INTERNATIONAL STANDARD

ISO 23472-5

First edition
2022-02

Foundry machinery — Vocabulary —

Part 5: Cupola furnaces and pouring devices and ladles

Machines de fonderie — Vocabulaire —

Partie 5: Cubilots et dispositifs de coulée et poches de coulées

Reference number
ISO 23472-5:2022(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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 306, *Foundry machinery*.

A list of all parts in the ISO 23472 series can be found on the ISO website.

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

Documentation gives rise to numerous international exchanges of both intellectual and material nature. These exchanges often become difficult, either because of the great variety of terms used in various fields or languages to express the same concept, or because of the absence of, or the imprecision of, useful concepts.

To avoid misunderstandings due to this situation and to facilitate such exchanges, it is advisable to select terms to be used in various languages or in various countries to express the same concept, and to establish definitions providing satisfactory equivalents for the various terms in different languages.

The objects involved in the ISO 23472 series are foundry machines used in foundry production.

The purpose of the ISO 23472 series is to provide definitions in English that are rigorous, uncomplicated and which can be understood by all concerned. The scope of each concept defined has been chosen to provide a definition that is suitable for general application within foundry machinery, which includes machines and equipment adapted in each stage of the processes within different casting processes.

As a metal thermoforming method that fills molten metal into the mold to produce machine parts or rough parts after solidification, casting has a long history and various processes, and its technology remains constantly developing and changing. According to the differences in the mold used, or different ways of molten metal filling or solidification, casting processes are usually divided into sand casting, permanent casting and other casting processes. According to different casting processes and different stages of production, casting equipment covered by foundry machinery is divided into the following major categories:

— molding and coremaking machines and other equipment related to non-permanent mold casting process;

— die casting machines and other equipment related to permanent mold casting process;

— abrasive blasting machines and other equipment related to cleaning and finishing for casting;

— cupola furnaces and pouring devices and ladles.

This document only involves terms and definitions of cupola furnaces, pouring devices and ladles, including basic concepts specifically concerning structural characteristics and functions, important mechanisms and parts, main technological processes and parameters of various cupola furnaces and their melting auxiliary equipment, burdening and charging equipment, pouring devices, ladles, molten metal treatment and transfer equipment, and other related equipment (see Figure 1).

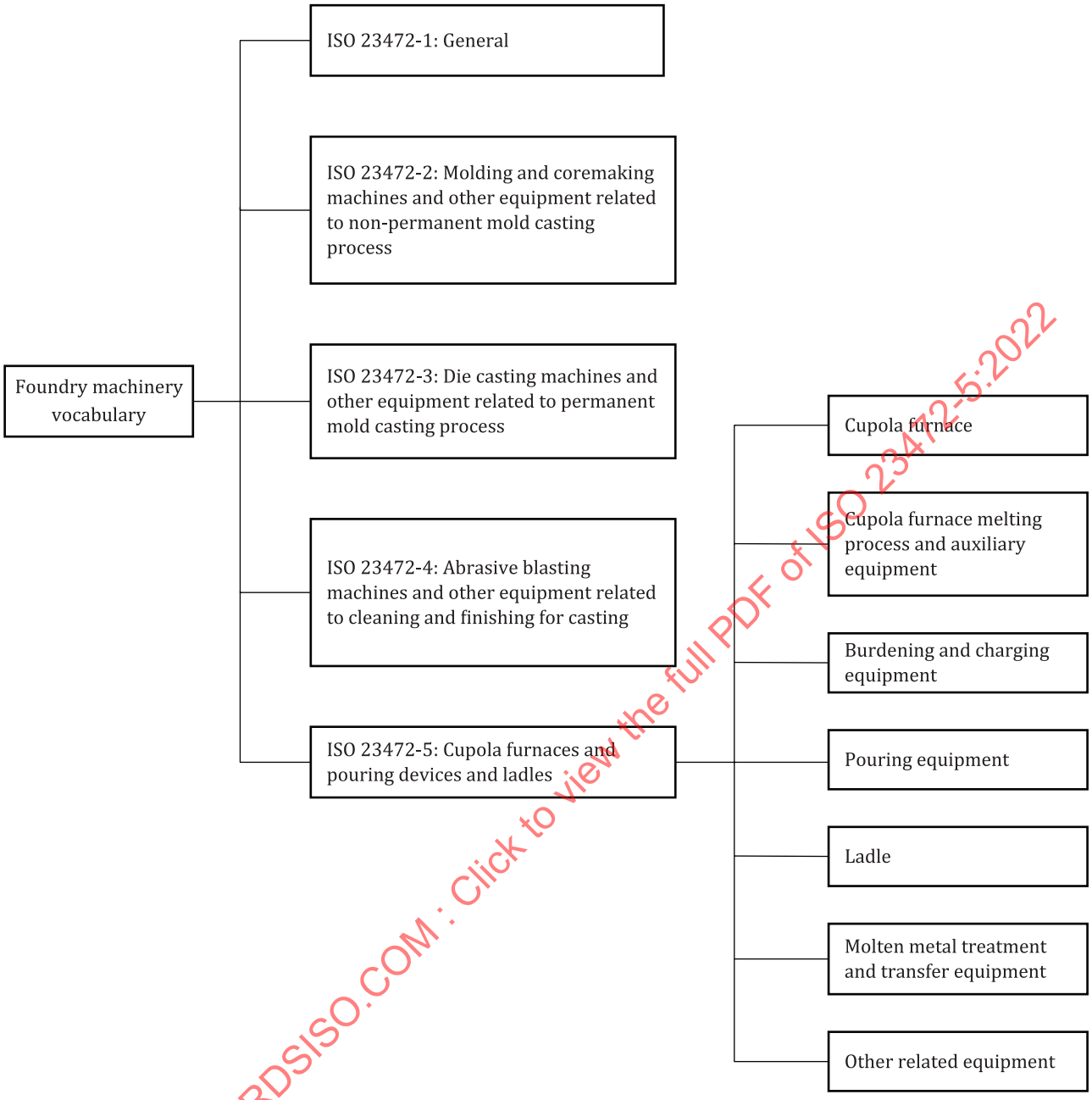


Figure 1 — Structure of vocabulary on cupola furnaces and pouring devices and ladles

Foundry machinery — Vocabulary —

Part 5:
Cupola furnaces and pouring devices and ladles

1 Scope

This document defines a set of terms and definitions for cupola furnaces, pouring devices and ladles in foundry machinery.

It applies to standards development in the foundry machinery field, technical documentation, related scientific and technical publications, etc.

This document is not applicable to process and equipment related to melting and pouring of nonferrous metal.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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/

3.1
alloy loss rate
percentage of alloy oxidized during melting relative to the amount added

3.2
automatic ladle replacement system
complete set of devices that sends the *ladle* (3.43) with *molten metal* (3.49) inside to the changing position and withdraws the empty ladle

3.3
automatic pouring machine
pouring equipment (3.56) that automatically and systematically completes the pouring process according to the set procedure

3.4
automatic transfer system for molten metal
system that automatically transfers *molten metal* (3.49) among each working station by a *ladle* (3.43), from the molten metal loading point, along a pre-set routing to the molten metal treatment station and slag-off position, finally loading molten metal into the pouring machine

Note 1 to entry: The system can also complete the inoculation and/or spheroidization process according to technical requirements during the transfer operation.

Note 2 to entry: The system usually includes a *ladle transfer car* (3.47) at the *forehearth* (3.29), a ladle for transfer, a transfer rail, a ladle transfer car with rotating and turnover capabilities, a spheroidization station, slag-off position, transfer safety warning facilities, etc.

3.5
blast intensity
blast volume (3.6) per unit cross-sectional area of the cupola *furnace chamber* (3.35) (*melting zone* (3.52))

Note 1 to entry: Expressed in $Nm^3/(m^2.min)$.

3.6
blast volume
air volume send into *cupola furnace* (3.20) per unit time

Note 1 to entry: Expressed in Nm^3/min.

3.7
blasting in
process of blowing air into the *cupola furnace* (3.20) through *tuyeres* (3.95)

3.8
bottom door
door at the bottom of the *cupola furnace* (3.20) for repairing lining

3.9
bottom pouring ladle
ladle (3.43) with an open-close mechanism to control the pouring of the *molten metal* (3.49) through a nozzle at the bottom of ladle

3.10
bottom pouring machine
pouring equipment (3.56) with a *bottom pouring ladle* (3.9)

3.11
bottom pouring nozzle
cup-shaped nozzle installed on a hole on the *bottom pouring ladle* (3.9)

3.12
charging section
section of the *cupola furnace* (3.20) with an opening on top of the section for charging

3.13
coke
fuel that is burnt in the furnace for generating heat to melt the metal

3.14
coke bed
coke (3.13) layer in the *cupola furnace* (3.20) between the *furnace bottom* (3.32) and the lower end of *melting zone* (3.52)

3.15
coke consumption ratio
ratio of *coke* (3.13) consumed in cupola melting to the mass of the *molten metal* (3.49) obtained

3.16
coke ratio
ratio of *metallic charge* (3.53) to *coke* (3.13) in mass during *cupola furnace* (3.20) melting

3.17
coke split
layer of *coke* (3.13) added into the *cupola furnace* (3.20) in between batches of *metallic charge* (3.53)

3.18
cokeless cupola furnace
cupola furnace (3.20) not using *coke* (3.13) as fuel

Note 1 to entry: Natural gas and other substitutes can be used as fuel.

3.19
combustion chamber
unit assembly for the *external-heating hot blast cupola furnace* (3.25) to burn carbon monoxide in furnace gas or other fuels and to generate high temperature *fume* (3.30)

3.20
cupola furnace
cylindrical vertical melting furnace with pig iron, foundry returns and/or steel scrap as *metallic charge* (3.53) for melting cast iron

Note 1 to entry: Cupola furnace melting is a process that produces heat through the reaction (combustion) of fuel (for example, *coke* (3.13)) and oxygen, so that the metallic charge melts and overheats, and finally obtains the required *molten metal* (3.49). In this process, the metallic charge is in direct contact with fuel and is blast-assisted from the *tuyere* (3.95) for continuous melting.

Note 2 to entry: An example of cupola furnace structure is given in Figure A.1.

[SOURCE: ISO 23472-1:2020, 3.37, modified — The words "required molten iron" have been replaced by "required molten metal" in Note 1 to entry and Note 2 to entry has been added.]

3.21
dehumidification blast
blast method with moisture removed from air before entering the *cupola furnace* (3.20)

3.22
desulfurization
process of sulphur reduction in *molten metal* (3.49) by adding desulfurizer

3.23
desulfurization ladle
ladle (3.43) that desulfurizes *molten metal* (3.49) by blowing in nitrogen or inert gas from bottom holes at the time of desulfurizer addition

3.24
effective height
vertical distance between the cross-section formed by the centre lines of the first ring of *tuyeres* (3.95) and the cross-section formed by the lower rim of gas exit at the *charging section* (3.12)

3.25
external-heating hot blast cupola furnace
hot blast cupola furnace (3.40) that heats combustion-supporting gas in an external *combustion chamber* (3.19) and blasts into the furnace

3.26
feeding level indicator
device for automatically detecting and displaying the height of charge stacked in the *cupola furnace* (3.20)

3.27
fixed forehearth
forehearth (3.29) with a wall of which there is a *tapping spout* (3.85) and a *slag spout* (3.73), rigidly connected to the *cupola furnace* (3.20) *well* (3.103) through the *furnace bridge* (3.33)

3.28
flux
non-metallic furnace charge added into the *cupola furnace* (3.20) to participate in *slag* (3.71) forming during melting, such as limestone and fluorite

Note 1 to entry: It reduces the melting point and viscosity of slag, facilitating the separation of slag and *molten metal* (3.49). In addition, it removes gas and impurities in the molten metal.

3.29
forehearth
container installed in front of the *furnace body* (3.31), through the *furnace bridge* (3.33) connected to the furnace *well* (3.103), for storage of *molten metal* (3.49)

3.30
fume
high temperature gas mixture with furnace gas released during the *cupola furnace* (3.20) melting process

3.31
furnace body
main structure part of the *cupola furnace* (3.20), usually referring to the zone from the *furnace bottom* (3.32) to the *charging section* (3.12)

3.32
furnace bottom
platform at the bottom of the *cupola furnace* (3.20) to support the *furnace body* (3.31)

3.33
furnace bridge
runner
spout through which the *molten metal* (3.49) flows from the furnace *well* (3.103) to the *forehearth* (3.29)

3.34
furnace campaign
production time for continuous melting, which is the interval between two lining repairs with the same sand bed

3.35
furnace chamber
space inside the *furnace body* (3.31) that has a *melting zone* (3.52) and a *preheating zone* (3.61) for completion of the melting process

3.36
furnace shell
metallic shell of the *furnace body* (3.31)

3.37
graphite spheroidization treatment
process where a spheroidization agent is added into *molten metal* (3.49) to release carbon to form mostly spheroid-shaped graphite during molten metal solidification

3.38
heat exchanger
heat exchange device to pass thermo energy from high temperature *cupola furnace* (3.20) gas to a low temperature medium (such as air)

3.39
holding furnace
furnace used to hold *molten metal* (3.49) from a melting furnace at a specific *pouring temperature* (3.59)

Note 1 to entry: In addition to storing and holding molten metal at a certain temperature, it also plays a role in homogenizing the composition of molten metal.

[SOURCE: ISO 23472-1:2020, 3.82]

3.40
hot blast cupola furnace
cupola furnace (3.20) with pre-heated blasting

3.41
induction heating device
device for maintaining the *molten metal* (3.49) temperature, by heat generated from an induction coil

3.42
inoculation device
device that can automatically and quantitatively add inoculants to *molten metal* (3.49) during pouring

3.43
ladle
container for *molten metal* (3.49) holding, treatment, transferring and pouring

Note 1 to entry: Ladles are made of welded steel plate and lined with refractory materials, some of them are also equipped with hanging beam and tilting mechanism or opening and closing mechanism for plug.

Note 2 to entry: In high pressure die casting, it is a device to ladle molten non-ferrous alloys from a *holding furnace* (3.39) to the shot sleeve.

[SOURCE: ISO 23472-1:2020, 3.87]

3.44
ladle cover
cover to set on the *ladle* (3.43) upper opening to reduce the heat loss of the ladle itself and *molten metal* (3.49) in the ladle

3.45
ladle heater
device for raising the temperature of the *ladle* (3.43) by flame or radiant heat

3.46
ladle heating
process to heat and dry the *refractory lining* (3.66) of the *ladle* (3.43) through heating and baking

3.47
ladle transfer car
equipment that transfers the *ladle* (3.43), with or without *molten metal* (3.49) inside, from one device to another

3.48
liningless cupola furnace
cupola furnace (3.20) without a *refractory lining* (3.66) at the *melting zone* (3.52) but protected by *slag* (3.71) formed on the furnace wall during the melting process

3.49
melt
molten metal
cast metal heated from solid to liquid, such as molten iron, molten steel and molten non-ferrous alloys

[SOURCE: ISO 23472-1:2020, 3.95]

3.50
melting capacity
mass of *molten metal* (3.49) melted in the *cupola furnace* (3.20) per unit time

Note 1 to entry: Usually expressed in t/h.

3.51
melting intensity
melting capacity (3.50) per cross-sectional area of the *furnace chamber* (3.35) (*melting zone* (3.52))

Note 1 to entry: Expressed in $t/(m^2.h)$.

3.52
melting zone
zone from where the *metal charge* (3.53) starts to melt to where it completely turns into molten state in the *furnace chamber* (3.35)

3.53
metallic charge
metal charge
metallic materials added into the *cupola furnace* (3.20), including pig iron, scrap steel, return charge and intermediate alloy

3.54
monorail overhead charger
complete device with winding mechanism to lift the charging bucket, let it move horizontally along the monorail and load charges into the *cupola furnace* (3.20)

3.55
oxygen enriched blast
melting process in which oxygen is supplied during blasting

3.56
pouring equipment
machine and device that pours *molten metal* (3.49) into mold

[SOURCE: ISO 23472-1:2020, 3.126]

3.57
pouring pressure
pressure of compressed air or inert gas inside the *pressure pouring furnace* (3.63) during the pouring process

3.58
pouring speed
molten metal (3.49) poured in mass per unit time

Note 1 to entry: Usually expressed in kg/s.

3.59
pouring temperature
temperature of *molten metal* (3.49) during pouring

3.60
pour-over spheroidization
spheroidization process with spheroidizing agent and covering agent/*flux* (3.28) placed and lightly compacted at the bottom of the preheated *tundish* (3.93) according to various tundish types

3.61
preheating zone
zone in the *furnace chamber* (3.35) extending from the lower rim of the charging door to the area where the *metal charge* (3.53) reaches the melting point

3.62
pressure control device
device to control the pressure of compressed air or inert gas inside the *pressure pouring furnace* (3.63) over *molten metal* (3.49)

3.63
pressure pouring furnace
sealed furnace with induction heating that can pour through pressing *molten metal* (3.49) out through controlling of air or inert gas pressure on top of molten metal

3.64
recarburization
process of increasing carbon content in *molten metal* (3.49) by adding carbon-based material during melting

3.65
recuperated hot blast cupola furnace
cupola furnace (3.20) that uses a recuperator to recover heat of exhaust gas from the furnace and that heats up fresh air which is blasted into the cupola furnace through the *tuyeres* (3.95)

3.66
refractory lining
refractory layer on the inner wall of the furnace or *ladle* (3.43)

3.67
sector ladle pouring machine
pouring equipment (3.56) with a sector-shaped pot which turns at the centre of the sector to let *molten metal* (3.49) flow out from the side of the pot at the turning axis, making the pressure head independent of the volume of molten metal inside and achieving a steady flow out of the machine

3.68
sector pouring ladle
ladle (3.43) in sector shape of which the poured amount is proportional to the angle of rotation of the ladle during the tilting operation

3.69
skip charger
complete device with a winding mechanism to pull the charging car running upwards on an upward inclined rail, lifting and loading the charging bucket into the *cupola furnace* (3.20)

3.70
skip hoist
cupola furnace (3.20) charger for charging at the top of the cupola *furnace body* (3.31), with the charging bucket lifted vertically and the charging car running horizontally on the rail

3.71
slag
oxide produced by metallurgical reaction in the *cupola furnace* (3.20) melting process, impurities brought in by furnace charge, corroded lining and ash content of *coke* (3.13)

3.72
slag separator
device that continuously separates and discharges *slag* (3.71) from *molten metal* (3.49)

3.73
slag spout
spout connected to a hole at the lateral side of the furnace *well* (3.103) or *forehearth* (3.29) for removal of *slag* (3.71)

3.74
slagging-off
operation to remove *slag* (3.71) on the surface of *molten metal* (3.49) inside the pouring *ladle* (3.43), prior to pouring molten metal into the mold cavity

3.75
spark arrester
device installed at the top of the *cupola furnace* (3.20) for trapping high temperature particles in *fume* (3.30)

3.76
spheroidization ladle
ladle (3.43) that spheroidizes *molten metal* (3.49) by adding spheroidizer

3.77
stack
part of the *cupola furnace* (3.20) above the *charging section* (3.12) for *fume* (3.30) exhaust

3.78
start-up
beginning of the melting operation at the *cupola furnace* (3.20)

Note 1 to entry: Blast in air to start melting.

3.79
stopper rod
rod-shaped part with refractory material to block the nozzle of the *bottom pouring ladle* (3.9) and to control the flow of *molten metal* (3.49)

3.80
stopper system
device that controls opening and closing of the nozzle through lifting and lowering of the *stopper rod* (3.79)

3.81
stratified air supply
blasting method in which each ring of the *tuyeres* (3.95) is equipped with a separate *wind box* (3.104) to adjust blasting parameters respectively

3.82
superheating zone
zone from the bottom plane of the *melting zone* (3.52) to the plane containing the centre of the first ring of the *tuyeres* (3.95)

3.83
synchronous pouring
pouring method in which the pouring machine and the molding line can move synchronously and pour during movement

3.84
tapping car
facility with *fume* (3.30) extraction and a weighing system that transfers the *ladle* (3.43) with *molten metal* (3.49) from the furnace to the slag-off position and returns the empty ladle to the loading position at the furnace

3.85
tapping spout
spout connected to a hole at the lateral side of the furnace *well* (3.103) or *forehearth* (3.29) for the tapping of *molten metal* (3.49)

3.86
tapping temperature
temperature of *molten metal* (3.49) tapped from the *cupola furnace* (3.20)

Note 1 to entry: The temperature of molten metal is measured in a tapping trough, which is at a certain distance from the *tapping spout* (3.85) of the furnace *well* (3.103) or *forehearth* (3.29).

3.87
teapot spout ladle
ladle (3.43) in which *molten metal* (3.49) at the bottom will be poured through an inclined slot during pouring

3.88
tilting forehearth
forehearth (3.29) that receives *molten metal* (3.49) through a bridge at the bottom part of the *cupola furnace* (3.20) and pours molten metal by means of tilting

Note 1 to entry: It is not fixed with the *furnace bridge* (3.33).

3.89
tilting ladle
ladle (3.43) with a tilting mechanism that pours *molten metal* (3.49) by rotating the pot around the horizontal axis

3.90
tilting pouring machine
tilting-ladle pouring machine
pouring equipment (3.56) which tilts the *ladle* (3.43) for pouring

Note 1 to entry: Its tilting centre line can be located at the centre of mass of the ladle or at the ladle spout.

3.91
tipping hopper
hopper device that receives and temporarily stores all kinds of *metal charge* (3.53), and automatically dumps it into the *transfer car* (3.92) or charging bucket

3.92
transfer car
car for receiving and transporting the prepared charge and loading it into the charging bucket

3.93
tundish
refractory lined vessel with one or more nozzles at its bottom, which can be interposed between the *ladle* (3.43) and the mold in teeming

3.94
tundish covered spheroidization
spheroidization process where the *tundish* (3.93) is equipped with a special cover to avoid magnesium flash, *fume* (3.30) and splash

3.95
tuyere
opening at the *furnace shell* (3.36) to let air blow in to support combustion

3.96
tuyere angle
angle between the centre line of the *tuyere* (3.95) and the horizontal plane of the outlet centre of this ring of the tuyeres

3.97
tuyere ratio
total *tuyere* (3.95) cross-sectional area as a percentage of the cross-sectional area of the *furnace chamber* (3.35)

3.98
tuyere ring-spacing
distance between the planes formed by the *tuyere* (3.95) centres of the two adjacent rings of tuyeres

3.99
tuyere sectional area
cross-sectional area at the exit end of the *tuyere* (3.95)

3.100
water cooled tuyere
tuyere (3.95) with a water jacket where cooling water is passed through

3.101
water-cooled cupola furnace
cupola furnace (3.20) with a water-cooled shell (or including a *tuyere* (3.95))

3.102
weighing mechanism
mechanism that forms a weighing system with a high precision weighing sensor to realize accurate weighing of *molten metal* (3.49) in the *ladle* (3.43)

3.103
well
space between the cross section formed by the centre lines of the first ring of the *tuyeres* (3.95) and the *furnace bottom* (3.32) in the *furnace chamber* (3.35)

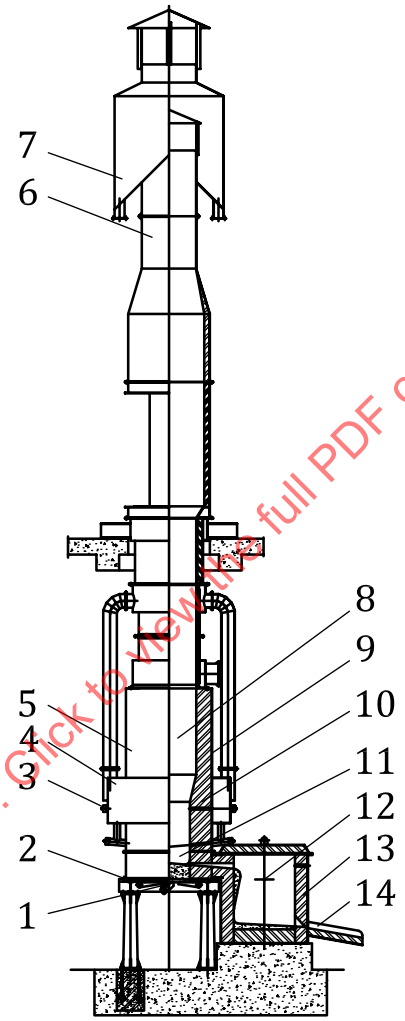
Note 1 to entry: It is used to collect *molten metal* (3.49) and *slag* (3.71) and to let it enter the *forehearth* (3.29). When there is no forehearth, it is used for the storage of molten metal.

3.104
wind box
ring-shaped box around the *furnace body* (3.31) that makes air from blowers blown through the *tuyeres* (3.95) into the *furnace chamber* (3.35) with equal pressure

3.105
wire feeder
device for spheroidizing or inoculating *molten metal* (3.49) by continuously inserting alloy cored wires containing spheroidizer or inoculant into the molten metal at a certain speed

Annex A
(informative)

Example of cupola furnace structure



Key

1	bottom door	8	furnace chamber
2	furnace bottom	9	furnace shell
3	tuyere	10	refractory lining
4	wind box	11	well
5	furnace body	12	slag spout
6	stack	13	forehearth
7	spark arrester	14	tapping spout

Figure A.1 — Example of cupola furnace structure