

When you have to consider universal joints, the

MAXXUS®

From KOP-FLEX® Brand Couplings is your clear choice

MAXXUS® is a technically advanced universal driveshaft designed for the toughest applications in the metals industry. Universal driveshafts in general offer many advantages over gear spindles. Universal driveshafts reduce chatter, handle more misalignment, and extend your lubrication schedule. But MAXXUS® is unique. Its block design allows the joints to carry more torque for a given swing diameter than competing yoke type universal joints. So MAXXUS® gives you the most torque capacity for a given space. Chances are, some of your applications require high torque capacity, but due to minimum roll diameter requirements, fall short of your design goals. What's more, MAXXUS® is easier to assemble and maintain than competing products. Call us today and we'll prove it to you.

How does MAXXUS® make assembly and maintenance easier?

- Easy lubrication. The lube fittings are recessed on the outside of the block joint (bearing cup). Easily accessible.
- Fewer parts than competing yoke designs. Fewer parts to assemble and fewer failure points.
- Multi-lip seals.



Compact "block" type Cross and Bearing assembly designed to maximize torque carrying capacity

How does MAXXUS® carry more torque for a given swing diameter?

- One piece forged center cross. High grade material.
- Carburized rolling surfaces on the cross and bearing cup. The bearings ride directly on the specially treated cross surface. Since the cross needs no sleeves, its diameter is bigger.
- No inner and outer bearing race.
- Precision quality bearings with crowned rollers designed specifically for U-joints. Optimum balanced design based on long experience.
- No castings used.
- Block design is torsionally stiffer than competing yoke type design. Carries greater shock loads.

This adds up to a compact design that maximizes the size of the center cross. So we've maximized the torque carrying capacity for a given swing diameter (outside diameter). For example, our 47 in. (1200 mm) diameter MAXXUS® driveshaft gives you a maximum torque capacity of 149 million lb. in. (16.8 million N.m.). We offer custom sizes and 37 standard sizes of MAXXUS® universal driveshafts. One is right for you.

Plus MAXXUS® has all advantages of other universal joints

- Less maintenance. Universal joints lose less grease than gear spindles. Depending on the application, universal joints need lubrication every one to six months.
- Larger misalignment capability. This can be especially important for bar mills.
- Practically no backlash. Because of the gear mesh, gear spindles have backlash. And backlash is a major culprit in inducing chatter or ripples on finish stands. Using a universal driveshaft can reduce chatter and improve the quality of your bars and strips.
- Fewer components than gear spindles, thereby reducing inventory and storage costs.
- Universal driveshafts are as easy to install as gear spindles — sometimes easier.
- Universal driveshafts consume less power.
- Less grease leakage means less mill floor contamination. Better for the environment.

**MAXXUS beats the competition in every size
(BASED ON RATED TORQUE CAPACITY LISTED IN RESPECTIVE CATALOGS)**

**FOR STEEL, ALUMINUM, COPPER AND
BRASS MILLS —**

- Rolling Mills
- Cold Reduction Mills
- Plate Mills
- Pipe Mills
- Structural Mills
- Temper Mills



**A universal
driveshaft that
gives you
higher torque
capacity and easier
maintenance.**

Index:

	Page
Application Experience	292
Selection Procedure	293
D & U Series Data	294
Design Options	295
Repair and Maintenance Program	296



Visit www.kopflex.com

Combining the strengths of KOP-FLEX® Brand Couplings and KOYO*

KOP-FLEX teamed up with KOYO SEIKO* Co. to bring you MAXXUS. KOP-FLEX combined KOYO'S* proven block type universal joint with a complete driveshaft to create one economical package. KOP-FLEX has an exclusive licensing agreement to design, manufacture, assemble, and sell the universal driveshaft in North America. KOP-FLEX also provides expert guidance for your application, technical support, and repair and maintenance service directly from our plant in Baltimore, USA, and Toronto, Canada.

KOP-FLEX has been a leader for over 80 years—ISO 9000 certified

KOP-FLEX, Inc., formerly a division of KOPPERS* Company, has been a leading manufacturer of coupling and spindles for over 80 years. Our 260,000 square foot plant near Baltimore is among the largest of its kind, and we have another plant in Toronto, Canada. KOP-FLEX earned ISO 9000 accreditation in October 1992, making us the first North American power transmission coupling maker to do so. ISO 9000 is the most comprehensive worldwide quality standard. Certification proves our design, production, service, inspection, and testing are all world class.

The experience of KOYO*

KOYO SEIKO* Co. is the premier universal driveshaft manufacturer in Japan, with about 70% of the Japanese universal driveshaft market. KOYO* developed the universal driveshaft for industrial applications in 1968. Many major mills and mill builders around the world use KOYO* universal driveshafts, including NKK*, NIPPON* STEEL, KAWASAKI* STEEL, KOBE* STEEL, TOKYO* STEEL, HITACHI*, POHANG* IRON & STEEL (KOREA), USS POSCO*, CHAPARRAL* STEEL, NUCOR-YAMATO*, DOFASCO*, ATLAS* STEEL, LASCO* STEEL, and others.

Selecting a universal driveshaft Applications

There is a MAXXUS driveshaft for each of the following metal industry applications (steel, aluminum, copper and brass):

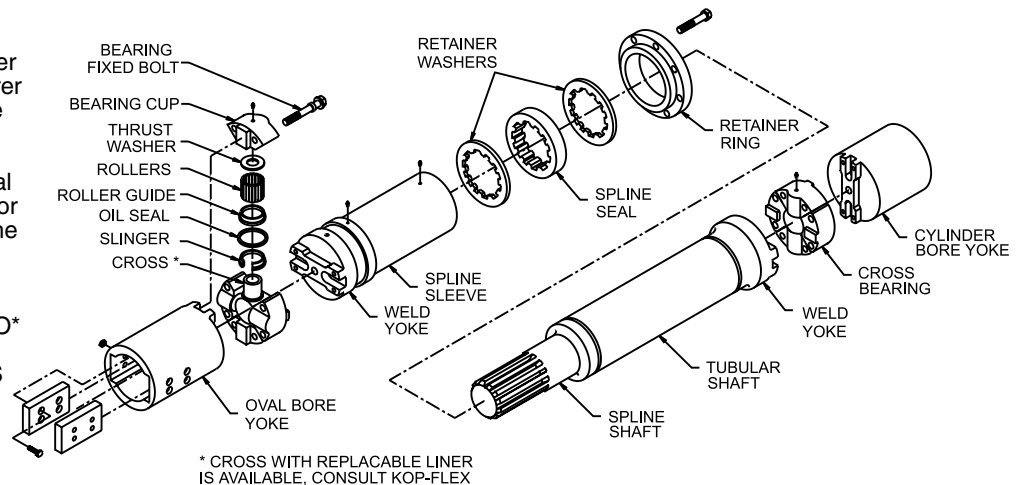
- | | | |
|---|------------------|--------------------|
| ■ Rolling mills—Hot strip, bar, and rod mills | ■ Levelers | ■ Straighteners |
| • Finishing stands | ■ Payoff reels | ■ Structural mills |
| • Roughing stands | ■ Picklers | ■ Temper mills |
| • Vertical edgers | ■ Pinch rolls | ■ Tension reels |
| • Coilers | ■ Pipe mills | ■ Tube mills |
| • Crop shears | ■ Plate mills | ■ Wire mills |
| ■ Cold reduction mills | ■ Runout tables | |
| ■ Continuous casters | ■ Scale breakers | |
| | ■ Slitters | |

KOP-FLEX offers two series of MAXXUS® universal driveshafts. The D and U series are for both reversing and non-reversing applications. The accompanying tables show the torque capacity, allowable operating angle, and dimensional data for both series. One is right for your application.

Shaft variety

Both the D and U series are available in a variety of configurations, depending on the driving method, telescoping stroke, shaft diameter, and shaft length. KOP-FLEX will design the most appropriate universal driveshaft for your mill and its operating conditions. See page 295 for available options.

MAXXUS Complete Assembly



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*NKK is a registered trademark of Nippon Kokan Kabushiki Kaisha, Ta Nkk Corporation.

*NIPPON STEEL is a trademark of Nippon Steel Corporation.

*KAWASAKI STEEL is a trademark of Kawasaki Steel Corporation.

*KOBE STEEL is a trademark of Kobe Steel, Ltd.

*TOKYO STEEL is a trademark of Tokyo Steel Mfg. Co.

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*CHAPARRAL STEEL is a trademark of Chaparral Steel Company.

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*DOFASCO is a trademark of Dofasco Inc.

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Selection Procedure

The following series of calculations will help you choose the right universal driveshaft, but it is a preliminary guide. Some important factors cannot be easily quantified. For example, you should consider the type of machine, peripheral equipment, and operating conditions. Take advantage of our expertise throughout the selection process. Confirm the final selection with our engineers.

1. Calculate application (operating) torque

$$T_a = \frac{HP \times 63,000}{\text{Speed (rpm)}}$$

2. Determine peak torque of the application (T_p)
3. Determine the suggested selection factor (SF) required from the table below.
4. Compare your application's torque with the driveshaft torque capacities shown in charts on page 294.

T_{DR} = Reversing Endurance torque limit (lb.-in.)

T_{DO} = Non-Reversing Endurance torque

limit (lb.-in.)

T_S = Yield torque limit (lb.-in.)

In order for a universal driveshaft to be suitable for your application:

ENDURANCE LIMIT CHECK

$T_a \times SF_e > T_{DR}$ (Reversing endurance torque limit) or $> T_{DO}$ (Non-Reversing endurance limit torque limit), depending on whether application is reversing or non-reversing.

YIELD LIMIT CHECK

If T_p (Torque Amplification Torque) is

known:

$$T_p \times 1.25 > T_S \text{ (Yield torque limit)}$$

If T_p is not known, check select to assure:

$$T_a \times SF_y > T_S \text{ (Yield torque limit)}$$

5. Also consider:

- Diameter limitations
- Length limitations
- Angular (misalignment) requirements
- Length compensation feature (slide) requirements

6. Bearing expected life calculation (B_{10} or L_e -Hours)

- Determine angle factor (KA) from the chart below
- Determine speed factor (KS) from the chart below
- Select bearing life factor (KB) from the charts on page 294.

Calculate bearing life hours (B_{10}) as follows:

$$B_{10}(\text{hours}) = 9000 \times \left[\frac{KB \times KA \times KS}{T_a} \right]^{2.907}$$

Note: T_a (application torque) is in lb.in.

Note: The calculated bearing life hours (B_{10}) should be at least 5,000 hours.

Since most mill applications will run at various torques and speeds, the normal expected B_{10} life should be based on the expected duty cycle.

$$L_e = \frac{1}{\frac{N_1}{L_1} + \frac{N_2}{L_2} + \frac{N_3}{L_3} + \dots \text{etc.}}$$

N_1 = Fraction of time at operating condition 1

L_1 = Life expectancy at operating condition 1

Let's assume an example application 1609 HP @ 680-1360 RPM operating angle is 3 degrees of misalignment. #260D MAXXUS Driveshaft.

Torque lb-in.	Speed RPM	Expect Time %	Cal B ₁₀ Hours
149,147	680	50%	9,578
99,431	1020	25%	20,949
74,573	1360	25%	36,502

Expected B-10 Life

$$L_e = \frac{1}{\frac{N_1}{L_1} + \frac{N_2}{L_2} + \frac{N_3}{L_3}}$$

If the duty cycle is not known, the normal expected B10 life will be calculated assuming the following duty cycle.

Torque lb-in.	Speed RPM	Expect Time %
Maximum	Minimum	33.3%
Average	Average	33.3%
Minimum	Maximum	33.3%

Lets assume the example application above (#260D MAXXUS) 1609 HP @ 680-1360 RPM operating angle is 3 degrees of misalignment.

Torque lb-in.	Speed RPM	Expect Time %	Cal B ₁₀ Hours
149,147	680	33.3%	9,578
99,431	1020	33.3%	20,949
74,573	1360	33.3%	36,502

Note: The calculated expected bearing life hours (B_{10}) should be at least 5000 hours

KOP-FLEX uses specialized computer programs that will select a universal joint custom-designed to suit your application.

Suggested Selection Factor (SF)

APPLICATION	Suggested Selection Factors	
	SF _e	SF _y
Auxiliary Mill Equipment: Coilers, Levelers, Pinch Rolls, Tinning Lines, Pickle Lines Wire, Small Bar & Rod Mills: All Stands. Medium Bar & Section Mills: Finishing Stands.	1.5	2.5
Cold Mills: Non-Reversing. Medium Bar & Section Mills: Roughing Stands. Large Bar & Section Mills: Finishing Stands.	1.75	3.0
Hot Strip Mills: Non-Reversing Finishing Stands. Cold Mills: Reversing. Large Bar & Section Mills: Non-Reversing Roughing Stands.	2.0	4.0
Hot Strip Mills: Non-Reversing Roughing Stands. Edgers, Non-Reversing.	2.5	5.0
Hot Strip Mills: Reversing Roughing Stands. Large Bar & Section Mills: Reversing Roughing Stands. Edgers, Reversing. Steckel Mills.	3.0	6.0
Reversing Slab, Plate and Blooming Mills.	4.0	8.0

Note 1 — use SF_e for selection based on Endurance. Note 2 — use SF_y for selection based on Yield.

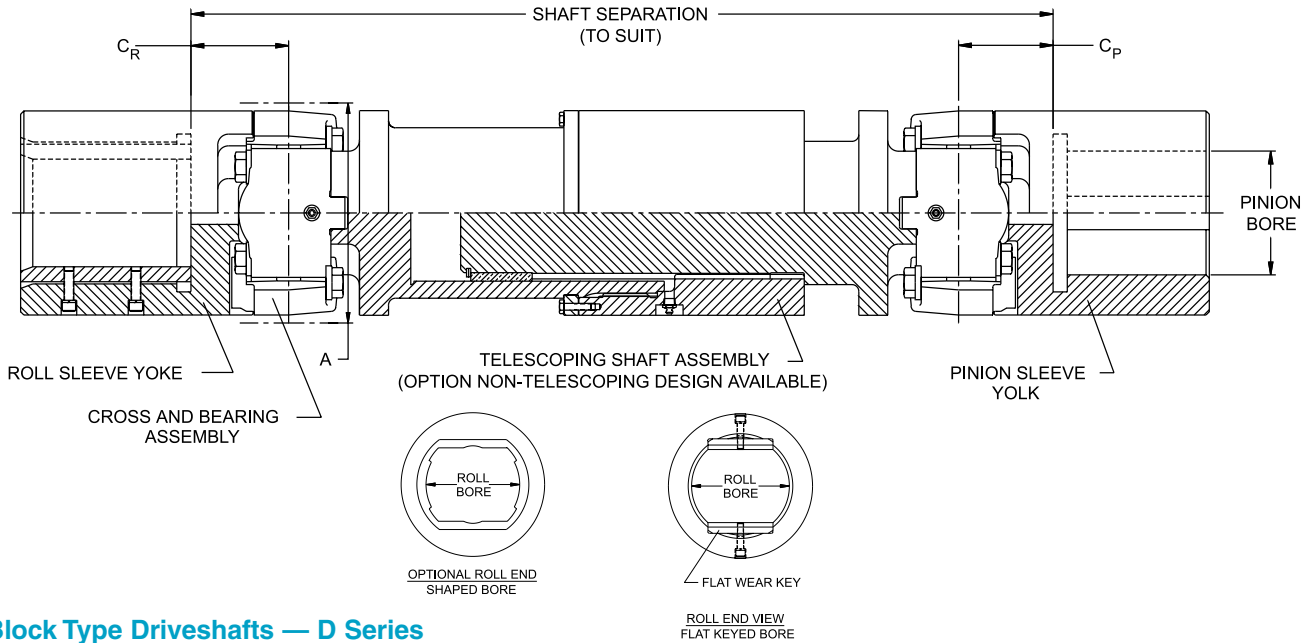
Note 3 — These selection factors are only to be used as general guide. Lower or Higher values may be acceptable based on experience. Confirm final selection with engineering.

Angle Factor (KA) Speed Factor (KS)

ROTATION SPEED		ANGLE (Degree)	
(RPM) Note 1	KS	Note 1	KA
100	2.17	3	1.00
200	1.72	4	0.91
300	1.50	5	0.84
400	1.36	6	0.79
500	1.26	7	0.75
600	1.19	8	0.71
700	1.13	9	0.69
800	1.08	10	0.66
900	1.04		
1000	1.00		
1100	0.97		
1200	0.94		
1300	0.92		
1400	0.89		
1500	0.87		

Note 1 — For speeds greater than 1500 rpm, consult KOP-FLEX.

Note 1 — For angles greater than 10 degrees, consult KOP-FLEX.



Block Type Driveshafts — D Series

Size (Swing Dia.)	Reversing Endurance Limit-T _{DR} lb-in.	Non-Rev Endurance Limit-T _{DO} lb-in.	Yield Limit-T _S lb-in.	Bearing Life K _B Factor	Operating Angle Degrees Note 1	A in.	C _R in.	C _P in.	Min. Shaft Separation in. Note 2
160D	96500	144700	301800	25000	10	6.30	3.15	3.15	26.97
190D	199100	298700	484100	47200	10	7.48	3.66	3.15	30.98
220D	312400	467300	646100	75600	10	8.66	4.33	4.33	35.04
260D	496500	744700	1230000	133600	10	10.24	4.80	5.00	40.08
300D	795700	1193000	2301000	201800	10	11.81	5.51	5.71	44.49
350D	1345000	1982000	3399000	338100	10	13.78	6.30	6.50	49.80
400D	1850000	2774000	4877000	485900	8	15.75	7.28	7.48	56.50
425D	2310000	3465000	6125000	592100	8	16.73	7.72	7.91	59.41
450D	2876000	3859000	6541000	711600	8	17.72	8.15	8.35	62.32
500D	4399000	5487000	9382000	947000	8	19.69	9.13	9.53	69.41
550D	6603000	7593000	12922000	1292000	6	21.65	9.88	10.08	73.98
600D	8506000	10797000	17967000	1726000	6	23.62	10.83	11.02	80.12
650D	10090000	13187000	22304000	2204000	6	25.59	11.46	11.85	85.39
700D	13276000	19116000	29827000	2583000	6	27.66	12.05	12.64	89.92
750D	15223000	20532000	34252000	3284000	6	29.53	13.58	13.58	97.24
800D	18498000	26285000	40359,000	3974000	6	31.50	13.98	14.76	102.95
850D	22923000	29294000	48237000	4859000	7	33.46	14.88	15.67	108.54
900D	29207000	35754000	58415000	5735000	7	35.43	15.55	16.34	113.19
950D	32482000	45047000	71426000	6594000	7	37.40	16.38	17.17	119.06
1000D	37970000	37970000	69213000	7948000	7	39.47	16.38	17.17	121.42
1100D	70452000	77349000	117715000	9736000	6	43.31	18.50	19.49	135.24
1200D	69036000	76376000	148697000	13542000	6	47.24	19.69	20.67	144.49

Note 1 - Increased misalignment capacity is available - consult KOP-FLEX.

Note 2 - For shorter shaft separation without telescoping feature - consult KOP-FLEX.

Block Type Driveshafts — U Series

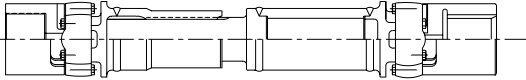
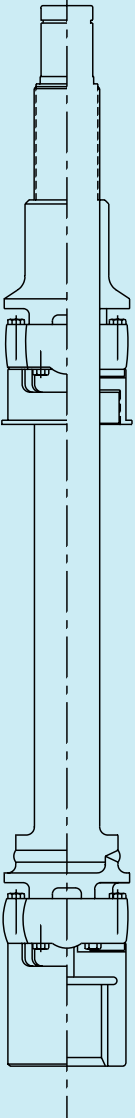
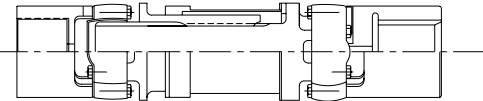
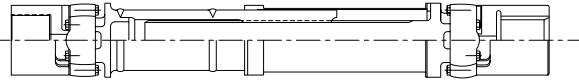
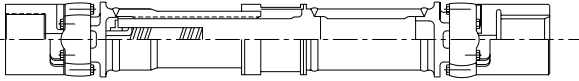
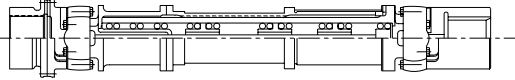
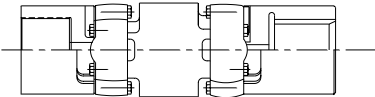
Size (Swing Dia.)	Reversing Endurance Limit-T _{DR} lb-in.	Non-Rev Endurance Limit-T _{DO} lb-in.	Yield Limit-T _S lb-in.	Bearing Life K _B Factor	Operating Angle Degrees Note 1	A in.	C _R in.	C _P in.	Min. Shaft Separation in. Note 2
285U	679000	1018000	2036000	173500	10	11.22	5.39	5.39	43.43
295U	714000	1071000	2160000	184100	10	11.61	5.71	5.71	45.08
345U	1345000	2018000	3540000	304500	10	13.58	6.50	6.50	52.95
365U	1676000	2514000	4390000	402700	10	14.37	6.69	6.89	54.33
390U	1853000	2779000	4824000	471700	10	15.35	7.09	7.09	56.69
420U	2443000	3664000	6417000	554000	10	16.54	7.52	7.52	59.80
440U	2744000	4116000	7567000	662400	8	17.32	8.15	8.35	63.90
490U	4449000	6673000	11063000	955900	8	19.29	8.94	9.33	69.02
525U	5357000	7594000	12480000	1124000	8	20.67	10.04	10.24	75.79
590U	8850000	13276000	20091000	1593000	8	23.23	9.84	10.24	80.12
640U	12508000	18764000	25844000	2018000	6	25.20	10.67	11.06	85.79
660U	12036000	18056000	26818000	2257000	6	25.98	11.30	11.89	89.29
690U	15635000	23454000	32836000	2522000	6	27.17	11.65	12.24	93.07
740U	17641000	26464000	42218000	3177000	6	29.13	12.60	13.19	96.62
840U	25725000	36730000	56680000	4346000	6	33.07	14.09	14.69	106.77

Note 1 - Increased misalignment capacity is available - consult KOP-FLEX.

Note 2 - For shorter shaft separation without telescoping feature - consult KOP-FLEX.

MAXXUS Telescoping Type Universal Driveshafts

Our D and U series driveshafts employ standardized cross bearings and are available in many types according to the driving method, telescoping stroke, shaft diameter, and shaft length. We design the most appropriate shafts according to the type of rolling mill and their operating conditions.

Telescoping Type	<p>Standard telescoping</p> <p>Most common telescoping type employed by cold mills, billet mills, bar mills, wire mills, and feed rollers.</p>		<p>Center Take-Off Type</p> <p>This shaft changes the driving route of the vertical mill, reducing the mill height providing a long service life, and facilitating roll replacement. The change of caliber becomes easier even on a horizontal mill.</p> 
	<p>Short telescoping</p> <p>This shaft is designed to be installed in a limited space and does not have a tube. The shaft is as short as possible to permit telescoping and is used wherever the swing diameter has a margin, either on the input or the output side.</p>		
	<p>Long telescoping</p> <p>This shaft is used where a long telescoping stroke is required. It is effective for a wire mill and a flying shear requiring a change of caliber.</p>		
	<p>Buffer spring type</p> <p>This shaft is equipped with a buffer spring to absorb the shock due to roll bumping during replacement of the roll and to prevent the shaft from contracting in rolling operation. It has a wide field of applications.</p>		
	<p>Preloaded spring type</p> <p>This shaft has long telescoping distance splines and is preloaded axially by a spring. It is effective for hot strip mills, cold strip mills, bar mills and wire mills.</p>		
	Fixed Type	<p>Tube type</p> <p>This shaft is used for a drive line requiring no telescoping and accommodates slight telescoping motion on the inside of the oval bore yoke.</p>	
<p>Coupling yoke type</p> <p>This shaft is the shortest and is used where there is no telescoping motion. It is used to modify tandem mills.</p>			

KOP-FLEX, the worldwide leader in coupling design, manufacturing and service

For over 80 years KOP-FLEX has provided the industry's most extensive service and repair facilities in North America. Primary facilities are located in Baltimore, Toronto, and our newest operation in Nove Mesto, Slovakia. Licensed repair facilities are located in Indiana, Texas and California. Each location houses state-of-the art equipment to provide a complete and thorough analysis of your repair needs.

The latest measurement equipment (CMM), inspection tools, non-destructive testing (MPI, Dye-Penetrant, X-Ray), balancing equipment, welding machines, and modern CNC machining centers can address needed repairs, with access to one of the largest engineering staffs in the industry. A dedicated service center team comprised of experienced engineers, customer service representatives, repair coordinators, and functional area experts is available to handle your repair needs.



Custom-Tailored Inventory and Maintenance Management Program Saves Money and Prevents Downtime

Are you currently spending too much money on spare parts inventory?

Is parts storage a hassle?

KOP-FLEX will inventory your spindle, coupling and universal joint stock and develop a usage profile.

KOP-FLEX will work with your staff to develop a usage profile and then we'll inventory parts appropriate to maximizing plant performance. Spindles, couplings and universal joints can then be shipped from our facility to you within 12 to 24 hours. You benefit via added convenience and reduced inventory investment.

KOP-FLEX not only repairs and refurbishes but offers a special program to enable peak plant efficiency:

- Company representatives will meet with you to understand your needs and your current inventory of gear spindles and heavy duty couplings
- A usage profile is developed
- Safety levels for components are established
- KOP-FLEX will inventory components vital to your operations, eliminating the initial capital expenditure and the cost associated with carrying inventory
 - Inventory is managed on an ongoing basis for a nominal fee
 - Regular review of your stock will help you reach your desired inventory levels

Look to KOP-FLEX, the industry leader in couplings, to keep your plant running smoothly and efficiently. Call one of our representatives today about designing a custom program for you.



Let an expert provide you with both an analysis and a recommendation

Unfortunately, no mechanical product can last forever and couplings are no exception. While KOP-FLEX products are designed and built to last, many applications are so severe that rapid wear and/or coupling damage may occur. KOP-FLEX has the largest and most experienced engineering staff in the industry, with an arsenal of modern analysis tools at our disposal including FEA, an in-house R&D center, and a staff focused solely on couplings. Let our technical experts go beyond mere failure analysis by providing our recommendations on how to prevent future coupling problems.



HIGH PERFORMANCE COUPLINGS

KOP-FLEX®

HIGH PERFORMANCE DISC COUPLINGS...

Available In Four Standard Styles...

Designed And Manufactured To Meet API 671 As Standard

These couplings are engineered to accommodate a broad range of demanding operating conditions: boiler feed pumps, centrifugal and axial compressors, generator sets, test stands, gas and steam turbines, marine drives, etc.

The HP disc coupling is the preferred choice for demanding turbomachinery applications. Superior quality, and a wide variety of standard and custom designs backed by unsurpassed engineering expertise make KOP-FLEX the industry leader.

- Inherent fail-safe designs
- KOPLON* coated flexible disc elements for maximum life
- Factory assembled
- Greatest reduced moment available
- Dynamically balanced

High Performance Flexible Diaphragm Couplings

The patented Flexible Diaphragm Coupling from KOP-FLEX® brand couplings transmits torque from the driving shaft via a rigid hub, then through a flexible diaphragm to a spacer. The diaphragm deforms while transmitting this torque to accommodate misalignment. The spacer in turn drives matching components attached to the driven equipment. Outstanding design features include:

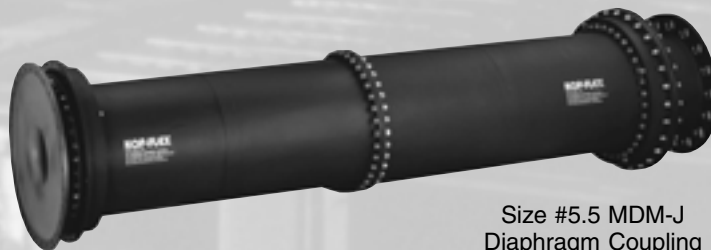
- Field-replaceable stockable diaphragms
- Specially-contoured one-piece diaphragm design
- Patented diaphragm shape
- Piloted fits
- Diaphragms are 15.5 PH shot-peened stainless steel
- Inherently low windage design
- Conforms to API 671 specifications

High Performance Gear Couplings

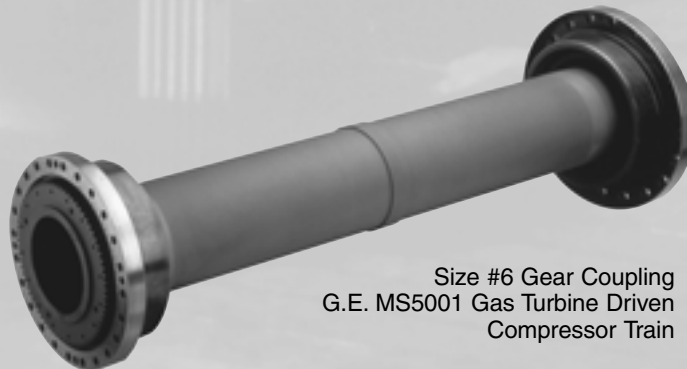
- Thousands in service
- Choose from straight or crowned nitrided gear teeth, depending on your application
- Precision lapped teeth, if required
- Heat-treated alloy components



Reduced Moment
High Performance Disc Coupling



Size #5.5 MDM-J
Diaphragm Coupling



Size #6 Gear Coupling
G.E. MS5001 Gas Turbine Driven
Compressor Train

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