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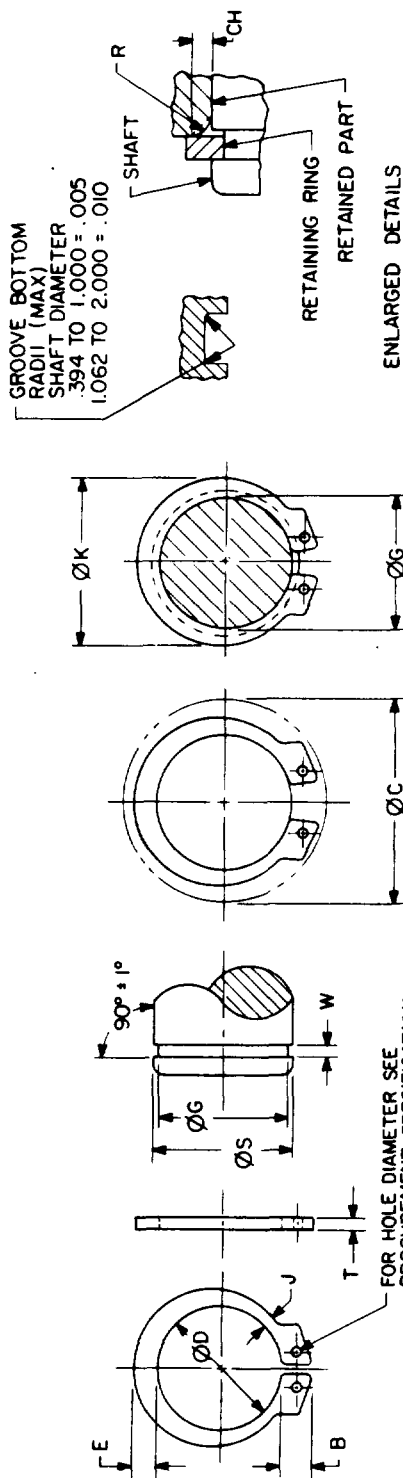
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TABLE 1. DIMENSIONS.

| ØS SHAFT (REF) | ØD FREE | B LUG HEIGHT | E LARGE SECTION HEIGHT | J SMALL SECTION HEIGHT | THICKNESS | ØG RECOMMENDED GROOVE | W WIDTH | ØK 3/ CLEAR | R 5/ OF RETAINED PART (REF) | CH 5/ MAX |
|----------------------|------------|--------------------|---------------------------------|---------------------------------|-----------|-----------------------------|------------|----------------|--------------------------------------|--------------|
| | | | | | | | | | | |
| INCH | MM | BASIC | TOL | BASIC | TOL | BASIC | TOL | BASIC | TOL | MAX |
| .394 | 10.0 | .362 | +.003 -.008 | .101 | .068 | +.004 | .039 | .047 | .039 | .039 |
| .473 | 12.0 | .435 | | .101 | .088 | | .053 | .070 | .058 | .058 |
| .500 | 12.7 | .460 | | .120 | .090 | | .050 | .075 | .070 | .070 |
| .591 | 15.0 | .543 | | .130 | .102 | +.005 | .057 | .086 | .070 | .058 |
| .625 | 15.9 | .575 | | .130 | .106 | | .059 | .090 | .074 | .062 |
| .669 | 17.0 | .616 | | .130 | .112 | | .062 | .094 | .077 | .064 |
| .750 | 19.0 | .689 | | .180 | .127 | | .077 | .112 | .089 | .074 |
| .787 | 20.0 | .689 | | .180 | .127 | | .077 | .116 | .089 | .074 |
| .875 | 22.2 | .804 | +.005 -.010 | .180 | .148 | +.006 | .083 | .125 | .100 | .083 |
| .984 | 25.0 | .906 | | .180 | .151 | | .084 | .136 | .100 | .083 |
| 1.000 | 25.4 | .906 | | .180 | .151 | | .084 | .137 | .100 | .083 |
| 1.062 | 27.0 | .978 | | .220 | .161 | | .090 | .152 | .106 | .088 |
| 1.125 | 28.6 | 1.036 | | .220 | .169 | | .095 | .158 | .112 | .093 |
| 1.181 | 30.0 | 1.087 | | .220 | .176 | | .098 | .164 | .112 | .093 |
| 1.188 | 30.2 | 1.087 | +.010 -.015 | .220 | .176 | +.007 | .098 | .164 | .112 | .093 |
| 1.250 | 31.7 | 1.150 | | .220 | .185 | | .103 | .170 | .112 | .093 |
| 1.312 | 33.3 | 1.208 | | .220 | .192 | | .106 | .177 | .112 | .093 |
| 1.375 | 34.9 | 1.268 | | .220 | .200 | | .110 | .183 | .112 | .093 |
| 1.378 | 35.0 | 1.268 | | .220 | .200 | | .110 | .183 | .112 | .093 |
| 1.500 | 38.1 | 1.380 | | .280 | .218 | | .123 | .208 | .128 | .107 |
| 1.562 | 39.7 | 1.437 | | .280 | .228 | | .127 | .214 | .128 | .107 |
| 1.575 | 40.0 | 1.437 | | .280 | .228 | | .127 | .215 | .128 | .107 |
| 1.750 | 44.4 | 1.608 | +.013 -.020 | .314 | .254 | +.008 | .140 | .234 | .128 | .107 |
| 1.772 | 45.0 | 1.608 | | .314 | .254 | | .140 | .237 | .128 | .107 |
| 1.938 | 49.2 | 1.782 | | .314 | .280 | | .154 | .258 | .153 | .128 |
| 1.969 | 50.0 | 1.782 | | .314 | .280 | | .154 | .261 | .153 | .128 |
| 2.000 | 50.8 | 1.840 | | .314 | .290 | | .160 | .264 | .153 | .128 |

(B) ENTIRE STANDARD REVISED

PA
NAVY-OS
Other Cust
ARMY-AR
AIR FORCE-99INTERNATIONAL
INTEREST

TITLE

RING, RETAINING, EXTERNAL, HEAVY-DUTY
(TAPERED SECTION TYPE)PROCUREMENT SPECIFICATION
MIL-R-21248

SUPERSEDES

MILITARY STANDARD
MS3217

PAGE 1 OF 5

FOR FOOTNOTES SEE PAGE 2

APPROVED

12 MAR 1968

REVISED

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- 1/ T = THICKNESS "T" APPLIES TO UNPLATED RINGS. FOR CORROSION RESISTANT STEEL AND PLATED RINGS, $\pm .002$ SHOULD BE ADDED TO THE MAXIMUM TOLERANCE, i.e., $\pm .002$ SHOULD BE $\pm .004/- .002$.
- 2/ FIM = (FULL INDICATOR MOVEMENT) IS THE MAXIMUM ALLOWABLE DEVIATION OF CONCENTRICITY BETWEEN THE GROOVE AND THE SHAFT.
- 3/ K = MAXIMUM DIAMETER WHEN THE RING IS PROPERLY SEATED IN THE GROOVE (DESIGN REFERENCE DIMENSION).
- 4/ C = ACTUAL CLEARANCE DIAMETER WHEN THE RING IS SPRUNG OVER THE SHAFT PRIOR TO INSTALLATION INTO THE GROOVE (DESIGN REFERENCE DIMENSION).
- 5/ R AND CH = RADII OR CHAMFER ALLOWABLE ON PARTS TO BE RETAINED BY THE RING. THRUST LOADS OF RINGS, RETAINING PARTS WITH CORNER RADII, OR CHAMFERS AS LISTED ON PAGE 1 ARE TABULATED ON PAGE 4.

REQUIREMENTS:

1. CLASSIFICATION: RETAINING RINGS FURNISHED UNDER THIS STANDARD SHALL BE TYPE I, CLASS 10 OF THE PROCUREMENT SPECIFICATION.
2. MATERIAL:
 - (a) CARBON SPRING STEEL, GRADE 1060 THRU 1095 (UNS G10600 THRU G10950) IN ACCORDANCE WITH ASTM A568 OR ASTM A682.
 - (b) CORROSION RESISTANT STEEL IN ACCORDANCE WITH AMS 5520 (UNS S15700).
 - (c) BERYLLIUM COPPER ALLOY NUMBER 170 (UNS C17000) OR ALLOY NUMBER 172 (UNS C17200) IN ACCORDANCE WITH ASTM B194.
3. HARDNESS:

TABLE II. HARDNESS

| SHAFT (REF) | CARBON STEEL | CORROSION RESISTANT STEEL | BERYLLIUM COPPER |
|------------------------------|--------------------------|---------------------------------|------------------------|
| .394-.625 .669-2.000 INCL | 67.5-75HR30N 47-52HRC | 63-69.5HR30N 44-51HRC | 54-62HR30N 34-43HRC |

4. PROTECTIVE FINISH OR SURFACE TREATMENT:

- (a) CARBON STEEL - SHALL BE AS SPECIFIED (SEE TABLE III):
 - (1) CADMIUM PLATE IN ACCORDANCE WITH QQ-P-410, TYPE II, CLASS 3 OR ASTM B090, TYPE II, CLASS 5.
 - (2) ZINC COAT IN ACCORDANCE WITH ASTM B633, TYPE II, CLASS Fe/Zn5, OR ASTM B695, TYPE II, CLASS 5.
 - (3) PHOSPHATE COAT IN ACCORDANCE WITH DOD-P-16232, TYPE 2, CLASS 2.
- (b) CORROSION RESISTANT STEEL - SHALL BE CLEANED, DESCALED AND PASSIVATED IN ACCORDANCE WITH QQ-P-35.
5. PART NUMBER: THE BASIC MS PART NUMBER IS FOLLOWED BY A DASH NUMBER TAKEN FROM TABLE III.
 EXAMPLE: MS3217-1200 IS THE PART NUMBER FOR A CARBON STEEL CADMIUM PLATE, EXTERNAL HEAVY DUTY RETAINING RING FOR USE ON A 2.000 DIAMETER SHAFT

NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN INCHES.
2. IN THE EVENT OF A CONFLICT BETWEEN THE TEXT OF THIS STANDARD AND THE REFERENCES CITED HEREIN, THE TEXT OF THIS STANDARD SHALL TAKE PRECEDENCE.
3. REFERENCED GOVERNMENT (OR NON-GOVERNMENT) DOCUMENTS OF THE ISSUE LISTED IN THAT ISSUE OF THE DEPARTMENT OF DEFENSE INDEX OF SPECIFICATIONS AND STANDARDS (DODISS) SPECIFIED IN THE SOLICITATION FORM A PART OF THIS STANDARD TO THE EXTENT SPECIFIED HEREIN.

| | | | |
|---|---------------------------|--|--------------------------|
| P.A. NAVY-OS Other Cust ARMY-AR AIR FORCE-99 | INTERNATIONAL INTEREST | TITLE RING, RETAINING, EXTERNAL, HEAVY-DUTY (TAPERED SECTION TYPE) | MILITARY STANDARD |
| PROCUREMENT SPECIFICATION MIL-R-21248 | | | MS3217 |
| SUPERSEDES | | PAGE 2 | OF 5 |

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TABLE III. DASH NUMBERS FOR MS3217

| ØS SHAFT (REF) | CARBON STEEL ^{1/} CADDIUM PLATE DASH NO. | CARBON STEEL ^{1/} ZINC COAT DASH NO. | CARBON STEEL ^{1/} PHOSPHATE COAT DASH NO. | STEEL CORROSION RESISTANT DASH NO. | BERYLLIUM ^{1/} COPPER DASH NO. |
|----------------------|---|---|--|--|---|
| .394 | -1039 | -2039 | -3039 | -4039 | -5039 |
| .473 | -1047 | -2047 | -3047 | -4047 | -5047 |
| .500 | -1050 | -2050 | -3050 | -4050 | -5050 |
| .591 | -1059 | -2059 | -3059 | -4059 | -5059 |
| .625 | -1062 | -2062 | -3062 | -4062 | -5062 |
| .669 | -1066 | -2066 | -3066 | -4066 | -5066 |
| .750 | -1075 2/ | -2075 2/ | -3075 2/ | -4075 2/ | -5075 2/ |
| .787 | -1075 2/ | -2075 2/ | -3075 2/ | -4075 2/ | -5075 2/ |
| .875 | -1087 | -2087 | -3087 | -4087 | -5087 |
| .984 | -1098 2/ | -2098 2/ | -3098 2/ | -4098 2/ | -5098 2/ |
| 1.000 | -1098 2/ | -2098 2/ | -3098 2/ | -4098 2/ | -5098 2/ |
| 1.062 | -1106 | -2106 | -3106 | -4106 | -5106 |
| 1.125 | -1112 | -2112 | -3112 | -4112 | -5112 |
| 1.181 | -1118 2/ | -2118 2/ | -3118 2/ | -4118 2/ | -5118 2/ |
| 1.188 | -1118 2/ | -2118 2/ | -3118 2/ | -4118 2/ | -5118 2/ |
| 1.250 | -1125 | -2125 | -3125 | -4125 | -5125 |
| 1.312 | -1131 | -2131 | -3131 | -4131 | -5131 |
| 1.375 | -1137 2/ | -2137 2/ | -3137 2/ | -4137 2/ | -5137 2/ |
| 1.378 | -1137 2/ | -2137 2/ | -3137 2/ | -4137 2/ | -5137 2/ |
| 1.500 | -1150 | -2150 | -3150 | -4150 | -5150 |
| 1.562 | -1156 2/ | -2156 2/ | -3156 2/ | -4156 2/ | -5156 2/ |
| 1.575 | -1156 2/ | -2156 2/ | -3156 2/ | -4156 2/ | -5156 2/ |
| 1.750 | -1175 2/ | -2175 2/ | -3175 2/ | -4175 2/ | -5175 2/ |
| 1.772 | -1175 2/ | -2175 2/ | -3175 2/ | -4175 2/ | -5175 2/ |
| 1.938 | -1193 2/ | -2193 2/ | -3193 2/ | -4193 2/ | -5193 2/ |
| 1.969 | -1193 2/ | -2193 2/ | -3193 2/ | -4193 2/ | -5193 2/ |
| 2.000 | -1200 | -2200 | -3200 | -4200 | -5200 |

^{1/} SUBSTITUTE CORROSION RESISTANT STEEL WHEN USED IN FOOD PROCESSING MACHINERY, OR IN FUEL OR LUBRICATION SYSTEMS, OR WHEN USED AT TEMPERATURES OVER 450°F (233°C).

RECOMMENDED DESIGN LIMITATIONS AND USAGE

- (a) INTENDED USE - TO PROVIDE LARGE SHOULDERS FOR POSITIONING AND RETAINING MACHINE COMPONENTS UNDER HEAVY LOADING CONDITIONS ON SHAFTS, EVEN IF COMPONENTS TO BE SECURED HAVE LARGE CORNER RADII OR CHAMFERS ABUTTING THE RINGS. THEY WITHSTAND COMPARATIVELY HEAVY SHOCK LOADS AND HIGH ROTATIONAL SPEEDS. THEY ELIMINATE THE NEED FOR SEPARATE THRUSTWASHERS. THE USE OF THE FOLLOWING FORMULAS ARE BASED ON THE FACT THAT THE RING WILL NOT FAIL IN COMPRESSION.

LIMITATION ON USE - THE FOLLOWING FORMULAS ARE NOT TO BE USED FOR BRITTLE MATERIALS SUCH AS CAST IRON, ETC.

WARNING - RING HALVES SHOULD NOT BE OVER EXPANDED DURING INSTALLATION SINCE THIS WILL LEAD TO RING FAILURE. IF RING HAS PLAY BETWEEN THE GROOVE DIAMETER AND THE INSIDE RING DIAMETER, THIS INDICATES THAT THE RING HAS BEEN OVER EXPANDED, (PROVIDING GROOVE HAS BEEN MACHINED TO RECOMMENDED DIMENSIONS).

FOR APPROXIMATE SAFETY RPM LIMITS SEE TABLE IV.

TABLE IV. CALCULATED RPM LIMITS. APPLY REQUIRED SAFETY FACTOR

| ØSHAFT (INCHES) | | .394 | .437 | .500 | .750 | 1.000 | 1.250 | 1.500 | 1.750 | 2.000 |
|---|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| CARBON STEEL AND CORROSION RESISTANT STEEL | RPM LIMIT | 80,000 | 69,000 | 65,000 | 40,500 | 30,000 | 23,000 | 18,500 | 15,500 | 14,000 |
| BERYLLIUM COPPER | RPM LIMIT | 51,000 | 44,000 | 41,500 | 26,000 | 19,000 | 14,500 | 12,000 | 10,000 | 9,000 |

| | | | | | | |
|--|--|---------------------------|--|-----------|-----------------------------|--|
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(b) ALLOWABLE THRUST LOAD CAPACITY OF THE RINGS. ABUTTING COMPONENTS TO HAVE SHARP CORNERS =

$$P = \frac{C_f \pi S T X}{F}$$

WHERE:

P = ALLOWABLE THRUST LOAD (POUNDS)
 S = SHAFT DIAMETER (INCHES)
 T = THICKNESS (INCHES)
 X = ULTIMATE SHEAR STRENGTH OF THE RING MATERIAL (PSI)^{1/}
 F = FACTOR OF SAFETY F = 4 IS RECOMMENDED TO INSURE A SAFE WORKING LOAD
 C_f = CONVERSION FACTOR, C_f = 1.3 IS RECOMMENDED SINCE THICKER RINGS INCREASE SAFETY OF ASSEMBLY

(c) ALLOWABLE LOAD CAPACITY OF GROOVE WALL =

$$P = \frac{C_f \pi S d Y}{F}$$

WHERE:

P = ALLOWABLE COMPRESSION LOAD (POUNDS)
 S = SHAFT DIAMETER (INCHES)
 d = GROOVE DEPTH (INCHES)
 Y = YIELD STRENGTH IN COMPRESSION OF THE GROOVE MATERIAL (PSI)
 F = FACTOR OF SAFETY, F = 4 IS RECOMMENDED TO INSURE A SAFE WORKING LOAD
 C_f = CONVERSION FACTOR, C_f = 2 IS RECOMMENDED SINCE CONTACT AREA IN GROOVE IS INCREASED DUE TO THICKER RING

(d) MINIMUM DISTANCE BETWEEN OUTER GROOVE WALL AND END OF SHAFT =

$$Z = 3d$$

WHERE:

Z = MINIMUM DISTANCE BETWEEN OUTER GROOVE WALL AND END OF SHAFT (INCHES)
 d = GROOVE DEPTH (INCHES)

(e) ALLOWABLE SHAFT DIAMETER =

$$S = \sqrt{\frac{G^2 + 4FP}{Y \pi C_f}}$$

WHERE:

S = ALLOWABLE SHAFT DIAMETER
 G = GROOVE DIAMETER
 F = FACTOR OF SAFETY (SEE FORMULA (c) ABOVE)
 P = DESIGN LOAD
 Y = YIELD STRENGTH IN COMPRESSION OF GROOVE MATERIAL (PSI)
 C_f = CONVERSION FACTOR (SEE FORMULA (c) ABOVE)

(f) DIFFERENTIAL ROTATION =

THE CONDITIONS UNDER WHICH A RETAINING RING MAY BE USED WHEN ADJACENT PARTS ROTATE RELATIVE TO IT, FALL INTO TWO CATEGORIES:

- (1) WHERE NO THRUST IS EXERTED BY ADJACENT PART. IN THIS CASE, DIFFERENTIAL ROTATION OF RING AND ADJACENT PART CREATES NO ELEMENT OF RISK IN THE APPLICATION OF THE RINGS BECAUSE NO FRICTIONAL TORQUE IS EXERTED BY THE MACHINE PART ON THE RING.
- (2) CONSIDERATION MUST BE GIVEN TO THE MAGNITUDE OF THE THRUST INVOLVED. THE FRICTION MOMENT MAY NOT EXCEED THE BENDING MOMENT, WHICH THE RING CAN TOLERATE WITHOUT RELEASING ITS PRESSURE AGAINST THE BOTTOM OF THE GROOVE, FORMULATED AS FOLLOWS:

$$f P N \leq \frac{S T E^2}{10} \quad \text{OR}$$

$$P = \frac{S T E^2}{f 10 N}$$

WHERE:

P = ALLOWABLE THRUST LOAD EXERTED BY ADJACENT PART (POUNDS)
 f = COEFFICIENT OF FRICTION
 S = WORKING STRESS OF RING UNDER MAXIMUM EXPANSION (PSI)^{2/}
 T = RING THICKNESS (INCHES)
 E = GREATEST WIDTH SECTION OF RING (INCHES)
 N = NEUTRAL RING DIAMETER (INCHES) = FREE DIAMETER PLUS 3/4 E DIMENSION

IN SUCH CASES WHERE DIFFERENTIAL ROTATION OCCURS, THE CALCULATION SHOULD BE BASED ON THE MAXIMUM POSSIBLE VALUE OF THE COEFFICIENT OF FRICTION.

(g) IMPACT CAPACITY OF THE RING AND THE GROOVE WALL =

$$I_R = \frac{PT}{2} \quad \text{FOR THE RING (INCH POUNDS), ABUTTING COMPONENTS TO HAVE SHARP CORNERS}$$

$$I_G = \frac{Pd}{2} \quad \text{FOR THE GROOVE (INCH POUNDS)}$$

WHERE:

P = ALLOWABLE THRUST LOAD OF RINGS OR GROOVES (POUNDS)
 T = RING THICKNESS (INCHES)
 I_R = IMPACT OF RING (INCH POUNDS)
 d = GROOVE DEPTH (INCHES)
 I_G = IMPACT CAPACITY OF GROOVE WALL (INCH POUNDS)

- 1/ X = 150,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS OF CARBON STEEL OR CORROSION RESISTANT STEEL.
 X = 110,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS OF BERYLLIUM COPPER.
 2/ S = 250,000 PSI WORKING STRESS FOR RINGS OF CARBON STEEL OR CORROSION RESISTANT STEEL.
 S = 180,000 PSI WORKING STRESS FOR RINGS OF BERYLLIUM COPPER.

| | | | |
|---|---------------------------|---|---|
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| PROCUREMENT SPECIFICATION MIL-R-21248 | SUPERSEDES | PAGE 4 OF 5 | |

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(h) LOAD CAPACITY, WITH THE RETAINED PART RADIUS OR CHAMFERED = WHEN THE RADIUS OR CHAMFER OF THE RETAINED PART DOES NOT EXCEED THE MAXIMUM RADIUS ALLOWED FOR THE BOTTOM OF THE RING GROOVE, THE LESSER LOAD CAPACITY COMPUTED FROM THE FORMULAS ON PAGES 4 AND 5 WILL APPLY. THE CORNER RADII AND CHAMFERS LISTED ON PAGE 1 WERE CHOSEN AS LARGE AS POSSIBLE FOR THE RING SIZES INVOLVED AND ARE RELATED TO THE MAXIMUM THRUST LOADS LISTED IN THE TABLE BELOW. IF THE CORNER RADII OR CHAMFERS ARE SMALLER THAN THOSE LISTED, THEN THE THRUST LOADS INCREASE PROPORTIONALLY, IN ACCORDANCE WITH THE FOLLOWING FORMULAS:

$$P^1 = \frac{P R}{R^1}$$

$$P^1 = \frac{P Ch}{Ch^1}$$

WHERE:

P¹ = NEW ALLOWABLE THRUST LOAD

P = LISTED ALLOWABLE THRUST LOAD

R¹ = NEW (SMALLER) CORNER RADIUS

R = LISTED CORNER RADIUS

Ch¹ = NEW (SMALLER) CHAMFER

Ch = LISTED CHAMFER

LIMIT LOADS LISTED IN TABLE V ARE BASED ON RINGS OF CARBON STEEL OR CORROSION RESISTANT STEEL (WORKING STRESS 250,000 PSI) AND OF RINGS OF BERYLLIUM COPPER (WORKING STRESS = 180,000 PSI) IF THE ALLOWABLE GROOVE CAPACITY LOADS AS CALCULATED BY USING THE FORMULA ON PAGE 4 ARE LESS, THEN THEY SHOULD BE USED.

TABLE V. LIMIT LOADS

| ØS SHAFT (REF) | | ALLOWABLE THRUST LOAD FOR RING ASSEMBLIES WITH PARTS HAVING MAXIMUM CORNER RADII OR CHAMFERS | |
|----------------------|-------|---|------------------|
| FROM | TO | CARBON STEEL OR CRES | BERYLLIUM COPPER |
| --- | .394 | 450 LB | 300 LB |
| --- | .473 | 550 LB | 400 LB |
| --- | .500 | 650 LB | 450 LB |
| .591 | .625 | 750 LB | 550 LB |
| --- | .669 | 900 LB | 650 LB |
| .750 | 1.000 | 2500 LB | 1800 LB |
| 1.062 | 1.378 | 4000 LB | 2900 LB |
| 1.500 | 1.772 | 5000 LB | 3600 LB |
| 1.938 | 2.000 | 6000 LB | 4300 LB |

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