

Performance Data

Bond Strength



3M™ Stitchless Bonding Film

Introduction

Many fabric bonding applications, such as structural seams in garments or outerwear apparel in general, require bonding films that provide high bond strength and durability.

3M™ Stitchless Bonding Films 7010 series (7012, 7013, 7016) show improved properties relative to the currently available products tested in several factors that are important to consider when choosing a bonding film for these applications, specifically:

- Excellent wash durability
- Potential for productivity improvements
- Can provide improved bond strength at similar bonding conditions
- Maintenance of bond strength across a wide range of bonding conditions

- Excellent bond strength to both nylon and polyester fabrics
- Very soft hand

These improvements should allow for better bonded garment performance and greater manufacturing flexibility.

Films Evaluated ¹	Thickness
3M™ Stitchless Bonding Film 7013	75 microns (3 mil)
3M™ Stitchless Bonding Film 7016	150 microns (6 mil)
Currently available film positioned as “low softening point”	150 microns (6 mil)
Currently available best-in-class film positioned as “high bond strength”	150 microns (6 mil)

Bond Strength / Bonding Conditions

A higher bond strength can improve durability of the bonded garment. Alternatively, to improve productivity and to protect the integrity of the fabrics used, lower bond temperatures and shorter dwell times are desirable.

The graphs that follow show the relative bond strengths² of the four films for the same bonding conditions³ and fabric⁴. A higher bond strength indicates that a more durable bond is possible at

the same conditions or that a lower temp / shorter dwell may be used to attain a similar bond strength to the other films.

Different fabrics can yield different bond strengths and it is, therefore, important to take into consideration fabric choice when selecting a bonding film and bonding conditions.

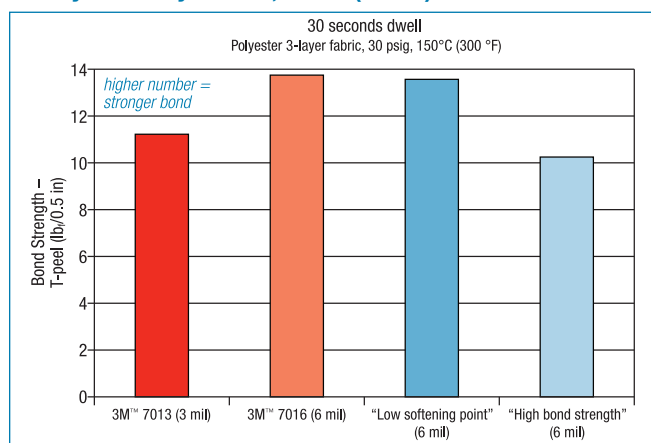
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Bond Strength / Bonding Conditions *(cont'd)*

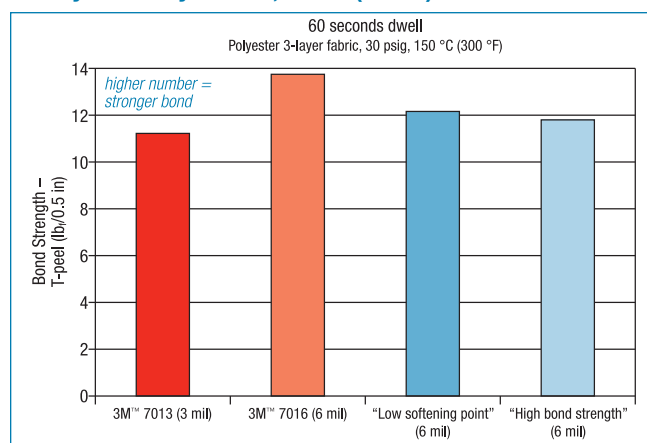
Polyester 3-layer fabric, 150 °C (300 °F) / 30 seconds dwell



The data shown above is for samples bonded on polyester 3-layer fabric. For the shorter dwell time condition, the 3M™ Stitchless Bonding Film 7016 shows comparable bond strength to the "low softening point" product and improved strength compared to the "high bond strength" product.

It should also be noted that the 3 mil 3M™ Stitchless Bonding Film 7013 shows comparable to superior bond strength compared to the "high bond strength" product that is twice as thick (6 mil).

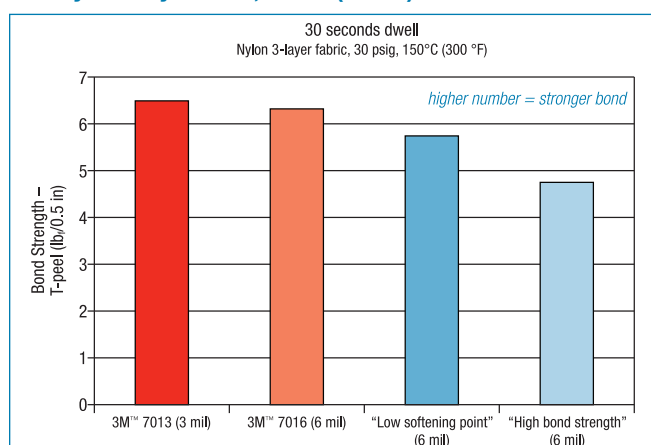
Polyester 3-layer fabric, 150 °C (300 °F) / 60 seconds dwell



The stitchless bonding film 7016 provides a stronger bond than all other film samples tested for the longer dwell time conditions.

Note that increasing the dwell time from 30 to 60 seconds noticeably decreases the bond strength of the "low softening point" film while the stitchless bonding film 7016 maintains its strength. This may indicate that for this particular fabric, the "low softening point" product is more sensitive to bonding conditions (dwell time) than the other products. That is, for the "low softening point" product, it may be possible for bond strength to deteriorate if the dwell time is too long.

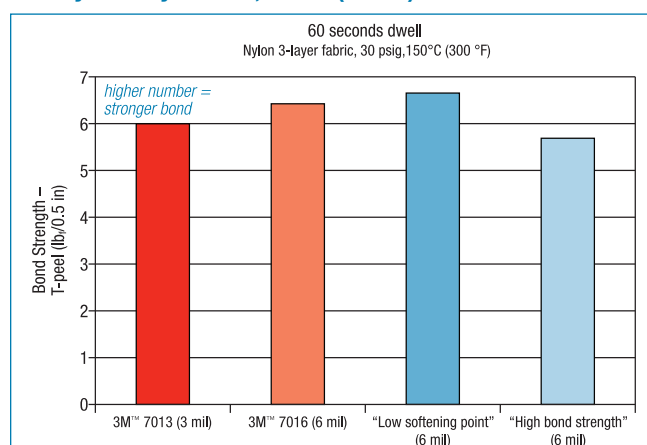
Nylon 3-layer fabric, 150 °C (300 °F) / 30 seconds dwell



As shown in the graphs above, tests were also performed with a nylon 3-layer outerwear fabric.

At the shorter dwell time, the stitchless bonding films 7013 (3 mil) and 7016 (6 mil) provide a stronger bond than the other films tested. Being able to produce strong bonds at shorter dwell times could improve productivity in a manufacturing setting.

Nylon 3-layer fabric, 150 °C (300 °F) / 60 seconds dwell



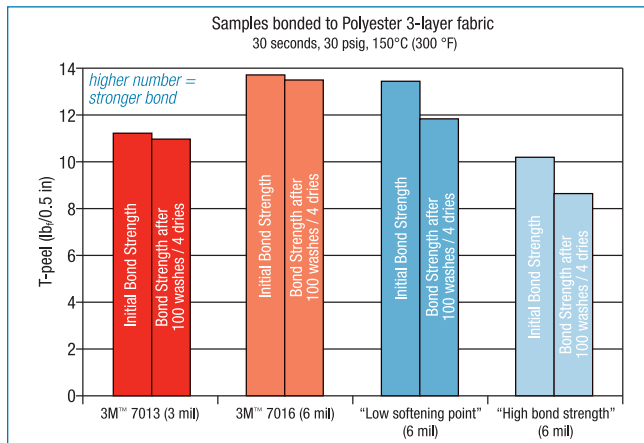
The 3 mil stitchless bonding film 7013 shows better bond strength than that obtained with the "high bond strength" film (6 mil) that is twice the thickness. This could be a potential material savings advantage.

At the longer dwell time, the stitchless bonding film 7016 has comparable bond strength to the "low softening point" product. The "high bond strength" product has the lowest bond strength of the samples measured at these conditions.

Wash Durability – Another important consideration in bonding film choice is durability. This is typically evaluated via wash testing⁵. Both the initial strength of the bonded seam and film composition play an important role in the durability of the bonded seam.

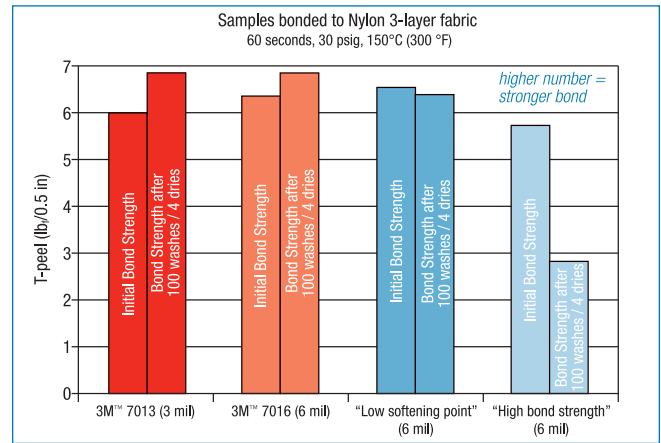
Both of the 3M films retain or slightly improve their bond strength after 100 washes and 4 dries. The “high bond strength” product loses a measurable amount of strength after the wash testing.

**Samples bonded to Polyester 3-layer fabric,
300 °F / 30 seconds / 30 psig**



Other testing has shown that 3M™ Stitchless Bonding Film 7013 bonded to polyester and nylon outerwear fabric can survive at least 350 wash cycles / 14 tumble dry cycles using the protocol discussed above. After this number of washes, the fabric on some samples begins to fail (the three fabric layers begin to separate).

**Samples bonded to Nylon 3-layer fabric,
300 °F / 60 seconds / 30 psig**



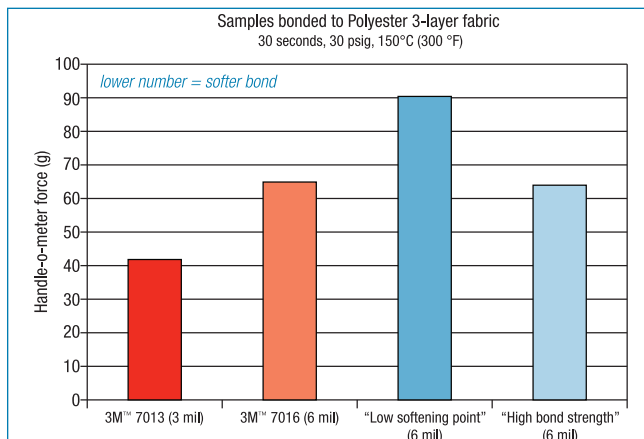
Softness – It is also vital to consider softness⁶ when designing a garment. Improved softness in a bonded seam allows for a more flexible and comfortable garment with better drape. In this test, a lower number indicates improved softness (less force required to bend the seam). The graphs that follow compare the relative softness of seams bonded with the four films on polyester and nylon fabrics at the same bonding conditions.

Because the film is thinner, the 3 mil film (stitchless bonding film 7013) shows improved softness relative to all of the 6 mil films tested.

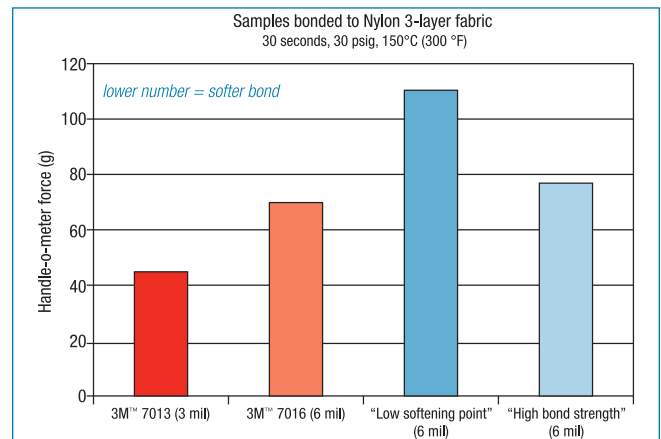
The bond softness provided by the 3M™ Stitchless Bonding Film 7016 film compared to the “high bond strength” film is approximately equivalent for the polyester fabric and shows a measurable improvement for the nylon fabric.

The “low softening point” film is substantially stiffer than all the other films tested for both fabric types. The increased stiffness would lead to greater “boardiness” in the seams of a finished garment.

Polyester 3-layer fabric, 150 °C (300 °F) / 30 seconds dwell



Nylon 3-layer fabric, 150 °C (300 °F) / 30 seconds dwell



Conclusions

In summary, 3M™ Stitchless Bonding Film 7013 and 3M™ Stitchless Bonding Film 7016 offer several performance advantages over other films currently available to apparel designers. These improvements should allow for better bonded garment performance. These advantages also could lead to improved manufacturing productivity and potential material savings while maintaining or improving quality in areas vital to outerwear performance.

3M™ Stitchless Bonding Film 7013

- Maintains the wash durability of the “low softening point” film while significantly improving bond softness
- Can achieve bond strength equivalent to the “high bond strength” film while improving wash durability, productivity, and bond softness
- All of these properties provided with a thinner film—75 micron vs. 150 micron (3 mil vs. 6 mil)

3M™ Stitchless Bonding Film 7016

- Provides equivalent bond strength and wash durability to the “low softening point” product while improving bond softness
- Exhibits equivalent bond softness to the “high bond strength” product while demonstrating improvements in regards to bond strength, productivity, and wash durability

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¹All testing was done with films 12.7 mm (0.5 inches) wide.

²Bond strength: T-peel (or 180° peel) – The unbonded ends (or tails) of the fabric were placed in the jaws of a constant rate of extension tensile testing machine. The force required to separate the bond was measured as the jaws moved apart at 12 inches per minute (30.5 cm/min).

³Bonding procedure: The bonding film (0.5 inch = 12.7 mm wide) was removed from its liner, then placed between the two fabric pieces and the entire assembly bonded using a heated static press with only the top platen heated at the conditions noted. The samples were bonded fabric face side to face side. (In some instances when the three-layer fabrics are bonded to the back side, the interlayer strength of the fabric is lower than the bond strength, resulting in the fabric separating without yielding a true bond strength result.) In order to ensure stable bond strength, at least twenty-four (24) hours were waited after bonding before performing any testing.

⁴Fabric referred to as Polyester is product # AT3828AKS from Amaterrace, PE microfiber taffeta. Fabric referred to as Nylon is product # AT3660AX from Amaterrace, FT rip stop.

⁵AATCC test method 124-2006—warm wash (~ 40°C water temperature) / cold rinse (< 29°C water temperature); tumble dry (“normal” dryer setting—exhaust temperature ~ 66 °C — for ~45 minutes). Twenty five wash cycles were completed followed by one tumble dry cycle. After each 25 wash / 1 dry cycle, samples were visually inspected for any failures. After 100 washes / 4 dries, samples were removed and measured for t-peel bond strength.

⁶Softness / hand test described by ASTM D6828.

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