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Replacing JB/T 6289-1992

Internal combustion engines – Casting aluminium pistons - Metallographic inspection

内燃机 铸造铝活塞 金相检验

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Table of Contents

Foreword.....	3
1 Scope	4
2 Technical Requirements	4
3 Test methods	5
4 Examination criteria.....	7

Foreword

This Standard is the revision to JB/T 6289-1992 "Internal combustion engines - Casting aluminium pistons - Metallographic inspection". Compared with JB/T 6289-1992, the main changes of this Standard are as follows:

- This Standard specifies the new provisions to microstructure's sampling sites;
- Specifies the specimen size of microstructure;
- Correct the individual errors in previous standard;
- Make wording edition according to GB/T 1.1-2000's provisions.

This Standard replaces JB/T 6289-1992.

This Standard was proposed by China Machinery Industry Federation.

This Standard internal combustion engine by the National Standardization Technical Committee.

Drafting organizations of this Standard: Shanghai Internal Combustion Engine Research Institute AND Shandong Binzhou Bohai Piston Co., Ltd.

Main drafters of this Standard: Li Guoen, Wang Yanliang, Zhang Guohua and Feng Zengjian.

The historical versions replaced by this Standard are as follows:

- GB 3508-1983, JB/T 6289-1992.

Internal combustion engines – Casting aluminium pistons - Metallographic inspection

1 Scope

This Standard specifies the metallographic-structure's grade-level, inspection and examination methods for internal combustion engines' casting eutectic aluminum-silicon alloy pistons AND aluminum-silicon-copper-magnesium (Al-Si-Cu-Mg) alloy pistons.

This Standard is applicable to metallographic-structure inspection of internal combustion engines' casting eutectic aluminum-silicon alloy pistons AND Al-Si-Cu-Mg alloy pistons, which are after heat treatment and of which the cylinder diameter is less than or equal to 200mm.

2 Technical Requirements

2.1 Macrostructure

Macrostructure defects refer only to the pinholes and loose in casting aluminum-alloy pistons pinholes and loose, collectively known as holes.

2.1.1 Dispersion holes

Examine in accordance with 1st-group pictures (see Pictures 2 to 7). Grade-levels 1 to 4 are deemed as conformance; grade-levels above 4 are deemed as nonconformance.

2.1.2 Concentration holes

Examine in accordance with 2nd-group pictures (see Pictures 8 to 13). Grade-levels 1 to 4 are deemed as conformance; grade-levels above 4 are deemed as nonconformance.

2.2 Microstructure

2.2.1 Eutectic aluminum-silicon alloy (sodium-salt modification)

It shall be in tiny eutectic-structure of α -solid solution and silicon; eutectic silicon shall be in small-dots and small-strips; there must not exist obvious-metamorphism strip silicon, large-chunk of primary silicon, or coarse α -solid solution; phenomena such as over-burning and cracks are strictly not allowed. Examine in accordance with 3rd-group pictures (see Pictures 14 to 19). Grade-levels 1 to 4 are deemed as conformance;

grade-levels above 4 are deemed as nonconformance.

2.2.2 Eutectic aluminum-silicon alloy (phosphorus modification)

It shall be in eutectic-structure of tiny primary silicon and α -solid solution; eutectic silicon shall be in short strip; there must not exist obvious-metamorphism strip silicon, large-chunk of primary silicon and severely-concentrated primary silicon; phenomena such as over-burning and cracks are strictly not allowed. Examine in accordance with 4th-group pictures (see Pictures 20 to 25). Grade-levels 1 to 4 are deemed as conformance; grade-levels above 4 are deemed as nonconformance.

2.2.3 Al-Si-Cu-Mg alloy

It shall be in tiny α -solid solution; the copper aluminum (Al_2Cu) shall be in small-chunks and small-strip; silicon shall be in spotty, small-chunks or small-strips, uniformly distributed; there must not have long-strip of silicon, relatively-more primary silicon and coarse-large α -solid solution. Examine in accordance with 5th-group pictures (see Pictures 26 to 31). Grade-levels 1 to 4 are deemed as conformance; grade-levels above 4 are deemed as nonconformance.

2.2.4 Fishbone iron-phase inclusions

Appropriate fishbone iron-phase inclusions that are uniformly distributed are allowed; however, it must not have relatively-more large-chunks or concentratedly-distributed fishbone iron-phase inclusions. Examine in accordance with 6th-group pictures (see Pictures 32 to 37). Grade-levels 1 to 4 are deemed as conformance; grade-levels above 4 are deemed as nonconformance.

2.2.5 Acicular iron-phase inclusions

A small amount of acicular iron-phase inclusions that are uniformly distributed are allowed; however, there must not have relatively-more long-acicular iron-phase inclusions. Examine in accordance with 7th-group pictures (see Pictures 32 to 37). Grade-levels 1 to 4 are deemed as conformance; grade-levels above 4 are deemed as nonconformance.

3 Test methods

3.1 Macrostructure inspection method

3.1.1 Sampling sites

It shall be at entire cross-section, along piston's centerline and going through pin-hole's centerline (see Figure 1).

3.1.2 Etching method

4.1.2 For concentration holes, the examination is shown in the 2nd-group pictures; examination description is shown in Table 2.

Table 2

Grade-level	Examination description of concentration holes		Picture number
1	Holes concentration is very slight	Maximum hole diameter $\leq 0.30\text{mm}$	8
2	Holes concentration is slight	Maximum hole diameter $\leq 0.50\text{mm}$	9
3	Holes concentration is relatively-obvious	Maximum hole diameter $\leq 0.80\text{mm}$	10
4	Holes concentration is obvious	Maximum hole diameter $\leq 1.20\text{mm}$	11
5	Holes concentration is relatively-serious	Maximum hole diameter $\leq 2.00\text{mm}$	12
6	Holes concentration is serious	Maximum hole diameter $> 2.00\text{mm}$	13

4.2 Microstructure examination criteria

4.2.1 For eutectic aluminum-silicon alloy (sodium-salt modification), the examination is shown in the 3rd-group pictures; examination description is shown in Table 3.

Table 3

Grade-level	Examination description of eutectic aluminum-silicon alloy (sodium-salt modification) microstructure (100x magnification)	Picture number
1	α -solid solution and eutectic silicon are very tiny, evenly distributed	14
2	α -solid solution is tiny; eutectic silicon is in small-spotty, evenly distributed	15
3	α -solid solution is relatively-tiny; eutectic silicon is in spotty; surrounding of eutectic silicon had occurred metamorphism phenomenon	16
4	α -solid solution is relatively-large; some eutectic silicon are in short-strip, some are in spotty; there are small amount of small-chunks (side-length $\leq 0.09\text{mm}$) of primary silicon	17
5	Eutectic silicon are in long-strip; there is no metamorphism	18
6	α -solid solution is in coarse; eutectic silicon and Al_2Cu gather into chunks, chain-distributed along the grain boundaries; there is over-burning	19

4.2.3 For Al-Si-Cu-Mg alloy microstructure, the examination is shown in the 5th-group pictures; examination description is shown in Table 5.

Table 5

Grade-level	Examination description of Al-Si-Cu-Mg alloy microstructure (100x magnification)	Picture number
1	α -solid solution is very tiny; Al_2Cu and eutectic silicon are in tiny chunks, uniformly distributed	26
2	α -solid solution is tiny; Al_2Cu and eutectic silicon are in small chunks, uniformly distributed	27
3	α -solid solution is relatively-small; Al_2Cu is in strips, uniformly distributed; there are concentrations of eutectic silicon lumps	28
4	α -solid solution is slightly-large; Al_2Cu is in chunks and intermittent meshes; eutectic silicon is in chunks and coarse-strips; there are individual tiny primary silicon occurred, unevenly distributed	29
5	α -solid solution is relatively-large; Al_2Cu is in large-chunks; eutectic silicon is in strips; there are obvious concentrations of eutectic silicon lumps	30
6	α -solid solution is coarse-large; Al_2Cu is distributed in meshes, unevenly distributed	31

α -solid solution is slightly larger, the copper aluminum (Al_2Cu) was massive and intermittent mesh, eutectic silicon blocky and rough strips, with initial individual tiny crystalline silicon occurs. Uneven distribution

α -solid solution is large, the copper aluminum (Al_2Cu) was a large block of eutectic silicon was strip, there is obviously a total of 30 product groups gather

α -coarse solid solution, the copper aluminum (Al_2Cu) reticular distribution, uneven distribution

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