UNITCHEATSHEET.COM · PRINTABLE BINDER

All engineering cheat sheets.

28 reference charts in one file: 62 pages of sizes, gauges, codes and conversions. US Letter paper. Each chart matches the single-chart PDF on the site. Use the contents to jump to a chart.

ACOUSTICS	Decibel chart
APPAREL	Shoe size conversion chart
DESIGN & PRINT	Paper size chart
ELECTRICAL	AWG wire gauge chart, Capacitor code chart, Resistor color code chart, SMD resistor code chart
FOOD & KITCHEN	Cooking conversion chart
HVAC	HVAC duct size chart
INSTRUMENTATION	Thermocouple types chart
MATERIALS	ASTM steel grades chart, Plastic resin codes chart
MECHANICAL	Bearing size chart, Bolt torque chart, Drill bit size chart, ISO tolerance chart, O-ring size chart (AS568), Sheet metal gauge chart, Socket & wrench size chart, Tap drill chart
PHOTOGRAPHY	Photography exposure chart
PHYSICAL REFERENCE	Force & weight conversion chart, Pressure units chart, Temperature reference chart
PLUMBING & PROCESS	Copper pipe size chart (Type K, L, M), NPT pipe thread chart, Pipe size chart (NPS)
WOODWORKING	Wood screw pilot hole chart

Free to print and share for personal, classroom and shop use. Check safety-critical values (torque, pressure, electrical) against the governing standard before use. Latest versions: unitcheatsheet.com/cheatsheets/

Contents

ACOUSTICS

Decibel chart 3

APPAREL

Shoe size conversion chart 5

DESIGN & PRINT

Paper size chart 7

ELECTRICAL

AWG wire gauge chart 9

Capacitor code chart 11

Resistor color code chart 13

SMD resistor code chart 15

FOOD & KITCHEN

Cooking conversion chart 18

HVAC

HVAC duct size chart 21

INSTRUMENTATION

Thermocouple types chart 23

MATERIALS

ASTM steel grades chart 25

Plastic resin codes chart 27

MECHANICAL

Bearing size chart 29

Bolt torque chart 31

Drill bit size chart 33

ISO tolerance chart 37

O-ring size chart (AS568) 40

Sheet metal gauge chart 42

Socket & wrench size chart 44

Tap drill chart 46

PHOTOGRAPHY

Photography exposure chart 48

PHYSICAL REFERENCE

Force & weight conversion chart 50

Pressure units chart 52

Temperature reference chart 54

PLUMBING & PROCESS

Copper pipe size chart (Type K, L, M) 56

NPT pipe thread chart 59

Pipe size chart (NPS) 60

WOODWORKING

Wood screw pilot hole chart 63

Decibel *chart*

Common sound levels from silence to shockwave — with NIOSH-recommended maximum daily exposure times.

LEVEL	SOURCE	NIOSH RECOMMENDED EXPOSURE LIMIT (DBA)
0 dB	Threshold of human hearing (young, healthy ear)	—
10 dB	Anechoic chamber, calm breathing	—
20 dB	Rustling leaves, watch ticking	—
30 dB	Whisper at 1 m, quiet rural area	—
40 dB	Library, residential nighttime	—
50 dB	Light traffic at distance, moderate rainfall	—
60 dB	Normal conversation at 1 m, dishwasher	—
65 dB	Air conditioner at 100 ft, normal office	—
70 dB	Vacuum cleaner, heavy traffic, alarm clock	—
75 dB	Garbage disposal, freight train at 50 ft	Below NIOSH's table (it starts at 80 dBA)
80 dB	Heavy traffic at 5 m, garbage truck, alarm	**25 h 24 min max**
85 dB	City traffic, electric razor, blow dryer	**8 hours max**
90 dB	Lawnmower, motorcycle at 7.5 m, food blender	**2 h 31 min max**
95 dB	Power tools, motorcycle, hand drill	**47 minutes max**
100 dB	Chainsaw, hand-held grinder, factory floor	**15 minutes max**
105 dB	Personal music player at max volume, helicopter	**4 min 43 s max**
110 dB	Rock concert at front row, leaf blower	**1.5 minutes max**
115 dB	Loud sporting event, ambulance siren	**28 seconds max**
120 dB	Threshold of pain, jet plane takeoff (200 ft)	**9 seconds max**
125 dB	Aircraft carrier deck, pneumatic riveter	**3 seconds max**
130 dB	Jackhammer at 1 m	**Hearing damage immediate**
140 dB	Jet engine at 30 m, .22 rifle at ear	**Permanent damage instant**
150 dB	Shotgun blast at ear, fireworks at 1 m	**Permanent damage instant**
165 dB	.357 Magnum at ear	**Permanent damage instant**
180 dB	Saturn V rocket launch at 100 m	**Immediate eardrum rupture**
194 dB	Theoretical maximum dB in Earth's atmosphere	Beyond this, sound becomes shockwave

Sources: NIOSH Publication No. 98-126 · OSHA 29 CFR 1910.95 · WHO Guidelines for Community Noise · ANSI S1.1 · ISO 80000-8
unitcheatsheet.com/cheatsheets/decibel-reference · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Decibel *chart*
Notes and pitfalls

About the exposure limits. NIOSH recommends a maximum daily noise dose using a 3 dB exchange rate — that means every 3 dB doubles the noise dose. 8 hours at 85 dB equals 4 hours at 88 dB equals 2 hours at 91 dB. OSHA's regulatory limit uses a 5 dB exchange rate (less strict), but NIOSH's 3 dB matches the physics of sound energy and is what audiologists recommend.

COMMON PITFALLS

- **The dB scale is logarithmic.** 70 dB isn't 'twice as loud' as 35 dB — it's about 11 times louder (in perceived loudness) and about 3,200 times more intense in sound energy ($10^{3.5} \approx 3{,}162$). Every 10 dB is roughly a doubling in perceived loudness.
- **The 3 dB doubling rule.** Every 3 dB doubles the sound energy. Two identical noise sources produce 3 dB more than one source alone (not 6 dB).
- **dB without context is meaningless.** The source levels above are typical sound levels at the stated distance. The exposure limits are A-weighted (dBA) 8-hour-equivalent limits, as NIOSH and OSHA measure them. 'dB' alone can refer to many different scales — electrical (dBm, dBV), radio (dBi), acoustic (dB SPL, dBA, dBC). Always check the reference.
- **A-weighting (dBA) is the standard for human hearing.** Raw dB SPL doesn't account for the ear's frequency sensitivity. dBA applies a filter that approximates the ear's response. Almost all consumer and occupational measurements are dBA. Industrial machinery specs are sometimes dBC (flatter, used for impulse noise).
- **Distance matters.** Sound pressure drops 6 dB per doubling of distance from a point source. A 100 dB chainsaw at 1 m is 94 dB at 2 m, 88 dB at 4 m, 82 dB at 8 m. Half the distance, 6 dB more.
- **Hearing damage is cumulative and permanent.** Inner ear hair cells don't regenerate. 28 seconds at 115 dBA gives the same noise dose as 8 hours at 85 dBA (NIOSH, 3-dB exchange rate). There's no recovery — only prevention.

COMMON APPLICATIONS

WHEN YOU'D WANT A MEASUREMENT	TYPICAL CONCERN THRESHOLD
Residential noise complaints	55 dB daytime / 45 dB nighttime (varies by city)
Office noise (productivity)	55 dB ambient, 65 dB peak
School classroom (acoustics)	35 dB background, 60 dB max
Hospital ICU (sleep / recovery)	40 dB nighttime / 45 dB daytime (WHO recommendation; not yet checked against the WHO text)
Industrial workplace (hearing protection required)	85 dB time-weighted average
Construction site boundary	75–85 dB depending on jurisdiction
Concert / venue (audience safety)	100 dB sustained / 115 dB peak
Headphone listening (CDC recommendation)	85 dB max for 8 hours; below 60% volume usually safe

Sources: NIOSH Publication No. 98-126 · OSHA 29 CFR 1910.95 · WHO Guidelines for Community Noise · ANSI S1.1 · ISO 80000-8
unitcheatsheet.com/cheatsheets/decibel-reference · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Shoe size conversion *chart*

Men's, women's, and kids' shoe sizes across US, UK, EU, and centimeters.

US MEN'S	US WOMEN'S	UK	EU	CM (FOOT LENGTH)
3	4.5	2.5	35	21.6
3.5	5	3	35.5	22.2
4	5.5	3.5	36	22.5
4.5	6	4	36.5	22.9
5	6.5	4.5	37	23.5
5.5	7	5	37.5	23.8
6	7.5	5.5	38	24.1
6.5	8	6	39	24.4
7	8.5	6.5	39.5	25.1
7.5	9	7	40	25.4
8	9.5	7.5	40.5	25.7
8.5	10	8	41	26
9	10.5	8.5	42	26.7
9.5	11	9	42.5	27
10	11.5	9.5	43	27.3
10.5	12	10	43.5	27.9
11	12.5	10.5	44	28.3
11.5	13	11	44.5	28.6
12	13.5	11.5	45	29.2
12.5	—	12	45.5	29.5
13	—	12.5	46.5	29.8
13.5	—	13	47	30.5

Sources: Brannock Device · EU sizes (Paris point) · UK sizes · Universal cm measure
unitcheatsheet.com/cheatsheets/shoe-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Shoe size conversion *chart*
Notes and pitfalls

About the systems. US sizes increase by 1/3 inch per size. UK sizes are about 1/2 size smaller than US men's (UK 9 ≈ US 10 men's). EU sizes are based on Paris points (1 size = 2/3 cm). The simplest universal measure is **foot length in cm** — measure your foot from heel to longest toe.

COMMON PITFALLS

- **Brand variation is huge.** Nike, Adidas, and New Balance can all be labeled 'size 10' and differ by half a size. Always check the brand's own size guide if buying online.
- **US Women's = US Men's + 1.5 (roughly).** A US women's 8 is approximately a US men's 6.5. Some shoes are sold in men's sizing only, requiring conversion. The 1.5 difference reflects historical convention, not foot biology.
- **EU sizes aren't exactly half-sizes.** EU jumps from 41 to 42 are 6.7 mm (1/3 cm × 2). US half-sizes are 4.2 mm. They don't always align cleanly, leading to fitting issues across the conversion.
- **UK and US men's sizes differ by 1.** UK 10 ≈ US 11 men's. This catches American buyers ordering from British retailers.
- **Width matters as much as length.** US sizes have separate width designations (B=narrow, D=standard, E=wide, etc.). EU sizes typically include width in fewer designations (M, W). Going up in length to accommodate width usually doesn't work.
- **Measure both feet.** Most people have one foot slightly larger than the other (often by 1/2 size). Size to the larger foot, not the smaller.
- **Foot size changes through the day.** Feet swell about 5-10% during the day. Try shoes in the late afternoon for the most realistic fit.

COMMON APPLICATIONS

KIDS' US (TODDLER / YOUTH)	EU	UK	APPROX. AGE (US)
4 (toddler)	19	3	~12-18 months
5 (toddler)	20	4	~18-24 months
6 (toddler)	22	5	~2 years
7 (toddler)	23-24	6	~2-3 years
8 (toddler)	25	7	~3 years
9 (little kid)	26	8	~3-4 years
10 (little kid)	27	9	~4-5 years
11 (little kid)	28	10	~5 years
12 (little kid)	30	11	~5-6 years
13 (little kid)	31	12	~6-7 years
1 (big kid, youth)	32	13	~7 years
2 (big kid)	33-34	1	~8-9 years
3 (big kid)	34-35	2	~9-10 years
4 (big kid)	36	3	~10-12 years (transition to adult)
5 (big kid)	37-38	4	Adult sizing begins for many

Sources: Brannock Device · EU sizes (Paris point) · UK sizes · Universal cm measure
unitcheatsheet.com/cheatsheets/shoe-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Paper size *chart*

A4 is 210 × 297 mm (8.27 × 11.69 in). **US Letter is 8.5 × 11 in** (216 × 279 mm). A4 is 6 mm narrower and 18 mm taller than Letter. A3 is 297 × 420 mm, twice the area of A4. US Legal is 8.5 × 14 in.

SIZE	DIMENSIONS (MM)	DIMENSIONS (INCH)	AREA
4A0	1682 × 2378 mm	66.22 × 93.62"	4.000 m²
2A0	1189 × 1682 mm	46.81 × 66.22"	2.000 m²
A0	841 × 1189 mm	33.11 × 46.81"	1.000 m²
A1	594 × 841 mm	23.39 × 33.11"	0.500 m²
A2	420 × 594 mm	16.54 × 23.39"	0.249 m²
A3	297 × 420 mm	11.69 × 16.54"	0.125 m²
A4	210 × 297 mm	8.27 × 11.69"	0.062 m²
A5	148 × 210 mm	5.83 × 8.27"	0.031 m²
A6	105 × 148 mm	4.13 × 5.83"	0.016 m²
A7	74 × 105 mm	2.91 × 4.13"	0.008 m²
A8	52 × 74 mm	2.05 × 2.91"	0.004 m²
A9	37 × 52 mm	1.46 × 2.05"	0.002 m²
A10	26 × 37 mm	1.02 × 1.46"	962 mm²

Sources: ISO 216 · ISO 269 · ANSI/ASME Y14.1 · Bleed conventions
unitcheatsheet.com/cheatsheets/paper-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Paper size *chart*
Notes and pitfalls

COMMON PITFALLS

- **A4 ≠ Letter.** A4 (210 × 297 mm) is narrower and taller than US Letter (216 × 279 mm). A document designed for one won't fit cleanly on the other. Use "scale to fit" carefully — text can become unreadably small or oversized.
- **Forgetting bleed crashes designs at the print shop.** If your background extends to the edge of the trim line (with no bleed), the trim tolerance shows as a white sliver. Always extend bleed by 3 mm minimum.
- **Safe area protects critical content.** Text or logos near the edge get clipped if the trim is off. Keep ≥ 3 mm (better: 5 mm) inside the trim for text.
- **"Letter size paper" varies by country.** In the US/Canada/Mexico, it's 8.5 × 11. In Latin America, "carta" is also 8.5 × 11. Most of the world: A4.
- **Envelope sizes don't follow paper sizes.** #10 (US business envelope) and DL (European business envelope) are different. C4 envelopes fit unfolded A4; DL envelopes fit A4 folded in thirds.

ISO 216 B SERIES

SIZE	DIMENSIONS (MM)	DIMENSIONS (INCH)
B0	1000 × 1414 mm	39.37 × 55.67"
B1	707 × 1000 mm	27.83 × 39.37"
B2	500 × 707 mm	19.69 × 27.83"
B3	353 × 500 mm	13.90 × 19.69"
B4	250 × 353 mm	9.84 × 13.90"
B5	176 × 250 mm	6.93 × 9.84"
B6	125 × 176 mm	4.92 × 6.93"
B7	88 × 125 mm	3.46 × 4.92"
B8	62 × 88 mm	2.44 × 3.46"

US / ANSI SERIES

SIZE	INCHES	MILLIMETERS
Letter / ANSI A	8.5 × 11"	216 × 279 mm
Legal	8.5 × 14"	216 × 356 mm
Tabloid / ANSI B	11 × 17"	279 × 432 mm
ANSI C	17 × 22"	432 × 559 mm
ANSI D	22 × 34"	559 × 864 mm
ANSI E	34 × 44"	864 × 1118 mm
Half Letter	5.5 × 8.5"	140 × 216 mm
Junior Legal	5 × 8"	127 × 203 mm
Government Letter	8 × 10.5"	203 × 267 mm

BLEED AND SAFE AREA FOR PRINT DESIGN

STANDARD	BLEED	SAFE AREA INSET	WHEN TO USE
Digital print (short run)	3 mm (1/8")	3 mm	Standard for digital business cards, flyers, brochures.
Offset print (commercial)	3 mm (1/8")	3-5 mm	Standard for commercial offset.
Large format / poster	5-10 mm	10 mm	Bigger sizes = more cutting tolerance needed.
Book covers / wrap	10-15 mm	5-10 mm from spine	Wrap and spine variations need bigger bleed.
Packaging / die-cut	3 mm	3-5 mm from die line	Die-cutting tolerance similar to trim.
US trade ("full bleed")	1/8" (3.175 mm)	1/8"	US shops often spec in inches; same idea.

Sources: ISO 216 · ISO 269 · ANSI/ASME Y14.1 · Bleed conventions
unitcheatsheet.com/cheatsheets/paper-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

AWG wire gauge *chart*

For copper building wire, use **14 AWG for a 15 A circuit**, **12 AWG for 20 A** and **10 AWG for 30 A**. These are the maximum breaker sizes in NEC 240.4(D). At 60 °C, 8 AWG carries 40 A and 6 AWG carries 55 A. A long run can need a larger wire to limit voltage drop.

AWG	DIAMETER, IN	DIAMETER, MM	AREA, MM²	AREA, KCMIL	RESISTANCE Ω / 1000 FT @ 20 °C	AMPACITY, 60 °C	AMPACITY, 75 °C	AMPACITY, 90 °C
4/0	0.46	11.68	107.2	211.6	0.04901	195	230	260
3/0	0.4096	10.4	85.03	167.8	0.0618	165	200	225
2/0	0.3648	9.266	67.43	133.1	0.07793	145	175	195
1/0	0.3249	8.251	53.48	105.5	0.09827	125	150	170
1	0.2893	7.348	42.41	83.69	0.1239	110	130	145
2	0.2576	6.544	33.63	66.37	0.1563	95	115	130
3	0.2294	5.827	26.67	52.63	0.197	85	100	115
4	0.2043	5.189	21.15	41.74	0.2485	70	85	95
5	0.1819	4.621	16.77	33.1	0.3133	—	—	—
6	0.162	4.115	13.3	26.25	0.3951	55	65	75
7	0.1443	3.665	10.55	20.82	0.4982	—	—	—
8	0.1285	3.264	8.366	16.51	0.6282	40	50	55
9	0.1144	2.906	6.634	13.09	0.7921	—	—	—
10	0.1019	2.588	5.261	10.38	0.9988	30	35	40
11	0.09074	2.305	4.172	8.234	1.26	—	—	—
12	0.08081	2.053	3.309	6.53	1.588	20	25	30
13	0.07196	1.828	2.624	5.178	2.003	—	—	—
14	0.06408	1.628	2.081	4.107	2.525	15	20	25
16	0.05082	1.291	1.309	2.583	4.015	—	—	—
18	0.0403	1.024	0.823	1.624	6.385	—	—	—
20	0.03196	0.8118	0.5176	1.022	10.15	—	—	—
22	0.02535	0.6438	0.3255	0.6424	16.14	—	—	—
24	0.0201	0.5106	0.2047	0.404	25.67	—	—	—
26	0.01594	0.4049	0.1288	0.2541	40.81	—	—	—

Sources: ASTM B258 · IEC 60228 · NFPA 70 · NFPA 70 (NEC)
unitcheatsheet.com/cheatsheets/awg-wire-gauge · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

AWG wire gauge *chart*
Notes and pitfalls

Ampacity notes. Values are for copper conductors, not more than three current-carrying conductors in a raceway, at 30 °C ambient. The temperature column refers to the conductor insulation rating (TW = 60 °C, THW/RHW = 75 °C, THHN/XHHW = 90 °C). Derating factors apply for higher ambient temperatures or more conductors — see NEC §310.15(B). **Aluminum is different;** reduce by roughly one column (e.g., 10 AWG Al ampacity ≈ 12 AWG Cu).

COMMON PITFALLS

- **Smaller number = bigger wire.** 4/0 AWG is huge; 30 AWG is hair-thin. This trips up everyone the first time.
- **AWG is not the same as metric gauge.** Some old British and Asian wires use SWG (Standard Wire Gauge) which uses similar numbers but slightly different diameters. Don't substitute without checking.
- **Stranded vs solid:** a 12 AWG stranded conductor has a slightly smaller copper area than 12 AWG solid (typically about 5% less). The published AWG number refers to the total conductor cross-section.
- **The ampacity column matters.** The same 12 AWG wire can carry 20 A (with TW insulation) or 30 A (with THHN). Reading the column is the difference between a working circuit and a fire.
- **Voltage drop, not ampacity, often governs long runs.** For runs over 50 ft, size up for voltage drop even if ampacity allows the smaller wire. See the sizing calculator.

COMMON APPLICATIONS

USE CASE	TYPICAL AWG	WHY
Lamp / fixture wiring	18, 16	Low current (under 10 A), flexibility matters
Doorbells, thermostats	18, 20	Class 2 signaling, very low current
15 A receptacles, lighting	14	Minimum for 15 A breaker per NEC
20 A kitchen / bath circuits	12	Minimum for 20 A breaker per NEC
Electric dryer (30 A)	10	30 A circuit @ 240 V
Electric range (40–50 A)	8, 6	Sized to breaker; 6 AWG common for 50 A
Subpanel feed (100 A)	3, 2	2 AWG Cu @ 75 °C insulation
Main service entrance (200 A)	2/0, 3/0	2/0 AWG Cu or 4/0 Al per NEC 310.12
USB cable (data)	28	USB 2.0 spec; thicker pairs (24) for power
Speaker wire (typical run)	16, 14	14 AWG for runs over 50 ft to keep loss low

Sources: ASTM B258 · IEC 60228 · NFPA 70 · NFPA 70 (NEC)
unitcheatsheet.com/cheatsheets/awg-wire-gauge · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Capacitor code *chart*

Three-digit codes, tolerance letters, microfarad/nanofarad/picofarad — every common capacitor marking decoded.

MARKING FORMAT	EXAMPLE	DECODED VALUE	WHERE YOU'LL SEE IT
Direct (with units)	100 µF, 0.1 µF, 4n7	Reads exactly as printed. '4n7' = 4.7 nF (European notation: position of unit letter is the decimal point).	Electrolytic, larger film, datasheet specs
3-digit code (pF)	104	10×10^4 pF = 100,000 pF = 100 nF = 0.1 µF	Ceramic disc, small film
3-digit code (pF)	473	47×10^3 pF = 47,000 pF = 47 nF = 0.047 µF	Ceramic disc
3-digit code (pF)	222	22×10^2 pF = 2,200 pF = 2.2 nF	Ceramic disc
3-digit + tolerance letter	104K	100 nF ±10%	Most common ceramic capacitor format
3-digit + tolerance letter	472J	4.7 nF ±5%	Tighter-tolerance ceramic
4-digit (precision pF)	1002	100×10^2 pF = 10,000 pF = 10 nF	Precision ceramic / NP0
4-digit (precision pF)	4992	499×10^2 pF = 49.9 nF	Precision tolerance class
µF marked directly	.1, .47, 1, 4.7, 10, 100, 470	Value in microfarads — usually electrolytic.	Electrolytic, large film
nF marked directly	100n, 220n	100 nF = 0.1 µF, 220 nF	European film capacitors
Voltage rating	100V, 25V, 6.3V	DC voltage rating (always shown alongside capacitance)	Critical for any application
Tolerance code letters	B = ±0.1 pF, F = ±1%, J = ±5%, K = ±10%, M = ±20%, Z = +80/−20%	—	Reading capacitor tolerance
Temp coefficient (ceramic)	NP0/C0G, X7R, Y5V	NP0 = best (low drift), X7R = mid, Y5V = worst (high drift but cheap)	All ceramic capacitors
Polarity (electrolytic)	Stripe on case, – terminal	Reversed polarity destroys electrolytic caps quickly	Always observe orientation

Sources: IEC 60062 · EIA-198 · EIA-RS-198

unitcheatsheet.com/cheatsheets/capacitor-markings · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Capacitor code *chart* Notes and pitfalls

How the 3-digit code works. First two digits = the significant figures, third digit = the multiplier (number of zeros). Result is always in **picofarads**. So '104' = 10 followed by 4 zeros = 100,000 pF = 100 nF = 0.1 µF. The 'KP' or 'K' suffix is the tolerance (±10%).

COMMON PITFALLS

- **'µ' and 'u' mean the same thing.** µF (microfarad) is often written as uF in ASCII-only contexts. Both equal 10^{-6} farads.
- **nF is rarely printed on US caps.** US capacitor catalogs traditionally use only pF (small) and µF (large). 100 nF is often listed as 0.1 µF or 100000 pF, but rarely as 100 nF. European catalogs use nF freely.
- **The 4 in '4n7' is the integer and 7 is the decimal — the letter is the decimal point.** So '4n7' = 4.7 nF. Common in European electronics. Similarly '2u2' = 2.2 µF, 'R47' = 0.47 Ω (for resistors, same convention).
- **Electrolytic capacitors have polarity.** Connecting them backwards causes them to fail violently (vented top, sometimes explosion). The stripe on the case marks the negative terminal. Non-polar 'NP' electrolytics exist for AC circuits.
- **Capacitance drifts with temperature, voltage, age.** Y5V ceramic loses 60-80% of capacitance at the edges of its temperature range. NP0/C0G is stable within 0.5%. Always check the dielectric type for precision work.
- **'105' is not 105 pF.** It's 10 × 10^5 pF = 1 µF. The third digit is a multiplier, not part of the number. This trips up beginners constantly.

COMMON APPLICATIONS

APPLICATION	TYPICAL CAPACITANCE	TYPE
Bypass cap on IC power pin	100 nF (0.1 µF)	Ceramic X7R
Power supply bulk filter	100-4700 µF	Aluminum electrolytic
Audio coupling (DC blocking)	1-10 µF	Film or electrolytic (non-polar preferred)
RC low-pass filter	1 nF to 1 µF	Film or ceramic (depending on frequency)
Crystal oscillator load	10-30 pF	NP0/C0G ceramic
Snubber across switch	10-100 nF	Film (X1/Y1 safety rated for mains)
Motor start (single phase)	30-200 µF	Polypropylene film, motor-run rated
Switched-mode supply output	100-1000 µF	Low-ESR aluminum or polymer
RF tuning	5-100 pF	Variable or NP0 ceramic

Sources: IEC 60062 · EIA-198 · EIA-RS-198
unitcheatsheet.com/cheatsheets/capacitor-markings · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Resistor color code *chart*

Hold the resistor with the gold or silver band on the right. On a 4-band resistor, bands 1 and 2 are digits, band 3 is the multiplier and band 4 is the tolerance. Example: **brown-black-red-gold = 1, 0, ×100, ±5% = 1,000 Ω (1 kΩ) ±5%.**

COLOR	DIGIT	MULTIPLIER	TOLERANCE	TEMP COEF
Black	0	×1	—	—
Brown	1	×10	±1.0%	100 ppm/°C
Red	2	×100	±2.0%	50 ppm/°C
Orange	3	×1K	—	15 ppm/°C
Yellow	4	×10K	—	25 ppm/°C
Green	5	×100K	±0.5%	—
Blue	6	×1M	±0.25%	10 ppm/°C
Violet	7	×10M	±0.1%	5 ppm/°C
Grey	8	×100M	±0.05%	—
White	9	×1G	—	—
Gold	—	×0.1	±5.0%	—
Silver	—	×0.01	±10.0%	—
None	—	—	±20.0%	—

Sources: IEC 60062 · IEC 60063

unitcheatsheet.com/cheatsheets/resistor-color-codes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Resistor color code *chart* Notes and pitfalls

Reading direction. Resistors don't have an arrow saying "this end first." Conventions: the tolerance band is usually *wider*, *set apart* from the others by a gap, or in a less common color (gold/silver/brown). If you can't tell which end, use a multimeter to confirm — color-blind eyes and faded resistors are why ohmmeters exist.

COMMON PITFALLS

- **Brown and red are easy to confuse** on small surface-mount or old through-hole parts, and the resulting resistance can be 10× off. When in doubt, measure.
- **Orange and yellow** can blur on heat-discolored parts. Again — measure.
- **The "preferred values" sequence** (E12 series for 5%, E24 for some, E96 for 1%) means not every theoretical value exists as a real part. 1 kΩ exists; 1.034 kΩ doesn't.
- **SMD resistors don't use color codes.** They use 3-digit (e.g. "103" = 10 × 10^3 = 10 kΩ), 4-digit (precision), or EIA-96 (a 3-character coded scheme). Different cheat sheet.

Sources: IEC 60062 · IEC 60063
unitcheatsheet.com/cheatsheets/resistor-color-codes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

SMD resistor code *chart*

A 3-digit SMD code is two digits and a multiplier: **103 = 10 × 10³ = 10 kΩ** and **472 = 4.7 kΩ**. A 4-digit code uses three digits: **1002 = 10 kΩ**. EIA-96 codes use two digits and a letter: **01C = 10 kΩ**. The letter R marks the decimal point: 4R7 = 4.7 Ω.

SYSTEM	FORMAT	DECODING	TYPICAL TOLERANCE	EXAMPLE
3-digit	ABC	AB × 10^{C} Ω	±5% (E24 series)	472 = 47 × 10² = 4.7 kΩ
4-digit	ABCD	ABC × 10^{D} Ω	±1% (E96 series)	4992 = 499 × 10² = 49.9 kΩ
EIA-96	NNX	(base from table for NN) × (multiplier from table for X)	±1% (E96 series)	01C = 100 × 100 = 10 kΩ
"R" notation	e.g. 4R7, R47, 0R10	R = decimal point	varies (read marking direction carefully)	4R7 = 4.7 Ω; R47 = 0.47 Ω; 0R10 = 0.10 Ω
Zero-ohm jumper	0, 00, 000, 0000	Not a resistor — a wire bridge	—	Used to route traces without a via

Sources: IEC 60062 · EIA-RS-279 · IEC 60063
unitcheatsheet.com/cheatsheets/smd-resistor-codes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

SMD resistor code *chart*
Notes and pitfalls

Quick rule of thumb: count digits and check for letters. Three numbers = general purpose (5%); four numbers = precision (1%); two numbers + letter = EIA-96 (1%, compact).

Watch out: `100` means 10 Ω (10×10^0), *not* 100 Ω. The trailing zero is the multiplier, not the third significant digit.

In practice, **A, B, C, X** cover 99% of what you'll see. The duplicates (Y/R, X/S, B/H) come from harmonizing different national standards.

COMMON PITFALLS

- **`100` ≠ 100 Ω.** In the 3-digit system, `100` is 10×10^0 = **10 Ω**. The 3rd digit is the multiplier. For 100 Ω, the marking is `101`.
- **3-digit and 4-digit codes look similar.** A part marked `1001` on an 0805 (4-digit, 1 kΩ) and `101` on an 0603 (3-digit, 100 Ω) can be confused if you don't count digits. When in doubt, measure.
- **Underlined codes are precision E24 in some manufacturer schemes.** A 122 (underlined middle digit) or a single underbar may mean precision (1% or better) at an E24 value not normally in the precision series. Convention varies by maker.
- **Zero-ohm jumper markings vary.** Single `0`, `00`, `000`, or `0000` all indicate a wire bridge, not a 0 Ω calculation. Don't try to decode them.
- **Tolerance and tempco aren't on the marking.** The code gives resistance only. For 1%, 0.1%, 0.01% variants or for low-tempco precision parts, you need the manufacturer's reel label or BOM.
- **Power rating is in the package, not the code.** An 0603 part marked `103` (10 kΩ) is rated about 0.1 W; a 1206 with the same `103` marking is rated 0.25 W. Same value, very different power handling.
- **0402 and smaller usually have no marking.** Below 0603 there's typically no room to print legible characters. The only way to identify the part is from the assembly BOM, the reel label, or a multimeter.
- **"R" on a non-EIA-96 code means decimal point.** 4R7 = 4.7 Ω, R47 = 0.47 Ω. In EIA-96, R is also one of the multiplier letters (×0.01) — context determines which. If the code is exactly 3 characters with two digits and one letter at the end, it's EIA-96; otherwise R is a decimal point.

READING 3-DIGIT CODES

MARKING	CALCULATION	VALUE
100	10×10^0	10 Ω
220	22×10^0	22 Ω
470	47×10^0	47 Ω
101	10×10^1	100 Ω
221	22×10^1	220 Ω
472	47×10^2	4.7 kΩ
103	10×10^3	10 kΩ
104	10×10^4	100 kΩ
105	10×10^5	1 MΩ
106	10×10^6	10 MΩ

READING 4-DIGIT CODES (PRECISION)

MARKING	CALCULATION	VALUE
1000	100×10^0	100 Ω
4700	470×10^0	470 Ω
1001	100×10^1	1 kΩ
4991	499×10^1	4.99 kΩ
1002	100×10^2	10 kΩ
4992	499×10^2	49.9 kΩ
1003	100×10^3	100 kΩ
1004	100×10^4	1 MΩ

EIA-96 MULTIPLIER LETTERS

LETTER	MULTIPLIER	LETTER	MULTIPLIER
Z	×0.001	**D**	×1000
Y or R	×0.01	**E**	×10000
X or S	×0.1	**F**	×100000
A	×1	—	—
B or H	×10	—	—
C	×100	—	—

WORKED EIA-96 EXAMPLES

MARKING	BASE (FROM TABLE)	MULTIPLIER (FROM LETTER)	VALUE
01A	01 → 100	A → ×1	100 Ω
01B	01 → 100	B → ×10	1 kΩ
01C	01 → 100	C → ×100	10 kΩ
29B	29 → 196	B → ×10	1.96 kΩ
38C	38 → 243	C → ×100	24.3 kΩ
39D	39 → 249	D → ×1000	249 kΩ
68X	68 → 499	X → ×0.1	49.9 Ω

Sources: IEC 60062 · EIA-RS-279 · IEC 60063
unitcheatsheet.com/cheatsheets/smd-resistor-codes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

SMD resistor code *chart*

Notes and pitfalls, continued

QUICK REFERENCE: COMMON VALUES

RESISTANCE	3-DIGIT (5%)	4-DIGIT (1%)	EIA-96 (1%)
10 Ω	100	10R0	01X
100 Ω	101	1000	01A
220 Ω	221	2200	34A
330 Ω	331	3300	51A
470 Ω	471	4700	66A
1 kΩ	102	1001	01B
2.2 kΩ	222	2201	34B
4.7 kΩ	472	4701	66B
10 kΩ	103	1002	01C
22 kΩ	223	2202	34C
47 kΩ	473	4702	66C
100 kΩ	104	1003	01D
1 MΩ	105	1004	01E

PACKAGE SIZES AND WHAT YOU'LL SEE ON EACH

PACKAGE (IMPERIAL)	SIZE (MM)	POWER (W)	TYPICAL MARKING
2512	6.4 × 3.2	1	3 or 4 digit
2010	5.0 × 2.5	0.75	3 or 4 digit
1206	3.2 × 1.6	0.25	3 or 4 digit
0805	2.0 × 1.25	0.125	3 or 4 digit
0603	1.6 × 0.8	0.1	3 digit or EIA-96
0402	1.0 × 0.5	0.063	Often unmarked or EIA-96
0201	0.6 × 0.3	0.05	Unmarked — refer to BOM
01005	0.4 × 0.2	0.031	Unmarked — refer to BOM

Sources: IEC 60062 · EIA-RS-279 · IEC 60063
unitcheatsheet.com/cheatsheets/smd-resistor-codes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Cooking conversion *chart*

Cups ↔ mL, oven temperatures across Fahrenheit, Celsius, and gas marks, and ingredient density (grams per cup) for accurate baking.

MEASURE	US CUSTOMARY	METRIC
1 teaspoon (tsp)	`1 tsp = 1/3 tbsp`	≈ 4.93 mL (round to 5 mL)
1 tablespoon (tbsp)	`1 tbsp = 3 tsp = 1/16 cup`	≈ 14.79 mL (round to 15 mL)
1 fluid ounce (fl oz)	`1 fl oz = 2 tbsp = 1/8 cup`	≈ 29.57 mL (round to 30 mL)
1/4 cup	`1/4 cup = 4 tbsp = 2 fl oz`	≈ 59.15 mL (round to 60 mL)
1/3 cup	`1/3 cup = 5 tbsp + 1 tsp`	≈ 78.86 mL (round to 80 mL)
1/2 cup	`1/2 cup = 8 tbsp = 4 fl oz`	≈ 118.29 mL (round to 120 mL)
2/3 cup	`2/3 cup = 10 tbsp + 2 tsp`	≈ 157.73 mL (round to 160 mL)
3/4 cup	`3/4 cup = 12 tbsp = 6 fl oz`	≈ 177.44 mL (round to 180 mL)
1 cup	`1 cup = 16 tbsp = 8 fl oz`	≈ 236.59 mL (round to 240 mL)
1 pint (US)	`1 pt = 2 cups = 16 fl oz`	≈ 473.18 mL
1 quart (US)	`1 qt = 2 pt = 4 cups`	≈ 946.35 mL
1 gallon (US)	`1 gal = 4 qt = 16 cups`	≈ 3.785 L

Sources: 21 CFR 101.9 · US customary cup · Metric cup (AU/NZ) · Oven conversions
unitcheatsheet.com/cheatsheets/cooking-conversions · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Cooking conversion *chart*
Notes and pitfalls

About 'cups' globally. The US nutrition-labeling cup is 240 mL (21 CFR 101.9); the US customary cup is 236.59 mL; the metric cup (Australia/NZ) is 250 mL; the imperial cup (UK, historical) is 284 mL. Most US recipes use the customary 236.59 mL, but rounding to 240 mL is fine for almost everything — except very precise baking.

COMMON PITFALLS

- **Fan / convection ovens run ~20 °C (35 °F) hotter than conventional ovens.** A recipe calling for 180 °C conventional means about 160 °C fan-assisted. Always check whether the recipe specifies which.
- **Volume measures vary by ingredient density.** 1 cup of flour is ~120 g; 1 cup of sugar is ~200 g; 1 cup of brown sugar (packed) is ~220 g; 1 cup of butter is ~227 g. Baking by weight (grams) is always more accurate than by volume.
- **UK and US measurements differ.** A UK pint is 568 mL; a US pint is 473 mL — a 20% difference. UK 'fl oz' = 28.4 mL; US 'fl oz' = 29.6 mL. Recipes from the UK won't scale cleanly to US measures.
- **Liquid vs dry measuring cups matter for baking.** Liquid cups have a spout and measure to the line. Dry cups are flat-topped and meant to be leveled. Using one for the other shifts the actual quantity by 5-10%.
- **Old recipes use unfamiliar units.** A 'dram' is 1/8 fl oz; a 'gill' is 1/2 cup; a 'jigger' is 1.5 fl oz (cocktail measure). When in doubt, use volume in mL.

Sources: 21 CFR 101.9 · US customary cup · Metric cup (AU/NZ) · Oven conversions
unitcheatsheet.com/cheatsheets/cooking-conversions · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Cooking conversion *chart*

Notes and pitfalls, continued

COMMON APPLICATIONS

OVEN TEMPERATURE (F)	USUAL OVEN SETTING (°C)	GAS MARK (UK)	DESCRIPTION
225 °F	110 °C	Gas mark 1/4	Very slow (drying, slow cooking)
250 °F	120 °C	Gas mark 1/2	Very slow
275 °F	140 °C	Gas mark 1	Slow / low
300 °F	150 °C	Gas mark 2	Slow
325 °F	160 °C	Gas mark 3	Moderately slow
350 °F	180 °C	Gas mark 4	Moderate (standard baking)
375 °F	190 °C	Gas mark 5	Moderately hot
400 °F	200 °C	Gas mark 6	Hot
425 °F	220 °C	Gas mark 7	Hot (roasting)
450 °F	230 °C	Gas mark 8	Very hot
475 °F	250 °C	Gas mark 9	Very hot (pizza, breads)
500 °F	260 °C	Gas mark 10	Very hot (high-temp pizza)
550 °F	290 °C	Beyond gas	Broiler / pizza-stone temperatures

Sources: 21 CFR 101.9 · US customary cup · Metric cup (AU/NZ) · Oven conversions
unitcheatsheet.com/cheatsheets/cooking-conversions · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

HVAC duct size *chart*

CFM capacity vs round duct diameter, friction loss reference, and round-to-rectangular equivalent sizing.

ROUND DUCT, IN (MM)	TYPICAL CFM (L/S) AT 0.08" WC/100 FT (0.65 PA/M)	EQUIVALENT RECTANGULAR, IN (MM)	NOTES
4" (102 mm)	~50 CFM (~24 L/s)	6 × 3 (152 × 76 mm)	Bath fan branch
5" (127 mm)	~85 CFM (~40 L/s)	6 × 4 (152 × 102 mm)	Small return / bath fan
6" (152 mm)	~110 CFM (~52 L/s)	8 × 4 (203 × 102 mm)	Standard supply branch to one room
7" (178 mm)	~170 CFM (~80 L/s)	10 × 4 (254 × 102 mm)	Larger supply branch
8" (203 mm)	~240 CFM (~110 L/s)	10 × 5 (254 × 127 mm)	Trunk to multiple branches
9" (229 mm)	~340 CFM (~160 L/s)	12 × 6 (305 × 152 mm)	Small main trunk
10" (254 mm)	~450 CFM (~210 L/s)	14 × 6 (356 × 152 mm)	Main trunk (small home)
12" (305 mm)	~720 CFM (~340 L/s)	16 × 8 (406 × 203 mm)	Main trunk (medium home)
14" (356 mm)	~1050 CFM (~500 L/s)	18 × 10 (457 × 254 mm)	Main trunk (larger home)
16" (406 mm)	~1450 CFM (~680 L/s)	20 × 12 (508 × 305 mm)	Light-commercial main
18" (457 mm)	~1950 CFM (~920 L/s)	24 × 12 (610 × 305 mm)	Light-commercial main
20" (508 mm)	~2520 CFM (~1200 L/s)	26 × 14 (660 × 356 mm)	Commercial main
24" (610 mm)	~4000 CFM (~1900 L/s)	30 × 18 (762 × 457 mm)	Commercial main

Sources: ACCA Manual D · ACCA Manual J · ASHRAE Fundamentals Handbook · ASHRAE
unitcheatsheet.com/cheatsheets/hvac-duct-sizing · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

HVAC duct size *chart*
Notes and pitfalls

Millimetres and litres per second are conversions (1 in = 25.4 mm, 1 CFM = 0.4719 L/s), rounded to whole numbers below 100 L/s and 2 significant figures above. Metric round duct comes in its own nominal sizes, so use the nearest size your supplier lists.

About these numbers. CFM values are at **0.08 inches water column friction per 100 feet** and approximately **700-1000 ft/min velocity** — the standard residential design point. Higher CFM in the same duct = higher velocity = more friction = more noise. Always design to the actual layout.

COMMON PITFALLS

- **1 ton of AC ≠ 1 ton of refrigerant.** A ton of cooling capacity = 12,000 BTU/h = the heat needed to melt 1 short ton of ice in 24 hours. Has nothing to do with refrigerant mass or duct weight. AC equipment is sized in tons.
- **Round ducts are more efficient than rectangular.** A round duct has less surface area (and friction) per unit of CFM than a rectangular equivalent. Always specify round when there's space. Rectangular is used when the available height is constrained.
- **Flexible duct adds 50% to friction.** A 6" rigid duct flows ~110 CFM; a 6" flex duct flows ~70-80 CFM at the same friction loss. Stretched flex performs much better than compressed or sagging flex.
- **Duct sizing affects equipment sizing.** An undersized duct system can't deliver the airflow the equipment is designed for, leading to overheating, short cycling, and reduced efficiency. The duct system and the equipment must match.
- **Static pressure budget matters more than CFM alone.** A typical residential system has ~0.5" wc total external static pressure available. The supply trunk, return, filter, and coil all eat into that. Sizing the trunk for 0.08" per 100 ft is the common rule, but real layouts often need bigger ducts to meet the pressure budget.
- **Long return ducts are often undersized.** Returns typically need to be larger than supplies because they handle the full system flow at lower available pressure. A 14" supply trunk often needs a 16" or 18" return.

COMMON APPLICATIONS

APPLICATION	TYPICAL CFM (L/S)	WHY
Bathroom exhaust fan	50-110 CFM (24-52 L/s)	Code minimum 50 CFM (intermittent) or 20 CFM (continuous, per ASHRAE 62.2)
Kitchen range hood (over electric)	100-300 CFM (47-140 L/s)	Higher for gas or high-output ranges
Kitchen range hood (commercial / pro)	600-1200 CFM (280-570 L/s)	Make-up air may be required by code above 400 CFM
Whole-house ventilation (ASHRAE 62.2)	30-100 CFM (14-47 L/s)	Continuous, based on floor area and bedroom count
Room supply (single bedroom)	60-100 CFM (28-47 L/s)	Heating-dominated climate; ~1 CFM per ft² of floor area
Room supply (large living area)	200-400 CFM (94-190 L/s)	Open floor plan; ~1.5 CFM per ft²
Total house airflow (typical)	350-1200 CFM (170-570 L/s)	1-3 ton residential system
1 ton air conditioning	400 CFM nominal (190 L/s)	Rule of thumb: 400 CFM per ton (12,000 BTU/h cooling)
2 ton AC	800 CFM (380 L/s)	Larger residential
3 ton AC	1200 CFM (570 L/s)	Average residential
5 ton AC (max residential)	2000 CFM (940 L/s)	Larger homes; above this typically commercial

Sources: ACCA Manual D · ACCA Manual J · ASHRAE Fundamentals Handbook · ASHRAE
unitcheatsheet.com/cheatsheets/hvac-duct-sizing · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Thermocouple types *chart*

Compare J, K, T, E, N, R, S, B thermocouple types — temperature ranges, accuracy, sensitivity, and color codes (US/ANSI and IEC/international).

TYPE	MATERIALS (+ / −)	RANGE, °C (°F)	TOLERANCE	SENSITIVITY	NOTES
J	Iron / Constantan	−210 to 760 °C (−346 to 1400 °F)	±2.2 °C (±4.0 °F) or ±0.75%	~52 µV/°C (~29 µV/°F)	Sensitive, low-cost. **Iron oxidizes** — limited above 540 °C in oxidizing atmospheres.
K	Chromel (NiCr) / Alumel (NiAl)	−270 to 1372 °C (−454 to 2502 °F)	±2.2 °C (±4.0 °F) or ±0.75%	~41 µV/°C (~23 µV/°F)	**Most common**. Wide range, oxidation-resistant. The default 'general-purpose' thermocouple.
T	Copper / Constantan	−270 to 400 °C (−454 to 752 °F)	±1.0 °C (±1.8 °F) or ±0.75%	~43 µV/°C (~24 µV/°F)	**Best for cryogenic and low temperatures**. Stable, accurate, good in moist environments. Limited to 400 °C.
E	Chromel / Constantan	−270 to 1000 °C (−454 to 1832 °F)	±1.7 °C (±3.1 °F) or ±0.5%	~68 µV/°C (~38 µV/°F)	**Highest sensitivity** of base-metal thermocouples. Good for low-temperature precision work.
N	Nicrosil / Nisil	−270 to 1300 °C (−454 to 2372 °F)	±2.2 °C (±4.0 °F) or ±0.75%	~36 µV/°C (~20 µV/°F)	Modern alternative to Type K. **More stable at high temperatures**, slower drift, more expensive.
R	Pt-13% Rh / Pt	−50 to 1768 °C (−58 to 3214 °F)	±1.5 °C (±2.7 °F) or ±0.25%	~10 µV/°C (~6 µV/°F)	**Platinum-based, very accurate**. Used in calibration labs, industrial high-temp. Expensive.
S	Pt-10% Rh / Pt	−50 to 1768 °C (−58 to 3214 °F)	±1.5 °C (±2.7 °F) or ±0.25%	~10 µV/°C (~6 µV/°F)	Similar to R, slightly less rhodium. **Used as international temperature standard** (ITS-90).
B	Pt-30% Rh / Pt-6% Rh	0 to 1820 °C (32 to 3308 °F)	±0.5% (above 800 °C / 1472 °F)	~8 µV/°C (~4 µV/°F)	**Highest temperature range**. Insensitive below 50 °C. Used in glass and

Sources: ASTM E230 · IEC 60584-1 · ANSI MC96.1 · IEC 60584-3 · ITS-90

unitcheatsheet.com/cheatsheets/thermocouple-types · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Thermocouple types *chart* Notes and pitfalls

°F values are converted from °C (°F = °C × 9/5 + 32; a tolerance or a per-degree value uses the factor 1.8 only) and rounded.

How thermocouples work. Two dissimilar metals joined at one end generate a small voltage (EMF) proportional to the temperature difference between the joined ('hot') end and the open ('cold' or reference) end. The voltage is on the order of microvolts per degree — typical 41 µV/°C for Type K. Modern instruments handle the cold-junction reference internally.

COMMON PITFALLS

- **Yellow + Red = Type K in US, but Type K in IEC is Green + White.** The two color-code systems are mutually incompatible. Confirm which standard your country / supplier uses.
- **The magnetic-side trick for Type K.** Type K negative leg (Alumel) is magnetic; the positive leg (Chromel) is not. A small magnet near the lead distinguishes them — useful when colors are faded or ambiguous.
- **Cold-junction compensation matters.** A thermocouple only measures the *difference* between hot and cold ends. The cold (reference) junction must be at a known temperature, or compensated electronically. Modern DAQ systems do this automatically.
- **Thermocouple wire ≠ thermocouple extension wire.** 'Thermocouple-grade' wire is more accurate but expensive. 'Extension-grade' is cheaper and used between the thermocouple head and the measurement instrument — but it's only valid in a limited temperature range.
- **Drift at high temperatures.** Type K loses accuracy after long-term exposure above 1000 °C — the chromel leg can become 'green rot' from sulfur contamination, shifting calibration by several °C. Type N is more drift-resistant.
- **Insulation matters for the rated range.** A Type K rated 'to 1260 °C' may have PVC insulation rated only to 105 °C. The thermocouple itself can survive higher than its insulation. Use mineral-insulated or ceramic-insulated probes for high temperatures.

COMMON APPLICATIONS

APPLICATION	RECOMMENDED TYPE	WHY
Industrial process (general)	K	Wide range, low cost, universally available.
Cryogenic / liquid nitrogen	T	Accurate at very low temperatures; copper leg resists corrosion.
Food / pharmaceutical (low-temp)	T	Good in moist environments, FDA-acceptable copper leg.
High-temperature furnaces	R, S, B	Platinum-based for high-temp stability; B for above 1500 °C.
Engine exhaust temperature	K	Common in automotive; durable up to 1100 °C peak.
Calibration lab reference	S	International temperature standard (ITS-90).
Cement / kiln / glass furnace	B	Stable above 1500 °C where K/N degrade.
Laboratory low-noise work	E	Highest sensitivity = best signal-to-noise at low temps.
Long-term oxidizing environments	N	More stable than K above 1200 °C.

Sources: ASTM E230 · IEC 60584-1 · ANSI MC96.1 · IEC 60584-3 · ITS-90
unitcheatsheet.com/cheatsheets/thermocouple-types · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

ASTM steel grades *chart*

Common ASTM steel grades — yield strength, tensile strength, and typical applications.

DESIGNATION	TYPE	YIELD, KSI (≈ MPA)	TENSILE, KSI (≈ MPA)	TYPICAL USE
A36	Carbon structural	36 (≈248 MPa)	58-80 (≈400–552 MPa)	General construction — beams, plate, angle iron. Most common low-strength structural steel.
A572 Gr 50	HSLA structural	50 (≈345 MPa)	65 min (≈448 MPa min)	Bridges, buildings — higher strength than A36 at similar cost.
A992	Wide-flange beams	50-65 (≈345–448 MPa)	65 min (≈448 MPa min)	W-shape structural beams (replaced A36/A572 for W-shapes since 1998).
A500 Gr B	HSS structural tube	46 (rect.) / 42 (round) — ≈317 (rect.) / 290 (round) MPa	58 min (≈400 MPa min)	Square / rectangular structural tubing. Common in modern construction.
A572 Gr 65	HSLA high-strength	65 (≈448 MPa)	80 min (≈552 MPa min)	High-strength bridges, heavy industrial.
A1011 / A1018	Carbon sheet/plate	30-50 (≈207–345 MPa)	49-65 (≈338–448 MPa)	Commercial-quality steel sheet — cold or hot rolled.
A283 Gr C	Low-carbon plate	30 (≈207 MPa)	55-75 (≈379–517 MPa)	Storage tanks, general structural plate.
A53 Gr B	Pipe (structural + flow)	35 (≈241 MPa)	60 min (≈414 MPa min)	Standard pipe — Type E (electric welded), Type F (furnace butt-welded).
A106 Gr B	Seamless pipe (high temp)	35 (≈241 MPa)	60 min (≈414 MPa min)	Pressure / high-temperature steam service.
A516 Gr 70	Pressure vessel plate	38 (≈262 MPa)	70 min (≈483 MPa min)	Boilers, pressure vessels — moderate / low temperature.
A537 Cl 1	Pressure vessel (Q&T)	50 (≈345 MPa)	70-90 (≈483–621 MPa)	Higher-strength pressure vessels, quenched and tempered.
1018	Low carbon (cold rolled)	54 (≈372 MPa)	64 (≈441 MPa)	Machine shafts, general purpose, weldable. Easy to machine.
1045	Medium carbon	45-60 (≈310–414 MPa)	82-91 (≈565–627 MPa)	Higher-strength shafts, axles. Flame / induction hardenable.
1144	Free-machining stressproof	100 (≈689 MPa)	115 (≈793 MPa)	Resulfurized, prehardened. Better machinability than 1045.
4140	Alloy (Cr-Mo)	60-200 (≈414–1379 MPa)	90-220 (≈621–1517 MPa)	Heat-treatable. Shafts, gears, high-strength fasteners. Hardenable to 50+ HRC.
4340	Alloy (Ni-Cr-Mo)	60-220 (≈414–1517 MPa)	100-260 (≈689–1793 MPa)	Aircraft, high-strength shafts. Superior toughness vs 4140.
8620	Low-alloy carburizing	40-90 (≈276–621 MPa)	55-180 (≈379–1241 MPa)	Gears, camshafts. Surface-hardened by carburizing.
304 / 304L	Austenitic stainless	30 (≈207 MPa)	75 (≈517 MPa)	Food, chemical, kitchen. Non-magnetic, weldable. The default stainless.
316 / 316L	Austenitic stainless (Mo)	30 (≈207 MPa)	75 (≈517 MPa)	Marine, chemical. Better corrosion (chloride) resistance than 304.
17-4 PH	Precipitation-hardened	170 (≈1172 MPa)	190 (≈1310 MPa)	Aerospace shafts, valves. Heat-treatable to high strength.
410	Martensitic stainless	35-85 (≈241–586 MPa)	70-110 (≈483–758 MPa)	Hardenable. Valve stems, fasteners, cutlery.
416	Martensitic (free-machining)	40-85 (≈276–586 MPa)	75-110 (≈517–758 MPa)	Free-machining version of 410. Valve parts.
A588 (Cor-Ten)	Weathering steel	50 (≈345 MPa)	70 (≈483 MPa)	Forms a protective rust patina — used in bridges, architecture.
A572 Gr 60	HSLA	60 (≈414 MPa)	75 min (≈517 MPa min)	Bridges (between Gr 50 and Gr 65 use cases).

Sources: AISC Steel Construction Manual · ASTM A6 · ASTM A53 · ASTM A516 · ASME BPVC · AISI
unitcheatsheet.com/cheatsheets/astm-steel-grades · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

ASTM steel grades *chart*
Notes and pitfalls

MPa values are converted from the ksi values (1 ksi = 6.894757 MPa) and rounded to the nearest whole MPa. The metric (M) editions of the ASTM standards state their own rounded SI values, which can differ by a few MPa. Use the standard's own figure for specification work.

About these designations. ASTM (American Society for Testing and Materials) designations begin with 'A' for ferrous metals; the number is the standard number, not a property. Yield and tensile values shown are *minimum* spec — actual material typically tests 10-20% higher. For heat-treatable alloys (4140, 4340, etc.), the strength range reflects different heat-treat conditions.

COMMON PITFALLS

- **'Steel' alone is ambiguous.** A36 and 4340 are both 'steel' but differ by 5× in strength. Always specify a grade.
- **Stainless isn't immune to corrosion.** 304 corrodes in saltwater; 316 is better but still pits eventually. For severe chloride or acid environments, use duplex, super duplex, or specialized alloys.
- **Yield ≠ working strength.** Allowable stress for structural design is typically 60-66% of yield (ASD method) — never the full yield value. Code-mandated safety factors apply.
- **Hardness ≠ strength directly.** A 50 HRC tool steel can be very strong AND very brittle. Working strength requires both strength AND toughness. Quenched-and-tempered 4140 at 30 HRC may be more useful than untempered 4140 at 60 HRC for many applications.
- **Welding considerations vary widely.** A36 welds easily with no preheat. 4140 needs preheat and post-weld stress relief to avoid cracking. High-strength steels (above ~80 ksi yield) often have welding restrictions.
- **Tensile vs yield: don't confuse.** Yield is where the steel permanently deforms. Tensile is where it breaks. The ratio (yield/tensile) tells you ductility — higher ratios mean more brittle. 4340 quenched and tempered has yield close to tensile; A36 has wide gap (high ductility).

COMMON APPLICATIONS

APPLICATION	RECOMMENDED GRADE	REASON
Residential beams, columns	A36 or A992	Cheap, weldable, code-accepted
Commercial steel framing	A992 (W-shapes), A500 (HSS)	Modern standards
Bridges	A572 Gr 50, A588	Higher strength + weatherproof
Pressure vessels (moderate T)	A516 Gr 70	Standard ASME pressure vessel grade
Hydraulic cylinder shaft	1045 or 4140 (hardened)	Wear resistance, strength
Bolts (Grade 5 equivalent)	Medium carbon, SAE J429	SAE 4140 for high-grade variants
Gear teeth	8620 (carburized) or 4140	Surface hardness + tough core
Marine hardware	316 stainless	Chloride corrosion resistance
Food / kitchen contact	304 stainless	Easy to clean, non-reactive
Architectural exposed	A588 (Cor-Ten) or 316 stainless	Weather resistance
Machine shop general stock	1018	Easy to machine, weld; cheap

Sources: AISC Steel Construction Manual · ASTM A6 · ASTM A53 · ASTM A516 · ASME BPVC · AISI
unitcheatsheet.com/cheatsheets/astm-steel-grades · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Plastic resin codes *chart*

The seven recycling codes plus common engineering plastics — chemical name, typical uses, temperature range, and recycling implications.

CODE	RESIN	COMMON USES	MAX TEMP	NOTES
1 — PET / PETE	Polyethylene terephthalate	Water bottles, soda bottles, food packaging, polyester fiber	60 °C (140 °F)	**Recyclable.** Most common single-use bottle. Don't reuse — leaches at warm temps.
2 — HDPE	High-density polyethylene	Milk jugs, detergent bottles, pipes, plastic bags, lumber	120 °C (248 °F)	**Recyclable.** Stiffer than LDPE. Resistant to most chemicals.
3 — PVC / V	Polyvinyl chloride	Pipes (rigid), wire insulation, flooring, medical tubing	60-80 °C (140-176 °F)	**Hard to recycle.** Contains chlorine — releases toxic fumes when burned.
4 — LDPE	Low-density polyethylene	Plastic bags, squeeze bottles, film, food wrap	80 °C (176 °F)	Sometimes recyclable. Softer, flexible. Food-safe.
5 — PP	Polypropylene	Yogurt containers, bottle caps, automotive parts, fibers	120 °C (248 °F)	**Microwave-safe.** Generally regarded as safe; better recyclability than 3 or 6.
6 — PS	Polystyrene	Disposable cups, foam packaging, CD cases, plastic cutlery	70-90 °C (158-194 °F)	**Hard to recycle.** Brittle. Styrofoam is expanded PS — banned in some cities.
7 — Other / O	Mixed / specialty (PC, ABS, nylon, etc.)	Multi-resin laminates, BPA-containing plastics, specialty parts	Varies widely	Usually NOT recyclable curbside. Includes engineering plastics.
ABS	Acrylonitrile butadiene styrene	LEGO, automotive trim, 3D printing, electronic housings	80 °C (176 °F)	Tough, machinable. The default 3D printing filament alongside PLA.
PC	Polycarbonate	Eyeglass lenses, safety shields, CD/DVD discs, baby bottles (old)	120 °C (248 °F)	Strong, transparent. **BPA controversy** — many countries restrict PC for food/baby use.
Acetal / POM (Delrin)	Polyoxymethylene	Gears, bearings, machined parts, precision mechanical	100 °C (212 °F)	**Self-lubricating**. Excellent machinability. Engineering plastic.
Nylon (PA)	Polyamide (Nylon 6, 6/6, 11, 12)	Gears, bushings, cable ties, textiles, fishing line	100-150 °C (212-302 °F)	Tough, abrasion-resistant. **Absorbs water** — changes dimensions slightly with humidity.
PMMA (Acrylic / Plexiglass)	Polymethyl methacrylate	Aquariums, signs, optical lenses, displays	80 °C (176 °F)	**Transparent like glass, easier to machine**. UV stable. Brittle vs PC.
PTFE (Teflon)	Polytetrafluoroethylene	Non-stick cookware, chemical seals, plumbing tape, gaskets	260 °C (500 °F)	**Extremely chemically resistant.** Releases toxic fumes only above 350 °C.
PLA	Polylactic acid	3D printing (standard filament), biodegradable packaging	60 °C (140 °F)	**Biodegradable** (industrial composting). Low temperature limit makes it unsuitable for hot environments.
PEEK	Polyetheretherketone	Aerospace, medical implants, oil & gas seals,	250 °C (482 °F)	**High-temperature engineering plastic.** Very expensive. Mechanical

Sources: ASTM D7611 · Modern Plastics Handbook · 21 CFR Part 177 · 3D printing materials
unitcheatsheet.com/cheatsheets/plastic-resins · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Plastic resin codes *chart*
Notes and pitfalls

About the recycling code. The chasing-arrow symbol with a number inside (1-7) is the **Resin Identification Code**, established by SPI in 1988. It identifies the resin — it does NOT mean the plastic is recyclable in your area. Local recycling varies wildly: most curbside programs accept 1 and 2; few accept 3, 6, or 7. Confirm with your local waste management.

COMMON PITFALLS

- **Recycling symbol ≠ recyclable.** The number tells you the resin. It does NOT mean your recycler accepts it. Most communities accept only 1 and 2 from curbside collection. Some specialty programs accept others.
- **'BPA-free' doesn't mean safer.** Many 'BPA-free' replacements use BPS or BPF — chemically similar with similar concerns. The safest food contact plastics for hot use are PP (5) and silicone (not coded — it's not a plastic in this sense).
- **Plastics degrade in sunlight (UV) and heat.** Don't expect outdoor longevity from indoor-rated plastics. Black plastics (with carbon black additive) last much longer outdoors than clear ones because carbon absorbs UV.
- **Plastic IDs aren't unique.** Two products both marked '5 / PP' may have very different additives, fillers, and impact modifiers, leading to very different properties. The code identifies the base polymer only.
- **Nylon and PA absorb water.** Nylon 6 can absorb up to 10% of its weight in water at equilibrium with humid air, causing it to swell ~3% and lose stiffness. For dimensional stability, use moisture-stable nylon grades (PA 12) or alternatives (acetal).
- **Thermoset vs thermoplastic isn't shown.** All resins in this chart are thermoplastics — they can be remelted. Thermosets (epoxy, polyester, vulcanized rubber) once cured can't be remelted and aren't typically labeled with these codes.

COMMON APPLICATIONS

USE CASE	RECOMMENDED PLASTIC	WHY
3D printing — beginner	PLA	Low warp, easy to print, biodegradable
3D printing — durable	PETG or ABS	Tougher than PLA, higher temp resistance
3D printing — engineering	Nylon, PC, PEEK	Best mechanical properties
Outdoor / UV exposure	HDPE, ABS, PC	UV-stable. PVC + LDPE degrade in sun.
Food / drink containers	PP, HDPE, PET	Non-leaching. Avoid PC (BPA), PS (styrene).
Microwave-safe container	PP	Highest temperature tolerance among common food plastics
Machined gears or bearings	Acetal (Delrin), Nylon, PTFE	Self-lubricating, dimensionally stable
Chemical / acid resistance	PTFE, HDPE, PP	PTFE for severe; HDPE for moderate
Clear / optical	PMMA (acrylic) or PC	PMMA for UV; PC for impact
High temperature (>150 °C)	PTFE, PEEK, PI	Standard plastics deform

Sources: ASTM D7611 · Modern Plastics Handbook · 21 CFR Part 177 · 3D printing materials
unitcheatsheet.com/cheatsheets/plastic-resins · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Bearing size *chart*

Common ball bearings — bore, outside diameter, and width for 6xxx-series single-row deep-groove bearings.

BEARING NUMBER	BORE, MM (IN)	OD, MM (IN)	WIDTH, MM (IN)	SERIES / NOTES
608	8 (0.315)	22 (0.866)	7 (0.276)	Skateboard / fidget spinner standard
6000	10 (0.394)	26 (1.024)	8 (0.315)	Light (60xx)
6001	12 (0.472)	28 (1.102)	8 (0.315)	Light series
6002	15 (0.591)	32 (1.260)	9 (0.354)	Light series
6003	17 (0.669)	35 (1.378)	10 (0.394)	Light series
6004	20 (0.787)	42 (1.654)	12 (0.472)	Light series
6005	25 (0.984)	47 (1.850)	12 (0.472)	Light series
6006	30 (1.181)	55 (2.165)	13 (0.512)	Light series
6007	35 (1.378)	62 (2.441)	14 (0.551)	Light series
6008	40 (1.575)	68 (2.677)	15 (0.591)	Light series
6200	10 (0.394)	30 (1.181)	9 (0.354)	**Medium (62xx)** — most common general-purpose
6201	12 (0.472)	32 (1.260)	10 (0.394)	Medium series
6202	15 (0.591)	35 (1.378)	11 (0.433)	Medium series
6203	17 (0.669)	40 (1.575)	12 (0.472)	Medium — typical small electric motor
6204	20 (0.787)	47 (1.850)	14 (0.551)	Medium series
6205	25 (0.984)	52 (2.047)	15 (0.591)	Medium — common gearbox bearing
6206	30 (1.181)	62 (2.441)	16 (0.630)	Medium series
6207	35 (1.378)	72 (2.835)	17 (0.669)	Medium series
6208	40 (1.575)	80 (3.150)	18 (0.709)	Medium series
6209	45 (1.772)	85 (3.346)	19 (0.748)	Medium series
6210	50 (1.969)	90 (3.543)	20 (0.787)	Medium series
6300	10 (0.394)	35 (1.378)	11 (0.433)	Heavy (63xx) — higher load capacity
6301	12 (0.472)	37 (1.457)	12 (0.472)	Heavy series
6302	15 (0.591)	42 (1.654)	13 (0.512)	Heavy series
6303	17 (0.669)	47 (1.850)	14 (0.551)	Heavy series
6304	20 (0.787)	52 (2.047)	15 (0.591)	Heavy series
6305	25 (0.984)	62 (2.441)	17 (0.669)	Heavy series
6306	30 (1.181)	72 (2.835)	19 (0.748)	Heavy series
6307	35 (1.378)	80 (3.150)	21 (0.827)	Heavy series
6308	40 (1.575)	90 (3.543)	23 (0.906)	Heavy series

Sources: ISO 15 · ABMA Standard 20 · ISO 492
unitcheatsheet.com/cheatsheets/bearing-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Bearing size *chart*
Notes and pitfalls

Bearing dimensions are defined in millimetres (ISO 15). Inches are converted at exactly 25.4 mm per inch and rounded to 0.001 in.

How bearing numbers work. For 6xxx-series ball bearings: the **first digit (6)** indicates single-row deep-groove ball bearing. The **second digit** is the series — 0 (extra light), 2 (medium), 3 (heavy), reflecting load capacity. The **last two digits** indicate bore: for digits ≥ 04, multiply by 5 (so 6206 = 30 mm bore). For 00-03, bore is 10/12/15/17 mm respectively. Width and OD scale with the series.

COMMON PITFALLS

- **Bearing number tells you size, not service condition.** A 6205 ZZ (with metal shields), 6205 2RS (rubber seals), 6205 C3 (looser radial clearance), and 6205 P5 (higher precision) all have the same dimensions but different sealing, clearance, and tolerance. The suffix matters.
- **Radial vs angular contact bearings.** 6xxx series carries mostly radial load. For combined radial + axial, use angular contact (7xxx) or tapered roller. A 6xxx bearing under significant axial load will fail.
- **Bore tolerance and shaft fit matter.** A 25 mm bore bearing has a specific tolerance (typically -0.000/-0.010 mm). The shaft must be sized for press fit (k5/k6/n6) or sliding fit (g6/h6) depending on whether the inner race rotates or is stationary.
- **Speed limits depend on lubrication.** A 6205 ball bearing can run at 12,000+ rpm with grease, 20,000+ rpm with oil. Above these limits, heat builds up faster than it can dissipate.
- **'Sealed for life' isn't.** Sealed bearings (2RS, 2Z) are good for 5-10 years in normal service, but seal life depends on temperature, dust exposure, and rotation speed. Hot or dirty environments shorten service life significantly.

COMMON APPLICATIONS

APPLICATION	TYPICAL BEARING	WHY
Skateboard / fidget spinner	608	8 mm bore standard
Inline skate wheel	608	Same as skateboard
Small electric motor (washer, fridge)	6203, 6204	Common shaft sizes
Larger electric motor (5 HP)	6205, 6206	25-30 mm shaft
Automotive wheel hub	Tapered roller	Not 6xxx — uses tapered roller bearings
Bicycle wheel hub (loose ball)	1/4" balls	Older designs; modern uses sealed cartridges
Bicycle bottom bracket (cartridge)	6804, 6805, etc.	Thin-section bearings (68xx series)
Industrial pillow block bearing	6206, 6208	Mounted in housing for shaft support
High-speed spindle (machine tool)	Angular contact	Not 6xxx — uses 7xxx series for axial load
Conveyor roller	6204, 6205	Plus seals for dust resistance

Sources: ISO 15 · ABMA Standard 20 · ISO 492
unitcheatsheet.com/cheatsheets/bearing-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Bolt torque *chart*

Typical dry torque for Grade 5 bolts: **3/8-16 = 30 ft·lbf** and **1/2-13 = 75 ft·lbf**. For class 8.8 metric bolts: **M10 = 53 N·m** and **M12 = 92 N·m**. Lubricated threads need about 25% less torque. If the manufacturer gives a torque value, use that value.

SIZE	GRADE	DRY (K=0.20)	LUBRICATED (K=0.15)	ANTI-SEIZE (K=0.10)
1/4-20	Grade 5	8 ft·lbf (11 N·m)	6 ft·lbf (8.1 N·m)	5 ft·lbf (6.8 N·m)
5/16-18	Grade 5	17 ft·lbf (23 N·m)	13 ft·lbf (18 N·m)	10 ft·lbf (14 N·m)
3/8-16	Grade 5	30 ft·lbf (41 N·m)	23 ft·lbf (31 N·m)	17 ft·lbf (23 N·m)
7/16-14	Grade 5	50 ft·lbf (68 N·m)	38 ft·lbf (52 N·m)	28 ft·lbf (38 N·m)
1/2-13	Grade 5	75 ft·lbf (102 N·m)	57 ft·lbf (77 N·m)	43 ft·lbf (58 N·m)
9/16-12	Grade 5	110 ft·lbf (149 N·m)	83 ft·lbf (113 N·m)	62 ft·lbf (84 N·m)
5/8-11	Grade 5	150 ft·lbf (203 N·m)	113 ft·lbf (153 N·m)	85 ft·lbf (115 N·m)
3/4-10	Grade 5	270 ft·lbf (366 N·m)	203 ft·lbf (275 N·m)	152 ft·lbf (206 N·m)
7/8-9	Grade 5	435 ft·lbf (590 N·m)	326 ft·lbf (442 N·m)	245 ft·lbf (332 N·m)
1-8	Grade 5	650 ft·lbf (881 N·m)	488 ft·lbf (662 N·m)	366 ft·lbf (496 N·m)
1/4-20	Grade 8	12 ft·lbf (16 N·m)	9 ft·lbf (12 N·m)	6 ft·lbf (8.1 N·m)
5/16-18	Grade 8	24 ft·lbf (33 N·m)	18 ft·lbf (24 N·m)	13 ft·lbf (18 N·m)
3/8-16	Grade 8	43 ft·lbf (58 N·m)	32 ft·lbf (43 N·m)	24 ft·lbf (33 N·m)
7/16-14	Grade 8	70 ft·lbf (95 N·m)	53 ft·lbf (72 N·m)	40 ft·lbf (54 N·m)
1/2-13	Grade 8	105 ft·lbf (142 N·m)	79 ft·lbf (107 N·m)	60 ft·lbf (81 N·m)
9/16-12	Grade 8	155 ft·lbf (210 N·m)	116 ft·lbf (157 N·m)	87 ft·lbf (118 N·m)
5/8-11	Grade 8	210 ft·lbf (285 N·m)	158 ft·lbf (214 N·m)	118 ft·lbf (160 N·m)
3/4-10	Grade 8	375 ft·lbf (508 N·m)	281 ft·lbf (381 N·m)	211 ft·lbf (286 N·m)
7/8-9	Grade 8	610 ft·lbf (827 N·m)	458 ft·lbf (621 N·m)	343 ft·lbf (465 N·m)
1-8	Grade 8	910 ft·lbf (1234 N·m)	683 ft·lbf (926 N·m)	512 ft·lbf (694 N·m)
M4 × 0.7	8.8	3 N·m (2.2 ft·lbf)	2 N·m (1.5 ft·lbf)	2 N·m (1.5 ft·lbf)
M5 × 0.8	8.8	6 N·m (4.4 ft·lbf)	5 N·m (3.7 ft·lbf)	4 N·m (3.0 ft·lbf)
M6 × 1.0	8.8	11 N·m (8.1 ft·lbf)	8 N·m (5.9 ft·lbf)	6 N·m (4.4 ft·lbf)
M8 × 1.25	8.8	26 N·m (19 ft·lbf)	20 N·m (15 ft·lbf)	15 N·m (11 ft·lbf)
M10 × 1.5	8.8	53 N·m (39 ft·lbf)	40 N·m (30 ft·lbf)	30 N·m (22 ft·lbf)
M12 × 1.75	8.8	92 N·m (68 ft·lbf)	69 N·m (51 ft·lbf)	52 N·m (38 ft·lbf)
M14 × 2.0	8.8	146 N·m (108 ft·lbf)	110 N·m (81 ft·lbf)	83 N·m (61 ft·lbf)
M16 × 2.0	8.8	229 N·m (169 ft·lbf)	172 N·m (127 ft·lbf)	129 N·m (95 ft·lbf)
M20 × 2.5	8.8	447 N·m (330 ft·lbf)	335 N·m (247 ft·lbf)	252 N·m (186 ft·lbf)
M4 × 0.7	10.9	4 N·m (3.0 ft·lbf)	3 N·m (2.2 ft·lbf)	2 N·m (1.5 ft·lbf)
M5 × 0.8	10.9	8 N·m (5.9 ft·lbf)	6 N·m (4.4 ft·lbf)	5 N·m (3.7 ft·lbf)
M6 × 1.0	10.9	15 N·m (11 ft·lbf)	11 N·m (8.1 ft·lbf)	8 N·m (5.9 ft·lbf)
M8 × 1.25	10.9	36 N·m (27 ft·lbf)	27 N·m (20 ft·lbf)	20 N·m (15 ft·lbf)
M10 × 1.5	10.9	75 N·m (55 ft·lbf)	56 N·m (41 ft·lbf)	42 N·m (31 ft·lbf)
M12 × 1.75	10.9	130 N·m (96 ft·lbf)	98 N·m (72 ft·lbf)	73 N·m (54 ft·lbf)
M14 × 2.0	10.9	207 N·m (153 ft·lbf)	155 N·m (114 ft·lbf)	116 N·m (86 ft·lbf)
M16 × 2.0	10.9	321 N·m (237 ft·lbf)	241 N·m (178 ft·lbf)	181 N·m (133 ft·lbf)
M20 × 2.5	10.9	628 N·m (463 ft·lbf)	471 N·m (347 ft·lbf)	353 N·m (260 ft·lbf)
M4 × 0.7	12.9	5 N·m (3.7 ft·lbf)	4 N·m (3.0 ft·lbf)	3 N·m (2.2 ft·lbf)
M5 × 0.8	12.9	10 N·m (7.4 ft·lbf)	7 N·m (5.2 ft·lbf)	5 N·m (3.7 ft·lbf)
M6 × 1.0	12.9	17 N·m (13 ft·lbf)	13 N·m (9.6 ft·lbf)	10 N·m (7.4 ft·lbf)

Sources: ISO 16047 · SAE J429 · Machinery's Handbook 31st ed. · ISO 898-1 · K-factor formula
unitcheatsheet.com/cheatsheets/bolt-torque · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap
for the live,
searchable chart

Bolt torque *chart*
Notes and pitfalls

The value in brackets is the same torque in the other unit (1 ft·lbf = 1.355818 N·m), rounded to the nearest whole unit (0.1 below 10).

About the values. Torque is the indirect way to achieve a target bolt tension. The K-factor depends on thread finish, lubrication, and washer condition — values shown are typical, not absolute. For critical joints, use a tension-indicating method (direct-tension washer, strain gauge, or yield-point method) rather than torque alone.

COMMON PITFALLS

- **Lubrication changes torque ~30%.** A dry-spec bolt over-torqued because someone added oil will snap. A lubed bolt under-torqued because spec was for lubed will loosen.
- **Used bolts have different friction.** Re-used fasteners may need different torque. Critical joints should use new fasteners.
- **Galvanized and stainless are different.** Galvanized increases friction (~20%); stainless tends to gall and seize. Use anti-seize on stainless.
- **Torque ≠ tension.** Even with perfect technique, torque-to-tension correlation has ±25% scatter. For mission-critical joints, measure tension directly.
- **Bolt grade matters more than size.** A Grade 8 1/4″ bolt holds more than a Grade 2 3/8″ bolt. Check the head markings.

COMMON APPLICATIONS

USE CASE	TYPICAL BOLT	NOTE
Automotive lug nut	1/2-20 or M14	Always check vehicle manufacturer spec — varies 80–150 ft·lbf
Engine cylinder head	M10–M12 stretch bolt	Torque-to-yield (TTY); use the angle method, not just torque
Bicycle stem bolt	M5 or M6	Typically 5–8 N·m. Over-torque cracks carbon parts
Bicycle pedal	9/16″ or M14	30–35 ft·lbf typical
Furniture assembly bolt	M6 or M8	Hand-tight + 1/4 turn; particleboard threads strip easily
Structural steel connection	3/4-10 A325	Slip-critical: turn-of-nut or DTI washer, not torque

Sources: ISO 16047 · SAE J429 · Machinery's Handbook 31st ed. · ISO 898-1 · K-factor formula
unitcheatsheet.com/cheatsheets/bolt-torque · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Drill bit size *chart*

Drill bits use four size systems: fractional inch, number, letter and metric. Number drills go from **#80 (0.0135 in)** to **#1 (0.2280 in)**. Letter drills go from **A (0.2340 in)** to **Z (0.4130 in)**. A 1/4 in bit is 6.350 mm. The nearest metric bit is 6.4 mm.

SIZE	SYSTEM	DECIMAL (IN)	MM	CLOSEST OTHER
0.3 mm	metric	0.0118	0.300	#80 (+0.043 mm)
#80	number	0.0135	0.343	0.3 mm (-0.043 mm)
#79	number	0.0145	0.368	1/64 (+0.029 mm)
1/64	fractional	0.0156	0.397	0.4 mm (+0.003 mm)
0.4 mm	metric	0.0157	0.400	1/64 (-0.003 mm)
#78	number	0.0160	0.406	0.4 mm (-0.006 mm)
#77	number	0.0180	0.457	0.5 mm (+0.043 mm)
0.5 mm	metric	0.0197	0.500	#76 (+0.008 mm)
#76	number	0.0200	0.508	0.5 mm (-0.008 mm)
#75	number	0.0210	0.533	0.5 mm (-0.033 mm)
#74	number	0.0225	0.571	0.6 mm (+0.029 mm)
0.6 mm	metric	0.0236	0.600	#73 (+0.010 mm)
#73	number	0.0240	0.610	0.6 mm (-0.010 mm)
#72	number	0.0250	0.635	0.6 mm (-0.035 mm)
#71	number	0.0260	0.660	0.7 mm (+0.040 mm)
0.7 mm	metric	0.0276	0.700	#70 (+0.011 mm)
#70	number	0.0280	0.711	0.7 mm (-0.011 mm)
#69	number	0.0292	0.742	0.7 mm (-0.042 mm)
#68	number	0.0310	0.787	1/32 (+0.006 mm)
1/32	fractional	0.0313	0.794	0.8 mm (+0.006 mm)
0.8 mm	metric	0.0315	0.800	1/32 (-0.006 mm)
#67	number	0.0320	0.813	0.8 mm (-0.013 mm)
#66	number	0.0330	0.838	0.8 mm (-0.038 mm)
#65	number	0.0350	0.889	0.9 mm (+0.011 mm)
0.9 mm	metric	0.0354	0.900	#65 (-0.011 mm)
#64	number	0.0360	0.914	0.9 mm (-0.014 mm)
#63	number	0.0370	0.940	0.9 mm (-0.040 mm)
#62	number	0.0380	0.965	1 mm (+0.035 mm)
#61	number	0.0390	0.991	1 mm (+0.009 mm)
1 mm	metric	0.0394	1.000	#61 (-0.009 mm)
#60	number	0.0400	1.016	1 mm (-0.016 mm)
#59	number	0.0410	1.041	1 mm (-0.041 mm)
#58	number	0.0420	1.067	1.1 mm (+0.033 mm)
#57	number	0.0430	1.092	1.1 mm (+0.008 mm)
1.1 mm	metric	0.0433	1.100	#57 (-0.008 mm)
#56	number	0.0465	1.181	3/64 (+0.010 mm)
3/64	fractional	0.0469	1.191	1.2 mm (+0.009 mm)
1.2 mm	metric	0.0472	1.200	3/64 (-0.009 mm)
1.3 mm	metric	0.0512	1.300	#55 (+0.021 mm)
#55	number	0.0520	1.321	1.3 mm (-0.021 mm)
#54	number	0.0550	1.397	1.4 mm (+0.003 mm)

SIZE	SYSTEM	DECIMAL (IN)	MM	CLOSEST OTHER
1.7 mm	metric	0.0669	1.700	#51 (+0.002 mm)
#51	number	0.0670	1.702	1.7 mm (-0.002 mm)
#50	number	0.0700	1.778	1.8 mm (+0.022 mm)
1.8 mm	metric	0.0709	1.800	#50 (-0.022 mm)
#49	number	0.0730	1.854	1.9 mm (+0.046 mm)
1.9 mm	metric	0.0748	1.900	#48 (+0.030 mm)
#48	number	0.0760	1.930	1.9 mm (-0.030 mm)
5/64	fractional	0.0781	1.984	#47 (+0.010 mm)
#47	number	0.0785	1.994	2 mm (+0.006 mm)
2 mm	metric	0.0787	2.000	#47 (-0.006 mm)
#46	number	0.0810	2.057	2.1 mm (+0.043 mm)
#45	number	0.0820	2.083	2.1 mm (+0.017 mm)
2.1 mm	metric	0.0827	2.100	#45 (-0.017 mm)
#44	number	0.0860	2.184	2.2 mm (+0.016 mm)
2.2 mm	metric	0.0866	2.200	#44 (-0.016 mm)
#43	number	0.0890	2.261	2.3 mm (+0.039 mm)
2.3 mm	metric	0.0906	2.300	#43 (-0.039 mm)
#42	number	0.0935	2.375	3/32 (+0.006 mm)
3/32	fractional	0.0938	2.381	#42 (-0.006 mm)
2.4 mm	metric	0.0945	2.400	3/32 (-0.019 mm)
#41	number	0.0960	2.438	2.4 mm (-0.038 mm)
#40	number	0.0980	2.489	2.5 mm (+0.011 mm)
2.5 mm	metric	0.0984	2.500	#40 (-0.011 mm)
#39	number	0.0995	2.527	2.5 mm (-0.027 mm)
#38	number	0.1015	2.578	2.6 mm (+0.022 mm)
2.6 mm	metric	0.1024	2.600	#38 (-0.022 mm)
#37	number	0.1040	2.642	2.6 mm (-0.042 mm)
2.7 mm	metric	0.1063	2.700	#36 (+0.005 mm)
#36	number	0.1065	2.705	2.7 mm (-0.005 mm)
7/64	fractional	0.1094	2.778	#35 (+0.016 mm)
#35	number	0.1100	2.794	2.8 mm (+0.006 mm)
2.8 mm	metric	0.1102	2.800	#35 (-0.006 mm)
#34	number	0.1110	2.819	2.8 mm (-0.019 mm)
#33	number	0.1130	2.870	2.9 mm (+0.030 mm)
2.9 mm	metric	0.1142	2.900	#33 (-0.030 mm)
#32	number	0.1160	2.946	2.9 mm (-0.046 mm)
3 mm	metric	0.1181	3.000	#31 (+0.048 mm)
#31	number	0.1200	3.048	3 mm (-0.048 mm)
3.1 mm	metric	0.1220	3.100	#31 (-0.052 mm)
1/8	fractional	0.1250	3.175	3.2 mm (+0.025 mm)
3.2 mm	metric	0.1260	3.200	1/8 (-0.025 mm)

Sources: ANSI B94.11M · ISO 235 · Machinery's Handbook

unitcheatsheet.com/cheatsheets/drill-bit-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Drill bit size *chart*

CHART, CONTINUED

SIZE	SYSTEM	DECIMAL (IN)	MM	CLOSEST OTHER
9/64	fractional	0.1406	3.572	#28 (-0.003 mm)
3.6 mm	metric	0.1417	3.600	9/64 (-0.028 mm)
#27	number	0.1440	3.658	3.7 mm (+0.042 mm)
3.7 mm	metric	0.1457	3.700	#26 (+0.034 mm)
#26	number	0.1470	3.734	3.7 mm (-0.034 mm)
#25	number	0.1495	3.797	3.8 mm (+0.003 mm)
3.8 mm	metric	0.1496	3.800	#25 (-0.003 mm)
#24	number	0.1520	3.861	3.9 mm (+0.039 mm)
3.9 mm	metric	0.1535	3.900	#23 (+0.012 mm)
#23	number	0.1540	3.912	3.9 mm (-0.012 mm)
5/32	fractional	0.1563	3.969	#22 (+0.019 mm)
#22	number	0.1570	3.988	4 mm (+0.012 mm)
4 mm	metric	0.1575	4.000	#22 (-0.012 mm)
#21	number	0.1590	4.039	4 mm (-0.039 mm)
#20	number	0.1610	4.089	4.1 mm (+0.011 mm)
4.1 mm	metric	0.1614	4.100	#20 (-0.011 mm)
4.2 mm	metric	0.1654	4.200	#19 (+0.016 mm)
#19	number	0.1660	4.216	4.2 mm (-0.016 mm)
4.3 mm	metric	0.1693	4.300	#18 (+0.005 mm)
#18	number	0.1695	4.305	4.3 mm (-0.005 mm)
11/64	fractional	0.1719	4.366	#17 (+0.029 mm)
#17	number	0.1730	4.394	4.4 mm (+0.006 mm)
4.4 mm	metric	0.1732	4.400	#17 (-0.006 mm)
#16	number	0.1770	4.496	4.5 mm (+0.004 mm)
4.5 mm	metric	0.1772	4.500	#16 (-0.004 mm)
#15	number	0.1800	4.572	4.6 mm (+0.028 mm)
4.6 mm	metric	0.1811	4.600	#14 (+0.023 mm)
#14	number	0.1820	4.623	4.6 mm (-0.023 mm)
#13	number	0.1850	4.699	4.7 mm (+0.001 mm)
4.7 mm	metric	0.1850	4.700	#13 (-0.001 mm)
3/16	fractional	0.1875	4.762	4.8 mm (+0.037 mm)
4.8 mm	metric	0.1890	4.800	#12 (+0.001 mm)
#12	number	0.1890	4.801	4.8 mm (-0.001 mm)
#11	number	0.1910	4.851	4.9 mm (+0.049 mm)
4.9 mm	metric	0.1929	4.900	#10 (+0.015 mm)
#10	number	0.1935	4.915	4.9 mm (-0.015 mm)
#9	number	0.1960	4.978	5 mm (+0.022 mm)
5 mm	metric	0.1969	5.000	#9 (-0.022 mm)
#8	number	0.1990	5.055	5.1 mm (+0.045 mm)
5.1 mm	metric	0.2008	5.100	#7 (+0.005 mm)
#7	number	0.2010	5.105	5.1 mm (-0.005 mm)
13/64	fractional	0.2031	5.159	#6 (+0.022 mm)
#6	number	0.2040	5.182	5.2 mm (+0.018 mm)
5.2 mm	metric	0.2047	5.200	#6 (-0.018 mm)

SIZE	SYSTEM	DECIMAL (IN)	MM	CLOSEST OTHER
7/32	fractional	0.2188	5.556	5.6 mm (+0.044 mm)
5.6 mm	metric	0.2205	5.600	#2 (+0.013 mm)
#2	number	0.2210	5.613	5.6 mm (-0.013 mm)
5.7 mm	metric	0.2244	5.700	#2 (-0.087 mm)
#1	number	0.2280	5.791	5.8 mm (+0.009 mm)
5.8 mm	metric	0.2283	5.800	#1 (-0.009 mm)
5.9 mm	metric	0.2323	5.900	A (+0.044 mm)
A	letter	0.2340	5.944	15/64 (+0.010 mm)
15/64	fractional	0.2344	5.953	A (-0.010 mm)
6 mm	metric	0.2362	6.000	B (+0.045 mm)
B	letter	0.2380	6.045	6 mm (-0.045 mm)
C	letter	0.2420	6.147	6.2 mm (+0.053 mm)
6.2 mm	metric	0.2441	6.200	D (+0.048 mm)
D	letter	0.2460	6.248	6.2 mm (-0.048 mm)
E	letter	0.2500	6.350	1/4 (+0.000 mm)
1/4	fractional	0.2500	6.350	E (+0.000 mm)
6.4 mm	metric	0.2520	6.400	E (-0.050 mm)
6.5 mm	metric	0.2559	6.500	F (+0.028 mm)
F	letter	0.2570	6.528	6.5 mm (-0.028 mm)
6.6 mm	metric	0.2598	6.600	G (+0.029 mm)
G	letter	0.2610	6.629	6.6 mm (-0.029 mm)
17/64	fractional	0.2656	6.747	H (+0.010 mm)
H	letter	0.2660	6.756	17/64 (-0.010 mm)
6.8 mm	metric	0.2677	6.800	H (-0.044 mm)
I	letter	0.2720	6.909	7 mm (+0.091 mm)
7 mm	metric	0.2756	7.000	J (+0.036 mm)
J	letter	0.2770	7.036	7 mm (-0.036 mm)
K	letter	0.2810	7.137	9/32 (+0.006 mm)
9/32	fractional	0.2813	7.144	K (-0.006 mm)
7.2 mm	metric	0.2835	7.200	9/32 (-0.056 mm)
L	letter	0.2900	7.366	7.5 mm (+0.134 mm)
M	letter	0.2950	7.493	7.5 mm (+0.007 mm)
7.5 mm	metric	0.2953	7.500	M (-0.007 mm)
19/64	fractional	0.2969	7.541	7.5 mm (-0.041 mm)
N	letter	0.3020	7.671	7.8 mm (+0.129 mm)
7.8 mm	metric	0.3071	7.800	N (-0.129 mm)
5/16	fractional	0.3125	7.938	8 mm (+0.062 mm)
8 mm	metric	0.3150	8.000	O (+0.026 mm)
O	letter	0.3160	8.026	8 mm (-0.026 mm)
8.2 mm	metric	0.3228	8.200	P (+0.004 mm)
P	letter	0.3230	8.204	8.2 mm (-0.004 mm)
21/64	fractional	0.3281	8.334	Q (+0.098 mm)
Q	letter	0.3320	8.433	8.5 mm (+0.067 mm)
8.5 mm	metric	0.3346	8.500	Q (-0.067 mm)

Sources: ANSI B94.11M · ISO 235 · Machinery's Handbook
unitcheatsheet.com/cheatsheets/drill-bit-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Drill bit size *chart*

CHART, CONTINUED

SIZE	SYSTEM	DECIMAL (IN)	MM	CLOSEST OTHER
23/64	fractional	0.3594	9.128	T (-0.035 mm)
9.2 mm	metric	0.3622	9.200	23/64 (-0.072 mm)
U	letter	0.3680	9.347	9.2 mm (-0.147 mm)
9.5 mm	metric	0.3740	9.500	3/8 (+0.025 mm)
3/8	fractional	0.3750	9.525	9.5 mm (-0.025 mm)
V	letter	0.3770	9.576	3/8 (-0.051 mm)
9.8 mm	metric	0.3858	9.800	W (+0.004 mm)
W	letter	0.3860	9.804	9.8 mm (-0.004 mm)
25/64	fractional	0.3906	9.922	10 mm (+0.078 mm)
10 mm	metric	0.3937	10.000	25/64 (-0.078 mm)
X	letter	0.3970	10.084	10 mm (-0.084 mm)
Y	letter	0.4040	10.262	13/32 (+0.057 mm)
13/32	fractional	0.4063	10.319	Y (-0.057 mm)
Z	letter	0.4130	10.490	10.5 mm (+0.010 mm)
10.5 mm	metric	0.4134	10.500	Z (-0.010 mm)
27/64	fractional	0.4219	10.716	10.5 mm (-0.216 mm)
11 mm	metric	0.4331	11.000	7/16 (+0.112 mm)
7/16	fractional	0.4375	11.112	11 mm (-0.112 mm)
11.5 mm	metric	0.4528	11.500	29/64 (+0.009 mm)
29/64	fractional	0.4531	11.509	11.5 mm (-0.009 mm)
15/32	fractional	0.4688	11.906	12 mm (+0.094 mm)
12 mm	metric	0.4724	12.000	15/32 (-0.094 mm)
31/64	fractional	0.4844	12.303	12.5 mm (+0.197 mm)
12.5 mm	metric	0.4921	12.500	31/64 (-0.197 mm)
1/2	fractional	0.5000	12.700	12.5 mm (-0.200 mm)
13 mm	metric	0.5118	13.000	33/64 (+0.097 mm)
33/64	fractional	0.5156	13.097	13 mm (-0.097 mm)
17/32	fractional	0.5313	13.494	13.5 mm (+0.006 mm)
13.5 mm	metric	0.5315	13.500	17/32 (-0.006 mm)
35/64	fractional	0.5469	13.891	14 mm (+0.109 mm)
14 mm	metric	0.5512	14.000	35/64 (-0.109 mm)
9/16	fractional	0.5625	14.287	14.5 mm (+0.212 mm)
14.5 mm	metric	0.5709	14.500	37/64 (+0.184 mm)
37/64	fractional	0.5781	14.684	14.5 mm (-0.184 mm)
15 mm	metric	0.5906	15.000	19/32 (+0.081 mm)
19/32	fractional	0.5938	15.081	15 mm (-0.081 mm)
39/64	fractional	0.6094	15.478	15.5 mm (+0.022 mm)
15.5 mm	metric	0.6102	15.500	39/64 (-0.022 mm)
5/8	fractional	0.6250	15.875	16 mm (+0.125 mm)

SIZE	SYSTEM	DECIMAL (IN)	MM	CLOSEST OTHER
16 mm	metric	0.6299	16.000	5/8 (-0.125 mm)
41/64	fractional	0.6406	16.272	16.5 mm (+0.228 mm)
16.5 mm	metric	0.6496	16.500	21/32 (+0.169 mm)
21/32	fractional	0.6563	16.669	16.5 mm (-0.169 mm)
17 mm	metric	0.6693	17.000	43/64 (+0.066 mm)
43/64	fractional	0.6719	17.066	17 mm (-0.066 mm)
11/16	fractional	0.6875	17.462	17.5 mm (+0.037 mm)
17.5 mm	metric	0.6890	17.500	11/16 (-0.037 mm)
45/64	fractional	0.7031	17.859	18 mm (+0.141 mm)
18 mm	metric	0.7087	18.000	45/64 (-0.141 mm)
23/32	fractional	0.7188	18.256	18.5 mm (+0.244 mm)
18.5 mm	metric	0.7283	18.500	47/64 (+0.153 mm)
47/64	fractional	0.7344	18.653	18.5 mm (-0.153 mm)
19 mm	metric	0.7480	19.000	3/4 (+0.050 mm)
3/4	fractional	0.7500	19.050	19 mm (-0.050 mm)
49/64	fractional	0.7656	19.447	19.5 mm (+0.053 mm)
19.5 mm	metric	0.7677	19.500	49/64 (-0.053 mm)
25/32	fractional	0.7813	19.844	20 mm (+0.156 mm)
20 mm	metric	0.7874	20.000	25/32 (-0.156 mm)
51/64	fractional	0.7969	20.241	20 mm (-0.241 mm)
13/16	fractional	0.8125	20.637	21 mm (+0.363 mm)
21 mm	metric	0.8268	21.000	53/64 (+0.034 mm)
53/64	fractional	0.8281	21.034	21 mm (-0.034 mm)
27/32	fractional	0.8438	21.431	21 mm (-0.431 mm)
55/64	fractional	0.8594	21.828	22 mm (+0.172 mm)
22 mm	metric	0.8661	22.000	55/64 (-0.172 mm)
7/8	fractional	0.8750	22.225	22 mm (-0.225 mm)
57/64	fractional	0.8906	22.622	23 mm (+0.378 mm)
23 mm	metric	0.9055	23.000	29/32 (+0.019 mm)
29/32	fractional	0.9063	23.019	23 mm (-0.019 mm)
59/64	fractional	0.9219	23.416	23 mm (-0.416 mm)
15/16	fractional	0.9375	23.813	24 mm (+0.188 mm)
24 mm	metric	0.9449	24.000	15/16 (-0.188 mm)
61/64	fractional	0.9531	24.209	24 mm (-0.209 mm)
31/32	fractional	0.9688	24.606	25 mm (+0.394 mm)
25 mm	metric	0.9843	25.000	63/64 (+0.003 mm)
63/64	fractional	0.9844	25.003	25 mm (-0.003 mm)
1/1	fractional	1.0000	25.400	25 mm (-0.400 mm)

Sources: ANSI B94.11M · ISO 235 · Machinery's Handbook
unitcheatsheet.com/cheatsheets/drill-bit-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Drill bit size *chart*
Notes and pitfalls

About the systems. Number drills (#1–#80) and letter drills (A–Z) are US industrial sizes — they fill the gaps between fractional sizes and are common in machining. Fractional drills (1/64″ steps) are the household standard. Metric drills are the international standard outside the US and Canada. Most drill index sets include all four systems together.

COMMON PITFALLS

- **Number drills count *down* as they get bigger.** #80 is the smallest, #1 is the largest. Just like AWG — and trips up everyone the first time.
- **Letter drills start where number drills end.** A (0.234″) is bigger than #1 (0.228″). Useful when you've outgrown the number set but haven't reached a clean fraction.
- **"Close enough" isn't always.** A 6 mm and a 15/64″ drill are 0.0094″ apart — fine for most through-holes, but a tight fit for a press-fit pin won't tolerate the difference.
- **Metric and US fractional don't line up.** 1/4″ ≈ 6.35 mm, not 6 mm. If a metric spec says 6 mm and you only have inch drills, the closest size is 15/64″ (5.95 mm) or 1/4″ (6.35 mm) — pick based on whether you want clearance or interference.
- **Drill bit diameter ≠ hole size.** A real-world hole is typically 0.001″–0.005″ larger than the bit due to runout and bit flexing. Critical for precision work.

COMMON APPLICATIONS

USE CASE	TYPICAL DRILL	NOTE
Pilot for #6 wood screw	3/32″	In softwood. Hardwood: tap drill #36.
Pilot for #8 wood screw	1/8″	In softwood. Hardwood: #29.
Pilot for #10 wood screw	9/64″	In softwood. Hardwood: #25.
Tap drill for 1/4″–20 UNC	#7 (0.201″)	75% thread engagement.
Tap drill for 5/16″–18 UNC	F (0.257″)	75% thread engagement.
Tap drill for 3/8″–16 UNC	5/16″	75% thread engagement.
Tap drill for M4 × 0.7	3.3 mm	75% thread engagement.
Tap drill for M6 × 1.0	5.0 mm	75% thread engagement.
Clearance for 1/4″ bolt	17/64″	Loose fit, standard.
Drywall anchor #6/#8	5/16″ or 3/8″	Check anchor packaging.

Sources: ANSI B94.11M · ISO 235 · Machinery's Handbook
unitcheatsheet.com/cheatsheets/drill-bit-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

ISO tolerance *chart*

Complete ISO 286 tolerance reference: IT grade values across size ranges, plus common hole and shaft fits (H7, h7, g6, k6, n6, p6, s6) with actual...

NOMINAL SIZE	IT5	IT6	IT7	IT8	IT9	IT10	IT11
≤ 3 mm	4 µm	6 µm	10 µm	14 µm	25 µm	40 µm	60 µm
3–6 mm	5 µm	8 µm	12 µm	18 µm	30 µm	48 µm	75 µm
6–10 mm	6 µm	9 µm	15 µm	22 µm	36 µm	58 µm	90 µm
10–18 mm	8 µm	11 µm	18 µm	27 µm	43 µm	70 µm	110 µm
18–30 mm	9 µm	13 µm	21 µm	33 µm	52 µm	84 µm	130 µm
30–50 mm	11 µm	16 µm	25 µm	39 µm	62 µm	100 µm	160 µm
50–80 mm	13 µm	19 µm	30 µm	46 µm	74 µm	120 µm	190 µm
80–120 mm	15 µm	22 µm	35 µm	54 µm	87 µm	140 µm	220 µm
120–180 mm	18 µm	25 µm	40 µm	63 µm	100 µm	160 µm	250 µm
180–250 mm	20 µm	29 µm	46 µm	72 µm	115 µm	185 µm	290 µm

Sources: ISO 286-1:2010 · ISO 286-2:2010 · ANSI B4.2 · ANSI B4.1
unitcheatsheet.com/cheatsheets/iso-tolerance-grades · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

ISO tolerance *chart* Notes and pitfalls

Reading the system. Each tolerance is two parts: a *letter* for the position of the tolerance band relative to nominal (uppercase H, K, N for holes; lowercase h, k, n for shafts) and a *number* for the IT grade (the band's width). So "H7" is a hole with the band starting at nominal, IT grade 7 wide. "h7" is a shaft with the band ending at nominal, IT grade 7 wide. "H7/h7" describes a clearance fit of 0 to 21 µm at Ø10–18 mm, or 0 to 21 µm at Ø18–30 mm — wider at larger nominal sizes.

COMMON PITFALLS

- **Uppercase and lowercase aren't optional.** H7 (hole) and h7 (shaft) are different tolerances. A drawing that says just "7" is ambiguous and wrong.
- **The same fit gives different clearance at different sizes.** H7/h7 at Ø10 is up to 18 µm of clearance; at Ø250 it's up to 92 µm. Don't memorize "H7/h7 = 21 µm" — that's only true at Ø18–30 mm.
- **Hole-basis (H) is the standard.** Industry convention is to use H as the hole tolerance and adjust the shaft. Hole tools (reamers, broaches) come in standard sizes; shafts are easier to grind to size.
- **"Press fit" depends on materials and surface finish.** A theoretically valid press fit (e.g. H7/p6) can still gall, score, or seize if the surface finish is rough or the materials are similar (steel-on-steel without lubrication). The tolerance band alone doesn't guarantee success.
- **ISO 286 isn't the same as ANSI/ASME Y14.5 GD&T.** ISO 286 is for size tolerances on cylindrical features. GD&T is the broader system for geometric tolerances (flatness, parallelism, true position). They're complementary, not competing.

Sources: ISO 286-1:2010 · ISO 286-2:2010 · ANSI B4.2 · ANSI B4.1
unitcheatsheet.com/cheatsheets/iso-tolerance-grades · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

ISO tolerance *chart*

Notes and pitfalls, continued

COMMON FITS AT Ø25 MM (WORKED EXAMPLE)

TOLERANCE	TYPE	UPPER Δ	LOWER Δ	ACTUAL SIZE AT Ø25	USE
H7	Hole	+21	0	25.000 to 25.021	Standard ground hole. The reference for most fits.
H8	Hole	+33	0	25.000 to 25.033	Machined hole, looser tolerance.
H9	Hole	+52	0	25.000 to 25.052	Coarser machined hole, free fit.
H11	Hole	+130	0	25.000 to 25.130	Cast or rough hole. Drilled-only OK.
h6	Shaft	0	-13	24.987 to 25.000	Precision shaft, ground.
h7	Shaft	0	-21	24.979 to 25.000	Standard ground shaft.
h9	Shaft	0	-52	24.948 to 25.000	Turned shaft.
g6	Shaft	-7	-20	24.980 to 24.993	Slight clearance. Used for sliding fit.
f7	Shaft	-20	-41	24.959 to 24.980	Free running with lubrication.
k6	Shaft	+15	+2	25.002 to 25.015	Transition fit, light press.
n6	Shaft	+28	+15	25.015 to 25.028	Medium press fit, requires arbor press.
p6	Shaft	+35	+22	25.022 to 25.035	Press fit, permanent assembly.
s6	Shaft	+48	+35	25.035 to 25.048	Heavy press / shrink fit, requires heating.

COMMON FITS AND WHAT THEY'RE FOR

FIT DESIGNATION	TYPE	USE CASE
H11/c11	Loose running	Rough applications, large clearance, e.g. agricultural shafts
H9/d9	Free running	Standard journal bearing fit
H8/f7	Close running	Precision running fit with light load and lubrication
H7/g6	Sliding	Easy to assemble, no significant force; locating slides
H7/h6	Locational clearance	Easy assembly, can rotate freely; gauge blocks
H7/k6	Transition (light press)	Press-on assembly, removable with arbor press
H7/n6	Transition (medium press)	Light interference; small motor / pulley fit
H7/p6	Press	Permanent assembly, requires substantial force
H7/s6	Heavy press / shrink	Shaft heated for assembly; gear hub on shaft

Sources: ISO 286-1:2010 · ISO 286-2:2010 · ANSI B4.2 · ANSI B4.1
unitcheatsheet.com/cheatsheets/iso-tolerance-grades · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

O-ring size *chart* (AS568)

In an AS568 dash number, the first digit sets the cross-section. **-0xx = 0.070 in (1.78 mm)** and -1xx = 0.103 in (2.62 mm). **-2xx = 0.139 in (3.53 mm)**, -3xx = 0.210 in (5.33 mm) and -4xx = 0.275 in (6.99 mm). Example: a -214 O-ring has a 0.984 in (25.00 mm) inside diameter.

DASH #	ID (INCH)	ID (MM)	CROSS-SECTION	SERIES / NOTE
001	0.029"	0.74 mm	0.040" (1.02 mm)	Very small (0xx)
004	0.070"	1.78 mm	0.070" (1.78 mm)	Small bore
008	0.176"	4.47 mm	0.070" (1.78 mm)	Small bore
010	0.239"	6.07 mm	0.070" (1.78 mm)	Small bore
012	0.364"	9.25 mm	0.070" (1.78 mm)	Small bore
014	0.489"	12.42 mm	0.070" (1.78 mm)	Small bore
016	0.614"	15.60 mm	0.070" (1.78 mm)	Small bore
020	0.864"	21.95 mm	0.070" (1.78 mm)	Small bore
024	1.114"	28.30 mm	0.070" (1.78 mm)	Common small (0xx)
030	1.614"	41.00 mm	0.070" (1.78 mm)	0xx series
040	2.864"	72.74 mm	0.070" (1.78 mm)	Larger 0xx
104	0.139"	3.53 mm	0.103" (2.62 mm)	1xx series
110	0.362"	9.19 mm	0.103" (2.62 mm)	1xx series
120	0.987"	25.07 mm	0.103" (2.62 mm)	1xx series
200	0.114"	2.90 mm	0.139" (3.53 mm)	2xx series begins
210	0.734"	18.64 mm	0.139" (3.53 mm)	2xx common
214	0.984"	25.00 mm	0.139" (3.53 mm)	Common metric-equivalent
218	1.234"	31.34 mm	0.139" (3.53 mm)	2xx common
222	1.484"	37.69 mm	0.139" (3.53 mm)	2xx common
226	1.984"	50.39 mm	0.139" (3.53 mm)	2xx common
230	2.484"	63.09 mm	0.139" (3.53 mm)	2xx larger
240	3.734"	94.84 mm	0.139" (3.53 mm)	2xx large
312	0.612"	15.54 mm	0.210" (5.33 mm)	3xx series
318	0.987"	25.07 mm	0.210" (5.33 mm)	3xx series
325	1.487"	37.77 mm	0.210" (5.33 mm)	3xx series

Sources: SAE AS568 · ISO 3601-1 · Parker O-Ring Handbook · ASTM D2000
unitcheatsheet.com/cheatsheets/o-ring-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap
for the live,
searchable chart

O-ring size *chart* (AS568) Notes and pitfalls

About AS568. The Aerospace Standard 568 (SAE) defines 369 specific O-ring sizes by dash number. Each series has a constant cross-section, with inside diameters scaling by series: 0xx = 0.070" (1.78 mm) CS, 1xx = 0.103" (2.62 mm) CS, 2xx = 0.139" (3.53 mm) CS, 3xx = 0.210" (5.33 mm) CS, 4xx = 0.275" (6.99 mm) CS. The above shows a representative sample; a full catalog is from Parker, McMaster-Carr, or AS568 reference.

COMMON PITFALLS

- **'AS568-214' specifies size only, not material.** Different materials (Buna-N, Viton, EPDM, silicone, FFKM) work for very different chemical and temperature conditions. Always specify both size *and* material.
- **O-ring stretches in service.** An installed O-ring should be stretched to about 1-5% of its free ID for static face seals. Less stretch = leakage; more stretch = premature failure.
- **Squeeze ratio matters.** A static face seal is typically squeezed 15-25% of cross-section thickness. Less = leakage; more = extrusion or compression set. Manufacturer recommendations vary by application.
- **Hardness (durometer) affects performance.** Standard is 70 Shore A. Softer (50A) seals at lower pressures but extrudes under high pressure. Harder (90A) handles high pressure but needs higher squeeze and surface finish.
- **Surface finish matters more than people think.** For dynamic seals (sliding/rotating), the mating surface should be Ra 8-32 µin (0.2-0.8 µm) — neither too rough (wears the ring) nor too smooth (microscratching). For static seals, Ra 32-63 µin is typical.

COMMON APPLICATIONS

APPLICATION TYPE	RECOMMENDED MATERIAL	NOTES
Standard fluid (oil/water 0-100°C)	NBR (Buna-N)	Cheapest, default for most applications
Hot oil (100-150°C)	FKM (Viton)	High temperature; petroleum oils
Steam, hot water	EPDM	Polar fluids; NOT petroleum
Aerospace fuel	FKM or FFKM	Resistant to JP-fuels
Cryogenic	Silicone	Down to ~−100°C
Food contact	FDA-grade silicone or EPDM	Confirm FDA 21 CFR 177.2600 compliance
High vacuum	FKM or low-outgassing FKM	Avoid plasticizer-rich elastomers
Strong acids	FFKM or Aflas	PTFE may also be used (with care)
High pressure (>3000 psi)	Standard + backup ring	Or harder durometer (90A vs 70A)

Sources: SAE AS568 · ISO 3601-1 · Parker O-Ring Handbook · ASTM D2000
unitcheatsheet.com/cheatsheets/o-ring-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Sheet metal gauge *chart*

A higher gauge number means thinner metal. **16 gauge steel is 0.0598 in (1.52 mm). 14 gauge steel is 0.0747 in (1.90 mm).** Aluminum uses a different scale: 16 gauge aluminum is 0.0508 in (1.29 mm). Always check the material for the gauge.

GAUGE	STEEL (UNCOATED)	GALVANIZED STEEL	ALUMINUM / B&S	COPPER / BRASS
3	0.2391″ / 6.07 mm	—	0.2294″ / 5.83 mm	0.2294″ / 5.83 mm
4	0.2242″ / 5.69 mm	—	0.2043″ / 5.19 mm	0.2043″ / 5.19 mm
5	0.2092″ / 5.31 mm	—	0.1819″ / 4.62 mm	0.1819″ / 4.62 mm
6	0.1943″ / 4.94 mm	—	0.1620″ / 4.12 mm	0.1620″ / 4.12 mm
7	0.1793″ / 4.55 mm	—	0.1443″ / 3.66 mm	0.1443″ / 3.66 mm
8	0.1644″ / 4.18 mm	0.1681″ / 4.27 mm	0.1285″ / 3.26 mm	0.1285″ / 3.26 mm
9	0.1495″ / 3.80 mm	0.1532″ / 3.89 mm	0.1144″ / 2.91 mm	0.1144″ / 2.91 mm
10	0.1345″ / 3.42 mm	0.1382″ / 3.51 mm	0.1019″ / 2.59 mm	0.1019″ / 2.59 mm
11	0.1196″ / 3.04 mm	0.1233″ / 3.13 mm	0.0907″ / 2.30 mm	0.0907″ / 2.30 mm
12	0.1046″ / 2.66 mm	0.1084″ / 2.75 mm	0.0808″ / 2.05 mm	0.0808″ / 2.05 mm
13	0.0897″ / 2.28 mm	0.0934″ / 2.37 mm	0.0720″ / 1.83 mm	0.0720″ / 1.83 mm
14	0.0747″ / 1.90 mm	0.0785″ / 1.99 mm	0.0641″ / 1.63 mm	0.0641″ / 1.63 mm
15	0.0673″ / 1.71 mm	0.0710″ / 1.80 mm	0.0571″ / 1.45 mm	0.0571″ / 1.45 mm
16	0.0598″ / 1.52 mm	0.0635″ / 1.61 mm	0.0508″ / 1.29 mm	0.0508″ / 1.29 mm
17	0.0538″ / 1.37 mm	0.0575″ / 1.46 mm	0.0453″ / 1.15 mm	0.0453″ / 1.15 mm
18	0.0478″ / 1.21 mm	0.0516″ / 1.31 mm	0.0403″ / 1.02 mm	0.0403″ / 1.02 mm
19	0.0418″ / 1.06 mm	0.0456″ / 1.16 mm	0.0359″ / 0.91 mm	0.0359″ / 0.91 mm
20	0.0359″ / 0.91 mm	0.0396″ / 1.01 mm	0.0320″ / 0.81 mm	0.0320″ / 0.81 mm
21	0.0329″ / 0.84 mm	0.0366″ / 0.93 mm	0.0285″ / 0.72 mm	0.0285″ / 0.72 mm
22	0.0299″ / 0.76 mm	0.0336″ / 0.85 mm	0.0253″ / 0.64 mm	0.0253″ / 0.64 mm
23	0.0269″ / 0.68 mm	0.0306″ / 0.78 mm	0.0226″ / 0.57 mm	0.0226″ / 0.57 mm
24	0.0239″ / 0.61 mm	0.0276″ / 0.70 mm	0.0201″ / 0.51 mm	0.0201″ / 0.51 mm
25	0.0209″ / 0.53 mm	0.0247″ / 0.63 mm	0.0179″ / 0.45 mm	0.0179″ / 0.45 mm
26	0.0179″ / 0.45 mm	0.0217″ / 0.55 mm	0.0159″ / 0.40 mm	0.0159″ / 0.40 mm
27	0.0164″ / 0.42 mm	0.0202″ / 0.51 mm	0.0142″ / 0.36 mm	0.0142″ / 0.36 mm
28	0.0149″ / 0.38 mm	0.0187″ / 0.47 mm	0.0126″ / 0.32 mm	0.0126″ / 0.32 mm

Sources: ASTM A568/A568M · ASTM A653/A653M · Brown & Sharpe gauge · ASTM A480 / A240
unitcheatsheet.com/cheatsheets/sheet-metal-gauge · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Sheet metal gauge *chart* Notes and pitfalls

Why the same number means different things. Steel sheet gauge originated as a US Standard Gauge in the 1800s and was tied to weight per square foot. Aluminum, copper, and brass adopted the Brown & Sharpe (B&S) system, which is identical to AWG wire gauge — a logarithmic series tied to diameter. The two systems collided at the names but never merged. Galvanized steel adds ~0.0025–0.004″ of zinc coating on top of the steel thickness, so a 14-gauge galvanized sheet is meaningfully thicker than a 14-gauge uncoated steel sheet.

COMMON PITFALLS

- **Same number, different thickness.** 16-gauge steel is 1.519 mm; 16-gauge aluminum is 1.291 mm — about 15% thinner. Specifying material AND gauge is non-negotiable.
- **Galvanized adds thickness.** 16-gauge galvanized is 0.0635″ vs 16-gauge uncoated steel at 0.0598″ — about 6% thicker. The zinc coating is real material.
- **Order stainless by decimal thickness.** No national standard defines gauge numbers for stainless steel. Mills publish their own gauge tables, and they differ from the uncoated-steel column above. Give the thickness in inches or millimeters, not a gauge number.
- **Copper is often sold by weight, not gauge.** '16 oz copper' means 16 ounces per square foot, which corresponds to roughly 24 gauge (0.0216″). Confusing if you're used to thinking in gauges.
- **'Gauge' is a tradesperson's word.** CAD drawings and engineering specs increasingly use decimal inches or millimeters directly. Always verify against actual dimensions for precision work.

COMMON APPLICATIONS

USE CASE	TYPICAL GAUGE	MATERIAL
Automobile body panels	18–22	Steel
Truck bed	12–14	Steel
HVAC ductwork (residential)	26–30	Galvanized steel
HVAC ductwork (commercial)	22–26	Galvanized steel
Range hood / vent	22–26	Galvanized steel or aluminum
Aircraft skin (general aviation)	16–22	Aluminum (2024 or 7075)
Aluminum siding	24–26	Aluminum
Sheet metal cabinet body	18–22	Steel or aluminum
Decorative copper flashing	16 oz (= ~24 gauge)	Copper (sold by weight)
Standing seam roof	22–24	Galvanized or aluminum

Sources: ASTM A568/A568M · ASTM A653/A653M · Brown & Sharpe gauge · ASTM A480 / A240
unitcheatsheet.com/cheatsheets/sheet-metal-gauge · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Socket & wrench size *chart*

SAE (fractional) socket sizes step in 1/16 in: 1/4, 5/16, 3/8, 7/16, 1/2, 9/16, 5/8, 11/16, 3/4, 13/16, 7/8, 15/16 and 1 in. **Metric sizes** step in 1 mm. The closest pairs are **19 mm and 3/4 in** (0.05 mm apart) and **8 mm and 5/16 in** (0.06 mm). A 3/4 in socket is 19.05 mm. A 23 mm socket is 0.906 in, between 7/8 and 15/16 in. Use the correct system when you can.

SIZE	SYSTEM	MM	INCH	CLOSEST OTHER SYSTEM
4 mm	Metric	4.00 mm	0.1575"	1/4 (+2.35 mm)
5 mm	Metric	5.00 mm	0.1969"	1/4 (+1.35 mm)
6 mm	Metric	6.00 mm	0.2362"	1/4 (+0.35 mm)
1/4	SAE	6.35 mm	0.2500"	6 mm (-0.35 mm)
7 mm	Metric	7.00 mm	0.2756"	1/4 (-0.65 mm)
5/16	SAE	7.94 mm	0.3125"	8 mm (+0.06 mm)
8 mm	Metric	8.00 mm	0.3150"	5/16 (-0.06 mm)
11/32	SAE	8.73 mm	0.3438"	9 mm (+0.27 mm)
9 mm	Metric	9.00 mm	0.3543"	11/32 (-0.27 mm)
3/8	SAE	9.52 mm	0.3750"	10 mm (+0.48 mm)
10 mm	Metric	10.00 mm	0.3937"	3/8 (-0.48 mm)
11 mm	Metric	11.00 mm	0.4331"	7/16 (+0.11 mm)
7/16	SAE	11.11 mm	0.4375"	11 mm (-0.11 mm)
12 mm	Metric	12.00 mm	0.4724"	1/2 (+0.70 mm)
1/2	SAE	12.70 mm	0.5000"	13 mm (+0.30 mm)
13 mm	Metric	13.00 mm	0.5118"	1/2 (-0.30 mm)
14 mm	Metric	14.00 mm	0.5512"	9/16 (+0.29 mm)
9/16	SAE	14.29 mm	0.5625"	14 mm (-0.29 mm)
15 mm	Metric	15.00 mm	0.5906"	9/16 (-0.71 mm)
5/8	SAE	15.88 mm	0.6250"	16 mm (+0.12 mm)
16 mm	Metric	16.00 mm	0.6299"	5/8 (-0.12 mm)
17 mm	Metric	17.00 mm	0.6693"	11/16 (+0.46 mm)
11/16	SAE	17.46 mm	0.6875"	17 mm (-0.46 mm)
18 mm	Metric	18.00 mm	0.7087"	11/16 (-0.54 mm)
19 mm	Metric	19.00 mm	0.7480"	3/4 (+0.05 mm)
3/4	SAE	19.05 mm	0.7500"	19 mm (-0.05 mm)
20 mm	Metric	20.00 mm	0.7874"	13/16 (+0.64 mm)

SIZE	SYSTEM	MM	INCH	CLOSEST OTHER SYSTEM
7/8	SAE	22.22 mm	0.8750"	22 mm (-0.22 mm)
23 mm	Metric	23.00 mm	0.9055"	7/8 (-0.78 mm)
15/16	SAE	23.81 mm	0.9375"	24 mm (+0.19 mm)
24 mm	Metric	24.00 mm	0.9449"	15/16 (-0.19 mm)
25 mm	Metric	25.00 mm	0.9843"	1 (+0.40 mm)
1	SAE	25.40 mm	1.0000"	25 mm (-0.40 mm)
26 mm	Metric	26.00 mm	1.0236"	1 (-0.60 mm)
1-1/16	SAE	26.99 mm	1.0625"	27 mm (+0.01 mm)
27 mm	Metric	27.00 mm	1.0630"	1-1/16 (-0.01 mm)
28 mm	Metric	28.00 mm	1.1024"	1-1/8 (+0.57 mm)
1-1/8	SAE	28.57 mm	1.1250"	29 mm (+0.43 mm)
29 mm	Metric	29.00 mm	1.1417"	1-1/8 (-0.43 mm)
30 mm	Metric	30.00 mm	1.1811"	1-3/16 (+0.16 mm)
1-3/16	SAE	30.16 mm	1.1875"	30 mm (-0.16 mm)
31 mm	Metric	31.00 mm	1.2205"	1-1/4 (+0.75 mm)
1-1/4	SAE	31.75 mm	1.2500"	32 mm (+0.25 mm)
32 mm	Metric	32.00 mm	1.2598"	1-1/4 (-0.25 mm)
33 mm	Metric	33.00 mm	1.2992"	1-5/16 (+0.34 mm)
1-5/16	SAE	33.34 mm	1.3125"	33 mm (-0.34 mm)
34 mm	Metric	34.00 mm	1.3386"	1-5/16 (-0.66 mm)
1-3/8	SAE	34.92 mm	1.3750"	35 mm (+0.08 mm)
35 mm	Metric	35.00 mm	1.3780"	1-3/8 (-0.08 mm)
36 mm	Metric	36.00 mm	1.4173"	1-7/16 (+0.51 mm)
1-7/16	SAE	36.51 mm	1.4375"	37 mm (+0.49 mm)
37 mm	Metric	37.00 mm	1.4567"	1-7/16 (-0.49 mm)
38 mm	Metric	38.00 mm	1.4961"	1-1/2 (+0.10 mm)
1-1/2	SAE	38.10 mm	1.5000"	38 mm (-0.10 mm)

Sources: ANSI B107.1 · ISO 2725 · DIN 3120 · ASME B18.2.1 · ISO 4014
unitcheatsheet.com/cheatsheets/socket-wrench-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Socket & wrench size *chart*
Notes and pitfalls

About socket sizing. Socket sizes refer to the across-flats (AF) dimension — the distance between two parallel hex faces. SAE sockets are sized in fractional inches; metric in millimeters. The two systems don't align cleanly — most SAE/metric pairs differ by 0.1 to 0.5 mm, which is just enough to round off a fastener's corners if you use the wrong one. Always size correctly when torque matters.

COMMON PITFALLS

- **Close-but-not-equal sizes round off corners.** 13 mm = 0.5118"; 1/2" = 0.5000" — that's 0.3 mm of slop. On a high-torque metric bolt with a 1/2" SAE socket, the corners can shear before the threads engage. Don't substitute under load.
- **Some metric and SAE sizes are functionally identical.** 19 mm ≈ 3/4" (within 0.05 mm) and 10 mm ≈ 3/8" (within 0.1 mm) work for low-torque applications. Above ~50 ft·lbf, always use the matching system.
- **Imperial cars often use metric sockets internally.** A 'made in USA' car may have metric bolts at engine and transmission interfaces (since most engines are metric-design). Always check both sizes.
- **The 6-point vs 12-point distinction matters.** 6-point (single hex) sockets engage the full flat; 12-point engage just the corners. High-torque applications need 6-point. 12-point is faster on visible bolts but rounds them off faster too.
- **Deep sockets and standard sockets have the same hex size.** The depth differs (deep ~3× standard length), but they fit the same fastener. Use deep sockets for studs or recessed bolts.

COMMON APPLICATIONS

COMMON FASTENER	TYPICAL SOCKET
1/4-20 hex head bolt	7/16" (across flats)
5/16-18 hex head bolt	1/2"
3/8-16 hex head bolt	9/16"
1/2-13 hex head bolt	3/4"
5/8-11 hex head bolt	15/16"
3/4-10 hex head bolt	1-1/8"
M6 hex head bolt	10 mm
M8 hex head bolt	13 mm
M10 hex head bolt	17 mm (sometimes 16 mm)
M12 hex head bolt	19 mm (sometimes 18 mm)
M14 hex head bolt	21 mm or 22 mm
M16 hex head bolt	24 mm
M20 hex head bolt	30 mm
Automotive lug nut (US car)	3/4" or 13/16" or 7/8"
Automotive lug nut (import)	17 mm, 19 mm, or 21 mm
Bike crank arm bolt	8 mm hex (Allen) inside 14 mm socket

Sources: ANSI B107.1 · ISO 2725 · DIN 3120 · ASME B18.2.1 · ISO 4014
unitcheatsheet.com/cheatsheets/socket-wrench-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Tap drill *chart*

For a **1/4-20** tap, use a **#7 drill (0.2010 in)**. For **#10-32**, use a #21 drill. For **#8-32**, use a #29 drill. For **3/8-16**, use a 5/16 in drill. For **M6 × 1.0**, use a **5.0 mm** drill. For **M8 × 1.25**, use a 6.8 mm drill. These sizes give 75% thread engagement.

THREAD	SYSTEM	TAP DRILL	TAP DRILL (DECIMAL)	CLEARANCE DRILL
#0-80	UN imperial	3/64	0.0469″	#52
#1-64	UN imperial	#53	0.0595″	#48
#1-72	UN imperial	#53	0.0595″	#48
#2-56	UN imperial	#50	0.0700″	#43
#2-64	UN imperial	#50	0.0700″	#43
#4-40	UN imperial	#43	0.0890″	#32
#4-48	UN imperial	#42	0.0935″	#32
#6-32	UN imperial	#36	0.1065″	#27
#6-40	UN imperial	#33	0.1130″	#27
#8-32	UN imperial	#29	0.1360″	#18
#8-36	UN imperial	#29	0.1360″	#18
#10-24	UN imperial	#25	0.1495″	#9
#10-32	UN imperial	#21	0.1590″	#9
1/4-20	UN imperial	#7	0.2010″	17/64
1/4-28	UN imperial	#3	0.2130″	17/64
5/16-18	UN imperial	F	0.2570″	21/64
5/16-24	UN imperial	I	0.2720″	21/64
3/8-16	UN imperial	5/16	0.3125″	25/64
3/8-24	UN imperial	Q	0.3320″	25/64
7/16-14	UN imperial	U	0.3680″	29/64
7/16-20	UN imperial	25/64	0.3906″	29/64
1/2-13	UN imperial	27/64	0.4219″	33/64
1/2-20	UN imperial	29/64	0.4531″	33/64
5/8-11	UN imperial	17/32	0.5313″	41/64
5/8-18	UN imperial	37/64	0.5781″	41/64
3/4-10	UN imperial	21/32	0.6562″	49/64
3/4-16	UN imperial	11/16	0.6875″	49/64
1-8	UN imperial	7/8	0.8750″	1-1/64
1-12	UN imperial	59/64	0.9219″	1-1/64
M2 × 0.4	metric	1.6 mm	—	2.4 mm
M2.5 × 0.45	metric	2.05 mm	—	2.9 mm
M3 × 0.5	metric	2.5 mm	—	3.4 mm
M3.5 × 0.6	metric	2.9 mm	—	3.9 mm
M4 × 0.7	metric	3.3 mm	—	4.5 mm
M5 × 0.8	metric	4.2 mm	—	5.5 mm
M6 × 1.0	metric	5.0 mm	—	6.6 mm
M8 × 1.25	metric	6.8 mm	—	9.0 mm
M8 × 1.0	metric	7.0 mm	—	9.0 mm
M10 × 1.5	metric	8.5 mm	—	11.0 mm

Sources: Machinery's Handbook 31st ed. · ISO 2306 · tap drill

unitcheatsheet.com/cheatsheets/tap-drill-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Tap drill *chart*
Notes and pitfalls

About thread engagement. 75% engagement is the standard compromise between thread strength and tapping effort. Higher engagement (90%) needs a smaller tap drill, more torque to tap, and only adds about 5% thread strength. Lower (50%) is faster to tap and used in soft materials, but the threads are weaker.

COMMON PITFALLS

- **75% engagement is not 75% of the OD.** It's 75% of the thread depth, which means a smaller difference. For M6 × 1.0: nominal OD 6.0 mm, tap drill 5.0 mm = 17% smaller hole.
- **Hand tap vs machine tap differs.** Hand taps use a 75% spec. CNC machine taps with chip evacuation may use 50–65% in production.
- **Through-holes vs blind holes.** In a blind hole, leave enough depth for chip clearance below the threaded portion — typically 2–3× the thread pitch.
- **Tapered taps vs bottoming taps.** A tapered tap has 8–10 chamfered threads (easier to start). A bottoming tap has 1–2 (cuts threads closer to the bottom). Don't tap a blind hole with a tapered tap and expect full-depth threads.
- **Clearance drill ≠ tap drill.** A 'clearance hole' is for a bolt to pass through freely. A 'tap drill' is for cutting threads. They're not the same hole.

COMMON APPLICATIONS

USE CASE	RECOMMENDATION	WHY
Tapped hole in aluminum	75% engagement	Standard. Use cutting fluid.
Tapped hole in cast iron	75% engagement	Standard. Dry tap or with light oil.
Tapped hole in mild steel	75% engagement	Standard. Use cutting fluid.
Tapped hole in stainless steel	65% engagement	Reduce tap stress; use sulfur-bearing fluid.
Tapped hole in brass	75% engagement	Use a 'gun tap' or cut tap with no rake.
Tapped hole in plastic	50% engagement	Plastic deforms; larger tap drill prevents thread tearout.
Tapped hole in titanium	65% engagement	High strength; reduce engagement to ease tapping.

Sources: Machinery's Handbook 31st ed. · ISO 2306 · tap drill
unitcheatsheet.com/cheatsheets/tap-drill-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Photography exposure *chart*

Aperture, shutter speed, and ISO as equivalent stops.

STOP	APERTURE (F-NUMBER)	SHUTTER (S)	ISO
−4 (4 stops darker)	f/64	1/4000	ISO 6
−3	f/45	1/2000	ISO 12
−2	f/32	1/1000	ISO 25
−1	f/22	1/500	ISO 50
0 (reference)	f/16	1/250	ISO 100
+1	f/11	1/125	ISO 200
+2	f/8	1/60	ISO 400
+3	f/5.6	1/30	ISO 800
+4	f/4	1/15	ISO 1600
+5	f/2.8	1/8	ISO 3200
+6	f/2	1/4	ISO 6400
+7	f/1.4	1/2	ISO 12800
+8 (4 stops brighter)	f/1	1 s	ISO 25600

Sources: ISO 517 · ISO 12232 · ISO 2240 · ISO 5800 · The Camera

unitcheatsheet.com/cheatsheets/photography-exposure · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Photography exposure *chart* Notes and pitfalls

How the table works. Each row is one 'stop' brighter than the row above it. Aperture stops are powers of √2 (so f/2 → f/2.8 → f/4 is each one stop). Shutter speeds are powers of 2 (1/1000 → 1/500 → 1/250 each one stop). ISO doubles each stop (100 → 200 → 400). A camera at f/8, 1/60, ISO 400 (stop +2) gives the same exposure as f/4, 1/250, ISO 400 (still stop +2 — we made aperture 2 stops brighter and shutter 2 stops darker, netting zero change).

COMMON PITFALLS

- **The aperture series isn't intuitively linear.** f/2 to f/2.8 looks like a small jump (only 0.8 difference) but is one full stop (2× light). The numbers are powers of √2 because aperture diameter scales linearly while light scales with area (diameter²).
- **'Wide open' aperture trades sharpness.** Lenses are usually sharpest at f/5.6 to f/11. Wide-open (f/1.4) has more aberrations; very stopped down (f/22) has diffraction softening. The 'sharpest' aperture is typically 2-3 stops below wide-open.
- **ISO noise depends on sensor size.** Full-frame at ISO 6400 looks better than APS-C at ISO 1600. Modern sensors have made high-ISO usable, but 'usable' depends on the print/output size and noise tolerance.
- **Shutter-speed reciprocal rule for handholding.** Without stabilization, the minimum shutter speed to avoid motion blur is roughly 1/focal length (for 50mm lens, use 1/60 or faster). With image stabilization, 2-4 stops slower may be possible.
- **Depth of field depends on three things.** Aperture (smaller f = shallower DoF), focal length (longer = shallower), and subject distance (closer = shallower). Same aperture at 200mm has much shallower DoF than at 24mm.
- **Sunny 16 is rough but reliable.** In bright sun, set aperture to f/16 and shutter to 1/ISO (e.g., 1/100 at ISO 100). Adjust from there. Useful when meters fail or for testing.

COMMON APPLICATIONS

SCENE / SITUATION	SUNNY 16 STARTING POINT	NOTES
Bright sunlight (the 'Sunny 16 rule')	f/16, 1/ISO, base ISO	At ISO 100: f/16 at 1/100 (or 1/125)
Bright cloudy	f/11 (1 stop brighter)	Slightly diffused
Overcast	f/8 (2 stops brighter)	Soft, no harsh shadows
Heavy overcast	f/5.6 (3 stops brighter)	Approaching low light
Open shade / sunset shade	f/4 (4 stops brighter)	Indirect light
Indoor (well-lit)	f/2.8 + ISO 800-1600	Or use flash
Indoor (dim restaurant)	f/1.8 + ISO 3200+	Or tripod for slow shutter
Night street lights	f/2.8 + ISO 6400 + 1/30	Or tripod, longer exposure
Stars / Milky Way	f/2.8 + ISO 3200 + 15-25s	500-rule: shutter ≤ 500/focal length for sharp stars
Frozen action (sports)	f/4-5.6 + 1/1000+	Increase ISO as needed
Motion blur (waterfall)	f/8-16 + 1/4-2s	Need ND filter in bright light
Portrait (blurred background)	f/1.4-2.8	Wide aperture = shallow DoF
Landscape (everything sharp)	f/8-11	Sharpest aperture for most lenses

Sources: ISO 517 · ISO 12232 · ISO 2240 · ISO 5800 · The Camera
unitcheatsheet.com/cheatsheets/photography-exposure · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Force & weight conversion *chart*

Real-world forces and weights from structural loads to atomic forces.

FORCE / WEIGHT	NEWTONS	LBF	KGF	CONTEXT
1 µN	10^{-6} N	2.25×10^{-7}	1.0×10^{-7}	Weight of a single grain of sand
1 mN	10^{-3} N	0.000225	0.000102	Weight of a small ant
10 mN	0.010 N	0.0022	0.0010	Weight of a US dollar bill (~1 g)
1 N	1.0 N	0.225	0.102	Weight of a small apple (~102 g) on Earth
10 N	10 N	2.25	1.02	Holding a 1 L bottle of water
100 N	100 N	22.5	10.2	Light grocery bag, ~10 kg of weight
500 N	500 N	112	51	Heavy bag of cement, ~50 kg
700 N	700 N	157	71	Average adult body weight (~70 kg)
1 kN	1,000 N	225	102	~100 kg load, refrigerator weight
5 kN	5,000 N	1,124	510	Climbing rope rated minimum breaking strength (single)
10 kN	10,000 N	2,248	1,020	Compact car weight (~1,000 kg / 2,250 lb)
15-20 kN	15-20 kN	3,370-4,500	1,500-2,040	Standard climbing rope rated breaking strength
30 kN	30,000 N	6,744	3,060	Mid-size SUV weight (~3,000 kg)
50 kN	50,000 N	11,240	5,100	Typical structural steel bolt yield (M16 grade 8.8)
100 kN	100 kN	22,480	10,200	Pickup truck loaded (~10,000 kg)
200 kN	200 kN	44,960	20,400	Semi-truck wheel load (~20,000 kg)
500 kN	500 kN	112,400	51,000	Concrete column design load (small building)
1 MN	10^{6} N	224,800	102,000	Large building column reaction, locomotive weight
1.7 MN	1.7 MN	382,000	173,000	Maximum thrust of an F-16 fighter jet engine
7-9 MN	7-9 MN	1.6-2 M lbf	700-900 t	Saturn V first-stage thrust per engine (×5 = 35 MN)
35 MN	35 MN	7.9 M lbf	3,570 t	Saturn V total liftoff thrust

Sources: Force unit definitions · ASCE 7 · AASHTO LRFD Bridge Design Specifications · UIAA-101
unitcheatsheet.com/cheatsheets/force-weight-reference · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Force & weight conversion *chart* Notes and pitfalls

Mass vs weight. The 'kgf' column is the weight (force) that a given mass would exert under standard gravity (g = 9.80665 m/s²). On the moon, the same mass would weigh about 1/6 as much. The numeric coincidence that 1 kg of mass weighs 1 kgf only applies at Earth's surface.

COMMON PITFALLS

- **Pounds are ambiguous.** The 'lb' alone can mean pound-mass (lbm) or pound-force (lbf). They're numerically equal at Earth's surface but dimensionally different. Engineering work should always specify which.
- **kgf is non-SI but widely used.** 1 kgf = 9.80665 N (the weight of 1 kg under standard gravity). Common in older European engineering documents and many catalog specs. Convert to newtons for any modern analysis.
- **'Tons' has three meanings.** Metric tonne (1000 kg ≈ 9.81 kN), US short ton (2000 lbm ≈ 8.90 kN), and UK long ton (2240 lbm ≈ 9.96 kN). Always specify which.
- **Loads vs reactions.** A 1 ton load on a beam produces equal and opposite reactions at supports — but the analysis depends on where the load is applied. Static equilibrium reactions are typically 50% each for symmetric loading.
- **Static vs dynamic loading.** A 100 kg person walking on a beam produces dynamic forces up to 1.5× static weight. Vehicles and machinery produce even higher impact factors. Design loads include impact multipliers per code (often 30-100% increase).

COMMON APPLICATIONS

STRUCTURAL / ENGINEERING REFERENCE	MAGNITUDE	NOTES
Office floor live load (residential)	1.92 kN/m² (40 psf)	Code minimum per IBC
Office floor live load (office)	2.40 kN/m² (50 psf)	Standard office
Office floor live load (heavy storage)	11.97 kN/m² (250 psf)	Warehouse / heavy storage
Snow load (light, southern US)	0.48 kN/m² (10 psf)	Mild winter region
Snow load (heavy, New England)	2.39 kN/m² (50 psf)	Severe winter region
Wind pressure (90 mph design)	0.69 kN/m² (14.5 psf)	ASCE 7 standard wind
Hurricane wind pressure (180 mph)	2.78 kN/m² (58 psf)	Coastal exposure category
Roof load (typical residential)	0.72 kN/m² (15 psf)	Dead load only
Bridge HS-20 truck wheel	72 kN (16,000 lbf)	Standard AASHTO design truck
Earthquake force (typical)	5-20% of building weight	Depends on seismic zone
Allowable bolt tension (1/2-13 Grade 5)	30 kN (6,750 lbf)	60% of proof load

Sources: Force unit definitions · ASCE 7 · AASHTO LRFD Bridge Design Specifications · UIAA-101
unitcheatsheet.com/cheatsheets/force-weight-reference · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Pressure units *chart*

Standard atmospheric pressure is **14.696 psi = 1.01325 bar = 101.325 kPa = 760 mmHg**. A typical car tire is 30–35 psi (2.1–2.4 bar, 210–240 kPa). **1 bar = 14.504 psi = 100 kPa**.

PRESSURE	PSI	BAR	KPA	OTHER / CONTEXT
Vacuum (perfect)	0	0	0	0 atm, 0 torr — theoretical only
Ultra-high vacuum (lab)	—	—	10^{-7} to 10^{-11} Pa	Used in semiconductor / surface science
Medium vacuum (process)	—	—	0.1 to 100 Pa	Distillation, evaporation, vacuum pumps
Light vacuum (industrial)	-14 to -5	-1 to -0.3	-100 to -30 kPa	Vacuum cleaners, pneumatic gripping
Mt. Everest summit air	4.9	0.34	34	≈ 1/3 atm, 250 mmHg
Commercial cabin (cruise)	11.3	0.78	78	Equivalent altitude ~7,000 ft (2,100 m)
1 atm (sea level standard)	14.696	1.01325	101.325	≡ 760 mmHg ≡ 29.92 inHg (defined exact)
Bicycle tire (low end)	30-40	2.1-2.8	210-280	MTB / fat tire
Car tire (typical)	30-35	2.1-2.4	210-240	Check driver's door placard for exact
Truck tire (light truck)	50-80	3.4-5.5	340-550	Higher load capacity
Bicycle tire (road)	70-130	4.8-9	480-900	Narrower tire, higher pressure
Shop compressed air	90-125	6.2-8.6	620-860	Typical pneumatic tools
Residential water (street)	40-80	2.8-5.5	280-550	Pressure-reducing valve to 50-60 psi for house
Residential gas (natural)	0.25	0.017	1.7	7 inH_2O — most residential supply
Espresso machine (brew)	130	9	900	Standard espresso brewing pressure
Pressure washer (consumer)	1500-3000	100-200	10,000-20,000	Cleaning automotive, decks
Pressure washer (industrial)	3000-7000	200-480	20-48 MPa	Surface prep, paint removal
Hydraulic system (mobile)	2000-3500	140-240	14-24 MPa	Excavators, loaders, machine tools
Hydraulic system (high-perf)	5000+	350+	35+ MPa	Press brakes, injection molding
Scuba tank (full)	3000	207	20.7 MPa	Most commonly used dive tank pressure
Scuba tank (high-pressure)	3442	237	23.7 MPa	DOT 3AA tanks, technical diving
CNG fuel tank	3000-3600	207-248	20-25 MPa	Compressed natural gas vehicles
Blood pressure (normal systolic)	2.3	0.16	16	120 mmHg — note: gauge pressure (above atm)
Blood pressure (normal diastolic)	1.5	0.10	10	80 mmHg
Hypertension threshold (systolic)	2.5	0.17	17	≥130 mmHg per current US guidelines
Intracranial pressure (normal)	0.07-0.29	0.005-0.020	0.5-2 kPa	5-15 mmHg
Boiler (residential)	12-30	0.8-2	80-200	Hydronic heating expansion tank
Boiler (commercial steam)	15-150	1-10	100-1000	Process steam
Ocean at 10 m depth	14.5	1.0	100	1 additional bar per 10 m depth
Ocean at 100 m	145	10	1.0 MPa	Recreational dive limit
Ocean at 1,000 m	1,450	100	10 MPa	Submarine operating depth
Mariana Trench (deepest)	16,000	1,100	110 MPa	Mariana Trench at ~11 km depth

Sources: ISO 2533 · American College of Cardiology · American Heart Association · Pressure unit definitions · Eaton · Parker
unitcheatsheet.com/cheatsheets/pressure-reference · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Pressure units *chart*
Notes and pitfalls

Gauge vs absolute. Most pressure measurements (tire, blood, hydraulic, etc.) are *gauge* pressure — relative to atmospheric. Absolute pressure is gauge + 14.7 psi (1 atm). The values above are gauge where that's the conventional measurement (tire, blood, hydraulics) and absolute where that's conventional (barometric, vacuum). Always check which your application expects.

COMMON PITFALLS

- **Tire pressure: cold vs hot.** Manufacturer specs are 'cold' pressure (before driving). Tire pressure rises 2-5 psi after 20 minutes of highway driving. Don't bleed off when hot — wait for cooldown.
- **Blood pressure 'over' is systolic / diastolic.** 120/80 means 120 mmHg peak (systolic, heart contracting) and 80 mmHg trough (diastolic, heart relaxing). Both are gauge pressures.
- **Hydraulic vs pneumatic confusion.** Hydraulic systems use incompressible liquid (oil), pneumatic systems use compressible gas (air). Hydraulic operates at much higher pressure (140-350 bar typical) than pneumatic (6-8 bar typical).
- **1 bar of water depth ≈ 10 m / 33 ft.** A useful diving rule. At 30 m depth: 1 atm surface + 3 atm water = 4 atm absolute = 60 psi.
- **Sea-level air pressure varies ±5%.** Standard atm is 1013.25 mbar. Weather systems push it up to 1050 (very high pressure / 'high') or down to 970 (storm). Hurricane pressure can drop below 920 mbar.

Sources: ISO 2533 · American College of Cardiology · American Heart Association · Pressure unit definitions · Eaton · Parker
unitcheatsheet.com/cheatsheets/pressure-reference · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Temperature reference *chart*

Freezing and boiling points of common substances, comfort and cooking temperatures, body temperatures, weather extremes — everything on one chart, in…

TEMPERATURE (°F)	TEMPERATURE (°C)	REFERENCE POINT
−459.67 °F	-273.15 °C	**Absolute zero** — no thermal motion. Defined exactly.
−320.4 °F	-195.8 °C	Liquid nitrogen boiling point (at 1 atm)
−109.3 °F	-78.5 °C	Dry ice (solid CO_2) sublimation
−40 °F	-40 °C	**F and C meet** — the only point where Fahrenheit equals Celsius
−128.6 °F	-89.2 °C	Coldest natural temperature on Earth (Vostok Station, Antarctica, 1983)
−4 °F	-20 °C	Home freezer (typical)
0 °F	-17.8 °C	Original Fahrenheit zero (saturated salt water); USDA freezer setting: 0 °F (−18 °C) or colder
−37.9 °F	-38.83 °C	Mercury freezes
32 °F	0 °C	**Water freezes** (1 atm)
34–38 °F	1–3 °C	Refrigerator (recommended 1–4 °C / 34–40 °F)
40 °F	4 °C	Refrigerator typical / cold air mass
50 °F	10 °C	Cool autumn day
59 °F	15 °C	Standard temperature for thermodynamics (ISO 13443)
68 °F	20 °C	**Room temperature** (common reference, ASHRAE comfort range)
72 °F	22 °C	Indoor comfort
77 °F	25 °C	STP (semiconductor industry), warm room
86 °F	30 °C	Hot summer day
98.6 °F	37 °C	**Human body temperature** (oral, healthy)
100.4 °F	38 °C	Low-grade fever threshold

TEMPERATURE (°F)	TEMPERATURE (°C)	REFERENCE POINT
104 °F	40 °C	High fever; hot tub max
113 °F	45 °C	Hot day in Death Valley / Persian Gulf
134 °F	56.7 °C	Highest recorded air temperature on Earth (Death Valley, 1913 — WMO official record)
140 °F	60 °C	Hot water supply (max) / safe holding temperature for food
165 °F	74 °C	Safe minimum internal temperature for poultry (USDA)
180–205 °F	82–96 °C	Coffee brewing (drip / pour-over range)
212 °F	100 °C	**Water boils** (1 atm)
350 °F	177 °C	Standard baking (gas mark 4)
375 °F	191 °C	Hot frying oil
400–450 °F	204–232 °C	Pizza, breads (gas mark 6–8)
572 °F	300 °C	Auto-ignition temperature of paper
621 °F	327.5 °C	Lead melts
1220 °F	660 °C	Aluminum melts
1984 °F	1084.6 °C	Copper melts
2192 °F	1200 °C	Industrial brazing (silver)
2732 °F	1500 °C	Steel melts (varies by alloy)
6192 °F	3422 °C	Tungsten melts (highest melting metal)
6692 °F	3700 °C	Carbon arc temperature
~10,000 °F	~5500 °C	Surface of the sun

Sources: ITS-90 · IUPAC · ISO 13443 · USDA Food Safety and Inspection Service · ASHRAE Standard 55
unitcheatsheet.com/cheatsheets/temperature-reference · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Temperature reference *chart*
Notes and pitfalls

About 'standard temperatures'. Different fields use different reference temperatures: *0 °C / 32 °F* for ice point; *20 °C / 68 °F* for ASHRAE 'room temperature'; *25 °C / 77 °F* for semiconductor 'STP'; *15 °C / 59 °F* for natural gas STP (ISO 13443); *0 °C and 100 kPa* for IUPAC STP since 1982. Always check which 'standard' your reference document means.

COMMON PITFALLS

- **Boiling point depends on pressure.** Water boils at 100 °C at sea level (1 atm). At 5,280 ft elevation (Denver), water boils at about 95 °C / 203 °F. At the top of Mt. Everest, around 70 °C / 158 °F. This affects cooking times and is why pressure cookers work.
- **Body temperature isn't exactly 37 °C.** Healthy oral temperatures range from 36.1 to 37.2 °C (97-99 °F), with diurnal variation. Rectal temperatures run about 0.5 °C higher; axillary (armpit) about 0.5 °C lower. '98.6 °F' is an average, not a rigid number.
- **'Room temperature' isn't standardized.** ASHRAE comfort range is 68-76 °F (20-24 °C) depending on humidity, season, and activity. Scientific 'room temperature' is often 20 °C (68 °F) or 25 °C (77 °F) depending on the field.
- **Fan ovens run hotter than conventional.** A recipe at 180 °C (350 °F) conventional should be 160 °C (320 °F) on a fan-assisted oven — about 20 °C / 36 °F cooler.
- **USDA safe-food temperatures are higher than European equivalents.** The US specifies 165 °F (74 °C) for poultry; UK / EU often accepts 70 °C (158 °F) if held for time. Both produce safe food if held for the appropriate time, but US guidance is more conservative.

COMMON APPLICATIONS

COOKING TEMPERATURE (°F)	(°C)	WHAT IT'S FOR
140 °F	60 °C	Steak: medium rare (below USDA's safe minimum of 145 °F with a 3-minute rest)
145 °F	63 °C	USDA safe minimum: whole cuts of beef, pork, lamb
150 °F	66 °C	Steak: medium
160 °F	71 °C	Ground beef safe internal temperature (USDA)
160 °F	71 °C	Steak: medium well
165 °F	74 °C	Poultry safe internal temperature (USDA)
170 °F	77 °C	Coffee brewing minimum (some methods)
180 °F	82 °C	Drip coffee, tea (green tea)
190 °F	88 °C	Tea (oolong, white)
200 °F	93 °C	Tea (black, herbal); espresso brewing temperature
212 °F	100 °C	Boiling water (sea level)
350 °F	177 °C	Standard baking temperature
375 °F	191 °C	Hot oil for shallow frying
400 °F	204 °C	Roasting vegetables; bread
450 °F	232 °C	Pizza, hot-temperature roasting
500 °F	260 °C	Pizza stone, very hot

Sources: ITS-90 · IUPAC · ISO 13443 · USDA Food Safety and Inspection Service · ASHRAE Standard 55
unitcheatsheet.com/cheatsheets/temperature-reference · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Copper pipe size *chart* (Type K, L, M)

Copper tube size is nominal. The outside diameter is always **1/8 in larger** than the nominal size, so **1/2 in copper has a 0.625 in OD**. **Type K** has the thickest wall, **Type L** is medium and **Type M** is the thinnest. All three have the same OD, so they use the same fittings.

NOMINAL SIZE	OD, IN (MM)	K WALL, IN (MM)	K ID, IN (MM)	L WALL, IN (MM)	L ID, IN (MM)	M WALL, IN (MM)	M ID, IN (MM)
1/4 in	0.375 (9.5)	0.035 (0.89)	0.305 (7.75)	0.030 (0.76)	0.315 (8.00)	—	—
3/8 in	0.500 (12.7)	0.049 (1.24)	0.402 (10.21)	0.035 (0.89)	0.430 (10.92)	0.025 (0.64)	0.450 (11.43)
1/2 in	0.625 (15.9)	0.049 (1.24)	0.527 (13.39)	0.040 (1.02)	0.545 (13.84)	0.028 (0.71)	0.569 (14.45)
5/8 in	0.750 (19.0)	0.049 (1.24)	0.652 (16.56)	0.042 (1.07)	0.666 (16.92)	—	—
3/4 in	0.875 (22.2)	0.065 (1.65)	0.745 (18.92)	0.045 (1.14)	0.785 (19.94)	0.032 (0.81)	0.811 (20.60)
1 in	1.125 (28.6)	0.065 (1.65)	0.995 (25.27)	0.050 (1.27)	1.025 (26.03)	0.035 (0.89)	1.055 (26.80)
1-1/4 in	1.375 (34.9)	0.065 (1.65)	1.245 (31.62)	0.055 (1.40)	1.265 (32.13)	0.042 (1.07)	1.291 (32.79)
1-1/2 in	1.625 (41.3)	0.072 (1.83)	1.481 (37.62)	0.060 (1.52)	1.505 (38.23)	0.049 (1.24)	1.527 (38.79)
2 in	2.125 (54.0)	0.083 (2.11)	1.959 (49.76)	0.070 (1.78)	1.985 (50.42)	0.058 (1.47)	2.009 (51.03)
2-1/2 in	2.625 (66.7)	0.095 (2.41)	2.435 (61.85)	0.080 (2.03)	2.465 (62.61)	0.065 (1.65)	2.495 (63.37)
3 in	3.125 (79.4)	0.109 (2.77)	2.907 (73.84)	0.090 (2.29)	2.945 (74.80)	0.072 (1.83)	2.981 (75.72)
3-1/2 in	3.625 (92.1)	0.120 (3.05)	3.385 (85.98)	0.100 (2.54)	3.425 (86.99)	0.083 (2.11)	3.459 (87.86)
4 in	4.125 (104.8)	0.134 (3.40)	3.857 (97.97)	0.110 (2.79)	3.905 (99.19)	0.095 (2.41)	3.935 (99.95)
5 in	5.125 (130.2)	0.160 (4.06)	4.805 (122.05)	0.125 (3.17)	4.875 (123.82)	0.109 (2.77)	4.907 (124.64)
6 in	6.125 (155.6)	0.192 (4.88)	5.741 (145.82)	0.140 (3.56)	5.845 (148.46)	0.122 (3.10)	5.881 (149.38)
8 in	8.125 (206.4)	0.271 (6.88)	7.583 (192.61)	0.200 (5.08)	7.725 (196.21)	0.170 (4.32)	7.785 (197.74)
10 in	10.125 (257.2)	0.338 (8.59)	9.449 (240.00)	0.250 (6.35)	9.625 (244.47)	0.212 (5.38)	9.701 (246.41)
12 in	12.125 (308.0)	0.405 (10.29)	11.315 (287.40)	0.280 (7.11)	11.565 (293.75)	0.254 (6.45)	11.617 (295.07)

Sources: Copper Development Association, The Copper Tube Handbook · 14.2b (Type L) · 14.2c (Type M) · Copper Tube Handbook, Table 14.1 · Standards

unitcheatsheet.com/cheatsheets/copper-pipe-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Copper pipe size *chart* (Type K, L, M) Notes and pitfalls

TYPE K, L, M AND DWV COMPARED

TYPE	COLOR CODE	WALL	STANDARD	USES LISTED BY THE CDA
K	Green	Thickest	ASTM B88	Water service and distribution, fire protection, solar, fuel oil, HVAC, snow melting, compressed air, natural gas, LP gas, vacuum
L	Blue	Medium	ASTM B88	Water service and distribution, fire protection, solar, fuel oil, natural gas, LP gas, HVAC, snow melting, compressed air, vacuum
M	Red	Thinnest	ASTM B88	Water service and distribution, fire protection, solar, fuel oil, HVAC, snow melting, vacuum
DWV	Yellow	Thin	ASTM B306	Drain, waste and vent; HVAC; solar (not a pressure tube)

Sources: Copper Development Association, The Copper Tube Handbook · 14.2b (Type L) · 14.2c (Type M) · Copper Tube Handbook, Table 14.1 · Standards

unitcheatsheet.com/cheatsheets/copper-pipe-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Copper pipe size *chart* (Type K, L, M) Notes and pitfalls, continued

WEIGHT AND WATER VOLUME PER LENGTH

SIZE	K LB/FT	L LB/FT	M LB/FT	K GAL/100 FT	L GAL/100 FT	M GAL/100 FT
1/4 in	0.145	0.126	—	0.38	0.40	—
3/8 in	0.269	0.198	0.145	0.66	0.75	0.83
1/2 in	0.344	0.285	0.204	1.13	1.21	1.32
5/8 in	0.418	0.362	—	1.73	1.81	—
3/4 in	0.641	0.455	0.328	2.26	2.51	2.68
1 in	0.839	0.655	0.465	4.04	4.29	4.54
1-1/4 in	1.04	0.884	0.682	6.32	6.53	6.80
1-1/2 in	1.36	1.14	0.94	8.95	9.24	9.51
2 in	2.06	1.75	1.46	15.66	16.08	16.47
2-1/2 in	2.93	2.48	2.03	24.19	24.79	25.40
3 in	4	3.33	2.68	34.48	35.39	36.26
3-1/2 in	5.12	4.29	3.58	46.75	47.86	48.82
4 in	6.51	5.38	4.66	60.70	62.22	63.18
5 in	9.67	7.61	6.66	94.20	96.96	98.24
6 in	13.9	10.2	8.92	134.47	139.39	141.11
8 in	25.9	19.3	16.5	234.61	243.48	247.27
10 in	40.3	30.1	25.6	364.28	377.97	383.97
12 in	57.8	40.4	36.7	522.36	545.70	550.61

Sources: Copper Development Association, The Copper Tube Handbook · 14.2b (Type L) · 14.2c (Type M) · Copper Tube Handbook, Table 14.1 · Standards

unitcheatsheet.com/cheatsheets/copper-pipe-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

NPT pipe thread *chart*

The NPT size is the pipe size, not the thread diameter. A **1/2 in NPT** thread has **14 threads per inch** and is cut on pipe with a **0.840 in OD**. All NPT threads taper **1 in 16** on the diameter, and the thread angle is 60°.

SIZE	TPI	PITCH, IN	PIPE OD, IN (MM)	E0, IN	E1, IN	L1 HAND-TIGHT, IN	L2 EFFECTIVE, IN	TURNS HAND-TIGHT
1/16	27	0.03704	0.3125 (7.9)	0.27118	0.28118	0.1600	0.2611	4.3
1/8	27	0.03704	0.405 (10.3)	0.36351	0.37360	0.1615	0.2639	4.4
1/4	18	0.05556	0.540 (13.7)	0.47739	0.49163	0.2278	0.4018	4.1
3/8	18	0.05556	0.675 (17.1)	0.61201	0.62701	0.2400	0.4078	4.3
1/2	14	0.07143	0.840 (21.3)	0.75843	0.77843	0.3200	0.5337	4.5
3/4	14	0.07143	1.050 (26.7)	0.96768	0.98887	0.3390	0.5457	4.7
1	11.5	0.08696	1.315 (33.4)	1.21363	1.23863	0.4000	0.6828	4.6
1-1/4	11.5	0.08696	1.660 (42.2)	1.55713	1.58338	0.4200	0.7068	4.8
1-1/2	11.5	0.08696	1.900 (48.3)	1.79609	1.82234	0.4200	0.7235	4.8
2	11.5	0.08696	2.375 (60.3)	2.26902	2.29627	0.4360	0.7565	5.0
2-1/2	8	0.12500	2.875 (73.0)	2.71953	2.76216	0.6820	1.1375	5.5
3	8	0.12500	3.500 (88.9)	3.34062	3.38850	0.7660	1.2000	6.1
3-1/2	8	0.12500	4.000 (101.6)	3.83750	3.88881	0.8210	1.2500	6.6
4	8	0.12500	4.500 (114.3)	4.33438	4.38712	0.8440	1.3000	6.8

Sources: NBS Handbook H28 (1957), Part II · Standard
unitcheatsheet.com/cheatsheets/npt-pipe-threads · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Pipe size *chart* (NPS)

NPS (Nominal Pipe Size) is a size name, not a measured diameter. From NPS 1/8 to NPS 12, the outside diameter is larger than the NPS number: **NPS 1 has a 1.315 in (33.4 mm) OD** and, in Schedule 40, a 1.049 in (26.6 mm) ID. From NPS 14 up, the OD equals the NPS in inches. For each NPS the OD stays the same. A higher schedule adds wall, so the ID gets smaller.

NPS	OUTSIDE DIAMETER	SCH 40 WALL	SCH 40 ACTUAL ID	SCH 80 WALL	SCH 80 ACTUAL ID
1/8"	0.405" (10.3 mm)	0.068" wall	0.269" (6.8 mm)	0.095" wall	0.215" (5.5 mm)
1/4"	0.540" (13.7 mm)	0.088" wall	0.364" (9.2 mm)	0.119" wall	0.302" (7.7 mm)
3/8"	0.675" (17.1 mm)	0.091" wall	0.493" (12.5 mm)	0.126" wall	0.423" (10.7 mm)
1/2"	0.840" (21.3 mm)	0.109" wall	0.622" (15.8 mm)	0.147" wall	0.546" (13.9 mm)
3/4"	1.050" (26.7 mm)	0.113" wall	0.824" (20.9 mm)	0.154" wall	0.742" (18.8 mm)
1"	1.315" (33.4 mm)	0.133" wall	1.049" (26.6 mm)	0.179" wall	0.957" (24.3 mm)
1-1/4"	1.660" (42.2 mm)	0.140" wall	1.380" (35.1 mm)	0.191" wall	1.278" (32.5 mm)
1-1/2"	1.900" (48.3 mm)	0.145" wall	1.610" (40.9 mm)	0.200" wall	1.500" (38.1 mm)
2"	2.375" (60.3 mm)	0.154" wall	2.067" (52.5 mm)	0.218" wall	1.939" (49.3 mm)
2-1/2"	2.875" (73.0 mm)	0.203" wall	2.469" (62.7 mm)	0.276" wall	2.323" (59.0 mm)
3"	3.500" (88.9 mm)	0.216" wall	3.068" (77.9 mm)	0.300" wall	2.900" (73.7 mm)
4"	4.500" (114.3 mm)	0.237" wall	4.026" (102.3 mm)	0.337" wall	3.826" (97.2 mm)
6"	6.625" (168.3 mm)	0.280" wall	6.065" (154.1 mm)	0.432" wall	5.761" (146.3 mm)
8"	8.625" (219.1 mm)	0.322" wall	7.981" (202.7 mm)	0.500" wall	7.625" (193.7 mm)
10"	10.750" (273.1 mm)	0.365" wall	10.020" (254.5 mm)	0.594" wall	9.562" (242.9 mm)
12"	12.750" (323.8 mm)	0.406" wall	11.938" (303.2 mm)	0.688" wall	11.374" (288.9 mm)

Sources: ASME B36.10M · ASME B36.19M · ASTM D1785, F441
unitcheatsheet.com/cheatsheets/pipe-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Pipe size *chart* (NPS) Notes and pitfalls

About NPS. Nominal Pipe Size is a label, not a measurement. The same NPS has the same outside diameter regardless of schedule — the wall thickness changes (and so does the inside diameter). NPS 1/8 through NPS 12 are listed; above 14, the NPS equals the actual OD in inches.

COMMON PITFALLS

- **NPS is not a measurement.** A '1-inch pipe' has an OD of 1.315″ and (Sch 40) ID of 1.049″. Neither equals 1″. The number is a historical category, not a dimension.
- **Schedule changes the ID, not the OD.** Threading and fittings work because OD is constant. Higher schedule = thicker wall = smaller ID = more pressure rating but more flow restriction.
- **NPS ≠ NPT.** NPT (National Pipe Taper) is the thread spec. NPS is the pipe size. A '1″ NPT thread' lives on a '1″ NPS pipe.'
- **Copper tube is different.** Type K/L/M copper uses NPS-like numbering but the actual OD is 1/8″ larger than the nominal size (a '1/2″ Type L' has 5/8″ OD). Don't confuse the two systems.
- **Above NPS 14, the rule changes.** NPS 14 has OD = 14.000″ exactly, NPS 16 has OD = 16.000″, etc. Below that, look it up.

COMMON APPLICATIONS

APPLICATION	TYPICAL NPS	SCHEDULE
Residential cold water supply	1/2 or 3/4	Sch 40 (or PEX/copper)
Residential hot water supply	1/2	Sch 40 (or PEX/copper)
Residential drain (waste)	1-1/2 or 2	Sch 40 PVC/ABS
Residential sewer main	3 or 4	Sch 40 PVC/ABS
Natural gas residential	1/2 or 3/4	Sch 40 black iron
Compressed air shop (~125 psi)	3/4 or 1	Sch 40 black iron
Hydraulic lines (high pressure)	varies	Sch 80 or higher
Process piping (industrial)	varies	Per process spec

ISO / DN SIZING (METRIC PIPE)

NPS	DN (ISO)	OD (MM)	OD (IN)	NOTES
1/8"	DN6	10.3	0.405"	Smallest standard
1/4"	DN8	13.7	0.540"	
3/8"	DN10	17.1	0.675"	
1/2"	DN15	21.3	0.840"	Common residential gas / hydronic
3/4"	DN20	26.7	1.050"	Common residential water
1"	DN25	33.4	1.315"	Common main / branch
1-1/4"	DN32	42.2	1.660"	
1-1/2"	DN40	48.3	1.900"	Common drain
2"	DN50	60.3	2.375"	Standard drain main
2-1/2"	DN65	73.0	2.875"	
3"	DN80	88.9	3.500"	Common sewer main
4"	DN100	114.3	4.500"	Larger sewer / industrial
6"	DN150	168.3	6.625"	Commercial water main
8"	DN200	219.1	8.625"	Large commercial / industrial
10"	DN250	273.0	10.750"	Large industrial
12"	DN300	323.9	12.750"	Large industrial

COPPER TUBING (TYPE K, L, M)

NOMINAL	OD (IN)	OD (MM)	TYPE K WALL	TYPE L WALL	TYPE M WALL
1/4"	0.375"	9.52	0.035"	0.030"	—
3/8"	0.500"	12.70	0.049"	0.035"	0.025"
1/2"	0.625"	15.88	0.049"	0.040"	0.028"
5/8"	0.750"	19.05	0.049"	0.042"	—
3/4"	0.875"	22.23	0.065"	0.045"	0.032"
1"	1.125"	28.58	0.065"	0.050"	0.035"
1-1/4"	1.375"	34.93	0.065"	0.055"	0.042"
1-1/2"	1.625"	41.28	0.072"	0.060"	0.049"
2"	2.125"	53.98	0.083"	0.070"	0.058"
2-1/2"	2.625"	66.68	0.095"	0.080"	0.065"
3"	3.125"	79.38	0.109"	0.090"	0.072"
4"	4.125"	104.78	0.134"	0.110"	0.095"

Sources: ASME B36.10M · ASME B36.19M · ASTM D1785, F441
unitcheatsheet.com/cheatsheets/pipe-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Pipe size *chart* (NPS)
Notes and pitfalls, continued

PEX TUBING

NOMINAL	OD (IN)	OD (MM)	SDR-9 WALL	ID (SDR-9)	COMMON USE
1/4"	0.375"	9.52	0.042"	0.292"	Specialty
3/8"	0.500"	12.70	0.056"	0.389"	Single fixture supply
1/2"	0.625"	15.88	0.070"	0.485"	Most common branch
5/8"	0.750"	19.05	0.083"	0.584"	Manifold home runs
3/4"	0.875"	22.23	0.097"	0.681"	Main lines, hydronic
1"	1.125"	28.58	0.125"	0.875"	Main runs
1-1/4"	1.375"	34.93	0.153"	1.069"	Larger commercial
1-1/2"	1.625"	41.28	0.181"	1.263"	Commercial
2"	2.125"	53.98	0.236"	1.653"	Commercial

Sources: ASME B36.10M · ASME B36.19M · ASTM D1785, F441
unitcheatsheet.com/cheatsheets/pipe-sizes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Wood screw pilot hole *chart*

Drill bit selection for wood screws across hardwood, softwood, plywood, and MDF.

SCREW SIZE	SOFTWOOD PILOT	HARDWOOD PILOT	CLEARANCE HOLE	COUNTERSINK
#4	1/16" (1.6 mm)	5/64" (2.0 mm)	3/32" (2.4 mm)	1/4" CSK
#6	5/64" (2.0 mm)	3/32" (2.4 mm)	7/64" (2.8 mm)	3/8" CSK
#8	3/32" (2.4 mm)	7/64" (2.8 mm)	9/64" (3.6 mm)	3/8" CSK
#10	7/64" (2.8 mm)	1/8" (3.2 mm)	5/32" (4.0 mm)	7/16" CSK
#12	1/8" (3.2 mm)	9/64" (3.6 mm)	3/16" (4.8 mm)	1/2" CSK
#14	9/64" (3.6 mm)	5/32" (4.0 mm)	13/64" (5.2 mm)	9/16" CSK
1/4" lag	5/32" (4.0 mm)	11/64" (4.4 mm)	17/64" (6.8 mm)	—
5/16" lag	13/64" (5.2 mm)	7/32" (5.6 mm)	21/64" (8.3 mm)	—
3/8" lag	1/4" (6.4 mm)	17/64" (6.7 mm)	25/64" (9.9 mm)	—
1/2" lag	5/16" (7.9 mm)	11/32" (8.7 mm)	33/64" (13.1 mm)	—

Sources: American Wood Council (AWC) · ANSI/ASME B18.6.1 · ANSI/ASME B18.2.1
unitcheatsheet.com/cheatsheets/wood-screw-pilot-holes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart

Wood screw pilot hole *chart*
Notes and pitfalls

About wood-screw holes. A **pilot hole** sits in the lower (deeper) piece and guides the screw thread. A **clearance hole** sits in the upper piece — the screw slips through without engaging the threads, so it can pull the upper piece tight against the lower. Without a clearance hole, threads grip both pieces and the joint never closes (a problem called 'jacking').

COMMON PITFALLS

- **'Self-drilling' or 'self-tapping' screws don't need pilots.** They have a fluted tip that cuts its own pilot. But they're more expensive and don't work as well in dense hardwood — for furniture-grade joinery, pre-drill regardless.
- **Splitting on edge grain is the most common problem.** Screwing too close to the edge of a board (< 1 screw-diameter from edge) tends to split. Pre-drill larger or use a different fastening method.
- **Pilot depth matters too.** A pilot needs to go ALL the way through the depth the screw will sit in. If you stop the pilot short, the bottom of the screw enters wood without a pilot and may split or bind.
- **Countersinks are usually overkill for #6/#8 screws in softwood.** A flat-head screw can pull itself flush into softwood. In hardwood, countersink to prevent the screw head from sitting proud.
- **Lag screws need MUCH bigger pilots than wood screws.** A 1/4" lag in hardwood needs an 11/64" pilot — almost 70% of the screw diameter. Without it, the screw won't drive (or it'll snap).
- **Treated lumber corrodes regular screws fast.** Modern pressure-treated lumber (ACQ, CA) is more corrosive than older CCA-treated wood. Use stainless or specifically-rated treated-lumber screws.

COMMON APPLICATIONS

MATERIAL	PILOT GUIDANCE	NOTES
Softwood (pine, fir, cedar)	Use 60-70% of screw root diameter	Wood compresses around the thread
Hardwood (oak, maple, walnut)	Use 75-90% of screw root diameter	Wood splits without proper pilot
Plywood / MDF	Same as softwood (often slightly oversized)	Less likely to split
Particleboard / chipboard	Use 70-80% of root, OR a coarse-thread screw	Specialized confirmat screws available
End grain (face into end)	Always pre-drill; consider longer screw	End grain has poor holding power
Decking (treated lumber)	Use ACQ-rated screws (galvanized/stainless)	Standard hardware corrodes

Sources: American Wood Council (AWC) · ANSI/ASME B18.6.1 · ANSI/ASME B18.2.1
unitcheatsheet.com/cheatsheets/wood-screw-pilot-holes · Updated November 2026 · Free to print and share. Check critical values against the standard before use.

Scan or tap for the live, searchable chart