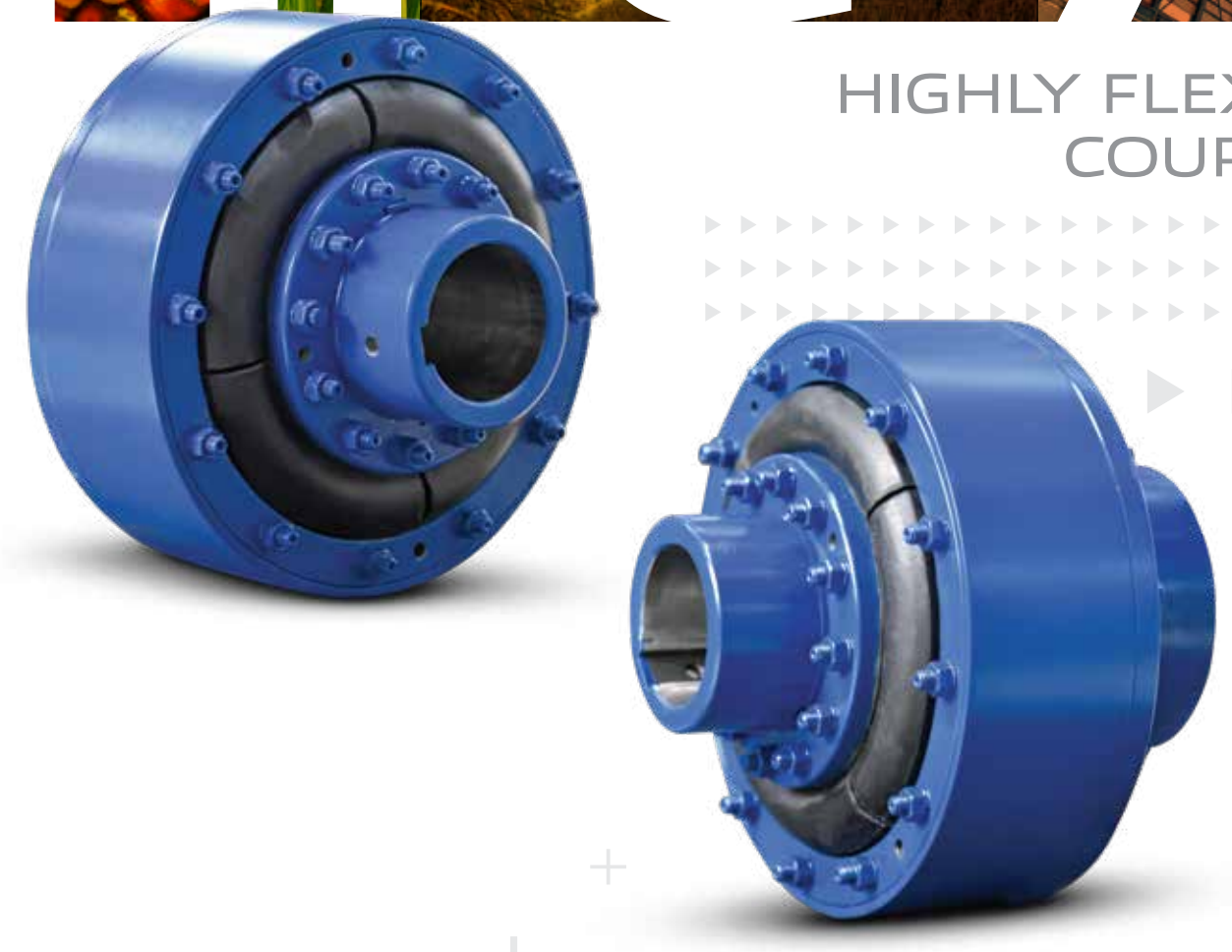
GEARING INDUSTRIES

ELECON COUPLINGS

HFC-A

HIGHLY FLEXIBLE COUPLING



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ELECON
GEARING THE FUTURE

INFRASTRUCTURE

WORLD'S MOST TECHNOLOGICALLY ADVANCED GEAR MANUFACTURING FACILITY

BHANUBHAI MEMORIAL CENTRE OF EXCELLENCE (BMCE)

In the last seven decades, Elecon have conducted intensive research in gear technology and manufacturing techniques. We have developed a variety of products in the transmission industry from worm gears to helical, from planetary to variable speed fluid couplings. This development has demanded a significant investment in manufacturing capability from gear cutting right through to heat treatment and profile grinding. This new plant has the capacity to manufacture sufficient helical gears to produce 1000 assembled gear units per month.

This plant is a tribute to our founding Chairman, Lt. Shri Bhanubhai Patel, who wanted to remain "Always a step ahead in technology"

HIGHLY FLEXIBLE COUPLINGS: HFC-A SERIES

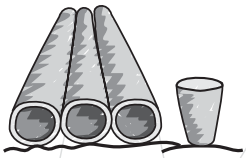
HIGHLY FLEXIBLE COUPLINGS

1. PRODUCTS OVERVIEW

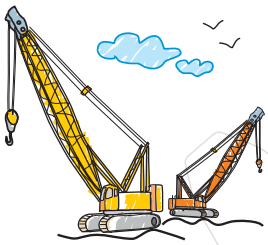
PRODUCTS OVERVIEW

RELIABLE SOLUTION FOR ALL INDUSTRY

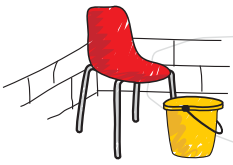
Steel Industry



Crane Industry

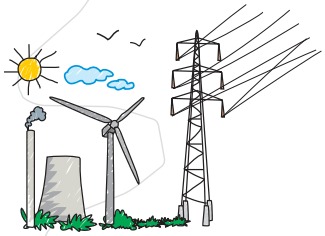


Marine Industry



Plastic Industry

‘ELECON’ Solution for Industry



Power Industry

Sugar Industry

Cement Industry

Rubber Industry

Mining Industry

Gearing industries. Gearing economies.

ELECON PRODUCTS CATALOGUE OVERVIEW

Geared Coupling
Torque: up to 6270 kN.m

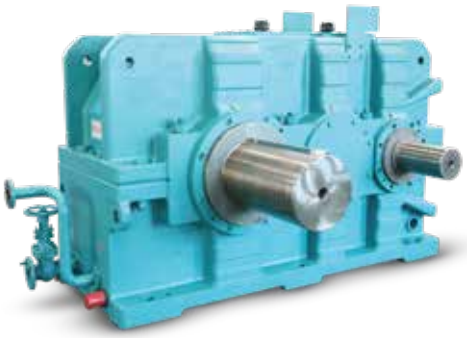
Fluid Coupling
Toque: up to 1300 kW

Flexible Coupling
Torque: up to 27060 Nm

General Application
Torque: up to 2320 kW

Torque Shaft Coupling
Toque: up to 6270 kNm

ELECON OTHER PRODUCTS



Helical Gear Unit

Ratio: 2:1.....400:1
Torque: 140 kNm...1400 kNm

Sugar Mill Drive

Gear Box Ratio: 63:1 to 500:1
Output Torque: up to 8000 kNm

Vertical Rolling Mill

Ratio: 16:1 to 50:1
Toque: up to 2500 kNm

Dual Tandam (kiln drive and Sugar mill drive)

Ratio: 45:1 to 250:1
Torque: up to 2070 kNm

High Speed Gear Unit

Prime Mover Power: up to 50 MW
Input Speed: up to 14000 rpm

Marine Application

HIGHLY FLEXIBLE COUPLINGS (HFC-A)

HFC-A couplings have a high torsional flexibility. HFC-A couplings are suited for machines with a non-uniform load distribution due to their low torsional rigidity and damping characteristics. This couplings are suitable for shaft misalignment. HFC-A couplings are available as solid shaft-to-shaft (NNC) or flange-to-solid shaft connections (FNC). One request, a special link can be made.

The coupling is delivered preassembled. The flexible rings are completely assembled. On the type NNC, the coupling halves have to be bolted together after the hub has been mounted. On the type FNC, after mounting the coupling hub, only the outer flange has to be connected to the machine.

Special outer flanges with different connection dimensions are available for the type FNC.

If the flexible rings are irreparably damaged or worn, the metal parts can rotate freely against one another, they are not in contact with one another.

Key Features

- The split flexible rubber rings can be changed without having to move the coupled machines. The flexible rings are mounted without backlash and give the coupling progressive torsional stiffness.
- The HFC-A coupling is available in 9 sizes having nominal torque between 1550 Nm to 89500 Nm. The coupling is suitable for ambient temperatures of between -40 °C and +80 °C.
- The HFC-A coupling is utilized in tough operating conditions to ensure long service life.
- HFC-A couplings are suitable for drives subject to high shock loads or large shaft misalignment. Also suitable for drive with periodically excited systems.

Applications:

- Cement mill.
- Sugar Cane mill.
- Tube mill.
- Marine drive.
- Crushers.
- Compressor drive
- Pump drive

3. DESIGN AND CONFIGURATIONS

The flexible ring is a key component of HFC-A coupling which determine its transmission characteristics. The flexible rings are made from natural rubber with a number of fabric lining. This flexible ring is split into four pieces that can be replaced without moving the motor or equipment.

Bolts and nuts connect the flexible rings to the hub and outer flanges.

On the FNC type, the outer flange is designed with connection dimensions for connection.

The flexible rubber rings are connected to the hub with a clamping ring and to the outer flange with a clamping ring, using pins and bolts.

Materials

HFC-A coupling is available in two types based on metal parts materials, i.e. Cast iron and Steel.

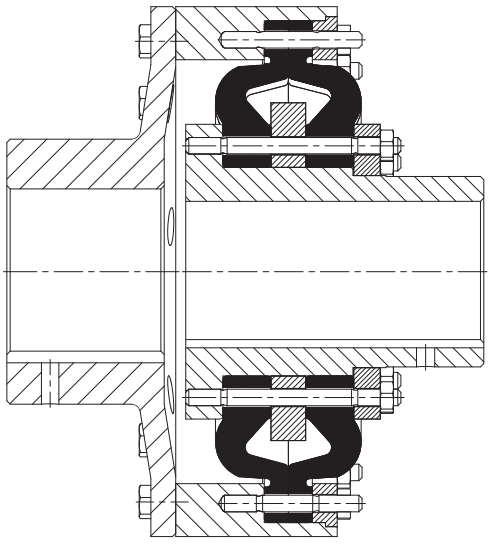
Components	Type	
	Cast Iron (HFC-A-SizeC)	Steel (HFC-A-SizeS)
Hub part-1	FG-260	Steel
Hub part-2	Steel	Steel
Retaining rings & outer rings	FG-260	Steel
Outer flange NNC, FNC	FG-260	Steel

Flexible rubber ring material

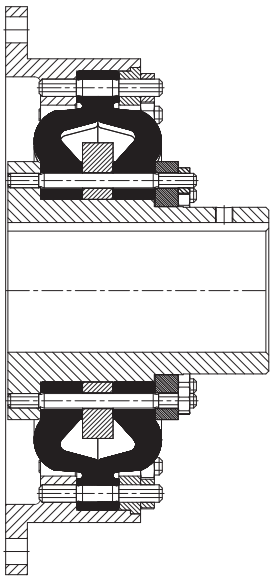
Material	Hardness	Marking	Ambient Temperature
Natural rubber	70 ShoreA	Size-2	-40 to +80°C

HFC-A coupling types

Type	Description
NNC	Coupling as shaft-shaft connection
FNC	Coupling as flange-shaft connection



Type NNC



Type FNC

4. CONFIGURATIONS

Coupling Selection

The HFC-A coupling is especially suitable for rough operating environments.

In case of machines which excite torsional vibration, Elecon recommends to carry out a torsional vibration calculation.

Elecon has capabilities to carry out torsional vibration analysis & can provide calculation accordingly.

Coupling load in continuous operation

Application factor for coupling

The operational principles of the driving and driven machines are divided into categories and the application factor derived from these in accordance with DIN 3990-1. Selection is as per below table.

Table 4.1

Application factor KA				
Torque characteristics of the driving machine	Torque characteristics of the driven machines			
	Uniform	Uniform with moderate shock loads	Non uniform	Very rough
Uniform	1.0	1.25	1.5	1.75
Uniform with moderate shock loads	1.25	1.5	1.75	2.0
Non-uniform	1.5	1.75	2.0	2.5

Temperature change effects on the torsional stiffness. So, temperature factor has been selected from below table.

Table 4.2

Temperature application factor KT						
		Temperature T_a on the coupling				
Coupling	Elastomeric material	-40 to -30°C	-30 to +50°C	Up to 60°C	Up to 70°C	Up to 80°C
HFC-A	Natural Rubber	1.1	1.0	1.25	1.4	1.6

Examples of torque characteristics of driven machines:

- Uniform with moderate shock loads: generators, fans, blowers.
- Non-uniform: Reciprocating compressors, mixers, conveyor systems.
- Very rough: Crushers, excavator, presses, mill

Coupling size $T_{KN} \geq T_N .KA.KT$

Coupling Maximum Torque & Overload conditions

The maximum torque is the highest load acting on the coupling in normal operation.

Maximum torques at a frequency upto 25 times an hour are allowed and must be lower than the maximum coupling torque. Examples of maximum torque running are: Starting operations, stopping operations or usual operating conditions with maximum load.

$T_{Kmax} \geq T_{max} .KT$

Overload torques are maximum loads which occur only in combination with special, infrequent operating conditions. Examples of overload torque conditions are: Motor short circuit, emergency stop or blocking due of component breakage. Overload torques must be lower than the maximum overload torque of the coupling. The overload condition may last only a short while, i.e. fractions of a second.

$T_{KOL} \geq T_{OL} .KT$

Coupling Load due to Dynamic Torque Load

Applying the frequency factor KF, the dynamic torque load must be lower than the coupling fatigue torque.

Dynamic torque load

$T_{KW} \geq T_W . KT . KF$

Frequency of the dynamic torque load

$f_{err} \leq 10$ Hz frequency factor KF=1.0

Frequency of the dynamic torque load

$f_{err} > 10$ Hz frequency factor KF= $\sqrt{f_{err}/_{10}Hz}$

Checking the maximum speed

For each load operations $n_{Kmax} \geq n_{max}$.

Checking permitted shaft misalignment and restorative forces

For all load conditions, the actual shaft misalignment must be less than the permitted shaft misalignment, as per Table 5.1.

Checking bore diameter, mounting geometry and coupling design

The check must be made on the basis of the dimension tables. On request, coupling with adapted geometry can be provided.

Checking low temperature and chemically aggressive environment

The permitted coupling temperature is specified in the temperature Factor KT table. In the case of chemically aggressive environments, please consult the manufacturer.

5. TECHNICAL SPECIFICATION

Table 5.1

Power ratings of HFC-A couplings								
Size	Rated torque T_{KN} (Nm)	Maximum torque T_{Kmax} (Nm)	Overload torque T_{KOL} (Nm)	Fatigue torque T_{Kw} (Nm)	Dynamic torsional stiffness for full load, C_{tdyn} (kNm/rad)	Allowable shaft missallignment misalignment, ΔK_{1500}		
						Axial, a (mm)	Radial, r (mm)	Angular, w (°)
270	1650	4950	6600	660	21	2.1	2.1	0.2
320	2750	8250	11000	1100	38	2.5	2.5	0.2
375	4500	13500	18000	1800	62	2.9	2.9	0.2
430	7000	21000	28000	2800	98	3.3	3.3	0.2
500	11000	33000	44000	4400	154	3.7	3.7	0.2
590	17900	53700	71600	7160	240	4.1	4.1	0.2
690	28000	84000	112000	11200	367	4.5	4.5	0.2
840	44500	133500	178000	17800	684	5	5	0.2
970	89500	268500	358000	35800	1105	5.5	5.5	0.2

Torsional stiffness & damping

The dynamic torsional stiffness is load-dependent and increases in proportion to capacity utilization. The values specified in the selection table apply to capacity utilization of 100%. The following table shows the correction factors for various rated loads.

$C_{tdyn} = C_{tdyn\ 100\%} . FKC$

Table 5.2

Correction factor FKC	Load T_N/T_{KN}						
	20%	50%	60%	70%	80%	100%	200%
	0.3	0.56	0.65	0.74	0.82	1	1.9

Torsional stiffness of HFC-A depends on the ambient temperature and the frequency and amplitude of the vibration excitation.

With flexible couplings the manufacturing process of the rubber elements and their aging primarily influence the stiffness value C_{tdyn}. For this reason calculation must be made with a tolerance for the dynamic stiffness of ± 20 %.

Permitted shaft misalignment

The allowable shaft misalignment depends on the operating speed. As the speed increases, lower shaft misalignment are permitted. The connection factors for different speeds are specified in the following table. The maximum speed for the respective coupling size must be noted.

$\Delta K_{perm} = \Delta K_{1500} . FKV$

Table 5.3

Correction factor, FKV	Speed in rpm			
	500	1000	1500	3000
	1.6	1.25	1.0	0.7

COUPLING SELECTION EXAMPLE

Given

Prime mover:

Electric motor, P_{motor} = 1450 kW,

n_1 = 990 rpm, Nominal torque, T_N = 13994 N.m

Working Machine:

Vertical rolling mill

Required output power, P_e = 1450 kW,

Speed, n_2 = 31.94 rpm.

Selection:

Application factor KA considering uniform driving machine (Electric motor) and non-uniform load driven machine (Vertical rolling mill) from table 4.1, KA = 1.5

Temperature application factor KT considering working temperature 50°C, KT = 1.0

T_N x KA x KT = 13994 x 1.5 x 1.0 = 20991 N.m

From table 5.1, select coupling with $T_{KN} \geq$ 20991 N.m.

Therefore coupling of size 690 is selected.

Torsional stiffness correction:

Load T_N/T_{KN} = (13994/28000) x 100 = ~ 50%

Therefore, correction factor for torsional stiffness from table 5.2, FKC = 0.56

Actual dynamic torsional stiffness of selected coupling, K_{tdyn} = 367 x 0.56 = 205.5 kNm/rad

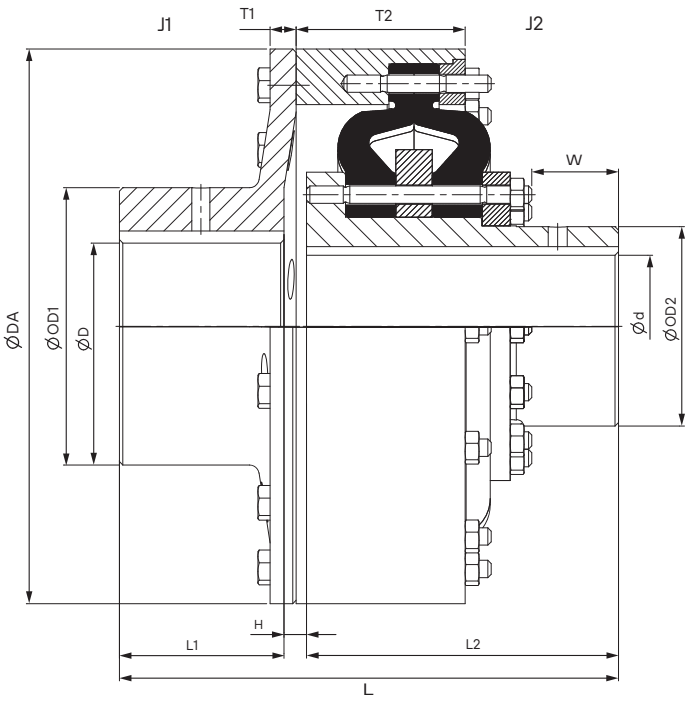
Misalignment correction:

Shaft misalignment correction factor from table 5.3 for 990 rpm, FKV = 1.25.

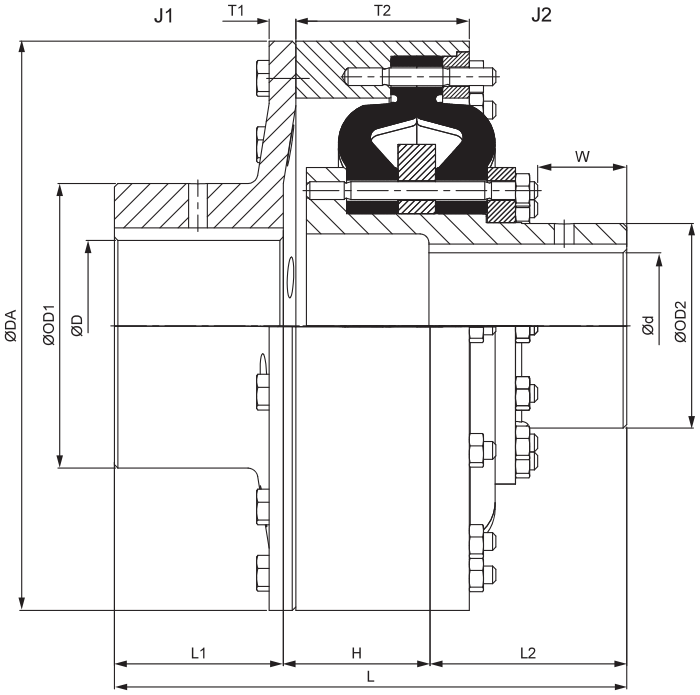
$\Delta K_{perm} = \Delta K_{1000}$ x FKV = 4.5 x 1.25 = 5.625 mm.

TECHNICAL SPECIFICATION

TYPE NNC



SIZE: 270 430



SIZE: 500 970

Size	Rated torque TKN (Nm)	Maximum speed		Dimensions in mm													Mass moment of inertia		Weight, m kg
		Cast iron type nkmax	Steel type nkmax	Keyway DIN 6885				DA	OD1	OD2	L1	L2	H	T1	T2	W	L		
				D min	D max	d min	d max											J1, kg.m²	J2, kg.m²	
270	1650	3000	4250	45	80	45	70	270	128	94	73	155	17	14	86	40	245	0.18	0.031	28
320	2750	2500	3600	55	100	55	85	320	160	115	93	180	13	16	97.5	50	286	0.44	0.078	50
375	4500	2100	3100	65	115	65	105	375	184	143	113	205	17	18	112	60	335	0.97	0.17	81
430	7000	1900	2650	75	130	75	120	430	208	165	133	235	15	22	126	65	383	1.9	0.34	115
500	11000	1600	2300	90	150	90	150	500	240	202	150	160	122	25	140	72	432	3.9	0.69	175
590	17900	1360	2000	100	140	100	170	590	224	230	180	190	140	28	163	90	510	7.7	1.4	255
				140	180				288									8.0		285
690	28000	1200	1650	110	140	110	200	690	224	278	210	220	150	32	176	100	580	15.5	3.2	350
				140	180				288									15.6		371
				180	210				336									15.8		386
840	44500	1000	1350	140	180	140	240	840	288	340	270	280	135	42	231	74	685	47	10.2	700
				180	220				352									48		726
970	89500	850	1180	160	200	160	280	970	320	390	340	350	177	70	290	87	867	96	25	1270
				200	240				384									98		1315
				240	280				448									101		1360
				280	320				512									104		1415

Configuration based variables

ΦD: Without finished bore

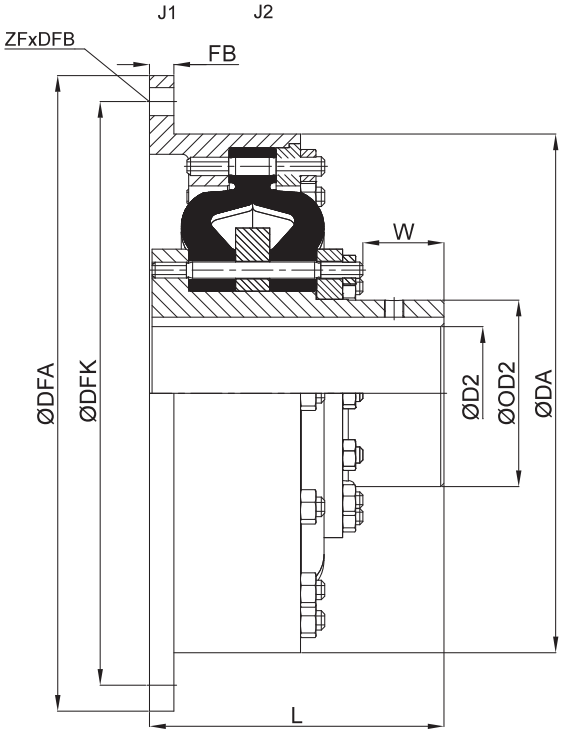
With Finish bore

Φd: Without finished bore

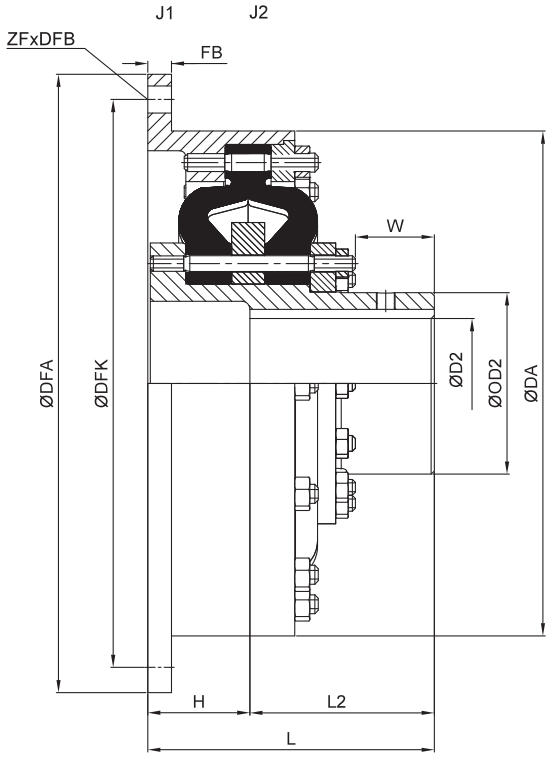
With Finish bore

COUPLING DIMENSION

TYPE FNC



SIZE: 270 430



SIZE: 500 970

Size	Rated torque TKN (Nm)	Maximum speed		Keyway DIN 6885		DA	OD2	H	L2	W	L	Flange connection dimensions					Mass moment of inertia		Weight, m kg
		Cast iron type nkmax	Steel type nkmax	D2 min	D2 max							DFA	DFK	FB	ZF	DFB	J1, kg.m²	J2, kg.m²	
270	1650	3000	4250	45	70	270	94	-	-	40	155	466.7g7	438.2	12	8	13	0.47	0.031	27
												325j6	300		8	14	0.16		19
320	2750	2500	3600	55	85	320	115	-	-	50	180	517.5g7	489	14	8	13	0.87	0.082	42
												392j6	360		8	18	0.39		33.5
375	4500	2100	3100	65	105	375	143	-	-	60	205	571.5g7	542.9	16	6	17	1.50	0.21	65
												448j6	415		8	18	0.78		53
430	7000	1900	2650	75	120	430	165	-	-	65	235	673.1g7	641.4	20	12	17	3.4	0.37	100
												515j6	475		8	22	1.5		78
500	11000	1600	2300	90	150	500	202	100	160	72	260	673.1g7	641.4	20	12	17	4.0	0.85	150
												585j6	545		10	22	2.7		140
590	17900	1350	2000	100	170	590	230	120	190	90	310	733.4g7	692.2	24	12	21	7.0	1.7	200
												692j6	645		10	26	6.0		190
690	28000	1200	1650	110	200	690	278	130	220	100	350	890g7	850	24	32	17	15	3.7	270
												800	750		12	26	11		250
840	44500	1000	1350	140	240	840	340	115	280	74	395	1105g7	1060	30	32	21	46	11	530
												960j6	908		16	30	32		470
970	89500	850	1180	160	280	970	390	155	350	87	505	1385g7	1320	35	24	31	130	26	1050
												1112j6	1051		16	35	76		920

Configuration based variables

ΦD2: Without finished bore

With Finish bore

ELECON CAPABILITIES

Design, Engineering & Development:

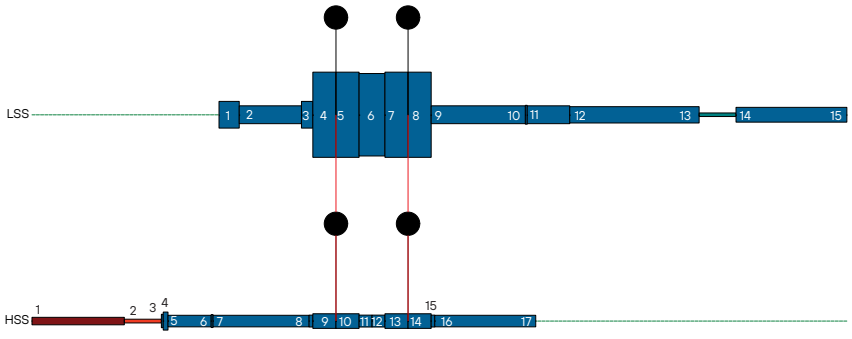
Elecon has advanced and unmatched capabilities in the design, engineering and development of Gearboxes and Couplings, combined with ultra-modern manufacturing facilities.

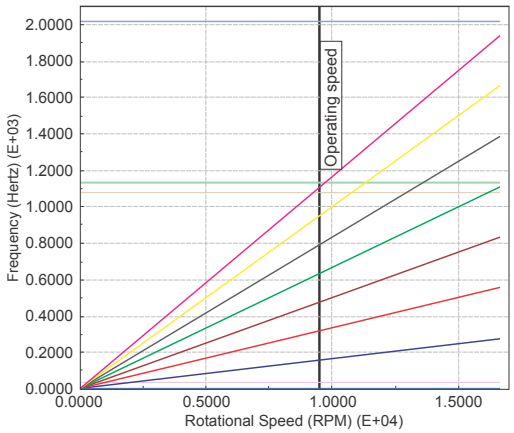
Elecon team with legacy of 70 years of business excellence in the field, shown proven customer satisfaction experience.

Apart from analytical expertise, Elecon has advanced high end simulation facilities:

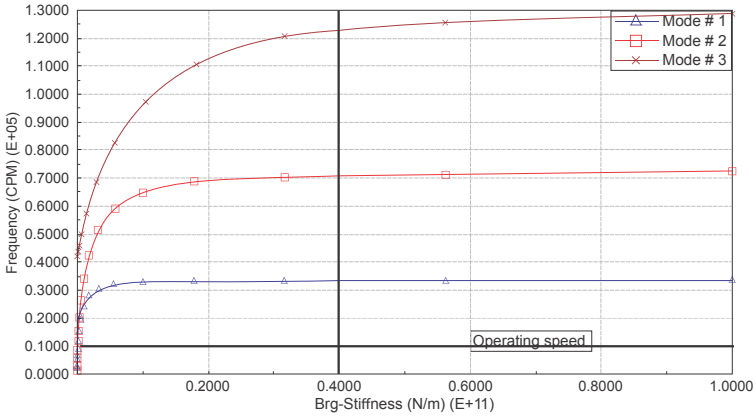
- FE analysis using Ansys software

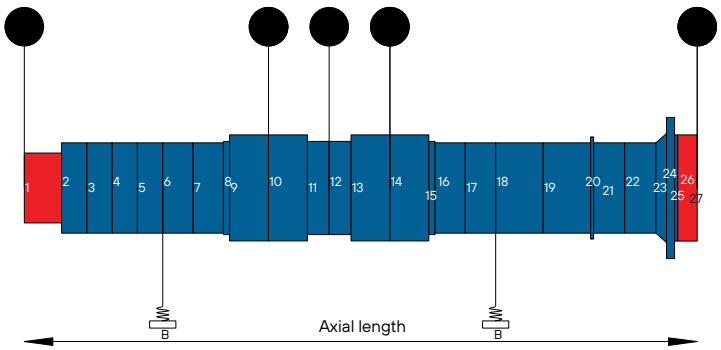
- Torsional vibration analysis of Drive train using Advanced Rotating Machinery Dynamics (ARMD) software.





- Rotor dynamic analysis of high speed rotors using Advanced Rotating Machinery Dynamics (ARMD) software.

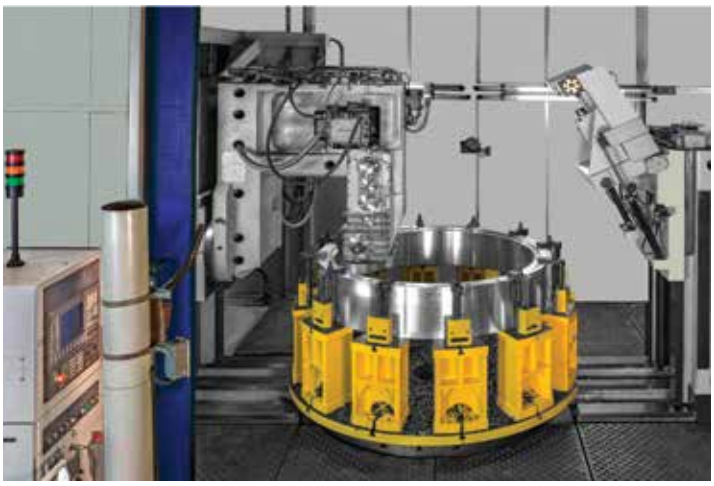




ELECON CAPABILITIES

MANUFACTURING FACILITY:

Elecon has ultra-modern world class, manufacturing facility, well established process flow with plant layout for reduced cycle time of products. High precision multi axis CNC machines for hobbing, surface grinding and teeth grinding and housing machining along with experienced workmen ensuring reliability of products.



ELECON CAPABILITIES

QUALITY:

Every Elecon product passes through thorough quality checking right from raw material to final run test, to verify that product meets its operation.

Elecon has in house metallurgical laboratory with advanced equipment to inspect the raw material properties such as chemical composition, grain size, inclusions and microstructure.

The equipment and quality instruments undergo pre-defined calibration schedule.

NABL APPROVED LAB

Universal Testing Machine, UTM-2 capacity: 1000Tones

Semiautomatic Vicker Hardness Tester

Brinell hardness Tester

Profile Projector

Metallurgical Microscope

Impact Testing Machine

ASSEMBLY AND TESTING

Fully equipped 2.2 MW test bench with advanced instrumentation and test data acquisition system. Assembly workmen are well experienced and process is well defined process and layout.

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