NAIL HOLE REPAIR PROCEDURES
FOR PASSENGER, LIGHT TRUCK AND TRUCK TIRES

www.KexTireRepair.com

IMPORTANT!

WARNING!

ALWAYS demount the tire from the wheel and complete a **thorough tire and wheel inspection** prior to returning the components to service.

PRECAUTIONS

- Repair products and materials used should be from the **same manufacturer** to ensure compatibility in the curing process. **NEVER mix products** from different repair material manufacturers.
- Repairs are limited to the **crown area only**. DO NOT repair sidewall or shoulder injuries.
- Regardless of the type of repair used, the **repair must fill the injury and seal the innerliner**. This is achieved with either a two piece repair (stem and patch) or a one piece repair (patch/stem combination repair unit).
- **NEVER use only a rubber stem or plug**; or **NEVER USE only a patch**. Both materials must be used for a proper tire repair.
- Specific repair limits should be based on recommendations or repair policy of the tire manufacturer and/or the type of tire service.
- Some "run-flat technology" tires cannot be repaired. Consult tire manufacturer for their repair policy and, if applicable, for their recommended repair procedures.
- Speed Ratings – Tire Manaufacturer should be consulted for its individual repair policy.
- Never use any rim that is bent, corroded, cracked or worn.
- For speed rated tires, the tire manufacturer must be contacted for its individual repair policy – some manufacturers will void the tire speed rating if the tire has been repaired. Check whether the speed rating is retained after repair.

GENERAL SAFETY INSTRUCTIONS

- Always read the operating and application instructions enclosed with the corresponding products, tools and machines and **follow the Safety, Handling and Disposal guidelines**.
- Always observe the safety instructions and symbols on the product packaging and refer to the manufacturer's **Safety Data Sheet (SDS).**
- When working with solutions, rotary tools, sharp-edged tools, hot devices and hot materials, always take the necessary precautions and **wear appropriate gloves, adequate eye protection (safety glasses or face shields), ear protection and observe maximum RPM** while repairing tires.
- Always keep dangerous tools, solutions etc. out of the reach of children and unauthorized persons.

WARNING: TIRES MUST ALWAYS BE PROPERLY REPAIRED AS DESCRIBED IN THIS CHART. Improperly repaired tires can fail while in service, such as by tread-belt separation and/or detachment, which may result in an accident causing serious personal injury or death.

ONLY PROPERLY TRAINED TIRE REPAIR TECHNICIANS SHOULD PERFORM THESE REPAIRS

MAXIMUM ALLOWABLE INJURY SIZE:

Passenger & Light Truck Tires	maximum injury size	1/4" (6mm)
Medium & Heavy Truck Tires	maximum injury size	3/8" (10mm)

Any injury exceeding the Maximum Allowable Injury Size, as stated above, will require a section repair to be performed at a Full Service Repair Facility.

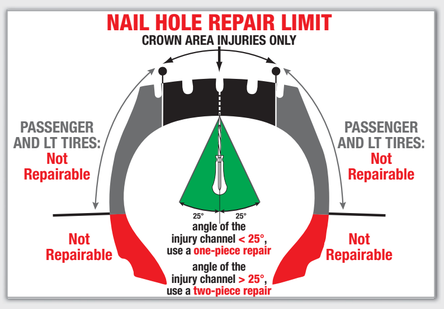
DO NOT REPAIR A TIRE WITH:

DO NOT REPAIR A TIRE WITH THESE TIRE INJURIES:
- Greater than 1/4-inch (6mm) in diameter for passenger and LT, 3/8-inch (10mm) for medium truck
- In the shoulder or sidewall areas
- In a position that would overlap an existing repair

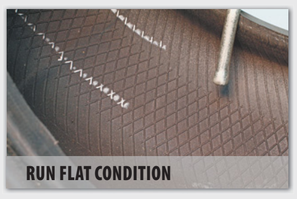
DO NOT REPAIR A TIRE WITH THESE TIRE CONDITIONS:
- Any conditions shown in the Non-Repairable Tire Conditions box
- 2/32-inch (3mm) or less remaining in tread depth
- Bead rubber torn down to steel
- Run flat conditions
- Broken or kinked beads
- Loose or broken radial body cables on inside shoulder
- Weather checking beyond 2/32-inch (3mm) deep
- Soft, mushy rubber on inside shoulder
- Broken or separated belts or tire with exposed fabric
- Liner separations too large for repair

DO NOT REPAIR A TIRE WITH THESE PREVIOUS REPAIRS:
- An existing improper repair
- Repairs that are outside of the repairable areas
- Where 3 previous repairs already exist
- An existing Non-Industry Standard Repair such as an "On the Wheel Repair / Outside In"
- Repair where a "Tire Sealant" has been used.

These Repair Charts reflect International Repair Standards, determined on the basis of practical experience, bench checks, and laboratory tests. THEY NEITHER INCORPORATE NOR ARE INTENDED AS A REFERENCE TO LOCAL, STATE, OR NATIONAL STANDARDS THAT MAY EXIST IN YOUR COMMUNITY. Stay within the limitation for repairable injuries indicated by the charts. When repairing a tire, it is imperative that a complete inspection be conducted to ensure that the tire is fit to be repaired and safely returned to service. Always follow proper repair procedures as illustrated in the appropriate KEX Tire Repair Manual(s). No tire can be safely repaired without demounting it from the rim, giving it a complete inspection, and properly repairing the injury with the appropriate inside repair unit and filler material. Always consult the tire manufacturer for the repair limits.



NON-REPAIRABLE TIRE CONDITIONS



NAIL HOLE REPAIR CHART

NAIL HOLE REPAIR CHART CROWN AREA ONLY			1-PIECE REPAIR (Injury Angle < 25 degrees)			2-PIECE REPAIR (Injury Angle > 25 degrees)					
						STEM	PATCH				BIAS PATCH
TIRE TYPE	Injury Size	Carbide Cuter	Combi with Pilot Wire	Patch-N-Plug Non-Reinforced	Patch-N-Plug Reinforced	STEM UNIT with Pilot Wire	Rubber Reinforced UNIVERSAL PATCHES (Round)	Rubber Reinforced UNIVERSAL PATCHES (Square)	MX RADIAL Patches	Fabric Reinforced UNIVERSAL PATCHES	Bias Ply Patches
PASSENGER	1/8" (3mm)	CC-3	KX-386	-	-	-	-		-	-	-
	1/4" (6mm)	CC-6	KX-387	KX-381	KX-375	KX-378	KX-UP-45	KX-4102	KX-MX10	KX-5101	NA
LIGHT TRUCK	1/4" (6mm)	CC-6	KX-387	KX-381	KX-375	KX-378	KX-UP-55	KX-4102	KX-MX12	KX-5102	KX-470
HEAVY DUTY TRUCK	1/4" (6mm)	CC-6	KX-387	KX-381	KX-375	KX-378	NA	NA	KX-MX12	KX-5102	KX-470
	3/8" (10mm)	CC-10	KX-388	KX-382	KX-376	KX-379	NA	NA	KX-MX14	KX-5103	KX-471

PRODUCTS USED

REPAIR UNITS:
Listed in the NAIL HOLE REPAIR CHART (see left)

CHEMICALS:
Buffing Solution..... KX-490F, KX-491F
Super Fast Drying Cement KX-511F
Liner Sealer..... KX-508F

ACCESSORIES:
Low Speed Air Buffer (RTT-SSB)
Air Vacuum w/Bag (795)
Carbide Cutter, 1⁄8" (CC-3)
Carbide Cutter, 3⁄16" (CC-4.5)
Carbide Cutter, 1⁄4" (CC-6)
Carbide Cutter, 5⁄16" (CC-8)
Carbide Cutter, 3⁄8" (CC-10)
Buffing Rasp, 2" (TCW-210-80)
QR Adapter (6068-125: CC-3)
QR Adapter (6068: CC-6)
QR Arbor (6067)
Awl/Injury Probe (190)
Ball Bearing Stitcher (30, 6005E)
Brass Bristle Cleaning Brush (6014)
Innerliner Scraper (932)
Marking Crayon (62W, 62Y)
Skiving Knife (929)
Pair of Pliers
Rep Boy Tire Spreader (3050-RB)
GREASE BULLY Nitrile gloves
StrongHold Gloves
Safety Glasses
A good light source

STEP 1 INSPECT

1.1 INSPECT THE TIRE ON THE OUTSIDE

Check tire surface and the valve for the source of the leak(s) by using a leak detector. Mark the injury with a tire crayon.

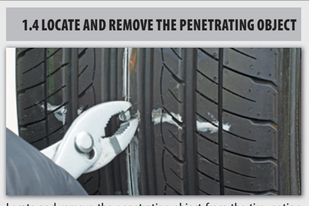
1.2 DEFLATE THE TIRE AND REMOVE FROM THE WHEEL

Deflate the tire before demounting, by safely removing the valve core. Safely remove the tire from the rim with the proper tire demounting tools and safety procedures, avoiding damage to the bead area.

1.3 PLACE ON TIRE SPREADER

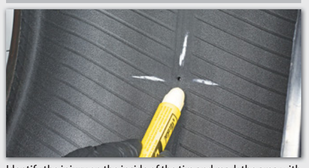
Place tire on a well lighted tire spreader and spread the beads. Never invert radial tires – and avoid excessive spreading of the tire or tire beads.

1.4 LOCATE AND REMOVE THE PENETRATING OBJECT



Locate and remove the penetrating object from the tire, noting the direction of penetration.

1.5 MARK THE INJURY ON THE INSIDE



Identify the injury on the inside of the tire and mark the area with a tire crayon.

1.6 INSPECT THE INJURY

Inspect the injury with an awl, probing the injury to determine the extent of the damage and determine the inclination angle of the injury channel.

Dipping the awl into KX-511F Super Fast Drying Cement before probing the injury channel serves as a lubricant, allowing easier insertion of the awl to inspect the injury.

Inspect the tire for any other damage. (See "IMPORTANT!" and "NON-REPAIRABLE TIRE CONDITIONS" section above).

1.7 REPAIR UNIT SELECTION

If the angle of the injury channel is greater than 25 degrees, a two-piece repair system must be used.

If the angle of the injury channel is less than 25 degrees, a one-piece repair system should be used.

Determine the injury size and refer to the NAIL HOLE REPAIR CHART above to select the appropriate repair unit.

The selection of the proper repair unit is dependent on several factors including injury size and angle, type of tire construction (radial or bias) and size of the tire to be repaired.

PASSENGER AND LIGHT TRUCK TIRES
For passenger and light truck tires, the maximum injury size that can be repaired is 1/4 inch (6mm) in diameter. Injuries should be in the crown area only. Shoulder and sidewall repairs in passenger tires are not recommended by the tire industry. Injuries exceeding 1/4 inch must be referred to an authorized full service repair facility.

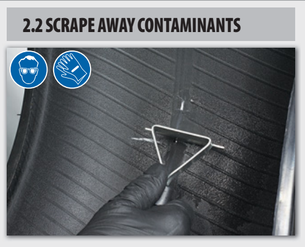
TRUCK TIRES
For truck tires, the maximum injury size that can be repaired is 3/8 inch (10mm) in diameter. Injuries should be in the crown area only. Injuries exceeding 3/8 inch or any injury in the shoulder, or sidewall must be referred to an authorized full service repair facility.

Check the warnings above (in the section marked "IMPORTANT!") for repairability of the tire.

STEP 2 PRE-CLEAN

2.1 APPLY PRE-BUFF CLEANER

2.2 SCRAPE AWAY CONTAMINANTS



Apply KX-491F Buffing Solution around the injury area. Using an innerliner scraper, scrape the area to be buffed removing the contaminates such as dirt, tire lubes, and mold release lubricants. The area cleaned should be slightly larger than the selected repair unit. Scrape the innerliner while the Buffing Solution is still wet. Repeat 2-3 times until the surface is clean.

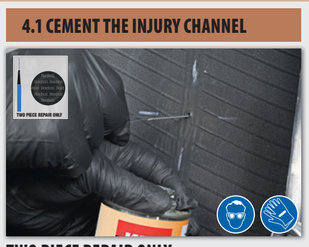
STEP 3 DRILL

3.1 DRILL THE INJURY CHANNEL

Determine the correct size Carbide Cutter from the NAIL HOLE REPAIR CHART above. Use a low speed tool (not to exceed 1200 rpm) to drill the injury from the inside out two or three times first and then from the outside in once or twice. Use full strokes with the carbide cutter, completely removing the cutter from the tire with each stroke.

STEP 4 FILL THE INJURY CHANNEL

4.1 CEMENT THE INJURY CHANNEL



TWO PIECE REPAIR ONLY
Apply KX-511F Super Fast Drying Cement to the injury channel using a #626 pull-wire or a #190 awl.

4.2 INSERT THE STEM

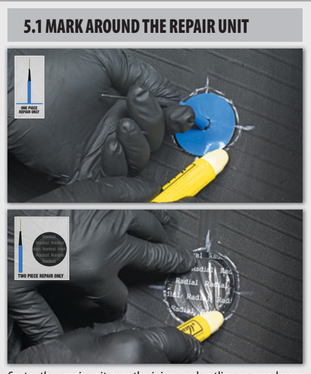
TWO PIECE REPAIR ONLY
Fully coat the KEX Stem Unit with cement and guide the pilot wire of the KEX Stem Unit through the injury channel. Pull Stem Unit from the outside of the tire until there is approximately ¼" (6 mm) of the stem remaining on the inside of the tire.

4.3 CUT THE STEM

TWO PIECE REPAIR ONLY
Cut the stem off leaving approximately 1/8" (3 mm) remaining on the inside of the tire. The remainder of the stem will be removed during the buffing process to provide a smooth surface.

STEP 5 BUFF

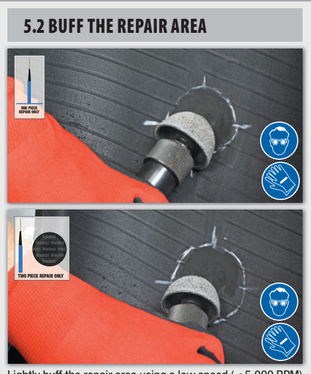
5.1 MARK AROUND THE REPAIR UNIT



Center the repair unit over the injury and outline an area larger than the unit, so buffing will not remove the crayon marks.

If the repair unit has bead arrows, make sure the arrows are pointing to the bead.

5.2 BUFF THE REPAIR AREA

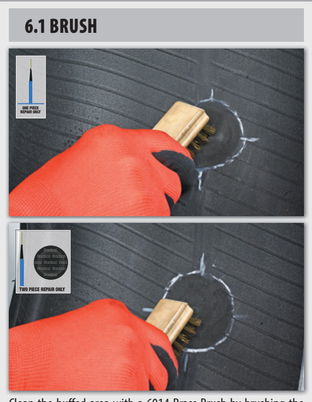


Lightly buff the repair area using a low speed (< 5,000 RPM) air or electric buffing tool with a clean buffing rasp, 36 to 60 grit (230-170 SSG) and remove all vent lines until you get a completely smooth surface. Continue lightly buffing the repair area to a smooth velvety finish (Buff Texture 1 or 2) by putting slight pressure on the buffing tool and keeping it in constant movement.

NOTE: If during the buffing procedure the Radial Plies (or Body Plies) are damaged or exposed, the tire should be replaced.

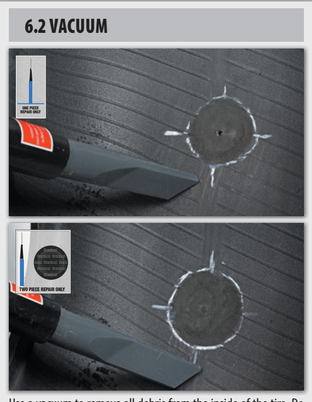
STEP 6 POST-CLEAN

6.1 BRUSH



Clean the buffed area with a 6014 Brass Brush by brushing the area several times in one direction. Avoid brushing the non-buffed areas where there are contaminants that could be pulled onto the freshly buffed area. Use a brush that is designated only for tire repair and not used for anything else. This will help avoid contaminants in the buffed area.

6.2 VACUUM



Use a vacuum to remove all debris from the inside of the tire. Do not touch the buffed area with the tip of the vacuum cleaner to avoid contamination. Always remove buffing dust with the use of a brass brush and vacuum. Never use compressed air. Do not use a Buffing Solution on the buffed texture after you have buffed to avoid leaving residues which reduce adhesion.

STEP 7 INSTALL

7.1 CEMENT THE INJURY CHANNEL

ONE PIECE REPAIR ONLY
Apply KX-511F Super Fast Drying Cement to the injury channel using a #626 pull-wire or a #190 awl. Super Fast Drying Cement provides the necessary lubrication for the insertion of the repair unit, and bonds it reliably to the tire.

7.2 CEMENT THE BUFFED AREA

Apply a thin, even coat of KX-511F Super Fast Drying Cement to the buffed area of the tire innerliner using a clean brush.

Use a swirling motion to apply the cement, as this will aid in the drying process as well as assure a thin, even coat. Completely cover the buffed area with cement to assure a good bond between the tire and the Repair Unit. Continue brushing and working the cement into the buffed area until the cement appears dry. Do not go outside the buffed area (Contaminates the brush).

Rotate the tire so that the cemented area is located between the 10 o'clock and 2 o'clock position. This will allow the solvent vapors, which are heavier than air, to "fall" away from the cemented innerliner.

Check the cement for dryness by touching the edge of the cemented area with the back of your finger. If the cement feels tacky, then it is dry. If it is not tacky, allow more drying time. Drying time depends on atmospheric conditions like heat and humidity. Hot temperature and high humidity require longer drying time of the cement. If the cement is not completely dry, the repair unit will lift off or blister and cause repair failure. Never use compressed air, hair dryers, heat guns, etc to aid in the drying of the cement.

Avoid any contamination on the bonding layer or the coat applied.

7.3 RELAX THE TIRE BEADS

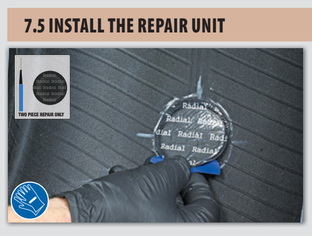
Relax the beads of the tire from the spreader. During the repair unit application the tire beads must be in a relaxed position.

7.4 INSTALL THE MINICOMBI REPAIR UNIT

ONE PIECE REPAIR ONLY
When installing a KEX Combi-Unit with Pilot Wire repair unit, insert the guide pin and stem through the cemented injury channel, from the inside outwards. Using a pair of pliers pull the guide pin from the outside until it is through the tire and you can see the rubber part of the Combi-Unit. Re-grasp on the rubber portion of the stem and continue pulling the stem until the Combi-Unit base, on the inside of the tire, is flush with the tire and slightly dimples.

The guide pin is only used to get the Combi-Unit through the tire. Once it is through the tire, re-grasp on the rubber portion of the Combi-Unit. If you pull on the guide pin only, it will pull out of the Combi-Unit.

7.5 INSTALL THE REPAIR UNIT

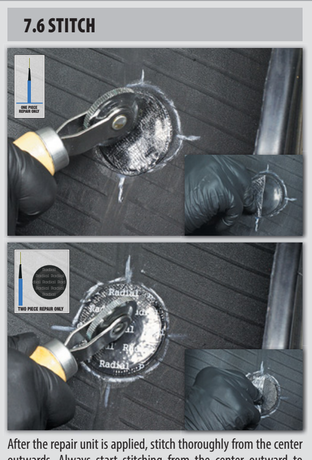


TWO PIECE REPAIR ONLY
Remove the poly or foil from the back of the repair unit. Without touching the bonding layer, center the repair unit over the injury and apply carefully pushing down on the repair unit with your thumb or fingers.

If using a directional repair unit, make sure to align the arrows in the correct direction.

If using a non-directional or Universal Repair Unit, it does not matter in which direction the repair unit is installed.

7.6 STITCH



After the repair unit is applied, stitch thoroughly from the center outwards. Always start stitching from the center outward to remove any trapped air that may be under the repair unit. Continue several times in different directions over the whole surface of the repair unit to make sure that it is completely stitched to the innerliner and that it adheres securely to the buffed surface area.

Remove the cellophane from the repair unit.

STEP 8 FINISH

8.1 APPLY LINER SEALER

Check the repair area for defects. The finished repair should show no peeling or lifting at the edges, and should neatly cover the repair area.

Apply a generous application of KX-508F Liner Sealer to the entire over-buffed area and the edge of the repair unit. If a Combi-Unit has been used, apply the Liner Sealer to the base of the Combi-Unit and any still exposed buffed areas.

8.2 RE-MOUNT & INFLATE

Safely mount the tire on the rim and inflate to the recommended tire pressure.

8.3 CUT THE STEM & BUFF

Cut the excess stem off or buff flush with the tread of the tire. DO NOT PULL ON THE STEM WHEN CUTTING IT OFF.

8.4 CHECK FOR LEAKS

Check both beads, the repair and the valve with a leak detector. If the tire continues to leak, it must be dismounted and re-inspected for other damage, and repaired correctly. If the damage is beyond repair limits, the tire should be scrapped.

8.5 BALANCE THE TIRE

Balance the tire. After the final inspection is done, the tire can immediately be put back into operation. The vulcanization between the repair unit and the tire is automatically completed under normal running conditions.

Training Videos, SDS, Technical Bulletins, Technical Data Sheets, Section Repair Charts, Product Catalogs, Product Brochures are available at www.kextirerepair.com. Article numbers listed here are KEX Tire Repair brand products.
This chart complies with industry standards for chemical repair methods as determined by the tire industry, and include the recommendations of TIA and TRMG.
This NAIL HOLE REPAIR PROCEDURES Wall Chart is meant for educational purposes only and is not meant to substitute for proper tire repair training.

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