CMS TFPX Phase-II upgrade	Standard Operating Procedure	
	SOP No.:	DC
	Title:	**DEE construction: Gluing parts into DEE mechanical structure**
	Revision:	v1
	Date:	September 13, 2024

Abstract

Describes the procedures to glue co-cured Carbon fiber-foam halves housing PEEK inserts, and titanium flower pattern evaporator, using the robotic gantry. The procedure takes place in the clean room. This is a two-person procedure.

Contents

I. Scope

This is a regular part in the integration process of the TFPX cartridge.

II. Purpose

The "DEE" is the mechanical structure supporting the silicon modules. It also provides cooling and support for power cables and e-links.

III. Definitions

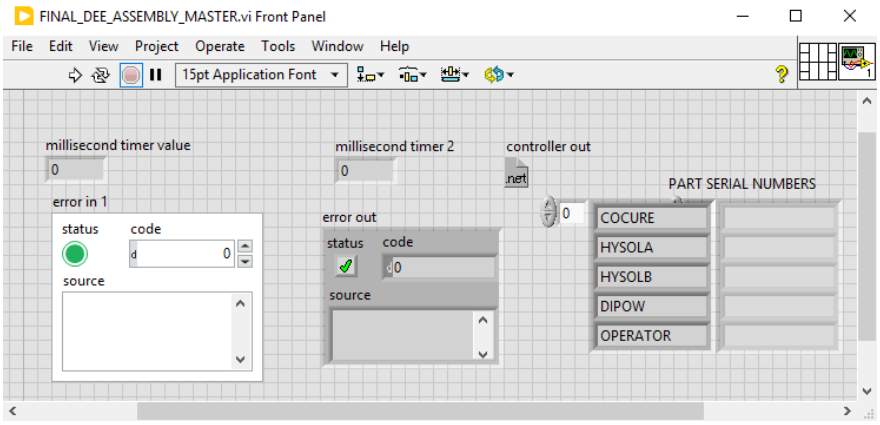

Figure 1: Front Panel of DEE_ASSEMBLY_MASTER.vi

- Motion Composer: is a program that runs GCODE. GCODE is a set of instructions for the Gantry to move along. Think of a GCODE path like the path a paintbrush needs to be moved along to make a painting.
- Flower Pattern: The cooling tube or evaporator has a flower shape which we call here flower pattern. The Gantry needs to deposit epoxy while it is moving along the flower pattern path in the Dee. For this, we have a GCODE script/program run by Motion composer. LabView program "depositwhilemoving", ONLY deposit epoxy while the Gantry is being moved by Motion Composer in the flower pattern.
- Carbon fiber-foam co-cure (CFF): The DEE structure is formed by two skins of carbon fiber and two bodies of carbon foam. One carbon fiber skin and carbon foam are co-cured in one entity, so that the DEE is composed of 2 halves of CFF (CFF_A and CFF_B). In between the two CFF, inserts and evaporator are sandwiched.
- Insert Filling: DEE has some PEEK inserts that will serve as clamping points for structures/objects on it. The Gantry moves to the location of the insert holes and deposit epoxy while STOPPED at that position.

- Front panel: It is the window through which the user interact with the software. It shows statistical information, status of the vacuum system, tools and elements in use and other relevant information (see figure 1)

IV. Equipment

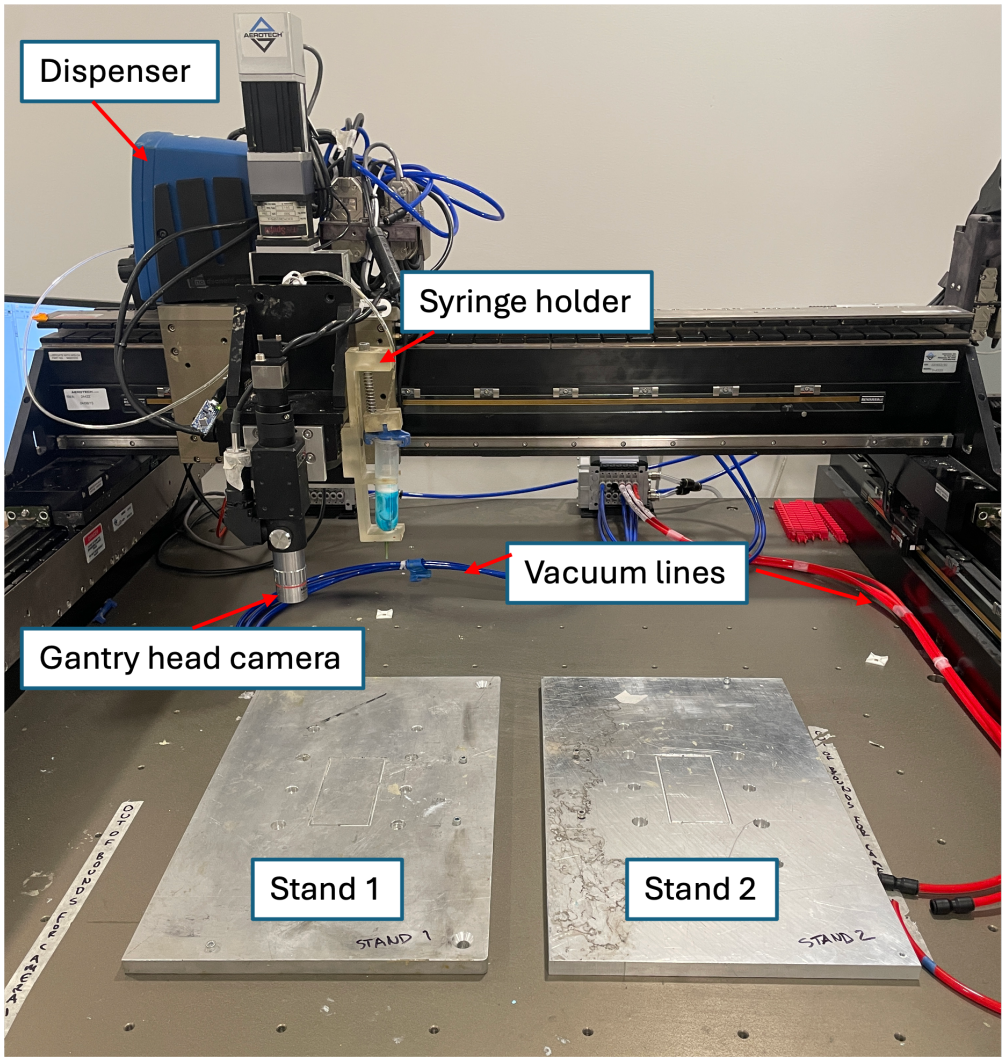

Figure 2: Gantry setup. Labels indicate the main parts of the setup.

1. Gantry (check that everything (labeled in the figure 2) is installed and working properly.
   - Syringe holder
   - Stands with alignment screws
   - Pressurised air Dispenser - Ultimus II

- Vacuum manifold and lines.
- Gantry head camera with light

2. Parts and tools

Figure 3: Parts and tools used in the DEE manufacturing process. Materials listed for epoxy preparation should be located on the table inside room PSB 375 where the epoxy mixing will be performed; the rest of materials must be located on the table in front of the gantry except for evaporator, inserts and tweezers which should be located on the table left to the gantry.

- Side A Half-Dee CFF_A
- Side B Half-Dee CFF_B
- PEEK Periphery
- EA9394 Epoxy parts A and B.
- Flower-Pattern Shape Titanium CO_2 tube/evaporator
- Box with PEEK inserts (56 will be used)
- Tweezers
- Two bottom jig plates

- One top jig plate

3. Epoxy preparation **(Performed in PSB 375)**
   - Bag of 12-20 Micron Diamond Powder
   - EA9394 Epoxy Part A
   - EA9394 Epoxy Part B
   - 2 Popsicle Sticks
   - Large Syringe, Piston, Cap, Olive Needle tip, Blue stopper cap
   - Digital Scale
   - Large Centrifuge with Counterweights Installed
   - Paper Towels
   - Isopropyl Alcohol
   - Rubber beakers
   - Silicone Gloves
   - N95 Mask
   - Extension cord
   - Square plastic sheet
   - Stopwatch
   - Box Fan
   - Mylar Plastic sheet
   - Painter's Tape
   - Small soft paint brush

V. Procedure

Person 1:

1. Check that the NPaq, power supplies, dispenser and vacuum pumps are turned on.
2. Check compressed air lines are open
3. Open LabView control software `C:\Users\co2_clt\Documents\Final_Dee_Assembly\Labview \FINAL_DEE_ASSEMBLY_MASTER.vi` Make sure it is opened with Labview 2024.

Person 2:

1. Ventilate the room with the fan
2. Put on N95 mask and gloves. Lay out paper towels over the table.
3. Materials are on the table.
4. Turn scale on
5. Check that centrifuge is ready to use.
6. Determine the amount of epoxy to be prepared using table in figure 4. A cal-

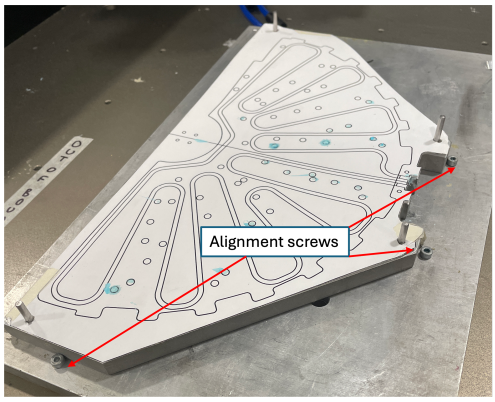

Figure 4: Jig alignment

4. Open Motion composer
5. Check that no other Gscript or Labview programs are running since they can interfere with the deposition.
6. Test presence of vacuum.
7. Identify parts. Handle with gloves, face mask. Check that the parts are in good condition.
8. Assign a new unique DEE number(`D_xxx`).
9. Run the control software and provide the information required:
   (a) Part numbers.
   (b) DEE identification.
   (c) other required info
10. Mount the bottom jig plate onto the stand 1 and align it using the alignment screws(Figure 4). Repeat for second bottom jig plate onto stand 2.
11. Mount the CFF_A onto the bottom jig plate on Stand 1 using the jig poles and holes in the CFF_A. Repeat for CFF_B on the bottom jig on stand 2.
12. Put a rubber beaker on the scale and tare. Pour 8.1 g of Part A EA9396 epoxy in the beaker. Tare it again. Pour

culator has been set up here in case a different amount of epoxy is desired. 35g of epoxy is used as reference in the following.

Epoxy calculator	A	B	Diamond	Total
35g batch ideal	8.1	2.4	24.5	35
100g batch ideal	23.1	6.9	70	100
25g batch ideal	5.8	1.7	17.5	25
Xg batch ideal	0.2	0.1	0.7	1
Xg batch ideal	0.5	0.1	1.4	2
Xg batch ideal	0.7	0.2	2.1	3
Xg batch ideal	0.9	0.3	2.8	4
Xg batch ideal	1.2	0.3	3.5	5
Xg batch ideal	1.4	0.4	4.2	6

Figure 4: Epoxy calculator table

7. Place the beaker on the scale and zero the scale. Add 8.1g of Part A using one side of the Popsicle stick.
8. Zero the scale again. Add 2.4g of Part B using the other side of the stick.
9. **Communicate with Person 1 to start the LabView program to set a timer for the mixing process. Wait for confirmation.**
10. Add 24.5g of diamond powder and mix until a uniform grayish-green consistency is achieved.
11. Prepare the syringe, don't forget to put the blue tip cap before centrifuging. Transfer the mixed epoxy into the syringe, ensuring minimal loss.
12. Centrifuge the syringe for 30 seconds at 2000 RPM.
13. Ensure no bubbles remain inside the epoxy after centrifugation. If bubbles are present, repeat centrifugation.
14. Push the white plastic piston down into the syringe using a sharpie/pen, making sure that the trapped air is removed.

2.4 g of part B EA9396 epoxy. Mix thoroughly for 2 minutes.

13. Spread plain epoxy on the PEEK periphery bottom face, using the paint brush.
14. glue the Periphery to CFF_A. Put some pressure around the periphery to ensure bonding. Use your hand/fingers
15. wait for Person 2 to bring the epoxy syringe into the clean room
16. Screw the blue pressure cap and hose assembly onto the syringe.
17. Unscrew the blue stopper cap at the bottom of the syringe, install the needle tip and load the syringe into the syringe holder.
18. Set the pressure at 35 psi. Make sure that after 20 minutes from this point, the pressure is adjusted to 45psi.
19. check that the needle tip is in the starting point for epoxy deposition as shown in figure 5. If needle tip is not in position, adjust it using motion composer interface.

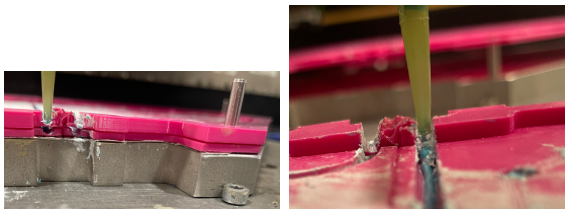

Figure 5: Needle stating position

20. Begin epoxy deposition by hitting OK button in the front panel of LabView program. Check for consistent epoxy flow. When deposition ends on CCF_A, gantry will move to starting point on CFF_B.
15. Take the Epoxy filled syringe to clean room. Pass it to Person 1.
16. get dressed to get into the clean room
17. Prepare inserts and Evaporator.
18. Once the epoxy deposition on stand 2 starts, move bottom jig from stand 1 to working table on the left of gantry.
19. Take inserts and stick them on the CFF_A carbon foam holes using the tweezers. Be careful not to break/damage the carbon foam.
20. Insert the evaporator into the groove making sure that it fits. Push with gently with fingers.
21. Spread plain epoxy over the top surface of the PEEK periphery using the paint brush, so that when CFF_B is stacked, the carbon fiber sticks to the periphery.
22. Prepare top jig plate to complete the full stack.
23. Clean up the working space.

Figure 6: Oven for curing DEE after assembly

21. Check that the needle tip is in the starting point for epoxy deposition. Adjust accordingly.

22. Begin epoxy deposition by hitting OK button in the front panel of LabView program. Check for consistent epoxy flow.

23. Remove CFF_B from Stand 2 and move it to working table on the left of the gantry. Bottom jig from stand 1 should already be on the table ready for stacking.

24. Flip CFF_B so that carbon foam face towards the floor.

25. Use poles on bottom jig to stack CFF_B on top of CFF_A.

26. stack top jig plate on top of CFF_B. Make sure everything fits.

27. Take the full stack into the oven; turn on the oven and let bake for 2 hours. Follow instructions fixed on the oven door as shown in the figure 6.

28. Clean up the working space.

VI. Documentation

Any special observations, e.g. damage to parts not already recorded during visual inspection, deviations from normal procedures, should be added to the report in the last step of the routine in the comments pop-up window

The following information is recorded in the report generated by the gluing software:

- Date, time (start–end) and operator name
- LabView software: version
- Id of parts used:
  - Carbon fiber-foam: S/N
  - DEE ID
  - Epoxy information
- observations/comments

Find the report at `C:\Users\co2_ctl\Documents\Final_Dee_Assembly\Dee_Assy_Reports\Report.xls`. Write an ELog entry and upload the report to it and to the appropriate DataBase.