

# Atmospheric Plasma Bracket Bonding Surface Preparation

## Project Description

Northrop Grumman attaches instrumentation to the sides of rockets via proprietary brackets. These Brackets are epoxied to the sides of the rockets. The surface of the backs of the brackets need to be prepared in order to bond better. The current process is slow and inefficient. NGC has tasked us with finding a better surface processing method using atmospheric plasma.

### Current Process

- Involves hand grinding, degreasing, and drying.
- Takes two to three days for a batch of approximately 50 brackets.
- Hand grinding can cause natural defects through human error.

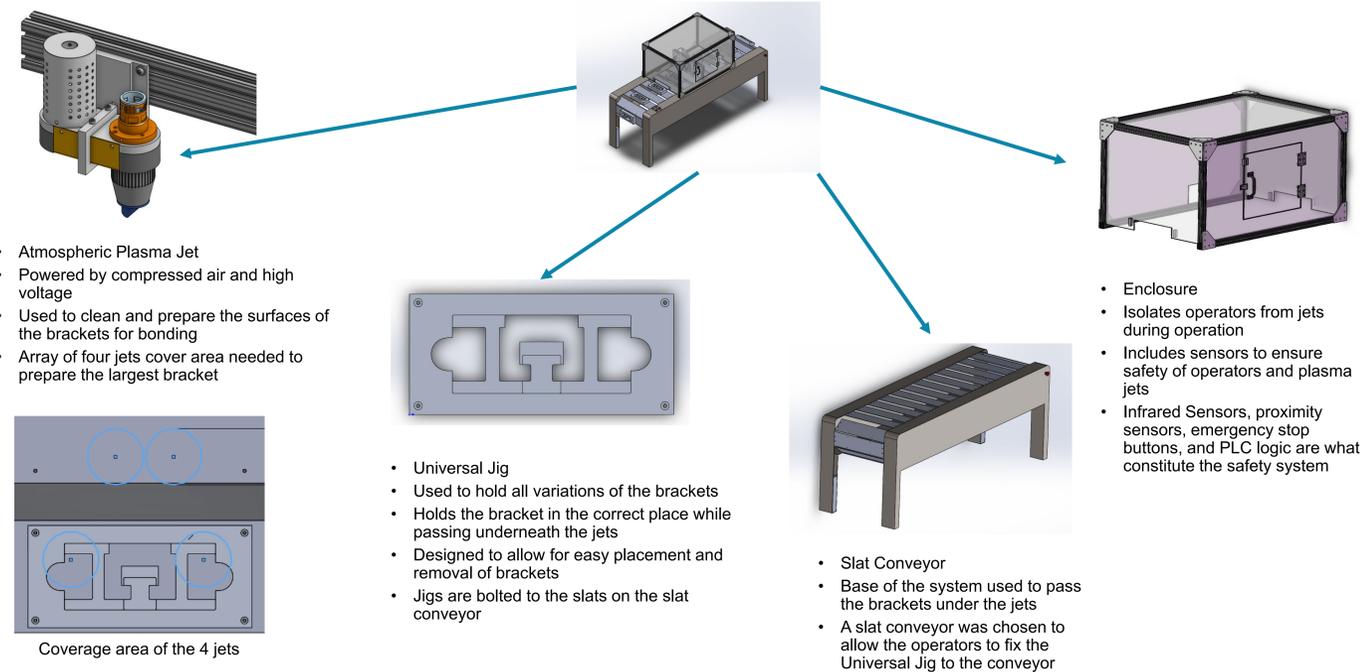
### Solution

- Atmospheric plasma can treat the surfaces more quickly and more efficiently.
- The surface treated by atmospheric plasma is more conducive for bonding than the surface treated by the current process.

### Requirements

- Limited number of jigs to hold all types of brackets
- Even treatment of each bracket surface via atmospheric plasma

## Design Description



## Performance Review

### Bracket Fitment Test

Tested to ensure that all brackets fit within the jig

### Bracket Placement Test

Tested to ensure ease of placement and removal of brackets

### Sensor Test

Tested control logic of sensors to ensure system shutoff

### Surface Disturbance Test

Tested bracket removal to ensure treated surface remains undisturbed

Requirement/Constraint	Target	Threshold	Predicted Performance	Actual Performance
Electrical grounding	5e5 ohms	1e6 ohms	5e5 ohms	Not tested
# of jig types needed	1	1	1	1
Precision of bracket placement in jig	10 mm	20 mm	5mm	7.6mm
Easy to place brackets in jigs	5 sec	15 sec	3 sec	2 sec
Fits in warehouse	1x3x3 m	5x3x3 m	3x1.65x1.5 m	3x1.65x1.5 m per specifications
Easy to move	250 kg	500 kg	318 kg	Unknown
Speed of bracket movement	150 mm/s	100 mm/s	150 mm/s	150 mm/s per specifications
Ease of maintenance	0 Inaccessible Subsystems	1 Inaccessible Subsystems	0 Inaccessible Subsystems	0 Inaccessible Subsystems
Safety shutoff	4 Devices	2 devices	7 devices	7 devices
Overall speed of process	60 sec/bracket	300 sec/bracket	10 sec/bracket	4 sec/bracket
Tipping Angle	45°	30°	31°	Unknown

## Conclusion

- A universal jig was made to fit all brackets
- The system was designed to treat a full set of brackets in 1 hour
- A redundant safety system was designed to protect operators of the system

### Lessons Learned

- Simplifying the design and reducing moving parts has a major benefit
- Work with commercially available parts when possible (limit custom parts)
- Communicate questions quickly and often

### Future Work

- The system should be assembled and tested to find the optimal height of the plasma jets over the brackets
- More investigation into specific slat conveyors and manufacturers to find the best solution for the conveyor needs to be done