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AEROSPACE STANDARD

AS 871 A

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MANUFACTURING AND INSPECTION STANDARDS FOR PREFORMED PACKINGS (O-RINGS)

1. PURPOSE

To establish standards for manufacture and inspection of elastomeric toroidal sealing rings, preformed packings (commonly known as O-rings).

2. SCOPE

This specification controls surface condition, manufacturing defects and inspection requirements, and defines methods of measurement for elastomeric toroidal sealing rings (O-rings) for static (including gasket) applications.

2.1 Limitations: The specification refers only to O-rings produced by molding processes and does not cover scarf-jointed O-rings manufactured from fully-cured round cords.

3. MANUFACTURING REQUIREMENTS

3.1 Mold Condition:

3.1.1 Surface Texture: The general finish of O-rings will be influenced by the finish and cleanliness of the mold-cavities from which they are produced. The surface texture of the forming cavities shall not exceed 16 microinches AA (0.4 micrometers) per ANSI B46.1 - 1962 and these surfaces shall be free from foreign material.

3.2 O-Ring Quality:

3.2.1 Dimensional Tolerance: The finished dimensions of the O-ring shall conform to those quoted in the relevant standard (see Fig. 1) except that the parting line projection may extend beyond the maximum cross section diameter. See paras 3.2.3 and 3.2.5. Variations in finished shape of section as permitted in paras 3.2.4 and 3. 2. 6 shall be within the cross-sectional tolerances specified in the relevant standard.

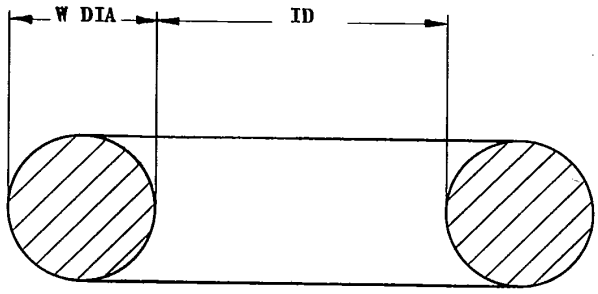
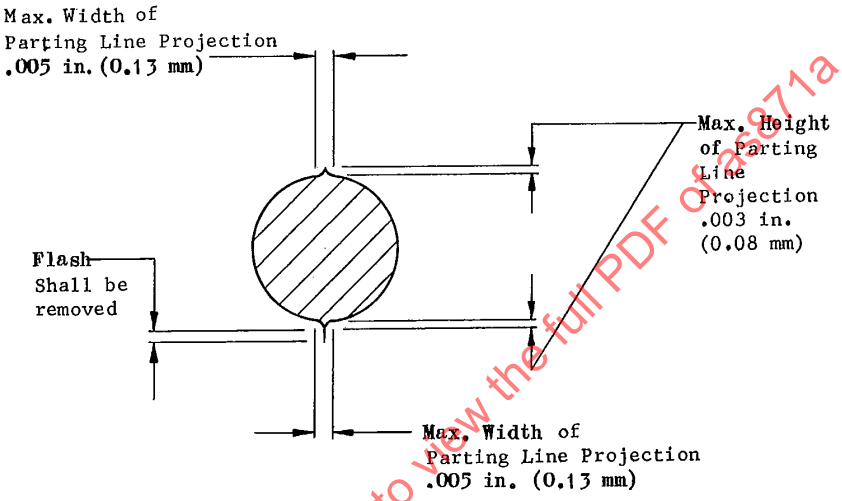


FIGURE 1

NOTE: Preferred methods of measurement are quoted in Para. 4.

3.2.2 Surface Condition: No foreign material (any extraneous embedded matter) or backrind is acceptable on the surface of the O-ring. Defects such as inclusions and indentations, flowmarks and other indicated faults shall not exceed the limits described in Appendix A.

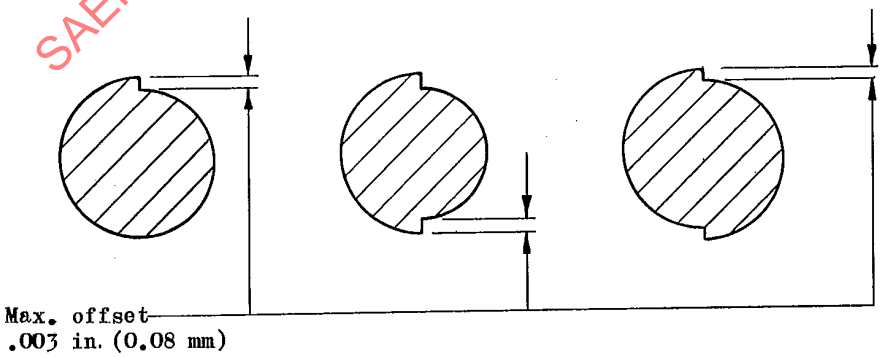
3.2.3 Parting Line Projection: This projection, a continuous ridge of material situated on the parting line, caused by worn or otherwise excessively rounded mold edges, shall not exceed .003 in. (0.08 mm) high or .005 in. (0.13 mm) wide, unless otherwise specified on the drawing. The parting line projection may extend beyond the maximum cross section diameter.
Flash, i.e. the very thin gage, sometimes film-like material, which extends from the parting line projection, shall be removed (See Fig. 2).



MAXIMUM PERMISSIBLE PARTING LINE PROJECTION

FIGURE 2

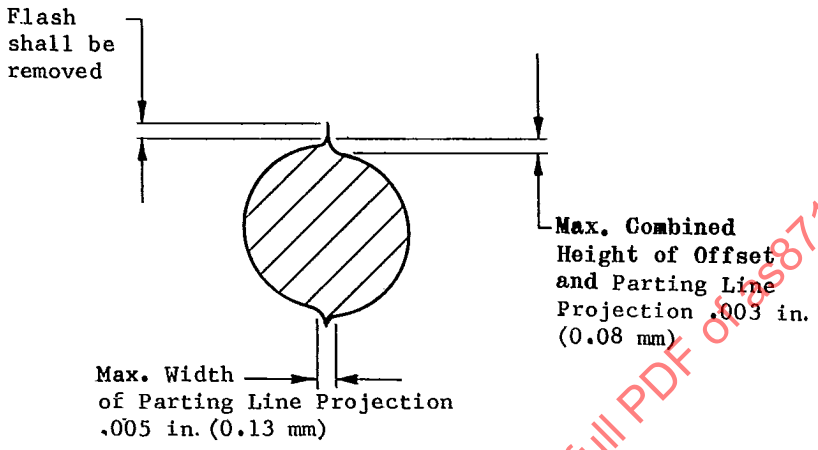
3.2.4 Off Register and Mismatch (Offset): Off register of the preformed packing resulting from the two halves of the mold cavities being out of line, and Mismatch of the preformed packing resulting from one half of the mold cavity being larger than the other shall not exceed .003 in. (0.08 mm) measured at the position of maximum offset on the molded O-ring (See Fig. 3) and shall not deviate from the nominal section of the ring in excess of the drawing tolerances.



FORMS OF OFF REGISTER AND MISMATCH

FIGURE 3

3.2.5 Combined Molding offset (Off Register and/or Mismatch) and Parting Line Projection: The combination of parting line projection and offset, shall not exceed .003 in. (0. 08 mm) high when measured at the position of maximum offset (See Fig. 4). It is permissible for this combined offset and parting line projection to extend beyond the maximum cross-section diameter.



COMBINED OFFSET (OFF REGISTER AND/OR MISMATCH) AND PARTING LINE PROJECTION

FIGURE 4

3.2.6 Flats: Flats resulting from the removal of flash on the inner and outer axial dimensions of an O-ring shall not exceed a depth of .003 in. (0.08 mm) and shall not cause deviation from the nominal section of the ring in excess of the drawing tolerances, i.e. when the cross sectional diameter is on its lower limit no flatting is permissible. Non-continuous flats shall be blended out smoothly.

4. METHODS OF MEASURING FOR RECEIVING INSPECTION

There shall be no lubrication used on gages or O-rings during inspection. Measurements shall be taken at room temperature. In cases of dispute the gages and the O-rings to be inspected shall be held at a temperature of 21 - 25 C (69.8 - 77 F) and a relative humidity of 45 to 55% for sufficient time to stabilize their dimensions.

Care shall be taken in the handling of the O-rings to avoid distortion and stretch resulting in any measurable dimensional change.

The contacting surfaces of the measuring gages shall have a maximum surface roughness of 16 microinches (0.4 micrometers) per ANSI B46.1 - 1962.

4.1 Cross Section ("W" dimension): Cross-sectional diameter shall be determined by one of the following means:

Micrometer (Ball type Anvils)
Vernier Calipers
Optical Comparator
Rotating Type Fixture with Dial Indicator
Other Equipment of Equivalent Accuracy

4.1.1 The micrometer or calipers may be preset to the dimension to be checked. Readings shall be taken at four (4) locations, 90 degrees apart, around the circumference, radially and parallel to the axis of the O-ring.

4.1.2 The rotating fixture may be one of two types: cylindrical, with the packing mounted on a cylinder of predetermined diameter, with rotatable dial indicator attachment. The other type consists of a surface plate and .500 in. (12. 700 mm) diameter flat contact button. The dimension shall be measured between a surface plate and a .500 in. (12. 700 mm) diameter flat contact button attached to an indicator. The measurement shall be made with the O-ring cross-section centered under the contact button and with O-ring rotated so that parting line projection, if any, does not interfere.

4.1.3 Dial indicators used in the inspection of O-rings shall be graduated in maximum increments of .001 in. (0.025 mm) and shall have a maximum contact pressure of one ounce (0.02835 kg). Care shall be taken to ensure that the contact pressure does not significantly affect the accuracy of the reading. The indicator reading shall not exceed the tolerance for any nominal cross-section when rotated through 360 degrees except as permitted in the area of the parting line projection. Refer to 3.2.1, 3.2.3, and 3.2.5.

4.1.4 An optical comparator of 10X magnification should be used to determine compliance with drawing requirements.

4.2 Inside Diameter ("ID"): Inside diameter shall be determined by one of the following means:

"Go" or "Not-Go" Plug-Gage
Flat Plug-Gage
Calibrated or Stepped Taper-Gage
Traveling Microscope
Optical Comparator

4.2.1 Sizes up to 2.510 in. (63.754 mm) exclusive, diameter shall be gaged for a sliding fit over a standard cylindrical "go" and "not go" diameter plug gage, a flat plug gage or tapered stepped gage or tapered gage. (See Figures 5, 6, 7 and 8.)

4.2.2 Sizes 2.510 in. (63.754 mm) and over may be gaged for a sliding fit over a flat plug gage (see Fig. 6) or on a tapered, stepped gage (calibrated or uncalibrated) that represents the specified minimum and maximum inside diameter.

4.2.3 The latter gage may be designed to be multi-purpose by having a series of truncated cones in the form of layers (see Fig. 7). Each step shall consist of a taper of such angularity that the sloping portion of the step shall cover the "go" diameters and the flat step the "not go" diameters. It will be necessary to have gages for each cross-section series and size. The top of each step shall be so sized that when a minimum I.D., maximum cross sectional diameter O-ring is dropped freely, in a radial plane over the step, the top of the step and the top of the O-ring will be in a plane. Similarly, the bottom of each step shall be sized so that a maximum I.D., maximum cross-sectional diameter O-ring will just clear the flat bottom step of the gage.

4.2.3.1 Mandrels with a .020 in./in. (0.02 mm/mm) taper, which are calibrated with a height gage, can be used to measure O-ring I.D. The height gage is arranged so that the tolerance spread is indicated for the particular O-ring measured. A micrometer adjustment is provided to permit realignment of the pointers for taking readings at the outside surfaces rather than the centerline of the O-ring (See Fig. 8).

4.2.3.2 A typical calibrated taper gage with .200 in. per ft. (0.2 mm/12 mm) taper measured on the diameter and along the axis, is similar to the taper gage shown in Fig. 8 except that lines are scribed or etched on the gage at .020 in. (0.508 mm) intervals. Length of the gage may vary depending on O-ring applications.

4.2.4 Other methods may be used to check the inside diameter of large size O-rings after it has been determined that the cross-section dimensions and the parting line projections are within tolerance. One method consists of a flat gage incorporating a predetermined rectangular groove. The groove shall have an inside diameter equal to the O-ring minimum and an outside diameter equal to the O-ring inside diameter maximum plus twice the cross-section maximum dimension. Depth shall be at least one-half the cross-section and no more than the cross-section. If the O-ring falls into this groove without stretching or "snaking", it will be considered within tolerance.

4.2.4.1 Another method utilizing an adjustable indicating type gage may be used. This method employs two half circles of fixed diameter, one of which is adjustable to the proper distance from the other for the diameter O-ring specified. The other half if adjustable by a spring-loaded inclined plane, the movement of which is controlled by a knob. The spring to be used depends upon the size and hardness of the ring to be checked. An indicating gage is attached to this end to ascertain that the I.D. dimension of the O-ring is within tolerances. A table of predetermined numbers for the I.D. to be checked must be furnished with this type of gage for proper setting of the adjustable gage blocks.

4.3 Surface Defects:

4.3.1 Wire gages of the appropriate size may be used to determine the size of the defect by comparison.

4.3.2 A minimum of 400 foot-candles of illumination shall be provided.

4.4 In cases of dispute, the methods of measurement shall be agreed between manufacturer and customer.

3. CLEANLINESS REQUIREMENT

All O-rings shall be kept clean at all times to avoid contaminants, dirt, or other deleterious material.

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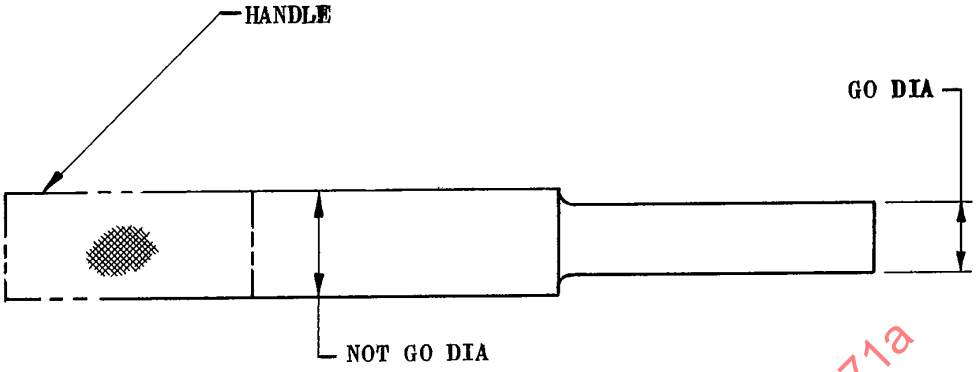
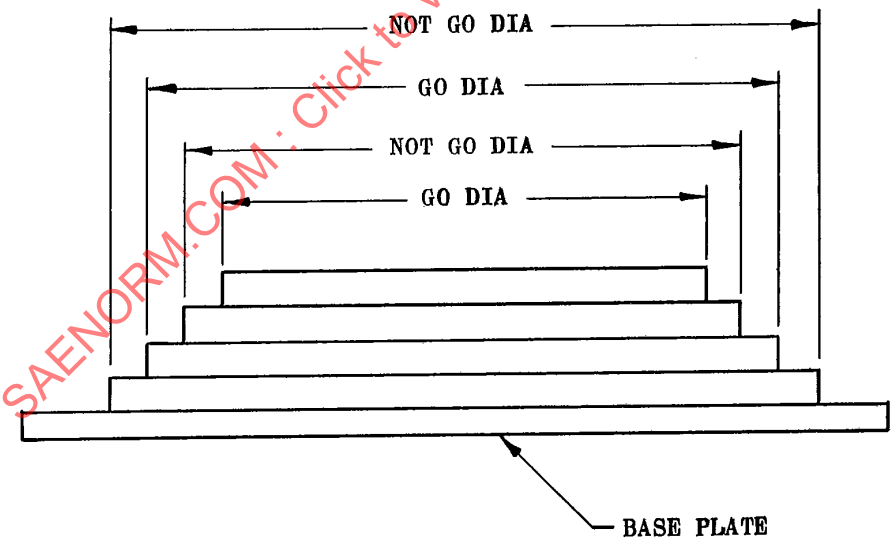


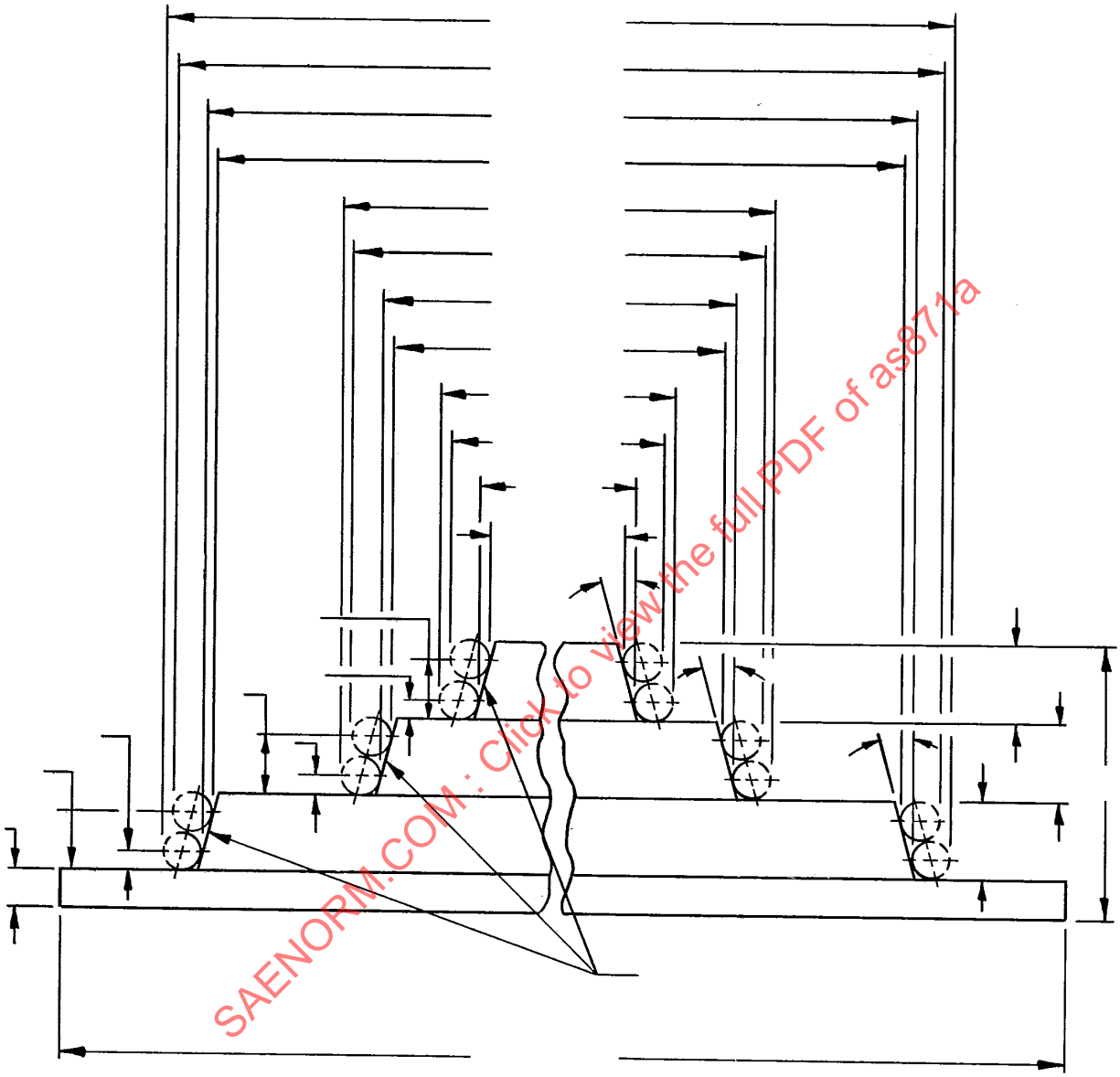
CYLINDRICAL GAGE

FIGURE 5



FLAT PLUG GAGE

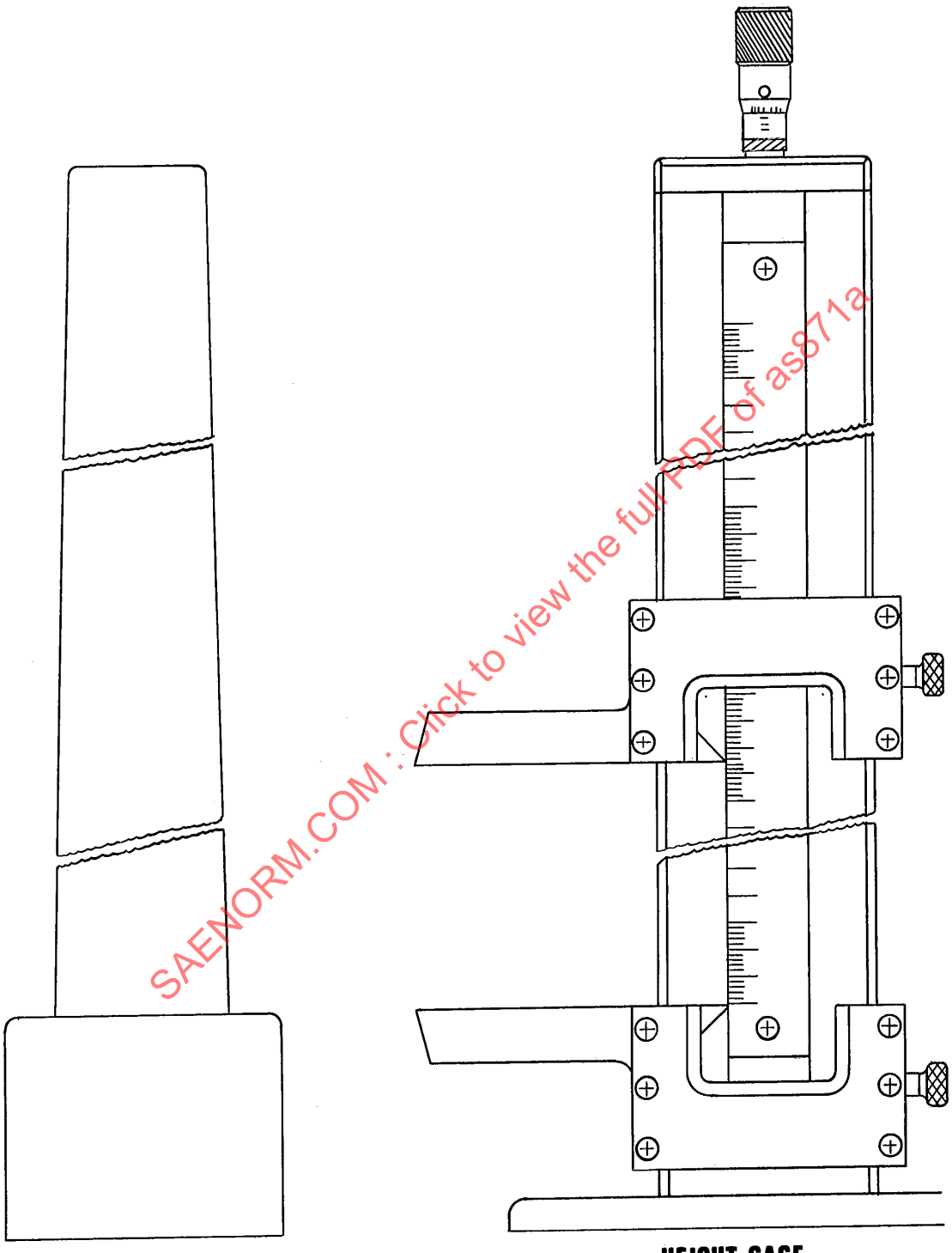
FIGURE 6



NOTE:- Phantom circles are gage wires used to determine and inspect for the correct size of the gage for a given size packing. Also, any number of steps can be provided as are practical without making the gage unwieldy.

TAPERED STEPPED GAGE

FIGURE 7



TAPER GAGE

HEIGHT GAGE

FIGURE 8

APPENDIX A

A1. DEFECTS

A1.1. Typical Defects in O-rings and their Permissible Limits

It is to be noted that the defects listed in this appendix do not include dimensional imperfections resulting from incorrect mold recesses, parting line projection, mold off register, mismatch faults and flats resulting from dressing. These are dealt with in paras. 3.2.1., 3.2.3., 3.2.4., 3.2.5., and 3.2.6.

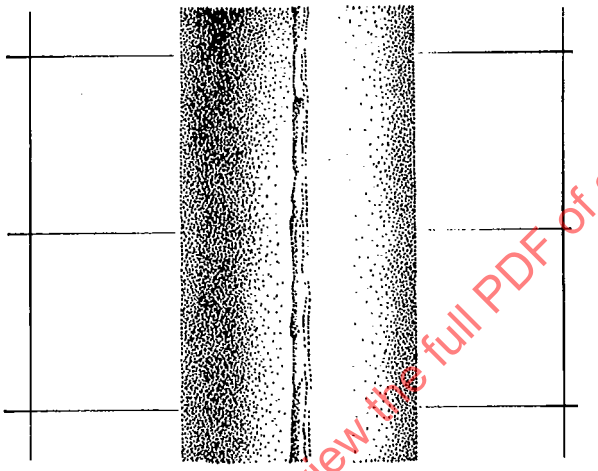
Index to appendix A

The sketches given in this appendix are guides and are included for reference purposes only.

Defects are not permitted to be cumulative, and no more than any two of the defects listed in this appendix are permissible on any O-ring and not more than one per circumferential inch.

A1.2. BACKRIND **UNACCEPTABLE**

A torn or gouged condition (recess) occurring at the mold parting lines, caused by thermal expansion over sharp mold edge or by premature cure.



SCALE: 10X

W = .103 in. (2.616 mm)

FIGURE 9

NOTE: Above sketch is for reference purposes only.

A1.3. PARTING LINE INDENTATION (MOLD-NICK)

A shallow saucer-like recess, sometimes triangular, located on the parting line at OD or ID and may have random orientation. Caused by deformity (e.g. “nicks”) on mold edge.

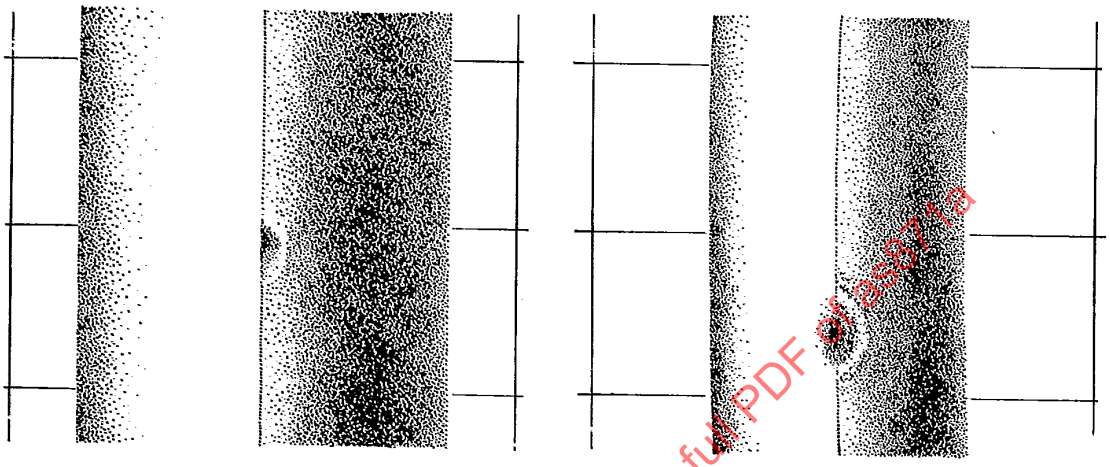


FIGURE 10

MAX. ACCEPTABLE PARTING LINE INDENTATION

Nom. Ring Cross Section (“W”)	Max. Depth		Max. Width or Length	
	(in.)	(mm)	(in.)	(mm)
Up to and inc. .070 in. (1.778 mm)	.002	0.05	.003	0.08
Over .070 in. (1.778 mm) up to and inc. .103 in. (2.616 mm)	.003	0.08	.005	0.13
Over .103 in. (2.616 mm) up to and inc. .139 in. (3.531 mm)	.004	0.10	.007	0.18
Over .139 in. (3.531 mm) up to and inc. .210 in. (5.33 mm)	.005	0.13	.010	0.25
Over .210 in. (5.33 mm)	.006	0.15	.015	0.38

Not more than one defect per inch (25.4 mm) of circumference. Random orientation permissible.

NOTE: Above sketches are for reference purposes only.