

Building and Truing a Spoked Wheel

Before you start:

1. The rim should be round and true. Don't try to pull a bent rim into shape with uneven spoke tension. Replace it.
2. Be sure you have the right length spokes. You did save one from each side of the old wheel for reference, didn't you?
3. Have a good spoke wrench. Size varies with spoke supplier. Don't use a thin ignition wrench; you'll ruin the chrome plating and likely the brass nipples as well.
4. Spoke threads and rim holes must be lubricated. Dip the threaded end of each spoke in wheel bearing grease and wipe off the excess. Dab a little grease into each dimple in the rim.
5. JAWA wheels use 36 spokes. They are laced 9 "inner" and 9 "outer" in each flange. Some early wheels are in a "cross 3" pattern. That is, every spoke crosses over 3 others on its way from hub to rim. (*Later ones are "cross 2" or "cross 1".*)
If the hub flanges are equal in diameter, all the spokes will be the same length. If the flanges are unequal, there are 18 longer ones for the small flange, and 18 shorter ones for the large flange.
6. Examine the rim. Note that the nipple holes are dimpled at an angle and offset side-to-side. You must lace so the nipples are positioned to match the angle and offset of these holes.
7. Examine the hub. Note that the pattern for one set of 18 spokes is rotated 1/2 spoke hole from the pattern in the other hub flange. You have to match the hub hole pattern of each flange to the same-side rim hole pattern. This is easier to see if the flanges are equal in size. If yours are unequal, look at the front hub of a bicycle; sight from the side across the 2 flanges and you can see what is meant.
8. Older bikes - Peraks (*or Stumps*) - have hubs with unequal flanges. The small flange has one elongated hole rather than 2 individual holes for each pair of adjacent spokes. This makes no difference in the lacing, but is done to ease installation of the small flange spokes.
9. Set up with a chair and a low table in front of you, with the rim supported at 3 points on your knees and the table. This lets the spokes fall vertically into the space between your legs.

Lacing or Building a Wheel:

There are 2 flanges, and each flange has inner and outer spokes, so you work with 4 groups of 9 spokes.

Group 1. Brake drum side, inner spokes.

- 1.1. Hold the hub in one hand, brake drum up. Drop the first 9 spokes down thru alternate holes of the top flange.
- 1.2. Position the hub with 9 spokes in the centre of the rim. One at a time, lift the spokes to the upper set of holes in the rim and thread a nipple a few turns on each. You will be using every 4th hole in the rim.

Group 2. Brake drum side, outer spokes.

- 2.1 Position the assembly, brake drum down. Drop the second set of 9 spokes down thru the bottom flange. The spoke heads are on the opposite side of the flange from the 9 already installed.
- 2.2. Turn the assembly, brake drum up, and lay the 9 loose spokes out flat.
- 2.3. The nipple holes in the rim are directionally dimpled (angled). Rotate the hub so the installed nipples match the direction of the dimples and the first 9 spokes are lightly tensioned.
- 2.4. Take one of the 9 loose spokes, and lay it in the direction opposite the first set of 9. Count that it crosses 3 of the spokes on the underside of the flange, and loosely thread on a nipple. Repeat for the remaining 8 spokes.

Don't overlook counting the first "cross" which will be close to the hub, almost over the head of the spoke being crossed. One side is now laced. It will be quite loose, but you should see about the same amount of nipple protruding from the rim at each spoke. Also, the nipples should lie correctly in the rim dimples. If not, something is wrong. Go back, find and fix it.

Group 3. Straight flange, inner spokes.

- 3.1. Position the assembly brake drum down.
- 3.2. The next step is critical - getting the correct relationship between sets of spokes in the 2 flanges.
- 3.3. Insert one spoke downward thru any hole in the upper flange. Place this spoke exactly vertical, and slide it down to touch the brake drum flange. Note that it falls exactly between 2 spokes in the brake drum flange.
- 3.4. You must assemble this spoke to the corresponding rim hole; i.e. one hole clockwise or counter-clockwise to the corresponding brake drum flange spoke. If the rim hole dimple is angled the wrong way, swing the spoke in the opposite direction, or move the spoke one hole either way in the flange and try again.

Repeat in a consistent pattern for the remaining 8 spokes.

Group 4. Straight flange, outer spokes.

- 4.1. Position the wheel brake drum up. Drop the last 9 spokes in the remaining holes of the straight flange.
- 4.2. Turn the wheel brake drum down, so the loose spokes are on top. Move these 9 spokes in the opposite direction to the inner spokes just under them, again crossing 3 spokes, and loosely thread the nipples in place.

The wheel is now fully laced. All the nipples should protrude slightly and fairly evenly from the rim. If done incorrectly,

you will see a pattern of uneven spoke protrusion. Generally a pattern of 2 spokes quite loose and 2 spokes relatively tight. Go back and fix as needed.

Wheel Truing:

1. The wheel will be quite loose and will rattle if shaken. Mount the wheel in the fork or frame with spacers, brake, etc. and tighten the axle nut just snug.

2. Tighten all the nipples to the same place on each spoke. Usually, this will be to the point where only a few or no threads show on the spokes.

Starting at the valve hole, finger tighten each nipple one turn in sequence, until all the spokes are snug. This may take several rotations of the wheel. Do not over tighten the first few loose spokes. Work around the rim and bring it along gradually. Now the wheel won't rattle when shaken.

3. It is easiest to true a wheel on a truing stand, but if you had one you already know all this and wouldn't be reading this far. The bike will do just fine.

4. Truing a wheel involves 3 different but interrelated aspects. There are more technical terms, but most people use wobble, hump (eccentricity) and offset. Tightening a spoke moves the rim toward that spoke; affecting both wobble and hump. Loosening a spoke lets the rim move away from that spoke. The wheel as laced should be pretty close to true. Work all 3 aspects in sequence as you gradually bring the spokes up to full tension.

5. Starting at the valve hole, use the wrench to tighten each nipple 1/2 turn. Repeat as needed to bring the wheel snug but not finished tight. The spokes should make a "thud" sound, not "ring", when struck.

6. Use a piece of stiff cardboard or stiff wire and C-clamp or masking tape it on the frame or fork to make a gauge to measure wobble and hump.

7. Minimize any wobble. Set the gauge so it just touches the side of the rim at one point. Tighten the spoke opposite the side touching the gauge one turn, and loosen the 2 adjacent spokes on the opposite side 1/2 turn each. As the wheel gets tighter, use 1/2 turn and then 1/4 turn increments. You should be able to get the wobble down to almost nothing. Some steel rims will have a variation in width, usually at the welded joint. If you encounter this, work for a wheel that appears straight on average when spun.

8. Minimize any hump. Move the gauge to the outside diameter of the rim and check for high and low spots - hump. Correct it by tightening 2 adjacent spokes (one on each side of the wheel) at the highest point. If the correction needed is great, tighten 2 adjacent spokes a full turn, and the 2 spokes on either side of this pair 1/2 turn each. Again, as the error gets smaller, tighten each spoke less. You should be able to get the hump down to 0.5mm, but as with wobble, the welded joint may introduce a variance - flat spot - that you cannot fully correct with spoke tension.

9. Check the offset. Offset is sometimes used to make room for the brake drum and sprocket. You did measure it or got it from someone who has it recorded, didn't you? It is the amount (if any) that the rim is offset to one side of the hub.

To measure the offset, remove the wheel and set it on a bench with the brake and axle spacers in place. Measure from bench to rim edge. As a check, turn the wheel over and measure again. These 2 dimensions added to the rim width should equal the hub width. If the offset needs correction, note which way you want the rim to move. This is accomplished by tightening all the spokes on that side, and loosening all of the spokes on the opposite side

If correction is needed, set the wheel back in the bike. Start at the valve hole and tighten the first spoke on the appropriate side 1/2 turn, then loosen the next spoke (opposite side) 1/2 turn, working your way around back to the valve hole. This will shift the rim relative to the hub without changing the overall tension in the wheel, and with minimal effect on wobble or hump. Re-measure and repeat the spoke tighten / spoke loosen process as needed. As the error gets smaller, go to tightening each nipple 1/4 turn, and omit the loosening. Get the offset within 0.5mm.

Keep rotating thru the above 3 steps until the wheel is true and the spokes tensioned. As you true, gradually increase the overall spoke tension by tightening more turns than you loosen. If the wheel gets too tight before it is true and you can't tighten a particular spoke any further, reverse the procedure and loosen opposing spokes.

Correct spoke tension is difficult to describe, but in general get the spokes as tight as you can using the

wrench you have. They should ring a clear note when struck with a metal tool. You can test the spokes on a new bike and compare the sound. It is unlikely that you can over tighten, as the nipples are brass and the wrench will round the nipple if you try to go too far. There are wrenches to measure nipple torque but due to friction variances, torque is not a particularly good indication of spoke tension. A clear ring tone is as good or better.

Once the spokes are tensioned, check for spokes protruding thru the nipples. There should not be much, maybe 1.0mm at the most. (This is critical, because if a spoke end is protruding, it can eventually puncture the tube, leading to a flat tyre. If that happens when riding the results can be instantly catastrophic.) These spoke ends must be ground off flush with the nipples. Use a 1/2 inch thick wheel on a bench grinder, spend a lot of time with a Dremel, or still more time with a small file. Don't forget the rim tape before you install the tyre and tube.

Due to small burrs or inaccuracies that may be present in the hub and rim holes, the spokes may "settle-in" and loosen a bit when the bike is ridden. Ride a few miles, accelerating, braking and over bumps. Check that the spokes still ring when struck. If necessary, tighten the entire wheel. Start at the valve hole and tighten each nipple no more than 1/4 turn until all the spokes ring. This can be done on the bike with the tyre in place.

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