Chapter 4 - Powerplant Installation

The big crate arrives!

Few things are more pleasing to the builder of a flying machine than receiving a giant wooden crate with an engine in it! If you are not yet ready to hang the motor, but just want to take a peek, open one of the side panels of the shipping crate (leaving the top panel to protect the motor).

Some general advice from the engineer...

"Somewhere in the beginning [of this guide, make] a mention of the [benefit to be found through] liberal use of blue LOCKTITE on anything installed without a locking device [this method] should be used. Also mentioning [that] the [desirable] practice of always using the specified values for torque when attaching anything to the engine aluminum casting and that less torque, together with blue LOCKTITE will make the treads last so much longer. Spark plugs should always be removed from a cold engine and new plugs with a new crush gasket and anti seize compound should be used". OK...;^)

When you are ready to attach the hoist and sling, gather at least two strong persons to uncrate the motor and tip it upright.

1. **[ ]** Remove all panels of the shipping crate. (I built my daughter a tree house with my shipping crates).
2. **[ ]** Slowly tip the engine, still bolted to the shipping palette, upright as it will go in the plane.
3. **[ ]** A small amount of oil may spill from the exhaust pipe (if installed). This is a normal side-effect of shipping the motor on end.
4. **[ ]** Position a pair of jack stands or wooden blocks under the aluminum engine mount plate so the engine rests level.
5. **[ ]** Remove the temporary screws holding the ECM (Engine Control Module) and Fuel Pumps to the shipping crate.
6. **[ ]** Coil up any excess wiring and fuel lines on top of motor. Fasten these items out of the way.
7. **[ ]** Pre-drill for the major firewall fittings. Mounting bolts, hoses, cables and conduit pass-throughs.
8. **[ ]** Polish, paint, or machine the firewall if desired.
9. **[ ]** Gather the engine mount bolts and nuts and appropriate wrenches.
10. **[ ]** Gather a spare ratcheting tiedown strap to help align the engine mount legs.
11. **[ ]** Take note of the time.

Hoisting the motor

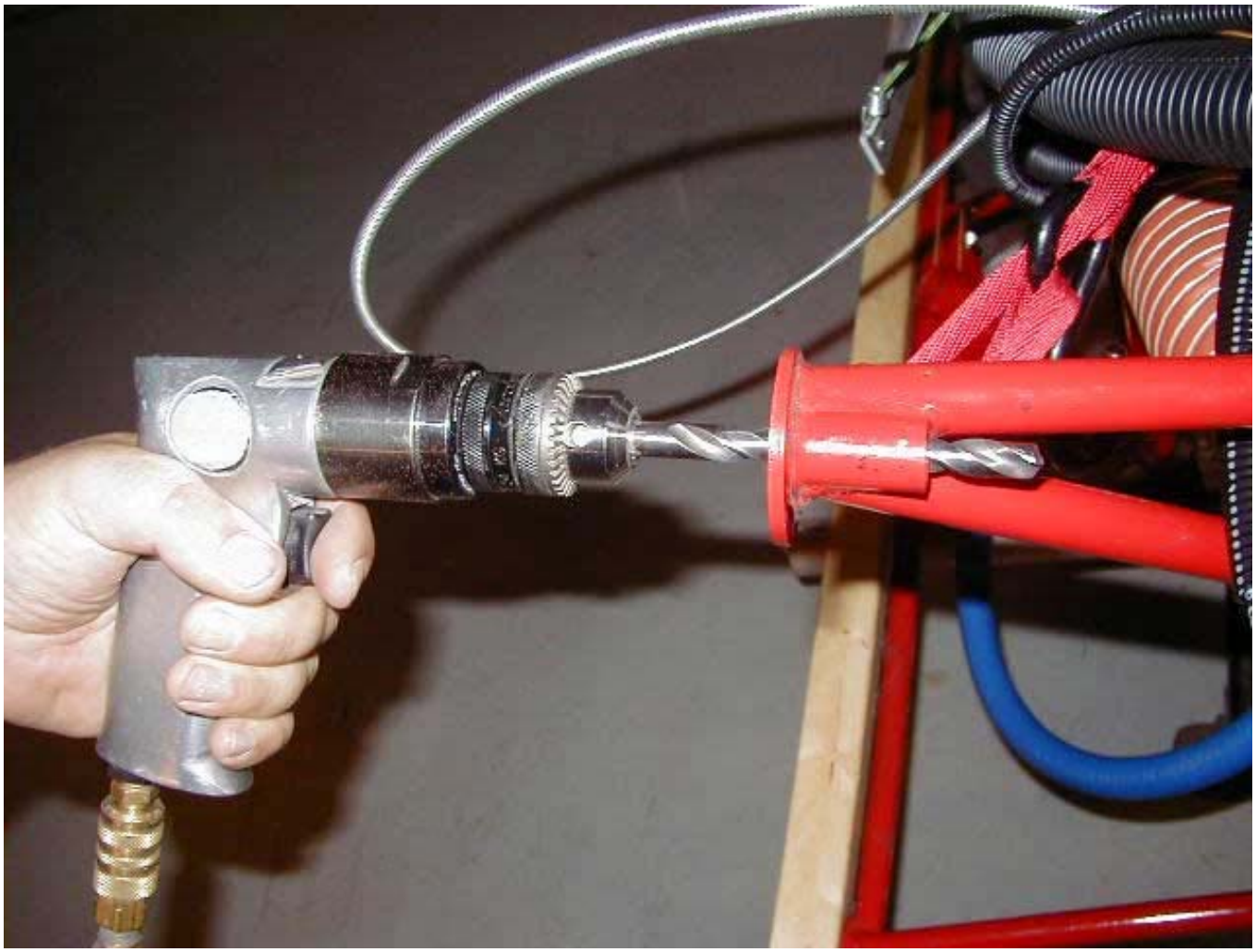
Be sure you have ample room to maneuver the engine hoist into position over the engine, all the way to the airframe. Have assistance standing by.

Do not allow the weight of the engine to rest on the engine mounting bolts until all bolts have been inserted and properly torqued.

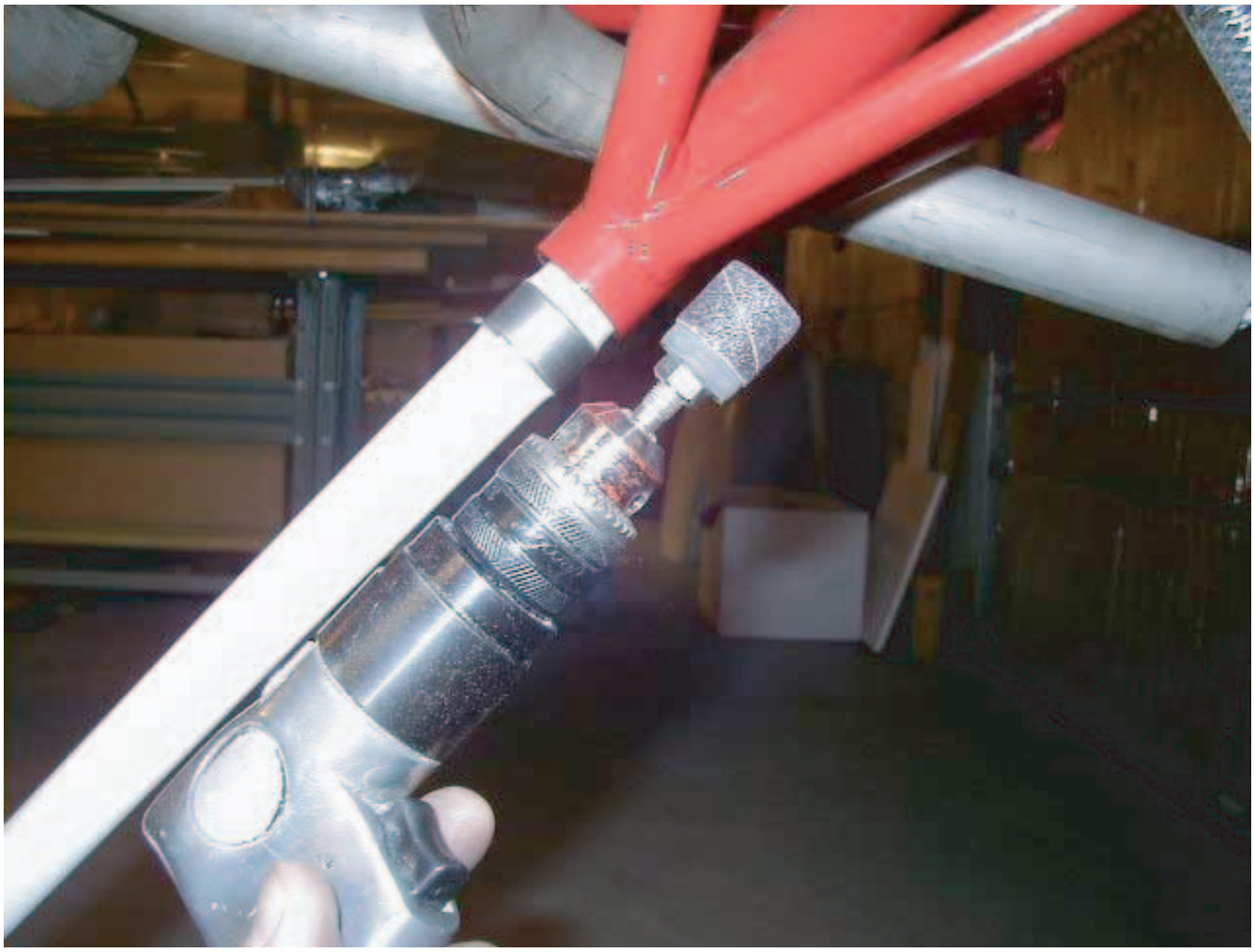
12. **[ ]** Position the hoist hook directly centered about 4" over the engine air intake manifold. Do not attach straps to the manifold itself!

13. **[ ]** Attach four strong ratcheting tiedown straps from the corners of the engine mount to the hook. Double up the straps where possible.
14. **[ ]** Attach another tiedown strap from the hook, under the PSRU bearing hub, and back to the hook. Make the ratchet handle accessible.
15. **[ ]** Slowly raise the hoist adjusting the straps as needed to balance and level the engine.
16. **[ ]** Remove the shipping palette.
17. **[ ]** Move the hoist close to the airframe but not yet into position.

Nose Gear Leg and Wheel



18. **[ ]** Clean out any scale or debris in the motor mount bolt holes using a sandpaper roll or a drill. Do not enlarge the holes!
19. **[ ]** Raise the hoist high enough to allow insertion of the nose gear leg into the receptacle.

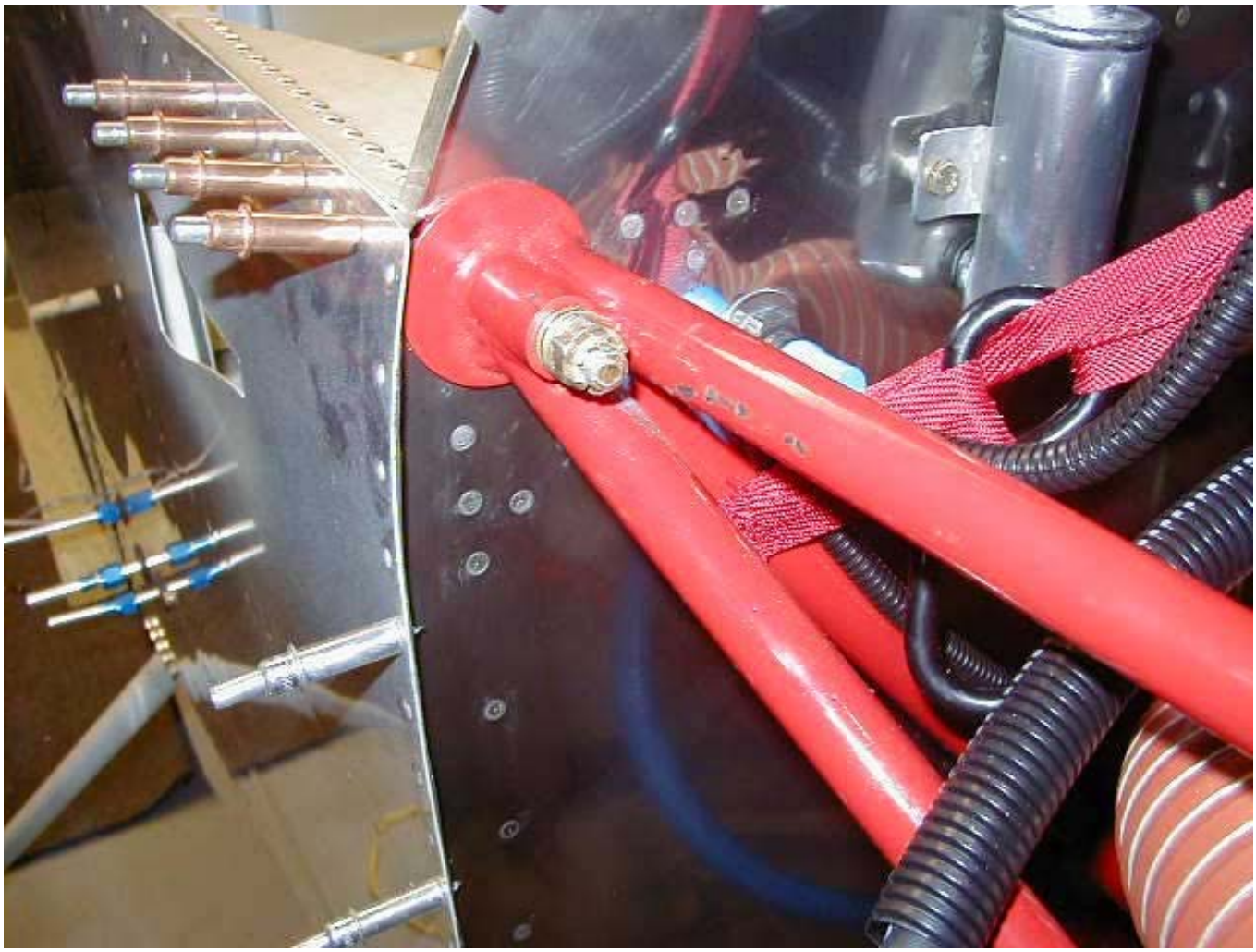


20. [ ] Clean out any loose scale or debris from inside the nose gear mount receptacle tube using a drum sander drill bit. If you prefer, an automotive brake cylinder hone with a splash of kerosene makes short change of this task.
21. [ ] Test fit the nose gear leg into the engine mount. It is likely to bind at the point where the mount tubes are welded to the gear tube.
22. [ ] Remove the gear leg and polish the inside of the gear tube with a drum sander drill bit or brake cylinder hone until the nose gear fits snugly into the gear tube. A tight fit is desirable, but not so tight that you must use force to insert the leg.
23. [ ] Swab out the inside of the gear tube with a rag on a stick.
24. [ ] Smear a light coating of Anti-sieze Compound onto the gear leg bearing surfaces and swab some more inside the gear tube.
25. [ ] Insert the nose gear leg and finish drilling and reaming the bolt hole for the 5/16" gear leg bolt. Use a 19/64" drill bit and 0.310" reamer to produce a snug bolt fit. Use a castellated lock nut to secure the bolt. Fiberlock nuts don't fare well near a hot exhaust pipe.
26. [ ] Raise the hoist as necessary and install the nose wheel fork components and nose wheel. Loosely fasten these for now.

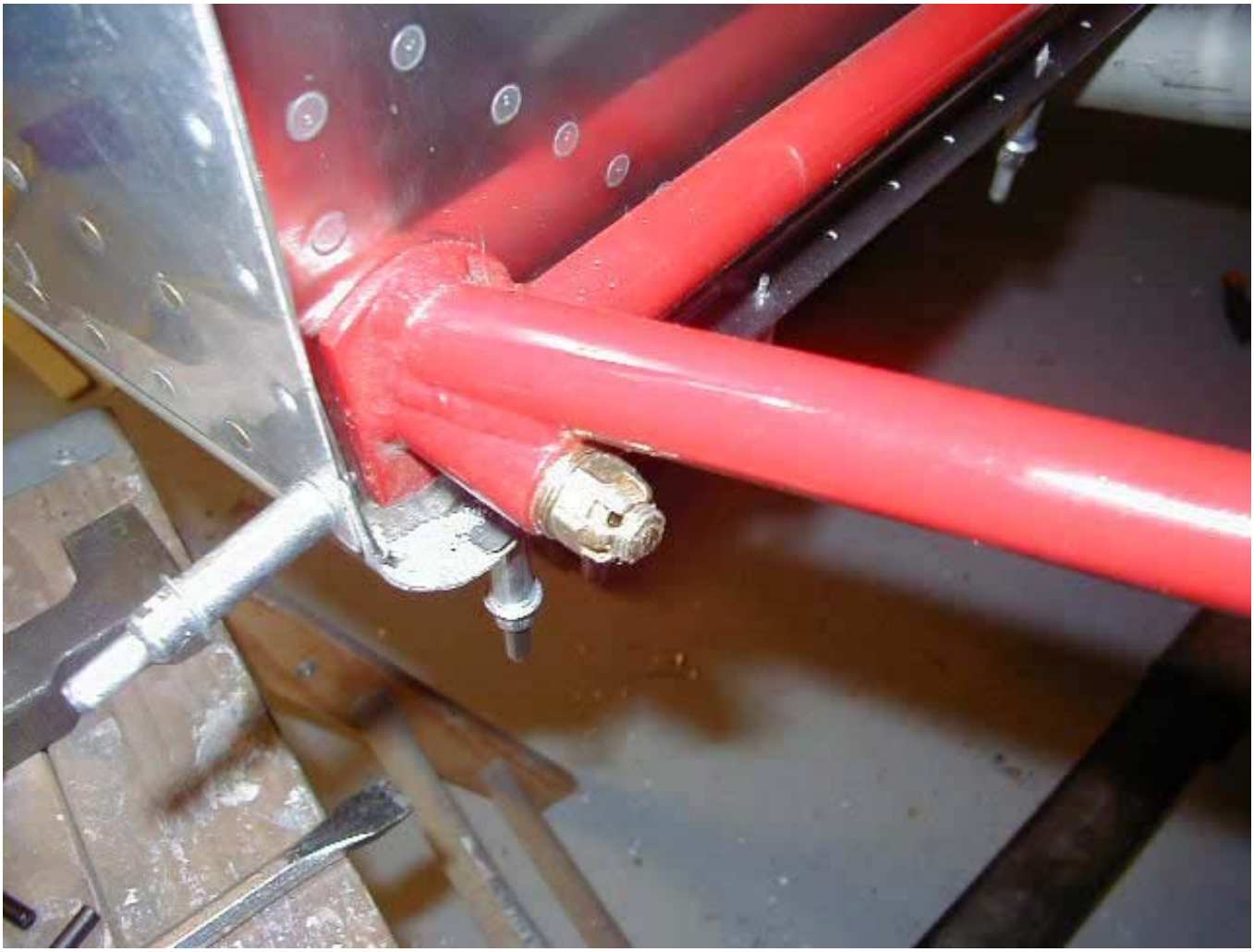
Motor Mounts

27. **[ ]** Move the hoist to position the engine against the firewall.
28. **[ ]** Shorten or lengthen the strap under the PSRU bearing hub as needed to orient the engine parallel to the firewall
29. **[ ]** Raise or lower the aircraft's empennage to help align the engine mount.

30. **[ ]** INSERT ONE OF THE UPPER BOLTS FIRST. Insert all mount bolts **from the cabin side**. Loosely install washers and nuts. Some builders have chosen to use AN6-20 (corners) AN6-22 (bottom center) bolts which are slightly shorter length than those provided by Vans. This eliminates the need for additional washers, but there's nothing wrong with using the ones Vans gives you with washers.



31. **[ ]** Note: If you need to, you can run a drill through the mount hole to ease the fit, but these bolts should be snug.
32. **[ ]** INSERT THE OTHER UPPER BOLT NEXT.
33. **[ ]** Reposition the hoist as required to bring the lower mount legs against the firewall.
34. **[ ]** INSERT THE BOTTOM OUTBOARD BOLTS NEXT.



35. **[ ]** If the mount legs appear slightly out of alignment with the firewall holes, pull the legs into place. The mount is precise, but able to flex slightly.
36. **[ ]** Snug down the four bolts we have installed thus far.
37. **[ ]** With the hoist raised just enough to hold the weight off the nose wheel, drill the center bottom pair of engine mount bolt holes through the firewall.

38. [ ] Clean any shavings away, and debur the holes as best you can.
39. [ ] INSERT THE BOTTOM INBOARD BOLTS.
40. [ ] **Torque all engine mount bolts to 200 in/lbs and install cotter pins**.
41. [ ] Slowly lower the hoist and observe as weight is transferred to the landing gear.

42. **[ ]** Disconnect the hoist and sling!
43. **[ ]** Reinstall the exhaust pipes. Be sure to use good metal gaskets.
44. **[ ] Torque the exhaust flange bolts to 270 in/lbs**.
45. **[ ]** A single band clamp is used in the center of the pair of pipes to prevent vibration. Another band clamp is used on the rearward pipe to secure it to the aluminum bracket hanging down from the rear of the motor. Reattach these next.
46. **[ ]** Note the time, take a well deserved break, brag to your friends about your really cool motor!

You may optionally insert a stainless steel shim stock strip around the lower nose gear tube to take up any slop between the gear leg and tube. This can be a blade removed from a feeler gauge, or just a thin strip of metal. The shim can be secured with a good glue or tape around the gear leg. This will be covered by the gear leg fairing, so don't worry too much about appearances. Understand that the nose gear leg is a giant spring. It must be able to move slightly in the tube. The purpose of the shim is just to assure there is no rattle during taxi and landing. It is wise to check this fit during every annual inspection.

Inspection Checklist II - Familiarization

The purpose of this checklist is just to gain familiarity with the engine and some of the parts involved in the next installation tasks.

- [ ] Locate and identify the spark plugs. You can identify their numbers from the numbers stamped on the ignition coil.
- [ ] Locate the **Fuel Inlet** (left side as viewed by seated pilot) and **Fuel Return** fittings (right side).
- [ ] Locate the **Coolant Temperature Probes**. The one by the starter motor is the one used by the Engine Control Module (ECM), the one in the left radiator inlet tube (if installed) will be used by your engine instrumentation.
- [ ] Locate the **Hose "Towers"**. These are the round aluminum fixtures where your radiator and heater hoses attach. There are two on top and one on the bottom. The bottom one contains your thermostat.
- [ ] Locate the **Coolant Drain Plug** on bottom of the lower hose tower.
- [ ] Locate the **PSRU Fill and Drain Plugs** (PSRU = Prop Speed Reduction Unit, a.k.a. gearbox).
- [ ] Locate the **PSRU Temperature Probe** (or plug if the probe is not yet installed).
- [ ] Locate the **PSRU Breather Tube and Filter**.
- [ ] Locate the **Crankcase Breather Tube and Filter**.
- [ ] Locate the **Oil Fill Cover Plate**. Note, it requires removal of two small bolts to add oil. The Subaru is not like other aircraft motors which need constant oil addition.
- [ ] Locate the **Oil Drain Plug**.
- [ ] Locate the **Oil Filter**.
- [ ] Locate the **Oil Temperature Probe** or plug if not installed yet.
- [ ] Locate the **Oil Pressure Sender** or plug if not installed yet.
- [ ] Locate the **Alternator Field and Output Terminals**.
- [ ] Locate the **Timing Belt Cover** and **Rubber Inspection Plug**

That should do for now. There are many more sensors on the motor, but these are factory installed and do not require our attention during installation. If you are curious, consult your Subaru repair manual for further details.