ROGERS CORPORATION

High Performance Foams Division
Carol Stream, IL, USA
Tel: 630.784.6200 Fax: 630.784.6201
Cust. Orders Toll Free: 800.237.2068
Samples, Literature, Tech Support Toll Free: 800.935.2940

www.rogerscorp.com

Contact Information

Rogers BVBA Belgium
Tel: +32.9.2353611 Fax: +32.9.2353658

Rogers Taiwan Inc.
Tel: +886.2.8660.9056 Fax: +886.2.8660.9057

Rogers Technologies (Singapore) Inc.
Tel: +65.6747.3521 Fax: +65.6747.7425

Rogers Japan Inc.
Tel: +81.3.5200.2700 Fax: +81.3.5200.0571

Rogers Korea Inc.
Tel: +82.31.291.3660 Fax: +82.31.291.3610

Rogers Shanghai International Trading Co., Ltd.
Tel: +86.21.6217.5599 Fax: +86.21.6267.7913

Rogers Shanghai International Trading Co., Ltd. - Beijing Branch
Tel: +86.10.5820.7667 Fax: +86.10.5820.7997

Rogers Shanghai International Trading Co., Ltd. - Shenzhen Branch
Tel: +86.755.8236.6060 Fax: +86.755.8236.6123

ROGERS CORPORATION

BISCO® Silicones

BISCO® MF-1™

SEATING SOLUTIONS DESIGN GUIDE

Table of Contents

www.rogerscorp.com

As Trains Advance, so Does the Seating

When the speed record for conventional rail travel reached nearly 580km/hr (360mph), it became clear that rail technology would continue to move rapidly into the future. As today's innovations continue to develop, it's clear that BISCO® MF-1™ materials will move ahead with the trend. While locomotion, appearance, and destination are usually the traits that receive first notice, one of the most important developments involves rider comfort.

Long-Lasting Comfort

By guaranteeing a performance degradation of no more than 10% over ten years, BISCO MF-1 seating materials reduce ergonomic hot spots and improve rider comfort. With a warranty of ten years (see complete warranty for details) to enforce this guarantee, BISCO MF-1 materials are a smart choice for seating applications. With consistent, lasting comfort resulting from lasting quality comes the need for fewer refurbishments.

Long-Lasting Comfort that Contributes to Sustainability Initiatives

With stable quality over at least ten years, the refurbishment of MF-1 material seats over the life of a vehicle's service (20-30 years) could be reduced to one time. As a comparison, other seating materials may require refurbishments as often as every three to five years, meaning a relatively small fleet of 50 rail cars could translate into more than 400,000 kg (more than 880,000 lbs) of materials designated for landfills over the 20-year life of the train!

Comfortable and Safe

In addition to both comfort and sustainability, Rogers is focused and knowledgeable on all flame, smoke, and toxicity (FST) requirements and how the standards, which govern FST compliance, impact the market. BISCO MF-1 material is produced to meet various FST specifications around the globe to ensure worry-free usability. It is with this attention to comfort, the environment, and a variety of rail standards, that BISCO MF-1 materials are manufactured.

Design Specifics

The intention of these design recommendations is not to invade the space of those who design for aesthetics, comfort, and ultimately purpose. This guide is, however, Rogers' offering of a look into the design optimization process, by sharing recommendations for effective seat design when purchasing BISCO MF-1 silicone block materials. Rogers is capable of handling all drawings, but those created for molded materials do not always offer the most optimal design for MF-1 material seats. This publication of recommendations highlights the advantages of how having two drawings can save both time and money. With this in mind, the designer can focus on: "Design to use. Design to buy."

Looking at an MF-1 Seat as a Series Of Pieces

Because BISCO MF-1 materials are not molded and do not fill to form as some other materials, it can be helpful to look at BISCO MF-1 seats as a series of pieces before seeing them as one unit. The best way to do this is to think of building-block towers and structures. Precision-engineered seats extend well beyond that of a simple block construction, so visualizing an assembled seat as one block upon the next can help build an understanding of how the design is first approached. It is with these blocks in mind that the layers are formed.

The profile of many seats could easily be cut into layers by selecting the main cushion unit of the design ("A") and separating that from additional pieces, such as bolsters, aprons, and supports, that have been "added" to the top and bottom of "A." If the additional pieces are labeled as "B" and "C," a very basic seat would appear as below:

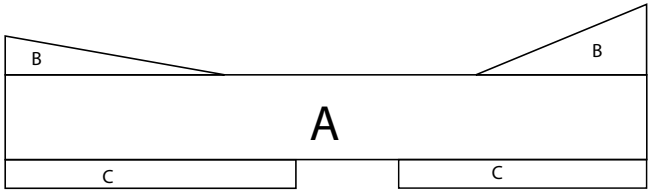


Figure 1: Building Blocks of a Seat Cushion

Now separate those additional pieces from the main unit ("A") and you have a series of layers:

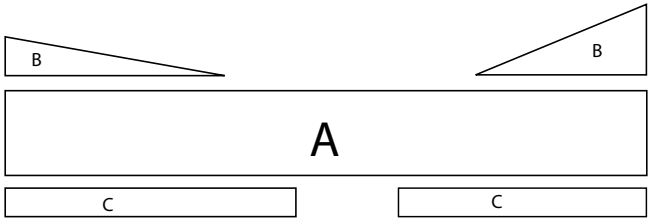


Figure 2: Separated Blocks for Fabrication and Gluing

In this example there are three separate layers. Each layer requires additional time and construction. While this particular seat design is simple, it is a perfect example of visualizing "building blocks." These "blocks" make it easier to determine if anything can be combined or removed if not completely necessary.

In the manufacturing of a molded seat design, all of the design features are often integrated into one piece. The same features, as it has just been demonstrated in the discussion on layers, when using BISCO MF-1 materials, are met with multiple fabricated pieces. While they do not add exponentially to cost, optimizing the number of pieces, cuts, and gluing stages will minimize fabrication costs and give power to the statement "Design to use. Design to buy."

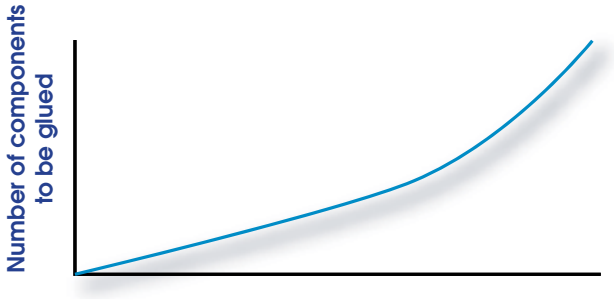
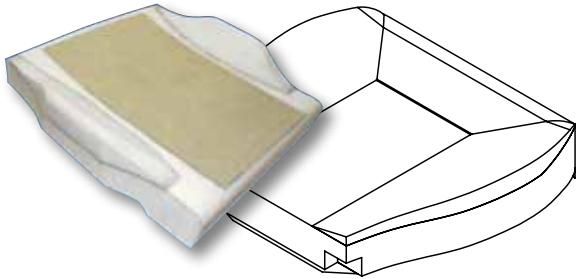


Figure 3: Components for Gluing Vs. Cost

One must "Design to use" for the obvious reasons with comfort, longevity, sustainability, and safety in mind. However, the manner in which the seat is built and sold must also weigh on the initial design.

"Design to buy" refers to the recommendation to develop two drawings during the design process to account for both material and processing alternatives: molded and fabricated BISCO MF-1 material. This will require additional

design work, but it will help to ensure that the seat you are receiving is effective and well designed for the material of choice. The seat created and fully optimized specifically for BISCO MF-1 materials will ensure the most competitive solution possible. With these recommendations, the superior quality of Rogers BISCO MF-1 material and your ability to design a seat that meets the needs of your company, the customer, and the daily rail traveler are perfectly suited for each application.



Terms

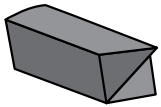
Block: The master form of BISCO MF-1 material. Standard sizes are generally 150mm-200mm (~6-8") thick with a width of 600mm (~ 24") and length of 1200mm (~48").

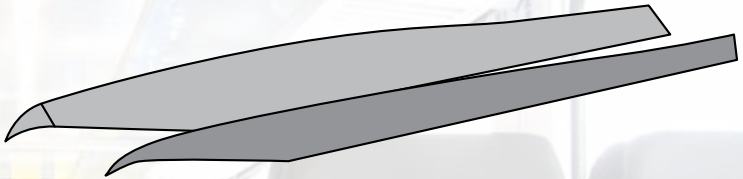
Sheet: A piece formed by cutting (or skiving) a specified thickness off the full width and length of the block.

Indention Force Deflection: A test method that is comprised of a disk that compresses the foam material a certain percentage of its thickness and then measures the amount of "push back" force.

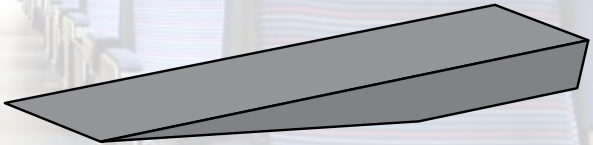
Apron: The portion of a seat cushion design that hangs and wraps around a seating spring system. This is only used in some North American systems.

Bolster: The portion of a seat assembly that improves armrest comfort while improving general seating comfort and provides separation among seating positions.



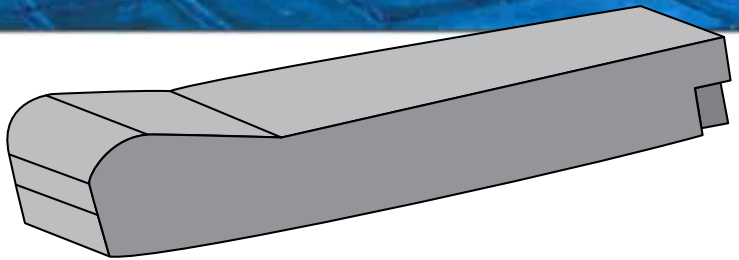


Bottom Pad: Often referred to as the actual seat cushion or a support for a main cushion. This component may be part of a full seat assembly or a simple pad that is part of an ergonomically designed seat pan.



Top Pad: A component often placed over a spring assembly and is only used in some North American designs.

Cushion or Main Cushion: The pad or assembled components intended for seating.



Seat Back: The portion of a seat design that may or may not be padded with foam materials. The seat back is typically designed to accommodate 1/3 of the passenger load.

Headrest: Typically a separate component of a complete seat design.

Skrim: A low cost woven industrial fabric that provides a wear and abrasion barrier between a foam material and the upholstery and is also used as a surface for gluing/ adhesion between the foam and the upholstery.

Note: BISCO MF-1 materials do not require protection for wear and abrasion.

Material Grade Recommendations

Selecting the appropriate material grade is important for comfort and cost. The chart below illustrates recommended thickness and grade combinations for both passenger and operator seats based on the material's indention force deflection (IFD):

Material Recommendations by Grade and Thickness				
Piece	Operator Seats		Passenger Seats	
	MF-1-35	MF-1-55	MF-1-35	MF-1-55
Seat Cushion	X	Min = 50mm	X	Min = 25mm
		Optimum = *		Optimum = *
Seat Back	X	Min = 50mm	Min = 20mm	X
		Optimum = *	Optimum = *	

* Dependent on type of seat, type of suspension, and design of pan

Table 1: Material Recommendations by Grade and Thickness

Forming a Radius

The strength, durability and unique cell structure of the BISCO MF-1 materials allow for a flat piece to bend to shape within a specific radii range (depending again on thickness and grade) with little to no degradation in quality or performance. Bending to form can help reduce the amount of material needed while simplifying the design. The table below provides information on maximum recommended radii for both grades in a broad thickness spectrum:

Formation of MF-1 Sheets		
Thickness mm	35 Grade	55 grade
	Maximum Bend Radius (mm)	Maximum Bend Radius (mm)
<20	20	30
20-30	30	45
30-50	50	75

Table 2: Formation of MF-1 Sheets

If the required radius falls outside of the recommendations or the pan does not enable the sheet to bend, straight cuts can often replace a radius.

The inherent properties of BISCO MF-1 material (as explained in the definition of indention force deflection) allow edges to push back with equal amounts of force when compressed, in this case, by a seat cover. Rogers is not proposing that these radii all be replaced by corners, but by a series of flat cuts, as shown on the next page:

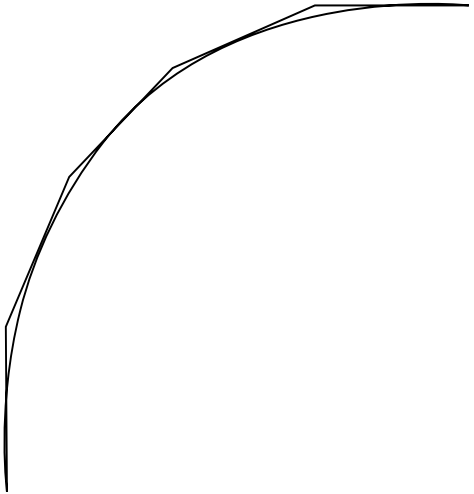


Figure 5: Straight Cuts in place of fabricated Radii

Rogers has the skill and equipment required to produce varying radii as needed, but reducing the number of radii in a design can help to reduce cost and lead time on a seat.

Multi-Plane Curves

If your seat design requires curves on one or more planes, Rogers also offers precision cutting through a CNC (Computer Numeric Control) operation. This does not mean that all curves are cost effective. The CNC is capable of producing multiple curves in one pass, but if curves lie on different planes, additional cuts will be needed and, as the number of cuts increases, the cost increases as well. Based on the straight blade of the CNC, multi-plane curves require multiple passes. If one or more curves are removed during a subsequent pass, gluing will be required. In these situations, the curves should be evaluated to determine if they are critically required.

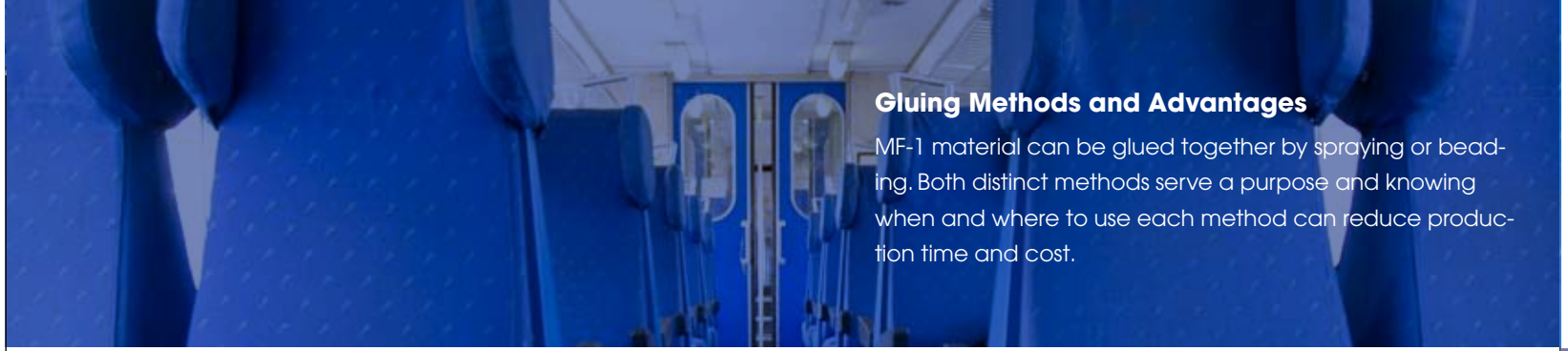
Fire Barriers and Fire Proofing

Rogers possesses the knowledge and ability to meet or exceed a range of ratings for the various flame, smoke, and toxicity (FST) specifications for much of the global rail market. These specifications include:

ASTM E662
ASTM E162
British Spec BS 6853
French Spec NFF-16-101
European Norm EN 45545
Polish Norm PN-K-02511

While each of these standards is unique, they have similarly stringent requirements for flame spread, smoke density and emission of hazardous or toxic gases. Test reports are available upon request.

To achieve the most stringent rating, many competitive materials must incorporate fire barriers into the cushion design. This adds costs to the seat and can compromise the integrity of the foam. While there may still be a preference to include a fire barrier in combination with BISCO MF-1 materials, there will be no long-lasting degradation of the foam due to abrasion wear between the cover and the foam. This is best demonstrated by the evaluation of Jounce and Squirm cycle testing. MF-1 materials pass the Jounce and Squirm test and remain intact throughout while competitive fire-retardant filled materials are worn into dust-like particles. Fire barriers are not always necessary to ensure compliance with these FST standards. This determination hinges on the design of the seat.



Gluing Methods and Advantages

MF-1 material can be glued together by spraying or beading. Both distinct methods serve a purpose and knowing when and where to use each method can reduce production time and cost.

Additional Hardware

Many seats are designed with the addition of third party hardware or add-ons such as muslin fabric, hook-and-loop skrim, and plastic components. Because third party materials are not considered a normal part of the assembly process for Rogers, these additions can increase lead times and cost. It is understood that some third-party hardware is required for the design and a positive solution can be reached. The need for hardware should be evaluated to determine if a change or modification to the pan would be more appropriate or cost effective. If hardware serves a purpose that the MF-1 material does not serve or if the seat is being designed as a refurbishment, then more recent material improvements would allow for it to be removed.

Spray Glue: This form of adhesion provides the best bond between materials. Glue is sprayed edge to edge and the foam pieces essentially become one unit. This strong bond will produce a distinctively harder edge at the joints.

Bead Glue: This form of adhesion provides a weaker bond than spraying, but it is less time consuming and more cost effective. The glue is beaded on to the material and does not extend out to the edges. Rogers does not recommend this for all areas or seats, but bead-gluing joints works well and is recommended for areas that will be ultimately exposed to the customer.

Both forms of gluing can be used on one seat and it is recommended to explore both options before deciding to exclusively use one or the other.

Closure

These recommendations are intended to assist in the design process when BISCO MF-1 materials will be used. Each recommendation provides a glimpse into the internal process when a drawing is received and a quote is required. Most significantly, each recommendation speaks to the value of the "Design to use. Design to buy." statement. With these recommendations, the superior quality of Rogers BISCO MF-1 material and your ability to design a seat that meets the needs of your company, the customer, and the daily rail traveler are perfectly suited for each application.