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TECHNICAL SPECIFICATION

BASIC SAFETY PUBLICATION

Fire hazard testing –
Part 11-40: Test flames – Confirmatory tests – Guidance

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FIRE HAZARD TESTING –

**Part 11-40: Test flames –
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FOREWORD

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IEC TS 60695-11-40 has been prepared by IEC technical committee 89: Fire hazard testing. It is a Technical Specification.

It has the status of a basic safety publication in accordance with IEC Guide 104 and ISO/IEC Guide 51.

The text of this Technical Specification is based on the following documents:

DTS	Report on voting
89/1498/DTS	89/1512/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

This second edition cancels and replaces the first edition published in 2002. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) former Clause 4 split into updated/rearranged new Clause 4 and Clause 5;
b) Table 1 updated and moved to new Clause 4;
c) former Clause 5 transformed to Clause 6;
d) former Clause 6 transformed to Clause 7;
e) former Clause7, Clause 8 and Clause 9 combined into an updated/rearranged new Annex A; and
f) all figures were updated.

This Technical Specification is to be used in conjunction with IEC 60695-11-2, IEC 60695-11-3, IEC 60695-11-4 and IEC 60695-11-5.

A list of all the parts in the IEC 60695 series, under the general title *Fire hazard testing*, can be found on the IEC website.

Part 11 consists of the following parts:

Part 11-2: Test flames – 1 kW nominal pre-mixed flame – Apparatus, confirmatory test arrangement and guidance

Part 11-3: Test flames – 500 W flames – Apparatus and confirmational test methods

Part 11-4: Test flames – 50 W flame – Apparatus and confirmational test method

Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance

Part 11-10: Test flames – 50 W horizontal and vertical flame test methods

Part 11-11: Test flames – Determination of the characteristic heat flux for ignition from a non-contacting flame source

Part 11-20: Test flames – 500 W flame test methods

Part 11-30: Test flames – History and development from 1979 to 1999

Part 11-40: Test flames – Confirmatory tests – Guidance

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

Standard flames are specified for various small-scale fire tests. Apparatus design and test parameters are specified in an effort to ensure consistent and defined flames. Burner designs, material specifications and fuel and air specifications are typical necessary parameters. Experience has shown that the quality of the flames and the resulting test measurements are influenced significantly by subtle variations in the equipment and test technique. Simple checks on flame qualities, such as flame colour and dimensions, or the melting characteristics of silver wire, are also sometimes specified or recommended.

The need for a relatively simple check on the power of a flame has been recognized, leading to the introduction of confirmatory tests based on copper block calorimetry. This document is intended to provide information and guidance about small-scale standard flames and the various copper block confirmatory tests.

FIRE HAZARD TESTING –

Part 11-40: Test flames – Confirmatory tests – Guidance

1 Scope

This part of IEC 60695, which is a Technical Specification, presents a general characterization of small-scale test flames and associated confirmatory tests based on copper block calorimetry. Guidance is presented for the selection of critical parameters in confirmatory test designs.

NOTE A theory of thermal dynamics presents, in Annex A, additional performance parameters for confirmatory tests, enabling a precise implicit mathematical characterization of confirmatory test heating curves.

This basic safety publication is intended for use by technical committee in the preparation of safety publications in accordance with the principles laid down in IEC Guide 104 and ISO/IEC Guide 51.

One of the responsibilities of a technical committee is, wherever applicable, to make use of basic safety publications in the preparation of its publications. The requirements, test methods or test conditions of this basic safety publication will not apply unless specifically referred to or included in the relevant publications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60695-4:2012, *Fire hazard testing – Part 4: Terminology concerning fire tests for electrotechnical products*

IEC 60695-11-2, *Fire hazard testing – Part 11-2: Test flames – 1 kW pre-mixed flame – Apparatus, confirmatory test arrangement and guidance*

IEC 60695-11-3, *Fire hazard testing – Part 11-3: Test flames – 500 W flames – Apparatus and confirmational test methods*

IEC 60695-11-4, *Fire hazard testing – Part 11-4: Test flames – 50 W flame – Apparatus and confirmational test method*

IEC 60695-11-5, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC Guide 104, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*

ISO 13943:2017, *Fire safety – Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60695-4 and ISO 13943 (some of which are reproduced below), and the following, apply.

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
confirmatory test
calorimetric procedure intended as a diagnostic indicator to reveal anomalous behaviour or conditions in a test flame, burner or associated hardware

[SOURCE: IEC 60695-4:2012, 3.2.4]

3.2
draught-free environment
space in which the results of experiments are not significantly affected by the local air speed

Note 1 to entry: A qualitative example is a space in which a wax candle flame remains essentially undisturbed. Quantitative examples are small-scale fire tests in which a maximum air speed of 0,1 $m.s^{-1}$ or 0,2 $m.s^{-1}$ is sometimes specified.

[SOURCE: ISO 13943:2017, 3.83]

3.3
diffusion flame
flame in which combustion occurs in a zone where the fuel and the oxidizing agent mix, having been initially separate

Note 1 to entry: Compare with the term pre-mixed flame (3.5).

[SOURCE: ISO 13943:2017, 3.82]

3.4
flame stabilizer
assembly normally fitted to the top of a standard laboratory Bunsen or Tirrill burner intended to mitigate the destabilizing effect of the turbulent mixing of flame gases with the ambient air, by providing an intervening layer of gas having an intermediate velocity between the ambient still air and the faster flame gases

[SOURCE: ISO 13943:2017, 3.173]

3.5
pre-mixed flame
flame in which combustion occurs in an intimate mixture of fuel and oxidizing agent

Note 1 to entry: Compare with the term diffusion flame (3.3).

[SOURCE: ISO 13943:2017, 3.307]

3.6
small-scale fire test
fire test performed on a test specimen of small dimensions

Note 1 to entry: There is no clear upper limit for the dimensions of the test specimen in a small-scale fire test. In some instances, a fire test performed on a test specimen with a maximum dimension of less than 1 m is called a small-scale fire test. However, a fire test performed on a test specimen of which the maximum dimension is between 0,5 m and 1,0 m is often called a medium-scale fire test.

[SOURCE: ISO 13943:2017, 3.346]

3.7
Venturi effect
reduction in pressure as a result of the increase in velocity of a fluid when it passes through a constriction in a pipe

4 Test flames

4.1 General

Flames consist of chemically exothermic reacting gaseous mixtures of oxidizer (typically oxygen or air mixture) and reducer or fuel (typically fuel gas or vapour). For standardized test flames, suitable hardware with supplies of combustible materials (i.e. fuel gas) delivers a continuous flow of the needed gaseous reactants to maintain the desired standardized flame. There are two types of test flames, as follows.

4.2 Diffusion flames

Diffusion flames are produced by a simple flow of fuel gases that combust at the point of mixing with air at the exit orifice of the hardware (e.g. the outlet of the burner tube). The advantages of diffusion flames are the simplicity of the hardware (often a simple tube), and the better simulation of actual flames likely to be encountered in equipment. The disadvantage is that they are geometrically less stable.

4.3 Pre-mixed flames

Pre-mixed flames are produced by mixing a part of the combustion air with the fuel gas prior to the combustion point at the outlet of the burner tube. The remaining part of the combustion air is provided in a similar way as with diffusion flames. The resulting flame has an inner/lower cone that is typically a lighter blue colour consisting of the pre-mixed gas and air mixture with excess fuel gas, and an outer/upper cone that is typically a very faint darker blue colour where the remaining needed additional air diffuses into this upper portion of the flame. The inner/lower cone is at a much lower temperature and is chemically reducing, while the outer/upper part of the flame is much hotter and more oxidizing.

Pre-mixed gases enter the stabilized flame at the upper end of the burner tube. Pre-mixed flames have the advantage of higher efficiency and higher flame temperature, and allow the metering of combustion air as well as fuel gas, but require much more complex hardware than used to produce diffusion flames. The combustion air in pre-mixed burners can be either directly metered or provided through an adjustable open shutter assembly using the Venturi effect.

4.4 Standardized test flames

Table 1 lists the standard test flames described in the IEC 60695 standard series.

Table 1 – Standardized test flames with confirmatory tests

IEC 60695 part No.	Nominal flame power	Flame type[a]	Gas purity	Typical overall flame height	Typical flame cone height	Copper block mass	Copper block height above burner	Time for copper block to increase in temperature from 100 °C to 700 °C
	W		%	mm	mm	g	mm	s
11-2	1 000	P,pre	≥ 95	178 ± 30	62 ± 16	10 ± 0,05	95 ± 1	46 ± 6
11-3 Method A	500	M, pre	≥ 98	approx. 125	approx. 40	10 ± 0,05	55 ± 1	54 ± 2
11-3 Method C	500	M or P, pre	≥ 98	approx. 125	approx. 40	10 ± 0,05	55 ± 1	54 ± 2
11-4	50	M, pre	≥ 98	20 ± 2	-	1,76 ± 0,01	10 ± 1	44 ± 2
11-5	[b]	P or B, dif	≥ 95	12 ± 1	-	0,58 ± 0,01	6,0 ± 0,5	23,5 ± 1,0

[a] M = methane, P = propane, B = butane, dif = diffusion, pre = pre-mixed.

[b] Assessments of the power of the needle flame vary. With butane, values of 49,75 W and 37,8 W have been calculated; with propane, a value of 40,4 W has been calculated.

4.5 Critical parameters

The most important parameters to be specified for the production of a standard flame are the design of the burner and the fuel gas and air flows.

In order to increase the accuracy of the measurement of fuel gas and air flows, it is recommended that mass flow meters are used.

The size of the flame should be used only for guidance. This is because different individuals have differing sensitivities to visible light, particularly at the blue end of the spectrum. Flame height is therefore a subjective judgement.

The confirmatory test is used to check that nothing is fundamentally incorrect with the apparatus and set-up – see 7.5.

5 Burners and fuel gases

5.1 Diffusion flame burners

A diffusion flame burner usually consists of a burner tube (e.g. a straight metal tube with a round cross-section) and a gas flow control valve. IEC 60695-11-5 specifies a diffusion flame burner.

5.2 Pre-mixed burners

5.2.1 Metered air pre-mixed burners

The design of pre-mixed burners provides for the control of both air and fuel gas. Both can be introduced through specified orifices with specified flow rates and back pressures. Normally, an extra manifold assembly is used for the metered air and the restrictive fuel gas orifice is still necessary to produce a high gas stream flow rate for proper mixing. Having both metered air as well as fuel gas will provide much better control of the resulting standardized flames. Mass flow meter are recommended to control air and the fuel gas.

5.2.2 Venturi air pre-mixed burners

In the traditional designs of Venturi air premixed burners, for example Bunsen and Tirrill type burners, air is drawn through an adjustable shutter using the Venturi effect of a high-speed fuel gas stream from a restrictive orifice. The orifice may be either fixed or adjustable using a tapered needle. Gas flow rate, back pressure and air shutter adjustments are especially critical. These burners, lacking the air manifold, have fewer parts and are generally simpler and less bulky in design than the metered air designs.

They are easier to operate and, in the case of adjustable orifices, allow the same hardware to be used to produce a range of flame sizes, although the flames are less consistent and not as suitable for test purposes.

5.3 Flame stabilizer

Flame stabilizer assemblies are sometimes added around the exit orifice to enhance flame stability and prevent the flame from leaving the top of the burner by providing a layer of pre-mixed gases with a reduced velocity interfaced between the main high velocity central flow and the surrounding still air, thus moderating the velocity gradient between the main central flow and the still air.

5.4 Fuel gases

A single chemical compound such as methane, propane or butane, of a purity not less than 95 % is frequently specified, although equivalently performing mixtures may also be suitable. A laboratory grade of as high a purity as is practicably possible should be specified.

6 Confirmatory test hardware

6.1 General

Copper block calorimetry measurements use a standard configuration of a copper block placed in the test flame, and the time for a specified temperature rise is recorded as an indication of the rate of heat delivered to the copper block.

6.2 Copper blocks

6.2.1 Material

The copper block material (electroplated tough pitch copper) is identified as Cu-ETP UNS C11000. This electrical grade copper has been found to possess the following essential characteristics:

a) it has a melting point well above the maximum anticipated test temperatures;

b) it has a high thermal diffusivity;

c) it is a well-defined chemical substance and is a high quality grade that is readily available; and

d) it is suitable for machining.

Annex A gives information on copper block calorimetry dynamics and theory.

NOTE ASTM B187 gives details of Cu-ETP UNS C11000 and gives information on chemical an physical properties of copper.

6.2.2 Mass

The heating time depends on the power of the flame and on the mass of the copper block. The copper mass therefore should be chosen as the main parameter for determining a suitable heating time.

6.2.3 Geometry

The copper block geometry shall be as simple as possible and easily defined and suitable for practical production. The size and shape of the copper block shall be designed to provide minimum disturbance to the flame and shall be completely enveloped within the critical flame areas.

6.3 Thermocouple

The thermocouple shall be suitable for operation up to the maximum anticipated temperature. It shall be small enough so as not to influence the heat capacity of the copper block and it shall be rugged enough so that the copper block can be suspended from it. Also, the thermocouple shall be able to withstand the extra high temperatures encountered just above the copper block in the top area of the flame during the test. The thermocouple junction shall be at a specified central position and depth within the copper block by inserting it in a drilled hole. Because of likely problems associated with other methods of attachment, it is recommended that the thermocouple wire be secured to the copper block by peening the copper block material around the thermocouple, taking care to prevent damage.

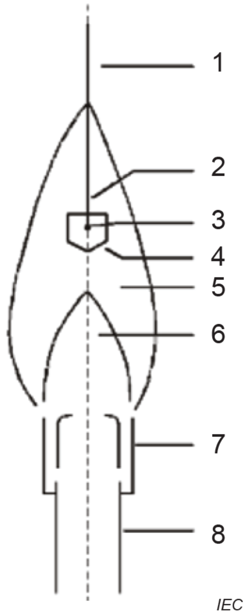
7 Confirmatory test procedure

7.1 General

Flames shall be adjusted and tested in a draught-free environment. The copper block is positioned in the flame and the time required for the copper block temperature to increase over a specified range is noted.

7.2 Copper block positioning

It is recommended that the copper block be suspended by the thermocouple wire and positioned at the start of the test centrally within the flame envelope at a defined distance above the burner hardware, and completely enveloped within the critical part of the flame. For pre-mixed flames of circular cross-section, the optimal position is usually just above the inner cone and completely within the outer cone. Linear flames will require special positioning to ensure complete contact of the probe with the critical part of the flame (see Figure 1).



Key

1	Supporting thermocouple wire
2	Wire fixed to block by peening
3	Thermocouple junction
4	Copper block
5	Upper flame, hot oxidizing
6	Lower flame, cooler, reducing
7	Flame stabilizer assembly
8	Pre-mixed burner barrel

Figure 1 – Positioning of the copper block

7.3 Test temperature ranges

The copper block gains heat by a combination of convection and conduction and loses heat through thermal radiation; see Clause A.1. The radiation effect is proportional to the fourth power of the absolute copper block temperature and is largely dependent on the copper block surface emissivity. To eliminate the variability from surface changes in emissivity, it is recommended that the maximum test temperature be limited to levels where radiation is minimal, yet high enough to have a sufficient range for suitable test times. A range of 100 °C to 700 °C has been found to be suitable.

IEC 60695-11-2, IEC 60695-11-3, IEC 60695-11-4 and IEC 60695-11-5 specify the measurement of time for temperature increase from 100 °C to 700 °C (see Table 1).

7.4 Test time ranges

The range of test times shall be reasonable for meaningful recording. The range shall be selected by the choice of the copper block mass and maximum test temperature. It is recommended that the test time be within the range of 30 s to 90 s, wherever possible.

7.5 Purpose of the confirmatory test

The purpose of a copper block confirmatory test is to check that nothing is fundamentally incorrect with the apparatus and set-up.

If the requirement of the confirmatory test is not met then, as a minimum, the following shall be checked:

a) Has the correct burner been selected?
b) Does the burner design conform to the specified design?
c) Has the correct fuel gas been selected?
d) Have the gas and air flows been correctly calibrated?
e) Has the correct copper block been selected?
f) Has the correct time interval been measured?
g) Is the thermocouple giving reliable readings?

Annex A
(informative)

Copper block calorimetry dynamics and theory

A.1 Fundamentals of thermal dynamics of copper block

The effectiveness of a test flame is directly related to the ability to deliver heat to the test specimen. Copper block calorimetry tests use a standard configuration of a mass placed in the test flame, and the time/heating characteristics are recorded as an indication of the rate of heat delivered to the test copper block. The measured rate of temperature increase is directly proportional to the rate of increase of the copper block net heat content and inversely proportional to the copper block heat capacity. The rate of change in the copper block net heat content is the result of convective, conductive and radiative effects. Convective and conductive increases in heat are both directly proportional to the difference between the flame and copper block temperatures, while the radiative loss is proportional to the fourth power of the copper block absolute temperature. The combination of these factors results in the following differential equation governing the absolute temperature (T) as a function of time (t):

$$dT/dt = \mathrm{A} - \mathrm{B}\,t - \mathrm{C}\,t^4 \qquad \text{(A.1)}$$

where A, B and C are characteristic constants. If A, B, C and the initial starting temperature (T_0) are known or assumed, then solutions of the equation can be determined to arbitrary precision using a numerical method such as the Runge-Kutta method.

Table A.1 lists data for the nominal 500 W methane flame having an overall height of 125 mm with a 40 mm inner blue cone.

Table A.1 – Typical data for a nominal 500 W methane flame

Time, t s	Temperature, T °C	Time, t s	Temperature, T °C	Time, t s	Temperature, T °C
0	33,20	20	305,55	100	878,30
1	50,75	25	364,30	105	891,25
2	66,40	30	419,80	110	904,80
3	79,20	35	472,20	115	916,40
4	94,30	40	521,35	120	928,65
5	108,50	45	566,85	125	939,15
6	123,00	50	610,60	130	948,75
7	137,65	55	649,90	135	957,90
8	151,70	60	687,35	140	965,80
9	164,90	65	719,85	145	973,65
10	178,50	70	750,75	150	980,85
11	191,75	75	777,55	155	986,25
12	204,75	80	801,65	160	990,30
13	218,20	85	824,00	165	994,15
14	230,95	90	843,70	170	997,30
15	243,85	95	862,30	175	998,10
				180	1 000,80

A.2 Calculation method for obtaining parameters A, B and C

The initial temperature T_0 is especially critical to the solution. Data are therefore sampled more frequently during the first 15 s of the test. It has been noted through experience, and is expected from theoretical considerations, that the test characteristic over limited intervals at lower temperatures should very closely follow the parabolic form as defined by Equation (A.2).

$$T(t) = \mathrm{k}_0 + \mathrm{k}_1\, t - \mathrm{k}2\, t^2 \qquad \text{(A.2)}$$

where $T(t)$ is the temperature which is a parabolic function of the time t in seconds, and k_0, k_1 and k_2 are parameters to be obtained from the measurement results.

For the above data in Table A.1, constants k_0, k_1 and k_2 are found using second order polynomial regression to determine the best parabolic fit to the first 15 s of data as

$$T\,/\,°\mathrm{C} = (34{,}57 + 15{,}34\, t\, \mathrm{s}^{-1} - 0{,}093\,84\, t^2\, \mathrm{s}^{-2})\,/\,°\mathrm{C} \qquad (R^2 = 0{,}999\,91) \qquad \text{(A.3)}$$

k_0 is therefore determined as 34,57 °C. The closeness of the parabolic fit over the first 15 s is illustrated by the R^2 value of 0,999 91 and by the figures in column 3 of Table A.2.

Table A.2 – Parabolic fit to initial data

Time, t s	Temperature, T °C	Parabolic fit for T °C
0	33,20	34,57
1	50,75	49,82
2	66,40	64,88
3	79,20	79,74
4	94,30	94,43
5	108,50	108,93
6	123,00	123,33
7	137,65	137,35
8	151,70	151,29
9	164,90	165,03
10	178,50	178,59
11	191,75	191,96
12	204,75	205,14
13	218,20	218,13
14	230,95	230,94
15	243,85	243,56

Determining the best fit constants for A, B and C is a more formidable task, but a fair first approximation can easily be found by noting the temperatures and approximate slopes near the start, mid-point and toward the end of the heating curve. Substituting these in the differential equation to get a system of three linear equations, and solving these using a method such as Gauss-Jordan elimination should be followed.

For any approximation for A, B and C, a heating characteristic can be developed from the precisely determined T_0 using the Runge-Kutta method, and the RMS error to the actual test data can be computed. Starting with the initial Gauss-Jordan approximation of A, B and C, successively tighter three-dimensional computer grid searches can then be conducted on A, B and C to determine better values, thus minimizing the resulting RMS errors to ultimately determine the best fit. Absolute temperatures should be used in order to solve the differential equation.

Analysis of the data given in Table A.1 gives the following values for A, B and C.

A = 18,68 (K × s^{-1})

B = 0,01103 (s^{-1})

C = 1,555 10^{-12} (K^{-3} × s^{-1})

Table A.3 lists calculated temperature versus time data and also shows the experimental data. The maximum deviation is less than 6 K and the RMS deviation is only 2,7 K.

The resulting characteristic asymptote is the ultimate copper block temperature, obtained by finding T when dT/dt = 0. In this case it is 1 295,9 K (1 022,8 °C).

A higher temperature versus time curve is obtained if the C T^4 term is ignored, i.e. eliminating the effect of radiative cooling. The upper dashed line in Figure A.1 is the resulting asymptote with the value of A / B = 1 693,6 K (1 420,4 °C), which is the effective flame temperature.

Figure A.1 shows both curves.

For a given heating curve, once parameters A, B and C are known, a characteristic time, t^*, can be obtained where t^* is the time taken for the copper block to rise in temperature from 100 °C to 700 °C. From the data in Table A.1, t(100 °C) = 4,33 s and t(700 °C) = 62,64 s, so t^* = 58,3 s.

However, data below 800 °C conform very closely to a parabolic form. In fact a parabolic function gives a significantly better fit to the <800 °C experimental data than does the fit to Equation (A.1) based on all the data.

In the case of the data in Table A.1, this results in the following equation:

$$T\ /\ °C = (35{,}89 + 145{,}743\ t\ s^{-1} - 0{,}06484\ t^2\ s^{-2})\ /\ °C \qquad (R^2 = 0{,}99991) \qquad \text{(A.4)}$$

The RMS error is 1,01 K for the Equation (A.4) fit compared with 3,08 K for the Equation (A.1) fit (see Figure A.2).

Therefore, a better and simpler method of obtaining a reliable value for t^* is to obtain a parabolic best fit to the data up to 800 °C and from this to obtain t^*.

From Equation (A.4), t(100 °C) = 4,43 s and t(700 °C) = 61,89 s, so t^* = 57,46 s.

Table A.3 – Calculated best fit data

Time, t s	Temperature, T °C	Equation (A.1) fit for T °C
0	33,20	34,57
5	108,50	108,82
10	178,50	178,96
15	243,85	245,15
20	305,55	307,51
25	364,30	366,17
30	419,80	421,23
35	472,20	472,80
40	521,35	520,97
45	566,85	565,86
50	610,60	607,56
55	649,90	646,20
60	687,35	681,89
65	719,85	714,76
70	750,75	744,96
75	777,55	772,61
80	801,65	797,86
85	824,00	820,87
90	843,70	841,77
95	862,30	860,72
100	878,30	877,85
105	891,25	893,32
110	904,80	907,26
115	916,40	919,78
120	928,65	931,03
125	939,15	941,12
130	948,75	950,14
135	957,90	958,22
140	965,80	965,41
145	973,65	971,85
150	980,85	977,60
155	986,25	982,69
160	990,30	987,26
165	994,15	991,28
170	997,30	994,86
175	998,10	998,10
180	1 000,80	1 000,95