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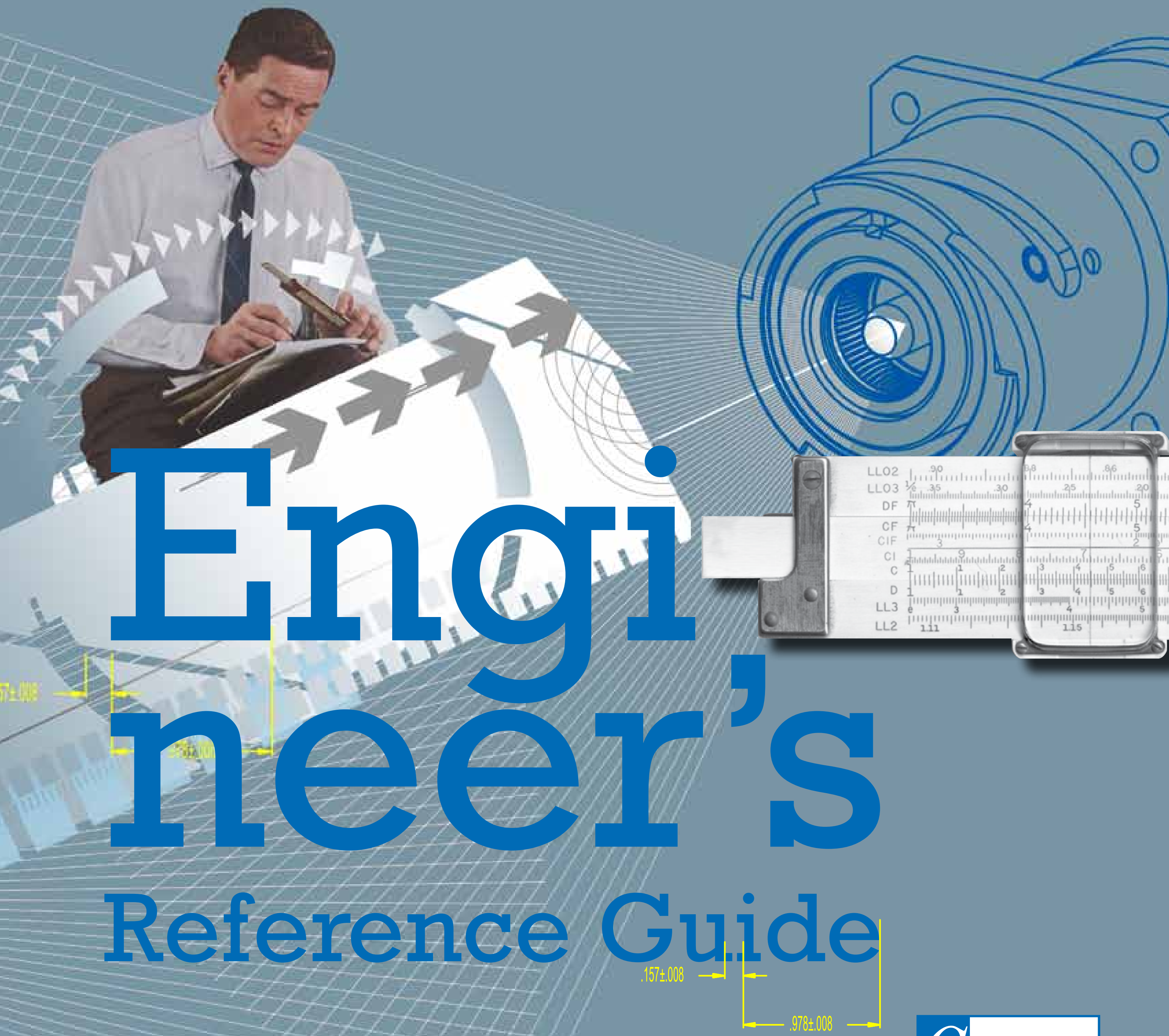


Engineer's Reference Guide

Glenair®

> *"Measurement is the act of determining the size, length, weight, time, temperature or amount of something. The science of measurement is called metrology."*

Standards

Units of measurement are generally not dictated by nature, rather, humans concoct a unit of measure and then agree to consider it a standard. There's no inherent length that equals one inch, nor is a mile ordained as superior to a kilometer. Out of convenience and necessity, measurement standards evolve to establish common benchmarks to facilitate scientific discoveries, law and commerce. We dedicate this issue of QwikConnect to the measurements commonly used in the interconnect industry, and hope that it will serve as a useful tool for interconnect engineers.

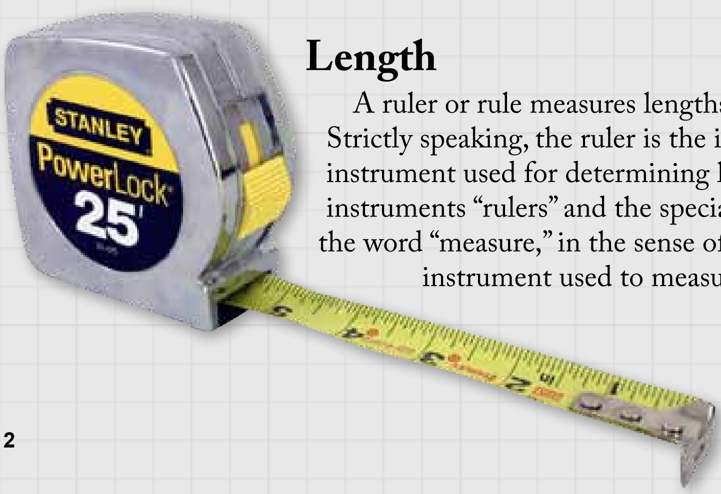
Units of Measurement

Units of measurement are generally defined in science and overseen by governmental or supra-governmental agencies. The General Conference on Weights and Measures (CGPM), established in 1875 by the Treaty of the Meter, oversees the International System of Units (SI) and has custody of the International Prototype Kilogram. The meter, for example, was redefined in 1983 by the CGPM as the distance traveled by light in free space in 1⁄299,792,458 of a second while in 1960 the international yard was defined by the governments of the United States, United Kingdom, Australia and South Africa as being exactly 0.9144 meters.

The original SI units for the six basic physical quantities were: the meter, second, kilogram, ampere, kelvin, and candela. The seventh base unit, the mole, was added in 1971 by the 14th CGPM

SI base units				
Unit name	**Unit symbol**	**Quantity name**	**Quantity symbol**	**Dimension symbol**
meter	m	length	l, x, r	L
kilogram	kg	mass	m	M
second	s	time	t	T
ampere	A	electric current	I	
kelvin	K	thermodynamic temperature	T	Θ
candela	cd	luminous intensity	I_v	J
mole	mol	amount of substance	n	N

There are two types of SI units, base units and derived units. Base units are the simple measurements for time, length, mass, temperature, amount of substance, electric current and light intensity. Derived units are constructed from the base units, for example, the watt, i.e. the unit for power, is defined from the base units as $m^2 \cdot kg \cdot s^{-3}$. Other physical properties may be measured in compound units, such as material density, measured in kg/m^3.



Length

A ruler or rule measures lengths or distances or it can be used to draw straight lines. Strictly speaking, the ruler is the instrument used to "rule" straight lines and the calibrated instrument used for determining length is called a "measure." Common usage calls both instruments "rulers" and the special name "straightedge" defines an unmarked rule. The use of the word "measure," in the sense of a measuring instrument, only survives in "tape measure," an instrument used to measure but not to draw straight lines.

Time

Time keeps track of elemental changes over a non spatial continuum. We denote time by numbers and/or named periods such as hours, days, weeks, months and years. Time is an irreversible series of occurrences within this non spatial continuum. We also use time to denote an interval between two relative points on this continuum.

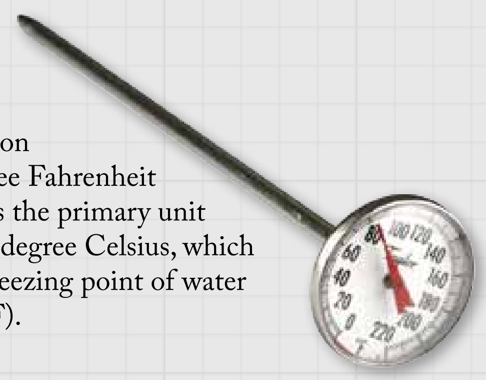
Mass

Mass refers to the intrinsic property of material objects to resist changes in their momentum. Weight, on the other hand, refers to the downward force produced when a mass is in a gravitational field. In free fall, (no net gravitational forces) objects lack weight but retain their mass. The Imperial units of mass include the ounce, pound, and ton. The metric units gram and kilogram are units of mass.

One device for measuring weight or mass is called a weighing scale or, often, simply a scale. A spring scale measures force but not mass, a balance compares weight, both require a gravitational field to operate. Some of the most accurate instruments for measuring weight or mass are based on load cells with a digital read-out, but require a gravitational field to function and would not work in free fall.

Current

The ampere, often shortened to amp, is the SI unit of electric current. Named after French mathematician and physicist André-Marie Ampère (1775–1836), Ampère's Force Law states there is an attractive or repulsive force between two parallel wires carrying an electric current. This force is used in the formal definition of the ampere, which states that it is "the constant current that will produce an attractive force of 2 × 10^{-7} newton per metre of length between two straight, parallel conductors of infinite length and negligible circular cross section placed one metre apart in a vacuum. The SI unit of charge, the "coulomb, " is the quantity of electricity carried in 1 second by a current of 1 ampere. Conversely, a current of one ampere is one coulomb of charge going past a given point per second.



Temperature

The Kelvin scale, named after engineer and physicist William Thomson, 1st Baron Kelvin (1824–1907), establishes an "absolute thermometric scale." Unlike the degree Fahrenheit and degree Celsius, the kelvin is not referred to or typeset as a degree. The kelvin is the primary unit of measurement in the physical sciences, but is often used in conjunction with the degree Celsius, which has the same magnitude. Subtracting 273.16 K from the temperature of the freezing point of water (0.01 °C) makes absolute zero (0 K) equivalent to −273.15 °C (−459.67 °F).

Light

"*Candela*," meaning "candle" in Latin, is the SI base unit of luminous intensity. It is the power emitted by a light source in a particular direction, weighted by the luminosity function—a standardized model of the sensitivity of the human eye to different wavelengths. A common candle emits light with a luminous intensity of roughly one candela. If emission in some directions is blocked by an opaque barrier, the emission would still be approximately one candela in the directions that are not obscured.

International Standards IP Protection Classification

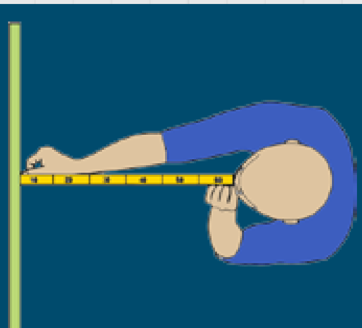
The IP Code, or Ingress Protection Rating, consists of the letters IP followed by two digits (or one digit and one letter and an optional letter.) As defined in international standard IEC 60529, IP Code classifies and rates the degrees of protection provided against the intrusion of solid objects (including body parts like hands and fingers), dust, accidental contact, and water in mechanical casings and with electrical enclosures.

First Numeral				Second Numeral		
IP		**Protection of Persons**	**Protection of Equipment**	**IP**		**Protection of Equipment**
0		No Protection	No Protection	**0**		No Protection
1		Protected against contact with large areas of the body (back of hand)	Protected against objects over 50 mm in diameter	**1**		Protected against vertically falling drops of water, e.g. condensation
2		Protected against contact with fingers	Protected against solid objects over 12 mm in diameter	**2**		Protected against direct sprays of water up to 15° from vertical
3		Protected against tools and wires over 2.5 mm in diameter	Protected against solid objects over 2.5 mm in diameter	**3**		Protected against sprays to 60° from vertical
4		Protected against tools and wires over 1 mm in diameter	Protected against objects over 1 mm in diameter	**4**		Protected against water sprayed from all directions (limited ingress permitted)
5		Protected against tools and wires over 1 mm in diameter	Protected against dust (limited ingress, no harmful deposit	**5**		Protected against low pressure jets of water from all directions (limited ingress permitted)
6		Protected against tools and wires over 1 mm in diameter	Totally protected against dust	**6**		Protected against strong jets of water
				7		Protected against the effects of immersion between 15 cm and 1 m
				8		Protected against long periods of immersion under pressure

The MEASUREMENT DICTIONARY

Arm's-length

In most cultures, the length of the human arm is, at least historically, a standardized unit of measure equal to approximately 28 inches (70 cm). The term "arm's-length" is also used figuratively to mean barely within reach, distant or detached. Examples of the former meaning include the Italian braccio, the Russian sadzhen, and the Turkish pik. An example from Shakespeare: "He took me by the wrist and held me hard. Then goes he to the length of all his arm, and, with his other hand thus o'er his brow, he falls to such perusal of my face as he would draw it. Long stayed he so." –Ophelia, Act 1, Scene 2, Hamlet.



The digits indicate conformity with the conditions summarized in the tables below. Where there is no protection rating with regard to one of the criteria, the digit is replaced with the letter X. The first digit indicates the level of protection that the enclosure provides against access to hazardous parts (e.g., electrical conductors, moving parts) and the ingress of solid foreign objects. The second digit indicates the level of protection of the equipment inside the enclosure against harmful ingress of water
For example, an electrical socket rated IP22 is protected against insertion of fingers and will not be damaged or become unsafe during a specified test in which it is exposed to vertically or nearly vertically dripping water. IP22 or 2X are typical minimum requirements for the design of electrical accessories for indoor use.

Levels of Sealing				
Connector Type	**Seal Rating**	**Sealing Method**	**Typical Shell Material**	**Contact Material**
Dust Tight	IP 65	Elastomer and/or epoxy	Aluminum or Plastic	Copper alloy/Brass/ others
Environmental	IP 66	Elastomer and/or epoxy	Aluminum or Plastic	Copper alloy/Brass/ others
Environmental	IP 67	Elastomer and/or epoxy	Aluminum or Plastic	Copper alloy/Brass/ others
Environmental	IP 68	Elastomer and/or epoxy	Aluminum or Plastic	Copper alloy/Brass/ others
Semi-Hermetic (-491 Mod Code)	1 X 10^{-4} Epoxy Special	Aluminum	Special	
Hermetic	1 X 10^{-4*}	Glass (soft) to Metal	Aluminum	Copper alloy/other
Hermetic	1 X 10^{-6*}	Glass to Metal	Cold Rolled Steel or Titanium	Alloy 52 or Kovar
Hermetic	1 X 10^{-8*}	Glass to Metal	Stainless Steel or Kovar	Alloy 52 or Kovar
Hermetic	1 X 10^{-10*}	Glass to Metal	Inconel or Stainless Steel	Inconel or Stainless Steel
Hermetic leak rate = CC He/Sec *Cubic centimeters of helium per second at 1 atmosphere pressure differential				

International Standards IP Protection Classification		
If the 1st IP number is…	**and the 2nd IP number is…**	**Then the IP rating is**
2	**3**	**IP 2 3**
(protection against solid objects)	(protection against liquids)	(Protection against touch with a finger and penetration of solid objects greater than 12 mm and against spraying water.)

The MEASUREMENT DICTIONARY

Avogadro's number (N_A)

Also known as Avogadro's constant, it is the number of atoms present in 0.012 kilograms of isotopically pure Carbon-12, being 6.0221415 x 10^{23}. By definition, the number of elementary entities (atoms or molecules) comprising one mole of a given substance. The atomic mass unit, in grams, is equal to one divided by this number. Italian chemist and physicist Amedeo Avogadro (1776–1856) was the first to conclude that equal volumes of gases (at the same temperature and pressure) must contain an equal number of molecules.

Glenair

Glenair Connector Material and Finish Options

This chart presents a selection of the broad range of base materials, plating options, specifications and codes available for Glenair-made connectors.

Code	Material	Finish	Finish Specification	Hrs. Salt Spray (dynamic)	Electrical Conductivity	Operating Temp. Range	RoHS	Notes
AB	Marine Bronze	Unplated	AMS 4640 alloy, unplated	1000	Conductive	-65 to +200°C	✓	Marine and geo-physical applications
AL	Aluminum	AlumiPlate, Clear Chromate	MIL-DTL-83488, Class 2, Type II over electroless nickel	500	Conductive	-65 to +175°C	✓	Approved for MIL-DTL-38999L and MIL-DTL-83513G.
C	Aluminum	Anodize, Black	AMS-A-8625 Type II Class 2	336	Non-Conductive	-65 to +175°C	✓	Glenair's standard black anodize finish.
E	Aluminum	Chem Film	MIL-DTL-5541 Type 1 Class 3	168	Conductive	-65 to +175°C		Glenair's standard chem film finish.
G	Aluminum	Anodize, Hardcoat	AMS-A-8625, Type III, Class 1, .001" thick	336	Non-Conductive	-65 to +200°C	✓	Glenair's preferred hardcoat finish.
JF	Aluminum	Cadmium, Gold	SAE-AMS-QQ-P-416 Type II, Class 2 over electroless nickel	48	Conductive	-65 to +175°C		Glenair's preferred gold cadmium finish.
LF	Aluminum	Cadmium, Clear	SAE-AMS-QQ-P-416 Type II Class 2 over electroless nickel	48	Conductive	-65 to +175°C		Glenair's preferred clear cadmium finish.
M	Aluminum	Electroless Nickel	AMS-C-26074 Class 4 Grade B; ASTM-B-733, SC 2, Type IV	48	Conductive	-65 to +200°C	✓	Glenair's standard electroless nickel finish.
MA	Aluminum	Electroless Nickel	AMS-C-26074 Class 4 Grade A	96	Conductive	-65 to +200°C	✓	Standard matte electroless nickel for space applications.
ME	Aluminum	Electroless Nickel	AMS-C-26074 Class 4 Grade A	96	Conductive	-65 to +200°C	✓	Electroless nickel with enhanced corrosion resistance.
MT	Aluminum	Nickel-PTFE	SAE AMS2454	500	Conductive	-65 to +175°C	✓	Approved for MIL-DTL-38999L and MIL-DTL-83513G.
NC	Aluminum	Zinc-Cobalt, Olive Drab	ASTM B 840 Grade 6 Type D over electroless nickel	350	Conductive	-65 to +175°C		Glenair's standard olive drab zinc-cobalt finish.
NF	Aluminum	Cadmium, Olive Drab	SAE-AMS-QQ-P-416 Type II Class 2 over electroless nickel	500	Conductive	-65 to +175°C		Glenair's standard olive drab cadmium finish.
TP2	Titanium	Electrodeposited Nickel	SAE-AMS-QQ-N-290 Class 1 Grade F	96	Conductive	-65 to +200°C	✓	Glenair's preferred finish for titanium connectors.
UC	Aluminum	Zinc-Cobalt, Black	ASTM B 840 Grade 6 Type D over electroless nickel	240	Conductive	-65 to +175°C		Glenair's standard black zinc-cobalt finish.
UCR	Aluminum	Zinc-Cobalt, Black	ASTM B 840 Grade 6 Type D over electroless nickel	240	Conductive	-65 to +175°C	✓	RoHS version of UC.
UF	Aluminum	Cadmium, Black	SAE-AMS-QQ-P-416 Type II Class 2 over electroless nickel	48	Conductive	-65 to +175°C		Glenair's preferred black cadmium finish.
XAL	Composite	AlumiPlate	MIL-DTL-86448, Class 2, Type II over electroless nickel	2000	Conductive	-65 to +175°C	✓	Approved for MIL-DTL-38999L.
XB	Composite	Unplated Black		2000	Non-Conductive	-65 to +175°C	✓	Glenair's standard unplated composite.
XM	Composite	Electroless Nickel	AMS-C-26074 Class 4, Grade B	2000	Conductive	-65 to +200°C	✓	Glenair's standard electroless nickel finish over composite.
XMT	Composite	Nickel-PTFE	GMF-002 Type II Class 2	2000	Conductive	-65 to +200°C	✓	Approved for MIL-DTL-38999L.
XW	Composite	Cadmium, Olive Drab	SAE-AMS-QQ-P-416 Type II Class 3 over electroless nickel	2000	Conductive	-65 to +175°C		Glenair's standard olive drab cadmium finish over composite.
XZN	Composite	Zinc-Nickel, Black	ASTM B841 Grade 5 over electroless nickel	2000	Conductive	-65 to +175°C		Glenair's standard black zinc-nickel finish over composite.
Z1	Stainless Steel	Passivate	SAE AMS 2700	500	Conductive	-65 to +200°C	✓	Glenair's standard passivated stainless steel.
Z16	Aluminum	Electroless Nickel	AMS-C-26074 Class 4 Grade B	48	Conductive	-65 to +200°C	✓	Standard matte electroless nickel for space applications
Z2	Aluminum	Gold	MIL-DTL-45204 Class 1 over electroless nickel	48	Conductive	-65 to +200°C	✓	Glenair's standard gold plating for space programs.
ZC	Stainless Steel	Zinc-Cobalt, Black	ASTM-B840, Grade 6	500	Conductive	-65 to +175°C		Glenair's standard zinc-cobalt over stainless steel.
ZCR	Stainless Steel	Zinc-Cobalt, Black	ASTM-B840, Grade 6	500	Conductive	-65 to +175°C	✓	RoHS version of ZC.
ZL	Stainless Steel	Electrodeposited Nickel	SAE-AMS-QQ-N-290 Class 2 Grade F	500	Conductive	-65 to +200°C	✓	Glenair's preferred nickel-plated stainless steel.
ZM	Stainless Steel	Electroless Nickel	AMS-C-26074 Class 1 Grade A	500	Conductive	-65 to +200°C	✓	Glenair's preferred nickel-plated stainless steel.
ZMT	Stainless Steel	Nickel-PTFE	SAE AMS2454	1000	Conductive	-65 to +175°C	✓	Glenair's new 1000 Hour Grey over stainless steel.
ZN	Aluminum	Zinc-Nickel, Olive Drab	ASTM B841 Grade 5 over electroless nickel	500	Conductive	-65 to +175°C		Glenair's standard olive drab zinc-nickel finish.
ZNU	Aluminum	Zinc-Nickel, Black	ASTM B841 Grade 5 over electroless nickel	500	Conductive	-65 to +175°C		Glenair's standard black zinc-nickel finish.
ZU	Stainless Steel	Cadmium, Black	SAE-AMS-QQ-P-416 Type II Class 2	500	Conductive	-65 to +175°C		Glenair's standard black cadmium over stainless steel.
ZW	Stainless Steel	Cadmium, Olive Drab	SAE-AMS-QQ-P-416 Type II Class 2 over electroless nickel	500	Conductive	-65 to +175°C		Glenair's standard olive drab cadmium over stainless steel.
ZR	Aluminum	Zinc-Nickel, Black	ASTM B841 Grade 5 over electroless nickel	500	Conductive	-65 to +175°C	✓	Glenair's RoHS compliant black zinc-nickel

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Glenair Backshell and Accessory Material and Finish Options

Backshell and accessory base materials, plating options, specifications and codes

Code	Material	Finish	Finish Specification	Hrs. Salt Spray (static)	Electrical Conductivity	Operating Temp. Range	RoHS	Notes
A	Aluminum	Cadmium, No Chromate	SAE-AMS-QQ-P-416 Type I Class 3	48	Conductive	-65 to +175°C		Not recommended for new projects. LF is preferred.
AB	Marine Bronze	Unplated		1000	Conductive	-65 to +200°C	✓	Marine and geophysical applications.
AL	Aluminum	AlumiPlate, Clear Chromate	MIL-DTL-83488, Class 2, Type II over electroless nickel	1000	Conductive	-65 to +175°C	✓	Approved for MIL-DTL-38999L and MIL-DTL-83513G.
B	Aluminum	Cadmium, Olive Drab	SAE-AMS-QQ-P-416 Type II Class 3	96	Conductive	-65 to +175°C		Not recommended for new projects. NF is preferred.
C	Aluminum	Anodize, Black	AMS-A-8625 Type II Class 2	336	Non-Conductive	-65 to +175°C	✓	Glenair's standard black anodize finish.
E	Aluminum	Chem Film	MIL-DTL-5541 Type 1 Class 3	168	Conductive	-65 to +175°C		Glenair's standard chem film finish.
G	Aluminum	Anodize, Hardcoat	AMS-A-8625 Type III, Class 1, .001" thick	336	Non-Conductive	-65 to +200°C	✓	Glenair's preferred hardcoat finish.
J	Aluminum	Cadmium, Gold	SAE-AMS-QQ-P-416 Type II, Class 2 over electroless nickel	500	Conductive	-65 to +175°C		Not recommended for new projects. JF is preferred.
JF	Aluminum	Cadmium, Gold	SAE-AMS-QQ-P-416 Type II, Class 2 over electroless nickel	1000	Conductive	-65 to +175°C		Glenair's preferred gold cadmium finish.
LF	Aluminum	Cadmium, Clear	SAE-AMS-QQ-P-416 Type II Class 2 over electroless nickel	1000	Conductive	-65 to +175°C		Glenair's preferred clear cadmium finish.
M	Aluminum	Electroless Nickel	AMS-C-26074 Class 4 Grade B; ASTM-B-733, SC 2, Type IV	48	Conductive	-65 to +200°C	✓	Glenair's standard electroless nickel finish.
MT	Aluminum	Nickel-PTFE	SAE AMS2454	1000	Conductive	-65 to +175°C	✓	Approved for MIL-DTL-38999L and MIL-DTL-83513G.
N	Aluminum	Cadmium, Olive Drab	SAE-AMS-QQ-P-416 Type II Class 3 over electroless nickel	500	Conductive	-65 to +175°C		Not recommended for new projects. NF is preferred.
NC	Aluminum	Zinc-Cobalt, Olive Drab	ASTM B 840 Grade 6 Type D over electroless nickel	350	Conductive	-65 to +175°C		Glenair's standard olive drab zinc-cobalt finish.
NF	Aluminum	Cadmium, Olive Drab	SAE-AMS-QQ-P-416 Type II Class 2 over electroless nickel	1000	Conductive	-65 to +175°C		Glenair's standard olive drab cadmium finish.
P	Stainless Steel	Electrodeposited Nickel	SAE-AMS-QQ-N-290 Class 1 Grade F	500	Conductive	-65 to +200°C	✓	Use ZM for electroless nickel alternative.
T	Aluminum	Cadmium, No Chromate	SAE-AMS-QQ-P-416 Type I Class 3 over electroless nickel	96	Conductive	-65 to +175°C		Not recommended for new projects. LF is preferred.
TP2	Titanium	Electrodeposited Nickel	SAE-AMS-QQ-N-290 Class 1 Grade F	96	Conductive	-65 to +200°C	✓	Glenair's preferred finish for titanium connectors.
U	Aluminum	Cadmium, Black	SAE-AMS-QQ-P-416 Type I Class 3	96	Conductive	-65 to +175°C		Not recommended for new projects. UF is preferred.
UC	Aluminum	Zinc-Cobalt, Black	ASTM B 840 Grade 6 Type D over electroless nickel	350	Conductive	-65 to +175°C		Glenair's standard black zinc-cobalt finish.
UCR	Aluminum	Zinc-Cobalt, Black	ASTM B 840 Grade 6 Type D over electroless nickel	350	Conductive	-65 to +175°C	✓	RoHS version of UC.
UF	Aluminum	Cadmium, Black	SAE-AMS-QQ-P-416 Type II Class 2 over electroless nickel	1000	Conductive	-65 to +175°C		Glenair's preferred black cadmium finish.
XAL	Composite	AlumiPlate	MIL-DTL-86448, Class 2, Type II over electroless nickel	2000	Conductive	-65 to +175°C	✓	Approved for MIL-DTL-38999L.
XB	Composite	Unplated Black		2000	Non-Conductive	-65 to +175°C	✓	Glenair's standard unplated composite.
XM	Composite	Electroless Nickel	AMS-C-26074	2000	Conductive	-65 to +175°C	✓	Glenair's standard electroless nickel finish over composite.
XMT	Composite	Nickel-PTFE	GMS-002 Class 2 Type II	2000	Conductive	-65 to +175°C	✓	Approved for MIL-DTL-38999L.
XO	Composite	Unplated Light Brown		2000	Non-Conductive	-65 to +175°C	✓	Not recommended for new projects. Use XB.
XW	Composite	Cadmium, Olive Drab	SAE-AMS-QQ-P-416 Type II Class 3 over electroless nickel	2000	Conductive	-65 to +175°C		Glenair's standard olive drab cadmium finish over composite.
XZN	Composite	Zinc-Nickel, Black	ASTM B841 Grade 5 over electroless nickel	2000	Conductive	-65 to +175°C		Glenair's standard black zinc-nickel finish over composite.
Z1	Stainless Steel	Passivate	SAE-AMS-SAE-AMS-QQ-P-35 Type VI	1000	Conductive	-65 to +200°C	✓	Glenair's standard passivated stainless steel.
Z2	Aluminum	Gold	MIL-DTL-45204 Class 1 over electroless nickel	48	Conductive	-65 to +200°C	✓	Glenair's standard gold plating for space programs.
ZC	Stainless Steel	Zinc-Cobalt, Black	ASTM-B840, Grade 6	500	Conductive	-65 to +175°C		Glenair's standard zinc-cobalt over stainless steel.
ZCR	Stainless Steel	Zinc-Cobalt, Black	ASTM-B840, Grade 6	500	Conductive	-65 to +175°C	✓	RoHS version of ZC.
ZL	Stainless Steel	Electrodeposited Nickel	SAE-AMS-QQ-N-290 Class 1 Grade F	1000	Conductive	-65 to +200°C	✓	Used on hermetic connectors. Use ZM for other applications.
ZM	Stainless Steel	Electroless Nickel	AMS-C-26074 Class 1 Grade A	1000	Conductive	-65 to +200°C	✓	Glenair's preferred nickel-plated stainless steel.
ZMT	Stainless Steel	Nickel-PTFE	SAE AMS2454	1000	Conductive	-65 to +175°C	✓	Glenair's new 1000 Hour Grey over stainless steel.
ZN	Aluminum	Zinc-Nickel, Olive Drab	ASTM B841 Grade 5 over electroless nickel	1000	Conductive	-65 to +175°C		Glenair's standard olive drab zinc-nickel finish.
ZNU	Aluminum	Zinc-Nickel, Black	ASTM B841 Grade 5 over electroless nickel	1000	Conductive	-65 to +175°C		Glenair's standard black zinc-nickel finish.
ZR	Aluminum	Zinc-Nickel, Black	ASTM B841 Grade 5 over electroless nickel	1000	Conductive	-65 to +175°C	✓	Glenair's RoHs compliant black zinc-nickel.
ZU	Stainless Steel	Cadmium, Black	SAE-AMS-QQ-P-416 Type II Class 3	1000	Conductive	-65 to +175°C		Glenair's standard black cadmium over stainless steel.
ZW	Stainless Steel	Cadmium, Olive Drab	SAE-AMS-QQ-P-416 Type II Class 2 over electroless nickel	2000	Conductive	-65 to +175°C		Glenair's standard olive drab cadmium over stainless steel.

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The Measurement Dictionary

Baker's dozen

From the archaic practice of bakers of adding a thirteenth loaf to a batch of twelve to avoid punishment for accidentally selling underweight bread. This custom dates from the thirteenth century, when the weights and prices of loaves of bread were strictly regulated, and bakers could be imprisoned for failure to deliver fair weight.

Bar

The bar is a widely used metric unit of measurement for pressure. One bar equals 100,000 Pascals. Even though bar is not an SI unit, it has been adopted as one of the most popular pressure units, particularly in European countries.

The value of 1 bar is a close approximation to atmospheric pressure and is often used to represent atmospheric pressure rather than "standard atmosphere" (101,325 Pascals) which is the correct value used by the scientific and engineering community.

Glenair Connector Plating Code and Mil-Spec Connector Finish Code Cross-Reference

MIL-DTL-38999 Series I and II

MIL-DTL-38999 Series I and II Finish Code	Material, Finish	Recommended Glenair Plating Code	Temperature Range
A	Aluminum, Cadmium Plated, Clear Chromate	**LF**	-65 to +175°C
B	Aluminum, Cadmium Plated, Olive Drab	**NF**	-65 to +175°C
C	Aluminum, Anodize, Hardcoat	**G2**	-65 to +200°C
E	Stainless Steel, Passivated	**Z1**	-65 to +200°C
F	Aluminum, Electroless Nickel Plated	**M**	-65 to +200°C
N	Stainless Steel, Electrodeposited Nickel (Hermetic)	**P**	-65 to +200°C
P	Aluminum, Pure Dense Aluminum (AlumiPlateSM)	**AL**	-65 to +175°C
R	Aluminum, Electroless Nickel Thick Matte Finish	**MA**	-65 to +200°C
T	Aluminum, Nickel-PTFE	**MT**	-65 to +175°C
U	Aluminum, Cadmium Plated, Clear Chromate	**LF**	-65 to +175°C
X	Aluminum, Cadmium Plated, Olive Drab	**NF**	-65 to +175°C
Z	Aluminum, Black Zinc-Nickel	**ZR**	-65 to +175°C

MIL-DTL-38999 Series III and IV

MIL-DTL-38999 Series III and IV Class Code	Material, Finish	Recommended Glenair Plating Code	Temperature Range
C	Aluminum, Anodize, Hardcoat	**G2**	-65 to +200°C
F	Aluminum, Electroless Nickel	**M**	-65 to +200°C
G	Aluminum, Electroless Nickel	**M**	-65 to +200°C
H	Stainless Steel, Passivated	**Z1**	-65 to +200°C
J	Composite, Cadmium Plated, Olive Drab	**XW**	-65 to +175°C
K	Stainless Steel, Passivated	**Z1**	-65 to +200°C
L	Stainless Steel, Electrodeposited Nickel	**ZL**	-65 to +200°C
M	Composite, Electroless Nickel Plated	**XM**	-65 to +200°C
P	Aluminum, Pure Dense Aluminum (AlumiPlate℠)	**AL**	-65 to +175°C
R	Aluminum, Electroless Nickel Thick Matte Finish	**MA**	-65 to +200°C
S	Stainless Steel, Electrodeposited Nickel	**ZL**	-65 to +200°C
T	Aluminum, Nickel-PTFE	**MT**	-65 to +175°C
W	Aluminum, Cadmium Plated, Olive Drab	**NF**	-65 to +175°C
X	Aluminum, Cadmium Plated, Olive Drab	**NF**	-65 to +175°C
Z	Aluminum, Black Zinc-Nickel	**ZR**	-65 to +175°C

MIL-DTL-28840			
MIL-DTL-28840 Finish Code	**Material, Finish**	**Recommended Glenair Plating Code**	**Temperature Range**
A	Aluminum, Cadmium Olive Drab over Nickel	**NF**	-65 to +175°C
B	Stainless Steel, Cadmium-Black over Nickel	**ZU**	-65 to +175°C
L	Aluminum, Nickel PTFE	**MT**	-65 to +175°C
S	Aluminum, Zinc Nickel, Non-Reflective	**ZR**	-65 to +175°C

SAE AS50151			
SAE AS50151 Class Code	**Material, Finish**	**Recommended Glenair Accessory Code**	**Temperature Range**
A, B, C, D, E, DJ, F, P, R, W	Aluminum, Cadmium Plated, Olive Drab	**NF**	-65 to +175°C
H, K	Stainless Steel, Electroless Nickel	**ZM**	-65 to +200°C
L,U	Aluminum, Electroless Nickel	**M**	-65 to +200°C

MIL-DTL-26482			
MIL-DTL-26482	**Material, Finish**	**Recommended Glenair Accessory Code**	**Temperature Range**
Series I	Aluminum, Cadmium Plated, Olive Drab	**NF**	-65 to +175°C
Series 2 Class L	Electroless Nickel	**M**	-65 to +200°C
Series 2 Class W	Aluminum, Cadmium Plated, Olive Drab	**NF**	-65 to +175°C

AS85049			
AS85049 Finish Code	**Material, Finish**	**Recommended Glenair Accessory Code**	**Temperature Range**
A	Aluminum, Black Anodize	**C**	-65 to +175°C
B	Stainless Steel, Cadmium Plated, Black	**ZU**	-65 to +175°C
G	Aluminum, Electroless Nickel Plated (Space)	**M**	-65 to +200°C
J	Composite, Cadmium Plated, Olive Drab	**XW**	-65 to +175°C
L	Composite, Cadmium Plated, Olive Drab[(1)]	**XX**	-65 to +175°C
M	Composite, Electroless Nickel Plated	**XM**	-65 to +200°C
N	Aluminum, Electroless Nickel Plated	**M**	-65 to +200°C
P	Aluminum, Cadmium Plated, Olive Drab[(1)]	**NFP**	-65 to +200°C
W	Aluminum, Cadmium Plated, Olive Drab	**NF**	-65 to +175°C
T	Composite, Unplated	**XO**	-65 to +175°C
(1) Selective plated with polysulfide barrier			

The Measurement Dictionary

Beat (music)

The beat is the basic unit of time in music. In popular use, beat can refer to a variety of related concepts including: tempo, meter, rhythm and groove. The tempo of a piece of music is defined by the number of beats equal to a whole note and is communicated in sheet music through the use of a time-signature, such as ¾, the ever popular waltz tempo, in which each measure in the composition contains 3 beats. Rhythm in music is characterized by a repeating sequence of stressed and unstressed beats (often called "strong" and "weak"). Again using the ¾ waltz as an example, the beat is counted out with the stress on the one, like so: ***one****, two, three;* ***one****, two, three.*

Beat (theater)

A theatrical (silent) pause in dialogue denoted in a script with a relative unit of time simply called a "beat." The exact length of a beat is undefined, rather it is interpreted by actors and directors according to the needs of the moment. Comedians are renowned for their use of the theatrical beat, or pregnant pause. Jack Benny was famous for his comedic timing that frequently employed a long beat or two followed by his signature exclamation, "well."

The MEASUREMENT DICTIONARY

Bell

Strikes of a ship's bell are used to indicate the hour aboard a ship and thereby to regulate the sailors' duty watches. Unlike civil clock bells, the strikes of the bell do not accord to the number of the hour. Instead, there are eight bells, one for each half-hour of a four-hour watch. In the age of sailing, watches were timed with a 30-minute hourglass. Bells would be struck every time the glass was turned, and in a pattern of pairs for easier counting, with any odd bells at the end of the sequence. Six bells in the morning watch, 7:00 for you land lubbers, was the traditional time of day for the bosun to announce with his whistle and the cry of "up spirits" the daily distribution of rum or other spirits to the crew––a practice finally outlawed on British naval ships on Black Tot Day, July 31st, 1970.

Galvanic Corrosion and Anodic Index Reference Tables

Galvanic Corrosion Table

	Metal	(V)
Most Noble/Cathodic	Gold, solid and plated, Gold-platinum alloy	0.00
	Rhodium plated on silver-plated copper	0.05
	Silver, solid or plated; monel metal. High nickel-copper alloys	0.15
	Nickel, solid or plated, titanium and special alloys such as Monel	0.30
	Copper, solid or plated; low brasses or bronzes; silver solder; German silvery high copper-nickel alloys; nickel-chromium alloys	0.35
	Brass and bronzes	0.40
	High brasses and bronzes	0.45
	18% chromium type corrosion-resistant steels	0.50
	Chromium plated; tin plated; 12% chromium type corrosion-resistant steels	0.60
	Tin-plate; tin-lead solder	0.65
	Lead, solid or plated; high lead alloys	0.70
	Aluminum, wrought alloys of the 2000 Series	0.75
	Iron, wrought, gray or malleable, plain carbon and low alloy steels	0.85
	Aluminum, wrought alloys other than 2000 Series aluminum, cast alloys of the silicon type	0.90
	Aluminum, cast alloys other than silicon type, cadmium, plated and chromate	0.95
	Hot-dip-zinc plate; galvanized steel	1.20
	Zinc, wrought; zinc-base die-casting alloys; zinc plated	1.25
	Magnesium & magnesium-base alloys, cast or wrought	1.75
Least Noble/Anodic	Beryllium	1.85

Galvanic corrosion occurs when dissimilar metals are in contact in the presence of an electrolyte. The corrosion of a metal, the anode, results from the positive current flowing from the anode to the less reactive (more noble) metal, the cathode, through the electrolyte. This form of corrosion has the potential to attack junctions of metals, or regions where one construction metal is changed to another. The critical point is the difference in potential of the two materials being considered as a joined pair.

The "anodic" or "less noble" metals such as magnesium, zinc and aluminium are more likely to be attacked than those at the "cathodic" or "noble" end of the series such as gold and silver.

Environment	Examples	Acceptable Anodic Index Difference
Harsh Environments	Outdoors, high humidity, and salt environments	Not more than 0.15 V difference
Uncontrolled Environments	Storage in warehouses or non-temperature and humidity controlled environments	Not more than 0.25 V difference
Controlled Environments	Temperature and humidity controlled	Not more than 0.50 V difference

Wire Gauge Size and Composition Reference Table

Wiring Information											
AWG wire sizes and other useful information. Reference fluoropolymer (ETFE) wire per MIL-W-22759/16 and solid wire per QQ-W-343, unless otherwise specified.											
Wire Gauge Size	Composition	Nominal Insulation Diameter	Maximum Conductor Diameter	Circular Mil Area	Wt Lbs/ 1000 ft Max	mm^2 Area	Ohms/ 1000 ft Max	TFE Insul (Amps)		PVC Insul* (Amps)	
								Bundle	Single	Bundle	Single
30	Solid		.010	101.00	.305	.049					
30**	7X38	.036.	012	112.00	.314						
28	Solid		.0126	160.00	.484	.080					
28**	7X36	.039	.015	175.00	.784						
26	Solid		.0159	254.00	.769	.128					
26**	19X38	.043	.020	304.00	.784						
24	Solid		.0201	404.00	1.22	.205					
24	19X36	.045	.024	475.00	2.57		26.20	2.0	3.3		
22	Solid		.0254	642.00	.94	.325					
22	19X34	.052	.031	754.11	3.68		16.20	2.5	4.5	5.0	9.0
20	Solid		.032	1,022.00	3.09	.519					
20	19X32	.060	.039	1,216.00	5.36		9.88	3.7	6.5	7.5	11.0
18	Solid		.0403	1,624.00	4.92	.823					
18	19X30	.071	.049	1,900.00	7.89		6.23	5.0	9.2	10.0	16.0
16	Solid		.0508	2,583.00	7.82	1.310					
16	19X29	.079	.055	2,426.30	9.95		4.81	6.5	13.0	13.0	22.0
14	Solid		.0641	4,107.00	12.40	2.080					
14	19X27	.093	.069	3,830.40	14.90		3.06	8.5	19.0	17.0	32.0
12	Solid		.080	6,530.00	19.70	3.310					
12	37X28	.114	.089	6,087.60	22.60		2.02	11.5	25.0	23.0	41.0
10	Solid		.102	10,380.00	31.40	5.270					
10	37X26	.139	.112	9,353.00	35.10		1.26	16.5	33.0	33.0	55.0
8	Solid		.1285	16,510.00	50.00	8.350					
8	133X29	.199	.169	16,984.10	63.50		.701	23.0	44.0	46.0	73.0
6	Solid		.162	26,250.00	79.40	13.300					
6	133X27	.250	.212	26,812.80	99.90		.445			60.0	101.0
4	Solid		.204	41,240.00	143.00	21.200					
4	133X25	.312	.268	42,613.00	157.00		.280			80.0	135.0
2	Solid		.258	66,370.00	200.00	33.600					
2	665X30	.388	.340	66,500.00	245.00		.183			100.0	181.0
1	Solid		.381	82,517.00	263.00	42.400					
1	817X30	.431	.380	81,700.00	314.00		.149				
1/0	Solid		.3249	105,600.0	319.50	53.490					
1/0	045X30	.479	.425	104,500.0	391.00		.116				
2/0	Solid		.3648	133,100.0	402.80	67.430					
2/0	330X30	.546	.475	133,000.0	504.00		.091				

* Based On Mil-W-5088 Ratings.
** Ref Extruded Fluoropolymer Wire (Tfe) Per Mil-W-16878D, Type Ee.

The Measurement Dictionary

Bore

In firearms, the measure of the approximate internal diameter of the barrel in relation to the diameter of the projectile used in it. Also referred to as gauge in shotguns and caliber for other guns. In a rifled barrel, the distance is measured between opposing lands and grooves; groove measurements are common in cartridge designations originating in the United States, while land measurements are more common elsewhere. A bullet should closely match the groove diameter of a barrel to ensure a good seal.

When the barrel diameter is given in inches, the abbreviation "cal" is used in place of "inches." For example, a small bore rifle with a diameter of 0.22 inch is a .22 cal; however, the decimal point is generally dropped when spoken, making it "twenty-two caliber" or simply a "two-two". Calibers of firearms can be referred to in millimeters, as in a "caliber of eighty-eight millimeters" (88 mm) or "a hundred and five-millimeter caliber gun" (often abbreviated as "105 mm gun").

EMP Diode Waveform Specifications

When specifying transient voltage suppression for a given lightning strike waveform (or "shape") and level (or magnitude), diodes must be compatible with EMI filter dielectric withstanding voltage (DWV) rating, expressed in volts at a given frequency at ambient temperature defining the maximum voltage a dielectric material can withstand before failing.

Diode Power Selection for Lightning Strike Waveform Threats

DO 160 Waveform	Level	Open Circuit Voltage/ Short Circuit Current (V/A)	Diode Peak Voltage (Vwm)	Diode Clamp Voltage (Vc)	Recomended Diode Power (Watts)
1 MHz Damped Ringing Sine 3	1	100/4	5 to 60	9.2 to 96.8	600
	2	250/10	5 to 150	9.2 to 243	600
	3	600/24	5 to 170	9.2 to 275	600
	4	1500/60	5 to 54	9.2 to 87.1	600
			58 to 150	93.6 to 243	1500
			160 to 170	259 to 275	3000
	5	3200/128	5 to 22	9.2 to 38.9	600
			26 to 60	42.1 to 96.8	1500
			64 to 130	103 to 209	3000
			150 to 170	243 to 275	5000
Double Exponential 6.4 x70 µsec 4	1	50/10	5 to 30	9.2 to 121	600
	2	125/25	5 to 75	9.2 to 121	600
	3	300/60	5 to 17	9.2 to 27.6	600
			18 to 26	29.2 to 42.1	3000
			28 to 110	45.4 to 177	5000
			120 to 170	193 to 275	15000
	4	750/150	5 to 11	9.2 to 18.2	3000
			12 to 60	19.9 to 96.8	5000
			64 to 170	104 to 275	15000
	5	1600/320	5.5 to 24	10.5 to 38.9	5000
			26 to 78	42.1 to 126	15000
			90	141	30000
Double Exponential 40 x 120 µsec 5A	1	50/50	5 to 30	9.2 to 48.4	1500
	2	125/25	5 to 75	9.2 to 121	3000
	3	300/300	5 to 15	9.2 to 24.4	3000
			17 to 170	26.7 to 291	15000
			180	291	30000
	4	750/750	17 to 28	26.7 to 45.4	15000
			30 to 48	55.2 to 77.4	30000
	5	1600/1600	None		

The MEASUREMENT DICTIONARY

Calorie (cal)

A common name for the CGS unit of heat energy. This calorie (also called a gram calorie or small calorie) is the amount of heat required at a pressure of one atmosphere to raise the temperature of one gram of water by one degree Celsius. Unfortunately, this varies with the temperature of the water, so it is necessary to specify which degree Celsius is meant. A traditional choice was the degree from 14.5°C to 15.5°C; raising the temperature of water through this range requires 4.1858 joules, a quantity called the 15° calorie. Another choice produces the thermochemical calorie, equal to exactly 4.184 joules. More common today is the international steam table calorie, or IT calorie for short, defined by an international conference in 1956 to equal exactly 4.1868 joules, exactly 1.163 milliwatt hours, or about 0.00396832 British thermal units (Btu). The name of the unit comes from the Latin "calor," meaning "heat."

Choosing the Right Diode for EMP Suppression

Tables for the selection of diodes and recommended DWV for a specified waveform voltage threat.

1. Determine the specification threat waveform and level.
2. Determine the maximum clamping voltage that the system can tolerate (this may be a different value for each pin of the connector).
3. Move down the table to the waveform and Voc/Isc (Open Circuit Voltage/Short Circuit Current) that is covered in the specification.
4. Move across the table left to right and select the recommended diode power level.
5. If the application is a high frequency data line, a low capacitance diode will be needed. There is no difference in the power rating.
6. High speed data lines, Ethernet or USB, cannot tolerate much capacitance at all. These will need a special diode and no filter can be used.
7. If a filter is to be used in the application, consult EMI Filter Rating table (below) to determine the minimum DWV voltage needed to protect the selected filter capacitance.
8. The filter DWV rating applies with or without a diode.

EMI Filter Rating in Dielectric Withstanding Voltage (DWV) For Compatibility with Transient Suppressing Diodes

DO 160 Waveform	Level	Waveform (Voc)		*Capacitance pF Minimum*						
				19000	**16000**	**9000**	**4000**	**1650**	**400**	**200**
1 MHz Damped Ringing Sine 3	1	100	▼ *Recommended Dielectric Withstanding Voltage* ▼	500	500	500	500	500	500	500
	2	250		500	500	500	500	500	500	500
	3	600		500	500	500	670	720	720	720
	4	1500		740	840	1210	1660	1800	1800	1800
	5	3200		1580	1790	2580	3530	3840	3840	3840
Double Exponential 6.4 x70 µsec 4	1	50		500	500	500	500	500	500	500
	2	125		500	500	500	500	500	500	500
	3	300		500	500	500	500	500	500	500
	4	750		820	850	900	900	900	900	900
	5	1600		1920	1920	1920	1920	1920	1920	1920
Double Exponential 40 x 120 µsec 5A	1	50		500	500	500	500	500	500	500
	2	125		500	500	500	500	500	500	500
	3	300		500	500	500	500	500	500	500
	4	750		900	900	900	900	900	900	900
	5	1600		1920	1920	1920	1920	1920	1920	1920

The MEASUREMENT DICTIONARY

Calorie (kcal or Cal)

A common name for the MKS unit of heat energy. This unit is properly called the "kilocalorie;" it is also called the kilogram calorie or large calorie. It is often (but certainly not always!) distinguished from the small calorie by capitalizing its name and symbol. The large calorie, or rather kilocalorie, is the amount of heat required at a pressure of one atmosphere to raise the temperature of one kilogram of water by one degree Celsius. Since this is 1000 times as much water as mentioned in the definition of the small calorie, the kilocalorie equals 1000 small calories, 4.1868 kilojoules, 3.9683 Btu, or 1.163 watt hours. (These conversions assume the IT calorie is in use; see previous entry.) These are the "calories" that joggers are trying to get rid of, the ones we gain by eating. The use of the same term "calorie" for two different-size units is endlessly confusing, but we seem to be stuck with it.

The Measurement Dictionary

Candlepower (cp)

A unit formerly used for measuring the light-radiating capacity of a lamp or other light source. One candlepower represents the radiating capacity of a light with the intensity of one "international candle," or about 0.981 candela as now defined. Since 1948 the candela has been the official SI unit of light intensity, and the term "candlepower" now means a measurement of light intensity in candelas, just as "voltage" means a measurement of electric potential in volts.

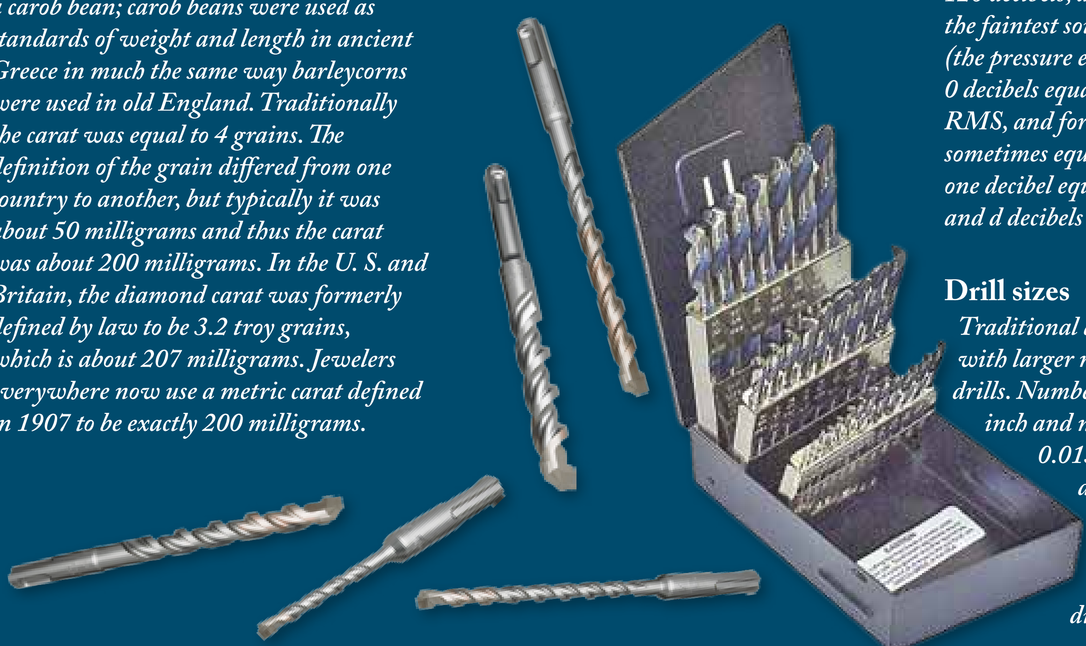
A dime is about the size of a 20 carat diamond

Carat (ct or c)

A unit of mass used for diamonds and other precious stones. Originally spelled karat, the word comes from the Greek "keration," a carob bean; carob beans were used as standards of weight and length in ancient Greece in much the same way barleycorns were used in old England. Traditionally the carat was equal to 4 grains. The definition of the grain differed from one country to another, but typically it was about 50 milligrams and thus the carat was about 200 milligrams. In the U. S. and Britain, the diamond carat was formerly defined by law to be 3.2 troy grains, which is about 207 milligrams. Jewelers everywhere now use a metric carat defined in 1907 to be exactly 200 milligrams.

Curie (Ci)

A unit of radioactivity. One curie was originally defined as the radioactivity of one gram of pure radium. In 1953 scientists agreed that the curie would represent exactly 3.7 x 10^{10} atomic disintegrations per second, or 37 gigabecquerels (GBq), this being the best estimate of the activity of a gram of radium. The unit is named for Pierre and Marie Curie, discoverers of radium.



Decibel (dB)

A customary logarithmic measure most commonly used (in various ways) for measuring sound. The human ear is capable of detecting an enormous range of sound intensities. Because of this great range, and because our perception of sound is not linear, it makes sense to measure sound on logarithmic scales. Informally, if one sound is 1 bel (10 decibels) "louder" than another, this means the louder sound is 10 times louder than the fainter one. A difference of 20 decibels corresponds to an increase of 10 x 10 or 100 times in intensity. The beginning of the scale, 0 decibels, can be set in different ways, depending on exactly which aspect of sound is being measured. For sound intensity (the power of the sound waves per unit of area) 0 decibels equals 1 picowatt per squareuare meter; this measure corresponds approximately to the faintest sound that can be detected by a person who has good hearing. A quiet room has a normal sound intensity of around 40 decibels, ten thousand times louder than the faintest perceptible sound, and a thunderclap may have an intensity of 120 decibels, a trillion times louder than the faintest sound. For sound pressure (the pressure exerted by the sound waves) 0 decibels equals 20 micropascals (μPa) RMS, and for sound power 0 decibels sometimes equals 1 picowatt. In all cases, one decibel equals about 0.115129 neper and d decibels equal d(ln 10)/20 nepers.

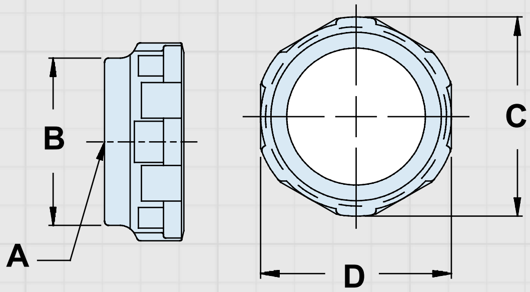
Drill sizes

Traditional drill sizes are numbers 1-80, with larger numbers indicating smaller drills. Number 1 has diameter 0.2280 inch and number 80 has diameter 0.0135 inch. Larger sizes are designated by letters or by specifying the diameter directly in 64ths of an inch. The metric drill size is the diameter in millimeters.

Connector-to-Backshell Interface Standards

See following two pages for connector designator codes.

Circular Connector Front End Dimensional Details								
Shell Size for Connector Designator					A Thread Ref	B Dia Max	C Dia Max	D Flats Ref
A	F/L	G	H	U				
-	08 09	-	-	-	7/16-28 UNEF	.59 (15.0)	.86 (21.8)	.75 (19.1)
-	-	-	09 A	-	M12 X 1 - 6H	.65 (16.5)		
08	-	-	-	-	1/2-20 UNF	.65 (16.5)		
-	-	-	-	08 9 A B	1/2-28 UNEF	.65 (16.5)	.98 (24.9)	.88 (22.2)
03	10 11	-	-	-	9/16-24 UNEF	.72 (18.3)		
-	-	-	11 B	-	M15 x 1 - 6H	.77 (19.6)		
10	-	-	-	-	5/8-24 UNEF	.77 (19.6)		
-	-	-	-	10 11 C D	5/8-28 UN	.77 (19.6)	1.16 (29.4)	1.00 (25.4)
-	12 13	-	-	-	11/16-24 UNEF	.84 (21.3)		
-	-	-	13 C	-	M18 x 1 - 6H	.89 (22.6)		
12 7	-	11 A	-	-	3/4-20 UNEF	.91 (23.1)		
-	-	-	-	12 13 F	3/4-28 UNS	91 (23.1)	1.28 (32.5)	1.13 (28.6)
-	14 15	-	-	-	13/16-20 UNEF	.97 (24.6)		
-	-	-	-	-	M22 x 1 - 6H	1.03 (26.2)		
14 12	-	13 B	13 B	-	7/8-20 UNEF	1.03 (26.2)		
-	-	-	-	14 15 G H	7/8-28 UN	1.03 (26.2)	1.41 (35.7)	1.25 (31.8)
-	16 17	-	-	-	15/16-20 UNEF	1.09 (27.7)		
-	-	-	17 E	-	M25 x 1 - 6H	1.15 (29.2)		
16 19	-	15 C	-	-	1-20 UNEF	1.15 (29.2)		
-	-	-	-	16 17 J K	1-28 UN	1.15 (29.2)	1.52 (38.5)	1.38 (35.1)
18 27	18 19	-	-	-	1-1/16-18 UNEF	1.22 (31.0)		
-	-	-	19 F	-	M28 x 1 - 6H	1.28 (32.5)		
-	-	17 D	-	-	1-1/8-18 UNEF	1.28 (32.5)		
-	-	-	-	18 19 M N	1-1/8-28 UN	1.28 (32.5)	1.64 (41.7)	1.50 (38.1)
20 37	20 21	-	-	-	1-3/16-18 UNEF	1.34 (34.0)		
-	-	-	21 G	-	M31 x 1 - 6H	1.41 (35.8)		
-	-	19 E	-	-	1-1/4-18 UNEF	1.41 (35.8)		
-	-	-	-	20 21 P R	1-1/4-28 UN	1.41 (35.8)	1.77 (44.9)	1.63 (41.3)
22	22 23	-	-	-	1-5/16-18 UNEF	1.47 (37.3)		
-	-	-	23 H	-	M34 x 1 - 6H	1.53 (38.9)		
-	-	-	-	22 23 S T	1-3/8-28 UN	1.53 (38.9)	1.89 (48.0)	1.75 (44.5)
24	24 25	23 F	-	-	1-7/16-18 UNEF	1.59 (40.4)		
-	-	-	25 J	-	M37 x 1 - 6H	1.66 (42.2)		
61	-	-	-	-	1-1/2-18 UNEF	1.66 (42.2)		
-	-	-	-	24 25 U M	1-1/2-28 UN	1.66 (42.2)	2.02 (51.2)	1.88 (47.6)
-	-	25 G	-		1-9/16-18 UNEF	1.66 (42.2)		2.00 (50.8)
28	-	-	-	-	1-3/4-18 UNS	1.97 (50.0)	2.16 (54.8)	-



NOTES:

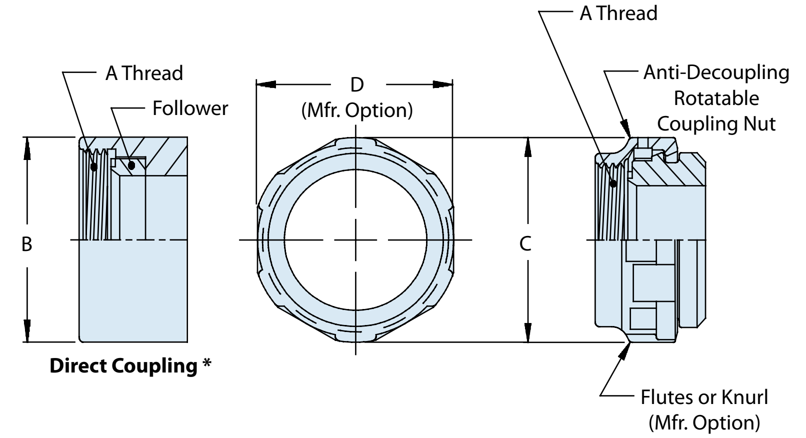
1. *Connector shell size designations in blue are for reference only; do not use in part numbers.*
2. *Metric dimensions (mm) are in parentheses and are for reference only. (1 inch = 25.4 mm)*
3. *Consult factory for accessory interface data not listed.*
4. *Use Glenair 600-091 or 600-157 tool to tighten coupling nut. Rubber jaw pliers or strap wrench may damage the parts.*

Connector-to-Backshell Interface Standards (continued)

Circular Connector Common Interface Standards

Connector Designator A

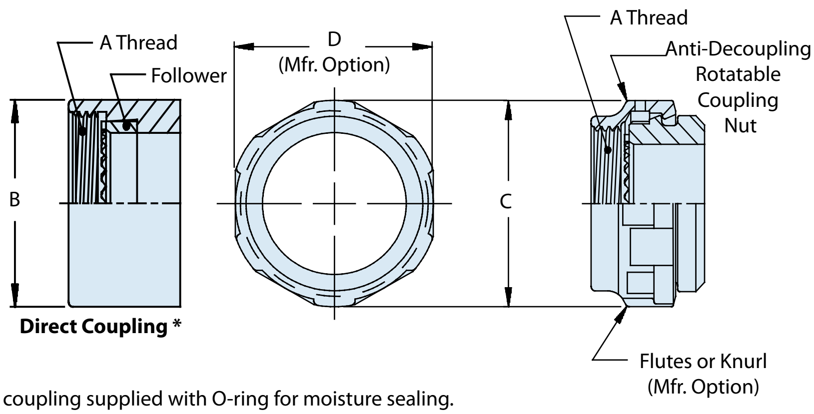
SPECIFICATION	SERIES
MIL-DTL-5015	MS34XX
MIL-DTL-26482	2
MIL-C-81703	3
MIL-DTL-83723	1 & 3
40M39569	NB
DEF 5326-3	
LN 29504	
NFC 93422	HE 302
PAN 6432-1	
PAN 6432-2	
PATT 602	
EN2997	



Note: Code A, rotatable coupling supplied without O-ring.
Environmental seal performed by interface geometry.
* Consult factory for direct coupling part numbers.

Connector Designator F

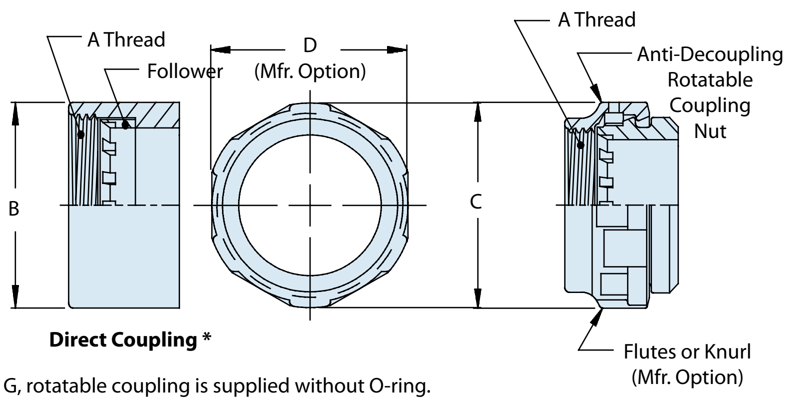
SPECIFICATION	SERIES
MIL-DTL-38999	I & II
40M38277	NLS
NFC 93422	HE 309
NFC93422	HE 308
PAN 6433-1	
PATT 614	
PATT 616	



Note: Direct coupling supplied with O-ring for moisture sealing.
Add modifier code 101A to end of part number for O-ring to be supplied on rotatable coupling.
* Consult factory for direct coupling part numbers.

Connector Designator G

SPECIFICATION
MIL-DTL-28840



Note: Code G, rotatable coupling is supplied without O-ring.
Environmental seal performed by interface geometry.
* Consult factory for direct coupling part numbers.

Circular Connector Common Interface Standards

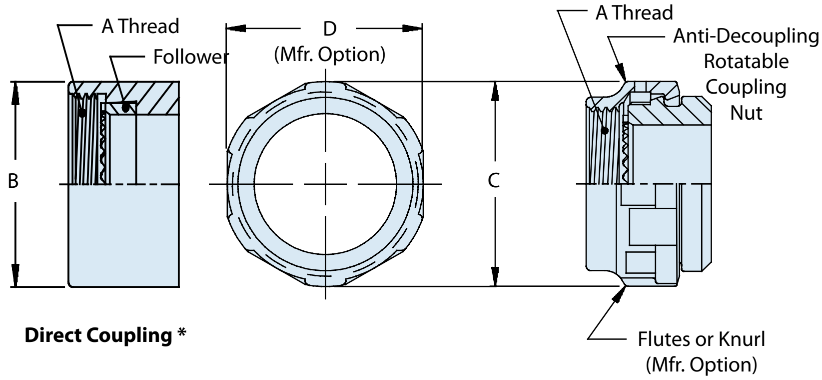
Connector Designator H

SPECIFICATION

MIL-DTL-38999
EN3645

SERIES

III & IV



Direct Coupling *

Note: Direct coupling supplied with O-ring for moisture sealing. Add modifier code 101A to end of part number for O-ring to be supplied on rotatable coupling.
* Consult factory for direct coupling part numbers.

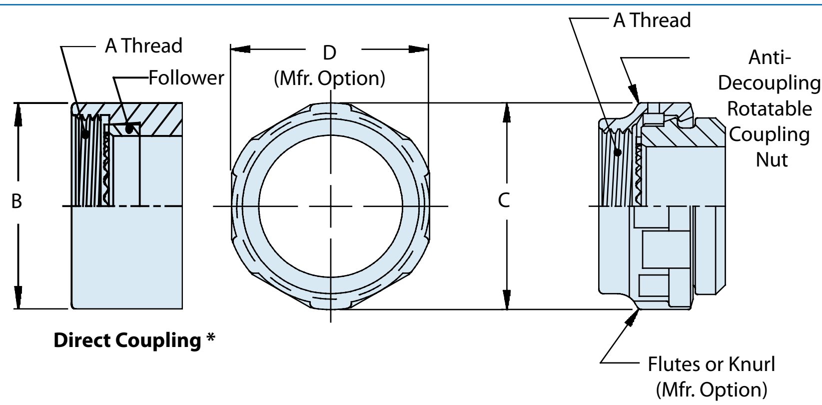
Connector Designator L

SPECIFICATION

EN3372
JN1003
LN 29729
NFC93422
PAN 6433-2
PATT
615
VG 96912

SERIES

HE306



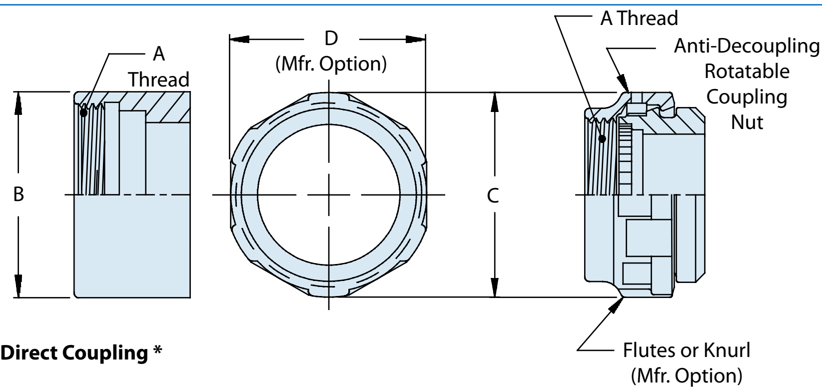
Direct Coupling *

Note: Direct coupling supplied with O-ring for moisture sealing.
Add modifier code 101A to end of part number for O-ring to be supplied on rotatable coupling.
* Consult factory for direct coupling part numbers.

Connector Designator U

SPECIFICATION

MIL-C-29600

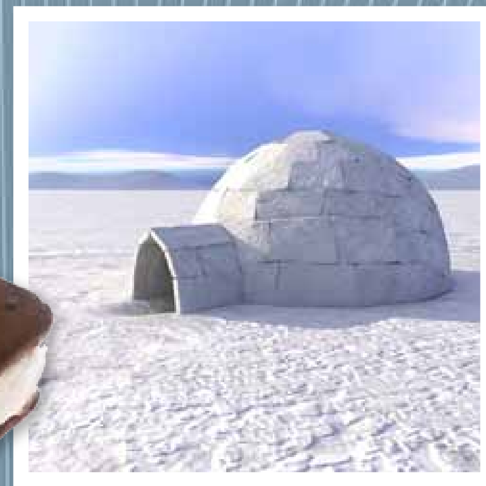


Direct Coupling *

Note: Direct coupling supplied with O-ring for moisture sealing. Add modifier code 101A to end of part number for O-ring to be supplied on rotatable coupling.
* Consult factory for direct coupling part numbers.

Illustrated Conversion Units Quick Reference Guide

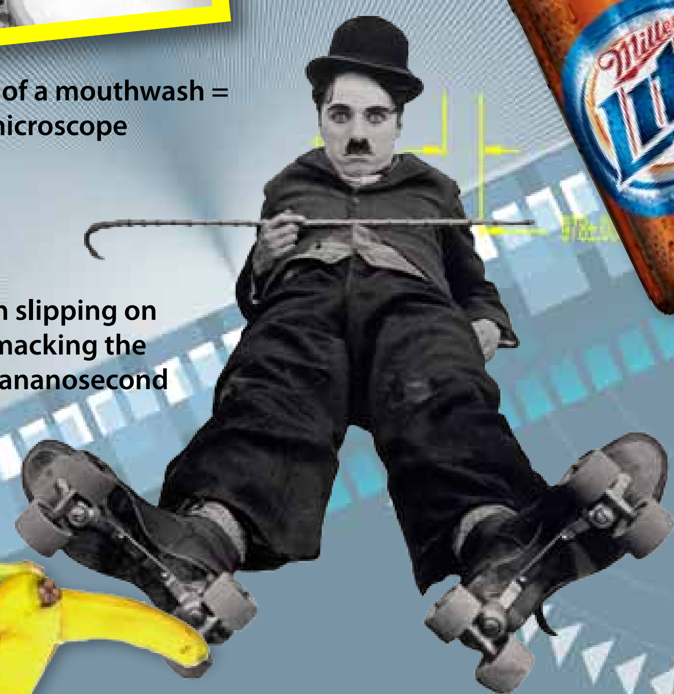
1000 aches = 1 megahurtz



Ratio of an igloo's circumference to its diameter: Eskimo Pi

1 millionth of a mouthwash = 1 microscope

365 days of drinking low-calorie beer = 1 lite year



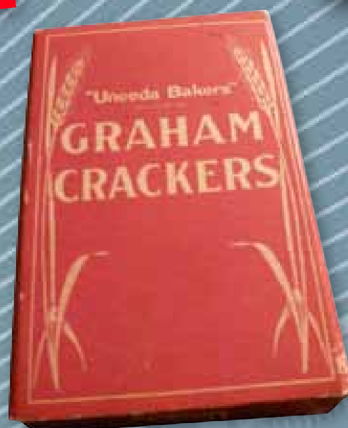
Time between slipping on a peel and smacking the pavement: 1 bananosecond

2000 pounds of Chinese soup = Won ton

Weight an evangelist carries with God: 1 billigram

1/2 million bicycles = 1 megacycle

Basic unit of laryngitis: 1 hoarsepower

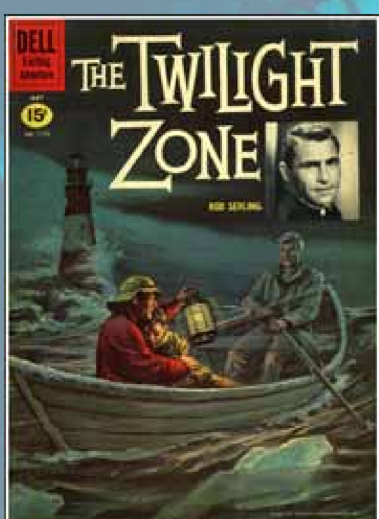


453.6 graham crackers = 1 pound cake

10 cards = 1 decacards

10 rations = 1 decoration

Shortest distance between two jokes: A straight line



16.5 feet in the Twilight Zone = 1 Rod Serling

1 million-million microphones = 1 megaphone

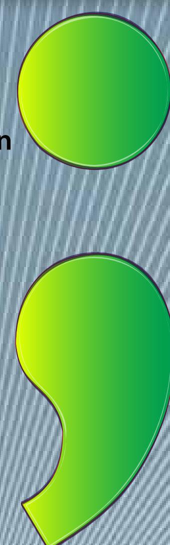
Time it takes to sail 220 yards
at 1 nautical mile per hour: Knot-furlong

2000 mockingbirds = two kilomockingbirds

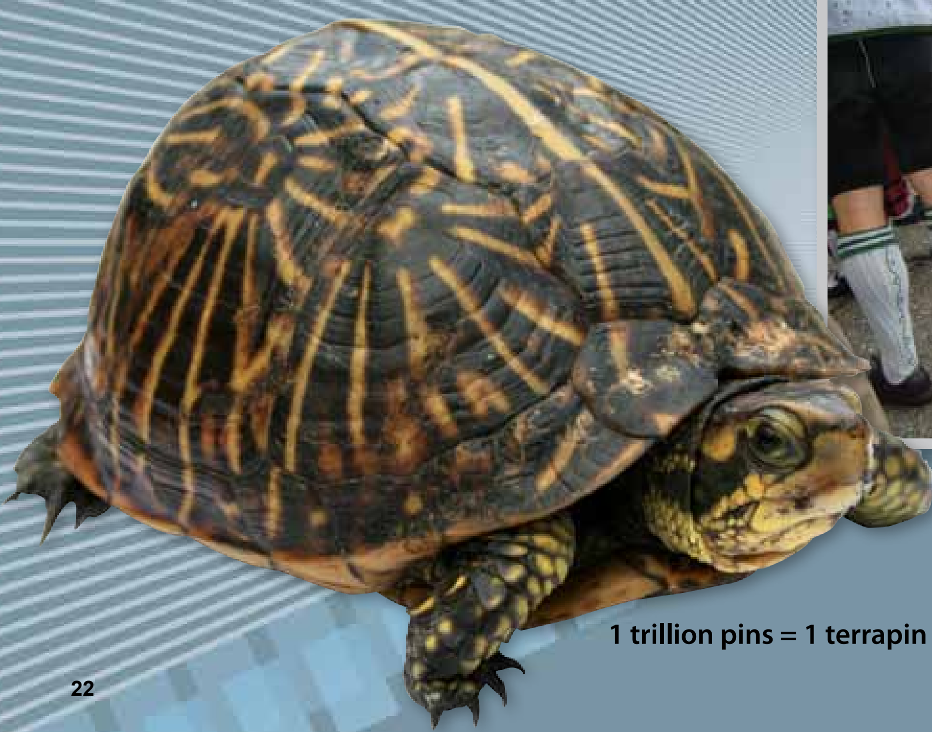
1 trillion sins =
1 cardinal sin

2 monograms =
1 diagram

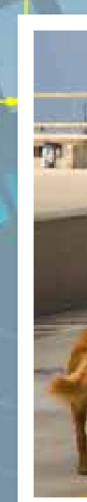
½ large
intestine =
one semicolon



1000 grams of wet socks
= 1 literhosen



1 trillion pins = 1 terrapin



1 millionth of a fish = 1 microfiche

8 nickels =
2 paradigms

4 lawyers = 2 paralegals

A first-date kiss: 1 peck

2 untruths = 1 paralyze

1 kilogram of falling figs =
1 Fig Newton

A one mile stroll: 1 Milwaukee

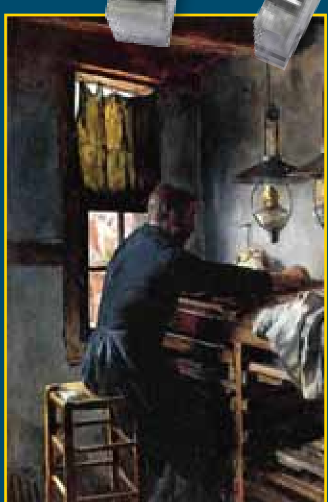
The MEASUREMENT DICTIONARY

Em

A printer's unit of relative distance, from the era of movable type. One em is the height of the type size (in points) being used. If 12 point type is being set, then one em is 12 points, and so on. An "Em dash" is used in typography to separate a subordinate clause—or a parenthetical statement—inside or at the end of a longer sentence.

En

A printer's unit of relative distance, equal to 1/2 em. If 12 point type is being set, then one en is 6 points, and so on. An "En dash" is used in typography to separate a range of numbers, as in the attribution for this picture, The Dutch Typesetter, Charles Frederic Ulrich (1858–1908)



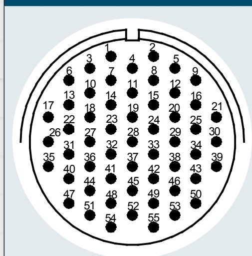
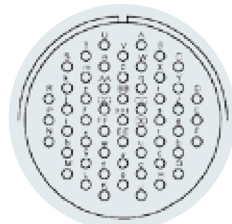
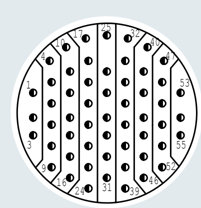
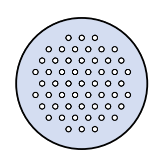
Contact Densities and Service Ratings

Center-to-Center Contact Distances

Type	Connector Specification	Insert Arrangement Specification	Max Shell Size	Max Number of Contacts	Contact Size	Center-to-Center
Standard	MIL-DTL-5015	MIL-STD-1651	48	85	16	0.241" (6.1 mm)
	MIL-DTL-22992	MIL-STD-1651	44	104	16	0.193" (4.9 mm)
	VG95234	MIL-STD-1651	26	52	16	0.203" (5.2 mm)
	MIL-DTL-28840	MIL-STD-1698	33	155	20	0.114" (2.9 mm)
Miniature	MIL-DTL-26482	MIL-STD-1669	24	61	20	0.135" (3.4 mm)
	MIL-DTL-26500	MIL-STD-1554	24	61	20	0.131" (3.3 mm)
	MIL-DTL-83723	MIL-STD-1554	24	61	20	0.131" 3.3 mm)
Subminiature	MIL-DTL-38999	MIL-STD-1560	24	128	22D	0.095" (2.4 mm)
Ultra-miniature	Series 80 "Mighty Mouse"		23	130	23	0.076" (1.9 mm)
Rectangular Nano	MIL-DTL-32139			51	30/32	0.025" (0.6 mm)
Rectangular Micro	MIL-DTL-83513			100	24/26	0.050" (1.3 mm)
D-Subminiature	M24308			104	20/22	0.109" (2.8 mm)
ARINC						

Contact Service Ratings

Service Rating	Operating Voltages	
	DC	AC RMS
A	700	500
B	2450	1750
C	4200	3000
D	1250	900
E	1750	1250
M	400	550
Instrument	250	200
I	850	600
II	1400	1000

Standard	Miniature	Subminiature	Ultraminiature
			
MIL-DTL-5015 MIL-DTL-22992 VG95234 (ITS) MIL-DTL-28840	**MIL-DTL-26482**	**MIL-DTL-38999**	**Series 80 "Mighty Mouse"**
Insert arrangement shown: 24-A55 • 55 #20 Contacts	Insert arrangement shown: 22-55 • 55 #20 Contacts	Insert arrangement shown: E35 • 55 #22D Contacts	Insert arrangement shown: 16-55 • 55 #23 Contacts

Wire Bundle Diameter Calculator

Calculating Wire Bundle Diameter	
When calculating wire bundle diameters, note that the gauge of the wire describes only the diameter of the metal conductor, and not the overall diameter including insulation and/or braids. Refer to the appropriate wire specification for the actual diameter of the wire for use in the following calculations.	
Steps	**Calculations**
(1a) Determine average wire diameter when all wires are the same diameter; or	Given 30 Wires @ .045 DIA **Avg. Wire DIA = .045**
(1b) Determine average wire diameter when wires are different diameters.	Given 15 Wires @ .045 **and** 15 Wires @ .135 15 x .045 = .68 15 x .135 = 2.03 + $\frac{2.71}{30}$ = **.090 Avg. Wire DIA** = 2.71
(2) Multiply average wire diameter by factor from Table I below	(1a) .045 x 6.5 = **.2925 Core Wire Bundle DIA** (1b) .090 x 6.5 = **.585 Core Wire Bundle DIA**
(3) Add thickness of any shielding or jacketing to core wire bundle diameter (for example, add .025 for braided sleeving	(1a) .2925 + .025 = **.3175 Wire Bundle Outside DIA** (1b) .585 + .025 = **.61 Wire Bundle Outside DIA**

Table I

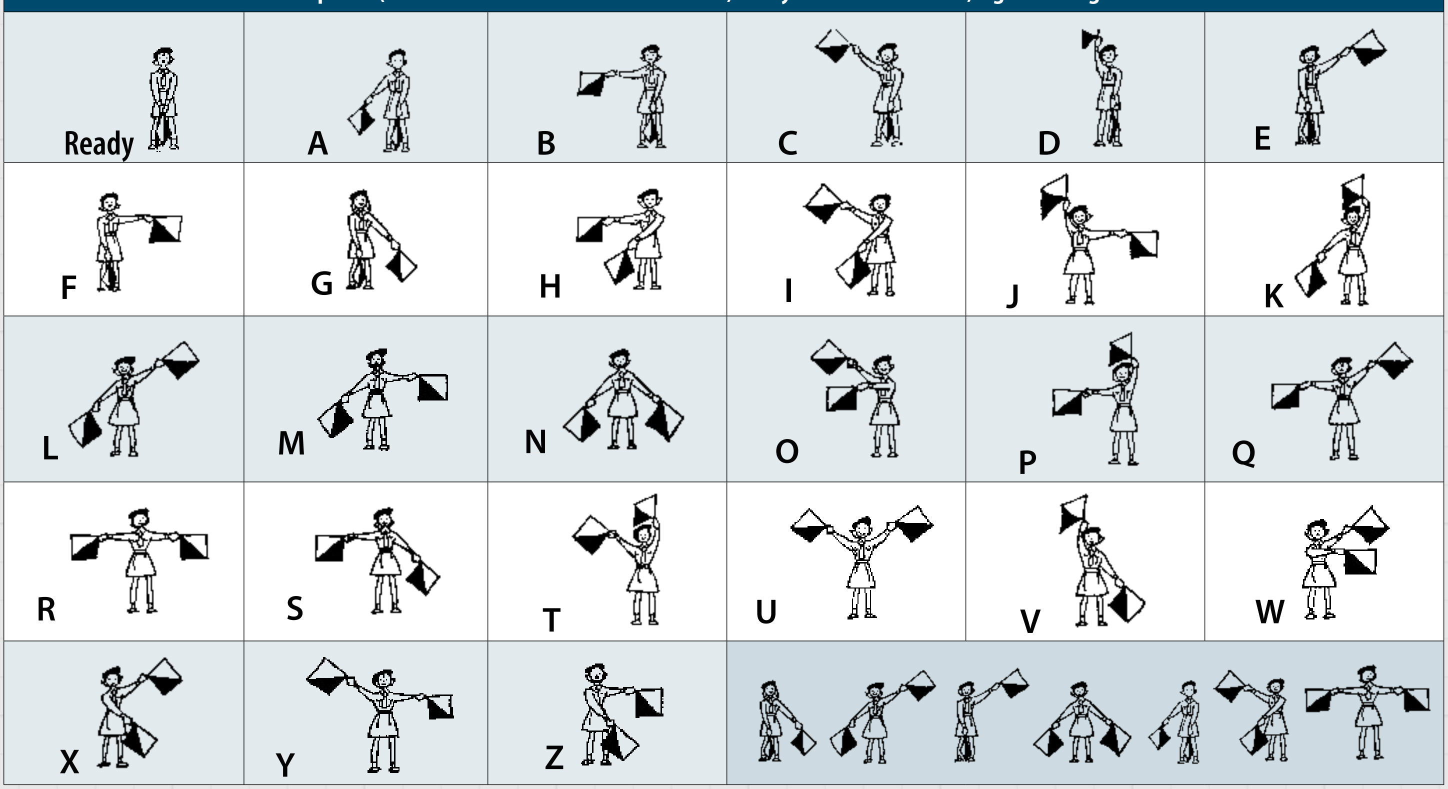
No. of Wires	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	24	28	32
Factor	1.0	2.0	2.2	2.4	2.7	2.9	3.0	3.3	3.8	4.0	4.3	4.6	5.0	5.3	5.6	6.0	6.5	6.9
No. of Wires	36	40	45	50	55	60	65	70	75	80	90	100	125	150	175	200	250	300
Factor	7.4	7.7	8.1	8.5	8.9	9.3	9.7	10.1	10.5	10.9	11.6	12.2	13.7	15.0	16.1	17.2	19.3	21.0

The Measurement Dictionary

Farad (F)

The SI unit of electric capacitance. Very early in the study of electricity scientists discovered that a pair of conductors separated by an insulator can store a much larger charge than an isolated conductor can store. The better the insulator, the larger the charge that the conductors can hold. This property of a circuit is called capacitance, and it is measured in farads. One farad is defined as the ability to store one coulomb of charge per volt of potential difference between the two conductors. This is a natural definition, but the unit it defines is very large. (Continued, next page)

Semaphore (You Never Know When You'll Need It) — If you make a mistake, signal "E" eight times.



AS39029, M29504 and Other High-Performance Contacts/Termini Reference Tables

Glenair Part Number	Part Description	Contact Size	Pin / Socket	Connector Series
MIL-DTL-38999 Fiber Optic Contacts				
181-001	M29504/5 Socket Terminus	16	Socket	D38999 Series III
181-002	M29504/4 Pin Terminus	16	Pin	D38999 Series III
181-035	Socket, Large Core Fiber	16	Socket	D38999 Series III
181-036	Pin, Large Core Fiber	16	Pin	D38999 Series III
181-052	Jewel Pin Terminus	16	Pin	D38999 Series III
181-053	Jewel Socket Terminus	16	Socket	D38999 Series III
181-048	Sealing Plug	16	Pin	D38999 Series III
181-065	#20 Pin Terminus	20	Pin	D38999 Series III
181-066	#20 Socket Terminus	20	Socket	D38999 Series III
MIL-PRF-28876 Fiber Optic Contacts				
181-039	M29504/14 Pin Terminus	16	Pin	M28876
181-040	M29504/15 Socket Terminus	16	Socket	M28876
181-051	M29504/3 Dummy Terminus	16	Dummy	M28876
Series 80 Mighty Mouse Fiber Optic Contacts				
181-057	Mighty Mouse Pin Terminus	16	Pin	Series 80 Mighty Mouse
181-075	Mighty Mouse Socket Terminus	16	Socket	Series 80 Mighty Mouse
Special Fiber Optic COTS Contacts Size 16 Front Release				
181-011	Front Release Socket with Pressure Sealing O-Ring(s)	16	Socket	COTS
181-012	Front Release Pin	16	Pin	COTS
181-051	M29504/3 Dummy Terminus	16	Dummy	COTS
ARINC Type Fiber Optic Contacts				
181-076	ARINC 801 Terminus	16	Genderless Pin	ARINC 801
187-079	M29504/6 Pin Terminus	16	Pin	ARINC 404, 600
187-080	M29504/7 Socket Terminus	16	Socket	ARINC 404, 600
Glenair High Density (GHD) Fiber Optic Contacts				
181-056	GHD Terminus, Non-keyed	18	Genderless Pin	GHD
181-047	GHD Terminus, Keyed	18	Genderless Pin	GHD
181-058	Dummy Terminus	18	Dummy	GHD
Glenair GFOCA Fiber Optic Contacts				
181-050	GFOCA Terminus		Genderless Pin	GFOCA
181-059	Dummy Terminus		Dummy	GFOCA
Next Generation Fiber Optic (NGCON) Contacts				
181-043	M29504/18	16	Genderless Pin	M64266

The Measurement Dictionary

In practical circuits, capacitance is often measured in microfarads, nanofarads, or picofarads (10^{-12} farad, or trillionths of a farad). The unit is named for the British physicist Michael Faraday (1791–1867). The picofarad (pF) is commonly pronounced "puff."

Faraday (Fd)

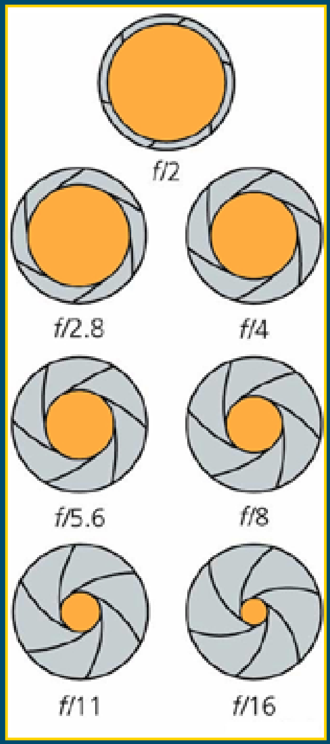
A unit of electric charge. In a process called "electrolysis," chemists separate the components of a dissolved chemical compound by passing an electric current through the compound. The components are deposited at the electrodes, where the current enters or leaves the solution. Michael Faraday determined that the same amount of charge is needed to deposit one mole of any element or ion of valence one (meaning that each molecule of the ion has either one too many or one too few electrons). This amount of charge, equal to about 96.4853 kilocoulombs or 26.8015 ampere hours, became known as Faraday's constant. Later, it was adopted as a convenient unit for measuring the charges used in electrolysis. One faraday is equal to the product of Avogadro's number and the charge (1 e) on a single electron.

Glenair Part Number	Part Description	Contact Size	Type
859-xxx	Grommet Sealing Plugs (MS27488 Type)	0-23	Sealing Plug
809-001	Series 80 Mighty Mouse Pin Contact	23	Crimp Contact
809-002	Series 80 Mighty Mouse Socket Contact	23	Crimp Contact
857-010	Pneumatic Socket Contact for Series 79	12	Pneumatic
857-011	Pneumatic Pin Contact for Series 79	12	Pneumatic
850-010	PCB Pin Contact to fit D38999/20 and /24	12-22	PCB Pin
850-011	PCB Socket Contact to fit D38999/20 and /24	12-22	PCB Socket
850-013	High Power Socket Contact	8	Power Socket
850-014	High Power Pin Contact	8	Power pin
850-015	M39029/56 Type Socket Contact with Solder Cup	10-22	Solder Cup
850-016	Pin Contact with Solder Cup	10-22	Solder Cup
850-017	M39029/58 Type Pin Contact with Solder Cup	12-22	Solder Cup
850-018	M39029/56-348 Type Socket Contact	22	Crimp Contact
850-019	M39029/58-360 Type Pin Contact	22	Crimp Contact
850-020	M39029/57 Type Socket Contact	22	Crimp Contact
857-027	M39029/58 Type High Power Pin with PC Tails	8	PCB Power
857-028	M39029/56 Type High Power Socket with PC Tails	8	PCB Power
687-348	Wire to Contact Crimp Adapter		Crimp Adapter
850-023	M39029/87 Thermocouple Pin Contact	16, 20, 22	Thermocouple
850-024	M39029/88 Thermocouple Socket Contact; Series I, II, IV	16, 20, 22	Thermocouple
850-025	M39029/89 Thermocouple Socket Contact; Series II	16, 20, 22	Thermocouple

The MEASUREMENT DICTIONARY

f ratio or f number or f stop (f/ or f)

A measure of the light-gathering power of camera and telescope lenses. The f ratio, for example "f/4" or "f4," is the aperture of the lens (the effective diameter of the lens, which may be reduced or "stopped down" for the exposure) expressed as a fraction of the focal length of the lens (the distance from the lens to the point where light is focused). Thus "f/4" indicates that the aperture is 1/4 the focal length. In cameras the f ratio is proportional to the squareuare root of the exposure time, so an f/8 setting requires a four times $((8/4)^2)$ *longer exposure than an f/4 setting. Because of this connection with exposure times, the f ratio is often said to express the "speed" of a lens.*



SAE-AS39029 Crimp Contact Selection Guide

Military Part Number	Glenair Part Number	Contact Size	Wire Accommodation	Pin / Socket	BIN Color Striping		
M39029/56-348	850-001-22-348	22	22-28 AWG	Socket	Orange	Yellow	Grey
M39029/56-351	850-001-20-351	20	20-24 AWG	Socket	Orange	Green	Brown
M39029/56-352	850-001-16-352	16	16-20 AWG	Socket	Orange	Green	Red
M39029/56-353	850-001-12-353	12	12-14 AWG	Socket	Orange	Green	Orange
M39029/56-527	850-001-10-527	10	10 AWG	Socket	Green	Red	Violet
M39029/57-354	850-003-22-354	22	22-28 AWG	Socket	Orange	Green	Yellow
M39029/57-357	850-003-20-357	20	20-24 AWG	Socket	Orange	Green	Violet
M39029/57-358	850-003-16-358	16	16-20 AWG	Socket	Orange	Green	Grey
M39029/57-359	850-003-12-359	12	12-14 AWG	Socket	Orange	Green	White
M39029/58-360	850-002-22-360	22	22-28 AWG	Pin	Orange	Blue	Black
M39029/58-363	850-002-20-363	20	20-24 AWG	Pin	Orange	Blue	Orange
M39029/58-364	850-002-16-364	16	16-20 AWG	Pin	Orange	Blue	Yellow
M39029/58-365	850-002-12-365	12	12-14 AWG	Pin	Orange	Blue	Green
M39029/58-528	850-002-10-528	10	10 AWG	Pin	Green	Red	Grey
M39029/63-368	850-021-20-368	20	20-24 AWG	Socket	Orange	Blue	Grey
M39029/64-369	850-022-20-369	20	20-24 AWG	Pin	Orange	Blue	White

BIN Color Coding									
0 BLACK	1 BROWN	2 RED	3 ORANGE	4 YELLOW	5 GREEN	6 BLUE	7 VIOLET	8 GREY	9 WHITE

Military Part Number	Glenair Part Number	Contact Size	Wire Accommodation	Pin / Socket	BIN Color Striping		
M39029/83-450	850-004-20-450	20	22-26 AWG	Pin	Yellow	Green	Black
M39029/83-451	850-004-20-451	20	28-32 AWG	Pin	Yellow	Green	Brown
M39029/83-508	850-004-20-508	20	20-24 AWG	Pin	Green	Black	Grey
M39029/84-452	850-005-20-452	20	22-26 AWG	Socket	Yellow	Green	Red
M39029/84-453	850-005-20-453	20	28-32 AWG	Socket	Yellow	Green	Orange
M39029/84-509	850-005-20-509	20	20-24 AWG	Socket	Green	Black	White
M39029/106-614	850-006-22-614	22	22-28 AWG	Socket	Blue	Brown	Yellow
M39029/106-615	850-006-20-615	20	20-24 AWG	Socket	Blue	Brown	Green
M39029/106-616	850-006-16-616	16	16-20 AWG	Socket	Blue	Brown	Blue
M39029/106-617	850-006-12-617	12	12-14 AWG	Socket	Blue	Brown	Violet
M39029/106-618	850-006-10-618	10	10 AWG	Socket	Blue	Brown	Grey
M39029/107-620	850-007-22-620	22	22-28 AWG	Pin	Blue	Red	Black
M39029/107-621	850-007-20-621	20	20-24 AWG	Pin	Blue	Black	Brown
M39029/107-622	850-007-16-622	16	16-20 AWG	Pin	Blue	Red	Red
M39029/107-623	850-007-12-623	12	12-14 AWG	Pin	Blue	Red	Orange
M39029/107-624	850-007-10-624	10	10 AWG	Pin	Blue	Red	Yellow

BIN Color Coding									
0 BLACK	1 BROWN	2 RED	3 ORANGE	4 YELLOW	5 GREEN	6 BLUE	7 VIOLET	8 GREY	9 WHITE

Basic Unit Conversion Tables

The MEASUREMENT DICTIONARY

Gauge [Ga]

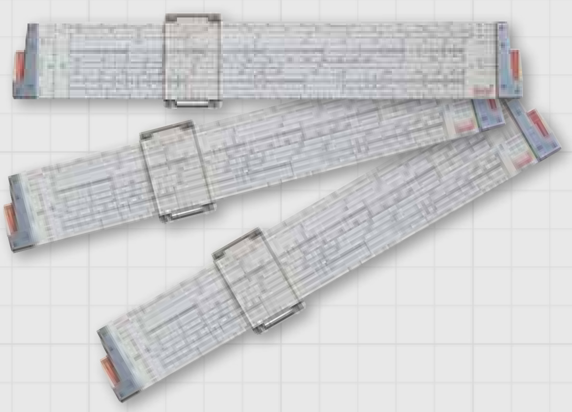
A traditional unit measuring the diameter (or the cross-sectional area) of a wire. Various wire gauge scales have been used in the U.S. and Britain. In traditional scales, larger gauge numbers represent thinner wires. (For very thick wires, repeated zeros are used instead of negative numbers, so gauges 00, 000, and 0000 represent -1, -2, and -3, respectively.) In the American Wire Gauge (AWG) scale, 0000 gauge represents a wire having a diameter of 0.46 inch and 36 gauge represents a diameter of 0.005 inch (5 mils). Diameters for the other gauges are obtained by geometric interpolation, meaning that the ratio between successive diameters is a constant, except for necessary roundoff. Thus n gauge wire has a diameter of .005•92((36-n)/39) inch. The metric wire gauge number is equal to 10 times the diameter of the wire, in millimeters; thus a metric 8 gauge wire has diameter 0.8 millimeters. A table of wire gauge equivalents is provided on Page 31.

Weights and Measures Conversion Table

From	To	Multiply by
inches	millimeters	25.4
millimeters	inches	0.0394
inches	centimeters	2.54
centimeters	inches	0.3937
feet	meters	0.3048
meters	feet	3.281
yards	meters	0.9144
meters	yards	1.094
miles	kilometers	1.609
kilometers	miles	0.6214
square inches	square centimeters	6.452
square centimeters	square inches	0.155
square meters	square feet	10.76
square feet	square meters	0.0929
square yards	square meters	0.8361
square meters	square yards	1.196
square miles	square kilometers	2.589
square kilometers	square miles	0.3861
acres	hectares	0.4047
hectares	acres	2.471
cubic inches	cubic centimeters	16.39
cubic centimeters	cubic inches	0.06102
cubic feet	cubic meters	0.02832
cubic meters	cubic feet	35.315
cubic yards	cubic meters	0.7646
cubic meters	cubic yards	1.308
cubic inches	liters	0.01639
liters	cubic inches	61.03
pints	liters	0.5682
liters	pints	1.76
US pints	liters	0.47311
liters	US pints	2.114
US gallon	liters	3.785
gallons	liters	4.546
liters	US gallons	0.2642
liters	gallons	0.22
grains	grams	0.0648
grams	grains	15.43
ounces	grams	28.35
grams	ounces	0.03527
pounds	grams	453.6
grams	pounds	0.002205
pounds	kilograms	0.4536
kilograms	pounds	2.205
tons	kilograms	1016.05
kilograms	tons	0.0009842

Inches (Decimal) To Millimeters (mm) Conversion Table			
Decimal	mm	Decimal	mm
0.001	0.0254	0.470	11.9380
0.002	0.0508	0.480	12.1920
0.003	0.0762	0.490	12.4460
0.004	0.1016	0.500	12.7000
0.005	0.1270	0.510	12.9540
0.006	0.1524	0.520	13.2080
0.007	0.1778	0.530	13.4620
0.008	0.2032	0.540	13.7160
0.009	0.2286	0.550	13.9700
0.010	0.2540	0.560	14.2240
0.020	0.5080	0.570	14.4780
0.030	0.7620	0.580	14.7320
0.040	1.0160	0.590	14.9860
0.050	1.2700	0.600	15.2400
0.060	1.5240	0.610	15.4940
0.070	1.7780	0.620	15.7480
0.080	2.0320	0.630	16.0020
0.090	2.2860	0.640	16.2560
0.100	2.5400	0.650	16.5100
0.110	2.7940	0.660	16.7640
0.120	3.0480	0.670	17.0180
0.130	3.3020	0.680	17.2720
0.140	3.5560	0.690	17.5260
0.150	3.8100	0.700	17.7800
0.160	4.0640	0.710	18.0340
0.170	4.3180	0.720	18.2880
0.180	4.5720	0.730	18.5420
0.190	4.8260	0.740	18.7960
0.200	5.0800	0.750	19.0500
0.210	5.3340	0.760	19.3040
0.220	5.5880	0.770	19.5580
0.230	5.8420	0.780	19.8120
0.240	6.0690	0.790	20.0660
0.250	6.3500	0.800	20.3200
0.260	6.6040	0.810	20.5740
0.270	6.8580	0.820	20.8280
0.280	7.1120	0.830	21.0820
0.290	7.3660	0.840	21.3360
0.300	7.6200	0.850	21.5900
0.310	7.8740	0.860	21.8440
0.320	8.1280	0.870	22.0980
0.330	8.3820	0.880	22.3520
0.340	8.6360	0.890	22.6060
0.350	8.8900	0.900	22.8600
0.360	9.1440	0.910	23.1140
0.370	9.3980	0.920	23.3680
0.380	9.6520	0.930	23.6220
0.390	9.9060	0.940	23.8760
0.400	10.1600	0.950	24.1300
0.410	10.4140	0.960	24.3840
0.420	10.6680	0.970	24.6380
0.430	10.9220	0.980	24.8920
0.440	11.1760	0.990	25.1460
0.450	11.4300	1.000	25.4000
0.460	11.6840		

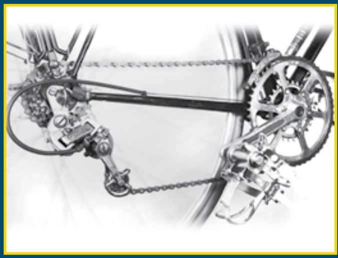
Fractions to Decimals to Millimeters (mm)					
Fraction	Decimal	mm	Fraction	Decimal	mm
1/64	0.0156	0.3969	33/64	0.5156	13.0969
1/32	0.0312	0.7938	17/32	0.5312	13.4938
3/64	0.0469	1.1906	35/64	0.5469	13.8906
1/16	0.0625	1.5875	9/16	0.5625	14.2875
5/64	0.0781	1.9844	37/64	0.5781	14.6844
3/32	0.0938	2.3812	19/32	0.5938	15.0812
7/64	0.1094	2.7781	39/64	0.6094	15.4781
1/8	0.1250	3.1750	5/8	0.6250	15.8750
9/64	0.1406	3.5719	41/64	0.6406	16.2719
5/32	0.1562	3.9688	21/32	0.6562	16.6688
11/64	0.1719	4.3656	43/64	0.6719	17.0656
3/16	0.1875	4.7625	11/16	0.6875	17.4625
13/64	0.2031	5.1594	45/64	0.7031	17.8594
7/32	0.2188	5.5562	23/32	0.7188	18.2562
15/64	0.2344	5.9531	47/64	0.7344	18.6531
1/4	0.2500	6.3500	3/4	0.7500	19.0500
17/64	0.2656	6.7469	49/64	0.7656	19.4469
9/32	0.2812	7.1438	25/32	0.7812	19.8438
19/64	0.2969	7.5406	51/64	0.7969	20.2406
5/16	0.3125	7.9375	13/16	0.8125	20.6375
21/64	0.3281	8.3344	53/64	0.8281	21.0344
11/32	0.3438	8.7312	27/32	0.8438	21.4312
23/64	0.3594	9.1281	55/64	0.8594	21.8281
3/8	0.3750	9.5250	7/8	0.8750	22.2250
25/64	0.3906	9.9219	57/64	0.8906	22.6219
13/32	0.4062	10.3188	29/32	0.9062	23.0188
27/64	0.4219	10.7156	59/64	0.9219	23.4156
7/16	0.4375	11.1125	15/16	0.9375	23.8125
29/64	0.4531	11.5094	61/64	0.9531	24.2094
15/32	0.4688	11.9062	31/32	0.9688	24.6062
31/64	0.4844	12.3031	63/64	0.9844	25.0031
1/2	0.5000	12.700	1	1.0000	25.4000



The MEASUREMENT DICTIONARY

Gear inch

A traditional unit for measuring the gears of bicycles. In low gears, the pedals are easy to turn but have to be turned very fast to achieve any speed; in high gears the pedals are harder to turn but don't have to be turned fast to achieve high speed. The gear value is computed in gear inches as the diameter of the drive wheel times the size of the front sprocket divided by the size of the rear sprocket, all measurements being in inches.

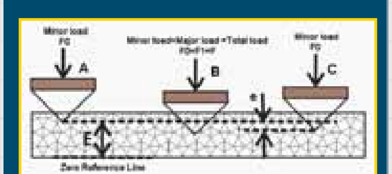


(This is the same as the diameter of the drive wheel times the number of gear teeth on the front sprocket divided by the number of teeth on the rear sprocket.) This is the diameter that the drive wheel would need to have to give the same pedal effort as if the pedals were attached directly to the wheel, as on a child's tricycle. Values range from about 25 gear inches for the low gears on mountain bikes to more than 100 gear inches for the highest gears on road bikes.

The MEASUREMENT DICTIONARY

Hardness

A measure of the hardness of a metal or mineral. Hardness is a property easy to appreciate but difficult to quantify and measure. The Mohs hardness scale is used in geology to give a rough estimate of hardness by testing which minerals are able to scratch the sample. In metallurgy, samples are tested for hardness by machines which indent the surface under a controlled pressure; the resulting measurement is often computed as the force applied divided by the surface area of the indentation. The Brinell, Vickers, Rockwell, and Knoop tests are among the techniques used. Plastics, rubber, and similar materials are tested with instruments called durometers and the resulting readings are often designated duro.



Internal Thread: M Profile

An internal thread is formed in holes, or in nuts. The M profile threads of tolerance class 6H/6g are intended for metric applications where inch class 2A/2B have been used. At the minimum material limits, the 6H/6g results in a looser fit than the 2A/2B.

Internal Thread — Limiting Dimensions M Profile

Basic Thread Designation	Tolerance Class	Minor Ø D_1 Min.	Minor Ø D_1 Max.	Pitch Ø D_2 Min.	Pitch Ø D_2 Max	Pitch Ø D_2 Tol.	Major Ø D Min.	Major Ø D Max*
M1.6 × 0.35	6H	1.221	1.321	1.373	1.458	0.085	1.600	1.736
M2 × 0.4	6H	1.567	1.679	1.740	1.830	0.090	2.000	2.148
M2.5 × 0.45	6H	2.013	2.138	2.208	2.303	0.095	2.500	2.660
M3 × 0.5	6H	2.459	2.599	2.675	2.775	0.100	3.000	3.172
M3.5 × 0.6	6H	2.850	3.010	3.110	3.222	0.112	3.500	3.698
M4 × 0.7	6H	3.242	3.422	3.545	3.663	0.118	4.000	4.219
M5 × 0.8	6H	4.134	4.334	4.480	4.605	0.125	5.000	5.240
M6 × 1	6H	4.917	5.153	5.350	5.500	0.150	6.000	6.294
M8 × 1.25	6H	6.647	6.912	7.188	7.348	0.160	8.000	8.340
M8 × 1	6H	6.917	7.153	7.350	7.500	0.150	8.000	8.294
M10 × 1.5	6H	8.376	8.676	9.026	9.206	0.180	10.000	10.397
M10 × 1.25	6H	8.647	8.912	9.188	9.348	0.160	10.000	10.340
M10 × 1	6H	8.917	9.153	9.350	9.500	0.150	10.000	10.294
M10 × 0.75	6H	9.188	9.378	9.513	9.645	0.132	10.000	10.240
M12 × 1.75	6H	10.106	10.441	10.863	11.063	0.200	12.000	12.452
M12 × 1.5	6H	10.376	10.676	11.026	11.216	0.190	12.000	12.407
M12 × 1.25	6H	10.647	10.912	11.188	11.368	0.180	12.000	12.360
M12 × 1	6H	10.917	11.153	11.350	11.510	0.160	12.000	12.304
M14 × 2	6H	11.835	12.210	12.701	12.913	0.212	14.000	14.501
M14 × 1.5	6H	12.376	12.676	13.026	13.216	0.190	14.000	14.407
M15 × 1	6H	13.917	14.153	14.350	14.510	0.160	15.000	15.304
M16 × 2	6H	13.835	14.210	14.701	14.913	0.212	16.000	16.501
M16 × 1.5	6H	14.376	14.676	15.026	15.216	0.190	16.000	16.407
M17 × 1	6H	15.917	16.153	16.350	16.510	0.160	17.000	17.304
M18 × 1.5	6H	16.376	16.676	17.026	17.216	0.190	18.000	18.407
M20 × 2.5	6H	17.294	17.744	18.376	18.600	0.224	20.000	20.585
M20 × 1.5	6H	18.376	18.676	19.026	19.216	0.190	20.000	20.407
M20 × 1	6H	18.917	19.153	19.350	19.510	0.160	20.000	20.304
M22 × 2.5	6H	19.294	19.744	20.376	20.600	0.224	22.000	22.585
M22 × 1.5	6H	20.376	20.676	21.026	21.216	0.190	22.000	22.407
M24 × 3	6H	20.752	21.252	22.051	22.316	0.265	24.000	24.698
M24 × 2	6H	21.835	22.210	22.701	22.925	0.224	24.000	24.513
M25 × 1.5	6H	23.376	23.676	24.026	24.226	0.200	25.000	25.417
M27 × 3	6H	23.752	24.252	25.051	25.316	0.265	27.000	27.698
M27 × 2	6H	24.835	25.210	25.701	25.925	0.224	27.000	27.513
M30 × 3.5	6H	26.211	26.771	27.727	28.007	0.280	30.000	30.786
M30 × 2	6H	27.835	28.210	28.701	28.925	0.224	30.000	30.513
M30 × 1.5	6H	28.376	28.676	29.026	29.226	0.200	30.000	30.417
M33 × 2	6H	30.835	31.210	31.701	31.925	0.224	33.000	33.513
M35 × 1.5	6H	33.376	33.676	34.026	34.226	0.200	35.000	35.417

Internal Thread — Limiting Dimensions M Profile								
		Minor Ø D_1		Pitch Ø D_2			Major Ø D	
Basic Thread Designation	Tolerance Class	Min.	Max.	Min.	Max	Tol.	Min.	Max*
M36 × 4	6H	31.670	32.270	33.402	33.702	0.300	36.000	36.877
M36 × 2	6H	33.835	34.210	34.701	34.925	0.224	36.000	36.513
M39 × 2	6H	36.835	37.210	37.701	37.925	0.224	39.000	39.513
M40 × 1.5	6H	38.376	38.676	39.026	39.226	0.200	40.000	40.417
M42 × 4.5	6H	37.129	37.799	39.077	39.392	0.315	42.000	42.964
M42 × 2	6H	39.835	40.210	40.701	40.925	0.224	42.000	42.513
M45 × 1.5	6H	43.376	43.676	44.026	44.226	0.200	45.000	45.417
M48 × 5	6H	42.587	43.297	44.752	45.087	0.335	48.000	49.056
M48 × 2	6H	45.835	46.210	46.701	46.937	0.236	48.000	48.525
M50 × 1.5	6H	48.376	48.676	49.026	49.238	0.212	50.000	50.429
M55 × 1.5	6H	53.376	53.676	54.026	54.238	0.212	55.000	55.429
M56 × 5.5	6H	50.046	50.796	52.428	52.783	0.355	56.000	57.149
M56 × 2	6H	53.835	54.210	54.701	54.937	0.236	56.000	56.525
M60 × 1.5	6H	58.376	58.676	59.026	59.238	0.212	60.000	60.429
M64 × 6	6H	57.505	58.305	60.103	60.478	0.375	64.000	65.241
M64 × 2	6H	61.835	62.210	62.701	62.937	0.236	64.000	64.525
M65 × 1.5	6H	63.376	63.676	64.026	64.238	0.212	65.000	65.429
M70 × 1.5	6H	68.376	68.676	69.026	69.238	0.212	70.000	70.429
M72 × 6	6H	65.505	66.305	68.103	68.478	0.375	72.000	73.241
M72 × 2	6H	69.835	70.210	70.701	70.937	0.236	72.000	72.525
M75 × 1.5	6H	73.376	73.676	74.026	74.238	0.212	75.000	75.429
M80 × 6	6H	73.505	74.305	76.103	76.478	0.375	80.000	81.241
M80 × 2	6H	77.835	78.210	78.701	78.937	0.236	80.000	80.525
M80 × 1.5	6H	78.376	78.676	79.026	79.238	0.212	80.000	80.429
M85 × 2	6H	82.835	83.210	83.701	83.937	0.236	85.000	85.525
M90 × 6	6H	83.505	84.305	86.103	86.478	0.375	90.000	91.241
M90 × 2	6H	87.835	88.210	88.701	88.937	0.236	90.000	90.525
M95 × 2	6H	92.835	93.210	93.701	93.951	0.250	95.000	95.539
M100 × 6	6H	93.505	94.305	96.103	96.503	0.400	100.000	101.266
M100 × 2	6H	97.835	98.210	98.701	98.951	0.250	100.000	100.539
M105 × 2	6H	102.835	103.210	103.701	103.951	0.250	105.000	105.539
M110 × 2	6H	107.835	108.210	108.701	108.951	0.250	110.000	110.539
M120 × 2	6H	117.835	118.210	118.701	118.951	0.250	120.000	120.539
M130 × 2	6H	127.835	128.210	128.701	128.951	0.250	130.000	130.539
M140 × 2	6H	137.835	138.210	138.701	138.951	0.250	140.000	140.539
M150 × 2	6H	147.835	148.210	148.701	148.951	0.250	150.000	150.539
M160 × 3	6H	156.752	157.252	158.051	158.351	0.300	160.000	160.733
M170 × 3	6H	166.752	167.252	168.051	168.351	0.300	170.000	170.733
M180 × 3	6H	176.752	177.252	178.051	178.351	0.300	180.000	180.733
M190 × 3	6H	186.752	187.252	188.051	188.386	0.335	190.000	190.768
M200 × 3	6H	196.752	197.252	198.051	198.386	0.335	200.000	200.768

NOTE: All dimensions are in millimeters.

*This Reference dimension is used in the design of tools, etc. In dimensioning internal threads it is not normally specified. Generally, major diameter acceptance is based on maximum material condition gaging.

The Measurement Dictionary

Hertz (Hz)

the SI unit of frequency, equal to one cycle per second. The hertz is used to measure the rates of events that happen periodically in a fixed and definite cycle; the becquerel, also equal to one "event" per second, is used to measure the rates of things which happen randomly or unpredictably. Multiples of the hertz are common: the frequencies of radio and television waves are measured in kilohertz (kHz), megahertz (MHz), or even gigahertz (GHz), and the frequencies of light waves in terahertz (THz).

The unit is named for the German physicist Heinrich Rudolf Hertz (1857–1894), who proved in 1887 that energy is transmitted through a vacuum by electromagnetic waves.

The Measurement Dictionary

Inch of mercury (in Hg)

a traditional unit of atmospheric pressure. In the United States, atmospheric pressure is customarily expressed as the height of a column of mercury exerting the same pressure as the atmosphere. When a traditional mercury barometer is used, this height is read directly as the height of the mercury column. These readings must be corrected for temperature since mercury, like most liquids, tends to expand as it warms. The conventional equivalent of one inch of mercury is 0.491153 pounds per squareuare inch or 3.38638 kilopascals (33.8638 millibars). In the symbol for the unit, Hg is the chemical symbol for mercury; it comes from the Latin word hydrargyrum ("water-silver") for the liquid metal.

International rubber hardness degree (IRHD)

a unit used to measure the hardness of rubber and similar materials (technically known as elastomers). Measurements are made using an IRHD durometer, and the results are usually similar, but not identical, to readings made with the older Shore "A" durometer.

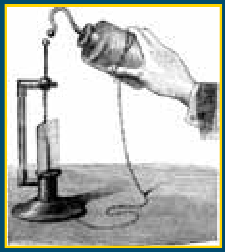
External Thread /Internal Thread									
	Nominal Size, TPI, Series	Class	Allowance	Max A Major Max Minor	Min Major Min Minor	Min B	Max A Pitch	Min Pitch	UNR C Minor Dia Major Dia (Min)
Ext.	0-80 UNF	2A	0.0005	0.0595	0.0563	-	0.0514	0.0496	0.0446
Int.		2B		0.0514	0.0465		0.0542	0.0519	0.0600
Ext.	0-80 UNF	3A	0.0000	0.0600	0.0568	-	0.0519	0.0506	0.0451
Int.		3B		0.0514	0.0465		0.0536	0.0519	0.0600
Ext.	1-64 UNC	2A	0.0006	0.0724	0.0686	-	0.0623	0.0603	0.0538
Int.		2B		0.0623	0.0561		0.0655	0.0629	0.0730
Ext.	1-64 UNC	3A	0.0000	0.0730	0.0692	-	0.0629	0.0614	0.0544
Int.		3B		0.0623	0.0561		0.0648	0.0629	0.0730
Ext.	1-72 UNF	2A	0.0006	0.0724	0.0689	-	0.0634	0.0615	0.0559
Int.		2B		0.0635	0.0580		0.0665	0.0640	0.0730
Ext.	1-72 UNF	3A	0.0000	0.0730	0.0695	-	0.0640	0.0626	0.0565
Int.		3B		0.0635	0.0580		0.0659	0.0640	0.0730
Ext.	2-56 UNC	2A	0.0006	0.0854	0.0813	-	0.0738	0.0717	0.0642
Int.		2B		0.0737	0.0667		0.0772	0.0744	0.0860
Ext.	2-56 UNC	3A	0.0000	0.0860	0.0819	-	0.0744	0.0728	0.0648
Int.		3B		0.0737	0.0667		0.0765	0.0744	0.0860
Ext.	2-64 UNF	2A	0.0006	0.0854	0.0816	-	0.0753	0.0733	0.0668
Int.		2B		0.0753	0.0691		0.0786	0.0759	0.0860
Ext.	2-64 UNF	3A	0.0000	0.0860	0.0822	-	0.0759	0.0744	0.0674
Int.		3B		0.0753	0.0691		0.0779	0.0759	0.0860
Ext.	3-48 UNC	2A	0.0007	0.0983	0.0938	-	0.0848	0.0825	0.0734
Int.		2B		0.0845	0.0764		0.0885	0.0855	0.0990
Ext.	3-48 UNC	3A	0.0000	0.0990	0.0945	-	0.0855	0.0838	0.0741
Int.		3B		0.0845	0.0764		0.0877	0.0855	0.0990
Ext.	3-56 UNF	2A	0.0007	0.0983	0.0942	-	0.0867	0.0845	0.0771
Int.		2B		0.0865	0.0797		0.0902	0.0874	0.0990
Ext.	3-56 UNF	3A	0.0000	0.0990	0.0949	-	0.0874	0.0858	0.0778
Int.		3B		0.0865	0.0797		0.0895	0.0874	0.0990
Ext.	4-40 UNC	2A	0.0008	0.1112	0.1061	-	0.0950	0.0925	0.0814
Int.		2B		0.0939	0.0849		0.0991	0.0958	0.1120
Ext.	4-40 UNC	3A	0.0000	0.1120	0.1069	-	0.0958	0.0939	0.0822
Int.		3B		0.0939	0.0849		0.0982	0.0958	0.1120
Ext.	4-48 UNF	2A	0.0007	0.1113	0.1068	-	0.0978	0.0954	0.0864
Int.		2B		0.0968	0.0894		0.1016	0.0985	0.1120
Ext.	4-48 UNF	3A	0.0000	0.1120	0.1075	-	0.0985	0.0967	0.0871
Int.		3B		0.0968	0.0894		0.1008	0.0985	0.1120
Ext.	5-40 UNC	2A	0.0008	0.1242	0.1191	-	0.1080	0.1054	0.0944
Int.		2B		0.1062	0.0979		0.1121	0.1088	0.1250
Ext.	5-40 UNC	3A	0.0000	0.1250	0.1199	-	0.1088	0.1069	0.0952
Int.		3B		0.1062	0.0979		0.1113	0.1088	0.1250
Ext.	5-44 UNF	2A	0.0007	0.1243	0.1195	-	0.1095	0.1070	0.0972
Int.		2B		0.1079	0.1004		0.1134	0.1102	0.1250
Ext.	5-44 UNF	3A	0.0000	0.1250	0.1202	-	0.1102	0.1083	0.0979
Int.		3B		0.1079	0.1004		0.1126	0.1102	0.1250
Ext.	6-32 UNC	2A	0.0008	0.1372	0.1312	-	0.1169	0.1141	0.1000
Int.		2B		0.1140	0.1040		0.1214	0.1177	0.1380
Ext.	6-32 UNC	3A	0.0000	0.1380	0.1320	-	0.1177	0.1156	0.1008
Int.		3B		0.1140	0.1040		0.1204	0.1177	0.1380

	External Thread /Internal Thread								
	Nominal Size, TPI, Series	Class	Allowance	Max A Major Max Minor	Min Major Min Minor	Min B	Max A Pitch	Min Pitch	UNR C Minor Dia Major Dia (Min)
Ext.	6-40 UNF	2A	0.0008	0.1372	0.1321	-	0.1210	0.1184	0.1074
Int.		2B		0.1190	0.1110		0.1252	0.1218	0.1380
Ext.	6-40 UNF	3A	0.0000	0.1380	0.1329	-	0.1218	0.1198	0.1082
Int.		3B		0.1186	0.1110		0.1243	0.1218	0.1380
Ext.	8-32 UNC	2A	0.0009	0.1631	0.1571	-	0.1428	0.1399	0.1259
Int.		2B		0.1390	0.1300		0.1475	0.1437	0.1640
Ext.	8-32 UNC	3A	0.0000	0.1640	0.1580	-	0.1437	0.1415	0.1268
Int.		3B		0.1389	0.1300		0.1465	0.1437	0.1640
Ext.	8-36 UNF	2A	0.0008	0.1632	0.1577	-	0.1452	0.1424	0.1301
Int.		2B		0.1420	0.1340		0.1496	0.1460	0.1640
Ext.	8-36 UNF	3A	0.0000	0.1640	0.1585	-	0.4600	0.1439	0.1309
Int.		3B		0.1416	0.1340		0.1487	0.1460	0.1640
Ext.	10-24 UNC	2A	0.0010	0.1890	0.1818	-	0.1619	0.1586	0.1394
Int.		2B		0.1560	0.1450		0.1672	0.1629	0.1900
Ext.	10-24 UNC	3A	0.0000	0.1900	0.1828	-	0.1629	0.1604	0.1404
Int.		3B		0.1555	0.1450		0.1661	0.1629	0.1900
Ext.	10-28 UNS	2A	0.0010	0.1890	0.1825	-	0.1658	0.1625	0.1464
Int.		2B		0.1600	0.1510		0.1711	0.1668	0.1900
Ext.	10-32UNF	2A	0.0009	0.1891	0.1831	-	0.1688	0.1658	0.1519
Int.		2B		0.1640	0.1560		0.1736	0.1697	0.1900
Ext.	10-32UNF	3A	0.0000	0.1900	0.1840	-	0.1697	0.1674	0.1528
Int.		3B		0.1641	0.1560		0.1726	0.1697	0.1900
Ext.	10-36 UNS	2A	0.0009	0.1891	0.1836	-	0.1711	0.1681	0.1560
Int.		2B		0.1660	0.1600		0.1759	0.1720	0.1900
Ext.	10-40 UNS	2A	0.0009	0.1891	0.1840	-	0.1729	0.1700	0.1592
Int.		2B		0.1690	0.1630		0.1775	0.1738	0.1900
Ext.	10-48 UNS	2A	0.0008	0.1892	0.1847	-	0.1757	0.1731	0.1644
Int.		2B		0.1720	0.1670		0.1799	0.1765	0.1900
Ext.	10-56 UNS	2A	0.0007	0.1893	0.1852	-	0.1777	0.1752	0.1681
Int.		2B		0.1750	0.1710		0.1816	0.1784	0.1900
Ext.	12-24 UNC	2A	0.0010	0.2150	0.2078	-	0.1879	0.1845	0.1654
Int.		2B		0.1810	0.1710		0.1933	0.1889	0.2160
Ext.	12-24 UNC	3A	0.0000	0.2160	0.2088	-	0.1889	0.1863	0.1664
Int.		3B		0.1807	0.1710		0.1922	0.1889	0.2160
Ext.	12-28 UNF	2A	0.0010	0.2150	0.2085	-	0.1918	0.1886	0.1724
Int.		2B		0.1860	0.1770		0.1970	0.1928	0.2160
Ext.	12-28 UNF	3A	0.0000	0.2160	0.2095	-	0.1928	0.1904	0.1734
Int.		3B		0.1857	0.1770		0.1959	0.1928	0.2160
Ext.	12-32 UNEF	2A	0.0009	0.2151	0.2091	-	0.1948	0.1917	0.1779
Int.		2B		0.1900	0.1820		0.1998	0.1957	0.2160
Ext.	12-32 UNEF	3A	0.0000	0.2160	0.2100	-	0.1957	0.1933	0.1788
Int.		3B		0.1895	0.1820		0.1988	0.1957	0.2160
Ext.	12-36 UNS	2A	0.0009	0.2151	0.2096	-	0.1971	0.1941	0.1821
Int.		2B		0.1920	0.1860		0.2019	0.1980	0.2160
Ext.	12-40 UNS	2A	0.0009	0.2151	0.2100	-	0.1989	0.1960	0.1835
Int.		2B		0.1950	0.1890		0.2035	0.1998	0.2160
Ext.	12-48 UNS	2A	0.0008	0.2152	0.2107	-	0.2017	0.1991	0.1904

The MEASUREMENT DICTIONARY

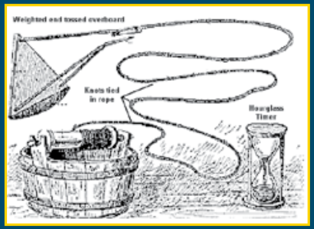
Jar

A traditional unit of electric capacitance, approximately equal to the capacitance of one of the Leiden jars used in electrical experiments as long ago as the eighteenth century. Benjamin Franklin is said to have measured the storage power of his electrical equipment in jars. There are 9 x 10^8 jars in a farad, so 1 jar is approximately 1.1 nanofarad.



Knot (kn or kt)

A unit of velocity equal to one nautical mile per hour. Knots are customarily used to express speeds at sea, including the speed of the ship as well as the speeds of the wind and of the current. The word comes from the former method of measuring a ship's speed, which involved use of a knotted cord called the log line. One knot equals about 1.1508 miles per hour, exactly 1.852 kilometers per hour, or 0.5143 meters per second. Since kt is the established symbol for the kilotonne, kn is the best choice as a symbol for the knot.



The MEASUREMENT DICTIONARY

Mach or mach (M or Ma)

A measure of relative velocity, used to express the speed of an aircraft relative to the speed of sound. The name of the unit is often placed before the measurement. Thus "Mach 1.0" is the speed of sound, "Mach 2.0" is twice the speed of sound, and so on. (The actual speed of sound varies, depending on the density and temperature of the atmosphere. At 0 °C and a pressure of 1 atmosphere the speed of sound is about 1088 ft/s, 331.6 m/s, or 741.8 mi/h). The mach speed is important to the control of an aircraft, especially at speeds close to or exceeding Mach 1.0. The unit is named for the Austrian physicist Ernst Mach (1838–1916).

Megahertz (MHz)

A common unit of frequency equal to one million per second. Frequencies of radio waves are commonly stated in megahertz.

External Thread /Internal Thread

	Nominal Size, TPI, Series	Class	Allowance	Max A Major Max Minor	Min Major Min Minor	Min B	Max A Pitch	Min Pitch	UNR C Minor Dia Major Dia (Min)
Int.		2B		0.1980	0.1930		0.2059	0.2025	0.2160
Ext.	12-56 UNS	2A	0.0007	0.2153	0.2112	-	0.2037	0.2012	0.1941
Int.		2B		0.2010	0.1970		0.2076	0.2044	0.2160
Ext.	1/4-20 UNC	1A	0.0011	0.2489	0.2367	-	0.2164	0.2108	0.1894
Int.		1B		0.2070	0.1960		0.2248	0.2175	0.2500
Ext.	1/4-20 UNC	2A	0.0011	0.2489	0.2408	0.2367	0.2164	0.2127	0.1894
Int.		2B		0.2070	0.1960		0.2224	0.2175	0.2500
Ext.	1/4-20 UNC	3A	0.0000	0.2500	0.2419	-	0.2175	0.2147	0.1905
Int.		3B		0.2067	0.1960		0.2211	0.2175	0.2500
Ext.	1/4-24 UNS	2A	0.0011	0.2489	0.2417	-	0.2218	0.2181	0.1993
Int.		2B		0.2150	0.2050		0.2277	0.2229	0.2500
Ext.	1/4-27 UNS	2A	0.0010	0.2490	0.2423	-	0.2249	0.2214	0.2049
Int.		2B		0.2190	0.2100		0.2304	0.2259	0.2500
Ext.	1/4-28 UNF	1A	0.0010	0.2490	0.2392	-	0.2258	0.2208	0.2064
Int.		1B		0.2200	0.2110		0.2333	0.2268	0.2500
Ext.	1/4-28 UNF	2A	0.0010	0.2490	0.2425	-	0.2258	0.2225	0.2064
Int.		2B		0.2200	0.2110		0.2311	0.2268	0.2500
Ext.	1/4-28 UNF	3A	0.0000	0.2500	0.2435	-	0.2268	0.2243	0.2074
Int.		3B		0.2190	0.2110		0.2300	0.2268	0.2500
Ext.	1/4-32 UNEF	2A	0.0010	0.2490	0.2430	-	0.2287	0.2255	0.2118
Int.		2B		0.2240	0.2160		0.2339	0.2297	0.2500
Ext.	1/4-32 UNEF	3A	0.0000	0.2500	0.2440	-	0.2297	0.2273	0.2128
Int.		3B		0.2229	0.2160		0.2328	0.2297	0.2500
Ext.	1/4-36 UNS	2A	0.0009	0.2491	0.2436	-	0.2311	0.2280	0.2161
Int.		2B		0.2260	0.2200		0.2360	0.2320	0.2500
Ext.	1/4-40 UNS	2A	0.0009	0.2491	0.2440	-	0.2329	0.2300	0.2193
Int.		2B		0.2290	0.2230		0.2376	0.2338	0.2500
Ext.	1/4-48 UNS	2A	0.0008	0.2492	0.2447	-	0.2357	0.2330	0.2243
Int.		2B		0.2320	0.2270		0.2401	0.2365	0.2500
Ext.	1/4-56 UNS	2A	0.0008	0.2492	0.2451	-	0.2376	0.2350	0.2280
Int.		2B		0.2350	0.2310		0.2417	0.2384	0.2500

Notes:

[a] For Class 2A threads with coating (plating) the max. is increased by the allowance, to the basic size. This is the same value as Class 3A.

[b] For uncoated hot-rolled, but not standard fasteners with cold rolled threads

[c] UN series external thread, Max.Diameter = Basic - Allowance, for Class 1A and 2A
= Basic for Class 3A

Morse Code and Phonetic Alphabet			
Character	**Morse Code**	**Telephony**	**Pionic (Pronunciation)**
A	• —	Alfa	(Al-Fah)
B	— • • •	Bravo	(Brah-Voh)
C	— • — •	Charlie	(Char-Lee) or (Shar-Lee)
D	— • •	Delta	(Dell-Tah)
E	•	Echo	(Eck-Oh)
F	• • — •	Foxtrot	(Foks-Trot)
G	— — •	Golf	(Golf)
H	• • • •	Hotel	Hoh-Tel)
I	• •	India	(In-Dee-Ah)
J	• — — —	Juliet	(Jew-Lee-Ett)
K	— • —	Kilo	(Key-Loh)
L	• — • •	Lima	(Lee-Mah)
M	— —	Mike	(Mike)
N	— •	November	(No-Vem-Ber)
O	— — —	Oscar	(Oss-Cah)
P	• — — •	Papa	(Pah-Pah)
Q	— — • —	Quebec	(Keh-Beck)
R	• — •	Romeo	(Row-Me-Oh)
S	• • •	Sierra	(See-Air-Rah)
T	—	Tango	(Tang-Go)
U	• • —	Uniform	(You-Nee-Form) or (Oo-Nee-Form)
V	• • • —	Victor	(Vik-Tah)
W	• — —	Whiskey	(Wiss-Key)
X	— • • —	Xray	(Ecks-Ray)
Y	— • — —	Yankee	(Yang-Key)
Z	— — • •	Zulu	(Zoo-Loo)
1	• — — — —	One	(Wun)
2	• • — — —	Two	(Too)
3	• • • — —	Three	(Tree)
4	• • • • —	Four	(Fow-Er)
5	• • • • •	Five	(Fife)
6	— • • • •	Six	(Six)
7	— — • • •	Seven	(Sev-en)
8	— — — • •	Eight	(Ait)
9	— — — — •	Nine	(Nin-Er)
0	— — — — —	Zero	(Zee-Ro)

The Measurement Dictionary

Ohm

The SI unit of electric resistance, reactance, and impedance. If a conductor connects two locations having different electric potentials, then a current flows through the conductor. The amount of the current depends on the potential difference and also on the extent to which the conductor resists the flow of current. For direct current circuits, this property of opposition to current flow is called the resistance. In alternating current circuits, the current flow is also affected by components, capacitors or inductors, that react to the change in the current over time. This opposition is called reactance; impedance measures the combined effect of resistance and reactance. All three quantities are measured in ohms. One ohm is the resistance, reactance, or impedance that requires a potential difference of one volt per ampere of current. The unit honors the German physicist Georg Simon Ohm (1787–1854). The capital Greek letter omega is used as the symbol for the ohm, since "O" would be easily misinterpreted as a zero.

Pencil hardness

A traditional measure of the hardness of the "leads" (actually made of graphite) in pencils. The hardness scale, from softer to harder, takes the form ..., 3B, 2B, B, HB, F, H, 2H, 3H, 4H, ... The letters stand for Black, Hard, and Firm. (There is no industry standard defining the scale, so there is some variation between manufacturers in how it is applied). In the U.S., many manufacturers use a numerical scale in which the grades B, HB, F, H, 2H correspond approximately to numbers 1, 2, 2-1/2, 3, and 4, respectively. The pencil hardness scales are not just used for pencils, however. They are used widely to state the durability of paints and other semi-soft coatings. The hardness rating of a coating is the hardness of the hardest pencil that does not penetrate and gouge the coating. This "scratch" hardness scale is analogous to the Mohs hardness scale used in geology to measure the hardness of minerals.

The Measurement Dictionary

Ring size

A measure of the inside diameter or inside circumference of a ring (the kind worn on a finger). A variety of ring sizing systems are used in various countries. In the U.S., a ring of size n has an inside circumference of 1.43 + 0.102•n inches, or about 36.3 + 2.60•n millimeters. (There is some variation, because U.S. ring sizes have never been standardized). In Britain, traditional ring sizes are stated as letters A, B, etc.; if we replace the letters by numbers n (A = 1, B = 2, etc.), then a ring of British size n has an inside circumference of 36.25 + 1.25•n millimeters, or about 1.43 + 0.049•n inches. A difference of 1 U.S. size thus corresponds rather closely to two letters in the British system. In Japan, sizing is by the inside diameter in increments of 1/3 millimeter; a ring of Japanese size n has an inside diameter of (n + 38)/3 millimeters and an inside circumference of 39.8 + 1.047•n millimeters. There is an international standard (ISO 8653) defining the ring size to be the inside circumference in millimeters, minus 40. Rings are now sized by this standard in most of Europe, so a ring of European size n has an inside circumference of exactly 40 + n millimeters. (The British scale is aligned with the European scale, with British size C corresponding to European size 0 and a difference of four British letters corresponding to 5 European sizes.)

Shoe size

All shoe sizes express in some way the approximate length of the shoe, or at least the length of the "last," the form on which the shoe is made. In the U.S., a difference of one full shoe size represents a length difference of 1/3 inch (8.47 mm), so shoe size n represents a length of Z + n/3, where Z is the length of a size 0 shoe (if there were such a thing). The value of Z is 3-11/12 inches (99.5 mm) for infants' and boys' shoes, 3-7/12 inches (91.0 mm) for girls' shoes, 7-11/12 inches (201.1 mm) for women's shoes, and 8-1/4 inches (209.6 mm) for men's shoes. The size number for a woman's shoe is 1 larger than for a man's shoe of the same length (for example, a man's 7-1/2 is the same length as a woman's 8-1/2). In Europe, shoe sizes are measured in Paris points, a unit equal to 2/3 centimeter. Ski boots and hiking boots worldwide are measured in mondo points, which are simply millimeters.

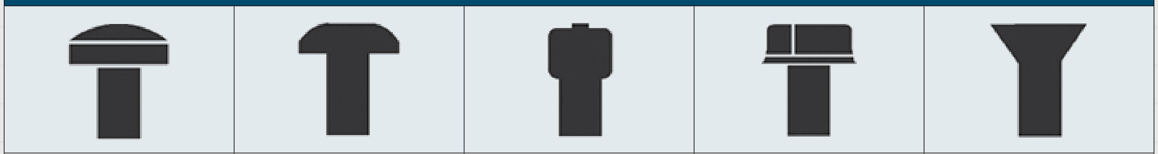
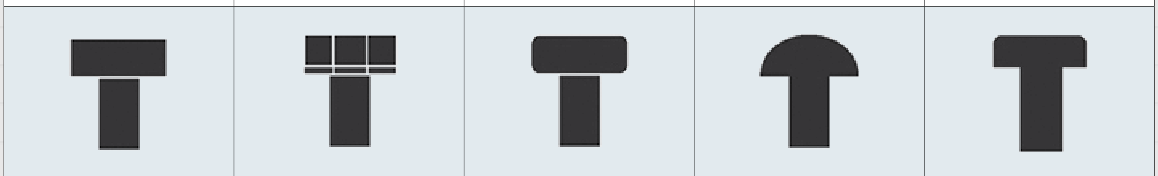
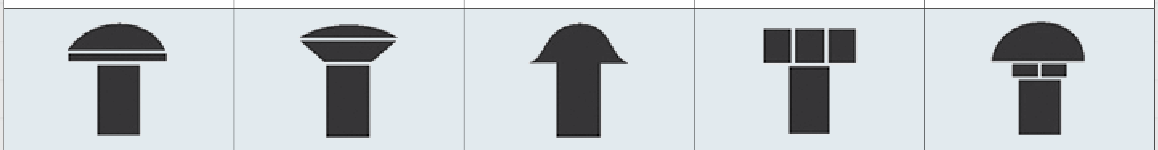
Volt (V)

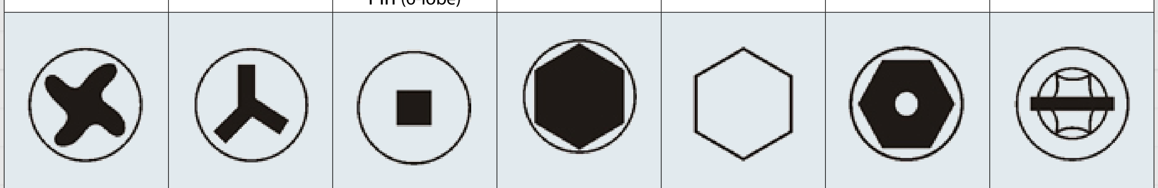
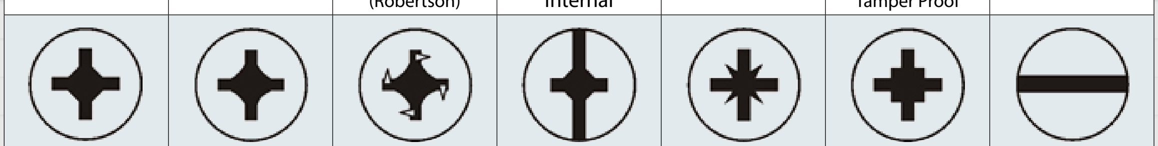
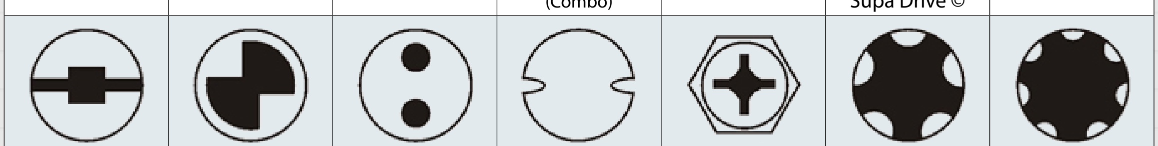
The SI unit of electric potential. Separating electric charges creates potential energy, which can be measured in energy units such as joules. Electric potential is defined as the amount of potential energy present per unit of charge. Electric potential is measured in volts, with one volt representing a potential of one joule per coulomb of charge. The name of the unit honors the Italian scientist Count Alessandro Volta (1745-1827), the inventor of the first battery.

Watt (W)

The SI unit of power. Power is the rate at which work is done, or (equivalently) the rate at which energy is expended. One watt is equal to a power rate of one joule of work per second of time. This unit is used both in mechanics and in electricity, so it links the mechanical and electrical units to one another. In mechanical terms, one watt equals about 0.00134102 horsepower (hp) or 0.737562 foot-pound per second (lbf/s). In electrical terms, one watt is the power produced by a current of one ampere flowing through an electric potential of one volt. The name of the unit honors James Watt (1736–1819), the British engineer whose improvements to the steam engine are often credited with igniting the Industrial Revolution.

Fastener Screw Head and Drive Styles

Screw Head Styles				
				
Binding Head	Button Head	Fillister Head	Flange Hex Head	Flat Head
				
Flat Fillister Head	Hex Washer head	Indented Hex Head	Round Head	Pan Head
				
Truss Head	Oval Head	Washer Head	Trimmed Head	Anchor Head

Drive Styles						
						
Torx © External (6-lobe)	Torx © Internal (6-lobe)	Torx - Internal Tamper Proof Pin (6-lobe)	Frearson	Clutch	Fluted Socket 4 flutes	Fluted Socket 6 flutes
						
Mortorq ©	Tri-Wing ©	Squareuare Socket (Robertson)	Hex Socket Allen Head Internal	Hexagon External	Hexagaon Internal Tamper Proof	Slotted 6 Lobe Combo
						
Quadrex ©	Phillips	Phillips II ©	Phillips/Slot Combination (Combo)	Post Drive © Phillips 1a	Phillips Squareuare Supa Drive ©	Slotted
						
Squareuare Slot Combination	Slotted Tamper Proof (One Way)	Spanner Drilled Tamper Proof	Spanner Slotted Tamper Proof	Phillips © Hex Head	5 Node Security	7 Node Security

Aircraft on Ground

I had a great phone call from a Glenair customer that—without revealing any company names or other clues that you sharpies will pick up on—I wanted to share with the Glenair family. My main motivation for telling this story is to highlight an important benefit of our same-day shipment inventory that may not always be readily apparent.

The gist of the call was our order fulfillment crew picked and shipped a somewhat obscure component overnight to a big regional aircraft maintenance facility enabling their mechanics to get a commercial aircraft back in service in record time. Over cocktails, the airline President remarked to the CEO of the OEM that manufactured the bird how pleased they were that spares were so readily available for their equipment. With a little research, the aircraft CEO determined Glenair had saved the day and called to thank us for a job well done. Bottom line, when his customers are happy, he's happy.

Now, we originally conceived our high-availability business model—with its ample inventory of ready-to-ship products—as a way to service the small quantity and just-in-time orders that are such a big part of our business. In fact, we usually tell customers, when they tour our facility and see the depth and breadth of our stockroom, our inventory program addresses a critical need found in literally every industry. That is, someone in the supply chain has to have product on hand when and where needed. It's just not possible to anticipate every requirement in advance. Someone (the user, a distributor, or the maker) has to have inventory, or manufacturing grinds to a halt.

But in this case, the value of our inventory program wasn't at the manufacturing stage, but at the repair and maintenance stage. An available inventory of spares—and in this case, a pretty obscure part number—was the difference between an idle aircraft stuck on the ground, and one back in service making money for its owner. Sure, the costs and benefits of inventory is a complex issue in business. But just imagine if the conversation at that cocktail party was about how difficult it was to get critical repair parts for the aircraft in question—instead of how easy. I think the phone call would have gone in quite a different direction. Anyway, kudos to everyone on the team for making an important customer's day. There is nothing more important in our business.

Chris Toomey

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