

**Production:** MARGARINE

**Objective:** Measurement of firmness of margarine

**Type of action:** Penetration test

**Test setting:**

Speed	Test mode	Trigger	Target	Hold
2 mm/s	Distance (c)	5 gf	12 mm	0 sec

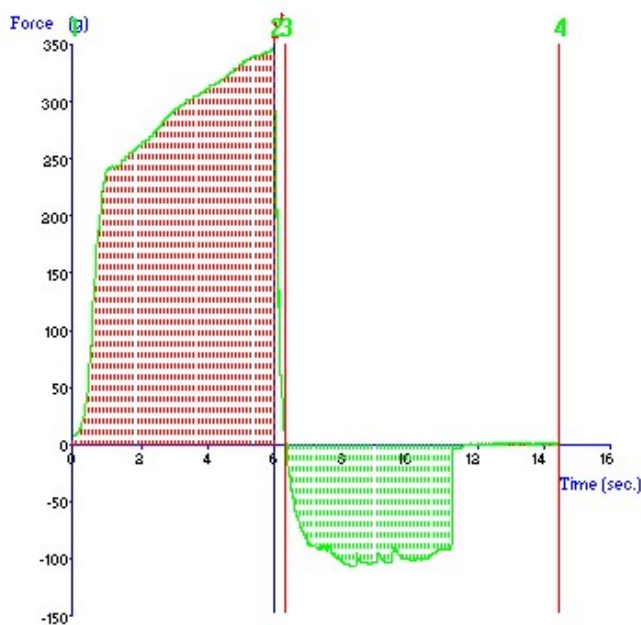
**Accessory:**

φ5 mm cylinder probe, Platform

**Test Set-Up:**

Remove samples from place of storage just prior to testing. Position the sample container centrally under the probe and commence the penetration test.

**Typical plots:**



The above curve was produced from sunflower margarine, tested at 4.5C. Tests were carried out in the original margarine (500g) container.

**Observations:**

When a 5g surface trigger is attained the probe proceeds to penetrate to a depth of 12mm. At this point (maximum +ve force), the probe returns to its original position at constant speed (e.g. 2.0 mm/s). The maximum +ve force and the +ve area under the curve give an indication of the softness of the sample. The smaller these values, the softer is the sample. The negative region of the graph, produced on probe return, is an indication of the adhesive property of the fat-based spread and/or as a result of a certain weight of sample that has adhered to the probe on return.

**Data Analysis:**

- ☒ Max Force
- ☒ Area (+)
- ☒ Area (-)

**Results**

Sample	Mean Max. +ve Force 'Firmness' (+/- S.D.) (g)	Mean +ve Area 'Work of Penetration' (+/- S.D.) (g s)	Mean -ve Area 'Resistance to probe withdrawal' (+/- S.D.) (g s)
A	341.1 +/- 10.5	1599.1 +/- 65.0	-452.4 +/- 34.3

**Notes:**

- A jagged curve produced on penetration may be as a result of an observed surface cracking, layer slip in some fat-based spreads or air pockets.
- It may be necessary to modify the test to penetrate a greater depth into the sample. This will subsequently decrease the softness value and increase the adhesiveness/resistance to probe withdrawal value. The distance of penetration should never exceed 75% of the depth of the product otherwise inaccuracies may be introduced. Any values obtained are only relative at the specified distance to which they are penetrated and should always be reported in order for comparisons to be made between tests.
- If penetrating the same sample more than once, consideration should be taken of the proximity of the test holes to each other and the side walls of the container. Penetration should not be carried out too close to neighbouring test holes e.g. not less than 15mm apart.
- Results obtained by a cylindrical probe or cone penetration are known to correlate as well with sensory determined spreadability as those obtained by better defined rheological measurements (Walstra *et al.*, 1980).
- When attempting to optimise test settings it is suggested that the first tests are performed on the hardest samples to anticipate the maximum testing range required and ensure that the force capacity allows testing of all future samples.
- Butter and margarine are predominantly fatty systems and the consistency at any temperature is determined primarily by the structure of the fatty phase, i.e. the proportions and distribution of solid and liquid glycerides and the size and nature of the fat crystals. Softness of comparative samples of butter and margarine is observed to approximately correlate with the total amount of fat in the sample and the percentage of saturation of this fat.
- Factors affecting the rheological properties of the fat-based spread -
  - Solid Fat Content (temperature dependent)
  - Type of fat present and predominant (saturated/unsaturated)
  - Dispersed particle volume fraction (especially in low-fat formulations)
  - Crystal modification (aggregated fat crystal network formation) - under standard test conditions results may indicate prior major temperature abuse and subsequent fat crystal modification.