

## **Epoxy Passive Fire Protection (PFP) Application and Inspection**

A passive fire protection (PFP) coating acts as a protective shield against heat and flames on industrial equipment or structures. It not only prevents corrosion and degradation in normal conditions but also extends the time before failure, delaying structural collapse in case of a fire. This coating becomes reactive during a fire, expanding to provide an extra layer of insulation. It is important to note that PFP systems do not extinguish or prevent fire spread; instead, they offer effective insulation during fire incidents. By utilizing PFP systems, you can confidently enhance the safety and protection of your steel structures against potential fire hazards. Various PFP options are available, including fire protection boards, molds, coatings like fiberboard systems and cementitious products, blanket systems, and intumescent formulations such as epoxy or acrylic coatings. When preparing specifications, it is crucial to consider corrosion protection and corrosion under fireproofing (CUF). PFP addresses two main fire types: cellulosic fires and hydrocarbon fires. For cellulosic fires, thin film intumescent coatings (either single pack water or solvent borne options) are commonly used, whereas epoxy intumescent coatings are preferred for aggressive hydrocarbon fires.

### **Consideration of Steel**

Steel mills produce high-quality steel through rigorous quality control measures, ensuring precise carbon content and meticulous production processes. These standards guarantee consistent, reliable results and exceptional characteristics, such as superior strength and remarkable load-bearing capacity. As a result, steel mills consistently deliver top-notch alloys that meet or exceed expectations, making them the preferred choice for industries that demand unmatched strength and durability. When it comes to structural steel fire protection in the hydrocarbon world, typical usage of Passive Fire Protection (PFP) is seen in petroleum refining, chemical facilities, LNG (Liquified natural gas) petroleum storage and processing industries, as well as offshore and onshore oil exploration. Steel is the primary construction material used in these industries due to its cost-effectiveness and speedy constructability. It retains its full load-bearing capacity at temperatures as high as 400°C but experiences a decrease in strength beyond that point. To extend the load-bearing capacity of steel structures, engineers specializing in equipment design often consider incorporating appropriate passive fire protection epoxy intumescent coatings. These coatings are especially beneficial for steel components that may be exposed to pool fires, jet fires, or a combination of both scenarios. Steel is both strong and relatively lightweight, making it easy to use in construction, pre-engineered construction, and modular constructions. However, risks such as structural failure, blocked escape routes, and potential loss of life or assets must be considered. Hence, protecting load-bearing steel to a prescribed fire duration provides firefighting crews with an opportunity to extinguish the fire and safely evacuate/save people.

### **Consideration of Environment**

In demanding environments like offshore oil exploration platforms or coastal plant facilities with high humidity and salinity, it is essential to prioritize the protection of exposed steelwork from the dangers of corrosion and fire. Passive fire protection is a critical solution specifically designed to withstand harsh environmental conditions and maintain top-notch performance for the entire lifespan of the asset. Underestimating the significance of choosing the right fire protection system can have serious consequences, jeopardizing the longevity of the asset and potentially leading to catastrophic outcomes in the event of a fire. Be wise in your selection, safeguard your valuable assets, and enjoy peace of mind. The proper selection of passive fire protection is paramount in ensuring satisfactory and proven performance. Industry recognized certification schemes like UL1709, including the rigorous cyclic durability testing outlined in UL2431 or NORSOK M501 guarantee that products tested in accordance will provide more than 20 years of real-life protection. UL2431, commonly referred to as the Standard for Safety for Durability of Fire Resistive Coatings and Materials, offers valuable guidance in selecting fire protective systems suitable for various environmental conditions. By subjecting materials to simulated scenarios, this standard guarantees the reliability of fire resistive coatings. Furthermore, it serves as a useful reference for selecting the appropriate topcoat when additional protection is required. Embracing UL2431 as a reference enhances decision-making processes and significantly contributes to safeguarding against potential fire hazards in exposed settings.

### **Consideration of EPC (Engineering procurement & construction companies) and Client needs**

In the initial stages of a design project, known as pre-FEED and FEED, a thorough assessment is carried out to evaluate all requirements related to Passive Fire Protection (PFP) and other safety measures. As the project design progresses, a clearer understanding of fire and blast scenarios emerges. A detailed zoned fire risk assessment is conducted, considering the impact of heat on structural integrity. This analysis not only identifies potential fire mitigation solutions for critical process safety components, but also determines the necessary position and rating of PFP requirements for the facility. For EPCs (Engineering, Procurement, and Construction companies), the choice of fire protection model is crucial to meet safety needs in both modular and stick-built scenarios. This ensures that operational requirements are fulfilled while also considering production capacity and the anticipated lifespan based on API Recommended Practice (RP) 754, which outlines Process Safety Performance Indicators for the Refining and Petrochemical Industries. Such a comprehensive approach enables underwriters to verify the incorporation of fire safety considerations into the design. To ensure the effective implementation of a PFP system that complies with relevant regulations, many owners and facility managers choose to collaborate with a reputable fire protection company. The ultimate objectives of fire safety, encompassing the protection of individuals and facilities, include preserving human lives, safeguarding properties, and

ensuring uninterrupted business operations. Considering the unique nature of the facility and the client's safety and regulatory concerns, asset protection is of paramount importance for storage and distribution facilities. Business continuity is vital not only for clients but also for the overall economy. When establishing an Emergency Planning Committee, it is imperative to prioritize the client's primary objectives and ensure compliance with statutory codes. Thorough examination of guidance documents like API2218 during the design phase guarantees adherence to explicit requirements. By incorporating industry recommendations, the project team gains a comprehensive understanding of the necessary measures for an effective and successful business continuity plan.

#### **Bid Document:**

The bid preparation process is crucial for project completion. It presents an opportunity for vendors to compete against each other in supplying products or services. This process is commonly utilized by EPC clients and agencies to fulfill project requirements. To be selected, vendors must showcase their capability, track record, and readiness to successfully execute the project using properly tested and certified products. Ensuring a successful bid involves including all necessary documents, such as Instructions to Bidders, Contract for Supply and Delivery of Goods, Schedule of Requirements, Technical Specifications, and Sample Forms. When pursuing a bid, it is of utmost importance to clearly outline expectations and highlight the eligibility of the bidder company. A well-crafted bid proposal can effectively establish the expertise of the contractor, subcontractor, or project management company and significantly enhance their chances of securing the job. The bid document should also incorporate a project schedule that outlines a logical sequence of tasks and due dates, ensuring timely completion. This schedule should encompass start dates, end dates, milestones, required work, costs, resources, dependencies, and the team members responsible for each task.

#### **Application Contract**

Epoxy PFP and Acrylic PFP coatings are spray-applied intumescent systems that hold significant importance in various projects. Hence, it is crucial to have an application contract that encompasses all crucial aspects, such as surface preparation, coating selection, third-party evaluation (to be duly verified), and the acquisition of previous project references. It is essential to identify and certify the qualifications of applicators and crew members through the respective application equipment/product vendor. Clearly defining the desired quality of the installed system is imperative, along with preparing a reference area prior to commencing the project. These vital criteria must be explicitly stated in the contract agreement. It is advisable to contemplate engaging subcontractors right from the outset of the qualification process.

#### **Application Requirement**

When applying Passive Fire Protection (PFP) coating, it is crucial to first identify the surface in need of protection and determine the type of substrate that will be evaluated. Start by understanding the surface preparation requirements and identifying the approved primers to be used beneath the PFP coating. The primer thickness should align with the specifications mentioned in the certification and test data, as well as the recommendations provided by the manufacturer. Consult with the primer manufacturer to determine the minimum and maximum recommended overcoating times for detailed information, refer to the specific technical data sheet of the product. Although there might not be a specific standard for coat-backs, it is recommended, according to API 2218 (3rd edition), to extend the fireproofing back 18 inches (450 mm) from primary beams for pipe racks to prevent conduction into them. Throughout the application process, carefully monitor atmospheric conditions in accordance with ISO 8502-4. Adhering to the required environmental conditions, as per good painting practice, is essential during the entire application process. Keep in mind that environmental conditions can affect coating performance, so it is mandatory to follow guidance documents such as ASTM D3276, Standard Guide for Painting Inspectors (Metal Substrates). Properly mix the products and ensure the correct mix ratio is used as it is critical for project success. The paint application crew should have access to appropriate mixing and quality control equipment. Additionally, use suitable application equipment endorsed by the supplier to meet the required standards. If opting for manual application, ensure that the applicators receive training to achieve a high-quality result.

#### **Application Constraints & Application Challenges for Epoxy PFP**

Due to HSE (Health Safety Environment) and specific site requirements may necessitate the use of special equipment or scaffolding. The complexity of the steel design and geometry might require the coating to be applied in multiple layers. All agreed upon ITP (inspection test plan) requirements must be adhered to. Additionally, it is important to follow recommendations such as installing mesh at specified points, as required by certification, and applying the coating as advised by the manufacturer trowel or spray. The required DFT (Dry Film Thickness) must be carefully measured to ensure compliance with product certification. Heated plural component spray pumps are necessary to meet production demands. Monitoring pressure loss during application and utilizing metering monitors with automatic shutdown capabilities are vital criteria for the applicator. Proper documentation of the PFP (Passive Fire Protection) coating installation must be thoroughly reviewed and accepted by both the vendor/applicator and the client in accordance with the contract. A daily log should be written and all the critical to quality CTQ points be signed off by the applicator and inspector to avoid costly repair and claims. Lastly, it is important to consider the distinctions between thin and thick film intumescent coatings and the potential cost implications for owners.

Epoxy PFP application for safety purposes presents unique challenges that must be addressed to ensure structural integrity according to design requirements. The applicator must have expertise in applying intumescent coatings and demonstrate proper

application techniques. It is crucial to follow basic quality control measures and adhere to the quality scheme to ensure the product or service meets all quality requirements. Specialized two-component spray equipment is typically needed for most epoxy PFP coatings, thus the applicator must receive training in equipment usage and maintenance. Maintaining accurate mix ratios and application temperatures is essential and may require the use of heating systems for consistent high-quality application. The equipment should offer user controls and data reporting capabilities to ensure a trouble-free application process and provide a project record. It is important to avoid surface defects like Amine surfacing or Blushing and blooming, which can impact performance. The product vendor should assess site samples and propose suitable remedial procedures if needed. Monitoring the correct installation depth of mesh is crucial for coating quality inspection and reporting. Attention should also be given to achieving the correct dry film thickness and including it in all quality control reports. Proper mixing and curing of the paint should be closely monitored throughout the project. The equipment log should contain information regarding the ratio and quantity of components used in the final product. Promptly addressing any adhesion loss to the substrate or primer is crucial. Achieving the correct dry film thickness at corners and edges of steel structures can be challenging. Installing mesh effectively supports char formation and strength during a fire, and any presence of holidays or pinholes should be avoided to prevent moisture ingress that may affect coating performance. When necessary, a suitable topcoat should be applied within the specified overcoating interval to ensure optimal performance throughout the lifespan of the asset. In some cases, tie coats may also be required prior to topcoat application.

### **Application and Applicators**

Epoxy PFP application is a fundamental component of the passive fire protection industry, playing a crucial role in safeguarding facility operations. The process of applying intumescent coatings takes place either at a fabrication/paint shop or on-site prior to final installation. Fireproofing involves a three-step procedure. First, the surface must be prepared and primed to establish a strong bond between the structural steel and the protective coating. Next, the intumescent coating is applied using either a single leg or plural component airless spray equipment. In some instances, a reinforcement mesh may be incorporated between coating layers to prevent char slumping during the intumescent process. To effectively protect against fire, a general guideline suggests using less coating on thicker steel surfaces and more coating on thinner steel surfaces. There are various tools and methods available to calculate the necessary thickness for a specific fire rating. Proper application of the coating necessitates specialized training for painters and the crew as it demands a collaborative effort to achieve the desired finish and thickness. The process involves mixing the product, following the required mixing ratio, heating individual parts A & B, ensuring convenient hose and spray gun length, using precut mesh if applicable, and employing a roller and thinner crew. All crew members must synchronize their actions to apply the epoxy PFP coating and achieve the desired outcome. The applicators' crew holds a significant role in the project, and it is imperative for them to be knowledgeable about epoxy PFP degradation processes, identifying application defects, understanding the fire performance when exposed, and comprehending the impact of defective application on the overall result. Familiarity with the project specifications, the relevance of the epoxy PFP manufacturer's application manual, quality control points, inspection hold points, and the required epoxy PFP thickness and details is crucial for applicators. Additionally, applicators are responsible for understanding the behavior of epoxy paints, such as vertical hold, spray patterns, as well as following health, safety, and environmental requirements, and conducting pre-job meetings. They play a critical role in project success by working with inspectors to identify and address defects. Inspectors, on the other hand, are responsible for preparing accurate production reports.

### **Project Schedule and PFP Schedule**

The project schedule is important in project management. It helps with planning, executing, monitoring, and communicating the project scope. It is closely connected to the project's budget and spending. The PFP schedule is critical for epoxy PFP, starting with surface preparation and primer application, followed by PFP application, inspection, acceptance, and packaging/loading. These activities are essential for the construction's critical path, and timely delivery is necessary. Efficient scheduling is crucial for meeting project milestones and promoting collaboration. Subsequent work can only start after the previous tasks are completed. The increasing number of activities makes schedules more complex, and epoxy PFP plays a crucial role in ensuring safety and compliance during inspection and handover. Coordinating the delivery schedule in advance prevents delays and incomplete work, reducing costs. Poor planning in PFP application leads to significant downtime, impacting project timelines. It's important to understand that epoxy PFP requires meticulous attention to detail, as it is more complex than regular paint finishes. Collaboration among paint manufacturer, inspection parties, and applicator crew, along with proper tools, can minimize delays in epoxy PFP application. adherence to project schedule and efficient PFP schedule management ensure successful project execution, compliance, and timely completion.

### **Final Inspection Requirement and Acceptance Criteria**

Inspection is a crucial component of quality assurance for epoxy PFP coating project's purpose.

Ensure project aligns with specification requirements and delivers accurate reports to client.

Certify Inspection requirement is **evaluated** through activity plan (ITP)

A few necessary steps to follow:

Identify steel type, prepare surface, apply primer, assess primer compatibility with epoxy PFP coating.

Document essentials of epoxy PFP coating: TDS, SDS, application guidelines.

It is important to keep records of mesh installation, film thickness, and topcoat application.

Necessity to address any defects or shortcomings before moving forward in the inspection process. It is most critical as a process of the final inspection in project acceptance.

Compliance with the desired film thickness inspection based on SSPC PA 2 standard. There is a Need for clear and concise preparation of final inspection documentation. Clear problem statement and approval or acceptance of remedied non-conformances in the final inspection report to prevent confusion in the future is critical.

Photographic documentation is a must whenever possible. If photographs are not feasible, a written description of the rectification or problem should be provided in the final document. Ensure that all repair and rectification work is completed and included alongside the original reports. Dedicate a separate section in the final report for non-conformances. All equipment used for project evaluation should possess valid yearly validation certificates. Additionally, remember to attach all relevant specifications, addendums, and appendices. Include reference copies of applicable codes and standards, along with manufacturers' Product Data Sheets (PDS) and Safety Data Sheets (SDS). It is crucial to attach manufacturers' application guides, drawings of the work area, and product batch test reports to the daily or weekly reports. Don't forget to include the corresponding adhesion report with each batch of production. Provide contact information for the Owner, Engineer, Contractor, Paint Salesman, and technical service representative. Clearly state the acceptance criteria and actual results, referencing the relevant prepared report. Finally, document the project's acceptance with the authorized signature of the applicator and owners' engineers. Always store packing information along with the final inspection report. For on-site work, be sure to include a detailed account of the final inspection, damage assessment, and rectification.

### **Regular Inspection and Yearly Follow up on the Coated Surface**

The Epoxy PFP coated surface is known for its durability, so it is unlikely to experience significant degradation or damage, but regular inspections are still necessary for safety. Pay close attention to areas near chemical storage to prevent leaks or exposure to harmful fumes. Also inspect areas where mechanical or hot repair work is done. Maintenance activities should include inspecting the Epoxy PFP coating, as well as other systems like lighting, electrical, HVAC, vessels, and heat exchangers. If any defects are found and repaired, inform the plant fire engineer for ongoing safety. Document the repairs in the plant log for future reference.

In conclusion, Jay Menon believes that the application and inspection of epoxy passive fire protection (PFP) are crucial for ensuring the safety and integrity of structures. Epoxy PFP has excellent fire-resistant properties, creating a strong barrier against the spread of fire and protecting both lives and property. By following thorough inspection guidelines and proper application techniques, we can effectively reduce the risks associated with fires and safeguard the environments we live in. Investing in epoxy PFP demonstrates a commitment to safety and provides peace of mind, knowing that proactive measures have been taken against potential fire hazards.

For Epoxy PFP product details from Jotun please follow this [link](#).