

Titanium End Segments Gluing Procedure – Overview

At OceanGate:

1. Measure the ID and OD of the clevis of the AFT and FWD Titanium end segments. Verify that their measurements are within tolerances
2. **Compile equipment** needed for the adhesion process (see list in separate document)
3. Load titanium end segments, old CF hull, domes, and equipment and deliver to Electroimpact the day before the new CF hull arrives at Electroimpact

At Electroimpact:

The titanium end segments and domes (before hull arrives):

1. Receive crane training from Electroimpact employee Nicholas Heacox
 - a. Unload the titanium end segments, old CF hull, domes, and equipment at Electroimpact during training days
2. Set the end segments and domes out of the way so the truck may back into the building the next day to unload the CF hull with the overhead crane
3. Set the AFT Titanium end segment down on cardboard on the ground so that it is resting on its seal face
4. Cover the bond surface of the segments to protect from foreign contaminants with aluminum foil

After the CF hull arrives – ~Thursday, January 28th and onward:

Prep the Carbon Fiber Hull

1. Label one end of the CF hull “FWD” and the other side “AFT” with blue tape
2. Degrease the FWD and AFT bond surfaces of the CF hull (see detailed procedure)
 - a. Record the contact angle throughout wiping process
3. Use procedure to check the abrasive for stearates or other contaminant before Step 4
4. Lightly roughen the bond surfaces of the carbon fiber using an abrasive
 - a. Do not expose reinforced fibers
5. Wipe bond surfaces of CF hull using MEK or Toluene
6. Use procedure to confirm that the compressed air for blowing particulates is clean and dry before Step 6
7. Blow particulates off of the CF hull using clean, dry compressed air

Prep the AFT Titanium End Segment

1. [Degrease](#) the bond surfaces of the AFT titanium end segment ([see detailed procedure](#))
 - a. Record the contact angle throughout wiping process
2. [Use procedure to check the abrasive](#) for stearates or other contaminant before Step 3
3. Lightly roughen the bond surface of the AFT segment using an abrasive
4. Degrease the bond surfaces of the AFT titanium end segment one final time
 - a. Check Surface Analyst reading throughout degreasing process. Continue until Surface Analyst yields desirable results

Final Prep Before Adhering CF Hull to AFT Segment

1. [Review the Hysol document](#) to familiarize yourself with use and application of the adhesive
2. Gather adhesive materials and shims
3. Lift the CF hull
4. Lower hull onto dunnage. Protect the CF hull from coming in contact with the dunnage by covering the contact points in Aluminum foil
5. Degrease and prep the AFT CF hull bonding surface one final time
6. Mix the adhesive
7. Lift the CF hull
8. Use blue tape on CF hull and AFT segment to protect areas where adhesive should not be applied
9. Use a stiff brush or small towel to coat bonding surfaces on CF hull and AFT segment
10. Coat vertical height/circular shims with adhesive and install on AFT segment
11. Lower the AFT end of the CF hull into the AFT Titanium end segment
12. Use the circumferential, rectangular shims outside of the CF hull so it is roughly axially centered within the AFT segment
13. Wipe off excessive adhesive that pushes out of the gap
14. Remove all 10 rectangular shims before the adhesive dries

POTENTIALLY: Install Lifting Points on AFT Segment for Alignment with FWD Segment

1. Install the lifting points on the AFT segment. These will be used to guide the alignment while the FWD segment is lowered later

Prep the FWD Titanium End Segment

1. [Degrease](#) the bond surfaces of the FWD titanium end segment ([see detailed procedure](#))
 - a. Record the contact angle throughout wiping process
2. [Use procedure to check the abrasive](#) for stearates or other contaminant before Step 3
3. Lightly roughen the bond surface of the FWD segment using an abrasive
4. Degrease the bond surfaces of the FWD titanium end segment one final time
 - a. Check Surface Analyst reading throughout degreasing process. Continue until Surface Analyst yields desirable results

Adhering FWD Segment to Vertical CF Hull

1. Gather adhesive materials and shims
2. Degrease and prep the FWD CF hull bonding surface one final time
3. Mix the adhesive
4. Use blue tape on CF hull and FWD segment to protect areas where adhesive should not be applied
5. Lift the FWD segment
6. Use a stiff brush or small towel to coat bonding surfaces on CF hull and FWD segment
7. Coat vertical height/circular shims with adhesive and install on CF hull
8. Lower the FWD segment toward the vertical CF hull
9. **Use tools to ensure the FWD segment is properly aligned with the AFT segment**
 - a. Use Plumb Bob or laser method, or horizontal lifting beams if they are attached
10. After proper alignment has been confirmed, fully lower FWD segment onto vertical CF hull
11. Use the circumferential, rectangular shims outside of the CF hull so it is roughly axially centered within the FWD segment
12. Wipe off excessive adhesive that pushes out of the gap
13. Remove all 10 rectangular shims before the adhesive dries
14. Lift and lower additional clump weight on top of FWD segment. Layout and secure the clump weight to the FWD segment so it is safe for people to climb in and out of the vertical hull without risk of the clump weight dropping on them

Allow Hysol EA 9394 adhesive to cure for 3 to 5 days

Setup Safe Environment for Team to Glue AE and Strain Sensors Inside of Hull

1. Lift and lower ladder into center of CF hull
 - a. Ensure that it is not leaning on the hull or either end segment
2. Setup self-standing ladder outside of CF hull
 - a. Or use 2-person lift – get lessons from Electroimpact employee on how to use
3. Setup lights (or give lights) to the people who will be climbing into the vertical hull
4. Double-check that the clump weight on top of the FWD segment is secure
5. Setup method for people to reach from the outside ladder to the inside, and vice versa
 - a. Potential walkway or place for people to step in-between the two ladders?