CHAPTER 6

WHEELS
Tires, rims and spokes, hubs, cassettes, and freewheels

I'm just sitting here watching the wheels go round and round. I really love to watch them roll.
—John Lennon

EARLY BICYCLES MAY HAVE EXISTED WITHOUT PEDALS AND STEERING SYSTEMS, BUT THEY ALWAYS HAD WHEELS. AFTER ALL, WITHOUT WHEELS, IT AIN'T A BIKE!

With the exception of molded composite versions, wheels on mountain bikes are strung together with spokes. The hub is at the center, and its bearings allow the wheel to turn freely around an axle. The rim is supported and aligned by the tension on the spokes. On most bikes, the rim serves as both support for the tire and as a braking surface.

On the rear wheel, a freewheel or cassette freewheel (rear hub with a built-in freewheel) allows the wheel to spin while coasting and engages when forward force is applied to the pedals (Fig. 6.1).

The tires provide grip and traction for propulsion and steering. The air pressure in the tire is your first line of suspension. On most mountain bikes, inner tubes keep the air inside the tires, but tubeless tires are making huge inroads into this dominance, particularly at the high-cost end.

This chapter addresses how to fix a flat, replace a tire or tube, true a wheel, fix a broken spoke or bent rim, overhaul hubs, change rear cogs, and lubricate cassettes and freewheels. Have at it.

REPLACING OR REPAIRING TIRES AND INNER TUBES

1. REMOVING A STANDARD TIRE AND TUBE

NOTE: If you have tubeless tires, skip to §vi-2.

1. Remove the wheel (see Chapter 2, §§ii-2 and §§ii-12). If the wheel is on a Cannondale "Lefty" one-legged fork, you can skip this step, because you can change the tire while the wheel is on the bike.

2. If your tire is not already flat, deflate it.

(a) To deflate a Schrader valve (the kind of valve you would find on your car's tire), push down on the valve pin with something thin enough to fit in that won't break off, such as a pen cap or a paper clip (Fig. 6.2).

(b) Presta valves are thinner and have a small...
threaded rod with a tiny nut on the end. To let air out, unscrew the little nut a few turns, and push down on the thin rod (Fig. 6.3). To seal, tighten the little nut down again (with your fingers only!): leave it tightened down for riding.

**NOTE:** If you have deep-section rims (i.e., Spinergy, Zipp, or Hed), you will probably have "valve extenders"—thin, threaded tubes that screw onto the Presta valve stems. To deflate most of them, you need to insert a thin rod (a spoke is perfect) down into the valve extender to release the air. To install valve extenders so they seal
properly and allow easy inflation, you need to unscrew the little nut on the Presta valve against the mashed threads at the top of the valve shaft (they are mashed to keep the nut from unscrewing completely off). Back the nut firmly into these mashed threads with a pair of pliers so it stays unscrewed and does not tighten back down against the valve stem from the vibration of riding, thereby preventing air from going in when you pump it into the valve. Spinergy extenders also extend the valve nut and thus do not require this additional procedure; they actually allow you to tighten and loosen the valve nut with the extender in place.

You also should wrap a turn or two of Teflon pipe thread tape around the top threads on the valve stem before screwing on the valve extender to seal it: if you do not, air will leak out when pumping, and your pressure gauge on your pump will not give an accurate reading of the pressure in the tire. Tighten the valve extender onto the valve stem with a pair of pliers.

3. If you can push the tire bead off of the rim with your thumbs without using tire levers, by all means do it, for there is less chance of damaging either the tube or the tire. It is easiest to start just one side or the other of the valve stem.

PRO TIP

Tire Removal

Removal of the tire is most easily accomplished by starting near the valve stem. That way, the beads of the deflated tire can have fallen into the dropped center of the rim on the opposite side of the wheel, making it effectively a smaller-circumference rim off of which you are pushing the tire bead. If, instead, you try to push the tire bead off of (or onto) the rim on the side opposite the valve stem, the circumference on which the bead is resting is larger, because the valve stem is forcing the beads to stay up on their seating ledges opposite the side where you are working. (Figure 6.7 illustrates a tubeless tire, but it does show the tire beads, rim ledges, and valley that I am talking about.)

4. If you can't get the tire off with your hands alone, insert a tire lever, scoop side up, between the rim sidewall and the tire until you catch the edge of the tire bead. Again, this is most easily done adjacent to the valve stem.
5. Pry down on the lever until the tire bead is pulled out over the rim (Fig. 6.4). If the lever has a hook on the other end, hook it onto the nearest spoke. Otherwise, keep holding it down.

6. Place the next lever a few inches away, and do the same thing with it (Fig. 6.4).

7. If needed, place a third lever a few inches farther on, pry it out, and continue sliding this lever around the tire, pulling the bead out as you go (Fig. 6.5). Some people slide their fingers around under the bead, but beware of cutting your fingers on sharp tire beads.

**NOTE:** There are various "quick" tire levers on the market that only require using the one lever. But if the tire is really stubborn, the tried and true three lever method outlined above may be the only way you can get the tire off.

8. Once the bead is off on one side, pull the tube out (Fig. 6.6). If you are patching or replacing the tube, you do not need to remove the other side of the tire from the rim. If you are replacing the tire, the other bead should come off easily with your fingers. If it does not, use the tire levers as outlined above.

**vi-2 REMOVING A TUBELESS TIRE**

If you have tubeless tires, do all tire removal and installation with your hands only, as tire levers can damage the sealing flap extending beyond the tire bead (Fig. 6.7), and then your tire will not seal. If you are planning on patching the tire, you must find the leak before removing it from the rim (§vi-3).

Because the "UST" tubeless system—originated by Mavic, Michelin, and Hutchinson and since adopted by Shimano and other wheel makers as well as most tire manufacturers—is the only one in wide use, this section specifically addresses that system.

1. Remove the wheel (see Chapter 2, §§ii-2 and §§ii-12). If the wheel is on a Cannondale "Lefty" one-legged fork, you need not remove the wheel.

2. If your tire is not already flat, deflate it at the valve.

   (a) Tubeless tire valves just screw into the rim with rubber seals around them. They can be either Schrader valves (the kind of valve you would find on your car's tire), Presta valves (Fig. 1.1B), or both. Mavic UST valves are both; unscrew and remove the outer, Schrader-size externally threaded tube to make it a Presta valve. To use it as a Schrader valve, screw on the
6.6 Removing the inner tube

Schrader tube after unscrewing the little nut on the end of the inner Presta valve.

(b) To deflate a Schrader valve, push down on the valve pin with something thin enough to fit in that won’t break off, such as a pen cap or a paper clip (Fig. 6.2).

(c) To let air out of a Presta valve, unscrew the little nut a few turns, and push down on the thin rod (Fig. 6.3). To seal, tighten the little nut down again (with your fingers only!). Leave it tightened down for riding.

3. Push inward on the tire beads all of the way around with your thumbs to get them to pop off of the “hump” (Fig. 6.7) and fall into the dropped center of the rim.

4. Starting adjacent to the valve stem, push the tire off of the rim with your thumbs. See the Pro Tip in §vi-1 for the reason to start at the valve stem.

6.7 Cross section of UST tubeless tire and rim

1. If the leak location is not obvious, put some air in the tube to inflate it until it is two to three times larger than its deflated size. Be careful. You can explode it if you put too much air in, especially with latex or urethane tubes.

**NOTE:** For tubeless tires, leave the tire on the rim and inflate it to 25–50 psi, then continue with steps 2 and 3.

2. Listen and/or feel for air coming out, and mark the leak(s).

3. If you cannot find the leak by listening and/or feeling, submerge the tube (or tubeless tire mounted on the rim) in water. Look for air bubbling out (Fig. 6.8), and mark the spot(s).

6.8 Checking for puncture

FINDING LEAKS

Keep in mind that you can only patch small holes. If the hole is bigger than the eraser end of a pencil, a round patch is not likely to work. A slit of up to an inch or so can be repaired with a long oval patch.
NOTE ON PATCHING TUBELESS TIRES:
The following instructions apply to patching a tube, but the procedure is the same for patching a tubeless tire, except that you patch the inside of the tire versus the outside of a tube. Also, you can always stick a tube inside a tubeless tire if you don’t want to deal with patching the tire. And as for using a tubeless tire where there are a lot of cacti or thorns, it is arduous and next to impossible to find and patch all of the holes. Rather than throw the (expensive) tire out, fill it with Slime (§vi-10).

vi-4 USING STANDARD PATCHES
1. Dry the tube thoroughly near the hole.
2. Rough up and clean the surface within about a 1-inch radius around the hole with a small piece of sandpaper (usually supplied with the patch kit). Do not touch the sanded area, and don’t rough up the tube with one of those little metal “cheese graters” that come with some patch kits. They tend to do to your tube what they do to cheese.
3. Use a patch kit designed for bicycle tires that has thin, usually orange, gummy edges surrounding the black patches. Rema and Delta are common brands.
4. Apply patch cement in a thin, smooth layer all over an area centered on the hole (Fig. 6.9). Cover an area that is bigger than the size of the patch.
5. Let the glue dry until there are no more shiny, wet spots (5–10 minutes).
6. Oftentimes, the cellophane atop the patch is scored. If you fold the patch now, then this cellophane will split at the scored cuts and be easy to remove after the patch is well stuck down. Remove the foil backing from the gummy underside of the patch (but not the cellophane top cover).
7. Stick the patch over the hole, and push it down in place, making sure that all of the gummy edges are stuck down. You are done, unless you want the cellophane cover off.
8. Although there is no need to do so, the standard procedure is to remove the cellophane top covering. Be careful not to peel off the edges of the patch (Fig. 6.10) when removing the cellophane. If the cellophane atop the patch was scored and you folded it before sticking down the patch, then the cellophane will split at the scored cuts, allowing you to peel outward and avoid pulling the newly adhered patch away from the tube.

6.9 Smoaring patch glue

6.10 Removing the cellophane backing
vi-5 USING GLUELESS PATCHES
There are a number of adhesive-backed patches on the market that do not require cement to stick them on. Most often, you simply need to clean the area around the hole with the little alcohol pad supplied with the patch. Let the alcohol dry, peel the backing off, and stick on the patch. The advantage of glueless patches is that they are very fast to use, take little room in a pack, and you never open your patch kit to discover that your glue tube is dried up. On the downside, I have not found any that stick nearly as well as the standard type. With a standard patch installed on a tube, you can inflate the tube to look for more leaks without having it in the tire. If you do that with a glueless patch, it usually lifts the patch enough to start it leaking. You must install it in the tire and on the rim before putting air in it after patching. And don’t expect the glueless patch to be a permanent fix, as you can with a glued-on Rema-style patch.

vi-6 INSTALLING A TUBE AND TIRE
Feel around the inside of the tire to see if there is anything sticking through that can puncture the tube. This is best done by sliding a rag all the way around the inside of the tire. The rag will catch on anything sharp and save your fingers from being cut by anything that is stuck in the tire.

1. Replace any tire that has worn-out areas (inside or out) where the tread-casing fibers appear to be cut or frayed.

2. Examine the rim to be certain that the rim tape is in place and that there are no spokes or anything else sticking up that can puncture the tube. Replace the rim tape if necessary. With an asymmetrically drilled rim, make sure the adhesive and/or the fit of the rim tape is very good. The rim tape only needs to slide over a little bit to expose the edge of one of the offset holes and puncture your tube.

3. By hand, push one side bead of the tire onto the rim. Ideally, you first want to check the direction of the tire rotation and orient the tire label so it is next to the valve stem for ease of finding both.

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PRO TIP

**Tire Direction**
Tire direction makes a difference for technical riding. On the front, you want the concave or v-shaped scooping edges of the tread blocks forward for braking (Fig. 2.2), whereas on the rear, you want the scooping edges oriented backward for propulsion traction. Some tires have an arrow indicating rotation direction for use either on the front or the rear. If not, hold the tire up above your head and look at the tread as the ground sees it. Consider which way the wheel is rotating and what happens during braking and driving. The best way to orient the tread will then be apparent.

4. Optional: Smear talcum powder around the inside of the tire and on the outside of the tube, so the two do not adhere to each other. Don’t inhale the stuff.

5. Put just enough air in the tube to give it shape. Close the valve, if a Presta.

6. Push the valve through the valve hole in the rim.

7. Push the tube up inside the tire all of the way around.
6.11–6.12 Installing a tire by hand

8. Starting at the side opposite the valve stem (see Pro Tip in §vi-1 for the reason why), push the tire bead onto the rim with your thumbs. Be sure that the tube doesn’t get pinched between the tire bead and the rim.

9. Work around the rim in both directions with your thumbs, pushing the tire onto the rim (Fig. 6.11). Finish from both sides at the valve (Fig. 6.12). You can usually install a mountain bike tire without tools. If you cannot, first try deflating the tube when you have gotten as far around as you can with your hands. You should now be able to push the tire on the last bit, as deflating the tube will allow the beads on the far side, opposite the valve stem, to drop into the lower center of the rim. If this does not allow you to complete the mounting by hand, use tire levers to pry the tire bead on, but make sure you don’t catch any of the tube under the edge of the bead. Finish the same way, at the valve.

10. Reseat the valve stem and draw up any nearby folds of the tube stuck under the tire bead by pushing up on the valve after you have pushed the last bit of bead onto the rim (Fig. 6.13). You may have to manipulate the tire so that all the tube is tucked under the tire bead.

11. Go around the rim and inspect for any part of the tube that might be protruding out from under the edge of the tire bead. If you have a fold of the tube under the edge of the bead, it can blow the tire off the rim either when you inflate it or while you are riding. It will sound as though a gun went off next to you and will leave you with an unpatchable tube.

12. Pump the tire up. Generally, 35–45 psi is a good amount. Much more, and the ride gets harsh. Much less, and you run the risk of a pinch flat, or “snake bite.”

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PRO TIP

**Low Tire Pressure**

If you have an anti-pinch-flat tube, like Hutchinson’s thick green tube, you can get a smoother ride, better traction on side hills, and lower rolling resistance on rough terrain by running on lower tire pressure (under 30 psi).

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**vi–7 INSTALLING A UST TUBELESS TIRE**

Again, these instructions apply to the UST tubeless system. To prevent damage to the seal, tire levers are not to be used for this procedure.
6.13 Seating the tube by pushing up on the valve

1. Examine the rim to be sure that the tire will seal to it. First of all, it must be a UST rim (and tire)—only a rim without spoke holes on the inside, and with the “hump” along the edge of each bead ledge, will seal with the tire (Fig. 6.7). Furthermore, the rim edges and the hump must not be dented or gouged, or air will escape at those spots.

2. Wet the edges of the tire (with dish soap and water or just water) to facilitate sealing it on initial inflation.

3. Determine rotation direction (see first Pro Tip under §vi-6), and locate the label at the valve stem. Starting opposite the valve, push one bead of the tire onto the rim with your thumbs and fingers only, finishing at the valve.

4. Push the other bead onto the rim by hand, again starting on the side of the rim opposite the valve stem (see first Pro Tip in §vi-1) and finishing at the valve stem. If you instead start at the valve stem, you will have to work harder, because the valve holds the tire bead up on the ledge and forces the rim to stretch around a larger circle. Consider adding tire sealant just before you push the last of the bead on to close off any slow leaks (see §vi-10 and Fig. 6.14).

6.14 Putting Slime tire sealant in a tubeless tire

5. Pump the tire up with a floor pump, initially putting air in as fast as possible until you hear the tire seat. Just as with a tubeless car tire, seating the bead is a lot more effective with an air compressor (Fig. 1.4), but it can be done with a manual pump. Sometimes, a UST tire can even be seated using a hand pump, but be aware that you have to get a lot of air into the tire in a hurry to force the beads to pop up over the humps and then onto the ledges.

6. Pump up (or deflate) to your desired riding pressure.

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**PRO TIP**

**Low Tire Pressure**

You can get a smoother ride, better traction on slick hills, and lower rolling resistance on rough terrain by running on lower tire pressure (under 30 psi). You can’t pinch-flat a tubeless tire (there is no tube to pinch!), although you can dent your rim. Begin by experimenting with tire pressures, and don’t be afraid to even try less than 20 psi with tubeless tires—you might discover that you like it!
INSTALLING A STANDARD TIRE AS A TUBELESS TIRE

With "Stan's No Tubes" tubeless systems, you can use a standard rim and tire and even make a 29-inch tire become tubeless. Stan's system includes liquid-latex-based sealant, ½ inch strapping tape, and a rubber rim strip with thick edges to seal the tire beads. The rim strips are available for three different 26-inch rim widths, as well as for 29-inch wheels. You can also forgo the rim strip and just tape over the rim holes with both strapping tape and electrical tape and use Stan's sealant (this was the original way Stan offered the system).

Do this only on wheels that you use frequently, because standard tires that you don't ride often are difficult to keep sealed with the sealant solution. If the wheel just sits, rather than being constantly stirred up by riding, the latex in the solution tends to pool up and harden at the bottom of the tire.

1. Unless you are using a UST rim (Fig. 6.7), use a drill to enlarge the inside valve hole to ¾ inch, and smooth the burred edge. This allows clearance for the rubber sealing section at the base of the valve stem. With a UST rim, skip to the second part of step 3.

2. Wrap two layers of ½-inch-wide fiberglass strapping tape around the rim, completely covering the rim holes. Cut through the tape at the valve hole.

3. Install the rim strip, stretching it evenly around the rim and pushing the edges under the rim hooks; wetting the strip with soapy water makes this easier. If you are using a UST rim (Fig. 6.7), install the valve instead of a rim strip. (If you are using Stan's old system, i.e., using Stan's sealant without the rim strip, wrap a layer of electrical tape over the strapping tape. This method works better if you first smooth the edges of the rim holes with sandpaper and clean the rim bed with rubbing alcohol before applying the strapping tape in step 2. Then install the valve, first dripping a little sealant solution around the rubber base and rubber washer.) Tighten the valve nut down by hand against the rim.

4. Determine rotation direction (see first Pro Tip under §vi-6), and locate the label at the valve stem.

5. Install one bead of the tire on the rim, covering the sidewalls and along the rim beads with a one-to-eight solution of dish soap and water.

6. Shake the sealant bottle well, and turn it upside down when pouring it to keep the particles in solution. Put 60g (1.5 scoops—or 2 to 2.5 scoops for large tires or more sealing protection) of the sealant solution into the tire. Install the other tire bead, as described in step 4 for installing UST tires. If you have Stan's 2 oz. refill bottle, you can install both beads of the tire first. You then unscrew the valve core and squirt in the sealant through the valve stem.

7. Inflate the tire to a maximum of 40 psi, preferably with an air compressor. Wear safety glasses. To check if you got the rim strip on correctly, it is a good idea to inflate the tire first with just soapy water covering it and the rim edge before adding the sealant.

8. Wherever you see soap bubbles, which indicate escaping air, tip the wheel so the latex solution flows to the area and fills the holes. Continue doing this, repeatedly reinflating the tire to 40 psi, until the tire seals completely.

When riding, the latex splashing around inside will not seal the tire beads or sidewalls if you did not seal them completely before. If you have leaks, redo step 8.
Tire sealants are blurring the lines between "standard" 26-inch mountain bike tires and UST tires.
For 2005, Geax, for instance, has a T.N.T. (Tube No Tube) tire, which is essentially a beefed up standard tire or a superlight UST tire, that comes with sealant. Run it with a tube on a standard rim, and it provides better sidewall cut resistance. Run it on a UST rim with the sealant, and you have a superlight and reliable tubeless tire.

vi-9 PATCHING TIRE CASING (SIDEWALL)
WITH A STANDARD TIRE AND TUBE
Unless it is an emergency, don't do it! If your casing is cut, it's best to get a new tire because patching the tire casing is dangerous. No matter what you use as a patch, the tube will find a way to bulge out of the patched hole, and when it does, your tire will go flat immediately. Imagine coming down a steep descent and suddenly your front tire goes completely flat—you get the picture. In emergency situations, you can put layers of nonstretchable material, such as a dollar bill, an empty energy bar wrapper (or two), even a short section of the exploded tube (double thickness is better) between the tube and tire (see Chapter 3, §iii-3b and Fig. 3.1).

vi-10 TIRE SEALANTS
Slime is green goo with chopped fibers in it; when it sloshes around in an inner tube (or inside a tubeless tire), it flows to punctures and seals them. There are other brands of tire sealants besides Slime (including Stan's No Tubes sealant mentioned in §vi-8 above); these instructions generally apply to them as well. Although they are messy (though washable with water) and add weight to your wheels, tire sealants can virtually eliminate flat tires due to simple punctures.

If installing sealant in a tube (rather than in a tubeless tire), only use it in a tube without cuts in it and with a Schrader valve (Fig. 6.2) in good condition. You can put Slime in a tube with a slow leak; simply inject it as described below, pump the tube up, and spin the wheel for about five minutes. Be warned that after about a year, the stuff dries up and doesn't work well anymore.

a. Putting tire sealant in a tubeless tire
Simply pop the tire off of one side of the rim (§vi-2), shake the bottle, and squirt 2–4 oz. or so of sealant into the tire (Fig. 6.14). You can also use one scoop—about 40 g—of Stan's No Tube sealant. Push the tire bead back onto the rim (§vi-7) and inflate. This can eliminate the aggravating air loss common with many UST tubeless tires.

b. Slime installation into a tube that's already installed in a tire
NOTE: The tube must be of proper size. If it is too small (for instance, a 26-by-1.325–1.5-inch tube inside of a 26-by-2.0-inch tire) and stretches when inflated in the tire, any holes will stretch open and won't seal.
1. Shake Slime bottle.
2. Remove Schrader valve core by using valve cap and core remover packaged with the Slime.
3. Rotate the wheel so the valve stem is at the 4 o'clock position.
4. Cut off the bottle spout, and connect the bottle spout and valve stem with the supplied surgical tubing.
5. Squeeze the bottle slowly to inject the Slime.
6. Stop squeezing after injecting 4 oz.; wait several minutes to clear the stem.
7. Remove the surgical tube.
8. Screw the valve core firmly back into the valve stem in a clockwise direction.

9. Inflate the tube.
   If the tube has a leak, spin the wheel for 5 minutes to spread the Slime around in the tube.

**NOTE:** If you have Presta valves (Figs. 1.1B and 6.3) and you want to use tire sealant, you can purchase tubes with it already installed.

c. Maintaining tire-sealant-filled tubes
When pumping in air, always have the stem at 4 o’clock and wait a minute before you connect the pump for Slime to drain away; if you don’t, Slime will leak out, eventually clogging the valve.

Sealing punctures:
1. If you find your tire flat, pump it up and ride it a bit to see if it seals.
2. If you get numerous punctures, you may need to pump repeatedly and ride the bike a bit until the tube seals up.
3. Pinch flats, caused by pinching the tube between the tire and rim, are hard to seal because the two “snake-bite” holes are on the side. Try laying the bike on the same side as the holes. Chances of sealing are not good.
4. Embedded nails and other foreign objects can be removed: spin the wheel to seal the hole.
5. Punctures on the rim side of the tube will not seal because the Slime is thrown to the outside.
6. Sidewall gashes in the tube need to be patched, but sidewall gashes in the tire cannot be patched so a new tire is required.
7. Replace the tube after a year or so. The sealant will have become too viscous to work properly anymore.

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**RIMS AND SPOKES**

**vi-11 TRUING A WHEEL**

For more information on truing wheels, see Chapter 12, §xi-4, on wheel building.

If your wheel has a wobble in it, you can fix it by adjusting the tension on the spokes. An extreme bend in the rim cannot be fixed by spoke truing alone, because the spoke tension on the two sides of the wheel will be so uneven that the wheel will rapidly fall apart.

Get a spoke wrench of the right size for your spoke nipples—they come in different sizes (as well as square or splined shapes), and you will wreck your nipples if you use a spoke wrench that is too large.

1. Check that there are no broken spokes in the wheel, or any spokes that are so loose that they flop around. If there is a broken spoke, follow the replacement procedure in the following section, vi-12. If there is a single loose spoke, check to see that the rim is not dented or cracked in that area. I recommend replacing the rim if it is.
   If the rim looks okay, mark the loose spoke with a piece of tape, and tighten it up with the spoke wrench until it seems to be at the same tension as adjacent spokes on the same side of the wheel (pluck the spoke and listen to the tone). Then follow the truing procedure below.

2. Grab the rim while the wheel is on the bike, and flex it side to side to check the hub-bearing adjustment. If the bearings are loose, the wheel will clunk side to side. The hub will need to be tightened before you true the wheel, or else the wheel will behave erratically. Follow the hub-adjustment procedure, §vi-15d, steps 28–31.