

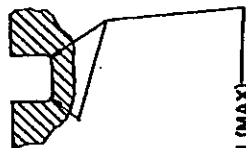
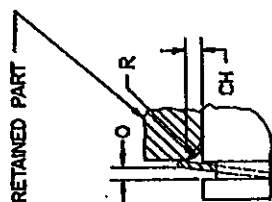
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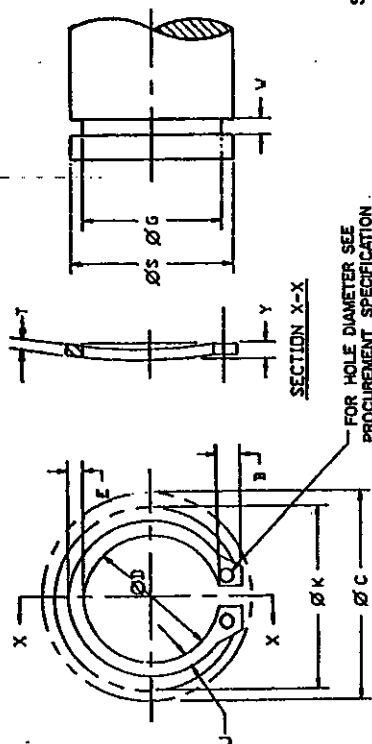
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ARMY- AT,ER,ME
NAVY- AS,MC,SH,YD



GROOVE BOTTOM RADI (MAX)
SHAFT DIAMETER .188 TO .236=SHARP CORNERS
.250 TO .354=.003
.375 TO 1.000=.005
1.023 AND OVER=.010

ENLARGED DETAILS



— FOR HOLE DIAMETER SEE
PROCUREMENT SPECIFICATION

TABLE 1. Operations

ØS SHAFT (INCH)	ØD PISTON PISTON	E ING HEIGHT		I LARGE SECTION HEIGHT		J SMALL SECTION HEIGHT		Z TAPER HEIGHT		Y OVERALL BOY HEIGHT		ØG EXPANDED CROUSE (ØIN)		W MIDTH		ØK ØIN	ØC ØIN	ØD ØIN	ØE ØIN	ØF ØIN	ØG ØIN	ØH ØIN	ØI ØIN	ØJ ØIN	ØL ØIN	ØM ØIN	ØN ØIN	ØO ØIN	ØP ØIN	ØQ ØIN	ØR ØIN	ØS ØIN	ØT ØIN	ØU ØIN	ØV ØIN	ØW ØIN	ØX ØIN	ØY ØIN	ØZ ØIN	ØAA ØIN	ØAB ØIN	ØAC ØIN	ØAD ØIN	ØAE ØIN	ØAF ØIN	ØAG ØIN	ØAH ØIN	ØAI ØIN	ØAJ ØIN	ØAK ØIN	ØAL ØIN	ØAM ØIN	ØAN ØIN	ØAO ØIN	ØAP ØIN	ØAQ ØIN	ØAR ØIN	ØAS ØIN	ØAT ØIN	ØAU ØIN	ØAV ØIN	ØAW ØIN	ØAX ØIN	ØAY ØIN	ØAZ ØIN	ØBA ØIN	ØBB ØIN	ØBC ØIN	ØBD ØIN	ØBE ØIN	ØBF ØIN	ØBG ØIN	ØBH ØIN	ØBI ØIN	ØBJ ØIN	ØBK ØIN	ØBL ØIN	ØBM ØIN	ØBN ØIN	ØBO ØIN	ØBP ØIN	ØBQ ØIN	ØBR ØIN	ØBS ØIN	ØBT ØIN	ØBU ØIN	ØBV ØIN	ØBW ØIN	ØBX ØIN	ØBY ØIN	ØBZ ØIN	ØCA ØIN	ØCB ØIN	ØCC ØIN	ØCD ØIN	ØCE ØIN	ØCF ØIN	ØCG ØIN	ØCH ØIN	ØCI ØIN	ØCJ ØIN	ØCK ØIN	ØCL ØIN	ØCM ØIN	ØCN ØIN	ØCO ØIN	ØCP ØIN	ØCQ ØIN	ØCR ØIN	ØCS ØIN	ØCT ØIN	ØCU ØIN	ØCV ØIN	ØCW ØIN	ØCX ØIN	ØCY ØIN	ØCZ ØIN	ØDA ØIN	ØDB ØIN	ØDC ØIN	ØDD ØIN	ØDE ØIN	ØDF ØIN	ØDG ØIN	ØDH ØIN	ØDI ØIN	ØDJ ØIN	ØDK ØIN	ØDL ØIN	ØDM ØIN	ØDN ØIN	ØDO ØIN	ØDP ØIN	ØDQ ØIN	ØDR ØIN	ØDS ØIN	ØDT ØIN	ØDU ØIN	ØDV ØIN	ØDW ØIN	ØDX ØIN	ØDY ØIN	ØDZ ØIN	ØEA ØIN	ØEB ØIN	ØEC ØIN	ØED ØIN	ØEE ØIN	ØEF ØIN	ØEG ØIN	ØEH ØIN	ØEI ØIN	ØEJ ØIN	ØEK ØIN	ØEL ØIN	ØEM ØIN	ØEN ØIN	ØEO ØIN	ØEP ØIN	ØEQ ØIN	ØER ØIN	ØES ØIN	ØET ØIN	ØEU ØIN	ØEV ØIN	ØEW ØIN	ØEX ØIN	ØEY ØIN	ØEZ ØIN	ØFA ØIN	ØFB ØIN	ØFC ØIN	ØFD ØIN	ØFE ØIN	ØFF ØIN	ØFG ØIN	ØFH ØIN	ØFI ØIN	ØFJ ØIN	ØFK ØIN	ØFL ØIN	ØFM ØIN	ØFN ØIN	ØFO ØIN	ØFP ØIN	ØFQ ØIN	ØFR ØIN	ØFS ØIN	ØFT ØIN	ØFU ØIN	ØFV ØIN	ØFW ØIN	ØFX ØIN	ØFY ØIN	ØFZ ØIN	ØGA ØIN	ØGB ØIN	ØGC ØIN	ØGD ØIN	ØGE ØIN	ØGF ØIN	ØGG ØIN	ØGH ØIN	ØGI ØIN	ØGJ ØIN	ØGK ØIN	ØGL ØIN	ØGM ØIN	ØGN ØIN	ØGO ØIN	ØGP ØIN	ØGQ ØIN	ØGR ØIN	ØGS ØIN	ØGT ØIN	ØGU ØIN	ØGV ØIN	ØGW ØIN	ØGX ØIN	ØGY ØIN	ØGZ ØIN	ØHA ØIN	ØHB ØIN	ØHC ØIN	ØHD ØIN	ØHE ØIN	ØHF ØIN	ØHG ØIN	ØHI ØIN	ØHJ ØIN	ØHK ØIN	ØHL ØIN	ØHM ØIN	ØHN ØIN	ØHO ØIN	ØHP ØIN	ØHQ ØIN	ØHR ØIN	ØHS ØIN	ØHT ØIN	ØHU ØIN	ØHV ØIN	ØHW ØIN	ØHX ØIN	ØHY ØIN	ØHZ ØIN	ØIA ØIN	ØIB ØIN	ØIC ØIN	ØID ØIN	ØIE ØIN	ØIF ØIN	ØIG ØIN	ØIH ØIN	ØIJ ØIN	ØIK ØIN	ØIL ØIN	ØIM ØIN	ØIN ØIN	ØIO ØIN	ØIP ØIN	ØIQ ØIN	ØIR ØIN	ØIS ØIN	ØIT ØIN	ØIU ØIN	ØIV ØIN	ØIW ØIN	ØIX ØIN	ØIY ØIN	ØIZ ØIN	ØJA ØIN	ØJB ØIN	ØJC ØIN	ØJD ØIN	ØJE ØIN	ØJF ØIN	ØJG ØIN	ØJH ØIN	ØJI ØIN	ØJJ ØIN	ØJK ØIN	ØJL ØIN	ØJM ØIN	ØJN ØIN	ØJO ØIN	ØJP ØIN	ØJQ ØIN	ØJR ØIN	ØJS ØIN	ØJT ØIN	ØJU ØIN	ØJV ØIN	ØJW ØIN	ØJX ØIN	ØJY ØIN	ØJZ ØIN	ØKA ØIN	ØKB ØIN	ØKC ØIN	ØKD ØIN	ØKE ØIN	ØKF ØIN	ØKG ØIN	ØKH ØIN	ØKI ØIN	ØKJ ØIN	ØKK ØIN	ØKL ØIN	ØKM ØIN	ØKN ØIN	ØKO ØIN	ØKP ØIN	ØKQ ØIN	ØKR ØIN	ØKS ØIN	ØKT ØIN	ØKU ØIN	ØKV ØIN	ØKW ØIN	ØKX ØIN	ØKY ØIN	ØKZ ØIN	ØLA ØIN	ØLB ØIN	ØLC ØIN	ØLD ØIN	ØLE ØIN	ØLF ØIN	ØLG ØIN	ØLH ØIN	ØLI ØIN	ØLJ ØIN	ØLK ØIN	ØLL ØIN	ØLM ØIN	ØLN ØIN	ØLO ØIN	ØLP ØIN	ØLQ ØIN	ØLR ØIN	ØLS ØIN	ØLT ØIN	ØLU ØIN	ØLV ØIN	ØLW ØIN	ØLX ØIN	ØLY ØIN	ØLZ ØIN	ØMA ØIN	ØMB ØIN	ØMC ØIN	ØMD ØIN	ØME ØIN	ØMF ØIN	ØMG ØIN	ØMH ØIN	ØMI ØIN	ØMJ ØIN	ØMK ØIN	ØML ØIN	ØMM ØIN	ØMN ØIN	ØMO ØIN	ØMP ØIN	ØMQ ØIN	ØMR ØIN	ØMS ØIN	ØMT ØIN	ØMU ØIN	ØMV ØIN	ØMW ØIN	ØMX ØIN	ØMY ØIN	ØMZ ØIN	ØNA ØIN	ØNB ØIN	ØNC ØIN	ØND ØIN	ØNE ØIN	ØNF ØIN	ØNG ØIN	ØNH ØIN	ØNI ØIN	ØNJ ØIN	ØNK ØIN	ØNL ØIN	ØNM ØIN	ØNN ØIN	ØNO ØIN	ØNP ØIN	ØNQ ØIN	ØNR ØIN	ØNS ØIN	ØNT ØIN	ØNU ØIN	ØNV ØIN	ØNW ØIN	ØNX ØIN	ØNY ØIN	ØNZ ØIN	ØOA ØIN	ØOB ØIN	ØOC ØIN	ØOD ØIN	ØOE ØIN	ØOF ØIN	ØOG ØIN	ØOH ØIN	ØOI ØIN	ØOJ ØIN	ØOK ØIN	ØOL ØIN	ØOM ØIN	ØON ØIN	ØOO ØIN	ØOP ØIN	ØOQ ØIN	ØOR ØIN	ØOS ØIN	ØOT ØIN	ØOU ØIN	ØOV ØIN	ØOW ØIN	ØOX ØIN	ØOY ØIN	ØOZ ØIN	ØPA ØIN	ØPB ØIN	ØPC ØIN	ØPD ØIN	ØPE ØIN	ØPF ØIN	ØPG ØIN	ØPH ØIN	ØPI ØIN	ØPJ ØIN	ØPK ØIN	ØPL ØIN	ØPM ØIN	ØPN ØIN	ØPO ØIN	ØPP ØIN	ØPQ ØIN	ØPR ØIN	ØPS ØIN	ØPT ØIN	ØPU ØIN	ØPV ØIN	ØPW ØIN	ØPX ØIN	ØPY ØIN	ØPZ ØIN	ØQA ØIN	ØQB ØIN	ØQC ØIN	ØQD ØIN	ØQE ØIN	ØQF ØIN	ØQG ØIN	ØQH ØIN	ØQI ØIN	ØQJ ØIN	ØQK ØIN	ØQL ØIN	ØQM ØIN	ØQN ØIN	ØQO ØIN	ØQP ØIN	ØQQ ØIN	ØQR ØIN	ØQS ØIN	ØQT ØIN	ØQU ØIN	ØQV ØIN	ØQW ØIN	ØQX ØIN	ØQY ØIN	ØQZ ØIN	ØRA ØIN	ØRB ØIN	ØRC ØIN	ØRD ØIN	ØRE ØIN	ØRF ØIN	ØRG ØIN	ØRH ØIN	ØRI ØIN	ØRJ ØIN	ØRK ØIN	ØRL ØIN	ØRM ØIN	ØRN ØIN	ØRO ØIN	ØRP ØIN	ØRQ ØIN	ØRR ØIN	ØRS ØIN	ØRT ØIN	ØRU ØIN	ØRV ØIN	ØRW ØIN	ØRX ØIN	ØRY ØIN	ØRZ ØIN	ØSA ØIN	ØSB ØIN	ØSC ØIN	ØSD ØIN	ØSE ØIN	ØSF ØIN	ØSG ØIN	ØSH ØIN	ØSI ØIN	ØSJ ØIN	ØSK ØIN	ØSL ØIN	ØSM ØIN	ØSN ØIN	ØSO ØIN	ØSP ØIN	ØSQ ØIN	ØSR ØIN	ØSS ØIN	ØST ØIN	ØSU ØIN	ØSV ØIN	ØSW ØIN	ØSX ØIN	ØSY ØIN	ØSZ ØIN	ØTA ØIN	ØTB ØIN	ØTC ØIN	ØTD ØIN	ØTE ØIN	ØTF ØIN	ØTG ØIN	ØTH ØIN	ØTI ØIN	ØTJ ØIN	ØTK ØIN	ØTL ØIN	ØTM ØIN	ØTN ØIN	ØTO ØIN	ØTP ØIN	ØTQ ØIN	ØTR ØIN	ØTS ØIN	ØTT ØIN	ØTU ØIN	ØTV ØIN	ØTW ØIN	ØTX ØIN	ØTY ØIN	ØTZ ØIN	ØUA ØIN	ØUB ØIN	ØUC ØIN	ØUD ØIN	ØUE ØIN	ØUF ØIN	ØUG ØIN	ØUH ØIN	ØUI ØIN	ØUJ ØIN	ØUK ØIN	ØUL ØIN	ØUM ØIN	ØUN ØIN	ØUO ØIN	ØUP ØIN	ØUQ ØIN	ØUR ØIN	ØUS ØIN	ØUT ØIN	ØUU ØIN	ØUV ØIN	ØUW ØIN	ØUX ØIN	ØUY ØIN	ØUZ ØIN	ØVA ØIN	ØVB ØIN	ØVC ØIN	ØVD ØIN	ØVE ØIN	ØVF ØIN	ØVG ØIN	ØVH ØIN	ØVI ØIN	ØVJ ØIN	ØVK ØIN	ØVL ØIN	ØVM ØIN	ØVN ØIN	ØVO ØIN	ØVP ØIN	ØVQ ØIN	ØVR ØIN	ØVS ØIN	ØVT ØIN	ØVU ØIN	ØVV ØIN	ØVW ØIN	ØVX ØIN	ØVY ØIN	ØVZ ØIN	ØWA ØIN	ØWB ØIN	ØWC ØIN	ØWD ØIN	ØWE ØIN	ØWF ØIN	ØWG ØIN	ØWH ØIN	ØWI ØIN	ØWJ ØIN	ØWK ØIN	ØWL ØIN	ØWM ØIN	ØWN ØIN	ØWO ØIN	ØWP ØIN	ØWQ ØIN	ØWR ØIN	ØWS ØIN	ØWT ØIN	ØWU ØIN	ØWV ØIN	ØWW ØIN	ØWX ØIN	ØWY ØIN	ØWZ ØIN	ØXA ØIN	ØXB ØIN	ØXC ØIN	ØXD ØIN	ØXE ØIN	ØXF ØIN	ØXG ØIN	ØXH ØIN	ØXI ØIN	ØXJ ØIN	ØXK ØIN	ØXL ØIN	ØXM ØIN	ØXN ØIN	ØXO ØIN	ØXP ØIN	ØXQ ØIN	ØXR ØIN	ØXS ØIN	ØXT ØIN	ØXU ØIN	ØXV ØIN	ØXW ØIN	ØXX ØIN	ØXY ØIN	ØXZ ØIN	ØYA ØIN	ØYB ØIN	ØYC ØIN	ØYD ØIN	ØYE ØIN	ØYF ØIN	ØYG ØIN	ØYH ØIN	ØYI ØIN	ØYJ ØIN	ØYK ØIN	ØYL ØIN	ØYM ØIN	ØYN ØIN	ØYO ØIN	ØYP ØIN	ØYQ ØIN	ØYR ØIN	ØYS ØIN	ØYT ØIN	ØYU ØIN	ØYV ØIN	ØYW ØIN	ØYX ØIN	ØYY ØIN	ØYZ ØIN	ØZA ØIN	ØZB ØIN	ØZC ØIN	ØZD ØIN	ØZE ØIN	ØZF ØIN	ØZG ØIN	ØZH ØIN	ØZI ØIN	ØZJ ØIN	ØZK ØIN	ØZL ØIN	ØZM ØIN	ØZN ØIN	ØZO ØIN	ØZP ØIN	ØZQ ØIN	ØZR ØIN	ØZS ØIN	ØZT ØIN	ØZU ØIN	ØZV ØIN	ØZW ØIN	ØZX ØIN	ØZY ØIN	ØZZ ØIN
		BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL	BASIC	TOL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										

ⓑ ENTIRE STANDARD REVISED

P.A. NAVY-OS <small>Other Dist</small> ARMY-AR AIR FORCE-99	INTERNATIONAL INTEREST	TITLE RING, RETAINING, EXTERNAL, BOWED (TAPERED SECTION TYPE)	MILITARY STANDARD MS16628
PROCUREMENT SPECIFICATION MIL-R-21248	SUPERSEDES:		PAGE OF 1 7

APPROVED 11 DEC 1958 REVISED (B) 4 MAY 1980

DD FORM 672-1 (COORDINATED)
1 MAY 73

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE

5365-0/30

FED. SUP CLASS
5365REQUIREMENTS:

1. CLASSIFICATION: RETAINING RINGS FURNISHED UNDER THIS STANDARD SHALL BE TYPE II, 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 ASTM B194.
3. HARDNESS:

TABLE II. HARDNESS

Ø SHAFT (REF)	CARBON STEEL	CORROSION RESISTANT STEEL	BERYLLIUM COPPER
.188 TO .236 INCL	-	-	77.9-82.0 HR15N $\frac{1}{2}$ (39-43 HRC EQUIV)
.250 TO .551 INCL	85.5-87.9 HR15N $\frac{1}{2}$ (50-55 HRC EQUIV)	83.5-85.9 HR15N $\frac{1}{2}$ (46-51 HRC EQUIV)	77.9-82.0 HR15N $\frac{1}{2}$ (39-43 HRC EQUIV)
.562 TO .669 INCL	68.5-73.0 HR30N $\frac{1}{2}$ (50-55 HRC EQUIV)	64.8-69.4 HR30N $\frac{1}{2}$ (46-51 HRC EQUIV)	58.6-62.2 HR30N $\frac{1}{2}$ (39-43 HRC EQUIV)
.688 TO 1.500 INCL	52.5-58.6 HR5N $\frac{1}{2}$ (48-53 HRC EQUIV)	50.3-56.1 HR5N $\frac{1}{2}$ (46-51 HRC EQUIV)	41.9-46.7 HR45N $\frac{1}{2}$ (39-43 HRC EQUIV)

$\frac{1}{2}$ USE HIGHEST SCALE TO PROVIDE SECTION WIDTH EQUAL TO OR GREATER THAN 5 TIMES THE BRAILE 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: MS16628-1100 IS THE PART NUMBER FOR A CARBON STEEL CADMIUM PLATE, EXTERNAL, BOWED 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 OR 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, BOWED (TAPERED SECTION TYPE)	MILITARY STANDARD MS16628
PROCUREMENT SPECIFICATION MIL-R-21248	SUPERSEDES:	PAGE 3	OF 7

DD FORM 1 MAY 72 672-1 (COORDINATED)

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5365-0130

USER ACTIVITIES:
ARMY-AT,ER,ME
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REVIEWER ACTIVITIES:
ARMY-AVAM
AIR FORCE-82
DLA-IS

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01-120

FED. SUP CLASS
5365

TABLE III. DASH NUMBERS FOR MS16628

Ø S SHAFT (REF)	CARBON STEEL 1/ CADMIUM PLATE	CARBON STEEL 1/ ZINC COAT	CARBON STEEL 1/ PHOSPHATE COAT	STEEL CORROSION RESISTANT	BERYLLIUM 1/ COPPER	BERYLLIUM COPPER 1/ CADMIUM PLATE
	DASH NO.	DASH NO.	DASH NO.	DASH NO.	DASH NO.	DASH NO.
.188					-5018	-5018-1
.197					-5019	-5019-1
.219					-5021	-5021-1
.236					-5023	-5023-1
.250	-1025	-2025	-3025	-4025	-5025	-5025-1
.276	-1027	-2027	-3027	-4027	-5027	-5027-1
.281	-1028	-2028	-3028	-4028	-5028	-5028-1
.312	-1031	-2031	-3031	-4031	-5031	-5031-1
.344	-1034	-2034	-3034	-4034	-5034	-5034-1
.354	-1035	-2035	-3035	-4035	-5035	-5035-1
.375	-1037	-2037	-3037	-4037	-5037	-5037-1
.394	-1039	-2039	-3039	-4039	-5039	-5039-1
.406	-1040	-2040	-3040	-4040	-5040	-5040-1
.438	-1043	-2043	-3043	-4043	-5043	-5043-1
.469	-1046	-2046	-3046	-4046	-5046	-5046-1
.500	-1050	-2050	-3050	-4050	-5050	-5050-1
.551	-1055	-2055	-3055	-4055	-5055	-5055-1
.562	-1056	-2056	-3056	-4056	-5056	-5056-1
.594	-1059	-2059	-3059	-4059	-5059	-5059-1
.625	-1062	-2062	-3062	-4062	-5062	-5062-1
.669	-1066	-2066	-3066	-4066	-5066	-5066-1
.672	-1067	-2067	-3067	-4067	-5067	-5067-1
.688	-1068	-2068	-3068	-4068	-5068	-5068-1
.750	-1075	-2075	-3075	-4075	-5075	-5075-1
.781	-1078	-2078	-3078	-4078	-5078	-5078-1
.812	-1081	-2081	-3081	-4081	-5081	-5081-1
.875	-1087	-2087	-3087	-4087	-5087	-5087-1
.938	-1093	-2093	-3093	-4093	-5093	-5093-1
.984	-1098	-2098	-3098	-4098	-5098	-5098-1
1.000	-1100	-2100	-3100	-4100	-5100	-5100-1
1.023	-1102	-2102	-3102	-4102	-5102	-5102-1
1.062	-1106	-2106	-3106	-4106	-5106	-5106-1
1.125	-1112	-2112	-3112	-4112	-5112	-5112-1
1.188	-1118	-2118	-3118	-4118	-5118	-5118-1
1.250	-1125	-2125	-3125	-4125	-5125	-5125-1
1.312	-1131	-2131	-3131	-4131	-5131	-5131-1
1.375	-1137	-2137	-3137	-4137	-5137	-5137-1
1.438	-1143	-2143	-3143	-4143	-5143	-5143-1
1.500	-1150	-2150	-3150	-4150	-5150	-5150-1

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

REVIEWER ACTIVITIES:
ARMY - AV, JM
AIR FORCE - 82
DLA - IS

P.A. NAVY - OS Other Cont ARMY - AR AIR FORCE - 99	INTERNATIONAL INTEREST	TITLE RING, RETAINING, EXTERNAL, BOWED (TAPERED SECTION TYPE)	MILITARY STANDARD MS16628
PROCUREMENT SPECIFICATION MIL-R-21248	SUPERSEDES:	PAGE 4 OF 7	

APPROVED 11 DEC 1988
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5365-0130

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054114

FED. SUP CLASS
5365

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

Ø/8 SHAFT (REF)	INACTIVE	SUBSTITUTE	SUBSTITUTE	SUBSTITUTE
	CARBON STEEL	CARBON STEEL 1/ CADMIUM PLATE	CARBON STEEL 1/ ZINC COAT	CARBON STEEL 1/ PHOSPHATE COAT
	MS16628	MS16628	MS16628	MS16628
.250	-25	-1025	-2025	-3025
.276	-27	-1027	-2027	-3027
.281	-28	-1028	-2028	-3028
.312	-31	-1031	-2031	-3031
.344	-34	-1034	-2034	-3034
.354	-35	-1035	-2035	-3035
.375	-37	-1037	-2037	-3037
.394	-39	-1039	-2039	-3039
.406	-40	-1040	-2040	-3040
.438	-43	-1043	-2043	-3043
.469	-46	-1046	-2046	-3046
.500	-50	-1050	-2050	-3050
.551	-55	-1055	-2055	-3055
.562	-56	-1056	-2056	-3056
.594	-59	-1059	-2059	-3059
.625	-62	-1062	-2062	-3062
.669	-66	-1066	-2066	-3066
.672	-67	-1067	-2067	-3067
.688	-68	-1068	-2068	-3068
.750	-75	-1075	-2075	-3075
.781	-78	-1078	-2078	-3078
.812	-81	-1081	-2081	-3081
.875	-87	-1087	-2087	-3087
.938	-93	-1093	-2093	-3093
.984	-98	-1098	-2098	-3098
1.000	-100	-1100	-2100	-3100
1.023	-102	-1102	-2102	-3102
1.062	-106	-1106	-2106	-3106
1.125	-112	-1112	-2112	-3112
1.188	-118	-1118	-2118	-3118
1.250	-125	-1125	-2125	-3125
1.312	-131	-1131	-2131	-3131
1.375	-137	-1137	-2137	-3137
1.438	-143	-1143	-2143	-3143
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).

USER ACTIVITIES:
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REVIEWER ACTIVITIES:
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FED SUP CLASS
5365RECOMMENDED DESIGN LIMITATIONS AND USAGE

- (a) **INTENDED USE** - TO PROVIDE SHOULDERS FOR POSITIONING AND RETAINING MACHINE COMPONENTS ON SHAFTS. THE RINGS ARE BENT LIKE A BOW OUT OF PLANE. FREE ENDS AND OPPOSITE EDGE ABUT MACHINE PART, MID-SECTION OF RING ABUTS OUTER GROOVE WALL. RING WILL TAKE UP END PLAY RESILIENTLY. THE RING WILL COUNTERACT CONSIDERABLE CENTRIFUGAL FORCES. 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. IF THE RING HAS PLAY BETWEEN THE GROOVE DIAMETER AND THE INSIDE RING DIAMETER THIS INDICATES THAT THE RING HAS BEEN OVER EXPANDED, (PROVIDING GROOVE DIAMETER HAS BEEN MACHINED TO RECOMMENDED DIMENSIONS).

FOR APPROXIMATE SAFETY RPM LIMITS SEE TABLE V.

TABLE V. APPROXIMATE SAFETY RPM LIMITS

Ø SHAFT (INCHES)		.250	.500	1	1.500
CARBON STEEL AND CORROSION RESISTANT STEEL	RPM LIMIT	80,000	40,000	20,000	15,000
BERYLLIUM COPPER	RPM LIMIT	50,000	25,000	13,000	11,000

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

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

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** =

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

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

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

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

$$Z = 3d$$

WHERE:

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

d = GROOVE DEPTH (INCHES)

- (e) **LOCATION OF GROOVE** =

$$L_{MAX} = L_{MIN} + T_{MIN} + \text{TAKE-UP (AS LISTED)}$$

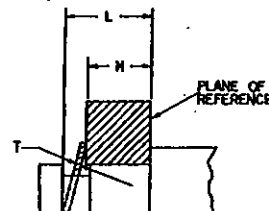
$$L_{MIN} = L_{MAX} + T_{MAX} + .005 \ 2/$$

$$\text{TAKE-UP} \geq \Delta L + \Delta H + \Delta T + .005$$

$$\text{WHERE: } \Delta L = L_{MAX} - L_{MIN}$$

$$\Delta H = H_{MAX} - H_{MIN}$$

$$\Delta T = T_{MAX} - T_{MIN}$$



- 1/ X = 120,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS UP TO AND INCLUDING .672 INCH SHAFT DIAMETER OF CARBON STEEL OR CORROSION RESISTANT STEEL.
X = 150,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS .688 INCH AND OVER SHAFT DIAMETER OF CARBON STEEL OR CORROSION RESISTANT STEEL.
X = 110,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS OF ALL SHAFT DIAMETERS AND OF BERYLLIUM COPPER.
2/ IT IS ADVISABLE FOR SAFER RING ASSEMBLY TO CALCULATE "MIN WITH ADDITIONAL .005" IN ORDER THAT THE RING IS NOT FLATTERED OUT COMPLETELY IN ADVERSE TOLERANCE CASES.

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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 PART BEING REPEATEDLY ACCELERATED AGAINST THE RING.

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

$$X T 1.1 g \geq \frac{W}{g} a$$

WHERE:

X = ULTIMATE SHEAR STRENGTH OF RING MATERIAL (PSI) ^{3/}
T = RING THICKNESS (INCHES)
S = SHAFT DIAMETER (INCHES)
W = WEIGHT OF ABUTTING PARTS (POUNDS)
g = ACCELERATION DUE TO GRAVITY (IN/SEC²)
S = AMPLITUDE OF VIBRATION (INCHES)
W = ANGULAR SPEED (RAD/SEC)
a = ACCELERATION (IN/SEC²)

OR FOR HARMONIC MOTION

$$a = 6W^2$$

$$X T 1.1 g \geq \frac{W}{g} 6W^2$$

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

$$1.65 Y G S \geq \frac{W}{g} \delta W^2$$

WHERE:

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

(g) IMPACT CAPACITY OF RING OR GROOVE WALL =

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

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

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

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

OR

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

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

LIMIT LOADS LISTED IN TABLE VI ARE BASED ON RINGS OF BERYLLIUM COPPER (WORKING STRESS 180,000 PSI) FOR ALL SIZES AND ON RINGS OF CARBON STEEL OR CORROSION RESISTANT STEEL (WORKING STRESS 250,000 PSI) FOR SIZES .250 AND LARGER. IF THE ALLOWABLE GROOVE CAPACITY LOADS AS CALCULATED BY USING THE FORMULA ON PAGE 6 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 RADIUS OR CHAMFERS	
FROM	TO	CARBON STEEL OR CORROSION RESISTANT STEEL	BERYLLIUM COPPER
.188	.236		105 LB
.250	.469	470 LB	340 LB
.500	.672	910 LB	650 LB
.688	1.023	1340 LB	950 LB
1.062	1.500	1950 LB	1400 LB

^{3/} X = 120,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS UP TO AND INCLUDING .672 INCH SHAFT DIAMETER OF CARBON STEEL OR CORROSION RESISTANT STEEL.

X = 150,000 PSI ULTIMATE SHEAR STRENGTH FOR RINGS .688 INCH AND OVER SHAFT DIAMETER OF CARBON STEEL OR CORROSION RESISTANT STEEL.

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

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