

PPG PITT-THERM 1000 FX

APPLICATION GUIDELINES

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1 INTRODUCTION

1.1 Scope

The purpose of these application guidelines is to provide information regarding how to apply the PITT-THERM 1000 FX consistently and correctly. These guidelines are not intended as a source for the determination of the PITT-THERM 1000 FX loadings or other specification criteria.

For the safe handling and use of the PITT-THERM 1000 FX, reference must also be made to both the Product Data Sheets (PDS) and the Safety Data Sheets (SDS), the latest versions and regional requirements are available on-line at www.ppgmmc.com

These guidelines are subject to the following:

1. Compliance with all applicable standards, regulations, and legislation of governmental bodies.
2. All equipment used is fully serviced and suitable for use with the PITT-THERM 1000 FX and all health & safety recommendations of the equipment manufacturer followed.
3. All applicators must be trained, competent and qualified in the application of the PITT-THERM 1000 FX for the type of application being undertaken – please refer to the QAP program.

The information contained in these guidelines is based upon independent test data, research and field experience, and is believed by PPG to be accurate at the time of publication. However, the contents are not to be construed as warranties to performance or results and will be subject to review and revision from time to time due to our policy of continuously improving our products, processes, and service.

The information provided in these application guidelines is not intended to be exhaustive; any person applying the product, by any method, or in any circumstance other than that specifically recommended in these application guidelines, should first obtain PPG's written confirmation as to the suitability of the proposed method. Additionally, there are many factors that can affect the application of the PPG PITT-THERM 1000 FX, which PPG cannot control or account for in these guidelines, such as the quality or condition of the substrate. Accordingly, the applicator is responsible for ensuring that the PPG PITT-THERM 1000 FX is correctly applied given the specific factors affecting the applicator's use of the PPG PITT-THERM 1000 FX.

These guidelines are a minimum set of requirements and additional and/or higher-level requirements may be set in clients' specifications or project specifications; in which case the additional and/or higher-level requirements should be adopted.

In the event of any doubt or lack of understanding, PPG Technical Support should be consulted for clarification.

1.2 Definitions

The following definitions are used throughout this document:

Word	Definition
Must or Shall	Indicates a mandatory requirement
Should	A preferred course of action
May	Indicates one acceptable course of action
Minimum or maximum	Indicates a mandatory requirement

International standards (ISO) and metric units (SI Units) are used generally throughout these guidelines; where other standards and units are used these are for guidance purposes only and typically the nearest convenient unit will be used e.g., 1 meter as a measure of length may be approximated to 3 feet where such use is appropriate.



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1.3 Acronyms and Abbreviations

The following Acronyms and Abbreviations are used throughout these guidelines:

Acronym or Abbreviation	Meaning
DFT	Dry Film Thickness
FTS	Field Technical Service
Mil	One thousandth of an inch
PDS	Product Data Sheet
PF	Plural Feed
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
SDS	Safety Data Sheet
Thou	One thousandth of an inch
WFT	Wet Film Thickness

1.4 Health & Safety

The PITT-THERM 1000 FX requires due care when handling. Warnings presented on PPG product labels, SDS's and in this manual must be heeded. This manual is intended to serve as a supplement to SDS and label information. Refer and become familiar with all precautionary information prior to use of these products. Always follow equipment manufacturer's recommendations with respect to spray equipment and any other equipment used.

Although the product is normally applied solvent-free, solvents are also used for rolling & finishing and cleaning of tools and equipment. Due consideration must be made with regards to health and safety.

1.4.1 Personal Protective Equipment (PPE)

The tasks and worksite must be evaluated with a risk assessment to determine what hazards are present, or likely to be present, based on the product handling, use and application conditions. All identified hazards should be removed where possible with the use of personal protective equipment (PPE) being a last resort to mitigate the remaining risks. Appropriate PPE, suitable for the work to be performed, should then be selected based on the hazards or potential hazards identified. Employees should be trained on the proper use and limitations of PPE used. Refer to the SDS for a selection of appropriate PPE for all materials used. Use of eye protection, gloves, respiratory protection and protective clothing must be considered for your particular use conditions when using the PITT-THERM 1000 FX.

1.4.2 First Aid

Skin and eye contact with PITT-THERM 1000 FX should be addressed by flushing the affected area(s) with large quantities of clean water as soon as possible. Proper eye wash facilities should be immediately accessible to employees. The location and proper operation of the nearest eyewash and safety shower should be established before any job is started. Always consult the product safety data sheet on what first aid measures are required.



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1.5 Environmental

It is important that PPG products be stored and used safely. However, we are especially concerned with the issue of disposal of waste from the use of our products. We believe that all paint-related waste materials should be disposed of properly in a way that poses minimal risks to people and our environment. For this reason, only those quantities necessary for application should be used on the job site. For the disposal of PITT-THERM 1000 FX material refer to applicable laws and regulations and/or seek the advice of specialist waste disposal providers. PPG recommends that unmixed materials are mixed prior to disposal.

1.6 Field Technical Support

PPG has a global Field Technical Service (FTS) network available to assist with any queries and provide project specific technical advice to aid with the application of the PITT-THERM 1000 FX, however FTS are not accountable as project inspectors and all application work, quality control and inspection remains the responsibility of the applicator. Please consult the regional PPG FTS in the first instance for technical support. PPG also recommend there also be a QA/QC inspector instructed by the owner/applicator for each project. All party's involvement should be agreed during a project kick-off meeting.



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2 MATERIAL HANDLING AND STORAGE

2.1 Pack Sizes

The PITT-THERM 1000 FX is available in one standard pack size: (Note: the application of PITT-THERM 1000 FX is based on an applied density and measured by weight not volume).

PPG PITT-THERM 1000 FX Kit	Details
PITT-THERM 1000 FX Kit	- Supplied in bulk filled containers suitable for application by single feed airless spray pump with follower plate or trowel application. - Consists of 1 pail of base (9 kg / 19.8 lbs) and 1 pail of hardener (7.76 kg / 17.1 lbs) = 16.76 kg (37 lbs) kit size

2.2 Storage Environment

PITT-THERM 1000 FX materials should be stored indoors and out of direct sunlight, the following storage temperature ranges should be maintained:

- General Storage: minimum 0°C (32°F) and maximum 35°C (95°F)
- Preconditioning of material before application is recommended. Please refer to the relevant application method in Section 5 of this document for more details.

NOTE: Where storage conditions deviate from these limits advice should be sought from PPG's FTS

In order to achieve the correct temperatures listed above it may be necessary to use heated or cooled storage units, especially in cold or hot climates. It is recommended that where the material has been stored at low temperatures, i.e., less than 5°C (41°F), that the temperature should be raised gradually to application temperature over a period of 48 hours.

Such storage units are typically built from standard site storage containers. The container will generally be lined with thermal insulation and should be suitably ventilated. For smaller areas a smaller "hot box" may be used that holds sufficient number of pails for the next shift. Thermostatic control is recommended to be used and min/max thermometers used and data recorded on daily quality logs.

Accelerated methods of heating PITT-THERM 1000 FX pails prior to use, such as electrical heaters in direct contact with the pail or hot water baths are not permitted. Such methods can cause overheating of the outer layers of material in the pail, which may produce undesirable changes to its properties (including a shorter pot life).



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3 SUBSTRATES AND SURFACE PREPARATION

3.1 Surface Preparation

All surfaces to be protected by the PITT-THERM 1000 FX must be correctly prepared and primed. Surface preparation and coating should be carried out in line with 'best industry practice' as indicated in many publications by organizations such as ISO, AMPP, ICORR, FROSIO, etc.

The standards of surface preparation contained herein are to be considered minimum requirements. Where other client or project specifications demand a higher level, then the higher level should be adopted.

3.2 Substrate Types

The PITT-THERM 1000 FX is suitable for the protection of, and application on, the following substrates:

- Carbon (Mild) Steel
- Galvanized Steel
- Aluminium
- Stainless Steel and Duplex

Please contact PPG FTS regarding other substrates.

3.3 Environmental Conditions

In addition to other specified environmental parameters, coating should only take place in the following conditions:

- Substrate temperature: Minimum 10°C (50°F) and at least 3°C (5°F) above dew point during application and curing. Maximum 60°C (140°F)
- Relative humidity: Maximum 85%
- Environment temperature: During application and curing should be above 10°C (50°F)

Environmental conditions must be monitored through the working shift as weather conditions can vary greatly. Where these environmental conditions cannot be met or maintained advice must be sought from PPG FTS.

Curing time will be significantly extended below 10°C (50°F) and will effectively cease below 0°C (32°F); however, curing will recommence when temperature rises again. Conversely, curing time will be reduced at temperatures above 10°C (50°F). Please refer to PDS for curing times. Lower ambient temperatures may affect the application rate - consult PPG for further information.

3.4 Surface Defect Repair

Before the application of any paint or insulation to the surface, it shall be inspected for any defects in accordance with ISO 8501-3.

All surface defects, including weld spatter, cracks, surface delamination and deep pitting which are likely to be detrimental to the protective paint system must be removed.

All fins at saw cuts, burrs and sharp edges shall be removed by grinding to a minimum radius of 2 mm (0.08 in).

Welds must be inspected for their condition, as these are often a source of corrosion. Undercut welds, blow holes, discontinuous seams and other defects must be rectified. As uneven welds are likely to be the source of corrosion, they will need to be ground smooth, it is not necessary to grind flush.



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3.5 Degreasing and Cleaning

All surfaces to be coated must be clean, dry and free of all oil, grease, dirt, dust and other contaminants; this should be carried out as per ISO 8504-1 (SSPC SP1) guidelines. ISO 8502-3, *"Preparation of steel substrates before application of paints and related products—Tests for the assessment of surface cleanliness—Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)"* provides a method of determining the amount of dust on a surface prior to coating. Dust, blast abrasives, etc. shall be removed from the surface after blast cleaning such that both the particle quantity rating and the particle size do not exceed rating 2 of ISO 8502-3.

3.6 Blast Cleaning

3.6.1 Introduction

Prior to the application of PITT-THERM 1000 FX, it is essential that the surface is suitably cleaned to remove any mill scale, rust or existing coating and that the surface is roughened to provide a suitable anchor pattern to ensure a strong bond to the substrate.

In most circumstances abrasive grit blast cleaning is the preferred method of preparation, and the aim is to produce a suitably cleaned, roughened surface with optimum profile depth and a sharp, dense, angular profile. The blast media should be chosen to produce a sharp, dense, angular profile with sufficient peak count.

The surface profile depth shall be in the target range of 50 to 75 μm (2 to 3 mils); locally minimum spot depth reading no lower than 30 μm are acceptable so long as majority of the surface is within target range. Depths greater than 75 μm , up to typically 100 μm are acceptable but do not provide additional benefit and risk not being fully covered by the primer with subsequent risk of rust bloom.

In addition to profile depth, blast cleaning shall produce a sufficient peak count. Optimum adhesion will be achieved when the peak count is in the range of 40 to 60 peaks per centimetre (100 to 150 peaks/inch).

Surface profile should be measured in accordance with a recognized standard such as ASTM D4417 using a combination of comparator gauges (see figure 1) and profile depth measurements (using probe type gauges and/or composite plastic tapes). Stylus type gauges are also acceptable but are difficult to use in the field, however, can be used on coupons to establish parameters such as grit type, pressures, distances, etc.



Figure 1: Surface Comparator Gauges

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Alternate surface preparation methods may be acceptable on a project-by-project basis and in agreement with PPG's FTS. Detailed information on surface preparation is provided in SSPC-SP COM "Surface Preparation Commentary" and associated referenced document, such as SSPC-PA 17, "Procedure for Determining Conformance to Steel Profile/Surface Roughness/Peak Count Requirements", and these must be referred to accordingly.

3.6.2. Carbon Steel Substrates

Abrasive grit blast cleaning should be carried out to a near white metal standard in accordance with ISO 8501-1 Visual standard Sa2½ or SSPC SP 10 / NACE 2.

3.6.3. Stainless and Duplex Steels and Non-Ferrous Substrates

Brush-off blast cleaning in accordance with SSPC-SP16 should be used for preparation of stainless and duplex steels, however the requirements for surface profile depth shall be increased in line with section 3.6.1. This is best achieved using a dense, hard grit such as garnet.

3.6.4 Galvanized Steel Substrates

PITT-THERM 1000 FXX is a thick film epoxy thermal barrier coating that provides a full barrier anti-corrosion protection system, as such the use of galvanizing with it is not regarded as necessary. However, many owners and engineering companies choose to use galvanizing and it is normally not possible to differentiate the areas that require insulation early enough so typically all the steel is galvanized up front and subsequently surface preparation undertaken on those areas where insulation will be applied. There are many variables in galvanizing of carbon steel and key factors that need considered in its preparation for coating; these are covered in standards such as ASTM A123, ASTM A143. ASTM A143, ASTM A385, ASTM D6386, etc. and in guidance from industry bodies such as the American Galvanizers Association (<https://galvanizeit.org/>) who provide guidance on matters such as design and fabrication and specification and inspection.

These standards and guidance recommended that the galvanizer is informed that the surfaces will be subsequently coated with a thick film epoxy intumescent coating to ensure that they follow their industries guidance to avoid producing excessively thick galvanizing layers with potentially poor adhesion properties. This is particularly important where "reactive steel" is used (where elements in the steel such as Silicone and Phosphorous are outside the recommended ranges).

Prior to beginning preparation of the steel for application, the galvanized steel should be inspected for any defects including uncoated areas, blow holes, delamination, dross inclusion, flaking, drainage spikes, etc. To test the zinc coating for adherence, run a stout knife smoothly along the surface of the steel without whittling and gouging, as detailed in the ASTM specifications A123/A123M and A153/A153M. The coating shall be deemed not adherent if the coating flakes off, exposing the base metal in advance of the knife point. Any defects should be repaired in accordance with the recommended standards and guidance described above.

Brush off blasting is recommended for the preparation of galvanized substrates in accordance with SSPC SP-16 and in accordance with ASTM D-6386 "Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting". However, these standards were developed for the application of thin decorative duplex coatings not specifically for thick film epoxy coatings and the minimum surface profile requirements quoted in these specifications (19 µm (0.75 mils)) are not considered sufficient.

For PITT-THERM 1000 FX, the target blast profile should be in the range of 50 µm (2 mils) to 75 µm (3 mils) using non-metallic grit with a sharp angular profile and a peak count in the range of 40 to 60 peaks per centimeter (100 to 150 peaks/inch). Spot minimums of 30 µm (1.2 mils) or spot maximums of 100 µm (4 mils) are acceptable if additional measurements around the spot are within the range of specified target anchor profile range (50 µm to 75 µm (2 mils to 3 mils)). Spot measurements below 30 µm (1.2 mils) are not acceptable and the area should be reworked, spot measurements above 100 µm (4 mils) may be accepted if it can be shown that the galvanizing has not been completely removed and that the primer coat can cover the peaks sufficiently.



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The measurement of surface profile and roughness on galvanizing can be problematic as galvanizing has a natural surface profile, nodular not angular, that can typically be in the range of 50 µm (2 mils) to 125 µm (5 mils); as such normal methods of measurement such as plastic replicator tape (Testex or equivalent) (per ASTM-D4417 Method C) are not suitable when used alone. The objective of blast cleaning is to create an angular profile over the natural texture. As such comparator tapes can be used in conjunction with profile comparators (per ASTM-D4417 Method A or ISO 8503).

The blast profile may be confirmed using portable stylus instrument in accordance with ASTM D-7127 or equivalent, however these devices are not considered robust enough or practical to use on site and their use is often restricted to establishing blast profile on coupons to determine the optimum parameters of grit type, size, hardness and blast parameters such as pressure, angle, distance, etc. that are then maintained throughout the project.

Following abrasive blast cleaning, surfaces should be blown down with clean, compressed air. In some atmospheric conditions, such as high humidity, or high temperature, or both, the formation of zinc oxide on the blasted surface will begin very quickly. Zinc oxide formation is not visible to the unaided eye; therefore, in any atmosphere, primer application should be started as soon as possible after surface preparation (ideally within an hour per ASTM D6386 recommendation) and completed within the same shift.

3.6.5 Wet blasting (Slurry/Vapor blasting)

This is a technique of wet abrasive blasting using a relatively low volume of water, grit and air pressure. The technique is very controllable with little interference to 'other trades', not producing sparks and therefore can be used in zoned environments (e.g., offshore or on a live petrochemical plant) and provides a blast profile similar to that obtained with dry grit blasting. Where wet blasting is used for surface preparation a suitable wet blast/surface tolerant primer from the PITT-THERM 1000 FX primer list must be used.

3.6.6 Hydro blasting (UHP water jetting)

This method of surface preparation uses water at pressures typically in excess of 2,400 bar (35,000 psi). As it cannot produce a blast profile, it is not suitable for new, previously un-blasted steel. This method is commonly used in maintenance situations to remove old paint or insulation coatings prior to the application of the PITT-THERM 1000 FX, in such circumstances the surface profile should be inspected after removal of the old coating and if necessary, a sweep blast undertaken to achieve the required surface profile. Where hydro blasting is used for surface preparation a suitable wet blast/ surface tolerant primer from the PITT-THERM 1000 FX primer list must be used.

3.6.7 Dry ice blasting

Dry ice blasting is an alternative to hydro-blasting and likewise does not produce a blast profile and has the same requirements as Section 3.5.6 above.

3.6.8 Power tool cleaning

Power tool cleaning is suitable for small areas such as repair/touch-up where blast cleaning is not possible. It is recommended that power tool cleaning is carried out in accordance with ISO-8504-3 (SSPC SP11) to achieve a surface cleaning level to ISO 8501-1 to a visual standard ST3 and to achieve a surface profile of a minimum of 50 µm (2 mil). Where power tool cleaning is used for surface preparation a suitable surface tolerant primer from the PITT-THERM 1000 FX primer list must be used.

Suitable power tools should be used but wire brushes are not recommended as they can cause surface polishing. please seek guidance from PPG FTS.



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3.7 Water-soluble Salt Contamination

Soluble salts are known to be detrimental to the life of coating systems and it is recommended that their level is reduced as low as reasonably practical to ensure the performance of the coating is maximized. Prior to coating application, the steel substrate shall be assessed for soluble-salt level in accordance with ISO 8502-6 and ISO 8502-9.

The required limits vary depending on factors including region, environment, end use, etc. For oil, gas and petrochemical projects the two most commonly specified requirements are those set out in Norwegian Standard NORSOK M-501 and in the International Association of Oil and Gas Producers (IOGP) specification S-715; these both specify a maximum level of 20 mg/m² as Sodium Chloride [NaCl].

However, this may not be practical, or necessary, to achieve in all situations e.g., in maintenance situations or for use in more benign environment. In these situations, guidance should be taken from the project specifications or in agreement with the client prior to commencement of the project.

Where no specific level is provided, PPG recommends that the following maximum values should be used:

Recommended maximum limits of water-soluble salts on steel substrate prior			
Conductivity	As Chloride [Cl]	As Sodium Chloride [NaCl]	As Mixed Salts
10 µS/cm	36 mg/m ²	60 mg/m ²	50 mg/m ²

The above figures are based on PPG practical experience and product knowledge; more details can be found on PPG's Information Sheet 1490.

Where testing shows higher levels than acceptable it is recommended that the surface shall be re-cleaned with potable water until the acceptance criterion is met followed by re-blasting.

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4 PRIMER SELECTION

4.1 Purpose

The selection of suitable primer system for use with the PITT-THERM 1000 FX is critical for both the insulation performance and the long-term life and corrosion protection of the system. The choice of which primer system to use will be dependent on many factors including: operating and design temperatures, substrate material and condition, preparation techniques employed, environmental conditions, application conditions, local regulations, project specification and individual client preferences.

The compatibility of the PITT-THERM 1000 FX with the primer must be verified; for this reason, only primer and coating systems satisfactorily tested and qualified by PPG shall be used under the PITT-THERM 1000 FX.

Ideally, the PITT-THERM 1000 FX should be used in conjunction with PPG primers as compatibility of primer and performance are readily verified. Please contact PPG for recommended primers that are compatible with the PITT-THERM 1000 FX.

4.2 Primer Condition

It is the applicator's responsibility to ensure that the primed surface and the primer itself are in an acceptable condition for over-coating with the PITT-THERM 1000 FX. Factors such as ageing of the primer (degradation and surface chalking), contamination, zinc salt formation, rust, bloom, etc. shall be considered when determining a surface's suitability before over-coating with the PITT-THERM 1000 FX.

In all situations the surface of the primer must be clean, dry and free of all contaminants immediately prior to over-coating with the PITT-THERM 1000 FX. Care should be taken to ensure that primer systems have reached sufficient levels of cure prior to over-coating with the PITT-THERM 1000 FX, please refer to primer PDS for specific details. Consult the relevant primer PDS for minimum and maximum over-coating times.

4.3 Primer Types

4.3.1 Epoxy Primers

Two-component epoxy-based primers with suitable temperature resistance are recommended with PITT-THERM 1000 FX including for use on non-ferrous substrates, such as stainless and duplex steels.

With certain epoxy-based coating systems, especially when applied under low-temperature and/or high humidity conditions, the formation of amine bloom or blushing may occur; this can be detrimental to inter-coat adhesion and should be checked for and removed prior to over-coating. Amine bloom formation on the primer surface can be removed by high pressure water-washing at a minimum of 170 bar (2500 psi) combined with the use of abrasive pads.



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4.3.2 Zinc Phosphate Epoxy Primers

Epoxy zinc phosphate primers are commonly specified in corrosion protection systems and suitably qualified zinc phosphate primers are compatible with PITT-THERM 1000 FX.

4.4 Primer Thickness

Prior to over-coating the applied primer with PITT-THERM 1000 FX, the Dry Film Thickness (DFT) should be checked to ensure that the required thickness has been achieved and the maximum allowable DFT has not been exceeded. The maximum primer thickness is dependent on the specific primer system used and reference should be made to the PITT-THERM 1000 FX recommended primer list. The thicknesses in the PITT-THERM 1000 FX primer list take precedence over the thickness on the primer PDS, and careful monitoring and measurement of primer thickness is required.

DFT measurement should be carried out in accordance with a recognized standard such as ISO 2808, SSPC PA2 or ASTM D1186. The method, frequency of measurement and number of measurements per spot should be agreed between applicator and client and confirmed prior to commencement of the contract. Optimal bonding is achieved when the primer's DFT is sufficient to just cover the peaks of the blast profile and maintain a rust-free condition prior to application the PPG PITT-THERM 1000 FX.

4.5 Reduction of Excessive Primer Thickness

Excessive primer thickness should be reduced to within that allowable DFT range in accordance with the PPG PITT-THERM 1000 FX recommended primer list. The preferred method to be used is abrasive sweep blasting followed by thorough vacuuming to remove contaminants from the surface. Sanding with P80-P100 grade aluminum oxide abrasive paper or proprietary abrasive pads may be suitable for small areas. Care should be taken to prevent polishing of the surface which would lead to inadequate adhesion of the PPG PITT-THERM 1000 FX; frequent changes of the abrasive should be made.

After primer reduction, surfaces should be cleaned of dust and contaminants in accordance with SSPC- SP1 and shall be washed with potable water and thoroughly dried, prior to the application of PPG PITT-THERM 1000 FX . Solvent must not be used for washing.

The primer manufacturer's application instructions should be followed where third part primers are used.



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5 PPG PITT-THERM 1000 FX APPLICATION

5.1 Application Methods

PPG PITT-THERM 1000 FX can be applied in a number of ways including:

- Heated plural feed airless spray
- Hand application by trowel

Note: It is not possible to apply PPG PITT-THERM 1000 FX by brush or roller. This section of the guidelines explains these two methods of application in detail.

5.2 Protection of Adjacent Surfaces

Adjacent surfaces that do not require insulating, and areas around field joint connections (block-outs) and other design details to be protected by hand application at a later date, should be completely masked off and covered using masking tape and/or paper or plastic sheeting in preparation for application. Once this has been complete application may begin. Masking should be removed immediately after application, before product has cured, otherwise it will be extremely hard and time consuming to remove.

5.3 Application Tools and Equipment

Hand application tools will be required regardless of whether the PITT-THERM 1000 FX is applied by heated plural feed airless spray or by hand. See below for an example of the minimum application tool requirements to correctly apply PITT-THERM 1000 FX, which should be regularly cleaned in order to avoid contamination or substandard quality application to the final surface finish of the coating.

Minimum Tools Required:

- Solvent resistant 4-inch short nap roller
- Solvent resistant 7–9-inch short nap roller
- Gauging trowel
- Floating trowel
- 2–4-inch brush
- Industrial spray bottle
- Weighing Scales
- WFT Wet Film Thickness Gauge
- 2–4-inch scraper
- IR Thermometer
- Masking tape
- Duct tape
- Plastic sheeting / brown paper



Figure 2: Minimum Tools Required

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5.4 Heated Plural Feed Airless Spray

5.4.1 Plural feed equipment

The PPG PITT-THERM 1000 FX is a two-component epoxy thermal barrier coating, therefore the most efficient application method for large areas of the coating is with heated plural airless spray equipment, which offers the advantage of not requiring any premixing of the two components which negates pot-life issues.

The equipment used must be purposely designed to spray thick film epoxy coatings such as PITT-THERM 1000 FX and must be capable of delivering the required ratios, pressures, temperatures, and flow rates to correctly apply the product. The equipment should also have a reliable track record of operating in a wide range of environmental conditions often for long periods without any issues that cause interruptions. Equipment that meets this criterion is supplied by a number of manufacturers. They will provide their own instructions on machine operation, maintenance and set up required to achieve a high-quality application. The information contained within these application guidelines is given for advice only and the contractor is responsible for determining the suitability of specific pieces of equipment and maintenance of the equipment in good working order according to the manufacturer's recommendations. PPG's advice may be sought on suitable equipment and suppliers where necessary.

5.4.2 Preconditioning of Material

Prior to application of PITT-THERM 1000 FX coatings using heated plural feed airless spray equipment it is strongly recommended that both base and hardener are stored in a heated storage unit at 25 to 35°C (77 to 95°F) for spray; 25 to 30°C (77 to 86°F) for trowel; for 24 hours prior to use. Storage at these temperatures will reduce the viscosity of the product, assisting machine filling and reducing start up time and aid mixing for hand application.

Base and hardener may be stored for up to 4 days in closed containers under these conditions. Prolonged storage of PITT-THERM 1000 FX at these temperatures should be minimized as much as possible. The material should be used after this period and not be re-heated again.



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5.4.3 Machine Operating Parameters

The operating parameters for PITT-THERM 1000 FX depend on a number of factors including the equipment type and environmental conditions. The below general parameters are provided for guidance purposes and is designed to serve as a starting position, but each parameter may need to be taken outside the levels stated due to actual site conditions.

Applicators must ensure the accuracy of parameters based on the factors influencing their application prior to use of PITT-THERM 1000 FX .

Operating Parameter	Recommended Values (for GRACO XM PFP plural pump)
Ratio settings	By Volume: 1:1 By Weight: 1.16:1 Tolerance: 10%
Pre-conditioning temperature	Base: 25 to 30°C (77 to 86°F) for min. 24 hours Hardener: 25 to 30°C (77 to 86°F) for min. 24 hours
Feed (storage) Tank Temperatures	Base: 35 to 40°C (95 to 104°F) Hardener: 38 to 45°C (100 to 113°F)
Feed (storage) tank levels	Base: 15rpm for 20 mins every 1 hour Hardener: 15 rpm for 20 mins every 1 hour
Feed (storage) tank stirrer speeds	Base: Min. 60% Hardener: Min. 50%
In-line Heater Temperatures	Base: 35 to 40°C (95 to 104°F) Hardener: 40 to 45°C (104 to 113°F)
Hose Heater Temperatures	55 to 60°C (122 to 140°F)
Gun exit temperature	40 to 50°C (104 to 122°F)
Spray tip size	6.31, 6,29
Feed (storage) tank pressures	Base: 5 bar (75 psi) Hardener: 5 bar (75 psi)
Hose diameters	Base: 3/4" Hardener: 1/2" Whip-end: 1/2"
Displacement Pump Pressure	175 to 240 bar (2500 to 3500 psi)
Recirculation	Base: On for 4 minutes before spraying to warm up the metering legs Hardener: On for 4 minutes before spraying to warm up the metering legs

Note:

The above parameters are recommended values as guidance only. Adjustments to these settings may be required due to variations such as ambient temperatures, hose lengths, air supply pressures, etc. PPG's Field Technical Services should be contacted if further assistance is required



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5.4.4 Hoses/Spray-Lines

Only hoses suitably rated shall be used; the equipment manufacturers guidance must be followed with regards to pressure ratings and maximum lengths of hoses.

The material deliver hoses to the mixing block should be of the following size:

5.4.3.1 Base – ¾" Diameter

5.4.3.2 Hardener- ½" Diameter

The whip-end line to the spray gun should be ½" diameter and kept as short as possible, normally a 5-metre (15 foot) length is sufficient.

Switch on the main pump for approximately 10 minutes at an input pressure of 1.4 bar (20 p.s.i.).

Spray lines should be emptied of all previous coating used. Empty a minimum of 10Kg (22lb) of base and 5Kg (11lb) of hardener through the sampling valves, prior to taking a ratio check. If the equipment does not have sampling valves, then the hoses before the mixing block should be disconnected. Material should be kept clean and unmixed so that it can be re-used.

It is important to preheat the lines of the pump to get hot material at the end of the hose with a consistent flow when application begins.

5.4.5 Spray tips and operating pressure

Typically spray tips of 0.725 to 0.775 mm (29 to 31 thou) internal diameter are recommended for application. Where a narrow spray fan pattern is required, such as smaller structural steel sections, a 20-to-30-degree angle tip should be used. If a wider spray fan pattern is required on larger structures and fire divisions, a 40-to-60-degree angle tip should be used. An operating pressure of 240 to 310 bar (3,500 to 4,500 p.s.i.) is typically recommended for application. The applicator should confirm the correct spray tips and operating pressure before applying PITT-THERM 1000 FX.

5.4.6 Ratio checks

Weight ratio checks should be carried out a minimum of twice a day; once at the start of the shift and a second midway through shift; additional ratio checks may be required whenever there has been a significant break in spraying of more than 1 hour or parts need replacing.

The weight ratios shall not deviate more than 10% from the target weight ratio of 1.16 : 1

Weight Ratio Range	Target Ratio	Allowed Range
PPG PITT-THERM 1000 FX	1.16 : 1	1.044 : 1 – 1.276 : 1

In addition to the weight ratio checks, the displacement pump pressure gauges should be checked constantly for pressure variations by the machine operator and the color of the mixed PPG PITT-THERM 1000 FX should be observed by the sprayer. Any color change would indicate the machine has gone off ratio and application should cease immediately, and a ratio check performed again.

Spray application should not be started until the correct weight ratio has been achieved. Results of all ratio checks should be recorded in a daily Quality Assurance / Quality Control (QA/QC) log.



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For typical non-metered ratio spray pumps, use the following procedure for ratio checks by weight:

1. Weigh clean empty pails for Base and Hardener and record the respective tare weights of the pails.
2. Fix nozzles (35 thousandths of an inch orifice size) to the Base and Hardener dump valves on the mixing block. This is particularly important to maintain the pressure in the system and gain accurate ratio checks.
3. Place the weighed empty pails under the ratio check valves located on the mixing block and open both material valves at exactly the same time and open the flow valve on the pump (take out of circulation)
4. Close both material valves at the same time when the base material pail is at least half full and close the pump flow valve (put pump into circulation)
5. Weigh each pail including dispersed material and record the total weight.
6. Find the net weight of each material dispensed by subtracting the tare weight of the pail from the total weight.
7. Calculate the ratio of Base to Hardener

Example Calculation:

Component	Empty Container Weight (kg)	Filled Container Weight (kg)	Nett Weight (kg)	Calculation of ratio	Ratio
Base	3.2	9.64	6.44	6.44 / 5.56	1.16 : 1
Hardener	3.1	8.66	5.56		

If the ratio is outside of tolerance, adjust the pressure settings and repeat the process.

5.4.7 Spraying

It is possible to apply the PITT-THERM 1000 FX with a coat thickness between 1 mm (40 mils) and typically up to a thickness of 6 mm (240 mils) depending on temperature, equipment and operator skill. It is recommended that typically 4-6 mm per coat is applied; once the material has gelled sufficiently, subsequent coats can be applied directly without waiting for PITT-THERM 1000 FX to fully cure. The coating can be applied with a normal spray pattern; however, it is advised use a roller to obtain a smooth finish.

Once the first coat has become tacky the second coat of the PITT-THERM 1000 FX can be sprayed to the final DFT (wet on tacky).

5.4.8 Flushing of equipment

Hot water can be used very effectively for flushing out lines and equipment, but care should be taken, as water will not dissolve epoxy resin-based materials. If a true solvent is required for equipment maintenance, the use of THINNER 91-92 is recommended, but this should be done with care with hot equipment.

Particular attention should be paid to the mixing block and worm, as material can congest here. These areas should be thoroughly cleaned at least every 2 hours or when the sprayer starts to lose the fan and checked to avoid future blockages.



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5.5 Hand Trowel Application

It is also possible to apply the PPG PITT-THERM 1000 FX by trowel, plaster trowel or other similar tools, and then smoothed off using a roller. Hand application is recommended for small areas such as block-outs.

5.5.1 Preconditioning of material

It is recommended that both base and hardener are stored at between 25 to 35°C (77 to 95°F) for at least 24 hours prior to use to ease mixing and application. Storage above this temperature will reduce the pot life when mixed. Base and hardener may be stored at these temperatures for the duration of the shelf life quoted on the PDS.

5.5.2 Thinning

PITT-THERM 1000 FX must not be thinned.

5.5.3 Mixing Ratio

The single feed kits of PITT-THERM 1000 FX come in specific size containers to allow the mixing of a full kit within the base container. It is recommended that only full kits be mixed to ensure correct mixing ratio, however smaller portions of material can be mixed if care is taken that the correct ratio is achieved by accurate weighing of the base and hardener before mixing. The mixing ratio should be 1.16 : 1 by weight and must not deviate from this by more than 10% (see section 5.4.5). Hand mixing by volume must never be attempted.

5.5.4 Mixing

Due to the high viscosity of PITT-THERM 1000 FX a high-powered mixer is required; standard paint mixers or drills are not suitable and must not be used as they may lead to improperly mixed material and excessive time taken to mix with resultant shortening of working pot-life.

The mixer should preferably be a cart mixer specifically designed for mixing of thick film epoxy coatings, as shown in Figure 5, to secure the pail and reduce the risk of accidents. Alternatively, a high torque, variable speed, paddle mixer of minimum 5 Horsepower air motor or 3725 W / 110 V electric motor equipped with 250 mm (10") diameter paddle or twin paddles should be used (an example is shown in Figure 4). The mixing should begin slowly, and speed built up gradually.

As mentioned above, a small amount of PPG thinner may be added to reduce viscosity for mixing and application. The amount required varies with initial material temperature but up to a maximum of 2% may be added. The solvent, if used, may be added to the base and mixed in until it has reached a smooth consistency, the hardener is then poured into the base pail, scraping the sides of the hardener pail to empty it completely. Mix carefully until a smooth texture and uniform color is achieved, which should take less than 5 minutes. Consideration should always be given to the relevant pot life and kits should not be mixed until they are ready to be used. For trowel application it may be beneficial to spread the material out on a flat board to dissipate heat and extend the working pot-life.



Figure 4: Epoxy Coating
Cart Mixer



Figure 5: High powered hand-
held mixer



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5.6 Application Quality of PPG PITT-THERM 1000 FX

5.6.1 Methods of Measurement for Wet Film Thickness

Wet film thickness should be measured regularly during application using a pre-cut bridge gauge, typically made from a scraper, gauge widths of between 40 to 100mm (1.5 to 4.0 inches) have been found to be most appropriate. Each gauge is placed into the wet material pressing down to the steel substrate or previous cured layer of insulation and when a line is left in the surface of the wet material the required depth has been achieved. We do not recommend the use of notch or pin gauges as they limit the measurement to one point.



Figure 3: Pre-cut Bridge Gauge

5.6.2 Final Surface Finish Appearance

Following spray application of the PITT-THERM 1000 FX, a trowel should be used to eliminate any voids and then followed by a roller to attain a smooth, uniform finish. The optimum time will depend on the temperature, but for most projects, it should be done within approximately 20 to 30 minutes after spraying; once the material has cured beyond the point it can no longer be worked, it is not possible to reverse this reaction and addition of solvent must not be used to try and achieve “re-activation”.

For rolling, a short nap, simulated sheepskin roller has been found to give good results, but other short or medium-naps solvent resistant, synthetic rollers may be suitable. It is recommended that the suitability of roller be established on a small area prior to use. Solvent should be used to lightly dampen the roller (it is recommended that a small spray mist bottle is used for this purpose) to prevent material pick-up on the roller, but one must ensure that the roller is suitable for use with strong solvents. It is recommended that PPG THINNER 91-92 is used, and the quantity used should be kept to an absolute minimum.

Care must be taken to ensure that all residual solvent has evaporated from the film before applying a subsequent layer of the PITT-THERM 1000 FX or a topcoat.

As an alternative to a smooth finish some clients prefer a sprayed stipple finish, this should be applied after the required DFT has been obtained. The quality and type of surface finish should be agreed by all parties at the beginning of the project by means of a reference area. It should be noted that PITT-THERM 1000 FX is generally considered an “industrial finish” rather than an “aesthetic finish” and achieving a high degree of evenness is generally considered impractical, however poor workmanship, such as runs and sags, should be avoided.



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5.7 Final Thickness Measurement

One of the most important aspects of quality control in the use of the PITT-THERM 1000 FX is the attainment of the correct final DFT to meet the required insulation requirement. It is imperative that the PITT-THERM 1000 FX is applied to the DFT stated in the project specification documentation/drawings and in accordance with thickness calculations provided by PPG.

The summary given below is believed by PPG to be accurate; however, it is qualified in its entirety by the certification criteria of the applicable independent classification societies. Additionally, project specific requirements might exceed these requirements and must be met.

5.7.1 Required DFT for a Given Insulation Rating

The thickness of insulation is the **minimum average** thickness required to achieve the insulation rating against which the product was tested. Each test standard differs in the method of testing and assessment and the limits on acceptable variance in thickness differ by standard as well. Application of epoxy insulation will always result in variation in thickness, typically with a normal distribution about an average thickness; it is essential that this variation is tightly controlled to ensure the fire performance.

The concept of a minimum average thickness recognizes that variation exists and that local low thicknesses are acceptable as long as there are compensation areas of higher thickness. It should be noted that the thickness stated in fire certification is the thickness of the insulation coating excluding any primer or topcoat.

5.7.2 Limits on Deviation from Minimum Average

PPG applies a statistical control method for measuring the average applied thickness. The thickness measurements should fall within the limits:

- 68% of readings are within 20% of the mean
- 95% of readings are within 30% of the mean
- 100% of readings are within 45% of the mean

This method aligns easily with modern electronic thickness measurement gauges. These gauges provide key statistical data on the mean thickness ($\bar{x}$), minimum measured thickness (t_{min}), maximum measured thickness (t_{max}) and the standard deviation (σ). The following requirements must be met:

- $\bar{x}$ must be $\geq$ specified thickness
- σ must be $\leq$ 15% of specified thickness
- t_{min} must be $\geq$ 45% of $\bar{x}$
- t_{max} should be $\leq$ 145% of $\bar{x}$ (higher thickness are acceptable on a project as long as the total thickness does not exceed the maximum allowable thickness, however this could indicate poor quality control and excessive material consumption). The maximum allowable thickness should $\leq$ 24 mm.



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5.7.3 Methods of Measurement for Dry Film Thickness

For high film epoxy coatings, two types of method for DFT measurement are typically employed:

- Non-destructive – the electromagnetic gauge
- Destructive – the drill and pin depth gauge method

Preference should be given to non-destructive methods to minimize the risk of damage to the system.

The destructive method should only be used where non-destructive methods are not achievable or to verify the accuracy of non-destructive methods where doubt exist. The use of destructive methods should be kept to a minimum.



Figure 6: Electromagnetic depth gauge

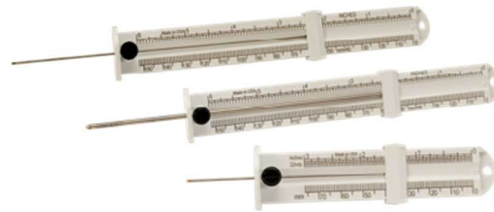


Figure 7: Pin depth gauge

5.7.4 Non-destructive Method

The use of magnetic induction or eddy current gauges for the measurement of the paint DFT has been common for many years. These gauges use interchangeable probes, which measure different ranges of thickness. Probes that will measure up to 50 mm (2 in) thickness of coating on ferrous or non-ferrous substrates are available.

Ensure the correct probe is used for the DFT range being applied so that an accurate measurement is achieved. In all cases, the manufacturer's instructions should be used to determine the correct method for use and calibration. Where electromagnetic gauges are concerned, particular note should be taken regarding their limited accuracy at edges and corners.

5.7.5 Destructive Method

Drilling of small diameter holes (typically less than 3mm (1/8")) and the use of a pin depth gauge to measure thickness at that point is acceptable. Care must be taken not to damage the substrate. All holes should be filled with the PITT-THERM 1000 FX as soon as possible (preferably in same shift) after measurements have been taken.

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5.7.6 Frequency of Measurements

The following information is given for guidance only and does not seek to override any project specific requirement for DFT measurement. Reference should always be made to the client's project specifications or recognized standards such as NACE, SSPC, BS, ISO, etc.

Open Sections (I Sections, Tees, Channels, etc.)

Webs: Two readings per metre (3 ft) length on each face of web

Flanges: Two readings per metre (3 ft) length on the outer face of each flange and one reading per metre length on the inner face of each flange.

Square and Rectangular Hollow Sections and Angles:

Two readings per metre (3 ft) length on each face.

Pipes & Circular Hollow Sections:

Eight readings per metre (3 ft) length evenly spread around the section.

Where members are less than 3 m (10 ft) in length, three sets of readings shall be taken, one at each end and another at the center of the member. Each set shall comprise of the number of readings on each face given above, as appropriate.

Flat Plate (e.g., decks bulkheads) and Large Vessels

On flat plate and large diameter vessels, two or three thickness readings should be taken every 1 m² (10 ft²). If deck and bulkheads are stiffened, readings should be taken at no more than 1 m (3 ft) intervals along the length of the flat area between the stiffeners. The stiffeners themselves should be measured as per the open sections or angles, as appropriate, as described above.

6 TOP COATING

The PITT-THERM 1000 FX has been extensively tested to industry recognized standards including NORSOK M501 to demonstrate its ability to withstand weather and environmental exposure without topcoats and as such, the use of a topcoat is generally considered optional and for aesthetic purposes only. However, when a topcoat is to be applied on the PITT-THERM 1000 FX, only qualified topcoats should be used.

The PITT-THERM 1000 FX can be top coated when it is sufficiently cured (see PDS for over-coating intervals) ensuring the surfaces are clean and dry and free from surface contamination including dust, grease, amine bloom, etc. Recommended minimum over coating intervals differs depending on topcoat therefore refer to PDS for relevant data.

Normally a polyurethane topcoat with a nominal DFT of 60 µm is recommended, although alternative topcoats such as isocyanate-free epoxy acrylics and poly-siloxanes can also be used. Ideally, the PITT-THERM 1000 FX should be used in conjunction with PPG topcoats as compatibility and performance are readily verified. Where non-PPG topcoats are used the top-coat manufacture must ensure their product is compatible for use with the PITT-THERM 1000 FX. Please contact PPG for details of PPG's qualified topcoats.

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7.0 TOUCH-UP & REPAIR

7.1 Damage back to bare steel

- a) Cut out the coating system to 10-20mm ($\frac{1}{2}$ "–1") from the damaged area in all directions.
- b) Prepare the steel to ISO 8501-1 St3 / SSPC-SP-11. The substrate should be dry, sound and free from all contamination and provide a sufficient roughness for the specified primer.
- c) Apply the primer to the specified DFT. The primer should be approved for use under PITT-THERM 1000 FX and should be suitable for ISO 8501-1 St3 / SSPC-SP-11 prepared steel substrates.
- d) After curing of the primer, slightly abrade 25–30mm (1-1 $\frac{1}{4}$ ") of the surrounding sound coating system to remove the existing topcoat.
- e) Reinstall the specified DFT of the PITT-THERM 1000 FX using the original product. Take care not to excessively overlap the existing coating or topcoat.
- f) If the system had been top coated, overcoat the repaired areas with the original topcoat to the specified DFT, overlapping the sound finish by 50mm (2").

NOTE: If the system includes PITT-CHAR NX, please refer to the PITT-CHAR NX APPLICATION GUIDELINES on how to repair the PFP portion.

7.2 Damage to PITT-THERM 1000 FX only

- a) Slightly abrade 25–30mm (1-1 $\frac{1}{4}$ ") of the surrounding sound coating system to remove the existing topcoat.
- b) Reinstall the specified DFT of the PITT-THERM 1000 FX using the original material. Take care not to excessively overlap the existing coating or topcoat.
- c) If the coating had been top coated, overcoat the repaired areas with the original topcoat to the specified DFT, overlapping the sound finish by 50mm (2").

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