Drive Shafts
Drive Shaft Purposes

Transmits power from the transmission to the differential

Allows the transmission and the rear axle assembly to be at different heights

Allows the rear axle to move up and down while maintaining a connection to the transmission
Drive Shaft Construction

Can be made of steel, aluminum, or composite material

Hollow shaft (May have cardboard liner to reduce noise)

Has a yoke welded to each end

Universal joints are used at each end

May have balance weights attached
Drive Shafts can be one or two piece
One Piece Hotchkiss

- Drive Shaft
- Front Universal Joint
- Sliding Yoke
- Rear Universal Joint
- Retaining Strap
- Retaining Bolts
- Drive Pinion Flange
2 piece Drive Shafts use a center bearing
Be careful to mark splines before separating drive shafts. Critical to keeping U-Joints In Phase

Out of Phase = Vibration!
Universal Joints

Can be called Cardan, Spicer, or Hooke joints

Allow for angle changes between the drive shaft, the transmission output shaft, and the rear axle housing
Universal Joint Characteristics

U-joints speed up and slow down twice per revolution

Increased operating angle = Increased speed variation
Keep Operating Angle less than $4^\circ$

Many say $3^\circ$ is maximum
Transmission and Differential can be tilted to keep operating angles small.

Output yoke & pinion yoke must be parallel regardless of driveshaft angle.
Transmission and Differential MUST be at the same angle to cancel speed variations (Vibration if wrong)
FIGURE 7-25  Canceling angles applied to reduce vibrations. (Courtesy of Ford Motor Co.)
driveshaft alignment

- **good**: input/output angles equal, not excessive
- **poor**: no angle joints will not rotate
- **bad**: excessive joints will fail
- **bad**: excessive angles not equal

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U-Joints must be kept in Phase

Small changes in phase = big vibration problem

Photo by Wes Knettle
When in Phase and same angle speed variations cancel from front to rear U-Joint.
Double Cardan U-Joint
Double Cardan U-Joints accept larger angles with no vibration. Do not recommend replacing individual pieces of the double cardan joint.
U-Joints often fail and can easily be replaced

http://www.agcoauto.com/content/news/p2_articleid/189

Excellent article on why U-joints fail
Tips for Disassembling a U-Joint

Index the joint’s components before disassembly

Remove all retaining rings before pressing on the spider

Use a U-joint tool kit, socket and vise, c-clamp, or press to press the spider from the yoke
Index components before disassembly

Might cause vibration if neglected
Remove all retaining rings
Easy way to ruin a driveshaft
U -joint Service

Avoid clamping hollow shaft in a vise to avoid denting shaft tube

Do not hammer U-Joint out of yoke.
   Use a vise or U-joint press

Clean yoke of burrs and pay extra attention to retaining ring grooves
U-joint Service

Use grease and caution to insure needle bearings stay in place on bearing cups

If bearing caps will not fully install disassemble and realign roller bearings

Insure that bearing retainers are fully seated
U-joint Service

Insure that U-joint swivels freely after pressing into drive shaft

Do not over tighten rear U-joint U-bolts
Most factory-installed universal joints are sealed and don’t require periodic lubrication.

After-market replacement joints are equipped with a grease fitting and must be greased periodically.
Types and Causes of Vibrations

High speed vibrations
   Usually caused by driveshaft imbalance

Vibrations during acceleration
   Usually caused by worn double Cardan joint

Low speed vibrations
   Usually caused by improper operating angles
Clunking noise while accelerating from a dead stop
Usually caused by worn or damaged U-joint

Squeaking noise
Often caused by worn or poorly lubricated U-joint
Check for Vibration

Look for the obvious:
worn U-joints, dents in driveshaft, missing weights

Reposition U-joint flange (easy to try)
Check for Vibration

Check Driveline Angles
    Front and rear angles should be within 1/2°

Check Driveshaft Runout
Measuring Drive Shaft Runout

Use a dial indicator

Measure at the center and at both ends of shaft

Should be less than .040” maximum runout

Replace the shaft if runout is greater than allowed

Be sure runout is not in pinion flange
Measuring Operating Angle

Check vehicle ride height (full gas tank – empty vehicle)

Use inclinometer to measure U-joint angles

No more than 4° U-joint angle

Equal angle front and rear U-joint