Possible measurements with the H25 KT testing machine (Tinius Olsen)

General overview of the machine:

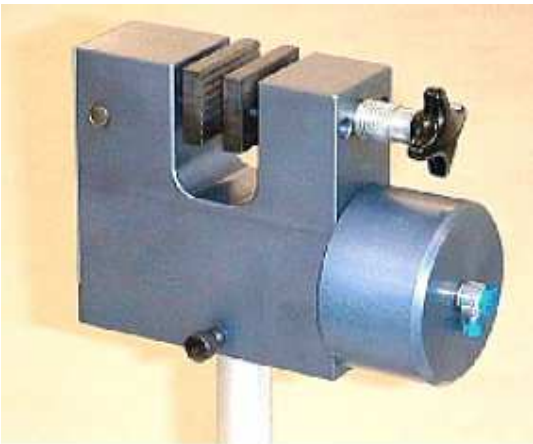
A 25000N digital loadcell is attached to the crosshead (horizontal beam) and can be moved up and down in steps of 0.001mm with speeds from 0.001-500mm/minute.
Movement comes from 2 stepper motors which are turning 2 screws in the vertical columns.

The machine is connected to a desktop PC for control and saving the data. Force and crosshead displacement are stored and are used to do all the calculations.

The different clamps and parts are attached to the machine either with a M16 thread or usually with an 8mm metal rod. The parts have a 16mm hole and the loadcell is fitted with a 16mm cylinder. The rod goes trough both parts and is tightened with a nut.

Different test types:

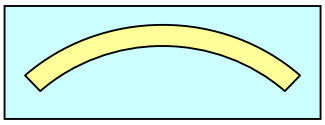
1. **Tensile tests:**



Using 2 pneumatic clamps (max. 16kN pressing) all sorts of materials can be tested. Although designed for wood testing all kinds of plastics can be done. As long as they don't slip in the jaws.

- **Testing of the motor casing material (longitudinal strength)**

The clamps are designed for flat specimens, but for the motor tube we need to test circular strips. One solution would be to cast the ends of the strips into flat fibreglass/epoxy cubes of 60x40mm (surface of the clamps). This would be a good solution if we don't need to test a lot of samples.



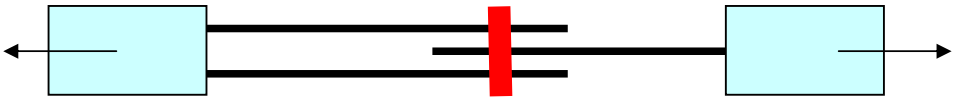
These cubes will not slip out of the jaws.
The only drawback here is that some extra work and costs are needed. I would make a few silicone casting moulds to cast the epoxy.

Possible results are ultimate tensile strength, yield strength, estimated E-modulus,…

For the extension of the samples we use the displacement of the crosshead. Minor slipping of the samples is possible. This results in small errors in the calculation of E-modulus and stretching of the sample. Longer samples will provide more accurate results.

- **Testing of the use of bolts to retain the bulkhead and nozzle**

Using basically the same specimens as above:



- **Tensile strength of propellant**

Same as above. The propellant cannot be fitted directly into the clamps!
It might be possible to make a mould and fixture for testing
I will only do this on proven propellants using KNO_3 as the oxidiser. (safety reasons)
Keep in mind the resolution of the load cell is only 0,8N and tests below 250N have a proven accuracy of only 2%.

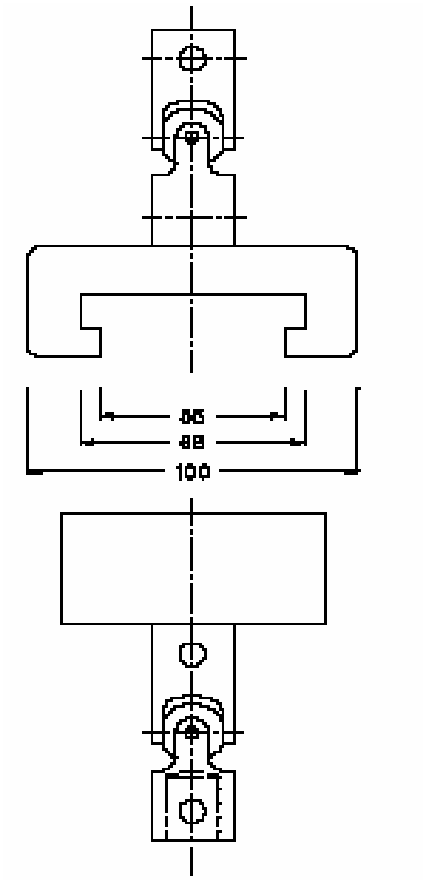
The E-modulus of brittle propellants will not be calculated, as the displacement will be too small.

2. <u>Adhesion tests:</u>

- Propellant inhibitor adhesion

The tests are done on 50x50mm samples. The samples must be flat. Normally a 50x60mm (melamin bonded) wood fibre plate is glued (with hot melt glue or white wood glue) to the sample so it fits in the clamps.
We also have aluminium plates, only to be used with the hot melt glue.

Maximum force for the hot melt is about 6kg/cm² (it stretches).
The test usually only suts for the calculation of maximum strength.

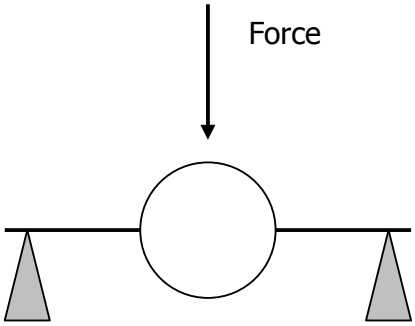


- Delamination of sandwich materials/composites

3. **<u>bending tests:</u>**

testing equipment is available for both 3-and 4-point bending tests. The deflection is measured with a deflection meter underneath the sample, between the supports. The supports are steel cylinders of 30mm diameter and the upper compression points are 30 or 60mm in diameter.
Maximum dimensions of the samples are 1000x100mm. Thickness is virtually unlimited (about 500mm). Maximum deflection is 100 mm.

3-point bending tests



- Rocket fin stiffness or bending strength

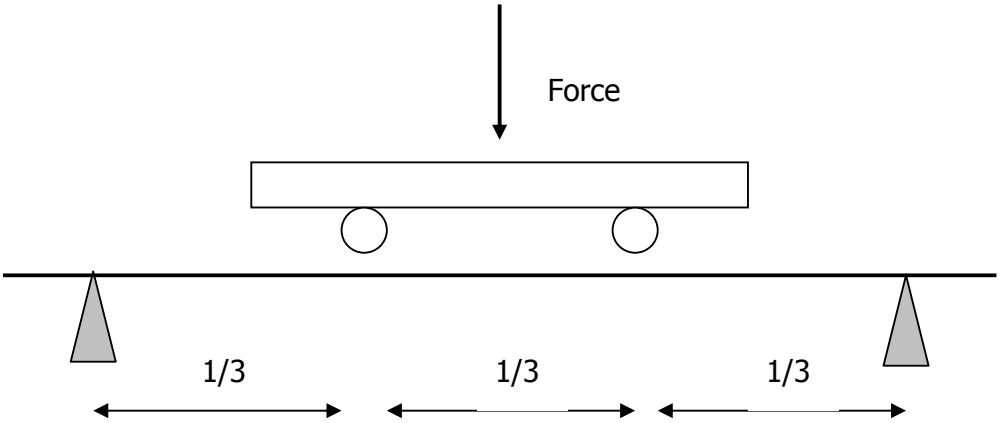
  It is possible to test both the fin material itself and the fin when it is attached to the the rocket body. In the last case you should recalculate the max. deflection as half of the rocket body hangs below the supports.

- Determination of the E-modulus of all sorts of materials.
  For example composites, metals, propellant,… Don't forget the maximum force of 25000N and minimum of about 200N.
  Very small samples will not produce accurate numbers.

  The 3 point bending is used to determine the adhesion strength between the different layers that make up a composite.

4-point bending tests

- Usually for compression tensile strength of sandwich structures. This method provides an even pressure distribution over the sample. Normally a distribution ratio of 1/3 is used.



4. **compression tests:**

The sample is compressed between 2 aluminium plates. The lower plate is actually a square of 250x250mm and the top plates are 95 and 195mm in diameter.

Usually this equipment is used to compress insulation foams and I don't know if there is another use for rocketeers.

Remarks:

This is just a fraction of the possibilities. If anyone has another idea please let me know. The machine is very polyfuntional.
I have tested tensile strength of parachute fabrics and lines, calibration loadcells to 20kN, composite sandwich fins, fibreglass epoxy, bolts,… For most problems we can make a fixture or something to be able to perform the necessary tests.

Also available:

- thermal conductivity (only for samples of 305x305mm and thickness 0-100mm) the material can not be hygroscopic or cause corrosion on the metal plates of the machine. Should work for foams, plastics, rubber, ceramics, glasswool,….

- Tests in a climatic chamber: for example propellant hygroscopic nature, temperature cycling tests,….
  The machine can be set at any temperature between 0-100°C and relative humidity between 0-100% (well not really 0%)

- …just ask and I will answer… (bert.kimpe@vt4.net)