

Shahab-3

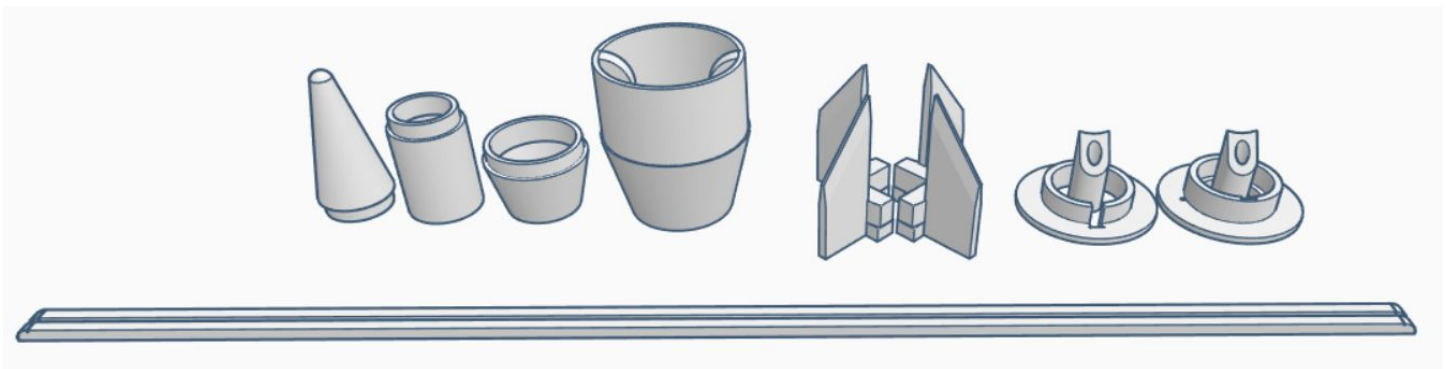
Builder's Kit Parts List

<u>Quantity</u>	<u>Part</u>
2	Centering Rings
2	Launch Lugs
4	Fins
1	Nose kit (4 parts)
2	Plastic Conduits
1	Template Sheet

Parts Needed to Complete

1.5 ounces	Nose Weight
1	Body Tube, ST-18, 18.75" long (476.3mm)
1	24mm Motor Tube, 2.25" long (57.2mm)
1	Shock Cord, ~36" long (~915mm) elastic
1	Shock Cord, ~18" long (~457mm) Kevlar
1	24" Parachute (610mm)
1	Motor clip (if desired)

3D Printed Builders Kit Parts



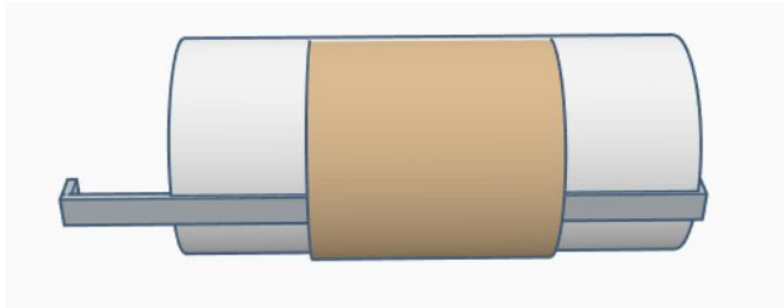
BACKGROUND

The Shahab-3 is a mobile, single-stage, liquid propellant medium-range ballistic missile (MRBM) manufactured in Iran. ("Shahab" means "Meteor" in Persian). Internet sources claim this missile is derived from the North Korean "Nodong" MRBM. Parade photos of both missiles appear to confirm this claim – the resemblance between the two missiles is striking. Essentially a scaled-up "Scud," the Shahab-3 is part of Iran's efforts to hold at risk other nations in the Middle East – particularly Israel. The Iranians have worked to extend the Shahab-3's range as much as possible. Some reports indicate the missile has a range of at least 1,500km. An extended Shahab-3 forms the basis of the Iranian Safir space launch vehicle.

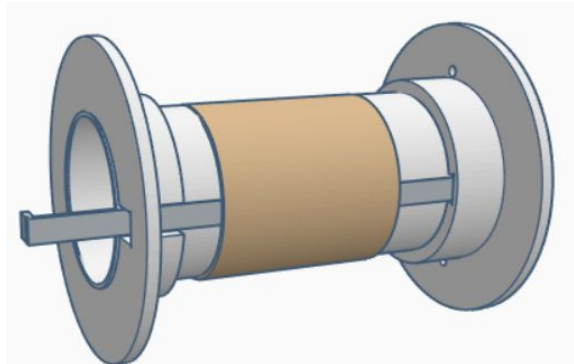
This model was created using photos and drawings of the Shahab-3 available on the internet. Based on reported dimensions, this model is approximately 1:27 scale.

KIT ASSEMBLY

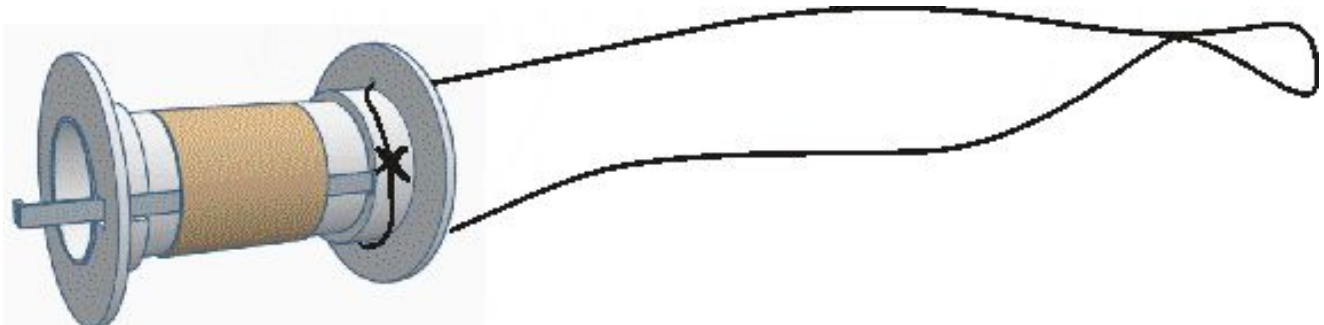
1. Assemble the motor mount. For Estes “D” motors, you’ll need a 24mm (BT-50 motor tube 2.25” (57.2mm) long. If you plan to use “E” Motors, you’ll need a motor tube 3.25” long (82.6mm) long. Note, this motor mount is intended for a “friction fit” of the rocket motor. If you want a motor clip (not included), place the clip over the motor tube (be sure to use the correct clip length for the motors you plan to use) so the forward edge of the clip is even with the forward edge of the motor tube. Secure the clip to the tube in the center of the motor tube with a wrap of 1” (25.4mm) masking tape. Then follow the directions below.



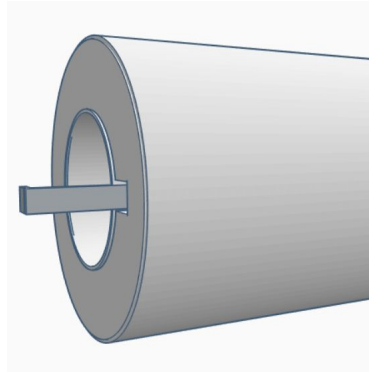
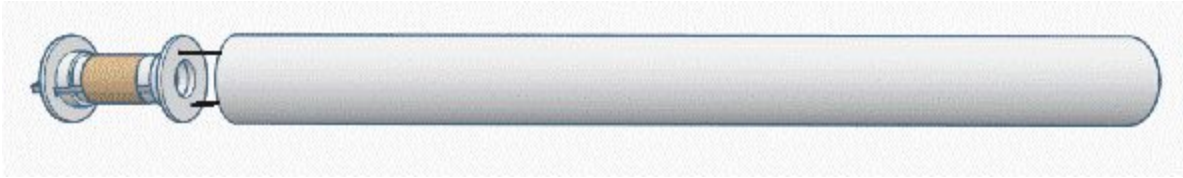
The forward centering ring has a built-in motor block and attach points for a shock cord. Using cyanoacrylate (CA) glue, or “super glue,” glue this ring to one end of the motor tube. Glue the other ring to the aft end of the motor tube, flush with the end of the tube. Apply fillets, if desired, to the tube/ring joints and allow to dry.



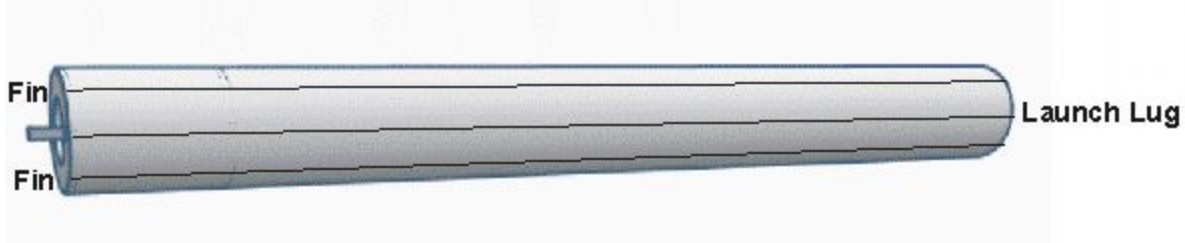
2. Attach the shock cord. The motor mount is designed to use a Kevlar anchor. 100-pound Kevlar works well. The length should be approximately 36” (914mm). Thread one end of the Kevlar through a hole in the forward centering ring. Do the same with the other end. Wrap the Kevlar around the motor tube and tie both ends together in a knot. Try to keep the Kevlar tight against the 3-D plastic, as this is preferable to the Kevlar “digging into” the motor tube. At the other end of the Kevlar, make a loop about 1” in diameter. To this loop, attach an elastic shock cord roughly 36” long (915mm). We prefer ¼” (6.35mm) braided elastic.



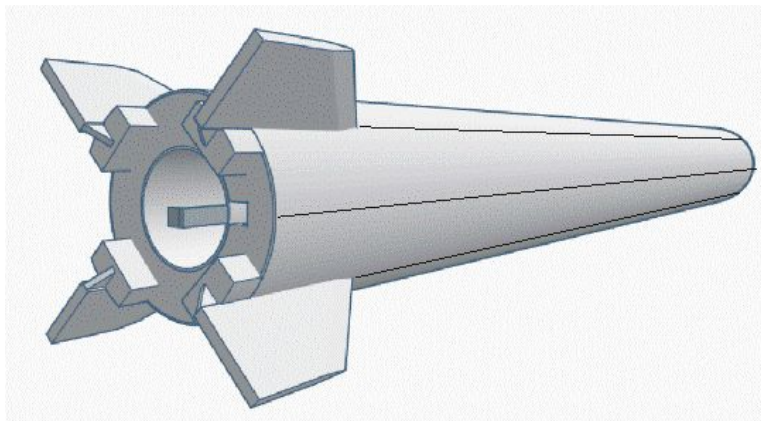
3. Install the motor mount. The body tube for the Shahab 3 is ST-18 (1.84” outside diameter, 1.80” inside diameter). The length should be 18.75”, or 476.3mm. If you can’t find a section of this length, you may need to buy two lengths, plus a tube coupler, to get the correct length. If you use two tubes, make sure they are straight when assembled! Test fit the motor mount assembly in body tube. If the fit is too tight, lightly sand the centering rings until you get the right fit. Apply a generous ring of CA inside the body tube, drop the shock cord through the tube, then insert the motor mount until the aft centering ring is flush with the end of the body tube. Allow to dry. Apply a bead of epoxy or CA to the exposed front ring/body tube joint for extra strength.



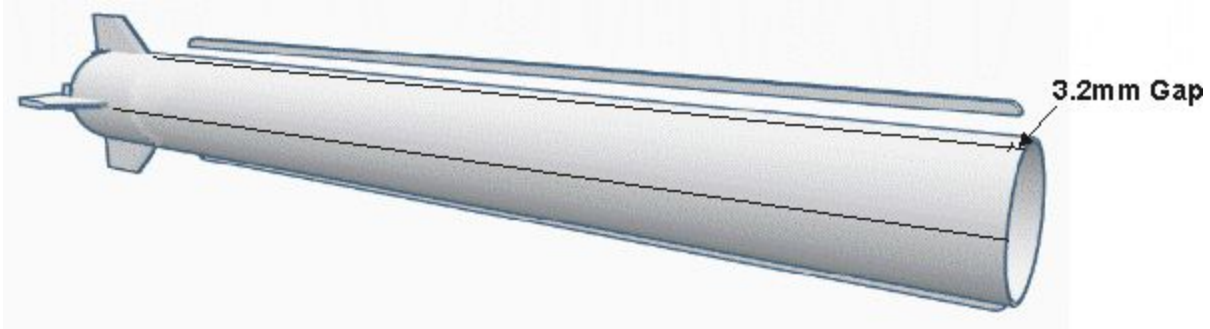
4. Mark the body tube. Place the body tube (aft end down) on the fin location guide (if you installed a motor clip you’ll have to cut a hole in the location guide for the clip). Mark the fin locations and the launch lug location. Using a straight edge, extend the fin marks and launch lug mark the entire length of the body tube.



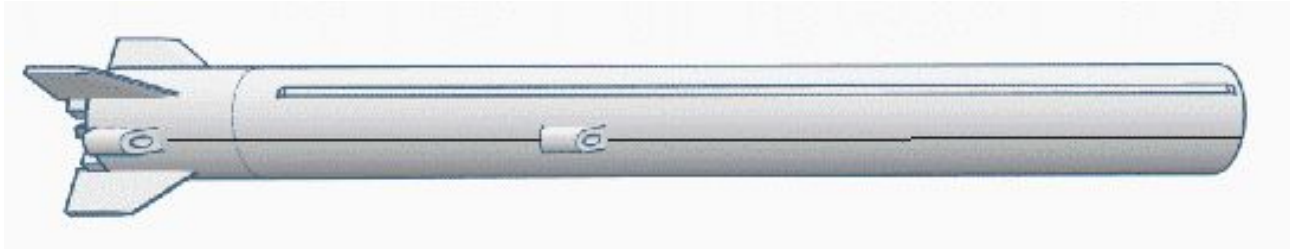
5. Assemble the fins. Glue one fin on each of the fin lines. The plastic piece at the bottom of each fin (a housing that holds jet vanes for steering the actual missile) will sit up against the aft centering ring (apply glue to this joint, as well as the fin/body tube joint). Make sure the fins are straight when drying. Apply CA or epoxy fillets to the fin/tube joints. For scale accuracy, the fillets should be thin – just for added strength.



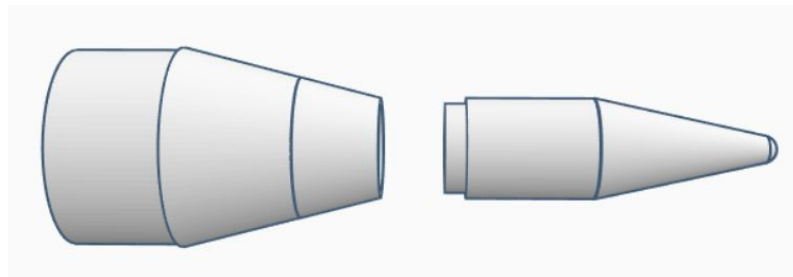
6. Airframe Conduits. The conduits are aligned with the fins. Select two of the fin lines (choose two fin lines 180° apart!) and mark 1/8" (3.2mm) from the FRONT of the body tube. Glue one conduit on each of the selected fin lines, with the front end of the conduit at the 1/8"/3.2mm mark. Make sure the conduit is straight along the tube. It should be parallel with the sides of the body tube, and aligned with the fin. Apply CA or epoxy fillets to the conduit/tube joints. For scale accuracy, the fillets should be thin.



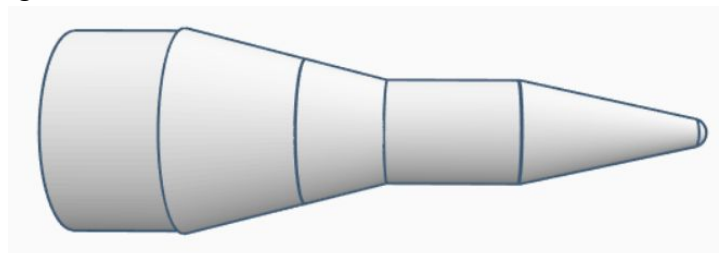
7. Attach the launch lugs. The launch lugs are, of course, located on the launch lug line. Mark this line 1/4" (6.4mm) and 9" (228.6mm) from that AFT end of the body tube. Attach the launch lugs with their aft ends at these marks using CA glue, making sure the launch lugs are aligned. Apply CA or epoxy fillets to the launch lug/body joints. Allow to dry.



8. Assemble the nose cone. Use CA glue when attaching nose cone sections. Glue the 3D-printed nose cone to the short section of 3D-printed tubing, making sure everything is straight. Glue the two segments of the frustum section together, but do not glue the frustum section to the tube yet. Note, there is an intentional "seam" on the frustum piece between the two parts of the frustum. This is the point where the missile's reentry vehicle separates from the missile. On our display model, a scribing tool was used to deepen the seam for greater visibility.



Epoxy weight into the tip of the nose cone. Add 1.5 oz of nose weight for D sized motors or 2.25 oz if you installed an E sized motor mount. Remember epoxy gets hot as it hardens. To protect the plastic, you can place the cone tip-down in cool water while the epoxy dries. Once you have added sufficient nose weight, glue the two parts of the nose cone together.



9. Finish the 3D-printed pieces. To finish the 3D-printed pieces, sand all pieces thoroughly, then spray with a sandable, filling primer. Sand the primer, then repeat the process at least once more. After two rounds of primer and sanding, the grooves from the 3D printing should all but disappear. Again, remember there is an intentional “seam” on the transition piece between the two parts of the frustum, as discussed in Step 8.

10. Final assembly. Use a 24” (610mm) parachute for your model, due to the nose weight. Attach the parachute to one of the attach points on the nose cone. Attach the free end of the elastic shock cord to the other attach point on the nose cone. As an alternative, tie a loop in the free end of the elastic shock cord and attach the parachute to the loop. Run a roughly 6” (152mm) length of Kevlar through one of the attach points on the nose cone and attach it to the elastic loop.



11. Finishing. We recommend painting your model with regular primer and sanding until you achieve a smooth finish. Shahab-3 missiles paraded in Iran are typically a brown-sand or yellow-sand color, with a black nose tip (as shown on the prototype model). However, some Iranian “Scud” missiles have been displayed sporting an interesting mottled camouflage scheme. Such a scheme could be applied to the Shahab-3, for those who seek a more stimulating paint job! This missile could also be finished as a North Korean “Nodong.” Parade photos of the Nodong reveal a silver-gray missile with a red nose tip. We recommend searching the internet for the paint scheme you like the most.

12. Flying. Unless you added a motor clip, the motor must be “friction-fitted” in the model. Wrap tape around the motor and insert into the motor mount. The motor should be snug (so it won’t be ejected) but not so tight you won’t be able to remove it later. A C11-3 will produce a very low altitude flight. A D12-3 will take your model a bit higher. We haven’t tested larger (“E” or “F”) motors, so try larger motors at your own risk! Please note – the fins on this scale model are quite small. We therefore recommend flying this model only in calm wind conditions.



***Aggressor Aerospace
Rocketry***