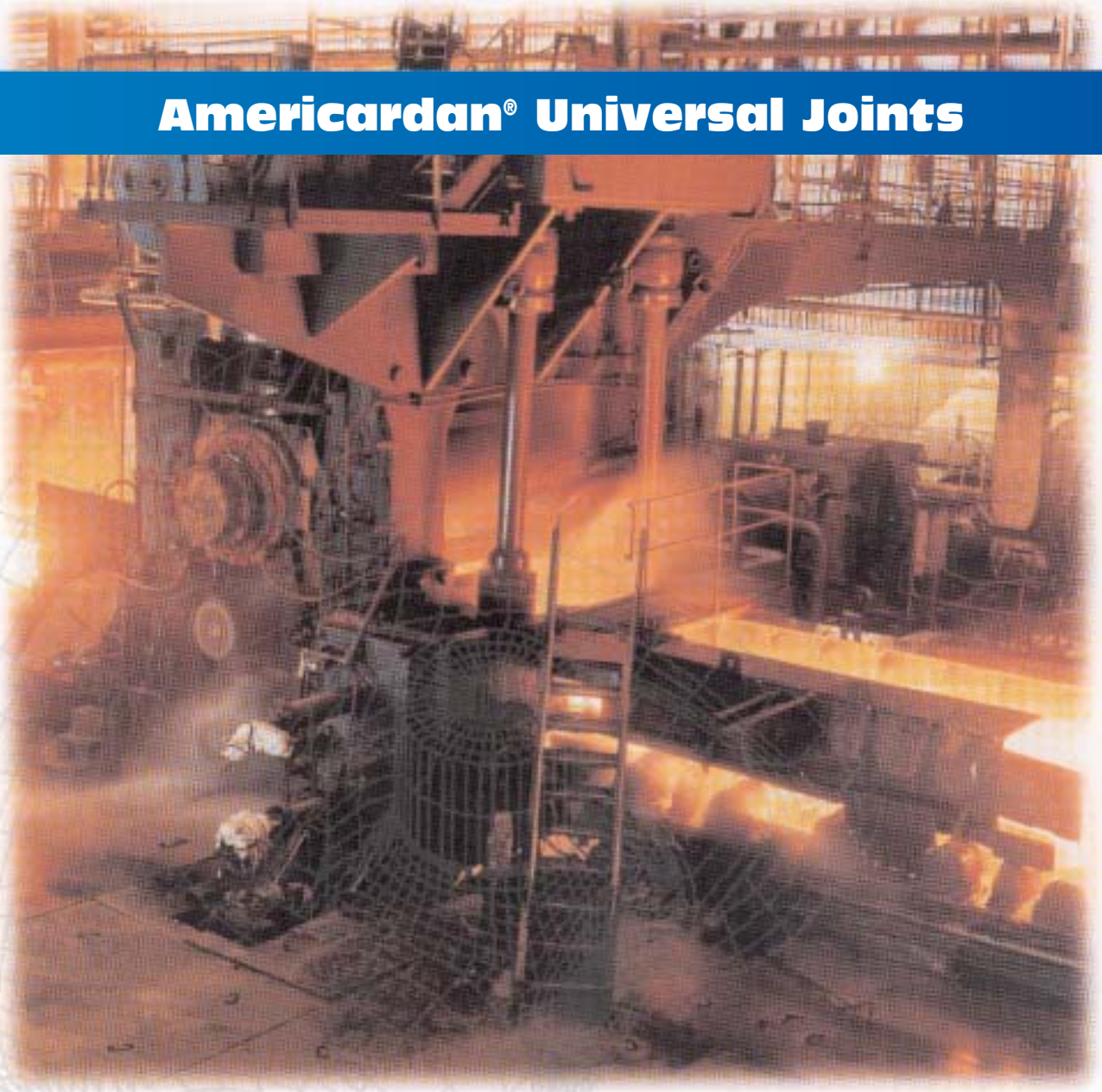
Americardan® Universal Joints



Ameridrives Couplings

The Power of Experience

Universal Joints

The Ameridrives Universal Joint

Ameridrives International, formerly Zurn Industries, Inc., a leader in power transmission equipment for over 60 years, offers a complete line of universal joints.

The universal joint is considered to be one of the oldest of all flexible couplings. It is commonly known for its use on automobiles and trucks. A universal joint in its simplest form consists of two shaft yokes at right angles to each other and a four point cross which connects the yokes. The cross rides inside the bearing cap assemblies, which are pressed into the yoke eyes.

Industrial applications operate continuously and with high torque loads. This demands maximum strength and long life of the universal joint components. The modern universal joint has become much more complex than its simple ancestor. The universal joints manufactured by Ameridrives International are made for demanding industrial applications.

Universal joints have several unique features that make them ideal for a variety of applications. Most significant is the ability of the universal joint to operate at high misalignment angles. Operating angles up to 15 degrees are not uncommon.

Another feature of the universal joint is the bearing and seal design that resists lubrication loss and contamination. This makes Ameridrives Universal Joints suitable for applications where severe atmospheric conditions would put other couplings at a distinct disadvantage.

When compared to other high misalignment couplings, universal joints operate with negligible backlash or radial clearance. The difference can be significant on applications where backlash is critical.

Ameridrives Universal Joint yokes are precisely engineered using the latest design technologies. They are manufactured as a one-piece, closed bearing eye design, assuring the highest degree of strength and minimum distortion under load.

The cross design is even more important and has received careful consideration through extensive computer analysis to match the strength characteristics of the yoke.

Yokes and crosses are both precision machined from heat treated alloy steels. They are assembled with minimum clearance bearing units using the latest in roller bearing technology including crowned rollers that minimize friction and provide long life.

The universal joint can be used as a single joint or it can be used in pairs. When used as a single joint, only angular misalignment is accommodated. Since nearly every installation requires the coupling to also accommodate offset misalignment, universal joints should be used in pairs. Using universal joints in pairs also corrects for non-uniform angular velocity caused by the rotational characteristics of a single joint.

Table of Contents

Page

Advantages and Features
Typical Applications

Advantages and Features

- *Domestic manufacture*
- *High torque capacity*
- *Long bearing life*
- *High operating angle capacity*
- *One piece yoke and bearing housing construction*
- *Eliminates unnecessary bolted connections and serrations in yokes*
- *Heat treated alloy steel components*
- *Ideal loading across entire bearing length due to balanced deflection between yokes and cross*
- *Replaceable inner bearing race on size U3440 and larger significantly reducing cross-maintenance expenses*
- *Available in four basic types*
- *Technical support and engineering services available*
- *Extensive repair facility*
- *Special sizes and designs available upon request*
- *Large sizes available*

These advantages and features of the Ameridrives Universal Joint provide for a compact design, long life and minimum maintenance.

Ameridrives International
Coupling Products

ISO 9001

AMERIDRIVES tcm COMMITTED TO TOTAL QUALITY

PTPA

MEMBER OF AGMA

Typical Applications

Following is a partial list of applications for the Ameridrives Universal Joint.

Agitators
Balancing Machines
Blowers and Fans
Compressors
Conveyors
Cooling Tower Fans
Cranes and Hoists
Crushers
Farming Equipment
Generators
Glass Manufacturing
Lumber Mills
Marine Propulsion
Mining Equipment
Oil and Gas
- Drilling
- Pumps
Packaging
Paper Mills
- Calendar Drives
- Sizing and Press Rolls
- Couch Rolls
- Process Pumps
Plastic Manufacturing
- Melt Pumps
Printing Presses
Pumps
- Irrigation
- Lift
- Sewage
Railway Drives
Rubber Processing
- Mixers
- Calendars
Shredders
Textile Equipment

Metals Industry

(Steel, Aluminum, Copper Brass)

Bar and Rod Mills
Cold Reduction
Continuous Casters
Hot Strip Mills
Levelers
Payoff Reels
- Pinch Rolls
- Coilers
- Brush Rolls
- Bridles
- Flatteners
- Slitters
Pipe Mills
Runout Tables
- Piercers
- Transfer Cars
- Structural Mills
Scale Breakers
Shears
Side Trimmers
Straighteners
Temper Mills
Tension Reels
Tube Mills
Vertical Edgers
Wire Mills

Construction

Yoke Assembly and Bearing Design

Basic Designs

The Ameridrives Universal Joint is available in seven basic designs:

2000 Series: *Yoke assembly parts furnished by domestic manufacturers.*

Sizes U2131-U2155: *Needle bearing design. Bearing caps are retained by snap rings.*

Sizes U2160-U2180: *Needles bearing design. Bearing caps are retained by bolts.*

Sizes U2190: *Uses two rows of roller bearings. Bearing caps are retained by snap rings. Lube fitting in center of cross.*

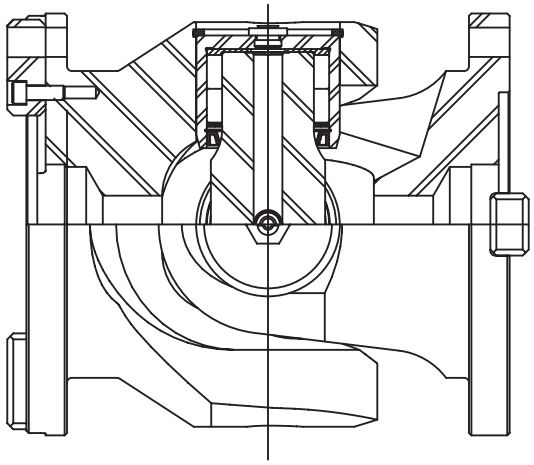
3000 Series:

Sizes U3055-U3100: *Needle bearing design. Lube fitting in center of cross.*

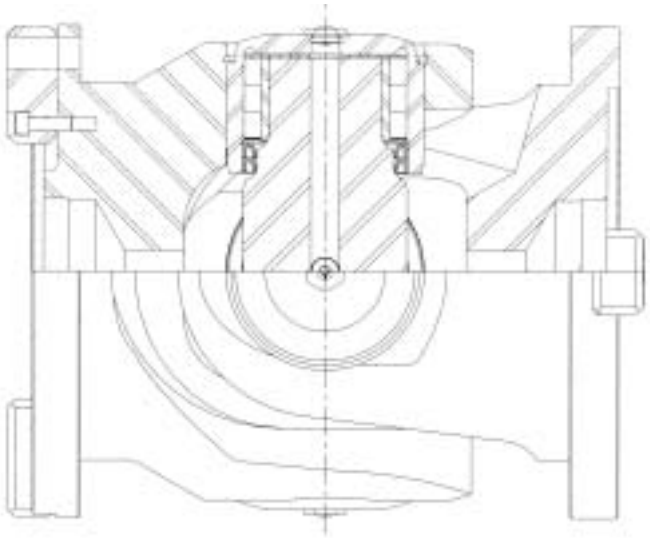
Sizes U3115-U3200: *Uses two rows of roller bearings. Bearing caps are retained by snap rings. Lube fitting in center of cross.*

Sizes U3225: *Uses two rows of roller bearings. Bearing caps are retained by snap rings. Lube fittings in center of cross is standard. Lube fittings in each bearing cap is optional.*

Sizes U3440-U3920: *Uses three or more rows of roller bearings. Includes replaceable inner races in the bearing assemblies. Bearing caps are retained by large snap rings. Lube fittings are in each bearing cap.*



SIZES U3180-U3390



SIZES U3440-U3920

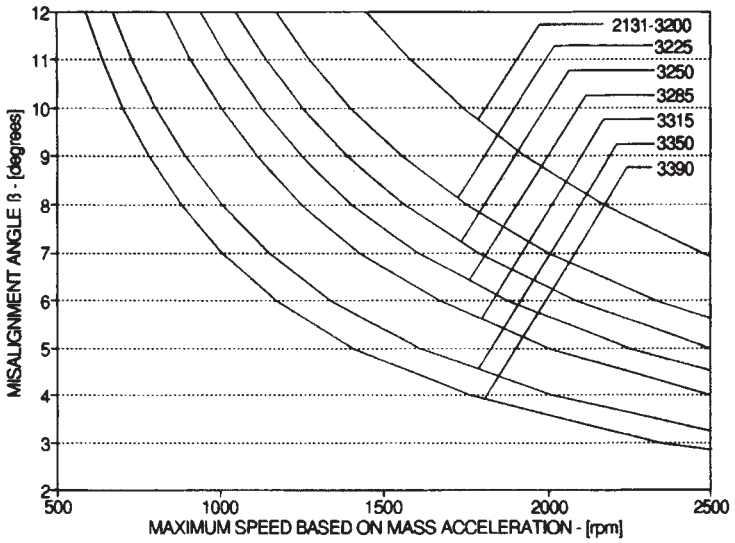
Selection Information and Speed Limits

I. Speed Limit Based on Limits of Mass Acceleration

When universal joints are operated at any angle greater than zero, the center section of the universal joint always runs irregularly, being accelerated and decelerated twice in every revolution. The maximum values of mass acceleration torque arising here are dependent on the operating speed and angle of deviation ß and upon the moment of inertia of the center shaft section [RPM x ß].

To ensure smooth running of the universal joint, especially at idling speed, the mass acceleration torque must not be allowed to exceed the limits shown in Table 1.

Table 1



II. Speed Limit Based on Lateral Critical Speed

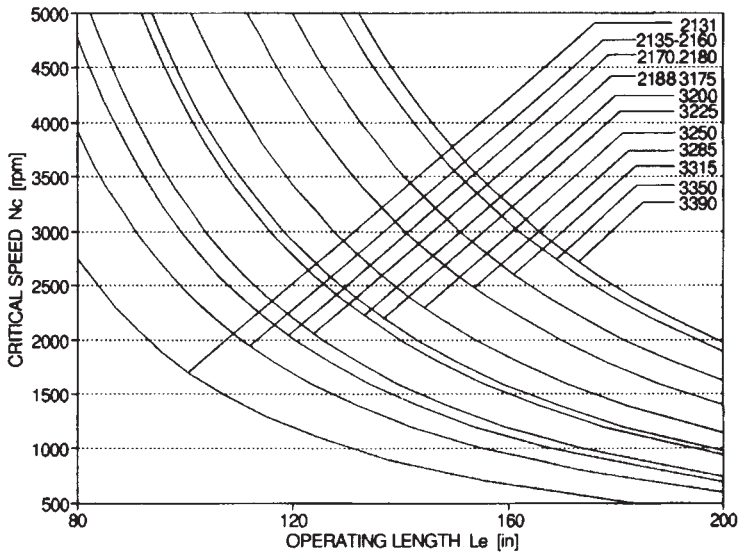
In applications where long lengths of shafts are required, the speed is restricted by the lateral critical speed of the center section. This speed is a function of the center tube diameter wall thickness, and the effective length. The maximum operating speed must be less than the lateral critical speed Nc shown in Table 2.

NOTE: Allowable Operating Speed = Nc x .75.

In many applications, operating at 1/2 critical speed will also create unacceptable vibration. For these applications the operating speed should be 8% above or below 50% of the maximum indicated.

For flange-to-flange lengths greater than shown, or if allowable speed is exceeded, contact Ameridrives International.

Table 2



III. Balancing

All standard universal joints under 300 RPM are supplied unbalanced. Between 300-850 RPM they are balanced, if required. Consult factory for further information. Over 850 RPM all universal joints are normally supplied balanced. Please consult the factory for special balancing requirements.

The speed limits on this page are only a guide. The actual limits are determined by the characteristics of the system in which the universal joint is installed.

Selection Procedure

See pages 26-27 for Application Data sheets for easy selection.

Four types of torque ratings are given for each joint size.

Endurance Torque (Te) *is the normal rating for fully reversing torque based on material strength.*

One way endurance torque (Tow) *is the normal rating for pulsating one way torque based on material strength.*

Life Torque (T_L) *is the bearing life rating of the universal joint. This torque is based on the B-10 life of the universal joint bearings. The life torque values listed are based on 5000 hours B-10 bearing life at 3º misalignment and 100 RPM. B-10 life is defined as the minimum life expectancy for a 90% probability of survival. Typically the average actual operating life of the bearings is 5X the calculated B-10 life.*

Peak Torque (Tp) *is the maximum allowable torque based on the yield strength capacity of the joint.*

The torque ratings are based on material strength. When approaching these limits the capacity of the desired flange connection should be verified. When the selection torque ***(Ts)*** *approaches the endurance torque* ***(Te)*** *or when the maximum torque approaches the peak torque capacity* ***(Tp)*** *of the universal joint, integral face pads are recommended. The number of pads and bolts are customized on a per application basis. Hirth radial teeth are also available on a per application basis.*

Universal Joint Selection

I. *Calculate application torque* ***(Ta)*** *and selection torque* ***(Ts)****.*

$$Ta = \frac{HP(63025)}{N}$$

N = *Speed (RPM)*

Ts = *Selection Torque =* ***Ta*** *x Service Factor (Table 3)*

Ts *must be less than* ***Te*** *for reversing torque applications or* ***Tow*** *for one way pulsating torque applications.*

II. *Check to see if life is sufficient*

$$Lh = \frac{1.5 \times 10^6}{A \times N}\left[\frac{TL}{Ta}\right]^{\frac{10}{3}}$$

Where:

Lh = *B-10 life in hours*

A = *operating angle in degrees*

N = *speed (RPM)*

TL = *life torque*

Ta = *application torque*

III. *Duty Cycle: In applications where the torque, speed and operating angle vary predictably during a typical load cycle or operational sequence, a duty cycle can be determined. First the load cycle must be analyzed and divided into groups of fixed combinations of torque, speed and operating angle. These groups represent percentages of the total operating time of the load cycle. Life expectancy can then be calculated using Miner's Theory, which takes into account the cumulative effect resulting from operating at varying conditions.*

The total life expectancy can be calculated using the following equation:

$$\text{Total Life Expectancy} = \frac{1}{\frac{N_1}{L_1} + \frac{N_2}{L_2} + \frac{N_3}{L_3} + \cdots + \frac{N_m}{L_m}}$$

Where:

N_1 = *fraction of total, time at operating condition 1*

L_1 = *life expectancy at operating condition 1 (hours)*

m = *total number of operating conditions*

IV. *Determine Peak Torque conditions.* ***Tp*** *must exceed the maximum operating torque.*

V. *Other considerations:*
There are many other items that can determine the size of a universal joint.

These include:

1. *Diameter and length limitations*
2. *Bore size (see page 19)*
3. *Equipment restrictions on forces and moments*
4. *Speed limits (see Tables 1 and 2)*
   a. *due to mass acceleration as a function of misalignment*
   b. *critical speed of center shaft*

Telescopic splines are available on ST and FT designs. The splines are required for angular misalignment unless one of the universal joint adapters has a clearance fit to the connected equipment. A clearance or slip fit allows the roll end to pull out under misalignment. The amount of roll end pull out can be calculated by multiplying the centerline to centerline of the universal joint yokes by 1 minus the cosine of the operating angle.

Nitrided or coated splines are available on request.

Longer or shorter travel is available. Consult Ameridrives International.

Axial travel of the telescopic spline on ST and FT designs under torque results in axial forces being applied to the support bearings. These forces are a function of the spline coefficient of function, operating torque, operating angle, and spline pitch diameter per the following formula.

$$F_{axial} = \frac{2T(\mu)(\cos ß)}{PD}$$

F axial = *Axial Force*
T = *Operating Torque*
μ = *Coefficient of Friction (.11 to .15 for lubricated steel on steel, contact Ameridrives for other coatings)*
ß = *Operating Angle (degrees)*
PD = *Spline Pitch Diameter*

If you have unusual conditions, please supply details with your inquiry. *See pages 26-27 for required Selection Data.*

Example:
One way cold mill with a 1800 HP motor at 400 RPM and a 2:1 reducer ratio with a 50% torque split requires two universal joints to operate at the following conditions:

900 HP per universal joint
200 RPM
3º Misalignment
1.5 Service Factor
12.5" Maximum O.D.
8.25" Bores
53" Shaft Separation
250% Peak Torque Factor

Table 3: Service Factors

LOAD	DRIVEN EQUIPMENT	CONTINUOUS NON-REVERSING DRIVERS MOTORS TURBINES	REVERSING DRIVERS D.C. MOTORS RECIPROCATING ENGINES
CONSTANT TORQUE	Generating Centrifugal Pumps Conveyors	1.00	1.50
	Continuous Caster Light Fans		
LIGHT SHOCK	Machine Tools Woodworking Machinery Paper Mill Equipment Bar and Rod Mills	1.25	2.00
	Compressors Pumps		
MEDIUM SHOCK	Fans Farming Equipment Cold Mills & Auxiliary Equipment Presses	1.50	2.25
	Traction & Locomotive Drives Mixers Crane Drives		
HEAVY SHOCK	Mining Equipment Rapid Transit Drives Hot Rolling Mill Drives Runout Tables Feed Roll Drives	2.00	3.00
VERY HEAVY SHOCK	Ore Crushers Scale Breakers Feed Roll Drives	3.00	5.00

Step I: Calculate Application Torque

$$Ta = \frac{900\ HP \times 63{,}025}{200\ RPM} = 283{,}610\ in.\text{-}lbs.$$

$$TS = 283{,}610 in.\text{-}lbs. \times 1.5 = 425{,}420\ in.lbs.$$

Preliminary Selection: U3285
(Tow = 621,300 in.lbs.)

Step II: Check Life

$$Lh = \left(\frac{1.5 \times 10^6}{3 \times 200}\right)\left(\frac{364{,}400}{283{,}610}\right)^{\frac{10}{3}} = 5{,}765\ hr.\ B\text{-}10\ life$$

Step III: Duty Cycle – not applicable

Step IV: Peak Torque
283,610 in.-lbs. x 2.5 = 709,025 in.-lbs.

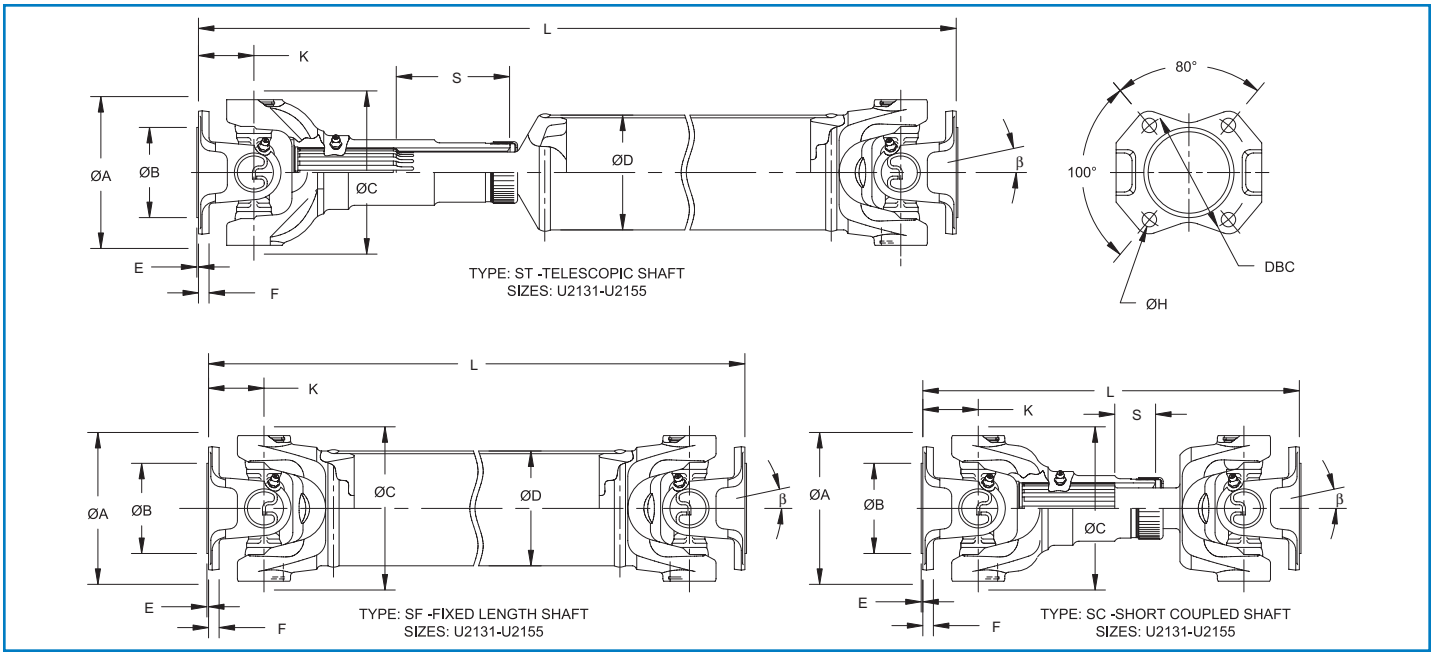
Step V: Check diameter limits, bore size, and speed limits

Selection: U3285ST with 12.38" O.D. design 2 flange adapters

It is important and necessary to understand the operational characteristics of universal joints before making a selection. *See pages 22 and 23.*
If you have any questions about your application, please contact Ameridrives International.

Engineering Data

Series 2000 Sizes U2131-U2155

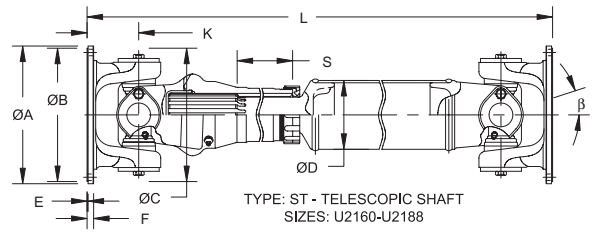


Series	U2131		U2135		U2141		U2148		U2155	
Torque Ratings										
	in-lb	Nm	in-lb	Nm	in-lb	Nm	in-lb	Nm	in-lb	Nm
Te	6,150	695	9,105	1,029	10,950	1,237	14,250	1,610	17,745	2,005
Tow	6,150	695	9,105	1,029	10,950	1,237	14,250	1,610	17,745	2,005
Tl	4,920	556	7,280	823	8,760	990	11,400	1,288	14,200	1,605
Tp	19,200	2,170	27,120	3,064	32,400	3,661	39,960	4,515	52,800	5,966
Dimensional Data (inches and millimeters except where noted										
ß	20°		20°		20°		22°		22°	
ß (SC)	15°		8°		8°		8°		5°	
	in	mm	in	mm	in	mm	in	mm	in	mm
A	3.88	98.6	4.62	117.3	4.62	117.3	5.88	149.4	5.88	149.4
B	2.38	60.5	2.75	69.8	2.75	69.8	3.75	95.2	3.75	95.2
C	3.75	95.2	4.25	108.0	4.69	119.1	4.81	122.2	5.63	143.0
D[1]	2.50	63.5	3.00	76.2	3.50	88.9	3.50	88.9	3.50	88.9
E	0.06	1.5	0.06	1.5	0.06	1.5	0.06	1.5	0.06	1.5
F	0.38	9.7	0.38	9.7	0.38	9.7	0.44	11.2	0.38	9.7
K	1.38	35.1	1.56	39.6	1.69	42.9	2.00	50.8	2.00	50.8
K (SC)	1.38	35.1	1.56	39.6	1.69	42.9	1.50	38.1	2.00	50.8
DBC	3.12	79.2	3.75	95.2	3.75	95.2	4.75	120.6	4.75	120.6
Bolt Qty.	4	4	4	4	4	4	4	4	4	4
H	0.38	9.7	0.44	11.2	0.44	11.2	0.50	12.7	0.50	12.7
Length L[2] / Length Compensation S										
	in	mm	in	mm	in	mm	in	mm	in	mm
ST L	13.00	330.2	14.88	378.0	14.13	358.9	15.25	387.4	15.38	390.7
S	3.06	77.7	3.62	91.9	3.47	88.1	2.50	63.5	2.50	63.5
SF L	7.67	194.8	8.59	218.2	9.03	229.4	10.03	254.8	10.80	274.3
SC L	8.88	225.6	9.50	241.3	9.50	241.3	8.50	215.9	9.75	247.7
S	1.25	31.8	0.75	19.1	0.75	19.1	1.00	25.4	1.00	25.4

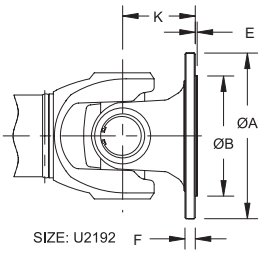
1) Special tube diameters available upon request
2) L is minimum for ST and SF design
Longer/shorter length compensation available upon request.
Popular flange yoke configurations shown, special designs available upon request

Engineering Data

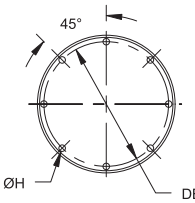
Series 2000 Sizes 2160-2192



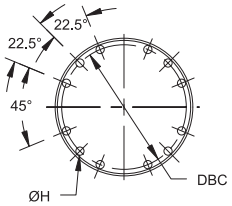
TYPE: ST - TELESCOPIC SHAFT
SIZES: U2160-U2188



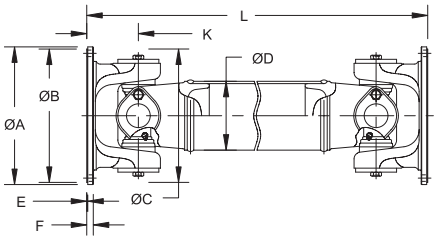
SIZE: U2192



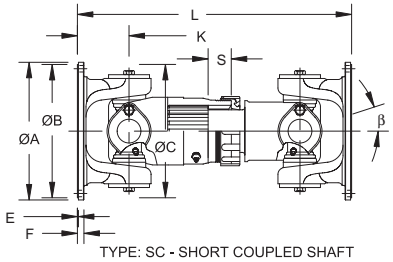
SIZES: U2160-U2170



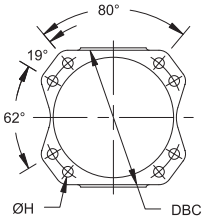
SIZE: U2180



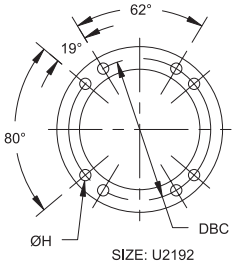
TYPE: SF - FIXED LENGTH SHAFT
SIZES: U2160-U2188



TYPE: SC - SHORT COUPLED SHAFT
SIZES: U2160-U2188



SIZE: U2188



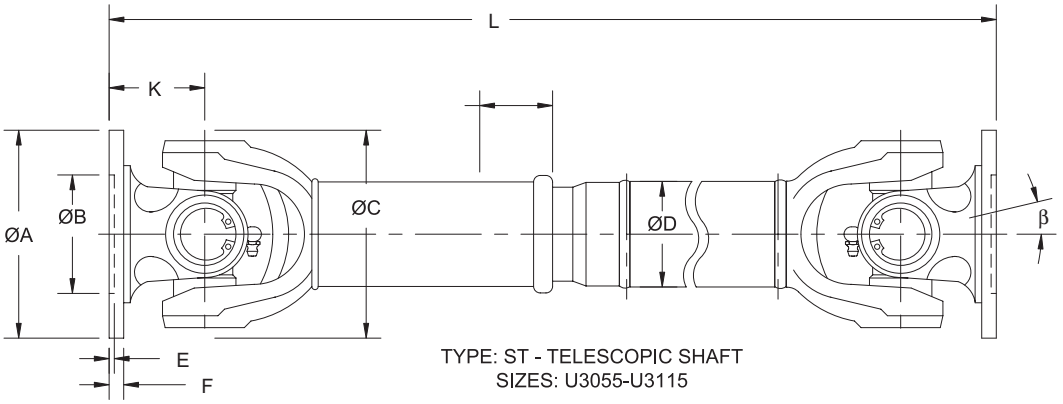
SIZE: U2192

Series	U2160		U2170		U2180		U2188		U2192	
Torque Ratings										
	in-lb	Nm	in-lb	Nm	in-lb	Nm	in-lb	Nm	in-lb	Nm
Te	30,000	3,390	45,000	5,085	57,000	6,441	75,000	8,475	133,100	15,040
Tow	30,000	3,390	45,000	5,085	57,000	6,441	75,000	8,475	199,650	22,559
TI	24,000	2,712	36,000	4,068	45,600	5,153	60,000	6,780	124,100	14,023
Tp	78,000	8,814	96,000	10,848	144,000	16,271	192,000	21,695	243,300	27,492
Dimensional Data (inches and millimeters except where noted)										
ß	26°		22°		30°		22°		25°	
ß (SC)	8°		8°		12°		8°		25°	
	in	mm	in	mm	in	mm	in	mm	in	mm
A	6.88	174.8	8.00	203.2	8.00	203.2	9.63	244.6	9.63	244.6
B	6.62	168.1	7.75	196.8	7.75	196.8	7.00	177.8	7.00	177.8
C	7.00	177.8	7.75	196.8	9.13	231.9	8.63	219.2	8.03	204.0
D[1]	3.50	88.9	4.00	101.6	4.50	114.3	4.50	114.3	5.50	139.7
E	0.06	1.5	0.06	1.5	0.06	1.5	0.09	2.3	0.09	2.3
F	0.38	9.7	0.38	9.7	0.38	9.7	0.63	16.0	0.59	15.0
K	2.75	69.8	3.00	76.2	3.38	85.9	3.50	88.9	4.33	110.0
K (SC)	1.88	47.8	2.00	50.8	2.59	65.8	2.50	63.5	4.33	110.0
DBC	6.13	155.7	7.25	184.1	7.25	184.1	8.25	209.5	8.25	209.5
Bolt Qty.	8	8	8	8	12	12	8	8	8	8
H	0.38	9.7	0.38	9.7	0.44	11.2	0.63	16.0	0.63	16.0
Length L[2] / Length Compensation S										
	in	mm	in	mm	in	mm	in	mm	in	mm
ST L	22.94	582.7	23.44	595.4	24.80	629.9	24.81	630.2	27.56	700.0
S	4.88	124.0	3.88	98.6	3.38	85.9	3.50	88.9	2.95	74.9
SF L	13.81	350.8	14.37	365.0	16.30	414.0	19.31	490.5	21.43	544.3
SC L	9.12	231.6	10.62	269.7	13.40	340.4	13.62	345.9	21.46	545.1
S	0.75	19.1	0.75	19.1	1.12	28.4	1.00	25.4	1.58	40.1

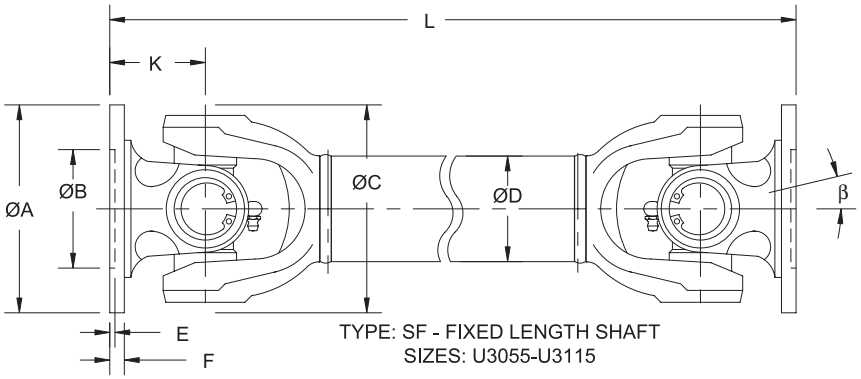
1) Special tube diameters available upon request
2) L is minimum for ST and SF design
Longer/shorter length compensation available upon request.
Popular flange yoke configurations shown, special designs available upon request

Engineering Data

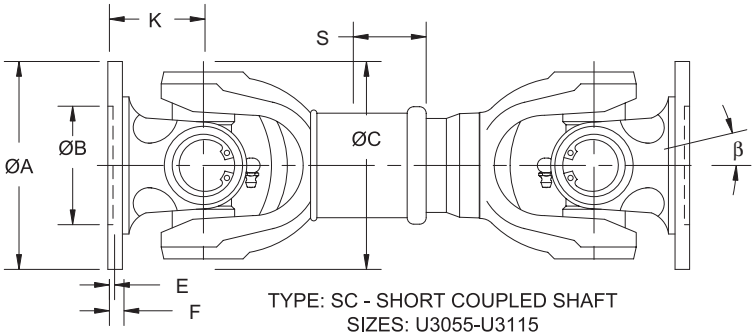
Series 3000 Sizes U3055-U3115



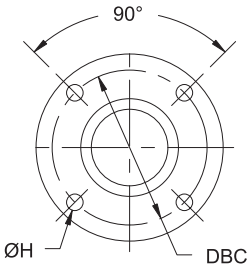
TYPE: ST - TELESCOPIC SHAFT
SIZES: U3055-U3115



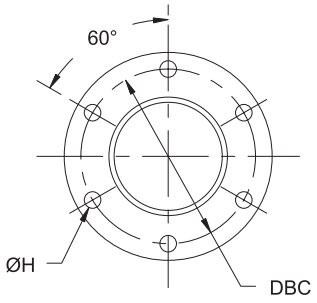
TYPE: SF - FIXED LENGTH SHAFT
SIZES: U3055-U3115



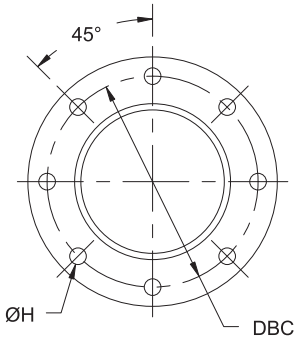
TYPE: SC - SHORT COUPLED SHAFT
SIZES: U3055-U3115



4 BOLT FLANGE DESIGN



6 BOLT FLANGE DESIGN



8 BOLT FLANGE DESIGN

Series	U3055		U3060		U3070	
Torque Ratings						
	in-lb	Nm	in-lb	Nm	in-lb	Nm
Te	1,037	117	1,382	156	2,852	322
Tow	1,556	176	2,073	234	4,278	483
Tl	1,319	149	2,053	232	3,478	393
Tp	2,333	264	3,110	351	6,417	725

Dimensional Data (inches and millimeters except where noted)

	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
ß	30°		25°		30°		20°		30°		18°	
A	2.28	58	2.56	65	2.56	65	2.95	75	2.95	75	3.54	90
B	1.18	30	1.38	35	1.38	35	1.65	42	1.65	42	1.85	47
C	2.05	52	2.05	52	2.36	60	2.36	60	2.76	70	2.76	70
D[1]	1.10	28	1.10	28	1.26	32	1.26	32	1.57	40	1.57	40
E	0.06	1.5	0.07	1.7	0.07	1.7	0.09	2.2	0.09	2.2	0.10	2.5
F	0.14	3.5	0.16	4	0.16	4	0.22	5.5	0.22	5.5	0.24	6
K	1.18	30	1.18	30	1.26	32	1.26	32	1.42	36	1.42	36
DBC	1.85	47	2.05	52	2.05	52	2.44	62	2.44	62	2.93	74.5
Bolt Qty.	4	4	4	4	4	4	6	6	6	6	4	4
H	0.20	5	0.24	6	0.24	6	0.24	6	0.24	6	0.31	8

Length L[2] / Length Compensation S

	in	mm	in	mm	in	mm
ST L/S	10.55 / 1.57	268 /40	11.42 / 2.36	290 / 60	11.81 / 1.38	300 / 35
SF L	6.30	160	6.50	165	7.87	200
SC L/S	6.50 / .79	165 / 20	7.09 / .79	180 / 20	7.87 / .98	200 / 25
SC L/S	6.89 / .98	175 / 25	7.87 / 1.18	200 / 30	8.86 / 1.38	225 / 35
SC L/S	7.68 / .98	195 / 25	8.86 / 1.18	220 / 30	9.84 / 1.38	250 / 35
SC L/S	8.46 / .98	215 / 25	9.25 / 1.18	235 / 30	10.63 / 1.38	270 / 35

Series	U3090		U3100		U3115	
Torque Ratings						
	in-lb	Nm	in-lb	Nm	in-lb	Nm
Te	4,593	519	6,483	733	11,543	1,304
Tow	6,890	779	9,725	1,099	17,315	1,957
Tl	5,682	642	9,080	1,026	16,381	1,851
Tp	10,334	1,168	14,587	1,648	25,972	2,935

Dimensional Data (inches and millimeters except where noted)

	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
ß	20°		18°		20°		18°		20°		18°	
A	3.54	90	3.94	100	3.94	100	4.72	120	4.72	120	5.91	150
B	1.85	47	2.24	57	2.24	57	2.95	75	2.95	75	3.54	90
C	3.39	86	3.39	86	3.86	98	3.86	98	4.53	115	4.53	115
D[1]	2.00	50	2.00	50	2.00	50	2.00	50	2.36	60	2.36	60
E	0.10	2.5	0.10	2.5	0.10	2.5	0.10	2.5	0.10	2.5	0.12	3
F	0.24	6	0.28	7	0.28	7	0.31	8	0.31	8	0.35	9
K	1.65	42	1.65	42	1.81	46	1.81	46	2.36	60	2.36	60
DBC	2.93	74.5	3.31	84	3.31	84	4.00	101.5	4.00	101.5	5.12	130
Bolt Qty.	4	4	6	6	6	6	8	8	8	8	8	8
H	0.31	8	0.31	8	0.31	8	0.31	8	0.31	8	0.39	10

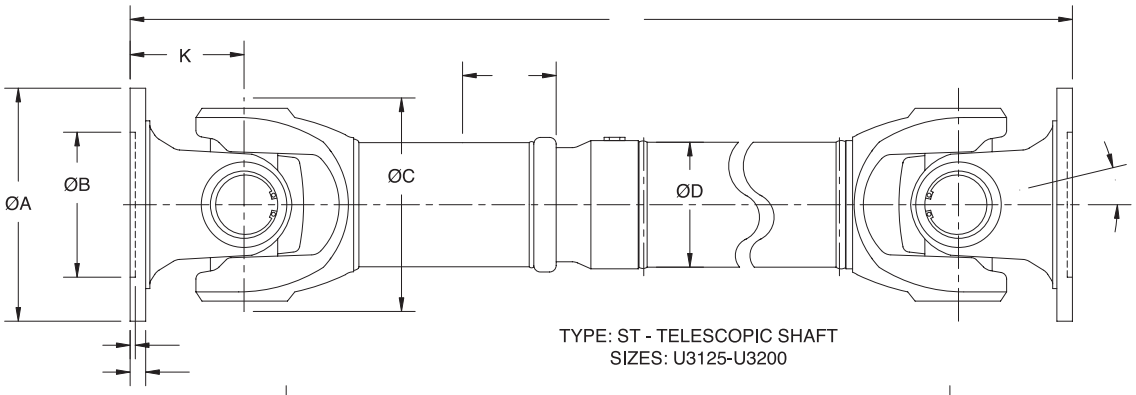
Mininum Length L[2] / Length Compensation S

	in	mm	in	mm	in	mm
ST L/S	13.70 / 1.57	348 / 40	14.72 / 1.57	374 / 40	18.6 / 2.36	473 / 60
SF L	8.50	216	9.84	250	11.85	301
SC L/S	8.86 / .98	225 / 25	10.04 / 1.18	255 / 30	12.80 / 1.38	325 / 35
SC L/S	9.84 / 1.57	250 / 40	11.02 / 1.57	280 / 40	14.17 / 1.97	360 / 50
SC L/S	11.02 / 1.57	280 / 40	12.20 / 1.57	310 / 40	15.75 / 2.36	400 / 60
SC L/S	12.20 / 1.57	310 / 40	13.38 / 1.57	340 / 40	16.93 / 2.36	430 / 60

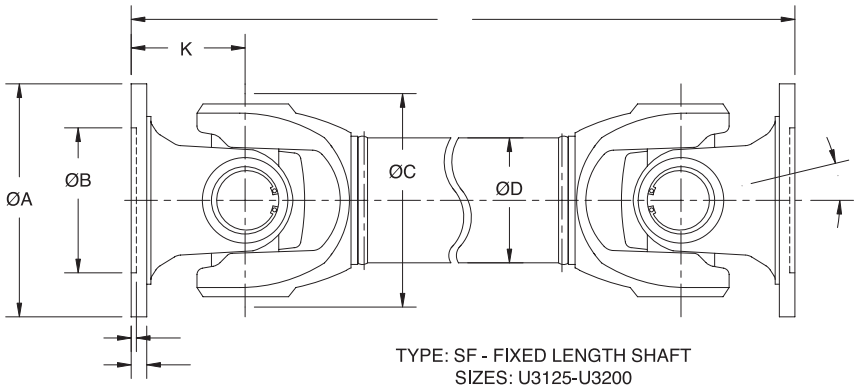
1) Special tube diameters available upon request
2) L is minimum for ST and SF design
Longer/shorter length compensation available upon request.
Popular flange yoke configurations shown, special designs available upon request

Engineering Data

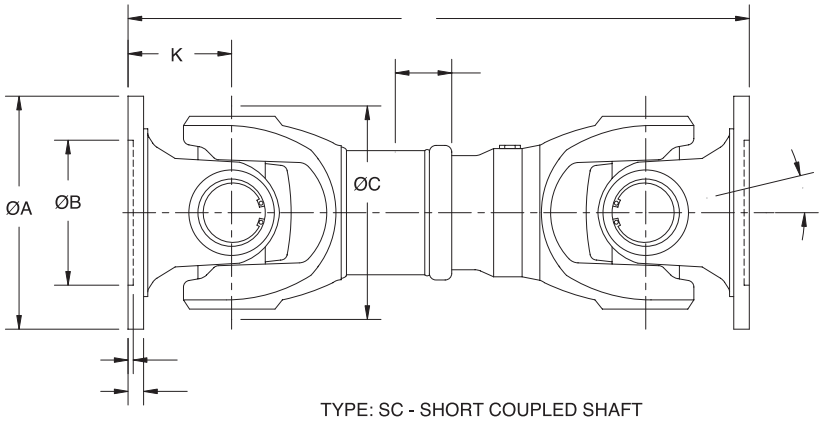
Series 3000 Sizes U3125-U3200



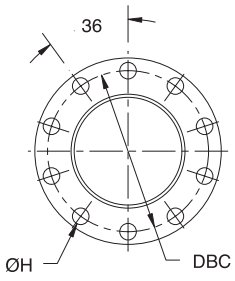
TYPE: ST - TELESCOPIC SHAFT
SIZES: U3125-U3200



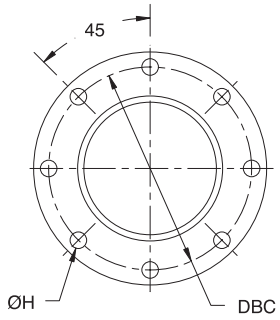
TYPE: SF - FIXED LENGTH SHAFT
SIZES: U3125-U3200



TYPE: SC - SHORT COUPLED SHAFT
SIZES: U3125-U3200



10 BOLT FLANGE DESIGN



8 BOLT FLANGE DESIGN

Series	U3125		U3140		U3155	
Torque Ratings						
	in-lb	Nm	in-lb	Nm	in-lb	Nm
Te	16,880	1,907	22,814	2,578	29,366	3,318
Tow	25,320	2,861	34,221	3,867	44,049	4,977
Tl	22,037	2,490	30,842	3,485	40,462	4,572
Tp	37,980	4,292	51,332	5,800	66,074	7,466

Dimensional Data (inches and millimeters except where noted)

	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
ß	20°		20°		20°		20°		20°		20°	
A	4.72	120	5.91	150	5.91	150	7.09	180	5.91	150	7.09	180
B	2.95	75	3.54	90	3.54	90	4.33	110	3.54	90	4.33	110
C	4.92	125	4.92	125	5.43	138	5.43	138	5.91	150	5.91	150
D [1]	2.75	70	2.75	70	3.15	80	3.15	80	3.50	90	3.50	90
E	0.10	2.5	0.12	3	0.12	3	0.14	3.6	0.12	3	0.14	3.6
F	0.35	9	0.35	9	0.39	10	0.39	10	0.47	12	0.47	12
K	2.36	60	2.36	60	2.56	65	2.56	65	2.95	75	2.95	75
DBC	4.00	101.5	5.12	130	5.12	130	6.12	155.5	5.12	130	6.12	155.5
Bolt Qty.	8	8	8	8	8	8	8	8	8	8	8	8
H	0.39	10	0.39	10	0.47	12	0.47	12	0.47	12	0.55	14

Mininum Length L[2] / Length Compensation S

		in	mm	in	mm	in	mm
ST	L/S	19.33 / 2.36	491 / 60	21.65 / 4.33	550 / 110	29.21 / 4.33	742 / 110
SF	L	12.09	307	13.58	345	17.91	455
SC	L/S	13.58 / 1.38	345 / 35	14.17 / 1.57	360 / 40	15.75 / 1.97	400 / 50
SC	L/S	14.76 / 1.97	375 / 50	15.75 / 3.15	400 / 80	18.31 / 3.15	465 / 80
SC	L/S	16.54 / 2.36	420 / 60	18.11 / 3.15	460 / 80	21.46 / 1.57 [3]	545 / 40 [3]
SC	L/S	17.72 / 2.36	450 / 60	–	–	23.03 / 3.15 [3]	585 / 80 [3]
SC	L/S	–	–	–	–	25.20 / 4.33 [3]	640 / 110 [3]

Series	U3160		U3175		U3200	
Torque Ratings						
	in-lb	Nm	in-lb	Nm	in-lb	Nm
Te	44,559	5,035	63,811	7,210	133,100	15,040
Tow	66,839	7,552	95,717	10,815	199,650	22,559
Tl	51,596	5,830	71,614	8,092	124,100	14,023
Tp	100,258	11,329	143,575	16,223	243,300	27,492

Dimensional Data (inches and millimeters except where noted)

	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
ß	30°		30°		30°		30°		30°		25°	
A	6.50	165	7.09	180	7.09	180	8.86	225	8.86	225	9.84	250
B	3.74	95	4.33	110	4.33	110	5.51	140	5.51	140	5.51	140
C	6.22	158	6.22	158	7.00	178	7.00	178	8.03	204	8.03	204
D [1]	4.00	100	4.00	100	4.38	110	4.38	110	5.50	140	5.50	140
E	0.12	3.0	0.14	3.6	0.14	3.6	0.20	5	0.20	5	0.24	6
F	0.47	12	0.47	12	0.55	14	0.59	15	0.59	15	0.71	18
K	3.39	86	3.39	86	3.78	96	3.78	96	4.33	110	4.33	110
DBC	5.51	140	6.12	155.5	6.12	155.5	7.72	196	7.72	196	8.58	218
Bolt Qty.	8	8	8	8	10	10	8	8	8	8	8	8
H	0.63	16	0.63	16	0.63	16	0.63	16	0.63	16	0.71	18

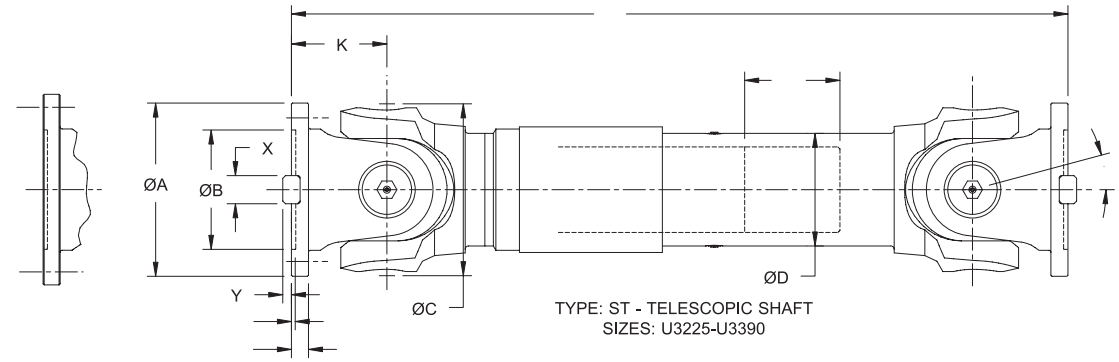
Mininum Length L[2] / Length Compensation S

		in	mm	in	mm	in	mm
ST	L/S	25.98 / 4.33	660 / 110	29.13 / 4.33	740 / 110	32.68 / 5.51	830 / 140
SF	L	16.93	430	18.31	465.00	20.47	520.00
SC	L/S	15.75 / 1.57 [3]	400 / 40 [3]	18.50 / 2.16 [3]	470 / 55 [3]	21.65 / 1.57 [3]	550 / 40 [3]
SC	L/S	17.32 / 1.97 [3]	440 / 50 [3]	19.69 / 2.36 [3]	500 / 60 [3]	23.62 / 2.17 [3]	600 / 55 [3]
SC	L/S	19.49 / 1.77	495 / 45	22.05 / 1.77	560 / 45	25.59 / 3.15	650 / 80
SC	L/S	21.85 / 3.15	555 / 80	23.62 / 2.36	600 / 60	28.35 / 4.33	720 / 110
SC	L/S	23.62 / 4.33	600 / 110	25.59 / 4.33	650 / 110	–	–

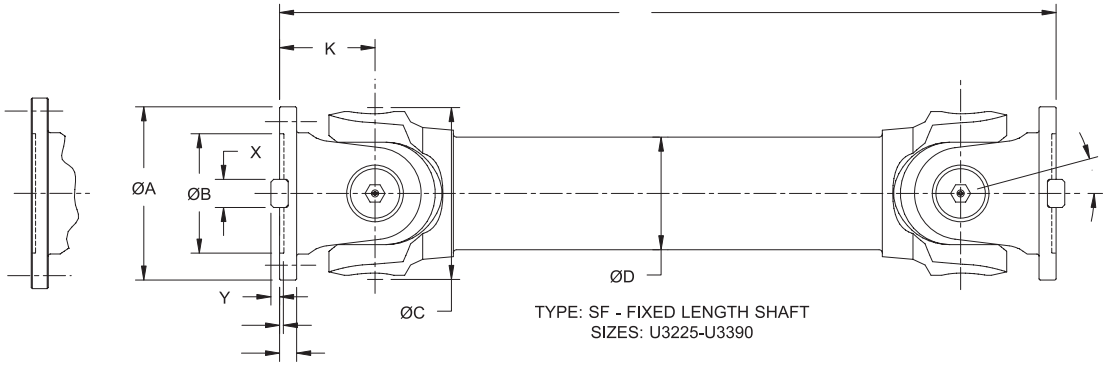
1) Special tube diameters available upon request
2) L is minimum for ST and SF design
3) Special yokes required, please consult factory.
Longer/shorter length compensation available upon request.
Popular flange yoke configurations shown, special designs available upon request

Engineering Data

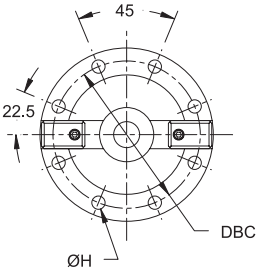
Series 3000 Sizes U3285-U3390



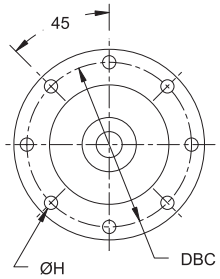
TYPE: ST - TELESCOPIC SHAFT
SIZES: U3225-U3390



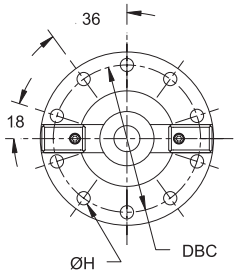
TYPE: SF - FIXED LENGTH SHAFT
SIZES: U3225-U3390



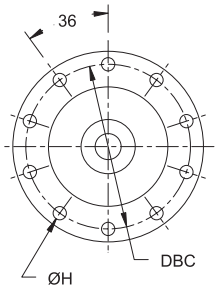
8 BOLT FLANGE DESIGN
WITH FACE KEY



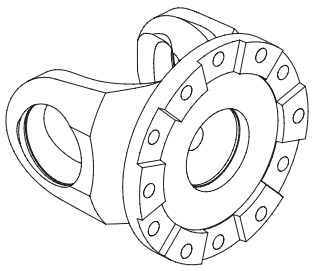
8 BOLT FLANGE DESIGN



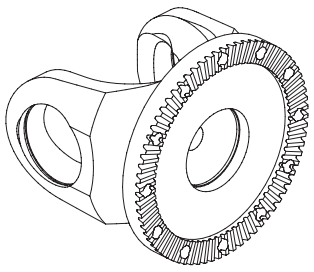
10 BOLT FLANGE DESIGN
WITH FACE KEY



10 BOLT FLANGE DESIGN



OPTIONAL FACE PAD DESIGN



OPTIONAL HIRTH RADIAL TOOTH DESIGN

Series	U3225		U3250		U3285	
Torque Ratings						
	in-lb	kNm	in-lb	kNm	in-lb	kNm
Te	233,800	26.4	265,400	30.0	414,200	46.8
Tow	350,700	39.6	398,000	45.0	621,300	70.2
Tl	170,800	19.3	248,100	28.0	364,400	41.2
Tp	464,800	52.5	538,000	60.8	862,000	97.4

Dimensional Data (inches and millimeters except where noted)

	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
ß	15°		15°		15°		15°		15°		15°	
A	8.86	225	9.84	250	9.84	250	11.22	285	11.22	285	12.40	315
B	4.13	105	5.51	140	4.13	105	6.89	175	4.92	125	6.89	175
C	8.86	225	8.86	225	9.84	250	9.84	250	11.22	285	11.22	285
D[1]	6.00	152	6.00	152	6.50	165	6.50	165	7.50	191	7.50	191
E	0.20	5	0.24	6	0.24	6	0.28	7	0.28	7	0.28	7.0
F	0.63	16	0.71	18	0.98	25	0.79	20	1.06	27	0.87	22
K	4.92	125	4.92	125	5.51	140	5.51	140	6.30	160	6.30	160
DBC	7.72	196	8.58	218	8.58	218	9.65	245	9.65	245	11.02	280.0
Bolt Qty.	8	8	8	8	8	8	8	8	8	8	8	8
H	0.63	16	0.71	18	0.75	19	0.79	20	0.83	21	0.87	22
X	1.26	32	–	–	1.57	40	–	–	1.57	40	–	–
Y	0.35	9	–	–	0.49	13	–	–	0.59	15	–	–

Mininum Length L[2] / Length Compensation S

		in	mm	in	mm	in	mm
ST	L	36.42	925	36.81	935	46.85	1190
	S	5.51	140	5.51	140	5.51	140
SF	L	22.44	570	24.61	625	28.35	720
FT	L	43.31	1100	46.06	1170	47.64	1210
	S	5.51	140	5.51	140	5.51	140
FF	L	19.69	500	22.05	560	25.20	640

Series	U3315		U3350		U3390	
Torque Ratings						
	in-lb	kNm	in-lb	kNm	in-lb	kNm
Te	661,600	74.8	979,500	110.7	1,400,000	158.2
Tow	992,300	112.1	1,469,000	166.0	2,100,000	237.3
Tl	507,400	57.3	733,800	82.9	989,500	111.8
Tp	1,348,000	152.3	2,067,000	233.6	2,750,000	310.7

Dimensional Data (inches and millimeters except where noted)

	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
ß	15°		15°		15°		15°		15°		15°	
A	12.40	315	13.78	350	13.78	350	15.35	390	15.35	390	17.13	435
B	5.12	130	8.66	220	6.10	155	9.84	250	6.69	170	11.02	280
C	12.40	315	12.40	315	13.78	350	13.78	350	15.35	390	15.35	390
D[1]	8.75	222	8.75	222	10.00	254	10.00	254	10.50	267	10.50	267
E	0.31	8	0.31	8	0.31	8	0.31	8	0.31	8	0.39	10.0
F	1.26	32	0.98	25	1.38	35	1.26	32	1.57	40	1.57	40
K	7.09	180	7.09	180	7.64	194	7.64	194	8.46	215	8.46	215
DBC	11.02	280	12.20	310	12.20	310	13.58	345	13.58	345	15.16	385.0
Bolt Qty.	10	10	10	10	10	10	10	10	10	10	10	10
H	0.91	23	0.87	22	0.91	23	0.94	24	0.98	25	1.06	27
X	1.57	40	–	–	1.97	50	–	–	2.76	70	–	–
Y	0.59	15	–	–	0.63	16	–	–	0.71	18	–	–

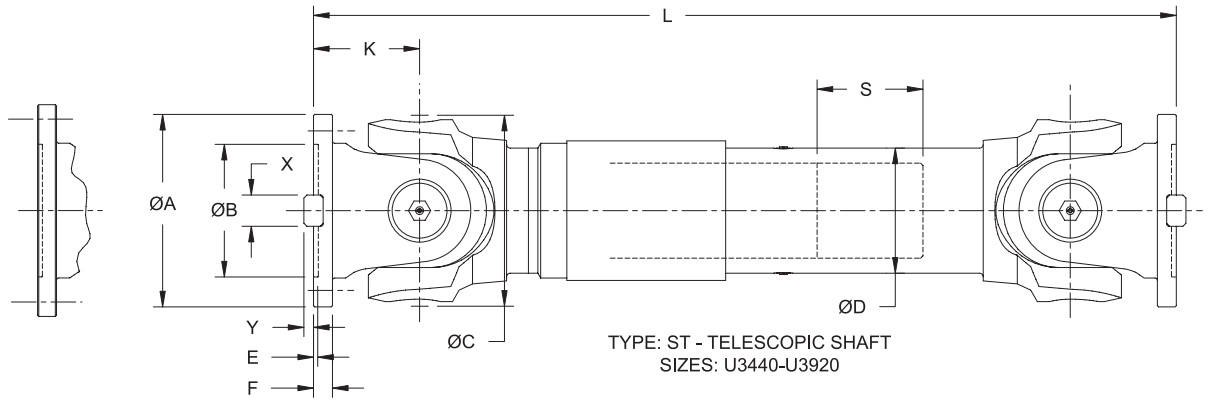
Mininum Length L[2] / Length Compensation S

		in	mm	in	mm	in	mm
ST	L	51.77	1315	55.51	1410	60.24	1530
	S	5.51	140	5.91	150	6.50	165
SF	L	31.69	805	33.66	855	37.60	955
FT	L	53.15	1350	57.68	1465	62.99	1600
	S	5.51	140	5.91	150	6.50	165
FF	L	28.35	720	30.55	776	33.86	860

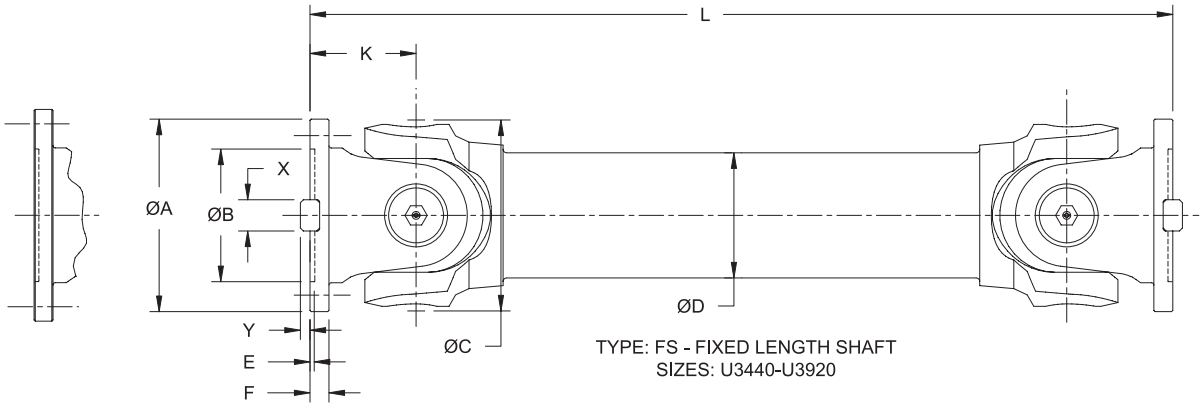
1) Special tube diameters available upon request
2) L is minimum for ST and SF design
Longer/shorter length compensation available upon request.
Popular flange yoke configurations shown, special designs available upon request

Engineering Data

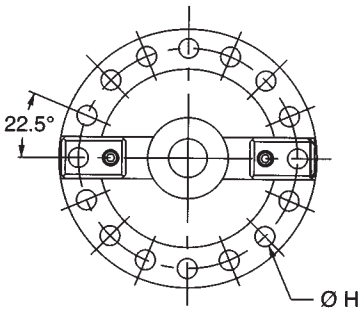
Series 3000 Sizes U3400-U3920



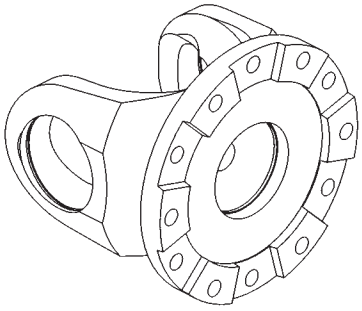
TYPE: ST - TELESCOPIC SHAFT
SIZES: U3440-U3920



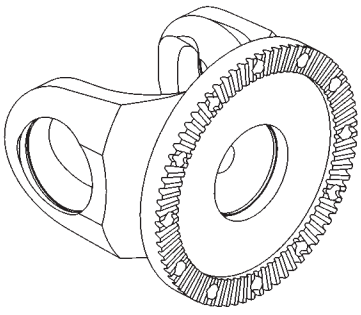
TYPE: FS - FIXED LENGTH SHAFT
SIZES: U3440-U3920



FACE KEY
16 - KEY



INTEGRAL FACE PAD



HIRTH RADIAL TOOTH CONNECTION

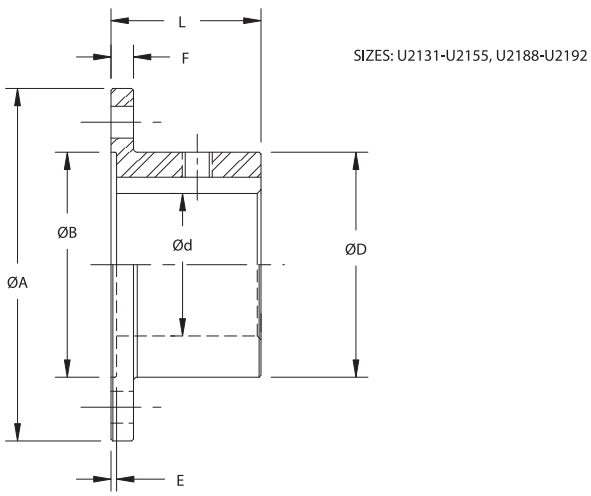
The torque ratings are based on material strength. When approaching these limits the capacity of the desired flange connection should be verified. When the selection torque (Ts) approaches the endurance torque (Te) or when the maximum torque approaches the peak torque capacity (Tp) of the universal joint, integral face pads are recommended. The number of pads and bolts are customized on a per application basis.

Size	U3440		U3490		U3550		U3620		U3680	
Torque Ratings										
	In-Lb	KNm	In-Lb	KNm	In-Lb	KNm	In-Lb	KNm	In-Lb	KNm
Te	2,382,000	269	3,170,000	358	5,253,000	594	6,660,000	753	8,178,000	924
Tow	3,573,000	404	4,755,000	537	7,880,000	890	9,996,000	1129	12,267,000	1386
T_L	1,665,000	188	2,126,000	240	2,994,000	338	4,224,000	477	5,959,000	673
Tp	4,890,000	553	7,180,000	811	11,000,000	1243	15,000,000	1695	16,700,000	1887
Dimensional Data (inches and millimeters except where noted)										
	In.	mm	In.	mm	In.	mm	In.	mm	In.	mm
ß	15°		15°		15°		15°		15°	
A	17.32	439.9	19.28	489.7	21.62	549.1	24.41	620	26.77	680
B	13.00	330.2	13.5	342.9	16	406.4	18	457.2	19	482.6
C	17.32	440	19.28	490.0	21.65	550	24.41	620	26.77	680
D	12.75	323.9	13.38	339.9	16.50	419.1	17.75	450.9	19.75	501.7
E	0.40	10.2	0.47	11.9	0.47	11.9	0.47	11.9	0.59	15
F	1.69	42.9	1.75	44.5	2	50.8	2.12	53.8	2.12	53.8
K	10.24	260	10.63	270	12.01	305	13.38	340	15.53	395
DBC	15.37	390.4	17.12	434.8	19.37	492	21.88	555.8	23.75	603.3
Bolt Quantity	16	16	16	16	16	16	16	16	16	16
Bolt Dia.	1-1/8	27	1-1/4	30	1-1/4	30	1-1/2	36	1-1/2	36
X	3.00	76.2	3.50	88.9	3.94	100.1	4.50	114.3	4.50	114.3
Y	0.87	22.1	0.87	22.1	0.87	22.1	0.87	22.1	1.00	25.4
Minimum Length L/Length Compensation S										
FT L	73.80	1874.5	78.10	1983.7	90.60	2301.2	95.50	2425.7	105.00	2667
S	7.50	190.5	7.50	190.5	9.50	241.3	9.50	241.3	10.00	254
FF L	40.96	1040.4	42.52	1080	48.04	1220.2	53.52	1359.4	62.12	1577.8

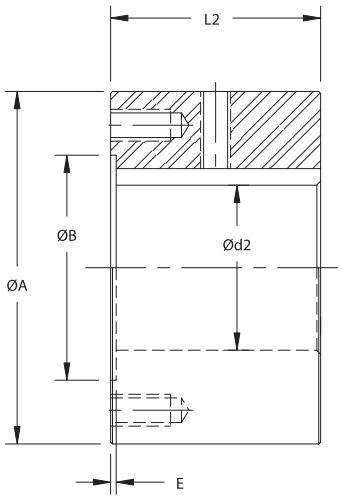
Size	U3720		U3760		U3800		U3860		U3920	
Torque Ratings										
	In-Lb	KNm	In-Lb	KNm	In-Lb	KNm	In-Lb	KNm	In-Lb	KNm
Te	9,800,000	1107	11,700,000	1322	13,670,000	1545	17,000,000	1921	20,800,000	2350
Tow	14,701,000	1661	17,571,000	1985	20,505,000	2317	25,500,000	2881	31,200,000	3525
T_L	7,077,000	800	8,248,000	932	9,555,000	1080	11,759,000	1329	14,263,000	1612
Tp	20,000,000	2260	23,900,000	2701	27,900,000	3153	34,680,000	3919	42,450,000	4797
Dimensional Data (inches and millimeters except where noted)										
	In.	mm	In.	mm	In.	mm	In.	mm	In.	mm
ß	15°		15°		15°		15°		15°	
A	28.35	720.0	29.92	760.0	31.50	800.0	33.85	860.0	36.22	920.0
B	20.00	508.0	21.00	533.4	22.00	558.8	24.00	609.6	35.00	635.0
C	28.35	720.0	29.92	760.0	31.50	800.0	33.85	860.0	36.22	920.0
D	21.75	552.5	23.25	590.6	24.75	628.7	27.00	685.8	28.00	711.2
E	0.62	15.7	0.62	15.7	0.62	15.7	0.62	15.7	0.75	19.1
F	2.25	57.2	2.38	60.5	2.50	63.5	2.62	66.5	2.75	69.9
K	16.44	417.6	17.35	440.7	18.27	464.1	19.64	498.9	20.47	519.9
DBC	25.75	654.1	27.38	695.5	28.88	733.6	31.25	793.8	33.50	850.9
Bolt Quantity	16	16	16	16	16	16	16	16	16	16
Bolt Dia.	1-1/2	36	1-1/2	36	1-1/2	36	1-1/2	36	1-1/2	36
X	4.50	114.3	4.50	114.3	4.50	114.3	4.50	114.3	5.00	127
Y	1.06	26.9	1.12	28.4	1.19	30.2	1.25	31.8	1.38	35.1
Minimum Length L/Length Compensation S										
FT L	108.25	2749.6	113.50	2882.9	117.00	2971.8	123.50	3136.9	128.00	3251.2
S	10.00	254	11.00	279.4	11.00	279.4	11.00	279.4	11.00	279.4
FF L	65.76	1670.3	69.40	1762.8	73.08	1856.2	78.56	1995.4	81.88	2079.8

Engineering Data

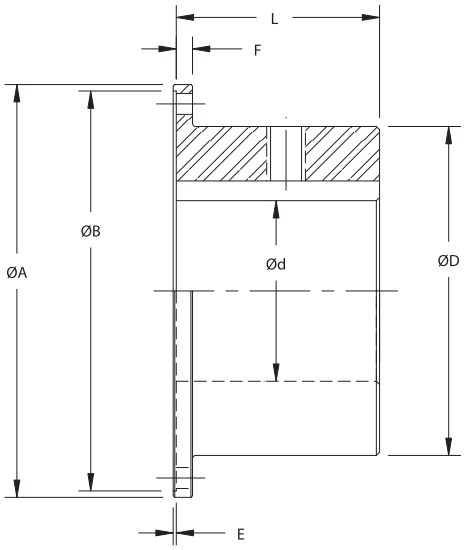
Series 2000 Dimensions

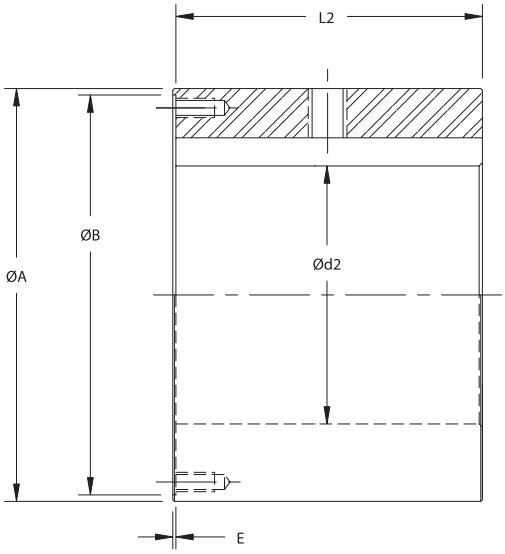


DESIGN 1



DESIGN 2

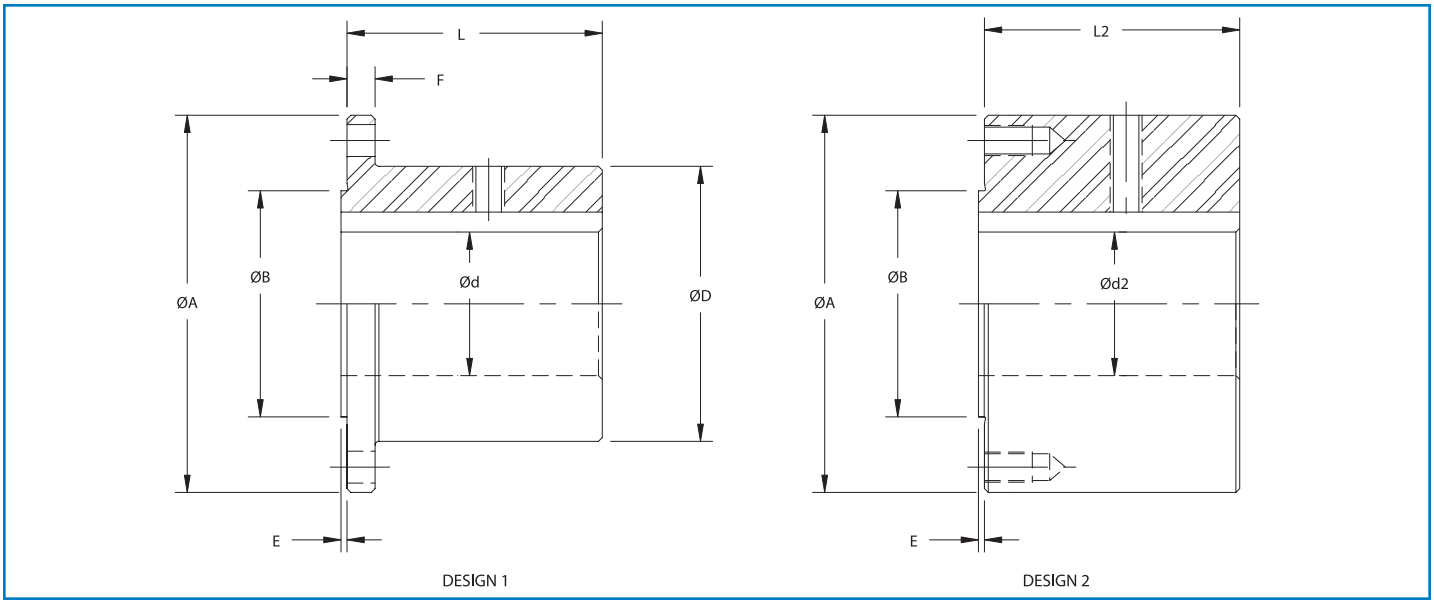




Size	U2131		U2135/U2141		U2148/U2155		U2160		U2170		U2180		U2188/U2192	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
A	3.88	98.6	4.63	115.8	5.88	149.4	6.88	174.8	8.00	203.2	8.00	203.2	9.63	244.6
B	2.38	60.5	2.75	69.9	3.75	95.2	6.62	168.1	7.75	196.8	7.75	196.8	7.00	177.8
E	0.08	2.0	0.08	2.0	0.08	2.0	0.055	1.4	0.055	1.4	0.055	1.4	0.14	3.6
F	0.38	9.7	0.38	9.7	0.38	9.7	0.38	9.7	0.38	9.7	0.38	9.7	0.63	16.0
L1	2.00	50.8	2.00	50.8	2.50	63.5	3.50	88.9	4.000	101.6	4.000	101.6	4.500	114.3
D1	2.44	62.0	2.88	73.2	3.75	95.2	5.25	133.3	6.38	162.1	6.38	162.1	6.88	174.8
d1	1.69	42.9	1.88	47.8	2.44	62.0	3.12	79.2	4.00	101.6	4.00	101.6	4.50	114.3
L2	2.50	63.5	3.00	76.2	3.00	76.2	5.00	127.0	6.00	152.4	6.00	152.4	6.00	152.4
d2	2.38	60.5	2.75	69.8	3.75	95.2	4.50	114.3	5.50	139.7	5.50	139.7	6.50	165.1

Engineering Data

Series 3000 Dimensions

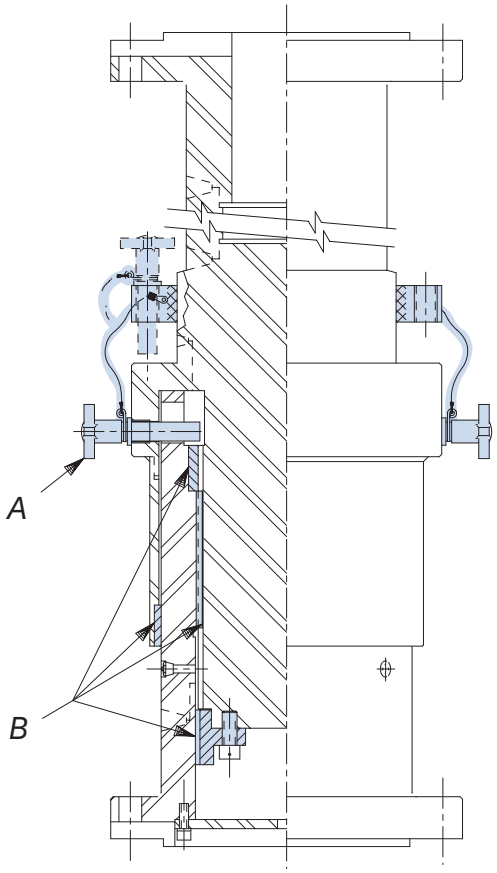


Size	U3055		U3055/U3060		U3060/U3070		U3070/U3090		U3090/U3100	
	in	mm	in	mm	in	mm	in	mm	in	mm
A	2.28	58.0	2.56	65.0	2.95	75.0	3.54	90.0	3.94	100.0
B	1.18	30.0	1.38	35.0	1.65	42.0	1.85	47.0	3.31	84.0
E	0.047	1.2	0.059	1.5	0.07	1.8	0.09	2.3	0.09	2.3
F	-	-	-	-	-	-	0.31	7.9	0.38	9.7
L1	-	-	-	-	-	-	2.000	50.8	2.000	50.8
D1	-	-	-	-	-	-	2.36	60.0	2.74	70.0
d1	-	-	-	-	-	-	1.56	40.0	1.81	46.0
L2	2.00	50.8	2.00	50.8	2.00	50.8	2.50	63.5	2.50	63.5
d2	1.18	30.0	1.38	35.0	1.65	42.0	1.75	44.4	2.00	56.9

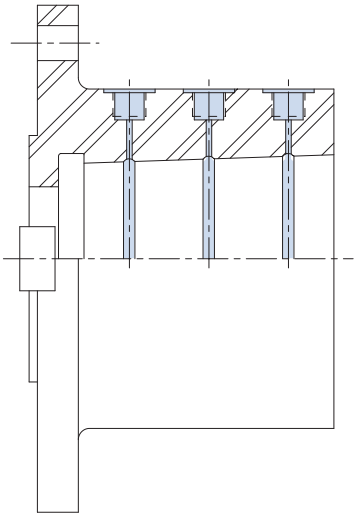
Size	U3100/U3115U/3125		U3115-U3155		U3140-U3175		U3175/U3200/U3225		U3200/U3225/U3250	
	in	mm	in	mm	in	mm	in	mm	in	mm
A	4.73	120.0	5.91	150.0	7.09	180.0	8.86	225.0	9.84	250.0
B	4.00	101.5	5.118	130.0	4.330	110.0	5.512	140.0	5.512	140.0
E	0.09	2.3	0.094	2.4	0.094	2.4	0.157	4.0	0.197	5.0
F	0.38	9.7	0.44	11.2	0.50	12.7	0.63	16.0	0.75	19.1
L1	2.500	63.5	4.000	101.6	4.000	101.6	5.500	139.7	6.000	152.4
D1	3.25	82.6	4.31	109.5	5.19	131.8	6.59	167.4	7.44	189.0
d1	2.12	53.8	2.88	73.2	3.44	87.4	4.44	112.8	4.94	125.5
L2	3.00	76.2	5.00	127.0	4.50	114.3	7.25	184.2	8.25	209.6
d2	2.69	68.3	3.54	89.9	4.13	104.9	5.88	149.4	6.56	166.6

Size	U3250/U3285		U3285/U3315		U3315/U3350		U3350U/3390		U3390	
	in	mm	in	mm	in	mm	in	mm	in	mm
A	11.22	285.0	12.40	315.0	13.78	350.0	15.35	390.0	15.35	390.0
B	6.890	175.0	6.890	175.0	8.661	220.0	9.843	250.0	9.843	250.0
E	0.236	6.0	0.236	6.0	0.276	7.0	0.276	7.0	0.276	7.0
F	0.81	20.6	0.88	22.4	1.00	25.4	1.12	28.4	1.12	28.4
L1	7.000	177.8	8.000	203.2	9.000	228.6	10.000	254.0	10.000	254.0
D1	8.41	213.6	9.69	246.1	10.88	276.4	12.09	307.1	12.09	307.1
d1	5.56	141.2	6.44	163.6	7.25	184.2	8.06	204.7	8.06	204.7
L2	9.38	238.3	10.25	260.4	11.25	285.8	12.25	311.2	12.25	311.2
d2	7.50	190.5	8.25	209.6	9.00	228.6	10.00	254.0	10.00	254.0

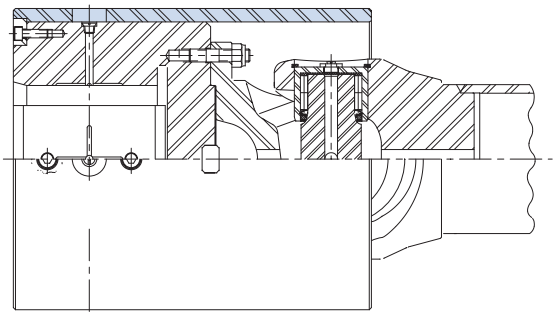
Design Variations and Custom Applications



Vertical Edger Design
A. Locking Pin Arrangement
B. Long Travel Shaft With Bearing Support

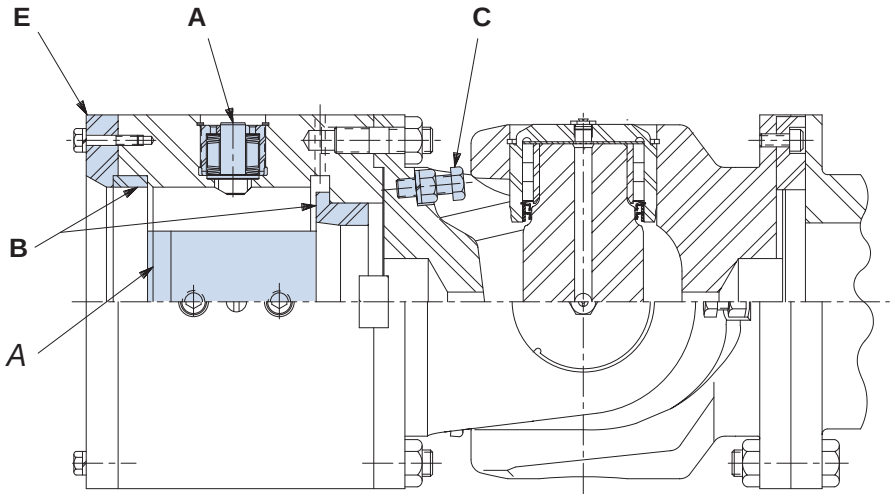


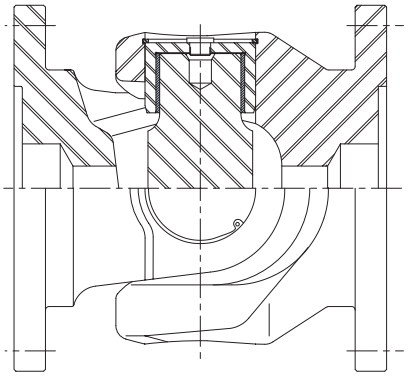
Hydraulic Removal Adapter



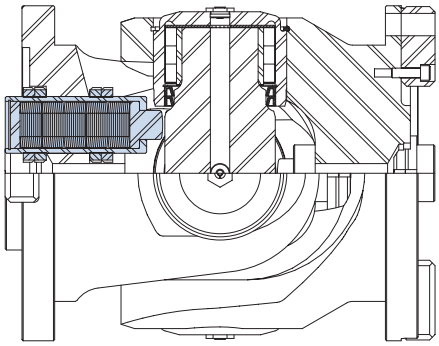
Roll Removal Support Mechanism

A. Detent Assembly
B. Replaceable Pilot Bearing
C. Angle Limiters
D. Replaceable Wear Keys
E. Hardened, Chamfered End Plate

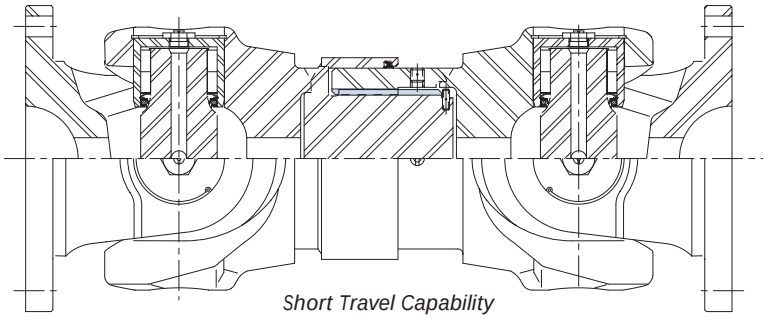




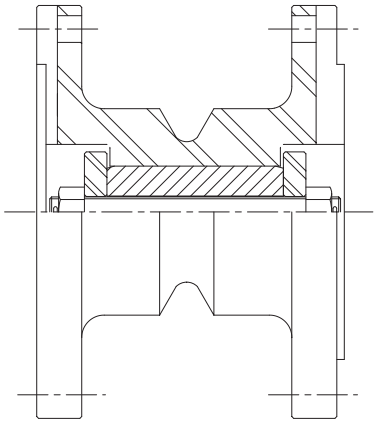
Composite Bearing



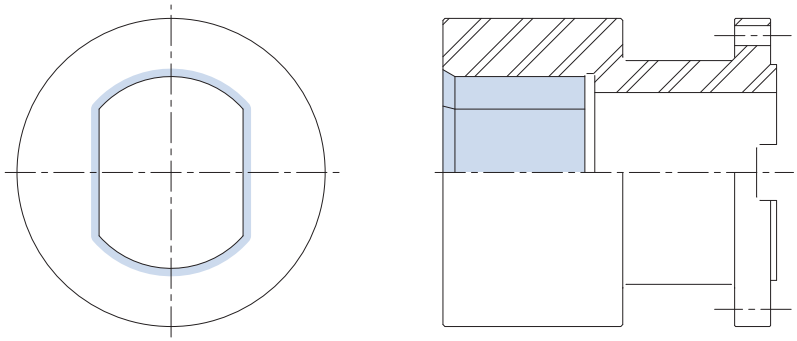
Hydraulic Removal Adapter



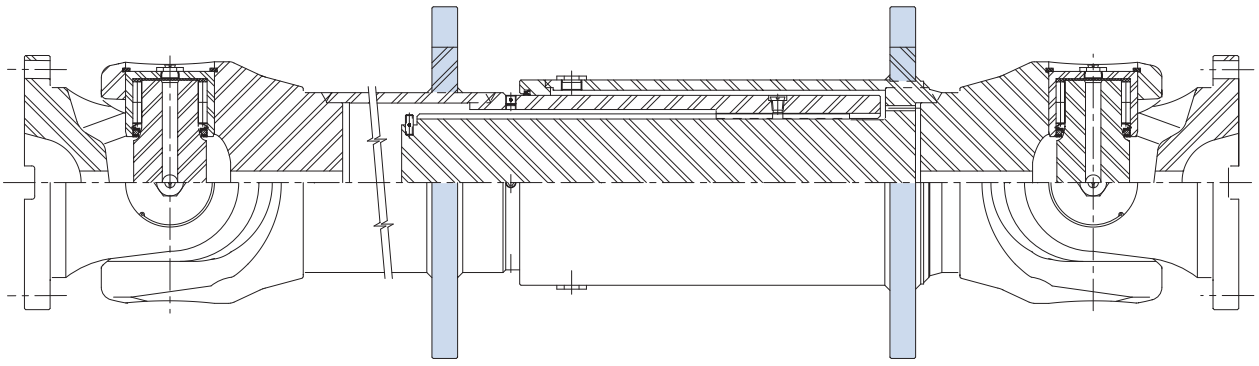
Short Travel Capability



Shear Spacer Assembly



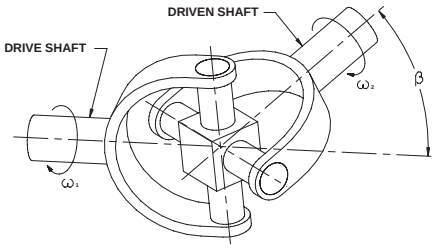
Developed and Hardened Roll End Bore



Long Travel Capability With Extension and Contraction Flanges

Kinematics and Motion Characteristics

When a universal joint is operated at an angle (ß), non-uniform motion is developed. With the driving yoke of the joint operating at a uniform rotational velocity (ω1), the driven yoke rotates non-uniformly with respect to angular displacement, velocity (ω2), and acceleration.



The average angular displacement and velocity is uniform. That is, if the driving yoke rotates one revolution, the driven yoke also rotates one revolution. However, during this one revolution, the incremental angular displacement and instantaneous angular velocity and acceleration are not transmitted uniformly through the joint. The angular displacement of the driven yoke during one revolution lags and leads the driving yoke twice.

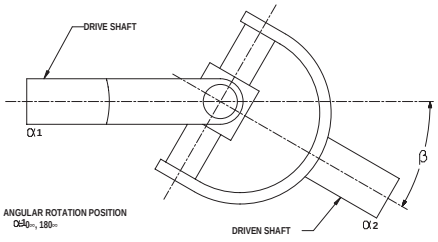
With a constant angular velocity (ω1), of the driving yoke, the driven yoke has a maximum difference of output angular velocity (φ), with respect to the driving yoke when the driving yoke lies in the plane of the joint angle and also when the driving yoke is normal or perpendicular to this plane. The driven yoke has the same angular velocity as the driving yoke at approximately 45º from the joint angle plane for small angles.

The maximum instantaneous angular acceleration and deceleration of the driven yoke occurs when the angular velocity of the driven yoke is the same as the driving yoke. Also, the maximum acceleration and deceleration coincide with the maximum lead and lag respectively. The incremental angular displacement, velocity, and acceleration increase as the joint angle is increased, but at an increasing rate.

For dynamic rotation the angular velocity of the driven yoke (ω2), can be determined for a given angular displacement (α1), with the formula

$$\omega_2 = \left(\frac{\cos ß \times \omega_1}{1 - \sin^2 \alpha_1 \times \sin^2 ß} \right)$$

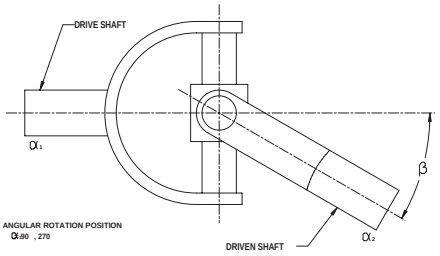
During one revolution of the drive yoke the driven yoke will reach a maximum angular velocity two times at a = 0º and 180º.



The maximum angular velocity will be

$$\omega_2 max = \frac{\omega_1}{\cos ß}$$

The driven yoke will also reach a minimum angular velocity two times during one revolution at α = 90º and 270º.



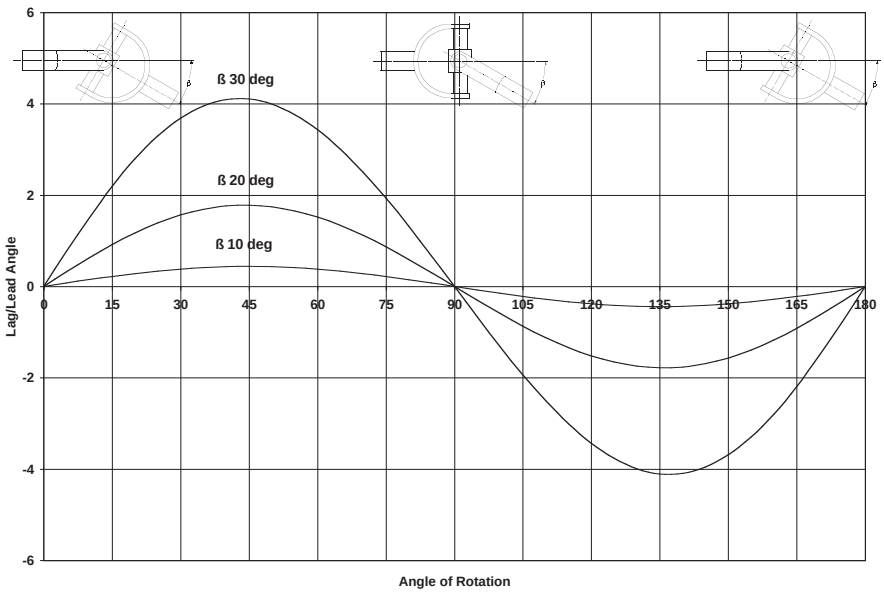
The minimum angular velocity will be

$$\omega_2 min = \cos ß \ \omega_1$$

Lead and lag angles (φ) of the driven shaft can be determined by the following equations

$$\varphi = \tan^{-1} \left(\frac{\tan \alpha_2 - \tan \alpha_1}{1 + \tan \alpha_1 \times \tan \alpha_2} \right)$$

$$\alpha_2 = \tan^{-1} \left(\frac{1}{\cos ß} \right) \times \tan \alpha_1$$

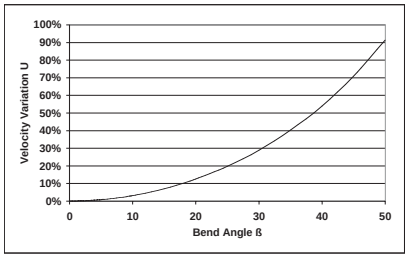


Lag and lead angle (φ) as a function of angular rotation (α) of the joint and bend angle (ß).

Kinematics and Motion Characteristics

Velocity variation (U) is a means for comparison of the angular velocities of the drive and driven shafts. Velocity variation (U) is calculated using the formula

$$U = \left(\frac{\omega_2 max - \omega_2 min}{\omega_1} \right) = \tan ß \times \sin ß$$



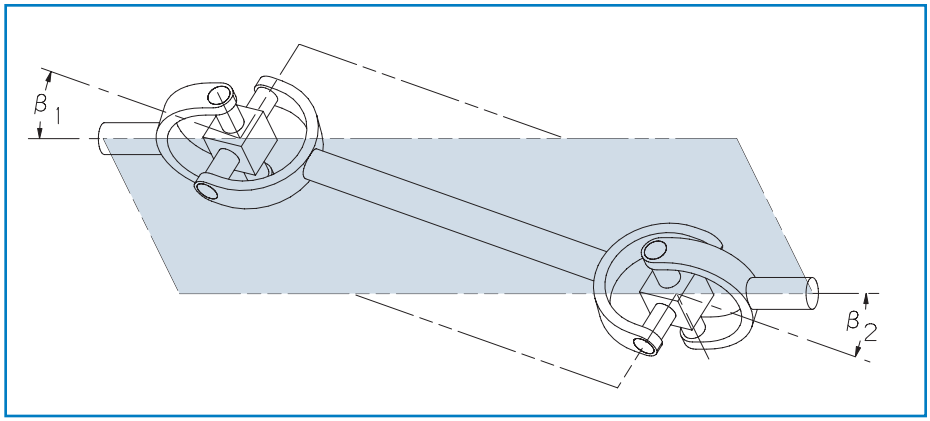
As a result of the non-uniform motion of a universal joint, few applications are suitable for a single universal joint. However, by placing two universal joints in tandem the irregularities of a single joint can be compensated. By arranging the two universal joints in either a "Z" or "W" bend configuration with joint angles ß1, and ß2, equal, the velocity variations developed in the first joint are in effect cancelled by the velocity variations in the second joint.

W Bend

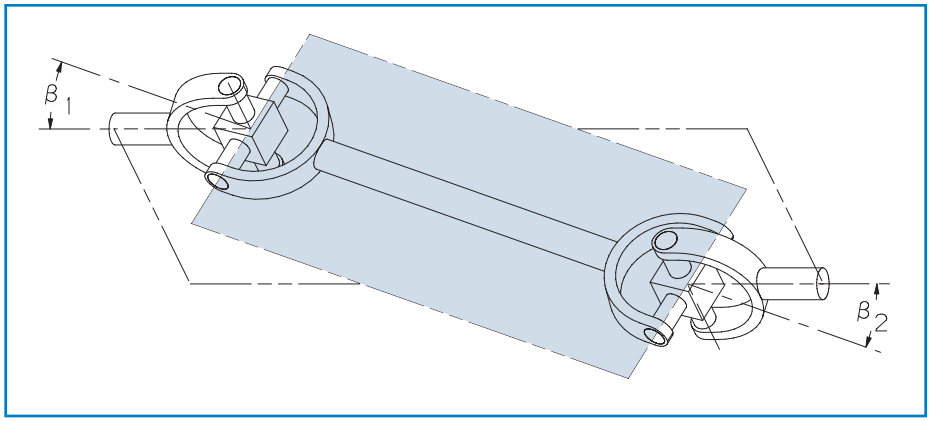
Z Bend

Synchronous rotation of the drive and driven shafts is possible provided that all three of the following conditions are met:

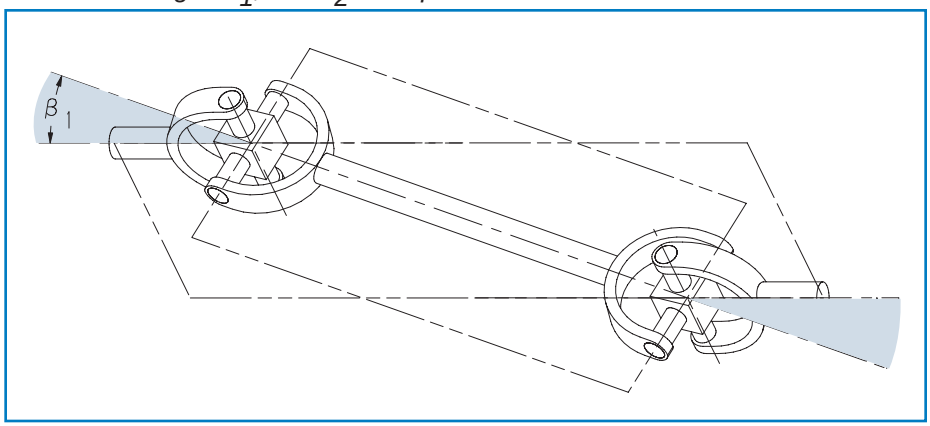
1. The axes of all shaft sections lie in the same place.



2. The bearing bores of the inboard yokes of the center section lie in the same plane.



3. The bend angles ß1, and ß2 are equal.



This ideal or phased arrangement will result in homokinetic operation of the universal joint driveline assembly. Failure to meet one or more of these requirements will result in some level of velocity fluctuation in the drive shaft. The acceptability of this velocity fluctuation is a function of the speed, system mass and the sensitivity of the application.

Bore Tolerances and Weights

Recommended Bore Tolerances

- *Recommended standard bore tolerances for interference fits are shown in table to the right.*
- *Bore tolerances conform to AGMA 9002-A86 standards.*

Interference Fits

Unless specified, bores will be furnished with an interference fit.

*When **shaft sizes only** are stated on order and they consist of fractional or decimal dimensions without tolerance, the bore will be sized for an interference fit in accordance with table above. If exact **shaft size** and tolerance do not agree with tables, the smallest shaft dimension will be considered "basic" and the standard negative bore tolerance will be applied.*

Example: Interference Fit

Shaft Size – *2.000 (Basic Size)*
1.999 (With Tolerance)

Bore Size – *1.999*
1.998

Interference Fit (Inches)			
Nominal Bore Size Over Thru	Shaft Tolerance	Bore Tolerance	Interference Range
0.0000 / 1.5000	+0000 / -0005	-0.0005 / -0.0010	-0.000 / -0.0010
1.5000 / 3.0000		-0.0010 / -0.0020	-0.000 / -0.0020
3.0000 / 4.0000		-0.0015 / -0.0030	-0.0005 / -0.0030
4.0000 / 5.0000		-0.0020 / -0.0035	-0.0010 / -0.0035
5.0000 / 7.0000		-0.0025 / -0.0040	-0.0015 / -0.0040
7.0000 / 8.0000		-0.0030 / -0.0050	-0.0020 / -0.0050
8.0000 / 9.0000		-0.0035 / -0.0055	-0.0025 / -0.0055
9.0000 / 10.0000		-0.0040 / -0.0060	-0.0030 / -0.0060
10.0000 / 11.0000		-0.0045 / -0.0065	-0.0035 / -0.0065
11.0000 / 12.0000	+.0000 / -.0010	-0.0050 / -0.0070	-0.0040 / -0.0070
12.0000 / 13.0000		-0.0055 / -0.0075	-0.0045 / -0.0075
13.0000 / 14.0000		-0.0060 / -0.0080	-0.0050 / -0.0080
14.0000 / 15.0000		-0.0065 / -0.0085	-0.0055 / -0.0085
15.0000 / 16.0000		-0.0065 / -0.0090	-0.0055 / -0.0090
16.0000 / 17.0000		-0.0070 / -0.0095	-0.0060 / -0.0095
17.0000 / 18.0000		-0.0075 / -0.0100	-0.0065 / -0.0100
18.0000 / 19.0000		-0.0080 / -0.0105	-0.0070 / -0.0105
19.0000 / 20.0000		-0.0085 / -0.0110	-0.0075 / -0.0110
20.0000 / 22.0000		-0.0100 / -0.0130	-0.0080 / -0.0130
22.0000 / 24.0000	+.0000 / -.0020	-0.0110 / -0.0140	-0.0090 / -0.0140
24.0000 / 26.0000		-0.0120 / -0.0150	-0.0100 / -0.0150

Standard Recommended Keyways (Inches)			
Nominal Bore Range Over Thru	Keyway Width	Depth Sq. Key	Depth Red. Key
.312 / .438	.094	.047	-
.438 / .562	.125	.063	.047
.562 / .875	.188	.094	.062
.875 / 1.250	.250	.125	.094
1.250 / 1.375	.312	.156	.125
1.375 / 1.750	.375	.188	.125
1.750 / 2.250	.500	.250	.188
2.250 / 2.750	.625	.313	.219
2.750 / 3.250	.750	.375	.250
3.250 / 3.750	.875	.438	.313
3.750 / 4.500	1.000	.500	.375
4.500 / 5.500	1.250	.625	.438
5.500 / 6.500	1.500	.750	.500
6.500 / 7.500	1.750	.875	.750
7.500 / 9.000	2.000	1.000	.750
9.000 / 11.000	2.500	1.250	.875
11.000 / 13.000	3.000	1.500	1.000
13.000 / 15.000	3.500	1.750	1.250
15.000 / 18.000	4.000	-	1.500
18.000 / 22.000	5.000	-	1.750
22.000 / 26.000	6.000	-	2.000

Universal Joint Weights and Minimum Length (pounds)

Size	Flange Dia. (Inches)	TYPE					Tube (Inches)
		ST	SF	FT	FF With Space	FF Without Spacer	
U2131	3.88	14	12	-	-	-	0.18
U2135	4.63	25	20	-	-	-	0.22
U2141	4.63	25	20	-	-	-	0.25
U2148	5.88	27	22	-	-	-	0.25
U2155	5.88	37	34	-	-	-	0.29
U2160	6.88	45	36	-	-	-	0.90
U2170	8.00	68	55	-	-	-	0.46
U2180	8.00	99	83	-	-	-	0.52
U2188	9.63	152	122	-	-	-	0.98
U2192	9.63	166	166	-	-	-	1.00
U3180	7.38	187	113	238	197	132	1.78
	8.88	194	120	267	223	147	1.78
U3200	8.86	288	214	299	252	178	1.78
	9.84	296	222	345	291	194	1.78
U3208	8.88	313	190	365	277	198	2.22
	10.00	321	198	409	316	214	2.22
U3225	8.86	362	239	426	352	259	2.22
	9.84	370	247	470	391	275	2.22
U3250	9.84	474	291	579	436	335	2.67
	11.22	483	300	617	466	353	2.67
U3285	11.22	714	446	786	564	445	3.22
	12.40	729	461	842	610	475	3.22
U3315	12.40	1,000	648	1,099	801	639	3.67
	13.78	1,020	668	1,172	866	679	3.67
U3350	13.78	1,354	867	1,490	1,056	882	4.22
	15.35	1,383	896	1,615	1,169	940	4.22
U3390	15.35	1,743	1,179	1,938	1,420	1,191	6.50
	17.13	1,789	1,225	2,104	1,563	1,282	6.50
U3440	17.32	-	-	2,761	1,987	1,737	10.91
U3490	19.28	-	-	3,840	2,965	2,590	11.58
U3550	21.62	-	-	5,204	3,724	3,339	14.13
U3620	24.41	-	-	6,979	5,284	4,728	16.95

Values may vary for specific applications.

Ameridrives INTERNATIONAL
Couplings Products
1802 Pittsburgh Avenue
Erie, PA 16512 4000

Tel 814 480 5000
Fax 814 453 5891

Rolling Mill Application Data for Selection and Design

Customer: _____ Inquiry No:

Contact Name: _____ No. of Units:

Type of Mill: _____ Phone: _____

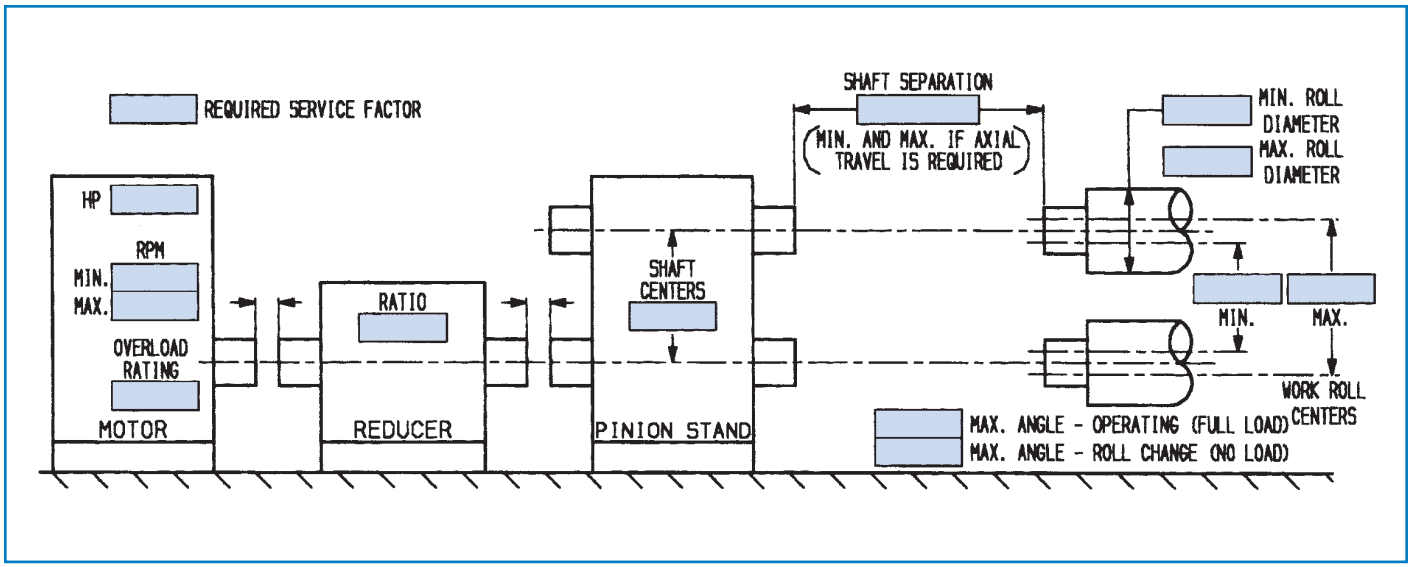
No. of Stands: _____ Fax: _____

Date: _____ No. of Pages _____
(including cover sheet)

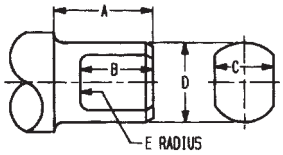
Fill in the boxes on the diagrams below for the following information.

1. Motor Horsepower
2. Motor RPM (Min. and Max.)
3. Required Service Factor
4. Motor Overload Rating
5. Reducer Ratio
6. Pinion Centers
7. Shaft Separation
8. Min. Work Roll Diameter
9. Max. Work Roll Diameter
10. Min. Work Roll Centers – Operating
11. Max. Work Roll Centers – Operating
12. Max. Operating Angle (Full Load)
13. Max. Roll Change Angle (No Load)
14. Bore Requirements

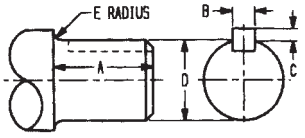
Comments or special features (e.g. pages 20-21) or special conditions such as: Ambient temperature, atmospheric, diameter limitation, roll change method, bore wear problems, vertical or reversing application, work roll or back up roll driven, torque amplification factor, shaft support, etc.: _____



STYLE 1



STYLE 2



BORE REQUIREMENTS		
	PINION SHAFT	ROLL NECK
STYLE		
A		
B		
C		
D		
E		

CAUTION: *This product will be selected based on the information supplied to Ameridrives International by the Purchaser. Complete and accurate information will help to minimize errors and misapplications. Further, it is the responsibility of the Purchaser to assure the interface connection between couplings and connected equipment (flanges, bolting, keys, hydraulic fits, etc.), are capable of handling anticipated loads. Ameridrives International will not be responsible for errors due to inaccurate or incomplete information supplied to Ameridrives International.*

INDUSTRIAL MAGZA® DIST. AUTORIZADO
MEX (55) 53 63 23 31 MTY (81) 83 54 10 18
QRO (442) 195 72 60 ventas@industrialmagza.com

Ameridrives INTERNATIONAL
Coupling Products
1802 Pittsburgh Avenue
Erie, PA 16512 4000

Tel 814 480 5000
Fax 814 453 5891

General Machinery Application Data for Selection and Design

Customer: _____ Inquiry No:

Contact Name: _____ No. of Units:

Type of Mill: _____ Phone: _____

No. of Stands: _____ Fax: _____

Date: _____ No. of Pages _____
(including cover sheet)

Complete the following information for your application.

1. Motor Horsepower _____
2. Motor RPM (Min. & Max.) _____
3. Required Service Factor _____
4. Operating RPM _____
5. Reducer Ratio _____
6. Normal Operating Torque _____
7. Shaft Separation (Min. & Max.) _____
8. Required Shaft Axial Slide _____
9. Operating Angle _____
9a. Operating Offset _____
10. No Load Angle _____
10a. No Load Offset _____
11. Horizontal Application _____
11a. Vertical Application _____
12. Drive End Bore & Keyway _____
13. Driven End Bore & Keyway _____
14. Diameter Limitations _____
15. Desired B-10 Life Hours _____

Comments or special conditions such as: Ambient temperature, atmosphere, etc.: _____

Note: If bolting to existing drive and driven flanges, please specify flange diameter, pilot diameter, bolt circle, number of bolts and bolt size: _____

Space provided below for sketch.

CAUTION: *This product will be selected based on the information supplied to Ameridrives International by the Purchaser. Complete and accurate information will help to minimize errors and misapplications. Further, it is the responsibility of the Purchaser to assure the interface connection between couplings and connected equipment (flanges, bolting, keys, hydraulic fits, etc.), are capable of handling anticipated loads. Ameridrives International will not be responsible for errors due to inaccurate or incomplete information supplied to Ameridrives International.*

Ameridrives® Couplings

PO Box 4000
Erie, PA USA 16512 4000
Tel 814 480 5000
Fax 814 453 5891
www.ameridrives.com

Ameridrives Couplings

The Power of Experience

Printed in U.S.A.

Form No. 774-ADV.8/03