Module 3: Chassis Components

A body-bound bolt is a type of bolt with a special shoulder that fits tightly in the drilled/reamed bolt hole to prevent movement of mating parts.

The channel is the inside C-shaped area on a frame rail.

The chassis is the supporting frame of a vehicle, including everything below the cab.

To couple/uncouple is to join/disconnect the truck/tractor to and from the trailer.

The fifth wheel is the coupling mechanism on the tractor that joins the tractor to the trailer.

The flange is a projecting rib or rim of an object (such as a frame rail) used for strength and for attachment to another object.

The frame stations are locations or positions on a frame assigned by the manufacturer as reference points for measurement purposes.

The huck rivet is a type of fastener in which the nut is crimped to the cap screw. It cannot be removed with conventional tools.

The kingpin is the pin on the trailer that connects to the tractor's fifth wheel.

The pintle hitch is the coupling mechanism that joins two trailers together.

Running gear is the combined parts of a trailer that allow it to be pulled down the road.

The web is the plate connecting the upper and lower flanges on a frame rail.

The yield strength is the maximum stress that a material will withstand before it is permanently bent or twisted out of shape.

Note: The higher the number, the stronger the material.

Basic Chassis Components

The frame assembly, which includes the rails, the cross members, the bracket, and the hangers.

The suspension components, which include leaf springs, air springs, and pads.

The axles, including the front axle and the bogie, or rear axles and springs.

Parts of a Frame Assembly

Frame rails.
  • A typical frame has two rails.
  • Rails are designed to carry the load.
  • Each rail consists of an upper flange, a lower flange, a web, and a channel.

Cross members.
  • There are usually four to six cross members located between the rails.
  • Their primary purposes are to stabilize and secure the rails and to support vehicle components such as the radiator, the engine, and the cab.

  • Cross members also serve as mounting pads for accessories, such as air tanks and fuel tanks, and special rubber cushion supports are used to help reduce road shocks.
  • Cross members may also be used to protect wires or tubing routed from one side of the vehicle to the other.

Note: The frame assembly is supported on the front and rear axles.
Frame Construction

The standard frame has straight, parallel rails.
A dropped frame has rails that are flared and dropped, which allows for a lower center of gravity, better vehicle stability, improved serviceability, and more room for larger engines and larger radiators.
An unequal offset frame has rails that unequally offset from the vehicle centerline.

Frame Reinforcements

Frame rail reinforcements are used to increase the resistance to bending and twisting forces and to increase the load-carrying capacity. Manufacturers often reinforce frames with additional layers of metal.
Other types of reinforcement may be added later and include fish plating, gussets, and brackets.
• Fish plating consists of bolting a steel plate to the outside of rails. It is applied to a standard frame when a vehicle must carry a load greater than the design allows or when the vehicle has to operate on rough terrain.
• Gussets and brackets are steel plates or angle iron reinforcements bolted or riveted to the rails for additional strength.

Common Procedures Performed on Frames

Adding attachments, such as fuel tank brackets or an air tank.
Lengthening the frame.
Reinforcing (strengthening) the frame.
Repairing cracks in the rails and/or cross members.
Removing/replacing/adding the cross members.
Straightening the frame.
Checking the frame alignment.

Guidelines for Working on Frames

When lifting or moving frame rails, use special care so you do not cut, scratch, or damage the exposed frame assembly.
• Cushion all chains and cables with a section of heavy hose or use a rubber lifting strap when hoisting.
• Place a block of wood between the jack and the frame when raising with a jack.
Never heat the frame rails for straightening purposes, as this could result in structural failure of the rail. If the frame must be straightened, all work must be done cold. Frame rails that are severely damaged should be replaced.
Drilling holes.
• Avoid drilling when possible, and use existing holes placed by the factory.
• When necessary, holes may be drilled in the web area only. Do not drill on the flanges.
• Do not drill holes beyond the central one-third of the web area.

Frame rails may be made of aluminum, carbon steel, or steel alloy, and each of these frame materials is manufactured to a different yield strength.
• The yield strength of aluminum ranges from 40,000 to 60,000 pounds per square inch (psi).
• The yield strength of carbon steel frames varies from 36,000 to 80,000 psi.
• The yield strength of steel alloy ranges from 80,000 to 110,000 psi.

Avoid drilling when possible, and use existing holes placed by the factory.
• When necessary, holes may be drilled in the web area only. Do not drill on the flanges.
• Do not drill holes beyond the central one-third of the web area.

• Do not drill any holes larger than the existing cross member or spring bracket bolt holes made by the manufacturer.
• Do not drill holes any closer to the frame flanges than the present bolt pattern used by the manufacturer.
• On aluminum frame rails, the edge (not the center) of the drilled hole must be no closer than 1.5 inches (38 mm) from the outer face of the flange.
• On steel frame rails, the edge (not the center) of the hole must be no closer than 1 inch (25 mm) from the outer face of the flange.
• Do not drill more than two holes on a vertical line.
• Do not drill holes too close together, as failure can occur across a line of holes.
• If possible, use a lead pencil or soapstone for marking the location of the holes to be drilled. The pencil lines can be seen more clearly if the surface of the rail is chalked first.
If a scribe must be used, make a very small mark. The entire scribe mark must lie within the circumference of the drilled hole, as a crack may start on any scribe mark that extends beyond the hole. This is especially important on aluminum frames.

**Bolting.**
- Clean both surfaces before bolting together, and remove all dirt and corrosion.
- Use bolts that fit freely in the holes, and do not force the bolts into place.
- Whenever unlike metals are fastened together, such as aluminum rails and steel cross members, special steps must be taken to prevent corrosion of the aluminum. Aluminum surfaces must be painted, or another surface covering, such as Alumilastic®, Grafo®, or equivalent, must be applied to the mating surfaces.
- Fill the empty bolt holes (unused holes) with extra bolts and nuts.

**Welding/cutting.**
- Follow all shop safety rules when welding and cutting, such as wearing approved masks/shields and gloves and operating only in an approved area.
- Disconnect the ground cable from the truck’s battery before welding or cutting to prevent damage to electrical and electronic components.
- Clamp the welding ground lead directly to the frame as close as possible to the welded area and never to rotating components.
- Bearings and other parts will be damaged if current must pass through them in order to complete the circuit.
- Use the welding rod and size recommended for the type of rail material (aluminum, steel, etc.), and follow the suggested current and voltage specifications.
- Use the welding/cutting method recommended by the frame manufacturer; gas-metal arc welding (GMAW), shielded-metal arc welding (SMAW), and gas tungsten arc welding (GTAW) are commonly recommended.
- Refer to the welding equipment manufacturer for appropriate settings.
- Do not weld attachments directly to the frame rail, as bolting and clamping are preferred attachment methods. To avoid direct welding, equipment brackets should be welded on a separate reinforcement, and then the reinforcements should be bolted to the rail.
- Do not weld into the radius of the flange or along the edge of the flange.

**Things to Check on Frames**

**Ready for Review**

- Loose or missing bolts or rivets.
- Cracks in side rails, cross members, and brackets.
- Elongated holes in side rails, cross members, and brackets.
- Distortion and lack of alignment.

**Frame Fasteners**

**Ready for Review**

- **Rivets.**
  - The two types of rivets commonly used for frame fastening are standard cold rivets and huck rivets.
- **Society of Automobile Engineers (SAE) bolting.**
  - Special SAE or metric body-bound bolts are used to prevent parts from bearing on the threaded portion of the bolt and are recommended for SAE body-bound bolt installation.
- **Metric bolting.**
  - Metric bolting is recommended for metric body-bound bolt installation.
- **Selection.**
  - To select the proper body-bound bolt length, measure the number of parts to be assembled together to determine the accumulated thickness, and this will then be used to determine the proper body length and overall bolt length.
- **Washers.**
  - A hardened steel flat washer must be used under each nut (both SAE and metric). When the rail is aluminum, two steel washers are used, one on each side of the rail.
Causes of Stress Leading to Frame Damage

- Incorrect bolting patterns.
- Notches.
- Improper load considerations, including overloading and uneven loading.
- Loose bolts.
- Abrupt changes in terrain.
- Operating vehicle on extremely rough terrain.
- Rail flanges that may have been welded or drilled with holes.

Practices to Follow in Frame Repairs

- Identify the source of stress that caused the original frame damage, and when making repairs, do not create new stress concentrations.
- Use reinforcement plates that are long enough to extend beyond the critical area so that the ends can be cut on an angle instead of square across the frame section.
- Avoid section gaps caused by the reinforcement plates stopping short of ends of adjacent cross member gussets or brackets.
- Never leave a sharp internal angle when cutting reinforcement plates or when modifying structural members.
- Avoid several holes in direct vertical alignment or holes too close together; a staggered bolt pattern with good spacing and sufficient edge distance is desirable.
- Remove all cracks, nicks, and burrs from the edges of reinforcement plates by grinding.
- Weld all small cracks. Parts with large cracks should be replaced.
- Repair enlarged holes by reaming to accept the next larger bolt diameter. For critical areas, body-bound bolts with hardened washers should be used.

Basic Procedure for Checking Alignment

- Check alignment by transferring vehicle reference points to a level floor with a plumb bob.
- Locate reference points at the same positions on both sides of the vehicle.
- Hang the plumb bob string through the trunnion (a type of suspension used on a two-axle configuration with eight tires—i.e., four tires per axle) and wheel hub centerlines and over the front of the washer at specified frame rail bolt locations. Do not run the plumb bob over the nut. If the washer is missing, remove the bolt and install the correct-size washer.
- Use the exact same bolt on each rail.
- Place a piece of masking tape under the plumb bob and accurately mark the location with a pencil.
- Continue marking reference points at all designated positions.
- Move the vehicle out of the way of the points marked on the floor.
- Snap a chalk line to connect the points in a crisscross pattern.
- Measure lines and compare measurements to check the frame for squareness.
- For example: M1M7 = M2M6, M2M8 = M3M7, M4M10 = M5M9.

Purposes of a Fifth Wheel

- The two purposes of the fifth wheel are to connect the tractor (power unit) to the trailer (payload/cargo) and to allow pivoting between the tractor and the trailer for turning corners or reversing.
Basic Types of Fifth Wheel Mounting Plates

- Stationary mounting plate.
- Sliding mounting plate, of which there are two types:
  1. The air type uses an air cylinder to release the lock mechanism.
  2. The manual type uses a lever to release the lock on the sliding mechanism.

Basic Types of Fifth Wheel Locking Systems

- Holland®.
- Simplex®.

Main Components of a Typical Fifth Wheel

- Pick-up ramp.
- Base plate pivot.
- Operating handle.
- Base mounting bracket.
- Mounting plate.
- Frame mounting supports.
- Skid ramp stop.

Parts of a Trailer

- Frame, including:
  - Inside or outside rails, which provide support for the load.
  - Kingpin, which locks into the tractor’s fifth wheel to connect the trailer to the tractor.
  - Bulkhead, which is the wall on the front of a trailer that prevents cargo from sliding into the tractor during stops.
  - Floor, walls (inside and outside), ceiling, and roof, which are all parts of the van's box shell that protect the cargo, and are commonly made of aluminum and reinforced lightweight material such as fiberglass-reinforced plastic (FRP).
  - Doors, which allow access to the cargo and are commonly of the swinging type or roll-up type.

- Running gear, including:
  - Axles, which carry the weight of the cargo and transmit the load to the wheels.
  - Wheels, which transmit the weight of the cargo from the axles to the tires and provide rotary motion.
  - Tires, which transmit the weight of the cargo from the wheels to the road and provide traction.

- Brakes, which slow and stop movement and consist of service brakes and emergency brakes.
- Suspension system, which is used to provide a smooth ride for driver and cargo.
- Sliding tandems, which are used to adjust the wheelbase of the trailer to help distribute the trailer weight.
- Landing gear, which holds up the front of the trailer when the trailer is not hooked to the tractor.
- Lights and electrical wiring, including clearance lights, turn signals, parking lights, rear lights, and brake lights. The wires that control these lights are contained in the “pigtail” at the front of the trailer.
- Air system, which consists of two air couplings (“glad hands”) that transmit air pressure from the tractor to the trailer brakes.
  - One glad hand provides air to the service brakes (pressurized only when brakes are applied).
  - The other glad hand provides air to emergency brakes (pressurized at all times).