BONTRAGER

WHEELWORKS AND COMPONENTS

WHEELBUILDING, WHEEL MAINTENANCE,
AND TUBELESS-COMPATIBLE RIM INSTRUCTIONS

PART NUMBER 231793 **SERVICE MANUAL 2003**

PAIRED-SPOKE WHEEL MAINTENANCE

MAINTENANCE

WHEEL BUILDING

REPLACEMENT SPOKES

SPECIAL ISSUES

Please note: Many sections of this manual must be read in their entirety before performing procedures. In some cases, revised or updated information may be available on the Bontrager wheelworks website at www.bontrager.com.
If you cannot find the information you need to service Bontrager wheels, please contact a technical service representative.

Foreword

These instructions are to be used as a guide in the maintenance, repair, or rebuilding of a Bontrager Wheelworks wheel.

These instructions are intended to be used only by an experienced wheel builder.

Bontrager wheel technology advances the state of spoked wheels. Bontrager Wheelworks wheels are strong, lightweight, fatigue resistant, and low maintenance.

Most Bontrager Wheelworks wheels are field serviceable. However, Bontrager wheels require great care and precision in their building. While simple maintenance on a Bontrager wheel is sometimes easier than working on a conventional wheel, only a skilled and experienced wheel builder should attempt to field-build a Bontrager wheel. Bontrager Wheelworks wheels with carbon fiber composite rims require special tools and training in their maintenance so this should only be done at the factory. If a Bontrager Wheelworks carbon wheel requires rebuilding, contact Bontrager customer service to send the wheel back to the factory.

Before attempting any Bontrager wheel maintenance, you should read the appropriate sections of this manual in their entirety. Make sure you fully understand this manual and you have the required tools before proceeding.

From time to time, we have found the need to update our instructions. For the most current version of this manual, go to http//www.bontrager.com.

Tool list

These recommended tools will improve the quality of your repair or rebuild:

Part Number	
59603	Standard spoke wrench
59607	Wrench Force Bontrager spoke wrench (for 3/16" internal nipples)
78537	Wrench Force Bontrager spoke wrench for 5.5 mm hex head nipples
	Wheel truing stand
	Wheel dishing tool
70047	Tension gauge
70042	Bontrager stressor
	Smoothed jawed, bent nosed pliers or similar devise to hold a bladed spoke straight
59932	Lubricant, Wrench Force chain lube
70046	Thread locking solution for standard nipples, Loctite® 242
	Small mallet for setting spoke elbows
	Nylon rod or wood dowel for setting spoke elbows
59756	3/8" drive socket driver
70043	Dial run out indicators
222135	Stressor retrofit kit

Lateral deviations

If the rim is slightly out of true but very round, you can loosen one spoke, and tighten the other, in the pair closest to the rim deviation (Fig. 1). The rim moves laterally, but not up or down. Since no other spokes are directly affected, you're done. To move the rim down and to the side, you can tighten just one spoke (Fig. 2).

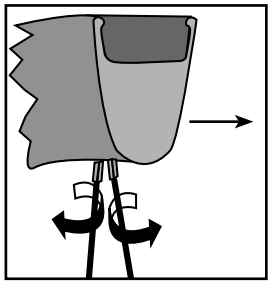

Fig. 1

Vertical deviations

If a wheel is true laterally, but out of round, its easy to fix with paired spokes. To move the rim towards the hub, equally tighten both members of a pair (Fig. 3).

Wheels built in our factory conform to a maximum vertical deviation of 0.4 mm (0.015 inches). A 23c tire with 120 PSI will exhibit more out-of-roundness than this.

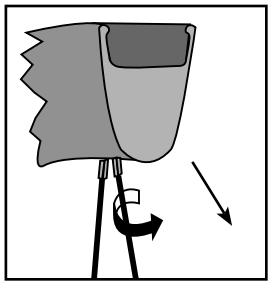

Fig. 2

Tightening nipples- stabilize bladed spokes

When tightening a nipple on a Bontrager wheel with bladed or aero spokes, stabilize the spoke to prevent rotation. Grasp each spoke with smooth jawed pliers or an adjustable wrench while rotating the nipple with the spoke wrench.

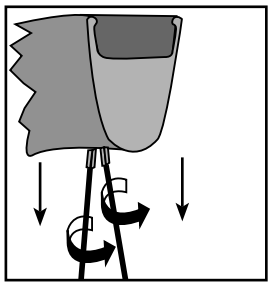

Fig. 3

A Word on Spoke Tension

One of the benefits of Bontrager paired spoke design is the ability to use increased spoke tension without deforming the rim. A loose spoke has a tendency for its nipple to continue to loosen further. As loose spokes get looser the wheel will require more frequent truing. A more highly tensioned wheel helps reduce this problem.

Spoke replacement

To repair a Bontrager wheel with a broken spoke, simply replace the spoke and bring it back to tension. Normally you will not need to re-tension any other spokes to have a true wheel.

1. Remove the broken spoke.

Remove the portion of the spoke attached to the hub (for a rear wheel, you may need to remove the cassette to do this).

For wheels with internal nipples, remove the tire and/or rim tape.

Remove the nipple from the section of broken spoke.

2. Inspect the wheel components for signs of damage.

Spokes fail for a variety of reasons, some of which may damage the rim at the same time. Look for other damaged spokes, or for signs of rim damage such as denting or bending. If a spoke nipple is deformed, replace it. Inspect the whole wheel. Do not re-use damaged parts.

3. Select the new spoke.

Determine the spoke and nipple to be used corresponding to the particular Bontrager wheel model (see Replacement Parts, pages 14-16).

4. Prepare the nipple.

Most Bontrager Wheelworks wheels use DT ProLock nipples. These nipples require no preparation before use.

For standard nipples, apply a drop of Loctite to the first 5 mm of the spoke threads.

For internal nipples, lubricate the spoke threads and the bottom of the nipple that contacts the rim with Wrench Force synthetic oil. Place the Bontrager nipple into the Wrench Force Bontrager spoke wrench with the NyLock ring first, such that the nylon insert is outermost on the wheel after installation (Fig. 4).

Fig. 4

5. Install the new spoke.

Feed the spoke through the hub. Insert the spoke from the correct side of the hub (follow the existing pattern). For bladed spokes, note that the spoke holes are slotted to allow the blade to be inserted easily.

Follow the correct lacing pattern, with the right number of crosses and over/under neighboring spokes as necessary. Be careful not to mar the rim with the threaded portion of the spoke.

Carefully start the nipple (see Installing Nipples on page 5 for a tip to ease nipple installation in deep aero rims) onto the end of the spoke 3 to 4 turns. Use a blade holder to prevent a bladed spoke from twisting during nipple installation and tensioning.

Note: For wheels with the Bontrager self locking nipples, if the spoke threads do not protrude at least 1 mm from the NyLock ring in the nipple, Loctite® 242 should be applied to the threads to ensure proper retention of the nipple.

6. Tension the new spoke

Place the wheel into the truing stand

Increase the tension on the new spoke until the wheel is reasonably true.

7. Correct the spoke line.

If needed, straighten the spoke as shown on page 8 to relieve elastic bending stress at the spoke elbow.

8. Confirm all tensions are within final specification range.

Follow the instruction for using the Bontrager/Hozan tension gauge. Check all spokes and compare to the Final Tension chart on page 9.

If the wheel spoke tension is out of spec, tension the wheel by following the instructions in Wheel Building: Tensioning and Truing on pages 8-9.

9. Adjust if necessary.

Adjust hop (radial rim deflection) and wobble (lateral rim deflection) to make the wheel round and true.

10. Perform final check

For bladed spokes, adjust all spoke blades to be parallel with the plane of the rim.

Verify that all spoke tensions are within the final acceptable range (see Wheel Building: Tensioning and Truing for information on spoke tension)

Reference Terms

When we refer to the left or right side of a wheel, this reference is to the wheel as it would be viewed in the bike, by the rider on the bike.

Pulling spokes are those that are under higher tension when driving force is applied to the pedals; they are angled rearward from the top of the hub.

Description of Bontrager wheel lacing patterns

When lacing Bontrager wheels with 3 or 4 cross lacing patterns, follow standard wheel lacing practices, and always follow previously established spoking patterns.

Bontrager road front wheels use a radial spoking pattern. Depending on the year, the spoke heads may face either inward or outward in the hub shell. Insert spokes from the same side of the hub shell as previously laced to achieve that lacing pattern. Changing spoke lacing on a used hub shell may cause the shell to crack.

Most of the rear Bontrager road wheels use a two cross pattern with 'normal' alternating spoke head orientation. Pulling spokes on most Bontrager rear wheels are heads-out. The Bontrager X Lite Carbon rear wheel is built 1-cross, with all spokes heads-in.

Unlike conventional wheels, the drive side spokes on Bontrager wheels are not always the shortest. Some Bontrager rear wheels use the same length spoke on both sides of the wheel, and sometimes with different spoke gauges. Refer to the spoke chart in Replacement Parts to get the right length spokes.

Installing nipples

Most Bontrager Wheelworks wheels use standard type nipples with DT's ProLock thread locking compound applied to the nipple threads. If using parts other than those originally found on a wheel, we recommend the use of Loctite® 242, a thread locking compound. Before threading a standard nipple onto its spoke, apply a drop of Loctite® to the first 4-5 mm of spoke threads. Other Bontrager Wheelworks wheels use internal nipples with NyLock inserts. With internal nipples, lubricate the spoke threads and the bottom of the nipple that contacts the rim with Wrench Force synthetic oil. Place the Bontrager nipple into the Wrench Force Bontrager spoke wrench with the NyLock ring first, such that the nylon insert is outermost on the wheel after installation.

If the rim has offset spoke holes, identify the right and left spoke holes. These holes are angled so that the spoke takes a straighter line to the rim. Never place a left spoke in a right hole, or vise versa as the bending force at the rim could cause fatigue and seriously weaken the spoke or nipple.

With deep cross section rims, it can be difficult to install nipples. Here's a trick. Make a nipple driver out of an old 14 gauge spoke. Cut the spoke to a length of about 100 mm (4 inches). With a pair of pliers, put two 'L' bends in the spoke (Fig. 5). With a pair of wire cutters, slightly crimp (do not cut!) the spoke threads about 3 or 4 threads from the spoke end. When installing nipples onto the driver, thread them on backwards, so that the wrench flats on the nipple face away from the tool. Gently thread the nipple onto the nipple driver until you meet resistance at the crimped threads. Then use the nipple driver to reach through the rim and engage the new spoke you are lacing up. The 'L' bends let you quickly rotate the nipple several turns.

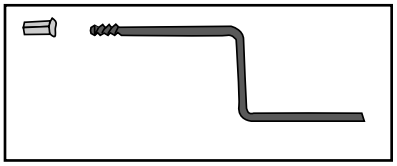

Fig. 5

Tightening nipples with bladed spokes

Bladed spokes are not as stiff in torsion as a round spoke of the same material and cross-sectional area. When tightening nipples on bladed spokes, stabilize the spoke to prevent rotation. Without this stabilization, the resultant spoke windup can damage the spoke.

Used parts

We use DT spokes and Pro-Lock nipples on many models. If excessive remnants of the thread locking material are left on the spoke or in the nipple, it can make it difficult to engage the threads.

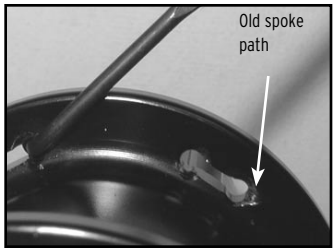

Fig. 6

Care should be taken to use the exact same spoke orientation as previously used on a hub. Spokes should pull in the same direction, with the same heads-in or heads-out positions as in the wheel previously. Look for the slight deformation caused by the original spoke (Fig. 6) and use that spoke orientation. Otherwise, the hub flange may prematurely exhibit fatigue cracks.

If in doubt, it's always best to use new parts. The time you spend building is an expensive component of the wheel build. Furthermore, your customer's satisfaction and safety should always be of prime concern.

Bontrager carbon composite wheels

Bontrager Wheelworks wheels with carbon fiber composite rims require special tools and training in their maintenance so this should only be done at the factory. If a Bontrager carbon wheel requires rebuilding, contact customer service to send the wheel back to the factory.

Determining left and right 'sides' of the hub and rim

The orientation of the hub is determined by looking at the hub logo, which will be in the correct position to be read by the rider on the bike (not upside-down). The rim has a decal listing its ETRTO and spoke lengths; this decal should read correctly from the right side of the bike.

Fig. 7

Wheel Building: Lacing Race X Lite road wheels

Lacing front wheels (radial wheels)

When looking at a front wheel from the right side with the valve hole at the top of the wheel, the first spoke hole to the right of the valve hole accepts a spoke from the right side hub flange (Fig. 8).

After lacing, go to the section Wheel Building: Tensioning and Truing on pages 8-9.

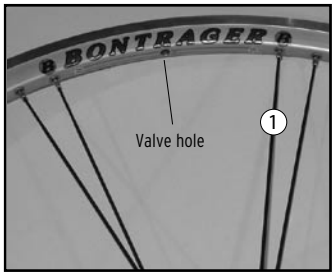

Fig. 8

Lacing rear 2 cross wheels

Place the rim on a flat surface with the right side of the rim facing up and the valve hole at the 12 o'clock position; at the far side of the rim (Fig. 9).

For Race X Lite rear wheels, identify the right side spokes. The right side spokes in the rear wheel are of a heavier gauge than the left side, so the right side spokes have a flatter shape (Fig. 10).

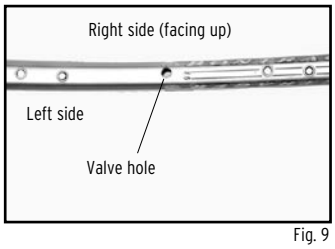

Fig. 9

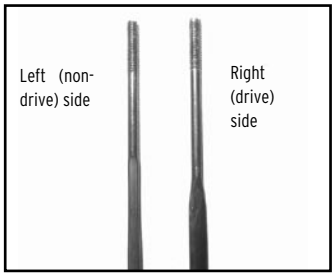

Fig. 10

Spoke #1

With the right side hub flange facing up, pick the spoke hole for the first right side pulling spoke. Insert the spoke from the right side of the hub (Fig. 11). The spoke head should face out, and be in the hole found more counter-clockwise of a joined pair of spoke holes.

At the rim place the spoke in the first right side spoke hole to the right (in a clockwise direction) of the valve hole (Fig. 12). Carefully thread a nipple onto the spoke 3-4 turns.

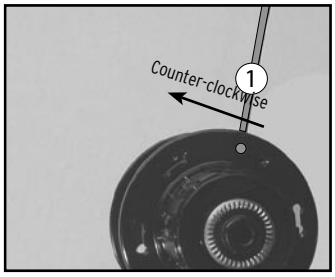

Fig. 11

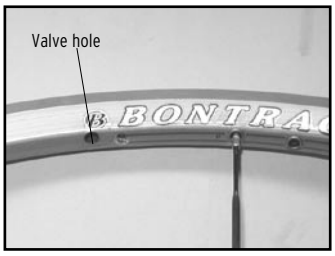

Fig. 12

Spoke #2

From the head of the first spoke, count counter-clockwise on the hub to the fifth spoke hole, or spoke "location". From the left of the hub, insert this non-pulling spoke through the right flange. There should be 4 spoke "locations" between the two spokes in the hub (Fig. 13).

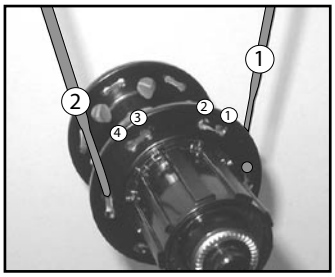

Fig. 13

Pass spoke #2 through the first right side spoke hole to the left of the rim's valve hole (Fig. 14) and attach a nipple.


Fig. 14

On the right side of the hub there should be four spoke holes between the two spokes (Fig. 13). The spoke on the right should be head out, and the spoke on the left should be head in.

At the rim between the two spokes, there should be one spoke hole and the valve hole.

Spoke #3

Insert the #3 spoke from the right side of the hub. It goes through the right flange two spoke holes counter-clockwise from spoke #1, so there should be one empty spoke hole between spoke #1 and #3 (Fig. 15).

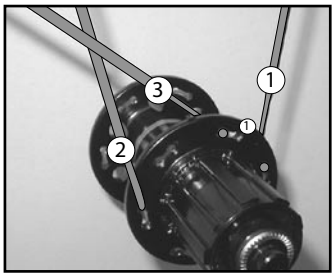

Fig. 15

Spoke #3 goes over spoke #2. After inserting the spoke, bow it slightly to the side with your fingers so that you can pull it under the rim and place it over the top of spoke #2. Be careful not to scratch the rim as you pull the spoke through.


Fig. 16

Attach this spoke to the rim four spoke holes counter-clockwise of spoke #1.

At the rim there should be one spoke hole between spokes #2 and #3. This establishes the pattern for the right side of the wheel, including the crosses.

Continue right side drive (pulling) spokes

Follow the established pattern to install the remaining right side pulling spokes (Fig. 17).

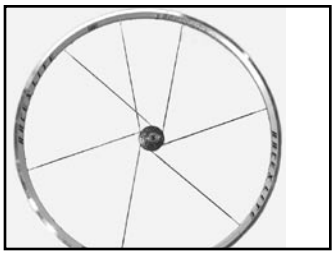

Fig. 17

Right side pulling spokes should have their heads out, in every second spoke location of the right hub flange. They should be in every fourth hole at the rim.

The first left side spoke

Identify the left side spokes. They have a slightly narrower blade shape than the right side spokes (Fig. 10).

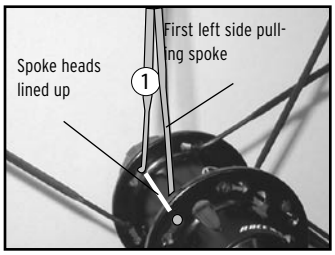

Fig. 18

Sight across the hub from spoke #1 and find the pair of spoke holes which most closely line up with spoke #1 (Fig. 18). Insert a left side spoke from the left side of the hub. At the rim, pass this spoke through the spoke hole in the adjacent pair with spoke #1 (Fig. 19, with left side of the wheel facing up).

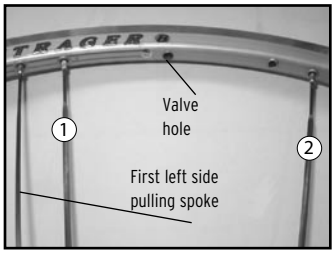

Fig. 19

The next left side pulling spokes

With the left side of the wheel facing up, insert the remaining left-side pulling spokes. To move them around the right side spokes already in place, gently bow the spokes. Be careful not to scratch or mar the rim with the threaded portion of any spoke.

Note: Inserting pulling spokes, which have all their heads on the outside of the hub flanges, is easier prior to installing any crossed spokes. The non-pulling spokes are inserted with their heads on the inside of the hub flange, and therefore will not have to be bowed as much; they don't have to be maneuvered through spokes on the opposing flange.

Connect the pulling spokes in the holes paired with the right side pulling spokes.

Complete the right side of the wheel

Insert the remaining right side spokes from the left side of the hub, so they will be heads-in on the right flange. Follow the spoke pattern already established for non-pulling right side spokes. Gently bow the non-pulling spokes as they are laced with their crossing pulling spokes. As before, thread each spoke nipple onto its spoke by 3 to 4 turns.

Complete the left side of the wheel

Insert the remaining left side spokes from the right side of the hub, so they will be heads-in on the left flange. To establish the correct spoke pattern, either compare to the right side of the wheel, or simply count two crosses and feed into the spoke hole in the rim. Gently bow the non-pulling spokes as they are laced with their crossing pulling spokes. Thread each spoke nipple onto its spoke by 3 to 4 turns.

When the wheel is completely laced, do a quick check. Each spoke should be crossed under or over one spoke. At the rim, the spokes should alternate the flange they originate from, left-right-left, etc.. Also, there should be spokes essentially "framing" the valve hole (Fig. 20) with the only cross between the valve hole and the hub occurring very close to the hub.

If everything checks out, go to Wheel Building: Tensioning and Truing.

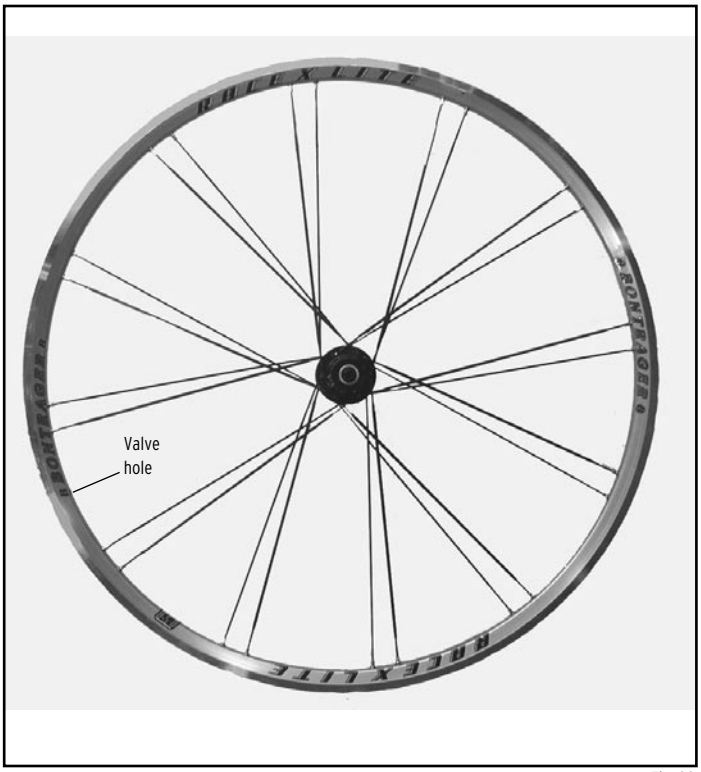

Fig. 20

Wheel Building: Tensioning and Truing

Initial tensioning

Place the wheel in a truing stand. Starting at the valve hole in the rim, begin tightening each nipple onto its spoke. Initially, run the nipple down until it covers all the threads. After this has been completed for the entire wheel, begin again at the rim valve hole (as a landmark) and consecutively tighten each nipple about one half turn.

Continue working around the wheel until the tension is about one half the final tension value for the wheel in progress. Follow the instructions for calibrating and using the Bontrager/Hozan spoke tensiometer on pages 10 and 11. For rear wheels, the tension specs apply to the right side spokes. For disc front wheels, the specs are for the left (disc) side of the wheel. Tension the opposite side just enough to obtain correct wheel dish.

Correct the spoke line

As a wheel rotates with the rider on the bike, the stress on each spoke changes. If a spoke does not take a straight line from the hub to the rim, the spoke will work as a spring. As the stress on the spoke increases or decreases, it will exhibit more or less of a curve. This flexing is one of the primary sources of fatigue failure in spokes. To eliminate this flex, the spoke must take a straight line from the hub to the rim. Examine the spokes in your wheel. If they are not straight, fix this now by following these instructions.

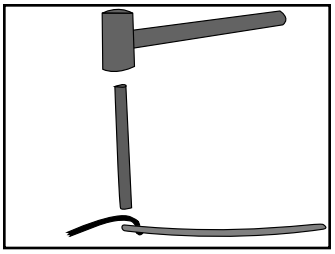

Fig. 21

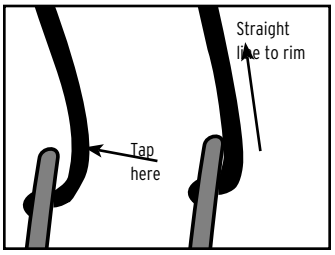

Fig. 22

Support the wheel on a flat surface with the right side facing up. Place the nylon punch on the first spoke about where the spoke leaves the hub flange (Fig. 22). Firmly tap the punch with a small mallet to make the spoke nearly conform to the shape of the hub flange (Fig. 21). Repeat this for all spokes. This operation normally reduces spoke tension.

Second tensioning and Truing

Gradually continue increasing the tension of the spokes. As you do so, also work on the hop, wobble, and dish of the wheel. Check the wheel dish using a wheel dishing tool. Hop and wobble (vertical and lateral rim deviations) should be brought to within +/- 0.5 mm.

As you tighten each nipple to correct spoke tension, remove wind-up of the spoke by backing the spoke wrench off about one quarter turn. This eliminates the wind-up caused by friction between the nipple and spoke, so removing the pinging or creaking sound some wheels emit upon first riding.

Repeat until tension, hop, wobble, and dish are all in tolerance.

Form the spoke holes in the hub

One cause of loss of spoke tension is the deformation of the hub flange by the spoke elbow. This deformation requires considerable force. The resulting deformation allows the spoke to lose tension.

The Bontrager Stressor box performs the spoke hole deformation in a controlled way so that no further deformation, or spoke tension loss, occurs. Follow the instructions for using the stressor box on pages 12 and 13.

Third truing

After forming the spoke holes in the hub, true the wheel again. Check the wheel for hop, wobble, and dish. Correct any dish, hop, and wobble (vertical and lateral rim deviations) to +/- 0.5 mm.

Stress Relieve the spokes

Use the Bontrager Stressor and again stress both sides of the wheel, as in the directions on pages 12 and 13.

Fourth (final) truing

After stressing the spokes, again check the wheel for hop, wobble, and dish. Correct any hop and wobble (vertical and lateral rim deviations) to +/- 0.4 mm.

For bladed spokes, adjust the spokes so the blades are parallel with the plane of the rim. Use the spoke wrench and pliers or other tool together to prevent nipple rotation.

Verify that all spoke tensions are within the acceptable range of the Final Tension chart. Also make sure the spoke tension is as even as possible for each side of the wheel.

Spoke Tension Chart

Spoke	Wheel	Front Load Spoke Deflection (disc side on disc wheels) gauge units	lbs.		Rear Load Spoke Deflection (drive side) gauge units	lbs.
14G New Aero blade (2.0/3.2 x 1.1/2.0)	Race X Lite Aero Carbon	N/A	N/A		120-140	270-400
	Race X Lite Aero	95-120	200-300		120-140	270-400
	Race X Lite	N/A	N/A		100-130	220-330
	Race Lite Tandem	100-130	220-350		100-130	220-330
	Race Lite	105-129	170-280		110-140	190-350
14/17G Revolution blade (2.0/2.5 x 1.0/2.0)	Race X Lite Aero Carbon	65-95	200-300		N/A	N/A
	Race X Lite	65-95	200-300		N/A	N/A
14/17G Revolution (2.0/1.5/2.0)	Race X Lite ATB	110-150	110-290		N/A	N/A
	2002 Race Lite Tubeless ATB	80-110	160-250		85-120	170-300
14/16G Special Revolution ing (2.0/1.6/2.0)	Race X Lite ATB	N/A	N/A		Not available at print-	
14/15G Competition (2.0/1.8/2.0)	Race Lite 29" ATB	110-150	110-290		110-150	110-290
	Race Lite 29" Disc Compatible	110-150	110-290		110-150	110-290
	Race Lite 29" ATB	110-150	110-290		110-150	110-290
	2003 Race Lite Tubeless	110-150	110-290		110-150	110-290
	Race Lite Tubeless Disc Specific	110-150	110-290		110-150	110-290
	Race Tubeless	110-150	110-290		110-150	110-290
	Race Tubeless Disc Specific	110-150	110-290		110-150	110-290
	Race 29" Disc Compatible	110-150	110-290		110-150	110-290
	Select Disc Compatible	110-150	110-290		110-150	110-290
	Select ATB	110-150	110-290		110-150	110-290
	Select Hybrid	110-150	110-290		110-150	110-290
	Select road	110-150	110-290		110-150	110-290
14G Champion (2.0)	Superstock 29" Disc Compatible	120-160	120-290		130-170	150-350
	Superstock Disc Compatible	120-160	120-290		130-170	150-350
	Superstock	120-160	120-290		130-170	150-350

Stressor Rebuild Instructions

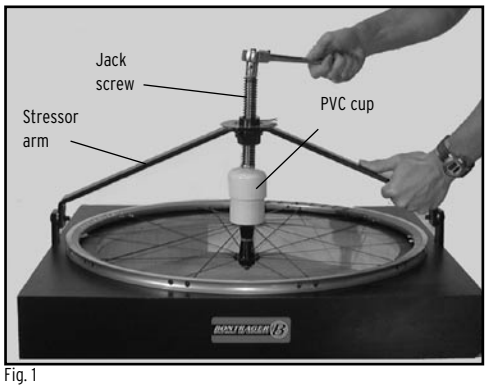

Fig. 1

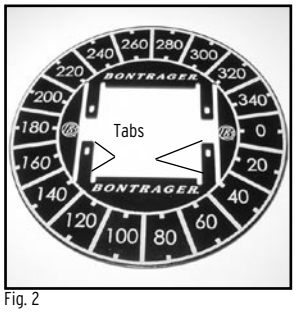

Fig. 2

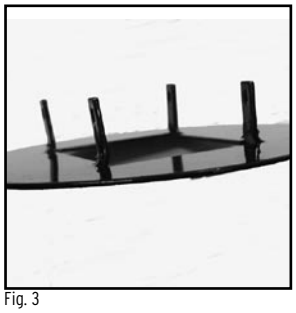
Fig. 3

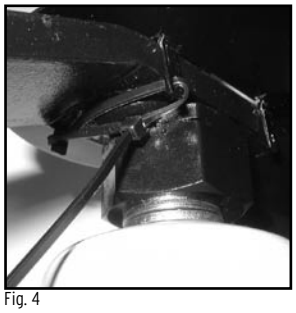
Fig. 4


Fig. 5

Stressor retrofit kit
Part #222135
Parts List

Dial (Fig. 2)
Indicator (Fig. 5)
Zip ties (2)
Manual

Introduction

This instruction sheet explain the procedure for updating the earlier version of the Bontrager stressor box. This revision adds accuracy to the stressing, while simplifying both performing the procedure and reading the charts.

After performing the update procedures, it's important to only use the revised stressing charts provided in the manual.

Update the stressor

1. Use a pliers to gently bend down the tabs of the dial (Fig. 2) to ninety degrees (Fig. 3).

2. Place the dial over the jack screw of the stressor, numbered side facing up.

3. Align the "0" on the dial with one of the stressor braces.

4. Thread the zip ties through the holes in each pair of tabs (Fig. 4) to firmly attache the dial to the stressor arms.

5. Slide the indicator (Fig. 5) over the jackscrew. It is a press fit, so requires careful alignment and a bit of a push. Slide it most of the way down the jack screw. You do not need to align the indicator at this time.

The completed assembly should look like Figure 6.

Stressing a wheel

The revised stressor does not use a torque wrench. Instead, the amount of stress is determined by the degrees of rotation of the jack screw (Fig. 1). With the new configuration, rotating the jack screw with a 3/8" breaker bar or socket driver works best.

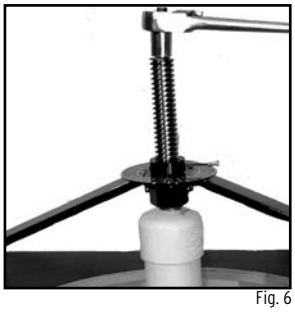
Fig. 6

1. Turn the jack screw to raise the PVC cup up as high as required to insert the wheel.

2. Place the wheel under the cup. Center the wheel over the hole, on the base of the stressor box.

3. Turn the jack screw by hand until the cup rests firmly against the hub. Make sure the flange is centered under the cup.

Fig. 7

4. Set the indicator at "0" (Fig. 7).

5. Rotate the jack screw to move the indicator to the recommended position (Fig. 8) for the wheel you are stressing (see the chart).

Fig. 8

Stress the other side

Some wheels require different degrees of rotation on one side than the other. Before stressing the second side, revisit the chart to determine the correct value for the wheel you are going to stress.

1. Loosen the threaded rod until the PVC cup clears the hub.

2. Repeat the stressing procedure on the opposite side of the wheel.

Calibration and Use of Bontrager/Hozan spoke tension gauge

Bontrager custom tension gauges

We have worked with Hozan to make a special gauge that is more accurate at the higher spoke tensions used on Bontrager Wheelworks wheels. Each Hozan gauge comes with a specific calibration bar for that gauge, with matching ID numbers on the gauge and bar. To obtain an accurate measurement, only a Bontrager/Hozan tool calibrated with its specific calibration bar will work. Standard Hozan gauges are not appropriate for making these measurements.

Calibration of the gauge should be done once a week. If the gauge is used frequently, or has been dropped or damaged in some way, it may be necessary to re-calibrate it more frequently.

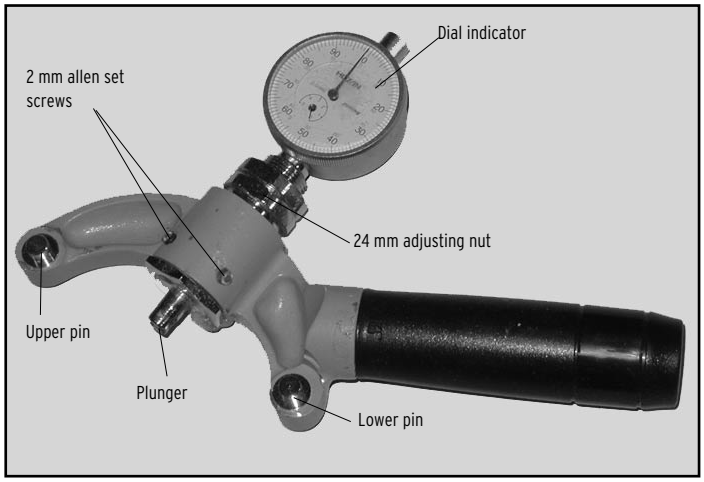

Fig. 24

Follow these instructions whenever spoke tension on a Bontrager wheel needs to be evaluated. It is important to note that incorrect usage of the gauge, even in experienced hands, can result in a wide fluctuation of readings. To successfully measure correct spoke tension, it is very important that the gauge be correctly calibrated, then used in an appropriate manner.

Required tools

Special Bontrager/Hozan (formerly Rolf/Hozan) spoke tension gauge

Calibration bar

2 mm allen wrench

24 mm end wrench

Calibrate the Gauge

1. Verify the dial indicator (Fig. 24) reads 0.00 at rest. If not, rotate the dial faceplate until gauge reads correctly. Make this adjustment before every reading to ensure correct measurement.

2. Hook the calibration bar (Fig. 25) over the upper pin and make sure the pin is at the top center of the calibration bar hole.

3. Rotate the calibration bar toward the lower pin until it contacts the lower pin.

4. Record the value shown on the indicator dial.

5. Repeat this procedure four more times, recording the value each time.

With a properly calibrated gauge the average of the five readings should be within +/- 0.03 mm of the number engraved on the calibration bar. If your results do not meet these specifications, the gauge requires adjustment as covered in the next section.

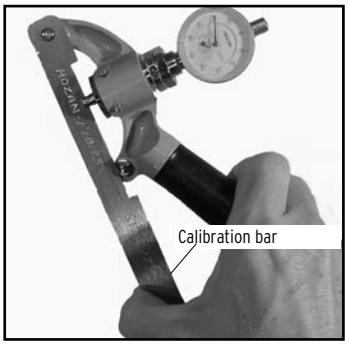

Fig. 25

Adjust the Gauge

1. Loosen the two 2 mm allen set screws.

2. Turn the 24 mm adjusting nut on the gauge handle to adjust the reading.

Note: Do NOT loosen or remove the indicator from the gauge body.

3. Tighten the two 2 mm allen set screws.

4. Repeat the procedure Calibrate the Gauge.

Measuring Spoke Tension

1. Establish a point on the spoke for the type of spoke being measured.

2. With the handle of a calibrated Bontrager/Hozan gauge pointing toward the rim, place the gauge upper pin on this point (Fig. 26) and push the gauge toward the spoke until the lower pin just touches the spoke. Do not press the lower pin into the spoke, as this will alter the gauge reading.

Gauge pin contact points by spoke type

DT Revolution	Both pins on 17 g section
Bladed spokes	Both pins on blade section
All others	Lower pin 10 mm from edge of rim

3. Note the value on the dial indicator.

4. Release the gauge. Reposition the gauge by rotating it slightly around the spoke.

5. Repeat steps 1 through 4 until you have found the lowest possible gauge reading for that spoke.

6. Compare the gauge reading to the spoke tension specifications. If the tension is out of specification, re-tension the spoke or wheel accordingly.

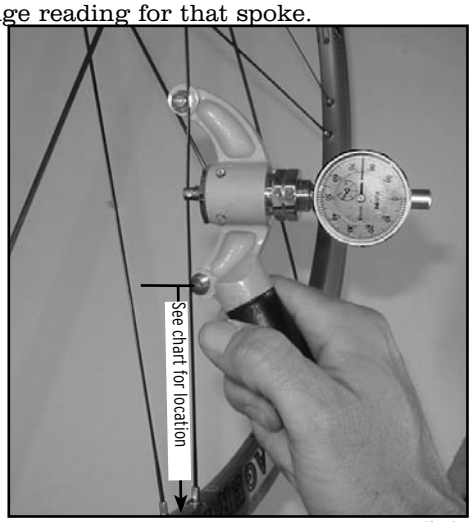

Fig. 26

Wheel Building: Stressing

Note: Before stressing a wheel, always make sure it is at the correct tension (see Tension and Truing section).

The amount of stress is determined by the degrees of rotation of the jack screw (Fig. 27). With the new configuration, rotating the jack screw with a 3/8" breaker bar or socket driver works best.

1. Turn the jack screw to raise the PVC cup up as high as required to insert the wheel.

2. Place the wheel under the cup. Center the wheel over the hole, on the base of the stressor box.

3. Turn the jack screw by hand until the cup rests firmly against the hub. Make sure the flange is centered under the cup.

4. Set the indicator to "0".

5. Rotate the jack screw through the number of degrees recommended for the wheel you are stressing (see the chart, page 13).

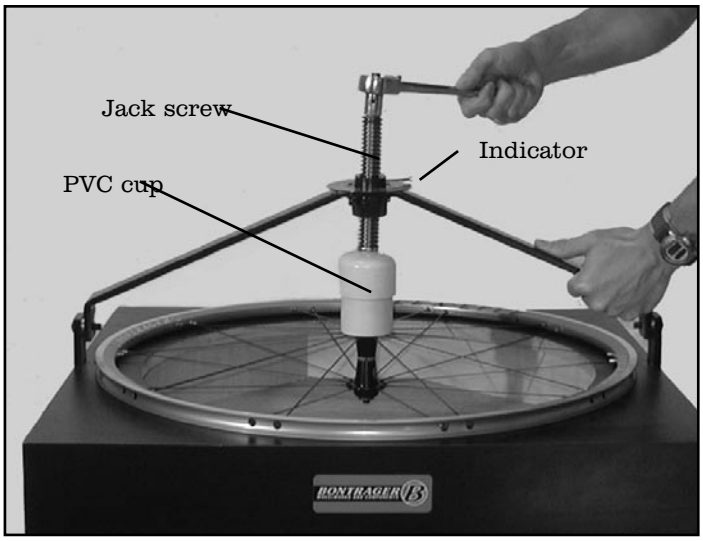

Fig. 27

Stress the other side

Some wheels require different degrees of rotation on one side than the other. Before stressing the second side, check the chart to determine the correct value for the wheel you are going to stress.

1. Loosen the threaded rod until the PVC cup clears the hub.

2. Repeat the stressing procedure on the opposite side of the wheel.

Wheelset			Degrees of Rotation			
			Front		Rear	
Brand	Nominal size	Model	Right up	Left up	Right up	Left up
Rolf	700c	Vector Pro	413	413	565	140
		Sestriere	371	371	730	139
		Vector Comp	457	457	645	204
		Vector	494	494	737	260
		Vector Hybrid	494	494	696	255
	650c	Vector Pro	374	374	507	132
		Vector Comp	423	423	592	184
		Vector	439	439	666	223
	26"	Propel, Propel Tubeless				
		Dolomite, Dolomite Tubeless	434	434	571	312
		Dolomite Disc	532	499	573	308
		Urraco	434	434	571	312
		Urraco Disc	354	545	573	308
		Satellite	402	402	528	289
Bontrager	26"	Race Lite ATB Tubeless (OSB rear)	450	450	657	278
		Race Lite ATB Tubeless (symmetric rear)	313	313	630	142
		Race Lite ATB (ASYM rear)	313	313	600	166
		Race ATB	457	457	685	215
		Race ATB Tubeless	459	459	694	239
		Race Modified Tubeless	450	450	657	278
		Superstock	426	426	612	231
		Select ATB	459	459	674	280
	26" Disc	Race Lite ATB Tubeless Disc	280	592	626	314
		Race ATB Disc	209	605	625	319
		Race ATB Tubeless Disc	313	619	625	314
		Race Modified Disc	276	591	622	314
		Superstock disc compatible	146	383	579	289
		Select ATB disc compatible	346	590	630	312
	29"	Race Lite ATB 29"	482	482	722	313
		Race ATB 29"	519	519	725	317
	29" Disc	Race Lite ATB 29" disc compatible	325	650	736	541
		Race ATB 29" disc compatible	384	704	698	368
	700c	Race X Lite Road Aero Carbon Tubular	367	367	515	153
		Race X Lite Road Aero	344	344	527	155
		Race X Lite Road	414	414	704	466
		Race Lite Road	461	461	643	381
		Race Lite Road Tandem	444	444	560	458
		Race Select Road	488	488	709	361
		Race Select Road Hybrid	488	488	638	436
	650c	Race X Lite Road Aero Carbon Tubular	329	329	466	135
		Race X Lite Road	389	389	643	429
		Race Lite Road	430	430	584	333
		Race Select Road	440	440	636	318

Replacement spokes

Model	size		spoke length		spoke type	nipple
			right	left side		
2001						
Bontrager Superstock	26"	F	254		DT 14g (2.0)	brass, 14g (2.0)
		R	267	251		
Bontrager Superstock Disc	26"	F	267	267	DT 14g (2.0)	brass, 14g (2.0)
		R	267	267		
Bontrager Race	26"	F	255		DT Competition 14/15 (2.0/1.8)	alloy, 14g (2.0)
		R	267	251		
Bontrager Race Disc	26"	F	266	264	DT Competition 14/15 (2.0/1.8)	alloy, 14g (2.0)
		R	264	265		
Bontrager Race Lite, tubeless compatible						
	26"	F	250		DT Revolution 14/17g	alloy, 14g (2.0)
		R	267	251		

For equivalents, 14g = 2.0 mm, 15g = 1.8 mm, and 17g = 1.5 mm.

2002

Wheel size	Model		Length right	Length left	Type	Nipple
26"	Race Lite Tubeless	F	251		14/17G Revolution	Pro-Lock, alloy
		R	266	269		
	Race Modified Tubeless	F	253		14/15G Competition	Pro-Lock, alloy
		R	268	265		
	Race Modified Disc	F	266	264	14/15G Competition	Pro-Lock, alloy
		R	264	265		
	Race Tubeless	F	251		14/15G Competition	Pro-Lock, alloy
		R	265	267		
	Race Disc	F	266	264	14/15G Competition	Pro-Lock, alloy
		R	265	264		
	Select	F	255		14/15G Competition	Pro-Lock, alloy
		R	268	269		
	Superstock	F	254		14G Champion	Pro-Lock, brass
		R	267	269		
	Superstock Disc	F	267		14G Champion	Pro-Lock, brass
		R	267			
29"	Race Lite	F	283		14/15G Competition	Pro-Lock, alloy
		R	300	298		
	Race	F	282		14/15G Competition	Pro-Lock, alloy
		R	300	297		
700c clincher	Race Lite Aero	F			Blade	Hex Pro-Lock, alloy
		R				
	Race X Lite	F	279		14/17G Revolution blade	Hex Pro-Lock, alloy
		R	291		14G New Aero blade (R), 14/17G Revolution blade (L)	
	Race X Lite (Campy)	F	279		14/17G Revolution blade	Hex Pro-Lock, alloy
		R	291		14G New Aero blade (R), 14/17G Revolution blade (L)	
	Race Lite	F	279		14G New Aero blade	Pro-Lock, alloy
		R	291			
	Select	F	278		14/15G Competition	Pro-Lock, brass
		R	294	293		
	Select Hybrid (135 OLD)	F	278		14/15G Competition	Pro-Lock, brass
		R	294	293		
700c tubular	Race Lite Carbon	F	276		14/17G Revolution blade	internal
		R	281	283	14G New Aero blade	
	Race Lite Carbon (Campy)	F	276		14/17G Revolution blade	internal
		R	281	283	14G New Aero blade	
	Race X Lite	F	279		14/17G Revolution blade	Hex Pro-Lock, alloy
		R	291		14G New Aero blade (R), 14/17G Revolution blade (L)	
	Race X Lite (Campy)	F	279		14/17G Revolution blade	Hex Pro-Lock, alloy
		R	291		14G New Aero blade (R), 14/17G Revolution blade (L)	
650 clincher	Race X Lite	F	253		14/17G Revolution blade	Hex Pro-Lock, alloy
		R	265		14G New Aero blade (R), 14/17G Revolution blade (L)	
	Race Lite	F	253		14G New Aero blade	Pro-Lock, alloy
		R	265			
	Select	F	252		14/15G Competition	Pro-Lock, brass
		R	268			
650 tubular	Race Lite Carbon	F			14/17G Revolution blade)	internal
		R			14G New Aero blade	

Spoke dimensions: Blade (2.0/3.6 x 1.0), 14/17G Revolution blade (2.0/2.5 x 1.0), 14G New Aero blade (2.0/3.2 x 1.1)
If no left spoke length is listed, it is the same as the right side

2003

Wheel size	Model		Length right	Length left	Type	Nipple
26"	Race X Lite Tubeless	F	251		14/17G Revolution	Hex Pro-Lock, alloy
		R	266	269	14/16G Special Revolution (R), 14/17G Revolution (L)	
	Race Lite Tubeless	F	252		14/15G Competition	Pro-Lock, alloy
		R	265	268		
	Race Lite Tubeless Disc	F	266	264	14/15G Competition	Pro-Lock, alloy
	Specific	R	264	265		
	Race Tubeless	F	251		14/15G Competition	Pro-Lock, alloy
		R	265	268		
	Race Tubeless Disc Specific	F	266	264	14/15G Competition	Pro-Lock, alloy
		R	264	265		
	Select	F	255		14/15G Competition	Pro-Lock, alloy
		R	268	269		
	Select Disc Compatible	F	268		14/15G Competition	Pro-Lock, alloy
		R	267	268		
	Superstock	F	254		14G Champion	Pro-Lock, brass
		R	267	269		
	Superstock Disc Compatible	F	267		14G Champion	Pro-Lock, brass
		R	267			
29"	Race Lite 29" Disc Compatible	F	300	298	14/15G Competition	Pro-Lock, alloy
		R	297	298		
	Race 29" Disc Compatible	F	299	297	14/15G Competition	Pro-Lock, alloy
		R	297	298		
	Superstock 29" Disc Compatible	F			14G Champion	Pro-Lock, brass
		R				
700c clincher	Race X Lite Aero	F	281		14G New Aero blade	internal
	(Campy or Shimano)	R	288			
	Race X Lite Aero Power Tap	F	281		14G New Aero blade	internal
		R	276	274	14G New Aero blade (R), 14/17G Revolution blade (L)	
	Race X Lite	F	279		14/17G Revolution blade	Hex Pro-Lock, alloy
	(Campy or Shimano)	R	291		14G New Aero blade (R), 14/17G Revolution blade (L)	
	Race Lite	F	279		14G New Aero blade	Pro-Lock, alloy
		R	291			
	Race Lite Tandem	F	281		14G New Aero blade	Pro-Lock, brass
		R	281			
	Select	F	278		14/15G Competition	Pro-Lock, brass
		R	294	293		
	Select Hybrid (135 OLD)	F	278		14/15G Competition	Pro-Lock, brass
		R	294	293		
700c tubular	Race X Lite Aero Carbon	F	276		14/17G Revolution blade	internal
	(Campy or Shimano)	R	281	283	14G New Aero blade	
	Race X Lite	F	279		14/17G Revolution blade	Hex Pro-Lock, alloy
	(Campy or Shimano)	R	291		14G New Aero blade	
650 clincher	Race X Lite	F	253		14/17G Revolution blade	Hex Pro-Lock, alloy
		R	265		14G New Aero blade (R), 14/17G Revolution blade (L)	internal
	Race Lite	F	253		14G New Aero blade	Pro-Lock, alloy
		R	265			
	Select	F	252		14/15G Competition	Pro-Lock, brass
		R	268			
650 tubular	Race X Lite Aero Carbon	F	249		14/17G Revolution blade	internal
		R	255	257	14G New Aero blade	

Spoke dimensions: Blade (2.0/3.6 x 1.0), 14/17G Revolution blade (2.0/2.5 x 1.0), 14G New Aero blade (2.0/3.2 x 1.1)
If no left spoke length is listed, it is the same as the right side

Tubeless Instructions and Troubleshooting

Tubeless Compatible technology allows the owner of these wheels to choose between a conventional tire with inner tube, or a tubeless tire, including all current tubeless-type tires. However, a conventional tire mounted on a tubeless compatible rim will not hold air without an inner tube.

⚠ WARNING

Do not attempt to use a standard tire without an inner tube. Such use may cause a rapid deflation of the tire resulting in loss of control resulting in personal injury. If you are unsure if a tire is a compatible tubeless design, consult your dealer.

The key to using tubeless tires on Tubeless Compatible rims is a special rim and its mated rim strip. This rim strip is made of a thermoplastic rubber material, so its impervious to air. Installed correctly in the special mated rim, it seals tightly to the tubeless tire to prevent air escaping through the spoke holes. There are additional surfaces which must seal tightly for the tubeless system to hold air. The rim's hook allows greater contact with the tubeless tire's smooth, enlarged bead so these two surfaces also seal up tight. The inside of the tubeless tire has a special coating to prevent air from escaping through the tire casing. When these features are all in order, no tube is needed. Just install a special presta valve stem into the rim, and inflate.

A properly mounted tubeless tire will 'bleed' air, up to 4 PSI (0.25 ATM) per day. If a tubeless tire loses air faster than 4 PSI (0.25 ATM) make sure the valve nut is tight, check for punctures, and make sure all sealing surfaces are smooth and clean. The sealing surfaces include the tire to rim contact, the tire to rim strip contact, the valve stem to rim strip contact, and the rim strip to rim contact. Dirt, sand, grime or roughness on any of these surfaces may allow extra air to escape. If necessary, purchase a replacement rim strip from your dealer.

In the case of a punctured tubeless tire, you can patch a small (less than 3mm) hole from the inside of the tire. A sticky glueless patch is recommended. It the puncture is greater than 3mm, or the tire casing is damaged instead of merely punctured, with any broken threads, replace the tire. If the air leaks rapidly and the source is not immediately obvious, it may be difficult to inflate the tire enough to locate the puncture. However, its easy to convert from tubeless to the use of a standard inner tube.

Complete bicycles sold with Tubeless Compatible wheels may have inner tubes installed in the tubeless tires to protect the rims in shipping and allow easy display. To convert these wheels to tubeless, see step #3.

1. Installing and inflating a tubeless tire

To inflate a newly installed tubeless tire, the tire must make full contact with the rim strip at the bottom of the rim well. To achieve this contact a tubeless tire has to fit on the rim more tightly than a similarly sized conventional tire. With the tire beads contacting the rim strip at the bottom of the rim well, air pressure is used to push the beads into their seated, sealed position against the rim hooks. A compressor is not required to seat the tire beads. A good floor pump or an air cartridge work, and a hand pump may work if nothing else is available. With a snug fitting tubeless tire, barehanded installation may be difficult. If you use tire levers for installation or removal, do not damage the rim or abrade the tire beads. If either surface is damaged, the roughened surface may allow a greater rate of air to bleed from the mounted tire.

Install the valve stem.

1. Center the special rim strip in the rim. Make sure it fully covers all spoke holes.
2. Align the slot on the head of the special tubeless valve with the rim (Fig. 1). Press the valve stem through

⚠ WARNING

Make sure the rim strip covers all of the spoke holes or spoke heads. If they are exposed they may allow air loss, or puncture the inner tube, and may cause loss of control resulting in personal injury.

the rim strip and rim.

3. Install the tubeless valve nut (Fig. 1) onto the the valve, and tighten firmly. There should be no gap between the valve and the rim strip.
4. Inspect the rim strip. Make sure the rim strip lies centered in the rim well, with no wrinkles or unevenness.

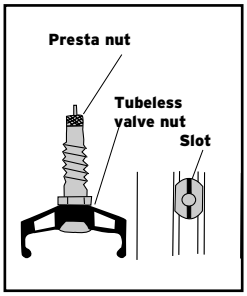

Fig. 1

Install the tubeless tire.

5. Lay one tire bead into the center of the rim well. Start opposite the valve to give the tire beads the maximum slack. If you start at the valve, the bead will lie on top of the valve. With the bead on top of the valve, some slack will be taken up which is needed to lift the tire bead over the rim shoulder (Fig. 2).

Note: If desired, the tire bead can be lubed with soapy water to aid in tire installation and seating of the bead.

6. Start opposite the valve again, and install the second tire bead. Before installing the last 10 inches (25cm) of the second bead, pivot the beads so the second bead is at the bottom of the rim well. With the additional slack afforded by this bead placement, finish installing the second bead until it is completely in the rim well.

Note: If you choose to use tools to mount the tire, be careful not to mar the rim or abrade the tire as this could reduce the required ability of the rim to seal to the special beads of a tubeless tire.

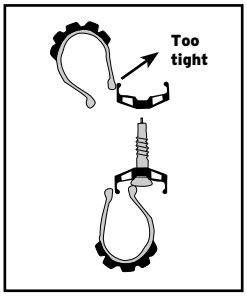

Fig. 2

Inflate the tubeless tire

Tip: During initial inflation it may be helpful to hold both beads, adjacent to the valve stem, up and out of the center channel with your fingers. This will help remove any gaps between the tire beads and rimstrip.

1. Begin to inflate the tire. The tubeless valve stem works just like a standard presta valve. Unlock the presta nut (Fig. 1), and use a pump with a presta fitting. Initially, its best to inflate the tubeless tire as rapidly as possible. This forces the beads out to the rim hook where they will seal (Fig. 3).
2. With the tire beads sealed to the rim hook, inflate the tire to about 60PSI (4 ATM) until the tire beads lock into the rim well (Fig. 3).
3. Visually check that the beads are seated correctly in their locked position(Fig. 3). Most tires have lines or marks running around the casing, just above the bead. When correctly installed, these lines are at an even distance from the rim. When the beads are correctly seated all around the rim, inflate (or deflate) to the desired pressure.

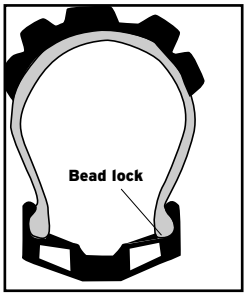

Fig. 3

⚠ WARNING

Failure to maintain a minimum tire inflation of 30PSI (2ATM) may result in rapid deflation causing a loss of control resulting in personal injury.

2. Adding an inner tube
Remove the tubeless tire

1. Let all the air out of the tire.

2. On tubeless compatible rims the bottom of the well is too narrow for both beads to rest fully against the rim bottom at the same time, so the tire must be placed to get one bead down. With the wheel facing you (Fig. 4), roll the tire up and away from the rim with your thumbs while you use your fingers to tuck the opposite bead into the rim well Fig. 5).

3. At the valve, pull the lower, slacker bead of the tire up, out, and away from the rim (Fig. 6).

4. Pull the loosened bead up and out of the rim, rolling and pushing the tire toward the hub (Fig. 7) until the first bead is completely off the rim. Repeat to remove the other bead.

Note: If you choose to use tools to remove the tire, be careful not to mar the rim as this could reduce its ability to seal to the special beads of a tubeless tire.

Remove the valve stem

5. Remove the tubeless valve nut. Thread the presta nut into the valve stem, and push the stem out of the rim.

Install the tire and tube

6. Make sure the rim strip is centered in the rim well and fully covers all spoke holes. Install the tire and tube in the normal manner. With an inner tube, either a conventional or tubeless tire can be used.

Fig. 4

3. Changing to a tubeless tire
Remove the tire and inner tube.

1. Remove the tire by following item #2 Adding an Inner Tube, except start removing the tire opposite the valve.

2. Refer to item #1, Installing and Inflating a Tubeless Tire.

4. Removal and installation of a rim strip
Remove the rim strip

1. After removing the tire (and tube, or tubeless valve stem) insert a round-bladed screwdriver (or similar tool) through the valve hole, and between the rim and rim strip (Fig 8). If the rim strip is to be used again, be careful not to tear or stretch the hole.

3. Lift the rim strip and place a tire lever underneath. Use the tire lever to lift and then roll the rim strip over the opposite rim hook (Fig. 9). Be careful not to mar or damage the rim, or rim strip, with the tire lever.

4. Continue to roll the rim strip up and out of the rim as you work your way fully around the rim.

Install the rim strip

1. Make sure the rim strip is in good condition, with no tears, holes, or deformed areas near the valve hole or along its edges.

2. Align the rim valve hole and rim strip valve hole. Place the special tubeless valve (or a similar item) through the rim strip valve hole, and then the rim. The 'U' shape of the rim strip should face the same direction as the 'U' shape of the rim well (Fig. 10).

3. Work the rim strip into the rim, moving away from the valve stem in both directions. With six to ten inches (15 to 25 cm) rim strip remaining outside the rim, manually lift and slightly stretch the rim strip so that it can be laid flat in the rim well.

4. Follow the appropriate installation procedures to install a tire.

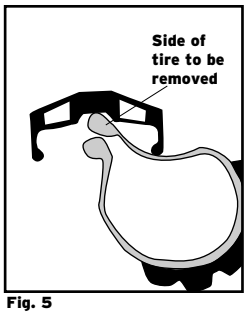

Fig. 5

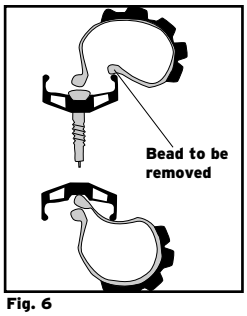

Fig. 6


Fig. 7

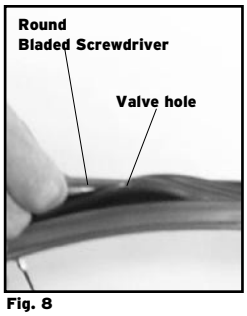

Fig. 8

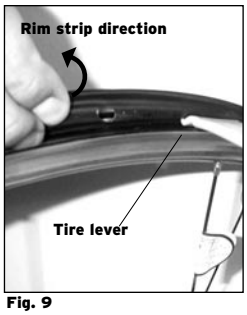

Fig. 9

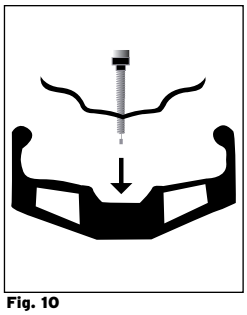
Fig. 10