

March 2008



# NFPA 1851 INSTRUCTIONAL PROGRAM

*Abbreviated printable version to electronic program*

## REPAIR MODULE



## In this module, you will learn about

- Replacing the entire moisture barrier
- Special types of repairs that you should discuss with the garment manufacturer
- Different types of repairs that can safely be done on moisture barriers
- Parameters for selecting the appropriate repair method
- Method for applying GORE-SEAM® tape correctly
- Procedures for repairing small punctures, small tears, larger tears, and seam-tape failures
- Procedures for patching a section
- Procedures for replacing a panel
- Procedures for repairing sealed seams

### This program does not address:

- Glove moisture barriers
- Footwear moisture barriers
- CBRN garments



This module describes the different methods for repairing damage to a moisture barrier.

## Repair Process

Section 8.4.3 says moisture barriers must be repaired by:

- Original garment manufacturer
- A Verified ISP



Improperly performed repairs can create safety issues. Although the NFPA 1851–2008 edition standard separates repairs into two categories, all CROSSTECH® moisture barrier repairs must be done by either your original garment manufacturer or a Verified ISP. See section 8 of the standard.

## Repair Process for CROSSTECH® Moisture Barrier



1. Select the appropriate repair method
2. Repair the damaged area
3. Test to make sure the repair is waterproof
4. Document the repair



# Replacement

Gore only endorses replacing the full moisture barrier in a garment when authorized by the garment manufacturer. Gore does not advocate ISPs creating complete moisture barriers without having the specific garment's pattern.

## Issues Resulting From Incorrect Pattern

- Difficulties tracking raw materials
- Improper sizing
- Differences in manufacturing methods



Gore *only* endorses replacing the full moisture barrier in a garment *when authorized by the garment manufacturer*. Gore does not advocate ISPs creating complete moisture barriers without having the specific garment's pattern.

## Repairs for Manufacturer's Special Consideration

- A tear across a seam or in a high-stress area
- A section that requires sewing a seam, a patch, or a panel
- An area that has previously been repaired

You should also check to see if the garment manufacturer has any unique guidelines for repairing their specific garment designs.



Before beginning to repair a moisture barrier, check with your garment manufacturer to see if it has any special guidelines about repairing a tear that crosses a seam or is in a high-stress area (for example the seat of the pants), a section by sewing a seam, a patch, or a panel, or an area that has previously been repaired.

## Selecting a Repair Method

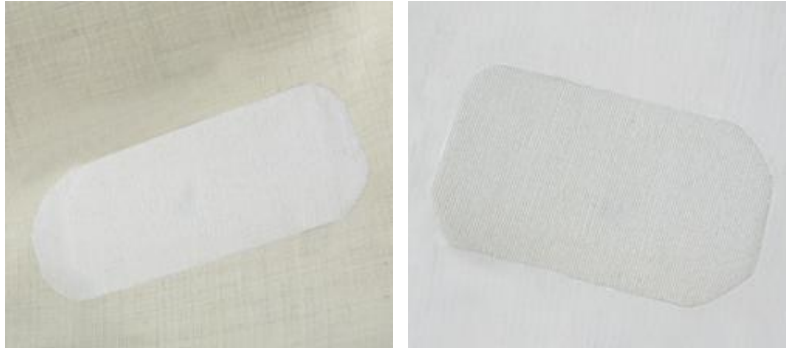
### Repair Considerations:

- Where the damage is
- How big the hole or tear is
- How complex the damage is
- The age of the gear versus the cost of the repair
- Total cost of repairs to date
- Whether any repairs already made
  
- Garment manufacturer guidelines supersede this information



Moisture barriers can be repaired. Choosing the right repair method depends on several factors. While there is not a “magic number” of maximum repairs that can be made to a moisture barrier, you should consider different factors when determining whether it is worthwhile to repair or replace the moisture barrier, factors such as where the damage is; how big the hole or tear is; how complex the damage is; the age of the gear versus the cost of the repair; the total cost of repairs to date; and the number and types of repairs already made.

## Selecting a Repair Method



Repair using GORE-SEAM™ tape only for small holes and tears



The following repair methods and criteria are general guidelines for moisture barriers. However, garment manufacturers may have additional requirements or repair guidelines, all of which supersede the information presented here. Options for repairing moisture barriers depend on the size and complexity of the damaged area. Some repairs that can be done using only GORE-SEAM™ tape. These simple repairs include a hole up to ½ inch in diameter, a slit up to three inches long, a slit across a seam up to three inches long (perpendicular to the moisture barrier seam), and a rip in the seam itself up to three inches long.

## Selecting a Repair Method



Sew-and-tape repair for straight tears



If a tear is straight and measures more than three inches long, you can repair it by sewing a seam and applying tape. If the tear is less than three inches, you can choose either the tape-only method or the sew-and-tape method.

## Selecting a Repair Method



Patch repair for irregular tears less than five square inches

*Note: Panels should be replaced for areas larger than five-square-inches*



If a tear is irregular and less than five square inches, you should use a patch cut from the same moisture barrier material used for the original moisture barrier. If damage is larger than a five-square-inch area, you should consult the garment manufacturer about replacing the entire panel.

## Selecting a Repair Method



GORE-SEAM® tape repair



Seam tape can be repaired if it lifts from the moisture barrier either at the end or anywhere along the seam.

## Barrier Protection

To be effective, a moisture barrier cannot have any holes or tears in it. Therefore, when repairing a CROSSTECH® moisture barrier, be careful with such things as scissors, needles, and other rough objects that could puncture the moisture barrier. Do not use staples or plastic tagging fasteners (such as those used for garment hangtags) to attach repair instructions tracking numbers to the moisture barrier.



When repairing a CROSSTECH® moisture barrier, be careful not to cause other damage, such as: holes from scissors, needles, staples, or fasteners.

## Barrier Protection



Be sure to seal any exposed stitch holes if you need to rip out a seam

*If you are repairing your thermal liner, be careful not to stitch through the moisture barrier at the same time.*



Also, be sure to seal any exposed stitch holes if you need to rip out a seam.

# Heat Press Operation

## Heat Press

- Model DK-8 Digital Combo
- George Knight & Company

## Seam Tape

- GORE-SEAM® tape is required for CROSSTECH® moisture barriers
- GORE-SEAM® tape is recommended for GORE™ RT7100 moisture barrier



In every repair method, you will need to apply GORE-SEAM® tape to the repaired area to ensure that the moisture barrier maintains its barrier properties. To purchase a heat press, request a **Model DK-8 Digital Combo** from:

George Knight & Company

52 Perkins Street

Brockton, Massachusetts 02302

Phone: (800) 525-6766 or (508) 588-0186

Fax: (508) 587-5108

Email: [info@heatpress.com](mailto:info@heatpress.com)

Website: <http://www.heatpress.com/>

GORE-SEAM® tape cannot be used on any product made by another manufacturer. When repairing CROSSTECH® moisture barrier or CROSSTECH® 3-Layer moisture barrier, you must use GORE-SEAM® tape. When repairing GORE™ RT7100 moisture barrier, it is recommended that you use GORE-SEAM® tape; however, it is not required.

## Heat Press Operation



When applying seam tape you must use a heat press, which requires elevated temperatures during operation. Before using the heat press, be sure to review and follow all safety instructions described in its operator's manual. To apply seam tape, you will need the following supplies: heat press with multiple bottom pads; GORE-SEAM® tape; scissors; timer or stopwatch.

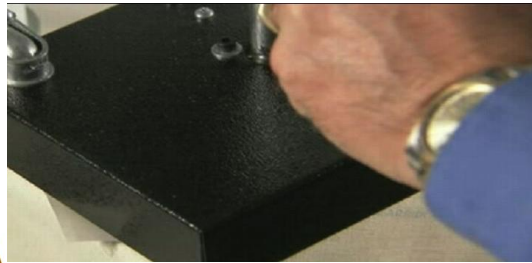
## Heat Press Operation



To apply GORE-SEAM® tape, perform the following steps:

1. Select the appropriate size bottom pad for the repair. For example, when repairing a curved area, such as a shoulder or crotch, you might find a smaller pad easier to use.
2. Adjust the pressure setting on the heat press to achieve a moderate pressure. See the operator's manual of the heat press for specific details on adjusting the pressure.
3. Put the damaged area of the moisture barrier on the bottom pad of the heat press with its seam-taped side facing up. For purposes of this video, we are showing a repair to the textile side. Some repairs will require applying tape to both the textile side and the seam-tape side.
4. Cut a piece of GORE-SEAM® tape at least ½ inch longer than the damaged area. Round the corners of the cut so they are less likely to peel when the garment is worn.
5. Place the GORE-SEAM® tape over the damaged area of the moisture barrier. The adhesive side of the tape should be touching the moisture barrier, not the heat press.
6. Make sure that both the GORE-SEAM® tape and the moisture barrier are flat with no folds, creases, or pleats. Remove any loose threads.

## Heat Press Operation



7. If your press does not have a non-stick upper surface, place a sheet of release paper on top of the GORE-SEAM® tape. This prevents glue from sticking to the upper surface of the press.
8. Lower the heat press onto the GORE-SEAM® tape for at least 20 seconds at 350°F. You may need to adjust this time/temperature recommendation depending on the complexity of the repair. For example, repairing a pin hole will need less time than replacing the seam tape in the crotch area of pants. If the tape overlays an existing piece of tape, extend the press time to ensure a durable bond.
9. Visually inspect the GORE-SEAM® tape. A 1/16-inch bead of glue along both edges of the tape indicates an adequate bond. If the tear requires seam tape on both sides of the moisture barrier, be sure to inspect both the textile side and the film side for a glue bead as shown here.
10. Let the repaired area cool before performing any additional repairs.

## Small Punctures and Tears

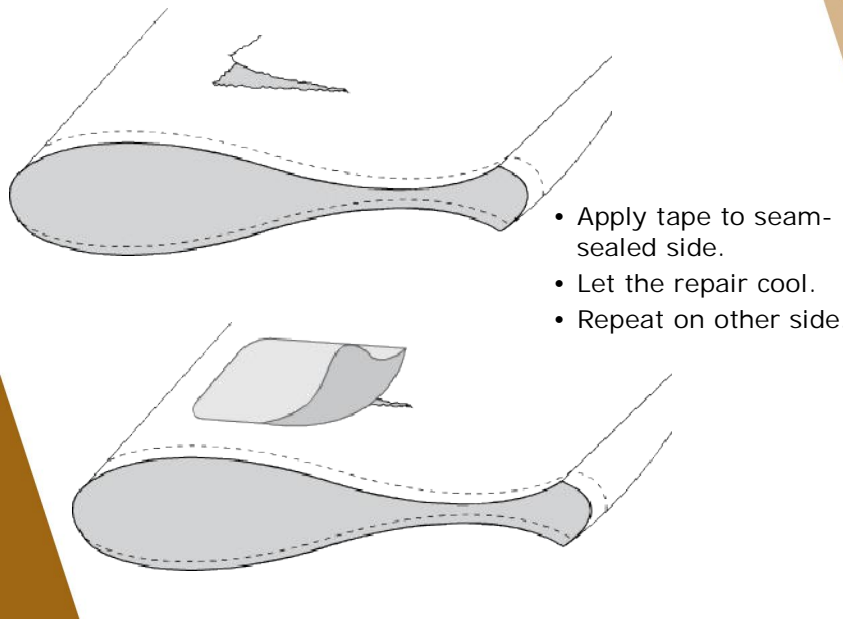
Typical repairs that can be done without stitching include:

- A hole up to ½ inch in diameter
- A slit up to 3 inches long in the CROSSTECH® moisture barrier
- A slit across a seam up to 3 inches long (perpendicular to the moisture barrier seam)
- A rip in the seam itself up to 3 inches long



Small tears and holes can be repaired simply by applying GORE-SEAM® tape.

## Small Punctures and Tears



When repairing the moisture barrier by simply applying GORE-SEAM® tape, it is important to apply tape to both sides of the moisture barrier as follows:

1. Apply tape to the seam-sealed side of the moisture barrier. See the Heat Press Operation section within this module for these procedures.
2. Allow the sample to cool.
3. Turn the moisture barrier over, and apply GORE-SEAM® tape to the other side of the moisture barrier.

## Larger Tears

You can repair a larger tear by sewing a seam in the tear as long as it meets these criteria:

- The tear is straight
- The tear is greater than 3 inches long
- The tear is less than 3 inches long, but you prefer to use this method



For larger tears, you can sew a seam and then apply tape.

## Larger Tears



The diagram shows a black silhouette of a sewing machine on the left. To its left is a vertical zig-zag line. To the right of the sewing machine is a hand holding a needle, with a line indicating the needle is stitching a tear in a material. The background is white with a brown diagonal stripe on the right side. Logos for 'CROSSTECH Products' and 'GORE' are visible in the top right and bottom right corners of the diagram area.

Sew-and-Tape Repair:

1. Use thread NFPA-1971-compliant thread. (See section 8.2.3.3 in NFPA 1851–2008 edition.)
2. Set sewing machine to zig-zag stitch.
3. Create seam without puckered seam allowance.
4. Seal seam.

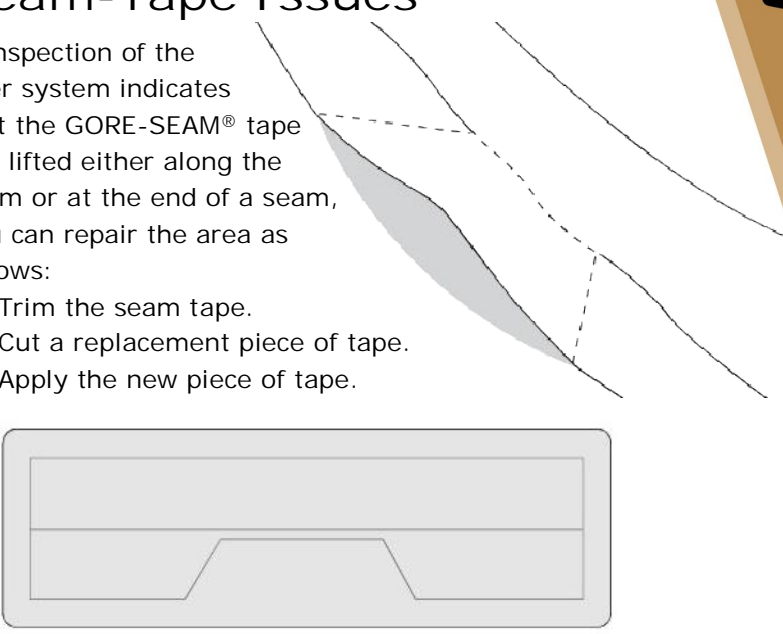
You can repair a larger tear as follows:

1. Use flame-resistant thread compliant with NFPA 1971 as defined in Section 8 of NFPA 1851.
2. If available, set the sewing machine to a zig-zag stitch.
3. Create a seam by sewing the tear together, avoiding a puckered seam allowance.
4. Seal the seam with GORE-SEAM® tape as described in the Heat Press Operation section of this module.

## Seam-Tape Issues

If inspection of the liner system indicates that the GORE-SEAM® tape has lifted either along the seam or at the end of a seam, you can repair the area as follows:

1. Trim the seam tape.
2. Cut a replacement piece of tape.
3. Apply the new piece of tape.

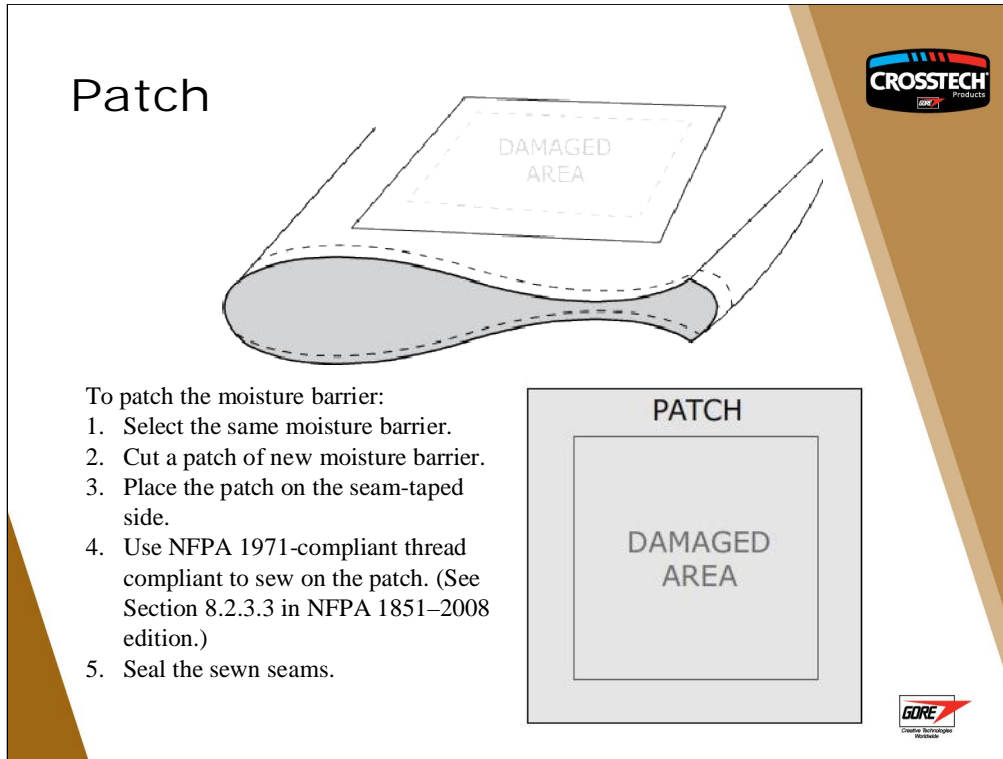


**CROSSTECH** Products  
GORE  
Create. Recover. Measure.

If inspection of the liner system indicates that the GORE-SEAM® tape has lifted either along the seam or at the end of a seam, you can repair the area as follows:

1. Carefully trim the seam tape to remove the unattached piece.
2. Cut a piece of GORE-SEAM® tape at least ½ inch longer than the unattached piece.
3. Apply the new piece of GORE-SEAM® tape, following the directions in the Heat Press Operation section of this module.

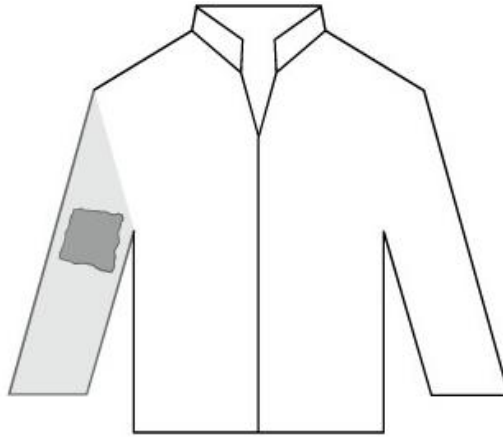
If the unattached piece of tape is too small to remove without damaging the CROSSTECH® moisture barrier, apply a new piece of GORE-SEAM® tape directly on top of the existing piece, overlapping all sides of the existing piece.



If a damaged area has an irregular tear that is less than 5 square inches or a cluster of pin-hole leaks, you can sew a patch of new CROSSTECH® moisture barrier over the damaged area. If the damaged area exceeds 5 square inches, you must replace the entire panel. Patching the moisture barrier involves the following steps:

1. Select the same CROSSTECH® moisture barrier material that you are repairing. Refer to the garment manufacturer’s label for specific materials of construction.
2. Cut a patch of new material at least one inch larger than the damaged area of the moisture barrier in all directions.
3. Place the patch on the seam-taped side of the moisture barrier, ensuring that the patch is oriented in the same direction as the existing moisture barrier and at least one inch of the patch extends beyond the damaged area in all directions.
4. Using flame-resistant thread compliant with NFPA 1971, sew the patch along all its edges to the moisture barrier.
5. Seal the sewn seams with GORE-SEAM® tape on the seam-taped side of the patch, i.e., membrane to membrane. See the Heat Press Operation section of this module for these procedures.

## Panel



Panel replacement for larger than  
five-square-inch area



If the damaged area of the CROSSTECH® moisture barrier is larger than five square inches (see Section 8.2.3 of NFPA 1851–2008 edition), you must replace the entire panel. Because garment designs differ from one line to another, consult with the garment manufacturer for specific guidelines on replacing a panel.

## Testing a Repair

Not testing for resistance to:

- Common chemicals
- Blood
- Body fluid



After you have completed the repair, use the Water Penetration Test to make sure the repaired section of the CROSSTECH® moisture barrier is waterproof. See the Testing Module of this program for procedures of this test. As you test the repair, keep in mind that water penetration is only one aspect of quality control. True performance includes liquid protection resistance against common chemicals, blood, and body fluids. Because of the destructive nature of these tests, you cannot perform them on repaired garments without retiring them from service.

## Effective Maintenance Log

- Includes all information per section 4.3.3 of standard
- Data can be retrieved easily
- Can be updated easily



It is important to keep a complete log of all maintenance activities for your moisture barrier.

This log can be in paper form, a computer spreadsheet, or a specialized software program for tracking gear.

The keys to an effective maintenance log are being able to retrieve the documentation when needed and being able to add subsequent repairs on an on-going basis. See Section 4.3.3 in NFPA 1851–2008 edition for a list of the data you should include in your maintenance log.