

**Ministry of Defence
Defence Procurement Agency, ADRP2
Abbey Wood
Bristol
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.

Aerospace Material Specification
ELASTOMERIC TOROIDAL SEALING RINGS (O RINGS)
FLUOROCARBON TYPE

NOTE 1. This specification is one of a series issued by Procurement Executive, Ministry of Defence, to meet a requirement not covered by an existing European or British Standard for aerospace material.

NOTE 2. The use of this specification will be reviewed periodically. Whenever possible it will be offered to AECMA as the basis of a European Standard (Aerospace) or to BSI for issue as a British Standard (Aerospace).

NOTE 3. The tests employed in this specification are chosen for their reproducibility and ability to control the properties of the material. They are not intended to be simulated service tests which, because of variability of test conditions, may be unsatisfactory for control purposes.

NOTE 4. Further guidance on the choice of rubber for any particular purpose may be obtained from Appendix 1 of DR Mat Tech Memo No 7 - "Rubber in Engineering Design" and SBAC TS No 97 "Recommended Design Guide for Rubber Materials for Aerospace Applications".

NOTE 5. This specification calls for the use of substances and/or 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.

NOTE 6. Information on the status and currency of this specification can be obtained from Specifications Section, Materials and Structures Department, Royal Aircraft Establishment, Farnborough Hants.

SECTION 1

Scope

1.1 Scope

This specification defines the requirements for toroidal sealing rings ('O' rings) manufactured from materials which have been approved to DTD 5543 - "Fluorocarbon Rubbers".

They may be used in reciprocating mechanisms or for static purposes in contact with air, silicone liquids and petroleum based fuels, lubricants and hydraulic fluids where temperatures up to 225°C are encountered. In certain applications the materials may be suitable for use outside this temperature range, but where such use is contemplated the designer should satisfy himself of the suitability.

The materials are not suitable for use in contact with certain phosphate ester based liquids.

They are generally suitable for use in contact with other ester based liquids, but there may be temperature limitations in service.

NOTE: At ordinary temperatures and in the absence of hostile environments e.g. when properly stored, these rubbers deteriorate only very slowly. For most practical purposes the effect is insignificant and storage life of fluorocarbon rubbers may be considered indefinite. However, the rate of deterioration increases markedly with increased temperature and the service life of the rubber therefore depends upon the operational temperature. Conversely, the maximum temperature at which the rubber may be used depends upon the useful life required.

1.2 Hardness values

Four different hardness ranges are detailed specifically in the Table of requirements and they are assigned the Grade numbers shown in the Table.

This division into ranges of hardness is designed for convenience and conforms to international usage.

However use of this specification is not limited to the particular hardness ranges specified. Where a nominal hardness other than those quoted is needed, this can be specified by the user and the basic requirements other than hardness shall be those given for the Grade embracing the proposed nominal hardness.

For example where a hardness of 75 is specified by a user the requirements of Grade 80 apply as the value of 75 lies within the 71 to 83 hardness range for Grade 80.

If a hardness value is so specified by a user then the tolerance will be taken as (+3, -9) unless a tighter tolerance is agreed with the supplier.

The Grade or nominal hardness required shall be stated in all drawings and contracts.

SECTION 2

Related Documents

Reference is made in this specification to the following:

BS 903	- Methods of testing vulcanized rubber.
BS 907	- Dial gauges for linear measurement.
BS F69	- Packaging and identification of vulcanized rubber items.
BS M48	- Dimensions of elastomeric toroidal sealing rings for aerospace use: inch series.
DTD 5543	- Fluorocarbon Rubbers.
SBAC TS49	-Elastomeric toroidal sealing rings ('O' rings), manufacturing and inspection standards for aerospace applications.

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, supersession or amendment of any related document.

SECTION 3

General Requirements

3.1 Dimensions

The dimensions shall be in accordance with BS M48 or other approved specification, standard or drawing stated on the order.

3.2 Freedom from Defects

The sealing rings shall be uniform in quality and condition, clean, smooth and free from foreign matter and imperfections detrimental to the performance of the parts as defined in SBAC TS 49.

SECTION 4

Type Approval

4.1 Type Approval

Before sealing rings can be accepted as complying with the requirements of this specification, they shall have received type approval. To obtain such approval the manufacturer of the rings shall satisfy the type of approving authority that type approval to DTD 5543 has been given for the particular compound and that the rings made from the compound will meet all the requirements of this specification.

Because of differences in measurement and test techniques the hardness values of O rings and sheet material made from the same compound may not necessarily be identical. It is sufficient therefore that the compound from which the O rings are made has been given type approval to DTD 5543, and it is not essential that the hardness value of the compound approved to a particular grade of DTD 5543 matches exactly the hardness value of the O rings submitted for approval.

4.2 Type Approving Authority

The type approving authority for sealing rings to this specification is:-

Defence Quality Assurance/Technical Support, Materials Centre, Royal Arsenal East, Woolwich.

4.3 Test Samples

When applying for type approval the manufacturer shall submit the following.

- 4.3.1 The compound reference number approved to DTD 5543.
- 4.3.2 The grade or nominal hardness of the O rings.
- 4.3.3 A representative test sample, together with details of the curing conditions used, as follows:
 - a. 30 rings (minimum) size 015 of BS M48, i.e. 1.78 mm section x 14 mm internal diameter,
 - and b. 30 rings (minimum) size 215 of BS M48, i.e. 3.53 mm section x 26.57 mm internal diameter.
- 4.3.4 Test results on samples from the same lot as 4.3.2.

4.4 Tests

All the tests listed in the Table shall be carried out on the samples specified in 4.3.3. Each property, when determined by the method given in the Table, shall comply with the requirements of this specification.

4.5 After formal type approval has been given, no change in the compound or vulcanizing conditions shall be made without the consent of the type of approving authority.

4.6 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

Test	Test Requirement					Test Method	
	Cross section (mm)	Grade 60	Grade 70	Grade 80	Grade 90		
(a) Apparent hardness, IRHD	1.70 to 2.70	60+3 - 9	70 + 3 - 9	80+3 - 9	90+3 - 9	Appendix I	
	over 2.79	60+5 - 7	70 + 5 - 7	80+5 - 7	90+3 - 7		
(b) Density, Mg/m ³	All Sections	Within ± 0.02 of the agreed value				BS 903 Part A1 Method A	
(c) Compression set, % max	(i) After 24 hrs. compression	1.70 to 2.79	50	45	45	Appendix II	
		over 2.79	40	40	40		
	(ii) After 70 hrs. compression	1.70 to 2.79	65	60	60		70
		over 2.79	60	55	55		
(d) Resistance to liquids, volume change, % max.	1.70 to 2.79	- 0 +10	- 0 +10	- 0 +9	- 0 +9	Appendix III	
	over 2.79	- 0 +8	- 0 +8	- 0 +7	- 0 +7		
(e) Resistance to heat ageing	(i) Change in hardness, IRHD max	All Sections	- 4 +6	- 4 +6	- 4 +6	Appendix IV	
		1.70 to 2.79	12	10	10		8
	over 2.79		10	8	7		6

SECTION 5

Routine Quality Control

- 5.1** Sealing rings shall be made only from compound which has satisfied the routine quality control requirements of DTD 5543.
- 5.2** From every batch of rubber mix, samples from the first lot of finished rings shall be tested for compliance with the requirements of tests (a), (b), (c) (ii), (d) and (e) of the Table, and samples from each subsequent lot of finished rings shall be tested for compliance with the requirements of tests (a) and (c) (i) of the Table.

- 5.3 As an alternative to 5.1, where batches of mix are intended solely for the manufacture of rings to this specification, the first production batch of rubber mix and subsequently at least every tenth batch of rubber mix shall be tested in accordance with the appropriate routine quality requirements of DTD 5543 and shall comply with the test requirements.

For all other batches of rubber mix, provided that the rings are sampled and tested as specified in 5.2, the testing of sample sheets may be dispensed with, but a test sheet must nevertheless be available for the Quality Assurance Authority.

- 5.4 The Quality Assurance Authority may, at any time, require any of the tests listed in the Table to be carried out on further rings in addition to those specified in 5.2.

NOTE: The term 'lot of finished rings' is defined as a number of rings from the same batch of rubber mix postcured in the same oven load. It may include rings of different sizes.

SECTION 6

Quality Assurance Documents

The manufacturer shall state on each quality assurance document (eg certificate of conformity) the part number, the specification number, the grade or nominal hardness, the date of vulcanisation (quarter and year), the item lot number, and the compound reference (manufacturer's designation) of the rubber material used.

SECTION 7

Packaging and Identification

Unless otherwise stated on the drawing or in the order or contract, the 'O' rings shall be packaged and the package identified in accordance with the requirements of BS F69.

APPENDIX I

Method for the Determination of Apparent Hardness

Hardness measurements required for test (a) shall be made by Method CM of BS 903 Part A26, except that wax shall not be used to locate the test piece. Three test pieces shall be used.

APPENDIX II

Method for the Determination of Compression Set

Compression set measurements shall be made by Method A of BS 903 Part A6 with the following modifications necessitated by the use of sealing rings as test pieces:

i Thickness Gauge

One of the following measuring instruments shall be used:

- An electronic thickness comparator firmly held in a rigid stand over a flat base plate not less than 50 mm in any direction, and have a moving contact member with a flat circular contact area of diameter $5 \text{ mm} \pm 0.05 \text{ mm}$. The force exerted by the moving contact member shall be $0.85 \text{ N} \pm 0.03 \text{ N}$.
- A dial gauge firmly held in a rigid stand above a flat base plate not less than 50 mm in any direction, and having a moving contact member with a flat circular contact area of diameter $5 \text{ mm} \pm 0.05 \text{ mm}$. The gauge shall have a scale graduated in unit divisions of 0.01 mm and shall comply where relevant with the requirements of BS 907. The force exerted by the moving contact member shall be $0.85 \text{ N} \pm 0.03 \text{ N}$.

Both instruments shall be capable of measuring to an accuracy of $\pm 0.005 \text{ mm}$ (NOTE: This applied to the instruments only, not to their capability of measuring 'O' ring cross sections).

ii Test Pieces

In the case of sealing rings having an internal diameter of 13 mm or greater the test piece shall consist of a section approximately 25 mm in length cleanly cut from a ring by straight cuts across the cord of the ring. In the case of sealing rings having an internal diameter of less than 13 mm, the test piece shall be a whole ring vented by a single cut through the cord section. The variation in cord diameter along the length of the test piece shall not exceed $\pm 2\%$ of the nominal cord diameter.

Three test pieces shall be used for each determination.

iii Measurement of Test Pieces

The cord diameter of each test piece shall be measured at a marked point approximately midway along its length, the measurement being made across the cord diameter at right angles to the plane of the ring (designated 'W' in BS M48). If an instrument with a moving contact member is used, the axis of movement shall be vertical and in line with the dimension being measured.

The measurement shall be taken as the original test piece thickness (t_c). The thickness of the test piece after recovery (t_r) shall be measured in a similar manner at the same point.

The ink or other agent used for marking shall have no deleterious effect on the rubber and shall be of contrasting colour to that of the rubber. It shall be so applied that it does not come into contact with the plates when the 'O' rings are under compression.

iv Spacers

The spacer(s) shall be chosen so that each test piece shall be compressed to a value (t s) of $75 \pm 2\%$ of its original thickness. t_s shall be measured to an accuracy of ± 0.01 mm.

Where more than one spacer is used in the same jig space they shall not vary in thickness by more than ± 0.01 mm.

The test pieces shall not be lubricated.

The duration of the compression period shall be 24 hours for test (c) (i) and $70(+2,-0)$ hours for test (c) (ii) and the temperatures shall be $200^\circ \pm 3^\circ\text{C}$.

*NOTE: At the test temperature rubbers complying with the requirements of this specification may **in time cause discolouration, etching or corrosion of the clamping surfaces and these should be periodically cleaned.***

APPENDIX III

Method for the Determination of resistance to Liquids

Volume change measurements shall be made by the volumetric method of BS 903, Part A16, using Test Liquid B.

The temperature of test shall be $40^\circ \pm 1^\circ\text{C}$, and the period of immersion $70(+2,-0)$ hours.

APPENDIX IV

Method for the Determination of Resistance to Heat Ageing

Test pieces appropriate to the test given below shall be conditioned by heating in air at 200°C for 30 minutes and allowed to cool in a dessicator, then aged by Method A or B of BS 903, Part A19 at a temperature of $250^\circ\text{C} \pm 3^\circ\text{C}$ for $70(+2,-0)$ hours.

- i Change in hardness. Hardness measurements shall be carried out before and after ageing by the appropriate method described in Appendix I.
- ii Loss in weight. Test pieces shall be weighed in air before and after ageing. The loss in weight shall be expressed as a percentage of the original weight.

©Crown copyright 1986
First published 1986

HMSO Publications are available from:

HMSO Publications Centre

(Mail and telephone orders only)
PO Box 276, London, SW8 5DT
Telephone orders 01-622 3316
General enquiries 01-211 5656
(queuing system in operation for both numbers)

HMSO Bookshops

49 High Holborn, London, WC1V 6HB	01-211 5656 (Counter service only)
258 Broad Street, Birmingham, B1 2HE	021-643 3757
Southey House, 33 Wine Street, Bristol, BS1 2BQ	(0272) 24306/24307
9-21 Princess Street, Manchester, M60 8AS	061-834 7201
80 Chichester Street, Belfast, BT1 4JY	(0232) 238451
13a Castle Street, Edinburgh, EH2 3AR	031-225 6333

HMSO's Accredited Agents

(see Yellow Pages)

and through good booksellers

£1.90 net

ISBN 0 11 772586 2