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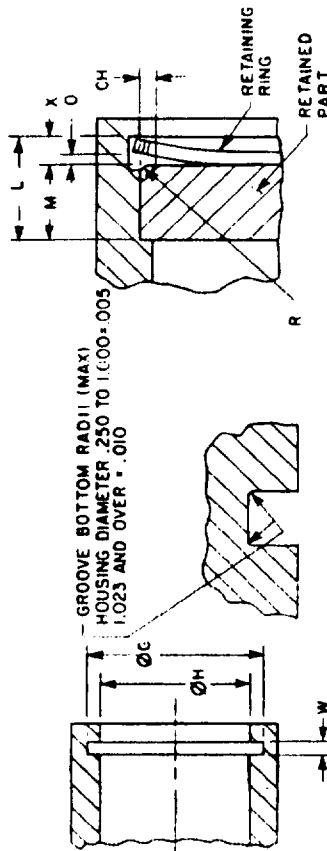
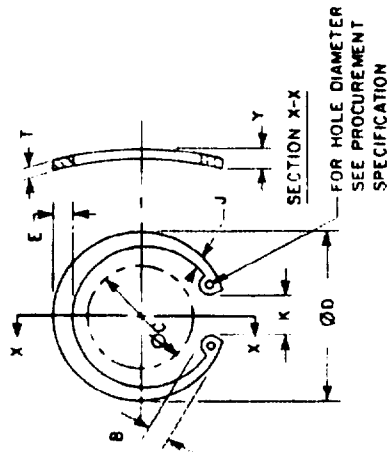
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AIR FORCE-82 NAVY-MC

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PA NAVY-OS Other Cast ARMY-AR AIR FORCE-99	INTERNATIONAL INTEREST	TITLE RING, RETAINING, INTERNAL, BOWED (TAPERED SECTION TYPE)	MILITARY STANDARD MS16629
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ENLARGED DETAILS

GROOVE DETAIL

HOUSING SECTION

TABLE 1. DIMENSIONS

Ø H HOLDING (REF)	Ø U HOLE	B HOLE HEIGHT	E LARGE SECTION HEIGHT	J SMALL SECTION HEIGHT	T THICKNESS	Y OVERALL SECTION HEIGHT	Ø G HOLE DIAMETER (REF)		F F F	Ø C CLEAR	X		O 2/ TAKE UP OF L AND H	R S/ OF RETAINING PART (REF)	MAX
							BASIC	TOL			MIN	MAX			
.250	.280	.045	.025	.015	.015	.036	.248	±.001	.04	.115	.020	.028	.008	.011	.0085
.312	.346	.064	.040	.018	.015	.047	.330	±.001	.05	.171	.020	.028	.008	.016	.013
.375	.415	.082	.049	.028	.025	.063	.397	±.002	.06	.204	.030	.038	.008	.023	.018
.438	.482	.108	.070	.030	.025	.073	.461	±.003	.07	.25	.030	.038	.008	.027	.021
.500	.548	.114	.073	.035	.035	.083	.530	±.003	.08	.26	.042	.053	.008	.027	.021
.562	.620	.132	.073	.035	.035	.093	.596	±.004	.09	.27	.042	.053	.008	.027	.021
.625	.694	.132	.080	.035	.035	.103	.665	±.004	.10	.275	.042	.053	.008	.027	.021
.688	.763	.132	.083	.036	.035	.113	.732	±.004	.11	.28	.042	.053	.008	.027	.021
.750	.831	.132	.070	.040	.035	.123	.806	±.005	.12	.28	.042	.053	.008	.027	.021
.812	.901	.146	.077	.044	.042	.133	.875	±.005	.13	.28	.042	.053	.008	.027	.021
.875	.971	.155	.084	.045	.042	.143	.944	±.006	.14	.28	.042	.053	.008	.027	.021
.901	1.000	.155	.087	.047	.042	.153	.979	±.006	.15	.28	.042	.053	.008	.027	.021
.938	1.041	.155	.091	.050	.042	.163	1.046	±.006	.16	.28	.042	.053	.008	.027	.021
1.000	1.111	.155	.104	.052	.042	.173	1.114	±.007	.17	.28	.042	.053	.008	.027	.021
1.062	1.180	.155	.106	.054	.042	.183	1.182	±.007	.18	.28	.042	.053	.008	.027	.021
1.125	1.249	.180	.116	.057	.050	.193	1.255	±.008	.19	.28	.042	.053	.008	.027	.021
1.188	1.319	.180	.120	.058	.050	.203	1.325	±.008	.20	.28	.042	.053	.008	.027	.021
1.250	1.388	.180	.124	.062	.050	.213	1.395	±.008	.21	.28	.042	.053	.008	.027	.021
1.312	1.458	.180	.124	.062	.050	.223	1.465	±.008	.22	.28	.042	.053	.008	.027	.021
1.375	1.526	.180	.130	.063	.050	.233	1.535	±.008	.23	.28	.042	.053	.008	.027	.021
1.438	1.596	.180	.130	.063	.050	.243	1.605	±.008	.24	.28	.042	.053	.008	.027	.021
1.500	1.666	.180	.133	.065	.050	.253	1.675	±.008	.25	.28	.042	.053	.008	.027	.021

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- 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. $\pm .002$ SHOULD BE $+.004/- .002$.
- 2/ FIM = (FULL INDICATOR MOVEMENT) IS THE MAXIMUM ALLOWABLE DEVIATION OF CONCENTRICITY BETWEEN THE GROOVE AND THE HOUSING.
- 3/ K = MINIMUM GAP WIDTH WHEN THE RING IS PROPERLY SEATED IN THE GROOVE. (DESIGN REFERENCE DIMENSION).
- 4/ C = ACTUAL CLEARANCE DIAMETER WHEN THE RING IS SPRUNG INTO THE HOUSING, PRIOR TO INSTALLATION INTO THE GROOVE (DESIGN REFERENCE DIMENSION).
- 5/ O = END PLAY TAKE UP (DESIGN REFERENCE DIMENSION).
- 6/ R AND CH = RADII OR CHAMFERS ALLOWABLE ON PARTS TO BE RETAINED BY THE RING. THRUST LOADS OF RINGS, RETAINING PARTS WITH CORNER RADII OR CHAMFERS ARE TABULATED ON PAGE 5.

REQUIREMENTS:

1. **CLASSIFICATION:** RETAINING RINGS FURNISHED UNDER THIS STANDARD SHALL BE TYPE II, CLASS 1 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

Ø B HOUSING (REF)	CARBON STEEL	CORROSION RESISTANT STEEL	BERYLLIUM COPPER
.250 TO .750 INCL	85.5 - 87.9 HR15N ✓ (50-55 HRC EQUIV)	83.9 - 85.9 HR15N ✓ (46-51 HRC EQUIV)	79.9 - 82.0 HR15N ✓ (39-43 HRC EQUIV)
.777 TO .901 INCL	66.7 - 71.2 HR30N ✓ (48-53 HRC EQUIV)	64.8 - 69.5 HR30N ✓ (46-51 HRC EQUIV)	58.6 - 62.2 HR30N ✓ (39-43 HRC EQUIV)
.938 TO 1.500 INCL	52.5 - 58.6 HR45N ✓ (48-53 HRC EQUIV)	50.3 - 56.1 HR45N ✓ (46-51 HRC EQUIV)	41.9 - 46.7 HR45N ✓ (39-43 HRC EQUIV)

✓ USE HIGHEST SCALE TO PROVIDE SECTION WIDTH EQUAL TO OR GREATER THAN 5 TIMES THE BRAILLE IMPRESSION DIAMETER.

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: MS16629-1100 IS THE PART NUMBER FOR A CARBON STEEL CADMIUM PLATE, INTERNAL, BOWED RETAINING RING FOR USE ON A 1.000 DIAMETER HOUSING.

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.

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TABLE III. DASH NUMBERS FOR MS16629

Ø H HOUSING (REF)	CARBON STEEL / CALCIUM PLATE	CARBON STEEL / ZINC COAT	CARBON STEEL / PHOSPHATE COAT	STEEL CORROSION RESISTANT	BERYLLIUM COPPER	DASH NO.
.250	-1025	-2025	-3025	-4025	-5025	-5025
.312	-1031	-2031	-3031	-4031	-5031	-5031
.375	-1037	-2037	-3037	-4037	-5037	-5037
.438	-1043	-2043	-3043	-4043	-5043	-5043
.453	-1045	-2045	-3045	-4045	-5045	-5045
.500	-1050	-2050	-3050	-4050	-5050	-5050
.512	-1051	-2051	-3051	-4051	-5051	-5051
.562	-1056	-2056	-3056	-4056	-5056	-5056
.625	-1062	-2062	-3062	-4062	-5062	-5062
.688	-1068	-2068	-3068	-4068	-5068	-5068
.750	-1075	-2075	-3075	-4075	-5075	-5075
.777	-1077	-2077	-3077	-4077	-5077	-5077
.812	-1081	-2081	-3081	-4081	-5081	-5081
.866	-1086	-2086	-3086	-4086	-5086	-5086
.875	-1087	-2087	-3087	-4087	-5087	-5087
.901	-1090	-2090	-3090	-4090	-5090	-5090
.938	-1093	-2093	-3093	-4093	-5093	-5093
1.000	-1100	-2100	-3100	-4100	-5100	-5100
1.023	-1102	-2102	-3102	-4102	-5102	-5102
1.062	-1106	-2106	-3106	-4106	-5106	-5106
1.125	-1112	-2112	-3112	-4112	-5112	-5112
1.181	-1118	-2118	-3118	-4118	-5118	-5118
1.188	-1118	-2118	-3118	-4118	-5118	-5118
1.250	-1125	-2125	-3125	-4125	-5125	-5125
1.259	-1125	-2125	-3125	-4125	-5125	-5125
1.312	-1131	-2131	-3131	-4131	-5131	-5131
1.375	-1137	-2137	-3137	-4137	-5137	-5137
1.378	-1137	-2137	-3137	-4137	-5137	-5137
1.438	-1143	-2143	-3143	-4143	-5143	-5143
1.456	-1145	-2145	-3145	-4145	-5145	-5145
1.500	-1150	-2150	-3150	-4150	-5150	-5150

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).

2/ SAME DASH NUMBERS SUITABLE FOR EITHER INSIDING DIAMETER (INCHES OR MM).

TABLE IV. SUBSTITUTION TABLE (CROSS REFERENCE OF PART NUMBERS)

Ø H HOUSING (REF)	INACTIVE	SUBSTITUTE CARBON STEEL / CALCIUM PLATE	SUBSTITUTE CARBON STEEL / ZINC COAT	SUBSTITUTE CARBON STEEL / PHOSPHATE COAT
MS16629	MS16629	MS16629	MS16629	MS16629
.250	-25	-1025	-2025	-3025
.312	-31	-1031	-2031	-3031
.375	-37	-1037	-2037	-3037
.438	-43	-1043	-2043	-3043
.453	-45	-1045	-2045	-3045
.500	-50	-1050	-2050	-3050
.512	-51	-1051	-2051	-3051
.562	-56	-1056	-2056	-3056
.625	-62	-1062	-2062	-3062
.688	-68	-1068	-2068	-3068
.750	-75	-1075	-2075	-3075
.777	-77	-1077	-2077	-3077
.812	-81	-1081	-2081	-3081
.866	-86	-1086	-2086	-3086
.875	-87	-1087	-2087	-3087
.901	-90	-1090	-2090	-3090
.938	-93	-1093	-2093	-3093
1.000	-100	-1100	-2100	-3100
1.023	-102	-1102	-2102	-3102
1.062	-106	-1106	-2106	-3106
1.125	-112	-1112	-2112	-3112
1.181	-118	-1118	-2118	-3118
1.188	-118	-1118	-2118	-3118
1.250	-125	-1125	-2125	-3125
1.259	-125	-1125	-2125	-3125
1.312	-131	-1131	-2131	-3131
1.375	-137	-1137	-2137	-3137
1.378	-137	-1137	-2137	-3137
1.438	-143	-1143	-2143	-3143
1.456	-145	-1145	-2145	-3145
1.500	-150	-1150	-2150	-3150

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).

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5365RECOMMENDED DESIGN, DIMENSIONS AND USAGE

- (a) INTENDED USE - TO PROVIDE SHOULDERS FOR POSITIONING AND RETAINING MACHINE COMPONENTS IN HOUSING (BORES). THE RINGS ARE BENT LIKE A BOW OUT OF PLANE. FREE END AND OPPOSITE EDGE ABUT OUTER GROOVE WALL. MID-SECTION OF RING ABUTS MACHINE PART, RING WILL TAKE UP END PLAY RESILIENTLY. 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 EXCESSIVELY CONTRACTED DURING INSTALLATION SINCE THIS WILL LEAD TO RING FAILURE. IF RING HAS PLAY BETWEEN THE GROOVE DIAMETER AND THE OUTSIDE RING DIAMETER THIS INDICATES THAT THE RING HAS BEEN EXCESSIVELY CONTRACTED, (PROVIDING GROOVE DIAMETER HAS BEEN MACHINED TO RECOMMENDED DIMENSIONS).

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

$$P = \frac{HETX}{F}$$

WHERE:

P = ALLOWABLE THRUST LOAD (POUNDS).
H = HOUSING DIAMETER (INCHES).
T = RING THICKNESS (INCHES).
X = ULTIMATE SHEAR STRENGTH OF THE RING MATERIAL (PSI). $\frac{1}{F}$
F = FACTOR OF SAFETY, F = 4, IS RECOMMENDED, SINCE THE RING UNDER THE LOAD IS SUBJECTED NOT ONLY TO PURE SHEAR STRESSES, BUT ALSO TO BENDING STRESSES.

- (c) ALLOWABLE LOAD CAPACITY OF GROOVE WALL =

$$P = \frac{HYdY}{F}$$

WHERE:

P = ALLOWABLE COMPRESSION LOAD (POUNDS).
H = HOUSING DIAMETER (INCHES).
d = GROOVE DEPTH (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 HOUSING:

$$Z = 3d$$

WHERE:

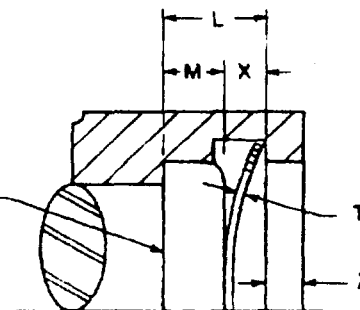
Z = MINIMUM DISTANCE BETWEEN OUTER GROOVE WALL AND END OF HOUSING (INCHES).
d = GROOVE DEPTH (INCHES).

- (e) LOCATION OF GROOVE:

$$L_{MAX} = M_{MIN} + X_{MAX}$$

$$L_{MIN} = M_{MAX} + X_{MIN}$$

PLANE OF REFERENCE



- $\frac{1}{F}$ X = 120,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS UP TO AND INCLUDING .750 INCH HOUSING DIAMETER OF CARBON STEEL OR CORROSION RESISTANT STEEL.
X = 150,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS .777 INCH AND OVER HOUSING DIAMETER OF CARBON STEEL OR CORROSION RESISTANT STEEL.
X = 110,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS OF ALL HOUSING DIAMETERS AND OF BERYLLIUM COPPER.

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(f) 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).

$$X T L 1 H \geq \frac{W}{g} a$$

OR FOR HARMONIC
MOTION $a = \delta \omega^2$

$$X T L 1 H = \frac{W}{g} \delta \omega^2$$

WHERE:

X = ULTIMATE SHEAR STRENGTH OF RING MATERIAL (PSI). $\frac{1}{T}$
T = RING THICKNESS (INCHES).
H = HOUSING DIAMETER (INCHES).
W = WEIGHT OF ABUTTING PARTS (POUNDS).
g = ACCELERATION DUE TO GRAVITY (IN/SEC²).
 δ = AMPLITUDE OF VIBRATIONS (INCHES).
 ω = ANGULAR SPEED (RAD/SEC).
a = ACCELERATION (IN/SEC²).

(2) COMPRESSIVE STRENGTH OF GROOVE MATERIAL (CRITICAL).

$$1.65 Y d H \geq \frac{W}{g} \delta \omega^2$$

WHERE:

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

(g) IMPACT CAPACITY OF RING ON GROOVE WALL =

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

$$I_G = \frac{P d}{2} - \text{FOR THE GROOVE (INCH POUNDS).}$$

WHERE:

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

(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 FORMULA ON PAGE 4 WILL APPLY. THE CORNER RADIUS 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 TABLE V.

IF THE CORNER RADIUS OR CHAMFERS ARE SMALLER THAN THOSE LISTED, THEN THE THRUST LOADS INCREASE PROPORTIONALLY IN ACCORDANCE WITH THE FOLLOWING FORMULAS:

$$P^1 = \frac{P CH}{LH^1}$$

OR

WHERE:

P¹ = NEW ALLOWABLE THRUST LOAD.
P = LISTED ALLOWABLE THRUST LOAD.
CH¹ = NEW (SMALLER) CHAMFER.
CH = LISTED CHAMFER.
R¹ = NEW (SMALLER) CORNER RADIUS.
R = LISTED CORNER RADIUS.

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

LIMIT LOADS LISTED ON TABLE V ARE BASED ON RINGS OF CARBON STEEL OR CORROSION RESISTANT STEEL (WORKING STRESS 250,000 PSI) AND 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

NOMINAL RING SIZE		ALLOWABLE THRUST LOAD FOR RING ASSEMBLIES WITH PARTS HAVING MAXIMUM CORNER RADIUS OR CHAMFERS.	
FROM	TO	CARBON STEEL OR CORROSION RESISTANT STEEL	BERYLLIUM COPPER
.250	.312	190 LB	140 LB
.375	.453	530 LB	380 LB
.500	.750	1100 LB	800 LB
.777	.938	1650 LB	1200 LB
1.000	1.500	2400 LB	1700 LB

$\frac{1}{X}$ = 120,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS UP TO AND INCLUDING .750 INCH HOUSING DIAMETER OF CARBON STEEL OR CORROSION RESISTANT STEEL.

X = 150,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS .777 INCH AND OVER HOUSING DIAMETER OF CARBON STEEL OR CORROSION RESISTANT STEEL.

X = 110,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS OF ALL HOUSING DIAMETERS AND OF BERYLLIUM COPPER.

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