

Arcspraying of continuously extruded, multi-void aluminium tubing

Application Data Sheet AU-AC-001

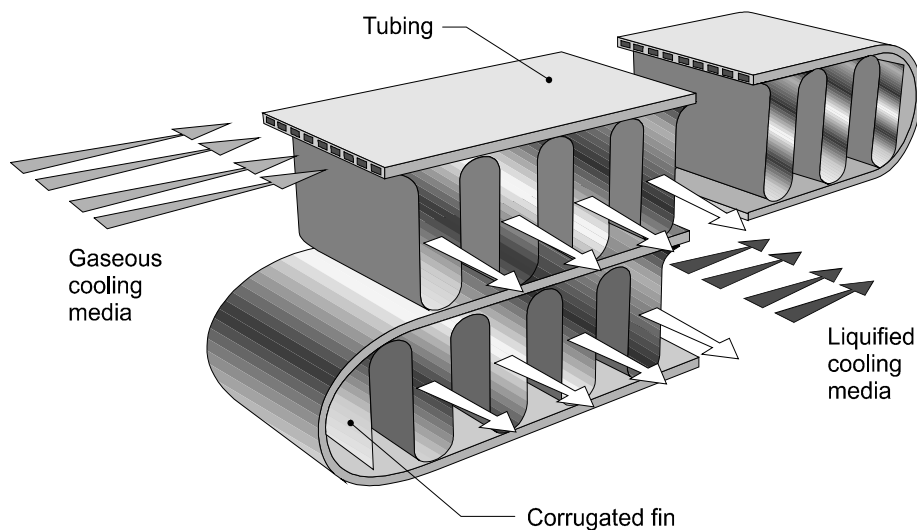


Fig 1. Structure of Serpentine-type Condenser

Introduction

Corrosion of heat exchangers for automotive air conditioning units can be a major problem. The unit is often located near the front grille of the vehicle and hence is exposed to a severely corrosive environment, with road salts, rain and high temperatures all contributing to high corrosion rates.

In order to reduce the rate of corrosion, historically several methods have been tried: zinc diffusion by flux brazing, sacrificial anodes of zinc, tin, or indium; chromating and painting. Due to inherent production difficulties, poor corrosion resistance, pollution, restriction in plating and high costs, none of these treatments provide an optimum solution.

Arcsprayed zinc offers equal or higher corrosion resistance, lower production costs and reduced pollution than other competing processes.

Manufacturing methods

Multi-void aluminium tubing is used in the production of serpentine-type condensers, widely used in air conditioning systems. The voids in the tubing provide a route for the cooling medium gas/liquid to extract heat from the incoming air. The joining/coating of the tubing and the corrugated fins is generally carried out by flux brazing or zincate nocolok brazing processes. In either case, problems are inevitable, e.g. damage to furnace and jigs by the flux used or increased costs through waste treatment processes.

Advantages of zinc sprayed tubing

- ✦ Highly corrosive flux is not required
- ✦ Zincate treatment and waste treatment not required
- ✦ Zinc is deposited at a pre-selected rate, which can be increased or decreased as required
- ✦ A zinc diffusion pattern equally uniform to zincate process is produced
- ✦ Productivity improves
- ✦ Post braze cleaning processes can be eliminated

Comparison of zinc coating methods on extruded aluminium

	Zinc Deposition Method		
	Zincate	Electroplating	Arcspray
Summary of method	By displacement reaction in a zinc alkaline solution, zinc is deposited on the surface of the substrate.	An electric current is passed through a plating solution containing zinc, held in an electrode in contact with aluminium. The zinc is plated onto the substrate.	Atomised molten zinc is projected onto the substrate.
Qty of zinc deposited	5-20g/m ²	5-20g/m ²	5-20g/m ²
Adhesion (exfoliation when bent)	Not good	Not good	Good
Brazability (by Nocolok brazing)	Good	Good	Good
Zinc diffusion after brazing	Good	Good	Good
Corrosion resistance	Good	Good	Good
Coating cost	High	High	Low
Advantage of process	Practical experience in use (well known process)	Uniform zinc deposit, short process time	Low process cost
Disadvantage of process	Long process time, waste water treatment takes time	Control of conditions for plating is difficult	Low levels of zinc dust bi-product

Arcspray method

The zinc coating is carried out 'in-line' with the extrusion press. The plant can be installed on to either new or existing lines. The number of individual arcspray pistols required is dependent on the number of extrusions being produced by the press, two pistols being used for each tube (one per side). The pistols are located on adjustable mounts, angled to allow even coverage of both flat parallel section and side section of the extrusion. The pistols are located in a spray chamber to contain unwanted dust and this is linked to an extraction/collection system. The chamber contains carbon supports/guides to ensure accurate location of the extrusion relative to zinc spray stream.

Spray equipment used

Pistol	Metallisation arcspray528E, electrically driven pistol and supplies package to feed power and air to the pistol. Length of supplies package varies relative to the installation.
Power source	Metallisation S250 energiser, rated at 250 amps maximum at 100% duty cycle. Typical spray rates for this application vary from 20-100A.
Controller	Metallisation 1600I controller, typically externally mounted for ease of integration into the extrusion line control system. Can be integrated into the energiser.

Material

1.6mm diameter, Metallisation 02E, 99.99% minimum purity zinc wire, typically supplied in 250kg drums. Wire can be supplied with leading and trailing ends available to enable joining of wire from one drum to the next, allowing continuous production.

References

SAE Technical Paper: Development of Pitting Corrosion Resistant Condenser with Zinc-Arc-Spray Extruded Multi-Cavity Tubing. Kazunori Ishikawa, Hiroshi Kawase & Hitoshi Koyama - Furukawa Aluminium Co, Ltd

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