Work Instruction - TacTip Manufacture & Assembly

Ella Maule

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1 Before You Start

1.1 Training

You will need to be formally trained and signed-off on the use of the following equipment:

- Gemini 400 water jet cleaning chamber
- Vacuum Chamber

We suggest you observe the assembly of a Tactip before you attempt to make your own. This Work Instruction is designed as a guidance document and as such is a live document, updated as new techniques or recommendations are made.

1.2 Warnings and Must Knows

- The support material used on the Object Printer is nasty, ALWAYS use gloves when handling.
- Fresh, clean gloves should be used during the gluing process; the oil from your hands can affect the bond.

1.3 Useful People

Tactip Printing: Jason (jason.welsby@brl.ac.uk) or Ugnius (ugnius.bajarunas@uwe.ac.uk), cc-ing in Andy if unsure about availability.

1.4 Equipment and Consumables

! If you notice any of the consumables running low let a technician know !

! If you notice any of the Techsil RTV27905 clear fill silicone running low let your PI know !

2 Work Instruction

2.1 Make Your TacTip Skin

2.1.1 Print

A technician will print your configurations for you. The following design guide should be followed to give the best result and ensure the file is provided in the correct format.

- File Type: .SLDPRT/.SLDAM or Fusion 360 equivalent or

To print, email the .SLDPRT and .SLDASM files to Andy or Josh including the quantity required and budget code. A well packed bed of prints will take 12hours + queue time.

2.1.2 Clean

Conditions and Prerequisites

- Wear fresh gloves
- Training on Gemini 400 water jet cleaning chamber completed and signed-off

Printer 1: Object Printer

1. Remove the bulk of the support by hand or using the dedicated tools.

   ! Be careful not to rip or damage the delicate skin !

2. Place items for further cleaning in the Gemini 400 water clean chamber.

   ! Allowing the support material to be exposed to water softens it, easing removal. Exposure for no longer than 10minutes suggested !

3. Close the door and lock securely.
4. Turn on the Gemini 400 at the wall followed by the central panel.
5. Set the pressure using the dial to roughly the middle of its range.
6. Select the required nozzle and load onto the hose (broad or narrow).
7. Cradle the part (or use a support fixture/ tools where available).
8. Holding the hose press the foot peddle to eject water.

   ! Be careful not to rip or damage the delicate skin !

9. Change pressure or nozzle type to achieve successful part clean and support removal.
10. For the silicone port, use a 22 gauge needle/ syringe to fully clear the hole. After, final blast in the water chamber is suggested.

    ! it is important this is done prior to fixing the lens to prevent trapping support material and inclusion in the silicone !

11. Dry the cleaned printed Tactip skin in the 40°C oven for up to 1 hour.
12. Leave the water chamber door open when not in use to preserve the door seals.

Printer 2: Fortus Multi-material Printer

! This method is not recommended as the chemical exposure has been noted to damage the assembly, in particular the soft skin!

If the part was printed using the Fortus printer the supports need to be dissolved away. A technician will do this for you.

2.2 Assemble In Lens

Conditions and Prerequisites

- Wear fresh gloves
- Prepare your work space with disposable surface protection (e.g blue roll)
- Tactip skin printed, cleaned and dried
- Acrylic lens cut on laser cutter
  - For standard ⌀ Tactips, 1-2mm thickness transparent acrylic
- Super Glue with 20 gauge hollow needle attached
- A piece of bluTak or equivalent

13. Remove protection film from both sides of acrylic lens.
14. Identify the smaller diameter face of the taper and place carefully onto clean surface (e.g blue roll); the taper will assemble into the shell first.
15. Apply a line of glue around the circumference of the printed Tactip shell inner lip.
16. Using a piece of BlueTac on the centre of the lens (larger face) assemble the lens into the shell.
17. With a clean, gloved finger press the lens to ensure it is flush with the lip.

    ! Be careful not to wipe glue across the lens !
18. Run a sealing line of glue around the lens shell interface.

    ! Check the lens for excess or over-spill. Light glue marks can be removed with IPA and a cotton bud. A patch test should be carried out before acetone is used !
19. Leave to cure at room temperature (moisture cure) for a minimum of 30 minutes.

2.3 Fill With Silicone

Conditions and Prerequisites

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- Training on the vacuum chamber completed and signed-off
- Wear fresh gloves
- TacTip with lens glued in
- TacTip hole plug
- Techsil RTV27905 Parts A and B
  - ∼20g of silicone (10g:10g) is required to fill a standard ⌀ hemispherical Tactip
- Single-use vesicle and stirrer
- Weighing scales to 0.1g resolution
- 20ml syringe (leur lock ideally)
- 17 gauge needle

2.3.1 Prepare Silicone

20. In a single use vesicle on a zero-ed weighing scale slowly add the Techsil PartA and PartB in 1:1 ratio by weight.

    ! Techsil RTV27905 has a ∼30 mins functional working time once mixed !

21. Stir the two parts slowly and deliberately for 3 mins to minimise air inclusions.

22. Turn Vacuum Chamber on via the red safety twist knob on the right side of the chamber - ensure the safety button is open.

23. Once the MCP screen appears, press the blue reset button on the right side of the chamber.

24. Touch the touch screen to see the menu and Select *Manual*.

25. Place silicon mix inside the chamber and close the door firmly.

26. Press *Pump* to turn the vacuum pump on and depressurise.

27. Wait and until chamber reaches 0mbar (∼1.5 mins) and then press *Pump* again to turn vacuum pump off.

28. To agitate, or bump, any remaining submerged or surface bubbles, vent the chamber *Fast* until 50 mbar before depressurising again with *Pump*.

29. Fully re-pressurise the vacuum chamber by pressing both leak *Slow* and *Fast*.

30. Once the chamber is at atmospheric pressure the door will be openable.

31. Turn the chamber off by twisting red safety knob.

32. Leave the door open when not in use to preserve the door seals.

2.3.2 Fill and Cure

33. Fully submerge the syringe tip in the silicone mix

34. Draw the silicone into the syringe slowly minimising any intake of air

35. Wipe the syringe down removing any external excess silicone

36. Screw/ push on the needle securely

37. Put the needle in the Tactip port

38. Holding the Tactip with the port vertically upwards, eject the silicone in slowly allowing the displaced air to escape

39. Once full, withdraw the syringe and install the plug firmly.

    ! An elastic band wrapped round the Tactip across the plug works well to hold it in securely during curing !

40. Place carefully into the 40°C oven (on a cure support if available) for minimum 24 hours (recommended maximum 48 hours)

2.4 Clean and Secure

Conditions and Prerequisites

- Wear fresh gloves
- Prepare your work space with disposable surface protection (e.g blue roll)
- Tactip skin printed, cleaned, dried, filled and cured
- Super Glue with 20 gauge hollow needle attached

41. Remove any support and/ or binding used during curing.
42. Wire away any excess or overspill silicone filling.
43. Remove the Tactip hole plug.

    ! This should come away easily !
44. Apply a small amount of superglue to the rim of the Tactip fill hole.
45. Re-insert the hole plug, wiping away any excess glue.
46. Leave to cure (moisture) for 30minutes
47. Check and clean the Tactip lens.

    ! Light glue, oil and finger marks can be removed with IPA and a cotton bud/ blue roll. A patch test should be carried out before acetone is used !

Congratulations, Your Tactip is now ready!