ENGINEERED SEALS & COMPONENTS, LLC.

SPECIALTY WEAR RINGS

WR-SERIES
NR-SERIES

KEY FEATURES OF METRIC WEAR RINGS:

- Many Inch cross sections available .062 .095 .125 .098 .187 .250
- Many MM cross sections available 1,5 2,0 3,0 3,5 4,0 5,0 6,0
- Ultra Precision +.001" / -.001" (0,025 / -0,025 mm) C/S Tolerances
- Diameters to 16 inch (400mm)
- Width up to 4.250 inch (105mm)
- Large material selection: Glass Filled Nylon - High Temp. Nylon
- Acetal - Carbon Filled HHTN - Laminate Composites
- Piston Style or Rod Style
- Special Slots on O.D.. or I.D..
- Butt Cut - Scarf Cut - Step Cut
- Special Gap con igurations
- Grooves on O.D. or I.D. or Spiral
- L-Shaped I.D. or O.D.


.1237
HOLD
TOL

ESC-LON ULTRA PRECISION WEAR RING ADVANTAGES

ESC uses the latest, state-of-the-art, injection equipment to injection mold a billet to very close tolerances from only the highest grade materials. Using internal lubricants and proprietary additives, ESC has formulated a version of glass filled nylon to be the best possible wear ring. We then machine each part to EXACTING tolerances. Our material and processes REALLY do make the *ESC*-LON Wear Rings are finished machined to a thickness tolerance of +/-.001 inches unless otherwise specified. The state-of the-art process and continuous improvement, generally keep the process Cpk's above 3.5. This provides better control of the extrusion gap and reduction of the apparatus or cylinder bending loads. *ESC* Ultra Precision Wear Rings are **THE** choice for demanding applications.

ESC-LON wear rings:

- Internally Lubricated. Port
- Passing Capable
- Non-Scoring.
- Highest Compressive Strength.
- Longest Wearing
- Low Moisture Absorption

SERIES NR ARE "NOISE REDUCING" DESIGN SERIES WR ARE SPECIFICALLY DEIGNED FOR YOUR APPLICATION

ALL WEAR RINGS ARE ULTRA PRECISION +/-.001 TOLERANCE CROSS SECTION

Noise Reducing Lubrication Groove
Special ID Groove Insuring 360° Continuous Lubrication
Available in Standard, PA940B, or Specialty Compounds

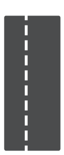
Noise Reducing Lubrication Groove
Special OD Groove Insuring 360° Continuous Lubrication
Available in Standard, PA940B, or Specialty Compounds

Noise Reducing Spiral Lubrication Groove
Special OD Groove Insuring 360° Continuous Lubrication
Available in Standard, PA940B, or Specialty Compounds

Noise Reducing Spiral Lubrication Groove
Special ID Groove Insuring 360° Continuous Lubrication
Available in Standard, PA940B, or Specialty Compounds

Specialty Compound Super Low Moisture Absorbing HTN-40
High Tempurature Capability
High Compressive Strength, Longer Wear

Specialty Compound Super Low Moisture Absorbing Acetal POM-95
Medium Duty, Low-Friction
Flexible, Easy to Install



Custom Designed Flow Control, Grooved Wear Rings
Special OD Groove to Control Oil Flow by the Wear Ring
Available in Standard, PA940B, or Specialty Compounds

Custom Designs, Shapes, and Compounds Composite V-100 Compound Wear Rings
"Zero" Moisture Absorbing, Polyester Resin with Polyester Fabric
High Compressive Strength, Good Wear, High Temperature Compounds Available

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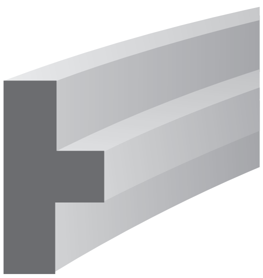
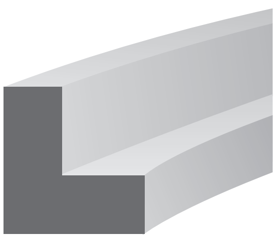
AVAILABLE WEAR RING SHAPES AND SPLITS

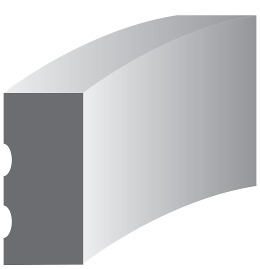


T-RING

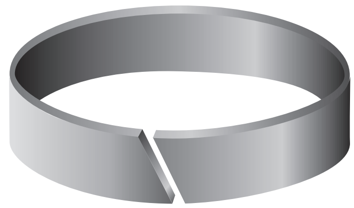


I.D. L-RING

O.D. L-RING

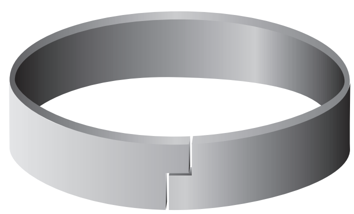


SPIRAL OR GROOVED

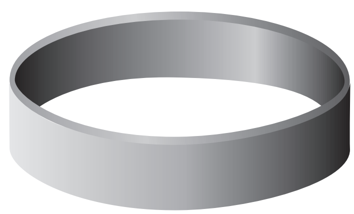


ANGLE CUT

BUTT CUT



STEP CUT

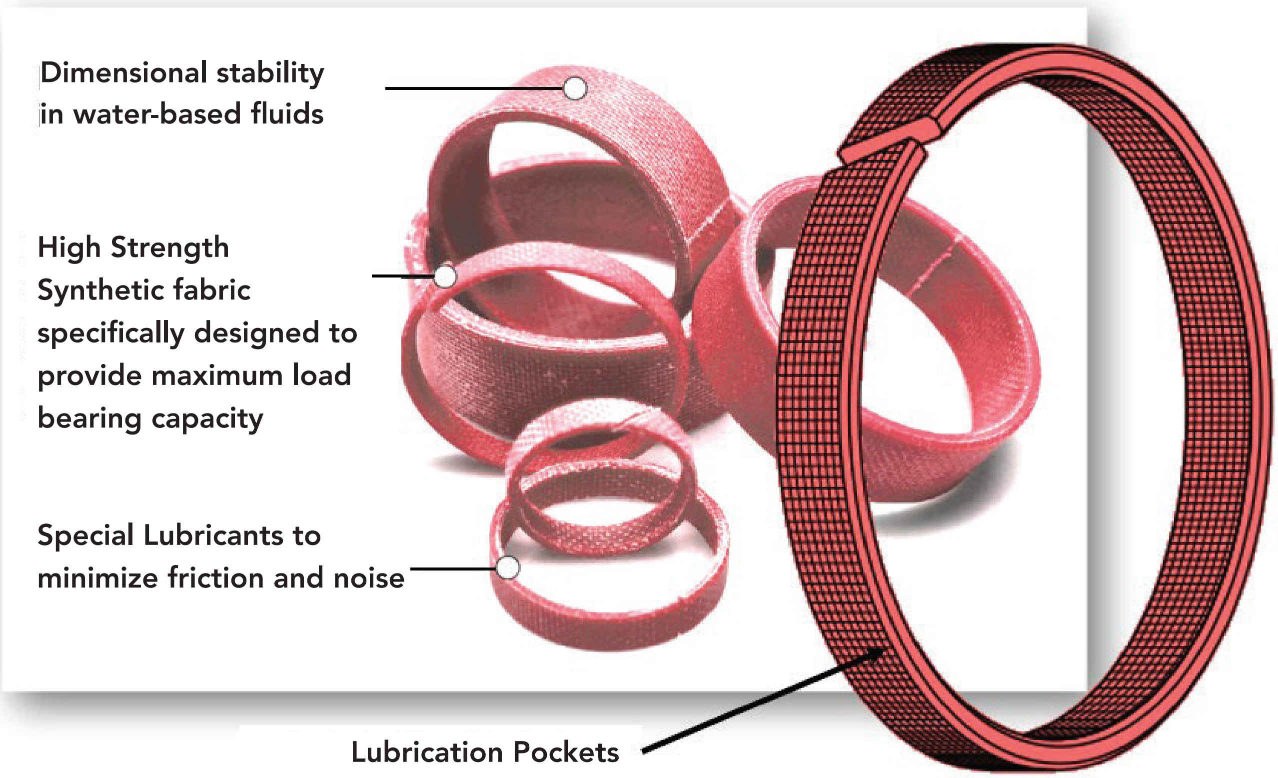


SOLID

WR - “NR” NOISE REDUCING WEAR RINGS

“Zero Swell” & Noise Reducing

Polyester Composite Wear Rings



- MANY SIZES AND WIDTH UP TO 30 INCH / 762mm OUTSIDE DIAMETER
- MEDIUM TO HEAVY DUTY USES
- ULTRA PRECISION C/S TOLERANCE +/-*.001” or +/-0,025mm
- METRIC OR INCH CROSS SECTIONS AVAILABLE
- 4 STANDARDS COMPOUNDS TO CHOOSE FROM V-100, V-131A , V333A WITH INTERNAL LUBRICANT
- WHAT EVER THE APPLICATION WE HAVE SOLUTIONS

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WR - “NR” NOISE REDUCING WEAR RINGS

WR “NR”-Series
Specialty Wear Rings

Special Oil Carrying Spiral Grooves Insuring 360 degrees of Continuous Lubrication

* ANY DIAMETER UP TO 16.00” / 400mm

* AND WIDTHS UP TO 4.00” / 105mm

* INSIDE OR OUTSIDE SPIRALS

* GROOVES OR MULTIPLE GROOVES INSIDE OR OUTSIDE

* MEDIUM TO HEAVY DUTY USES

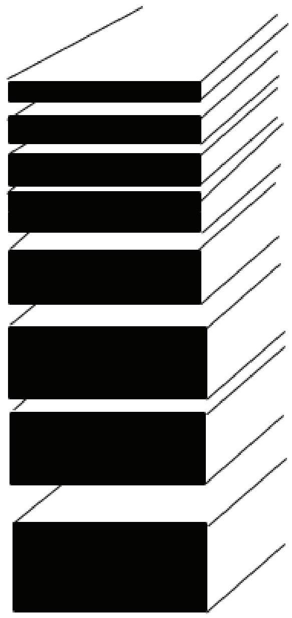
* ULTRA PRECISION C/S TOLERANCE +/-0.001” (+/-0,025mm)

* METRIC OR INCH CROSS SECTIONS AVAILABLE

ULTRA-PRESISION WEAR RING CROSS SECTIONS INCH AND METRIC

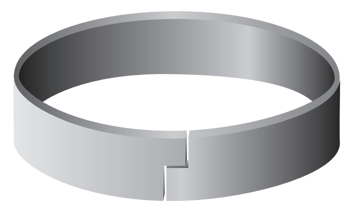
RADIAL CROSS SECTIONS

Nominal Inches	Actual Inches
0.062	.062 / .060
0.080	.080 / .078
0.093	.093 / .091
0.098	.098 / .096
0.100	.100 / .098
0.125	.125 / .123
0.187	.187 / .186
0.250	.250 / .248



BUTT CUT

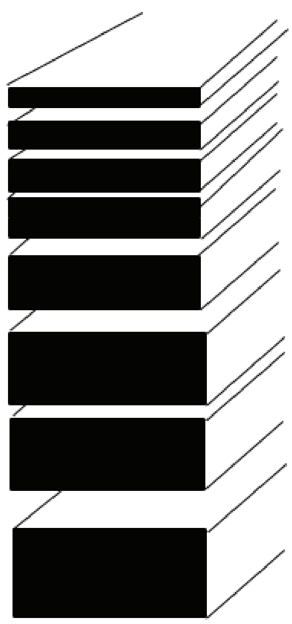
ANGLE CUT



STEP CUT

RADIAL CROSS SECTIONS

Nominal mm	Actual mm
1,50	1,50 / 1,45
2,00	2,00 / 1,95
2,50	2,50 / 2,45
3,00	3,00 / 2, 95
3,50	3,50 / 3,45
4,00	4,00 / 3,95
5,00	5,00 / 4,95
6,00	6,00 / 5,95



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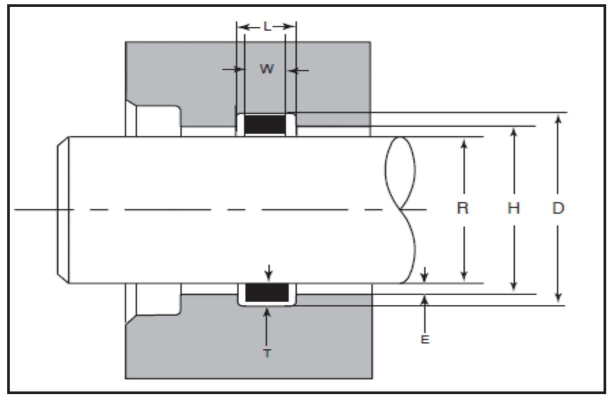
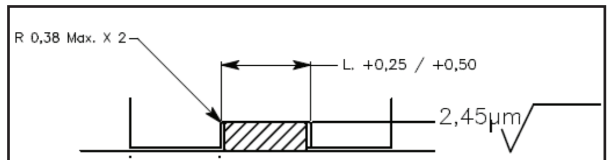
ESC-LON ULTRA PRECISION WEAR RING GROOVE DESIGN GUIDE - METRIC

Rod Groove Calculations- METRIC (mm)

Formula for calculating Rod Wear Ring grooves using alternative extrusion gaps, metal-to-metal clearances and machining tolerances:





Groove Detail

1. Minimum Groove Diameter, ***D***:

D *=* *Maximum ROD Diameter* ***R*** *(+ 0,05) +2x (Max Wear Ring Cross Section,* T_1*)*

2. Maximum Groove Diameter, D_1:

Maximum Groove Diameter $D_1 = D + (M$ *machining tolerances)*

3. Minimum Throat Diameter, ***H***:

H *=* *Maximum Groove Diameter* D_1 *-2x* [*Minimum Wear Ring Cross Section*] *+2x* [*Desired minimum radial Metal-to-metal Clearance CL*]

4. Minimum Groove Width, ***L***:

L *= (Nominal Width* W_1*) + 0,25*

5. Maximum Extrusion gap, (total) E_1:

$$E_1 = H_1\ max + \frac{(D_1\ max. - H_1\ max.)}{2} - (T\ min. - R_1\ min.)$$

Notes:

* Add (0,025 to 0,05) to Maximum Rod to compensate for ovality and assembly.

1. Tolerance for ***L*** is +0,25 / +0,50.
2. Groove radii must not exceed 0,38 max.
3. ESC recommends a minimum of 0,13 metal-to-metal clearance. Using the above calculations may result in metal to metal contact if the wear ring material's compressive strength properties are not considered. *See **Table 1** and **Table 2** for further details.* Contact ESC if additional assistant is required.

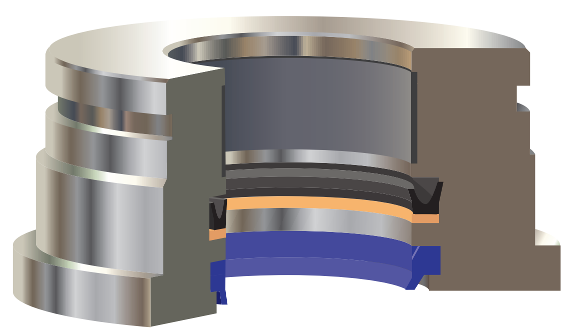
Example for above Formulas:

Given: Bore 49,95/50,00 (***B***) Wear Ring thickness 2,95/3,00 and 25,00 (***L***) wide. Rod machining tolerance is 0,05. Minimum desired radial metal-to-metal clearance is 0,13.

1. 50,00 + 0,05 +6,0 = 56,05 (***D*** Minimum Groove Diameter)
2. 56,05 + 0,05 = 56,10 (D_1 Maximum Groove Diameter)
3. 56,10 - (2x 2,95) + (2x 0,13 = 50,46 Minimum Throat Diameters, ***H***
4. 25,00 + 0,25 = 25,25 Minimum Groove Width, ***L* min.**
5. 50,51 + (56,10 - 50,51 / 2) - (2,95 + 49.95) = 0.014

Extrusion Gap Maximum *E* max

R= Rod Dia. = 49,95 / 50,00
H = Throat Dia. = 50,51 / 50,46
L. = Groove Width = 25,25 / 25,50
E. = TOTAL Extrusion Gap = 0,40



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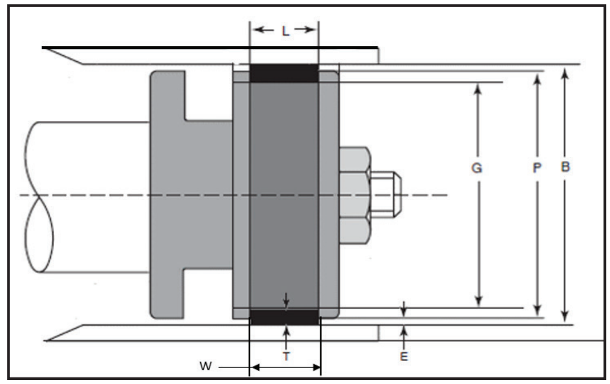
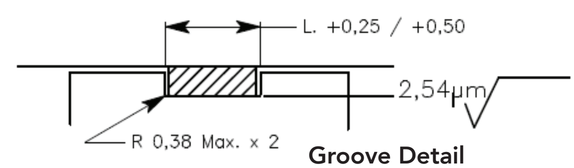
ESC-LON ULTRA PRECISION WEAR RING GROOVE DESIGN GUIDE - METRIC

Piston Groove Calculations - METRIC (mm)

Formula for calculating Piston Wear Ring grooves using alternative extrusion gaps, metal-to-metal clearances and machining tolerances:





Groove Detail

1. Maximum Groove Diameter, G_1:

G_1= Minimum Bore Diameter B_1 (-0,05) -2x (Max Wear Ring Cross Section, T_1)

2. Minimum Groove Diameter, *G*:

Minimum Groove Diameter G=G_{1} - (M machining tolerances)

3. Maximum Piston Diameter, P_1:

P_1= Minimum Groove Diameter G +2x [Minimum Wear Ring Cross Section] -2x [Desired minimum radial Metal-to-metal Clearance CL]

4. Minimum Groove Width, *L*:

L = (Nominal Width W_1) + 0,25

5. Maximum Extrusion gap, E_1:

$$E_1 = B\ max - (G\ min. + T\ min. + \frac{(P\ min. - G\ min.)}{2}$$

Notes:

* Subtract this amount (-0,025 or -0,05) from Minimum Bore to allow for Bore ovality and Installation.

1. Tolerance for *L* is +0,25 / +0,50.
2. Groove radii must not exceed 0,38 max.
3. ESC recommends a minimum of 0,13 metal-to-metal clearance. Using the above calculations may result in metal to metal contact if the wear ring material's compressive strength properties are not considered. *See **Table 1** and **Table 2** for further details.* Contact ESC if additional assistant is required.

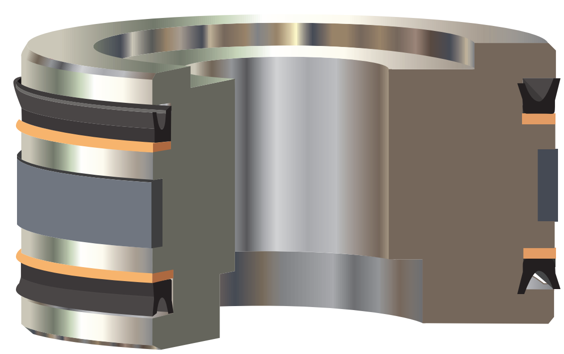
*** Extrusion Gap *DOES NOT* take into consideration tube swell under pressure.**

Example for above Formulas:

Given: Bore 74,95/75,00 (***B***) Wear Ring thickness 2,95/3,00 and 15,00 (***L***) wide. Piston machining tolerance is -0,05. Minimum desired radial metal-to-metal clearance is 0,13 per side.

1. 74,95 - 0,05 -6,0 = 68,90 (G1 Maximum Groove Diameter)
2. 68,90 - 0.05 = 68,85 (G Minimum Groove Diameter)
3. 68,85 +(2x 2,95) - (2x 0.13) = 74,49 Maximum Piston Diameter, P_1
4. 15,00 + 0,25 = 15,25 Minimum Groove Width, ***L min.***
5. 75,00 - (68,85 + 2,95) + ((74.,44-68,85)/2)) = 0,40 Extrusion Gap Maximum ***E*** max.

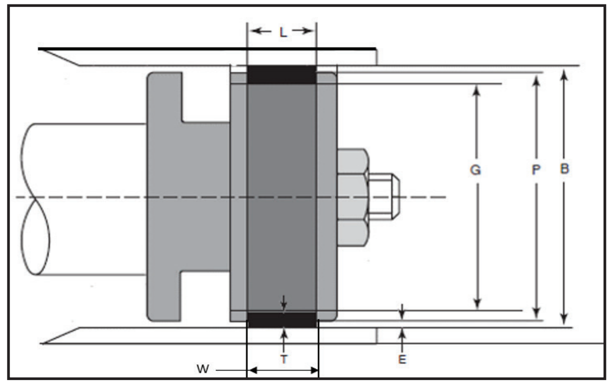
B.= Bore Dia. 75,00 / 74,95
P.= Piston Dia. 74,49 / 74,44
G. = Groove Dia. 68,90 / 68,85
L. = Groove Width 15,50 / 15,25
E. = TOTAL Extrusion Gap 0,40

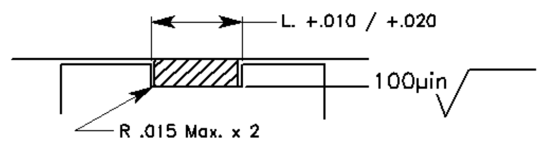


ESC-LON ULTRA PRECISION WEAR RING ENGINEERING GUIDE - INCH

Piston Groove Calculations - INCH

Formula for calculating Piston Wear Ring grooves using alternative extrusion gaps, metal-to-metal clearances and machining tolerances:





Groove Detail

1. Maximum Groove Diameter, G_1:

G_1 = Minimum Bore Diameter B_1 (-.002") -2x (Max Wear Ring Cross Section, T_1)

2. Minimum Groove Diameter, G:

Minimum Groove Diameter $G=G_{1}$ - (M machining tolerances)

3. Maximum Piston Diameter, P_1:

P_1 = Minimum Groove Diameter G +2x [Minimum Wear Ring Cross Section] -2x [Desired minimum radial Metal-to-metal Clearance CL]

4. Minimum Groove Width, L:

L = (Nominal Width W_1) + .010

5. Maximum Extrusion gap, E_1:

$$E_1 = B\ max - \left(G\ min. + T\ min. + \frac{P\ min. - G\ min.}{2}\right)$$

Notes:

* Subtract this amount (-.001 or -.002) from Minimum Bore to allow for Bore ovality and Installation.

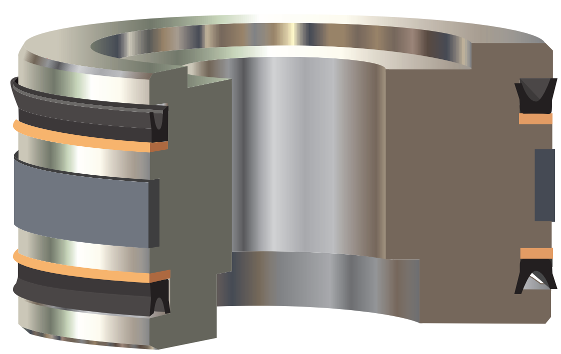
1. Tolerance for L is +.010 / +.020.
2. Groove radii must not exceed .015" max.
3. ESC recommends a minimum of 0.005" metal-to-metal clearance. Using the above calculations may result in metal to metal contact if the wear ring material's compressive strength properties are not considered. *See **Table 1** and **Table 2** for further details.* Contact ESC if additional assistant is required.

*** Extrusion Gap *DOES NOT* take into consideration tube swell under pressure.**

Example for above Formulas:

Given: Bore 3.000/3.003 (***B***) Wear Ring thickness 0.123/0.125 and 0.500 (***L***) wide. Piston machining tolerance is -0.002. Minimum desired radial metal-to-metal clearance is 0.005 per side.

1. 3.000 - 0.002 -0.250 = 2.748 (G1 Maximum Groove Diameter)
2. 2.748 -0 .002 = 2.746 (G Minimum Groove Diameter)
3. 2.746 +(2x 0.123) - (2x 0.005) = 2.982 Maximum Piston Diameter, P_1
4. 0.500 + 0.010 = 0.510 Minimum Groove Width, ***L min.***
5. 3.003 - (2.746 + 0.123) + ((2.980-2.746)/2)) = 0.017 Extrusion Gap Maximum ***E*** max.



B.= Bore Dia. 3.003 / 3.000
P.= Piston Dia.2.982 / 2.980
G. = Groove Dia. 2.746 / 2.748
L. = Groove Width 0.510 / 0.520
E. = TOTAL Extrusion Gap 0.017

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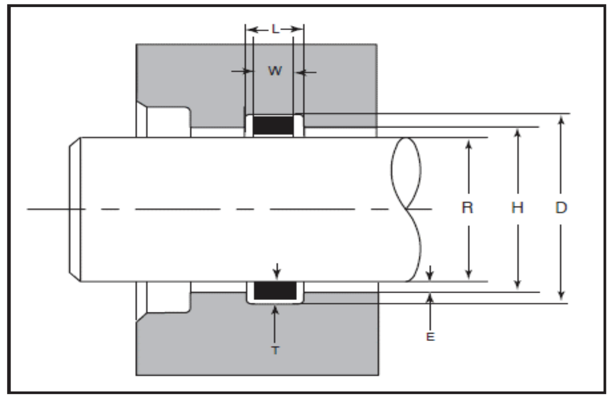
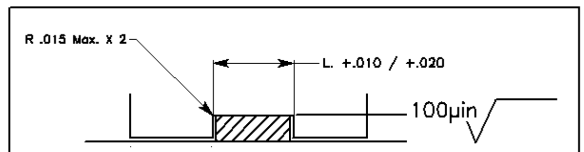
ESC-LON ULTRA PRECISION WEAR RING ENGINEERING GUIDE - INCH

Rod Groove Calculations- INCH

Formula for calculating Rod Wear Ring grooves using alternative extrusion gaps, metal-to-metal clearances and machining tolerances:





Groove Detail

1. Minimum Groove Diameter, ***D***:

$$D = \text{Maximum ROD Diameter } R \; (+0.001") + 2x \; (\text{Max Wear Ring Cross Section, } T_1)$$

2. Maximum Groove Diameter, ***D₁***:

$$\text{Maximum Groove Diameter } D_1 = D + (M \text{ machining tolerances})$$

3. Minimum Throat Diameter, ***H***:

$$H = \text{Maximum Groove Diameter } D_1 - 2x \left[\text{Minimum Wear Ring Cross Section} \right] + 2x \left[\text{Desired minimum radial Metal-to-metal Clearance CL} \right]$$

4. Minimum Groove Width, ***L***:

$$L = (\text{Nominal Width } W_1) + .010$$

5. Maximum Extrusion gap, (total) ***E₁***:

$$E_1 = H_1 \; max + \frac{(D_1 \; max. - H_1 \; max.)}{2} - (T \; min. - R_1 \; min.)$$

Notes:

* Add (0.001" to 0.002") to Maximum Rod to compensate for ovality and assembly.

1. Tolerance for ***L*** is +0.010 / +0.020.
2. Groove radii must not exceed 0.015" max.
3. ESC recommends a minimum of 0.005" metal-to-metal clearance. Using the above calculations may result in metal to metal contact if the wear ring material's compressive strength properties are not considered. *See **Table 1** and **Table 2** for further details.* Contact ESC if additional assistant is required.

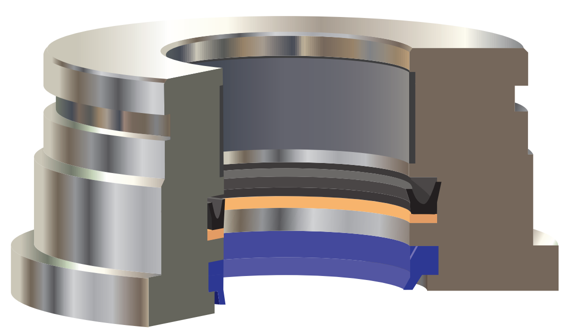
For Large Extrusion Gap Seals, Consider using a series 757 Back-up Ring.

Example for above Formulas:

Given: Bore 1.499/1.500 (***B***) Wear Ring thickness 0.123 / 0.125 and 0.500 (***L***) wide. Rod machining tolerance is 0.002. Minimum desired radial metal-to-metal clearance is 0.005.

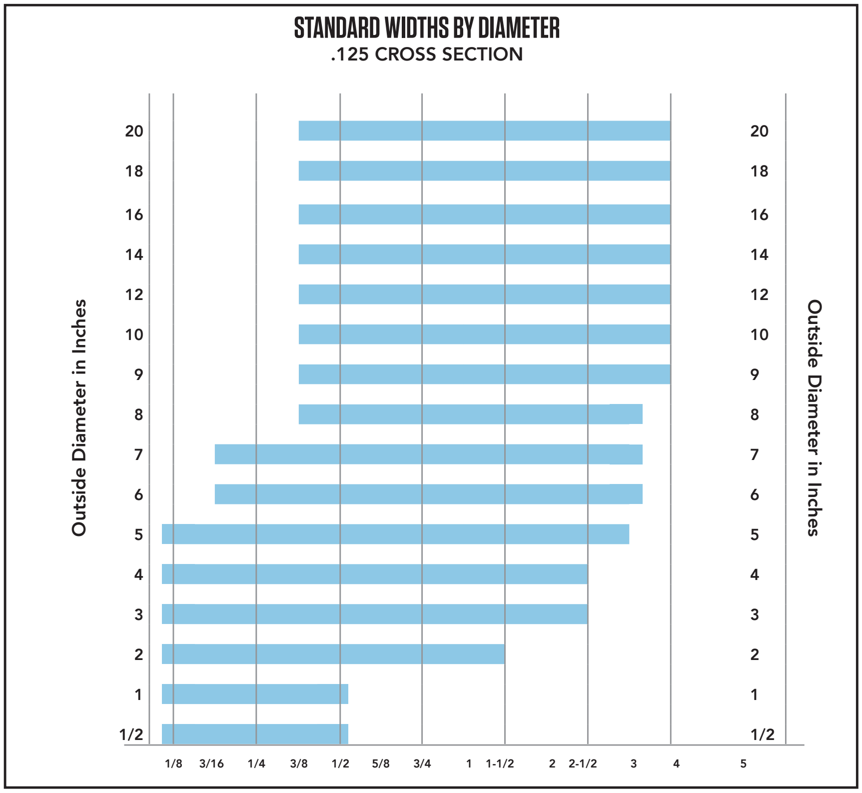
1. 1.500 + 0.001 -0.250 = 1.751 (***D*** Minimum Groove Diameter)
2. 1.751 + 0.002 = 1.753 (D_1 Maximum Groove Diameter)
3. 1.753 - (2x 0.123) + (2x 0.005) = 1.517 Minimum Throat Diameters, ***H***
4. 0.500 + .010 = .510 Minimum Groove Width, ***L* min.**
5. 1.519 + (1.753-1.519 / 2) - (0.123 + 1.499) = 0.014

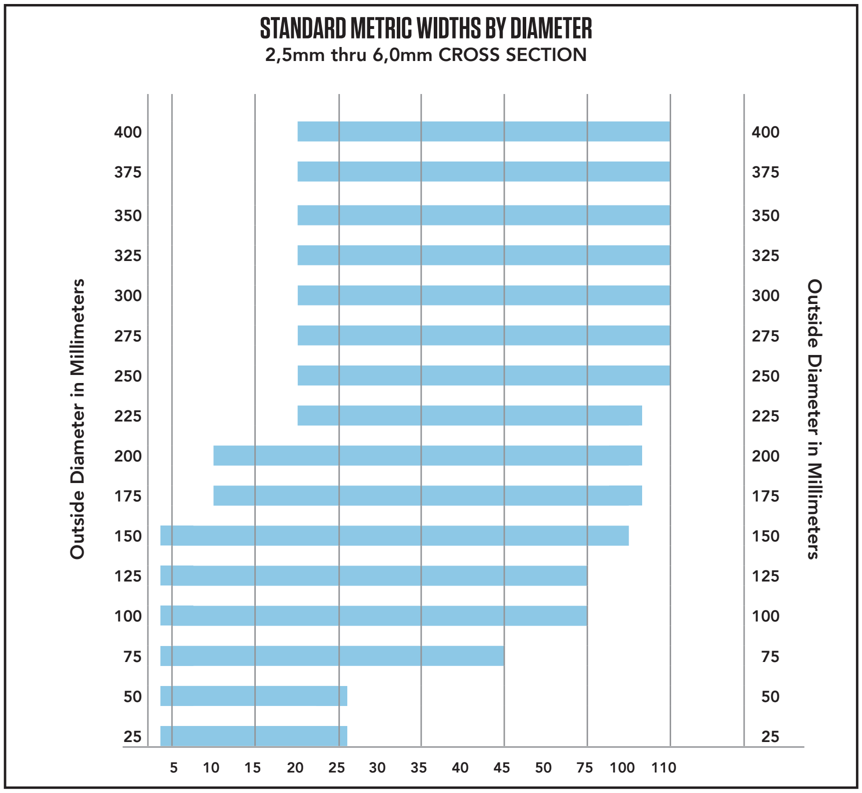
Extrusion Gap Maximum *E* max



R= Rod Dia. = 1.498 / 1.500
H = Throat Dia. = 1.517 / 1.519
L. = Groove Width = 0.510 /0 .520
E. = TOTAL Extrusion Gap = 0.014

AVAILABLE WEAR RING WIDTHS BY DIAMETER INCH AND METRIC

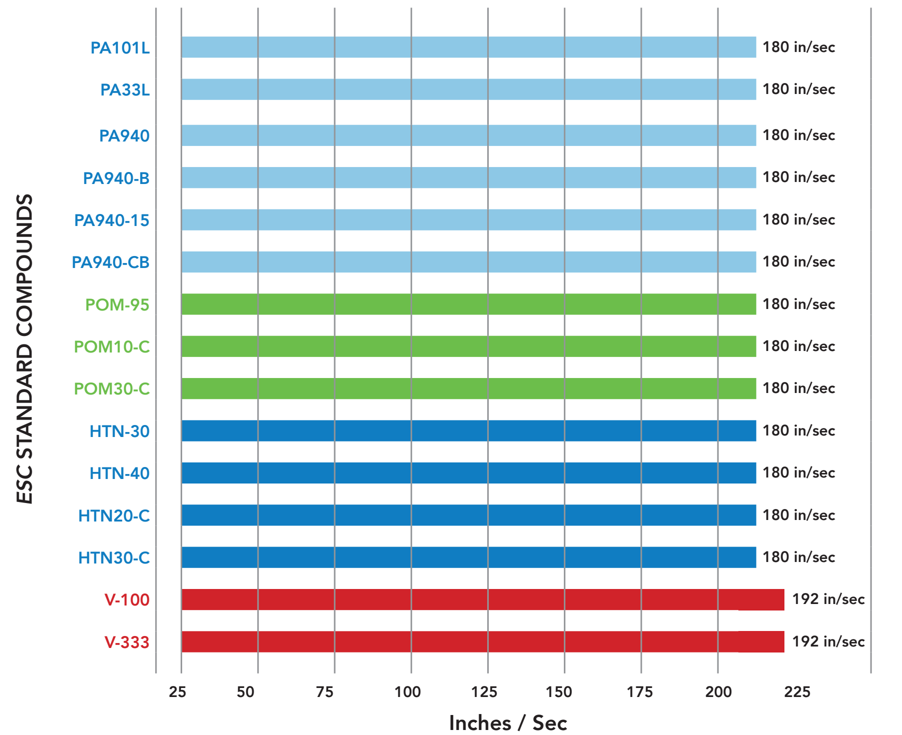




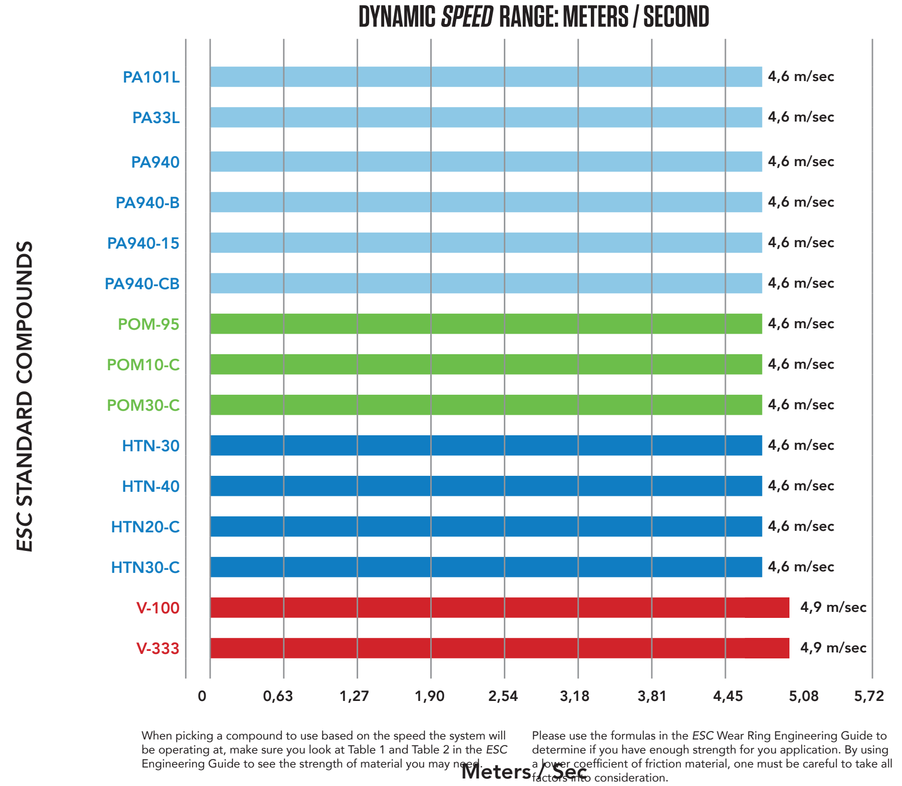
The graph above shows the current capability of *ESC* size range, Consult factory for availability for specific size, cross section and widths.

RECOMMENDED OPERATING SPEED RANGE FOR *ESC* ULTRA PRECISION WEAR RINGS

DYNAMIC *SPEED* RANGE: INCHES / SECOND



DYNAMIC *SPEED* RANGE: METERS / SECOND



When picking a compound to use based on the speed the system will be operating at, make sure you look at Table 1 and Table 2 in the *ESC* Engineering Guide to see the strength of material you may need.

As system speed increases, so does friction. As friction increases the

Please use the formulas in the *ESC* Wear Ring Engineering Guide to determine if you have enough strength for you application. By using a lower coefficient of friction material, one must be careful to take all factors into consideration.

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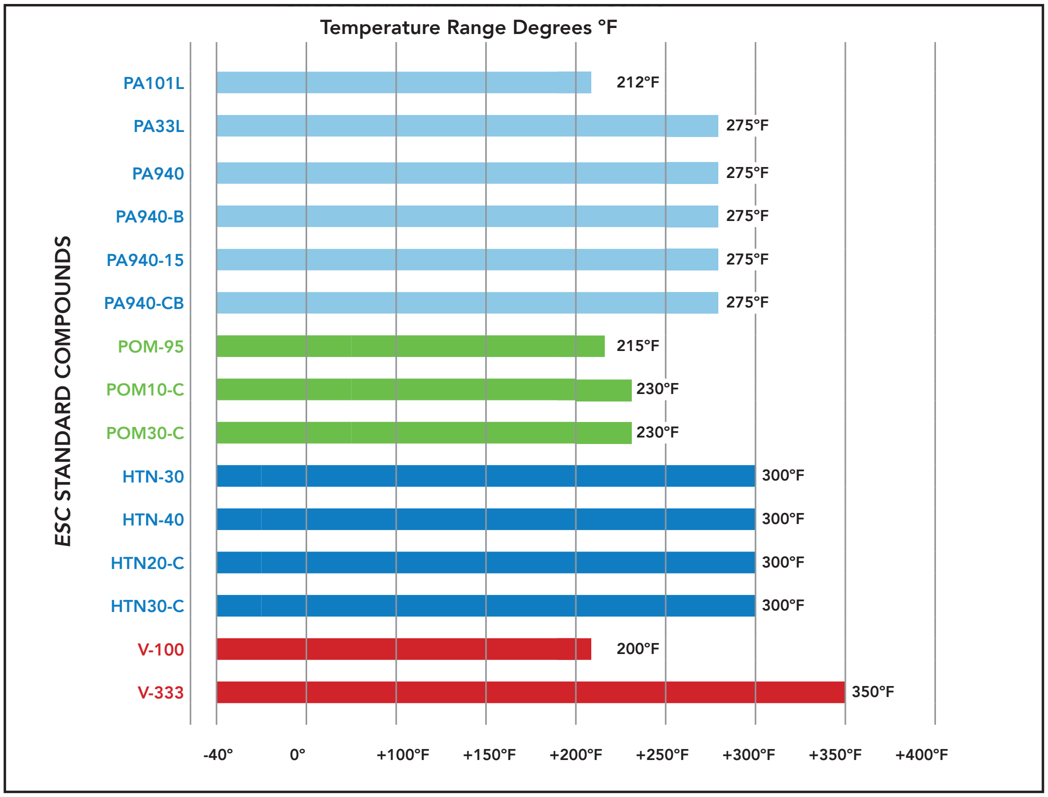
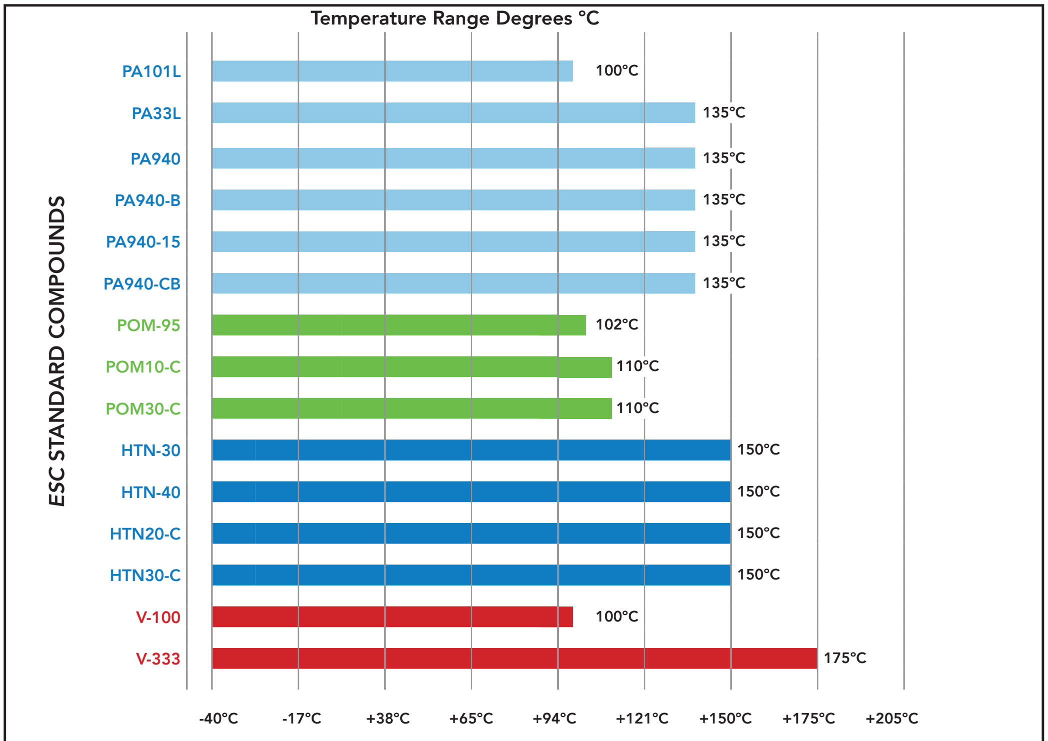
RECOMMENDED TEMPERATURE RANGE FOR *ESC* ULTRA PRECISION WEAR RINGS





When using this chart, keep in mind, as a plastic gets hotter it will loose much of it's tensile and compressive strength. Typically at +65°C most Nylons will loose about 40-50% of the Tensile and Compressive strength. Refer to the ESC Wear

ESC ULTRA PRECISION WEAR RING TYPICAL COMPOUND SPECIFICATIONS

ESC's standard materials used in Wear Ring manufacturing. These are the most common materials used. Please contact *ESC* for specialty grades to meet your specific needs.

ESC-Ion™ NYLON Wear Ring Materials

Property			COMPOUND NUMBER				
			PA940-B	PA940	PA940-15	PA940-CB	PA933-BK
			40% GF 6 NYLON / PROPRIETARY LUBRICANT	40% GF 6 NYLON	40% GF 6 - NYLON / PTFE	40% GF 6 NYLON / PROPRIETARY LUBRICANT	33% GF 6/6 NYLON / PROPRIETARY LUBRICANT
	Test Method	Units	Value	Value	Value	Value	Value
Tensile Strength	ASTM D638	Mpa (psi)	184 (26,700)	169 (24,500)	138 (20,000)	169 (24,500)	186 (27,000)
Tensile Elongation	ASTM D638	%	2.5	2.5	3	2.5	3
Tensile Modulus	ASTM D638	Mpa (psi)	13,000 (1,980,000)	13,10 (1,900,000)	12,756 (1,850,000)	10,135 (1,470,000)	11,032 (1,600,000)
Flexural Strength	ASTM D790	Mpa (psi)	280 (40,600)	262 (38,000)	234 (34,000)	263 (38,142)	276 (40,000)
Flexural Modulus	ASTM D790	Mpa (psi)	11,721 (1,700,000)	11,031 (1,600,000)	12,066 (1,750,000)	10,273 (1,490,000)	810,800 (1,200,000)
Shear Strength	ASTM D2344	Mpa (psi)					
Compressive Strength	ASTM D695	Mpa (psi)	193 (28,000)	165 (24,000)	138 (20,000)	165 (24,000)	227 (33,000)
Parallel to laminate	ASTM D695	Mpa (psi)					
Normall to laminate	ASTM D695	Mpa (psi)					
Hardness, Rockwell	ASTM D785	R	R120	R120	R120	R120	R120
Specific Gravity	ASTM D792		1.49	1.46	1.60	1.44	1.40
Water Absorption 24 hrs. @ 73 F (23 C)	ASTM D570	%	1.0	1.0	1.0	1.0	0.9
Coefficient of Friction (Dynamic)		40 psi, 50 fpm	0.27	0.30	0.25	0.23	0.27
Deflection Temperature C (F)							
@264 psi (1.8 Mpa)	ASTM D648	°C (°F)	204 (400)	204 (400)	204 (400)	204 (400)	260 (500)
@66 psi (0.45Mpa)	ASTM D648	°C (°F)	210 (410)	210 (410)	210 (410)	210 (410)	252 (486)
Coefficient of Linear Thermal Expansion	ASTM D696	m/m/C (in/in/F)	.000027 (.000015)	.000027 (.000015)	.000027 (.000015)	.000027 (.000015)	.000026 (.000012)
Tg-Glass Transition		C° (F°)	60 (140)	60 (140)	60 (140)	60 (140)	60 (140)
Service Range		Degrees F	-65F to +275F	-65F to +275F	-65F to +275F	-65F to +275F	-65F to +275F
Operating Speed- MAX.		m / sec. (feet / sec)	4.6 (15.0)	4.6 (15.0)	4.6 (15.0)	4.6 (15.0)	4.6 (15.0)
Color			Black	Black	Black	"CB" Blue	Black

TABLE 1

* Estimated By the Laboratory.
The information provided in this data sheet corresponds to our knowledge on the subject at the date of this publication. This information may be subject to revision as new knowledge and experience becomes available. The data provided fall within the normal range of product properties and relate only to the specific material designated; these data may not be valid for such materials used in combination with any other material, additives or pigments or in any process, unless expressly indicated otherwise. The data provided should not be used to establish specifications limits or used alone as the basis of design; they are not intended to substitute for any testing you may need to do to determine the suitability of a specific compound for your particular purpose. Since Engineered Seals, LLC cannot anticipate all variation in actual end-use conditions ESC makes no warranties and assumes no liability in connection with any use of this information. Caution: Do not use this product in medical application involving permanent implantation in the human body.We highly recommend testing in your specific application, this is a guide only.

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ESC ULTRA PRECISION WEAR RING TYPICAL COMPOUND SPECIFICATIONS

ESC's standard materials used in Wear Ring manufacturing. These are the most common materials used. Please contact *ESC* for specialty grades to meet your specific needs.

ESC-Ion ™ "Zero Swell" / Low Friction Wear Ring Materials

Property			COMPOUND NUMBER				
			HTN-40	HTN-30C	V-100	POM-95	POM-10C
			40% Glass Filled	30% Carbon Filled with PROPRIETARY LUBRICANT	COMPOSITE POLYESTER/ POLYESTER	Acetal	Carbon Filled POM
	Test Method	Units	Value	Value	Value	Value	Value
Tensile Strength	ASTM D638	Mpa (psi)	207 (30,000)	283 (41,000)	76 (11,000)	55 (8,000)	106 (15,500)
Tensile Elongation	ASTM D638	%	2.0	1.4	NA	>10	3-4
Tensile Modulus	ASTM D638	Mpa (psi)	14,135 (2,050,000)	24,821 (3,600,000)	76 (11,000)	241 (35,000)	8,618 (1,250,000)
Flexural Strength	ASTM D790	Mpa (psi)	307 (44,500)	440 (63,870)	NA	90 (13,000)	155 (22,500)
Flexural Modulus	ASTM D790	Mpa (psi)	13,100 (1,900,000)	21,373 (3,100,000)	3,309 (480,000)	2,448 (355,000)	(1,070,000)
Compressive Strength	ASTM D695	Mpa (psi)	207 (30,000*)	241* (35,000*)		62 (9000)	104* (15,000*)
Normal to laminate		Mpa (psi)			345 (50,000)		
Parallel to laminate		Mpa (psi)			100 (14,500)		
Notched 1/8"	ASTM D256	J/m (ft-lb/in)	91 (1.7)	78 (1.60)	NA	80 (1.5)	(1.2)
Unnotched 1/8"	ASTM D256	J/m (ft-lb/in)	641 (12.0)	705 (14.45)	NA	1,495 (28.0)	(10)
Hardness, Rockwell	ASTM D785	R	R125	R125	R135	R80	R110
Specific Gravity	ASTM D792		1.52	1.40	NA	1.41	1.42
Water Absorption 24 hrs. @ 73 F (23 C)	ASTM D570	%	0.23	.20	<0.1	.12	.12
Coefficient of Friction (Dynamic)	40 psi, 50 fpm		0.32	.18	.17-.12	.21	.20
Heat Deflection Temperature							
@264 psi (1.8 Mpa)	ASTM D648	°C (°F)	277 (530)	282 (540)	NA	96 (205)	135 (275)
@66 psi (0.45Mpa)	ASTM D648	°C (°F)			NA	154 (309)	
Coefficient of Linear Thermal Expansion Flow	ASTM D696	m/m/C (in/in/F)	.000022 (.000012)	.000022 (.000012)	NA	(.000060)	(.000051)
Tg-Glass Transition		C° (F°)	123 (253)	123 (253)	121 (250)	-50 (-58)	-50 (-58)
Service Range		Degrees F	-65F to +300F	-65F to +300F	-65F to +200F	-40F to +212F	-40F to +225F
Operating Speed- MAX.		m / sec. (feet / sec)	4.6 (15.0)	4.6 (15.0)	4.69 (16.0)	4.6 (15.0)	4.6 (15.0)
Color			Black	Black	Red or or Pearl	Black or White	Royal BLUE

TABLE 2

* Estimated By the Laboratory.

The information provided in this data sheet corresponds to our knowledge on the subject at the date of this publication. This information may be subject to revision as new knowledge and experience becomes available. The data provided fall within the normal range of product properties and relate only to the specific material designated; these data may not be valid for such materials used in combination with any other material, additives or pigments or in any process, unless expressly indicated otherwise. The data provided should not be used to establish specifications limits or used alone as the basis of design; they are not intended to substitute for any testing you may need to do to determine the suitability of a specific compound for your particular purpose. Since Engineered Seals, LLC cannot anticipate all variation in actual end-use conditions ESC makes no warranties and assumes no liability in connection with any use of this information. Caution: Do not use this product in medical application involving permanent implantation in the human body.We highly recommend testing in your specific application, this is a guide only.

Factors that influence the LIFE of elastomer seals & components

The properties profile of an elastomer seal component will normally remain constant for years if it is properly stored. In the event of improper storage, a large number of influencing factors can result in drastically reduced seal life.

Ultimately the seal is no longer fit for use due to cracking, hardening, softening, swelling, permanent deformation, breaking, and surface damage, etc.

To avoid this, Engineered Seals & Components, based on the DIN 7716 and ISO 2230 standards, recommends the following information to be used as a guideline for storage, cleaning, and maintenance of elastomer seals and components.

Cleaning: Contact ESC Engineering for instruction on cleaning of Seals & Components.

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ENGINEERED SEALS & COMPONENTS
SEALS & COMPONENTS STORAGE CONDITIONS / SHELF LIFE

Temperature

The recommended storage temperature for elastomer seals and components is +15C (+59F) and should not exceed +25C (+77F). Sources such as radiators, forced air units or boilers should be at least 1 meter or 3 feet away from the product.

Direct sunlight should be avoided. If temperatures drop below -10C (+14F) elastomer products tend to become very stiff. Special care should be taken to prevent the product from becoming deformed. Chloroprene material should not be stored below -12C (-10F).

Humidity

It is very important to ensure that the relative humidity in storage facilities stay below 65%. Storage in humid areas with condensation must be avoided. Sealed polyethylene bags or foil bags are a good choice. By the same token extreamely dry condition will cause will cause premature failures also.

Light / Radiation

Elastomer seals and components must be protected against light with high UV content. This light may cause damage to the products. Examples of light sources with high UV content include intense artificial light or direct sun light.

Light caused damage may be prevented by adding UV barriers or filters to window panes in the storage area. All types of radiation such as gamma or radioactive radiation must be avoided.

Cleaning: Contact ESC Engineering for instruction on cleaning of Seals & Components.

Solvents / Greases

Greases, oils and solvents may cause damage to elastomer seals and components. Therefore it is imperative that seals and other plastic components do not come in contact with these media in storage, unless packaged by the manufacturer this way.

Deformation

Elastomer seals and Thermoplastic components which are packed to tightly or crushed in a box will cause deforming. If the parts are exposed to tensile or compressive stress, the parts may be deformed. Cracking may occur or the parts may not be able to be installed correctly. It is a must that the seals and components be stored without being exposed to strain or deformation.

Oxygen / Ozone

Generally, elastomer seals and components should be protected against circulating air by using stable packaging such as airtight containers or polyethylene bags. This very important for rvery small seals with large surface to volume ratio. Mercury vapor lamps, florescent light sources, electric motors - generally any device that is capable of producing ozone through sparks, electrical discharges or high-voltage fields must be avoided if at all possible. Ozone is harmful to many elastomers, so storage areas must be ozone free. This also applies to organic gases as well as combustion gases as they are capable of producing ozone via a photochemical process.

Storage Period

A key criteria for the storage period of elastomers and components is the time which the product was produced. ESC indicates the date of the manufacture on the packing bags. The manufacture Quarter and the Year are the label in the Cure Date box. The recommended maximum storage period depends on the type of elastomer. **See Table S-1.**

The typical shelf life may be prolonged based on the actual product conditions at the end of the typical shelf life. Trained and experienced experts can approve a prolonged storage period based on a visual inspection of representative samples. The samples should not reveal any permanent distortion, mechanical damage or surface cracking. The material should not show any signs of hardening or softening nor any kind of tackiness.

Table S-1
Shelf Life Recommended in Years

	Typical Shelf Life	Possible Extension
TPU H-Poly	5	2
ESC-Thane	5	2
TPC-ET (Hytrel)	10	5
NBR (Molded)	6	3
NBR (Machined)	4	
HNBR	8	4
FKM, FPM	10	5
MVQ (Silicone)	10	5
PTFE	15	5
PA (ESC-Ion)	10	5
POM (ESC-tal)	10	5
PPA (ESC-HTN)	10	5
PEEK	10	5
UHMWPE	10	5

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