Polynt Reichhold Group

After the merger on May 2017 the new Polynt-Reichhold Group is a global Company in the Intermediates, Coating and Composite Resins, Thermoset Compounds, Gel-coats and niche Specialties. This combination enhances the Group’s leading position as a global vertically integrated specialty chemicals player, with significant global presence in Europe, North America and Asia, a strategy initiated by Polynt with the successful integration of PCCR and CCP in the last years and now further reinforced by Reichhold’s global scale, extensive product portfolio and R&D competencies.

Polynt-Reichhold Group is known for its superior quality and impressive range of products and with its excellent distribution network it can provide first-class service to customers whatever their market. Customer Service and Technical Service teams are renowned for their customer focus, offering the best service even after products have left manufacturing.

The Group strives to keep customers satisfied, assisting them in producing premium quality products every time they use its products.

Product innovation is important for the Group’s business and it’s the reason for which it constantly works with customers to find solutions to problems.

Introducing new or improved products ensures that Polynt-Reichhold Group continue not only to deliver what the market wants and needs, but also when it is wanted and needed.
Introduction to the Fire Retardant System

Fire triangle
The triangle illustrates the three elements a fire needs to ignite: heat, fuel, and oxygen. A fire occurs when those 3 elements are present and combined in the right mixture. A fire can be extinguished by removing any one of the 3 elements.

As a result, different physical processes need to be considered for fire retardant:

- Cooling: endothermic decomposition reaction of the flame retardant additive that causes a decrease in the temperature needed to maintain combustion, thus limiting the emission of combustible gas by the polymer.
- Dilution: a release of inert gases (CO2, NH3, H2O, etc.) from the thermal decomposition of additives contributes to the dilution of combustible gases below the ignition threshold.
- Formation of a protective layer: some flame retardants lead to the formation of a solid protective layer limiting the transfer of heat and mass between the polymer and the flame.

The fire retardants and their mode of action
There is no single solution for fireproofing materials. Different options can be used alone or in combination (cooling, inhibition of combustion reaction, thermal protection) in order to achieve the target. However, it is important to find the best compromise between improved fire resistance and other requirements such as mechanical properties, weather resistance (water, UV), economic feasibility and environmental issues.

These fire retardant options are:

- **Halogenated compounds**: Brominated derivatives are the most effective. Very often associated with antimony oxides (synergy), halogenated derivatives exhibit a chemical mode of action mainly in the gas phase. Their performance, which is efficient at even relatively low content, is characterized by the generation of opaque and toxic fumes during combustion.
- **Metal hydroxides**: mainly aluminium trihydrate, which acts as both a flame retardant and a smoke suppressor. The resulting performance is interesting, but to be effective, these compounds must be used in very large quantities, often greater than 50% in mass, which will result in a significant decrease of mechanical characteristics and an increase in density and difficulty of wetting.
- **Phosphate and nitrogen compounds**: phosphorus derivatives have the ability to form a protective layer when the polymer burns, thus limiting the supply of oxygen and energy to the fuel. Ammonium polyphosphates have the advantage of combining the action of phosphoric acid with that of nitrogen in the gas phase.
- **Intumescent systems**: intumescence is the ability of a material to develop a carbon shield of such thickness that gas and heat transfers are limited. The recipes involve an acidic substance, an inflating agent and a carbon source that leads to the formation of a «char» when the temperature of the polymer rises. It helps to limit the spread of fire by blocking the passage of smoke, flame and heat while giving the product a lower density than common charged systems.
The table in central pages of this brochure shows the type of fire retardant for each listed product:

- **HF** - Halogen Free;
- **H** - Halogen;
- **I** - Intumescent;
- **FI** - Filled.

**Standards**

A large number of standards exist because fire risk level depends on the environment the components are going to be exposed to (the risk class being related to the evacuation conditions).

A direct comparison of individual national tests and associated classifications with the European Standards is very difficult because it could be subject to different interpretations of the various ratings.
A typical example is represented by below table comparing the most commonly used Standards for the Building Industry in Europe:

<table>
<thead>
<tr>
<th>Euroclass</th>
<th>DIN 4102-1</th>
<th>German</th>
<th>Euroclass</th>
<th>French</th>
<th>Euroclass</th>
<th>UK (Engl., Wales, N.I.)</th>
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</thead>
<tbody>
<tr>
<td>EN 13501-1</td>
<td>No Smoke</td>
<td>No droplets</td>
<td>EN 13501-1</td>
<td>NF P92-507</td>
<td>EN 13501-1</td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td>✔</td>
<td>✔</td>
<td>A1</td>
<td>non combustible</td>
<td>A1</td>
<td>non combustible</td>
</tr>
<tr>
<td>A2 - s1, d0</td>
<td>✔</td>
<td>✔</td>
<td>A2 - s1, d0</td>
<td>M0</td>
<td>A2 - s1/s2/s3, d0/d1/d2</td>
<td>limited combustible</td>
</tr>
<tr>
<td>B/C - s1, d0</td>
<td>✔</td>
<td>✔</td>
<td>B - s1/s2/s3, d0/d1</td>
<td>M1</td>
<td>B - s1/s2/s3, d0/d1/d2</td>
<td>Class 0</td>
</tr>
<tr>
<td>A2/B/C - s2/ s3, d0</td>
<td>✔</td>
<td>✔</td>
<td>C - s1/s2/s3, d0/d1</td>
<td>M2</td>
<td>C - s1/se/s3, d0/d1/d2</td>
<td>Class 1</td>
</tr>
<tr>
<td>A2/B/C - s3, d2</td>
<td>✔</td>
<td>✔</td>
<td>D - s1/s2/s3, d0/d1</td>
<td>M4</td>
<td>D - s1/s2/s3, d0/d1/d2</td>
<td>Class 3</td>
</tr>
<tr>
<td>D - s1/s2/s3, d0</td>
<td>✔</td>
<td>✔</td>
<td>E</td>
<td>M4</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>D - s1/s2/s3, d1/d2</td>
<td>✔</td>
<td>✔</td>
<td>F</td>
<td>M4</td>
<td>F</td>
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<tr>
<td>E</td>
<td>✔</td>
<td>✔</td>
<td>E</td>
<td>d2</td>
<td>E</td>
<td></td>
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<tr>
<td>F</td>
<td>✔</td>
<td>✔</td>
<td>F</td>
<td>d2</td>
<td>F</td>
<td></td>
</tr>
</tbody>
</table>

**Reaction to fire classification: B - s1, d0**
Main indicator; fire classification.
From highest rating A1 via A2, B, C, D, E to F being the lowest level of performance.

Additional indicator; smoke production.
From highest classification s1 via s2 to s3 being the lowest level of performance.

Additional indicator; burning droplet forming.
From highest classification d0 via d1 to d2 being the lowest level of performance.

<table>
<thead>
<tr>
<th>Euroclass</th>
<th>Classification for smoke or droplets</th>
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<tbody>
<tr>
<td>A1</td>
<td>Not inflammable</td>
</tr>
<tr>
<td>A2</td>
<td>Almost not inflammable</td>
</tr>
<tr>
<td>B</td>
<td>Very difficulty inflammbale</td>
</tr>
<tr>
<td>C</td>
<td>Moderately inflammbale</td>
</tr>
<tr>
<td>D</td>
<td>Well inflammbale</td>
</tr>
<tr>
<td>E</td>
<td>Very inflammbale</td>
</tr>
<tr>
<td>F</td>
<td>Extremely inflammbale</td>
</tr>
<tr>
<td>Process</td>
<td>Type of resin</td>
</tr>
<tr>
<td>---------</td>
<td>--------------</td>
</tr>
<tr>
<td>DION FR 7721-00</td>
<td>HLU-SU</td>
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<td>DION FR 800-200</td>
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<td>DION FR 820-024</td>
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<td>DION FR 820-080</td>
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<td>DION FR 820-606</td>
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<td>DION FR 840-820</td>
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<td>DION FR 840-850</td>
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<td>DION FR 844-030</td>
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<td>DION FR 850-700</td>
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<tr>
<td>DION FR 850-850</td>
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<td>DION FR 9300-00</td>
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<td>NORSODYNE H 94233 L</td>
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These results have been obtained on specimens. They are able to demonstrate the capability of our products to be compliant with the requirements. End users have to check the compliance of the laminates they make.
<table>
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<th>REFERENCE</th>
<th>Process</th>
<th>Type of resin</th>
<th>Type of Gelcoat</th>
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<th>MILITARY</th>
<th>VEHICLE</th>
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<td>DION® FR 7721-00</td>
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<td>UTAC n° 18-502/1</td>
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<td>DION® FR 800-200</td>
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<td>FL-H</td>
<td>-</td>
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<td>MIL R8470</td>
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<td>DION® FR 820-034</td>
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<td>H</td>
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<td>FL-H</td>
<td>-</td>
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<td>POLYCOR 2335</td>
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<td>NORSODYNE H 81285 TF</td>
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<td>NORSODYNE H 81311 TFA</td>
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<td>MIL R2167 / MIL R7575</td>
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</table>

* This has been obtained with HL2 Paint
Railways Standards

Transportation: EN 45545 Part 2 +A1: 2016 - Fire Protection on Rail Vehicles

The standard EN 45545-2 came into force in January 2018. From January 2015 to December 2017, it was possible to use the national standards to qualify materials installed in railway vehicles. Now, all new materials are tested against the European Standard in order to guarantee the same level of security whatever the location in the EU.

The standard EN 45545-2 is no longer just a simple pass/fail or a classification to a single fire test; compliance depends upon the Operation/Design Categories combined with the type of Part to be produced which then leads to a series of requirements (parameters) from the following main three tests:

1. ISO 5658-2 to measure CFE (kWm-2) or Flame Spread
2. ISO 5660-1 (50 kWm-2) to measure MAHRE (kWm-2) or Heat Release
3. ISO 5659-2 (50 kWm-2) + FTIR to measure Ds(4); VOF4 + CITG or Smoke/Toxicity

The standard calls for high performance products to be used in high risk scenarios, with a definite emphasis on passenger/staff safety.

1. **Operation Category**: the relationship between service, infrastructure + evacuation conditions
   - OC1 = Typically Surface Operation with short tunnels, such as a Tramway or Heavy Rail
   - OC2 = Typically City Metro Systems or surface rail with longer tunnels, short time to safety
   - OC3 = Typically very long tunnel sections (Alps, or Channel Tunnel), longer time to safety
   - OC4 = Special Vehicles operating mainly underground with restricted evacuation routes (Channel Tunnel Motor Vehicle Transporters)

2. **Design Category**:
   - A = Automated Stock with no staff on board
   - D = Double Decked Rail Stock
   - S = Sleeping/Couchette Rail Stock
   - N = All Other (Standard) Stock

These two parameters are linked to give a required Hazard Level (HL), each of which has a set of requirements (e.g. R1, R2 + R3) that depend on the part to be produced. Where HL3 is the highest performance and is typically achievable using SMC as the application method.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Design</th>
<th>N</th>
<th>A</th>
<th>D</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>OC1</td>
<td>HL1</td>
<td>HL1</td>
<td>HL1</td>
<td>HL2</td>
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</tr>
<tr>
<td>OC2</td>
<td>HL2</td>
<td>HL2</td>
<td>HL2</td>
<td>HL2</td>
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</tr>
<tr>
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<td>HL2</td>
<td>HL2</td>
<td>HL2</td>
<td>HL3</td>
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</tr>
<tr>
<td>OC4</td>
<td>HL3</td>
<td>HL3</td>
<td>HL3</td>
<td>HL3</td>
<td></td>
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</table>

The Higher the Risk, the Higher the Safety Factors required: HL3 > HL2 > HL1

There are many interior part definitions to be considered. For instance, the following all require R1 compliance: IN1; IN4; IN5; IN6A; IN7; IN8; IN10B; IN12; IN13 + IN15: a further three require R2 and one R3. The end user will be aware of these definitions.

**Results + Requirements**

The key parameters are listed below with the requirements for each Hazard Level. Results are averages of three specimens tested to the required methods.
### Targets to be reached according to requirement

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Parameter</th>
<th>Definition</th>
<th>HL1</th>
<th>HL2</th>
<th>HL3</th>
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</thead>
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<tr>
<td><strong>R1</strong></td>
<td>CFE</td>
<td>Min</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>MAHRE</td>
<td>Max</td>
<td>n/a</td>
<td>90</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>D_{(4)}</td>
<td>Max</td>
<td>600</td>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>VOF4</td>
<td>Max</td>
<td>1200</td>
<td>600</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Cit_{(4 +8)}</td>
<td>Max</td>
<td>1.2</td>
<td>0.9</td>
<td>0.75</td>
</tr>
<tr>
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<td>Min</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>MAHRE</td>
<td>Max</td>
<td>n/a</td>
<td>n/a</td>
<td>90</td>
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<td>D_{(4)}</td>
<td>Max</td>
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<td></td>
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<td>0.9</td>
<td>0.75</td>
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<td>n/a</td>
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<td></td>
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<td>300</td>
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<td></td>
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<td>Max</td>
<td>1.2</td>
<td>0.9</td>
<td>0.75</td>
</tr>
</tbody>
</table>

### Example of classification of gel coat + resin and resin alone

The data highlighted in this brochure provides an outline explanation of the final requirements for pieces manufactured for use in fire performance applications. The data shown within this document provides an indication and examples based on our experiences and does not aim to cover all thermoset application technologies. It is the responsibility of the end users to check the compliance of their material versus the standard.
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