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# SURFACE VEHICLE RECOMMENDED PRACTICE

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## Universal Joints and Driveshafts—Nomenclature—Terminology—Application

RATIONALE

To keep up with current driveline technology. Additions are linkshaft (or intermediate shaft), monoblock tubular shaft, slip in tube driveshaft and the flex coupling joint.

1. SCOPE

The following definitions and illustrations are intended to establish common nomenclature and terminology for universal joints and driveshafts used in various driveline applications. In addition, useful guidelines are included for the application of universal joints and driveshafts. For more specific details, see Universal Joint and Driveshaft Design Manual, AE-7.

2. REFERENCES

2.1 Applicable Publication

The following publication forms a part of this specification to the extent specified herein.

2.1.1 SAE Publication

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AE-7 Universal Joint and Driveshaft Design Manual

3. DEFINITIONS

Basic Driveline Terms:

3.1 Driveline

An assembly of one or more driveshafts with provisions for axial movement, which transmits torque and/or rotary motion at a fixed or varying angular relationship from one shaft to another.

3.2 Driveshaft

An assembly of one or two universal joints connected to a solid or tubular shaft member (see Figure 1).

3.3 Halfshaft

A driveshaft, normally one of two, that connects the chassis mounted final drive unit to the independently sprung driven wheel of a vehicle (see Figures 2 and 3).

3.3.1 Linkshaft

An intermediate solid or tubular shaft that connects the final drive unit to a halfshaft inboard joint. It is supported by a bearing and bracket attached to the powertrain. It allows the use of equal length (and possible common) halfshafts and aids in equalizing inboard joint angles (see Figure 3.5).

3.4 Driveshaft Length, Center-to-Center

The distance between the outermost universal joint centers on a driveshaft. On driveshafts with fixed centers, it is the nominal dimension, while on driveshafts with variable length centers, it is the compressed and extended lengths (see Figure 1).

3.5 Slip

The permissible length of axial travel.

3.6 Stroke or Plunge Distance

The relative axial displacement of an end motion or stroking universal joint's driving and driven members.

3.7 Phase Angle

The relative rotational position of the universal joint yokes on a driveshaft or driveline (see Figure 1).

3.8 Critical Speed

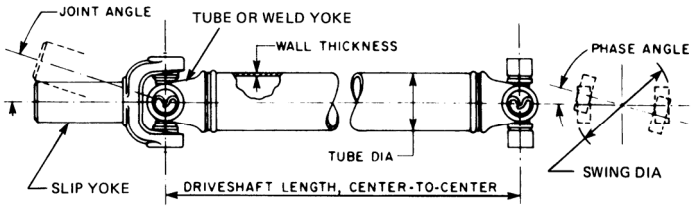
The speed at which the rotational speed coincides with the transverse natural vibration frequency of the driveshaft.

3.9 Balancing

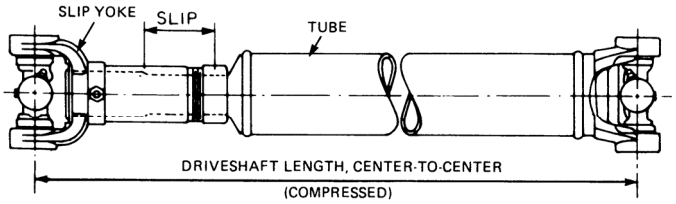
A procedure by which the mass distribution of a rotating body is measured and, if necessary, altered in order to ensure that it is within specified limits.

3.10 Mass Damper

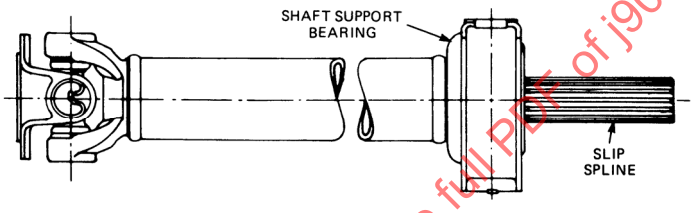
A concentrated mass generally clamped on a halfshaft midway between the universal joints. It is used to reduce the natural bending frequency of the halfshaft below a disturbing frequency (see Figure 4).



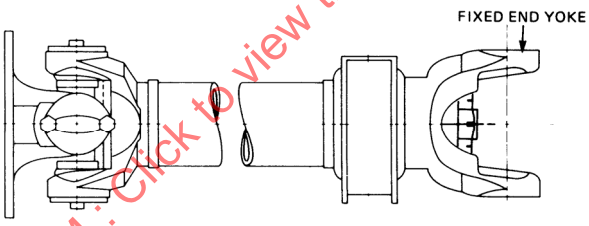

(a) TWO-JOINT OUTBOARD SLIP DRIVESHAFT




(b) TWO-JOINT INBOARD SLIP DRIVESHAFT




(c) SINGLE JOINT COUPLING SHAFT




(d) SINGLE JOINT COUPLING SHAFT

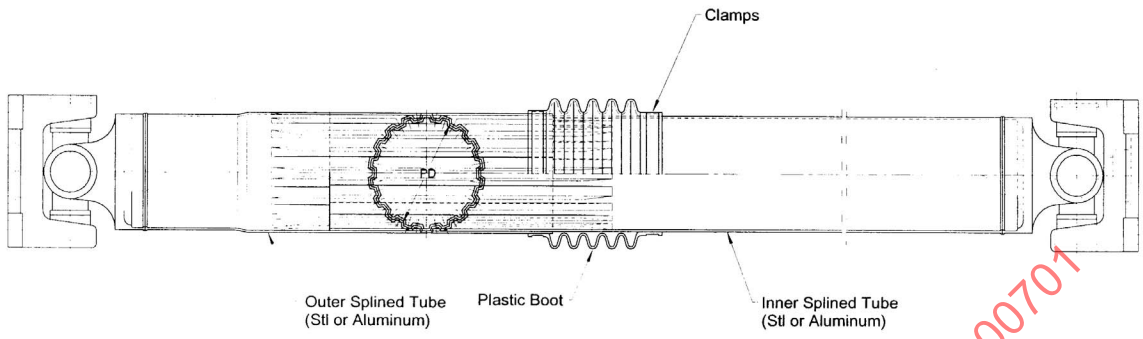



FIGURE 1 - BASIC DRIVESHAFT CONSTRUCTIONS

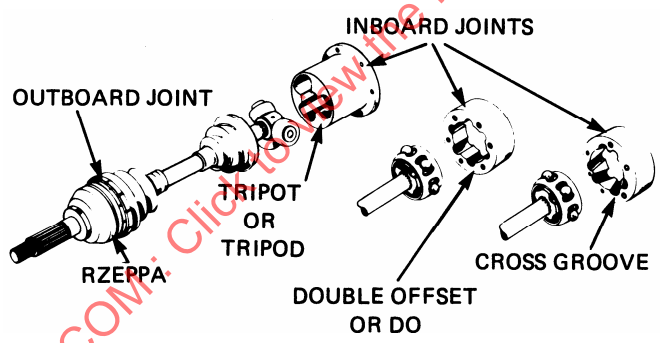



FIGURE 2 - TYPICAL FRONT-WHEEL-DRIVE HALFSHAFT WITH ALTERNATE INBOARD END MOTION UNIVERSAL JOINTS

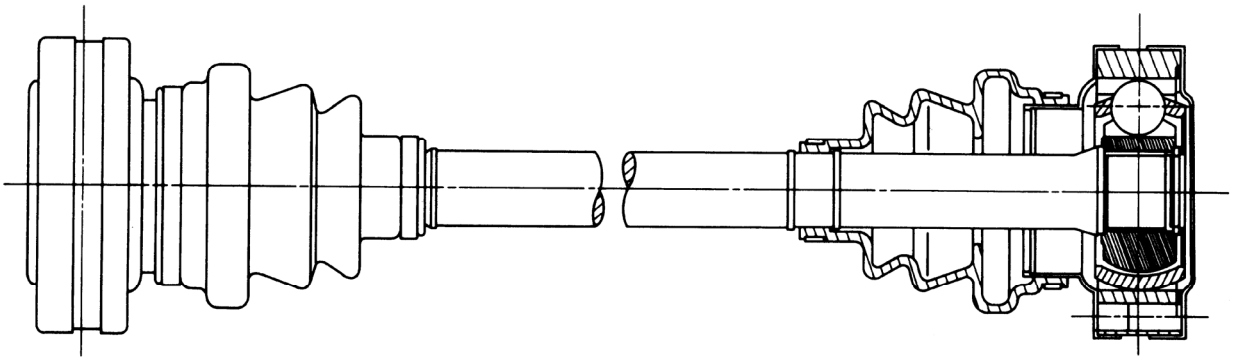


FIGURE 3 - TYPICAL REAR-WHEEL-DRIVE HALFSHAFT WITH END MOTION UNIVERSAL JOINTS (CROSS GROOVE TYPE SHOWN)

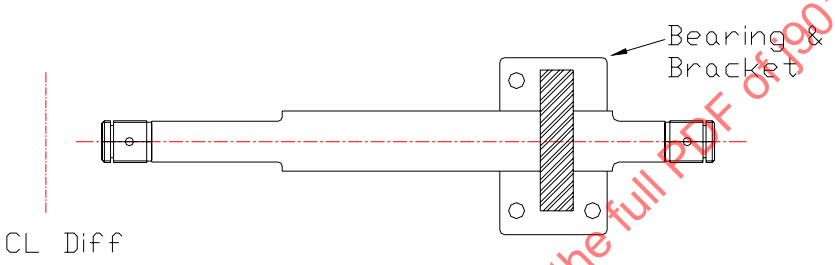



FIGURE 3.5 - LINKSHAFT

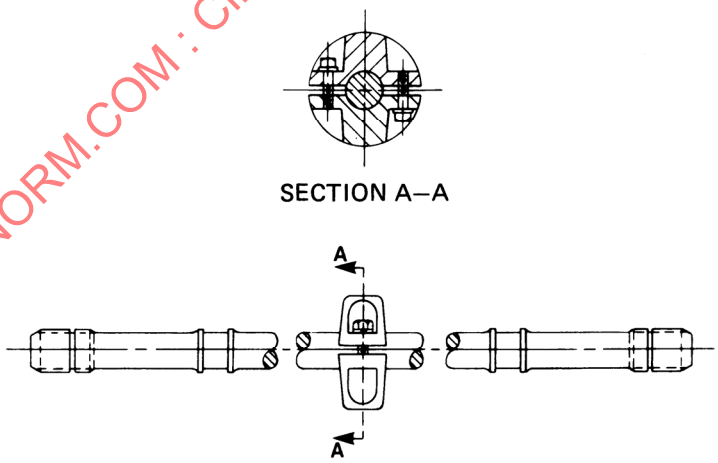



FIGURE 4 - AXLE SHAFT MOUNTED MASS DAMPER

3.11 Torsional Damper or Vibration Absorber

A torsionally tuned mechanical device which generally consists of an inertia ring attached to a drivetrain component by means of an elastomeric inner ring. It is tuned to a specific disturbing frequency (see Figures 5 and 6).

3.12 Isolation Damper

A mechanical torque transmitting device incorporated in a halfshaft which functions as a disturbance isolator. It eliminates, by means of an elastomeric inner ring or rings, undesirable throttle or shift induced noises or disturbances resulting from transaxle gear lash. This device is normally installed only on one halfshaft in a vehicle (see Figures 7 and 8).

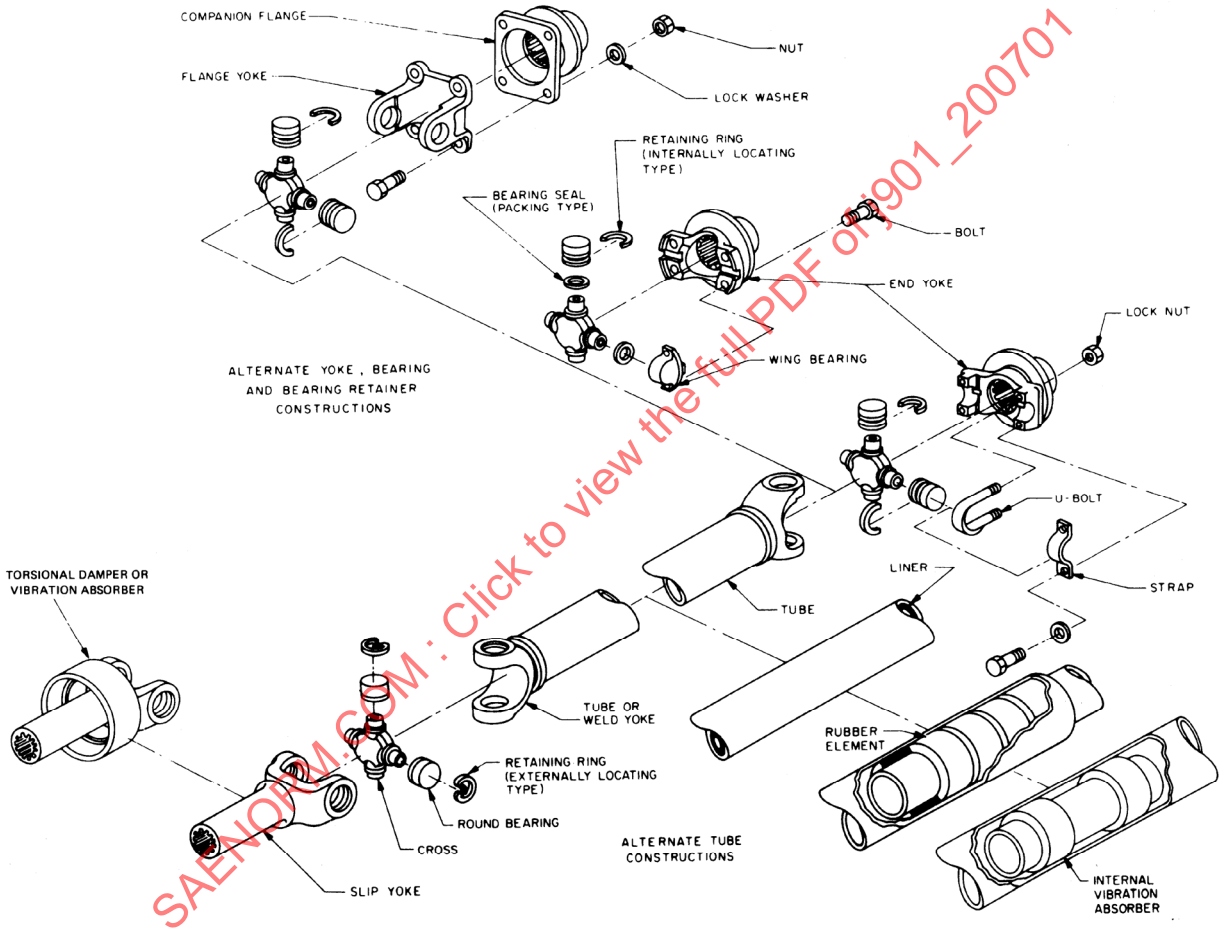





FIGURE 5 - TYPICAL TWO-JOINT OUTBOARD SLIP DRIVESHAFT

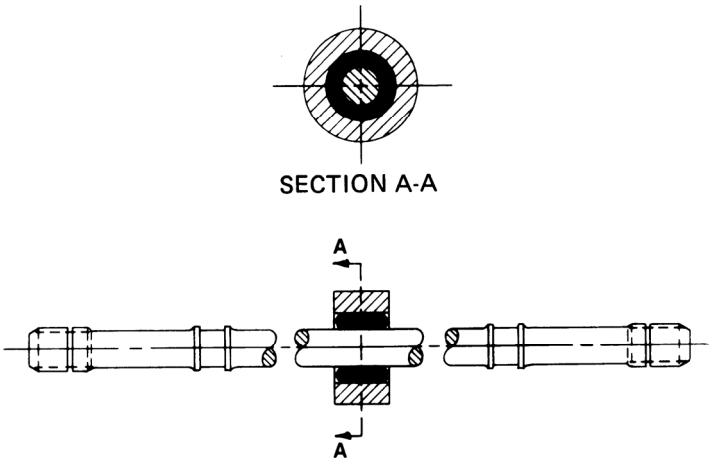



FIGURE 6 - AXLE SHAFT MOUNTED TORSIONAL DAMPER

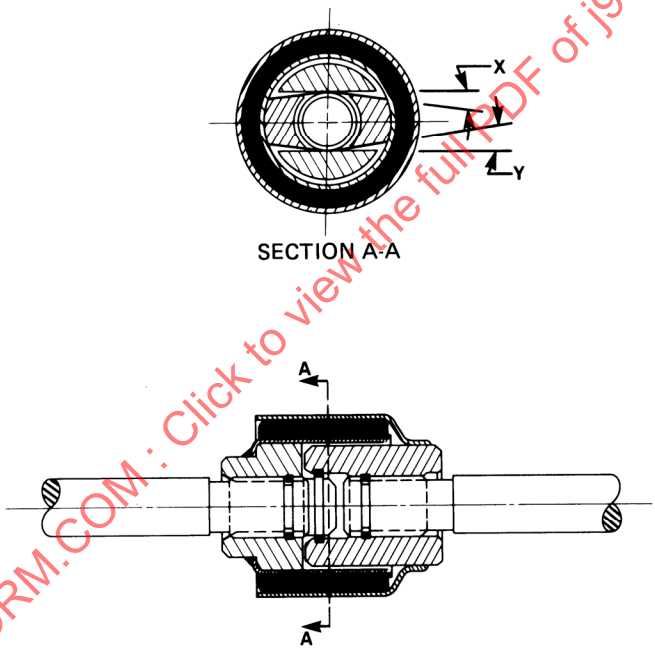



FIGURE 7 - SPLIT AXLE SHAFT MOUNTED ISOLATION DAMPER

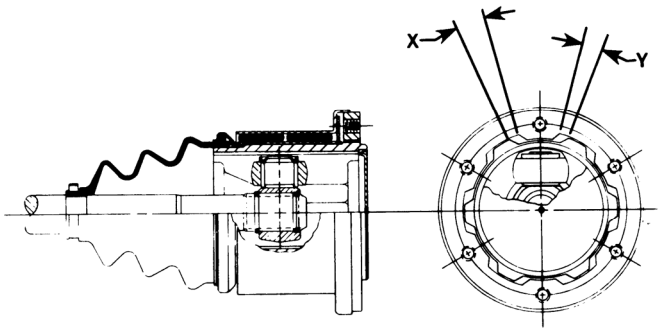



FIGURE 8 - INBOARD CV JOINT MOUNTED ISOLATION DAMPER

## 4. BASIC UNIVERSAL JOINT TERMS

### 4.1 Universal Joint

A mechanical device which can transmit torque and/or rotational motion from one shaft to another at fixed or varying angles of intersection of the shaft axes.

### 4.2 Nonconstant Velocity Universal Joint

A universal joint which transmits rotational motion with a variation in angular velocity between the output and input members when operating at joint angles greater than zero. The average angular velocity ratio is unity (for example: the Cardan or Hooke joint).

### 4.3 Constant Velocity or CV Universal Joint

A universal joint which transmits rotational motion with an angular velocity ratio of unity between output and input members (for example: the Rzeppa joint).

### 4.4 Near Constant Velocity Universal Joint

A universal joint which transmits rotational motion with an angular velocity ratio of unity when operating at the design joint angle and at zero. When operating at other angles, the angular velocity ratio is near unity (for example: the double Cardan joint).

### 4.5 Self-Supporting Universal Joint

A universal joint supported by internal means (for example: the Rzeppa joint).

### 4.6 Nonself-Supporting Universal Joint

A universal joint which requires an external means of support (for example: the formerly used Tracta joint).

### 4.7 Fixed Center Universal Joint

A universal joint which maintains the joint center at a fixed location and can resist axial thrust forces (for example: the Cardan or Hooke joint).

### 4.8 End Motion or Stroking Universal Joint

A universal joint which permits relative axial movement between input and output members resulting in a variable joint center location (for example: the tripot joint).

### 4.9 Outboard Joint

A universal joint located at the wheel end of a halfshaft (see Figure 2).

### 4.10 Inboard Joint

A universal joint located at the differential or final drive end of a halfshaft (see Figure 2).

### 4.11 Joint Angle

The acute angle described by the intersection of the rotational axes of the input and output members of a universal joint and measured in the plane described by these axes (see Figure 1).

4.12 Swing Diameter

The maximum diameter of the circular path described by a rotating universal joint (see Figure 1).

4.13 Constant Velocity, Bisecting Angle or Homokinetic Plane

The plane described by all contact points of a universal joint which produces an angular velocity ratio of unity between the output and input members. This plane bisects the obtuse angle formed by the input and output member rotational axes and is perpendicular to the plane containing these axes.

4.14 Torsional Equivalent Angle

The joint angle of a single nonconstant velocity universal joint which produces the same speed variation as a driveline with two or more nonconstant velocity universal joints.

4.15 Inertia Equivalent Angle

The joint angle of a single nonconstant velocity universal joint which describes the inertia effects of a driveline.

4.16 Inertia Drive Equivalent Angle

The joint angle of the first nonconstant velocity universal joint in a two-joint system. In a three-or-more-joint system, it is the joint angle of a single nonconstant velocity universal joint which produces the same maximum acceleration as the maximum of the sum of the accelerations of all but the last nonconstant velocity universal joint in the driveline.

4.17 Inertia Coast Equivalent Angle

The joint angle of the last nonconstant velocity universal joint in a two-joint system. In a three-or-more-joint system, it is the joint angle of a single nonconstant velocity universal joint which produces the same maximum acceleration as the maximum of the sum of the accelerations of all but the first nonconstant velocity universal joint in the driveline.

4.18 Secondary Couple

A bending moment on the driving and driven members of a universal joint produced by an angular change in the direction of torque. It is a function of torque and joint angle. In a nonconstant velocity universal joint, the bending moment on the driving member oscillates from zero to maximum, while simultaneously on the driven member the moment varies from maximum to zero, twice per revolution. In a constant velocity universal joint, the bending moment on both driving and driven members is constant for all positions of joint rotation.

4.19 Bearing Factor

A size characteristic for comparing the various size Cardan and double Cardan type universal joints relative to bearing capacity. It is the product of the projected needle roller bearing area on the cross trunnion times the torque radius (see Figure 9).

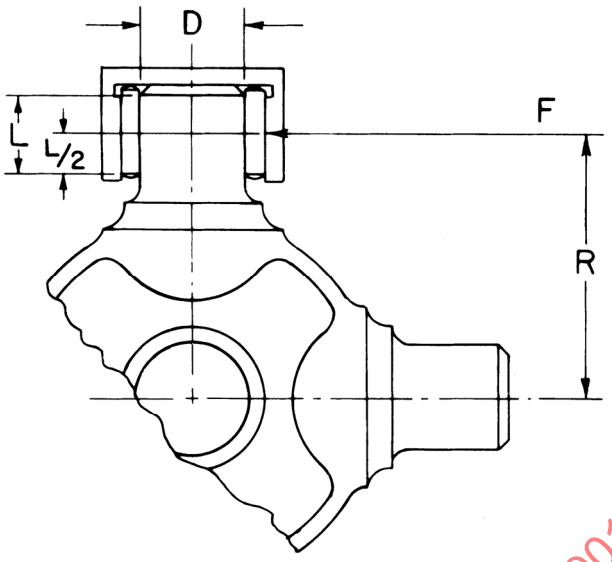



FIGURE 9 - NEEDLE ROLLER BEARING AND CROSS CONFIGURATION

5. UNIVERSAL JOINTS

5.1 Nonconstant Velocity Types

5.1.1 Cardan or Hooke Universal Joint

A nonconstant velocity universal joint which consists of two yokes drivably connected by a cross through four bearings (see Figure 10).

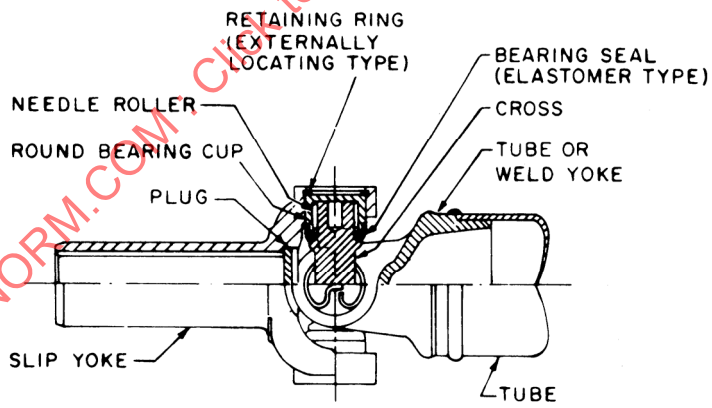



FIGURE 10 - CARDAN UNIVERSAL JOINT

5.1.1.1 Flexible Coupling Joint

A near constant velocity joint which transfers torsional load through winding packets that are vulcanized in rubber. The joint dampens vibrations, absorbs shock loads in the rotational, angular and axial directions and can be operated under a small deflection angle (see Figures 10.1 and 10.2).

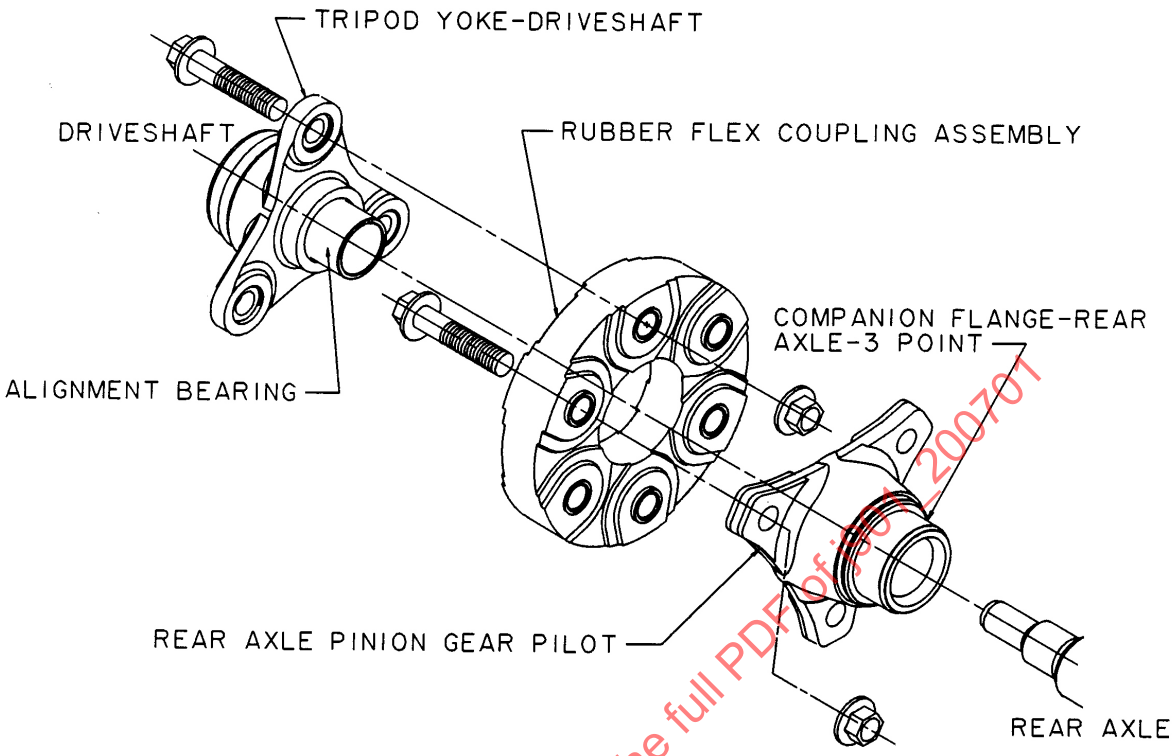



FIGURE 10.1

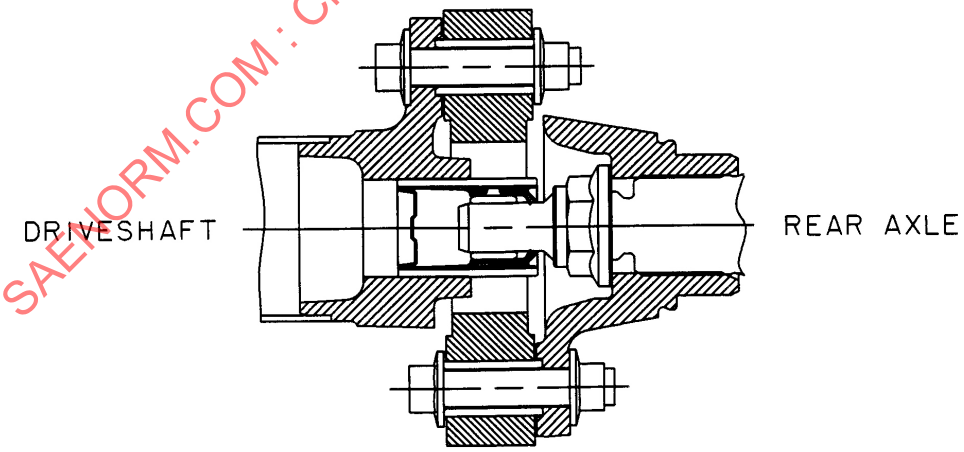



FIGURE 10.2

5.1.1.2 Yoke

The basic torque and/or motion input and output member with drivable means of attachment.

5.1.1.3 Slip Yoke

A yoke which accommodates axial movement (see Figures 11 and 5).

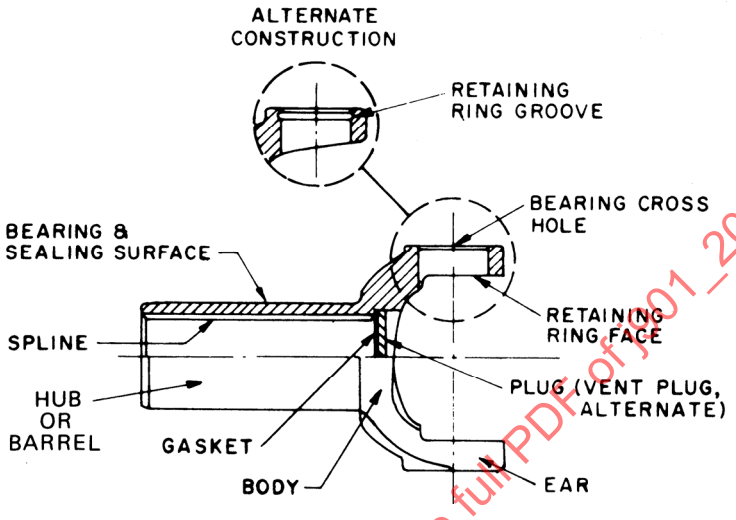



FIGURE 11 - SLIP YOKE

5.1.1.4 Tube or Weld Yoke

A yoke with a piloting hub for attachment to a tube or other shaft member (see Figures 12 and 5).

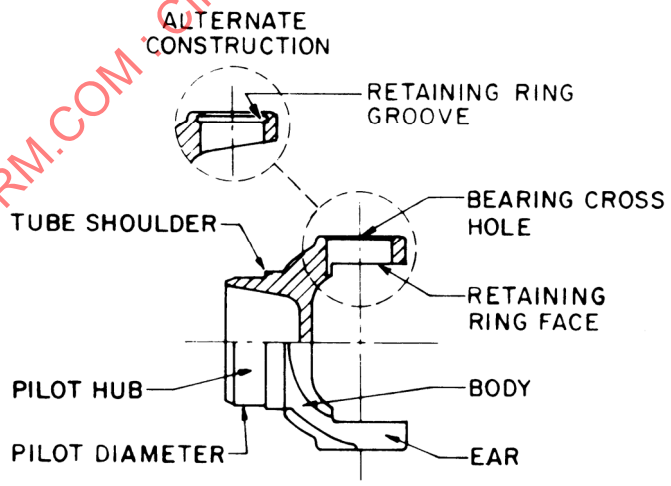



FIGURE 12 - TUBE OR WELD YOKE

5.1.1.5 End Yoke

A yoke which attaches a driveshaft to another drivetrain component (see Figures 13, 14, and 5).

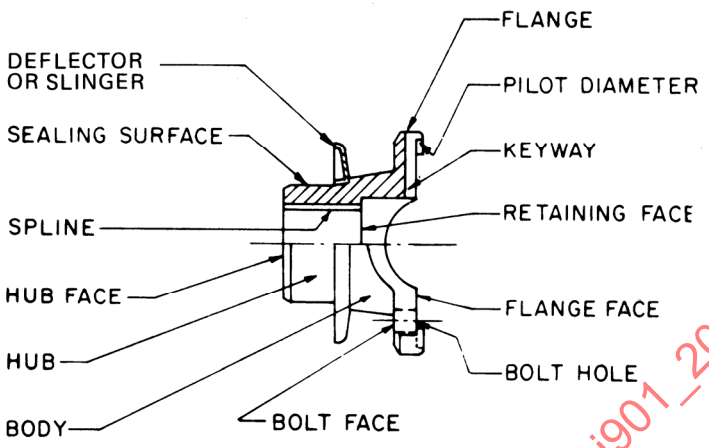



FIGURE 13 - END YOKE (WING BEARING TYPE)

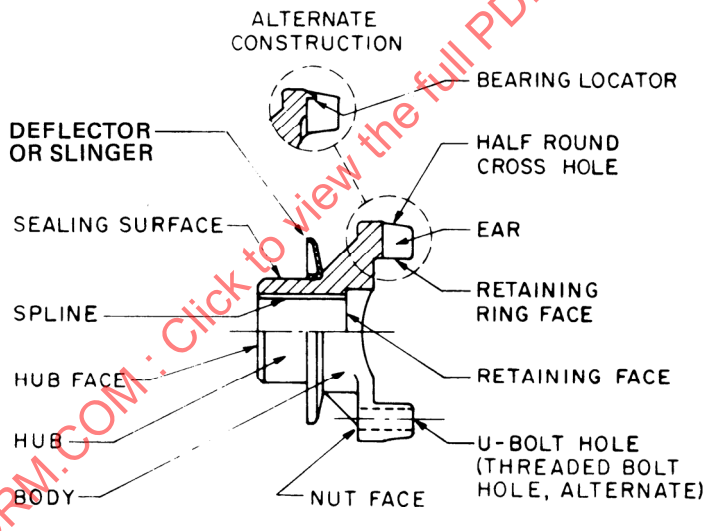



FIGURE 14 - END YOKE (ROUND BEARING TYPE)

5.1.1.6 Flange Yoke

A yoke which attaches a driveshaft to a companion flange (see Figures 15 and 5).

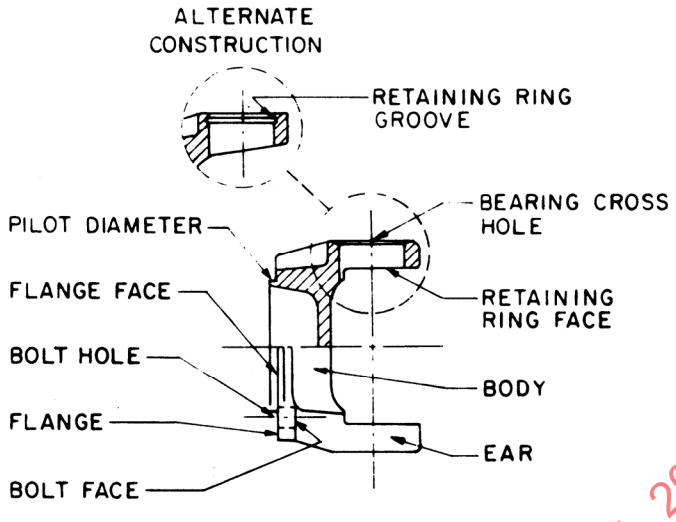



FIGURE 15 - FLANGE YOKE

5.1.1.7 Companion Flange

A flange member that fixedly attaches a driveshaft to another drivetrain component (see Figures 16 and 5).

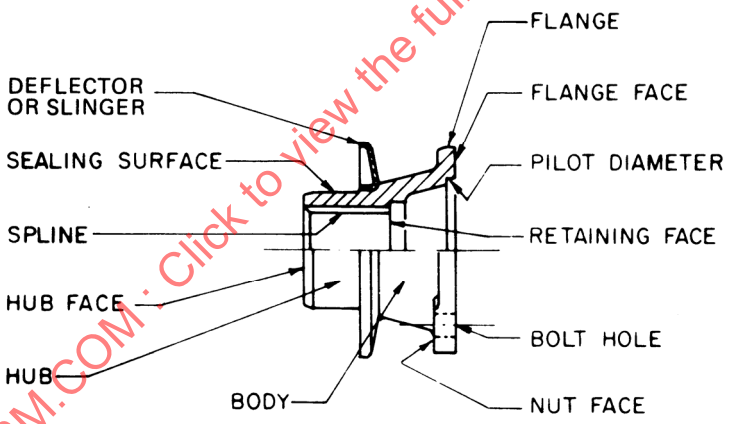



FIGURE 16 - COMPANION FLANGE

5.1.1.8 Ear

One of two projecting parts of a yoke symmetrically located with respect to the rotational axis (see Figure 11).

5.1.1.9 Hub

The central part of a member used for attachment to another member (see Figure 11).

5.1.1.10 Bearing Cross Hole

A through hole in each ear of a yoke used to locate a round bearing (see Figure 11).

5.1.1.11 Half Round Cross Hole

A semicircular hole located on the end of each ear of some end yoke designs (see Figures 14 and 5).

5.1.1.12 Bearing Locator

A projection in a half round cross hole, of some end yoke designs, used to locate a round bearing with respect to the yoke centerline (see Figure 14).

5.1.1.13 Retaining Ring Groove

A groove used to locate a retaining ring (see Figure 11).

5.1.1.14 Retaining Ring

A removable member used as a shoulder to retain and position a round bearing in a hole (see Figures 10, 17, and 5).

5.1.1.15 U-Bolt

A clamping type bolt with two threaded parallel legs used to retain a round bearing in some end yoke designs (see Figures 17 and 5).

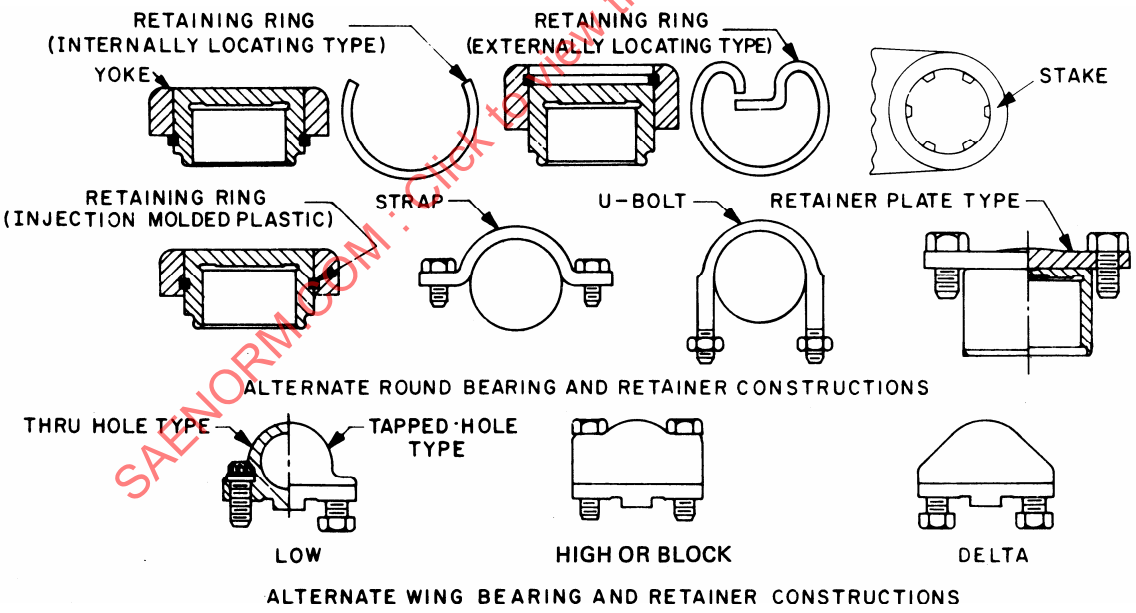



FIGURE 17 - BEARING AND RETAINER TYPES

5.1.1.16 Round Bearing

Consists of a round bearing cup with needle rollers generally held in place by a needle roller retainer or a bearing seal (see Figures 17 and 5).

5.1.1.17 Round Bearing Cup

A cup-shaped member used as the bearing bore of a round bearing and for positioning the thrust end of a cross trunnion (see Figures 10 and 18).

5.1.1.18 Needle Roller

One of the rolling elements of a bearing (see Figures 10 and 18).

5.1.1.19 Needle Roller Retainer

A member used to retain needle rollers in a bearing.

5.1.1.20 Bearing Seal

A flexible member which prevents the escape of lubricant from or entry of foreign matter into a bearing (see Figures 10, 19, and 18).

5.1.1.21 Deflector or Slinger

A protective member whose function is to exclude foreign objects from the bearing seal (see Figures 13 and 18).

5.1.1.22 Seal Retainer

A member used to hold a bearing seal in position on the bearing (see Figure 18).

5.1.1.23 Wing Bearing

Consists of a wing bearing cup with needle rollers generally held in place by a needle roller retainer or a bearing seal (see Figures 17 and 5).

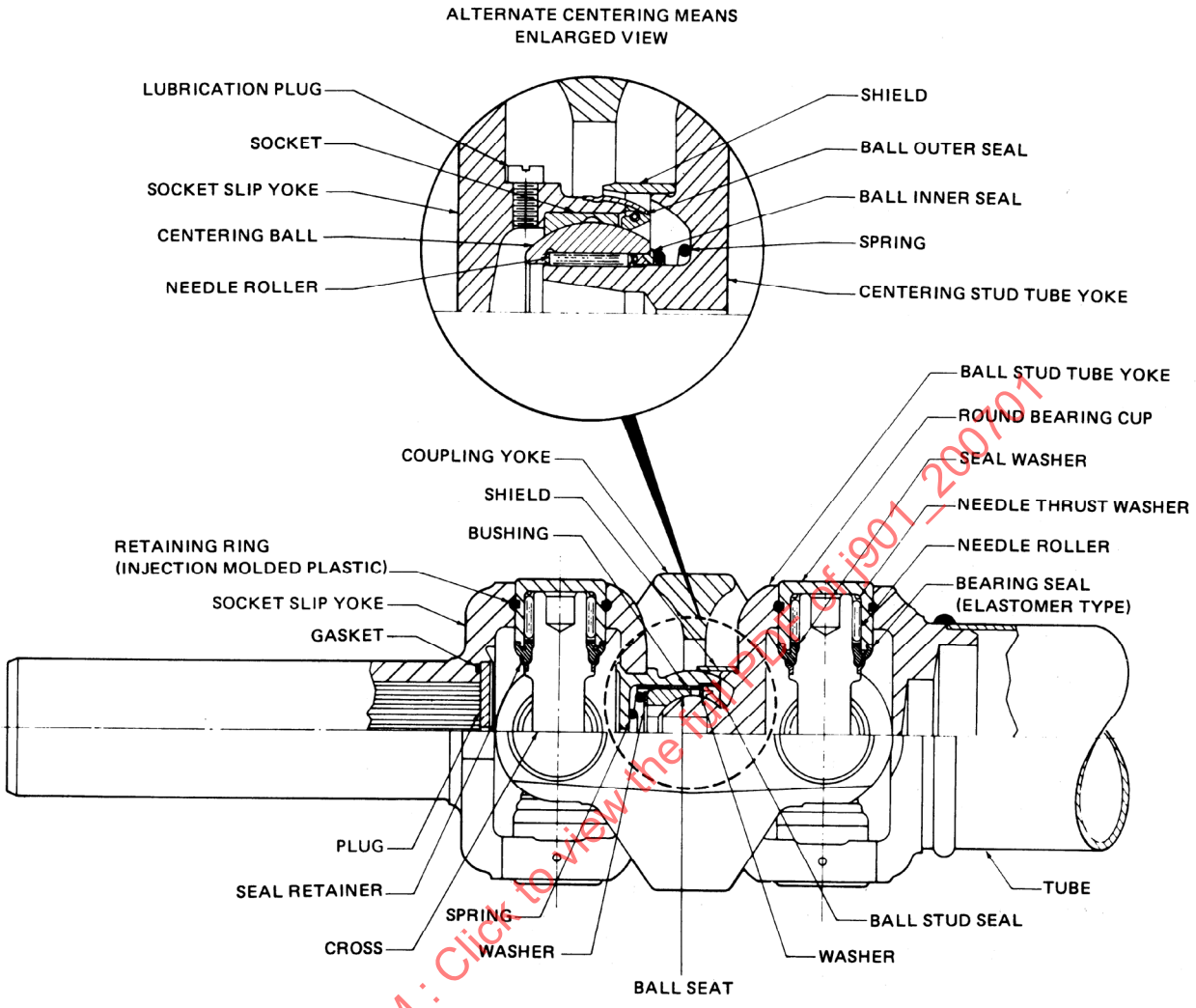



FIGURE 18 - DOUBLE CARDAN UNIVERSAL JOINT

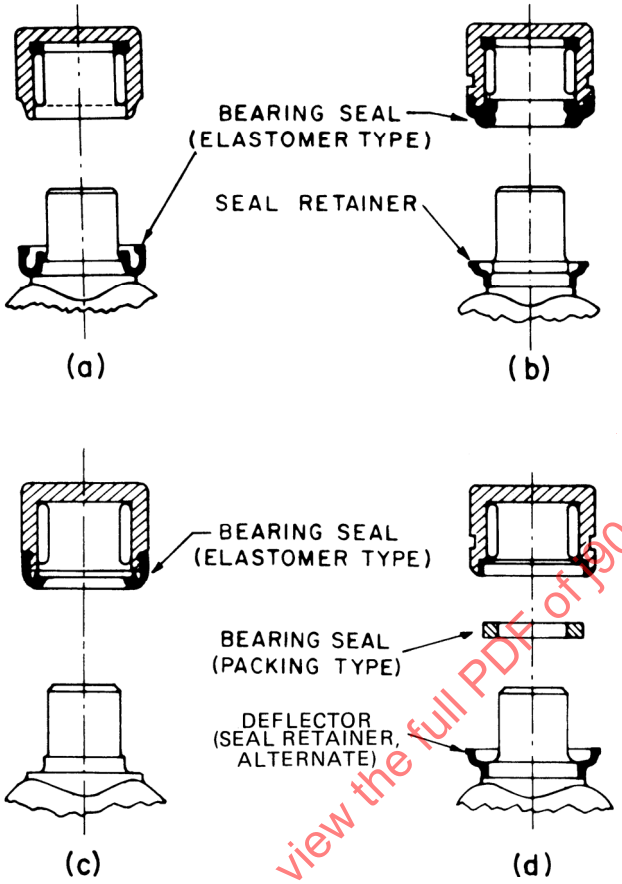



FIGURE 19 - BEARING SEAL TYPES

5.1.1.24 Wing Bearing Cup

A member with a key and projecting wings used as the bearing bore of a wing bearing and for positioning the thrust end of a cross trunnion. The low wing bearing type cup has thin flanged wings for attachment. The high wing or block bearing type cup has thick flanged wings for attachment. The delta wing bearing type cup has delta-shaped flanged wings for attachment (see Figure 17).

5.1.1.25 Round Bearing (Retainer Plate Type)

Consists of a round bearing with a generally integral retainer plate for retaining and positioning the bearing in a yoke (see Figure 17).

5.1.1.26 Strap

A narrow plate type member used to retain a round bearing in some end yoke designs (see Figures 17 and 5).

5.1.1.27 Retaining Ring Face

A surface used for positioning a round bearing with a retaining ring (see Figure 11).

5.1.1.28 Thrust Face

The closed end of a bearing used as a thrust surface.

5.1.1.29 Cross

The intermediate drive member which has four equally spaced trunnions in the same plane (see Figures 20 and 5).

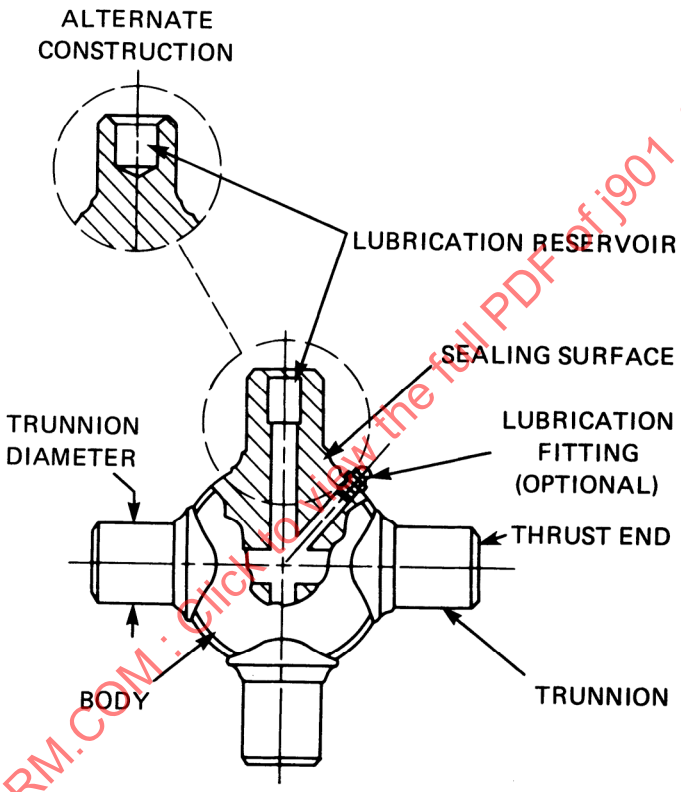



FIGURE 20 - CROSS



5.1.1.30 Trunnion

Any one of the four projecting journals of a cross (see Figure 20).

5.1.1.31 Trunnion Diameter

The diameter of a projecting journal of a cross (see Figure 20).

5.1.1.32 Thrust End

The end of the cross trunnion used as a thrust surface (see Figure 20).

5.2 Constant Velocity Types

5.2.1 Double Cardan Universal Joint

A near constant velocity universal joint which consists of two Cardan universal joints whose crosses are connected by a coupling yoke with internal supporting and centering means and has intersecting shaft axes. At the design joint angle and at zero, the instantaneous angular velocity ratio is unity, while at joint angles it is near unity (see Figure 18).

5.2.1.1 Coupling Yoke

A double yoke which connects the two halves of a double Cardan universal joint (see Figure 18).

5.2.1.2 Socket Yoke

A yoke incorporating a socket (see Figure 18).

5.2.1.3 Socket

A separate bearing member or integral cavity in a yoke used to pivotally locate and support the ball of a ball and socket type centering device (see Figure 18).

5.2.1.4 Ball and Socket Type Centering Device

A mechanism which functions as a self-aligning bearing and provides internal supporting and centering means for a double Cardan type universal joint. The two basic types of ball and socket designs are the centering ball and stud and the ball stud and seat constructions (see Figure 18).

5.2.1.5 Centering Stud Yoke

A yoke incorporating a centering stud (see Figure 18).

5.2.1.6 Centering Stud

A part of a yoke used to support a centering ball (see Figure 18).

5.2.1.7 Centering Ball

A partly spherically shaped member which pivots and provides supporting and centering means (see Figure 18).

5.2.1.8 Ball Stud Yoke

A yoke incorporating a ball stud (see Figure 18).

5.2.1.9 Ball Stud

A partly spherically shaped part of a yoke which pivots and provides supporting and centering means (see Figure 18).

5.2.1.10 Ball Seat

A full or segmented ring-like angular contact bearing member located in a socket which supports and centers the ball stud (see Figure 18).

5.2.2 Tripot or Tripod Universal Joint (End Motion Type)

A constant velocity universal joint, radially self-supported and permitting axial movement, which consists of a housing drivably connected to a shaft through three equally spaced trunnion mounted balls (see Figure 21).

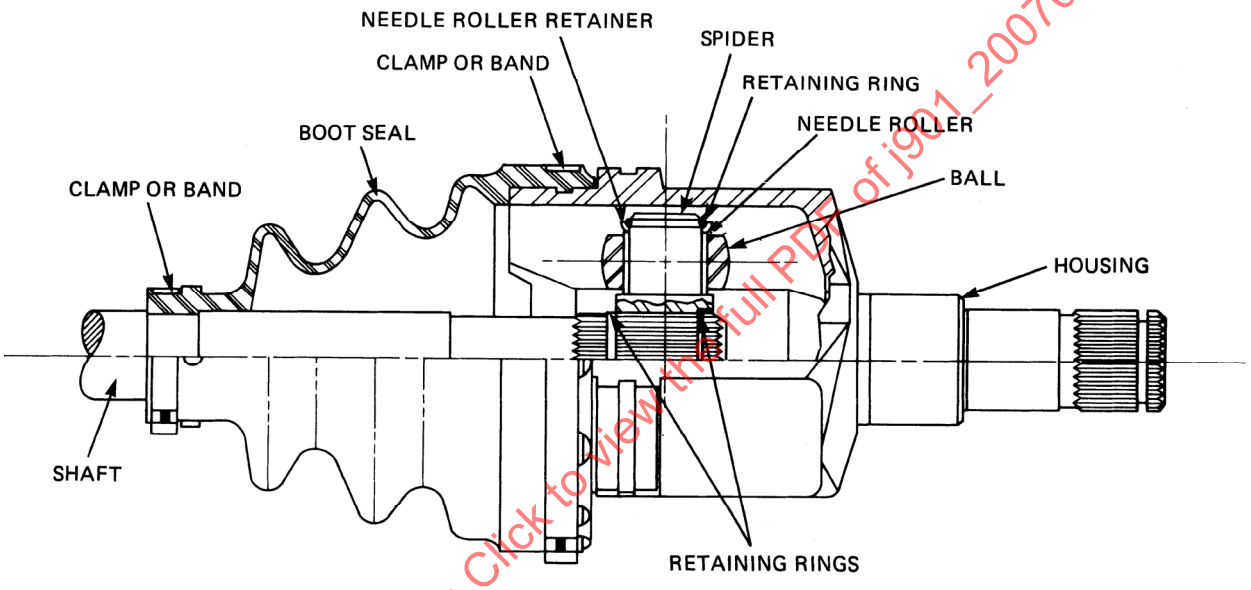



FIGURE 21 - TRIPOT OR TRIPOD UNIVERSAL JOINT (END MOTION TYPE)

5.2.2.1 Housing

A member with three equally spaced, partly cylindrical axial ball bores on the cylindrical inner clearance surface and with drivable means of attachment. In the tulip type housing, these ball bores have open circular segments on the periphery, as well as on the inner clearance surface Figures 21, 22, and 23.

5.2.2.2 Spider

A member with three equally spaced trunnions in the same plane and with internally splined drivable means of attachment (see Figures 21 and 22).

5.2.2.3 Ball

A partly spherically shaped member which pivots and transmits torque from the housing to the shaft through the spider and permits axial movement. Generally, needle rollers are used between the ball and the spider (see Figures 21 and 22).

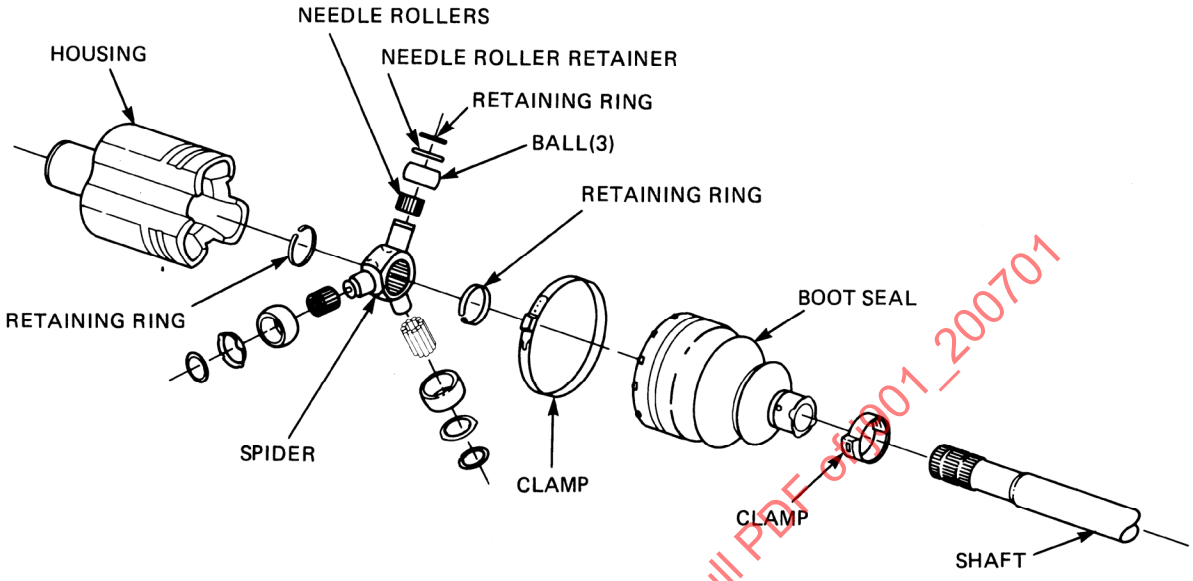



FIGURE 22 - TRIPOT OR TRIPOD UNIVERSAL JOINT (END MOTION TYPE)

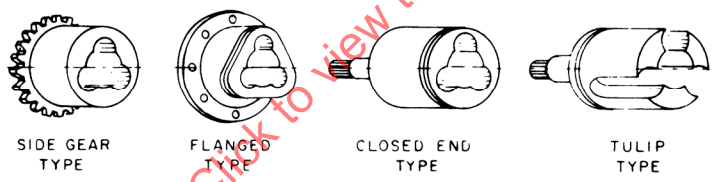



FIGURE 23 - TYPICAL TRIPOT OR TRIPOD JOINT HOUSING CONSTRUCTIONS

5.2.2.4 Boot Seal

A flexible member that prevents the escape of lubricant from or entry of foreign matter into the universal joint (see Figures 21 and 22).

5.2.2.5 Band

A ring-like member used to hold the boot seal in position on the universal joint or shaft (see Figure 12).

5.2.2.6 Clamp

An adjustable band used to hold the boot seal in position on the universal joint or shaft (see Figures 21 and 22).

5.2.2.7 Needle Roller Retainer

A member that radially positions and retains the needle rollers on the spider trunnion (see Figures 21 and 22).

5.2.2.8 Retaining Ring

A removable member used as a shoulder for retaining and positioning universal joint components in an assembly (see Figures 21 and 22).

5.2.3 Tripot or Tripod Universal Joint (Fixed Center Type)

A self-supported constant velocity universal joint which consists of a housing drivably connected to a forked shaft through three equally spaced trunnion mounted balls and retained as an assembly by a retaining clip. The joint center is maintained in a substantially fixed axial location by means of a spring-loaded centering device (see Figure 24).

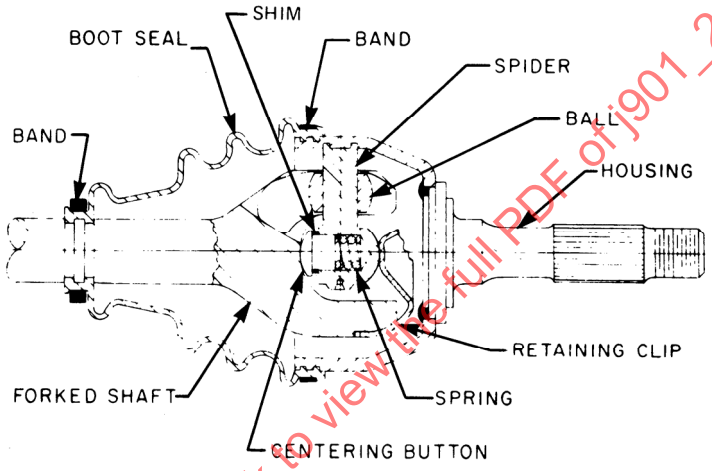



FIGURE 24 - TRIPOT OR TRIPOD UNIVERSAL JOINT (FIXED CENTER TYPE)

5.2.3.1 Housing

A bell-shaped member retaining a spider with rotating and sliding balls mounted on three equally spaced trunnions located in the same plane, and with drivable means of attachment (see Figure 24).

5.2.3.2 Ball

A partly spherically shaped member which pivots and transmits torque from the housing to the shaft through the spider (see Figure 24).

5.2.3.3 Forked Shaft

A member with tulip-shaped prongs incorporating three equally spaced partly cylindrical axial ball bores, and with drivable means of attachment (see Figure 24).

5.2.3.4 Retaining Clip

A 3-pronged spider-like or dog muzzle-shaped resilient member which retains the universal joint as an assembly (see Figure 24).

5.2.3.5 Centering Button

A thrust loaded member which locates the universal joint center (see Figure 24).

5.2.3.6 Shim

A resiliently yieldable C-ring shaped member which axially preloads the universal joint to a desired value (see Figure 24).

5.2.4 Rzeppa Universal Joint (Pronounced Sheppa)

A self-supported constant velocity universal joint which consists of an outer and inner race drivably connected through balls positioned in the constant velocity plane by axially offset meridionally curved grooves and maintained in this plane by a cage located between the two races (see Figure 25).

5.2.4.1 Outer Race (Bell Type)

A bell-shaped member with axially offset meridionally curved ball grooves on the partly spherical inner bearing surface with drivable means of attachment (see Figures 25 and 26).

5.2.4.2 Outer Race (Disc or Flange Type)

An annular member with axially offset meridionally curved ball grooves on the partly spherical inner bearing surface and with drivable means of attachment.

5.2.4.3 Inner Race

An annular member with axially offset meridionally curved ball grooves on the partly spherical outer bearing surface and with internally splined drivable means of attachment (see Figures 25 and 26).

5.2.4.4 Cage

A ring-like member with concentric outer and inner partly spherical bearing surfaces and with a circumferential series of openings or windows for maintaining balls in a common plane (see Figures 25 and 26).

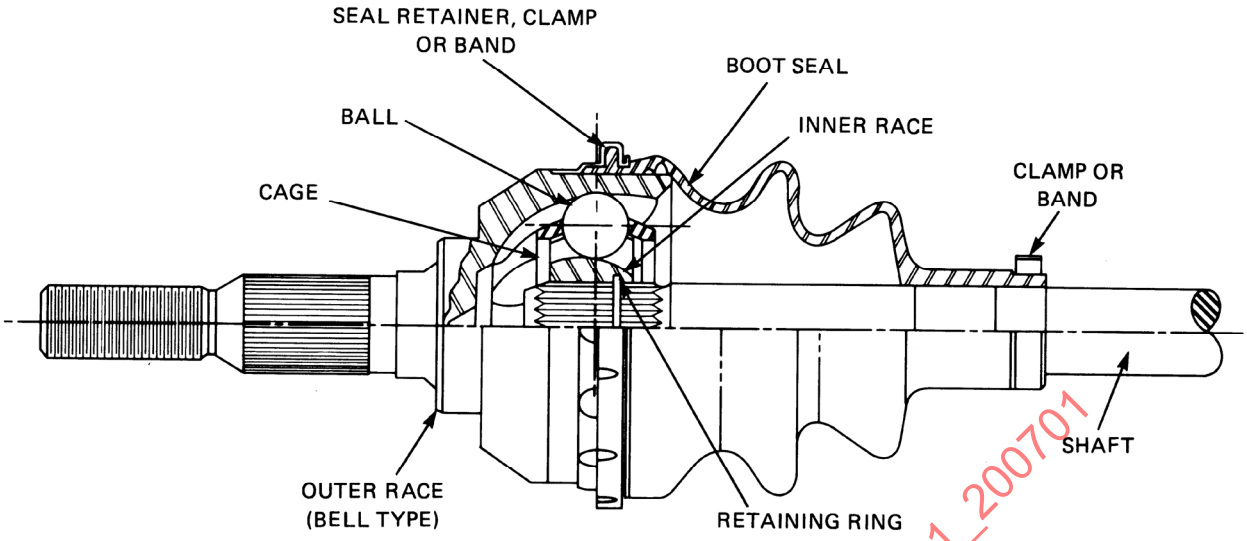



FIGURE 25 - RZEPA UNIVERSAL JOINT

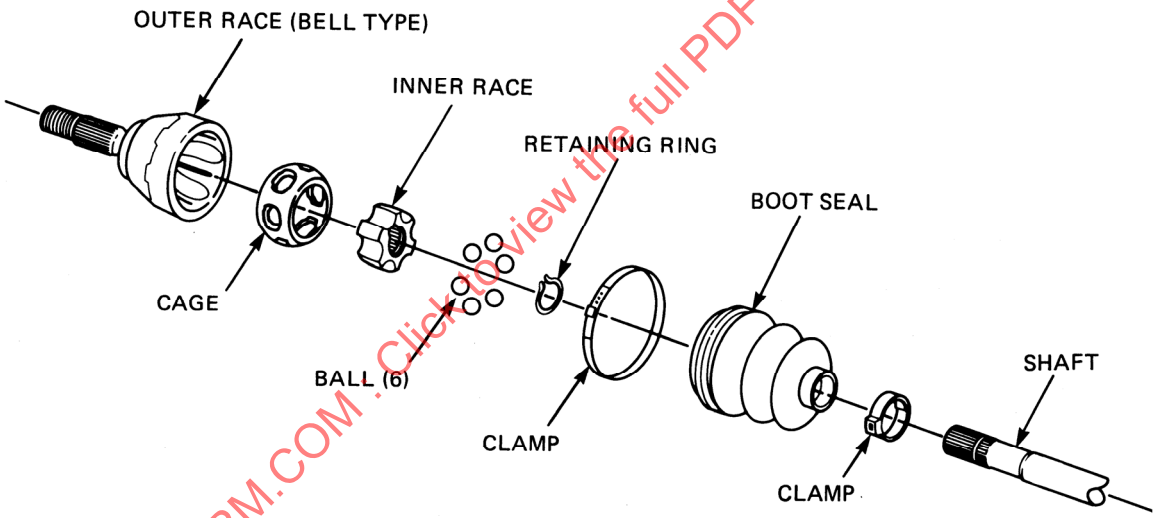



FIGURE 26 - RZEPPA UNIVERSAL JOINT

5.2.4.5 Ball

One of the intermediate drive members of a ball type constant velocity universal joint (see Figures 25 and 26).

5.2.5 Cross Groove Universal Joint

A constant velocity universal joint, radially self-supported, that consists of an outer and inner race drivably connected through balls located in circumferentially spaced straight or helical grooves, alternately inclined relative to the rotational axis. The balls are positioned in the constant velocity plane by an intersecting groove relationship and maintained in this plane by a cage located between the two races. The joint permits axial movement since the cage is not positionably engaged to either race (see Figures 27, 28, and 29).

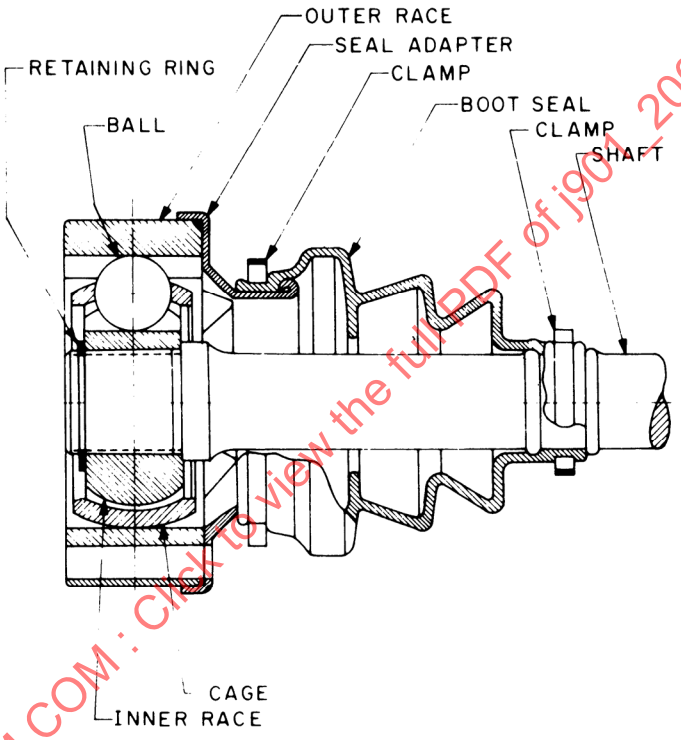



FIGURE 27 - CROSS GROOVE UNIVERSAL JOINT

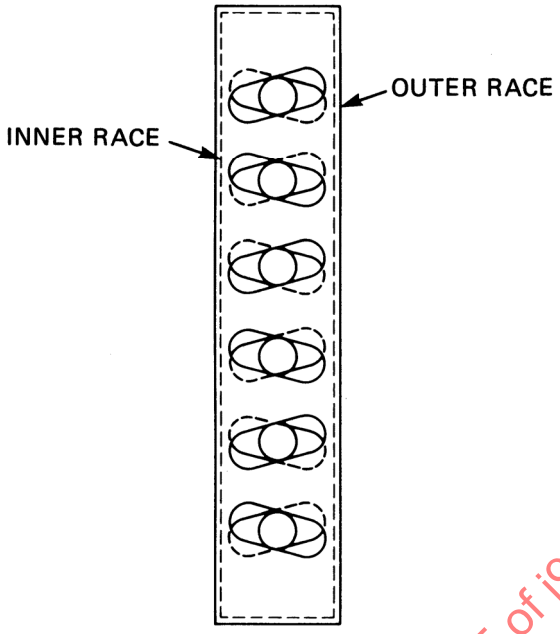



FIGURE 28 - DEVELOPMENT VIEW OF CROSS GROOVE JOINT ILLUSTRATING RELATIONSHIP OF OUTER AND INNER RACE BALL GROOVES AND POSITIONING OF BALLS

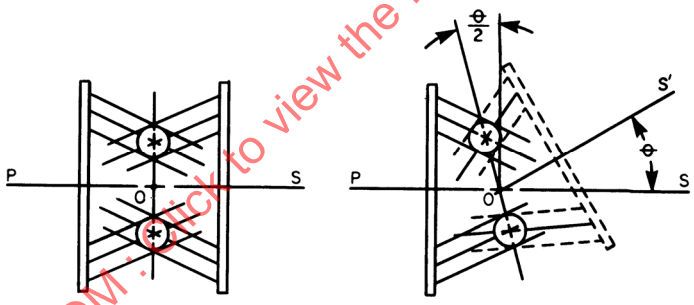



FIGURE 29 - DIAGRAM ILLUSTRATING POSITIONING OF BALLS IN CROSS GROOVE JOINT BISECTING ANGLE PLANE

5.2.5.1 Outer Race

A member with circumferentially spaced straight or helical ball grooves alternately inclined on the cylindrical inner surface and with drivable means of attachment (see Figures 27, 28, and 30).

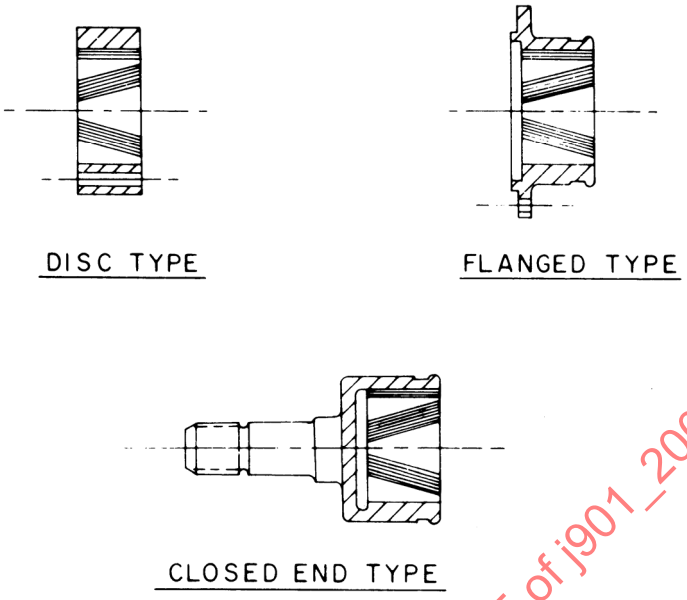



FIGURE 30 - TYPICAL CROSS GROOVE JOINT OUTER FACE CONSTRUCTIONS

5.2.5.2 Inner Race

An annular member with circumferentially spaced straight or helical ball grooves alternately inclined on the partly spherical or conical outer surfaces and with internally splined drivable means of attachment (see Figures 27 and 28).

5.2.5.3 Cage

A ring-like member with concentric outer and inner cylindrical or partly spherical or conical surfaces, and with a circumferential series of openings or windows for maintaining balls in a common plane (see Figure 27).

5.2.5.4 Seal Adapter

A member used to connect the boot seal to the outer race (see Figure 27).

5.2.6 Double Offset or DO Universal Joint (End Motion Type)

A constant velocity universal joint, radially self-supported that consists of an outer and inner race drivably connected through the balls located in axially straight grooves. The balls are positioned and maintained in the constant velocity plane by a cage with axially offset spherical surfaces located between the two races. The joint permits axial movement since the cage is positionably engaged only by the inner race (see Figures 31 and 32).

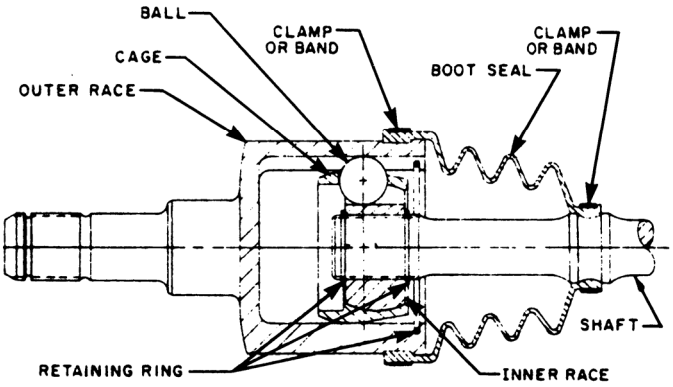



FIGURE 31 - DOUBLE OFFSET OR DO UNIVERSAL JOINT (END MOTION TYPE)

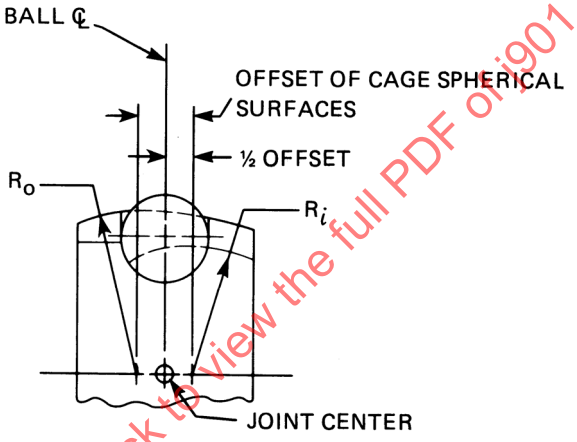



FIGURE 32 - DIAGRAM ILLUSTRATING OFFSET RELATIONSHIP OF DOUBLE OFFSET CAGE SPHERICAL SURFACES

5.2.6.1 Outer Race

A member with axially straight ball grooves on the cylindrical inner bearing surface and with drivable means of attachment (see Figures 31 and 33).

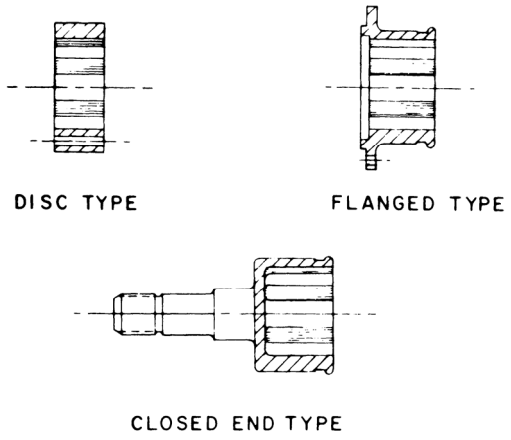



FIGURE 33 - TYPICAL DOUBLE OFFSET JOINT OUTER RACE CONSTRUCTIONS

5.2.6.2 Inner Race

An annular member with axially straight ball grooves on the partly spherical outer bearing surface and with internally splined drivable means of attachment (see Figure 31).

5.2.6.3 Cage

A ring-like member with axially offset outer and inner partly spherical bearing surfaces, and with a circumferential series of openings or windows for maintaining balls in a common plane (see Figures 31 and 32).

5.2.7 Double Offset or DO Universal Joint (Fixed Center Type)

A self-supported constant velocity universal joint which consists of an outer and inner race drivably connected through balls located in axially straight grooves. The balls are positioned and maintained in the constant velocity plane by a cage with axially offset spherical surfaces located between the two races (see Figure 34).



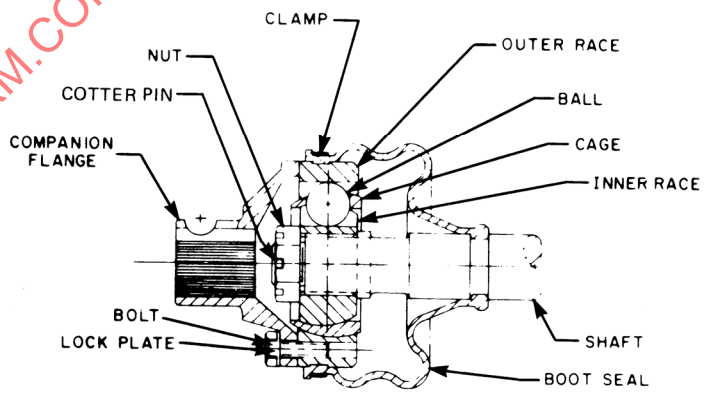



FIGURE 34 - DOUBLE OFFSET OR DO UNIVERSAL JOINT
(FIXED CENTER TYPE)—STEERING SHAFT DESIGN ILLUSTRATED

5.2.7.1 Outer Race

An annular member with axially straight ball grooves on the partly spherical inner bearing surface and with drivable means of attachment (see Figure 34).

6. DRIVESHAFT TYPES

6.1 Two-Joint Outboard Slip Driveshaft

A driveshaft or part of a driveline having a universal joint at each end. Axial movement is provided outboard of joint centers (see Figure 1).

6.2 Two-Joint Inboard Slip Driveshaft

A driveshaft or part of a driveline having a universal joint at each end. Axial movement is provided inboard of joint centers (see Figure 1).

6.3 Single Joint Coupling Shaft

The coupling member or members of a multiple joint driveline consisting of one universal joint, tube, shaft support, and slip spline or fixed spline shaft (see Figure 1).

An exploded view of a typical two-joint outboard slip driveshaft with alternate component constructions is illustrated in Figure 5. An exploded view of a typical two-piece heavy-duty truck driveline is shown in Figure 35, and Figure 36 illustrates a typical short coupled driveshaft.



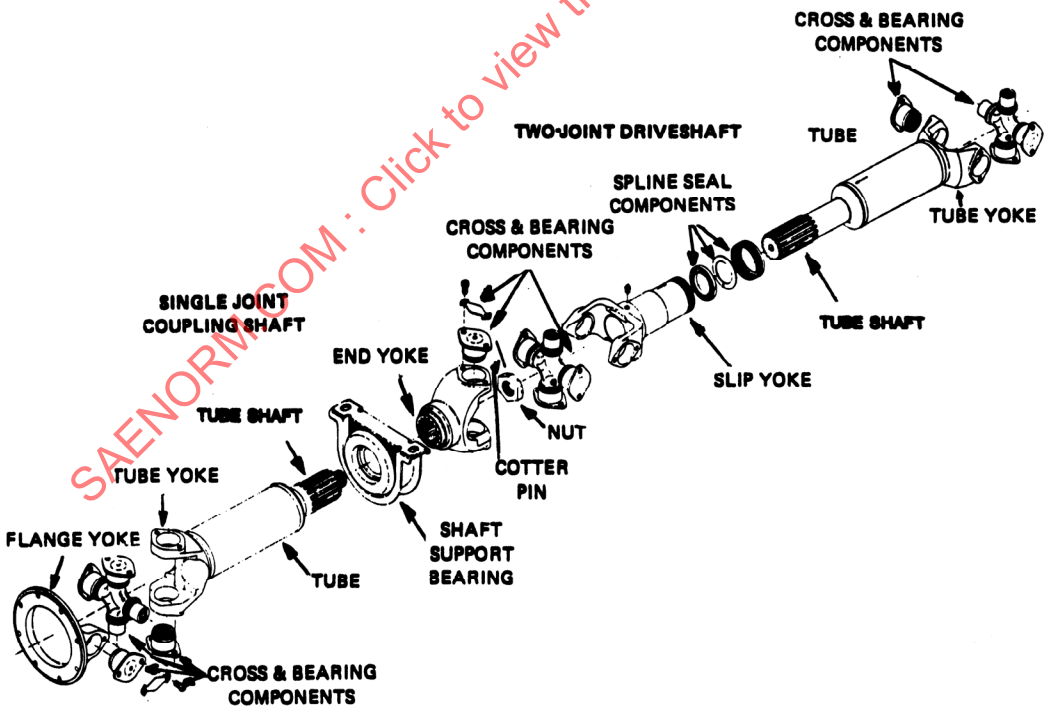



FIGURE 35 - TYPICAL TWO-PIECE HEAVY-DUTY TRUCK DRIVELINE

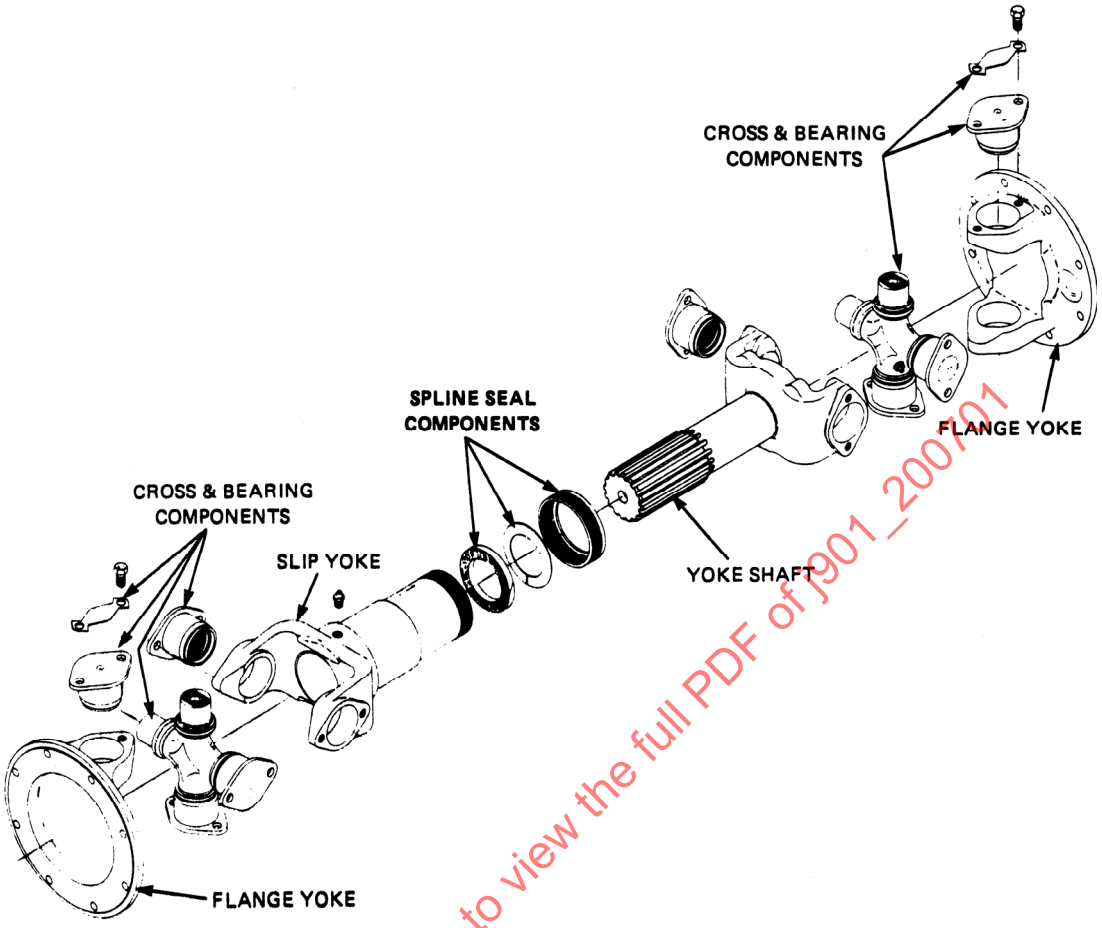



FIGURE 36 - TYPICAL SHORT COUPLED DRIVESHAFT

Trucks, as well as numerous other on/off-highway type vehicles, have widely varying application requirements. In addition to one or two rear axles, such vehicles may also incorporate a front steer axle or front-wheel-drive halfshafts in all-wheel-drive configurations. Various typical driveline arrangements are shown schematically in Figures 37, 38, 39, and 40.

## 7. FRONT- AND REAR-WHEEL-DRIVE HALFSHAFTS

### 7.1 Front-Wheel-Drive Halfshaft

A halfshaft having an outboard fixed center universal joint and an inboard end motion universal joint (see Figure 2).