Combustion Room Checklist

Yahoo

Personal checklist which may be littered with terrible typographical errors, scattered with gregarious grammatical mistakes, peppered with perpetual procedural breaches, or cluttered with catastrophic conceptual blunders.

Before running...

☐ Send mail to: experiments@ept.ntnu.no a few days before the start of experiment

- stating the experiment dates
- the fuel that you will be using
- if it is not ethylene or fuel which we bought, you will have to state the expected fuel usage as well (e.g. how many litres)

☐ Check that you have enough fuel!

☐ Check that you have enough disk space to store all images and logging data!

☐ Use soap water to perform a leak check

- make sure that there is no leakage at all points
- make sure that all the connections are hooked up the way as they are intended to be, with appropriates valves closed / open
- do a nitrogen test, and make sure that the MFCs give the specified flow rate

The day itself

☐ Call the fire alarm!

- Update: no longer required to turn off fire alarm as of 25-02-2020
- 91 89 73 94 (usually it is Jari who picks up the phone)
- inform them of the alarms to switch off: 10-33, 10-34, 10-35
- and the combustion room: C159F and C159G

☐ If using spark ignitor, remember to put up the electrical hazard sign.

☐ Turn off the gas alarms by turning the timer knobs just outside of the control room. From time to time, check that the alarm is still off.

☐ Check that the CO gas alarm is off, from the touchscreen panel outside the control room.

☐ Increase the ventilation to at least 85% (2nd floor or the touch panel in the control room).

☐ Turn on the compressors in the gas room.

- [ ] After the control program has been reset, fill up the nitrogen flushing tank to about 3 or 5 bar. Preferably more than 5 bar for annular rig. Will not fill up if you have not reset the control box after it has gone into fault!
- [ ] Check again that all intended valves are open, and that there are no leaks. Remember to open up the valve that leads to the solenoid air pressure detector! Else, the main air pressure will not be registered, and you won't be able to start the rig!
- [ ] Check that pipe connections are as intended to be.
- [ ] When using the single sector, check the the valves on the annular side are properly closed. vice-versa when using the annular rig, since they are sharing the same MFCs and pipings.
- [ ] Open all gas valves and gas supply knobs as required, and turn on mirror cooling.
  - Check that there is no kinking of pipes, or any unintended closed valves which can lead to pressure build-up!

Signals and Data AcQuistion (DaQ)

- [ ] Check that all the BNC cables are hooked up to the control box as intended (e.g. M1A1 to M1A1).
- [ ] Check that you have all 4 modules in the DaQ. Missing any one would mean an error message.
- [ ] Connect any necessary BNC connectors to the right DaQ module and channel.

Pressure measurements

- [ ] Turn on amplifier.
- [ ] Check that the excitation voltage is set at 10 V, and that the gain is 100 (these values depend on nature of experiments. Do a test run to determine the ideal values.). Remember to have LPF (low-pass filter) on by pressing (but not holding) the LPF button.
- [ ] Check that flow rate is zero, then tare the channels !!! by pressing and holding the button "AZ". This is the same button as the LPF button.
- [ ] Test it with cold flow, and check that we have signals on each pressure sensor, and they are at the intended channels.
- [ ] If the pressure logging does not work. Plug and unplug the USB cable (connected to the back of the control PC).

Camera measurements

- [ ] Turn on PTU and the intensifer controllers. Turn on the cameras. Then, start the DaVis program.
- [ ] Do an intensity calibration while the intensifers are not being fired.

- [ ] Check that the captured window area of the camera is what you intended it to be. For faster downloading and saving of images, do not apply image transformation.
- [ ] Key in gain factor of intensifiers.
- [ ] Take calibration images without the filters.
- [ ] Put on the OH/CH filters before taking the flame images.
- [ ] Take some test images to check that there is no saturation (i.e. < 4000 intensity values).
- [ ] Always remember to cap the lens when not in use! And NEVER expose the intensifier to unncessary light!

Control program

- [ ] Change the minimum nitrogen pressure (the default limit is 5 bar, which we may not be able to achieve it at times, esp if there is some ongoing maintenance)
- [ ] Remember to log the data. Check that the logging works.
- [ ] Note when the program first crashes. It will happen on an hourly basis. Unplug the USB cable, plug it back in. Then relaunch the LabView program.

LASER

- [ ] Always wear safety goggles! Make sure that it blocks out the right wavelength.
- [ ] Always remember to place dump plane right at exit of laser.
- [ ] Laser alignment to be done in a brightly lit room so that pupil remains contracted!
- [ ] Always start with a low power first (check if laser is defined by power percentage or current).
- [ ] Turn on PC before starting laser. Else, the PC may mis-identify the laser as a peripheral mouse device (at least for the laser in the jet room).
- [ ] Makes sure that there is connection between laser and PC.
  - make sure that the COM1 port is open.
  - Do this by checking under device manager, check that the COM1 port is open.
  - COM1 port (laser) - at any point, either the laser software OR DaVis can communicate to the laser. But not both at the same time.
- [ ] Use deionised water. You can get them from the Varmeteknisk lab (B135).

DYE LASER

☐ Always remember to place dump plane right at exit of laser.

☐ Usual procedure for operating the edgewave laser (interlock safety features, red button, key of cooling unit ...)

☐ Turn on cooling for the dye laser. Is the tap labelled kalvann. Check that it is flowing out to the drain properly with no leakage.

☐ With cooling water tap on, you can turn on both of the dye circulators.

☐ For the laser power, 56 A is the max for the edgewave laser. But 50 is the max for dye laser (so that components do not crack). 105 W is about the max

DYE LASER (change of dye)

☐ Switch on dye laser and note current power output.

☐ Turn off everything (laser, cooling supply etc).

☐ Disconnect water pipes and the power suuply of the two dye circulators. Take note of the connection. (Out of the resonator, in from the amplifier?)

☐ Get ethanol from Bjørn. Need at least 8 litres of it + additional litres for flushing the dye circulators, and to clean up after that. Get 100% ethanol ideally, but 98% or 99% works as well.

☐ Prepare a large workstation with

- gloves, napkins
- empty containers (at least 8 litres in total volume for draining of old dye)
- 4 clean beakers
- glass mixing rod
- small white plastic tray
- spatula (usually in the Sirah Credo blue box, placed
- short, fat, flathead screwdriver
- black thrash bag (for contaminated waste disposal)
- pipe (hose connector) for the draining of old dye from the circulators
- weighing balance.

☐ Calibrate weighing balance with the given calibrated weights (1 g and 200 g). Handle them only with clean gloves since even oil on fingers may introduce inaccuracies!

☐ Wear lab coat and gloves! So that it does not stain your clothing!

☐ Dye changing procedure:

1. Pour ethanol into one of the beakers (not too much, say about 1000 ml).
2. Measure the necessary dye powder using spatula with weighing balance. Double check the required value (0.54 g for resonator, 0.18 g for amplifier).

3. Pour powder into one of the beakers (which is already filled with ethanol). Then, pour more ethanol into this beaker to wash down the remaining powder in the plastic tray into the beaker.
4. Crush the undissolved dye with a mixing rod.
5. Split the dissolved dye mixture into 4 beakers equally. Then, top all of them up with ethnanol so that you have 4 litres in total.
6. Take photo of circulator positions! IMPT!
7. Carry the circulator (carefully!) up to the workstation.
8. Connect the hose connector the pipe outlet of the circulator cell. Tighten the hose clamp real tight with the screwdriver.
9. Place the empty container (meant for draining of old dye). Make sure it is well positioned to collect old dye without risk of spillage.
10. Open tape to drain dye, and get someone to lift the pipes inside the circulator. Also, tilt the circulator forward and backward carefully to get as much of the old dye as possible.
11. Close tap. Then pour in ethanol. Turn on power supply of the circulator, to let the ethanol run through the circulator a few times, to rinse the circuit clean.
12. Open tap to drain the ethanol out. Repeat rinse if necessary.
13. Close tap. Top up circulator with the new dye solution which you have concocted!
14. Remove hose connector. Place circulator back into position. COnnect, and hook eveything back up.

☐ Repeat dye changing procedure for both circulators.

☐ Once the dye solution in both circulators are changed, double check connections.

☐ Fire up laser, note the new power output to see whether there is an improvement in power output.

☐ If all good, wipe down all stuff that come into contact with dye solution with ethanol. Do a thorough job! Place gloves and other contaminated objects into the black thrash bag.

At the end of the day

- [ ] Switch off amplifiers
- [ ] Turn off all the gas supply knobs, so that we can clear the remaining fuel.
- [ ] Re-light the rig to burn off remaining fuel.
- [ ] Shut down mirror cooling.
- [ ] Set all flow rates to zero.
- [ ] Shut off the compressor.
- [ ] Reduce ventilation down to 50%.
- [ ] Switch off LaVision before switching off the cameras, PTU, and intensifier controllers.
- [ ] Optional: but I do have the habit of closing the valve that leads to the solenoid air pressure detector. Then, opening up the mirror cooling valve. In that case, 1) you depressurise all the air hoses, so it is safer, and 2) additional safeguard
- [ ] Switch off the control box.

Other tips

★ Always wear protective goggles when changing pipes, tightening pipes etc. esp if compressed air

★ Check that the pipe connections are as intended, and no one has changed it.

★ When taking calibration images, choose the slowest possible shutter speed.

★ For the regulators, we often have issues with exceeding a certain flow rate (happens at around 200 to 300 slpm). If you wish to increase the flow rate, you have to bypass the regulators. For fuel, always consider twice before doing that. If it is air, it is o.k. to bypass the regulators. In fact, it is recommended to do so! But always keep in mind that it is always pressurised, even without the regulators to indicate the pressure level.

★ For fuel lines, it is important to connect the solenoid valve (an electro-mechanically operated valve) upstream of the MFC. Then, ask Stein to program the solenoid valve into the LabView code. A fuel line is programmed differently from an air line. Need to be careful with that!

★ For air lines, DO NOT connect it to a solenoid valve since you are supposed to keep the air flowing even when all electro-mechanical mechanisms fail!

★ Remember to place flame arrestors for the fuel lines going into the mixing tank.

★ Always good to check the flow rate output of MFCs using nitrogen first.

★ Always do an intensity calibration regularly, to have a nice image.

★ Check that the swirlers are placed in the right position.

★ For chamber walls, always use a level spirit to ensure that it is properly placed into the groove of the combustion chamber. If using quartz wall, place ceramic wool.

★ Program code for the atmospheric rigs (single sector and annular) will freeze hourly. so solution is to: unplug and plug the USB cable labelled DAQ. Sometimes, you may have to do a full restart: switch off power supply. When the light for the control box goes off, immediately switch it back on and reset it. Then, the nitrogen will not be flushed out, and you will not have to refill it. Håkon's comment: Often if the full restart is required to obtain contact with the control cabinet, there is something creating a short circuit in the system. In my opinion there should be done some investigative work to check if there are any point of potential short circuit. Typical causes are the glow plug and speaker cables.

Assembly

 Always use ceramic wool when using quartz wall.

 After adjusting the focus of the lens, consider taping with electric tapes (doesnt leave sticky traces), so that the focus ring does not move.

 A habit to gather all the following tools before starting assembly of annular rig:

- 2x M10 wrench for nuts and bolts that fasten plenum and bottom plate
- 1x M13 wrench for nut that clamps down the top plate
- 2x M22 wrench, and a 1x 27 wrench for pipes and barbed hose adapters
- 1x big, and 1x small screwdriver