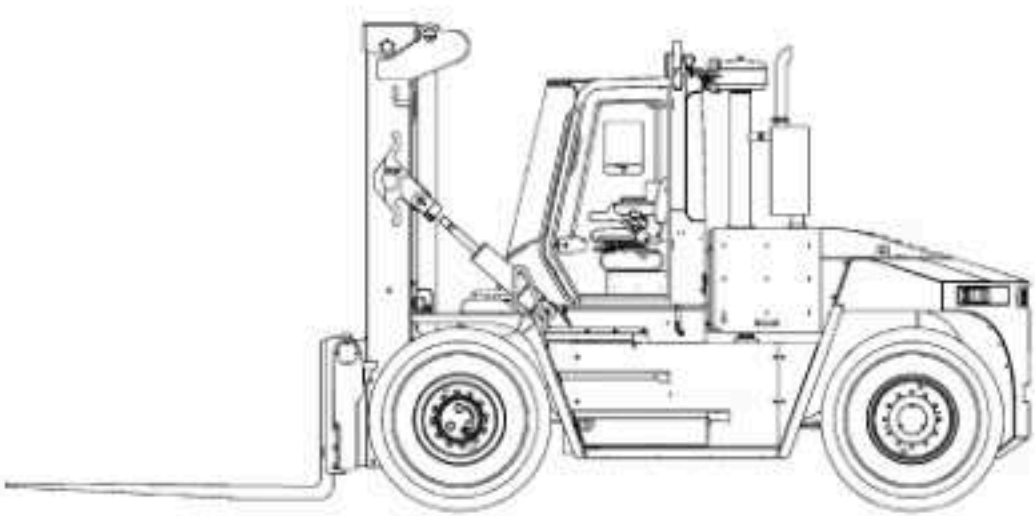
SERVICE MANUAL

B236 (H400HD, H450HD, H400HDS, H450HDS)



Rev. 08/14

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This section is for the following models:

H14.00-20.00XM [A214];
H16.00-18.00XM-12EC (H400-450H-EC) [A214];
H16.00-18.00XM/XMS-12 (H400-450HD/HDS) [A236];
H16.00-22.00XM-12EC (H400-500HD/HDS-EC) [B214];
H16XM-12, H18XM-12, H20XM-12, H22XM-12 (H400HD, H450HD, H500HD, H550HD) [B236];
H16XM-12EC, H18XM-12EC, H22XM-12EC (H400HD-EC, H450HD-EC, H500HD-EC) [C214]

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Table 1. Counterweight Weights (Continued)

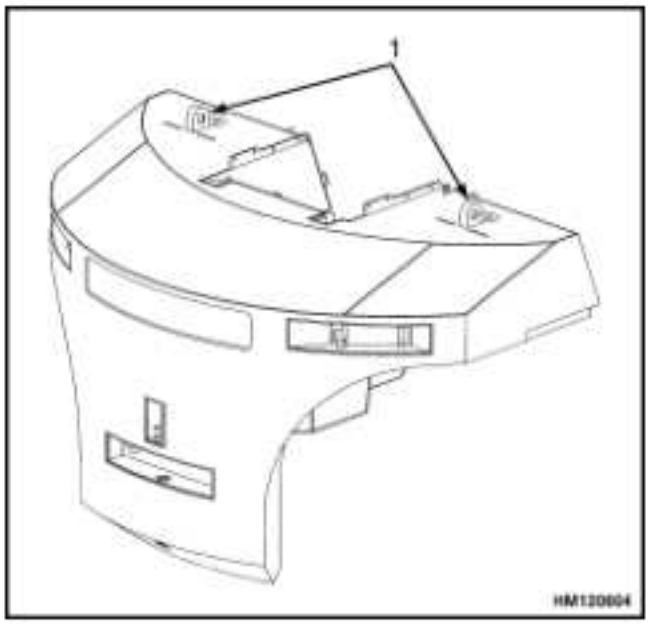
Model	Weight
H400HD	8,300 kg (18,298 lb)
H400HDS	9,000 kg (19,842 lb)
H450HD	9,630 kg (21,231 lb)
H450HDS	9,630 kg (21,231 lb)

REMOVE

WARNING

The counterweight is very heavy. Verify that the lifting device has the capacity to lift the main counterweight. See Table 1 for counterweight weights.

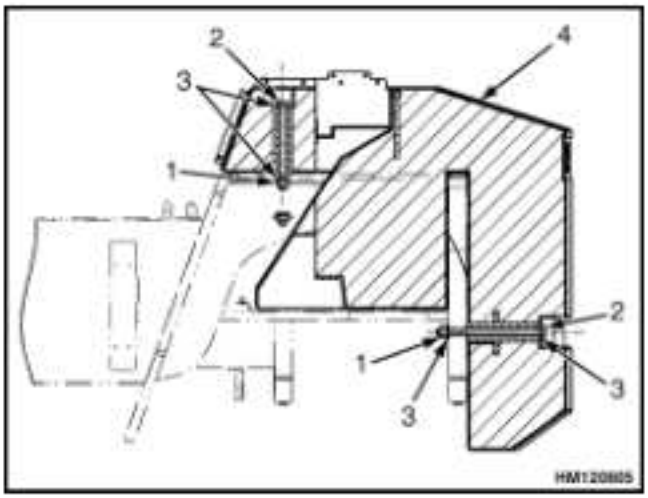
1. Place truck on solid, level surface.
2. Lower the mast completely.
3. Shut down the engine.
4. Apply parking brake.
5. Attach a lifting device to the two lift points of the counterweight. See Figure 2.



1. LIFT POINTS

Figure 2. Lift Points

6. Remove four capscrews, washers, and nuts that hold the counterweight to the frame. See Figure 3.



1. NUT
2. CAPSCREW
3. WASHER
4. COUNTERWEIGHT

Figure 3. Counterweight Mounting Capscrews, Washers, and Nuts

WARNING

Never lift the counterweight straight up. This will cause damage to the frame and my cause personal injury.

7. Raise and move backward the counterweight slowly at the same time.
8. Lower counterweight to the floor.

INSTALL

1. Attach a lifting device to the two lift points of the counterweight. See Figure 2.
2. Install the counterweight on the frame by aligning the flange over the frame member.
3. Install the four capscrews, washers, and nuts. Tighten the capscrews to 1500 N·m (1106 lbf ft).

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Table 7. APC200 Fault Codes (Continued)

Fault Code	Fault Explanation	APC200 Action	Troubleshooting
92.10	Software related fault. Duplicate digital output assignment.	Controller reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
92.11	Software related fault. Digital output selected on unsupported wire.	Controller reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
92.12	Software related fault. Digital output pattern faulty.	Controller reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
92.13	Software related fault. Digital output selected on transmission wire.	Controller reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
92.14	Software related fault. Error in speed sensor 1-2 assignment.	Controller reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
92.15	Software related fault. Error in speed sensor 3 assignment.	Controller reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
92.16	Software related fault. Duplicate speed sensor assignment.	Controller reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
92.17	Software related fault. Invalid supply voltage selected.	Controller reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
92.18	Software related fault. Duplicate analog input pattern.	Controller reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
92.19	Software related fault. Pressure sensor wires interfere with analog input wires.	Controller reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
92.20	Software related fault. Wrong configuration regarding servo motor or brake valve (on analog outputs 4-5-6).	Controller reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
92.30	Software related fault. Wrong configuration regarding full flow selection and past digital error treatment.	Controller reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.

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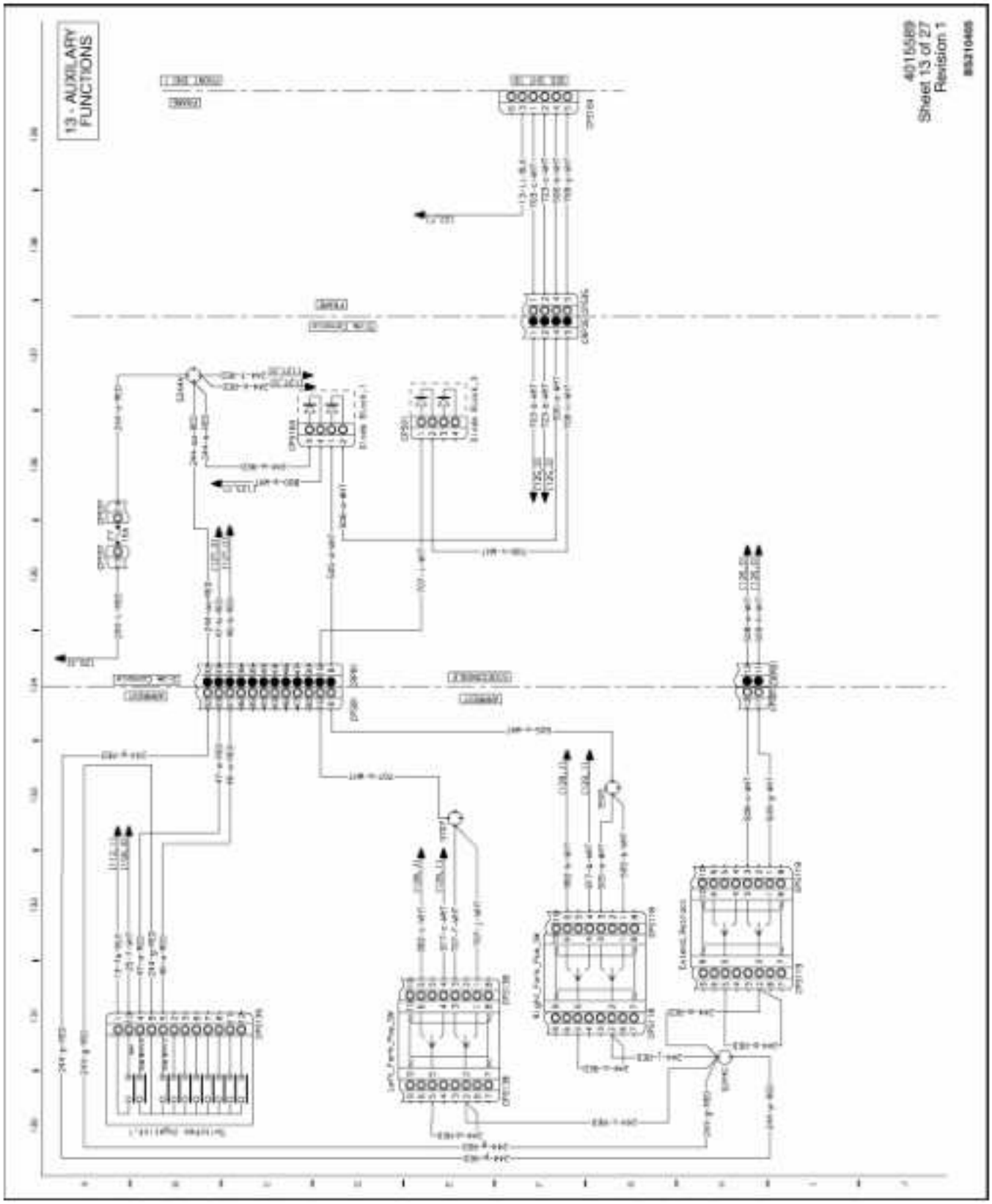


Figure 1. Electrical Schematic Tier 4 (Sheet 13 of 27)

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Pressure Switch

The pressure switch signals if system pressure is applied by the clutch supply valve to the intensifier valves.

Test

When system pressure is above 16.5 bar (239 psi), the internal resistance of the pressure switch is 1 kOhm. When no pressure is applied, the internal resistance is 2 kOhms. The APC200 controller measures the actual resistance and determines that the following conditions exist:

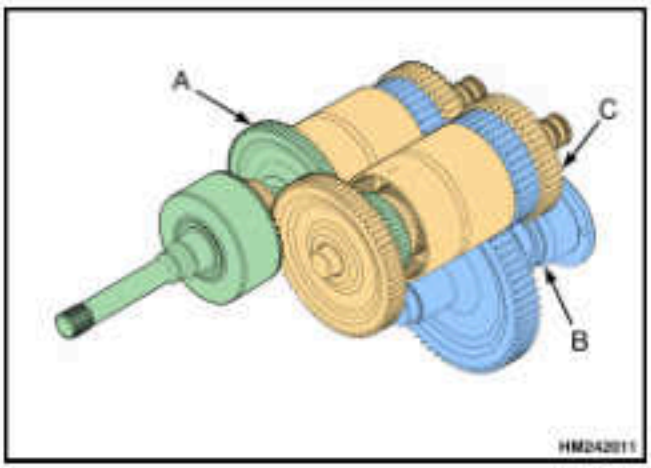
- 0 to 500 Ohms - Short circuit.
- 500 to 1,500 Ohms - System pressure applied.
- 1,500 to 4,000 Ohms - No system pressure.
- 4,000 Ohms or higher - Open circuit.

Verify the pressure circuit resistance by opening the Monitor screen in the Dana Dashboard software. View either the Pressure Switch Resistance Gauge or the Analog Input Signal for the pressure switch (Analog input 0). The location of the pressure switch is shown in Figure 6.

Speed Sensor

The speed sensors determine the rotation speed of the different gear groups. The APC200 controller calculates the speed ratios between the different groups and compares the calculated values with the programmed values. If deviation exceeds an allowable value, the APC200 controller generates a fault code and eventually enters a protection mode. See Figure 14. The following are a few examples of speed inputs and ratios that are monitored by the APC200 controller:

- Converter Speed Ratio
  - The ratio between engine speed and turbine speed is called the converter speed ratio. The converter speed ratio is a measure of the power being transferred through the converter. This ratio is a major factor for the APC200 controller to determine if a higher or lower gear is to be selected during the automatic selection mode. During calibration, a sudden change in converter speed ratio is used to determine the clutch piston position at the moment the clutch starts clamping.
- Transmission Ratio
  - Each selected transmission gear has a specific transmission ratio. When one of the direction clutches is closed and the output speed has reached a certain value for checking, the actual ratio is compared with the specified ratio. If deviation exceeds 5%, one of the clutches is assumed to be slipping. A fault is flagged and the APC200 controller enters the Shut Down Mode.
- Gear Ratio
  - If the turbine, drum, or output speed sensor fails, the APC200 controller calculates the 'actual ratio' based on the value of the remaining sensors. This allows continued operation of the transmission. Speed sensor failure is indicated by a fault code. If the engine speed sensor fails, or if more than one speed sensor fails, the APC200 controller will enter the Limp Home Mode and flag a fault.
- Maximum Torque During Inching
  - The APC200 programming interprets the inching pedal position as the required pressure for the inching clutch. The heat generated in the inching clutch is proportional to the power transferred by the torque converter (converter speed ratio). When the power is transferred at an excessively high level for an extended period of time, the APC200 controller will release pressure in the clutch and flag a fault.



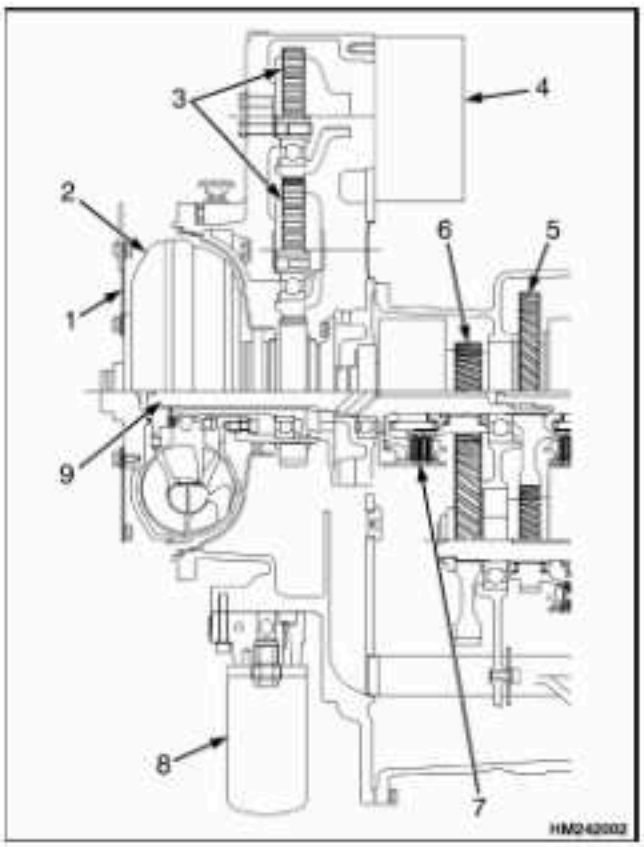
A. TURBINE SPEED
B. OUTPUT SPEED
C. DRUM SPEED

Figure 14. Schematic Speed Sensor Locations

Test

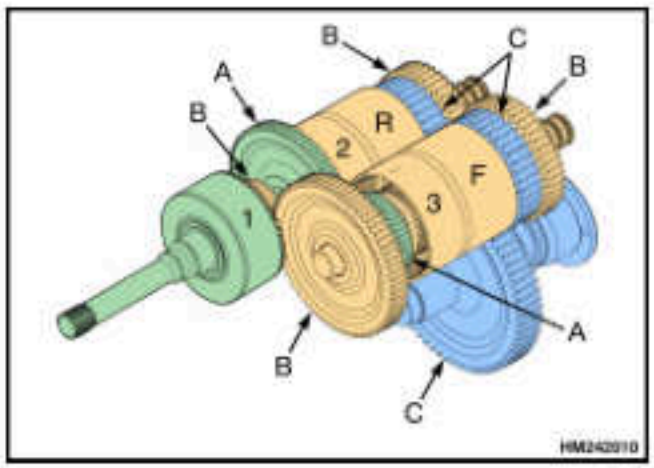
Dana Dashboard software shows functionality of each of the speed sensors under 'Speed Monitor'. Electrical functionality can be tested by using the schematic shown in Figure 15. Observe the correct sensor polarity. Pin 1 must be connected to 12 Volt+. Pin 2 must be connected to 12 Volt . For the engine speed sensor, pin A must be connected to 12 Volt+.

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1. DRIVE PLATE
2. TORQUE CONVERTER
3. PUMP DRIVE GEAR
4. TRANSMISSION PUMP
5. INPUT GEAR
6. INTERCONNECTING GEAR
7. CLUTCH
8. TRANSMISSION FILTER
9. TRANSMISSION INPUT SHAFT

Figure 1. Transmission Input Section



A. INPUT GEARS
B. INTERCONNECTING GEARS
C. OUTPUT GEARS

Figure 2. Gear Engagement

If clutches belonging to one group would be engaged simultaneously, the transmission would lock. Erroneous clutch engagement is prevented by the transmission control system.

Different speeds are obtained by engaging either the forward or the reverse clutch, and by engaging the 1st, 2nd, or 3rd speed clutch.

When the transmission is in **NEUTRAL**, the forward clutch and the reverse clutch are disengaged, while one of the speed clutches remains engaged.

The clutches consist of a hub which carries friction discs with internal splines, and a drum which carries steel discs with external splines. See Figure 3.

The friction discs and the steel discs are alternately installed. By pressurizing the clutch piston, the friction discs and the steel discs are clamped together, which causes the hub and the drum to rotate as one unit. When hydraulic pressure is released, the return springs force the piston back against the clutch housing and allows the hub and drum to rotate independently. The drum, steel discs, piston, spacer, and return springs rotate at the same speed. The hub and friction discs rotate at the same speed.

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