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NAVAL AIR SYSTEMS COMMAND  
NAVAL AIR SYSTEMS COMMAND HEADQUARTERS  
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28 July 1997

From: Commander, Naval Air Systems Command, 1421 Jefferson Davis Highway, Arlington, VA 22243-5120

Subj: FLASHJET® COATINGS REMOVAL FOR METALLIC MATERIALS


Ref: (a) Xenon Flashlamp and Carbon Dioxide Advanced Coatings Removal Development and Evaluation Program U.S. Navy Add-on Program Final Report, MDC 93B0341  
(b) Xenon Flashlamp and Carbon Dioxide Advanced Coatings Removal Development and Evaluation Program U.S. Navy Follow-on Program Final Report, MDA 96X0019

Encl: (1) FLASHJET® Coatings Removal Process Specification for Metallic Materials, Revised 28 July 1997

1. The Naval Air Systems Team has been conducting a joint Navy-Air Force-Industry program for development, evaluation, and demonstration of the synergistic Xenon Flashlamp and Carbon Dioxide (FLASHJET®) coatings removal process for aircraft. Navy specific tests on metallic and composite aircraft surfaces were conducted as reported in references (a) and (b).

2. After successful development and initial demonstration of the FLASHJET® process and review of references (a) and (b), the Xenon Flashlamp/CO<sub>2</sub> (FLASHJET®) process is authorized for removing organic coatings from metallic fixed wing aircraft surfaces in accordance with enclosure (1).

3. AIR-4.3 point of contact is Mr. J. Kozol, Code 4.3.4.2, (301) 342-8068.

  
DALE L. MOORE  
By direction

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NAVAL AIR SYSTEMS COMMAND

FLASHJET® COATINGS REMOVAL PROCESS SPECIFICATION FOR METALLIC MATERIALS

Revised: 28 July 1997

1. PURPOSE: This Specification outlines the procedures and requirements for removal of organic coatings from metallic substrates using the FLASHJET® Coatings Removal Process. This process is intended for use at depot level capable activities which can demonstrate compliance with this Specification. In addition to the enclosed requirements, Local Process Specifications (LPSs) or Local Engineering Specifications (LESs) will provide aircraft and coating type specific instructions for FLASHJET® production operations. LPS and LES documents shall be approved by the appropriate materials competency manager.

2. GENERAL INFORMATION: The FLASHJET® Coatings Removal Process employs high intensity pulsed light energy, a dry ice particle stream, and effluent collection simultaneously to pyrolyze the organic coating, sweep away the residue, and trap any harmful effluents in disposable filters. While some superficial corrosion products may be partially removed, this process is not authorized or adequate as a complete corrosion removal technique from metallic surfaces.

2.1 Glossary: The following words/terms are used within this document and are defined here to aid the reader of the text.

- (a) Color Sensor: Voltage settings can be controlled by this sensor which uses a color camera to differentiate between different topcoat and primer coatings as well as substrates.
- (b) Effluent: The flowing decomposed coating material.
- (c) Flashlamp: A quartz tube filled with xenon gas.
- (d) Motion Sensor: Indicates stripping head movement within a predetermined stripping head rate of travel.
- (e) Pelletizer: A machine that makes dry ice (CO<sub>2</sub>) pellets.
- (f) Proximity Sensor: Controls the robot and maintains the predetermined stand-off distance between the Stripping Head Assembly and the surface being stripped.
- (g) Pyrolysis: Thermal degradation and decomposition of a substance.
- (h) Qualification or Certification: The process of determining whether a person is capable of performing an identified task at a predetermined skill level.
- (i) Qualified Personnel: A person who has demonstrated by passing written and/or performance evaluation test(s) that the person has the skills and job knowledge to perform in accordance with established FLASHJET® System operating procedures.
- (j) Scrubber: An activated charcoal filter to trap hazardous vapors.
- (k) Sniffer: A detector used to determine when scrubber filters are full and need to be changed.
- (l) Substrate: Outer surface of aircraft skin.
- (m) Trained Personnel: Persons who have successfully completed a course of classroom and/or on-the-job training in a specific task or operation.
- (n) Xenon Gas: A colorless gas that radiates light when electrically energized.

(o) Gantry: A static overhead structure which supports a robotic FLASHJET® stripping System.

(p) Mobile Manipulator: A heavy lift vehicle incorporating and operating a FLASHJET® System in a robotic assisted mode.

## 2.2 Applicable Documents:

2.2.1 Government Documents: The following documents, except as otherwise noted herein, form a part of this specification to the extent specified herein.

### Specifications

#### Military

MIL-S-13165 - Shot Peening of Metal Parts

NAVAIR-01-1A-509 - Aircraft Cleaning and Corrosion Control

(Copies of Federal and Military specifications, standards, and handbooks required in connection with specific procurement functions are available from the DODSSP - Customer Service Standardization Documents Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094. For other government documents, contact the appropriate government agency or the contracting agency.)

2.2.2 Non-Government Documents - The following documents form a part of this Specification to the extent specified herein.

### Specifications

#### American National Standards Institute

ANSI Z87.1 - 1989 - Practice for Occupational and Educational Eye and Face Protection.

(Application for copies of ANSI-adopted standards should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

### Manuals

FLASHJET® System Operation and Maintenance (O&M) Manual

3. APPLICATION: The FLASHJET® Coatings Removal Process may be used to clean or remove organic coatings from all aluminum, steel, titanium, and laminate face sheets bonded to aluminum or Kevlar honeycomb core substrates using guidelines and instructions contained in this Specification. When used in accordance with this Specification, this process may be applied to all exterior moldline surfaces of all fixed wing aircraft types without restriction as to the number of applications.

## 4. EQUIPMENT AND FACILITIES:

### 4.1 Equipment:

4.1.1 FLASHJET® Coatings Removal System; McDonnell Douglas Aerospace-St. Louis. The following subsystems make up FLASHJET®:

(a) Stripping Head: An integrated unit consisting of the flashlamp module, dry ice delivery nozzle, proximity/motion and color sensors, and a light containment/noise abatement/effluent capture shroud.

(b) High Voltage Power Supply/Controller: A cabinet consisting of the power control module, charging capacitors, control computer/remote control pendant interface, and the flashlamp water cooling system.

(c) Dry Ice Pelletizer and Delivery System: A system consisting of an air compressor, liquid CO<sub>2</sub> storage tank, Cold Jet Model 65-200 pelletizer or equivalent pelletizer capable of delivering CO<sub>2</sub> pellets at up to 1,000 lb/hr, an air dryer, and dry ice particle delivery hoses.

(d) Effluent Collection System: A system consisting of a vacuum, particulate trap, high efficiency particulate air (HEPA) filters, pre-HEPA filters, and an activated charcoal scrubber. The particulate trap, HEPA and pre-HEPA filters have a combined efficiency of 99.7% for particulates in excess of 0.3 microns. The scrubber has an efficiency of 99% in removing organic compounds.

(e) Cell Controller: An assembly consisting of a console that houses both the cell controller and the color sensor computers, a programmable logic controller, an air conditioning unit, a power supply, remote control pendant, and associated software.

(f) Robot Manipulator System: This system is a gantry-style robot specifically configured to provide accessibility to parts being stripped. The overhead robot consists of raised structure, traversing carriage, rigid mast and vertical carriage, with an offset arm and wrist. Or,

(g) Mobile Manipulator System: This system is a heavy-lift vehicle integrated manipulator incorporating and operating a Stripping Head as specified in 4.1.1(a).

4.1.2 Ancillary equipment/tools/fixtures/hoists/ etc.

#### 4.2 Facilities:

4.2.1 FLASHJET<sup>®</sup> stripping cell which meets all local building codes and safety regulations.

4.2.1.1 Adequate ventilation to prevent CO<sub>2</sub> buildup in excess of OSHA requirements.

4.2.1.2 Welding Curtain (or equivalent barrier), UV attenuation factor of 500 (Suggested source: J.C. Goss Co., Detroit, MI), used to enclose the FLASHJET<sup>®</sup> Coatings Removal System stripping head [4.1.1(a)] and protect personnel in the cell from UV radiation in the event that the FLASHJET<sup>®</sup> System is operating and personnel are without other personal protective measures specified in 5.4.

#### 5. MATERIALS:

5.1 Foil Paper, Commercially Available.

5.2 Foil Tape, Commercially Available

#### 5.3 Hearing Protection:

(a) Foam Ear Plus, 25 dB Noise Reduction Rating (NRR) or greater.

(b) Ear Muffs, 25 dB NRR or greater.

#### 5.4 UV Protection:

(a) Shaded UV Rated Glasses ≥99% UV light absorption, meeting ANSI standard Z87.1-1989 (Suggested source: UVEX Ultra-Spec 2000, Model S028, UVEX Safety Inc., Smithfield, RI).

(b) Sunscreen lotion, SPF of 30 or more, commercially available.

6. GENERAL INSTRUCTIONS:

6.1 Processing:

6.1.1 Pre-Stripping Requirements:

6.1.1.1 There are no pre-cleaning requirements associated with the FLASHJET® process.

6.1.1.2 Composite skins, acrylic plastic material, cabin windows, cockpit windshields, lenses, rubber, and other items which could be affected by the FLASHJET® process shall be masked with foil paper and tape (5.1, 5.2).

6.1.1.3 Prior to stripping, the aircraft shall be defueled and the fuel system preserved or made inert in accordance with local safety requirements.

6.1.2 Controls and Sensors Requirements:

6.1.2.1 FLASHJET® system pre-determined control parameters shall be in agreement with those included in the FLASHJET® System Operation and Maintenance (O&M) Manual. The predetermined controls have been optimized to provide the most effective stripping rates.

6.1.2.2 The dry ice pelletizer feeders shall be set at 40% pellet flow rate.

6.1.3 Performance Requirements:

Note: These performance requirements have been tested for and been met during the development of acceptable stripping parameters and require only periodic surveillance.

6.1.3.1 FLASHJET® process parameters shall be set to the values in the Table 1.

Parameter	Range Required
	Metals
Input Voltage (Volts)	2100 - 2200
Flash Frequency (Hz)	4.0 - 6.0 Hz
Substrate Standoff (inches)	1.3
Stripping Speed (in/sec)	1.0 - 1.4
CO <sub>2</sub> Pelletizer Pressure (psi)	150
CO <sub>2</sub> Nozzle Inlet Pressure (psi)	120
CO <sub>2</sub> Nozzle Outlet Pressure (psi)	15
CO <sub>2</sub> Pelletizer Feeder Rate (%)	40
CO <sub>2</sub> Pellet Flow (lb/hr per 2 nozzles)	700 (+/- 50)
Substrate Angle (Degrees)	21

Table 1: Required Process Parameters

6.1.3.2 Stripping parameters selected shall not induce mechanical stress damage in parts as evidenced by less than 0.001 inch almen strip deflection when tested with MIL-S-13165 Test Strip N, made from 2024-T3 aluminum alloy, regardless of the number of stripping passes.

6.1.3.3 The proper stripping parameters (CO<sub>2</sub> flow, traverse rate, input voltage, and flash frequency) selected shall limit substrate temperatures to less than or equal to 200°F when stripping the topcoat and leaving some amount of primer intact.

6.1.4 Stripped Surface Requirements:

6.1.4.1 Metallic surfaces shall be stripped so that some degree of primer remains intact. It is not necessary to remove the coating to the bare substrate. Some stripped surfaces may show blends of remaining primer and topcoat which is acceptable as long as the remaining paint film is smooth. With a remaining paint film, subsequent repaint only requires a tie-coat application of primer followed by a normal application of topcoat, per the applicable paint specification.

6.1.5 Post-Stripping Requirements:

6.1.5.1 Spot stripping shall be performed if necessary to remove paint from areas that cannot be reached by the process.

6.2 Procedures: FLASHJET<sup>®</sup> equipment (4.1) shall be used to strip organic coatings per the procedures outlined in the System Operation and Maintenance (O&M) Manual, which is provided with the system.

6.2.1 FLASHJET<sup>®</sup> System Set-Up: Initial operating parameters are specified in 6.1.3.1. Special case operating parameters for the specific coatings type, thickness, color, and substrate are determined by Engineering (Code 4.3.4) and are not to be exceeded by operators. Default parameters are listed in Table 1.

6.2.2 FLASHJET<sup>®</sup> System Operation: Select the individual part stripping program to perform and complete the actual coatings removal operation. The operator monitors sensor feedback and indicators on the cell controller during the process. The FLASHJET<sup>®</sup> System contains a series of interconnected sensing devices/interlocks to reduce risks to personnel safety and prevent damage to the equipment and to the substrates being stripped.

- (a) If dry ice particle stream flow is interrupted, the flashlamp control will automatically be placed in a standby mode.
- (b) If the pulsed light energy is disrupted, the dry ice delivery system will be placed in a standby mode.
- (c) If the effluent collection system vacuum is disrupted, both flashlamp and dry ice delivery systems will be placed in a standby mode to prevent exposure of personnel to harmful effluents.
- (d) If the stripping head is not at the proper standoff distance and moving within the predetermined rates, the flashlamp will not be allowed to operate in order to prevent substrate damage.
- (e) On-line color sensor monitoring determines if the flashlamp is allowed to be fired or is to be placed in the standby mode until the correct color is sensed.
- (f) The high voltage power supply/controller has several safety features which will not allow the unit to operate unless all the interlocks are satisfied. The power supply will not operate if there is any disruption of cooling water flow to the flashlamp, a low water indication in the flashlamp cooling water reservoir, any airflow blockage or disruption of any component cooling system, or any open or unlatched door. The internal capacitors and inductors are automatically discharged upon system shut-down.

(g) The pelletizer hydraulic system will automatically shut down in the event of an over-pressure condition, low fluid level condition, or fluid over-temperature condition.

(h) The pelletizer liquid injection system will automatically shut down in the event of several over-pressure conditions.

(i) E-stops are available to the operators for emergency shut down of the entire FLASHJET® System.

(j) Collision avoidance sensors shutdown the system with unrecognized contact.

6.2.3 If a sensing device has triggered an interruption in the FLASHJET® stripping process, identify the cause and provide the appropriate response actions in accordance with the FLASHJET® Operation and Maintenance Manual to continue the stripping process.

6.3 FLASHJET® Log Sheets: Log sheets are provided in the FLASHJET® O&M Manual as a recommended means of documenting System operation, performance, and problems.

## 7. SAFETY:

7.1 Personnel: All operators shall be provided with the necessary training, procedures and personal protective equipment to comply with the applicable local and Federal safety requirements .

### 7.2 Automated Equipment:

7.2.1 At least two operators shall be present in the controller area during operation of the FLASHJET® system. No one shall be present in the immediate vicinity of the Stripping Head.

### 7.3 Process Safety:

7.3.1 All FLASHJET® equipment, work stands, and the aircraft shall be properly grounded electrically.

7.3.2 Refer to 6.1.1.3.

7.3.3 Hearing protection (5.3) is required for personnel in the immediate operating area when the FLASHJET® system is operating. Either ear plugs or ear muffs are required.

7.3.4 Adequate UV protection is required for personnel who are in the area when the FLASHJET® system is operating. Adequate protection includes a long-sleeved shirt or lab coat, sunscreen [5.4(b)] and safety glasses [5.4(a)]. Use sunscreen on exposed skin whenever in close proximity to the stripping head (xenon lamp). The protective curtain/screen (4.2.1.2) provides UV protection, so that personnel behind the curtain/screen are not at risk.

7.3.5 Warning signs shall be posted in the cell area to caution personnel that hearing protection and UV protection are required.

## 8. QUALITY ASSURANCE:

8.1 Certification: Operators are certified upon completion of training specified in 9.

### 8.2 Process Approval:

8.2.1 Process equipment shall be certified during the FLASHJET® system acceptance testing.

8.2.2 Stripping of coatings using the FLASHJET® Coating Removal Process shall be performed by qualified personnel as specified in 9.1.5.

### 8.3 Process Control:

8.3.1 Maintain surveillance (via FLASHJET<sup>®</sup> log sheets) to assure conformance to the requirements of this Specification regarding personnel, pre-strip requirements (6.1.1), system parameter selection and performance.

### 8.4 Acceptance Inspection:

8.4.1 Parts stripped shall be visually inspected to determine:

- (a) That the surface conforms to the requirements of 6.1.4.
- (b) That the areas stripped have a smooth, clean, and uniform condition.
- (c) That any masked surfaces have been properly protected from the effects of FLASHJET<sup>®</sup> stripping.

8.4.2 Parts stripped shall be visually inspected to determine that parts are free from distortion, warpage, or other defects.

## 9. TRAINING:

### 9.1 Type of Training:

9.1.1 Training shall be classroom and hands-on type.

9.1.2 No prerequisite is necessary.

9.1.3 Course length is 40 hours.

9.1.4 Classroom training (16 hours) consists of providing a thorough understanding of theory of operation, equipment description, process operation, and FLASHJET<sup>®</sup> System set-up parameters. Scheduled inspection and maintenance procedures necessary to ensure peak FLASHJET<sup>®</sup> performance are also included.

9.1.5 Hands-on training (24 hours) consists of equipment familiarization, system set-up, system operation, and operator qualification tests in a FLASHJET<sup>®</sup> facility to ensure a complete understanding of the equipment and its operation.

9.1.6 Training will include operation and maintenance training for the stripping head subsystem, the effluent capture system, and the cell controller. Each subsystem vendor will provide training for operation and maintenance of their equipment.

9.1.7 Training materials include all documentation necessary for system operation, scheduled inspection and maintenance procedures.

9.2 Periodicity: Refresher required if operator has not operated FLASHJET<sup>®</sup> within the past 12 months.