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REVIEWER ACT 25  
ARMY - AV, GL, M  
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USER ACTIVITIES  
ARMY - AT, ER, ME  
NAVY - AS, MC, SH, YD

NAVY-OS  
Other Cost  
ARMY - AR  
AIR FORCE-99  
PROCUREMENT SPECIFICATION  
MIL-R-21248

INTERNATIONAL  
INTEREST  
TITLE  
RING, RETAINING, EXTERNAL, BEVELED  
(TAPERED SECTION TYPE)  
SUPERSEDES

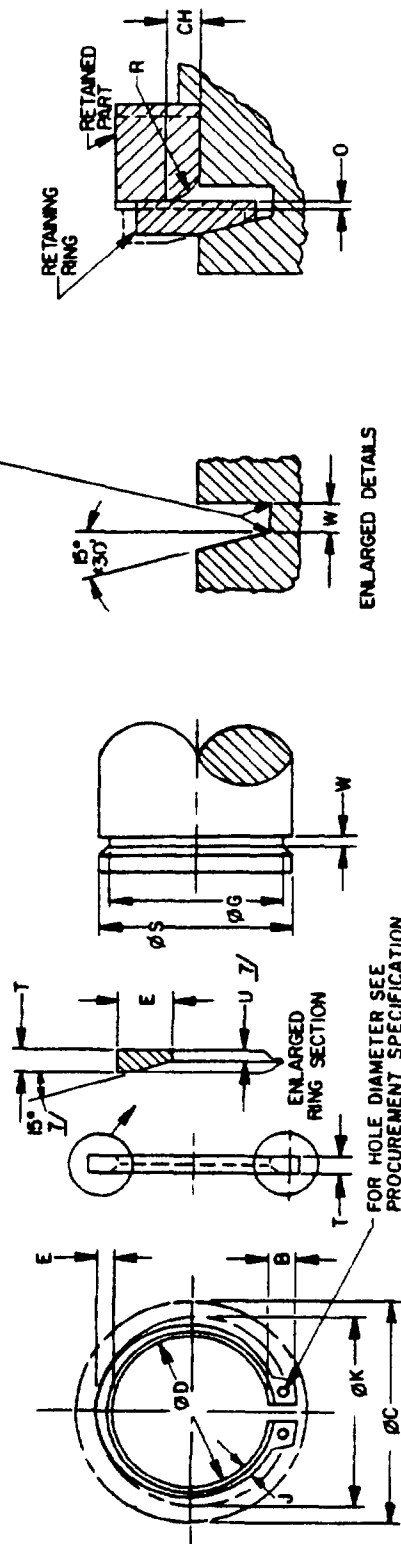
MILITARY STANDARD  
MS16630  
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DD FORM 1 672-1 (COORDINATED)

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE

5365-0116

GROOVE BOTTOM RADI (MAX)  
SHAFT DIA 1000 TO 2000-005  
2.062 AND OVER-010



ENLARGED DETAILS

FOR HOLE DIAMETER SEE  
PROCUREMENT SPECIFICATION

TABLE 1. DIMENSIONS

SHAFT DIAMETER (INCH)	SHAFT DIAMETER (MM)	Ø D FREE		Ø B LOC HEIGHT		Ø E LARGE SECTION HEIGHT		Ø J SMALL SECTION HEIGHT		U THICKNESS AT BEVELED EDGE		T THICKNESS		Ø G RECOMMEND GROOVE (MM)		Ø R Ø R Ø R		Ø C Ø C Ø C		Ø S Ø S Ø S		Ø F Ø F Ø F		Ø H Ø H Ø H	
		BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL
1.000	25.4	925	+ .005	167		.116	± .005	.065	± .005	.034		.042		.930		1.144		1.410		.005		.057		.034	
1.023	26.0	944	- .010	168		.118		.066		.033		.042		.951		1.170		1.430		.005		.058		.035	
1.062	27.0	942		181		.122		.069		.041		.050		.992		1.217		1.500		.005		.060		.036	
1.125	28.6	1.041		182		.128		.071		.041		.050		1.051		1.284		1.550		.005		.063		.038	
1.188	30.2	1.096		182		.132		.072		.041		.050		1.108		1.351		1.610		.005		.064		.038	
1.250	31.7	1.154		183		.140		.076		.040		.050		1.166		1.424		1.690		.005		.068		.041	
1.312	33.3	1.214	+ .010	183	± .004	.146		.076		.039		.050		1.224		1.490		1.750		.006		.068		.041	
1.375	34.9	1.272	- .015	184		.152		.082		.039		.050		1.282		1.562		1.800		.006		.072		.042	
1.438	36.5	1.333		184		.160		.086		.039		.050		1.343		1.634		1.870		.006		.076		.045	
1.500	38.1	1.397		214		.168		.091		.038		.050		1.397		1.706		1.950		.007		.079		.047	
1.562	39.7	1.466		235		.172		.093		.049		.062		1.459		1.778		2.100		.007		.082		.049	
1.625	41.3	1.503		235		.180		.093		.049		.062		1.516		1.849		2.170		.007		.087		.052	
1.687	42.9	1.569	+ .013	235		.184		.099	± .006	.048		.062		1.573		1.912		2.240		.007		.090		.054	
1.750	44.4	1.618	- .020	237		.188		.101		.048		.062		1.631		1.981		2.310		.008		.091		.054	
1.771	45.0	1.637		237		.190		.102		.048		.062		1.650		2.004		2.330		.008		.092		.055	
1.812	46.0	1.675		238		.192		.102		.048		.062		1.688		2.047		2.360		.008		.092		.055	
1.875	47.6	1.735		239		.196		.104		.048		.062		1.748		2.114		2.440		.008		.094		.056	
1.945	50.0	1.819		245		.200		.106		.047		.062		1.832		2.209		2.540		.009		.094		.057	
2.000	50.8	1.850		239		.204		.108		.047		.062		1.863		2.246		2.550		.009		.096		.057	
2.062	52.4	1.906	+ .015 - .025	264	± .005	.208	± .007	.111	± .007	.062	± .0015	.078		1.921		2.315		2.680		.009		.098		.059	

(B) ENTIRE STANDARD REVISED

APPROVED 11 DEC 1958

REVISED

(B) 18 APRIL 89

FED SUP CLASS  
5365

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REVIEWER ACTIVITIES  
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 ARMY-AR  
 AIR FORCE-99

PROCUREMENT SPECIFICATION  
 MIL - R - 21248

INTERNATIONAL  
 INTEREST

SUPERSEDES

TITLE  
 RING, RETAINING, EXTERNAL, BEVELED  
 (TAPERED SECTION TYPE)

MILITARY STANDARD

MS16630

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TABLE 1. DIMENSIONS - CONTINUED

Ø S SHAFT (REF)	Ø D FREE TOL	B LIC HEIGHT	E LANCE SECTION HEIGHT	J SPALL SECTION HEIGHT	U 1/ THICKNESS AT BEVELED EDGE	T 1/ THICKNESS	Ø G RECOMMENDED GROOVE (REF)	W WIDTH GROOVE (REF)	Ø K 1/ CLEAR	O 2/ TIME UP	R 3/ OF RETAINED PART (REF)	CH 4/ (REF)
2 125	54.0	1 964	212	113	062	078	1 979	067	2 386	010	096	059
2 156	54.8	1 993	212	113	062	078	2 008	067	2 410	010	097	058
2 250	57.1	2 081	220	116	061	078	2 096	066	2 513	010	100	060
2 312	58.7	2 139	222	118	060	078	2 154	065	2 577	010	100	060
2 375	60.3	2 197	224	119	060	078	2 212	065	2 640	011	100	060
2 437	61.9	2 255	228	120	060	078	2 270	065	2 704	011	102	061
2 500	63.5	2 313	232	122	059	078	2 328	064	2 772	011	104	062
2 559	65.0	2 371	238	125	059	078	2 397	064	2 845	011	106	063
2 625	66.7	2 428	242	127	058	078	2 448	064	2 910	011	109	064
2 687	68.3	2 485	246	129	059	078	2 505	064	2 975	012	111	067
2 750	69.8	2 543	248	131	073	093	2 563	078	3 041	012	112	067
2 815	73.0	2 659	256	133	072	093	2 679	078	3 172	013	115	069
2 937	74.6	2 717	260	136	072	093	2 737	078	3 239	013	116	070
3 000	76.2	2 775	264	138	071	093	2 795	077	3 306	013	117	070
3 062	77.8	2 832	268	141	071	093	2 852	077	3 347	014	107	064
3 125	79.4	2 892	272	143	070	093	2 912	076	3 439	014	120	072
3 156	80.2	2 920	274	143	070	093	2 940	076	3 469	014	120	072
3 250	82.5	3 006	280	145	070	093	3 026	075	3 571	015	123	074
3 346	85.0	3 092	286	147	069	093	3 112	075	3 669	015	126	076
3 437	87.3	3 179	292	148	069	093	3 199	075	3 767	016	129	077
3 500	88.9	3 237	295	149	084	109	3 257	091	3 821	016	122	073
3 543	90.0	3 277	298	149	084	109	3 297	091	3 866	016	123	074
3 625	92.0	3 352	296	153	083	109	3 372	090	3 954	017	127	076
3 687	93.7	3 410	302	156	083	109	3 430	090	4 028	017	129	078
3 750	95.2	3 468	310	160	082	109	3 488	089	4 098	017	133	080
3 875	98.4	3 584	318	163	082	109	3 604	089	4 229	018	137	082
3 938	100.0	3 642	318	163	081	109	3 662	088	4 290	018	137	082
4 000	101.6	3 700	318	163	081	109	3 720	088	4 350	019	135	081

1/ T = THICKNESS "T" APPLIES TO UNPLATED RINGS FOR CORROSION RESISTANT STEEL AND PLATED RINGS, +.002 SHOULD BE  
 ADDED TO THE MAXIMUM TOLERANCE, I.E., +.002 SHOULD BE +.004/-.002.

2/ F/M = (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 AT THE MINIMUM POSITION HALF WAY DOWN IN THE GROOVE.

4/ C = CLEARANCE DIAMETER WHEN THE RING IS SPRING OVER THE SHAFT PRIOR TO INSTALLATION INTO THE GROOVE.

(DESIGN REFERENCE DIMENSION).

5/ O = END PLAY TAKE UP.

6/ R AND CH = RADII OR CHAMFERS ALLOWABLE ON PARTS TO BE RETAINED BY THE RINGS. THRUST LOADS FOR RINGS, RETAINING  
 PARTS WITH CORNER RADIII OR CHAMFERS ARE TABULATED ON PAGE 6.

7/ 15° AND U = THESE DIMENSIONS ARE FOR GROOVE LOCATION CALCULATIONS ONLY (SEE (E) ON PAGE 5) AND NOT FOR  
 INSPECTION PURPOSES.

FED SUP CLASS  
 5365

APPROVED 11 DEC 1958 REVISED (B) FOR CHANGES SEE PAGES 1 THRU 6

FED SUP CLASS  
5365**REQUIREMENTS:**

1. **CLASSIFICATION:** RETAINING RINGS FURNISHED UNDER THIS STANDARD SHALL BE TYPE III, CLASS 2 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 QQ-C-533.
3. **HARDNESS:**

TABLE II. HARDNESS

Ø SHAFT (REF)	CARBON STEEL	CORROSION RESISTANT STEEL	BERYLLIUM COPPER
1.000 TO 1.023 INCL	47-53HRC	44-51HRC	56.5-62HR30N
1.062 TO 3.437 INCL	47-52HRC	44-51HRC	37-43HRC
3.500 AND OVER	45-50HRC	44-51HRC	—

4. **PROTECTIVE FINISH OR SURFACE TREATMENT:**
  - (a) CARBON STEEL— SHALL BE AS SPECIFIED (SEE TABLE III OR IV):
    - (1) CADMIUM PLATE IN ACCORDANCE WITH QQ-P-416, TYPE II, CLASS 3 OR ASTM B696, 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 OR IV.  
 EXAMPLE: MS16630-1100 IS THE PART NUMBER FOR A CARBON STEEL CADMIUM PLATE, EXTERNAL BEVELED RETAINING RING FOR USE ON A 1.000 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. <b>NAVY-03</b> Other Code <b>ARMY-AR</b> <b>AIR FORCE-99</b>	INTERNATIONAL INTEREST	TITLE <b>RING, RETAINING, EXTERNAL, BEVELED (TAPERED SECTION TYPE)</b>	<b>MILITARY STANDARD</b>
			<b>MS16630</b>
PROCUREMENT SPECIFICATION <b>MIL-R-21248</b>	SUPERSEDES	PAGE <b>3</b>	OF <b>6</b>

 USER ACTIVITIES  
 ARMY-AT,ER,ME  
 NAVY-AS,MC,SH,YD

 REVIEWER / RES  
 ARMY-AV,VL,AM  
 AIR FORCE-82  
 DLA-IS

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TABLE III DASH NUMBERS FOR MS16630

Q & S SHAFT (REF)	CARBON STEEL Cadmium PLATE ✓	CARBON STEEL ZINC COAT ✓	CARBON STEEL PHOSPHATE COAT ✓	STEEL CORROSION RESISTANT ✓	BARLYLLIUM COOPER ✓	Q & S SHAFT (REF)	CARBON STEEL Cadmium PLATE ✓	CARBON STEEL ZINC COAT ✓	CARBON STEEL PHOSPHATE COAT ✓	STEEL CORROSION RESISTANT ✓
	DASH NO	DASH NO	DASH NO	DASH NO	DASH NO		DASH NO	DASH NO	DASH NO	DASH NO
1 000	-1100	-2100	-3100	-4100	-5100	2 437	-1243	-2243	-3243	-4243
1 023	-1102	-2102	-3102	-4102	-5102	2 500	-1250	-2250	-3250	-4250
1 062	-1106	-2106	-3106	-4106	-5106	2 559	-1255	-2255	-3255	-4255
1 125	-1112	-2112	-3112	-4112	-5112	2 625	-1262	-2262	-3262	-4262
1 188	-1118	-2118	-3118	-4118	-5118	2 687	-1268	-2268	-3268	-4268
1 250	-1125	-2125	-3125	-4125	-5125	2 750	-1275	-2275	-3275	-4275
1 312	-1131	-2131	-3131	-4131	-5131	2 875	-1287	-2287	-3287	-4287
1 375	-1137	-2137	-3137	-4137	-5137	2 937	-1293	-2293	-3293	-4293
1 438	-1143	-2143	-3143	-4143	-5143	3 000	-1300	-2300	-3300	-4300
1 500	-1150	-2150	-3150	-4150	-5150	3 062	-1306	-2306	-3306	-4306
1 562	-1156	-2156	-3156	-4156	-5156	3 125	-1312	-2312	-3312	-4312
1 625	-1162	-2162	-3162	-4162	-5162	3 156	-1315	-2315	-3315	-4315
1 687	-1168	-2168	-3168	-4168	-5168	3 250	-1325	-2325	-3325	-4325
1 750	-1175	-2175	-3175	-4175	-5175	3 344	-1334	-2334	-3334	-4334
1 771	-1177	-2177	-3177	-4177	-5177	3 437	-1343	-2343	-3343	-4343
1 812	-1181	-2181	-3181	-4181	-5181	3 500	-1350	-2350	-3350	-4350
1 875	-1187	-2187	-3187	-4187	-5187	3 543	-1354	-2354	-3354	-4354
1 969	-1196	-2196	-3196	-4196	-5196	3 625	-1362	-2362	-3362	-4362
2 000	-1200	-2200	-3200	-4200	-5200	3 687	-1368	-2368	-3368	-4368
2 062	-1206	-2206	-3206	-4206	-5206	3 750	-1375	-2375	-3375	-4375
2 125	-1212	-2212	-3212	-4212	-5212	3 875	-1387	-2387	-3387	-4387
2 156	-1215	-2215	-3215	-4215	-5215	3 938	-1393	-2393	-3393	-4393
2 250	-1225	-2225	-3225	-4225	-5225	4 000	-1400	-2400	-3400	-4400
2 312	-1231	-2231	-3231	-4231	-5231					
2 375	-1237	-2237	-3237	-4237	-5237					

✓ 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)

TABLE IV SUBSTITUTION TABLE (CROSS REFERENCE OF PART NUMBERS)

Q & S SHAFT (REF)	INACTIVE	SUBSTITUTE	SUBSTITUTE	SUBSTITUTE	Q & S SHAFT (REF)	INACTIVE	SUBSTITUTE	SUBSTITUTE	SUBSTITUTE
	CARBON STEEL	CARBON STEEL Cadmium PLATE ✓	CARBON STEEL ZINC COAT ✓	CARBON STEEL PHOSPHATE COAT ✓		CARBON STEEL	CARBON STEEL Cadmium PLATE ✓	CARBON STEEL ZINC COAT ✓	CARBON STEEL PHOSPHATE COAT ✓
	MS16630	MS16630	MS16630	MS16630		MS16630	MS16630	MS16630	MS16630
1 000	-100	-1100	-2100	-3100	2 437	-243	-1243	-2243	-3243
1 023	-102	-1102	-2102	-3102	2 500	-250	-1250	-2250	-3250
1 062	-106	-1106	-2106	-3106	2 559	-255	-1255	-2255	-3255
1 125	-112	-1112	-2112	-3112	2 625	-262	-1262	-2262	-3262
1 188	-118	-1118	-2118	-3118	2 687	-268	-1268	-2268	-3268
1 250	-125	-1125	-2125	-3125	2 750	-275	-1275	-2275	-3275
1 312	-131	-1131	-2131	-3131	2 875	-287	-1287	-2287	-3287
1 375	-137	-1137	-2137	-3137	2 937	-293	-1293	-2293	-3293
1 438	-143	-1143	-2143	-3143	3 000	-300	-1300	-2300	-3300
1 500	-150	-1150	-2150	-3150	3 062	-306	-1306	-2306	-3306
1 562	-156	-1156	-2156	-3156	3 125	-312	-1312	-2312	-3312
1 625	-162	-1162	-2162	-3162	3 156	-315	-1315	-2315	-3315
1 687	-168	-1168	-2168	-3168	3 250	-325	-1325	-2325	-3325
1 750	-175	-1175	-2175	-3175	3 344	-334	-1334	-2334	-3334
1 771	-177	-1177	-2177	-3177	3 437	-343	-1343	-2343	-3343
1 812	-181	-1181	-2181	-3181	3 500	-350	-1350	-2350	-3350
1 875	-187	-1187	-2187	-3187	3 543	-354	-1354	-2354	-3354
1 969	-196	-1196	-2196	-3196	3 625	-362	-1362	-2362	-3362
2 000	-200	-1200	-2200	-3200	3 687	-368	-1368	-2368	-3368
2 062	-206	-1206	-2206	-3206	3 750	-375	-1375	-2375	-3375
2 125	-212	-1212	-2212	-3212	3 875	-387	-1387	-2387	-3387
2 156	-215	-1215	-2215	-3215	3 938	-393	-1393	-2393	-3393
2 250	-225	-1225	-2225	-3225	4 000	-400	-1400	-2400	-3400
2 312	-231	-1231	-2231	-3231					
2 375	-237	-1237	-2237	-3237					

✓ 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)

PA NAVY-OS Other Cust ARMY-AR AIR FORCE-99	INTERNATIONAL INTEREST	TITLE RING, RETAINING, EXTERNAL, BEVELED (TAPERED SECTION TYPE)	MILITARY STANDARD <b>MS16630</b>
PROCUREMENT SPECIFICATION MIL- R - 21248	SUPERSEDES	PAGE 4	OF 6

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RECOMMENDED DESIGN LIMITATIONS AND USAGE

- (a) INTENDED USE - TO PROVIDE SHOULDERS FOR POSITIONING AND RETAINING MACHINE COMPONENTS ON SHAFTS. TAPERED DESIGN PRINCIPLE PERMITS RINGS TO MAINTAIN PRACTICALLY CONSTANT CIRCULARITY WITHIN THE LIMITS OF EXPANSION IN NORMAL USE. THE RINGS WITH BEVEL ON INNER CIRCUMFERENCE, WHEN SPRUNG INTO GROOVE WITH TAPERED OUTER WALL CORRESPONDING TO RING BEVEL WILL SELF ADJUST AND PROVIDE SECURE PRESSURE FIT AXIALLY TO TAKE UP END-PLAY. THE USE OF THE FOLLOWING FORMULAS ARE BASED ON THE FACT THAT THE RING MATERIAL 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 - RINGS SHOULD NOT BE OVER EXPANDED DURING INSTALLATION SINCE THIS WILL LEAD TO RING FAILURE.

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

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

WHERE:

P = ALLOWABLE THRUST LOAD (POUNDS)  
S = SHAFT DIAMETER (INCHES)  
T = RING THICKNESS (INCHES)  
X = ULTIMATE SHEAR STRENGTH OF THE RING MATERIAL (PSI) 1/  
F = FACTOR OF SAFETY

A SAFETY FACTOR, F=4, IS RECOMMENDED, SINCE THE RING UNDER LOAD IS SUBJECTED NOT ONLY TO PURE SHEAR STRESSES BUT ALSO TO BENDING STRESSES.

- (c) ALLOWABLE LOAD CAPACITY OF GROOVE WALL =

$$P = \frac{\pi S d^2 Y}{F}$$

WHERE:

P = ALLOWABLE COMPRESSION LOAD (POUNDS)  
S = SHAFT DIAMETER (INCHES)  
d = BASIC GROOVE DEPTH OF BEVELED GROOVE (INCHES)  
Y = YIELD STRENGTH IN COMPRESSION OF THE GROOVE MATERIAL (PSI)  
F = FACTOR OF SAFETY

TO INSURE A SAFE WORKING LOAD, A SAFETY FACTOR, F=2, IS RECOMMENDED.

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

$$Z = 1.5d$$

WHERE:

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

- (e) DEFLECTION, (UNDER LOAD)=

$$\Delta L = \frac{L}{E d^3}$$

WHERE:

d = GROOVE DEPTH (INCHES)  
E = YOUNG'S MODULUS OF ELASTICITY OF GROOVE MATERIAL  
L = APPLIED LOAD (POUNDS)  
 $\Delta L$  = DEFLECTION, AT LOAD "L" (INCHES)

- (f) LOCATION OF GROOVE=

- (1) MINIMUM INSERTION OF RING IN GROOVE -

$$L_{\text{MIN.}} \geq M_{\text{MAX.}} + U_{\text{MAX.}} + \text{TAKE-UP (AS LISTED)}$$

- (2) MAXIMUM INSERTION OF RING IN GROOVE -

$$L_{\text{MAX.}} \leq M_{\text{MIN.}} + U_{\text{MIN.}} + 2 \text{ TIMES TAKE-UP (AS LISTED)}$$

- (3) TAKE-UP= (IN ORDER TO FUNCTION PROPERLY THE RING TAKE-UP SHOULD EXCEED THE SUM TOTAL OF THE TOLERANCES.)

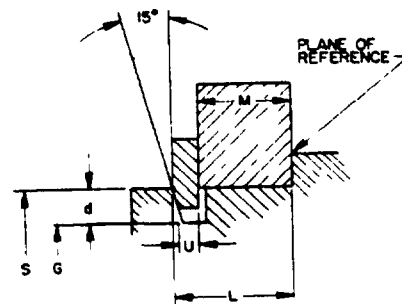
$$\text{TAKE-UP} > \Delta L + \Delta M + \Delta U \quad \text{WHERE:} \quad \begin{aligned} \Delta L &= L_{\text{MAX.}} - L_{\text{MIN.}} \\ \Delta M &= M_{\text{MAX.}} - M_{\text{MIN.}} \\ \Delta U &= U_{\text{MAX.}} - U_{\text{MIN.}} \end{aligned}$$

1/ X = 150,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS OF CARBON STEEL AND CRES.

X = 100,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS OF BERYLLIUM COPPER

2/  $\frac{d}{2}$  = HALF OF THE GROOVE DEPTH OF THE BEVELED GROOVE WILL MAINTAIN THE MINIMUM CONTACT AREA OF RING IN GROOVE.

ALLOWABLE LOAD CALCULATION SHOULD BE BASED ON  $\frac{d}{2}$



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USER ACTIVITIES  
ARMY-AT, ER, ME  
NAVY-AS, MC, SH, YD

REVIEWER AC  
ARMY-AV, G, L, M  
AIR FORCE-82  
DLA-15

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## (g) VIBRATION=

A RETAINING RING WILL BE SECURE AGAINST VIBRATION IF ITS SHEAR FATIGUE STRENGTH EQUALS OR EXCEEDS THE FORCE CREATED BY THE MASS OF THE PARTS BEING REPEATEDLY ACCELERATED AGAINST THE RING.

## (1) SHEAR STRENGTH OF RING (CRITICAL) (ABUTTING COMPONENTS TO HAVE SHARP CORNERS)=

$$X T L . 1 S \geq \frac{W}{g} a \text{ OR FOR HARMONIC MOTION } a = \delta \omega^2$$

$$X T L . 1 S \geq \frac{W}{g} \delta \omega^2$$

WHERE:

X = ULTIMATE SHEAR STRENGTH OF RING MATERIAL (PSI)  $\frac{3}{4}$   
T = RING THICKNESS (INCHES)  
S = SHAFT DIAMETER (INCHES)  
W = WEIGHT OF ABUTTING PARTS (POUNDS)  
g = ACCELERATION DUE TO GRAVITY (IN./SEC.<sup>2</sup>)  
 $\delta$  = AMPLITUDE OF VIBRATION (INCHES)  
a = ACCELERATION (IN./SEC.<sup>2</sup>)  
 $\omega$  = ANGULAR SPEED (RAD/SEC.)

## (2) COMPRESSION STRENGTH OF GROOVE MATERIAL (CRITICAL).

$$Y \frac{d}{2} 1.658 \geq \frac{W}{g} \delta \omega^2 \text{ WHERE:}$$

Y = YIELD STRENGTH IN COMPRESSION OF THE GROOVE MATERIAL (PSI)  
d = GROOVE DEPTH (INCHES)  
OTHER SYMBOLS AS SHOWN IN (1).

## (h) IMPACT CAPACITY OF RING OR GROOVE WALL=

$$I_R = \frac{P T}{2} - \text{FOR THE RING (INCH POUNDS), ABUTTING COMPONENTS TO HAVE SHARP CORNERS.}$$

$$I_G = \frac{P d}{4} - \text{FOR THE GROOVE (INCH POUNDS)}$$

WHERE:

P = ALLOWABLE THRUST LOAD OF RINGS OR GROOVES (POUNDS).  
T = RING THICKNESS (INCHES).  
I<sub>G</sub> = IMPACT CAPACITY OF GROOVE WALL (INCH POUNDS).  
d = GROOVE DEPTH (INCHES).  
I<sub>R</sub> = IMPACT CAPACITY OF RING (INCH POUNDS).

## (1) LOAD CAPACITY (WITH THE RETAINED PART RADIUS OR CHAMFER)=

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 SHEETS 5 AND 6 APPLY. THE CORNER RADII AND CHAMFERS LISTED ON SHEETS 1 AND 2 WERE CHOSEN AS LARGE AS POSSIBLE FOR THE RING SIZES INVOLVED AND ARE RELATED TO THE MAXIMUM THRUST LOADS LISTED IN THE FOLLOWING TABLE. IF THE CORNER RADII OR CHAMFERS ARE SMALLER THAN THOSE LISTED, THEN THE THRUST LOADS INCREASE PROPORTIONALLY, IN ACCORDANCE WITH FOLLOWING FORMULAS.

$$P^1 = \frac{P CH}{CH^1} \text{ OR}$$

WHERE:

P<sup>1</sup> = NEW ALLOWABLE THRUST LOAD  
P = LISTED ALLOWABLE THRUST LOAD  
CH<sup>1</sup> = NEW (SMALLER) CHAMFER  
CH = LISTED CHAMFER  
R<sup>1</sup> = NEW (SMALLER) CORNER RADIUS  
R = LISTED CORNER RADIUS

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

LIMIT LOADS LISTED BELOW ARE BASED ON RINGS OF STEEL (WORKING STRESS 250,000 PSI) AND FOR BERYLLIUM COPPER (WORKING STRESS 180,000 PSI) IF THE ALLOWABLE GROOVE CAPACITY LOADS AS CALCULATED BY USING THE FORMULA ON PAGES 5 AND 6 ARE LESS, THEN THEY SHOULD BE USED.

TABLE V. LIMIT LOADS.

NOMINAL RING SIZE		ALLOWABLE THRUST LOAD FOR RING ASSEMBLIES WITH PARTS HAVING MAXIMUM CORNER RADII OR CHAMFERS.	
FROM	TO	CARBON STEEL OR CORROSION RESISTANT STEEL	BERYLLIUM COPPER
1.000	1.023	1340 LB	970 LB
1.062	1.500	1950 LB	1400 LB
1.562	2.000	3000 LB	2100 LB
2.062	2.687	5000 LB	
2.750	3.437	7350 LB	
3.500	4.000	10500 LB	

$\frac{3}{4}$  X = 150,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS OF STEEL

X = 100,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS OF BERYLLIUM COPPER

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USER ACTIVITIES  
ARMY-ATER, ME  
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REVIEWER ACTIVITIES  
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DLA-IS

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