
**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*

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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 14400 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 19, *Wheels*.

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Introduction

The purpose of this International Standard is to ensure the safe operation of road vehicles. The wheel is a highly stressed component of the vehicle that may be subject in service 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.

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

1 Scope

This International Standard specifies requirements for the use, and general maintenance and safety of wheels and rims, and defines their out-of-service conditions, such as cracked, worn and bent wheels. It is applicable to wheels intended for use on road vehicles as defined in ISO 3833, excepting mopeds and motorcycles, and including multi-piece wheels for trucks.

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

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.

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 Wheels 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 exactly correspond 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.

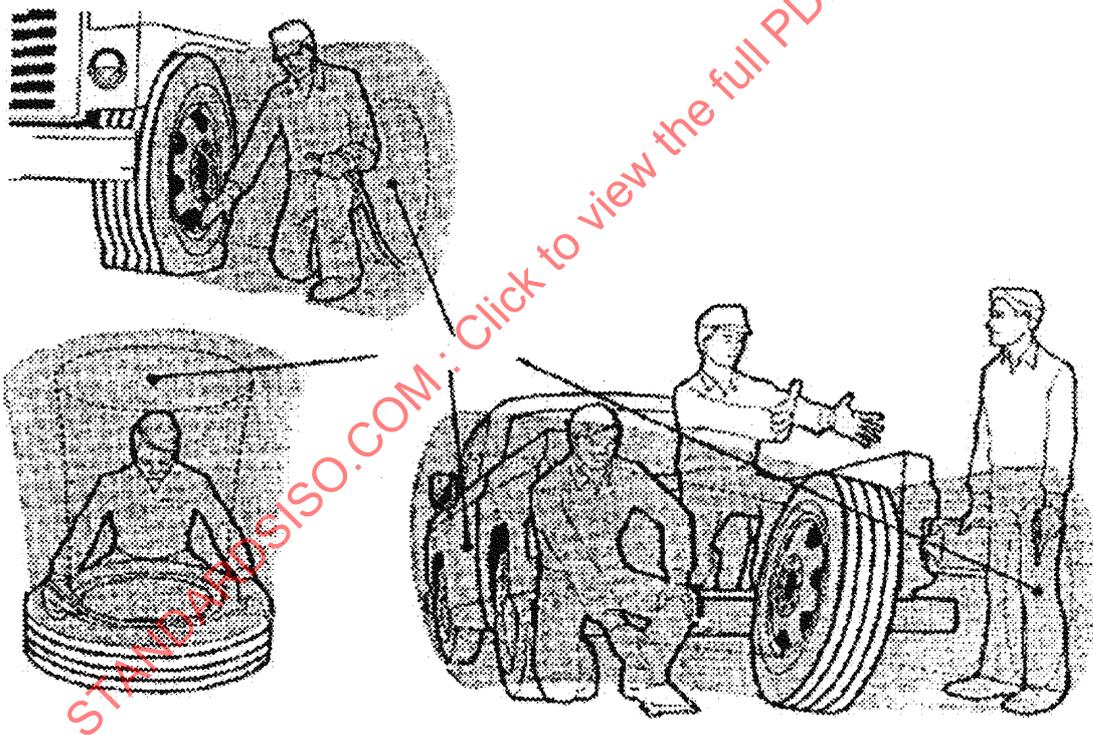
4.2 Wheel mounting and removal

Mounting and removal of wheels shall be carried out by trained personnel only. Only the correct tools shall be used to carry out the various operations.

On multi-piece rims, prior to inflation of the tyre, the correct positioning of the lock ring, the loose flange ring and rubber O-rings, or sealing rings if applicable, shall be carefully checked, always avoiding any correction by means of a hammer. In the case of incorrect positioning, all the air shall be let out of tyre and the whole mounting procedure repeated.

When inflating tyres, the wheel shall be placed in a safety cage or else safety chains shall be put round the wheel. The operator shall not stay in the near dangerous areas or trajectories. *Trajectory* means any potential path or route that a rim wheel component can travel during an explosive separation, or the sudden release of the pressurized air, or an area at which an airblast from a single piece rim wheel can be released. Examples of such trajectories are shown by shaded areas in Figure 1. The correct air pressure specified for the tyre shall be maintained and regular checks shall be made; otherwise, damage to tyre and/or wheel rim can occur.

Where multi-piece rims and divided (bolted) type wheels are involved, for safety reasons the tyres shall be fully deflated before the unbolting of the wheel and tyre assembly from the vehicle axle is started. This safety requirement applies to both tyres in a dual wheel application.



NOTE Under some circumstances, the trajectory can deviate from its expected path.

Figure 1 — Trajectories

4.3 Studs and nuts

All mounting parts such as studs and nuts (with flat captive washer or with spherical or conical seats) shall fit exactly to the wheel being mounted.

NOTE Any incorrect interchangeability or confusion can cause the wheel centre to fail.

Studs and nuts of all wheels shall be fastened, preferably using a torque wrench or in any case by means of a suitable tool capable of reaching the torque value specified by the vehicle manufacturer. The sequence is across and not round the wheel centre. The exact sequence shall conform to that given in the manual of the vehicle manufacturer.

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	<ul style="list-style-type: none"> — Insufficient tightening torque, loose nut — Improper installation procedure — Use of improper bolt/nut — Mounting surface not flat — Excessive load — Damaged or worn nut seat — Inequality of tightening torque between the nuts 	2
	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
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
Wear/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	— Excessive load, excessive air pressure — Corrosion from excessive airline moisture or improper tyre mounting lubricants, etc.	15
	Valve-aperture cracks	— Excessive load, excessive air pressure — Improper finish of rim hole — Corrosion	16
	Butt-weld cracks	— Excessive load — Improper welding	17
	Bead-seat cracks	— Excessive load, excessive air pressure — Improper matching of tyre and rim — Tyre tool damage — Tyre bead not fully seated against flange	18
	Rim-gutter cracks	— 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	— Excessive load, excessive air pressure — Improper welding	20
	Side-ring cracks	— 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	— 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

Table 2 — (continued)

Type	Appearance	Probable cause	See Figure
Deformation	Bent rim flanges	— Impact from kerbs, holes, or road hazards — Abuse in tyre mounting or demounting	23
	Distorted bead seat	— Impact damage — Run-flat running — Improper tyre installation procedure — Shipping damage	24
	Distorted side ring	— Improper installation/removal of side ring — Impact damage	25
	Excessive run-out	— Impact damage — Run-flat running — Improper installation procedure — Shipping damage	26
	Burrs	— Tyre tool damage	27
Wear/ corrosion	Rim flange wear	— Tyre chafing — Insufficient air pressure — Excessive load	28
	Excessive corrosion on tyre side of rim and gutter area	— Excessive air line moisture — Improper tyre mounting lubricants — Accumulation of water, mud and salt in gutter area	29

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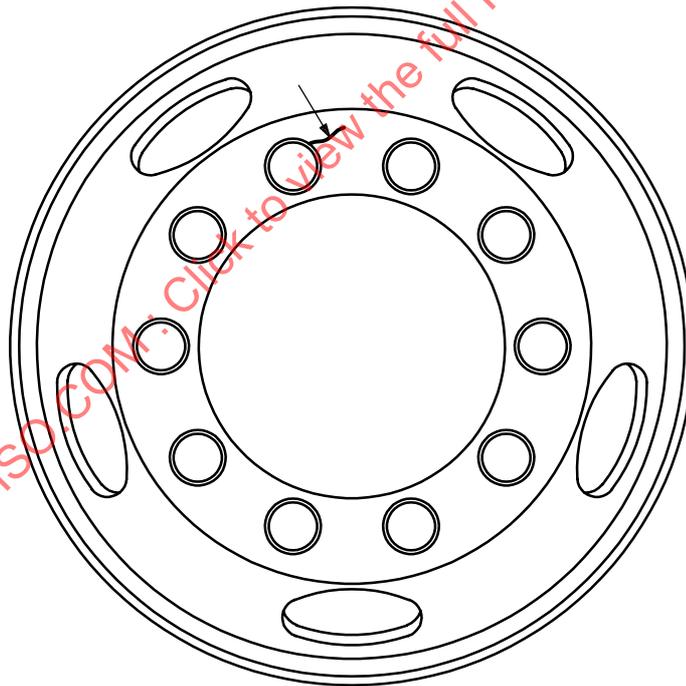


Figure 2 — Bolt-hole cracks

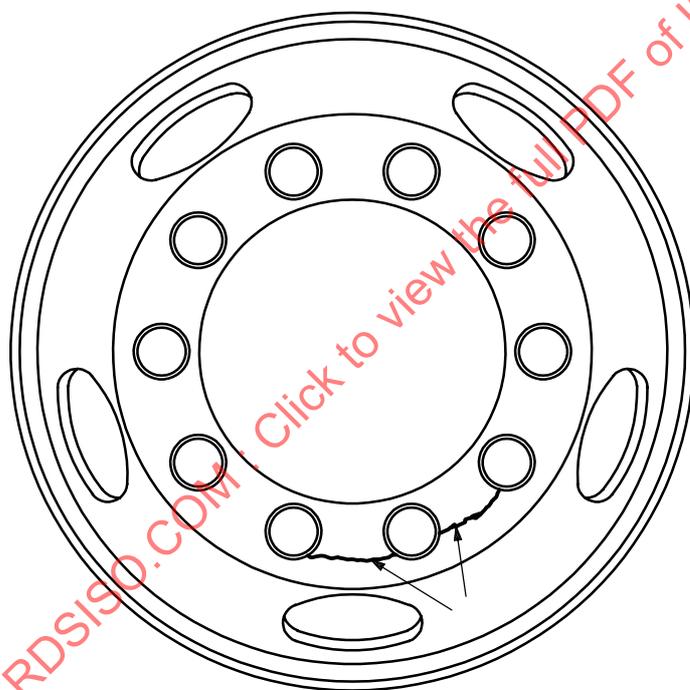
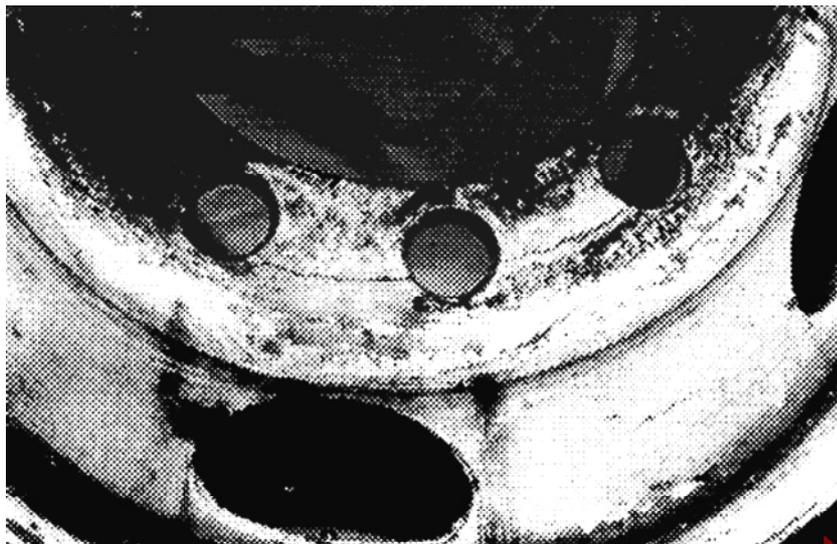


Figure 3 — Bolt-hole-to-bolt-hole cracks

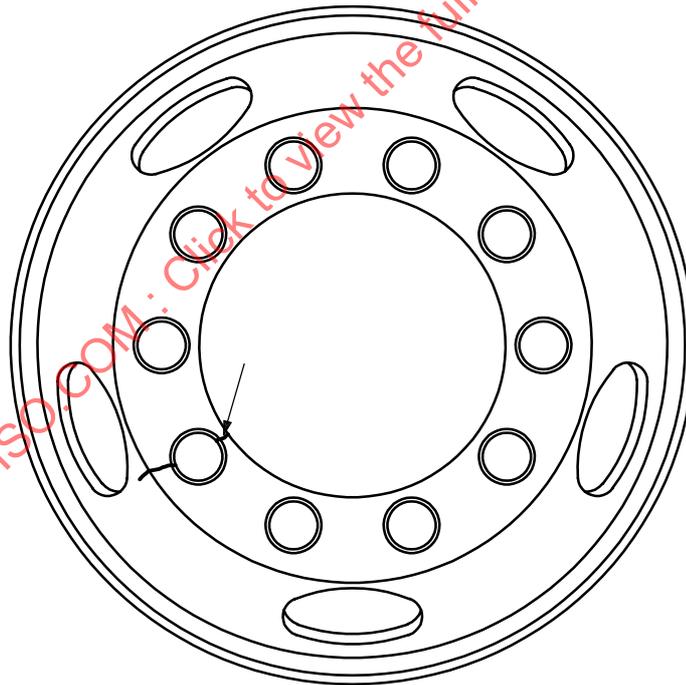


Figure 4 — Bolt-hole-to-centre-hole cracks

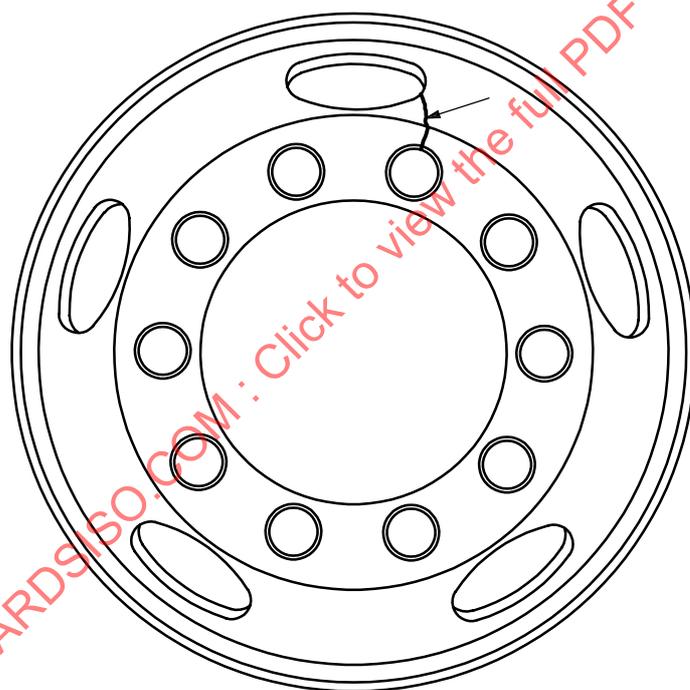
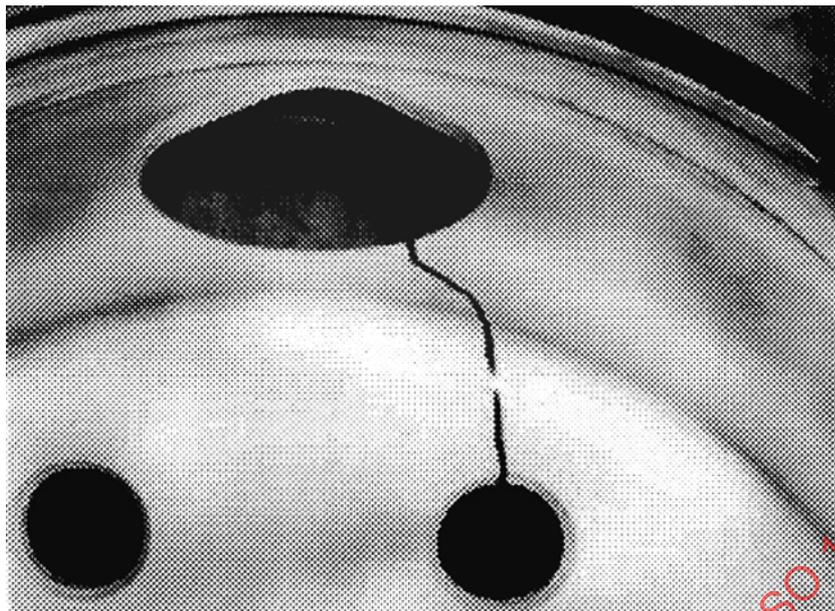


Figure 5 — Bolt-hole-to-hand-hole cracks

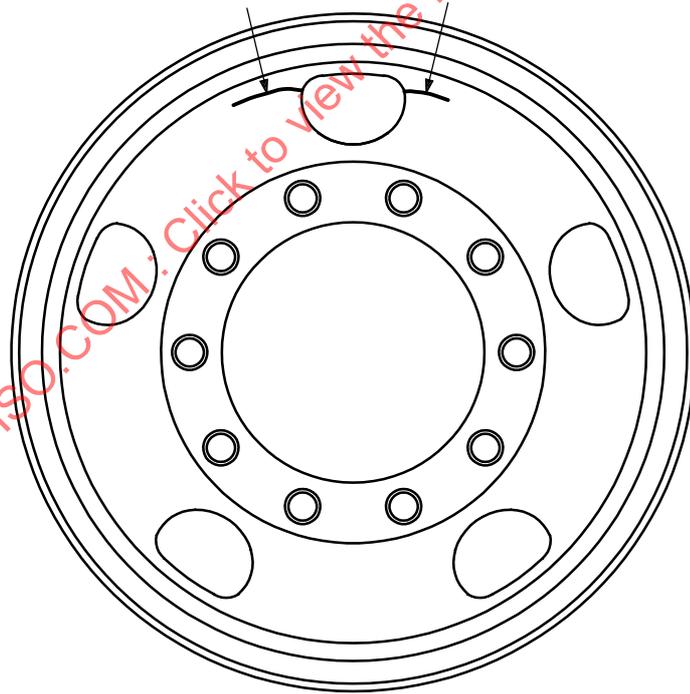
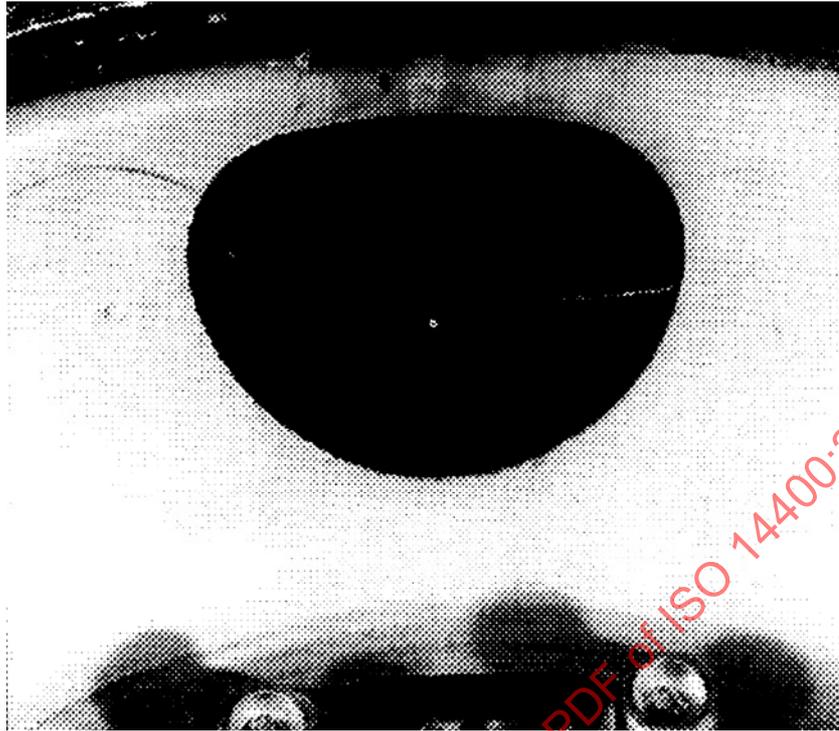


Figure 6 — Hand-hole cracks

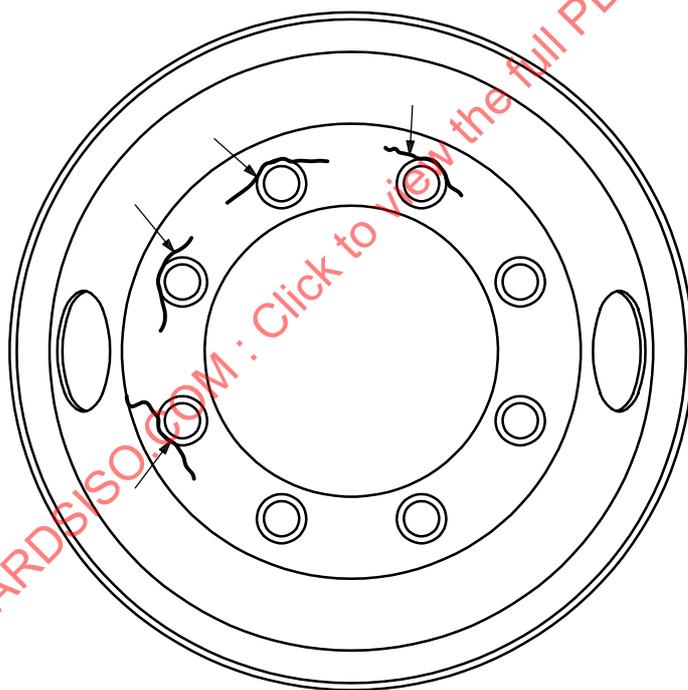
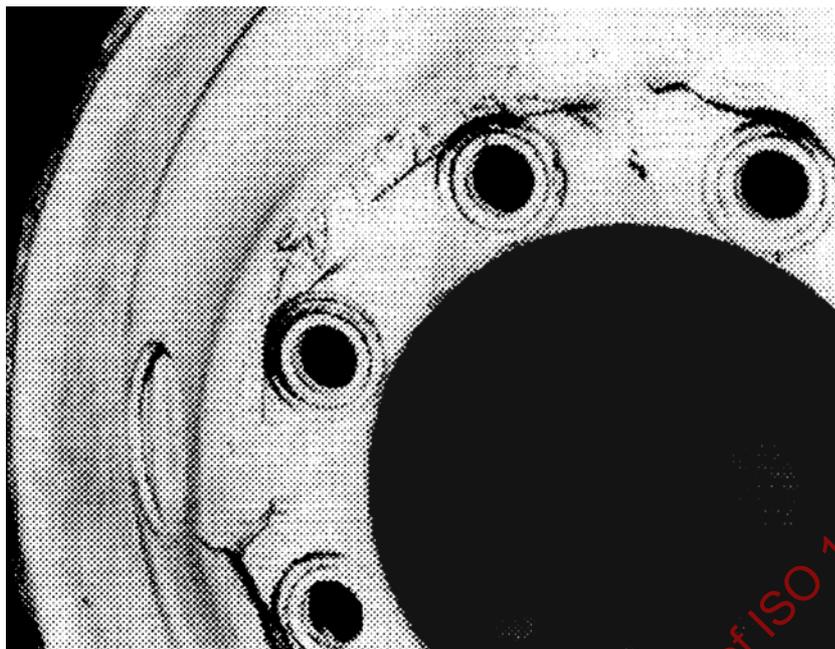


Figure 7 — Circumferential cracks on mounting area of hub-piloted wheels

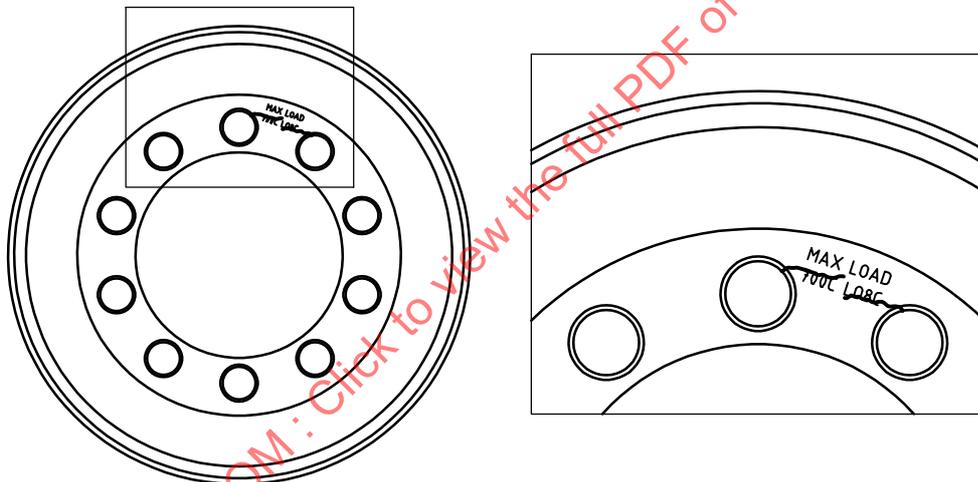


Figure 8 — Cracks at stamp

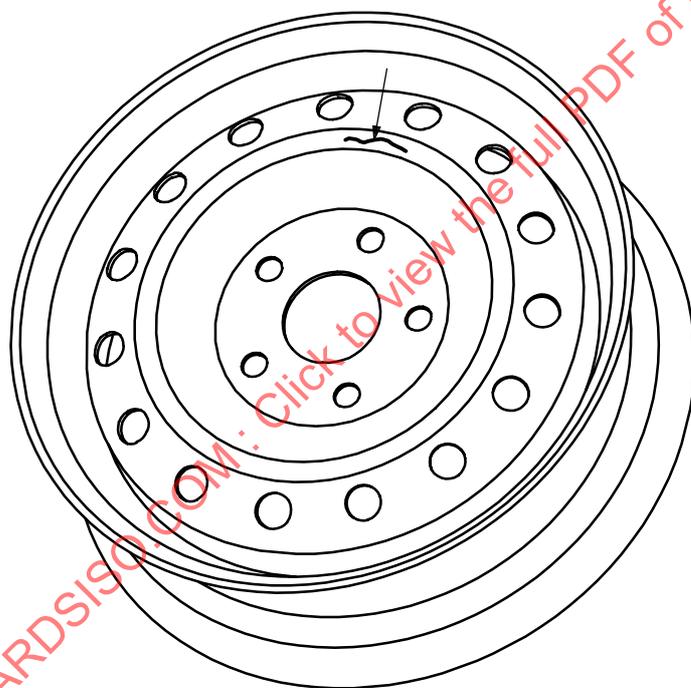
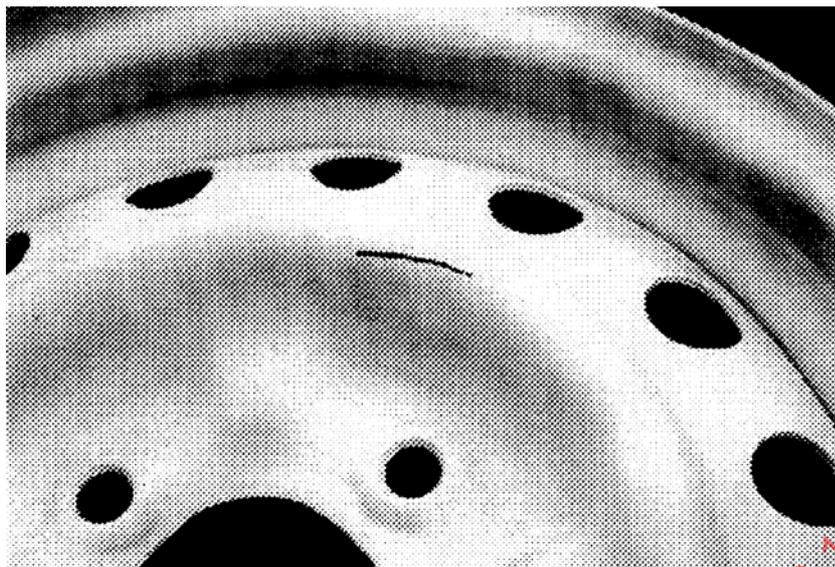


Figure 9 — Disc-hat cracks

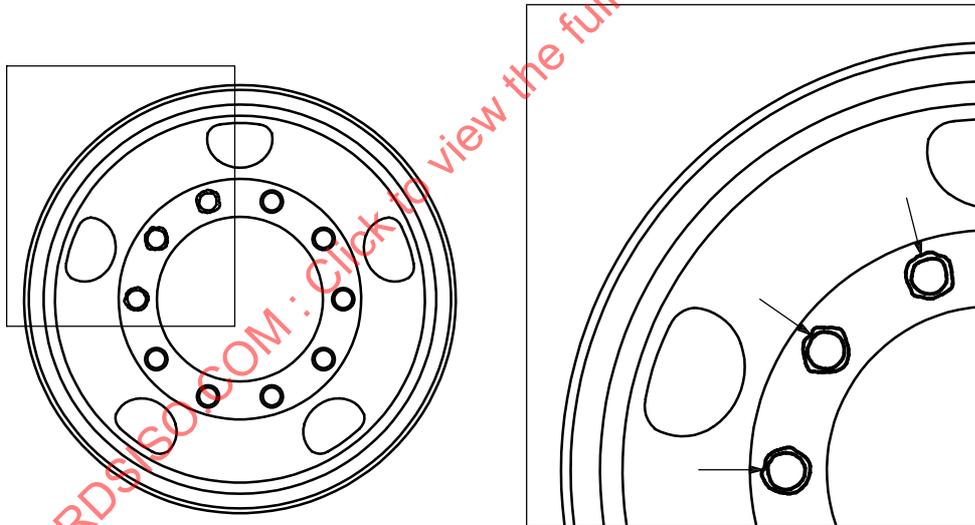
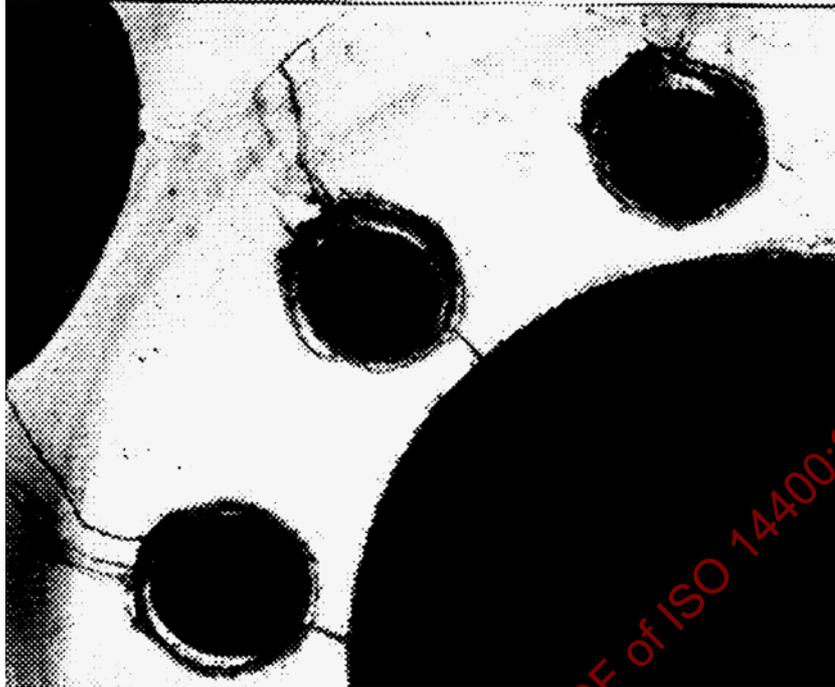
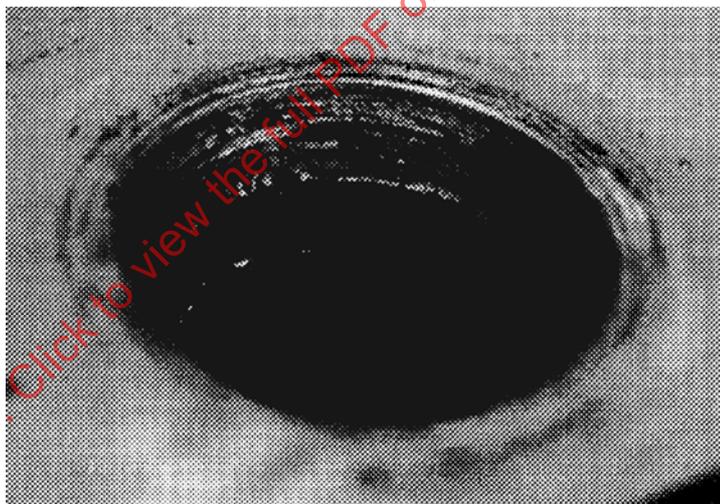
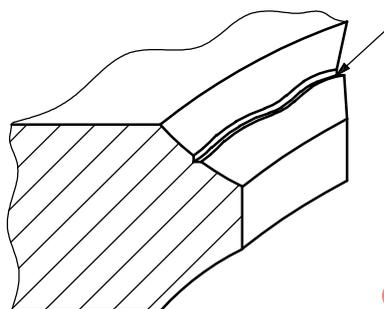
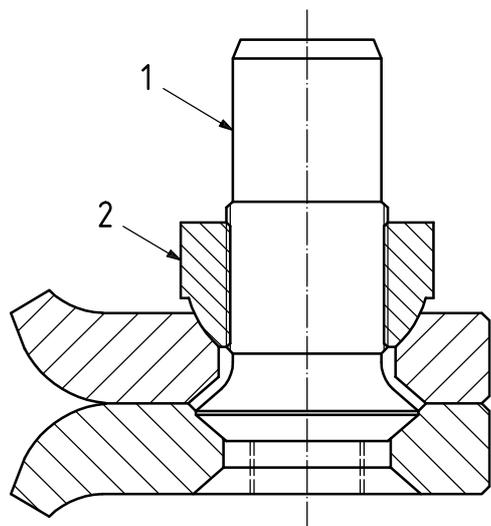


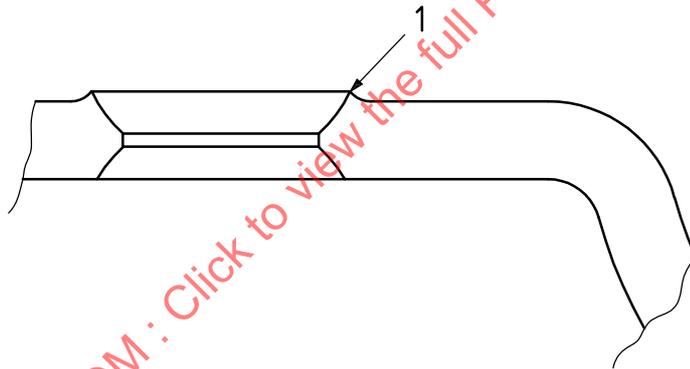
Figure 10 — Elongated bolt holes



Key

- 1 inner nut
- 2 outer nut

Figure 11 — Distorted nut seat



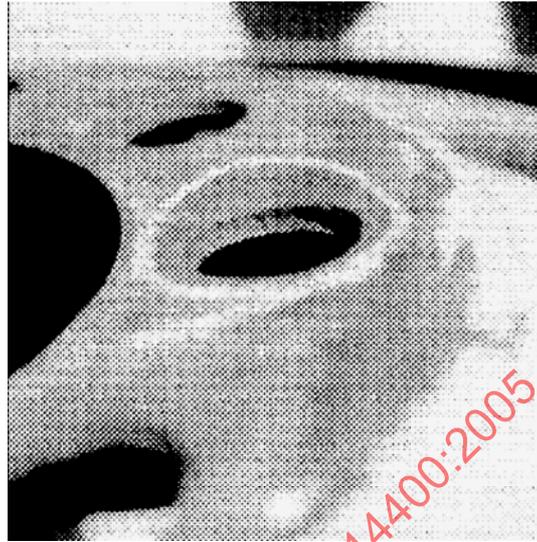
Key

1 nut side

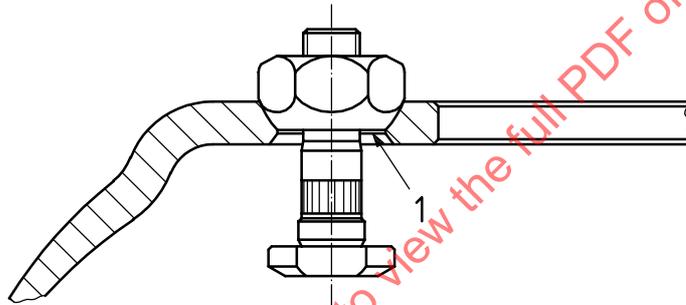
Figure 12 — Burrs around bolt holes



a) New acceptable



b) Worn unacceptable



Key
1 narrow land

Figure 13 — Worn nut seat

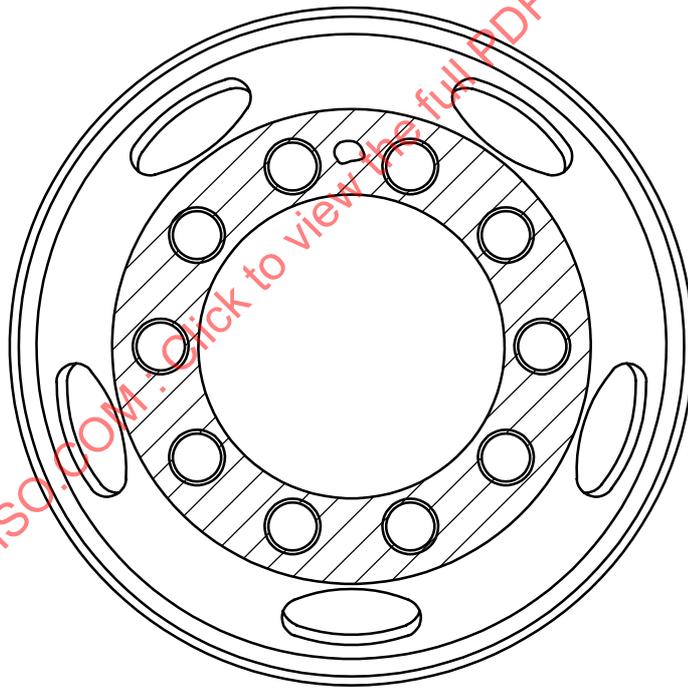
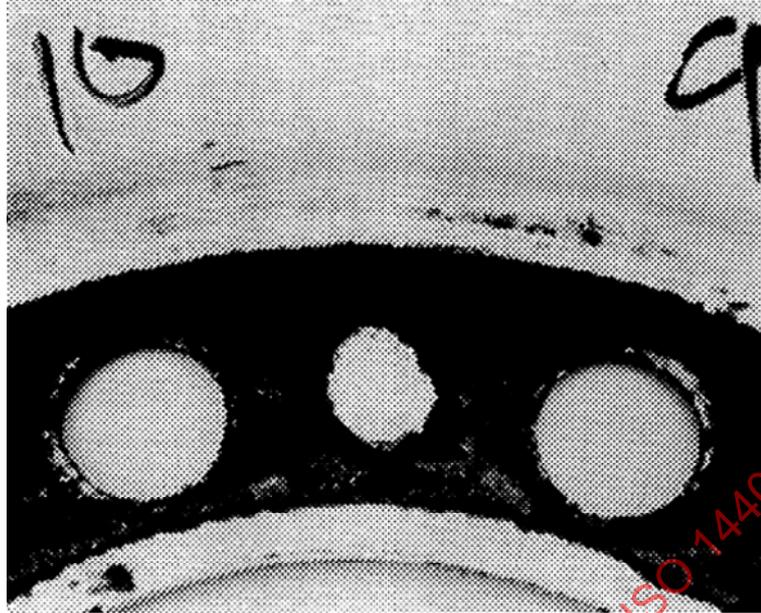


Figure 14 — Excessive wear/corrosion of wheel attachment face

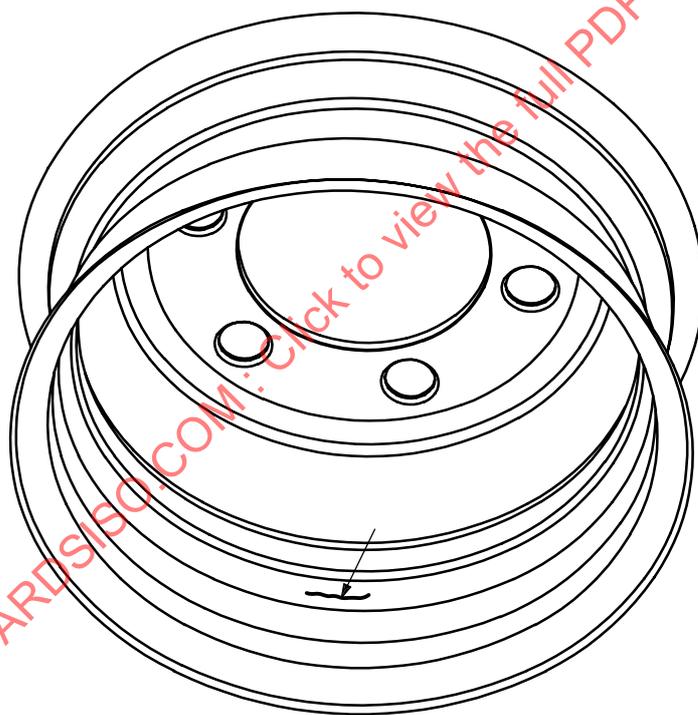


Figure 15 — Circumferential cracks in rim well

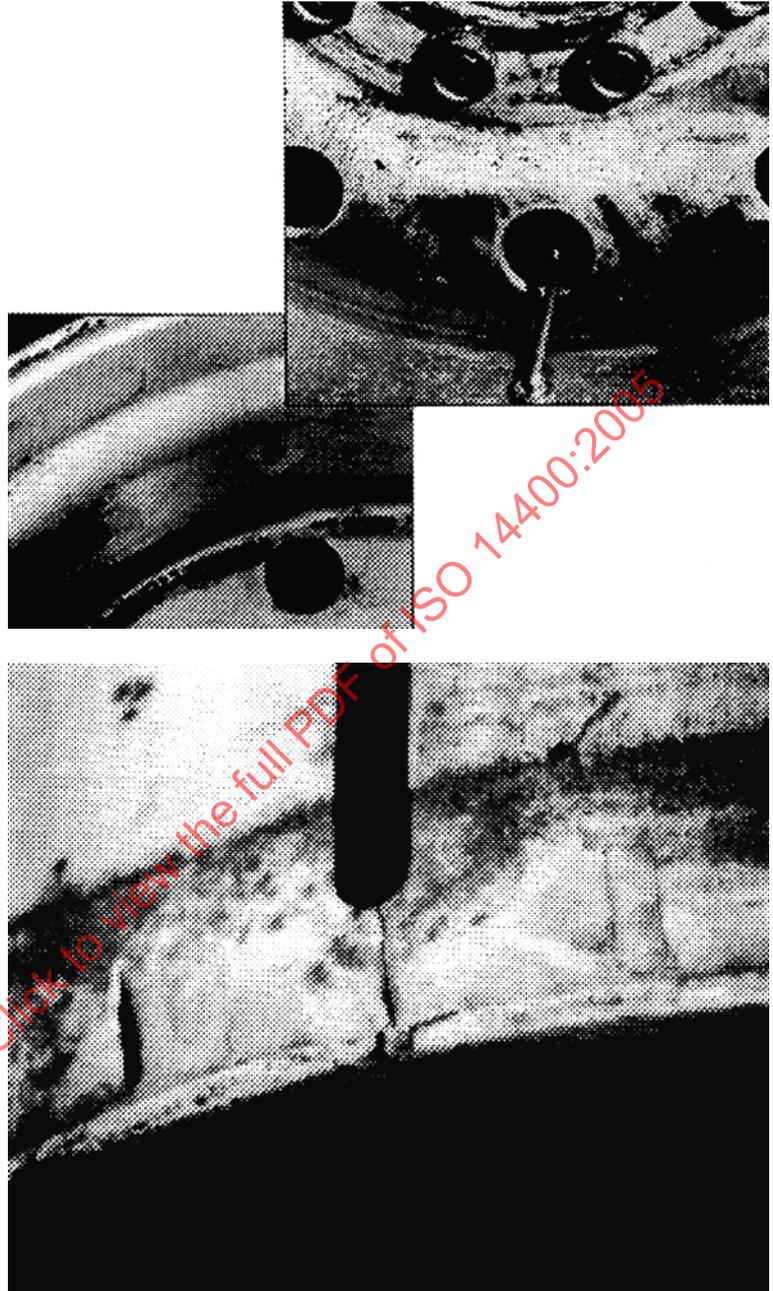
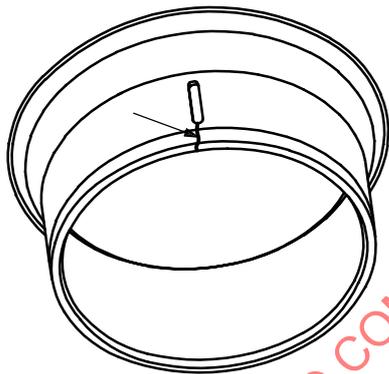
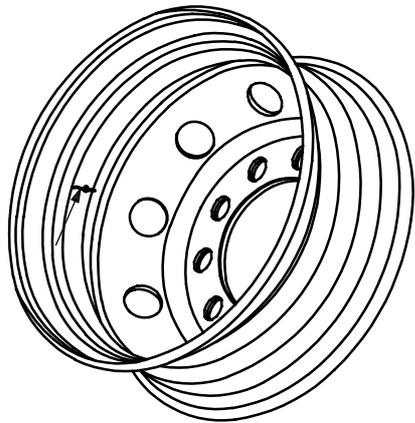


Figure 16 — Valve-aperture cracks

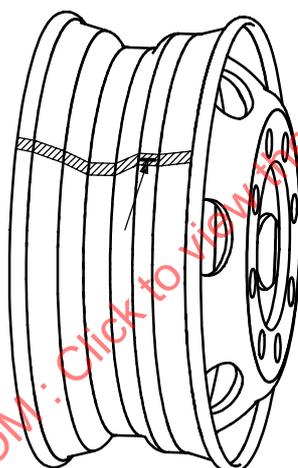
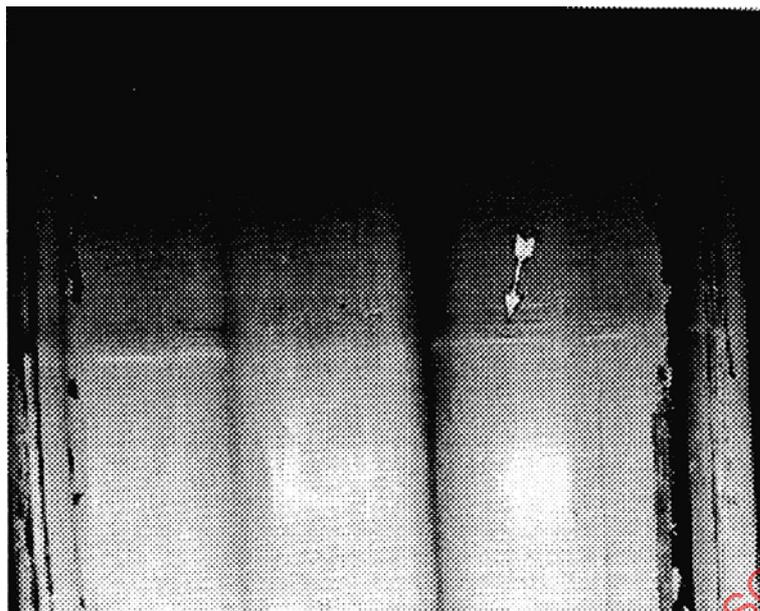


Figure 17 — Butt-weld cracks

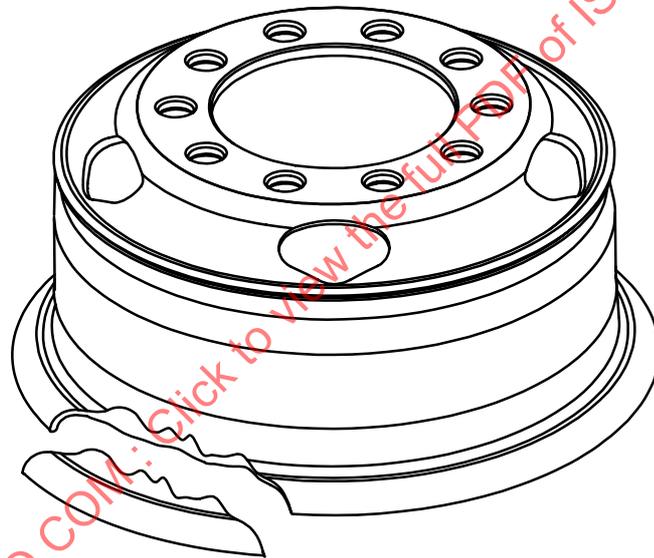
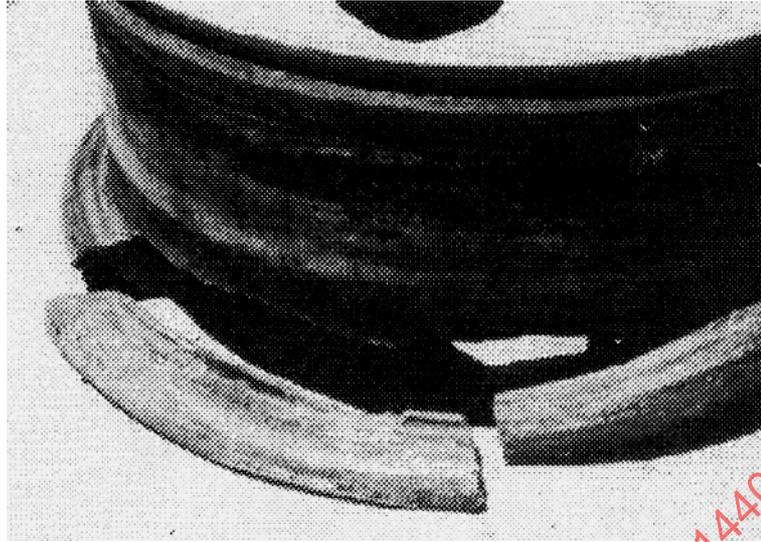


Figure 18 — Bead-seat cracks

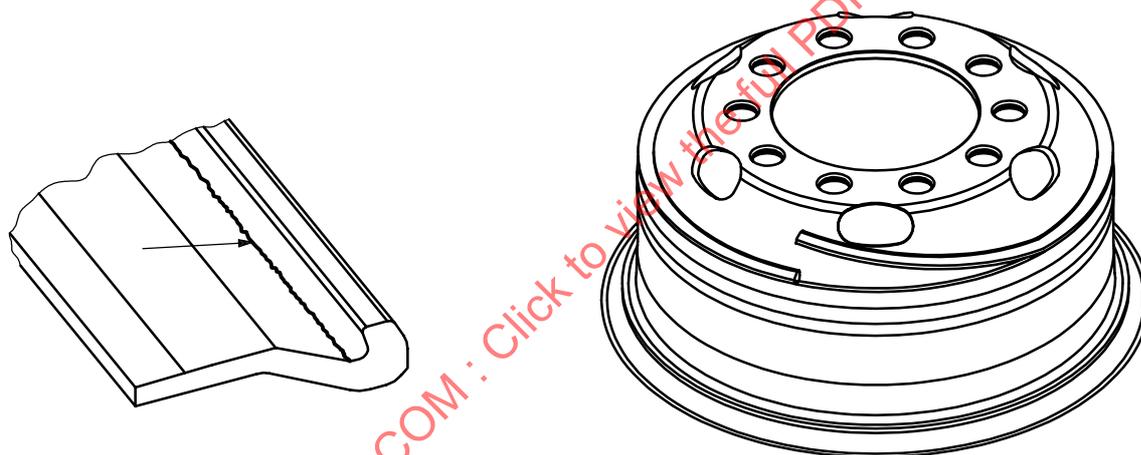
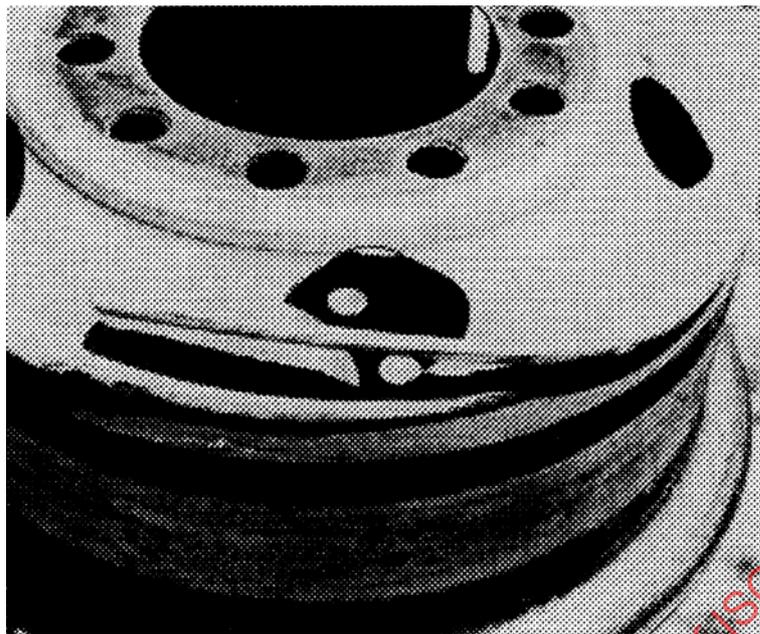


Figure 19 — Rim-gutter cracks

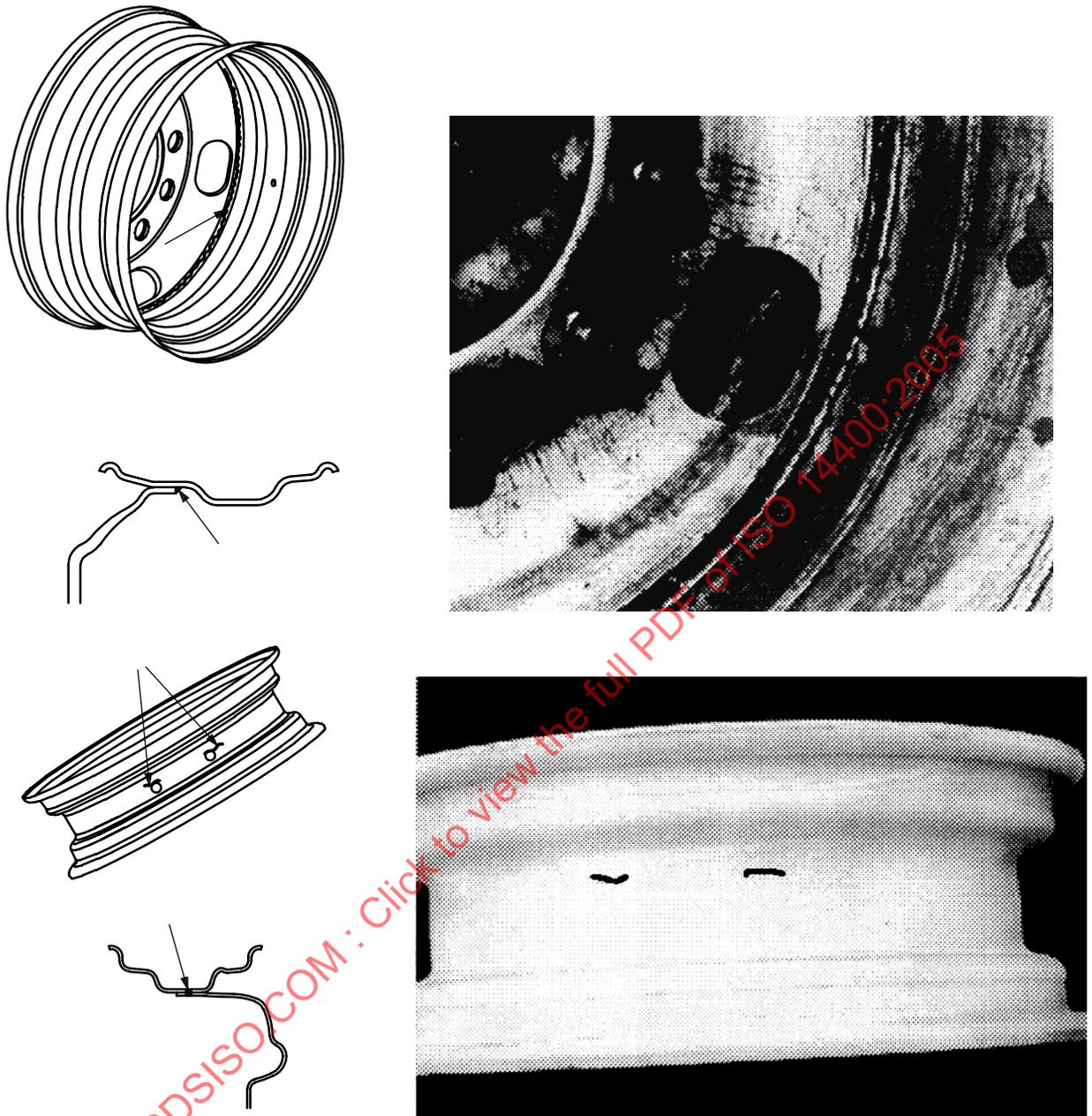


Figure 20 — Disc-to-rim weld cracks

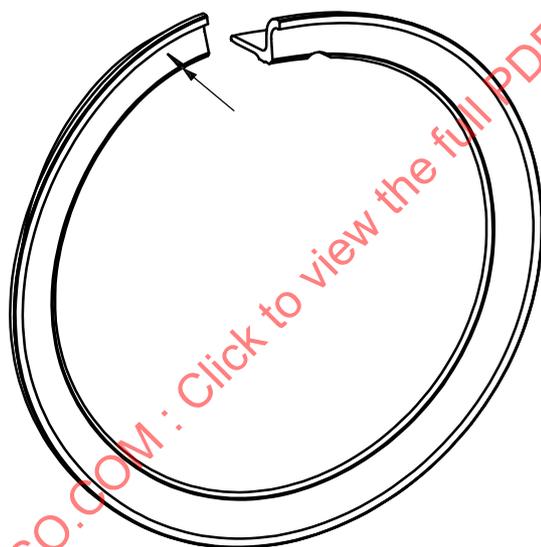
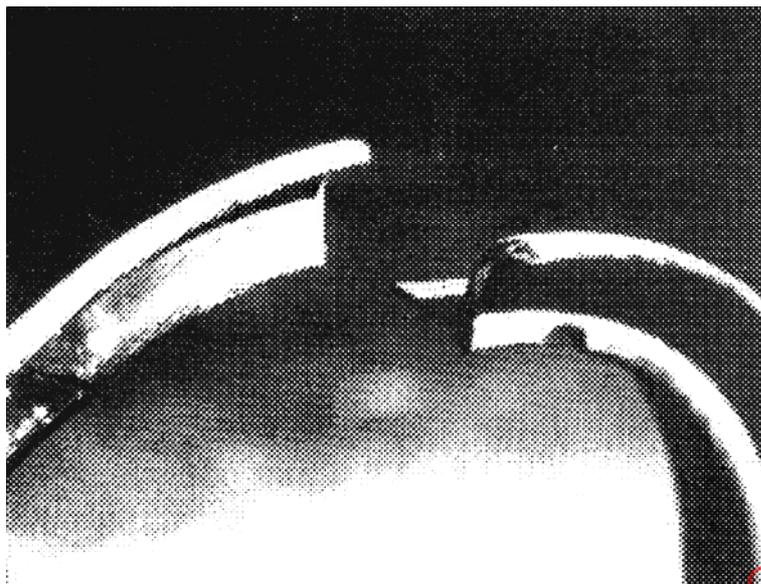


Figure 21 — Side-ring cracks



Figure 22 — Lock-ring cracks