High Capacity Industrial Universal Joints

Ameridrives
INTERNATIONAL

Ameridrives 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.

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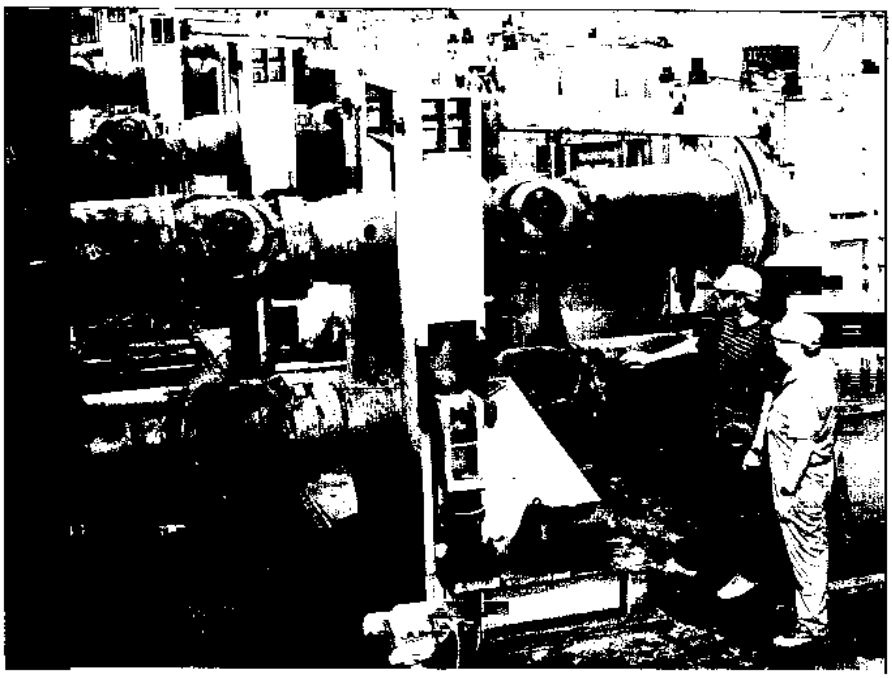
Advantages and Features

- Domestic manufacture
- High torque capacity
- Long bearing life
- High operating angle capability
- 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' U3600 FT Universal Joints on a large section mill.

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
- Calender Drives
- Sizing and Press Rolls
- Couch Rolls
- Process Pumps

Plastic Manufacturing
- Melt Pumps

Printing Presses
Pumps
- Irrigation
- Lift
- Sewage

Railway Drives
Rubber Processing
- Mixers
- Calenders

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

Ameridrives International
Coupling Products

Construction
Yoke Assembly and Bearing Design

Basic Designs

The Ameridrives Universal Joint is available in seven basic bearing 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: Needle bearing design. Bearing caps are retained by bolts.

Sizes U2190-U2191: Wing bearing design. Bearing caps are bolted to the yokes.

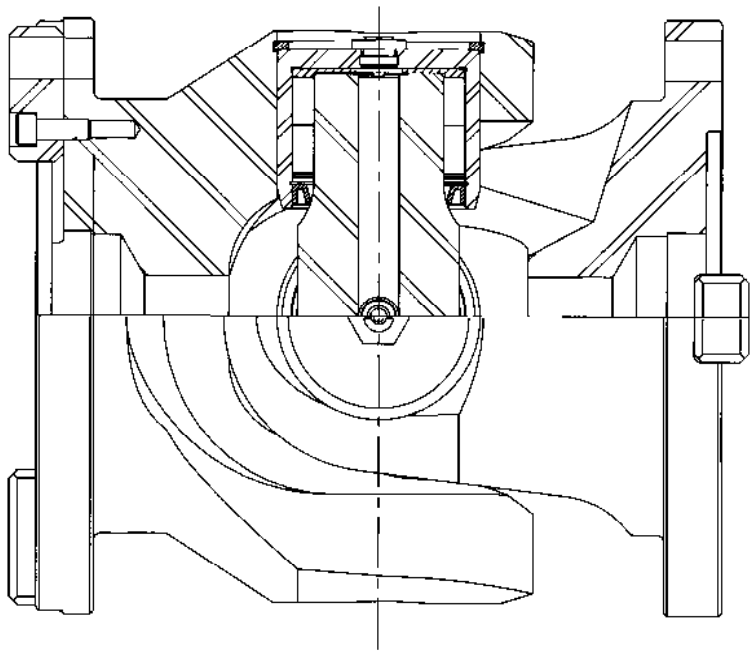
3000 Series:

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

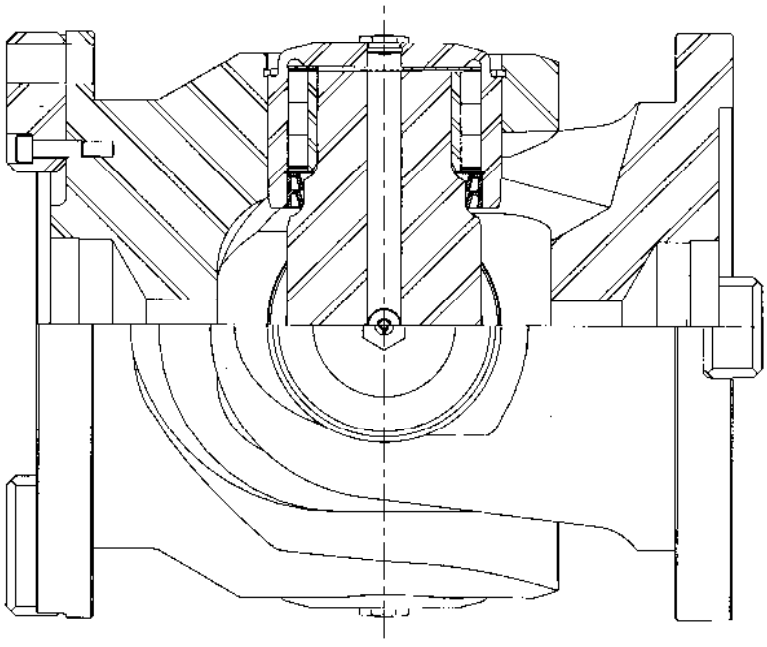
Sizes U3115-U3200: Uses two rows of roller bearings. Bearing caps are retained by snap rings. Lube fitting in center of cross.

Sizes U3208-U3390: Uses two rows of roller bearings. Bearing caps are retained by snap rings. Lube fittings are in each bearing cap.

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 U3208 - U3390



SIZES U3440 - U3920

3000 SERIES

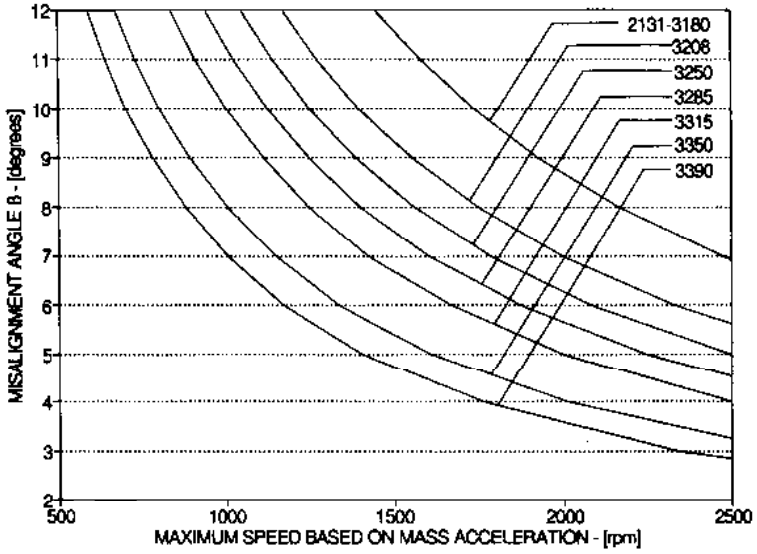
Selection Information and Speed Limits

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 β and upon the moment of inertia of the center shaft section [RPM x β].

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

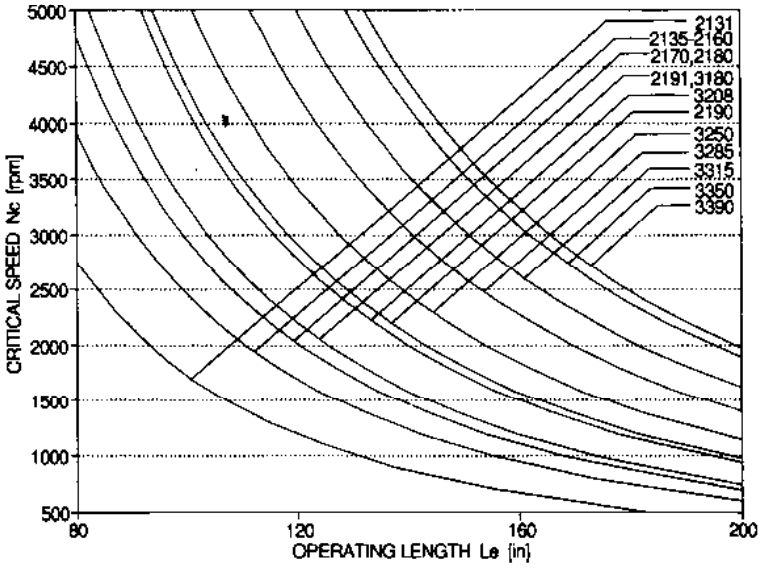
In applications where long lengths of shafts are required, the speed is restricted by the lateral critical speed of the center section. This speed is a function of the center tube diameter wall thickness, and the effective length. The maximum operating speed must be less than the lateral critical speed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

NOTE:
Allowable Operating Speed = Nc x .75.

In many applications, operation 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 3° 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)**.

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

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.

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

Where:

Lh = B-10 life in hours

A = operating angle in degrees

N = speed (RPM)

$\mathbf{T_L}$ = 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:

$\mathbf{N_1}$ = fraction of total, time at operating condition 1

$\mathbf{L_1}$ = 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 friction, operating torque, operating angle, and spline pitch diameter per the following formula.

$$\mathbf{F\ axial} = \frac{2T(\mu)(\cos\beta)}{PD}$$

F axial = Axial Force
T = Operating Torque
μ = Coefficient of Friction (.11 to.15 for lubricated steel on steel, contact Ameridrives for other coatings)
β = 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
3° 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
LIGHT SHOCK	Continuous Casters Light Fans Machine Tools Woodworking Machinery Paper Mill Equipment Bar & Rod Mills	1.25	2.00
MEDIUM SHOCK	Compressors Pumps Fans Farming Equipment Cold Mills & Auxiliary Equipment Presses	1.50	2.25
HEAVY SHOCK	Traction & Locomotive Drives Mixers Crane Drives 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

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

Ts = 283,610 in.-lbs. x 1.5 = 425,420 in.-lbs.

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

Step II. Check Life

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

Step III. Duty Cycle - not applicable.

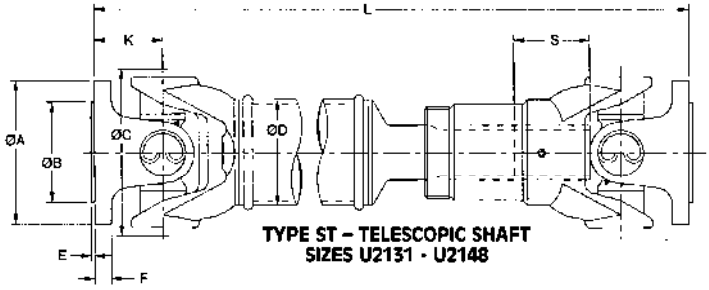
Step IV: Peak Torque
283,610 in.-lbs. x 2.5 = 709,025 in.-lbs.

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

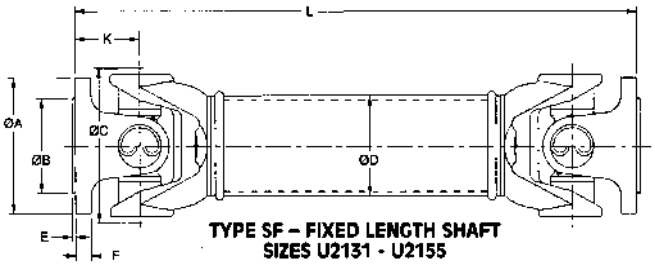
Selection: U3285ST with 12.38" O.D. design 2 flange adapters.

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.

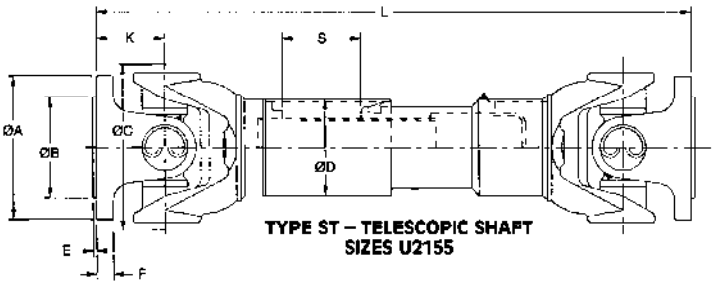
Engineering Data
Series 2000 Sizes U2131 - U2191



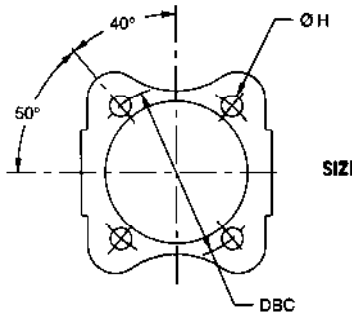
TYPE ST – TELESCOPIC SHAFT
SIZES U2131 - U2148



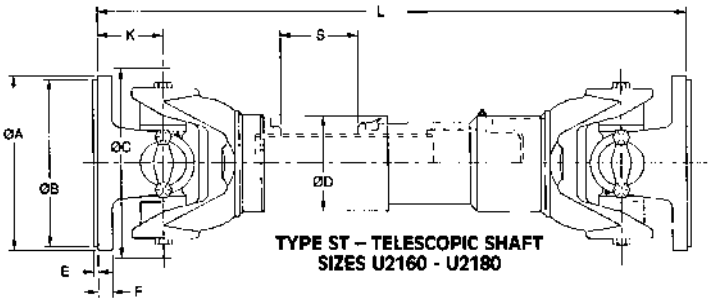
TYPE SF – FIXED LENGTH SHAFT
SIZES U2131 - U2155



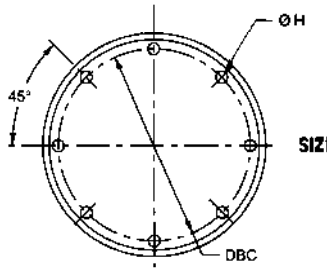
TYPE ST – TELESCOPIC SHAFT
SIZES U2155



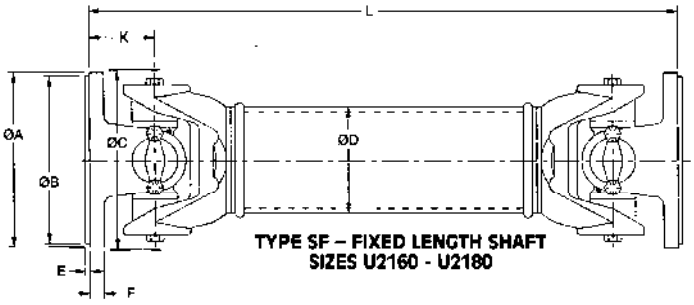
SIZES U2131 - U2155



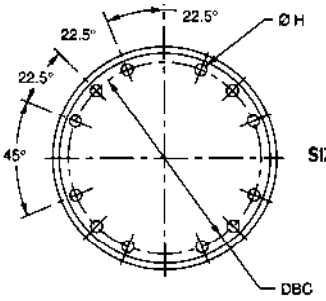
TYPE ST – TELESCOPIC SHAFT
SIZES U2160 - U2180



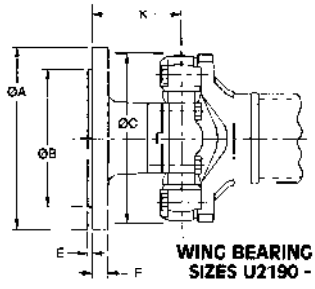
SIZES U2160 - U2170



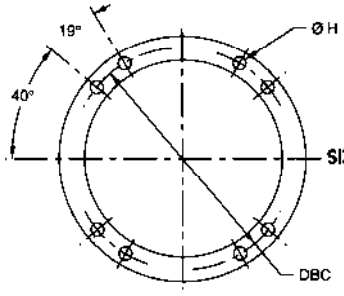
TYPE SF – FIXED LENGTH SHAFT
SIZES U2160 - U2180



SIZE U2180



WING BEARING DESIGN
SIZES U2190 - U2191

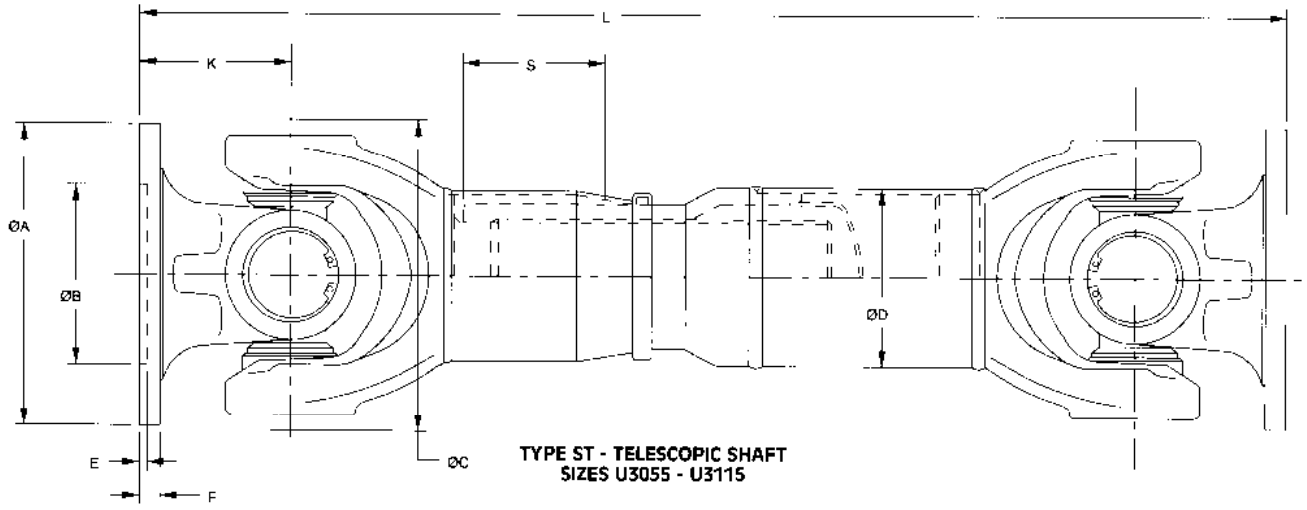


SIZES U2190 - U2191

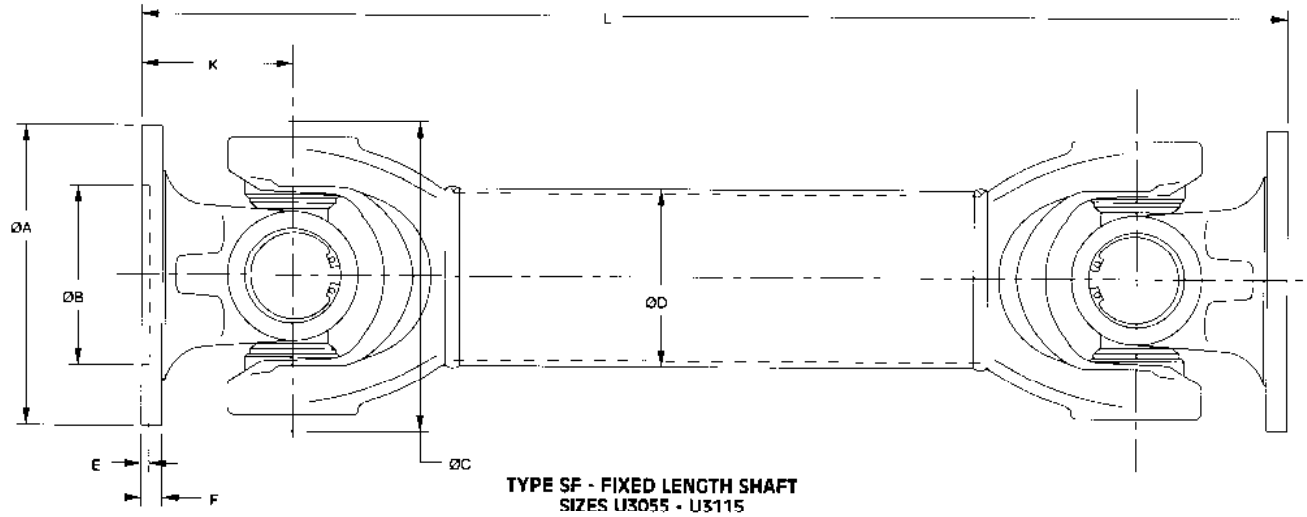
Size	U2131		U2135		U2141		U2148		U2155	
Torque Ratings										
	In-Lb	Nm	In-Lb	Nm	In-Lb	Nm	In-Lb	Nm	In-Lb	Nm
Te	6,150	695	9,105	1029	10,950	1237	14,250	1610	17,745	2005
Tow	6,150	695	9,105	1029	10,950	1237	14,250	1610	17,745	2005
T_L	4,920	556	7,280	823	8,760	990	11,400	1288	14,200	1605
Tp	19,200	2169	27,120	3064	32,400	3660	39,960	4515	52,800	5966
Dimensional Data (inches and millimeters except where noted)										
	In.	mm	In.	mm	In.	mm	In.	mm	In.	mm
β	20°	20°	20°	20°	20°	20°	20°	20°	20°	20°
A	3.88	98.6	4.63	117.6	4.63	117.6	5.88	149.4	5.88	149.4
B	2.38	60.5	2.75	69.9	2.75	69.9	3.75	95.3	3.75	95.3
C	3.88	98.6	4.25	108.0	4.69	119.1	5.13	130.3	6.00	152.4
D	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
DBC	3.12	79.2	3.75	95.3	3.75	95.3	4.75	120.7	4.75	120.7
Bolt Quantity	4	4	4	4	4	4	4	4	4	4
Bolt Hole	0.38	9.7	0.44	11.2	0.44	11.2	0.50	12.7	0.50	12.7
Minimum Length L / Length Compensation S										
ST L	13.66	347.0	14.96	380.0	14.62	371.3	15.50	393.7	17.25	438.2
S	3.12	79.2	3.62	91.9	2.34	59.4	2.50	63.5	3.00	76.2
SF L	8.50	215.9	8.75	222.3	9.63	244.6	10.25	260.4	11.50	292.1

Size	U2160		U2170		U2180		U2190		U2191	
Torque Ratings										
	In-Lb	Nm	In-Lb	Nm	In-Lb	Nm	In-Lb	Nm	In-Lb	Nm
Te	30,000	3390	45,000	5085	57,000	6441	75,000	8475	103,000	11638
Tow	30,000	3390	45,000	5085	57,000	6441	75,000	8475	103,000	11638
T_L	24,000	2712	36,000	4068	45,600	5153	60,000	6780	93,600	10576
Tp	78,000	8814	96,000	10847	144,000	16271	192,000	21695	204,000	23051
Dimensional Data (inches and millimeters except where noted)										
	In.	mm	In.	mm	In.	mm	In.	mm	In.	mm
β	20°	20°	20°	20°	30°	30°	20°	20°	20°	20°
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	196.9	7.75	196.9	7.00	177.8	7.00	177.8
C	7.00	177.8	7.75	196.9	9.13	231.9	8.63	219.2	8.87	225.3
D	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	0.44	11.2	0.69	17.5	0.69	17.5
K	2.75	69.9	3.00	76.2	3.38	85.9	4.28	108.7	4.75	120.7
DBC	6.12	155.4	7.25	184.2	7.25	184.2	8.25	209.6	8.25	209.6
Bolt Quantity	8	8	8	8	12	12	8	8	8	8
Bolt Hole	0.38	9.7	0.38	9.7	0.44	11.2	0.62	15.7	0.62	15.7
Minimum Length L / Length Compensation S										
ST L	20.35	516.9	23.44	595.4	24.80	629.9	25.68	652.3	27.50	698.5
S	3.00	76.2	3.00	76.2	3.00	76.2	5.00	127.0	5.00	127.0
SF L	14.00	355.6	14.75	374.7	16.75	425.5	19.50	495.3	21.50	546.1

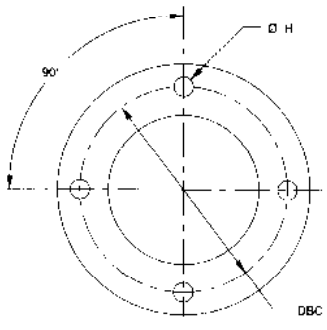
Engineering Data
Series 3000 Sizes U3055 - U3115



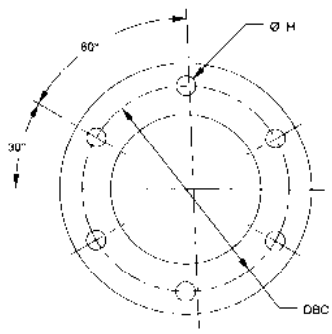
TYPE ST - TELESCOPIC SHAFT
SIZES U3055 - U3115



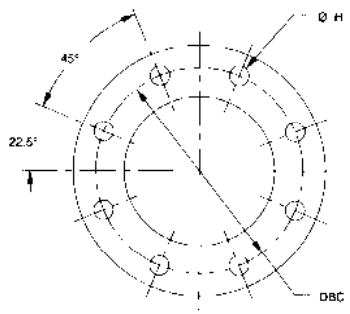
TYPE SF - FIXED LENGTH SHAFT
SIZES U3055 - U3115



4 - HOLE



6 - HOLE



8 - HOLE

Size	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
T_L	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
β	30°	30°	30°	30°	30°	30°	30°	30°	30°	30°	30°	30°
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	1.12	28	1.12	28	1.25	32	1.25	32	1.56	40	1.56	40
E	0.06	1.5	0.07	1.7	0.07	1.7	0.08	2	0.10	2.5	0.10	2.5
F	0.14	3.5	0.16	4	0.16	4	0.22	5.5	0.24	6	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	75
Bolt Qty.	4	4	4	4	4	4	6	6	6	6	4	4
Bolt Dia.	–	5	–	6	–	6	–	6	–	6	–	8

Minimum Length L / Length Compensation S

ST L	10.55	268	11.42	290	12.01	305
S	1.57	40	2.36	60	1.38	35
SF L	6.30	160	6.50	165	7.87	200

Size	U3090		U3100		U3115	
Torque Ratings						
	In-Lb	Nm	In-Lb	Nm	In-Lb	Nm
Te	4,593	519	6,483	733	11,543	1304
Tow	6,890	778	9,725	1099	17,315	1956
T_L	5,682	642	9,080	1026	16,381	1851
Tp	10,334	1168	14,587	1648	25,972	2935

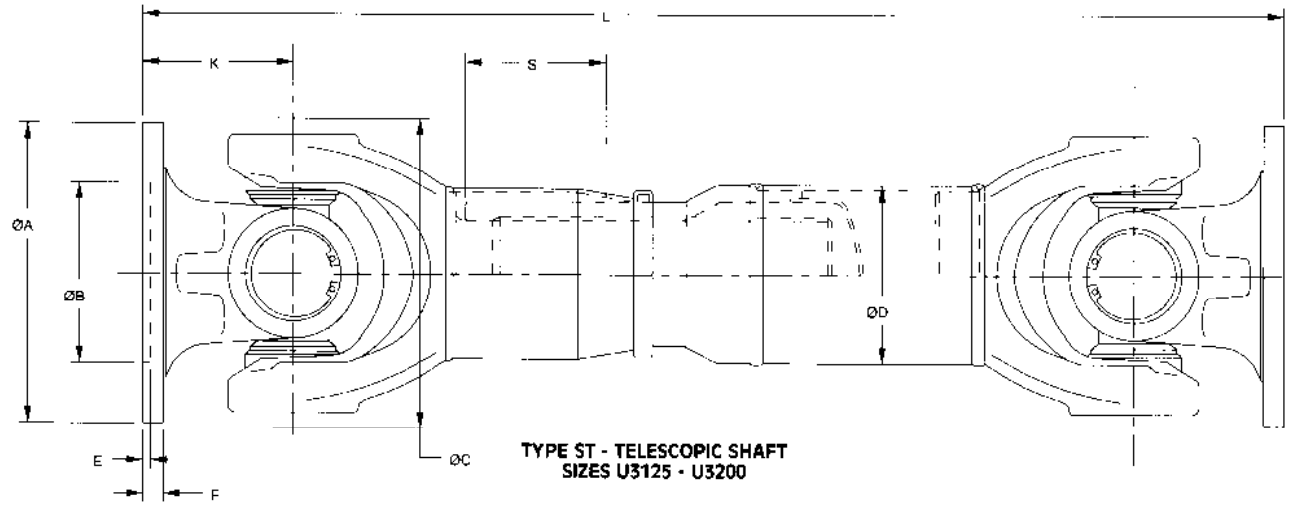
Dimensional Data (inches and millimeters except where noted)

	In.	mm	In.	mm	In.	mm	In.	mm	In.	mm	In.	mm
β	20°	20°	20°	20°	20°	20°	20°	20°	20°	20°	20°	20°
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	2.00	50	2.00	50	2.00	50	2.00	50	2.35	60	2.35	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
Bolt Dia.	–	8	–	8	–	8	–	8	–	8	–	10

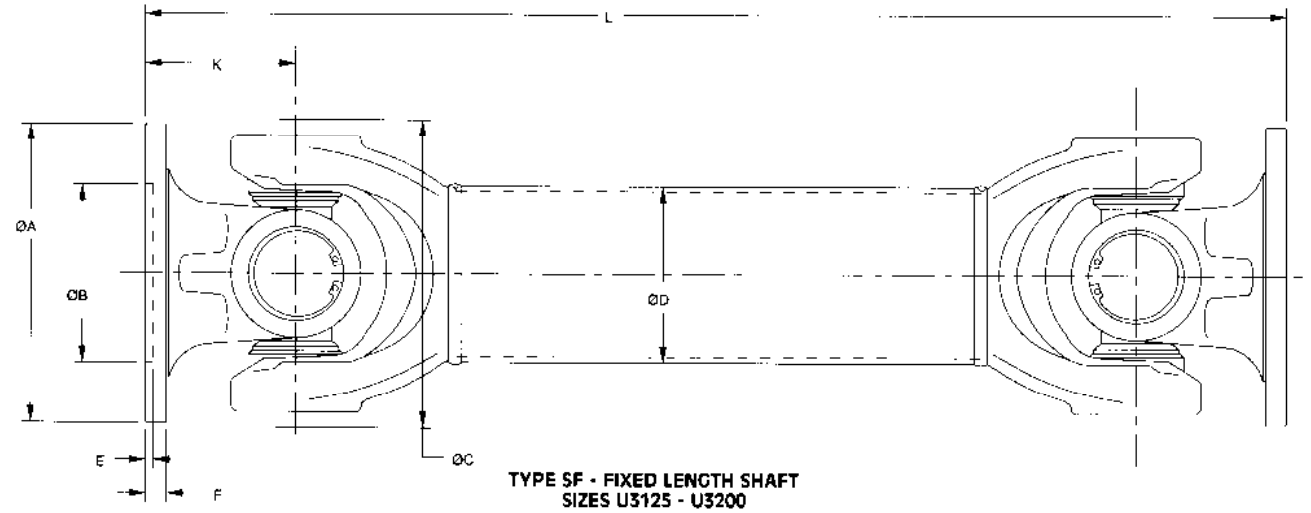
Minimum Length L / Length Compensation S

ST L	13.70	348	14.72	374	18.62	473
S	1.57	40	1.57	40	1.57	40
SF L	8.50	216	9.84	250	11.85	301

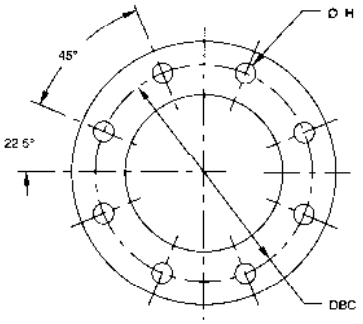
Engineering Data
Series 3000 Sizes U3125 - U3200



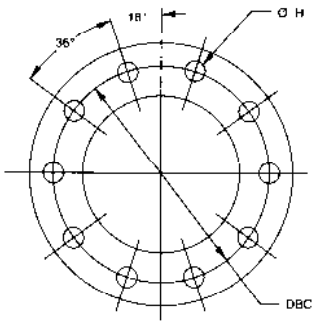
TYPE ST - TELESCOPIC SHAFT
SIZES U3125 - U3200



TYPE SF - FIXED LENGTH SHAFT
SIZES U3125 - U3200



8 - HOLE



10 - HOLE

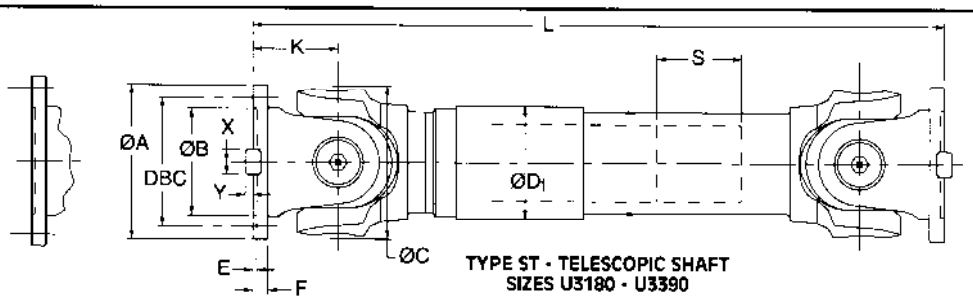
Size	U3125		U3140		U3155	
Torque Ratings						
	In-Lb	Nm	In-Lb	Nm	In-Lb	Nm
Te	16,880	1907	22,814	2578	29,366	3318
Tow	25,320	2861	34,221	3867	44,049	4977
T_L	22,037	2490	30,842	3485	40,462	4572
Tp	37,980	4292	51,332	5800	66,074	7466
Dimensional Data (inches and millimeters except where noted)						
	In. mm		In. mm		In. mm	
β	20° 20°		20° 20°		20° 20°	
A	4.72 120		5.91 150		5.91 150	
B	2.95 75		3.54 90		3.54 90	
C	4.92 125		4.92 125		5.83 148	
D	2.75 70		2.75 70		3.12 80	
E	0.10 2.5		0.12 3		0.12 3	
F	0.35 9		0.35 9		0.35 9	
K	2.36 60		2.36 60		2.56 65	
DBC	4.00 101.5		5.12 130		5.12 130	
Bolt Qty.	8 8		8 8		8 8	
Bolt Dia.	– 10		– 10		– 12	
Minimum Length L / Length Compensation S						
ST L	19.33	491	21.65	550	29.21	742
S	2.36	60	4.33	110	4.33	110
SF L	12.09	307	13.58	345	17.91	455

Size	U3125		U3140		U3155	
	In. mm		In. mm		In. mm	
β	20° 20°		20° 20°		20° 20°	
A	4.72 120		5.91 150		5.91 150	
B	2.95 75		3.54 90		3.54 90	
C	4.92 125		4.92 125		5.83 148	
D	2.75 70		2.75 70		3.12 80	
E	0.10 2.5		0.12 3		0.12 3	
F	0.35 9		0.35 9		0.35 9	
K	2.36 60		2.36 60		2.56 65	
DBC	4.00 101.5		5.12 130		5.12 130	
Bolt Qty.	8 8		8 8		8 8	
Bolt Dia.	– 10		– 10		– 12	

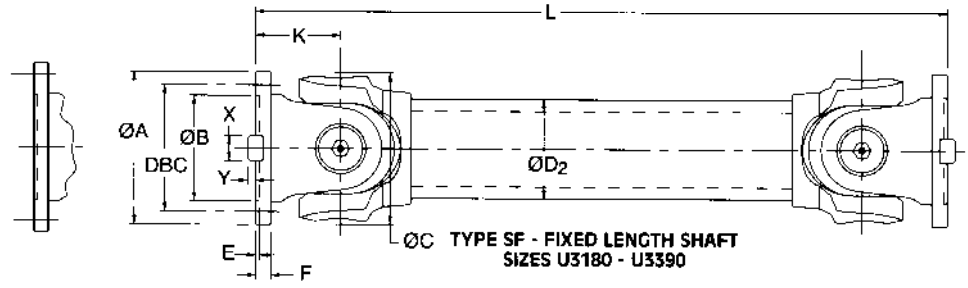
Size	U3160		U3175		U3200	
Torque Ratings						
	In-Lb	Nm	In-Lb	Nm	In-Lb	Nm
Te	44,559	5035	63,811	7210	133,100	15040
Tow	66,839	7552	95,717	10815	199,650	22559
T_L	51,596	5830	71,614	8092	124,103	14023
Tp	100,258	11329	143,575	16223	243,300	27492
Dimensional Data (inches and millimeters except where noted)						
	In. mm		In. mm		In. mm	
β	30° 30°		30° 30°		30° 30°	
A	6.50 165		7.09 180		8.86 225	
B	3.74 95		4.33 110		5.51 140	
C	6.22 158		6.22 158		7.01 178	
D	4.00 100		4.00 100		4.38 110	
E	0.14 3.6		0.14 3.6		0.20 5	
F	0.47 12		0.47 12		0.55 14	
K	3.39 86		3.39 86		3.78 96	
DBC	5.51 140		6.12 155.5		6.12 155.5	
Bolt Qty.	8 8		8 8		10 10	
Bolt Dia.	– 16		– 16		– 16	
Minimum Length L / Length Compensation S						
ST L	25.98	660	29.13	740	32.68	830
S	4.33	110	4.33	110	5.50	139.7
SF L	16.93	430	18.31	465	20.47	520

Size	U3160		U3175		U3200	
	In. mm		In. mm		In. mm	
β	30° 30°		30° 30°		30° 30°	
A	6.50 165		7.09 180		8.86 225	
B	3.74 95		4.33 110		5.51 140	
C	6.22 158		6.22 158		7.01 178	
D	4.00 100		4.00 100		4.38 110	
E	0.14 3.6		0.14 3.6		0.20 5	
F	0.47 12		0.47 12		0.55 14	
K	3.39 86		3.39 86		3.78 96	
DBC	5.51 140		6.12 155.5		6.12 155.5	
Bolt Qty.	8 8		8 8		10 10	
Bolt Dia.	– 16		– 16		– 16	

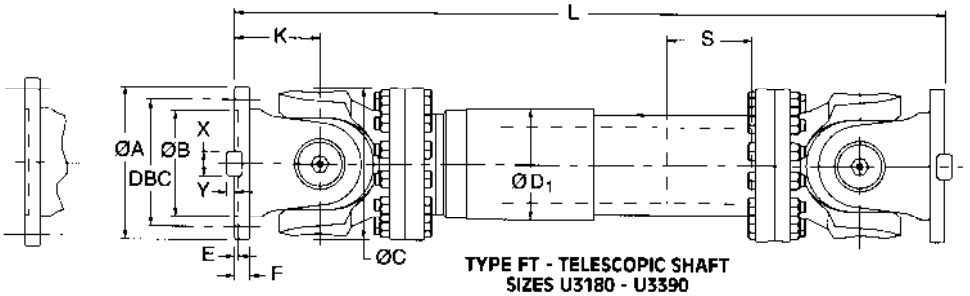
Engineering Data
Series 3000 Sizes U3180 - U3390



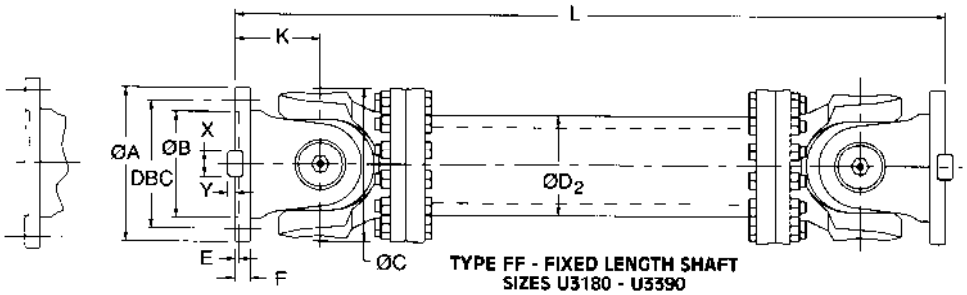
TYPE ST - TELESCOPIC SHAFT
SIZES U3180 - U3390



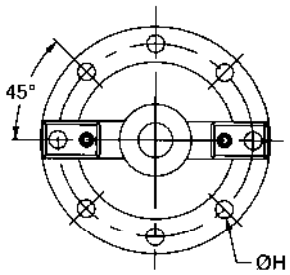
TYPE SF - FIXED LENGTH SHAFT
SIZES U3180 - U3390



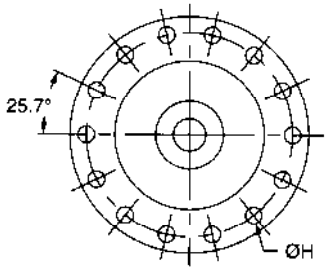
TYPE FT - TELESCOPIC SHAFT
SIZES U3180 - U3390



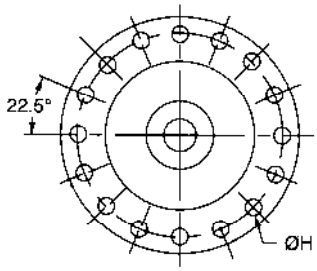
TYPE FF - FIXED LENGTH SHAFT
SIZES U3180 - U3390



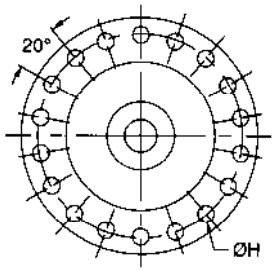
FACE KEY
8 - HOLE



14 - HOLE



16 - HOLE



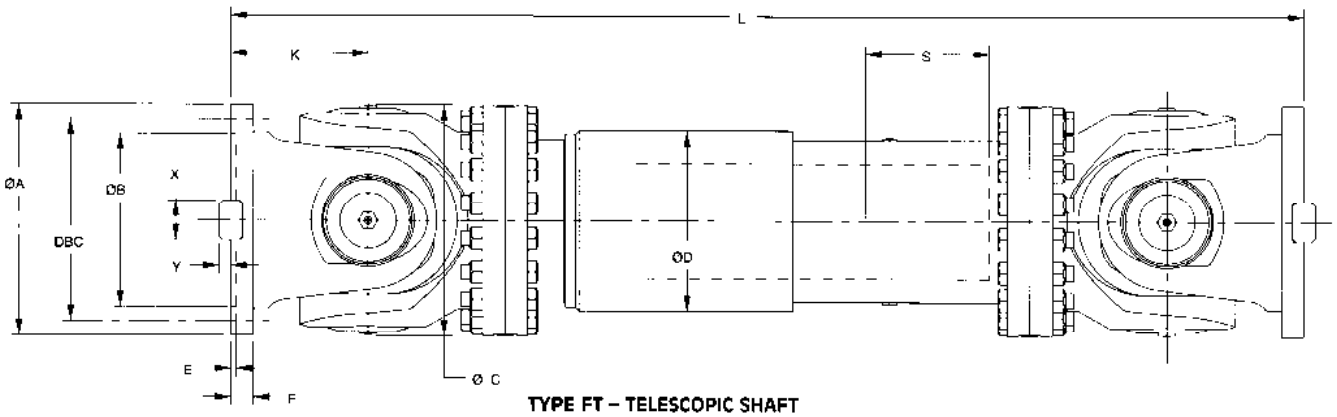
18 - HOLE

Note: Integral Face Pad and Hirth Radial tooth connections are available. See page 16.

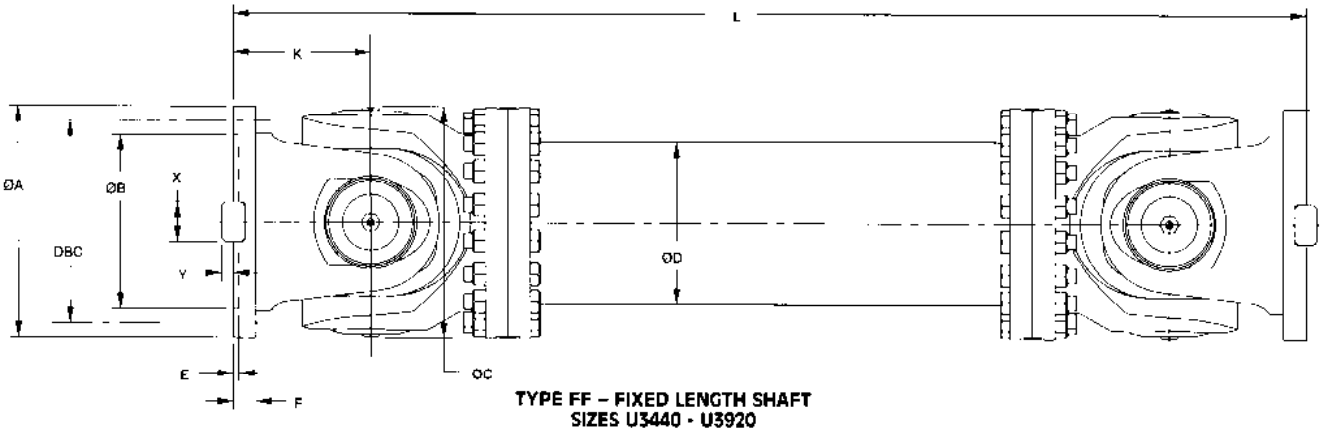
Size	U3180		U3208		U3225		U3250	
Torque Ratings								
	In-Lb	kNm	In-Lb	kNm	In-Lb	kNm	In-Lb	kNm
Te	117,900	13.3	209,600	23.7	233,800	26.4	265,400	30.0
Tow	176,850	20.0	314,400	35.5	350,700	39.6	398,000	45.0
T_L	109,900	12.4	153,100	17.3	170,800	19.3	248,100	28.0
Tp	215,500	24.4	416,670	47.1	464,800	52.5	538,000	60.8
Dimensional Data (inches and millimeters except where noted)								
	In. mm	In. mm	In. mm	In. mm	In. mm	In. mm	In. mm	In. mm
β	25° 25°	25° 25°	15° 15°	15° 15°	15° 15°	15° 15°	15° 15°	15° 15°
A	7.38 187.5	8.88 225.6	8.88 225.6	10.00 254.0	8.88 225.6	10.00 254.0	10.00 254.0	11.00 279.4
B	5.25 133.4	5.25 133.4	5.51 140.0	5.51 140.0	5.51 140.0	5.51 140.0	6.89 175.0	6.89 175.0
C	7.09 180.0	7.09 180.0	8.19 208.0	8.19 208.0	8.86 225.0	8.86 225.0	9.84 250.0	9.84 250.0
D1	5.25 133.4	5.25 133.4	6.25 158.8	6.25 158.8	6.25 158.8	6.25 158.8	7.25 184.2	7.25 184.2
D2	4.50 114.3	4.50 114.3	5.50 139.7	5.50 139.7	5.00 127.0	5.00 127.0	6.50 165.1	6.50 165.1
E	0.20 5.1	0.20 5.1	0.20 5.1	0.20 5.1	0.20 5.1	0.20 5.1	0.25 6.4	0.25 6.4
F	0.67 17.0	0.67 17.0	0.83 21.1	0.83 21.1	0.83 21.1	0.83 21.1	0.98 24.9	0.98 24.9
K	4.33 110.0	4.33 110.0	4.72 120.0	4.72 120.0	4.92 125.0	4.92 125.0	5.51 140.0	5.51 140.0
DBC	6.25 158.8	7.75 196.9	7.75 196.9	8.50 215.9	7.75 196.9	8.50 215.9	8.50 215.9	9.50 241.3
Bolt Qty.	8 8	14 14	8 8	14 14	8 8	14 14	8 8	16 16
Bolt Dia.	5/8 16	5/8 16	5/8 16	3/4 18	5/8 16	3/4 18	3/4 18	3/4 18
X	1.00 25.4	– –	1.25 31.8	– –	1.25 31.8	– –	1.62 41.1	– –
Y	0.25 6.4	– –	0.38 9.7	– –	0.38 9.7	– –	0.50 12.7	– –
Minimum Length L / Length Compensation S								
ST L	38.95	989.3	41.26	1048.0	41.30	1049.0	44.82	1138.4
S	5.00	127.0	5.50	139.7	5.00	127.0	5.50	139.7
SF L	18.74	476.0	20.32	516.1	21.12	536.4	24.24	615.7
FT L	40.57	1030.5	43.02	1092.7	43.25	1098.6	46.04	1169.4
S	5.00	127.0	5.50	139.7	5.00	127.0	5.50	139.7
FF L	17.32	439.9	18.88	479.6	19.68	499.9	22.04	559.8

Size	U3285		U3315		U3350		U3390	
Torque Ratings								
	In-Lb	kNm	In-Lb	kNm	In-Lb	kNm	In-Lb	kNm
Te	414,200	46.8	661,600	74.8	979,500	110.7	1,400,000	158.2
Tow	621,300	70.2	992,300	112.1	1,469,000	166.0	2,100,000	237.3
T_L	364,400	41.2	507,400	57.3	733,800	82.9	989,500	111.8
Tp	862,000	97.4	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	In. mm	In. mm
β	15° 15°	15° 15°	15° 15°	15° 15°	15° 15°	15° 15°	15° 15°	15° 15°
A	11.00 279.4	12.38 314.5	12.38 314.5	13.75 349.3	13.75 349.3	15.38 390.7	15.38 390.7	17.32 439.9
B	6.89 175.0	6.89 175.0	8.66 220.0	8.66 220.0	9.84 250.0	9.84 250.0	11.02 280.0	11.02 280.0
C	11.22 285.0	11.22 285.0	12.41 315.0	12.41 315.0	13.78 350.0	13.78 350.0	15.38 390.0	15.38 390.0
D1	8.50 215.9	8.50 215.9	9.50 241.3	9.50 241.3	11.00 279.4	11.00 279.4	12.00 304.8	12.00 304.8
D2	7.75 196.9	7.75 196.9	8.75 222.3	8.75 222.3	10.00 254.0	10.00 254.0	10.50 266.7	10.50 266.7
E	0.28 7.1	0.28 7.1	0.31 7.9	0.31 7.9	0.31 7.9	0.31 7.9	0.31 7.9	0.31 7.9
F	1.06 26.9	1.06 26.9	1.25 31.8	1.25 31.8	1.38 35.1	1.38 35.1	1.62 41.1	1.62 41.1
K	6.30 160.0	6.30 160.0	7.09 180.0	7.09 180.0	7.64 194.0	7.64 194.0	8.46 215.0	8.46 215.0
DBC	9.50 241.3	11.00 279.4	11.00 279.4	12.19 309.6	12.19 309.6	13.50 342.9	13.50 342.9	15.37 390.4
Bolt Qty.	8 8	14 14	8 8	16 16	8 8	16 16	8 8	18 18
Bolt Dia.	3/4 18	7/8 22	7/8 22	7/8 22	7/8 22	1 24	1 24	1-1/8 27
X	1.62 41.1	– –	1.62 41.1	– –	2.00 50.8	– –	2.75 69.9	– –
Y	0.50 12.7	– –	0.50 12.7	– –	0.63 16.0	– –	0.75 19.1	– –
Minimum Length L / Length Compensation S								
ST L	49.53	1258.1	52.42	1331.5	56.35	1431.3	60.20	1529.1
S	5.50	139.7	5.50	139.7	6.00	152.4	6.50	165.1
SF L	28.22	716.8	31.00	787.4	34.18	868.2	37.40	950.0
FT L	50.38	1279.7	53.85	1367.8	58.57	1487.7	63.59	1615.2
S	5.50	139.7	5.50	139.7	6.00	152.4	6.50	165.1
FF L	25.20	640.1	28.36	720.3	30.56	776.2	33.84	859.5

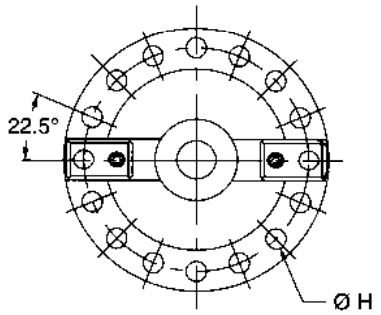
Engineering Data
Series 3000 Sizes U3400 - U3920



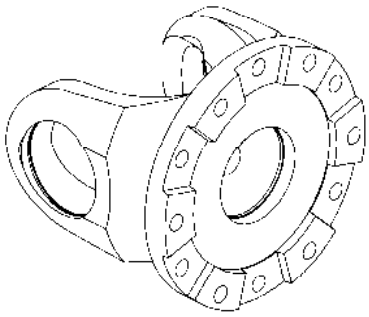
TYPE FT – TELESCOPIC SHAFT
SIZES U3440 - U3920



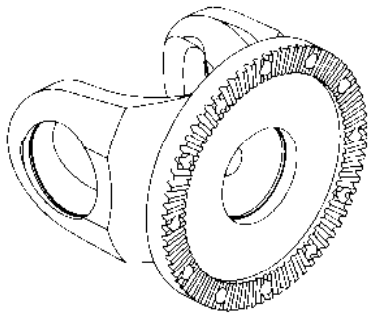
TYPE FF – FIXED LENGTH SHAFT
SIZES U3440 - U3920



FACE KEY
16 - HOLE



INTEGRAL FACE PAD



HIRTH RADIAL TOOTH CONNECTION

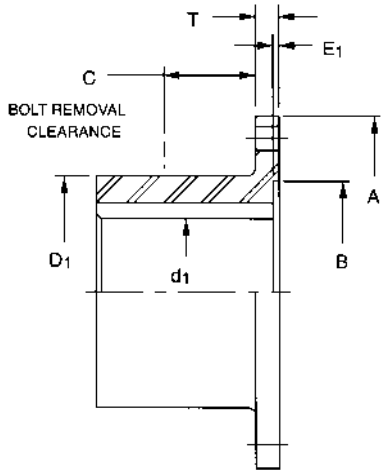
The torque ratings are based on material strength. When approaching these limits the capacity of the desired flange connection should be verified. When the selection torque (**Ts**) approaches the endurance torque (**Te**) or when the maximum torque approaches the peak torque capacity (**Tp**) of the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

Te = normal fully reversing torque rating
Tow = normal pulsating one way torque rating
TL = B-10 bearing life rating (based on 5000 hours B-10 bearing life at 3° misalignment and 100 RPM)
Tp = peak torque or maximum allowable torque

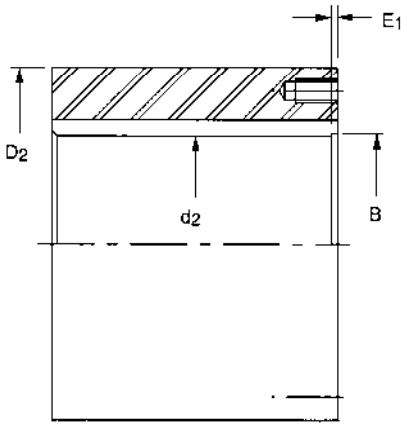
Size	U3440		U3490		U3550		U3620		U3680	
Torque Ratings										
	In-Lb	KNm	In-Lb	KNm	In-Lb	KNm	In-Lb	KNm	In-Lb	KNm
Te	2,382,000	269	3,170,000	358	5,253,000	594	6,660,000	753	8,178,000	924
Tow	3,573,000	404	4,755,000	537	7,880,000	890	9,996,000	1129	12,267,000	1386
T_L	1,665,000	188	2,126,000	240	2,994,000	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
β	15°	15°	15°	15°	15°	15°	15°	15°	15°	15°
A	17.32	439.9	19.28	489.7	21.62	549.1	24.41	620.0	26.77	680.0
B	13.00	330.2	13.50	342.9	16.00	406.4	18.00	457.2	19.00	482.6
C	17.32	440.0	19.28	490.0	21.65	550.0	24.41	620.0	26.77	680.0
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	15.0
F	1.69	42.9	1.75	44.5	2.00	50.8	2.12	53.8	2.12	53.8
K	10.24	260.0	10.63	270.0	12.01	305.0	13.38	340.0	15.53	395.0
DBC	15.37	390.4	17.12	434.8	19.37	492.0	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	2667.0
S	7.50	190.5	7.50	190.5	9.50	241.3	9.50	241.3	10.00	254.0
FF L	40.96	1040.4	42.52	1080.0	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
β	15°	15°	15°	15°	15°	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	25.00	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	127.0
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	254.0	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

Flange Adapter Dimensions

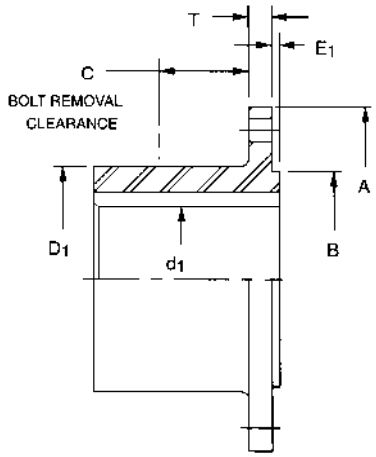


DESIGN 1

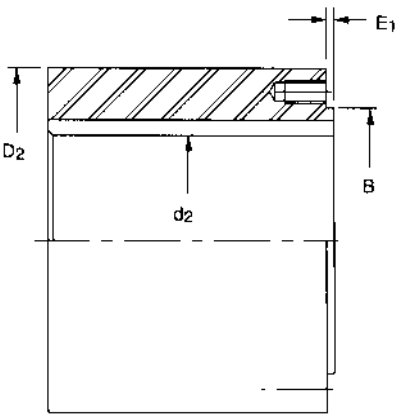


DESIGN 2

2000 SERIES



DESIGN 1



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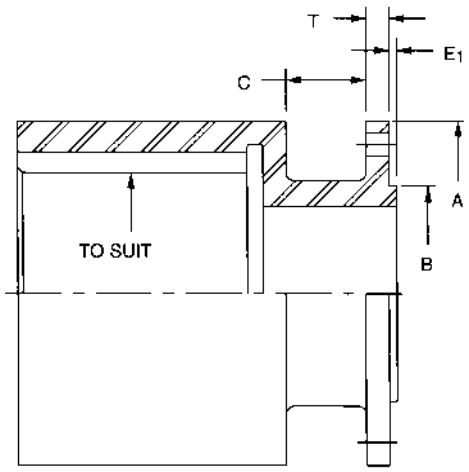


DESIGN 3

3000 SERIES

Size	U2131	U2135	U2141	U2148	U2155	U2160	U2170	U2180	U2190	U2191
A	3.88	4.63	4.63	5.88	5.88	6.88	8.00	8.00	9.63	9.63
B	2.38	2.75	2.75	3.75	3.75	6.62	7.75	7.75	7.00	7.00
T	0.38	0.50	0.50	0.38	0.38	0.38	0.38	0.50	0.38	0.38
E1	0.08	0.08	0.08	0.08	0.08	0.04	0.04	0.04	0.11	0.11
C	1.75	2.00	2.00	2.00	2.00	1.75	1.75	2.00	2.50	2.50
D1	2.44	2.88	2.88	3.75	3.75	5.25	6.38	6.38	6.88	6.88
d1	1.69	1.88	1.88	2.44	2.44	3.50	4.00	4.00	4.50	4.50
D2	3.88	4.56	4.56	5.88	5.88	6.88	8.00	8.00	9.63	9.63
d2	2.38	2.75	2.75	3.75	3.75	4.75	5.50	5.50	6.50	6.50

Size	U3055		U3060		U3070		U3090		U3100	
A	2.28	2.56	2.56	2.95	2.95	3.54	3.54	3.94	3.94	4.72
B	1.18	1.38	1.38	1.65	1.65	1.85	1.85	2.24	2.24	2.95
T	–	–	–	–	–	0.25	0.25	0.25	0.31	0.31
E1	0.05	0.05	0.06	0.06	0.07	0.09	0.09	0.09	0.09	0.09
C	–	–	–	–	–	1.10	1.10	1.10	1.10	1.23
D1	–	–	–	–	–	2.12	2.12	2.31	2.31	3.30
d1	–	–	–	–	–	1.25	1.25	1.62	1.62	2.25
D2	2.28	2.56	2.56	2.95	2.95	3.54	3.54	3.94	3.94	4.72
d2	1.18	1.38	1.38	1.65	1.65	1.85	1.85	2.24	2.24	2.95

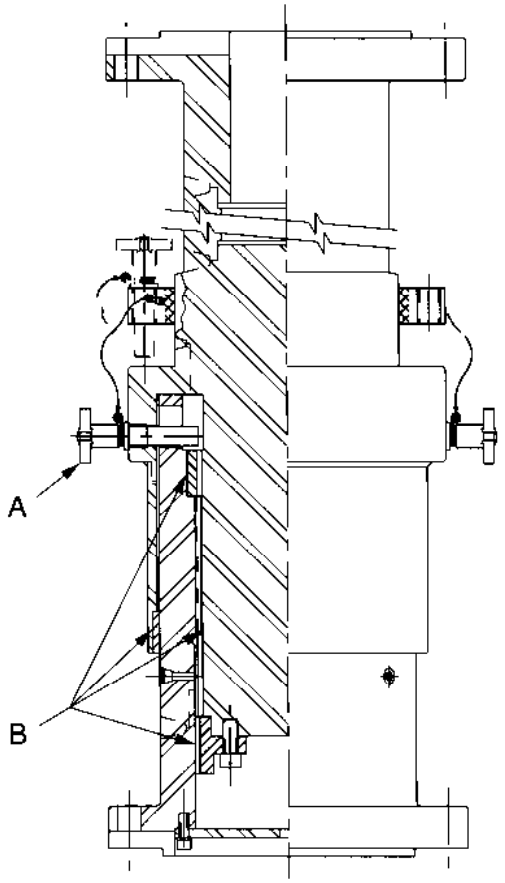
Size	U3115		U3125		U3140		U3155		U3160	
A	4.72	5.91	4.72	5.91	5.91	7.09	5.91	7.09	6.50	7.09
B	2.95	3.54	2.95	3.54	3.54	4.33	3.54	4.33	3.74	4.33
T	0.38	0.38	0.38	0.38	0.44	0.44	0.44	0.44	0.44	0.50
E1	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
C	1.23	1.25	1.25	1.38	1.42	1.57	1.65	1.78	1.65	1.96
D1	3.30	4.31	3.30	4.31	4.31	5.19	4.31	5.19	4.31	5.19
d1	2.25	2.88	2.25	2.88	2.88	3.44	2.88	3.44	2.88	3.44
D2	4.72	5.91	4.72	5.91	5.91	7.09	5.91	7.09	6.50	7.09
d2	2.95	3.54	2.95	3.54	3.54	4.33	3.54	4.33	3.54	4.33

Size	U3175		U3180		U3200		U3208		U3225	
A	7.09	8.86	7.38	8.88	8.86	9.84	8.88	10.00	8.88	10.00
B	4.33	5.51	5.25	5.25	5.51	5.51	5.51	5.51	5.51	5.51
T	0.50	0.63	1.06	1.06	0.63	0.63	0.88	1.38	0.63	0.63
E1	0.09	0.16	0.14	0.14	0.16	0.16	0.14	0.14	0.14	0.14
C	1.96	2.08	3.00	3.00	3.00	3.00	3.00	3.88	3.00	3.00
D1	5.19	6.59	4.50	6.25	6.59	7.56	6.25	6.50	6.25	6.50
d1	3.44	4.38	3.12	4.25	4.38	5.00	4.25	4.62	4.25	4.62
D2	7.09	8.86	7.38	8.88	8.86	9.84	8.88	10.00	8.88	10.00
d2	4.33	5.88	4.88	5.88	5.88	6.56	5.88	6.62	5.88	6.62

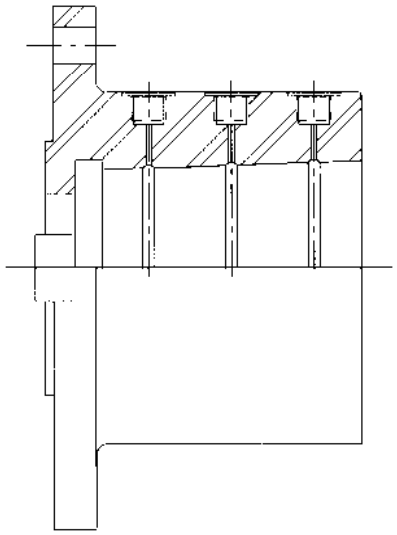
Size	U3250		U3285		U3315		U3350		U3390	
A	10.00	11.00	11.00	12.38	12.38	13.75	13.75	15.38	15.38	17.32
B	6.89	6.89	6.89	6.89	8.66	8.66	9.84	9.84	11.02	11.02
T	1.25	1.25	1.12	1.12	1.62	1.62	1.50	1.88	1.62	1.69
E1	0.19	0.19	0.22	0.22	0.25	0.25	0.25	0.25	0.25	0.25
C	3.88	3.88	3.88	3.88	4.62	4.62	4.62	5.25	5.25	6.00
D1	6.50	7.50	7.50	8.69	8.69	9.50	9.50	10.62	10.62	12.25
d1	4.62	5.31	5.31	6.19	6.19	6.75	6.75	7.25	7.25	8.25
D2	10.00	11.00	11.00	12.38	12.38	13.75	13.75	15.38	15.38	17.32
d2	6.62	7.31	7.31	8.31	8.31	9.12	9.12	10.31	10.31	11.62

Size	U3440	U3490	U3550	U3620	U3680	U3720	U3760	U3800	U3860	U3920
A	17.32	19.28	21.62	24.41	26.77	28.35	29.92	31.50	33.85	36.22
B	13.00	13.50	16.00	18.00	19.00	20.00	21.00	22.00	24.00	25.00
T	1.69	2.25	2.00	2.22	2.22	2.25	2.50	2.50	2.62	2.75
E1	0.31	0.38	0.38	0.38	0.50	0.50	0.50	0.50	0.50	0.62
C	6.00	6.50	6.50	7.50	7.50	7.50	8.00	8.00	8.50	8.50
D1	12.25	14.38	16.50	18.50	20.50	22.50	24.00	25.50	27.88	30.00
d1	8.25	10.00	11.25	12.75	14.00	15.50	16.50	17.50	19.00	20.50
D2	17.32	19.28	21.62	24.41	26.77	28.35	29.92	31.50	33.85	36.22
d2	11.62	12.88	14.75	16.75	18.38	19.50	20.63	21.62	23.25	25.00

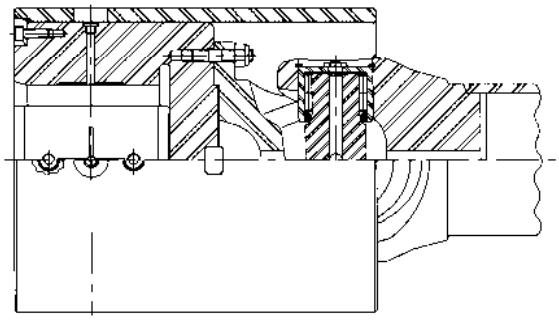
Design Variations and Custom Applications



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

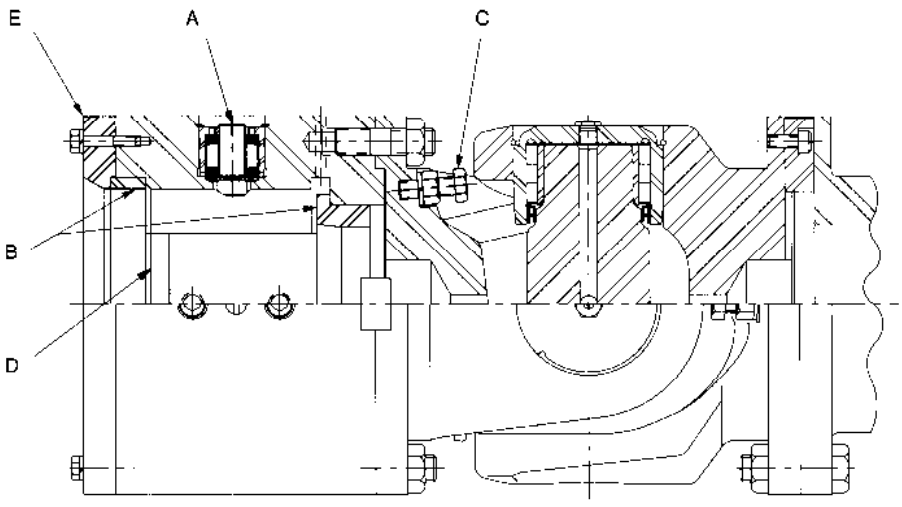


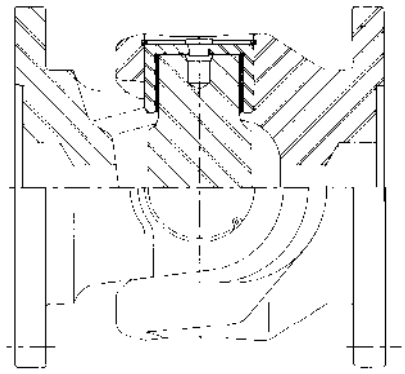
Hydraulic Removal Adapter



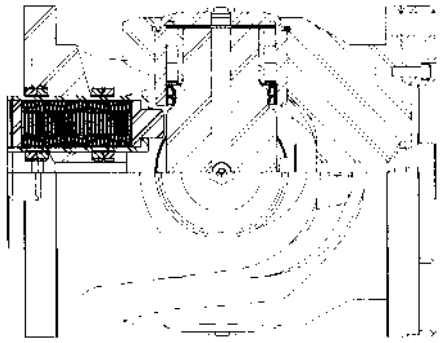
Roll Removal Support Mechanism

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

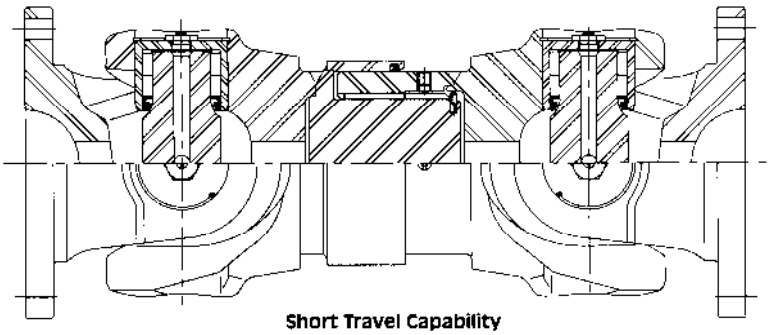




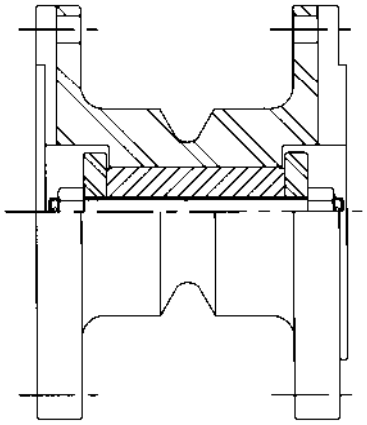
Composite Bearing



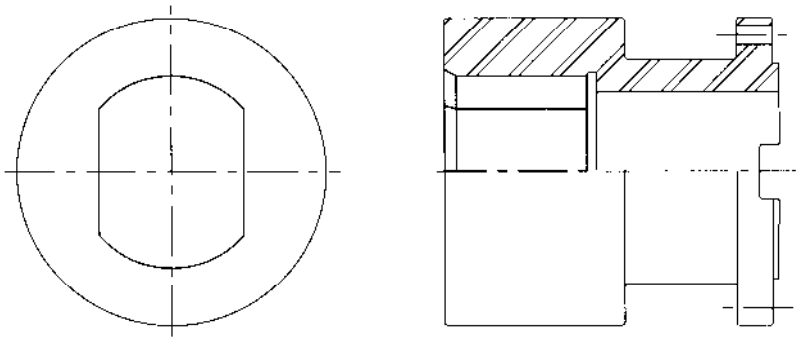
Roll End Support Mechanism



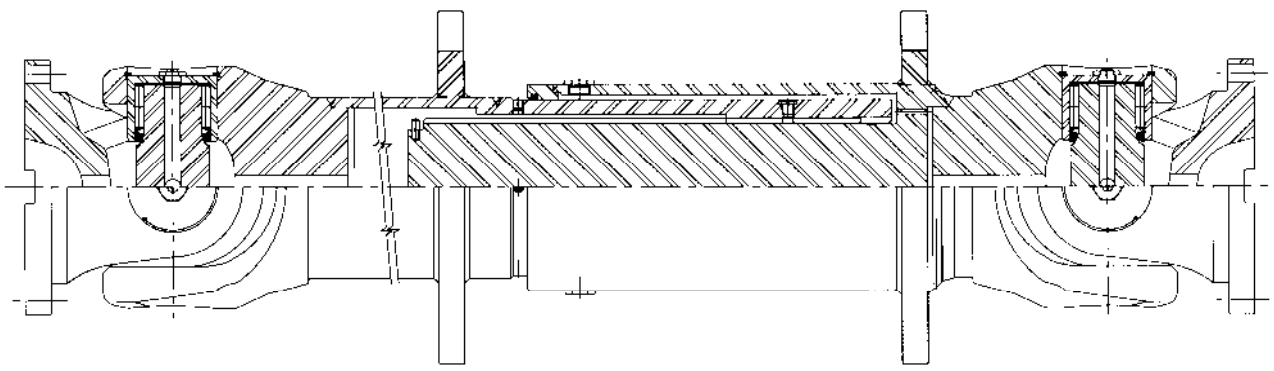
Short Travel Capability



Shear Spacer Assembly



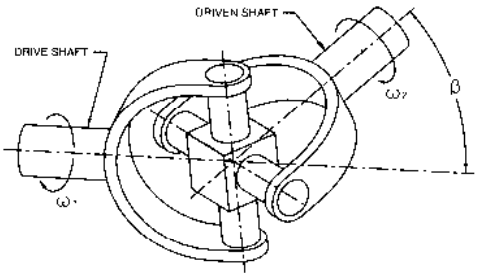
Developed and Hardened Roll End Bore



Long Travel Capability With Expansion and Contraction Flanges

Kinematics and Motion Characteristics

When a universal joint is operated at an angle (β), non-uniform motion is developed. With the driving yoke of the joint operating at a uniform rotational velocity to (ω_1), the driven yoke rotates non-uniformly with respect to angular displacement, velocity (ω_2), 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.

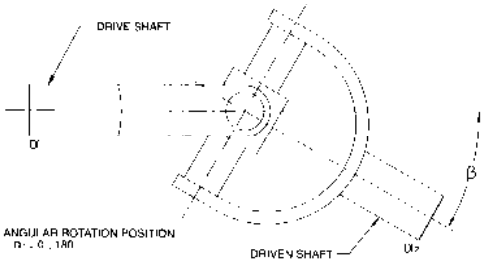
With a constant angular velocity (ω_1), of the driving yoke, the driven yoke has a maximum difference of output angular velocity (φ), with respect to the driving yoke when the driving yoke lies in the plane of the joint angle and also when the driving yoke is normal or perpendicular to this plane. The driven yoke has the same angular velocity as the driving yoke at approximately 45° 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 (ω_2), can be determined for a given angular displacement (α_1), with the formula

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

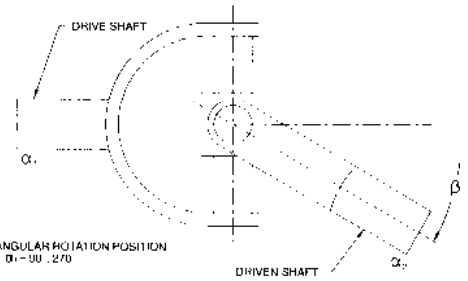
During one revolution of the drive yoke the driven yoke will reach a maximum angular velocity two times at $\alpha = 0°$ and 180°.



The maximum angular velocity will be

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

The driven yoke will also reach a minimum angular velocity two times during one revolution at $\alpha = 90°$ and 270°.



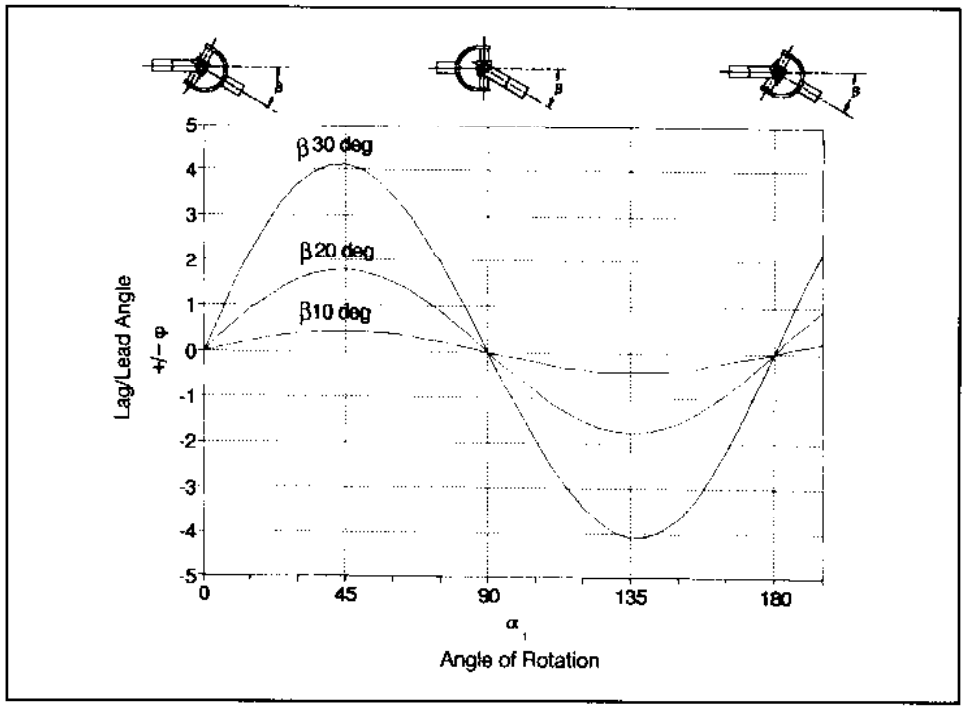
The minimum angular velocity will be

$$\omega_2 min = \cos\beta\ \omega_1$$

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

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

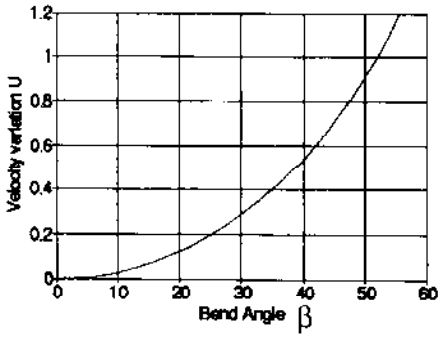
$$\alpha_2 = \tan^{-1} \left(\frac{1}{\cos\beta} \times \tan\alpha_1 \right)$$



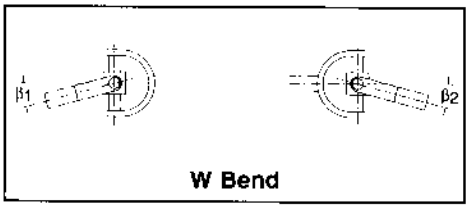
Lag and lead angle (φ) as a function of angular rotation (α) of the joint and bend angle (β).

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

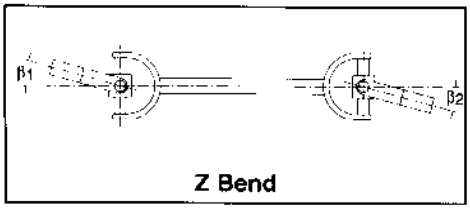
$$U = \left(\frac{\omega_2 max - \omega_2 min}{\omega_1}\right) = \tan\beta \times \sin\beta$$



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 β_1, and β_2, equal, the velocity variations developed in the first joint are in effect cancelled by the velocity variations in the second joint.



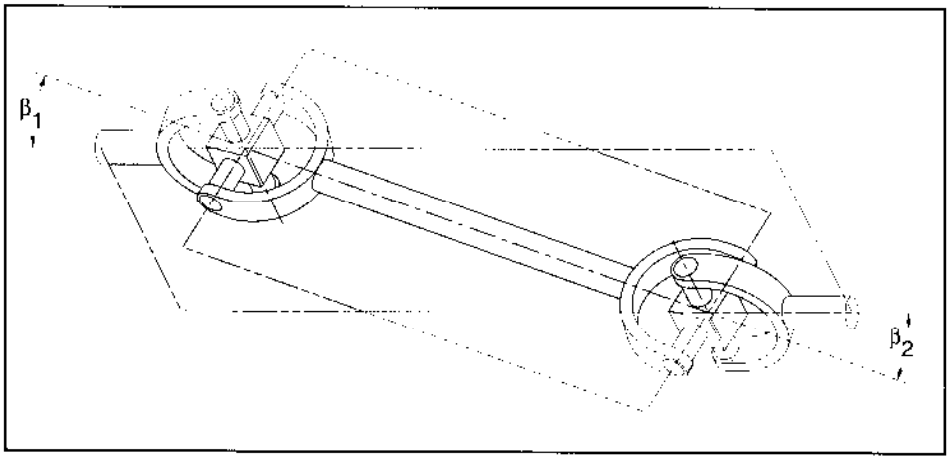
W Bend



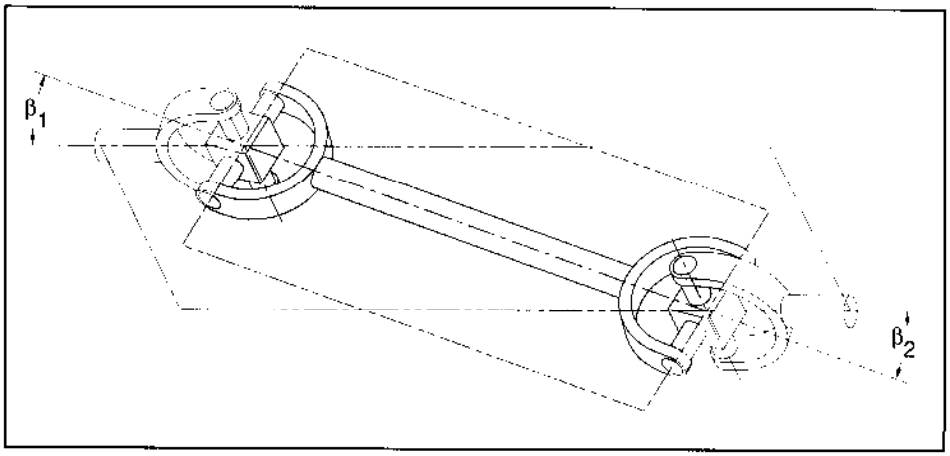
Z Bend

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

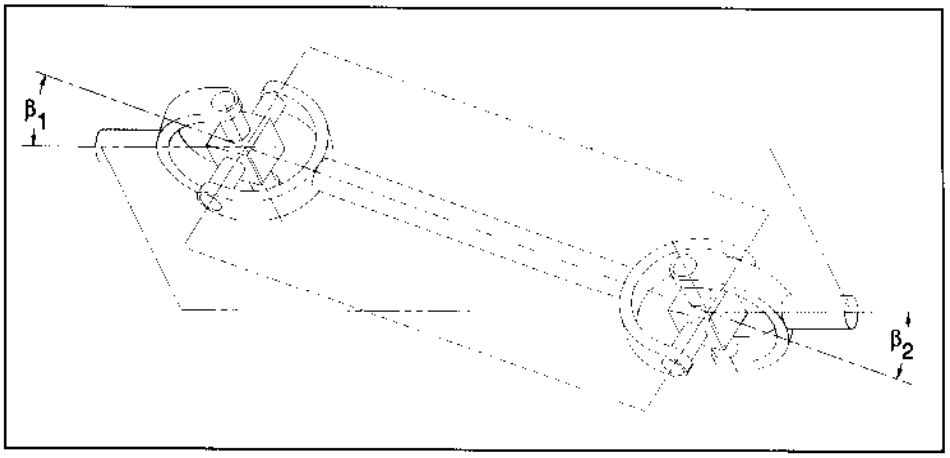
1. The axis of all shaft sections lie in the same plane.



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



3. The bend angles β_1 and β_2 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 driven 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 above.
- 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	-.0005 / -.0010	-.0000 / -.0010
1.5000 / 3.0000		-.0010 / -.0020	-.0000 / -.0020
3.0000 / 4.0000		-.0015 / -.0030	-.0005 / -.0030
4.0000 / 5.0000		-.0020 / -.0035	-.0010 / -.0035
5.0000 / 7.0000		-.0025 / -.0040	-.0015 / -.0040
7.0000 / 8.0000		-.0030 / -.0050	-.0020 / -.0050
8.0000 / 9.0000		-.0035 / -.0055	-.0025 / -.0055
9.0000 / 10.0000		-.0040 / -.0060	-.0030 / -.0060
10.0000 / 11.0000		-.0045 / -.0065	-.0035 / -.0065
11.0000 / 12.0000	+.0000 / -.0010	-.0050 / -.0070	-.0040 / -.0070
12.0000 / 13.0000		-.0055 / -.0075	-.0045 / -.0075
13.0000 / 14.0000		-.0060 / -.0080	-.0050 / -.0080
14.0000 / 15.0000		-.0065 / -.0085	-.0055 / -.0085
15.0000 / 16.0000		-.0065 / -.0090	-.0055 / -.0090
16.0000 / 17.0000		-.0070 / -.0095	-.0060 / -.0095
17.0000 / 18.0000		-.0075 / -.0100	-.0065 / -.0100
18.0000 / 19.0000		-.0080 / -.0105	-.0070 / -.0105
19.0000 / 20.0000		-.0085 / -.0110	-.0075 / -.0110
20.0000 / 22.0000		-.0100 / -.0130	-.0080 / -.0130
22.0000 / 24.0000	+.0000 / -.0020	-.0110 / -.0140	-.0090 / -.0140
24.0000 / 26.0000		-.0120 / -.0150	-.0100 / -.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 at 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
U2190	9.63	152	122	–	–	–	0.98
U2191	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	8.88	362	239	426	352	259	2.22
	10.00	370	247	470	391	275	2.22
U3250	10.00	474	291	579	436	335	2.67
	11.00	483	300	617	466	353	2.67
U3285	11.00	714	446	786	564	445	3.22
	12.38	729	461	842	610	475	3.22
U3315	12.38	1,000	648	1,099	801	639	3.67
	13.75	1,020	668	1,172	866	679	3.67
U3350	13.75	1,354	867	1,490	1,056	882	4.22
	15.38	1,383	896	1,615	1,169	940	4.22
U3390	15.38	1,743	1,179	1,938	1,420	1,191	6.50
	17.32	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.

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Rolling Mill Application Data for Selection and Design

Customer: _____ Inquiry No.:

Contact Name: _____ No. of Units:

Type of Mill: _____ Phone: _____

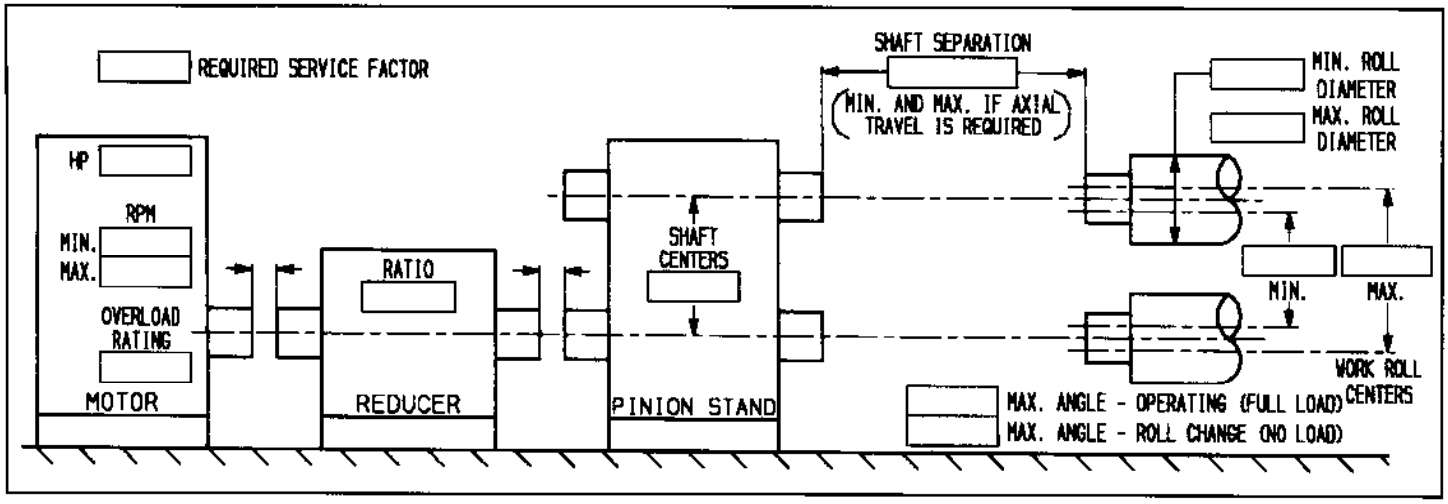
No. of Stands: _____ Fax: _____

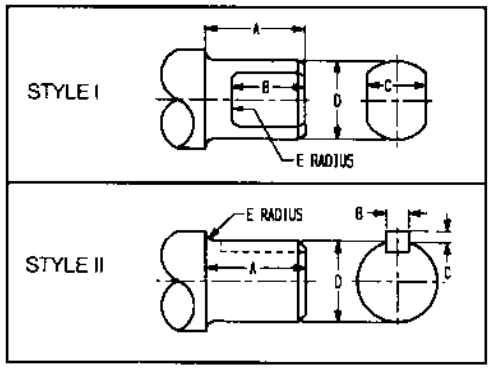
Date: _____ No. of Pages _____
(including cover sheet)

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. Minimum Work Roll Diameter
9. Maximum Work Roll Diameter
10. Minimum Work Roll Centers - Operating
11. Maximum Work Roll Centers - Operating
12. Maximum Operating Angle (Full Load)
13. Maximum Roll Change Angle (No Load)
14. Bore Requirements

Comments or special features (e.g. page 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.: _____





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.

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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. and Max.) _____
3. Required Service Factor _____
4. Operating RPM _____
5. Reducer Ratio _____
6. Normal Operating Torque _____
7. Shaft Separation (Min. and 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, atmospheric, 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.

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