12 – ADJUSTABLE-CONE HUBS

ABOUT THIS CHAPTER

Adjustable-cone hubs have a threaded axle, loose balls or balls in a retainer, cones that thread onto the axle, and cups that are fixed inside the hub shell. This includes adjustable-cone front hubs, adjustable-cone rear hubs that accept a thread-on freewheel, and freehubs (rear hubs that have the freewheel integrated into the hub). Shimano Parallax hubs are adjustable-cone hubs that sometimes require a special adjustment procedure, which is covered in a separate section later in this chapter.

There are also cartridge bearing hubs, with cartridge bearings that press into the hub shell. These are covered in a separate chapter, **CARTRIDGE-BEARING HUBS** (page 13-1). This additional chapter covers Suzue sealed hubs, SunTour/Sanshin/Specialized hubs, Bullseye hubs, Ringlè hubs, Mavic hubs, and other brands that are similar in design to the listed brands.

GENERAL INFORMATION

TERMINOLOGY

Hub shell: The main structure of the hub. The hub shell includes the housing for the bearings, a hub core, and two hub flanges.

Axle: The shaft that goes through the hub about which the hub turns.

Quick-release axle: A hollow axle, so the quick-release mechanism can be installed through the axle to retain the wheel to the bicycle.

Solid axle: An axle that has axle nuts threaded onto it that retain the wheel to the bicycle.

Cone: A conical-shaped piece of metal that the bearings roll on that is positioned inside the circle of balls. A cone may be a built-in feature on an axle, or it may thread onto an axle.

Cup: A surface that bearings roll on that is positioned outside the circle of balls. A cup is usually a permanent part of the hub shell.

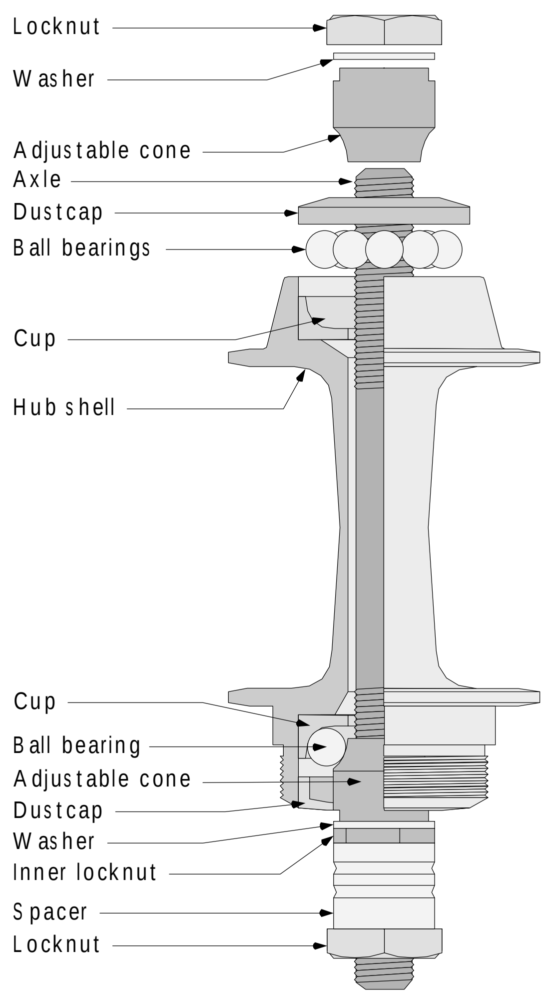
Race: The surface of a cup or cone on which ball bearing rolls.

Locknut: A nut that threads onto an axle and tightens against a cone to lock the position of the cone relative to the axle.

Dustcap: A piece of plastic, metal, or rubber that threads or presses onto the outer end of the hub shell to cover the hole through which the bearings are accessed. In some cases, the dustcap attaches to the cone instead of the hub shell.

Seal: A rubber piece attached to the dustcap, cone, or axle spacer that fills the gap between the axle and dustcap to reduce the entry of dirt.

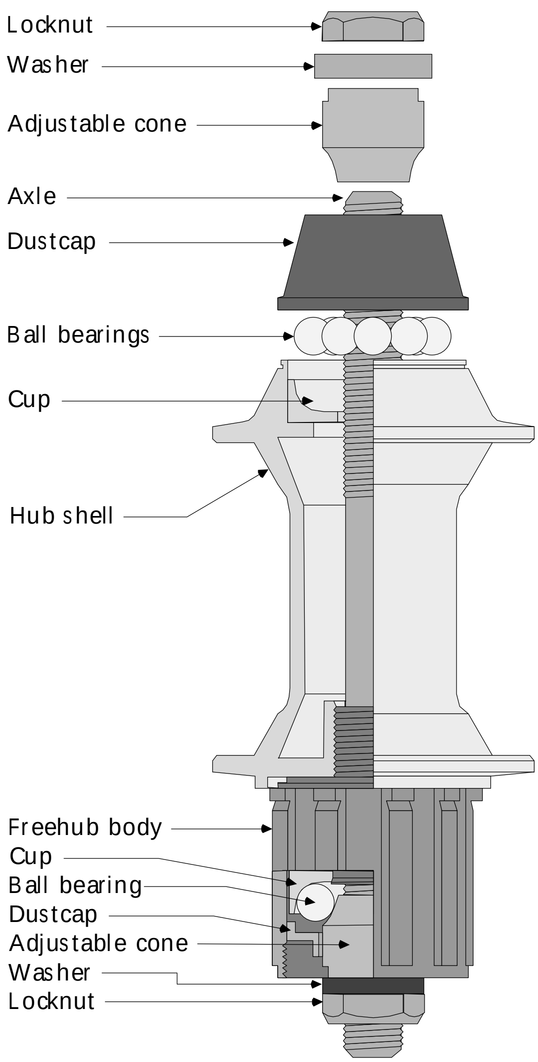
Freewheel: A set of gears on a freewheeling mechanism that threads onto a rear hub.



12.1 *Adjustable-cone rear hub for thread-on freewheel.*

Freehub: A hub that uses the freewheeling mechanism as part of the hub.

Freehub body: The portion of a freehub that is the freewheeling mechanism.



12.2 *Adjustable-cone freehub.*

PREREQUISITES

Wheel removal and installation

Before overhauling or adjusting a hub, the wheel is removed from the bike. See the **WHEEL REMOVAL, REPLACEMENT, AND INSTALLATION** chapter (page 18-6) if unsure about wheel removal and installation.

Freewheel removal and installation

To overhaul or adjust a rear hub with a thread-on freewheel, the freewheel must be removed. See the **FREE-HUB MECHANISMS AND THREAD-ON FREEWHEELS** chapter (page 25-9) for freewheel removal. If not yet be acquainted with chapter 25, it may be unclear whether the hub has a thread-on freewheel or is a freehub. There are two ways to determine this. If the hub is a Shimano or Campagnolo model and has a bulge on the hub core just inside the right-side hub flange, it is definitely a freehub. If the hub is a SunTour brand, the hub core will appear fatter than the core of the same front hub. If unsure or mistaken in identifying whether the rear hub is a freehub, it will not be a big problem. If the rear hub is actually a freehub, then when attempting freewheel removal no notches or splined hole in the face of the freewheel will be found to engage the freewheel remover. This chapter is also needed to perform an optional freehub-body removal and installation on a freehub.

INDICATIONS

There are several reasons to overhaul the hub(s), and several reasons to adjust them. An overhaul should be done as part of a regular maintenance cycle, the duration of which will change depending on the type of riding, the amount of riding, and the type of equipment. Adjustments should be done on the basis of need.

Maintenance cycles

If starting out with hub(s) known to be in good condition with good quality grease, they should be able to be ridden thousands of miles without needing an overhaul. If the equipment sees little wet-weather riding, then an appropriate maintenance cycle would be 2000–3000 miles in most cases. If a lot of wet-condition riding is done, then the maintenance cycle might need to be as often as every 750-1000 miles. Parts rust whether being ridden or not, so another factor is how long the bike may be sitting before it will be used again. For example, if ridden 200 miles in the rain in the fall then put away for four months of winter, it would probably be a good idea to overhaul the hub(s) before putting the bike away for the winter.

Other factors affecting the maintenance cycle are the presence of a grease injection system and/or whether there are seal mechanisms. *Grease-injection systems do not eliminate the need for overhauling.* They only increase the acceptable time between overhauls; furthermore, they are only as good as the customer is consistent and thorough about pumping in new grease. Seal mechanism hubs (adjustable-cone hubs with rubber seals between the cone and dustcaps) *do not have effective water-tight seals.* Their effectiveness varies with the brand and model. At best, they can lengthen the acceptable time between overhauls. With seal mechanisms or grease-injection systems, the best policy is to initially overhaul the hub(s) on a normal-length maintenance cycle and see if the grease is found to be in good condition. If so, then extend the maintenance cycle the next time.

Symptoms indicating need of overhaul

What symptom would lead to feeling the hub(s) should be overhauled? One is that when performing an adjustment, the looseness (free play) in the bearings cannot be eliminated without the bearing becoming excessively tight (does not turn smoothly). The lack of smoothness could be caused by dry grease, contaminated grease, or worn parts. Another symptom is that when removing the wheel and rotating the axle, the end of the axle oscillates, indicating a bent axle (which should always be replaced). Finally, there may be a broken axle, which may not be obvious until the quick-release skewer is removed, and then the axle falls out in two pieces.

Symptoms indicating need of adjustment

The primary symptom experienced indicating the hub(s) need adjustment is looseness in the bearings. This can be detected by grasping the rim (with the wheel mounted in the bike) and jerking it side-to-side while feeling for a knocking sensation. Inspect for loose bearings and loose locknuts every 300–500 miles. The only way to check for a loose locknut is to put a tool on the locknut and see if it is secure. Another possible symptom indicating that hubs need adjustment is that when loosening the quick-release lever 45° from its fully-closed position, *play cannot be detected at the rim*. A properly adjusted quick-release hub has no play when installed to full security in the bike, but does have play when the skewer is not clamping with full force. Non-quick-release hubs simply feel tight when removed and the axle is rotated. A quick-release axle that feels a little tight out of the bike is *extremely* tight when installed in the bike.

One other case in which it is recommend to adjust the hub(s) is on any new bike. Factory adjustments are not very reliable. Due to poor factory set-up, hubs may be completely worn out after as little as 1000 miles of use.

TOOL CHOICES

The design or brand of hub(s) will determine the tools needed. Table 12-1 covers tools for adjustable-cone hub(s) only. This table covers all tools for the job. The preferred choices are in **bold**. A tool is preferred because of a balance among: ease of use, quality, versatility, and economy.

ADJUSTABLE-CONE-HUB TOOLS (table 12-1)

Tool	Fits and considerations
Hozan C354	Axle vise w/threaded holes for holding axle during hub disassembly, grips very securely
Campagnolo P	Axle vise w/smooth holes for holding axle during hub disassembly
Park AV-1	Axle vise w/smooth holes for holding axle during hub disassembly
Stein HV-1	Hub vise for holding hub during adjustment
Bicycle Research TC/S	Thread chaser set for numerous thread descriptions of axles with inch pitch
Campagnolo 1170004	Dustcap puller for Campagnolo C-Record hubs
Bicycle Research CW1	13, 14, 15, & 16mm cone wrench
Campagnolo Q1	13 & 14mm cone wrench, lacks leverage and hand protection
Campagnolo Q2	15 & 16mm cone wrench, lacks leverage and hand protection
Hozan C57	Three cone wrenches fit 13/14mm, 15/16mm, & 15/17mm
Kingsbridge 250A	11 & 12mm cone wrench, lacks leverage and hand protection
Kingsbridge 250B	13 & 14mm cone wrench, lacks leverage and hand protection
Kingsbridge 250C	15 & 16mm cone wrench, lacks leverage and hand protection
Kingsbridge 250D	17 & 18mm cone wrench, lacks leverage and hand protection
Kingsbridge 250E	14 & 17mm cone wrench, lacks leverage and hand protection
Kingsbridge 250F	13 & 15mm cone wrench, lacks leverage and hand protection
Park SCW-13 thru SCW-18	Six high-quality cone wrenches from 13–18mm with good leverage and hand cushioning, thin design fits all cones
VAR 20/1	13 & 14mm cone wrench, too thick and lacks hand protection
VAR 20/2	15 & 16mm cone wrench, too thick and lacks hand protection
VAR 20/3	17 & 18mm cone wrench, too thick and lacks hand protection
Wheels Mfg. C1	13 & 14mm cone wrench, lacks hand protection
Wheels Mfg. C2	15 & 16mm cone wrench, lacks hand protection
Wheels Mfg. C3	15 & 16mm cone wrench, lacks hand protection

TIME AND DIFFICULTY RATING

Overhauling a hub, including freewheel (or cog) removal and bearing adjustment, is a 30-45 minute job of moderate difficulty. Adjusting the hub alone (including freewheel removal) is a 10-12 minute job of moderate difficulty.

COMPLICATIONS

Bent axles

The only complication created by a bent axle is that there is no point to adjusting the hub if the axle is bent. The job description must be changed to overhauling the hub.

Broken axles

It is not unusual to have a job description of adjusting a hub with a quick-release axle, and upon removing the wheel and quick release it is found that the axle is broken. In this case the job description must be changed to hub overhaul.

Worn-out cups

After disassembling the parts and cleaning, the first thing that should be inspected for is pitted cups. Cups are not replaceable and this would be the end of the job. The only repair would be hub or wheel replacement.

Cones not available

Many older hubs and inexpensive new ones have no parts available. This becomes critical if cones are needed. There is a section of this chapter about cone interchangeability. If it is no help, then the hub with bad cones will need to be replaced or ridden until it "dies."

Damaged dustcaps

Dustcaps for many hubs are not an available replacement part. If they are damaged or lost it can be the "end of the line" for the hub.

Mysterious play

There are two things that can cause a mysterious play in the bearings of the hub that will not go away no matter how the adjustment is refined. A loose cup in the hub shell will cause this problem, and so will a loose locknut on the side of the hub not being adjusted.

HUB-AXLE THREADS (table 12-2)

Pitch	Approximate axle O.D.	Approximate nut or cone I.D.	Nominal measurement (thread type[1])	Typical occurrences
1mm	8.70–8.90mm	7.80–8.10mm	9mm × 1mm (Metric/ISO)	QR axle front hubs on most road and mountain bikes from Europe and Asia. Front hub solid axles[2] on SunTour/Specialized and Shimano (modern) hubs.
1mm	9.70–9.90mm	8.80–9.10mm	10mm × 1mm (Metric/ISO)	QR axle rear hubs on most road and mountain bikes from Europe and Asia. Rear hub solid axles[2] on SunTour/Specialized and Shimano (modern) hubs.
26tpi	7.70–7.90mm	6.80–7.10mm	5/16" × 26tpi[3] (BSC)	Solid axle[2] front hubs on most European road bikes (not Campagnolo) and from Asia (includes older Shimano).
26tpi	8.70–8.90mm	7.80–8.10mm	9mm × 26tpi (Italian)	Campagnolo (and other Italian brands) and some Joy Tech (Jou Yu) front QR axles.
26tpi	9.30–9.50mm	8.40–8.70mm	3/8" × 26tpi[4] (BSC)	Solid axle[2] rear hubs on most European road bikes and from Asia (includes older Shimano). Occasional older solid axle front MTB hubs (usually w/flats on the axle ends).
26tpi	9.70–9.90mm	8.80–9.10mm	10mm × 26tpi (Italian)	Campagnolo (and other Italian brands) and some Joy Tech (Jou Yu) rear QR axles.
24tpi	7.70–7.90mm	6.80–7.10mm	5/16" × 24tpi (BSC)	Solid axle[2] front hubs from American hub manufacturers found on many bikes from department stores.
24tpi	9.30–9.50mm	8.40–8.70mm	3/8" × 24tpi[4] (BSC)	Solid axle[2] rear hubs on bikes with a coaster brake or three-speed type hub.

1 The listed thread types are only the ones that occur commonly. Other thread types exist and should be identified by measuring the diameter and pitch.

2 Solid axles are those that use axle nuts to hold the wheel to the frame/fork.

3 The 5/16" diameter is sometimes called 8mm. This is incorrect because the resulting mixed-unit diameter and pitch end up sounding like an Italian thread when it is, in fact, a BSC thread.

4 The 3/8" diameter is sometimes called 9.5mm. This is incorrect because the resulting mixed-unit diameter and pitch end up sounding like an Italian thread when it is, in fact, a BSC thread.

Unusual bearing sizes

Almost all hubs use 3/16" balls in the front hub and 1/4" in the rear. The consistency of this is so great that it lulls mechanics into thinking that all hubs use these sizes. Consequently a wrong size gets used and the hub either adjusts or wears poorly. Campagnolo hubs are the most likely cause of trouble, with their frequent use of 7/32" balls, which are barely distinguishable from 3/16".

THREADS

Axle threads come in several standards. Measure pitch and diameter and make sure a replacement axle matches. This is usually not an issue unless trying to upgrade a non-quick-release axle to a quick-release axle, or have Joy Tech (Jou Yu) or Campagnolo brand hubs, which have relatively unique threads. See table 12-2 (page 12-4) for axle-thread information.

CONE INTERCHANGEABILITY

In every possible case, replace a worn cone with an identical cone. There will be many times when this will not be possible so it becomes necessary to know how to pick a correct substitute cone. For this there are some general guidelines and testing procedures that can be used to determine compatibility.

These general guidelines are based on certain tendencies that are common to certain brands.

Shimano has made more models of hubs over the years than anyone could possibly keep track of. Many of these models are externally different only. It is quite common that the cones in one model are identical to another model. Even when not identical, the cones may differ only in ways such as quality, finish, design of seal, or overall length. If seal differences exist, then the quality of the seal may be compromised but not the functionality of the hub. If only a length difference exists, it can often be made up for with a spacer change. The Shimano Parts Dealer Parts Catalog has excellent descriptive information about cones. If the dimensions for two different cones match, they are usually interchangeable with few critical complications. Wheels Mfg. makes duplicates of certain Shimano cones. Some distributors (including United Bicycle Parts and Quality Bicycle Products) have created compatibility charts or systems to make it easier to determine which Shimano cone substitutes for another Shimano cone.

Suzue hubs are knockoffs of some older Shimano hubs, so there is often compatibility between Suzue and Shimano cones.

Atom, Normandy, Maillard, and some “Schwinn Approved” hubs are all different names that appear on what are essentially the same hub, so cones of one type can often be used on a hub with one of the other names. Sachs has bought the Maillard company and sometimes the older parts will be called Sachs when they fit the older Maillard, Normandy, and Atom hubs.

“Schwinn Approved” has appeared mostly on Maillard products (early seventies through the mid-seventies), but during the same time period “Schwinn Approved” appeared on Sanshin and Shimano products on occasion.

Sanshin, Sunshine, and SunTour are different brand names that appear on hubs made by the Sanshin company, so compatibility often exists between hubs with these brand names.

Jou Yu and Joy Tech are two names for the same company.

Wald company makes a number of replacement axle sets that fit a variety of historical and current American-made front hubs that are found on department-store bikes and older fat-tire one-speeds. These brands include Wald, Weco, Union, Schwinn, Ross, New Departure, Excel, and Enlite.

The test to determine cone compatibility has a number of steps that originally test for a likely replacement cone, and then empirically tests for compatibility. See figures 12.3, 12.4, 12.5, 12.6, 12.7, and 12.8 (page 12-6).

Hold the old cone and possible substitute together small end to small end.

Check whether the small-end diameters match.

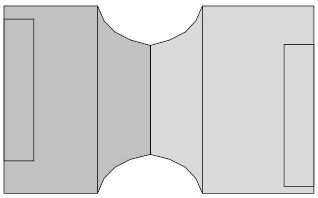
Check whether the curves of the two cones appear symmetrical.

Check whether the overall cone length of the possible replacement is equal or longer (replacement can’t be shorter).

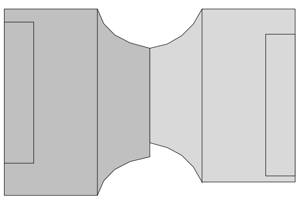
Check whether replacement’s overall diameter is equal to or less than original (replacement diameter cannot be larger unless hole in dustcap can be enlarged).

Test-mate the replacement cone against the balls in place in the hub cup and see if the grease print on the cone indicates that the balls will be rolling on the middle of the cone race (balls cannot roll on either end of the cone race).

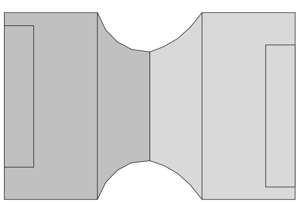
If everything is acceptable except that the thread descriptions don't match, replace the axle and hardware as well.



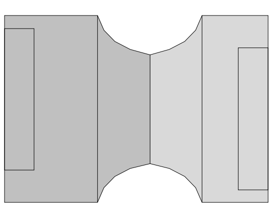
12.3 *The right cone is possibly a suitable replacement for the left cone because the small-end diameters match and the curves of the races match.*



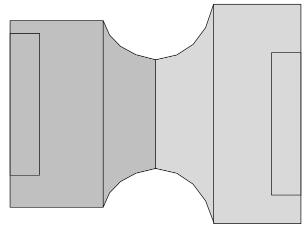
12.4 *Although the curves of the races match, the right cone is not likely to be a suitable replacement for the left cone because the small-end diameters do not match.*



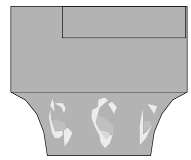
12.5 *Although the small-end diameters match, the right cone is not likely to be a suitable replacement for the left cone because the curves of the races do not match.*



12.6 *Although the small-end diameters match and the curves of the races match, the right cone is an probably an unsuitable replacement for the left cone because of its shorter overall length. Due to the length difference, the cone wrench flats are likely to end up inaccessible (below the face of the dustcap).*



12.7 *Although the small-end diameters match and the curves of the races match, the right cone is an probably an unsuitable replacement for the left cone because of its larger overall diameter. Due to the diameter difference, the right cone is unlikely to fit in the hole in the dustcap.*



12.8 *The grease prints in the middle of the race on this cone indicate that the ball bearings will contact the correct area on the race.*

When a compatible cone cannot be found, there is one additional thing to try short of running the hub with worn-out cones or replacing the hub or wheel. If a substitute cone was found that failed the grease print test because the balls were contacting too high or low on the cone race, then it may still be useable by changing the ball-bearing size.

Smaller balls will allow the cone to insert further so the contact will be further from the small end of the cone (watch for the wrench flats ending up below the dustcap face). Larger balls will position the cone further out so the contact will be closer to the small end of the cone race. Using smaller balls may reduce the wear life, but the hub has no wear life left without replacing the worn cones, so anything that works is a meaningful gain. When the ball-bearing size changes so will the quantity. Just put in the maximum number of balls that will fit in the cup without jamming.

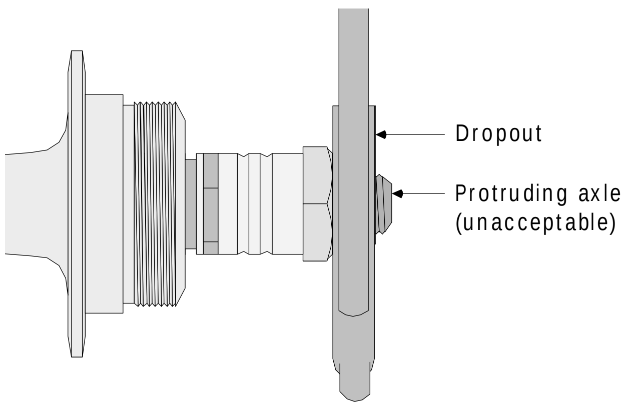
For this purpose it is useful to have some odd-size balls on hand, such as 11/64", 7/32", 15/64", and 17/64". These ball sizes (except 7/32"— used in Campagnolo hubs) are likely to be available only by special order from larger industrial bearing supply houses.

ADJUSTABLE-CONE-HUB OVERHAUL & ADJUSTMENT PROCEDURE

NOTE: If just adjusting hub and not overhauling it, do steps 1–7, then skip to PRELIMINARY ADJUSTMENT just after step 57.

COMPONENT REMOVAL AND PRE-DISASSEMBLY INSPECTION

1. **[ ] Remove wheel from bike and skewer (if any) from hub.**
2. **[ ] Place wheel back in dropouts.**



12.9 It is unacceptable for the quick-release axle to protrude beyond the face of the dropout.

3. **[ ] Observe wheel in bike and determine whether QR axles protrude beyond dropout faces.**
4. **[ ] If QR axles protrude, measure dropout thickness. This is maximum axle protrusion. Maximum axle protrusion is: ________mm.**
5. **[ ] Rotate axle and check for oscillation at ends that indicates bends.**
6. **[ ] Rotate axle and feel for severe grittiness that indicates worn out parts.**

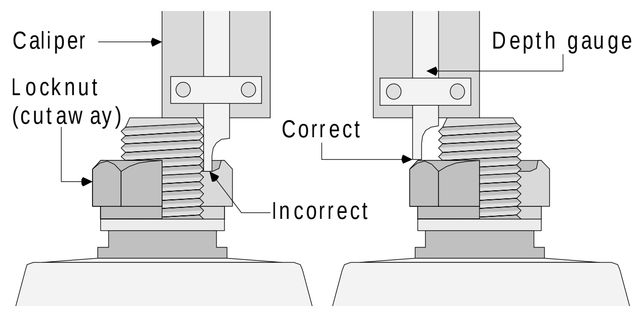
Adjustable-cone rear hubs with thread-on freewheels require freewheel removal for hub adjustment or overhaul. It is recommended, but not required, to remove freehub cogs when overhauling a freehub, but there is no reason to remove the cogs to adjust a freehub bearing.

7. **[ ] Remove freewheel (if any, for overhaul or adjustment) or freehub cogs (for overhaul only, not adjustment).**

In the next step, determine the correct axle protrusion (the distance the end of the axle protrudes beyond the face of the locknut that is found just inside of the dropout). In most cases, the axle protrusion should be equal on both sides. One rare exception is when one dropout is thicker than the other (in which case the axle protrusions should differ by the amount the dropout thickness differs). Certain inexpensive bikes have a plate of metal that the derailleur attaches to, which bolts onto the outer face of the right-rear dropout. This is called a bolt-on derailleur hanger. The bolt-on derailleur hanger is part of the dropout, so in this case consider the right dropout to be thicker than the left dropout by the thickness of the bolt-on hanger.

In the next steps, measure the two axle protrusions and average them to determine the correct axle protrusion. If the right-rear dropout is thicker, add half the difference in thickness to the average axle protrusion for the correct right-side protrusion, and subtract half the thickness difference from the average axle protrusion for the correct left-side protrusion.

When measuring the axle protrusion, use the depth gauge of a caliper and measure from the high point on the face of the locknut to the end of the axle. Some axles have a recess in their face. *Do not measure down into any recess.*



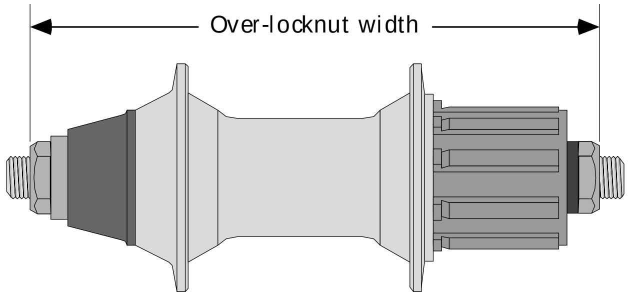
12.10 Measuring the axle protrusion.

Determine correct axle protrusion

8. **[ ] Right-side axle protrusion: ________mm.**
9. **[ ] Left-side axle protrusion: +________mm.**
10. **[ ] Total axle protrusion is: =________mm.**
    ÷ 2
11. **[ ] AVG. AXLE PROTRUSION =________mm.**

Measure over-locknut width

In the next step, measure the overall width from the left locknut to the right locknut. This measurement will be needed if parts are replaced with non-exact replacements. If some sort of substitute part that is not the same effective width as the original is used, it could affect the fit of the wheel to the frame or fork. By knowing how much the final width differs from the original width, it will be known how many washers to add or subtract on the side of the hub that has the substitute part.

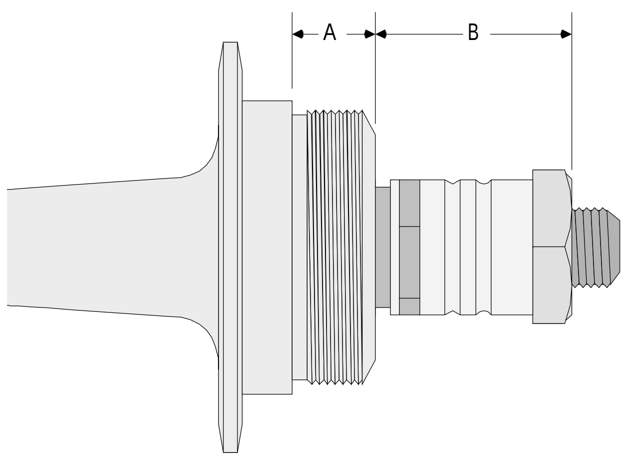


12.11 Measure the over-locknut width.

12.[ ] Measure over-locknut width.
OVER-LOCKNUT WIDTH IS: ________mm.

NOTE: Front hubs, go to step 17.

Steps #13 through #16 apply to rear hubs only. The purpose of these steps is to get a measurement that corresponds to the distance the freewheel or freehub cogs sit from the dropout. This distance must be maintained when overhauling the hub or the rear derailleur might need adjustment or the freewheel may not even have enough room to be re-installed. The measurement will not be needed unless right-side parts are replaced with non-identical parts, or if left-side and right-side parts get mixed up.



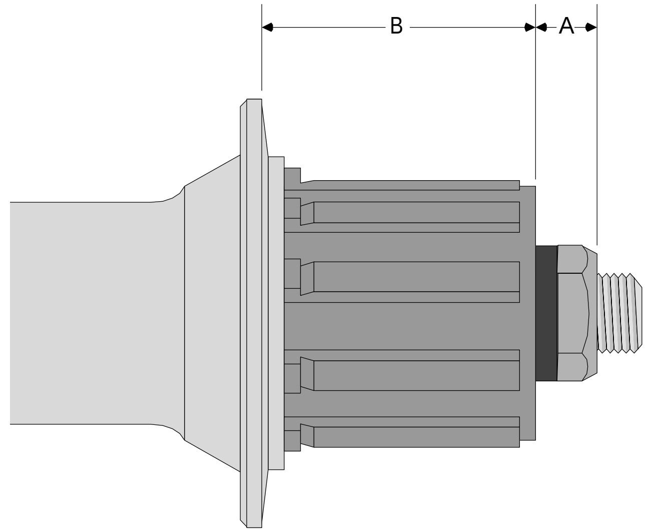
12.12 Determine freewheel space by adding measurement A to measurement B.

NOTE: Freehubs, go to step 16.

Measure and calculate freewheel space:

13.[ ] Freewheel shoulder to end-of-shell: _______mm
14.[ ] End-of-shell to locknut face: +________mm
15.[ ] FREEWHEEL SPACE =________mm
(Skip to step 17.)

Measure and calculate freehub space

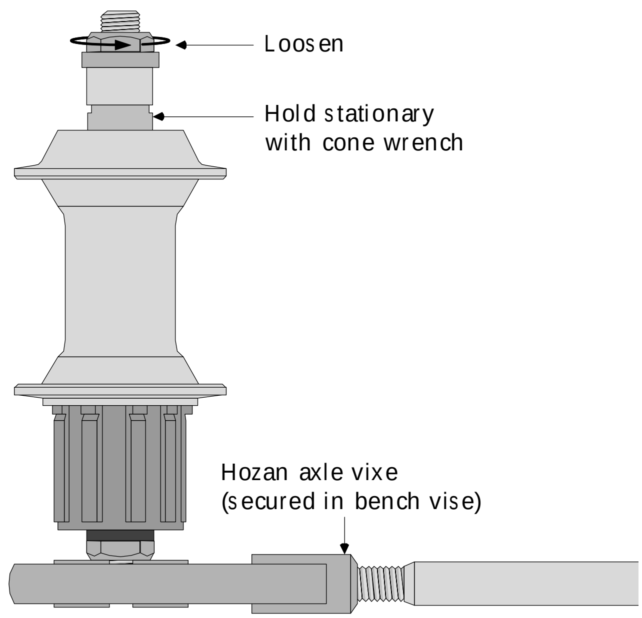


12.13 Determine freehub space by adding measurement A to measurement B.

16.[ ] For freehubs, measure from end of freehub body (where cogs came off) to locknut face. Add this to measurement from right flange to outer end of freehub body to calculate freehub space.
Freehub body to nut face: _________mm
Body flange to outboard end of freehub body +_________mm
FREEHUB SPACE =_________mm

DISASSEMBLY

Disassembling the first end of the axle is a lot easier if the axle is not free to turn. The ideal way to do this is to have the end of the axle that is not being disassembled held in a bench vise. When securing the axle in a vise, it is easy to damage either the axle or the locknut. If the axle is a not-quick-release type, there is enough axle to grasp securely with the axle directly in "soft jaws." Soft jaws are inserts made of aluminum, copper, plastic, or wood that cover the face of the vise jaws. All of these materials are softer than the axle threads so the axle threads will not be damaged. Quick-release axles do not protrude far enough to get a good grip with soft jaws, which might lead to clamping the vise tighter, which could crush the hollow quick-release axle. For this reason, a special axle vise is required for use with quick-release axles. Grasping the axle by the locknut can lead to damage of the locknut.

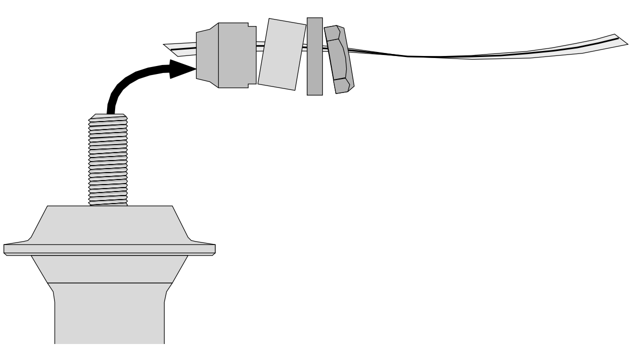


12.14 With the hub secured in a Hozan axle vise, use a cone wrench to hold the cone while breaking loose the locknut.

17.[ ] Clamp *right* end of QR axle in axle vise, or *right* end of solid axle in soft jaws.

18.[ ] Hold left cone stationary with cone wrench while breaking loose left locknut with adjustable wrench. (Use cone wrench on locknut only if locknut has round face.)

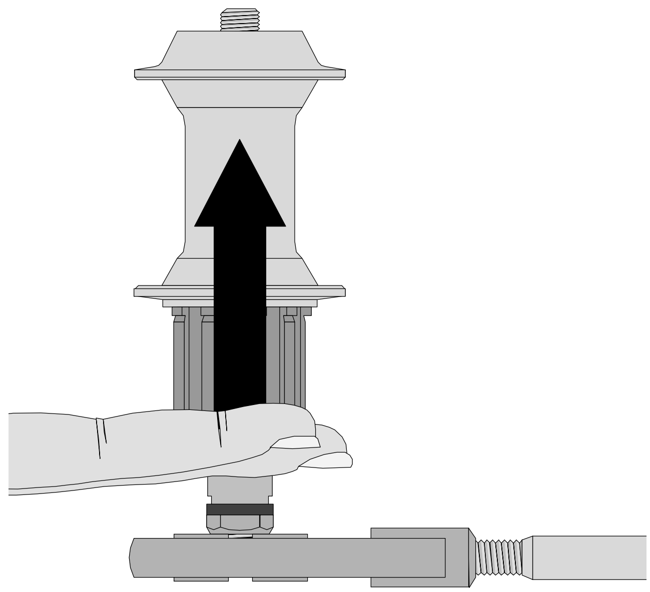
There are few standards about the number and sequences of parts on the end of the axle. Furthermore, keeping left-side and right-side rear-axle parts separate is critical on rear hubs (front hubs usually are symmetrical). For this reason, the next step suggests transferring parts directly from the axle to a bundling tie (wire or plastic bread-bag ties work). Some parts, particularly outer locknuts, have a certain way they need to face, so it is just as important to maintain the specific orientation of each part as it comes off the axle as it is to maintain the order.



12.15 Transfer the parts one-by-one from the end of the axle to a bundling tie to maintain the correct order and orientation.

19.[ ] Thread left-end parts off axle and onto bundling tie (maintaining order and orientation).

20.[ ] Lift hub off axle, cupping hand below hub to catch ball bearings.



12.16 Cup a hand under the hub with the axle between two fingers while lifting off the hub in order to catch any ball bearings that fall out.

Steps #21 through #24 are about removing the right-side axle parts. Removing these enables checking for a bent axle, damaged threads, replacing the cone if damaged, and resetting the right-side axle protrusion if necessary. The tendency is to skip these steps if the cone is not in need of replacement, but some important problems could be missed , especially if this is the first time overhauling this hub.

If the hub is a rear hub with a thread-on freewheel, a variety of parts configurations might be found in the next step. These will break down into one of two fundamental categories, axles sets with a single locknut on the right and axle sets with a double locknut on the right. Some of the variations might be whether there is a big spacer built into the outer locknut of a double-locknut design and whether there are single or multiple spacers.

In these next steps, use *two* ties to bundle the right-side parts. This will enable keeping track of the left-side (first off, single tie) and right-side (second off, two-ties) parts.

21.[ ] Reverse axle in axle vise or soft jaws.

22.[ ] Hold cone (or lower locknut of double-locknut hub) stationary with cone wrench while breaking loose locknut with adjustable wrench. (Use cone wrench on locknut only if locknut is round.)

23.[ ] *Only if double-locknut hub*: hold cone stationary while breaking loose lower locknut.

24.[ ] Thread right-end parts off axle and onto two bundling ties, while maintaining order and orientation.

Rubber seals on dustcaps or cones rotate relative to the part they are attached to. Seal effectiveness can be improved and seal drag reduced by lubricating between the seal and what it is attached to. Seals will be removed at this time to enable greasing later. Seals can possibly be re-installed backwards, so note their orientation if removing them from a dustcap, or simply leave them on the left-side and right-side parts bundles if removing them from a cone.

25.[ ] Remove rubber seals (if any) from dustcaps (note orientation) or cones (leave seals on bundles).

Next, remove the ball bearings. This is a critical step because bearing sizes and quantities are not universal. For front hubs, 10– 3/16" balls per side is most common. The most likely exception that will not be obvious is that some older Campagnolo hubs use slightly oversize 7/32" balls. For rear hubs, the most common quantity and size are 9– 1/4" balls per side. The quantity of balls for the right side and left side of any hub is almost always universally equal, so if eleven are counted on the right and nine on the left, it is certain that a ball dropped from one side to the other and that ten per side is the correct amount. On the other hand if the quantity per side differs by one, it is extremely possible that one ball was lost.

26.[ ] Remove ball bearings one side at a time and determine quantity and size per side and record observations here:
Quantity: Left______ Right______
Size: Left______ Right______

Dustcap removal is next. It is optional, with removal only making cleaning and inspection easier. That dustcap removal is optional is important, because with some hubs it is *easy* to bend or break the dustcap when attempting to remove it. This happens most often with some Shimano freehubs. To pry out the dustcap use a plastic tire lever. Lever gently in one location, then move a few degrees and lever a little more, then move again and lever a little more. Continue like this until the dustcap eases out. If it will not come out easily, *do not remove it.*

27.[ ] Pry dustcaps out unless damage is likely. Were dustcaps very loose? Yes? No? (circle one)

The next step only applies to rear freehubs, and is optional. The hub can be cleaned with the freehub body still attached. It makes for extra work when drying after cleaning. Techniques for freehub-body removal are not covered here, as they are optional and *are* covered as part of the **FREEHUB MECHANISMS AND THREAD-ON FREEWHEELS** chapter (page 25-9).

28.[ ] Only if working on rear freehub, remove freehub body (optional).

29.[ ] Clean all parts, including outside of hub shell.

INSPECTION

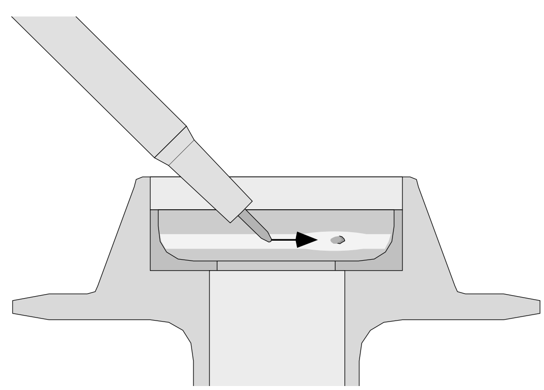
Hub-shell damage in regard to the bearings is rare. Cracks may appear on some inexpensive steel hubs on the backside of the bearing area when the bearings become extremely over-tight. Some inexpensive hub shells made of multiple parts joined together may fail at the joints. The evidence of this type of failure is greasing oozing out a seam in the hub shell. This external inspection is done first because any failure is non-repairable and the job is over.

30.[ ] Inspect outside of hub shell for damage. Good? Bad?

The bearing cups are supposed to be permanently pressed into the hub shell. Occasionally they work loose. If not inspected for, this might cause substantial frustration when trying to eliminate play when making the adjustment. Firmly press a finger into a cup and try to force it to rotate. If it does rotate, it must be fixed by dripping Loctite 290 behind the cup.

31.[ ] Inspect pressed in cups for looseness. See if they rotate or jiggle. Good? Bad?

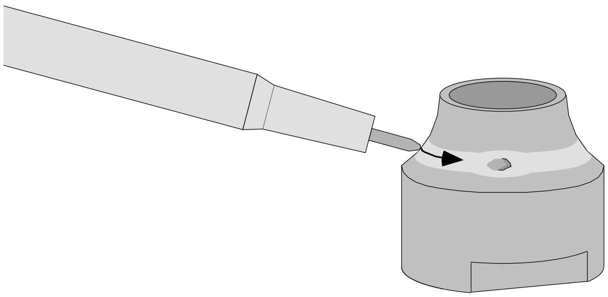
By design hub cups wear out long after the cones have worn out. This is good because the cups cannot be replaced. When a cup wears out, a new hub is needed. Check for cup wear by looking in the cups for the wear line left by the balls. Trace this wear line with the tip of a ball point pen. If it snags on anything, the cup is shot and the hub should be replaced.



12.17 Inspect the cup for pits with the tip of a ball point pen.

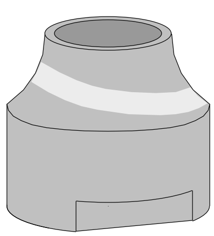
32.[ ] Trace ball path in cups with a ball point pen to check for pits. Good? Bad?

If the cups were worn out, the cones are virtually certain to be. If not, be sure to check the cones carefully so that a worn out one will not damage a cup, leading to a hub replacement. Cones wear out by developing pits (galling). Find the shiny wear line left by the balls on the conical portion of the cone. Trace this wear line with the tip of a ball point pen to check for pits.

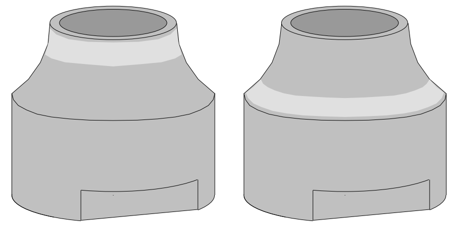


12.18 *Inspect the cone for pits with the tip of a ball point pen.*

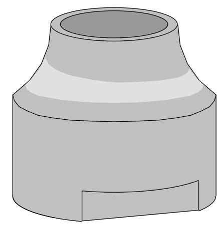
When inspecting the cone for pits, other symptoms with the wear line might be detected. If the wear line wanders from high on the cone race to low on the cone race, the cone may still be useable but the wear pattern indicates a probable bent axle. If the wear pattern is at the top or bottom of the cone race, it indicates that the cone is the wrong one for that particular hub, or that the wrong-size bearings are in use. An unusual looking wear pattern that does not indicate a particular problem is when the wear line is fat halfway around the cone and thin on the other half. This happens because the cone does not rotate during use so all the load is experienced on the bottom half. This pattern is not seen all the time because in many cases the rear wheel is in and out often, and the axle and cones end up rotated into a different positions with each installation of the wheel.



12.19 *A wear line that is low on the cone race at one point and high on the cone race at another point indicates the axle is bent.*



12.20 *A wear line that is at the top of the cone race (left cone), or bottom of the cone race (right cone) indicates that the cone is the wrong one for the hub or that the balls are the wrong size.*



12.21 *When the wear pattern is fatter on half the cone race it indicates that the axle has been in the same position for most of the life of the hub, no particular problem is indicated.*

33. [ ] Trace ball path on cones with a ball point pen to check for pits and inspect for other wear problems. Good? Bad?

Next, inspect the axle for bends. Roll the axle on a flat smooth surface such as a Formica counter top or a glass display case. Look under the axle as it rolls for a humping up and down that indicates it is bent. A bent axle is an axle in the process of breaking, and should be replaced, not straightened. A bent axle can be caused by misaligned dropouts. Axles can also bend from severe impact to the wheel or high pedaling loads.

34. [ ] Inspect axle for bends. Good? Bad?

Threads can be damaged on the axle from getting nicked, from a keyed lock washer rotating around the axle, or from excess torque on a locknut, which results in stripped threads. If the threads are nicked from impact against something or damaged by a rotated lock washer, they can be repaired with the thread file (metric-pitch quick-release axles) or Bicycle Research thread chaser (inch-pitch solid axles). Threads stripped from an over-tightened locknut cannot be repaired. Replace the axle.

35. [ ] Inspect axle for damaged threads. Good? Bad?

Some axles have slots along their length. A key on the lock washer engages the slot. The only function of the key is to enable the factory to adjust the hub without a cone wrench. However, the washer often rotates around the axle and the key damages the threads as well as itself. If a key is damaged, the washer is sure to rotate again. File out the damaged key or replace the washer with an unkeyed one. If installing a replacement axle without a slot, get rid of the keys on the inside of the washers.

36.[ ] Inspect keyed lock washers for damaged keys. Good? Bad?

Inspect the locknuts for damage, usually resulting from being over-tightened or from poor wrench fit or use. Locknuts have to match the original thread and thickness. If the new locknut has a different thickness, make up the difference by adding or subtracting washers.

37.[ ] Inspect locknuts for damaged threads, cracks, warpage, and rounded off flats. Good? Bad?

Inspect the dustcaps for looseness and damage. If they were loose (determined during removal), then re-install them with Loctite 242. If a dustcap is bent, try to straighten it out. It is only critical if the dustcap is deformed to the point that it rubs on a part of the axle set that the dustcap overlaps.

A simple technique for straightening a bent dustcap is to put the dustcap on the bench face down and insert a socket that is a close fit inside the dustcap and tap on the dustcap with a soft mallet.

38.[ ] Inspect dustcaps for looseness (done in step 27) and damage. Good? Bad?

ASSEMBLY

If installing a new axle, the length does not have to match exactly. For quick-release axles, the minimum axle protrusion per side should be no less than one-half the dropout thickness, and the maximum should be no more than the dropout thickness. For non-quick-release axles, the minimum length should be no less than the sum of the dropout thickness, plus the thickness of the washers under the axle nuts, plus the thickness of the axle nuts.

Calculate new axle protrusion

NOTE: If not replacing axle with new one of different length, go to step 42.

39.[ ] Repeat original average axle protrusion from step 11 here: ________mm.

40.[ ] Measure difference between axles and divide by two.
Difference is: _______mm
÷ 2
1/2 axle difference =_______mm

41.[ ] If new axle is shorter, subtract difference (or if longer, add) from/to old protrusion.
Old protrusion (step 39) _______mm
1/2 axle difference (step 40) ±________mm
New protrusion is: =________mm

Parts replacement

42.[ ] Replace bad parts on bundles with good parts.

Preparation of hub shell for assembly

If the freehub body has been removed in step #28, it is time to replace it. Be sure it is dry and oiled inside. Techniques for cleaning, drying, oiling, and installation are all covered in the freewheel chapter.

43.[ ] Install freehub body if it was removed in step 28.

Fill both cups generously with grease and put the balls into the cups. If unsure of the ball quantity, fill the cups with balls without forcing any in.

The most important thing about dustcap installation is to make sure that they end up level rather than tipped. Tap the dustcap in with a rubber or plastic mallet. Do the best possible to level the dustcap at this point, and then when the hub is assembled, give the wheel a spin and check whether the dustcaps wobble as they spin. Straighten them as necessary.

44.[ ] Pack grease and balls in one side of hub, then install dustcap.

45.[ ] Pack grease and balls in other side of hub, then install dustcap.

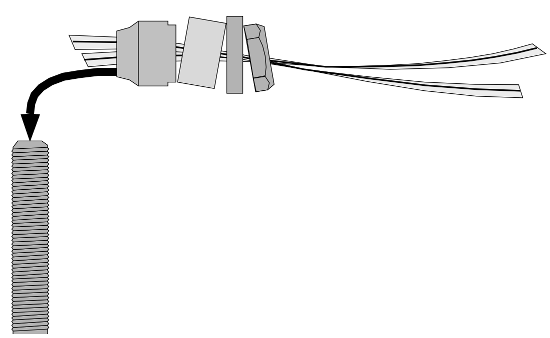
46.[ ] Grease seals, if any, and install on dustcaps or cones.

Set right-side axle protrusion

47.[ ] Grease axle threads.

48.[ ] Install axle in axle vise or soft jaws with right end up. (Right end is longer-threaded end if right parts bundle is bigger bundle, or shorter-threaded end if right parts bundle is smaller bundle.)

When disassembling the axle set, the assumption is that all the parts are in the correct orientation. If these parts were not correctly oriented, or if the bundle came apart during cleaning and the order and orientation is uncertain, make sure the outer locknuts go on correctly. If one side of the locknut is flat and smooth and the other side is not, the non-smooth side faces out, so as to grip the inside face of the dropout and hold the wheel more securely in the bike.



12.22 Transferring the parts from the bundling tie to the axle.

49.[ ] Transfer all parts from right-side bundle (two ties) to axle.
50.[ ] Position top locknut so axle protrusion equals average axle protrusion plus .2mm.
51.[ ] Hold top locknut stationary with wrench and tighten parts below it snugly up against locknut.
52.[ ] Measure axle protrusion, then adjust protrusion if necessary.
53.[ ] Loosen axle slightly in axle vise (or vise) so that axle is free to turn.
54.[ ] Hold cone with cone wrench and torque locknut to 120–180in-lbs (30–45lbs@4").

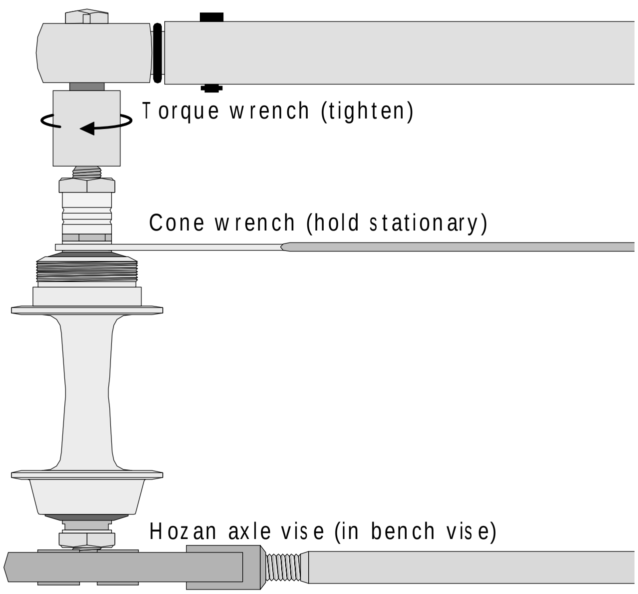
Install axle in hub

55.[ ] Turn axle over in axle vise (or vise).
56.[ ] Drop hub (right-side down) onto axle.
57.[ ] Transfer left-side parts bundle to axle.

PRELIMINARY ADJUSTMENT

NOTE: If just adjusting a front hub or thread-on-freewheel rear hub:
1. Do steps 1 through 7,
2. Break loose left-side locknut from cone by holding cone stationary and turning locknut counterclockwise.
3. Hold right cone with cone wrench and torque locknut to 120–180in-lbs (30–45lbs@4").

NOTE: If just adjusting (not overhauling) a freehub:
1. Back cone off enough to push right side of axle out far enough to access right-side cone.
2. Secure right-side cone and locknut together to 120–180in-lbs (30–45lbs@4").
3. Place right side of axle in axle vise/soft jaws.



12.23 Preparing a hub for adjustment.

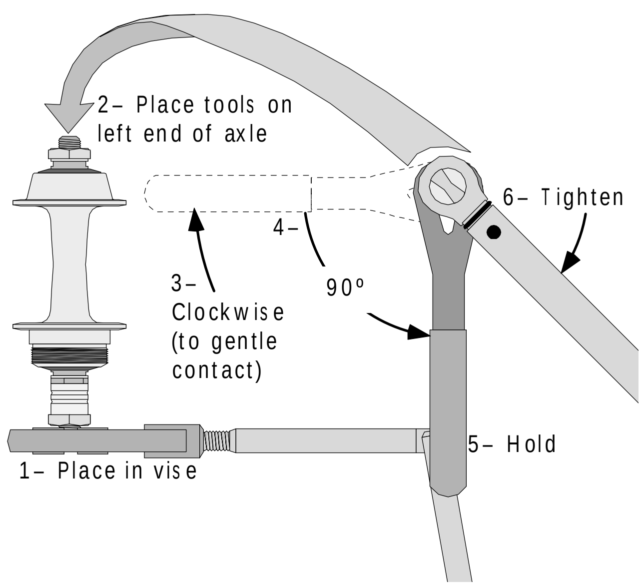
The next few steps are a preliminary to adjusting the hub. The left-side parts will be put in a position close to their final position, but *deliberately at a very loose adjustment*. This prepares the hub for adjustment because the adjustment procedure is based on starting too loose and eliminating the looseness. A very high degree of initial looseness is required for quick-release hubs because the axle is compressed by the load of the closed quick release, which will take up some of the excess play before the adjustment is even started.

The adjustment procedure recommends using calibration stickers (BBI Hub Dial stickers). The stickers will be put on the hub to calibrate the adjustment. The surfaces must be grease-free for the stickers to stick well, particularly on the cone. Even if not using the stickers, it will be necessary to mark the hub in some way, so cleaning is still required.

The adjustment procedure (page 12-15) is very different from the way most mechanics adjust hubs. The procedure uses an adjustment-calibration sticker (a BBI product), but a piece of masking tape that you mark yourself can be used as an alternative to the sticker. This approach (with sticker or tape) may seem awkward at first, but students at BBI that were very experienced with hub adjustment prior to arriving at BBI, endorse this approach wholeheartedly.

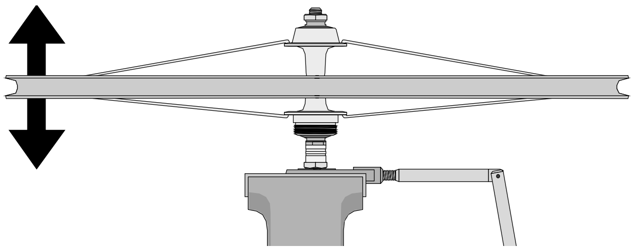
If parts were replaced, or right and left parts were mixed together, it is time to check the over-locknut width and freewheel-space/freehub-space measurements against the originals.

58.[ ] Tighten cone until it very gently contacts bearings, then back it off a full 90°.
59.[ ] Hold cone stationary and tighten locknut to it to 120–180in-lbs (30–45lbs@4").



12.24 Preliminary setting of the cone.

60. [ ] Jerk rim up and down and check for *obvious* (even extreme) knocking. If adjustment is not adequately loose, go back to step 58 and start even looser.



12.25 Jerk up and down on the rim to check for obvious knocking that indicates that the adjustment is loose enough.

61. [ ] Clean left dustcap and left cone thoroughly (with acetone or alcohol).
62. [ ] If non-matching right-side hub parts were installed, check freewheel/freehub-space from steps 15 or 16 and adjust if necessary.
63. [ ] If non-matching hub parts were installed, compare to over-locknut width in step 12 and adjust if necessary.

FINAL ADJUSTMENT

Adjusting a hub can be challenging. The first challenge of adjusting a hub is that the cone needs to be adjusted relative to the axle. The axle wants to turn unless fixed somehow. This could be done in the vise, but there is another challenge in that the quick-release axle in the bike is compressed compared to its length out of the bike. If a perfect adjustment of a quick-release axle out of the bike were made, it would be over-tight in the bike and with no easy way to tell. The wheel can't mounted *inside* the dropouts to make the adjustment because then there is load on both outer locknuts and they can't be turned. Yet one more challenge is to keep track of the adjustments. The cone position must be compared to where it was relative to the axle; however, the axle is so small that there is no way to mark it to track the progress of the adjustment.

The following adjustment procedure solves all these problems. It pre-loads the axle so that the in-the-bike adjustment will not be tighter than when performing the adjustment. It fixes the axle from rotating, and by also fixing the hub from rotating, this technique allows tracking the cone position relative to the hub rather than relative to the axle.

This adjustment procedure assumes a Stein HV-1 hub axle vise is being used to hold the wheel stationary. Although the HV-1 is an inexpensive and excellent tool, as an alternative the wheel can simply be mounted to the *outside* of a rear dropout on a bike. Alternatively, cut a few inches of chainstay and a rear dropout out of a trashed frame to clamp in the vise to substitute for the HV-1.

Non-quick-release hub-adjustment preparation

NOTE: For quick-release axles, go to step 65.

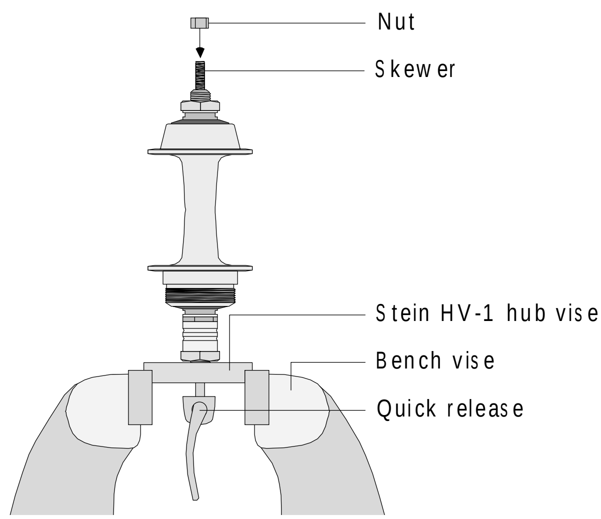
64. [ ] Clamp Stein HV-1 in vise and use axle nut to bolt right end of axle into hole of HV-1 securely (about 240in-lbs).

Quick-release hub-adjustment preparation

NOTE: For non-quick-release axles, go to step 70.

65. [ ] Put Stein HV-1 in vise securely.
66. [ ] Insert QR skewer through bottom of HV-1 and into right end of axle (no springs).

In the next step, a nut (standard 5mm ×.8mm *or* quick-release adjusting nut) is put on the end of the skewer so that it will bear against the end of the axle when the skewer is secured. The nut then transfers the load though the axle, simultaneously securing the axle from rotation and compressing the axle in the same fashion that it will be when the wheel is installed in the bike. When the wheel is mounted normally in the bike, the force is applied through the dropout to the outer locknut and then to the axle.



12.26 The hub is mounted in the Stein HV-1 vise (in bench vise jaws), using a 5 × .8mm nut on the end of the quick-release skewer.

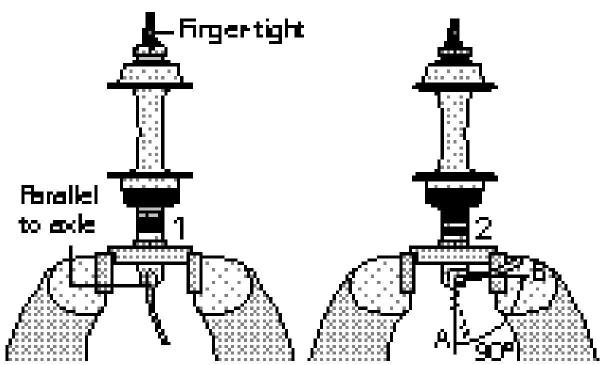
Using a 5mm ×.8mm nut instead of the quick-release adjusting nut has some advantages. Sometimes the large diameter of the quick-release adjusting nut interferes with an open-end or adjustable wrench being used on the locknut. The regular nut allows use of any wrench, including a deep socket (so that a ratchet drive or torque wrench can be used to secure the adjustment). Some older French skewers and some American skewers are not compatible with a 5mm nut so use the quick-release adjusting nut in these cases.

67. [ ] Put nut (no spring) on skewer.

The quick-release lever must be clamped with the same force during the adjustment as it is during normal wheel installation for the adjustment to be accurate. The common tendency is to not secure the lever tight enough. When it is properly set, force is required to close the lever starting when the lever is parallel to the axle and the lever must be closed down all the way until it is perpendicular to the axle. Many quick-release levers are curved; when the lever is curved, the straight portion at the base of the lever is the only part to be concerned with regarding the starting and ending positions. See figure 12.27.

68. [ ] With base of quick-release lever parallel to axle, secure nut tight with fingers.

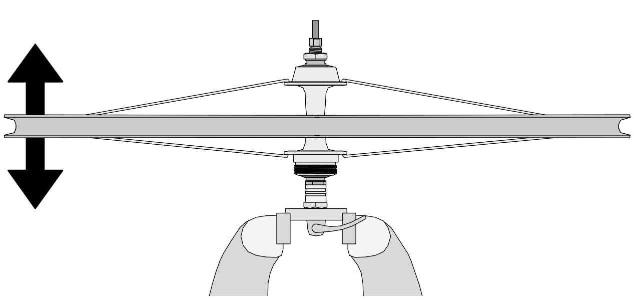
69. [ ] Close quick-release lever 90° until base of lever is perpendicular to axle.



12.27 Adjust the quick release so force to close begins at A and close the lever until it matches position B.

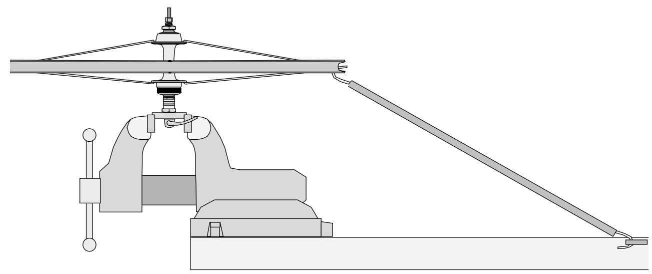
Adjustment Procedure

70. [ ] Jiggle rim to check hub for looseness, and set left cone and locknut to looser position if no play is felt.



12.28 With a finger on the end of the end of the axle to feel for knocking, jerk up and down on the rim.

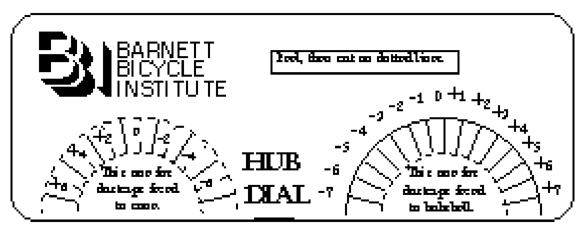
Next, the rim needs to be fixed from turning so the cone can be adjusted relative to the hub. A bungee cord or its substitute is used. It will need to be attached, detached, and re-attached several times without loosing the position of the hub, so set up the bungee cord to a fixed point on the rim and a fixed point on the bench or vise.



12.29 Attach a bungee cord to the rim at the valve hole (or valve), then attach the other end to a fixed point on the bench.

71. [ ] Attach a bungee cord to valve/valve hole, and to fixed point on bench/vise to fix rim from turning.

The following adjustment procedure is very different from the way most mechanics adjust hubs. The procedure uses an adjustment-calibration sticker (a BBI product), but a piece of masking tape that you mark yourself can be used as an alternative to the sticker. This approach (with sticker or tape) may seem awkward at first, but students at BBI who were very experienced with hub adjustment prior to arriving at BBI endorse this approach wholeheartedly.



12.30 A BBI Hub Dial Sticker.

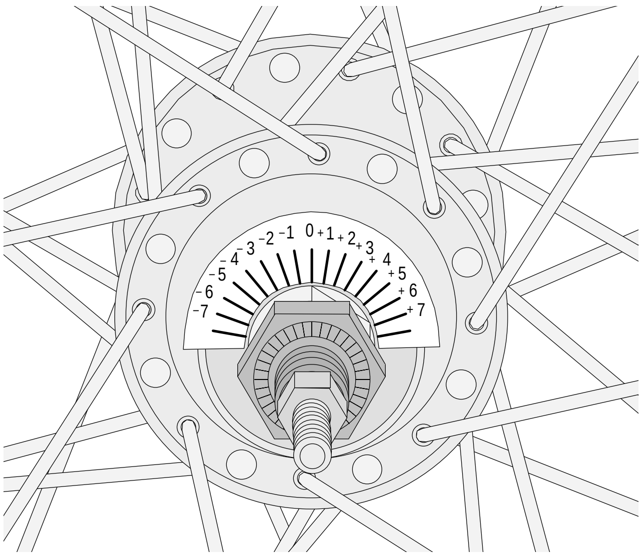
If the hub has a dustcap that rotates with the hub shell, the cone needs to be marked with a scribe between the wrench flats, or use one edge of one of the wrench flats as the cone mark.

If the hub has a dustcap that remains stationary as the hub shell rotates, use a fine-tip felt marker to put a mark on the hub shell right at the edge of the stationary dustcap.

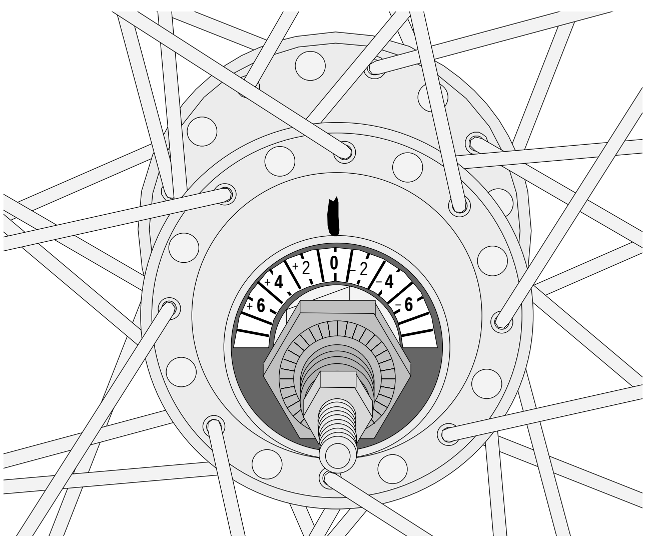
72. [ ] Check whether dustcap rotates with hub shell and mark cone if dustcap rotates or hub shell if dustcap is stationary.

If the hub has a dustcap that rotates with the hub, use the BBI Hub Dial sticker that has numbers outside of the dial marks. If the hub has a dustcap that remains stationary as the hub rotates, use the BBI Hub Dial sticker that has numbers on top of the dial marks.

The Hub Dial sticker needs to be cut out and attached to the dustcap so that the calibration lines are right against the cone and so that the "0" mark lines up with the cone mark or hub-shell mark.



12.31 *BBI Hub Dial Sticker placed on a rotating dustcap so that the "0" mark lines up with the edge of a cone-wrench flat.*



12.32 *When the BBI Hub Dial Sticker goes on a stationary dustcap, mark the hub shell in line with the "0" on the sticker.*

73. [ ] Cut out Hub Dial sticker and put it on dustcap so that "0" mark lines up with cone mark or shell mark. If not using a BBI Hub Dial sticker, draw a mark on dustcap lining up with cone mark or hub-shell mark.

In the next step, hold the cone stationary while breaking loose the locknut. If the cone and locknut both turn counterclockwise simultaneously, the axle may turn with them. This will cause the locknut on the other end of the axle against the HV-1 to break loose. This will not be obvious, but as adjustment continues to be set tighter and tighter, a slight amount of play will persistently remain. The play being felt will be the loose locknut on the end of the axle against the HV-1. By this time the adjustment is probably way over-tight and the right-side locknut and cone need to be resecured. Start over. Avoid this by *keeping the cone absolutely stationary while breaking loose the locknut.*

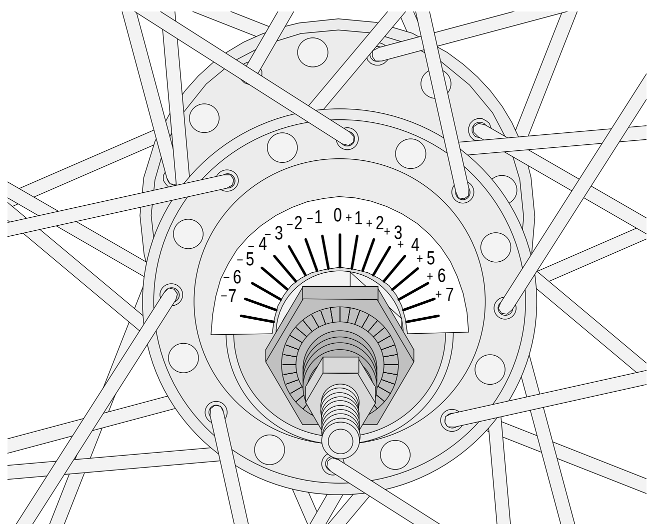
74. [ ] Holding left cone *absolutely* stationary, loosen left locknut.

75. [ ] Adjust cone clockwise to next dial mark (+), hold cone absolutely stationary and secure locknut 120–180in-lbs (30–45lbs@4"). If not using a BBI Hub Dial sticker, simply draw a new mark 1–2mm clockwise from original on dustcap.

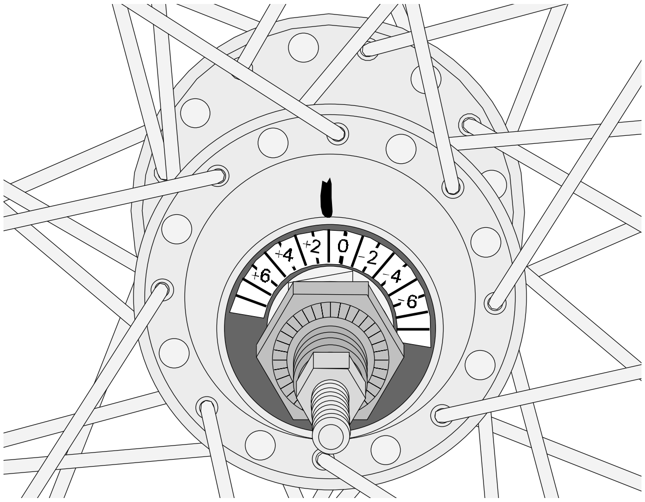
The next step is to jiggle the rim and feel if there is knocking that indicates the adjustment is too loose, then reset the cone to the next positive mark on the Hub Dial. This adjustment needs to be very precise. If the mark is under- or over-shot, try again. See figures 12.33 and 12.34.

76. [ ] Remove bungee cord and check for knock in hub by jiggling rim (rotate wheel and check at many points about rim).

77. [ ] Re-attach bungee cord and repeat adjustment process to next "+" mark. If not using a BBI Hub Dial sticker, draw a new mark 1–2mm clockwise on dustcap or hub shell.



12.33 *The cone has been turned 10° clockwise so that the edge of the wrench flat lines up with "+1" on the sticker.*

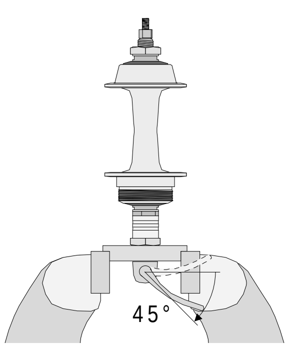


12.34 The cone (and sticker) has been turned 10° clockwise so that the "+1" on the sticker lines up with the mark on the hub shell.

NOTE: If knock is felt easily in step 76, perform steps 77–78.

78.[ ] Repeat step 71, then 74–76 as many times as necessary (each time moving cone mark to next "+" mark on hub dial), until play is not felt. If at any time play becomes detectable intermittently (play can be felt at some points on rim, but not at all points on rim) the next adjustment should only be halfway to next mark.

The objective in the next step is to loosen the quick-release lever enough to take the compression load off the axle, but to leave it tight enough so that the wheel will not wiggle relative to what it is mounted to, when jiggling the rim to check for free play in the adjustment. To accomplish this, the lever needs to be opened halfway back from the perpendicular-to-axle position a position parallel to the axle (45°). If the wheel ends up loosely mounted at this quick-release position, the quick release was not properly set initially, and the adjustment should be started over again.



12.35 Loosen the quick-release lever 45°, then check for knock.

79.[ ] Once knock is eliminated, remove bungee, loosen QR lever 45°, and check for knock.

NOTE: If knock is not felt in step 79 (with lever loosened), perform step 80, otherwise go to step 81.

80.[ ] Secure skewer lever, re-attach bungee, return halfway to last adjustment and repeat check with bungee off and QR lever loosened 45°.

NOTE: Once knock is felt in step 80 (with lever loosened) perform steps 81–83.

81.[ ] Adjustment is good: Yes? No?

82.[ ] Remove wheel from HV-1, remove skewer and nut if any, install freewheel or freehub cogs, install wheel normally.

83.[ ] Check at rim for knocking and adjust skewer setting tighter (within normal range) if knocking is felt.

SHIMANO PARALLAX HUBS

Shimano makes several front hubs that are in a style group called "Parallax." Some of these hubs are completely conventional in every way except the oversize diameter of the hub-shell core. Some of them have special axle designs that requires some slightly different techniques.

All models of Parallax hubs have rubber seal covers that hide the access to the cones. These soft seals must be pulled over the locknut and off the end of the axle before servicing the hub.

The way to tell the difference between the varieties of Parallax hubs is simple. If a threaded axle protrudes past the face of the locknut, the hub is completely conventional. If a smooth unthreaded stud protrudes from the face of the locknut, then the hub has a special axle.

There are actually two different special axles. One is a 10mm conventional axle with a 9mm unthreaded end that protrudes past the locknut. The other is a 11mm axle that does not protrude through the locknut at all. Both of these designs require a different approach from each other and different approach from other hubs.

The way to identify the 10mm design is to break loose the locknut. If the smooth stud remains stationary while the locknut turns, then the axle is the 10mm variety. Currently hubs of this design have the designation "Parallax 100" on a gold sticker, but this could change or the sticker might be removed. Another indicator that the hub may be of this variety is that the smooth protruding stud is black steel; however, this could change also.

The certain way to identify the 11mm design is to break loose the locknut. If the smooth stud rotates while the locknut turns, then the axle is the 11mm variety. Currently hubs of this design have the designation "Parallax 110" on a gold sticker, but this could change or the sticker might be removed. Another indicator that the hub may be of this variety is that the smooth protruding stud is chrome steel; however, this could change also. Some of the 11mm-axle hubs have special locknuts with a built in rotating washer shaped like the letter "D." If this washer is present, then the hub definitely is the 11mm-axle variety. (See figure 12.36.)

SERVICING 10MM-AXLE PARALLAX HUBS

There are only two special considerations with servicing these hubs. When overhauling this variety, a different technique is required for holding the axle. Also, although the axle-thread description is a conventional 10mm × 1mm, the special reduced diameter 9mm ends and extra thread length require the axle to be replaced with original matching parts only.

The recommended Hozan C354 axle vise with threaded hole is adequate but not ideal for grasping the end of the axle for disassembly purposes. Better choices would be Park AV-1, United Bicycle Tool AX, or Campagnolo P.

SERVICING 11MM-AXLE PARALLAX HUBS

There are actually two varieties of this hub. One has a simple round-face locknut on the end of the axle. The other has a built-in rotating washer that is shaped like the letter "D" and has a tab in the face of the washer that fits into the axle slot.

Complications

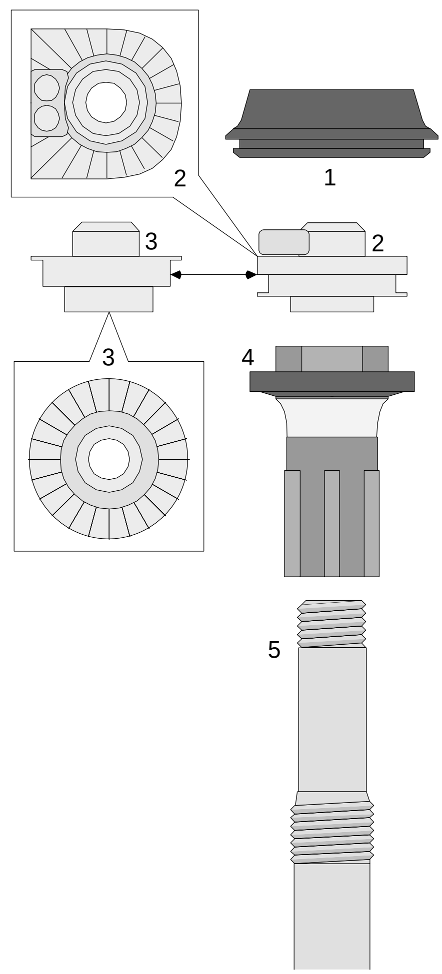
The fact that the axle does not protrude through the locknut means that there is no way to pre-load the axle and then adjust the hub. This reduces the hub adjustment to pure trial-and-error; furthermore, the design of the hub makes it impossible to use the Hub Dial Stickers or any other marking system to track the increments of adjustment. Estimating the amount that the cone wrench moves for each adjustment is the only way to control the size of each adjustment.

The presence of the "D"-shaped washer makes it virtually impossible to grasp the axle in any kind of a vise and makes it extremely difficult to grasp the end of the axle to feel for free play or a tight adjustment.

The steel locknut threads onto an aluminum axle with very little thread engagement due to the low profile of the locknut. The possibility of stripping axle threads is high. There is no way to measure torque, so the mechanic must subjectively reach a tightness that will not strip the axle or allow the cone to work loose. Using Loctite 222 on the cone and locknut threads greatly reduces this problem.

Service procedures

The hub with no "D"-shaped washer can be held by grasping the smooth stud protruding from the locknut face in a smooth jaw axle vise such as the Park AV-1.



12.36 *Parts of a Shimano Parallax hub with an 11mm axle: 1. rubber seal, 2. locknut/"D"-washer assembly, 3. alternate regular locknut, 4. cone w/seal, 5. 11mm axle.*

To hold the axle while disassembling a hub with a "D"-shaped washer, gently grasp the smooth stud and the tab on the face of the "D"-shaped washer in a smooth-jawed vise.

When adjusting the hub, grasp the axle in an axle vise or bench vise so that it cannot rotate. Start with the cone backed off at least 90° from the point it first contacts the bearings. Secure the locknut. Jiggle the end of the axle to check for free play. Do not interpret the looseness of the "D"-shaped washer as play in the bearings.

When the amount of free play is correct, it should disappear when the wheel is securely mounted in the fork and reappear when the skewer is loosened 45°. It will take repeated trial and error adjustments to find the subtle setting that has no play when the skewer is fully tight but has play when the skewer is loosened 45°.

ADJUSTABLE-CONE-HUB TROUBLESHOOTING (table 12-3)

Cause	Solution
SYMPTOM: *The axle feels tight or rough to rotate when play is first eliminated (or on a quick-release hub it fails to develop play when the quick-release lever is loosened 45°).*	
Last adjustment was too large.	Try to find an in-between adjustment.
Misinstalled dustcap rubbing on axle set.	Observe whether dustcap turns true as the wheel turns and reset if needed.
Bent axle causes portion of the axle set to rub dustcap.	Inspect for bent axle and replace.
Dry grease.	Disassemble, inspect, overhaul.
Cones and/or cups galled.	Disassemble, inspect, replace parts.
Seal mechanism drag.	Check that seal mechanisms are not incorrectly positioned and/or lubricate seals.
Wrong size balls.	Disassemble, measure balls.
SYMPTOM: *Play cannot be eliminated without severely over-tightening the adjustment.*	
Locknut on end of axle set that is mounted in vise not secured.	Check locknut security.
Cups and/or cones galled.	Disassemble, inspect and replace.
Loose cups in hub shell.	Disassemble, inspect and repair with appropriate Loctite.
SYMPTOM: *Properly adjusted bearings feel sluggish but not rough when rotating the axle.*	
Seal mechanism drag.	Grease seal mechanisms.
Dry grease.	Disassemble, inspect, overhaul.
Plastic dustcap rubbing.	Align dustcap.
SYMPTOM: *When adjusting or inspecting the hub, an erratic looseness or tightness is detected that comes and goes and changes location.*	
Too many balls in the cup(s).	Disassemble and check ball quantity.
SYMPTOM: *When rotating the axle set, a pattern is detected of a consistent tight spot and a consistent loose spot.*	
Bent axle.	Inspect for bent axle and replace.
Low-precision parts.	None.
SYMPTOM: *When inspecting the cone, a wear pattern is detected that is high on the cone race on one-half of the cone and is low on the cone race 180° away.*	
Bent or broken axle.	Inspect and replace.
SYMPTOM: *Axle is bent or broken.*	
Dropouts are misaligned.	Check and align dropouts.
Weak dropouts combined with a weak axle.	Avoid using quick-release axle, or upgrade quality of solid axle.
High torque from very low gear pulls cog set and hub forward beyond the elasticity of axle.	Use strongest axle available.
SYMPTOM: *When riding the bike, a clicking sound is heard from a hub (usually the front), but the hub feels normal when inspected.*	
Loose balls rotating around the cone drop over the top of the cone and bump into the last ball over the top.	Normal, but possibly the hub is short on grease.
SYMPTOM: *When inspecting the cone, the wear pattern is very high or very low on the cone race. Wear life has probably been very short.*	
Wrong size balls.	Measure balls.
Inappropriate cone for hub.	Inspect cone.