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## Praxair and TAFE Arc Spray Nickel Chrome Aluminum Micromatrix-Composite Wire-73MXC®

### Material Review:

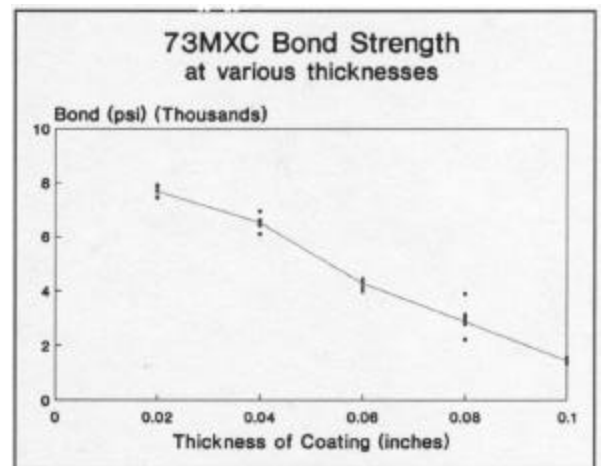
73MXC is a nickel chrome aluminum alloy (NiCrAl) designed to be self-bonding, have higher oxidation resistance and better machinability than comparable products. Specifically designed for selective removal in acid baths.

73MXC is a unique cored wire product for use in arc spray systems. It is available exclusively from Praxair and TAFE. Measured bond strengths exceed 7500 psi at 0.020" thickness. Additionally, the bond strength of 73MXC depends on thickness. At 0.060" the coating still retains in excess of 4500 psi tensile bond strength. A graph of bond strength versus thickness appears in Figure 1. 73MXC can be sprayed with any Praxair and TAFE arc spray equipment. In many instances, use of the Arc Jet® is preferred (See Bulletin 1.1.8.4).

**CAUTION:** All Praxair and TAFE wires have been optimized for arc spraying. Use of alternate wires usually cause problems such as excessive tip wear, spitting and feeding problems. We only recommend Praxair and TAFE certified wires.

### Application Review:

Arc spray coatings of 0.004" to 0.006" can be readily applied in one pass. Thicker coatings up to 0.100" have been applied by continuous spraying. 73MXC can be machined to a 32 microinches (AA) finish using Tungsten Carbide tools or ground to a smooth finish with aluminum oxide or silicon carbide wheels. The surface should be prepared by grit blasting (60 mesh aluminum oxide at 60 psig blast pressure). In all cases the surface to be sprayed must be clean and exhibit freshly exposed metal.



73MXC is specifically formulated to meet the following specifications: PWA 36947 for PWA 271-47 Rev D, Rolls Royce MSRR9507/14, and GE Manual operation number 70-49-39 as an alternate to 70-49-21. The chemistry of this material conforms to G.E. Specification B50TF 119-S10 Rev.

### Special Properties:

73MXC is specifically designed to allow for selective removal in an acid bath environment. Specifically Ni-5 Al such as Praxair and TAFE's 75B™ can be effectively removed in a 50% concentration of nitric acid at 160°F, however, the 73MXC coating will not be removed under these conditions, thereby allowing for selective coating removal during aircraft engine repair. 73MXC is unaffected by 50% nitric acid at room temperature. If complete removal is required of both 73MXC and nickel aluminum, it is possible to do so with specific blends of hot nitric, hydrochloric and phosphoric acids. These formulations are generally held proprietary by the aircraft engine manufacturers. Contact your specific manufacturer for details.

<b>Coating</b>			
Acid	73MXC	Metco 443	Ni-5 Al
50% nitric balance water room temperature	No effect	No effect	etched
50% nitric balance water 160°F	No effect	No effect	Etched
Acid Blend A balance water 160°F	No effect	No effect	Etched
Acid Blend B balance water 160°F	etched	etched	Etched

<b>Composition:</b>	
Nickel	70% minimum
Chromium	18% nominal
Aluminum	6% nominal
All Other	Less than 6%

### A quick comparison between 73MXC and Metco 443:

	73MXC	M-443
Bond strength (psi)		
a. at 0.015-0.020"	7500	4000*
b. 0.060"	4500	N/A
Hardness		
a. R <sub>B</sub>	95	85-90
b. R <sub>15N</sub>	65	
c. DPH <sub>300</sub>	240	
d. KHN		220
Surface roughness (AA)**		
a. as sprayed	300-700	300-700
b. as machined	30-40	30-40
Acid bath		
a. 50% HNO <sub>3</sub> @ RT	No effect	No effect
b. 50% HNO <sub>3</sub> @ 160°F	No effect	No effect
c. Acid Blend A @ 160°F	No effect	No effect
d. Acid Blend B @ 160°F	etched	etched
Other properties		
a. spray rate (lbs/hr/100 amps)	8.5	6-8
b. coverage (oz/sqft/0.001")	0.7	0.64
c. deposit efficiency	80%	80%

\* thickness = 0.015"

\*\* depends on air pressure

### Coating Physical Properties

Wire Size	1/16 in
Deposit Efficiency	80 percent
Melting Point	1250°F (Aluminum Component)
Bond Strength Tensile <sup>a</sup>	7500 psi blasted surface
Coating Texture (as sprayed) <sup>b</sup>	550 microinch (AA) attainable
Hardness	65 R <sub>15N</sub> (95 R <sub>B</sub> converted)
Microhardness	240 DPH
Coating Density <sup>c</sup>	6.2 gm/cc
Coating Weight	0.034 lbs/ft <sup>2</sup> /mil
Abrasion Resistance	Good
Impact, Sharp Edge and Bend Resistance	Good
Coefficient of Thermal Expansion	7 x 10 <sup>-6</sup> in/in°F
Heat Resistance	Good
Corrosion Resistance	Excellent

### Spraying

Spray Rate	8.5 lbs/hr/100 amps (4.5 kg/hr/100 amps)
Coverage (wire consumption)	0.8 oz/ft <sup>2</sup> /0.001 in (0.98 kg/m <sup>2</sup> /100 microns)
Spray Pattern (approximate 4 inch standoff)	Cross Nozzle Positioner - 1 in (2.5 cm) vertical height x 1-3/4 in (4.4 cm) width Slot Nozzle/Positioner - 2 in (5 cm) vertical height x 1 in (2.5 cm) width
Length of Wire per lb	113 ft (1/16 in)

<sup>a</sup> Values are for steel substrates according to ASTM C633-69

<sup>b</sup> 4 inch standoff, 50 psi - 8830, depends on nozzle cap, air pressure - fine with high psi, average with medium psi, and rough with low psi.

<sup>c</sup> Density depends on air pressure.

## Spraying Procedure:

Coating Type				
	Normal 8830/8835	Arc Jet 8830/8835	Arc Jet 9000	9000
Atomizing Air Pressure:Primary Secondary	50 <sup>c</sup> ---	50 <sup>c</sup> 40 <sup>c</sup>	60 <sup>c</sup> 60 <sup>c</sup>	60 <sup>c</sup> ---
Nozzle Cap	Blue	*	Green	Green
Nozzle/Positioner (Cross=C; Slot=S)	Short C	**	Long C	Long C
Arc Load Volts <sup>a</sup>	30-32	30-32	31-33	31-33
Amps <sup>b</sup>	100-200	100-200	100-200	100-200
Standoff Inches	3-5	3-5	3-5	3-5
Coating Thickness/Pass-mils	5	5	5	5
Coating Texture-microinches aa	200-350	150-250	150-250	200-350

Using excessive voltage reduces quality of coating. Voltage should be adjusted to give minimum noise and smooth arc operation. Excessive voltage causes larger particles and poor spray pattern. Too low a voltage will cause popping.

Be sure not to overheat substrate even if this means stopping to allow cooling, use air jet cooling if greater speed is required. Note that on some applications where preheating is tolerable, preheating work to 300°F can improve bond and deposit efficiency.

NOTE: Standard air caps and positioners can be used in 8830 or 9000 systems.

- \* P/N 450729 8830 Arc Jet Air Cap
- \*\* P/N 620074 Arc Jet Modified Short Cross (8830)

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- <sup>a</sup> When using power lead extensions other than the normal 12 foot furnished, the voltage must be increased by approximately 3.4 volts per 50 foot extension; i.e. add 3.4 volts to the recommended voltage setting for a given wire if the extension is increased to a 50 foot length.
  - <sup>b</sup> Can vary between 50-300 depending on size of workpiece and traverse speed.
  - <sup>c</sup> For finer finish, raise air pressure at point of finish.

## Finishing:

An exceptionally good finish can be achieved by turning:

Surface Speed	110 fpm (0.08 m/s)
Traverse Speed	0.002-0.003 inches per rev.
Depth of Cut	0.015-0.025 in (250 micron) for first few cuts then 0.001-0.005 in (125 micron) to finish

Coated tungsten carbide and ceramic tools can be used to obtain a finish of 32 AA. Grinding can also be used to obtain a good smooth finish. Dress frequently and do not permit coating to overheat. Cutting oil is not required.

High nickel alloys are difficult to finish. If a grinding wheel is used, it may tend to load up which in turn tends to smear the coating or increase pull-out. If a cutting tool is used, even a ceramic or diamond tool, pull out may be a problem on the very hardest coatings. However, it is fairly easy to generate a 20-microinch finish using the correct grinding wheel and grinding technique. A 15-microinch finish can be obtained with care. Secondary finishing is required below 10 microinches.

A typical grinding wheel specification obtained from Norton and others could be:

- Silicon carbide
- 37 C
- I hardness
- 8 porosity
- Vitrified open wheel

Typical Grinding Setup:

- Wheel rpm: Med/High
- Shaft rpm: Low
- SFPM: High with the work running opposite the wheel
- Amount removed per pass 0.0005

Use very light pressure and clean wheel.

Super finishing with either silicon carbide or diamond cloth using a mineral base (non-sulfur) 5 to 10 weight hydraulic oil or kerosene can produce finishes below 10 microinches AA. Typically, it is a good idea to start with a 240 grit paper, then progress to 320, 400 and perhaps to 600, 1200, even 4000. If diamond cloth is selected, one should use a 9 to 15 micron particle size (obtained from 3M or others).

The objective is to use the 240 cloth to completely remove the grinding marks from the 37C wheel. Then, use the 320 cloth to remove the marks from the 240 cloth. Then use the 400 --- and so on. If one switches to the finer cloths too soon, a high polish will result on the "high spots", but many of the original deep grinding marks will remain. Patience is the secret to the art.

Speeds & Feeds	Dry Grinding	Wet Grinding
Wheel Speed SFPM	6000	6000
Work Speed SFPM	60	70 rough
Wheel Traverse IPM	7 rough 2.5 finish	12
In Feed (inches)	0.001 rough 0.0005 finish	0.001 0.0005
Coolant	--	Water Sol, 1-50

## Hazards:

Observe normal spraying practices, respiratory protection and proper airflow patterns advised. For general spray practices, see AWS Publications AWS C2.1-73, "Recommended Safe Practices for Thermal Spraying" and AWS TSS-85, "Thermal Spraying, Practice, Theory and Application." Thermal spraying is a completely safe process when performed in accordance with proper safety measures. Become familiar with local safety regulations before starting spray operations. DO NOT operate your spraying equipment or use the spray material supplied before you have thoroughly read the Praxair and TAFE Instruction Manual.

A Material Safety Data Sheet will be sent with each initial purchase and updated as required.

DISREGARDING THESE INSTRUCTIONS MAY BE DANGEROUS TO YOUR HEALTH.

**The Information provided herein is believed to be accurate and reliable; however, results may vary with workpiece preparation and operator technique. Praxair and TAFE warrants only that the wires are free of defects in material and workmanship. No other warranty is expressed or implied.**



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