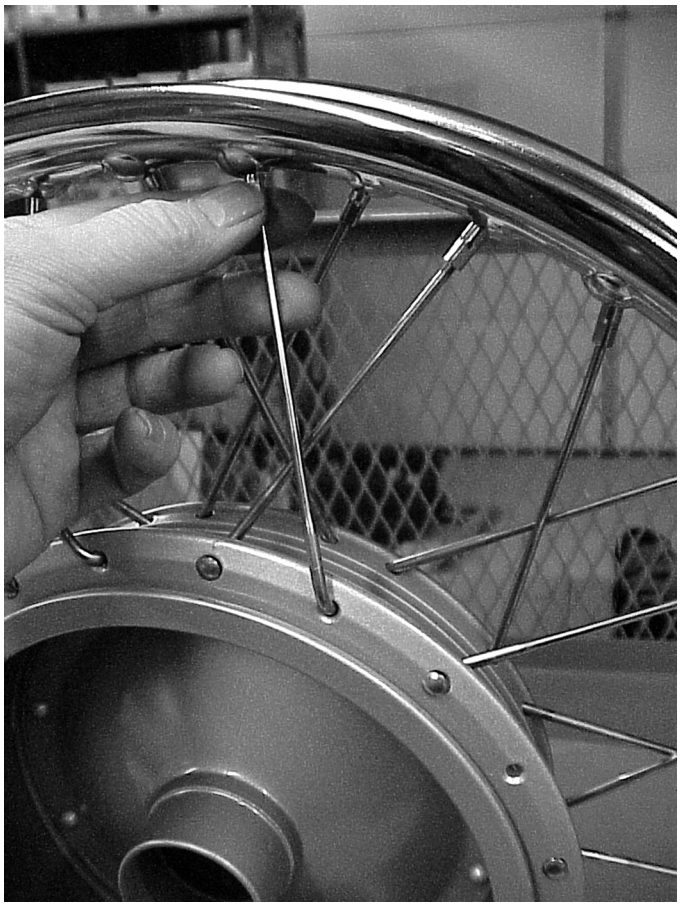
A Collection of Articles on

Building British Motorcycle Spoke Wheels

by John Healy



Working on a motorcycle can require skills not normally acquired through daily living. Building motorcycle wire wheels is just one such activity. It is beyond the scope of this booklet to provide you all of the skills required to be a wheel builder.

While we try to provide information that would aid in the assembly and truing of a spoke wheel, it is beyond our ability to control all of the factors that come into play during this process. We also have no idea of the ability or skill of the reader to build a safe wheel. We cannot inspect the final product, and as such, this booklet should act only as a guide.

Building and truing a wheel requires a certain amount of skill and training. It also requires MORE than a fundamental understanding of the principles at work. The strength of the wheel is directly related to the skill of the person doing the job. A wheel that is not assembled, trued and tighten properly can be dangerous.

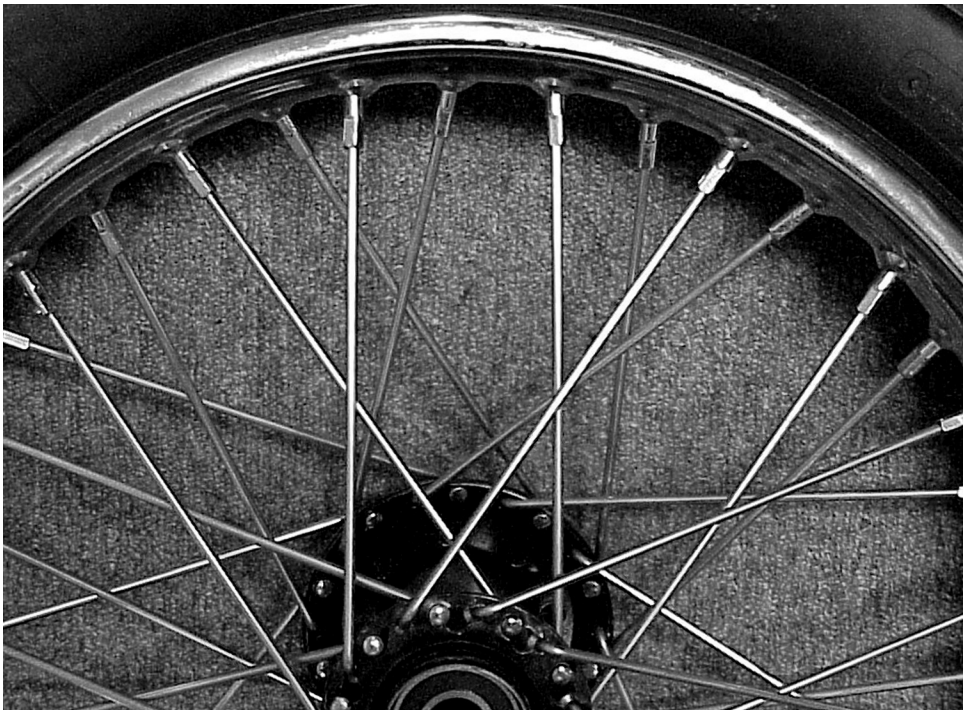
Although we point out the common pitfalls of not properly tensioning the spokes, using nipples that are too small for the nipple piercing in the rim, and rims that are not dimpled and pierced to the proper angle for the hub being used, there are other factors beyond the control of the writer.

If you are uncertain about your skills, or wish to learn wheel building, I strongly recommend that you seek council and opinions of a professional wheel builder who can advise and check your progress. Just because you are able to get all of the spokes in the right holes and going in the right direction does not make you a wheel builder. The important wheel building work is yet to be done.

A spoke wheel failure, although uncommon, can lead to death or some thing worse. Because we have no control over the original design of the wheel, or the work you perform on it, we will not assume any liability.

Lacing and Truing Triumph Rims

By John Healy



This is what it should look like when your done: Freshly powder coated hub, Buchanan stainless spokes and chrome nipples and new rim. If you got it right there will be no bend in the spoke near the nipple. If the rim is handed, putting the rim on the wrong way will leave you with bent spokes. Any bending will cause the wheel to be weak and will lead to early spoke failure.

"Be sure to tell them to measure the hub/rim offset before removing the rim."

Traditionally British motorcycles come with rims incorporating 36 to 40 spokes (Triumph used 40). These rims typically are offered in diameters to fit tires from 16 inch to 21 inch and can be found in various widths. To aid manufacturers a system has been devised to identify these rims. A Triumph front rim is said to be WM2 x 19 and the rear WM3 x 18 (see chart page 22). Once a size and width had been selected Triumph had these rims dimpled and drilled to fit their concept of wheel building and their motorcycle's wheel hub.

Buying a rim today can be tricky. Often there are some very good values in standard rims, but often don't meet the demands of a restorer. Although these rims will fit and perform as well as the original, they often have different lacing and dimpling patterns. If you are concerned with originality you need to be armed with more than the rim diameter and size.

Hubs—

For hubs Triumph used pressed steel, cast iron and aluminum . Here are the basic styles:

1. **"Spool"** Triumph rear hubs on 500 and 650 pre oil in the frame models and disc wheel hubs are spool. It is a steel or aluminum hub with equal or near equal flanges to hold the spokes.
2. **"Drum"** Used extensively on Triumph front wheels they are cast iron with an intergrel brake drum. They use straight nail head spokes.
3. **"Offset drum"** The offset drum was popular with Triumph for many of their front wheels. Early models used a pressed steel hub with an intergral brake drum. Later models, with the cast iron drum, used nail head spokes on one side and bent spokes on the other. In 1971 Triumph introduced the "conical" drum which is an other version of an offset drum.

Spokes—

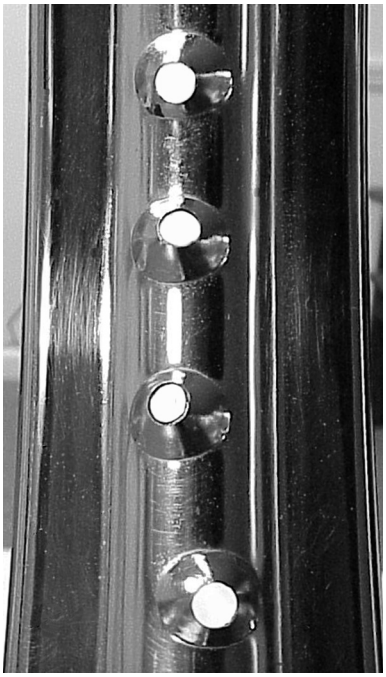
Triumph used cadmium plated carbon steel spokes. Early models had cadmium plated nipples while later models used chrome plated nipples.

1. **"Single diameter"** (typically 9 gauge) which have one diameter from end to end.
2. **"Swedged" or "butted"** (typically 8-10 gauge) which have two gauges: one on the head end and a smaller on the nipple end.
3. **"Bent"** where the head end is bent to fit into the hub.
4. **"Nail Head"** where the head is straight where it sits in the hub.
5. Triumph always used **"rolled"** threads on their spokes for strength and safety.

N.o.s. cadmium plated spokes are all but extinct. If you find a set they will most certainly need to be replated. Central Wheel makes a very good reproduction of n.o.s. They are available in plated steel or plain and polished stainless. Their butted 8/10

37-1007 1971-73 Rear rim with alternative left-right dimpling. Due to the difference in spool hub flange diameters this rim is handed

37-1230 19 to 1970 Front rim with alternative "2 by 2" dimpling— 2 dimples on the left then 2 on the right. This rim is not handed.



37-7030 1976-up Rear rim with "3 by 1" dimpling— 3 dimples on left sprocket) side of rim and one on the right (disc) side. This rim is handed.

ga. polished stainless with chrome nipples make a very good choice for the Triumph restorer. Buchanan also makes a very good quality spoke. It is a bit harder to get the Buchanan spoke to look good on a restoration. I like to polish of the "B" from the head of the spoke on all exposed spoke heads.

Rims—

Triumph used Jones (early models), Dunlop (through the sixties and seventies) and Radelli (in the eighties) rims. Original Dunlop and Jones rims are getting quite rare and can set the restoration budget back a lot of money.

Front Rims - size and lacing patterns:

1. **37-1230** WM2 x 19 with "2 by 2" dimpling (used on 650 models thru 1970 and 500 models thru 1974). Pierced with .300 diameter nipple holes and drilled for a cross 1 lacing pattern. The rim is not "handed" and will fit on either way.
2. **37-3818** WM2 x 19 with "left - right" dimpling (used 1971-1972). Pierced with .250 inch nipple holes and drilled for cross 2 on the small side and cross 1 lacing pattern on the brake side. The rim is "handed" and will only fit on one way.
3. **37-4129** WM2 x 19 with "left - right" "cross dimpling" (to allow spokes to clear brake caliper) (used 1973 - up). Pierced with .250 inch nipple holes and drilled cross 3 lacing pattern. The rim is not "handed."

Rear Rims - size and lacing patterns:

1. **37-1007** WM3 x 18 (37-1471 WM2 x 18 on some 6T models) with "left - right" dimpling (used on 650 models to 1970 and 500 models to 1974). Pierced with .300 inch nipple holes and drilled for a cross 3 lacing pattern on a spool hub. This rim is "handed."
2. **37-3784** WM3 x 18 with "left - right" dimpling (used 1971-1973 on 650 models). Pierced with .250 inch nipple holes and drilled for a cross 2 lacing pattern on a conical hub (5 inch on the small side and 9 7/8 inch on the brake side). This rim is "handed."
3. **37-7018** WM3 x 18 (Because the 10 gauge spokes break these were used in 1976 only. Replace with 37-7030) with "3-1" dimpling. Pierced with .250 inch nipple holes for a cross 3 lacing pattern.
4. **37-7030** WM3 x 18 with "3 by 1" "cross" dimpling (used on all disc brake 750 twins). Pierced with .300 inch nipple holes for a cross 3 lacing pattern. A lot of after market rims are dimpled "2 by 2." Due to the large offset both the stock "3 by 1" and after market "2 by 2" rims are "handed."

Rim Widths measured inside rim flanges:

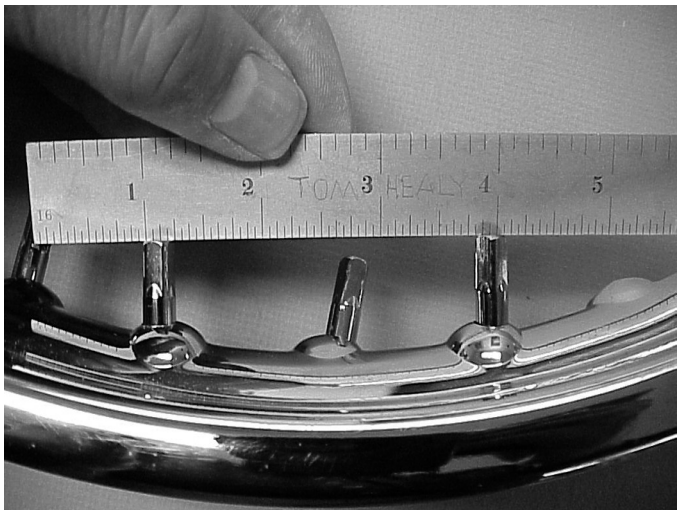
WM0	is 1.5"
WM1	is 1.60"
WM2	is 1.85"
WM3	is 2.15"

Spoke Gauges are as follows:

12	=	2.60mm (.104" dia)
10	=	3.20mm (.124" dia)
9	=	3.60mm (.142" dia)
8	=	4.00mm (.156" dia)

Lacing Triumph's 650 rear rim 37-1007

You will need the following:
1 Rim 37-1007 WM3 x 18
1 Hub
10 Spokes 37-1107 8/10 ga - 7 9/16" - 90°
10 Spokes 37-3402 (old 37-1107-90°) 8/10 ga - 7 9/16" - 110°
20 Spokes 37-1108 8/10 ga 7 7/8" - 90°
40 Nipples
Lubricating oil
Spoke wrench
6 inch ruler

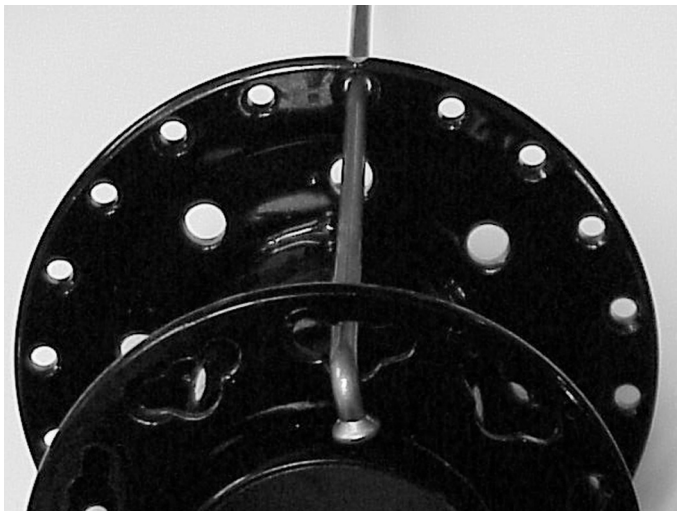


To lace this wheel you will need to know: The hand of the rim, the hand of the hub, the spoke crossing pattern, which spokes are in tension and which ones are in compression and their location in the hub and rim. Before truing the rim you will have to center the rim on the hub using the manufacturers hub/rim offset dimension. Be sure you know this dimension before removing the old rim from the hub.

The first spoke goes in a hole in the **brake drum** hub flange (large). To start, we locate this spoke hole by placing a spoke or other pointer thru the center of any "keyhole" on the small flange side and into the spoke hole directly opposite (see photo #2). Mark both, as you will be using them for reference.

The rim is also handed and will only go on the rim one way. The spoke holes in the rim on the **brake drum** flange side come out at a sharper angle than the ones on the **keyhole** flange side. Insert a couple of nipples and measure each side (see photo #1 above). The **wider** pair go to the spokes on the **brake drum** flange side. Once you have determined the rim's "hand" mark the **brake drum** side with a magic marker.

Lay the rim on a table with the **brake drum** side down. Center the hub inside the rim with the **brake drum** side down (large flange). Turn the rim until the valve stem hole "roughly" aligns with the center of marked "keyhole" (see photo #3).



Put the first **37-3402** -120° spoke into the **marked reference** hole on the **brake drum** flange. It should be inserted from the **inside** of the hub and turned **counter clockwise** (ccw). Then counting 7 dimples **ccw** from the valve stem hole in the rim put the spoke in the hole and thread on a nipple until a few threads are left showing. To install the remaining nine **37-3402** spokes start by counting two holes **ccw** from the marked reference hole and install next spoke. Then count 4 dimples **ccw** from the first spoke nipple and install spoke as above. Follow the same pattern for the remaining 8 spokes.

Note: It will easier to insert the spokes if you slide the rim over the edge of the table and rotate them as you insert each spoke. (As all references are given to the valve stem hole being at 12 o'clock, be sure to reset the rim before starting the next set.)

To install the **37-1107**-90° inner spokes, locate the reference hole on the **brake drum** flange. Go one hole **clock-**

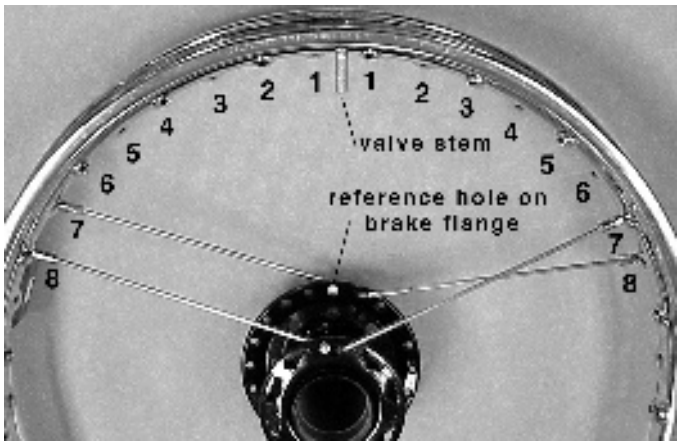


Photo #4: First set of 10 37-3402 spokes laced in the "brake drum" flange. First spoke goes ccw from inside into marked hole in hub and 7 holes ccw from valve stem. After lacing first spoke in referenced hole move two holes in the hub and four in the rim and install the next spoke.

wise and insert a spoke from the outside of the hub and turn it **cw** (spoke #2 in photo #3). Count 8 dimples **cw** from the valve stem hole and put the spoke in the rim and thread on a nipple until a couple of threads still show. Install the remaining nine by going **cw** to the next open hole and count **cw** 4 dimples from the last inner spoke nipple. Follow the same pattern for the remaining 8 spokes. It should look like photo #5.

Move your attention to the hub's small flange. Put a **37-1108** spoke into the referenced **keyhole** placing it on the **inside** of the flange and in a **ccw** direction. **Count 8** dimples **ccw** from the valve stem hole. Put the spoke in the hole and thread on a nipple until a few threads still show (photo #6). Repeat for the other nine spokes.

Start the first of the last 10 **37-1108** spokes in the same referenced **keyhole** laying the spoke on the outside of the flange and in a **cw** direction. **Count 7** dimples **cw** from

Photo #5: The second set of 10 37-1107 spokes lace in the "brake drum" flange. First spoke goes cw from the outside one hole cw from the marked hole and 8 holes cw from the valve stem. After lacing first spoke in referenced hole move two holes in the hub and four in the rim and install the next spoke.

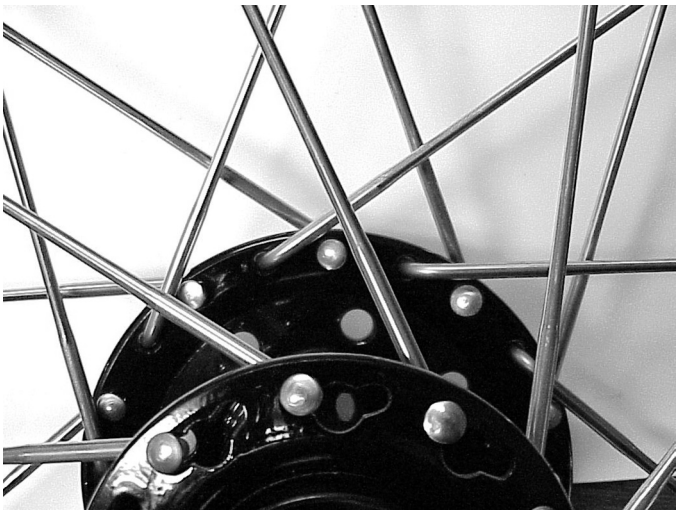


Photo #6: The third set of 10 37-1108 spokes lace in the "keyhole" flange. The first spoke goes ccw from the outside into the marked "keyhole" and 8 holes ccw from the valve stem. After lacing the first spoke in the referenced keyhole move to the next keyhole and four holes over in the rim.

the valve stem hole. Put the spoke in the hole and thread on a nipple until a few threads still show (photo #7). Repeat for the last nine spokes.

That's it... you have laced the rim.

Notes :

1. This wheel is laced with drive side outside and "keyhole" flange inside spokes are in tension during acceleration.
2. For Triumph 650s the wheel offset is 2" measured from the drive side hub flange (where the brake drum is attached) to the centerline of the rim. To use side of rim the offset is 1/2" (assuming a 3.00 inch wide WM3 rim). This measurement can be adjusted based on the actual width of the replacement rim. *
3. For Triumph 500s the offset is 1 31/32" for centerline and 15/32 for edge of rim.*

Photo #7: The last set of 10 37-1108 spokes lace in the "keyhole" flange. First spoke goes cw from the inside in the open side of the keyhole and 7 holes cw from the valve stem. After lacing the first spoke in the referenced keyhole move to the next open keyhole and four holes over in the rim.

Rim Type	Inner width	Normal Tire Size Range
WM0	1.500”	2.00-2.50
WM1	1.600”	2.50-3.00
WM2	1.850”	3.25-3.50
WM3	2.156”	4.00

Rims are made to an international standard. Although WM4 and larger are available few British bikes used them.

The small print: Working on a motorcycle often requires skills not normally acquired through daily living. An improperly laced, tensioned, centered or trued wheel is dangerous and can lead to death or worse. If you are not sure of your skill, or the skill of your mechanic, intrust the wheel to an expert.

Hints for beginners:
1. Before removing a rim from the hub always measure and record the rim’s offset.
2. For future reference always take a detailed photo of the rim before taking it apart.
3. Never replate or use a rusted rim. There is no way to gauge the amount of rust inside the flange of the rim. You could be lacing a rim that will fail at the first bump.
4. Lubricate (anti-seize for stainless) all of the threads and heads of the nipples that bear on the rim before installing.
5. When first offering the nipples to the spokes, do not run the nipple all the way down the spoke. Leave 3 or 4 threads showing until all of the spokes are installed.
6. Buy a spoke wrench that fits your nipples.
7. To ensure the wheels integrity and your safety it is very important to buy your spokes and nipples from the same manufacturer. Although to the untrained eye spoke and nipple threads look and often feel the same, often they aren’t. Spoke threads are not standardized around the world.

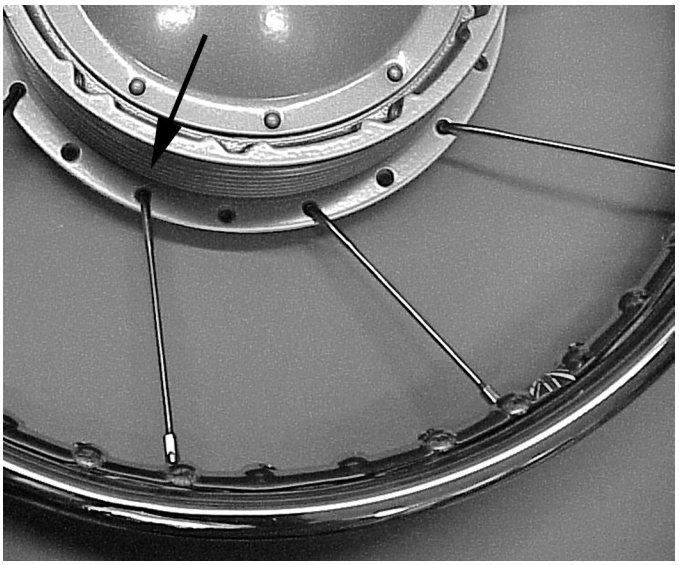
Vocabulary:
Tension: The spokes are said to be in tension when the force is pulling on the spoke. The spoke is strongest when in tension.
Compression: The spoke is said to be in compression when the force is pushing on the spoke. The spoke is weakest in compression.

Spokes come with different angle heads. From left: 120°, 90° and “nail” head. Also the two spokes on the left are 8/10 ga. “butted” and the one on the right is 10 ga. “straight.”

Cross pattern: The number of spokes, on same side of the wheel, a spoke crosses before it reaches the rim.
Cross Dimpled: To allow the spokes on the T140 to clear the disc brake caliper Triumph had to narrow the spoke pattern. To do this the rim is dimpled and nipple holes drilled in such a way that the spokes crossed each other from side to side as they go into the rim. The rear rim has a unique “3 by 1” cross dimpling to allow for the large offset of the rim to clear the caliper.
Dimple: Most rims have dimples, but not all. (Sun alloy rim’s thick cross section allows a nipple “seat” to be machined into the rim.) Dimples allow the spoke’s nipple to “seat.” Without a dimple the head of the nipple would not have full support and when the nipple was tightened the spoke would bend. To prevent early spoke failure all spokes must be straight after final tightening.
Hand: If a rim is handed it will only fit one way. A rim can be handed because of spoke angle or dimpling offset. One way to establish the hand of the rim is to insert four nipples (see illustration) and measure the distance between a pair on each side.
Hop and Wobble: A rim is said to hop if it moves up and down more than .010” when spun. To wobble if it moves from side to side. The rim is “moved” by loosing a **SET** of spokes and tightening the opposing triangulated **SET.**
Hub spoke diameter: The center line of the circle scribed by the heads of the spokes in the hub.
Nipple: Spokes are secured to the rim with a threaded nipple. Nipples can be stainless steel, carbon steel, aluminum or brass. They are often plated. Cadmium plating was popular on early bikes while chrome became popular in the sixties.
Rim Offset: To center the rim in the motorcycle an offset measurement is given. It is the distance between a reference point, like the side of a sprocket or spoke flange, to the edge or center of the rim. Triumph typically gave the offset of the rear wheels from the outside face of the sprocket to the edge of the rim. The front from the edge of the brake hub to the edge of the rim.
Rim or Wheel spoke diameter: (Not to be confused with tire rim diameter) The diameter of the rim where the nipples set in the rim. This measurement is used in spoke length formulas.

Lacing 1966-70 Front Wheel

by John Healy



Viewed from "nail" head spoke side.
The 2x2 dimpled 37-1230 wm2x19 rim is not handed. The key to lacing this wheel is starting with the **brake side - inside spoke** as shown. Arrow in the photo shows the correct hole in the brake side flange. It is located across from the wide space between the opposite side spoke pair.

The introduction of the wider front brake shoe in 1966 required a redesign of the front brake hub. The "nail" head spokes used in previous designs were retained for the left side, but the new "flange" on the brake side required "bent" head spokes to finish the set.

The straight forward lacing of Triumph's full width front hub was lost and now the wheel builder had to understand which set (of 10) spokes to start with to lace the rim. The key spokes to this puzzle is the **flange side - inside** set.

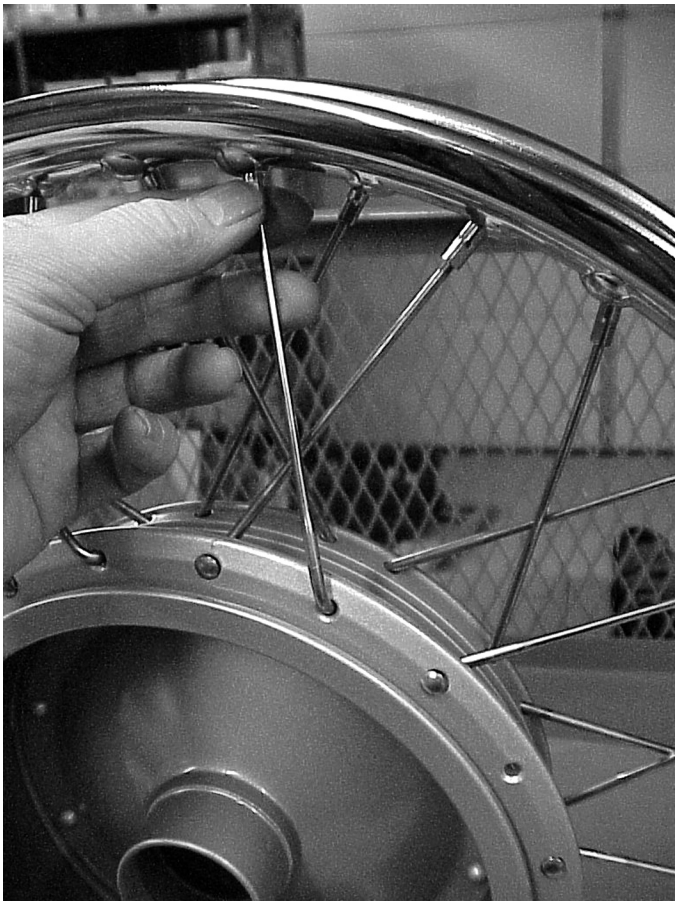
The previous rim (WM2x19 - 37-1230 with its 2-by-2 dimpling design) was retained, as were 20 of the nail head spokes used on the left side. New were 20 "bent" head spokes that were laced into the brake side flange. An experienced wheel builder should quickly see that the inner spokes on the flange side would need to be inserted and laced to the rim first. Failing to do so would require bending some of the spokes later to finish lacing the wheel.

Now it would be easy to offer the other 10 flange side spokes at this time but:

• **To give the wheel some stability and make it easier to handle** lets offer 10 of the "nail" head spokes and start inserting them so they lay in the opposite direction from the first set of 10 flange side spokes. (see spoke 2 in picture). Put the last 10 "nail" head spokes in place and finish the wheel by offering the remaining 10 flange side outside spokes.

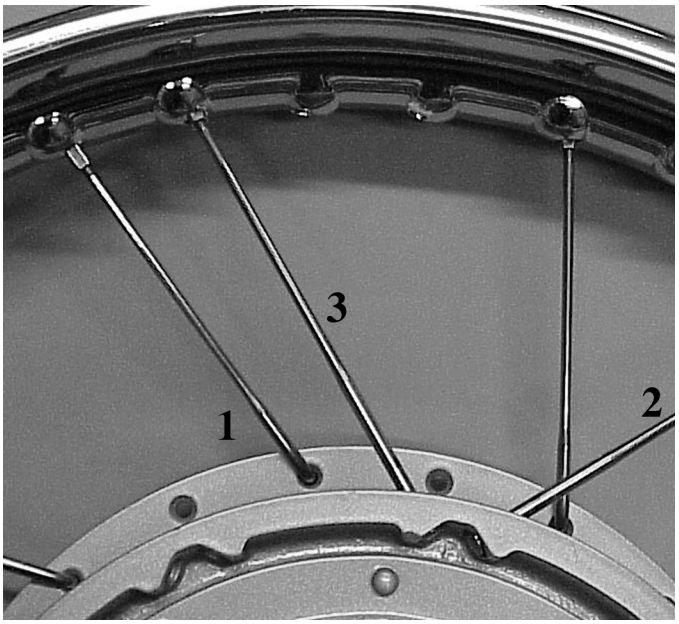
There is a way of running the spoke nipples on the spoke that makes the final job easier. If you are only doing the occasional wheel you can just thread each nipple on until only a couple of spoke threads show.

I have done this successfully for years.
If you are doing a lot of wheels you may want to modify a screw driver by grinding back the edge leaving a "tit" in the middle. You adjust the length of the tip until it lifts the screw driver out of the nipple with only a couple of threads showing on the spoke. The "tit" also keeps the screwdriver from slipping out of the spoke nipple as you turn it.

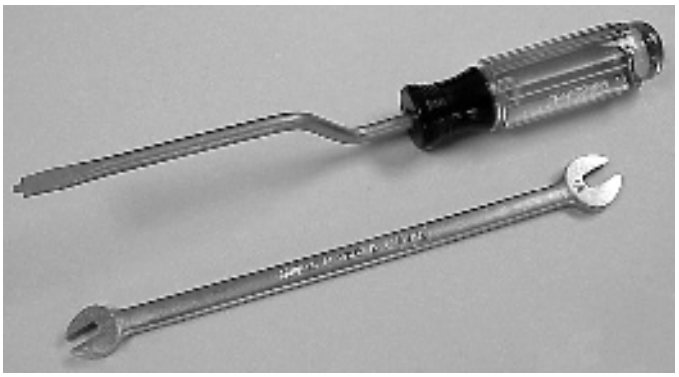


View from Brake flange side. Installing the last set of 10 brake side outside spokes.

Some wheel builders use a “Yankee” screw driver or an swivelling offset screwdriver. They make a special straight bit or modify a Phillips screw bit as illustrated. Two of the blades are ground off and the leading edges of the remaining two blades squared off. The “tit” engages the spoke and lifts the bit out of the nipple as the nipple is screwed on the spoke leaving all 40 spokes threaded equally. With time the length of the “tit” is adjusted.

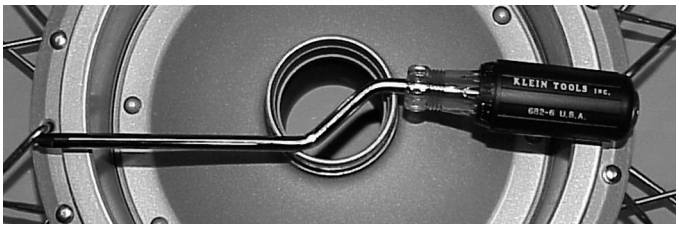


Viewed from “nail” head spoke side.
After lacing all of the brake side-inside spokes **(1)** laying them counter clockwise, as shown above, push the opposite side Nail head spoke **(2)** into the hub hole so it lays clockwise. Finish lacing by inserting the other nail head spoke **(3)** laying counter clockwise and finish with the brake side - outside spoke laying clockwise.

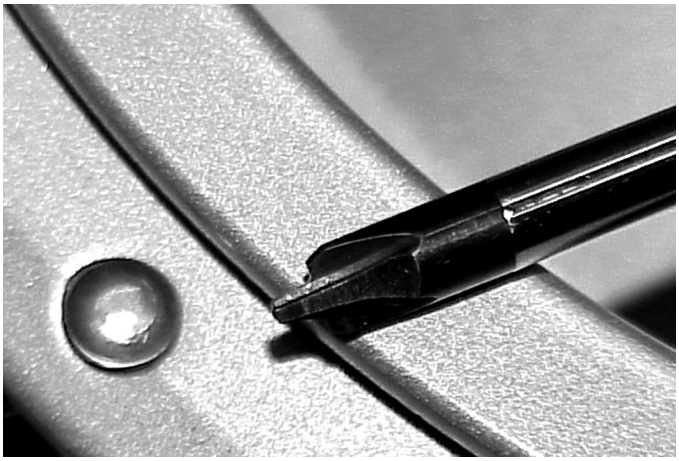


Modified Craftsman offset screwdriver (#41331) and my favorite Snap-on Spoke wrench (Snap-on #1351).
You will have to file the opening a bit to get the wrench to fit the nipples snugly.

Photo A: View from Brake flange side.
The pattern of the dimples and how the spokes lay into the holes can be seen in this photograph. Note that the spokes are butted. 8 ga. at the hub and 10 ga. at the rim. The nipples are .300” in diameter.



I use a swivelling offset screw driver to do the initial tightening of the nipples. The tip has been modified, see below. It speeds up offering the nipples.



This screw driver tip started as a phillips head. Two of the blades have been ground back and the leading edges of the remaing two have been ground square. This leaves a “tip” in the center that hits the spoke as the nipple is being tighten. It lifts the blade out of the nipple and leaves all of the nipples threaded evenly on the spokes. I bought this one at Home Depot and modified it on my grinding wheel. It is possible to do the same thing with a regular screw driver by leaving a couple of threads showing on all of the spokes.

Reflections in the Rim

by John Healy

Check the parts

Nipples:

Most British bikes use .250 inch or .300 inch diameter nipples. On the other hand some British replacement rims made in Japan use .281 inch diameter nipples.

It is of more than passing interest that the major supplier of spokes in the US offers British replacement rims made in Japan. More importantly they are also fond of supplying some of their Triumph replacement spoke kits with .281 inch nipples. Measure the "piercing" in the rim for the nipples and be sure you have the right diameter nipple to fit the hole. If you find your rim is pierced for .300 inch nipples and you have .281 inch in the kit do not continue. The smaller nipples can pull right through the hole in the rim as the spokes are tightened. Some Rims are handed:

Go to most any bike show and you will see wheels where the spokes curve as they meet the nipple. This can happen if you have the wrong rim, but more often than not the rim is correct, and the spokes bend because the rim was laced on "backwards." The holes in the rim for the small diameter side of the hub are accepting spokes from the large diameter and visa-versa.

Typically rims for "straight" or "spool" hubs, where the angle of the spokes are the same for both sides, are not handed. Triumph front wheels from 1963-1970 using rim 37-1230 are not handed. Norton rear drum wheels using rim 06-7712 are not handed.

Rims for wheels with hubs that have spoke flanges of different diameters are usually handed. Triumph rear wheels for 1963--1970 using rim 37-1007 are handed. Norton disc brake front wheels offer a different reason for a handed rim. Even though the wheel uses a spool hub, because of the radical offset to clear the front brake caliper, Norton owners should note that their front rim 06-1951 is handed.

Anytime a wheel hub has two different diameter spoke flanges, or the rim has a radical offset, such as with Norton front disc wheel, one should check the replacement rim. If you put the rim on "backwards" the spokes will bend as they near the nipple. A curved spoke is not only visually distracting, it weakens the wheel.

Before starting compare rims:

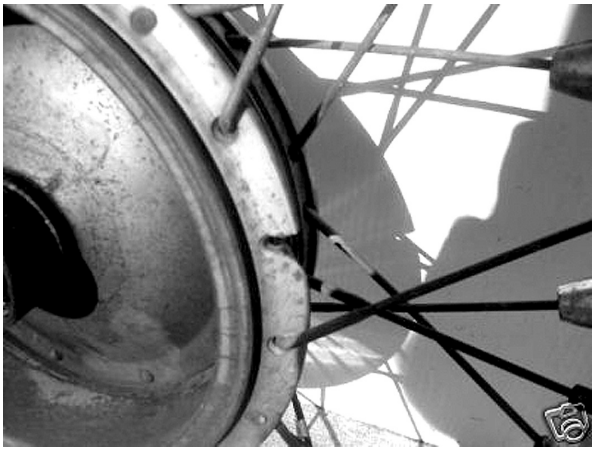
It is possible to lace rims with different spoke patterns to a hub as long as they were pierced at the correct angle to suit the hub's spoke flanges. In fact most wheel builders stock a dozen or so basic rims and adapt the spoking pattern to suit. It just makes good economic sense, but for the restorer or novice wheel builder it just adds another hurdle to overcome.

Most novice wheel builders are not able to look at the rim and see the spoke pattern required. They usually take a picture of the wheel before they take it apart or copy another laced wheel. The generic rim, a great economic benefit to the professional wheel builder, can be a novices nightmare.

If you are a restorer, and wish the rim to look just as it did as it left the factory, or you are new to wheel lacing it is best to search out a supplier that will honor your request for a "stock" pattern rim. It could cost a bit more money than the generic, but it will make the job easier and you won't have some know-it-all pointing out that you have laced the wrong rim.

A Triumph rim pierced to accept a .300 inch nipple with a smaller .281 inch nipple. I show this because in the US .281 inch Japanese style nipples often find their way into Triumph spoke kits. It is possible this nipple could pull through during tightening, or fail in use, it is important to be sure you use the correct nipple for your rim.

A few minutes on a bench grinder, touched up with a file and you have the perfect wheel building screwdriver. The tip secures the blade in the nipple and then pushes the screwdriver out of the nipple as the spoke hits it. It quickly threads all the nipples to the same depth.



These castings are getting old and have often been abused. Before lacing and truing one of these wheels I would carefully check the hub for cracks. Although Buchanan suggest in the literature that comes with the spokes to tighten them to 65 inch pounds, I would suggest that you keep the tension to 30 to 35 inch pounds. I would also try to be sure that you have ALL the spokes tightened evenly. This way no one spoke is taking all of the load.

Loosen First:

If there is a single concept to remember when learning to true wheels it is check for overtight spokes and — LOOSEN FIRST! Whether you are moving the rim to establish the offset, trying to move a section that has a wobble or trying to remove a hop, you should always attempt to loosen the offside (as with a wobble) or low spot (as with a hop) spokes first.

If you wish to move a section of the rim to the right… check, and loosen (if tight), the opposing left side spokes first. If you still have to move the rim a bit more you can then tighten the right side spokes.

If you are trying to remove a high spot, first see if any of the spokes in the ajoining low spots are tight. Often this is all you will have to do to move the rim enough to be straight or true.

You will often find a wobble or hop caused by a single or small group of overtightened spokes. It is inevitable that some spokes will get tighter before the rest. As a spoked wheel is a geometric object, tightening a spoke, or a series of spokes, will draw up a spoke, or series of spokes, somewhere else on the rim. So remember check and loosen off-side or low spot spokes first.

Flat spots:

Flat spots are often more the result of a novice wheel builder's efforts than the manufacturer of the rim. Except for the area near the weld, flat spots in new rims are usually introduced by the person truing the wheel. Because of the way rims are made it would be difficult to introduce a flat spot in the rim during manufacture. The typical flat spot in a new rim is at the weld and is usually well within the tolerance allowed. Any deflection in the tire caused by such a flat spot would not be detectable when riding the bike.

I have laced rims returned as "defective" because of such "weld" flat spots to where 95% of the rim would lace to less than .010 inches deflection and the "flat" spot would measure an additional .005 inches or only .015 inches total. This is well within wheel building tolerances.

Tighten the spokes evenly:

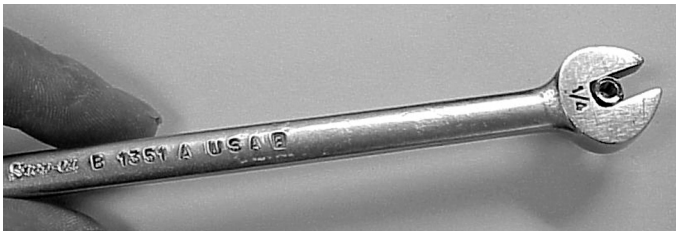
This statement is often misunderstood. What it doesn't mean is to tighten each spoke the same amount no matter how tight it is becoming. If you are going around the rim taking a full turn on each spoke, and you come to a spoke that is obviously tighter, either skip it or better yet loosen it until it is the same tension as the rest of the spokes. The goal is to get the rim true and straight with ALL of the spokes the SAME tension.

Often, that tight spoke will introduce a wobble, hop or flat spot in what was a perfectly round and true rim. Except for a flat spot caused by an accident, it's rare that the most imperfect rim cannot be trued so that it is acceptably round and straight. That said, lack of skill could take a perfect rim and leave it laced so it hops and wobbles so bad as to render the wheel unusable. Lacing, truing and tensioning wheels is not a black art, but a learned skill.

Loose spokes:

Whether loose from abuse or just not tensioned properly when built, a wheel with loose spokes will cause problems! There is constant changing load on the wheel as it rolls. If the spoke isn't tensioned properly it will stretch

Put a pair of nipples in one side of the rim as above. With a small scale measure how wide they are. Do the same to the other side. On a 1963-1970 Triumph rear rim # 37-1007 the difference between the two will be about 1/4 inch. The widest pair will go on the brake drum side of the hub. To ease assembly mark this side "brake drum."



I bought this Snap-on wrench, and modified it for spoke nipples, when I first started to work for Andrews Motorcycle Sales in 1959. Pete Andrews, a wheel builder at Indian Motorcycles, got me started building wheels and could true a wheel in the time it took him to smoke a Camel.

and relax with each revolution of the wheel.

Remember when you found out that you could break a wire coat hanger by bending it back a forth? Well this is what is happening to a loose spoke, and just like the coat hanger it will eventually break.

The proper stretching of the spoke during initial tensioning actually protects the spoke, and especially the bend, from the rigors of a constantly changing load. Proper tightening avoids this by stretching the spoke beyond the point where typical pulsating loads will cause any stretching or bending as in the case of the head of the spoke.

Thus the proper tightening is some where *between* where the spoke is stretched beyond its yield point, and not be able to return to its original length, and the amount it will stretch under normal loads. To quote Ray Englehart from his article on ***The Nuts and Bolts of Motorcycle Fasteners*** Motorcycle Consumer News, October 1999, "In theory, so long as the preload is greater than the greatest load in the cycle, the fatigue life would be infinite."

Just how tight is tight:

Although seemingly simply, it is probably the most difficult wheel building skills to learn. Although a few manufacturers tout torque figures, few wheel builders have the equipment to measure the tension on the spoke. Most wheel builders rely upon "feel" to get it right.

Although I have seen and used tension-measuring devices on bicycle wheels, whose thin spokes lend themselves to such devices, I have never seen one for a motorcycle wheel. In fact I have never seen a motorcycle spoke tensioning gauge offered for sale.

So how do you get the spoke tension right? First and foremost you *start with a spoke wrench that fits the nipple***.** If the wrench is loose on the nipple you will never get it tight. This often requires that you modify several 8 inch to 10 inch open end wrenches by grinding or filing the openings until they fit the nipples perfectly.

I started out with 1/4 inch and 3/16 inch 8 inch long Snap-on open end wrenches. A short spoke nipple wrench, such as the one made by Rowe USA, is great for initial lacing (to keep from damaging the rim I have radiused the edge of face of the Rowe spoke wrench), but to get a heavy 9 or 8-gauge spoke tight requires a properly fitting 8 inch or longer wrench.

One way to get the "feel" of a properly tightened nipple is to check the tightness of a several wheels that have been done by a professional wheel builder. Sound is another way to check the tension of the spokes. Remember that you are trying to get the spoke to stretch more than it ever will with the loads it will encounter in normal service. Heavier 8 gauge spokes will require more tension to reach the required stretch than a lighter 10 gauge or 8-10 gauge-butted spoke.

Tap the spoke with the spoke wrench and if the spoke doesn't ring "clear", and the sound is flat, the spoke is not tight enough. Check a professionally built wheel and you will get feeling of just what different gauge spokes should sound like when the nipple is tight enough.

Points to reflect upon:

— To prevent permanently damaging the rim or grave personal injury, be sure the diameter of the nipple matches the hole in the rim. Unless you want the nipples to pull through the rim, don't get caught putting .281 inch nipples in .300 inch holes! Many of the British spoke kits from Buchanan come with .281" nipples designed to be used in Japanese rims.

— With a good set of spokes that are all the proper length, running each nipple on the spoke so that the same amount of threads are showing on all spokes will get the rim running pretty close.

— Loosen first! Removing wobbles or hop? Check to see if you have a tight spoke pulling it out of line first.

— It is much easier locating the rim to the hub (often called offset) when the spokes are only just coming up snug. At this stage, often just loosening a set of spokes will do the trick. Then start with making rounds taking full turns on each nipple. It is certainly much easier at this point to get the offset correct than when the spokes are all tight.

— Before assembly oil the spokes and nipples, or if stainless spokes and/or nipples are used, lubricate with anti-seize compound or supplied lubicant..

— The wheel is a geometric object… if you tighten a spoke, any spoke, it will have some effect on all the rest of the spokes. It will have the most effect upon the spokes diametrically opposite. So when you make a change in one area you must check to see what effect it has had on the rest of the rim, especially directly opposite. The key is to make small changes, check to see what the change did and remember to check for overly tight spokes and loosen first.

— If stainless spokes have been electrochemically polished special care must be taken as the process removes some of the thread from the spoke. This weakens the threads and special care must be taken. Buchanan strongly suggests these spokes be used in static displays only (show bikes).

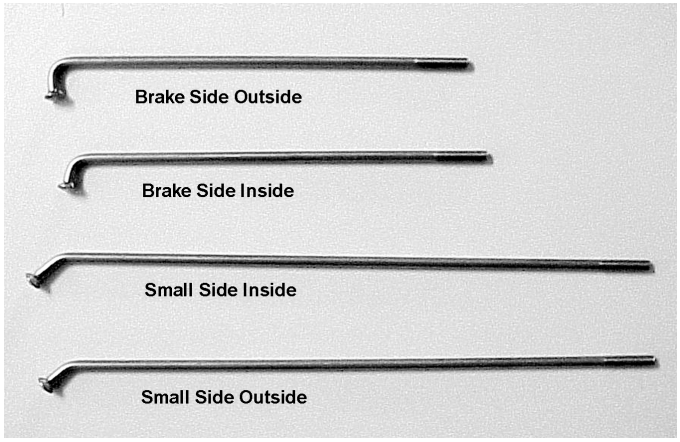
— If you are rounding the nipple before it is tight you need a better fitting wrench. Stainless nipples are often preferred by novice wheel builders. The chrome doesn't peel from abuse from ill fitting spoke wrenches.

— You should strive to get all of the spokes the same tension. Ending up with spokes with different tensions will be near impossible to true and will make a weaker wheel.

— When the truing is finished in order to prevent the spoke from puncturing the tube, check and grind flush any spoke that protrudes out of its nipple.

Lacing Triumph BSA Front Conical

by John Healy



Put a pair of nipples in one side of the rim as above. With a small scale measure how wide they are. Do the same to the other side. On a 1963-1970 Triumph rear rim # 37-1007 the difference between the two will be about 1/4 inch. The widest pair will go on the brake drum side of the hub. To ease assembly mark this side "brake drum."

The front conical rim (37-3818) is **handed**. You can see from the pictures that the angle the nipple exits the rim varies from one side to the other. To verify this place loose nipples in the rim and compare the angles of each side before offering the rim. This simple step will save you from having to remove and relace the rim if you guessed wrong.

If you are using Buchanan spokes you will have to check to see if they fit into the spoke holes in the hub. Typically you will have to increase the size of the hole in the hub to accomadate the new Buchanan spoke. This is normal. You will also have to have enough room in the hole to allow the spoke to be rotated to its final position. Care should be taken to be sure the inside set of 10 on the small-side of the hub (off-brake-drum-side) can turn freely as they are offered in position.

Each set of 10 spokes for this wheel is unique and must be placed in the proper hole. See picture of spokes for further explanation.

NOTE:
*The hub used in the pictures is **chromed plated** and special care must be taken to insure the spokes are able to be fit into the spoke holes and move freely in the hub before it is plated. This would be the same if you are going to paint the hub. It is an understatement to say: "it is a bit of a bother to have to drill out spoke holes after you have chrome plated the hub."*

First Set of 10 Spokes:
This rim laces differently to the conical rear rim. While there is a bit of leeway when you begin to lace the spokes to the rear wheel, the front wheel is not that forgiving. You must start with a specific spoke. What I like to call the **key spoke**.

With this wheel the **key spoke** is the **brake-side-inside** (the one I like to start with first). It is offered to the **clockwise** most spoke hole of the brake-side pair as viewed from the **large-side** of the hub.

Place the spoke into the hub from the outside, turning it so it radiates **clockwise** as viewed form the **brake-side** of the hub. Locate the dimple in the rim with the hole facing the spoke on the **rim's brake-side**. Offer the nipples so a couple of threads still show.

Second Set of 10 Spokes:

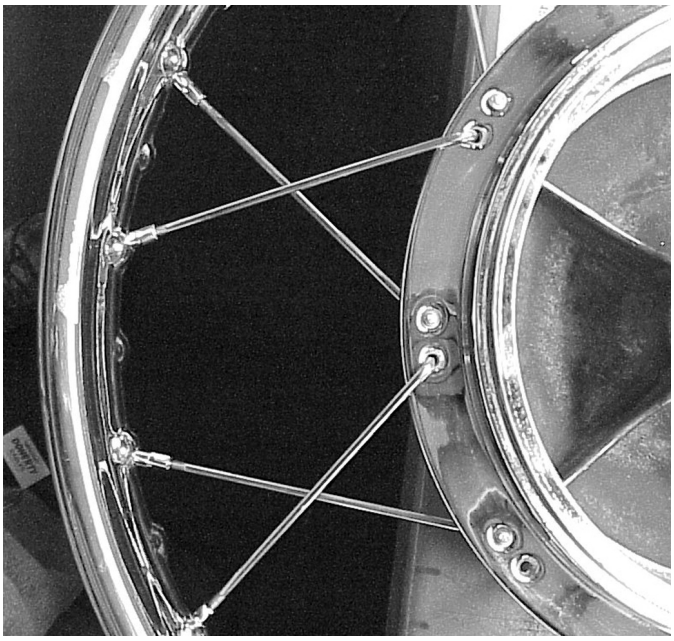
Still on the brake-side offer the next set of spokes. From the inside of the flange offer the remaining 10 spokes laying them so they radiate **counter-clockwise** when viewed from the **brake-side**. Locate the dimple on the rim with the hole facing the spoke on the rim's hub-large-side. Offer the nipples so a couple of threads still show.

Third Seto fo 10 Spokes:

Now move attention to the **small-side** of the hub offering the 10 **small-side-inside** spokes and lay them so they radiate **clockwise** as viewed from the **small-side** of the hub. Locate the dimple on the rim with the hole facing the spoke on the hub's small-side. Offer the nipples so a couple of threads still show.

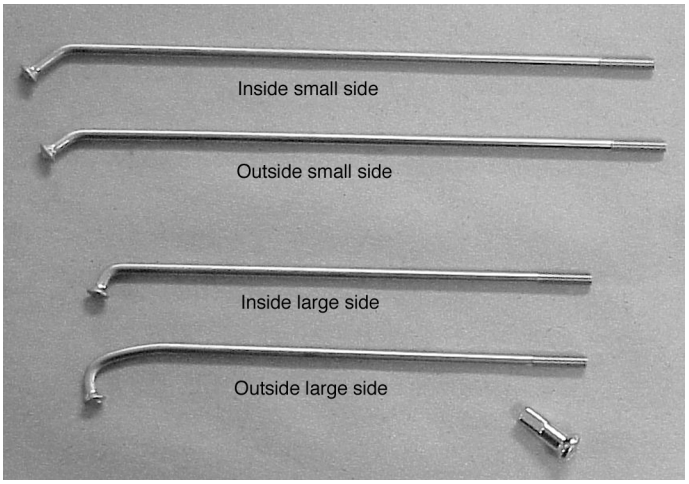
Last Set of 10 Spokes:

Next offer the **small-side–outside** spokes and lay them so they radiate clockwise as viewed from the small-side of the hub. Locate the dimple on the rim with the hole facing the spoke on the rim's hub-small-side of the rim. Offer the nipples so a couple of threads still show.



Lacing Triumph BSA Rear Conical

by John Healy



The set of 40 spokes for the rear conical wheel consists of 4 sets or 10 spokes each. Buchanan spoke sets are made to fit a rim that is dimpled and pierced to the original pattern.

Buchanan supplies a heavy duty spoke for these wheels. For the spokes to fit into the hub you will have to enlarge the holes in the hub.

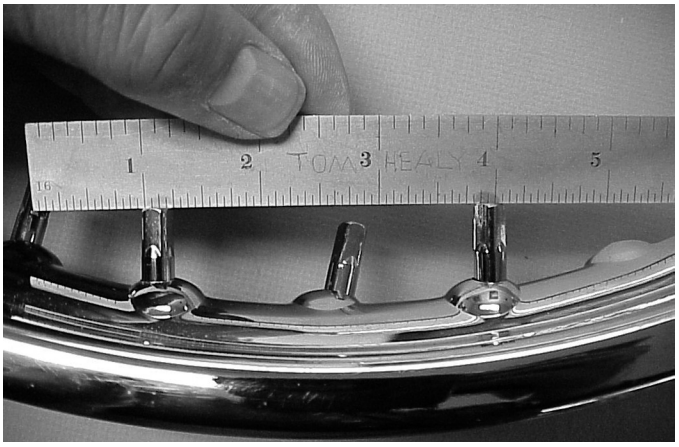
The Conical wheel rim is handed. You can see from the pictures that the angle the nipple exits the rim varies from one side to the other. To verify this place loose nipples in the rim and compare the angles at each side before offering the rim. This simple step will save you from having to remove and relace the rim if you guessed wrong.

If you are using Buchanan spokes you will have to check to see if they fit into the holes in the hub. Typically you will have to increase the size of the hole in the hub to allow the spokes to enter the hole and turn in the proper direction. Only enlarge the hole until you are able to insert the spoke and turn it toward the rim. It is important that you enlarge the holes in the same direction as the original holes.

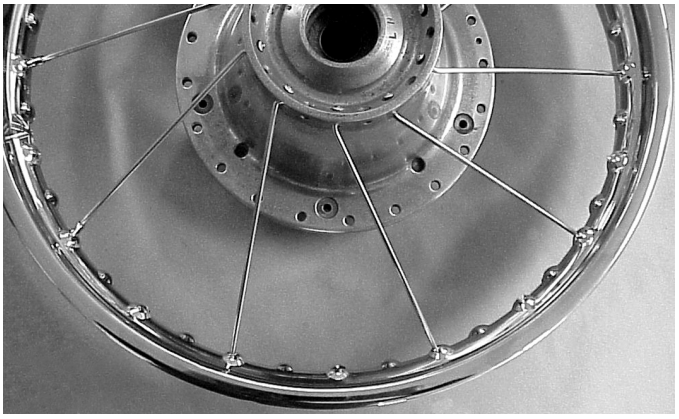
You will want to start with the off-drive side (right) set of twenty spokes. They are the longer ones. These spokes are made up of two sets of 10. An inner and an outer. The inner have a longer bend at the head as can be seen in the photo. Offer these first radiating counter clockwise as you view the hub from the right side. Run the nipple on these 10 spokes until thee is still a couple of threads showing.

Now offer the 10 outside spokes and radiate them clockwise as viewed from the right side. Do not put the nipples on these spokes yet. You will want to be able to move them to get the drive side inside spokes in place.

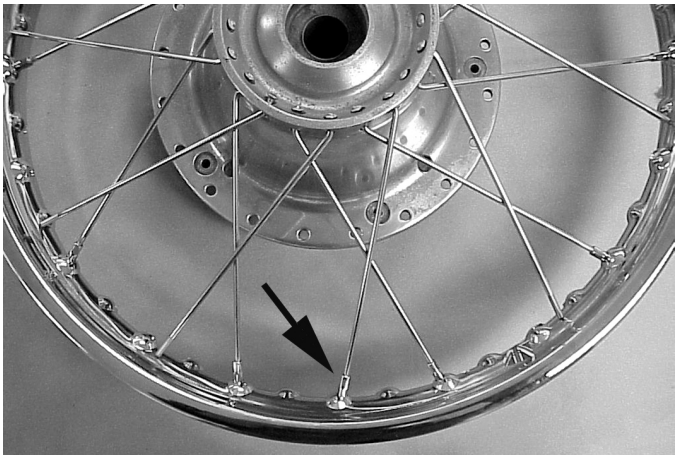
Now switch your attention to the drive side (left). You start with the inside set of 10. Offer the first inside spoke as shown in the picture. You will have to angle the spoke as you offer it to clear the right hand side spokes. These spokes radiate counter clockwise as you view the right side of the hub. Offer the nipples to these spokes running the nipple up until a couple of threads still show.



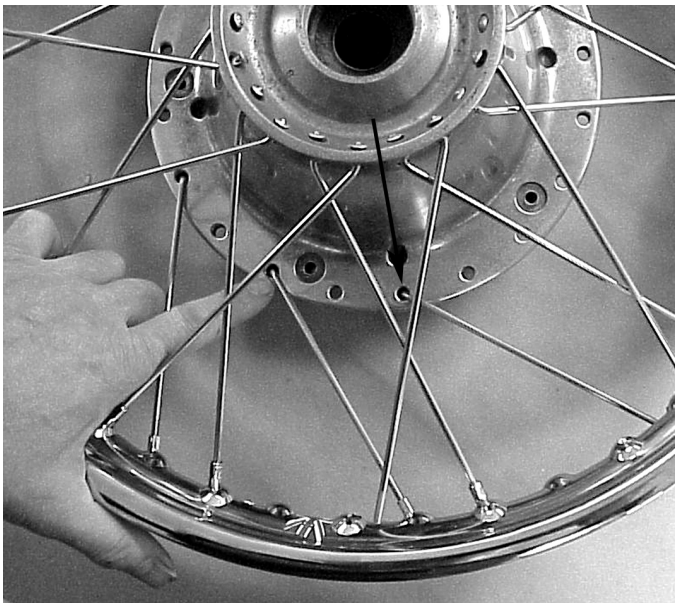
Put a pair of nipples in one side of the rim as above. With a small scale measure distance between the centerline of the nipples. Do the same to the other side. The widest pair will go on the brake drum side of the hub. To ease assembly mark this side “brake drum.”



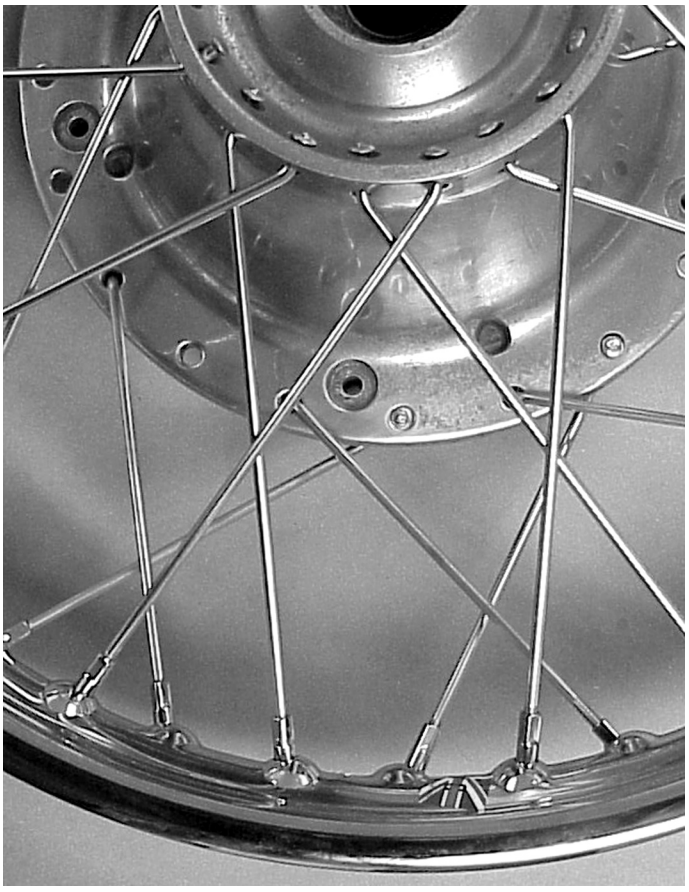
Start with the 10 inside spokes on the small side of the hub. Pass the spoke through the hub and turn it counter clockwise. Offer the nipple to the spoke as shown



Offer the 10 outside spokes to the small side of the hub. Pass them through the hub and turn them clockwise. Do not attach them to a nipple at this time.



Turn your attention to the large side of the hub. Offer the 10 inside spokes and turn them counter clockewise. Notice that you start in the hole indicated by the arrow in the picture above.



Offer the last set of ten outside spokes turning them clockwise on the large side of the hub and finish by affixing all the remaining nipples.

When first offering the nipples onto the spoke leave a couple of threads showing when first offering the nipples

Now go back and offer the nipples to the 10 right side outside spokes and run the nipples on the spoke as above. Now is a simple matter to offer the 10 drive side outside 10 spokes which will radiate clockwise as viewed from the right side of the hub. Offer our nipples as above and you are ready to start truing your new rim.

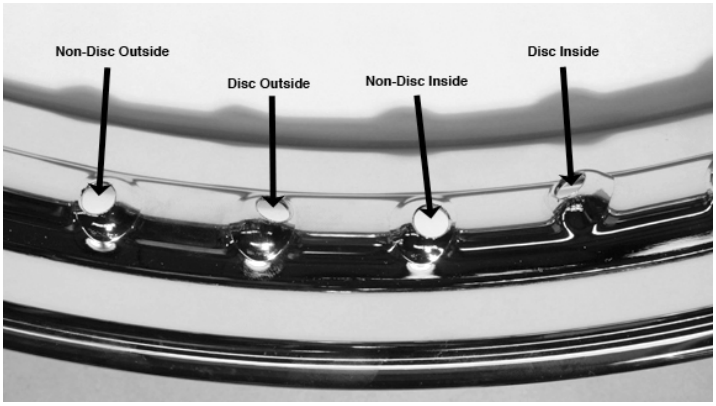
PLEASE READ BEFORE INSTALLATION
Special knowledge and Training Required

_____Working on a motorcycle often requires skills not normally acquired through daily living. We feel that special training is required to install this product. It is beyond the scope of this document to supply you with all the information and training required to lace, true and tension this product properly.

If feel you have the expertise and choose to perform this work it is with the understanding that you assume all liability arrising from the installation and use of this product.If you do not wish to accept all liability for this product return it for a full refund. If the dealer fails to cooperate please call 1-508-946-1144 for further assistance..

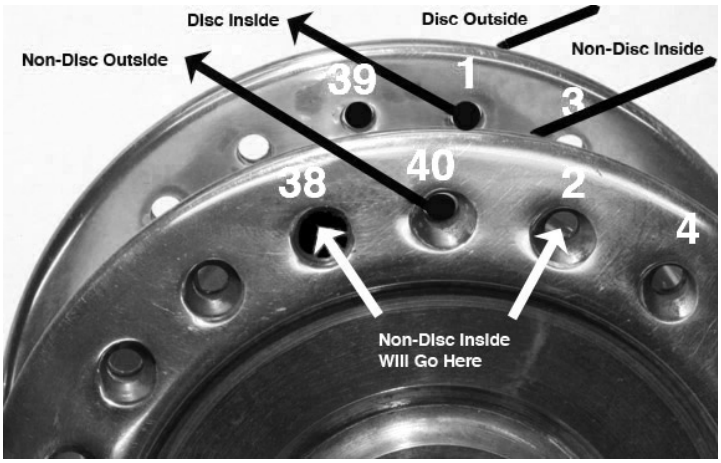
Further information on lacing and truing wheel rims is available in the Triumph workshop manual. **Improper lacing, truing and tightening spokes can make the motorcycle extremely dangerous to operate. Operating a motorcycle with improperly installed, trued and tensioned wheel rims can lead to death or worse.**

If you feel that you do not have the required skills or lack the training **DO NOT INSTALL THIS PRODUCT!** Please, return this product to the dealer who sold it for installation or a refund of your purchase price. If the dealer fails to cooperate please call 1-508-946-1144 for further assistance..



In the picture above the three dimples are on the left, and the single dimple is on the right. The three dimples in a row go on the non-disc side.

• This rim is dimpled, and drilled, in a 3x1 pattern. **One of the dimples is on the disc side. The remaining three are on the non-disc side.**
• So you don't "get off on the wrong foot" put a "D" on the single dimple side of the rim.
• The three dimples on the near side of the picture are
• You can put a short length of tape on the rim and mark the spoke holes to help you remember which spoke it will receive.



• **All of the pictures are taken from the non-disc side**.
• You will want to offer all 20 of the inside spokes first.
• Pick any hole in the disc side flange and offer the 10 disc side inside spokes radiating them counter clockwise as viewed from the non-disc side.
• Come directly opposite hole #1 to the non-disc flange. The spoke hole adjacent and just to the right will be non-disc side #2 or inside spoke. Put your first non-disc side inside spoke in this spoke hole follow with the other 9 and radiate them all clockwise.
• Finish by putting the 20 outside spokes in the hub as pictured.

Norton Front Disc Rim 06-6119

Central Wheel Norton disc front rims are dimpled and drilled in a different pattern than the stock Norton Disc Rim! When laced it will be easier to true, easier to establish the offset and in the end be a stronger wheel. It is stronger and easier to true because they cross the disc side outside spoke to the non-disc side dimple. This makes the rim easier to true and gives the wheel more lateral stability.

The rim is handed. You will notice the dimpling follows a 3x1 pattern. The single dimple on the disc side. The three dimples in a row go on the non-disc side. It is a confounded nuisance to discover you put the rim on backwards after offering a dozen odd spokes.

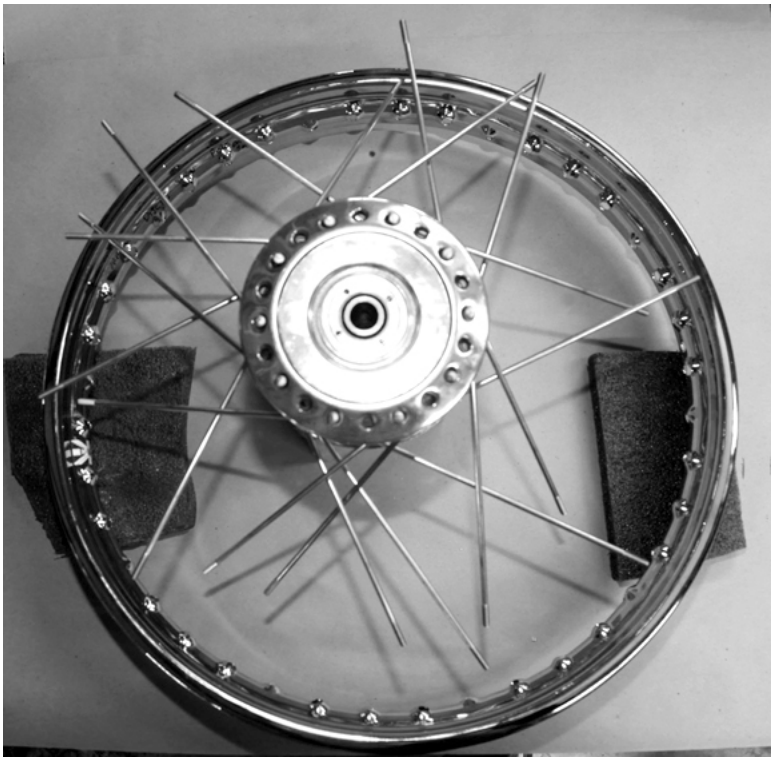
The original rim had all 20 disc side spokes vertical. This gave you little, if any, control on setting, and holding, the rim's 1/2" offset. By moving the disc side outside spoke to the opposite side of the rim it gives you more ability to establish the offset and hold it as you tensioned the rim.

This 3x1 lacing isn't something new. This pattern has been used by Triumph on their rear disc wheels since 1973.

Because of the spoke pattern these disc wheels have always been one of the harder wheels to do. Your success depends a lot on getting the spoke tension as even as you can right from the start. Remember it is just as important to loosen a nipple that is coming up tighter than its neighbors as it is to tighten a nipple that is looser.

It is also important to establish the rim's offset at the start. Trying to move this rim once the spokes are getting tight is difficult at best. To overcome some of the difficulty I work with the 20 disc spoke nipples first. I leave setting and tensioning the non-disc nipples to the end.

• The 20 inside spokes lay in different directions.
• Viewed from the non-disc side: disc spokes radiate counter clockwise the non-disc spokes radiate clockwise.
• To start you put the 20 inside spokes in place and put them into the single hole on the disk side.



• To start you put the 20 inside spokes in place radiating in the correct direction.
• You will have to do some weaving but when you are done it will look something like this.
• Those two pieces of 1" stiff foam are real handy.

With this wheel I break from my normal routine of bringing the top ALL of the nipples to the end of the spoke threads. **What I will do is bring all of the disc side nipples to the end of the thread and all of the non-drive side nipples a little more than half way.**
• With the rim in the truing stand I go around the rim taking a couple of turns on each of the disc side nipples. I do this until the some of the nipples start to engage the rim and it begins to stabilize

• Remember I have left all of the non-disc side nipples loose.

Now working with just my fingers with the nipples that have seated I get all of the hop and most of the wobble out of the rim. It is just as important to loosen nipples as it is to tighten them to move the rim.

The eureka moment in wheel building is when you realize that thee are two steps in building a wheel: Truing and tensioning.

• Now I go around the disc side nipples with my fingers threading any nipples that have not seated yet, up to the rim. Then I take a trip around the those 20 nipples loosening any that have come up more than finger tight and tightening any that have loosened. The rim should be still true.

My goal is to have equal tension on ALL twenty disc side nipples and the rim running true (especially hop).

• At this point you look at the rim's offset. Place a straight edge on the side of the hub where the disc is mounted.

Because the non-disc side spokes have the ability to draw the rim out of its 1/2" offset as you tension them we need to move the rim as far as you can get it away from the hub's disc surface.

• Half way. All of the nipples are run up so they are half way up the spoke threads. This allows the rim to move a bit making it easier to put the outside spokes into the rim.

• After all of the outside spokes are in place run all of the disc side nipples up so the square head of the nipple is even with the end of the spoke's threads. Run the non-disc side nipples up past half way.

• Be sure to lubricate spoke threads and the underside of the nipple where it rests on the rim!
• This rim is drilled for .300" nipples. Do not use .281" or 250" nipples!
• Don't assume you have .300" diameter nipples - measure them.
•The slip of paper included with Buchanan spokes indicating to tighten the spokes to 80" pounds refers to Harley wheels. It is easy to get 45 pounds on the disc side spokes, but you will need to be clever to get 35 pounds on the non-disc side nipples. This will only happen when you get ALL of the spokes tensioned evenly. If you over tighten the nipples you will crack the chrome and/or pull the nipple through the rim.

• To start the process of setting up the rim offset you want to move the rim as far as you can to the disc side. When you tighten the non-disc side spokes it will pull back quickly.

In talking with Brian Slark (Norton's US Service Manager) he claimed the wheel builders at the factory put the wheel assembly on the floor, disc side down, and stood on the edge of the rim to move it as far away from the 1/2" offset as they could. They then tapped the non-disc side outside spokes bending the spoke's hook to relieve the tension. His help keep the rim in position.

• With the offset of the rim as far as you can get it to the disc side start taking turns around the rim on the disc side nipples until they come up to full tension. For this rim, and the disc side nipples, it would be near 35 to 40 inch pounds at the final truing.

Half Way There

• Now is time to turn you attention to the non-disc side nipples. You all ready got all of the hop out of the rim with the disc side spokes. Go around the rim and thread all 20 non-disc side nipples until the seat on the rim.

• Go around again taking a turn or two making sure to loosen any nipple that starts to come up tight before the others. What you want is to have all 20 nipples evenly tightened before you do final tensioning.

Much of your success getting this rim true and tensioned is in your ability to get all of the spoke

• You are looking for 1/2" offset.
Hold the straight edge on the hub's brake disc mounting surface. Measure 1/2" from straight edge to side of rim.

tensions even. It is an important detail with wheel building, but especially with the original, or this version, of the front disc Norton rim, or the Triumph T140 rear disc rim.

• At this point turn your attention to all 40 nipples as you go around. Take a turn, or two, being sure to balance the tension as you go. You want to pay close attention to the offset at this point. Check after each go around. You will see that initial offset will be quickly pulled to 1/2" or less if you don't pay attention.

In the end the disc side spokes will be tighter than the non-disc side, but if you get the nipple tension even at the beginning the difference will not be too much. I usually see around 40 inch pounds on the disc side and 25 to 30 inch pounds on the non-disc side.

Remember these rims will not handle the 80 inch pounds you see recommended on the Buchanan information sheet that comes with their spoke sets. These are not the Harley rims that tension is recommended for!

Note: The disc side inside spoke, being near vertical, has no axial pull on the rim and will only influence the rim's hop. But the disc side outside spoke crosses to the non-disc side of the rim and will provide a little axial pull on the rim. This tension will help pull the rim back toward the disc side helping you a little bit in maintain your ½" offset. When tightening I often favor the outside spoke a bit over the inside spoke to provide a little axial pull on the rim to the disc side.

More times than not at this point the rim will have very little hop and a little bit of wobble. Often you will find yourself loosening a couple of the nipples that came up tight and you can get the rim running very true.

If as you tighten the non-disc side nipples you loose the 1/2" offset DO NOT keep tightening the disc side nipples to try to pull it back. You will pull the nipple through the rim before the rim will budge.

It is best to unloosen the non-disc side spokes and start over getting the rim as far as you can toward the disc side. Often placing the wheel on the floor and standing on the rim pushing the rim toward the disc side of the hub And setting the non-disc side outside spokes with a leather, or plastic, mallet.

Once you get the rim laced, if you follow the drill where you snug up the non-disc side spokes truing the rim for hop (getting it about a .010" average), and most of the wobble while all of the nipples are finger tight leaving all of the non-disc side nipples loose it will go a lot quicker. The other thing you need to do is to push the rim as far away from the disc side of the hub as you can. It helps if while the rim is pressed past the 1/2" offset that you tap the outside spokes with a leather, or plastic, mallet a couple inches away from the spoke's hook.

John

Norton MKIII Rear Wheel

using Central Wheel 3x1 dimpled rim

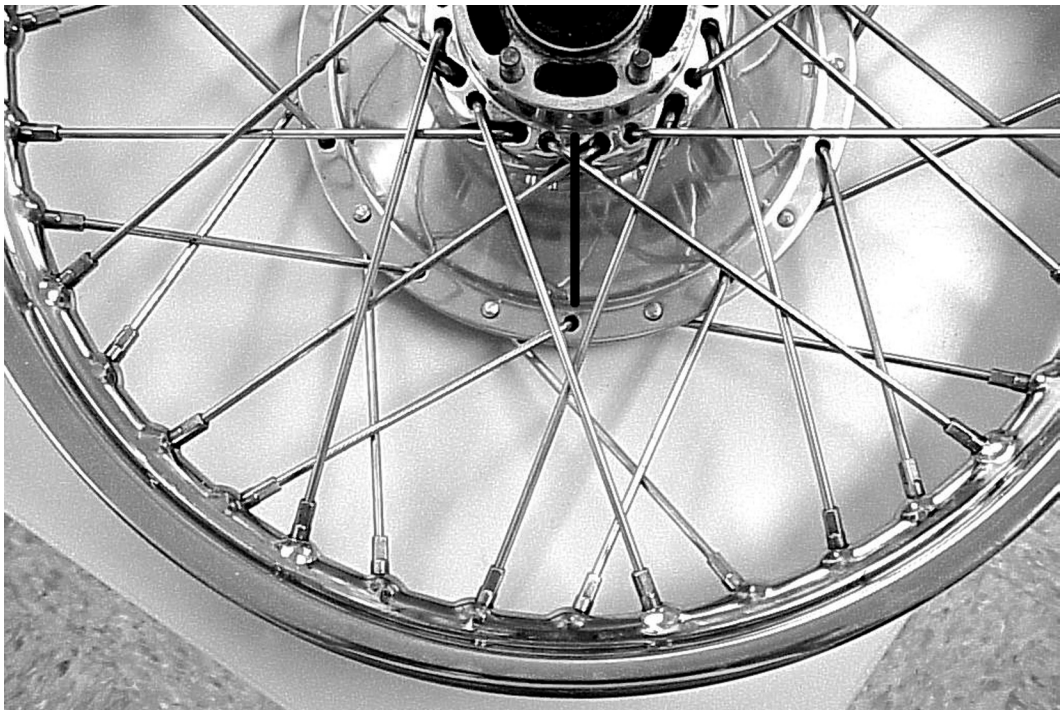
Norton disc wheels are fun to lace and offer the newby a real challenge. The superimposed line above indicates how to offer the drive side inside spoke.

This rim is handed. The three dimples in a row go on the drive-side of the wheel. The single dimple goes on the disc-side.

The offset: 1 1/16” from the drive-side edge of the aluminum hub. As we know of no factory specific information about the rim offset and as such this dimension has been taken from a stock wheel. To be sure you have the correct offset for your wheel measure your wheels offset before taking it apart.

Lacing Norton disc wheels has always been a challenge. With the disc side spokes radiating out from the rim/hub in nearly a flat plane it is hard to get the rim offset correct (though not as hard as the earlier Norton rear disc wheel). The disc side set of spokes, being nearly vertical, or right angles to the rim/hub, provide very little sideways pull for the wheel builder to locate the rim.

We are looking at the wheel from the disc side. You can clearly see the 3x1 dimpling with the three dimples in a row on the drive side of the rim. The single disc side is in the foreground. This puts a little angle on one of the disc side spokes making the wheel stronger and easier to true.



The off-disc-side set of spokes, being at a more normal angle to the rim/hub, exert a lot more sideways pull on the rim.

Central wheel, with their 3x1 dimpling pattern (standard on the T140 rear disc wheel), have offered some help. With one of the disc-side spokes crossing over to the 3 dimple side, they have created a little more angle on the spoke and this gives the wheel builder a bit more control over the rim alignment.

Thus where it was nearly impossible to pull the rim back toward the disc with the stock 1x1 dimpling, the 3x1 dimpling gives you one set of spokes that have some effect when trying to pull the rim to the disc side.

The key spoke in lacing this rim is the off-disc-side inside set of spokes. These are offered from the outside of the hub and are turned so the face in a clockwise direction. The proper hole can be located by looking across from where the disc side spokes cross.

Although the drive-side-inside spoke is the key spoke, when starting to lace this wheel it is more convenient to put it in place after you offer the longer disc-side spokes. Placing disc-side spokes in the rim should be obvious. You will end up doing a bit of spoke flipping, but you will quickly sort this out.

Once these three sets of spokes are set in place with the spoke nipples threaded on a few threads you can offer the last set of disc-side spokes. Those are farthest to the back and radiate counter clockwise in the picture above. Offer the last 10 nipples and you are ready to true the rim.

T140 Front Disc Wheel

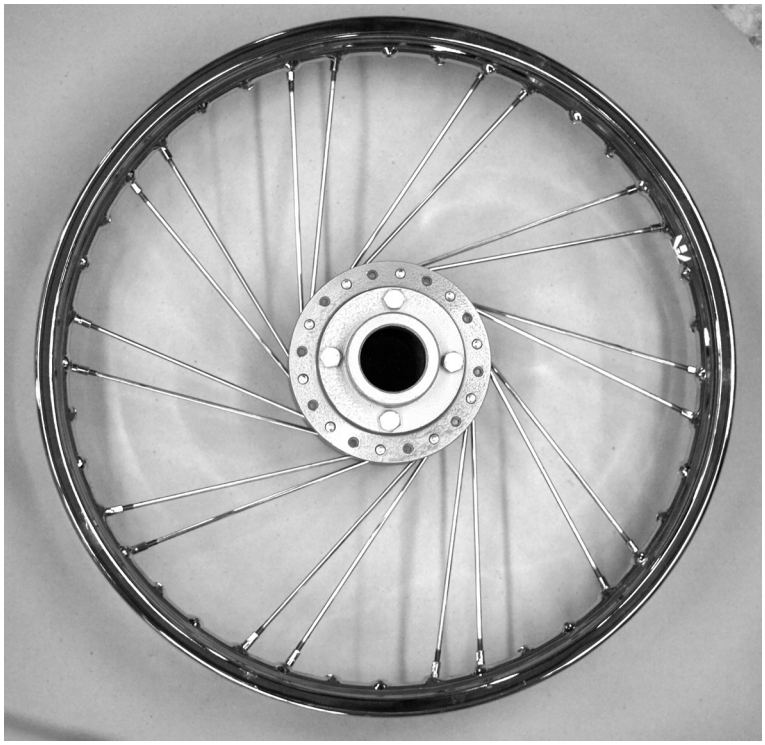
This rim is not handed.

As viewed from non-disc side:
All inner spokes rotate clockwise.
All outer spokes rotate counter clockwise

All of the inner spokes are the same length (7 13/16") and head angle. 80°.
All of the outer spokes are the same length (7 13/16") and head angle 95°.
Nipples are .250" diameter.

All 20 inner spokes are offered first and secured with a nipple to the rim.

Once all of the inner spokes are offered offer all 10 spokes for one side and then flip the assembly over and offer the final 10 spokes.



Front Disc Wheel
Viewed from Left Side (non-side) all inside spokes radiate clockwise.

Rear Disc Wheel

Before you start:

1976 750 twins were laced with light gage spokes. If working on a 1976 rear wheel you will have to replace the rim with a later one or drill out the original nipple holes to .300". The light gage spokes break in normal service. While there wasn't recalls in those days, the factory never supplied replacement spokes, or rim for that year. Because the original spokes were not up to the job Buchanan only supplies spoke sets in the late condition. You will also have to drill out the hub's spoke holes (#27 drill) to fit larger gage spokes.

Measure rim offset before taking the wheel apart!!!!

Lubricate both spoke threads and nipples where it contact the rim.

To aid assembly, when initially offering nipples only run them on half way up the thread.
This rim is handed:
- **Three dimples are on the sprocket side.**
- **The single dimple is on the disc side.**
- **The through bolt nuts are on the disc side**
- **There are two variants of the hub:**

Early and Late.

Early models Smith speedometer drives are mounted on the disc side. Right hand wheel hub is threaded Left Hand for speedo drive adaptor. The Left Hand hub is threaded Right Hand.

Late models Veglia speedometer drives are mounted on the sprocket side. The Right Hand hub is threaded Left Hand. The Left Hand hub is not threaded. Hub has slot for Veglia's drive arm.

- **The sprocket is on the left side.**
- **The disc is on the right side.**

After identifying the hub mark the sides of the hub and rim with an magic marker: Disc (RH) and sprocket (LH).

The Wheel Offset

The center-line of the rim is 2.910 from the inside of the sprocket face. The rim is 3.00" wide so the offset to the edge of the rim is 1.410" (1 13/32").

Spokes

There are 4 different spokes used on the rear disc wheel. The spokes on the sprocket side are longer than the spokes on the disc side:

Sprocket Outside 7 3/8" head angle 95°
Sprocket Inside 7 3/8" head angle 80°

Disc Outside 7 1/4" head angle 95°
Disc Inside 7 1/4" Head angle 70°

The idea of the 3x1 dimpling (illus.1) is to give the rim more strength. To accommodate the disc's caliper, the spokes on the disc side radiate out from the hub at a near vertical angle. By crossing one disc side spoke to the sprocket side it triangulates one of the disc side spokes making the wheel stronger.

Lacing Truing Tensioning

Lacing

Using the picture (illus.2 note arrow) to establish the position of the 20 inside spokes offer them to the rim and screw on the nipple half way (half of the spoke's threads exposed).

Offer the 20 outside spokes, radiating in the opposite direction from that sides inside spokes. Screw on the nipples leaving half of the spoke's threads exposed.

Truing Rim

Run the DISC SIDE nipples onto their respective spoke until the square end is at the end of the spoke thread. Then go around the rim taking equal turns on the DISC SIDE nipples until the rim stops shaking and rim is relatively stable.
Due to variations in spoke lengths not all

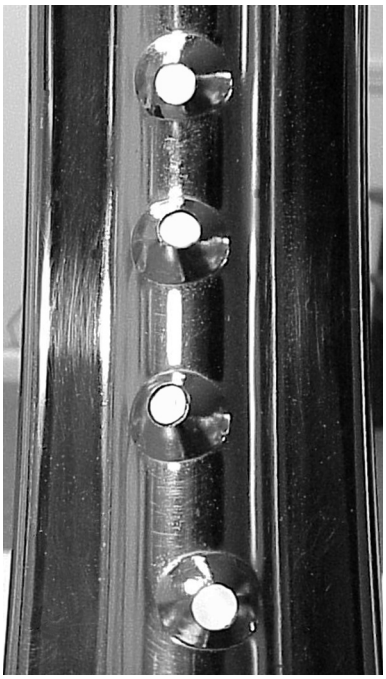


Illustration 1:
Triumph read disc rim is handed.
This is called a 3x1 rim. Three nipples are on the sprocket side and the single dimple

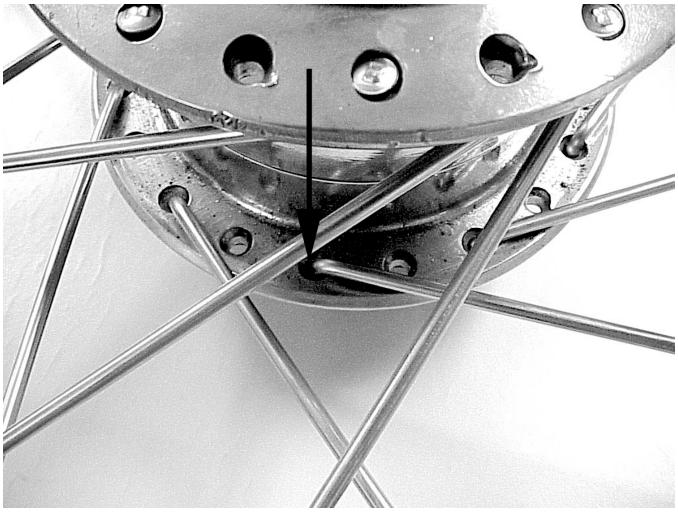


Illustration 2:
Viewing from the SPROCKET SIDE of hub.
Sprocket side inner spokes radiate clockwise. Disc side inner spokes radiate counter clockwise.
Outside spokes radiate the opposite direction of their inner spokes.
Note relationship of the the hub's spoke

nipples will come up to the rim at the same time. Working with the nipples that came up to the rim start to remove any hop and wobble. When you get it close bring up the nipples that are still loose up to the rim. As all of the nipples are still finger tight take out any hop loosing low spot nipples and snugging up high spot nipples. This isn't final truing so get it close with all of the nipples as close to the same tension as you can.

Remember when you loosen, or tighten, a nipple you effect the nipples diametrically opposite. Tighten a nipple on one side and it tightens opposing and opposite nipples

Tightening

Still on the disc side we will start tightening all 20 of the disc side spokes and do nearly all of the hop and wobble work at this point. Pay attention to any spoke that is coming up tighter than the others and loosen it so it will be the same as the others.

20 Sprocket Side Nipples

Now turn your attention to the sprocket side nipples. As you did with the disc side, go around, an in turn, bringing all of the nipples to the rim. Again some will come to the rim before the others. When they all come to the rim take a couple turns on each of the 20 nipples making sure you keep the tension even. Don't forget to loosen if one is coming too tight to fast.

Setting the Rim Offset

At this point you want to pay attention to the rim offset. The sprocket side spokes have much more influence on the rim's offset than the disc side spokes. You want to end up with the edge of the rim 1 13/32" away from the face of the side of hub where the sprocket mounts.

The trick is to start with the rim offset past the proper 1 13/32" offset. Stand on the rim, disc side down, while it is on the floor forcing it to the disc side past the proper offset point. We are looking to get the offset as close to 2" as we can.

While the sprocket side spokes are in tension, tap the sprocket side spokes near the hooked end with a plastic or leather mallet to take tension off them and let the rim move away from the hub. You want the rim's offset to be at least a 1/2" more than the 1 13/32" (close to 2").

Tensioning

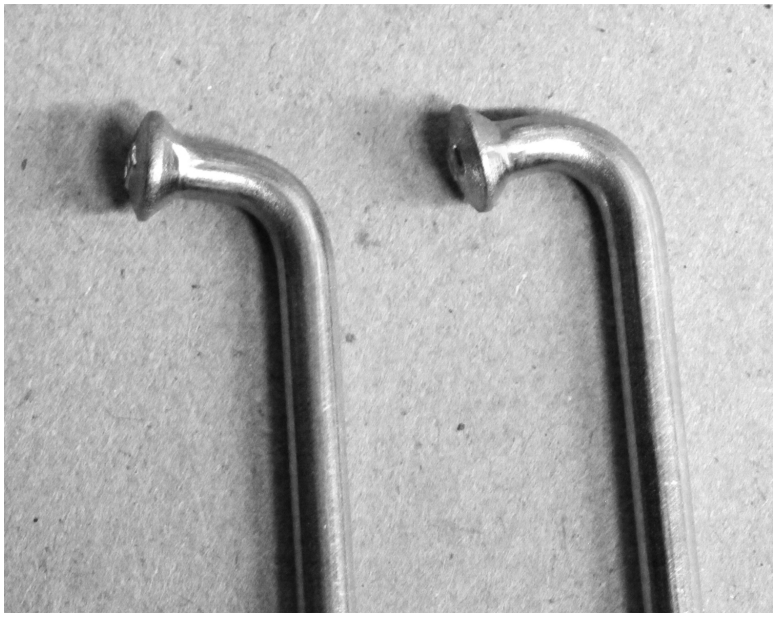
With the rim set off about 1/2" on the disc side you can start tensioning all 40 of the nipples as evenly as you can. Because of the angle of the sprocket side spokes, if you don't pay attention, they will quickly pull the rim past the 1 13/32" offset.

With all of the 40 nipples evenly finger tight I go around the rim taking 2 turns on the disc side and 1 turn on the sprocket side spokes. As the rim starts to come up tight I favour the disc side outside spoke giving it a bit more tension than the disc side inside spoke. This way the rim stays in an exaggerated offset as I tighten the spokes. When the disc side starts to come up to their final tension (around 40-45 inch pounds) I can pull the rim to the final offset using the sprocket side spokes. If we did it right, and are a bit lucky) the sprocket side spokes will end up around 25-30 inch pounds.

I realize this is hard to explain, and I did as best as I can. If you don't get it the first time loosen the nipples and start over, AND DON'T FORGET TO WALK AWAY FOR A DAY. It is amazing what the brain can sort out if given a rest!

<u>If, as you tighten the non-disc side nipples, you loose the 1 13/32" offset DO NOT keep tightening the disc side nipples to try to pull it back. You will pull the nipples through the rim before the rim will budge.</u>

Finish by checking, and correcting any wheel hop or wobble (aka run out).



BSA 190mm Front Wheel

Spoke kit consist of:
20 - Outside spokes 5 15/16" 95° head angle
20 - Inside Spokes 5 15/16" 80° head angle
40 .250" 10 gage nipples

Measure rim offset before taking wheel apart!!

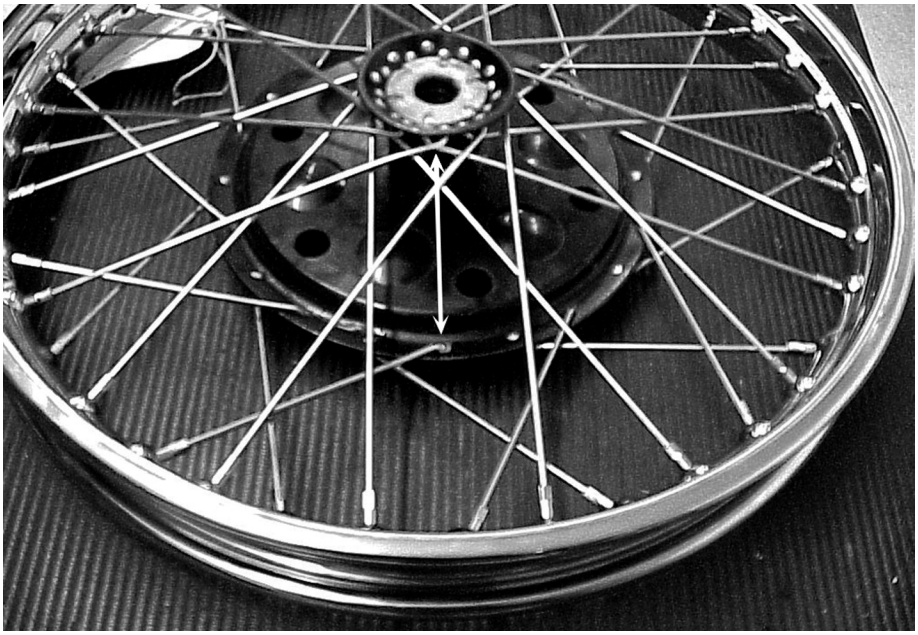
This rim is not handed and will go on the wheel either way. The only thing on this wheel to catch you up is the spoke's head angle. All of the 80° spokes go on the inside and all of the 90° spokes on the outside. Both sides of the wheel have spokes with a cross one pattern.

<u>As viewed in the picture:</u>
The near side inside spokes radiate clockwise.
The near side outside spokes radiate counter clockwise.
The far side outside spokes radiate clockwise.
The far side inside spokes radiate counter clockwise.

To aid assembly, when offering the nipples to the inside spokes leave half of the spoke threads visible. This allows you to move the rim to get the other spokes into the rim's spoke holes.

Start with the 20 inside spokes first. Then following the pattern.

Once all of the spokes have their nipples, turn each until the square end of the nipple is at the end of the thread. Then follow the tightening and tension sequence.



BSA 68-5556 Front Wheel

Spoke kit consist of:
20 - 5 15/16" 10 gage spokes
20 - 8 7/8" 10 gage spokes
40 .250" 10 gage nipples

This rim is handed and will only go on the wheel one way. The drum side spokes are cross two and the spool side spokes are cross four. Because of how this rim is laced it can be a challenge to get right.

In the picture above there is a white line with arrow points at each end. On the drum end it is pointing to the drum side inside spoke that is radiating clockwise in the picture. The spool end is pointing to a point half way between two spool side spokes that cross each other. The inside spoke is to the left of the arrow head and radiating counter clockwise. The outside spoke is to the right of the arrow head and radiating clockwise.

To lace this wheel you have to offer all of the 20 spool side and ten of the inside drum side spokes (and what a tangled mess we weave) at one time. Once these are offered, and juggled so they are all going in the proper direction, you can align the rim holes with the appropriate spokes and run on the 30 nipples. You have left offering the drum side outside spokes until the end.

Once you have the first 30 spokes laced you can offer the drum side outside spokes. Be sure to flip them so they radiate in a counter clockwise direction as shown in photo above and offer the nipples. Offering only the 30 spokes gives you less spokes to deal with and you are dealing with a 30 leg octopus rather than a 40 leg one.

Don't be disappointed if you don't get it the first time. With this wheel I have had professional "wheel builders" claim we sent them the wrong rim.