

## T.O. 1-1-8 FLASHJET® Process

2-16A. FINISH SYSTEM REMOVAL BY FLASHJET® PROCESS is an effective method that utilizes a Xenon Flashlamp, Carbon Dioxide (CO<sub>2</sub>) pellet blasting, and effluent capture system. This process requires precise control, usually robotics, and is restricted to depot application and must be approved by the System Program Manager (SPM). The FLASHJET® Process is good for finish system removal on metallic and non-metallic surfaces.

a. The stripping process results from the use of a pulsed light energy source, Xenon Flashlamp, emitting brilliant flashes of light. As the coating absorbs the photon energy, its temperature rises to the point that a thin layer is ablated. The depth of the coating layer removed is determined by the energy density setting of the lamp. Coupled in this process to the stripping head containing the lamp is a low pressure dry ice (CO<sub>2</sub>) particle stream. Residue created by the lamp ablating the coating system is simultaneously removed by the dry ice and effluent capture system. The synergy of the xenon flashlamp and dry ice particle stream results in an efficient means to remove coatings and cleans the surface in one operation.

b. System Primary Components. There are seven primary components to this paint removal system.

(1) Stripping Head. The stripping head contains the Flashlamp module/ reflector assembly. Two CO<sub>2</sub> pellet blasting nozzles along with an effluent capture shroud are attached to the stripping head. Additionally, there are color and proximity sensors attached to the head unit. These provide control parameters for focal standoff of the strip head.

(2) High Voltage Power Supply. This system requires a computer controlled high

voltage power supply for the Flashlamp. Electrical energy requirements for this all Subsystems except the System Controller (6) are 480 volts, 100 amps, 3-phase. The electrical supply requires a deionized water cooling system. Computer control is for parameters of energy density and flash repetition rates.

(3) Dry Ice (CO<sub>2</sub>) Particle Delivery Unit. This unit manufactures pellets from liquid carbon dioxide and provides a means of delivery and control to the two nozzles in the stripping head. Control parameters consist of air pressure regulation and mass flow rate (feeder rate) of the pellets. A dry ice pelletizer feeder rate of 50% is equal to about 750 lb/hr (375 lb/hr per nozzle).

(4) Liquid CO<sub>2</sub> Storage Tank. A liquid CO<sub>2</sub> storage tank is required as part of the CO<sub>2</sub> pellet subsystem. The tank options are a permanent installation, portable installation, or utilizing a transporter trailer. There are advantages and disadvantages with each of the storage systems. Each of the storage systems will require refrigeration (or vacuum-jacketed storage vessels) to prevent excessive liquid bleed off and heater units to maintain proper tank pressure.

(5) Effluent Capture System. The effluent capture system consists of the effluent containment shroud (mounted on the stripping head), a high-velocity/high-volume vacuum source, a cyclone particle separator, pre-High Efficiency Particulate Air (HEPA) and HEPA filter module, and an active charcoal tub scrub (air scrubber).

(6) System Controller. The system controller provides control and monitoring of the coating removal process as well as providing a common interface for the operator to each of the subsystems.

## T.O. 1-1-8 FLASHJET® Process

(7) Robotic Manipulators. Systems are available for...both off-aircraft components as well as complete aircraft paint removal applications. For off-aircraft components and for complete small aircraft paint removal the optimum robotic system is the gantry style. This unit has a motion control assembly (end effector) with a stripping head assembly mounted on it. These are mounted to an overhead gantry framework with tracks capable of fore and aft movement. A gantry configuration robot is used to provide a stable positioner for access to the part or aircraft being stripped. The gantry assembly provides three axes of movable support for the motion control assembly. Linear X-axis and Y-axis movement is accomplished with a bridge and carriage structure supported on beams with tracks. A telescoping vertical arm provides Z-axis movement. This system is effective for off-aircraft components and small aircraft with a wing span under 50 feet. When stripping larger aircraft a mobile robotic manipulator is required. Configuration of the manipulator is a key element when stripping large aircraft. Size of the aircraft being stripped is the determining factor in what kind of manipulator will be required.

c. Teaching. There are a number of considerations that must be made when using a fully automated robotic system. As an automated process, each part configuration or aircraft type to be stripped must be scanned and the profile taught to the robotic controller. Robot movement must be carefully taught to prevent umbilical damage or inadvertent contact of the strip head that could cause damage. Set-up of a new part or aircraft requires identifying part "features" and locating a new part within a 15 degree rotation of the position of the last similar part or aircraft.

d. Personnel Qualifications. Personnel operating The FLASHJET® System must be properly trained in its operation. Operators must be thoroughly indoctrinated in the FLASHJET® Process requirements, parameters, and safety precautions specified in this technical order and any other system peculiar aircraft or equipment technical order.

e. Pre-strip Preparation. Normally, no pre-cleaning is necessary for this process. Masking of windows and other glass or Plexiglas is required. Some areas may be contaminated with dust/condensate and will require a wipe with a clean cotton cloth using one of the pre-paint wipe solvents such as DS-104, DS-108, or MIL-L-81772. Suitable masking material is Protex-20V available from Mask-off Company, Monrovia, CA.

f. Process Control. The following process controls are designed to provide for the removal of the majority of known coating systems. Where a range is given the nominal value should be used unless technical data or a process order directs otherwise. These instructions are not intended to be all inclusive, they are general guidelines to be used in conjunction with the specific instructions applicable to system peculiar aircraft or equipment manuals.

(1) Flashlamp Voltage. The voltage supplied to the flashlamp is variable from 1000 to 2300 volts with the nominal setting being 2100 volts. Some coating systems can be removed at lower voltage settings and each coating system should be tested to determine the optimum setting. The age of the flashlamp must be monitored and factored into voltage settings; higher voltage may be required as the lamp ages. The minimum voltage necessary to strip most current coating systems is 1600 volts.

## T.O. 1-1-8 FLASHJET® Process

(2) Standoff Distance. The distance from the surface being stripped to the flash window may range from 1.00 to 5.00 inches with the nominal distance being 2.19 inches. However, with experience in using the system, optimum standoff distance will be determined with other variables of energy settings, flash frequency, and rate of head travel.

(3) Flash Frequency. The repetition rate of the flash is a consideration in the strip rate. To deliver maximum energy the power supply must fully recharge the capacitors for each flash. A maximum repetition rate of 4 flashes per second is required for full power recharge. The flash frequency is variable from 0.50 Hz to 6.00 Hz with 4 Hz being the nominal setting.

(4) Strip Head Velocity. The rate at which the stripping head passes over the surface is a variable to the strip rate. Typically, the higher the energy setting the higher the rate of travel. The highest rate of removal is attained at 2300 volts, flashes at 4 Hz, and travel at 1.00 inch per second. This is not necessarily the best procedure for all cases. Using lower energy settings and head travel will provide finer control over strip depth and minimize heating of delicate substrates. The rate of travel of the stripping head may vary from 0.50 inches per second to 5.00 inches per second with 1.00 inch per second being the nominal.

(5) Blast Pressure. The nominal CO<sub>2</sub> blast pressure is 120 psig as measured at the nozzle plenum. For most systems this requires a 150 psig setting at the pelletizer pressure controller. This 150 psig also establishes a 15 psig nozzle outlet pressure for the pellets. This setting should not be increased as it will increase nozzle velocity of the pellets in the blast operation.

(6) Pellet Blast Angle. This angle is fixed at 25° for optimum performance.

(7) Solid CO<sub>2</sub> Pellet Size. The pellets shall be a nominal 0.125 inches in diameter and 0.188 inches long. This is controlled by the extrusion plate in the pelletizer. It can be modified by changing the extrusion assembly. The assembly which creates the nominal pellets is defined by the following manufacturer's part number:

2D0056- FLASHJET® Pellet Extrusion Assembly

Cold Jet Inc. is the manufacturer. The revision shown is current as of the date of this writing. The effect of design revisions should be verified prior to approval.

(8) Pellet Flow Rate. The solid pellet flow rate measured at the pelletizer should range from 630 to 770 lb/hour with the nominal flow rate being about 700 lb/hour (350 lb/hour per nozzle).

(9) Pellet Hardness. The pellet hardness is controlled by the above hardware definition and by the purity of the liquid CO<sub>2</sub>. The hardware should meet the above requirements and the CO<sub>2</sub> should meet the Compressed Gas Association (CGA) specification as defined in CGA G-62-1994.

(10) Effluent Capture System Flow Rate. An air flow of 1800 cfm minimum is required. This is the minimum necessary to obtain a good effluent capture at the shroud.

### g. Operational Safety Requirements.

(1) All FLASHJET® System equipment, work stands, and the aircraft shall be properly grounded per T.O. 00-25-172 and

## T.O. 1-1-8 FLASHJET® Process

the applicable aircraft or equipment manual during all FLASHJET® Process operations.

(2) The facility used for the this process shall have adequate air flow/ventilation to prevent build up of oxygen-depleting CO<sub>2</sub>. The base Bioenvironmental Engineer shall be consulted for proper ventilation requirements.

(3) No special clothing is required for operating the FLASHJET® System. However, personnel involved with maintenance of the filters on the effluent capture system components shall wear protective clothing as determined by the base Bioenvironmental Engineer.

(4) There is always a potential hazard of robots colliding with personnel when they are powered. These automatic systems can not sense the presence of personnel in the area and its movements can be unpredictable. All areas within the robots reach must be roped off and signs posted to prevent accidental entry by unauthorized personnel.

(5) The flashlamp emits an ultraviolet element when flashing which can be harmful to the eyes. Shaded UV-rated glasses ( $\geq 99\%$  UV light absorption) must be worn by anyone within eyesight of the flashlamp.

(6) The noise levels at the Stripping head produced by air pressure from the CO<sub>2</sub> and sonic shock resulting from the flashlamp pulse can cause hearing damage over time. All personnel must wear hearing protection capable of 25 dB noise reduction rating (NRR) or greater.

### h. Post Strip Cleaning.

(1) A mechanical or chemical stripping method may be selected to strip

those areas not stripped by the FLASHJET® Process. This is generally about 5% of the total external area to be repainted, depending on aircraft or part outer moldline configuration. Selection of the process to be used for localized stripping must consider the substrate to be stripped, accessibility to the areas, and preparation requirements to determine the proper method.

(2) After completion of the FLASHJET® Process, some areas contaminated with dust / condensate will require wipe down with a clean cotton cloth soaked in any of the approved pre-paint wipe solvents or cleaning compounds.

i. Specific Technical Data and Work Directives. Each aircraft System Program Manager or Equipment Item Manager shall prepare detailed masking instructions that conform to all the requirements of this technical order and incorporate these instructions in their system peculiar aircraft/equipment technical order. The system specific instructions shall be implemented prior to initiating the FLASHJET® Process for finish system removal operation on any aircraft, component, or piece of equipment.