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FSPE Flame Spray Application Guide

Contents:

Please refer to the following documents prior to consulting this guide:

FSPE Technical Data Sheet

FSPE Material Safety Data Sheet

Produced in co-operation with IBIX

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FSPE - Flame Spray Technique

These guidelines were produced using IBIX Flame Spray Equipment.
Individual gun settings may vary.
Machine settings will differ with other equipment.

Flame Spray Equipment

Please follow the manufacturer's instructions for the flame spray equipment.
It is advised to follow the recommended settings for pressures and ensure that the correct powder volume is set for the surface area to be coated. For example, the recommended settings for powder volume are:

- *For a **0.5m²** surface area approximate setting of 3.3 - 3.6 on powder feed.*
- *For a **1.0m²** Surface area approximate setting of 3.7 – 4.0 on powder feed.*
- *For larger joint surfaces and items such as pipe bends and buckle arrestors settings of 4.0 – 5.0 can be used.*

NOTE: The above settings are for the large gun with a wide spray pattern; for small to medium guns it is recommended to start at the low end of this range, adjusting the feed accordingly, as required.

Heating the pipe

Preheat the substrate preferably using a suitable heat source to ensure that the metal is fully saturated with heat and not just the surface. The preheat temperature will be dependent on the FSPE used and the wall thickness of the pipe being coated. ***Please refer to manufacturer guidelines / data sheet for application temperatures.***

NOTE: The latent heat from a thick wall pipe may cure the epoxy, whereas thin wall pipe may not have enough latent heat to ensure correct curing of the epoxy. This should be verified with the epoxy supplier and heat source supplier.

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Application of the FSPE top coat

NOTE**: **Before lighting the flame to spray the top coat, any residual powder in the gun must be cleared using the flame spray equipment airline. Residual powder in the gun can melt and cause 'spitting' of molten polymer during the application process.

Once the flame has been lit, gradually open the air flow to "full" ensuring that the flame is not extinguished by an incorrect air to gas ratio. The flame should be strong and short; this ensures maximum heating capacity without the need for the powder to stay within the flame for an extended period of time and possibly degrade.

*Before spraying onto the pipe; apply the powder onto a test panel to ensure the material does not burn as it passes through the flame. If the material burns, the flame colour will change to orange/yellow, lower the gas level accordingly to ensure the material is only being melted and the **flame is similar to that depicted in the appendix**; Taking care not to extinguish the flame.*

*When spraying, **an adequate distance should be kept between the tip of the flame and the surface of the applied coating** (5 - 20cm), to safeguard against overheating or burning the material. Ideally the powder will travel out of the flame for a short period of time before landing on the item being coated.*

NOTE: The length of time the flame is in contact with the powder should be minimal.

Method

- *On a pipe laid horizontally it is best to apply thin layers in a quick horizontal sweeping manner. Moving from top to bottom of the pipe to obtain a thin even coating over the entire section. **The direction of powder application must be perpendicular to the pipe section to prevent irregular build-up of material. Only go in one direction (top to bottom OR bottom to top), going back on top of fresh material without allowing it to flow can lead to the formation of voids.***
- *Once the first layer has been applied and the powder has flowed out, creating a 'wet' look on the surface, the second layer can be applied in the same manner. **Building quick, thin layers to create a homogeneous coating is preferable to slow thick layers.***
- *Continue to spray the length of the coating section in a sweeping horizontal manner. **It is essential to only apply thin layers, ensuring a 'wet' glossy look before applying more material**, to eliminate the possibility of air entrapment leading to porosity in the coating and impaired physical properties. This application process can be continued to the desired thickness.*
- *Once the desired thickness of material has been built up on the item being coated, it is best to gently heat the surface to assist the coating to fully flow out into a smooth finish.*

NOTE: The coating should be kept between 200-220°C during application. As coating thickness increases, the temperature of the coating will move towards the lower end of the range. To prevent sagging or uneven coating build; ensure temperature is kept >200°C to allow flow out each layer prior to applying a subsequent layer.

Quenching

For ideal product properties it is strongly recommended to quench the applied coating within the coating surface temperature range of 160°C to 140°C and then allow the temperature to cool down to 60°C. Before quenching ensure the FSPE surface has been allowed to flow out into a smooth uniform coating.

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IBIX Recommended Machine Settings- *Spartacus™ & Centurion™*

PARAMETER	TYPE OF GUN	RECOMMENDED SETTING
AIR PRESSURE ON THE MAIN AIR SUPPLY INLET		
	Large Medium & Small	6 - 7 BAR 4 BAR *The air regulator on the gun (regulating the air volume for the air-gas mix) should be set fully open.*
AIR PRESSURE FOR THE POWDER		
	ALL GUNS	2 - 3 BAR *During spraying pressure may drop to 1 bar.* *If this pressure is set too high, the powder flow may be inconsistent.*
LPG GAS PRESSURE		
	ALL GUNS	3 bar LPG pressure. *Ensure that a pressure gauge is provided on the gas bottle.* *Ensure LPG is of good quality.*

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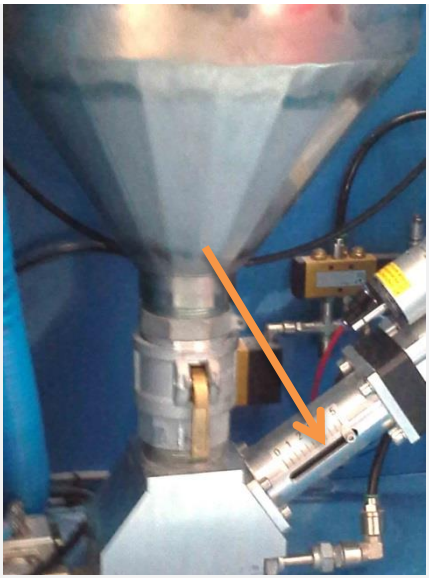
AIR VOLUME FOR THE FLAME ***(regulated on the gun itself)***		
	Large Medium & Small	Fully open *Main air supply pressure set to <u>6-7 bars</u>* Fully open *Main air supply pressure set to <u>4 bars</u>* *If, with Medium and Small Guns, the air pressure on the main regulator is kept at 6-7 bars, the sprayer will need to find the most appropriate air volume on the gun. If he opens the air valve completely, the air volume may be too high and cause the flame to die.*
POWDER VOLUME		
	*N.B. With new **Centurion** guns, the powder flow can be higher, thanks to the wider spray pattern, the high powder volume will be spread on a larger area*	According to the surface area to coat. • For a **0.5m²** surface area approximate setting <u>3.3 - 3.6</u> • For a **1.0m²** Surface area approximate setting <u>3.7 – 4.0</u> • For larger joint surfaces and items such as pipe bends and buckle arrestors settings of <u>4.0 – 5.0</u> can be used.

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FSPE Flame Spray Troubleshooting Guide

Indication	Cause	Solution
Water marks	During quenching uneven water flow or sprinklers cause the coating to set/contract unevenly, leaving marks.	Ensure water flow is sufficient to evenly cover the coated surface. This effect can be reduced by smoothing the surface of the coating during quenching.
Sagging †	Overheating the coating is the standard cause; heating the material too high above its melting point will cause the material to become fluid, being pulled around the joint by gravity. Applying the material in uneven bands, or at inconsistent thicknesses around the joint, can also result in sagging.	If the sagging is not excessive it can be restored during quenching by smoothing the surface of the coating; the material will contract to form a smooth coating. Sagging can also be restored by cutting away excess material, smoothing the surface, and layering material as per the coating procedure. When re-heating, the surface should be heated to a minimum of 160°C to ensure homogeneity of layers.

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Burnt Coating †	FSPE is a very stable coating material, however as with all plastics, overheating can cause degradation. Yellowing of the coating indicates degradation. The usual cause is overexposure to the flame due to proximity. However, degradation can also occur when a very thin coating is applied (<1mm) during a 3LPE application: heat required to cure FBE can result in overheating when applying a thin coating to large pipes, which have a greater latent heat.	Ensure a short clean flame (*See appendix A*). **Remove degraded material (see *'Delamination'*).** Increase the distance between the tip of the flame and the pipe; best practice indicates a constant distance in the range of 5-20cm. Ensure that the flame spray gun continuously moves during application of the powder. Do not allow the flame to be focused on one area for a prolonged period.
Porosity †	Gases & moisture released during melting of the powder get trapped in the material, leading to the development of voids. Applying too much material at once, or not leaving time to allow previous layer to begin to melt, will cause gas & moisture to become trapped.	Ensure *FSPE Flame Spray Technique* application guide is followed correctly. Allow time for material to begin to melt, releasing gas & moisture. When material begins to look glossy, begin applying next layer.
Material Spitting	Lumps of molten material 'spit' from the flame spray equipment, landing in the freshly applied coating. This is caused by the gun head becoming hot and some particles of FSPE melting to the inside. Eventually as they build up, these lumps will be forced out of the gun by air or passing material.	Clean the feed hole of the gun with the airline provided, or other equipment. Humidity can cause particles to lump together, making it easier to lump in the gun. Dry the material in cases of high humidity.

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Inter coat Delamination †	If proper care is not taken during application of the material, the coating can degrade (see *'burnt coating'*). New material applied on top of this degradation will not fuse with the previous layer, resulting in layers of delaminated material, preventing the formation of a single homogeneous coating.	Follow the guidelines above for '*Burnt Coating'* to avoid degradation. Remove degraded material by abrasion until only clean material remains, and smooth to prevent uneven thickness. Reheat and build coating to required thickness as per application guide, ensuring surface temperature is >160°C prior to applying new material. Provided reheating & application is performed correctly, a homogeneous film will be created.
No adhesion to epoxy layer (3LPP) †	Lack of adhesion between the top coat FSPE layers is usually the result of poor tie layer application.	

† Any of these issues can result in impaired physical performance of the coating and failure to adequately protect the substrate.

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Appendix A – Depiction of Ideal Flames

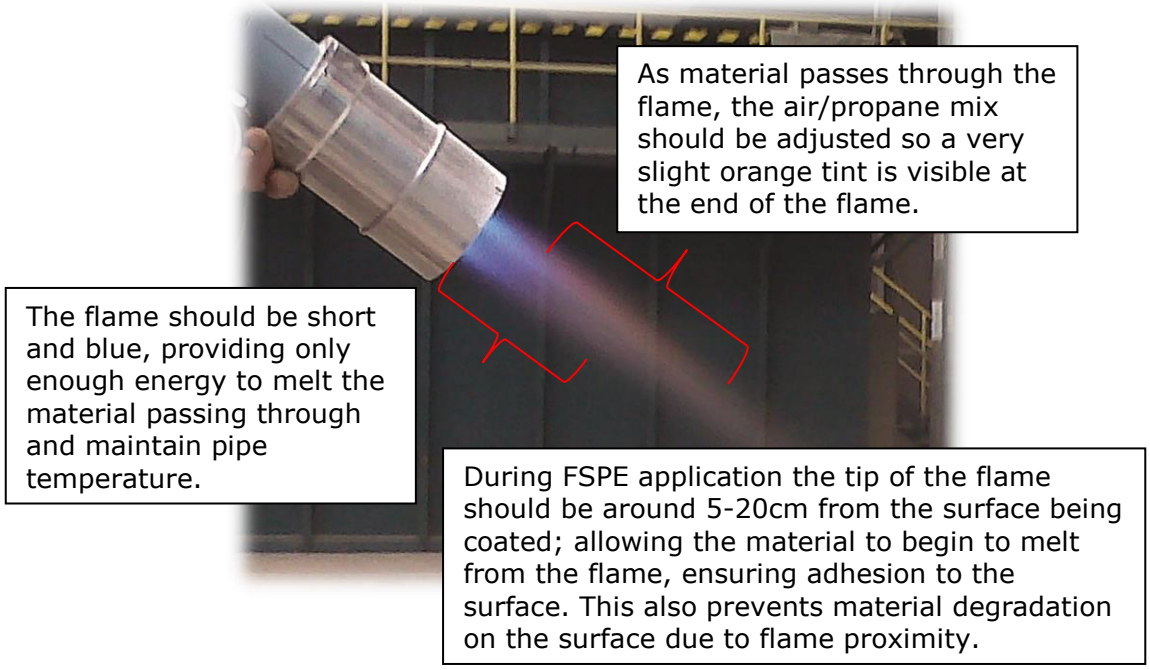

Figure 1: Depicting the ideal flame during application using the **Spartacus**™ Ibix equipment.

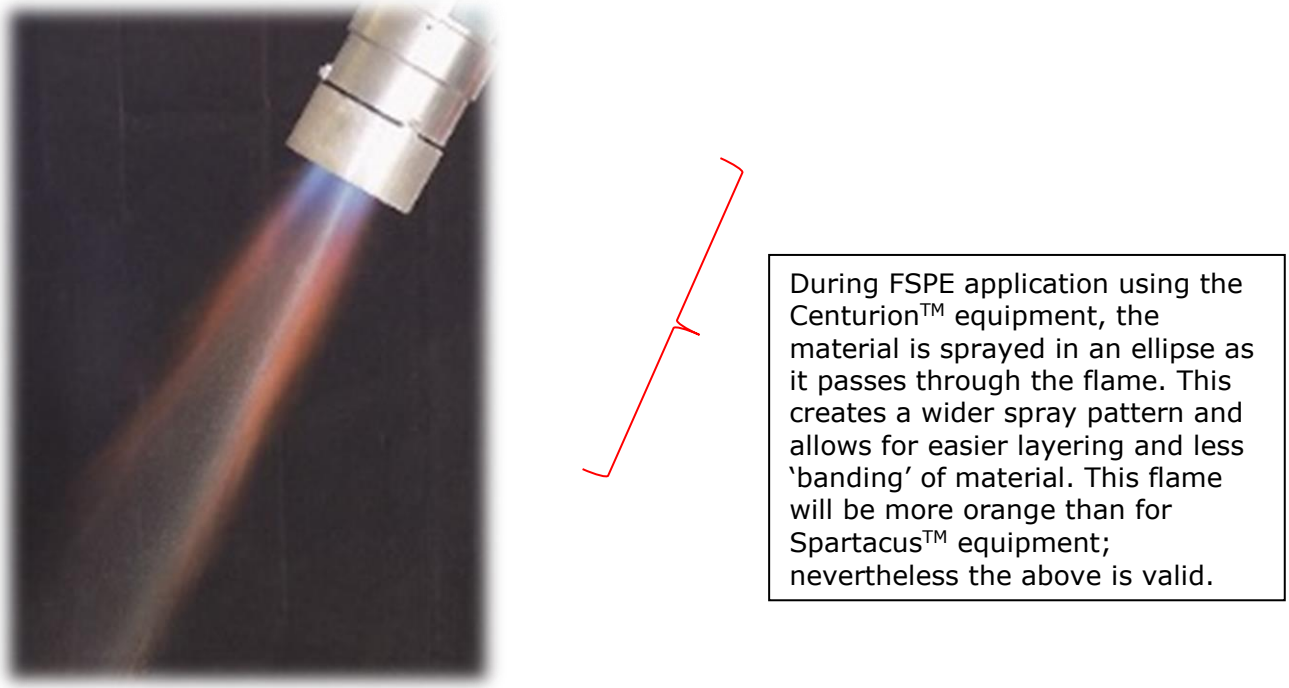

Figure 2: Depicting the ideal flame during application using the **Centurion**™ IBIX equipment.