Bridge Products

Steelflex® Modular Expansion Joint Systems

Steelflex® Strip Seal Expansion Joint Systems

Delcrete™ Strip Seal Expansion Joint Systems

Delastic® Preformed Neoprene Compression Seals

Protect Your Investment
**Meeting the Challenge**

**Protect Your Investment**

Since the early 1960’s The D.S. Brown Company has provided expansion joint systems and structural bearing assemblies for bridges around the globe. Bridge expansion joint systems are directly exposed to vehicular wheel loads and, therefore, must resist dynamic forces causing fatigue and wear. In addition, these expansion joint systems must remain watertight to protect the bridge superstructure and substructure from corrosion.

To satisfy the demanding needs of bridge expansion joint systems, D.S. Brown is committed to product research and development, supported by world-renowned, independent testing laboratories.

For example, D. S. Brown pioneered processing improvements of its Steelflex® rail profiles from the traditional extrusion method to the innovative hot-rolled/machined and hot-rolled/non-machined technology. Quality is further improved through in-house neoprene sealing element extrusion capabilities. Together, these initiatives have allowed D.S. Brown to improve the watertight integrity of its expansion joint systems while reducing the cost of these assemblies to the owner/agency.

Use the design guide below to select and specify the appropriate D.S. Brown bridge product. The D.S. Brown Company’s Steelflex® and Delastic® Expansion Joint Systems are designed to protect your investment.

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**Design Guide/Table of Contents**

<table>
<thead>
<tr>
<th>Approximate Total Joint Movement</th>
<th>&lt;2” (51mm)</th>
<th>3” (76mm)</th>
<th>4” (102mm)</th>
<th>&gt;4” (102mm)</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steelflex® Modular Expansion Joint Systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3-6</td>
</tr>
<tr>
<td>Maurer System® Swivel Expansion Joint Assembly by The D.S. Brown Company</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Steelflex® Strip Seal Expansion Joint Systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8 - 10</td>
</tr>
<tr>
<td>Delcrete® Strip Seal Expansion Joint Systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Delastic® Preformed Neoprene Compression Seals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Fabricated Steel Products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Cableguard® Elastomeric Wrap System</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13 - 14</td>
</tr>
</tbody>
</table>

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The D.S. Brown Company

Founded in 1890 and based in North Baltimore, Ohio, USA, The D.S. Brown Company is a worldwide designer, manufacturer and supplier of engineered products for the highway and bridge construction markets.

D.S. Brown is fully integrated, performing and controlling all requirements of a project internally:

- Research and Development
- Engineering Design/CAD Detailing
- Rubber Compounding, mixing, extruding and molding
- Custom steel fabrication and machining
- Load testing

With offices and fabrication facilities throughout the USA, D.S. Brown is well positioned to satisfy all of your structural bearing assembly, expansion joint system and specialty bridge product requirements.

The D.S. Brown Company
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North Baltimore, OH 45872

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Email: dsb@dsbrown.com
D.S. Brown Steelflex® Modular Expansion Joint Systems have gained overwhelming worldwide acceptance for accommodating and sealing large joint movements on bridge structures. By incorporating the results of recent research activities, each joint system is designed to provide watertight, fatigue resistant, long-term maintenance-free performance.
System Components

Steelflex® Modular Expansion Joint Systems are highly engineered assemblies which consist of Steelflex® centerbeams and edge beams. The centerbeams and edge beams not only carry the dynamic wheel loads but also accept the series of strip seal style sealing elements that create a watertight joint. All Steelflex® Modular Expansion Joint Systems are designed to accommodate up to 80mm of movement per neoprene sealing element and, thus, the joint designation is presented in multiples of 80mm (i.e. D-160, D-240, etc.).

Each Steelflex® centerbeam is rigidly supported by its own support bar using a full-penetration welded connection. Support bars span the joint opening and are arranged below the centerbeams in a direction parallel to the structural movement. Stainless steel slide plates are attached to each end of the support bars (both top and bottom surfaces) to provide a low coefficient-of-friction surface. Movements up to ±0.79 inches (20mm) transverse to the support bars (for D-320 joint assemblies and larger) can be accommodated by a Steelflex® Modular Expansion Joint System. For large longitudinal movements and transverse movements beyond the allowable limits, the Maurer System™ Swivel Expansion Joint Assembly by The D.S. Brown Company should be considered (see page 7).

Elastomeric springs and bearings containing a PTFE sliding surface are utilized to accommodate all longitudinal, transverse, and rotational movements. The precompressed springs and slide bearings are located directly above and below the support bar, respectively. The precompressed spring is designed to have a specific compression force on the support bar which, in turn, produces a downward force on the slide bearing. This arrangement allows the spring and bearing to work together and resist uplift of the support bar as vehicular loads travel across the assembly.

Closed-cell polyurethane control springs are installed in all Steelflex® Modular Expansion Joint systems to provide equidistant spacing between centerbeams throughout the joint system’s complete movement range. The control spring orientation is such that the maximum compressive force is generated on the centerbeams when the modular expansion joint assembly is at its maximum opening.
Steelflex® Modular Expansion Joint Systems

**Design Principles**

**Fatigue Resistance**

Modular expansion joint assemblies are subjected to millions of high dynamic stress cycles due to passing vehicle loads. Recognizing the significance of these dynamic loads on the long-term performance of expansion joint systems, D.S. Brown became the first North American company to introduce fatigue-resistant design principles to modular expansion joint assemblies. It is strongly recommended that a specification which includes fatigue design provisions be included in the contract documents.

The results of extensive field and laboratory research have been utilized to achieve a fatigue-resistant expansion joint system. All primary members have been fatigue tested to determine the fatigue design category of each component (i.e. Steelflex® centerbeam, centerbeam/support connection and support bar). Using these test results, a fatigue-resistant joint assembly can be detailed to satisfy the contract specifications and ensure the owner of a maintenance-free expansion joint system solution.

**Watertight Integrity**

In the past, unsealed fabricated steel joint systems have been specified on structures with large movements. Unfortunately, these older joint system solutions have not been effective in preventing water and debris from passing through the deck joint to the underlying superstructure. This accumulation of water and debris corrodes steel components, deteriorates concrete and results in unnecessary rehabilitation costs. Even when these unsealed, fabricated joint systems utilize a trough to collect drainage, in most cases problems develop as they become filled with debris.

Steelflex® Modular Expansion Joint Systems solve these problems with their excellent watertight design characteristics. Each system not only bridges the joint gap but also protects the structure from premature corrosion. Design of the strip seal sealing element is based on compression of the neoprene seal lug into the gland recess of the centerbeam and edge beam. This mechanically locked neoprene seal not only provides excellent watertight characteristics but also achieves high pullout resistance. The strip seal sealing element has superior performance characteristics over the box seal design, including improved watertight capabilities, pullout strength and replaceability.

**Installation Considerations**

As in all other expansion joint system solutions, a proper installation is required to ensure long-term, maintenance-free performance of modular expansion joint systems. Special attention is directed to installation considerations such as:

- Joint lifting and handling
- Field splices (when necessary)

Detailed information on recommended installation practices can be found in The D.S. Brown Modular Expansion Joint Assembly Installation Data Sheet. It is also suggested that the contractor/owner utilize the services of a trained D.S. Brown technical representative to review proper installation techniques and be on-site during the initial installation of a Steelflex® Modular Expansion Joint System.
Steelflex® Modular Expansion Joint Systems

Joint Selection & Design Data

Selection of the proper Steelflex® Modular Expansion Joint System is based primarily on the anticipated structural movement at the joint location. For joint assemblies oriented perpendicular to the structural movement, simply select the Steelflex® Modular Expansion Joint System with a total movement range larger than the anticipated structural movement. Joint assemblies installed on curved or skewed structures require the calculation of structural movements parallel and perpendicular to the joint assembly. The largest of these two movements should be used to select the appropriate Steelflex® Modular Expansion Joint System.

The table below provides expansion joint assembly and blockout dimensions for a wide range of Steelflex® Modular Expansion Joint Sizes.

<table>
<thead>
<tr>
<th>Joint Device Symbol</th>
<th>Model Number</th>
<th>Total Movement</th>
<th>Cells</th>
<th>&quot;A&quot; Blockout Depth</th>
<th>&quot;B&quot; Blockout Width</th>
<th>&quot;C&quot; Min.</th>
<th>&quot;C&quot; Max.</th>
<th>Mid Temp</th>
<th>&quot;W&quot;</th>
<th>&quot;X&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-160</td>
<td>6.30 (160)</td>
<td>2</td>
<td>14</td>
<td>15</td>
<td>3.35</td>
<td>5.71</td>
<td>8.17</td>
<td>12.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-240</td>
<td>9.45 (240)</td>
<td>3</td>
<td>14</td>
<td>18</td>
<td>4.92</td>
<td>9.65</td>
<td>12.24</td>
<td>12.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-320</td>
<td>12.60 (320)</td>
<td>4</td>
<td>14</td>
<td>22</td>
<td>6.50</td>
<td>13.78</td>
<td>16.32</td>
<td>12.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-400</td>
<td>15.75 (400)</td>
<td>5</td>
<td>14</td>
<td>25</td>
<td>8.07</td>
<td>17.91</td>
<td>20.39</td>
<td>12.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-480</td>
<td>18.90 (480)</td>
<td>6</td>
<td>14</td>
<td>28</td>
<td>9.65</td>
<td>21.85</td>
<td>24.47</td>
<td>12.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-560</td>
<td>22.05 (560)</td>
<td>7</td>
<td>14</td>
<td>31</td>
<td>11.22</td>
<td>25.98</td>
<td>28.54</td>
<td>12.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-640</td>
<td>25.20 (640)</td>
<td>8</td>
<td>15.25</td>
<td>34</td>
<td>12.80</td>
<td>30.12</td>
<td>32.62</td>
<td>13.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-720</td>
<td>28.35 (720)</td>
<td>9</td>
<td>15.5</td>
<td>37</td>
<td>14.37</td>
<td>34.06</td>
<td>36.69</td>
<td>13.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dimensions are based on design provisions in NCHRP Report 402. Dimensions are based on 0 degree skew. Bold numbers represent inches; metric (mm) shown in parentheses. Shallower depths (X) may be possible upon special request.
Maurer System™
Swivel Expansion Joint Assembly by
The D.S. Brown Co.

Conventional large movement expansion joint devices, such as D.S. Brown’s Steelflex® Modular Expansion Joint System, are limited to primarily longitudinal movements and/or less than ±0.79 inches (20mm) transverse displacement. For joint locations which produce more demanding structural movements, the Maurer System™ Swivel Expansion Joint Assembly by The D.S. Brown Company is provided in the U.S.A. through an exclusive license agreement with Maurer Söhne, Munich, Germany. Typical applications include:

- Long-span structures
- Structures located in seismic zones
- Curved structures
- Structures with differential longitudinal movements or differential vertical movements
- Structures with anticipated substructure settlement

Performance Features

By utilizing a common-to-all-centerbeam swiveling support bar, the Maurer System™ Swivel Expansion Joint Assembly by The D.S. Brown Company is able to accommodate large longitudinal displacements (X), extensive transverse displacements (Y), and vertical displacements (Z), as well as vertical rotations ($\Phi_x$, $\Phi_y$) of up to 10 degrees. The centerbeams are free to slide on swiveling support bars, which provide equidistant control for centerbeams without the limitations of typical mechanical control devices. To ensure long-term performance, all Maurer System™ Swivel Expansion Joint Assemblies by The D.S. Brown Company are designed and fabricated using fatigue-resistant connection details.

For assistance with selecting the appropriate size patented Maurer System™ Swivel Expansion Joint Assembly by The D.S. Brown Company, please contact D.S. Brown.

Seismic Movement Capability

Dynamic tests conducted at the University of California at Berkeley subjected the Maurer System™ Swivel Expansion Joint Assembly by The D.S. Brown Company to high-velocity seismic displacements. This first-of-its-kind test program included velocities of more than 40 inches per second (1015mm/sec) in both longitudinal and transverse directions. The successful test results proved the unique capabilities of this patented device in seismic applications.

Multi-Directional Movement Capabilities

Dynamic Testing, University of California, Berkeley, CA, USA.

Lacey V. Murrow Floating Bridge, Seattle, WA, USA.
Steelflex® Strip Seal Expansion Joint Systems

For decades, cast-in-place Steelflex® Strip Seal Expansion Joint Systems have provided superior watertight performance and longevity over bolt-down, segmental and pourable expansion joint systems. Because of this proven performance, Steelflex® Strip Seal Expansion Joint Systems have become the overwhelming choice of owners and specifying engineers around the world for accommodating up to five inches (127mm) of total structural movement.

System Components


Steel Rail Profiles

Steelflex® rail profiles are one-piece construction, manufactured using innovative hot rolled/non-machined and hot rolled/machined technology. All proprietary steel rails are available in ASTM A36 or ASTM A588 steel grades.

Recent design improvements have eliminated all horizontal “legs” on the proprietary steel rail profiles to facilitate proper concrete placement during installation. Independent field and laboratory testing has demonstrated that improperly consolidated concrete around the steel rail, anchorage, and/or reinforcement could lead to performance issues. Anchorage of the proprietary steel rail profile into the deck concrete is the primary load carrying mechanism and, therefore, is critical to ensure long-term performance. Research has confirmed that properly sized and spaced shot-on studs provide an economical, field-proven anchorage method.

Because it is field-proven, the Steelflex® SSCM2 rail profile has become widely accepted worldwide as an economical standard in the industry. Other proprietary steel profiles are available to satisfy your specific project needs.

*SSCM available upon request
System Components

Neoprene Sealing Elements

Selection of a neoprene strip seal sealing element is based on the maximum movement either perpendicular (MR\text{L}) or parallel (MR\text{T}) to the Steelflex® Strip Seal Joint Assembly. To assist in your selection, the following table provides movement ranges for each sealing element type and the corresponding proprietary steel rail profile. Information is also provided on the range of joint opening dimensions. The preferred joint opening dimensions for sealing element installation is approximately 2.0 inches (51mm).

However, the preferred joint opening dimension for A2R-O and L2R-O seals is approximately 3.0 inches (76mm).

All D. S. Brown neoprene sealing elements are in-house designed and tested to provide a watertight seal at the connection to the Steelflex® rail profile. Factory molded neoprene sealing element splices can also be produced to accommodate your specific project needs.

<table>
<thead>
<tr>
<th>Sealing Element Cross-Section</th>
<th>Sealing Element</th>
<th>Movement Range</th>
<th>Joint Opening</th>
<th>Corresponding Steelflex® Rail</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MR\text{L}</td>
<td>MR\text{T}</td>
<td></td>
</tr>
<tr>
<td>A2R</td>
<td>A2R – 400</td>
<td>4.0 (102)</td>
<td>±2.0 (51)</td>
<td>0.5 – 4.5 (13) (114)</td>
</tr>
<tr>
<td></td>
<td>A2R – XTRA</td>
<td>7.0 (178)</td>
<td>±2.0 (51)</td>
<td>0.5 – 7.5 (13) (191)</td>
</tr>
<tr>
<td></td>
<td>A2R – O</td>
<td>4.0 (102)</td>
<td>±0.5 (13)</td>
<td>1.0 – 5.0 (25) (127)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2</td>
<td>L2 – 400</td>
<td>4.0 (102)</td>
<td>±2.0 (51)</td>
<td>0 – 4.0 (0) (102)</td>
</tr>
<tr>
<td></td>
<td>L2-500</td>
<td>5.0 (127)</td>
<td>±2.0 (51)</td>
<td>0 – 5.0 (0) (127)</td>
</tr>
<tr>
<td></td>
<td>L2-O</td>
<td>4.0 (102)</td>
<td>±0.5 (13)</td>
<td>1.0 – 5.0 (25) (127)</td>
</tr>
</tbody>
</table>

Bold numbers represent inches; metric (mm) in parentheses.
Design Considerations

Anchorage

Anchorage type, size and spacing for the Steelflex® SSCM2 joint system is illustrated. Anchorage details for other Steelflex® rail profiles are available.

Upturn Details

A watertight joint system is maintained through a simple upturn detail into the concrete barrier. The upturn angle varies depending on the barrier detail, joint skew and Steelflex® rail profile.

Horizontal Miter Details

Highly skewed structures often require fabrication of a horizontal break in the joint system to orient the steel rail 90 degrees to the face of the concrete barrier. Neoprene strip seal sealing elements are installed in a continuous piece, without vulcanization, up to a 35 degree angle.

East Fork White River Bridge, Columbus, IN, USA.
Since its introduction in 1983, the Delcrete™ Elastomeric Concrete/Steelflex® Strip Seal Expansion Joint System has been utilized on hundreds of bridges worldwide as an alternative to more labor intensive, cast-in-place expansion joint rehabilitation solutions. This expansion joint system also offers superior long-term performance when compared to various pourable joint solutions.

Components to this system include: low profile SSA2 or SSE2 Steelflex® rail profiles and Delcrete™ Elastomeric Concrete.

Delcrete™ Elastomeric Concrete is a pour-in-place, free-flowing, two-part polyurethane-based elastomeric concrete. Delcrete™ has been compounded to bond to a variety of surfaces including steel and concrete.

Following are the design features of the industry’s premier elastomeric concrete:

- Polyurethane chemistry
- Non-brittle over extreme temperature ranges
- Resistant to nearly all chemicals
- One hour cure time
- Permanent, long-term repair solution

Although initially developed for the bridge rehabilitation market, the outstanding performance record of Delcrete™ has resulted in bridge owners specifying Delcrete™ Strip Seal Expansion Joint Systems for new bridge construction projects as well.

**Installation**

Proper installation of Delcrete™ is essential to ensure long-term performance. Therefore, a D.S. Brown technical representative or a representative of its licensed applicator shall be present on the job site during all phases of the installation.

Basic installation considerations include:

- Minimum ambient and concrete substrate temperature: 45°F (7°C)
- Sandblast entire blockout, including steel rail profile, followed by a compressed air sweep
- Blockout area must be completely dry before installation

A comprehensive list of installation procedures is found in The D.S. Brown Delcrete™ Strip Seal Expansion Joint System Installation Data Sheet.
Delastic® Preformed Neoprene Compression Seals

In 1960 The D. S. Brown Company began designing and extruding the first generation of Delastic® Preformed Neoprene Compression Seals. Since that time continuous improvements have been made to this versatile, cost-effective joint sealing solution. To withstand the demanding requirements of bridge/highway installations, all Delastic® Preformed Compression Seals are extruded from neoprene (polychloroprene) compounds which satisfy the ASTM standard specification D3542 for Preformed Polychloroprene Elastomeric Joint Seals for Bridges.

In addition to highway and bridge applications, Delastic® Neoprene Compression Seals have also been used in spillways, dams, parking structures, stadium ramps and pedestrian overpasses. Information on additional seal designs is available.

Installation

In all installation applications, the joint width must be properly set for the specified Delastic® seal. Also, the vertical faces of the joint must be clean and free of spalled concrete. Desirable installation temperatures range from 35°F (2°C) to 80°F (27°C). At temperatures below this range the lubricant/adhesive has limited effectiveness, while at temperatures above this range the seals become difficult to compress for installation.

Manual and automatic tools are available to facilitate installation. D.S. Brown Delastilube™ or Delastilube™ HS lubricant/adhesive is used primarily to lubricate the seal for installation purposes. The Delastilube™ products meet ASTM D2835 and D4070 standards.

Design Data

The table below can be used to select the appropriate Delastic® Neoprene Compression Seal for your project. In addition to accommodating perpendicular movements (summarized in the table), Delastic® seals are also capable of accepting approximately 15-20% lateral shear, vertical shear and rotational movements.

<table>
<thead>
<tr>
<th>Delastic® Seal</th>
<th>Delastic® SEAL CHARACTERISTICS</th>
<th>JOINT DESIGN CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal Width (W)</td>
<td>Nominal Height (H)</td>
</tr>
<tr>
<td>CV-1250</td>
<td>1.25 (32)</td>
<td>1.25 (32)</td>
</tr>
<tr>
<td>CV-1625</td>
<td>1.63 (41)</td>
<td>1.88 (48)</td>
</tr>
<tr>
<td>CV-1752</td>
<td>1.75 (44)</td>
<td>1.75 (44)</td>
</tr>
<tr>
<td>CV-2000</td>
<td>2.00 (51)</td>
<td>2.00 (51)</td>
</tr>
<tr>
<td>CV-2250</td>
<td>2.25 (57)</td>
<td>2.33 (59)</td>
</tr>
<tr>
<td>CV-2502</td>
<td>2.50 (64)</td>
<td>2.50 (64)</td>
</tr>
<tr>
<td>CV-3000</td>
<td>3.00 (76)</td>
<td>3.25 (83)</td>
</tr>
<tr>
<td>CV-3500</td>
<td>3.50 (89)</td>
<td>3.50 (89)</td>
</tr>
<tr>
<td>CV-4000</td>
<td>4.00 (102)</td>
<td>4.00 (102)</td>
</tr>
<tr>
<td>CV-4500</td>
<td>4.50 (114)</td>
<td>4.50 (114)</td>
</tr>
<tr>
<td>CA-5001</td>
<td>5.00 (127)</td>
<td>5.00 (127)</td>
</tr>
<tr>
<td>CA-6000</td>
<td>6.00 (152)</td>
<td>6.00 (152)</td>
</tr>
</tbody>
</table>

Bold numbers represent inches; metric (mm) shown in parentheses.
Joint opening dimensions (A) are based on minimum and maximum pressures allowed in ASTM D3542.
Minimum depth dimensions (B) include a 0.25 inch (6mm) recess below the roadway surface.
**Fabricated Steel Products**

Fabricated steel plate expansion joint systems, such as finger joint assemblies and sliding plate and armor joint systems, are still specified on many bridge projects due to proven long-term structural performance. These joint systems are also convenient to install on bridge rehabilitation projects requiring a shallow joint depth and/or staged construction.

In addition to fabricated steel plate expansion joint systems, D.S. Brown supplies fabricated steel bridge railings to meet your specific project requirements.

To ensure high-quality workmanship, all fabricated steel products should be fabricated in an AISC-Major Steel Bridge certified facility.

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**Cableguard™ Elastomeric Wrap**

Due to the premature failure of corrosion protection systems on cable-supported structures, D.S. Brown began development of its patented Cableguard™ Elastomeric Wrap System in the early 1990s. This alternative corrosion protection system, developed exclusively for bridge cables, is applicable during construction or rehabilitation of cable-stayed and suspension bridges.

The Cableguard™ wrap is based on cross-linking a chlorosulfonated polyethylene polymer that is manufactured into a 45 mil (1.14mm) thick, three-ply (polymer-fabric reinforcement-polymer) laminated construction.

Several Cableguard™ Elastomeric Wrap features are highlighted as follows:
Cableguard™ Elastomeric Wrap System

Highlighted Features

Environmentally Friendly

Cableguard™ Elastomeric Wrap is applied directly over existing polyethylene, paint or galvanized cable surfaces using a Skewmaster™ automatic wrapping device. The Cableguard™ Elastomeric Wrap encapsulates the entire cable. The Cableguard™ system does not require sandblasting, high-pressure washing or any type of solvent. Therefore, containment and disposal of hazardous materials is eliminated.

Simple Installation

After applying the Cableguard™ Wrap, intimate heat is applied to fuse the 50 percent overlapped wrap (total thickness of 90 mils) and shrink the wrap snuggly to the cable surface. This fusion and shrinkage creates an impermeable barrier against the intrusion of moisture into the cable. However, even though the Cableguard™ wrap shrinks securely to the cable, it does not fuse or bond to the cable. Therefore, partial removal for inspection of the internal strands is not impaired.

Proprietary Cable Band Treatment

The Cableguard™ Elastomeric Wrap System features a watertight sealing mechanism at the cable bands of suspension bridges. This proprietary system includes an extruded neoprene wedge and stainless steel clamping straps.

Color-Fast

Cableguard™ wrap is available in virtually any color without applying paint.
Notes
Steelflex® Expansion Joint Systems

Fred Hartman Bridge, Houston, Texas, USA.

Longport Bridge, Ocean City, NJ, USA.

KaoPing Bridge, Kaohsiung, Taiwan.

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