INTERNATIONAL STANDARD

ISO 3601-3

Second edition
2005-11-01

Fluid power systems — O-rings —

Part 3: Quality acceptance criteria

Transmissions hydrauliques et pneumatiques — Joints toriques —

Partie 3: Critères de qualité

Reference number
ISO 3601-3:2005(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 3601-3 was prepared jointly by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 10, *Aerospace fluid systems and components*, and by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 7, *Sealing devices*.

This second edition cancels and replaces the first edition (ISO 3601-3:1987), which has been technically revised.

ISO 3601 consists of the following parts, under the general title *Fluid power systems — O-rings*:

— *Part 1: Inside diameters, cross-sections, tolerances and size identification code*

— *Part 3: Quality acceptance criteria*

— *Part 5: Suitability of elastomeric materials for industrial applications*

The following parts are in preparation:

— *Part 2: Housing dimensions for general applications*

— *Part 4: Anti-extrusion devices (back-up rings)*

Introduction

In fluid power systems, power is transmitted and controlled through a fluid (liquid or gas) under pressure within an enclosed circuit. Components must be designed to meet these requirements under varying conditions. Testing of components to meet performance requirement provides users a basis of assurance for determining design application and for checking component compliance with their stated requirements.

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Fluid power systems — O-rings —

Part 3:
Quality acceptance criteria

1 Scope

This part of ISO 3601 lays down the quality acceptance criteria of O-rings used in fluid systems, the dimensions of which are standardized in ISO 3601-1, ISO 16031-1 and ISO 16031-2.

This part of ISO 3601 also defines and classifies surface imperfections on O-rings and specifies maximum acceptable limits for these imperfections.

This part of ISO 3601 is also applicable to O-rings to be used in aerospace construction.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3601-1, *Fluid power systems — O-rings — Part 1: Inside diameters, cross-sections, tolerances and size identification code*

ISO 5598, *Fluid power systems and components — Vocabulary*

ISO 16031-1, *Aerospace fluid systems — O-rings, inch series: Inside diameters and cross sections, tolerances and size-identification codes — Part 1: Close tolerances for hydraulic systems*

ISO 16031-2, *Aerospace fluid systems — O-rings, inch series: Inside diameters and cross sections, tolerances and size-identification codes — Part 2: Standard tolerances for non-hydraulic systems*

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in ISO 5598 and the following apply.

3.1
backrind
longitudinal imperfection in which the rubber adjacent to the flash line shrinks below the level of the moulding and has a “U”-like or “W”-like cross section with the flash frequently being ragged or torn

[see Figure 1]

3.2
combined flash
combination of offset, flash and parting line projection

3.3
inside diameter
d_1
O-ring inside diameter

3.4
cross-section diameter
d_2
O-ring cross-section diameter

3.5
excessive trimming
flattened and often roughened area around the inner and/or outer diameters of an O-ring caused by the trimming process

[see Figures 2a and 2b]

3.6
flash
film-like material that extends from the parting line projection or inner and/or outer diameters, caused by mould separation or present due to inadequate trimming

[see Figure 3]

3.7
flow mark
thread-like recess, usually curved, of very slight depth in the unflexed state, with normal surface texture and round edge, caused by incomplete flow and knit of the material

[see Figure 4]

3.8
foreign material
any extraneous matter embedded in the surface of the O-ring, e.g. contamination, dirt, etc.

3.9
indentation
depression, usually irregular in form, caused by the removal of inclusions from the surface or the build-up of hardened deposits on the surface of the mould cavity

[see Figure 5]

3.10
mismatch
cross-sectional radius in one ring half being unequal to that of the other half, caused by dimensional difference in mould halves

3.11
non-fill
randomly spaced, irregularly shaped surface indentation having a coarser texture than the normal O-ring surface, caused by incomplete filling of, and or the trapping of air in, the mould cavity

[see Figure 6]

3.12
off-register
misalignment of O-ring halves, caused by the lateral shift of one mould cavity plate relative to other

3.13
offset
mismatch and/or off-register of O-ring halves

[see Figure 7]

3.14
parting-line indentation
shallow saucer-like recess sometimes triangular in shape, located on the parting line at the inner and/or outer diameters, caused by deformation of the mould edge at the parting line

3.15
parting-line projection
continuous ridge of material situated at the parting line of inner and/or outer diameters caused by worn or excessively rounded edges of the mould cavity

4 Grades

4.1 **Grade N** (general purpose)

Grade N (general purpose) identifies acceptance criteria for O-rings intended for general use. See Table 1.

4.2 **Grade S** (special)

Grade S (special) identifies acceptance criteria for O-rings intended for applications requiring a higher level of quality and/or precision with respect to dimensional tolerances of surface imperfections. For example, aerospace or critical industrial or automotive applications are covered by this grade. See Table 2.

4.3 **Grade CS** (critical service)

This grade identifies acceptance criteria for O-rings intended for applications requiring a much higher level of quality and/or precision with respect to dimensional tolerances of surface imperfections. For example, critical service aerospace or medical applications, where the surface of the O-ring must be near-perfect to perform in a satisfactory manner, are covered by this grade. See Table 3.

4.4 Selection of grade

If the user does not specify the grade at the time of purchase, Grade N will be assumed to be the quality requirement, except for specific aerospace applications where Grade S will be assumed to be the quality requirement.

5 Surface condition

5.1 The O-ring surfaces shall be free from cracks, ruptures, blisters or other imperfections that are greater than the limits given in Tables 1, 2 and 3 when the unstretched ring is viewed under a ×2 magnifier viewer with adequate illumination. Other methods should be agreed between the manufacturer and the user.

5.2 There shall be no foreign material embedded in the surface visible under the viewing conditions given in 5.1.

5.3 Flow marks, non-fills and indentations within the limits of Tables 1, 2 and 3 shall not be allowed if

a) there are more than three in any 25 mm length of circumference for Grades N and S or there is more than one in any 25 mm length of circumference for Grade CS;

b) they interconnect;

c) there are more than three that are separated from each other by a distance that is less than the maximum limiting dimensions of such imperfection for Grades N and S, or there are more than two that are separated from each other by a distance that is less than the maximum limiting dimensions of such imperfection and only one per 25 mm length of circumference for Grade CS.

5.4 There shall be no flow marks that are essentially radially orientated.

5.5 The surface resulting from any excessive trimming shall be smoothly blended.

5.6 Wire gauges of the appropriate size may be used to determine the size of the defect by comparison.

5.7 In case of dispute, the methods of measurement shall be agreed upon between the manufacturer and the customer.

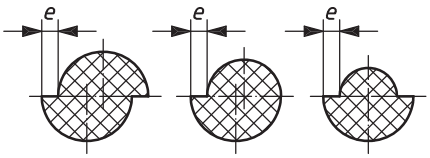
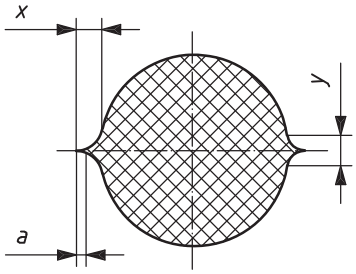
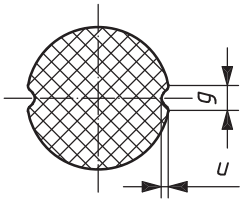
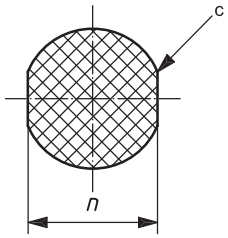
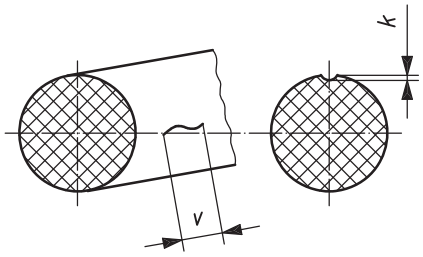
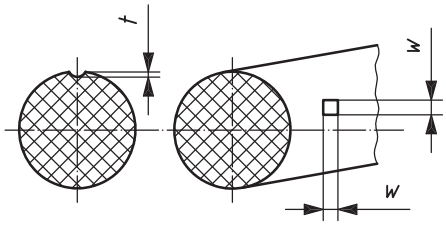
6 **Identification statement** (reference to this part of ISO 3601)

Use the following statement in test reports, catalogues and sales literature when electing to comply with this part of ISO 3601:

"Surface imperfection limits are in accordance with ISO 3601-3:2005, *Fluid power systems — O-rings — Part 3: Quality acceptance criteria*."

Table 1 — Limits of size for surface imperfections for Grade N O-rings

Dimensions in millimetres

Surface imperfection type	Diagrammatic representation	Limiting dimensions	Maximum limits of imperfections Grade N O-rings Cross-section, d_2				
			> 0,8[b] ⩽ 2,25	> 2,25 ⩽ 3,15	> 3,15 ⩽ 4,50	> 4,50 ⩽ 6,30	> 6,30 ⩽ 8,40[b]
Off-register, mismatch (offset)		e	0,08	0,10	0,13	0,15	0,15
Combined flash (combination of offset, flash and parting line projection)		x	0,10	0,12	0,14	0,16	0,18
		y	0,10	0,12	0,14	0,16	0,18
		a	When the flash can be differentiated, it shall not exceed 0,07 mm.				
Backrind		g	0,18	0,27	0,36	0,53	0,70
		u	0,08	0,08	0,10	0,10	0,13
Excessive trimming (radial tool marks not allowed)		n	Trimming is allowed provided the dimension n is not reduced below the minimum diameter d_2 for the O-ring.				
Flow marks (radial orientation of flow marks is not permissible)		v	1,50[a]	1,50[a]	6,50[a]	6,50[a]	6,50[a]
		k	0,08	0,08	0,08	0,08	0,08
Non-fills and indentations (including parting line indentations)		w	0,60	0,80	1,00	1,30	1,70
		t	0,08	0,08	0,10	0,10	0,13

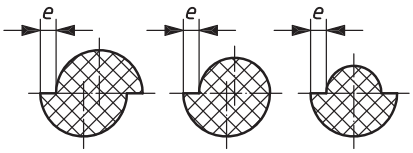
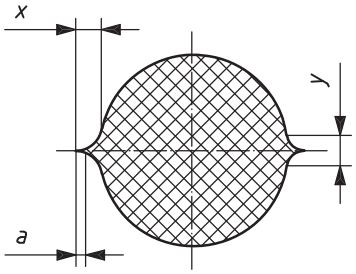
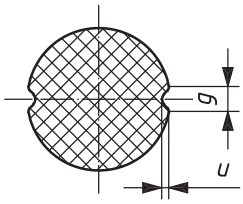
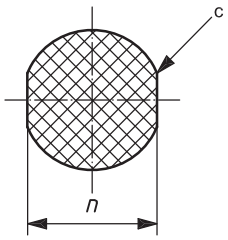
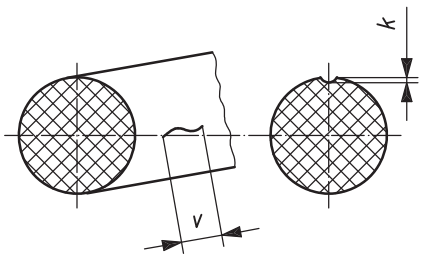
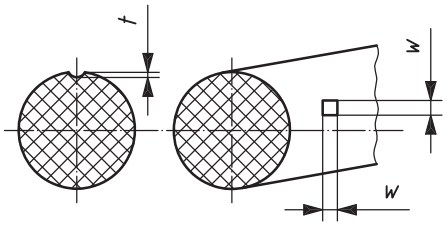
[a] Or 0,05 times the O-ring's inside diameter (d_1), whichever is greater.

[b] Limits of imperfections for cross sections < 0,8 mm or > 8,40 mm shall be agreed upon between manufacturer and customer.

[c] Round edges.

Table 2 — Limits of size for surface imperfections for Grade S O-rings

Dimensions in millimetres

Surface imperfection type	Diagrammatic representation	Limiting dimensions	Maximum limits of imperfections Grade N O-rings Cross-section d_2				
			> 0,8[b] ⩽ 2,25	> 2,25 ⩽ 3,15	> 3,15 ⩽ 4,50	> 4,50 ⩽ 6,30	>6,30 ⩽ 8,40[b]
Off-register, mismatch (offset)		*e*	0,08	0,08	0,10	0,12	0,13
Combined flash (combination of offset, flash and parting line projection)		*x*	0,10	0,10	0,13	0,15	0,15
		y	0,10	0,10	0,13	0,15	0,15
		a	When the flash can be differentiated, it shall not exceed 0,05 mm.				
Backrind		*g*	0,10	0,15	0,20	0,20	0,30
		u	0,05	0,08	0,10	0,10	0,13
Excessive trimming (radial tool marks not allowed)		*n*	Trimming is allowed provided the dimension *n* is not reduced below the minimum diameter d_2 for the O-ring.				
Flow marks (radial orientation of flow marks is not permissible)		*v*	1,50[a]	1,50[a]	5,00[a]	5,00[a]	5,00[a]
		k	0,05	0,05	0,05	0,05	0,05
Non-fills and indentations (including parting line indentations)		*w*	0,15	0,25	0,40	0,63	1,00
		t	0,08	0,08	0,10	0,10	0,13

[a] Or 0,05 times the O-ring's inside diameter (d_1), whichever is greater.

[b] Limits of imperfections for cross sections < 0,8 mm or > 8,40 mm shall be agreed upon between manufacturer and customer.

[c] Round edges.

Table 3 — Limits of size for surface imperfections for Grade CS O-rings

Dimensions in millimetres

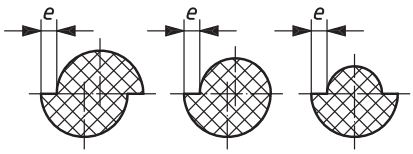
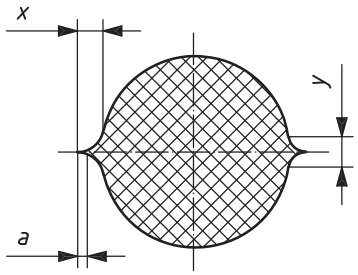
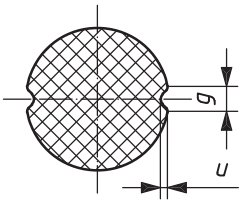
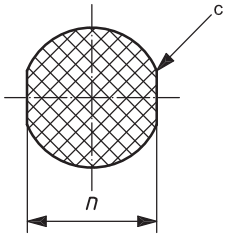
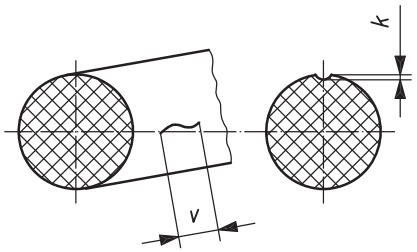
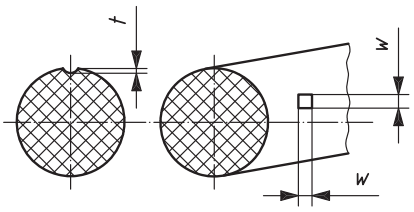
Surface imperfection type	Diagrammatic representation	Limiting dimensions	Maximum limits of imperfections Grade N O-rings Cross-section d_2				
			> 0,8[b] ⩽ 2,25	> 2,25 ⩽ 3,15	> 3,15 ⩽ 4,50	> 4,50 ⩽ 6,30	>6,30 ⩽ 8,40[b]
Off-register, mismatch (offset)		*e*	0,04	0,04	0,06	0,06	0,08
Combination of offset and parting line projection		*x*	0,07	0,07	0,10	0,13	0,13
		y	0,10	0,10	0,13	0,13	0,13
		a	Not permissible				
Backrind		*g*	Not permissible				
		u	Not permissible				
Excessive trimming (radial tool marks not allowed)		*n*	Trimming is allowed provided the dimension *n* is not reduced below the minimum diameter d_2 for the O-ring.				
Flow marks (radial orientation of flow marks is not permissible)		*v*	1,50[a]	1,50[a]	1,50[a]	4,56[a]	4,56[a]
		k	0,05	0,05	0,05	0,05	0,05

Table 3 — (*continued*)

Dimensions in millimetres

Surface imperfection type	Diagrammatic representation	Limiting dimensions	Maximum limits of imperfections Grade N O-rings Cross-section d_2				
			> 0,8[b] ⩽ 2,25	> 2,25 ⩽ 3,15	> 3,15 ⩽ 4,50	> 4,50 ⩽ 6,30	>6,30 ⩽ 8,40[b]
Non-fills and indentations (including parting line indentations)		*w*	0,08 0,13 [d]	0,13 0,25 [d]	0,18 0,38 [d]	0,25 0,51 [d]	0,38 0,76 [d]
		t	0,08	0,08	0,10	0,10	0,13

a Or 0,03 times the O-ring's inside diameter (d_1), whichever is greater, subject to a maximum of 30 mm.

b Limits of imperfections for cross sections < 0,8 mm or > 8,40 mm shall be agreed upon between manufacturer and customer.

c Round edges.

d Mould deposit indentations only.

a Unacceptable for CS O-rings; acceptable within dimensional limits for N and S O-rings.

Figure 1 — Backrind

Figure 2A — Illustration of acceptable excessive trimming

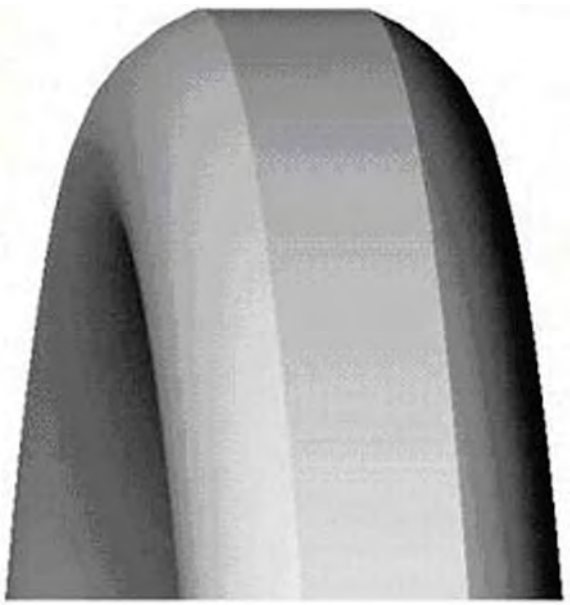
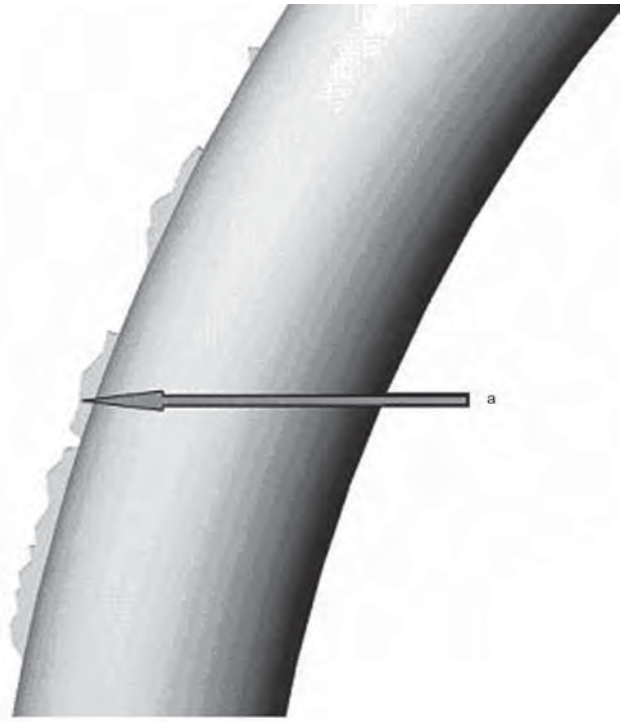
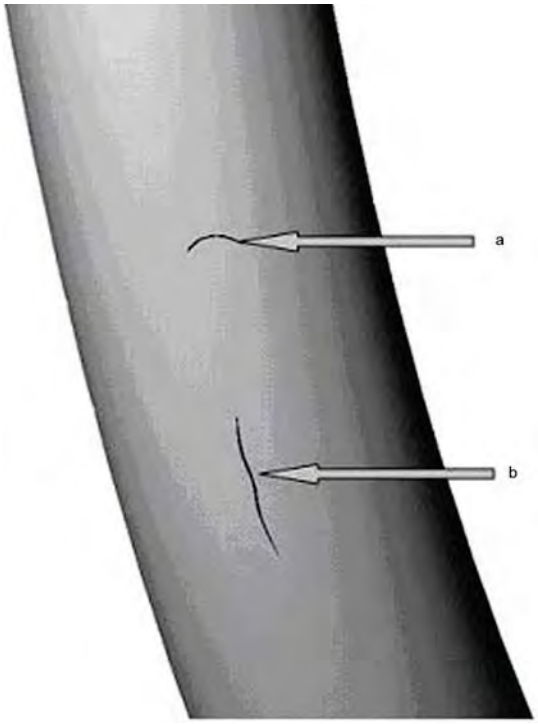


Figure 2B — Illustration of unacceptable excessive trimming



[a] Unacceptable for CS O-rings.

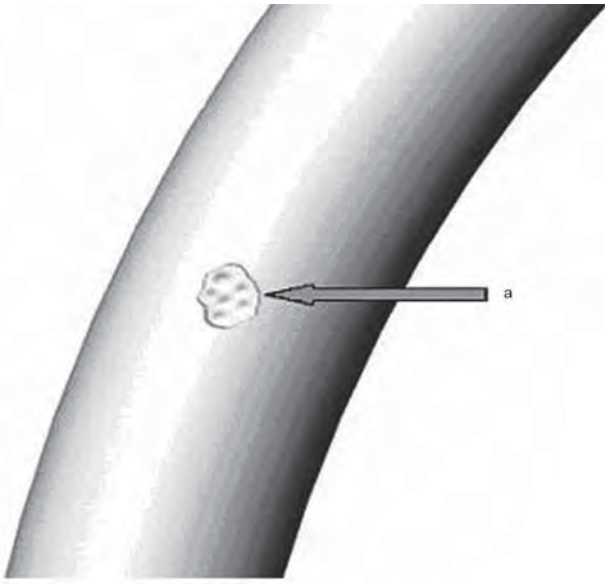
Figure 3 — Flash



a Radial orientation of flow mark is unacceptable.

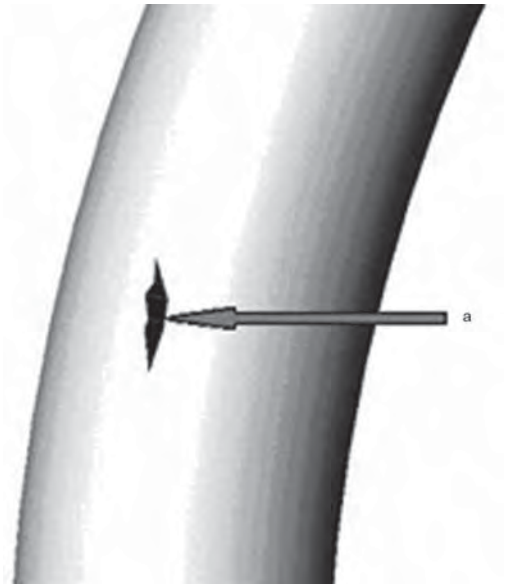
b Acceptable within dimensional limits.

Figure 4 — Flow marks



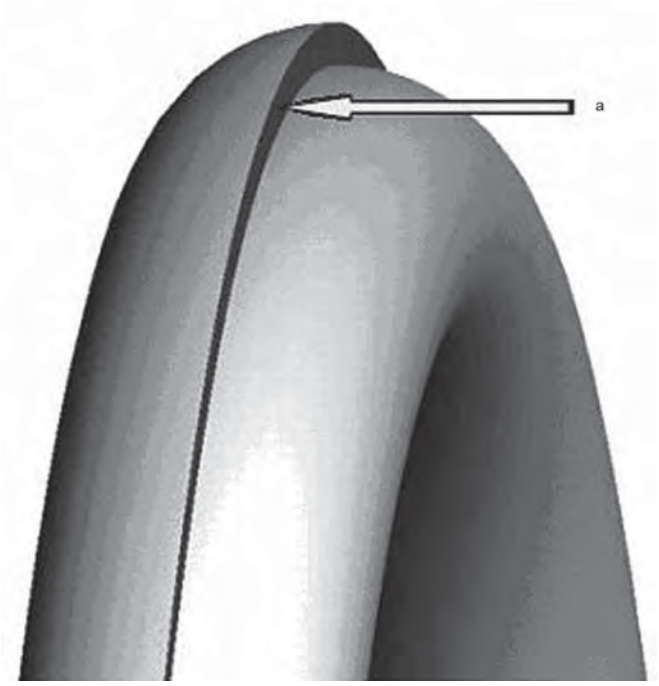
a Acceptable within dimensional limits.

Figure 5 — Mould deposit indentation



a Acceptable within dimensional limits.

Figure 6 — Non-fills, inclusions and indentations



a Acceptable within dimensional limits.

Figure 7 — Off-register / mismatch

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ICS 23.100.60; 83.140.50

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