Module 2: Hydraulic Drum Brakes and Components

- HYDRAULIC DRUM BRAKES AND COMPONENTS
- DRUM BRAKE OPERATION
- DRUM BRAKE LINING AND SHOES
- BACKING PLATE
- WHEEL CYLINDERS
- TERMS AND DEFINITIONS
- COMPONENTS OF A DRUM BRAKE ASSEMBLY
- FUNCTIONS OF DRUM BRAKE ASSEMBLY COMPONENTS
- DRUM AND HUB ASSEMBLY DEFECTS
- PARTS OF A BRAKE SHOE
- FUNCTIONS OF BRAKE SHOE PARTS
- TYPES OF BRAKE SHOE APPLICATIONS
- BRAKE SHOE MATERIALS
- BRAKE SHOE DEFECTS
- DRUM BRAKE HARDWARE AND THEIR USES
- ADJUSTMENT OF DRUM BRAKE ASSEMBLIES
- CONDITIONS TO INSPECT IN BRAKE DRUM ADJUSTMENT SYSTEMS

Hydraulic Drum Brakes and Components

READY FOR REVIEW

- The primary components of the drum brake system are:
  1. The backing plate, which is made from steel and is attached to steering or suspension components by bolts and supports the wheel cylinder, brake shoes, and levers
  2. The brake drum and brake shoe assembly, which fit over the brake linings,form the braking surface for these linings, and consist of steel shoe and brake lining material.
  3. The wheel cylinder, which is attached to the backing plate. The pistons push against the brake shoes, which then make contact with the brake drum to slow or stop the vehicle.
  4. The retaining clips and springs
     - The brakes are held against the backing plate by the retaining clips and springs.
     - The hold down spring is used to retain the brake shoe in position in relation to the backing plate.
     - During vehicle operation, it keeps the brake shoe in position.
  5. Automatic brake self-adjuster
     - To manually adjust the brakes, it may be necessary to release the adjusting lever away from the star wheel.
     - Insert a small screwdriver through the adjust slot in the backing plate and push on the adjusting lever.
     - The brake adjuster can now be used to adjust the brakes in the usual way.

Drum Brake Operation

READY FOR REVIEW

- Drum brakes, once common on all wheels of light vehicles, are now less commonly used and are typically found on just rear wheels in disc-drum combinations.
- Drum brake systems operate by forcing friction-lined brake shoes against the inner surfaces of rotating drums, with shoes designed to operate with self-energizing action.
- A drum brake has two brake shoes with a friction material called a lining attached, and shoes expand against the inside surface of a brake drum and slow the wheel down. The harder the linings are forced against the brake drum, the higher the braking force. Drum brakes can be expanded mechanically or hydraulically.
- A main advantage claimed for drum brakes is that shoe mountings can be designed to assist their own operation (called self-energizing). Less hydraulic pressure is needed to stop the vehicle, which is why many older drum-braked vehicles didn't use a brake booster.
- The main disadvantage of drum brakes is that the friction area is almost entirely covered by lining, so most heat must be conducted through the drum to reach outside air to cool. With hard use, drum brakes can cause overheating and, eventually, brake "fade," which is the gradual loss of brake stopping power during prolonged or strenuous use. Very high temperatures occur at brake drums, which causes deterioration in the frictional value of the lining or pad material, which is common in drum brakes.
- Another problem with drum brakes is the difficulty in getting water out of the drum; if a vehicle is driven through water, it takes longer to get the brakes working effectively again.
- Three brake designs in general use are the single leading shoe, the twin leading shoe, and the duo-servo.

- Each design uses wedging or self-energizing action of the brake shoe to assist the lining to grip the rotating drum when the brakes are applied. The twin-leading shoe has an actuator for each brake shoe, which can be mechanical; however, a hydraulic actuator is popular on light vehicles, and a hydraulic actuator is called the wheel cylinder.
- Some brakes have two wheel cylinders with one piston in each cylinder and when the brakes are applied, hydraulic pressure forces each piston to move outwards, pushing on one end of the brake shoe. The direction of the rotation of the drum produces a wedging action on both brake shoes, with both called leading shoes.
- The brake drum system was once popular on front wheels because it is very efficient in the forward direction due to the self-energizing or self-wedging action of shoes as the drum rotates. The main disadvantage is that it is only about 30% as efficient in reverse, therefore it is usually combined with a single leading shoe arrangement on the rear to provide a balanced system.
- A single leading shoe system uses a single wheel cylinder with two pistons, and when the brakes are applied, both shoes press against the brake drum. One shoe is called the leading shoe, the other is called the trailing shoe. The leading shoe tends to be self-energized, while the trailing shoe tends to be forced off the drum. This arrangement is common on rear wheels as they work equally well in forward and reverse, and makes an effective handbrake that can also have a self-adjusting mechanism.
- A duo-servo design also uses one wheel cylinder with two pistons. It is a high energy brake that exerts large self-energizing forces; the lower ends of shoes are linked but not firmly anchored to the backing plate, which allows the complete shoe assembly to float, within limits. When the brakes are applied, both shoes are carried around by the drum, until the secondary shoe contacts the anchor pin. The self-energizing force of the primary shoe and its wheel cylinder application force are now transferred to the secondary shoe through a lower linkage. The force is then applied to a secondary shoe from both ends, with the wheel cylinder at the top and the linkage from the primary shoe at the bottom.
- The design of the duo-servo allows the primary shoe to have the shorter lining and to always fit ahead of the wheel cylinder in terms of drum rotation. Most important is that the shoes are fitted correctly, since the secondary shoe does most of the work. The linings may also have different frictional values, and colors of retraction springs indicate different spring strengths. This design is common on the rear wheels and works well in both directions.
- Drum brake systems need to be adjusted to allow for wear of lining, and if not adjusted, pedal travel will be too long to be safe.

Drum Brake Lining and Shoes

READY FOR REVIEW

- Brake linings are friction material attached to brake shoes in drum brakes and can be riveted or, more commonly, bonded to brake shoes. Most have a manufacturer's code on the edge of the lining that identifies the specified coefficient of friction.
- Brake operations are affected by the composition of friction material. Linings that provide good braking with low pedal pressures tend to lose efficiency when they get hot, which results in an increased stopping distance. Linings that maintain a stable friction coefficient over a wide temperature range generally require higher pedal pressures to provide efficient braking and may need the use of a booster.
- Precautions to be aware of include the fact that linings used to be made of asbestos. Concerns about health problems associated with asbestos led to the use of nonasbestos alternatives. When removing older brake linings where asbestos may have been used, handle with care, wear protective clothing, do not inhale any brake dust residue, and never use an air hose to blow the brake off any component.

Backing Plate

READY FOR REVIEW

- The backing plate is bolted to the axle housing or suspension member, and it provides a mounting for the wheel cylinders and brake shoes to act against the rotating drum.
- All of the brake unit components, except the brake drum, are mounted on a backing plate bolted to the vehicle axle housing or suspension.
- The backing plate is usually pressed from heavy gauge steel, it has a raised outer edge that fits into a groove or recess in the brake drum, and it helps keep out any dust or dirt.
- Some vehicles have manual brake adjusters, so openings are usually provided to allow for adjustments without having to remove the wheel and the brake drum.

Wheel Cylinders

READY FOR REVIEW

- The wheel cylinder and piston react to hydraulic pressure from the master cylinder, and the outward movement of the piston forces the shoe and lining against the drum.
- Location and function:
  - Located inside the brake drum and bolted to the backing plate
  - Converts hydraulic pressure from the master cylinder into mechanical force that pushes the brake linings against the brake drum
  - Either single piston/single action or dual action/double cylinder with a piston at each end
- Composition and contamination:
  - Usually made of cast iron or aluminum alloy
  - Operates under difficult conditions of extreme pressures and temperatures
  - Some are sleeved with stainless steel to be longer-wearing and more resistant to corrosion.
  - Contamination, particularly from water, lowers the boiling point of the brake fluid and may cause pitting and fluid loss.
  - Wheel cylinder cups seal the cylinder against fluid loss.
- Fitting:
  - May be fitted with a spreader and light expansion spring to keep lips in contact with the cylinder during retraction and while at rest
  - Helps keep air out of the system
  - Most are fitted with bleed nipples to allow air to be bled from the system after assembly and a flexible cover, or boot, to allow for piston movement and to keep out the dust and moisture.

Terms and Definitions

READY FOR REVIEW

- **Adjust** is to position parts relative to each other for the most efficient operation.
- A **cam** is a mechanical part in which a circle is enlarged in one area so that the rotation of the part causes movement of another part when the enlarged area contacts the other part.
- **Concentric** is referring to circles that share a common center.
  Note: The drum and hub assembly consists of circles that are intended to be concentric.
- A **drum** is a part of the wheel assembly that is engaged by the brakes to slow or stop the vehicle.
- **Eccentric** refers to circles that have different centers.
- **Foundation brakes** are the mechanical components that provide braking force.
- **Frayed** is the deterioration of a cable in which individual strands of the cable are broken or worn.
- To **machine** is to use lathes, drills, or other equipment to change the shape or surface finish of metal.
- **Orientation** is the positioning of a part relative to the vehicle and to other parts.
- **Self-energizing** is the term applied to the braking system whose design allows the braking force to be multiplied by friction.
- **Shoe-to-drum clearance** is the distance between the shoes and the drum when the vehicle is moving.
- A **strut** is the shaped metal part used in brake systems to hold the brake shoes apart.
- **Tempered** is the condition of being hardened by the application of heat.
- **Wallowing** is the condition of a hole becoming enlarged due to wear from a part moving loosely inside it.
- To **warp** is to become deformed as a result of excessive heat or pressure.

Components of a Drum Brake Assembly

READY FOR REVIEW

- Backing plate
- Anchor
- Brake shoe
- Return spring (lower)
- Brake drum

Functions of Drum Brake Assembly Components

READY FOR REVIEW

- The brake drum serves as a portion of the wheel assembly against which the brake shoes apply pressure to stop the rotation of the wheel.
- The backing plate provides a base for the drum brake assembly onto which other parts are mounted.
- The primary shoe exerts pressure on the inside of the drum on the side of the brake assembly toward the front of a forward-moving vehicle.
  Note: The primary shoe is also referred to as the forward or leading shoe.
- The secondary shoe exerts pressure on the inside of the drum on the side of the brake assembly toward the rear of a forward-moving vehicle.
  Note: The secondary shoe is also referred to as the reverse or trailing shoe.
- The wheel cylinder transfers force from the movement of the brake pedal to cause one or both shoes to be pressed against the drum.
- The hold-down holds the shoe to the backing plate while allowing limited movement of the shoe; it may be springs, bolts, guide pins, or clips.
- The anchor holds one end of the shoes in place to allow the shoes to pivot to make contact with the brake drum; it may be single or double.
- The shoe spring returns shoes to an unactuated position.
- The adjuster hardware provides a means of adjusting the clearance between the shoe and the drum when the shoes are not actuated for braking.

Drum and Hub Assembly Defects

READY FOR REVIEW

- Improper wheel mounting hardware (studs and nuts) may mean that hardware may be missing, loose, rusted, stripped, or damaged.
- Cracks or breaks in the drum may mean separation of metal or missing metal.
- Heat checking may mean thin cracks in the surface of the drum braking surface.
- Hard spotting may mean tempered areas of metal that become visible when the drum is machined.
- Eccentric condition may mean that the center of the hub and the center of the outside of the drum are not the same.
- Out-of-round condition may mean that the drum or hub diameter is not equal around the entire assembly.
- Incorrect diameter may mean that the inside diameter of the drum is not within an acceptable tolerance.
- Scoring may mean that there are scratches and cuts in the surface of the drum.
- Bell-mouthed condition may indicate uneven wear of the drum leading to a greater diameter on the inboard side of the drum.

Parts of a Brake Shoe

READY FOR REVIEW

- Lining
- Table (rim)
- Anchor end (heel)
- Web
- Adjusting end (toe)

Functions of Brake Shoe Parts

READY FOR REVIEW

- The lining contacts the drum to provide friction to stop wheel rotation.
- The table (rim) provides a surface to which the lining can be mounted.
- The web reinforces the table and provides the means of mounting hardware for brake operation.
- The weld binds the table and web together.
- The anchor end (heel) positions the shoe and prevents the shoe from rotating with the drum.
- The adjusting end (toe) allows installation of the adjusting device.

Types of Brake Shoe Applications

READY FOR REVIEW

- Non-servo means that as the brake is applied, the shoes apply force independently because of the bottom anchor.
- A single cylinder duo-servo has dual wheel cylinder pistons that apply equal force on the primary and secondary shoes. The force is multiplied by the rotation of the primary shoe against the secondary shoe forcing against the brake drum.
- A double cylinder has double wheel piston cups applying equal force in both directions at both ends of the shoes.

Brake Shoe Materials

READY FOR REVIEW

- Semimetallic materials consist of aluminum, lead, silicas, and other ingredients mixed with resin, molded into shapes, and used for severe duty only.
- Organic materials consist of fiber, organic materials, and resins/bonding agents and are the most commonly used type.

Brake Shoe Defects

READY FOR REVIEW

- Excessive wear may result in inadequate lining remaining for proper braking.
- Oil or grease contamination may indicate that areas of the lining are coated with oil or grease, which can lead to softened material or reduced friction between the lining and the drum.
- Glazing means that the surface of the shoe lining is hard and smooth.
- Scoring means that the surface of the shoe lining contains cuts and streaks.
- Gouging means that the surface of the shoe lining contains relatively deep scratches or pits.
- Cracks means that the surface of the shoe lining contains fine cracks.
- Shoe deformities include bending, wear, or warping of the table or web of the shoe.

Drum Brake Hardware and their Uses

READY FOR REVIEW

- Springs position movable parts, such as holding parts, in relation to one another or return a part to a previous position. Examples are the shoe return spring and the adjuster spring.
- Clips hold parts together where excessive pressure is not a problem. Examples are shoe hold-down clips and cups, retainer clips, and anti-rattle clips.
- Pins provide a stationary mounting point or positioning guide. Examples are anchor pins and guide pins.
- Levers transmit force from one part to another through a pivoting motion. Examples are adjuster levers and parking brake levers.
- Cables and links transmit force from one part to another with a pulling motion. Examples are the parking brake cable, the adjuster cable, and the adjuster link.
- Adjuster hardware provides the means of adjusting the position of shoes.

Adjustment of Drum Brake Assemblies

READY FOR REVIEW

- The clearance between the shoe and the drum is adjusted using a manual or automatic adjustment mechanism.
- A manual adjustment mechanism may use star wheels or centric adjusting devices to lengthen or shorten the clearance distance.
- A manual adjustment mechanism is a periodic maintenance item.
- Automatic adjustment mechanisms commonly use cables or links that turn the star wheel as the lining wears.
- If the system is equipped with an automatic adjuster, the automatic system usually has to be disengaged to allow manual adjustment.

Conditions to Inspect in Brake Drum Adjustment Systems

READY FOR REVIEW

- Drum brake adjustments may be manual or automatic, depending on the conditions.
  1. Manual adjustment:
     - Teeth on the star wheel
     - Threads on the adjusting screw and pivot nut
     - Improper seating of slots
     - Freedom of movement in the star wheel, cam, or other adjustment mechanism
     - The access plug is installed.
  2. Automatic adjustment:
     - The adjustment mechanism engages the adjuster. An example would be the lever engages the star wheel.
     - Linkages free of wear. An example would be frayed cables and worn wedges.
     - Linkages free of deformities and damage. Examples would be links bent and ratchet teeth broken.
     - Free movement of all parts
     - Operation of related parts

