

Flammability and smoke testing machine

1. Test conditions (32 tests total):

- Oxygen contents tested for 7% , 14% , 21% , and 30%.
- Air pressure tested at , one atmosphere (zero gauge) , and two atmospheres (14.7 PSI gauge).
- Temperature test is run at 4 power levels : (1) 78F (25.5C) , (2) 140F (60C) , (3) 500F (260C) , and (4) 1100F (593C), (heat is applied in the form of infrared heaters (electric) and calibrated with a shiny copper rod (6" tall and 1" Dia.) with a thermocouple in the center.

2. Flame source : a small carbon arc that is movable from outside the chamber even when the chamber is pressurized .

3. Instrumentation :

- Oxygen content sensor
- Air pressure gauge (cleanable diaphragm type to prevent clogging)
- Video camera with time stamp
- Timer
- scale
- hand held light meter
- Drying oven instrumentation (see below)
- Calibration rod temperature meter

4. Features :

- Horizontal 3 meter , 3" Dia. , pipe made in sections assembled with over-center band clamps (quick to remove or install) mounted cross wise on a short chimney at the top of the chamber , with a dimmable 4x4 light grid at one end (behind a hinged & gasketed (platinum catalyzed flame resistant silicon rubber) borosilicate window and a second identical window at the other end (only openable at one atmosphere)
- All 321 welded double wall vacuum insulated construction
- Separate vented drying oven with external reading , internal scale , sample is dried till moisture loss (weight loss stops). Circuit python controlled E- paper screen shows two graphs , temperature and weight . The controller automatically slowly raises the temperature till the weight loss stops or a preset limit is reached
- Two removable borosilicate windows in the test chamber one for observation (observation window also serves as a access door) and one for the camera to record .
- 2 atmosphere pressure vent (manually activatable).
- Oxygen is automatically maintained at the set level (7% , 14% , 21% , and 30%)
- Camera is just a high quality web cam with date stamp software and a light hood .
- Test rig includes a dedicated Panasonic Tough book (CF-30 or 31)
- Entire test equipment (with replacement windows and consumables) fits into three padded fireproof cases: the drying oven , test chamber , and smoke tubes respectively . The cases can be checked as airline baggage (the smoke tube case

fits inside a larger, very tough, Nomex padded duffel bag with extra space for personal items).

- The test equipment requires electricity 24-32 VDC (amps ?), compressed air 20-3000 PSI, and compressed Oxygen 20-2,200 PSI.
- The test rig is unaffected by variations in voltage, air, & Oxygen pressure within design parameters.
- Overall construction is very high quality with special emphasis on ease of cleaning and easy field maintenance and repair.

5. Test procedure starting with clean equipment :

1. Cut 35 samples to 1" x 6" (thickness is determined by the particular test being run).
2. Put 32 samples into automatic drying oven (set aside 3 samples).
3. Turn on oven, continue when samples are dry (store samples in oven during the test).
4. Calibrate 4x4 light grid with hand held light meter.
5. Calibrate test chamber heaters (3x120° apart) with copper rod.
6. Begin with the 16 one atmosphere tests.
7. Weigh sample, record in (electronic) test form.
8. Attach sample to test rack, close hatch.
9. Set Oxygen percentage.
10. Set power setting.
11. Start camera
12. Attempt to ignite sample for 2 minutes, if it does not ignite try another 2 minutes, if it does not ignite after 6 minutes then proceed to the next step.
13. Count the lights visible in the 4x4 grid, record.
14. Open window, press face to eye port, record smoke affect on eye onto microphone (transcribe to test report later).
15. Terminate test
16. Remove and weigh sample
17. Clean all windows
18. Repeat test at the next power and oxygen setting.
19. When all 16 one atmosphere tests are complete, proceed to two atmosphere tests.
20. Two atmosphere tests are identical to one atmosphere tests except direct smoke exposure to the human eyeball is omitted.
21. When all 32 tests are completed, all test equipment is thoroughly cleaned and a back up of the test is copied to a SD card.