BS EN 16905-2:2020

BSI Standards Publication

Gas-fired endothermic engine driven heat pumps

Part 2: Safety

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National foreword

This British Standard is the UK implementation of EN 16905-2:2020.

The UK participation in its preparation was entrusted to Technical Committee GSE/37, Gas fired sorption and laundering appliances.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Pompes à chaleur à moteur endothermique alimenté au gaz - Partie 2: Sécurité

Gasbefeuerte endothermische Motor-Wärmepumpen - Teil 2: Sicherheit

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Full document details: BS EN 16905-2:2020

Contents

Page

European foreword 4

1 Scope 5
1.1 Scope of EN 16905 5
1.2 Scope of EN 16905-2 5

2 Normative references 6

3 Terms and definitions 7

4 Classification 8
4.1 General 8
4.2 Classification of GEHP appliances 8
4.3 GEHP appliance classification according to the maximum water side operating pressure (PMS): 8

5 Design requirements 9
5.1 Structure 9
5.2 Material 12
5.3 EMC / electrical requirements 19

6 Operational requirements 20
6.1 General requirements 20
6.2 Soundness 20
6.3 Heat input at standard rating conditions 21
6.4 Limit temperatures 21
6.5 Limit operating conditions 22
6.6 Insulation resistance 22
6.7 Transient overvoltage 22
6.8 Withstand voltage 23
6.9 Waterproof performance 23
6.10 Sound power level 23
6.11 Engine perform 23
6.12 Power failure 25
6.13 Abnormalities 25
6.14 Starting current 25

7 Test methods 25
7.1 General test conditions 25
7.2 Soundness 27
7.3 Heat input at standard rating conditions 29
7.4 Limit temperatures 29
7.5 Limit operating conditions 30
7.6 Insulation resistance test 31
7.7 Transient overvoltage test 31
7.8 Withstand voltage test 31
7.9 Waterproof performance test 31
7.10 Sound power level test 32
7.11 Engine performance 32
7.12 Power failure test 33
7.13 Abnormalities test 33

Documents
Document Sharing Hub

Full document details: BS EN 16905-2:2020

7.14 Starting current test 33
8 Risk assessment 33
9 Marking and instructions 34
9.1 GEHP appliance marking 34
9.2 Installation instructions 36
9.3 User's instructions 38
9.4 Gas convertion instructions 38
9.5 Presentation 39
Annex A (informative) Calculation of conversion of NO_X 40
Annex B (normative) Engine startup test method 41
B.1 General 41
B.2 Test condition 41
B.3 Test method 41
Annex C (normative) CO concentration test method 42
C.1 General 42
C.2 Test condition 42
Annex D (normative) NO_X concentration test method 45
D.1 Definitions 45
D.2 General 45
Annex E (normative) Power failure test method 48
E.1 General 48
E.2 Test method 48
Annex F (informative) Examples for marking 49
F.1 Data-plate (see 9.1.1) 49
F.2 Additional data-plate (see 9.1.2) 49
Annex G (informative) Examples for NO_X calculation 50
G.1 $E_{rpm\ equivalent}$ calculation 50
G.2 NO_X ppm to mg/kWh conversation 50
G.3 Temperature and humidity correction formula calculation 50
Bibliography 51

Documents
Document Sharing Hub
Full document details: BS EN 16905-2:2020

European foreword

This document (EN 16905-2:2020) has been prepared by Technical Committee CEN/TC 299 "Gas-fired sorption appliances, indirect fired sorption appliances, gas-fired endothermic engine heat pumps and domestic gas-fired washing and drying appliances", the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2020 and conflicting national standards shall be withdrawn at the latest by July 2020.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This standard comprises the following parts under the general title, *Gas-fired endothermic engine driven heat pumps:*

— *Part 1: Terms and definitions;*

— *Part 2: Safety;*

— *Part 3: Tests conditions;*

— *Part 4: Tests methods;*

— *Part 5: Calculation of seasonal performances in heating and cooling mode.*

These documents will be reviewed whenever new mandates could apply.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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Full document details: BS EN 16905-2:2020

1 Scope

1.1 Scope of EN 16905

This European Standard specifies the requirements, test methods and test conditions for the rating and performance calculation of air conditioners and heat pumps using either air, water or brine as heat transfer media, with gas-fired endothermic engine driven compressors when used for space heating, cooling and refrigeration, hereafter referred to as "GEHP appliance".

This European Standard only applies to GEHP appliances with a maximum heat input (based on net calorific value) not exceeding 70 kW at standard rating conditions.

This standard only applies to GEHP appliances under categories I_{2H}, I_{2E}, I_{2Er}, I_{2R}, $I_{2E(S)B}$, I_{2L}, I_{2LL}, I_{2ELL}, $I_{2E(R)B}$, I_{2ESi}, $I_{2E(R)}$, I_{3P}, I_{3B}, $I_{3B/P}$, II_{2H3+}, II_{2Er3+}, $II_{2H3B/P}$, $II_{2L3B/P}$, $II_{2E3B/P}$, $II_{2ELL3B/P}$, II_{2L3P}, II_{2H3P}, II_{2E3P} and II_{2Er3P} according to EN 437:2018.

This standard only applies to GEHP appliances having:

a) gas fired endothermic engines under the control of fully automatic control systems;

b) closed system refrigerant circuits in which the refrigerant does not come into direct contact with the fluid to be cooled or heated;

c) where the temperature of the heat transfer fluid of the heating system (heating water circuit) does not exceed 105 ºC during normal operation;

d) where the maximum operating pressure in the

   1) heating water circuit (if installed) does not exceed 6 bar

   2) domestic hot water circuit (if installed) does not exceed 10 bar.

This European Standard applies to GEHP appliances only when used for space heating or space cooling or for refrigeration, with or without heat recovery.

The GEHP appliances having their condenser cooled by air and by the evaporation of external additional water are not covered by this European Standard.

Packaged units, single split and multisplit systems are covered by this European Standard. Single duct and double duct units are covered by this European Standard.

The above GEHP appliances can have one or more primary or secondary functions.

This European Standard is applicable to GEHP appliances that are intended to be type tested. Requirements for GEHP appliances that are not type tested would need to be subject to further consideration.

In the case of packaged units (consisting of several parts), the standard applies only to those designed and supplied as a complete package.

NOTE All the symbols given in this text are used regardless of the language used.

1.2 Scope of EN 16905-2

This part of EN 16905 specifies the safety requirements, the safety test conditions and the safety test methods of gas-fired endothermic engine driven heat pumps for heating and/or cooling mode including the engine heat recovery.

Documents
Document Sharing Hub
Full document details: BS EN 16905-2:2020

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 161, *Automatic shut-off valves for gas burners and gas appliances*

EN 378-2, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 2: Design, construction, testing, marking and documentation*

EN 437:2018, *Test gases — Test pressures — Appliance categories*

EN 549, *Rubber materials for seals and diaphragms for gas appliances and gas equipment*

EN 1561:2011, *Founding — Grey cast irons*

EN 10029, *Hot-rolled steel plates 3 mm thick or above — Tolerances on dimensions and shape*

EN 10226-1, *Pipe threads where pressure tight joints are made on the threads — Part 1: Taper external threads and parallel internal threads — Dimensions, tolerances and designation*

EN 10226-2, *Pipe threads where pressure tight joints are made on the threads — Part 2: Taper external threads and taper internal threads — Dimensions, tolerances and designation*

EN 12102-1:2017, *Air conditioners, liquid chilling packages, heat pumps, process chillers and dehumidifiers with electrically driven compressors — Determination of the sound power level — Part 1: Air conditioners, liquid chilling packages, heat pumps for space heating and cooling, dehumidifiers and process chillers*

EN 12102-2:2019, *Air conditioners, liquid chilling packages, heat pumps, process chillers and dehumidifiers with electrically driven compressors — Determination of the sound power level — Part 2: Heat pump water heaters*

EN 14800, *Corrugated safety metal hose assemblies for the connection of domestic appliances using gaseous fuels*

EN 16436-1, *Rubber and plastics hoses, tubing and assemblies for use with propane and butane and their mixture in the vapour phase — Part 1: Hoses and tubings*

EN 16905-1, *Gas-fired endothermic engine driven heat pumps — Part 1: Terms and definitions*

EN 16905-3:2017, *Gas-fired endothermic engine driven heat pumps — Part 3: Test conditions*

EN 16905-4:2017, *Gas-fired endothermic engine driven heat pumps — Part 4: Test methods*

EN 55014-1, *Electromagnetic compatibility — Requirements for household appliances, electric tools and similar apparatus — Part 1: Emission (CISPR 14-1)*

EN 55014-2, *Electromagnetic compatibility — Requirements for household appliances, electric tools and similar apparatus — Part 2: Immunity — Product family standard*

EN 60335-1, *Household and similar electrical appliances — Safety Part 1: General requirements (IEC 60335-1)*

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Full document details: BS EN 16905-2:2020

EN 60335-2-40:2003, *Household and similar electrical appliances — Safety — Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers (IEC 60335-2-40:2002)*

EN 60335-2-102, *Household and similar electrical appliances — Safety — Part 2-102: Particular requirements for gas, oil and solid-fuel burning appliances having electrical connections (IEC 60335-2-102)*

EN 60529, *Degrees of protection provided by enclosures (IP Code) (IEC 60529)*

EN 61000-3-2, *Electromagnetic compatibility (EMC) — Part 3-2: Limits — Limits for harmonic current emissions (equipment input current ≤ 16 A per phase) (IEC 61000-3-2)*

EN 61000-3-3, *Electromagnetic compatibility (EMC) — Part 3-3: Limits — Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current <= 16 A per phase and not subject to conditional connection (IEC 61000-3-3)*

EN 61000-3-11, *Electromagnetic compatibility (EMC) — Part 3-11: Limits — Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems — Equipment with rated current <= 75 A and subject to conditional connection (IEC 61000-3-11)*

EN 61000-3-12, *Electromagnetic compatibility (EMC) — Part 3-12: Limits — Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase (IEC 61000-3-12)*

EN 61000-6-1, *Electromagnetic compatibility (EMC) — Part 6-1: Generic standards — Immunity for residential, commercial and light-industrial environments (IEC 61000-6-1)*

EN 61000-6-3, *Electromagnetic compatibility (EMC) — Part 6-3: Generic standards — Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3)*

EN ISO 2553, *Welding and allied processes — Symbolic representation on drawings — Welded joints (ISO 2553)*

EN ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes (ISO 3166-1)*

EN ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers (ISO 4063)*

EN ISO 7010, *Graphical symbols — Safety colours and safety signs — Registered safety signs (ISO 7010)*

ISO 857-2, *Welding and allied processes — Vocabulary — Part 2: Soldering and brazing processes and related terms*

ISO/TR 25901-3, *Welding and allied processes — Vocabulary — Part 3: Welding processes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 16905-1 and the following apply.

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

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3.1
maximun water operating pressure
PMS
maximum water operating pressure at which the GEHP appliance can be used, in bars given by the symbol "PMS", followed by the equals sign, the numerical value and the unit "bar"

4 Classification

4.1 General

GEHP appliances can be classified according to:

— the gases they use;

— the unit structure;

— air blowing system.

4.2 Classification of GEHP appliances

4.2.1 Classification of gases

Gases are classified into three families, possibly divided into groups according to the value of the Wobbe index. Families and groups of gas used in this standard are in accordance with those of the EN 437:2018. This standard is for GEHP appliances working with 2nd and 3rd gas family only.

4.2.2 Classification according to the unit structure

4.2.2.1 Single split

Single GEHP appliance in combination with single heating/cooling device to form a discrete matched functional unit.

4.2.2.2 Multi split

Single GEHP appliance with a single refrigerant circuit in combination with multiple heating/cooling devices.

4.2.3 Classification according to the air blowing system

4.2.3.1 Non ducted type

Air introduced from the space containing the unit and discharged within the same space.

4.2.3.2 Ducted type

Air introduced from the space containing the unit and discharged outside this space.

4.3 GEHP appliance classification according to the maximum water side operating pressure (PMS):

— pressure class 1: PMS = 1 bar

— pressure class 2: PMS = 3 bar

— pressure class 3: 3 bar < PMS < 6 bar

NOTE Internal cooling circuits in GEHP appliances are not considered under this classification, e.g. internal cooling circuits for internal combustion engine in GEHP appliances.

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Full document details: BS EN 16905-2:2020

5 Design requirements

5.1 Structure

5.1.1 General

The structure of the equipment shall satisfy the following requirements in consideration of safety and durability:

a) The edge of the part which people touch with hands in service or in the case of maintenance and checking shall be sufficiently smooth.

b) The control section and electric section shall not be influenced by the weather condition.

c) The thermal insulation material, etc. shall not produce detachment or omission in normal use.

d) The movable parts of the blower, etc. shall not easily come into contact with a human body in normal use.

e) The thermal insulation material, etc. used near (less than 50 mm) the electric component section shall be fire-resistant, except in cases where there is no possibility that danger such as electric shock, fire arises if the thermal insulation material, etc. burns.

f) The confirmation of drain of the condensed water can be easily performed.

g) The connecting port, etc. for refrigerant collection shall be provided.

h) The refrigerant circuit shall be safe for an abnormal pressure rise.

i) The GEHP appliance shall be equipped with control and safety devices for start, operation and control of the gas supply.

j) These devices shall ensure the automatic start and the automatic monitoring for the operating functions of the engine and the GEHP appliance as well as the gas supply.

k) In case of failure of the normal operating functions (malfunctions), the gas supply shall be cut off, if need be, with lock-out in accordance with the operating programme.

l) The functional safety specification for control and supervision as well as for the automatic restart shall be part of the design documents.

m) The operation of safety devices shall not be overruled by adjusting and control devices.

n) The design of the control and safety system shall be such that it is not possible to perform two or more actions which are unacceptable in combination. The order of the actions shall be fixed in such a manner that it is not possible to change it.

o) Any parts of a GEHP appliance which are not intended to be altered by the user or the installer shall be protected in an appropriate manner. Paint may be used for this purpose provided that it withstands the temperature to which it is subjected during normal operation of the GEHP appliance.

p) Levers and other controlling and setting devices shall be clearly marked and give appropriate instructions so as to prevent any error in operation/use. Their design shall be such as to preclude accidental operation.

q) GEHP appliances shall be so designed and constructed that gas release at any state of operation is limited in order to avoid a dangerous accumulation of unburned gas in the GEHP appliance.

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5.1.2 Structure of each part

5.1.2.1 Gas inlet connection

The gas inlet connection shall be as follows:

a) The gas inlet connection port, normally, shall be exposed to the outside or shall be located so that it is able to be easily identified visually.

b) For the screw threads of the gas connecting port, those specified in EN 10226-1 or EN 10226-2 shall be used.

5.1.2.2 Automatic shut-off valve

The automatic shut-off valve shall be as follows.

a) The gas passage to an engine shall be closed by two or more automatic shut-off valves provided in series at the time of engine stop.

b) Each automatic shut-off valve shall have the independent function.

c) Each automatic shut-off valve shall comply with the requirement of EN 161.

d) Composition of the automatic shut-off valves shall be C+C or B+J.

e) Safety devices which require non-volatile lockout to occur shall give rise to simultaneous signal to close the two or more valves.

Instead of J-class valves also C-class valves are possible, instead of C-class valves also B-class valves.

In response to a control device, if the delay between the signals to close the two valves is not greater than 5 s, the signals are considered to be simultaneous.

5.1.2.3 Gas carrying circuit

The gas carrying circuit shall be as follows:

a) The gas carrying circuit used for the part which becomes negative pressure shall have sufficient strength to negative pressure. Under the normal operation condition, each part of the gas carrying circuit shall be free from abnormalities such as deformation during the period from the close of the gas shut off valve in the gas inlet side to the stop of the engine.

b) The surface treatment such as a tinning shall be given to the inner surface of the copper pipe of 2 mm or less in inner diameter used for a gas carrying circuit.

c) The gas carrying circuit used for the part which becomes positive pressure shall have sufficient strength to positive pressure.

d) When there is leakage of fuel gas from the gas carrying circuit used for the part which becomes positive pressure, the GEHP appliance shall be structured so that the leaked fuel gas is released easily to atmosphere without dangerous to the health of persons and domestic animals exposed.

e) Gas carring circuit shall be so designed and constructed that gas release at any state of operation is limited in order to avoid a dangerous accumulation of unburned gas in the GEHP appliance.

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5.1.2.4 Soundness of the engine

Soundness of the engine shall be ensured according to the following items:

The leakage of the engine shall

a) be ignited immediately with the mixture designed to be burned in the engine, or

b) be contained by the entire engine being surrounded by combustion air or cooling water, or

c) be released easily outside into atmosphere, or

d) lead to non-operation of the engine under such leakage conditions.

5.1.2.5 Combustion products circuit

The combustion products circuit shall be as follows:

a) The combustion products circuit shall have the structure to endure the temperature of combustion products, vibration of an engine, etc. sufficiently.

b) The opening of combustion products exhaust outlet shall be structured so that a steel ball of 16 mm in diameter cannot enter or birds, etc. cannot invade.

c) Condensation shall not affect the operational safety, then the combustion products circuit shall have the structure which is capable of easily discharging condensation drain without blocking the combustion products.

5.1.2.6 Casing

The casing shall be as follows:

a) The opening of casing to intake air for combustion shall be structured so that a steel ball of 16 mm in diameter cannot enter or birds, etc. cannot invade and be not affected by fallen leaves.

b) The panel for checking and maintenance shall have the structure to endure the repetitive use of attachment and detachment.

5.1.2.7 Motor for engine startup

The motor for engine startup shall have the function to prevent overheat.

5.1.2.8 Engine ignition device

The engine ignition device shall be structured so that the noise radiation (radio noise) generated by the engine ignition device gives no interference to other equipment.

5.1.2.9 Engine protective device

The engine protective device shall be as follows:

a) When the number of rotations of an engine exceeds that designated by the manufacturer, the engine protective device shall have the function in which the engine stops and the gas carrying circuit is automatically closed.

b) When the engine oil decreases to the degree which the manufacturer designates, the engine protective device shall have the function in which the engine stops and the gas carrying circuit is automatically closed.

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c) When the engine cooling water (anti-freeze solution) exceeds the temperature which the manufacturer designates, the engine protective device shall have the function in which the engine stops and the gas carrying circuit is automatically closed.

5.1.3 Refrigerant circuit

The strength of each part of refrigerant circuit shall conform to the specification of EN 378-2 and have the structure to endure vibration of an engine, etc. sufficiently.

5.1.4 Engine lubricant oil circuit

In case of leakage from the lubricant oil circuit, there shall be no escape of oil to outside of GEHP appliance.

5.2 Material

5.2.1 General

The quality and thickness of the materials used in the construction of the GEHP appliances shall be such that the constructional and operational characteristics are not significantly altered during a reasonable life and under normal conditions of installation and use.

All parts of the GEHP appliance shall withstand the mechanical, chemical and thermal conditions to which they may be subjected when the GEHP appliance is used normally.

The materials of the parts containing domestic water shall not affect the quality of the domestic water in respect of either health or taste.

The whole of the domestic hot water circuit shall be made up of corrosion resistant materials or shall be protected against corrosion.

Materials shall be appropriate for their use, under intended application and at the maximum water pressure stated in the installation instruction.

5.2.2 Gas carrying circuit

The material used for the part which contains fuel gas shall be as follows:

a) The metallic material shall be anti-corrosion or of which the surface is given an anti-corrosion treatment.

b) The rubber hose shall have quality to sufficiently endure the pressure and components of a fuel gas and conform to the specification of EN 16436-1 or that at least equivalent thereto in the performance.

c) The metal braided flexible hose shall be that which conforms to EN 14800 or that at least equivalent thereto in the performance.

d) The material of the gas carrying circuit of the part in which the gas pressure downstream from the regulator becomes negative pressure shall sufficiently endure the negative pressure.

e) Rubber materials of packing and sealing used in gas carring circuit shall comply with the relevant requirements of EN 549.

5.2.3 Combustion products circuit

The material used for the combustion products circuit shall be as follows.

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a) The metallic material shall be heatproof and anti-corrosion or of which the surface is given an anti-corrosion treatment.

b) The material other than metal shall be resistant to combustion gas and drain water.

5.2.4 Thermal insulation material, etc.

The thermal insulation material, sound absorbing material, etc. of the periphery of an engine shall be that which does not burn or naturally burns out within 10 s when it burns.

5.2.5 Vibration-proof material

The vibration-proof material which supports an engine shall be oilproof, heatproof and durable.

5.2.6 Materials and thicknesses of walls or tubes under water pressure of pressure class 3

5.2.6.1 General

The characteristics of the materials and the thicknesses of walls under pressure shall comply with the requirements of 5.2.6.2, 5.2.6.3 and 5.2.6.4. If other materials and/or other thicknesses are used, these shall have an equivalent level of fitness for purpose.

5.2.6.2 Materials

Materials for parts under pressure shall be appropriate for their duty and envisaged use.

The following materials satisfy these criteria:

— steels that have the properties and chemical composition detailed in Table 1;

— cast irons that have the mechanical properties detailed in Table 2;

— the non-ferrous materials detailed in Table 3 and Table 4.

5.2.6.3 Thickness

The minimum wall thicknesses of parts under water pressure are given in Table 5 and Table 6.

For rolled steel the tolerances are given in EN 10029.

The thicknesses of cast walls given in the production drawings shall not be less than the nominal minimum thicknesses given in Table 6 for parts of cast iron or of cast materials which are subjected to pressure. The actual minimum thickness of the GEHP appliance sections and of parts subjected to pressure shall be greater than 0,8 times those given in the drawings.

5.2.6.4 Welded seams and welding fillers

Materials shall be suitable for welding. The materials given in Table 7 may be used and do not require additional heat treatment for welding.

Welded seams shall show no cracks or bonding faults and butt welded seams shall be faultlessly welded over the whole cross-section.

Single-sided fillet welds and half Y-welds without full penetration into the base metal shall not be subjected to bending stresses. Double fillet welds are permissible if sufficiently cooled.

Corner welds, edge welds and similar welds which are subject to considerable bending stresses under unfavourable manufacturing or operating conditions are to be avoided.

For welded-in longitudinal stays, stay tubes or stay bolts, the shearing cross-section of the fillet weld shall be at least 1,25 times the required cross-section of the bolt or stay tube.

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Details of the welds mentioned are given in Table 7. Welding fillers shall permit a joint appropriate to the base material to be made.

The terms given in Table 7 are in accordance with EN ISO 2553; the reference numbers of welding processes are respectively in accordance with ISO/TR 25901-3, ISO 857-2 and EN ISO 4063.

Table 1 — Mechanical properties and chemical compositions of carbon and stainless steels

Mechanical properties						**Chemical composition by mass** %									
Materials	**Steel type**	**Tensile strength *R*m** N/mm²	**Yield point *R*oH/*R*p 0,2** N/mm²	**Breaking elongation *A*long at *L*o = 5 *d*o** %	**Breaking elongation *A*transv at *L*o = 5 *d*o** %	**C**	**P**	**S**	**Si**	**Mn**	**Cr**	**Mo**	**Ni**	**Ti**	**Nb/Ta**
Pipes, sheets	carbon	≤ 520	≤ 0,7 [a]	≥ 20	—	≤ 0,25	≤0,05	≤0,05	—	—	—	—	—	—	—
	ferritic	≤ 600	≥ 250	≥ 20	≥ 15	≤ 0,08	≤0,045	≤0,030	≤ 1,0	≤1,0	15,5 to 18	≤1,5	—	≤ 7 × %C	≤ 12 × %C
	austenitic	≤ 800	≥ 180	≥ 30	≥ 30	≤ 0,08	≤0,045	≤0,030	≤ 1,0	≤2,0	16,5 to 20	2,0 to 3,0	9 to 15	≤ 5 × %C	≤ 8 × %C

[a] Ratio yield point–tensile strength.
An adequate high temperature yield point for the highest possible temperature of the steel shall be guaranteed.

Table 2 — Minimum requirements for cast iron

Flake graphite cast iron (EN 1561:2011): – Tensile strength R_m ≥ 150 N/mm² – Brinell hardness 160 HB to 220 HB 2,5/187,5
Spheroidal graphite cast iron (annealed ferritic): – Tensile strength R_m ≥ 400 N/mm² – Notch impact strength ≥ 23 J/cm²

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Table 3 — Parts in aluminium and aluminium alloys

	Tensile strength R_m N/mm²	Temperature range °C
Al 99,5	≥ 75	up to 300
Al Mg2 Mn 0,8	≥ 275	up to 250

Table 4 — Parts in copper or copper alloys

	Tensile strength R_m N/mm²	Temperature range °C
SF – Cu	≥ 200	up to 250
Cu Ni 30 Fe	≥ 310	up to 350

Table 5 — Minimum thicknesses for rolled parts

Carbon steels; aluminium			Protected steels; stainless steels; copper		
a [a] mm	b [b] mm	c [c] mm	a [a] mm	b [b] mm	c [c] mm
4	3	2,9	2	2	1

[a] Column a: for walls of combustion chambers exposed to water and fire, and for horizontal walls of convection heating surfaces.

[b] Column b: for walls exposed only to water and for rigid shapes, for example convection heating surfaces outside the combustion chamber.

[c] Column c: tubes of convection heat exchangers.

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