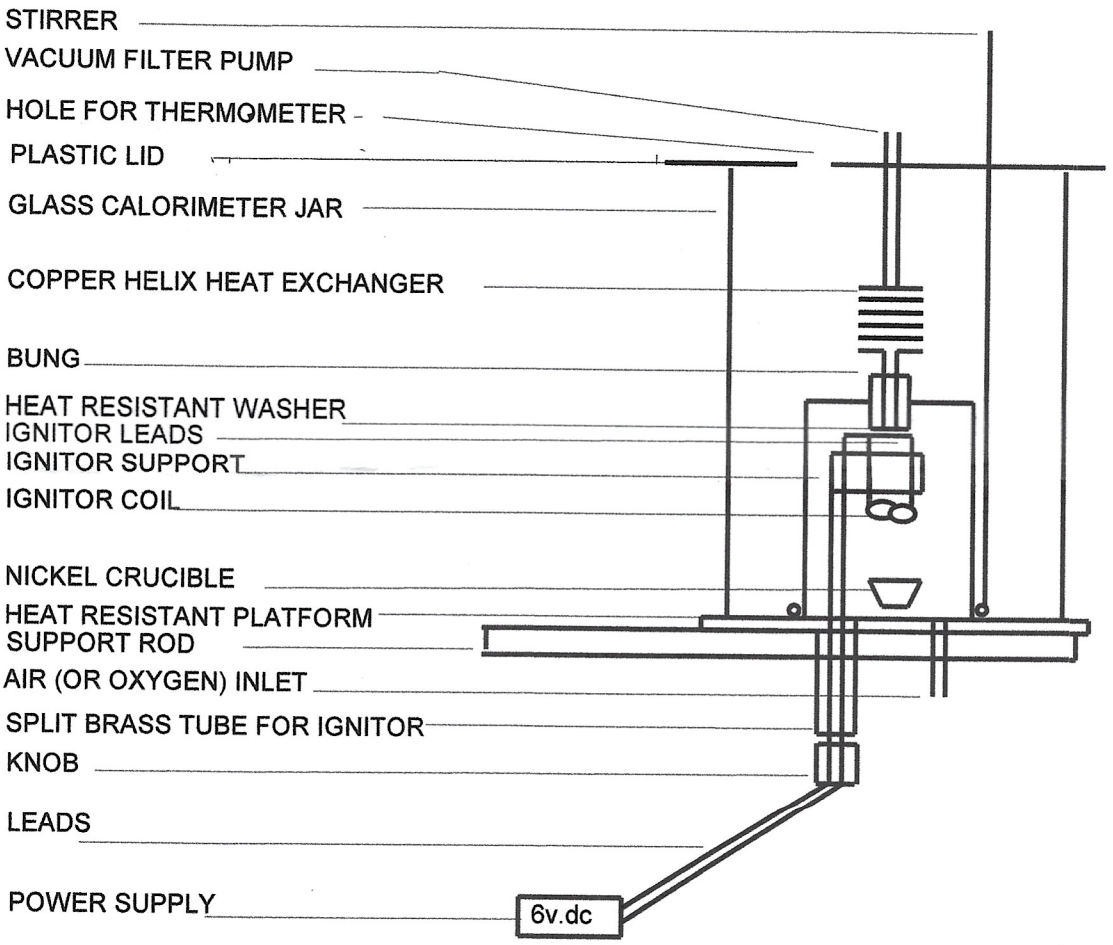
~~YTL-270-H~~

ASSEMBLY FOR FOOD CALORIMETER



YTL-270-H

FOOD CALORIMETER

1. PRELIMINARY

Carefully unpack the apparatus, and check that the following components are present:-

Glass calorimeter vessel
Clear plastic lid
Loop stirrer
Copper helix with bung
Support table
Ignitor support and leads
Nickel crucible
Spare ignitor coils

Before setting up, it will be convenient to obtain data for calculating the water equivalent of the calorimeter, for which purposes the masses of the relevant components should be found.

Carefully remove the lid, stirrer and copper helix and separately weigh the following:

(a) Glass vessel (Specific heat capacity 780 joules kg °'C')
(b) Copper helix, complete (specific heat capacity 380 joules kg °'C')
(c) Stirrer, complete (Specific heat capacity 370 joules kg °'C')

And calculate the total water equivalent from:

(Mass of glass vessel x 780) + (Mass of copper helix x 380) + (Mass of stirrer x 370) = (Water equivalent joule ° 'C')

It is recommended that this value is inscribed on the outer jacket of the calorimeter in glass marking ink.

2. ADDITIONAL APPARATUS REQUIRED

BYC-395-N	Bunsen burner, natural (methane) gas
CYL-303-130T	Measuring cylinder, 500ml
EKP-141-010E	Multitap transformer, to supply 6Va.c. for ignitor coil or other 6Va.c. or d.c. power supply
PXY-400-U	Filter pump
FB68403	Retort stand base
STA-830	Retort stand rod
FB55305	Metal clamping screwhead
STE-321-011E	Bosshead
STF-520-051S	Retort ring 100mm
THL-630-070N	Thermometer,-5 to 50 x 0.1 ° C
FB507	Rubber tubing
	Cylinder of oxygen (obtainable from specialist suppliers)

3. SETTING UP PROCEDURE

After ascertaining the masses as in paragraph 1, put the stirrer into the calorimeter, and carefully fit the bung carrying the copper helix, checking that it is a good gas-tight fit. (The purpose of the heat resistance washer is to protect the underside of the bung from the combustion flame.)
If the ignitor holder is not fitted to the support table, proceed as follows:

Undo the plastic knob on the bottom of the ignitor holder stem , from top face of support table, pass ignitor holder stem through split brass tube, then thread the leads through the knob and up from the bottom of the ignitor holder stem up to ceramic holder. Tighten knob

onto ignitor holder. Fit leads into top of connector block by undoing small screws in side of block then pushing tinned ends of leads into top holes . Retighten screws (Small screw driver will be required for this.)

Fit the helical ignitor coil into the bottom holes of connector block by repeating above procedure, making sure the screws are tight and that the coil is not distorted.

Fit the platform on to a retort stand at a convenient height (about 80 to 150mm above the bench).

Carefully stand the calorimeter on the platform, and hold by means of a retort ring.

Fill the calorimeter vessel with water just to cover the upper coil of the copper helix and note volume of water. Fit the stirrer and plastic lid in position.

Connect the outlet of the copper helix to a filter pump, and the tube protruding downwards from the platform to a cylinder of oxygen.

Fit the selected thermometer; use a ring cut from rubber tube to support the thermometer with the bulb just above the top of the inner calorimeter vessel.

4 PROCEDURE FOR SOLID SAMPLES

A piece of toast is suitable for this experiment. Pieces of about 250 to 500mg in mass should be dried in an oven at about 105 ° C and cooled in a dessicator, being kept there until required for use.

Lower the platform a few centimetres below the calorimeter. Push the ignitor holder up as far as it will go, and swing round to just touch the inside of the glass calorimeter chamber.

Place the sample in the crucible, find its mass quickly, place the crucible in the recess on top of the platform, and apply a moderate suction by the filter pump. Raise the platform to support the calorimeter.

Stir the water in the calorimeter until a steady temperature is attained and record this temperature.

Start a *gentle* stream of oxygen from the cylinder- a pressure of about 20.5kNm² will be required. *It is important to start the oxygen supply before the ignitor coil is turned on.*

By manipulating the external control knob, gently position the ignitor coil just to touch the sample. Switch the electric current (6 volt, 4 amp max.) on *briefly* to ignite the sample, which will burn freely in the oxygen atmosphere. Immediately raise the ignitor coil and swing it out of the way towards the side of the glass vessel. The oxygen pressure needs careful adjustment, so that the sample burns quietly without sputtering and consequent loss of mass. Should the sample sputter, the oxygen supply must be reduced until quieter combustion is obtained. Stir the water continuously throughout combustion, which will take about five minutes.

If the sample fails to burn the first time, turn off the ignitor coil and the oxygen supply. Clear the apparatus of fumes of vaporised material by drawing air through before making a second attempt at ignition.

When combustion has ceased, turn off the filter pump and oxygen supply and continue stirring until maximum temperature is observed and record this temperature.

When cool, remove the crucible and ascertain the mass of sample consumed.

From data obtained, calculate the energy value of the sample, making a correction for the

water equivalent of the calorimeter as determined under paragraph 1. However, for 'biological' purposes it may be required to compare the energy values of various types of food, which can be done easily if the mass of the sample and of the water in the calorimeter are kept constant. Then the energy values of the sample are directly proportional to the temperature rise.

5 PROCEDURE FOR LIQUID SAMPLES

The apparatus may also be used to compare the heat of combustion of various liquids such as alcohols.

The liquid is placed in a small spirit lamp, which is immediately capped with the ground cover to prevent evaporation and its mass found. The calorimeter is prepared as in paragraph 4, *but oxygen is NOT used with liquid fuels.* Uncap and light the burner, place in position on the platform and maintain an adequate air supply by the filter pump, if necessary, leave a small space between the platform and calorimeter to supplement the air supply. Continue combustion until a temperature rise of about 5 °C is attained, lower the platform, extinguish the burner, and record maximum temperature reached.

Again ascertain the mass of liquid consumed and calculate the energy value as before.

6 NOTES

When foodstuff is used for the first time, an exploratory attempt should be made with air rather than oxygen.

None-volatile liquids such as olive oil can conveniently be handled and burned in the crucible if first absorbed in a small wad of ceramic wool.

The ignition of sugar can be facilitated by using a little cigarette ash, spread on top of the sample, to act as a catalyst to promote combustion.

A unit used for the energy values of foods is the kilogram - calorie or kilocalorie.

1 kilocalorie = 4.180 joules; 10^6 joules = 239 kilocalories.

7 SPARE PARTS

YTL-290-030H	Nickel crucible
YTL-290-050B	Ignitor coils, Pk of 12
YTL-290-070S	Glass calorimeter vessel

8 ACCESSORIES

THC-534-010N	Spirit lamp, 5ml, for volatile liquid samples.

For additional apparatus required see paragraph 2.