SPECIFICATION

Platen: Copper, dull, nickel plated (other options available)
Platen Dimensions: 483min x 235min
Parallel Tracks: Using 1” cube applicator (maximum 10)
Weight: 38kg (851b)
Dimensions: 550mm wide x 350mm high x 610mm deep
Temperature Sensing: 10 points on centreline at width intervals, 37min
Resolution: 0.1 °C
Accuracy: (-5°C to +70°C +/- 0.1%) (70°C to 90°C-2.2%+0.3%)
Display: Point temperature and temperature differential between
Adjacent points.
Indication: Lamps; instrument ON, heating, cooling. Coolant failure.
Alarms: Audible and visual for water flow failure.

SERVICES REQUIRED

Mains: 220 - 240 volts AC
110 - 120 volts AC
Air: 4 litres/minimum at 100 psig
Water: Normal mains supply
Water Drain: Gravity

COMPLETE INSTRUMENT COMPRISES

• MFFTB Instrument
• Mains cable
• Air connector
• Water connectors
• Roving temperature sensor; M176/1 Bead and Cable Probe
• Cube applicator 75μm x 1” cube
• Guide bar
• Quantity - desiccant
• Quantity - indicator crystals
• Five hypodermic type dispensers
• Spare fuses
• Instruction book

OPTIONAL EXTRAS

• Additional cube applicators
• Frame for up to five applicators

SPECIAL OPTIONS

- Extended range by the addition of three programmes; 43-70,
  53-80, 63-90 °C
- Unit for Nitrogen supply only, no air processor fitted
- Unplated copper platen
The "minimum film forming temperature" has been described as "the minimum temperature at which a water-borne synthetic latex or emulsion will coalesce when laid on a substrate as a thin film. When this process occurs, in the absence of pigmentation or other opacifying materials, a clear transparent film is formed. At lower temperatures than the minimum, a white, powdery, cracked film will result".

The minimum film forming temperature is usually closely related to the glass transition temperature (Tg) but not synonymous with it; whilst the Tg may be determined by predicted calculation, the minimum film forming temperature is best determined by the use of a MFFT Bar, the basic principles of which are described in ASTM D2354. Early instruments were usually cumbersome, inaccurate and slow to achieve equilibrium. ICI plc devised a simple integrated instrument, which was able to achieve the desired results quickly and efficiently. The initial development was carried out in ICI Paints' laboratories.

A nickel plated copper platen is electronically cooled at one end and warmed at the other end. Air or nitrogen is caused to flow over the surface, from cool end to warm end as a uniform blanket. To achieve the required degree of uniformity the air or gas is delivered via a carefully designed sintered metal distribution block; the design is such that freezing does not take place at the inlet.

For use with air, a drying system is incorporated into the housing together with a flow controller. The air dryer contains indicator crystals, which are clearly visible in a transparent container. The complete air conditioning system is readily accessible at the side of the instrument. Water at normal mains pressure removes the excess heat from the coolers. Quick release couplings are provided. Water is normally drawn from a laboratory tap and the outlet is run to drain by gravity. Alarms, both audible and visual are actuated in the event of cooling water supply failure.

Temperature sensors are mounted at intervals under the surface of the platen. These are used to control the temperature of the platen in accordance with the chosen programme. They are also used to indicate the platen temperatures down the length of the bar, or they can be switched to indicate differential temperatures between adjacent sensing points, so proving an instantaneous indication of temperature gradient.

A roving probe temperature sensor is provided to facilitate temperature measurement at every point on the platen, it also serves to check the static sensors.

A hinged perspex cover over the platen provides thermal insulation whilst allowing visual inspection of the determination as it progresses. A transparent cursor is mounted on the cover to simplify the identification of the exact film forming temperature.

<table>
<thead>
<tr>
<th>Standard model MFFT-60</th>
<th>°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cool end (Left)</td>
<td>-5</td>
</tr>
<tr>
<td>Warm end (Right)</td>
<td>+13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extended range model MFFT90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional programmes</td>
</tr>
<tr>
<td>Cool end</td>
</tr>
<tr>
<td>Warm end</td>
</tr>
</tbody>
</table>
INSTRUCTIONS FOR AN MFFT BAR

1. Check that the platen is clean and free from grease.

2. Check that air dryer indicator crystals are blue. If pink, change crystals. Unscrew transparent container, empty refill with activated alumina and silica gel indicating crystals.

3. Connect airline via coupler. Right hand side of air control panel.

4. Connect cold mains water and water drain (gravity). IN is right spigot, left is OUT spigot.

5. Close cover.

6. Turn on water. Water will flow only when cooling lamp is ON.

7. Turn on air supply. Check flow rate which should be 4 litres/minimum. Adjust flow rate if necessary. (See page 8.)

8. Select desired temperature programme. (14)

9. Plug in mains 240V 50Hz or 115V 6Hz dependent on model.

10. Switch on (1).

11. Lamps (1), (2) and (3) will be illuminated (except at higher temperature programmes when cooling light may illuminate at a low repetitive rate). On low temperature programmes cooling light is ON almost continuously. Allow 10-20 minutes for equilibrium condition to be achieved, this will be signalled by very slow intermittency of illumination of heating and cooling lamps (2) and (3).

12. Check temperature gradient using temperature selector control (11) either mode. Select on (10) temperature increments or differential temperature. (2°C lower temperature programmes 3°C higher temperature programmes.)

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**Alarm and On Module**

1. Mains switch - On/O
2. Heating lamp indicator
3. Cooling lamp indicator
4. Coolant failure lamp
5. Pressure gauge
6. Pressure regulator
7. Air flow controller

**Indication Module**

8. Temperature display
9. Probe socket
10. Temperature mode switch
11. Temperature sensor selector

**Control Module**

12. Heating LED
13. Cooling LED
14. Programme selector

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13 Apply emulsion using 75 micron cube applicator from warm end right to cold end left, or in form starting and finishing right hand side. Apply control strip using emulsion of known MFFT Up to 10 single tracks can be applied. All coatings should be applied within ten minutes. If there is a delay in applying a track, close the cover to prevent ice formation, reopening the cover as soon as the next coating material is ready. The use of several applicators is recommended if more than one emulsion is to be applied. If the hypodermic barrel dispensers are part filled with emulsion(s) beforehand, the cube applicator(s) can be charged quickly and easily. The guide bar is used to maintain even, straight tracks.

14 Close cover.

15 Check after about one hour when the film should be started to form.

16 When films have formed (see illustration) set cursor to read point on track where the film has coalesced over 90% of the track width.

17 Read scale number above cursor - set temperature sensor selector (11) to corresponding number. If cursor is between two scale numbers read temperatures corresponding to higher and lower scale numbers and interpolate result.

18 Use roving probe to read exact temperature of platen at MFFT point.
In the illustration below the cursor would be moved until it aligned with the point at which 90% of the track width has coalesced, i.e. on line with two on the scale.

Temperatures corresponding with two will depend on the programme selected for the test.

<table>
<thead>
<tr>
<th>Programme</th>
<th>Degrees</th>
<th>Celsius</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-5</td>
<td>-3</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>+2</td>
</tr>
<tr>
<td>3</td>
<td>+5</td>
<td>+7</td>
</tr>
<tr>
<td>4</td>
<td>+15</td>
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<tr>
<td>5</td>
<td>+23</td>
<td>+26</td>
</tr>
<tr>
<td>6</td>
<td>+33</td>
<td>+36</td>
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Extended Range

<table>
<thead>
<tr>
<th>Programme</th>
<th>Degrees</th>
<th>Celsius</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>+43</td>
<td>+46</td>
</tr>
<tr>
<td>8</td>
<td>+53</td>
<td>+56</td>
</tr>
<tr>
<td>9</td>
<td>+63</td>
<td>+66</td>
</tr>
</tbody>
</table>

Copper plate
Non linearity above 80°C gives a repeatable error. Use indicated temperature and table below to give corrected temperature.

<table>
<thead>
<tr>
<th>Display</th>
<th>80.5</th>
<th>81.0</th>
<th>81.5</th>
<th>82.0</th>
<th>82.5</th>
<th>83.0</th>
<th>83.5</th>
<th>84.0</th>
<th>84.5</th>
<th>85.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td>81.3</td>
<td>81.8</td>
<td>82.4</td>
<td>83.0</td>
<td>83.6</td>
<td>84.2</td>
<td>84.8</td>
<td>85.4</td>
<td>85.9</td>
<td>86.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Display</th>
<th>85.5</th>
<th>86.0</th>
<th>86.5</th>
<th>87.0</th>
<th>87.5</th>
<th>88.0</th>
<th>88.5</th>
<th>89.0</th>
<th>89.5</th>
<th>90.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td>87.2</td>
<td>87.8</td>
<td>88.4</td>
<td>89.0</td>
<td>89.6</td>
<td>90.2</td>
<td>90.8</td>
<td>91.5</td>
<td>92.1</td>
<td>92.7</td>
</tr>
</tbody>
</table>

The MFFT bar is sometimes used for tests on pigmented emulsion, where the MFFT determination is more difficult because there is no clearly defined change in "colour" of the coalesced film.

There is, however, a slight change in the shininess of the surface and using a wooden spatula, lightly scraped on the surface, it is easy to define where the coalesced film stops and where the remaining film is poorly integrated and heavily cracked with very poor adhesion.

Immediately after use the platen should be cleaned; the most common method is to use a dilute detergent applied with a nylon scouring pad.

Solvents to the particular coating can be used.

Copper platens can be bright finished using dilute citric acid.

Some users apply the coatings to self-adhesive plastic tape or film which has been laid on the platen. The temperature error due to the intervening layer is said to be about 0.1 °C. Cleaning is accomplished very quickly - the method commends itself when the MFFT bar is used for production control.
AIR PROCESSOR

1. Dessicator
2. Dessicator (need replacing when indicating crystals turn pink)
3. Indicating crystals
4. Water inlet and outlet
5. Water inlet and outlet
6. Air inlet
7. Air inlet filter (auto-drain)
RHOPOINT
HIGH-LOW
TEMPERATURE
CONTROLLER
S1212114

The controller is used with transformers to provide control over the heating and cooling systems operated at low voltage but high current.

Power for the controller at about 60mA is derived from the load supply. Zero crossing gate switching is employed for minimal R.F. Interference. Pre-selected levels of temperature can be switched in each of the two channels; lamps indicate operation of the Triac units.

Triac units are fitted adjacent to the heater and/or coolers.

The controller is mounted on a Eurocard 100mm x 160mm.

Module size 3U x 21E (137mm high X 107mm wide).
The multipoint temperature indicator S 1212 accepts up to 10 sensors of the standard Celstar type via rear panel connections providing digital indication of temperature, to an accuracy of 0.07°C.

The 3.5 digit LCD display reads 199.9 in the range between -40°C and +100°C.

Module size 3U (146 mm high x 107 mm wide.)
OPERATIONAL AND TEST NOTES

1 The Rhopoint S1212 indicator multipoint temperature indicator is a self-contained module. To withdraw it from the front panel, release the four screws, one each, top and bottom, left and right of the module's panel and pull the unit forward using the handle provided.

The roving probe sensor is not waterproof but alternative sheathed sensors are available for tests in ice and boiling water.

2 Differential temperatures should be checked with air flowing and the platen cover closed, with coolant water flowing.

The temperature differential between sensing points should be 2.0±0.2°C on lower programmes, 3.0 ±0.2°C on higher programmes. See table page.

3 Test the evenness of film formation using two emulsions of known MFFT. A 6°C emulsion can be tested on programmes 1 or 2, a 15°C emulsion can be tested on programmes 2 or 3. If both emulsions are used simultaneously, programme 2 would be the appropriate range.

4 The range of MFFT points on dried paints should be less than ±0.75°C from the mean position.

5 The temperature controller is tested in situ. Adjustment is provided to minimise oversheet or undershoot to ±0.2°C.

6 Coolant water is checked by ensuring that it flows from the outlet to drain. Water flows only when cooling lamp is on.

7 Coolant alarm is checked by turning off the water coolant for a SHORT TIME. If difficulty is experienced with alarm, reset reverse water flow with mains on until alarm is silenced.

8 Air leaks are identified by checking with a 10 litre air storage bottle with pressure set at 15 PSI, flow at 4 litres per minute supply should last 2½ minutes.

Check air dispersion plastic filter - left hand side of platen cover. Ensure that it is free of paint or contamination which would affect linear air flow. Check that lid seal fits uniformly without gaps and that the air exit - right hand side of platen cover is uniform and not distorted.

10 Set pressure regulator to 60 PSI.

11 Check flow controller over its range and set finally to 4 litres per minute.

12 Check that cursor is free running and square and free of contamination.

13 The desiccant will normally last for 4 or 5 determinations, when the indicator crystals will turn from blue to pink. The desiccant (activated alumina) and indicator crystals (silica gel) should be replaced. Remove container by rotation. Discard contents and refill to red line. Replace container making sure that it seats on the ring seal.
FUSES

Fuses fitted.

**FS1** One 50mA, A/S, 20x5 mm fuse is fitted in the temperature indicator unit. See diagram on page 9.

**FS2** One 3,15A/S, 20x5mm fuse is fitted on the main PCB. See diagram below.

**FS3** One 10A, 40x10mm HRC (IR A350- 10) fuse is fitted on the PCB.

**FS4** Two 5A, A/S, 20x5mm