Extreme Sealing Tape
Exterior Durability Report

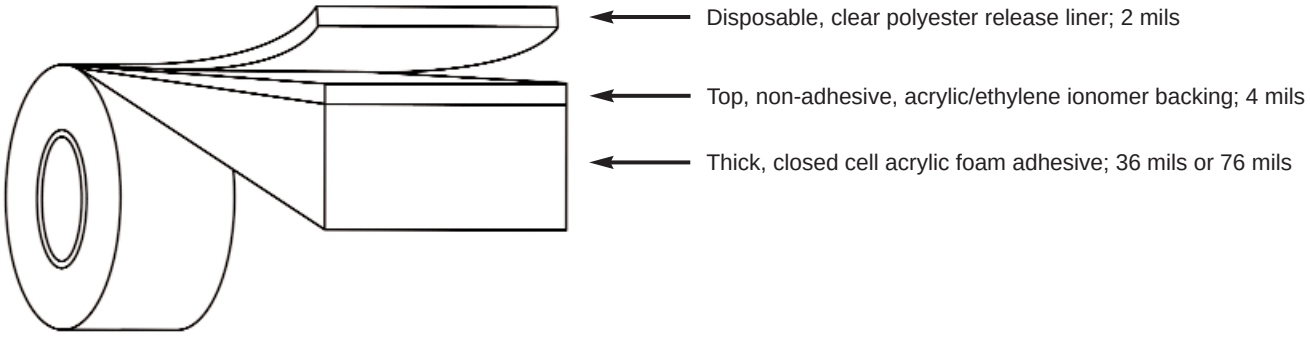
Technical Bulletin **May, 2013**

Summary of Technical Data:
This report provides outdoor weathering data, temperature and humidity resistance, and solvent immersion resistance of 3M™ Extreme Sealing Tape.

- The acrylic adhesive used in the 3M™ Extreme Sealing Tape is manufactured from the same technology platform as the 3M™ VHB™ Tapes.
- When properly applied, 3M™ Extreme Sealing Tape is expected to be durable for 3-5 years in harsh UV climates and 4-9 years in mild UV climates. Gray and black colors last 25% longer.
- The tensile strength of the ionomer backing remained unaffected after high heat and humidity aging (185°F [85°C] and 85% RH) – **See chart #1**.
- Static shear testing at elevated temperatures supports a short term (minutes/hours) temperature exposure of 300°F (149°C) and a long term (days/weeks) temperature exposure of 250°F (121°C) – **see chart #2**
- Adhesion data after exposure (solvent immersion, elevated temperature and cycle) indicate very good resistance to many common industrial solvents as well as elevated temperature and cycle conditions – **see chart #3**.

Product Description:
The 3M™ Extreme Sealing Tape is a tacky, single coated tape that has many potential uses for a wide variety of difficult sealing applications. As a single coated tape, the sealing is generally done by "oversealing" an existing joint or penetration, as opposed to "between surface sealing" applications done with a double coated tape, gasket, or liquid sealant/adhesive. One specific, intended use for this tape is "roof-to-trim" sealing and sealing around roof top mechanical fasteners on commercial vehicles to eliminate large quantities of liquid sealants.

This tape was specifically designed for outdoor exposure to direct sunlight, as well as temperature and humidity extremes. Painting the tape with a compatible and durable outdoor paint is one method to provide additional protection against the effects of UV radiation. The basic construction of the tape is shown below:



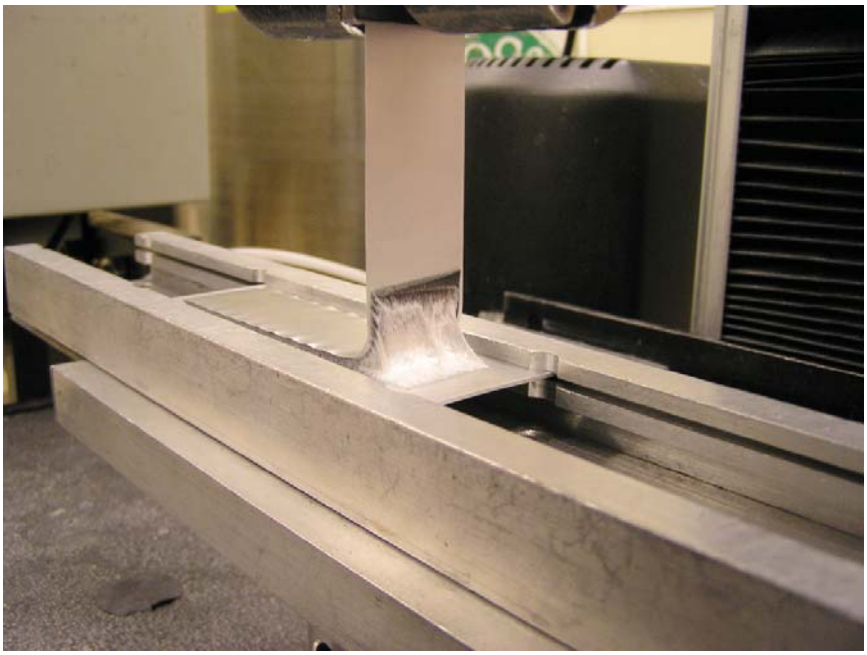
Note: While this data will show the durability capability of this tape, durability in any specific application is dependant on achieving a good level of adhesion to the substrates being sealed and in having a design where the static and dynamic stresses acting on the tape are within the product strength capability. It is also important to understand that the sealing performance of this tape is dependent on application technique. More specifically, surfaces must be properly prepared prior to tape application and the tape must be pressed into tight interfaces and properly rolled down on all surfaces.

Outdoor Weathering of 3M™ Extreme Sealing Tape:

In an actual application in Japan, on the top of a commercial truck, 3M™ Extreme Sealing Tape 4412N was examined after five years in use, and strength and performance were retained. Accelerated aging was also conducted at the 3M Weathering Resource Center in St. Paul, MN as well as actual outdoor weathering conducted in both Arizona and Florida.

Tape Sample Preparation and Tape Adhesion Testing:

1" x 4" long strips of 3M™ Extreme Sealing Tape were bonded to clean, bare aluminum test coupons with no additional surface preparation. The clear, matte, disposable release liner was removed from the non-adhesive top side of the 3M™ Extreme Sealing Tape. Samples were then exposed to direct UV from the sun in both Arizona and Florida. Samples were removed and tested after one, two and three years. Control samples were kept in a constant temperature and humidity room at 70°F (21°C) and 50% relative humidity. Anodized aluminum foil peel strips were bonded to the 1" x 4" piece of tape after weathering using 3M™ VHB™ Tape 5925. Ninety degree peel adhesion tests were run based on ASTM D3330. Crosshead speed was 12 inches per minute. Two samples were tested at each exposure condition.



Typical 90 degree peel adhesion test of 3M™ Extreme Sealing Tape showing “foam split” mode of failure to bare aluminum. 3M™ VHB™ Tape 5925 was used to bond the aluminum foil peel strip to the non-adhesive, ionomer top surface of the 3M™ Extreme Sealing Tape.

Visual comparison of freshly applied 3M™ Extreme Sealing Tape 4412N (left); and 3M™ Extreme Sealing Tape 4412N after weathering in direct UV exposure.

Real-world outdoor weathering was done in both Arizona and Florida. The results of the three year study indicate that, when properly applied, 3M™ Extreme Sealing Tapes are durable for an estimated 3-5 years when directly exposed to the sun in climates where the UV intensity is harsh and 4-9 years when the UV intensity is mild.

Accelerated weathering tests indicate that 3M™ Extreme Sealing Tapes 4411G, 4412G, and 4411B are more resistant to the effects of UV radiation. These gray and black tapes are expected to be approximately 25% more UV resistant than the neutral/translucent 3M™ Extreme Sealing Tapes 4411N and 4412N.

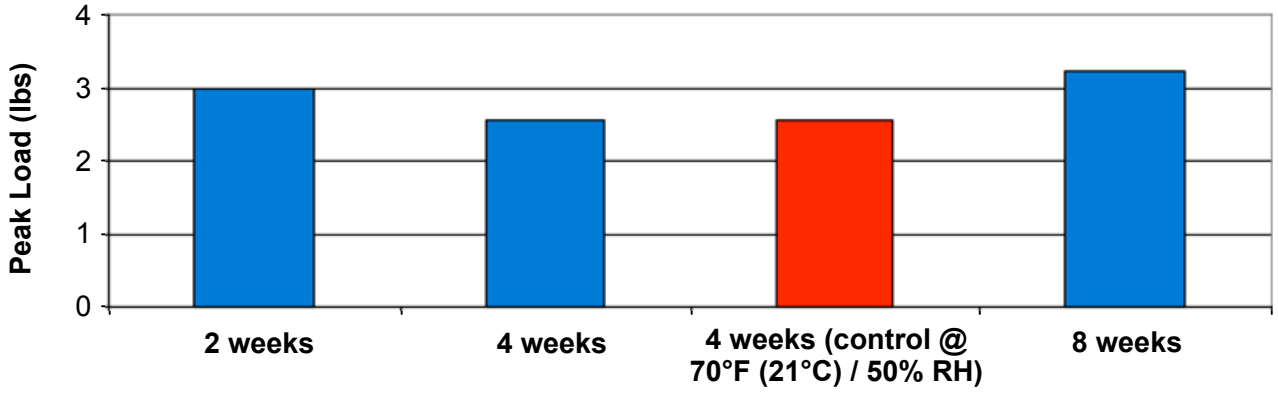
Chart #1

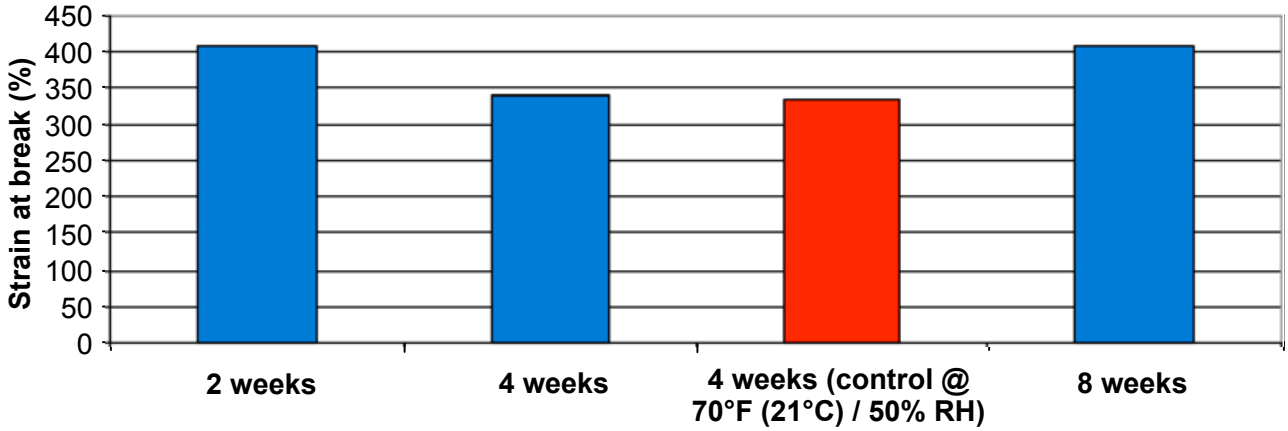
3M™ Extreme Sealing Tape 4412N – Tensile Strength

Effects of high temperature & high humidity on ionomer film only

Tensile testing on 1/2" wide ionomer film only

Aged at 185°F (85°C) and 85% RH





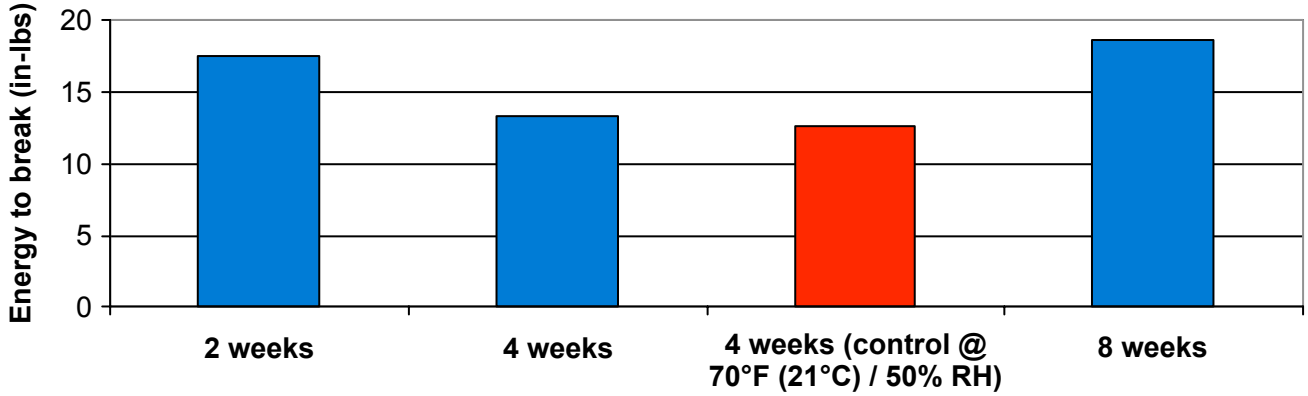
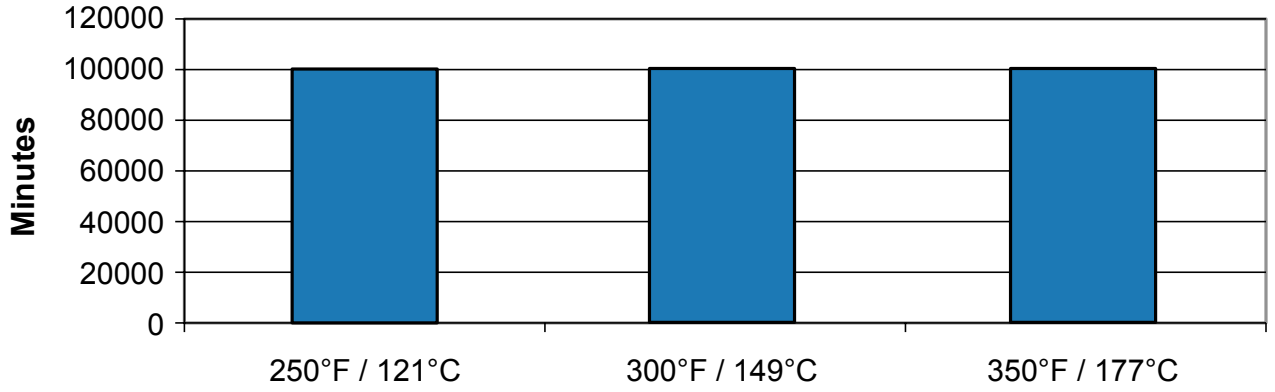


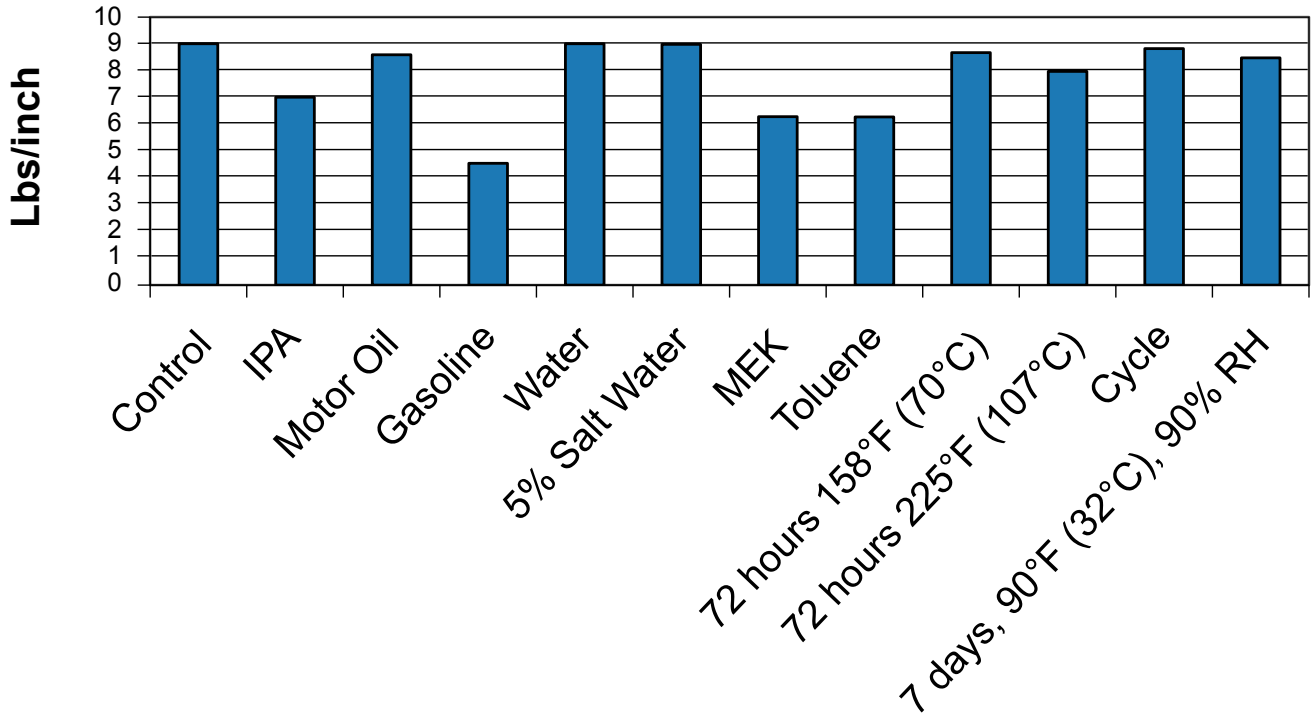
Chart #2
Static Shear of 3M™ Extreme Sealing Tape 4412N at Elevated Temperatures
ASTM D-3654 (1" x 1", 100 grams, stainless steel)
Panel Prep: 1 wipe 50/50 IPA/water; Prime with 3M™ Adhesion Promoter 111



3M™ Extreme Sealing Tape 4412N held 100 grams of weight at all three elevated temperatures for the full 10,000 minutes. The samples at 300°F (149°C) turned light brown and the samples at 350°F (177°C) turned darker brown. There was some odor detected at the 350°F (177°C) temperature. Some discoloration is expected for organic materials exposed to elevated temperatures. Based on this data, the tape should not be adversely affected by normal temperature variations encountered during outdoor exposures. The long term high temperature tolerance of this tape (days and weeks) is 250°F (121°C). The short term high temperature tolerance of this tape (minutes and hours) is 300°F (149°C).

Immersion Resistance, Temperature Resistance, Temperature Cycling Resistance, & High Humidity Resistance:

Chart #3
Exposure Data – 3M™ Extreme Sealing Tape 4412N
ASTM D3330 (modified to 90 degrees, stainless test panels)
(Notes: Immersions are 4 hr dwells in test fluid, Cycle is 4 hrs/158°F (70°C), 4 hrs/-20°F (-29°C), 16 hrs/RT)
Panel Prep: 1 wipe 50/50 IPA/water; Prime with 3M™ Adhesion Promoter 111



Elevated temperatures typically increase the wet-out of the adhesive onto the test substrates and increase the adhesive peel strengths when returned to room temperature.This data was generated without backing the 3M™ Extreme Sealing Tape 4412N with 3M™ VHB™ Tape 5925.

Most samples retained reasonable strength and color after the immersion condition. The only exception on the color retention was the gasoline immersion sample where the tape turned slightly yellow in color. Some reduction in peel adhesion performance is expected with these severe immersion conditions. Despite the immersion, the tape continues to bond well to the stainless test panel. The lowest performance, obtained after the immersion in gasoline, still achieved peel adhesive strength over 4 lbs per inch width of tape. This level of adhesion should still be useful for most sealing applications. Total immersion is a far more strenuous condition than an occasional splash condition. This tape, as with most tapes made of organic materials, is not recommended for continuous immersion in organic solvents.

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Summary Comments and Precautions:

Unless otherwise indicated, the surface preparation in the testing above was cleaning with a 50:50 mixture of isopropyl alcohol and water. All of this testing was done on either bare aluminum or bare stainless steel as indicated. Both bare aluminum and bare stainless steel are materials with high surface energy, which make them receptive to adhesive bonding. Substrates that do not have high surface energy (e.g. some painted metals and most plastics) generally need to be either abraded and cleaned, or treated with an adhesion promoter to obtain maximum adhesive bonds (especially applications subjected to ocassional splashes of organic solvents). The end user must evaluate the tape in each specific application (as the substrate changes) to ensure that 3M™ Extreme Sealing Tape and the chosen surface preparation meets the total use requirements.

Technical Information

The technical information, recommendations and other statements contained in this document are based upon tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed.

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