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ABOUT THIS CHAPTER

This chapter is about cartridge-bearing hubs. These hubs are often called sealed-bearing hubs, but both loose-ball hubs and cartridge-bearing hubs can have sealed bearings. The design of cartridge-bearing hubs varies tremendously with almost every manufacturer designing hubs in a different way. About the only factor all cartridge-bearing hub manufacturers have in common is that they all use a cartridge bearing that is pressed into the hub shell. Hadley and Conrad are names that are sometimes used for the cartridge bearing. Cartridge-bearing hubs include front hubs, rear hubs that accept a thread-on freewheel, and freehubs (rear hubs that have the freewheel mechanism integrated into the hub).

There is no way all brands and models can be covered in this chapter, so there is a generic freehub procedure (with different steps for all design variations) and a generic front-hub/non-freehub-rear procedure (with different steps for all design variations). In addition, there is procedure for Chris King freehubs, which are popular and too unique to cover in the generic procedure.
GENERAL INFORMATION

TERMINOLOGY

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

Axle spacer: Any hardware on the end of an axle that sets the distance from the dropout to the outer bearing of the hub. Sometimes shortened to spacer.

Bearing mount: Any surface a cartridge bearing engages, either at its inner perimeter or its outer perimeter. Sometimes shortened to mount.

Cartridge bearing: A fully self-contained bearing unit that cannot be disassembled. A bearing cartridge includes ball bearings and an inner and outer race. The bearings are usually hidden behind seals. The entire assembly is shaped like a short cylinder with a hole through the center. Sometimes shortened to cartridge.

Driver: See freehub body.

Dustcap: A piece that threads or presses onto the outer end of the hub shell to cover the hole through which the bearings are accessed.

Freehub body: The segment of a rear hub to which the gears attach. It rotates on its own bearings and includes at least a part of the ratchet mechanism. Also called driver.

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

Inner race: The cylinder at the inner perimeter of a bearing cartridge.

Mount: See bearing mount.

Outer race: The cylinder at the outer perimeter of a bearing cartridge.
**Pawl:** A lever with a distinct corner at one end and a rounded surface on the other end. The rounded end acts as a pivot for the rotation of the pawl. The sharp end engages the teeth in a ratchet ring in one relative direction of rotation and slips over the teeth in the other relative direction of rotation.

**Pawl spring:** A spring that moves the pawl outward to engage the ratchet ring.

**Ratchet mechanism:** A mechanism that engages two parts together to move as one when one of the parts is under torsional load but it permits the two parts to rotate independently when no torsional load is being applied to the part.

**Ratchet plate:** A plate with directional gear teeth on one face. Two ratchet plates (with gear-teeth faces against each other), function as a ratchet mechanism. When load is applied in one direction, the plates lock together and turn as one. When load is applied in the other direction, the directional teeth ride over each other, so the parts are allowed to rotate independently. Sometimes called *star ratchet* or *star driver*.

**Ratchet ring:** A ring with directional teeth on its inner perimeter.

**Seal:** A rubber or plastic ring or a rubber-covered metal ring, that covers a gap between two parts to prevent the entry of contaminants.

**Shoulder:** A flat surface that the face of a cartridge bearing seats against. A shoulder can be on the shaft going through the bearing or in the cylinder into which the bearing is inserted. The shoulder fixes the location of the bearing.

**Snap-ring:** A metal ring that fits in a groove on the outside or inside of a cylinder to trap the location of another item on or in the cylinder. The snap-ring’s shape must be deflected to get it out of its mounting groove. Sometimes called a *circlip*. 
Spacer sleeve: A sleeve placed over an axle that sets the distance between two cartridge bearings. Sometimes shortened to sleeve.

Spring washer: See wavy washer.

Star ratchet: A alternate name for a ratchet plate.

Wavy washer: A washer made out of spring-grade steel that is shaped somewhat like a potato chip (but with a hole through the center). The thickness of a wavy washer is reduced under load. This feature enables the wavy washer to act as a variable-thickness spacer.
PREREQUISITES

Wheel removal and installation

Before overhauling or adjusting a hub, the wheel must be removed from the bike. See the Wheel Removal, Replacement, and Installation chapter if unsure about wheel removal and installation.

FREEWHEEL REMOVAL AND INSTALLATION

To overhaul or adjust a rear hub with a thread-on freewheel, it is necessary to remove the freewheel. See the Freehub Mechanisms and Thread-on Freewheels chapter for freewheel removal. If not yet acquainted with chapter 25, it may be unclear whether the hub has a thread-on freewheel or is a freehub. There is a simple way to determine this. Examine the outer face of the gear set and look for splines in the hole the axle comes out of. If there are no splines, it is not a freehub. If there are splins, rotate the gears counterclockwise to the wheel. If the splines rotate with the gears, the hub is a freehub. If the splines remain stationary, the hub in not a freehub and the gear set is a freewheel that threads onto the hub.
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. This short cycle may be surprising. It is commonly thought that cartridge-bearing hubs are maintenance-free because they are “sealed.” The seals in these hubs are effective for keeping dirt out and increase the longevity of the grease by minimizing exposure to air that dries out grease. The seals are no guarantee that water will not get in the bearings and they do not prevent internal wear from contaminating the grease with microscopic abrasive particles of metal. If a lot of wet-condition riding is done, then the maintenance 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 four months for the winter, it would probably be a good idea to overhaul the hub(s) before putting the bike away for the winter.
SYMPTOMS INDICATING NEED OF OVERHAUL

What symptoms would lead to the feeling that the hub(s) should be overhauled? One is that when turning the axle it does not turn smoothly. Since there are no adjustments on most cartridge-bearing hubs, the tightness is unlikely to be caused by a poor adjustment. 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). Yet another symptom is a squealing or clicking sound coming from the hub that indicates a bearing is loose in its mount. Finally, the hub may have 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

Technically, cartridge bearings cannot be “adjusted.” This is because, unlike an adjustable-cone hub that has a cup facing out toward the end of the axle and a cone facing in toward the middle of the axle, a cartridge bearing has an inner race facing out from the axis of the axle and an outer race facing in toward the axis of the axle. On an adjustable-cone hub, the bearing is adjusted by moving the cone on the axle so that it becomes closer to or further from the cup. In a cartridge-bearing hub, moving the inner race closer or further from the outer race could only be accomplished by expanding or shrinking the race, which is impossible since it is hardened steel. On the other hand it is possible to mis-adjust a cartridge bearing on a threaded axle. If the hardware on the axle just outside of the inner race is threaded onto the axle too far, it will displace the inner race from the correct orientation with the outer race, causing the ball bearings to bind between them (see figure 13.1). This happens because the balls ride in shallow troughs in each race. When the troughs do not line up with each other, the effective width of the channel they create together becomes narrower than the ball bearings.

The symptom created when the hardware is too tight against the inner race is that of a tight bearing. In the case that the axle is quick release (usually), the symptom may go away when the wheel is removed from the bike because of the nature of quick-release axles to expand when the load of the quick-release skewer is released. Therefore, a hub that is apparently fine when checked out of the bike could be over-tight in the bike (when there is no way to check it).
**TOOL CHOICES**

**GENERAL-USE TOOLS**

There are several tools used for servicing cartridge-bearing hubs that are used on other parts of the bike. These include:

- Hex-key wrenches (various sizes up to 6mm)
- Cone wrenches (various sizes up to 16mm)
- Plastic mallet
- Internal snap-ring pliers (various sizes and angles of tips)
- Soft jaws for the vise
- Axle vise (or other radius-jaw clamps) in a wide variety of sizes

**CUSTOM SUPPORTS AND DRIVERS**

Several tools may be needed that cannot be purchased, so they must be made by the mechanic. These tools are usually simple to make and inexpensive, but they require some resourcefulness. These custom tools fall into two categories: *supports* and *drivers*.

**Custom supports:** The hub and driver must be supported at various times during bearing removal and installation. An assortment of lengths and diameters of PVC pipe and PVC plumbing fittings from the hardware store serve this purpose well. Another way to support the driver is by putting a cassette cog on it, then inserting the driver into the vise with the cassette cog resting on top of the vise.
Custom drivers: There are occasions when cartridge bearings need to be pressed in, but there is not a compatible installation tool. In this case, a driver is used to impact the bearing for installation. The ideal driver contacts the face of the outer race of the bearing, has a hole in the center that is larger than the inner race, and is a few tenths of a millimeter smaller in diameter than the bearing. Sometimes a socket tool is just right (although they are often too short to clear the axle). Sections of tubing (bicycle-frame and fork tubes, seat posts, handlebar sections) or pipe (PVC, copper, or steel) from the hardware store are potential drivers. There may even be occasions where a bicycle tool made for a completely different purpose is the right O.D., I.D., and length to be a useful driver.

Bearing-removal tools

There are several tools recently discontinued or currently available that are in the category of “universal” cartridge-bearing removers. Due to the variety of hub designs, no tool can be truly universal, but with a good assortment of tools and a little ingenuity, virtually any hub can be serviced. There are three choices of removal tools: the Bicycle Research Sealed Bearing Remover Kit (#SBR-K), split-lip extractors, and the CalVan #28. For the complex area of bearing removal, the well-equipped mechanic would want each of these tools.

One more tool that should not be overlooked is the axle itself. When the axle is the shouldered type, it always acts as a bearing remover while the axle is being removed. Once the axle and bearing are separated, the axle can be installed back into the hub and used as a driver to remove the second bearing as well.
**Bicycle Research SBR-K design**

The Bicycle Research SBR-K is the most universal tool. It works on the principle of an expanding cylinder that grips the inside bore of the bearing by means of friction. This design eliminates the need for access to the back face of the bearing, which is not always accessible. This tool kit includes five sizes of removers: 10mm, 12mm, 1/2", 15mm, and 17mm. The limitation of the tool is that bearings that have a large I.D./O.D. difference, are heavily secured with Loctite or are corroded in place may have more friction holding them in place, then the tool can generate between itself and the bearing. If this is the case, the tool will keep slipping out before the bearing is moved.

Proper care and use of the SBR-K is important. The expanding cylinders are easily destroyed if they are expanded when not contained by a bearing they are designed to fit, so never tighten the bolts unless the expanding cylinder is inside a bearing that it is intended to fit.

**Bicycle Research SBR-K procedure**

1. Select expansion cylinder that matches bearing I.D.
2. Grease inside cone of expansion cylinder, then install under bolt on tapered end of driver, but do not tighten bolt.
3. Clean outside of expander and inside of bearing with alcohol or other residue-free solvent.
4. Insert shaft-end of tool into outer face of bearing, then pull on shaft end until expansion ring compresses and inserts into bearing. Adjust tool position so flat face of expansion ring is flush with outer face of bearing.
5. Hold bolt in shaft-end of tool stationary with hex key while tightening bolt at expander end as tight as possible (short of rounding hex key or hex sockets in bolts).

6. Place hub or freehub body on support, then tap on shaft with plastic mallet to drive out bearing.

7. Loosen bolt in expander end of tool, then pull or tap bearing off expander end.

**Split-lip Extractor Design**

The *split-lip extractor* design is a cylinder that is split in half (lengthwise). One end of the cylinder has lips that catch behind the bearing. When the split cylinder is compressed (closed), the lips pass through the bearing. When the split is spread open and supported by the insertion of a chisel, the lips can no longer pass through the bearing. Use a 3/8" cut chisel for 12–14mm I.D. bearings, and use a 1/2" cut chisel for 15–17mm I.D. bearings. When impact is applied to the chisel, the bearing is driven out. The advantage of these split-lip tools is that they never slip out. The disadvantage of this design is that if there is not adequate clearance on the back side of the bearing for the lips, the tool will not fit.

**Split-lip Extractor Procedure**

1. Compress tool-cylinder halves, then install tool (lip-end first) into outer face of bearing being removed.

2. Install chisel into tool split (from opposite side) and wedge chisel firmly into tool.

3. Place hub or freehub body on support with bearing being removed on bottom.

4. Use ballpeen hammer to tap on chisel until bearing is removed, then separate chisel from tool.
**CalVan #28 design**

The **CalVan #28** is a single tool with lipped prongs that spread apart as the tool handle is tightened. The lips are somewhat thinner than the split-lip type of tool, so the CalVan #28 may fit some bearings that the split-lip tool will not. Since it is not size specific like the other removers, it is more universal. However, the fit is not precise and the tool is much more awkward to use.

**CalVan #28 procedure**

1. Loosen tool handle so prongs contact each other.
2. Insert prongs into outer face of bearing being removed, until lips of prongs are behind bearing.
3. Hold prong-end of tool stationary while turning tool handle clockwise as tightly as possible.
4. Support wheel or freehub body in air with one hand while using slide hammer on tool to apply downward impact until bearing is extracted.
5. Loosen tool handle to remove CalVan tool from bearing.

**Bearing-installation tools**

There are several tools recently available or currently available that are in the category of “universal” cartridge-bearing installers.

There are two varieties of universal bearing installers. These are the Bicycle Research Sealed Bearing Installation Kit (#SBI-K) and the White Industries Bearing Press (#Bearing-PR). Both work on the principle that various diameters of spacers mate against the face of the bearing, with a threaded shaft that inserts through the bearings and spacers to draw the whole assembly together when tightened. The difference between the tools is primarily in the number and configuration of spacers.
The White Industries tool has spacers that match the bearing O.D.s of 24mm, 28mm, and 30mm, and some of these spacers have lips that fit in 15mm and 17mm holes. The shaft itself fits a bearing with a 12mm I.D.

The Bicycle Research tool has spacers that match the O.D.s of 24mm, 26mm, 28mm, 30mm, 32mm, and 35mm bearings. Additional spacers match bearing I.D.s of 12mm, 15mm, and 17mm. The shaft itself fits a bearing with a 10mm I.D.

Despite these differences in spacers and shaft diameters, both tools will fit most popular hub designs. The I.D. spacers on the Bicycle Research tool tend to get lost in the hub unless the entire installation process is done with the tool precisely horizontal. The White Industries tool has an edge in ease of use because its I.D. spacers cannot slip out of position.

**Using bearing installers**

There are several objectives to keep in mind while setting up a bearing installer with the parts that are being assembled. First, if the tool shaft or a pilot matches the I.D. of the bearing, this insures good alignment. Second, if the bearing is being installed into a recessed mount, the O.D. of the pilot or pressure washers on the tool must not exceed the diameter of the bearing or else the pilot or pressure washers will jam. Finally, the bearing is most protected if the pilot or pressure washers contact the outer race only. If the tool simultaneously applies pressure to the outer and inner races, it is almost as good. It is not preferred but it is acceptable, for the tool to apply pressure just to the inner races. Concerns about load on the inner race are primarily an issue when impact is the method of insertion. The steady pressure of an installation tool is not likely to damage the bearing through the application of force to the inner race.
ABOUT THE REST OF THIS CHAPTER

From here on, this chapter is divided into two sections. The first section, **GENERIC SERVICE PROCEDURE**, is suitable for servicing many of the different brands of cartridge-bearing hubs. Following this section is a section for **CHRIS KING HUBS**.
GENERIC SERVICE PROCEDURE

DESIGN VARIATIONS

There are a limited number of ways that cartridge-bearing hubs can be designed. Variations are seen in the way axle spacers attach to axles, how bearings are retained in the hub shell or freehub body, how axles engage the bearings, how the bearings are fixed in location (to the axle, driver, or hub shell), and the design of the ratchet mechanism. Familiarize yourself with the following terminology to prepare for using the generic procedure.

AXLE SPACERS

Axle spacers attach to the axle in four different ways. They either press on, thread on, are secured by set screws, or are fixed permanently to the axle.

Press-on spacer: These stay in place by means of friction. The friction may be created by a mild press fit or by an O-ring between the spacer and the axle.

Thread-on spacer: These engage the axle by means of a thread. The spacer may have wrench flats on its outside, or it may have a hex socket on one face. Some have pin holes for a pin spanner. When one of these spacers is present, there is usually a wrench fitting on the spacer on the opposite end of the axle, as well, or in the axle, itself. Sometimes there is not a wrench fitting in the opposite end, so the axle must be clamped in an axle vise to unthread the spacer.

Set-screw spacer: These are retained to the axle by means of a set screw that threads through the side of the spacer that binds against the axle. When one of these spacers is present, there is usually a small hex-socket screw (or screws) in the side of the spacer. Sometimes there is a collar covering the spacer and all that can be seen is an access hole in the collar (for identification purposes).
Fixed spacer: These most often are found on the right end of the axle. They do not have external wrench flats or set screws. They will not pull off by hand or respond to leverage. They may have a hex-key fitting in their outer face, but it may only be a way to keep the axle from turning while a thread-on spacer on the other end of the axle is being removed or installed.

**Bearing retention to shell and driver**

There are three ways that the bearings may be retained to the hub shell and the driver (freehub body).

**Press-fit retention:** These are press fit (interference fit) to the external mounting surface. Force is always required for removal and installation. The security of the interference fit is sometimes augmented with Loctite between the mating surfaces.

**Snap-ring retention:** This system relies on a snap-ring in a groove just past the bearing face to trap the bearing in the mount. It often is an augmentation to a press-fit retention system and not the sole method of retention.

**Shoulder retention:** This system relies on shoulders fixed to the external and internal mounts to trap the bearing in place. The bearing is a slip fit into the external mount. There may be grease or anti-sieze on the mounting surfaces.

**Bearing retention to axle**

There are three ways that the bearings may be retained to the axle.

**Press-fit retention:** These are press fit (interference fit) to the axle. Force is always required for removal and installation. The security of the interference fit is sometimes augmented with Loctite between the mating surfaces. The axle may have shoulders or not.
Slip fit: This system relies on axle spacers fixed to the axle outward from the bearing(s) and spacer sleeves or shoulders in the hub shell inward from the bearing. The axle should slip in or out of the bearings when the axle spacers are removed. The axle never has shoulders.

Shoulder retention: This systems relies on shoulders built into the axle (located inward of the bearings) to trap the axle in place. The bearing is a slip fit or a press fit to the axle.

**Axle types**

Axles fall into two basic categories: shouldered or smooth.

**Shouldered axle:** The axle has fixed sections inward from the bearings that are a larger diameter than the axle where it passes through the bearings. Impact is usually required for removal and one of the bearings must come out with the axle.

**Smooth axle:** The axle is the same diameter inward from the bearings as it is where it passes through the bearings. It may be possible to remove the axle without force but impact may be required. The bearings will stay in place when the axle is removed.

**Ratchet mechanisms**

There are two common ratchet mechanisms: pawl ratchets and ratchet plates.

**Pawl ratchets:** Pawls are attached to the outside of the driver (freehub body) and engage a ratchet ring fixed to the inside of the hub shell. Individual leaf springs or coil springs may push out on each pawl, or a single circular spring may enclose all the pawls, causing them to pivot outward to engage the ratchet ring. The ratchet ring is typically a permanent part of the hub.
**Ratchet plates:** Two plates engage and disengage each other by means of directional gear-teeth on their common faces. One plate engages the driver (freehub body) by means of either internal or external splines. The other plate engages the hub shell by means of an external spline. A spiral coil spring presses against one of the plates to keep the plates in contact.
GENERIC FREEHUB SERVICE PROCEDURE

The following procedure is suitable for many brands and models of freehubs with cartridge bearings. This includes Campagnolo, Hügi, Ringlé, White Industries, and numerous others. Cartridge-bearing front hubs and cartridge-bearing rear hubs that accept thread-on freewheels are in the next section.

**Preparation**

1. Remove wheel from bicycle.
2. Remove QR from hub.
3. Remove cassette (cogs).
4. **Disc brakes only:** Remove disc (to prevent contamination, accidental bending, or injury to hands from sharp disc edges).
5. Inspect axle spacers closely for wrench flats, internal hex fittings, and set screws.
6. Inspect holes in ends of axle for internal hex fittings.

**Axle-spacer removal**

**NOTE:** Axle spacers may be different on each side, and different washers may be present on each side. When removing spacers, keep track of which side they came off of and whether washers were present under spacers.

7. **Press-on spacers only:** Pull on spacer(s) to remove from axle. **NOTE:** Only if certain that spacers are press on, use thin, flat screwdriver to pry up stuck spacers!
8. **Press-on spacers only:** Inspect axle ends for O-rings, then remove any O-rings.
9. **Thread-on spacers only:** Attach wrench to spacers on both ends of axle (or spacer on one end and axle on other end), then unthread spacer(s).

10. **Set-screw spacers only:** Use hex key to loosen set screw(s) one full turn, then attempt to pull off spacer(s). If still stuck, loosen set screw(s) another turn and try again. *NOTE: Some hubs have multiple set screws with access through a single hole. Rotate axle to check for additional set screws!*

11. Carefully note any washers (or an additional spacer) located between axle spacers and bearings, then bundle washers and/or spacers with corresponding axle spacers.

12. If axle spacers came off both sides and are not identical, put a second bundle tie through the right-side set to mark it.

**Axle and freehub-body removal**

13. Inspect right end of axle for fixed spacer or shoulder that would obstruct freehub body from sliding off end of axle.
14. **No obstruction observed in step 13:** Watching carefully for loose pawls, springs, ratchet plates, spacer sleeves, and washers behind freehub body, pull freehub body out of hub shell. Separate pawls and springs, ratchet plate(s) and spring, and spacer sleeves or washers from freehub body and/or hub shell. Record quantity and location of any washers or spacer sleeves here:

   Washer(s): # location
   Spacer(s): # location

**For ratchet-plate mechanisms only:** Record location and orientation of spiral spring here (check all that apply):

   adjacent to hub shell [ ]
   adjacent to freehub body [ ]
   small-end toward plate [ ]
   large-end toward plate [ ]

15. **Obstruction is observed in step 13:** Skip freehub-body removal until after axle removal is completed.

16. Using finger pressure, try pushing axle out right end of hub, then try pushing axle out left end of hub. If axle responds to finger pressure, complete axle removal, then note which side axle came out of and which end of axle (if not symmetrical) was on right side of hub.

   Axle came out of: Right [ ] Left [ ]

   Distinguishing feature:

17. Inspect faces of bearings for snap-rings, then remove snap-rings with snap-ring pliers. Carefully note locations snap-rings were found:
18. **If axle will not respond to finger pressure:** Place hub on support (left-side down, unless fixed spacer is on right), gently tap on end of axle with plastic mallet, then note which side axle came out of and which end of axle (if not symmetrical) was on right side of hub.

   Axle came out of: Right [ ]    Left [ ]
   
   Distinguishing feature:

19. **If freehub body is still attached to hub:** Watching carefully for loose pawls, springs, ratchet plates, spacer sleeves, and washers behind freehub body, pull freehub body out of hub shell. Separate pawls and springs, ratchet plate(s) and spring, and spacer sleeves or washers from freehub body and/or hub shell.

   Record quantity and location of any washers or spacer sleeves here:
   
   Washer(s): #   location
   Spacer(s): #   location

   **For ratchet-plate mechanisms only:** Record location and orientation of spiral spring here (check all that apply):
   
   adjacent to hub shell [ ]
   adjacent to freehub body [ ]
   small-end toward plate [ ]
   large-end toward plate [ ]

20. Look for seal that may be located in right end of hub shell or on inside end of freehub body, then inspect seal and remove if damaged. Check seal location and orientation here:

   In hub shell [ ]    On freehub body [ ]
   Flatter face out [ ]    Flatter face in [ ]
**Bearing Removal from Axle or Hub Shell**

21. **If bearing came out with axle (or bearing fell out when axle was removed):** Place bearing/axle assembly in vise so bearing is resting on top of vise, axle is loose (not clamped) in vise and short end of axle is pointing up. Use plastic mallet to tap axle out of bearing.

   Bearing information:
   
   Side: Right [ ]   Left [ ]
   
   O.D.:    I.D.:    Code:
   
   Washer notes:

22. **Slip-fit bearings only:** Pull on bearing in either side of hub with fingers to check for slip-fit bearing, then remove bearing with fingers if possible (watching for flat or wavy washers behind bearings). Make notations (bearing and washer locations, bearing dimensions, and 6xxx code numbers on seals).

   Bearing information:
   
   Side: Right [ ]   Left [ ]
   
   O.D.:    I.D.:    Code:
   
   Washer notes:

23. Inspect for presence of spacer sleeve (if any) located between bearings. Remove sleeve now if either bearing has been removed.

24. **Slip-fit bearings only:** Pull on remaining bearing in hub with fingers to check for slip-fit bearing, then remove bearing with fingers if possible (watching for flat or wavy washers behind bearings). Make notations (bearing and washer locations, bearing dimensions, and 6xxx code numbers on seals).

   Bearing information:
   
   Side: Right [ ]   Left [ ]
   
   O.D.:    I.D.:    Code:
   
   Washer notes:

   **NOTE:** See bearing-remover section for bearing-remover tools and tool techniques.
25. **Press-fit bearings only:** Engage bearing extractor through outside face of bearing (either side of hub). If tool requires impact with mallet, place hub on support.

26. **Press-fit bearings only:** Remove bearing from hub and look for flat or wavy washers located behind bearing, then make notations (bearing and washer locations, bearing dimensions, and 6xxx code numbers on seals).

Bearing information:

- Side: Right [ ] Left [ ]
- O.D.:     I.D.:     Code:
- Washer notes:

27. **Press-fit bearings only:** Engage bearing extractor to remaining bearing (if any) in hub. If tool requires impact with mallet, place hub on support.

28. **Press-fit bearings only:** Remove bearing from hub and look for flat or wavy washers located behind bearing, then make notations (bearing and washer locations, bearing dimensions, and 6xxx code numbers on seals).

Bearing information:

- Side: Right [ ] Left [ ]
- O.D.:     I.D.:     Code:
- Washer notes:

**Bearing removal from freehub body**

*NOTE: Some manufacturers do not support replacing bearings in freehub body and sell complete freehub bodies only. Campagnolo and Hügi are notable in this regard.*

29. Inspect freehub body for snap-rings installed in front of any bearings, then remove snap-rings.
30. Inspect freehub body to see if outer race of bearings are visible from outer end, inner end, or both ends. Bearings will remove from whichever end(s) outer race(s) are visible.

31. Place cassette cog onto freehub body for additional support. 

**NOTE: See bearing-remover section for bearing-remover tools and tool techniques.**

32. Install bearing remover into outer face of bearing being removed. If tool requires impact with mallet, place freehub body in vise jaws (resting on end of body or cog but not clamped in vise).

33. Remove bearing from freehub body and look for a sleeve or washers located behind bearing, then make notations (bearing and washer locations, sleeve location, bearing dimensions, and 6xxx code numbers on seals).

Bearing information: Freehub-body end: Right [ ] Left [ ] O.D.: I.D.: Code: Washing/sleeve notes:

34. Install bearing remover into outer face of remaining bearing to be removed. If tool requires impact with mallet, place freehub body in vise jaws (resting on end of body or cog but not clamped in vise).

35. Remove bearing from freehub body and look for a sleeve or washers located behind bearing, then make notations (bearing and washer locations, sleeve location, bearing dimensions, and 6xxx code numbers on seals).

Bearing information: Freehub-body end: Right [ ] Left [ ] O.D.: I.D.: Code: Washing/sleeve notes:
Cleaning and Inspection

36. Check all bearings for free play, tightness, or roughness. If considering reusing any bearings (discouraged), use seal pick to remove seals. *NOTE: Keep bearings for now!*
37. Clean all parts with solvent and dry thoroughly (cleaned cartridge bearings must be dried with compressed air).
38. Inspect all threads for damage.
39. Inspect all bearing mounts for corrosion and for polishing (indicates bearings have been moving inappropriately in mount; Loctite will be needed for reinstallation).
40. If reusing any bearings, pack with grease and press seals back in.
41. Use parts bundles and notes in removal steps to organize all parts in correct sequences for left and right sides of hub and inner and outer ends of freehub body.
42. If replacing bearings, substitute new bearings in parts layout for old bearings.

Bearing Installation into Freehub Body

*NOTE: See bearing-installer section for guidelines and techniques for use of tools to press in bearings.*

43. Assemble freehub body, bearings, sleeves (if any) and washers (if any) in correct sequence (noted in steps 33–35) on shaft of installer, with appropriate pilots/washers in place. Then, gently tighten tool until all parts are fully seated. Remove freehub body from installer.

44. *Snap-ring retention only:* Identify flatter face of snap ring, then install into freehub body with flatter face out. *NOTE: Press on snap-ring to confirm it is fully seated.*
Bearing installation into hub shell

**NOTE:** See bearing-installer section for guidelines and techniques for use of tools to press in bearings.

45. **Slip-fit bearings only:** Grease all mounts, then install left-side bearings and washers (if any), spacer sleeve (if any), and right-side bearing and washers (if any) into hub shell.

46. **Smooth-axle hubs only:** Install left-side bearings and washers (if any), hub shell, and right-side bearings and washers (if any) onto bearing installer, then gently tighten installer until all parts are fully seated. Remove hub from installer.

47. **Shouldered-axle hubs only:** Install right-side bearings and washers (if any) and hub shell onto bearing installer, then gently tighten installer until all parts are fully seated. Remove hub from installer.

48. **Snap-ring retention only:** Identify flatter face of snap ring(s), then install into hub shell against outer face of bearing(s) with flatter face(s) out. **NOTE:** Press on snap-ring to confirm it is fully seated.

Ratchet-mechanism assembly

49. **Pawl system only:** Lubricate pawls and springs with oil (oil can be heavy, but grease usually interferes with pawl action), then install pawls and spring(s) to freehub body.

50. **Ratchet-plate system only:** Lubricate spiral spring and place in location and orientation noted in step 14 or 19.

51. **Ratchet-plate system only:** Lubricate all surfaces on ratchet plates with light grease or heavy oil. Assemble ratchet mechanism (plates, spacers, springs), in order noted in step 14 or 19, to back face of freehub body.
Axle and freehub-body installation

52. Install seal (if any) to hub shell or end of freehub body (as noted in step 20).

53. Smooth axle only: Grease axle and determine right/left orientation of axle (noted in step 17).

54. Smooth axle only: Install axle into freehub body (watch right/left orientation of axle), then install any spacers or washers noted in steps 14 or 19 to axle.

55. Smooth axle only: Install freehub body to hub shell. For pawl systems only, use gentle inward pressure and counterclockwise rotation to seat pawls (also try poking pawls in individually). Alternatively, compress pawls by wrapping with lightweight rubber band. Seat freehub body, then carefully remove rubber band.

56. Shouldered axle only: Place hub on support (side with bearing already installed facing down). Then, install axle (watch right/left orientation as noted in step 18) and tap axle with plastic mallet until shoulder stops axle installation.

57. Shouldered axle only: Place remaining hub bearing over end of axle, then use driver to seat axle into hub shell. Install remaining snap-ring (if any).

58. Shouldered axle only: Grease axle, then install freehub body to axle. For pawl systems only, use gentle inward pressure and counterclockwise rotation to seat pawls (also try poking pawls in individually). Alternatively, compress pawls by wrapping with lightweight rubber band. Seat freehub body, then carefully remove rubber band.
**AXLE-SPACER INSTALLATION**

59. *Thread-on axle spacers only*: Treat axle threads with oil, then thread on axle spacer(s). Use wrenches on both spacers, or on spacer on one side and on axle on other side, to secure spacers. Only in absence of manufacturer’s recommendations, torque to 60in-lbs.

60. *Set-screw axle spacers only*: Grease protruding axle, slide axle spacer(s) onto axle, then gently secure set screw(s).

61. *Press-on axle spacers only*: Install O-rings (if any) to axle or inside of spacer, grease protruding axle ends, then press on axle spacer(s).

**COMPLETION**

62. Grease freehub-body splines, then install cassette.

63. Install QR mechanism.

64. Install wheel.
GENERIC FRONT HUB AND FREEWHEEL HUB SERVICE PROCEDURE

This procedure works with most cartridge-bearing front hubs and with cartridge-bearing rear hubs that utilize a thread-on freewheel. Whichever type of hub is being serviced, there is always the potential for differences between the left and right side, so observations are just as critical here as they are when servicing a freehub.

**Preparation**

1. Remove wheel from bicycle.
2. Remove QR from hub.
3. **Rear hubs only:** Remove thread-on freewheel.
4. **Disc brakes only:** Remove disc (to prevent contamination, accidental bending, or injury to hands from sharp disc edges).
5. Inspect axle spacers closely for wrench flats, internal hex fittings, and set screws.
6. Inspect holes in ends of axle for internal hex fittings.

**Axle-spacer removal**

*NOTE:* Axle spacers may be different on each side, and different washers may be present on each side. When removing spacers, keep track of which side they came off of and whether washers were present under spacers.

7. **Press-on spacers only:** Pull on spacer(s) to remove from axle. **NOTE:** Only if certain that spacers are press on, use thin, flat screwdriver to pry up stuck spacers!
8. **Press-on spacers only:** Inspect axle ends for O-rings, then remove any O-rings.
9. **Thread-on spacers only**: Attach wrench to spacers on both ends of axle (or spacer on one end and axle on other end), then unthread spacer(s).

10. **Set-screw spacers only**: Use hex key to loosen set screw(s) one full turn, then attempt to pull off spacer(s). If still stuck, loosen set screw(s) another turn and try again. *NOTE: Some hubs have multiple set screws with access through a single hole. Rotate axle to check for additional set screws!*

11. Carefully note any washers located between axle spacers and bearings, then bundle washers with corresponding spacers.

12. If axle spacers came off both sides and are not identical, put a second bundle tie through the right-side set to mark it.

**Axle removal**

13. Using finger pressure, try pushing axle out right end of hub, then try pushing axle out left end of hub. If axle responds to finger pressure, complete axle removal, then note which side axle came out of and which end of axle (if not symmetrical) was on right side of hub.

   Axle came out of: Right [ ]   Left [ ]

   Distinguishing feature:

14. Inspect faces of bearings for snap-rings, then remove snap-rings with snap-ring pliers. Carefully note locations snap-rings were found.

15. **If axle will not respond to finger pressure**: Place hub on support (with fixed-spacer end of axle, if any, facing down). Gently tap on end of axle with plastic mallet, then note which side axle came out of and which end of axle (if not symmetrical) was on right side of hub.

   Axle came out of: Right [ ]   Left [ ]

   Distinguishing feature:
16. **If bearing came out with axle (or bearing fell out when axle was removed):** Place bearing/axle assembly in vise so bearing is resting on top of vise, axle is loose (not clamped) in vise and short end of axle is pointing up. Use plastic mallet to tap axle out of bearing.

Bearing information:
- Side: Right [ ] Left [ ]
- O.D.: I.D.: Code:
- Washer notes:

17. **Slip-fit bearings only:** Pull on bearing in either side of hub with fingers to check for slip-fit bearing, then remove bearing with fingers if possible (watching for flat or wavy washers behind bearings). Make notations (bearing and washer locations, bearing dimensions, and 6xxx code numbers on seals).

Bearing information:
- Side: Right [ ] Left [ ]
- O.D.: I.D.: Code:
- Washer notes:

18. Inspect for presence of spacer sleeve (if any) located between bearings. Remove sleeve now if either bearing has been removed.

19. **Slip-fit bearings only:** Pull on remaining bearing in hub with fingers to check for slip-fit bearing, then remove bearing with fingers if possible (watching for flat or wavy washers behind bearings). Make notations (bearing and washer locations, bearing dimensions, and 6xxx code numbers on seals).

Bearing information:
- Side: Right [ ] Left [ ]
- O.D.: I.D.: Code:
- Washer notes:

**NOTE:** See bearing-remover section for bearing-remover tools and tool techniques.
20. **Press-fit bearings only**: Engage bearing extractor through outside face of bearing (either side of hub). If tool requires impact with mallet, place hub on support.

21. **Press-fit bearings only**: Remove bearing from hub and look for flat or wavy washers located behind bearing, then make notations (bearing and washer locations, bearing dimensions, and 6xxx code numbers on seals).

Bearing information:

<table>
<thead>
<tr>
<th>Side: Right</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>O.D.:</td>
<td>I.D.:</td>
</tr>
</tbody>
</table>

Code:

Washer notes:

22. **Press-fit bearings only**: Engage bearing extractor to remaining bearing (if any) in hub. If tool requires impact with mallet, place hub on support.

23. **Press-fit bearings only**: Remove bearing from hub and look for flat or wavy washers located behind bearing, then make notations (bearing and washer locations, bearing dimensions, and 6xxx code numbers on seals).

Bearing information:

<table>
<thead>
<tr>
<th>Side: Right</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>O.D.:</td>
<td>I.D.:</td>
</tr>
</tbody>
</table>

Code:

Washer notes:

**Cleaning and Inspection**

24. Check all bearings for free play, tightness or roughness. If considering reusing any bearings (discouraged), use seal pick to remove seals.

25. Clean all parts with solvent and dry thoroughly (cleaned cartridge bearings must be dried with compressed air).

26. Inspect all threads for damage.
27. Inspect all bearing mounts for corrosion and for polishing (indicates bearings have been moving inappropriately in mount; Loctite will be needed for reinstallation).
28. If reusing any bearings, pack with grease and press seals back in.
29. Use parts bundles and notes in removal steps to organize all parts in correct sequences for left and right sides of hub and inner and outer ends of freehub body.
30. If replacing bearings, substitute new bearings in parts layout for old bearings.

**Bearing installation into hub shell**

**NOTE:** See bearing-installer section for guidelines and techniques for use of tools to press in bearings.

31. **Slip-fit bearings only:** Grease all mounts, then install left-side bearings and washers (if any), spacer sleeve (if any), and right-side bearing and washers (if any) into hub shell.

32. **Smooth-axle hubs only:** Install left-side bearings and washers (if any), hub shell, and right-side bearings and washers (if any) onto bearing installer, then gently tighten installer until all parts are fully seated. Remove hub from installer.

**NOTE:** No bearing installers are compatible with 20mm thru-axles used on some MTBs. Typically, all the parts must be stacked up on the bench top in sequence, then impact (plastic mallet) must be applied (directly or through a custom driver) until all parts are seated.

33. **Shouldered-axle hubs only:** Install right-side bearings and washers (if any) and hub shell onto bearing installer, then gently tighten installer until all parts are fully seated. Remove hub from installer.
34. **Snap-ring retention only**: Identify flatter face of snap ring(s), then install into hub shell against outer face of bearing(s), with flatter face(s) out. *NOTE: Press on snap-ring to confirm it is fully seated.*

**Axle installation**

35. **Smooth-axle hubs only**: Grease axle and install into hub (watch right/left orientation of axle, as noted in step 13).

36. **Shouldered-axle hubs only**: Place hub on support (side with bearing already installed facing down), then install axle (watch right/left orientation, as noted in step 15) and tap axle with plastic mallet until shoulder stops axle installation.

37. **Shouldered-axle hubs only**: Place remaining hub bearing over end of axle, then use driver to seat axle into hub shell. Install remaining snap-ring (if any).

**Axle-spacer installation**

38. **Thread-on axle spacers only**: Treat axle threads with oil, then thread on axle spacer(s). Use wrenches on both spacers, or on spacer on one side and on axle on other side, to secure spacers. Only in absence of manufacturer’s recommendations, torque to 60in-lbs.

39. **Set-screw axle spacers only**: Grease protruding axle, slide axle spacer(s) onto axle, then gently secure set screw(s).

40. **Press-on axle spacers only**: Install O-rings (if any) to axle or inside of spacer, grease protruding axle ends, then press on axle spacer(s).

**Completion**

41. **Rear hub only**: Grease freewheel threads, then install freewheel.

42. Install QR mechanism.

43. Install wheel.
CHRIS KING FREEHUBS

This section applies specifically to the Chris King MTB, road, and DiscGo-Tech rear hubs. Although not specifically for the BMX hub, once you are familiar with the hubs covered here, the BMX hub should not be a challenge to service.

There are two levels of service possible. The basic service includes cleaning or replacement of drive mechanisms and greasing of bearings. The full service adds to this bearing replacement and drive mechanism parts replacement. The basic service requires one inexpensive special tool, the Hub Cone Adjusting Tool #77301. The full service requires a complete Chris King Hub Service Kit (number unavailable). Additionally, a 2–1/4" section of 2–1/4" I.D. PVC pipe and ordinary shop tools are needed.
TOOL TERMINOLOGY

The following tools are all part of the Chris King Hub Service Kit.

**Cog spline wrench:** A large-diameter ring with splines on the inner perimeter. It is labeled “cog spline wrench.”

**Cone washer:** A steel washer with a conical face on one side.

**Driveshell bushing:** A long cylinder with a larger diameter at one end. It is labeled “driveshell bushing.”

**Extension shaft:** A threaded shaft with two thread diameters, ending in a knurled shaft at one end.

**Hub cone adjusting tool:** A medium-length cylinder with four steel pins in a recess in one end. It is labeled “hub cone adjusting tool.”

**Knurled ring:** A ring with several steps of various diameters on each face and with a knurled texture at the outermost perimeter. It is labeled “knurled ring.”

**Spline driver:** A short cylinder with a square hole in one face and a splined configuration in the opposite face. It is labeled “spline driver.”

**Split rings:** Two rings (large and small) split in half and held together by means of an O-ring in the groove in the outer perimeter of the ring. They are labeled “lg split ring” and “sm split ring.”

**T-handle:** A large, stepped cylinder with a threaded shaft at one end and a handle inserted through a ball at the other end. It is labeled “T-handle.”
PART TERMINOLOGY

**Adjusting cone:** A ring with four holes in its face, which resembles a dust cap that is used to adjust the bearing preload.

**Axle end:** A cap that threads onto the left end of the axle.

**Capture plate:** A simple metal washer that keeps the needle-bearing cage from moving out of the needle-bearing race.

**Capture sleeve:** A metal cylinder with one flat face that keeps the needle bearing cage from moving the other way out of the needle-bearing race.

**Drive ring:** A ring that has teeth on one face and helical splines on the inner perimeter.

**Drive side of hub shell:** The side of the hub shell with the larger-diameter hole.

**Drive spring:** A large-diameter spring that moves the drive ring.

**Driven ring:** A ring that has teeth on one face and splines on the outer perimeter.

**Driveshell:** A complexly shaped cylinder to which the cogs attach. When installed, it resembles a freehub body on a conventional freehub.

**Needle bearing:** A bearing that is a cylinder instead of a ball.

**Needle-bearing cage:** A plastic cage of cylindrical shape that holds the needle bearings.

**Needle-bearing race:** A steel bearing surface in the shape of a simple cylinder on which the needle bearings roll.

**Non-drive side of hub shell:** The side of the hub shell with the smaller-diameter hole.
Plastic seal (small and large): A thin washer-like seal made of plastic that resembles a shim washer.

RingDrive: The Chris King name for the freewheeling design that is used in these hubs instead of a conventional pawl and ratchet-ring design.

Seal ring: A ring that is threaded on the outside, splined on the inside and has a blue rubber seal installed in one face.

Spring retainer: A flat metal ring that has a slight taper to one face and a clear step-down in diameter on the other face, which supports the drive spring.
FULL HUB SERVICE

AXLE AND BEARING-SEAL REMOVAL

1. Remove cogs.
2. Insert a 5mm hex key in each end of axle, then unthread left-side axle-end/adjusting-cone assembly.
3. Pull driveshell and axle out drive side of hub with firm counterclockwise twisting motion.

**NOTE: Skip to step 7 if replacing bearings.**

4. Insert tip of razor knife in diagonal split of metal snap-ring in face of drive-side hub-shell bearing to lift one end of ring, then pull snap ring out of bearing. Repeat on non-drive side.
5. Use seal pick to lift soft, rubber seal out of face of each bearing.

   Chris King recommends use of a light spray lubricant instead of solvent when cleaning parts and bearings to avoid any possibility of damaging plastic and rubber parts with solvent.

6. Flush exposed bearings with light spray lubricant and dry with compressed air. Use light lubricant on brush to carefully clean helical splines on driveshell and inside drive end of hub shell.

   In the next step, removing the O-ring makes it easier to pull the axle out, but it is not necessary. If you remove it, take care not to lose it and to remember to replace it.

7. Remove small O-ring from non-drive end of axle, then push axle out large end of driveshell.

   **NOTE: Skip to step 35 if not replacing bearings.**
**Non-drive-side bearing removal**

In the next step, the split ring, extension shaft, and cone washer are assembled to the T-handle. If the extension shaft is threaded in too much, the split ring is expanded and will not pass through the bearing. The small split ring is not symmetrical, so observe which face of the ring is a larger diameter.

8. Place small split ring (large-diameter-face first) on small end of extension shaft, place cone washer (cone-side first) against split ring, then thread extension shaft fully into end of T-handle without expanding split ring.

9. Insert T-handle through drive side of hub.

The knurled ring is a complexly shaped tool with several steps or shoulders of various diameters on each of its faces. The purpose of the configuration is to insure, if properly oriented, that the knurled ring acts somewhat like a pilot to align the bearing and the T-handle. Another function of the knurled ring, achieved by threading it on the recommended amount, is to set the depth of the split ring so that when the split ring is expanded, it is in the correct position relative to the bearing. If the wrong end of the knurled ring is threaded on first, then the number of turns will not work to correctly position the split ring.

10. Thread knurled ring, big-end first, fully onto extension shaft, then back off exactly seven full turns.

A sure sign in the next step that the knurled ring has been threaded on the wrong amount is that the T-handle gets tight in a fraction of a turn when tightening it to expand the split ring. If this happens, loosen the T-handle and unthread the knurled ring about one turn, then try again.
11. Pull tool assembly out drive side of hub until knurled ring seats against hub. Then, hold extension shaft stationary and turn T-handle clockwise until split ring is fully expanded.

12. Turn knurled ring fully clockwise.

13. Tap on T-handle tool with plastic mallet to drive bearing out non-drive side of hub.

14. Unthread knurled ring, then remove (in order) non-drive-side bearing and small plastic seal.

15. Unthread extension shaft and remove tools from hub.

**Drive-side bearing removal**

16. Place large split ring on small end of extension shaft, place cone washer (cone-side first) against split ring, then thread extension shaft fully into end of T-handle without expanding split ring.

17. Insert T-handle into non-drive side of hub.

18. Thread knurled ring (big-end first) onto extension shaft exactly three full turns.

19. Pull tool assembly out non-drive side of hub until knurled ring seats against hub, then hold extension shaft stationary and turn T-handle clockwise until split ring is fully expanded.

20. Turn knurled ring fully clockwise.

In the next two steps, as the bearing is pressed out there are a number of other parts that will come out at the same time. The set up of the tool is designed to insure that all the parts come out together, trapped on the tool in the order they are installed in the hub shell. By following the directions closely, it is possible to then take these numerous parts off the tool in order, so as to become familiar with the sequence and orientations of the parts.
21. With drive side of hub supported on PVC pipe, tap on T-handle tool with plastic mallet to drive bearing out drive side of hub.

22. Unthread knurled ring, then remove (in order) drive-side bearing, large plastic seal, driven ring (externally splined), drive ring (internally splined), drive spring, and spring retainer.

23. Unthread extension shaft and remove tools from hub.

**Driveshell disassembly**

In the next step, the driveshell is inserted in the cog spline wrench and both are grasped in the vise. There is no need for high force when closing the vise, and the tools and parts could easily be damaged by excess force. Consider the side of the tool with writing to be the front face and the blank side to be the back face.

24. Insert driveshell into back face of cog spline wrench, then gently secure flats of wrench in vise.

25. Place spline driver on 3/8" drive wrench, then use spline driver to unthread seal ring from driveshell.

26. Remove capture plate, then needle-bearing cage from driveshell with your fingers (needle-bearing race and capture sleeve remain in driveshell).

The previous step says that the needle-bearing race and capture sleeve remain in the driveshell. In some cases, in the next step they may be loose and prone to falling out without encouragement. If this is the case, it is fine to let them come out at this time.

27. Remove cog spline wrench from vise, remove driveshell from cog spline wrench, then reinsert driveshell into front face of cog spline wrench.
28. Place small split ring (large-diameter-end first) on small end of extension shaft, place cone washer (cone-side first) against split ring, then thread extension shaft fully into end of T-handle without expanding split ring.
29. Insert T-handle through small end of driveshell.
30. Thread knurled ring (small-end first) onto extension shaft exactly 2–1/2 turns, then pull tool through driveshell until large shoulder on face of knurled ring seats inside end of driveshell.
31. Holding extension shaft stationary, turn T-handle clockwise until split ring is fully expanded, then turn knurled ring fully clockwise.
32. Grasp flats of cog spline wrench in vise, then tap on T-handle with plastic mallet to drive bearing parts out bottom of driveshell.
33. Remove cog spline wrench from vise, unthread knurled ring from extension shaft, then remove (in order) needle-bearing race, capture sleeve, bearing, and small plastic seal.
34. Unthread extension shaft and remove all tools from driveshell.

**Bearing and RingDrive lubrication**

Chris King makes special grease for use in the Chris King hubs. Although deviation from the recommended grease may not be as critical inside the ball bearings, the wrong lubricant can make the RingDrive non-functional. The recommended grease is very light and, in its absence, Chris King recommends a high-quality 10W oil, never another grease! When greasing the bearings, it is critical to use a moderate amount. Too much grease will make it impossible to seat the rubber seal and snap ring.

*NOTE: Skip to step 39 if replacing bearings.*
35. Place small bead of Chris King grease one-half to two-thirds of the way around inside of hub-shell bearings.
36. Place rubber seals over grease and carefully seat between inner and outer races.

37. Engage one end of split ring in groove between inner and outer races, then work all the way around, seating split ring into bearing. Repeat for other bearing.

38. Use finger to separate drive rings and put bead of Chris King grease in gap between drive rings. Release ring, then smear excess grease over helical splines.

**NOTE: Skip to step 56 if not replacing bearings.**

**Non-drive-side bearing installation**

All three of the bearing cartridges are non-symmetrical. Upon examining the hole in each of the three bearing cartridges, it can be seen that one end of the hole is tapered inside. When each bearing is installed, be sure to note which way this “internally-tapered end” should face. Failure to orient the bearings correctly will make it impossible to complete the hub assembly and also makes it extremely difficult to remove the bearing without damaging the plastic seal that sits behind each bearing. In all three cases, the correct bearing orientation is such that the tapered end of the hole ends up facing out from the center of the hub.

39. Holding T-handle threaded-end up, place small bearing (internally-tapered end first) onto T-handle, then place small plastic seal on top of bearing.
In the following bearing installation, as well as all the other bearing installations, the correct orientation of the knurled ring is critical in two respects. First, the knurled ring must face the correct way so that the intended surface on the hub shell or driveshell supports the high load of pressing in the bearings and so that the knurled ring serves its purpose of aligning everything. Second, the knurled ring needs to be correctly seated against the supporting surface. If these cautions are not observed, the supporting surface and the bearing counterebore can easily be damaged while pressing the bearings.

40. With T-handle tool held threaded-end up, place hub shell (non-drive-side first) over tool, then thread knurled ring (large-end first) onto T-handle.

By Chris King’s recommendation, a seemingly redundant process is used when seating each bearing. The company’s position is that this process insures proper bearing alignment. This is why the next step includes tightening the T-handle twice.

41. Tighten T-handle until bearing seats fully. Loosen T-handle, rotate knurled ring 180° either way, then secure T-handle again. Remove tools.

Drive-side bearing and RingDrive installation

42. Check that O-ring is in place inside inner perimeter of spring retainer, then install spring retainer in drive side of hub so that stepped face faces out drive side of hub.
43. Insert drive spring in drive side of hub.
44. Use Chris King grease to lubricate toothed face and helical spline of drive ring (internally splined), then insert ring so teeth face out drive side of hub.
45. Insert driven ring (externally splined) tooth-face first into hub so splines engage hub shell splines.

46. Place large plastic seal over driven ring, then insert large bearing so internally tapered end faces out of hub.

47. Insert T-handle through non-drive side of hub, then thread knurled ring (large-end first) onto T-handle and against face of bearing.

48. Tighten T-handle until bearing seats fully. Loosen T-handle, rotate knurled ring 180° either way, then secure T-handle again. Remove tools.

**Driveshell Assembly**

49. Holding T-handle threaded-end up, place onto threaded end (in order) driveshell bushing (small-end first), small bearing (internally tapered-end first), small plastic seal, and driveshell (large-end first).

50. Thread on knurled ring (large-end first) until it seats over end of driveshell.

51. Tighten T-handle until bearing seats fully. Loosen T-handle, rotate knurled ring 180° either way, then secure T-handle again. Remove tools.

If the needle-bearing race did not fall out while disassembling the driveshell assembly, the following step will be needed in full to install the capture sleeve and needle-bearing race. If they did fall out during disassembly, the two parts should simply slip into place during the next step, and it will be unnecessary to use the seal ring as an installation press for these parts.

52. Place capture sleeve (flat face facing out) and needle-bearing race into large end of driveshell. If necessary, use spline driver and seal ring to seat needle-bearing race fully, then remove seal ring.
53. Insert driveshell into back face of cog spline wrench, then gently secure cog spline wrench in vise.
54. Grease needle-bearing cage with Chris King grease, then insert needle-bearing cage and capture plate into driveshell.
55. Thread seal ring into driveshell, then secure to 100in-lbs. Remove driveshell from tools.

**Axle Assembly and Adjustment**

56. Insert axle into large end of driveshell until it seats with a “pop,” then put small O-ring back onto threaded end of axle.
57. Insert axle/driveshell assembly into drive side of hub with a clockwise rotation and a forceful push, until it seats with a “pop.”
58. Put 5mm hex key in vise, either end pointing up, then place right end of axle onto hex key.
59. Thread adjusting cone fully onto axle end, then thread assembly onto left end of axle (do not secure).

Like all other hubs that utilize quick-release retention, the axle of a Chris King hub compresses when the wheel is installed in the dropouts and the quick release is properly secured. Unlike conventional hubs, it is not possible to simulate this compressive load at the same time as making the adjustment, so it is necessary to use a trial and error process of adjustment, starting with an adjustment that is clearly too loose, then making fine adjustments until the looseness just disappears once the wheel is correctly installed in the bike.

60. Holding axle end stationary, rotate adjusting cone clockwise until contact is felt, then rotate counterclockwise 1/4 turn. Stabilize adjusting cone while gently securing axle end.
61. Place wheel in frame and correctly secure quick release, then check for knock by jerking laterally on rim. (If no knock is felt the first time this step is attempted, redo step 60 with a slightly looser starting adjustment.)

62. If knock is felt, remove wheel and put right end of axle back on hex key in vise.

63. While stabilizing adjusting cone, loosen axle end, then turn adjusting cone a few degrees clockwise and secure axle end. Repeat check in step 61 and stop if knock is eliminated.
13.1 The side load on the inner race of the right bearing cartridge causes contact to occur between the races and the ball bearings at inappropriate points (contact points indicated by arrows).
13.2 Bearing-removal tools.
13.3 White Industries bearing-installation tool.
Axle spacer (threaded here, but may be press-on)
Washer
Freehub mechanism (replace as a unit)
Seal
Ratchet plate
Ratchet plate
Cartridge bearing
Dustcap
Axle spacer (press-on)

Axle
Spacer sleeve
Springs
Cartridge bearing
Hub spline
Hub shell
Axle

13.4 Hügi freehub.
13.5 Ringlé freehub.
13.6 White Industries freehub.
13.7 Phil Wood FSA rear hub.
13.8 The Chris King hub tool set.
13.9 The Chris King cassette hub.