BONUS SECTION 2: POWER ASSIST UNITS — VACUUM BOOSTER AND HYDRO-BOOST

10 Targeted Practice Questions

1. A vacuum brake booster uses engine intake manifold vacuum to provide power assist. The booster amplifies pedal force by:

A. Using vacuum to pressurize brake fluid before it enters the master cylinder, reducing the work required by the master cylinder pistons

B. Creating a pressure differential across a large flexible diaphragm — atmospheric pressure pushes one side while vacuum holds the other side low, producing a net force that assists the master cylinder pushrod

C. Using a vacuum-driven hydraulic pump that supplements master cylinder output pressure during brake application

D. Storing compressed vacuum energy in an accumulator that releases instantly when the brake pedal is pressed, providing a brief but powerful boost

2. A technician is testing a vacuum brake booster. With the engine running, the technician firmly applies the brake pedal and holds pressure for 30 seconds. The pedal holds its position without dropping. The engine is then turned off and the pedal is pumped several times to deplete the vacuum reserve. With no vacuum in the booster, the pedal is applied and held. The pedal again holds its position. What does this test result confirm?

A. The booster diaphragm is leaking since pedal hold should be softer without vacuum assistance

B. The master cylinder has no internal bypass — the hydraulic system is holding pressure correctly in both conditions

C. The booster check valve is functioning correctly since it maintained vacuum after engine shutdown

D. The pushrod adjustment is correct since the pedal held at the same height in both conditions

3. A vehicle with a vacuum brake booster develops a brake pedal that gradually becomes harder over several minutes of idling. Engine vacuum measures normal at 18 inches of mercury. The MOST likely cause is:

A. The booster diaphragm has a slow leak that gradually depletes the vacuum reserve during idle

B. Brake fluid is boiling inside the master cylinder from engine heat, reducing hydraulic efficiency

C. The booster check valve is stuck open, continuously bleeding vacuum from the booster reserve

D. The engine is producing excessive exhaust backpressure that is reducing effective intake manifold vacuum

4. A hydro-boost power brake system differs from a vacuum booster in that:

A. Hydro-boost uses compressed air from an engine-driven compressor rather than vacuum as its power source

B. Hydro-boost uses power steering pump hydraulic pressure as its power source, making it independent of engine vacuum

C. Hydro-boost applies hydraulic pressure directly to the brake fluid without using a mechanical pushrod to the master cylinder

D. Hydro-boost uses an electric motor to generate assist pressure rather than relying on engine-driven systems

5. A vehicle with a hydro-boost system has a hard brake pedal but the power steering operates with normal effort. The technician should check:

A. Power steering pump pressure output since both systems share the same pump

B. The hydro-boost accumulator, which stores hydraulic pressure reserve specifically for the brake booster and operates independently from the power steering circuit

C. The hydro-boost return line for restriction since a blocked return prevents fluid from circulating through the booster

D. The power steering fluid level since a low level affects the booster before affecting the steering gear

6. A brake booster check valve is a one-way valve. In normal operation it:

A. Opens during brake application to allow atmospheric air into the front chamber of the booster diaphragm

B. Allows engine vacuum to flow into the booster and prevents vacuum from escaping back to the intake manifold when the engine is off or vacuum drops

C. Controls the rate of vacuum buildup in the booster to prevent sudden diaphragm movement during gentle brake applications

D. Opens to equalize pressure between the front and rear booster chambers when the brake pedal is released

7. A customer reports that after the engine stalls unexpectedly, the first brake application after the stall has normal assist but the second application has significantly reduced assist. This is normal because:

A. The booster diaphragm loses its elasticity after the first application without engine vacuum

B. The booster typically stores enough vacuum reserve for one to two full-power-assist brake applications after the engine stops

C. The master cylinder compensating port closes when engine vacuum drops, reducing fluid flow on subsequent applications

D. The brake booster requires a minimum of 500 RPM to maintain adequate vacuum and the stall caused immediate booster failure

8. An electric vacuum pump is installed on a vehicle with a diesel engine or hybrid powertrain. This pump activates when:

A. The brake pedal is pressed, providing vacuum on demand with each brake application

B. A vacuum pressure switch detects that booster vacuum has dropped below a specified threshold, running the pump until vacuum is restored to the normal operating range

C. The vehicle speed exceeds 25 mph, pre-charging the booster in anticipation of highway braking

D. The engine is running at idle since diesel and hybrid engines never produce adequate vacuum at any operating condition

9. A technician removes a vacuum brake booster from a vehicle and inspects the pushrod length before installing a replacement unit. Incorrect pushrod length that is too short will result in:

A. The compensating port remaining closed, causing brake drag from the moment the new booster is installed

B. Excessive brake pedal free play and a longer than normal pedal stroke before hydraulic pressure begins to build

C. The booster diaphragm being pulled to an off-center position that reduces its effective area and power output

D. Premature contact between the booster reaction disc and the master cylinder piston on the first brake application

10. A vehicle with a hydro-boost system is being bled after a repair. The technician notices the brake pedal feels normal but the power steering has a slight moan during low-speed turns. The correct procedure is to:

A. Bleed the power steering system by turning the steering wheel lock-to-lock several times with the engine running to purge air from the shared fluid circuit

B. Replace the power steering pump since moaning indicates impending pump failure unrelated to the brake repair

C. Add power steering fluid to the reservoir and recheck since fluid was lost during the hydro-boost repair

D. Perform a separate hydro-boost bleed procedure using a scan tool since air in the booster produces steering noise as a secondary symptom

BONUS SECTION 2 — ANSWERS AND EXPLANATIONS

1. B — Pressure differential across diaphragm assists pushrod — The booster contains a large rubber diaphragm. The rear chamber is connected to atmospheric pressure when the pedal is pressed while vacuum is maintained in the front chamber. The pressure difference across the diaphragm creates a substantial force that acts in the same direction as the driver's pedal input, multiplying the effective force applied to the master cylinder pushrod.

2. B — Master cylinder has no internal bypass — This two-stage test isolates the master cylinder from the booster. By confirming the pedal holds firm under sustained pressure both with and without vacuum assist, the test verifies the hydraulic circuit is sealed correctly and the master cylinder is not bypassing internally. The booster and master cylinder both pass their respective portions of this diagnostic sequence.

3. A — Booster diaphragm has a slow leak — A booster that functions correctly at startup but becomes progressively harder during extended idling has a slow vacuum leak across the diaphragm. At idle, engine vacuum production is adequate to initially fill the booster, but a slow diaphragm leak gradually equalizes pressure across both chambers, reducing the pressure differential and progressively diminishing assist.

4. B — Hydro-boost uses power steering pump pressure — Hydro-boost systems are commonly used on diesel engines and large vehicles that produce insufficient intake manifold vacuum for a traditional booster. The power steering pump generates the hydraulic pressure that powers the hydro-boost unit, making the system independent of engine vacuum and capable of providing consistent assist regardless of engine load or throttle position.

5. B — Check the hydro-boost accumulator — The hydro-boost accumulator is a separate component that stores hydraulic pressure specifically for emergency brake assist if the engine stalls or pump pressure drops. It operates independently from the steering gear circuit. Normal power steering with hard braking indicates the pump is producing adequate pressure but the accumulator or booster's internal valve is not properly utilizing that pressure for brake assist.

6. B — Allows vacuum in, prevents vacuum from escaping — The check valve is installed between the intake manifold vacuum source and the booster. It allows vacuum to flow into the booster freely during engine operation. When the engine stops or intake vacuum drops temporarily, the check valve closes and traps the stored vacuum in the booster, preserving the power assist reserve for subsequent brake applications.

7. B — Booster stores reserve for one to two applications — The vacuum booster is designed to hold a reserve of approximately 20–25 inches of mercury that allows one to two full-power-assist brake applications after the engine stops or stalls. This reserve is intentionally limited in capacity. Drivers should be aware that if the engine stalls, they have limited assisted braking available and should stop the vehicle promptly before the reserve is depleted.

8. B — Activates when vacuum drops below threshold — The electric vacuum pump is controlled by a vacuum pressure switch that monitors booster vacuum continuously. When the booster vacuum drops below the minimum specification — typically around 10–15 inches of mercury depending on the application — the switch signals the pump to run until the vacuum is restored to the normal operating range, then the pump shuts off.

9. B — Excessive pedal free play and longer stroke — A pushrod that is too short leaves a gap between the pushrod tip and the master cylinder primary piston. This gap must be taken up by pedal movement before the pushrod contacts the piston and begins to build hydraulic pressure. The result is an unusually large free play zone at the top of the pedal stroke where the pedal moves without producing any braking effect.

10. A — Bleed power steering by turning lock-to-lock — Air introduced into the hydro-boost system during a brake repair circulates throughout the shared power steering fluid circuit. Turning the steering wheel from lock to lock several times with the engine running and the reservoir full forces air through the pump, steering gear, and hydro-boost unit and back to the reservoir where it can escape. This is the standard procedure for purging air from any power steering or hydro-boost system after repair.