NATO INTERNATIONAL STAFF - DEFENCE INVESTMENT DIVISION

ALLIED
FIRE
ASSESSMENT
PUBLICATION

AFAP-4
(Edition 3)

NATO REACTION-TO-FIRE TESTS FOR MATERIALS

SURFACE SPREAD OF FLAME

AFAP - 4
(Edition 3)

JULY 2010

1157-10/3

AFAP-4

NATO REACTION-TO-FIRE TESTS FOR MATERIALS

SURFACE SPREAD OF FLAME

AFAP-4
(Edition 3)

JULY 2010

Page blank

NORTH ATLANTIC TREATY ORGANIZATION

NATO STANDARDISATION AGENCY (NSA)

NATO LETTER OF PROMULGATION

30 July 2010

1. AFAP-4(Edition 3) – NATO REACTION-TO-FIRE TESTS FOR MATERIALS - SURFACE SPREAD OF FLAME is a non classified NATO publication. The agreement of interested nations to use this publication is recorded in STANAG 4602.

2. AFAP-4(Edition 3) is effective on receipt. It supersedes AFAP-4(Edition 2) which shall be destroyed in accordance with the local procedure for the destruction of documents.

3. It is permissible to distribute copies of this publication to Contractors and Suppliers and such distribution is encouraged.

Cihangir AKSIT, TUR Civ
Director, NATO Standardization Agency

Page blank

Record of Changes

Change Date	Date Entered	Effective Date	By Whom Entered

Table of contents

Preface

1. This Allied Publication forms part of a series as follows:

   AFAP-1 NATO reaction-to-fire tests for materials - POLICY FOR THE PRE-SELECTION OF MATERIALS FOR MILITARY APPLICATIONS.

   AFAP-2 NATO reaction-to-fire tests for materials - SMOKE GENERATION

   AFAP-3 NATO reaction-to-fire tests for materials - TOXICITY OF FIRE EFFLUENTS

   AFAP-4 NATO reaction-to-fire tests for materials - SURFACE SPREAD OF FLAME

   AFAP-5 NATO reaction-to-fire tests for materials - HEAT RELEASE RATE

2. The contribution to fire hazard from a particular material, depends on a number of interrelated factors. It is not only influenced by the reaction-to-fire properties of the material, but also by the way in which the material is used in practice and by the fire scenario to which it is exposed. These Allied Publications define methods for the assessment of reaction-to-fire properties of materials, valid under the specific conditions of each test. They provide comparisons between candidate materials, but do not predict the behaviour of the materials, or combinations of materials, in actual fire conditions. Together, they are intended to be used as part of the comparative screening process for the pre-selection of materials on the basis of their fire characteristics.

3. Any enquiries regarding this Allied Publication in relation to an invitation to tender or a contract in which it is incorporated are to be addressed to the Technical Authority.

NATO REACTION-TO-FIRE TESTS FOR MATERIALS

SURFACE SPREAD OF FLAME

Warning

This Allied Publication may call for the use of substances and/or procedures that may be injurious to health or damaging to the environment if adequate precautions are not taken. Test operators shall be responsible for implementation of such precautions, in order to ensure the safe operation of the test. The text of this Allied Publication refers only to technical requirements and in no way absolves the user from statutory or other legal obligations relating to health and safety and environmental legislation. Full account shall be taken of further health and safety advice/warnings that appear in the normative references and equipment manuals. Where attention is drawn to particular hazards, those quoted may not be exhaustive.

1. SCOPE

This Allied Publication defines a method for the determination of surface spread of flame of a material. The procedure is an implementation of ISO 5658-2: 2006 for the measurement of surface spread of flame and of IMO FTP Code Part 5 for heat release measurements. These are supplemented to include detailed requirements for specimen preparation for particular types of material, additional details for test and calibration procedures to enhance repeatability/ reproducibility and requirements for data presentation.

2. NORMATIVE REFERENCES

2.1. The following documents are referred to in this Allied Publication:

ISO 291 Plastics - Standard atmospheres for conditioning and testing: 1997. Incorporating Corrigendum 1: 1998;

ISO 1514 Paints and varnishes - Standard panels for testing: 2004;

ISO 5658-2 Reaction to fire tests - Spread of flame - Part 2: Lateral spread on building and transport products in vertical configuration: 2006;

IMO International Code for Application of Fire Test Procedures: 1998; Part 5 Test for surface flammability for surface materials and primary deck coverings;

STANAG 4602 Fire Assessment of Materials. 2004.

2.2. This Allied Publication has been prepared with reference to the particular versions of the standards specified above, which were current at the time of publication. From time to time, all standards are subject to revision and NATO will keep this prospect under review. Not withstanding this fact, the versions of the standards specified above shall continue to be used, without amendment, until such time as NATO specifies the use of any amendments or revisions published by the relevant standards organisations.

2.3. National and international standards are available from the relevant national standards body for each nation or from ISO. NATO STANAGs and Allied Publications can be obtained from the NATO STANAG point of contact for each nation.

3. DEFINITIONS

3.1 Technical Authority

The relevant national authority, responsible for providing regulations and guidance on fire reaction of materials associated with procurement and in service support.

4. PRINCIPLE OF THE TEST

The procedure uses the test detailed in ISO 5658-2 to evaluate surface spread of flame characteristics of specimens exposed to a graded radiant heat flux field. In addition heat release rate measurements are made in accordance with IMO FTP Code Part 5. Data on critical heat flux at extinguishment and average heat for sustained burning are derived from observations of time to ignition, spread and extinguishment of flame along the length of the specimen. Data on total heat release and peak heat release rate are derived from measurement of temperature increase in the exhaust fume stack. Data on total heat release and peak heat release rate are derived from measurements of temperature increase in the exhaust fume stack.

5. GENERAL

5.1 Conduct of tests

The tests shall be carried out in accordance with ISO 5658-2 supplemented and amended by the provisions of this Allied Publication. Where the provisions of ISO 5658-2 conflict with the provisions of this Allied Publication, the provisions of this Allied Publication shall be applied. Where no information is given in this Allied Publication all of the provisions of ISO 5658-2 shall be applied.

5.2 Additional information

Only the information that is additional to ISO 5658-2 is included in this document. All remaining information appears in ISO 5658-2 and in order to carry out the test specified by this Allied Publication it must be read in conjunction with ISO 5658-2.

5.3 Heat release rate measurement

In addition to data on surface spread of flame, heat release data shall be measured and recorded by using the apparatus and procedures specified in IMO Resolution MSC.61(67) Parts 5 & 6. Where the provisions of this IMO resolution conflict with the provisions this Allied Publication or of ISO 5658-2, the provisions of this Allied Publication or ISO 5658-2 shall be applied in accordance with Section 5.1 above.

6. TEST SPECIMENS *(ISO 5658-2 Sect 6)*

6.1 Number of test specimens *(ISO 5658-2 Section 6.2)*

Obtain test data for three valid replicate specimens for each material. Unless otherwise agreed by the Technical Authority at least six specimens shall be supplied for test. Record the weight and dimensions of each test specimen in the test report.

6.2 Test specimen thickness (ISO 5658-2 Section 6.2.4)

Materials of thickness 40 mm or less shall be tested using their full thickness. For materials of normal thickness greater than 40 mm, the unexposed face shall be cut away to reduce the thickness to 40 mm. The original thickness and reduction of thickness shall be recorded in the test report.

The extension clip described in ISO 5658-2 Section 6.2.4 shall not be used.

6.3 Form of test specimens

The test specimen form shall be determined in accordance with ISO 5658-2, with reference to Annexes 1 & 2 of this Allied Publication.

6.4 Asymmetrical products

In the case where materials submitted for evaluation have faces which differ or contain laminations of different materials arranged in a different order in relation to the two faces, the Technical Authority shall determine whether either or both faces of the materials are required to be tested. The test results shall only be valid for the particular face tested.

6.5 Conditioning

Condition the test specimens to constant mass as described in ISO 5658-2 Section 6.4, except using the conditions (23 ± 2) °C, (50 ± 10) %R.H. (See ISO 291: 1997)

6.6 Small samples of material

When the material to be tested is usually supplied in pieces with dimensions smaller than those required to make specimens (e.g. tiles), if possible, obtain the same material with larger lateral dimensions (e.g. in sheet form) and prepare each test specimen as a single piece with no join. Ensure that other characteristics of the larger form (e.g. colour, composition, thickness, etc) are exactly the same.

However, if the material is not available with larger dimensions it is permissible, for the purposes of this Allied Publication, to construct test specimens from two or more pieces joined together. Where this is necessary, the Technical Authority shall determine the position and nature of the joint(s), taking account of the following:

The construction of joint(s) (i.e. whether simply butted, bonded with an adhesive or held by mechanical interlock or other fixing method), their position with respect to the radiant panel

(which affects the heat flux received) and orientation (horizontal, vertical, etc) influence the ease with which flame spreads across the joint(s). These aspects shall be standardised when testing for the purpose of comparing two or more different materials.

Construct the specimen using the smallest number of pieces possible. Position the joint(s) vertically, wherever practical. Construct the specimen by placing full size (or largest practicable) pieces into the specimen holder starting from the position that will be closest to the radiant panel (hot end) and fill the remaining area with the largest possible cut pieces.

7. ADDITIONAL EQUIPMENT AND INSTRUMENTATION *(ISO 5658-2 Sect 9)*

7.1 Heat flux meter (ISO 5658-2 SECT 9.1 & ANNEX C)

7.1.1 Calibration of the working heat flux meter

Calibration of the working heat flux meter used in the setting-up and calibration procedure (ISO 5658-2 Section 10.1) shall be traceable by no more than 4 steps, to the primary standard maintained by LNE - France or SP - Sweden (see below). Details of how to obtain such a calibration may be obtained from the Technical Authority.

Note: Technical enquiries, on this subject, may also be directed to:

LNE Laboratoire National de Metrologie et d'Essais
Centre for Metrology and Instrumentation
Division for Optical Radiation Metrology
and Thermal Properties of Materials
29, Avenue Roger Hennequin
78197 Trappes Cedex
France
Tel : +33 1 30 69 10 00
Fax : +33 1 30 69 12 34
e-mail: info@lne.fr

SP Technical Research Institute of Sweden
Fire Technology
Box 857
SE-501 15 Boras
Sweden
Tel.: + 46 (0)10 516 50 00
Fax : + 46 33 13 55 02
e-mail: info@sp.se

7.1.2 Transfer calibrations

Transfer calibrations shall be made using the radiant panel of an ISO 5658-2 flame spread apparatus, according to the procedures described in Annex 3 of this Allied Publication. (Steps 2 and 3 in Figure 1 of Annex 3).

8. SETTING-UP AND CALIBRATION PROCEDURE *(ISO 5658-2 Sect 10)*

Set-up and calibrate the apparatus in accordance with ISO 5658-2 Section 10 and IMO FTP Code Part 5.

9. TEST PROCEDURE *(ISO 5658-2 Sect 11)*

Carry out the test procedure in accordance with ISO 5658-2 Section 11 and IMO FTP Code Part 5 supplemented and amended by the provisions of this Allied Publication as follows:

9.1 Procedure

Three valid replicate tests shall be performed for each face required to be tested (see Section 6 of this Allied Publication).

9.2 Duration of test (ISO 5658-2 Sect 11.8)

Terminate the test in accordance with ISO 5658-2 Section 11.8. In addition, if the test is still in progress, then terminate the test after 40 minutes from the start of exposure of the specimen.

9.3 Repeat tests (ISO 5658-2 Sect 11.11 & 11.12)

In the case where tests are rejected for the reasons given in ISO 5658-2 Section 11.11 or 11.12, all available data for these test specimens shall be reported together with the reason(s) for rejection of the test.

10. EXPRESSION OF FIRE PERFORMANCE *(ISO 5658-2 Sect 11/12 & IMO FTP Code Part 5)*

10.1 Test data (ISO 5658-2 Sect 11)

During the test the following data are recorded, for each specimen:

- time to ignition (minutes, seconds)
- time of the arrival of the flame front at each 50 mm station (minutes, seconds)
- time (minutes, seconds) and position (mm) along the centreline of the specimen at which flaming ceases to advance
- duration of test (minutes, seconds)
- observations of the burning behaviour of the specimen in accordance with ISO 5658-2 Section 11.13

10.2 Derived fire characteristics - flame spread

For each specimen tested, from the observations of the movement of the flame front calculate the following parameters:

- **Heat for sustained burning (MJ/m^2),** at each position - *(ISO 5658-2 Sect 3.9)*

The product of time from the start of exposure of a specimen to the arrival of the flame front at a specified position and the incident heat flux corresponding to that position measured on a non-combustible calibration board

- **Heat for ignition (MJ/m²)** - *(IMO FTP Code Part 5)*

The product of time from the start of exposure of a specimen to the arrival of the flame front at the 150 mm position and the incident heat flux corresponding to that position measured on a non-combustible calibration board.

- **Average heat for sustained burning Q_{sb} (MJ/m^2)** - *(ISO 5658-2 Sect 3.2 & 3.9)*

The average of the values of heat for sustained burning measured at 50 mm intervals, the first at 150 mm and then at each subsequent position up to and including the 400 mm position (or the final position if the test is terminated before the 400 mm position is reached).

- **Critical heat flux at extinguishment, CFE (kW/m^2)** - *(ISO 5658-2 Sect 3.5)*

The incident heat flux at the surface of a specimen at the point along its horizontal centreline where the flame ceases to advance and may subsequently go out. The heat flux value reported is based on interpolations of measurements with a non-combustible calibration board.

10.3 Derived fire characteristics - heat release *(IMO FTP Code Part 5)*

Calculate the following parameters, for each specimen tested;

- **Graph of Heat Release Rate, Q (kW) against Time (seconds)**

Graph converted from the stack thermocouple output/time data;

- **Peak heat release rate, Q_p (kW)**

The peak heat release rate is the maximum of the heat release rate during test period;

- **Time to maximum heat release rate, t_Q (minutes, seconds)**

The time from the start of the test to reach the peak heat release rate;

- **Total heat release, Q_t (MJ)**

Total heat release, given by integration of the positive part of the heat release rate vs. time curve (as shown in the diagram in IMO FTP Code Part 5). Start the summation at the first positive value after the dip in heat release rate that occurs as the specimen is inserted. End the summation 180 seconds after all flaming ceased or when the heat release values become negative, whichever occurred first.

10.4 Mean fire characteristics parameters

Calculate average values for the three valid test specimens for the following parameters:

Heat for ignition (MJ/m^2)

Average heat for sustained burning, Q_{sb} (MJ/m^2)

Critical heat flux at extinguishment, CFE (kW/m^2)

Peak heat release rate, Q_p (kW)

Total heat release, Q_t (MJ)

If flashing and/or transitory flaming occurs, but no sustained flaming, report no value on Q_{sb} and CFE (see also ISO 5658-2 Section 11.13). If no flashing and flaming occurs, Q_{sb} can be reported as not applicable and CFE > 50.5 kW/m^2.

An average shall only be calculated for specimens that showed sustained flaming. This means that the average can be based on less than three test results.

11. TEST REPORT

The test report shall include a reference to this Allied Publication together with the following information:

Note: Some of the following information may be required by the Technical Authority for the database described in AFAP-1.

a) the name and address of the laboratory undertaking the test;

b) the name and address of the supplier and where different, of the manufacturer (original source) of the material tested;

c) the date(s) of the test;

d) a full description of the material tested including, where applicable and/or known;

name

application

type of material (chemical composition)

type of product (form or shape e.g. sheet or tube etc.)

essential dimensions (including mass or density, sheet size/thickness etc.)

colour (facing colour)

details of any coatings (including substrates, surface preparation techniques, no. of layers, colour, coverage rates, etc.)

specifications

NATO Stock No.s or other Unique Identification No.s

details of any previous tests known

other relevant technical data

e) a full description of the test specimens, including weight, thickness, face tested, the position and nature of any joints in the specimen (see Section 6.6 above) and

where appropriate any substrate or air gap. If the material has been reduced in thickness in accordance with Section 6.2 of this Allied Publication, report both the thickness tested and the original thickness of the material as received;

f) the number of specimens tested;

g) the type of pilot flame used for each specimen;

h) all of the information on the fire performance of the product described in Section 10 of this Allied Publication;

i) observations of the burning behaviour of the specimen, in accordance with ISO 5658-2 Section 11.13

j) all available data from any rejected tests together with the reason(s) for rejection of the test (see Section 9.3 of this Allied Publication);

k) the statement: "These results relate only to the behaviour of the specimens of the material under the particular conditions of test."

Note: The Materials Fire Characteristics Data Sheets from the STANAG 4602 database described in AFAP-1 may, optionally, be used for recording some of the test results. (Copies are shown in Annex 4 of this Allied Publication).

ANNEX 1 - PREPARATION OF TEST SPECIMENS

A – Paint/coating

A.1 Paint/coating test specimens shall consist of mild steel panels[1], of nominal thickness 3 mm, coated on the upper (i.e. exposed) face with the paint system under test.

A.2 The dimensions of the test panels shall be 800 $^{+0}/_{-5}$ mm x 155 $^{+0}/_{-5}$ mm (as specified in ISO 5658-2 Section 6.2.3).

A.3 Prepare the surface of each test panel and apply the paint/coating system to the required thickness, according to the manufacturer's instructions that will be used in the end use application. The method of surface preparation shall be recorded in the test report. The back and edges of the panel shall not be coated.

A.4 In the absence of specific instructions on surface preparation from the manufacturer, the method of surface preparation shall be as specified by the Technical Authority.

Note: Examples of suitable surface preparation techniques can be found in ISO 1514.

A.5 Dry (or heat cure) each coated test panel for the manufacturers specified time under the specified conditions, and then, condition them at (23 ± 2) °C, (50 ± 10) % R.H. for 7 days, with free circulation of air and without exposing them to direct sunlight.

A.6 The surface spread of flame test procedure shall then be carried out within 7 days.

[1] Where the end use application of a paint/coating is on mild steel of less than 3 mm thickness, or on a different non-combustible substrate material, which has lower heat absorption, the smoke generation may be greater and/or more rapid. In such cases the Technical Authority may require that the material is tested on the end use substrate. If paint/coating is applied on a combustible substrate it shall be tested as part of the end use composite.

B – Tubes and pipes

Specimens shall be prepared as required in any relevant material/product specification as directed by the Technical Authority. In the absence of a material/product specification, specimens shall be prepared, without a substrate, as follows;

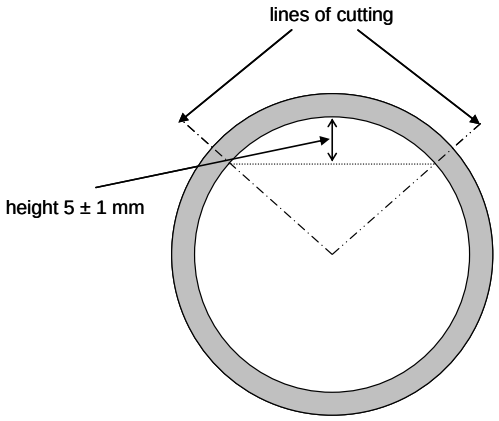
B.1 Flexible materials

If the material is sufficiently flexible, cut the tube or pipe lengthwise into strips and construct flat specimens, 800 $^{+0}/_{-5}$ mm x 155 $^{+0}/_{-5}$ mm.

B.2 Rigid materials

If the material is rigid use the specimen construction described in ISO 5658-2:2006 Annex F Test method for flame spread of plastic piping, supplemented as follows;

The height under the curve shall be $\leq$ 5 mm[1] as shown in the diagram below.



[1] The exception to this is that if the internal diameter is $\leq$ 10 mm the tube/pipe strips shall be cut with a semi-circular cross section.

ANNEX 2 - FORM OF TEST SPECIMENS

Material type	Form of test specimen
INTERIOR PAINT SYSTEMS, WET AND DRY SPACES	Full system including primer(s), undercoat(s) finish(s) etc. as recommended by the manufacturer for initial application. Applied in accordance with Annex 2 of this Allied Publication. Test with the painted face exposed to the radiant panel.
INTERIOR DECK COVERING	End use thickness[1]. Test alone, with the upper face exposed to the radiant panel. No application of adhesive, underlay or substrate.
THERMAL INSULATION (STRUCTURE)	Insulation at end use thickness[1], with glass cloth facing bonded with the adhesive used in manufacture of the final product. Test with the glass cloth side exposed to radiant panel. No application of installation adhesive, vapour barrier coating or substrate, etc.
DECORATIVE LININGS	End use thickness[1]. Test alone, with the outer face exposed to the radiant panel. No application of installation adhesive, coatings, fixings or substrate, etc.
UPHOLSTERY FABRICS	End use thickness[1]. Tested alone, with the outer face exposed to the radiant panel. No application of inter-liner, substrate or other backing/facing.
UPHOLSTERY FOAM (CORE)	End use thickness[1]. Tested alone. No application of covering, backing, substrate etc.
UPHOLSTERY FOAM (BARRIER)	End use thickness[1], tested alone. No application of covering, backing, substrate etc.

[1] Materials with a thickness greater than 40 mm shall be cut to give a specimen thickness of 40 mm as described in Section 6.2 of this Allied Publication.

ANNEX 3 – HEAT FLUX METER CALIBRATIONS

Introduction

Most laboratories operate a procedure for calibration of heat flux meters that requires a transfer method or secondary method of calibration (see figure 1). This is to reduce the cost burden of having all heat flux meters calibrated by a primary method.

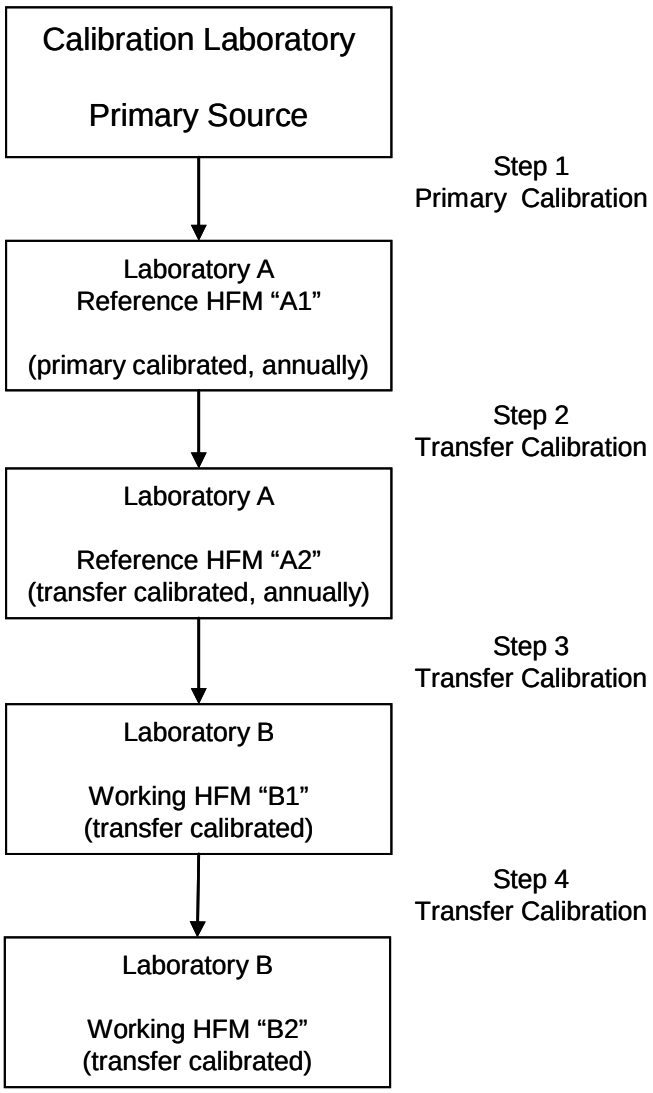


Figure 1. Schematic illustration of possible 4 step calibration scheme.

It is recommended that reference heat flux meters are calibrated against a primary standard at least once every 5 years (Step 1 in Figure 1) and that working heat flux meters should be transfer calibrated and cross-checked against other heat flux meters in a laboratory within a period not exceeding 12 months (Steps 2 and 3 in Figure 1), depending upon their level of usage.

Factors that should be considered when carrying out transfer calibrations include;

- Type of radiation source
- Geometry and uniformity of radiation source
- Temperature of radiation source
- View angle of heat flux meter in relation to the source
- Angular sensitivity of the heat flux meter in relation to the source.

Heat flux meters used to calibrate the radiant panel-specimen configuration in the spread of flame test (AFAP-4) are exposed to incident heat which is comprised of both radiation and convective components. The relative proportion of each component is dependent upon the orientation of the apparatus and the level of incident heat.

Setting up procedure

Mount the calibration specimen in the specimen holder facing the radiant panel as shown in Figure 2. There are eight 25 mm diameter holes cut in the calibration specimen, designed to house a 25 mm diameter heat flux meter.

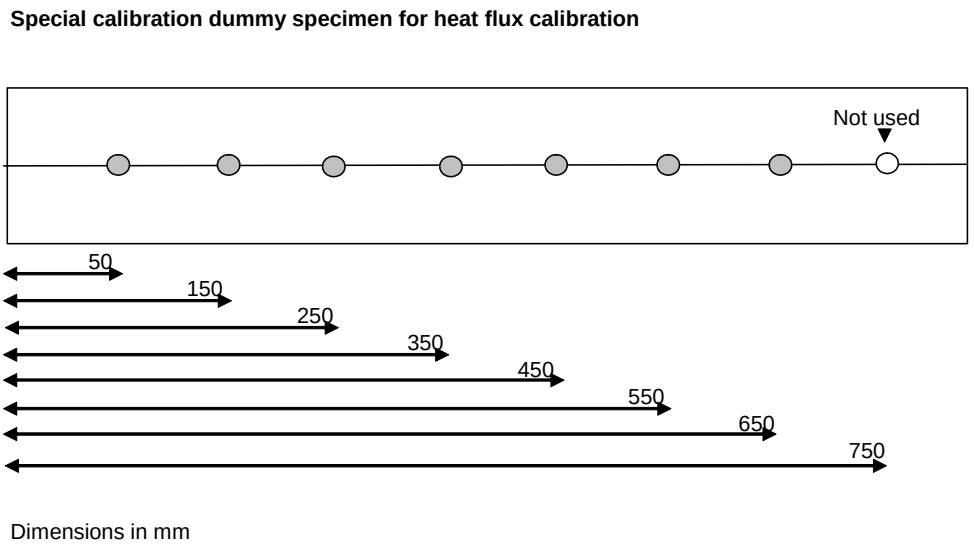


Figure 2. Diagram showing heat flux meter locations.

The heat flux measurement at the lowest level of heat flux is the most unstable. Given that a stable radiation level is required to enable a reliable transfer calibration, the eighth location in the calibration specimen is not to be used.

Insert the primary calibrated heat flux meter into one of the holes in the calibration specimen and ensure that the heat flux meter face is flush with the exposed surface. Mark around the cooling jacket which is protruding from the rear unexposed surface of the calibration specimen. Repeat this for the working heat flux meter. Inserting each heat flux meter up to this mark will ensure that the meter will be flush with the exposed surface during each calibration run.

Attach suitable lengths of plastic tubing securely to the water cooling pipes of each heat flux meter. Water can then be supplied to the water jacket of each heat flux meter by tap or a water tank and pump arrangement. The outlet pipe from the heat flux meter can then be fed into a drain or returned back to the tank in the latter case.

Locate a sheathed thermocouple approximately 20 mm into the entrance of water cooling outlet pipe. Also locate a bare wire thermocouple close to the apparatus, set up to monitor the ambient air temperature.

Connect the output leads from the heat flux meter and thermocouples to a calibrated data logging device or PC, capable of measuring to a resolution of 0.001 mV, using the correct type of cable.

Protect exposed tubing and wires with thermal blanket and aluminium foil.

Procedure for Step 2 calibrations

Insert the primary calibrated heat flux meter into the first hole up to the reference mark described earlier. Turn on the water supply and ensure that the water flow from the outlet pipe is continuous and free from air bubbles.

Start the fume exhaust system and the radiant panel in accordance with the test procedure.

Plug each of the remaining holes with circular discs of non-combustible board, so that they are flush at the exposed surface.

Monitor the output of the primary calibrated heat flux meter and the stack thermocouples on the data logger until the output voltage readings have stabilised. Once in this stabilised condition, record the heat flux meter reading over a period of 5 minutes using a scan interval of less than or equal to 5 seconds.

Then replace the primary calibrated heat flux meter with the working heat flux meter and repeat the above procedure.

In order to calibrate the working heat flux meter over the working range of the spread of flame apparatus, repeat the above procedure for the next six locations, each time ensuring that each vacant hole is plugged with a circular disc of non-combustible board and that the heat flux meter is inserted up to the reference mark described above, so that its surface is flush with the front of the calibration specimen.

Procedure for Steps 3 & 4

For Step 3 & 4 calibrations, the primary calibrated heat flux meter is replaced with the reference heat flux meter (transfer calibrated) and the remainder of the procedure as outlined above should then be followed.

Data presentation and results

Determine the average voltage output for each heat flux meter at each of the different locations in the calibration board, which are equivalent to different thermal exposure conditions. Convert the measured voltage output from the primary calibrated heat flux meter to a heat flux using the appropriate calibration equation. Tabulate the data as shown below in Table 1.

	Calibrated heat flux meter		Heat flux meter to be calibrated		
Distance along specimen holder (mm)	Average voltage (mv)	Average heat flux (kW/m^2)	Average voltage (mv)	Water coolant temperature (Deg C)	Ambient air temperture (Deg C)
50	8.21	50.48	4.37	23.00	23.70
150	7.47	45.91	3.97	24.00	25.00
250	5.89	36.24	3.14	25.00	25.50
350	3.85	23.70	2.05	23.50	23.50
450	2.54	15.60	1.35	23.70	24.00
550	1.12	6.86	0.59	23.00	23.50
650	0.50	3.09	0.27	24.50	25.50
			Average =	**23.81**	**24.39**

Table 1. Example of tabulated data.

Plot the primary calibrated heat fluxes against the voltage output of the working heat flux meter, as shown in Figure 3. The calibration equation for the working heat flux meter is determined from the slope and intercept of the straight line relationship as shown in Figure 3.

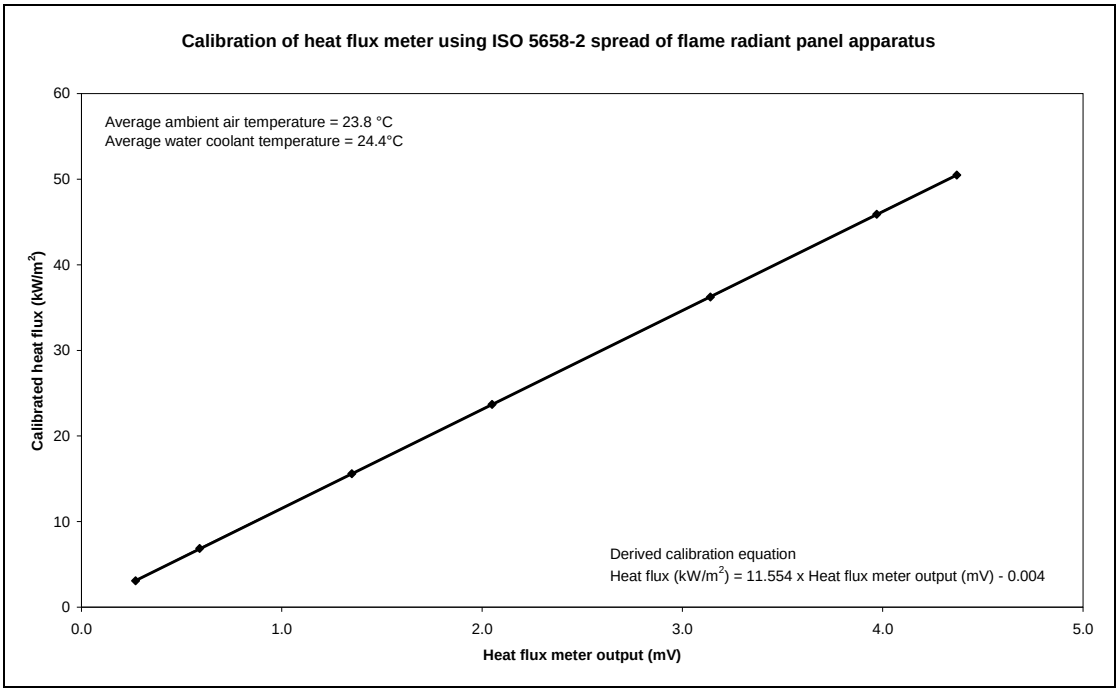


Figure 3. Example of plotted data for heat flux meter calibration.

Note: It is recommended that a historical log of the calibrations for each heat flux meter is retained by the laboratory. This is useful information that can be used to identify any problems associated with the heat flux meter that can occur from time to time. As a general rule, the calibration of an individual heat flux meter should be fairly stable provided that it is kept free from occurrences that could result in damage, e.g. shock, impact, etc.

ANNEX 4 - DATASHEETS (optional)

SECURITY MARKING

SPREAD OF FLAME **STANAG 4602**

AFAP-4 (ISO 5658-2 modified) Edition No: **Item Ref.**

Report No.	**Report Date**
Report Title	
Test Laboratory Address	**Supplier Address**
Material	

Test specimen

(i) Thickness mm or μm:

(ii) Specimen construction and preparation:

Backing board: Thickness (mm)

Air gap Yes/No Thickness (mm)

(iii) Coatings:

(iv) Face tested:

Derived Fire Characteristics	**Test 1**	**Test 2**	**Test 3**	**Mean**
Critical flux at extinguishment CFE (kW/ m^2)				
Average heat of sustained burning Q_{sb} (MJ/m^2)				
Total heat released Q_t (MJ)				
Peak heat release rate Q_p (kW)				

Repeat Tests:

(Details of any repeat tests required in accordance with AFAP-4)

Observations:

(Including time to ignition as described in ISO 5658-2 Section 11 and a description of any relevant characteristics or behaviour such as charring, dripping, severe shrinkage, erratic burning or afterglow)

This document contains commercial Information – See conditions of release. These results relate only to the behaviour of the specimens of the material under the particular conditions of test (See appropriate Standard)

SECURITY MARKING

SECURITY MARKING

SPREAD OF FLAME **STANAG 4602**

AFAP-4 (ISO 5658-2 modified) Edition No. **Item ref.**

Material:

Item Ref.	**Report No.**				**Report Date**	
Flame spread measurements	**Test 1**		**Test 2**		**Test 3**	
Time;	minutes	seconds	minutes	seconds	minutes	seconds
to ignition:						
to travel 50 mm:						
to travel 100 mm:						
to travel 150 mm:						
to travel 200 mm:						
to travel 250 mm:						
to travel 300 mm:						
to travel 350 mm:						
to travel 400 mm:						
to travel 450 mm:						
to travel 500 mm:						
to travel 550 mm:						
to travel 600 mm:						
to travel 650 mm:						
to travel 700 mm:						
to travel 750 mm:						
to extinguishment:						
duration of test:						
Final travel (mm):						
Area specimen burnt (mm^2):						
Weight (g):						
Length (mm):						
Width (mm):						
Thickness (mm):						
Heat for sustained burning:	**Test 1**		**Test 2**		**Test 3**	
150 mm:						
200 mm:						
250 mm:						
300 mm:						
350 mm:						
400 mm:						

SECURITY MARKING