Metallisation
Thermal spray equipment and consumables

MANUFACTURE OF SPRAYED METAL MOULDS

Application Data Sheet PM-ST-001

INTRODUCTION

The Metallisation Metal Spraying Process is in increasing use today for the manufacture of low cost moulds and tools for the plastics foundry and other industries. In this process, metal in the form of a molten spray, is deposited on to a suitable pattern; the spray solidifies immediately on the surface to produce a dense deposit which may be backed with resin, metal or concrete to form a tool. Sprayed metal moulds can be made in an extremely short time compared to conventional tooling methods. Costs may be considerably lower than conventional methods.

EQUIPMENT

Metallisation 340 or 140E Arcspray or Mark 73 Flamespray System

APPLICATIONS

For low pressure mouldings sprayed metal moulds can be used with every confidence as a production tool. In high pressure moulding such as injection moulding, the tool life may be only 50-100 mouldings (under favourable conditions 2500 mouldings have been produced from one tool and it has remained in a usable condition) but this is usually for prototype work. In the foundry industry, sprayed tooling gives lives greater than resin patterns and eliminates the problems of sand adhering to the pattern as a result of static build-up.

The metal spraying process is used for mouldings in: Expanded Polyurethane, Polyurethane GRP (DMC and SMC), GF Nylon Polycarbonates, RIM, Acetal etc., on a prototype basis. Components ranging from vehicle seats, body panels, steering wheels, bumpers, spoilers, light clusters etc., to jet engine intake nacelles, have all been produced from sprayed metal shells.

TOOL MANUFACTURE

PATTERNS

Patterns may be of almost any material. Wood and metal are often employed as are plastics, certain waxes, textiles etc. Existing components may be used. Textured surfaces will be reproduced on the sprayed tool surface. Care should be taken to minimise the incidence of deep, narrow holes and slots as these may be difficult to spray. Draw angles should be as generous as possible although, depending on shape and size, as little as half a degree may be acceptable. Wooden patterns should be varnished / sealed before spraying.

PREPARATION

The pattern should be mounted on a flat plate prior to spraying. Where an existing component is used as a pattern, the split line must be carefully chosen and a framework built along the split line on the outside of the part. Gaps between the pattern and the mounting plate must be completely filled with wax, plasticine etc. If this is not done, it may be impossible to extract the pattern after spraying.

The surface of the pattern must be clean, dry and free from debris. A thin film of cleaning agent is particularly desirable if the sprayed tool is to be '"shocked" out. A film of Metallisation Release Agent 21115 is applied evenly to the surface with an air operated spray gun; several coats of 'Crystic' must be necessary to obtain the necessary uniform surface sheen. On highly polished surfaces, application of crystic may not be handled or contaminated after preparation; even finger prints may be reproduced in the moulded surface.

MATERIALS

Moulds have been made in many materials, including tin-zinc, zinc, zinc alloys, brass, copper and aluminium. It may be possible to use other materials or combinations of materials in certain circumstances. Most commercial applications have centred around zinc or zinc alloy faced moulds offering a high degree of surface definition, insignificant shrink and in the case of tin-zinc, a virtually mirror finish, these materials providing excellent spraying characteristics.

SPRAYING

Using either arc or flame spraying equipment (Arcspray 340, 140 or Mark 73), it is normal to apply an initial deposit of zinc alloy to give high surface definition. This is normally done at a relatively low pistol throughput directing the spray stream first at corner radii and the bottoms of any slots, pockets etc. and then at the remainder of the surface. Rapid movement of the pistol relative to the pattern and air jet cooling are recommended. The above measures ensure that the initial coating is applied as evenly as possible and that excessive heat input (which could distort the pattern) is avoided. Surface temperatures should not exceed 35°C, hence particular care must be taken when utilising flamespraying equipment.

Depending on size and geometry, when the deposit thickness has reached 750μm, (0.030”) the deposition rate may be increased and the spraying range (when arc spraying) reduced until the required thickness is reached, typically this will be 3mm (1/8”) maximum.

The final 250μm (0.010”) may be sprayed with a coarse deposit of aluminium to aid the bonding of any backing material.

Table 1

		INITIAL DEPOSIT	BUILD-UP	FINAL DEPOSIT
ARC	Equipment	Arcspray 340/140E	Arcspray 340/140E	Arcspray 340/140E
	Spray Head	CG20F	CG20F	CG20F
	Material	Zinc Alloy or Zinc	Zinc or Zinc Alloy	Aluminium
	Wire Size	1.6mm	1.6mm	1.6mm
	Current	50-100A	150-200A	100A
	Voltage	18-22V	18-22V	28-31V
	Air Pressure	5.4 bar (80 psi)	4.5 bar (70 psi)	4 bar (60 psi)
	Spraying Range	30 cm (12 in)	23 cm (9 in)	23 cm (9 in)

Table 2

		INITIAL DEPOSIT	BUILD-UP	FINAL DEPOSIT
FLAME	Equipment	Mark 73	Mark 73	Mark 73
	Nozzle Type	Fine Spray	Fine Spray	Fine Spray
	Fuel Gas	Propane	Propane	Propane
	Material	Zinc Alloy or Zinc	Zinc Alloy or Zinc	Aluminium
	Wire Size	2.0mm	2.0mm	2.0mm
	Propane Pressure	1.4 bar (20 psi)	1.4 bar (20 psi)	20 psi (1.4 bar)
	Oxygen Pressure	2.0 bar (28 psi)	2.0 bar (28 psi)	2.0 bar (28 psi)
	Air Pressure	3.7 bar (55 psi)	3.7 bar (55 psi)	3.7 bar (55 psi)
	Spraying Range	30 cm (12 in)	30 cm (12 in)	30 cm (12 in)
	Wire Speed	Normal	Normal	Increased

INCORPORATION OF TEMPERATURE CONTROL TUBES

Where necessary, Temperature Control Tubes may be built into the mould at any time after the initial deposit has been applied. The tubes should be prepared by de-greasing, abrasive blasting and spraying with zinc before placing them in position.

BACKING

To provide additional strength and rigidity, it is normal to support the sprayed tool in a bolster and back with a suitable material.

Selection of the backing material should be made carefully; the choice will depend on strength required, its ability to retain or dissipate heat and its ability to match the thermal expansion of the sprayed face. Materials used include epoxy resins (filled and unfilled), metal and concrete.

If desired, temperature control tubes can be included in the backing.

RELEASE

After backing, the mould may be soaked in hot water for several hours. Most shapes with a simple geometry can be removed by inserting wedges on the land area between the pattern and the sprayed metal. Highly complex shapes should have suitable pressure points built into the pattern in order that some means is available for applying the force necessary to separate the component.

"Shocking" out the sprayed tool is also commonly used as an alternative to soaking. If this technique is to be employed, additional care of the initial pattern preparation will be required.

SEALING

Sometimes, the inherent porosity is advantageous since it facilitates vacuum forming and allows the release of gases which may be evolved during curing of the moulding. However, where porosity is detrimental, the face of the tool may be sealed with Metallisation Sprayseal M or Mould Seal. This sealant must be allowed to cure fully before the tool is used since, if uncured, it may react with the moulding resin. Sprayseal M should not be exposed to temperatures greater than 150°C. Any backing materials should be fully cured prior to sealing with Sprayseal M since the solvents contained may react with uncured resins.

- REFERENCE TECHNICAL BULLETIN N°S :-

2.2.2 Metallisation 02E Zinc

2.3.14 Metallisation 21E Zinc/Aluminium Alloy

2.3.15 Metallisation 24E Zinc Alloy

2.3.2 Metallisation 07E 70/30 Tin Zinc

2.2.1 Metallisation 01E Aluminium

2.2.3 Metallisation 05E Copper

2.3.2 Metallisation 13E 70/30 Brass

2.3.8 Metallisation 15E Phosphor Bronze