RECOMMENDED PROCEDURES FOR THE APPLICATION OF RILSAN® POLYAMIDE 11 COATING TO MASSIVE PARTS PIPE COUPLINGS, FITTINGS AND SIMILAR ITEMS

FORWARD

Rilsan® is an engineering polymer. It was invented and originally developed in France. It has become one of the most widely used high performance coating powders in the world, with one of the longest field life experiences. Currently, powder manufacturing plants are located at Serquigny in Normandy and Birdsboro in Pennsylvania.

Rilsan® has excellent corrosion, abrasion, impact and weathering resistance, together with good thermal and electrical insulation characteristics. Specific grades and colours have approvals for use in contact with potable water, and are widely accepted in contact with food and water throughout the world. Current details of these approvals can be provided on request.

In common with all other coatings, full effectiveness is only obtained by satisfactory metal pre treatment and controlled application processes.

This information is provided by Arkema to assist customers in the successful application and use of Rilsan® (Nylon 11) coating. Customers are advised to contact Arkema if the planned application is not within the scope of this guidance or if any features of the proposed application are unclear.

The information contained in this document is based on trials carried out by our research centres and data selected from literature, but shall in no event be held to constitute or imply any warranty, undertaking, or express or implied commitment on our part. Our formal specifications define the limit of our commitment. No liability whatsoever can be accepted by Arkema with regard to the handling, processing or use of the product or products concerned, which must in all cases be employed in accordance with all relevant laws and/or regulations in force in the country or countries concerned.

1. Pre treatment

1.1 Visual inspection of components before proceeding

All items intended for coating should be visually examined for manufacturing and material defects, which could render them unsuitable for coating. Their design and manufacture should be in accordance with good surface engineering practices. Wherever possible any item intended for coating should not have sharp edges and corners.

1.1.1. Castings shall be free from porosity, cracks, flash and sharp edges and corners.

1.1.2. Welded fabrications shall use continuous welds. Welds shall be free from porosity, slag, weld spatter, and undercut.

1.1.3. All items intended for coating shall be uncoated and free from oil and grease.

1.1.4. Items will have a suspension point for ease of handling during some or all of the pre-treatment and the coating process. This suspension point may be a bolt hole or special "eye" in the casting to accommodate a hook. When designed for use with the dipping process it will allow most powder to fall from the item when it is removed from the fluidised bed.

1.2 Degreasing

Where necessary all items intended for coating shall be degreased to remove all oil, grease and residual surface solids.

1.2.1 Ferrous items too large for conventional degreasing (e.g., large diameter pipe couplings) may be pre-baked at a temperature/time parameter sufficient to rid them of oil or grease. (Care must be taken not to affect the metallurgy of the item by excessive temperature/time).

1.2.2 Non-ferrous items may not be treated as per 1.2.1. Items too large for conventional de-greasing may be hand wiped prior to grit blasting, when the item is intended for fluid bed coating.

1.2.3 Non-ferrous items intended for electrostatic coating may be pre-treated, following an appropriate chemical cleaning process.

1.3 Grit-blasting

All items intended for coating must be grit blasted. Grit used should be angular steel grit or corundum with a minimum size of G17 (Met abrasive) (G40 SAE). The air projecting the grit must be dry and oil free. Wheel blasting is acceptable. The blast profile shall be between 55 µm and 65 µm, peak to valley height for fluid bed process and between 35 µm and 45 µm for the electrostatic spray gun process. The graphite layer beneath the surface of cast iron should not be exposed.

1.3.1 All grit blasted surfaces shall comply with Standard ISO 8501-01. SA 2.5/3 quality and shall be free of dust. The surface roughness according to Standard ISO 4287-1 shall comply with Rz range 55 to 65 µm, for the fluid bed coating (Refer to Annex 1), and Rz range 35 to 45 µm for the electrostatic spray coating.

1.3.2 All items shall be primed or processed within 8 hours of grit blasting and should be housed in a dry ambient atmosphere in the interim period. If any visual sign of rusting is observed, immediately prior to processing, the items shall be re-blasted. See also 2.0.

1.3.3 All threaded holes shall be protected during grit blasting by the use of rubber or some other suitable bung or by slave studs.

1.4 Out gassing

1.4.1 Ferrous castings, which can possess invisible porosity resulting in blistered coatings, shall be out-gassed by pre-heating during at least 45 minutes at 30°C above their coating process temperature. Coating must take place as soon as the castings have cooled sufficiently to process and within four hours of out gassing.

1.4.2 Non-ferrous castings, which give rise to blistered coatings, shall be pre-heated at between 235°C and 265°C for approximately two hours. Coating must take place as soon as the castings have cooled sufficiently to process and within four hours of out gassing.

1.4.3 Out gassing, when conducted, must precede grit blasting.

2 Priming

Priming for all processes must take place within eight hours of grit blasting; onto clean, dust free surfaces.

Do not store primer next to the oven, as it is flammable and excessive solvent loss will result.

2.1 Primer for fluid bed coating, spray coating onto hot substrate , roto-coating and flame spray

All surfaces must be sprayed with Primgreen® LAT 12035 so that a continuous film is obtained when dry. Items should not be stacked for spraying and should be treated individually. Application may be conducted by conventional or electrostatic spray gun, or by dipping in diluted primer. The primer shall be touch dry before pre-heating. Primer thickness shall be 8 to 12 µm (cure film) or 100 to 150 µm (wet film) (refer to annex 1). During preheating before coating, the primer is cured to a RAL colour standard approximately 8017.

Primgreen® LAT 12035 has a shelf/pot life of one year (in normal conditions - see technical data sheet)

Note that for extreme use conditions (e.g. water temperatures above 50°C) Arkema will recommend a different primer.

2.2 Primer for electrostatic spray coating onto ferrous metals

All surfaces must be sprayed with Rilprim® type LES201A /104B. This primer is supplied in two packs and is mixed in a 50/50 ratio by volume. Application may be conducted by conventional or electrostatic spray gun so that a continuous film is obtained when dry. The primer shall be dried before the application of the powder. Primer thickness shall be 5 to 8 µm (dry film) (refer to annex 1).

2.2.1 Unmixed primer Rilprim® LES201A/104B components have a shelf life of 18 months (in normal conditions – see technical data sheet)

2.2.2 Mixed primer Rilprim® LES201A/104B has a pot life of eight hours. Although it will remain a liquid after this, its adhesive properties may be impaired and it should be discarded.

3 Coating methods (suitability for various components)

The fluid bed (dip), spray coating onto hot substrate and roto-coating (internal) methods are to be used on castings and fabrications where a coating thickness of not less than 250 microns is required.

The electrostatic spray coating method can be used where the surface preparation can be damaged by the preheat temperature of approximately 300° C used for the fluid bed process, and where under some conditions a high metal temperature can alter the physical and toughness properties of the metal. However it will not be possible to achieve a coating thickness of more than 200 microns.

The coating of metal parts to be used in contact with the potable water shall be done with, Rilsan® coating powders and primers having potable water approvals

3.1 Fluid bed coating

3.1.1 Masking

Threaded holes should be masked with heat proof bungs, glass wool or slave studs to prevent them being coated. In some instances very high temperature "grease" such as Rocol Copper Anti-Seize can also be used.

3.1.2 Pre-heating

Pre-heating must take place in ovens fitted with temperature indicators/controllers, which are capable of controlling within the Arkema recommended dip coat temperature ranges (See the Arkema Application Handbook and Annex 3 for specific temperature recommendations). Ovens should normally be of the forced air circulation type accurate between 260 to 330°C anywhere in the workspace.

3.1.3 Dipping, coating appearance, cooling

The preheated item is submerged in the fluidised bed of Rilsan® coating powder for several seconds to achieve the required coating thickness. While submerged smaller items are moved in a back and forth or figure eight motion to ensure even flow of the fluidised powder over the hot substrate. When removed from the fluidised bed excess powder can be removed using dry and oil free compressed air from an air gun, to ensure an even coating.

Dipping must produce an even, smooth, uniform colour, fully fused, unburned coating with a pinhole free surface.

The coated component shall be allowed to air cool to ambient temperature before inspection and packing**.**

3.2 Spray coating onto hot substrate

3.2.1 Masking

Where necessary this will be conducted as per 3.1.1.

3.2.2 Pre-heating

Pre-heating for spray coating onto hot substrate must be conducted generally as per 3.1.2.

3.2.3 Coating procedures, coating appearance, cooling

Spray coating onto hot substrate should be conducted with fluid bed (T) grade Rilsan® coating powder using powder blowing guns, or electrostatic grade (ES) Rilsan® coating powder when using conventional electrostatic guns to obtain thinner coatings. Powder must be applied in a manner to achieve a coating with even thickness and without sagging on heavy sections. Spraying may be followed by post fusing, at an oven air temperature of 215°C ± 15°C if unfused powder remains on the surface. A second coat of electrostatic grade may be applied directly after this post fusion, followed by a second post fusion in order to build up the required film thickness. Please contact our technical service team for advice, if needed.

The resulting coating shall comply with the requirements of 3.1.3.

The coated component shall be allowed to air cool to ambient temperature before inspection and packing.

3.3 Rotocoating (internal surfaces)

3.3.1 Masking

Where necessary this will be conducted as per 3.1.1.

3.3.2 Pre-heating

Pre-heating for Rotocoating must be conducted generally as per 3.1.2.

3.3.3 Coating procedures, coating appearance, cooling

Rotocoating process must be conducted with an adapted Rilsan® fluid bed coating powder Items coated must be properly rotated to obtain the minimum coating thickness required on the whole internal surface.

The resulting coating shall comply with the requirements of 3.1.3.

The coated component shall be air cooled to ambient temperature before inspection and packing.

3.4 Electrostatic spray coating

The following method applies to the coating by electrostatic spraying onto a substrate at room temperature.

3.4.1 Masking

Where necessary, masking may be conducted by means of appropriate self adhesive tapes, powder removal (after spraying) on selected areas, or by means of solid masks.

3.4.2 Coating procedures, coating thickness

Items to be coated must be hooked and primed as defined in Section 2. Powder must be applied to give a visually good covering.

After post-fusing, a minimum coating thickness of 100 microns shall result. Thicker coating is possible but it will not be possible to achieve more than 200 microns. See the ARKEMA recommendation and Annex 4.

3.4.3 Post fusion

Post fusion must take place in ovens fitted with temperature indicator/controllers capable of providing an air temperature of 210-220°C. The oven should normally be of the forced air circulation type, accurate to +/- 5°C anywhere in the work compartment at this temperature. The air speed circulation will not exceed 3 m/s.

When the powder has melted and formed a completely smooth glossy film the item is removed from the oven and air-cooled at room temperature before inspection and packing.

3.5 Flame spray coating

3.5.1 Masking

Where necessary this will be conducted as per 3.1.1.

3.5.2 Pre-heating

Pre-heating for flame spray coating must be conducted generally with flame on flame spray material but propanic blowtorch, infrared, induction or convection oven can be used too.

Surface temperature of 250°C is required to obtain good adhesion.

3.5.3 Coating procedures, coating appearance, cooling

Spray coating onto hot substrate should be conducted with fluid bed (T) grade Rilsan® coating powder using flame spray equipment to obtain minimum 300 µm coating thickness. ES, ESY and MC grades can not be used. Powder must be applied in a manner to achieve a coating with even thickness and without sagging on heavy sections. Please contact our technical service team for advice, if needed.

Spraying must produce an even, smooth, uniform colour, fully fused, unburned coating with a pinhole free surface.

The coated component shall be allowed to air cool to ambient temperature before inspection and packing.

4 Touch up system

Hooked points, pin holes, and damaged areas must be repaired with a touch up product. The product Arkema recommend is **PERMABOND® ET 536 (**available from www.**permabond**.com)

5 Stripping

A non-conforming coating can be removed from a salvageable work piece using one of the different processes listed below:

- Burning coating in an oven equipped with fume filtration at 450°C
- Burning coating in a pyrolisis oven at 450°C, when equipped with an afterburner at 1200°C and fume filtration
- Burning coating in a fluid bed furnace at 420°C/450°C, when equipped with an afterburner at 900°C and fume filtration.

Adequate safety precautions shall be taken for the above processes. Personnel should have read and be fully acquainted with the appropriate Health and Safety documentation produced by Arkema.

After burning off, the work piece must be grit blasted and de-dusted as in paragraph 1.3.

Due to the chemical and abrasion resistance of Rilsan® coating it is not commercially feasible to use chemical or mechanical stripping processes.

6 Coating quality

6.1 Visual inspection

The coating must appear uniform in colour and texture and not have blisters, bubbles, crazed areas, or contaminate inclusions. It must be completely fused to a smooth continuous film. No bare metal must be visible except where masking has been conducted. No tears, runs, sags or excessive coating build up must exist.

6.2 Thickness test

6.2.1 Coatings applied on ferrous substrates may be measured with conventional magnetic type thickness gauges, calibrated to account for any galvanising or plating, and to account for the grit blast profile.

Coatings on aluminium or non-ferrous metals must be measured by electrical meters (e.g., from ELCOMETER, FISCHER) calibrated for the metal concerned, and the grit blast profile.

6.2.2 Coating thickness shall be measured in at least three representative places around the coated item.

6.2.3 Coatings applied by fluid bed, spraying onto hot surface and roto-coating shall always be a minimum of 250 microns thick. On sharp edges where the radius of curvature is less than 3 mm, the minimum thickness must not be less than 150 microns. Maximum coating thickness is not important as long as it does not interfere with the fitting of any mating parts.

6.2.4 Electrostatic spray applied coating shall be a minimum of 100 microns thick.

6.3 Adhesion test

Periodic checks shall be made according to NF EN10310 Annex B.

Arkema can provide further for information on this test method**.**

6.4 Holidays/pinhole check

6.4.1 Periodic checks for porosity and coating continuity should be conducted using an ELCOMETER wet sponge type HOLIDAY DETECTOR (9 volts DC), or a scanning electrode energized by a high-arc-voltage (set at 6V per micron of minimum coating thickness). The detection of porosity will be accompanied by a sound and light signal provided by the holiday detector. Particular attention should be paid to the edges of the coated item (e.g.flanges).

6.4.2 Items found to be defective must be repaired with according to the touch up procedure, or rejected for re-coating, if touch up repair is not practical.

Note that local standards may exist with the above or more extensive requirements for coating quality control. The above checks are a minimum and local standards should be complied with if in existence. An example of a local standard is ANSI/AWWA C224-01 of the American Water Works Association. Quality control of the coated parts should in any case be defined between the customers and suppliers of these coated parts.

7 Handling, transportation and storage requirements

Although Rilsan® coating is more resistant to impact and abrasion than virtually all other coatings, items should be handled without causing damage to the coating, especially on edges such as flanges.

Items should not be stored directly on a rough surface, either in the storage area of the coater, or in the final user warehouse. Although not necessary, it is recommended that flanges and other edges be protected with wood or cardboard. This recommendation should always be complied with for larger and heavier items that have a greater value.

Handling during loading and unloading for transportation should be carried out correctly in order to avoid coating damage. Large items should be transported in a wooden crate or on a wooden pallet, or handled with a woven fabric sling with a correct load rating. During transportation items should be adequately packed in cardboard or wood packaging depending on the size and weight, and/or stabilised with wooden chocks and fabric strapping.

It is normally recommended to store coated items out of direct sunlight, however the appearance, adhesion, mechanical and corrosion resistance of Rilsan® T MAC and ES MAC products is not affected by more than 6 months storage in tropical conditions (e.g. Florida exposure).

For specific information concerning the relative performance of individual grades, it is important to consult Arkema.
All personnel handling or using Rilsan® fine powders and associated products shall have read and be fully acquainted with the appropriate Health and Safety documentation provided by Arkema. Users are urged to ensure that they are in possession of the latest issue of the material safety data sheet and that the product is suitable for their purpose.

Arkema is not able to foresee every use for its' products. IN THE EVENT OF DOUBT, PLEASE CONTACT ARKEMA FOR ADVICE.

ARKEMA has a policy of continuous product improvement. This may lead to changes in materials, documentation and processing procedures. Please ensure that this document has not been superseded.

The information contained in this document is based on trials carried out by our research centres and data selected from literature, but shall in no event be held to constitute or imply any warranty, undertaking, or express or implied commitment on our part. Our formal specifications define the limit of our commitment. No liability whatsoever can be accepted by Akema with regard to the handling, processing or use of the product or products concerned, which must in all cases be employed in accordance with all relevant laws and/or regulations in force in the country or countries concerned.

Two Layers Coating System
Dip Coating, Spraying onto hot substrate, Rotocoating

Steel and Iron shall be free of oil and grease

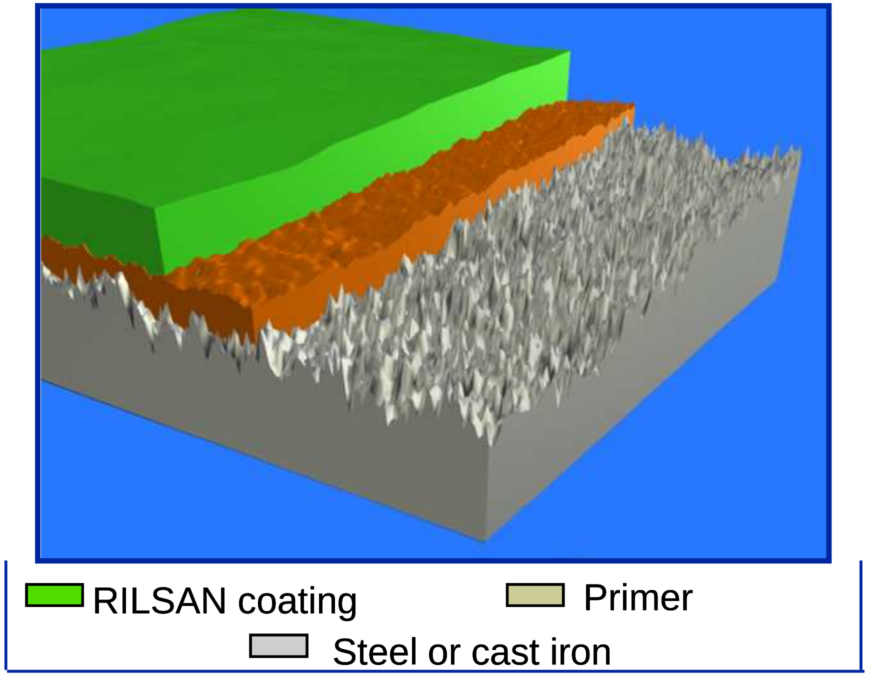
Grit Blasting
With angular G40 SAE steel grit or cast iron

- Level of cleaness according to ISO 8501-1 : SA 2.5- 3
- Roughness according to ISO 4287-1
  Rz : 55 µm to 65 µm

Rilsan® Coating system

Layer 1: primer cure film thickness 8 to 12 µm

Layer 2 : Rilsan® coating thickness optimal 350 µm ± 50 µm
Minimal 250 µm



Two Layers Coating System
Electrostatic Spraying

Steel and Iron shall be free of oil and grease

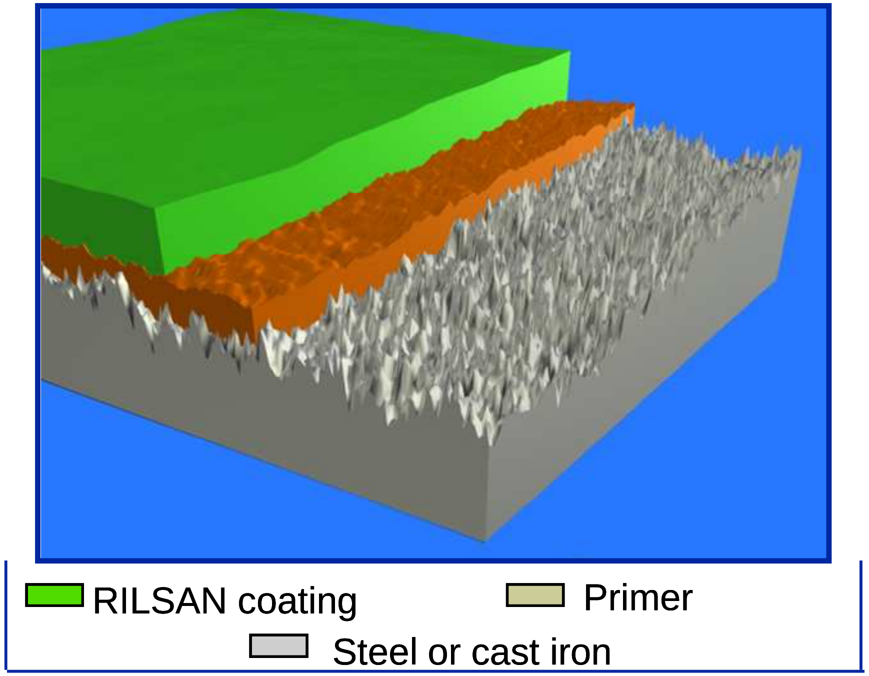
Grit Blasting
With angular G40 SAE steel grit or cast iron

- Level of cleaness according to ISO 8501-1 : SA 2.5- 3
- Roughness according to ISO 4287-1
  Rz : 35 µm to 45 µm

Rilsan® Coating system

Layer 1: primer cure film thickness 5 to 8 µm

Layer 2 : Rilsan® coating thickness optimal 200 µm ± 50 µm
Minimal 100 µm



PRE-HEATING CONDITIONS FOR THE FLUIDISED BED PROCESS

The following graphs give some guidelines, but it should be understood that many factors inside the oven will affect this recommendation, and the ideal preheating conditions will be unique to a particular coating plant.

The most important factors in determining oven residence time are correct cure of the primer as indicated by the primer cure colour guide combined with the final adhesion properties of the coating.

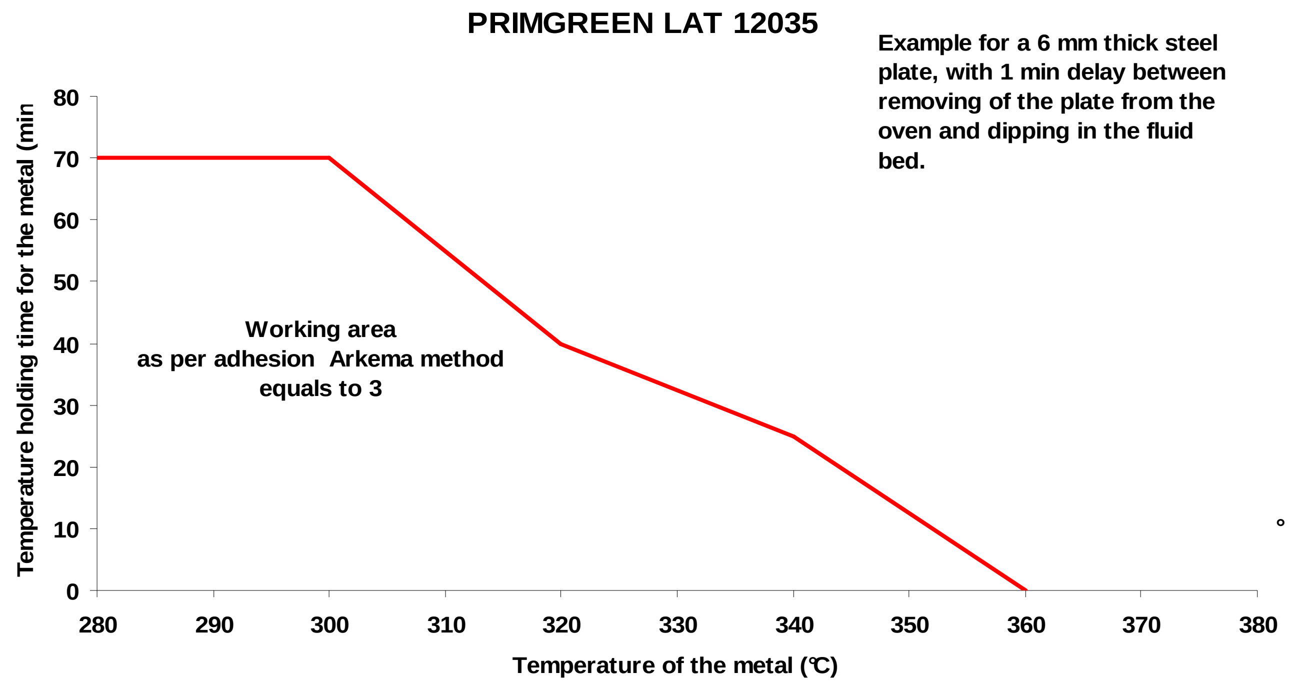
Fluidised Bed Primer Cure Colour Guide

Under Cured

Good

Over Cured

PRIMGREEN® LAT 12035
Example of preheating chart for accessories or thick wall tubing



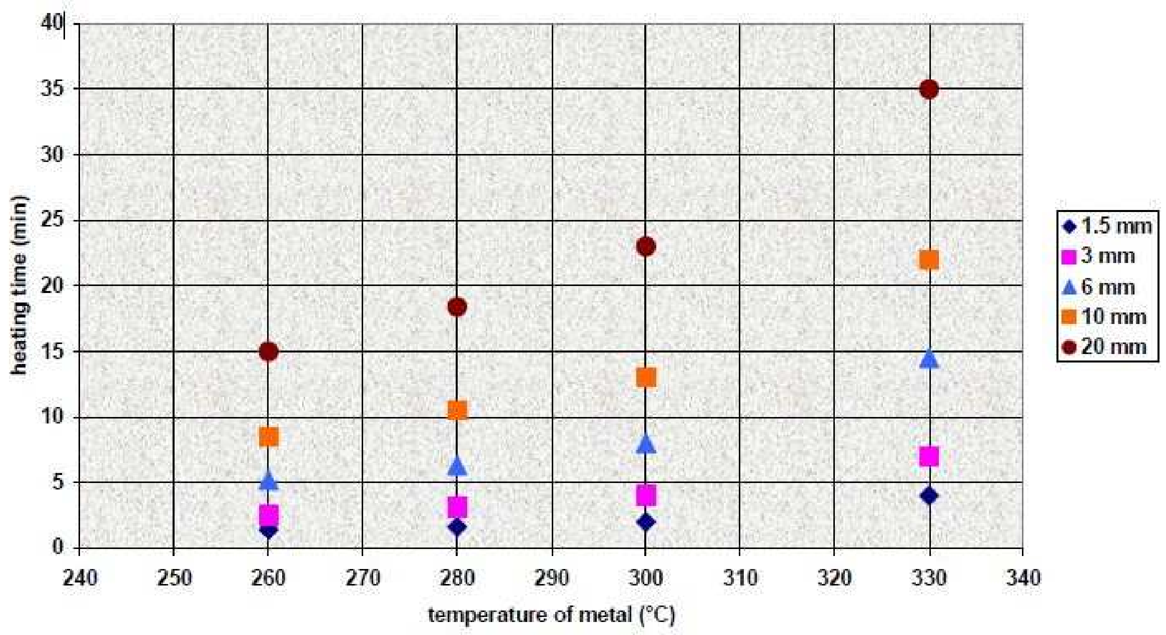
The above graph can be used as a guide to determine the correct temperature holding time for a 6 mm thick metal, primed using Primgreen® LAT 12035. As a function of the metal temperature at saturation (X axis), the red line defines the maximum temperature holding time for the primed metal (Y axis), i.e. the maximum time the primed metal should spend at the saturation temperature. Below the red curve, the adhesion of the coating system is optimum. Above this curve, degradation of the primer occurs leading to a drop of adhesion.

Heating Time / temperature of metal depending of the wall thickness

Primer optimum curing time and temperature are first determined on the thickest walls of a part to be coated, using the primer color guide. Let us consider an example for a part made of two different wall thicknesses : a 6 mm thick wall and a 20 mm thick wall, and let us take an air convection heated oven at a temperature of 330°C. The graph below shows an example of the temperature increase of mild steel (metallic plates in this case) as a function of time for different metal thicknesses. The temperature increase will depend on the oven characteristics, the air flow, the part shape and the type of metallic substrate to be coated (mild steel, aluminium, etc.).

Let us assume that the primer on the 20 mm thick wall is well cured for an heating time of 20 minutes. This will correspond to a metal temperature of about 290°C (see on the graph below). This metal temperature is also a well suited temperature to get a good quality Rilsan® coating using the dip coating technology. Indeed, for thick metal walls, there is no need to reach the saturation temperature in order to get a good quality Rilsan® coating, because the huge amount of heat accumulated in the metal will help melting the powder particles. On the same graph, one can see that the 6 mm thick wall of the part to be coated will have reached the oven temperature of 330°C after about 14 minutes of heating. This means that the primed 6 mm thick wall will have spent 6 minutes (20 minutes–14 minutes) at 330°C. Referring to the graph above, one can see that this saturation temperature holding time at 330°C should yield an optimum adhesion of the coating on the 6 mm thick wall. On a real part, the graph below will be slightly different because of the heat conduction between thin and thick walls. So, this example has to be considered as a theoretical case aimed at showing how to determine the proper application conditions. For each type of part to be coated, the applicator has to check whether the application parameters that he has defined are leading to an optimum adhesion of the coating system.

Heating Time / temperature of metal depending of the wall thickness



Post fusing conditions for the electrostatic spraying process