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Replacing GB/T 1148-1993

Internal combustion engines – Aluminium pistons - Specifications

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Foreword

This Standard is the revision to GB/T 1148-1993 "Aluminium piston - Reciprocating internal combustion engines - Technical specifications".

Compared with GB/T 1148-1993, the main technical changes are as follows:

- Replace the photos of Part 3; add names for some parts;
- Add dimensional tolerance of ring-land's outer-diameter, ring-groove's root-diameter, and ring-groove's width in technical requirements; specify the volume of combustion chamber, the size of circlip-groove as well as the size of dowel-pin; and refine the piston's mass difference of which the mass is less than 400 g;
- Add provisions in technical requirements on inner cooling gallery, cleanliness and surface treatment;
- Make necessary modifications and additions to some test methods.

This Standard replaces GB/T 1148-1993 since its implementation.

This Standard was proposed by China Machinery Industry Federation.

This Standard shall be under the jurisdiction of National Standardization Technical Committee of Internal Combustion Engine (SAC/TC 177).

Drafting organizations of this Standard: Shanghai Internal Combustion Engine Research Institute, Shandong Binzhou Bohai Piston Co., Ltd., Chengdu Galaxy Power Co., Ltd., AND Shijiazhuang Jingang Internal Combustion Engine Parts Group Ltd.

Main drafters of this Standard: Su Qinghua, Lin Fenghua, Ma Xuejun, Wen Jun, Liu Jindong, Jiang Dianchang and Ren Dezhong.

The previous versions replaced by this Standard are:

- GB 1148-1982 and GB/T 1148-1993.

Internal combustion engines – Aluminium pistons - Specifications

1 Scope

This Standard specifies the internal combustion engine casting aluminium piston's each part's name, technical requirements, test methods, inspection rules, mark, package, transport and storage.

This Standard is applicable to reciprocating-piston internal combustion engine casting aluminium piston of which the cylinder diameter is not greater than 200 mm (hereinafter referred to as piston).

2 Normative references

The following referenced documents are indispensable for the application of this Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. However, the parties who enter into agreement based on this Standard are encouraged to investigate whether the latest versions of these documents are applicable. For undated reference documents, the latest versions apply to this Standard.

GB/T 228 Metallic materials - Tensile testing at ambient temperature (GB/T 228-2002, eqv ISO 6892:1998)

GB/T 893.1 Circlips for holes - Type A

GB/T 893.2 Circlips for holes - Type B

GB/T 1149.1 Internal combustion engines - Piston rings - Part 1: General specifications (GB/T 1149.1-2008, ISO 6621-4:2003)

GB/T 1800.1-2009 Geometrical product specifications (GPS) - Limits and fits - Part 1: Bases of tolerances deviations and fits (ISO 286-1:1988,MOD)

GB/T 1958-2004 Geometrical product Specifications (GPS) - Geometrical tolerance - Verification prescription

GB/T 2828.1 Sampling procedures for inspection by attribute - Part 1: Sampling schemes indexed by acceptance mass limit (AQL) for lot-by-lot inspection (GB/T 2828.1-2003, ISO 2859-1:1999, IDT)

17f	Lower side face angle of keystone ring-groove	33	Wear-resistant ring carrier
18	Combustion chamber	34	Serrated top lands
18a	Inner diameter of combustion chamber	35	Oil accumulation groove
18b	Outer diameter (also known as throat) of combustion chamber	36	Scrape oil groove
18c	Depth of combustion chamber	37	Steel control strut
19	Inner cooling gallery	38	Oil drain hole
20	Pin-bore	39	Decompression cavity
21	Pin-bore axis	40	Drain hole on the pin boss
22	Upper pin boss	41	Transverse slot hole
23	Lower pin boss	42	Transverse slot
24	Pin-bore sleeve	43	Longitudinal slot
25	Circlip-groove	44	Longitudinal slot hole
25a	Circlip grooves distance	45	Located pin
25b	Bottom diameter of circlip groove	46	Notch for circlip
25c	Width of circlip-groove	47	Skirt scavenging gas zone
26	Pin boss draft angle	48	Skirt notch
27	Pin boss gap	49	Rib
28	Outlet of cooling gallery	50	Center hole

4.5.3 The diameter tolerance of pin-bore shall comply with the following provisions:

a) When diameter of pin-bore is greater than 18 mm, its diameter tolerance shall comply with IT5 specified by GB/T 1800.1; when diameter of pin-bore is not greater than 18 mm, its diameter tolerance shall be IT6.

b) The diameter of piston pin-bore shall be divided into groups according to the minimum size. The groups shall be represented by 1, 2, 3, … and ordered from the minimum size to the maximum one. The pin-bore of which the diameter tolerance is less than 0.01 mm shall not be divided into groups.

4.5.4 Compression height tolerance: gasoline machining piston on crown-surface is 0.2 mm; diesel machining piston is 0.1 mm; non-gasoline machining piston on crown-surface is 0.4 mm.

4.5.5 Tolerance of ring-groove width: the width tolerance of parallel ring-groove is 0.03 mm; the width tolerance of keystone ring-groove is 0.02 mm.

4.6 Shape and position tolerance

4.6.1 Perpendicularity OF each tessellation line on both upper and lower sides of ring-groove TO skirt axis is 25: 0.07.

4.6.2 The end surface round run-out OF each tessellation line on both upper and lower sides of ring-groove TO skirt axis is 0.05 mm.

4.6.3 The flatness of lower side of ring-groove shall comply with provisions of Table 4.

Table 4 Unit: mm

Piston diameter	Flatness
≤ 150	0. 015
> 150	0. 025

4.6.4 Axiality OF head's outer circle and outer circle of ring-land TO skirt axis is Φ0.06 mm.

4.6.5 Radial round run-out OF root circle of ring-groove TO skirt axis is 0.20 mm.

4.6.6 Axiality OF inner surface axis of skirt TO skirt axis shall comply with provisions of Table 5.

Table 5 Unit: mm

Wall thickness	Axiality
≤ 3	Φ 0.4
>3~5	Φ 0.5
>5	Φ 0.7

4.6.7 Position of pin-bore axis to skirt axis and perpendicular to skirt axis is 0.20 mm.

4.6.8 Perpendicularity of pin-bore axis to skirt axis is 100: 0.035.

4.6.9 Cylindricity of pin-bore shall comply with provisions of Table 6.

Table 6 Unit: mm

Pin-bore diameter	Cylindricity	
≤ 18	0.0035	0.005[a]
>18	0.0050	0.008[a]
[a] In case of intermittent cutting in processing on the circumferential surface of the pin-bore due to decompression chamber and oil hole, it shall adopt this value.		

4.6.10 Straightness of pin-bore axis is Φ0.006Ⓜmm.

4.6.11 Round run-out of root circle of circlip-groove to pin-bore axis is 0.30 mm.

4.6.12 When skirt is oval, the longitudinal axis of oval shall be perpendicular to the pin-bore axis. Its maximum offset shall comply with provisions of Table 7.

Table 7

Piston diameter / mm	Offset
≤150	≤ 5°
>150	≤ 3°

4.7 Roughness parameters of machining surface

4.7.1 Outer circle surface: *Ra* is 1 μm~5 μm.

4.7.2 Pin-bore surface: *Ra* shall not be greater than 0.63 μm.

4.7.3 Upper and lower sides of ring-groove: *Ra* shall not be greater than 0.63 μm; upper and lower sides of wear-resistant ring carrier shall not be greater than 1.25 μm.

4.7.4 Root circle surface of ring-groove: *Ra* shall not be greater than 0.63 μm.

4.7.5 Other machining surface: follow the provisions of product drawings.

4.8 Appearance quality

4.8.1 Casting surface of piston shall be flawless and 1 mm higher than parting boundary line. Cracks and flashes are not allowed.

4.8.2 Defects of machining surface shall comply with the following provisions:

a) Cracks and burrs on all machining surfaces of piston are not allowed.

b) Any visible eyelet on two sections of pin-bore surfaces, i.e., within the range from inner end to 1/4 of the total length of the whole section, and circlip-groove. Eyelets of other parts on each section shall comply with provisions of Table 8. Meanwhile, less than 10 slight shrinkages of which the diameter is ≤0.3 mm are allowed to exit in 1 cm^2 area.

Table 8

Pin-bore diameter / mm	Max diameter of eyelet / mm	Eyelet depth / mm	Eyelet quantity / pcs
≤18	1.0	≤1.0	≤1
>18	1.5	≤1.0	≤1

c) Eyelets are allowed to exist on the outer surface of skirt according to provisions of Table 9. The spacing between eyelets must not be less than 15 mm nor 5 mm from the edge. Meanwhile, less than 10 slight shrinkages of which the diameter is ≤0.3 mm are allowed to exist in 1 cm^2 area.

Table 9

Skirt wall thickness / mm	Max diameter of eyelet / mm	Eyelet depth / mm	Eyelet quantity / pcs
≤3	1.0	≤0.5	≤3
>3	1.5	≤1.0	≤3

d) Register end surface and register inner circle surface of piston are allowed to have one eyelet for each. The maximum diameter shall not exceed 1.5 mm and the depth shall not be greater than 1.0 mm.

e) Visible eyelets are not allowed to exist on piston's crown-surface, upper and lower sides of ring-groove.

f) Visible eyelets of which the maximum diameter shall not be greater than 0.4 mm are allowed to exist on head's outer circle, outer circle of ring-land, and root circle surface of ring-groove. There shall not be more than 5 eyelets in 1 cm^2 area, and its distribution area shall not be greater than 5% of the part's area where it exists.

4.8 Mass difference of finished piston

4.16.1 For the piston that adopts hard anodized treatment, the oxide film thickness of crown-surface is 0.04 mm~0.08 mm, and the oxide film thickness of ring-groove is 0.01 mm±0.003 mm.

4.16.2 When piston skirt adopts graphitization treatment, the thickness of graphite layer is 0.015 mm±0.005 mm.

4.16.3 When piston adopts tin-plating treatment, the thickness of tin coating is 0.001 mm~0.002 mm.

4.17 Piston for maintenance

The outer circle size of piston for maintenance shall be enlarged; the sizes are +0.25 mm, +0.50 mm, +0.75 mm, +1.00 mm and +1.25 mm.

5 Inspection methods

5.1 Tensile strength

For the samples that are used for inspecting piston's high temperature and room temperature's tensile strength, it shall be cut between pin-bore and head surface. If the size is insufficient, it shall be transversely cut in the head. If the size in the head is insufficient, it may use the metal test-bar that uses the same material, same casting technique and same heat treatment as that of the piston. Take 0.8 times of the measured value according to provisions of Table 2. Prepare the sample according to GB/T 228. The tensile strength at high temperature must be heated to 300°C ± 5°C, then preserve the heat for 0.5 h to determine.

5.2 Hardness

The position for hardness determination shall be at the solid position BETWEEN root circle of ring-groove on the crown-surface AND the inner wall. Determination points shall be 2 points along the direction of pin-bore axis. Then determine another point in the direction perpendicular to the pin-bore axis. Determine three points in total, and calculate the hardness difference.

5.3 Volume stability

Select a cross section in the ring-land of piston. Measure its diameter in the direction of pin-bore axis and the direction perpendicular to the pin-bore axis. Heat the piston to 250°C ± 5°C. Maintain the temperature for 5 h. After cooling to room temperature, re-measure each diameter change of two directions on the same measurement point before heating, then calculate the percentage.

5.4 Metallographic structure

5.8 Inner cooling gallery

The technical requirements for inner cooling gallery shall adopt ultrasonic test according to provisions of GJB 1580A, or cut-open the piston along the diameter direction for inspection.

5.9 Cleanness

The measurement for cleanness shall comply with provisions of GB/T 3821.

5.10 Thickness of surface treatment layer

5.10.1 Adopt vortex thickness meter to measure the hard anodized film and graphite layer thickness according to provisions of GB/T 4957.

5.10.2 Adopt γ-ray thickness gauge to measure the thickness of galvanized film.

Note: If the manufacturer does not have above measurement conditions, it shall use metallurgical microscope to measure the thickness of surface treatment layer.

6 Acceptance rules

6.1 Aluminum piston shall be able to leave factory only after it is tested as qualified by the quality inspection department of the manufacturer according to the product drawings and relevant technical documents.

6.2 When the buyer sample-inspect the product quality, it shall be carried out according to provisions of GB/T 2828.1. Inspection items, batching principle, sampling scheme, determination and re-inspection rules shall be agreed upon by the seller and the buyer.

7 Mark, package, transport and storage

7.1 Mark

7.1.1 Each product shall be clearly marked with:

a) Manufacturer's name or trademark;

b) Code for grouping size and size of maintenance;

c) Mass or mass-group code;

d) Factory serial number or date of manufacture.

The mark shall be permanent. The position, size and method of mark shall comply with provisions of product drawing. Pay attention to keep the product

from damage that affects the use.

7.1.2 The following items shall be clearly marked on the package box:

a) Manufacturer's name, trademark and address;

b) Product name, model and part number;

c) Grouping size code;

d) Maintenance size code;

e) Mass or mass-group code;

f) Quantity;

g) Implementation standard;

h) Quality certification mark;

i) Packaging date: ___ YY ___ MM.

7.1.3 The following items shall be clearly marked outside the package case:

a) Pictorial marks of product category;

b) Manufacturer's name and address;

c) Product name, model, size code and mass code;

d) Quantity;

e) Total mass and appearance dimensions;

f) Implementation standard;

g) Quality certification mark;

h) Receiving organization and address;

i) "Handle with care", "Moisture-proof", "Anti-pressure" and other marks;

j) Date of manufacture: ___ YY ___ MM.

7.2 Package

7.2.1 Each piston must be clean before packaging and anti-corrosively treated. Pack it with strong impervious wrapping material and put it into the packaging box. Pistons of same model, same size group and same mass group shall be put into a packaging box.

7.2.2 Each packaging box shall be attached with product certification with inspector's signature from the technical inspection department of the manufacturer.

7.2.3 Packaging box contained with pistons must be put into anticorrosive packaging case and kept from damage during normal transport. The total mass of the case shall not exceed 50 kg.

7.3 Transport

It shall be anti-bump, rain-proof and moisture-proof during transport.

7.4 Storage

The valve shall be stored in a ventilated and dry warehouse. Under normal circumstances, since the date of delivery, the manufacturer shall assure the products from corrosion within 12 months.

7.5 Others

The packaging, transport and storage shall be agreed by the buyer and the seller.

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