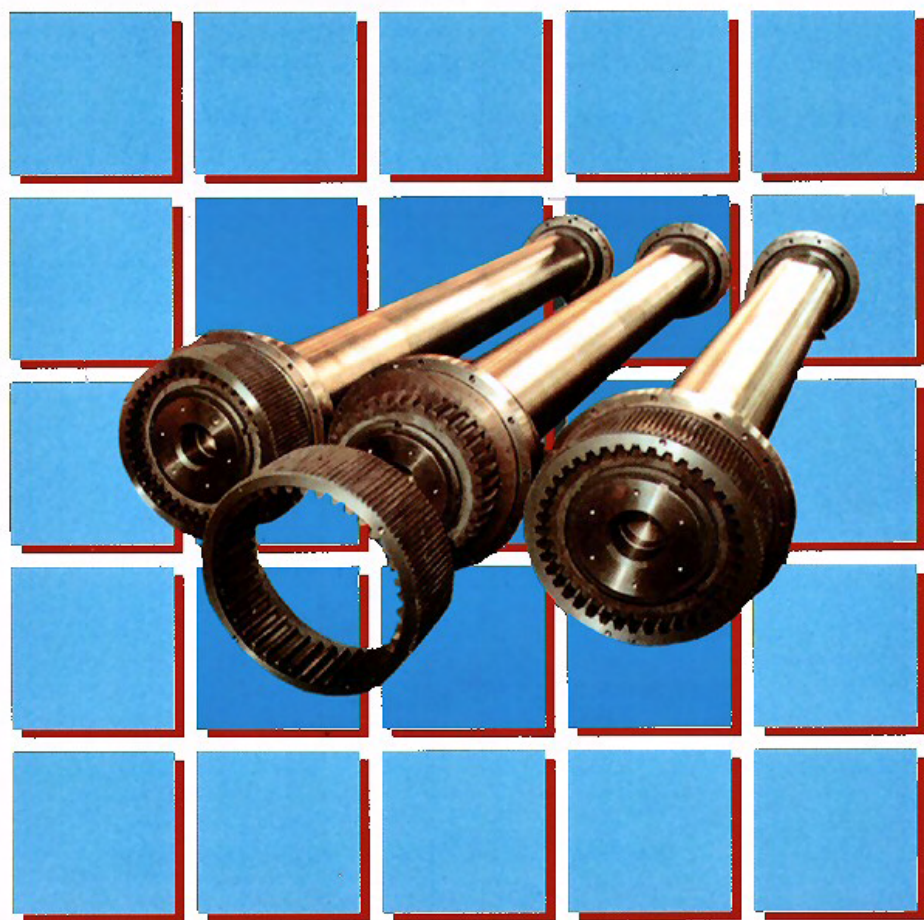
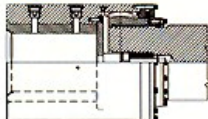
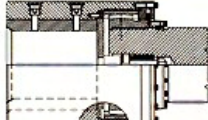
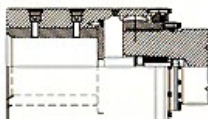
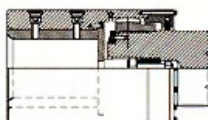
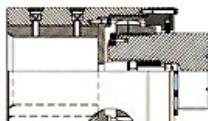
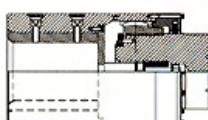
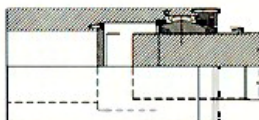
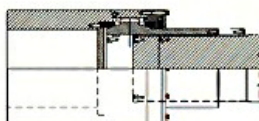
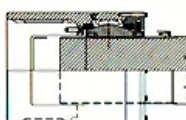


GEAR SPINDLES



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The present catalogue relates to MAINA's present production of Gear Spindles, and provides a description of their technical specification in order for a proper selection to be made.
However, our engineers are always at your disposal to make suggestions for your choice and provide with you any further information requested.

The present edition supersedes all previous editions.

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PRODUCT CONCEPT

Modern steel and non ferrous mills require top performance from the power transmission equipment with higher loads and speeds being needed.

Rolling mill spindle couplings are components of vital importance, with regard to productivity objectives and high quality standard of the end product.

Gear spindle coupling requirements:

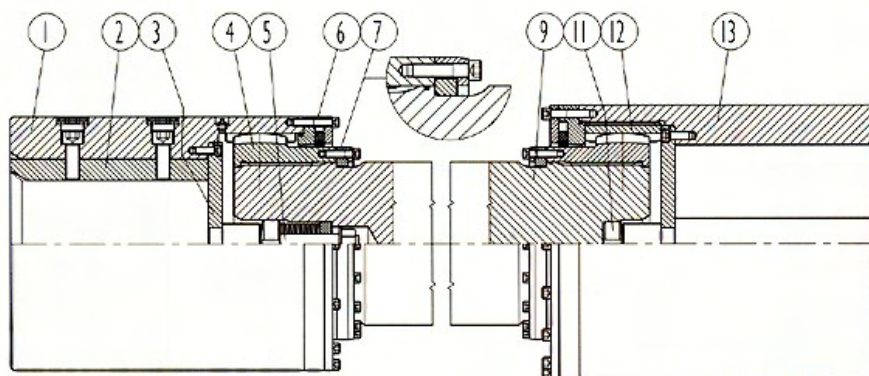
- * High torque capacity under minimum space condition.
- * Suitability to endure high instantaneous peak loads, due to torque amplification, created by material entering or any disturbance during rolling process.
- * Suitability to transmit the max torque with angular misalignment of 3° and over.

MAINA gear spindles meet today's extreme operating requirements for high misalignment and torque by means of the following features:

- * Gear tooth profile, designed for each application, obtains a maximum area contact with minimum backlash and stress concentration.
- * Selection of material, heat treatment and surface hardening ensure the MAINA gear spindle will endure combined compressive, bending and shear stresses.
- * Surface finish precision of the gear tooth improve the load distribution and increase the working surface.
- * Special sealing set avoids leakage of lubricant and contamination maintaining the lube film, essential for a long tooth life.
- * Precise manufacturing and exact balancing assure optimum life and performance, for high speed operations.

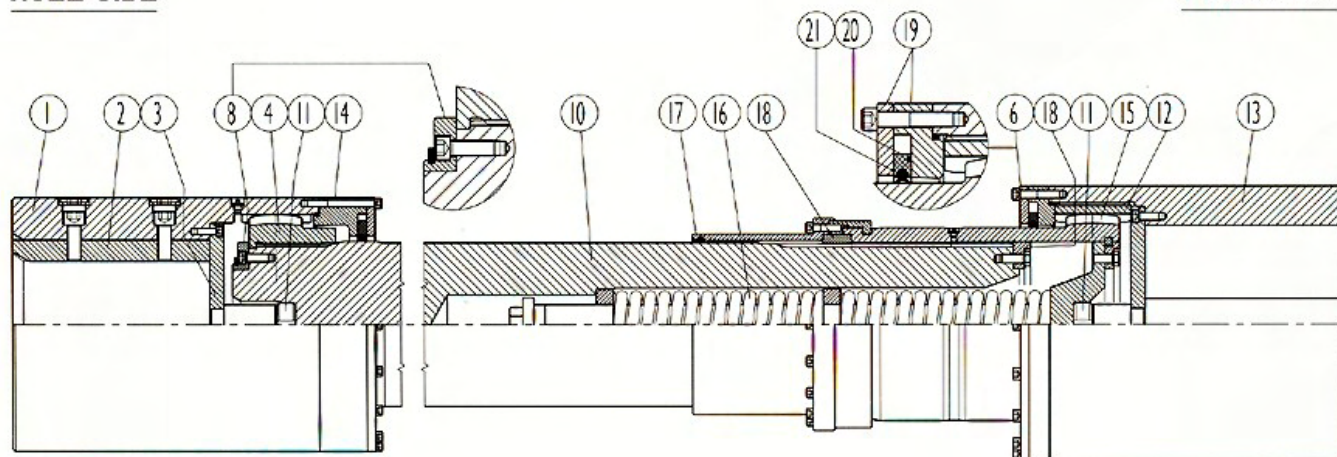
MAIN COMPONENT LIST

01	ROLL SLEEVE	Comp. Code BAA
02	FLAT WEAR KEY	Comp. Code BFA
03	THRUST PLATE	Comp. Code BFN
04	GEAR HUB	Comp. Code BBA
05	SLEEVE ALIGNING DEVICE	Comp. Code BK
06	SEALING SET ON HUB	Comp. Code BJ
07	EXTERNAL HUB RETAINER	Comp. Code BHB
08	INTERNAL HUB RETAINER	Comp. Code BHD
09	INTERMEDIATE SHAFT	Comp. Code BDA
10	LONG SPLINE SHAFT	Comp. Code BEA
11	THRUST BUTTON	Comp. Code BKJ
12	INTERMEDIATE SLEEVE	Comp. Code BCA
13	PINION SLEEVE	Comp. Code BAB
14	SEALING SET ON SHAFT	Comp. Code BJ
15	LONG SPLINE GEAR HUB	Comp. Code BBC
16	SPRING LOADED UNIT	Comp. Code BL
17	COVER	Comp. Code BH
18	CENTERING BUSHING	Comp. Code BH
19	SEAL RETAINER	Comp. Code BJ
20	FLOATING RING	Comp. Code BJ
21	SEAL	Comp. Code OI



ROLL SIDE

PINION SIDE



GEAR TOOTH SHAPE & DESIGN

CROWNED FLANKS

To maximize the gear spindle performances, the gear tooth design must be optimized, according to the following parameters:

- * Max angle of misalignment (under load)
- * Max angle of misalignment (at roll change)
- * Max operating torque
- * Peak operating torque
- * Type of drive (unidirectional or reversible)

The hub teeth have crowned flanks. This prevents gear tooth end loading, reduces contact stress and increases the contact area.

The amount of flank crown, based on the maximum angle of misalignment (usually at roll change), is optimized to obtain the minimum backlash, using specialized computer programs, verifications by 3-D modeling system and Finite Elements Analysis.

CROWNED TIP

The tips of the teeth are crowned with a radius equal to the one of the mating internal gear.

The crowned external tip which is in contact with the root of the internal gear tooth, assures an accurate radial piloting, with concentric sphere/cylinder action. This permits minimum diametral clearance, which, by physically centering the internal and external gear teeth, assures good dynamic balance characteristics under all loads, speed, and misalignment conditions.

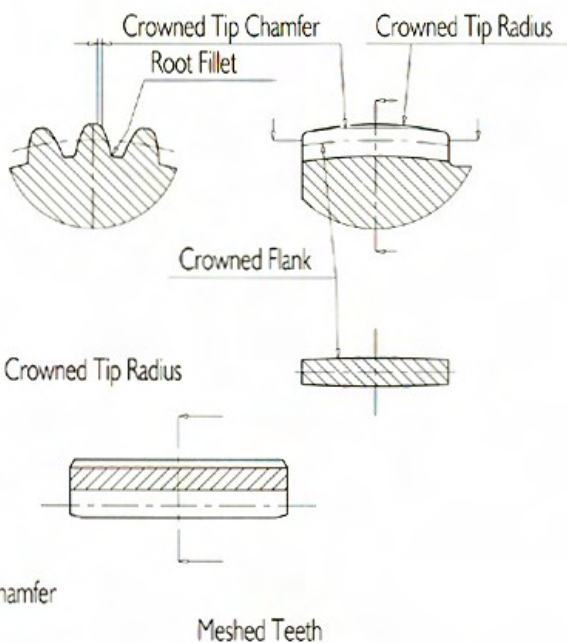
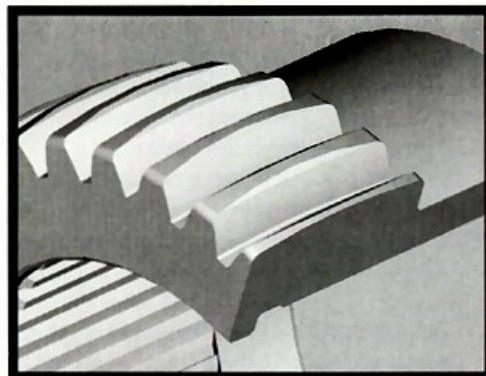
CROWNED CHAMFER

Faces of the external teeth adjacent to the tips are chamfered by suitable cutting tools to eliminate interference with the internal teeth root fillets.

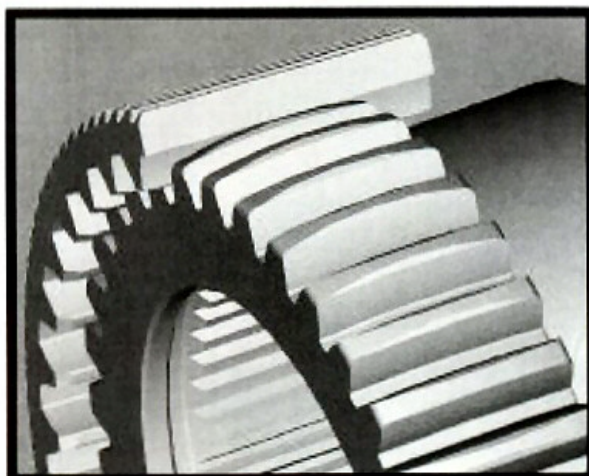
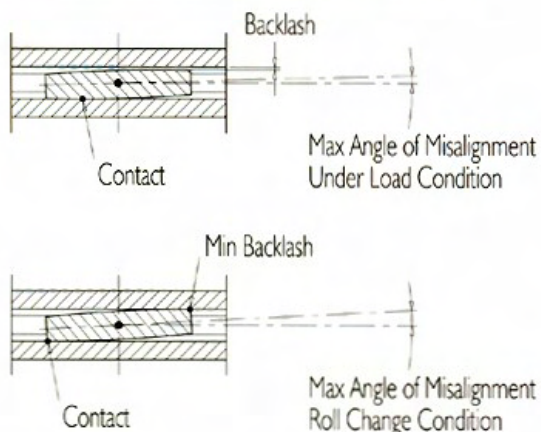
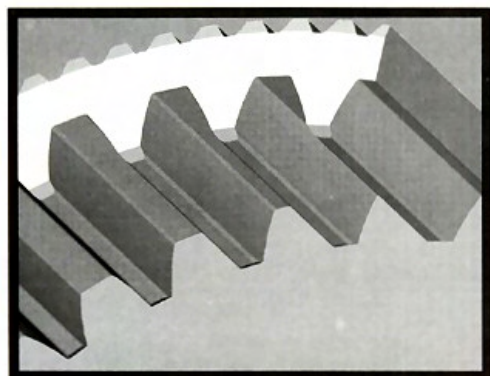
At the same time this assures the total contact of the gear tooth flanks and permits freedom to misalign.

Also the internal gear tip is chamfered to avoid dangerous vibrations during teeth movement.

Crowned Male



Straight Female



GEAR TOOTH MATERIALS & HEAT TREATMENTS

Any gear spindle coupling component, operating for the torque transmission, is manufactured from special alloy steel and is heat treated.

The selection of a proper combination of steel and heat treatment, depending on the stressing level and the required operating life, can be:

TYPE A - X38CrMo V51 SGN

Type X38CrMo V51 alloy tool steel core hardened and tempered with final heavy duty nitriding cycle

Surface hardness > 1100 [Hv]

Gear teeth ground before and after nitriding

TYPE B - 18NiCrMo5 CHG

Type 18NiCrMo5 alloy steel case hardened and tempered

Surface hardness > 625[Hv]

Gear teeth ground after case hardening and tempering

TYPE C - 31CrMo12 SGN

Type 31CrMo12 alloy steel hardened and tempered and special gas nitriding cycle for high depth

Surface hardness > 750[Hv]

On request: gear teeth ground after gas nitriding

TYPE D - 42CrMo4 NGN

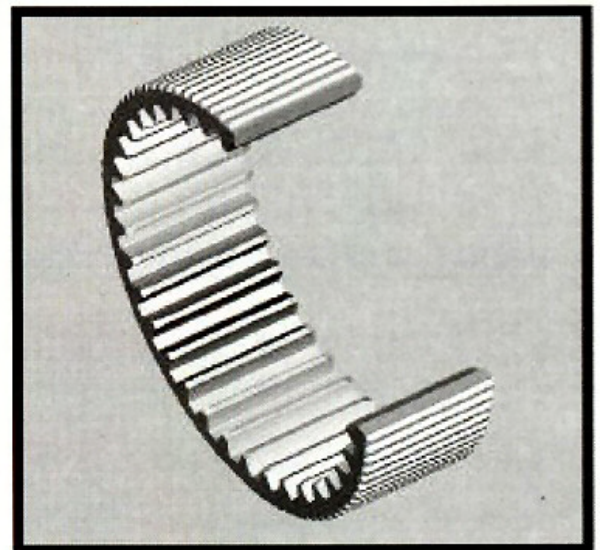
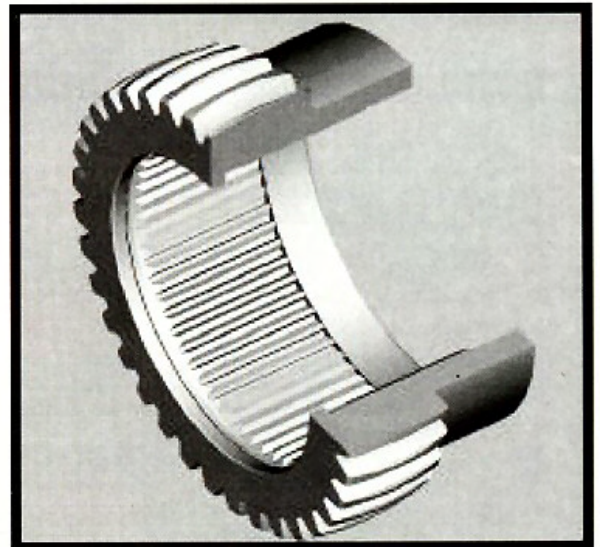
Type 42CrMo4 alloy steel hardened and tempered and normal gas nitriding cycle for standard depth

Surface hardness > 550 [Hv]

TYPE E - 42CrMo4 IHT

Type 42CrMo4 alloy steel hardened and tempered and full contour induction hardening

Surface hardness > 550 [Hv]



Material Type	Load Intensity				Shock Intensity				Working Angle				No Load Angle				Operating Speed				Operating Temperature			
	L	M	H	V	L	M	H	V	L	M	H	V	L	M	H	V	L	M	H	V	L	M	H	V
A				●				●				●				●				●				●
B			●				●				●				●				●				●	
C		●				●				●				●				●				●		
D	●				●					●				●				●				●		
E	●				●					●				●				●				●		

L = Light : M = Medium : H = Heavy : V = Very heavy

MILL SPINDLE SIZE SELECTION

After a pre-selection made on the basis of the required design and the available space (min. roll diameter), check that the final selection complies with the following conditions (A, B & C)

With SGNG & CHG materials, spindle heads type C & G must be employed instead of A & E types.

Spindle heads type H, J, K & L, have to be selected and designed by our technical department.

A) RATED TORQUE CHECK

The rated torques, T_k & T_f , in TAB.04 & 05, correspond to the torques to be transmitted by the gear elements based on load angle = 1.5° & service factor $K_1 = 1$.

A1) CHECK THE PRELIMINARY SELECTION by comparing the rating torque revised according to the proper factors with the continuous torque required at the max load angle.

$$\frac{T_k \times K_2 \times K_r}{K_1} \geq T_d \quad \text{where:} \quad T_d = \frac{N \times 30 \times M_o}{n \times \pi \times 100} \quad \text{and:}$$

T_k [kNm] = fatigue torque.....TAB.04-05
 T_d [kNm] = max continuous torque for each spindle
 N [kW] = motor power in case of Twin Drive or 60% of motor power when the pinion box is installed
 n [RPM] = base spindle speed
 M_o [%] = continuous motor over load....(ex. 70÷135%)
 K_1 = service factor.....TAB.01
 K_2 = misalignment factor.....TAB.02
 K_r = 1.0 for unidirectional drive
 = 0.7 for reversing drive

A2) BESIDES, CHECK THAT:

$$T_f \times K_2 \geq T_{max} \quad \text{where:} \quad T_{max} = \frac{N \times 30 \times P_o \times TAF}{n \times \pi \times 10000} \quad \text{and:}$$

T_f [kNm] = peak torque (90% yield limit).....TAB.04-05
 T_{max} [kNm] = maximum torque for each spindle
 TAF [%] = torque amplification factor (ex. 120÷220%)
 K_2 = misalignment factor.....TAB.02
 P_o [%] = peak motor over load.....(ex. 150÷275%)

B) OPERATING SPEED AND DYNAMIC CONDITION CHECK

The maximum admitted speed depends on the load angle. In the continuous rolling mills it is recommended that admissible speeds are verified, based on real under load angular misalignment at each single stand.

$$n_{adm} \geq n_{max} \quad \text{where:} \quad n_{adm} = n_k \times K_3 \quad \text{and:}$$

n_{adm} [RPM] = maximum admissible spindle speed
 n_{max} [RPM] = max spindle speed
 n_k [RPM] = max base speed.....TAB.04-05
 K_3 = speed factor.....TAB.03

In case of application requiring angular misalignment higher than 1.5° at a rotation speed of about 500 RPM, when the selected material for the gear elements is case hardened & tempered (B) or induction hardened (E), please ask MAINA technical department to check sliding velocity, PV factor and thermal capacity.

C) DIMENSIONAL CHECK

The max bores specified in the tables are reference values, and they are linked to the mechanical features of the materials used, as well as to the real torque. After selecting the size, based on application torque and speed, check that the minimum roll diameter is greater than the head outside diameter shown on dimensional tables (from 6 to 16). In any case consult MAINA technical department for final size selection.

IMPORTANT:

The purchaser is responsible for the spindle size and type selection, our proposal must be considered as a recommendation only.

Since only the purchaser knows exactly the operating conditions the installation requires, he shall assume the responsibility of:

- Checking that the selected spindles are suitable to the application requirements
- Verifying that all documents and drawings prepared on the basis of information received from the purchaser are correct and complying with the real requirements.

TAB.01 - SERVICE FACTOR - K1

Steel Mill Type	Factor K1
One Way Cold Mill & Aux Equipment	1.50 ÷ 1.75
Reversing Cold Mill	2.00 ÷ 2.50
One Way Hot Mill	2.25 ÷ 2.75
Reversing Hot Mill	3.00 ÷ 3.50

TAB.02 - MISALIGNMENT FACTOR - K2

Load Angle [Deg°]	Materials				
	A	B	C	D	E
	Factor K2				
0°30'	1.18	1.27	1.41	1.56	1.89
0°45'	1.15	1.22	1.33	1.44	1.66
1°00'	1.10	1.16	1.23	1.30	1.42
1°15'	1.05	1.08	1.11	1.15	1.19
1°30'	1				
1°45'	0.94	0.92	0.89	0.87	0.88
2°00'	0.88	0.84	0.79	0.77	0.79
2°15'	0.82	0.76	0.70	0.69	0.72
2°30'	0.76	0.69	0.64	0.63	0.67
2°45'	0.70	0.63	0.59	0.59	0.62
3°00'	0.65	0.58	0.55	0.55	0.58

TAB.03 - SPEED FACTOR - K3

Load Angle [Deg°]	Factor K3
0°30'	2.94
0°45'	1.98
1°00'	1.49
1°15'	1.20
1°30'	1
1°45'	0.86
2°00'	0.75
2°15'	0.67
2°30'	0.60
2°45'	0.55
3°00'	0.50

MILL SPINDLE RATING TORQUES & SPEED

TAB.04

NOTE: Tk = fatigue pulsating torque based on 1.5 degrees misalignment
Tf = max peak torque based on 90 % yield limit of material

Designs **A.B.C.D.E.F.G**

SIZE	MATERIAL - A			MATERIAL - B			MATERIAL - C			MATERIAL - D			MATERIAL - E		
	BASE TORQUE	PEAK TORQUE	MAX SPEED	BASE TORQUE	PEAK TORQUE	MAX SPEED	BASE TORQUE	PEAK TORQUE	MAX SPEED	BASE TORQUE	PEAK TORQUE	MAX SPEED	BASE TORQUE	PEAK TORQUE	MAX SPEED
	Tk [kNm]	Tf [kNm]	nk [l/min]	Tk [kNm]	Tf [kNm]	nk [l/min]	Tk [kNm]	Tf [kNm]	nk [l/min]	Tk [kNm]	Tf [kNm]	nk [l/min]	Tk [kNm]	Tf [kNm]	nk [l/min]
22	369	922	2745	226	565	1600	143	357	1880	100	250	1250	59	147	900
23	429	1072	2570	267	667	1510	171	962	1760	120	300	1180	69	172	840
24	488	1220	2424	290	725	1420	186	465	1660	130	325	1110	75	187	790
25	534	1335	2292	316	790	1340	201	502	1570	139	347	1050	80	200	750
27	674	1685	2146	417	1042	1260	262	655	1470	184	460	980	109	272	700
28	775	1937	2029	462	1155	1180	295	737	1390	205	512	920	118	295	660
29	846	2115	1912	502	1255	1120	320	800	1310	222	555	870	128	320	620
31	915	2287	1810	543	1357	1060	345	862	1240	239	597	830	139	347	590
32	1206	3015	1708	751	1877	1000	474	1185	1170	335	837	780	197	492	560
34	1380	3450	1620	826	2065	940	529	1322	1110	369	922	740	214	535	530
36	1516	3790	1518	897	2242	890	572	1430	1040	396	990	700	230	575	500
37	1638	4095	1445	970	2425	840	618	1545	990	428	1070	660	248	620	470
40	2285	5712	1343	1402	3505	790	885	2212	920	617	1542	620	366	915	440
42	2620	6550	1270	1633	4082	740	1030	2575	870	730	1825	580	427	1067	410
44	3010	7525	1197	1792	4480	700	1145	2862	820	794	1985	540	460	1150	390
46	3280	8200	1124	1945	4862	660	1239	3097	770	860	2150	510	499	1247	370
48	4030	10075	1066	2505	6262	620	1576	3940	730	1113	2782	490	653	1632	350
51	4610	11525	1007	2755	6887	590	1764	4410	690	1225	3062	460	711	1777	330
53	5060	12650	949	2995	7487	560	1905	4762	650	1320	3300	430	765	1912	310
56	5470	13675	905	3240	8100	530	2060	5150	620	1425	3562	410	826	2065	290
59	6770	16925	847	4010	10025	500	2555	6387	580	1770	4425	390	1026	2565	280
62	7320	18300	803	4335	10837	470	2760	6900	550	1912	4780	370	1108	2770	260
64	7920	19800	759	4680	11700	440	2970	7425	520	2048	5120	350	1187	2967	250
67	8550	21375	730	5035	12587	420	3180	7950	500	2185	5462	330	1268	3170	230
70	10980	27450	686	6480	16200	400	4110	10275	470	2835	7087	310	1642	4105	220
74	11840	29600	657	6990	17475	380	4425	11062	450	3050	7625	300	1770	4425	210
77	12770	31925	613	7520	18800	360	4745	11862	420	3260	8150	280	1892	4730	200
80	13690	34225	584	8070	20175	340	5085	12712	400	3490	8725	270	2030	5075	190

TAB.05

NOTE: Tk = fatigue pulsating torque based on 1.5 degrees misalignment
Tf = max peak torque based on 90 % yield limit of material

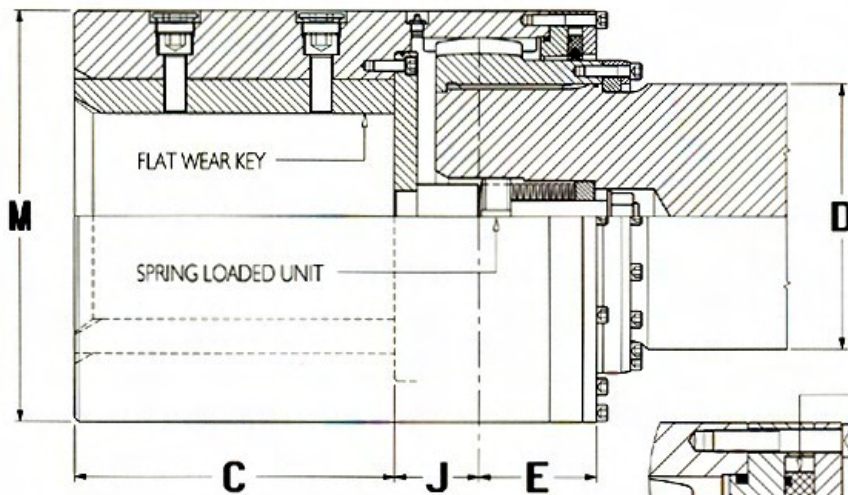
Designs **H.J.K.L**

SIZE	MATERIAL - A			MATERIAL - B			MATERIAL - C			MATERIAL - D			MATERIAL - E		
	BASE TORQUE	PEAK TORQUE	MAX SPEED	BASE TORQUE	PEAK TORQUE	MAX SPEED	BASE TORQUE	PEAK TORQUE	MAX SPEED	BASE TORQUE	PEAK TORQUE	MAX SPEED	BASE TORQUE	PEAK TORQUE	MAX SPEED
	Tk [kNm]	Tf [kNm]	nk [l/min]	Tk [kNm]	Tf [kNm]	nk [l/min]	Tk [kNm]	Tf [kNm]	nk [l/min]	Tk [kNm]	Tf [kNm]	nk [l/min]	Tk [kNm]	Tf [kNm]	nk [l/min]
22	337	842	2745	203	507	1600	125	312	1880	85	212	1250	50	125	900
23	387	967	2570	234	585	1510	145	362	1760	99	247	1180	58	145	840
24	441	1102	2424	268	670	1420	167	417	1660	115	287	1110	68	170	790
25	499	1247	2292	303	757	1340	190	475	1570	131	327	1050	77	192	750
27	616	1540	2146	374	935	1260	233	582	1470	160	400	980	94	235	700
28	700	1750	2029	426	1065	1180	267	667	1390	184	460	920	108	270	660
29	790	1975	1912	483	1207	1120	304	760	1310	211	527	870	124	310	620
31	899	2247	1810	539	1347	1060	342	855	1240	236	590	830	137	342	590
32	1093	2732	1708	661	1652	1000	410	1025	1170	280	700	780	165	412	560
34	1253	3132	1620	762	1905	940	477	1192	1110	329	822	740	193	482	530
36	1429	3572	1518	871	2177	890	547	1367	1040	379	947	700	221	552	500
37	1586	3965	1445	964	2410	840	610	1525	990	419	1047	660	243	607	470
40	2067	5167	1343	1250	3125	790	773	1932	920	525	1312	620	312	780	440
42	2382	5955	1270	1440	3600	740	895	2237	870	612	1530	580	360	900	410
44	2705	6762	1197	1649	4122	700	1029	2572	820	707	1767	540	416	1040	390
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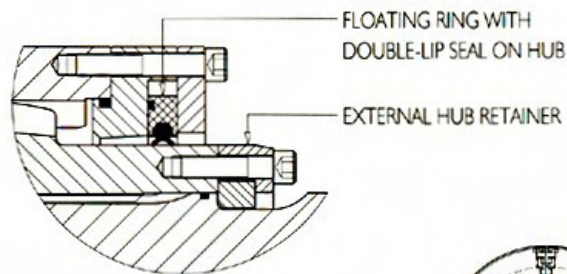
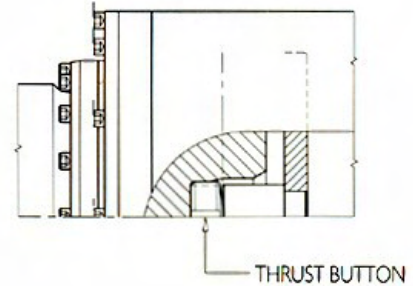
SPINDLE HEAD TYPE A

Spindle head for flat products and standard angles.
Suitable for materials Type E, D and C when not ground.

ROLL END



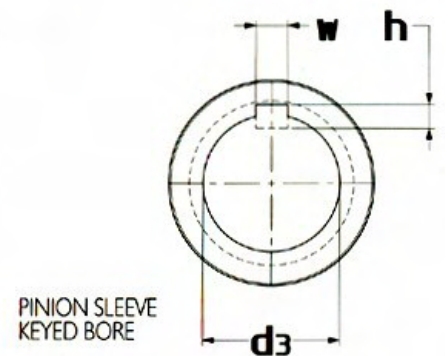
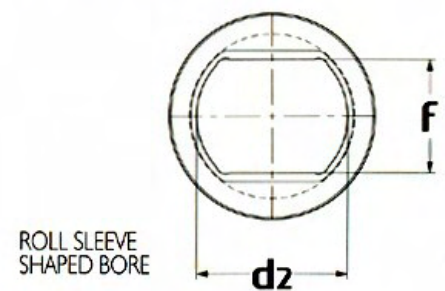
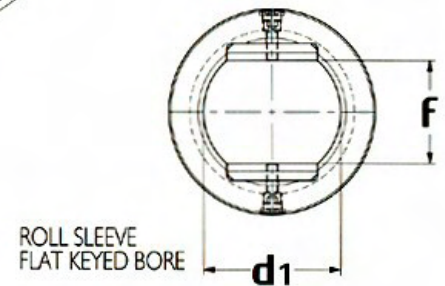
PINION END



TAB.06

SPINDLE HEAD TYPE A

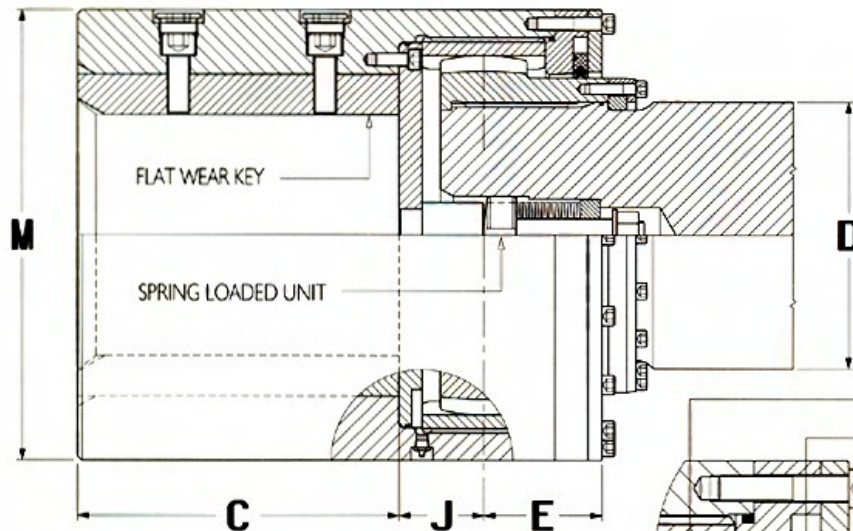
SIZE	Dimensions [mm]					Roll Sleeve			Pinion Sleeve	
	M	C	J	E	D	max d ₁	max d ₂	max f	max d ₃	Keyways w x h
22	270	200	63	95	159	170	200	127	190	50 x 40
23	285	210	65	97	170	180	210	135	200	
24	295	220	66	98	181	190	220	142	210	
25	310	235	67	99	192	200	230	150	220	
27	325	245	73	103	198	210	245	157	230	63 x 45
28	340	260	75	105	211	225	260	168	240	
29	355	270	77	107	222	235	275	176	255	
31	370	285	79	109	235	245	285	184	265	
32	390	300	85	112	248	255	300	190	280	75 x 50
34	410	315	87	114	262	270	315	202	290	
36	430	330	90	126	276	285	330	214	305	
37	450	350	92	128	290	300	350	225	320	
40	480	370	104	135	309	315	365	236	340	90 x 65
42	505	390	106	137	326	330	390	248	360	
44	530	410	109	140	343	350	410	262	380	
46	555	430	112	143	360	370	430	276	395	
48	580	450	123	149	373	385	450	288	410	100 x 75
51	610	475	126	152	393	405	475	304	435	
53	640	500	130	180	413	425	500	318	460	
56	670	520	133	183	433	445	525	332	480	
59	705	550	145	190	457	470	550	352	500	130 x 90
62	735	570	149	194	478	490	575	366	525	
64	765	600	153	198	499	515	605	386	545	
67	795	620	156	201	520	540	630	405	570	
70	830	650	169	209	544	560	660	420	590	150 x 100
74	865	680	173	213	568	590	690	440	620	
77	900	710	177	217	592	610	720	460	640	
80	935	740	181	221	616	640	750	480	670	



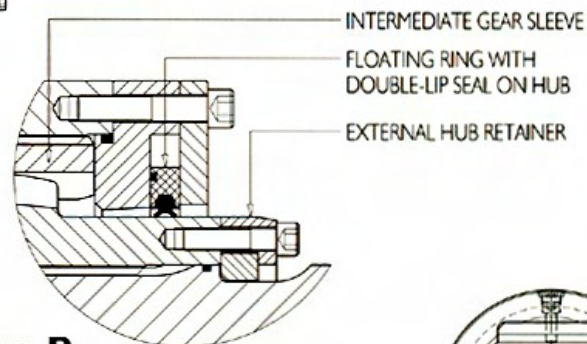
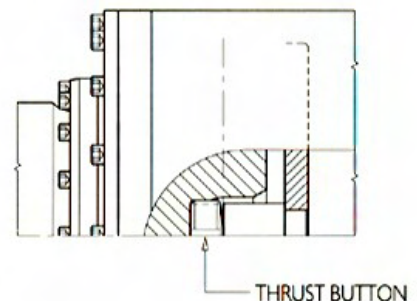
SPINDLE HEAD TYPE B

Spindle head for flat products and standard angles.
Suitable for any material

ROLL END



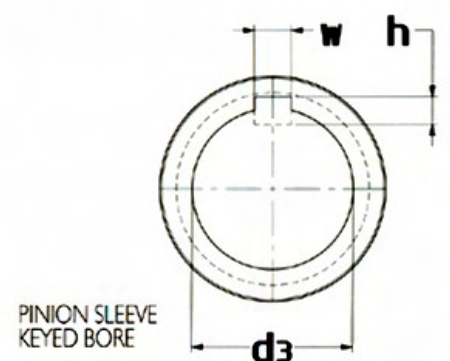
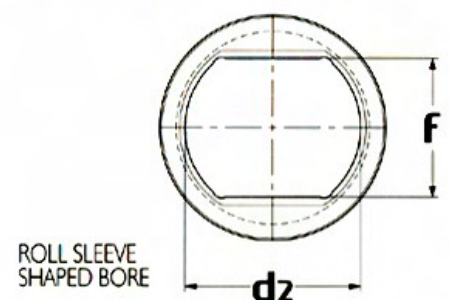
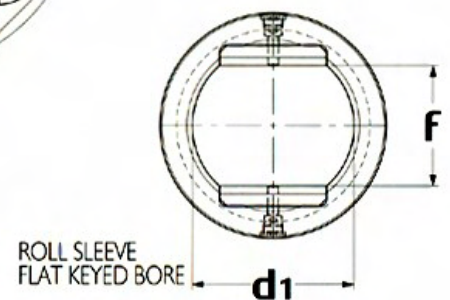
PINION END



TAB.07

SPINDLE HEAD TYPE B

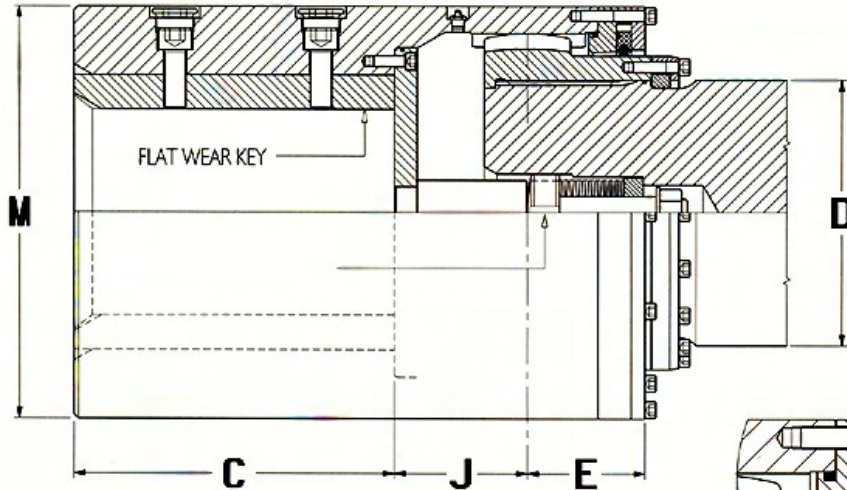
SIZE	Dimensions [mm]					Roll Sleeve			Pinion Sleeve	
	M	C	J	E	D	max d1	max d2	max f	max d3	w x h
22	285	200	63	95	159	200	235	150	200	50 x 40
23	300	210	65	97	170	210	250	158	210	
24	315	220	66	98	181	220	260	165	225	
25	330	235	67	99	192	235	275	176	235	
27	350	245	73	103	198	245	290	184	250	63 x 45
28	365	260	75	105	211	260	305	195	260	
29	385	270	77	107	222	270	320	202	275	
31	400	285	79	109	235	285	335	214	285	75 x 50
32	425	300	85	112	248	300	355	225	300	
34	450	315	87	114	262	315	370	236	320	
36	470	330	90	126	276	330	390	248	335	
37	490	350	92	128	290	350	410	262	350	90 x 65
40	525	370	104	135	309	370	435	278	375	
42	550	390	106	137	326	390	460	292	390	
44	575	410	109	140	343	410	480	308	410	100 x 75
46	605	430	112	143	360	430	500	322	430	
48	635	450	123	149	373	450	530	338	450	
51	665	475	126	152	393	475	555	356	475	
53	695	500	130	180	413	500	580	375	495	130 x 90
56	725	520	133	183	433	520	610	390	515	
59	770	550	145	190	457	550	645	415	550	
62	800	570	149	194	478	570	675	430	570	150 x 100
64	830	600	153	198	499	600	705	450	590	
67	860	620	156	201	520	620	735	465	610	
70	910	650	169	209	544	650	770	490	650	
74	950	680	173	213	568	680	805	510	675	180 x 130
77	990	710	177	217	592	710	840	530	705	
80	1030	740	181	221	616	740	870	555	735	



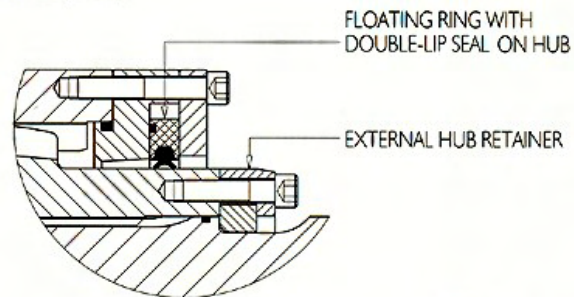
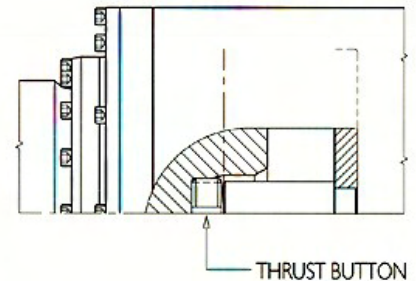
SPINDLE HEAD TYPE C

Spindle head for flat products and standard angles.
Suitable for any material requiring ground tooth flanks

ROLL END



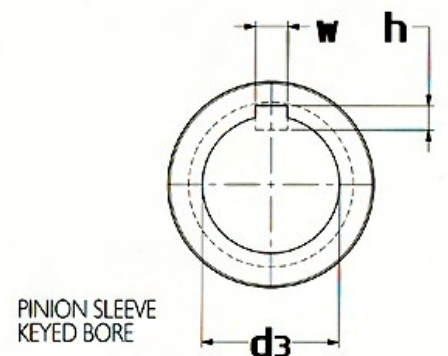
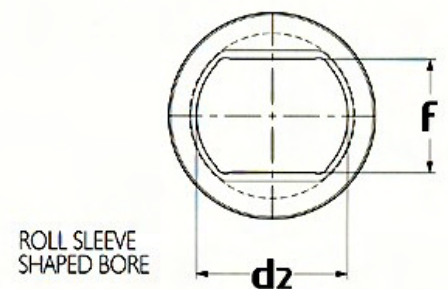
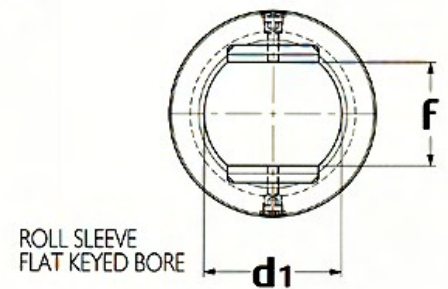
PINION END



TAB.08

SPINDLE HEAD TYPE C

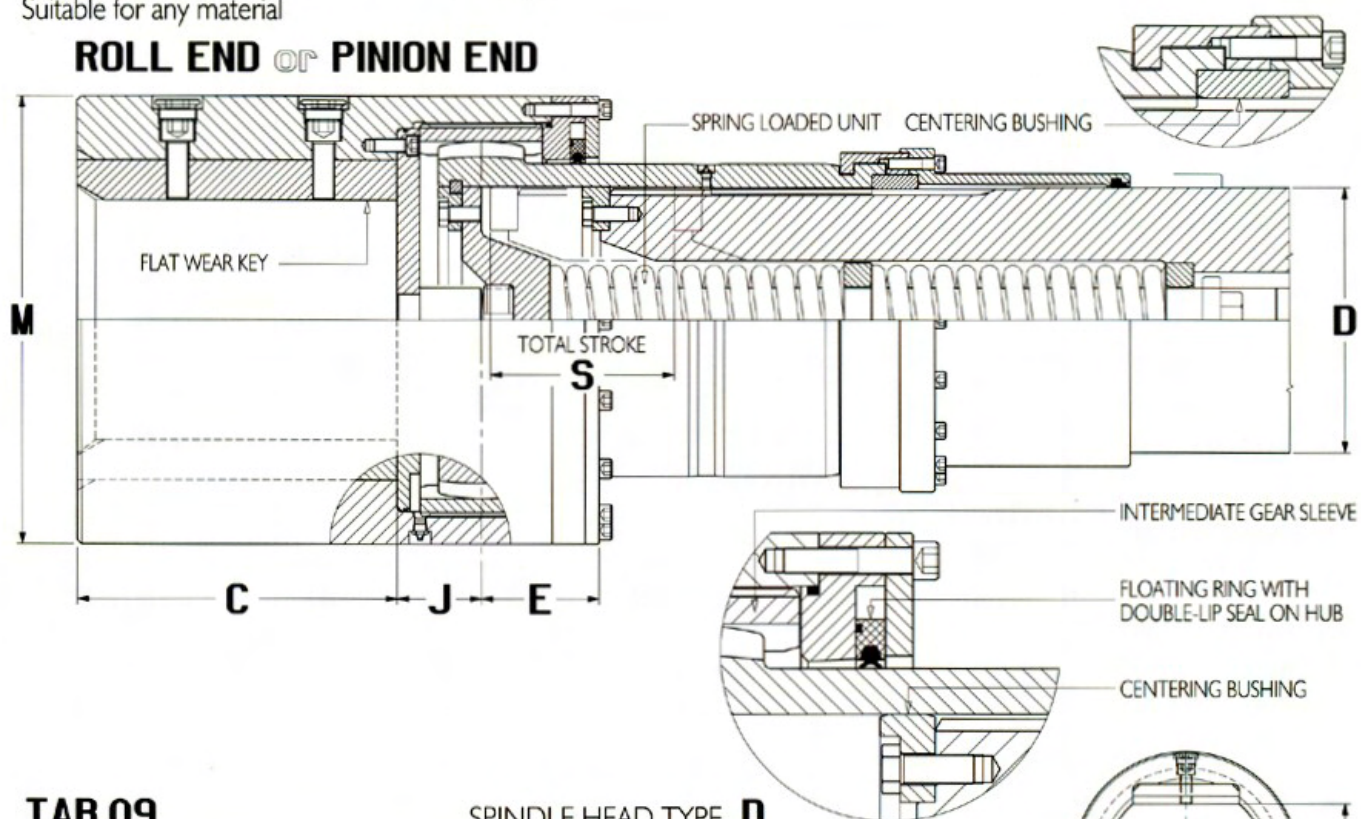
SIZE	Dimensions [mm]								
	M	max * C	J	E	D	Roll Sleeve			Pinion Sleeve Keyways w x h
						max d1	max d2	max f	max d3
22	270	200	123	95	159	170	200	127	190
23	285	210	125	97	170	180	210	135	200
24	295	220	126	98	181	190	220	142	210
25	310	235	127	99	192	200	230	150	220
27	325	245	130	103	198	210	245	157	230
28	340	260	132	105	211	225	260	168	240
29	355	270	134	107	222	235	275	176	255
31	370	285	136	109	235	245	285	184	265
32	390	300	138	112	248	255	300	190	280
34	410	315	140	114	262	270	315	202	290
36	430	330	143	126	276	285	330	214	305
37	450	350	145	128	290	300	350	225	320
40	480	370	151	135	309	315	365	236	340
42	505	390	153	137	326	330	390	248	360
44	530	410	156	140	343	350	410	262	380
46	555	430	159	143	360	370	430	276	395
48	580	450	167	149	373	385	450	288	410
51	610	475	170	152	393	405	475	304	435
53	640	500	174	180	413	425	500	318	460
56	670	520	177	183	433	445	525	332	480
59	705	550	188	190	457	470	550	352	500
62	735	560 *	192	194	478	490	575	366	525
64	765	550 *	196	198	499	515	605	386	545
67	795	550 *	199	201	520	540	630	405	570
70	830	525 *	212	209	544	560	660	420	590
74	865	520 *	216	213	568	590	690	440	620
77	900	510 *	220	217	592	610	720	460	640
80	935	505 *	224	221	616	640	750	480	670



SPINDLE HEAD TYPE D

Spindle head for flat products and standard angles.
Suitable for any material

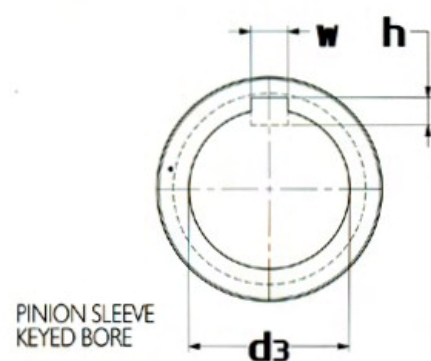
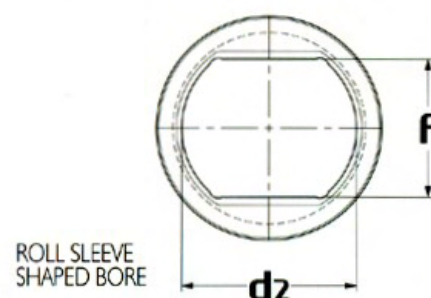
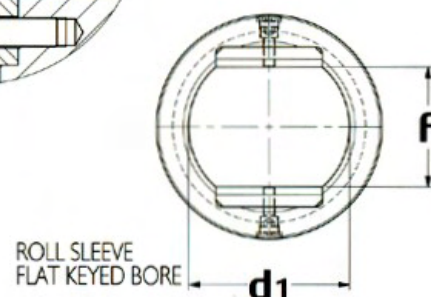
ROLL END or PINION END



TAB.09

SPINDLE HEAD TYPE D

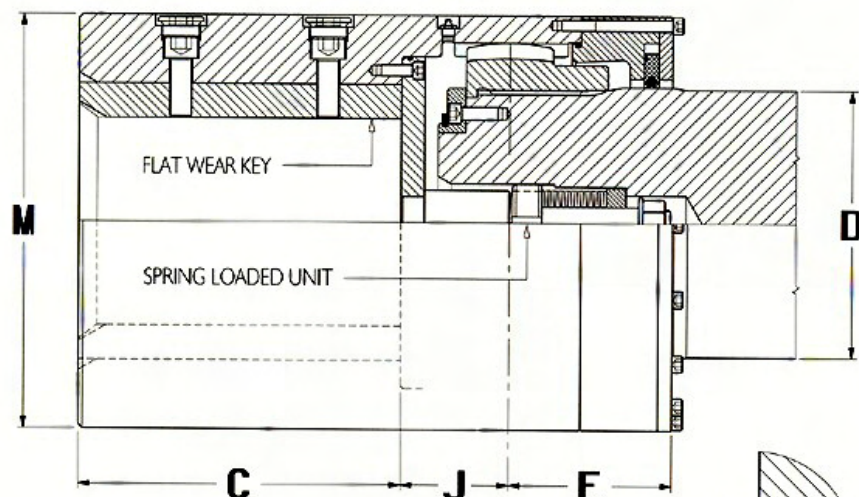
SIZE	Dimensions [mm]						Roll Sleeve				Pinion Sleeve	
	M	C	J	E	D	Stroke max S	max d ₁	max d ₂	max f	max d ₃	Keyways w x h	
22	285	200	63	95	159	200	200	235	150	200	50 x 40	
23	300	210	65	97	170	200	210	250	158	210		
24	315	220	66	98	181	200	220	260	165	225		
25	330	235	67	99	192	200	235	275	176	235	63 x 45	
27	350	245	73	103	198	250	245	290	184	250		
28	365	260	75	105	211	250	260	305	195	260		
29	385	270	77	107	222	250	270	320	202	275	75 x 50	
31	400	285	79	109	235	250	285	335	214	285		
32	425	300	85	112	248	300	300	355	225	300		
34	450	315	87	114	262	300	315	370	236	320	90 x 65	
36	470	330	90	126	276	300	330	390	248	335		
37	490	350	92	128	290	300	350	410	262	350		
40	525	370	104	135	309	400	370	435	278	375	100 x 75	
42	550	390	106	137	326	400	390	460	292	390		
44	575	410	109	140	343	400	410	480	308	410		
46	605	430	112	143	360	400	430	500	322	430	130 x 90	
48	635	450	123	149	373	500	450	530	338	450		
51	665	475	126	152	393	500	475	555	356	475		
53	695	500	130	180	413	500	500	580	375	495	150 x 100	
56	725	520	133	183	433	500	520	610	390	515		
59	770	550	145	190	457	600	550	645	415	550		
62	800	570	149	194	478	600	570	675	430	570	180 x 130	
64	830	600	153	198	499	600	600	705	450	590		
67	860	620	156	201	520	600	620	735	465	610		
70	910	650	169	209	544	700	650	770	490	650		
74	950	680	173	213	568	700	680	805	510	675		
77	990	710	177	217	592	700	710	840	530	705		
80	1030	740	181	221	616	700	740	870	555	735		



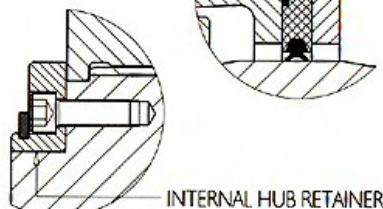
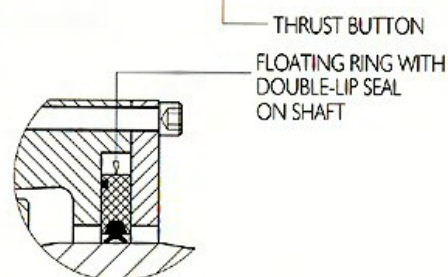
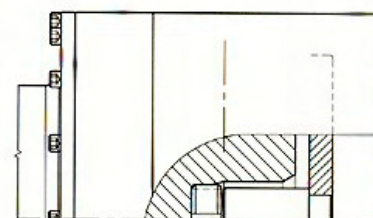
SPINDLE HEAD TYPE E

Spindle head for flat products and high angles.
Suitable for materials Type E, D and C when not ground.

ROLL END



PINION END

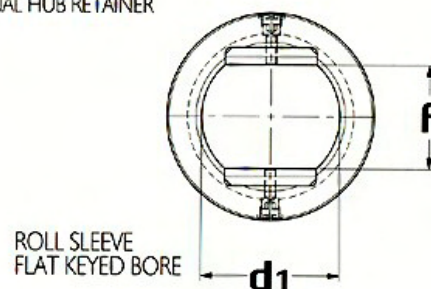


INTERNAL HUB RETAINER

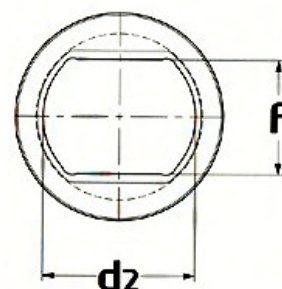
TAB.10

SPINDLE HEAD TYPE E

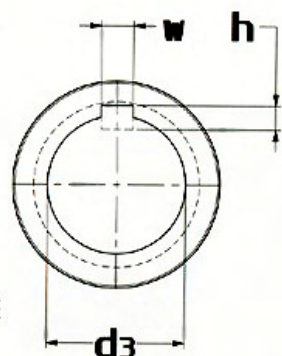
SIZE	Dimensions [mm]					Roll Sleeve			Pinion Sleeve	
	M	C	J	E	D	max d1	max d2	max F	max d3	Keyways w x h
22	270	200	83	113	159	170	200	127	190	50 x 40
23	285	210	85	115	170	180	210	135	200	
24	295	220	86	118	181	190	220	142	210	
25	310	235	87	121	192	200	230	150	220	
27	325	245	96	127	198	210	245	157	230	63 x 45
28	340	260	98	130	211	225	260	168	240	
29	355	270	100	133	222	235	275	176	255	
31	370	285	102	136	235	245	285	184	265	
32	390	300	110	150	248	255	300	190	280	75 x 50
34	410	315	112	153	262	270	315	202	290	
36	430	330	115	158	276	285	330	214	305	
37	450	350	117	161	290	300	350	225	320	
40	480	370	134	179	309	315	365	236	340	90 x 65
42	505	390	136	183	326	330	390	248	360	
44	530	410	139	186	343	350	410	262	380	
46	555	430	142	189	360	370	430	276	395	
48	580	450	158	198	373	385	450	288	410	100 x 75
51	610	475	161	202	393	405	475	304	435	
53	640	500	165	220	413	425	500	318	460	
56	670	520	168	224	433	445	525	332	480	
59	705	550	185	246	457	470	550	352	500	130 x 90
62	735	570	189	250	478	490	575	366	525	
64	765	600	193	254	499	515	605	386	545	
67	795	620	196	259	520	540	630	405	570	
70	830	650	214	267	544	560	660	420	590	150 x 100
74	865	680	218	272	568	590	690	440	620	
77	900	710	222	277	592	610	720	460	640	
80	935	740	226	282	616	640	750	480	670	



ROLL SLEEVE
FLAT KEYED BORE



ROLL SLEEVE
SHAPED BORE

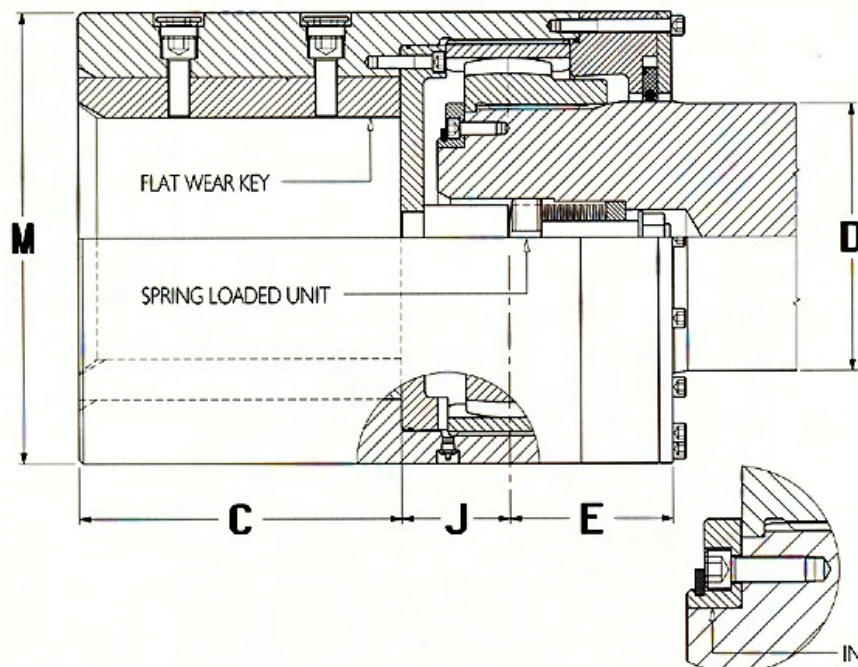


PINION SLEEVE
KEYED BORE

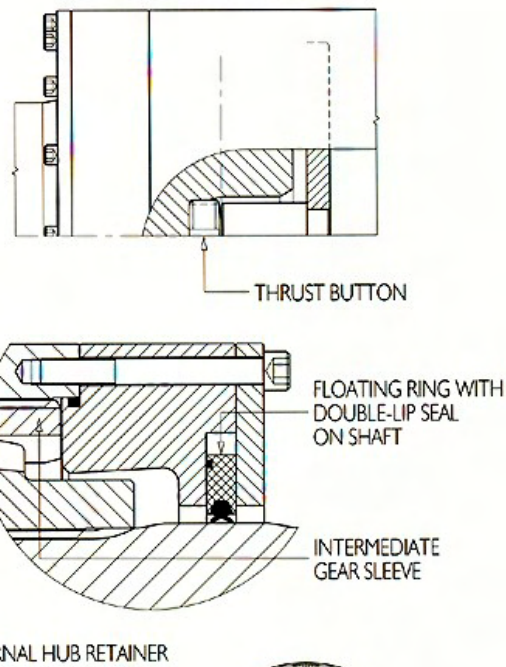
SPINDLE HEAD TYPE F

Spindle head for flat products and high angles.
Suitable for any material.

ROLL END



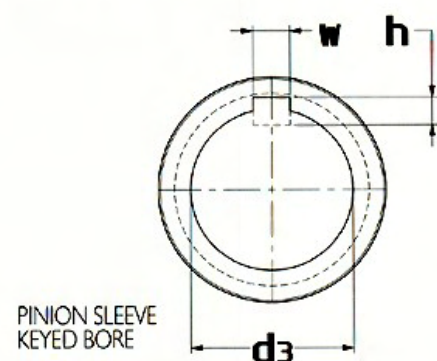
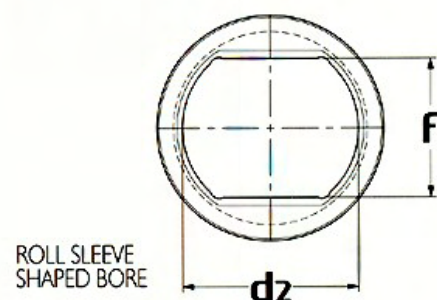
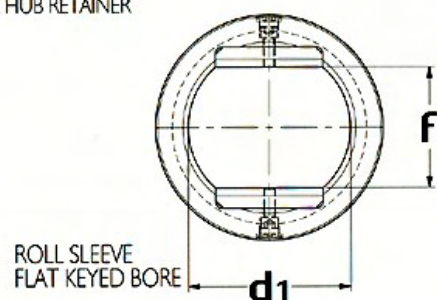
PINION END



TAB.11

SPINDLE HEAD TYPE F

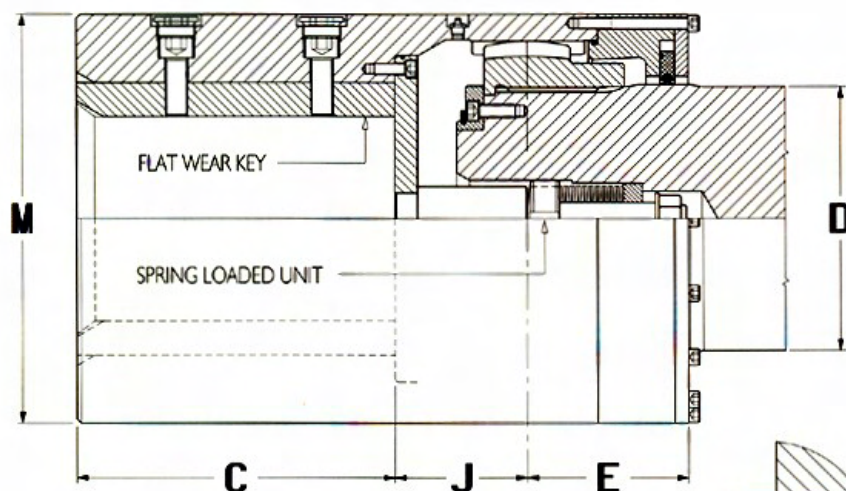
SIZE	Dimensions [mm]					Roll Sleeve			Pinion Sleeve	
	M	C	J	E	D	max d1	max d2	max F	max d3	Keyways w x h
22	285	200	83	113	159	200	235	150	200	50 x 40
23	300	210	85	115	170	210	250	158	210	
24	315	220	86	118	181	220	260	165	225	
25	330	235	87	121	192	235	275	176	235	63 x 45
27	350	245	96	127	198	245	290	184	250	
28	365	260	98	130	211	260	305	195	260	
29	385	270	100	133	222	270	320	202	275	75 x 50
31	400	285	102	136	235	285	335	214	285	
32	425	300	110	150	248	300	355	225	300	
34	450	315	112	153	262	315	370	236	320	90 x 65
36	470	330	115	158	276	330	390	248	335	
37	490	350	117	161	290	350	410	262	350	
40	525	370	134	179	309	370	435	278	375	100 x 75
42	550	390	136	183	326	390	460	292	390	
44	575	410	139	186	343	410	480	308	410	
46	605	430	142	189	360	430	500	322	430	130 x 90
48	635	450	158	198	373	450	530	338	450	
51	665	475	161	202	393	475	555	356	475	
53	695	500	165	220	413	500	580	375	495	150 x 100
56	725	520	168	224	433	520	610	390	515	
59	770	550	185	246	457	550	645	415	550	
62	800	570	189	250	478	570	675	430	570	180 x 130
64	830	600	193	254	499	600	705	450	590	
67	860	620	196	259	520	620	735	465	610	
70	910	650	214	267	544	650	770	490	650	180 x 130
74	950	680	218	272	568	680	805	510	675	
77	990	710	222	277	592	710	840	530	705	
80	1030	740	226	282	616	740	870	555	735	



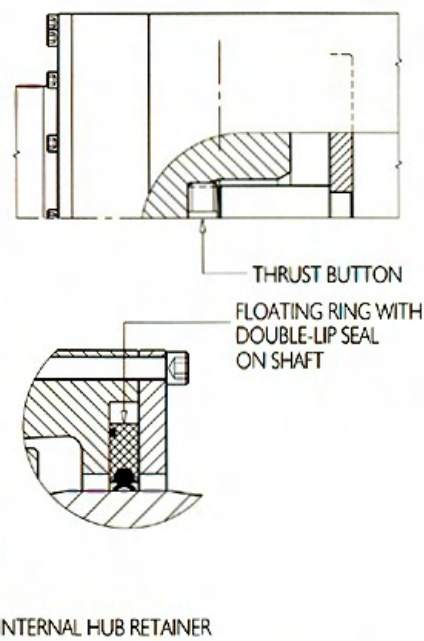
SPINDLE HEAD TYPE G

Spindle head for flat products and high angles.
Suitable for any material requiring ground tooth flanks.

ROLL END

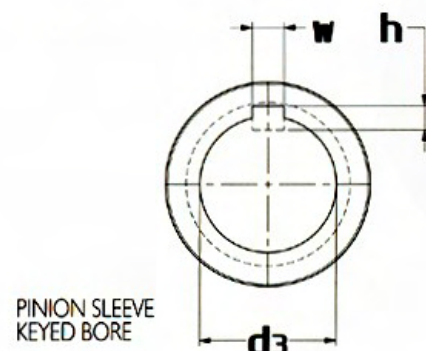
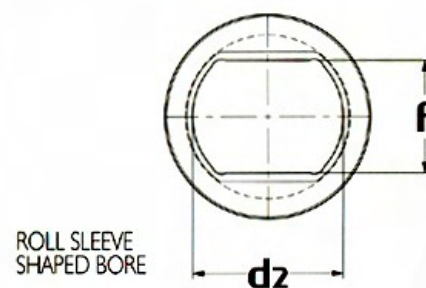
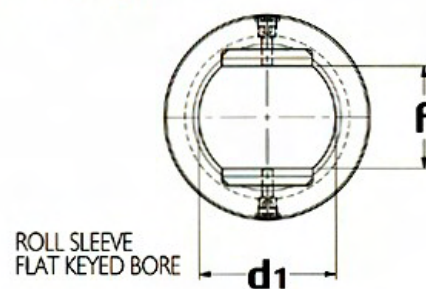


PINION END



TAB.12 SPINDLE HEAD TYPE G

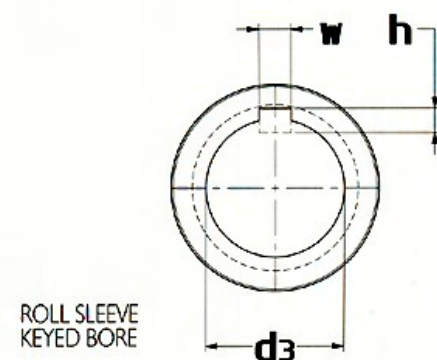
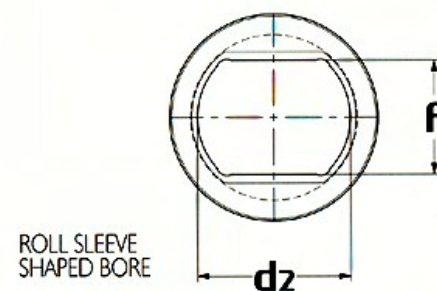
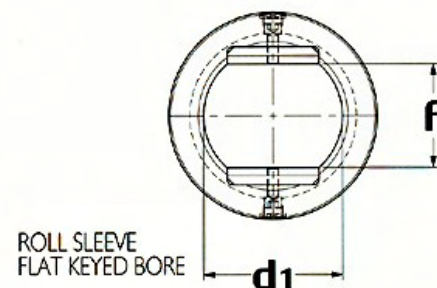
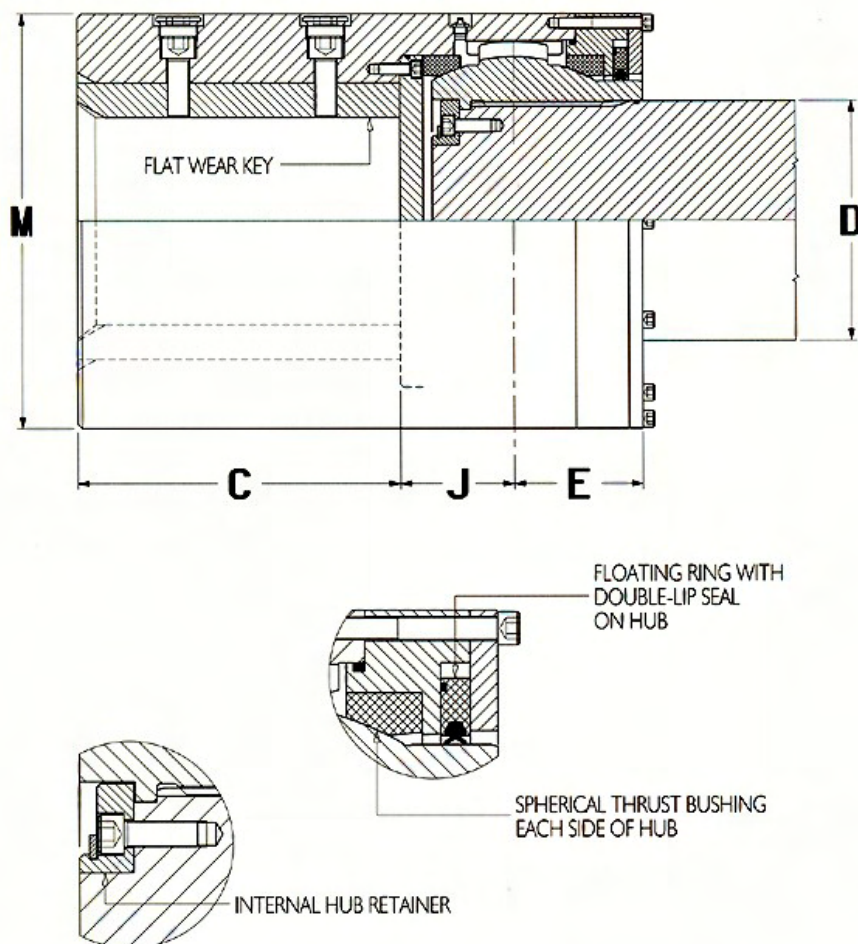
SIZE	Dimensions [mm]					Roll Sleeve			Pinion Sleeve	
	M	max* C	J	E	D	max d1	max d2	max f	max d3	Keyways w x h
22	270	200	123	113	159	170	200	127	190	50 x 40
23	285	210	125	115	170	180	210	135	200	
24	295	220	126	118	181	190	220	142	210	
25	310	235	127	121	192	200	230	150	220	
27	325	245	130	127	198	210	245	157	230	
28	340	260	132	130	211	225	260	168	240	63 x 45
29	355	270	134	133	222	235	275	176	255	
31	370	285	136	136	235	245	285	184	265	
32	390	300	138	150	248	255	300	190	280	75 x 50
34	410	315	140	153	262	270	315	202	290	
36	430	330	143	158	276	285	330	214	305	
37	450	350	145	161	290	300	350	225	320	90 x 65
40	480	370	151	179	309	315	365	236	340	
42	505	390	153	183	326	330	390	248	360	
44	530	410	156	186	343	350	410	262	380	100 x 75
46	555	430	159	189	360	370	430	276	395	
48	580	450	167	198	373	385	450	288	410	
51	610	475	170	202	393	405	475	304	435	130 x 90
53	640	500	174	220	413	425	500	318	460	
56	670	520	177	224	433	445	525	332	480	
59	705	550	188	246	457	470	550	352	500	150 x 100
62	735	560*	192	250	478	490	575	366	525	
64	765	550*	196	254	499	515	605	386	545	
67	795	550*	199	259	520	540	630	405	570	
70	830	525*	212	267	544	560	660	420	590	
74	865	520*	216	272	568	590	690	440	620	150 x 100
77	900	510*	220	277	592	610	720	460	640	
80	935	505*	224	282	616	640	750	480	670	



SPINDLE HEAD TYPE H

Spindle head for long products. Suitable for materials Type E, D and C when not ground

ROLL END



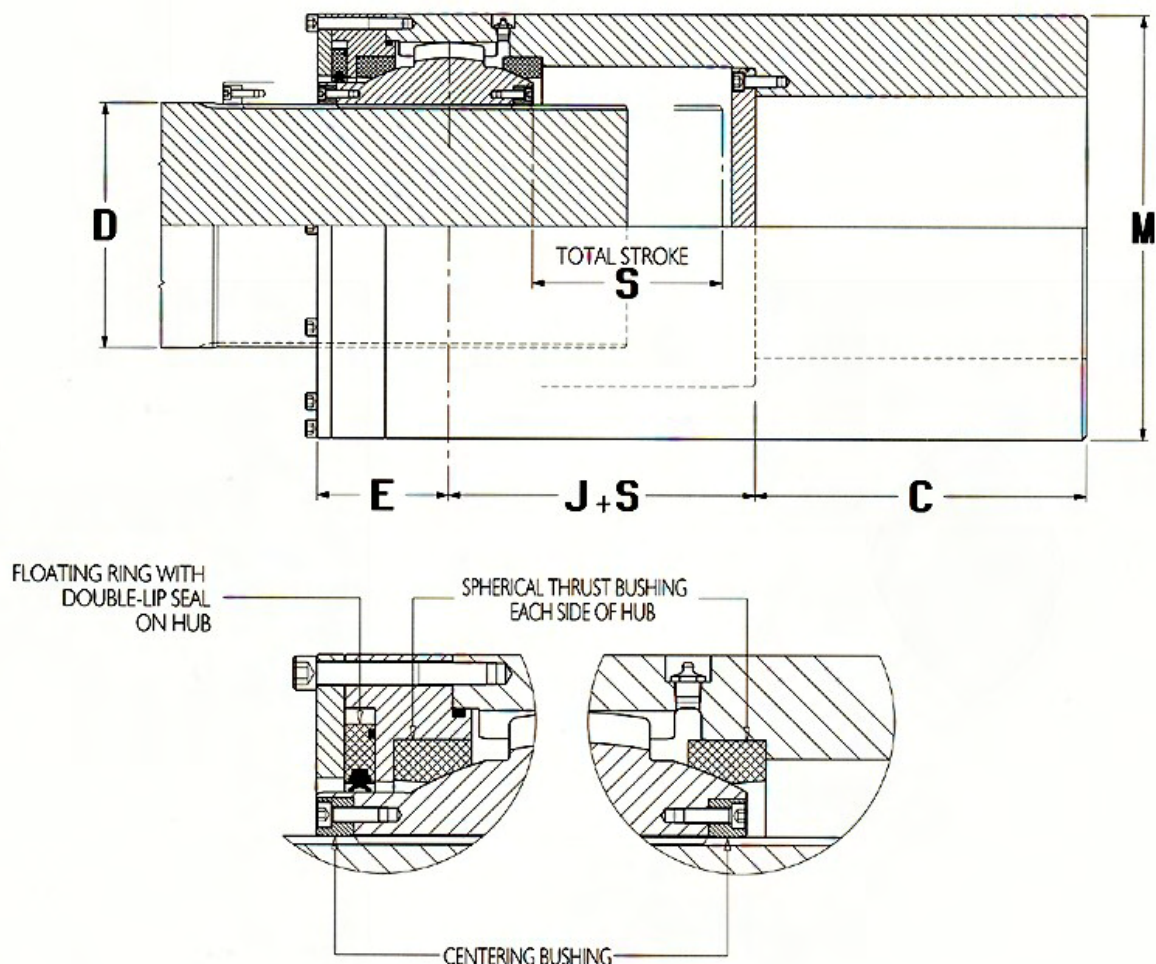
TAB.13 SPINDLE HEAD TYPE H

SIZE	Dimensions [mm]					Roll Sleeve				Keyways w x h
	M	C	J	E	D	max d1	max d2	max f	max d3	
22	270	200	79	95	138	170	200	127	190	50 x 40
23	285	210	82	98	148	180	210	135	200	
24	295	220	85	101	158	190	220	142	210	
25	310	235	88	104	168	200	230	150	220	
27	325	245	93	108	175	210	245	157	230	
28	340	260	97	112	186	225	260	168	240	63 x 45
29	355	270	100	115	199	235	275	176	255	
31	370	285	104	119	210	245	285	184	265	
32	390	300	111	124	216	255	300	190	280	75 x 50
34	410	315	115	128	232	270	315	202	290	
36	430	330	119	135	246	285	330	214	305	
37	450	350	123	139	260	300	350	225	320	90 x 65
40	480	370	135	148	265	315	365	236	340	
42	505	390	140	153	285	330	390	248	360	
44	530	410	146	159	303	350	410	262	380	100 x 75
46	555	430	151	164	323	370	430	276	395	

SPINDLE HEAD TYPE J

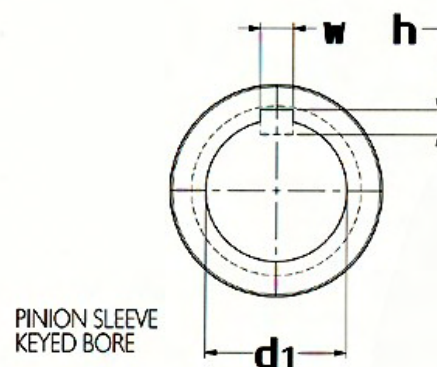
Spindle head for long products. Suitable for materials Type E, D and C when not ground

PINION END



TAB.14 SPINDLE HEAD TYPE J

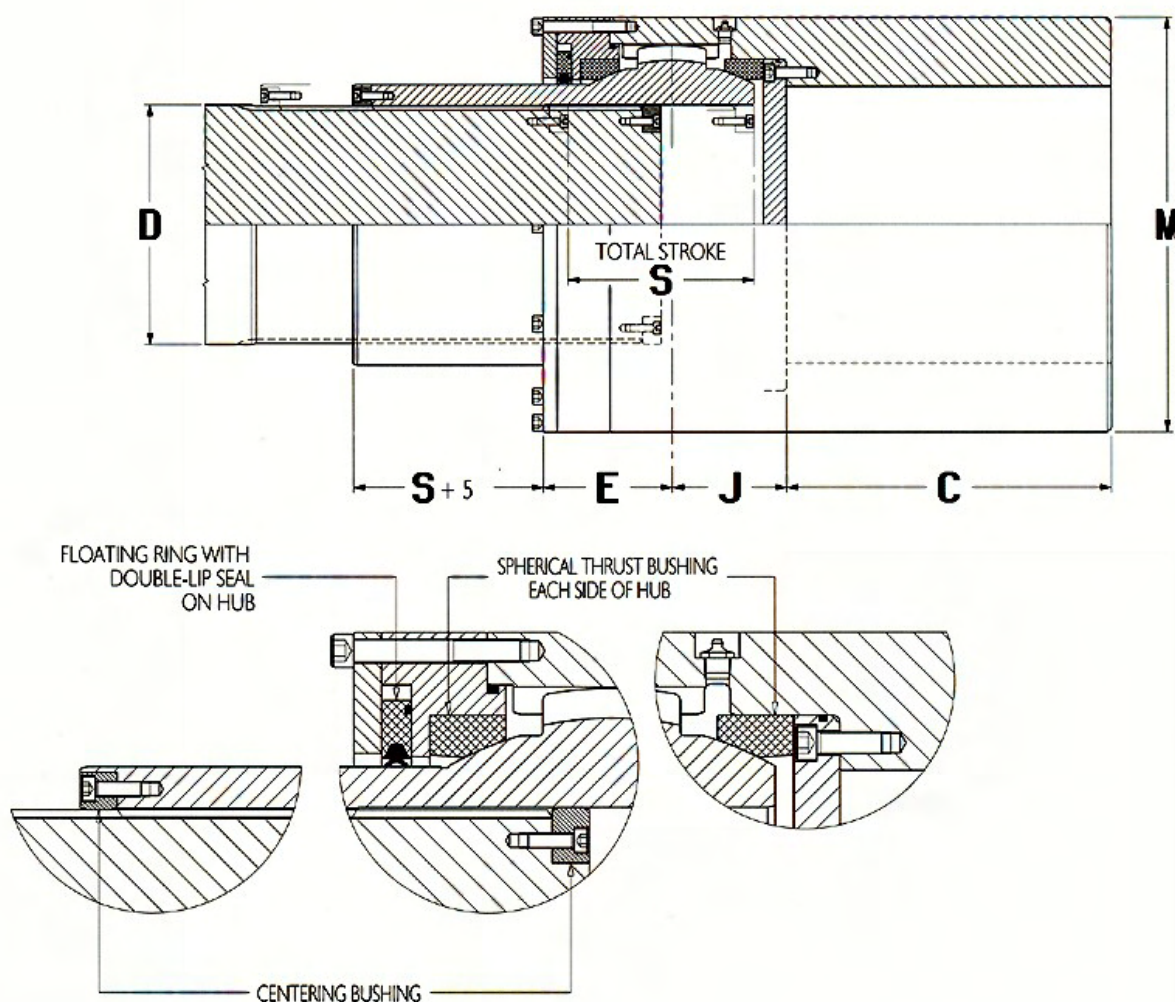
SIZE	Dimensions [mm]						Pinion Sleeve	
	M	C	J	E	D	Stroke max S	max d1	Keyways w x h
22	270	200	79	95	138	200	175	45 x 38
23	285	210	82	98	148	200	185	
24	295	220	85	101	158	200	195	
25	310	235	88	104	168	200	205	50 x 40
27	325	245	93	108	175	250	215	
28	340	260	97	112	186	250	225	
29	355	270	100	115	199	250	240	63 x 45
31	370	285	104	119	210	250	250	
32	390	300	111	124	216	300	260	
34	410	315	115	128	232	300	270	75 x 50
36	430	330	119	135	246	300	285	
37	450	350	123	139	260	300	300	
40	480	370	135	148	265	400	315	90 x 65
42	505	390	140	153	285	400	335	
44	530	410	146	159	303	400	355	
46	555	430	151	164	323	400	370	



SPINDLE HEAD TYPE K

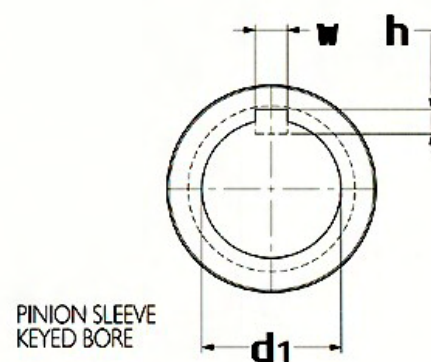
Spindle head for long products. Suitable for materials Type E, D and C when not ground

PINION END



TAB.15 SPINDLE HEAD TYPE K

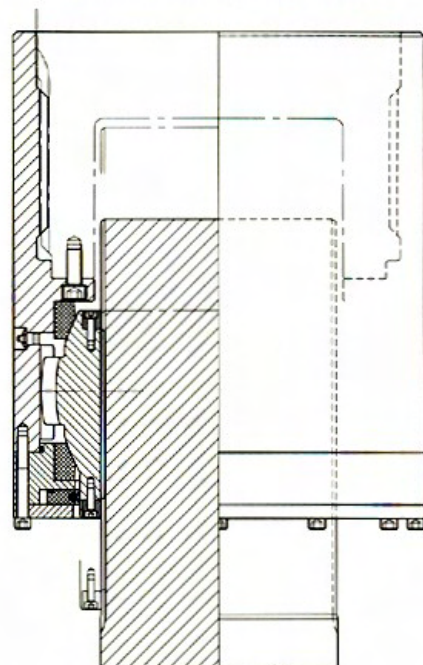
SIZE	Dimensions [mm]						Pinion Sleeve	
	M	C	J	E	D	Stroke max S	max d ₁ Keyways w x h	
22	270	200	79	95	138	200	190	50 x 40
23	285	210	82	98	148	200	200	
24	295	220	85	101	158	200	210	
25	310	235	88	104	168	200	220	
27	325	245	93	108	175	250	230	
28	340	260	97	112	186	250	240	63 x 45
29	355	270	100	115	199	250	255	
31	370	285	104	119	210	250	265	
32	390	300	111	124	216	300	280	
34	410	315	115	128	232	300	290	
36	430	330	119	135	246	300	305	75 x 50
37	450	350	123	139	260	300	320	
40	480	370	135	148	265	400	340	
42	505	390	140	153	285	400	360	90 x 65
44	530	410	146	159	303	400	380	
46	555	430	151	164	323	400	395	100 x 75



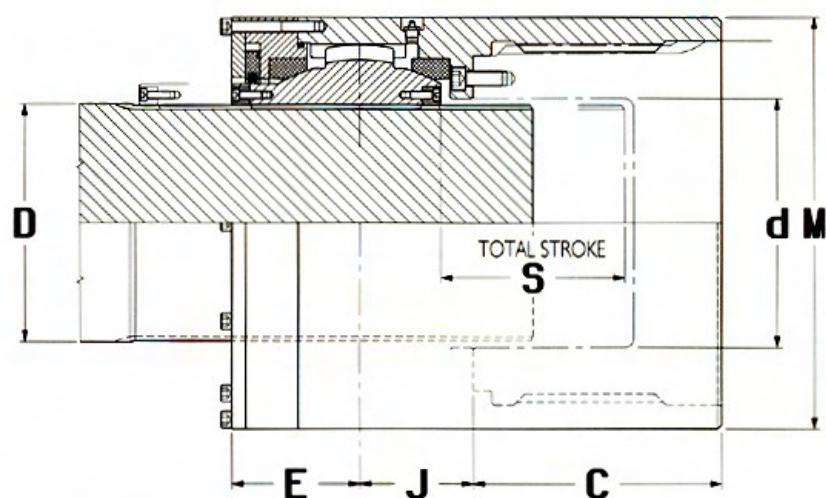
SPINDLE HEAD TYPE L

Spindle head for long products. Suitable for materials Type E, D and C when not ground

VERTICAL DESIGN

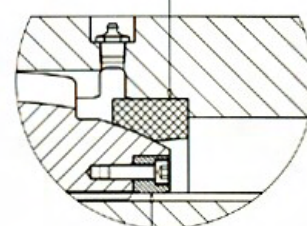
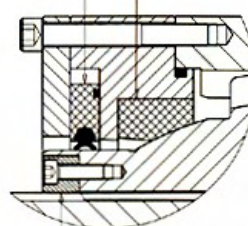


PINION END



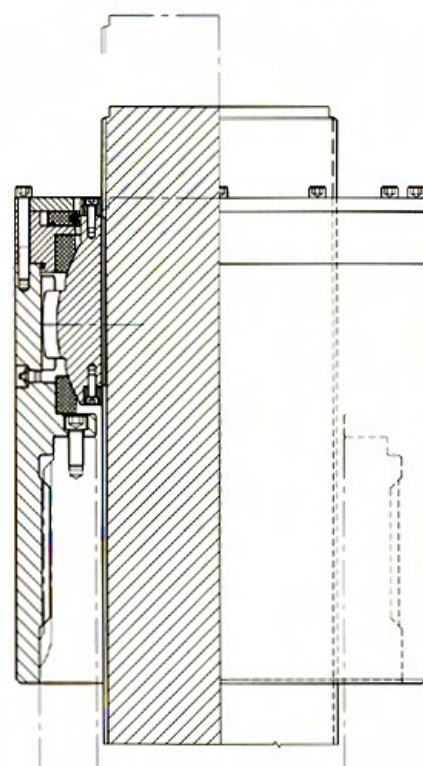
FLOATING RING WITH
DOUBLE-LIP SEAL
ON HUB

SPHERICAL THRUST BUSHING
EACH SIDE OF HUB



CENTERING BUSHING

THROUGH DESIGN

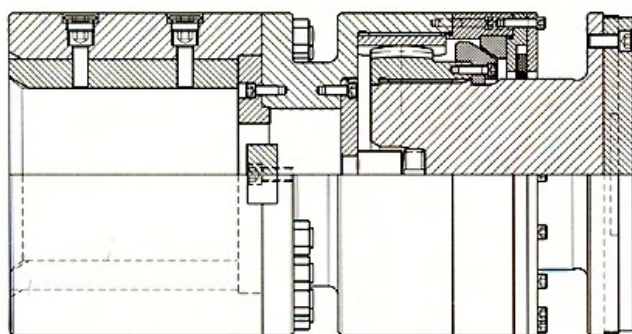


TAB.16

SPINDLE HEAD TYPE L

SIZE	Dimensions [mm]						Pinion Sleeve	
	M	C	J	E	D	Stroke max min	d	
22	270		79	95	138	According to the need	147	According to pinion hollow shaft dimensions Spline diameter, bolt diameter, number & size of bolts
23	285		82	98	148		157	
24	295		85	101	158		167	
25	310		88	104	168		177	
27	325		93	108	175		184	
28	340		97	112	186		195	
29	355		100	115	199		208	
31	370		104	119	210		220	
32	390		111	124	216		227	
34	410		115	128	232		243	
36	430		119	135	246		258	
37	450		123	139	260		272	
40	480		135	148	265		278	
42	505		140	153	285		298	
44	530		146	159	303		316	
46	555		151	164	323		337	

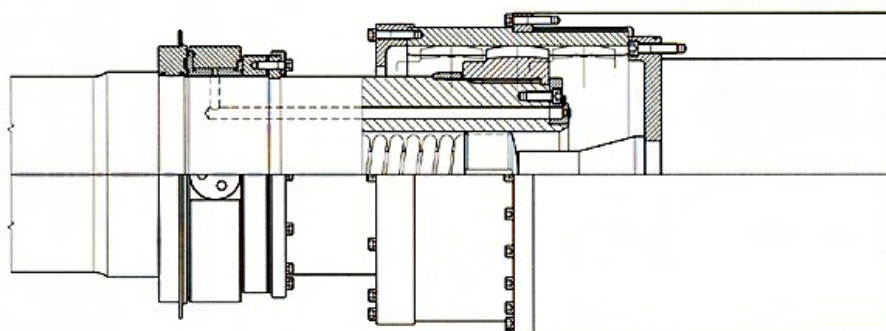
SPINDLE HEAD SPECIAL DESIGNS



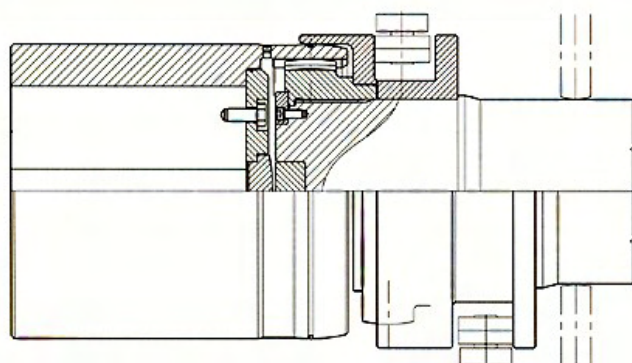
KNUCKLE DESIGN

SPINDLE HEAD TYPE U

**FORCED LUBRICATION
AND COOLING DESIGN**



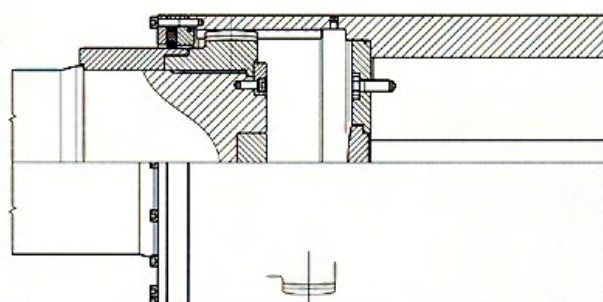
SPINDLE HEAD TYPE V



DISENGAGEABLE DESIGN

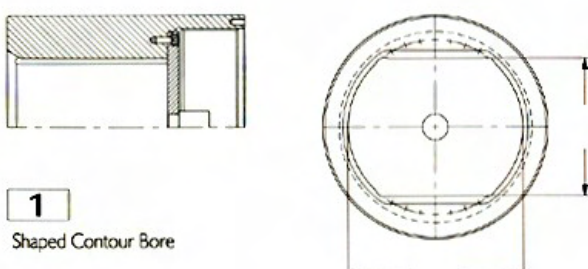
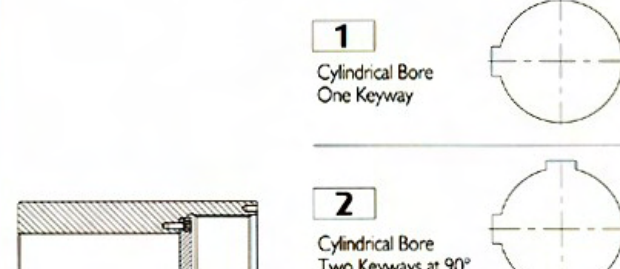
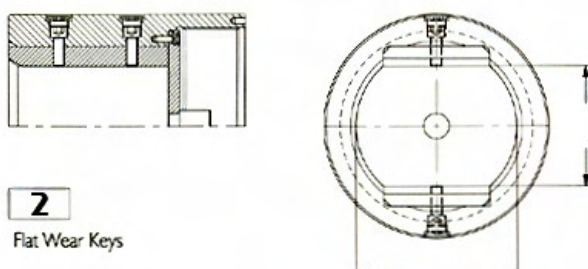
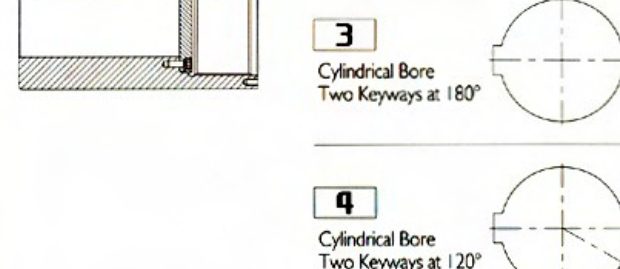
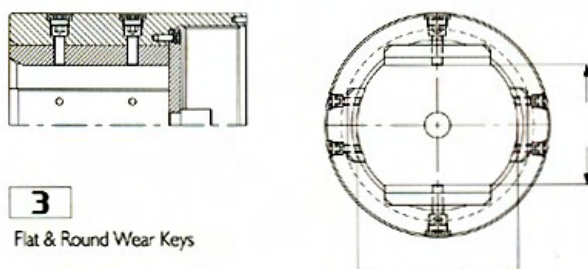
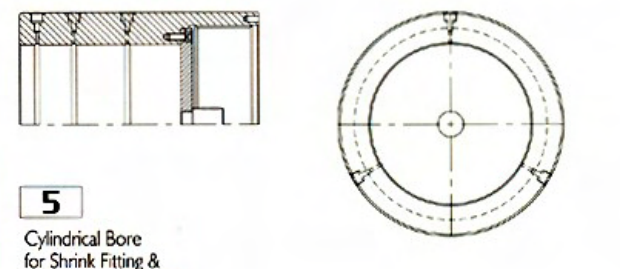
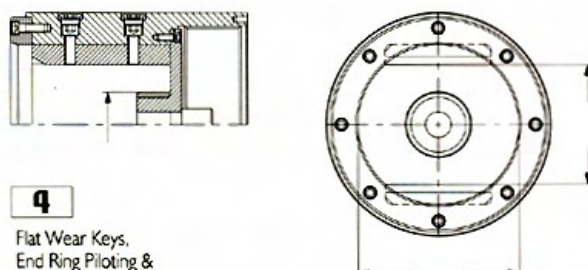
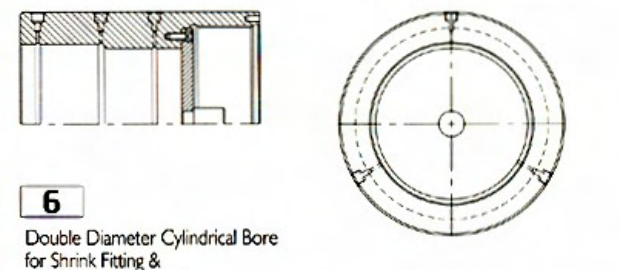
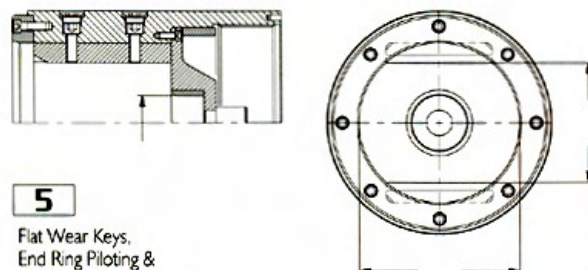
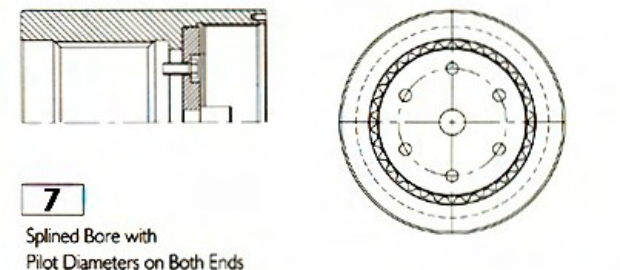
SPINDLE HEAD TYPE W

STROKE DESIGN



SPINDLE HEAD TYPE X

SPINDLE HEAD BORE DESIGNS

ROLL END	PINION END
1 Shaped Contour Bore 	1 Cylindrical Bore One Keyway 
2 Flat Wear Keys 	2 Cylindrical Bore Two Keyways at 90° 
3 Flat & Round Wear Keys 	3 Cylindrical Bore Two Keyways at 180° 
4 Flat Wear Keys, End Ring Piloting & Inner Centering Bushing 	4 Cylindrical Bore Two Keyways at 120° 
5 Flat Wear Keys, End Ring Piloting & Outer Centering Bushing 	5 Cylindrical Bore for Shrink Fitting & Oil Pressure Removal 
	6 Double Diameter Cylindrical Bore for Shrink Fitting & Oil Pressure Removal
	7 Splined Bore with Pilot Diameters on Both Ends

SPINDLE SHAFT DESIGNS

SPINDLE SHAFT **A** - Standard Type Solid Shaft



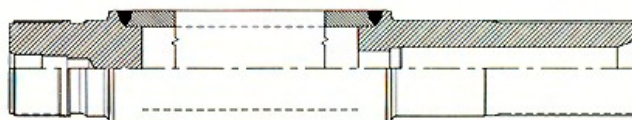
SPINDLE SHAFT **B** - Standard Type Tubular Welded Shaft (1)



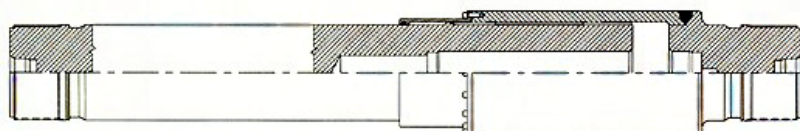
SPINDLE SHAFT **C** - Long Spline Type Solid Shaft



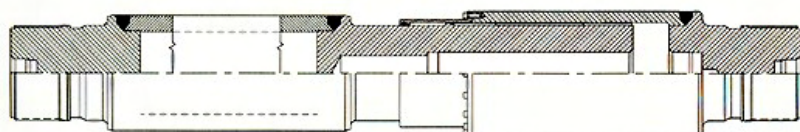
SPINDLE SHAFT **D** - Long Spline Type Tubular Welded Shaft (1)



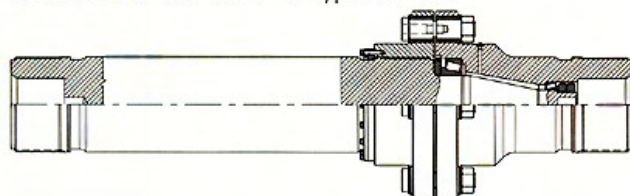
SPINDLE SHAFT **E** - Telescopic Type Solid Shaft



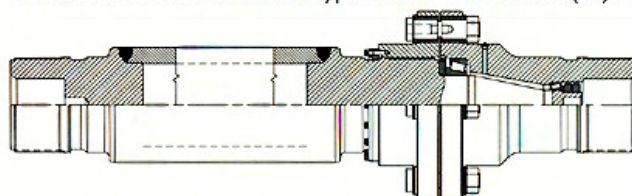
SPINDLE SHAFT **F** - Telescopic Type Tubular Welded Shaft (1)



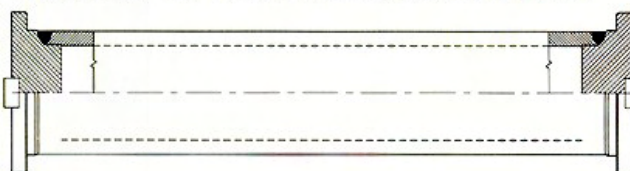
SPINDLE SHAFT **G** - Shear Pin Type Solid Shaft



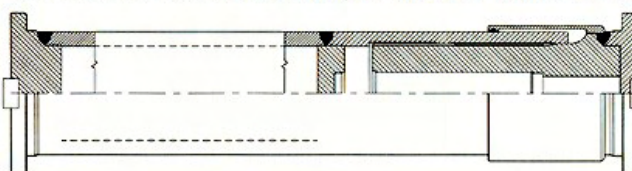
SPINDLE SHAFT **H** - Shear Pin Type Tubular Welded Shaft (1)



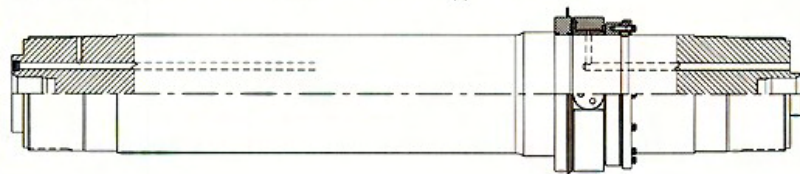
SPINDLE SHAFT **J** - Flanged Type Tubular Welded Shaft (2)



SPINDLE SHAFT **K** - Telescopic Flanged Type Tubular Welded Shaft (2)

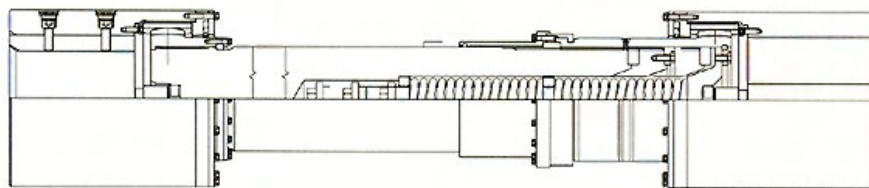


SPINDLE SHAFT **L** - Continuous Lubrication Type Solid Shaft

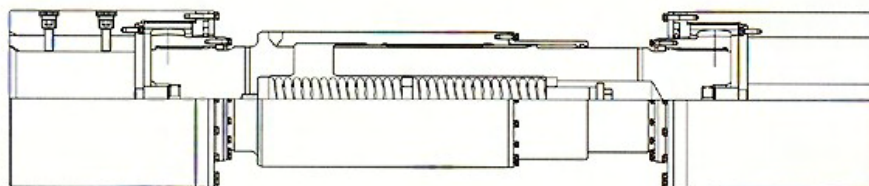


- 1) Shafts for high torsional stiffness
- 2) Shafts for spindle heads type U

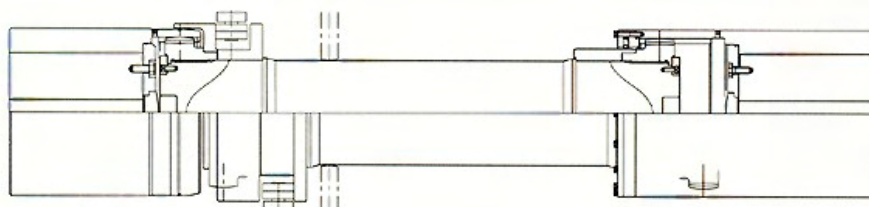
SPECIAL SPINDLE ARRANGEMENTS



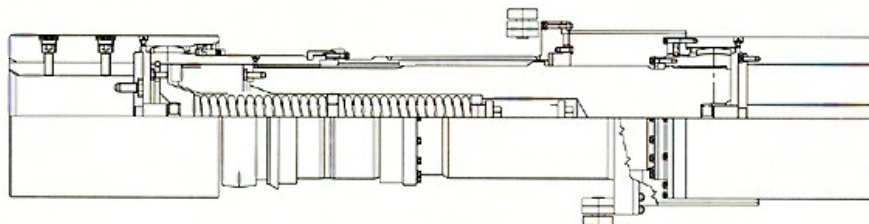
1



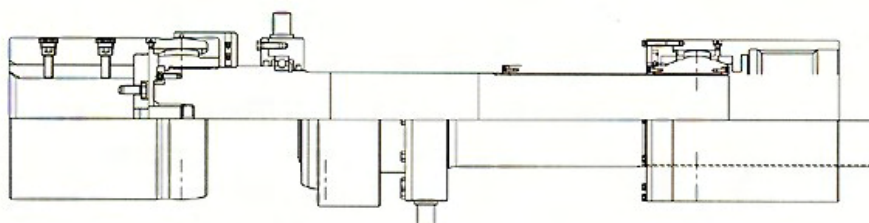
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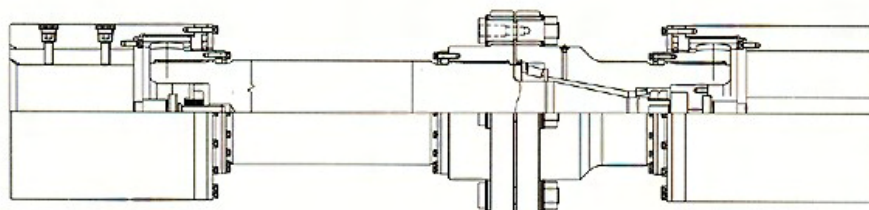
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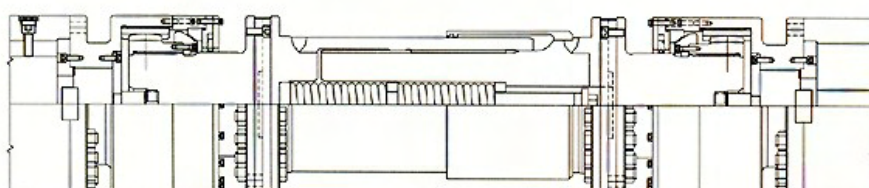
4



5



6



7



8

1 - 2

Telescopic Design

3 - 4 - 5

Disengageable Design

6

Safety Device Design

7

Easy Maintenance Design

8

Vertical Design

MILL SPINDLE IDENTIFICATION

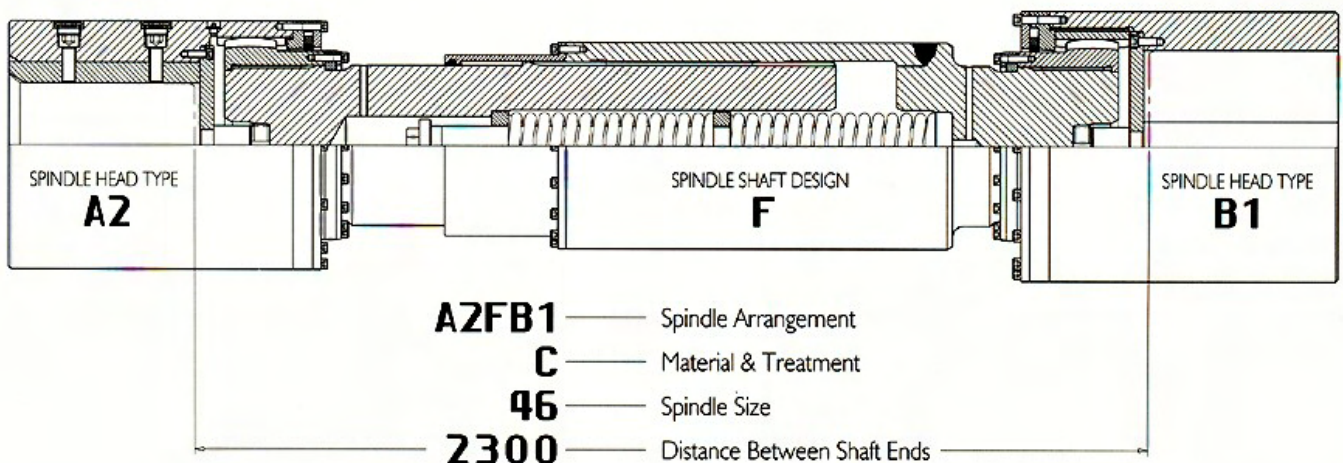
SPINDLE HEAD STANDARD DESIGNS	SPINDLE HEAD SPECIAL DESIGNS	SPINDLE HEAD BORE DESIGNS	MATERIALS & HEAT TREATMENTS	SPINDLE SHAFT DESIGNS
A See Page 8 B See Page 9 C See Page 10 D See Page 11 E See Page 12 F See Page 13 G See Page 14 H See Page 15 J See Page 16 K See Page 17 L See Page 18	U V W X	1 2 3 4 5 1 2 3 4 5 6 7	A X38CrMoV51 SGNG B 18NiCrMo5 CHG C 31CrMo12 SGN D 42CrMo4 NGN E 42CrMo4 IHT See Pages: 05 - 06 - 07	A B C D E F G H J K L

Example of Identification

MILL SPINDLE type A2FB1C4602300

MILL SPINDLE composed by :

- Roll End Spindle Head, Design **A**
- Roll End Bore, Design **2**
- Spindle Shaft, Design **F**
- Pinion End Spindle Head, Design **B**
- Pinion End Bore, Design **1**
- Material & Heat Treatment **C**
- Spindle Size **46**
- Distance Between Shaft Ends **2300**



ENGINEERING DATA REQUIRED

Head Office : MAINA ORGANI DI TRASMISSIONE SpA - C.so ALESSANDRIA, 160 - 14100 ASTI - ITALY
 PHONE : 0039.141.272591 - FAX : 0039.141.272595 - Email : info@maina.it

Customer : _____
 Contact Name : _____
 Inquiry No. : _____
 No. of Units : _____

Phone : _____
 Fax : _____
 Email : _____

Data required for each Stand. If data are not available, fill in the boxes in the table at the next page

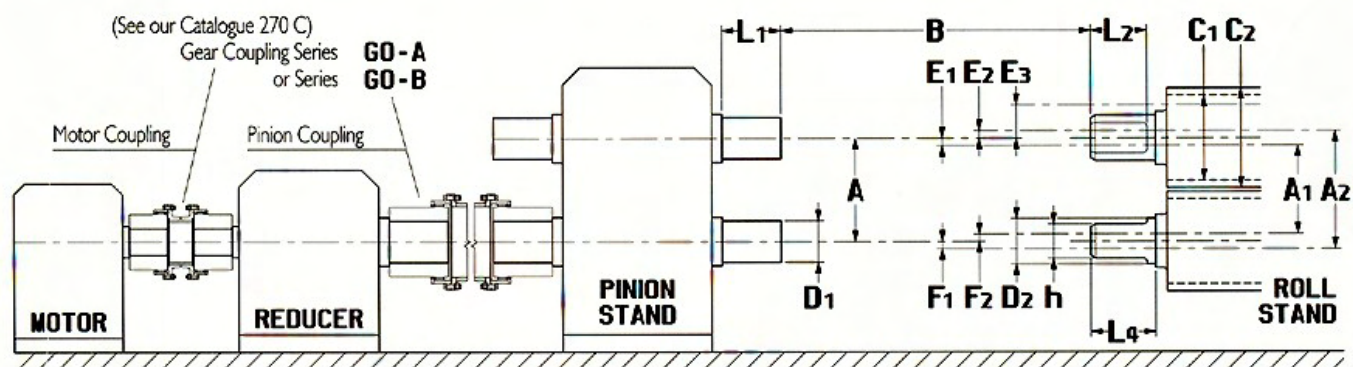
Item	Data Required	Unit	Note	Value
01	Type & Number of Mill Stands	[-]		
02	Rated Motor Power	[kW]	■	
03	Motor Speed (Base / Max)	[RPM]	■	
04	Motor Continuous Overload Rating	[%]		
05	Motor Peak Overload Rating	[%]		
06	Torque Amplification Factor TAF	[-]		
07	Gear Reducer Ratio	[-]	■	
08	Torque Split Ratio (60/40 by default)	[-]		
09	Minimum Stiffness Required	[kNm/Rad]		
10	Service Factor	[-]	■	
11	Yield Limit Safety Factor	[-]		
12	Operating Cycle Time	[sec]		
13	Operating Cycle Frequency	[sec]		
14	Year Production	[Ton]		
15	Shifting Mode & Size	[mm]	■	Yes ☐ No ☐
16	Bending Mode & Size	[mm]		Yes ☐ No ☐
17	Crossing Mode & Size	[mm]		Yes ☐ No ☐
18	Reversing Application	[-]	■	Yes ☐ No ☐
19	Vertical Application	[-]	■	Yes ☐ No ☐
20	Max Angle Operating (Under Load)	[Deg°]	■	
21	Max Angle at Roll Change (No Load)	[Deg°]	■	

Note ■ - Min. data required for a budget price.

ADDITIONAL INFORMATION

a	Work Roll or Back Up Roll Driven :
b	Roll Change Method and Spindle Support Type :
c	Outside Diameter Limitation :
d	Ambient Temperature :
e	Presence and Type of Process Contaminant Liquids :

ENGINEERING DATA REQUIRED

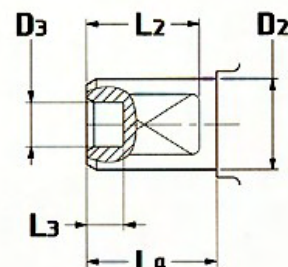
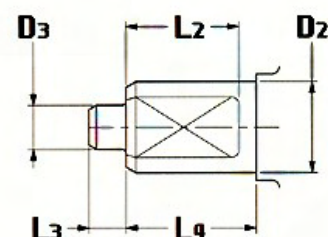


Data required for each Stand.

Item	Data Required	Dim.	Unit	Note	Value
22	Pinion Centers	A	[mm]	■	
23	Min Work Roll Center Distance	A1	[mm]		
24	Max Work Roll Center Distance	A2	[mm]		
25	Distance Between Shaft Ends	B	[mm]	■	
26	Min Work Roll Diameter	C1	[mm]	■	
27	Max Work Roll Diameter	C2	[mm]		
28	Pinion Shaft Diameter and Design	D1	[mm]	■	
29	Roll Neck Diameter and Design	D2	[mm]	■	
30	Pilot Diameter	D3	[mm]		
31	Min Offset of Top W.R. Operating Position	E1	[mm]		
32	Max Offset of Top W.R. Operating Position	E2	[mm]		
33	Max Offset of Top W.R. at Roll Change	E3	[mm]		
34	Min Offset of Bottom W.R. Operating Position	F1	[mm]		
35	Max Offset of Bottom W.R. Operating Position	F2	[mm]		
36	Roll Neck Across Flats Distance	h	[mm]		
37	Pinion Shaft Engagement	L1	[mm]	■	
38	Roll Neck Engagement	L2	[mm]	■	
39	Pilot Engagement	L3	[mm]		
40	Roll Neck Length	L4	[mm]		

Note ■ - Min. data required for a budget price.

For Roll End & Pinion End
Bore Design See Page 20.



CUSTOMER PRELIMINARY SELECTION

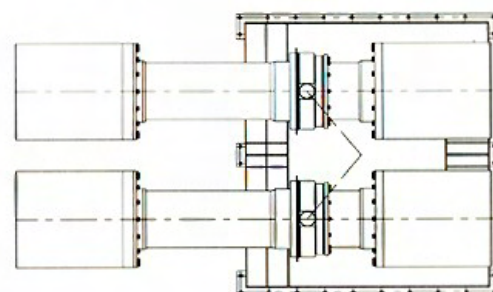
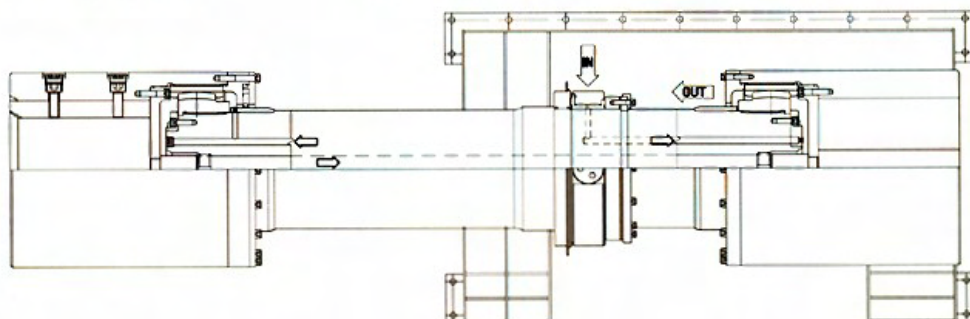
f	Intermediate Sleeve (Insert Ring)	Yes ☐ No ☐
g	Intermediate Sleeve Alignment (Pinion Stand / Roll Stand)	Yes ☐ No ☐
h	Sleeve Aligning Device / Spring Loaded Thrust Button	Yes ☐ No ☐
j	Disengaging Design for Vertical Roll Change	Yes ☐ No ☐
k	Shear Pin Device or other Overload Protection	Yes ☐ No ☐
l	Preliminary MILL SPINDLE Design Selection :	

MAINA Organi di Trasmissione SpA will not be responsible for errors due to inaccurate or incomplete information supplied.

CIRCULATING OIL SPINDLE ARRANGEMENT

This arrangement can solve technical and economic problems of lubrication, wear, heating and environmental pollution.

ROLL END FIXED TYPE PINION END



Realization

The device can be used either with fixed and telescopic spindles. To realize it, you must have a recirculating oil system or you have to connect to the centralized lubrication system for gearboxes and pinions.

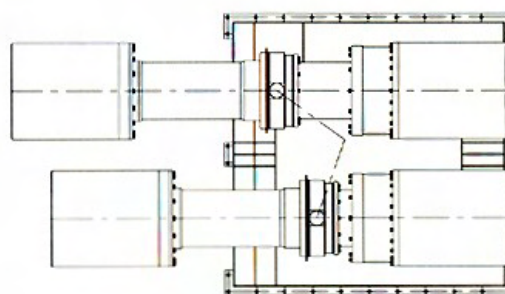
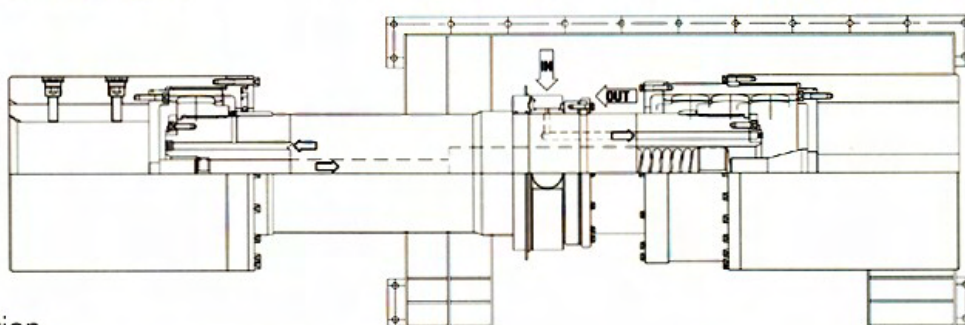
The recirculating oil system must be equipped with:

- * Motor pump able to feed the required quantity of oil at a pressure of 1.5-2 bar
- * Adjusting equipment (pressure and capacity)
- * Devices for filtering (40-63 micron) and cooling (40-45°C)
- * Safety and alarm equipment.

The return oil has to be collected in a pinion side fixed sump, to be then conveyed in the oil tank.

The spindle feed system is very simple and has limited dimensions. It is realized by a rotating distributor, receiving oil from the fixed feed system, and conveying it by means of pipes to the two rotating heads. The oil coming from the roll head is conveyed in the pinion head and then transferred in the collection sump.

ROLL END TELESCOPIC TYPE PINION END



Advantages of forced lubrication.

It reduces environmental pollution and maintenance costs, as it eliminates weekly lubrication and environment cleaning, while considerably reducing lubricant consumption.

The forced lubrication and cooling system assures a long tooth lifetime and allows to reach high and concomitant angles, speed, torque, extreme working cycles which otherwise would not permit the spindle natural cooling.

As a matter of fact, by continuously conveying fresh and cool oil in the meshing area, it is possible to cool the spindles and to keep, on the tooth flanks, a coat of oil having a lubricant height able to avoid any metal/metal contact.

Also the knuckle performances are improved so, by reducing power loss, you can save energy.

INSTALLATION, LUBRICATION, USE AND MAINTENANCE

MILL SPINDLES

INSTALLATION, LUBRICATION, USE AND MAINTENANCE

A STATUS AT DELIVERY

- A.1 Maina mill spindles are supplied, unless otherwise specified, fully assembled. In some cases, the pinion sleeve is delivered earlier, to allow its assembly onto the pinion stand in the manufacturer workshop. Painting must be required in the order.
- A.2 The anticorrosion protection for inner and interface surfaces is usually performed by one of the following ways:
- By an oil based, transparent amber film, for indoor storage, medium period. Normally, it is not necessary to remove before assembly;
 - By a dry, wax based, transparent film, for indoor storage, long period and for sea transport. In this case, it is necessary to remove with a solvent before assembly, taking care of not damaging the seals;
 - By black MoS₂ lubricant laques for running in, which do not need being cleaned.
- Maina Mill spindles are supplied unlubricated.

B SUGGESTIONS FOR HANDLING AND STORAGE

- B.1 To avoid any injury to persons or damage to the spindles, always transport and store in horizontal position.
- B.2 Employ rugged nylon ropes or proper belts to lift and handle. When using metallic ropes, protect any spindle surface to avoid contact.
- B.3 Always handle in horizontal position; in case non-horizontal handling is required, secure telescopic parts.
- B.4 When lifting and storing, the flexible parts (roll and pinion sleeves) may move, causing harm; keep at a safe distance.
- B.5 Avoid any kind of impact to the unit when handling and storing.
- B.6 Store in a covered, dry place and never lay directly on the ground.
- B.7 When storing for over six months, check the status of unpainted parts and apply a new protection film.

C SAFETY STANDARDS

- C.1 Spindles in operation can be very dangerous, and the user must provide for suitable protection devices, according to the local applicable work safety regulations.
- C.2 Handling, installation, use and maintenance must be performed by qualified personnel only.
- C.3 Always wear and/or employ proper safety protection when handling, installing, lubricating, operating and performing maintenance.
- C.4 During operation, design values (torque, speed, working angles, DBSE etc.) must never be exceeded.

OBSERVE THE EC REGULATIONS FOR MACHINERY.

D PREPARATION FOR ASSEMBLY

- D.1 The operations of check and assembly must be performed by qualified personnel only.
- D.2 Before assembling, make sure the operation limit values (max rolling torque, angles, power, speed, overloads etc.), shown in the drawing, correspond to the plant features.

These values must never be exceeded.

- D.3 Check that the distance between shaft ends and the assembly tolerance of the pinion sleeve correspond to the expected values. Make sure the fitting backlash of the sleeve with the roll neck is included, according to its dimensions, in 0,20 - 0,60 mm (check that any dimension and tolerance complies with the drawing).
- D.4 Clear the spindle of packing and check carefully what is contained in it.
- D.5 Check the state of the spindle. Should you find any oxidation, ask immediately our technical department about the intervention to make.
- D.6 Remove the seal retainer fasteners and dismantle the spindle to three components:
- 1)- ROLL SLEEVE ASSEMBLY
 - 2)- INTERMEDIATE SHAFT ASSEMBLY WITH GEAR HUBS AND SEALING SET
 - 3)- PINION SLEEVE ASSEMBLY
- Make sure all components are undamaged, free from any foreign matters and from any harmful protection. While handling the intermediate shaft assembly, pay attention to the sleeve aligning device and to the thrust plate which might fall down, as they may come out from the inside of the shaft.
- D.7 Carefully clean the pinion shaft, making sure its surface is free from any scratching. In case of keyfitting, it is advisable to apply some grease on the shaft, before assembling. Apply some antiseizure laque on the key flanks and seats.
- Do not apply any antiseizure substance in case of shrink fitting.**
- D.8 Remove the thrust plate from the sleeves (roll and pinion side), by the proper puller holes. If necessary, remove the seeger ring and/or the thrust plate fasteners first. In some cases, it is necessary to remove the intermediate sleeve first.
- Make sure not to damage, while disassembling, the o-ring placed between the thrust plate and the sleeve.**
- D.9 Remove the protection film from the sleeve holes (roll and pinion side), by employing solvent and rags.
- Do not employ metal brushes or tools which may spoil the surfaces.**

E ASSEMBLY OF COMPONENT

- E.1 PINION SLEEVE KEYFITTED WITH INTERFERENCE
- E.1.1 Prepare the sleeve before any other component (thrust plate, intermediate sleeve, o-ring, etc.)
- E.1.2 Heat in oil or in a furnace to obtain the expansion necessary for fitting onto the shaft. For a max fitting interference between hub and shaft of 1/1000, it is normally required to heat at a temperature of 180°C.
- E.1.3 Fit the sleeve on the shaft protrusion following the axial positioning given in the project and let it cool to ambient temperature. For any further information, please see Maina specification PFB 1100.
- E.1.4 Fit the thrust plate inside the sleeve, by lubricating its outer surface, and after checking the correct position of the o-ring inside the groove.
- E.1.5 Apply the recommended grease on the sleeve gear teeth.
- E.1.6 Should the spindle have the intermediate sleeve, it has to be fitted inside the sleeve, taking care of keeping the alignment

INSTALLATION, LUBRICATION, USE AND MAINTENANCE

marks (holes must have a diameter of 3 mm and a depth of 2 mm) placed on the gear teeth face.

This fitting could turn out to be difficult, due to very small machining tolerances. In this case, we suggest to preheat the sleeve (80°C - 100°C), by a diffusion flame.

NEVER EMPLOY THE TORCH.

Before doing this operation, clear the gear teeth of the grease.

- E.1.7 Apply a thick coat of the prescribed grease on the intermediate sleeve gear teeth.

E.2 SHRINK FITTED PINION SLEEVE AND OIL PRESSURE REMOVAL

Please ask for specific assembly instructions (PFB 1202).

E.3 ROLL SLEEVE

- E.3.1 Fit the thrust plate inside the roll sleeve, after checking the correct position of the o-ring inside the groove. Any thrust plate fasteners must be tightened by a dynamometrical wrench, as shown in the drawing.
- E.3.2 In case also the roll sleeve has the intermediate sleeve, please follow the same assembly procedure as described for the pinion side (see paragraph E.1.6 and E.1.7).
- E.3.3 Fit the so-obtained roll assembly onto the intermediate shaft, keeping, here too, the alignment marks. Make sure the thrust button or the sleeve aligning device is properly fitted inside the shaft.
- E.3.4 The sealing set locking must be made by holding up the axial force of the springs (shock absorber or sleeve aligning device). Employ three threaded stay rods for the axial positioning, then use standard locking screws which must be tightened by a dynamometrical wrench at the torques stated in the drawing. Where necessary, tie the locking screws with a steel wire.
- E.3.5 When disassembling the inner spring loaded unit, be very careful to the spring release; when re-assembling, keep the initial pre-load conditions stated in the drawing, taking care of making a correct assembly of springs, spacers and spring stud. In case of Belleville washers, carefully follow the assembly scheme and the total number of springs shown in the drawing (never make any modification).
- E.3.6 While handling and lifting the telescopic assemblies, do not extract the splined gear teeth, the sleeve aligning device and the thrust buttons. In case splines should come out, relubricate them with the recommended grease when re-assembling, and pay attention to the angular alignment between male and female, keeping the alignment marks.

F ASSEMBLY IN THE PLANT

- F.1 Assemble the bottom spindle first, then the top spindle.
- F.2 Make sure the thrust button is fitted inside the shaft on the pinion side.
- F.3 Put and keep the intermediate assembly with the roll head in horizontal position. Fit the pinion gear end inside the pinion sleeve already fitted in the pinion stand. In case the spindle has the intermediate sleeve, fit the gear end inside the sleeve, already assembled in the pinion sleeve.
While fitting the gear teeth, pay attention to the assembly angular markings.
- F.4 Fit the seal retainers, paying attention not to turn or damage

the seal lips (grease the sliding surface). Tighten the seal retainer fasteners at the torques shown in the drawing by employing a dynamometrical wrench.

- F.5 The spindle, now completely assembled and supported by the spindle support, is ready for the roll neck fitting.
- F.6 Check that the angular alignment of the sleeve bore flat wear plates complies with the roll neck ones. The alignment error must be contained in the extension of the lead-in chamfers placed on the bore edge. Check the effectiveness of any sleeve aligning device supporting the roll sleeve.
Also check that the spindle support is properly adjusted on the spindles and allows easy and soft roll neck entry into the hub bore. Adjust the lead-in speed, movement must never be too fast, as it must allow air bleed, complete grease spreading, and the correct positioning of the sleeve.
- F.7 Grease the lead-in chamfers and the sleeve bore walls, as well as the roll neck surfaces, with MoS₂ grease.
- F.8 Insert the roll necks in the sleeves with great care, checking that their movement is constant and uniform.
- F.9 Once the spindles are installed and the spindle support is open, fill the two heads with grease. In case of telescopic spindles, put them, one after the other, in the minimum extended position and complete the grease filling of the telescopic shafts.
Once the operation of greasing is concluded, carefully close every grease feed and drain plug.
- F.10 Check that the spindle support is totally disengaged from the spindles. Spindles in operation must never be in contact with the spindle support (verify every angle condition).

G LUBRICATION

Maina mill spindles must be lubricated after installation, at rolls in and in working position.

G.1 GREASE PACKED LUBRICATION

It is the most common type of lubrication employed with gear spindles. To be effective, heads and telescopic shafts must be filled with the proper grease which has to be renewed quite frequently. It must be renewed to compensate aging and oxidation (very harmful to lubrication). Loss of lubrication capacity is influenced by high temperatures, pressure, effect of centrifugation, absorption of humidity and water, impurities.

G.1.1 Lubrication of heads

- Open one of the plugs placed on the seal retainer (preferably the one on the top) and pump grease through one of the grease nipples placed on the spindle shaft, close to the head. The operation is completed when grease continuously comes out of the top plug.
- Close the plugs. This last operation is essential because, even in case one plug only is missing, the head loses, in rotation, all the grease in few minutes (due to centrifugal force).

G.1.2 Lubrication of telescopic shaft

Telescopic shafts must be lubricated in the minimum extended position, completely filling with grease their back chamber. To let the grease in, open the plug placed on the top and pump the grease through a grease nipple placed on the bottom. The operation is completed when grease continuously comes out of the top plug; make sure that the

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shafts are completely filled with grease.

G.1.3 Recommended grease technical features

The technical features here listed are recommended for normal duties (torque, speed and angles): However, please follow the instructions shown in the drawing of the spindle; for any further explanation please ask our technical department.

NLGI Grade	1 ÷ 0
Thickener	lithium / complex lithium
Grade of penetration	310 ÷ 385
Flash point	170 ÷ 250°C
Oil	mineral / synthetic
Oil viscosity at 40°C	800 ÷ 1800 cSt
Oil viscosity at 100°C	45 ÷ 150 cSt
Additives	EP
MoS2 mineral load	5 ÷ 10%
Timken load	25 ÷ 95 kg
Weld load	500 ÷ 800 kg
Corrosion	negative

Grease must be EP type and must contain 5-10% of micronized solid additives (MoS2 or MoS2 + graphite); this to support overloads and emergency conditions of lubrication. It must also contain additives preventing rust and wear. Grease must be water repellent type and have a high adhesion, water must be lower than 0,2%. For high rotation speed, grease must also be centrifugation resistant (high speed factor $d \times n$).

In EP grease (recently modified for problems of environmental pollution), check that, for lack of lead and chlorine, the new EP compounds are as effective as the previous ones, and do not attack steel, thus aiding wear.

G.1.4 Grease lubrication intervals

- Startup After some hours of operation, lubricate again (heads only) adding grease, if necessary.
- Breaking in For the first month of operation, lubricate every three days.
- Normal operation After the first month of operation, lubricate every week.
- Splines must be lubricated every 2/4 months, depending on the shifting (dynamic or static shifting) and on the frequency of its use.
- Middle size mill spindles, having effective seals and operation temperatures of 70-90°C, need to be relubricated so that the grease in the gear tooth chamber is fully renewed every 150-750 hours of operation.

G.2 OIL PACKED LUBRICATION

This type of lubrication can be employed only with a proper

and effective seal system, with special long lasting seals. After lubrication and before installation, check that every plug and every seal retainer is closed. Filling must be made following all procedures and levels or quantities shown in the assembly drawing and/or in the spare part identification drawing.

G.2.1 Technical features required for lubricating oil

ISO grade of viscosity at 40°C	=> 1500 cSt
Viscosity at 100°C	=> 64 cSt
Flash point	=> 227°C
Timken EP Ok	=> 32 kg
Four ball EP test (weld load)	=> 500 kg

Oil must be centrifugation resistant, must be EP type and must contain 5-10% of solid additives for emergency lubrication (MoS2), and additives preventing rust and wear. H2O content must be lower than 0,2%.

G.2.2 Oil lubrication intervals

- Startup After some hours, check seal effectiveness.
- Normal operation Lubricate every month or every two months, depending on seal effectiveness, rotation speed, working temperature, type of oil employed.

G.3 CONTINUOUS OIL LUBRICATION

This type of lubrication can be employed on prearranged spindles, and when there is a special system of seals and oil distribution / recirculation. Oil features (viscosity, quantity, pressure, filtering) must be selected according to the requirements of the spindle lubrication and cooling system and the oil distribution and conditioning centralized system. The exact data are shown in the spindle assembly drawing and in the spare part identification drawing. Oil must be EP type and must have the following features:

ISO grade of viscosity at 40°C	=> 680 cSt
Viscosity index	=> 95 cSt
Flash point	=> 225°C
Timken EP Ok	=> 32 kg
Four ball EP test (weld load)	=> 500 kg

Delivery oil must be carefully filtered at 40-63 absolute micron of millimeters or less, and it must not exceed the temperature of 45°C. Often check the seal status and the presence of flow / pressure. In case of dripping or loss in pressure or flow rate or excessive head heating, increase oil flow and make a prompt intervention. Oil forced lubrication can be used with high speed rotation, high torques and high working angles, i.e. in case of high flows of circulating power, it is necessary to lubricate and cool the spindle heads. These systems can be also employed to automatize lubrication, and to standardize and limit lubricant consumption.

G.4 SELECTION OF LUBRICANT

Selection of lubricant must be made following our instructions, and must consider working conditions, environmental conditions, availability and compatibility with environmental protection laws in force in the country. The

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type of lubricant, its physical-chemical features and the intervals of lubrication must be defined by the lubricant supplier and must be submitted to our technical department for acceptance.

H MAINTENANCE

After installation and startup, we suggest to schedule the following regular checks, to assure the spindles a proper operation and a long life.

H.1 STARTUP AND BREAKING IN

New mill spindles installed in new plants need the first checks to be scheduled as follows:

- 1st check 12 hours after installation
- 2nd check 2 days later
- 3rd check 8 days later
- 4th check and further checks every 30 days, for the first six months.

H.1.1 Attentions

- 1) Check flange bolt tightening; retighten if necessary.
- 2) Check the temperature of the spindle in operation: it must not be 35 ÷ 40°C higher than the ambient temperature. In case, check lubrication.
- 3) Check noise and/or any possible vibration in operation. In case any noise and/or any anomalous vibration are present, investigate the possible causes and promptly remedy defects.
- 4) Check there is no lubrication leak due to centrifugation or other reasons, to seal wear or break, or to grease nipple, plug, air valve break. In case, promptly remedy.

H.2 NORMAL OPERATION

Afterwards, checks must be made every 5/6 months or after 4000/6000 hours of operation, or after serious rolling mill accidents. Intervals between checks must never exceed 12 months. We suggest to keep a maintenance chart for each spindle, showing:

- Position of the spindle in the plant (stand number, top / bottom)
- Length of operation
- Type of finished product
- Tonnage of production achieved
- Accidents / strandings occurred
- Surveyed backlash
- Replaced components

This will enable you to estimate the residual life of different components and decide for necessary spares.

H.2.1 Attentions

- 1) Completely dismantle the spindle, clean and check carefully each component, and in particular:
 - Working gear teeth and splined gear teeth
 - Seals
 - Wear on roll bore surface
 - Buttons and axial thrust plates
 - Sleeve aligning device
- 2) Replace items whose wear cannot give adequate warranties of life until the following check.
This is the reason why it is advisable to have enough spares to guarantee the continuity of the plant running.

ONLY MAINA ORIGINAL SPARES OR SPARES OFFICIALLY APPROVED BY MAINA CAN BE ACCEPTED; OTHERWISE WARRANTY SHALL EXPIRE.

- 3) Gear hubs are slightly shrinkfitted onto the shaft. This is why, in case of replacement, you may need heating them in oil at 90°C, to make assembly easier.
- 4) Reinstall the spindles following the initial assembly procedures, reversing top and bottom position, so to distribute wear on both tooth flanks. It is advisable to reverse the spindle position no later than every 12 months.

H.3 SPARES

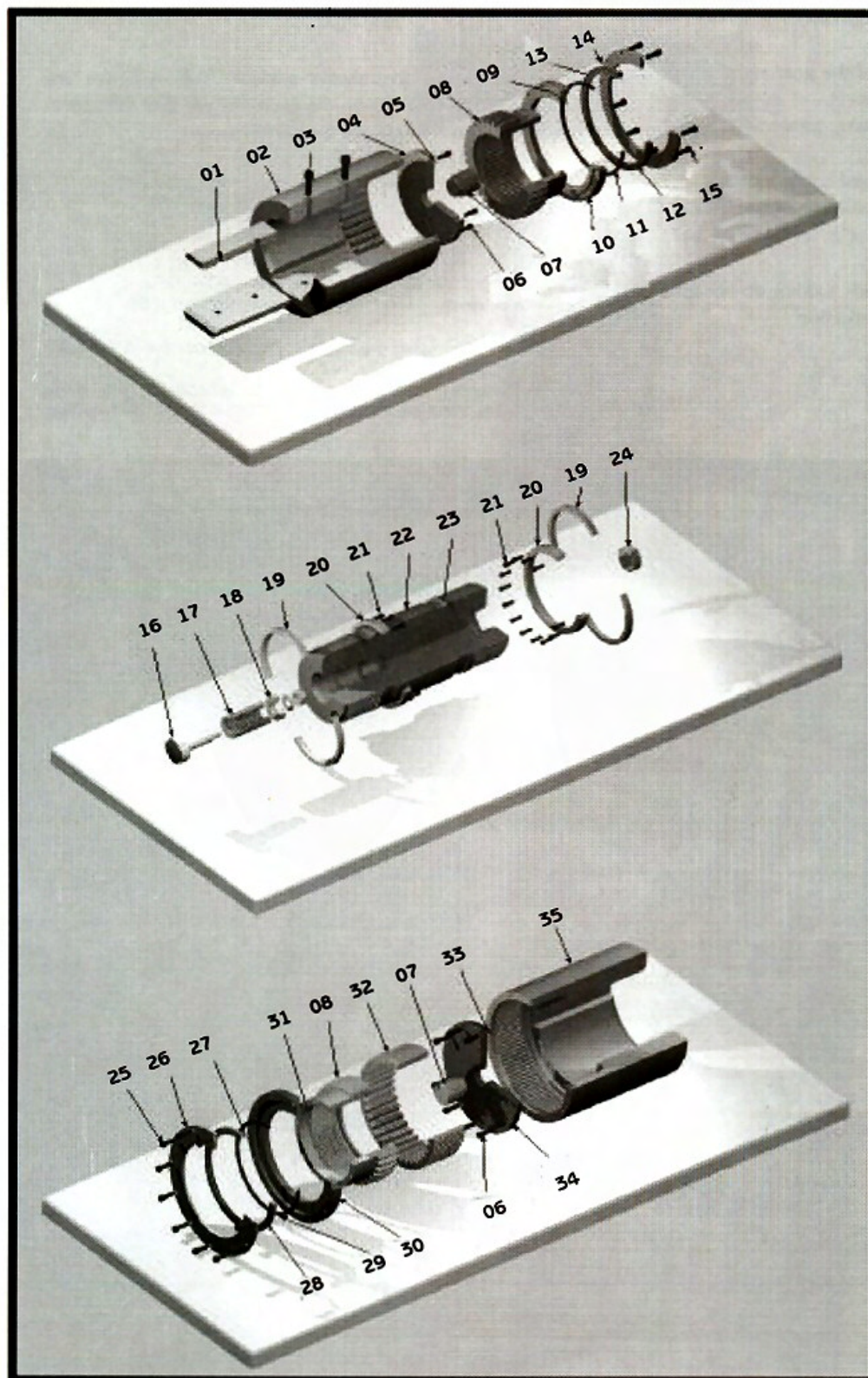
To guarantee continuity of the plant running, we suggest to have the following spares in stock:

- 1 roll hub and fitting accessories
- 1 set of fitting accessories for roll hub (centering rings, flat keys, accessories and bolts)
- 2 roll and pinion complete sets of working gear teeth (sleeves, hubs, accessories and bolts)
- 2 roll and pinion complete sets of thrust assemblies (buttons, plates, spring units, drive pins, accessories and bolts)
- 2 complete sets of seals (dynamic and static seals, retainers, floating rings, covers, accessories and bolts)
- 8 dynamic main seals.

It is also advisable to keep in stock one or two complete spare spindles to replace damaged spindles in case of rolling mill accidents / strandings.

Spare spindles are useful to make a precautionary rotation on the working spindles, and to make detailed checks and repairs at MAINA workshop.

MILL SPINDLE COMPONENTS



- 01 - FLAT WEAR KEY
- 02 - ROLL SLEEVE
- 03 - FLAT WEAR KEY FASTENERS
- 04 - ROLL END THRUST PLATE
- 05 - O-RING
- 06 - THRUST PLATE FASTENERS
- 07 - THRUST PLATE BUTTON
- 08 - GEAR HUB
- 09 - O-RING
- 10 - SEAL RETAINER
- 11 - DOUBLE-LIP SEAL
- 12 - FLOATING RING
- 13 - O-RING
- 14 - END RING
- 15 - END RING FASTENERS

- 16 - SPRING STUD
- 17 - SPRING LOADED UNIT
- 18 - SPRING SEAT
- 19 - TWO-HALF LOCKING RING
- 20 - HUB RETAINER
- 21 - HUB RETAINER FASTENERS
- 22 - LONG SPLINE SHAFT
- 23 - O-RING
- 24 - THRUST BUTTON

- 25 - END RING FASTENERS
- 26 - END RING
- 27 - O-RING
- 28 - FLOATING RING
- 29 - DOUBLE-LIP SEAL
- 30 - SEAL RETAINER
- 31 - O-RING
- 32 - INTERMEDIATE SLEEVE
- 33 - O-RING
- 34 - PINION END THRUST PLATE
- 35 - PINION SLEEVE

AFTER SALES AND RECONDITIONING SERVICES

MAINA reputation, in the power transmission equipment field, worldwide, is not only due to their design and manufacturing accuracy, but also to their acquired experience in servicing the end-user during maintenance and inspection. For many years, MAINA has been providing a reconditioning service, whose main provisions are listed below:

- reconditioning cycle schedule of the gear spindle couplings on every single stand;
- disassembly, dimensional checking, penetrant liquids magnaflux checks to verify the fitness;
- replacement of worn and damaged components.

The advantages of such a service are manifest:

- guarantee is long-lasting, since it is renewed at every reconditioning by MAINA;
- scheduling of maintenance avoids sudden down-times resulting in expensive delays in production.

SUCH A SERVICE FOR THE COSTUMER MEANS:

- CERTAIN COSTS
- SAVINGS
- RELIABILITY OF THE PLANT

Our technical service, always available, will recognise any possible problem arising on the plant and will take the appropriate measures to improve the performance.

HOT STRIP - F4 STAND
Bottom gear spindle

Starting up date: Aug. 8th 1986
Disassembly date: Sept. 6th 1988

This gear spindle coupling guaranteed a hot coils production of 6,086,000 metric tons, without being removed.
After reconditioning (seals and thrust buttons replaced), this gear spindle coupling will be installed on the top roll, so that it will work on the tooth flank not yet worn.

