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NATO REACTION-TO-FIRE TESTS FOR MATERIALS

POLICY FOR THE PRE-SELECTION OF MATERIALS FOR MILITARY APPLICATIONS

AFAP - 1
(Edition 3)

JULY 2010

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AFAP-1

NATO REACTION-TO-FIRE TESTS FOR MATERIALS

POLICY FOR THE PRE-SELECTION OF MATERIALS FOR MILITARY APPLICATIONS

AFAP-3
(Edition 3)

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NATO STANDARDISATION AGENCY (NSA)

NATO LETTER OF PROMULGATION

30 July 2010

1. AFAP-1(Edition 3) – NATO REACTION-TO-FIRE TESTS FOR MATERIALS - POLICY FOR THE PRE-SELECTION OF MATERIALS FOR MILITARY APPLICATIONS is a non classified NATO publication. The agreement of interested nations to use this publication is recorded in STANAG 4602.

2. AFAP-1(Edition 3) is effective on receipt. It supersedes AFAP-1(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

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Table of contents

1. INTRODUCTION 1
2. SCOPE 2
2.1 General 2
2.2 Fire scenarios and test conditions 2
2.3 Fire critical effects and fire tests 3
2.4 Materials 3
2.5 Acceptance criteria 4
2.5.1 Criteria for classification of materials 4
2.5.2 Performance requirements for specific applications 4
3. DEFINITIONS 5
3.1 General 5
3.2 Fire critical effects: 5
3.3 Fire Stages 6
4. TEST METHODS 6
4.1 Description of the tests 6
4.1.1 Non-combustibility 6
4.1.2 Oxygen index 7
4.1.3 Flammability temperature (Temperature index) 7
4.1.4 Smoke generation 7
4.1.5 Toxicity of fire effluents 7
4.1.6 Surface spread of flame 8
4.1.7 Heat release rate (Cone calorimeter method) 8
4.1.8 Test applicability 8
4.1.9 Assessment protocol 8
5. GUIDANCE 8
5.1 Substrates 9
5.2 Form of test specimen 9
5.3 Specimen thickness 9
5.4 Orientation of layered materials 9
5.5 Colour 9
5.6 Identification of materials tested. 10
5.7 Mounting / fixing of test specimen 10
5.8 Wider applicability of test results 10
5.9 Heat flux meter calibration 10
6. TEST LABORATORIES 12
7. ACCEPTANCE CRITERIA AND CLASSIFICATION OF MATERIALS 12
8. RECORDING OF FIRE CHARACTERISTICS DATA (DATABASE) 17
9. NORMATIVE REFERENCES 17

Annex 1 – DATABASE - Item References 1-1
Annex 2 – DATABASE – Keywords 2-1
Annex 3 – DATABASE - Datasheet Formats 3-1
Annex 4 – Performance requirements in terms of STANAG 4602 fire classification systems 4-1
Annex 5 – Testing sequence flow diagrams 5-1

Tables:

TABLE 1 - STANAG 4602 REACTION-TO-FIRE CLASSIFICATIONS - GENERIC MATERIALS ---------- 13
TABLE 2 - STANAG 4602 REACTION-TO-FIRE CLASSIFICATIONS - UPHOLSTERED FURNITURE, MATTRESSES AND BEDDING COMPONENTS ---------- 14
TABLE 3 - STANAG 4602 REACTION-TO-FIRE CLASSIFICATIONS – VERTICALLY SUPPORTED TEXTILES AND FILMS ---------- 16
TABLE 4 - DATABASE ITEM REFERENCE - GROUPS & SUB-GROUPS ---------- 1-2
TABLE 5 - LIST OF ALLOWED DATABASE KEYWORDS---------- 2-1
TABLE 6 - PERFORMANCE REQUIREMENTS IN TERMS OF STANAG 4602 FIRE CLASSIFICATION SYSTEMS ---------- 4-2

Figures:

FIGURE 1 – AN ILLUSTRATION OF THE NUMBER OF HEAT FLUX METER TRANSFER CALIBRATION STEPS ---------- 12
FIGURE 2 – LOCATIONS OF COMPONENTS ---------- 4-1
FIGURE 3 – TESTING SEQUENCE FOR GENERIC MATERIALS ---------- 5-1
FIGURE 4 – TESTING SEQUENCE FOR UPHOLSTERED FURNITURE, MATTRESSES & BEDDING COMPONENTS ---------- 5-2

Datasheets:

DATASHEET 1 – FIRE CHARACTERISTICS DATA SHEET - GENERIC MATERIALS ---------- 3-2
DATASHEET 2 – FIRE CHARACTERISTICS DATA SHEET - UPHOLSTERED FURNITURE, MATTRESSES & BEDDING COMPONENTS / VERTICALLY SUPPORTED TEXTILES AND FILMS 3-3
DATASHEET 3 – NON-COMBUSTIBILITY (AFAP-1) ---------- 3-4
DATASHEET 4 – OXYGEN INDEX (AFAP-1) ---------- 3-5
DATASHEET 5 – FLAMMABILITY TEMPERATURE (AFAP-1) ---------- 3-6
DATASHEET 6 – SMOKE GENERATION (AFAP-2) ---------- 3-7
DATASHEET 7 – TOXICITY OF FIRE EFFLUENTS (AFAP-3) ---------- 3-9
DATASHEET 8 – SURFACE SPREAD OF FLAME (AFAP-4) ---------- 3-11
DATASHEET 9 – HEAT RELEASE RATE (AFAP-5) ---------- 3-13
DATASHEET 10 – UPHOLSTERED FURNITURE CRIB NO. 5 (BS 5852) ---------- 3-15
DATASHEET 11 – MATTRESSES CRIB NO. 7 (BS 6807) ---------- 3-16
DATASHEET 12 – BEDDING COMPONENTS CRIB NO. 7 (BS 7175) ---------- 3-17
DATASHEET 13 – VERTICALLY SUPPORTED TEXTILES & FILMS RESISTANCE TO FLAME PROPAGATION (IMO FTP CODE PART 7) ---------- 3-18
DATASHEET 14 – UPHOLSTERED FURNITURE CIGARETTE & MATCH (IMO FTP CODE PART 8) --- 3-19
DATASHEET 15 – UPHOLSTERED FURNITURE CIGARETTE & MATCH (IMO FTP CODE PART 9) --- 3-20
DATASHEET 16 – ADDITIONAL FIRE TESTS/OTHER TECHNICAL DATA ---------- 3-21

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

POLICY FOR THE PRE-SELECTION OF MATERIALS FOR MILITARY APPLICATIONS

1. INTRODUCTION

1.1 Fire constitutes a major threat to the safety of armed forces personnel and the operational performance of military platforms and equipment. The fire behaviour of materials used in military applications, is potentially a major contributing factor to fire hazard and the use of unsuitable materials can significantly increase the hazard/problems associated with fires. Consequently, there is a critical need to characterise the fire properties of materials used in military applications. In carrying out the overall assessment, it is essential to take into account the fire scenario(s) that can be realistically expected in particular service environments. The aim being, to minimise the occurrence of fire and to reduce the risk of escalation once started. This Allied Publication includes reference to a series of test methods intended to provide comparisons between candidate materials as part of the pre-selection screening process, under a range of test conditions, although these conditions do not necessarily replicate those of any particular fire scenario or fire stage (see Sections 2.2 & 2.3).

1.2 Within NATO/PfP, a number of national authorities have written and/or adopted fire tests and acceptance criteria for materials, resulting in a variety of differing individual national and international military standards. Some of the fire tests and acceptance criteria, introduced by these standards, have been produced by civil national and international organisations (e.g. ISO [1], IMO [2] etc.) mainly for specific non-military applications.

1.3 The series of Allied Fire Assessment Publications (AFAPs), described here, aims to promote harmonisation, within NATO/PfP, of the standards used by the relevant national technical authorities carrying out pre-selection of materials. This will offer advantages in multi-national procurement projects and allowing standardization of fire tests for the pre-selection of materials for military applications. The objective is the elimination of duplicate research, design, development and testing of defence materiel, in accordance with NATO Principles of Standardization.

1.4 These AFAPs have been developed primarily for military applications on surface warships and submarines. They may also be adapted for use in the land, air or defence clothing / commissariat areas as required.

[1] ISO - International Standards Organisation
[2] IMO - International Maritime Organisation

2. SCOPE

2.1 General

This Allied Publication;

a. provides guidance to the designer on the performance requirements for control and pre-selection of materials for military applications, on the basis of their fire characteristics, to ensure that only suitable materials are fitted in military platforms and equipment. The, “Pre-selection of materials”, is considered to be the initial part of the design/selection process, used to screen candidate materials for a particular application, to rank reaction-to-fire properties.

b. identifies and describes the main reaction-to-fire laboratory tests (small scale tests) that may be required, highlights their shortcomings and limitations in relation to a real fire situation and recommends designers to exercise care in making judgements from the test results.

c. defines the format of common data sheets for incorporation into national databases of fire test results and the method by which participating nations will record and share fire test data (see Section 8).

d. defines a classification system for materials which can be used to link STANAG 4602 test results to the requirements of ANEP-77 Naval Ship Code (NSC) and also that can be used for development of national regulations for other vessels including submarines.

2.2 Fire scenarios and test conditions

It is recognised that within the scope of NATO operations (air, land and sea) there is a very wide range of materials and applications and that for each, there may be many potential fire scenarios to be considered. It would not be possible within the context of these Allied Publications to evaluate the performance of materials in all potential scenarios.

The test methods described in the Allied Fire Assessment Publications can be used to evaluate materials under a range of different test conditions. Where appropriate, a general indication of the severity of the test conditions used in each method is given in Section 4 of this Allied Publication.

The development of fire can conveniently be described in terms of, “fire stages”, defined by the prevalent thermal and oxygen conditions and these are described in detail ISO 19706 Table 1. The main, “fire stages”, are also listed in Section 3.3 of this Allied Publication. However, there is not necessarily a direct relationship between the test conditions of the AFAP methods and any particular, “fire stage”, as described in ISO 19706.

The Allied Fire Assessment Publications are not based on the definition of a particular fire scenario.

The Allied Fire Assessment Publications do not cover fires where materials are exposed to attack from dangerous substances such as weapons, munitions, explosives, propellants and fuels, blast, shock, fragments, etc. Assessment of structural non-metallic materials

under these conditions may require specific assessment, e.g. large scale tests, modelling, etc, of structure and joints for evaluation and is outside the scope of this Allied Publication.

2.3 Fire critical effects and fire tests

The fire tests described in these Allied Publications each assess a particular aspect of reaction-to-fire performance, under a specific set of experimental conditions. They may be used to provide comparisons between candidate materials, but do not necessarily predict the behaviour of the materials, or combinations of materials, in actual fire conditions.

The fire tests described in the Allied Fire Assessment Publications are small scale reaction-to-fire tests for pre-selection of materials only. In order to ensure that the design of defence equipment is such that it will meet specific fire requirements, when exposed to expected fire scenarios in full scale military applications, it may be necessary to make further evaluation of the expected performance of materials, within the context of the application in which they will be used, by large/full scale testing or fire safety engineering methods, which are beyond the scope of these Allied Publications.

The Allied Fire Assessment Publications cover:

Non-combustibility
Ignitability
Flammability
Smoke obscuration
Toxicity
Spread of flame
Heat release

These Allied Fire Assessment Publications do not cover:

Ignitability under small flame attack (e.g. ISO 11925-2) except for textiles and upholstered furniture
Corrosivity of combustion products
Total heat of combustion / calorific potential
Long term / delayed toxicity.

Note: The Allied Fire Assessment Publications relate to reaction-to-fire properties only and as such do not address fire resistance of products and/or structures.

2.4 Materials

The Allied Fire Assessment Publications cover:

Insulants
Composites (structural and non structural, including pipes)
Paints / coatings and adhesives
Deck covering
Bulkhead, ceiling and deck finishing materials
Textile fabrics (curtains, furnishing, etc)
Upholstery (mattress component materials, seat foams, etc).
Furniture component materials

The Allied Fire Assessment Publication do not cover:

Electrical cables
Tests on complete items of furniture
Systems (e.g. fire doors)
Applications and/or products in which the mechanical behaviour under fire conditions in the real scale have an effect on the reaction-to-fire behaviour of the product.

2.5 Acceptance criteria

AFAPs 2-5 cover the standardization of fire test methodologies, and recording of results only. AFAP-1 provides sets of criteria for classification of fire performance of materials in surface ships and submarines. These criteria are not directly applicable to other military platforms and equipment (e.g. land, air) but may be adapted by the Technical Authority with caution, with regard to the different fire scenarios.

2.5.1 Criteria for classification of materials

Where STANAG 4602 is specified, the Tables in Section 7 of this Allied Publication define sets of criteria used to classify materials in relation to three main reaction-to-fire characteristics:

Contribution to Fire Growth	(F-classification)
Smoke Generation	(S-classification)
Toxicity of Fire Effluents	(T-classification).

Using this hierarchical classification system, the performance requirement for each fire characteristic is defined for each material/product application in terms of the F, S and T classifications based on other standards and historical data as appropriate.

2.5.2 Performance requirements for specific applications

For naval vessels that are to be built in accordance with the NSC[1], requirements for fire safety are defined in Chapter VI. The NSC is intended to provide at least an equivalent level of safety to the relevant merchant shipping codes (as stated in Chapter 1 Regulation 1). This has been achieved by defining acceptance criteria for each material / product application based on SOLAS [2] and/or HSC Code [3] requirements, amended as necessary for relevance to naval environments. The performance requirements in the NSC are based on the test methods and acceptance criteria defined in the FTP Code [4] or HSC Code.

The classifications shown for each application are used to link STANAG 4602 test results to the NSC in columns 3 and 4 of Table 6 in Annex 4. In addition the NATO FRT Group [5] responsible for STANAG 4602 has defined a set of enhanced performance requirements

[1] NSC - NATO ANEP-77 Naval Ship Code
[2] SOLAS - IMO Convention on Safety Of Life At Sea
[3] HSC Code - IMO High-Speed Craft Code
[4] FTP Code - IMO Fire Test Procedures Code
[5] NATO FRT Group - Non-Entitled Group Of Experts On Fire Reaction Tests

based on knowledge and experience of the group for surface ships (columns 5 and 6) and separately for submarines (column 7).

3. DEFINITIONS

The following terms and definitions are used for the purposes of this Allied Publication:

3.1 General

a. PRE-SELECTION OF MATERIALS — The initial part of the design/selection process, used to screen candidate materials for a particular application, to rank reaction-to-fire properties.

b. TECHNICAL AUTHORITY — The relevant national authority, responsible for providing regulations and guidance on reaction-to-fire properties of materials/products associated with procurement and in service support.

c. REACTION-TO-FIRE — Response of a test specimen when it is exposed to fire under specified conditions in a fire test. (ISO 13943)

d. NON-COMBUSTIBLE — Not capable of undergoing combustion under specified conditions. (ISO 13943)

Note: IMO MSC.61(67) Annex 1, Part 1. defines acceptance criteria to define non-combustibility of a material based on the test method in ISO 1182.

e. FIRE RESISTANCE — Ability of a test specimen to withstand fire or give protection from it for a period of time. (ISO 13943)

Note 1: Typical criteria used to assess fire resistance in a standard fire test are fire integrity, fire stability, and thermal insulation. (ISO 13943)

Note 2: “Fire-resistant” (adj.) refers only to this ability. (ISO 13943)

3.2 Fire critical effects:

a. IGNITABILITY (ease of ignition) — Measure of the ease with which a test specimen can be ignited, under specified conditions. (ISO 13943)

b. FLAMMABILITY — Ability of a material or product to burn with a flame under specified conditions. (ISO 13943)

c. OBSCURATION BY SMOKE — Reduction in the intensity of light due to its passage through smoke. cf. extinction area of smoke, extinction coefficient, opacity of smoke, optical density of smoke, specific extinction area of smoke and specific optical density of smoke. (ISO 13943)

Note 1: In practice, obscuration by smoke is usually

measured as the transmittance, which is normally expressed as a percentage. (ISO 13943)

Note 2: Obscuration by smoke causes a reduction in visibility. (ISO 13943)

Note 3: Further impairment of visibility may be brought about by exposure of the eyes to sensory irritants in combustion products, but this aspect is not addressed by these tests.

d. TOXICITY — Ability of a substance to produce adverse effects upon a living organism, e.g. irritation, narcosis or death.

e. SPREAD OF FLAME — Propagation of a flame front, boundary of flaming combustion at the surface of a material or propagating through a gaseous mixture. (ISO 13943)

f. HEAT RELEASE RATE — Rate of thermal energy production generated by combustion.

g. FIRE GROWTH — Stage of fire development during which the heat release rate and the temperature of the fire are increasing. (ISO 13943)

h. CONTRIBUTION TO FIRE GROWTH — Combination of ignitability, spread of flame and heat release rate that characterises the ability of the material to contribute to the development of the fire.

3.3 Fire Stages

Main fire stages as described in ISO 19706 Table 1 (see Section 2.2)

a. NON-FLAMING

b. WELL VENTILATED FLAMING

c. UNDER VENTILATED FLAMING

4. TEST METHODS

4.1 Description of the tests

The selected methods are ISO test methods or are based on the methodology detailed in ISO test methods.

4.1.1 Non-combustibility

ISO 1182 provides a test method for selection of materials which, whilst not completely inert, produce only a very limited amount of heat and flame when exposed to temperatures of approximately 750°C. Such materials are described as, "non-combustible". The method shall be adopted as presented in the IMO FTP Code Part 1. The procedure determines rise in temperature of the furnace and specimen surface when the material under test is

exposed in a furnace initially at approximately 750°C under specified conditions. Observations of any flaming and specimen mass loss are also recorded.

4.1.2 Oxygen index

ISO 4589-2 provides a test method for the empirical measurement of the burning behaviour of specimens under specified conditions of test, which can be used as part of the assessment of the IGNITABILITY of the material. The procedure determines the minimum concentration of oxygen, in a mixture of oxygen and nitrogen, at ambient temperature, flowing upwards in a test column, that will support candle-like combustion of a small vertical test piece.

4.1.3 Flammability temperature (Temperature index)

ISO 4589-3 Annex A provides a test method for the empirical measurement of the burning behaviour of specimens under specified conditions of the test, which can be used as part of the assessment of the FLAMMABILITY of the material. The procedure determines the minimum temperature of heated air, flowing upwards in a test column, that will support candle-like combustion of a small vertical test piece.

Note: The oxygen index and flammability temperature tests use a small flame ignition source to assess the burning characteristics of a material. For information on behaviour of a material when exposed to larger flame attack and/or under radiant heating, it is necessary to employ tests that expose the specimens to such conditions. Examples are the surface spread of flame and heat release rate tests, described in AFAP-4 and AFAP-5 respectively.

4.1.4 Smoke generation

AFAP-2 (based on ISO 5659-2 modified) provides a test method for the measurement of smoke production from small specimens, when exposed to specified conditions of test, which can be used as part of the assessment of the propensity for a material to produce visible fire effluents (i.e. smoke), leading to loss of visibility due to OBSCURATION BY SMOKE.

Note: Three test conditions are considered: 25 kW/m^2 with and without a pilot flame and 50 kW/m^2 without a pilot flame. A heat flux of 25 kW/m^2 is related to an early fire stage (smouldering or small flaming fire), while 50 kW/m^2 is related to an intermediate fire stage (growing flaming).

4.1.5 Toxicity of fire effluents

AFAP-3 provides a test method for the assessment of the toxicity of the combustion products from small specimens, which can be used as part of the assessment of the propensity of a material to contribute to TOXICITY. The procedure uses a tube furnace test method for determination of TOXICITY INDEX values. This Allied Publication is intended to form part of the pre-selection screening process for materials and should not be interpreted as an assessment of toxicity hazard under actual fire conditions. It is directed at the analysis of gaseous species which cause acute toxicity; i.e. lethal to man for a 30 minute exposure. Delayed/long term toxicity is not considered.

Note: Two temperatures of combustion are considered: 350°C and 800°C. At 350°C the combustion of material is related to an early stage of fire. At 800°C all combustible materials will ignite and the organic phase will burn to completion and hence, 800°C is related to a late fire stage (large flaming fire).

4.1.6 Surface spread of flame

AFAP-4 (based on ISO 5658-2 modified and IMO FTP Code Part 5) provides a test method for the measurement of the SPREAD OF FLAME on a surface of a material, under specified conditions of test, which can be used as part of the assessment of the propensity of a material to make a CONTRIBUTION TO FIRE GROWTH.

Note: The heat release parameters determined by this test method depend both on the HRR per unit area of the material and on its rate of flame spread, as the burning area of the specimen gradually increases throughout the test. Therefore, HRR data from AFAP-4 and AFAP-5 cannot be directly compared and may rank materials in a different order.

Note: Information on ignitability/flammability under radiant heating with a pilot flame can also be obtained from this test.

4.1.7 Heat release rate (Cone calorimeter method)

AFAP-5 (based on ISO 5660 Parts 1 & 2 modified) provides a test method for the measurement of the HEAT RELEASE RATE of a material, which can be used as part of the assessment of the propensity of a material to contribute to FIRE GROWTH.

Note: Three levels of irradiation are considered: 35 kW/m², 50 kW/m² and 75 kW/m². They are related respectively to: early, intermediate and late fire stages.

Note: Information on ignitability/flammability under radiant heating, with a spark ignition source, can also be obtained from this test.

4.1.8 Test applicability

The relevant national Technical Authority shall be consulted on applicable fire tests for specific materials/applications.

For the purposes of this Allied Publication, the test methods for Oxygen Index (ISO 4589-2) and Flammability Temperature (FT) (ISO 4589-3 Annex A) are not applicable to paints/coatings or to adhesives.

Other test methods may be required for specific applications (e.g. textile fabrics and upholstery assemblies)

4.1.9 Assessment protocol

Depending on what information is already known about the nature of the material/product submitted for test and any predicted performance, the assessment may be performed in a logical sequence in order to limit unnecessary testing. Flow diagrams showing recommended examples of logical sequences for testing of generic materials and of upholstered furniture/mattresses/bedding components, are presented in Annex 5.

5. GUIDANCE

There are a variety of experimental details and specimen preparation issues that may affect the results obtained from the fire tests described in these Allied Fire Assessment Publications. Specific guidance is given in the individual AFAPs and the test standards to which they refer. Additional requirements may be invoked by the national authorities

making use of these Allied Fire Assessment Publications. The following gives general guidance on the factors that may need consideration.

In order to obtain valid comparison of materials it may be necessary to take account of some or all of the following aspects. They include, but are not limited to:

5.1 Substrates

Coating materials:

The properties of the substrate may affect the behaviour of the material in the test and should reflect the substrate in end use applications as far as practicable. The type of substrate material used (e.g. steel, aluminium, composite, etc) and its dimensions, such as thickness, affect the heat absorption characteristics of the test specimen as a whole.

For most tests it is necessary to apply coating materials such as paints, vapour barriers, adhesives, etc, to a substrate such as a metal panel, in order to produce a workable test specimen. Specific guidance is provided in each Allied Fire Assessment Publication.

5.2 Form of test specimen

Toxicity:

This is particularly important in considering the type of test specimen to be used in the toxicity test, which uses a very small test specimen (~1 gram). Within this limit it is necessary either to obtain a homogeneous specimen for each component or to test a representative sample containing relevant proportions of the components.

5.3 Specimen thickness

Specimen thickness affects heat absorption characteristics and may have other effects such as distortion of thinner sheet materials, etc. Hence, the results from a test are strictly applicable only to the thickness of the material used for the test specimen.

However, national authorities may specify procedures to assess a range of thicknesses of a material, by testing the maximum and minimum of the range and as appropriate, thicknesses in between,. Care should be taken in choosing the number and distribution of thicknesses tested so that the effects of this parameter are adequately evaluated..

5.4 Orientation of layered materials

Where materials have faces which differ or contain laminations of different materials arranged in a different order in relation to the two faces, the appropriate national authority must determine whether either or both faces of the materials are required to be tested, taking into account the end use of the material and the appropriate fire scenarios. The test result are strictly valid only for the particular face tested.

5.5 Colour

As a general rule, it is found that darker colours (see Note 1) absorb radiant heat more efficiently, which may affect ignition times, etc. Hence, the results from a test are strictly applicable only to the colour of the material used for the test specimen.

However, the Technical Authority may specify procedures to assess a range of colours of a material (see Note 2).

Note 1: The apparent colour in visible wavelengths may not be directly related to emissivity and infra-red absorbance and hence the colour black is not necessary the worst case. Red is often found to be the more sensitive to heating, because the absorption spectra of the colour red is close to near-IR. However, this is not a systematic rule and a case by case assessment should be made.

Note 2: A recommended example procedure is to test three colours through the range being assessed, from the lightest to the darkest (e.g. one test specimen for each colour selected). If the results are identical for all colours tested, any colour within the range may be accepted.

Note 3: Changing colour by using pigments of different chemical compositions (different organic content, different structure, etc) can affect the fire properties of the material/product.

5.6 Identification of materials tested.

Each AFAP contains a test report section describing all of the information to be recorded concerning identification of the material under test. The test results relate only to the material tested and when manufacturers develop and change materials specifications, it may be necessary to re-assess the materials. The national authorities concerned must be informed when a materials specification changes and the decision as to whether to re-test lies with the approving authority. It is essential that this information is recorded fully and reported along with the test data and input to the national databases.

5.7 Mounting / fixing of test specimen

Where the materials are non-homogeneous and/or directional in any way, and/or they are mounted containing joints or cavities, consideration shall be given to the orientation and dimensions of such features relative to the dimensions of the test specimen.

5.8 Wider applicability of test results

Strictly, the results from any given test are applicable only to the materials in the form (thickness, colour, mounting, orientation, substrates, etc.) that was used to make the test specimens. However, at the discretion of the national authorities, provision may be made to allow wider application of results.

For example, if in practice a coating material is used on a more dense substrate (therefore with a higher heat adsorption) than that used for the test, then the behaviour in the real application is likely to be superior to that seen in the tests. The same principle can be applied to other similar properties mentioned above.

5.9 Heat flux meter calibration

The test methods within AFAP-2, AFAP-4 and AFAP-5 require the use of heat flux gauges to set the levels of irradiance within the equipment. For the purposes of obtaining data that can be compared between laboratories internationally, it is important that the heat flux gauges are all calibrated in a standardised way that is traceable back to the primary standard maintained by LNE - France or SP - Sweden (see table below and ISO 14934-2 clauses a and b). An estimation of the uncertainties associated with the calibration with the primary standards is provided in ISO 14934-2 clauses c and d. Details of how to obtain such a calibration may be obtained from the Technical Authority.

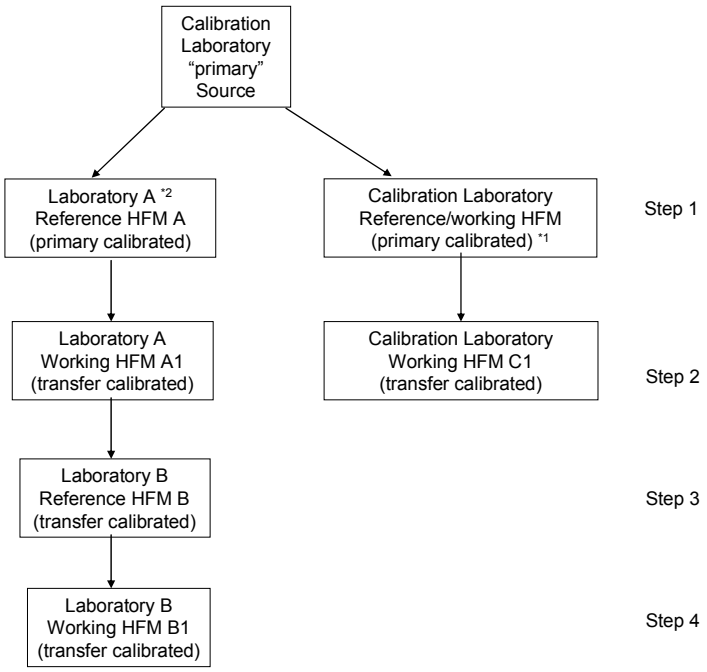
Note: Technical enquiries, on this subject, may also be directed to:

LNE Laboratoire National de Métrologie et d'Essais Direction Métrologie Scientifique et Industrielle Pôle Photonique-Energétique 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 10 516 50 00 Fax : + 46 33 13 55 02 e-mail: info@sp.se

Most laboratories operate a procedure for calibration that requires a transfer method or secondary method of calibration. Guidance on the sources of uncertainties associated with secondary calibrations is provided in ISO 14934-3, specifically Annex A. For the purposes of this Allied Publication, the following shall apply;

- The calibration of the heat flux gauge used to calibrate the test equipment shall be traceable back to a primary standard as defined in ISO 14934-2 in no more than four steps (see
-
- Figure **1**).
- Transfer calibrations of heat flux gauges shall be carried out in the test equipment to be calibrated using the procedures described in the relevant AFAP to ensure that consistent levels of convective and radiative heat transfer are maintained.
- Laboratories shall maintain records of calibrations and be able to demonstrate traceability to a primary standard.

Figure 1 - An Illustration Of The Number Of Heat Flux Meter Transfer Calibration



Steps

*1 This procedure for calibration of heat flux meters is limited to those laboratories that maintain a primary calibration source and may involve one step for heat flux meters (C1) that cannot be calibrated directly by the primary source, for example, due to location of cooling water pipes, giving a total of two steps.

*2 This procedure for calibration of heat flux meters is for those laboratories that, for example, maintain a national calibration standard.

6. TEST LABORATORIES

Tests to determine the fire characteristics of materials shall be performed at independent laboratories qualified to appropriate standards for quality management and for technical competence, as specified by the Technical Authority. The relevant standards are to be clearly indicated on the test report.

Contractors must verify the acceptability to the Technical Authority of the chosen laboratory before conducting a test.

7. ACCEPTANCE CRITERIA AND CLASSIFICATION OF MATERIALS

The following tables define acceptance criteria used to classify materials and products in relation to three main reaction-to-fire characteristics, determined in accordance with the test methods described above:

Contribution to Fire Growth (F-classification)

Smoke Generation (S-classification)

Toxicity of Fire Effluents (T-classification).

Table 1 - STANAG 4602 Reaction-To-Fire Classifications - Generic Materials

Contribution to fire growth – F classification:

Classification	Test	Requirement
F1	AFAP-1 Non-combustibility (ISO 1182) [1]	$\Delta T_{FURNACE}$ ≤ 30 °C $\Delta T_{SPECIMEN\ SURFACE}$ ≤ 30 °C Mass loss ≤ 50 % Duration of sustained flaming ≤ 10 seconds
F2	AFAP-4 and	CFE ≥ 20.0 kW/m² Q_{sb} ≥ 1.5 MJ/m² Q_t ≤ 0.7 MJ q_p ≤ 4.0 kW
	AFAP-5 (50 kW/m^2)	MARHE ≤ 90 kW/m²
F3	AFAP-4	CFE ≥ 20.0 kW/m² Q_{sb} ≥ 1.5 MJ/m² Q_t ≤ 0.7 MJ q_p ≤ 4.0 kW
F4	AFAP-4	CFE ≥ 7.0 kW/m² Q_{sb} ≥ 0.25 MJ/m² Q_t ≤ 2.0 MJ q_p ≤ 10.0 kW

Smoke Generation – S classification:

Classification	Test	Requirement
S1	AFAP-2 (25NP, 25P, 50NP) [2]	$D_{s,max} \leq 200$
S2	AFAP-2 (25NP, 25P, 50NP) [2]	$200 < D_{s,max} \leq 500$

Toxicity of Fire Effluents – T classification:

Classification	Test	Requirement
T1	AFAP-3	Toxicity Index ≤ 10.0

[1] As presented in IMO FTP Code Part 1, see Section 4.1.1 above

[2] Materials shall meet the requirement in all three tests modes according to AFAP-2 Clause 9.6, i.e. 25 kW/m^2 with and without pilot flame and 50 kW/m^2 without pilot flame.

Table 2 - STANAG 4602 Reaction-To-Fire Classifications - Upholstered Furniture, Mattresses And Bedding Components:

Contribution to fire growth – F(Furniture) classification:

Classification	Test	Requirement	
F(Furniture)1	BS 5852 (upholstered furniture) BS 6807 (mattresses) BS 7175 (bedding components) and	Crib No. 5 (upholstered furniture) Crib No. 7 (mattresses) Crib No. 7 (bedding components)	PASS [1] PASS [2] PASS [3]
	AFAP-5 (upholstered composite specimens tested at 25 kW/m^2) [4] and	MARHE	≤ 75 kW/m²
	IMO FTP Code Part 8 (upholstered furniture) Part 9 (mattresses, bedding components)	Cigarette and Match flame equivalent	PASS PASS
F(Furniture)2	BS 5852 (upholstered furniture) BS 6807 (mattresses) BS 7175 (bedding components) and	Crib No. 5 (upholstered furniture) Crib No. 7 (mattresses) Crib No. 7 (bedding components)	PASS PASS PASS
	IMO FTP Code Part 8 (upholstered furniture) Part 9 (mattresses, bedding components)	Cigarette and Match flame equivalent	PASS PASS
F(Furniture)3	IMO FTP Code Part 8 (upholstered furniture) Part 9 (mattresses, bedding components)	Cigarette and Match flame equivalent	PASS PASS

[1] Resistant to ignition source 5 for upholstery composites as specified in BS 5852:2006, Clause 11.
[2] Resistant to ignition source 7 as specified in BS 6807:2006, Clause 9.
[3] Resistant to ignition source 7 as specified in BS 7175:1989, Clause 9.
[4] Assembled upholstered composite test specimens as specified in AFAP-5 Annex 1C, tested at an irradiance of 25 kW/m^2.

Table 2: (continued) STANAG 4602 Reaction-To-Fire Classifications – Upholstered Furniture, Mattresses And Bedding Components:

Smoke Generation – S(Furniture) classification:

Classification	Test	Requirement
S(Furniture)1	AFAP-2 (25P upholstered composite specimens)[1]	$D_{s,max} \leq 300$
S(Furniture)2	AFAP-2 (25P upholstered composite specimens)[1]	$300 < D_{s,max} \leq 500$

Toxicity of Fire Effluents – T(Furniture) classification:

Classification	Test	Requirement
T(Furniture)1	AFAP-3 (tests on individual components)	Toxicity Index ≤ 10.0

[1] Assembled upholstery composite test specimens as specified in AFAP-2 Annex 1C, tested in mode 2 according to AFAP-2 Clause 9.6, i.e. 25 kW/m^2 with pilot flame.

Table 3 - STANAG 4602 Reaction-To-Fire Classifications – Vertically Supported Textiles And Films:

Contribution to fire growth – F(Textiles) classification:

Classification	Test	Requirement	
F(Textiles)1	AFAP-1 (ISO 4589-2) and	Oxygen Index	≥ 27 %
	AFAP-1 (ISO 4589-3 Annex A)	Flammability Temperature (FT)	≤ 170 °C
F(Textiles)2	IMO FTP Code Part 7	Afterflame time Burn through to edge Ignition of cotton wool below Char length Surface flash	≤ 5 seconds none none ≤ 150 mm ≤ 100 mm

Smoke Generation – S(Textiles) classification:

Classification	Test	Requirement
S(Textiles)1	AFAP-2 (25NP, 25P, 50NP) [1]	$D_{s,max} \leq 200$

Toxicity of Fire Effluents – T(Textiles) classification:

Classification	Test	Requirement
T(Textiles)1	AFAP-3 [2]	Toxicity Index ≤ 10.0

[1] Materials shall meet the requirements in all three tests modes according to AFAP-2 Clause 9.6, i.e. 25 kW/m^2 with and without pilot flame and 50 kW/m^2 without pilot flame.
[2] AFAP-3 tests on individual components.

8. RECORDING OF FIRE CHARACTERISTICS DATA (DATABASE)

The participating nations agree to:

8.1 record the results of fire tests carried out in accordance with these AFAPs in a national "STANAG 4602 - Fire Assessment of Materials Database" maintained by the appointed national Point Of Contact (POC). The duties of the POC are defined in Sections 8.2 - 8.8 below. Any changes to the national POC's details are to be notified to the Lead Nation/Custodian for STANAG 4602;

8.2 exchange the data between national authorities at their discretion, taking into account national security and commercial considerations as appropriate;

8.3 allocate a unique Item Reference (Group, Sub-Group etc) to each assessment, according to the system defined in Annex 1;

8.4 allocate Keywords to each assessment, according to the system defined in Annex 2;

8.5 maintain the database electronic format such that data can be extracted into common formatted "STANAG 4602 - Fire Characteristics Data Sheets"; The format of the datasheets are given in Annex 3;

8.6 use a common format for "STANAG 4602 - Fire Characteristics Data Sheets" to carry out the exchange of data;

8.7 hold the data at an appropriate security level;

8.8 send data between nations by means appropriate to its security classification.

9. NORMATIVE REFERENCES

9.1 The following documents are referred to in this Allied Publication;

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;
ANEP-77	Naval Ship Code. June 2008;
BS 5852	Methods of test for assessment of the ignitability of upholstered seating by smouldering and flaming ignition sources. 2006;
BS 6807	Methods of test for assessment of the ignitability of mattresses, upholstered divans and upholstered bed bases with flaming types of primary and secondary sources of ignition. 2006;

BS 7175	Methods of test for the ignitability of bedcovers and pillows by smouldering and flaming ignition sources. 1989;
FTP Code	International Code for the Application of Fire Test Procedures; MSC.61(67);
HSC Code 1994	International Code of Safety for High-Speed Craft MSC.36(63) amended by MSC.119(74) and MSC/Circ.1057;
HSC Code 2000	International Code of Safety for High-Speed Craft, 2000 (2000 HSC Code) MSC.97(73) amended by MSC.119(74);
ISO 1182	Fire tests – Building materials – Non-combustibility test. 2002;
ISO 4589-2	Plastics – Determination of burning behaviour by oxygen index – Part 2: Ambient-temperature test. 1996. Incorporating Amd 1. 2005;
ISO 4589-3	Plastics – Determination of burning behaviour by oxygen index – Part 3: Elevated-temperature test. Appendix A. Measurement of flammability temperature (FT). 1996;
ISO 5658-2	Reaction to fire tests – Spread of flame – Part 2: Lateral spread on building products in vertical configuration. 2006;
ISO 5659-2	Plastics – Smoke generation – Part 2: Determination of optical density by a single-chamber test. 2006;
ISO 5660-1	Reaction-to-fire tests – Heat release, smoke production and mass loss rate. Part 1: Heat release (Cone calorimeter method). 2002;
ISO 5660-2	Reaction-to-fire tests – Heat release, smoke production and mass loss rate. Part 2: Smoke production rate (dynamic measurement). 2002;
ISO 9705	Fire tests – Full-scale room test for surface products. 1993;
ISO 11925-2	Reaction to fire tests – Ignitability of building products subjected to direct impingement of flame – Part 2: Single-flame source test. 2002;
ISO 13943	Fire safety – Vocabulary. 2008;
ISO 14934-2	Fire tests – Calibration and use of heat flux meters – Part 2: Primary calibration methods. 2006;
ISO 14934-3	Fire tests – Calibration and use of heat flux meters – Part 3: Secondary calibration method. 2006;
ISO 19706	Guidelines for assessing the fire threat to people. 2007;

MSC/Circ.1120	Unified interpretations of SOLAS Chapter II-2, the FSS code, the FTP code and related fire test procedures. 2 June 2004.
Resolution A.753(18)	Guidelines for the application of plastic pipes on ships.
SOLAS	International Convention for the Safety of life at Sea. 1974 (as amended);
STANAG 1059	Distinguishing letters for geographical entities for use in NATO;
STANAG 4602	Fire assessment of materials. 2004.

9.2 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.

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

Annex 1
DATABASE - Item References

Format

The item reference number provides a unique identifier for each assessment and is defined as follows:

<GROUP> . <SUB-GROUP> . <SERIAL NUMBER> . <NATION>

Where,

<GROUP>	is the main materials application as defined in Table 4.
<SUB - GROUP>	is a sub division of main materials application as defined in Table 4.
<SERIAL NUMBER>	is a sequential number, allocated within each Group/Sub-Group, by the "STANAG 4602 - Fire Assessment of Materials - Database - Point Of Contact" for the nation that carried out the fire assessment.
<NATION>	is the nation that carried out the fire assessment of the material - denoted by the distinguishing letters for the nation defined in STANAG 1059.

Allocation by POC

Each material assessment shall be allocated a unique **Item Reference (IR)** by the **STANAG 4602 Point Of Contac**t for the nation that carried out the assessment.

Once a unique IR has been raised by the original POC it shall not be changed by other nations when entering the data in their own database .

When copies of the data sheets for the assessment are disseminated to the other POCs (as per Section 8) the data shall be recorded into each national database under its original IR i.e. with the same group, sub-group, serial number and nation reference.

Example; **01 . 01 . 36 . DEU** would be a record of an assessment carried out in Germany entered by the German POC, for a fibre reinforced plastic (FRP) material used in a structural application. This particular data sheet would be for the 36th material in this group/sub-group to be assessed in Germany.

Similarly, **01 . 01 . 36 . GBR** would be a record of an assessment carried out in the UK, entered by the UK POC, for a different FRP material that is also used in a structural application. This particular data sheet would be for the 36th material in this group/sub-group to be assessed in the UK.

Hence, once this data has been disseminated to all nations by the respective POCs, all of the national databases would contain both records under their original Item Ref.s i.e. **01 . 01 . 36 . GE** and **01 . 01 . 36 . GBR**

Table 4 - Database Item Reference - GROUPs & SUB-GROUPs

MAIN GROUP		SUB-GROUP	
No.	Title	No.	Title
1	Structural Materials	1	Fibre Reinforced Plastics (FRP) Structure
		2	FRP Fittings (e.g. Doors, Hatches)
		3	Timbers, Plywood, Fibre-Boards
		4	Complete Minor Bulkheads/Partitions (Core + Finishes)
		5	Others
2	System Materials	1	Plastics Various
		2	Composites Various
		3	Rubbers Various
		4	Electrical Various
		5	Sealants, Adhesives and Tapes
		6	Others
3	Habitability Materials	1	Deck Coverings and Screeds
		2	Upholstery Seat Foams
		3	Upholstery Mattresses and Components
		4	Upholstery Curtains, Covers and Drapes
		5	Decorative Finishes and Laminates
		6	Ropes, Cordage and Webbing
		7	Uniforms, Clothing etc
		8	Others
4	Paint Materials	1	Primers
		2	Finish
		3	Interior Dry Systems
		4	Interior Wet/Dry systems
		5	Anti-Slip
		6	Reactor and NBCD Compartments
		7	Powder Coatings
		8	Vapour Barriers
		9	Others
5	Insulation Materials	1	Structure Thermal
		2	Structure Fire
		3	Structure Acoustic
		4	Ventilation and Air Conditioning
		5	Pipe Systems (Rigid and Flexible)
		6	Special Applications
		7	Others
6	Miscellaneous Materials	1	Non Habitability Materials
		2	Others (Note: Only to be used for materials that are not appropriate in Groups 1 to 5)

Annex 2
DATABASE - Keywords

The keywords are separate from the Item Reference groups and sub-groups described above (Annex 1) and differ in that many keywords from each category may be entered for any one assessment. They are designed to aid searching and sorting of records from the database.

The keywords are divided into three categories (see Table 5 below). Enter all of the keywords which apply to the "Application", "Material", and "Type of product" for the material that has been assessed.

Only keywords/phrases from Table 5 may be entered. They shall be entered exactly as written in Table 5.

Table 5 - List of allowed database keywords

Application	**Material** (type or composition)	**Type of product** (form or shape)
Application unknown/undefined	Composition unknown	Form unknown
Application not listed	Composition not listed	Type not listed
Structural	Fibre reinforced plastic (FRP)	Sheet
Non-structural	Glass reinforced plastic (GRP)	Tube
	Carbon fibre reinforced plastic (CFRP)	Pipe
Bulkhead (wall)		Coating
Deck (floor)	Natural material	Foam
Deckhead (ceiling)	Leather	Liquid
Door	Wood	Moulded shape
Hatch	Plywood	Honeycomb
Vent	Fibreboard	Textile/fabric
Ancillary fitting		
Pipe	Polymer	
Window	Plastic	
	Synthetic rubber	
System	Natural rubber	
Habitability	Elastomer	
Electrical	Thermoset	
Air conditioning	Thermoplastic	
Ventilation		
	Ceramic	
Thermal insulation	Metal	
Fire insulation	Glass	
Acoustic insulation	Non ferrous alloy	
Pipe insulation	Cast alloy	
Rigid insulation	Steel	
Flexible insulation		
Sealant		
Adhesive		
Filler		
Flooring		
Deck screed		
Upholstery		
Seat		
Mattress		
Curtain		

Application	**Material** (type or composition)	**Type of product** (form or shape)
Cover Bedding Laminate Cordage Webbing Clothing Primer paint Finish paint Interior paint Exterior paint Anti-slip paint Powder coating Vapour barrier Dry compartment Wet compartment Reactor compartment NBCD compartment		

Annex 3
DATABASE – Test report format

DATASHEET 1 – FIRE CHARACTERISTICS DATA SHEET - GENERIC MATERIALS ---------- 3-2
DATASHEET 2 – FIRE CHARACTERISTICS DATA SHEET - UPHOLSTERED FURNITURE, MATTRESSES & BEDDING COMPONENTS / VERTICALLY SUPPORTED TEXTILES AND FILMS 3-3
DATASHEET 3 – NON-COMBUSTIBILITY (AFAP-1) ---------- 3-4
DATASHEET 4 – OXYGEN INDEX (AFAP-1) ----------3-5
DATASHEET 5 – FLAMMABILITY TEMPERATURE (AFAP-1) ---------- 3-6
DATASHEET 6 – SMOKE GENERATION (AFAP-2) ---------- 3-7
DATASHEET 7 – TOXICITY OF FIRE EFFLUENTS (AFAP-3) ---------- 3-9
DATASHEET 8 – SURFACE SPREAD OF FLAME (AFAP-4) ----------3-11
DATASHEET 9 – HEAT RELEASE RATE (AFAP-5) ----------3-13
DATASHEET 10 – UPHOLSTERED FURNITURE CRIB NO. 5 (BS 5852) ----------3-15
DATASHEET 11 – MATTRESSES CRIB NO. 7 (BS 6807) ----------3-16
DATASHEET 12 – BEDDING COMPONENTS CRIB NO. 7 (BS 7175) ----------3-17
DATASHEET 13 – VERTICALLY SUPPORTED TEXTILES & FILMS - RESISTANCE TO FLAME PROPAGATION (IMO FTP CODE PART 7)----------3-18
DATASHEET 14 – UPHOLSTERED FURNITURE - CIGARETTE & MATCH EQUIVALENT FLAME (IMO FTP CODE PART 8)----------3-19
DATASHEET 15 – UPHOLSTERED FURNITURE - CIGARETTE & MATCH EQUIVALENT FLAME (IMO FTP CODE PART 9)----------3-20
DATASHEET 16 – ADDITIONAL FIRE TESTS / OTHER TECHNICAL DATA ----------3-21

DATASHEET 1 - Materials fire characteristics data sheet – Generic Materials

SECURITY MARKING

FIRE CHARACTERISTICS DATA SHEET – GENERIC MATERIALS

NATO STANAG 4602

Material Name:		**Item Ref:**
Main Group:	**Sub Group:**	
Material Description:		Other (e.g. Density)
NATO Stock No. or Unique Identification Number:		**Supplier:**
Specification:		
Keywords **Application:** **Materials:** (type or composition) **Type of product:** **(form or shape)**	**Colour** **(Facing colour)**	**Phone:** **Fax:**
Original Source:		

NON-COMBUSTIBILITY **Test Date:** **AFAP-1 (ISO 1182)** **ΔT FURNACE (°C)** **ΔT SPECIMEN SURFACE (°C)** **Mass loss** **Duration of sustained flaming**	**SURFACE SPREAD OF FLAME** **Test date:** **AFAP-4 (ISO 5658-2 modified)** **Critical heat flux at extinguishment** **CFE (kWm^{-2})** **Average heat for sustained burning** **Q_{sb} (MJm^{-2})** **Total heat released:** **Q_t (MJ)** **Peak heat release rate:** **Q_p (kW)**
Heat Release Rate **Test date:** **AFAP-5 (ISO 5660-1 modified)** **MARHE:** **HRR30max** **SPR30max**	**CONTRIBUTION TO FIRE GROWTH** **Classification:**
SMOKE GENERATION **Test Date:** **AFAP-2 (ISO 5659-2 modified)** **1. 25 kWm^{-2} no pilot flame** **Mode 1:** **2. 25 kWm^{-2} + pilot flame** **Mode 2:** **3. 50 kWm^{-2} no pilot flame** **Mode 3:** **Classification:**	**TOXICITY of FIRE EFFLUENTS (AFAP-3):** **Toxicity Index:** **Test Date:** **Classification:**

Essential dimensions (eg density, thickness etc)

For further information see additional sheet

SCOPE/LIMITATIONS

1. This material is acceptable for use in the following situations:

2. Extension of use of this material is restricted because:

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

DATASHEET 2 - Materials fire characteristics data sheet – Upholstered Furniture, Mattresses & Bedding Components / Vertically Supported Textiles and Films

SECURITY MARKING

FIRE CHARACTERISTICS DATA SHEET **NATO STANAG 4602**

Upholstered furniture, mattresses & bedding components / Vertically supported textiles and films

Material Name:		**Item Ref:**
Main Group:	**Sub Group:**	
Material Description:		Other (e.g. Density)
NATO Stock No. or Unique Identification Number:		**Supplier:**
Specification:		
Keywords **Application:** **Materials:** (type or composition) **Type of product:** (form or shape)	**Colour** (Facing colour)	**Phone:** **Fax:**
Original Source:		

BS 5852 (Crib No. 5): **Test date:** **BS 6807 (Crib No. 7):** **Test date:** **BS 7175 (Crib No. 7):** **Test date:**	**Test Date:** **Oxygen Index AFAP-1 (ISO 4589 Part 2)** **%** **Flammability Temperature (FT) AFAP-1 (ISO 4589 Part 3 Annex A) (Temperature Index)** **°C**
IMO FTP Code Part 8 (Upholstered Furniture) **IMO FTP Code Part 9: (Mattresses)** **Test Date:** **Cigarette** **Match flame equiv.**	**IMO FTP Code Part 7** **(Vertically supported textiles and films)** **Test date:** **Result:**
Heat Release Rate AFAP-5 (ISO 5660-1 modified) **Test date:** **MARHE:**	
Upholstered furniture, mattresses & bedding components CONTRIBUTION TO FIRE GROWTH:	**Vertically supported textiles & films CONTRIBUTION TO FIRE GROWTH:**

SMOKE GENERATION AFAP-2 (ISO 5659-2 modified) **Test Date:** D_{Smax} **Mode 1:** **Mode 2:** **Mode 3:** **Classification:**	**TOXICITY of FIRE EFFLUENTS (AFAP-3):** **Toxicity Index:** **Test Date:** **Classification:**

Essential dimensions (eg density, thickness etc)

For further information see additional sheet

SCOPE/LIMITATIONS

1. This material is acceptable for use in the following situations:

2. Extension of use of this material is restricted because:

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

DATASHEET 3 – Non-Combustibility (AFAP-1)

NON-COMBUSTIBILITY **SECURITY MARKING** **STANAG 4602**
AFAP-1 (ISO 1182)

Item ref.

Report No.	**Report Date**
Report Title	
Test Laboratory Address	**Supplier Address**
Material	
Specimen description:	
Test Results: ΔT Furnace: Mass loss: ΔT Specimen surface: Duration of sustained burning: **Classification:**	
Observations	
Deviations from test method	

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 CLASSIFICATION

DATASHEET 4 - Oxygen Index (AFAP-1)

OXYGEN INDEX **SECURITY MARKING** **STANAG 4602**

AFAP-1 (ISO 4589-2) **Item ref.**

Report No.	**Report Date**
Report Title	

Test Laboratory Address	**Supplier Address**

Material

Test specimen form	**Length mm**	**Width mm**	**Thickness mm**

Test Results:

Oxygen Index [concentration, V/V]:

Standard deviation:

Ignition procedure (A or B)

Oxygen concentration increment (d) (V/V):

Observations

(a description of any relevant characteristics or behaviour such as charring, dripping, severe shrinkage, erratic burning or afterglow)

Deviations from test method

(for example special equipment/holder used to support the test specimen)

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

DATASHEET 5 - Flammability Temperature (AFAP-1)

SECURITY MARKING

FLAMMABILITY TEMPERATURE (FT) **STANAG 4602**

AFAP-1 (ISO 4589-3 Annex A) (TEMPERATURE INDEX) **Item Ref.**

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

Test specimen form	**Length mm**	**Width mm**	**Thickness mm**

Test Results

Ignition procedure (A or B)

Flammability temperature:

Observations:

(a description of any relevant characteristics or behaviour such as charring, dripping, severe shrinkage, erratic burning or afterglow)

Deviations from test method:

(for example special equipment/holder used to support the test specimen)

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

DATASHEET 6 - Smoke Generation (AFAP-2)

SMOKE GENERATION **SECURITY MARKING** **STANAG 4602**

AFAP-2 (ISO 5659-2 modified) Edition No. **Item Ref.**

Report No.	**Report Date**
Report Title	
Laboratory Address	**Supplier address**
Material	
Test specimen **(I) Thickness mm or μm:** **(II) Specimen construction and preparation:** **(III) Coatings:** **(IV) Faced tested:**	
Repeat Tests: (Details of any repeat tests required in accordance with AFAP-2)	
Observations: (Observations of the specimens and times from the start of the test at which the observations were made, together with details of any invalid tests and the reasons for these)	

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

DATASHEET 6 - Smoke Generation (continued)

SMOKE GENERATION **SECURITY MARKING** **STANAG 4602**

AFAP-2 (ISO 5659-2 modified) Edition No. **Item Ref.**

Material:

Mode 1 25 kWm^2 no pilot flame				
Parameter	**Test 1**	**Test 2**	**Test 3**	**Mean of Tests**
$D_{s,max}$				
Time to $D_{s,max}$ (seconds) t_{max}				
VOF4 (= $Ds_1 + Ds_2 + Ds_3 + Ds_4/2$) (optional)				
D_s10				
Clear beam correction factor D_c				

Mode 2 25 kWm^2 + pilot flame				
Parameter	**Test 1**	**Test 2**	**Test 3**	**Mean of Tests**
$D_{s,max}$				
Time to $D_{s,max}$ (seconds) t_{max}				
VOF4 (= $Ds_1 + Ds_2 + Ds_3 + Ds_4/2$) (optional)				
D_s10				
Clear beam correction factor D_c				

Mode 3 50 kWm^2 no pilot flame				
Parameter	**Test 1**	**Test 2**	**Test 3**	**Mean of Tests**
$D_{s,max}$				
Time to $D_{s,max}$ (seconds) t_{max}				
VOF4 (= $Ds_1 + Ds_2 + Ds_3 + Ds_4/2$) (optional)				
D_s10				
Clear beam correction factor D_c				

DATASHEET 7 - Toxicity of Fire Effluents (AFAP-3)

TOXICITY of FIRE EFFLUENTS | **SECURITY MARKING** | **STANAG 4602**

AFAP-3 **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:

(iii) Coatings:

(iv) Combustion boat size (Standard or Large):

TOXICITY INDEX AFAP-3 | **Classification:**

TOXIC GAS	**FORMULA**	Cf **(ppm)**	**Test Temperature °C**	C_θ **(ppm)**	**Contribution to Index** $\frac{C\theta}{Cf}$
Carbon Dioxide	CO_2	**100000**	**800**		
Carbon Monoxide	**CO**	**4000**	**800**		
Nitrogen Oxides	NO_X **(NO +** NO_2**)**	**100**	**800**		
Sulphur Dioxide	SO_2	**400**	**800**		
Hydrogen Fluoride	**HF**	**50**	**800**		
Hydrogen Bromide	**HBr**	**150**	**800**		
Hydrogen Chloride	**HCl**	**500**	**800**		
Hydrogen Cyanide	**HCN**	**90**	**800**		
Phenol	C_6H_5OH	**250**	**800 (see note)**		
Formaldehyde	**HCHO**	**500**	**350**		
Acrolein	CH_2CHCHO	**5**	**350**		
				Toxicity Index =	

Note: A contribution from Phenol is only included if the Toxicity Index determined for the other gases is greater than 6 and less than 10.

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

DATASHEET 7 - Toxicity of Fire Effluents (continued)

SECURITY MARKING

TOXICITY OF FIRE EFFULENTS **STANAG 4602**

AFAP-3 Edition No. **Item Ref.**

Material:

Repeat Tests:

(details of any repeat tests required in accordance with AFAP-3)

Observations:

(Observations of the specimens and times from the start of the test at which the observations were made, together with details of any invalid tests and the reasons for these)

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

DATASHEET 8 - Surface Spread of Flame (AFAP-4)

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)

SECURITY MARKING

DATASHEET 8 - Surface Spread of Flame (continued)

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

DATASHEET 9 - Heat Release Rate (AFAP-5)

SECURITY MARKING

HEAT RELEASE RATE **STANAG 4602**

AFAP-5 (ISO 5660-1 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:** **(III) Coatings:** **(IV) Face tested:**	
Repeat Tests: (details of any repeat tests required in accordance with AFAP-5)	
Observations:	
Deviations from test method:	

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

DATASHEET 9 - Heat Release Rate (continued)

HEAT RELEASE RATE	**SECURITY MARKING**	**STANAG 4602**
AFAP-5 (ISO 5660 modified)		**Item ref.**

PARAMETER			TEST 1	TEST 2	TEST 3	MEAN
Irradiance (25 kW/m^2 or 50 kW/m^2)		(kW/m^2)				
Time To Ignition	t_{ig}	(seconds)				
Peak Heat Release Rate	$\dot{q}_{A,max}$	(kW·m^{-2})				
Total Heat Release	$Q_{A,tot}$	(MJ·m^{-2})				
Max Ave Rate Of Heat Emission	MAHRE	(kW·m^{-2})				
Max Sliding Ave Heat Release Rate	*HRR30max*					
Max Sliding Ave Smoke production Rate	*SPR30max*					
Test duration		(seconds)				
Time to peak heat release rate		(seconds)				
Ave. heat release rate for 180 s after ign	$\dot{q}_{A,180}$	(kW·m^{-2})				
Ave. heat release rate for 300 s after ign.	$\dot{q}_{A,300}$	(kW·m^{-2})				
Specimen mass loss	m_A	(g·m^{-2})				
Average mass loss rate between ignition and end of test	$\dot{m}_A$	(g·m^{-2}·s^{-1})				
Average mass loss rate between 10-90% of mass loss	$\dot{m}_{A,10-90}$	(g·m^{-2}·s^{-1})				
Smoke production non flaming phase	$S_{A,1}$	(m^2·m^{-2})				
Smoke production flaming phase	$S_{A,2}$	(m^2·m^{-2})				
Total smoke production	$S_{A,1}+S_{A,2}$	(m^2·m^{-2})				
Peak smoke production rate	$P_{sA,max}$	(s^{-1} [= (m^2·s^{-1})/m^2])				
Time to peak smoke production rate		(seconds)				
Ave. P_{sA} for 180 s after ign.	$P_{sA,180}$	(s^{-1} [= (m^2·s^{-1})/m^2])				
Ave. P_{sA} for 300 s after ign.	$P_{sA,300}$	(s^{-1} [= (m^2·s^{-1})/m^2])				
CO_2 yield between ignition and end of test		(kg·kg^{-1})				
CO yield between ignition and end of test		(kg·kg^{-1})				

SECURITY MARKING

DATASHEET 10 – Upholstered Furniture - Crib No. 5 (BS 5852)

SECURITY MARKING STANAG 4602

BS 5852
Upholstered furniture

Crib No. 5

Item Ref.

Report No.	Report Date
Report Title	
Test Laboratory Address	Supplier Address
Material	
Test specimen (describe all layers separately and the make up of test specimen):	
Results: Test date: BS 5852 upholsterd furniture Crib No 5: **Result:**	
Observations made during the tests:	
Deviations from test method: (Including non-standard placement of ignition sources, as described in BS 5852 Appendix B.3)	

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

DATASHEET 11 – Mattresses - Crib No. 7 (BS 6807)

SECURITY CLASSIFICATION STANAG 4602

BS 6807 Mattresses **Crib No. 7** Item Ref.

Report No.	Report Date
Report Title	
Test Laboratory Address	Supplier Address
Material	
Test specimen (describe all layers separately and make up of test specimen):	
Test Results: Test date: Top ignition Ignition from below Smouldering cigarette test: Result: Match flame equivalent test:	
Observations made during the tests:	
Deviations from test method:	

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

DATASHEET 12 – Bedding Components - Crib No. 7 (BS 7175)

SECURITY MARKING STANAG 4602

BS 7175
Bedding Components

Crib No. 7

Item Ref.

Report No.	**Report Date**
Report Title	
Test Laboratory Address	**Supplier Address**
Material	
Test specimen (describe all layers separately and the make up of test specimen):	
Results: **top ignition** **ignition from below** **Test date:** **Smouldering cigarette test:** **Match flame equivalent test:**	
Observations made during the tests:	
Deviations from test method:	

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

DATASHEET 13 – Vertically Supported Textiles & Films - Resistance To Flame Propagation (IMO FTP Code Part 7)

SECURITY MARKING

IMO FTP Code Part 7
Vertically supported textile and films

Resistance to flame propagation

STANAG 4602

Item Ref.

Report No.	**Report Date**
Report Title	
Test Laboratory Address	**Supplier Address**
Material	
Test specimen:	
Results: Mode of flame application: Duration of flame application (seconds): (surface application only) **After flame time (seconds):** (surface application only) **Burn through to edge:** (surface application only) **Ignition of cotton wool from flaming drops:** **Average char length (mm):** **Occurrence of surface flash and its propagation length (mm):**	
Observations made during the tests:	
Deviations from test method or repeat tests (IMO FTP Code Part 7 section 3.2):	

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 CLASSIFICATION

DATASHEET 14 – Upholstered Furniture – Cigarette & Match Equivalent Flame (IMO FTP Code Part 8)

SECURITY MARKING **STANAG 4602**

IMO FTP Code Part 8 **Cigarette and**
Upholstered furniture **Match flame equivalent**

Item Ref.

Report No.	**Report Date**
Report Title	
Test Laboratory Address	**Supplier Address**
Material	
Test specimen (describe all layers separately and the make up of test specimen):	
Results: Test date: **Smouldering cigarette test:** **Result:** **Match flame equivalent test:**	
Observations made during the tests:	
Deviations from test method:	

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

DATASHEET 15 – Mattresses, Bedding Components – Cigarette & Match Equivalent Flame (IMO FTP Code Part 9)

SECURITY MARKING STANAG 4602

IMO FTP Code Part 9
Mattresses, bedding components

Cigarette and
Match flame equivalent

Item Ref.

Report No.	Report Date
Report Title	
Test Laboratory Address	Supplier Address
Material	
Test specimen (describe all layers separately and the make up of test specimen):	
Results: Test date: Smouldering cigarette test: Butane flame test:	
Observations made during the tests:	
Deviations from test method:	

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

DATASHEET 16 - Materials fire characteristics data sheet - Additional Fire Tests/Other Technical Data

SECURITY CLASSIFICATION

ADDITIONAL FIRE TESTS / OTHER TECHNICAL DATA **STANAG 4602**

Item Ref.

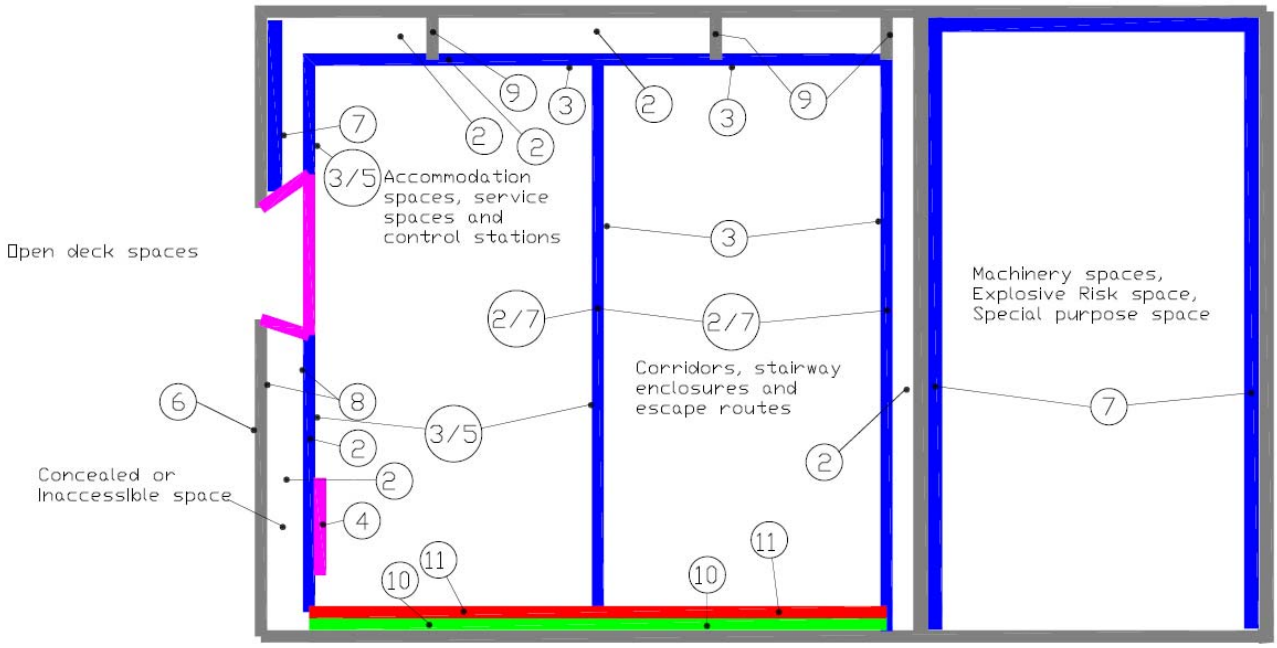
This document contains commercial Information – See conditions of release. These results relate only to the behaviour of the specimens of the material under the particular conditions of test (See appropriate Standard)

SECURITY CLASSIFICATION

Annex 4

Performance requirements in terms of STANAG 4602 fire classification systems

Figure 2 – Locations of components



Note: This diagram has been adapted from the explanatory sketches shown in the appendix to MSC/Circ.1120 and shows the arrangements for surface ships.

Key:

1	Insulation in cargo spaces, mail rooms, baggage rooms and refrigerated compartments of service spaces. (Not applicable to (H) Type ships). (Note: these compartments are not shown in the diagram above.)
2	Panels, linings and draught stops including doors, smoke curtains, vents
3	Painted surfaces or veneer or fabrics or foils (Walls / bulkheads of corridors, stairway enclosures and escape routes.) (Ceilings and deckheads) (Plinths & skirting)
4	Decoration
5	Painted surfaces or veneer or fabrics or foils (Walls / bulkheads of accommodation spaces, service spaces and control stations) (Plinths & skirting)
6	Exterior surfaces
7	Insulation (except insulation in 1 above)
8	Surfaces and paints in concealed or inaccessible spaces
9	Grounds and supports
10	Primary deck covering 1st layer
11	Floor finishing (covering)

Table 6 - Performance requirements in terms of STANAG 4602 fire classification systems

1 No.	2 Components	3 Criteria according to NSC (in relation to IMO FTP Code) Type A Type B> 50 NC Type (H)	4 Criteria according to NSC (in relation to IMO FTP Code) all other Types	5 Criteria according to STANAG 4602 Type A Type B> 50 NC Type (H)	6 Criteria according to STANAG 4602 all other Types	7 Criteria according to STANAG 4602 Submarines	8 Comments	9 Rule reference: NSC Chapter VI (ANEP-77 June 2008)
1	Insulation in cargo spaces, mail rooms, baggage rooms and refrigerated compartments of service spaces. (Not applicable to Type (H) ships.)	S_{FTP}, T_{FTP} (1)(7)	(1)	F3 S1 T1 (1)(7)	F3 S1 T1 (1)	F3 S1 T1 (1)	In relation to STANAG 4602 the Naval Administration may allow certain types of insulation to be combustible due to functional requirements, e.g. thermal insulation of submarine hulls.	Reg 4.11.1 Reg 4.11.3 Reg 5.6.1
2	Panels, linings and draught stops including doors, smoke curtains, vents.	F1 (4) (Optional F3 S_{FTP} T_{FTP})	F1 (Optional F3 S_{FTP} T_{FTP})	F1 T1 (4)	F1 T1	F1 T1	1. The Naval Administration may require S1 and T1 for all ship types. 2. Due to functional requirements, in relation to STANAG 4602, the Naval Administration may specify F2 / F3 and/or S1 T1. 3. F3 Mail rooms, baggage rooms, saunas and refrigerated compartments of service spaces.	Reg 4.12 Reg 5.4.1 Reg 5.7.1
3	Painted surfaces or veneers or fabrics or foils, on walls and bulkheads, in corridors, stairway enclosures and escape routes. Ceilings and deckheads in all spaces. Plinths and skirting in corridors, stairway enclosures and escape routes.	F3 S_{FTP} (2) T_{FTP} (2)	F3 (2) S_{FTP} T_{FTP}	F3 S1 T1 (2)	F3 S1 T1 (2)	F3 S1 T1 (2)	1. In relation to STANAG 4602, the Naval Administration may require materials used on large surface areas relative to the room to be F2 S1 T1. 2. Components tested individually for toxicity.	Reg 4.16 Reg 5.4.1
4	Decoration.	F3 S_{FTP} T_{FTP}	S_{FTP} T_{FTP}	F3 S1 T1	F3 S1 T1	F3 S1 T1	The term, "decoration", used in the NSC, is taken from equivalent sections of SOLAS. It is illustrated in the diagram in MSC.Circ/1120, Where its interpretation is uncertain the Naval Administration shall be consulted.	Reg 4.13.2 Reg 4.13.3 Reg 4.14-16 Reg 5.2
5	Painted surfaces or veneers or fabrics or foils on walls and bulkheads, in accommodation spaces, service spaces and control stations. Plinths and skirting in accommodation spaces, service spaces and control stations.	F3 S_{FTP} (2) T_{FTP} (2)(5)	S_{FTP} T_{FTP}	F3 S1 T1	F3 S1 T1	F3 S1 T1	1. In relation to STANAG 4602, the Naval Administration may require materials used on large surface areas, relative to the room, to be F2 S1 T1. 2. Components shall be tested individually for toxicity.	Reg 4.16 Reg 5.4.1

Table 6 - Performance requirements in terms of STANAG 4602 fire classification systems

1 No.	2 Components	3 Criteria according to NSC (in relation to IMO FTP Code) Type A Type B> 50 NC Type (H)	4 Criteria according to NSC (in relation to IMO FTP Code) all other Types	5 Criteria according to STANAG 4602 Type A Type B> 50 NC Type (H)	6 Criteria according to STANAG 4602 all other Types	7 Criteria according to STANAG 4602 Submarines	8 Comments	9 Rule reference: NSC Chapter VI (ANEP-77 June 2008)
6	Exterior surfaces.	-	-	F3 / F4	F3 / F4	F3 / F4	In relation to STANAG 4602, the Naval Administration may also require certain types of materials used on exterior surfaces of the vessel to fulfil smoke and toxicity requirements (e.g. non-slip paint, hangar, RADAR absorbing materials, submarine cladding, etc).	-
7	Insulation (except insulation in row 1 above).	F1 Optional S_{FTP} T_{FTP} (1)(4)	F1 Optional S_{FTP} T_{FTP} (1)	F1 T1 (1) (4)	F1 T1 (1)	F1 T1 (1)	In relation to STANAG 4602 the Naval Administration may specify F2/F3 and/or S1 for all ship types.	Reg 4.11 Reg 5.7.1
8	Surfaces and paints in concealed or inaccessible spaces.	F3 (5)	F3	F3 T1	F3 T1	F3 T1	In relation to STANAG 4602 the Naval Administration may specify S1 for all ship types.	Reg 4.16
9	Grounds and supports.	F1 or F3 Optional S_{FTP} T_{FTP}	F1 or F3 (6) Optional S_{FTP} T_{FTP}	F1 T1 (4)	F1 T1	F1 T1	Due to functional requirements, in relation to STANAG 4602 the Naval Administration may specify, F2 / F3 and/or S1 T1.	Reg 4.12 Reg 5.7.1
10	Primary deck covering (1st layer).	F4 S_{FTP} T_{FTP} (6)	F4 S_{FTP} T_{FTP} (6)	F4 S2 T1 (6)	F4 S2 T1 (6)	F4 S2 T1 (6)	-	Reg 3.16.4.1 Reg 5.5.1
11	Floor finishing (covering).	F4 S_{FTP} T_{FTP} (3)	F4 S_{FTP} T_{FTP} (3)	F4 S2 T1 (3)	F4 S2 T1 (3)	F4 S2 T1 (3)	-	Reg 4.16 Reg 5.4.1
12	Case furniture (all parts) (e.g. desks, wardrobes, dressing tables, bureaux, or dressers).	F1 (4)(8)	F1 (8)	F1 T1 (4)	F1 T1	F1 T1	Due to functional requirements, in relation to STANAG 4602, F2 / F3 and/or S1 may be specified by the Naval Administration.	Reg 1 Table 1-1 Reg 4.13.1
13	Free-standing furniture (frames / non-upholstered parts) (e.g. such as chairs, sofas, or tables).	F1 (4)	F1	F1 T1 (4)	F1 T1	F1 T1	Due to functional requirements, in relation to STANAG 4602, F2 / F3 and/or S1 may be specified by the Naval Administration.	Reg 1 Table 1-1

Table 6 - Performance requirements in terms of STANAG 4602 fire classification systems

1 No.	2 Components	3 Criteria according to NSC (in relation to IMO FTP Code) Type A Type B> 50 NC Type (H)	4 Criteria according to NSC (in relation to IMO FTP Code) all other Types	5 Criteria according to STANAG 4602 Type A Type B> 50 NC Type (H)	6 Criteria according to STANAG 4602 all other Types	7 Criteria according to STANAG 4602 Submarines	8 Comments	9 Rule reference: NSC Chapter VI (ANEP-77 June 2008)
14	Vertically supported textiles and films (such as curtains, drapes, sunblinds).	F(Textiles)2	F(Textiles)2	F(Textiles)1	F(Textiles)1	F(Textiles)1 S(Textiles)1 T(Textiles)1	1. In relation to STANAG 4602 the Naval Administration may specify S(Textiles)1 and/or T(Textiles)1 for all ship types. 2. The Naval Administration may specify F(Textiles)2 for some applications for surface ships.	Reg 1 Table 1-1
15	Upholstered furniture and mattresses and bedding components.	F(Furniture)3 Optional: Smoke & Toxicity (9)	F(Furniture)3 Optional: Smoke & Toxicity (9)	F(Furniture)2 S(Furniture)2 T(Furniture)1	F(Furniture)2 S(Furniture)2 T(Furniture)1	F(Furniture)2 S(Furniture)1 T(Furniture)1	1. The Naval Administration may require F(Furniture)1 and/or S(Furniture)1 for all vessels. 2. The Naval Administration may require components to be tested individually.	Reg 1 Table 1-1 Reg 4.13.1 Reg 5.7.2
16	Composite pipe systems.	IMO Resolution A.753(18) Appendix 3	IMO Resolution A.753(18) Appendix 3	F3 S1 T1	F3 S1 T1	F3 S1 T1	1. In relation to STANAG 4602, the Naval Administration may require pipes with large surface areas relative to the room to be F2 S1 T1. 2. Guidelines for application of plastic pipes on ships, including requirements for fire resistance, are given in IMO Resolution A.753(18).	-

(1) Vapour barriers and adhesives used in conjunction with insulation, as well as the insulation of pipe fittings for cold service systems, need not be of non-combustible materials, but they shall be kept to the minimum quantity practicable and their exposed surfaces shall have low flame-spread characteristics.
(2) Applicable to paints, varnishes and other finishes.
(3) For type A-D ships only in corridors and stairway enclosures. In other spaces S2 T1 apply. On type (H) ships all floor finishing shall comply with F4 S2 T1.
(4) For type (H) ships the material may be non-combustible or fire restricting. The latter shall be tested according to IMO FTP Code Part 10 (ISO 9705 or AFAP-5 as appropriate).
(5) Also applicable for internal assembly and evacuation stations.
(6) Only in accommodation and service spaces and control stations.
(7) The Naval Administration may require non-combustible materials in all spaces for non (H) ships.
(8) Except that a combustible veneer not exceeding 2 mm may be used on the working surface of such articles.
TBD To be determined
Text in italic indicates comments that additional the NSC
(9) Smoke & Toxicity in this context means acceptable fire properties to the Naval Administration in terms of, smoke generation, and toxic fume production, see Reg. 5.7.2. Note that the IMO FTP Code does not contain acceptance criteria for these materials and the Naval Administration shall be consulted
NC - Non-crew

Annex 5
Testing sequence flow diagrams

Examples of testing sequence for F-classification applied to generic materials and upholstered furniture.

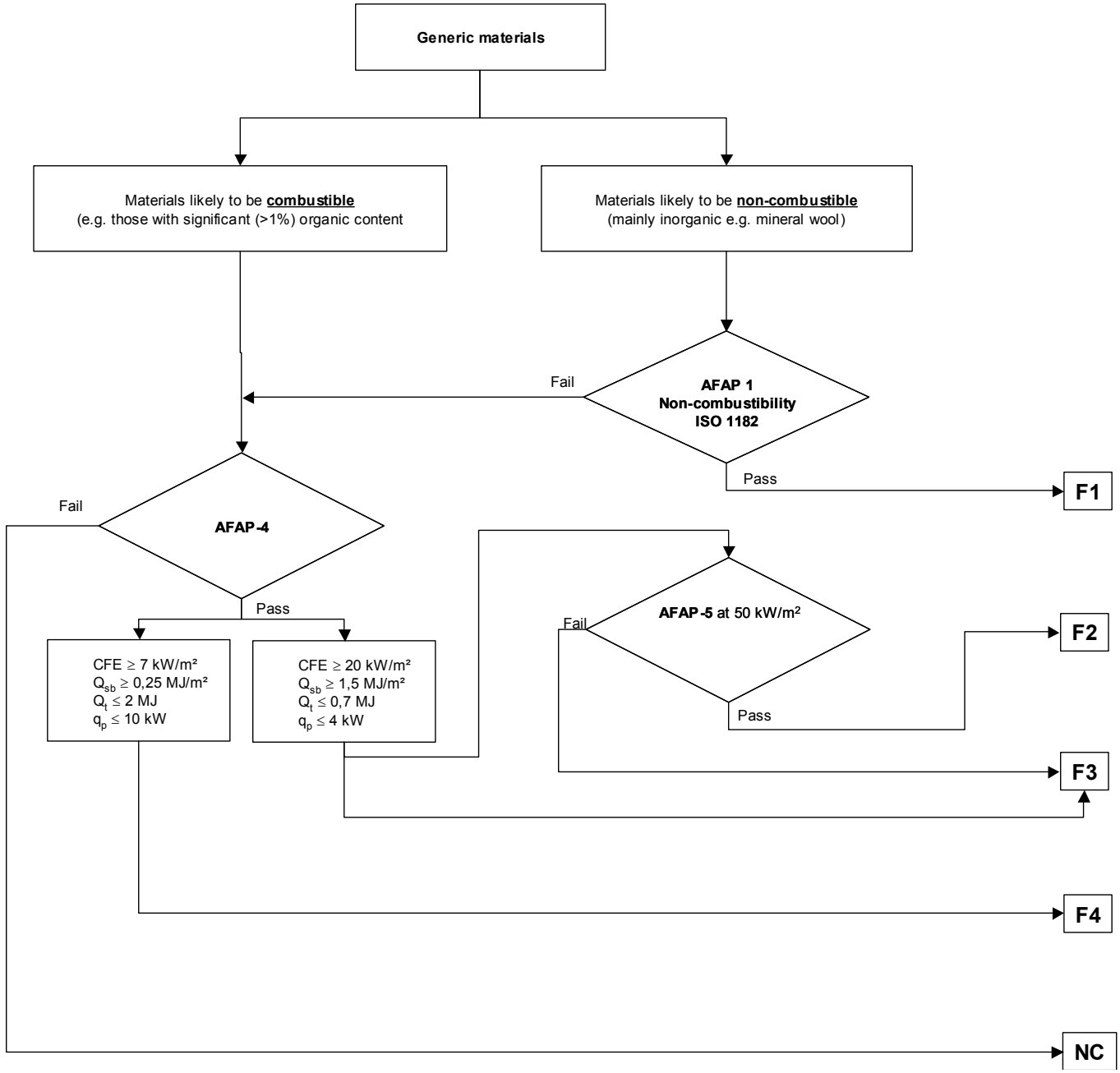


Figure 3 – Testing Sequence For Generic Materials

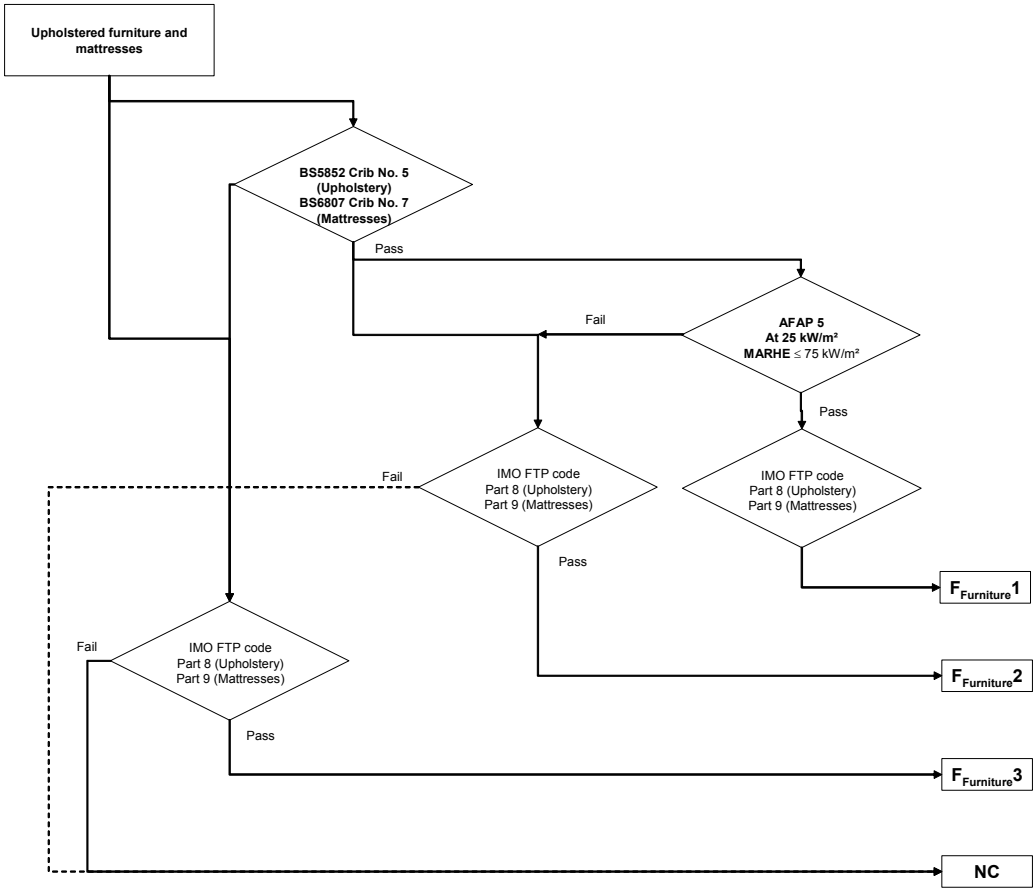


Figure 4 – Testing Sequence For Upholstered Furniture, Mattresses & Bedding Components