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# Air Brake System Technical Guide

A complete, plain-language reference to the pneumatic braking system of heavy commercial vehicles — every circuit and component explained, with troubleshooting and maintenance.

Edition 1 · Heavy commercial vehicles (truck · bus · trailer) · vadenoriginal.com

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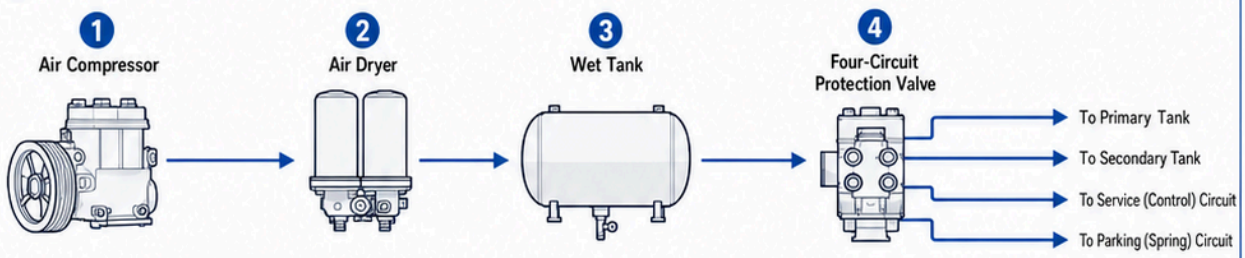


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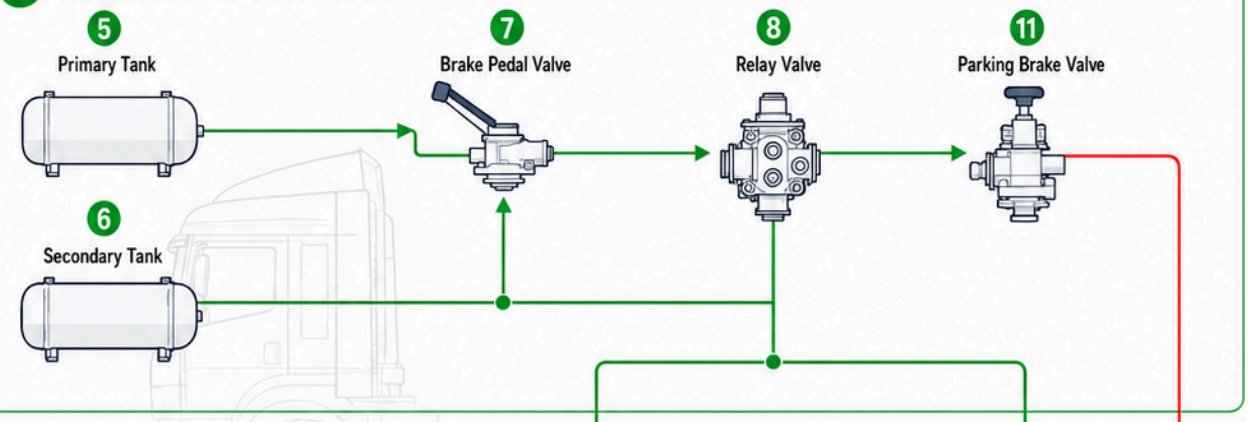


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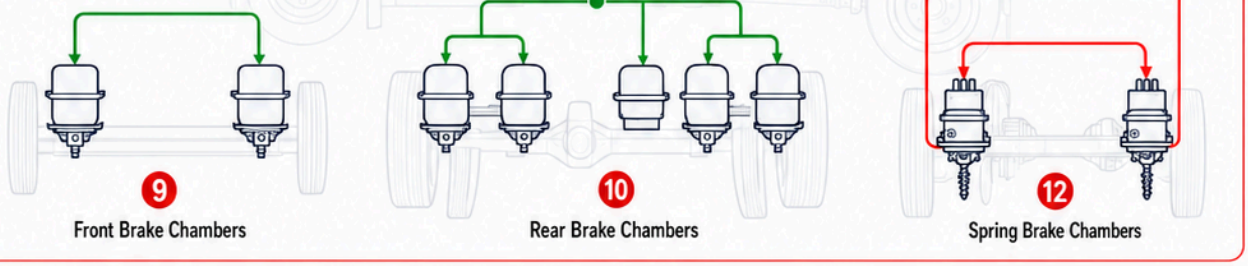


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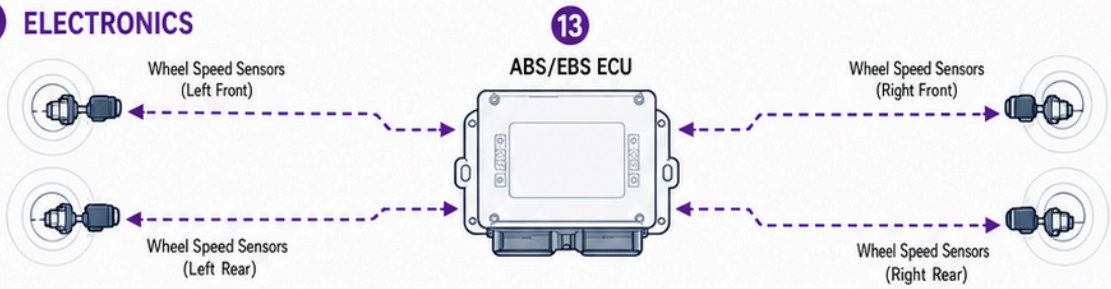


## LEGEND

- Supply Air
- Service / Control Air
- Parking Brake Circuit (Spring)
- ABS / EBS Signal (Electrical)
- Arrow denotes flow direction

# Introduction: How an Air Brake System Works

Heavy commercial vehicles do not stop the way a passenger car does. Instead of pushing hydraulic fluid through a sealed line, a truck, bus or trailer brakes with **compressed air**. There are good engineering reasons for this. Air is free, endless and safe to vent to atmosphere, so a small leak never leaves the system dry the way a burst hydraulic line does. Air lines can be long and can be coupled and uncoupled quickly — essential when tractors and trailers are joined and separated every day. And because air is a stored, pressurized medium, it can hold a large vehicle's brakes fully applied for parking with no ongoing effort from the driver.

## The Fail-Safe Spring-Brake Principle

The most important idea in the whole system is counter-intuitive: on the parking and emergency circuit, **air holds the brakes off, and loss of air applies them**. A powerful spring inside each spring brake chamber wants to clamp the brakes on at all times. During normal operation, compressed air compresses that spring and holds it back. If system pressure falls too far — a ruptured line, a failed compressor, a runaway leak — the spring simply pushes the brakes on automatically. The vehicle brakes itself to a stop rather than rolling free. That is why a properly maintained air brake system is called *fail-safe*.

## Two Jobs: Charging and Applying

It helps to think of the system as two circuits doing two different jobs:

- **The supply (charging) circuit** — the compressor, governor, air dryer and reservoirs — builds and stores a reserve of compressed air, typically around 120 psi.
- **The service (application) circuit** — the foot brake (treadle) valve, relay valves and brake chambers — meters air from that reserve to apply the brakes in proportion to how hard the driver presses the pedal.

Storing air first, then metering it on demand, is what lets a heavy vehicle brake instantly and repeatedly without waiting for pressure to build.

## Dual Circuits for Redundancy

For safety, the service system is split into two independent halves — a **primary** and a **secondary** circuit, usually dividing the rear and front axles. Each has its own reservoir and plumbing. If one half fails, the other still delivers braking, and the dashboard warning buzzer and gauges alert the driver. No single failure leaves the vehicle without brakes.

## How to Use This Guide

Each section stands on its own, so you can jump straight to the component or symptom you are working on, or read straight through to build the full picture. Throughout, note that **VADEN ORIGINAL** manufactures aftermarket versions of the core pneumatic components described here — compressors, valves, air dryers and repair kits.

The sections that follow trace the air's path in order: from the compressor that makes it, through the valves that control it, to the chambers that turn it into stopping force.

# The Air Supply (Charging) Circuit

Every air brake system begins with the charging circuit — the group of components that take in atmospheric air, compress it, dry it, and store it as clean, high-pressure energy ready for the driver to use. On a heavy truck, tractor or bus, the brakes only work as well as the air feeding them. A charging circuit that delivers wet, dirty, or under-pressured air will eventually cause valves to stick, reservoirs to corrode, and lines to freeze. Understanding how air is made and stored is the foundation for diagnosing the rest of the system.

## Air Compressor

The air compressor is the heart of the charging circuit. It is engine-driven — belt-driven on older units, but most modern units are gear-driven off the timing gears and lubricated and cooled directly from the engine. It runs continuously whenever the engine turns, but it does not always pump air. When system pressure drops to the **cut-in** point (commonly around 100 psi), the compressor loads and builds air; when it reaches the **cut-out** point (typically about 120–130 psi), it stops pumping and runs unloaded. This cycling keeps the reservoirs within a safe working band.

**Failure symptom:** Slow pressure build-up — taking far longer than the roughly 3 minutes allowed to raise pressure from 85 to 100 psi — points to a worn compressor. Excessive oil passing into the air system (oil fouling the dryer and downstream valves) is another classic sign of worn rings or seals. VADEN ORIGINAL manufactures replacement compressors for major heavy-vehicle platforms.

## Governor, Unloader and Pressure Regulator

The governor is the pressure-sensing control that tells the compressor when to load and unload. It monitors reservoir pressure and, at cut-out, sends a signal to the compressor's **unloader** mechanism, which holds the intake valves open so the compressor spins freely without building pressure. When pressure falls back to cut-in, the governor vents that signal and the compressor resumes pumping. On many systems the same governor signal also triggers the air dryer's purge cycle.

**Failure symptom:** A governor set too high (or stuck) lets pressure climb until the safety valve pops off; set too low, and the system never reaches full working pressure. If the unloader sticks, the compressor may run loaded constantly (overheating and pushing oil) or never load at all.

## Air Dryer and Desiccant Cartridge

Compressing air heats it and concentrates the moisture and oil vapor it carries. As that air cools in the reservoirs, water condenses out. The air dryer removes this contamination before it reaches the tanks. Air passes through a replaceable **desiccant cartridge**, whose beads adsorb water vapor, while a filter captures oil aerosols. At cut-out, the dryer runs a **purge cycle**: it back-flushes the collected water and oil out through the purge valve with a sharp burst of air, and regenerates the desiccant for the next cycle.

**Failure symptom:** Water draining from the reservoirs means the dryer is no longer doing its job — usually a saturated desiccant cartridge that needs replacing (typically once a year or per the maintenance schedule). A dryer that hisses continuously has a leaking purge valve. VADEN ORIGINAL supplies both complete air dryers and service desiccant cartridges.

### One-Way and Check Valves

Check valves allow air to flow in one direction only. Placed between the dryer and the reservoirs, and between the individual tanks, they let each reservoir fill but prevent it from bleeding back if the pressure upstream drops. This is what protects the system after a failure: if a line ruptures or the compressor stops, the check valves trap the air already stored downstream so the remaining circuits keep their pressure.

**Failure symptom:** A leaking or stuck-open check valve lets one circuit drain another. A telltale sign is losing air from a tank that should have held pressure overnight, or one reservoir dragging down the whole system when a single line leaks — defeating the split-circuit protection.

### Reservoirs: Wet, Primary and Secondary

Stored air is held in a series of reservoirs (air tanks). The first tank the compressor feeds is the **wet tank** (supply reservoir). It is called "wet" because it is the collection point where any remaining condensed water and oil that got past the dryer settles out, before cleaner air is passed on to the two working tanks — the **primary** reservoir (which typically feeds the rear-axle service brakes) and the **secondary** reservoir (which feeds the front/steer-axle brakes). Splitting supply this way means a leak in one circuit still leaves the other able to stop the vehicle.

Because the wet tank collects liquid, condensate must be drained regularly. Many tanks have a manual pull-cord or petcock drain valve at the lowest point; others use automatic drain valves. Draining matters year-round:

- **Corrosion:** standing water rusts the tank from the inside and sends debris downstream into valves.
- **Freezing:** in cold weather, accumulated water can freeze in lines and valves, disabling the brakes.
- **Capacity:** water sitting in a tank displaces the air volume the system is counting on.

| Reservoir | Primary role | Typically feeds |
|---|---|---|
| Wet (supply) | Collects residual water/oil; distributes to working tanks | Primary and secondary reservoirs |
| Primary | Working air storage | Rear-axle service brakes |
| Secondary | Working air storage | Front/steer-axle service brakes |

A daily draining habit and a healthy dryer work together: the dryer removes most moisture up front, and draining clears whatever still reaches the wet tank — keeping the stored air clean, dry and ready to brake.

# The Service (Application) Circuit

The service circuit is the everyday brake — the system you command with your right foot every time you slow or stop. Unlike the parking and emergency circuits, which use stored spring force, the service circuit does its work with compressed air delivered on demand from the vehicle's reservoirs. When you press the treadle, that pedal effort is converted into a metered air pressure signal, that signal races down the frame to each axle, and at every wheel a brake chamber turns air pressure back into raw mechanical force. Understanding how that pedal press travels to the wheel is the key to diagnosing weak, slow, or uneven braking.

## The Dual Foot Brake (Treadle) Valve

The foot brake valve — often called the treadle or pedal valve — is the driver's command center. On a modern truck it is a **dual** valve, meaning it contains two separate sections fed by two independent reservoirs (typically primary and secondary). This split is a safety feature: if one air circuit fails, the other still delivers braking. As the driver pushes the pedal, the valve meters out air pressure in proportion to pedal effort — press lightly and it delivers a small pressure; press hard and it delivers up to full reservoir pressure. This is called *application pressure*, the signal that tells the rest of the system how hard to brake.

## Relay Valves — Fast Application at Distant Axles

The rear axles and the trailer are a long way from the treadle valve. If their chambers had to fill through that small, distant signal line, braking would lag badly. Relay valves solve this. Mounted close to the axles they serve, a relay valve reads the small application signal from the foot valve and then opens a large, short path from a nearby reservoir straight to the brake chambers. It "relays" the driver's command using local air, filling the chambers quickly and releasing them just as fast. The result is a rapid, even application across all axles.

## Quick Release Valves — Fast Release

When you lift off the pedal, air must escape the chambers quickly or the brakes will drag. A quick release valve, plumbed close to the chambers, senses the drop in signal pressure and dumps the chamber air straight to atmosphere through a large local port — rather than forcing it all the way back up the line to the treadle valve. This gives a clean, prompt release.

## Service Brake Chambers

The brake chamber is where air becomes force. Inside its housing a flexible rubber **diaphragm** is backed by a pushrod. When application air enters, it presses on the diaphragm and drives the pushrod outward against a return spring. Chambers are sized by area (Type 20, Type 24, Type 30, and so on) — the larger the diaphragm, the more force the same pressure produces. VADEN ORIGINAL manufactures service and spring brake chambers to OE-equivalent specifications.

## Automatic Slack Adjusters

The pushrod does not act on the brake directly — it works through the slack adjuster, a lever splined to the S-cam shaft. The slack adjuster does two jobs. First, as a lever arm it multiplies the chamber's linear push into torque that rotates the camshaft. Second, being *automatic*, it continuously takes up slack as the brake linings wear, holding the **free-stroke** (the pushrod travel before the shoes touch the drum) within limits. Correct free-stroke is critical: excessive travel means lost braking force and is a common out-of-service defect. VADEN ORIGINAL supplies automatic slack adjusters alongside its chambers and valves.

## S-Cam, Drum and Shoes

As the camshaft rotates, the S-shaped cam at its end turns between the two brake shoe rollers, spreading the shoes apart and forcing their friction linings against the inside of the spinning brake drum. Friction slows the wheel. Release the pedal and shoe return springs pull the shoes back off the drum.

## The Disc-Brake Alternative

Many newer trucks and trailers use air-actuated disc brakes instead of drums. Here the same brake chamber bolts to a caliper; its pushrod drives an internal lever-and-spindle mechanism that clamps friction pads against a rotor. Air disc brakes offer more consistent stopping, better fade resistance, and faster pad changes, though the pneumatic supply feeding them is identical.

# Parking & Emergency (Spring) Brakes

On heavy vehicles the parking and emergency brakes are not a separate mechanical hand lever pulling a cable — they are built into the rear (and trailer) brake chambers as **spring brakes**. The clever, fail-safe idea behind them is that a powerful mechanical spring does the holding, and air pressure is used only to *hold that spring off*. Whenever air is present the brake is released; whenever air is lost the spring applies the brake. This is the opposite logic of a normal service brake, and it is what keeps a truck from rolling away when the engine — and therefore the compressor — is shut down.

## How a spring brake chamber works

A spring brake chamber is really two chambers stacked together. The forward (service) side works like an ordinary brake chamber, applying the brakes when the driver presses the pedal. The rear side contains a large, heavily preloaded coil spring. Air delivered to that rear chamber compresses the spring and holds it back, keeping the brake released. Release the air (park the truck, or lose system pressure) and the spring drives the pushrod out, applying full braking force with no air at all.

- **Fail-safe:** loss of air = automatic apply. A leak, a burst line, or a drained reservoir cannot leave you with no brakes.
- **Parking:** the dash park valve (yellow diamond knob) exhausts the spring chambers, applying the springs.
- **Emergency / breakaway:** if system pressure falls too far (roughly the 20–45 psi range, depending on the valving), the springs apply automatically — this is also what stops a trailer that breaks away and loses its supply line.

## Anti-compounding — why forces must not stack

If the springs are already applied *and* the driver also presses the service pedal, both forces could add together on the same slack adjuster and pushrod. That "compounding" can overload the foundation brake, the cam, and the S-cam hardware. To prevent it, the system uses an **anti-compounding (inversion / park-release) valve**. When the spring brakes are applied, this valve routes or balances service air into the spring side so the two forces are not summed. Never rely on stacking spring plus service pressure to "brake harder" — it is a recipe for broken components.

## Caging (winding off) a spring brake safely

To service a chamber with no air available, the spring must be mechanically **caged**. Every spring brake chamber includes a release (caging) bolt and washer for this purpose.

- Chock the wheels and, where possible, restore system air first so the springs are already held off.
- Insert the caging bolt into the pushrod cavity, seat it, and turn it to wind the spring back and hold it compressed.
- Confirm the pushrod has retracted before removing or reworking the chamber.

**Safety note:** the power spring stores enough energy to kill or maim. Never cut, weld, or force open a spring chamber, and never remove the clamp band on a non-serviceable unit — cage it first, or replace it as a sealed assembly. VADEN ORIGINAL manufactures spring brake chambers and their release/caging hardware to the correct preload and stroke specifications; always fit the chamber type and rating specified for the axle.

# Load Sensing & Air Suspension Control

The braking effort an axle needs depends on how much weight sits on it. A tractor or trailer running empty carries only a fraction of its laden weight, so applying full braking force to lightly loaded wheels will lock them, trigger constant ABS cycling, and flat-spot tyres. Load sensing solves this by matching delivered brake pressure to actual axle load.

## The Load Sensing Valve (ALB)

The load sensing valve — also called an ALB (Automatic Load-dependent Braking) valve, or simply a load or brake proportioning valve — sits between the foot valve (or relay valve) and the service brake chambers. It continuously measures axle load and meters the brake pressure allowed through to the chambers accordingly:

- **Empty:** the valve limits delivered pressure, so a light application produces gentle, controlled braking instead of instant lock-up.
- **Laden:** the valve passes full reservoir pressure through, giving the brakes the force needed to stop a fully loaded vehicle.
- **Part load:** output pressure scales proportionally between those two limits.

On steel-suspended vehicles the valve reads load mechanically through a linkage arm connected between the axle and the chassis — as the springs compress under load, the arm angle changes and the valve opens further. On air-suspended vehicles the same job is done pneumatically: the valve senses air-spring (bellows) pressure, which rises and falls directly with axle load.

## Levelling Valves and ECAS

Air suspension holds the chassis at a set ride height regardless of load by adding or releasing air in the bellows. On conventional systems a mechanical levelling valve, linked to the axle, admits air when the vehicle squats under load and exhausts it when the load is removed. Electronically Controlled Air Suspension (ECAS) replaces that mechanical valve with height sensors and an ECU driving solenoid valves, giving faster, more precise levelling plus features such as kneeling and raise/lower control. Because a load-sensing brake valve reads bellows pressure, correct ride height is essential — a levelling fault feeds the ALB a false load signal and skews braking.

## Why Load-Proportional Braking Matters

- **Stability:** balanced pressure front-to-rear and tractor-to-trailer prevents premature lock-up, jack-knifing and trailer swing, especially when empty on wet roads.
- **Even wear:** matching force to load spreads work across the axles, extending lining and drum/disc life and avoiding flat-spotted tyres.
- **Stopping power:** the laden vehicle always gets full braking when it needs it.

Because these valves work hard and must stay accurately calibrated, worn or seized units directly compromise braking balance. VADEN ORIGINAL manufactures aftermarket ALB (load sensing) and levelling valves to OE specification for reliable, correctly proportioned braking.

# ABS & EBS Electronic Braking

Anti-lock Braking Systems (ABS) and Electronic Braking Systems (EBS) sit on top of the pneumatic foundation you already know. Air still does the mechanical work of clamping the brakes, but electronics now decide, moment by moment, exactly how much air reaches each chamber. The goal is simple: keep the wheels rotating during hard braking so the driver retains steering control and stopping distances stay short.

## Wheel Speed Sensors and the Exciter Ring

ABS begins with knowing how fast each wheel is turning. A toothed **exciter ring** (tone ring) is pressed onto the hub and rotates past a fixed **wheel speed sensor**. As the teeth sweep by, the sensor generates an alternating signal whose frequency rises and falls with wheel speed. The ECU reads all sensors and compares them. A wheel decelerating far faster than the vehicle is about to lock. Clogged teeth, a corroded ring, or an excessive sensor air gap are common causes of intermittent ABS faults, so keep the ring clean and the sensor fully seated.

## The ABS Modulator Valve

When the ECU sees an impending lock-up, it commands the **ABS modulator valve** on that wheel (or axle). The modulator is a fast-acting solenoid pack plumbed between the service line and the brake chamber. It does not create braking pressure on its own — it regulates the pressure the driver is already applying. Under ECU control it cycles through three states many times per second.

## ECU Logic: Release, Hold, Re-apply

- **Release (dump):** the modulator vents chamber air to atmosphere, letting the wheel spin back up.
- **Hold:** the valve seals the chamber, freezing pressure at its current level.
- **Re-apply (build):** air is metered back in to restore braking as traction returns.

This release-hold-reapply cycle repeats several times a second, which is why drivers feel a pulsing pedal during an ABS stop. The **ABS warning lamp** on the dash confirms the system: it lights at key-on for a bulb and self-check, then goes out. A lamp that stays on means ABS has faulted and reverted to normal (non-anti-lock) braking — the truck still stops, but without wheel-lock protection, and the fault must be diagnosed.

## EBS: Electronic Braking System

EBS goes a large step further. Instead of the pedal sending only air, it sends an **electronic demand signal** — brake-by-wire. A pedal-mounted sensor tells the ECU how hard the driver is braking, and the ECU commands pressure electronically at each axle, with air as a backup circuit if the electronics fail. Because an electrical signal travels far faster than a pressure wave down a long air line, EBS delivers noticeably **quicker response and shorter, more even lag** between front and rear axles.

EBS also integrates functions that plain ABS cannot. It manages **ASR (traction control)** by braking a spinning drive wheel or trimming engine torque, supports **electronic stability control** to counter rollover and jackknife, balances brake wear across axles, and communicates tractor-to-trailer over the ISO 11992 data line for coordinated braking. In short, ABS only prevents lock-up during braking; EBS actively governs the entire braking event and vehicle stability.

VADEN ORIGINAL manufactures aftermarket **ABS and EBS modulator valves and wheel speed sensors** built to match OE response and fitment for heavy trucks, buses and trailers.

# The Trailer Braking Circuit

When a tractor pulls a trailer, the air brake system has to reach across the coupling and control brakes on a unit that has its own reservoirs and chambers. Two air lines make the crossing, and a handful of valves manage how air flows, when the trailer brakes apply, and — critically — what happens if the trailer ever comes loose.

## Crossing to the Trailer: Gladhands and the Tractor Protection Valve

Air passes between tractor and trailer through two coupling connectors called **gladhands**. They are color-coded so they cannot be crossed by mistake:

- **Red gladhand — supply (emergency) line:** carries a steady flow of air to charge the trailer reservoirs. This line also senses breakaway.
- **Yellow gladhand — service (control) line:** carries the signal that tells the trailer how hard to brake, whether from the foot valve or the hand valve.

Sitting at the back of the tractor is the **tractor protection valve**. Its job is to protect the tractor's air supply. If a hose ruptures or the trailer breaks away and system pressure falls to roughly 20–45 psi, this valve automatically closes the supply and service lines at the tractor, sealing off the leak so the tractor keeps enough air to stop itself.

## The Trailer Control (Hand) Valve

Mounted on the steering column or dash, the **trailer control valve** — the "hand valve" or "trolley valve" — lets the driver apply only the trailer brakes independently of the foot brake. It feeds a signal down the yellow service line. It is meant for testing and low-speed maneuvering, not for holding a parked rig or for normal stops, which should always use the foot valve so tractor and trailer brake together.

## Onboard the Trailer: Relay Valve, Reservoirs and Chambers

The trailer carries its own **reservoirs**, charged through the red supply line, and its own **relay valve**. Because the service signal would be slow travelling the full length of the rig, the relay valve uses the small control signal as a command and delivers full reservoir pressure locally to the **brake chambers**, giving fast, even application at every axle. VADEN ORIGINAL manufactures aftermarket relay valves, chambers and coupling components to OE specifications for exactly these positions.

## Breakaway and Emergency Behaviour

If the trailer separates, the red supply line is torn open and its pressure drops. That pressure loss triggers the trailer's spring brakes (and emergency function) to apply automatically, bringing the runaway trailer to a stop, while the tractor protection valve seals the tractor. In short, the trailer circuit mirrors the tractor's own layout — supply, control, relay, reservoirs and chambers — engineered to fail safe rather than fail loose.

# Troubleshooting & Maintenance

Most air-brake faults announce themselves early — a lazy pressure build, a faint hiss, a warning lamp that won't clear. Reading those signs correctly saves downtime and keeps the vehicle legal. The table below pairs the symptoms a driver or technician sees most often with their likely causes and a first-response check. Always chock the wheels and drain the system to zero before opening any pneumatic line, and remember that many wear items in these circuits — dryer cartridges, brake chambers, slack adjusters, valves — are manufactured by VADEN ORIGINAL as direct-fit aftermarket replacements.

| Symptom | Likely cause | Check / remedy |
|---|---|---|
| Slow air pressure build-up (compressor takes too long to reach cut-out) | Worn compressor, restricted or fouled air dryer, leaking governor, or system leaks bleeding off supply | Time the build-up (governed engine rpm should reach ~85–100 psi in about 3 minutes from empty). Check the dryer and its purge valve, inspect the governor cut-in/cut-out, and leak-test the supply side. |
| Excessive moisture / water in the tanks when drained | Saturated or failed air dryer cartridge, no dryer fitted, or dryer purge/heater not working | Replace the dryer cartridge and confirm the purge valve exhausts on each unload cycle. Drain all reservoirs; heavy oily water also points to compressor ring wear passing oil downstream. |
| Brakes drag or will not fully release | Seized slack adjuster or camshaft, weak return spring, over-adjusted pushrod, blocked exhaust port on a relay or quick-release valve, or a partially applied spring brake | Confirm full air is reaching the spring-brake chambers (park side released). Check slack-adjuster free movement, verify the relay/quick-release valve exhausts promptly, and re-set pushrod stroke to spec. |
| Audible air leak (hiss) with the engine off or brakes applied | Leaking chamber diaphragm, cracked line or fitting, worn valve O-rings, or a failing park-control/foot valve | Fully charge, shut down, and listen — soapy water finds the source. A leak only when the pedal is pressed isolates the service circuit; a leak at rest points to supply or park lines. Replace the failed seal, line, or valve. |
| ABS warning lamp stays on | Damaged wheel-speed sensor or ring (exciter), sensor air-gap out of tolerance, wiring/connector fault, or a stored ECU fault | Read blink codes or scan the ABS ECU. Inspect the sensor, its ring teeth, and the harness; re-seat the sensor against the tone ring and clear codes after repair. Never release a vehicle with a live ABS fault. |
| Low-air warning light or buzzer active | System pressure below ~60 psi from a large leak, compressor not building, or a faulty low-pressure switch | Check gauge readings against the switch; if pressure is genuinely low, trace the leak or compressor fault before driving. Do not move the vehicle until pressure is restored above the warning threshold. |
| Uneven or pulling braking side to side | Mismatched pushrod stroke, one seized slack adjuster, contaminated (oil/grease) linings, unequal chamber sizes, or a lazy relay valve | Compare pushrod stroke across axles, inspect linings and drums for glazing or contamination, and verify chamber sizes match by axle. Correct adjustment and replace fouled friction material in axle sets. |

## Service intervals

Follow the OEM schedule and local regulations, but these checks form a sound baseline routine:

- **Drain reservoirs** — daily on vehicles without an automatic drain; weekly at minimum. Any oily or milky discharge signals dryer or compressor trouble.
- **Replace the air dryer cartridge** — typically every 12 months or per manufacturer mileage; sooner in high-humidity or heavy-duty duty cycles.

- **Inspect slack adjuster free-stroke** — confirm free movement and, on automatic slack adjusters, that they take up slack correctly; never mask a fault by manual re-adjustment alone.
- **Check chamber pushrod stroke** — measure applied stroke against the marked limit for the chamber size; re-adjust or replace before it reaches the legal maximum.
- **Inspect linings and drums** — measure lining thickness, check drums for scoring, heat cracks and out-of-round, and replace friction material in axle sets to keep braking balanced.

# Component Quick Reference & Glossary

Use this table as a fast lookup when identifying parts on the vehicle or matching a replacement. Each row names the component, states its job in one line, and lists the equivalent VADEN ORIGINAL aftermarket product category.

| Component | Function (one line) | VADEN ORIGINAL category |
|---|---|---|
| Air compressor | Engine-driven pump that generates the system's compressed air. | Air Compressor |
| Governor | Senses reservoir pressure and controls when the compressor loads and unloads. | Governor |
| Air dryer / cartridge | Removes moisture and oil from the air before it reaches the tanks. | Air Dryer Valve |
| Unloader valve | Vents the compressor to idle once cut-out pressure is reached. | Unloader Valve |
| Relay valve | Speeds brake response by feeding local air to remote chambers on a control signal. | Relay Valve |
| Quick release valve | Dumps chamber air fast on release so brakes let go promptly. | Quick Release Valve |
| Brake chamber | Converts air pressure into mechanical push-rod force to apply the service brake. | Brake Cylinder |
| Spring (park) chamber | Mechanical spring applies the park/emergency brake when air is exhausted. | Spring Brake Chamber |
| Slack adjuster | Lever that transmits push-rod force to the S-cam and sets brake clearance. | Slack Adjuster |
| Load sensing valve (ALB) | Reduces brake pressure to lightly loaded or empty axles to prevent lock-up. | Load Sensing Valve |
| Levelling valve | Adds or vents air-suspension bellows air to hold chassis ride height. | Levelling Valve |
| ABS/EBS modulator | Electronically modulates chamber pressure to prevent wheel lock and manage braking. | ABS/EBS Modulator Valve |
| Exhaust brake | Restricts engine exhaust flow to slow the vehicle without the service brakes. | Exhaust Brake Valve |
| Clutch servo | Air-assisted actuator that reduces clutch-pedal effort on the release mechanism. | Clutch Servo |

## Glossary

- **Cut-in / cut-out:** The two governor pressure set points — cut-out (typically about 8.1–8.5 bar / 120–130 psi) stops the compressor from building further; cut-in (roughly 0.7–1.0 bar lower) restarts it as air is used.

- **Wet tank:** The first ("supply") reservoir downstream of the dryer, where any remaining moisture and oil collect before air passes to the primary and secondary tanks.
- **S-cam:** The S-shaped cam at the foundation brake that the slack adjuster rotates to spread the shoes against the drum.
- **Gladhand:** The palm-shaped coupler joining tractor and trailer service and emergency air lines; colour-coded to prevent cross-connection.
- **Anti-compounding:** A valve arrangement that prevents the spring (park) force and the service application from adding together on one chamber, which would overstress the foundation brake.
- **Free-stroke:** The push-rod travel taken up before the shoes contact the drum; used to check adjustment and slack-adjuster health.
- **ALB:** Automatic Load-sensing Braking — the load sensing valve function that scales braking effort to axle load.
- **Fail-safe:** The design principle by which loss of air applies the spring brakes, so a leak or system failure stops the vehicle rather than releasing it.