VADEN® ORIGINAL

TECHNİCAL GUİDE

Truck Wheel Hub: Faults, Replacement and Maintenance Guide

How to spot truck wheel hub bearing noise, heat and seal leaks, set bearing endplay correctly, replace the hub step by step and extend its service life.

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If a tractor unit's front wheel starts to hum, if an oil trace shows up on the inner face of a trailer rim, or if one wheel feels noticeably hotter than the others during a break, the issue is no longer the tyre or the brake — it is on the wheel hub side. The wheel hub is a silent component; by the time it starts making noise, the damage has usually already progressed. This guide explains, from a workshop point of view, what the hub does, why bearing endplay is so critical, how to read a leaking seal, the discipline required when removing and refitting, and the maintenance habits that extend service life.

This document was prepared by the VADEN technical team, based on heavy commercial vehicle axle and wheel group service practice together with OE manufacturer documentation. The figures given here are general reference values; for exact data such as bearing adjustment clearance, preload procedure and tightening torque, the current OE service manual matching the vehicle's engine/chassis code is authoritative. Last updated: September 2026.

What Is a Wheel Hub / Axle Hub? Function and Operating Principle

The wheel hub (axle hub) is the cast or forged body on a heavy commercial vehicle that connects the wheel to the axle end, rotates on a set of tapered roller bearings inside it while carrying the vehicle weight and road loads, and carries the brake drum or disc together with the ABS tone ring. In heavy commercial applications, wheel hub bearing adjustment clearance is typically held within a band of 0.025–0.15 mm; with correct adjustment and regular lubrication, a service life of over 500,000 km can be achieved.

The same component is known by several names in the field and in catalogues: **wheel hub**, **axle hub**, **hub assembly**, in Turkish catalogues **porya**, in German catalogues **Radnabe**. They all belong to the same group; regardless of the name used to search for it, the selection criteria are identical: axle type, axle code and OE reference number.

The wheel hub's operating principle looks simple, but the load table is heavy. The hub rotates on two tapered roller bearings seated on the axle spindle. The bearings are fitted facing each other — one inner, one outer — so that together they carry both the vertical wheel load and the lateral force generated in a corner. The wheel rim is bolted to the studs on the outer face; in drum systems the drum is centred on the hub, in disc systems the disc is bolted to the hub. On ABS-equipped vehicles the toothed tone ring is either pressed onto the hub or rotates with the hub within the brake group.

The inside of the wheel hub is a sealed lubrication volume: the hub cap seals the outer side and a radial shaft seal seals the inner side. Lubrication is provided either by grease or by an oil bath arrangement. An oil bath arrangement has a cooling advantage, but when the seal leaks the consequences are more severe because the oil reaches the brake lining directly. Three things determine bearing life, and all three are decided on the workbench: correct adjustment clearance, clean and sufficient lubrication, and sound sealing.

Classic hub with adjustable tapered roller bearings

This is the traditional arrangement used on the majority of heavy commercial vehicles. The inner and outer tapered roller bearings are fitted separately, the clearance is set by hand with the axle nut and locked with a retaining element. The advantage is that it can be serviced; the

disadvantage is that the result depends entirely on the discipline of the technician making the adjustment. Bearing tolerance classes are generally defined according to the **ISO 492** family; however, the valid adjustment value for a specific axle must be confirmed not from the standard text but from the relevant OE catalogue and service manual.

Pre-set (unitised) hub bearing assembly

On newer axles, the two bearing rows, the spacer ring and the seals are combined into a single cartridge at the factory. Preload is set in production; no adjustment is made in the field, only the specified torque is applied. The risk of assembly error drops, but in return the unit is replaced as a whole. Which arrangement an axle uses is determined not by guesswork, but by the axle code on the axle plate.

Sealing and signal elements

Within the wheel hub group, the seal, the cap and the ABS ring may look like auxiliary parts, yet a significant share of failures starts here. Radial shaft seals generally correspond to the lipped seal definition in the **ISO 6194** family; a scratch-free running surface on the ring where the seal lip presses directly determines service life. The ABS tone ring is the input for the anti-lock braking system covered by **ECE R13**: if a ring tooth is broken, the system reads that wheel incorrectly. Standard references are indicative; part-specific values must be confirmed from the relevant OE catalogue.

The ABS ring on the hub is only the input of the anti-lock chain; our heavy vehicle air brake ABS system guide shows how modulators, valves and warning lamp logic interact.

Components and auxiliary elements

- **Hub body:** cast or forged main body; carries the wheel studs and the brake group.
- **Inner and outer tapered roller bearings:** the paired set that carries vertical and lateral load together.
- **Bearing outer races (cups):** pressed into the hub as an interference fit; renewed as a set together with the bearings.
- **Radial shaft seal:** provides oil/grease sealing on the inner side; renewed at every removal.
- **Hub cap and its gasket:** closes the outer side and carries the level window in oil bath arrangements.
- **Axle nut, lock washer and retaining element:** the locking chain that fixes the adjustment clearance.
- **Wheel stud and nut:** connects the wheel to the hub; the fastening system is generally defined in the **DIN 74361** family.
- **ABS tone ring:** the toothed ring that generates the wheel speed signal.

Wheel hub types and typical service approach (general reference; exact data confirmed from the OE catalogue by axle code)

Hub / axle arrangement	Lubrication	Bearing adjustment	Characteristic service note

Hub / axle arrangement	Lubrication	Bearing adjustment	Characteristic service note
Classic adjustable tapered roller hub (tractor/truck front axle)	Grease or oil bath	Adjusted in the field (clearance band 0.025–0.15 mm)	Adjustment discipline determines life; torque wrench and dial gauge essential
Driven rear axle hub (drum brake)	Usually shared with differential oil, or separate grease	Adjusted in the field	Axle shaft and flange gasket are assessed together
Disc brake hub (front and rear)	Grease or oil bath	Adjustable or pre-set depending on arrangement	Disc run-out depends on the hub face; do not close up without measuring run-out
Pre-set (unitised) hub bearing cartridge	Grease-filled at the factory, lifetime	No field adjustment, torque only	The unit is replaced complete; individual bearings are not renewed inside it
Trailer / semi-trailer axle hub	Mostly oil bath	Adjusted in the field	Temperature monitoring is critical because it runs long distances without stopping

The wheel hub differs even on the same vehicle make and model according to the axle manufacturer, axle capacity, brake type (drum/disc) and tone ring position. Do not select the part by "vehicle model" alone; confirm the axle code on the axle plate, the axle capacity, the stud count together with the pitch circle diameter (PCD) and, where possible, the OE number on the old hub. A wrong PCD or wrong bearing seat dimension may look like "it fits" in the workshop, but it will reveal itself through overheating on the first loaded run.

How can a wheel hub / axle hub failure be identified?

Wheel hub failures announce themselves through three channels: noise, heat and leakage. The table below matches the symptoms most frequently seen in the field with their probable causes and the verification method.

Wheel hub / axle hub symptom–cause–verification table (field diagnostic reference)

Symptom	Probable cause	Check / verification
Hum or growl rising with speed; noise falling as speed drops	Fatigue, pitting or loss of lubrication on the bearing surfaces	Lift the vehicle and turn the wheel by hand, listening for noise and roughness; listen at the hub body with a stethoscope
Vibration in the steering, noise changing with cornering direction	Excessive bearing clearance or loss of preload	Hold the wheel at the 12 and 6 o'clock positions and rock it; measure axial clearance with a dial gauge
Oil/grease trace on the inner rim face and on the brake group	Inner seal leaking, scored seal seat or damaged cap gasket	Clean the area and check again after a short run; distinguish whether the leak comes from the hub or from the axle flange

Symptom	Probable cause	Check / verification
One wheel clearly hotter than the others; the hub centre cannot be touched by hand	Excessive bearing preload, low oil level or damaged bearing	Compare hub temperatures of the wheels on the same axle with an infrared thermometer
Oil on the brake lining, brake pull or a sudden drop in lining life	Oil leaking from the hub seal reaching the drum/disc surface	Remove the drum and inspect the lining surface visually; check the seal lip and the running ring
ABS warning lamp, especially at low speed or under braking	Tone ring tooth broken/dirty, ring loose, or bearing clearance has disturbed the sensor gap	Read which wheel the fault code belongs to; inspect the ring visually and check the sensor signal with an oscilloscope
Wheel nuts loosening repeatedly, darkening at the stud roots	Deformation on the hub stud face, damaged rim seating face, or torque procedure not applied	Dimensional check of the wheel studs and the hub seating face; re-check with a torque wrench

Clearance or preload? Order of manual check and measurement

Both extremes are errors in wheel hub bearing adjustment. Excessive clearance lets the wheel move, disturbs disc run-out and makes the bearing work under impact; excessive preload keeps the bearing permanently under pressure, heats it and breaks down the oil film. The field sequence is this: lift the vehicle safely, hold the wheel at the 12 and 6 o'clock positions and rock it, then move on to measurement. A clear clearance felt by hand is always excessive; however, feeling nothing does not prove the adjustment is correct — you also feel nothing when preload is excessive. That is why the decision is made with a dial gauge.

Diagnosis by heat: comparative measurement

On the wheel hub, the difference matters far more than the absolute temperature. During a road break, measure the hub temperature of the wheels on the same axle with an infrared thermometer; if there is a consistent and repeatable difference, the hotter side is suspect. To separate out heat coming from the brake, take the measurement after a straight stretch where the brake has not been used. The most common mistake in the field is to blame a hot wheel directly on the brake; in fact a binding brake and an over-preloaded hub produce a similar temperature picture.

Isolating the source of a leak

A leak coming from the wheel hub and one coming from the axle shaft flange gasket are frequently confused in the field. The correct method is to clean and dry the area completely and, after a short loaded drive, to trace where the wetting starts: if the trace starts at the seal line, the hub seal is at fault; if it starts around the flange bolts, the flange gasket is. On oil bath hubs, a continuously dropping level in the hub cap also confirms a leak.

If you are looking for an entry-level account of the bearing behaviour behind these signs, the guide what is a wheel hub, its bearing failure and symptoms offers an introductory frame.

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 wheel hub / axle hub replaced? Step by step

Wheel hub replacement is a job in which the vehicle's weight is held on lifting equipment. Personal protective equipment is essential: safety goggles, steel-toe boots, impact- and oil-resistant gloves. Never go under the vehicle relying on a jack alone; secure it with stands and chock the wheels. The hub, drum and brake group are heavy together; work with a lifting aid or with at least two people. Energy remaining in the brake springs must be released according to the manufacturer's procedure before removal.

1. **Secure the vehicle:** Park on level, solid ground, apply the parking brake, chock the other wheels, take the axle load with lifting equipment and set it down on stands. Disconnect the battery isolator if ABS components will be touched.
2. **Remove the wheel, brake group and sensor:** Slacken the wheel nuts by one turn while the vehicle is still on the ground, then take the wheel off. On a drum system remove the drum; on a disc system remove the caliper and suspend it; never let the caliper hang from the brake hose. Clean around the ABS sensor, then twist it free from its bore and secure its cable safely; a sensor pulled by force will break at the body.
3. **Open the hub cap and locking elements:** Remove the hub cap and, on oil bath arrangements, drain the oil into a clean container. Remove the split pin, lock washer and axle nut in the correct removal sequence. Do not plan to reuse the locking elements that have been removed.
4. **Pull the hub and clean the area:** Draw the hub off the axle spindle without dropping the outer bearing. Clean the spindle surface, the seal running ring and the bearing seats with a clean cloth and a suitable cleaner. This job does not progress with dirt present: a single grain of sand left on the spindle will chew up the new bearing within the first kilometres.
5. **Inspect the removed parts:** Look for pitting on the bearing raceways, bluing (a sign of overheating), cage deformation and scoring on the seal ring. If the bearing is damaged, renew the inner and outer set together with their outer races from the same set; also inspect the other wheel on the same axle.
6. **Verify the new part:** Place the new hub side by side with the old one and compare stud count, pitch circle diameter (PCD), centre bore diameter, bearing seat dimensions and the tooth count of the tone ring. On a unitised cartridge, do not open the packaging until the moment of fitting; if the grease is contaminated, the unit is lost from the start.

7. **Seat the races, bearings and the new seal:** Press the outer races fully into their seats with a suitable pressing tool; do not drive them in with an old race or a chisel. Pack the bearings with the specified grease/oil so that the gaps between the rollers are completely filled — grease smeared on the surface does not lubricate. Fit the new seal without tilting it, with the lip facing the oil side, and apply a thin film of oil to the lip.
8. **Adjust and lock the bearings:** Slide the hub onto the spindle, fit the outer bearing and the axle nut. The general procedure is to tighten the nut to the seating torque specified by the manufacturer while continuously rotating the hub, then slacken the nut and bring it to the specified final value, and verify the clearance with a dial gauge. The measurement is taken by pushing the hub in and out with the dial gauge tip aligned with the axle centreline. There is no adjustment on a unitised cartridge, only the specified torque is applied. Once adjustment is complete, fit a new lock washer and retaining element.
9. **Close up, fill with oil and apply the torques:** Fit the hub cap with a new gasket and, on oil bath arrangements, top up the level to the marker line. Fit the brake group and push the ABS sensor into its bore until it touches the ring. Fit the wheel and tighten the wheel nuts in a crosswise sequence, in stages and with a torque wrench, to the manufacturer's value.
10. **Test and re-check the torque:** Before lowering the vehicle, turn the wheel by hand and check for noise and friction. After a short test drive, compare the hub temperature with the other wheel and check for leaks and ABS warnings. Always repeat the wheel nut torque check after the first 50–100 km.

What are the most common mistakes in wheel hub / axle hub replacement?

Over-tightening a wheel hub bearing on the logic of "make it tight so it does not move" is one of the most expensive mistakes made in the field. Under excessive preload a tapered roller bearing generates its own heat; the oil film thins, the surface turns blue and the bearing reaches the end of its life in a short time. At an advanced stage the hub can seize and start a chain of events that ends in wheel loss. Adjustment is done not by feel, but with a dial gauge and the manufacturer's procedure.
Refitting a used seal, lock washer or split pin is not an acceptable practice. The seal lip takes the imprint of the ring during its first run and will not seat in the same place on a second assembly; locking elements, once deformed, no longer provide reliable locking. These three parts are renewed at every removal.

- **Driving the bearing outer race in by hammering:** A seat surface hammered with a chisel or an old race gets crushed; the race does not seat fully and the clearance measurement is wrong from the outset.
- **Replacing only the damaged bearing:** The inner and outer bearings have seen the same load and the same mileage; when only one side is renewed, the new bearing quickly falls to the condition of the old one.

- **Just smearing grease on the surface:** Lubrication happens between the roller and the race; an assembly made without filling the cage means a dry start.
- **Using the wrong grease or the wrong oil:** When greases with different soap bases are mixed, the consistency breaks down and the lubricating property is lost; grease is not put into an oil bath hub, nor oil into a grease-packed hub.
- **Fitting the seal tilted or the wrong way round:** A seal fitted backwards leaks from day one; a seal seated crooked leaks within a few thousand kilometres.
- **Forcing the tone ring or leaving it dirty:** Metal swarf and grease trapped between the teeth corrupt the signal and generate fault codes; a ring that has been forced works loose.
- **Tightening the wheel nuts out of sequence and not repeating the torque check:** Without crosswise, staged tightening the rim seats crooked; if the check after the first 50–100 km is skipped, the loosening that follows bedding-in goes unnoticed.
- **Leaving an oil-soaked brake lining in place:** The seal is renewed, but if the oil-soaked lining is not replaced, the brake performance and pulling problem continues.

Wheel hub / axle hub technical values and check points

Wheel hub figures given below are general reference ranges commonly encountered on heavy commercial vehicle axle groups. The axle manufacturer, axle capacity, brake type and bearing arrangement change these ranges; for exact data, the current OE service manual matching the axle code is authoritative.

Wheel hub / axle hub technical values (general reference; units mm, °C, microns)

Parameter	Typical range (general reference)	Note
Bearing axial adjustment clearance (endplay)	0.025–0.15 mm	Measured with a dial gauge; a narrower band may be defined by the axle manufacturer
Pre-set (unitised) cartridge preload	Set at the factory, not adjusted in the field	Only the specified torque is applied; no clearance measurement is expected
Hub surface temperature (normal operation)	30–60 °C above ambient temperature	Brake use raises the reading; comparison is made after a brake-free stretch
Accepted temperature difference between wheels on the same axle	Generally below 15–20 °C	A consistent and repeatable difference is suspect
Hub surface temperature accepted as a warning threshold	Approximately above 100–120 °C	Oil/grease starts to degrade; do not continue without finding the cause
Brake disc run-out (measured on the hub)	Generally in the 0.05–0.15 mm band	Bearing clearance must be corrected before measuring
ABS tone ring tooth count	Commonly 80–100 teeth	Tooth count is system-specific; a broken tooth corrupts the signal
ABS sensor fitting gap	Sensor is pushed in until it touches the ring	The working gap forms by itself during the first rotations; it is not set by hand

Parameter	Typical range (general reference)	Note
Oil volume of an oil bath hub	Approximately 0.3–0.6 litres	The level is given by the marker line on the hub cap

Typical torque bands for the wheel hub group (general reference, Nm; exact values from the OE service manual)

Fastening point	Typical torque band (general reference)	Application note
Wheel nut (M22x1.5 class heavy commercial application)	550–650 Nm	Crosswise and staged tightening; re-check after the first 50–100 km
Axle nut — seating (while rotating the hub)	Approximately 130–250 Nm	Applied so the bearings seat fully; not the final value
Axle nut — final tightening after slackening	Approximately 30–80 Nm or a procedure angle	Value and method are axle-specific; the clearance is then verified with a dial gauge
Hub cap bolts	20–45 Nm	With a new gasket; crosswise tightening
Brake disc — hub fastening bolts	200–300 Nm	Single-use in most applications; renewed

The torque and clearance values above are an indicative range only. The front and rear axles of the same vehicle may call for different procedures; some axle manufacturers define angle-controlled tightening, others a multi-stage procedure with measurement verification. Although the wheel fastening system is generally defined in the DIN 74361 family, the valid torque value varies with stud size, rim type and the manufacturer's instructions. In practice, the current OE service manual specific to the axle code is what counts.

- Has the bearing axial clearance been measured with a dial gauge, and is the value within the manufacturer's band?
- Is there any roughness, binding or irregular noise when the wheel is turned by hand?
- Are the inner seal line and the inner rim face dry — were they checked again after the test drive?
- On an oil bath hub, is the level at the marker line and is the cap gasket new?
- Has the hub temperature been compared with the other wheel on the same axle?
- Are the tone ring teeth complete and clean, and have the fault codes been read?
- Were the wheel nuts torqued in a crosswise sequence, and is the first 50–100 km check planned?

How is a wheel hub / axle hub maintained and its life extended?

The wheel hub is one of the longest-lasting groups on a regularly maintained vehicle; on a neglected vehicle it turns into one of the most expensive failures. Three factors determine its life: lubrication, sealing and correct adjustment. The most common hub failure in the field is not actually spontaneous bearing fatigue, but the gradual loss of lubrication following a leaking seal; in other words, most hub failures start with a preventable leak.

- **Periodic oil/grease check:** On an oil bath hub the level should be checked visually at every service; on a grease-packed arrangement, renewal should be carried out at the interval specified by the manufacturer.
- **Closing a small leak before it grows:** A thin oil trace on the inner rim face does not mean "nothing has happened yet"; from that point on the seal will only leak more.
- **The habit of monitoring heat:** Adding a hub temperature check to break inspections in long-haul fleets is the cheapest practice there is for preventing roadside breakdowns.
- **Wheel nut torque discipline:** After every job where a wheel has been removed, the torque check must be repeated within the first 50–100 km.
- **Assessment together with brake work:** When a drum or disc is replaced, the hub bearing clearance and seal condition must always be checked; the group is already open.
- **Loading, tyre pressure and washing:** Overloading combined with under-inflated tyres directly increases bearing load; directing high-pressure water at the seal line strains the sealing and carries water inside.
- **Keeping records:** When it is recorded which bearing set and seal were fitted to which wheel and when, the root cause of a recurring failure is found far more quickly.

In fleet operations, the most efficient approach is to think of the wheel hub not as a single part but as a set: renewing the bearing set, outer races, seal, cap gasket and locking elements at the same service is far more economical than the cost of lifting the vehicle again a few months later.