PDR Review Debrief

Key Stakeholder Concerns:

Strip Rate: The stakeholders think the strip rates are too low. Note also that the test panels have about half the coating thicknesses of parts in the field. It is unlikely that users will buy equipment that will slow down their production line, regardless of the environmental benefit.
(Note: for down the road)

Flammability / Explosion Hazard: Can the laser be used safely on aircraft? Should we be concerned about vapors and/or other substances that can ignited with the laser? What are the dangers/limitations? If we are only stripping parts off aircraft, we will be need to re-evaluate the laser applications. (I.e. are we competing with PMB glove boxes, which strip 10 times as fast?)

A.I. Need to review and discuss Anteon different methods of air sampling, i.e. characterization

Effluent & Dust Collection: Stakeholders were interested in characterizing what actually comes off the panel (as opposed to our worker exposure air sampling). Stringent regulations (with regards to Cr and Cd) may require 100% collection via vacuum systems.

Substrate damage: Can the laser depaint parts/aircraft without damaging the substrate? Stakeholders expressed concerns that lasers act as "knives", especially on composites, and apply too much heat. Stakeholders desire more safeguards and controls to prevent damage from depainting.

Operational Environment: The system (laser and support equipment) will have to withstand harsh conditions (i.e. high temperatures, high temperature fluctuations, and high humidity). Systems need to be made more rugged, with reliability and easy of maintenance in mind.

Laser System Footprint and Operation: The stakeholders favor a small, compact, portable system that is easy to operate and easy to maintain. A simple user interface and logical controls layout are desired.

Laser System Ergonomics: Stakeholders desire ergonomically sound systems. Lighter end effectors and greater maneuverability are desired. All systems presented at the PDR require improvements in this area.

System Support: Stakeholders desire local (US support) to avoid logistical issues and communication concerns.

A.I. Follow-up with commercial vendor of Flashtec inc.

NDI: Are we modifying the surface of the substrate such that conventional NDI techniques do not work?

Design Modification Discussions

SLCR

General Discussion Points:

- Discuss Warping Issue.
- Old thyratron ad transformer will be sent back to SLCR shortly.
- Discuss cost of thyratron and lease arrangements.
  a. Transformer in the unit was set at the European settings

- Diode laser replacements have not been received.
- Calibration of the output beam
- Diode aiming Beam

Robotics for CO2 lasers

Tech Manual issues:

Manual needs to explain error codes, contain a detailed construction and wiring diagrams for subcomponents, and a troubleshooting guide to pin-point causes of malfunction and to describe steps to resolve issues

Filling the chiller tank is difficult. The tank fills from the bottom up. Operators need pressurized water, hose, and a nozzle connector to fill the tank. Can this be simplified? The maintenance manual only requires the use of regular (tap) water. No corrosion inhibitors, bio inhibitors, or antifreeze need to be added. Does this effect the chiller's performance - even for long-term use?

1. Mirrors may be misaligned during transport. A tool, such as a guide laser, may be a good idea for aligning mirrors.

2. Other laser vendors offer tele-modules, which allow for remote diagnostic services and troubleshooting. This laser may also benefit from such a feature to monitor performance, and to schedule maintenance and service trips.

3. Fuses should have indicators, showing "good" and "bad" fuses/circuits, which may require resetting and/or replacement
4. The start-up time for a "cold" system is currently 30 minutes (manual) – to allow for sufficient CO2 concentration to build up. Can the system start-up time be reduced?
5. Place protective glasses/lenses on the diode guide lasers to avoid damage from laser beam reflections.

6. The manual states that the high voltage supply (thyratron) or electrical components can be damaged if the laser is fired without properly purging the system with CO2 gas, or in the absence of CO2 gas (30 min process). There is no warning light or shut-off when the CO2 gas is not present. The laser needs to

have a sensor (gas mixture analyzer) that automatically prevents accidental damage due to insufficient CO2 gas.

7. The current gas bottle holder on the cart is not designed for US-standard gas bottles. Suggest redesign for portable use in US. Suggest a place for two bottles (one plus back-up).
8. CO2 exhaust gas vents to room. Is this a potential safety issue in a closed environment?
9. The laser system cover needs to integrate safety locks that would not allow operation of the system without the cover on – high voltage, etc.
10. Last mirror needs to be cleaned often, due to residue and effluent accumulation. Need to improve vacuum suction / dirt removal to avoid frequent mirror cleaning.
11. Vacuum system and laser system need to be interlocked to avoid damage to optics and hazardous worker conditions.
12. Power requirements need to be set-up for US standards (transformer needed to be replaced).

Quantel

General Discussion Points:

Technical / Design

1. Can a beam raster mechanism be integrated (with an on/off switch)?
2. How can we capture dust particles and effluents in an open environment (i.e. outside the glovebox?) – separate vacuum system or integrated vacuum collection system? Vacuum system and laser system need to be interlocked to avoid damage to optics and hazardous worker conditions.
3. Install a swivel joint where fiber optic cable meets the end effector to reduce torque and strain on operator (may be difficult because of tricky fiber optic end connections
4. Tool to determine the output beam for calibration

Note:

- What are the temperatures ranges with chillers that the laser system can function in.
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Nice Have Items

The weight of the gun needs to be reduced. The operators experience strain on the wrists, arm, and shoulders after prolonged use

- Can the chiller size be reduced and/or integrated into the laser system cabinet? Reduce the footprint of the laser system and support equipment.
- Some connections on the base of the laser cabinet are too close to the ground and will present problems in harsher environments. Enclose connections or move to the top.
- Power requirements need to be set-up for US standards (no external transformer)
- Install a sensor to avoid long dwell times (which can cause substrate damage).
- Use inflatable tires to reduce shock during transport in hangar and easy maneuverability of total system.
- Waist belt would reduce strain on the operator.

Cleanlaser

General Discussion Points:

- Talk about increasing strip rate by using more powerful laser while demonstrating laser equivalency (to use current test data for future (perhaps scaled-up) systems).
- Discuss Warping Issue.
- Conversion chart what does 1-10 relates to i.e. 8khz- 35khz
- Discussions point Operator adjust parameters issues
- Specialized endo-effectors
- Power frequency switch 50-120 watts

Technical / Design

1. Masking the edge areas
2. Sensor attached to wheels when lifting the effector away
3. Tool to determine the output beam for calibration
4. Digital output scale versus 1-10 Knobs
5. Increase or varying the spot size,
6. Selector switch turn off the rastering.
7. Vacuum system and laser system need to be interlocked to avoid damage to optics and hazardous worker conditions.
8. Install a swivel joint where fiber optic cable meets end effector to reduce torque and strain on operator (may be difficult because of tricky fiber optic end connections)
9. Combine vacuum and fiber optic cable
10. Use waist belt to clip in lines to reduce weight and strain on operator
11. For the nozzle with wheels:
12. Install a sensor that only allows the laser to fire when at least one wheel is turning
13. Install another set of wheels on the nozzle to fix the approach angle, thereby fixing the focal distance
14. For the short nozzle (without wheels): install a sensor that monitor the focal distance and provides feedback to the operator. (However, not sure if free-handing is a good idea with this focused beam at all.)
15. Install a second (removable) handle (similar to grinder/sander)
16. Can the size of the laser end effector be reduced?
17. Can we capture the dust/particulates such that it does not collect on the protective glass of the laser? Suggest vacuum at the bottom of the end effector (nozzle), not the top. Also, bring in a small gas line through fiber/vacuum hose to purge the protective window to avoid accumulation of particles on optic.
18. Work on making the system rugged for field use (high & low temps, high humidity, dust, etc.)
19. Use sturdier materials for the protective window in the end effector.
20. Power requirements need to be set-up for US standards (no external transformer).

Laserline

General Discussion Points:

- Discuss detailed plans/strategy to convert current system into a handheld system.
- Discuss progress w/ integrating Cleanlaser's end effector
- New scan head will be installed as soon as it arrives and the old one will be sent back to Laserline
- What parameters to we use?
- Simplified User Interface
- Pulse Diode vs. Continuous Wave?