HOLVERSON DESIGNS, INC.

TANGENT™

FLYING MODEL ROCKET KIT

cat# HDD0001

BIG, FUN STABLE SPORT FLYER

LASER-CUT BALSA

requires assembly
skill level 1
beginners or easy

large, easy-to-work-with parts for beginners

easy-to-follow plans and activity sheet designed to be filed and collected

PARACHUTE RECOVERY

includes 3-in-1 fin alignment tool

also available in an educational pack for schools and youth groups

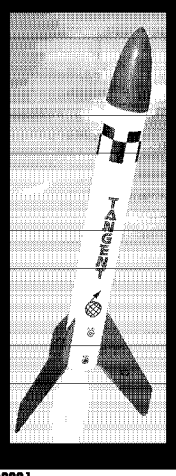
diameter: 42mm (1.64")
length: 45.3cm (17.125")
net weight: 56g (2 oz.)
launch weight: 79g (2.8 oz.)

recommended engines
A8-3 (First Flight),
B4-4, B6-4, C6-5

predicted altitudes:
A8-3: 35m (115'), B4-4: 87m (285'), B6-4: 90m (295'), C6-5: 180m (590')

made in the USA

Holverson Designs, Inc.
25075 CO HWY L20
Soldier, IA 51572
http://www.pionet.net/~holverson



TANGENT™ HDI2001

Skill Level 1

HOLVERSON DESIGNS, INC.

diameter: 42mm (1.64") • length: 45.3cm (17.125") • net weight: 56g (1.25 oz.)
recommended engines: A8-3 (first flight), B4-4, B6-4, C6-5

Thank you! We would like to thank you for purchasing this Holverson Designs flying model rocket. We hope that you enjoy building and flying this model as much as we have. Please let us know if you like your kit, or if you have any questions or need technical advise. Contact us at: Holverson Designs, Inc. 25075 CO HWY L20, Soldier, Iowa 51572 or http://www.pionet.net/~holvrson

This instruction sheet is laid out to allow you to start a rocket plans reference file. Save your entire set of instructions for future reference.

ist2001 3035

Your **Tangent™** is more than just a simple, easy to build, balsa and paper single stage sport rocket. The parts are large and easy to manage, guaranteeing first time success. **Tangent™** will help you acquire basic skills necessary to construct more advanced rockets or even aircraft projects with ease and confidence. You can go Tangential by upgrading the basic single stage model. Check out the payloading and multi-staging options on the **Roc-activity Sheet**.

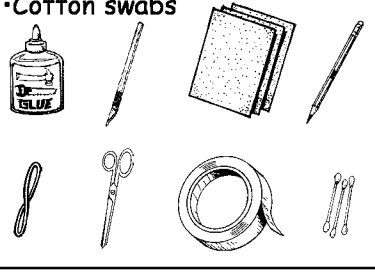
This new **Roc-activity Sheet**, developed specifically for the **Tangent™**, will help you get the most out of your rocketry experience.

After building a few more kits, perhaps you will decide to design and successfully build your own ideas and have a great time in the process. Watching your ideas materialize on the design or building board and then launching them into the sky is a lot of fun and, believe it or not, whether you are building this kit in school, with a youth group or at home, **Tangent™** will get you started!

IMPORTANT:
Step 1: Please read and complete the **Roc-activity Sheet** for the **Tangent™**.
A) This **Roc-activity Sheet** is designed to get you familiar with the parts , their function and how they are assembled into the finished **Tangent™**.
B) Definitions to terms used in the building instructions are found on the **Roc-activity** sheet.
C) Matching exercises allow you to gain better insight to the function and importance of each part.
D) The full size drawing of the **Tangent™** can be used as a coloring exercise. Use pencils or markers to color the various parts as you complete their assembly.
Step 2: Construct your **Tangent™** using the activity sheet as a reference for parts and definitions.
Step3: Study the preflight and launch sequences on the back of the **Roc-activity Sheet** so you'll know how to properly launch your **Tangent™** before arriving at the field.

Required materials

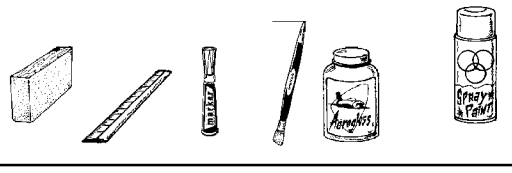
- Carpenter's glue (yellow or white)
- Hobby Knife
- Sand Paper (220, 320, 400 grit)
- Pencil
- Rubber Band (to hold fin alignment tool in place)
- Scissors
- Masking Tape
- Cotton swabs



Optional materials

- Ruler
- Sanding Block
- Paint brush
- Wood Sealer (Aerogloss)
- Marking or Coloring Pens
- Paint (water colors, acrylics, enamels or aerogloss)

Note: Your local hobbyshop will stock most of the materials listed above, in addition to technical advice to improve your hobby skills.



Builder's notes:

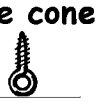
1. You will need a flat, clean surface covered with a protective sheet of paper or cardboard. The kit card with the **Tangent's™** picture on the front works for this purpose too.
2. Read each construction step first, before beginning construction.
3. Collect required parts and construction supplies for each step.
4. Test fit all parts **first** before applying glue!
5. The tube marking guide is located adjacent to Step 7. This guide is a tool. You will cut this guide out of the instruction sheet and use it as a pattern to mark the fin and launch lug locations on the body tube.
6. Work carefully and study each section before beginning. The more care you put into building your **Tangent™**, the better it will fly!
7. While you wait for parts to dry, study the preflight checklist and safety precautions for launching a model rocket. These instructions are located on the back of the **Roc-activity Sheet**.

- Have Fun Building your **Tangent™**!

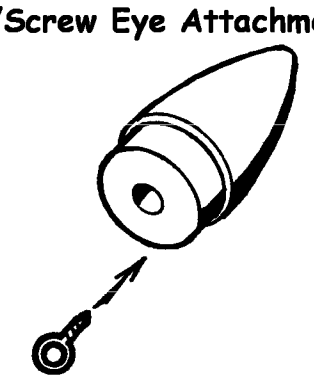
☐ 1. Nose Cone/Screw Eye Attachment

parts needed

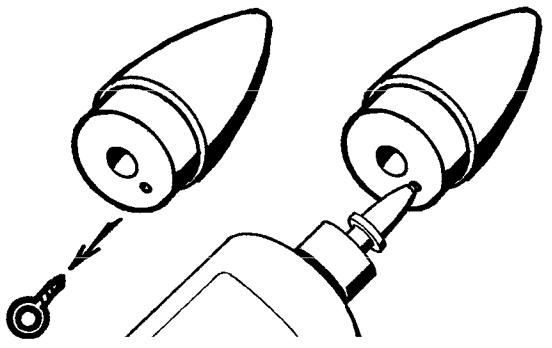
nose cone



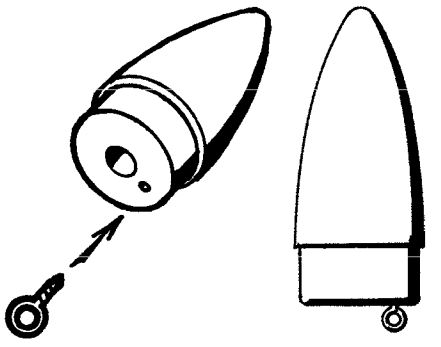
screw eye



A. Use **screw eye** to make a hole in **nose cone** base, near the center.



B. Remove screw eye and squeeze glue into hole.



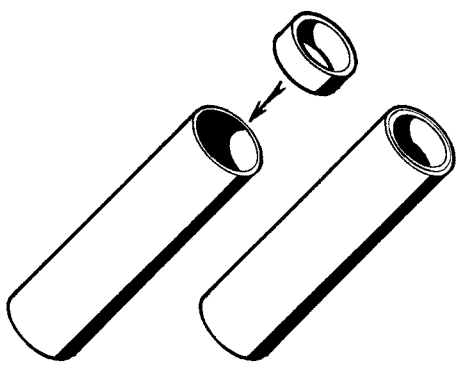
C. Reinstall screw eye. Turn screw until base of eye is touching the base of nose cone.
D. Allow to dry.

☐ 2. Engine Tube and Engine Block Assembly

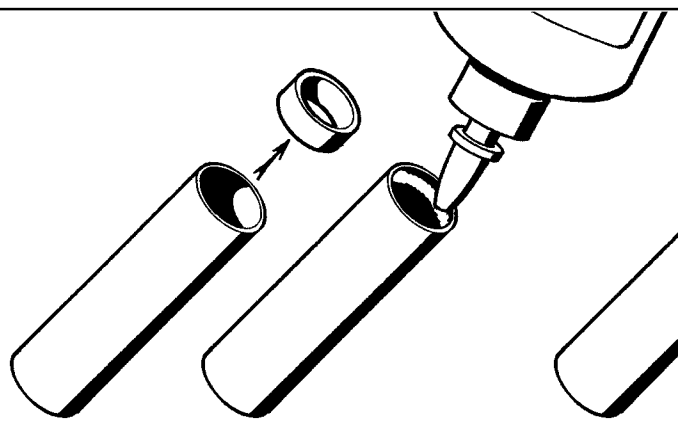
parts needed

engine tube

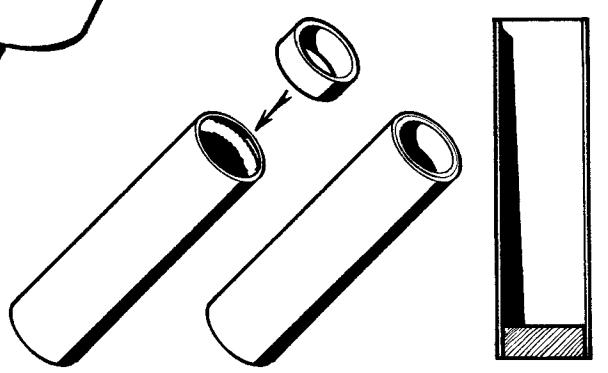
engine block



A. Test fit **engine block** into one end of **engine tube**.
NOTE: If engine block is too large, lightly sand the outside surface until it slides smoothly into engine tube.



B. Remove engine block and apply a thin layer of glue to the **INSIDE** of one end of engine tube.

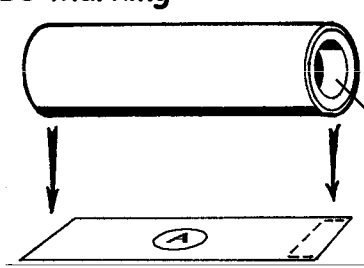


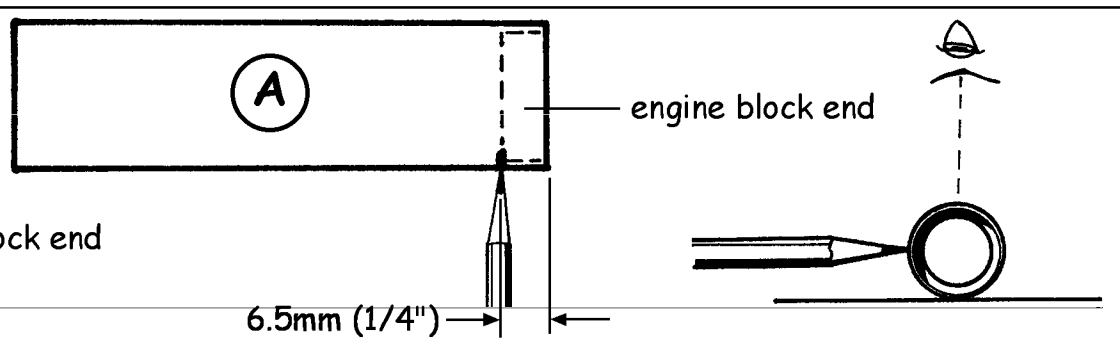
C. Push engine block into glue until block is even with end of tube.
D. Press end of tube against work surface to ensure an even fit.

☐ 3. Engine Tube Marking

parts needed

engine tube assembly

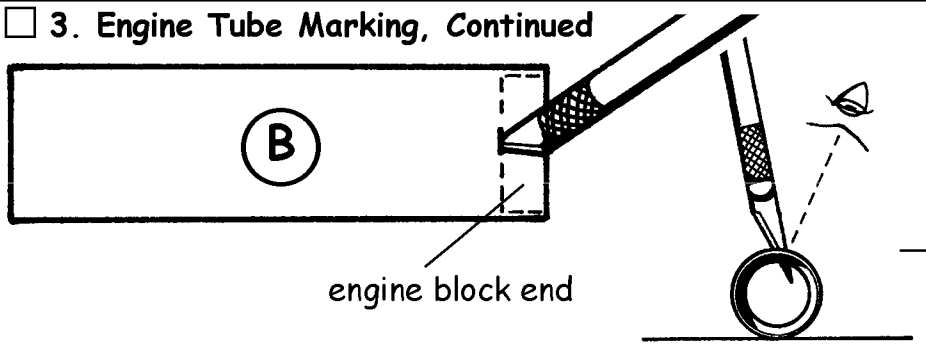




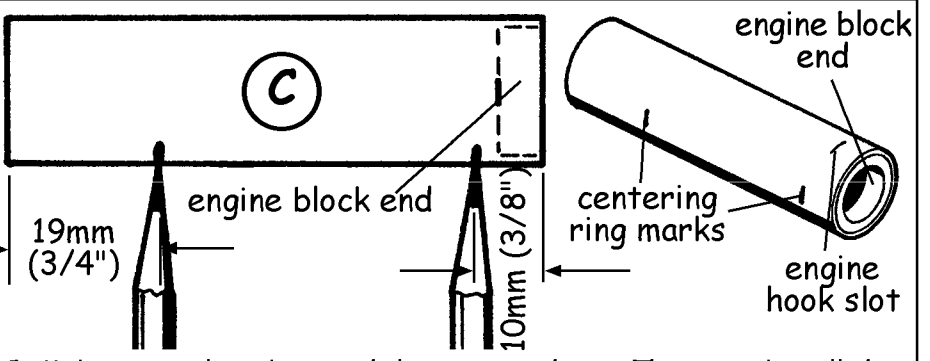
NOTE: In this step, lay engine tube directly on drawing (A) with engine block positioned as shown.
- Sight above tube, place your pencil on side of tube and make marks as shown.

A. Make one mark on engine tube about 1/8 inch long , like this |.
Turn tube 90 degrees so you can see the mark you just made.
- Position tube on drawing (B) (continued on next page).

☐ 3. Engine Tube Marking, Continued



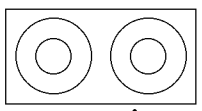
B. Carefully use your knife to make an 1/8 inch slit on the pencil mark you just made.
Note: This narrow slit is used to hold the **engine hook** in place.
•Slide engine tube to drawing (C).



C. Make a pencil mark at each location as shown. These marks will show you where to position the **CENTERING RINGS**.
D. When finished with this step, you should have ONE-3mm (1/8") slit and TWO-3mm (1/8") pencil marks on the engine tube.

☐ 4. Engine Mount Assembly

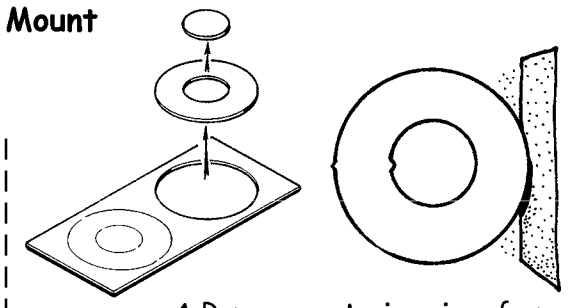
parts needed



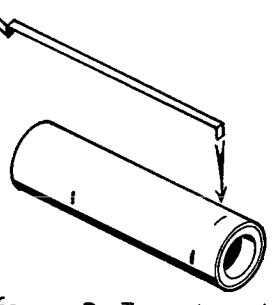
centering rings

engine hook

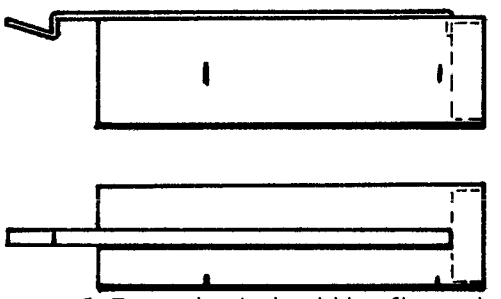
engine tube assembly



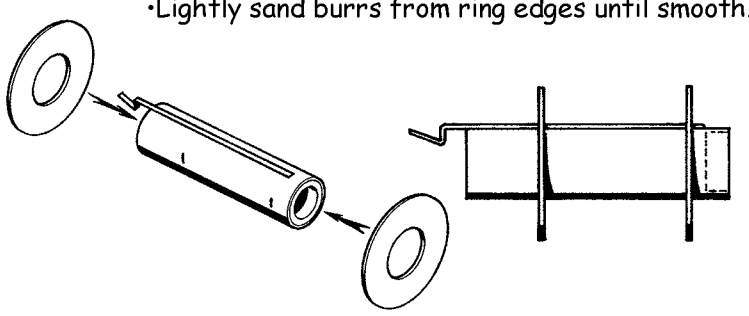
A. Remove **centering rings** from card using a knife if necessary.
•Lightly sand burrs from ring edges until smooth.



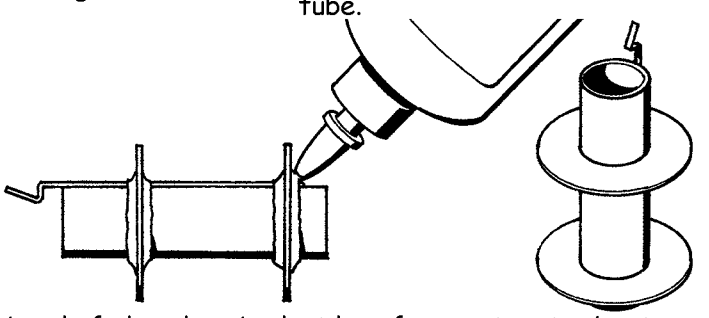
B. Insert engine hook into 1/8 inch slit on engine tube.



C. Engine hook should lay flat and straight along side of engine tube.



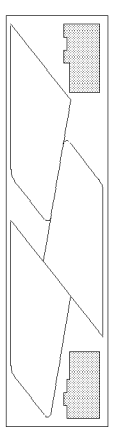
D. Slide centering rings onto both ends of engine tube.
•Position one ring on each mark as shown.
•Looking at the engine mount from the side, evenly space centering rings as shown.



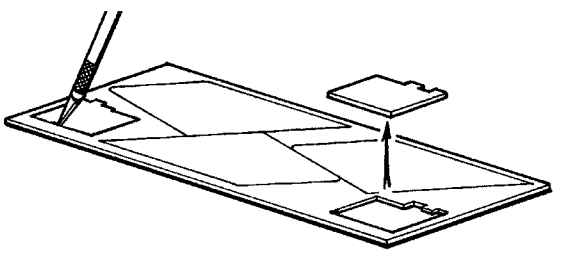
E. Apply a bead of glue along both sides of centering ring/engine tube joint.
•Smooth glue with your finger and wipe away any excess glue.
F. Allow engine mount assembly to dry completely.

☐ 5. Fin Alignment tool

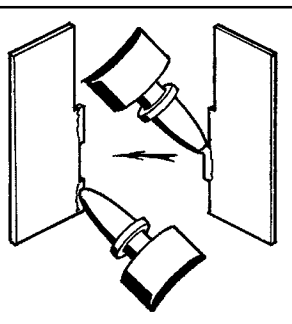
parts needed



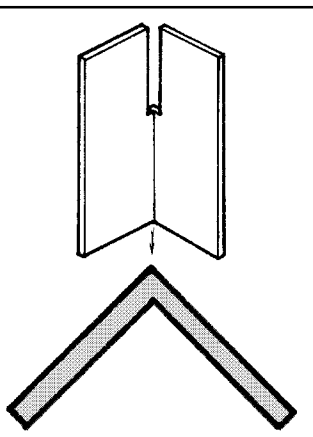
balsa sheet



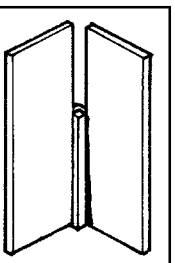
NOTE: The fin alignment tool is used in three different ways: 1. as a marking guide (step 7); 2. as an alignment holder while fins dry (step 9); and 3. as a gauge to check proper fin spacing (**Roc-activity Sheet**, bottom end view).
A. Locate balsa fin sheet.
•Lightly sand both sides of sheet
•Remove fin alignment tool (two pieces) from sheet.



B. Place pieces together at 90 degrees so tab fits into groove.
• Apply glue to edges of groove.



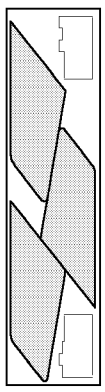
C. Set tool on shaded illustration. Use this full size pattern to make sure sides of tool join at 90 degrees.
•Wipe excess glue from joint and allow to dry.



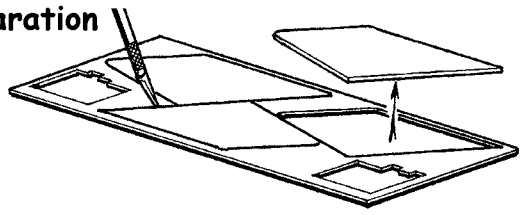
D. When dry, the alignment tool should look like this. **In order for alignment tool to do its job well, the two halves must form a 90 degree angle.**
NOTE: To make glue joint stronger, glue a scrap piece of wood into joint as shown. Do not cover fin slot with scrap wood.

☐ 6. Fin Preparation

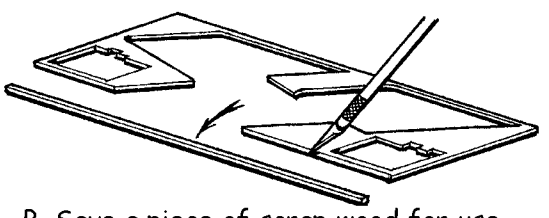
parts needed



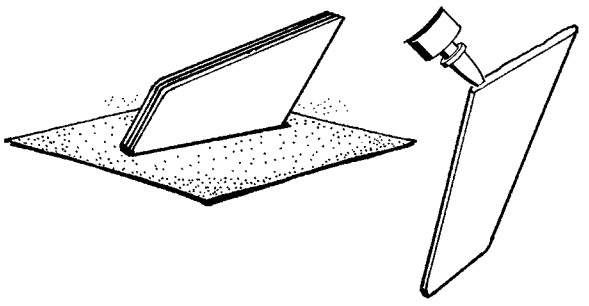
balsa sheet



A. Remove fins from BALSA SHEET.



B. Save a piece of scrap wood for use as a glue applicator in steps 8 and 10.



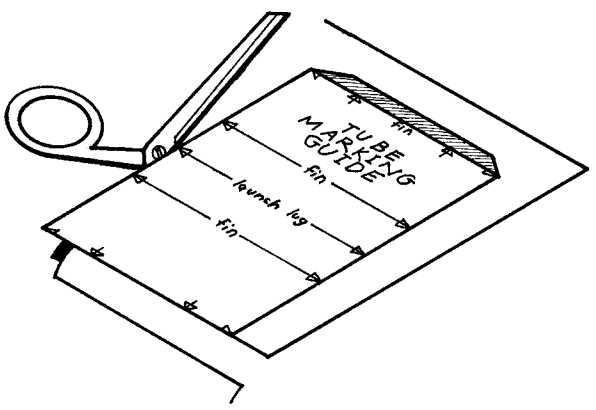
C. Sand fin edges smooth by stacking fins together and lightly sanding the four edges even. Three to four passes over 220 grit sandpaper is sufficient.
NOTE: Although your Tangent will fly o.k. with flat edges, rounding or airfoiling the fins will allow your model to slip through the air with less drag, resulting in a higher altitude on the same engine impulse. See Holverson Technical Note #1, for more information on airfoiling fins and wings.The technical note is available upon request from Holverson Designs.

D. Apply a thin coat of glue to the **root edge** of each fin and allow to dry.
NOTE: This pre-glueing step allows a stronger bond between the fin and body tube when the second layer of glue is applied.

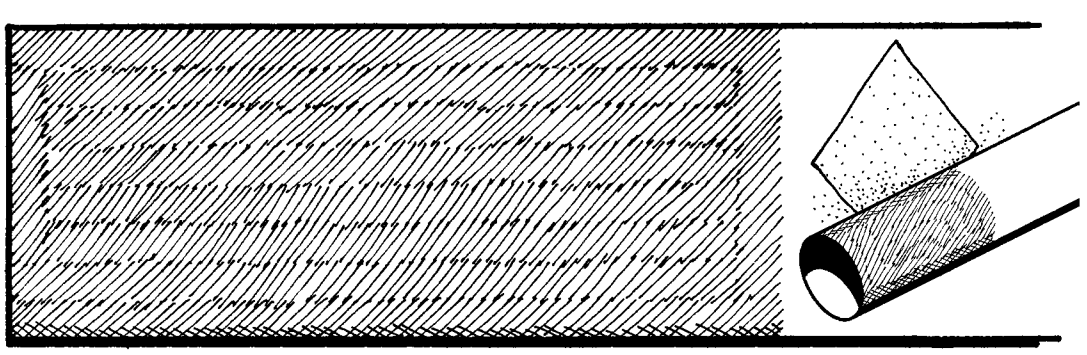
☐ 7. Body Tube Preparation

parts needed

body tube

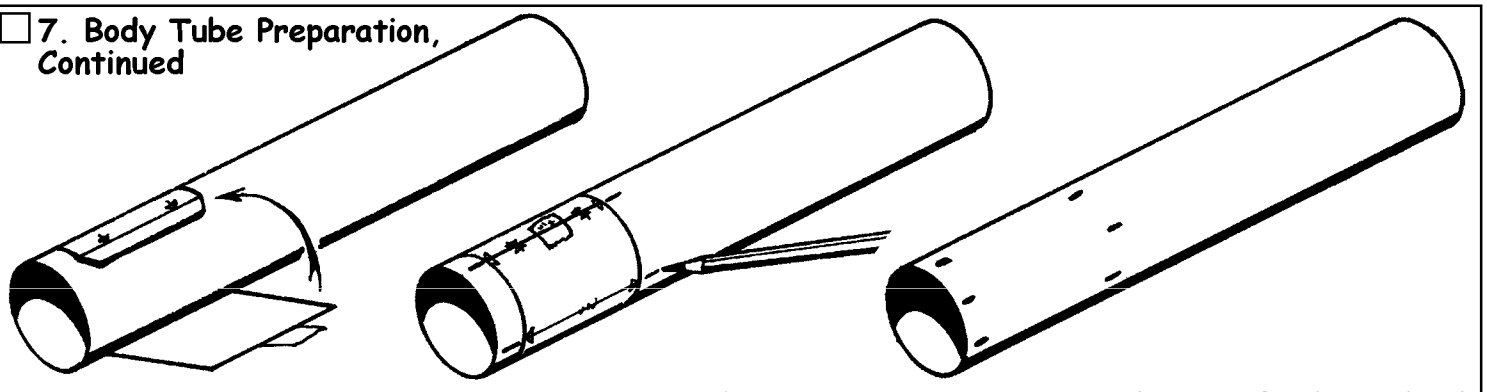


A. Cut **tube marking guide** from Step 7 of this instruction sheet.



B. Using 400 grit sandpaper, **lightly** sand 4 inches of one end of BODY TUBE to remove glossy finish.

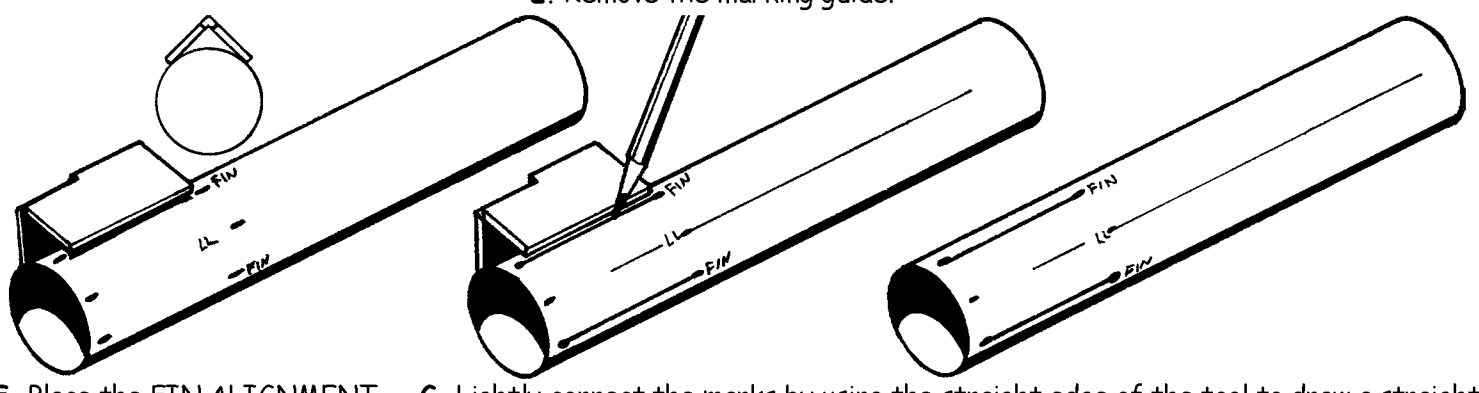
☐ 7. Body Tube Preparation, Continued



C. Wrap marking guide around sanded end of tube about 25mm (1") inch from the end.
- Use a small piece of scotch tape to secure guide tightly around tube.

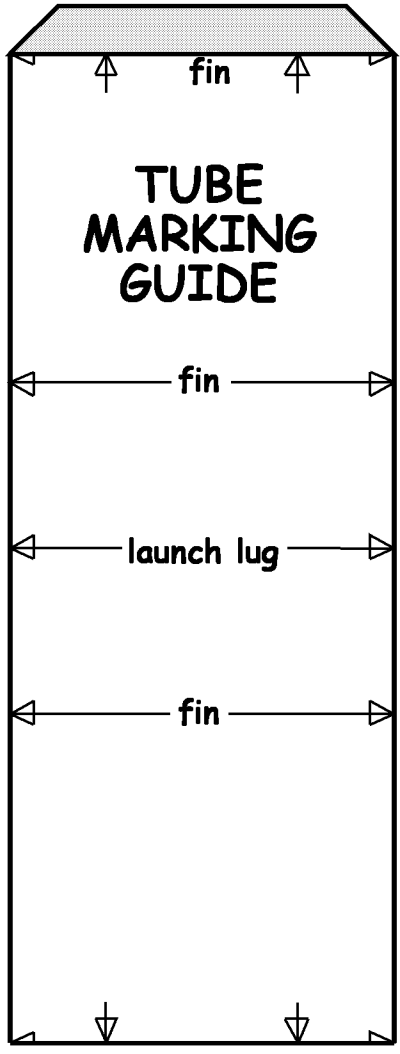
D. Using a pencil, make a mark on **BODY TUBE** at the point of each arrowhead as shown.
- Write "LL" on **BODY TUBE** next to the guide line that reads LAUNCH LUG. This will help you to remember which line is to be used for launch lug attachment.

E. Remove the marking guide.



F. Place the FIN ALIGNMENT TOOL on the BODY TUBE and match edge of tool with tube marks.

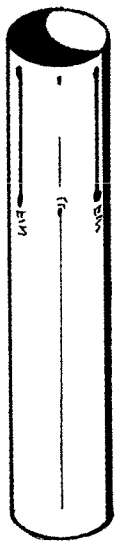
G. Lightly connect the marks by using the straight edge of the tool to draw a straight line on the tube.
- When you are finished you should have three lines, evenly spaced 120 degrees apart around BODY TUBE. Remember the fourth line marked "LL" is for the LAUNCH LUG.



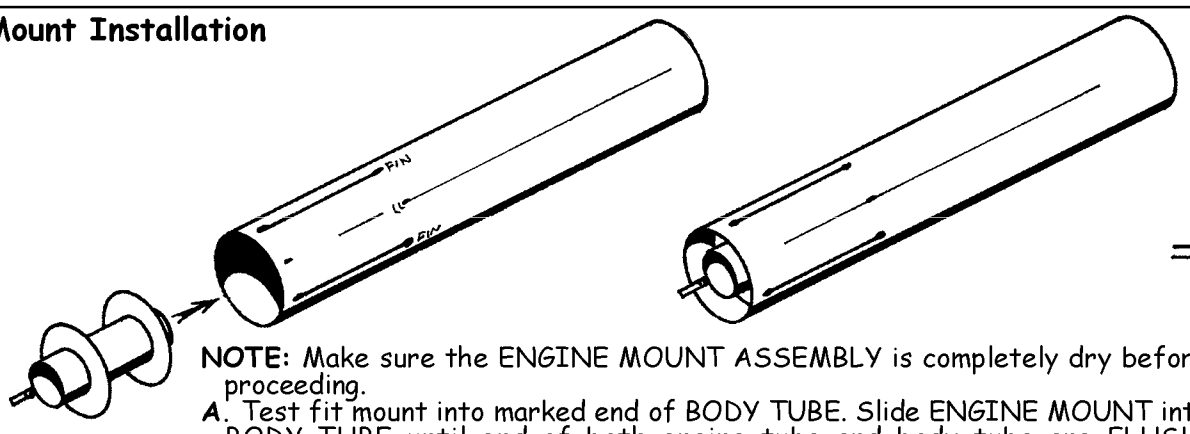
☐ 8. Engine Mount Installation

parts needed

engine mount assembly

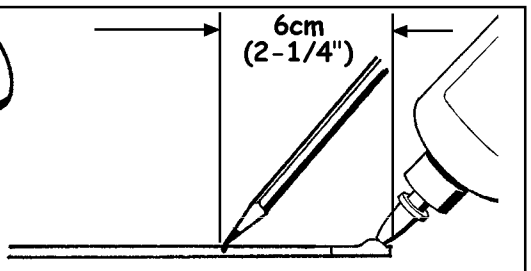


body tube

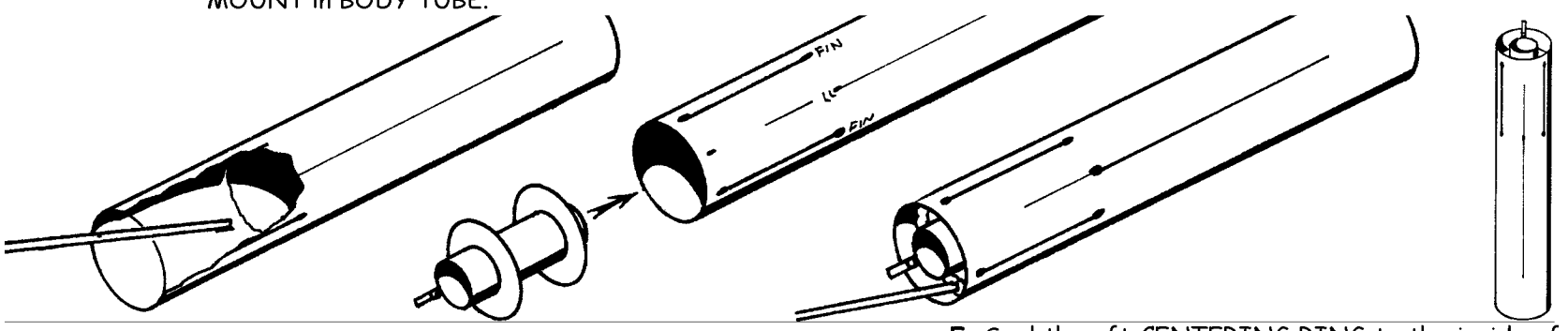


NOTE: Make sure the ENGINE MOUNT ASSEMBLY is completely dry before proceeding.

A. Test fit mount into marked end of BODY TUBE. Slide ENGINE MOUNT into BODY TUBE until end of both engine tube and body tube are FLUSH.
NOTE: Refer to Activity sheet drawing of **Tangent™** for proper location of ENGINE MOUNT in BODY TUBE.



B. Remove ENGINE MOUNT.
- Mark **glue applicator** 6cm (2-1/4") from one end. This mark will be used to tell you how far into the BODY TUBE you will go to apply glue.



C. Load glue on applicator and coat INSIDE of BODY TUBE from 6cm (2-1/4") back to about 2cm (3/4") inch from marked end as shown.

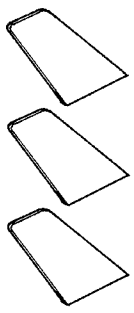
D. Slide ENGINE MOUNT ASSEMBLY into BODY TUBE in one smooth steady motion. **Do not stop until ENGINE TUBE is flush or even with end of BODY TUBE!**
- This end is now considered the rear or aft end of the **Tangent™**.

E. Seal the aft CENTERING RING to the inside of BODY TUBE by applying a bead of glue to the joint.
- Smooth glue bead with your finger.
- Stand BODY TUBE vertically on forward end and allow to dry.

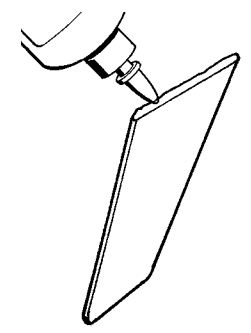
☐ 9. Fin Attachment

parts needed

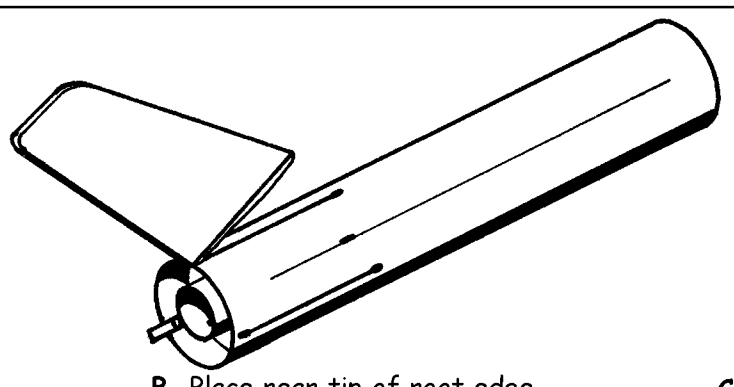
body tube assembly



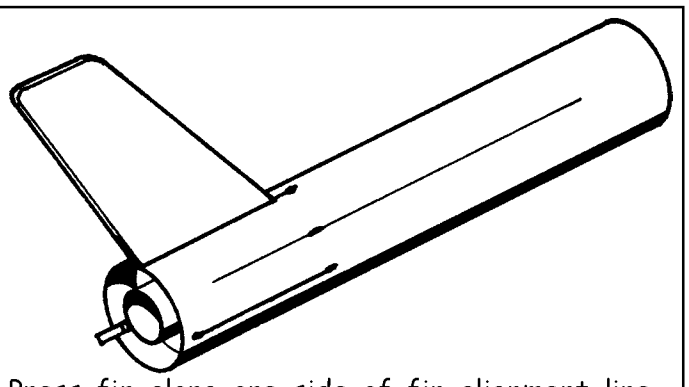
fins



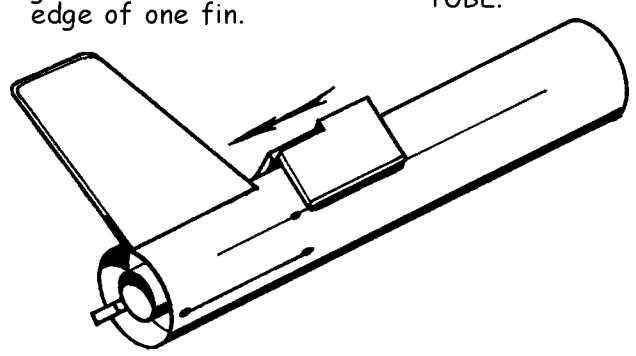
A. Apply a bead of glue to the root edge of one fin.



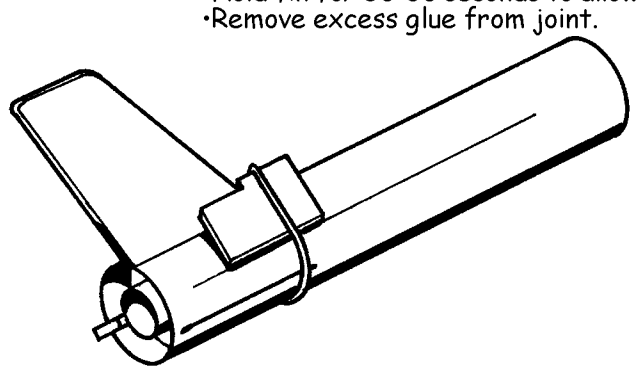
B. Place rear tip of root edge at end of one fin line on BODY TUBE.



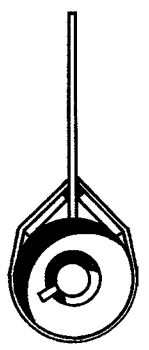
C. Press fin along one side of fin alignment line.
- Hold fin for 30-60 seconds to allow glue to bond to tube.
- Remove excess glue from joint.



D. Carefully slide ALIGNMENT TOOL slot onto LEADING EDGE of FIN.



E. Use a weak rubber band to hold ALIGNMENT TOOL on BODY TUBE.



F. View fin position from rear, top and front of BODY TUBE. Adjust fin so it stands vertically on tube and is attached along one side of fin line.
Note: Make sure glue does not attach alignment tool to body tube.
- Allow fin to dry.
- Repeat these steps for the other two fins.

HINT: Make a cradle to hold the **Tangent™** while the fins are drying. Use the scrap wood from the Fin SHEET and your creativity.

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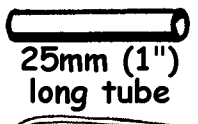
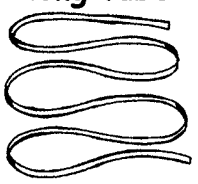
TANGENT

☐ 10. Shock Cord Mount

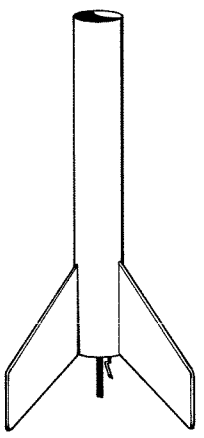
parts needed



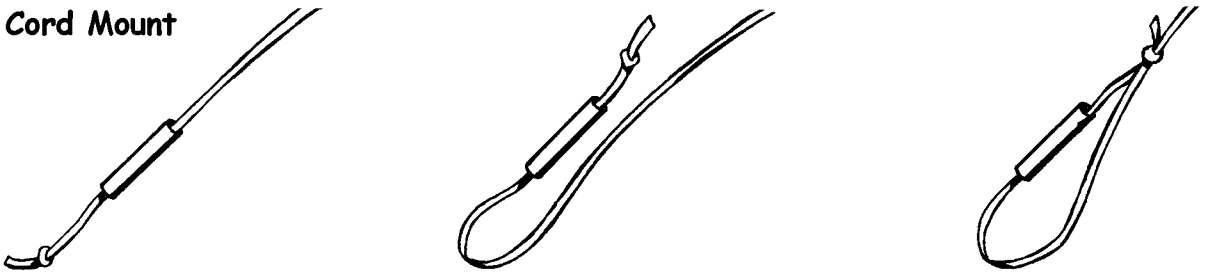
25mm (1") long tube



shock cord

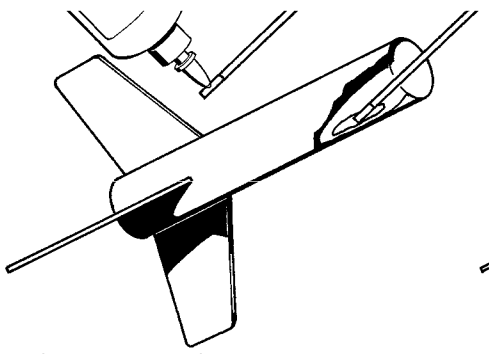


air frame assembly

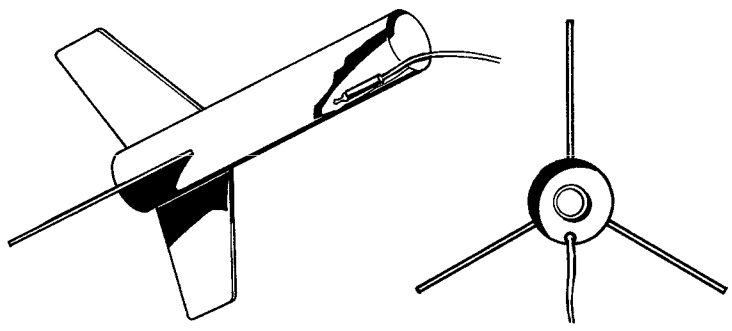


Note: One of three options can be used to tie shock cord to mount:
1. Pass cord through mount, tie large knots in the lower end , then pull knot against bottom of mount tube;
2. Pass cord through mount, tie large knots in upper end and pull knot tight against upper end of mount tube;
3. Loop cord and tie securely, keeping mount in cord loop.

A. Load glue onto applicator again.



B. This time use the 6cm (2-1/4 ") mark as a guide and apply glue to inside of body tube from the forward end.

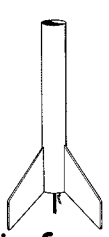


C. Position mount flat against inside of BODY TUBE and allow glue to set-up for 5-10 minutes.
- Apply more glue to mount and blend mount into body tube wall to make a smooth joint between the two.
- Allow to dry thoroughly.

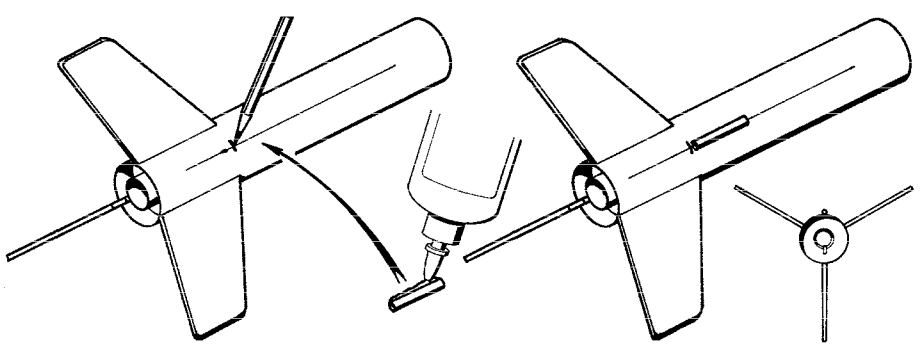
☐ 11. Launch Lug Attachment

parts needed

51mm (2") launch lug



air frame assembly

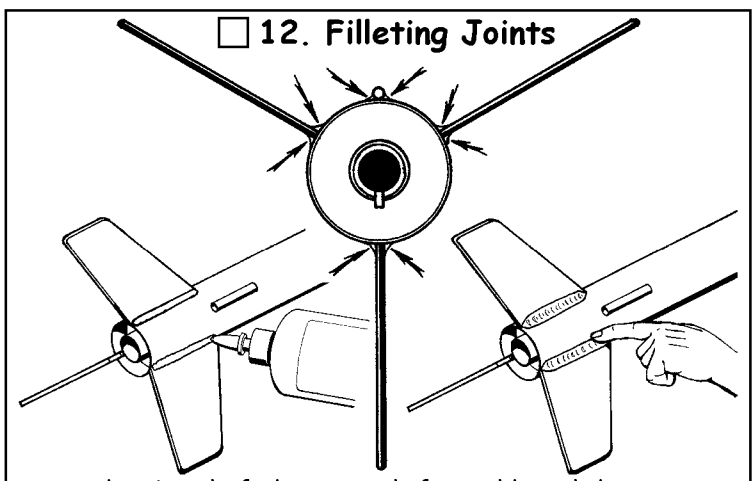


A. Measure 75mm (3") inches from the rear end of BODY TUBE and make a mark on the "LL" line.

B. Apply a small line of glue on Launch Lug and attach LUG starting at 75mm (3") inch mark.

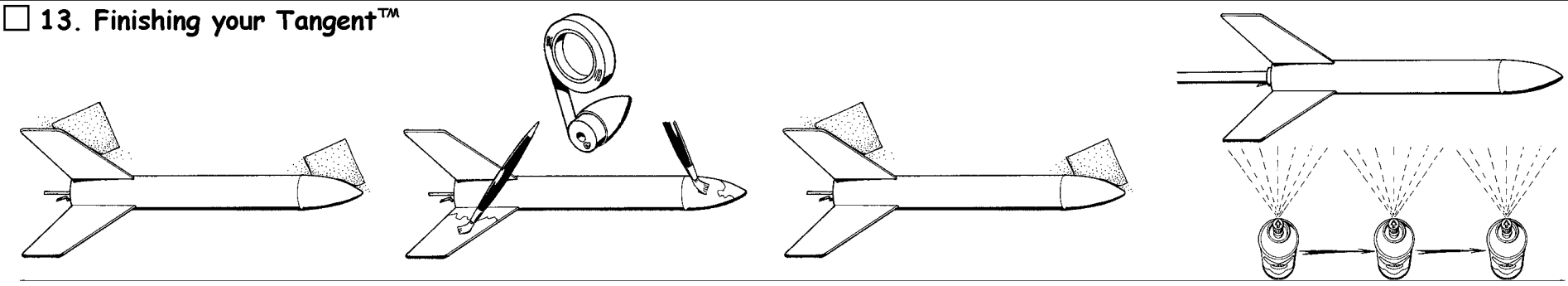
C. Align LAUNCH LUG with BODY TUBE.
- Wipe excess glue away from joint and allow to dry.

☐ 12. Filleting Joints



- Apply a bead of glue to each fin and launch lug joint.
- Smooth glue into a radius or fillet joint.
- Wipe excess glue away and allow to dry.

☐ 13. Finishing your Tangent™



NOTE, READ CAREFULLY: Performance, in terms of burnout velocity and maximum altitude gained, will be affected by how much care you give to building and finishing your **Tangent™**. Studies show as much as 20% increases in altitude and speed can be gained if smooth sanded and painted surfaces are used instead of rough unsanded ones.*

- Once the fins, nose and body are sanded with 220 grit paper, use a tack cloth or towel to remove any dust.
- Apply sanding sealer (aerogloss) to all surfaces. Allow to dry completely.
- Sand surfaces lightly with 320 grit paper.
- Apply two to three more coats of sealer, sanding with 400 grit paper.
- Now the surfaces are filled, sealed and very smooth.
- Spray or brush colors onto surfaces.
- Use light coats to avoid paint runs, or excess weight build up.
- Start with a light dusting of paint for the first coat. So light , most of the wood and tube are visible behind the paint. Let dry 5 to 10 minutes.
- The second coat should go on a little heavier and should resemble the texture and look of an orange skin. Let dry 5 to 15 minutes.
- Final coats can go on heavier without to achieve a deep gloss finish.
- Make a wand from newspaper or a dowel and old engine casing to hold Tangent™ while painting.
- Begin spraying before the model and continue spraying after the model is passed with the nozzle.
- Roll the model to distribute the paint and prevent running if excess spraying occurred.
- You may paint the body and nose cone separately. Make sure forward opening of BODY TUBE is plugged with paper to avoid overspray.
- Mask the TENON of NOSE CONE before painting.
- Allow both nose and body to dry. Acrylics take a day, enamels about 3 days.

NOTE: If you do not wish to paint your **Tangent™**, the white body tube will take marking pens. Interesting color patterns can be made and are more convenient than painting, especially in a classroom or youth group setting.

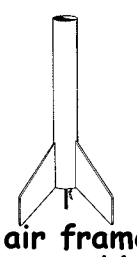
*source: Aerodynamic Drag of Model Rockets by Dr. Gerald M. Gregorek, Cat. No. 2843, published by Estes Industries and available at most hobbyshops that stock model rocket supplies.

☐ 14. Parachute/Nose Cone Attachment

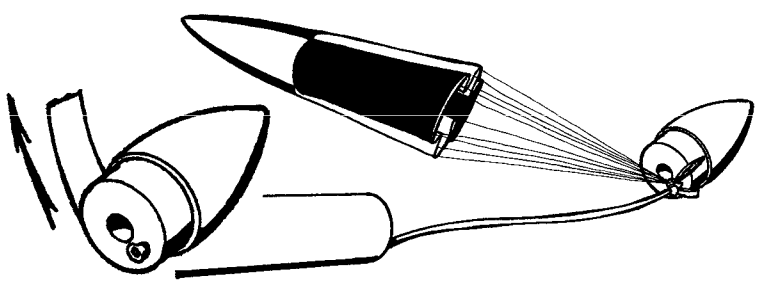
parts needed

nose cone assembly

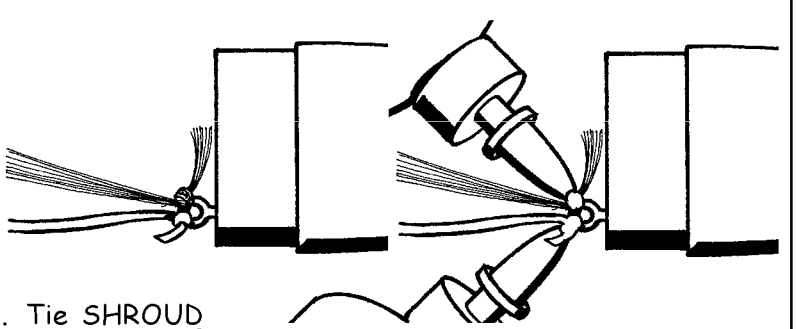
parachute



air frame assembly



A. Remove masking tape from NOSE CONE TENON.
- Cut out and apply decals any way you wish. A suggestion of decal locations is shown in the picture of **Tangent™** illustrated on your instruction sheet header and color kit card.



B. Tie SHROUD LINES of preassembled PARACHUTE to the SCREW EYE.

C. Tie SHOCK CORD to SCREW EYE.

D. Use yellow glue to secure each knot.

NOTE: Before launching your **Tangent™**, read the preflight, launching and "what to expect" instructions on the back of the Activity Sheet. Have fun flying your **Tangent™**!

ROC-ACTIVITY* SHEET FOR THE TANGENT™

Suggestions for using this activity sheet:
It is very improtant to work through this activity sheet first, then start construction.

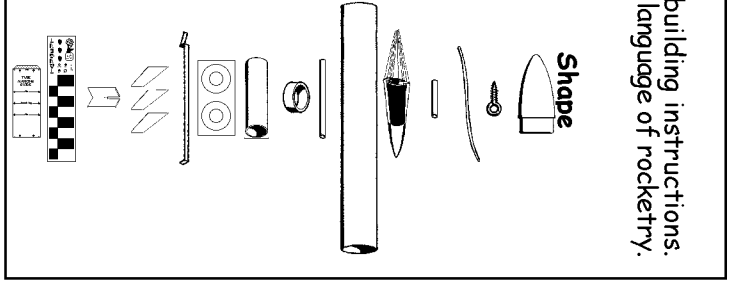
Activity 1. Identify parts and their proper names.
Activity 2. Match parts with its function.
Activity 3. Define the bolded terms from the instruction sheet.
Activity 4. Color in cut-away drawing as parts are completed.
Activity 5. Learn preflight and flight procedures.
Activity 6. Go Tangentia.l
Activity 7. Sources to broaden your knowledge of model rocketry.

The **Rock-activity Sheet** contains several activities to enhance your building experience. You will see that some activities can be done before begining construction (activity 1 and 2). Others can be worked as construction progresses (activities 2-4), and some are best left until your **Tangent**™ is completed (activities 5-8).

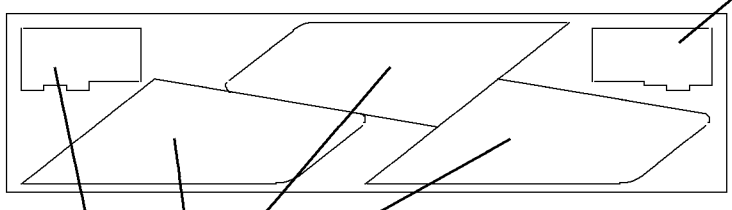
Read the **Roc-activity sheet** and instructions first before starting construction.
Have fun building your new **Tangent**™!

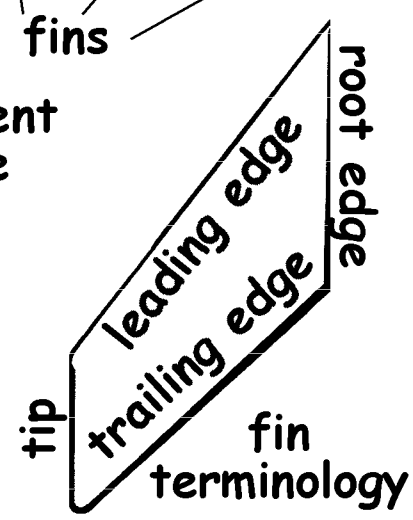
Actitvity 1: Talking the Talk- Parts check-off and their names.
The components (or parts) of your Tangent have specific names. These names are referred to in the building instructions. Learning the terminology and definitions during your building process will help you speak, more easily, the language of rocketry. Make sure that you have all these parts before starting construction.

Yes, I have it!	Name	Material
☐ (bnc42001)	1. Nose Cone (1)	Balsa Wood
☐ (msc00002)	2. Screw Eye (1)	Metal
☐ (sc03100)	3. Shock cord(1)	Elastic Fabric
☐ (ll04025)	4. Shock cord Mount (1)	25mm (1") Long white Paper/Mylar Tube
☐ (pp00046)	5. Parachute (1)	Plastic Canopy, Cotton Lines
☐ (bt42030)	6. Body Tube (1)	30cm (12") Long, 42mm (1.64") Diameter Paper Tube
☐ (ll04051)	7. Launch Lug (1)	51mm (2") Long White Paper/Mylar Tube
☐ (cr01914)	8. Engine Block (1)	6mm (1/4") High Paper
☐ (br01907)	9. Engine Tube (1)	7cm (2.75") Long, 19mm (.74") Diameter Paper Tube
☐ (cr04219)	10. Centering Rings (2)	White Paper Spacing Rings
☐ (eh00070)	11. Engine Hook (1)	Steel
☐ (bal20010)	12. Fins (3)	Balsa
☐ (bal20010)	13. Fin Alignment Tool	Balsa
☐ (dec02001)	14. Decal Sheet	
	15. Tube Marking Guide	Cut Out From Step 7



balsa sheet





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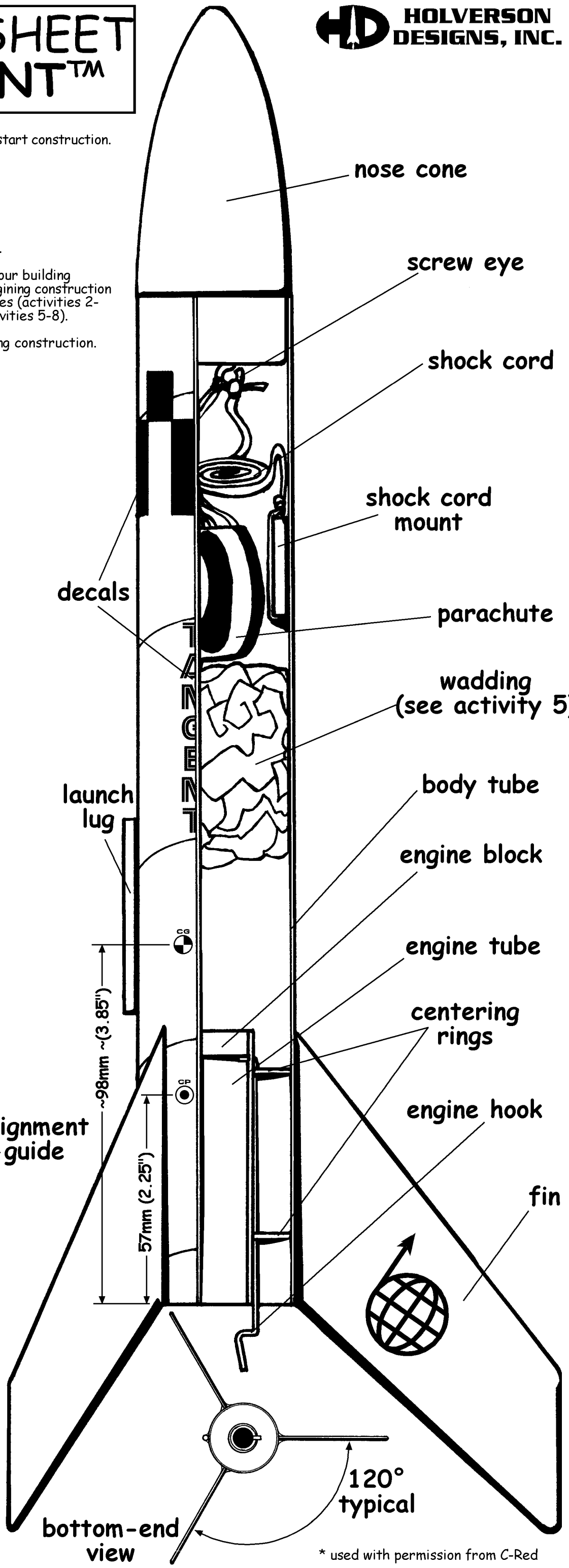


* used with permission from C-Red

Activity 2: Matching Parts And What They Do
Select the correct function letter and write it after the part name. Answers below.

Part Name	Answer
1. Nose Cone	_____
2. Screw Eye	_____
3. Shock Cord	_____
4. Shock Cord Mount	_____
5. Parachute	_____
6. Body Tube	_____
7. Launch Lug	_____
8. Engine Block	_____
9. Engine Tube	_____
10. Centering Rings	_____
11. Engine Hook	_____
12. Fins	_____
13. Fin Alignment Tool	_____
14. Decals	_____
15. Tube Marking Guide	_____

Function

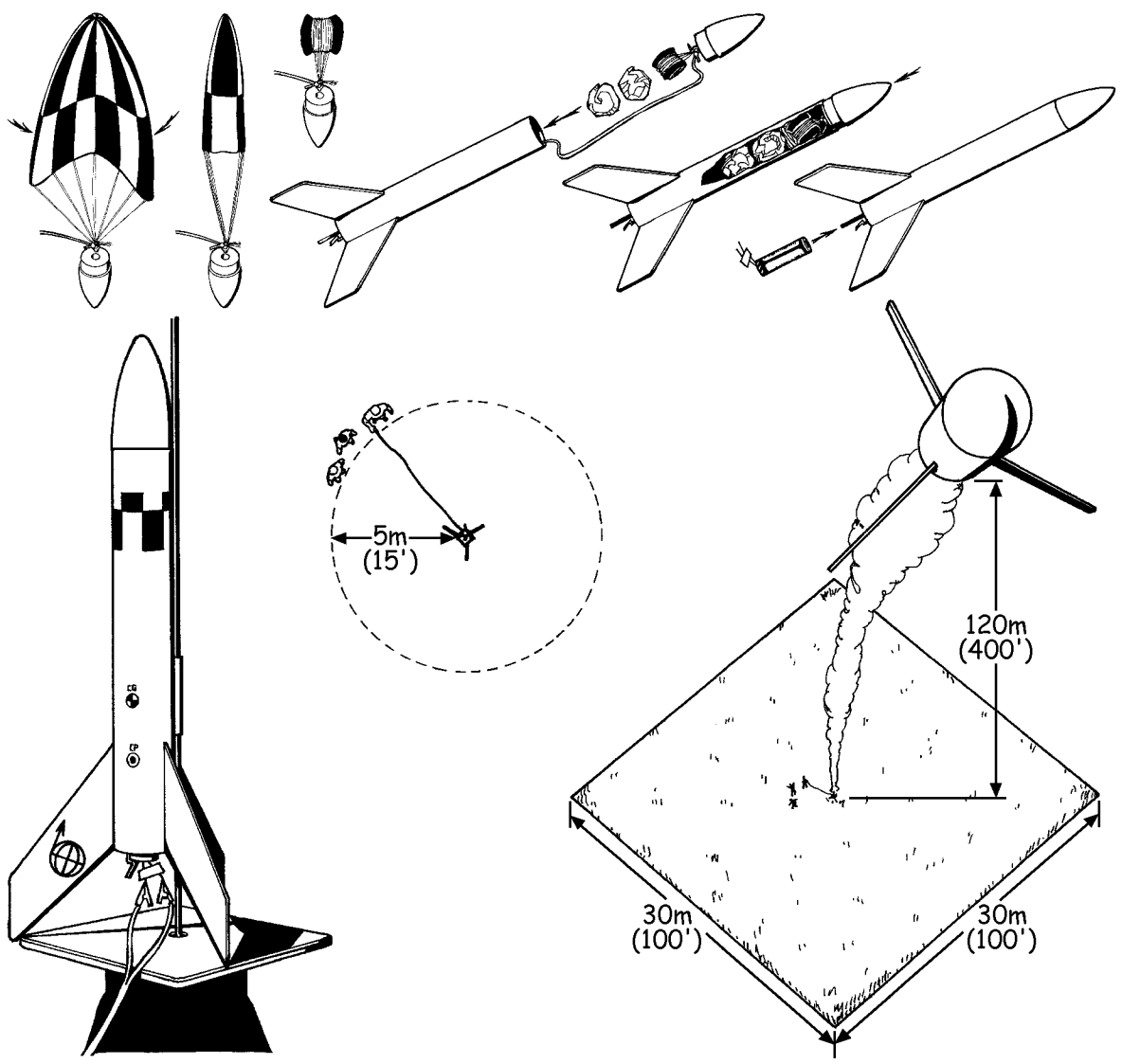
A. Houses the engine inside rocket. The engine block is attached to this component.
B. Major airframe shape that houses all internal subassemblies such as shock cord, parachute, engine mount, fins, wadding, etc.
C. Aesthetic designs and tracking aids which add visual interest or information to the model's exterior.
D. Positions engine tube on the center line of the body tube and helps transmit engine energy to move the rocket airframe.
E. Primary guidance device attached to exterior of airframe. Its function is vital during the first three feet of the rocket's flight.
F. Small ring that helps retain the rocket engine with the airframe during boost. This part helps to transmit the engine's energy into the air frame, resulting in the forward motion of the rocket airframe.
G. Holds the engine in place during the pre launch and ejection charge activation phases. Allows recovery device to be deployed properly without loss of engine.
H. The forward shaped section of the airframe. Introduces the rocket into the surrounding air + initiates a smooth airflow around the rocket's airframe.
I. Guide to ensure fins are properly positioned with body tube during construction.
J. Attachment point of shock cord to the main airframe of the rocket.
K. A simple wrap to locate fin and launch lug glue positions on body tube airframe during construction.
L. One of several recovery methods to safely return a model to earth for another flight. This device uses air drag to slow the rocket's acceleration due to gravity force.
M. The anchor attached to the nose cone to which the shock cord is connected.
N. Secondary guidance systems. Provides stability in the direction of flight shortly after rocket lifts off.
O. Stretch cord that absorbs the energy of nose cone separation at ejection and holds the various airframe components together on descent.

answers: 1.H, 2.M, 3.O, 4.J, 5.L, 6.B, 7.E, 8.F, 9.A, 10.D, 11.G, 12.N, 13.I, 14.C, 15.K

Activity 3: Define Bolded Terms
The following terms are written in capital letters in the instructions. Based on the information in each step and from this activity sheet, see if you can define these terms.

Step#	Term	What Does It Mean?
1	**nose cone**	
1	**screw eye**	
2	**engine tube**	
2	**engine block**	
3	**centering rings**	
5	**fin alignment tool**	
6	**fin**	
7	**body tube**	
7	**tube marking guide**	
10	**shock cord**	
10	**shock cord mount**	
11	**launch lug**	
14	**parachute**	

Activity 4: Adding A Little Color!
•Colors are important to any learning process, whether you're an elementary, jr high, high school, college level student, or an educator. Colors help relate and reinforce the parts function and how they go together. As you complete the construction steps, refer back to the drawing of the **Tangent**™ on this activity sheet. Use various color pencils or markers to illustrate the parts that make up your **Tangent**™. Take the time to do a nice job on this activity and give some thought to the colors you use. Make your **Tangent**™ look as attractive as you can!



Activity 5: Preflight the **Tangent**™ for Launch
•Loosely crumple 3-4 sheets of recovery wadding (available where you purchase your rocket supplies).
•Insert wadding into body tube.
•Fold parachute lengthwise
Note: Recovery wadding is important since it protects the parachute from melting during the ejection of hot gasses at apogee.
•Roll parachute toward shroud lines.
•Wrap shroud lines loosely around parachute.
•Chute should slide easily into body tube.
•Lay shock cord on top of chute.
Note: Nose cone should fit smoothly. Do not trap shock cord or parachute between body tube and nose tenon! Refer to cutaway for proper wadding, chute, and shock cord placement.
•Slide nose cone into place.
Note: Talcum powder can be used to keep plastic parachutes flexible and easy to open. Dust a little powder on 'chute before packing.
Note: After chute and shock cord are installed, a little colored chalk can be sprinkled into rocket. Tempera paint or marking chalk aides in tracking the rocket at chute deployment and adds some color to the event!
•Install engine and igniter as per manufacturer's instructions.
•Always use a launch pad and electronic launch controller. Follow the NAR safety code and manufacturer's instructions for use of these products.

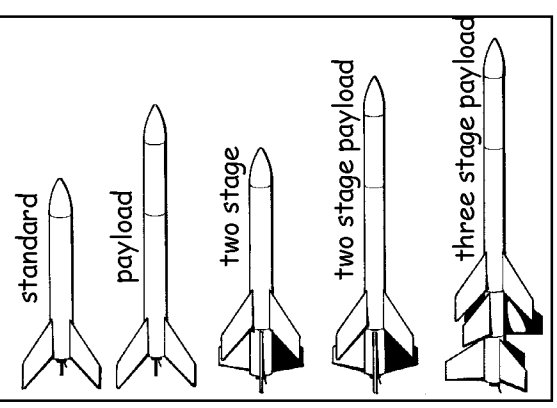
What to Expect When Flying Your Tangent™
•The **Tangent**™ will boost and coast vertically. After coasting to its maximum altitude or apogee, the ejection charge will separate the nose cone from the main body tube. The parachute will deploy and the rocket will return safely to the ground.
•Select a calm wind day for your first flight. Any ball field will provide enough room for flight operations.
•The width or length of field should measure about 1/4 of the overall altitude your **Tangent**™ will achieve.
•After flight and recovery, replace the engine, igniter, and wadding and fly again!

Activity 6: Going Tangential
Uprating is a method used by builders of full scale launch vehicles. By uprating or increasing vehicle performance, the operational life of a basic design can be extended. Higher altitudes or heavier payloads can be achieved. For example the NASA's unmanned satellite launchers all began as basic rockets in the 1950's and early 1960's. The Delta , Atlas and Titan are all still valuable space launchers due to the progressive performance increases derived from uprating.

Our basic **Tangent**™ as been uprated by adding a booster stage to increase altitude performance. A payload section has also been flown. A second booster stage was also successfully flight tested. To aid in recovery of booster stage-two, a streamer was deployed at separation for better visual tracking.

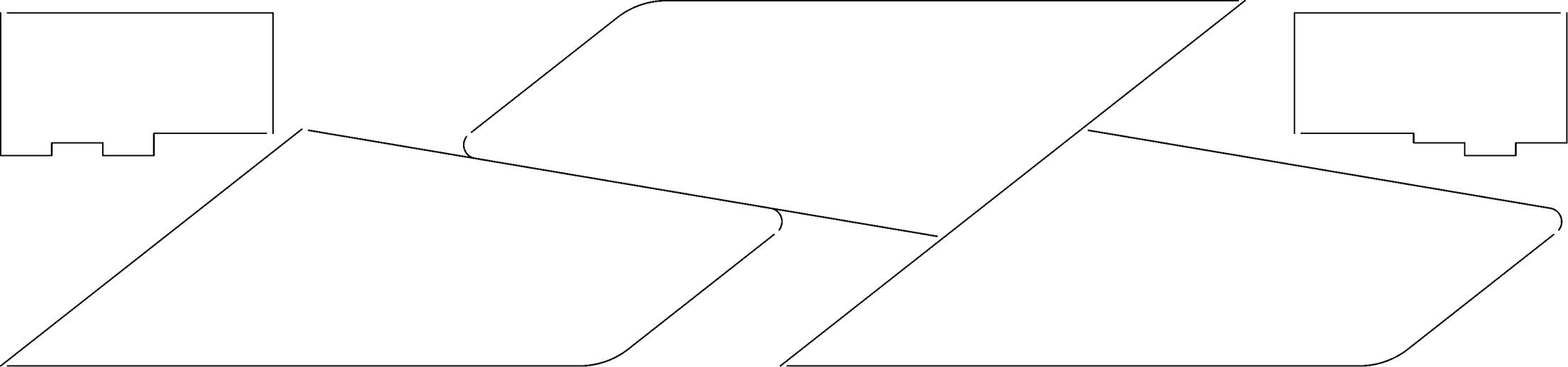
Tangent™ should prove to be a rugged workhorse in your rocket fleet. By uprating, you can expand the basic design and modify it's performance as your needs change. These are just four possible Tangential paths you can take with your model.

If you would like more information on how to uprate your **Tangent's**™ performance, contact Holverson Designs at www.pionet.net/~holvrson.



Activity 7: Exploring The World Of Model Rocketry, Sources For Further Study
Apart from building the many kits and products available to you, the time you spend in this hobby will always be more fun and rewarding with further study. Much has been published! Learning what has been done in model rocketry and what remains to be tried is just one aspect. Below we've listed a few addresses and sources to help you along your personal exploration relating to model rocketry. Hopefully they will enrichen your experience as you reflect on what you want to achieve.

Holverson Tech Sheets and Education Materials, 25075 CO HWY L20, Soldier, IA 51572
NARTS Publications, P.O. Box 1482, Saugud, MA 01906
Estes Technical Pubs and Curriculum Packages, Estes Industries, P.O. Box 227, Penrose, CO 81240
Hand book of Model Rocketry by G. Harry Stine



TANGENT

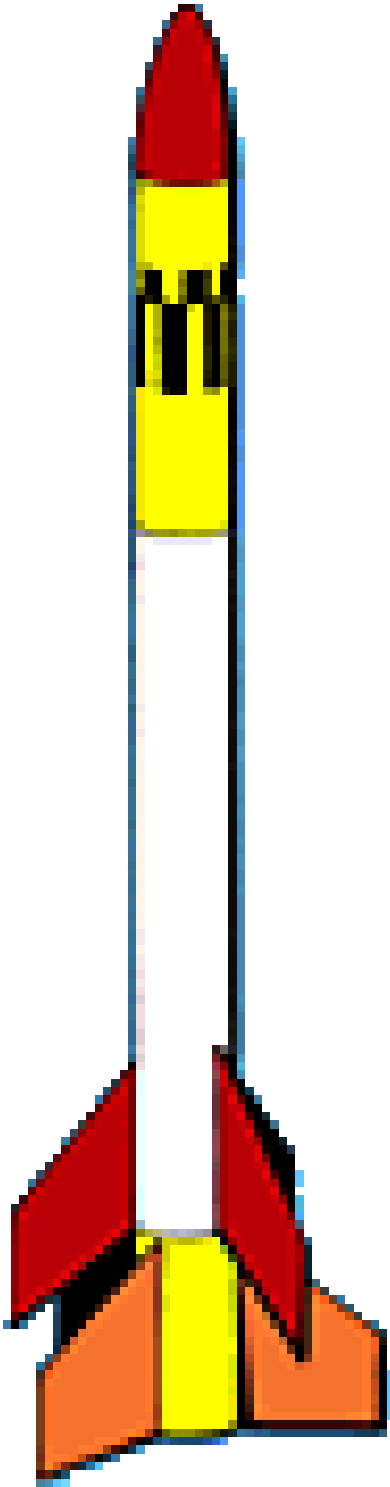
CP

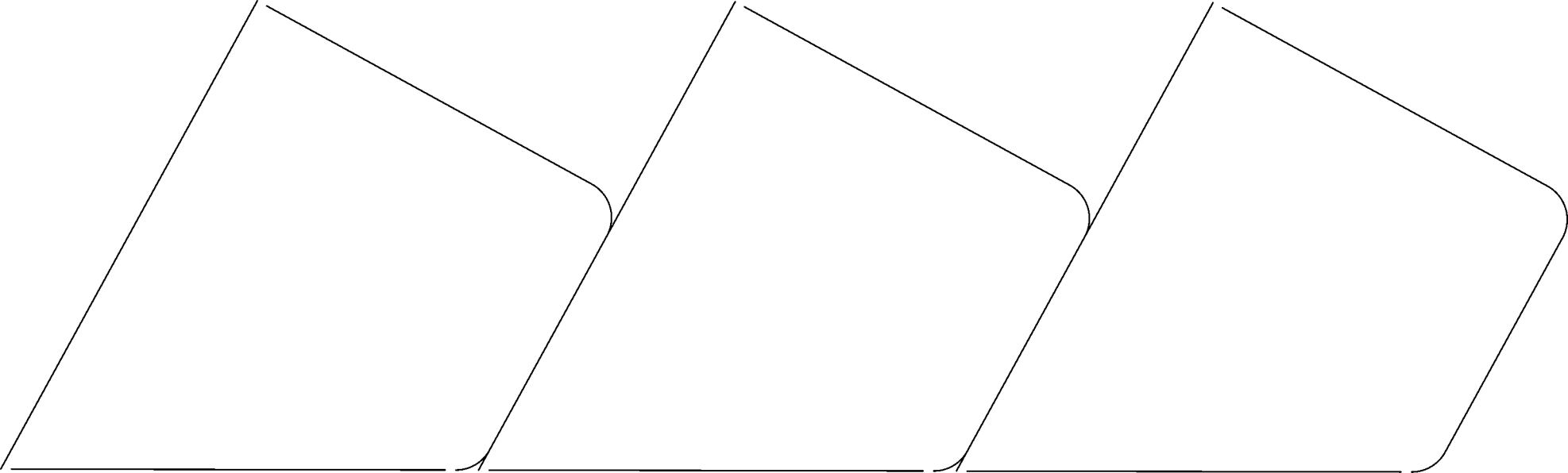
FUEL

CG

LOX

holverson designs
pm# dec2001





SUSTAINER

STAGE TWO

EXHAUST

BOOSTER

STAGE ONE

EXHAUST

HYPERBOLIC TANGENT