

Reference Materials

Decimal & Millimeter Equivalents

Decimals		Millimeters		Decimals		Millimeters	
$\frac{1}{64}$	0.015625	—	0.397	$\frac{33}{64}$	0.515625	—	13.097
$\frac{1}{32}$	0.03125	—	0.794	$\frac{17}{32}$	0.53125	—	13.494
$\frac{3}{64}$	0.046875	—	1.191	$\frac{35}{64}$	0.546875	—	13.891
$\frac{1}{16}$	0.0625	—	1.588	$\frac{9}{16}$	0.5625	—	14.288
$\frac{5}{64}$	0.078125	—	1.984	$\frac{37}{64}$	0.578125	—	14.684
$\frac{3}{32}$	0.09375	—	2.381	$\frac{19}{32}$	0.59375	—	15.081
$\frac{7}{64}$	0.109375	—	2.778	$\frac{39}{64}$	0.609375	—	14.478
$\frac{1}{8}$	0.1250	—	3.175	$\frac{5}{8}$	0.6250	—	15.875
$\frac{9}{64}$	0.140625	—	3.572	$\frac{41}{64}$	0.640625	—	16.272
$\frac{5}{32}$	0.15625	—	3.969	$\frac{21}{32}$	0.65625	—	16.669
$\frac{11}{64}$	0.171875	—	4.366	$\frac{43}{64}$	0.671875	—	17.066
$\frac{3}{16}$	0.1875	—	4.763	$\frac{11}{16}$	0.6875	—	17.463
$\frac{13}{64}$	0.203125	—	5.159	$\frac{45}{64}$	0.703125	—	17.859
$\frac{7}{32}$	0.21875	—	5.556	$\frac{23}{32}$	0.71875	—	18.256
$\frac{15}{64}$	0.234375	—	5.953	$\frac{47}{64}$	0.734375	—	18.653
$\frac{1}{4}$	0.2500	—	6.350	$\frac{3}{4}$	0.7500	—	19.050
$\frac{17}{64}$	0.265625	—	6.747	$\frac{49}{64}$	0.765625	—	19.447
$\frac{9}{32}$	0.28125	—	7.144	$\frac{25}{32}$	0.78125	—	19.844
$\frac{19}{64}$	0.296875	—	7.541	$\frac{51}{64}$	0.796875	—	20.241
$\frac{5}{16}$	0.3125	—	7.938	$\frac{13}{16}$	0.8125	—	20.638
$\frac{21}{64}$	0.328125	—	8.334	$\frac{53}{64}$	0.828125	—	21.034
$\frac{11}{32}$	0.34375	—	8.731	$\frac{27}{32}$	0.84375	—	21.431
$\frac{23}{64}$	0.359375	—	9.128	$\frac{55}{64}$	0.859375	—	21.828
$\frac{3}{8}$	0.3750	—	9.525	$\frac{7}{8}$	0.8750	—	22.225
$\frac{25}{64}$	0.390625	—	9.922	$\frac{57}{64}$	0.890625	—	22.622
$\frac{13}{32}$	0.40625	—	10.319	$\frac{29}{32}$	0.90625	—	23.019
$\frac{27}{64}$	0.421875	—	10.716	$\frac{59}{64}$	0.921875	—	23.416
$\frac{7}{16}$	0.4375	—	11.113	$\frac{15}{16}$	0.9375	—	23.813
$\frac{29}{64}$	0.453125	—	11.509	$\frac{61}{64}$	0.953125	—	24.209
$\frac{15}{32}$	0.46875	—	11.906	$\frac{31}{32}$	0.96875	—	24.606
$\frac{31}{64}$	0.484375	—	12.303	$\frac{63}{64}$	0.984375	—	25.003
$\frac{1}{2}$	0.5000	—	12.700	$\frac{1}{1}$	1.000	—	25.400

1 mm = 0.03937"

0.001" = 0.0254 mm

Reference Materials

Conversion Factors

Prefixes for SI Units	Symbol = Prefix	Factor by which unit is multiplied
	T = tera	10^{12}
	G = giga	10^9
	M = mega	10^6
	k = kilo	10^3
	h = hecto	10^2
	da = deka	10
	d = deci	10^{-1}
	c = centi	10^{-2}
	m = milli	10^{-3}
	μ = micro	10^{-6}
	n = nano	10^{-9}
	p = pico	10^{-12}
	f = femto	10^{-15}
	a = atto	10^{-18}
Mass	1 kg = 2.2046 lb _m 1 g = 2.2046 x 10 ⁻³ lb _m 1 slug = 14.59 kg	1 lb _m = 0.4536 kg 1 lb _m = 453.6 g 1 kg = 0.06852 kg
Density	1 kg / m ³ = 0.0624 lb _m / ft ³ 1 g / cm ³ = 62.4 lb _m / ft ³ 1 g / cm ³ = 0.0361 lb _m / in ³ 1 slug / ft ³ = 515.4 kg / m ³	1 lb _m / ft ³ = 16.02 kg / m ³ 1 lb _m / ft ³ = 1.602 x 10 ⁻² g / cm ³ 1 lb _m / in ³ = 27.7 g / cm ³ 1 kg / m ³ = 0.00194 slug / ft ³
Length	1 mm = 0.03937 in 1 m = 3.2808 ft	1 in = 25.4 mm 1 ft = 0.3048 m
Velocity	1 m / s = 3.281 ft / s 1 km / h = 0.9113 ft / s 1 km / h = 0.62137 mile / h	1 ft / s = 0.3048 m / s 1 ft / s = 1.097 km / h 1 mile / h = 1.6093 km / h
Volume	1 m ³ = 1000 liters 1 m ³ = 61,020 in ³ 1 m ³ = 35.31 ft ³ 1 m ³ = 264.2 gal 1 gal = 231.0 in ³ 1 gal = 0.1337 ft ³ 1 in ³ = 578 x 10 ⁻⁶ ft ³	1 liter = 0.001m ³ 1 in ³ = 16.39 x 10 ⁻⁶ m ³ 1 ft ³ = 0.02832 m ³ 1 gal = 0.003785 m ³ 1 in ³ = 0.004329 gal 1 ft ³ = 7.481 gal 1 ft ³ = 1728 in ³
Flow Rate	1 gal / min = 0.06309 liters / s 1 gal / min = 0.002228 ft ³ / s 1 liter / s = 0.03531 ft ³ / s	1 liter / s = 15.85 gal / min 1 ft ³ / s = 448.8 gal / min 1 ft ³ / s = 28.32 liters / s
Force	1 N = 1 kg · m / s ² 1 N = 10 ⁵ dynes 1 N = 0.22481 lb _f	1 kip = 1000 lb _f 1 lb _f = 32.174 lb _m · ft / s ² 1 dyne = 10 ⁻⁵ N 1 lb _f = 4.4482 N

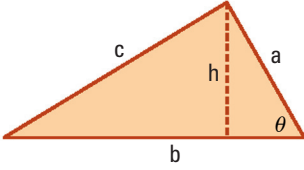
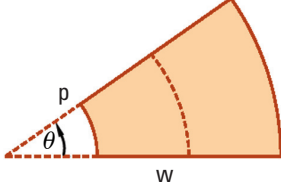
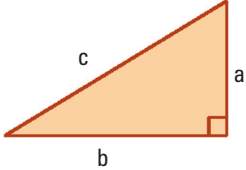
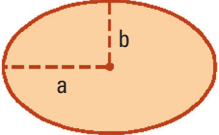
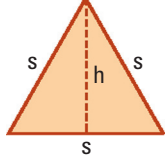
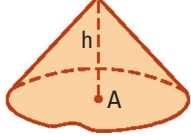
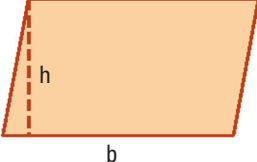
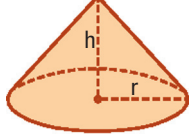
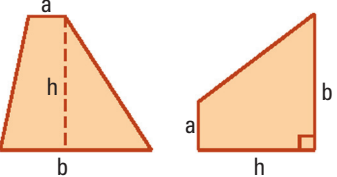
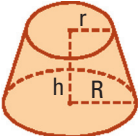
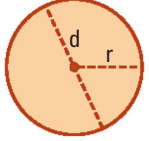
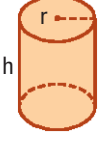
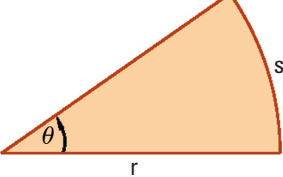
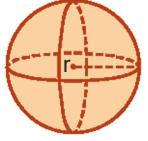
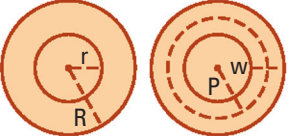
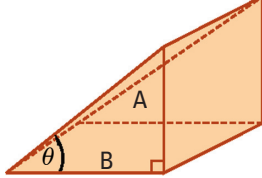
Reference Materials

Conversion Factors

Energy	$1 \text{ J} = 1 \text{ N} \cdot \text{m}$ $1 \text{ J} = 0.73756 \text{ ft} \cdot \text{lb}_f$ $1 \text{ kJ} = 0.9478 \text{ Btu}$	$1 \text{ Btu} = 778.17 \text{ ft} \cdot \text{lb}_f$ $1 \text{ ft} \cdot \text{lb}_f = 1.35582 \text{ J}$ $1 \text{ Btu} = 1.0551 \text{ kJ}$ $1 \text{ kcal} = 4.1868 \text{ kJ}$
Pressure	$1 \text{ Pa} = 1 \text{ N} / \text{m}^2$ $1 \text{ bar} = 10^5 \text{ N} / \text{m}^2$ $1 \text{ Pa} = 1.4504 \times 10^{-4} \text{ lb}_f / \text{in}^2$ $1 \text{ MPa} = 145 \text{ lb}_f / \text{in}^2$ $1 \text{ atm} = 1.01325 \text{ bar}$	$1 \text{ ksi} = 1000 \text{ lb}_f / \text{in}^2$ $1 \text{ lb}_f / \text{in}^2 = 144 \text{ lb}_f / \text{ft}^2$ $1 \text{ lb}_f / \text{in}^2 = 6894.8 \text{ Pa}$ $1 \text{ lb}_f / \text{in}^2 = 6.90 \times 10^{-3} \text{ MPa}$ $1 \text{ atm} = 14.696 \text{ lb}_f / \text{in}^2$
Power	$1 \text{ W} = 1 \text{ J} / \text{s}$ $1 \text{ W} = 3.413 \text{ Btu} / \text{h}$ $1 \text{ kW} = 1.341 \text{ hp}$	$1 \text{ hp} = 2545 \text{ Btu} / \text{h}$ $1 \text{ Btu} / \text{h} = 0.293 \text{ W}$ $1 \text{ hp} = 0.7457 \text{ kW}$ $1 \text{ hp} = 550 \text{ ft} \cdot \text{lb}_f / \text{s}$
Temp.	$T(\text{K}) = 273.15 + T(^{\circ}\text{C})$ $T(\text{K}) = 5/9[T(^{\circ}\text{F}) - 32] + 273.15$ $T(^{\circ}\text{C}) = 5/9[T(^{\circ}\text{F}) - 32]$ $T(^{\circ}\text{R}) = 459.67 + T(^{\circ}\text{F})$	$T(^{\circ}\text{C}) = T(\text{K}) - 273.15$ $T(^{\circ}\text{F}) = 9/5[T(\text{K}) - 273] + 32$ $T(^{\circ}\text{F}) = 9/5[T(^{\circ}\text{C})] + 32$ $T(^{\circ}\text{F}) = T(^{\circ}\text{R}) - 459.67$
Specific Heat	$1 \text{ kJ} / \text{kg} \cdot \text{K} = 0.238846 \text{ Btu} / \text{lb}_m \cdot ^{\circ}\text{R}$ $1 \text{ kcal} / \text{kg} \cdot \text{K} = 1 \text{ Btu} / \text{lb}_m \cdot ^{\circ}\text{R}$	$1 \text{ Btu} / \text{lb}_m \cdot ^{\circ}\text{R} = 4.1868 \text{ kJ} / \text{kg} \cdot \text{K}$
Thermal Conductivity	$1 \text{ W} / \text{m} \cdot \text{K} = 2.39 \times 10^{-3} \text{ cal} / \text{cm} \cdot \text{s} \cdot \text{K}$ $1 \text{ W} / \text{m} \cdot \text{K} = 0.578 \text{ Btu} / \text{ft} \cdot \text{h} \cdot ^{\circ}\text{F}$ $1 \text{ cal} / \text{cm} \cdot \text{s} \cdot \text{K} = 241.8 \text{ Btu} / \text{ft} \cdot \text{h} \cdot ^{\circ}\text{F}$	$1 \text{ cal} / \text{cm} \cdot \text{s} \cdot \text{K} = 418.4 \text{ W} / \text{m} \cdot \text{K}$ $1 \text{ Btu} / \text{ft} \cdot \text{h} \cdot ^{\circ}\text{F} = 1.730 \text{ W} / \text{m} \cdot \text{K}$ $1 \text{ Btu} / \text{ft} \cdot \text{h} \cdot ^{\circ}\text{F} = 4.136 \times 10^{-3} \text{ cal} / \text{cm} \cdot \text{s} \cdot \text{K}$
Universal Gas Constant		$R = 8.314 \text{ kJ} / \text{kmol} \cdot \text{K}$ $R = 1545 \text{ ft} \cdot \text{lb}_f / \text{lbmol} \cdot ^{\circ}\text{R}$ $R = 1.986 \text{ Btu} / \text{lbmol} \cdot ^{\circ}\text{R}$
Standard Acceleration of Gravity		$g = 9.80665 \text{ m} / \text{s}^2$ $g = 32.174 \text{ ft} / \text{s}^2$
Standard Atmospheric Pressure		$1 \text{ atm} = 1.01325 \text{ bars}$ $1 \text{ atm} = 14.696 \text{ lb}_f / \text{in}^2$

Reference Materials

Formulas From Geometry

<p>Triangle $h = a \sin \theta$ Area = $1/2bh$ (Law of Cosines) $c^2 = a^2 + b^2 - 2ab \cos \theta$</p> 	<p>Sector of Circular Ring (p = average radius, w = width of ring, θ in radians) Area = θpw</p> 
<p>Right Triangle (Pythagorean Theorem) $c^2 = a^2 + b^2$</p> 	<p>El- Area = πab Circumference $\approx 2\pi \sqrt{\frac{a^2 + b^2}{2}}$</p> 
<p>Equilateral Triangle $h = \frac{\sqrt{3}s}{2}$ Area = $\frac{\sqrt{3}s^2}{2}$</p> 	<p>Cone (A = area of base) Volume = $\frac{Ah}{3}$</p> 
<p>Parallelogram Area = bh</p> 	<p>Right Circular Cone Volume = $\frac{\pi r^2 h}{3}$ Lateral Surface Area = $\pi r \sqrt{r^2 + h^2}$</p> 
<p>Trapezoid Area = $\frac{h}{2}(a + b)$</p> 	<p>Frustum of Right Circular Cone Volume = $\frac{\pi(r^2 + rR + R^2)h}{3}$ Lateral Surface Area = $\pi s(R + r)$</p> 
<p>Circle Area = $\pi r^2 = \frac{\pi d^2}{4}$ Circumference = $2\pi r = \pi d$</p> 	<p>Right Circular Cylinder Area = $\pi r^2 h$ Lateral Surface Area = $2\pi rh$</p> 
<p>Sector of Circle (θ in radians) Area = $\frac{\theta r^2}{2}$ $s = r\theta$</p> 	<p>Sphere Volume = $\frac{4}{3}\pi r^3$ Surface Area = $4\pi r^2$</p> 
<p>Circular Ring (p = average radius, w = width of ring) Area = $\pi(R^2 - r^2) = 2\pi pw$</p> 	<p>Wedge (A = area of upper face, B = area of base) A = $B \sec \theta$</p> 

Reference Materials

Approximate Physical Properties of Some Common Liquids (BG Units)

Liquid	Temperature (°F)	Density, ρ (slugs/ft ³)	Specific Weight, γ (lb/ft ³)	Dynamic Viscosity, μ (lb/ft)	Kinematic Viscosity, ν (ft ² /s)	Surface Tension, σ (lb/ft)	Vapor Pressure, P _v (lb/in. (abs))	Bulk Modulus, E_v (lb/in.)
Carbon tetrachloride	68	3.09	99.5	2.00 E - 5	6.47 E - 6	1.84 E - 3	1.9 E + 0	1.91 E + 5
Ethyl alcohol	68	1.53	49.3	2.49 E - 5	1.63 E - 5	1.56 E - 3	8.5 E - 1	1.54 E + 5
Gasoline ^c	60	1.32	42.5	6.5 E - 6	4.9 E - 6	1.5 E - 3	8.0 E + 0	1.9 E + 5
Glycerin	68	2.44	78.6	3.13 E - 2	1.28 E - 2	4.34 E - 3	2.0 E - 6	6.56 E + 5
Mercury	68	26.3	847	3.28 E - 5	1.25 E - 6	3.19 E - 2	2.3 E - 5	4.14 E + 6
SAE 30 oil ^c	60	1.77	57.0	8.0 E - 3	4.5 E - 3	2.5 E - 3	—	2.2 E + 5
Seawater	60	1.99	64.0	2.51 E - 5	1.26 E - 5	5.03 E - 3	2.56 E - 1	3.39 E + 5
Water	60	1.94	62.4	2.34 E - 5	1.21 E - 5	5.03 E - 3	2.56 E - 1	3.12 E + 5

^a In contact with air.

^b Isentropic bulk modulus calculated from speed of sound.

^c Typical values. Properties of petroleum products vary.

Approximate Physical Properties of Some Common Liquids (SI Units)

Liquid	Temperature (°C)	Density, ρ (kg/m ³)	Specific Weight, γ (kN/m ³)	Dynamic Viscosity, μ (N·s/m ²)	Kinematic Viscosity, ν (m ² /s)	Surface Tension, σ (N/m)	Vapor Pressure, P _v [N/m (abs)]	Bulk Modulus, E_v (N/m ²)
Carbon tetrachloride	20	1,590	15.6	9.58 E - 4	6.03 E - 7	2.69 E - 2	1.3 E + 4	1.31 E + 9
Ethyl alcohol	20	789	7.74	1.19 E - 3	1.51 E - 6	2.28 E - 2	5.9 E + 3	1.06 E + 9
Gasoline ^c	15.6	680	6.67	3.1 E - 4	4.6 E - 7	2.2 E - 2	5.5 E + 4	1.3 E + 9
Glycerin	20	1,260	12.4	1.50 E + 0	1.19 E - 3	6.33 E - 2	1.4 E - 2	4.52 E + 9
Mercury	20	13,600	133	1.57 E - 3	1.15 E - 7	4.66 E - 1	1.6 E - 1	2.85 E + 10
SAE 30 oil ^c	15.6	912	8.95	3.8 E - 1	4.2 E - 4	3.6 E - 2	—	1.5 E + 9
Seawater	15.6	1,030	10.1	1.20 E - 3	1.17 E - 6	7.34 E - 2	1.77 E + 3	2.34 E + 9
Water	15.6	999	9.80	1.12 E - 3	1.12 E - 6	7.34 E - 2	1.77 E + 3	2.15 E + 9

^a In contact with air.

^b Isentropic bulk modulus calculated from speed of sound.

^c Typical values. Properties of petroleum products vary.

Reference Materials

Approximate Physical Properties of Some Common Gases at Standard Atmospheric Pressure (BG Units)

Gas	Temperature (°F)	Density, ρ (slugs/ft ³)	Specific Weight, γ (lb/ft ³)	Dynamic Viscosity, μ (lb \times s/ft ²)	Kinematic Viscosity, ν (ft ² /s)	Gas Constant, ^a R (ft \times lb/slug \times °R)	Specific Heat Ratio, ^b κ
Air (standard)	59	2.38 E - 3	7.65 E - 2	3.74 E - 7	1.57 E - 4	1.716 E + 3	1.40
Carbon dioxide	68	3.55 E - 3	1.14 E - 1	3.07 E - 7	8.65 E - 5	1.130 E + 3	1.30
Helium	68	3.23 E - 4	1.04 E - 2	4.09 E - 7	1.27 E - 3	1.242 E + 4	1.66
Hydrogen	68	1.63 E - 4	5.25 E - 3	1.85 E - 7	1.13 E - 3	2.466 E + 4	1.41
Methane (natural gas)	68	1.29 E - 3	4.15 E - 2	2.29 E - 7	1.78 E - 4	3.099 E + 3	1.31
Nitrogen	68	2.26 E - 3	7.28 E - 2	3.68 E - 7	1.63 E - 4	1.775 E + 3	1.40
Oxygen	68	2.58 E - 3	8.31 E - 2	4.25 E - 7	1.65 E - 4	1.554 E + 3	1.40

^aValues of the gas constant are independent of temperature.

^bValues of the specific heat ratio depend only slightly on temperature.

Approximate Physical Properties of Some Common Gases at Standard Atmospheric Pressure (SI Units)

Gas	Temperature (°C)	Density, ρ (kg/m ³)	Specific Weight, γ (N/m ³)	Dynamic Viscosity, μ (N \times s/m ²)	Kinematic Viscosity, ν (m ² /s)	Gas Constant, ^a R (J/kg \times K)	Specific Heat Ratio, ^b κ
Air (standard)	15	1.23 E + 0	1.20 E + 1	1.79 E - 5	1.46 E - 5	2.869 E + 2	1.40
Carbon dioxide	20	1.83 E + 0	1.80 E + 1	1.47 E - 5	8.03 E - 6	1.889 E + 2	1.30
Helium	20	1.66 E - 1	1.63 E + 0	1.94 E - 5	1.15 E - 4	2.077 E + 3	1.66
Hydrogen	20	8.38 E - 2	8.22 E - 1	8.84 E - 6	1.05 E - 4	4.124 E + 3	1.41
Methane (natural gas)	20	6.67 E - 1	6.54 E + 0	1.10 E - 5	1.65 E - 5	5.183 E + 2	1.31
Nitrogen	20	1.16 E + 0	1.14 E + 1	1.76 E - 5	1.52 E - 5	2.968 E + 2	1.40
Oxygen	20	1.33 E + 0	1.30 E + 1	2.04 E - 5	1.53 E - 5	2.598 E + 2	1.40

^aValues of the gas constant are independent of temperature.

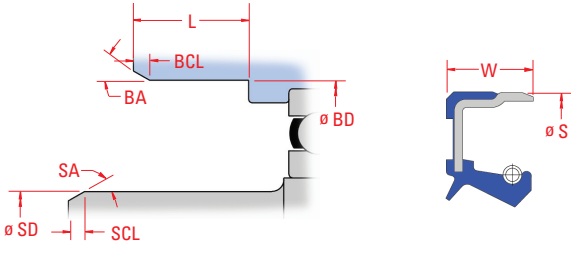
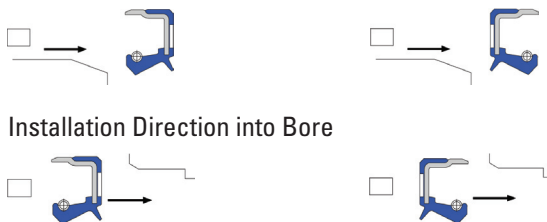

^bValues of the specific heat ratio depend only slightly on temperature.

Radial Shaft Seals Parameters

Company: Contact Name: Phone:	Date: E-Mail: Fax:																											
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See **Design Information chapter (page 18B) for parameters explanation.

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Terms and Conditions of Sale

1. Terms & Conditions of Sale: All descriptions, quotations, proposals, offers, acknowledgements, acceptances, and sales of Seller's products are subject to and shall be governed exclusively by the terms and conditions stated herein. Buyer's acceptance of any offer to sell is limited to these terms and conditions. Any terms or conditions in addition to, or inconsistent with those stated herein, proposed by Buyer in any acceptance of an offer by Seller, are hereby objected to. No such additional, different or inconsistent terms and conditions shall become part of the contract between buyer and Seller unless expressly accepted in writing by Seller. Seller's acceptance of any offer to purchase by Buyer is expressly conditional upon Buyer's assent to all the terms and conditions stated herein, including any terms in addition to, or inconsistent with those contained in Buyer's offer. Acceptance of Seller's products shall in all events constitute such assent.

2. Payment: Payment shall be made by Buyer of 1% discount within ten (10) days of delivery or net thirty (30) days from the date of delivery of the items purchased hereunder. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 15 days after Buyer's receipt of the shipment.

3. Delivery: Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for any delays in delivery.

4. Warranty: All items sold hereunder are subject to a manufacturer's warranty. THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE OR REPRESENTATION OF ANY KIND WHATSOEVER, INCLUDING BUT NOT LIMITED TO MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISCLAIMED.

NOTWITHSTANDING THE FOREGOING, THERE ARE NO WARRANTIES WHATSOEVER ON ITEMS BUILT OR ACQUIRED WHOLLY OR PARTIALLY TO BUYER'S DESIGNS OR SPECIFICATIONS.

5. Limitation of Remedy: SELLER'S LIABILITY ARISING FROM OR IN ANY WAY CONNECTED WITH THE ITEMS SOLD ON THIS CONTRACT SHALL BE LIMITED EXCLUSIVELY TO REPAIR OR REPLACEMENT OF THE ITEMS SOLD OR REFUND OF THE PURCHASE PRICE PAID BY BUYER, AT SELLER'S SOLE OPTION, IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS ARISING FROM OR IN ANY WAY CONNECTED WITH THIS AGREEMENT OR ITEMS SOLD HEREUNDER, WHETHER ALLEGED TO ARISE FROM BREACH OF CONTRACT, EXPRESS OR IMPLIED WARRANTY, OR IN TORT, INCLUDING WITHOUT LIMITATION, NEGLIGENCE, FAILURE TO WARN OR STRICT LIABILITY.

6. Indemnification: (a) Buyer will indemnify and hold harmless Seller and any officers, directors, or control person thereof against any losses, claims, damages, liabilities, or expenses to which such person may become subject under the Magnuson-Moss Act, or any applicable state or federal Consumer Protection Law, common law or any other law or any order, rule, or regulation of any court or regulatory authority, insofar as such losses, claims, damages, liabilities or expenses (or actions in respect thereof) arise out of or are based upon any malfunctions or claimed defects in material or workmanship of Buyer's product or components thereof and will reimburse Seller and any officer, director or control person thereof for any legal or other expenses reasonably incurred by them in connection with investigation or defending against any such loss, claim, damages, liability or action.

(b) Promptly after receipt by an indemnified party under subparagraph (a) above of notice of the commencement of any action, such indemnified party shall, if a claim in respect thereof is to be made against the indemnifying party under such subsection, notify the indemnifying party in writing of the commencement thereof; but the omission so to notify the indemnifying party shall not relieve it from any liability that it may have to any indemnified party otherwise than under such subparagraph. In case such action shall be brought against any indemnified party, and it shall notify the indemnifying party of the commencement thereof, the indemnifying party shall be entitled to participate in, and, to the extent that is shall wish, jointly with any other indemnifying party similarly notified, to assume the defense thereof, with counsel who shall be reasonably satisfactory to such indemnified party (who shall not, except with the consent of the indemnified party, be counsel to the indemnifying party), and after notice from the indemnifying party to such indemnified party of its election so to assume the defense thereof, the indemnifying party will not be liable to such indemnified party under such subsection for any legal or other expenses subsequently incurred by such indemnified party in connection with the defense thereof other than reasonable costs of investigation. Notwithstanding the foregoing, the indemnifying party shall not have any obligations to indemnify the indemnified party for any settlement made without the indemnifying party's consent.

7. Special Tooling: Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time. A charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture, modify or prepare items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller, which is utilized in the manufacture, modification preparation of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer.

8. Buyer's Property: Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Seller's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in the Seller's possession or control.

9. Taxes: Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder if any such taxes must be paid by the Seller if Seller is liable for the collection of such tax the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any

sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

10. Force Majeure: Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter "Events of Force Majeure"). Events of Force Majeure shall include without limitations, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carriers or suppliers, shortages of materials and any other cause beyond Seller's control.

11. Any special requirements for items to be provided by Seller hereunder including without limitation compliance with military specifications, special documentation, or testing requirements, must be communicated to Seller in writing at the time the items are first requested. Any such requests that are communicated to Seller after preparation to manufacture an item has commenced may result in additional charges for rework or remanufacture of the item.

12. Entire Agreement/Governing Law: The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold and there are no oral or other representations or agreements which pertain thereto. This agreement shall be governed in all respects by the law of the State of Iowa. No actions arising out of the sale of the items sold hereunder of this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

13. Claims: Claims for shortages or erroneous charges must be presented to Seller within fifteen (15) days after receipt of or access to the Goods or such claims will not be allowed.

14. Arbitration: In the event of a disagreement as to the interpretation of this contract or any alleged breach thereof, or any claims by Buyer against Seller, it is mutually agreed that such dispute shall be submitted to binding arbitration before a panel of three (3) Arbitrators consisting of two (2) party-nominated (non-impartial) Arbitrators and a third (impartial) Arbitrator (hereinafter "umpire") as the sole and exclusive remedy. The party desiring arbitration of a dispute shall notify the other party, said notice including the name, address and occupation of the Arbitrator nominated by the demanding party. The other party shall, within thirty (30) days following receipt of the demand, notify in writing the demanding party of the name, address and occupation of the Arbitrator nominated by it. The two (2) Arbitrators so selected shall, within thirty (30) days of the appointment of the second Arbitrator, select an umpire. If the Arbitrators are unable to agree, each arbitrator shall submit to the other Arbitrator a list of three (3) proposed individuals, from which list each Arbitrator shall choose one (1) individual. The names of the two (2) individuals so chosen shall be subject to a draw, whereby the individual drawn shall serve as umpire.

The parties shall submit their cases to the panel by written and oral evidence at a hearing time and place selected by the umpire. Said hearing shall be held within thirty (30) days of the selection of the umpire. The panel shall be relieved of all judicial formality, shall not be obligated to adhere to the strict rules of law or of evidence, shall seek to enforce the intent of the parties hereto and may refer to, but are not limited to, relevant legal principals. The decision of at least two (2) of the three (3) panel members shall be binding and final and not subject to appeal except for grounds of fraud and gross misconduct by the Arbitrators. The award will be issued within thirty (30) days of the close of the hearings. Each party shall bear the expenses of its designated Arbitrator and shall jointly and equally share with the other the expense of the umpire and of the arbitration.

The arbitration proceeding shall take place in or in the vicinity of Cedar Rapids, Iowa. The procedural rules applicable to this arbitration shall, except as provided otherwise herein, be in accordance with the Commercial Arbitration Rules of the American Arbitration Association.

15. Jurisdiction: In the event that arbitration is not performed, for any reason, as set forth in ¶13 of this Agreement, Buyer consents to the exclusive jurisdiction of the Courts of Iowa or the United States District Court for the Northern District of Iowa, Central Division in any and all actions and proceedings between the parties whether arising under any contract resulting herefrom or otherwise and irrevocably agrees to service of process by certified mail return receipt requested at Buyer's address herein or as may hereafter be given to Seller by certified mail return receipt requested, actually received by Seller. Buyer waives the right to jury trial.

16. Quality Control: The items sold hereunder may be subjected to quality control procedures. Seller employs the C-0 sampling plan when it performs inspections. A written plan and quality manual is available for inspection by Buyer upon Buyer's written request. The quality control work performed hereunder is subject to the warranty provisions of ¶4 of this Agreement. There is no manufacturer's warranty for quality control work performed hereunder and Seller offers no additional warranty for said work.

17. The Seller's employees or agents are not authorized to make any representations concerning the Goods and/or Service unless confirmed by the Seller in writing. In entering into the Contract, the Buyer acknowledges that it does not rely on and waives any claim for breach of, any such representations, which are not so confirmed.

18. Any typographical, clerical or other error or omission in any sales literature, quotation, price list, acceptance of offer, invoice or other document or information issued by the Seller shall be subject to correction without any liability on the part of the Seller.

19. Returns: Customer must obtain authorization from ESP for any return of goods purchased. An ESP RGA# must be used with all documentation pertaining to the returned good items. A 20% restocking fee shall be charged on customer returned goods.