

# FAI A Gyrocopter 2018 (S9A)

## NOTES:

1. This design won a Bronze medal in the 2014 FAI World Championships flown by Trip Barber. The design was developed by Keith Vinyard.
2. At the time of this publication, this design is the state of the art generally used by the USA FAI team in international competition.
3. These plans describe building the gyrocopter assembly shown. They do not include instructions on building an FAI style fiberglass body tube.

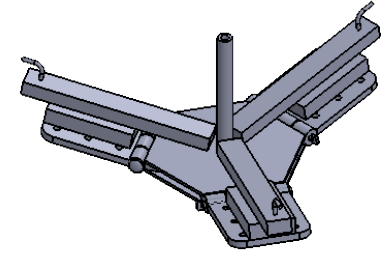


Scale = 1:4 Unless otherwise noted	Drawing Title:	FAI A Gyrocopter 2018 (S9A)
Dimensions are: in. [ mm]	Drawn By:	Doug Hillson NAR #61624
	Checked By:	Trip Barber NAR #4322
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	Release Date:	8/25/18

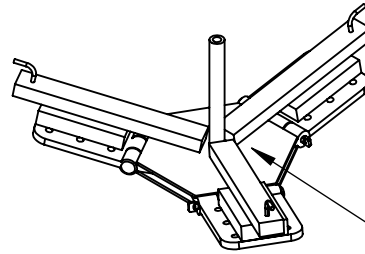
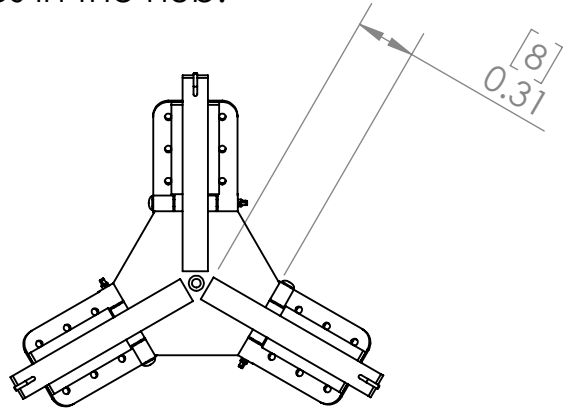
# Hub Assembly

## Hub Assembly Instructions:

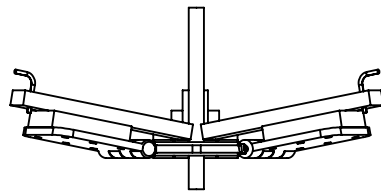
1. Glue hinges to bottom plywood bulkhead using cyanoacrylate.
2. Glue the top plywood bulkhead to the hinges using epoxy.
3. Glue aluminum spacer through the assembly using epoxy.
4. Glue balsa pieces to hinges.
5. Do not glue music wire hooks to balsa until blades are glued to the hub.
6. After blades are installed, the music wire hooks are pushed through incidence stops in the hub.



Completed Hub  
Isometric View



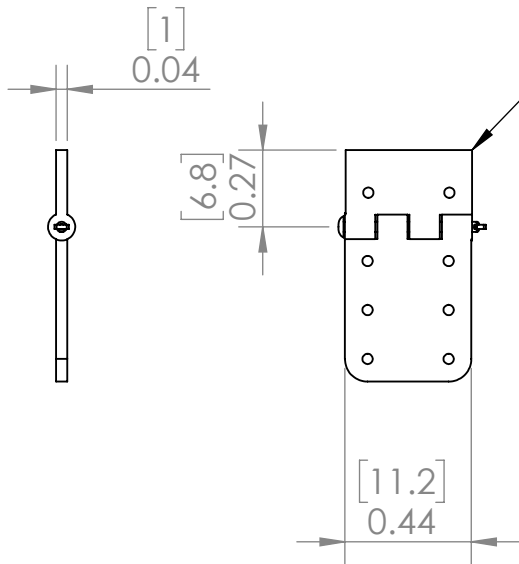
The incidence will be adjusted during trimming to ensure a dihedral angle of 10 deg.



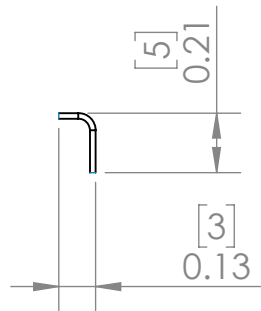
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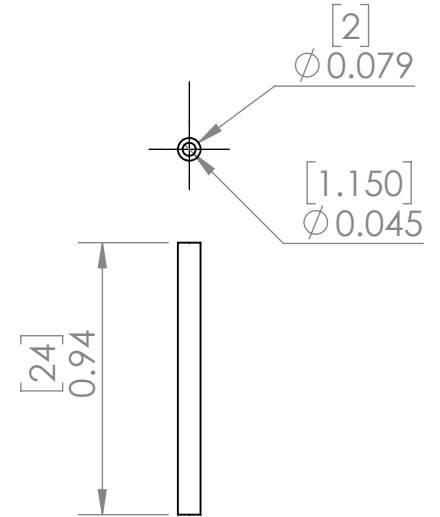
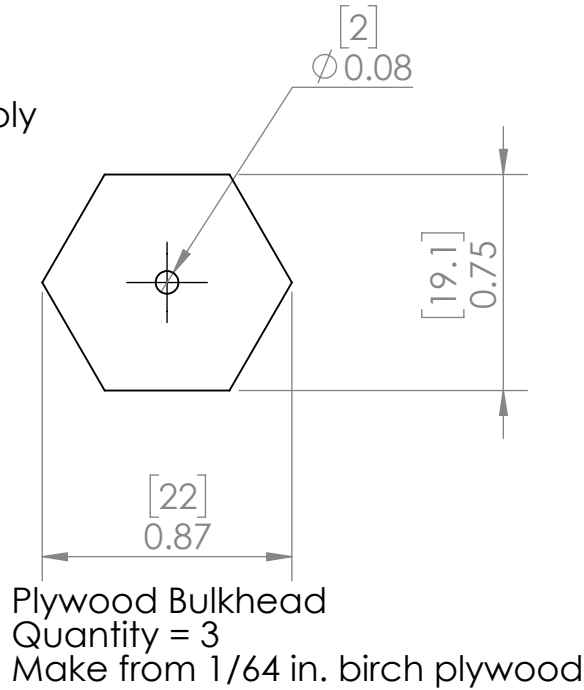
# Hub Assembly



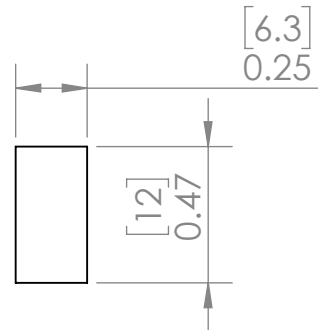
Small Nylon Hinge  
Quantity = 3  
Hinges are Klett model airplane hinges, which are commercially available



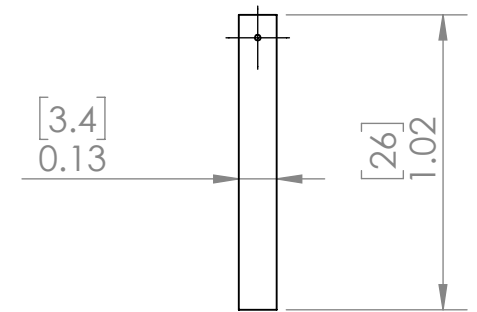
Quantity = 3  
Make from music wire



Aluminum Spacer  
Quantity = 2  
Only one spacer used for Hub Assembly  
Cut from Nominal 3/32 in aluminum tube



Quantity = 3  
Cut from 3/32 in. medium density balsa



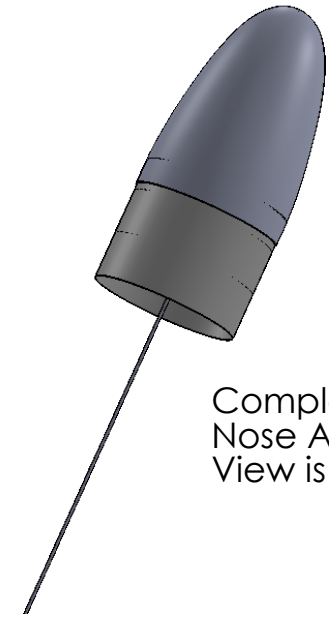
Quantity = 3  
Cut from 3/32 in. medium density balsa

Scale = 3:2 Unless otherwise noted	Drawing Title:	FAI A Gyrocopter 2018 (S9A)
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Dimensions are: in. [ mm]	Checked By:	Trip Barber NAR #4322
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# Nose Assembly

## Nose Assembly Instructions:

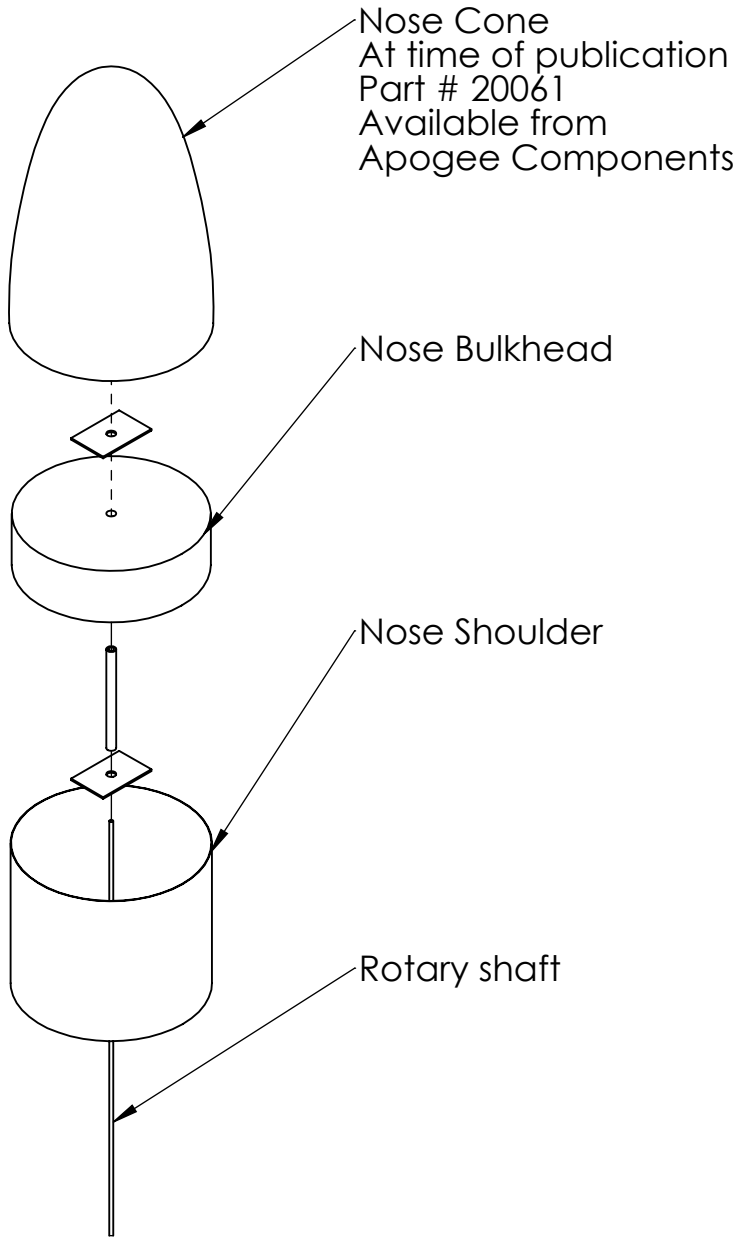
1. Glue aluminum spacer tube into Styrofoam bulkhead using epoxy.
2. Glue plywood cap on aluminum spacer and bulkhead using epoxy.
3. Glue 0.030" carbon rod rotary shaft into nose assembly using epoxy.
4. Glue fiberglass shoulder onto Styrofoam bulkhead.
5. Glue nose cone onto assembly using epoxy.



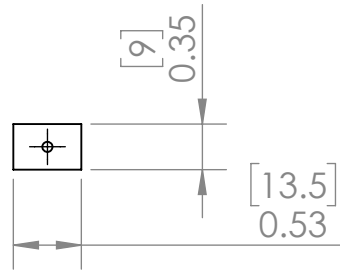
Completed  
Nose Assembly  
View is cropped

Scale = 1:2 <small>Unless otherwise noted</small>	Drawing Title:	FAI A Gyrocopter 2018 (S9A)
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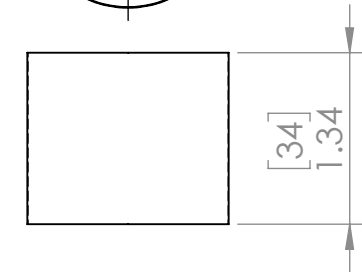
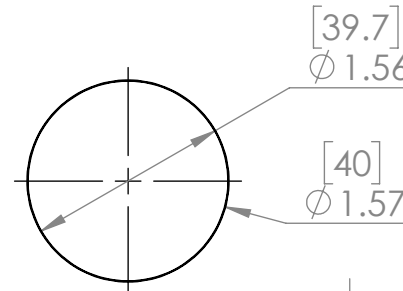
# Nose Assembly



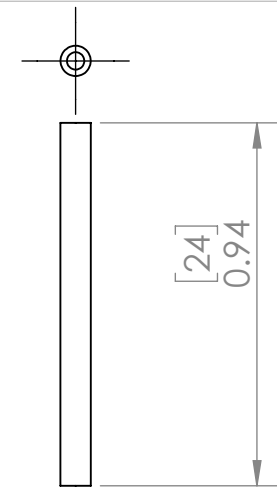
Nose Cone Assembly  
Exploded View  
View is cropped



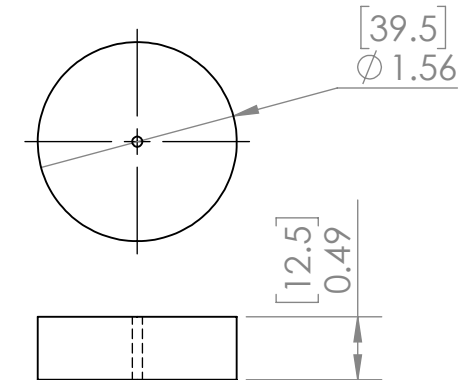
Spacer Cap  
Quantity = 2  
Make from 1/64 in. plywood



Nose Shoulder  
Quantity = 1  
Make from fiberglass or  
card stock  
Must be a snug fit in  
body tube  
If made from fiberglass  
use a mandrel with an OD  
of 39.7 mm



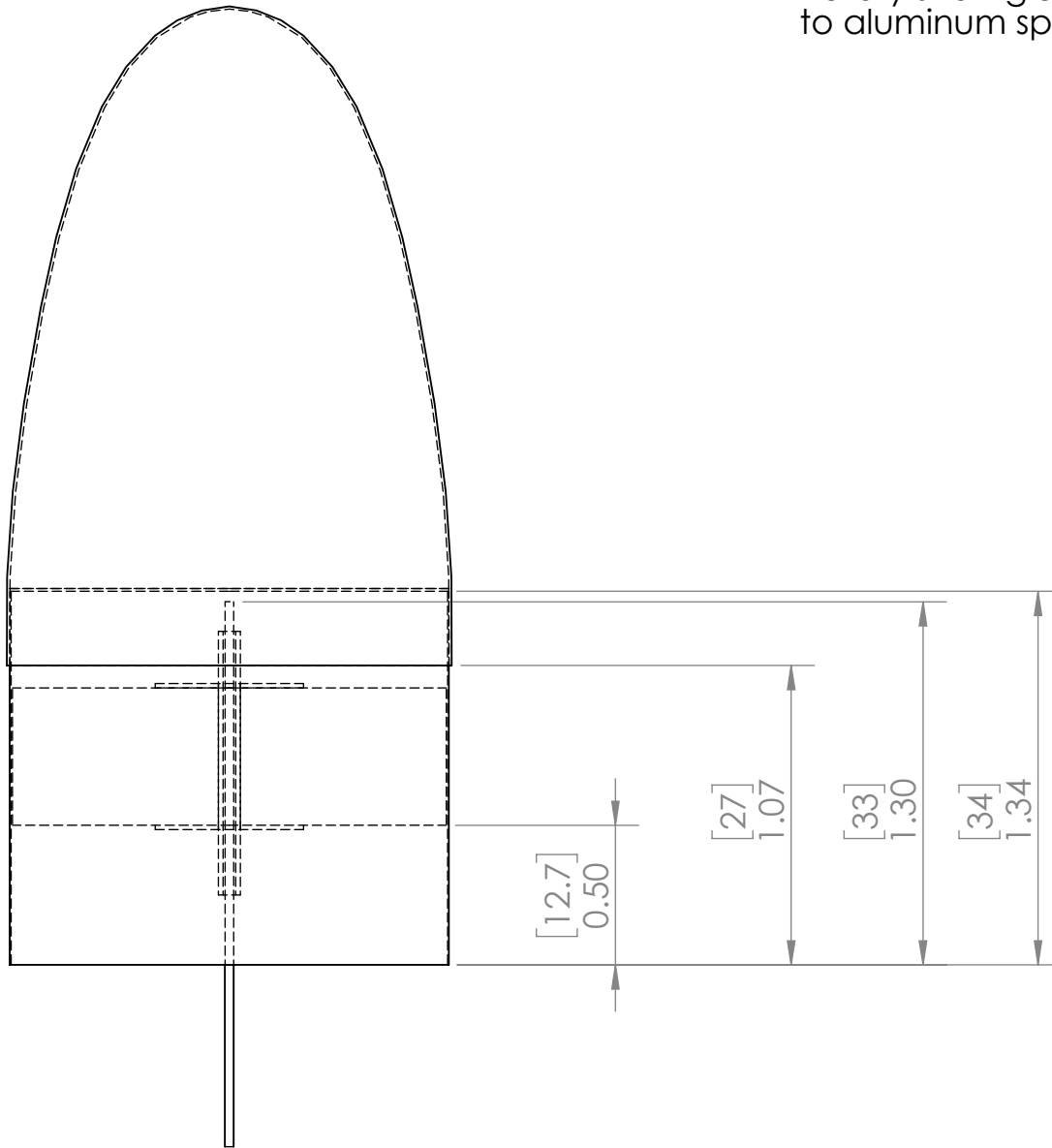
Aluminum Spacer  
Quantity = 2  
Only one spacer used  
for Nose Cone Assembly  
Cut from Nominal 3/32 in  
Aluminum Tubing



Nose Bulkhead  
Quantity = 1  
Make from Styrofoam  
Must be a snug fit in  
fiberglass shoulder

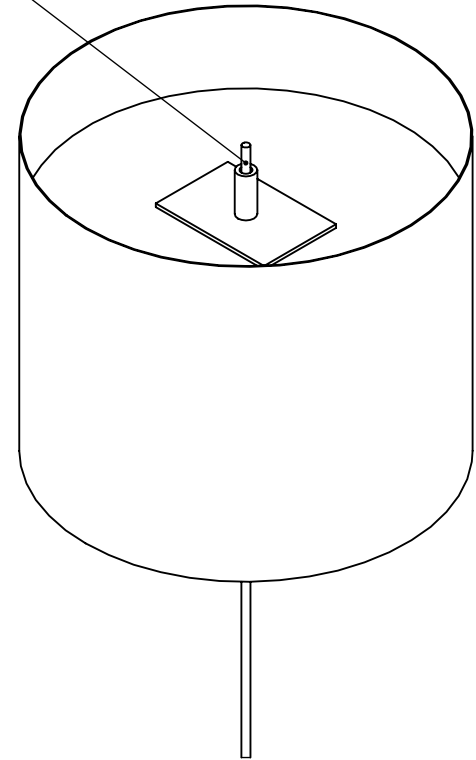
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# Nose Assembly



Completed Nose Assembly  
View is cropped

Rotary shaft glued  
to aluminum spacer



Assembly View  
View is cropped  
Nose cone not  
shown for clarity

Scale = 3:2  
Unless otherwise noted

Dimensions are:  
in. [ mm]

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Drawing Title: FAI A Gyrocopter 2018 (S9A)

Drawn By: Doug Hillson NAR #61624

Checked By: Trip Barber NAR #4322

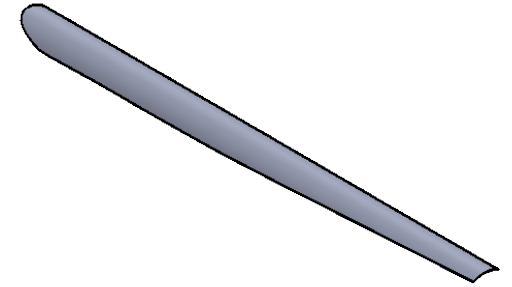
Revision: Rev 1

Release Date: 8/25/18

# Blade Construction

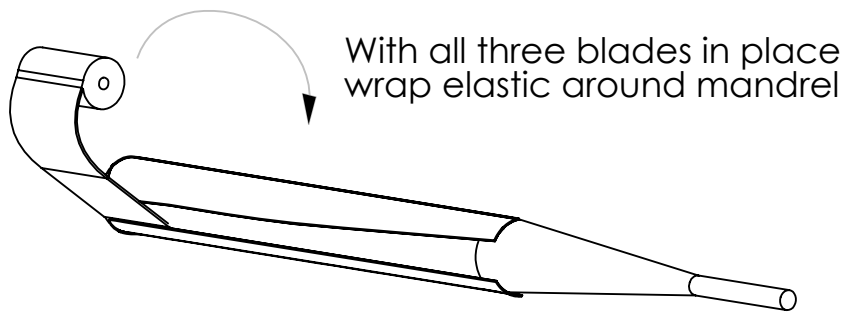
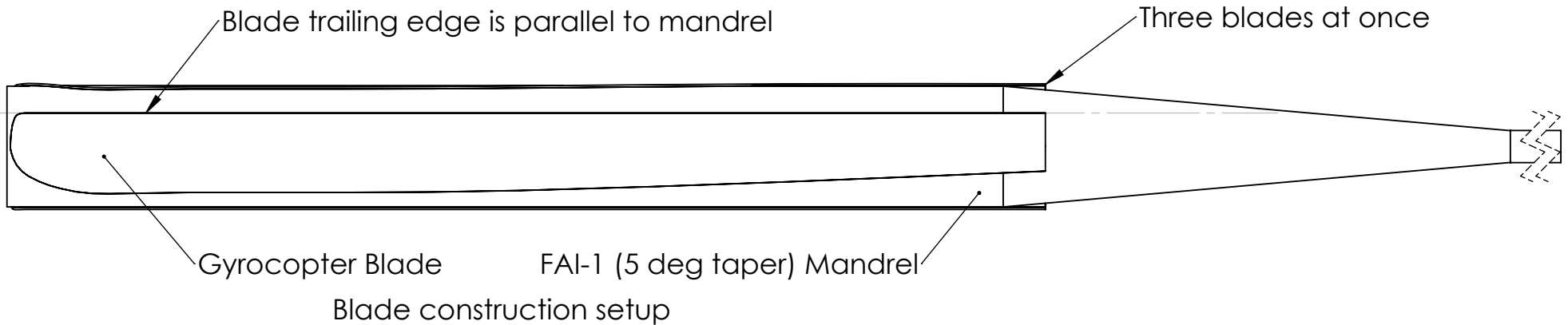
## Blade Instructions:

1. Cut out blades from lightweight 4 to 6 lbs. 1/32 in. balsa and sand smooth.
2. Wet the blades with ammonia.
3. Tape the blades into position on an FAI-1 (5 deg taper) FAI mandrel. All three blades can be formed at the same time.
4. Tightly wrap an elastic medical band around the three blades and the mandrel.
5. Let the blades dry for 24 hours.
6. Remove the blades and apply finishing epoxy to the last ~25 mm of each blade - this is to prevent blade damage at ejection.



Completed Blade  
Isometric View

Scale = 1:4

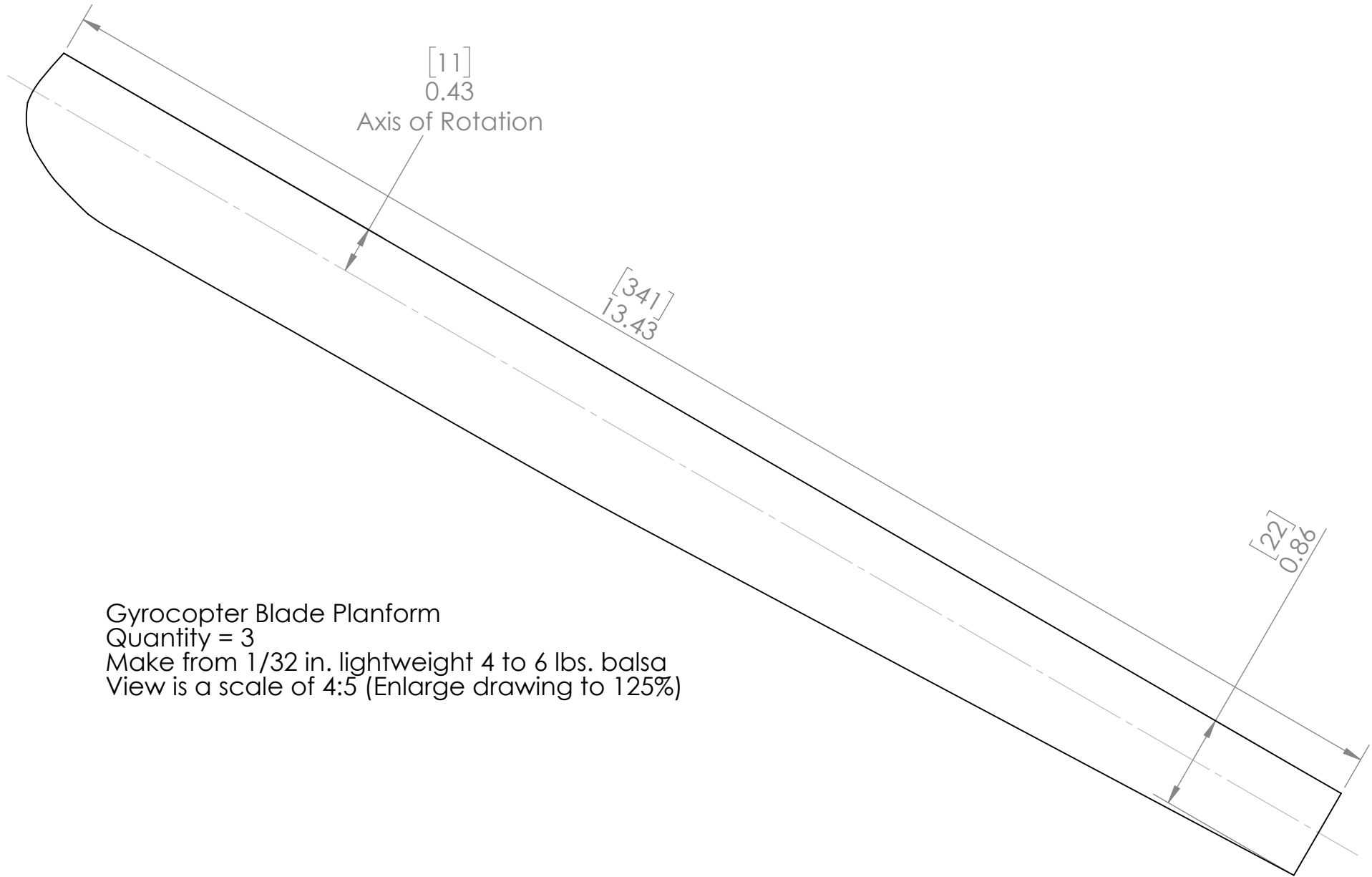


Scale = 1:4

Scale = 1:2 <small>Unless otherwise noted</small>	Drawing Title:	FAI A Gyrocopter 2018 (S9A)
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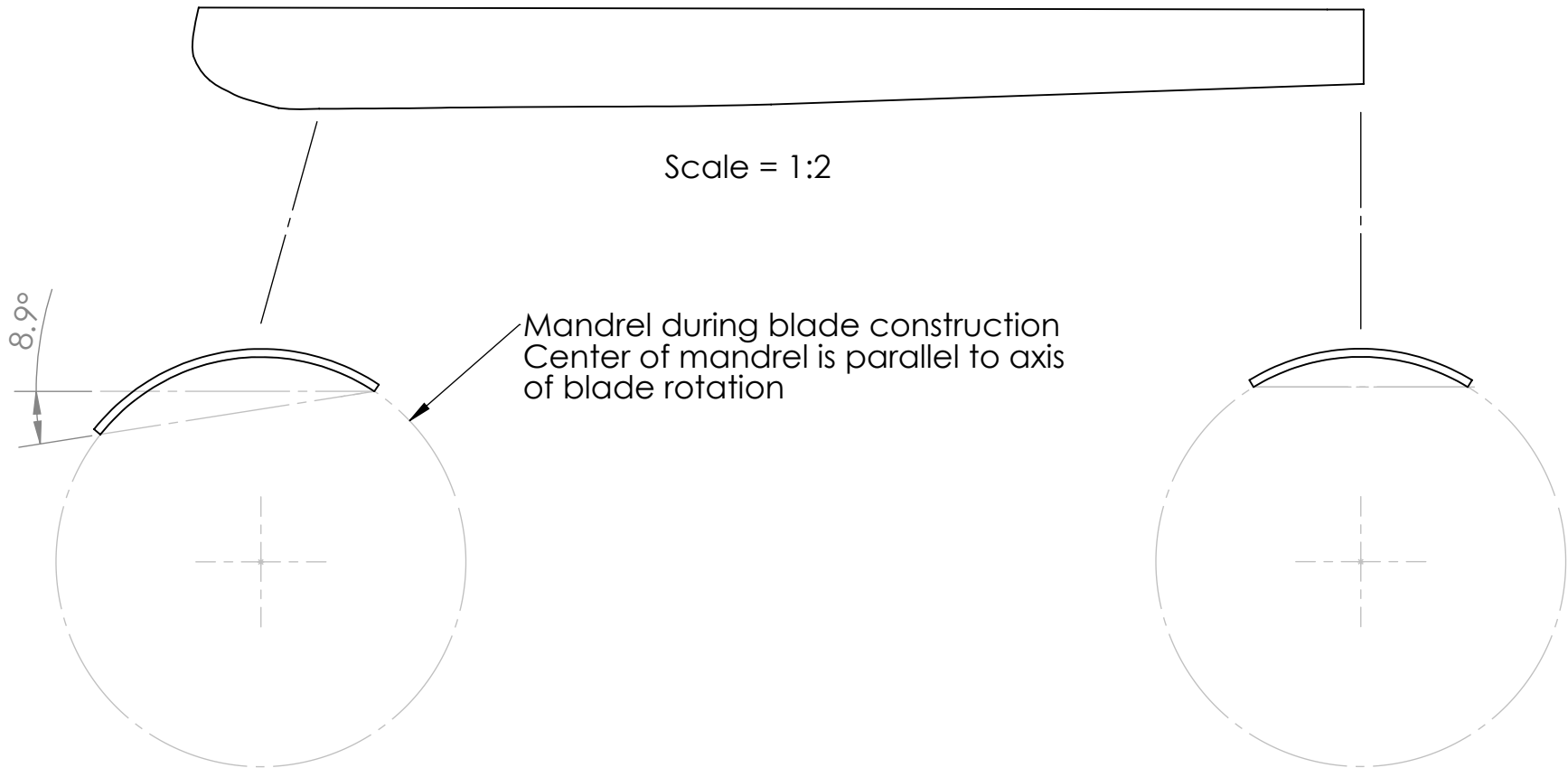
# Blade Construction



Gyrocopter Blade Planform  
 Quantity = 3  
 Make from 1/32 in. lightweight 4 to 6 lbs. balsa  
 View is a scale of 4:5 (Enlarge drawing to 125%)

Scale = 4:5 <small>Unless otherwise noted</small>	Drawing Title:	FAI A Gyrocopter 2018 (S9A)
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# Blade Construction



Blade at approximate Max Chord  
(Viewed from tip to root)  
pitch angle = ~ 9 deg

Blade Tip  
(Viewed from tip to root)  
pitch angle = ~ 0 deg

The pitch angle of the blade at maximum chord is approximately 9 deg. The pitch angle at the tip is approximately 0 deg. This is as viewed from the tip toward the center of rotation.

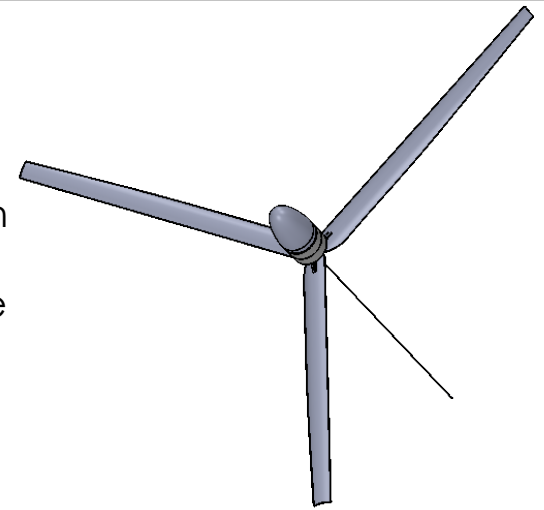
The change in pitch angle should result automatically due to the geometry and construction method.

Scale = 3:2 <small>Unless otherwise noted</small>	Drawing Title:	FAI A Gyrocopter 2018 (S9A)
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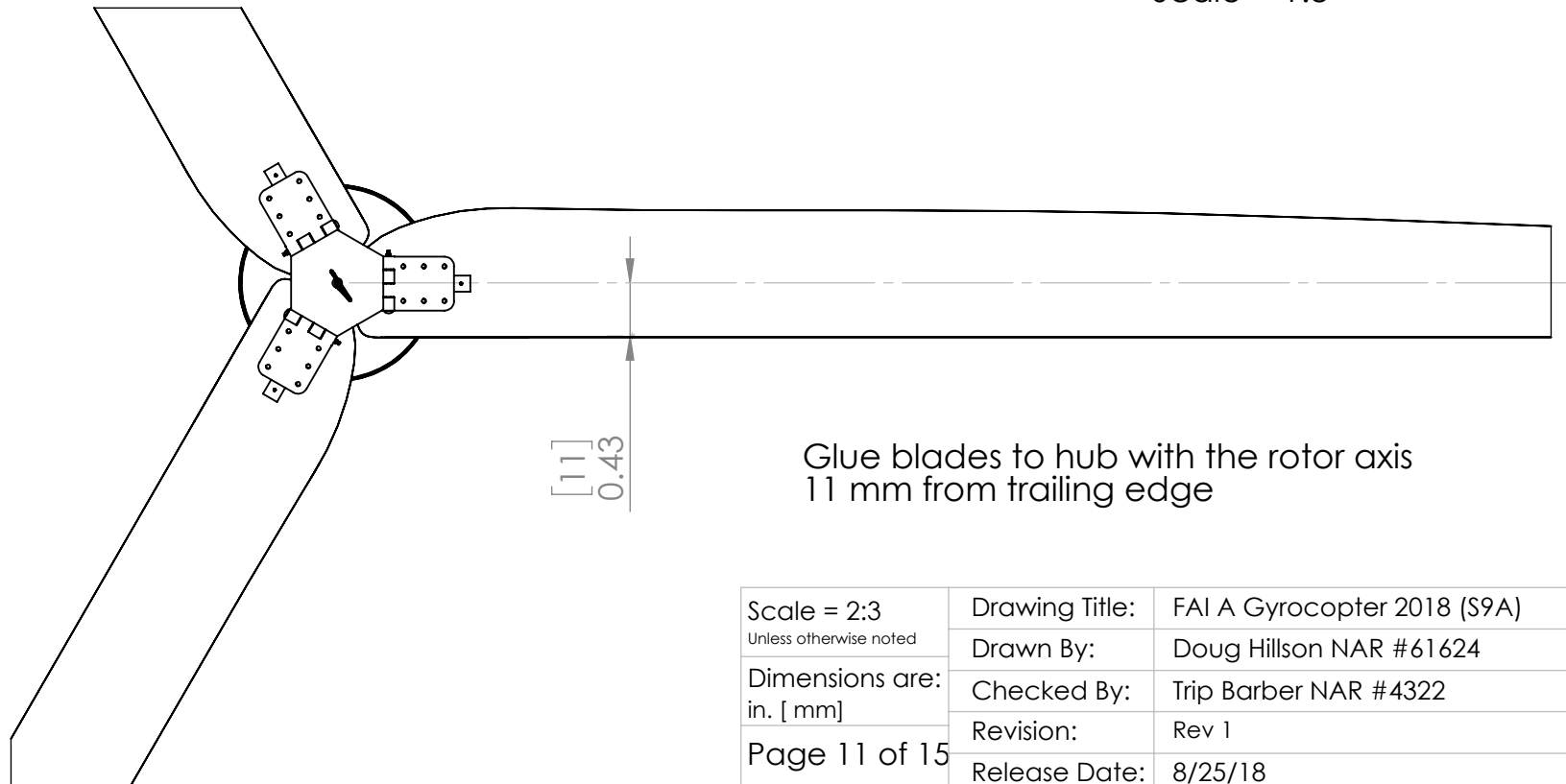
# Gyrocopter Assembly

Finally Assembly Instructions:

1. Glue blades to hub assembly.
2. Insert music wire hooks through the blades and hub assembly and glue with cyanoacrylate.
3. Insert 6 small orthodontic rubber bands on the rotary shaft of the nose cone assembly before placing the hub on the shaft. Use one per blade (3 spare)
4. Insert aluminum spacer onto rotary shaft and glue with cyanoacrylate with the top of the spacer approximately 22 mm from the bottom of the nose cone shoulder.
5. Reinforce the spacer glue joint with nylon thread and smear cyanoacrylate on the threads.
6. Glue shock mount hook to end of rotary shaft using epoxy and cyanoacrylate covered nylon thread.



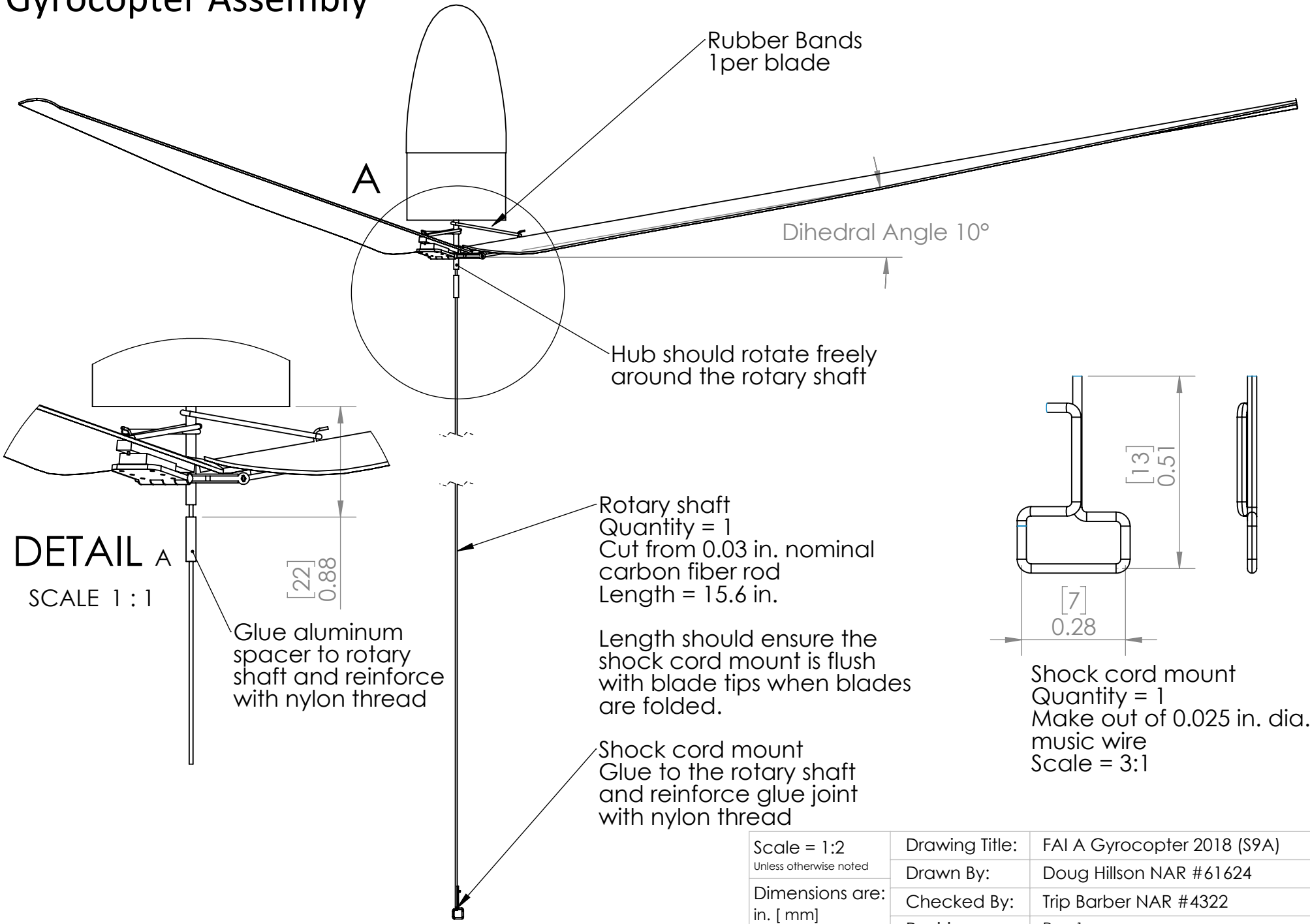
Completed Gyrocopter  
Isometric View  
Scale = 1:8



Glue blades to hub with the rotor axis  
11 mm from trailing edge

Scale = 2:3 Unless otherwise noted	Drawing Title:	FAI A Gyrocopter 2018 (S9A)
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# Gyrocopter Assembly



Back blade not shown for clarity

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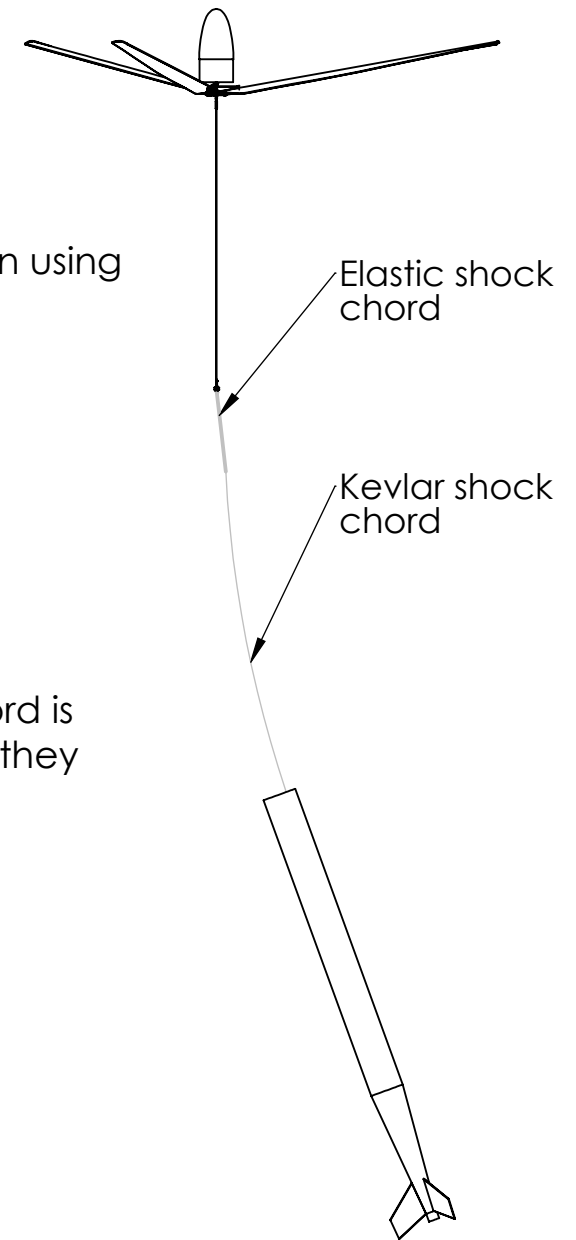
# Rocket Attachment and Flying Instructions

## Rocket Attachment Instructions:

1. Use an FAI-1 (5 deg taper) body tube for flying the gyrocopter.
2. Internally mount a Kevlar shock chord approximately 700 mm long to a fin using an external epoxy fin fillet.
3. Use an approximately 200 mm long elastic shock chord mounted to the gyrocopter shock cord mount.

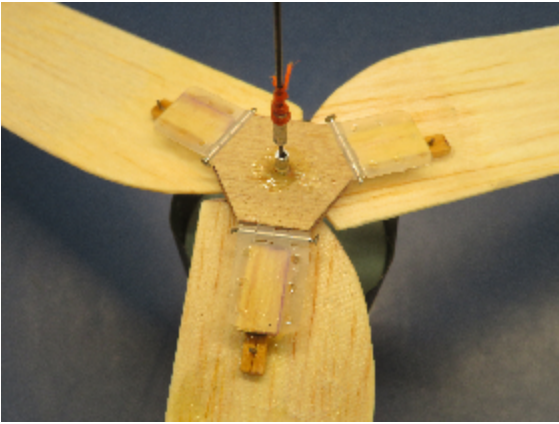
## Flying Instructions for 13 mm NAR Certified motors:

1. Insert motor.
2. Dispense 0.1 grams of black powder on top of the motor ejection cap.
3. Insert wadding in body tube.
4. Insert rubber bands on blade hooks (1 per hook, others are spares)
5. Fold blades and insert gyrocopter in the rocket making sure the shock cord is inserted into the body tube first and will not tangle around the blades as they eject.
6. Fly out of a tower.

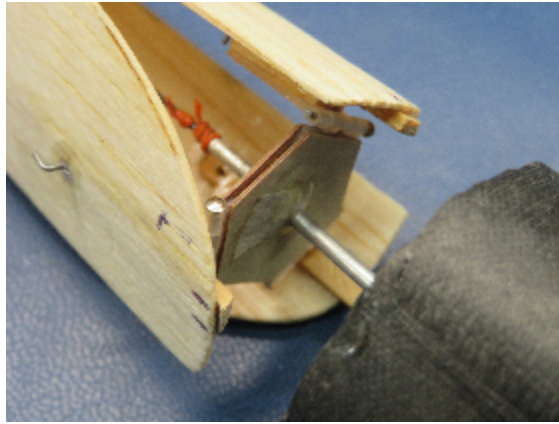


Scale = 1:9 <small>Unless otherwise noted</small>	Drawing Title:	FAI A Gyrocopter 2018 (S9A)
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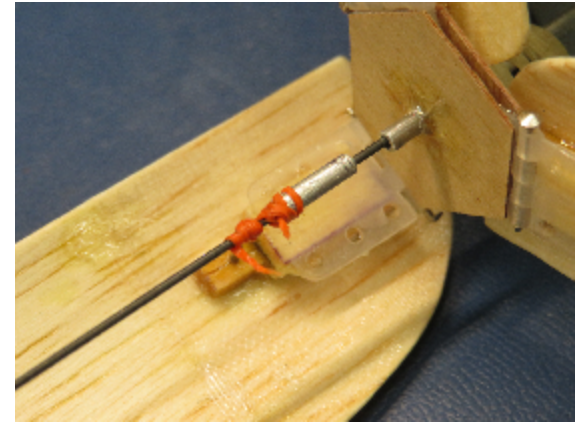
# Photographs of Sample Gyrocopter



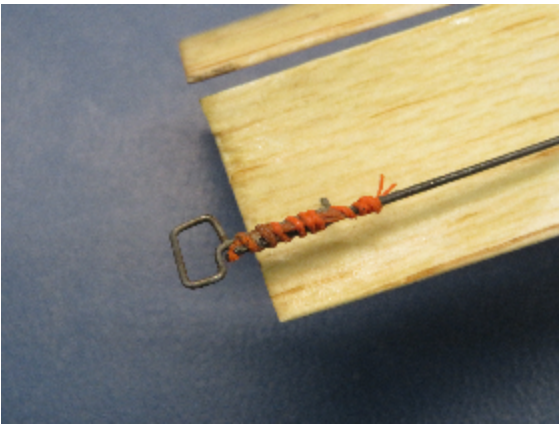
Rotor Hub Bottom



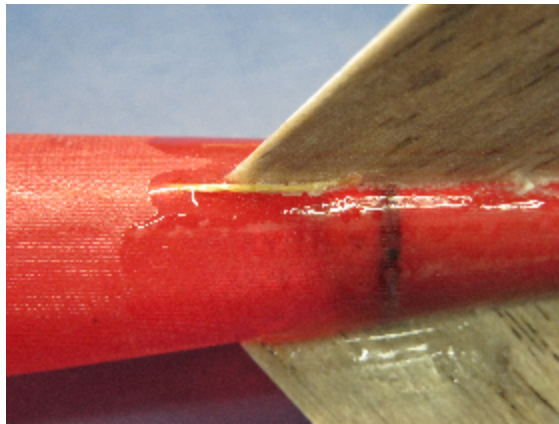
Rotor Hub Top



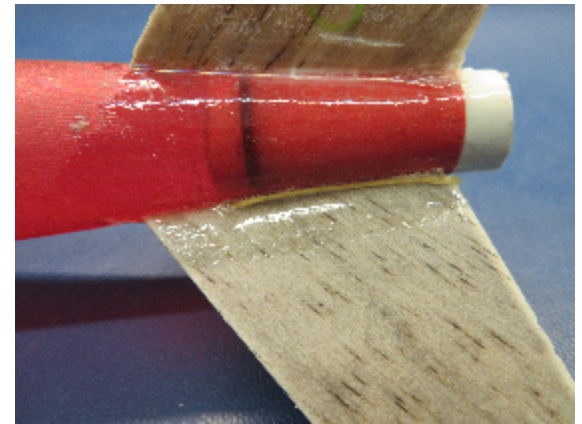
Hub Attachment



Shock Cord Mount  
on Gyrocopter



Shock Cord Mount on Rocket



Shock Cord Mount on Fin  
Fillet of Rocket

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# Photographs of Sample Gyrocopter



Blades Taped on Mandrel  
Before Wrapping



Blades Wrapped on Mandrel



Finished Blades

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