

MICHELIN X[®] TWEEL[™] SSL

AIRLESS RADIAL TIRE



SERVICE MANUAL

EFFECTIVE: JULY 11, 2023

tweel.michelinman.com

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Introduction



WARNING

Read this manual carefully – it is important for the SAFE operation and servicing of your airless radial tire.

Michelin is dedicated and committed to the promotion of safe practices in the care and handling of all tires. This manual is a collection of best practices that will allow owners to increase their skid steer loader tire knowledge and get the maximum life out of their tires. This manual covers the full life cycle of this tire, including selection, maintenance, and life extension through retreading. For more complete specifications contact your local Michelin Representative or refer to the Michelin Tweel Technologies website at www.michelintweel.com.

MICHELIN® X® TWEEL® SSL airless radial tires are subject to a continuous development program. Michelin North America, Inc. reserves the right to change product specifications at any time without notice or obligation.

Please consult your skid steer loader manufacturer's service manual for proper and safe procedures for changing your tires including the correct torque specifications.

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I. Foreword and Glossary

The MICHELIN® X® TWEEL® SSL tire is designed specifically for skid steer loader applications. In operation, it functions very much like a conventional pneumatic skid steer tire but is a single unit replacing the tire/wheel/valve assembly. There is no air pressure to maintain. Service and maintenance of the X® TWEEL® SSL tire is considerably less complex than the comparable procedures associated with a conventional pneumatic tire and wheel assembly. The inherent service simplicity of the X® TWEEL® SSL tire precludes any necessity to include instructions for such common practices as mounting the tire onto the rim and selecting or maintaining an inflation pressure setting.

A. X® TWEEL® SSL Terminology and Operational Components Overview.

- **Shear Beam.** The “shear beam” is the steel reinforced rubber structure that forms the rubber tread ring assembly. The shear beam has a precisely designed amount of flexibility that allows the footprint of the X® TWEEL® SSL tire to mimic the long footprint behavior and traction mobility of a conventional pneumatic radial tire operating at a specified tire pressure. In the retreading process, once the remnants of the original tread have been buffed off of the X® TWEEL® SSL core, the wear surface can be renewed by bonding a pre-cured retread to the outer circumference of the shear beam.
- **Urethane spokes assembly.** An important feature of the X® TWEEL® SSL tire is that it is supported by a network of flexible and extensible urethane spokes. The X® TWEEL® SSL tire supports the axle load by “hanging” the load from the upper spokes. Thus, the load is carried by the upper spokes in tension and not by the lower spokes in compression.
- **Steel Wheel.** The non-removable steel wheel/rim assembly that is integral to the X® TWEEL® SSL tire.
 - **Center bore.** The center bore is the big hole in the center of the steel wheel assembly. The center bore is machined to a precise internal

dimension so that it will be a precision fit over the hub of the vehicle and help center the X® TWEEL® SSL with respect to the vehicle hub.

- **Stud holes.** The stud holes are the eight evenly spaced holes concentric to the center bore that comprise the lug nut clamping locations to attach the X® TWEEL® SSL to the vehicle. The condition of these stud holes is subject to wear and therefore must be carefully inspected when the core is being evaluated for retread suitability.



B. Urethane interface bonding. The urethane spokes are chemically bonded to both the steel wheel and rubber shear beam. These high-tech bond interfaces are very important to the structural integrity of the X® TWEEL® SSL tire and are therefore an important inspection point in determining suitability of the core for retreading. Because bond integrity has some sensitivity to high temperature exposure, it is also a point of consideration when selecting curing parameters and determining handling precautions.

This will be discussed in more detail in the retreading section of this service manual.

C. X® TWEEL® SSL Core. The X® TWEEL® SSL “core” is the entire reusable structural component of the X® TWEEL® SSL tire onto which the retread is built. In other words, it’s the tire with little or no tread remaining.

II. Normal Fitment and Application

The 10N16.5 and 12N16.5 X® TWEEL® SSL tire sizes are intended for skid steer loader applications for which the equipment manufacturer recommends a 10-16.5 or 12-16.5 tire size. The X® TWEEL® SSL steel wheel is designed to accommodate the common 8 X 8” bolt circle which fits most vehicles, but Michelin offers other bolt circle options to satisfy a wider variety of needs through the 12N16.5 X® TWEEL® SSL 2 Piece product (shown below). Contact your local Michelin Representative to learn more.



The standard 12N16.5 X® TWEEL® SSL steel wheel is not reversible, and has “coined” mounting holes that are stamped in such a way that the raised area surrounding the holes provides a Belleville-washer-like effect which helps maintain proper clamping force and are thus designed for use only with the taper seat lug nuts. Some brands of skid steer loaders are originally equipped with flat seat lug nuts. Flat seat lug nuts are not compatible with the 12N16.5 X® TWEEL® SSL assembly’s mounting holes. Taper seat lug nuts must be substituted for flat seat lug nuts if the vehicle is not already supplied with them. These taper seat lug nuts are generally available from suppliers of skid steer loader maintenance and repair

parts. The raised “coin” feature must face outward (away from the vehicle hub) when installed.



The standard 10N16.5 X[®] TWEEL[®] SSL and the 12N16.5 X[®] TWEEL[®] SSL 2 Piece products, on the other hand, are designed to be compatible with whichever lug nuts came on the skid steer loader, and are reversible so that they provide 2-4 different wheel offsets.

III. **Technical Specifications and Product Offerings**

See the Michelin Tweel Technologies website for the full line of X[®] TWEEL[®] SSL product offerings and technical specifications. The maximum speed and load capacity can be found on the website, as well as on the sidewall of the X[®] TWEEL[®] SSL tire. Please contact your local Michelin Representative if you have any technical or performance related questions.

IV. **Installing the X[®] TWEEL[®] SSL Tire**

All normal tire service procedural considerations and safety precautions apply for installing or removing X[®] TWEEL[®] SSL tires. As with a conventional wheel and tire assembly, the vehicle must be lifted appropriately and properly supported by work (jack) stands. Failure to properly support the vehicle is a violation of OSHA/IMSA safety standards and is not recommended. Never take unnecessary safety risks. Be aware that a new X[®] TWEEL[®] SSL tire weighs 80-120 KG (175-265 LB), depending on the model, so service personnel must be prepared to lift and support this amount of mass when handling the X[®] TWEEL[®] SSL tire.

Before installing the X[®] TWEEL[®] SSL tire, inspect all wheel and hub components carefully to be certain that all mounting contact surfaces are clean and undamaged. Also ensure that each lug stud is tightly fitted into the hub, and stud threads are in proper condition to easily accept the lug nuts. Inspect the condition of the lug nut threads and the tapered contact surfaces which will engage with the wheel. Studs and/or lug nuts which are worn or damaged must be renewed or replaced prior to installing the X[®] TWEEL[®] SSL tire. Any lug fastener which cannot be easily screwed hand tight against the wheel should be regarded as being a damaged fastener assembly and thus unacceptable for continued service until the proper repairs are made. The lug fasteners must be carefully tightened in the proper sequence and to the torque value specified by the equipment manufacturer. Merely tightening the nuts “good and tight” with an unregulated pneumatic impact wrench should not be regarded as an acceptable procedure. Failure to properly install the X[®] TWEEL[®] SSL and correctly tighten the fasteners can result in damaged fasteners and/or an accidental wheel-off. Such accidents can cause both personal injury and property damage.

V. Recordkeeping

Michelin seeks to ensure that each X[®] TWEEL[®] SSL customer has a positive experience with each purchase. In order to ensure that your product is performing to expectations and evaluate methods to improve the product, Michelin seeks customer feedback. Michelin wants to know how X[®] TWEEL[®] SSL tires perform in each of the myriad applications and environments in which skid steer loaders are used. So that performance data can have the value of genuine science, it is highly recommended that the user record and track the X[®] TWEEL[®] SSL tire performance on each vehicle and the hours of operation.

For tracking purposes, Michelin recommends that you capture the following:

- Company name, address, and contact information
- Vehicle make, model, and year
- Vehicle hour meter reading at time of installation and removal
- Dates of installation and removal

- Type of work done by the vehicle
- Type of surface(s) the vehicle is operated on
- Serial number of each individual X[®] TWEEL[®] SSL tire (this is located on the wheel near the stud holes on the side typically facing the vehicle hub)
- Tread depth reading, date, and hour meter readings at each vehicle inspection or /intervention
- Operator feedback
- Damage, concerns, or observations
- Comparative experience with other tire products tried on this vehicle

VI. Tire Rotation

In most skid steer loader applications, the tires on the front or rear of the vehicle (most commonly the rear) will slip more readily when the loader turns, and therefore the tire wear rate will vary from front to back. In order to maximize the wear life of any set of skid steer tires, it is recommended that tires be rotated at appropriate intervals. Regarding the X[®] TWEEL[®] SSL tire, it is advisable to cross (X) rotate the tires at whatever interval keeps the tread depths even to within 1/8" (3 mm) front vs. rear. Typically, the wear rate difference is such that the approximate time for tire rotation is whenever the most worn tires reach approximately half tread depth. Appropriate tire rotation will help to ensure that X[®] TWEEL[®] SSL tires deliver the maximum available tread life.

VII. Product usage

The X[®] TWEEL[®] SSL tire should not be driven in such a way that sharp curbs, rebar, angle iron or similar sharp/abrasive items will contact the spokes, shear beam sidewalls, or steel wheel. Such objects can cut or tear the urethane spokes, cut or tear the sidewall rubber, or permanently deform the steel wheel. Such impacts may make an X[®] TWEEL[®] SSL core unsuitable for retreading or take the tire out of service.

Tread wear life will vary widely depending on the application. Concrete and asphalt will wear out a tread much faster than off-road use, for example.

Assuming that the belt package has not been exposed and the core is still in good condition, an X[®] TWEEL[®] SSL core can be retreaded one or more times. A tire in an application with a high tread wear rate is likely to be retreaded more times than a tire in low wear rate application.

VIII. Damage Limit Guidelines

Unlike a conventional pneumatic tire, the X[®] TWEEL[®] SSL tire will not experience a “rapid air loss” failure. Whereas tread punctures and cuts can render a conventional tire unserviceable, such issues do not immobilize the X[®] TWEEL[®] SSL tire. **However, extensive damage to the urethane spokes, *can* render an X[®] TWEEL[®] SSL tire unserviceable.** In most circumstances, a severely damaged or fatigued X[®] TWEEL[®] SSL tire will result in an oscillating ride height. If this occurs the operator should use caution and stop the vehicle for inspection.

The X[®] TWEEL[®] SSL tire can generally remain in service with one or even several broken or cut spokes. As long as the vehicle’s operation and/or handling are not noticeably affected by the broken spokes, the X[®] TWEEL[®] SSL tire can be considered safe for continued operation. Broken spokes are warrantable if six (6) or more spokes are completely broken or three (3) or more spokes are completely broken consecutively.

It is highly recommended that any cracked or torn spokes be repaired as soon as possible as this can double the remaining life of the X[®] TWEEL[®] SSL tire. Michelin has developed a spoke repair method which is described later in this manual.

Additionally, loss of adhesion can occasionally occur at the bond between the urethane spokes assembly and its interface with the steel wheel or the rubber shear beam. A separation of greater than 2” (50.8 mm) in depth measured from the outside edge of the urethane is considered warrantable, but as long as the X[®] TWEEL[®] SSL tire performs as desired it can continue to be used.

IX. X[®] TWEEL[®] SSL Tire Diameter and Tread Depth Matching

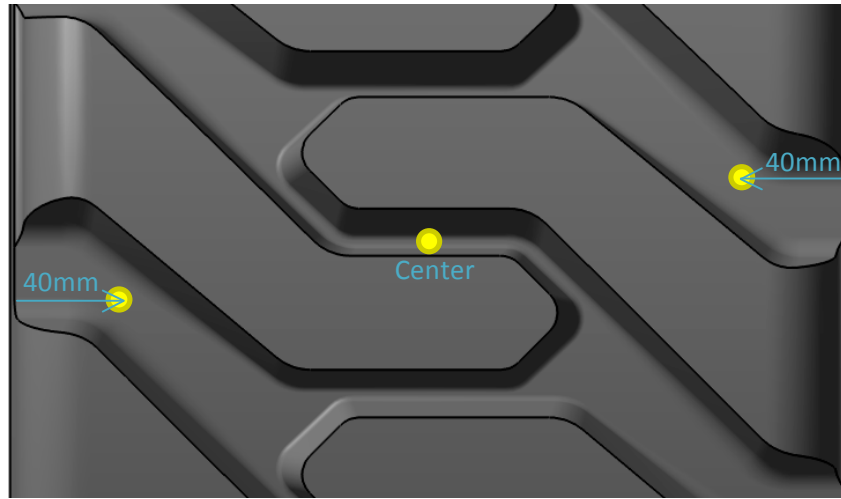
Skid steer loaders generally have a direct mechanical coupling (usually a drive chain) linking the rotation of the front wheel to the rear wheel on each side of the vehicle. This dictates that the pair of wheels on each side of the vehicle will operate at exactly the same rotational speed at any given moment. To assure that the pair of X[®] TWEEL[®] SSL tires on the same side of the vehicle are (with each revolution) trying to travel the same distance with respect to the ground, it is important that their respective circumferences (and thus the distance traveled with each tire revolution) be fairly closely matched. This is especially important if the vehicle is operated on hard surfaces which do not easily allow tire slippage. If the X[®] TWEEL[®] SSL tires on a vehicle are all “a matching set ” (as in “all first life”, or “all matching retreads”), and if all the tread depths are not different from one another by more than 1/8” (3 mm), or likewise if the diameters match within 1/4” (6 mm) or the circumferences match within 13/16” (20 mm), the revolutions per kilometer for each tire within the set should be sufficiently similar that it will not impose unnecessary wear and tear on either the vehicle or the X[®] TWEEL[®] SSL tires.

X. Tread Wear Removal Point

In order to maximize the ease of retreading and minimize the effort required to prepare the X[®] TWEEL[®] SSL core for retreading, it is advisable to remove the X[®] TWEEL[®] SSL from service with not less than approximately 4/32” (3 mm) of tread depth remaining. The following 2 pages contain instructions on how to measure the tread depth.

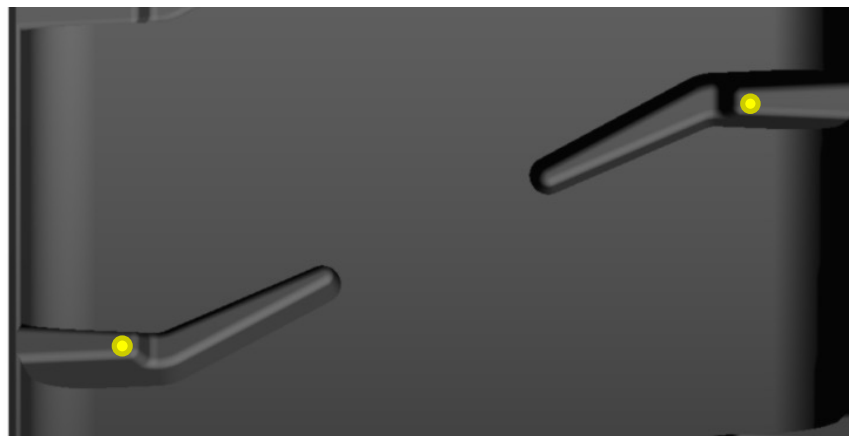
Tread Depth Measurement – X® TWEEL® SSL All Terrain

The initial tread depth is 31/32". The tread depth should be measured in the 3 locations shown below, half-way in-between the tread blocks (as shown by the orange dots), with the gauge bridging from the two nearest blocks. Measure the depth from the bottom of the groove to the top of the tread blocks. If the data system only allows for two inputs, then measure at the 2 outside locations.



Tread Depth Measurement – X® TWEEL® SSL Hard Surface Traction

The initial tread depth is a 48/32". The tread depth should be measured in the 2 locations shown below. Measure the depth from the bottom of the deepest groove to the top of the tread block.

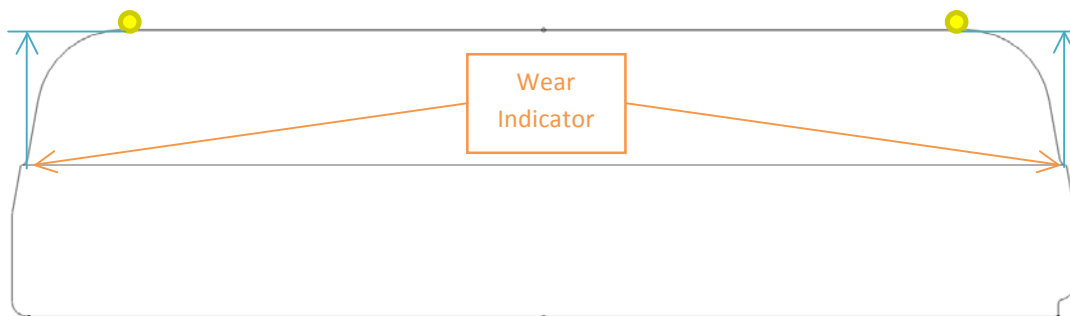


Tread Depth Measurement – X® TWEEL® SSL Hard Surface

The wear indicator is a ridge at the base of the tread on both sides, 360 degrees around.



The tread depth should be measured in the 2 locations shown below. To measure the tread depth, measure vertically from the wear indicator up to the flat surface of the shoulder. The initial tread depth is 50/32”.



XI. Repairing Spoke Cracks and Tears

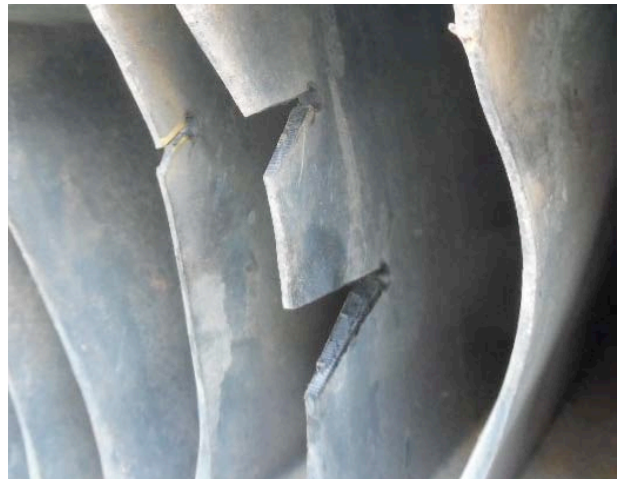
Repairing spokes can double the remaining spoke life. The sooner a crack is found and repaired, the longer the spoke will last.

Preparation:

- Inspect the X[®] TWEEL[®] SSL tire for spoke cracks as often as is convenient, such as whenever the vehicle is inspected, cleaned, sent in for maintenance, or whenever the tires are rotated. It's easiest to inspect the tires when unmounted.
- Clean spokes if caked with dirt or other material to make cracks more apparent. A pressure washer works well. Any rocks wedged between spokes should be pried loose to prevent future damage. With the aid of a flashlight, look for spoke cracks along the edge of each spoke on both sides of the tire. Be careful to identify even quarter inch long cuts and tears.
- To look for cracks on the inside of a tire while it's mounted on a vehicle, clean all spoke surfaces, then look between each pair of spokes using a flashlight and carefully search for cracks on the far side of the spoke. Tires with cracks on the vehicle side will have to be unmounted to allow access to make the crack repair.
- Repair any cracks that are found by following the repair steps on the next page.



SPOKE EDGE CRACKS



REPAIRED CRACKS

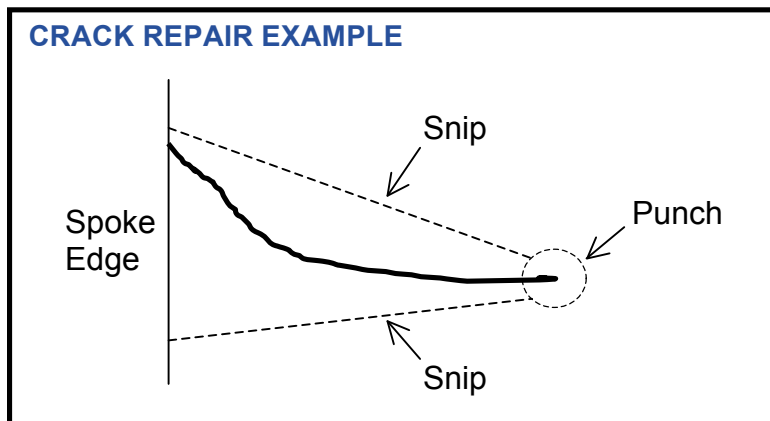
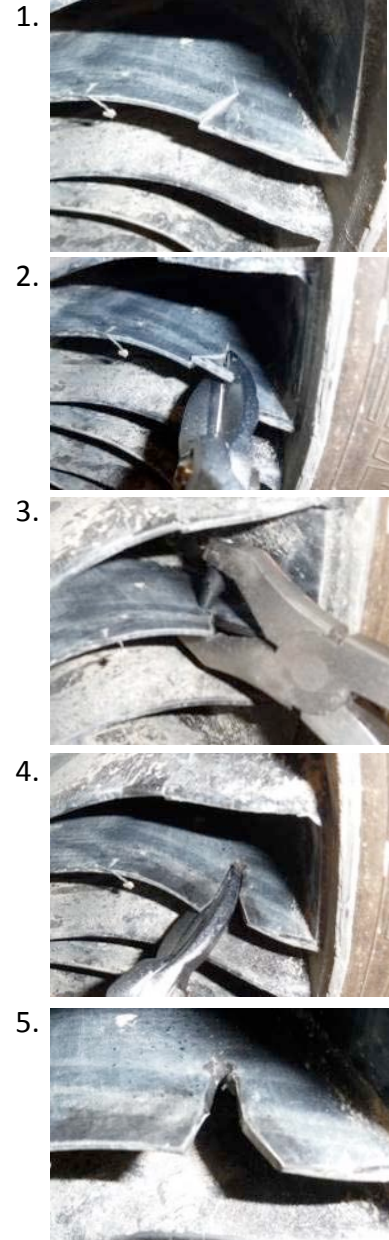
Required Tools

- Milwaukee 48-22-4030 Aviation Snips, Straight Cutting
- Hole Punch – “Big Leather Punch” from Brettuns Village
<http://www.brettunsvillage.com/leather/tools/tools/#punch>



Spoke Repair Instructions

1. Check to see whether or not the 5mm hole punch can reach the crack tip.
2. If the punch tool can't reach the crack tip, use the aviation snips to cut away spoke material at shallow angles to the crack until the tool can reach the crack tip.
3. Use the hole punch to make a 5mm hole that completely removes the crack tip.
4. If the crack faces leading up to the punched hole still touch, use the aviation snips to cut away material on both sides of the crack so that there is a gap between the faces all the way up to the hole.
5. Use a flashlight to look at the far side of the punched hole and double-check that the crack tip is completely removed. If a small crack is still visible, use the punch to elongate the hole until the crack tip is removed.



XII. Retreading the X[®] TWEEL[®] SSL

In North America, certain Michelin Retread Technologies (MRT) franchises are equipped to retread the X[®] TWEEL[®] SSL tire. Please contact your local Michelin Representative for more information.

Because the X[®] TWEEL[®] SSL tire is a non-pneumatic tire, contains a structural urethane component, and includes an integrated steel wheel which is not detachable, X[®] TWEEL[®] SSL tire retreading requires slightly different retreading procedures and considerations than the typical pneumatic tire. Some additional tooling and techniques are likely to be required with regard to lifting, mounting, buffing, treading, and enveloping the X[®] TWEEL[®] SSL tire if using conventional retreading equipment. Special consideration needs to be given to the selection of tread bonding products as these products must be appropriately chosen for compatibility with the choice of curing temperature and curing duration. Additionally, the retread shop must ensure that all lifts and hooks are capable of supporting up to 265 lbs.

What follows is X[®] TWEEL[®] SSL tire specific information to help all retread shops successfully retread X[®] TWEEL[®] SSL cores. These guidelines are organized in the same order as the steps in a standard retread process.

A. Core Inspection and Suitability for Retreading: The X[®] TWEEL[®] SSL tire can be retreaded multiple times so long as the core integrity is carefully inspected and judged to be sound. Thoroughly inspect the X[®] TWEEL[®] SSL tire for evidence of physical damage or core degradation. In addition to the obvious necessity to inspect the retread area for suitability, be sure to inspect the X[®] TWEEL[®] SSL steel wheel and urethane spokes for any signs of damage. Further, one should inspect the core carefully to be certain there is no separation in the bond between the urethane spokes assembly and its interface with the steel wheel or the rubber shear beam.

Be sure to remove any rocks or other objects that are wedged between or embedded in the spokes. Clean off any debris that could interfere with the inspection process or otherwise cause problems during the retread process.

The following are considerations which may be useful in helping determine whether or not an X[®] TWEEL[®] SSL core is suitable for retreading:

- If the wheel center disk is cracked, if the mounting holes are out of round or greater than 17.5mm in diameter, or if any other serious damage is present (such as excessive rust), the core should be rejected for retreading.



- If the wheel edge is dented or deformed, the following actions are recommended to determine suitability and prepare for retreading:
 - If wheel edge is dented toward the center axis of X[®] TWEEL[®] SSL core with a deformation of no more than 1 inch, use a large hammer or another appropriate tool to return the edge as close to original shape as possible. Otherwise, reject core for retreading.



- If wheel edge is dented away from the center axis of X® TWEEL® SSL core with a deformation of no more than ½ inch, leave as-is with no repair. Otherwise, reject the core for retreading.



- Spoke cuts and tears are acceptable if 5 or fewer spokes are completely broken (torn along their entire width) and 2 or fewer consecutive spokes are completely broken.



- A completely torn spoke may be cut out and eliminated from the assembly with the aid of a hook knife or other suitable tool(s).
- Partially torn spokes should be repaired by following the spoke repair method found in the previous section of this manual.

- Any X® TWEEL® SSL core with evidence of unsticking of the urethane bond interface (at either the steel wheel or the rubber shear beam) must be examined carefully for the general integrity of the bond. Localized unsticking is acceptable, but an X® TWEEL® SSL core with unsticking to a depth of more than 2" (50.8 mm) from the edge of the urethane should be rejected for retreading.



- Any X® TWEEL® SSL core that has the tread rubber worn away to the point of exposing the steel belt package in the shear beam will require extra effort to prep the core for retreading, but localized exposed steel does not necessarily mean that the core is unsuitable for retreading. The X® TWEEL® SSL tire is more tolerant of steel intervention than a typical pneumatic. Even so, steel interventions represent significant additional preparation effort and therefore there is a practical limit to the extent of such repairs. Cores with large sections of missing cables (any single area of exposed steel on the tread surface greater than roughly 4 square inches or any sidewall gouge greater than 1 inch deep) should be rejected.

B. Buffing and Core Preparation.

Retread Recommendations and Location of Belts

X TWEEL SSL Size	Tread Width	Buffing Radius	Target Buffed Circumference	Belt Width	Under Tread Thickness
<i>10N16.5 AT & AT2</i>	W255 to W265	Flat or Maximum Radius	88.8" (2255 mm)	9.5" (242 mm)	<1mm
<i>10N16.5 HST & HST2</i>			88.8" (2255 mm)		<1mm
<i>12N16.5 AT & AT2</i>	W290 to W300		97.5" (2475 mm)	10.7" (272 mm)	1 mm
<i>12N16.5 HST & HST2</i>			96.9" (2460 mm)		<1mm

- Lifting the X[®] TWEEL[®] SSL tire.** The X[®] TWEEL[®] SSL tire can be lifted by sliding a long hook between the spokes where the spoke spacing is largest and lifting under the shear beam so that the X[®] TWEEL[®] SSL tire hangs by the shear beam. The hook must support at least 265lbs. To prevent the X[®] TWEEL[®] SSL tire from sliding off the end of the hook, it's important to include a raised stop at the end of the hook. Straps can work in the place of hooks as well. Here are a few examples of hooks and hook attachments.



- Mounting on the buffer or builder.** Any practical attachment method that properly and securely mounts the X[®] TWEEL[®] SSL tire concentric to the center bore and in the same plane as the wheel mounting face is acceptable. An expanding three jaw chuck to center and drive the inner circumference of the X[®] TWEEL[®] SSL tire center bore has been used in the past.

While the three jaw chuck accomplishes the radial centering purpose, it is also necessary to oppose the chuck with a guide plate (or similar device) in contact with the X[®] TWEEL[®] SSL steel rim outer flange (or perhaps the wheel disc itself). So doing holds the X[®] TWEEL[®] SSL tire against the chuck and also assures acceptable control over the potential for lateral runout of the X[®]

TWEEL® SSL tire as it rotates during the buffing and retread building processes.



Example of the 3 jaw chuck



Tire mounted on chuck



Guide plate example

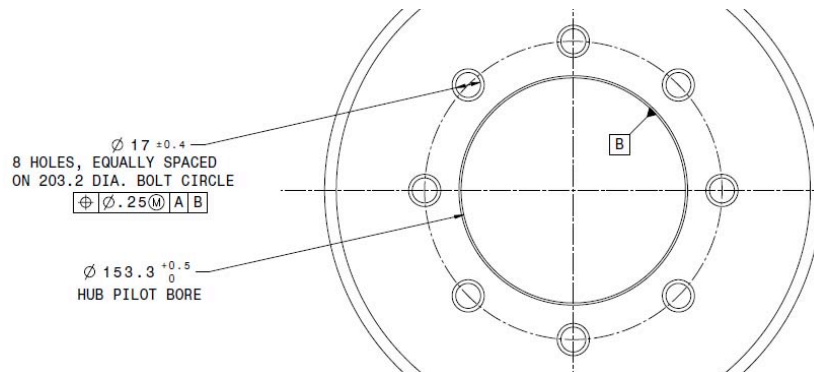
As an alternative, the X® TWEEL® SSL tire can be mounted the same way it is on a skid steer loader by designing and machining hub adaptors with studs and lug nuts that fit the X® TWEEL® SSL bolt circle. The 8 X 8" bolt pattern will work for all X® TWEEL® SSL cores, including the 2 Piece product, which has an 8 X 8" adaptor plate as an option. Centering adjustment capability or spacers will be required to accommodate the various wheel offsets. A drawing of the bolt circle and pilot bore dimensions as well as a list of the wheel offsets for each X® TWEEL® SSL product is listed below for use in adaptor design. The adaptor design will otherwise be dependent on the retread equipment to which it has to attach.

X® TWEEL® SSL Wheel Offsets and 8 on 8" Bolt Pattern (dimensions in mm)

12N16.5 X® TWEEL® SSL standard offset = -23.75 mm

12N16.5 X® TWEEL® SSL 2 Piece offsets = -58.0, -34.0, +22.0, or +46.0 mm

10N16.5 X® TWEEL® SSL standard offsets = -20.0 or +10.0 mm



Example of hub adaptor for 8 on 8" bolt pattern



Other successful methods include using a cone shaped centering pin and backing plate that fits the outer diameter of the wheel.



- **Buffing Profile:** The tread area of the X[®] TWEEL[®] SSL core has a flat profile, but the typical buffing machine in use in industrial retreading shops buffs to a curved profile. However, a flat or nearly flat profile is highly recommended. Below are two methods which have worked successfully in the absence of a buffing machine with the option to buff to a flat profile:
 - **Method 1 - Plunge Buffing:** One method which has been demonstrated as being successful involves plunging the buffing head straight into the tread surface and repeating the process by backing the buffer head out and stepping it over by slightly less than the width of the buffing head... then again plunging to the same depth. This process is repeated in succession until the entire surface has been covered. (This is much the same concept as mowing a lawn in successive adjacent strips). The depth of the buff will be limited by what is achievable at the edges of the tread.

The steel cable under the individual tread blocks will likely be found to be slightly elevated at the tread block locations and especially so under the inner and outer edges of the tread blocks. It is important to stop the buffing depth slightly above the depth of the cable. If the cable is touched by the buffer, the X® TWEEL® SSL core is not ruined, but additional “buzz out” work and “ribbon filling” will likely be required to prepare the core. This extra work can be avoided with careful buffing.



- **Method 2- Multistage Arc-radius Buffing:** Although this method does not yield a completely flat crown profile, retreads done this way have been successful. With this approach, one first centers the buffing head at the center of the X® TWEEL® SSL tread, sets the buffer to its maximum buff radius, and then proceeds to buff the tread off to that profile. Following the initial buff, with the buff depth taken to the limit at the shoulders, there will still be insufficient material removal at the center of the tread. To remedy this, the buffing head is recentered at the one quarter distance mark across the tread width and one half of the tread is carefully buffed. The process is repeated by recentering the buffing head at the three quarter distance mark across the tread face and the other half of the tread is rebuffed.

C. Localized Damage Repair. As with any retread preparation, it is necessary to remove any foreign object that may be imbedded in the core, and it is necessary to “buzz out” any fraying steel cable exposure per normal

procedures. Following the buzz out and skiving as necessary to produce a sound core for retreading, voids must be filled with ribbon rubber or equivalent per normal pneumatic tire retreading standards. Likewise, gouges in the sidewall of the shear beam should be filled with rubber to allow a smooth surface for holding an envelope vacuum.

D. Liquid Bonding Compounds. It is recommended that a suitable liquid bonding compound be applied to the buffed core surface and used in accordance with the manufacturer's recommendation. Applying the bonding liquid by spray, roller, or brush have each been done successfully.

E. Products that Aid in the Escape of Trapped Air. If the buffed surface of the core has required intervention and filler rubber has been applied, or if there are any undulations in the lateral profile of the buffed core that have been left by the buffing procedure, pockets of air could get trapped under the tread and interfere with proper bonding of the retread. The application of wicking cord webbing fabrics has proven very effective in eliminating this concern.



String style wicking cord

F. Choice of Cushion Rubber. The X[®] TWEEL[®] SSL core has been successfully retreaded multiple times using a curing temperature of 210° F (99° C) for 4 hours. Depending on the tread thickness and tread pattern, the time may need to be longer or shorter. However, it's critical that the curing temperature does not exceed 100° C. Higher temperatures are known to be detrimental to the integrity of the bond between the urethane spokes and the steel wheel and

between the urethane spokes and the shear beam. As such, it is essential to choose a cushion rubber (to be applied to the underside of the procured tread) that will properly cure under the selected conditions. Consult the recommendations of the cushion rubber manufacturer to be certain that the rubber chosen will be appropriate for the temperature and time exposure.

G. Choice of Pre-cured Tread Rubber. The 12N16.5 X[®] TWEEL[®] SSL core buffed width is a little over 300mm, regardless of tread type, so a tread width of 290-300mm is ideal, but widths down to 280mm will work. The 10N16.5 X[®] TWEEL[®] SSL core buffed width is about 265mm, so a tread width of 255-265mm is ideal, but widths down to 245mm will work.

An X[®] TWEEL[®] SSL core specific pre-cured tread is now commercially available in the All Terrain tread pattern for 12N16.5 X[®] TWEEL[®] SSL cores. Currently this is available as a retread option for MRT franchises that are equipped to retread the X[®] TWEEL[®] SSL tire. Other pre-cured tread options and treads for 10N16.5 X[®] TWEEL[®] SSL cores are being developed. If the current MRT offerings do not meet the needs of the user for the intended application, it is recommended that the tread selection be made from available commercial offerings based on performance needs such as cut resistance, abrasion resistance, wear resistance, mud traction, snow traction, and so on.

There is another method of retreading available that doesn't use pre-cured treads. The Marangoni process builds up uncured tread rubber and then carves in the preferred tread pattern prior to curing the retread. It also uses a steam chamber for its curing process. This method is acceptable given the curing temperature does not exceed 100° C. Careful inspection also needs to be done to minimize the oxidation of the steel wheel caused by the steam.

H. Enveloping the retreaded X[®] TWEEL[®] SSL core. Although conventional curing envelopes can be utilized with the X[®] TWEEL[®] SSL core retreading process, it's necessary to seal the envelope to the X[®] TWEEL[®] SSL core's relatively small

sidewalls. It has been demonstrated effective to staple, or otherwise affix, a temporary layer of a disposable soft band rubber material to the sidewalls of the X[®] TWEEL[®] SSL core that can serve as a conformable “gasket” so that the envelope can achieve an airtight vacuum seal atop the tread rubber area. Although other mechanisms may also be conceivable, most industrial retread shops have fabricated some sort of clamping fixture system which has clamping shells that are drawn together by means of a threaded rod, or similar means of applying the clamping force, which clamps the shells to the X[®] TWEEL[®] SSL core at the location of the shear beam sidewall. So doing conforms the trapped “gasket rubber” and seals the interior sides of the envelope to the exterior sidewalls of the X[®] TWEEL[®] SSL shear beam and thereby provides a vacuum tight seal of the interior of the envelope above the crown of the core. These photos show a few examples of clamping rings. The clamping rings are designed with openings in order to allow proper chamber airflow through the tire center.



- I. **Chambering the retreaded X[®] TWEEL[®] SSL core.** A mechanism is required for suspending the enveloped and clamped X[®] TWEEL[®] SSL tires inside the curing chamber. Depending on the weight of the clamping device, the assembly is likely to weigh slightly in excess of 250 pounds and one must provide lifting support accordingly. The X[®] TWEEL[®] SSL tire can be cured in either the vertical and horizontal orientation if the hot X[®] TWEEL[®] SSL tire is handled carefully. In either case, it's best to make sure the weight of the X[®] TWEEL[®] SSL is supported through the shear beam rather the steel wheel.



Example of horizontal orientation



Example of vertical orientation

J. Curing Parameters. In the presence of elevated temperatures, the urethane spokes soften slightly, and the bonds at the urethane interfaces temporarily weaken somewhat. These changes are only temporary, and normal properties return as soon as the X[®] TWEEL[®] SSL tire cools, but this suggests that curing temperatures and handling need to be carefully considered during and after curing, while the tire is still hot. The following curing parameters have been demonstrated to provided good results:

- Vacuum applied to sealed envelope
- Chamber air pressure = 85 to 95 psi
- Curing temperature = 206° to 210° F (97° to 99° C)
- Curing duration = At least 4 hours, depending on tread selection
- X[®] TWEEL[®] SSL tire must cool fully before being returned to service

These temperature and time recommendations have worked well and have had no detrimental effect on the long term integrity of the X[®] TWEEL[®] SSL core even after multiple retreads of the same core. Depending on the tread thickness and tread pattern, the time may need to be longer or shorter. However, it's critical that the curing temperature does not exceed 100° C. Higher temperatures are known to be detrimental to the integrity of the bond between the urethane spokes and the steel wheel and between the urethane spokes and the shear beam.

Warnings

- 1. The standard 12N16.5 X[®] TWEEL[®] SSL must be mounted with the raised portions of the mounting holes facing out and using taper seat lug nuts. This does not apply to the 10N16.5 X[®] TWEEL[®] SSL or 12N16.5 X[®] TWEEL[®] SSL 2 Piece, which are reversible and can be mounted with the hardware accompanying the vehicle.**
- 2. The X[®] TWEEL[®] SSL is not indestructible. Avoid damage to the spokes to get as many hours as possible out of the X[®] TWEEL[®] SSL. Repair any cracked or torn spokes to double the remaining life.**
- 3. Be sure to properly torque the lug nuts as per manufacturers specifications.**
- 4. Failure to properly install the X[®] TWEEL[®] SSL and correctly tighten the fasteners can result in personal injury and/or property damage.**
- 5. Do not exceed the maximum speed and load capacity marked on the sidewall of the X[®] TWEEL[®] SSL.**
- 6. When installing the X[®] TWEEL[®] SSL be sure to properly support the vehicle as per OSHA/IMSA regulations.**