



TECHNICAL GUIDE

Hydraulic Clutch Pedal Unit: Fault Diagnosis, Replacement, Maintenance

How to diagnose a faulty hydraulic clutch pedal unit on trucks, replace and properly bleed it, and maintain it to prevent a spongy clutch pedal.

When a heavy commercial vehicle feels like the clutch never fully disengages, the pedal goes spongy underfoot, or it doesn't spring back after being pressed, drivers often blame the pressure plate or the clutch kit. Yet field experience frequently points somewhere else: the fault sits higher up, inside the hydraulic unit right behind the pedal itself. In modern trucks and buses the clutch is no longer actuated by individual linkage rods and cables but hydraulically, through a master cylinder integrated into the pedal assembly. This guide explains, from a foreman's and service technician's perspective, what the hydraulic clutch pedal unit does, how it fails, the correct diagnostic sequence, removal and installation with a focus on bleeding discipline, and the maintenance habits that extend its service life.

This document was prepared by the VADEN technical team based on heavy commercial vehicle clutch actuation service practice and OE manufacturer documentation. The values given here are general reference ranges; for exact data such as hydraulic fluid type, pedal free travel, and connection torques, the current OE service manual matching the vehicle's engine/chassis code is authoritative. Last updated: September 2026. Component sizing is based on the relevant international standard family (ISO/EN/DIN/SAE) and the manufacturer OE specification.

What Is a Hydraulic Clutch Pedal Unit? Function and Working Principle

A hydraulic clutch pedal unit is the actuation assembly that converts the mechanical force applied by the driver's foot into hydraulic pressure via a master cylinder integrated into the pedal arm, and transmits that pressure through the clutch line to the slave cylinder — and, where fitted, through a servo/booster — to the clutch fork. Fluid drawn from the reservoir is compressed by the pedal pushrod to disengage the clutch.

The same unit goes by several names in the field and in catalogs: **clutch master cylinder, clutch actuation unit, pedal master cylinder assembly, clutch pump**, and, when supplied as one piece with the pedal arm, **complete pedal unit**. All belong to the same hydraulic actuation family; regardless of the name used, the selection criterion is the same: chassis/engine code and OE reference number.

The working principle combines leverage with hydraulic pressure. When the driver presses the pedal, the pedal arm rotates about a pivot pin and pushes the pushrod forward. The pushrod drives the piston inside the master cylinder along the bore. In the first instant of piston movement, it closes off the reservoir feed port (the compensation port); from that point the fluid inside the cylinder is compressed and pressure builds. This pressure travels through the outlet fitting and the clutch hose to the slave cylinder (release cylinder). The slave cylinder piston extends and, either directly or with the help of a servo/booster, pushes the clutch fork, releasing the pressure plate — the clutch disengages and the gear can be changed.

When the pedal is released, the piston returns, the compensation port reopens, and the excess fluid in the circuit flows back to the reservoir. This return flow compensates for thermal expansion and for the volume change caused by pad wear. This compensation mechanism is exactly why hydraulic actuation self-adjusts compared to cable-operated systems, and why it depends so

heavily on precise seals. Once a seal starts leaking, pressure escapes and the reservoir level quietly drops.

Which OE systems is it found on?

The geometry and actuation character of the hydraulic clutch pedal unit depend less on the vehicle brand and more on the **clutch actuation architecture** and **chassis/engine code** it is built into. In heavy-duty service, this unit is most commonly encountered on the **Mercedes-Benz Actros** and **Axor**, MAN **TGA / TGS / TGX**, DAF **CF** and **XF**, Volvo **FH** and **FM**, Scania, and Iveco **Stralis** families; on the booster side, Wabco- and Knorr-sourced OE units are common. These names are given only as **application examples**; within each family there are different unit variants depending on trim level and pedal group. The correct part is determined by engine/chassis code and OE number, not by brand name; the relevant OE service procedure governs hydraulic line and fitting dimensions.

Synchronized and non-synchronized variants

The hydraulic clutch pedal unit is manufactured in two basic variants depending on the gearbox control it is used with. The **synchronized unit** is used on gearboxes where gear changes are smoothed by synchromesh, with actuation characteristics and stroke values set accordingly. The **non-synchronized unit** is intended for applications without synchromesh or with a different actuation logic. Although the two look similar from the outside, piston stroke, output characteristics, and connection dimensions can differ; fitting the wrong variant spoils pedal feel and gear engagement. VADEN's category tree reflects this distinction clearly: **Synchronized** and **Non-Synchronized** units are listed separately.

Components and supporting elements

- **Pedal arm and bearing:** the lever that transfers foot force through a leverage ratio to the pushrod, rotating on a pivot pin.
- **Integrated master cylinder:** the body housing the piston that converts mechanical force into hydraulic pressure.
- **Pushrod:** the rod connecting the pedal arm to the piston, carrying the free-travel adjustment.
- **Reservoir feed port:** the connection that feeds hydraulic fluid into the cylinder and provides the compensation function.
- **Sealing elements (repair kit seals):** the seals and O-rings in front of and behind the piston — the root component in most leaks.
- **Outlet fitting and clutch hose (546):** the line carrying pressure from the master cylinder to the slave cylinder.
- **Return spring:** the spring and pedal stop that return the pedal to its upper position.

System / Application	Actuation type	Characteristic feature	Service note
Servo-assisted hydraulic actuation (heavy tractor)	Master cylinder + line + booster-assisted slave cylinder	Pedal effort reduced by the booster	Booster and master cylinder fail independently; diagnose separately

System / Application	Actuation type	Characteristic feature	Service note
Direct hydraulic actuation (mid-range)	Master cylinder + line + slave cylinder	No booster, higher pedal effort	Bleeding and seal maintenance are decisive
Synchronized unit (325)	Synchromesh gearbox actuation	Stroke/output characteristic matched to synchronized shifting	Variant must not be mixed up; confirm against OE
Non-synchronized unit (326)	Non-synchromesh / different actuation	Different piston stroke and connection dimensions	Wrong variant spoils gear engagement
Complete pedal unit (939)	Pedal arm + integrated master cylinder together	Arm, bearing, and cylinder as a single set	Complete unit is required when a repair kit is not enough

The hydraulic clutch pedal unit varies by vehicle and trim level: even within the same tractor family, the synchronized/non-synchronized variant, booster connection, and pedal group geometry can differ. Do not select the unit by "vehicle model" alone — verify it against the engine/chassis code, model year, and, where possible, the OE number on the old unit. Fitting the wrong variant spoils pedal feel and gear engagement, and can also cause forced installation.

How is a hydraulic clutch pedal unit fault recognized?

Most hydraulic clutch pedal unit faults fall under two headings: loss of hydraulic pressure (leakage or air) and mechanical failure (pedal arm, bearing, pushrod, spring). The first typically shows up as the clutch not disengaging and a spongy pedal feel; the second as the pedal not returning or as a creaking noise. The table below matches field symptoms with likely causes and verification methods.

Symptom	Likely Cause	Check / Verification
Pedal feels soft/spongy; firms up after a few presses	Air in the system, internal leak at the master cylinder seal, or low reservoir level	Check reservoir level; observe feel change after bleeding; hold the pedal down and watch for slow creep
Gear engages hard, clutch doesn't fully disengage, chatter on shift	Insufficient stroke: master cylinder not building pressure, internal seal leaking, or air present	Measure pedal stroke; observe slave cylinder travel; check lines and fittings for leaks
Reservoir fluid level keeps dropping with no visible outside leak	Internal leak from the master cylinder's rear seal into the pedal box	Check for moisture/wetness behind the pedal and around the pushrod area; indicates internal leak requiring seal repair kit
Pedal stays at the bottom, doesn't return on its own	Return spring broken/loose, piston seal sticking, or pedal bearing jammed	With the engine off, pull the pedal by hand and test free movement; visually inspect spring and bearing
Pedal is very stiff, requires strong effort	Servo/booster inactive, blocked line, or dry/corroded pedal bearing	Check servo supply (air/hydraulic); lubricate pedal pivot; check line clearance

Symptom	Likely Cause	Check / Verification
Fluid drop or wet trace around the pedal area	Outlet fitting, hose connection, or master cylinder front seal leaking	Clean the area, press the pedal, and trace the direction the leak spreads from
Creaking, clicking, or vibration when pressing/releasing the pedal	Dry pedal pivot pin, worn bearing, or play at the pushrod mount	Move the pedal by hand to check for play; inspect pin and bearing for lubrication/wear
Clutch feels tight on first use in the morning, improves once warm	A small amount of air in the system, or a seal that stiffens in cold weather	Observe repeatedly through cold-warm cycles; evaluate bleeding and seal condition

Leak, air, or mechanical?

Separating these is half the diagnosis. If the pedal on a hydraulic clutch pedal unit feels spongy and firms up after a few pumps, **air** is the first suspect. If the reservoir level is dropping with no outside trace, the problem is an **internal leak** from the master cylinder's rear seal into the pedal box; a repair kit or a complete unit then becomes necessary. If the pedal doesn't return, or feels stiff or creaks, the problem is not hydraulic but **mechanical** — the spring, bearing, pin, or pushrod. Replacing parts without separating these three possibilities is the most common and most expensive mistake.

Pedal stroke and free-travel check

Diagnosis of a hydraulic clutch pedal unit centers on pedal free travel and total stroke. The first few millimeters of pedal movement (free travel) is the clearance until the piston closes the compensation port; if this clearance is too large, the remaining stroke is not enough to build pressure and the clutch fails to disengage. If it is too small, the piston can never open the port, fluid cannot return to the reservoir, and the clutch stays partially engaged, burning the friction lining. Free travel and total stroke values are vehicle-specific; the exact figure must be confirmed against the OE service manual.

Internal leak test

If the master cylinder's internal seal is leaking, the pedal slowly sinks to the floor when held down. With the engine off, press the pedal with moderate force and hold it steady: if you feel a slow "melting" sensation under your foot, there is an internal leak, and the fluid is usually going into the pedal box rather than outside. This test is the fastest way to explain a dropping fluid level with no external trace.

This test only covers the pedal end of the line; for the full symptom picture at both ends, see our guide on [clutch master and slave cylinder failure symptoms](#).

Further reading

For a plain-language technical overview of this subject, see the reference article on [Wikipedia](#). Always confirm specific figures and procedures against the vehicle manufacturer service data.

How is a hydraulic clutch pedal unit replaced? Step by step

The fluid used in hydraulic systems is aggressive toward seals and painted surfaces as well as skin and eyes; protective glasses and fuel/chemical-resistant gloves are mandatory. In systems using DOT-type fluid, spills strip paint — do not splash it. Do not access the pedal assembly unless the vehicle is secured and unable to move. The correct fluid type and bleeding procedure are vehicle-specific; confirm the OE service manual before starting work.

- 1 Secure the vehicle:** Stop the engine, apply the parking brake, chock the wheels, and disconnect the battery switch/negative terminal. On servo/booster-equipped systems, release air pressure according to procedure if applicable.
- 2 Drain the system:** Drain the hydraulic fluid from the slave cylinder bleed nipple into a clean container. Draw off the reservoir with a suction tool. Drained fluid must not be reused. Wipe up any spills immediately — they will stain painted surfaces.
- 3 Record the pushrod setting:** Before fitting the new unit, measure and record the current pushrod length and pedal free travel. This value is your reference for setting free travel correctly during installation; skipping it means the clutch either won't disengage or will stay permanently half-engaged.
- 4 Remove the pedal linkage:** Remove the pivot pin/clip connecting the pedal arm to the pushrod. Do not force a seized pin — apply penetrating fluid and wait. Photograph the position of the return spring.
- 5 Disconnect the hydraulic line:** Undo the outlet fitting/hose with the correct size wrench, holding the counter body steady. Immediately plug the open line end and the unit outlet with clean caps — even a single particle entering the hydraulic system will score a seal.
- 6 Disconnect the reservoir feed:** Remove the hose/clip at the reservoir feed port, keeping fluid drip under control. Cap the openings.
- 7 Remove the unit:** Undo the bolts securing the master cylinder/complete pedal unit to the chassis/cab body and take the unit out. Note bolt length and sequence.
- 8 Prepare the new unit or repair kit:** For a complete replacement, compare the new unit with the old one (mounting hole pattern, outlet direction, pedal arm geometry, synchronized/non-synchronized variant). For a repair-kit rebuild, clean the housing and inspect the cylinder bore; if there is scoring or corrosion, a repair kit is not enough and a complete unit is required. Lightly wet the new seals with the correct fluid before fitting.
- 9 Fit the unit:** Seat the unit without forcing it, start the bolts by hand, and tighten in the correct sequence and to OE torque. Connect the reservoir feed and hydraulic line; tighten the fitting to the correct torque without over-tightening and crushing the tapered sealing face.

- 10 Set the pushrod and free travel:** Set the pushrod length to your recorded value and bring pedal free travel into the OE range. Do not forget the locknut. If free travel is wrong, the system will never work correctly.
- 11 Fill with the correct fluid and BLEED:** Fill the reservoir with the **correct type** of fluid for the vehicle (mineral oil vs. DOT4 — mixing them swells or dissolves seals). Bleed the system through the slave cylinder nipple, either with two people ("press-release") or with a pressure/vacuum bleeding tool, until all air is expelled. This step is critical; incomplete bleeding is the number-one cause of "spongy pedal" and "clutch won't disengage" complaints. Do not let the reservoir run dry during the process, which would draw air back in.
- 12 Test sealing and function:** Mark the reservoir level, press the pedal several times and confirm a firm feel develops. Check all connections with a dry cloth. Start the engine and try shifting gears; confirm the clutch fully disengages and the pedal returns. After a short test drive, recheck cold — some leaks only appear after a thermal cycle.

Common Mistakes to Avoid

Using the wrong type of hydraulic fluid is the most destructive mistake with a hydraulic clutch pedal unit. Putting DOT-type fluid into a system designed for mineral oil (or vice versa) swells or dissolves the seals; the system starts leaking entirely within days, ruining even a newly fitted unit. Always confirm the system's fluid type from the OE label or service manual before adding fluid, and never mix types.

Trying to silence a spongy pedal by "just adding a bit more fluid" only hides the problem. If reservoir level keeps dropping, there is either an external leak or an internal leak underneath; topping up only delays the fault, and with an internal leak the fluid simply fills the pedal box. The correct response is to find the source and fix it with a seal/repair kit or a complete unit.

- **Incomplete bleeding:** Even a single remaining air bubble makes the pedal spongy and prevents full clutch disengagement; bleeding is not finished until no trace of air remains.
- **Skipping the pushrod adjustment:** If free travel is wrong, the clutch won't disengage properly even with a sound unit, or it stays half-engaged and burns the lining.
- **Dirty assembly:** Dust or grit entering the hydraulic system scores the seal; the area around fittings and ports must be cleaned before disassembly.
- **Fitting the wrong variant:** Installing a non-synchronized unit in place of a synchronized one (or vice versa) spoils stroke and output character, worsening gear engagement.
- **Letting the reservoir run dry while bleeding:** Once the level bottoms out, air re-enters the system and the job has to start over.
- **Not lubricating the pedal pivot:** A dry pin and bearing create creaking, stiffness, and play over time; apply the correct grease at every service.
- **Over-tightening the fitting:** Crushing the tapered sealing face makes the leak permanent; use a torque wrench.

- **Neglecting the return spring/clip:** A missing or fatigued spring won't return the pedal; check it at every disassembly.
- **Reusing drained fluid:** Used hydraulic fluid carries moisture and particles; always refill with fresh fluid.

Technical Values and Checkpoints

The values below are general reference ranges commonly encountered in heavy commercial vehicle hydraulic clutch actuation systems. Vehicle family, synchronized/non-synchronized variant, trim level, and model year change these ranges; always check the vehicle manufacturer's current service manual for exact data.

Hydraulic clutch pedal unit technical values (general reference)

Parameter	Typical range / condition (general reference)	Note
Hydraulic fluid type	Mineral oil OR DOT4, depending on vehicle	Never mix; determined by OE label/manual
Pedal free travel (clearance)	On the order of a few millimeters	Exact value is vehicle-specific; set via the pushrod
Total pedal stroke	Application-specific	Insufficient stroke prevents full disengagement
Reservoir fluid level	Between Min–Max marks	Continuous drop indicates internal/external leak
Unit/pedal mounting bolt torque	General range — follow OE value	Sequence and torque taken from the manual
Outlet fitting / hose torque	General range — narrow tolerance	Over-tightening crushes the sealing face
Internal leak test (pedal sink)	No sink should occur when held down	Slow sinking = master cylinder seal leak

The torque and stroke values above are only a guiding range. Even within the same vehicle family, synchronized/non-synchronized variant and pedal group can require different values; some manufacturers define separate torque for initial assembly versus reassembly. What governs in practice is the current service manual specific to the vehicle manufacturer's engine/chassis code.

- Is the reservoir level between Min and Max; has it dropped since the last service?
- Is pedal free travel within the OE range; is the pushrod locknut tight?
- Does the pedal sink when held down (internal leak) — check with the engine off?
- Are the outlet fitting, hose, and reservoir connection dry — checked both hot and cold?
- Is the pedal pivot pin/bearing free of play and properly lubricated; any creaking?
- Is the return spring intact, does the pedal fully return when released?
- On servo-equipped systems, is the booster supply (air/hydraulic) normal; is the pedal excessively stiff?

Maintenance and Service Life

The hydraulic clutch pedal unit has no fixed "replacement interval" of its own; its lifespan is determined by hydraulic fluid quality, seal condition, pedal pivot lubrication, and correct installation. A unit running the correct fluid type, with periodic level checks and a lubricated pivot, is one of the vehicle's longer-lasting components. By contrast, a unit running on moisture-contaminated old fluid, with a dry pivot, or that has been exposed even once to the wrong fluid type, starts leaking before the year is out.

- **Fluid discipline:** Hydraulic fluid — especially in DOT-type systems — absorbs moisture; it should be changed per the manufacturer's interval and the level checked regularly. Contaminated fluid shortens seal life.
- **Loyalty to the correct type:** Always use the system's defined fluid type when topping up or replacing; never mix mineral and DOT fluid.
- **Pedal pivot lubrication:** The pin, bearing, and pushrod mount should be greased periodically with the correct grease; this is the cheapest prevention for creaking and stiffness.
- **Free-travel monitoring:** As the friction lining wears and mechanical parts settle in, free travel can drift; check and adjust it at each service.
- **Periodic visual inspection:** At every service, review reservoir level, fitting/hose connections, and any fluid trace inside the pedal box.
- **Post-intervention monitoring:** After any work on the hydraulic system, recheck sealing and pedal feel within the first few hundred kilometers.
- **Acting early:** Address the pedal at the first sign of sponginess or dropping level; a delayed internal leak lets fluid fill the pedal box and cause further damage.

For fleet operators, the most efficient approach is to treat the unit as part of a system rather than in isolation. Evaluating the master cylinder's seal condition, outlet fitting, and hose during the same service as a clutch kit or slave cylinder job is far more economical than bringing the vehicle back down a few months later. VADEN's hydraulic clutch pedal unit and connection product family is built exactly on this logic: complete pedal units, repair kits, clutch hoses, and synchronized/non-synchronized variants can be matched to the engine/chassis code alongside the master and slave cylinders, so a vehicle going in for clutch work leaves with a complete actuation set in a single visit. A ten-minute sealing and pedal-feel check before sending the vehicle back out is the cheapest insurance against being stranded on the road.