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Internal combustion engines — Piston rings — Expander/rail oil-control rings

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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.

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 34, *Propulsion, powertrain and powertrain fluids*.

This third edition cancels and replaces the second edition (ISO 6627:2011), which has been technically revised.

The main changes are as follows:

— previous nomenclature referred to the rails as segments;

— barrel faced rail was added;

— PVD specification for rails was added;

— figures and tables were revised;

— new dimension introduced for expander;

— applicable bore diameter range increased to 140mm.

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

This document is one of a series of International Standards dealing with piston rings for reciprocating internal combustion engines. Others are the ISO 6621 series, the ISO 6622 series, ISO 6623, the ISO 6624 series, ISO 6625 and the ISO 6626 series (see Clause 2 and the Bibliography).

The common features and dimensional tables included in this document represent a broad range of variables. In selecting a ring type, the designer will above all need to consider the particular operating conditions. Moreover, it is essential that the designer refers to the specifications and requirements of ISO 6621-3 and ISO 6621-4 before completing the selection.

Internal combustion engines — Piston rings — Expander/rail oil-control rings

1 Scope

This document specifies the essential dimensional features of expander/rail oil-control rings, without providing a complete product description (because expander-rail designs vary from piston-ring manufacturer to piston-ring manufacturer, the interaction between the manufacturer and the client will determine specific design details).

This document applies to expander/rail oil-control rings of nominal diameters ranging from 40 mm to 140 mm for reciprocating internal combustion engines for road vehicles and other applications. It also applies to piston rings for compressors working under analogous conditions.

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 6621-1, *Internal combustion engines — Piston rings — Part 1: Vocabulary*

ISO 6621-3, *Internal combustion engines — Piston rings — Part 3: Material specifications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6621-1 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 Symbols and abbreviated terms

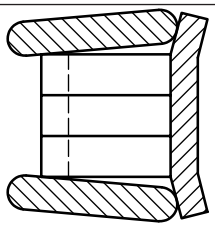
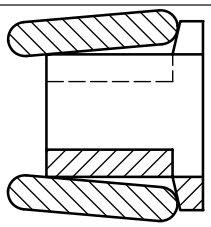
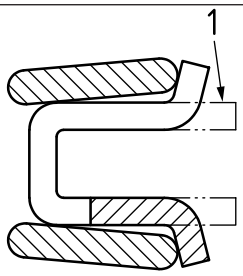
For the purposes of this document, the symbols and abbreviated terms in Table 1 apply.

Table 1 — Symbols and abbreviated terms

Symbols and abbreviated terms	Description
a_1	Rail radial wall thickness
a_8	Expander radial thickness excluding tab
a_9	Expander radial thickness
a_{11}	Assembly radial thickness
a_{14}	Tab radial thickness
a_{15}	Pad radial thickness
d_1	Nominal ring assembly diameter (nominal bore diameter)
h_1	Nominal assembly axial width
h_{24}	Rail face contact width
h_8	Barrel gauge width
h_9	Expander axial width
h_{10}	Rail axial width near inside diameter (ID), after coiling
h_{11}	Rail axial width near outside diameter (OD), after coiling and surface treatment or plating
h_{12}	Nominal rail axial width
h_{13}	Expander axial width over pads
h_{14}	Pad height
h_{28}	Axial distance between height of expander tab and height of expander pad
p_o	Nominal unit pressure
s_1	Rail closed gap
t_2, t_3	Barrel face drop (barrel drop on peripheral surface)
F_t	Tangential force
F_{tc}	Specific tangential force
θ	Tab angle
CR1…CR2	Chromium-plating thickness
ES1…ES3	Types of expander/rail oil-control rings
PNH	High nominal unit pressure
PNL	Low nominal unit pressure
PNM	Medium nominal unit pressure
PNR	Reduced nominal unit pressure
PNV	Very high nominal unit pressure
TT00…TT30	Nominal tab angle
NS010…NS050	Nitrided surface (rail)
NX003…NX025	Nitrided surface (expander)
PC001…PC020	PVD coating thickness

5 Ring types and designations

5.1 Types of expander/rail oil-control rings

ES1	
ES2	
ES3	

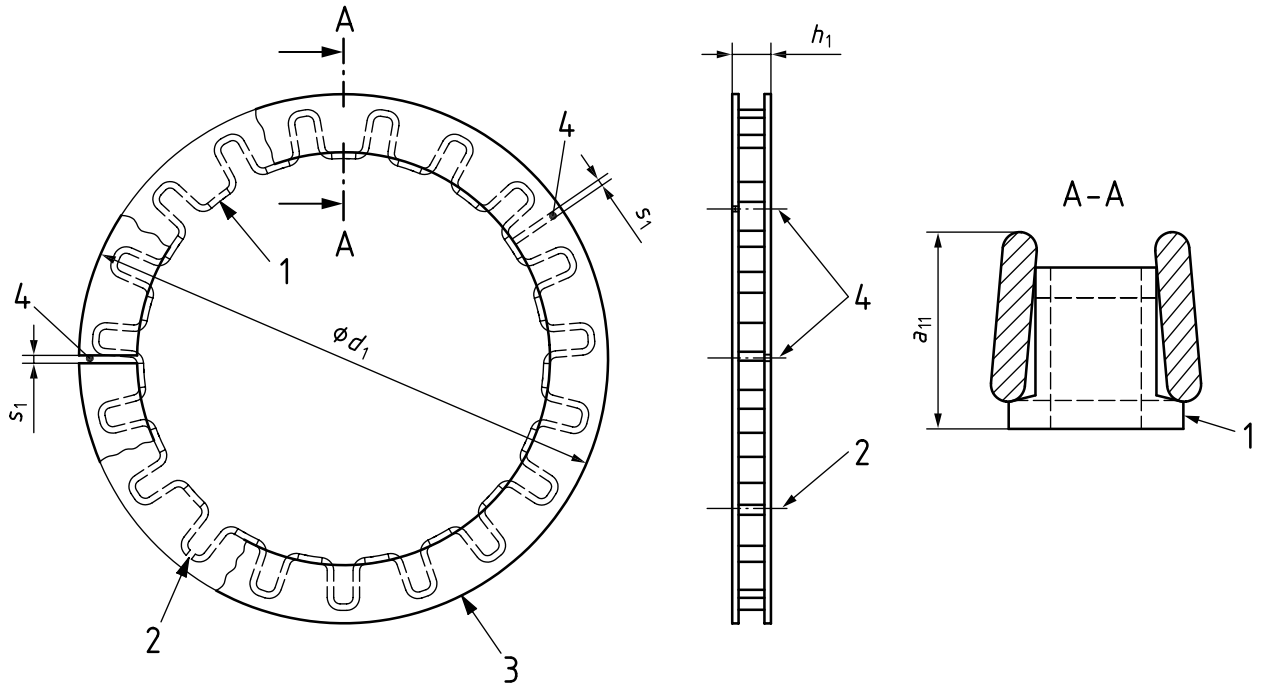
Key

1 centring pad (optional)

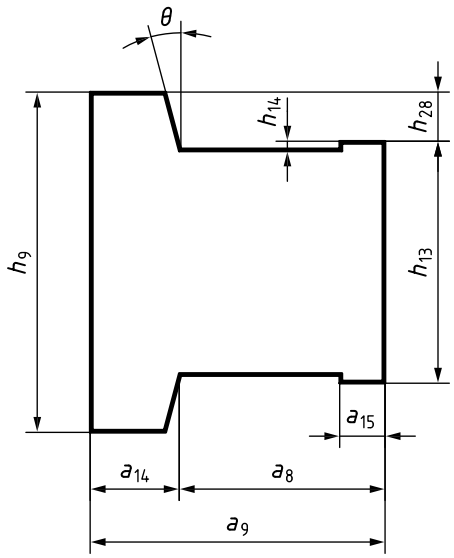
Figure 1 — Expander/rail oil-control ring designs

5.2 General features

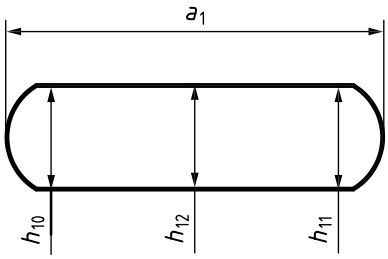
The expander/rail assembly shall be in accordance with Figure 2.



a) Assembly



b) Expander



c) Rail

Key

1 tab
2 expander ends
3 peripheral surfaces
4 rail closed gaps
θ tab angle dimensions are defined in Table 3

NOTE This is a schematic drawing of the three expander types shown in Figure 1.

Angles between rail and expander gaps (all three components) should be larger than 30° in assembly[a].

[a] For assembly arrangement regarding tangential force measurement, see ISO 6621-2.

Figure 2 — Expander/rail assembly

5.3 Designation examples

The following are examples of piston ring designations in accordance with this document.

EXAMPLE 1 Expander/rail oil-control ring type ES1 (ES1) of nominal diameter d_1 = 90 mm (90) and nominal assembly width h_1 = 3 mm (3,0), with rails made of unalloyed steel subclass 68 (MC68), a chromium-plated peripheral surface of minimum thickness 0,05 mm (CR1), and with an expander made of 16 % Cr minimum austenitic steel, of material subclass 67 (MC67) and tangential force, F_t, according to the medium nominal contact pressure class (PNM):

Piston ring ISO 6627 - ES1-90 × 3,0-MC68/CR1-MC67/PNM

EXAMPLE 2 Expander/rail oil-control ring type ES2 (ES2) of nominal diameter d_1 = 90 mm (90) and nominal assembly width h_1 = 2,5 mm (2,5), with rails made of 11 % Cr minimum martensitic steel, subclass 65 (MC65), nitrided on the peripheral and inside surfaces (NS020) to a minimum depth of 0,020 mm on the peripheral surface, and with an expander made of 16 % Cr minimum austenitic steel, of material subclass 67 (MC67), nitrided on the surface (NX), and tangential force, F_t, according to the reduced nominal contact pressure class (PNR):

Piston ring ISO 6627 - ES2-90 × 2,5-MC65/NS020-MC67/NXPNR

EXAMPLE 3 Expander/rail oil-control ring type ES3 (ES3) of nominal diameter d_1 = 90 mm (90) and nominal assembly width h_1 = 4,0 mm (4,0), with rails made of unalloyed steel subclass 68 (MC68), a chromium-plated peripheral surface of minimum thickness 0,05 mm (CR1) with lapped stripe (h24) of 0,30 mm, and with an expander made of 16 % Cr min. austenitic steel, of material subclass 67 (MC67) and tangential force, F_t, according to the high nominal contact pressure class (PNH):

Piston ring ISO 6627 - ES3-90 × 4,0-MC68/CR1-MC67/PNH, h24=0,3

6 Common features

6.1 Expander

6.1.1 Design considerations

In order to optimize the fit of the oil ring assembly into the engine cylinder bore, the following should be considered in the design of the expander/rail oil-control rings:

— total circumferential deflection of the expander;

— piston groove depth;

— sizing of the expander for rail functionality, such that $h_{28} + h_{14}$ shall not exceed h_{10};

— features on the lands adjacent to the oil ring groove;

— groove-corner radius.

Details shall be agreed between the supplier and customer.

6.1.2 Without surface treatment

The expander without surface treatment is typically used together with the rail made per MC68.

6.1.3 Nitrided surface (NX)

The expander with a nitrided surface is typically used together with the rails made per MC65, 66, or 69. Expander nitrided case depth is given in Table 2.

Table 2 — Expander nitrided case

Dimensions in millimetres

Code	Nitrided case depth	Tolerance
NX003	0,003	+ 0,012 0
NX010	0,010	
NX015	0,015	
NX020	0,020	
NX025	0,025	
NOTE 1 The tolerance for NX applies at the contact area between the rail internal diameter and the expander. NOTE 2 For the definition of the nitrided case depth, see ISO 6621-2. NOTE 3 Nitrided case depth can be determined by supplier and customer.		

6.1.4 Tab angle

The expander is usually designed with the tabs at a slight angle (expander tab angle, see Figure 3). This results in side sealing between the rail and the side of the piston groove. Table 3 presents the recommended tab angles.