

Run Tank Stand User Manual

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1 Scope

This document does not provide the engineering analysis behind the design, but instead just provides some insight into how to use the thing. If you are interested in a somewhat outdated analysis, search on the drive for my work term report that I wrote on the subject.

This document *does* discuss the water jacket and load cell.

2 Consumables/Replaceables Quick Reference Guide

1. O Rings are -360 and -366 size. You need at least one of each.
2. All bolts that touch the vertical columns (except the bottom four) are 1/4-20, and should be 1 long. Slightly longer or shorter is fine, but 1" is recommended. For your sanity they should be fully threaded. By my count around 50 are required. Accordingly, about 100 washers and 50 nuts are needed.
3. The bolts connecting the base plate to the legs are 3/8-16. They need to be at least 2 inches long, plus or minus 0.25 (longer is ok, but becomes progressively more annoying). The partially threaded 2" bolts with 1" threaded are good for this.
4. The bolts connecting the columns to the base plate are also 3/8-16. They should be about 1.5 inches long.
5. Screws for the feet are #10-24, and at least 2" long

3 Full Bill of Materials

| Item Name | Item Description | Suggested Source | Quantity |
|--------------------------|--|----------------------------|----------|
| Columns | 1.5"x1.5"x1/8" steel angle, 7.5 feet in length | E3 | 4 |
| Top plate | 1'x1'x1/8" steel plate | E3 | 1 |
| Base plate | 13"x24"x1/4" steel plate | E3 | 1 |
| Legs | 1"x1"x1/8" square tube | E3 | 2 |
| Column support brackets | 1.5"x1.5"x1/8" steel angle, 1.5" long | E3 | 4 |
| Column stiffening plates | 12"x3"x1/8" steel plate | E3 | 8 |
| Top plate brackets | 1.5"x1.5"x1/8" steel angle, 1.25" long | E3 | 4 |
| Feet | Rubber bumper with unthreaded hole | McMaster-Carr ¹ | 4 |
| Shield panels | 12"x48"x1/4" polycarbonate sheet | E3 | 4 |

¹<https://www.mcmaster.com/#9540k793/=1as9gh9>

| | | | |
|-----------------------------|--|--|------------------|
| Feet fasteners | #10-24, min 2" long, with washers and nuts | E5 | 4 |
| Leg fasteners | 3/8-16, min 2" long, with washers and nuts | Wherever | 4 |
| All other fasteners | 1/4-20, ideally 1" (1.5" ok), with washers and nuts | Wherever | 50 (100 washers) |
| Water jacket sealing cap | Machined aluminum cap to seal between the water jacket shell and the run tank | Make it ourselves | 1 |
| Water jacket shell | 6" OD/ 7.75" ID polycarbonate tube, 36" length | McMaster-Carr ² | 1 |
| Water jacket inlet adapter | 3D printed custom shape | 3D Print centre or WatIMake | 1 |
| Water jacket outlet adapter | 3D printed custom shape | 3D Print centre or WatIMake | 1 |
| O Ring - shell side | -366 | McMaster-Carr ³ | 1 |
| O Ring - tank side | -360 | McMaster-Carr ⁴ | 1 |
| Hose clamps | 8" ones for the adapters around the jacket, and minimum 1.5" ones for the hose-to-adapter connection | Home Depot, McMaster-Carr ⁵ | 4 large, 2 small |

Some items are not mentioned in the table, such as the entire run tank assembly (for obvious reasons), the inlet and outlet hoses (mostly because I don't have those dimensions on hand and you can easily replace them with pretty much anything as long as it's flexible enough and has the same size), and the load cell with associated material (it's pretty self-explanatory, just hang it by a threaded rod using nuts and stuff).

4 Assembly Reference

4.1 Stand Assembly

As much as possible, the stand should be left in an assembled or mostly assembled state. There's a lot of stuff to align so it's best if it's not moved around too much. The order of assembly for the stand is roughly detailed:

1. setup all the columns with shields and stiffener plates on 3/4 sides (try to datum the bottom off of a flat surface while doing so). These should go on the inside of the columns

²<https://www.mcmaster.com/#8585k59/=1aswn3e>

³<https://www.mcmaster.com/#9452k391/=1asx6f4>

⁴<https://www.mcmaster.com/#9452k516/=1as82k7>

⁵<https://www.mcmaster.com/#5011t43/=1atedgj>

2. Attach the feet to the legs
3. Attach the legs to the base plate
4. Attach the columns to the base plate using the brackets. Fiddle with it until it stands up straight and the columns are all touching the base plate instead of being held up by other columns and/or the bracket.
5. Attach the top plate brackets to the columns. Fiddle with positioning until the top surface of all the top plate brackets are at the same elevation and nicely flat. Make sure that the brackets are attached to the outside of the columns, folding over and inwards (to fold over the columns, so to speak)
6. Attach the top plate to the brackets, on top.
7. Hang the load cell, checking for:
 - Proper engagement length into the load cell, so it doesn't accidentally fall off the threaded rod
 - Double nut and double washer hanging the threaded rod from the top plate
 - A nice amount of extra threaded rod length sticking out the top (probably at least 2")
 - Some method of preventing load cell from unthreading itself (a nut tightened against it is good, threadlocker is also good)
 - Proper tank height so that the blast shields are effective
8. After the tank is hung with all the hose attachments done, affix the last blast shield panel. This panel can go on the outside with only the 4 corner connections. **This side needs to face away from the viewing area.**

4.2 Water Jacket Assembly

1. Of special note is that the water jacket (at least the sealing cap) needs to be assembled alongside the oxidizer tank, as it's held in place by the bolt circles.
2. Put O rings into the sealing cap
3. Affix inlet and outlet adapters (don't forget to apply gasket and/or other sealing strategies)
4. Slide the sealing cap onto the bottom end of the oxidizer tank. Check for ripped O-Rings
5. Assemble the remainder of the oxidizer tank.
6. Slide the jacket shell on from the top end of oxidizer tank (keeping the inlet on the **bottom**).
7. Use some duct tape to hold the sealing caps onto the water jacket shell.

8. The top of the water jacket can be held concentric with the tank by using shims/wedges.
9. After the rest of the tank is assembled, and the whole thing is brought outside and is ready to be hooked onto the load cell, attach the hoses to the inlet and outlet adapters. **Be aware of where the hoses route.** The open side of the tank stand (final panel) must face away from the spectator area. Therefore the hoses should already be routed through the gap at the bottom of the tank stand.
 - Note that the hoses definitely require nicely tightened hose clamps and probably some sort of sealing (gasket tape or something like that).

5 Usage Notes

- The water jacket is *not* to be run during the filling procedure. Heating is only to be performed after the tank is full and the line to the supply tank is closed. This is to prevent backflow resulting from a run tank pressure higher than that of the supply tank.
- Checks should be performed to ensure that no water exists in any heating hose located outside (i.e., exposed to cold temperatures). This can be done by slowly rotating the hose through a number of rotations at least equal to the number of coils. Further cleaning should be performed by running compressed air through the hose for about 1 minute.