UNIVERSAL SHAFTS

ORGANI DI TRASMISSIONE

250 F

SISTEMA QUALITÀ CERTIFICATO UNI EN ISO 9001/2000 SINCERT DNV

OUR PRODUCTION PROGRAM

GEAR SPINDLES	CATALOGUE 197 C
GEAR REDUCERS	CATALOGUE 260 B
GEAR COUPLINGS	CATALOGUE 270 C
HIGH SPEED GEAR COUPLINGS	CATALOGUE 272 B

CONTENTS

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.
Our engineers are however always at your disposal to make suggestions for your choice and provide you with any further information requested.

The present edition supersedes any previous edition.

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

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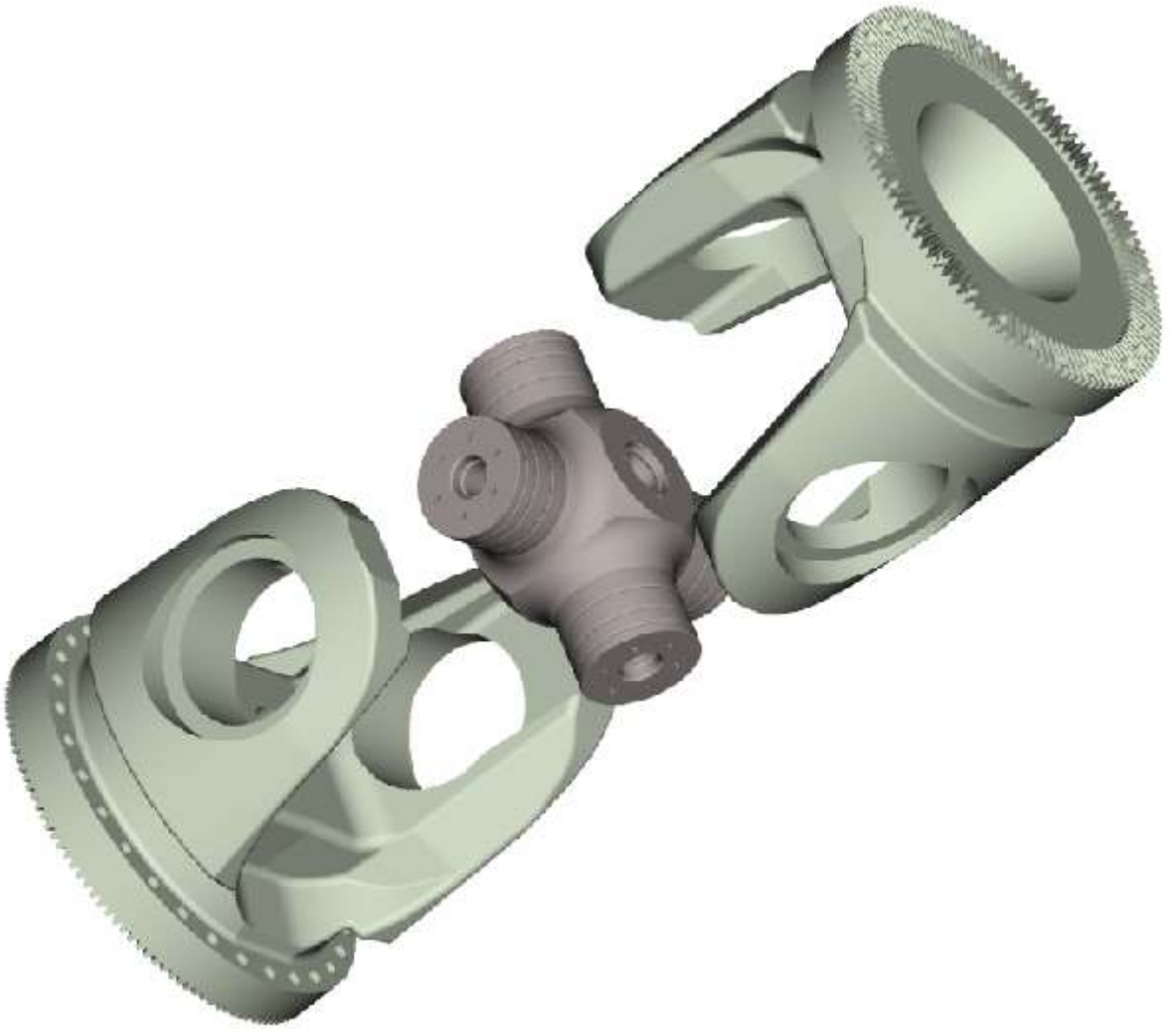
ENGINEERING AND MANUFACTURING

MAINA PATTERN IS GUARANTEED BY:

Design and experience we have made in cooperation with all the industrial plant 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 customer's requirements, yet maintaining the basis project features.

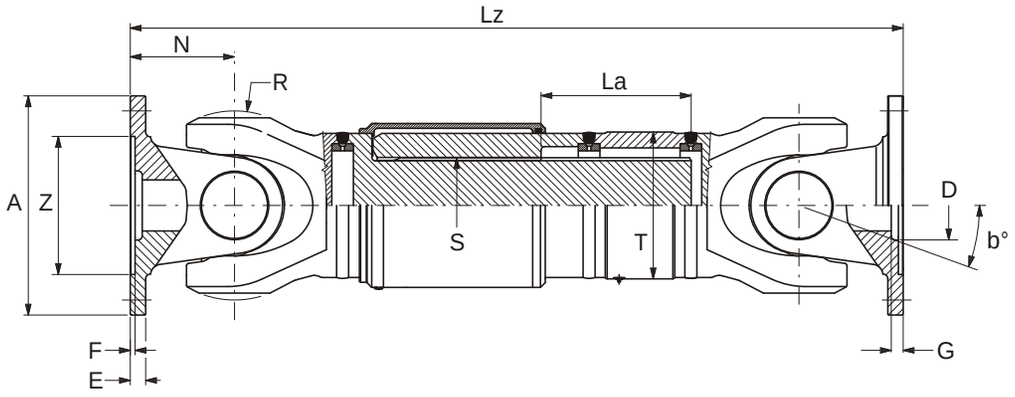


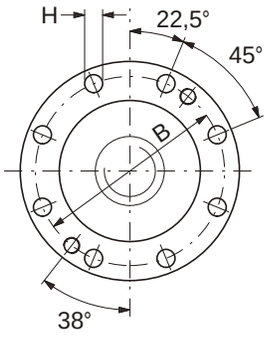
SERIES A

ENGINEERING DATA

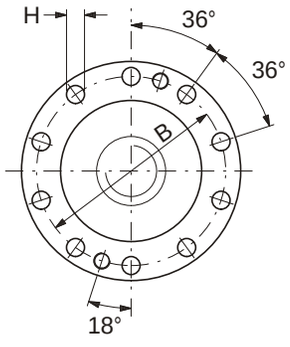
TYPE

AA

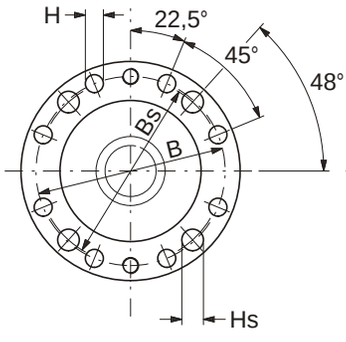




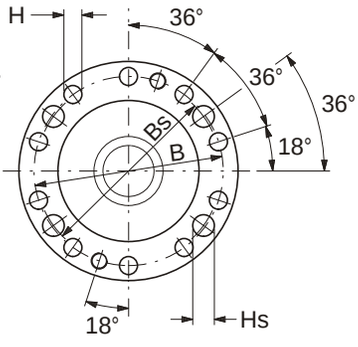
SIZE 18 - 28
8 HOLES



SIZE 31 - 39
10 HOLES



SIZE 18 - 28
8 HOLES

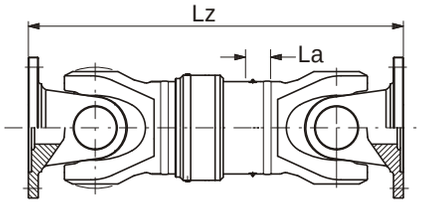


SIZE 31 - 39
10 HOLES

STANDARD FLANGE CONNECTION

TYPE

AB



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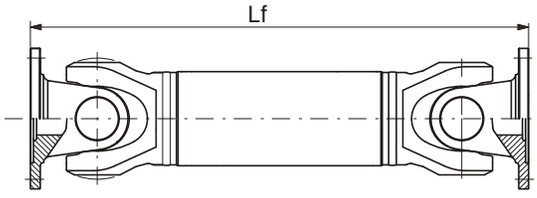

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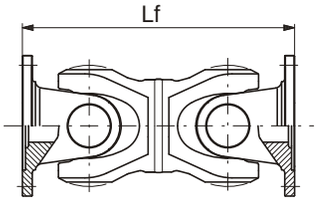

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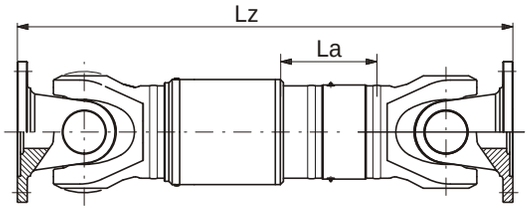
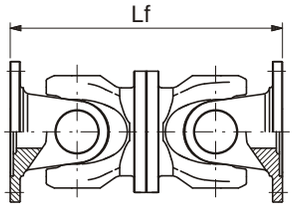


DOWEL PIN CONNECTION ACCORDING TO DIN 15451

AH



ENGINEERING DATA — SERIES A

TYPE

AA - Telescopic Shaft, medium length compensation
AB - Telescopic Shaft, short length compensation, short design
AC - Fix Length Shaft, tubular design
AD - Fix Length Shaft, short design
AE - Telescopic Shaft, long length compensation
AH - Fix Length Shaft, flange short design

TABLE 1

SIZE			18	22	25	28	31	35	39
RATING TORQUES									
Mk ⊛		[kNm]	21	40	48	71	103	146	196
MDSch ⊛		[kNm]	15	26	38	58	85	116	156
MDW ⊛		[kNm]	10	18	24	37	54	76	103
STANDARD DIMENSIONS									
A ①		[mm]	225	250	285	315	350	390	435
b°		◁°	15	15	15	15	15	15	15
B ②		[mm]	196	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 ③			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	1350	1495
	La std	[mm]	140	145	150	155	160	170	180
	Lz max	[mm]	1205	1310	1485	1625	1875	2080	2315
	La max	[mm]	550	600	650	700	800	900	1000
AB	Lz min	[mm]	615	685	795	900	1045	1175	1350
	La std	[mm]	40	50	50	60	65	65	70
AC	Lf	[mm]	495	535	615	695	780	835	930
	Lf max	[mm]	1205	1310	1485	1625	1875	2080	2315
	Lf lim	[mm]	3280	4000	4720	5020	5740	6450	7170
AD	Lf	[mm]	440	480	560	640	720	780	840
AE	Lz min	[mm]	985	1050	1180	1295	1495	1620	1775
	La std	[mm]	280	290	300	310	320	340	360
	Lz max	[mm]	1505	1610	1880	2085	2375	2680	2915
	La max	[mm]	800	850	1000	1100	1200	1400	1500
	Lz lim	[mm]	3280	4000	4720	5020	5740	6450	7170
AH	Lf	[mm]	440	480	560	640	720	780	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 ≠ Lz min, then Lz = Lz min + (La - La std)
Lz max, Lz lim, Lf max, Lf lim valid if max allowable speed or torsional stiffness do not create any problem.

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

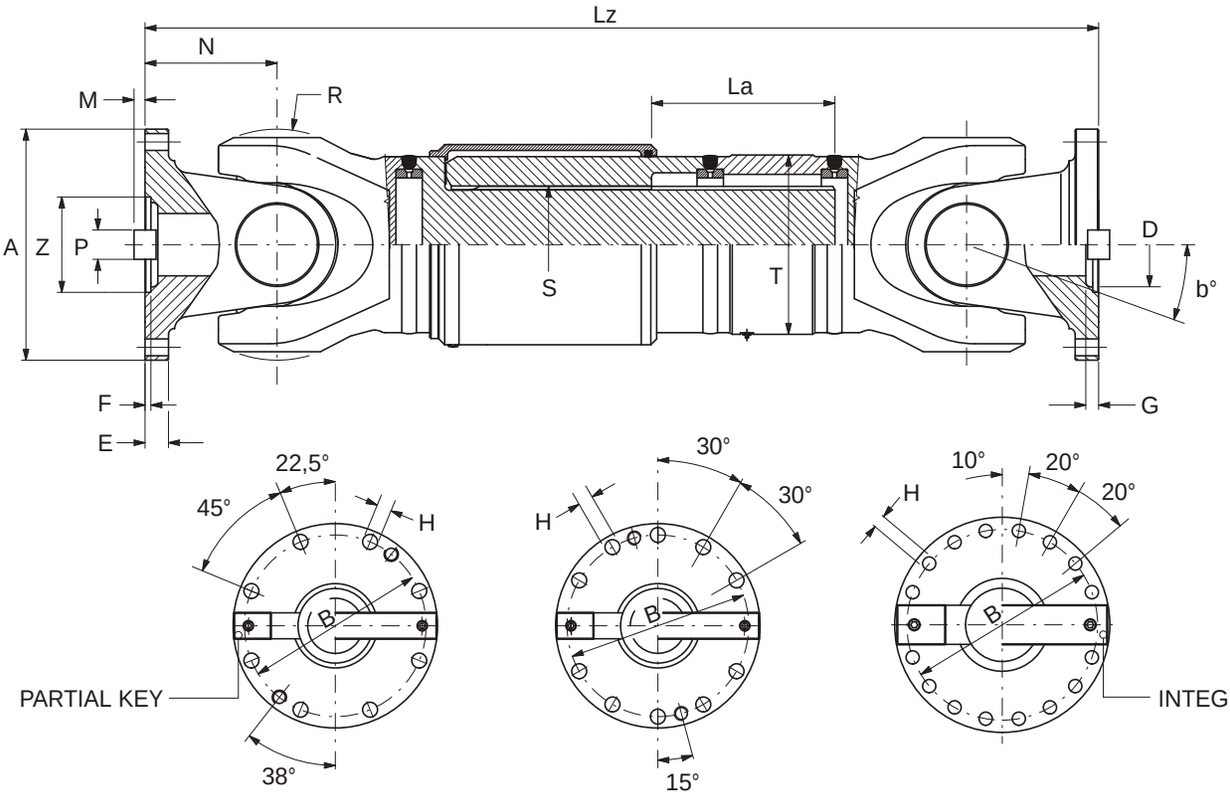
① When required tolerance h7
② Tolerance ± 0.1 mm
③ Male and female splined shaft nitrided
⊛ Torque transmission capacity is restricted by state and type of flange connection.

SERIES B

ENGINEERING DATA

TYPE

BA



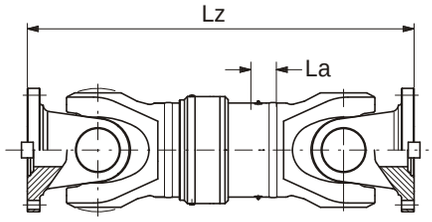
SIZE 18 - 28
8 HOLES

SIZE 31 - 39
10 HOLES

SIZE 44 - 62
16 HOLES

TYPE

BB



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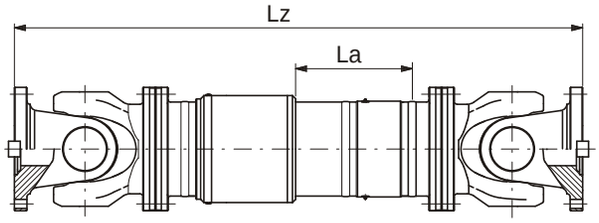

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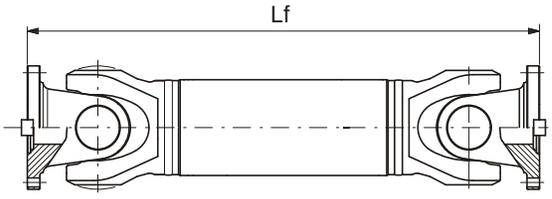
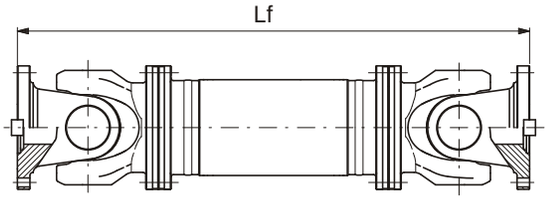


BG



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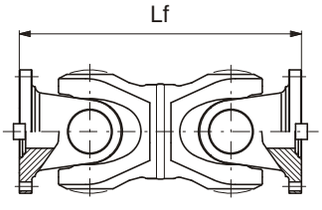

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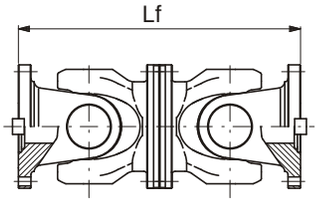

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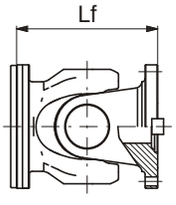

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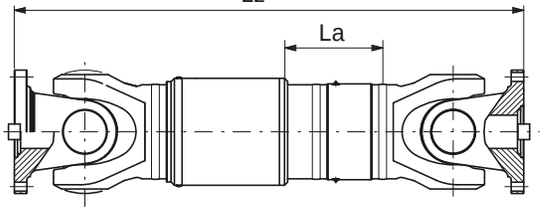
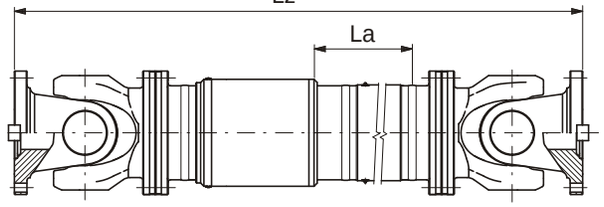


BJ



ENGINEERING DATA — SERIES B

TYPE

BA - Telescopic Shaft, medium length compensation
BB - Telescopic Shaft, short design
BC - Fix Length Shaft, tubular design
BD - Fix Length Shaft, short design
BE - Telescopic Shaft, long length compensation or high torsional stiffness or special arrangement
BF - Telescopic Shaft, medium length compensation (flange intermediate assembly)
BG - Fix Length Shaft, flange tubular design
BH - Fix Length Shaft, flange short design
BJ - Telescopic Shaft, long length compensation or high torsional stiffness or special arrangement (flange intermediate assembly)
BK - Flange Joint

TABLE 2

SIZE			18	22	25	28	31	35	39	44	49	55	62
RATING TORQUES													
Mk		[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_{DW}		[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°			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	Lz min	[mm]	795	855	985	1080	1235	1350	1495	1680	1760	1965	2250
	La std	[mm]	140	145	150	155	160	170	180	190	200	210	230
	Lz max	[mm]	1205	1310	1485	1625	1875	2080	2315	2590	2810	3155	3570
	La max	[mm]	550	600	650	700	800	900	1000	1100	1250	1400	1550
BB	Lz min	[mm]	615	685	795	900	1045	1175	1350	1470	1550	1730	1960
	La std	[mm]	40	50	50	60	65	65	70	70	70	80	80
BC	Lf	[mm]	495	535	615	695	780	835	930	1140	1205	1355	1530
	Lf max	[mm]	1205	1310	1485	1625	1875	2080	2315	2590	2810	3155	3550
	Lf lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	10040	11300
BD	Lf	[mm]	440	480	560	640	720	780	840	1040	1080	1220	1360
BE	Lz min	[mm]	985	1050	1180	1295	1495	1620	1775	1985	2085	2310	2620
	La std	[mm]	280	290	300	310	320	340	360	380	400	420	460
	Lz max	[mm]	1505	1610	1880	2085	2375	2680	2915	3255	3585	3990	4410
	La max	[mm]	800	850	1000	1100	1200	1400	1500	1650	1900	2100	2250
	Lz lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	10040	11300
BF	Lz min	[mm]	970	1000	1130	1340	1585	1690	1850	2075	2200	2400	2750
	La std	[mm]	140	145	150	155	160	170	180	190	200	210	230
	Lz max	[mm]	1380	1455	1630	1885	2225	2420	2670	2985	3250	3590	4070
	La max	[mm]	550	600	650	700	800	900	1000	1100	1250	1400	1550
BG	Lf	[mm]	715	730	800	950	1140	1225	1350	1660	1745	1800	2050
	Lf max	[mm]	1380	1455	1630	1885	2225	2420	2670	2985	3250	3590	4050
	Lf lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	10040	11300
BH	Lf	[mm]	440	480	560	640	720	780	840	1040	1080	1220	1360
BJ	Lz min	[mm]	1160	1195	1325	1555	1845	1960	2130	2380	2525	2745	3120
	La std	[mm]	280	290	300	310	320	340	360	380	400	420	460
	Lz max	[mm]	1680	1755	2025	2345	2725	3020	3270	3650	4025	4425	4910
	La max	[mm]	800	850	1000	1100	1200	1400	1500	1650	1900	2100	2250
	Lz lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	10040	11300
BK	Lf	[mm]	220	240	280	320	360	390	420	520	540	610	680

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 = fix length
Lf min = minimum fix length
Lf max = maximum fix length with standard tube
Lf lim = maximum fix 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.

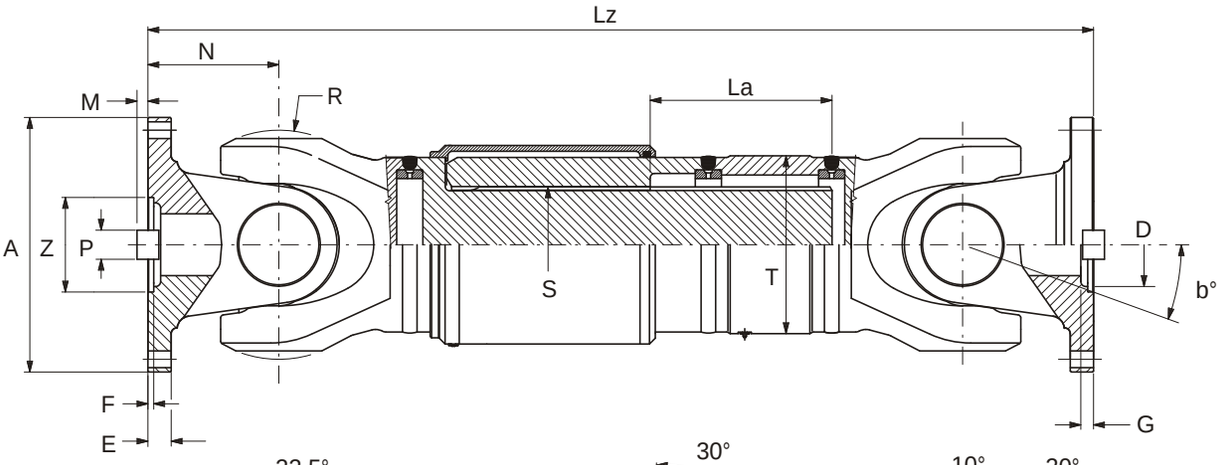
① When required tolerance h7
② Tolerance ± 0.1 mm
③ Male and female splined shaft nitrided.

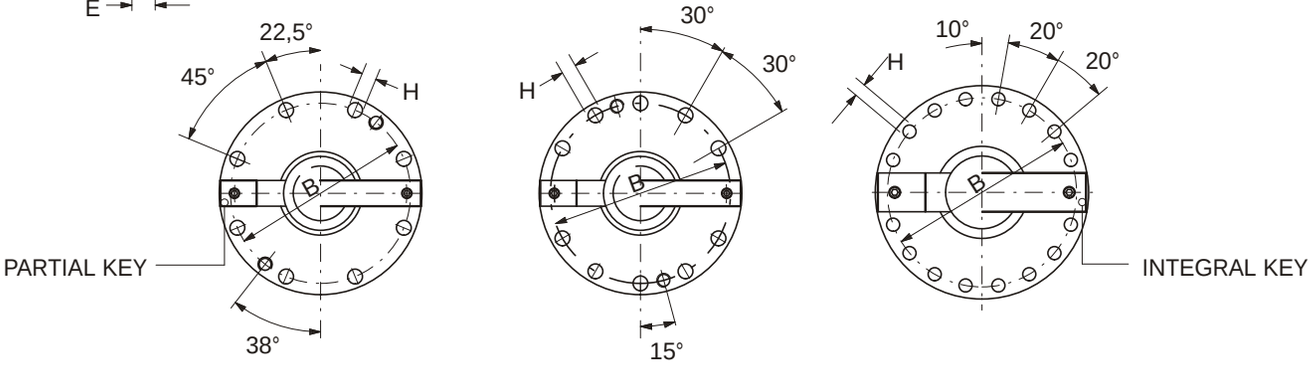
SERIES C

ENGINEERING DATA

TYPE

CA





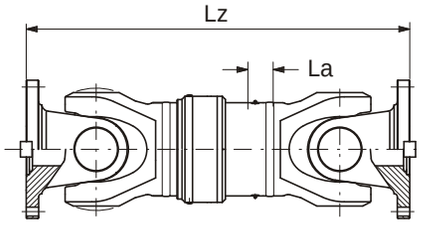
SIZE 18 - 25
8 HOLES

SIZE 28 - 35
10 HOLES

SIZE 39 - 62
16 HOLES

TYPE

CB



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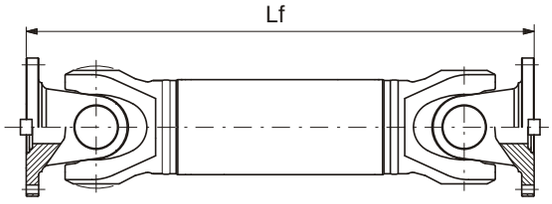

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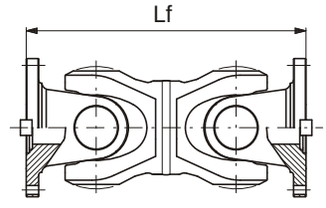

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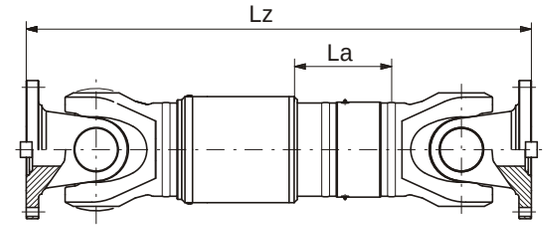
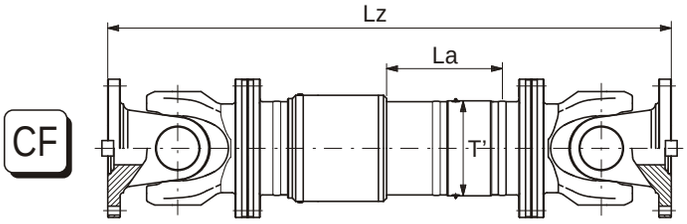


CF



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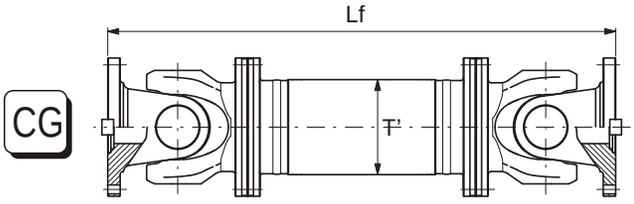

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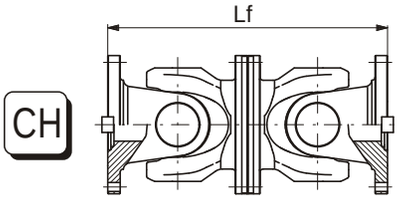

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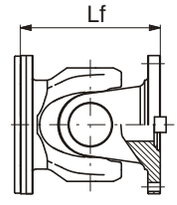

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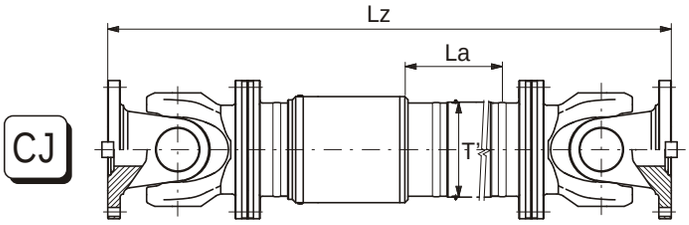


TYPE

CA - Telescopic Shaft, medium length compensation
CB - Telescopic Shaft, short design
CC - Fix Length Shaft, tubular design
CD - Fix Length Shaft, short design
CE - Telescopic Shaft, long length compensation or high torsional stiffness or special arrangement
CF - Telescopic Shaft, medium length compensation (flange intermediate assembly)
CG - Fix Length Shaft, flange tubular design
CH - Fix Length Shaft, flange short design
CJ - Telescopic Shaft, long length compensation or high torsional stiffness or special arrangement (flange intermediate assembly)
CK - Flange Joint

TABLE 3

SIZE			18	22	25	28	31	35	39	44	49	55	62
RATING TORQUES													
Mk		[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_{DW}		[kNm]	12	24	37	54	76	106	146	262	321	516	760
STANDARD DIMENSIONS													
A ①		[mm]	225	250	285	315	350	390	440	490	550	600	680
b°		◁°	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	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
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	2250
	La std	[mm]	140	145	150	155	160	170	180	190	200	210	230
	Lz max	[mm]	1205	1310	1485	1625	1875	2080	2315	2590	2810	3155	3570
	La max	[mm]	550	600	650	700	800	900	1000	1100	1250	1400	1550
CB	Lz min	[mm]	615	685	795	900	1045	1175	1350	1470	1550	1730	1960
	La std	[mm]	40	50	50	60	65	65	70	70	70	80	80
CC	Lf	[mm]	495	535	615	695	780	835	930	1140	1205	1355	1530
	Lf max	[mm]	1205	1310	1485	1625	1875	2080	2315	2590	2810	3155	3550
	Lf lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	10040	11300
CD	Lf	[mm]	440	480	560	640	720	780	840	1040	1080	1220	1360
CE	Lz min	[mm]	985	1050	1180	1295	1495	1620	1775	1985	2085	2310	2620
	La std	[mm]	280	290	300	310	320	340	360	380	400	420	460
	Lz max	[mm]	1505	1610	1880	2085	2375	2680	2915	3255	3585	3990	4410
	La max	[mm]	800	850	1000	1100	1200	1400	1500	1650	1900	2100	2250
	Lz lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	10040	11300
CF	Lz min	[mm]	970	1000	1130	1340	1585	1690	1850	2075	2200	2400	2750
	La std	[mm]	140	145	150	155	160	170	180	190	200	210	230
	Lz max	[mm]	1380	1455	1630	1885	2225	2420	2670	2985	3250	3590	4070
	La max	[mm]	550	600	650	700	800	900	1000	1100	1250	1400	1550
CG	Lf	[mm]	715	730	800	950	1140	1225	1350	1660	1745	1800	2050
	Lf max	[mm]	1380	1455	1630	1885	2225	2420	2670	2985	3250	3590	4050
	Lf lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	10040	11300
CH	Lf	[mm]	440	480	560	640	720	780	840	1040	1080	1220	1360
CJ	Lz min	[mm]	1160	1195	1325	1555	1845	1960	2130	2380	2525	2745	3120
	La std	[mm]	280	290	300	310	320	340	360	380	400	420	460
	Lz max	[mm]	1680	1755	2025	2345	2725	3020	3270	3650	4025	4425	4910
	La max	[mm]	800	850	1000	1100	1200	1400	1500	1650	1900	2100	2250
	Lz lim	[mm]	3280	4000	4720	5020	5740	6450	7170	7890	9020	10040	11300
CK	Lf	[mm]	220	240	280	320	360	390	420	520	540	610	680

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 = fix length
Lf min = minimum fix length
Lf max = maximum fix length with standard tube
Lf lim = maximum fix 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.

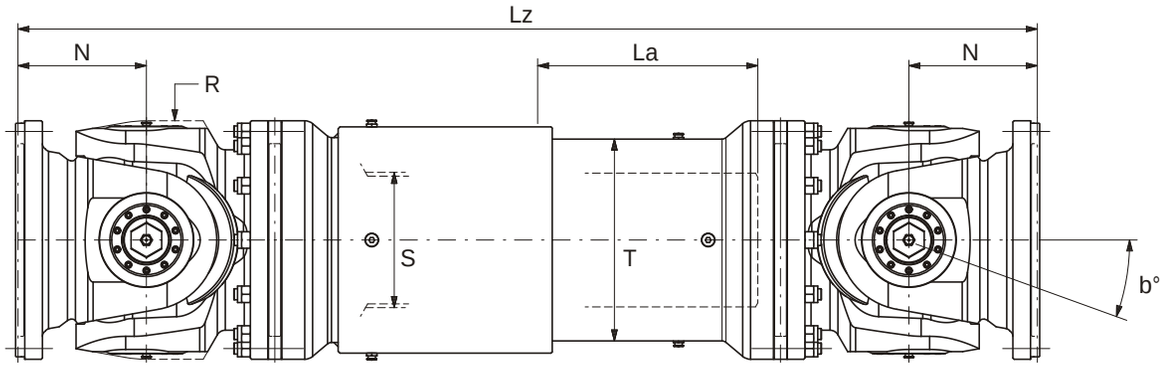
① When required tolerance h7
② Tolerance ± 0.1 mm
③ Male and female splined shaft nitrided.

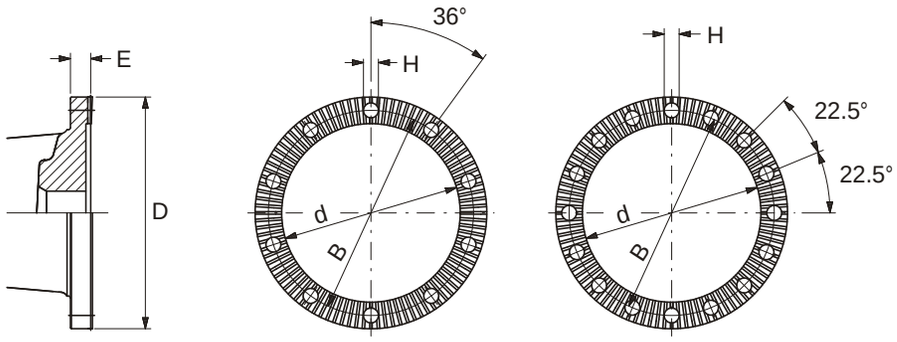
SERIES S

ENGINEERING DATA

TYPE

SF



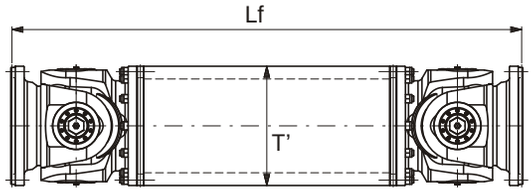


SIZE 35 - 39
10 HOLES

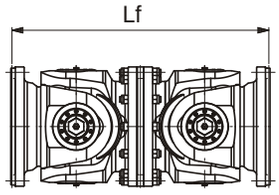
SIZE 44 - 55
16 HOLES

TYPE

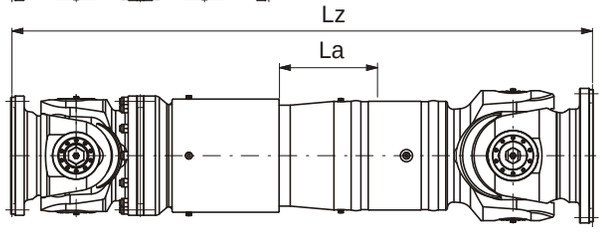
SG



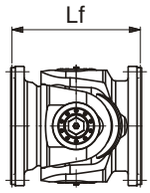
SH



SJ



SK



ENGINEERING DATA — SERIES S

TYPE

SF - Telescopic Shaft, medium length compensation
(flange intermediate assembly)
SG - Fix Length Shaft, flange tubular design
SH - Fix Length Shaft, flange short design
SJ - Telescopic Shaft, medium length compensation
series S flange joint roll side
series B weld joint pinion side, bigger rotation
SK - Flange Joint

TABLE 4

SIZE			35	39	44	49	55
RATING TORQUES							
Mk		[kNm]	264	389	560	743	1115
M_{DSch}		[kNm]	204	300	431	572	859
M_{DW}		[kNm]	143	211	302	401	602
STANDARD DIMENSIONS							
D		[mm]	350	390	440	490	550
d		[mm]	280	315	340	380	440
B ①		[mm]	315	350	400	450	510
H		[mm]	19	21	21	23	23
E		[mm]	35	40	42	47	50
z ②			72	72	96	96	96
b		◁°	10	10	10	10	10
R		[mm]	350	390	440	490	550
N		[mm]	195	210	260	270	305
T		[mm]	323.9	355.6	368	419	457.2
S DIN 5480 ③			210x6	220x6	250x6	280x8	320x8
T'		[mm]	350	390	440	490	550
LENGTH / LENGTH COMPENSATION							
SF	Lz min	[mm]	1690	1850	2075	2200	2400
	La std	[mm]	170	180	190	200	210
	Lz max	[mm]	2420	2670	2985	3250	3590
	La max	[mm]	900	1000	1100	1250	1400
SG	Lf	[mm]	1225	1350	1660	1745	1800
	Lf lim	[mm]	6450	7170	7890	9020	10040
SH	Lf	[mm]	780	840	1040	1080	1220
SJ	Lz min	[mm]	1720	1950	2095	2270	2470
	La std	[mm]	170	180	190	200	210
	Lz max	[mm]	2450	2770	3005	3320	3660
	La max	[mm]	900	1000	1100	1250	1400
SK	Lf	[mm]	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
When Lz ≠ Lz min, then Lz = Lz min + (La - La std)

Lf = fix length
Lf min = minimum fix length
Lf lim = maximum fix length of universal shaft
Lz max and Lf lim valid if max allowable
speed or torsional stiffness do not create any problem.

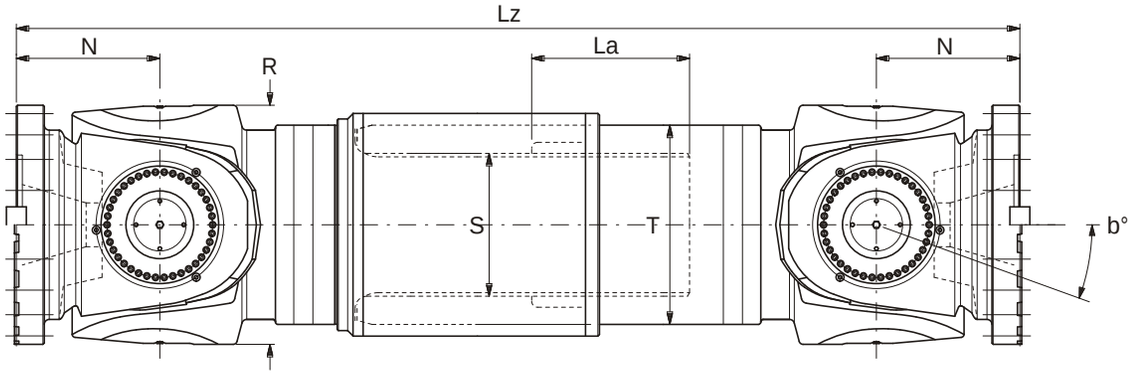
① Tolerance ± 0.1 mm
② Number of teeth
③ Male and female splined shaft nitrided

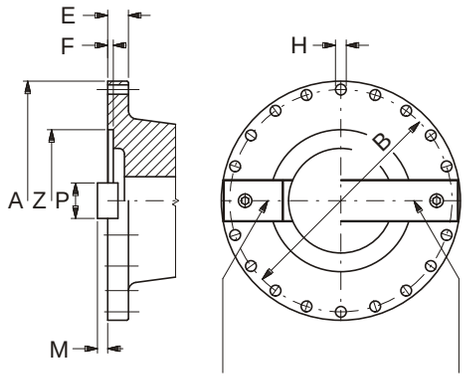
SERIES D - SERIES G

ENGINEERING DATA

TYPE

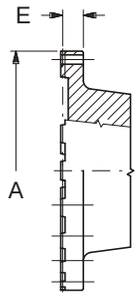
DA
GA

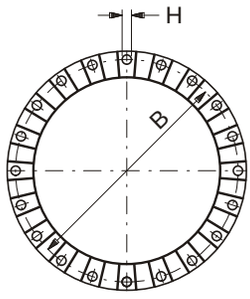




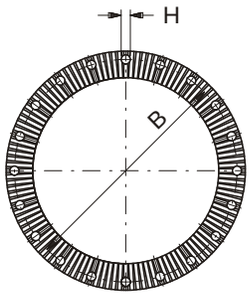
PARTIAL KEY

INTEGRAL KEY





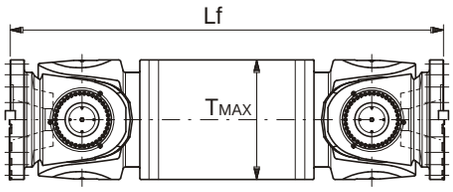
DOG TOOTH FLANGE



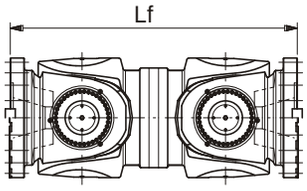
HIRTH SERRATION FLANGE

TYPE

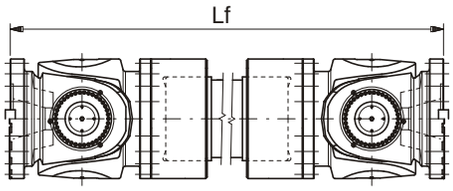
DC
GC



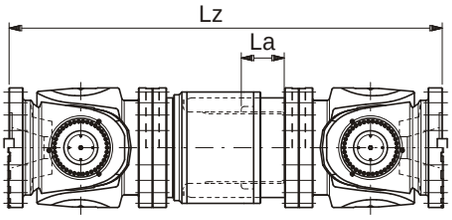
DD
GD



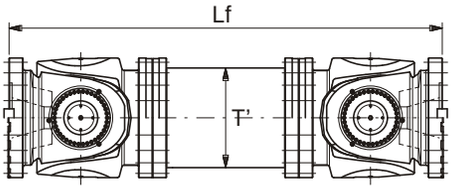
DL
GL



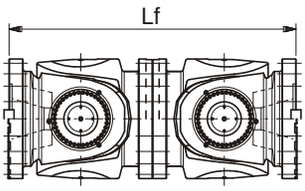
DF
GF



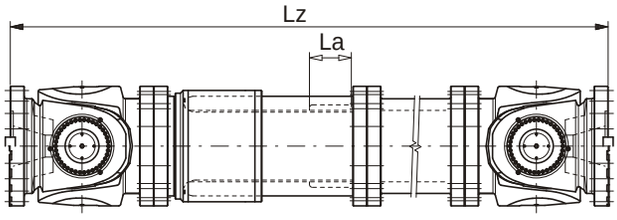
DG
GG



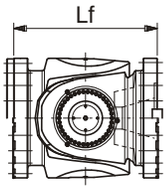
DH
GH



DM
GM



DK
GK



TYPE WITH STANDARD FLANGES

DA - Telescopic Shaft
DC - Fix Length Shaft, tubular design
DD - Fix Length Shaft, short design
DL - Fix Length Shaft, intermediate shaft design
DM - Telescopic Shaft, intermediate tubular design
DF - Telescopic Shaft, flange intermediate design
DG - Fix Length Shaft, flange tubular design
DH - Fix Length Shaft, flange short design
DK - Flange Joint

TYPE WITH LARGER FLANGES

GA - Telescopic Shaft
GC - Fix Length Shaft, tubular design
GD - Fix Length Shaft, short design
GL - Fix Length Shaft, intermediate shaft design
GM - Telescopic Shaft, intermediate tubular design
GF - Telescopic Shaft, flange intermediate design
GG - Fix Length Shaft, flange tubular design
GH - Fix Length Shaft, flange short design
GK - Flange Joint

TABLE 5

SIZE			60	65	70	75	80	85	90	95	100	105	110	115	120	125
RATING TORQUES																
Mk		[kNm]	1070	1310	1650	2040	2520	3010	3490	4170	4850	5630	6400	7370	8370	9470
MDSch		[kNm]	960	1180	1480	1830	2250	2740	3170	3800	4360	5070	5770	6610	7510	8490
MDW		[kNm]	660	815	1020	1260	1550	1890	2185	2620	3010	3495	3980	4560	5180	5860
STANDARD FLANGES SERIES D																
A		[mm]	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250
b°		∢°	10÷15	10÷15	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	1100	1140
Z (H7)		[mm]	380	400	420	450	470	500	530	560	590	620	650	680	710	750
P (h9)		[mm]	100	120	120	130	140	160	160	160	180	180	195	220	230	240
M		[mm]	27.5	30	30	32.5	35	37.5	40	42.5	45	47.5	50	52.5	55	57.5
F		[mm]	15	15	15	15	18	18	20	20	20	22	22	25	25	27.5
E		[mm]	70	75	80	85	90	95	100	105	110	115	120	125	130	135
H		[mm]	34	28	28	31	31	37	37	37	43	43	43	49	49	53
i ②			16	30	34	30	34	30	32	34	32	34	32	30	32	30
R		[mm]	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250
N		[mm]	360	390	420	450	480	510	540	570	600	630	660	690	720	750
S			360x8	400x8	440x10	480x10	530x12	570x12	610x14	650x14	690x16	740x16	780x18	830x18	880x20	1030x20
T		[mm]	508	558.8	609.6	660.4	711.2	760	810	860	910	960	1010	1050	1100	1150
T'		[mm]	508	558.8	609.6	640	690	715	765	815	845	895	945	970	1020	1070
T MAX		[mm]	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250
LARGER FLANGES SERIES G																
A		[mm]	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300
B ①		[mm]	595	645	690	740	775	825	875	915	965	1015	1050	1100	1150	1190
Z (H7)		[mm]	400	420	450	470	500	530	560	590	620	650	680	710	750	790
P (h9)		[mm]	120	120	130	140	160	160	160	180	180	195	220	230	240	250
M		[mm]	30	30	32.5	35	37.5	40	42.5	45	47.5	50	52.5	55	57.5	60
F		[mm]	15	15	15	18	18	20	20	20	22	22	25	25	27.5	27.5
E		[mm]	75	80	85	90	95	100	105	110	115	120	125	130	140	150
H		[mm]	28	28	31	31	37	37	37	43	43	43	49	49	49	53
i ②			30	34	30	34	30	32	34	32	34	32	30	32	32	32
LENGTH / LENGTH COMPENSATION																
DA	GA	Lz	[mm]	2420	2610	2800	2950	3140	3290	3480	3620	3810	3960	4130	4270	4450	4570
		La	[mm]	300	300	350	350	400	400	450	450	500	500	550	550	600	600
DC	GC	Lf	[mm]	1640	1780	1910	2050	2190	2320	2460	2600	2730	2870	3000	3150	3300	3450
DD	GD	Lf	[mm]	1440	1560	1680	1800	1920	2040	2160	2280	2400	2520	2640	2760	2880	3000
DF	GF	Lz	[mm]	2630	2840	3040	3200	3410	3570	3780	3940	4140	4310	4490	4650	4850	4990
		La	[mm]	300	300	350	350	400	400	450	450	500	500	550	550	600	600
DG	GG	Lf	[mm]	1850	2010	2150	2300	2460	2600	2760	2920	3060	3220	3360	3530	3700	3870
DH	GH	Lf	[mm]	1440	1560	1680	1800	1920	2040	2160	2280	2400	2520	2640	2760	2880	3000
DK	GK	Lf	[mm]	720	780	840	900	960	1020	1080	1140	1200	1260	1320	1380	1440	1500
DL	GL	Lf	[mm]	4640	5030	5420	5800	6190	6580	6960	7350	7740	8120	8500	8900	9300	9700
DM	GM	Lz	[mm]	3040	3290	3520	3710	3950	4140	4380	4580	4810	5010	5220	5410	5620	5770
		La	[mm]	300	300	350	350	400	400	450	450	500	500	550	550	600	600

Lz = Shortest length
La = Length compensation
Lf = Shortest fix length
Length dimension (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.

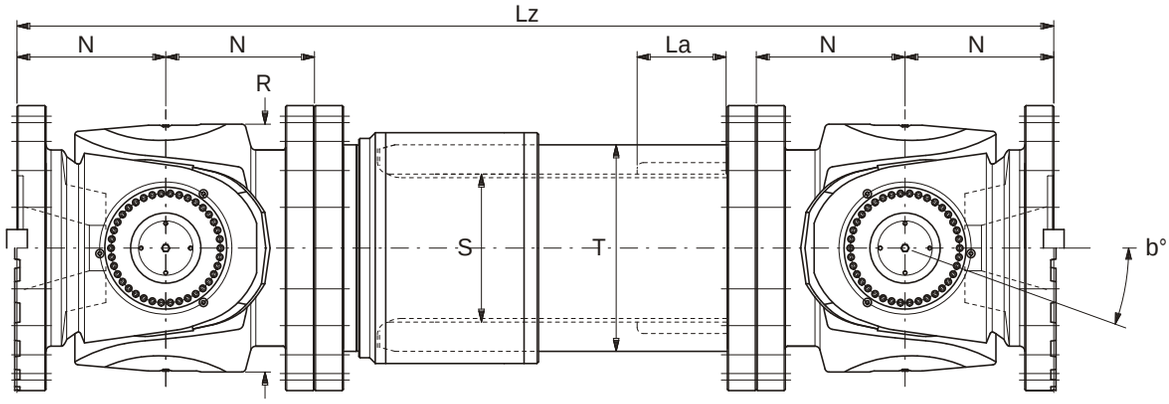
① Tolerance ± 0.1 mm
② i = number of holes

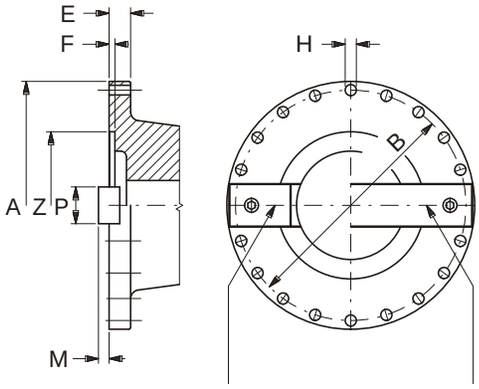
SERIES F - SERIES J

ENGINEERING DATA

TYPE

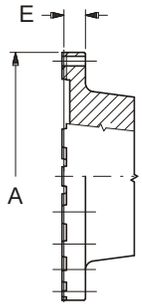
FF
JF

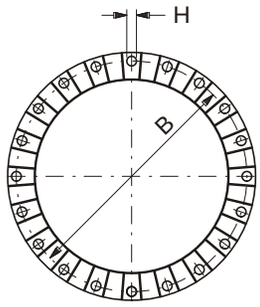




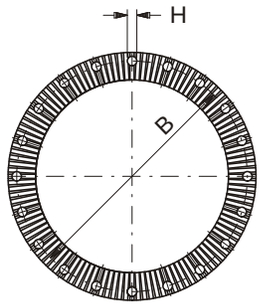
PARTIAL KEY

INTEGRAL KEY





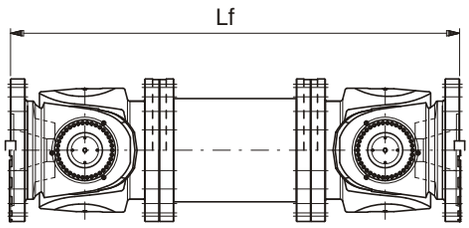
DOG TOOTH FLANGE



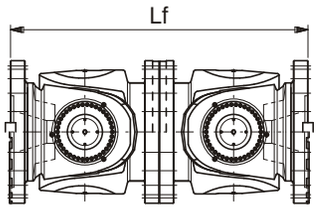
HIRTH SERRATION FLANGE

TYPE

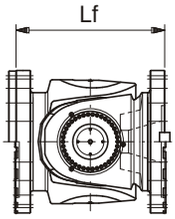
FG
JG



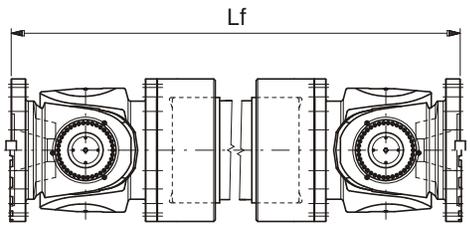
FH
JH



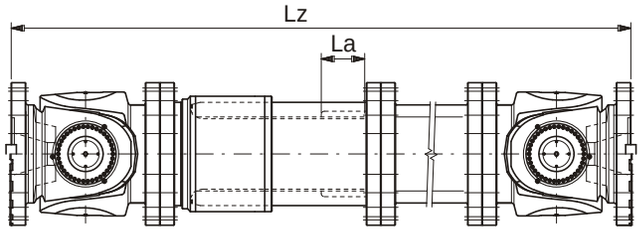
FK
JK



FL
JL



FM
JM



ENGINEERING DATA — SERIES F - SERIES J

TYPE WITH STANDARD FLANGES

FF - Telescopic Shaft, flange intermediate design
FG - Fix Length Shaft, flange tubular design
FH - Fix Length Shaft, flange short design
FK - Flange Joint
FL - Fix Length Shaft, intermediate shaft design
FM - Telescopic Shaft, intermediate tubular design

TYPE WITH LARGER FLANGES

JF - Telescopic Shaft, flange intermediate design
JG - Fix Length Shaft, flange tubular design
JH - Fix Length Shaft, flange short design
JK - Flange Joint
JL - Fix Length Shaft, intermediate shaft design
JM - Telescopic Shaft, intermediate tubular design

TABLE 6

SIZE			60	65	70	75	80	85	90	95	100	105	110	115	120	125
RATING TORQUES																
Mk		[kNm]	1410	1750	2230	2720	3300	3980	4750	5530	6500	7470	8630	9900	11200	12665
MDSch		[kNm]	1270	1580	2015	2465	2990	3590	4290	4925	5910	6755	7735	8860	10040	11350
MDW		[kNm]	875	1090	1390	1700	2060	2475	2960	3395	4075	4660	5335	6110	6930	7830
STANDARD FLANGES SERIES F																
A		[mm]	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250
b°			5÷10	5÷10	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	1100	1140
Z (H7)		[mm]	380	400	420	450	470	500	530	560	590	620	650	680	710	750
P (h9)		[mm]	100	120	120	130	140	160	160	160	180	180	195	220	230	240
M		[mm]	27.5	30	30	32.5	35	37.5	40	42.5	45	47.5	50	52.5	55	57.5
F		[mm]	15	15	15	15	18	18	20	20	20	22	22	25	25	27.5
E		[mm]	70	75	80	85	90	95	100	105	110	115	120	125	130	135
H		[mm]	34	28	28	31	31	37	37	37	43	43	43	49	49	53
i ②			16	30	34	30	34	30	32	34	32	34	32	30	32	30
R		[mm]	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250
N		[mm]	360	390	420	450	480	510	540	570	600	630	660	690	720	750
S			400x8	440x10	480x10	530x12	570x12	610x14	650x14	690x16	740x16	780x18	830x18	880x20	1030x20	1080x20
T		[mm]	558.8	609.6	660.4	690	715	765	815	845	895	945	970	1020	1070	1120
LARGER FLANGES SERIES J																
A		[mm]	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300
B ①		[mm]	595	645	690	740	775	825	875	915	965	1015	1050	1100	1150	1190
Z (H7)		[mm]	400	420	450	470	500	530	560	590	620	650	680	710	750	790
P (h9)		[mm]	120	120	130	140	160	160	160	180	180	195	220	230	240	250
M		[mm]	30	30	32.5	35	37.5	40	42.5	45	47.5	50	52.5	55	57.5	60
F		[mm]	15	15	15	18	18	20	20	20	22	22	25	25	27.5	27.5
E		[mm]	75	80	85	90	95	100	105	110	115	120	125	130	140	150
H		[mm]	28	28	31	31	37	37	37	43	43	43	49	49	49	53
i ②			30	34	30	34	30	32	34	32	34	32	30	32	32	32
LENGTH / LENGTH COMPENSATION																
FF	JF	Lz	[mm]	2630	2840	3040	3200	3410	3570	3780	3940	4140	4310	4490	4650	4850	4990
		La	[mm]	300	300	350	350	400	400	450	450	500	500	550	550	600	600
FG	JG	Lf	[mm]	1850	2010	2150	2300	2460	2600	2760	2920	3060	3220	3360	3530	3700	3870
FH	JH	Lf	[mm]	1440	1560	1680	1800	1920	2040	2160	2280	2400	2520	2640	2760	2880	3000
FK	JK	Lf	[mm]	720	780	840	900	960	1020	1080	1140	1200	1260	1320	1380	1440	1500
FL	JL	Lf	[mm]	4640	5030	5420	5800	6190	6580	6960	7350	7740	8120	8500	8900	9300	9700
FM	JM	Lz	[mm]	3040	3290	3520	3710	3950	4140	4380	4580	4810	5010	5220	5410	5620	5770
		La	[mm]	300	300	350	350	400	400	450	450	500	500	550	550	600	600

Lz = Shortest length
La = Length compensation
Lf = Shortest fix length
Length dimension (Lz and La) 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

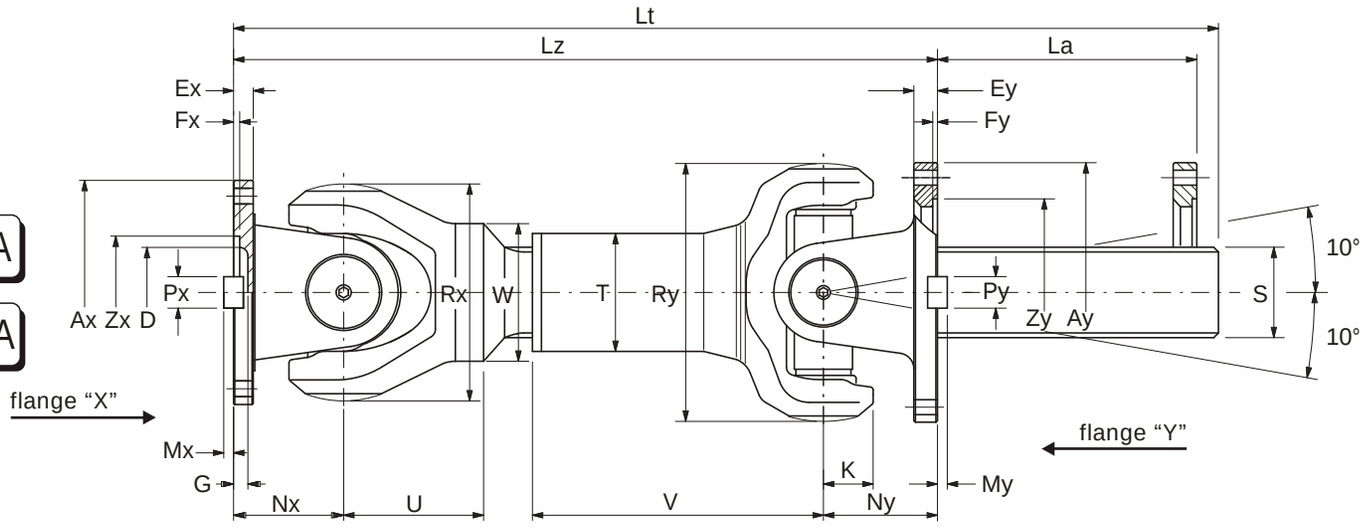
SERIES E - SERIES H

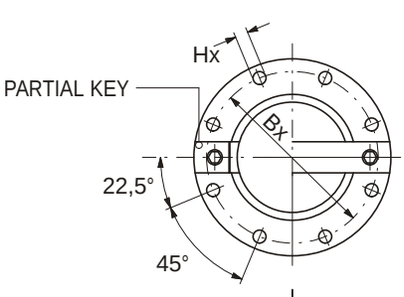
ENGINEERING DATA

TYPE

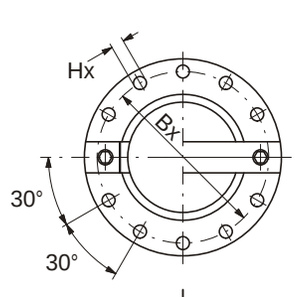
EA

HA

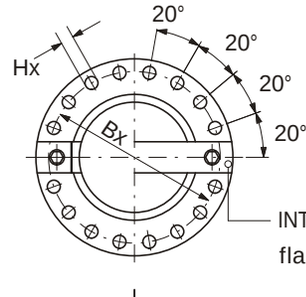




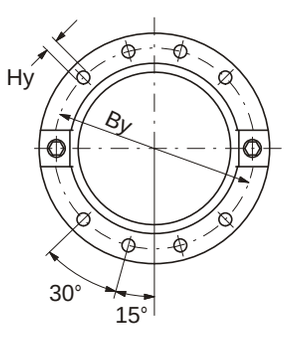
SERIES E SIZE 18 - 28 8 HOLES | SERIES H SIZE 18 - 25 8 HOLES



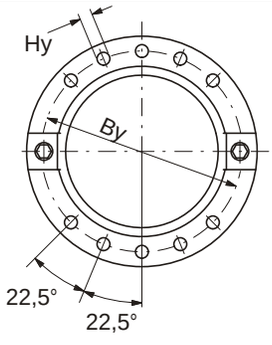
SERIES E SIZE 31 - 39 10 HOLES | SERIES H SIZE 28 - 35 10 HOLES



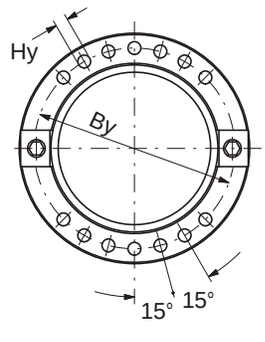
SERIES E SIZE 44 - 55 16 HOLES | SERIES H SIZE 39 - 55 16 HOLES



SIZE 18 - 28
8 HOLES



SIZE 31 - 44
10 HOLES



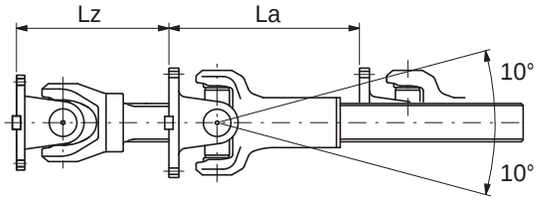
SIZE 49 - 55
14 HOLES

flange “Y”

TYPE

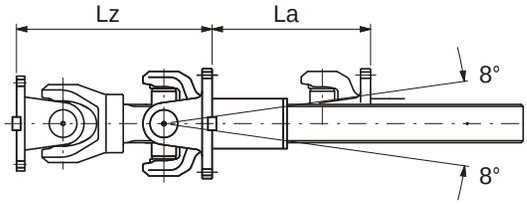
EB

HB



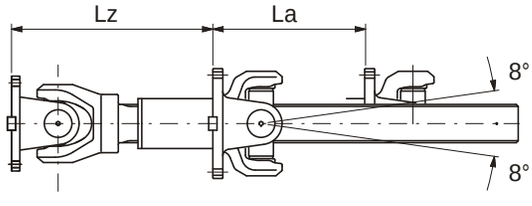
EC

HC



ED

HD



TYPE WITH 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 WITH 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 7

		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
		M_{DSch}	[kNm]	19	37	58	85	120	163	224	400	496	800
		M_{DW}	[kNm]	12	24	37	54	76	106	146	262	321	516
		STANDARD FLANGE “X” SERIES E											
		A_x ①	[mm]	180	225	250	285	315	350	390	440	490	550
		B_x ②	[mm]	155.5	196	218	245	280	310	345	385	425	492
		Z_x (H7)	[mm]	90	105	105	125	130	155	170	190	205	250
		P_x (h9)	[mm]	25	32	40	40	40	50	70	80	90	100
		M_x	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5
		F_x	[mm]	5	5	6	7	8	8	8	10	12	12
		E_x	[mm]	17	20	25	27	32	35	40	42	47	50
		H_x	[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
		R_x	[mm]	180	225	250	285	315	350	390	440	490	550
		N_x	[mm]	110	120	140	160	180	195	210	260	270	305
		U	[mm]	145	160	180	200	230	245	260	325	335	375
		W	[mm]	137	150	175	200	250	284	316	355	368	418
		S DIN 5480 ③		85x2.5	100x2.5	115x2.5	130x3	150x3	170x5	185x5	210x5	210x5	240x5
		FLANGE “Y”											
		A_y ①	[mm]	250	315	330	390	435	480	520	600	650	710
		B_y ②	[mm]	220	285	300	355	390	430	480	550	595	650
		Z_y (H7)	[mm]	165	220	210	260	275	320	360	420	450	520
		P_y (h9)	[mm]	25	32	40	40	40	50	100	80	90	100
		M_y	[mm]	7	9	12.5	15	15	16	22.5	20	22.5	22.5
		F_y	[mm]	5	5	6	7	8	8	12	12	12	15
		E_y	[mm]	20	30	30	30	35	38	50	55	55	50
		H_y	[mm]	17	17	19	21	23	23	25	28	31	31
		R_y	[mm]	250	315	330	390	435	480	520	600	650	710
		N_y	[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											
		A_x ①	[mm]	225	250	285	315	350	390	440	490	550	600
		B_x ②	[mm]	196	218	245	280	310	345	385	425	492	544
		Z_x (H7)	[mm]	140	140	175	175	220	250	280	320	380	450
		P_x (h9)	[mm]	32	40	40	40	50	70	80	90	100	100
		M_x	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5
		F_x	[mm]	5	6	7	7	8	8	8	10	12	15
		E_x	[mm]	17	20	25	27	32	35	40	42	47	50
		H_x	[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	1695	1775	2000
		La	[mm]	600	600	750	750	850	850	900	900	950	950
		Lt	[mm]	1215	1290	1550	1770	1870	2000	2150	2385	2540	2730
EB	HB	Lz	[mm]	320	340	395	420	485	550	600	750	790	880
		La	[mm]	600	600	750	750	850	850	900	900	950	950
		Lt	[mm]	1355	1430	1700	1790	2055	2200	2420	2650	2780	2870
EC	HC	Lz	[mm]	465	500	575	620	710	810	885	1098	1155	1280
		La	[mm]	600	600	750	750	850	850	900	900	950	950
		Lt	[mm]	1260	1330	1590	1670	1920	2050	2240	2440	2560	2630
ED	HD	Lz	[mm]	470	530	620	680	795	890	960	1135	1195	1360
		La	[mm]	600	600	750	750	850	850	900	900	950	950
		Lt	[mm]	1215	1290	1550	1630	1870	2000	2150	2445	2530	2710

Lz = Shortest length
La = Length compensation
Lt = Total length

① When required tolerance h7
② Tolerance ± 0.1 mm
③ Nitroxidated male spline shaft
④ For special arrangement V dimension can be modified

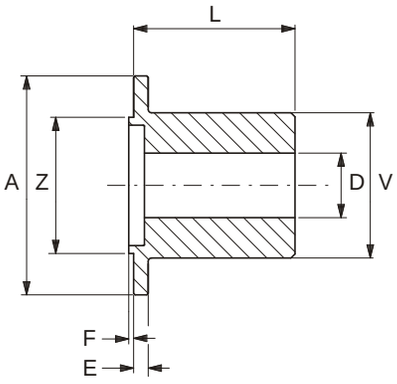
COMPANION FLANGES

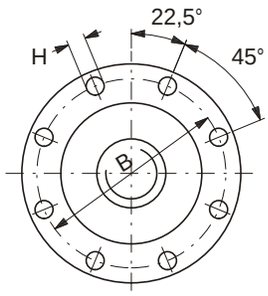
INNER CENTERING

TYPE

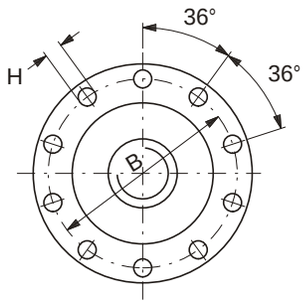
EA

FLANGE WITHOUT FACE KEY





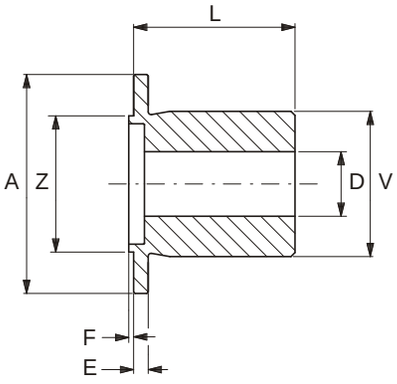
SIZE 18 - 28
8 HOLES

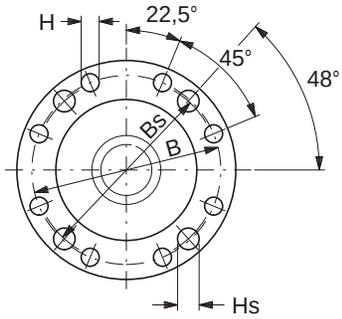


SIZE 31 - 39
10 HOLES

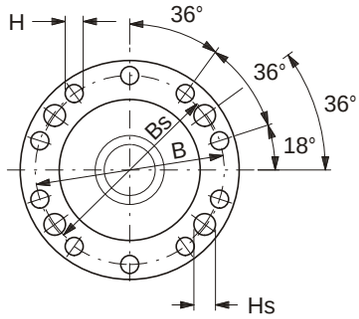
EB

DOWEL PIN CONNECTION ACCORDING TO DIN 15452





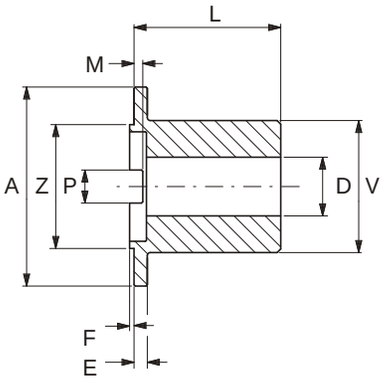
SIZE 18 - 28
8 HOLES

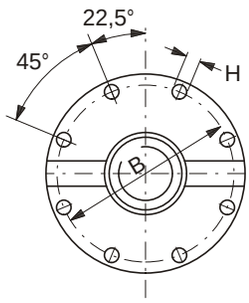


SIZE 31 - 39
10 HOLES

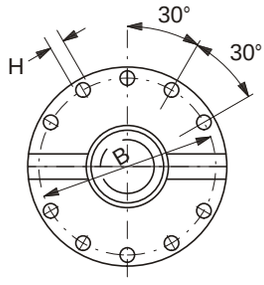
EC

FLANGE WITH FACE KEY - STANDARD TYPE

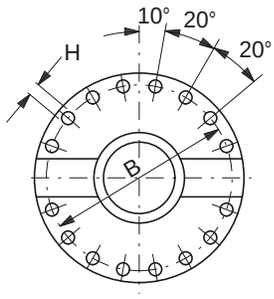




SIZE 18 - 28
8 HOLES



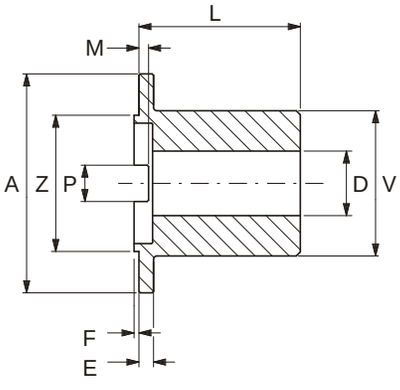
SIZE 31 - 39
10 HOLES

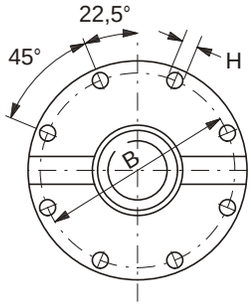


SIZE 44 - 62
16 HOLES

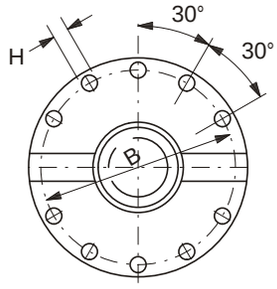
ED

FLANGE WITH FACE KEY - LARGER TYPE

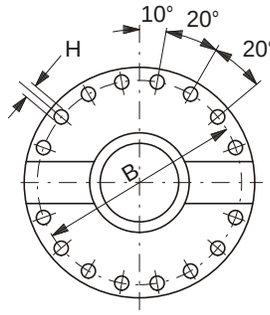




SIZE 18 - 25
8 HOLES



SIZE 28 - 35
10 HOLES



SIZE 39 - 62
16 HOLES

TABLE 8 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	[mm]	140	140	175	175	220	250	280
G ⑤	[kg]	38	50	68	93	123	171	220

TABLE 9 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]	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 (f8)	[mm]	140	140	175	175	220	250	280
G ⑤	[kg]	29	34	54	75	100	152	180

TABLE 10 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 (f8)	[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 11 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 (f8)	[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 mm
② Maximum values
③ Maximum finished bore diameter
④ Different lengths on request
⑤ G = weight calculated for solid hub

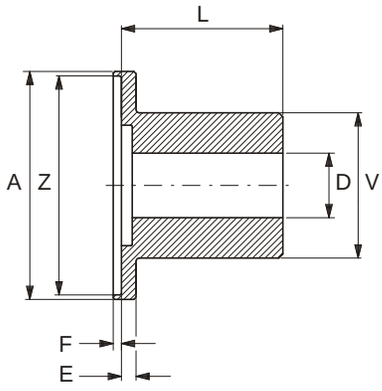
COMPANION FLANGES

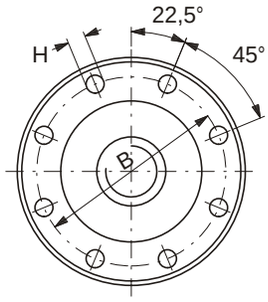
OUTER CENTERING

TYPE

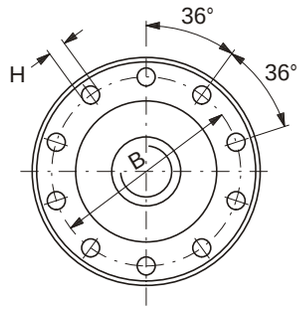
FLANGE WITHOUT FACE KEY

EE





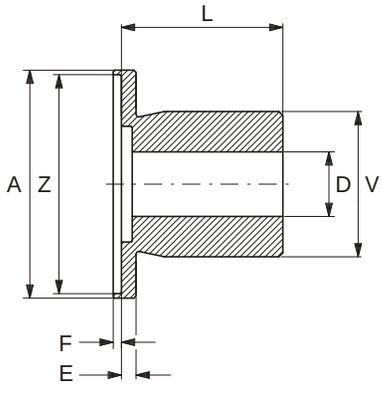
SIZE 18 - 28
8 HOLES

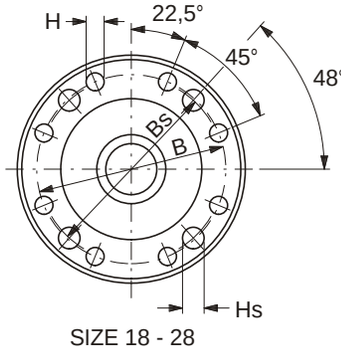


SIZE 31 - 39
10 HOLES

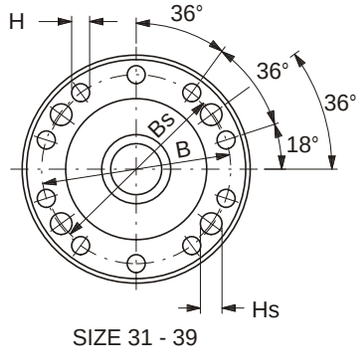
DOWEL PIN CONNECTION ACCORDING TO DIN 15452

EF





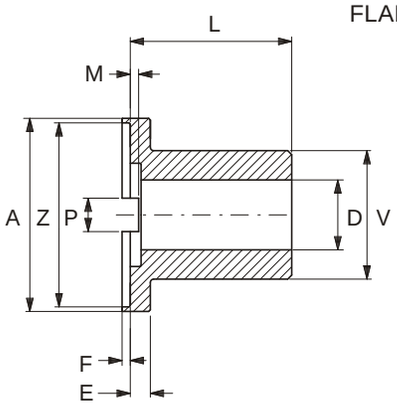
SIZE 18 - 28
8 HOLES

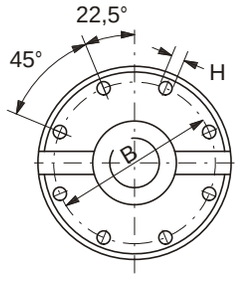


SIZE 31 - 39
10 HOLES

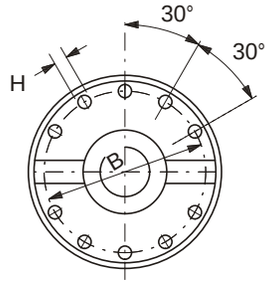
FLANGE WITH FACE KEY - STANDARD TYPE

EG

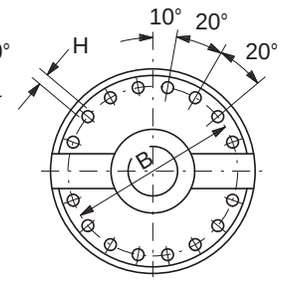




SIZE 18 - 28
8 HOLES



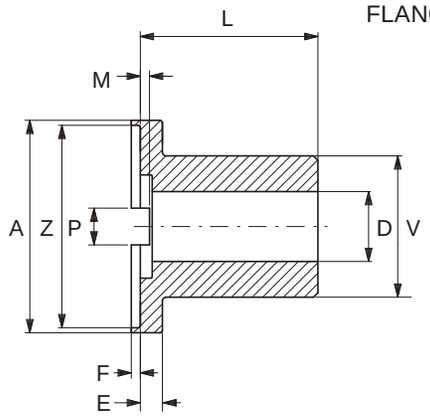
SIZE 31 - 39
10 HOLES

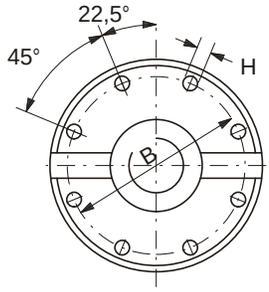


SIZE 44 - 62
16 HOLES

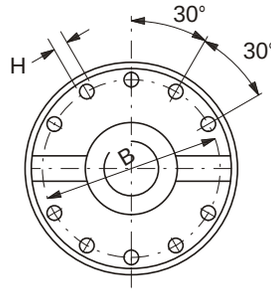
FLANGE WITH FACE KEY - LARGER TYPE

EH

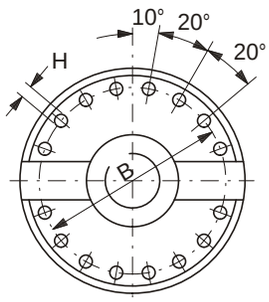




SIZE 18 - 25
8 HOLES



SIZE 28 - 35
10 HOLES



SIZE 39 - 62
16 HOLES

TABLE 12 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 13 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
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]	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 14 TYPE EG

SIZE		18	22	25	28	31	35	39	44	49	55	62
A	[mm]	190	235	260	295	330	365	405	460	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	68	95	124	172	224	295	427	610

TABLE 15 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

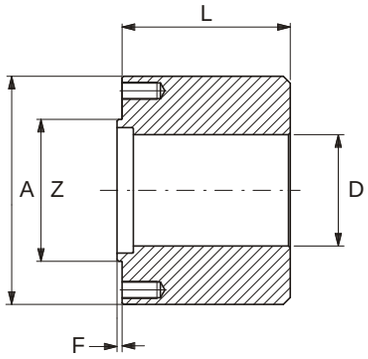
CYLINDRICAL COMPANION FLANGES

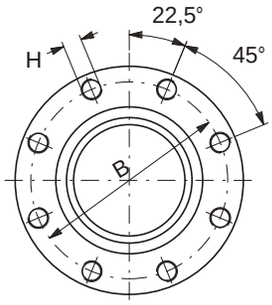
INNER CENTERING

TYPE

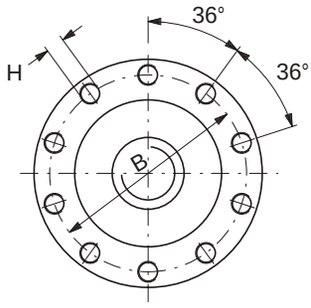
FLANGE WITHOUT FACE KEY

EJ





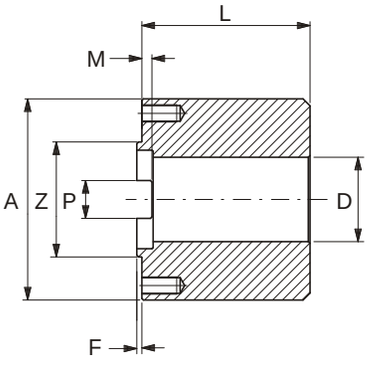
SIZE 18 - 28
8 HOLES

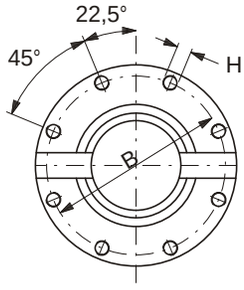


SIZE 31 - 39
10 HOLES

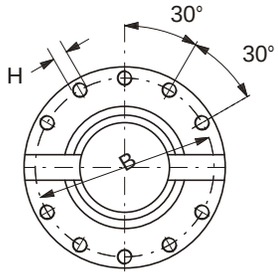
FLANGE WITH FACE KEY - STANDARD TYPE

EK

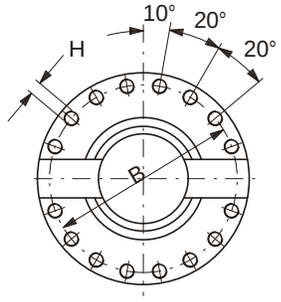




SIZE 18 - 28
8 HOLES



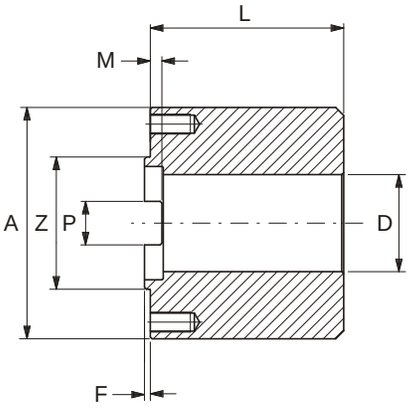
SIZE 31 - 39
10 HOLES

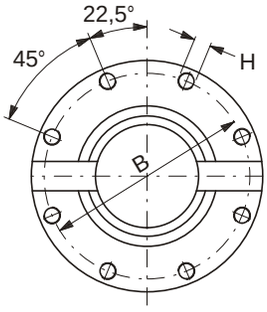


SIZE 44 - 62
16 HOLES

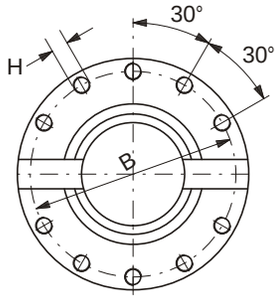
FLANGE WITH FACE KEY - LARGER TYPE

EL

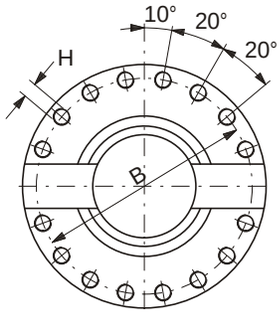




SIZE 18 - 25
8 HOLES



SIZE 28 - 35
10 HOLES



SIZE 39 - 62
16 HOLES

INNER CENTERING

CYLINDRICAL COMPANION FLANGES

TABLE 16 — 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 (f8)	[mm]	140	140	175	175	220	250	280
G ④	[kg]	62	81	111	142	183	255	337

TABLE 17 — 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	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]	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 (f8)	[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 18 — 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	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 (f8)	[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

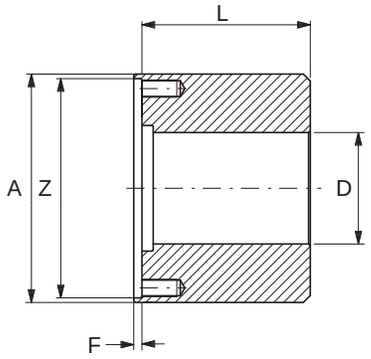
CYLINDRICAL COMPANION FLANGES

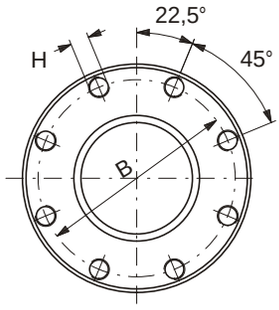
OUTER CENTERING

TYPE

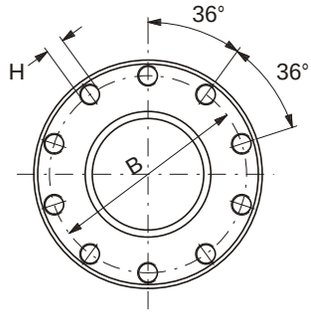
FLANGE WITHOUT FACE KEY

EM





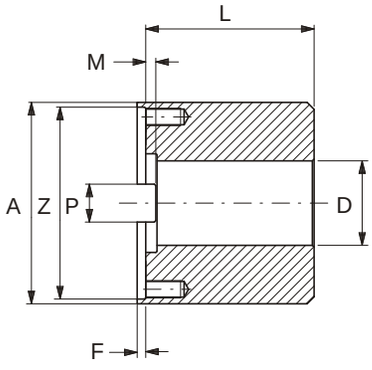
SIZE 18 - 28
8 HOLES

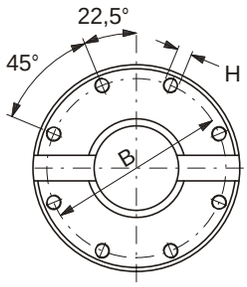


SIZE 31 - 39
10 HOLES

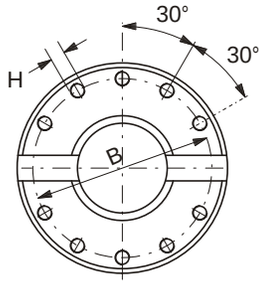
FLANGE WITH FACE KEY - STANDARD TYPE

EN

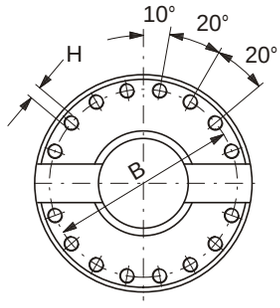




SIZE 18 - 28
8 HOLES



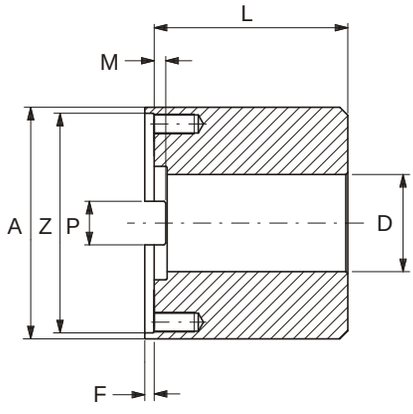
SIZE 31 - 39
10 HOLES

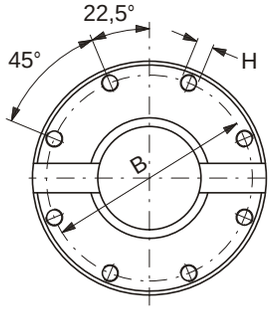


SIZE 44 - 62
16 HOLES

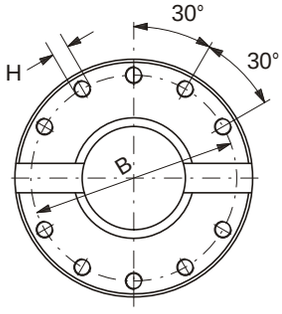
FLANGE WITH FACE KEY - LARGER TYPE

EP

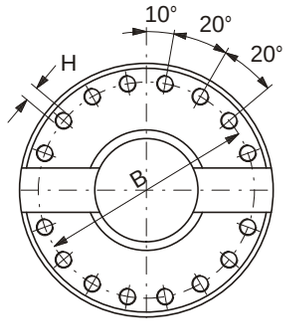




SIZE 18 - 25
8 HOLES



SIZE 28 - 35
10 HOLES



SIZE 39 - 62
16 HOLES

OUTER CENTERING

CYLINDRICAL COMPANION FLANGES

TABLE 19

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 ③	[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 20

TYPE EN

SIZE		18	22	25	28	31	35	39	44	49	55	62
A	[mm]	190	235	260	295	330	365	405	460	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 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 (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 21

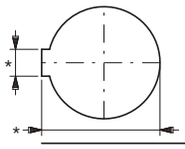
TYPE EP

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 ③	[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

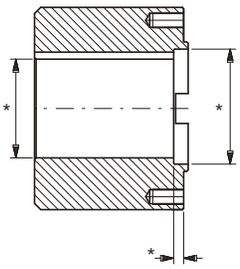
① Tolerance ± 0.1 mm
② Maximum finished bore diameter
③ Different lengths on request
④ G = weight calculated for solid hub

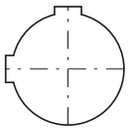
BORE DESIGNS

TYPE OF FITTING

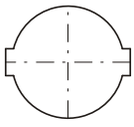


01
Cylindrical Bore,
1 keyway

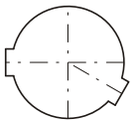




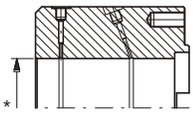
02
Cylindrical Bore,
2 keyways at 90°



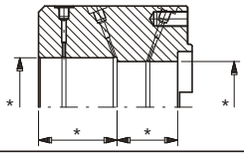
03
Cylindrical Bore,
2 keyways at 180°



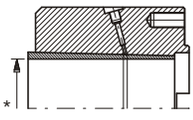
04
Cylindrical Bore,
2 keyways at 120°



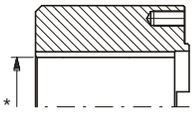
05
Cylindrical Bore for
fitting and oil
pressure removal



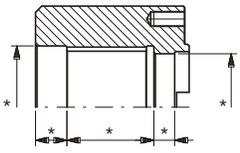
06
Cylindrical Bore with 2
diameters for fitting
and oil pressure removal



07
Taper Bore and Taper
Bush for fitting and
oil pressure removal

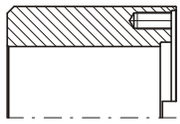


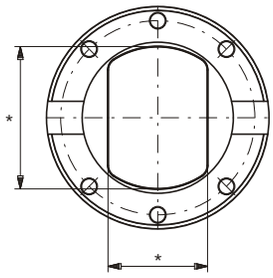
08
DIN 5480 Splined Bore,
or equal, without
centerings



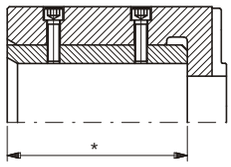
09
DIN 5480 Splined Bore,
or equal, with
centering diameters

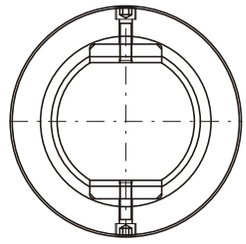
Companion flanges type 01 ÷ 04 are usually made of
AISI 1045 hardened and tempered whereas type 05÷14 of
AISI 4140 hardened and tempered.
Companion flanges type 10 ÷ 14 have hardened contact surfaces.
For inquiries please send us dimensions indicated with *
and, for type 10 ÷ 14, a general drawing.



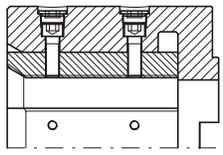


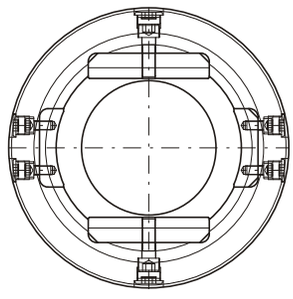
10
Integral Bore



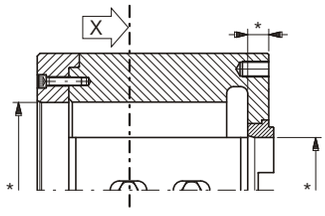


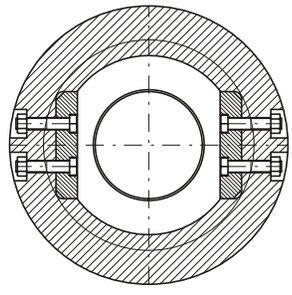
11
Replaceable flat keys





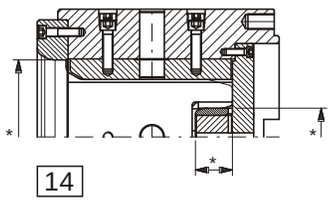
12
Replaceable flat and
round keys

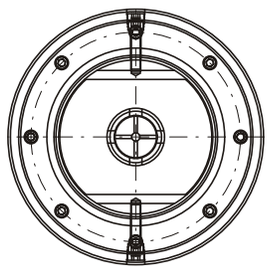




13
Replaceable flat keys,
inner and outer bush

X - SECTION





14
Replaceable flat keys,
outer bush and inner
centering

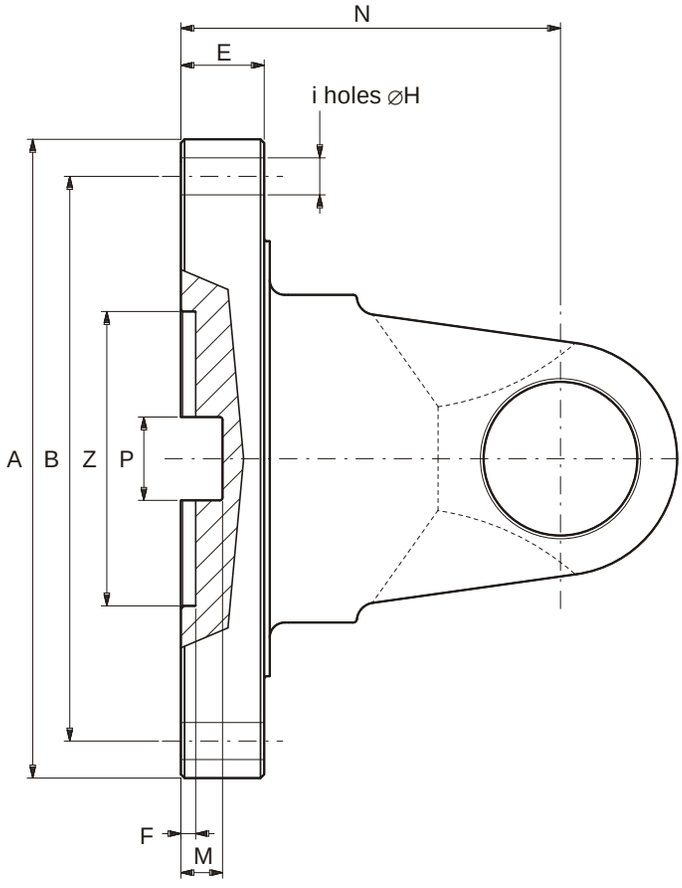


TABLE 22

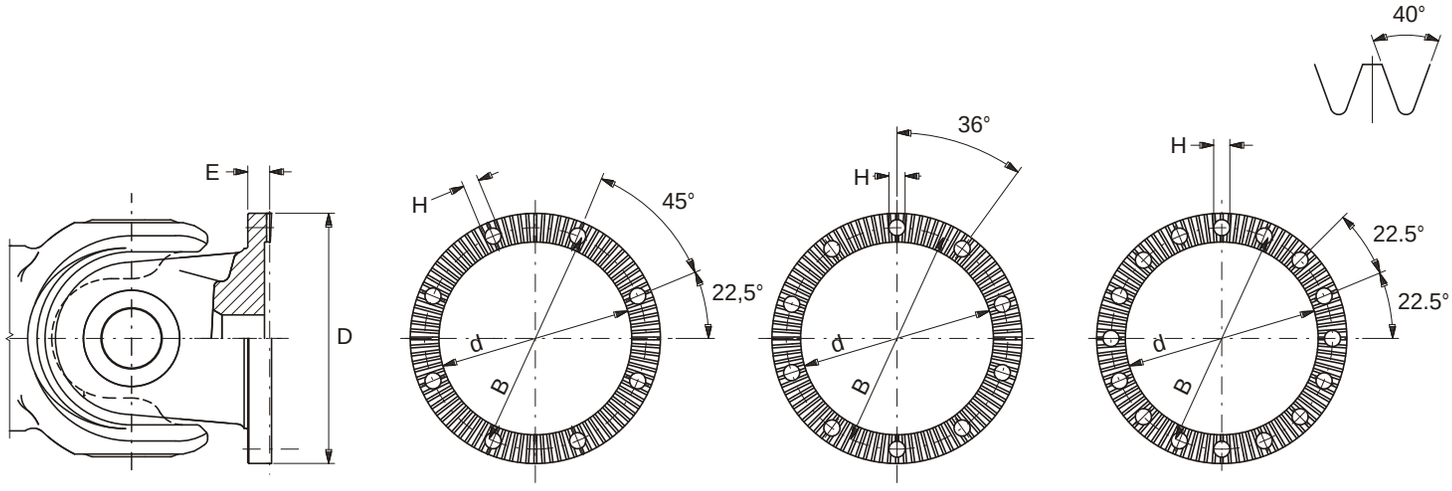
SIZE		18	22	25	28	31	35	39	44	49	55	62
A	[mm]	250	285	315	350	390	440	490	550	600	650	700
B	[mm]	218	245	280	310	345	385	425	492	544	595	645
Z (H7)	[mm]	140	175	175	220	250	280	320	380	450	490	500
P	[mm]	40	40	40	50	70	80	90	100	100	120	130
M	[mm]	7	9	12.5	15	15	16	18	20	22.5	22.5	30
F	[mm]	5	6	7	7	8	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 48 and 49.
EXAMPLE: EXTRA LARGE FLANGE SIZE 22
CODE: DB.C2201.285 where 285 is “A” dimension

Different dimensions on request

HIRTH - SERRATION

ENGINEERING DATA



SIZE 18 - 28
8 HOLES

SIZE 31 - 39
10 HOLES

SIZE 44 - 62
16 HOLES

TABLE 23

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 mm
② z = number of teeth

Different hole patterns may be checked for special applications.

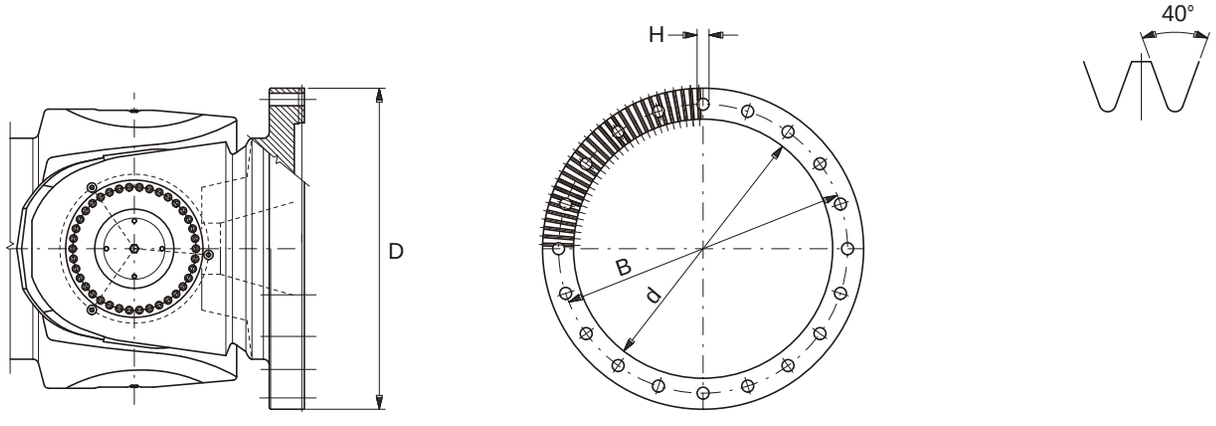


TABLE 24

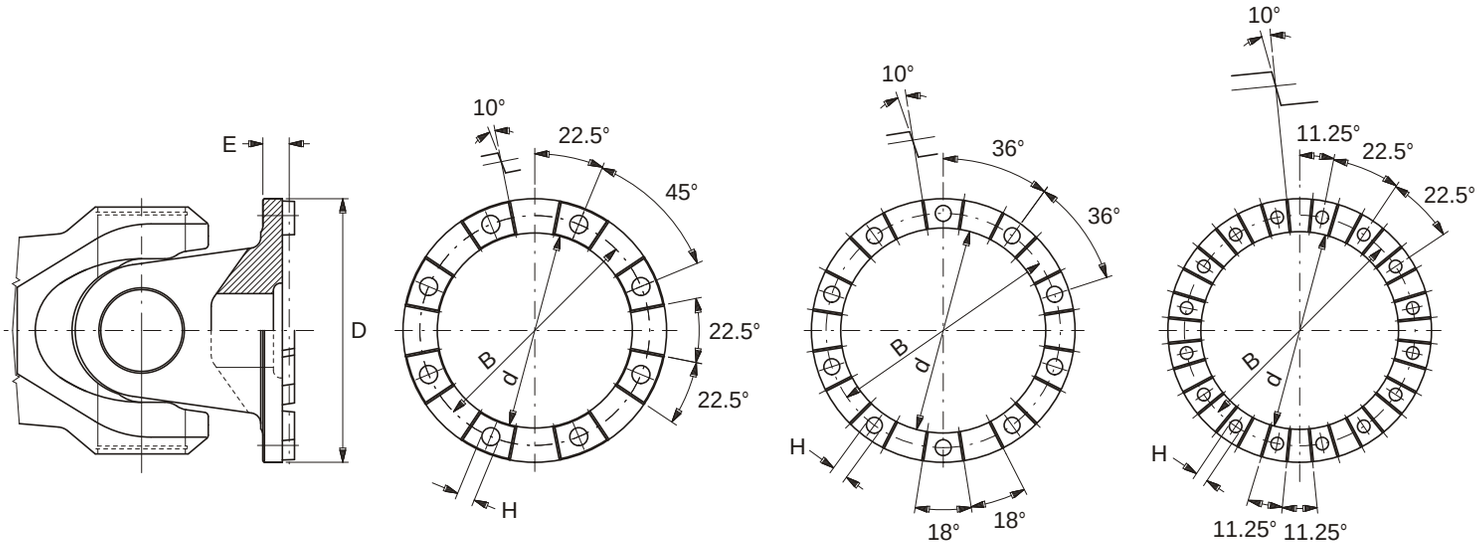
D	[mm]	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300
d	[mm]	480	520	570	610	650	680	710	760	800	840	880	925	960	1000	1040
B ①	[mm]	555	595	645	695	740	790	825	875	915	965	1015	1050	1100	1140	1190
H	[mm]	25	28	28	31	31	31	37	37	43	43	43	49	49	53	53
i ②		30	30	30	32	32	36	32	32	30	30	30	30	30	30	30
E	[mm]	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140
z ③		120	120	120	144	144	144	144	144	180	180	180	180	180	180	180

① Tolerance ± 0.1 mm
② i = number of holes
③ z = number of teeth

Different hole patterns may be checked for special applications.

ENGINEERING DATA

DOG TEETH



SIZE 18 - 28
8 HOLES

SIZE 31 - 39
10 HOLES

SIZE 44 - 62
16 HOLES

TABLE 25

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 mm
② z = number of teeth

Different hole patterns may be checked for special applications.
Special applications with 4 dog - teeth available.

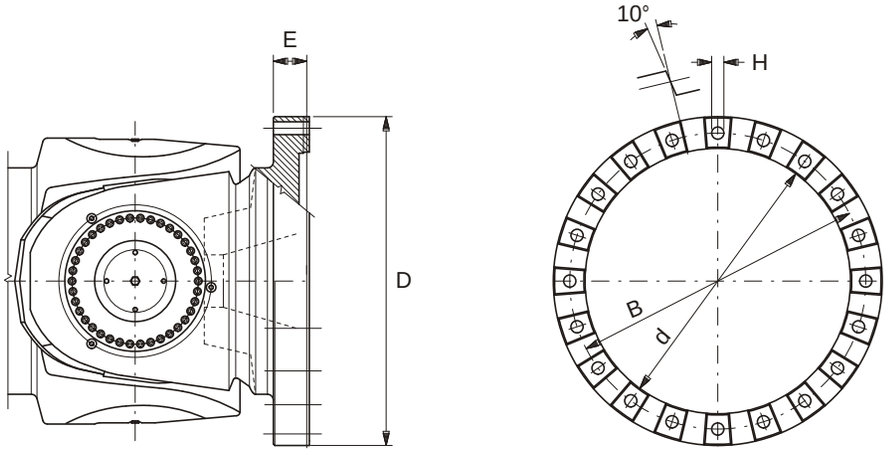


TABLE 26

D	[mm]	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300
d	[mm]	480	520	570	610	650	680	710	760	800	840	880	925	960	1000	1040
B ①	[mm]	555	595	645	690	740	775	825	875	915	965	1015	1050	1100	1140	1190
H	[mm]	25	28	28	31	31	37	37	37	43	43	43	49	49	53	53
i ②		30	30	34	30	34	30	32	34	32	34	32	30	32	30	32
E	[mm]	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140
z ③		30	30	34	30	34	30	32	34	32	34	32	30	32	30	32

① Tolerance ± 0.1 mm
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

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 the 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).

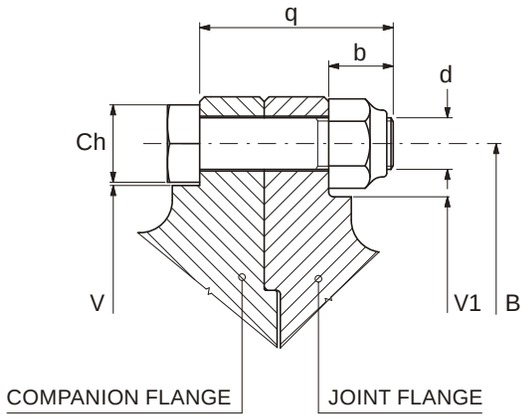


TABLE 27

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	3330
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

ENGINEERING DATA

JOURNAL CROSS ASSEMBLIES

UNIVERSAL SHAFTS SERIES A - B - C

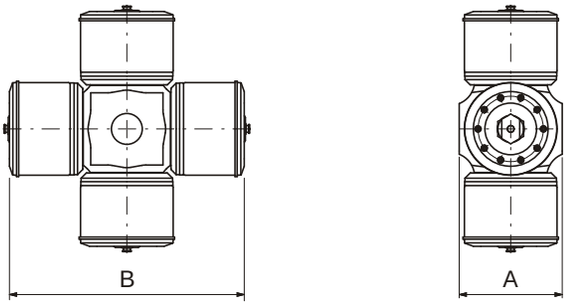


TABLE 28

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

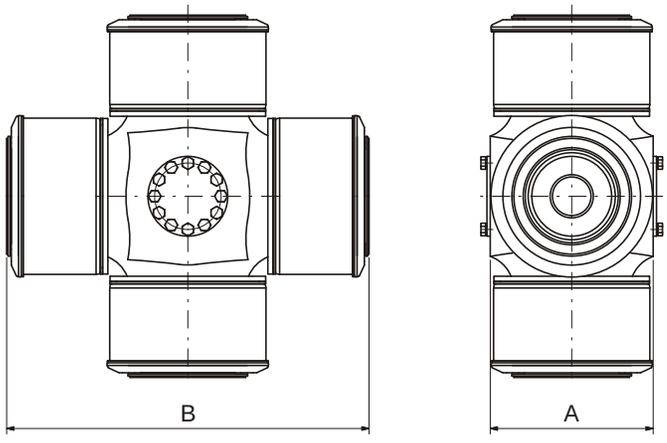


TABLE 29

SIZE		60	65	70	75	80	85	90	95	100	105	110	115	120	125
A	[mm]	245	260	285	300	325	340	360	375	400	420	440	460	480	500
B	[mm]	545	590	635	680	726	770	815	862	908	953	998	1044	1090	1135
W	[kg]	240	305	380	470	570	680	810	950	1110	1280	1480	1690	1920	2170

UNIVERSAL SHAFTS SERIES E - H

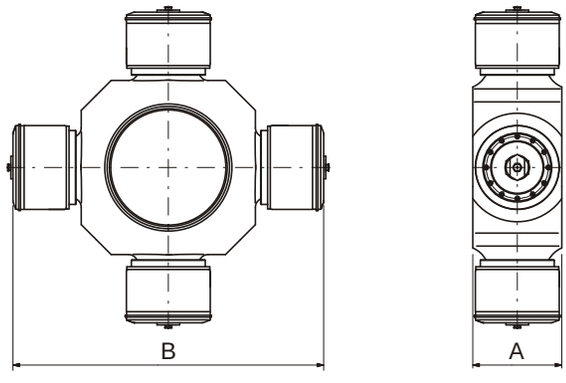


TABLE 30

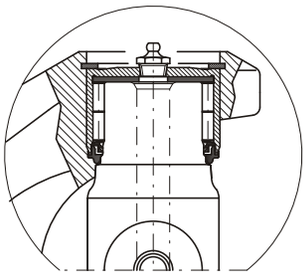
SIZE		18	22	25	28	31	35	39	44	49	55
A	[mm]	50	60	70	80	90	100	110	135	150	165
B	[mm]	225.5	285.5	306.5	360	400	440	472	551	628.5	685.5
W	[kg]	6	14	16	24	30	48	81.5	91	146	173

W = Weight in [kg]
Journal cross supplied as complete unit only

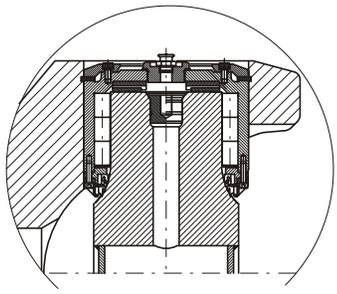
For identification see page 48
For lubrication see page 46

DESIGN VARIATIONS

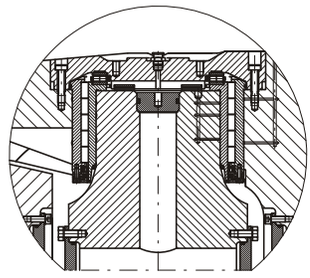
BEARING TYPES



SUITABLE FOR SIZE < 44

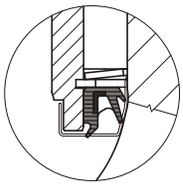


SUITABLE FOR SIZE ≥ 44

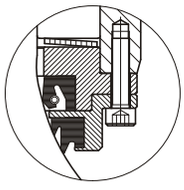


FOR HEAVY DUTY
SUITABLE FOR SIZE ≥ 60

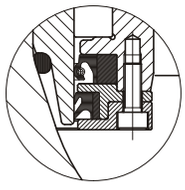
SEAL TYPE



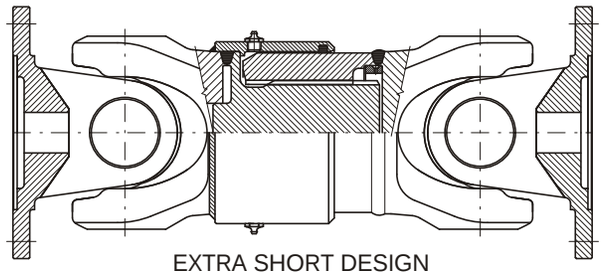
SIZES 18 ÷ 39



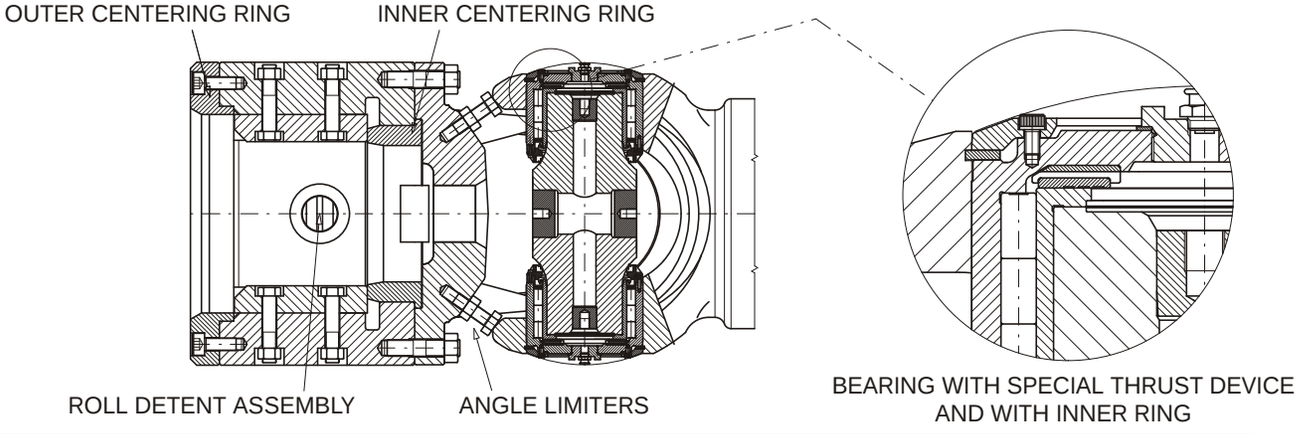
SIZES 44 ÷ 62



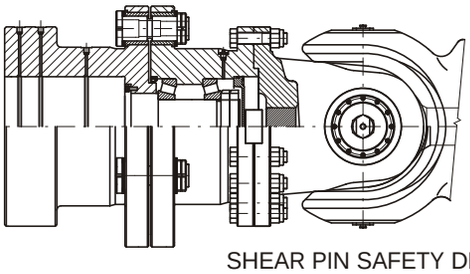
SIZES ≥ 60



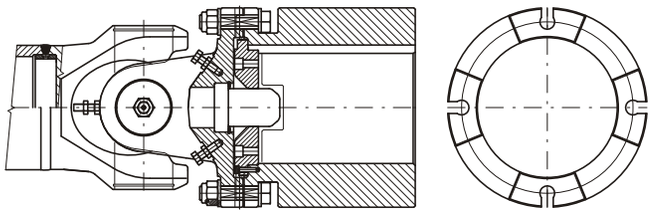
EXTRA SHORT DESIGN



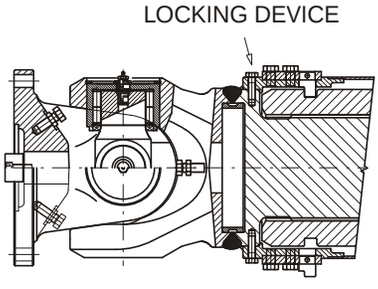
BEARING WITH SPECIAL THRUST DEVICE
AND WITH INNER RING

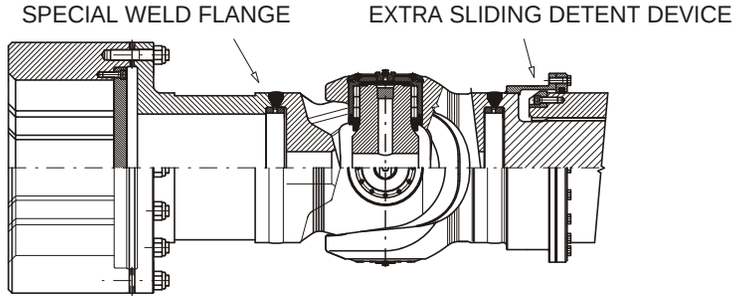


SHEAR PIN SAFETY DEVICE

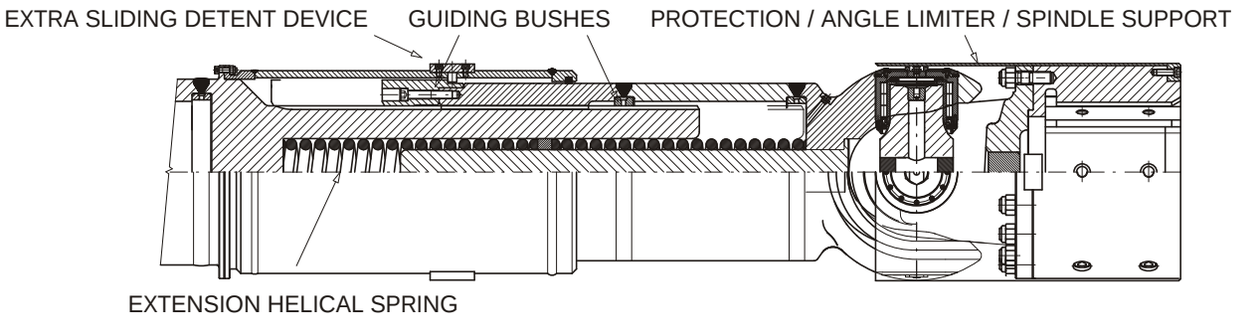


QUICK ENGAGEMENT

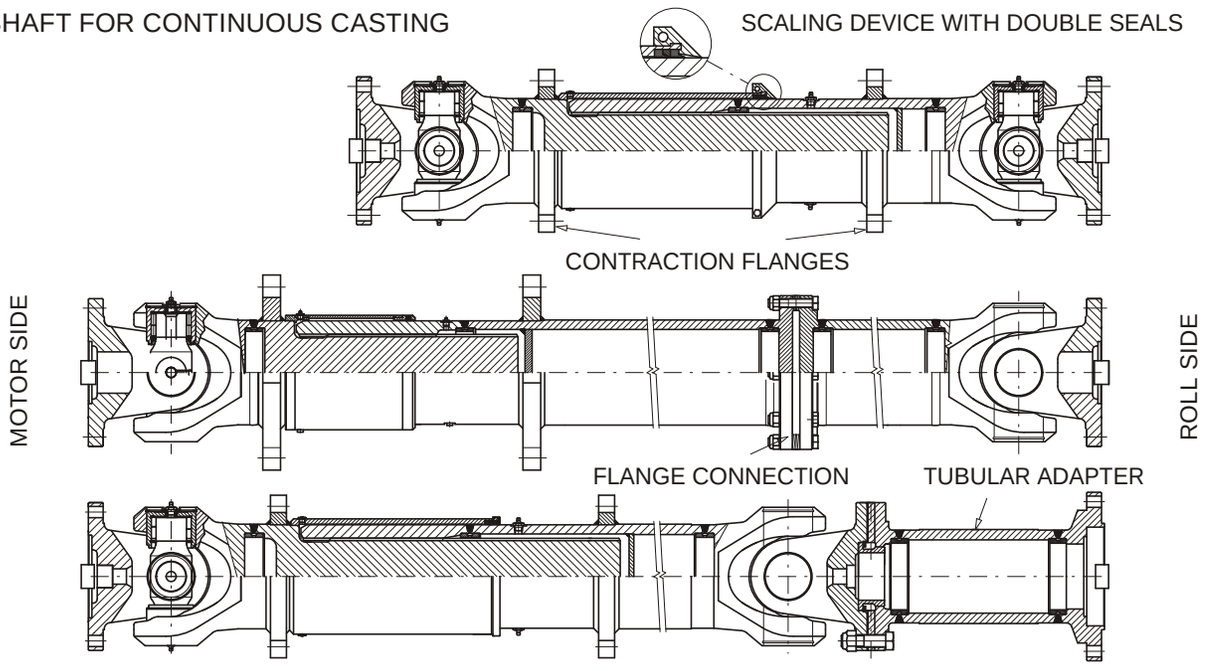




DESIGN VARIATIONS

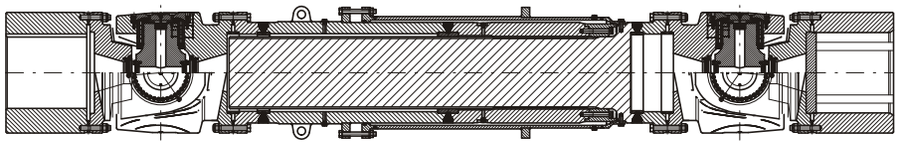


UNIVERSAL SHAFT FOR CONTINUOUS CASTING

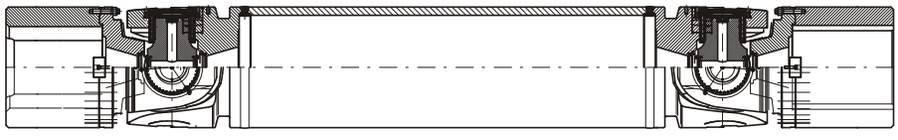


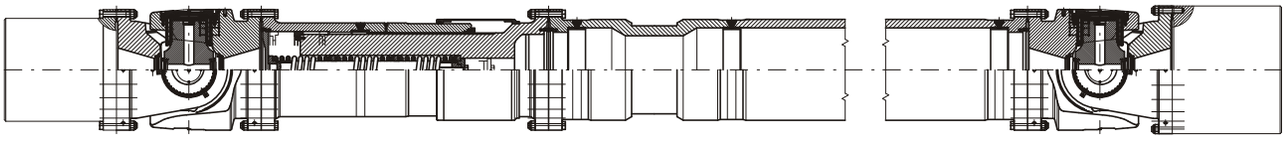
HEAVY AND EXTRA HEAVY UNIVERSAL SHAFTS FOR ROLLING MILL

EDGER MILL DESIGN

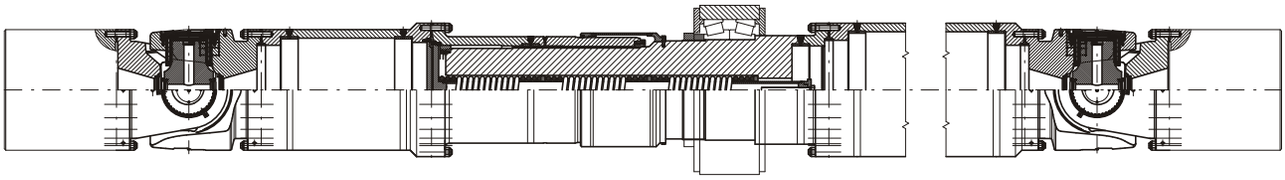


HIGH TORSIONAL
STIFFNESS DESIGN





DESIGN WITH SPINDLE CARRIER AND TWO-HALF ROLLER BEARING OR BUSHING



DESIGN WITH SPINDLE CARRIER AND TAPER 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 (β1 = β2)
- 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 β1 and β2 angles should be checked, in order to limit the difference to 1° ÷ 1.5° max (n > 300 rpm).
More important differences (2° ÷ 3°) 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.
βh = angle on the horizontal plane
βv = angle on the vertical plane

$$tg\,\beta 1\text{-}2 = \sqrt{tg^2\ \beta v + tg^2\ \beta h}$$

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 37 page 40.

MAXIMUM SPEEDS

In order to achieve silent and vibrationless operating conditions, make sure that the rotating speed is 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 36 page 39.
For dynamical speed refer to table 37 page 40.

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

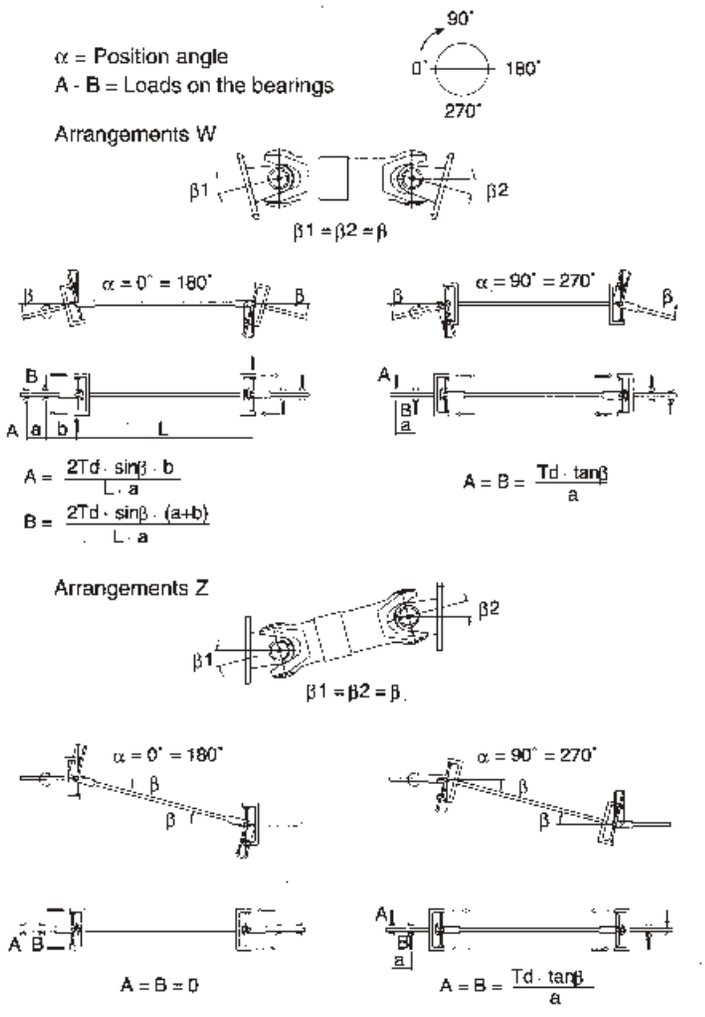
The axial forces occur during the length variations of the universal shaft under load.
Such forces increase as the torque increases.

$$Fa = Td\ \frac{\mu}{rm}\ \cos\ \beta$$

Fa = axial force
Td = 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.



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_{DW} = Alternating torque (kNm)
It corresponds to the fatigue maximum limit torque for a shaft subject to alternating load σ min/σ max - 1 ÷ 0 (stress σ_{D-1} per 2 10^6 cycles).

M_{DSch} = Pulsating torque (kNm)
It corresponds to the fatigue maximum limit torque for a shaft subject to a pulsating load σ min/σ max 0 ÷ 1 (stress σ_{D-1} per 2 10^6 cycles).

M_{CS} = Limit torque = 1.3 MK (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).

Ks = 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 $Td = \frac{N}{n} \quad Z \quad 9.6 \quad (kNm)$

- Maximum torque $Tmax = Td \quad Ks \quad (kNm)$

SERVICE AND LIFE FACTORS

TABLE 31

Service factors SF			
	Type of drive		
Load type	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 calenders, 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 32

Life factors K_L					
Deflection angle		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
	very heavy	1.55	1.75	1.95	2.20
	continuous heavy duty	1.75	1.95	2.20	2.45

Readings in tables 31 and 32 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:

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

$$Td \times K_L = T_D \quad \begin{matrix} < M_{DW} \text{ for alternating torque drives} \\ < M_{DSch} \text{ for pulsating torque drives} \end{matrix}$$

$Tmax < M_{CS}$ for $t = 0{,}5 \div 1$ sec.
$Tmax < M_K$ for $t > 1$ sec.

SELECTION BASED ON BEARING LIFE

Selection of the correct size of universal shaft will prove adeguate, 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 not important, 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:

$$Tmax < M_{CS} \text{ or } M_K$$

- Average torque

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

The cubed average torque and the average speed will be:

$$T_{dA} = \sqrt[3]{\frac{\sum (T_1^3 \; n_1 \; t_1 + \ldots + T_n^3 \; n_n \; t_n)}{\sum (n_1 \; t_1 + \ldots + n_1 \; t_n)}}$$

$$n_A = \frac{\sum (n_1 \; t_1 + \ldots + n_n \; t_n)}{\sum (t_1 + \ldots t_n)}$$

- Life check

L_{Rh} = 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 x b)
a = operation factor, it depends on the drive type
b = lubrication factor; it depends on the load type

TABLE 33

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 34

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 35 page 38 (kNm)
β_A = average working angle (°)

$$L_{Ch} = \frac{1.5 \;\; 10^7}{n_A \;\; Td_A^{10/3}} \quad C \;\; R = (h)$$

The following outcome shall be achieved:

$$L_{Ch} \sim L_{Rh}$$

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:

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

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

$$Tslip < M_{DW}$$

$$Tslip = \frac{G \;\; 9.81 \;\; \mu \;\; D \;\; N°}{2000} = kNm$$

where:
G = load on the wheel (kg)
μ = friction factor 0.14 to 0.25
D = wheel diameter (m)
N° = number of driven wheels

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

$$K > Ku$$

$$Ku = \frac{(fn \;\; 2 \;\; \pi)^2 \;\; J_1 \;\; J_2}{(J_1 + J_2)} = Nm/rad$$

where:
K = torsional stiffness of the universal shaft, to be requested to MAINA Technical Dept. (Nm/rad)
Ku = required torsional stiffness (Nm/rad)
fn = required frequency > 10 to 25 HZ. It is calculated for the response times of the speed adjustements of CD motors < 1 sec.
J_1 = moments of inertia from the universal shaft to the motor (kgm^2)
J_2 = moments of inertia from the universal shaft to the rolls (kgm^2)

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 hours of operation per day.

- Selection data:
- Driven by a DC electric motor along with a flywheel on the drive shaft (PD^2 = 2700 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 kW
- Motor rated rotating speed n_1 = 960 rpm
- Reduction gear ratio R = 1/8
- Rotating speed of universal shaft $n = \frac{n_1}{R} = \frac{960}{8}$ = 120 rpm
- Life requirement > 25000 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 Ks = 5
Load distribution factor Z = 0.7
Service factor SF = 4
Life factor KL = 1.4

$Td = \frac{1200}{120}$ 0.7 9.6 = 67 kNm

Tmax = 67 5 = 335 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 a 1420 mm and a length compensation of 70 mm.

M_K = 302 kNm
M_{DSch} = 224 kNm
$M_{CS} = M_K$ 1.3 = 392.6 kNm
$T_K = T_d$ SF = 67 4 = 268 kNm = M_K
$T_D = T_d$ K_L = 67 1.4 = 94 kNm < M_{DSch}
Tmax = 335 kNm < M_{CS}

In this case the bearing life check would be left out, as the deflection angle is < 3°.

II - Fix universal shaft for connection of a reduction gear with a 2-high reversing cold mill.
24 hours 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 kW
- Motor rated rotating speed n_1 = 960 rpm
- Reduction gear ratio R = 1/1.28
- Rotating speed of universal shafts $n = \frac{n_1}{R} = \frac{960}{1.28}$ = 750 rpm
- Life requirement > 10000 h = L_{Rh}
- 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

$Td = \frac{2600}{750}$ 0.66 9.6 = 22 kNm

Tmax = 22 3 = 66 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 Lf = 2000 mm - dynamically balanced.

M_K = 167 kNm
M_{DW} = 76 kNm
$M_{CS} = M_K$ 1.3 = 217.1 kNm
$T_K = Td$ SF = 22 5 = 110 kNm < M_K
$T_D = Td$ K_L = 22 1.4 = 31 kNm < M_{DW}
Tmax = 66 kNm < M_{CS}

From page 36 table 33 and 34, the coefficients
a = 1 b = 0.60 R = a b = 0.6 can be obtained.
From page 38 table 35, the life constant C = 55000 kNm can be obtained

$T_{dA} = T_d$; $n_A = n$.

The calculated theoretical life will be:

$$Lch = \frac{1.5 \quad 10^7}{n_A \quad Td_A^{10/3}} \quad C \quad R = \frac{1.5 \quad 10^7 \quad 55000 \quad 0.6}{750 \quad 22^{10/3}} = 22000 \text{ h}$$

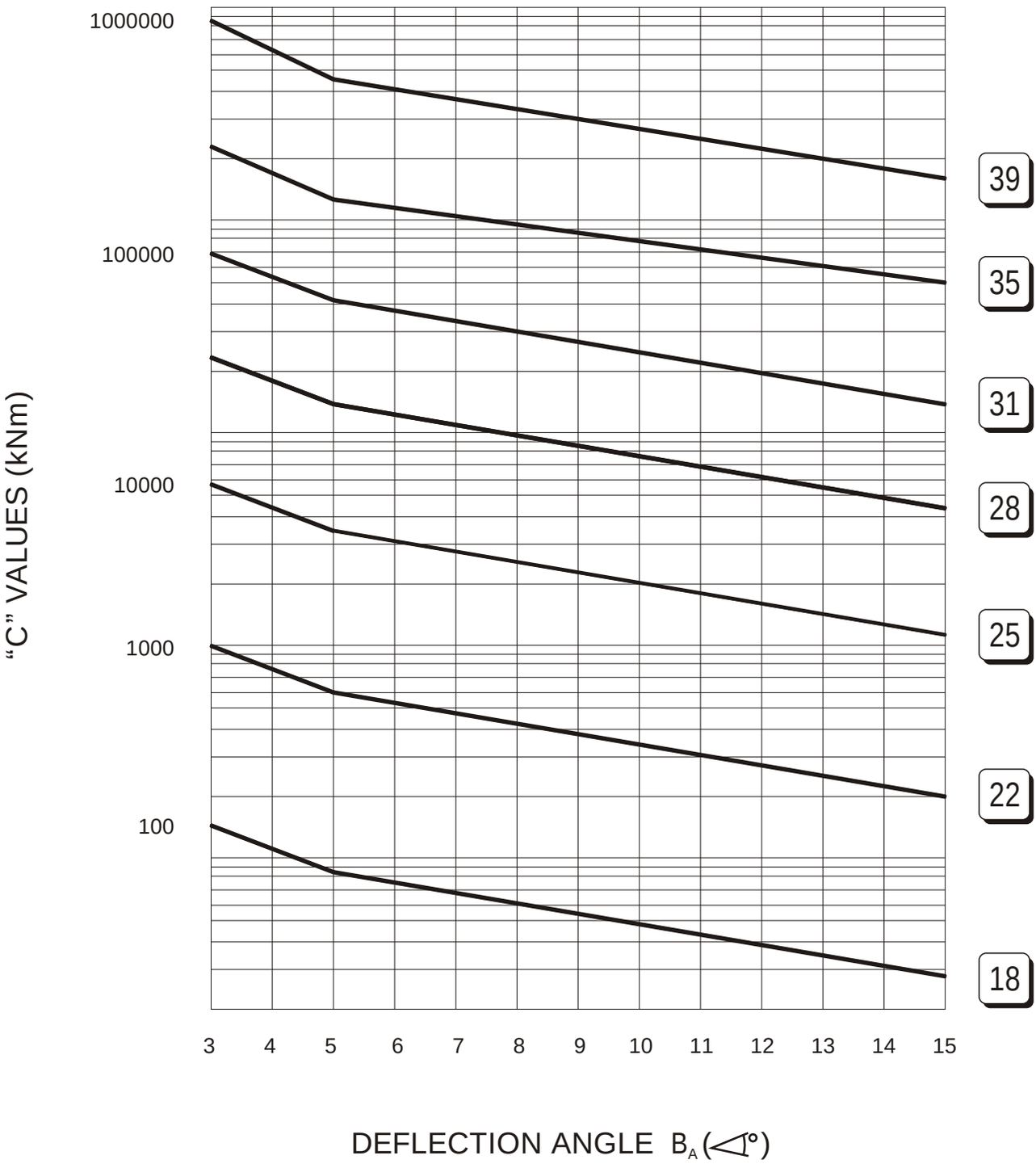
Lch = L_{Rh} as requested

In this case, one will be able to rely on average life expectancies ≥ 88000 hrs.

SIZE SELECTION

Table 35 shows the life costant of universal shafts as a function of working angle.

TABLE 35

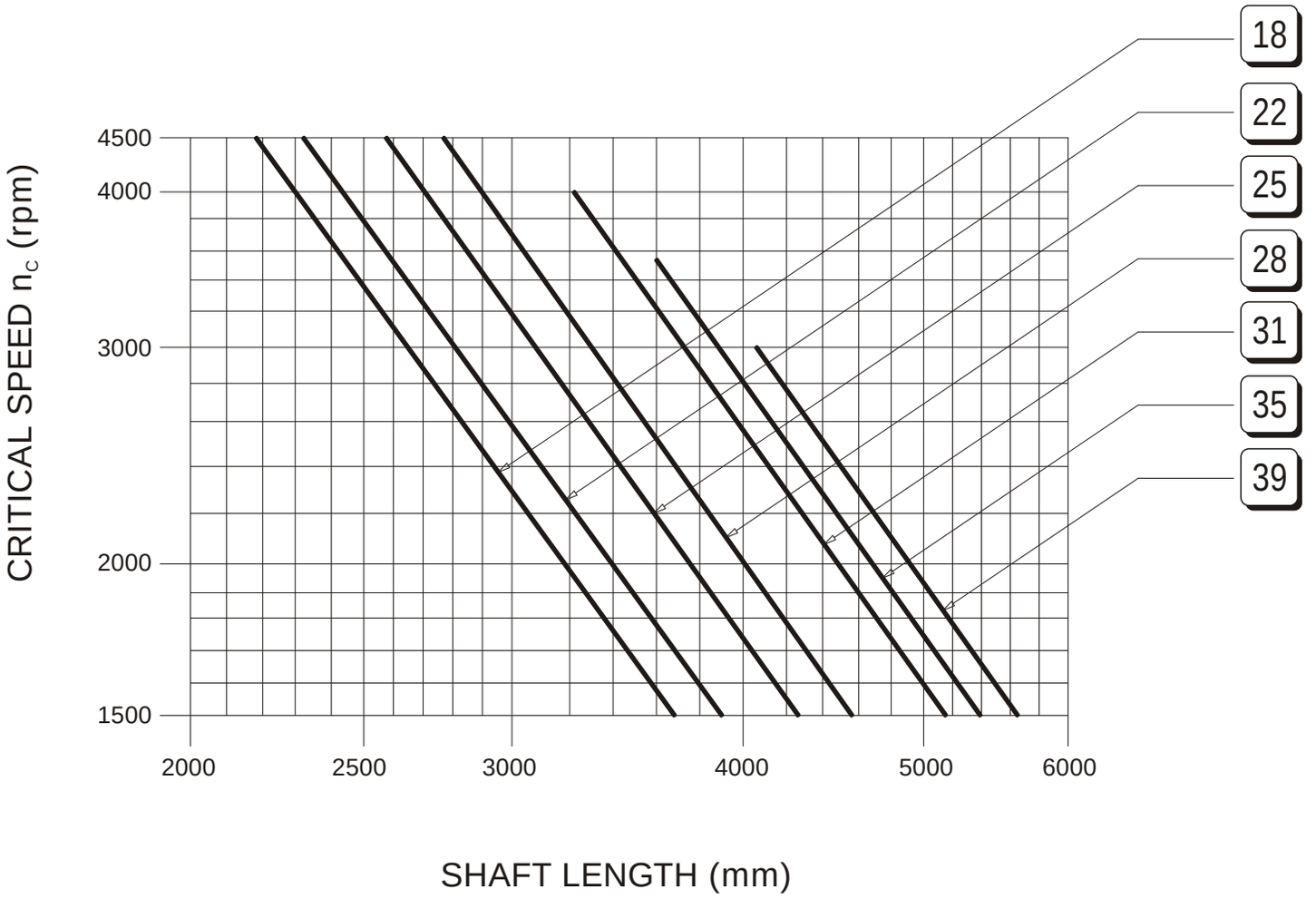


SIZE SELECTION

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.

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

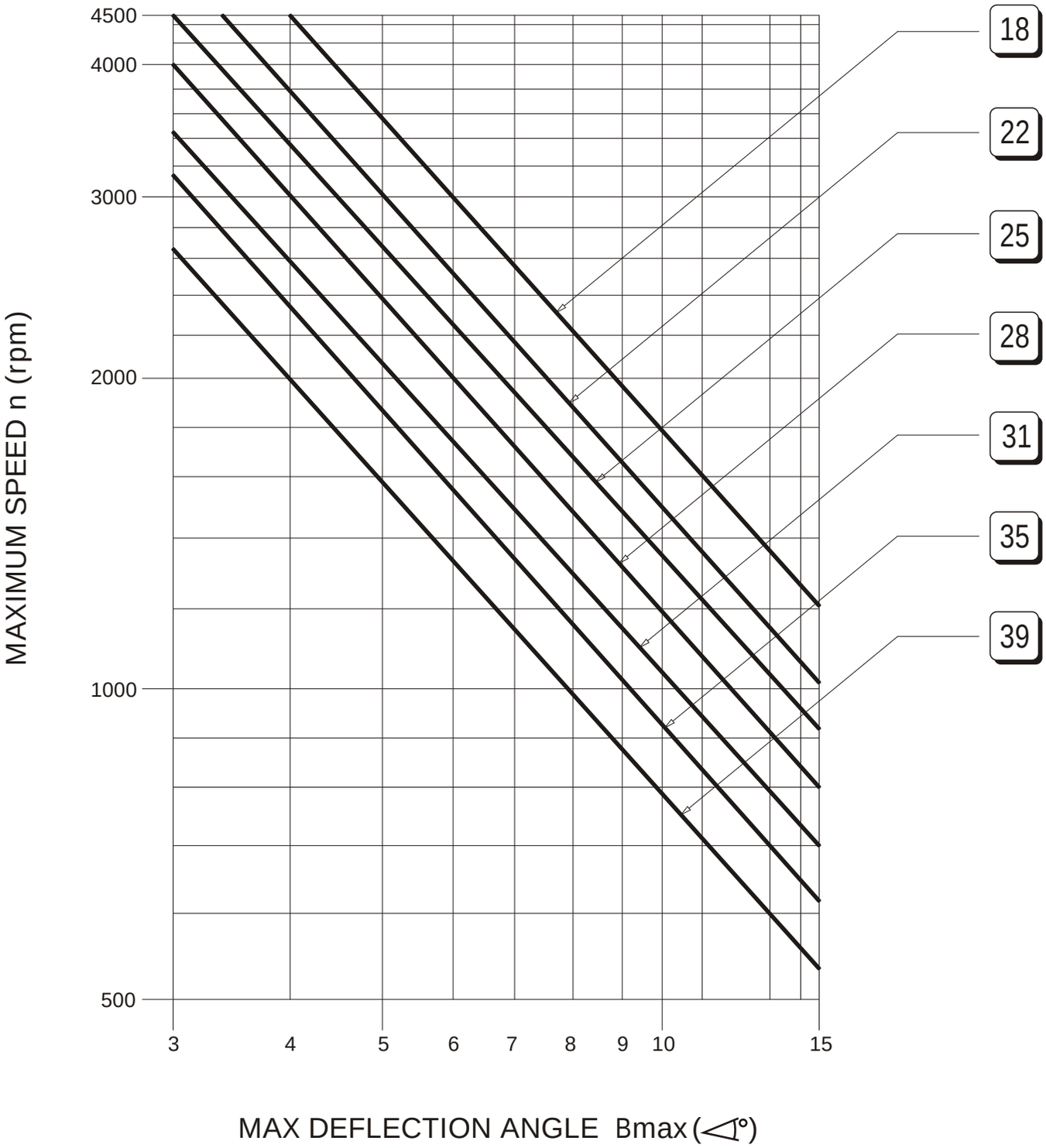
TABLE 36



SIZE SELECTION

Table 37 shows the maximum alowable speed values as a function of the working angle and the size of the universal shaft.
In fact as previously stated at page 34, 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 angular speed.

TABLE 37



ENGINEERING DATA — WEIGHTS

G min = weight in [kg] at Lz min and La min or Lf

G La = weight in [kg] for 100 mm length compensation La

G Lz or G Lf = weight in [kg] for 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
	G min	80	123	185	270	415	555	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	2090

EXAMPLE: BA25 Lz' = 1300 La' = 250

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

ENGINEERING DATA — GREASE QUANTITIES

Q min = quantity of grease in [Kg] at Lz min and La min for length compensator

Q La = quantity of grease in [Kg] for 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	2.05	2.50
ALL TYPES	Q bearing	0.05	0.07	0.16	0.28	0.40	0.68	0.92	1.40	1.85	2.40	3.50

EXAMPLE: BA25 Lz' = 1300 La' = 250 0.16 Kg of grease for 8 bearings. For the length compensator:

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

MASS MOMENTS OF INERTIA

J min = mass moment of inertia in [kg m^2] at Lz min and La min or Lf
J La = mass moment of inertia in [kg m^2] for 100 mm length compensation La
J Lz or J Lf = mass moment of inertia in [kg m^2] for 100 mm tube

TABLE 39

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	3.8350	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	1.6040
	J La	0.0038	0.0094	0.0183	0.0264	0.0645	0.0809	0.1337	0.1500	0.2560	0.4224	0.7616
BB	J	0.1854	0.4618	0.8680	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

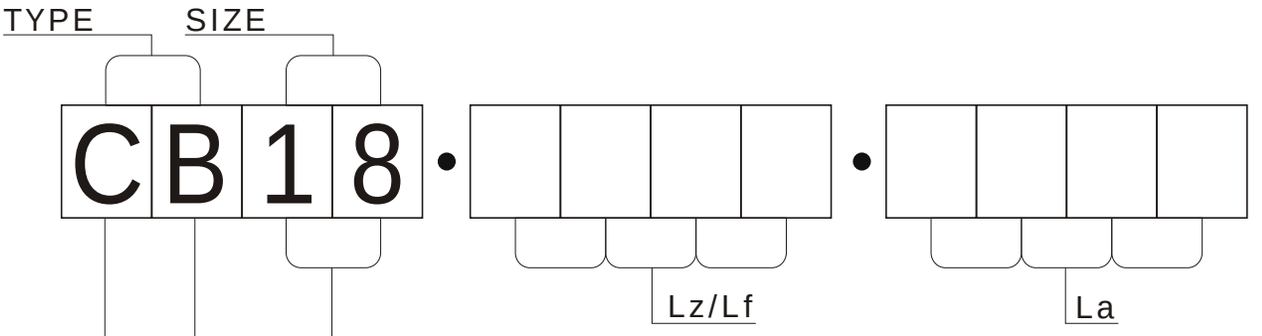
SIZE		18	22	25	28	31	35	39	44	49	55	62
TYPE												
CA	Lz	795	855	985	1080	1235	1350	1495	1680	1760	1965	2250
	La	140	145	150	155	160	170	180	190	200	210	230
	J min	0.2615	0.5575	1.0857	2.0517	4.0390	6.9691	12.2931	21.7275	34.3622	61.7192	116.404
	J Lz	0.0176	0.0234	0.0422	0.0696	0.1875	0.4367	0.5762	0.7205	0.8843	1.5793	1.6040
	J La	0.0038	0.0094	0.0183	0.0264	0.0645	0.0809	0.1337	0.1500	0.2560	0.4224	0.7616
CB	J	0.2194	0.4953	0.9536	1.8410	3.5257	6.1460	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	0.4310	0.8071	1.5614	2.7187	4.7100	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	1.6080
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

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

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

UNIVERSAL SHAFT IDENTIFICATION



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

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

EXECUTION (SERIES D, G, F, J)	
A	Telescopic Shaft
C	Fix Length Shaft, tubular design
D	Fix Length Shaft, short design
F	Telescopic Shaft, flange intermediate design
G	Fix Length Shaft, flange tubular design
H	Fix Length Shaft, flange short design
K	Flange Joint
L	Fix Length Shaft, intermediate shaft design
M	Telescopic Shaft, intermediate tubular design

EXECUTION (SERIES S)	
F	Telescopic Shaft, medium length compensation (flange intermediate assembly)
G	Fix Length Shaft, flange tubular design
H	Fix Length Shaft, flange short design
J	Telescopic Shaft, medium length compensation series S flange joint roll side series B weld joint pinion side, bigger rotation
K	Flange Joint

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)

EXAMPLE OF IDENTIFICATION:

UNIVERSAL SHAFT WITH LENGTH COMPENSATION
MEDIUM-LARGER FLANGES SHORT DESIGN, SIZE 18
COLLAPSED LENGTH Lz = 795, SLIDE La = 140

CODE: CB18.0795.0140

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 S	SIZE	35	39	44	49	55									
SERIES D - G	SIZE	60	65	70	75	80	85	90	95	100	105	110	115	120	125
SERIES F - J	SIZE	60	65	70	75	80	85	90	95	100	105	110	115	120	125
SERIES E - H	SIZE	18	22	25	28	31	35	39	44	49	55				

COMPANION FLANGE IDENTIFICATION

E	A	COMPANION FLANGE WITH INNER CENTERING, WITHOUT KEY	PAG. 18
E	B	COMPANION FLANGE WITH INNER CENTERING, ACCORDING TO DIN 15452	PAG. 18
E	C	COMPANION FLANGE WITH INNER CENTERING, WITH KEY, STANDARD TYPE	PAG. 18
E	D	COMPANION FLANGE WITH INNER CENTERING, WITH KEY, LARGER TYPE	PAG. 18
E	E	COMPANION FLANGE WITH OUTER CENTERING, WITHOUT KEY	PAG. 20
E	F	COMPANION FLANGE WITH OUTER CENTERING, ACCORDING TO DIN 15452	PAG. 20
E	G	COMPANION FLANGE WITH OUTER CENTERING, WITH KEY, STANDARD TYPE	PAG. 20
E	H	COMPANION FLANGE WITH OUTER CENTERING, WITH KEY, LARGER TYPE	PAG. 20
E	J	CYLINDRICAL COMPANION FLANGE WITH INNER CENTERING, WITHOUT KEY	PAG. 22
E	K	CYLINDRICAL COMPANION FLANGE WITH INNER CENTERING, WITH KEY, STANDARD TYPE	PAG. 22
E	L	CYLINDRICAL COMPANION FLANGE WITH INNER CENTERING, WITH KEY, LARGER TYPE	PAG. 22
E	M	CYLINDRICAL COMPANION FLANGE WITH OUTER CENTERING, WITHOUT KEY	PAG. 24
E	N	CYLINDRICAL COMPANION FLANGE WITH OUTER CENTERING, WITH KEY, STANDARD TYPE	PAG. 24
E	P	CYLINDRICAL COMPANION FLANGE WITH OUTER CENTERING, WITH KEY, LARGER TYPE	PAG. 24

SERIES	
A	LIGHT
B	MEDIUM - STANDARD FLANGES
C	MEDIUM - LARGER FLANGES
S	HYSHAFT
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 S	SIZE	35	39	44	49	55									
SERIES D - G	SIZE	60	65	70	75	80	85	90	95	100	105	110	115	120	125
SERIES F - J	SIZE	60	65	70	75	80	85	90	95	100	105	110	115	120	125
SERIES E - H	SIZE	18	22	25	28	31	35	39	44	49	55				

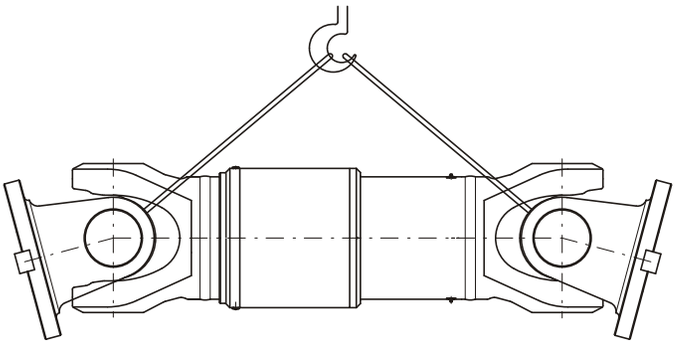
INSTALLATION, MAINTENANCE AND LUBRICATION

1) TRANSPORT AND STORAGE

1.1 MAINA universal shafts are generally supplied assembled (complete male and female assembly), balanced (if necessary) and, unless otherwise requested, painted (coat of primer + final color) according to MAINA specification PFB 1104.

1.2 A proper surface protection coat normally realizes protection against corrosion on the flange machined surfaces. Different anticorrosion treatments shall be required in the order.
Bearings and length compensator are pre-lubricated.

1.3 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.



1.4 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.

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

1.6 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.

1.7 Store preferably on suitable wooden frames. Avoid any kind of impact when handling and storing.
Shocks and impacts, during transport and storage, could damage bearings, splined parts and their protective caps.

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

1.9 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.

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

2) ASSEMBLY

2.1 Remove the universal shaft from the packaging and check its conservation state.

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

2.3 Balance weights should never be removed.

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

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

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

2.7 Heat the companion flanges uniformly (100÷150 °C) for key fitting and (300÷350 °C) for shrink fitting before assembling onto the 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).

2.8 The companion flanges must be firmly fix 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

2.9 Check that the dimensions between shaft ends (minimum and maximum distances) are in accordance to MAINA drawings.
NOTE:
When installing fix length universal shafts, one of the units must be free to move, to compensate slight length variation, due to manufacturing tolerances or temperature changes.

2.10 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.

2.11 Before fitting the joint flanges, their surfaces have to be accurately cleaned. They must be free from grease, coat or rust.

2.12 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 30 or our drawings.
The self-locking nuts lose their features and must be replaced, after a certain period of operations (about 5 screwings and unscrewings).
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 MoS_2.

2.13 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 tube and intervals of lubrication.

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

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.

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.

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 165°C
Thickener percentage	7%
Mineral oil	75%
Oil viscosity at 40°C	1000÷1500 cSt
Oil viscosity at 100°C	60÷100 cSt
Addition agents EP type	2%
MoS2 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):

CASTROL	CASTROL MOLUB-ALLOY 870
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 41.

5) MAINTENANCE

5.1 To ensure a trouble-free life of the universal shafts, a maintenance schedule and a 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/Nibration

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

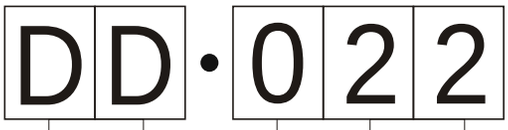
D	A	KEY
D	B	FLANGE YOKE
D	C	HEXAGONAL BOLT / STUD BOLT

As for the flange joke with larger flange than the corresponding of series C,G,J, it is necessary to add in the code the flange diameter

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

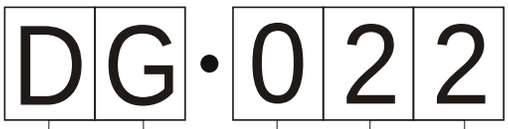
EXAMPLE OF IDENTIFICATION:
FLANGE YOKE WITH KEY
UNIVERSAL SHAFT SERIES “C”
SIZE 22 FLANGE DIAMETER = 285
CODE DB.C2201.285

EXAMPLE OF IDENTIFICATION:
FLANGE YOKE WITH KEY
UNIVERSAL SHAFT SERIES “B”
SIZE 22
CODE DB.B2201



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

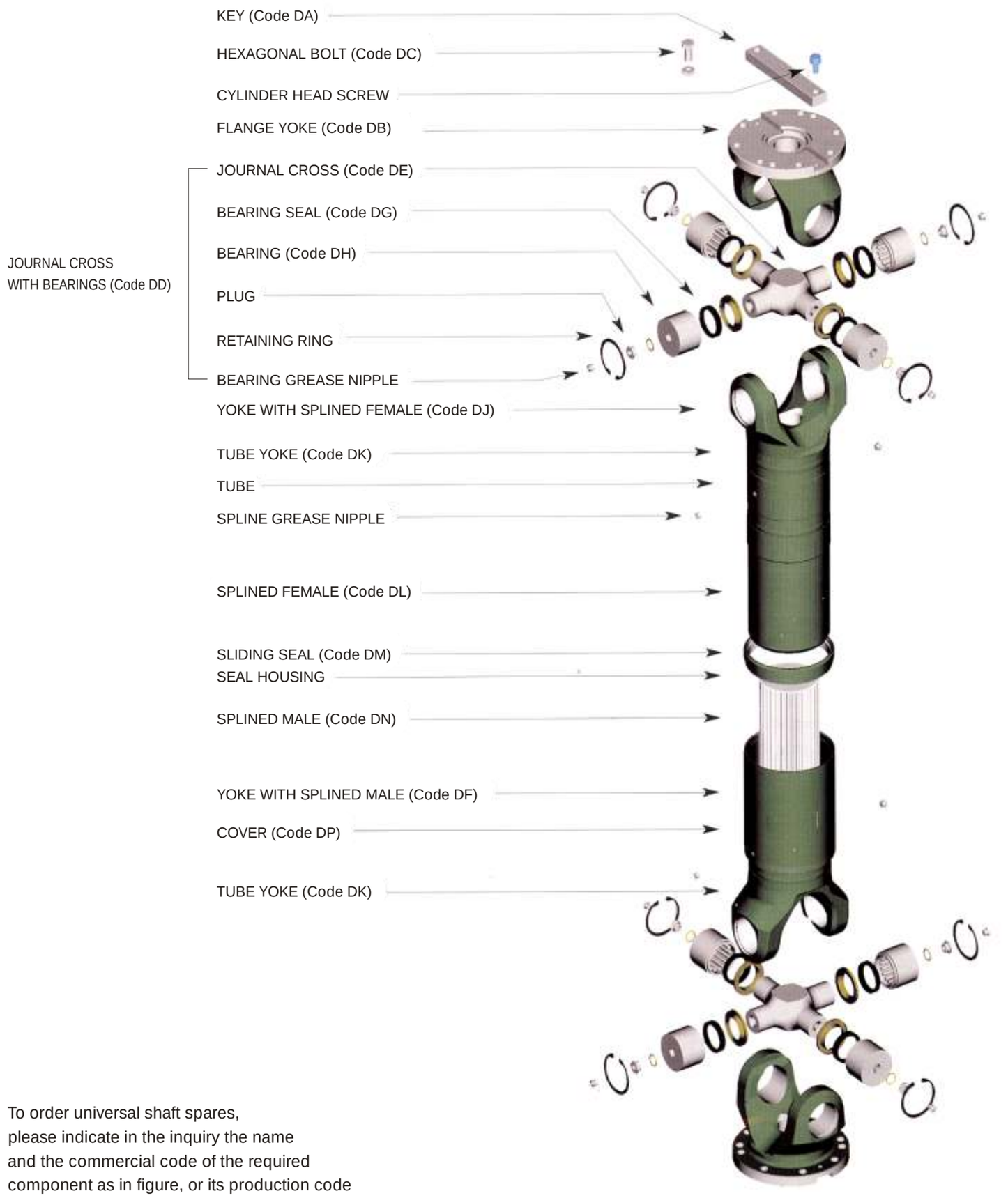


D	G	BEARING SEAL	D	Q	HOLLOW EXTERNAL YOKE
D	H	BEARING	D	R	HOLLOW INTERNAL YOKE
D	J	YOKE WITH SPLINED FEMALE	D	S	BEARING COVER
D	K	TUBE YOKE	D	T	COVER CAP SCREW
D	L	SPLINED FEMALE	D	U	THRUST BEARING
D	M	SLIDING SEAL	D	V	SYNTHETIC DISC
D	N	SPLINED MALE	D	W	ANTI-PIERCING BEARING DEVICE
D	P	COVER			

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	120	125
SERIES F - J	SIZE	60	65	70	75	80	85	90	95	100	105	110	115	120	125
SERIES E - H	SIZE	18	22	25	28	31	35	39	44	49	55				

SPARE PART IDENTIFICATION

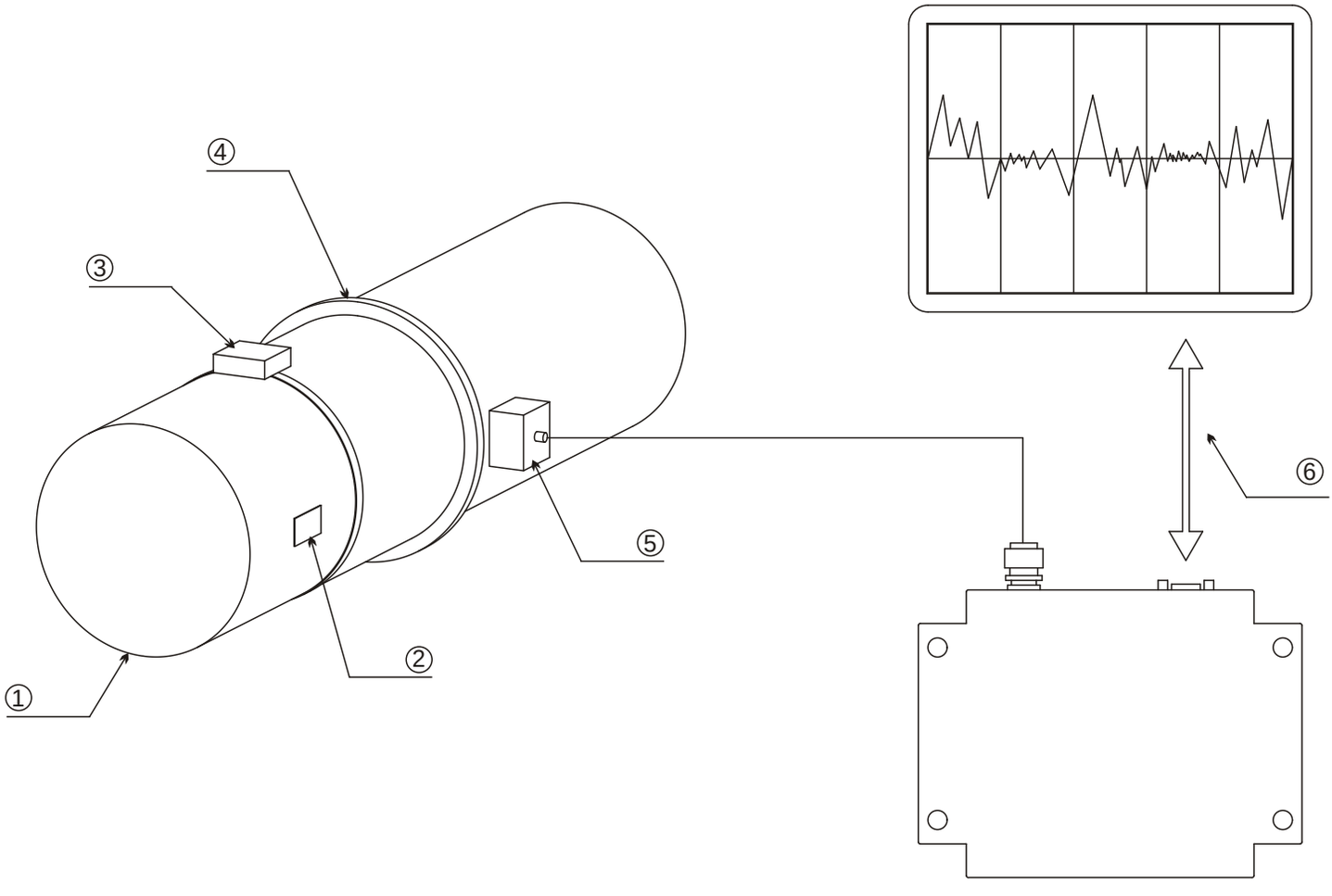


To order universal shaft spares, please indicate in the inquiry the name and the commercial code of the required component as in figure, or its production code indicated in the assembly drawing.

TORQUE MONITORING

Strength of Maina Company is the design and production of special torque monitoring devices, particularly for extremely severe applications as in plate mills, steckel mills and hot strip mills, always complying with the transmission dimensions.
They base on the application of strain gauges on an external cylindrical surface, subject to torque flow, which deform by transmitting a signal to telemetric device through a rotor aerial.
The signals, decoded by a special software, enable obtaining the time torque diagram.

GENERAL MEASUREMENT CONFIGURATION



① Shaft
② Sensor
③ Sensor signal amplifier
④ Rotor antenna
⑤ Stator antenna
⑥ Power supply and torque signal

TECHNICAL DATA FOR SELECTION

UNIVERSAL SHAFTS FOR GENERAL MACHINERY APPLICATION

Installation

Type of installation .....
Type of operation .....
Shocks .....
Reversing service .....
Intermitted service .....
Ambient conditions .....
Ambient temperature .....

Motor

Type .....
Torque ..... kNm
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 .....

TECHNICAL DATA FOR SELECTION

UNIVERSAL SHAFTS FOR ROLLING MILL DRIVES

Installation

Type of installation .....
Type of operation .....
New equipment/overhaul .....
Ambient conditions .....
Ambient temperature .....

Motor

Type/adjustment .....
Power ..... kW
Speed ..... rpm
Nominal torque ..... kNm
Max continuous torque ..... kNm
Cut out torque ..... kNm

Intermediate gear / Pinion stand

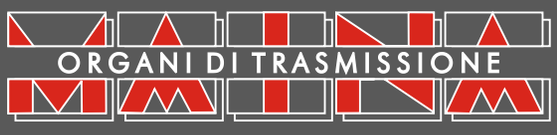
Type of high speed flexible coupling .....
Ratio .....
Number of outputs .....
Output shaft end diameter ..... mm - length ..... mm
Output max. perm. universal shaft diameter ..... mm

Driven unit

Normal working torque ..... kNm
Max working torque ..... kNm
Impact torque ..... kNm
Cut out torque ..... kNm
Torque distribution - top ..... % - middle ..... % - bottom ..... %
Roll speed range ..... rpm
Roll diameter max/min ..... mm
Roll end diameter ..... mm - length ..... mm
Shape of roll end .....
Roll change horizontal/vertical .....

Universal shaft

Working deflection angle - min ..... ° - max ..... °
Working length min/max ..... / ..... mm
Roll movement max ..... mm
Quick release device requested - yes ☐ - no ☐
Universal shaft connection - flange ☐ - hub ☐
Required universal shaft size .....



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