

ICS 77.140.60

J31

Registration number: 51592—2015



Mechanical Industry Standard of the People's Republic of China

JB/T12282-2015

Continuous cast iron hollow profiles

Issued on October 10, 2015

Implemented on March 1, 2016

Released by the Ministry of Industry and Information Technology of the People's Republic of China



Contents

Introduction	3
1. Scope	3
2. Normative References	4
3. Dimensions and Specifications of Continuous Cast Iron Hollow Profiles	4
4. Classification and Grades	5
4.1 Classification	5
4.2 Grades	5
5. Technical Requirements	7
5.1 Mechanical Properties	7
5.2 Metallographic Structure	8
5.3 Chemical Composition	8
5.4 Surface Quality and Dimensional Tolerances	8
5.5 Machining Allowance	9
5.6 Straightness	10
5.7 Delivery Condition	10
6. Test Methods	10
6.1 Tensile Testing	10
6.2 Hardness Testing	11
6.3 Impact Testing	11
6.4 Metallographic Examination	11
6.5 Surface Quality, Dimensions, and Straightness	11
7. Inspection Rules	12
7.1 Batch Classification	12
7.2 Evaluation of Test Results Validity and Retesting	12
8. Marking and Quality Certificate	12
8.1 Marking	12
8.2 Quality Certificate	12
9. Packaging, Storage, and Transportation	13
Figure 1 Schematic Diagram of Hardness Testing Locations.....	11
Table 1 Specifications of Continuous Cast Iron Hollow Profiles.....	4
Table 2 Mechanical Properties of Continuous Cast Gray Iron Hollow Profiles.....	5
Table 3 Mechanical Properties of Continuous Cast Ductile Iron Hollow Profiles.....	6
Table 4 Impact Energy Absorption of Continuous Cast Ductile Iron Hollow Profiles.....	7
Table 5 Dimensional Tolerances for the Outer Diameter and Wall Thickness of Continuous Cast Iron Hollow Profiles.....	9
Table 6 Machining Allowance for Continuous Cast Iron Hollow Profiles.....	9
Table 7 Straightness Tolerances for Continuous Cast Iron Hollow Profiles.....	10



Introduction

This standard was drafted following the guidelines outlined in GB/T 1.1-2009.

It was proposed by the China Machinery Industry Federation and is overseen by the National Technical Committee for Standardization of Foundry (SAC/TC 54).

The primary organizations responsible for drafting this standard are Shaanxi Tongxin Continuous Casting Pipe Industry Technology Co., Ltd. and Xi'an University of Technology.

Other contributors include Hebei Jianzhi Casting Group Co., Ltd., Riyue Heavy Industry Co., Ltd., Henan Guangrui Auto Parts Co., Ltd., and CSR Qishuyan Locomotive and Vehicle Technology Research Institute Co., Ltd.

The key individuals involved in drafting this standard are Xu Yang, Yan Puxuan, Wang Haisheng, Xu Chunjie, Ren Jiahong, Song Xianfa, Guo Fayin, and Qian Kuncai.

This is the first edition of this standard.

Continuous cast iron hollow profiles

1. Scope

This standard defines the dimensions, classification and grades, technical requirements, testing methods, inspection rules, marking and certification, as well as the packaging, storage, and transportation of continuous cast gray iron and ductile iron hollow profiles (hereinafter referred to as "continuous cast iron hollow profiles").

The standard applies to continuous cast iron hollow profiles produced using water-cooled crystallizer continuous drawing, with external cross-sectional shapes including circular, rectangular, regular polygonal, and elliptical forms.



2. Normative References

The following documents are essential for the application of this standard. For dated references, only the version cited applies. For undated references, the latest version (including any amendments) applies to this document.

GB/T 228.1: Metallic Materials — Tensile Testing — Part 1: Method of Test at Room Temperature

GB/T 229: Metallic Materials—Charpy Pendulum Impact Test Method

GB/T 231.1: Metallic Materials—Brinell Hardness Test—Part 1: Test Method

GB/T 1348: Spheroidal Graphite Iron Castings

GB/T 5612: Designation System for Cast Iron Grades

GB/T 7216: Metallographic Examination of Gray Cast Iron

GB/T 9439: Gray Iron Castings

GB/T 9441: Metallographic Examination of Spheroidal Graphite Cast Iron

3. Dimensions and Specifications of Continuous Cast Iron Hollow Profiles

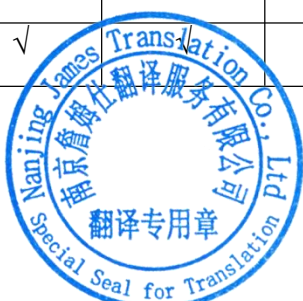
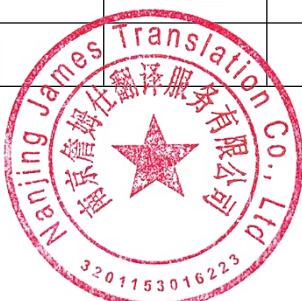
3.1 The external cross-sectional shapes of continuous cast iron hollow profiles include circular, rectangular, regular polygonal, elliptical, and other shapes.

3.2 Table 1 shows the corresponding relationships between the outer diameter and wall thickness for circular profiles. For profiles with other cross-sectional shapes, the corresponding relationships between outer diameter and wall thickness can be referenced from Table 1.

Table 1 Specifications of Continuous Cast Iron Hollow Profiles

Dimensions in millimeters

Outer Diameter D	Wall Thickness δ						
	6~8	>8~10	>10~13	>13~16	>16~20	>20~25	>25~35
60~80	√	√					
>80~100	√	√	√				
>100~125	√	√	√	√			
>125~160		√	√	√	√		
>160~200			√	√	√	√	
>200~250			√		√	√	√



>250~300				√	√	√	√
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Table 1 Specifications of Continuous Cast Iron Hollow Profiles (Continued)

Dimensions in millimeters

Outer Diameter D	Wall Thickness δ						
	6~8	>8~10	>10~13	>13~16	>16~20	>20~25	>25~35
>300~350				√	√	√	√

Note 1: The symbol "√" indicates the recommended profile specifications.

Note 2: For polygonal profiles, the outer diameter and wall thickness should be selected based on the diameter of the inscribed circle and the minimum wall thickness, as indicated in Table 1.

Note 3: For example, if the selected outer diameter is $\phi 128$ with a wall thickness of 15, the specification should be denoted as $\phi 128 \times 15$.

4. Classification and Grades

4.1 Classification

Continuous cast iron hollow profiles are classified into continuous cast gray iron hollow profiles and continuous cast ductile iron hollow profiles based on the graphite morphology in their metallographic structure.

4.2 Grades

The designation method for continuous cast iron hollow profiles should comply with the requirements of GB/T 5612.

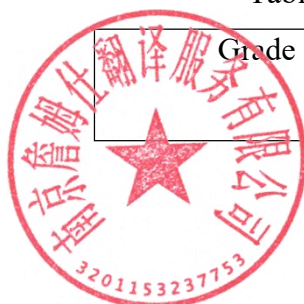
4.2.1 Grades of Continuous Cast Gray Iron Hollow Profiles

The grades of continuous cast gray iron hollow profiles are divided into six categories: HT/GLZ200, HT/GLZ225, HT/GLZ250, HT/GLZ275, HT/GLZ300, and HT/GLZ350, as shown in Table 2.

Note: HT/GLZ is the Pinyin abbreviation for "Gray Iron/Pipe Continuous Casting".

Table 2 Mechanical Properties of Continuous Cast Gray Iron Hollow Profiles

Grade	Tensile Strength R_m MPa	Hardness HGW	Notes



HT/GLZ200	≥200	150~230	
HT/GLZ225	≥225	170~240	
HT/GLZ250	≥250	180~250	
HT/GLZ275	≥275	190~260	
HT/GLZ300	≥300	200~275	Heat Treatment Permitted
HT/GLZ350	≥350	235~290	Heat Treatment Permitted

4.2.2 Grades of Continuous Cast Ductile Iron Hollow Profiles

The grades of continuous cast ductile iron hollow profiles are divided into twelve categories: QT/GLZ350-22, QT/GLZ350-22R, QT/GLZ350-22L, QT/GLZ400-18, QT/GLZ400-18R, QT/GLZ400-18L, QT/GLZ400-15, QT/GLZ450-10, QT/GLZ500-7, QT/GLZ550-5, QT/GLZ600-3, and QT/GLZ700-2, as shown in Table 3.

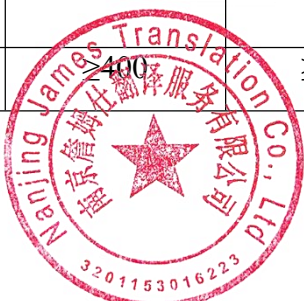
Note: QT/GLZ is the Pinyin abbreviation for "Ductile Iron/Pipe Continuous Casting".

Table 3 Mechanical Properties of Continuous Cast Ductile Iron Hollow Profiles

Grade	Tensile Strength R _m , MPa	Yield Strength R _{p0.2} MPa	Elongation A %	Hardness HBW	Main Matrix Structure
QT/GLZ350-22	≥350	≥220	≥22	≤170	Ferritic
QT/GLZ350-22R	≥350	≥220	≥22	≤170	Ferritic

Table 3 Mechanical Properties of Continuous Cast Ductile Iron Hollow Profiles (Continued)

Grade	Tensile Strength R _m , MPa	Yield Strength R _{p0.2} MPa	Elongation A %	Hardness HBW	Main Matrix Structure
QT/GLZ350-22L	≥350	≥220	≥22	≤170	Ferritic
QT/GLZ400-18	≥400	≥250	≥18	120~185	Ferritic
QT/GLZ400-18R	≥400	≥250	≥18	120~185	Ferritic
QT/GLZ400-18L	≥400	≥240	≥18	120~185	Ferritic
QT/GLZ400-15	≥400	≥250	≥15	120~190	Ferritic



QT/GLZ450-10	≥450	≥310	≥10	160~210	Ferritic
QT/GLZ500-7	≥500	≥320	≥7	170~230	Ferritic+Pearlitic
QT/GLZ550-5	≥550	≥350	≥5	180~250	Ferritic+Pearlitic
QT/GLZ600-3	≥600	≥370	≥3	190~270	Pearlitic+Ferritic
QT/GLZ700-2	≥700	≥420	≥2	225~305	Pearlitic

Note: The letter "R" in the grade signifies that the material meets impact performance requirements at room temperature (23° C). The letter "L" indicates that the material is required to meet impact performance standards at low temperatures, either -20° C or -40° C.

5. Technical Requirements

5.1 Mechanical Properties

5.1.1 Mechanical Properties of Continuous Cast Gray Iron Hollow Profiles

The mechanical properties of continuous cast gray iron hollow profiles should conform to the specifications outlined in Table 2.

5.1.2 Mechanical Properties of Continuous Cast Ductile Iron Hollow Profiles

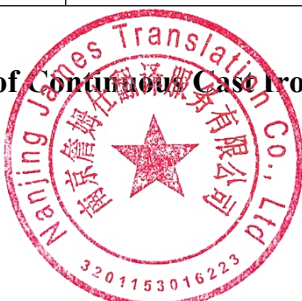
5.1.2.1 The mechanical properties of continuous cast ductile iron hollow profiles should meet the requirements specified in Table 3.

5.1.2.2 For continuous cast ductile iron hollow profiles with impact performance requirements, the impact energy absorption should comply with the values specified in Table 4.

Table 4 Impact Energy Absorption of Continuous Cast Ductile Iron Hollow Profiles

Grade	Minimum Impact Energy Absorption J		
	Room Temperature (23 ± 5)° C	Low Temperature (-20 ± 2)° C	Low Temperature (-40 ± 2)° C
	Average Value of Three Specimens	Average Value of Three Specimens	Average Value of Three Specimens
QT/GLZ350-22L	-	12	12
QT/GLZ350-22R	17	-	-
QT/GLZ400-18L	-	12	12
QT/GLZ400-18R	14	-	-

5.1.3 Hardness of Continuous Cast Iron Hollow Profiles



The hardness of continuous cast iron hollow profiles is not considered a criterion for acceptance. However, if hardness requirements are specified by the purchaser, the hardness of continuous cast gray iron hollow profiles should be referenced from Table 2, and the hardness of continuous cast ductile iron hollow profiles should be referenced from Table 3.

5.2 Metallographic Structure

5.2.1 Metallographic Structure of Continuous Cast Gray Iron Hollow Profiles

5.2.1.1 The matrix structure and graphite morphology of continuous cast gray iron hollow profiles are typically not used as criteria for acceptance. If the purchaser has specific requirements, these should be mutually agreed upon by both the supplier and the purchaser.

5.2.1.2 The presence of up to 3% carbides in the surface layer of continuous cast gray iron hollow profiles is permitted.

5.2.2 Metallographic Structure of Continuous Cast Ductile Iron Hollow Profiles

5.2.2.1 The graphite in continuous cast ductile iron hollow profiles should predominantly be spherical, with a nodularity level of at least Grade 3 as specified in GB/T 9441 (nodularity should be no less than 80%). If there are specific requirements regarding the number or size of graphite nodules, these should be agreed upon by both the supplier and the purchaser.

5.2.2.2 The matrix structure of continuous cast ductile iron hollow profiles is typically not used as an acceptance criterion. If the purchaser has particular requirements, they should be agreed upon by both parties.

5.2.2.3 The surface layer of continuous cast ductile iron hollow profiles may contain up to 3% carbides.

5.3 Chemical Composition

The chemical composition of continuous cast iron hollow profiles is determined by the supplier, as long as the mechanical properties specified in this standard are met. Generally, chemical composition is not used as an acceptance criterion. However, if the purchaser has specific requirements, the composition should be agreed upon by both the supplier and the purchaser.

5.4 Surface Quality and Dimensional Tolerances

5.4.1 Surface Quality

5.4.1.1 Outer Surface Quality

The requirements for the outer surface quality are as follows:



a) The outer surface of continuous cast iron hollow profiles should be smooth, with allowable protruding streaks no higher than 2 mm.

b) The outer surface may have periodic arc-shaped scars, typical of continuous casting, covering up to 1/4 of the circumference. If scars cover more than 1/4 of the circumference, they should be spaced at least 2.0 meters apart.

5.4.1.2 Inner Surface Quality

When the inner diameter of the profile is greater than 150 mm or the wall thickness exceeds 20 mm, the inner surface protruding ring seams (i.e., annular ridges formed at the junction of steps during periodic drawing pauses) of continuous cast iron hollow profiles should generally not exceed 2 mm in height. When the inner diameter is 150 mm or less, or the wall thickness is 20 mm or less, the height of these protruding ring seams on the inner surface should generally not exceed 1 mm.

5.4.2 Dimensional Tolerances

The dimensional tolerances for the outer diameter and wall thickness of continuous cast iron hollow profiles are specified in Table 5.

Table 5 Dimensional Tolerances for the Outer Diameter and Wall Thickness of Continuous Cast Iron Hollow Profiles

Dimensions and Specifications	Outer Diameter (mm)				Wall Thickness (mm)			
	60~125	>125~200	>200~250	>250	6~10	>10~16	>16~25	>25
Dimensional Tolerances	+1.0 -1.0	+1.2 -1.0	+1.5 -1.0	+2.0 -1.0	+1.5 -0.5	+2.0 -0.5	+2.0 -1.0	+3.0 -1.5

5.5 Machining Allowance

The machining allowance for continuous cast iron hollow profiles should be selected according to Table 6.

Table 6 Machining Allowance for Continuous Cast Iron Hollow Profiles

Units: millimeters

Hollow Profile Outer Diameter <i>D</i>	Minimum Machining Allowance (One Side)	Minimum Machining Allowance (One Side of Inner Bore)						
		Wall Thickness of Continuous Cast Iron Hollow Profiles						
		6~8	>8~10	>10~13	>13~16	>16~20	>20~25	>25~35
60~80	2.0							



>80~100	1.2	2.0	2.0	2.5				
>100~125	1.5	2.0	2.0	2.5	2.5			
>125~160	1.7		2.5	2.5	2.5	3.0		
>160~200	2.0			3.0	3.0	3.0	3.0	
>200~250	2.2			3.0	3.0	3.0	3.5	3.5
>250~350	2.5				3.0	3.5	4.0	4.0

5.6 Straightness

The straightness of continuous cast iron hollow profiles should meet the requirements specified in Table 7. If the customer has special straightness requirements, the tolerance should be agreed upon through negotiation between the supplier and the customer.

Table 7 Straightness Tolerances for Continuous Cast Iron Hollow Profiles

Outer Diameter <i>D</i> mm	Straightness Tolerance mm/m	
	Continuous cast gray iron hollow profiles	Continuous cast ductile iron hollow profiles
60~100	4	5
>100~160	3	4
>160	2	3

5.7 Delivery Condition

Continuous cast iron hollow profiles may be supplied in the as-cast state, after heat treatment, as raw blanks, or after rough machining. The delivery length and dimensional tolerances should be mutually agreed upon by the supplier and the customer.

6. Test Methods

6.1 Tensile Testing

6.1.1 Tensile test specimens for continuous cast iron hollow profiles should be sampled directly from the profile itself, cut along the axial direction. The specimens must be prepared according to the standards specified in GB/T 228.1.

6.1.2 If the purchaser has specific sampling requirements, the sampling method should be mutually agreed upon by the supplier and the purchaser.



6.1.3 Tensile testing of the continuous cast iron hollow profile specimens should be performed in accordance with GB/T 228.1.

6.2 Hardness Testing

6.2.1 If hardness testing is requested by the purchaser, a sample should be taken by cutting a section perpendicular to the axis of the hollow profile. Hardness should be measured at three points on the cross-section: near the outer edge, in the middle, and near the inner edge (see Figure 1). The average of these measurements will represent the sample's hardness. For profiles with a wall thickness of less than 15 mm, the hardness at the center of the wall cross-section will be used as the acceptance criterion.

6.2.2 The hardness test should be carried out according to the guidelines specified in GB/T 231.1.

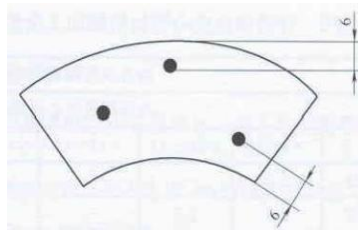


Figure 1 Schematic Diagram of Hardness Testing Locations

6.3 Impact Testing

6.3.1 Impact test specimens should be cut directly from the profile.

6.3.2 The shape, size, and testing methods for impact test specimens should follow the guidelines specified in GB/T 229.

6.4 Metallographic Examination

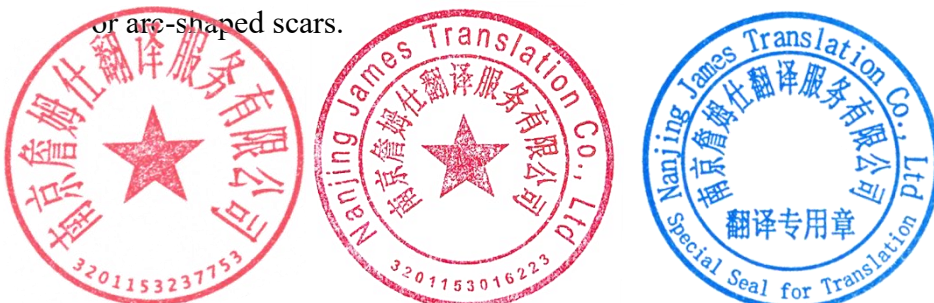
6.4.1 Metallographic specimens should be sampled from the profile itself.

6.4.2 The metallographic examination of continuous cast gray iron hollow profiles should be conducted according to the standards outlined in GB/T 7216.

6.4.3 The metallographic examination of continuous cast ductile iron hollow profiles should be carried out in accordance with GB/T 9441.

6.5 Surface Quality, Dimensions, and Straightness

6.5.1 Surface quality should be visually inspected to identify any visible defects, such as protrusions or arc-shaped scars.



6.5.2 The outer diameter should be measured using a vernier caliper, with deviations conforming to the specifications in Table 5.

6.5.3 Wall thickness should be measured on the cross-section of the profile after sawing, using a vernier caliper. The deviations between the maximum, minimum, and nominal dimensions (including the drawing dimensions and machining allowance) should comply with the specifications in Table 5.

6.5.4 Straightness can be checked using a 1-meter steel straightedge. The maximum gap between the straightedge and the profile's surface should not exceed the tolerance specified in Table 7.

7. Inspection Rules

7.1 Batch Classification

During continuous and stable production, a set of samples should be taken every 2 hours to test mechanical properties, metallographic structure, and other relevant characteristics.

7.2 Evaluation of Test Results Validity and Retesting

The rules for evaluating the validity of mechanical property test results and the retesting procedures for continuous cast gray iron hollow profiles should follow the provisions of GB/T 9439. For continuous cast ductile iron hollow profiles, the procedures should be in accordance with GB/T 1348.

8. Marking and Quality Certificate

8.1 Marking

Continuous cast iron hollow profiles should be marked to indicate the material grade, dimensions and specifications, quantity, and the name of the manufacturing company. If the purchaser has specific requirements for the product markings, these should be determined through mutual agreement between the supplier and the purchaser.

8.2 Quality Certificate

A quality certificate, signed and stamped by the inspection department, must accompany the continuous cast iron hollow profiles when they leave the factory. The certificate should include the following details:

- a) Name of the manufacturing company
- b) Product type and specifications



- c) Material grade
- d) Inspection results
- e) Production batch number

9. Packaging, Storage, and Transportation

9.1 After passing inspection, continuous cast iron hollow profiles must be stored separately by material grade and specification, with clear labels attached.

9.2 The packaging method for continuous cast iron hollow profiles should be mutually agreed upon by the supplier and the purchaser.

9.3 The transportation method should also be mutually agreed upon by the supplier and the purchaser.



JB/T 12282-2015

Mechanical Industry Standard of the People's
Republic of China

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JB/T 12282-2015

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Published and distributed by Machinery
Industry Press

No. 22, Baiwanzhuang Street, Beijing

Postal Code: 100037

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Specifications

210mm × 297mm • 0.75 printed sheets • 19,
000 characters

First edition, first printing, August 2016

Price: 15.00 RMB

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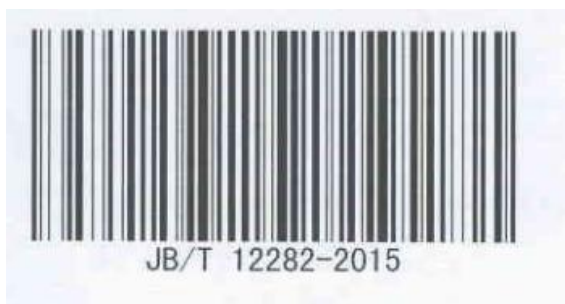
ISBN: 15111 • 13216

Website: <http://www.cmpbook.com>

Editorial Office Phone: (010) 88379399

Direct Sales Center Phone: (010) 88379693

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