
Foundry machinery — Vocabulary —
Part 1:
General

STANDARDSISO.COM : Click to view the full PDF of ISO 23472-1:2020



STANDARDSISO.COM : Click to view the full PDF of ISO 23472-1:2020



COPYRIGHT PROTECTED DOCUMENT

© ISO 2020

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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.....	iv
Introduction.....	v
1 Scope.....	1
2 Normative reference.....	1
3 Terms and definitions.....	1
Bibliography.....	23
Alphabetical index.....	24

STANDARDSISO.COM : Click to view the full PDF of ISO 23472-1:2020

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*.

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 of the molds 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 general terms and definitions of foundry machinery, including basic concepts concerning foundry machinery and related casting methods and production processes. The detailed terms of the specific categories are defined in other parts of the ISO 23472 series (see [Figure 1](#)).

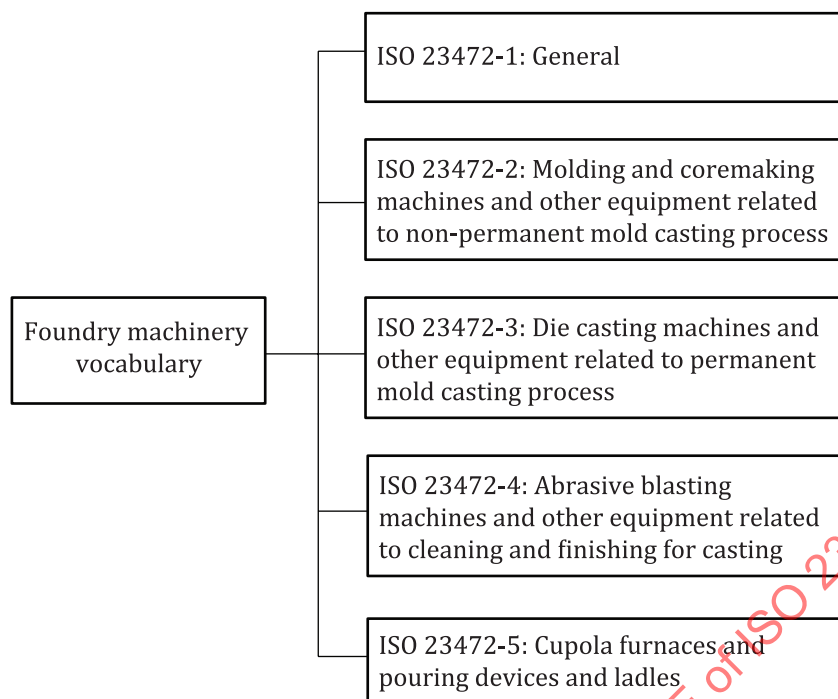


Figure 1 — Structure of foundry machinery vocabulary

Foundry machinery — Vocabulary —

Part 1: General

1 Scope

This document gives an overview on the terms and definitions of foundry machinery that are commonly and widely used.

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

2 Normative reference

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

abrasive blasting

shot blasting

process in which the workpiece to be cleaned or surface to be treated is subjected to continuous attack by *abrasive media* (3.3) to achieve a desired result

3.2

abrasive blasting machinery

shot blasting machinery

machine used for *shot blasting* (3.1) process by either centrifugal force or compressed air to accelerate *abrasive media* (3.3)

3.3

abrasive media

shot blasting media

granular metallic or non-metallic material to be forcibly applied to a surface to achieve a desired result

Note 1 to entry: For the classification of metallic abrasives, see ISO 11124-1. For the classification of non-metallic abrasives, see ISO 11126-1.

3.4

adding and compacting sand device

device for sand adding and compacting by vibration in molding process in *expendable pattern casting* (3.58), for example, shower adding sand machine and *vibrating table* (3.176)

3.5

automatic mode

full-automatic mode

operating mode where the completion of a casting cycle initiates the next casting cycle

EXAMPLE To continuously produce *castings* (3.11) with any external process steps being automatically carried out by ancillary device.

3.6

batch sand mixer

batch sand mill

machine for batch mixing (blending, coating, kneading) of molding or core sand with bonding agents, water and complementary mold material additions

Note 1 to entry: The machines are provided with rotating paddles and/or milling rollers and fast rotating paddles for the aeration of the material. Typically, machines consist of a circular container in which rotating ploughs and/or mill wheels (mullers) are mounted.

3.7

binder

bonding substance

material with bonding property, mainly used to prepare molding (core) sand, coating and core adhesive in foundry production

Note 1 to entry: Foundry binders are usually divided into two categories: inorganic and organic binders, or clay binders and non-clay binders.

3.8

burdening

<melting> process in which the proportion of various metallic charge is determined according to the requirement of the chemical composition of *casting alloy* (3.10), the actual situation of burden and the changing law of elements in *melting* (3.98)

3.9

burdening

<molding> process in which the mixing proportion of various *molding materials* (3.108) is determined according to the requirement of *molding sand* (3.111) properties in *molding sand preparation* (3.112)

3.10

cast metal

cast alloy

metal with proper castability which is used to produce *castings* (3.11), including cast iron, cast steel and non-ferrous cast alloys (such as cast aluminium alloy, magnesium alloy, copper alloy, zinc alloy and titanium alloy)

3.11

casting

<products> metal part or rough part that has been given its shape in a *mold* (3.101) by *solidification* (3.160) of *molten metal* (3.95)

3.12

casting

<technology> process in which *molten metal* (3.95) is poured, injected or suctioned into the mold cavity and solidified to obtain metal parts or rough parts with certain shapes, sizes and properties

3.13

casting cooling

process in which the temperature of a *casting* (3.11) drops gradually after it is formed

Note 1 to entry: It includes the cooling of the casting in the *mold* (3.101), as well as the secondary cooling of the casting after removal from the mold.

3.14**casting cooling and transferring system**

system used for recooling of *casting* (3.11) after demolding

Note 1 to entry: It uses *continuous conveyor* (3.23), such as vibrating conveyor or overhead chain conveyor, and can be equipped with ventilating and spray cooling system.

3.15**centrifugal casting**

process in which *molten metal* (3.95) is filled into a *mold* (3.101) that rotates around a horizontal or vertical axis and solidifies under the action of centrifugal force to produce *castings* (3.11)

Note 1 to entry: The molten metal is evenly distributed to the surface of the mold cavity under the centrifugal force produced by the rotation of the mold, forming cylindrical cylinder sleeve, pipe and other ringlike castings.

3.16**centrifugal casting machine**

machine that uses *centrifugal casting* (3.15) process to produce *castings* (3.11), such as horizontal centrifugal casting machine and centrifugal casting-pipe machine

3.17**ceramic mold casting**

process in which the ceramic mold is used to pour *castings* (3.11)

Note 1 to entry: Ceramic mold casting is a kind of *precision casting* (3.127) method, which is mainly used for single piece and small batch manufacturing of metal molds, as well as turbine blades, impellers and other precision castings.

Note 2 to entry: Ceramic mold is made by casting ceramic slurry, then spraying and firing, and then ceramic solid mold or thin shell mold is made.

3.18**clay bonded sand**

molding sand (3.111) that uses clay as binder and is made of foundry sand, clay, water and additives (such as seacoal, etc.) mixed in a certain proportion

Note 1 to entry: Clay is a commonly used binder in sand mold casting production, which can be divided into kaolin or bentonite.

Note 2 to entry: Clay bonded sand can be divided into wet sand and dry sand according to different conditions of use, in which wet sand is also called *green sand* (3.79).

3.19**cleaning**

process of removing contaminant and unwanted material (for example, *sand core* (3.140) and residual sand on the surface from casting, gate and riser, flash, burr, oxide scale, etc.) from *casting* (3.11)

3.20**compacting**

process of compacting loose *molding sand* (3.111) by jolting, squeezing, shooting, air flowing and other ways during the molding process to obtain the strength required for *sand mold* (3.146)

3.21**continuous casting**

process of continuously casting metal ingots, pipes or fixed section long *castings* (3.11)

Note 1 to entry: Process in which *molten metal* (3.95) is poured into a cooled mold open on both sides via tundish. The shaping element of the strand is the *mold* (3.101). On the short way through the mold, so much heat is extracted from the molten metal that it solidifies completely or with the formation of a load-bearing edge shell. The strand is pulled out of the mold on the opposite side with the aid of a drawing device. In this way, different strand formats with a constant cross-section can be produced.

3.22

continuous casting machine

machine that uses *continuous casting* (3.21) process to produce *castings* (3.11)

3.23

continuous conveyor

machine and device used for long distance continuous conveying of loose material (such as *sand* (3.69)) or items (such as *castings* (3.11)) in foundry shop

Note 1 to entry: The types of machines include belt conveyor, pan conveyor, vibrating conveyor, overhead chain conveyor, etc., excluding pneumatic conveyor for conveying clay, dry sand, seacoal and other powder materials.

3.24

continuous sand mixer

machine in which the sand with bonding agents are continuously mixed and conveyed to the discharge gate

Note 1 to entry: Typically, the mixing takes place by screw-type mixing principles.

3.25

core

component of a mold used to form the inner cavity within a *casting* (3.11), a protruding part on the side or a deep groove in case of pronounced undercuts and/or negative (back) drafts

Note 1 to entry: According to different uses or requirements, there are *sand core* (3.140), metal core, soluble core, ceramic core and so on.

3.26

core assembly molding

molding process in which the *core box* (3.28) is used instead of the *pattern* (3.117) and the produced *sand cores* (3.140) are assembled directly into the *mold* (3.101)

Note 1 to entry: It is mainly used for batch production of complex *castings* (3.11) or repeated production of large castings.

3.27

core blower

machine where the sand is transported by means of compressed air into the *core box* (3.28)

Note 1 to entry: The sand is conveyed along in front of the compressed air. Typically used for resin-coated dry sand.

3.28

core box

mold for sand core making, whose inner cavity has the shape and size required for the *sand core* (3.140)

Note 1 to entry: It is usually made of metal, wood or plastic.

Note 2 to entry: It can be divided into integral type and bisection type according to its structure and can be divided into hot core box and cold core box according to its use temperature.

3.29

core sand coremaking mixture

mixture of raw sand, various binders and additives mixed in a certain proportion, which meets a certain property requirement of making *sand core* (3.140)

3.30

core shooter

machine where compressed air is rapidly expanded via the sand reservoir into the sand

Note 1 to entry: After expanding, the sand is then fluidized by the airstream and the sand-air-mix is transported into the core box. Typically used for cold box, hot box and inorganic binder systems.

3.31**core storehouse and conveying system**

system used for automatic conveying, storing and distributing of *sand core* (3.140), for example, core three-dimensional storehouse

3.32**coremaking**

process in sand casting process that uses *core sand* (3.29), *core box* (3.28) and other toolings to make sand core, including hand coremaking and machine coremaking

3.33**coremaking line**

equipment used to make ready-to-use single cores and/or core assemblies

Note 1 to entry: A line may consist of, e.g., a sand preparation equipment, core making machine, equipment for handling, deflashing, assembling, coating and drying of cores.

3.34**coremaking machinery**

machines used to make solid and/or hollow cores

3.35**counter pressure casting****differential pressure casting**

pressure casting process in which *molten metal* (3.95) is filled up the *mold* (3.101) and solidified under counter pressure of compressed air

Note 1 to entry: The actual casting process is carried out in a similar way to *low pressure casting* (3.89), also with the help of a riser tube. The *cast metal* (3.10) is conveyed up into the *die* (3.45) by the riser tube. However, the pressurization of the metal bath in the furnace in order to convey the melt up into the die is caused by a pressure difference up by lowering the gas pressure in the pressurized die a little. This causes an overpressure in the furnace which causes the metal to rise into the die.

Note 2 to entry: Its working pressure levels are usually higher than ones in low pressure casting.

3.36**crystallizer**

special *die* (3.45) with water-cooled structure for rapid solidification of molten metal and used for continuous or *semi-continuous casting* (3.150), *suction casting* (3.163) and *electroslag melting and casting* (3.54)

3.37**cupola furnace**

cylindrical vertical *melting furnace* (3.99) with pig iron, foundry returns and/or steel scrap as metallic charge for melting cast iron

Note 1 to entry: Cupola furnace *melting* (3.98) is a process that produces heat through the reaction (combustion) of fuel (for example, coke) and oxygen, so that the metallic charge melts and overheats, and finally obtains the required molten iron. In this process, the metallic charge is in direct contact with fuel and is blast-assisted from the tuyere for continuous melting.

3.38**decoring****core knock-out**

process in which *sand core* (3.140) is removed from the inner cavity of the casting by hammering or any other way

3.39**decoring cell**

complete set of *decoring* (3.38) equipment that consists of a *decoring machine* (3.40), a robot for loading and unloading workpieces, and an *exhaust system* (3.56), etc.

3.40

decoring machine

machine that removes the *sand core* (3.140) from the inner cavity of the *casting* (3.11) by pneumatic or hydraulic impact hammer

Note 1 to entry: It is usually composed of hammering mechanism, conveying mechanism for workpiece and a chamber which prevents dust from escaping. Among them, the conveying of the workpiece can adopt motorized roller, mobile car, turntable, manipulator or robot.

3.41

decorticating

process of removing the *shell mold* (3.154) after *casting* (3.11) is formed in the *investment casting* (3.83)

3.42

degating

process of removing the gate and riser from *casting* (3.11)

Note 1 to entry: Commonly used methods are striking, grinding wheel or machine cutting, flame cutting, etc.

3.43

degating device

device used to remove gate and riser of castings, such as gate hydraulic cutting machine and riser impacting hammer

3.44

dewaxing

process of removing wax pattern assembly from shell mold and forming cavity by melting, dissolving or burning in *investment casting* (3.83)

Note 1 to entry: Commonly used methods are hot water dewaxing, steam dewaxing, etc.

3.45

die

permanent mold

mold (3.101) made of metal materials

Note 1 to entry: It is not destroyed after the *casting* (3.11) has been removed and can be used repeatedly.

3.46

die casting

high pressure die casting

process in which *molten metal* (3.95) is injected into a *die* (3.45) and held under pressure until complete solidification

3.47

die casting cell

die casting machine (3.48), together with auxiliary and ancillary equipment, which form a complete production unit

3.48

die casting machine

machine with the purpose to inject *molten metal* (3.95) under pressure into a parted die which is connected to the platens of the machine

3.49

disposable mold

mold (3.101) that is destroyed to remove the *casting* (3.11)

3.50**drying machine and plant for sand mold
drying machine and plant for sand core**

machine and related equipment used for *sand mold* (3.146) or *sand core* (3.140) drying in foundry production, such as passing type drying chamber, hot blast drying furnace and electric far infrared drying furnace

3.51**duplex melting
duplexing**

method of producing *molten metal* (3.95) with two kinds of furnaces

Note 1 to entry: Usually melting in a furnace with high thermal efficiency (e.g. *cupola furnace* (3.37)), refining and heating in a furnace which can easily control the composition and temperature of the alloy (e.g. electric furnace).

3.52**dust separator**

air cleaning device to remove contaminated particulates prior to discharge to the atmosphere

3.53**electromagnetic pump**

device for raising, conveying, proportioning and pouring *molten metal* (3.95) by electromagnetic force

3.54**electroslag melting and casting**

process of melting and refining metal by the resistance heat produced by the current passing through slag and casting *molten metal* (3.95) into castings or ingots

Note 1 to entry: Under the action of gravity, the molten metal passes through slag directly into the bottom *crystallizer* (3.36) by means of separate droplets and solidifies, thus obtaining castings or ingots.

3.55**environmental protection and waste disposal equipment**

machine, device and system used to dispose *foundry wastes* (3.71), such as foundry duster and dust extraction system, plants for preparation of dusts and slurries and swarf recycling plants

3.56**exhaust system**

extraction device which collects contaminated air under a slight negative pressure and transports it via appropriate ducting to a dust collector

3.57**expendable pattern
lost foam pattern**

pattern (3.117) made of polystyrene foam and other flammable materials which disappears because of combustion and gasification under the high temperature of *molten metal* (3.95)

3.58**expendable pattern casting
lost foam casting****EPC**

casting method which uses *expendable pattern* (3.57) for *molding* (3.104)

Note 1 to entry: It is not necessary to strip after molding. When *pouring* (3.125), high temperature *molten metal* (3.95) causes the pattern to burn, gasify and disappear, and fills up the cavity occupied by the pattern at the same time

3.59

expendable pattern making device

machine and device used to make *expendable pattern* (3.57) and store pattern materials in *expendable pattern casting* (3.58), such as bead storage equipment, pre-foaming machine, forming machine and adhesive machine

3.60

feeder

machine and device used for continuous and uniform control of loose material flow and short distance conveying in foundry production, which have gate valve function when stop feeding, such as vibrating feeder, belt feeder, disk feeder and pneumatic feeding system

3.61

firing

process in *investment casting* (3.83) and *ceramic mold casting* (3.17), in which the shell mold or ceramic mold should be heated to a high temperature before pouring and held for a period of time at high temperature in order to increase the strength of the shell and remove the residual material or moisture

3.62

flask

molding box

rigid frame which contains *molding sand* (3.111) and supports *sand mold* (3.146) and becomes a part of the *mold* (3.101), is a main tooling in *sand casting* (3.137) production, usually made of metal

Note 1 to entry: A complete flask is usually composed of two or more molding boxes. The upper molding box is called upper flask or cope, the lower molding box is called lower flask or drag, and the middle molding box is called middle flask.

Note 2 to entry: The flasks should be attached with alignment and positioning device while closing, as well as lifting, turning over and clamping devices or to keep closed by weight.

3.63

flask molding

box molding

molding (3.104) method which uses *flask* (3.62) in *sand casting* (3.137) production

Note 1 to entry: Fill sand and compact in the flask, and still use the flask to support *sand mold* (3.146) after *stripping* (3.162) for lifting and/or moving mold and *pouring* (3.125).

3.64

flaskless molding

molding (3.104) method which does not use *flask* (3.62) in *sand casting* (3.137) production

3.65

foundry

<technology> process in which *molten metal* (3.95) is poured, injected or suctioned into the mold cavity and solidified to obtain metal parts or rough parts with certain shapes, sizes and properties

Note 1 to entry: It should also include melting metals, making molds, as well as cleaning and finishing processes for the obtained parts.

3.66

foundry

<enterprise> professional factory with independent production, management and operation for *foundry* (3.65)

3.67

foundry

<production department> workshop used to complete one or several processes in *foundry* (3.65) production, such as *molding* (3.104) shop, *coremaking* (3.32) shop, *melting* (3.98) shop and casting fettling shop, final machining and coating shop

3.68**foundry equipment**

all kinds of machinery and plant used in foundry production, including various process equipment, such as *molding* (3.104), *coremaking* (3.32), *melting* (3.98), *pouring* (3.125), *shakeout* (3.84), *cleaning* (3.19) equipment, etc., as well as a variety of auxiliary and associated equipment for *foundry* (3.65)

3.69**foundry sand
sand**

refractories with a certain particle size, shape and particle distribution requirement used to make sand mold (core) for *foundry* (3.65).

3.70**foundry tooling**

general terms of the tools used in the processes of *molding* (3.104) and *coremaking* (3.32) in *sand casting* (3.137) production, such as *pattern* (3.117), *pattern plate* (3.119), *flask* (3.62), *core box* (3.28), etc.

3.71**foundry waste**

waste water, waste gas and solid waste generated in foundry production

Note 1 to entry: Solid waste includes waste sand, waste residue, and dusts and slurries collected by *exhaust system* (3.56).

Note 2 to entry: Most foundry waste needs to be recycled or up-to-standard discharged after disposal for comprehensive utilization and environmental protection.

3.72**furnace charge
charging material**

general terms of all raw materials involved in the melting process in the *melting furnace* (3.99), including metallic charge, flux and fuel, etc.

3.73**fusible pattern**

pattern (3.117) made of fusible materials which can be melted by autoclave, hot water, high temperature steam, etc.

EXAMPLE Wax pattern used in *investment casting* (3.83).

3.74**gas cleaning**

process of removing dust, aerosol and harmful gas produced in the production

3.75**gassing equipment**

central supply systems and equipment used to produce and/or condition reactive gasses and supply them to the gassing station or into the sand mixture

Note 1 to entry: Typical processes (binder system / reactive gas) are:

- silicate/CO₂
- urethane (coldbox)/amine
- furan resin; peroxide or epoxy resin; peroxide/SO₂
- alkaline resin/methyl-formate
- inorganic binders/hot air (as dehydration assistance).

3.76

graphite mold casting

process in which graphite mold is used to pouring castings

Note 1 to entry: It is a *precision casting* (3.127) method, mainly used for active metal casting, such as titanium alloy casting, also suitable for casting high carbon steel wheels, etc.

Note 2 to entry: Graphite mold is made by processing graphite block, or by pressurized forming, drying and sintering for graphite molding sand.

Note 3 to entry: Graphite mold is *semi-permanent mold* (3.151) and can be reused many times.

3.77

gravity die casting

process in which *permanent mold* (3.43) is used and *molten metal* (3.95) is poured into the mold cavity under gravity to produce *castings* (3.11)

3.78

gravity die casting machine

machine that uses *gravity die casting* (3.77) process to produce *castings* (3.11)

Note 1 to entry: It usually consists of mechanisms of die opening and closing, core pulling, castings ejecting, etc.

3.79

green sand

wet *clay bonded sand* (3.18) that can be used directly for *molding* (3.104)

3.80

grind fettling machine

machine used to remove flashes and burrs from *castings* (3.11) by grinding

3.81

grinding cell

complete set of grinding equipment that consists of *grind fettling machine* (3.80), automatic workpiece conveying mechanism and robots for loading and unloading workpieces, etc.

3.82

holding furnace

furnace used to hold *molten metal* (3.95) from a *melting furnace* (3.99) at a specific *pouring* (3.125) temperature

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.

3.83

investment casting

lost wax casting

casting process which uses *expendable pattern* (3.57) formed of wax-base material

Note 1 to entry: Its main processes include:

- the pattern is coated several layers applied as slurry and stucco alternately directly to the surface of the pattern;
- after drying coating layers, the wax pattern is removed from *shell mold* (3.154), usually by melting out using steam autoclave;
- the shell mold is heated, and *molten metal* (3.95) is poured in high temperature shell mold.

Note 2 to entry: It is a major *precision casting* (3.127) method, which is often referred to directly as precision casting.

3.84**knock-out
shakeout**

process of separating *castings* (3.11) from the *molding box* (3.62) and/or *sand mold* (3.146), and/or separating *sand core* (3.140) from castings

3.85**knock-out cell**

complete set of equipment used to complete the *knock-out* (3.84) process, composed of *shakeout* (3.86), vibrating conveyor, sand hopper, *exhaust system* (3.56), etc.

Note 1 to entry: Vibrating conveyor is usually used to convey molds before knock-out, castings and/or *used sand* (3.171) after knock-out.

3.86**knock-out equipment
shakeout**

equipment used to separate castings from the molding box and/or the mold and/or cores from castings

Note 1 to entry: Typical principles are vibrations on grids and trays.

3.87**ladle**

container for *molten metal* (3.95) holding, treatment, transferring and *pouring* (3.125)

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* (3.46), it is a device to ladle molten non-ferrous alloys from a holding furnace to the shot sleeve.

3.88**lost pattern casting**

casting process of using lost pattern in which the *pattern* (3.117) can be discharged from the cavity by melting, dissolving, gasifying or burning after the *mold* (3.101) is formed without *stripping* (3.162)

Note 1 to entry: Patterns made of soluble or combustible materials are called lost pattern, such as *fusible pattern* (3.73) and *expendable pattern* (3.57).

3.89**low pressure casting**

casting process in which *molten metal* (3.95) fills up the mold cavity under lower gas pressure

Note 1 to entry: The *mold* (3.101) is placed above the sealed holding furnace (or crucible). When compressed air is injected into the *holding furnace* (3.82), pressure is produced on the surface of the molten metal which enables the molten metal to fill up the mold through the riser and controls solidification. After the casting solidifies, the air pressure is removed and the surplus metal returns to the holding furnace.

Note 2 to entry: The pipe installed on the holding furnace (or the cover of crucible), the lower end of which plunged into the molten metal and the upper end of which connected to the mold gate is called riser.

3.90**low pressure casting machine**

machine that uses *low pressure casting* (3.89) process to produce *castings* (3.11)

Note 1 to entry: The machine mainly consists of three parts: *holding furnace* (3.82) and attachments, metal mold opening and closing mechanism (metal mold casting machine), and liquid level pressure control system.

3.91**magnet separator**

machine used to separate ferro-magnetic material from the used sand

3.92

magnetic mold casting

cavityless casting process in which the pattern is made of polyfoam, and the iron shot is used to replace *molding sand* (3.104) for *molding* (3.111) on magnetic molding machine

Note 1 to entry: Electricity produces electromagnetic field in a certain direction where the shot is fixed for *pouring* (3.125). After the casting solidifies, the electricity is cutoff and electromagnetic field disappears. The casting is removed after the shot is loosened.

3.93

manipulator and robot for foundry

robotic arm and robot used in foundry production, such as capturing manipulator for castings in *knock-out cell* (3.85), core assembling and dip coating robot in *coremaking line* (3.33)

3.94

manual mode

operating mode where the individual steps in the machine cycle are hand initiated

EXAMPLE To perform individual steps of the process (only in the sequence which is fixed by the program), for example like finishing the casting cycle or running the casting cycle in order to examine or to look for faults.

3.95

melt

molten metal

cast metal (3.10) heated from solid to liquid, such as molten iron, molten steel and molten non-ferrous alloys

3.96

melt transferring

process in which *molten metal* (3.95) is transferred from *melting furnace* (3.99) to *holding furnace* (3.82), or molten metal is removed from melting furnace or holding furnace and transferred to the *pouring* (3.125) station

3.97

melt transferring equipment

equipment and system used to *melt transferring* (3.96), including *ladle* (3.87), transfer car, automatic transloading system for molten iron, etc.

3.98

melting

melt preparation

process in which metallic charge is converted from solid into liquid by heating and its temperature and composition are enabled to meet the specified requirements

Note 1 to entry: Melting process also includes removing impurities in *molten metal* (3.95) by metallurgical reaction, and modification, inoculation, alloying treatment, etc.

3.99

melting furnace

industrial furnace used to melt *cast metal* (3.10)

EXAMPLE *Cupola furnace* (3.37), electric arc furnace, electric induction furnace, crucible furnace, etc.

3.100

metal pattern

reusable *pattern* (3.117) made of metal materials, usually used in a large batch of machine *molding* (3.104) process

3.101 mold mould

combination of cavities which forms the shape of *castings* (3.11) and *molten metal* (3.95) filling channel

Note 1 to entry: It is usually made of specially mixed molding sand, metal or other refractory materials.

Note 2 to entry: According to the service life, it can be divided into two main types: *permanent mold* (3.45) and *non-permanent mold* (3.114).

3.102 mold and flask conveyor mold conveyor flask conveyor

equipment used to convey *sand mold* (3.146) and *flask* (3.62) on *molding line* (3.105), such as bogie, track, transfer truck, mold car, etc.

3.103 mold shell making

process of making *mold shell* (3.154) in *investment casting* (3.83) process

3.104 molding

process of using *molding sand* (3.111) to make *mold* (3.101) by *pattern* (3.117) and/or other *foundry toolings* (3.70) in *sand casting* (3.137) production, including manual and machine molding method

Note 1 to entry: Molding usually includes sand filling, *compacting* (3.20), *stripping* (3.162), finishing and other auxiliary processes.

3.105 molding line

equipment used to make ready-to-pour sand molds

Note 1 to entry: A molding line consists of molding stations (automatic molding machines for complete molds) or several molding machines (molding group) that produce the molding parts separately. It can also include lines for core setting, mold closing, weighting or clamping, pouring, cooling, knocking out of the mold parts and emptying of the boxes as well as integral transfer systems linking the various stations and lines.

3.106 molding machine unit

complete set of equipment that centers molding machine and includes devices of *sand* (3.69) feeding, *pattern plate* (3.119) replacing, *flask* (3.62) conveying and others

3.107 molding machinery

machines used to make sand molds

Note 1 to entry: There are various machinery types which compact granular molding materials including but not limited to:

- jolt molding machines (compaction by jolting the molding machine deck);
- squeeze molding machines (compaction by squeezing the pattern equipment and the molding sand together);
- jolt and squeeze molding machines;
- shoot-, blow-, fluidization- and squeeze molding machines;
- impulse molding machines (the molding sand is compacted by a compression wave which acts on the top of the sand fill);
- air-flow-squeeze molding machines (similar to impulse-molding machines, except that the compressed air escapes through nozzles in the pattern plate);

- dynamic squeeze molding machines (compensating pressure squeeze pistons act on the top of the sand fill);
- suction and squeeze molding machines (the pressure differential between the molding box and the pattern draws in the molding sand);
- vacuum-molding machines (unbonded sand is compacted by vacuum);
- sand slingers (the molding sand is flung into the molding box by the centrifugal force of a rotating wheel).

3.108

molding material

materials used to *molding* (3.104)

Note 1 to entry: It usually refers to raw materials used to make *sand mold* (3.146) and other disposable mold (core), including *foundry sand* (3.69), *binder* (3.7) and hardener, as well as other additives that improves the properties.

Note 2 to entry: Its broader meaning also includes *molding mixtures* (3.111) made of the above materials in a certain proportion.

3.109

molding process with clay bonded sand

molding (3.104) process in which *clay bonded sand* (3.18) is used to make *mold* (3.101)

Note 1 to entry: When using clay bonded sand for molding, an external force needs to be applied to compact in order to obtain the strength required for mold.

3.110

molding process with non-clay bonded sand

molding process with self-hardening sand

molding (3.104) process in which self-hardening sand is used to make *mold* (3.101)

Note 1 to entry: The strength required for *mold* is mainly achieved by self-hardening of *molding sand* (3.111).

Note 2 to entry: During the molding process, the molding sand filling usually needs to be carried out under the vibration state to increase the fluidity and filling effect of molding sand and increase the density of mold.

3.111

molding sand

molding mixture

mixture for making *sand mold* (3.146) which meets certain property requirements

Note 1 to entry: It is made up of *foundry sand* (3.69), *binder* (3.7), additives and other *molding materials* (3.108) mixed in a certain proportion

Note 2 to entry: According to the difference of the binder used, it is usually divided into *clay bonded sand* (3.18) and *non-clay bonded sand* (3.113).

3.112

molding sand preparation

preparation of *molding sand* (3.111) in sand casting production, including *burdening* (3.9), *sand mixing* (3.144) and *used sand treatment* (3.173)

3.113

non-clay bonded sand

chemical hardening sand

molding (core) sand mixed with *foundry sand* (3.69) and non-clay binder in a certain proportion

Note 1 to entry: Non-clay binders used are usually divided into organic binder (such as resin binder) and inorganic binder (sodium silicate binder).

Note 2 to entry: Chemical hardening sand solidifies the binder by chemical reaction to obtain the required strength of the mold (core). According to the hardening methods, it can be divided into:

- self-hardening sand (hardened in a certain period of time by adding hardener);
- gas-hardening sand (hardened by blowing hardening gas, such as cold core box for coremaking);
- hot-hardening sand, hot-hardening resin sand (hardened by heating, such as hot core box for coremaking).

3.114

non-permanent mold

mold (3.101) which is destroyed after the casting has been removed and cannot be reused

3.115

non-permanent mold casting

process in which *non-permanent mold* (3.114) is used to produce castings, such as *sand casting* (3.137), *investment casting* (3.83), *lost foam casting* (3.58), etc.

3.116

on-line control

automatic control of the quality of *molding sand preparation* (3.112) in the *sand casting* (3.137) production site where *clay bonded sand* (3.18) is used for molding

EXAMPLE The amount of water required for *sand mixing* (3.144) and the amount of clay and seacoal are determined through testing the water content and temperature of *reconditioned sand* (3.132), as well as compactability, permeability and wet compression strength of *molding sand* (3.111) online.

3.117

pattern

foundry tooling (3.70) used to form mold cavity when *molding* (3.104)

Note 1 to entry: The size of pattern is slightly larger than the size of *casting* (3.11) to compensate the shrinkage of the casting during solidification and cooling, as well as machining allowance of the casting surface.

Note 2 to entry: According to the volume of production and the difference of *casting* (3.12) methods, the structure and materials of pattern are different. Structurally, the pattern can be made into a whole, or two or more parts; from the material, pattern can be made of wood, metal, plastic, polyfoam or other materials.

Note 3 to entry: If *cores* (3.25) are needed in the further course of casting production, the respective core prints also need to be added to the pattern.

3.118

pattern assembly

whole formed by several wax patterns welded directly or indirectly on a common runner pattern in order to make *shell mold* (3.154) and pour in *investment casting* (3.83) process

3.119

pattern plate

combination of *pattern* (3.117) and pattern mounting plate

Note 1 to entry: It can be divided into one-side pattern plate (upper pattern/cope plate and lower pattern/drag plate), two-side pattern plate (match plate) and combined-type pattern plate.

Note 2 to entry: Rigid plate for fixing and installing patterns is called pattern mounting plate.

3.120

permanent mold casting

process in which *permanent mold* (3.45) is used to produce *castings* (3.11)

EXAMPLE (*high pressure*) *die casting* (3.46), *low pressure casting* (3.89), *gravity die casting* (3.77), *centrifugal casting* (3.15), continuous and *semi-continuous casting* (3.150), etc.

3.121

plaster mold casting

process in which plaster mold is used to produce castings

Note 1 to entry: It is a *precision casting* (3.127) method, mainly used to cast small non-ferrous metal castings with low melting point, such as aluminium alloy and zinc alloy castings.

Note 2 to entry: Plaster mold is made by pouring the slurry of plaster, filler and additives, and by natural drying.

3.122

pneumatic conveyance equipment

complete set of devices for continuously conveying loose materials (such as sand, seacoal, etc.) in closed pipes by using the energy of air flow

3.123

post-processing for casting

whole process of *castings* (3.11) from demolding to leaving the factory, including castings secondary cooling, cleaning, testing, repairing, heat treatment, rough machining, coating, coding, packing, storing, etc.

3.124

post-processing line for casting

complete equipment for *post-processing for casting* (3.123)

3.125

pouring

operation of filling melted or refined *molten metal* (3.95) into the *mold* (3.101)

Note 1 to entry: In general, pouring is carried out in the atmosphere, and the molten metal fills up the mold under the action of gravity. However, in alloy casting with higher requirements, it is possible to pour under negative pressure or vacuum, or under a protective atmosphere, or fill up the mold under pressure.

3.126

pouring equipment

machine and device that pours *molten metal* (3.95) into *mold* (3.101)

3.127

precision casting

general term of methods of obtain precision castings

Note 1 to entry: Castings produced by precision casting are not only of high dimensional accuracy, but also of a smooth surface, and do not need processing or need less processing.

Note 2 to entry: There are many methods of precision casting, such as *shell mold casting* (3.155), *investment casting* (3.83), *ceramic mold casting* (3.17), *graphite mold casting* (3.76), *die casting* (3.46), etc.

3.128

raw sand new sand

foundry sand (3.69) used for the first time without contact with *molten metal* (3.95) or *binder* (3.7)

3.129

raw sand drying equipment

machine used to reduce the moisture of *raw sand* (3.128) by heating and other ways

Note 1 to entry: It is equipment used for *molding sand preparation* (3.112) in sand casting production.

3.130

reclamation equipment

equipment including storage and conveying facilities used for the reclamation of used sands by mechanical and/or thermal processing means

Note 1 to entry: Machines used to destroy the binder by thermal and/or mechanical and/or chemical/physical means.

3.131

reclaimed sand

used sand (3.171) with property achieving or getting close to *raw sand* (3.128) by *sand reclamation* (3.147) process

Note 1 to entry: It can be used instead of raw sand.

3.132

reconditioned sand

used sand (3.171) that can be reused through the process of *used sand treatment* (3.173)

Note 1 to entry: It cannot completely replace *raw sand* (3.128).

3.133

refining

process in which gas, impurity elements and inclusions are removed from *molten metal* (3.95) to purify it and improve its quality

3.134

rotary knock-out and cooling drum

knock-out drum

cooling drum

rotating or reciprocating machinery through which sand and castings are conveyed and separated

Note 1 to entry: The rolling movement of the castings breaks up the lumps of sand as the drum rotates.

3.135

rough casting

casting (3.11) that needs to be cleaned or further processed into parts or finished products

3.136

sand aerator

machine used to aerate the mixed sand

EXAMPLE Belt aerator (conveyor belt with impact bars) or wheel aerator (drum with impact bars).

3.137

sand casting

<technology> casting process in which *sand mold* (3.146) is used and *molten metal* (3.95) is poured under the action of gravity

3.138

sand casting

<products> *castings* (3.11) produced by *sand casting* (3.137) process

3.139

sand coating machinery

equipment used to prepare ready-to-use coated sands

3.140

sand core

disposable *core* (3.25) made of specially mixed core sand. It is destroyed because of heat during solidification of the poured metal or during *knock-out* (3.84) and/or *decoring* (3.38)

3.141

sand hopper and silo system

devices and systems for storing *molding material* (3.108) and *used sand* (3.171), including hopper, intermediate bunker, silo, level-sensing device, and device for locking and feeding, etc.

3.142

sand lump crushers

machines used to break down lumps of used sand by mechanical means

3.143

sand mixer

mill

muller

machine used for *sand mixing* (3.144)

Note 1 to entry: According to the difference of working mode or binder used, sand mixer can be divided into two types: batch and continuous type.

Note 2 to entry: According to the working mechanism and the principle of sand mixing, sand mixer can be divided into:

- sand mixer with only mixing function (such as blade sand mixer and rotor sand mixer);
- sand mixer with mixing, rolling, rubbing and grinding functions (such as roller sand mixer and speed muller).

3.144

sand mixing

process in which the binder and additives are evenly mixed with the *foundry sand* (3.69) in a certain proportion, and the binder adheres effectively to the surface of sand particles through mixing and/or rolling, rubbing and other mechanical method

Note 1 to entry: It is main process of *molding sand preparation* (3.112) in sand casting production.

Note 2 to entry: According to the difference of binder used, a certain proportion of water or hardener which hardens binder should be added during sand mixing.

3.145

sand mixing cell

complete set of *sand mixing* (3.144) equipment centering on *sand mixer* (3.143) and including automatic *burdening* (3.9) and adding water device and online *testing and controlling device for molding sand properties* (3.165)

3.146

sand mold

disposable mold (3.49) made of specially mixed *molding sand* (3.111), which is destroyed when the casting is removed

3.147

sand reclamation

process of *used sand* (3.171) or waste sand treatment to recover its property in order to replace *raw sand* (3.128)

Note 1 to entry: Remove inert membrane (residual binder and other impurities) from the surface of used sand particles by physical or chemical means such as burning, washing, air impacting or mechanical friction.

Note 2 to entry: There are many ways of sand reclamation, including dry process, wet process and thermal process.

3.148**screening equipment**

machine used to classify and/or remove unwanted materials for loose materials (such as *foundry sand* (3.69)) by particle size

Note 1 to entry: This may be achieved by vibration, rotation or other means.

3.149**semi-automatic mode****one cycle automatic mode**

operating mode where each cycle is hand initiated but thereafter automatically proceeds to completion

EXAMPLE To produce *castings* (3.11) in which at least one of the steps of the process which is performed outside the machine is executed by the operator.

3.150**semi-continuous casting**

continuous casting (3.21) process in which cast tube or ingot with limited length can only be obtained

3.151**semi-permanent mold**

non-metallic *mold* (3.101) which can be poured many times

Note 1 to entry: It is made of non-sand materials, such as graphite mold.

3.152**semisolid casting****rheocasting****thixocasting**

casting (3.12) process in which semisolid metal slurry with certain fluidity or semisolid ingot in liquid-solid temperature range is directly cast

Note 1 to entry: The former is also called rheocasting, and the latter is also called thixocasting.

3.153**setting mode**

operating mode where any step in the process can be selected and operated by hand in any sequence with restricted operation of the safety functions

EXAMPLE To perform individual steps of the process (not necessarily in operating cycle sequence), e.g., like changing a *die* (3.45).

3.154**shell mold****mold shell**

mold (3.101) with a thin shell made of *molding sand* (3.111) or other refractory materials

3.155**shell mold casting**

casting process in which *shell mold* (3.154) made of synthetic resin bonded sand is used

Note 1 to entry: Synthetic resin bonded sand shell mold is a thin shell *mold* (3.101) made of mixture of *raw sand* (3.128) and resin.

Note 2 to entry: It is a *precision casting* (3.127) method.

3.156**shell molding machine**

machine that makes synthetic resin bonded sand *shell mold* (3.154)

Note 1 to entry: Synthetic resin bonded sand shell mold is usually made by sand blowing which forms a thin shell with a certain thickness on the heated surface of the *pattern* (3.117), and then heating to harden to achieve the required strength and rigidity.

3.157

shot

<abrasive blasting> *abrasive media* (3.3) that are predominantly round particles, for example, steel shot, iron shot

3.158

shot

<die casting> process of injecting molten or semisolid metal into a die cavity under high pressure

3.159

shot

<molding> process of rapidly filling a *flask* (3.62) or *core box* (3.28) to obtain a sand mold or core by suddenly expanding compressed air

3.160

solidification

process in which *molten metal* (3.95) is converted from liquid to solid after it fills the *mold* (3.101) to produce *castings* (3.11)

3.161

squeeze casting

squeeze die casting

liquid die forging

process in which molten (or semisolid) metal is slowly and smoothly filled into the *die* (3.45) under the action of high pressure and solidified under high pressure to obtain *castings* (3.11)

3.162

stripping

process of separating *pattern* (3.117) from *sand mold* (3.146) after mold is formed in *molding* (3.104) process

Note 1 to entry: It is the separating process between sand mold and *pattern plate* (3.119) in the process of machine molding. The stripping modes include:

- pin-lifting (pattern plate and worktable are stationary; sand mold is lifted from the pattern plate);
- backhaul stripping (sand mold is stationary; pattern plate is separated from sand mold during backhaul dropping with worktable);
- rollover (after the pattern plate, worktable and sand mold make a 180° turnover, the pattern plate and worktable remain stationary, sand mold drops and separates from the pattern plate);
- pattern leaking (stripping plate is attached to the pattern plate; sand mold is separated from pattern plate through the drop of stripping plate).

3.163

suction casting

process in which *molten metal* (3.95) is suctioned into a *mold* (3.101) [*crystallizer* (3.36)] by using a vacuum

Note 1 to entry: Plunge the gate (or riser) of the mold into the molten metal in the lower crucible and vacuum the mold; under the action of negative pressure, molten metal rises along the gate (or riser) and is suctioned into the cavity and solidifies rapidly to obtain *castings* (3.11). After *solidification* (3.160), the vacuum is removed, and the *excess molten metal is automatically returned to the crucible*.

3.164

suction casting machine

machine that uses *suction casting* (3.163) process to produce *castings* (3.11), mainly composed of body frame, lifting and turning mechanism, vacuum system, cooling system and control valve

3.165**testing and controlling device for molding sand properties**

test apparatus used to test and control properties of molding (core) sand

EXAMPLE Normal temperature property tester for molding (core) sand, high temperature property tester, moisture controller in *sand mixing* (3.144), on-line *molding sand* (3.111) property tester, etc.

3.166**testing device for foundry sand**

test apparatus used to measure the basic property of *raw sand* (3.128), such as standard sieves, particle size analyzer, etc.

3.167**testing device for melt qualities**

apparatus used to test temperature or composition of *molten metal* (3.95)

3.168**testing device for sand mold/core**

device used for sand mold (core) hardness or strength testing, such as *sand mold* (3.143) hardness tester, *sand mold* (3.143) strength tester, etc.

3.169**three-dimensional (3D) printing device for molding****three-dimensional (3D) printing device for coremaking**

device that makes sand mold (core) by 3D printing technology

3.170**turnkey project for foundry**

whole process of building a new foundry factory, including project consulting, planning, designing, project implementation and delivery

3.171**used sand**

molding sand (3.111) or *core sand* (3.29) that has been used and in contact with *molten metal* (3.95) and/or *binder* (3.7) in foundry production

3.172**used sand cooling equipment**

machine that reduces heat of *used sand* (3.171) by air flowing, humidifying, stirring, vibrating, heat exchanging or other ways to make it meet the requirement of temperature for reuse as *molding material* (3.108)

3.173**used sand treatment**

process of reconditioning the property of *used sand* (3.171) for reuse by magnetic separating, shattering, screening, cooling and other ways

3.174**vacuum casting**

casting (3.12) process in which metals are melted, poured and crystallized under vacuum conditions

3.175**vacuum-sealed molding process****vacuum sealed process****V-process**

molding (3.104) process in which the sand in *flask* (3.62) is sealed by elastic plastic film and is compacted by vacuum negative pressure

Note 1 to entry: It is a molding process using dry sand without *binder* (3.7) and water.

Note 2 to entry: Special *pattern plate* (3.119) with suction box and suction flask are adopted.