THIS SPE ION IS APPROVED FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMEN OF DEFENSE

REQUIREMENTS FOR ACQUIRING THE PRODUCT(S) DESCRIBED HEREIN SHALL CONSIST OF TH CIFICATION SHEET AND THE ISSUE OF THE FOLLOWING SPECIFICATION LISTED IN THAT ISSUE OF THE DODISS E CIFIED IN THE SOLICITATION MIL-R-21248

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PREPARING ACTIVITY DLA-IS

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REVIEW AS,AT,AV,ER,MC,ME,SH YD 82

USER

PROJECT NUMBER 5365-0200

DISTRIBUTION STATEMENT A Approved for public release distribution is unlimited

MILITARY SPECIFICATION SHEET

TITLE

RING, RETAINING, EXTERNAL INTERLOCKING

SPECIFICATION SHEET NUMBER

MS90708 28 JUNE 95 REV C

SUPERSEDING

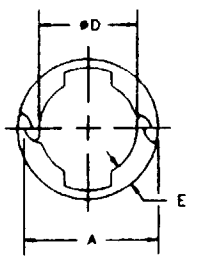
MS90708B 25 AUG 89

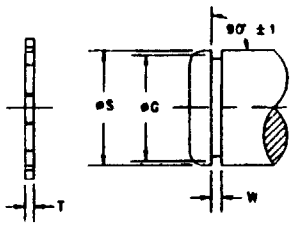
AMSC-N/A FSC-5365

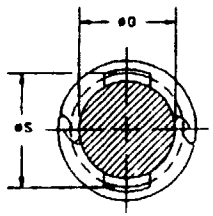
Page 1 of 5

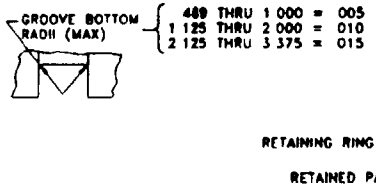
© DENOTES CHANGES

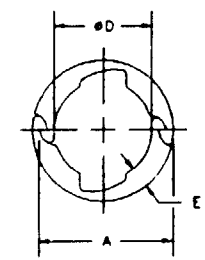
INCH-POUND



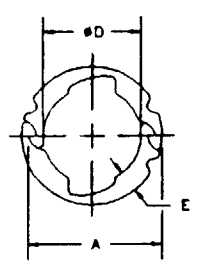








ALTERNATE DESIGN NO. 1 WITH TAPERED BRIDGE



ALTERNATE DESIGN NO. 2 WITH PLIER TIP NOTCHES TO FACILITATE ASSEMBLY

TABLE I DIMENSIONS

ENLARGED DETAILS

øS SHAFT (REF)		øD 1/ FREE (REF)	A WIDTH ACROSS LUGS		E		T 2/ THICKNESS		øG RECOMMENDED GROOVE (REF)		W WIDTH		R 4/ CH 4/ OF RETAINED PART (REF)	
INCH	MM	BASIC	BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL	MAX	MAX
469	11 9	414	585	± 003	105		035		419	± 0015	040		052	040
500	12 7	459	625		105	± 005	035		464	004	040		052	040
594	15 1	538	710	± 004	105		035		544	FIM 3/	040	+ 003	052	040
625	15 9	569	740		105		035		575		040	- 000	052	040
669	17 0	593	815		135		042		599		047		065	050
				± 005						± 002				
750	19 0	673	894		135		042	± 002	680	004	047		065	050
781	19 8	703	925		135		042		711	FIM 3/	047		065	050
875	22 2	796	1 017		135		042		805	± 003	047		065	050
984	25 0	863	1 172		188		050		872	004	056		086	066
1 000	25 4	863	1 172	± 006	188	± 006	050		872	FIM 3/	056		081	062
1 125	28 6	1 002	1 311		188		050		1 013		056		085	066
1 188	30 2	1 064	1 373		188		050		1 075	± 003	056		086	066
1 250	31 7	1 126	1 435		188		050		1 138	005	056		086	066
1 375	34 9	1 250	1 559	± 007	.188		050		1 263	FIM 3/	056	+ 004	086	066
1 500	38 1	1 374	1 683		188		050		1 388		056	- 000	086	066
1 562	39 7	1 412	1 778		222		062		1 427		068		100	077
1 625	41 3	1 474	1 840		222		062		1 489		068		100	077
1 750	44 4	1 597	1 963		222		062		1 614	± 005	068		100	077
1 772	45 0	1 597	1 963	± 008	222		062		1 614	005	068		094	072
1 875	47 6	1 721	2 090		222		062		1 739	FIM 3/	068		100	077
1 969	50 0	1 779	2 209		262		078		1 797		086		114	088
2 000	50 8	1 809	2 242		262	± 007	078		1 828		086		114	088
2 125	54 0	1 933	2 364		262		078		1 953		086		114	088
2 156	54 8	1 933	2 364		262		078	± 003	1 953		086		104	080
2 250	57 1	2 057	2 488		262		078		2 078		086		114	088
				± 010						± 005				
2 375	60 3	2 180	2 610		262		078		2 203	006	086	+ 005	114	088
2 500	63 5	2 304	2 734		262		078		2 328	FIM 3/	086	- 000	114	088
2 625	66 7	2 428	2 858		262		078		2 453		086		114	088
2 750	69 8	2 518	3 049		323		093		2 544		103		143	110
2 875	73 0	2 642	3 172		323		093		2 669		103		143	110
				± 012						± 006				
3 000	76 2	2 754	3 294		329	± 008	093		2 794	006	103		143	110
3 250	82 5	3 013	3 542		325		093		3 044	FIM 3/	103		144	111
3 375	85 7	3 114	3 761	± 015	395		109		3 145		120		182	140

FOR FOOTNOTES SEE PAGE 2

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1/ ⌀D = DIMENSION "D" SHOULD NOT BE USED AS PART OF AN INSPECTION PROCEDURE USE DIMENSION A

2/ 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

3/ FIM = (FULL INDICATOR MOVEMENT) IS THE MAXIMUM ALLOWABLE DEVIATION OF CONCENTRICITY BETWEEN THE GROOVE AND THE SHAFT

4/ R AND CH = RADII OR CHAMFERS ALLOWABLE ON PARTS TO BE RETAINED BY THE RINGS THRUST LOADS FOR RINGS RETAINING PARTS WITH CORNER RADII OR CHAMFERS, ARE TABULATED ON PAGE 4

REQUIREMENTS

1 CLASSIFICATION RETAINING RINGS FURNISHED UNDER THIS STANDARD SHALL BE TYPE I CLASS B 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
469 TO 625 INCL	66 5-71 5HR30N	44-51HRC	56 5-62HR30N
669 TO 1 500 INCL	52 5-59 0HR45N	44-51HRC	-
1 562 TO 3 375 INCL	48 0-53 0HRC	44-51HRC	-
669 TO 1 875 INCL	-	-	37-43HRC

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 OR ZINC-NICKEL PLATE IN ACCORDANCE WITH AMS 2417, TYPE 2

(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 Z, 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 MS90708-1200 IS THE PART NUMBER FOR A CARBON STEEL CADMIUM PLATE EXTERNAL INTERLOCKING 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 DOCUMENT AND THE REFERENCES CITED HEREIN, THE TEXT OF THIS DOCUMENT SHALL TAKE PRECEDENCE

© 3 UNLESS OTHERWISE SPECIFIED, ISSUES OF REFERENCED DOCUMENTS ARE THOSE IN EFFECT AT THE TIME OF SOLICITATION

TABLE III DASH NUMBERS FOR MS90708

ØS SHAFT (REF)	CARBON STEEL 1/ CADMIUM PLATE OR ZINC-NICKEL PLATE (C)	CARBON STEEL 1/ ZINC COAT	CARBON STEEL 1/ PHOSPHATE COAT	STEEL CORROSION RESISTANT	BERYLLIUM 1/ COPPER
	DASH NO	DASH NO	DASH NO	DASH NO	DASH NO
469	-1046	-2046	-3046	-4046	-5046
500	-1050	-2050	-3050	-4050	-5050
594	-1059	-2059	-3059	-4059	-5059
625	-1062	-2062	-3062	-4062	-5062
669	-1066	-2066	-3066	-4066	-5066
750	-1075	2075	-3075	-4075	-5075
781	-1078	-2078	-3078	-4078	-5078
.875	-1087	-2087	-3087	-4087	-5087
984	-1098	-2098	-3098	-4098	-5098
1 000	-1098	-2098	-3098	-4098	-5098
1 125	-1112	-2112	-3112	-4112	-5112
1 188	-1118	-2118	-3118	-4118	-5118
1 250	-1125	-2125	-3125	-4125	-5125
1 375	-1137	-2137	-3137	-4137	-5137
1 500	-1150	-2150	-3150	-4150	-5150
1 562	-1156	-2156	-3156	-4156	-5156
1 625	-1162	-2162	-3162	-4162	-5162
1 750	-1175	-2175	-3175	-4175	-5175
1 772	-1175	-2175	-3175	-4175	-5175
1 875	-1187	-2187	-3187	-4187	-5187
1 969	-1196	-2196	-3196	-4196	
2 000	-1200	-2200	-3200	-4200	
2 125	-1212	-2212	-3212	-4212	
2 156	-1212	-2212	-3212	-4212	
2 250	-1225	-2225	-3225	-4225	
2 375	-1237	-2237	-3237	-4237	
2 500	-1250	-2250	-3250	-4250	
2 625	-1262	-2262	-3262	-4262	
2 750	-1275	-2275	-3275	-4275	
2 875	-1287	-2287	-3287	-4287	
3 000	-1300	-2300	-3300	-4300	
3 250	-1325	-2325	-3325	-4325	
3 375	-1337	-2337	-3337	-4337	

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)

TABLE IV SUBSTITUTION TABLE (CROSS REFERENCE OF PART NUMBERS)

ØS SHAFT (REF)	INACTIVE CARBON STEEL	SUBSTITUTE CARBON STEEL CADMIUM PLATE 1/ OR ZINC-NICKEL PLATE (C)	SUBSTITUTE CARBON STEEL ZINC COAT 1/	SUBSTITUTE CARBON STEEL PHOSPHATE COAT 1/
	MS90708	MS90708	MS90708	MS90708
469	-46	-1046	-2046	-3046
500	-50	-1050	-2050	-3050
594	-59	-1059	-2059	-3059
625	-62	-1062	-2062	-3062
669	-66	-1066	-2066	-3066
750	-75	-1075	-2075	-3075
781	-78	-1078	-2078	-3078
875	-87	-1087	-2087	-3087
984	-98	-1098	-2098	-3098
1 000	-98	-1098	-2098	-3098
1 125	-112	-1112	-2112	-3112
1 188	-118	-1118	-2118	-3118
1 250	-125	-1125	-2125	-3125
1 375	-137	-1137	-2137	-3137
1 500	-150	-1150	-2150	-3150
1 562	-156	-1156	-2156	-3156
1 625	-162	-1162	-2162	-3162
1 750	-175	-1175	-2175	-3175
1 772	-175	-1175	-2175	-3175
1.875	-187	-1187	-2187	-3187
1 969	-196	-1196	-2196	-3196
2 000	-200	-1200	-2200	-3200
2 125	-212	-1212	-2212	-3212
2 156	-212	-1212	-2212	-3212
2 250	-225	-1225	-2225	-3225
2 375	-237	-1237	-2237	-3237
2.500	-250	-1250	-2250	-3250
2 625	-262	-1262	-2262	-3262
2 750	-275	-1275	-2275	-3275
2.875	-287	-1287	-2287	-3287
3 000	-300	-1300	-2300	-3300
3 250	-325	-1325	-2325	-3325
3 375	-337	-1337	-2337	-3337

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)

PREPARING ACTIVITY DLA-IS	MILITARY SPECIFICATION SHEET	SPECIFICATION SHEET NUMBER
CUSTODIANS ARMY- AR NAVY-	TITLE	MS90708 28 JUNE 95 REV C
AIR FORCE- 99 DLA-	RING RETAINING EXTERNAL INTERLOCKING	SUPERSEDING
REVIEW AS AT,AV,ER,MC,ME,SH,YD,82		MS90708B 25 AUG 89
USER		AMSC- N/A FSC -5385
PROJECT NUMBER 5365-0200		
DISTRIBUTION STATEMENT A Approved for public release distribution is unlimited		Page 3 of 5

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RECOMMENDED DESIGN LIMITATIONS AND USAGE

(a) INTENDED USE - TO PROVIDE HIGH CIRCULAR SHOULDERS FOR POSITIONING AND RETAINING MACHINE COMPONENTS ON SHAFTS. THE IDENTICAL SEMI-CIRCULAR HALVES HELD TOGETHER BY THE INTERLOCKING PRONGS FORM A BALANCED RING CONCENTRIC WITH THE SHAFT, WHICH WILL WITHSTAND HIGH ROTATIONAL SPEEDS. THE USE OF THE FOLLOWING FORMULAS IS 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 - 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 V

TABLE V APPROXIMATE SAFETY RPM LIMITS

ØSHAFT (INCHES)		500	1 000	1 500	2 000	2 500	3 000	3 375
CARBON STEEL AND CORROSION RESISTANT STEEL	RPM LIMIT	50,000	30 000	22 000	15,000	12,000	9,000	6,800
BERYLLIUM COPPER	RPM LIMIT	32,000	19,000	14,000				

(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 = 3 IS RECOMMENDED TO INSURE A SAFE WORKING LOAD
- C_F = CONVERSION FACTOR, C_F = 3/4 IS RECOMMENDED SINCE SHEAR AREA IS REDUCED AT THE CUTOUTS IN THE RING

(c) ALLOWABLE LOAD CAPACITY OF GROOVE WALL =

$$P = \frac{C_F \pi S d X}{F}$$

WHERE
- P = ALLOWABLE COMPRESSION LOAD (POUNDS)
- S = SHAFT DIAMETER (INCHES)
- d = GROOVE DEPTH (INCHES)
- Y = YIELD STRENGTH IN COMPRESSION OF THE GROOVE MATERIAL
- F = FACTOR OF SAFETY, F = 2 IS RECOMMENDED TO INSURE A SAFE WORKING LOAD
- C_F = CONVERSION FACTOR, C_F = 3/4 IS RECOMMENDED SINCE CONTACT AREA IN THE GROOVE WALL IS REDUCED AT THE CUTOUTS IN THE 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 =

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

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

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

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(f) DIFFERENTIAL ROTATION =

DIFFERENTIAL ROTATION OF RING AND ADJACENT PART CREATES NO ELEMENT OF RISK IN THE APPLICATION OF THE RING UP TO THE ALLOWABLE LOAD CALCULATED TO THE ABOVE FORMULA (b)

(g) IMPACT CAPACITY OF RING OR GROOVE WALL =

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

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

WHERE
- P = ALLOWABLE THRUST LOAD OF RING OR GROOVES (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 RADIUSED 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 PAGE 4 WILL APPLY THE CORNER RADII AND CHAMFERS LISTED ON PAGE 1 WERE CHOSEN AS LARGE AS POSSIBLE FOR THE RING SIZES INVOLVED AND ARE RELAED TO THE MAXIMUM THRUST LOADS LISTED IN TABLE VI IF THE CORNER RADII OR CHAMFERS ARE SMALLER THAN THOSE LISTED, THEN THE THRUST LOADS INCREASE PROPORTIONALLY IN ACCORDANCE WITH THE FOLLOWING FORMULAS

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

WHERE
- P^1 = NEW ALLOWABLE THRUST LOAD
- P = LISTED ALLOWABLE THRUST LOAD
- CH^1 = NEW (SMALLER) CHAMFER
- CH = LISTED CHAMFER
- R^1 = NEW (SMALLER) CORNER RADIUS
- R = LISTED CORNER RADIUS

LIMIT LOADS LISTED BELOW ARE BASED ON RINGS OF 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 GIVEN ABOVE ARE LESS, THEN THEY SHOULD BE USED

TABLE VI 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
469	625	610 LB	440 LB
669	875	880 LB	630 LB
984	1.500	1250 LB	900 LB
1 562	1 875	1900 LB	1370 LB
1 969	2 625	3050 LB	-
2 750	3 250	4300 LB	-
3 375	-	5950 LB	-

PREPARING ACTIVITY DLA-IS CUSTODIANS ARMY- AR NAVY- AIR FORCE- 99 DLA- REVIEW AS AT AV ER MC,ME,SH YD,82 USER PROJECT NUMBER 5365-0200	MILITARY SPECIFICATION SHEET TITLE RING RETAINING, EXTERNAL INTERLOCKING	SPECIFICATION SHEET NUMBER MS90708 28 JUNE 95 REV C SUPERSEDING MS907088 25 AUG 89 AMSC N/A FSC -5365
DISTRIBUTION STATEMENT A Approved for public release distribution is unlimited		Page 5 of 5