

The Cassini-Huygens Mission to Saturn and its Moons - Technicians' Guide

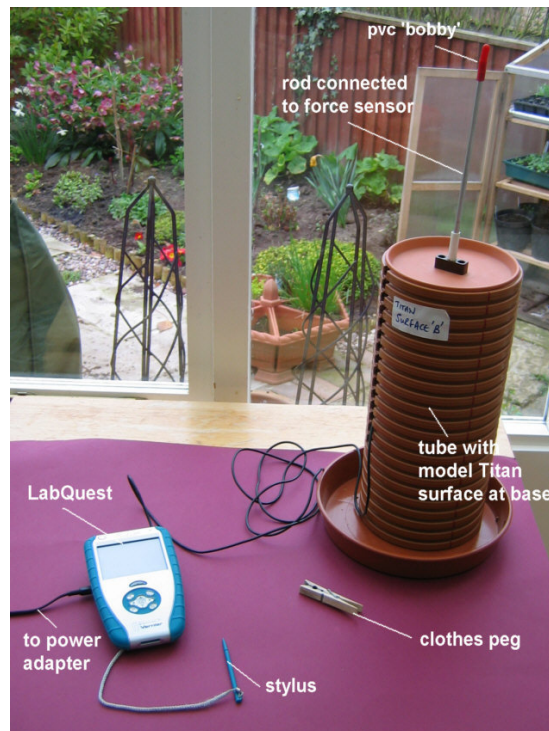


Figure 1 Setup of LabQuest with Huygens Titan lander

Equipment required

Vernier LabQuest datalogger and its power adapter/charger
force sensor with collision bumper fitted DT272
testing jig (see construction details)

Construction details for testing jig

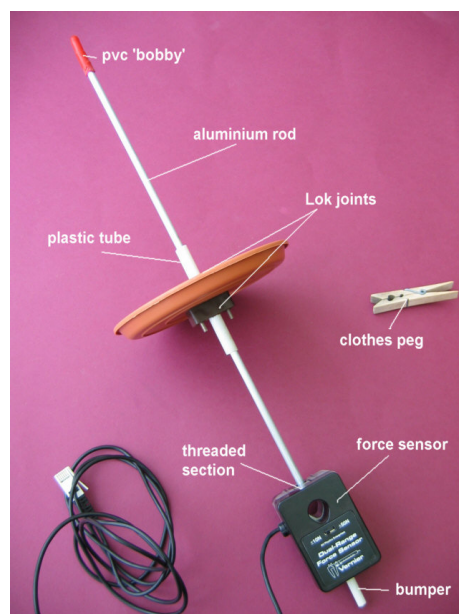


Figure 1 Assembly of testing jig

4 gully raising pieces - Marley UG52X (B&Q)
1 pkt Lok joints (B&Q or garden centre)
8 15cm Sankey Soft TC Colormatt saucers (B&Q or garden centre)
4 24cm saucers – Sankey (B&Q or garden centre)
aluminium rod 6mm diameter (B&Q)
pvc 'bobby' Ref RST 030 020 (Scientific and Chemical)
plastic clothes peg
plastic tubing with internal diameter to just allow aluminium rod to slide freely inside it (model shop or W Hobby*)
clay (Art/Pottery Department)
fine grit for use in bird cage (pet shop)
fine gravel for use in an aquarium (pet shop)
silver sand (B&Q)
access to sieves 2.36mm and 5.00mm or near (Geology/Geography Department)
4 paper labels c. 6cm x 3.5cm
1 pkt fluorescent circular labels c.1cm diameter
glue

*Access is needed to a tap and die set.

First saw 22cm long x 1cm wide vertical cut-outs from the top of each of the gully raising pieces. These are to allow free movement of the sensor cable. 10cm up from the base on the inside of these gully pieces stick eight or so of the fluorescent labels. Their baseline will mark the fill levels of the sand, clay, grit and gravel. Glue a small saucer to the base of each gully raising.

Saw off a 10cm length of the plastic tubing. Drill a hole in the centre of the 15cm saucer to take this piece of plastic tubing. Drill out the central holes of two of the Lok joints (pieces without protrusions) to fit the plastic tubing. Position one of the Lok joints so that its central hole is over the hole in the saucer and mark the positions of its other two holes on the saucer. Drill holes through the saucer at these positions large enough to take small nuts and bolts that can be fitted through one Lok joint on one side of the saucer and another on the opposite side. Screw the Lok joints to the saucer and fit the plastic tube through the central hole and the Lok joints with about 3.5cm protruding on each side.

Screw the collision bumper into the force sensor. Saw off a 35cm length of aluminium rod and tap a 1cm long thread onto one end of it. Screw the threaded end of the rod into the mounting hole of the force sensor. Place the rod holding the force sensor into the plastic tube fitted to the 15cm saucer so that the sensor is up against the lower Lok joint and fit a pvc 'bobby' to the top end as safety protection. Secure it in position by clamping the rod above the opposite side of the saucer with a clothes peg. Set the force sensor on its $\pm 50\text{N}$ range.

Sieve the gravel so that it has a particle size between about 2.36mm and 5mm. The grit should be OK as it is, likewise the sand and clay. To prevent the clay from drying out between usage wrap it in a plastic bag and store inside a sealed plastic box.

Place the gully raising pipes on the 24cm saucers and fill with silver sand, clay, fine grit and fine gravel respectively to the 10cm level indicated by the fluorescent labels. Stick labels on the outside of each pipe indicating 'Titan surface A', 'Titan surface B', Titan surface C' and 'Titan surface D'.

Suppliers

W Hobby Limited
Knight's Hill Square
London SE27 0HH
Tel: 020 8761 4244
Web: <http://www.hobby.uk.com>
E-mail: mail@hobby.uk.com

Scientific and Chemical Supplies Limited
Carlton House
Livingstone Road
Bilston
West Midlands WV14 0QZ
Tel: 0845 165 0845
Fax: 01902 402 343
E-mail: customerservices@scichem.co.uk
Web: <http://www.scichem.co.uk>

Production of specimen Force-time graphs

Using each 'Titan surface' in turn, follow the student activity instructions to obtain Force-time graphs and print off copies of each. Label them with what they consist of – sand, clay, fine grit and fine gravel.

Also, for use in discussion sessions, make copies of the annotated and unannotated impact signature (Force-time graph) shown in Figure 3 on the following page that was produced as the Huygens probe landed on Titan.

Setting of force sensor range

The force sensor can be set on a $\pm 10\text{N}$ or a $\pm 50\text{N}$ range. Which is appropriate will depend on the sand, clay, fine grit and gravel used. Test with the force sensor set to the $\pm 50\text{N}$ range first and see what the maximum force reading is from each of the surface samples. If none exceed 10N set the force sensor on its $\pm 10\text{N}$, otherwise select its $\pm 50\text{N}$ range.

Huygens impact signatures (Force-time graphs)

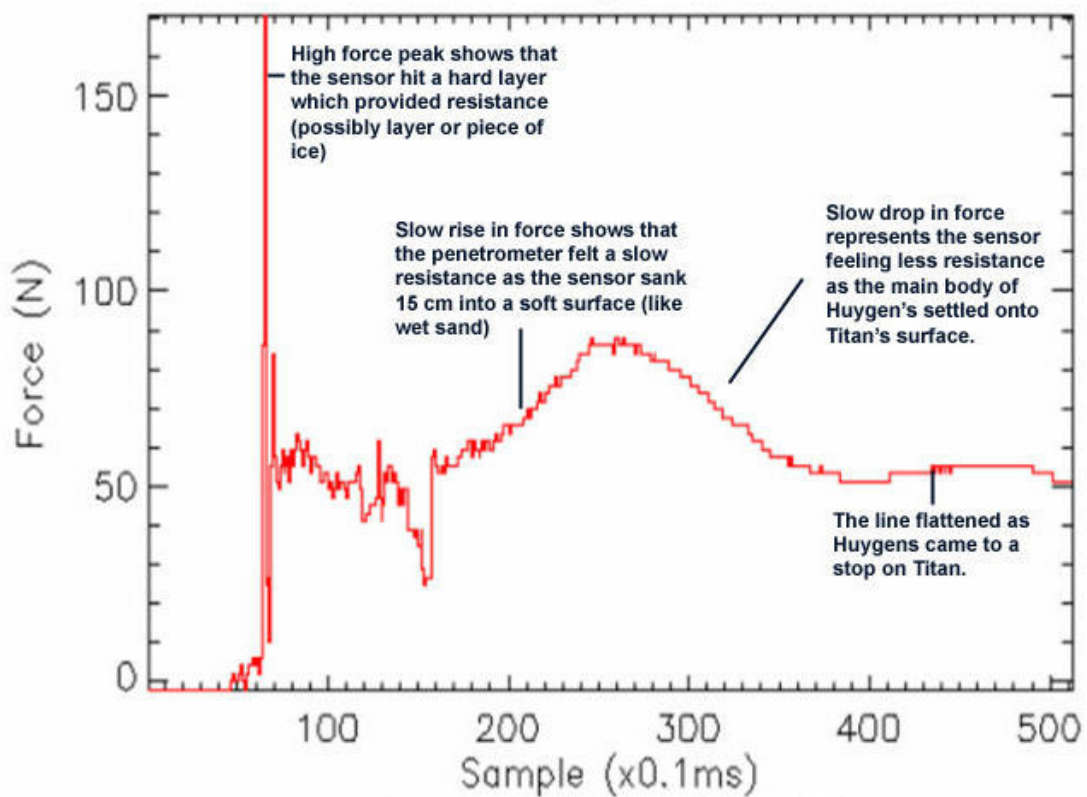
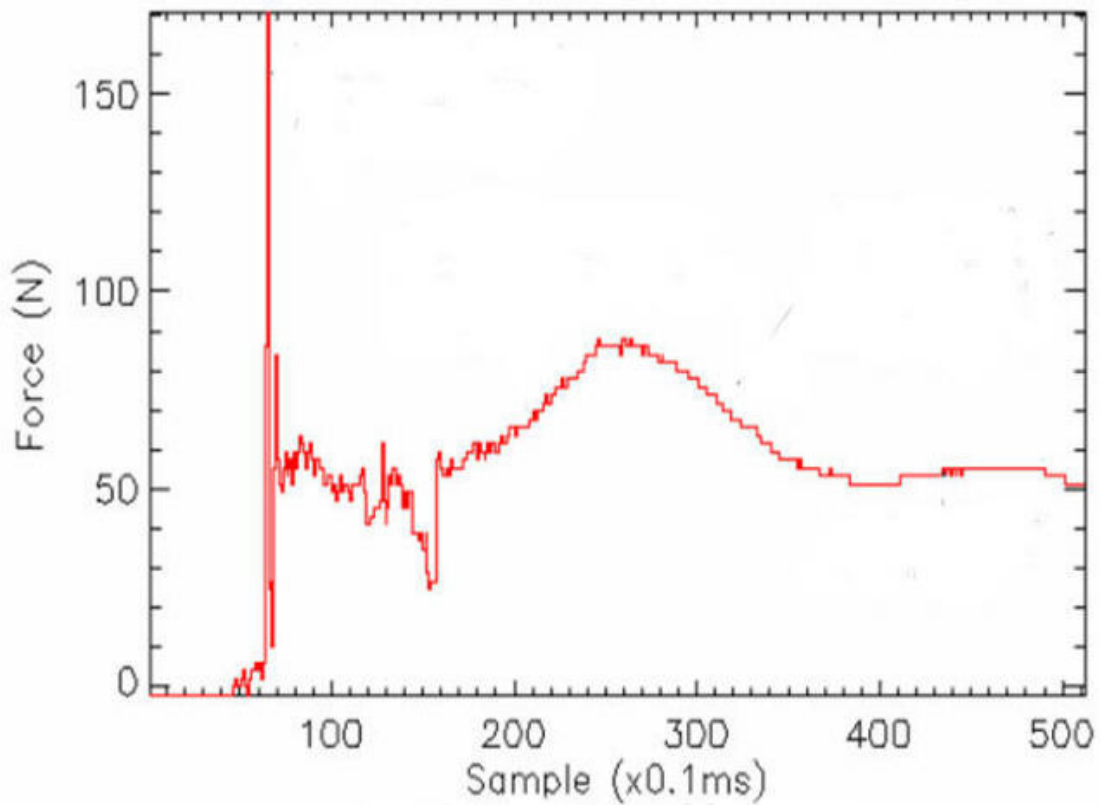


Figure 3 Impact signatures (Courtesy Rutherford Appleton Laboratory Space Electronics Group and the Planetary and Space Sciences Research Institute at the Open University)

Key setup details

Channel 1: Force $\pm 10\text{N}$ or $\pm 50\text{N}$ range with reverse setting

Rate: 1000 samples/s

Recording time: 1s

Triggering: across 0.5N

Pre-trigger: 200 points (0.2s)

Acknowledgements

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