



BSI Standards Publication

**Road vehicles — Wheels and rims — Use,
general maintenance and safety requirements
and out-of-service conditions**

National foreword

This British Standard is the UK implementation of [ISO 14400:2021](#). It supersedes [BS ISO 14400:2005](#), which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AUE/15, Safety related to vehicles.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2021
Published by BSI Standards Limited 2021

ISBN 978 0 539 02894 2

ICS 43.040.50

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 October 2021.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

INTERNATIONAL
STANDARD

ISO
14400

Second edition
2021-10-12

**Road vehicles — Wheels and rims
— Use, general maintenance and
safety requirements and out-of-
service conditions**

*Véhicules routiers — Roues et jantes — Exigences en matière
d'utilisation, de maintenance générale et de sécurité, et conditions de
mise hors service*



Reference number
ISO 14400:2021(E)



COPYRIGHT PROTECTED DOCUMENT

© ISO 2021, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO’s member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents		Page
Foreword		iv
Introduction		v
1	Scope	1
2	Normative references	1
3	Terms and definitions	1
4	Use and general maintenance requirements	1
4.1	Wheel and wheel components	1
4.2	Wheel mounting and removal	2
4.3	Studs and nuts	2
5	General safety requirements	3
6	Out-of-service conditions	3
Bibliography		19

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 33, *Vehicle dynamics and chassis components*.

This second edition cancels and replaces the first edition ([ISO 14400:2005](http://www.iso.org/iso/14400:2005)), which has been technically revised.

The main changes are as follows:

- added off-road vehicles to the scope since the sections apply equally to that as well as road vehicles.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The purpose of this document is to ensure the safe operation of vehicles. The wheel is a highly stressed component of the vehicle that in service may be subject to extreme forces. Therefore, it is absolutely necessary to handle these parts with care and to pay particular attention to their mounting, removal and maintenance in order to ensure safe operations and to prevent servicing accidents.

This page deliberately left blank

Road vehicles — Wheels and rims — Use, general maintenance and safety requirements and out-of-service conditions

1 Scope

This document specifies requirements for the use, general maintenance and safety of wheels and rims including multi-piece wheels and rims. This document defines their out-of-service conditions, such as cracked, worn and bent wheels and rim components. It is applicable to wheels intended for use on road as defined in ISO 3833 and off road vehicles. This document does not include mopeds and motorcycles.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 3911](#), *Wheels and rims for pneumatic tyres — Vocabulary, designation and marking*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in [ISO 3911](#) apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Use and general maintenance requirements

WARNING — On multi-piece rims, the use of the wrong ring components can result in catastrophic wheel failure.

4.1 Wheel and wheel components

Wheels or parts of wheels which cannot be identified shall not be used even if they seem to have the correct functions and the identical dimensions. The characteristics of the wheel centre shall correspond exactly to vehicle parts, especially the axle hub and the brake, in order to guarantee a proper fitting and an effective load transmission.

A neutral non-aggressive mounting paste or liquid shall be used to lubricate the tyre beads. The hub, studs, nuts and the wheel attachment face shall be carefully cleaned. In the case of multi-piece wheels, all contact surfaces shall be cleaned.

Inspect parts for out-of-service conditions, see [Clause 6](#). If cleaning does not restore the original condition for the mating surfaces or if the parts have any of the conditions described in [Clause 6](#), the parts shall be replaced.

On the new vehicle and always after a wheel replacement, the mounting torque shall be verified after approximately 50 km of running and, where necessary, the wheel nuts shall be retightened. Periodic checks should also be carried out.

5 General safety requirements

After removal, wheels, rims, studs and nuts shall be checked closely to ensure that they are in good condition: namely that any fracture, crack, deformation, corrosion, heavy wear or other kind of non-conformity are not present.

Moreover, no technical modification on the wheel shall be made. Repair by means of welding or by the addition of material on rims or wheel centres having breakage, fissures, cracks or high wears, shall not be made, as they can introduce additional stresses in the critical areas.

NOTE Further detailed information regarding safety recommendations can be found in the technical catalogues of the wheel and/or vehicle manufacturers.

6 Out-of-service conditions

Typical out-of-service conditions of wheels, rims and components are shown in the following tables and figures. The conditions of wheel centres are shown in Table 1 and Figures 2 to 14, and the conditions of rims and components are shown in Table 2 and Figures 15 to 29.

Before checking, wheels shall be cleaned of mud and dirt.

Wheels, rims and components in such conditions shall be removed from service and discarded. Rubber components (valves, sealing rings and O-rings) with excessive ageing, brittleness or cracks shall be removed from service and discarded.

Table 1 — Typical out-of-service conditions of wheel centres

Type	Appearance	Probable cause	See Figure
Crack	Bolt-hole cracks	<div><div>— Insufficient tightening torque, loose nut</div><div>— Improper installation procedure</div><div>— Use of improper bolt/nut</div><div>— Mounting surface not flat</div><div>— Excessive load</div><div>— Damaged or worn nut seat</div><div>— Inequality of tightening torque between the nuts</div></div>	2

Type	Appearance	Probable cause	See Figure
	Bolt-hole-to-bolt-hole cracks	<ul style="list-style-type: none">— Insufficient tightening torque— Insufficient attachment face [hub] backup— Improper installation procedure— Mounting surface or attachment face [hub] not flat— Use of improper bolt/nut— Worn mounting surface/attachment face [hub]— Excessive load	3
	Bolt-hole-to-centre-hole cracks	<ul style="list-style-type: none">— Insufficient tightening torque— Foreign material between mounting surface and attachment face [hub] which prevents flush contact	4
	Bolt-hole-to-hand-hole cracks	<ul style="list-style-type: none">— Excessive load	5
	Hand-hole cracks	<ul style="list-style-type: none">— Excessive load— Dent, bruise, sharp edge around hand hole	6
	Circumferential cracks on mounting area of hub-piloted wheels	<ul style="list-style-type: none">— Excessive load— Use of improper bolt/nut— Insufficient attachment face [hub] backup— Worn or damaged nut— Improper tightening torque	7
	Cracks at stamp	<ul style="list-style-type: none">— Excessive stamping depth— Excessive load	8
	Disc-hat cracks	<ul style="list-style-type: none">— Excessive load	9
Deformation	Elongated bolt holes	<ul style="list-style-type: none">— Loose or worn nut— Insufficient tightening torque— Excessive dirt or nut— Excessive paint buildup— Excessive tightening torque— Broken hardware	10

Type	Appearance	Probable cause	See Figure
	Distorted nut seat	<ul style="list-style-type: none">— Loose inner nut— Use of improper or worn bolt/nut— Excessive tightening torque of inner nut— Improper installation procedure	11
	Burrs around bolt holes	<ul style="list-style-type: none">— Excessive tightening torque— Use of improper bolt/nut	12
W e a r / corrosion	Worn nut seat	<ul style="list-style-type: none">— Excessive tightening torque— Rust— Improper inner nut contour	13
	Excessive wear/corrosion of wheel attachment face	<ul style="list-style-type: none">— Insufficient attachment face [hub] backup— Worn attachment face [hub]— Improper installation procedure	14

Table 2 — Typical out-of-service conditions of rims and components

Type	Appearance	Probable cause	See Figure
Crack	Circumferential cracks in rim well	<ul style="list-style-type: none">— Excessive load, excessive air pressure— Corrosion from excessive airline moisture or improper tyre mounting lubricants, etc.	15
	Valve-aperture cracks	<ul style="list-style-type: none">— Excessive load, excessive air pressure— Improper finish of rim hole— Corrosion	16
	Butt-weld cracks	<ul style="list-style-type: none">— Excessive load— Improper welding	17
	Bead-seat cracks	<ul style="list-style-type: none">— Excessive load, excessive air pressure— Improper matching of tyre and rim— Tyre tool damage— Tyre bead not fully seated against flange	18

Type	Appearance	Probable cause	See Figure
	Rim-gutter cracks	<ul style="list-style-type: none">— Excessive load, excessive air pressure— Tyre tool damage— Dent by hammer— Excessive corrosion— Improper trimming of flash butt weld— Mismatch of rim and side ring— Improper tyre mounting	19
	Disc-to-rim weld cracks	<ul style="list-style-type: none">— Excessive load, excessive air pressure— Improper welding	20
	Side-ring cracks	<ul style="list-style-type: none">— Excessive load, excessive air pressure— Bent side ring— Excessive corrosion— Tyre tool damage— Damaged or distorted rim gutter area— Mismatch of rim and side ring— Use of mismatched tyre— Improper installation procedure of side ring	21
	Lock-ring cracks	<ul style="list-style-type: none">— Excessive load, excessive air pressure— Bent lock ring— Excessive corrosion— Tyre tool damage— Damaged or distorted rim gutter area— Use of mismatched lock ring— Improper installation procedure of lock ring	22

Type	Appearance	Probable cause	See Figure
Deformation	Bent rim flanges	<ul style="list-style-type: none">— Impact from kerbs, holes, or road hazards— Abuse in tyre mounting or demounting	23
	Distorted bead seat	<ul style="list-style-type: none">— Impact damage— Run-flat running— Improper tyre installation procedure— Shipping damage	24
	Distorted side ring	<ul style="list-style-type: none">— Improper installation/removal of side ring— Impact damage	25
	Excessive run-out	<ul style="list-style-type: none">— Impact damage— Run-flat running— Improper installation procedure— Shipping damage	26
	Burrs	<ul style="list-style-type: none">— Tyre tool damage	27
Wear/ corrosion	Rim flange wear	<ul style="list-style-type: none">— Tyre chafing— Insufficient air pressure— Excessive load	28
	Excessive corrosion on tyre side of rim and gutter area	<ul style="list-style-type: none">— Excessive air line moisture— Improper tyre mounting lubricants— Accumulation of water, mud and salt in gutter area	29

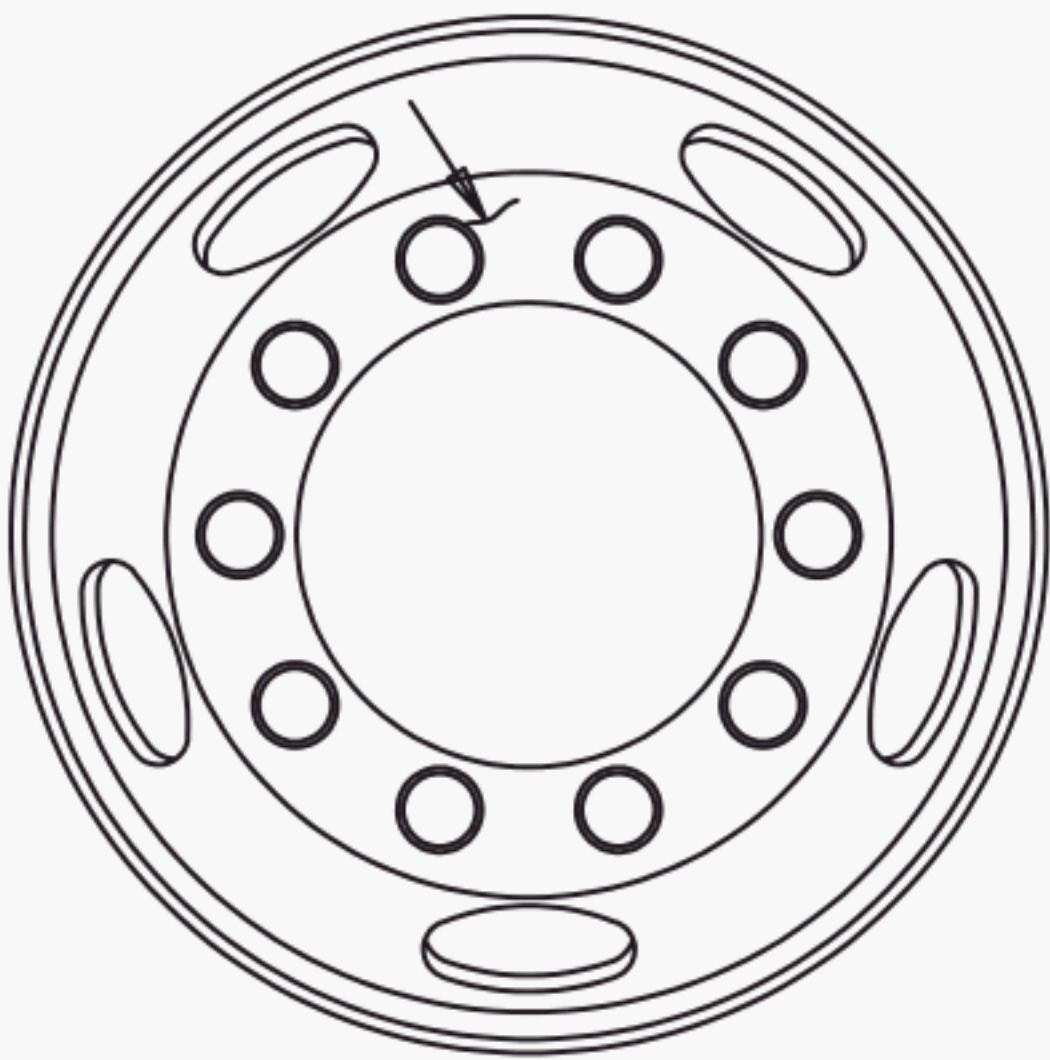


Figure 2 — Bolt-hole cracks

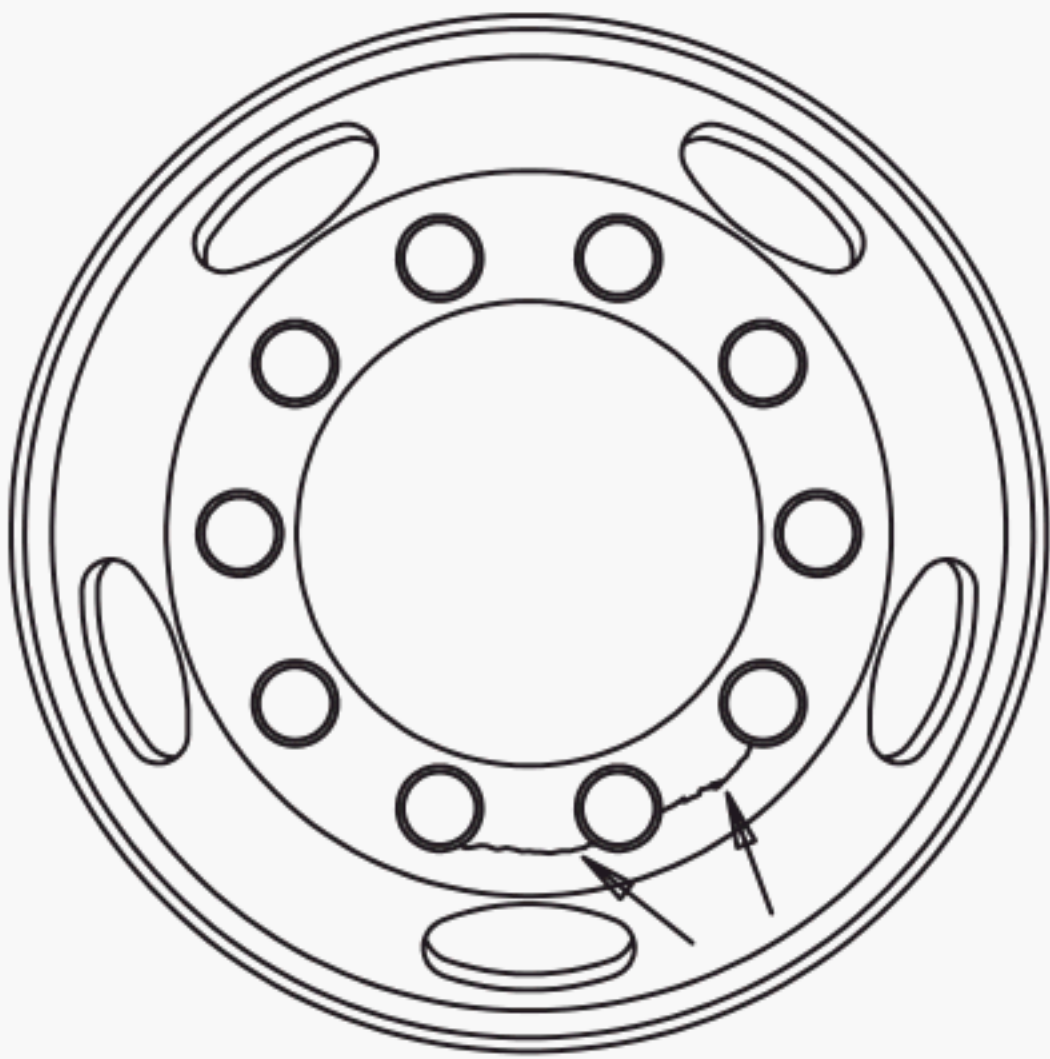


Figure 3 — Bolt-hole-to-bolt-hole crack

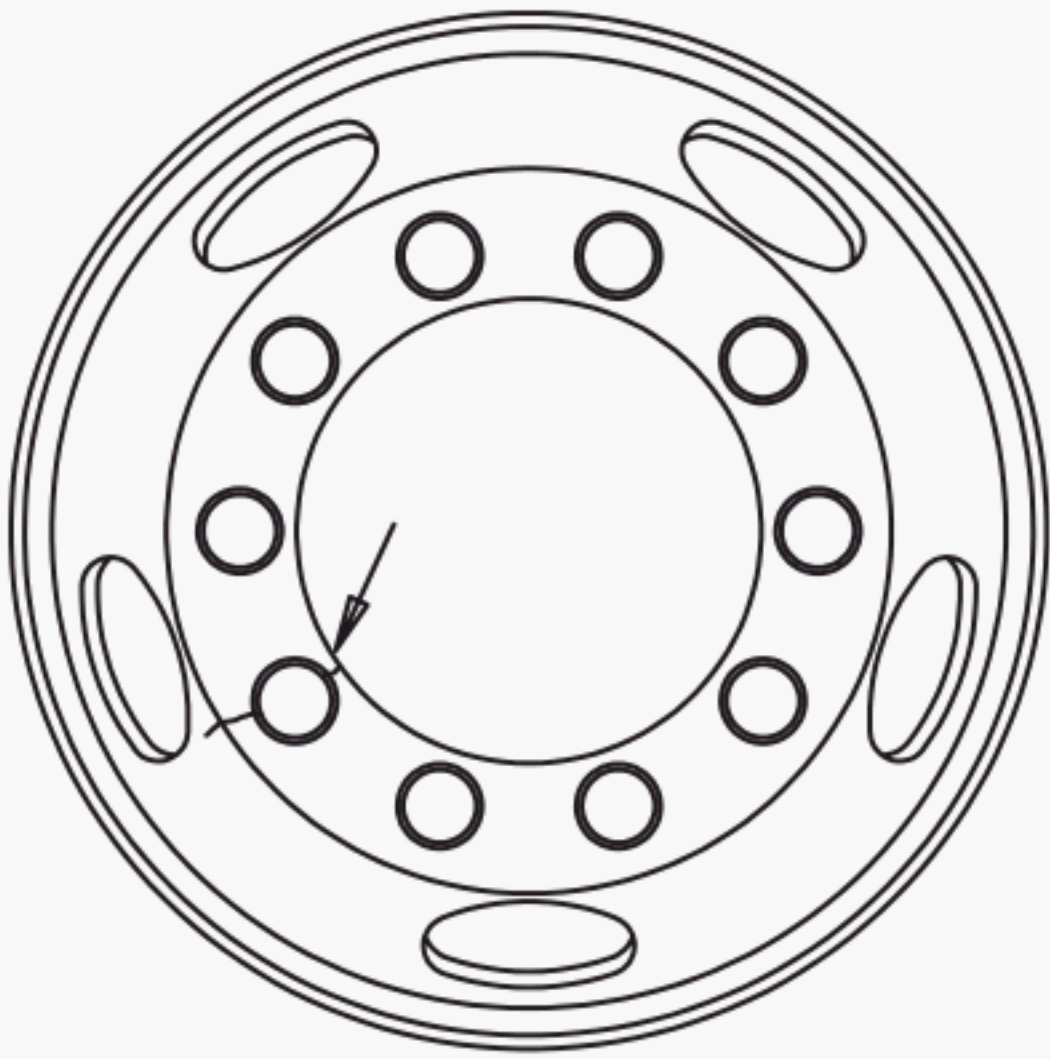


Figure 4 — Bolt-hole-to-centre-hole cracks

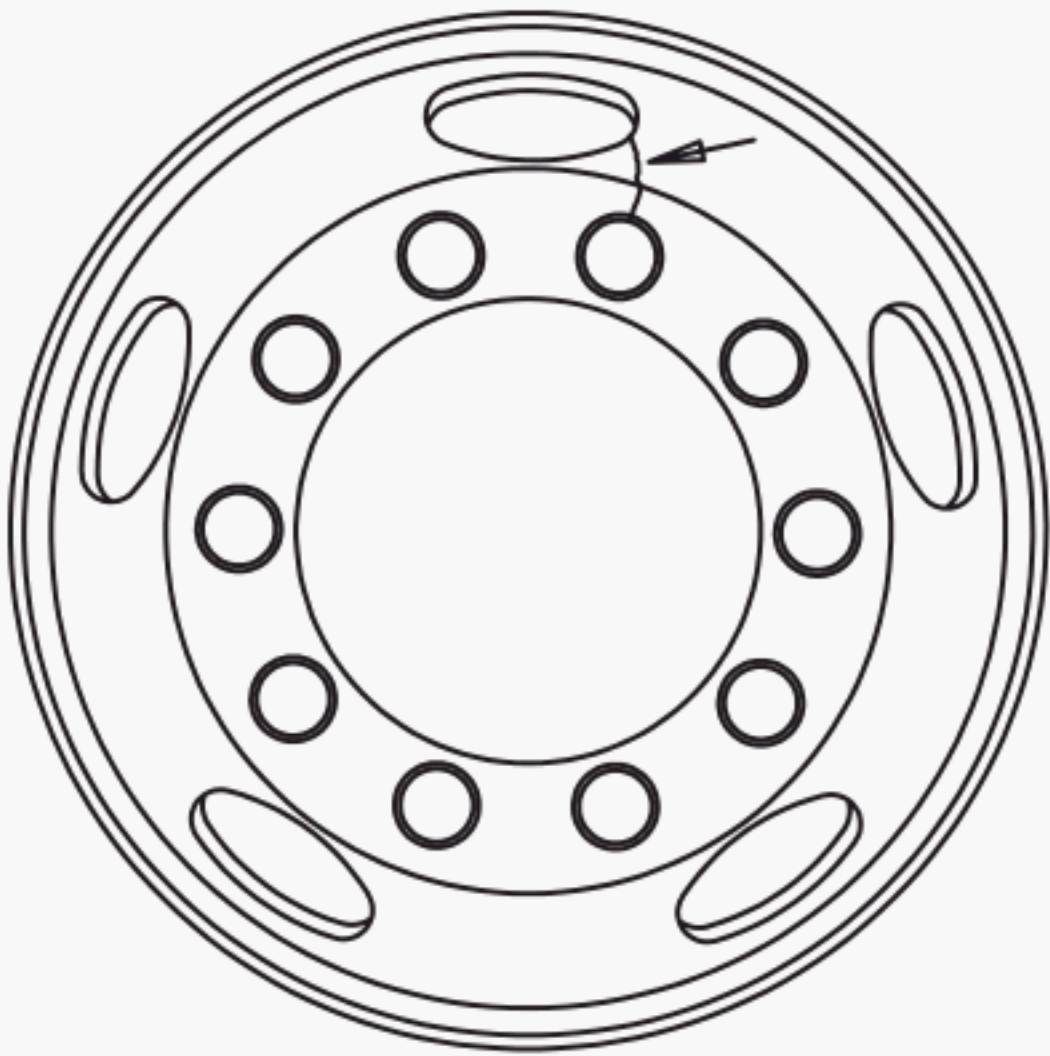


Figure 5 — Bolt-hole-to-hand-hole cracks

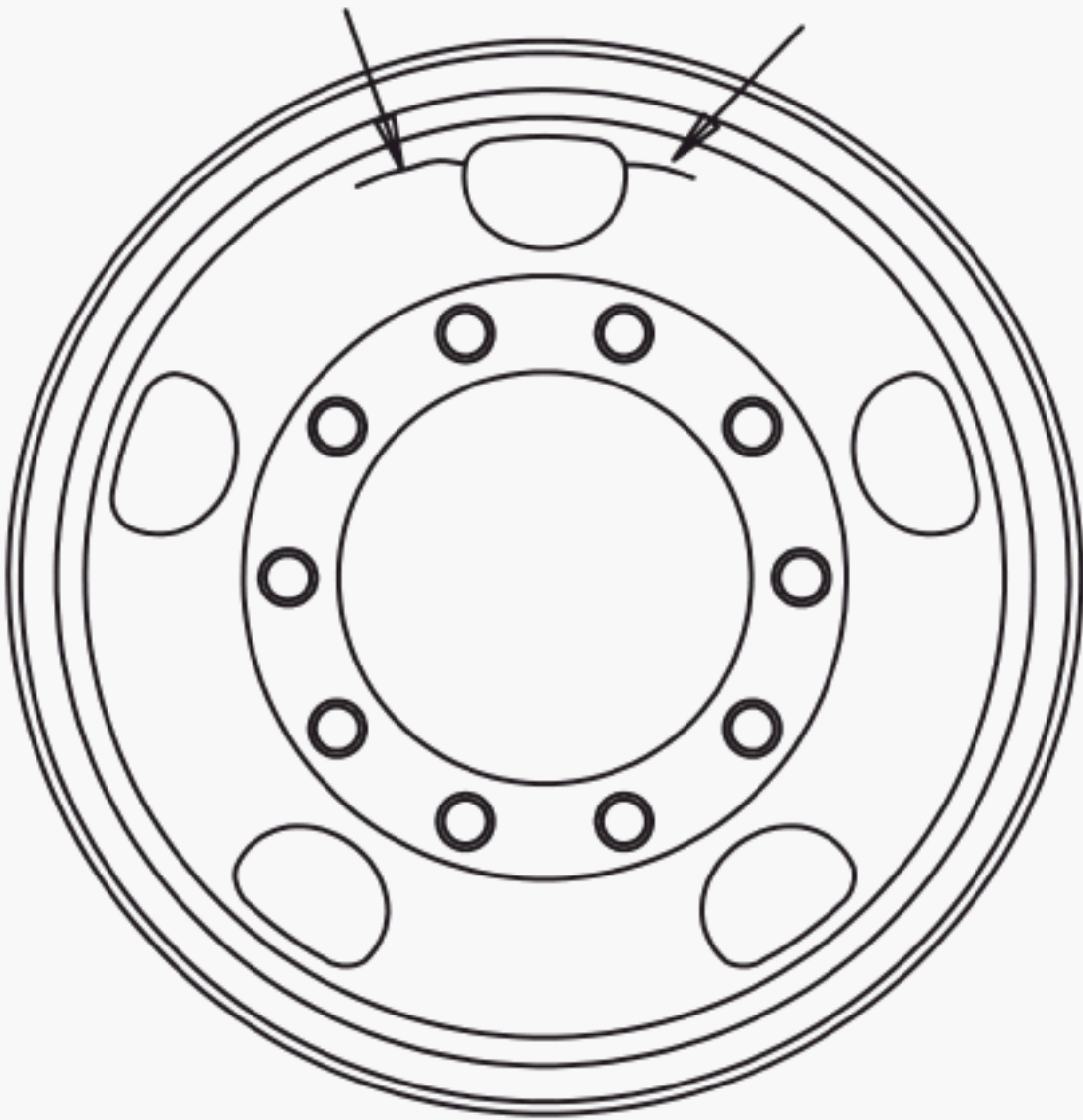


Figure 6 — Hand-hole cracks

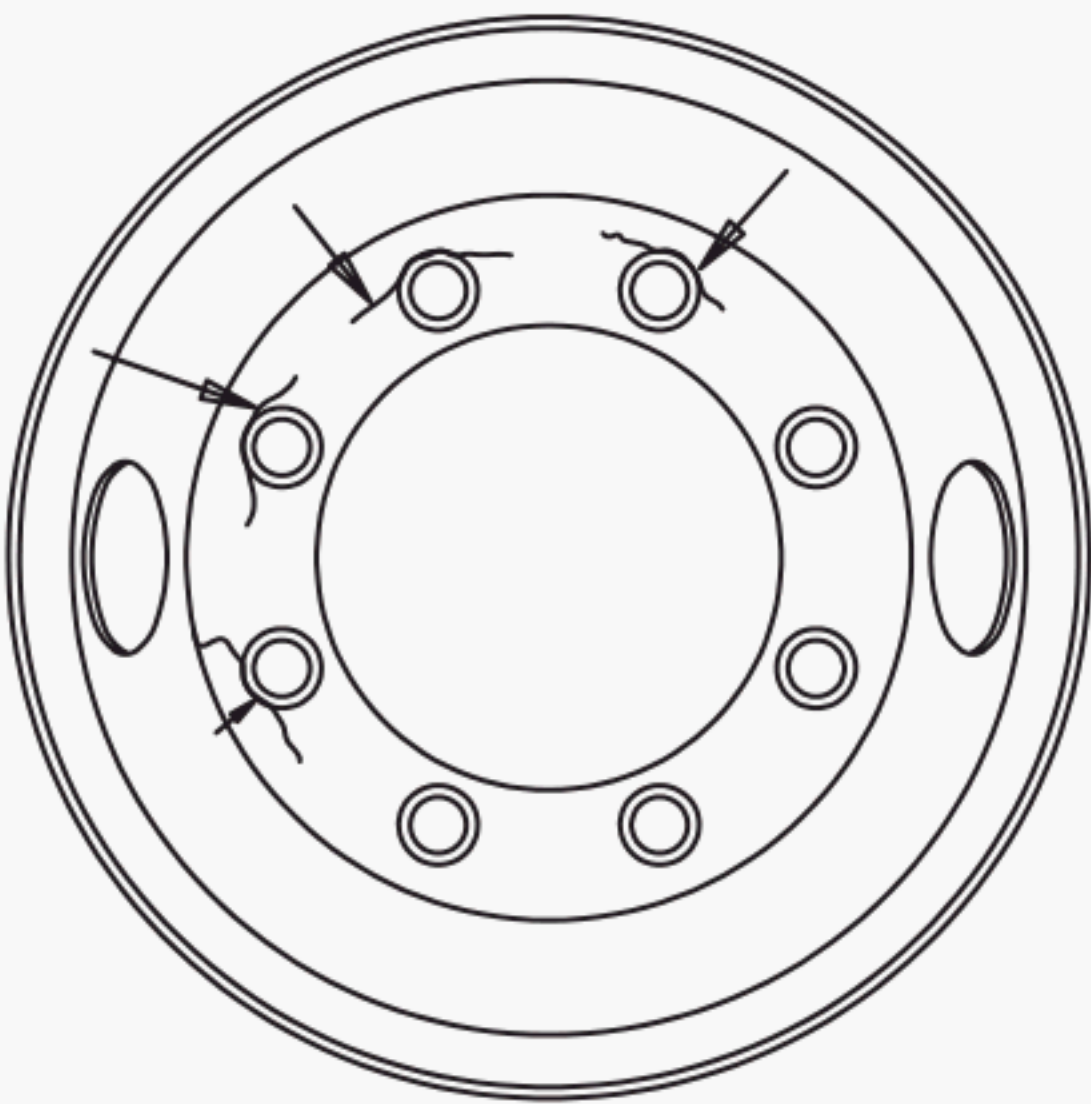


Figure 7 — Circumferential cracks on mounting area of hub-piloted wheels

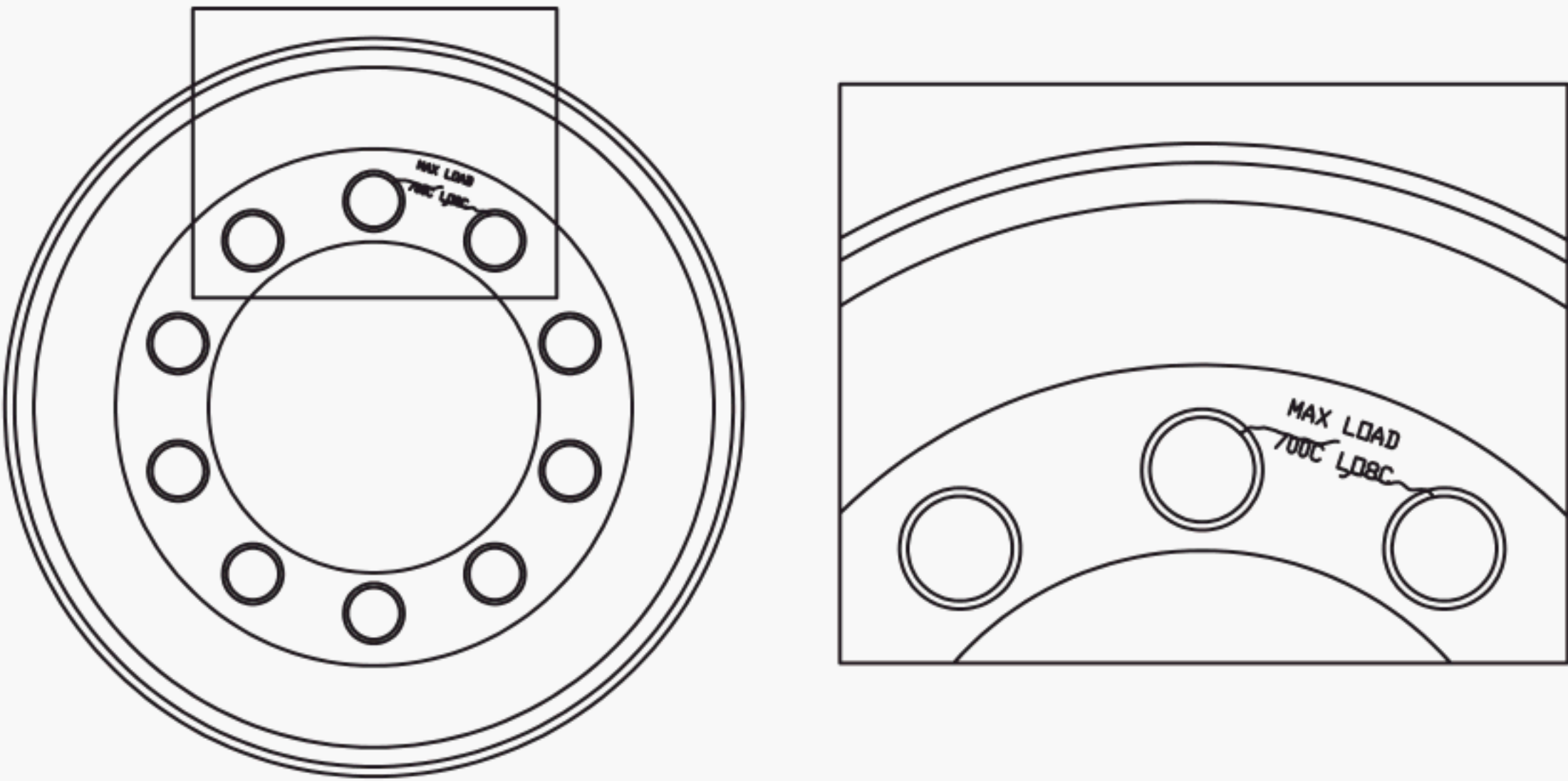


Figure 8 — Crack at stamp

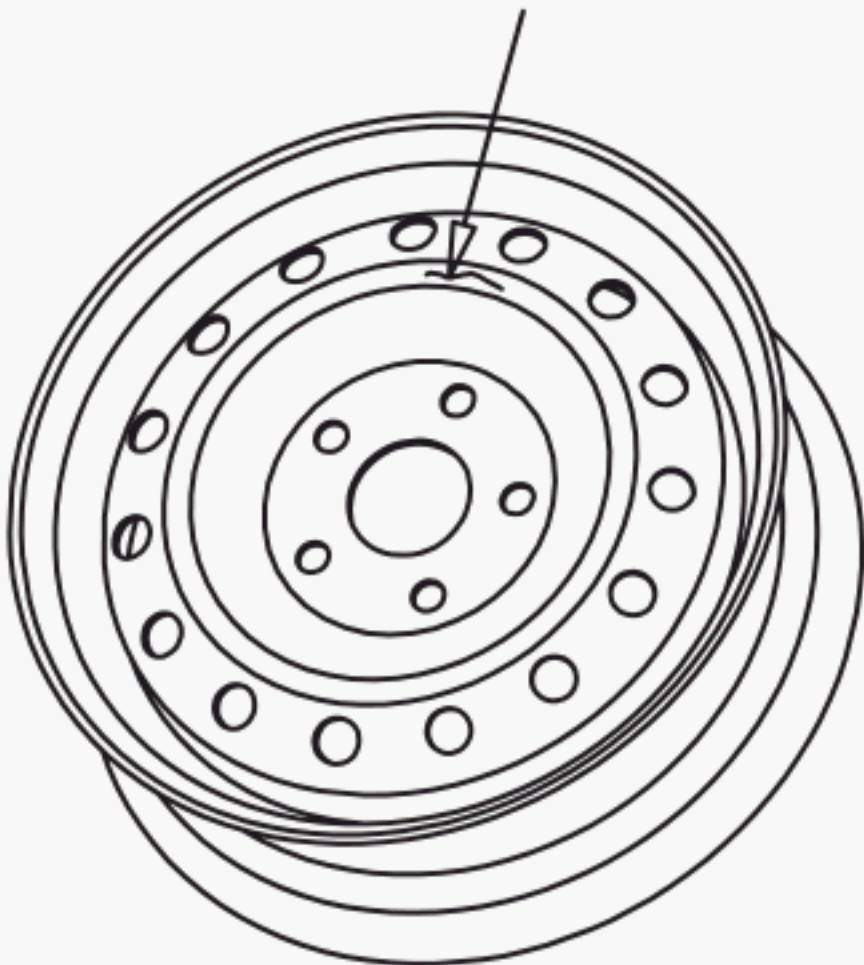


Figure 9 — Disc-hat cracks

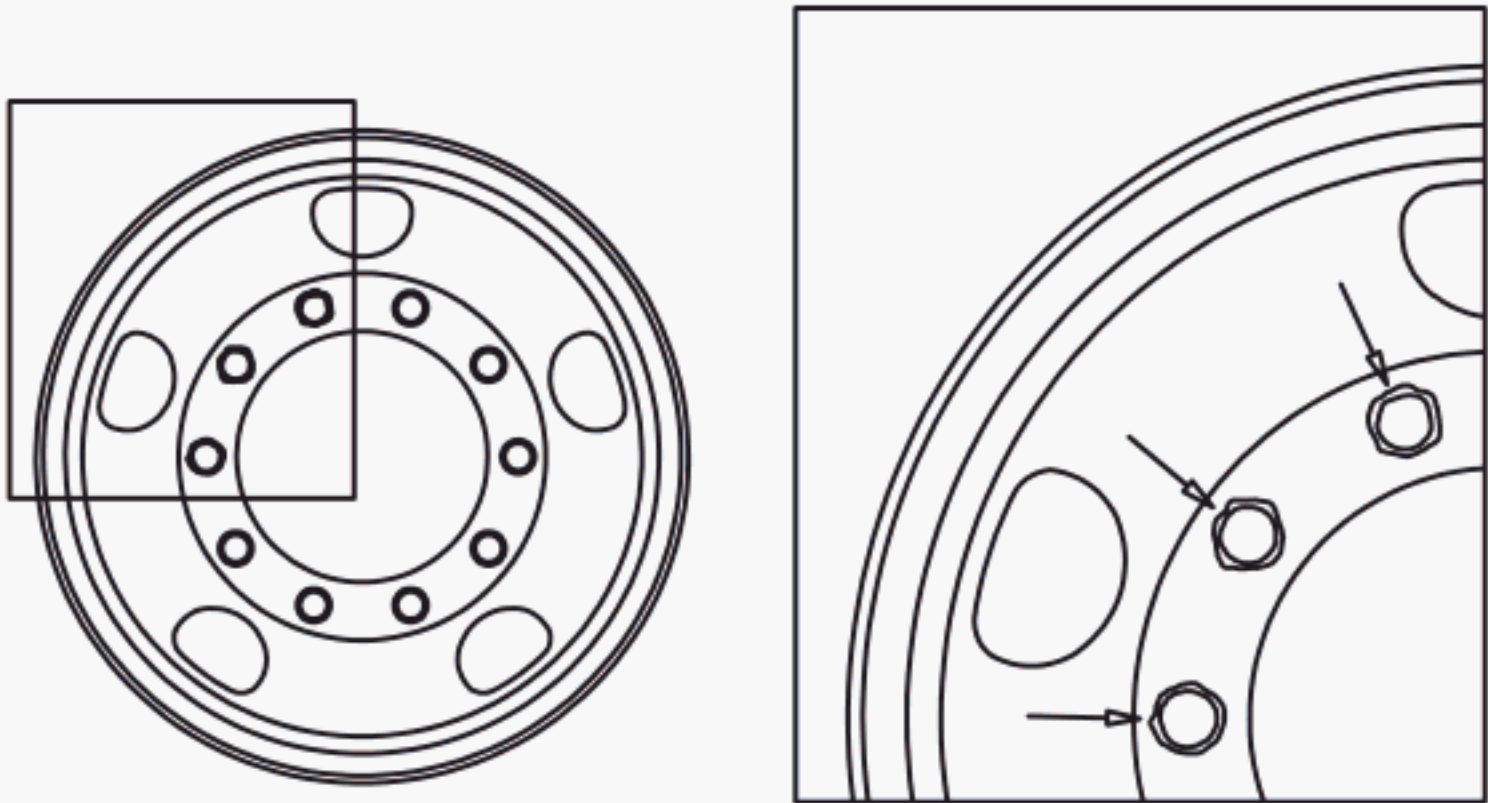
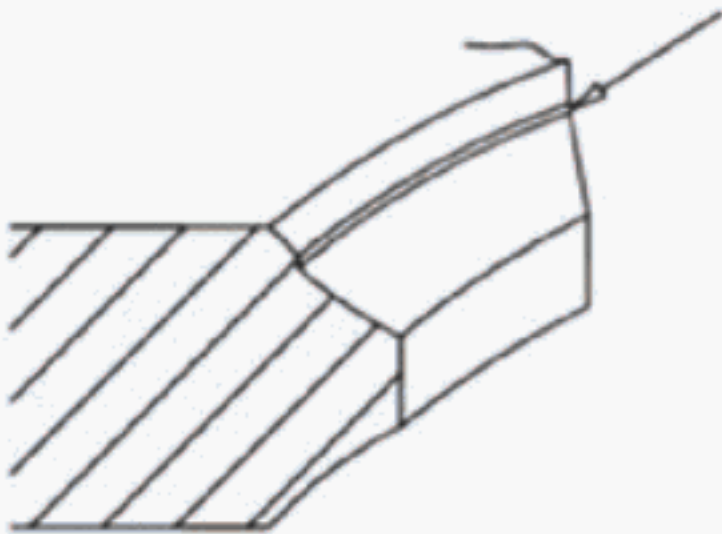
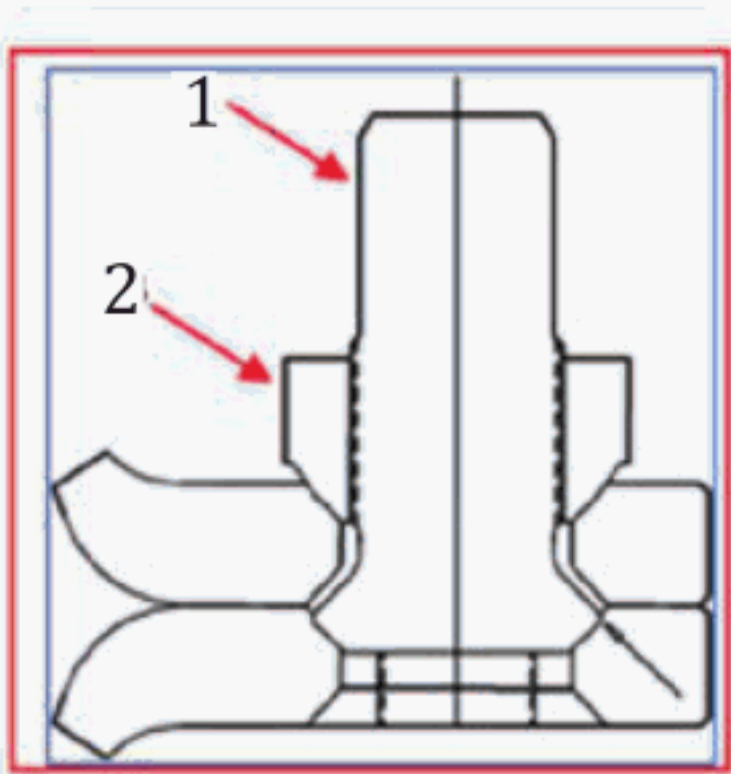


Figure 10 — Elongated bolt holes



Key

- 1 inner nut
- 2 outer nut

Figure 11 — Distort nut seat

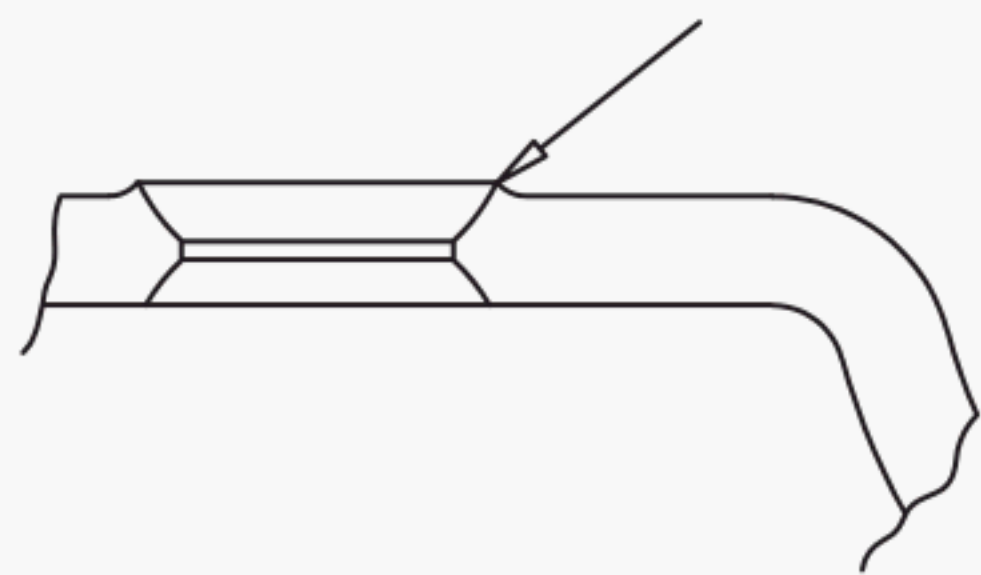
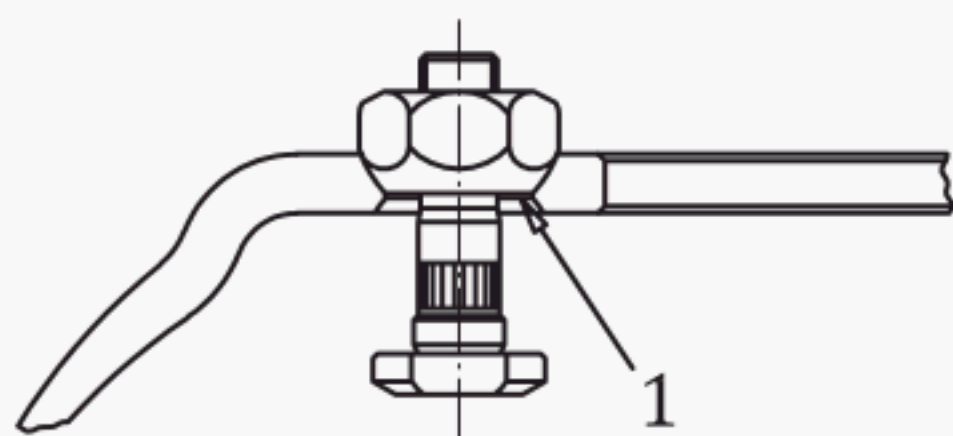


Figure 12 — Burrs around bolt holes



Key
1 narrow land

Figure 13 — Worn nut seat

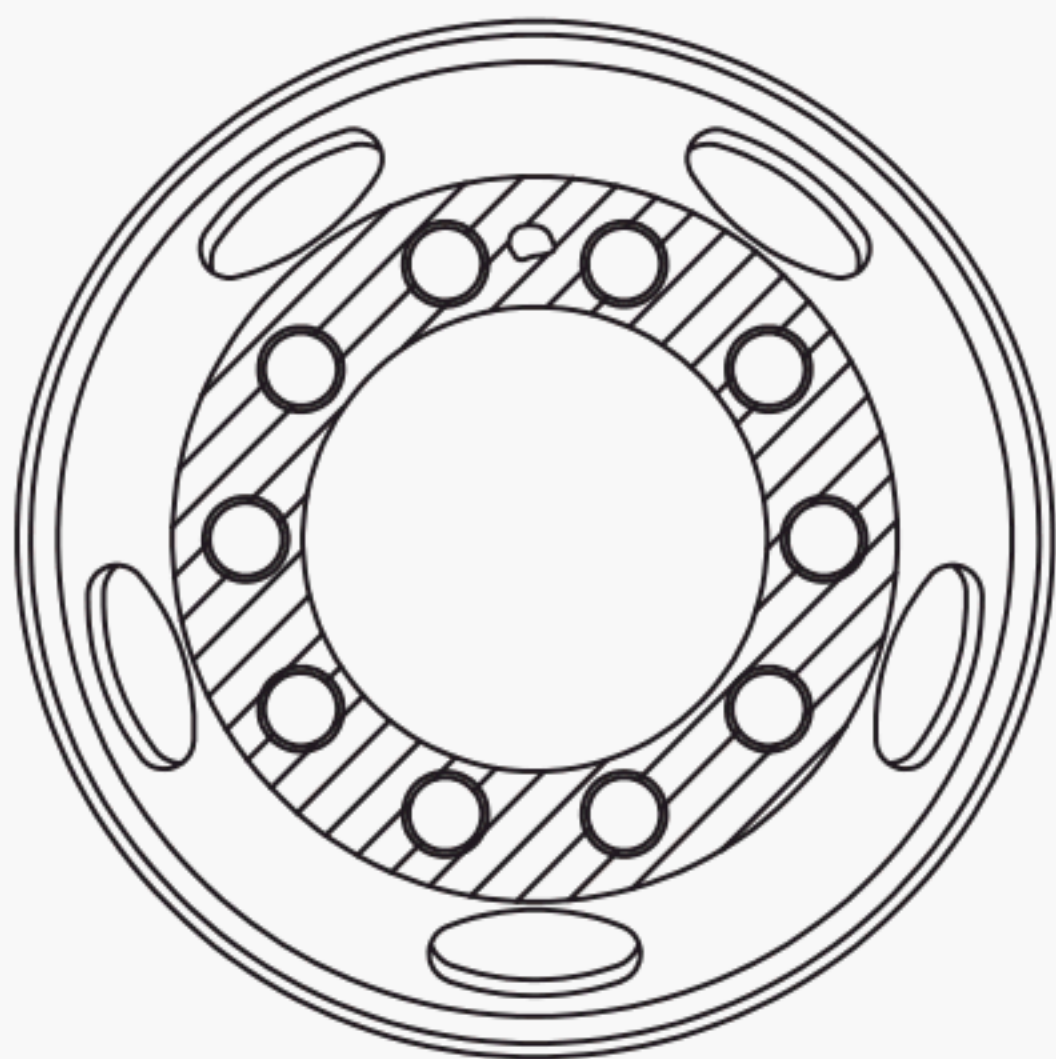


Figure 14 — Excessive wear/ corrosion of wheel attachment face

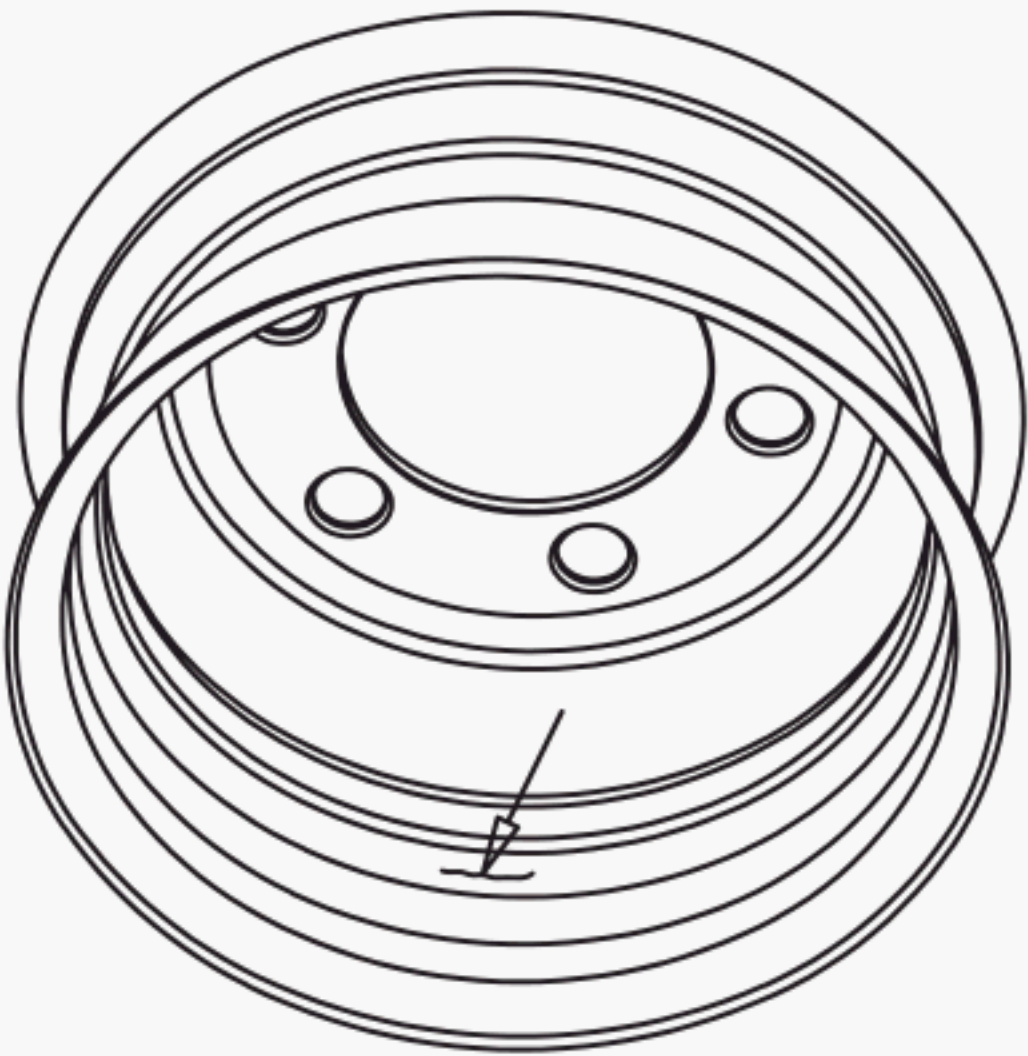


Figure 15 — Circumferential cracks in rim well

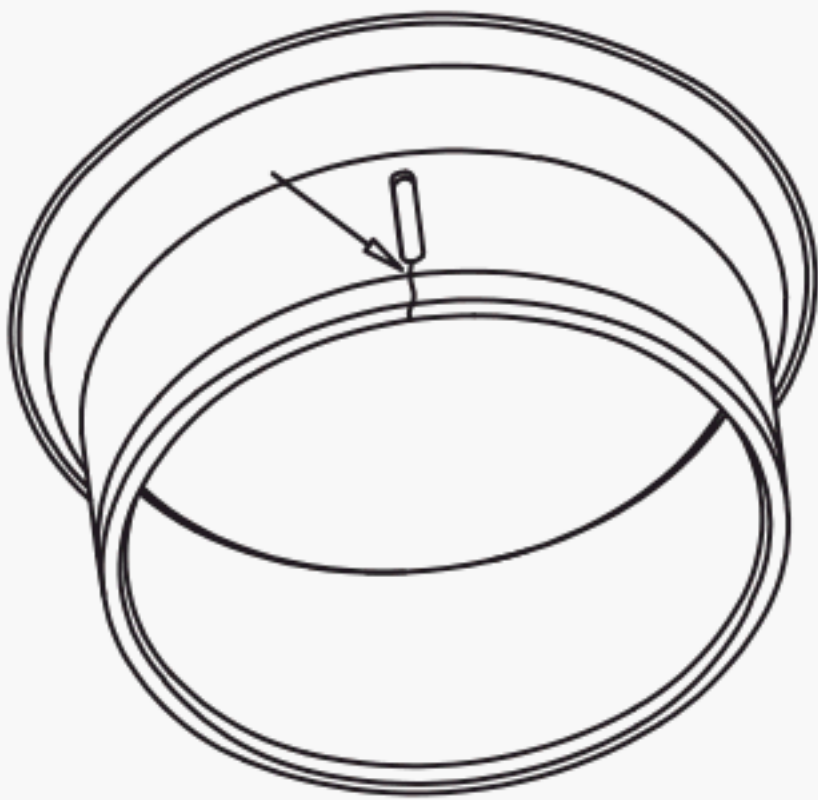
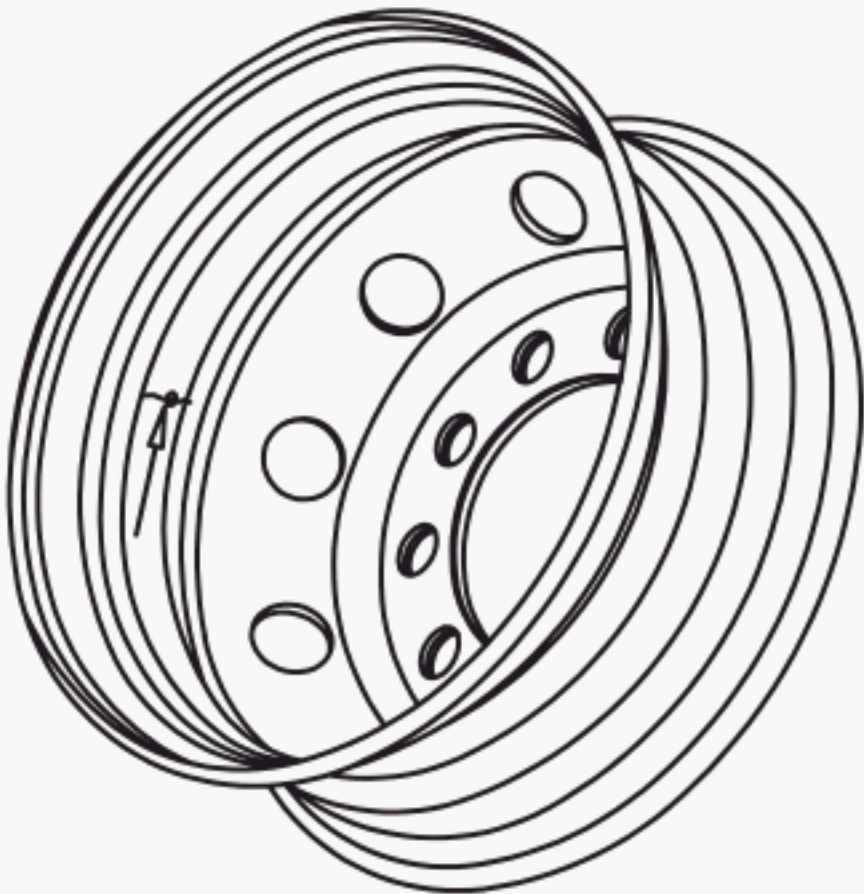


Figure 16 — Valve-aperture cracks

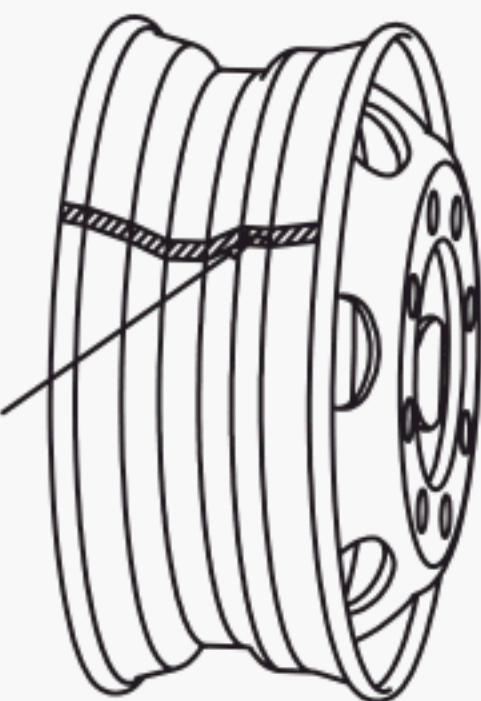


Figure 17 — Butt-weld cracks

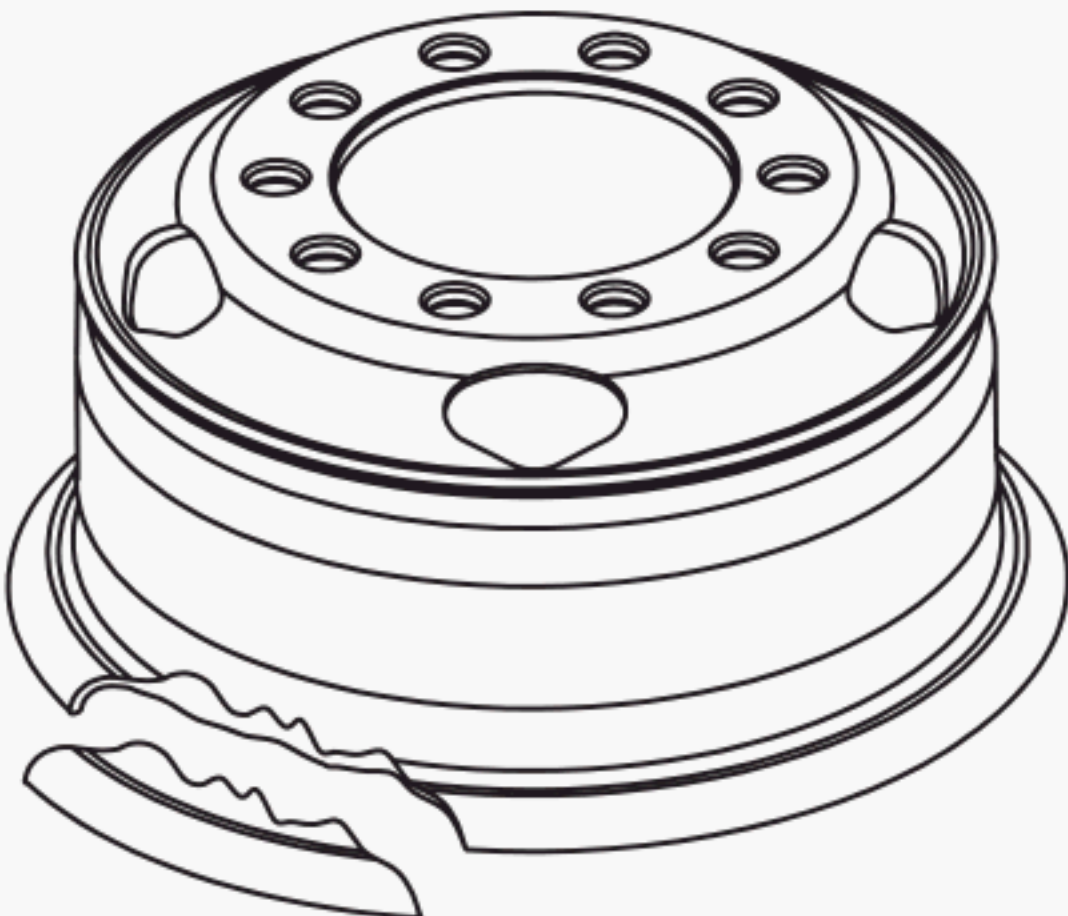


Figure 18 — Bead-seat cracks

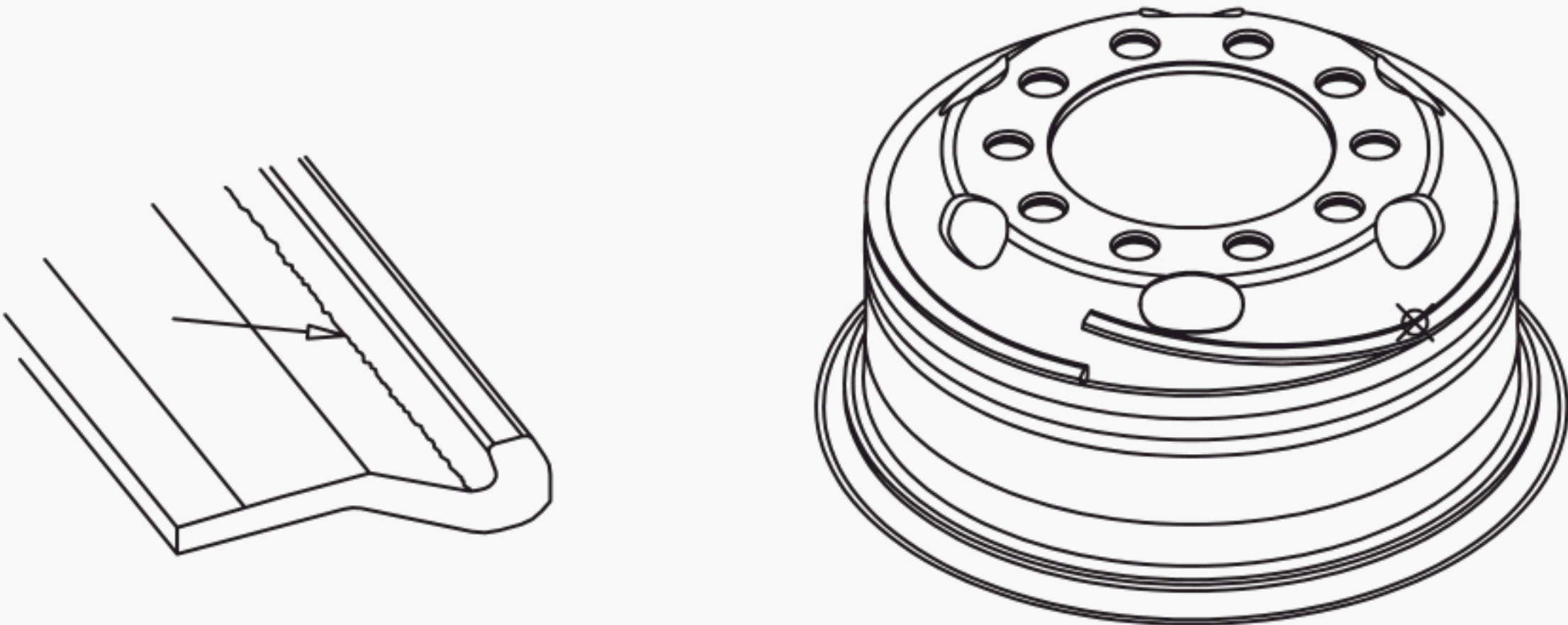


Figure 19 — Rim-gutter cracks

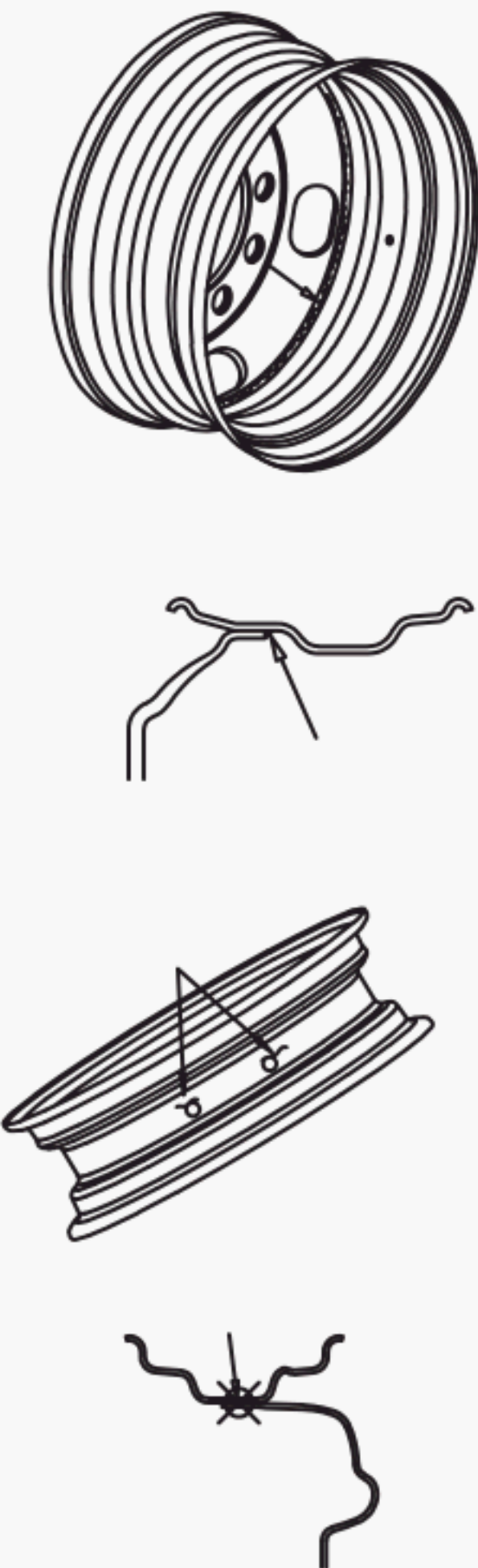


Figure 20 — Disc-to-rim weld cracks

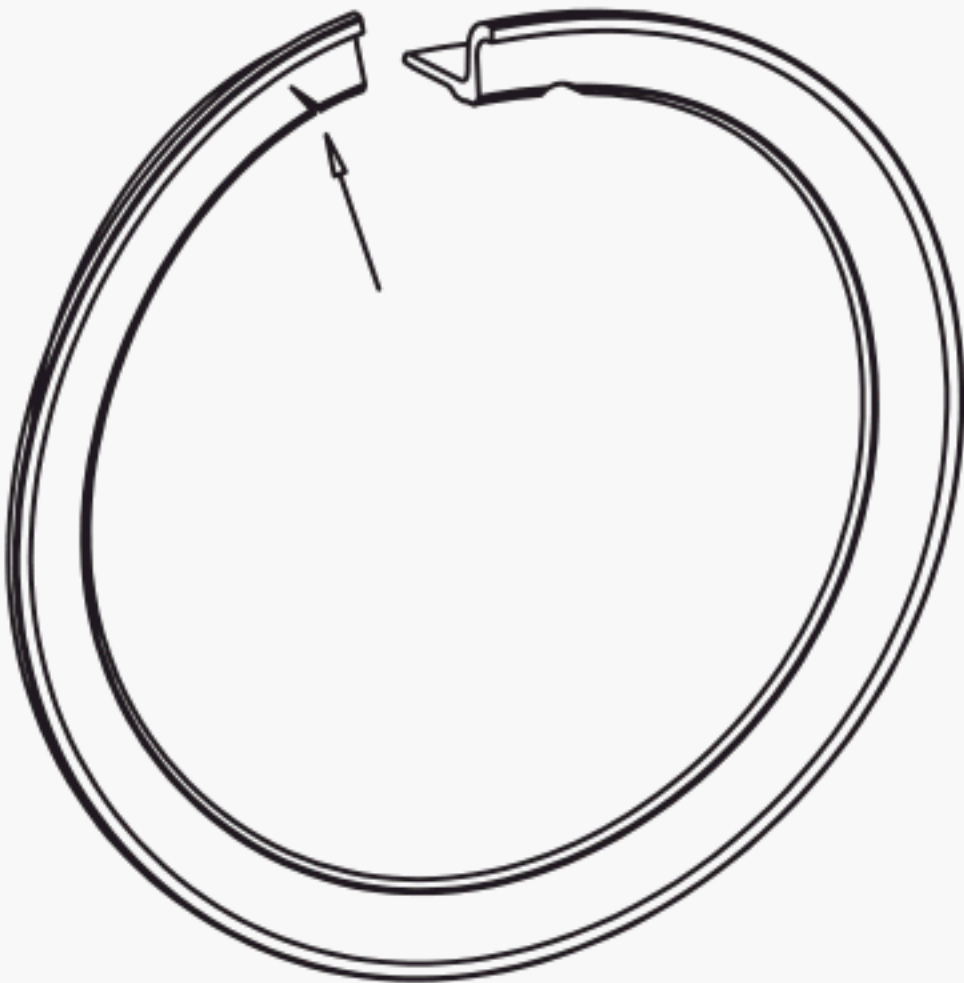


Figure 21 — Side-ring cracks

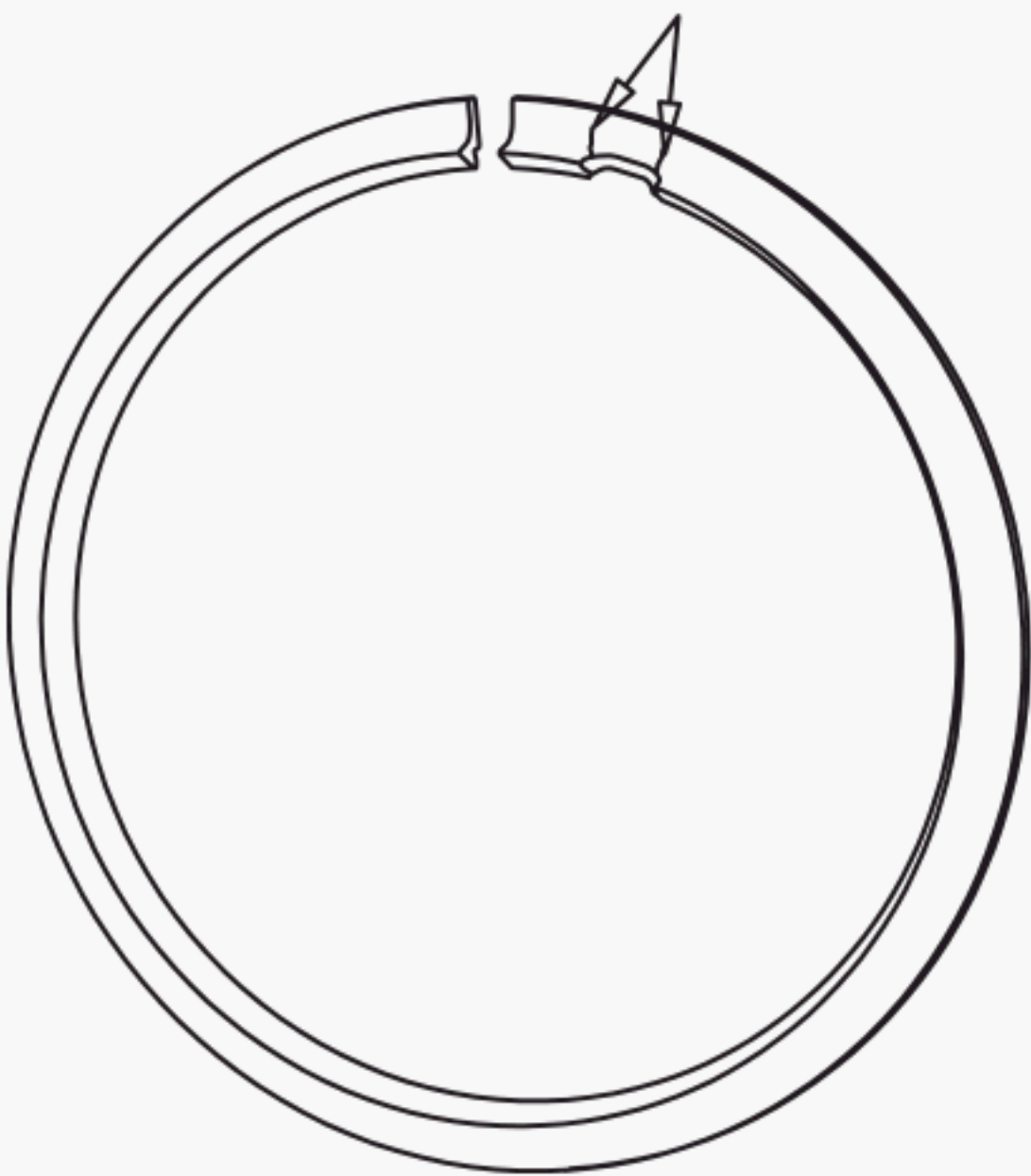


Figure 22 — Lock-ring cracks

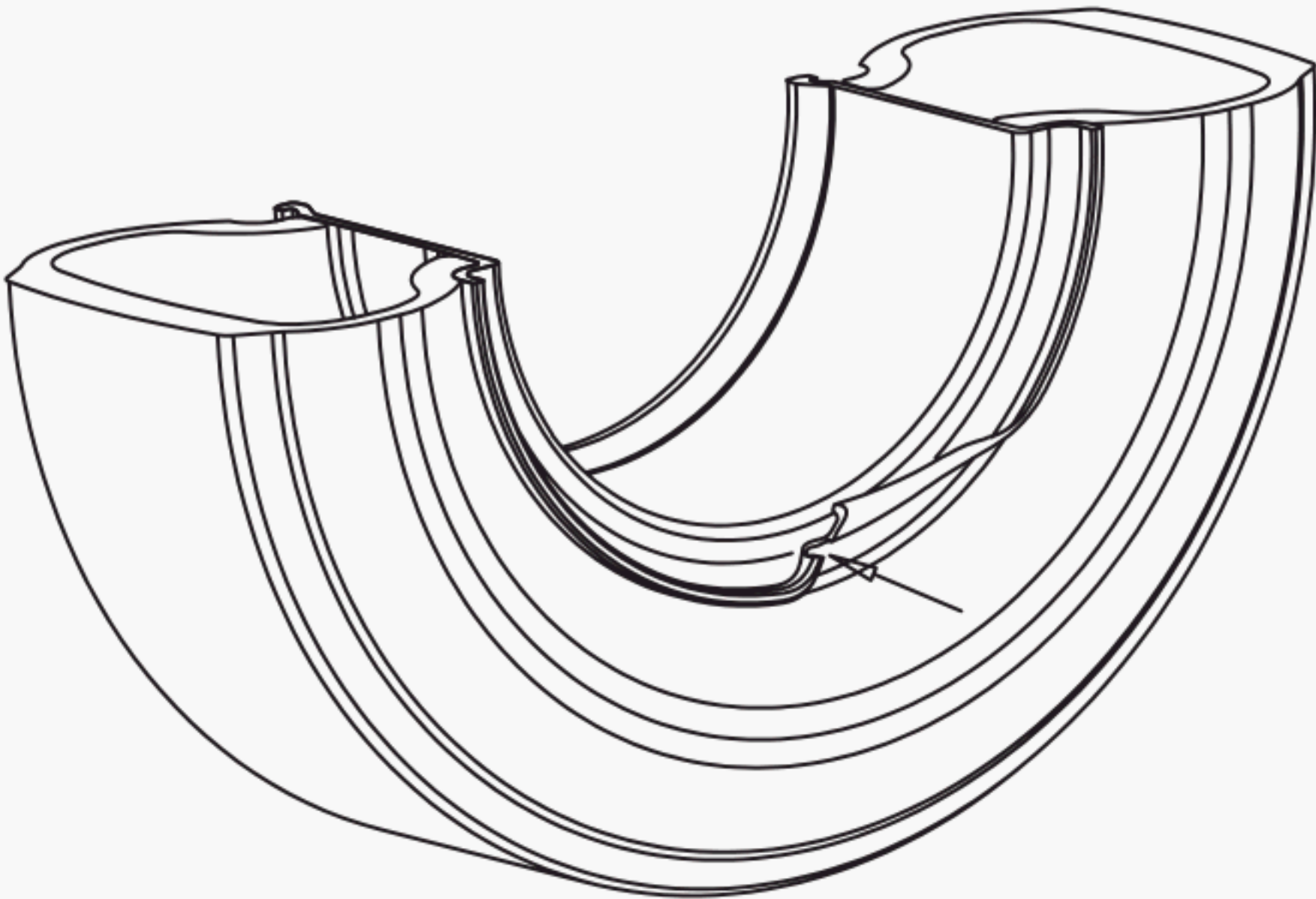


Figure 23 — Bent rim flanges

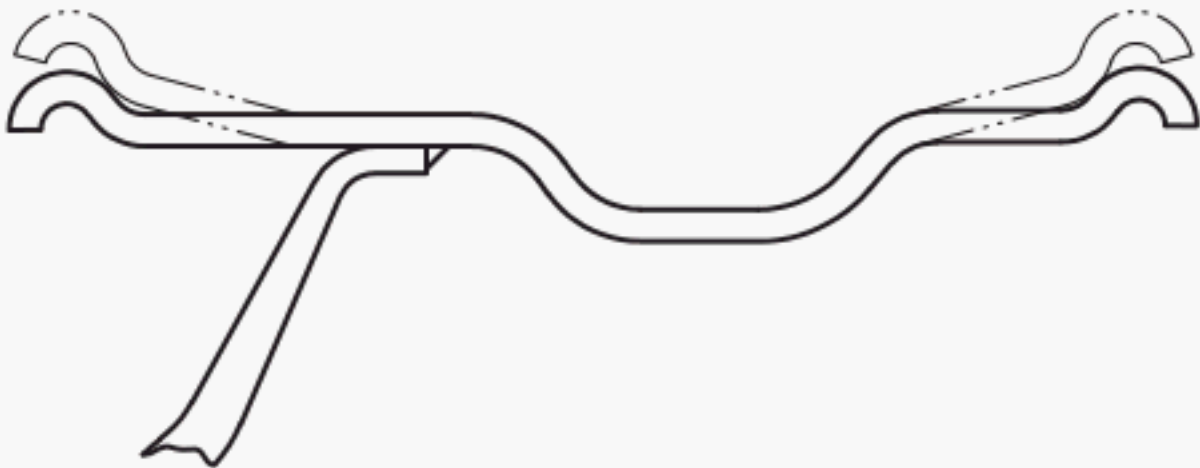


Figure 24 — Distorted bead seat



Figure 25 — Distorted side ring

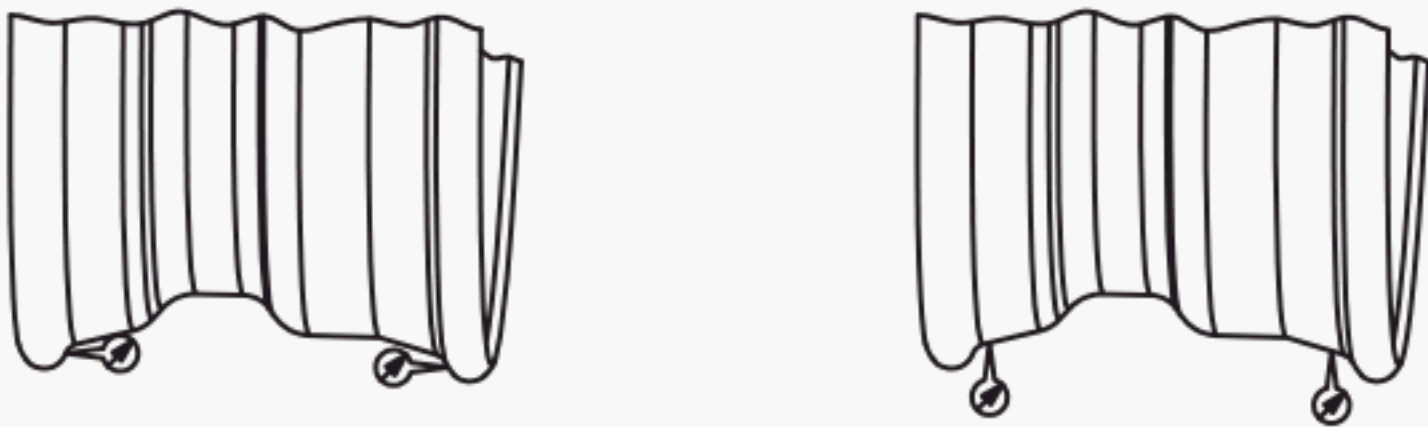


Figure 26 — Excessive run out

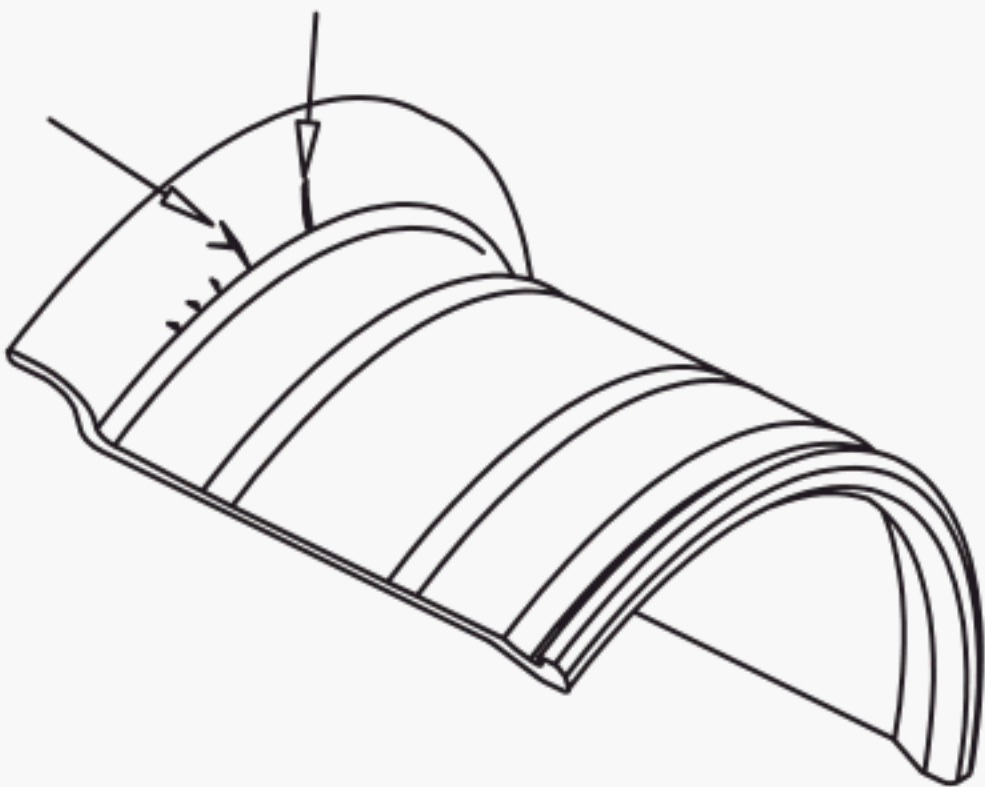


Figure 27 — Burrs

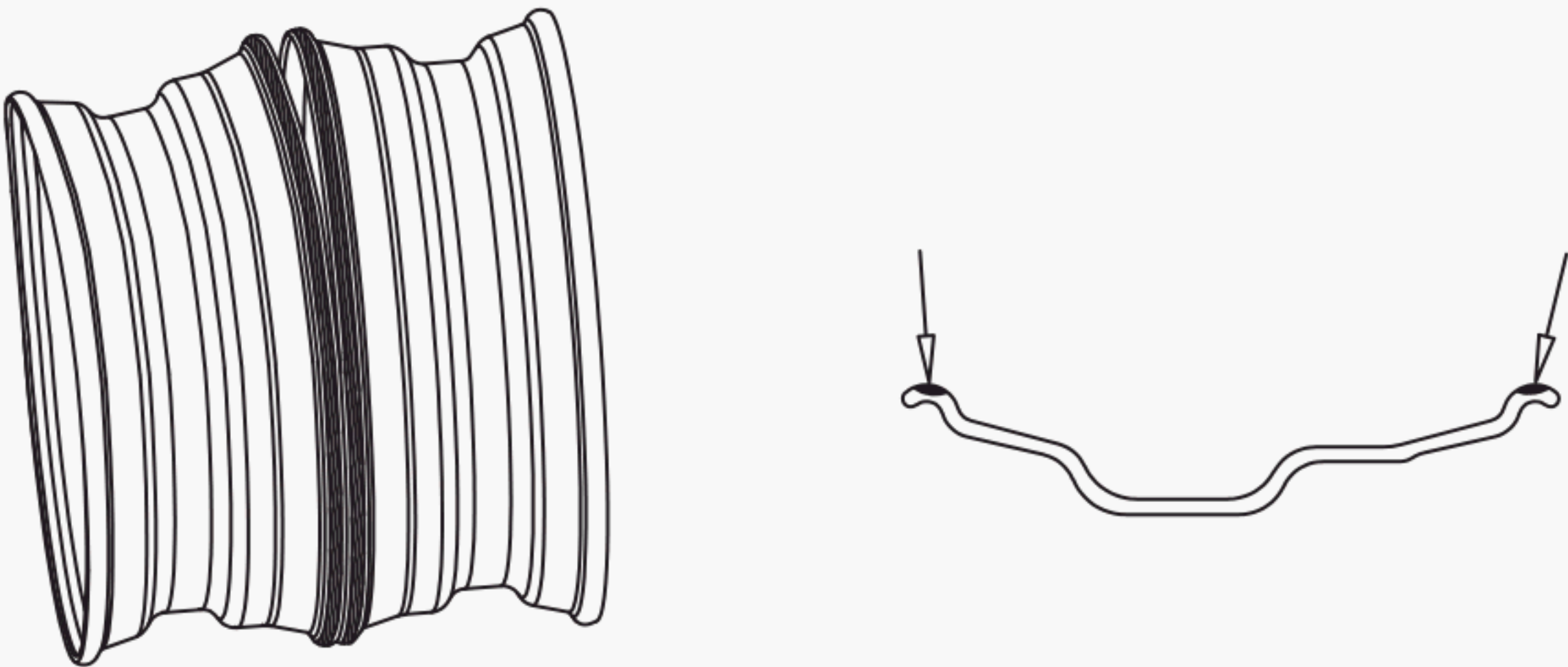


Figure 28 — Rim-flange wear

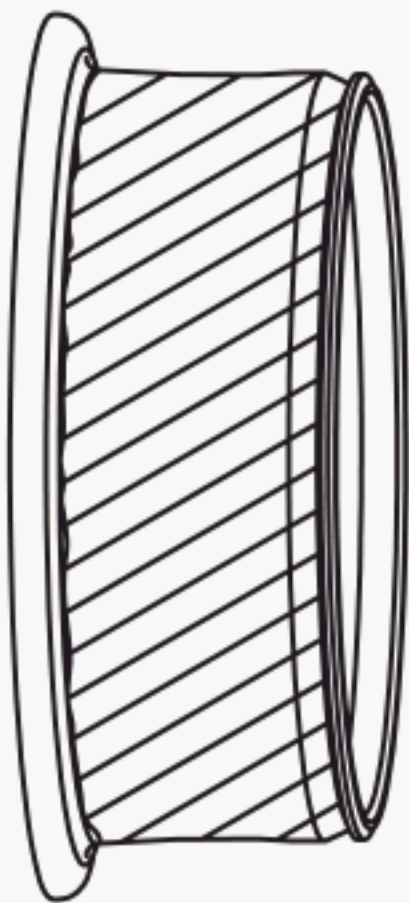
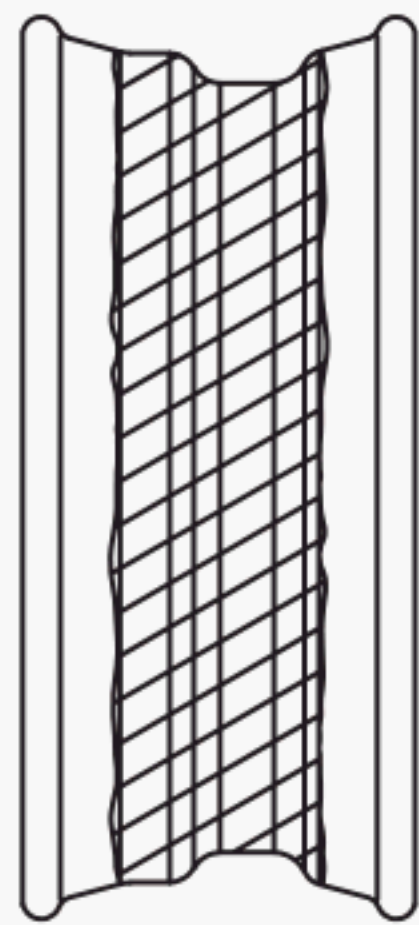


Figure 29 — Excessive corrosion on tyre side of rim and gutter area

Bibliography

ISO 3833, *Road vehicles — Types — Terms and definitions*

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards-based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Copyright in BSI publications

All the content in BSI publications, including British Standards, is the property of and copyrighted by BSI or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use.

Save for the provisions below, you may not transfer, share or disseminate any portion of the standard to any other person. You may not adapt, distribute, commercially exploit or publicly display the standard or any portion thereof in any manner whatsoever without BSI's prior written consent.

Storing and using standards

Standards purchased in soft copy format:

- A British Standard purchased in soft copy format is licensed to a sole named user for personal or internal company use only.
- The standard may be stored on more than one device provided that it is accessible by the sole named user only and that only one copy is accessed at any one time.
- A single paper copy may be printed for personal or internal company use only.

Standards purchased in hard copy format:

- A British Standard purchased in hard copy format is for personal or internal company use only.
- It may not be further reproduced – in any format – to create an additional copy. This includes scanning of the document.

If you need more than one copy of the document, or if you wish to share the document on an internal network, you can save money by choosing a subscription product (see 'Subscriptions').

Reproducing extracts

For permission to reproduce content from BSI publications contact the BSI Copyright and Licensing team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email cservices@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Useful Contacts

Customer Services

Tel: +44 345 086 9001

Email: cservices@bsigroup.com

Subscriptions

Tel: +44 345 086 9001

Email: subscriptions@bsigroup.com

Knowledge Centre

Tel: +44 20 8996 7004

Email: knowledgecentre@bsigroup.com

Copyright & Licensing

Tel: +44 20 8996 7070

Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

