

## WAR-TIME SPECIFICATIONS FOR I.P. THERMOMETERS

The Standardization Committee was recently reorganized, and a number of new sub-committees were set up, including one to deal with apparatus.

One of the most important functions of this Apparatus Sub-Committee is to ensure that all recommended or standardized apparatus is constructed on sound practical lines, and in this connection it has been fortunate in securing the co-operation of expert representatives from the three major trade associations dealing with scientific instruments, laboratory equipment and glassware.

The first task of the Apparatus Sub-Committee has been to reconsider the whole of the existing thermometer specifications. Under war-time conditions it is vital that the best use should be made of the limited skilled labour and specialized material available, and with this object in view the following set of war-time specifications has been prepared. Although they are designated "war-time," it will be seen that the required degree of accuracy has been maintained, whilst unnecessarily restrictive dimensions have been relaxed. The general result is a co-ordination of the requirements of the manufacturer and of the user. The Sub-Committee is confident that the thermometers will be as satisfactory as the previous instruments, and, moreover, considers that improvements have been introduced in many cases. Advantage has been taken of this opportunity to include specifications for some thermometers in general use, but not previously specified. Two thermometers appearing in previous I.P. specifications have now been withdrawn, as it is felt that other specified thermometers adequately replace them. These are the "I.P. Cut-back Viscosity" and the "I.P. Setting Point" thermometers, replaced by the "Redwood Cup Low" and the "Cloud and Pour" thermometers, respectively.

The complete list of war-time thermometer specifications is printed below, prior to publication in the next edition of "Standard Methods," so that the new standard thermometers can come into general use immediately. Thermometers conforming to the 1935 and 1942 specifications may still be used, but thermometers should be manufactured in future to conform to the new specifications until further notice.





## WAR-TIME STANDARD THERMOMETERS

### INTRODUCTION

These specifications cover glass thermometers graduated in Centigrade or Fahrenheit degrees and specified in Institute of Petroleum Methods. The thermometers shall conform to the general requirements and to the special requirements listed below.

However, thermometers with different identification marks but which conform to all the other requirements of the specification are permissible.

Purchasers should not accept thermometers as complying with these specifications because they are marked with I.P. markings, as these inscriptions are identification marks and do not necessarily constitute a guarantee.

Purchasers must satisfy themselves that the permissible scale errors, given in the table of special requirements, have not been exceeded.

It is essential that thermometers be marked with a material resistant to the action of hot petroleum products.

### GENERAL REQUIREMENTS

*Type.*—Mercury in glass, solid stem except where otherwise stated. Gas filled.

*Stem.*—The stem shall be made of lead-glass or other suitable glass. Enamel back.

*Bulb.*—The bulb shall be made of a suitable thermometric glass approved by the National Physical Laboratory. At present these glasses include:

	Identification mark.	Approved for temperatures up to
Normal glass made by James Powell & Sons, Ltd.	Single blue stripe.	350° C.*
Normal glass made by Frank Toney & Co., Ltd.	Two blue stripes.	350° C.*
Corning boro-silicate made by Corning Glass Co.	—	450° C.
Normal glass, Dial, made by Plowden & Thomson	Double blue stripes.	350° C.

\* May be used up to 400° C. if a careful examination of the zero is made periodically.

*Expansion and Contraction Chamber.*—No contraction chamber shall be above the immersion line, and no enlargement of the bore shall be within 10 mm. of the immersion line or of any part of the scale.

*Graduation and Figuring.*—The graduation lines shall be clearly etched, and of uniform thickness, not exceeding 0.15 mm.† The lines shall all be at right angles to the axis of the thermometer. When the thermometer is viewed from the front and in a vertical

† In the case of the "V.I." thermometers the graduation lines shall not exceed 0.10 mm. in thickness.



position, the lines shall all finish on a line parallel to the axis on the left-hand side. Certain of the graduation lines shall be extended on the right-hand side, but the shortest graduations shall not extend across the bore. When the diameter of the tube permits, the figures shall be upright when the thermometer is viewed from the front and is in a vertical position (except in the case of the "Congealing Point" thermometer), and should preferably be placed so that they would be intersected by the line to which they refer if it were extended.

*Marking.*—In addition to the special markings given in the table, each thermometer shall be marked with an identification number and the maker's or vendor's name or trade mark. Each thermometer shall also be marked with the immersion at which it is to be used—e.g., "Full immersion," "11 cm. immersion," etc. Thermometers intended to be used at partial immersion should have a line etched round the stem to indicate the depth of immersion.

*Permanency of Range.*—Thermometers must be suitably annealed, and thermometers which are normally used at temperatures of 200° C. and upwards and certain other specified thermometers shall be subjected to a test for permanency of range. This test shall consist of heating the finished thermometer for 24 hours at the highest temperature shown on the scale, and then checking the rise, if any, after the thermometer has been allowed to cool and stabilize for 4 or 5 days.

The permanency of range test shall be applied to the following:

- "I.P. 4W. Crude Oil Dist."
- "I.P. 5W. Low Dist."
- "I.P. 6W. High Dist."
- "I.P. 7W. Loss on Heating."
- "I.P. 16W. P.M. High."
- "I.P. 22W. A.M. Oxidation."
- "I.P. 28W. Cleveland."
- "I.P. 32W. V.I. 210° F."
- "I.P. 37W. Sludge."
- "I.P. 41W. Drop Point High."

*Verification.*—For referee purposes, only thermometers which have been tested at the National Physical Laboratory shall be used, and the appropriate corrections shall be applied. Satisfactory thermometers will be marked with the N.P.L. monogram and year of test and a certificate of corrections issued.

It is desirable that thermometers shall be re-tested at intervals not exceeding five years.

*Scale Errors.*—The scale error maxima, given in the table of special requirements, are intended as a guide to manufacturers, who are expected to guarantee that they are not exceeded.

#### SPECIAL NOTE.

Existent stocks of thermometers, conforming to the I.P. 1935 and 1942 specifications, may be used. New thermometers shall, however, conform to the present requirements.



# SPECIAL REQUIREMENTS.

Name and Special Marking.	" I.P. 1W. Cloud and Pour."	" I.P. 2W. Low Cloud and Pour."	" I.P. 3W. Demulsification."	" I.P. 4W. Crude Oil Dist."	" I.P. 5W. Low Dist."	" I.P. 6W. High Dist."	" I.P. 7W. Loss on Heating."
Range . . . . .	-36° F. to 120° F.	-70° F. to 70° F.	30° F. to 220° F.	-4° C. to 360° C.	-2° C. to 300° C.	-2° C. to 400° C.	150° C. to 175° C.
Graduation . . . . .	2° F.	2° F.	1° F.	2° C.	1° C.	1° C.	1° C.
Immersion . . . . .	108 mm.	76 mm.	Total	Total.	Total.	Total.	Total.
Dimensions : Overall length, ± 10 mm.	250 mm.	260 mm.	—	310 mm.	380 mm.	420 mm.	180 mm.
Stem, diameter . . . . .	5.5-8.0 mm.	5.5-8.0 mm.	5.5-8.0 mm.	5.5-8.0 mm.	5.5-8.0 mm.	5.5-8.0 mm.	5-7 mm.
Bulb, shape . . . . .	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.
" length . . . . .	10 mm. max.	10 mm. max.	—	10-20 mm.	8-16 mm.	8-16 mm.	10-20 mm.
" diameter . . . . .	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.
Length of graduated portion . . . . .	60-90 mm.	60-90 mm.	Not less than 170 mm.	150-180 mm.	210-250 mm.	300-360 mm.	60-90 mm.
Distance, bottom of bulb to . . . . .	-36° F. Not less than 120 mm.	-70° F. Not less than 120 mm.	—	0° C. Not less than 95 mm.	0° C. 100-110 mm.	0° C. 25-40 mm.	150° C. 45-65 mm.
Longer lines at each . . . . .	10° F. from -30° F.	10° F.	5° F.	10° C.	5° C.	5° C.	5° C.
Figured at each . . . . .	20° F. from -20° F.	20° F. from -60° F.	10° F.	20° C.	10° C.	10° C.	5° C.
Expansion chamber . . . . .	To allow heating to 212° F.	To allow heating to 140° F.	Required.	Required.	Required.	Required.	Required.
Top finish . . . . .	Plain.	Plain.	Ring.	Ring.	Ring.	Ring.	Ring.
Scale error not to exceed plus or minus . . . . .	2° F.	2° F.	1° F.	2° C.	0.5° C. to 150° C. 1° C. above 150° C.	1° C. to 300° C. 2° C. above 300° C.	0.5° C.
See notes . . . . .	—	1 and 2	—	—	—	—	3

1. To be filled with toluene or other suitable liquid coloured red with permanent dye; the filling above the liquid to be gas under pressure.
2. A tropical type marked " I.P. 2W. Low Cloud and Pour Tropical," shall have an expansion chamber to allow heating to 180° F.
3. The lines at 162° C. and 164° C. should be approximately twice as thick as those at other points and should be extended to the left-hand side.



**SPECIAL REQUIREMENTS—continued.**

Name and Special Marking.	" I.P. 8W. Redwood Cup Low."	" I.P. 9W. Redwood Cup Medium."	" I.P. 10W. Redwood Cup High."	" I.P. 11W. Redwood Bath Low."	" I.P. 12W. Redwood Bath Medium."	" I.P. 13W. Redwood Bath High."	" I.P. 14W. Cold Test."
Range . . . . .	30° F. to 110° F.	100° F. to 180° F.	170° F. to 250° F.	30° F. to 110° F.	100° F. to 180° F.	170° F. to 250° F.	—80° C. to 20° C.
Graduation . . . . .	0.5° F.	0.5° F.	0.5° F.	1° F.	1° F.	1° F.	0.5° C.
Immersion . . . . .	65 mm.	65 mm.	65 mm.	65 mm.	65 mm.	65 mm.	Total.
Dimensions:							
Overall length, $\pm 10$ mm.	340 mm.	340 mm.	340 mm.	—	—	—	300 mm.
Stem, diameter . . . . .	5.5-8.0 mm.	5.5-8.0 mm.	5.5-8.0 mm.	5.5-8.0 mm.	5.5-8.0 mm.	5.5-8.0 mm.	5.5-8.0 mm.
Bulb, shape . . . . .	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.
„ length . . . . .	10-16 mm.	10-16 mm.	10-16 mm.	20 mm. max.	20 mm. max.	20 mm. max.	8-16 mm.
„ diameter . . . . .	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.
Length of graduated portion . . . . .	150-190 mm.	150-190 mm.	150-190 mm.	120 mm. min.	120 mm. min.	120 mm. min.	170-210 mm.
Distance, bottom of bulb to . . . . .	30° F. 115 mm. min.	100° F. 115 mm. min.	170° F. 115 mm. min.	30° F. 100 mm. min.	100° F. 100 mm. min.	170° F. 100 mm. min.	0° C. 220 mm. max.
Longer lines at each . . . . .	1° F. and 5° F.	1° F. and 5° F.	1° F. and 5° F.	5° F.	5° F.	5° F.	1° C. and 5° C.
Figured at each . . . . .	5° F.	5° F.	5° F.	10° F.	10° F.	10° F.	5° C.
Expansion chamber . . . . .	To allow heating to 212° F.		Required.	To allow heating to 212° F.		Required.	To allow heating to 45° C.
Top finish . . . . .	Ring.	Ring.	Ring.	Ring.	Ring.	Ring.	Plain or ring.
Scale error not to exceed plus or minus . . . . .	0.5° F.	0.5° F.	1.0° F.	1.0° F.	1.0° F.	1.0° F.	1° C.
See notes . . . . .	1	1	1	2	2	2	3 and 4

1. A swelling (the bottom of which shall be 100-105 mm. from the bottom of the bulb) shall be provided.
2. A swelling need not be provided.
3. To be filled with toluene or other suitable liquid coloured red with permanent dye; the filling above the liquid to be gas under pressure.
4. A tropical type marked " I.P. 14W. Cold Test Tropical," shall have an expansion chamber to allow heating to 80° C.



**SPECIAL REQUIREMENTS—continued.**

Name and Special Marking.	" I.P. 15W. P.M. Low."	" I.P. 16W. P.M. High."	" I.P. 17W. Wax Setting Point."	" I.P. 18W. Congealing Point."	" I.P. 19W. Ring and Ball."	" I.P. 20W. Aniline Low."
Range . . . . .	20° F. to 230° F.	200° F. to 700° F.	90° F. to 170° F.	68° F. to 212° F.	-2° C. to 160° C.	-36° C. to 42° C.
Graduation . . . . .	1° F.	5° F.	0.2° F.	1.0° F.	1.0° C.	0.2° C.
Immersion . . . . .	56 mm.	56 mm.	80 mm.	Total.	Total.	50 mm.
Dimensions : Overall length, ± 10 mm.	280 mm.	280 mm.	380 mm.	245 mm.	300 mm.	410 mm.
Stem, diameter . . . . .	5.5-8.0 mm.	5.5-8.0 mm.	5.5-8.0 mm.	5-6 mm.	5.5-8.0 mm.	5.5-8.0 mm.
Bulb, shape . . . . .	Spherical.	Spherical.	Cylindrical.	Ellipsoidal.	Cylindrical.	Cylindrical.
„ length . . . . .			20 mm. max.	10-12 mm.	14 mm. max.	10-20 mm.
„ diameter . . . . .	8 mm. max.	8 mm. max.	Not greater than stem.	4.5-6.0 mm.	Not greater than stem.	Not greater than stem.
Length of graduated portion . . . . .	150-180 mm.	150-180 mm.	200-240 mm.	Not less than 150 mm.	160-200 mm.	230-270 mm.
Distance, bottom of bulb, to . . . . .	20° F. 70 mm. min.	200° F. 70 mm. min.	90° F. 100-120 mm.	68° F. Not less than 30 mm.	0° C. 70-90 mm.	-36° C. 100-120 mm.
Longer lines at each . . . . .	5° F.	10° F. and 50° F.	1° F.	5° F.	5° C.	1° C.
Figured at each . . . . .	10° F.	50° F.	5° F.	10° F.	10° C.	2° C.
Expansion chamber . . . . .	Required.	Required.	To allow heating to 212° F.	Required.	Required.	To allow heating to 100° C.
Top finish . . . . .	Ring.	Ring.	Plain.	Ring.	Ring.	Ring.
Scale error not to exceed plus or minus . . . . .	1° F.	5° F. to 500° F. 10° F. above 500° F.	0.4° F.	1° F.	1° C.	0.3° C.
See notes . . . . .	1	1	2 and 3	4 and 5	—	6

1. A swelling to be provided to ensure the location of the thermometer collar at the correct point (see I.P.-34/42, Section 2 (d)).
2. Top of contraction chamber to be not more than 41 mm. from the bottom of the bulb.
3. The thermometer shall be standardized for the following temperatures of the emergent mercury column :

Thermometer Reading.

90° to 130° F.

130° to 170° F.

Average Temperature of Emergent Mercury Column.

70° F. ± 10° F.

80° F. ± 10° F.

4. See Fig. 1.
5. Figures to be horizontal in line with the long axis of thermometer.
6. The thermometer shall be standardized over the entire range for an average temperature of the emergent mercury column of 20° C. ± 5° C.



**SPECIAL REQUIREMENTS—continued.**

Name and Special Marking.	" I.P. 21W. Aniline High."	" I.P. 22W. A.M. Oxidation."	" I.P. 23W. Reid V.P."	" I.P. 24W. Gum."	" Abel Oil Cup Fahrenheit."	" Abel Water Bath Fahrenheit."
Range . . . . .	25° C. to 105° C.	195° C. to 205° C.	94° F. to 108° F.	204° F. to 218° F.	50° F. to 150° F.	90° F. to 190° F.
Graduation . . . . .	0.2° C.	0.1° C.	0.2° F.	0.2° F.	1° F.	1° F.
Immersion . . . . .	50 mm.	100 mm.	Total.	Total.	—	—
Dimensions :						
Overall length, $\pm 10$ mm.	410 mm.	260 mm.	260 mm.	260 mm.	9 in. approx.	9 in. approx.
Stem, diameter . . . .	5.5-8.0 mm.	5.5-8.0 mm.	5.5-8.0 mm.	5.5-8.0 mm.	0.24-0.28 in.	0.24-0.28 in.
Bulb, shape . . . . .	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.	Spherical.	Cylindrical.
„ length . . . . .	10-20 mm.	25-35 mm.	25-35 mm.	25-35 mm.	—	0.8 in. approx.
„ diameter . . . . .	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.	0.35 $\pm$ 0.05 in.	Not greater than stem.
Length of graduated portion .	230-270 mm.	70-110 mm.	60-90 mm.	60-90 mm.	At least 4.75 in.	At least 3.55 in.
Distance, bottom of bulb to .	25° C. 100-120 mm.	200° C. 150-180 mm.	94° F. 130-150 mm.	204° F. 130-160 mm.	50° F. 2.75-3.15 in.	90° F. 3.95-4.35 in.
Longer lines at each . . .	1° C.	0.5° C.	1° F.	1° F.	5° F. and 10° F.	5° F. and 10° F.
Figured at each . . . . .	2° C.	1° C.	2° F.	2° F.	10° F.	10° F.
Expansion chamber . . .	Required.	Required.	To allow heating to 212° F.	Required.	Required.	Required.
Top finish . . . . .	Ring.	Ring.	Ring.	Ring.	Plain.	Plain.
Scale error not to exceed plus or minus . . . . .	0.3° C.	0.2° C.	0.2° F.	0.4° F.	0.5° F.	1.0° F.
See notes . . . . .	1	—	—	—	2	2

1. The thermometer shall be standardized for the following temperatures of the emergent mercury column :

Thermometer Reading.	Average Temperature of Emergent Mercury Column.
Up to 35° C.	20° C. $\pm$ 5° C.
35° C. to 65° C.	25° C. $\pm$ 5° C.
Above 65° C.	30° C. $\pm$ 5° C.

2. A swelling is to be provided in the stem to ensure that the thermometer shall be fixed in its brass collar so that the distance from the top of the collar to the bottom of the bulb is  $2.40 \pm 0.05$  in. for the "oil-cup" and  $3.5 \pm 0.1$  in. for the "water-bath" thermometer. The brass collar shall be of the following dimensions : Outside diameter, push fit in socket. Thickness of tube, 22 I.W.G. Thickness of flange,  $0.1 \pm 0.001$  in. A model apparatus is deposited in the Standards Department of the Board of Trade.



**SPECIAL REQUIREMENTS—continued.**

Name and Special Marking.	"I.P. 25W. C.F.R. Low."	"I.P. 26W C.F.R. Med."	"I.P. 27W. C.F.R. High."	"I.P. 28W. Cleveland."	"I.P. 29W. V.I. 68° F."	"I.P. 30W. V.I. 77° F."
Range . . . . .	80° F. to 220° F.	180° F. to 320° F.	280° F. to 400° F.	20° F. to 760° F.	(31.5° F. to 32.5° F.) 66.5° F. to 71.5° F.	(31.5° F. to 32.5° F.) 74.0° F. to 80.0° F.
Graduation . . . . .	2° F.	2° F.	2° F.	5° F.	0.05° F.	0.05° F.
Immersion . . . . .	50 mm.	50 mm.	50 mm.	25 mm.	Total.	Total.
Dimensions :						
Overall length . . . . .	160 mm. ± 5 mm.	160 mm. ± 5 mm.	160 mm. ± 5 mm.	320 mm. ± 10 mm.	280 mm. ± 10 mm.	280 mm. ± 10 mm.
Stem, diameter . . . . .	5.5-6.5 mm.	5.5-6.5 mm.	5.5-6.5 mm.	5.5-8.0 mm.	5.0-8.0 mm.	5.0-8.0 mm.
Bulb, shape . . . . .	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.
„ length . . . . .	10 mm. max.	10 mm. max.	10 mm. max.	13 mm. max.	20-35 mm.	20-35 mm.
„ diameter . . . . .	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.
Length of graduated portion . . . . .	70-90 mm.	70-90 mm.	70-90 mm.	200-240 mm.	60-90 mm.	60-90 mm.
Distance, bottom of bulb to . . . . .	80° F. Not less than 60 mm.	180° F. Not less than 60 mm.	280° F. Not less than 60 mm.	20° F. 40-60 mm.	68° F. 170-210 mm.	77° F. 170-210 mm.
Longer lines at each . . . . .	10° F.	10° F.	10° F.	10° F.	0.1° F. and 0.5° F.	0.1° F. and 0.5° F.
Figured at each . . . . .	20° F.	20° F.	20° F.	20° F.	1° F.	1° F.
Expansion chamber . . . . .	Required.	Required.	Required.	Required.	To allow heating to 212° F.	
Top finish . . . . .	Plain.	Plain.	Plain.	Ring.	Ring.	Ring.
Scale error not to exceed plus or minus . . . . .	2° F.	2° F.	2° F.	10° F.	0.1° F. at 68° F. and 70° F.	0.1° F. at 77° F.
See notes . . . . .	1 and 2	1 and 2	1 and 2	—	3, 4 and 5	3, 4 and 5

1. Diameter of swelling on stem, if required, to be not less than 8 mm. and not more than 9 mm. Distance bottom of bulb to centre of swelling shall be 40 mm. ± 1 mm.
2. A contraction chamber shall also be provided and the distance from the bottom of the bulb to the top of the contraction chamber shall be as short as possible but shall in no case exceed 25 mm.
3. The graduation lines for these thermometers shall not exceed 0.10 mm. in thickness.
4. Top of contraction chamber to be not more than 120 mm. from bottom of bulb.
5. The range 31.5° F. to 32.5° F. is for checking purposes only.



# SPECIAL REQUIREMENTS—continued.

Name and Special Marking.	" I.P. 31W. V.I. 100° F."	" I.P. 32W. V.I. 210° F."	" I.P. 33W. Kin. Vis. 32° F."	" I.P. 34W. Kin. Vis. 130° F."	" I.P. 35W. Kin. Vis. 140° F."	" I.P. 36W. Kin. Vis. 200° F."
Range . . . . .	(31.5° F. to 32.5° F.) 97.5° F. to 102.5° F.	(31.5° F. to 32.5° F.) 208.5° F. to 213.5° F.	29.0° F. to 35.0° F.	127.0° F. to 133.0° F.	137.0° F. to 143.0° F.	197.0° F. to 203.0° F.
Graduation . . . . .	0.05° F.	0.05° F.	0.1° F.	0.1° F.	0.1° F.	0.1° F.
Immersion . . . . .	Total.	Total.	Total.	Total.	Total.	Total.
Dimensions : Overall length ± 10 mm. . . . .	280 mm.	280 mm.	280 mm.	280 mm.	280 mm.	280 mm.
Stem, diameter . . . . .	5.0-8.0 mm.	5.0-8.0 mm.	5.0-8.0 mm.	5.0-8.0 mm.	5.0-8.0 mm.	5.0-8.0 mm.
Bulb, shape . . . . .	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.
„ length . . . . .	20-35 mm.	20-35 mm.	20-35 mm.	20-35 mm.	20-35 mm.	20-35 mm.
„ diameter . . . . .	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.	Not greater than stem.
Length of graduated portion . . . . .	60-90 mm.	60-90 mm.	50-80 mm.	50-80 mm.	50-80 mm.	50-80 mm.
Distance, bottom of bulb to . . . . .	100° F. 170-210 mm.	210° F. 170-210 mm.	32° F. 170-210 mm.	130° F. 170-210 mm.	140° F. 170-210 mm.	200° F. 170-210 mm.
Longer lines at each . . . . .	0.1° F. and 0.5° F.	0.1° F. and 0.5° F.	0.5° F.	0.5° F.	0.5° F.	0.5° F.
Figured at each . . . . .	1° F.	1° F.	1° F.	1° F.	1° F.	1° F.
Expansion chamber . . . . .	To allow heating to 212° F.	Required.	To allow heating to 212° F.	To allow heating to 212° F.	To allow heating to 212° F.	Required.
Top finish . . . . .	Ring.	Ring.	Ring.	Ring.	Ring.	Ring.
Scale error not to exceed plus or minus . . . . .	0.1° F. at 100° F.	0.1° F. at 210° F. and 212° F.	0.2° F. at 32° F.	0.2° F. at 130° F.	0.2° F. at 140° F.	0.2° F. at 200° F.
See notes . . . . .	1, 2 and 3	1, 2 and 3	—	4	4	4

1. The graduation lines for these thermometers shall not exceed 0.10 mm. in thickness.
2. Top of contraction chamber to be not more than 120 mm. from bottom of bulb.
3. The range 31.5° F. to 32.5° F. is for checking purposes only.
4. The contraction chamber to be 80-120 mm. from bottom of bulb.

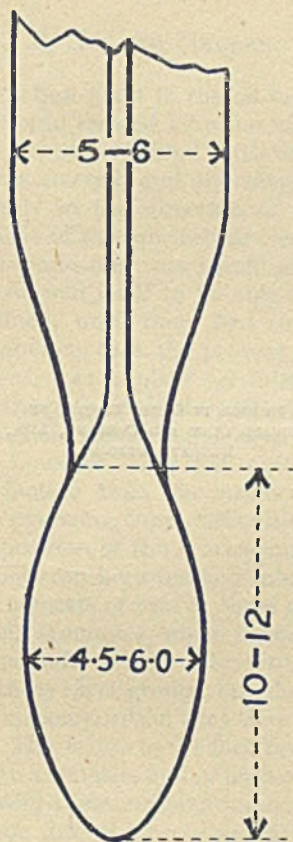


# SPECIAL REQUIREMENTS—concluded.

Name and Special Marking.	" I.P. 37W. Sludge."	" I.P. 38W. Pen. and Duct."	" I.P. 39W. Sp. Gr."	" I.P. 40W. Drop Point Low."	" I.P. 41W. Drop Point High."	" I.P. 42W. Breaking Point."
Range . . . . .	144-0° C. to 156-0° C.	23-0° C. to 27-0° C.	30° F. to 100° F.	20° C. to 120° C.	100° C. to 230° C.	-40° C. to 30° C.
Graduation . . . . .	0-2° C.	0-1° C.	0-2° F.	1° C.	1° C.	0-5° C.
Immersion . . . . .	100 mm.	Total.	Total.	100 mm.	100 mm.	250 mm.
Dimensions : Overall length, $\pm 10$ mm. .	270 mm.	260 mm.	440 mm.	250 mm.	250 mm.	370 mm.
Stem, diameter . . . . .	5-0-8-0 mm.	5-0-8-0 mm. Lens front.	5-5 to 8-0 mm.	4-5 to 6-0 mm.	4-5 to 6-0 mm.	6-0 to 7-0 mm.
Bulb, shape . . . . .	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.	Cylindrical.
„ length . . . . .	10-25 mm.	20-40 mm.	15-25 mm.	6-0 mm. max.	6-0 mm. max.	10-16 mm.
„ diameter . . . . .	Not greater than stem.	Not greater than stem.	Not greater than stem.	3-35-3-65 mm.	3-35-3-65 mm.	Not greater than stem.
Length of graduated portion .	50-80 mm.	40-60 mm.	300-350 mm.	Not less than 100 mm.	Not less than 100 mm.	Not less than 60 mm.
Distance, bottom of bulb to .	150° C. 170-210 mm.	25° C. 170-210 mm.	30° F. 40-60 mm.	20° C. Not less than 100 mm.	100° C. Not less than 100 mm.	
Longer lines at each . . . .	1° C.	0-5° C.	1-0° F.	5° C.	5° C.	1° C. and 5° C.
Figured at each . . . . .	2° C.	1° C.	2-0° F.	10° C.	10° C.	5° C.
Expansion chamber . . . . .	Required.	To allow heating to 100° C.	To allow heating to 212° F.	Required.	Required.	To allow heating to 80° C.
Top finish . . . . .	Ring.	Ring.	Ring.	Ring.	Ring.	Ring.
Scale error not to exceed plus or minus . . . . .	0-2° C. at 150° C.	0-1° C. at 25° C.	0-2° F.	1° C.	1° C.	0-5° C.
See notes . . . . .	—	1	—	2, 3 and 4	2, 3 and 4	5

1. 5 to 8 mm. diameter to be interpreted as "not go" or "go" through rings of these dimensions.
2. For dimensions and location of sleeve, see I.P.-31/44, Section 2.
3. The surfaces of the thermometer and of the sleeve shall be roughened or indented to ensure an effective key between the cement and the surfaces.
4. The stem immediately above the bulb shall be reduced in diameter to be approximately equal to, but not smaller than, that of the bulb over a length of approximately 2 cm.
5. A swelling 8-10 mm. in diameter, the bottom of which shall be 250 mm.  $\pm 2$  mm. from the bottom of the bulb, shall be provided to ensure that the thermometer is used at the correct immersion and to support it in the inner tube of the apparatus.





The section at right angles to the perpendicular  
to be circular everywhere.  
All dimensions in mm.

FIG. 1.  
BULB OF "CONGEALING POINT" THERMOMETER.



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