

TDC: 5:151 Rev.No.:02 Effective Dt.:15/11/96

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**ELASTOMERIC COMPOUNDS  
for OIL FIELD EQUIPMENT**

**Revision record:**

Rev:00/16.04.90 : First issue

Rev:01/04.12.93 : Editorial corrections

Rev:02/15.11.96 : Elastomer TDCs 5:131,135,154,155,156,157,161,162,163,179,183 & 184 merged & rewritten

**1.0 MATERIAL SPECIFICATION** - Elastomer materials of grade specified in P.O.or drg. The property requirements are as given in Table-1.

**2.0 GENERAL**

These Elastomeric compounds are for use as O-rings/packings in water and oil based drilling fluids, sea water, petroleum based lubricants and ethleneglycol anti-freeze mixtures.

Shall be manufactured to the relevant size in the drawing.

The grade nos. specified correspond to the Standards of M/s National;USA.

**3.0 ENGINEERING REQUIREMENTS**

**MATERIAL PROPERTIES:** The property requirements for the elastomers are given in table-1.

The hardness tests shall be carried out as per D2240/ D1415 and tensile tests as per D412/D1414(as per D1457 for PTFE materials).Additional property requirements for grades MS-447 & MS 452 (tested as per D621) are as follows.

|                                                                              | MS 447   | MS 452  |
|------------------------------------------------------------------------------|----------|---------|
| Coefficient of thermal expansion (in/in/ $F \times 10^{-5}$ ) at 75 to 300°F | 6.0+ 0.5 | 7.6+0.5 |
| % deformation under load(max.)(24 Hours at 2000 psi at 70°F Min).            | 5.0      | 3.5     |
| % permanent deformation (max.)after load release                             | 2.0      | 2.2     |

**4.0 INSPECTION & TESTING**

The dimensions on the finished product shall conform to the relevant drawing.

Sampling inspection shall be carried out for visual,dimensions & hardness as per Cl.8.0.

The following type tests shall be carried out for conformance to this specification:

**TYPE TESTS**

**AIR AGING TEST :** This test shall be carried out in an Air oven (ASTM D573) or by heating in air in a test tube enclosure (ASTM D865).The purpose of this test is to determine the influence of elevated temperatures on the physical properties of vulcanized rubber.

The test shall be carried out at Minimum test temperature shown in table-2 for each grade for 70 hrs. in accordance with ASTM D412 and properties after air aging test shall conform to table-2.

**COMPRESSION SET TEST :** This test shall be carried out in accordance with ASTM D395 B i.e. Compression set under constant deflection in air with exceptions listed out in ASTM D1414 Cl.10.0

The test shall be performed at a minimum test temperature indicated in table-2 for 70 hours, except for Grade MS 225. For grade MS:225, the test duration shall be 22 hours.

The maximum permanent compression set shall comply to table-2.

**LOW TEMPERATURE BRITTLINESS TEST :** This test ensures that rubber will not exhibit fracture when subjected to specified impact conditions.The Test shall be carried out in accordance with ASTM D2137/D746 and shall PASS at the test temperature indicated in table-2.

**IMMERSION TEST :** This test ensures the ability to withstand the effect of liquids and shall be carried out in accordance with ASTM D471/D1414.

The liquids used for the test shall be ASTM Oil 1&3 at a minimum temperature indicated in Table-3 for various grades and Distilled water at a minimum temperature of 212°F for a period of 70 hrs.

Permissible variation in properties after immersion in liquids are given in Table- 3.

Immersion test is not applicable for grades MS 447 & MS 452.

**VALIDITY :** The validity of these Type test results is for two years from the date of test,in the case of PSL 1,2 & 3. However, in case of PSL 4,this test shall be carried out for each batch of purchase order. The type test shall be conducted at approved laboratory or witnessed by BHEL.

**5.0 SPECIAL REQUIREMENTS**

Insert ring shall be positioned as shown in BHEL drawing or the drawing approved by BHEL.

After Moulding, all parts must be inspected by the vendor/manufacturer to ensure proper positioning of the insert ring. The NDE to be followed can be RT/MT and meet the requirement indicated in the drawing.

The ring must be generally located in the web of the seal, but in no case, in flexible lip of the seal. No part of the ring shall be visible to the naked eye unless it is specified in the drawings.

#### 6.0 DOCUMENTATION

For PSL 1,2 & 3: Certificate of compliance which indicates P.O.No, Drg No, Material grade & type tested compound no, Batchwise Cure/mould date & Shelf life(expiry date) shall be submitted.

For PSL 4 : Test certificates for the physical properties, in addition to certificates mentioned above shall be submitted for each P.O.

#### 7.0 MARKING AND PACKING

Each item shall be packed in polythene cover individually with suitable preservatives like French chalk powder with label having following details.

- (a) Drg. Number & size (b) Purchase Order No. (c) Batch Number  
(d) Compound No. (e) Date of Cure/Mould (f) Shelf life (expiry date)  
(g) Any other relevant details specified in the Purchase Order/drawing.

Each item shall be supplied in sturdy carton boxes to protect against permanent distortion during shipment and storage and from sunlight, dust etc. during shipment and storage. Each box shall contain only one size and lot of the product as given below.

- (1) Size more than 6" -- each separate box (2) Size 2" to 6" -- 5 nos. in one box  
(3) Size below 2" -- 10 nos. in one box.

Each box shall also be labeled with details specified above viz (a) to (g) above.

#### 8.0 SAMPLING PLAN: for elastomeric compounds based on MIL-STD-105(latest) single sampling normal inspection.

| Lot size   | Sample size | Acceptance/Rejection criteria                         |
|------------|-------------|-------------------------------------------------------|
| 26 to 50   | 8           | No defect permitted                                   |
| 51 to 90   | 13          | -do-                                                  |
| 91 to 150  | 20          | Accept when no. of defect $\leq 1$ ; Otherwise reject |
| 151 to 280 | 32          | -do-                                                  |
| 281 to 500 | 50          | Accept when no. of defect $\leq 2$ ; Otherwise reject |

For lot size 25 Nos. & below, 100% inspection shall be done.

TABLE-1 PROPERTY REQUIREMENT OF ELASTOMERS

| Elastomer Grade             |       | MS-219 | MS-220 | MS-221 | MS-225 | MS-231 | MS-233 | MS-426      | MS-427 | MS-428 | MS-430 | MS-431 | MS-447 | MS-452 |
|-----------------------------|-------|--------|--------|--------|--------|--------|--------|-------------|--------|--------|--------|--------|--------|--------|
| material                    |       | NBR    | NBR    | NBR    | NBR    | FKM    | FKM    | TFEP        | TFEP   | FVMQ   | HSN    | XNBR   | PTFE   | PTFE   |
| Hardness                    | Value | 60±5   | 70±5   | 90±5   | 70±5   | 90±5   | 70±5   | 90+10<br>-5 | 80±5   | 85±10  | 80±5   | 70±5   | 65±5   | 63±5   |
|                             | Type  | (A)    | (A)    | (A)    | (A)    | (A)    | (A)    | (A)         | (A)    | (A)    | (A)    | (A)    | (D)    | (D)    |
| Applicable                  | Min.  | 0      | -20    | -20    | 32     | 0      | -20    | -20         | -20    | -50    | -20    | -20    | -50    | -50    |
| Temp. Range(°F)             | Max.  | 180    | 180    | 180    | 200    | 250    | 250    | 250         | 250    | 250    | 250    | 180    | 250    | 250    |
| Tensile strength in         |       |        |        |        |        |        |        |             |        |        |        |        |        |        |
| Psi (min)                   |       | 2000   | 2000   | 2500   | 2000   | 1600   | 1500   | 2200        | 2000   | 1000   | 2500   | 2000   | 1500   | 1000   |
| Ultimate elongation         |       |        |        |        |        |        |        |             |        |        |        |        |        |        |
| % (min)                     |       | 500    | 300    | 200    | 350    | 100    | 100    | 100         | 100    | 150    | 150    | 300    | 75     | 75     |
| Tensile modulus (psi)at 200 |       | 400    | 800    | 600    | 500    | 500    | -      | 1000        | 500    | 500    | 400    | -      | -      | -      |
| 100% elongation (min)       |       |        |        |        |        |        |        |             |        |        |        |        |        |        |
| Tensile modulus (psi)at     |       |        |        |        |        |        |        |             |        |        |        |        |        |        |
| 50% elongation (min)        |       | -      | -      | -      | -      | -      | -      | 1500        | -      | -      | -      | -      | -      | -      |
| Shelf life in years         |       | 2      | 2      | 2      | 2      | 4      | 4      | 4           | 4      | 4      | 2      | 2      | 10     | 10     |

NBR - Nitrile FVMQ - Fluoro Silicone (Silastic LS) FKM - Fluoro carbon(VITON, FLUOREL)  
HSN - Hydrogenated Nitrile TFEP - Tetra fluoro ethylene & Propylene(AFLAS) XNBR - Carboxylated Nitrile  
PTFE - Teflon (W/25% carbon/graphite filler)-MS447; PTFE - Teflon (W/RYTON/MoS2/Carbon filler)-MS452

**TABLE-2 : AIR AGING, COMPRESSION AND LOW TEMPERATURE BRITTLENESS TEST REQUIREMENTS**

| Grade  | (*)<br>Min.<br>Test<br>Temp<br>°F | AIR AGING TEST          |                        |                           |               | COMPRESSION<br>TEST RESULT<br>(Compression<br>set)<br>in (%)<br>max | TEST TEMP.<br>FOR LOW<br>TEMPERATURE<br>BRITTLENESS<br>TEST. |
|--------|-----------------------------------|-------------------------|------------------------|---------------------------|---------------|---------------------------------------------------------------------|--------------------------------------------------------------|
|        |                                   | Acceptable variation in |                        |                           |               |                                                                     |                                                              |
|        |                                   | Hardness<br>points      | Tensile<br>Strength(%) | Ultimate<br>Elongation(%) | Volume<br>(%) |                                                                     |                                                              |
| MS 219 | 180                               | ± 05                    | ± 10                   | ± 20                      | ± 10          | 40                                                                  | 0°F                                                          |
| MS 220 | 180                               | ± 10                    | ± 15                   | ± 20                      | ± 05          | 30                                                                  | 0°F&-20°F                                                    |
| MS 221 | 180                               | ± 05                    | ± 10                   | ± 30                      | ± 10          | 25                                                                  | 0°F&-20°F                                                    |
| MS 225 | 212                               | ± 10                    | ± 10                   | ± 20                      | ± 10          | 40                                                                  | 32°F                                                         |
| MS 231 | 250                               | ± 10                    | - 40max                | - 20max                   | ± 10          | 40                                                                  | 0°F                                                          |
| MS 233 | 250                               | ± 10                    | - 40max                | - 20max                   | ± 10          | 40                                                                  | 0°F&-20°F                                                    |
| MS 426 | 250                               | ± 10                    | ± 10                   | ± 15                      | ± 10          | 30                                                                  | 0°F&-20°F                                                    |
| MS 427 | 250                               | ± 10                    | - 25                   | - 25                      | -             | 40                                                                  | 0°F&-20°F                                                    |
| MS 428 | 250                               | ± 05                    | ± 10                   | ± 10                      | ± 10          | 30                                                                  | 0°F, -20°F,<br>-50°F&-75°F                                   |
| MS 430 | 250                               | ± 10                    | ± 10                   | ± 20                      | ± 10          | 30                                                                  | 0°F&-20°F                                                    |
| MS 431 | 180                               | ± 05                    | ± 15                   | ± 20                      | ± 10          | 35                                                                  | 0°F&-20°F                                                    |
| MS 447 | -                                 | -                       | -                      | -                         | -             | -                                                                   | 0°F, -20°F<br>& -50°F                                        |
| MS 452 | -                                 | -                       | -                      | -                         | -             | -                                                                   | 0°F, -20°F<br>& -50°F                                        |

(\*) Min. test temperature is same for both air aging test &amp; compression test

**TABLE-3 : IMMERSION TEST REQUIREMENT**

| Grade  | Min Test temp. °F (*) | Permissible variation in properties (±) with |                    |                       |        |              |                    |                       |        |                 |                    |                       |        |
|--------|-----------------------|----------------------------------------------|--------------------|-----------------------|--------|--------------|--------------------|-----------------------|--------|-----------------|--------------------|-----------------------|--------|
|        |                       | ASTM Oil # 1                                 |                    |                       |        | ASTM Oil # 3 |                    |                       |        | Distilled water |                    |                       |        |
|        |                       | Hard-ness                                    | Ten-sile stren-gth | Ulti-mate Elon-gation | Volume | Hard-ness    | Ten-sile stren-gth | Ulti-mate Elon-gation | Volume | Hard-ness       | Ten-sile stren-gth | Ulti-mate Elon-gation | Volume |
| MS 219 | 180                   | 05                                           | 10                 | 20                    | 10     | 10           | 20                 | 15                    | 20     | 05              | 15                 | 20                    | 10     |
| MS 220 | 180                   | 10                                           | 20                 | 20                    | 10     | 10           | 20                 | 20                    | 10     | 10              | 20                 | 20                    | 10     |
| MS 221 | 180                   | 05                                           | 15                 | 30                    | 10     | 05           | 15                 | 30                    | 10     | 05              | 15                 | 10                    | 05     |
| MS 225 | 212                   | 05                                           | 05                 | 10                    | 05     | 05           | 05                 | 10                    | 10     | -               | -                  | -                     | -      |
| MS 231 | 250                   | 05                                           | 15                 | 10                    | 05     | 05           | 10                 | 10                    | 05     | 05              | 20                 | 10                    | 10     |
| MS 233 | 250                   | 05                                           | 15                 | 10                    | 05     | 05           | 10                 | 10                    | 05     | 05              | 20                 | 10                    | 10     |
| MS 426 | 250                   | 10                                           | 15                 | 20                    | 10     | 10           | 15                 | 20                    | 20     | 10              | 15                 | 20                    | 10     |
| MS 427 | 250                   | 05                                           | 15                 | 25                    | 10     | 10           | 20                 | 25                    | 10     | 05              | 15                 | 20                    | 10     |
| MS 428 | 250                   | 05                                           | 15                 | 10                    | 10     | 10           | 20                 | 10                    | 30     | 05              | 10                 | 10                    | 10     |
| MS 430 | 250                   | 10                                           | 10                 | 20                    | 10     | 10           | 10                 | 20                    | 10     | 06              | 10                 | 10                    | 10     |
| MS 431 | 180                   | 10                                           | 20                 | 20                    | 10     | 10           | 20                 | 20                    | 10     | -               | -                  | -                     | -      |

\*Min. test temp. specified is only for immersion test with ASTM Oil #1 &amp; 3. For distilled water, the test temp. is 212°F.

NOTE: Values indicated in Table are % values, except for Hardness. For hardness, it is variation in absolute value.

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