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**Nistelle® C POWDER**

**JK®591P for Carbon Fuels**
**JK®591H for Hydrogen Fuel**

**TECHNICAL NOTE**
Date: 2/14/05
Replaces: 12/16/03
No: C-007


## DESCRIPTION

JK®591, Nistelle® C powder, offers coatings that are characterized by their corrosion resistance to oxidizing acids such as nitric and sulfuric. Coatings of JK®591 exhibit good metal-to metal wear and abrasion resistance and are well suited for applications in the chemical industry for pumps and valve parts. Nistelle® C is similar in composition as Haynes Hastelloy® C.

**JK®591H** is sized the same as the original JK®591 powder and may best be used with hydrogen fuel parameters where the fine powder size is not likely to inhibit long spray periods.

**JK®591P** is recommended for use with carbon fuels such as propylene, propane, ethylene or methane (natural gas), especially for long spray durations. This powder is coarser than JK®591H. The powder appears to be user-friendlier than previous JK®591 without significantly affecting the coating properties. This cut of powder may be used with hydrogen as fuel; however the coatings contain slightly less oxides and a small increase in porosity and unmelted particles.

## APPROXIMATE COMPOSITION, WT %

| | |
|---|---|
| Chromium | 16.5 |
| Iron | 5.5 |
| Molybdenum | 17.0 |
| Nickel | Balance |
| Tungsten | 4.5 |

## SIZE DISTRIBUTION

JK®591H - 325 Mesh / 10 micron
JK®591P - 270 Mesh / 15 micron

## APPLICATIONS

Restoration of, or increasing the wear or corrosion resistance of: **Yankee Dryer rolls** used in paper manufacturing, **Boiler Tubes** in coal fired power generation boilers, paper mill digester boiler tubes, **Pump Components, Fan Blades**, etcetera...

## COATING CHARACTERISTICS:

| | SET A (JK®591P) | SET B* (JK®591H) | Set C (JK®591P) |
|---|---|---|---|
| Bond Strength, PSI (Per ASTM C-633) | Unknown | 6,582 Avg. | 4,960 Avg. |
| Microhardness, DPH [300g] | 355-447 | 349-491 | 357-447 |
| Macrohardness, 15N (Rc Conversion) | 77.0-82.6 (34-44) | 82.0-84.6 (43-48) | 76.6-80.6 (33-40) |
| Estimated porosity, % | <1 | <. 5 | <1 |
| Maximum Coating Thickness, Inches As-Sprayed, Flat or Irregular Surfaces | .040 | Unknown | .040 |
| Maximum Coating Thickness, Inches As-Sprayed, on Cylindrical Shapes | .090 | .187+ | .090 |
| Est. Maximum Service Temperature, °F | 1400 | 1400 | 1400 |
| Est. Deposit Efficiency, % | 55-60 | 55-60 | 60 |
| Estimated Coverage, $Lb/Ft^2/.010"$ | .6 | .6 | .67 |
| Est. Surface Finish, Microinch AA As-Sprayed | 200-300 | 120-150 | 200-300 |
| Est. Surface Finish, Microinch AA Ground And Lapped | 3-5 | <2 | <2 |
| Abrasive Wear Resistance, $MM^3$ Loss Per ASTM G65-80, Approximate | 34.3 | Unknown | Unknown |
| Machinability | Fair | Excellent | Good |
| Oxide Level | High | Moderate | Moderate |

*__Note__ :If possible preheat the part, making sure not to oxidize the substrate, and apply the coating up to 450°F. Do not let the part cool more than 150°F during the application of the coating. Let the part slow cool, in air when coating build-up is complete.

*The above data in no way constitutes a specification. Parameters and other technical information in this document are for guidance only. Stellite Coatings may make changes as additional data becomes available.*

## CORROSION DATA

The corrosion resistance of JK®591P applied by parameter set A is rated as shown for the following environments. These results are based on laboratory tests of the coating. Because of porosity in the coating, even though less than 1% is possible, and due to other variables in the operating environment, field-testing the coating is considered as the best method of evaluation of the coating.

| MEDIA | CONCENTRATION VOL.% | °F | RESULTS |
|---|---|---|---|
| Formic Acid | 30 | 150 | Excellent |
| Acetic Acid | 30 | Boiling | Excellent |
| Sulfuric Acid | 5 | 150 | Excellent |
| Nitric Acid | 65 | 150 | Satisfactory |

## FINISHING

### GRINDING

This is the preferred method of finishing JK®591 coatings, especially when applied by SET A and C parameters.

Wheel Type: 60-220 SiC Vitrified wheel of H to L hardness
Cross Feed Per Pass: .035-.075
Part Surface Speed: 40-65 Feet Per Minute
In Feed Per Pass: .0005" - .001"

### MACHINING : TURNING, MILLING OR DRILLING OF JK®591H, SET B COATINGS

The use of tungsten carbide tools is recommended since JK®591H coatings work-harden and can rapidly dull the tool. Dull tools increase the work-hardening effect and may damage the coating. Lubricating the coating and tool during machining is recommended. If the coating begins to machine hard, sharpen the tool, lower the surface speed of the part or tool and decrease the size of cut being made. Unlike most thermal spray coating when machined, JK®591H usually produces shavings similar to wrought alloys.

### POLISHING AND LAPPING

SiC or diamond media is recommended. Do not lap coatings dry. Use a lubricant as recommended for the particular media used in each step. Remove debris, wash and dry the coating surface prior to proceeding to the next grit size. Avoid contamination of the lapping surfaces by cleaning them prior to application of fresh media.

Recommended grit size progression after grinding or machining:

320, 400, and then 600 - U.S. Screen Sizes

Super-finishing to a mirror finish can be accomplished with SiC or diamond paste or slurry. Diamond media may produce the best results by using the following grain size progression:

15 or 9 micron and then 6 or 3 micron

### SAFETY

*In addition to compliance to the bottle label warning of the hazards dust and fumes may cause, the use of shaded glasses during the spraying of this powder reduces the brightness and glare produced, and is recommended.*

**PARAMETER NOTES (See Pages 5-7):**

1. Pressures shown are running pressures with powder feeding.
2. Manifold pressures for JK®II system are critical, manifold regulators must be located at factory supplied hose ends.
3. Manifold pressure too low will not allow enough flow. If it is too high the controller will pulse upon start up.
4. JK®II system does not correct flow due to change in gas temperature or pressures at the meters, JK®IIA system compensates and flow is displayed as true Standard Cubic Feet per Hour (SCFH):

   $T = 0\ ^{\circ}C \qquad P = 14.7\ PSIA$

5. A heat exchanger to control the water inlet temperature to the gun is recommended. Adjust water flow to achieve outlet temperature. Water temperatures may affect coating quality and torch performance.
6. Powder feed rate must be checked with powder flowing through lit gun.

   Powder Feed Rate (PFR) = (Powder Weight (g) Initial-Powder Weight Final (g)/ Powder Feed Time (min.)

   Powder feed time must be greater than 1 min. PFR is linear to RPM of the feeder. To achieve required PFR, change RPM as follows:

   RPM (NEW) = (PFR (Required) X RPM (Original))/ PFR (Calculated)

7. JK®II flowmeter requires change for specific gas use:

   $H_2$ - Part #972915 $C_3H_6$ - Part #972763

8. Maximum console inlet gases pressure is 150 PSI.
9. Console pressures shown are for JK®IIA, JK®III pressures are anticipated to be similar but not proven.
10. Confirm with Stellite Coatings Engineering group if your JKIIA is capable of running methane gas via your unit $H_2$ mass-flowmeter, if so then this value may be used to initial establish operating conditions.
11. Ignition of JK®IIA with methane or natural gas as pilot and main fuel requires ramping the manifold pressure manually from approximately 95 psig to 140 psig during cycle start. If procedure is improperly done the flame may not light and/or the gas could explode violently. To extinguish the flame, the reverse procedure must be used.
12. Pressures are shown are for reference. Due to different differential pressures caused by different torch, torch hose bundles and console, conditions shown are significantly broader than reproduced runs with one system. Reproduced ranges on a single Jet Kote® system is typically less than 5 psig variation. JK®IIA and JK®III systems are usually reproduced less than 3 psig variations.

## SET A OPERATING PARAMETERS [1]

| | | | |
|---|---|---|---|
| Fuel Gas | Propylene ($C_3H_6$) | | |
| Powder Carrier Type | Nitrogen ($N_2$) | | |
| Nozzle | 5/16 x 6 | | |
| Injector | #50 | | |
| Console Type | **JK®II** | **JK®II NOVA-A** | **JK®IIA /JK®III** |
| Manifold Pressures, PSI | (2) (7) | (8) (12) | (3) (9) |
| Oxygen | 120 | 120 | 90-95 |
| Main Fuel Gas | 80 | 80 | 80 |
| Carrier Gas | 85 | 80 | 85 |
| Hydrogen (Pilot) | 25 | | 90 |
| Console Pressures, PSI [12] | | | |
| Oxygen | 79-85 | | 74-78/68-72 |
| Main Fuel | 62-65 | | 57-64/54-61 |
| Carrier | 46-52 | 46-52 | 46-52 |
| Console Flows [4] | | | |
| Oxygen | 1070-1080 | 1080-1100 | 1080-1100 |
| Main Fuel | 50-52% | 110-115 Estimated | 110-115 |
| Carrier | 35-40 | 88-90 | 88-90 |
| JK®IIA Console Settings | | | |
| Oxygen | | | 60.0-61.1 |
| Main Fuel | | | 36.6-38.3 |
| Carrier | | | 88.1-90.1 |
| Cooling Water [5] | | | |
| °F IN | 80-90 | 80-90 | 80-90 |
| °F OUT | 110-120 | 110-120 | 110-120 |
| Flow, GPM | 8-9 | 8-9 | 8-9 |
| Powder feed Settings | | | |
| RPM (Approximate) | 3.5-4.1 | 3.5-4.1 | 3.5-4.1 |
| Feed Rate [6], grams/Min. | 60-69 | 60-69 | 60-69 |
| Spray Distance, Inches | 9-10 | 9-10 | 9-10 |

| | |
|---|---|
| Thickness Per Pass, Inches | .001 maximum |
| Torch to Part speed, Ft/Min. | 200-300 |
| Torch Move Per Pass, Inch/Rev. | .100 |

Preheat Recommended, If Possible

Cooling **AVOID EXTREME COATING TEMPERATURE VARIATIONS!**

- IF USED DIRECTLY ON COATING AREA, STOP WHEN FLAME IS OFF COATING AREA
- AIR COOLING OF UN-COATED AREA PERMITTED

Maximum Part Temperature During Application of Coating is 400°F.

Notations above (1-12) please see page 4 for details.

## SET B OPERATING PARAMETERS [1]

| | | | |
|---|---|---|---|
| Fuel Gas | Hydrogen ($H_2$) | | |
| Powder Carrier Type | Nitrogen ($N_2$) | | |
| Nozzle | ¼ x 9 | | |
| Injector | #40 | | |
| Console Type | **JK®II** | **JK®II NOVA-A** | **JK®IIA /JK®III** |
| Manifold Pressures, PSI | (2) (7) | (8) | (3) (9) |
| Oxygen | 120 | 120 | 90 |
| Main Fuel Gas | 120 | 120 | 90 |
| Carrier Gas | 85 | 80 | 85 |
| Hydrogen (Pilot) | 25 | | |
| Console Pressures, PSI [12] | | | |
| Oxygen | 52-55 | | 54-61/51-58 |
| Main Fuel | 70-75 | | 74-80/70-76 |
| Carrier | 45-52 | 45-52 | 45-52 |
| Console Flows [4] | | | |
| Oxygen | 450 | 450 | 450 |
| Main Fuel | 1200 | 1220 | 1220 |
| Carrier | 30-35 | 77 | 77 |
| JK®IIA Console Settings | | | |
| Oxygen | | | 25.0 |
| Main Fuel | | | 65.6-67.8 |
| Carrier | | | 65.1-78.1 |
| Cooling Water [5] | | | |
| °F IN | 80-90 | 80-90 | 80-90 |
| °F OUT | 115-120 | 115-120 | 115-120 |
| Flow, GPM | 12-13 | 12-13 | 12-13 |
| Powder feed Settings | | | |
| RPM (Approximate) | 1.5 | 1.5 | 1.5 |
| Feed Rate [6], grams/Min. | 30-35 | 30-35 | 30-35 |
| Spray Distance, Inches | 7-8 | 7-8 | 7-8 |

| | |
|---|---|
| Thickness Per Pass, Inches | .001 maximum |
| Torch to Part speed, Ft/Min. | 200-300 |
| Torch Move Per Pass, Inch/Rev. | .100 |

Preheat Recommended, If Possible

Cooling **AVOID EXTREME COATING TEMPERATURE VARIATIONS!**

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## SET C OPERATING PARAMETERS [1]

| | | |
|---|---|---|
| Fuel Gas | Methane ($CH_4$) | |
| Powder Carrier Type | Nitrogen | |
| Nozzle | 5/16 x 6 | |
| Injector | #50 | |
| Console Type | **JK®IIA** | **JK®III** |
| Manifold Pressures, PSI | (3) (11) | (9) |
| Oxygen | 100 | 90-95 |
| Main Fuel Gas | 130 | 90-95 |
| Carrier Gas | 85 | 85 |
| Console Pressures, PSI [12] | | |
| Oxygen | 74-85 | 70-81 (estimated) |
| Main Fuel | 71-78 | 67-73 (estimated) |
| Carrier | 44-50 | 44-50 |
| Console Flows [4] | | |
| Oxygen | 1000 | 1000 |
| Main Fuel | 276 (350 $H_2$ reading[10]) | 276 |
| Carrier | 77 | 77 |
| JK®IIA Console Settings | | |
| Oxygen | 55.6 | |
| Main Fuel | 19.7 (19.4 Using $H_2$ flowmeter[10]) | |
| Carrier | 77.0 | |
| Cooling Water [5] | | |
| °F IN | 85-95 | 85-95 |
| °F OUT | 115-120 | 115-120 |
| Flow, GPM | 11.8-12.5 | 11.8-12.5 |
| Powder feed Settings | | |
| RPM (Approximate) | 1.8-3.7 | 1.8-3.7 |
| Feed Rate [6], grams/Min. | 31-65 | 31-65 |
| Spray Distance, Inches | 8 | 8 |

| | |
|---|---|
| Thickness Per Pass, Inches | .001 maximum |
| Torch to Part speed, Ft/Min. | 200-300 |
| Torch Move Per Pass, Inch/Rev. | .100 |

Preheat Recommended, If Possible

Cooling **AVOID EXTREME COATING TEMPERATURE VARIATIONS!**

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- AIR COOLING OF UN-COATED AREA PERMITTED

Maximum Part Temperature During Application of Coating is 400°F.

Notations above (1-12) please see page 4 for details.