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Ministry of Defence
Defence Procurement Agency, ADRP2
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BS34 8JH

OBSOLESCENCE NOTICE

All DTD specifications were declared obsolescent from 1st April 1999. All DTD 900 series approvals also lapsed at that time. The standards will no longer be updated but will be retained as obsolescent documents to provide for the servicing of existing equipment.

Further Guidance

The aim in declaring the specifications obsolescent is to recognise that the documents are not being updated and thus should be used with care by both purchaser and supplier. For example, a specification could contain valid technical information but may also contain type approval clauses that contradict procurement policy and/or use materials that do not comply with environmental legislation. The obsolescent specification can still be used as a basis for a purchase provided that the supplier and purchaser agree suitable changes to the specification within the purchase order/contract.

For the DTD 900 system, each specification has provided an MoD approved material and process. For these items, the declaration of obsolescence will constitute the termination of both the extant MoD approval and the continuing MoD assessment that had underpinned those approvals. Again, the technical content of the document remains valid and can be used by both purchaser and supplier as a basis for a contract but an acceptable (to the parties) approval/assessment procedure would be required.

PROCUREMENT EXECUTIVE,
MINISTRY OF DEFENCE

DTD 5627

April 1982

Aerospace Material Specification

FIBROUS POLYAMIDE MATERIAL FOR USE AS AN EXPLOSION SUPPRESSANT AND AS A BAFFLE MATERIAL IN AIRCRAFT FUEL TANKS

NOTE 1. This specification is one of a series issued by the Procurement Executive, Ministry of Defence, either to meet a limited requirement not covered by an existing British Standard/or aircraft material, or to serve as a basis for inspection of material, the properties and uses of which are not sufficiently developed to warrant submission to the British Standards Institution for standardisation.

NOTE 2. The tests employed in this specification are mostly chosen for their reproducibility and ability to control the properties of the material. Simulated service tests are included as an indication of what may be achieved under specific conditions. The user is advised to confirm the suitability of the material for any given application.

NOTE 3. This specification calls for the use of substances and test procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and in no way absolves either the supplier or the user from statutory obligations related to health and safety at any stage of manufacture or use.

This specification has been devised for the use of the Ministry of Defence and its contractors in the execution of contracts for the Ministry and, subject to the Unfair Contract Terms Act 1977, the Ministry will not be liable in any way whatever (including but without limitation negligence on the part of the Ministry, its servants or agents) where the Specification is used for other purposes.

SECTION 1

Scope

1 SCOPE

The material covered by this specification is a polyamide fibrous structure intended for the suppression of explosions in aircraft fuel tanks. The latter may be integral tanks, rigid or flexible tanks.

The material is coloured white to distinguish it from the grey polyester material used for flame and fire suppression in dry bays. (See DTD 5624).

The material is intended for long term use in tanks containing standard aircraft fuels such as Avtur, Avcat and Avtag, at temperatures of up to 110°C, with intermittent peaks of temperature up to 130°C.

SECTION 2

Related documents

2. Reference is made in this specification to the following:

DTD 5624	Fibrous polyester material for use as a flame and fire suppressant in aircraft dry bays.
BS 5214	Testing machines for rubbers and plastics.
ASTM D 1692-76	Rate of burning or extent and time of burning, or both, of cellular plastics using a supported specimen.

The related documents listed are those applicable at the date of publication of this specification. Their current applicability must be confirmed by all users of this specification. The Quality Assurance Authority will supply, on request, information concerning any changes that may be necessary due to cancellation, replacement, supercession or amendments of any related document.

SECTION 3

General Requirements

3.1 Composition

The material covered by this specification shall consist of a fibrous polyamide construction in which bonds between fibres are formed by a melding process, and no adhesives shall be used.

Melding may be described as a combination of melting and welding, in which a bond is formed between two fibres in contact with each other by raising their temperature to a point where the polymer forming the surface layer of the fibres softens sufficiently for bonding to occur.

3.2 Freedom from Defects

The blocks or sheets of material supplied shall be such that they lie substantially flat on both of the main faces. The blocks or sheets shall be free from surface imperfections or any other defects which would impair satisfactory performance.

However in cases where the material will be further shaped before fitting into a tank, it is permissible for material possessing surface defects to be supplied, provided that the positions of any such defects are suitably identified by the manufacturer, and their nature and level of incidence are such that the material can be accepted by the firm concerned with the shaping operation.

3.3 Damage-free Performance

The material shall not chemically interact with, nor cause physical damage to, rigid or flexible fuel tanks and sealants used for these tanks.

3.4 The tests listed in Table 1 shall be carried out to the satisfaction of the Type Approval Authority on the sample specified in 4.3.4. Each property of the material, when determined by the method given in Table 1 shall comply with the requirement also listed in Table 1.

3.5 The manufacturer shall also submit a certificate that material complying with the requirements of Table 1 has also been tested according to Table 2 and has given a satisfactory performance. The certificate must be from a source which is acceptable to the Type Approval Authority and it is advisable for this fact to be established at an early stage in the development and testing of a material.

3.6 After formal type approval has been given, no change in the details listed in 4.3.1, 4.3.2, 4.3.3 shall be made without the consent of the Type Approval Authority.

3.7 Duration of Approval

Type approval shall last for a period of five years.

A manufacturer may then apply for re-approval with a submission following the requirements of the specification current at the time of re-submission.

Re-approval shall also last for five years.

There is no limit to the number of re-approvals possible, provided that the material complies with all the requirements of the specification current at each re-submission.

TABLE 1

TYPE APPROVAL TESTS

	PROPERTY	REQUIREMENT	METHOD
(a)	Colour	White	
(b)	Polyamide content, % min	99	
(c)	Density g/litre	8.5 ± 1	Appendix 2
(d)	Density gradient, maximum	1.25	Appendix 2
(e)	Fibre diameter, μm	41.5 ± 3.0	Appendix 3
(f)	Grab strength, N minimum	400	Appendix 4
(g)	Initial (50%) compression force, N minimum	5.0	Appendix 5
(h)	Loss of compression force, % max after 5 cycles to 50% compression	4.0	Appendix 5
(i)	Compression set, % max	2.0	Appendix 5
(j)	Contaminants (extractable) % max	0.2	Appendix 6
(k)	Fuel retention, % max	4.5	Appendix 7
(l)	Flammability	Self extinguishing	Appendix 8

NOTE: Specimens for the tests detailed in Table 1 shall be cut from a standard block to the pattern shown in Appendix 1.

TABLE 2

SIMULATED SERVICE TESTS

The material shall perform successfully in the following types of test:

(a) Explosion suppression.
(b) Flame propagation.
(c) Resistance to hot fuel/hot air cycles.
(d) Microbiological test.
(e) Assessment of entrained solids contamination.

Advice should be sought from the type approving authority on the current status of test methods and conditions.

TABLE 3

ROUTINE QUALITY CONTROL TESTS

	PROPERTY	REQUIREMENT	METHOD
(a)	Colour	White	
(b)	Density of individual block (g/litre)	8.5 ± 2.0	
(c)	Density of batch (g/litre)	8.5 ± 1.0	Appendix 2
(d)	Density gradient (max)	1.5	Appendix 2
(e)	Grab strength, N, minimum	300	Appendix 4
(f)	Initial compression force, N, minimum	2.5	Appendix 5
(g)	Loss of compression force, %, maximum	5.0	Appendix 5
(h)	Compression set, %, maximum	3.0	Appendix 5
(i)	Contaminants (extractable) % max.	0.2	Appendix 6
(j)	Fuel retention, %, maximum	4.5	Appendix 7

NOTE: Specimens for the tests described in Table 3 shall be cut from a standard block to the pattern shown in Appendix 1.

SECTION 4

TYPE APPROVAL

4.1 Before any particular material can be accepted as complying with the requirements of this specification, it shall have received type approval. To obtain such approval the manufacturer shall satisfy the Type Approval Authority that the materials will meet all the requirements of this specification.

4.2 The Type Approval Authority for material to this specification is:

Director
Aeronautical Quality Assurance
Aeronautical Materials Division
Harefield House
Harefield
Uxbridge
Middlesex UD9 6DB

4.3 When applying for type approval the manufacturer shall submit the following:-

4.3.1 Full details of the physical and chemical composition of the fibre and the length and crimp ratio of the fibre used in the carding and subsequent melding process.

4.3.2 Details of the standard melding process.

4.3.3 Details of the composition and amount of any surface treatment applied to the fibres.

4.3.4 A sample of the material in the form of a standard sheet or block.

4.3.5 Test results for the properties listed in Table 1 of a sample similar to the one submitted and coming from the same manufactured batch.

All information and data supplied will be treated as commercial-in-confidence.

SECTION 5

ROUTINE QUALITY CONTROL

5.1 Frequency of Testing

Every block manufactured shall be tested for compliance with the requirements of tests (a) and (b) in Table 3.

Every batch shall be tested for compliance with the requirements of test (c) in Table 3.

One block, chosen at random from every batch (not more than 85 standard blocks) will be tested for compliance with the requirements of tests (d), (e), (f), (g), (h) and (i) in Table 3. If it fails to comply with the requirement of any one of these tests then a further two blocks from the batch may be tested for that particular requirement, and both must comply for the batch to be released as complying with this specification.

Test (j) shall be carried out on one block chosen at random from every twentieth batch.

5.2 The Quality Assurance Authority named in the contract may, at any time, require any batch to be checked for compliance with any requirement of Tables 1, 2 and 3.

SECTION 6

SUPPLY, PACKAGING AND IDENTIFICATION

6.1 Supply

Unless otherwise agreed between supplier and customer, the supply shall be as standard blocks of 480 mm x 480 mm x 120 mm with the density gradient being in the 120 mm direction and the main fibre orientation in a 480 mm direction.

6.2 Packaging

Each block shall be enclosed in a heat-sealed envelope of polyethylene film and packed in a container of suitable strength.

6.3 Identification

A label bearing the individual block number shall be securely attached to the polyethylene envelope of each block.

Each case shall also be marked with the numbers of the blocks contained in it, the appropriate batch number, and the date of manufacture.

APPENDIX 1

Pattern for cutting test specimens

The specimens shall be cut with a band knife from a standard block (480 x 480 x 120 mm) to the pattern shown in Figure 1.

The principal fibre direction and top (lower density) surface of the block shall be determined and the block sectioned into four pieces by first cutting into halves by a cut in the main fibre direction, and second by cuts in the main plane of the halves which are 60 mm distant from the top (lower density) surface in the case of one half, and 60 mm distant from the bottom surface for the other half.

The sections shall be identified as A, B, C and D, and their upper (lower density) surfaces identified by arrows as shown in Figure 1.

Specimens shall be cut from the sections as shown in Figure 1.

For Section A, the specimens shall be cut from the marked end.

For Section B, the specimens shall be cut from the unmarked end.

For Section C, the specimens shall be cut from the centre of the block.

For Section D, the specimens shall be cut from the marked and unmarked ends.

Specimens shall be numbered as detailed in Figure 1.

Cutting shall be to within ± 1 mm of the given dimensions.

APPENDIX 2

Determination of density and density gradient

The density of the block is given by

$$\frac{\text{Mass of all four sections}}{27.7} \text{ g/litre}$$

The density gradient is given by

$$\frac{\text{Mass of sections B + D}}{\text{Mass of sections A + C}}$$

Masses shall be measured to the nearest 0.1 g.

APPENDIX 3

Determination of fibre diameter

The size of the specimen (number 10) is 100 x 40 x 60 mm.

Three sections each 100 mm x 60 mm x 162 mm shall be cut from approximately the centre of the specimen. Pieces cut at random from these sections shall be mounted on microscope slides using a suitable mounting material. Using a microscope fitted with a suitable measuring device, the diameter of twenty different fibre sections shall be measured in micrometres to the nearest 0.5 μm at comparatively straight regions between bonds.

The average of the twenty results to the nearest 0.5 μm shall be reported as the fibre diameter.

APPENDIX 4

Determination of grab strength

The size of the specimen is 200 x 120 x 60 mm and the main orientation of the fibres is in the 200 mm direction.

A centre section 25 mm wide shall be marked in the 200 mm direction.

The specimen shall be tested in tension using a tensile testing machine conforming to BS 5214 Part 1 Grade A, and having clamps with jaws 25 mm wide and 50 mm deep. The jaws shall be fitted with rubber facings.

The specimen shall be inserted with the 200 mm dimension in the direction of separation and the marks of the 25 mm wide strip aligned with the edge of the jaws to give a test length of 100 mm approximately at the centre of the specimen.

The crosshead speed shall be 200 mm/minute and separation shall continue until rupture of the specimen.

Four specimens shall be tested, namely numbers 5, 6, 16 and 17 (Figure 1).

The maximum force attained for each specimen shall be recorded and the mean of the four results reported as the grab strength of the material.

APPENDIX 5

Determination of compression force, loss of compression force and compression set

The size of a specimen is 100 x 100 x 60 mm. Two specimens shall be placed together with their higher density surfaces uppermost to form a block of nominal height 120 mm. The true height shall be measured.

Using a testing machine conforming to BS 5214 Part 1 Grade A the block shall be compressed by 50% of its true height. Five compression cycles shall be carried out on the block using a compression speed of 100 mm/minute.

The maximum compression forces A and B attained in the first and fifth cycles shall be recorded.

The value of A shall be reported as the compression force of the specimens.

The percentage loss in compression force shall be calculated as $\frac{A-B}{A} \times 100$

The height of the specimens shall be re-measured after the block is allowed to recover for 1 hour from completion of the compression test.

The compression set shall be measured as:

$$\frac{h_1 - h_2}{h_1} \times 100$$

Where h_1 = original true height of block
h_2 = height after recovery from compression

The specimens shall be tested in the following pairings:

3 and 14, 4 and 13, 8 and 21, 9 and 20.

The respective mean values of the test results shall be reported as the compression force, loss of compression force and compression set of the material.

APPENDIX 6

Determination of contaminants (extractable)

A specimen 25 x 25 x 50 mm approximately shall be cut at random from any available part of the block. The cutting shall be carried out using a knife sufficiently sharp that negligible debris is generated by the cutting process.

The specimen shall be pre-conditioned by drying for 4 hours at 70°C followed by cooling in a desiccator.

The specimen shall be weighed to the nearest 0.1 milligram and extracted using a 60 ml Soxhlet thimble and appropriate apparatus. The test liquid shall be a 70:30 (by volume) mixture of iso-octane and toluene.

After extraction for 3 hours under continuous reflux the specimen shall be dried for 4 hours at 70°C and allowed to cool in a desiccator.

The specimen shall be re-weighed to the nearest 0.1 milligram.

The loss in weight shall be calculated as a percentage and taken to represent the contaminants (extractable) content.

APPENDIX 7

Determination of fuel retention

Four specimens each 150 x 150 x 120 mm should be cut symmetrically from the centre of a standard block with the edges of the specimens parallel to the sides of the block.

Tests shall be done on pairs of specimens, with diagonal pairing.

The weight and dimensions of each specimen shall be measured accurately to the nearest 0.1 g and 0.5 mm respectively.

Two specimens shall be placed one on top of the other in a fuel tank of approximate dimensions 350 x 180 x 180 mm.

The specimens must not touch the walls of the tank.

An aviation fuel shall be run in to completely immerse the specimens. After air bubbles have stopped emerging from the immersed material the fuel shall be allowed to drain out at a rate of 500 ± 50 ml/minute.

When the flow rate falls to less than 5 drops per minute the top specimen shall be removed and weighed.

The procedure shall be repeated with the position of the specimens reversed.

The result for each specimen shall be calculated from

$$\%\ \text{fuel retention} = \frac{(W_f - W)}{V\,P} \times \frac{8.5}{d} \times 100$$

where W_f = weight of specimen with retained fuel.
W = dry weight of specimen.
V = volume of specimen.
d = density of specimen.
P = density of fuel

The test shall be repeated using the other pair of specimens.

The mean of the four results obtained shall be reported as the fuel retention of the material (normalised to 8.5 g/litre density material).

APPENDIX 8

Determination of flammability

The size of the specimen (number 15 - Figure 1) is 240 x 380 x 60 mm. A sample 250 x 150 x 60 mm shall be obtained by cutting at 130 mm distance from the uncut 240 mm edge and 90 mm distance from the uncut 380 mm edge. A 13 mm slice shall be cut from the top (lower density surface) of this 250 x 150 x 60 mm specimen, and this slice subsidivided into 5 test specimens each 50 x 150 x 13 mm.

The five test specimens obtained shall be tested according to ASTM 1692-76.

Approved for issue:

D K Thomas

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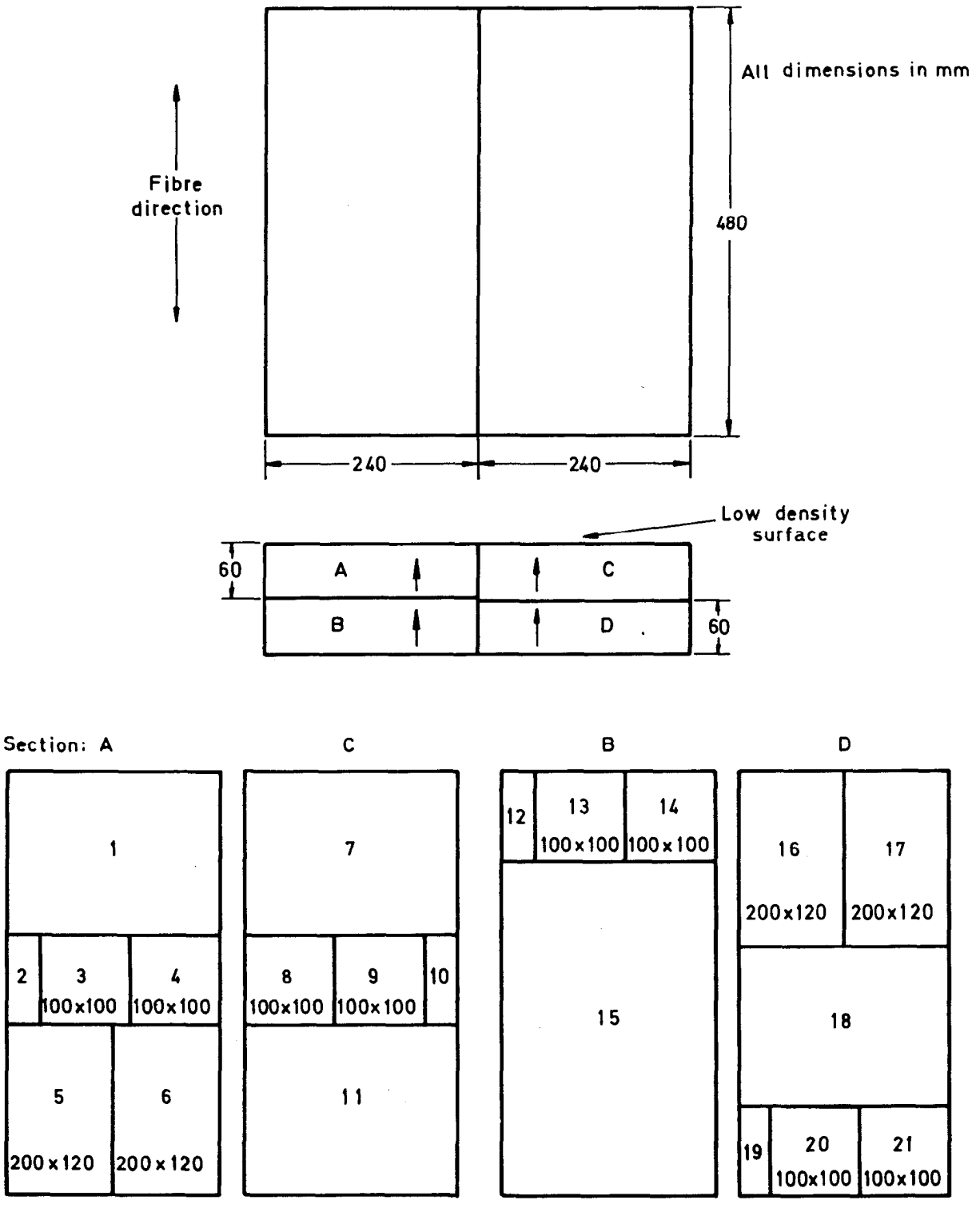

Fig 1 Standard cutting plan for test specimens

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