Abridged Wheel Building

Selecting Components

Match the rim and hub spoke count. Most common are 36, 32, and 28. More spokes = stronger wheel.
Measure the hub and rim (or use the manufacturer's specs). Measuring is often better.
Calculate the spoke length/lengths with a spreadsheet, table, or calculator. On dished wheels (most rear wheels), drive side spokes will be 1 or 2mm shorter.
For single wall rims, round down to the nearest mm, for double wall round up.
Double check measurements and spoke cross # to avoid later confusion. (3x is most common)

Hubs and spokes can be re-used if in good condition. Bent rims should not be re-laced.

Before Starting

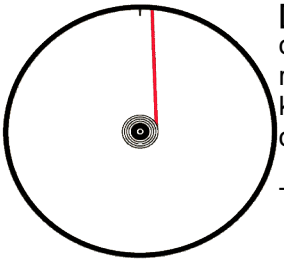
Prep the spokes (linseed oil, chain lube, loc-tite, or spoke-prep)
Double check everything spoke count

Lacing the wheel

Spokes are always divided into 4 groups:
Drive side Trailing (R)
Non-drive Trailing (L)
Drive side Leading(R)
Non-drive Leading (L)

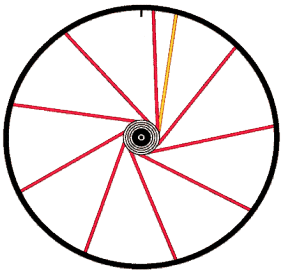
Spokes can be inserted in any order and from either side of the hub, but the order below is easy to assemble.

Tip: On deep double wall rims without eyelets, an old cut spoke can be used to pull the nipple though.



[1ST SET] Start with the Drive side trailing spokes. Drop a spoke through the hub from the outside. Lace it through the hole to the right(clockwise) of the valve stem on the rim. On offset rims, use the first hole clockwise from the valve hole which is closest to the hub. This is called the key spoke. Lace the other drive-side trailing spokes into every 2nd hole on the hub and 4th hole on the rim.

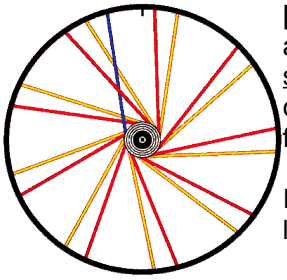
Turn each spoke nipple so that a few (4-6) threads on each spoke remain showing.



[2ND SET] Lace the non-drive side trailing spokes next. The first spoke of this set is vital to getting everything else correct. Start with the hole in the hub slightly ahead (cw) of the key spoke on the opposite side of the hub. Lace the spoke to the hole in the rim ahead of the key spoke. Lace the rest of this set in every 4th hole on the rim.

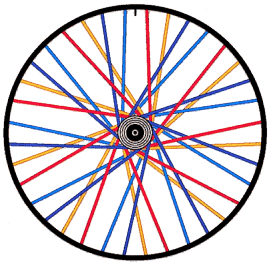
Check your work. All spoke heads should be on the outside edges of the hub. The holes on the rim should be a right spoke, left spoke, empty, empty pattern when viewed from the drive-side.

Twist the hub clockwise so that all the spoke nipples are seated in the hub.



[3RD SET] The third set can be on either side. Drop them in from the opposite side of the wheel and swing them around. They will be laced so they cross three of the trailing spokes on the same side (for 3 Cross). The spoke will cross the first two on the outside of the wheel, but the third cross should be made inside. It is ok to bend spokes while doing this. The spoke will lace to a free hole such that it is next to a spoke from the opposite side. Check your work.

If this set doesn't reach or seems too long check for spoke nipples not seated, wrong spoke length, wrong cross pattern, wrong hole, etc.



[4TH SET] The 4th set is inserted similar to the third set. If they don't reach, you probably put the wrong spokes in the wrong place. (or maybe have the wrong length of spokes)

Tensioning the Wheel
The goal is to make a wheel that is:
1. Perfectly true (side to side)
2. Perfectly round (up and down)
3. Correctly dished (centered in the frame)
4. Has all spokes equally tight (tension / music pitch)

Turn each spoke nipple so that only 2 threads are exposed. The wheel should be slightly tight at this point

Don't tighten some spokes more than others until every spoke is snug. Start and end every operation at the valve hole.

Begin with full turns, reduce to 1/2 turns, then 1/4 turns.

Constantly check all four goals as the wheel nears completion and make gradual adjustments.

The spokes are tight enough when all make a sharp ping when plucked. Or – use a spoke tension meter. On rear multi-speed wheels, the drive side will be tighter than non-drive when correctly dished. Drive side tension on rear wheels is more important than non drive side. Tighter spokes make a stronger wheel.

Final Steps
Residual Twist: Eliminate twisted spokes by tightening 1/4 turn then loosening 1/4 turn.
Stress-Relieving the Wheel: Don't skip this step. Best technique - squeeze sets of four spokes tightly.

Wheel Truing Tips
Check carefully for broken spokes and replace before you start
Check for dents and cracks in the rim. Some dents can be repaired with a hammer or vice grips.
Lubricate spoke nipples.
Make small adjustments at the worst spot, only until it is not the worst spot anymore.
If you try to fix one spot all at once – you'll over do it and wreck the wheel or make it worse.
Watch, listen and feel for twisting spokes.
Flat spots are difficult to eliminate.
Loosen spokes only if over-tight or making large adjustments on opposite side
Consider effect on nearby spokes and the effect on the whole wheel (equal and opposite reactions)
For many older wheels 1.0mm variance is 'good enough' 0.3mm to 0.1mm variance is very good.

References and Further Reading
The Bicyle Wheel by Jobst Brandt. (The definitive book on wire-spoke bicycle wheels)
Spocalc by Damon Rinard (A popular excel spreadsheet spoke calculator and hub and rim database)
http://www.sheldonbrown.com/rinard/spocalc.xls