Power Trains Study Notes
Universal Joints and Drive Lines

**Drive shafts**

**Hotchkiss drive shaft:** The most common drive shaft used on rear wheel drive vehicles.

**Construction:** External tube with u-joint attached to each end. Tube can be constructed of steel, aluminum, fiber composites

**Torque Tube:** Solid shaft without universal joints. Can be used when angle and length between driving and driven components is constant

**Slip yoke:** Attached to the end of the drive shaft. The slip yoke splines to the transmission output shaft, and is free to slide in and out of the transmission. This is necessary because as the rear suspension changes position, the length of the drive shaft must also change.

**Slip joint:** Performs the same job as the slip yoke, but is not attached at the transmission. The slip joint has internal splines on one side, and external splines on the other side.

**Output shaft seal and bushing:** The transmission output shaft housing contains a seal and a bushing. The seal is retained in the end of the housing and seals the outside of the slip yoke. The bushing is retained in the output shaft housing, and supports the slip yoke.

**Cardan Universal Joint:** Consists of a cross, bearing caps, needle rollers, seals, and retainer rings. Factory installed u-joints may be "lubed for life". If so, they will not have a grease zerk. Replacement u-joints will have a grease zerk. When installing a universal joint, make sure that the zerk will be accessible. When greasing a new u-joint, be sure that grease escapes from all four seals

**Double Cardan U-Joint:** Consists of 2 cardan assemblies, with a center housing, and center ball and socket. Double cardan u-joints are constant velocity joints.

**Drive Shaft Velocity:** The output shaft from the transmission turns the drive yoke at output shaft speed. The drive shaft, however, speeds up and slows down twice during every revolution.

**Drive Shaft Phasing:** A drive shaft is said to be "in phase" when the yokes on either end of the drive shaft are in alignment. By having the drive shaft in phase, the velocity changes cancel out, and the differential pinion shaft turns at a steady speed.
**Operating Angles:** The universal joint operating angles of the drive shaft must be within specification to prevent vibration and u-joint damage. Observe technical manual specifications for adjustment.

**Noise and Vibration Diagnosis:** All drivelines have balance weights. Missing balance weights are a major cause of vibration. Most automotive drive shafts can be balanced with the following procedure:

With the vehicle on a lift, have an assistant run the vehicle to about 45 miles per hour. Carefully bring a piece of chalk into contact with the shaft. Bring the vehicle to a stop. Install 2 hose clamps opposite the chalk marks, and repeat procedure. If balance is not achieved, move the clamps to opposite directions a short distance. Repeat this procedure until balance is achieved.

Driveline run out is another cause of vibration. This is checked with a dial indicator. Slip yoke spline wear, slip yoke bushing wear, worn carrier bearing, out of phase, worn u-joints and drive yoke run out can also cause drive line vibration. Also, be sure to inspect the drive shaft for dents.

A bad u-joint may cause a clunking noise during acceleration, and you may hear a squeaking noise. A balance problem will vary in intensity with road speed.

**Front Wheel Drive Systems**

**Half Shaft:** Term used to describe front wheel drive vehicle drive shafts

**Constant Velocity Joints:** By design, cv joints supply uniform torque and constant speed through a wide range of angles. They are used on front wheel drive systems. CV joints can be classified as plunging or fixed.

**Plunging CV Joints:** Plunging CV joints are located on the inboard side of the half shaft. As the suspension angle changes with road variations, they allow the half shaft to change lengths

**Fixed CV Joint:** Used on the outboard side of the half shaft, they are capable of the extreme operating angles required. Because the outer cv joint operates at extreme angles, it will generally tent to wear faster than the inner cv joint.

**Torque Steer:** If the half shafts are unequal lengths, the shorter one will operate at a more extreme angle. This will create more resistance to turning than the longer shaft, and differential action will occur. In order to prevent torque steer, an intermediate shaft is used on the long side. The outer shaft will be the same length as the short shaft on the other side. A bent axle shaft, bad wheel bearing, or bad cv joint may also cause the vehicle to pull to the side with the problem. Torque steer does not occur in rear wheel drive vehicles.
**CV Joint Boots:** Follow manufacturer’s service procedures for boot inspection and replacement. Boot failure is a major factor in CV joint failure. If the boot is damaged, the joint must be inspected for contamination and wear. Joint replacement is normally recommended if a boot is torn. A special lubricant is used for CV joints.

**Wheel Bearings:** Front wheel drive vehicles use either double row ball bearings, or opposed tapered roller bearings.

**Noise Diagnosis:** A worn inner CV joint will sometimes cause a clunking noise during torque output changes (acceleration, deceleration). A worn outer CV joint will cause a clicking noise during turns. The noise will be most noticeable when turning toward the side with the bad joint.