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SDC Production Epoxy Use

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ABSTRACT

We summarize the amounts and task lengths of the various epoxies used in the construction of SDC2R and project our needs for the remaining straw tracking chambers. With the result we can calculate the minimum amount of time required for application and curing of all the epoxies that go into a chamber. Assuming the straw-straw lamination sessions occur on the same days as straw installation they only contribute one day to the total time requirement. The structural epoxies take two days per view for four days total. Spot gluing the pins takes about one hour per end per view for application and less than 12 hours to cure for a total of two days. The RTV for pin gas sealing takes one long day in 4 two-hour sessions. Since the frame caulking for He seal can take place during stringing or other tasks the total time which must be alloted for gluing is

$$1 + 4 + 2 + 1 = 8 \text{ days}$$

1. Dispenser Settings and Procedures

There are some general tips to keep in mind when using the EFD dispenser to apply epoxies. You will sometimes need to gradually increase dispensing pressure to continue to use a thickening batch of epoxy. The dispenser's vacuum pressure (right-hand knob and gauge) is used keep fluid epoxies from dripping between spots or between applications. As the epoxy thickens the vacuum pressure must be *decreased* to maintain spot size. It is common (and dismaying) to discover that your spot size has shrunk to nil in the middle of an x-view traverse.

Here are the epoxy-application tasks required to build a straw chamber:

1.1. straw-to-straw lamination

Straws are held together within an array through spot aplication of Epo-Tek 301-2, a very liquid epoxy with an 8-hour pot life and two day cure. Its mix ratio is 1:0.35 A:B by weight. You will usually find the part A to be crystallized; it must be heated for 15 minutes or so to clear — we use a heat gun aimed at the can. Try to keep it below 50°C. Allow to cool before mixing.

An orange metal tip is bent to a 45° angle to attain access to the inside epoxy sites in the straw array. Start with 10 psi dispensing pressure and a pulse setting of "0". You may need vacuum pressure to keep the epoxy from dripping between pulses. Between each visible pair of straws there are three epoxy sites: behind-left, behind-right and the visible tangent. Carefully put a spot of epoxy at each tangent. We do not attempt to get between the straws in the middle layer.

The epoxy is applied in rows roughly centered between the straw array supports — the endplates and the three corrals — for a total of 4 rows. There is enough clearance on the x-view stand to apply two rows of epoxy from above and below the stand. The other two rows on this side are applied at some point when the chamber is off the stand. Since the y-view is only two layers and it is removed from the stand to attach to x there is no need to epoxy from above or below the stand.

1.2. straw-endplate potting

Once the straw arrays have been laminated and the two views attached to form a complete frame the electrical and structural contact between straw and frame is made by applying Epo-Tek 410E conductive silver epoxy.

Purple tip, 40psi delivery pressure, 2 or 3-s count for the inside cavities; 25psi for outside. For y we used the purple tip with 30psi and a 3-s count. Since the y view has only two layers a 2-s count is used on the second side. The dispenser tip is bent 45° approximately 2mm from the end to access the cavities directly behind the straw in the outside plane. In each gap work the tip in and left, count for 3s, go in and right, count for 3s and then fill the visible gap between straw and endplate. You should note how the inside is filling by looking through the next gap and by observing whether the epoxy backs

up when you approach an inside cavity from the next gap. Any epoxy left after potting should be used to fill the endplate segment gaps.

Getting to the backside requires either removing the chamber from its stand or, in the case of x, crawling under the granite table (it's accessible but it hurts your head).

1.3. endplate segment joining

This task is done when the segmented endplate is at the top. The gaps between segmented endplates need to be filled for two reasons: the nearby straws need ground points and the gas manifold must be sealed.

Use Epo-Tek 410E to form a ground surface immediately around and between the "gap" inserts. This should be done with left over epoxy from the straw-endplate potting (you can use the same tip). Just plug the active-area side of the gap with tape — something removeable like purple electrical tape — and squirt some silver epoxy into the slot against the ultem inserts there. Fill the slot between these inserts.

The remainder of the seal is made with filled Tra-Bond 2143D.

1.4. inside manifold seal

If the segmented endplate is at the top you must seal the gaps betweeen segments first. The inside manifold seal ensures that no gas escapes the manifold around the ultem inserts. We apply unfilled Tra-Bond 2143D around each ultem insert in the manifold, making sure to put a continuous bead down around the insert. Use a purple tip and start with 40psi. As the epoxy thickens you will need to increase the pressure but remember that above 60psi you risk the syringe tip popping off, ejecting the entire batch of epoxy. *Do not allow the tip or any epoxy to touch the upper portion of the inserts. Clean off any epoxy spilled there.*

1.5. manifold coverplate gluedown

green tip, 10psi; clamp down the plate. After the manifold has been sealed inside put a bead of Epo-Tek 410E silver epoxy around the manifold cavity where the coverplate will rest. The bead can be small but make it continuous. Gently fit the coverplate on over the inserts, pressing evenly along the entire length (be patient). If you are done for the day clamp this plate down or remember to do so after the outside manifold seal is complete (but before this silver epoxy has cured).

1.6. outside manifold seal

green tip, 40-60psi. Once the coverplate is glued down the manifold seal can be completed. Mix enough microballoon filler into one packet of Tra-Bond 2143D so that it just barely flows off an upheld spatula (scoop up a blob of the mix and lift a spatula. I think the stuff should slowly stretch down to where it might actually drop). Start with 40psi and dispense the filled epoxy around each insert. As the epoxy thickens you will need to increase pressure but keep below 60psi. Again, *do not allow the epoxy to touch the upper portion of the inserts.*

2. Post-Wiring Procedures

2.1. Spot Gluing

After the chamber has been strung and tested for tension and high-voltage standoff we spot epoxy the wire ends into position as a backup to the collar system.

Dispense a spot of Fibre-Glast 87/88 epoxy (40psi; orange tip; #4 pulse setting; small vacuum pressure) at the pin/ultem interface where the wire exits. This should be at the flat side of the pin and the spot should be large enough such that the epoxy immediately spreads to cover at least half the pin/ultem seam. The mix ratio of 88:87 is 5:1.

This step is performed on the top set of pins; after 12 hours rotate the chamber 180° to get the other end of the view. Spot gluing therefore takes 2 days for all but SDC3, where it takes 1.

2.2. Pin/ultem Seal

Dow 3110 two-part RTV encapsulant is applied around each installed pin to form a gas seal. After the chamber has been spot-glued, seal the top end of the vertical set of wires with 3110 at 10-20psi dispensing pressure and a purple tip. To form the seal place a thick bead of RTV on the ledge formed by the collar surrounding the pin. Make sure enough RTV is applied to completely cover the top of the ultem feedthrough and the seam between it and the pin.

3. Insert Gluing Procedure

3.1. Mix epoxy

Zero the balance with the empty Pyrex dish on the pan. Remove the dish, stir the part A and drop about 2.5?g into the dish. Note the reading and zero the balance with the dish+part A on the pan. With the dispenser at 10 psi and pulse mode add a few drops of part B. Weigh and gradually add more part B until you have a 10:1 mix of A to B. Wipe away any spills on the balance, turn off the display and cover. Stir the epoxy and note the time and amount mixed in the logbook.

3.2. Load Syringe Barrel

Use a spatula to scrape epoxy out of dish and into 3-cc barrel. Carefully insert a wiper piston into the barrel and press slowly toward the tip with the tip pointing upward. This should ensure no air is trapped inside the barrel. Wipe both ends of the barrel with a dry Kimwipe and attach to dispenser line. Attach a pblue tip.

3.3. Flip Straws

(2nd session only) Stand on the ladder, gently grasp a straw near its top end and pull directly upward. The lower end may catch in the frame. Flip the straw using both hands near the ends of the straw, cradling it to prevent crushing or bending. Reinsert vertically into the stand. Do not allow the straw to strike the Teflon sharply.

3.4. Install inserts into Teflon

Press from above to avoid catching some glove in the Teflon hole. Leave a few millimeters above the Teflon.

3.5. Apply epoxy to sleeves

Lay a generous bead of epoxy in each of the two grooves in the gold-plated sleeve. Hold the dispenser tip against the sleeve while turning the ULTEM with your other hand. Depress the pedal after you've started turning and release before you stop (where you started). Use about 20-psi dispensing pressure (lower if you're slower).

3.6. Fit straws onto inserts

Carefully slide the straws down over the sleeves until the straw's bottom edge is aligned with the sleeve's bottom edge. Grasp the straw a few inches above its end.

3.7. Remove excess epoxy

Turn the ULTEM and straw from below with one hand while gently scraping excess epoxy off the straw with a small spatula. Then wipe any remaining epoxy off the straw with a small Kimwipe. Don't tear the Kimwipe or you will produce dust.

3.8. Position inserts

Pull the ULTEMs down until the sleeves contact the Teflon and turn for the small notches to face forward (toward you).

3.9. Align inserts

(2nd session only) Hold the bottom ULTEMs you just positioned and gently turn the straw so that the upper ULTEMs' marks face you, so that all the marks face in the same direction.

3.10. Position straws

Examine the bottom edges of the straws. If a straw is not down to the Teflon gently slide it down. DON'T PRESS THE STRAW AGAINST THE TEFLON; YOU MAY DISTORT THE END AND AFFECT THE INSERT ALIGNMENT.

3.11. Clean up!

Wipe out the mixing dish, clean off all spatulae and all surfaces. Remove your syringe barrel from the dispenser and *clean the end of the dispenser line.* Log your finishing time and any comments, such as damaged straws or funky inserts/materials. Anything you feel like saying, log it! And put your initials.

A. Epoxy usage for SDC2R

Table A.1: Recorded epoxy use for SDC2Rx

Date	Task	Epoxy	Batches	Duration	Amount
10/21	straw-straw lamination	Epo-Tek 301-2	2	4:30	2g
11/3	straw-straw lamination II	Epo-Tek 301-2	1	0:55	?g
11/4	straw-endplate potting I	Epo-Tek 410E	1	2:45	15g
			2	0:40	6
			3	?	3
			total	3:25	24g
11/4	inside manifold seal I	Tra-Bond 2143D	1	1:20	1 kit
11/5			2	1:10	1
			3	1:15	1
			total	3:45	3 kits
11/5	coverplate gluedown I	410E	1	0:30	1.5g
11/5	outside manifold seal I	2143D	4	3:40	4 kits
11/6	straw-endplate potting II	Epo-Tek 410E	1	1:00	9g
			2	0:50	9
			3	0:50	9
			total	2:40	27g
11/6	endplate segment joint	Epo-Tek 410E	1	1:10	3g
			2	0:10	6
			total	1:20	9g
11/6	inside manifold seal II	Tra-Bond 2143D	1	1:30	1 kit
11/6			2	1:05	1
11/7			3	1:40	1
			total	4:15	3 kits
11/5	coverplate gluedown II	410E	1	0:20	1.5g
11/5	outside manifold seal II	2143D	1	0:45	1 kit
			2	1:00	1
			total	1:45	2 kits

Table A.2: Recorded epoxy use for SDC2Ry

Date	Task	Epoxy	Batches	Duration	Amount
11/2	straw-straw lamination	Epo-Tek 301-2	2	2:20	1.35g
11/10	straw-straw lamination II	Epo-Tek 301-2	1	1:00	1.35g
11/10	inside manifold seal I	Tra-Bond 2143D	3	¿:30	?
11/24	straw-endplate potting I	Epo-Tek 410E	1	0:20	6g
			2	?	6
			total		12g
11/24	coverplate gluedown I	410E	1		
11/26	outside manifold seal I	2143D	1	0:50	1 kit
			2	0:50	1
			total	1:40	2 kits
11/26	seal around manifold cover	2143D	1	0:25	1 kit
11/27	straw-endplate potting II	Epo-Tek 410E	1	0:22	6.64g
			2	0:48	6.64
			3	0:50	6.64
			total	2:00	19.92g
11/27	endplate segment joint	Epo-Tek 410E	1	0:30	1.5g
11/28		Tra-Bond 2143D	1	0:40	1 kit
11/27	inside manifold seal II	Tra-Bond 2143D	1	1:15	1 kit
11/27			2	1:25	1
11/28			3	0:45	1
			total	3:25	3 kits
11/28	coverplate gluedown II	410E	1	0:40	3g
11/5	outside manifold seal II	2143D	1	0:50	1 kit
			2	1:00	1
			total	1:50	2 kits

Table A.3: Total of each type of epoxy used in SDC2R. To get the amount of 410E on hand I weighed the new and opened containers of part A:

$$m_{new} = 454.5\text{g}; \qquad m_{open} = 261.5; \qquad m_{used} = m_{new} - m_{open} = 193.0\text{g}$$

Since we started with two 1-lb kits we have about $453.6 \times 2 - 193.0 = 714$g

Epoxy	Amount	$\times 7$	on Hand	to Order
Epo-Tek EP110				1lb
Epo-Tek 410E	110g	770g	714g	1lb = 454g
Epo-Tek 301-2			(plenty)	
Tra-Bond 2143D	23 kits	161 kits	76 kits	200 kits