# International Standard 6621/3

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

# Internal combustion engines — Piston rings — Part 3: Material specifications

*Moteurs à combustion interne — Segments de piston — Partie 3: Spécifications des matériaux*

**First edition — 1983-12-15**



**UDC 621.43-242.3** **Ref. No. ISO 6621/3-1983 (E)**

**Descriptors :** road vehicles, internal combustion engines, piston rings, material specifications, mechanical properties.



Price based on 2 pages

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.



International Standard ISO 6621/3 was developed by Technical Committee ISO/TC 22, *Road vehicles*, and was circulated to the member bodies in March 1982.



It has been approved by the member bodies of the following countries:



| | | |
|---|---|---|
| Australia | Hungary | Romania |
| Austria | Iran | South Africa, Rep. of |
| Belgium | Ireland | Spain |
| Brazil | Italy | Sweden |
| China | Japan | United Kingdom |
| Czechoslovakia | Korea, Dem. P. Rep. of | USA |
| Egypt, Arab Rep. of | Korea, Rep. of | USSR |
| France | Netherlands | |
| Germany, F.R. | Poland | |

No member body expressed disapproval of the document.



Printed in Switzerland

# Internal combustion engines — Piston rings — Part 3: Material specifications

## 0 Introduction

ISO 6621 is one of a series being developed dealing with piston rings for reciprocating internal combustion engines:

ISO 6621, *Internal combustion engines — Piston rings —*

*Part 1: Vocabulary.*

*Part 2: Measuring principles.*

*Part 3: Material specifications.*

*Part 4: General specifications.*

*Part 5: Quality requirements.*

ISO 6622, *Internal combustion engines — Piston rings —*

*Part 1: Rectangular rings.*

*Part 2: Rectangular rings with narrow ring width.*

ISO 6623, *Internal combustion engines — Piston rings — Scraper rings.*

ISO 6624, *Internal combustion engines — Piston rings —*

*Part 1: Keystone rings.*

*Part 2: Half keystone rings.*

ISO 6625, *Internal combustion engines — Piston rings — Oil control rings.*

ISO 6626, *Internal combustion engines — Coil spring loaded oil control rings.*

This part of ISO 6621 provides a user's guide to the types of materials available for piston rings.

There are many such materials made by different manufacturers using different casting and machining techniques, all suited to their application. In many instances the chemical compositions differ but the method of manufacture and heat treatment, if used, result in materials with similar mechanical properties from different manufacturers. The performance of rings made from two different materials will therefore be very similar; i.e. several subclasses of materials may meet a given requirement. The final choice of material and subclass shall therefore be agreed between the customer and supplier.



Choice of material made in accordance with the mechanical strength criteria in the table shall also take into account the final coating of rings, engine characteristics (rating, liner surface, etc.) and microstructural features such as graphite, cementite and ferrite.

For ring manufacture, it is convenient to group the materials into classes according to their moduli since for a ring of given dimensions, the pressure exerted by the ring on the cylinder wall is determined only by the modulus. The material strength is also generally related to modulus, i.e. the higher the modulus the higher the strength, although there are some exceptions depending on method of manufacture. Material hardness on the other hand is determined by both chemical composition and heat treatment; this is made clear from the division of classes into subclasses.

## 1 Scope and field of application

This part of ISO 6621 establishes a classification of materials intended for the manufacture of piston rings, based on mechanical properties and the stresses that these materials are capable of withstanding.

This part of ISO 6621 applies to the manufacture of piston rings up to and including 200 mm diameter for reciprocating internal combustion engines. It also applies to piston rings for compressors working under similar conditions.

## 2 Reference

ISO/R 80, *Rockwell hardness test (B and C scales) for steel.*

## 3 Mechanical properties

See the table.

**Table — Mechanical properties**

| Class | Mechanical properties MPa or N/mm² | | Materials meeting the required mechanical properties | | | |
|---|---|---|---|---|---|---|
| | Typical modulus of elasticity | Minimum bending strength | Type of material | Minimum hardness | Specific details | Subclass |
| 10 | 90 000<br>100 000 | 300<br>350 | Grey cast iron | 93 HRB<br>95 HRB | Non-heat-treated | 11<br>12 |
| 20 | 115 000<br>130 000 | 450<br>450<br>450<br>500<br>650 | Grey cast iron | 23 HRC<br>28 HRC<br>40 HRC<br>32 HRC<br>37 HRC | Heat-treated | 21<br>22<br>23<br>24<br>25 |
| 30 | 145 000 | 550<br>500 | Carbidic cast iron | 25 HRC<br>30 HRC | Heat-treated pearlitic<br>Heat-treated martensitic | 31<br>32 |
| 40 | 160 000 | 600<br>600<br>600<br>1 000 | Malleable cast iron | 95 HRB<br>22 HRC<br>30 HRC<br>27 HRC | Heat-treated pearlitic<br>Heat-treated martensitic<br>Heat-treated martensitic<br>Heat-treated carbidic | 41<br>42<br>43<br>44 |
| 50 | 160 000 | 1 100<br>1 300<br>1 300<br>1 300<br>— | Spheroidal graphite cast iron | 23 HRC<br>23 HRC<br>28 HRC<br>95 HRB<br>97 HRB | Heat-treated martensitic<br>Heat-treated martensitic<br>Heat-treated martensitic<br>Pearlitic<br>Ferritic | 51<br>52<br>53<br>54<br>55 |
| 60 | 200 000 | — | Steel | 38 HRC<br>40 HRC<br>48 HRC | CrMoV - alloyed<br>CrSi - alloyed<br>CrSi - alloyed | 61<br>62<br>63 |



NOTE — The hardness values are averages from three measurements on one ring, one being at the gap and one each 90° and 180° around from the gap. HRB and HRC hardness testing is in accordance with ISO/R 80.

The application of the hardness measuring methods HRB and HRC is restricted, due to the geometry and the material of piston rings. The hardness values stated are used only for grouping the materials into the individual subclasses. Other hardness measuring methods and their equivalent values shall be agreed between customer and manufacturer.