76	512030B	51203 1	73	715187B	71518 0	73	D47E	N/A	M3
8075	80750 2	76	512040B	51204 8	73	715218B	71521 0	73	D4GI	N/A	M7
8076	80760 1	76	514050B	51405 9	73	715250B	71525 8	73	D7HC	N/A	M6
8078	80780 9	76	514062B	51406 6	73	750541	N/A	87	D7WI	N/A	M7
8081	42682 6	83	611078	61108 6	72	750542	N/A	87	D8SI	N/A	M7
8082	42684 0	83	611078B	61107 9	72	750543	N/A	87	D8TI	N/A	M7
8083	42686 4	83	611094	61100 0	72	750544	N/A	87	D9CI	N/A	M6
8401	08401 9	26	611094B	61109 3	72	750545	N/A	87	HWD	01474 0	16,M10
8497	N/A	26	611125B	61112 3	72	751016	75106 5	64	MB560	42475 4	88
8498	N/A	26	612010B	61201 4	73	751028	75102 7	65	MG1001	34185 3	57
8501	43061 8	101	612020	61203 8	73	757077	75707 4	NCL	MG1001MM	34184 6	57
8501CP	08501 6	NCL	612020B	61202 1	73	757087	75798 8	NCL	MG1758	33587 6	58
8505	43062 5	101	613003B	61300 4	72	759383	75933 7	93	MG1780	33605 7	58
14712	N/A	32,56,83	613004B	61304 2	72	759387	75938 2	89	MG272-16R2	33073 4	NCL
51205B	51205 5	68	613005	N/A	72	759394	75958 0	93	MG280/281-CA	22068 4	NCL
56716B	56716 1	68	613005B	61305 9	72	759398	75939 9	93	MG6001DC	33450 3	57
56724B	56724 6	68	613006	61360 8	72	759400	75965 8	93	MG-S278-4R	33800 6	58
56748B	56748 2	71	613006B	61306 6	72	759563	75959 7	89	MG-S281-4R	33840 2	58
60004	60004 2	109	613007	N/A	72	759570	75950 4	91	MM1E	10188 9	35
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\* = Made to Government Specs  
 • = Furnished with Pocket Clip  
**NCL** = Not In Catalog  
**\*A** = These UPC codes start with  
**708200** ... all other UPC  
 codes start with **038728**

Due to continuous improvements,  
 actual product may differ slightly  
 from photograph.

A collection of various General Instruments measuring tools including thermometers, tachometers, and digital meters. The tools are arranged on a dark, textured background. A semi-transparent white box is overlaid in the center, containing the title and navigation links.

# Instruments Reference

**Glossary**  
**Alphabetical Index**  
**Numerical Index**

# Instrument Glossary

## TEMPERATURE & HUMIDITY MEASUREMENTS

### Distance-to-Spot ratio (D:S)

The distance-to-spot ratio (D:S) is the ratio of the distance to the object and the diameter of the temperature measurement area. For instance if the D:S ratio is 8:1, measurement of an object 8 inches away will average the temperature over a 1 inch diameter area. For better accuracy the spot needs to be kept on the object being measured.

### Emissivity

Emissivity is measured by the amount of energy radiated when the surface is directly observed. The emissivity of a black body is unity at all wavelengths whereas painted surfaces are typically 0.95.

### Sling Psychrometer

A sling psychrometer consists of two thermometers mounted together within a handle. One thermometer is ordinary. The other has a cloth wick over its bulb and is called a wet-bulb thermometer. It is used in determining the relative humidity.

**Fahrenheit** or F

**Celsius** or C

$$^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32$$

$$^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times 0.555$$

$$\text{Kelvin} = ^{\circ}\text{C} + 273.15$$

$$\text{Rankin} = ^{\circ}\text{F} + 459.67$$

### Dry-bulb

Dry-bulb temperature is the temperature registered by the dry-bulb thermometer of a psychrometer. It is identical to the temperature of the air.

### Wet-bulb

Wet-bulb temperature is the temperature that the air would have if cooled to saturation by the evaporation of water.

### Humidity

The degree of water vapor or wetness in the air.

### Relative Humidity (RH)

The amount of water vapor in a sample of air compared to the maximum amount of water vapor the air can hold at any specific temperature. It ranges from 1 to 100% RH.

### Thermistor

A semiconductor material whose resistivity changes with temperature.

### Thermocouples

A widely used type of temperature sensor that can also be used as a means to convert thermal potential difference into electric potential difference. They are sets of two dissimilar metals used to measure temperature. Some of the most commonly used types of thermocouples are:

**J** (Fe/constantan) **K** (chromel/alumel)

**T** (Cu/constantan) **E** (chromel/constantan)

**R** (Pt/Pt - 30% RH) **S** (Pt/Pt - 10% RH)

**N** (NiCrSi-NiSi).

### Heat index

The temperature the body feels when heat and humidity are combined. The body dissipates heat by varying the rate and depth of blood circulation, by losing water through the skin and sweat glands, and, as a last resort, by panting, when blood is heated above 98.6°F (37° C). Sweating cools the body through evaporation. However, high relative humidity retards evaporation, robbing the body of its ability to cool itself. When heat gain exceeds the level the body can remove, body temperature begins to rise, and heat related illnesses and disorders may develop.

### Wind chill

The term used to describe the rate of heat loss on the body resulting from the combined effect of low temperature and wind. As winds increase, heat is carried away from the body at a faster rate, driving down both the skin temperature and eventually the internal body temperature.

### Data Logger

An instrument that records or logs data, much of which may be real-time and later downloaded to a computer for studies.

### Moisture content

The amount of moisture in material being tested. Some moisture meters directly read % material moisture and others provide a relative scale.

## WATER QUALITY

### pH

A measure of acidity and alkalinity of a solution on a scale in which a value of 7 represents neutrality and lower numbers indicate increasing acidity and higher numbers increasing alkalinity. Each unit of change represents a tenfold change in acidity or alkalinity and is the negative logarithm of the effective hydrogen-ion concentration or hydrogen-ion activity in gram equivalents per liter of the solution. It ranges from 0 to 14.

### Oxygen Reduction Potential (ORP)

This is basically a measurement to oxidize contaminants. It is the only practical method we have to electronically monitor sanitizer effectiveness.

### Reduction/Oxidation Reaction (Redox)

This describes all chemical reactions in which atoms have their oxidation number (oxidation state) changed.

### Oxidation

This describes the loss of electrons by a molecule, atom or ion.

### Reduction

This describes the gain of electrons by a molecule, atom or ion.

### Total Dissolved Solids (TDS)

This is a measurement for the combined content of all inorganic and organic substances present within a liquid. Total Dissolved Solids (TDS) of the water tells you the quality of water. It may be used to check if your reverse osmosis water system is working properly. It may also be used to decide if the membrane or cartridges should be changed or not.

### Dissolved Oxygen (DO)

This is the relative amount of oxygen that is dissolved in a given sample.

### Electrical Conductivity (EC)

This is the measurement of the electrical conductivity of water. Clean water has a low EC. When you add nutrients and pH adjusters, the EC will increase.

### Conductivity (μS)

This is a measurement of the number of ions in a liquid. It is commonly used to measure the quality of a solution.

### Automatic temperature compensation (ATC)

Automatic correction for the influence of temperature on a given measurement.

## SOUND MEASUREMENTS

**A-frequency-weighting** is mandated for the protection of workers against noise-induced deafness affecting their health and welfare. The levels, are not single event, or "peak" levels, but represent averages of acoustic energy over periods of time such as 8 hours or 24 hours, and over long periods of time such as years. This allows old data to be compared with new measurements.

**C-frequency-weighting** is primarily used in the measurement of the peak value of a noise.

## GAS MEASUREMENTS

### Carbon Monoxide (CO)

An odorless and very toxic gas. CO is formed as a product of the incomplete combustion of carbon or a carbon compound.

### Carbon Dioxide (CO<sub>2</sub>)

This gas is naturally present in the atmosphere at levels of approximately 0.035%. Short-term exposure to CO<sub>2</sub> at levels below 2% (20,000 parts per million or ppm) has not been reported to cause harmful effects. Higher concentrations can affect respiratory function and cause excitation followed by depression of the central nervous system. High concentrations of CO<sub>2</sub> can displace oxygen in the air, resulting in lower oxygen concentrations for breathing. Therefore, effects of oxygen deficiency may be combined with effects of CO<sub>2</sub> toxicity. It is often monitored with IAQ equipment.

### Indoor Air Quality (IAQ)

This is used to determine the health of the workplace or building by measuring gasses such as carbon dioxide.

### Lower explosive limit (LEL)

This is the lowest amount of gas that will cause an explosion. Detectors that sense lower levels of gas will warn you more quickly of the presence of a combustible gas than detectors that sense higher levels.

### Parts per million (ppm)

This is the ratio of how much of the tested solid, liquid or gas is present within a million of the sampled solid, liquid (solution) or gas (air) molecules.

## LIGHT MEASUREMENTS

### Lux

A photometric unit of illuminance or illumination equal to one lumen per square meter.

### Foot-candle (fc)

A unit of illuminance or illumination equal to one lumen per square foot.

$$fc = 10.76 \times lux$$

$$lux = fc / 10.76$$

### Ultraviolet light (UV)

This is the part of the electromagnetic spectrum which is adjacent to and greater in energy than visible light. The ultraviolet spectrum extends from 180 to 400 nanometers (nm) and is divided into three categories: shortwave (UV-C), medium-wave (UV-B), and longwave (UV-A).

**UV-A** Ultraviolet radiation in the wavelength band of 320 - 390nm with a peak in energy at about 365 nm; a component of the spectrum of solar radiation that can tan human skin or cause redness in sensitive skin.

**UV-B** Ultraviolet radiation in the wavelength band of 290 - 320nm with a peak in energy at about 312 nm; a component of the spectrum of solar radiation that can cause sunburn and skin cancer. This band is only partially blocked by the atmospheric ozone layer.

**UV-C** Ultraviolet radiation in the wavelength band of 200 - 290nm with a peak in energy at about 254 nm; a very harmful component of the spectrum of solar radiation that can cause chromosome mutations, death of single-cell organisms, and damage to the cornea of the eye.

This band is almost completely blocked by the atmospheric ozone layer.

## EMF/BTU MEASUREMENTS

### Electro-Magnetic Interference (EMI)

Radiation which may affect the performance of electronic equipment.

### Electromagnetic field (EMF)

This is the field comprised of the electric field and the magnetic field (magnetic induction). The field can be viewed as the combination of an electric field and a magnetic field. All electric and magnetic fields are electromagnetic fields and can't be divided.

### British thermal unit (BTU or Btu)

This is a unit of energy commonly used in the power, steam generation, and heating and air conditioning industries.

### Manometer

These are instruments (such as a pressure gauge) for measuring the pressure of gases and vapors.

### Barometric pressure

The pressure in the atmosphere at any given location typically measured in inHg.

## AIRFLOW MEASUREMENTS

### Anemometer

This is an instrument for measuring and indicating the force or speed of the air movement.

**Area of a rectangular duct**  $L \times W$

**Area of a circular duct**  $Pi R^2$   $Pi = 3.14$

**CFM (ft<sup>3</sup>/min)** =

$$\text{Air Velocity (ft/min)} \times \text{Area (ft}^2\text{)}$$

**GMM (m<sup>3</sup>/min)** =

$$\text{Air Velocity (m/min)} \times \text{Area (m}^2\text{)}$$

**Square feet /144** = square inches

## ELECTRICAL MEASUREMENTS

**Measurement categories** (Over-voltage categories).

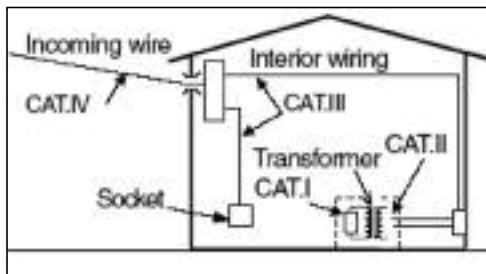
To ensure safe operation of measuring instruments, IEC61010 establishes safety standards for various electrical environments, categorized as CAT I to CAT IV, and called measurement categories. Higher-numbered categories correspond to electrical environments with greater momentary energy, so a measuring instrument designed for CAT III environments can endure greater momentary energy than one assigned for CAT II.

**CAT I:** Secondary electrical circuits connected to an AC electrical outlet through a transformer or similar device.

**CAT II:** Primary electrical circuits of equipment connected to an AC electrical outlet by a power cord.

**CAT III:** Primary electrical circuits of the equipment connected directly to the distribution panel, and feeders from the distribution panel to outlets.

**CAT IV:** The circuit from the service drop to the service entrance, and to the power meter and primary over-current protection device (distribution panel).



**Power (W)** = voltage (V) X current (A)

**(RMS reading) x (1.414)** =

Peak to Peak reading

### True Root Mean Square (TRMS)

A TRMS meter is used to measure non sinusoidal waveforms (harmonics).

**Volt (E)** is the unit of electric pressure or electromotive force. It is the potential that will produce a current of 1 ampere through a resistance of 1 ohm. The volt (symbol: V) is the SI derived unit of electric potential difference or electromotive force.

**Ampere (I)** is the unit of electrical current (coulombs per second). The ampere, in practice often shortened to amp, (symbol: A) is a unit of electric current, or amount of electric charge per second.

**Ohm (R)** is the unit of electrical resistance (volts/ampere). The ohm (symbol:  $\Omega$ ) is the SI unit of electrical impedance or, in the direct current case, electrical resistance,

**Watts (W)** and **Kilowatts (KW)** are units of electric power.

**Kilovolt-ampere (KVA)** is a measurement of apparent electric power.

**Kilowatt hour (Kwhr)** is a unit of electrical energy or work performed.

**Joule (J)** is a metric unit of energy: watt per second. 1 Kwhr = 2,655,224 ft-lb = 1.341 hp-hr = 3412 Btu = 3,600,000 joules.

**Ohm law relationships** (direct current)

$$E = IR + W/I = \sqrt{WR}$$

$$W = I^2R = E^2/R = EI$$

$$I = E/R = W/E = \sqrt{W/R}$$

$$R = E/I = W/I^2 = E^2/W$$

### Capacitance

The ability an electronic component has to store energy as an electrical charge.

### Insulation Resistance

The property of a material to resist the flow of electrical current and expressed in Megohms as the ratio of an applied electrical potential divided by the flow of electrical current.

## INDUSTRIAL

### NIST Certification - Traceability

Calibration in accordance with and against standards traceable to NIST (National Institute of Standards and Technology, USA). Traceability to NIST is a means of ensuring that reference standards remain valid and their calibration remains current.

### Peak Hold

Output of the maximum measurement indicated by an instrument during the time duration for which this display mode has been active.

### Refractometer

An instrument for measuring refractive indices in a fluid or solution.

### Stroboscope

An instrument for determining the speed of cyclic motion that causes the motion to appear slowed or stopped.

### Tachometer

A device for indicating speed of rotation.

### Fiber optic inspection scope

This type of scope has the ability to see around a bend and see or capture images of hard-to-reach places.

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Company UPS Code for the listed items start with 681035.

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