

UNIVERSAL SHAFTS



CONTENTS

ENGINEERING AND MANUFACTURING	page 3
ENGINEERING DATA – SERIES A	page 4/5
ENGINEERING DATA – SERIES B	page 6/7
ENGINEERING DATA – SERIES C	page 8/9
ENGINEERING DATA – SERIES D – SERIES G	page 10/11
ENGINEERING DATA – SERIES F – SERIES J	page 12/13
ENGINEERING DATA – SERIES E – SERIES H	page 14/15
COMPANION FLANGES WITH INNER CENTERING	page 16/17
COMPANION FLANGES WITH OUTER CENTERING	page 18/19
CYLINDRICAL COMPANION FLANGES WITH INNER CENTERING	page 20/21
CYLINDRICAL COMPANION FLANGES WITH OUTER CENTERING	page 22/23
BORE DESIGNS	page 24
ENGINEERING DATA – SPECIAL AND EXTRA LARGE FLANGES	page 25
ENGINEERING DATA – HIRTH SERRATION	page 26
ENGINEERING DATA – DOG TEETH	page 27
ENGINEERING DATA – FLANGE BOLTING	page 28
ENGINEERING DATA – JOURNAL CROSS ASSEMBLIES	page 29
DESIGN VARIATIONS	page 30/31
OPERATING PRINCIPLES	page 32
SIZE SELECTION	page 33/38
ENGINEERING DATA – WEIGHTS	page 39
ENGINEERING DATA – MASS MOMENTS OF INERTIA	page 40
UNIVERSAL SHAFT IDENTIFICATION	page 41
COMPANION FLANGES IDENTIFICATION	page 42
INSTALLATION, MAINTENANCE AND LUBRICATION	page 43/45
SPARE PARTS IDENTIFICATION	page 46/47
TECHNICAL DATA FOR SELECTION	page 48/49

The present catalogue relates to MAINA's present production of Universal shafts, and provides a description of their technical specification in order for a proper selection to be made.

By the way, our engineers are always at your disposal to make suggestions for your choice and provide with you any further information requested.

The present edition supersedes all previous editions.

MAINA RESERVE THE RIGHT TO CHANGE ANY TECHNICAL SPECIFICATION CONTAINED HEREIN, WITHOUT NOTICE.

Any reproduction, even partial, of the present catalogue violates the copyright and will therefore be prosecuted.

PUBLISHED BY MAINA S.P.A.

PRINTED IN ITALY BY CAST

© COPYRIGHT 2003

ENGINEERING AND MANUFACTURING

MAINA PATTERN IS GUARANTEED BY:

Design and experience with have made in cooperation with all the industrial plants maintenance managers. This has led to manufacture the monolithic yoke design. All our universal shafts have been designed and developed by MAINA technical department. Our skilled engineers can also propose and project very special solutions, able to fit the customers' requirements, yet maintaining the basis project features.

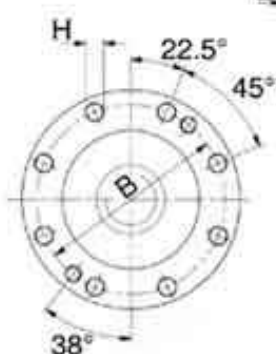
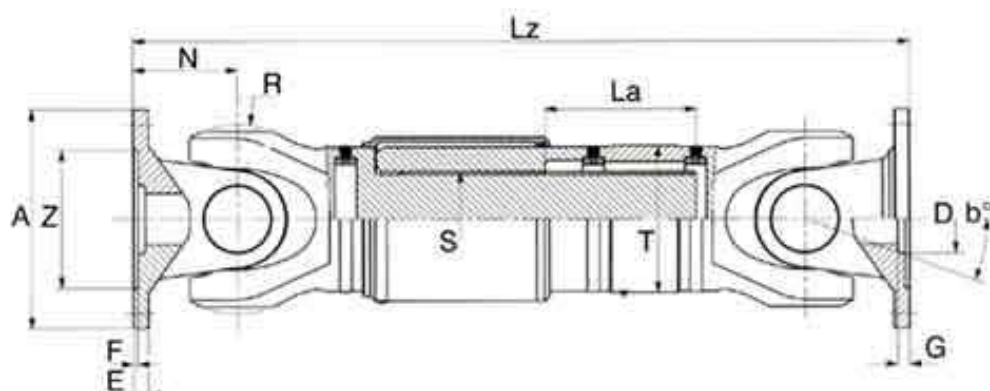


SERIES A

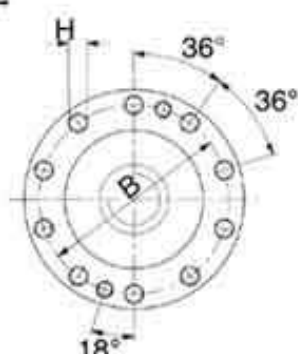
ENGINEERING DATA

TYPE

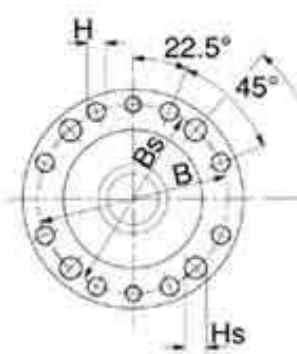
AA



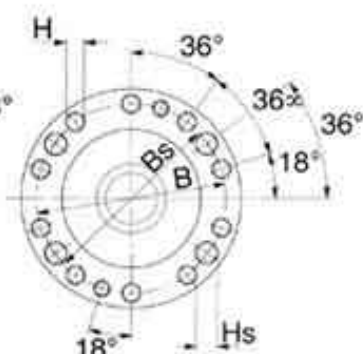
SIZE 18 - 28
8 HOLES



SIZE 31 - 39
10 HOLES



SIZE 18 - 28
8 HOLES



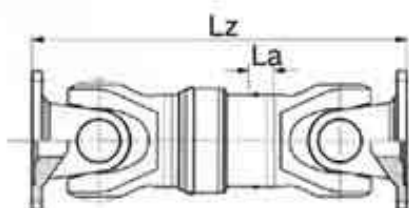
SIZE 31 - 39
10 HOLES

STANDARD FLANGE CONNECTION

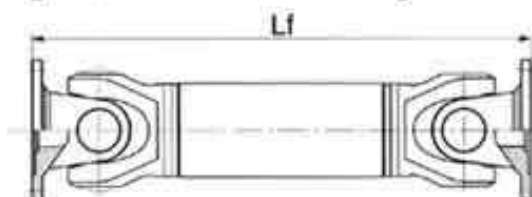
DOWEL PIN CONNECTION ACCORDING
TO DIN 15451

TYPE

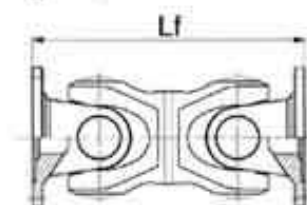
AB



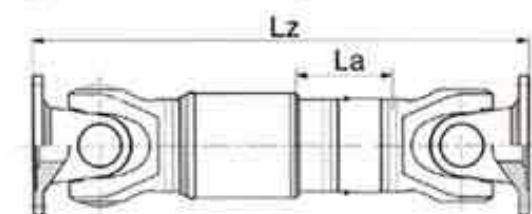
AC



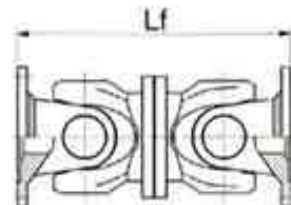
AD



AE



AH



ENGINEERING DATA

SERIES A

TYPE

AA - Telescopic Shaft, medium length compensation
 AB - Telescopic Shaft, short length compensation, short design
 AC - Fixed length Shaft, tubular design

AD - Fixed length Shaft, short design
 AE - Telescopic Shaft, long length compensation
 AH - Fixed length Shaft, flanged short design

TABLE 1

SIZE		18	22	25	28	31	35	39
RATING TORQUES								
⊗ Mk	[kNm]	21	40	48	71	103	146	196
⊗ MoSch	[kNm]	15	26	38	58	85	116	156
⊗ MoW	[kNm]	10	18	24	37	54	76	103
STANDARD DIMENSIONS								
A ①	[mm]	225	250	285	315	350	380	435
b*	<	15	15	15	15	15	15	15
B ⊕	[mm]	198	218	245	280	310	345	385
Bs	[mm]	192	214	240	270	300	340	378
Z (H7)	[mm]	140	140	175	175	220	250	280
F	[mm]	5	6	7	7	8	8	8
E	[mm]	15	18	20	22	25	32	32
H (C12)	[mm]	16	18	20	22	22	24	27
Hs (H12)	[mm]	21	25	28	30	32	32	35
G	[mm]	15	15	15	16	16	18	20
D	[mm]	80	90	90	110	115	140	155
R	[mm]	180	225	250	285	315	350	390
N	[mm]	110	120	140	160	180	195	210
S DIN 5480		90x3	110x3	130x4	140x4	180x5	190x5	210x6
T	[mm]	139.7	152.4	177.8	203	254	298.5	323.9
LENGTH / LENGTH COMPENSATION								
AA	Lz min	[mm]	795	855	985	1080	1235	1495
	La std	[mm]	140	145	150	155	160	180
	Lz max	[mm]	1205	1310	1485	1625	1875	2315
	La max	[mm]	550	600	650	700	800	1000
AB	Lz min	[mm]	615	685	795	900	1045	1350
	La std	[mm]	40	50	50	60	65	70
AC	Lf	[mm]	495	535	615	695	780	930
	Lf max	[mm]	1205	1310	1485	1625	1875	2315
	Lf lim	[mm]	3280	4000	4720	5020	5740	7170
AD	Lf	[mm]	440	480	560	640	720	840
AE	Lz min	[mm]	985	1050	1180	1295	1495	1775
	La std	[mm]	280	290	300	310	320	360
	Lz max	[mm]	1505	1610	1880	2085	2375	2915
	La max	[mm]	800	850	1000	1100	1200	1500
	Lz lim	[mm]	3280	4000	4720	5020	5740	7170
AH	Lf	[mm]	440	480	560	640	720	840

Lz min = shortest length corresponding to La std
 La std = standard length compensation
 Lz max = shortest length corresponding to La max
 La max = maximum length compensation
 Lz lim = maximum length of universal shaft
 When $Lz \neq Lz \text{ min}$, then $Lz = Lz \text{ min} + (La - La \text{ std})$

Lf = fixed length
 Lf min = minimum fixed length
 Lf max = maximum fixed length with standard tube
 Lf lim = maximum fixed length of universal shaft

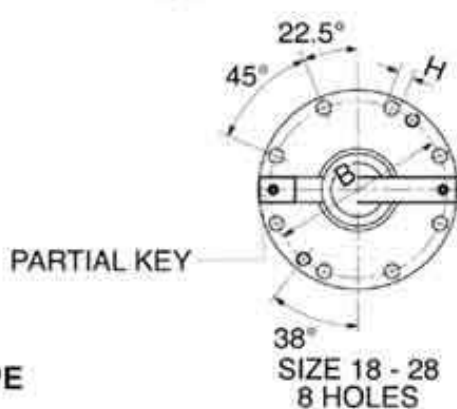
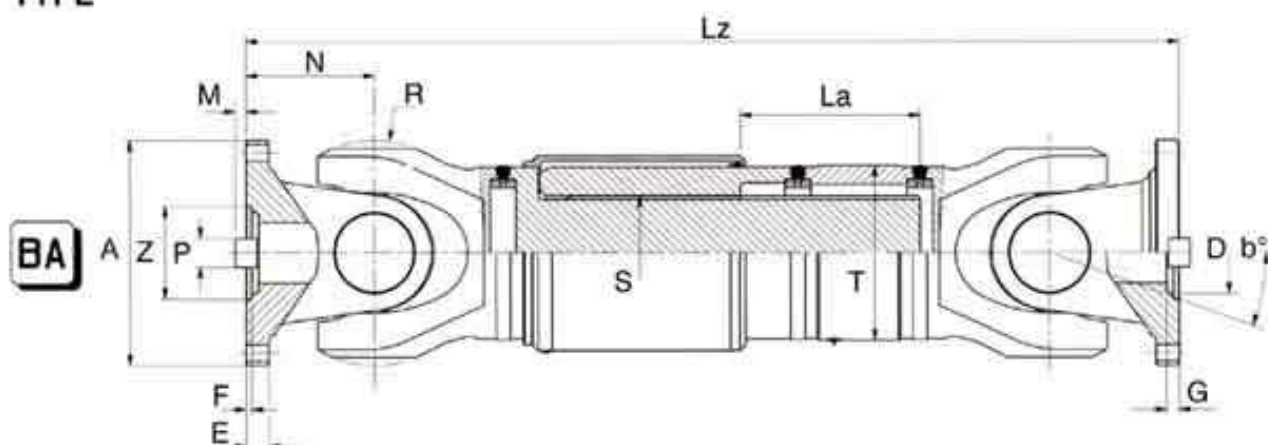
(1) When required tolerance h7
 (2) Tolerance $\pm 0.1 \text{ mm}$
 (*) Torque transmission capacity is restricted by state and type of flange connection.

Lz max, Lz lim, Lf max, Lf lim valid if max allowable speed or torsional stiffness do not create any problem.

SERIES B

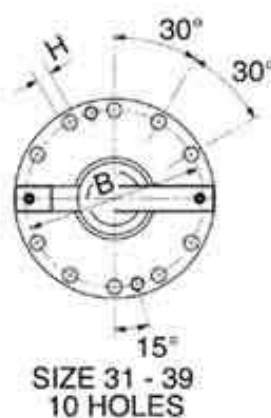
ENGINEERING DATA

TYPE



PARTIAL KEY

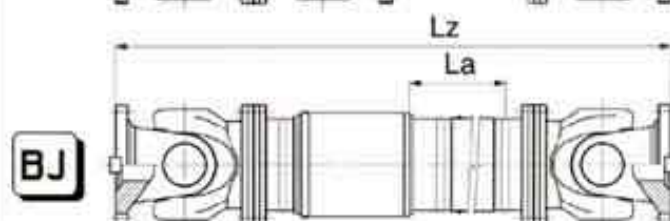
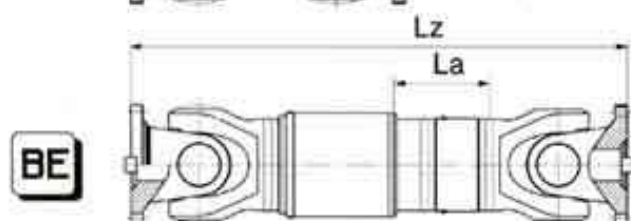
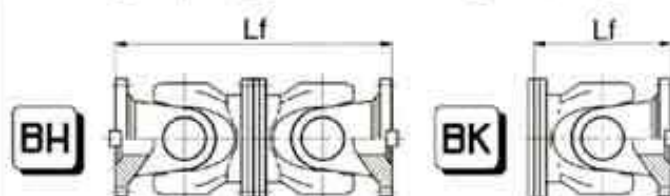
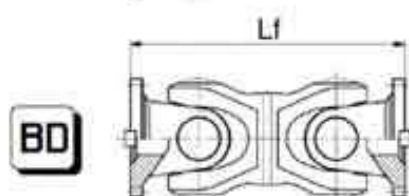
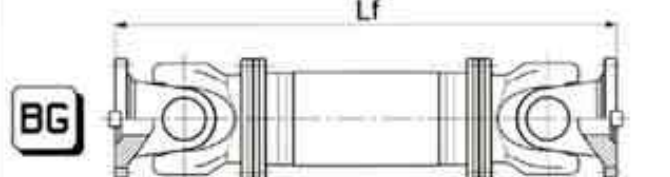
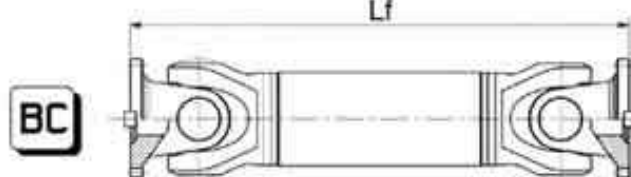
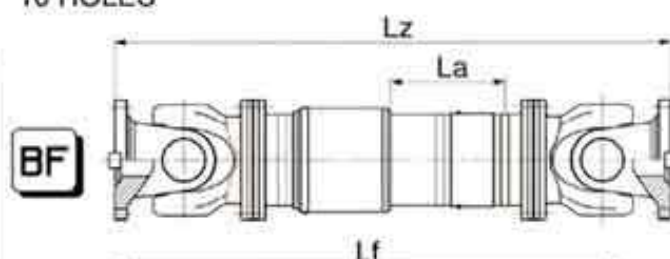
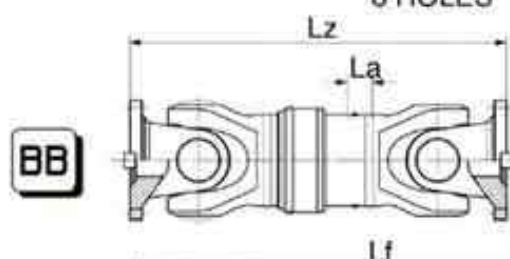
SIZE 18 - 28
8 HOLES



INTEGRAL KEY

SIZE 44 - 62
16 HOLES

TYPE



ENGINEERING DATA

SERIES B

TYPE

- BA** - Telescopic Shaft, medium length compensation
- BB** - Telescopic Shaft, short design
- BC** - Fixed length Shaft, tubular design
- BD** - Fixed length Shaft, short design
- BE** - Telescopic Shaft, long length compensation or high torsional stiffness or special arrangement

TYPE

- BF** - Telescopic Shaft, medium length compensation (flanged intermediate assembly)
- BG** - Fixed length Shaft, flanged tubular design
- BH** - Fixed length Shaft, flanged short design
- BJ** - Telescopic Shaft, long length compensation or high torsional stiffness or special arrangement (flanged intermediate assembly)
- BK** - Flanged Joint

TABLE 2

SIZE		18	22	25	28	31	35	39	44	49	55	62
RATING TORQUES												
M_k	[kNm]	28	56	82	119	167	227	302	522	647	1031	1350
M_{Dsch}	[kNm]	19	37	58	85	120	163	224	400	496	800	1150
M_{ow}	[kNm]	12	24	37	54	76	106	146	262	321	516	760
STANDARD DIMENSIONS												
A (1)	[mm]	180	225	250	285	315	350	390	440	490	550	620
b*	[mm]	15	15	15	15	15	15	15	15	15	15	15
B (2)	[mm]	155.5	196	218	245	280	310	345	385	425	492	555
Z (H7)	[mm]	90	105	105	125	130	155	170	190	205	250	280
P (h9)	[mm]	25	32	40	40	40	50	70	80	90	100	110
M	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5	27.5
F	[mm]	5	5	6	7	8	8	8	10	12	12	15
E	[mm]	17	20	25	27	32	35	40	42	47	50	55
H	[mm]	17	17	19	21	23	23	25	28	31	31	37
G	[mm]	15	15	15	16	16	18	20	25	30	30	35
D	[mm]	80	90	90	110	115	140	155	150	160	190	220
R	[mm]	180	225	250	285	315	350	390	440	490	550	620
N	[mm]	110	120	140	160	180	195	210	260	270	305	340
S DIN 5480 (3)		90x3	110x3	130x4	140x4	180x5	190x5	210x6	220x6	250x6	280x8	320x8
T	[mm]	139.7	152.4	177.8	203	254	298.5	323.9	355.6	368	419	457.2
LENGTH / LENGTH COMPENSATION												
BA	L_z min	[mm]	795	855	985	1080	1235	1350	1495	1680	1760	2250
	L_a std	[mm]	140	145	150	155	160	170	180	190	200	230
	L_z max	[mm]	1205	1310	1485	1625	1875	2080	2315	2590	2810	3570
	L_a max	[mm]	550	600	650	700	800	900	1000	1100	1250	1550
BB	L_z min	[mm]	615	685	795	900	1045	1175	1350	1470	1550	1960
	L_a std	[mm]	40	50	50	60	65	70	70	70	80	80
BC	L_f	[mm]	495	535	615	695	780	835	930	1140	1205	1530
	L_f max	[mm]	1205	1310	1485	1625	1875	2080	2315	2590	2810	3550
	L_f lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	11300
BD	L_f	[mm]	440	480	560	640	720	780	840	1040	1080	1360
BE	L_z min	[mm]	985	1050	1180	1295	1495	1620	1775	1985	2085	2620
	L_a std	[mm]	280	290	300	310	320	340	360	380	400	460
	L_z max	[mm]	1505	1610	1880	2085	2375	2680	2915	3255	3585	4410
	L_a max	[mm]	800	850	1000	1100	1200	1400	1500	1650	1900	2250
	L_z lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	11300
BF	L_z min	[mm]	970	1000	1130	1340	1585	1690	1850	2075	2200	2750
	L_a std	[mm]	140	145	150	155	160	170	180	190	200	230
	L_z max	[mm]	1380	1455	1630	1885	2225	2420	2670	2985	3250	4070
	L_a max	[mm]	550	600	650	700	800	900	1000	1100	1250	1550
BG	L_f	[mm]	715	730	800	950	1140	1225	1350	1660	1745	2050
	L_f max	[mm]	1380	1455	1630	1885	2225	2420	2670	2985	3250	4050
	L_f lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	11300
BH	L_f	[mm]	440	480	560	640	720	780	840	1040	1080	1360
BJ	L_z min	[mm]	1160	1195	1325	1555	1845	1960	2130	2380	2525	3120
	L_a std	[mm]	280	290	300	310	320	340	360	380	400	460
	L_z max	[mm]	1680	1755	2025	2345	2725	3020	3270	3650	4025	4910
	L_a max	[mm]	800	850	1000	1100	1200	1400	1500	1650	1900	2250
	L_z lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	11300
BK	L_f	[mm]	220	240	280	320	360	390	420	520	540	680

L_z min = shortest length corresponding to **L_a std**
L_a std = standard length compensation
L_z max = shortest length corresponding to **L_a max**
L_a max = maximum length compensation
L_z lim = maximum length of universal shaft
 When **L_z = L_z min**, then **L_z = L_z min + (L_a - L_a std)**

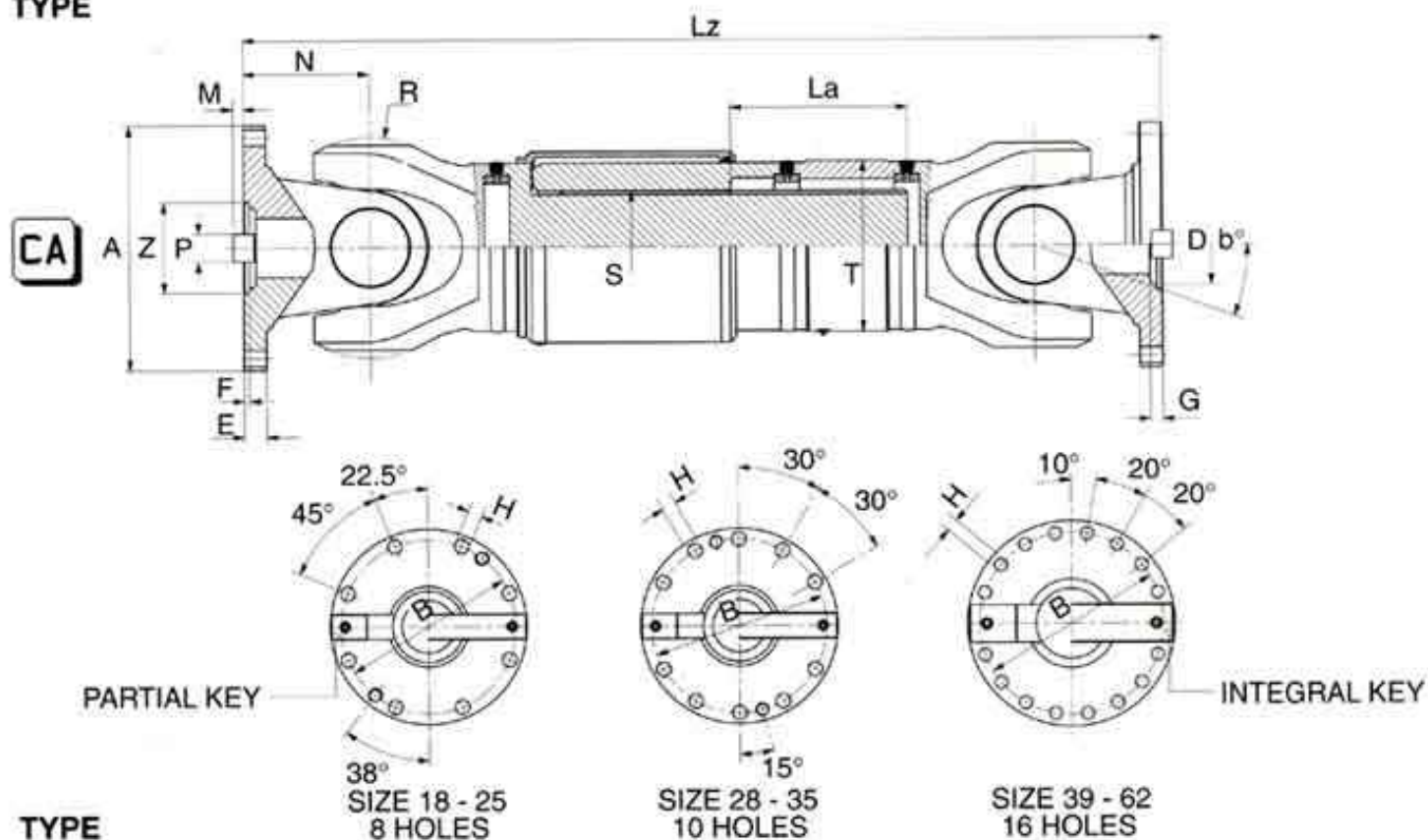
L_f = fixed length
L_f min = minimum fixed length
L_f max = maximum fixed length with standard tube
L_f lim = maximum fixed length of universal shaft
L_z max, L_z lim, L_f max, L_f lim valid if max allowable speed or torsional stiffness do not create any problem.

- (1) When required tolerance **h7**
- (2) Tolerance ± 0.1 mm
- (3) Male and female spined shaft nitrided on request

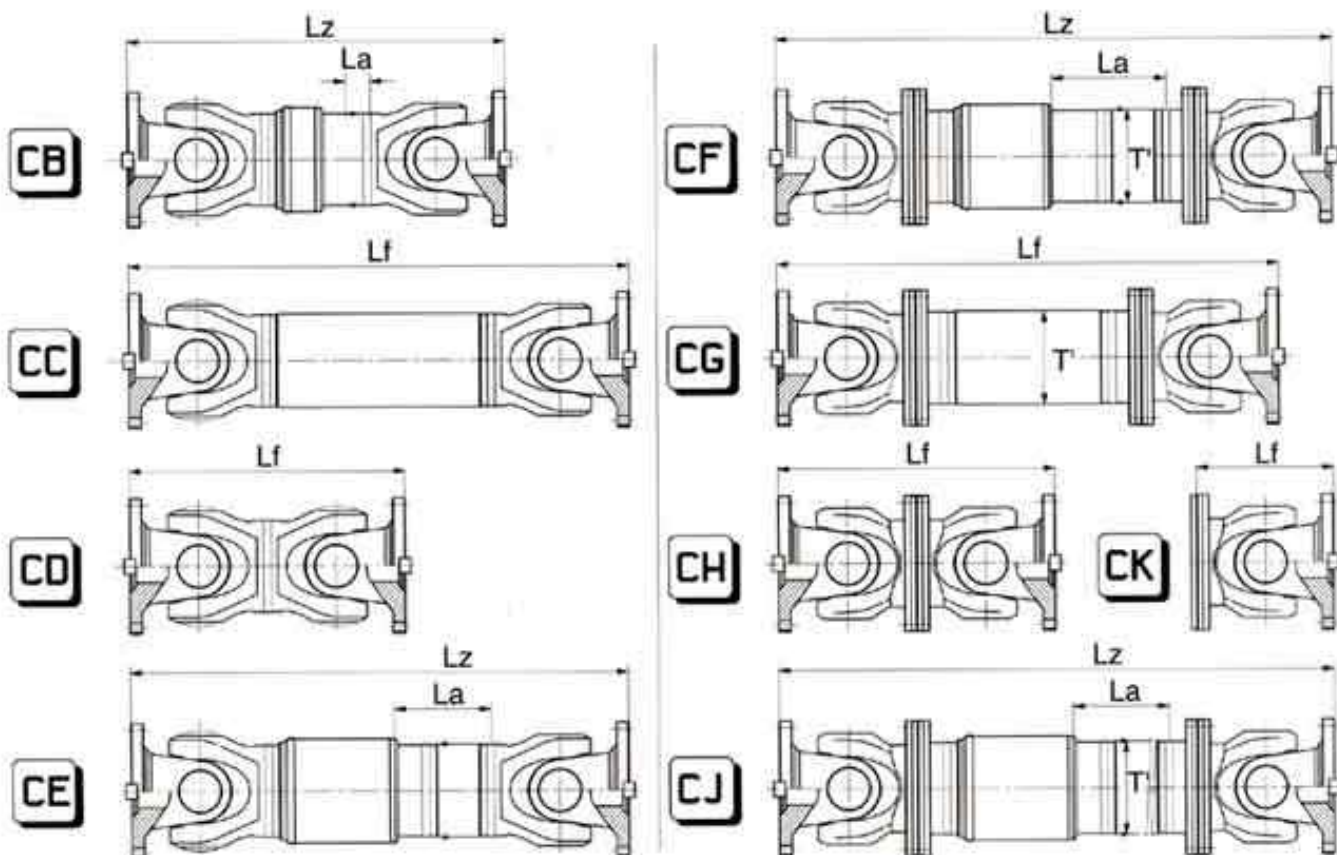
SERIES C

ENGINEERING DATA

TYPE



TYPE



ENGINEERING DATA

SERIES C

TYPE

- CA** - Telescopic Shaft, medium length compensation
CB - Telescopic Shaft, short design
CC - Fixed length Shaft, tubular design
CD - Fixed length Shaft, short design
CE - Telescopic Shaft, long length compensation
 or high torsional stiffness or special arrangement

TYPE

- CF** - Telescopic Shaft, medium length compensation
 (flanged intermediate assembly)
CG - Fixed length Shaft, flanged tubular design
CH - Fixed length Shaft, flanged short design
CJ - Telescopic Shaft, long length compensation or high torsional
 stiffness or special arrangement (flanged intermediate assembly)
CK - Flanged Joint

TABLE 3

SIZE		18	22	25	28	31	35	39	44	49	55	62
RATING TORQUES												
M_k	[kNm]	28	56	82	119	167	227	302	522	647	1031	1350
M_{PSch}	[kNm]	19	37	58	85	120	163	224	400	496	800	1150
M_{OW}	[kNm]	12	24	37	54	76	106	146	262	321	518	760
STANDARD DIMENSIONS												
A (1)	[mm]	225	250	285	315	350	390	440	490	550	600	680
b*	[mm]	15	15	15	15	15	15	15	15	15	15	15
B (2)	[mm]	196	218	245	280	310	345	385	425	492	544	615
Z (H7)	[mm]	140	140	175	175	220	250	280	320	380	450	450
P (H9)	[mm]	32	40	40	40	50	70	80	90	100	100	110
M	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5	27.5
F	[mm]	5	6	7	7	8	8	8	10	12	15	15
E	[mm]	17	20	25	27	32	35	40	42	47	50	55
H	[mm]	17	19	21	23	23	25	28	31	31	34	37
G	[mm]	15	15	15	16	16	18	20	25	30	30	35
D	[mm]	80	90	90	110	115	140	155	150	160	190	220
R	[mm]	180	225	250	285	315	350	390	440	490	550	620
N	[mm]	110	120	140	160	180	195	210	260	270	305	340
S DIN 5480 (3)		90x3	110x3	130x4	140x4	160x5	190x5	210x6	220x6	250x6	280x8	320x8
T	[mm]	139.7	152.4	177.8	203	254	298.5	323.9	355.6	368	419	457.2
T'	[mm]	168.3	177.8	203	244.5	273	323.9	355.6	368	419	457.2	508
LENGTH / LENGTH COMPENSATION												
CA	Lz min	[mm]	795	855	985	1080	1235	1350	1495	1680	1760	1965
	La std	[mm]	140	145	150	155	160	170	180	190	200	210
	Lz max	[mm]	1206	1310	1485	1625	1875	2080	2315	2590	2810	3155
	La max	[mm]	550	600	650	700	800	900	1000	1100	1250	1400
CB	Lz min	[mm]	615	685	795	900	1045	1175	1350	1470	1550	1730
	La std	[mm]	40	50	50	60	65	70	70	70	80	80
CC	Lf	[mm]	495	535	615	695	780	835	930	1140	1205	1355
	Lf max	[mm]	1205	1310	1485	1625	1875	2080	2315	2590	2810	3155
	Lf lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	10040
CD	Lf	[mm]	440	480	560	640	720	780	840	1040	1080	1220
	Lz min	[mm]	985	1050	1180	1295	1495	1620	1775	1985	2085	2310
CE	La std	[mm]	280	290	300	310	320	340	360	380	400	460
	Lz max	[mm]	1505	1610	1880	2085	2375	2680	2915	3255	3585	3990
	La max	[mm]	800	850	1000	1100	1200	1400	1500	1650	1900	2100
	Lz lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	10040
	Lf	[mm]	970	1000	1130	1340	1585	1690	1850	2075	2200	2750
CF	La std	[mm]	140	145	150	155	160	170	180	190	200	210
	Lz max	[mm]	1380	1455	1630	1885	2225	2420	2670	2985	3250	3590
	La max	[mm]	550	600	650	700	800	900	1000	1100	1250	1400
	Lf	[mm]	715	730	800	950	1140	1225	1350	1660	1745	2050
CG	Lf max	[mm]	1380	1455	1630	1885	2225	2420	2670	2985	3250	3590
	Lf lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	10040
	Lf	[mm]	440	480	560	640	720	780	840	1040	1080	1220
CH	Lz min	[mm]	1160	1195	1325	1555	1845	1960	2130	2380	2525	2745
	La std	[mm]	280	290	300	310	320	340	360	380	400	460
	Lz max	[mm]	1680	1755	2025	2345	2725	3020	3270	3650	4025	4910
	La max	[mm]	800	850	1000	1100	1200	1400	1500	1650	1900	2100
	Lz lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	10040
CJ	Lf	[mm]	220	240	280	320	360	390	420	520	540	610
	Lf	[mm]	220	240	280	320	360	390	420	520	540	610

Lz min = shortest length corresponding to La std
 La std = standard length compensation
 Lz max = shortest length corresponding to La max
 La max = maximum length compensation
 Lz lim = maximum length of universal shaft
 When Lz ≠ Lz min, then Lz = Lz min + (La - La std)

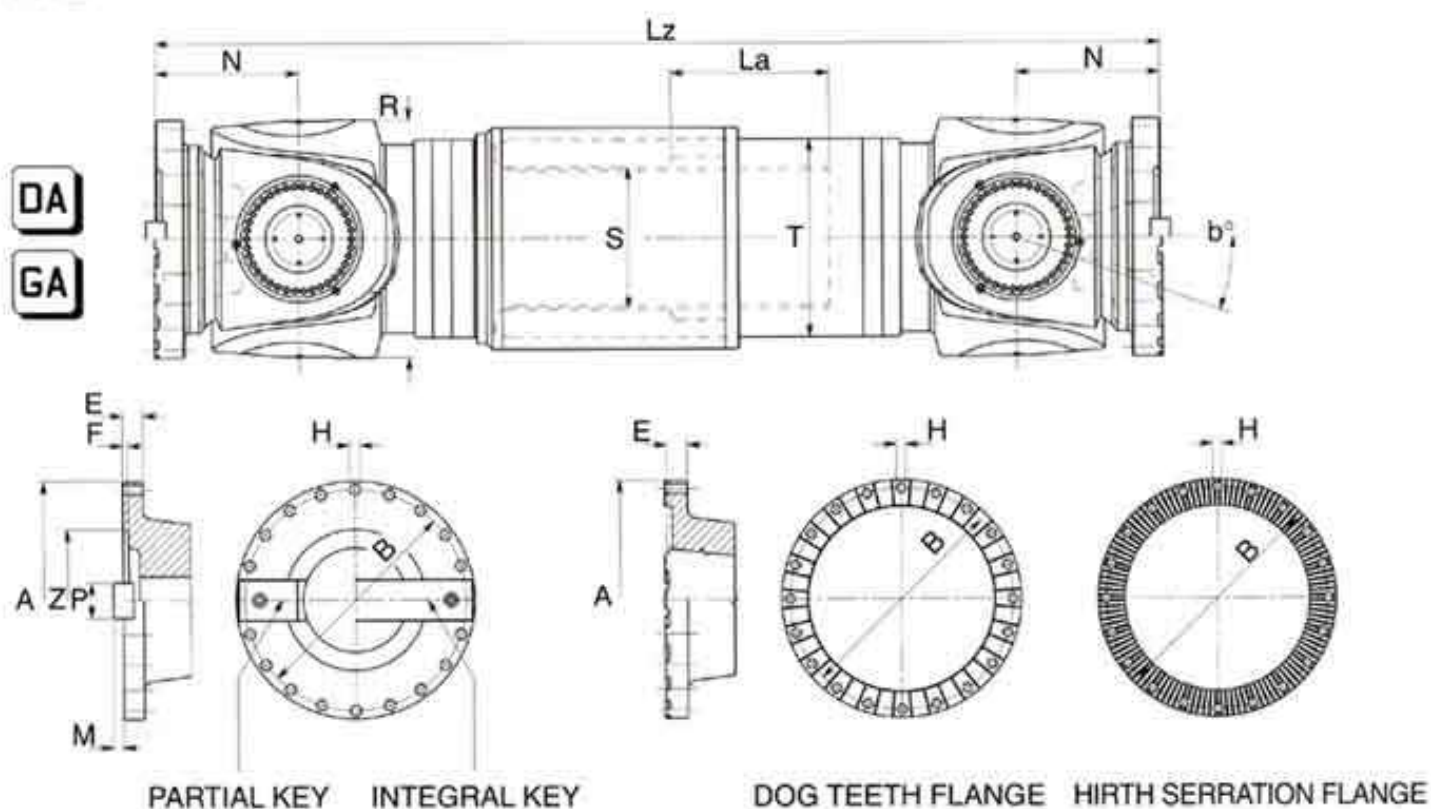
Lf = fixed length
 Lf min = minimum fixed length
 Lf max = maximum fixed length with standard tube
 Lf lim = maximum fixed length of universal shaft
 Lz max, Lz lim, Lf max, Lf lim valid if max allowable
 speed or torsional stiffness do not create any problem.

- (1) When required tolerance h7
 (2) Tolerance ± 0.1 mm
 (3) Male and female splined
 shaft nitrided on request.

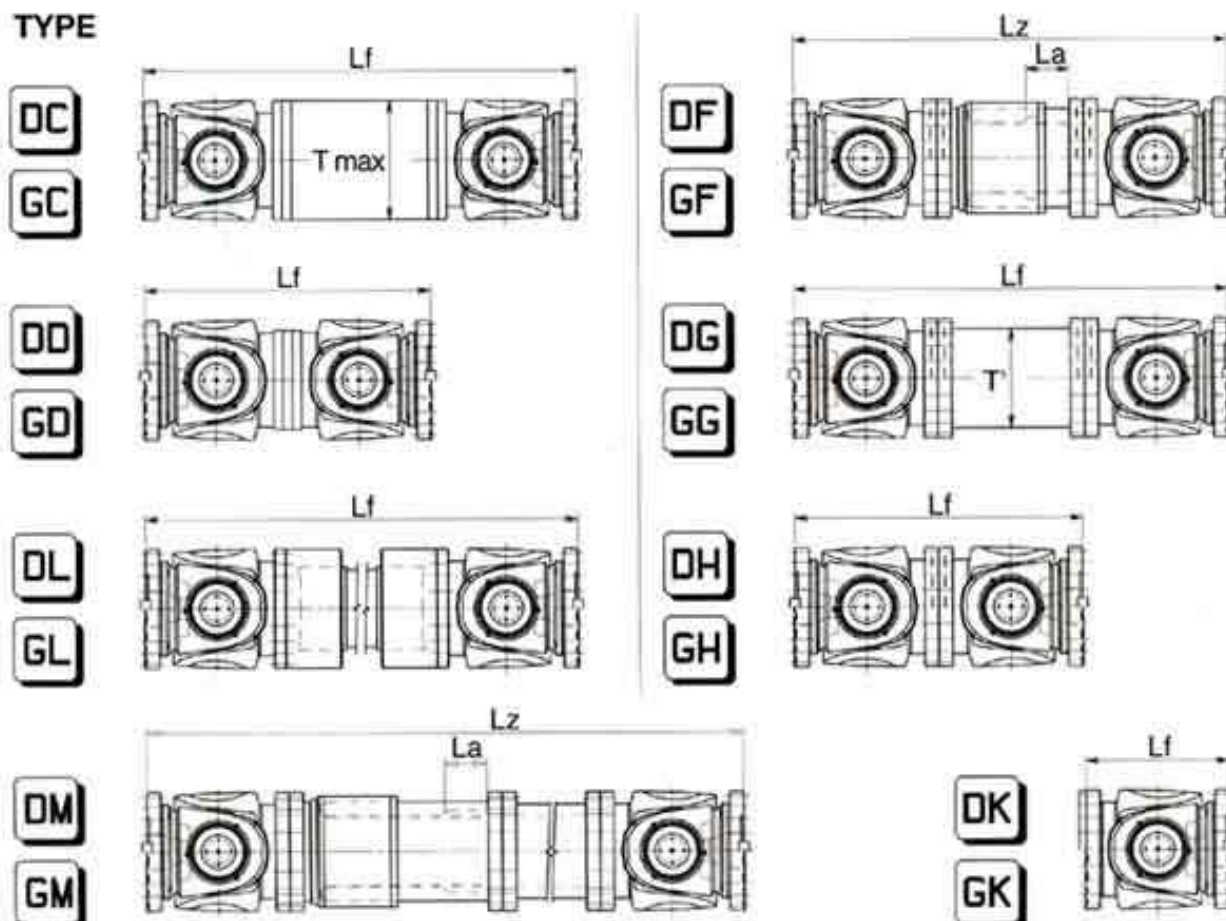
SERIES D - SERIES G

ENGINEERING DATA

TYPE



TYPE



ENGINEERING DATA

SERIES D - SERIES G

TYPE STANDARD FLANGES

- DA - Telescopic Shaft
- DC - Fixed length Shaft, tubular design
- DD - Fixed length Shaft, short design
- DL - Fixed length Shaft, intermediate shaft design
- DM - Telescopic Shaft, intermediate tubular design
- DF - Telescopic Shaft, flanged intermediate design
- DG - Fixed length Shaft, flanged tubular design
- DH - Fixed length Shaft, flanged short design
- DK - Flanged Joint

TYPE LARGER FLANGES

- GA - Telescopic Shaft
- GC - Fixed length Shaft, tubular design
- GD - Fixed length Shaft, short design
- GL - Fixed length Shaft, intermediate shaft design
- GM - Telescopic Shaft, intermediate tubular design
- GF - Telescopic Shaft, flanged intermediate design
- GG - Fixed length Shaft, flanged tubular design
- GH - Fixed length Shaft, flanged short design
- GK - Flanged Joint

TABLE 4

SIZE		60	65	70	75	80	85	90	95	100	105	110	115
RATING TORQUES													
Mk	[kNm]	1070	1310	1650	2040	2520	3010	3490	4170	4850	5530	6400	7370
Mosch	[kNm]	960	1180	1480	1830	2250	2740	3170	3800	4360	5070	5770	6610
Mow	[kNm]	660	815	1020	1260	1550	1890	2185	2620	3010	3495	3980	4560
STANDARD FLANGES SERIES D													
A	[mm]	600	650	700	750	800	850	900	950	1000	1050	1100	1150
b ^a	[mm]	10+15	10+15	10+15	10+15	10+15	10+15	10+15	10+15	10+15	10+15	10+15	10+15
B (1)	[mm]	544	595	645	690	740	775	825	875	915	965	1015	1050
Z (H7)	[mm]	380	400	420	450	470	500	530	560	590	620	650	680
P (H9)	[mm]	100	120	120	130	140	160	160	160	180	180	195	220
M	[mm]	27.5	30	30	32.5	35	37.5	40	42.5	45	47.5	50	52.5
F	[mm]	15	15	15	15	18	18	20	20	20	22	22	25
E	[mm]	70	75	80	85	90	95	100	105	110	115	120	125
H	[mm]	34	28	28	31	31	37	37	43	43	43	49	49
I (2)	[mm]	18	30	34	30	34	30	32	34	32	34	32	30
R	[mm]	600	650	700	750	800	850	900	950	1000	1050	1100	1150
N	[mm]	360	390	420	450	480	510	540	570	600	630	660	690
S	[mm]	360x8	400x8	440x10	480x10	530x12	570x12	610x14	650x14	690x16	740x16	780x18	830x18
T	[mm]	508	558.8	609.6	660.4	711.2	760	810	860	910	960	1010	1050
T*	[mm]	508	558.8	609.6	640	690	715	765	815	845	895	945	970
T MAX	[mm]	600	650	700	750	800	850	900	950	1000	1050	1100	1150
LARGER FLANGES SERIES G													
A	[mm]	650	700	750	800	850	900	950	1000	1050	1100	1150	1200
B (1)	[mm]	595	645	690	740	775	825	875	915	965	1015	1060	1100
Z (H7)	[mm]	400	420	450	470	500	530	560	590	620	650	680	710
P (H9)	[mm]	120	120	130	140	160	160	160	180	180	195	220	230
M	[mm]	30	30	32.5	35	37.5	40	42.5	45	47.5	50	52.5	55
F	[mm]	15	15	15	18	18	20	20	20	22	22	25	25
E	[mm]	75	80	85	90	95	100	105	110	115	120	125	130
H	[mm]	28	28	31	31	37	37	43	43	43	49	49	49
I (2)	[mm]	30	34	30	34	30	32	34	32	34	32	30	32
LENGTH / LENGTH COMPENSATION													
DA GA	Lz	[mm]	2420	2610	2800	2950	3140	3290	3480	3620	3810	3960	4130
	La	[mm]	300	300	350	350	400	400	450	450	500	500	550
DC GC	Lf	[mm]	1840	1780	1910	2050	2190	2320	2460	2600	2730	2870	3000
DD GD	Lf	[mm]	1440	1560	1680	1800	1920	2040	2160	2280	2400	2520	2640
DF GF	Lz	[mm]	2630	2840	3040	3200	3410	3570	3780	3940	4140	4310	4490
	La	[mm]	300	300	350	350	400	400	450	450	500	500	550
DG GG	Lf	[mm]	1850	2010	2150	2300	2460	2600	2760	2920	3060	3220	3360
DH GH	Lf	[mm]	1440	1560	1680	1800	1920	2040	2160	2280	2400	2520	2640
DK GK	Lf	[mm]	720	780	840	900	960	1020	1080	1140	1200	1260	1320
DL GL	Lf	[mm]	4640	5030	5420	5800	6190	6580	6960	7350	7740	8120	8500
DM GM	Lz	[mm]	3040	3290	3520	3710	3950	4140	4380	4580	4810	5010	5220
	La	[mm]	300	300	350	350	400	400	450	450	500	500	550

Lz = Shortest length

La = Length compensation

Lf = Shortest fixed length

Length dimensions (Lz and La) for reference only. Series D and G central body designed on request.

Please contact MAINA for selection of series D and G universal shafts.

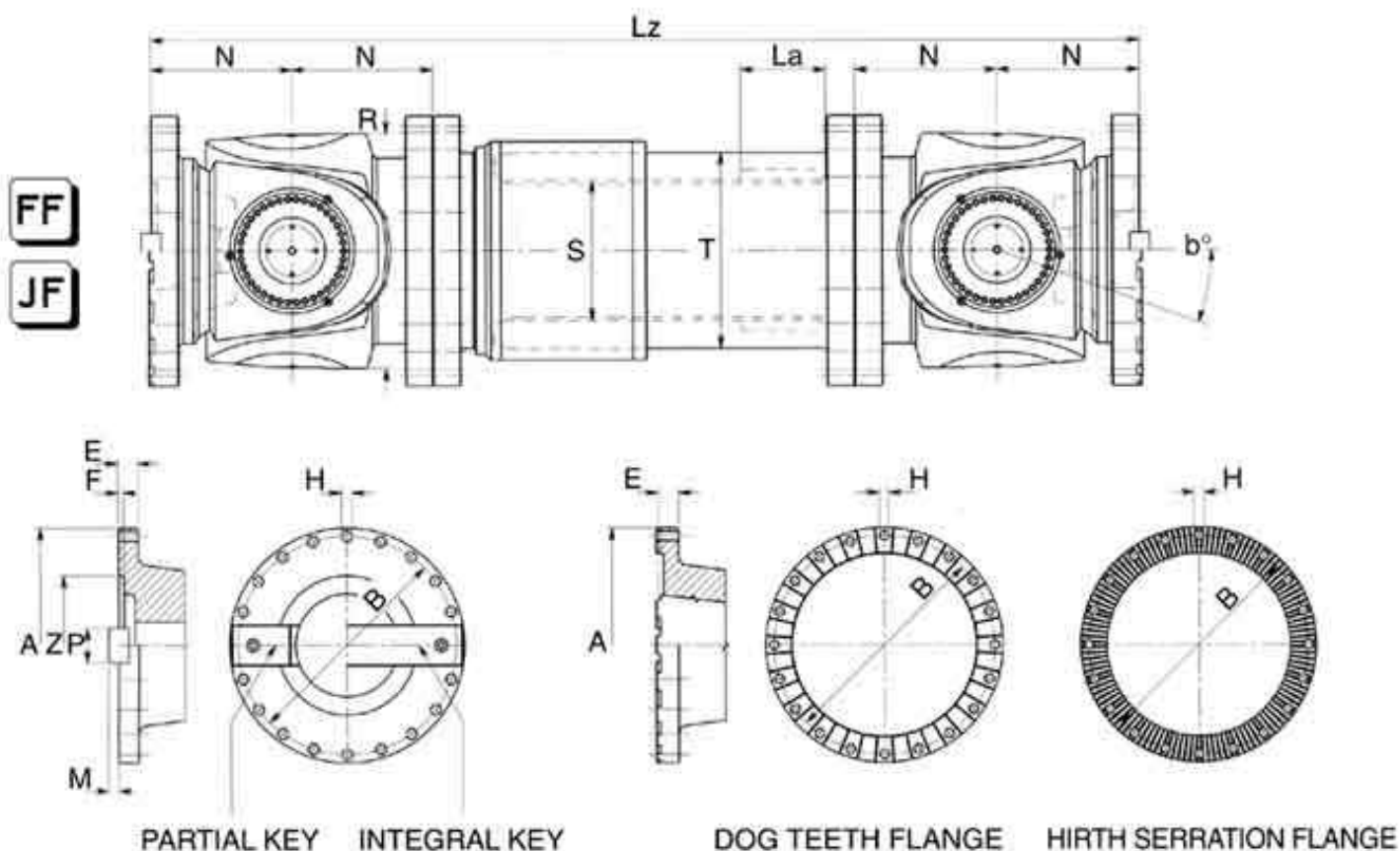
(1) Tolerance ± 0.1 mm

(2) i = number of holes

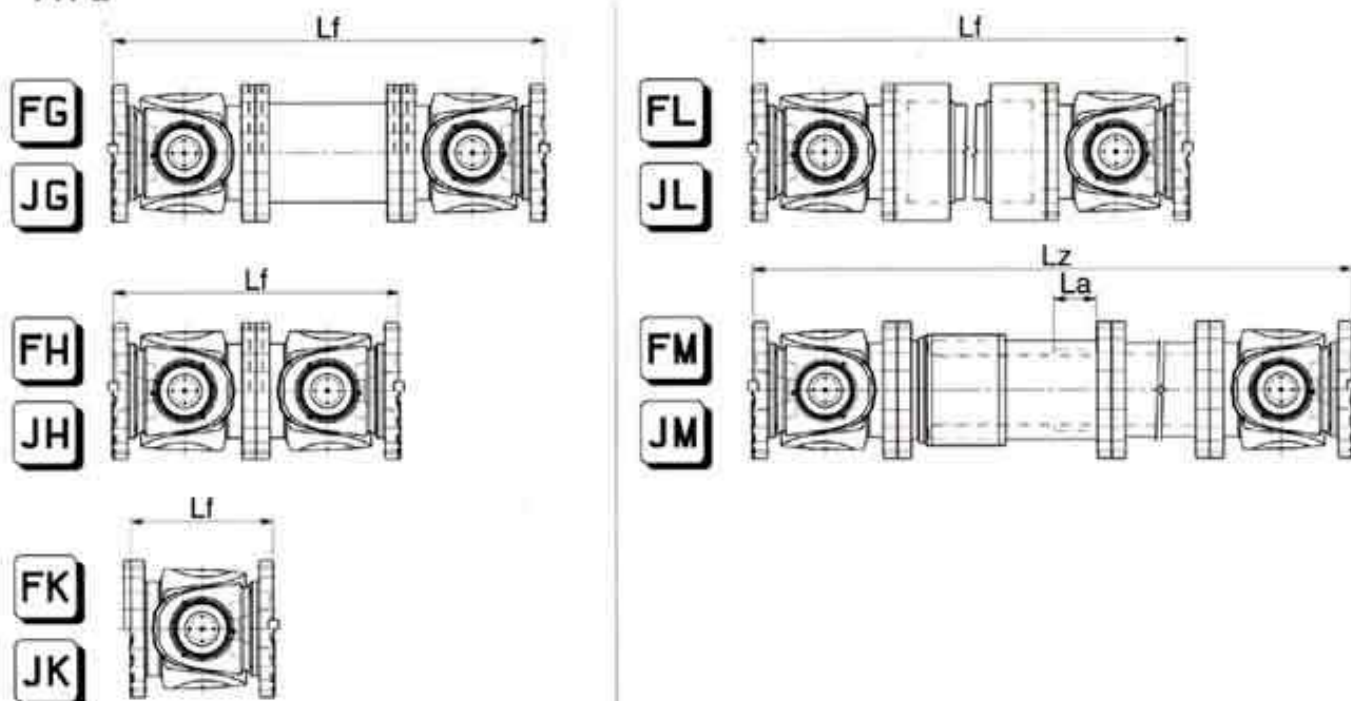
SERIES F - SERIES J

ENGINEERING DATA

TYPE



TYPE



ENGINEERING DATA
SERIES F - SERIES J
TYPE STANDARD FLANGES

- FF** - Telescopic Shaft, flanged intermediate design
FG - Fixed length Shaft, flanged tubular design
FH - Fixed length Shaft, flanged short design
FK - Flanged Joint
FL - Fixed length Shaft intermediate shaft design
FM - Telescopic Shaft intermediate tubular design

TYPE LARGER FLANGES

- JF** - Telescopic Shaft, flanged intermediate design
JG - Fixed length Shaft, flanged tubular design
JH - Fixed length Shaft, flanged short design
JK - Flanged Joint
JL - Fixed length Shaft, intermediate shaft design
JM - Telescopic Shaft, intermediate tubular design

TABLE 5

SIZE		60	65	70	75	80	85	90	95	100	105	110	115
RATING TORQUES													
M_k	[kNm]	1410	1750	2230	2720	3300	3980	4750	5530	6500	7470	8630	9900
M_{sch}	[kNm]	1270	1580	2015	2465	2990	3590	4290	4925	5910	6755	7735	8860
M_{tw}	[kNm]	875	1090	1390	1700	2080	2475	2960	3395	4075	4660	5335	6110
STANDARD FLANGES SERIES F													
A	[mm]	600	650	700	750	800	850	900	950	1000	1050	1100	1150
b*	<7	5+10	5+10	5+10	5+10	5+10	5+10	5+10	5+10	5+10	5+10	5+10	5+10
B (1)	[mm]	544	595	645	690	740	775	825	875	915	965	1015	1050
Z (H7)	[mm]	380	400	420	450	470	500	530	560	590	620	650	680
P (H9)	[mm]	100	120	120	130	140	160	160	160	180	180	195	220
M	[mm]	27.5	30	30	32.5	35	37.5	40	42.5	45	47.5	50	52.5
F	[mm]	15	15	15	15	18	18	20	20	20	22	22	25
E	[mm]	70	75	80	85	90	95	100	105	110	115	120	125
H	[mm]	34	28	28	31	31	37	37	37	43	43	43	49
I (2)		16	30	34	30	34	30	32	34	32	34	32	30
R	[mm]	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350
N	[mm]	360	390	420	450	480	510	540	570	600	630	660	690
S		400x8	440x10	480x10	530x12	570x12	610x14	650x14	690x16	740x16	780x18	830x18	870x18
T	[mm]	558.8	609.6	660.4	690	715	765	815	845	895	945	970	1020
LARGER FLANGES SERIES J													
A	[mm]	650	700	750	800	850	900	950	1000	1050	1100	1150	1200
B (1)	[mm]	595	645	690	740	775	825	875	915	965	1015	1050	1100
Z (H7)	[mm]	400	420	450	470	500	530	560	590	620	650	680	710
P (H9)	[mm]	120	120	130	140	160	160	160	180	180	195	220	230
M	[mm]	30	30	32.5	35	37.5	40	42.5	45	47.5	50	52.5	55
F	[mm]	15	15	15	18	18	20	20	20	22	22	25	25
E	[mm]	75	80	85	90	95	100	105	110	115	120	125	130
H	[mm]	28	28	31	31	37	37	37	43	43	43	49	49
I (2)		30	34	30	34	30	32	34	32	34	32	30	32
LENGTH/LENGTH COMPENSATION													
FF JF	L_z	[mm]	2630	2840	3040	3200	3410	3570	3780	3940	4140	4310	4490
	L_a	[mm]	300	300	350	350	400	400	450	450	500	500	550
FG JG	L_f	[mm]	1850	2010	2150	2300	2460	2600	2760	2920	3080	3220	3360
FH JH	L_f	[mm]	1440	1560	1680	1800	1920	2040	2160	2280	2400	2520	2640
FK JK	L_f	[mm]	720	780	840	900	960	1020	1080	1140	1200	1260	1320
FL JL	L_f	[mm]	4640	5030	5420	5800	6190	6580	6960	7350	7740	8120	8500
FM JM	L_z	[mm]	3040	3290	3520	3710	3950	4140	4380	4580	4810	5010	5220
	L_a	[mm]	300	300	350	350	400	400	450	450	500	500	550

L_z = shortest length

L_a = length compensation

L_f = shortest fixed length

Length dimensions (L_z and L_a) for reference only. Series F and J central body designed on request.

Please contact MAINA for selection of series F and J universal shafts.

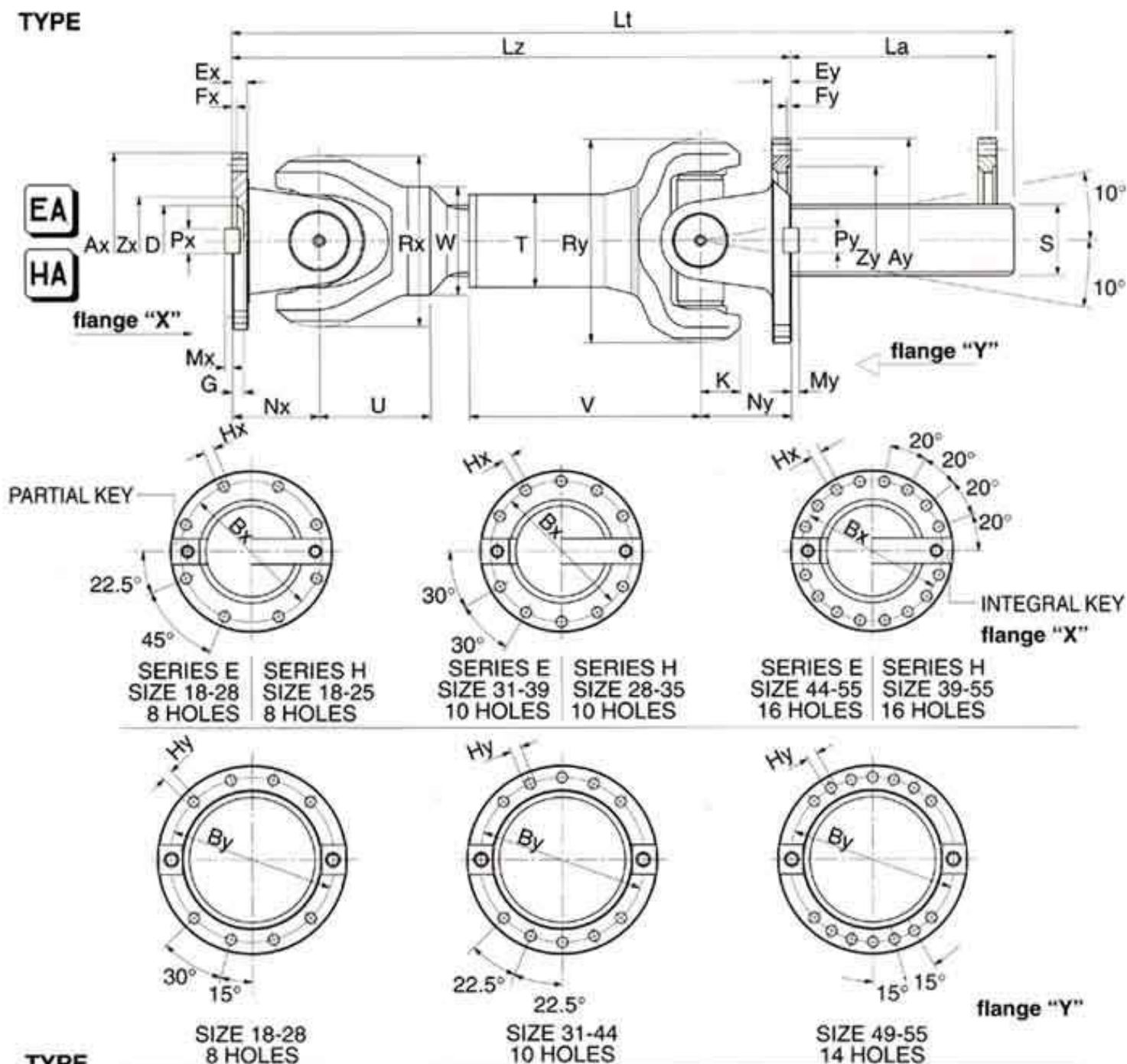
(1) Tolerance ± 0.1 mm

(2) i = number of holes

SERIES E - SERIES H

ENGINEERING DATA

TYPE



TYPE

EB

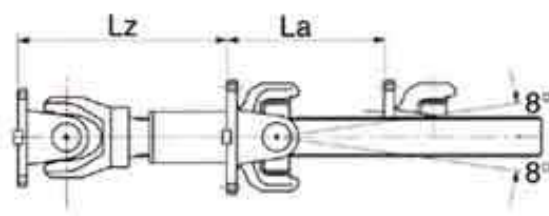
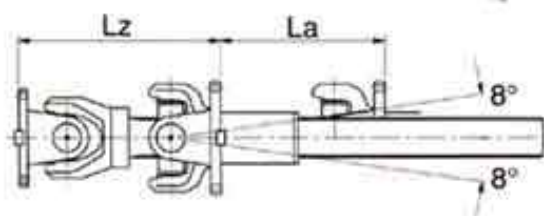
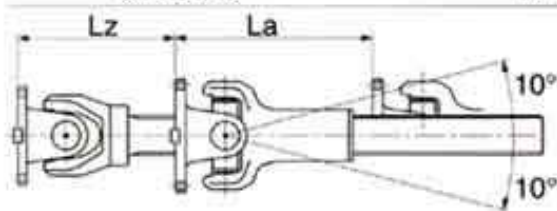
HB

EC

HC

ED

HD



ENGINEERING DATA

SERIES E - SERIES H

TYPE STANDARD FLANGE SIDE "X"

EA - Telescopic Shaft, standard type (external flange)
EB - Telescopic Shaft, standard type (internal flange)
EC - Telescopic Shaft, reversed type (external flange)
ED - Telescopic Shaft, reversed type (internal flange)

TYPE LARGER FLANGE SIDE "X"

HA - Telescopic Shaft, standard type (external flange)
HB - Telescopic Shaft, standard type (internal flange)
HC - Telescopic Shaft, reversed type (external flange)
HD - Telescopic Shaft, reversed type (internal flange)

TABLE 6

SIZE		18	22	25	28	31	35	39	44	49	55
RATING TORQUES											
Mk	[kNm]	28	56	82	119	167	227	302	522	647	1031
Moseh	[kNm]	19	37	58	85	120	163	224	400	495	800
Mow	[kNm]	12	24	37	54	76	106	146	262	321	516
STANDARD FLANGE "X" SERIES E											
Ax ①	[mm]	180	225	250	285	315	350	390	440	490	550
Bx ②	[mm]	155.5	198	218	245	280	310	345	385	425	492
Zx (H7)	[mm]	90	105	105	125	130	155	170	190	205	250
Px (H9)	[mm]	25	32	40	40	40	50	70	80	90	100
Mx	[mm]	7	9	12.5	15	15	18	18	20	22.5	22.5
Fx	[mm]	5	5	6	7	8	8	8	10	12	12
Ex	[mm]	17	20	25	27	32	35	40	42	47	50
Hx	[mm]	17	17	19	21	23	23	25	28	31	31
G	[mm]	15	15	15	16	16	18	20	25	30	30
D	[mm]	80	90	90	110	115	140	155	150	160	190
Rx	[mm]	180	225	250	285	315	350	390	440	490	550
Nx	[mm]	110	120	140	160	180	195	210	250	270	305
U	[mm]	145	160	180	200	230	245	260	325	335	375
W	[mm]	137	150	175	200	250	264	316	355	368	418
SOIN 5480 ③		85x2.5	100x2.5	115x2.5	130x3	150x3	170x5	185x5	210x5	210x5	240x5
FLANGE "Y"											
Ay ①	[mm]	250	315	330	390	435	480	520	600	650	710
By ②	[mm]	220	285	300	355	390	430	480	550	595	650
Zy (H7)	[mm]	165	220	210	260	275	320	360	420	450	520
Py (H9)	[mm]	25	32	40	40	40	50	100	80	90	100
My	[mm]	7	9	12.5	15	15	18	22.5	20	22.5	22.5
Fy	[mm]	5	5	6	7	8	8	12	12	12	15
Ey	[mm]	20	30	30	30	35	38	50	55	65	50
Hy	[mm]	17	17	19	21	23	23	25	28	31	31
Ry	[mm]	250	315	330	390	435	480	520	600	650	710
Ny	[mm]	120	130	145	160	180	210	230	280	290	320
T	[mm]	110	130	150	165	195	215	250	270	270	330
V ④	[mm]	270	320	370	420	490	550	600	640	680	700
K	[mm]	37.5	45	52	63	73	80	95	115	134	150
LARGER FLANGE "X" SERIES H											
Ax ①	[mm]	225	250	285	315	350	390	440	490	550	600
Bx ②	[mm]	198	218	245	280	310	345	385	425	492	544
Zx (H7)	[mm]	140	140	175	175	220	250	280	320	380	450
Px (H9)	[mm]	32	40	40	40	50	70	80	90	100	100
Mx	[mm]	7	9	12.5	15	15	18	18	20	22.5	22.5
Fx	[mm]	5	6	7	7	8	8	8	10	12	15
Ex	[mm]	17	20	25	27	32	35	40	42	47	50
Hx	[mm]	17	19	21	23	23	25	28	31	31	34
G	[mm]	15	15	15	16	16	18	20	25	30	30
D	[mm]	80	90	90	110	115	140	155	150	160	190
LENGTH/LENGTH COMPENSATION											
EA HA	Lz	[mm]	710	790	910	1000	1155	1300	1420	1685	1775
	La	[mm]	600	600	750	750	850	850	900	900	950
	Lt	[mm]	1215	1290	1550	1770	1870	2000	2150	2385	2540
EB HB	Lz	[mm]	320	340	395	420	485	550	600	750	790
	La	[mm]	600	600	750	750	850	850	900	900	950
	Lt	[mm]	1355	1430	1700	1790	2055	2200	2420	2650	2780
EC HC	Lz	[mm]	485	500	575	620	710	810	885	1098	1155
	La	[mm]	600	600	750	750	850	850	900	900	950
	Lt	[mm]	1260	1330	1590	1670	1920	2060	2240	2440	2630
ED HD	Lz	[mm]	470	530	620	680	795	890	960	1135	1195
	La	[mm]	600	600	750	750	850	850	900	900	950
	Lt	[mm]	1215	1290	1550	1630	1870	2000	2150	2445	2530

Lz = Shortest length

La = Length compensation

Lt = Total length

(1) When required tolerance h7

(2) Tolerance ± 0.1 mm

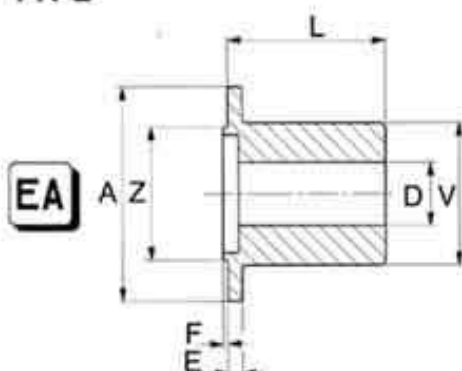
(3) Male spline shaft nitro-oxidized

(4) For special arrangement V dimension can be modified

COMPANION FLANGES

INNER CENTERING

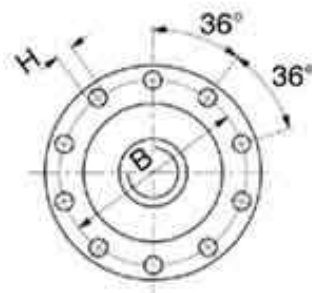
TYPE



FLANGE WITHOUT FACE KEY

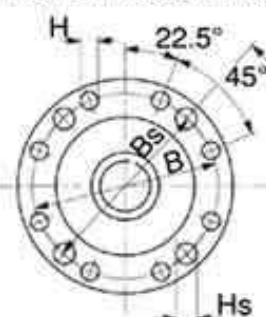
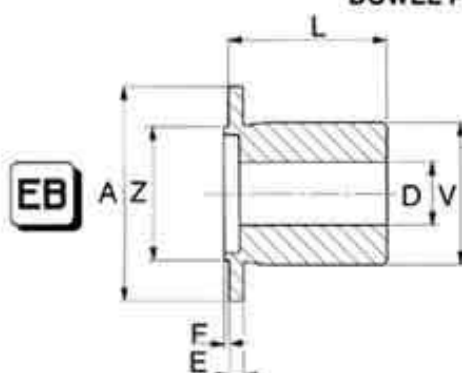


SIZE 18 - 28
8 HOLES

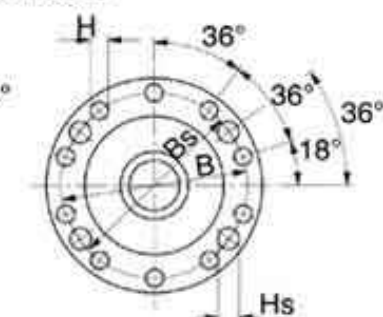


SIZE 31 - 39
10 HOLES

DOWEL PIN CONNECTION ACCORDING TO DIN 15452

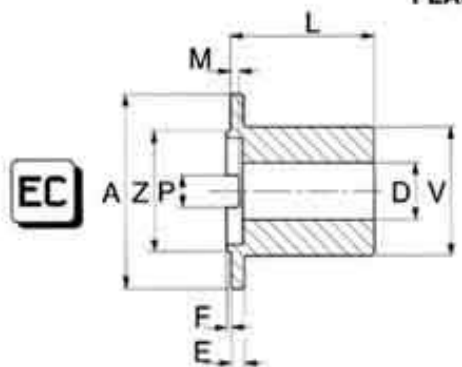


SIZE 18 - 28
8 HOLES

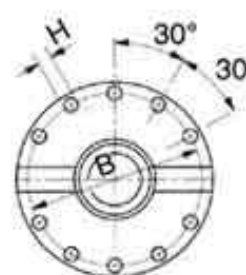


SIZE 31 - 39
10 HOLES

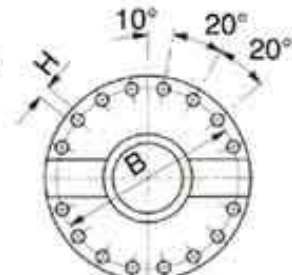
FLANGE WITH FACE KEY - STANDARD TYPE



SIZE 18 - 28
8 HOLES

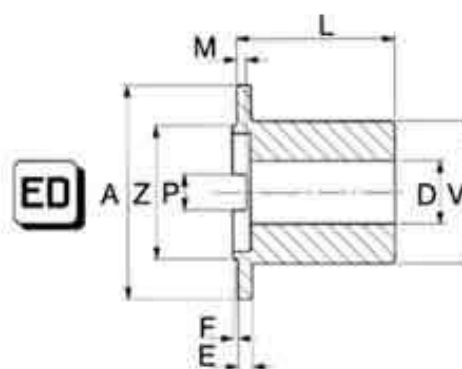


SIZE 31 - 39
10 HOLES

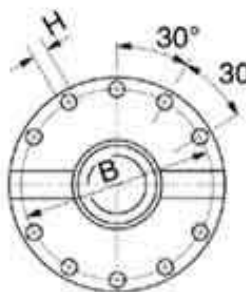


SIZE 44 - 62
16 HOLES

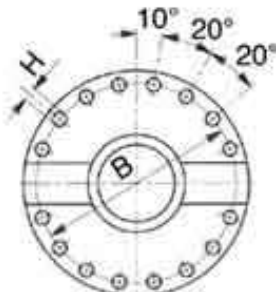
FLANGE WITH FACE KEY - LARGER TYPE



SIZE 18 - 25
8 HOLES



SIZE 28 - 35
10 HOLES



SIZE 39 - 62
16 HOLES

INNER CENTERING

COMPANION FLANGES

TABLE 7

TYPE EA

SIZE		18	22	25	28	31	35	39
A	[mm]	225	250	285	315	350	390	440
B ⁽¹⁾	[mm]	196	218	245	280	310	345	385
H (C12)	[mm]	16	18	20	22	22	24	27
V ⁽²⁾	[mm]	171	190	214	247	277	307	342
D ⁽³⁾	[mm]	115	125	140	165	185	205	225
L ⁽⁴⁾	[mm]	200	210	220	230	240	270	280
E	[mm]	15	18	20	22	25	32	32
F	[mm]	4	5	6	6	7	7	7
Z (m)	[mm]	140	140	175	175	220	250	280
G ⁽⁵⁾	[kg]	38	50	68	93	123	171	220

TABLE 8

TYPE EB

SIZE		18	22	25	28	31	35	39
A	[mm]	225	250	285	315	350	390	435
B ⁽¹⁾	[mm]	196	218	245	280	310	345	385
Bs ⁽¹⁾	[mm]	192	214	240	270	300	340	378
H (C12)	[mm]	16	18	20	22	22	24	27
Hs (H12)	[mm]	21	25	28	30	32	32	35
V ⁽²⁾	[mm]	165	175	205	225	260	290	310
D ⁽³⁾	[mm]	100	110	130	140	160	180	180
L ⁽⁴⁾	[mm]	180	180	185	215	215	265	265
E	[mm]	15	18	20	22	25	28	32
F	[mm]	4	5	6	6	7	7	7
Z (m)	[mm]	140	140	175	175	220	250	280
G ⁽⁵⁾	[kg]	29	34	54	75	100	152	180

TABLE 9

TYPE EC

SIZE		18	22	25	28	31	35	39	44	49	55	62
A	[mm]	180	225	250	285	315	350	390	440	490	550	620
B ⁽¹⁾	[mm]	155.5	196	218	245	280	310	345	385	425	492	555
H	[mm]	17	17	19	21	23	23	25	28	31	31	37
V ⁽²⁾	[mm]	130.5	171	190	214	247	277	307	342	378	445	499
D ⁽³⁾	[mm]	90	115	125	140	165	185	205	225	255	295	335
L ⁽⁴⁾	[mm]	170	200	210	220	230	240	270	280	300	320	360
E	[mm]	17	20	25	27	32	35	40	42	47	50	55
F	[mm]	4	4	5	6	7	7	7	9	11	11	14
P	[mm]	25	32	40	40	40	50	70	80	90	100	110
M	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5	27.5
Z (m)	[mm]	90	105	105	125	130	155	170	190	205	250	280
G ⁽⁵⁾	[kg]	20	39	51	68	95	124	172	224	295	427	598

TABLE 10

TYPE ED

SIZE		18	22	25	28	31	35	39	44	49	55	62
A	[mm]	225	250	285	315	350	390	440	490	550	600	680
B ⁽¹⁾	[mm]	196	218	245	280	310	345	385	425	492	544	615
H	[mm]	17	19	21	23	23	25	28	31	31	34	37
V ⁽²⁾	[mm]	171	190	214	247	277	307	342	378	445	493	599
D ⁽³⁾	[mm]	115	125	140	165	185	205	225	255	295	325	370
L ⁽⁴⁾	[mm]	200	210	220	230	240	270	280	300	320	350	400
E	[mm]	17	20	25	27	32	35	40	42	47	50	55
F	[mm]	4	5	6	6	7	7	7	9	11	14	14
P	[mm]	32	40	40	40	50	70	80	90	100	100	110
M	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5	27.5
Z (m)	[mm]	140	140	175	175	220	250	280	320	380	450	450
G ⁽⁵⁾	[kg]	38	50	68	94	124	172	224	295	431	574	920

(1) Tolerance ± 0.1

(2) Maximum values

(3) Maximum finished bore diameter

(4) Different lengths on request

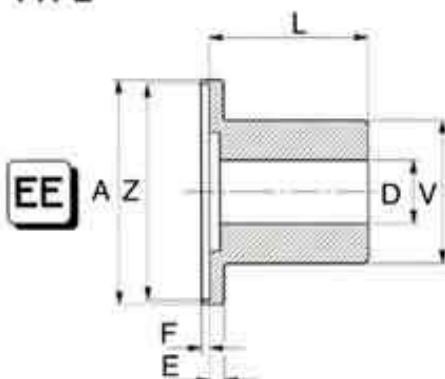
(5) G = weight calculated for solid hub.

COMPANION FLANGES

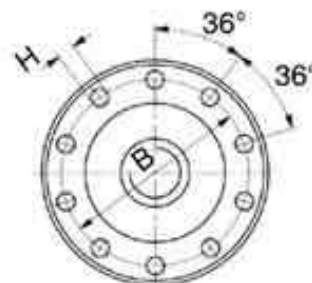
OUTER CENTERING

TYPE

FLANGE WITHOUT FACE KEY

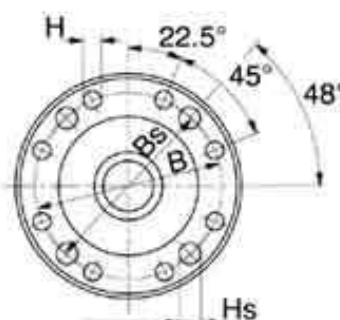
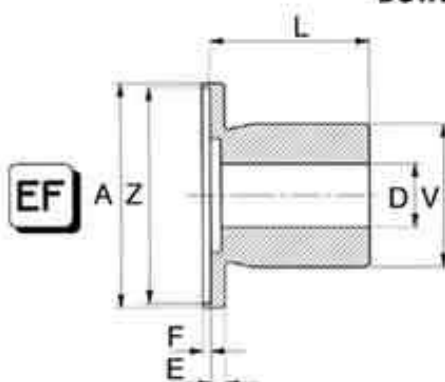


SIZE 18 - 28
8 HOLES

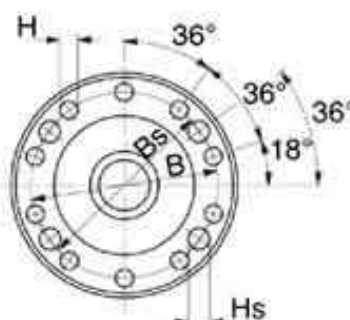


SIZE 31 - 39
10 HOLES

DOWEL PIN CONNECTION ACCORDING TO DIN 15452

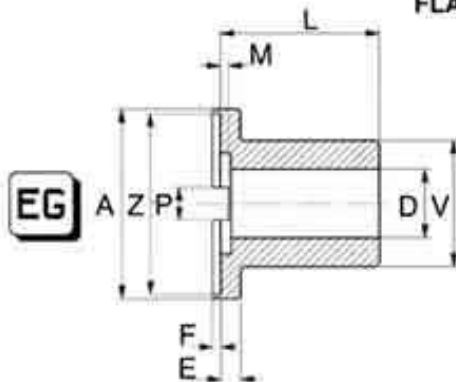


SIZE 18 - 28
8 HOLES



SIZE 31 - 39
10 HOLES

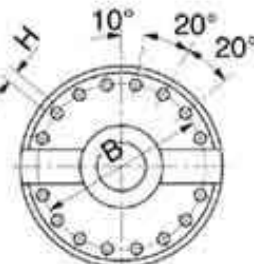
FLANGE WITH FACE KEY - STANDARD TYPE



SIZE 18 - 28
8 HOLES

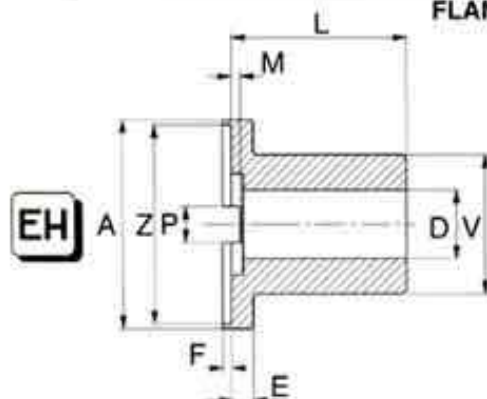


SIZE 31 - 39
10 HOLES



SIZE 44 - 62
16 HOLES

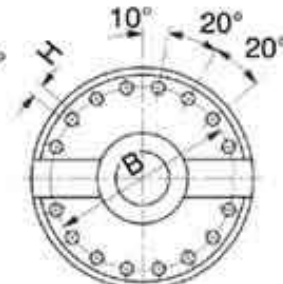
FLANGE WITH FACE KEY - LARGER TYPE



SIZE 18 - 25
8 HOLES



SIZE 28 - 35
10 HOLES



SIZE 39 - 62
16 HOLES

OUTER CENTERING
COMPANION FLANGES
TABLE 11
TYPE EE

SIZE		18	22	25	28	31	35	39
A	[mm]	235	260	295	330	365	405	460
B ①	[mm]	196	218	245	280	310	345	385
H (C12)	[mm]	16	18	20	22	22	24	27
V ②	[mm]	171	190	214	247	277	307	342
D ③	[mm]	115	125	140	165	185	205	225
L ④	[mm]	200	210	220	230	240	270	280
E	[mm]	15	18	20	22	25	32	32
F	[mm]	4	5	6	6	7	7	7
Z (H7)	[mm]	225	250	285	315	350	390	440
G ⑤	[kg]	38	50	68	93	123	171	220

TABLE 12
TYPE EF

SIZE		18	22	25	28	31	35	39
A	[mm]	235	260	295	330	365	405	455
B ①	[mm]	196	218	245	280	310	345	385
Ba ①	[mm]	192	214	240	270	300	340	378
H (C12)	[mm]	16	18	20	22	22	24	27
Ha (H12)	[mm]	21	25	28	30	32	32	35
V ②	[mm]	165	175	205	225	260	290	310
D ③	[mm]	100	110	130	140	160	180	190
L ④	[mm]	160	160	185	215	215	265	265
E	[mm]	15	18	20	22	25	28	32
F	[mm]	4	5	6	6	7	7	7
Z (H7)	[mm]	225	250	285	315	350	390	435
G ⑤	[kg]	29	34	54	75	100	152	180

TABLE 13
TYPE EG

SIZE		18	22	25	28	31	35	39	44	49	55	62
A	[mm]	190	235	260	295	330	365	405	480	510	570	640
B ①	[mm]	155.5	196	218	245	280	310	345	385	425	492	555
H	[mm]	17	17	19	21	23	23	25	28	31	31	37
V ②	[mm]	130.5	171	190	214	247	277	307	342	378	445	499
D ③	[mm]	90	115	125	140	165	185	205	225	255	295	335
L ④	[mm]	170	200	210	220	230	240	270	280	300	320	360
E	[mm]	17	20	25	27	32	35	40	42	47	50	55
F	[mm]	4	4	5	6	7	7	7	9	11	11	14
P	[mm]	25	32	40	40	40	50	70	80	90	100	110
M	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5	27.5
Z (H7)	[mm]	180	225	250	285	315	350	390	440	490	550	620
G ⑤	[kg]	20	39	51	66	95	124	172	224	295	427	610

TABLE 14
TYPE EH

SIZE		18	22	25	28	31	35	39	44	49	55	62
A	[mm]	235	260	295	330	365	405	460	510	570	620	700
B ①	[mm]	196	218	245	280	310	345	385	425	492	544	615
H	[mm]	17	19	21	23	23	25	28	31	31	34	37
V ②	[mm]	171	190	214	247	277	307	342	378	445	493	599
D ③	[mm]	115	125	140	165	185	205	225	255	295	325	370
L ④	[mm]	200	210	220	230	240	270	280	300	320	350	400
E	[mm]	17	20	25	27	32	35	40	42	47	50	55
F	[mm]	4	5	6	6	7	7	7	9	11	14	14
P	[mm]	32	40	40	40	50	70	80	90	100	100	110
M	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5	27.5
Z (H7)	[mm]	225	250	285	315	350	390	440	490	550	600	680
G ⑤	[kg]	38	50	68	94	124	172	224	295	431	574	870

 (1) Tolerance ± 0.1 mm

(2) Maximum values

(3) Maximum finished bore diameter

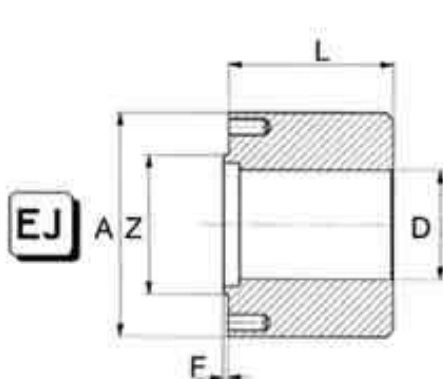
(4) Different lengths on request

(5) G = weight calculated for solid hub.

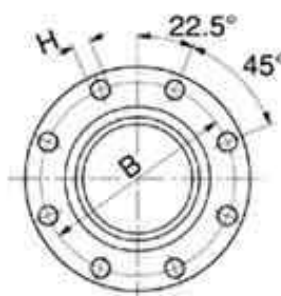
CYLINDRICAL COMPANION FLANGES

INNER CENTERING

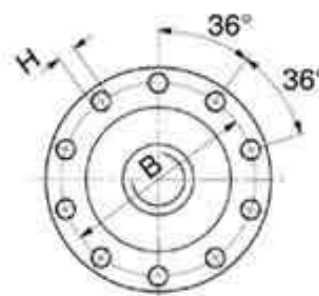
TYPE



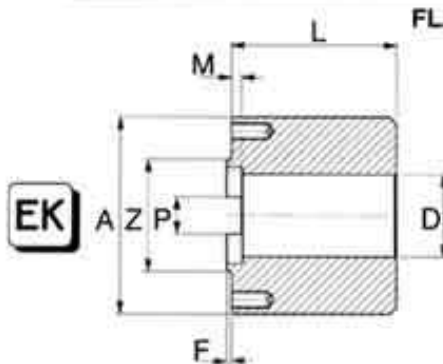
FLANGE WITHOUT FACE KEY



SIZE 18 - 28
8 HOLES



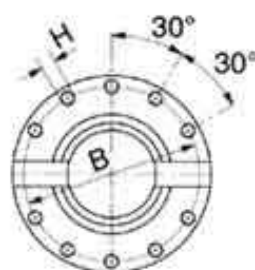
SIZE 31 - 39
10 HOLES



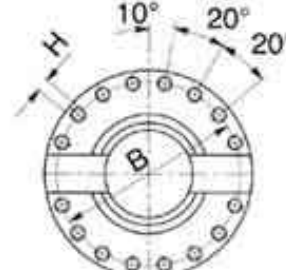
FLANGE WITH FACE KEY - STANDARD TYPE



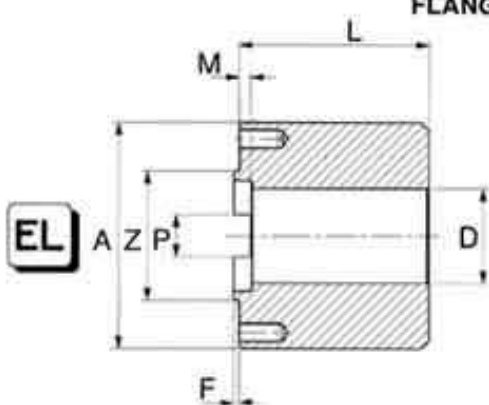
SIZE 18 - 28
8 HOLES



SIZE 31 - 39
10 HOLES



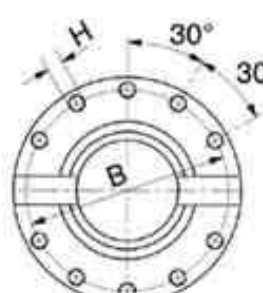
SIZE 44 - 62
16 HOLES



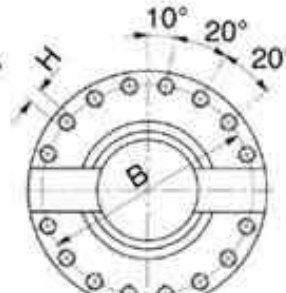
FLANGE WITH FACE KEY - LARGER TYPE



SIZE 18 - 25
8 HOLES



SIZE 28 - 35
10 HOLES



SIZE 39 - 62
16 HOLES

INNER CENTERING
CYLINDRICAL COMPANION FLANGES
TABLE 15
TYPE EJ

SIZE		18	22	25	28	31	35	39
A	[mm]	225	250	285	315	350	390	440
B (1)	[mm]	196	218	245	280	310	345	385
H	[mm]	M16	M18	M20	M22	M22	M24	M27
D (2)	[mm]	150	170	190	210	235	260	295
L (3)	[mm]	200	210	220	230	240	270	280
F	[mm]	4	5	6	6	7	7	7
Z (4)	[mm]	140	140	175	175	220	250	280
G (4)	[kg]	62	81	111	142	183	255	337

TABLE 16
TYPE EK

SIZE		18	22	25	28	31	35	39	44	49	55	62
A	[mm]	180	225	250	285	315	350	390	440	490	550	620
B (1)	[mm]	155.5	198	218	245	280	310	345	385	425	492	555
H	[mm]	M18	M16	M18	M20	M22	M22	M24	M27	M30	M30	M36
D (2)	[mm]	120	150	170	190	210	235	260	295	325	365	420
L (3)	[mm]	170	200	210	220	230	240	270	280	300	320	360
F	[mm]	4	4	5	6	7	7	7	9	11	11	14
P	[mm]	25	32	40	40	40	50	70	80	90	100	110
M	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5	27.5
Z (4)	[mm]	90	105	105	125	130	155	170	190	205	250	280
G (4)	[kg]	34	62	81	111	142	183	255	337	447	600	860

TABLE 17
TYPE EL

SIZE		18	22	25	28	31	35	39	44	49	55	62
A	[mm]	225	250	285	315	350	390	440	490	550	600	680
B (1)	[mm]	196	218	245	280	310	345	385	425	492	544	615
H	[mm]	M16	M18	M20	M22	M22	M24	M27	M30	M30	M33	M36
D (2)	[mm]	150	170	190	210	235	260	295	325	365	400	450
L (3)	[mm]	200	210	220	230	240	270	280	300	320	350	400
F	[mm]	4	5	6	8	7	7	7	9	11	14	14
P	[mm]	32	40	40	40	50	70	80	90	100	100	110
M	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5	27.5
Z (4)	[mm]	140	140	175	175	220	250	280	320	380	450	450
G (4)	[kg]	62	81	111	142	183	255	337	447	600	794	1150

(1) Tolerance ± 0.1 mm

(2) Maximum finished bore diameter

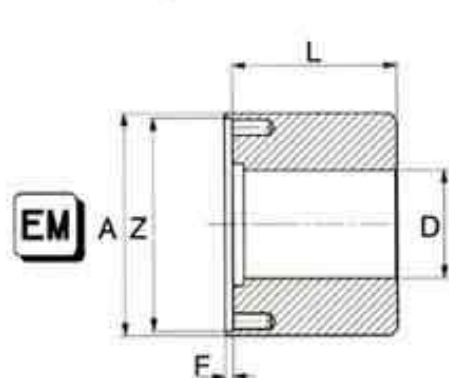
(3) Different lengths on request

(4) G = weight calculated for solid hub.

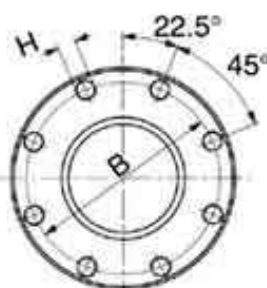
CYLINDRICAL COMPANION FLANGES

OUTER CENTERING

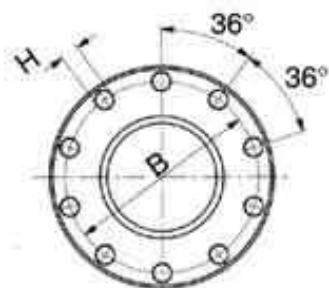
TYPE



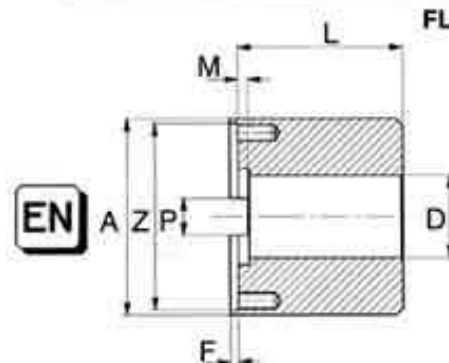
FLANGE WITHOUT FACE KEY



SIZE 18 - 28
8 HOLES



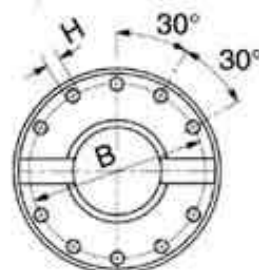
SIZE 31 - 39
10 HOLES



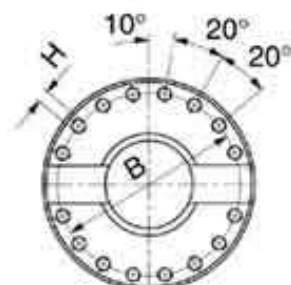
FLANGE WITH FACE KEY - STANDARD TYPE



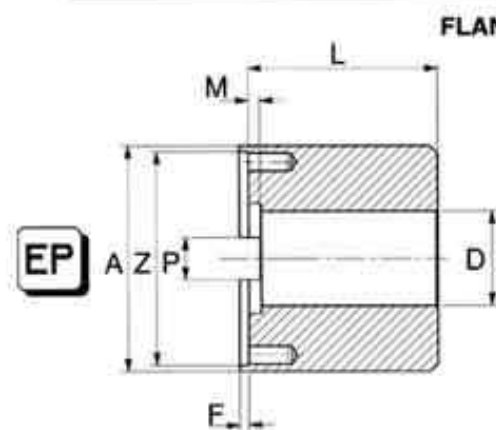
SIZE 18 - 28
8 HOLES



SIZE 31 - 39
10 HOLES



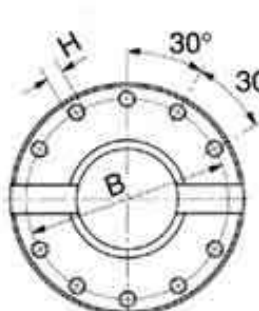
SIZE 44 - 62
16 HOLES



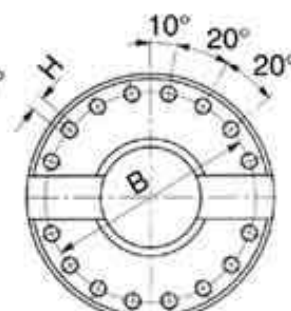
FLANGE WITH FACE KEY - LARGER TYPE



SIZE 18 - 25
8 HOLES



SIZE 28 - 35
10 HOLES



SIZE 39 - 62
16 HOLES

OUTER CENTERING
CYLINDRICAL COMPANION FLANGES
TABLE 18
TYPE EM

SIZE		18	22	25	28	31	35	39
A	[mm]	235	260	295	330	365	405	460
B ⁽¹⁾	[mm]	196	218	245	280	310	345	385
H	[mm]	M16	M18	M20	M22	M22	M24	M27
D ⁽²⁾	[mm]	155	175	195	220	245	270	310
L ⁽²⁾	[mm]	200	210	220	230	240	270	280
F	[mm]	4	5	6	6	7	7	7
Z ^(H7)	[mm]	225	250	285	315	350	390	440
G ⁽⁴⁾	[kg]	68	87	118	155	197	275	365

TABLE 19
TYPE EN

SIZE		18	22	25	28	31	35	39	44	49	55	62
A	[mm]	180	235	280	295	330	385	405	480	510	570	640
B ⁽¹⁾	[mm]	155.5	196	218	245	280	310	345	385	425	492	555
H	[mm]	M16	M16	M18	M20	M22	M22	M24	M27	M30	M30	M36
D ⁽²⁾	[mm]	125	155	175	195	220	245	270	310	340	380	420
L ⁽²⁾	[mm]	170	200	210	220	230	240	270	280	300	320	360
F	[mm]	4	4	5	6	7	7	7	9	11	11	14
P	[mm]	25	32	40	40	40	50	70	80	90	100	110
M	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5	27.5
Z ^(H7)	[mm]	180	225	250	285	315	350	390	440	490	550	620
G ⁽⁴⁾	[kg]	36	68	87	118	155	197	275	365	481	641	910

TABLE 20
TYPE EP

SIZE		18	22	25	28	31	35	39	44	49	55	62
A	[mm]	235	260	295	330	365	405	460	510	570	620	700
B ⁽¹⁾	[mm]	196	218	245	280	310	345	385	425	492	544	615
H	[mm]	M16	M18	M20	M22	M22	M24	M27	M30	M30	M33	M36
D ⁽²⁾	[mm]	155	175	195	220	245	270	310	340	380	415	450
L ⁽²⁾	[mm]	200	210	220	230	240	270	280	300	320	350	400
F	[mm]	4	5	6	6	7	7	7	9	11	14	14
P	[mm]	32	40	40	40	50	70	80	90	100	100	110
M	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5	27.5
Z ^(H7)	[mm]	225	250	285	315	350	390	440	490	550	600	680
G ⁽⁴⁾	[kg]	68	87	118	155	197	275	365	481	641	830	1210

(1) Tolerance $\pm 0,1$ mm

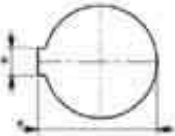

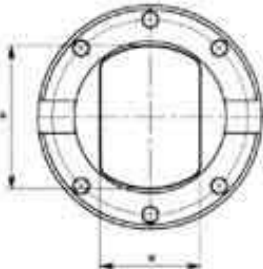
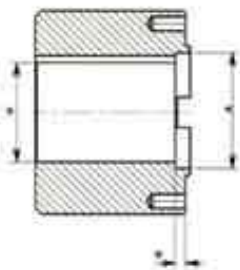
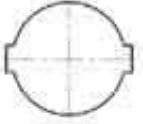

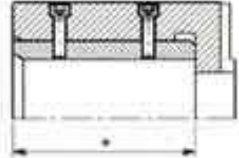
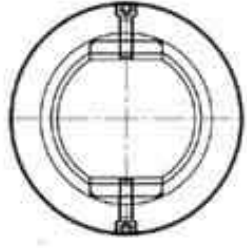
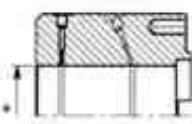
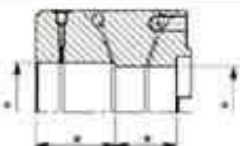
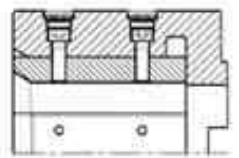
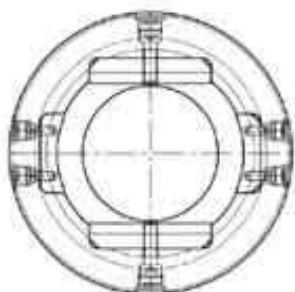
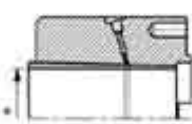
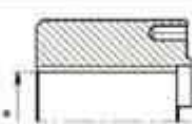
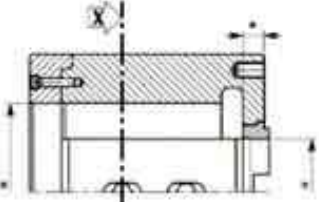
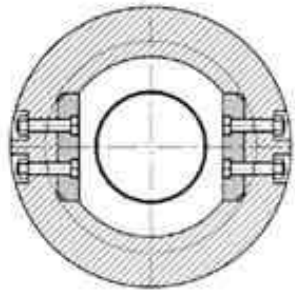

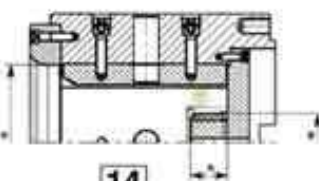
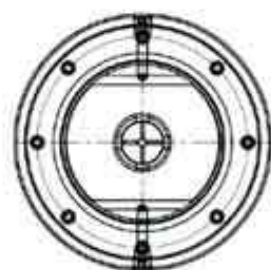
(2) Maximum finished bore diameter

(3) Different lengths on request

(4) G = weight calculated for solid hub.

BORE DESIGNS

TYPE OF FITTING

 <p>01 Cylindrical Bore, 1 keyway</p>	 <p>10 Integral Bore</p> 
 <p>02 Cylindrical Bore, 2 keyways at 90°</p>	
 <p>03 Cylindrical Bore, 2 keyways at 180°</p>	
 <p>04 Cylindrical Bore, 2 keyways at 120°</p>	 <p>11 Replaceable flat keys</p> 
 <p>05 Cylindrical Bore for fitting and oil pressure removal</p>	
 <p>06 Cylindrical Bore with 2 diameters for fitting and oil pressure removal</p>	 <p>12 Replaceable flat and round keys</p> 
 <p>07 Tapered Bore and Tapered Bush for fitting and oil pressure removal</p>	
 <p>08 DIN 5480 Splined Bore, or equal, without centering</p>	 <p>13 Replaceable flat keys, inner and outer bush</p> 
 <p>09 DIN 5480 Splined Bore, or equal, with centering diameters</p>	<p>X - SECTION</p>
<p>Companion flanges type 01 + 04 are usually made of AISI 1045 hardened and tempered whereas type 05 + 14 of AISI 4140 hardened and tempered. Companion flanges type 10 + 14 have hardened contact surfaces. For inquiries please send us dimensions indicated with * and, for type 10 + 14, a general drawing.</p>	 <p>14 Replaceable flat keys, outer bush and inner centering</p> 

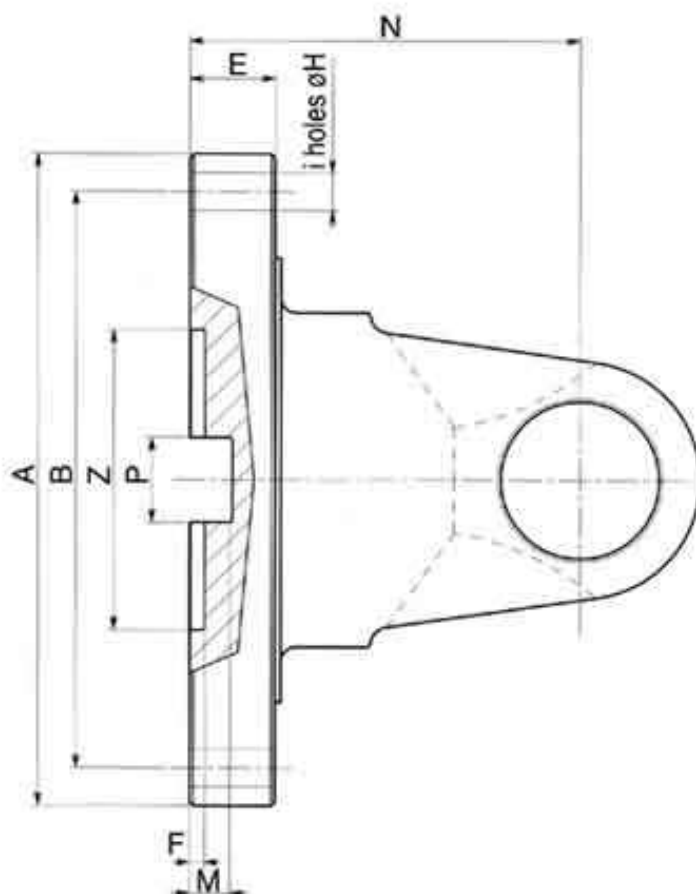


TABLE 21

SIZE		18	22	25	28	31	35	39	44	49	55	62
A	[mm]	250	285	315	350	390	440	490	550	600	650	700
B	[mm]	218	245	280	310	345	385	425	492	544	595	645
Z (H7)	[mm]	140	175	175	220	250	280	320	380	450	490	500
P	[mm]	40	40	40	50	70	80	90	100	100	120	130
M	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5	30
F	[mm]	5	6	7	7	8	8	8	10	12	15	15
E	[mm]	17	20	25	27	32	35	40	42	47	50	70
H	[mm]	19	21	23	23	25	28	31	31	34	28	28
I		8	8	10	10	10	16	16	16	16	30	34
N	[mm]	140	155	180	205	235	255	275	325	345	385	430

For identification see pages 46 and 47.

EXAMPLE: EXTRA LARGE FLANGE SIZE 22

CODE: DB.C2201.285 where 285 is "A" dimension

Different dimensions on request

HIRTH - SERRATION

ENGINEERING DATA

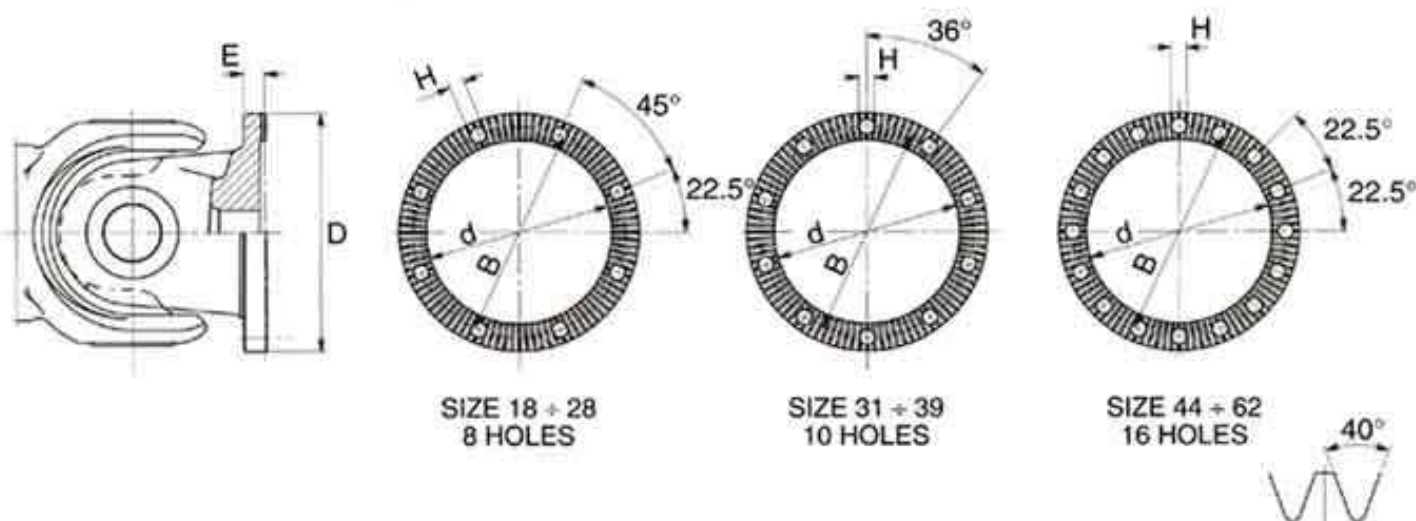


TABLE 22

D	[mm]	180	225	250	285	315	350	390	440	490	550	620
d	[mm]	140	180	200	225	250	280	315	340	380	440	500
B (1)	[mm]	160	203	225	255	280	315	350	400	450	510	575
H	[mm]	13	13	15	17	19	19	21	21	23	23	25
E	[mm]	17	20	25	27	32	35	40	42	47	50	55
z (2)		36	48	48	60	60	72	72	96	96	96	120

(1) Tolerance ± 0.1

(2) z = number of teeth

Different hole patterns may be checked for special applications.

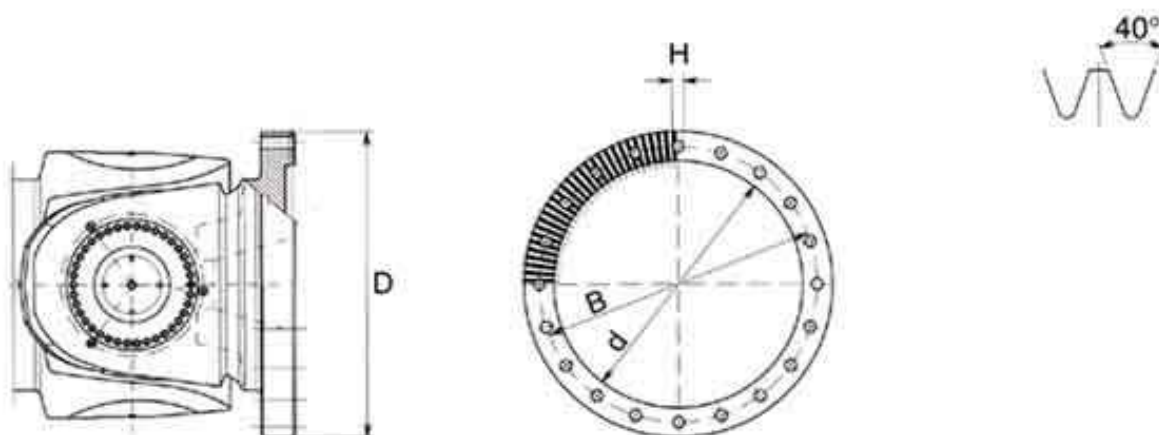


TABLE 23

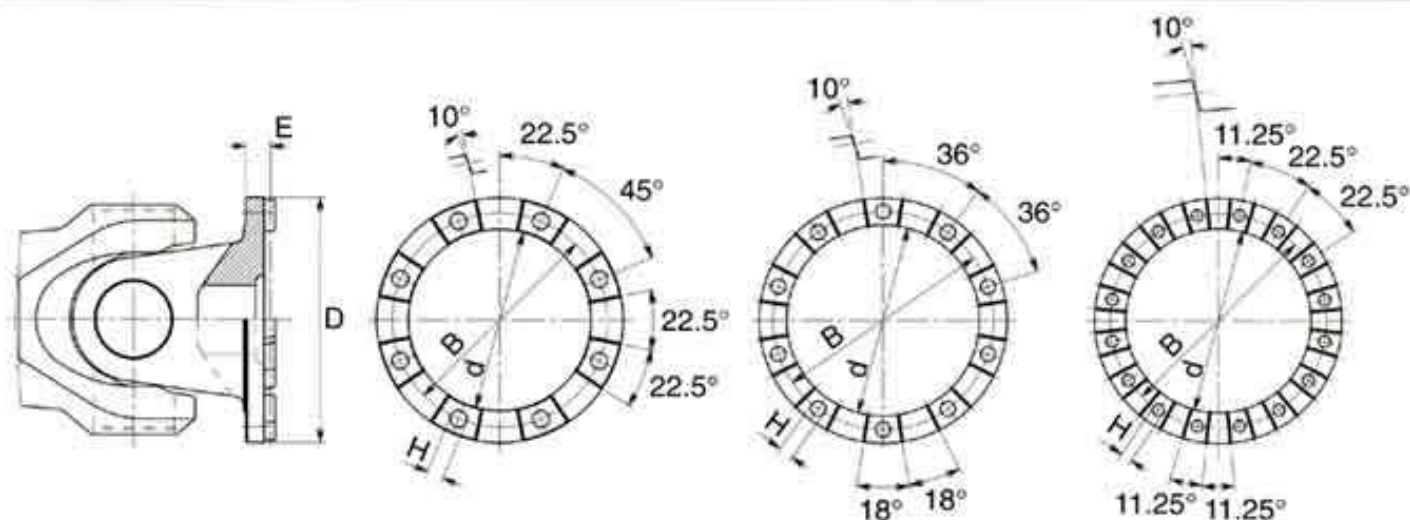
D	[mm]	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200
d	[mm]	480	520	570	610	650	680	710	760	800	840	880	925	960
B (1)	[mm]	555	595	645	695	740	790	825	875	915	965	1015	1050	1100
H	[mm]	25	28	28	31	31	31	37	37	43	43	43	49	49
i (2)		30	30	30	32	32	36	32	32	30	30	30	30	30
E	[mm]	70	75	80	85	90	95	100	105	110	115	120	125	130
z (3)		120	120	120	144	144	144	144	144	180	180	180	180	180

(1) Tolerance ± 0.1

(2) i = number of holes

(3) z = number of teeth

Different hole patterns may be checked for special applications.



SIZE 18 ÷ 28
8 HOLES

SIZE 31 ÷ 39
10 HOLES

SIZE 44 ÷ 62
16 HOLES

TABLE 24

D	[mm]	180	225	250	285	315	350	390	440	490	550	620
d	[mm]	130	165	185	205	245	270	300	330	360	430	490
B ①	[mm]	155.5	196	218	245	280	310	345	385	425	492	555
H	[mm]	13	15	17	17	19	19	21	21	23	23	25
E	[mm]	17	20	25	27	32	35	40	42	47	50	55
z ②		8	8	8	8	10	10	10	16	16	16	16

(1) Tolerance ± 0.1

(2) z = number of teeth

Different hole patterns may be checked for special applications.

Special applications with 4 dog - teeth available.

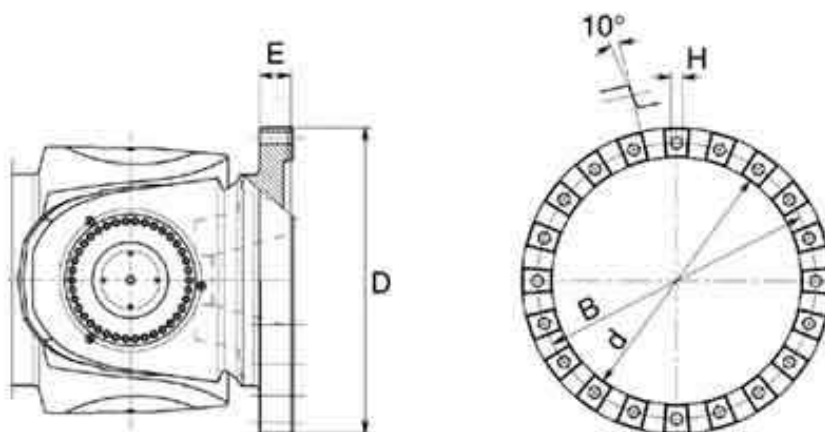


TABLE 25

D	[mm]	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200
d	[mm]	480	520	570	610	650	680	710	760	800	840	880	925	960
B ①	[mm]	555	595	645	690	740	775	825	875	915	965	1015	1050	1100
H	[mm]	25	28	28	31	31	37	37	37	43	43	43	49	49
i ②		30	30	34	30	34	30	32	34	32	34	32	30	32
E	[mm]	70	75	80	85	90	95	100	105	110	115	120	125	130
z ③		30	30	34	30	34	30	32	34	32	34	32	30	32

(1) Tolerance ± 0.1

(2) i = number of holes

(3) z = number of teeth

Different hole patterns may be checked for special applications.

Special applications with 4 dog - teeth available.

FLANGE BOLTING

ENGINEERING DATA

Hexagonal or cylindrical headed bolts in accordance to DIN 931 - 10.9 or 12.9, self-locking nuts according to DIN 980 - 10 or 8.

The bolts are inserted from companion flange side. With larger flanges it is possible to insert the bolts from the joint side.

With cylindrical companion flanges it is possible to use stud bolts.

The bolts are to be tightened with a dynamometrical wrench, in accordance to the indicated torque.

Maximum tightening torque must not exceed 90% of the elastic limit of the bolt material and must be applied to oiled bolts (friction factor 0.12).

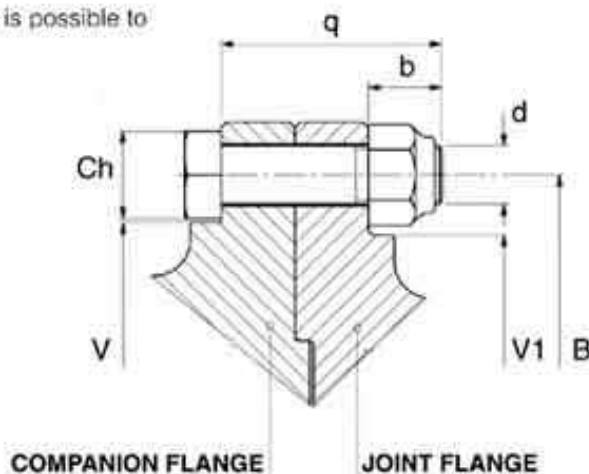


TABLE 26

SIZE		18	22	25	28	31	35	39	44	49	55	62
SERIES A												
FLANGE	[mm]	225	250	285	315	350	390	440				
B	[mm]	196	218	245	280	310	345	385				
d	[mm]	M16	M18	M20	M22	M22	M24	M27				
q	[mm]	50	60	70	75	80	100	100				
b	[mm]	20	24	30	31	30	36	36				
V1	[mm]	150	160	190	220	250	280	310				
V	[mm]	171	190	214	247	277	307	342				
Ch	[mm]	24	27	30	32	32	36	41				
i		8	8	8	8	10	10	10				
Ma	[Nm]	287	396	560	745	745	967	1415				
SERIES B												
FLANGE	[mm]	180	225	250	285	315	350	390	440	490	550	620
B	[mm]	155.5	196	218	245	280	310	345	385	425	492	555
d	[mm]	M16	M16	M18	M20	M22	M22	M24	M27	M30	M30	M36
q	[mm]	55	60	75	80	100	100	110	120	130	140	160
b	[mm]	21	20	25	26	36	30	30	36	36	40	50
V1	[mm]	114	152.5	173	189.5	228.5	259.5	288.5	304	329	412	460
V	[mm]	129.5	171	190	214	247	277	307	342	377	444	499
Ch	[mm]	24	24	27	30	32	32	36	41	46	46	55
i		8	8	8	8	10	10	10	16	16	16	16
Ma	[Nm]	287	287	396	560	745	745	967	1415	1920	1920	3300
SERIES C												
FLANGE	[mm]	225	250	285	315	350	390	440	490	550	600	680
B	[mm]	196	218	245	280	310	345	385	425	492	544	615
d	[mm]	M16	M18	M20	M22	M22	M24	M27	M30	M30	M33	M36
q	[mm]	55	65	80	85	100	100	120	130	140	140	160
b	[mm]	21	25	30	31	36	30	40	46	46	40	50
V1	[mm]	114	152.5	173	189.5	228.5	259.5	288.5	304	329	412	460
V	[mm]	171	190	214	247	277	307	342	377	444	492	599
Ch	[mm]	24	27	30	32	32	36	41	46	46	50	55
i		8	8	8	10	10	10	16	16	16	16	16
Ma	[Nm]	287	396	560	745	745	967	1415	1920	1920	2600	3300

Ma = Tightening torque of flange bolts (10.9)

i = Number of bolts/holes per flange

UNIVERSAL SHAFTS SERIES A - B - C

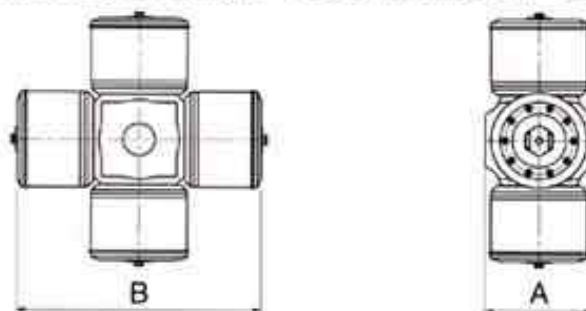


TABLE 27

SIZE		18	22	25	28	31	35	39	44	49	55	62
A	[mm]	53	64	70	78	90	100	125	145	165	185	205
B	[mm]	151	197	220	250	275	302	341	418	464	522	590
W	[Kg]	4.5	7.5	12	18	26.5	40	56	85	122	160	260

UNIVERSAL SHAFTS SERIES D - G - F - J

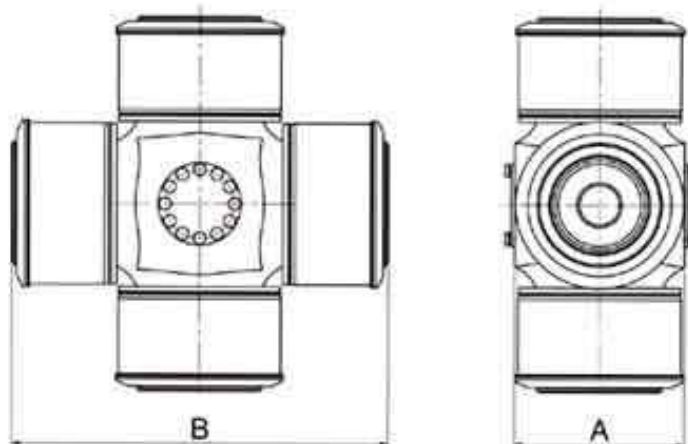


TABLE 28

SIZE		60	65	70	75	80	85	90	95	100	105	110	115
A	[mm]	245	265	285	300	325	345	365	385	405	425	445	470
B	[mm]	545	590	635	680	726	770	815	862	908	953	998	1044
W	[Kg]	240	305	380	470	570	680	810	950	1110	1280	1480	1690

UNIVERSAL SHAFTS SERIES E - H

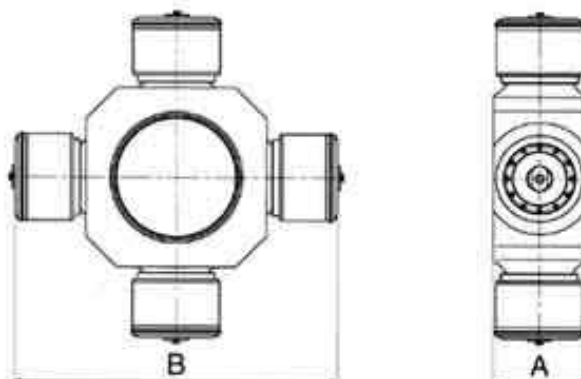


TABLE 29

SIZE		18	22	25	28	31	35	39	44	49	55
A	[mm]	50	60	70	80	90	100	110	135	150	165
B	[mm]	225.5	285.5	306.5	360	400	440	472	551	628.5	685.5
W	[Kg]	6	14	16	24	30	48	81.5	91	146	173

W = Weight in [Kg]

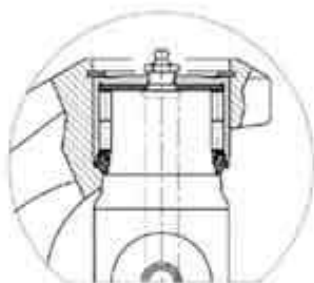
Journal cross supplied as complete unit only.

For identification see page 46.

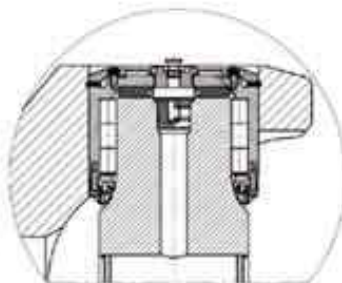
For Lubrication see page 44.

DESIGN VARIATIONS

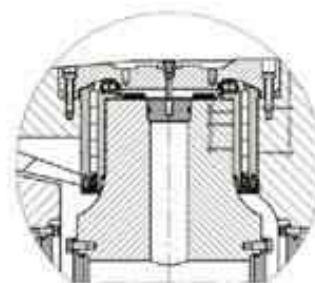
BEARING TYPES



SUITABLE FOR SIZE < 44



SUITABLE FOR SIZE ≥ 44



FOR HEAVY DUTY
SUITABLE FOR SIZE $\geq D60$

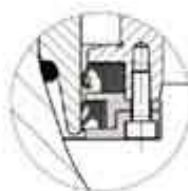
SEAL TYPES



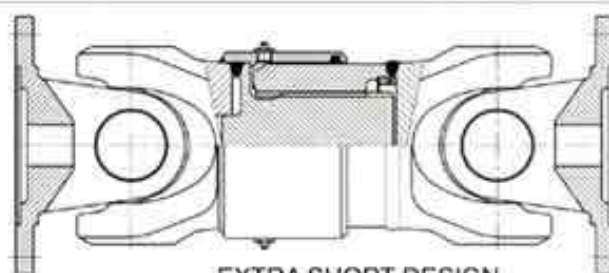
SIZES 18 + 39



SIZES 44 + 62



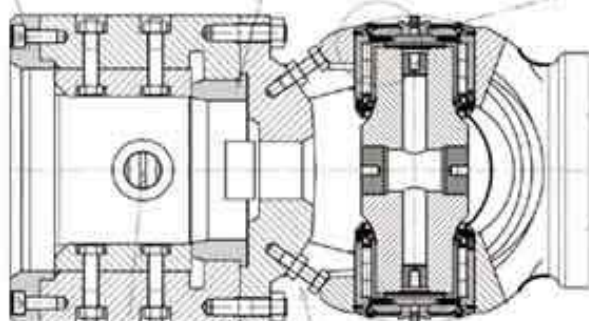
SIZES $\geq D60$



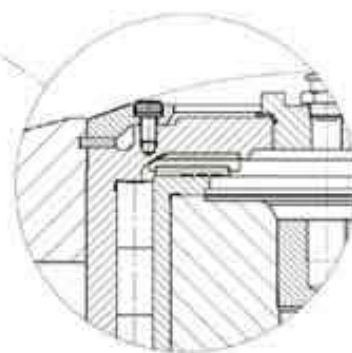
EXTRA SHORT DESIGN

OUTER CENTERING RING

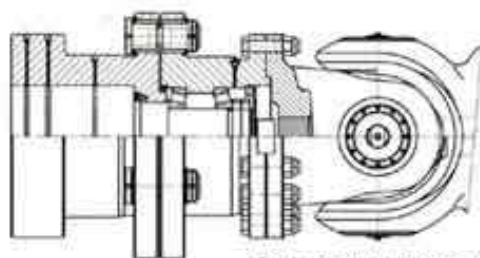
INNER CENTERING RING



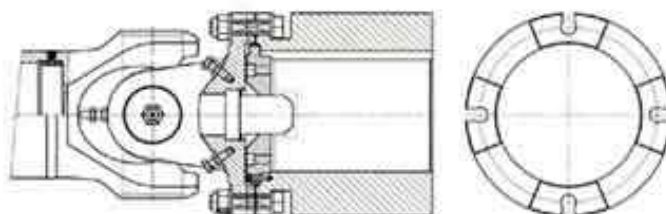
ROLL DETENT ASSEMBLY ANGLE LIMITERS



BEARING WITH SPECIAL THRUST DEVICE
AND WITH INNER RING

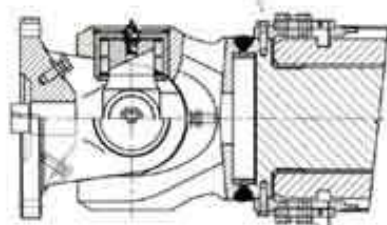


SHEAR PIN SAFETY DEVICE

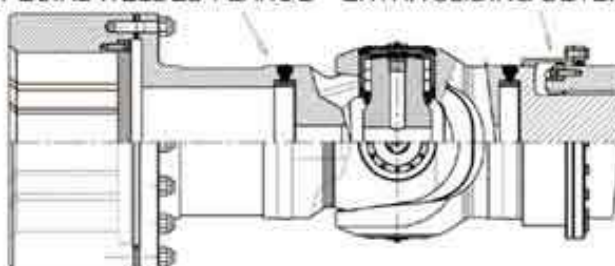


QUICK ENGAGEMENT

LOCKING DEVICE

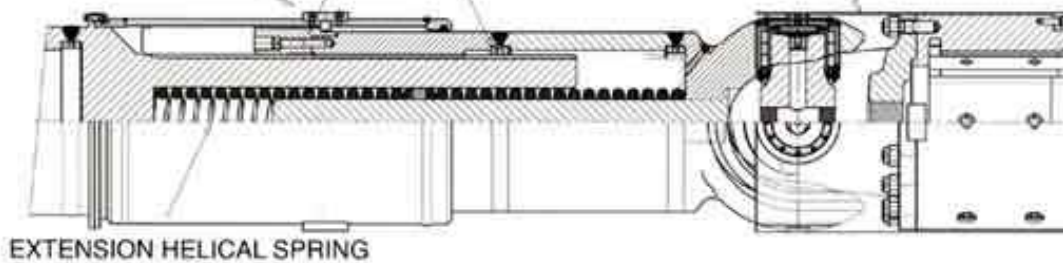


SPECIAL WELDED FLANGE EXTRA SLIDING DETENT DEVICE



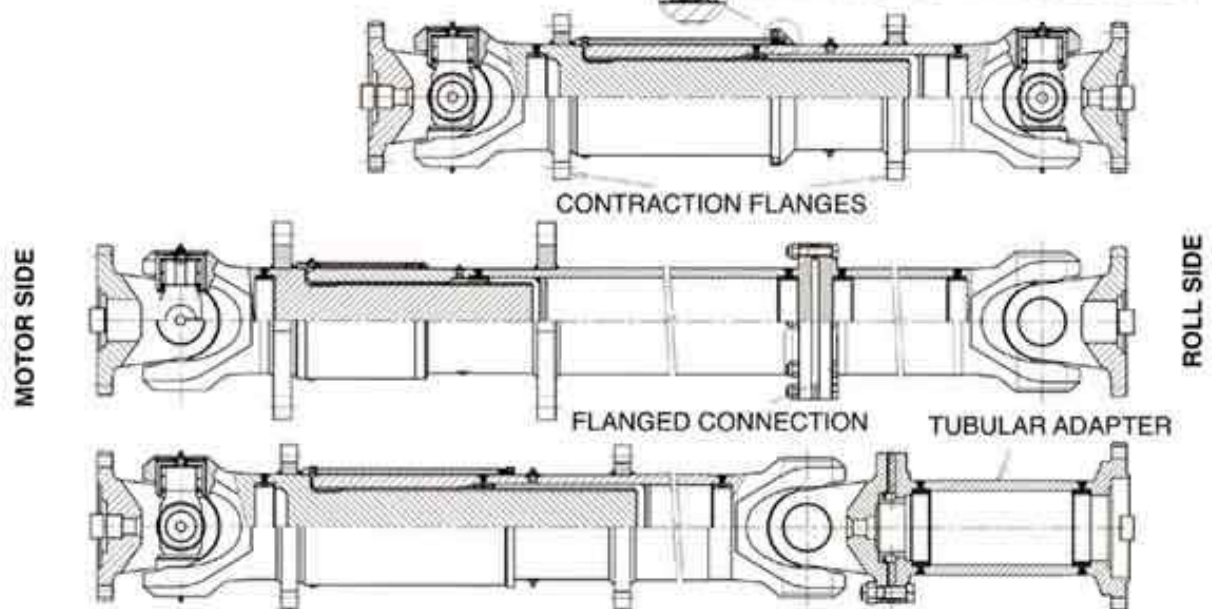
DESIGN VARIATIONS

EXTRA SLIDING DETENT DEVICE GUIDING BUSHES PROTECTION / ANGLE LIMITER / SPINDLE SUPPORT



UNIVERSAL SHAFTS FOR CONTINUOUS CASTING

SCALING DEVICE WITH DOUBLE SEALS

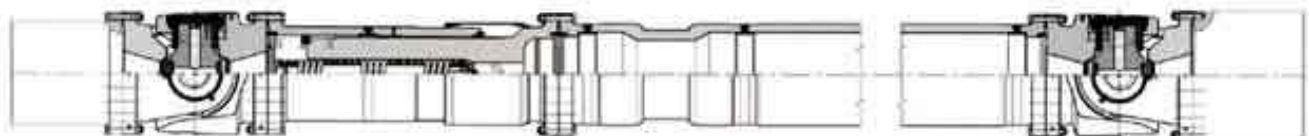


HEAVY AND EXTRA HEAVY UNIVERSAL SHAFTS FOR ROLLING MILL

EDGER MILL DESIGN



HIGH TORSIONAL STIFFNESS DESIGN



DESIGN WITH SPINDLE CARRIER AND TWO HALVES ROLLER BEARING OR BUSHING



DESIGN WITH SPINDLE CARRIER AND TAPERED ROLLER BEARINGS

OPERATING PRINCIPLES

REQUIREMENTS FOR ANGULAR POSITIONING

Universal shafts have the peculiarity to transmit drive between two shafts being either parallel and misaligned (Z arrangement) or incidental (W arrangement), maintaining the rotating speed of the driven shaft promptly equal to that of the driving shaft, provided the following geometrical conditions are met:

- same deflection angle in both joints ($\beta_1 = \beta_2$)
- the inner yoke axis of both joints shall be on the same level
- both the drive shaft and the driven shaft shall also be on the same level.

In case of space misalignment over different levels, but providing identical combinations (Z/Z or W/W) and identical angles, uniformity is guaranteed.

For high speed transmissions, the equality of β_1 and β_2 angles should be checked, in order to limit the difference to $1^\circ \pm 1.5^\circ$ max. ($n > 300$ rpm).

More important differences ($2^\circ \pm 3^\circ$) may be accepted in case of slow speed transmissions only ($n < 300$ rpm).

RESULTING ANGLE

In case of misalignment over several levels, both the horizontal and the vertical angles should be taken into consideration to determine the angulation.

β_h = angle on the horizontal plane

β_v = angle on the vertical plane

$$\tan \beta_{1-2} = \sqrt{\tan^2 \beta_v + \tan^2 \beta_h}$$

CALCULATING THE MAXIMUM ANGLE

In order to obtain a silent transmission, centrifugal forces in the central section shall not be allowed to rise over a given limit.

Centrifugal forces depend on the moment of inertia of the central section of the universal shaft and on the product of the number of revolutions by the deflection angle.

n = max number of revolution in operation

β = max angulation

See table 36 page 38.

MAXIMUM SPEEDS

In order to achieve silent and vibrationless operating conditions, it should be made sure that the rotating speed be lower than the maximum permissible speed set as a critical bending limit as well as a dynamical limit mentioned earlier.

For critical bending speed refer to table 35 page 37.

For dynamical speed refer to table 36 page 38.

LOADS ON THE BEARINGS

While designing the size of a universal shaft, it is important to remember that certain operating conditions involve axial and radial forces. Such forces must be supported by the shaft bearings of the machines which are drivingly connected by means of the universal shafts.

- Axial Forces

The axial forces occur during the length variations of the universal shaft under load.

Such forces increase as the torque increases:

$$F_a = T_d \cdot \frac{\mu}{r_m} \cdot \cos \beta$$

F_a = axial force

T_d = torque

r_m = average radius of the splined profile

μ = friction coefficient. It depends on surface roughness and hardness. Tabulated values 0.11 ± 0.15 for steel against lubricated steel

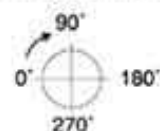
β = angulation

- Radial Forces

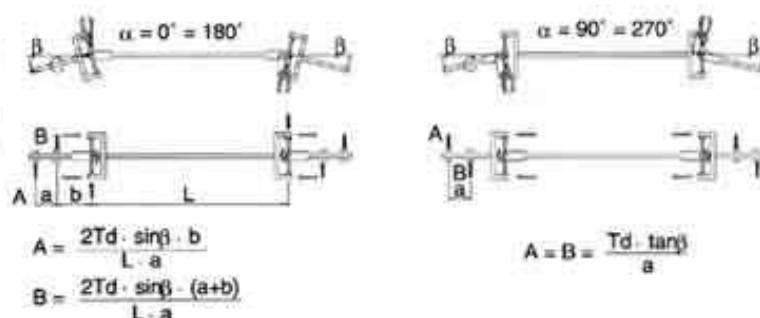
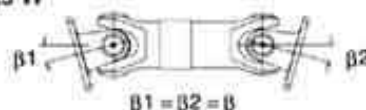
Torque transmission by means of a universal shaft causes bending moments to occur at the shafts, generating radial forces which are therefore proportional to the torque and the deflection angle. These forces are not constant: they vary periodically following a sinusoidal curve, twice every revolution of the universal shaft.

α = Position angle

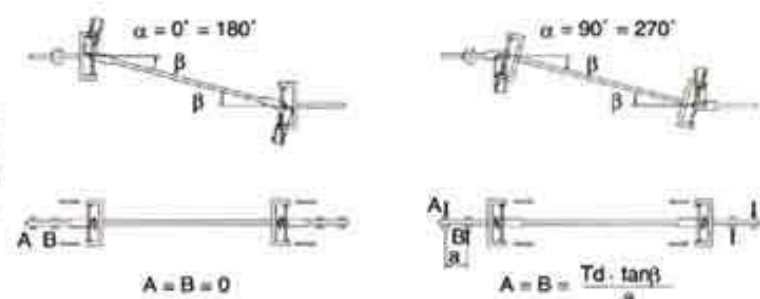
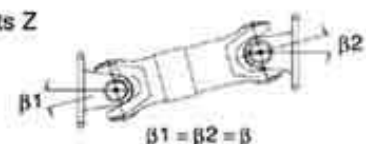
A - B = Loads on the bearings



Arrangements W



Arrangements Z



SIZE SELECTION

RATING CHARACTERISTICS OF UNIVERSAL SHAFTS

- M_k** = Rating designed torque (kNm)
It corresponds to the maximum allowable, static constant torque.
Only unfrequent, minor load peaks are admitted.
- M_{aw}** = Alternating torque (kNm)
It corresponds to the fatigue maximum limit torque for a shaft subject to alternating load $\sigma_{\min}/\sigma_{\max} = 1 + 0$ (stress σ_{D+1} per $2 \cdot 10^6$ cycles).
- M_{asc}** = Pulsating torque (kNm)
It corresponds to the fatigue maximum limit torque for a shaft subject to a pulsating load $\sigma_{\min}/\sigma_{\max} = 0 + 1$ (stress σ_{D+1} per $2 \cdot 10^6$ cycles).
- M_{cs}** = Limit torque = 1,3 M_k (kNm)
It corresponds to the maximum static torque provided by the maximum permissible elastic limit, and it shall never be overcome. Such a stress level may only be reached just 5 times/h for 0,5 + 1 sec.

OPERATING PARAMETERS

- N** = Maximum motor or brake absorbed power (kW).
If absorbed power or calculating data are missing, consider the motor rated load multiplied by absorption percentage (0,75 + 2,25).
- n** = Rated rotation speed of universal shaft (rpm).
- K_s** = Overload factor.
Such factor, considering: inertia and connection times – possible jammings – maximum short circuits – electric motor absorption, shall assess the existing ratio between the rating torque and the maximum or occasional torque. An indication of possible readings should be looked for within the 1,25 + 10 range.
For rolling mills the T.A.F. (Torque Amplification Factor) value should be considered (1,3 + 2).
- Z** = Distribution factor.
Such factor is supposed to take into consideration the different torque distribution over several outputs controlled by just one generator.
Some tabulated examples are provided, as follows:
Two driven work roll stands = 0,5 + 0,66
Three driven work roll stands = 0,66 + 0,75
Roll flatteners = 0,75 + 1
Feeding rolls = 1
Pinch rolls = 0,5 + 0,75
Rubber mixers = 0,5 + 0,66
For single drives, always consider = 1

LOAD DATA

- Absorbed torque $T_d = \frac{N}{n} \cdot Z \cdot 9,6$ (kNm)
- Maximum torque $T_{\max} = T_d \cdot K_s$ (kNm)

SERVICE AND LIFE FACTORS

TABLE 30

Load type	Service factors SF		
	Type of drive		
	U	M	H
Constant torque CT	1.1	1.25	1.5
With light shocks LS	1.5	1.75	2
With medium shocks MS	2	2.5	3
With high shocks HS	3	4	5
With very high shocks VHS	5	7.5	10

- Type of drive

- U** = On-going drive with low pickup torques and without reversals and/or throbs. Drives from turbines, DC motors, hydraulic motors.
- M** = On-going drive with medium pickup torques and with occasional reversals and/or low throbs. Drives from AC motors, DC motors, multi-cylinder endothermic motors.
- H** = Drive with reversal, high pickup torques and/or important throbs. Drive from AC motors, DC motors, single-cylinder endothermic motors.

- Type of drive equipment

- CT** = Electric current generators having a constant load, centrifugal pumps, conveyer belts, machine tools, wood processing equipment, medium-power fans, fluid product stirrers, heavy-duty machine tools.
- LS** = Multi-cylinder reciprocating pumps and compressors, large-power fans, edge and light section rolling mills, machine tools, viscous product stirrers, locomotives.
- MS** = Rolling mills for long products, tube rolling mills, paper milling machines, rubber calendars, flatteners, hoisting operations, transverse traverses and slippages.
- HS** = Pump and single-cylinder compressors, presses, one-way roll tables, one-way roughing mills, taking up rolls for winding reels, rotating drills, heavy-duty excavators, mixers, grinders, bending machines, locomotives, rubber stirrers, hoisting operations, transverse traverses and slippages.
- VHS** = Reversing roughing mills, reversing roll tables, scale breakers, winding reels, reciprocating shears.

TABLE 31

Deflection angle	Life factors K _L			
	3°	5°	10°	15°
General services	1	1.15	1.25	1.4
light	1.15	1.25	1.4	1.55
moderate	1.25	1.4	1.55	1.75
Industrial services heavy	1.4	1.55	1.75	1.95
very heavy	1.55	1.75	1.95	2.20
continuous heavy duty	1.75	1.95	2.20	2.45

Readings in tables 30 and 31 are given as a simple indication and should not be taken as binding: their interpolation is allowed.

SIZE SELECTION

SELECTION BASED UPON THE LOAD CAPACITY

Selection of the correct size of universal shaft will prove adequate if the following requirements are fully met:

$$T_d \times SF = T_K < M_K$$

$$T_d \times K_L = T_0 \quad \begin{array}{l} < M_{ow} \text{ for alternating torque drives} \\ < M_{psen} \text{ for pulsating torque drives} \end{array}$$

$$T_{max} < M_{cs} \quad \text{for } t = 0.5 - 1 \text{ sec.}$$

$$T_{max} < M_K \quad \text{for } t > 1 \text{ sec.}$$

SELECTION BASED ON BEARING LIFE

Selection of the correct size of universal shaft will prove adequate, if the calculated theoretical life of the bearings matches the required life.

Calculation methods, illustrated below, are based on the specifications of ISO 281 standards. Usually, the average life of bearings is approx. 4 times longer than the calculated theoretical life. When it comes to drives characterized by important torque and/or rotating speed variations, in order not to oversize the universal shaft, the average torque and/or the average speed should be used to calculate the bearing life. In case the deflection angle is smaller than 3°, as the bearing oscillations are unimportant, no life dynamic test will be required. Only the static condition shall be checked, which will be deemed properly verified if meeting the following requirements:

$$T_{max} < M_{cs} \text{ or } M_K$$

- Average torque

Stage of process	1	2	3... n
Speed (rpm)	n_1	n_2	$n_3...n_n$
Torque (kNm)	T_1	T_2	$T_3...T_n$
Time ratio (%)	t_1	t_2	$t_3...t_n$

The cubed average torque and the average speed will be:

$$T_{dA} = \sqrt[3]{\frac{\sum (T_i^3 \cdot n_i \cdot t_i + \dots + T_n^3 \cdot n_n \cdot t_n)}{\sum (n_i \cdot t_i + \dots + n_n \cdot t_n)}}$$

$$n_A = \frac{\sum (n_i \cdot t_i + \dots + n_n \cdot t_n)}{\sum (t_i + \dots + t_n)}$$

- Life check

L_{Rn} = required life (h)

L_{Ch} = calculated theoretical life (h)

n_A = average rotating speed (rpm)

β_A = average working angle (°)

T_{dA} = average working torque (kNm)

C = life constant (kNm)

R = life reduction factor ($R = a \times b$)

a = operation factor, it depends on the drive type

b = lubrication factor; it depends on the load type

TABLE 32

DRIVING MACHINE	ELECTRIC MOTOR	MULTI-CYLINDER COMBUSTION ENGINE
a	1	0.8

In case of elastic or hydraulic coupling, $a = 1$ in any case.

TABLE 33

LOAD TYPE	UNIFORM	PULSATING	ALTERNATING
b	1	0.85	0.6

- Data:

T_{dA} = average working torque (kNm)

n_A = average rotating speed (rpm)

C = life constant, function of the size of the universal shaft selected and the working angle Table 34 page 36 (kNm)

β_A = average working angle (°)

$$L_{Ch} = \frac{1.5 \cdot 10^6}{n_A \cdot T_{dA}^{10/3}} \cdot C \cdot R = (h)$$

The following outcome shall be achieved

$$L_{Ch} > L_{Rn}$$

If not, switch to the next bigger size and repeat the check.

SPECIAL SELECTIONS

- For high speed universal shafts having high deflection angle check that:

$$n_{max} < n$$

- For high speed universal shafts having long lengths check that:

$$n_{max} < 0.8 n_L$$

- For universal shafts driving horizontal displacements on rails, i.e. crane transverse traverses or locomotive drives, check that:

$$T_{slip} < M_{ow}$$

$$T_{slip} = \frac{G \cdot 9.81 \cdot \mu \cdot D \cdot N^0}{2000} = \text{kNm}$$

where: G = load on the wheel (kg)

μ = friction factor 0.14 to 0.25

D = wheel diameter (m)

N^0 = number of driven wheels

- For universal shafts driving paper mill rolls or plate stretching roll check that:

$$K > K_U$$

$$K_U = \frac{(I_n \cdot 2 \cdot \pi)^2 \cdot J_1 \cdot J_2}{(J_1 + J_2)} = \text{Nm/rad}$$

where:

K = torsional stiffness of the universal shaft, to be requested to MAINA Technical Dept. (Nm/rad)

K_U = required torsional stiffness (Nm/rad)

I_n = required frequency > 10 to 25 HZ. It is calculated for the response times of the speed adjustments of CD motors < 1 sec.

J_1 = moments of inertia from the universal shaft to the motor (kgm²)

J_2 = moments of inertia from the universal shaft to the rolls (kgm²)

SIZE SELECTION

SELECTION EXAMPLES

- I - Telescopic universal shaft for connection of a reduction gear with the first stand of a 3-high billet roughing mill.
16 hrs. of operation per day

- Selection data:

- Driven by a DC electric motor along with a flywheel on the drive shaft ($PD^2 = 2700 \text{ kgm}^2$)
- Very heavy duty industrial service
- Pulsating load with considerable shocks
- Safety high speed coupling with pre-selected shear pins set at 4 times the motor rating torque
- Motor rated load $N = 1200 \text{ kW}$
- Motor rated rotating speed $n_1 = 960 \text{ rpm}$
- Reduction gear ratio $R = 1/8$
- Rotating speed of universal shaft $n = \frac{n_1}{R} = \frac{960}{8} = 120 \text{ rpm}$
- Life requirement $> 25000 \text{ h}$
- Deflection angle 1°
- Minimum distance between centres: 445 mm
- Min. length 1310 mm, max. length 1360 mm, length compensation 50 mm

- Selecting the universal shaft

Overload factor $K_s = 5$

Load distribution factor $Z = 0.7$

Service factor $SF = 4$

Life factor $K_L = 1.4$

$$T_d = \frac{1200}{120} \cdot 0.7 \cdot 9.6 = 67 \text{ kNm}$$

$$T_{\max} = 67 \cdot 5 = 335 \text{ kNm}$$

Based upon the Table 2 of page 7 it is possible to select a universal shaft BB 39 having a flange diameter of 390 mm, a min. length of 1350 mm, a max. length of 1420 mm and a length compensation of 70 mm.

$$M_k = 302 \text{ kNm}$$

$$M_{\text{osc}} = 224 \text{ kNm}$$

$$M_{\text{cs}} = M_k \cdot 1.3 = 392.6 \text{ kNm}$$

$$T_k = T_d \cdot SF = 67 \cdot 4 = 268 \text{ kNm} < M_k$$

$$T_0 = T_d \cdot K_L = 67 \cdot 1.4 = 94 \text{ kNm} < M_{\text{osc}}$$

$$T_{\max} = 335 \text{ kNm} < M_{\text{cs}}$$

In this case the bearing life check would be left out, as the deflection angle is $< 3^\circ$.

- II - Fixed universal shaft for connection of a reduction gear with a 2-high reversing cold mill.
24 hrs. of operation per day.

- Selection data:

- Driven by a DC electric motor
- Very heavy duty industrial service
- Pulsating load with shocks and reversals
- Safety high speed coupling with quick-release device, set at 2.5 times the motor rating torque
- Motor rated load $N = 2600 \text{ kW}$
- Motor rated rotating speed $n_1 = 960 \text{ rpm}$
- Reduction gear ratio $R = 1/1.28$
- Rotating speed of universal shafts $n = \frac{n_1}{R} = \frac{960}{1.28} = 750 \text{ rpm}$
- Life requirement $> 10000 \text{ h} = L_{\text{ch}}$
- Deflection angle 4°
- Minimum distance between centres: 355 mm
- Flange-to-flange distance 2000 mm – compensating axial movement along the roll neck

- Selecting the universal shaft

Overload factor $K_s = 3$

Load distribution factor $Z = 0.66$

Service factor $SF = 5$

Life factor $K_L = 1.4$

$$T_d = \frac{2600}{750} \cdot 0.66 \cdot 9.6 = 22 \text{ kNm}$$

$$T_{\max} = 22 \cdot 3 = 66 \text{ kNm}$$

Based upon the table 3 of page 9 it is possible to select a universal shaft BC 31 having a flange diameter of 350 mm, a special length L_f 2000 mm – dynamically balanced.

$$M_k = 167 \text{ kNm}$$

$$M_{\text{osc}} = 76 \text{ kNm}$$

$$M_{\text{cs}} = M_k \cdot 1.3 = 217.1 \text{ kNm}$$

$$T_k = T_d \cdot SF = 22 \cdot 5 = 110 \text{ kNm} < M_k$$

$$T_0 = T_d \cdot K_L = 22 \cdot 1.4 = 31 \text{ kNm} < M_{\text{osc}}$$

$$T_{\max} = 66 \text{ kNm} < M_{\text{cs}}$$

From page 34 table 32 and 33, the coefficient $a = 1$ $b = 0.60$
 $R = a \cdot b = 0.6$ can be obtained.

From page 36 table 34, the life constant $C = 55000 \text{ kNm}$ can be obtained $T_{dA} = T_d; nA = n$.

The calculated theoretical life will be:

$$L_{\text{ch}} = \frac{1.5 \cdot 10^7}{n_A \cdot T_{dA}^{100}} \cdot C \cdot R = \frac{1.5 \cdot 10^7 \cdot 55000 \cdot 0.6}{750 \cdot 22^{100}} = 22000 \text{ h}$$

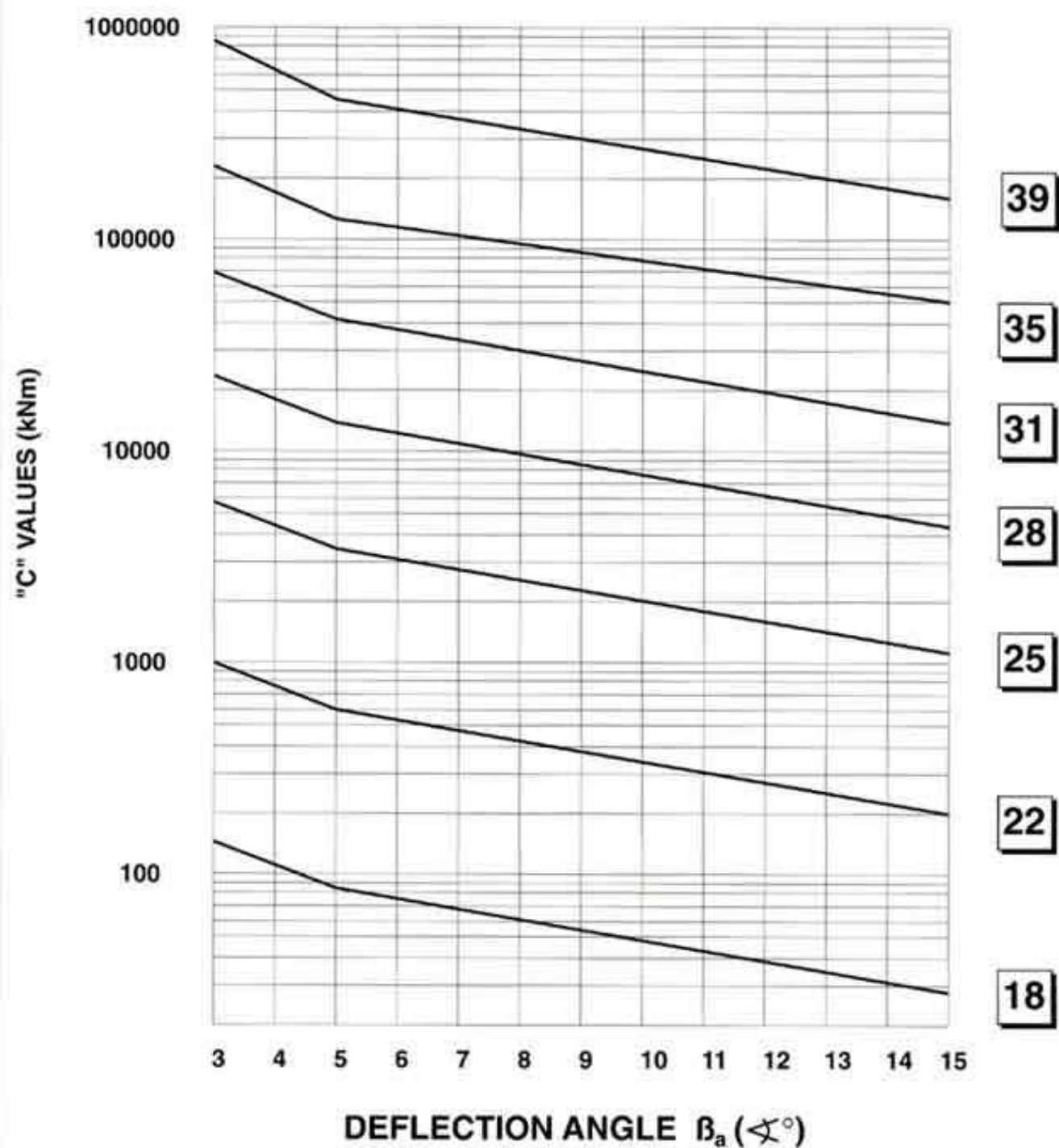
$$L_{\text{ch}} = L_{\text{ch}} \text{ as requested}$$

In this case, one will be able to rely on average life expectancies
 $= > 88000 \text{ hrs.}$

SIZE SELECTION

Table 34 shows the life constant of universal shafts as a function of the working angle.

TABLE 34

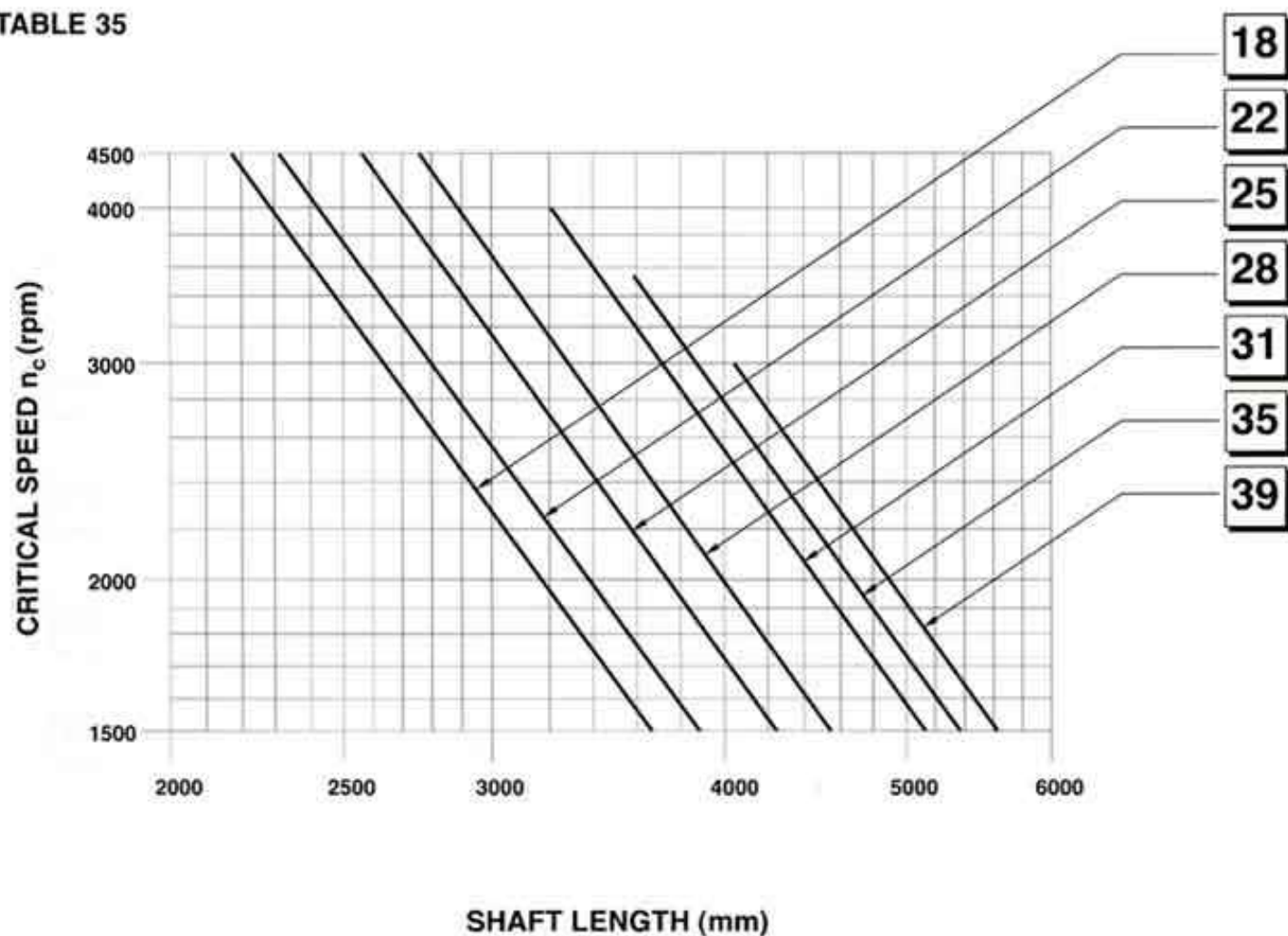


SIZE SELECTION

After choosing the type and size of universal shaft based upon its application, its performance and its life, it is necessary to ensure that the maximum rotational speed is less than 80% of the first critical bending speed.

$$n_{\max} < 0.8 n_c$$

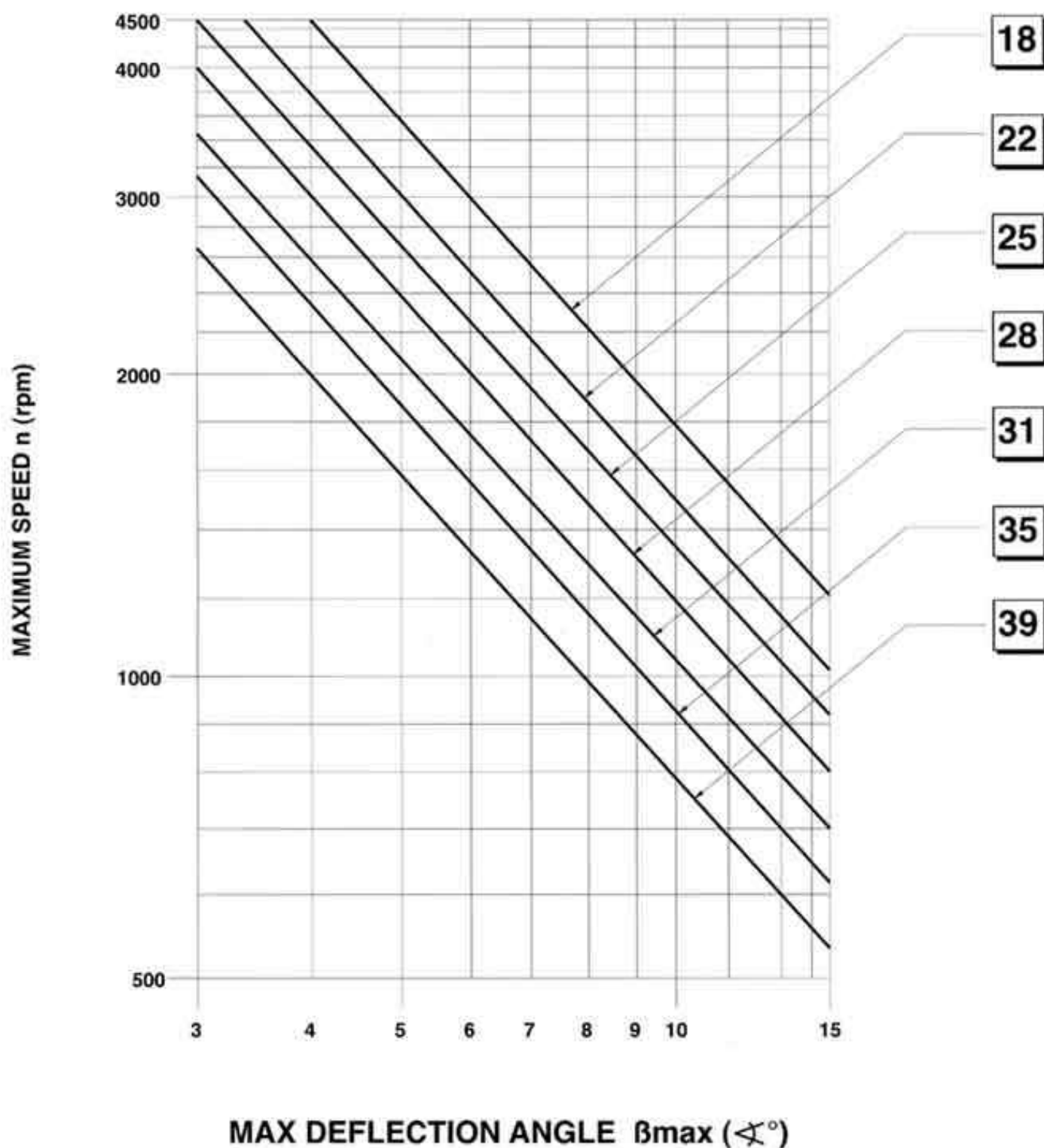
TABLE 35



SIZE SELECTION

Table 36 shows the maximum allowable speed values as a function of the working angle and the size of the universal shaft. In fact as previously stated at page 32, the intermediate shaft is subject to periodical variations of its angular speed and therefore to inertial torques increasing proportionally to the square of both the working angle and the angular speed.

TABLE 36



ENGINEERING DATA

WEIGHTS

G min = weight in [Kg] at Lz min and La min or Lf
 G La = weight in [Kg] per 100 mm lenght compensation La
 G Lz or G Lf = weight in [Kg] per 100 mm tube

TABLE 37

SIZE		18	22	25	28	31	35	39				
TYPE												
AA	Lz	795	855	985	1080	1235	1350	1495				
	La	140	145	150	155	160	170	180				
	G min	80	123	185	270	415	565	785				
	G Lz	4.4	4.8	6.4	8.0	14.1	25.5	28.1				
	G La	4.3	6.9	9.5	11.4	17.9	20.1	25.6				
AB	G	62	101	151	228	351	478	714				
AC	Lf	495	535	615	695	780	835	930				
	G min	47	78	112	171	244	331	478				
	G Lf	4.4	4.8	6.4	8.0	14.1	25.5	28.1				
AD	G	44	75	109	166	233	318	455				
SIZE		18	22	25	28	31	35	39	44	49	55	62
TYPE												
BA	Lz	795	855	985	1080	1235	1350	1495	1680	1760	1965	2250
	La	140	145	150	155	160	170	180	190	200	210	230
	G min	81	125	189	276	421	564	800	1132	1442	2039	3025
	G Lz	4.4	4.8	6.4	8.0	14.1	25.5	28.1	27.7	32.4	45.6	39.7
	G La	4.3	6.9	9.5	11.4	17.9	20.1	25.6	27.2	35.6	45.6	60.0
BB	G	63	103	155	234	357	487	729	992	1263	1782	2640
BC	Lf	495	535	615	695	780	835	930	1140	1205	1355	1530
	G min	48	80	116	176	250	340	493	722	942	1331	2130
	G Lf	4.4	4.8	6.4	8.0	14.1	25.5	28.1	27.7	32.4	45.6	39.7
BD	G	45	77	113	171	239	327	470	694	901	1269	2050
SIZE		18	22	25	28	31	35	39	44	49	55	62
TYPE												
CA	Lz	795	855	985	1080	1235	1350	1495	1680	1760	1965	2250
	La	140	145	150	155	160	170	180	190	200	210	230
	G min	84	127	193	280	427	572	812	1139	1456	2059	3065
	G Lz	4.4	4.8	6.4	8.0	14.1	25.5	28.1	27.7	32.4	45.6	39.7
	G La	4.3	6.9	9.5	11.4	17.9	20.1	25.6	27.2	35.6	45.6	60.0
CB	G	66	105	159	238	363	495	741	999	1277	1802	2680
CC	Lf	495	535	615	695	780	835	930	1140	1205	1355	1530
	G min	51	82	120	180	256	348	505	729	956	1351	2170
	G Lf	4.4	4.8	6.4	8.0	14.1	25.5	28.1	27.7	32.4	45.6	39.7
CD	G	48	79	117	175	245	335	482	701	915	1289	2050

EXAMPLE: BA25 Lz' = 1300 La' = 250

$$m = G \min + G Lz \cdot \frac{(Lz' - Lz)}{100} + G La \cdot \frac{(La' - La)}{100} = 189 + 6.4 \cdot \frac{(1300 - 985)}{100} + 9.5 \cdot \frac{(250 - 150)}{100} = 219 \text{ Kg}$$

ENGINEERING DATA

GREASE QUANTITIES

Q min = quantity of grease in [Kg] at Lz min and La min for lenght compensator
 Q La = quantity of grease in [Kg] per 100 mm lenght compensation La
 Q bearing = quantity of grease in [Kg] for 8 bearings
 Q min, Q La, Q bearing are quantities of reference

SIZE		18	22	25	28	31	35	39	44	49	55	62
TYPE												
AA BA CA	La	140	145	150	155	160	170	180	190	200	210	230
	Q min	0.9	0.7	1.1	1.4	2.7	3.7	8.2	10.7	7.1	17.0	20.0
	Q La	0.35	0.30	0.40	0.75	0.70	1.00	1.20	2.65	1.95	2.06	2.50
ALL TYPES	Q bearing	0.05	0.07	0.16	0.28	0.40	0.68	0.92	1.40	1.85	2.4	3.5

EXAMPLE: BA25 Lz' = 1300 La' = 250

0.16 Kg of grease for 8 bearings. For the lenght compensator:

$$Q = Q \min + Q La \cdot \frac{(La' - La)}{100} = 1.1 + 0.4 \cdot \frac{(250 - 150)}{100} = 1.5 \text{ Kg of grease}$$

MASS MOMENTS OF INERTIA

ENGINEERING DATA

J min = mass moment of inertia in [Kg m²] at Lz min and La min or Lf
 J La = mass moment of inertia in [Kg m²] per 100 mm length compensation La
 J Lz or J Lf = mass moment of inertia in [Kg m²] per 100 mm tube

TABLE 38

SIZE		18	22	25	28	31	35	39
TYPE								
AA	Lz	795	855	985	1080	1235	1350	1495
	La	140	145	150	155	160	170	180
	J min	0.2248	0.5152	0.9791	1.9124	3.7851	6.5390	11.448
	J Lz	0.0176	0.0234	0.0422	0.0696	0.1875	0.4367	0.5762
	J La	0.0038	0.0094	0.0183	0.0264	0.0645	0.0809	0.1337
AB	J	0.1827	0.4530	0.8470	1.7017	3.2718	5.7159	10.494
AC	Lf	495	535	615	695	780	835	930
	J min	0.1492	0.3887	0.7005	1.4221	2.4648	4.2799	7.6847
	J Lf	0.0176	0.0234	0.0422	0.0696	0.1875	0.4367	0.5762
AD	J	0.1394	0.3759	0.6761	1.3808	2.3490	4.0840	7.2083

SIZE		18	22	25	28	31	35	39	44	49	55	62
TYPE												
BA	Lz	795	855	985	1080	1235	1350	1495	1680	1760	1965	2250
	La	140	145	150	155	160	170	180	190	200	210	230
	J min	0.2275	0.5240	1.0001	1.9495	3.835	6.6307	11.6501	21.0589	32.5762	58.5372	111.374
	J Lz	0.0176	0.0234	0.0422	0.0696	0.1875	0.4367	0.5762	0.7205	0.8843	1.5793	1.604
	J La	0.0038	0.0094	0.0183	0.0264	0.0645	0.0809	0.1337	0.15	0.256	0.4224	0.7618
BB	J	0.1854	0.4618	0.868	1.7388	3.3217	5.8076	10.6961	18.9479	29.7552	53.2112	97.3382
BC	Lf	495	535	615	695	780	835	930	1140	1205	1355	1530
	J min	0.1519	0.3975	0.7215	1.4592	2.5147	4.3716	7.8868	15.0669	24.6962	44.0222	91.2352
	J Lf	0.0176	0.0234	0.0422	0.0696	0.1875	0.4367	0.5762	0.7205	0.8843	1.5793	1.6088
BD	J	0.1421	0.3847	0.6971	1.4179	2.3989	4.1757	7.4104	14.3259	23.5512	41.8252	88.5122

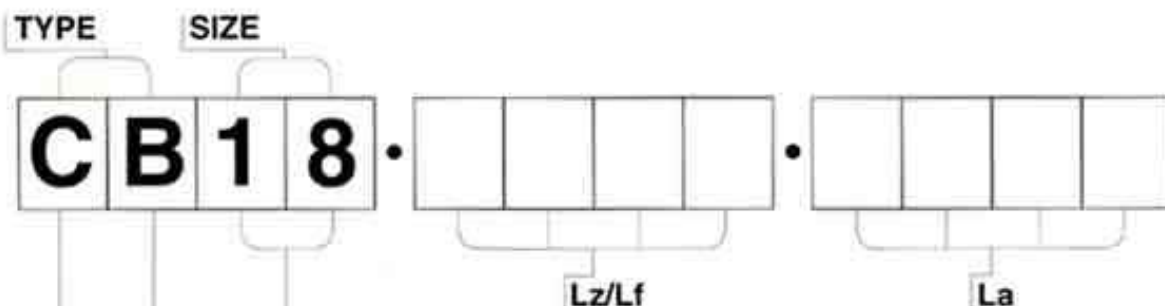
SIZE		18	22	25	28	31	35	39	44	49	55	62
TYPE												
CA	Lz	795	855	985	1080	1235	1350	1495	1680	1760	1965	2250
	La	140	145	150	155	160	170	180	190	200	210	230
	J min	0.2615	0.5575	1.0857	2.0517	4.039	6.9691	12.2931	21.7275	34.3622	61.7192	116.404
	J Lz	0.0176	0.0234	0.0422	0.0696	0.1875	0.4367	0.5762	0.7205	0.8843	1.5793	1.604
	J La	0.0038	0.0094	0.0183	0.0264	0.0645	0.0809	0.1337	0.15	0.256	0.4224	0.7616
CB	J	0.2194	0.4953	0.9536	1.841	3.5257	6.146	11.3391	19.6165	31.5412	56.3932	106.3382
CC	Lf	495	535	615	695	780	835	930	1140	1205	1355	1530
	J min	0.1859	0.431	0.8071	1.5614	2.7187	4.71	8.5298	15.7355	26.4822	47.2042	96.265
	J Lf	0.0176	0.0234	0.0422	0.0696	0.1875	0.4367	0.5762	0.7205	0.8843	1.5793	1.608
CD	J	0.1761	0.4182	0.7827	1.5201	2.6029	4.5141	8.0534	14.9945	25.3372	45.0072	93.5422

EXAMPLE: BA25 Lz' = 1300 La' = 250

$$J = J_{\min} + J_{Lz} \cdot \frac{(Lz' - Lz)}{100} + J_{La} \cdot \frac{(La' - La)}{100}$$

$$J = 1.0001 + 0.0422 \cdot \frac{(1300 - 985)}{100} + 0.0183 \cdot \frac{(250 - 150)}{100} = 1.1513 \text{ Kg m}^2$$

UNIVERSAL SHAFT IDENTIFICATION



SERIES	
A	LIGHT
B	MEDIUM - STANDARD FLANGES
C	MEDIUM - LARGER FLANGES
D	HEAVY
E	VERTICAL - STANDARD FLANGE
F	EXTRA HEAVY
G	HEAVY - LARGER FLANGES
H	VERTICAL - LARGER FLANGE
J	EXTRA HEAVY - LARGER FLANGES

EXAMPLE OF IDENTIFICATION:

UNIVERSAL SHAFT WITH LENGTH COMPENSATION
MEDIUM LARGER FLANGES SHORT DESIGN. SIZE 18
COLLAPSED LENGTH $L_z = 795$. SLIDE $L_s = 140$.
CODE: CB18.0795.0140

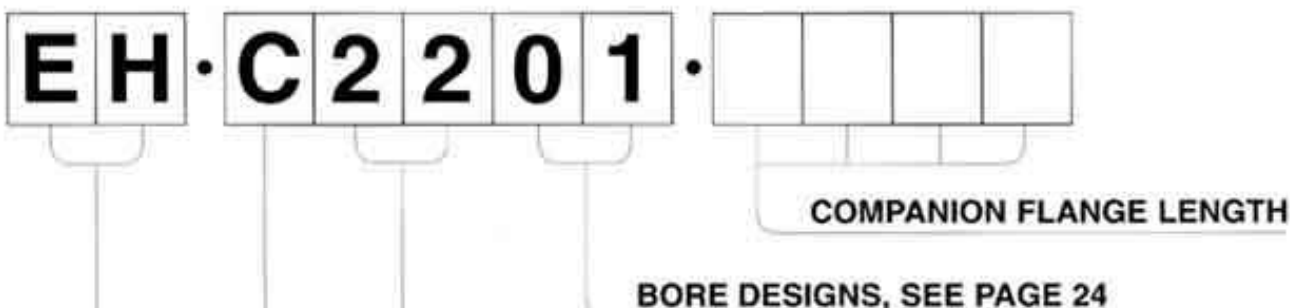
EXECUTION (SERIES A,B,C)	
A	Telescopic Shaft, medium length compensation
B	Telescopic Shaft, short design
C	Fixed length Shaft, tubular design
D	Fixed length Shaft, short design
E	Telescopic Shaft, long length compensation, or high torsional stiffness or special arrangement
F	Telescopic Shaft, medium length compensation (flanged intermediate assembly)
G	Fixed length Shaft, flanged tubular design
H	Fixed length Shaft, flanged short design
J	Telescopic Shaft, long length compensation, or high torsional stiffness or special arrangement (flanged intermediate assembly)
K	Flanged Joint

EXECUTION (SERIES D, G, F, J)	
A	Telescopic Shaft
C	Fixed length Shaft, tubular design
D	Fixed length Shaft, short design
F	Telescopic Shaft, flanged intermediate design
G	Fixed length Shaft, flanged tubular design
H	Fixed length Shaft, flanged short design
K	Flanged Joint
L	Fixed length Shaft, intermediate shaft design
M	Telescopic Shaft, intermediate tubular design

EXECUTION (SERIES E, H)	
A	Telescopic Shaft, standard type (external flange)
B	Telescopic Shaft, standard type (internal flange)
C	Telescopic Shaft, reversed type (external flange)
D	Telescopic Shaft, reversed type (internal flange)

SERIES A	SIZE	18	22	25	28	31	35	39					
SERIES B - C	SIZE	18	22	25	28	31	35	39	44	49	55	62	
SERIES D - G	SIZE	60	65	70	75	80	85	90	95	100	105	110	115
SERIES F - J	SIZE	60	65	70	75	80	85	90	95	100	105	110	115
SERIES E - H	SIZE	18	22	25	28	31	35	39	44	49	55		

COMPANION FLANGES IDENTIFICATION



E A	COMPANION FLANGE WITH INNER CENTERING, WITHOUT KEY	PAG. 16
E B	COMPANION FLANGE WITH INNER CENTERING, ACCORDING TO DIN 15452	PAG. 16
E C	COMPANION FLANGE WITH INNER CENTERING, WITH KEY, STANDARD TYPE	PAG. 16
E D	COMPANION FLANGE WITH INNER CENTERING, WITH KEY, LARGER TYPE	PAG. 16
E E	COMPANION FLANGE WITH OUTER CENTERING, WITHOUT KEY	PAG. 16
E F	COMPANION FLANGE WITH OUTER CENTERING, ACCORDING TO DIN 15452	PAG. 16
E G	COMPANION FLANGE WITH OUTER CENTERING, WITH KEY, STANDARD TYPE	PAG. 16
E H	COMPANION FLANGE WITH OUTER CENTERING, WITH KEY, LARGER TYPE	PAG. 16
E J	CYLINDRICAL COMPANION FLANGES WITH INNER CENTERING, WITHOUT KEY	PAG. 20
E K	CYLINDRICAL COMPANION FLANGES WITH INNER CENTERING, WITH KEY, STANDARD TYPE	PAG. 20
E L	CYLINDRICAL COMPANION FLANGES WITH INNER CENTERING, WITH KEY, LARGER TYPE	PAG. 20
E M	CYLINDRICAL COMPANION FLANGES WITH OUTER CENTERING, WITHOUT KEY	PAG. 22
E N	CYLINDRICAL COMPANION FLANGES WITH OUTER CENTERING, WITH KEY, STANDARD TYPE	PAG. 22
E P	CYLINDRICAL COMPANION FLANGES WITH OUTER CENTERING, WITH KEY, LARGER TYPE	PAG. 22

SERIES	
A	LIGHT
B	MEDIUM - STANDARD FLANGES
C	MEDIUM - LARGER FLANGES
D	HEAVY
E	VERTICAL - STANDARD FLANGES
F	EXTRA HEAVY
G	HEAVY - LARGER FLANGES
H	VERTICAL - LARGER FLANGES
J	EXTRA HEAVY - LARGER FLANGES

EXAMPLE OF IDENTIFICATION:

COMPANION FLANGE WITH OUTER CENTERING, WITH KEY, LARGER TYPE
 UNIVERSAL SHAFT SERIES "C"
 SIZE 22, BORE DESIGN 01, LENGTH 295
 CODE: EH.C2201.0295

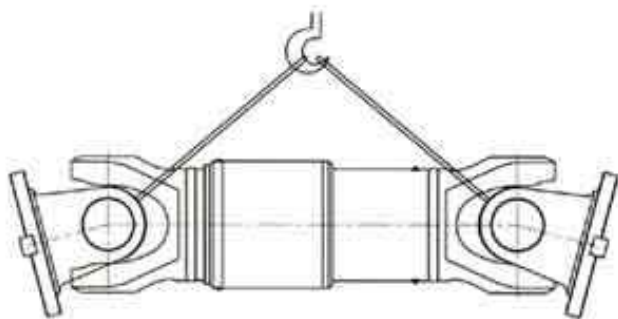
SERIES A	SIZE	18	22	25	28	31	35	39					
SERIES B - C	SIZE	18	22	25	28	31	35	39	44	49	55	62	
SERIES D - G	SIZE	60	65	70	75	80	85	90	95	100	105	110	115
SERIES F - J	SIZE	60	65	70	75	80	85	90	95	100	105	110	115
SERIES E - H	SIZE	18	22	25	28	31	35	39	44	49	55		

INSTALLATION, MAINTENANCE AND LUBRICATION

1) TRANSPORT AND STORAGE

1.1 MAINA universal shafts are supplied balanced (if necessary) and, unless otherwise requested, painted (coat of primer + final color) according to MAINA specification PVA 700. Bearings and shafts are pre-lubricated.

1.2 Lift horizontally, using suitable nylon ropes. If handling in a vertical plane, secure the shaft in order to prevent the splined parts from separating, before lifting.



1.3 Transport and store in horizontal position. The lifting equipment have to be selected according to the weights shown in our drawings or in our catalogue.

1.4 Do not hang or transport in vertical position. For vertical transport it is necessary to require a special safeguard to keep the parts together.

1.5 Packings must be able to avoid any impact to the universal shafts and must protect them from any environmental event and from humidity and condensate.

1.6 Store preferably on suitable wooden frames. Shocks and impacts, during transport and storage, could damage bearings, splined parts and their protective caps.

1.7 For long period of storage, machined parts should be protected against corrosion.

1.8 On request MAINA can provide 2 types of antioxidant protection as follows:

- a) **indoor storage, short period (max 1 month)**, with an oil based, transparent, amber film, which need not be removed before installation;
- b) **indoor storage, medium period or shipment by sea (max 3 months)** with a dry, wax based, transparent film, which must be removed with a solvent, before installation.

For longer storage it is necessary to check the surface conditions and eventually cover with a new protection film.

1.9 For long storage (exceeding three months) relubricate bearings and length compensator, before installation.

2) ASSEMBLY

2.1 Before assembling, flanges and companion flanges must be thoroughly cleaned to guarantee a perfect contact between each surface.

2.2 Balance weights should never be removed.

2.3 Splined parts must never be disassembled, to avoid interchanging, with consequent misalignment and unbalance of the unit.

2.4 The universal shaft yokes must be aligned. Check the arrow markings.

2.5 In the companion flanges, the coaxial tolerance of centering and the perpendicular position must be in a restricted range.

2.6 Heat the companion flanges uniformly (100 + 150 °C) for key fitting and (300 + 350 °C) for shrink fitting before assembling onto shafts. Wait for the complete cooling of companion flanges, before assembling the universal flanges. Ask for MAINA specification PFB 1202 (in case of shrink fitting) and PFB 1100 (in case of key fitting).

2.7 The companion flanges must be firmly fixed and centered onto the shaft.

Check that:

- no backlash is present,
- no end float is present,
- keys or splined shafts have no clearance on their flanks.

INSTALLATION, MAINTENANCE AND LUBRICATION

- 2.8** Check that the dimensions between shaft ends (minimum and maximum distances) are in accordance to MAINA drawings.

NOTE:

When installing fixed length universal shafts, one of the units must be free to move, to compensate slight length variation, due to manufacturing tolerances or temperature changes.

- 2.9 WHEREVER PEOPLE OR MATERIAL COULD BE ENDANGERED BY OPERATING UNIVERSAL SHAFTS, SAFETY DEVICES MUST BE PROVIDED BY THE USER, FOLLOW APPLICABLE SAFETY CODES AND REGULATIONS.**

- 2.10** Before fitting the joint flanges it is necessary to clean accurately their surfaces. They must be free from grease, coat or rust.

- 2.11** Complete flange bolting sets are available on request. MAINA normally provide:

- hexagon or cylindrical headed bolts (in accordance to DIN 931 - 12.9 or 10.9)
- self-locking nuts (according to DIN 980 - 10 or 8).

The bolts are to be tightened with a dynamometrical wrench or another similar device, in accordance to the torque table of page 28 or our drawings.

Normally the bolts are inserted from the companion flange side, fitting the tightening nuts on the flanges of the universal shaft. In special cases it is also possible to insert the bolts from the joint side or to use stud bolts.

NOTE:

DO NOT LUBRICATE THE BOLTS OR NUTS WITH LUBRICANTS CONTAINING MoS₂.

- 2.12** Bearings and length compensator have been pre-lubricated at our workshop and do not require lubrication before installation in case of short period of storage. See section "LUBRICATION" for types of lube and intervals of lubrication.

- 2.13** If the setting at work takes place three months later than assembly, check the conditions of universal shafts and relubricate.

- 3.2** MAINA recommend the following lubrication intervals:

- FIRST YEAR

Every 200÷350 hours of actual operation time.

- AFTER FIRST YEAR

For normal applications every 2000÷3000 hours or every six months.

For heavy duty applications every 500÷1000 hours or every two or three months.

The intervals depend on frequency of impacts, level of load, environmental conditions, rotating speed, reversing operation, operating angle, seal condition, frequency of shaft movements, length of stroke, movements under/no load. Particularly unfavourable working conditions may require shorter grease intervals.

- 3.3** The lubrication points of standard universal shafts are placed respectively

- in the centre of journal cross or on each bearing bottom, to lubricate the bearings
- on the spacer and on the cover to lubricate the length compensator.

3.4 NOTE:

- a) When regreasing, use a compatible lubricant.
- b) Grease nipples must be cleaned before greasing.
- c) Do not lubricate with too high pressure:
MAXIMUM PERMISSIBLE GREASE PRESSURE 6 BAR.
- d) Pump the grease in the bearings until the old lubricant flows out of seals or relief valves.
- e) Spacer side containing the splined shaft must be completely filled with grease. Lubricate in the minimum length compensation position.
Do not pump more grease than required in the drawing. After lubricating make the spline slide with opened plugs once or twice.

4) LUBRICANTS

- 4.1** For normal applications MAINA recommend mainly lithium thickened greases.

- 4.2** For temperature ranges from +90 to -30°C, use grease with Penetration 1 or 2, according to DIN 51804. Please contact MAINA if the temperature is outside this range.

3) LUBRICATION

- 3.1** The performance and working life of universal shafts greatly depend on a lubrication programme.
Do not let the spline slide before lubricating it.

INSTALLATION, MAINTENANCE AND LUBRICATION

- 4.3** For very important heavy duties MAINA recommend the following specification of lubricant:

Thickener	lithium
Worked penetration	315÷325 possible 265÷295
Dropping point	174÷193°C possible 185°C
Thickener percentage	7%
Mineral oil	75%
Oil viscosity at 38°C	1500÷2000 SSU
Oil viscosity at 99°C	150÷210 SSU
Addition agents EP type	2%
MoS ₂ mineral addendum	5÷10%
Timken EP OK load	18 Kg
Corrosion	negative

MAINA recommend the following greases for universal shaft size equal to or bigger than size 39 and for heavy duty conditions (rolling stand):

TRIBOL	MOLUB-ALLOY 870 MILL GREASE
WULKEN	MOLUBROL W/PA10
OPTIMOL	LONGTIME PD2
KLUBER	KLUBERLUB BE41-1501
MOBIL	MOBILUX EP111
SIGNAL	MOLYVIS GLA SPECIAL

Greases must also:

- contain oxidation inhibitors
- be water-repellent
- be free of alkalis, acids, impurities
- have a good thermal stability

- 4.4** For high operation speed (>500 rpm), the addition agents must have a good resistance to centrifugation.
- 4.5** For moderate industrial services MAINA recommend the following greases:

BP	ENERGREASE LS2
ESSO	BEACON EP2
SHELL	ALVANIA EP2
MOBIL	MOBILUX 2
TEXACO	MULTIFAK EP2

Synthetic greases may also be used.

- 4.6** The right type of grease to employ is shown in the drawing. For grease quantity see page 39.

5) MAINTENANCE

- 5.1** To ensure a trouble-free life of the universal shafts, a maintenance schedule and lubrication programme are essential.

The following should be taken as a guide, the frequency of inspections depending on working conditions and type of equipment the universal shafts are installed on.

5.2 INITIAL INSPECTION

- 1st check after approx 1 week
- 2nd check after approx 2÷3 weeks
- 3rd check after approx 4÷6 weeks

5.3 REGULAR INSPECTION

Every 1000÷2000 working hours or, at least, once a year for light applications and every six months for heavy duty applications.

The periodical checks are to be carried out as follows:

- 1) Bolts**
Tighten when necessary.
- 2) Wear**
Check the following:
 - radial clearance of bearings
 - end float of the journal cross
 - radial clearance of the slip stub shaft
 - torsional clearance of the slip stub shaft
- 3) Noise/Vibration**
Any unusual sound or excessive vibrations should be located and corrected immediately.
- 4) Temperature**
Make sure that bearings do not exceed the ambient temperature by more than 35÷40°C.
- 5) Position of the companion flanges**
Check that the supports have not yielded because of base settlements or deformations.
- 6) Lubrication**
Check that no grease dripping is present, due to centrifugation or other causes, i.e. wear or breakage of seals, wear or loss of grease nipples, plugs or relief valves.

For any further information about installation, maintenance and lubrication, ask for MAINA specification PFB 1400 (series A-B-C-E-H) and PFB 1403 (series D-G-F-J).

SPARE PARTS IDENTIFICATION

DB · B 2 2 0 1 ·

FLANGE DIAMETER

FLANGED YOKE DESIGNS

- 01 WITH KEY
- 02 HIRTH
- 03 DOG TEETH

D A	KEY
D B	FLANGED YOKE
D C	HEXAGONAL BOLT / STUD BOLT

As far as the flanged yoke with larger flange than the corresponding of series C, G, J is concerned, it is necessary to add in the code the flange diameter.

SERIES			
A	LIGHT	D	HEAVY
B	MEDIUM - STANDARD FLANGES	E	VERTICAL - STANDARD FLANGES
C	MEDIUM - LARGER FLANGES	F	EXTRA HEAVY
G	HEAVY - LARGER FLANGES	H	VERTICAL - LARGER FLANGES
J	EXTRA HEAVY - LARGER FLANGES		

EXAMPLE OF IDENTIFICATION:
FLANGED YOKE WITH KEY
UNIVERSAL SHAFT SERIES "C"
SIZE 22 FLANGE DIAMETER = 285
CODE: DB.C2201.285

EXAMPLE OF IDENTIFICATION:
FLANGED YOKE WITH KEY
UNIVERSAL SHAFT SERIES "B"
SIZE 22
CODE: DB.B2201

DD · 0 2 2

D D	JOURNAL CROSS WITH BEARINGS
D E	JOURNAL CROSS
D F	YOKE WITH SPLINED MALE

SERIES	
0	SERIES A, B, C, D, F, G, J
1	SERIES E, H

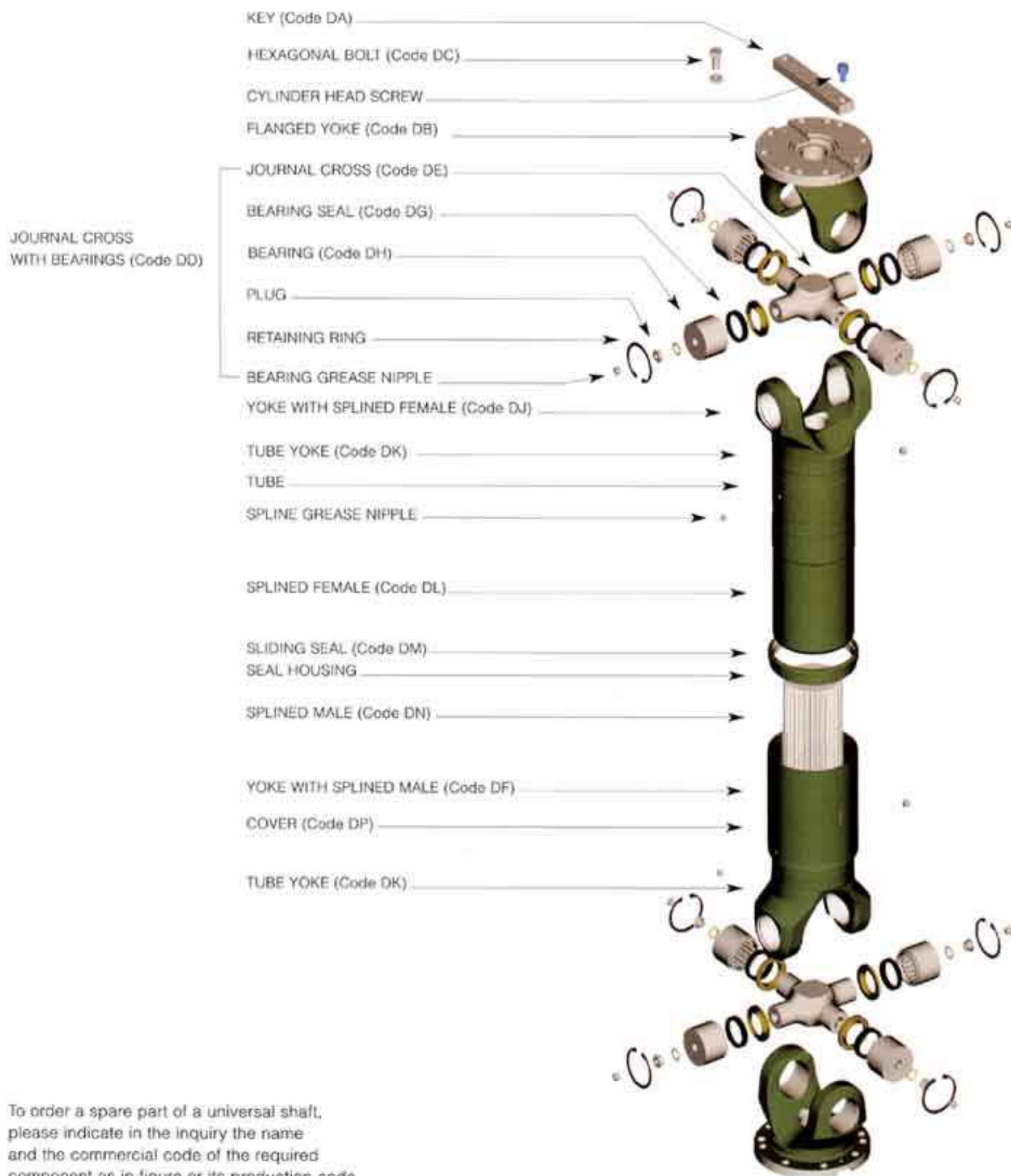
DG · 0 2 2

D G	BEARING SEAL	D Q	HOLLOW EXTERNAL YOKE
D H	BEARING	D R	HOLLOW INTERNAL YOKE
D J	YOKE WITH SPLINED FEMALE	D S	BEARING COVER
D K	TUBE YOKE	D T	COVER CAP SCREW
D L	SPLINED FEMALE	D U	THRUST BEARING
D M	SLIDING SEAL	D V	SYNTHETIC DISC
D N	SPLINED MALE	D W	ANTI-PIERCING BEARING DEVICE
D P	COVER		

SERIES	
0	ALL SERIES

SERIES A	SIZE	18	22	25	28	31	35	39					
SERIES B - C	SIZE	18	22	25	28	31	35	39	44	49	55	62	
SERIES D - G	SIZE	60	65	70	75	80	85	90	95	100	105	110	115
SERIES F - J	SIZE	60	65	70	75	80	85	90	95	100	105	110	115
SERIES E - H	SIZE	18	22	25	28	31	35	39	44	49	55		

SPARE PARTS IDENTIFICATION



To order a spare part of a universal shaft, please indicate in the inquiry the name and the commercial code of the required component as in figure or its production code indicated in the assembly drawing.

TECHNICAL DATA FOR SELECTION

UNIVERSAL SHAFTS FOR GENERAL MACHINERY APPLICATION

Installation

Kind of installation
 Kind of operation
 Shocks
 Reversing service
 Intermitted service
 Ambient conditions
 Ambient temperature

Motor

Type
 Torque Nm
 at speed rpm
 Power range kW
 Speed range rpm
 Max continuous torque kNm
 Cut out torque kNm
 Shaft end diameter mm – length mm

Intermediate gear

Type of clutch/flexible coupling
 Ratio
 Number of inputs
 Number of outputs
 input shaft end diameter mm – length mm
 Output shaft end diameter mm – length mm
 Max perm. input universal shaft diameter mm
 Max perm. output universal shaft diameter mm

Universal shaft

Position of universal shaft
 Normal working torque kNm
 Max working torque kNm
 Impact torque kNm
 Cut out torque kNm
 Speed range rpm
 Working length min/max mm
 Max movement mm
 Working deflection angle – horizontal vertical
 Universal shaft connection – flange ☐ hub ☐
 Input shaft end diameter mm – length mm
 Required universal shaft size