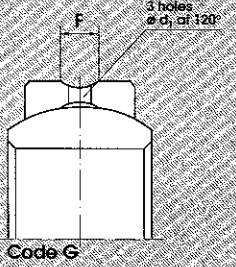
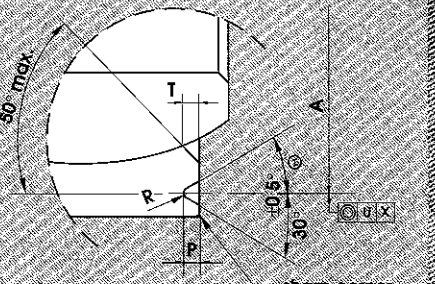
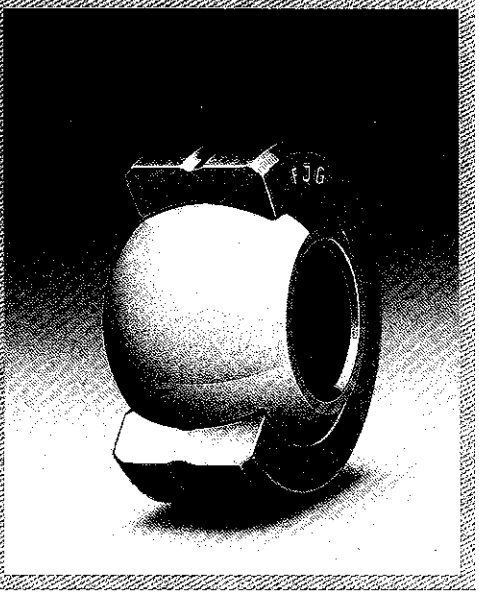


Code G

Code G
with grease hole in outer ring and lubrication groove, on external face, on spherical surface





Dimensions in millimetres

T max.	U	d_1 ±200	F ±200	α	Out of round µm Δds	Out of round µm ΔDs	Static Limit Load Rating in kN Radial	Static Limit Load Rating in kN Axial	With lubricating groove Radial	With lubricating groove Axial	Radial play in µm Suffix N	Radial play in µm Suffix P	Axial play max. in µm Suffix N	Axial play max. in µm Suffix P	Mass g	Dash No.
				10°			28	11	18	7					9	03
0,5	0,08			12°			42	16	28	11	10				9	04
				11°			57	23	35	15	to	2			14	05
		1,5		9°			70	25	41	17	30	to	120	35	18	06
			2,8	8,5°	-13	-13	85	34	53	21		10			23	07
0,8				9°			110	39	76	29					32	08
				9,5°			144	47	103	41				40	41	09
				8,5°			183	63	138	55		3			54	10
		2,0		8,5°			266	85	210	79		to 12			95	12
	0,12			9°			350	124	270	109	10				122	14
				9°			452	158	366	143	to	4	229		177	16
1,2				5,5°			635	235	518	203	50	to		50	240	20
		2,5	4,0	5,5°	+3 -15	+3 -15	963	363	815	313		15			435	24
				5,5°			1255	480	1100	425					668	28
				5°			1720	661	1545	594		5 to 20		60	952	32

Grease type: A = NATO G 354/MIL-G-23 827
B = NATO G 395/MIL-G-81 322
Outer ring: Dry film lubricant in the spherical according to 3400 AMIL-L-46010
Inner ring: Passivated ISO 8075

Suffix N = internal clearance normal
Suffix P = internal clearance reduced

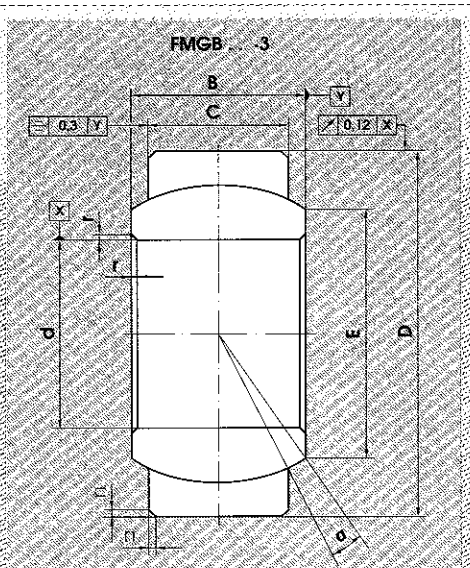
Type of mounting: S = without mounting grooves
R = with mounting grooves

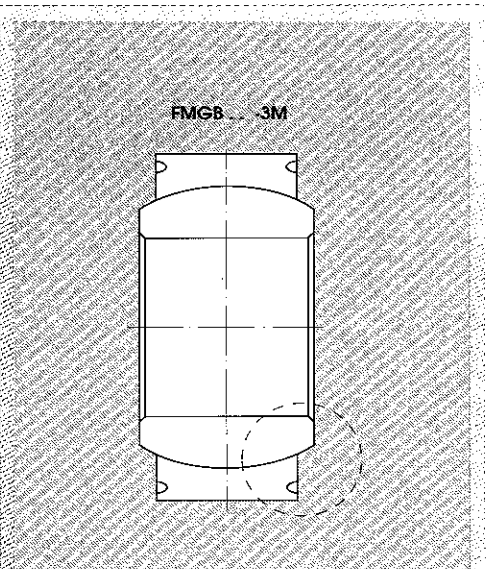
SPHERICAL BEARINGS

Without slots, corrosion resisting steel.

Series: **FMGB...·3**
Material
Outer ring: EN 2539 (1.4548.4)
Inner ring: EN 2030 (1.3544.9)

Series: **FMGB...·3 M with mounting grooves**
Material
Outer ring: EN 2539 (1.4548.4)
Inner ring: EN 2030 (1.3544.9)





Bearing Number		d	ΔdmP µm	D	ΔDmp µm	B	ΔBmp µm	C	ΔCmp µm	E min.	r x 45°	r1 x 45°	A	ΔAmp µm	P	ΔPmp µm
FMGB 3·3	FMGB 3·3 M	4,826		15,875		11,100		8,179		7,660			14,351			
FMGB 4·3	FMGB 4·3 M	6,350		15,875		11,100		8,179		7,660		0,381	14,351		0,762	
FMGB 5·3	FMGB 5·3 M	7,937		17,462		11,100		7,925		10,181		to	15,926			
FMGB 6·3	FMGB 6·3 M	9,525		20,637		12,700		10,185		11,967		0,635	18,135			
FMGB 7·3	FMGB 7·3 M	11,112		23,812		14,275		11,100		13,774			21,311			
FMGB 8·3	FMGB 8·3 M	12,700		25,400		15,875		12,700		15,554			22,911		1,016	
FMGB 9·3	FMGB 9·3 M	14,287	0	28,575	0	17,450	0	13,487	+254	18,457	0,127		26,086			
FMGB 10·3	FMGB 10·3 M	15,875	-12	30,162	-12	19,050	-127	14,275	0	19,098	to	0,508	27,661	-254		-381
FMGB 12·3	FMGB 12·3 M	19,050		34,925		22,225		15,875		22,674	+381	to	31,826			
FMGB 14·3	FMGB 14·3 M	22,225		41,275		22,225		19,050		26,941		0,762	38,176			
FMGB 16·3	FMGB 16·3 M	25,400		53,975		34,925		25,400		32,378			50,876			
FMGB 20·3	FMGB 20·3 M	31,750		60,325		38,100		28,575		37,075			57,227		1,524	
FMGB 24·3	FMGB 24·3 M	38,100		68,262		42,850		30,937		45,500		0,762	65,164			
FMGB 28·3	FMGB 28·3 M	44,450		76,200		46,024		33,325		49,878		to	73,102			
FMGB 32·3	FMGB 32·3 M	50,800		82,550		49,199		34,925		56,075		1,016	79,452			

Lubricant: Grease NATO G 354/MIL-G-23 827

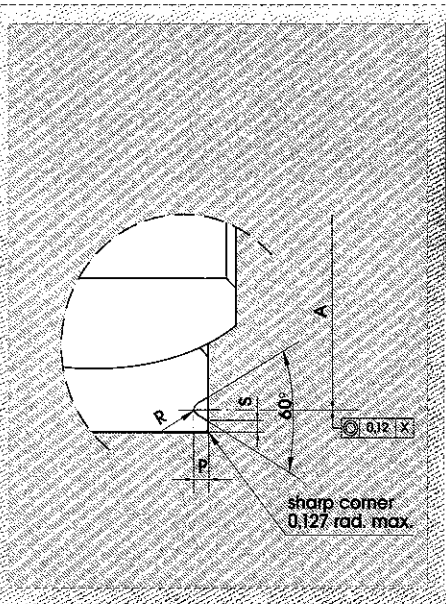
Procurement Specification MIL-B-8976

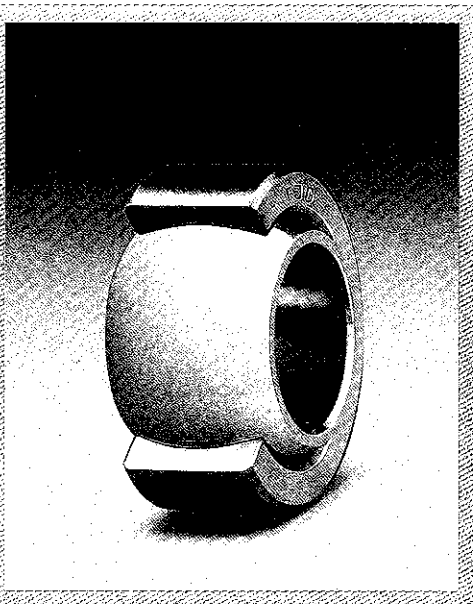
Designation

Each bearing is designated as in the following example:

FMGB 6 ·3 M AX .6

- FMGB 6 — Bearing Number
- ·3 — Material-Code
- M — with mounting grooves
- AX — Suffix AX = reduced Axial play
- .6 — Outerring slideways treated with Molykote sliding varnish 3400A MIL-L-46 010 A





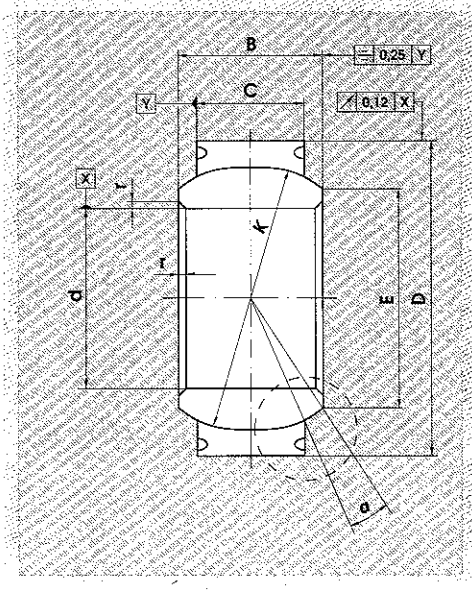
Dimensions in millimetres

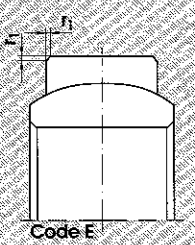
R		S	α	Axial play µm		Static Limit Load Rating in kN		Mass g	Bearing Number	
	ΔRmp µm	min.		Suffix A	Suffix Ax	Radial	Axial			
			17°			52,0	24,8	14	FMGB 3·3	FMGB 3·3 M
0,127		0,254	17°			52,0	24,8	14	FMGB 4·3	FMGB 4·3 M
			14°			68,5	28,3	16	FMGB 5·3	FMGB 5·3 M
			10°			107,6	49,4	22	FMGB 6·3	FMGB 6·3 M
			12°			138,7	60,8	36	FMGB 7·3	FMGB 7·3 M
			9°			183,6	82,3	45	FMGB 8·3	FMGB 8·3 M
			11°	30	0	230,3	96,0	61	FMGB 9·3	FMGB 9·3 M
	+254		12°	to	to	263,6	109,0	72	FMGB 10·3	FMGB 10·3 M
			14°	60	30	355,6	139,5	104	FMGB 12·3	FMGB 12·3 M
0,254		0,508	7°			475,6	204,1	158	FMGB 14·3	FMGB 14·3 M
			15°			880,2	368,3	440	FMGB 16·3	FMGB 16·3 M
			14°			1102,4	465,1	499	FMGB 20·3	FMGB 20·3 M
			15°			1364,7	531,0	762	FMGB 24·3	FMGB 24·3 M
			14°			1644,8	635,1	838	FMGB 28·3	FMGB 28·3 M
			14°			1889,2	694,6	975	FMGB 32·3	FMGB 32·3 M

SPHERICAL BEARINGS

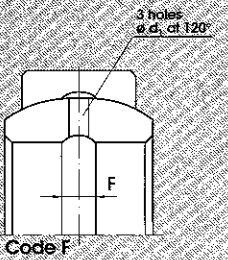
Without slots, corrosion resisting steel, dimensions according to EN 4265/ EN 4266.

Series:	**EN 4265**	**Series:**	**EN 4266**
Material		Material	
Outer ring:	EN 2539 (1.4548.3) hardness HRc 28-38 before swaging	Outer ring:	EN 2539 (1.4548.3) hardness HRc 28-38 before swaging cadmium plated yellow passivated
Inner ring:	EN 2030 (1.3544) hardness HRc 55-62	Inner ring:	EN 2030 (1.3544) hardness HRc 55-62





Code E
without grease hole or lubrication groove



Code F
with grease holes in inner ring and lubrication groove, on inner ring bore, on spherical surface of outer ring

Dash No.	d	D		B	C		E	K	r	r_1	A		P	R	Θ
		Δdmp µm	ΔDmp µm	ΔBmp µm	ΔCmp µm		min.	≈		0 -250		ΔAmp µm	0 -250		±0,5°
03	4,826		15,875	0 -8	11,100		8,31		7,62	13,5			14,30			0,127 to 0,254	20°
04	6,350		15,875		11,100		8,31		7,62	13,5		0,64	14,30		0,64		
05	7,937		17,463		11,100		8,05		10,14	14,4			15,88				
06	9,525		20,638		12,700		10,31		11,84	17,3			18,08				
07	11,113		23,813	0 -9	14,270		11,23		13,64	19,7			21,26				
08	12,700		25,400		15,880		12,83		15,42	22,1			22,86		0,89		
09	14,288	0	28,575		17,450	0	13,61	+130	18,31	25,2	0,13	0,76	26,04	0			
10	15,875	-13	30,163		19,050	-50	14,40	0	18,97	26,7	to		27,61	-200			
12	19,050		34,925	0 -11	22,230		16,00		21,64	30,9	0,38		31,78			0,254 to 0,432	30°
14	22,225		41,275		22,230		19,18		25,27	33,7			38,13				
16	25,400		53,975		34,930		25,53		32,23	47,5			50,83				
20	31,750		60,325	0 -13	38,100		28,70		37,13	53,1		1,02	57,18		1,4		
24	38,100		68,263		42,850		31,06		43,10	60,4			65,10				
28	44,450		76,200		46,020		33,45		49,91	67,9			73,05				
32	50,800		82,550		49,200		35,05		56,10	74,6			79,35				

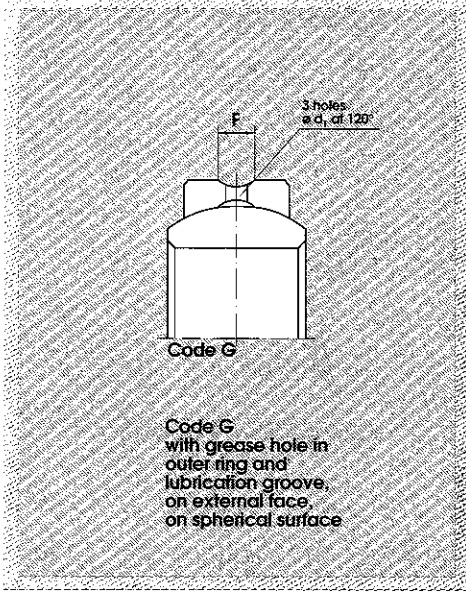
Procurement Specification EN 2337

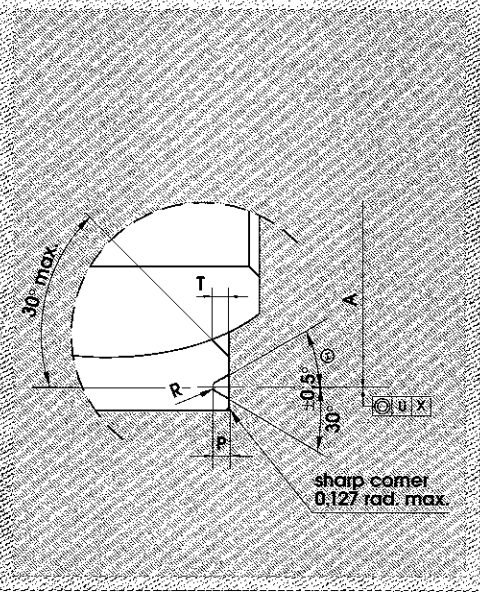
Designation

Each bearing is designated as in the following example:

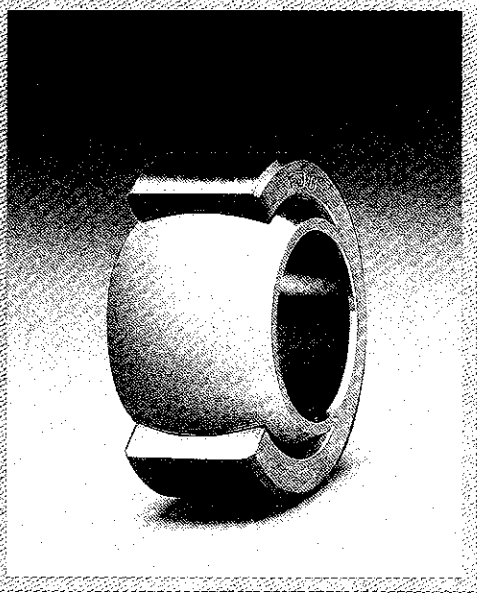
EN 4265 A P 16 E R

- EN 4265 — Number of EN standard
- A — Grease type
- P — Radial and axial play
- 16 — Dash-No.
- E — Type of lubrication
- R — Type of mounting grooves





Code G
with grease hole in outer ring and lubrication groove, on external face, on spherical surface



Dimensions in millimetres

T max.	U	d_1 ±200	F ±200	α	Out of round µm Δds	Out of round µm ΔDs	Static Limit Load Rating in kN Radial	Static Limit Load Rating in kN Axial	With lubricating groove Radial	With lubricating groove Axial	Radial play in µm Suffix N	Radial play in µm Suffix P	Axial play max. in µm Suffix N	Axial play max. in µm Suffix P	Mass g	Dash No.
				16°			54	23	36	17					14	03
0,5	0,08			16°			61	26	46	19	10				14	04
				15,5°			63	24	47	18	to	2			16	05
		1,5		9,5°			95	37	70	30	30	to	120	35	27	06
			2,8	11°	-13	-13	120	47	94	39		10			36	07
0,8				9,5°			158	62	126	51					45	08
				10,5°			195	72	156	58		3		40	61	09
		2,0		12°			220	79	175	66		to 12			73	10
	0,12			14°			285	93	225	75					109	12
				6°			370	141	301	120	10				159	14
1,2				14,5°			705	265	610	235	to	4	229		440	16
				12,5°			890	340	758	300	50	to		50	500	20
		2,5	4,0	14°	+3 -15	+3 -15	1100	410	950	360		15			700	24
				13°			1330	480	1170	430					900	28
				13°			1530	520	1350	460		5 to 20		60	1050	32

Grease type: A = NATO G 354/MIL-G-23 827
B = NATO G 395/MIL-G-81 322
Outer ring: Dry film lubricant in the spherical according to 3400 A MIL-L-46010
Inner ring: Passivated ISO 8075

Suffix N = internal clearance normal
Suffix P = internal clearance reduced

Type of mounting: S = without mounting grooves
R = with mounting grooves

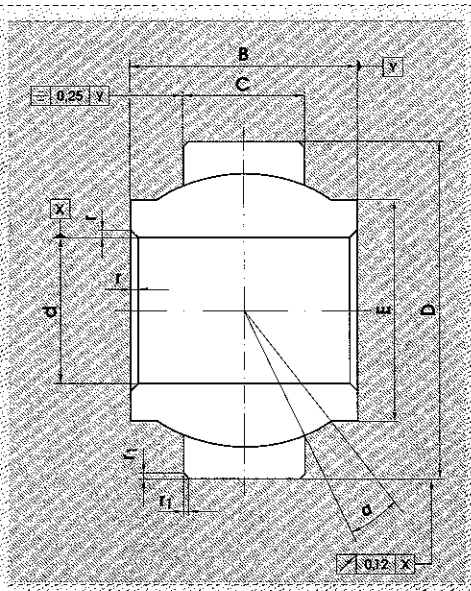
SPHERICAL BEARINGS

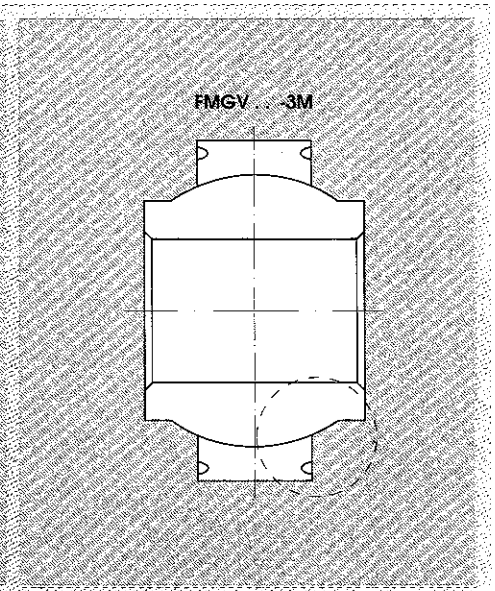
Without slots.

Series: **FMGV...3**
Material
Outer ring: EN 2539 (1.4548.4)
Inner ring: EN 2030 (1.3544.9)

Series: **FMGV...3 M**
with mounting grooves
Material
Outer ring: EN 2539 (1.4548.4)
Inner ring: EN 2030 (1.3544.9)

Series: **NSA 8138...**
Material
Outer ring: EN 2539 (1.4548.4)
Inner ring: EN 2030 (1.3544.9)





Bearing Number		NSA No.	d	Δdmp µm	D	ΔDmp µm	B	ΔBmp µm	C	ΔCmp µm	E min.	r x 45°	r_1 x 45°	A	ΔAmp µm
FMGV 3·3	FMGV 3·3 M	03	4,826		14,288		12,70		5,21		7,62		0,38	12,65	
FMGV 4·3	FMGV 4·3 M	04	6,350		18,796		15,06		6,35		9,50		to	17,17	
FMGV 5·3	FMGV 5·3 M	05	7,937		23,012		20,65		8,64		12,65		0,63	21,39	
FMGV 6·3	FMGV 6·3 M	06	9,525		23,012		20,65		8,64		12,65			21,39	
FMGV 7·3	FMGV 7·3 M	07	11,112		25,400		22,23		8,64		15,34		0,51	22,81	
FMGV 8·3	FMGV 8·3 M	08	12,700	0	28,575	0	23,80	0	10,06	+250	18,09	0,13	to	25,98	0
FMGV 10·3	FMGV 10·3 M	10	15,875	-12	34,925	-12	30,48	-127	14,28	0	21,34	to	0,76	32,33	-200
FMGV 12·3	FMGV 12·3 M	12	19,050		39,688		32,51		15,62		24,06	0,38		36,50	
FMGV 14·3	FMGV 14·3 M	14	22,225		44,450		35,56		15,75		28,10		0,76	41,28	
FMGV 16·3	FMGV 16·3 M	16	25,400		53,976		47,63		21,08		31,85		to	50,80	
FMGV 20·3	FMGV 20·3 M	20	31,750		63,500		47,63		25,40		38,31		1,01	60,33	

Lubricant: Grease NATO G 354/MIL-G-23 827

Procurement Specification MIL-B-8976

Designation

Each bearing is designated as in the following example:

FMGV 3.3 M .6

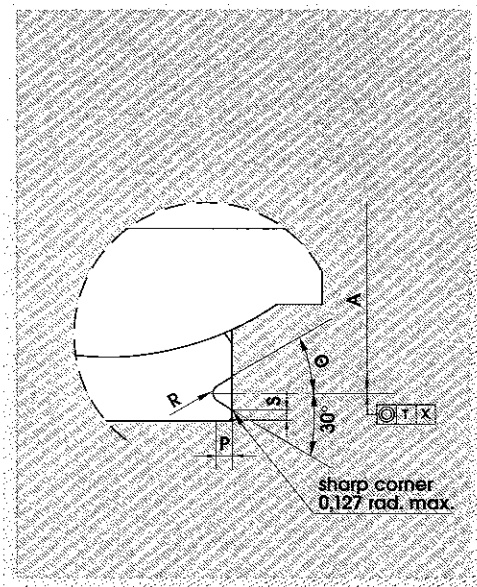
Series designation
Bore number
with mounting grooves

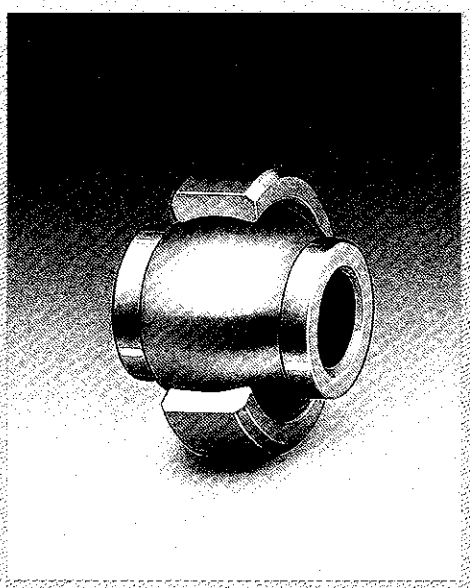
Outerring slideways treated with Molykote sliding varnish 3400A MIL-L-46 010 A

NSA 8138 - 03

Series designation

Bore number





Dimensions in millimetres

P		R		S	Θ	α	T	Internal clearance µm		Static Limit Load Rating in kN		Mass g	NSA No.	Bearing Number
	ΔPmp µm		ΔRmp µm	min.	±0,5°			Radial	Axial	Radial	Axial			
						15°				34,7	11,6	9	03	FMGV 3·3 FMGV 3·3 M
0,64		0,13		0,25	20°	24°	0,08			42,2	17,2	18	04	FMGV 4·3 FMGV 4·3 M
						23°				72,5	14,1	32	05	FMGV 5·3 FMGV 5·3 M
						23°				97,8	14,1	32	06	FMGV 6·3 FMGV 6·3 M
						22°		10	0	128,9	14,1	46	07	FMGV 7·3 FMGV 7·3 M
0,89	0 -250		+180			20°		to	to	161,4	19,2	73	08	FMGV 8·3 FMGV 8·3 M
						20°		30	80	257,8	38,6	114	10	FMGV 10·3 FMGV 10·3 M
		0,25		0,50	30°	19°	0,13			322,3	46,3	145	12	FMGV 12·3 FMGV 12·3 M
1,40						19°				364,5	47,0	195	14	FMGV 14·3 FMGV 14·3 M
						21°				604,5	84,3	368	16	FMGV 16·3 FMGV 16·3 M
						21°				871,3	122,3	504	20	FMGV 20·3 FMGV 20·3 M

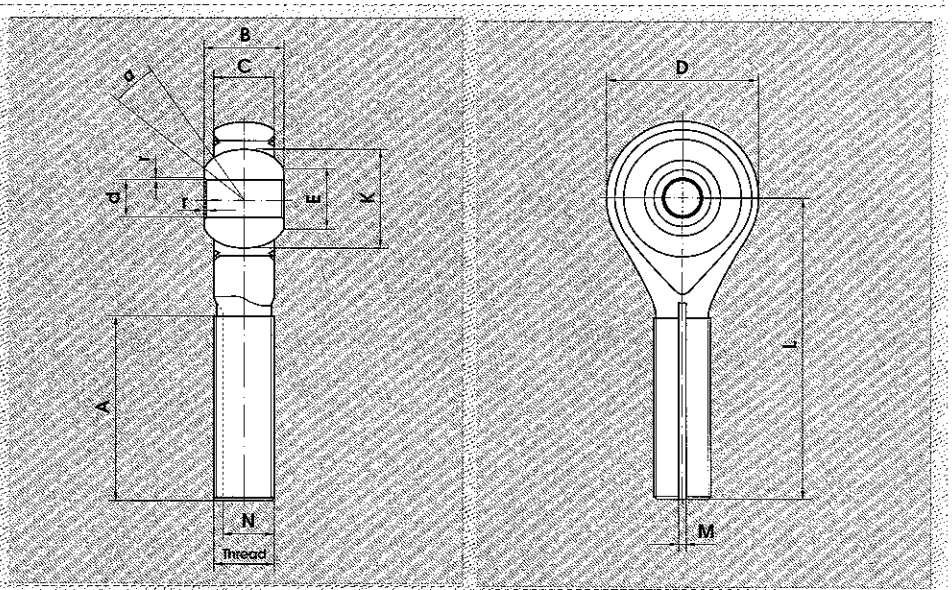
ROD ENDS

Male type.

Series: **FMS 3 E...**
Material
Rod end: Heat treatable steel Cadmium plated, yellow passivated
Outer ring: Bronze 2.0966
Inner ring: EN 2031 (1.3505.9) Chromium plated

Series: **FMS 3 E...3**
Material
Rod end: EN 2539 (1.4548.4)
Outer ring: EN 2136 (1.4044.6)
Inner ring: EN 2030 (1.3544.9)

Series: **NSA 8140...**
Material
Rod end: EN 2539 (1.4548.4)
Outer ring: EN 2136 (1.4044.6)
Inner ring: EN 2030 (1.3544.9)

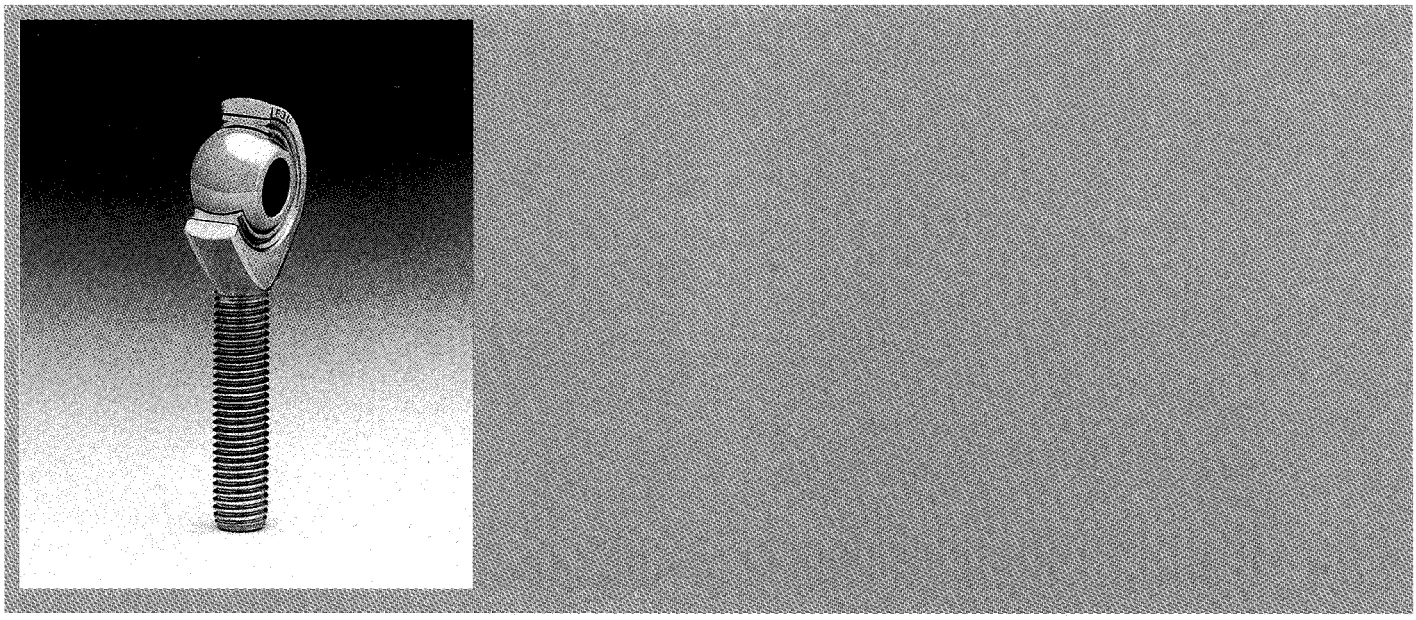


Dash No.	d	D ΔDmp µm	D ΔDmp µm	B	B ΔBmp µm	C	C ΔCmp µm	E min.	K	L	A ΔLmp µm	A ΔAmp µm	Threads UNJF-3A MIL-S-8879	r x 45°
3	4,826		20,5	11,100		8,560		7,660	13,487	39,675		25,400	.3125-24	
4	6,350		20,5	11,100		8,560		7,660	13,487	39,675		25,400	.3125-24	
5	7,937		22,9	11,100		8,306		10,181	15,062	47,625		26,975	.3125-24	
6	9,525		26,0	12,700		10,566		11,967	17,450	49,225		31,750	.3750-24	
7	11,112	0	29,2	14,275	0	11,481		13,774	19,837	53,975		34,925	.4375-20	0,1
8	12,700	-12	34,0	15,875	-127	13,081	±127	15,554	22,225	61,925	±254	38,100	.5000-20	to
10	15,875		38,7	19,050		14,656		19,098	26,975	66,675		41,275	.6250-18	0,4
12	19,050		45,1	22,225		16,256		22,674	31,750	73,025		44,450	.7500-16	
14	22,225		51,4	22,225		19,431		26,941	34,925	85,725		47,625	.8750-14	
16	25,400		70,5	34,925		25,781		32,378	47,625	104,775		53,975	.1.2500-12	

3	4,826		20,5	11,100		8,560		7,660	13,487	39,675		25,400	+1524	.3125-24
4	6,350		20,5	11,100		8,560		7,660	13,487	39,675		25,400	-762	.3125-24
5	7,937		22,9	11,100		8,306		10,181	15,062	47,625		26,975		.3125-24
6	9,525		26,0	12,700		10,566		11,967	17,450	49,225		31,750		.3750-24
7	11,112	0	29,2	14,275	0	11,481		13,774	19,837	53,975		34,925	+1524	.4375-20
8	12,700	-12	34,0	15,875	-127	13,081	±127	15,554	22,225	61,925	±254	38,100	-762	.5000-20
10	15,875		38,7	19,050		14,656		19,098	26,975	66,675		41,275		.6250-18
12	19,050		45,1	22,225		16,256		22,674	31,750	73,025		44,450		.7500-16
14	22,225		51,4	22,225		19,431		26,941	34,925	85,725		47,625		.8750-14
16	25,400		70,5	34,925		25,781		32,378	47,625	104,775		53,975		.1.2500-12

Lubricant: Grease NATO G 354/MIL-G-23 827
All dimensions to be met after plating

L = Lefthand thread
K = Keyway in shank
G = Grease nipple



Dimensions in millimetres

M	ΔVmp µm	N	ΔNmp µm	α	Radial play in µm	Axial play max. in µm Suffix A	Axial play max. in µm Suffix AX	Static Radial Limit Load Rating in kN	Mass g	Dash No.
1,575		6,604		17°				23,5	27	3
1,575		6,604		17°				23,5	27	4
1,575		6,604		14°				23,5	31	5
2,362		7,900		10°	0	30	0	34,3	50	6
2,362	+127	9,400	0	12°	to	to	to	43,8	68	7
2,362	0	11,074	-127	9°	50	60	30	67,3	113	8
3,175		13,741		12°				79,0	168	10
3,175		16,840		14°				104,8	263	12
3,962		19,735		7°				120,8	358	14
4,750		28,854		15°				272,7	1043	16

Designation

Each bearing is designated as in the following example:

FMS 3 E 5· 3 L K AX G .6

- Series designation
- Dash No.
- Material-Code
- Outer ring- slideways treated with Molykote Sliding varnish 3400 A MIL-L-46 010 A
- Grease nipple
- Reduced axial play
- Keyway in shank
- Lefthand thread

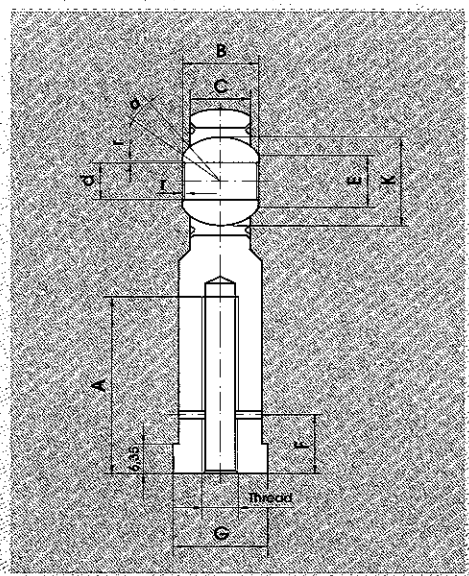
ROD ENDS

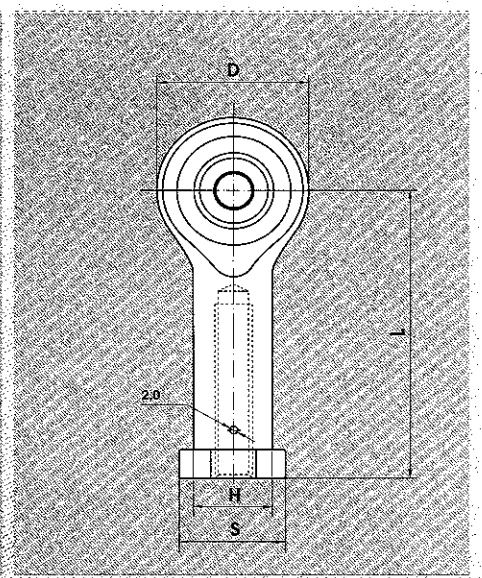
Female type.

Series: **FMS 3 F...**
Material
Rod end: Heat treatable steel
Cadmium plated,
yellow passivated
Outer ring: Bronze 2.0966
Inner ring: EN 2031 (1.3505.9)
Chromium plated

Series: **FMS 3 F...-3**
Material
Rod end: EN 2539 (1.4548.4)
Outer ring: EN 2136 (1.4044.6)
Inner ring: EN 2030 (1.3544.9)

Series: **NSA 8141...**
Material
Rod end: EN 2539 (1.4548.4)
Outer ring: EN 2136 (1.4044.6)
Inner ring: EN 2030 (1.3544.9)

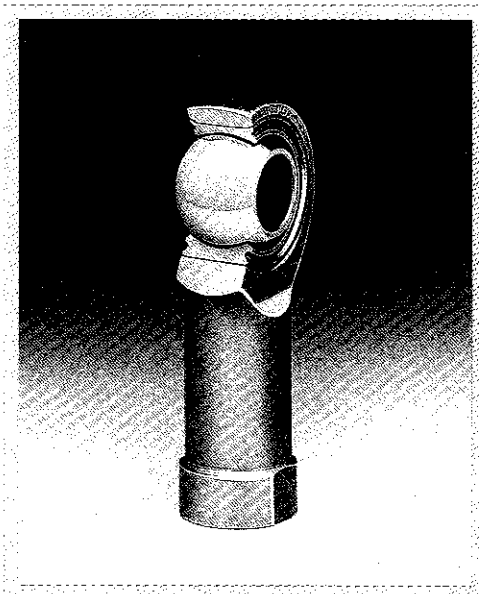




Dash No.	d		D		B		C		E	K	L		A		G	
		Δdmp µm		ΔDmp µm		ΔBmp µm		ΔCmp µm	min.			ΔLmp µm		ΔAmp µm		ΔGmp µm
3	4,826		20,5		11,100		8,560		7,660	13,487	34,925		19,050		11,100	
4	6,350		20,5		11,100		8,560		7,660	13,487	37,312		19,050		11,125	
5	7,937		22,9		11,100		8,306		10,181	15,062	34,925		19,050		12,700	
6	9,525		26,0		12,700		10,566		11,967	17,450	41,275		23,800		14,300	
7	11,112	0	29,2	±254	14,275	0	11,481	±127	13,774	19,837	46,024	±254	26,975	+1524	15,875	±254
8	12,700	-12	34,0		15,875	-127	13,081		15,554	22,225	53,975		28,575	-762	19,050	
10	15,875		38,7		19,050		14,656		19,098	26,975	66,675		38,100		22,225	
12	19,050		45,1		22,225		16,256		22,674	31,750	73,025		41,148		25,400	
14	22,225		51,4		22,225		19,431		26,941	34,925	85,725		47,625		28,575	
16	25,400		70,5		34,925		25,781		32,378	47,625	104,775		53,975		31,750	

Lubricant: Grease NATO G 354/MIL-G-23 827
All dimensions to be met after plating

L = Lefthand thread
G = Grease nipple



Dimensions in millimetres

H	ΔHmp µm	S	ΔSmp µm	F	ΔSmp µm	Threads UNJF-3B MIL-S-8879	r x 45°	α	Radial play in µm	Axial play max. in µm Suffix A	Suffix AX	Static Radial Limit Load Rating in kN	Mass g	Dash No.
10,719		12,700		9,652		.3125-24		17°				24,4	27	3
10,719		12,954		9,652		.3125-24		17°				24,4	27	4
10,719		14,732		9,652		.3125-24		14°				25,1	31	5
14,402		16,510		11,176		.3750-24		10°				34,1	50	6
15,490	±127	18,288	±254	12,700	±381	.4375-20	0,1	12°	0	30	0	43,8	82	7
18,670		22,098		14,220		.5000-20	to	9°	to	to	to	71,9	127	8
21,840		25,400		17,530		.6250-18	0,4	12°	50	60	30	79,0	190	10
25,020		26,924		20,830		.7500-16		14°				104,8	231	12
28,190		30,149		23,880		.8750-14		7°				120,8	426	14
31,370		33,325		27,180		1.0000-12		15°				181,3	612	16

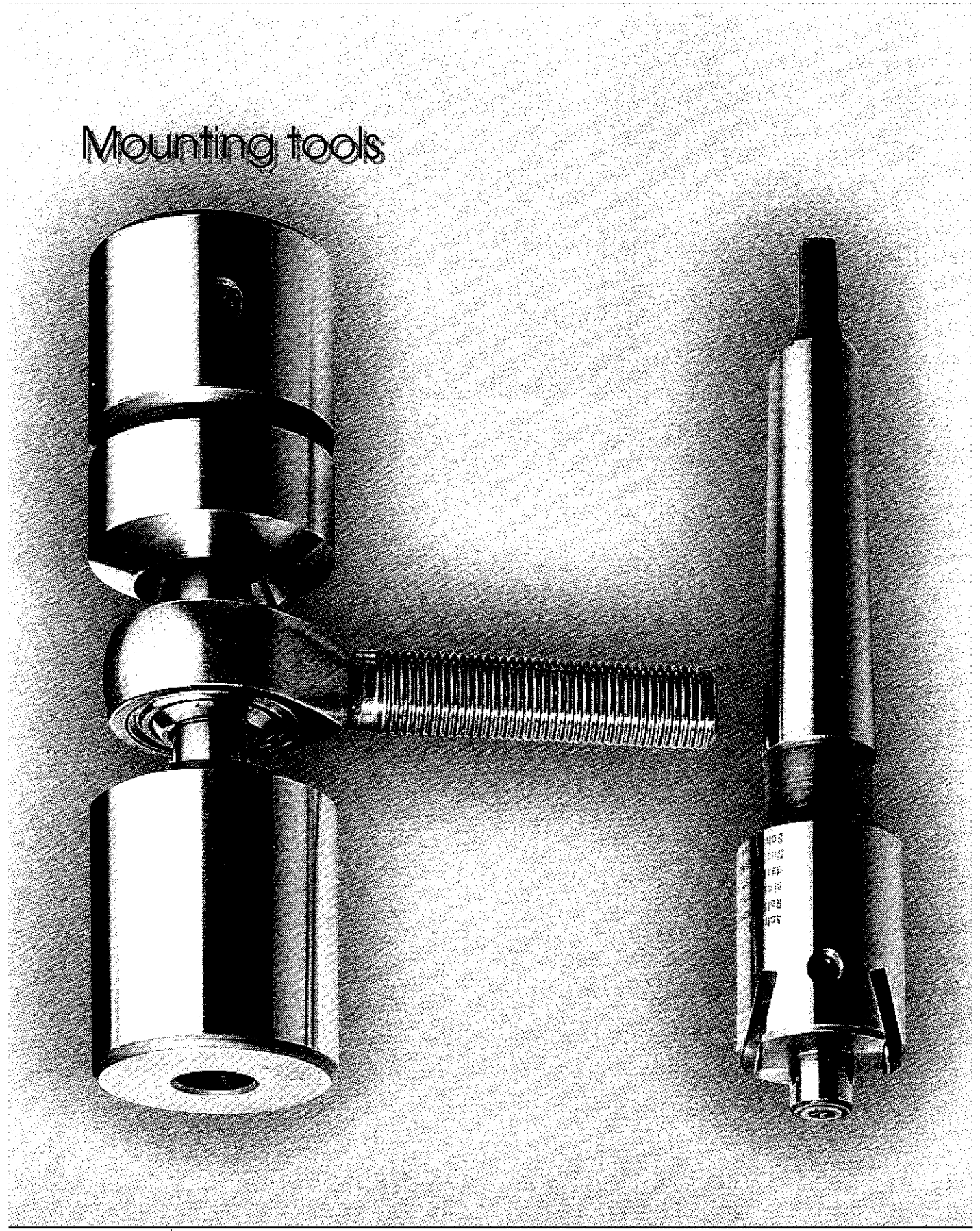
Designation

Each bearing is designated as in the following example:

FMS 3 F 5· 3 L AX G .6

- Series designation
- Dash No.
- Material-Code
- Outer ring- slideways treated with Molykote sliding varnish 3400 A MIL-L-46 010 A
- Grease nipple
- Reduced axial play
- Lefthand thread

Mounting tools



Two current and in practice proven methods of installation of spherical bearings with mounting grooves on the outer ring are:

a) the staking process and respectively
b) the roller staking method.

RWG Frankenjura cannot give a general recommendation which method should be selected. In certain instances the particular circumstances may limit the flexibility of choice (i.e. the kind of design, bearing position).

No matter which kind of installation is chosen, always consider that the resulting performance of the bearing depends also on the skill and care with which the mounting process is done. RWG Frankenjura offers and supplies for both methods the required toolings.

Both illustrations show their design and the way they work. The quality of the housing bore cannot be over emphasized as to the proper installation of the bearing.

Consequently the following notices concerning the housing should be observed:

1. Size of the bore should be true and surface quality has to be Ra = 0,8µm max.

2. Parallelism of the bore should be controlled within 50 % of the bore tolerance.

3. The ovality of the bore should be within the diameter tolerance.

4. The concentricity of the chamfer (45°) to the bore should be within the tolerance.

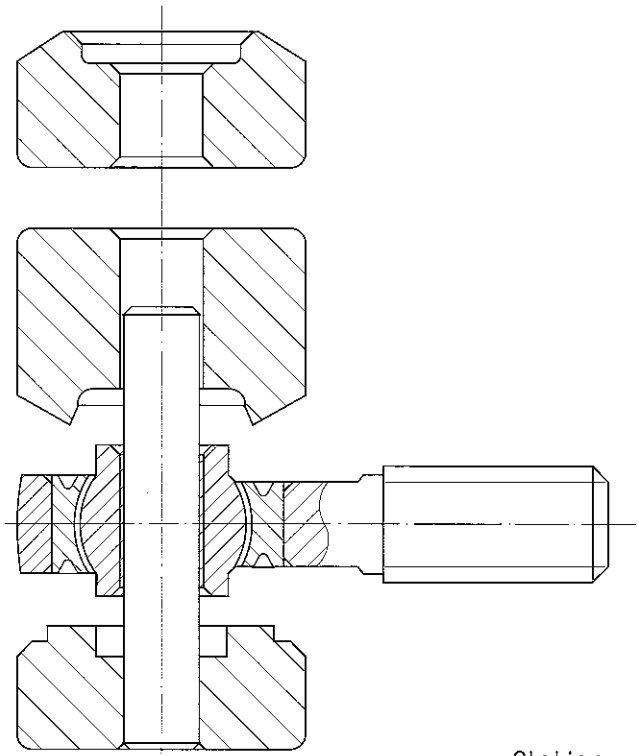
These are critical features which should be indicated on the housing´s drawing. The approximate load F for the staking method is defined in the following formula:

$$F = 400 \cdot \frac{daN}{mm} \times A \; daN$$

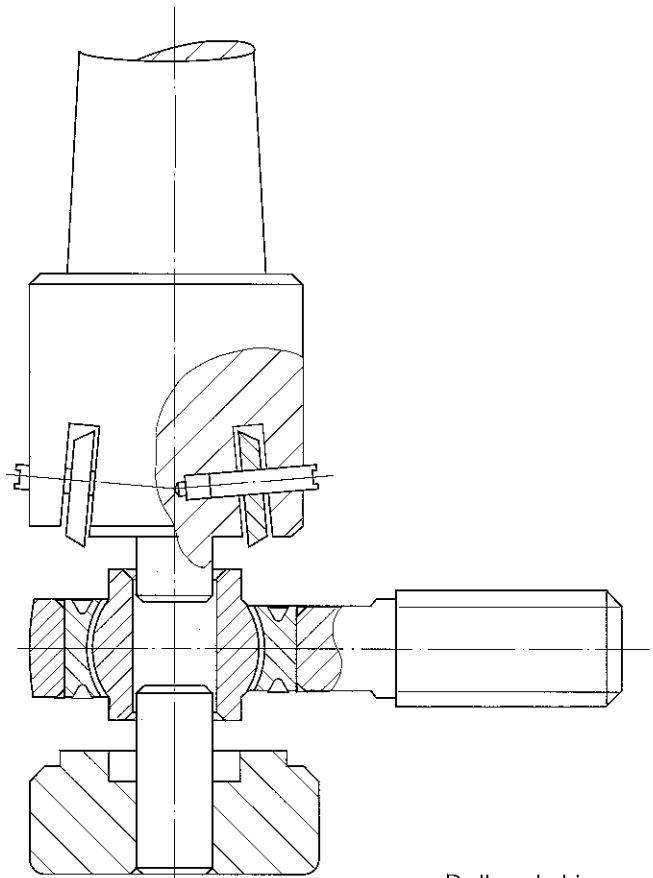
whereas A is the center diameter of the mounting groove of the bearing.

The roller staking method uses a rotating rolling head in a vertical drill head. Generally, lower loads are required than in the staking method.

For further advice in special applications or practical demonstration of techniques contact RWG Frankenjura´s Engineering Department.

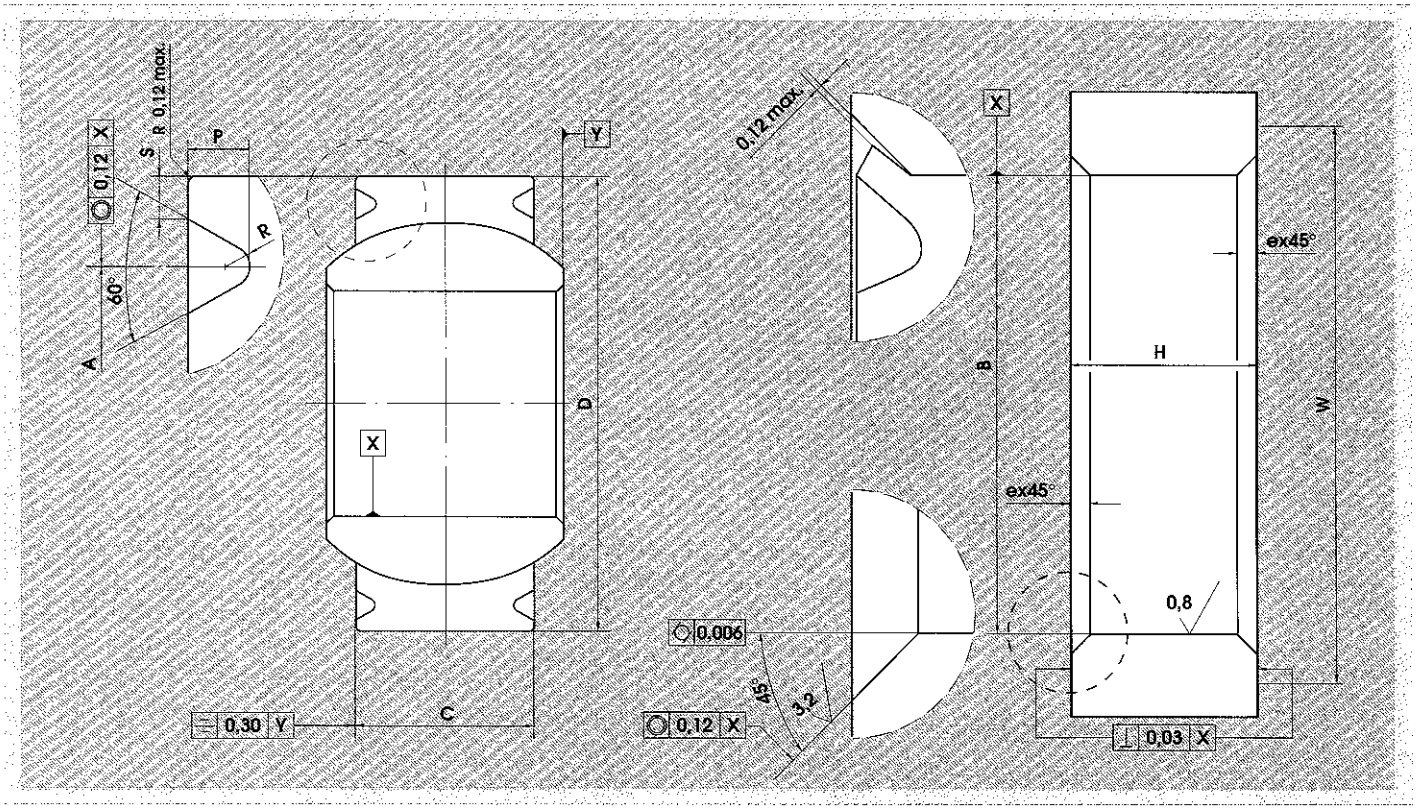


Staking



Roller staking

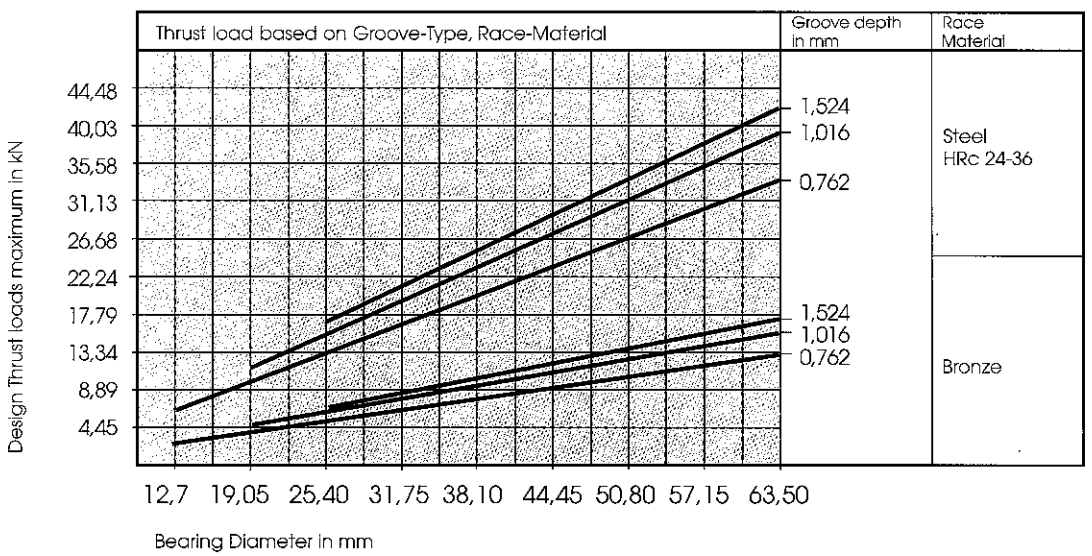
SPHERICAL BEARINGS



Example

Spherical Bearings — Housing

D	ΔDmp µm	ΔDs µm	C	ΔCmp µm	A	ΔAmp µm	R	ΔRmp µm	P	ΔPmp µm	S min.	B	ΔBmp µm	ΔBs µm	H	ΔHmp µm	e x 45°	Δcmp µm	W min.
30	9	+6 -15	14,5	±100	27,4	+100	0,3	+100	0,7	+200	0,45	30	+8 -5	+8 -5	14,8	-100	0,8	+100	37,5



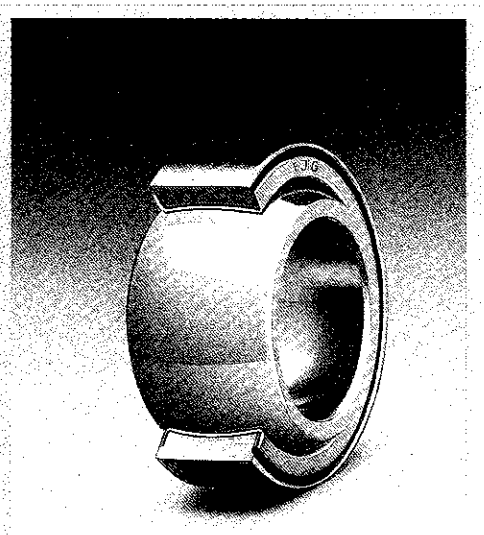
Sealed RWG Frankenjura spherical bearings

Most of the RWG Frankenjura spherical bearings, metal-to-metal as well as „FRASLIP"lined, are now available in sealed versions. The seals prevent dirt and other contaminants from penetrating into the inner of the bearing and thus increase the life of the bearing considerably.

The sealing elements are inert to all solid and liquid contaminants specified in the relevant standards for spherical bearings.

Almost all sealed RWG Frankenjura spherical bearings are dimensionally interchangeable with standard series bearings.

Please contact our technical department for additional information (i.e. design, limiting conditions, performance).



FRASLIP LINED BEARINGS

Engineering Information

FRASLIP antifriction material was developed by RWG Frankenjura as a low friction lining material for use between the moving parts of spherical bearings.

FRASLIP has three components. The base is a woven polyester fabric. This fabric has an especially formulated teflon layer on the sliding side. The reverse side is covered with a special adhesive which bonds to the metal backing under controlled heat and pressure conditions.

The outstanding features mentioned below make FRASLIP lined bearings well suited for the increasing demands of the aerospace industry.

- No lubrication required
- Temperature range from - 55°C to +163°C
- Low coefficient of friction
- High load capacity
- Low wear rate under dynamics conditions
- The selflubricating spherical bearings are inert to all solid and liquid contaminants specified in the relevant standards EN 2064, EN 2755 and MIL-B-81820.
- High corrosion resistance. Inner rings are made of stainless steel 1.3544 i.e. AISI 440C and 1.4534.5 i.e. AMS 5629; outer ring material is 1.4548 i.e. AMS 5643 and 1.4545 i.e. AMS 5659.
- FRASLIP lined spherical bearings meet the requirements of EN 2064 and EN 2755 for metric sizes and MIL-B-81820 for inch sizes. The applicable MS (Military Standards) are shown in the dimensional tables.

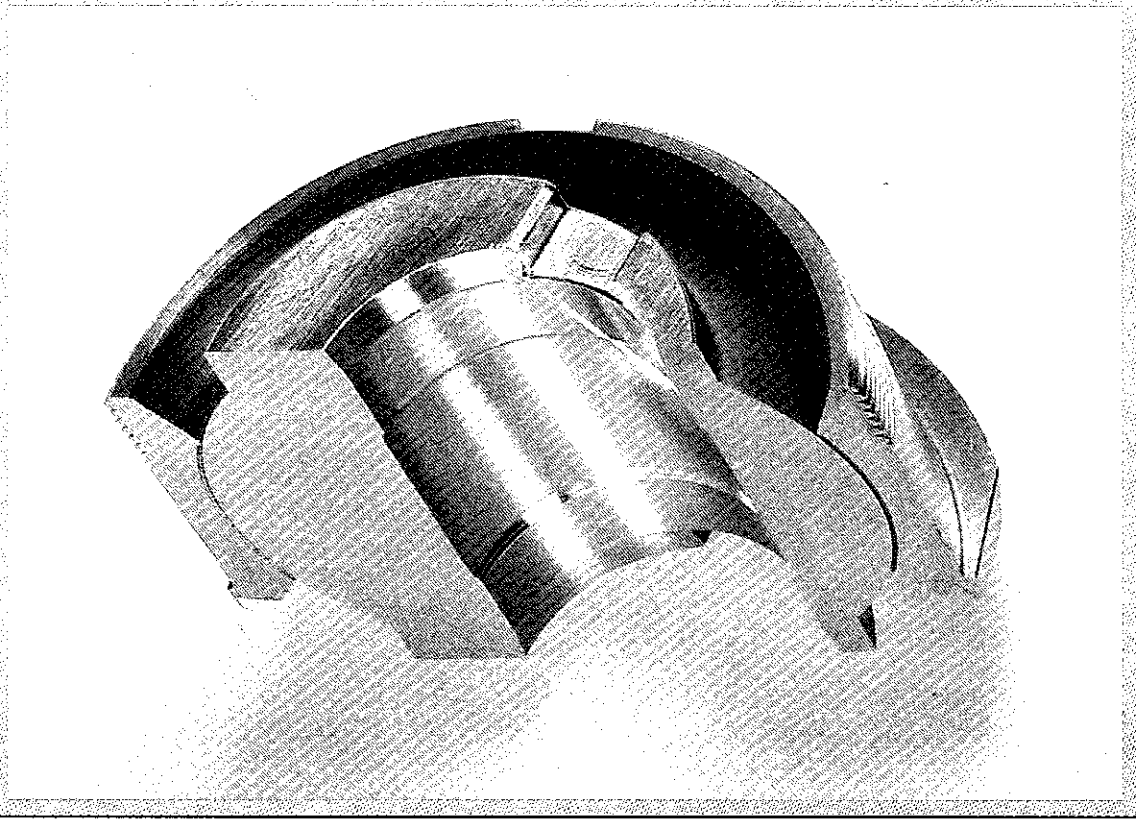
Static load ratings

The static radial load values specified in the data sheets represent the safe operating load limit. These values correspond to a specific pressure of 450 MPa max. on the projected radial area. The static axial load limit corresponds to a specific pressure of 225 MPa max. on the projected axial surface.

The ultimate Radial or Thrust load rating

The ultimate radial or thrust load ratings are defined as 1.5 times the static radial or axial load limits respectively.

Ring or ball fracture will not occure under these loads nor will the ball be pushed out of the outer ring.



Dynamic Radial load ratings

Dynamic radial load ratings are shown in the dimensional tables.

The test conditions and admissible wear rates are specified in the standards EN 2064, EN 2755 and MIL-B-81 820.

In fact the actual results achieved with FRASLIP lined bearings are much better and are illustrated in table A.

It must be pointed out that the wear tests laid down in EN 2064, EN 2755 and MIL-B-81 820 above serve as a basis for comparing the performance of lined bearings under equal test conditions.

In aircraft service we rarely encounter applications which are equal or similar to these test conditions (unidirectional loads). The real loads encountered are in fact often combined loads, shock loads, sinusoidal or square wave loads with simultaneously occuring vibrations (see table B).

table A

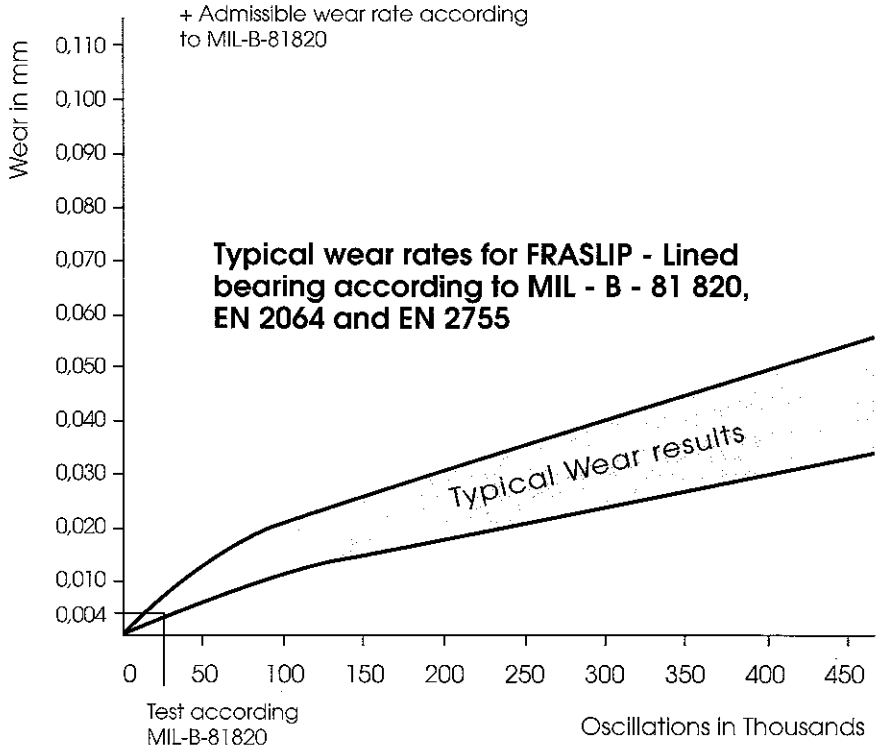


table B

	Typical load applications occuring in reality	
1	+Fr, 0, Time	steady load
2	+Fr, 0, Time	steady load with interfering oscillations by vibrations
3	+Fr, 0, Time	load applied in a sinusoidal manner
4	+Fr, 0, Time	shock load
5	+Fr, 0, -Fr, Time	Reversal load load applied in a sinusoidal manner
6	+Fr, 0, -Fr, Time	Reversal shock load

FRASLIP LINED BEARINGS

The essential factors affecting the life of FRASLIP lined bearings are as follows:

1. Type of load (see table B)
2. Total load, axial and radial
3. Number of stress cycles required
4. Temperature range
5. Angle of oscillation
6. Number of oscillating cycles required
7. Surface speed
8. Environment

The calculation of the life of FRASLIP lined bearings, taking into account all the above mentioned factors is not possible at present. On the other hand, in most cases RWG Frankenjura is able -based on its long experience- to give assistance in selecting a suitable bearing for a specific application.

In each critical application, i.e. vital parts with extreme loads, a close-to-reality qualification test of the bearings should be carried out.

In practice, experience has shown specific loads of between 105 and 125 MPa to be acceptable in loading conditions 2, 3 and 4-ignoring dispersion and safety factors. This corresponds to a conversion factor of 0,60 to 0,75 for the dynamic ratings given in the corresponding tables.

Recommended tolerances on mating parts:

Mounting fits

metric size		inch size	
housing	shaft	housing	shaft
J 6	h 6	$^{+8}_{-5}$ µm	g 6

With loading conditions 5 and 6, these ratings have to be further reduced. In these cases there are special problems concerning the limitation of the clearance and the determination of the failure criteria.

In the case of high surface velocities, deviating largely from the figures given in EN 2064, EN 2755 and MIL-B-81 820, special attention should be given to the establishing if this stress is continuous or intermittent.

Where stress of this type is applied only for short periods relative to the stationary periods, the influence of high surface velocity on life is insignificant. Continuous high surface velocity leads to excessive heat build up with consequent higher wear rates.

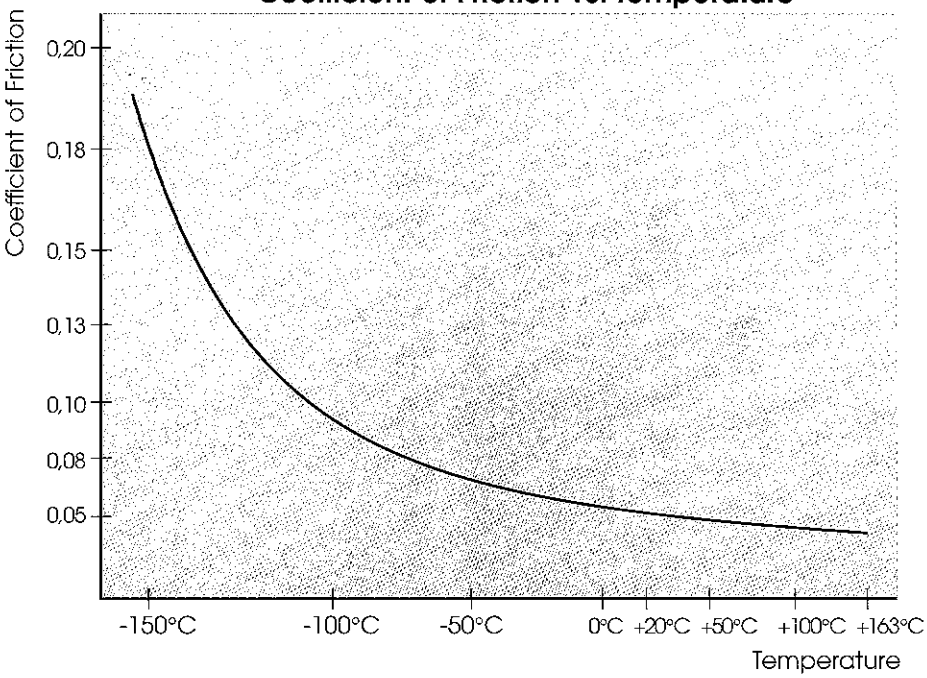
The starting torque rate at 20°C can double at -50°C.

The concept of installation is the same as shown in the table referring to metal-to-metal spherical bearings.

In cases of special mounting problems please contact RWG Frankenjura engineering section.

table C

Coefficient of Friction vs. Temperature



Journal series

FRASLIP lined journal bearings are used for slow rotational, oscillatory or linear motions.

They are produced in metric and inch sizes. The applicable specification for metric series is EN 2311 and for inch series MIL-B-81934. There are two different designs:

- Plain journal bearings
- Flanged journal bearings.

Plain journal bearings will not support axial loads. Flanged journal bearings support axial as well as radial loads. Bearings are manufactured in either aluminium alloy anodised or stainless steel passivated or cadmium plated, corresponding to the dimensional tables.

The bore is lined with FRASLIP, i.e. there is no need for lubrication.

The flange type also has FRASLIP on the face of the flange. The outer surface is finished to 0,8 µm Ra. In order to obtain trouble free service and a long life, the following precautions should be taken:

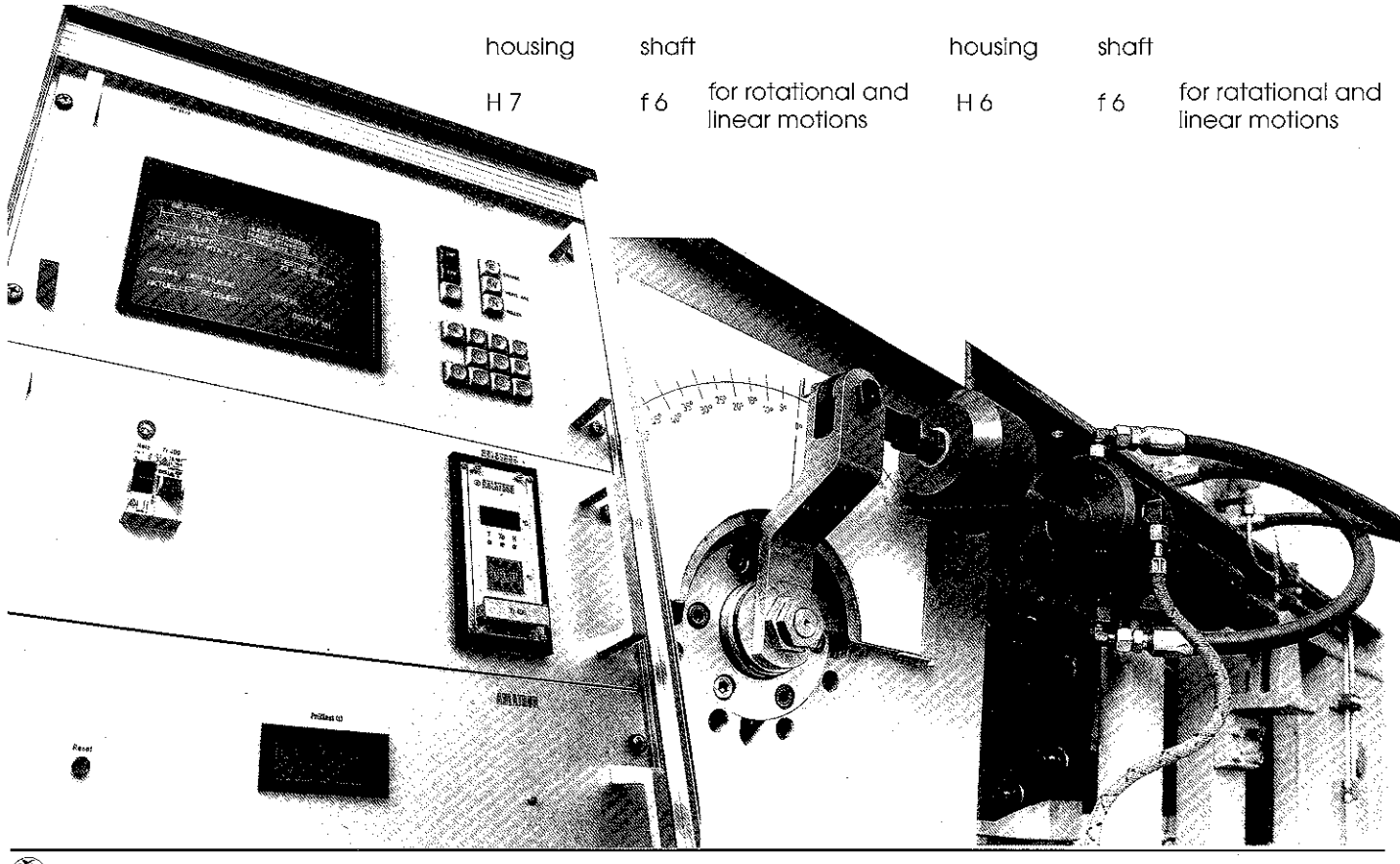
- Bearing and shaft alignment should be ensured to eliminate edge loading in the bearing.
- The admissible static and dynamic load ratings must be observed.
- Shaft hardness should be 50 HRc min. and shaft surface finish has to be 0,4 µm Ra max.
- Temperature range from -55°C to +163°C.
- The journal bearings are inert to all solid and liquid contaminants specified in EN 2311 and MIL-B-81934.

The recommended tolerances on mating parts for journal type bearings are as follows.

Hydraulic tools are recommended for fitting journal bearings to their housing. Misalignment, with consequent edge loading, must be avoided. Impact tools should not be used. When mounting shafts, the shaft end has to be round or tapered to avoid damage to the thin liner. To prevent corrosion shaft material should be stainless steel or other corrosion resistant material. Steel alloy shafts should be chrome plated or treated otherwise.

Mounting fits

metric size			inch size		
housing	shaft		housing	shaft	
H 7	f 6	for rotational and linear motions	H 6	f 6	for rotational and linear motions

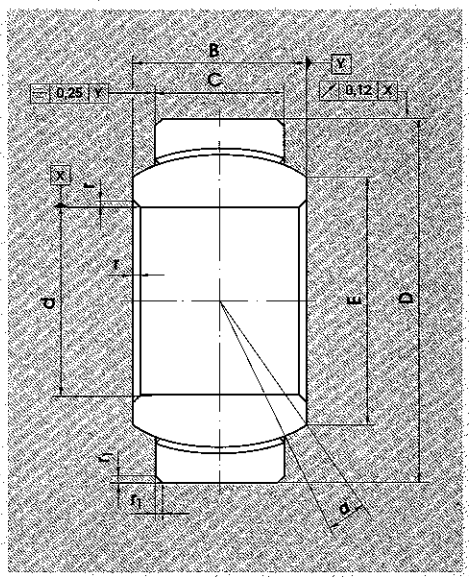


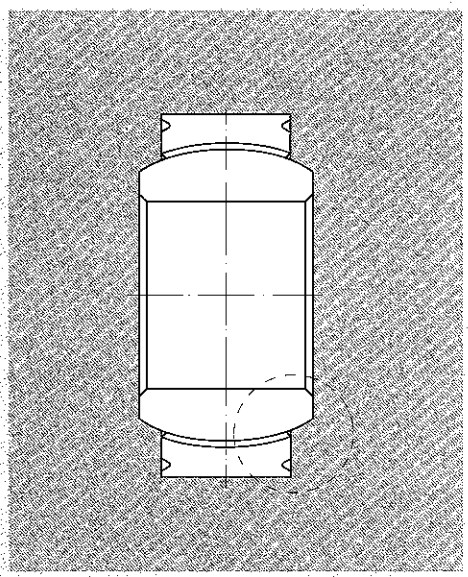
SPHERICAL BEARINGS

Corrosion resisting steel FRASLIP lined.

Series: **FRA...**
Material
Outer ring: EN 2539 (1.4548.3)
Inner ring: EN 2030 (1.3544.9) Chromium plated
Liner: PTFE

Series: **FRA...R**
Material
Outer ring: EN 2539 (1.4548.3)
Inner ring: EN 2030 (1.3544.9) Chromium plated
Liner: PTFE





With swaging grooves - Code R

Bearing Number		d		D		B		C		E	r	r_1	A		P	R
			Δdmp µm		ΔDmp µm		ΔBmp µm		ΔCmp µm	min.				ΔAmp µm		
FRA 12	FRA 12 R	12		22		10		7		14,3			20,2			
FRA 15/26	FRA 15/26 R	15	0	26	0	12		9		18,7		0,5	24,2		0,5	0,2
FRA 15	FRA 15 R	15	-8	28	-9	12		9		18,7	0,5	to	26,2		to	to
FRA 17/30	FRA 17/30 R	17		30		14		10		21,2	to	1,2	28,2		0,7	0,3
FRA 17	FRA 17 R	17		32		14		10		21,2	0,8		30,2			
FRA 20	FRA 20 R	20	0	35	0	16	0	12	±100	24,9		0,6	33,2	0		
FRA 25	FRA 25 R	25	-10	42	-11	20	-60	16		30,0		to	39,4	+100	0,7 to	
FRA 30	FRA 30 R	30		47		22		18		34,3		1,5	44,4		0,9	0,3
FRA 35	FRA 35 R	35		55		25		20		40,5			51,8			to
FRA 40	FRA 40 R	40	0	62	0	28		22		45,0	0,6	0,8	58,8		1,2	0,4
FRA 45	FRA 45 R	45	-12	68	-13	32		25		51,3	to	to	64,8		to	
FRA 50	FRA 50 R	50		75		35		28		58,2	1,0	1,7	71,8		1,4	

Procurement Specification EN 2755

Designation

Each bearing is designated as in the following example:

FRA 12 R P

Series designation
12 = Bore number
R = with mounting grooves
P = chromium plated ball