DualGuard 2000
Fluoropolymer Barrier FRP Duct

Composites USA
A Critical Process Systems Group Company
Worried about meeting Insurance Underwriter and Building Code Requirements for corrosive fume exhaust?

DualGuard 2000™
Fluoropolymer Barrier FRP Duct

Your worries are over!
Insurance underwriters and local building codes routinely require the use of low smoke, fire safe materials in the construction of process facilities. DualGuard 2000 meets these requirements without the use of either internal or external sprinklers making it less expensive to install. Building Codes in the United States, Canada, and many other locations around the globe, including those of B.O.C.A. and the U.B.C./I.B.C. require testing to ASTM E-84 for flame spread and smoke development. Duct must exhibit a flame spread of 25 or less and a smoke development of 50 or less on both the inside and the outside of the duct to be used without sprinklers. DualGuard 2000 has been tested by both Factory Mutual and Underwriters Laboratories. Its flame spread of 5 and smoke development of 10, on both the inside and outside of the duct, assures you that a DualGuard system will meet building codes and insurance requirements.

ASTM E-84 Smoke Density Generation

- Flame Spread of 5 on both the inside and outside of the duct (ASTM E-84)
- Smoke Development of 10 on both the inside and outside of the duct (ASTM E-84)
- VeilGuard in the corrosion liner for premium corrosion resistance
- Built to long established industry guidelines for corrosion resistant fiberglass composites
- Easy to assemble with a variety of joining techniques
- Independent 3rd party QA auditing by Factory Mutual and U.L.

Factory Mutual Approvals
- DualGuard 2000 passed Factory Mutual’s new, tougher 4922 test procedure for non-sprinkler fume and smoke removal systems - File no. 4B1A5M.AM.
- DualGuard 2000 passed Factory Mutual’s new 4910 test procedure for Clean Room Approved Materials - File No. 3006453.

Underwriters Laboratories Listing
- DualGuard 2000 passed U.L. 181 test procedure, leading to its listing as a Class 1 Duct in accordance with U.L. requirements - File No. MH26567.
- U.L. 181 Listing meets the requirements for NFPA and the International Mechanical Code (IMC).
You'll share our passion: fire safe and easy to install!

DualGuard 2000 takes the heat when exposed to a direct flame source and will continue to exhaust hazardous chemical process fumes during a fire. DualGuard does not require collapsing sleeves or dampers which would prevent hazardous smoke removal. DualGuard will not generate toxic gases that can endanger employees.

The advantages of the DualGuard resin system include corrosion resistance, high temperature resistance, does not readily burn, gives off low smoke, and has low smoke toxicity.

DualGuard 2000 duct and dampers are available in almost every conceivable configuration with sizes as small as 1/2 inch and as large as 24 feet in diameter. Fittings include elbows, transitions, tees, reducers, stacks, fume hoods, dampers and more. See our product catalog or visit our web site for a complete product listing.

DualGuard Meets the Construction Standards for Corrosive Fume Fiberglass Duct!

Dual Guard is built to the same standards that have guided the fiberglass corrosion industry for over thirty years.

1. Inner Surfacing Layer - Fluoropolymer surfacing veil resulting in a 25 mil (0.63mm / 0.025 inch) thick reinforced resin-rich surface. Not all FM ducts provide a corrosion veil; none use a premium veil.
2. Interior Layer - reinforced with non-continuous glass strands at 20% - 30% by weight, having fiber lengths from 0.5 - 2.0 inches.
3. Structural Layer - continuously wound fiberglass to provide optimal strength for a given application. This layer is typically 65% by weight glass.
4. External Layer - woven fiberglass cloth for ease of bonding using either conventional fiberglass joining techniques or proprietary Composites USA bonding systems.
**FM and U.L. Test Results that will exceed your expectations!**

<table>
<thead>
<tr>
<th>Factory Mutual / U.L. Test Criteria</th>
<th>Flame Spread Inside</th>
<th>Flame Spread Outside</th>
<th>Smoke Development Inside</th>
<th>Smoke Development Outside</th>
<th>Fire Propagation Index (FPI)</th>
<th>Smoke Damage Index (FPI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DualGuard 2000</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>1.8</td>
<td>0.04</td>
</tr>
<tr>
<td>FM Limits (Max.)</td>
<td>25</td>
<td>25</td>
<td>n.a.</td>
<td>50</td>
<td>6.0</td>
<td>0.40</td>
</tr>
<tr>
<td>U.L. Limits (Max.)</td>
<td>25</td>
<td>25</td>
<td>50</td>
<td>50</td>
<td>n.a.</td>
<td>n.a</td>
</tr>
</tbody>
</table>

**About U.L. Testing** - U.L. testing involves destructive product tests for flame and smoke generation, strength-pressure, vacuum, tension, bending - impact and puncture resistance, erosion and a number of other criteria including long term stability at low and elevated temperature.

In addition to assuring the product will not burn, U.L. Listing assures the customer that the product provided is built to provide years of service in rugged industrial environments.

**About FM Test Protocols** - Factory Mutual has long tested products for flame propagation and smoke generation. Duct products that successfully pass these critical battery of tests are given FM Approval to their 4922 protocol, which allows corrosive fume and smoke exhaust duct to be installed without sprinklers.

**The key tests for FM 4922:**

1. The ASTM E-84 tunnel test, measuring flame spread and smoke generation in a controlled burn chamber.
2. 50 kW-scale FMRC Flammability Apparatus Test to measure the Critical Heat Flux (CHF - a heat flux at which ignition is not expected to occur) and the Thermal Response Parameter (TRP - a measure of ignition resistivity), as well as the ignition and peak Chemical Heat Release Rate (CHRR).
3. The oxygen bomb calorimeter (for heat content) in accordance with D 240-85.
5. The Factory Mutual horizontal / vertical burn test which measures flame propagation, temperature rise and strength retention during actual duct fires at temperature over 1000°F.

Shown here is a view of the configuration for the FM 4922 horizontal test, with a heptane-fed fire exhausted through 24 feet of duct. Temperatures can reach 1500°F during the 25 minute two stage test. Key criteria include flame and smoke generation, maintenance of structural integrity and limits of the duct temperature rise.

**Factory Mutual also has a Clean Room Materials Test Protocol, 4910** - The 4910 protocol builds upon the results of the 4922 testing with additional samples and testing to insure suitability for Clean Room product installations. The 4910 test evaluates materials' fire propagation behavior, potential for smoke contamination, and potential for contamination by corrosive products of combustion.

**The key tests for FM 4910:**

1. Ignition tests, during which samples are exposed to increasing heat flux levels up to 60 kW/m², are used to calculate the thermal response parameter (TRP).
2. Fire propagation tests, in which samples are burned in the presence of 40% oxygen, help generate the fire propagation index (FPI).
3. Combustion tests, similar in nature to the fire propagation tests, run at 21% oxygen are used to generate smoke index (SI) numbers.

From the above tests, Factory Mutual calculates a Smoke Damage Index (SDI) which is the total mass of smoke generated to the total mass of the material loss. The 4910 upper limit for the SDI is 0.40.

FPI values are used for classification of materials as either non propagating (good) or propagating. The 4910 upper limit for the FPI is 6.0.
Corrosion Resistance that will exceed your needs!

VeilGuard is one of the most chemically resistant polymers available today. In addition to its chemical resistance, with a U.L. 94 V-0 rating, VeilGuard also has the advantages of low flammability and low smoke generation. It is resistant to chemical attack from most acids, bases and solvents, has excellent temperature resistance, and better barrier properties than PTFE or FEP. Use of this material in the corrosion liner for DualGuard 2000 series products offers significant advantages compared to systems with glass, polyester or no liner reinforcement.

**Comparison of Corrosion Liner Veils**

<table>
<thead>
<tr>
<th>VEIL MATERIAL</th>
<th>FLAME SPREAD</th>
<th>SMOKE GENERATION</th>
<th>MELT TEMPERATURE</th>
<th>HF or CAUSTIC ATTACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiberglass C-veil or MatFM</td>
<td>No Burning</td>
<td>No Smoking</td>
<td>&gt;1000°C</td>
<td>Attacked</td>
</tr>
<tr>
<td>Polyester veil (Nexus)</td>
<td>Burns Readily</td>
<td>Heavy Smoke</td>
<td>250°C</td>
<td>Mild Attack</td>
</tr>
<tr>
<td>VeilGuard Fluoropolymer</td>
<td>No Burning</td>
<td>No Smoke</td>
<td>240°C</td>
<td>No Effect</td>
</tr>
<tr>
<td></td>
<td>94 V-0</td>
<td>U.L. 444 Pass</td>
<td></td>
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**SERIES 2000 Copolymer Resin**

The resin used in the DualGuard 2000 system offers excellent corrosion resistance in and of itself. And as noted above, the VeilGuard veil used in DualGuard 2000 products offers better corrosion resistance than any other competing veil. Used together, DualGuard 2000 offers an unbeatable combination of properties.

The resin system used in DualGuard 2000 is a proprietary copolymer product developed specifically for enhanced corrosion resistance, low flame propagation and low smoke development in pipe and duct applications. In addition to its superior fire performance, very low smoke evolution, and higher temperature performance, Series 2000 resin offers excellent corrosion resistance to a wide variety of acids, solvents and bases. Specifically, this applies to the types of vapors typically found in exhaust streams from laboratory, semiconductor, plating and pharmaceutical operations. Tests of DualGuard resin demonstrated fatigue strengths (cycles to failure) equivalent to epoxy pipe, and better fatigue strength than vinyl ester.

ASTM C-581 test results are shown for DualGuard 2000 exposed to a variety of reagents. These measurements reflect flex modulus and strength retention following full liquid immersion for one year - a service much more severe than a duct installation where exposures are typically diluted vapors. As can be seen from the charts, DualGuard 2000 compares very favorably against fire retardant vinyl ester in a variety of exposure conditions.

**DualGuard 2000 vs FR Vinyl Ester Corrosion Resistance Comparison**

Full Liquid Immersion 12 Months

<table>
<thead>
<tr>
<th>Reagent</th>
<th>FR Vinyl Ester</th>
<th>Dual Guard</th>
</tr>
</thead>
<tbody>
<tr>
<td>15% Hydrochloric Acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modulus</td>
<td></td>
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</tr>
<tr>
<td>Modulus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15% Nitric Acid Strength</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15% Nitric Acid Modulus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol Strength</td>
<td></td>
<td></td>
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<tr>
<td>Alcohol Modulus</td>
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</tr>
</tbody>
</table>

**DualGuard 2000 Corrosion Resistance**

Full Liquid Immersion 12 Months

<table>
<thead>
<tr>
<th>Reagent</th>
<th>% Retention Physical Properties</th>
</tr>
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<tbody>
<tr>
<td>H₂SO₄ 10%</td>
<td></td>
</tr>
<tr>
<td>HCL 15%</td>
<td></td>
</tr>
<tr>
<td>HNO₃ 5%</td>
<td></td>
</tr>
<tr>
<td>HF 1%</td>
<td></td>
</tr>
<tr>
<td>NaClO₃ 5.25%</td>
<td></td>
</tr>
<tr>
<td>D.I. Water</td>
<td></td>
</tr>
<tr>
<td>Caustic pH 10</td>
<td></td>
</tr>
<tr>
<td>Chloroform 25%</td>
<td></td>
</tr>
<tr>
<td>Methanol 5%</td>
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</table>
Other Composites USA products:
- Dual Laminate Equipment & Structures - Corrstop
- Specialized Composite Plastic Equipment - FlameGuard
- Fiberglass Scrubbers & Skid Systems
- Fiberglass Tanks & Vessels
- Fiberglass Stacks

Services
- Consulting
- Design
- Manufacturing
- Construction
- Inspection/Testing

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Fab-Tech Inc.
NEHP Inc.

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