

Fabrication Procedure for the HYTEC DOE/SBIR Sector

William K. Miller
August 28, 1999

Abstract

This procedural document details the bond fabrication and final machining procedure for the HYTEC DOE/SBIR Sector.

Table of Contents

1. Introduction.....	3
2. Dimensional check of individual components.....	3
2.1 Cooling Tube	3
2.2 Facings, Bushings and Washers	3
2.3 Tube Reinforcement Parts.....	4
3. Pre-weigh all components	4
4. Pre-clean all components	4
4.1 Clean Sector parts.....	4
4.2 Clean fabrication jig	4
5. Bond procedure	4
5.1 AIT Technology adhesive.....	5
5.2 Bond Facing #1 to Cooling Tube.....	5
5.2.1 Position Facing #1	5
5.2.2 Pre-position the Cooling Tube Jigs	5
5.2.3 Pre-Position Tube on Facing #1	5
5.2.4 Apply adhesive to Carbon Tube	6
5.2.5 Position Tube on Facing #1	6
5.2.6 Coverplate.....	6
5.2.7 Curing adhesive	6
5.2.8 Weigh assembly	6
5.3 Bonding Facing #2.....	6
5.3.1 Apply adhesive to Carbon Tube	6
5.3.2 Prep the Bushings.....	7
5.3.3 Insert the Bushings.....	7
5.3.4 Install Facing #2.....	7
5.3.5 Rotate the Bushings.....	7
5.3.6 Remove excess adhesive	7
5.3.7 Install the Coverplate	7
5.3.8 Curing adhesive	7
5.3.9 Weigh assembly	7
5.4 Bond Carbon Washers	7
5.4.1 Pre-Inspection and prep of surfaces	8
5.4.2 Apply adhesive Carbon Bushings and Facings.....	8
5.4.3 Position the Washers	8
5.4.4 Remove excess adhesive	8
5.4.5 Put assembly in jig	8
5.4.6 Curing adhesive	8
5.4.7 Weigh assembly	8
5.5 Bonding Cooling Tube Reinforcement Parts.....	8
5.5.1 Installing the Carbon Cooling Tube Cut Jigs	9

5.5.2	Cut Carbon Tubes to length.....	9
5.5.3	Magnolia 24-4 adhesive.....	10
5.5.4	Bonding Carbon Tube Aluminum Sleeve.....	10
5.5.5	Cutting the Carbon Tube and Aluminum Sleeve.....	10
5.5.6	Weigh Assembly	10
5.5.7	Pressure check Sector Tube	11
5.5.8	Machine Sector	11
5.5.9	Weigh Assembly	11
5.5.10	Bond on Aluminum Reinforcement Part	11
5.5.11	Weigh Assembly	12
5.5.12	Bond on Aluminum Sector 90 degree Head	12
5.5.13	Weigh Assembly	12
5.6	Dimensional Check	13

1. Introduction

Fabrication of a HYTEC Sector includes pre and post weighing all incorporated materials, bonding the individual components (facings, cooling tube, and reinforcement parts) together with adhesive using an oven bake cure, and then a final machining process to obtain the proper finished dimensions.

2. Dimensional check of individual components

A random sample shall be taken and dimensional checks performed on all components that will be used in the fabrication of the Sector. A visual inspection of all components shall be used to discover latent defects. The Sector Facings thickness and flatness should be measured. All checked dimensions should be recorded for further reference. A data sheet shall be filled out with each fabricated Sector and logged for future reference.

2.1 Cooling Tube

Note: The Cooling Tube is a delicate and expensive part. Always use extreme care when handling it. Never twist or flex it. Bending the tube can break it.

Check the cooling Tube's flatness, height, and straightness. Place it on the granite table. Use a feeler gage or a height gage to record data. Take a few diameter measurements of the tube at various points. Compare these values with previously recorded data (other tubes). Record all data and note any significant variations. Hand trace the Tube on a blank sheet of paper and indicate where dimensions were taken.

2.2 Facings, Bushings and Washers

Record the Facings width and flatness. Record the length and diameter of the Bushings and Washers. Visually inspect the perpendicularity of the Bushing on the granite table. Check any recorded dimensions against drawing specifications.

Note: Check finished Facing width vs. Facing material width. Facings may need to be hand sanded down to their final dimension prior to bonding them to any parts. If Facing must be sanded –equal material must be sanded from each side.

2.3 Tube Reinforcement Parts

Inspect and record the dimensions of the Cooling Tube aluminum reinforcement parts.

3. Pre-weigh all components

Any component that will be integrated into the final assembly of a Sector must be weighed. The components weight should be recorded the nearest tenth of a gram (record in data sheet). Use the precision scale. **Do not forget to calibrate the scale prior to use.** When bonding several Sectors at one time, keep each individual Sector's components separate, so as to track their individual masses correctly.

4. Pre-clean all components

Standard clean procedures must be used prior to bonding. Prepare a clean area for bonding. Rubber gloves must be worn during the clean procedure and at all times after the parts have been cleaned. Skin oils deposited on the parts can interfere with bond adhesion.

4.1 Clean Sector parts

Isopropyl Alcohol and a clean wipe should be used to wipe down all parts prior to bonding. Use new wipes frequently. Place parts on a clean surface, or clean bag in preparation for bonding. Any contaminated parts must be re-cleaned.

4.2 Clean fabrication jig

Use Isopropyl Alcohol to wipe down the Sector fabrication jig parts (Baseplate, Coverplate, and Tube centering jigs) necessary for bonding. Handle the Sector fabrication jigs using appropriate clean procedures.

5. Bond procedure

The Sector is bonded together in separate steps. Each step involves critically locating parts, applying adhesive and then curing the adhesive in climate controlled

convection oven. The subassembly is then allowed to cool and then is repeated until the bonded Sector assembly is complete.

5.1 AIT Technology adhesive

AI Technology, EG7658, a two part epoxy adhesive is used to bond the coolant tube to the Sector's facings. It is an aluminum nitride, filled adhesive that has good thermal conductivity properties (see MSDS specifications). It can be unmanageable to spread – therefore it can be thinned with MEK. MEK is highly volatile and will quickly evaporate. MEK has been found to be a cancer agent so it must be handled appropriately (see manufacturer specifications). Mix epoxy in a 1/1 part (weight) ratio using a scale.

This epoxy is also expensive, so be careful not to mix too much up at once so as not to waste it. Its room temperature cure time is about 1 week so it may be re-thinned with MEK and used within this time period. It may also be stored in the refrigerator to prolong this cure time.

5.2 Bond Facing #1 to Cooling Tube

The positional relationship between the Facings and the Cooling Tube is important. Pins in the Baseplate are used to locate the Facings. Removable Centering Jigs (pinned to the Baseplate) are used to locate the Tube.

Note: Facing #1 and Facing #2 when in position are mirror images of each other.

5.2.1 Position Facing #1

Place Facing #1 down on the bond Baseplate (note the Facings orientation – see drawing ATLAS-FXT-0020). Slide the Facing down until it's bottom radius indexes on the two bottom pins. While maintaining this contact, rotate Facing #1 until it's right side external notch indexes on the Baseplate's right side pin. Lock Facing #1 down in this position with the Facing lockdown clip on the right side. When done, the Facing should be firmly held in position, and indexed off the two bottom pins and one right side pin. *Check to make sure that the lockdown clip is allowing the facing to sit down flat on the Baseplate.*

5.2.2 Pre-position the Cooling Tube Jigs

After Facing #1 is located and fixed in position, snap the Cooling Tube Tangential Locating Jig (over it's pins) in position. Also put the Cooling Tubes Centering Jig in position and screw it's thumbscrew down loose. The Tube Centering Jig should be able to freely slide up and down when in position. Slide the Centering Jig up to its highest position.

5.2.3 Pre-Position Tube on Facing #1

Place the Cooling Tube down on Facing #1. Slide the Tube down until two of its bottom bends touch the Cooling Tube Tangential Locator. Slide the Tube Centering Jig down until it just registers and centers the top two bends in the Cooling Tube. Do not impart

any force into the Tube with the Centering Jig; the Jig should not force the Tube to bend open slightly. Mark the Tube where it protrudes past the Facing (both places). Remove Tube and push Centering Jig up to its previous position.

5.2.4 Apply adhesive to Carbon Tube

Mix up some of the EG7658 and thin to the desired consistency. Trowel epoxy (in a “V” shape) to one side of the Cooling Tube, approximately 0.6 gm. Remember to be careful because the Tube is an expensive and delicate part. Do not apply epoxy to the Tube in the areas that protrude past the Facing.

5.2.5 Position Tube on Facing #1

Position Tube over Facing #1 (in its nominal position) with epoxy facing Facing #1. Place Tube on Facing #1. Index bottom Tube bends against the Tangential Locating Jig. Slide the Tube Centering Jig down until it tangentially touches the top Tube bends. Just use the Centering Jig to align the Tube in its proper position, do not impart any force into the Tube.

5.2.6 Coverplate

Gently put the Coverplate down onto the Tube and Facing #1.

5.2.7 Curing adhesive

The convective oven should have been pre-heated to a temp of 185°F (85°C) for at least 10 minutes. Place the Jig, the Facing, and the Cooling Tube assembly in the Convective Oven. Apply about 8-10 Lbs. of compressive force to the top of the Coverplate. Cure the assembly in the oven for 1 hour. Remove and allow to cool down before proceeding.

5.2.8 Weigh assembly

Weigh the Tube, Facing #1, and Baseplate Assembly. Do not remove the Tube and Facing from the Baseplate.

5.3 Bonding Facing #2

Epoxy will be applied to the Cooling Tube and then Facing #2 will be placed in position. A reminder: Facing #2 is the mirror image of Facing #1. The alignment between Facing #1 and #2 is critical. Any misalignment between the two Facings can cause the Sector assembly on the Composite Ring to be complicated. The Bushings will also be bonded during this phase of the Sector fabrication.

5.3.1 Apply adhesive to Carbon Tube

Trowel epoxy on top of Cooling Tube as described in Step 5.2.4.

5.3.2 Prep the Bushings

Create a ringed fillet of epoxy, (use temperature curing adhesive like Epotek??), around both ends of the O.D. of the Bushing. Repeat for all 3 bushings.

5.3.3 Insert the Bushings

Place the Bushings in the 3 holes in Facing #1. Push the Bushings down until they bottom on the aluminum bond jigs.

5.3.4 Install Facing #2

Place Facing #2 down on the Cooling Tube (note the Facings orientation). Make sure the both Facing's bottom radii index on the two bottom pins and that the right side external notches on each face index on the Baseplate's right side pin. Observe the adhesive fillet between the Cooling Tube and Facing #2 to determine if there are any voids.

5.3.5 Rotate the Bushings

Twist each Bushing to get a good continuous fillet between the Bushings and the Facings. Closely inspect the fillets between the Bushings and Facings to determine there are no voids. Re-push the Bushings down until they bottom on the aluminum bond jigs.

5.3.6 Remove excess adhesive

Use a square edged scraper to remove any excess adhesive (adhesive fillet) between the outside of Facing #2 and the Carbon Bushing. An adhesive fillet in the corner between these two parts will have to be removed so the Carbon Washers can be correctly bonded in place.

5.3.7 Install the Coverplate

Gently put the Coverplate down onto Facing #2.

5.3.8 Curing adhesive

The convective oven should have been pre-heated to a temperature of 185°F (85°C) for at least 10 minutes. Place the Jig, Facings, and Cooling Tube assembly in the Convective Oven. Apply about 8-10 Lbs. of compressive force to the top of the Coverplate. Cure the assembly in the oven for 1 hour. Remove and allow to cool before proceeding.

5.3.9 Weigh assembly

Weigh the Tube, and Facing Assembly. Mark Bonded Assembly so as not to get multiple Sectors confused.

5.4 Bond Carbon Washers

The Carbon Washers fit on the Carbon Bushing and against the outside of the Facings. It is important to get a good bond using adhesive Epotek??? between the Carbon Washers, the Carbon Bushings, and the Facings.

5.4.1 Pre-Inspection and prep of surfaces

Visually inspect the outside corners between the Carbon Bushings and the Facings. Scrape any excess adhesive from the corners that may prevent the Carbon Washer from sitting flush against both surfaces. Wipe down the surfaces with Isopropyl Alcohol to clean bond area.

5.4.2 Apply adhesive Carbon Bushings and Facings

Mix up some of the Epotek?? and mix to the desired consistency. Apply a light coating of epoxy to the Facings and the diameter of the Carbon Bushings.

5.4.3 Position the Washers

Push the Carbon Washers over the Carbon Bushings. A .004” bond thickness is desired between the outside of the Facings and the Washers. Visually center the Washers around the Bushings. Force adhesive between the Washer and Bushing if voids are visible.

5.4.4 Remove excess adhesive

Carefully remove any excess adhesive from the surfaces. Use a chamfered scraper to scrape around the outside of the Washer. A small adhesive fillet in the corner between the Facings and Washers is desired.

5.4.5 Put assembly in jig

Place the Assembly on the Baseplate. Put the Coverplate on the Assembly.

5.4.6 Curing adhesive

The convective oven should have been pre-heated to a temp of 185°F (85°C) for at least 10 minutes. Place the Jig, Facings, and Cooling Tube assembly in the Convective Oven. Apply about 8-10 Lbs. of compressive force to the top of the Coverplate. Cure the assembly in the oven for 1 hour. Remove and allow to cool down before proceeding.

5.4.7 Weigh assembly

Weigh the Bonded Assembly.

5.5 Bonding Cooling Tube Reinforcement Parts

Reinforcement Parts will be bonded to the Carbon Tube for structural strength. First the Carbon Tube must be cut to length, and then a aluminum Sleeve will be bonded on (over) the Carbon Tube. This Carbon Tube and Aluminum Sleeve sub-assembly will then be cut to length. Another reinforcement part will bond the Facings to the Aluminum Sleeve to provide further strength and stability. Finally a 90 degree Head will be bonded to the end of the Aluminum Sleeve which contains a hose barb (or quick disconnect) for

coolant connections. Magnolia 24-4 (or equivalent) is the bond adhesive used to bond the aluminum Reinforcements Parts together.

5.5.1 Installing the Carbon Cooling Tube Cut Jigs

Note: The Cooling Tubes are extremely delicate. Care must be taken so as to not impart any bending force into the Tubes with the Cutting Jigs. Shim Cutting Jigs as required.

Two Cooling Tube cut jigs need to be assembled on the Bonding Baseplate. One Cooling Tube cut Jig, on the left, will be used to cut the Carbon Cooling Tube to length. The right Cooling Tube cut jig will be used to cut both the Carbon Tube and the aluminum Sleeve after they have been bonded together.

5.5.1.1 Position Bonded Sector Assembly on Baseplate

Place bonded Sector Assembly on the Bond Baseplate.

5.5.1.2 Install clamp spacer , washer, and bottom of clamp

Loosely assemble Spacer, Washer, and Bottom half of Clamp to Baseplate using two #4-40 screws.

5.5.1.3 Align clamp to tube

Move radius of Clamp to be tangential to Sector Facings. Orientate Clamp to line up with Cooling Tube. Clamp down Spacer, and Washer using Screws.

5.5.1.4 Shim clamp

The Clamp is now oriented correctly with the Tube, but it may not be set to the correct elevation. If the Clamp is not at the correct vertical elevation it will impart a bending force into the Tube and will break it. Place shims between the bottom half of the Clamp and the Spacer to bring the Clamp to the correct elevation.

5.5.1.5 Finish clamp assembly

Install top half of Clamp using four #4-40 screws. Torque screws finger tight using a allen wrench.

5.5.2 Cut Carbon Tubes to length

Only one Carbon Tube can be cut at a time. Cut one Carbon Tube in the Clamp, unbolt the clamp, flip the Bonded Sector Sub-assembly and cut the second Carbon Tube.

Note: Eye protection and a filter mask must be worn.

5.5.2.1 Cut Carbon Tube #1

Using a new Dremel tool cutting aluminum oxide cutting disk, carefully slice the Carbon Tube to length. The cutting disk is guided by the slot in the Clamp.

5.5.2.2 Cut Carbon Tube #2

Unbolt Clamp. Flip Bonded Sector Assembly. Bolt Clamp and cut Carbon Tube #2.

5.5.2.3 Clean Carbon Tube

Using a can of compressed air, stick the nozzle tube down halfway into the Carbon Tube. Blow air through the Cooling Tube. Repeat this process with the other side of the Cooling Tube. Visually inspect the Carbon Tube for carbon particles, and inspect the cut for problems.

5.5.3 *Magnolia 24-4 adhesive*

Magnolia 24-4 epoxy is a 2 part room temperature curing adhesive. Each part of the epoxy initially is transparent but becomes opaque when mixed. Mix epoxy in a 1/1 ratio by weight using a scale. Epoxy cure time approximately 24 hours.

5.5.4 *Bonding Carbon Tube Aluminum Sleeve*

5.5.4.1 Apply adhesive

Apply a generous amount of adhesive to the outside diameter of the Cooling Tubes where they extend past the Sector Facings.

Note: Be careful not to get adhesive in the Carbon Tube.

5.5.4.2 Install aluminum Sleeves

Slide and twist a aluminum Sleeve over the Carbon Tube. Try to concentrically center the Sleeve over the Tube to maintain a continuously uniform bond with free of voids. Bottom the Sleeve on the Carbon Tube. Repeat for second Tube.

5.5.4.3 Remove excess adhesive

Wipe off all excess adhesive at base of Sleeve.

5.5.4.4 Curing adhesive

The bonded Sector assembly should be set upright for the 24 hour curing period. *If a sector was cured on its side gravity would pull the Sleeve down to touch the Tube tangentially thus removing the potential for a concentric bond.*

5.5.5 *Cutting the Carbon Tube and Aluminum Sleeve*

The procedure for cutting the Carbon Tube with the aluminum Sleeve bonded on is the same as used to cut the Carbon Tube. See Steps 5.5.1.1 to 5.5.2.3. . Remove any aluminum burrs with a knife. Visually inspect the cut Tube ends for bond voids. Apply adhesive to any visible voids as necessary and cure for 24 hours.

5.5.6 *Weigh Assembly*

Weigh the bonded Sector assembly.

5.5.7 Pressure check Sector Tube

Pressure check Sector Tube to 15 Psi. Connect rubber tubing to both ends of the Sector. One end of the rubber tubing runs to a regulator and air source, the other end will be capped off. Place the Sector under water. Slowly increase the air pressure using the regulator. Constantly rotate the Sector around under water and observe any small bubbles that may be collecting on the Carbon Tube. Look for bubbles at the base of the Aluminum Sleeve where it meets the Sector Facings. Record any potential leaks and the maximum pressure achieved (15 Psi).

5.5.8 Machine Sector

The Sector's finished mounting hole features are machined at this stage. The Sector is positioned (see Step 5.2.1) on the Machining Baseplate (the machining baseplate has through holes instead of counterbores where the Carbon Washers are located). The Coverplate is placed on top of the Bonded Sector Assembly. Four Thumbscrews draw the Coverplate down finger tight.

The machine shop uses the Baseplate surfaces to define the precise locations of the mounting holes. The machine shop also uses the Baseplate and Coverplate face as the Datum from which the washes are machined to their finished thickness.

5.5.9 Weigh Assembly

Weigh the machined Sector assembly.

5.5.10 Bond on Aluminum Reinforcement Part

The Aluminum Reinforcement part is used to structurally reinforce the Cooling Tube to the Facings to prevent breaking the Tube off as it projects out past the Facing. It is adhesively bonded to the O.D. of the Aluminum Sleeve and to the outside of the Facings.

5.5.10.1 Remove excess Adhesive

Visually inspect Bonded Sector for excess adhesive on Sector Facings and the O.D of the Aluminum Sleeve. Slip the Aluminum Reinforcement part in place to check for obstructions. Scrape or sand any excess adhesive away.

5.5.10.2 Prepare bond surfaces

Wipe Sector bonding surfaces with Isopropyl Alcohol. Thoroughly clean the Aluminum Reinforcement parts with Isopropyl Alcohol.

5.5.10.3 Apply Adhesive

Outline areas adhesive is necessary. Apply adhesive to Sector Facings and O.D. of Aluminum Sleeve (next to Facing). Slide Reinforcement piece over aluminum sleeve into position. Bottom Reinforcement part against Facings. If there is some clearance between the Aluminum Reinforcement part slot and the outside dimensions of the Facings, make

sure that there is no angular clocking between the two parts and that the outside surface of the Reinforcement part is parallel to the outside surface of the Facings.

5.5.10.4 Remove excess Adhesive

Wipe off all excess adhesive.

5.5.10.5 Curing Adhesive

The bonded Sector assembly should be set upright for the 24 hour curing period.

5.5.11 Weigh Assembly

Weigh the Sector .

5.5.12 Bond on Aluminum Sector 90 degree Head

The Sector Head must be bonded on the Tube end and face the correct direction. See Hytec drawing HYT-ATLAS-0030 for reference. The profile of the top Facing identifies the correct bond direction for the Sector Head.

5.5.12.1 Remove excess Adhesive

Visually inspect the Sector O.D of the Aluminum Sleeve for excess adhesive. Scrape or sand any excess adhesive away.

5.5.12.2 Prepare bond surfaces

Wipe end of Aluminum Sleeve with Isopropyl Alcohol. Thoroughly clean the Aluminum Sector Head parts with Isopropyl Alcohol. Wash bonded surface with a caustic alkaline solution like Alconox just before bonding. Final wash with distilled water and blow dry. Bond tube connections immediately after.

5.5.12.3 Apply Adhesive

Outline areas adhesive is necessary. Apply adhesive to end of Aluminum Sleeve. Be careful not to get adhesive in Tube. Slide Sector Head over Aluminum Sleeve and twist it 360 degrees to thoroughly mix adhesive. Bottom Sector Head on end of Sector Tube. Make sure that the Sector Heads are orientated perpendicular to the Sector Facing and that the bond between the two parts is concentric.

5.5.12.4 Remove excess Adhesive

Wipe off all excess adhesive.

5.5.12.5 Curing Adhesive

The bonded Sector assembly should be set upright for the 24 hour curing period.

5.5.13 Weigh Assembly

Weigh the final Sector assembly.

5.6 Dimensional Check

Measure the Sector dimensions as a final check. Measure the Bushing/Washer through hole locations, the and the Facings flatness.



Sector Fabrication Data Sheet

1. Introduction

This document is a data sheet for the fabrication of a Hytec Sector. Hytec's Fabrication procedure document has detailed instructions on the fabrication of a Sector.

Hytec Sector No.	Date

Hytec Drawing No.	REV

2. Dimensional check of individual components

2.1 Cooling Tube

	Side A (Avg.)	Side B (Avg.)
Flatness		
Diameter		n/a

2.2 Bushings

	#1	#2	#3
Height			
Diameter(s)			

2.2 Washers

	#1	#2	#3	#4	#5	#6
Height						
Diameter(s)						

2.2 Facing Dimensions

	#1	#2
Thickness		
Flatness		
Misc.		

2.3 Aluminum Sleeves

	#1	#2
Length		
Diameter(s)		

2.3 Facing Reinforcement parts

	#1	#2
Slot width		
Diameter		
Misc. Dims		
Misc. Dims		

2.3 Cooling Tube 90 Sector Head

	#1	#2
Counterbore		
Misc. Dims		
Misc. Dims		
Misc. Dims		

3.0 Weights of Individual components

Part	Weight (gm)					
Facings						
Bushings						
Washers						
Tube						
Aluminum Sleeves						
Alum Reinforcements						
Tube 90 Heads						

5.2.8 Weight of Facing #1 and Cooling Tube

(gm)

5.3.9 Weight of Facings, Bushings, and Cooling Tube

(gm)

5.4.7 Weight of Facings, Bushings, Tube and Washers

(gm)

5.5.6 Weight of Bonded Assembly and Alum. Sleeves Cut

(gm)

5.5.7 Pressure check Carbon Tube

	Comments
Pressure 10 psi	

5.5.9 Weight of Machined Sector

(gm)

5.5.9 Weight of Sector with Alum. Reinforcements

(gm)

5.5.12 Weight of Finished Assembly

(gm)

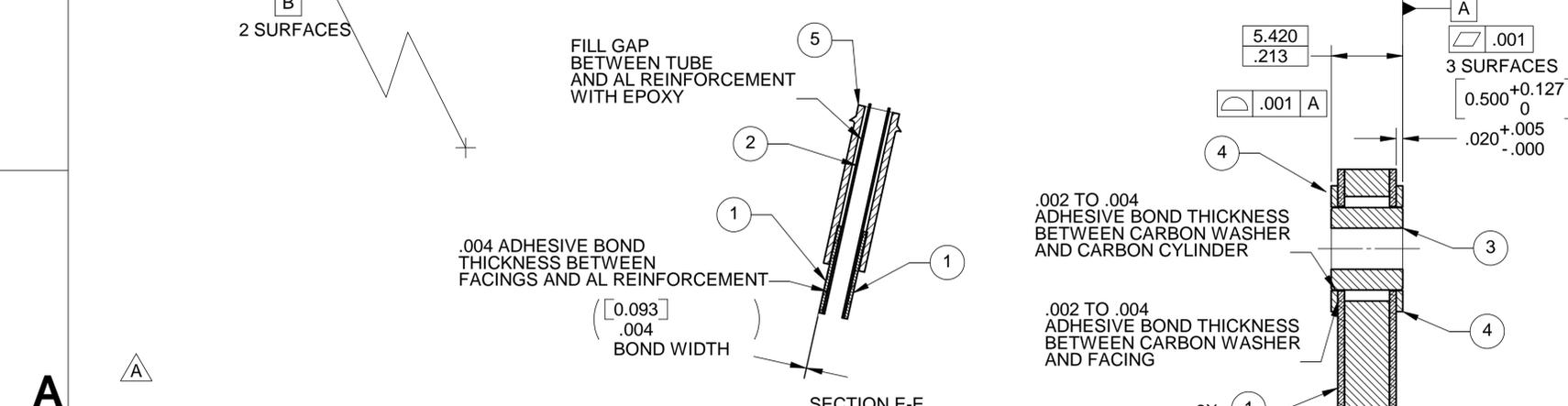
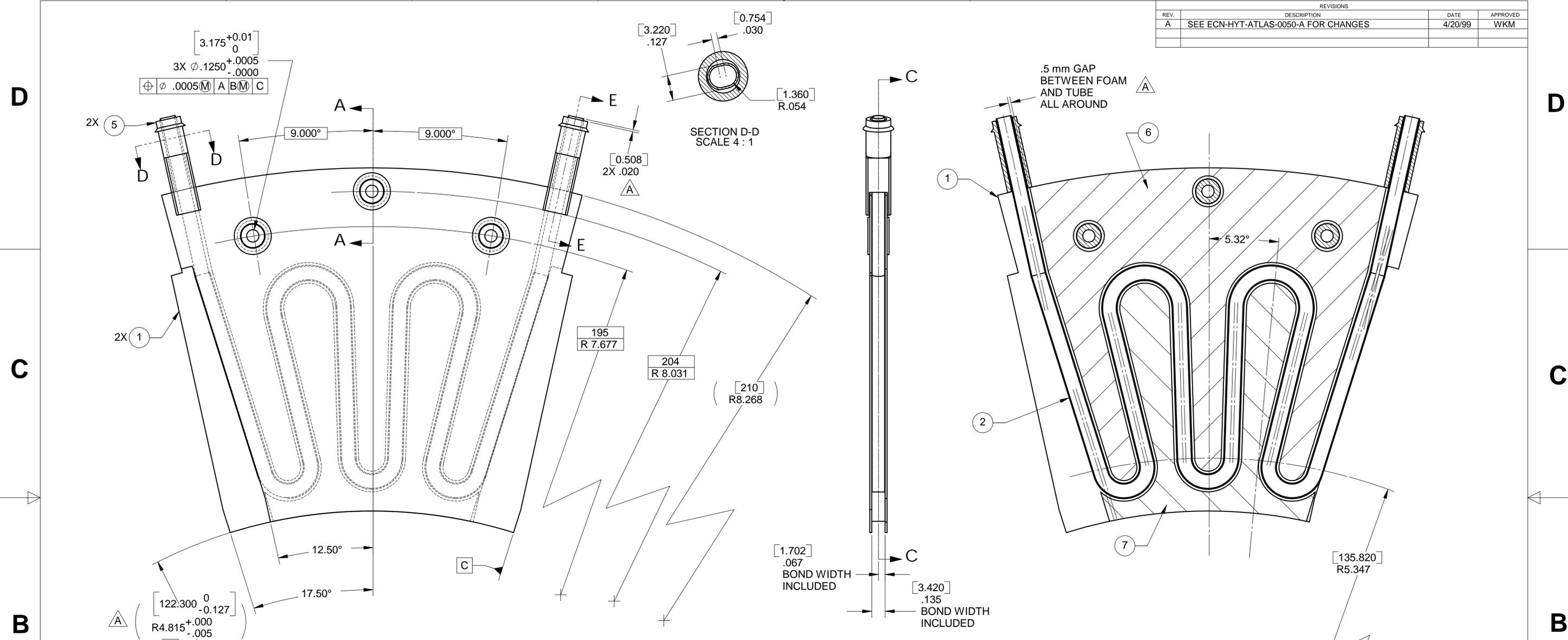
5.6 Measured Machine Dimensions

	#1	#2	#3
Bore Dia.			
Length			
Flatness			

	1-2	2-3	1-3
Hole to Hole Dimensions			

8 7 6 5 4 3 2 1

REV.	DESCRIPTION	DATE	APPROVED
A	SEE ECN-HYT-ATLAS-0050-A FOR CHANGES	4/20/99	WKM



ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	2	HYT-ATLAS-0051	ATLAS -DOE SBIR - SECTOR FACING
2	1	HYT-ATLAS-0052	ATLAS -DOE SBIR - SECTOR COOLING TUBE
3	3	HYT-ATLAS-0053-3	ATLAS -DOE SBIR - SECTOR CYLINDRICAL INSERT
4	6	HYT-ATLAS-0053-1	ATLAS -DOE SBIR - SECTOR WASHER
5	2	HYT-ATLAS-0017	ATLAS -DOE SBIR - SECTOR COOLING TUBE REINFORCEMENT
6	1	HYT-ATLAS-0054-1	ATLAS- DOE SBIR- SECTOR CARBON FOAM
7	1	HYT-ATLAS-0054-3	ATLAS- DOE SBIR- SECTOR CARBON FOAM PART #2

PARTS LIST

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL DIMENSIONS IN INCHES
2. DIMENSIONS AND TOLERANCING PER ASME Y14.5M-1994
3. SURFACE TEXTURE PER ANI/ASME B 46.1-1985
4. COUNTERSINK 82 DEGREES ALL TAPPED HOLES TO MAJOR DIAMETER
5. COUNTERSINK 82 DEGREES APPROXIMATELY .015 DEEP ALL DRILLED HOLES
6. PARTS TO BE THOROUGHLY CLEANED TO REMOVE ALL OIL, GREASE, DIRT AND CHIPS
7. HYTEC WILL BOND ASSEMBLY TOGETHER

HYTEC, INC

ATLAS-DOE SBIR SECTOR ASSEMBLY

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES -TOLERANCES-		CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE DO NOT SCALE DRAWING		TITLE ATLAS-DOE SBIR SECTOR ASSEMBLY	
DECIMALS .XX = +/- .03 .XXX = +/- .010	ANGULAR = +/- .30° SURFACE FINISH = 250				
FINISH	SIGNATURE	DATE	DESIGNED	W. K. MILLER	4/8/99
			DRAWN	W. K. MILLER	4/8/99
			CHECKED	HARRY SALAZAR	-
			ENGR.	W. O. MILLER	-
			APPROVED	-	-

PART NO. **HYT-ATLAS-0050**

DWG. NO. **HYT-ATLAS-0050 D** SIZE **1 of 1**

SCALE **2/1** REVISION **A**

8 7 6 5 4 3 2 1

8 7 6 5 4 3 2 1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	SEE ECN HYT-ATLAS-0051-A FOR CHANGES	4/20/99	WKM

D

D

C

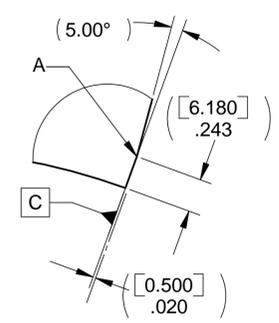
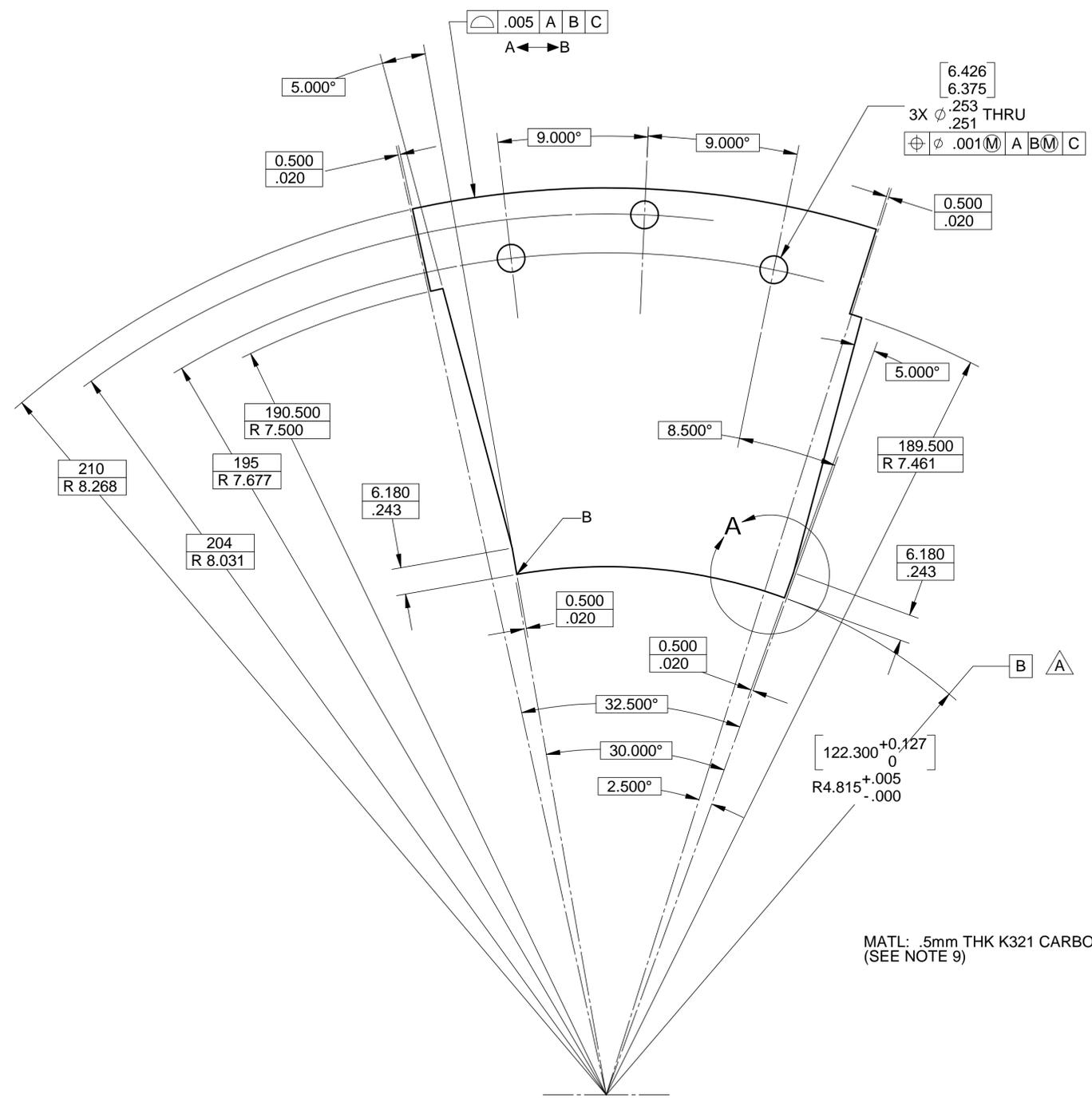
C

B

B

A

A



DETAIL A
SCALE 1.5 : 1

MATL: .5mm THK K321 CARBON CARBON FACING
(SEE NOTE 9)

NOTES: UNLESS OTHERWISE SPECIFIED

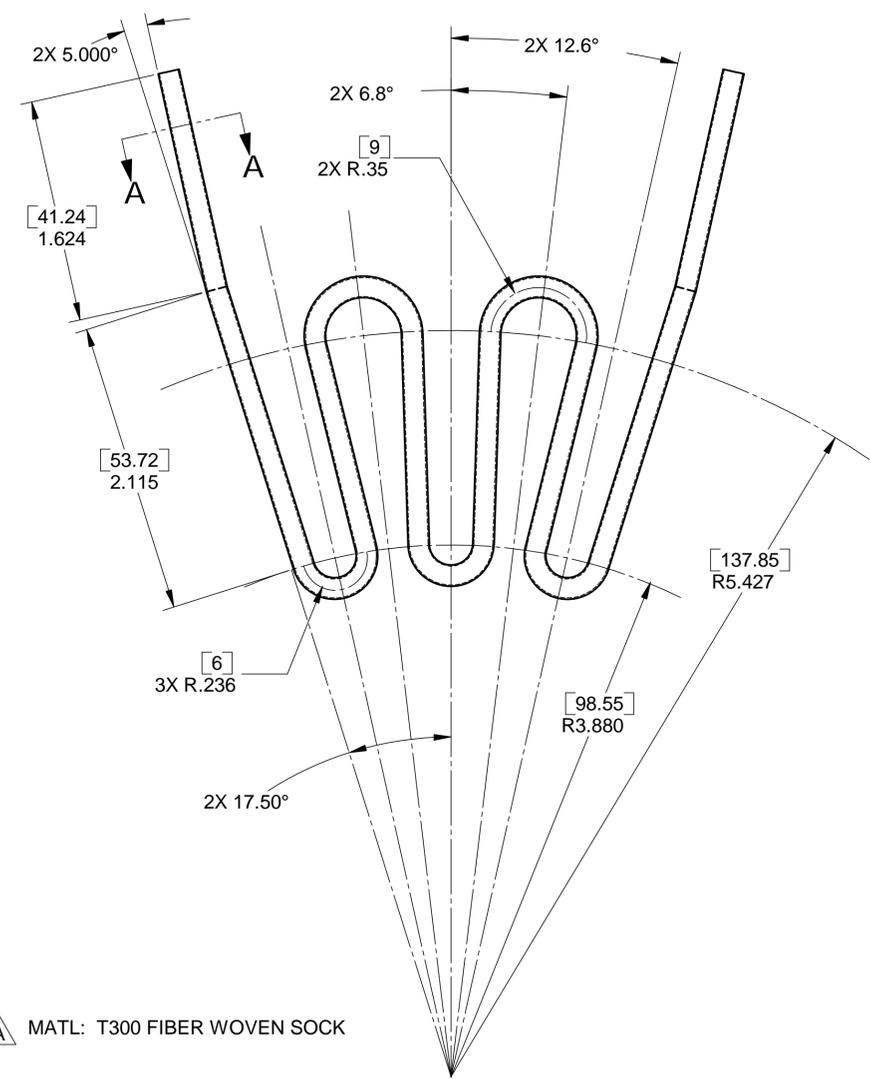
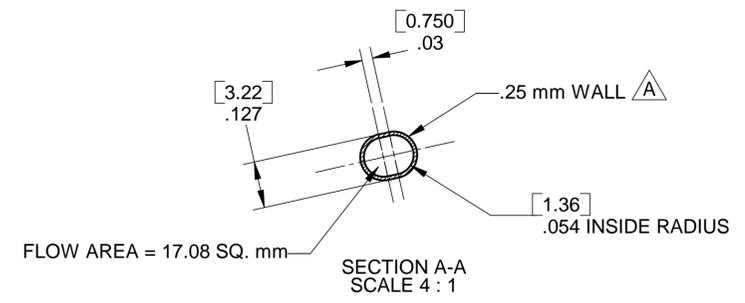
- ALL DIMENSIONS IN INCHES
- DIMENSIONS AND TOLERANCING PER ASME Y14.5M-1994
- SURFACE TEXTURE PER ANI/ASME B 46.1-1985
- REMOVE ALL BURRS AND BREAK SHARP EDGES TO A MAXIMUM OF .015
- COUNTERSINK 82 DEGREES ALL TAPPED HOLES TO MAJOR DIAMETER
- PARTS TO BE THOROUGHLY CLEANED TO REMOVE ALL OIL, GREASE, DIRT AND CHIPS
- INSPECTION REPORTS TO BE PROVIDED

PARTS LIST			
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES -TOLERANCES- DECIMALS .XX = +/- .03 .XXX = +/- .010 ANGULAR = +/- 30' SURFACE FINISH = 250	CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE DO NOT SCALE DRAWING		HYTEC, INC TITLE ATLAS DOE SBIR SECTOR FACING
	FINISH	SIGNATURE	DATE
PART NO. HYT-ATLAS-0051	DESIGNED	W. K. MILLER	4-7-99
	DRAWN	W. K. MILLER	4-7-99
	CHECKED	W. O. MILLER	4/15/99
	ENGR.	W. O. MILLER	-
	APPROVED	-	-
DWG. NO. HYT-ATLAS-0051 D		SCALE	2/1
SIZE SHEET NO. 1 of 1		REVISION A	

8 7 6 5 4 3 2 1

8 7 6 5 4 3 2 1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	SEE ECN HYT-ATLAS-0052-A FOR CHANGES	4/20/99	WKM



△ MATL: T300 FIBER WOVEN SOCK

D
C
B
A

D
C
B
A

△
NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL DIMENSIONS IN INCHES
2. DIMENSIONS AND TOLERANCING PER ASME Y14.5M-1994
3. SURFACE TEXTURE PER ANI/ASME B 46.1-1985
4. PARTS TO BE THOROUGHLY CLEANED TO REMOVE ALL OIL, GREASE, DIRT AND CHIPS

PARTS LIST			
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES -TOLERANCES-	CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE DO NOT SCALE DRAWING		HYTEC, INC
			TITLE ATLAS DOE SBIR SECTOR COOLING TUBE
DECIMALS X _i = +/- .1 .XX = +/- .010	ANGULAR = +/- .30° SURFACE FINISH = 250	SIGNATURE	DATE
FINISH		DESIGNED W. K. MILLER	4/7/99
		DRAWN W. K. MILLER	4/7/99
		CHECKED HARRY SALAZAR	-
		ENGR. W. O. MILLER	-
		APPROVED -	-
PART NO. HYT-ATLAS-052		DWG. NO. HYT-ATLAS-0052 D SIZE 1 of 1	
		SCALE 3/2	REVISION A

8 7 6 5 4 3 2 1

8 7 6 5 4 3 2 1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	SEE ECN HYT-ATLAS-0053-A FOR CHANGES	4/20/99	WKM

D

D

C

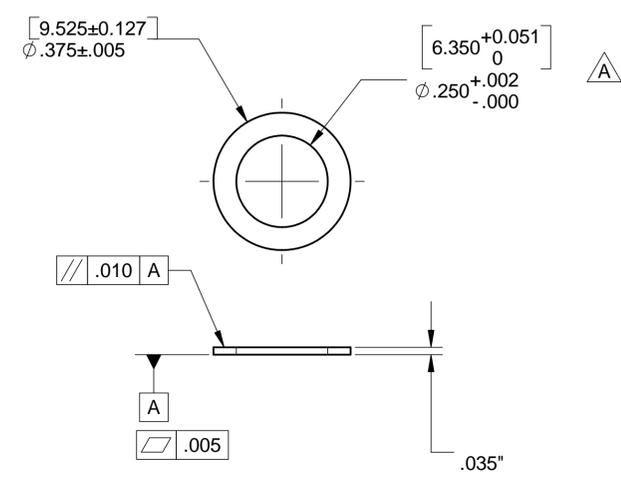
C

B

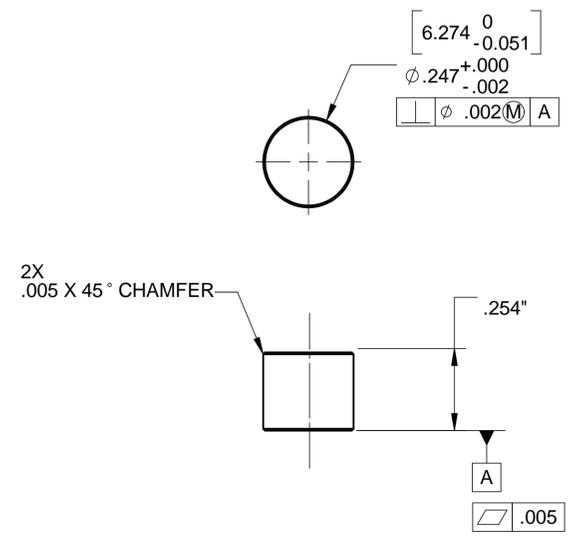
B

A

A



-1 WASHER
P.N. HYT-ATLAS-0053-1
MATL: CARBON CARBON



-3 CYLINDRICAL INSERT
P.N. HYT-ATLAS-0053-3
MATL: CARBON CARBON

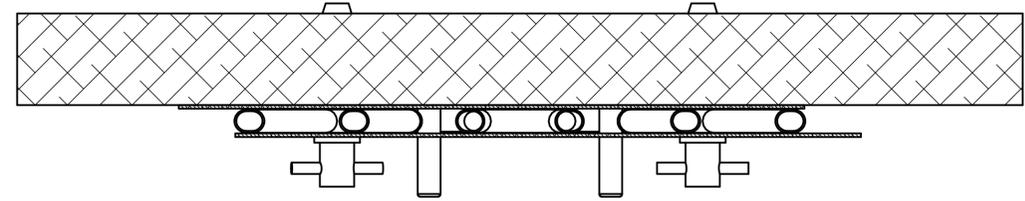
- NOTES: UNLESS OTHERWISE SPECIFIED
- BOTTOM DIMENSIONS IN INCHES; TOP DIMENSIONS IN MM
 - DIMENSIONS AND TOLERANCING PER ASME Y14.5M-1994
 - SURFACE TEXTURE PER ANI/ASME B 46.1-1985
 - PARTS TO BE THOROUGHLY CLEANED TO REMOVE ALL OIL, GREASE, DIRT AND CHIPS

PARTS LIST			
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES -TOLERANCES-	CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE DO NOT SCALE DRAWING		HYTEC, INC TITLE ATLAS DOE SBIR SECTOR MOUNTING PARTS
	DECIMALS .XX = +/- .03 .XXX = +/- .005	ANGULAR = +/- 30' SURFACE FINISH = 250	
FINISH	SIGNATURE	DATE	REVISION A
	DESIGNED W. K. MILLER	4/7/99	
	DRAWN W. K. MILLER	4/7/99	
PART NO. HYT-ATLAS-0053	CHECKED HARRY SALAZAR	-	SCALE 4/1
	ENGR. W. O. MILLER	-	
	APPROVED -	-	

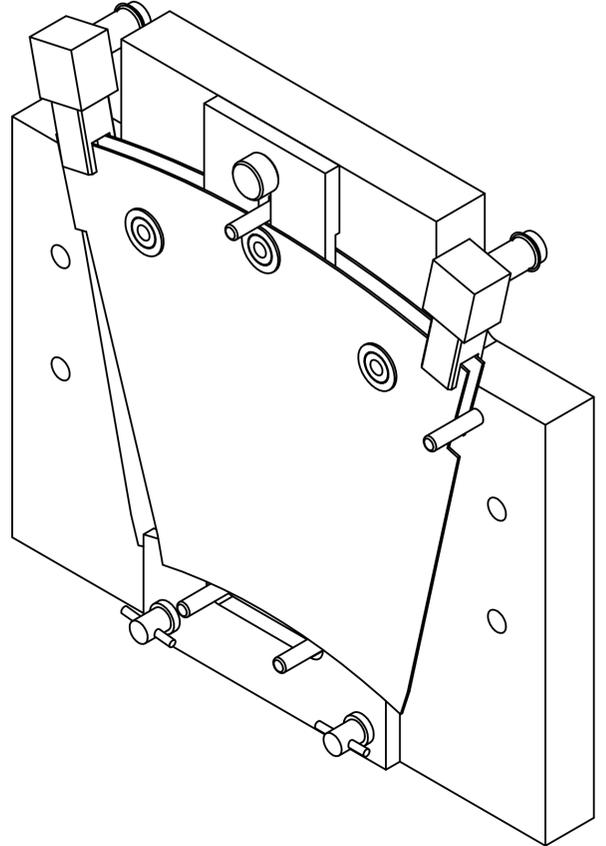
8 7 6 5 4 3 2 1

8 7 6 5 4 3 2 1

REV.		DESCRIPTION	DATE	APPROVED



SECTION B-B
SCALE 2 : 1



TANGENTIAL REGISTRATION FOR LOCATING TUBE

2

A

5

REGISTRATION PIN FOR FACING LOCATION

(HYTEC SECTOR)
HYT-ATLAS-0050
(SEE NOTE 9)

REGISTRATION PIN FOR FACING LOCATION

1

5

1

.154

4

3

SECTION A-A
SCALE 2 : 1

B

B

B

C

B

2X 4

3

TANGENTIAL REGISTRATION FOR LOCATING TUBE

A

2X REGISTRATION PIN FOR FACING LOCATION

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL DIMENSIONS IN INCHES
2. DIMENSIONS AND TOLERANCING PER ASME Y14.5M-1994
3. SURFACE TEXTURE PER ANI/ASME B 46.1-1985
4. REMOVE ALL BURRS AND BREAK SHARP EDGES TO A MAXIMUM OF .015
5. ALL INSIDE CORNERS TO BE .015 RADIUS MAX
6. COUNTERSINK 82 DEGREES ALL TAPPED HOLES TO MAJOR DIAMETER
7. COUNTERSINK 85 DEGREES APPROXIMATELY .015 DEEP ALL DRILLED HOLES
8. PARTS TO BE THOROUGHLY CLEANED TO REMOVE ALL OIL, GREASE, DIRT AND CHIPS
9. HYTEC SECTOR SHOWN FULLY ASSEMBLED
10. COVERPLATE NOT SHOWN
11. PIN DIA. IS .1875 +0/- .0003.

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	ATLAS-FXT-0021-1	SECTOR FAB. JIG BASEPLATE
2	1	ATLAS-FXT-0022-1	SECTOR FAB. JIG TUBE CENTERING JIG
3	1	ATLAS-FXT-0022-3	SECTOR FAB. TANGENT LOCATOR JIG
4	2	McMASTER #98405A006	.188 DIA. LOCATING PIN (SEE NOTE 11)
5	1	McMASTER #91746A113	#4-40 UNC THUMB SCREW
6	1	ATLAS-FXT-0021-3	SECTOR FAB. JIG COVERPLATE (SEE NOTE 10)

PARTS LIST

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
-TOLERANCES-

DECIMALS ANGULAR = +/- 30'
.XX = +/- .03 SURFACE FINISH = 250
.XXX = +/- .010

CAD GENERATED DRAWING,
DO NOT MANUALLY UPDATE
DO NOT SCALE DRAWING

HYTEC, INC

TITLE
**ATLAS DOE SBIR
SECTOR FABRICATION
JIG ASSEMBLY**

FINISH

PART NO.
ATLAS-FXT-0020-1

	SIGNATURE	DATE
DESIGNED	W. K. MILLER	5/14/99
DRAWN	W. K. MILLER	5/14/99
CHECKED	HARRY SALAZAR	-
ENGR.	W. O. MILLER	-
APPROVED	-	-

DWG. NO.	SIZE	SHEET NO.
ATLAS-FXT-0020 D	1 of 1	

SCALE 1/1 REVISION

8 7 6 5 4 3 2 1

A

A