TATA STEEL

TATA

Tata Steel Technical Directive

R1430100 Technical directive for heating, ventilation, cooling and sanitary installations

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1 General provisions

1.1 General

1. This document describes the minimum requirements imposed by Tata Steel in IJmuiden on heating, cooling, air-conditioning and sanitary systems, including the associated measuring and control systems.
2. This document pursues uniformity and a basic level for the systems, the construction process and the provision of information. This simplifies the management and data management of the systems.

1.2 Standards and regulations

The materials and systems must be designed and comply with the following requirements in the most recent form:

- Applicable laws and regulations.
- All applicable standards and guidelines, as established by the Netherlands Standardisation Institute in Delft.
- Tata Steel Standards and Technical Directives, see standards.
- Tata Steel pipe specs, see pipe specs.
- ISSO publications.
- F-gases regulation (EU) Number 517/2014.
- The water worksheets (only in Dutch).

1.3 Validity of regulations

The abovementioned regulations will apply as they apply on the day of the tendering procedure, or in the absence of a tender, the day that coincides with the price offer. The contractor must ensure he has knowledge of the aforementioned regulations. The Tata Steel Standards, Tata Steel Technical Guidelines and the Tata Steel Pipe specs prevail in all cases of doubt.

1.4 Execution

1. The delivery and assembly includes all parts and auxiliary materials necessary for the establishment of a good, complete and operational system, even if these are not mentioned in particular or indicated on the drawings.
2. In his contract price, the contractor must include the necessary suspension and mounting material for pipes, ducts and all eligible constituent parts, belonging to the systems or structures according to the technical specification.
3. Fixings to concrete structures must be made by means of brass spread plugs. The holes to be drilled for this are also part of the contractor's work, unless otherwise stated in the technical specification.
4. Load-bearing steel structures will not be welded or drilled.
5. Drilling holes and making fissions (and sealing them) is part of the contractor's work, unless otherwise stated in the technical specification.
6. Penetrations of technical systems by fire and smoke-resistant partitions must be finished fire-resistant by a Tata Steel contractor and comply with the implementation requirements set out in the ISSO/SBR publication 809 "Fire-safe penetrations".
7. Unless otherwise agreed, the mounting and support structures must be coated in accordance with Tata Steel Standard S3105601.
8. Before the contractor proceeds to manufacture, he must submit all assembly drawings - including those of subcontractors - to the client for inspection.

1.5 Nameplates

All components that are important for the operation and functioning of the system, such as boilers, pumps, burners, Air Handling Units (AHU), chillers and the like must bear the name and instruction plates of the manufacturer, which, depending on the nature of the component, indicate the year of construction, the function, capacity, pressure, discharge pressure, resistance and other essential data. In addition, all group distributions, control parts, individual sensors, valves, pointers and the like in the system must bear a Resopal nameplate (design text and nameplate in accordance with Tata Steel Standard S1768101, Chapter 3.3). For the order of these nameplates, the contractor must offer an overview of the nameplates to the client for approval. Place and number of nameplates also to be determined in consultation with the client. If it is unavoidable to place valves or other fittings above suspended ceilings (e.g. in the drinking water pipe network above a toilet group), this must also be clearly indicated by means of a nameplate under the suspended ceiling.

1.6 Markings and Color Codes

All pipes and ducts will be marked with medium bands in accordance with Tata Steel Standard S1768101, Chapter 3.1 and comply with EC regulation 1272/2008 (Classification, Labelling and Packaging - CLP).

2 Heat generation and distribution

2.1 General

1. The marking and painting of the gas pipeline, as well as the gas and fire-tight passage of all pipe and duct terminals to and from the boiler/space and the necessary ventilation facilities are part of the work of the contractor.

2.2 Gas-fired appliances

2.2.1 General

1. At Tata Steel in IJmuiden, gas with a higher calorific value is used than Groningen natural gas. The gas-fired heaters to be used will be suitable for the firing of high calorific natural gas.
    - Gas category I2h.
    - Wobbe band index of 49.3 – 55.7 MJ/m^{3}n at 0°C,
2. Gas-fired appliances must bear a GASTEC QA quality mark, gas label SV (Clean Combustion) and be at least HR 107.
3. Design gas-fired applicances at least with a gas main valve, gas filter, overflow valve, condensation drain, thermometer in the supply and return pipe, pressure gauge, filling and drain valve, necessary control and safety equipment and an expansion vessel.
4. Burners must be detachable on the electricity and gas side, with sufficient cable length.

2.2.2 Gas-fired heaters in spaces with a rated power ≤100 kW

1. Gas-fired appliances with a rated power ≤100 kW must be connected and commissioned by an approved gas installer, a guaranteed installer, the manufacturer or supplier (if approved). After commissioning, a report of the check of the construction and design of the gas system, including the test of strength and leak density test, will be provided.
2. These appliances must be installed and comply with the requirements of the publication "Quality requirements for installing high-efficiency central heating boilers up to 100 kW" (only in Dutch) from various trade associations.

2.2.3 Gas-fired appliances in spaces with a rated power >100 kW

1. Before the start of the assembly, the contractor must provide an approved design assessment document. The contractor must prepare a design for the total gas system (gas pipeline system/gas consumption appliances) which must be assessed by the SCIOS scope 7A/7B certified inspection department of Tata Steel (SPME-ESS-HTD-LOG-IKA-GKI). The other combustion plants must be assessed by a SCIOS-certified company. The inspection body will then draw up the draft assessment document.
2. Gas-fired appliances in boiler rooms with a rated power more than 100 kW will undergo an initial inspection upon commissioning. This EBI (dutch abbreviation for “Eerste Bijzondere Inspectie” (Initial Special Inspection)) must be carried out for the applicable scope of the gas-fired appliance in question.
3. The fuel supply line from the central gas meter to the combustion plant must undergo an initial inspection (EBI) in accordance with SCIOS scope 7A control (at a rated power > 100 kW).
4. The EBI must be carried out by a SCIOS-certified company or by the SCIOS scope 7A/7B certified inspection department of Tata Steel (SPME-ESS-HTD-LOG-IKA-GKI). Only after approval of the EBI may the gas system be commissioned.
5. Upon commissioning, a certificate of commissioning must be issued by the contractor, including the corresponding system file (belonging to the relevant SCIOS scope), which includes:
    - A basic report.
    - Limit values.
    - Isometric projection of the system.
    - A copy of the initial special inspection (EBI).

- Electrical diagrams.
- Installation, operating and maintenance instructions.
- Information about connected equipment.

2.3 Installation of gas-fired appliances

1. When installing more than one gas-fired appliance, it should be possible to disassemble a gas-fired appliance, while the other gas-fired appliances may remain in operation. Each gas-fired appliance must be lockable separately.
2. No pipes, cableways of such may be attached to the jacket of the gas-fired appliance if it is to be dismantled for maintenance and inspection work.
3. In the case of new construction or renovation, at least one gas meter must be included in the low pressure system of the gas pipeline to one or more gas-fired appliances. There must also be a possibility to vent and flush the gas line.

2.4 Replacement of gas-fired appliances

1. When replacing a gas-fired appliance, the new appliance and the associated system components must meet the requirements applicable to a new system. These requirements apply to the new gas-fired appliance with the associated system parts up to the flue gas outlet. The following principles apply to the rest of the system:
    a. The 'new' system must comply with all legal requirements;
    b. The flue gas outlet must be replaced if it is older than 15 years.

2.5 Flue gas exhaust systems

1. Flue gas exhaust systems designed as a concentric version, with aluminium, plastic or stainless steel (stainless steel only in combination with a stainless steel heat exchanger) flue gas material.
2. Flue gas exhause, roof ducting and outlet structures must bear a CE mark, a GASTEC QA mark or a KOMO mark.
3. The bracketing of the flue gas exhaust system must comply with ROGAFA basic regulations for installing flue gas discharges (only in Dutch).
4. Install a lockable measuring point in the flue gas exhaust for flue gas measurements.
5. To clean the gas-fired appliance, a movable piece between flanges must be included (if necessary) in the flue gas outlet, in such a way that removal of the piece in question is possible without additional facilities.
6. The design must comply with the requirements of the installation instructions of the appliance manufacturer. If they do not give instructions, the installation instructions of the discharge manufacturer apply.
7. The resulting structure used will be suitable for the intended outlet in terms of performance and execution. If the outlet is placed close to an obstacle, such placement must be permitted by the manufacturer of that outlet structure.
8. Install concentric flue gas exhausts at a minimum distance of 5 mm from walls.
9. If it is not reasonably possible to design the flue gas discharges concentrically, they may be designed as individual air supply and flue gas discharge if such a version is permitted in the installation instructions of the appliance manufacturer. In this situation, the following additional requirements apply:
    a. Install flue gas exhaust at a minimum distance of 35 mm from walls.
    b. Install air supply at a minimum distance of 5 mm from walls.
10. When using an existing structural shaft as an outer sheath, the following requirements apply:
    a. Design the flue gas exhaust system concentrically.
    b. Design the flue gas exhaust system as a rigid system. The application of a flexible product specifically manufactured for this purpose as a whole is also possible.

c. There must be no connections in the system.
d. If the appliance or exhaust manufacturer regularly prescribes bracketing or centring, this must be possible, possibly by opening the shaft for installation where necessary.
e. There should be no deterioration.
f. The use of an architectural shaft as an air supply for a closed appliance not permitted.

2.6 Condensate drain

1. The gas-fired appliance and the flue gas exhaust system must be connected to a condensatate drain facility. The requirements for this connection are the following:
    a. Connection with an open connection with the collecting funnel and the stench trap.
    b. The connection is made of plastic.
    c. The diameter of the discharge pipe will be at least 40 mm.
    d. The diameter of the appliance pipe will be at least 32 mm.
    e. Slope condensation discharge pipe at least 5 mm per metre.
2. If the flue gas exhaust system is fitted with a separate condensation collection facility and possibly a stench trap, it must also be connected to the sewer system. The same requirements apply as described above for the connection of the appliance.
3. The appliance manufacturer may indicate that the appliance cannot be directly connected to a flue gas exhaust system made of, for example, plastic. In that case, a separate condensate drain facility must be mounted above the appliance (i.e. where the condensate could enter the appliance) on the instruction of the appliance manufacturer.

2.7 Counterflow Heat Exchangers (CHE)

1. CHEs should be installed in such a way that they can be removed without the need to drain the entire system.
2. The pipes should be fitted in such a way that only the loosening of the flange connections, without further disassembly of fittings, is sufficient to carry out inspections and maintenance on the CHE.
3. If condensate is not returned to a central system, the water must be cooled to a temperature of 30°C (measured on the site of the main sewer) before the condensate can be discharged to the main sewer (see Standard S3493201).

2.8 Pressure expansion vessels

1. Pressure expansion vessels must comply with the PED directive and Tata Steel directive R1300401. The size of pressure expansion vessels should be selected (preferably) so that they fall within category 1 or 2 (PS*V < 1000; PS is the design pressure in bar and V is the volume in litres) of pressure vessels of group-2 gases (harmless).
2. Connect the vessels to the lowest pressure part of the system in such a way that warming of the vessel is prevented. Also install the safety valve and a pressure gauge on the expansion vessel. The pressure difference between expansion vessel and safety valve may not exceed 0.1 bar.
3. Disconnection of the expansion vessels without draining the system must be possible by means of a connection group or a valve without a handle.
4. Install the discharge pipe from the overflow valve to the nearest water outlet.

2.9 Radiators

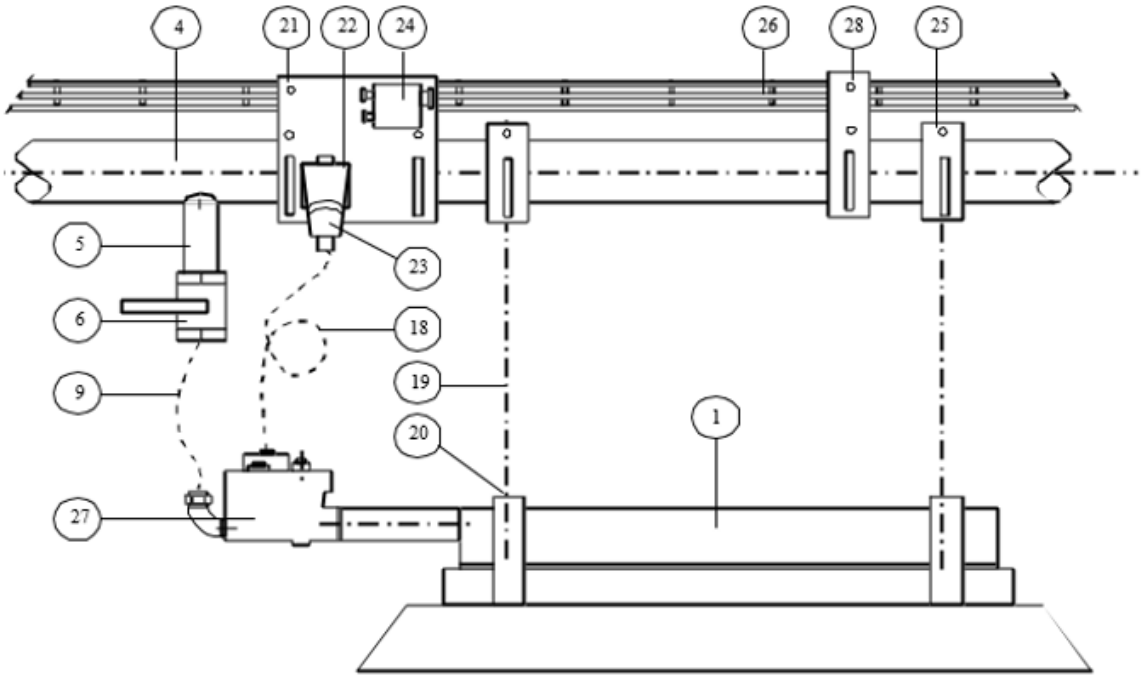
1. Installation should be in a way that the heating units cannot cause noise when expanding and shrinking and that re-assembly is easy.
2. Adjusting radiators, use internally adjustable valves.
3. Install heating units between lockable fittings and fit them with a chrome drain tap and vent valve.
4. The distance from the bottom of the radiator to the finished floor is at least 100 mm (in washing and changing rooms at least 250 mm).
5. Radiators must be packed and supplied in factory colour.
6. Install radiators in their original packaging, which may only be removed when the structural work has progressed to such an extent that no more contamination or damage to the elements can occur.
7. After installation of the radiators, they may need to be disassembled and reassembled due to structural work. The costs for this are payable by the contractor.

2.10 Air heaters

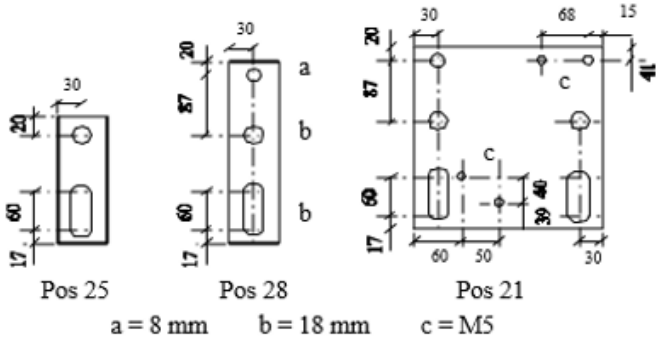
1. The connection of (wall-mounted) air heaters to the pipe network must be carried out with intermediate placement of (adjustment) valves.

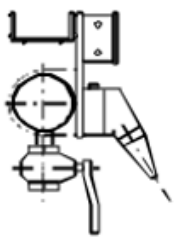
2.11 Infrared and dark tube heaters

1. Gas-fired radiators must be supplied complete with automatic burner and gas block which is suitable for a gas pressure of 100 mbar. The appliances must be suitable for the firing of high calorific natural gas (see 2.1.1).
2. Burners must be CE-marked according to EN416-1 (overhead radiant tube heaters) or EN419-1 (infrared heaters). I2h must also be approved.
3. Apply the suspension and connection of the heaters in accordance with Figure 1.
4. Delivery and assembly include:
    a. 1 gas hose with sufficient passage (GASTEC QA approval).
    b. Heat-resistant connection cable, type NWPK 3 x 11/2 mm^2 with AMP clamps and equipped with CEE-form contact plug, Mennekes (or equivalent) type 248, 16A, 2p+a.
    c. Mounting plate (with scratch brackets) with wall socket Mennekes (or equivalent) 16A, type 101 and 1 electric junction box.
    d. Brackets for setting the radiation angle complete with suspension chains and pipe brackets.



4 gas pipeline
5 pipe connection ½"G 50 mm
6 Ball valve GASTEC QA colour
9 Gas hose set with GASTEC QA colour
18 E-cable NWPK 3x1,5 mm2
19 Suspension chain d=5 DIN 766
20 End link of the chain
21 Plate 260 x 250 x 5
22 Wall socket 101-16A-2P+A Mennekes
23 Contact Plug 248-16A-2P+A Mennekes
24 Universal junction box
25 Pipe brackets manufactured by Hamos type 1501
26 Cable duct manufactured by Nieuwa type GB 100/55L
27 Gas block
28 Support bracket 260 x 60 x 5

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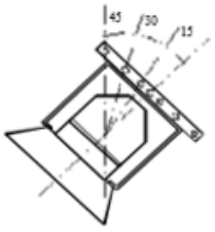

Hanging angles

Figure 1: Detail suspension and connection of infrared and overhead radiant tube heaters.

3 Cold generation and distribution

3.1 General

1. Design cooling systems and the work on cooling systems, where applicable, in accordance with the latest editions of the F-gas Regulation and, furthermore, all applicable regulations and standards.
2. Self-contained units and cooling units must be supplied with their standard switching, control and protection equipment. The earthing of the casing must be carried out on an earthing rail. Potential-free contacts must be fitted for the purpose of reporting malfunctions. The system must include a "fire contact" which switches off the machine when operated (by external command). This fire contact must be fitted on the terminal strip.
3. The choice and selection of the cooling equipment, including the associated refrigerant, must be made clear in advance by the contractor and offered to the client for approval.
4. Cooling units that must be in operation at low outdoor temperatures (+15°C and below) must be equipped with crankcase heating and condenser pressure control. If cooling is not necessary at low outdoor temperatures, an outdoor thermostat must lock the switch-on at this outside temperature.
5. Perform soldering with 40% silver (Degusa 44.04.h). A watertight lacquer must be applied on other copper pipes and joints fitted to the work.
6. When using multiple cooling circuits in 1 cooling unit, they must be physically separated. The cooling circuits must not be connected in any way.

3.2 Air-cooled condensers

1. Fit air-cooled condensers with valves in the refrigerant pipes near the connection of the condensers installed outside. Condensers fitted with a condenser pressure regulator.
2. Air-cooled condensers and evaporators with a pigmented titanium dioxide coating, supplier Conpro (progreen), Altena (Alu coat 507 Basis W) or Blygold (PoluAl XT or MC).

3.3 Water-cooled condensers

1. Design water-cooled condensers with coaxial or shell and tube heat exchangers.
2. When using leak water (surface water) as a cooling water medium, follow the following design principles:
    a. Maximum summer supply temperature: 26°C;
    b. Minimum supply temperature winter: 5°C;
    c. Pollution factor condensers: 0.88 m^2. K/W.
    d. The available pre-pressure at ground level depends on the location of the site. For the design, a minimum available pre-pressure of 1 bar can be assumed. Before starting the engineering, the actual pre-pressure must be requested.
3. Control the condenser pressure of a water-cooled condenser by means of a water control valve, placed in the return pipe of the cooling water.
4. Make the water-side connection of the condenser of the cooling unit with a ball valve, thermometer, pressure gauge and filling/drain tap (for the purpose of acids of the condenser), both in the supply and in the return pipe.
5. In the case of water-cooled systems, a pressure switch must be included in the condenser's water supply, which switches off the system when the water pressure is lost and automatically switches it back on when the water pressure returns. This pressure switch must be electrically connected to the terminal strip of the system.
6. If the condenser water is not returned to a central cooling system, the water must be cooled to a temperature of 30°C (measured at the site of the main sewer) before the condensate can be discharged to the main sewer (see Tata Steel standard S3493201).

3.4 Small cooling equipment (split units and the like)

1. Depending on the situation, the liquid and suction pipes and the power cable must be mounted together in an impact-resistant PVC tube or plastic gutter. This also applies to outside pipes (to prevent insulation from being broken by pests).

3.5 Cold water generators for indoor or outdoor installation

1. Cold water generators with attached or mounted air-cooled condenser(s) must be supplied as a complete operating unit.
2. The water-side connections must be fitted with the intermediate positioning of flexible connections and valves. Carry out this in accordance with the manufacturer's instructions.
3. If there is a possibility of the system being frozen, it must be filled with a water/glycol mixture suitable for an outdoor temperature of up to -15°C. A ready-made Glycol mixture should be used for this purpose. In order to prevent bacteria formation and clogging, mixing with water onsite is not permitted.
4. Cold water generators must be supplied including all necessary switch, control and safety equipment. The generator must be positioned on a foundation plate by means of efficient vibration dampers. The provision of the architectural data is part of the contractor's work.

3.6 Buffer vessels

1. If the contents of the cooled water system are insufficient to obtain a quiet adjustment of the cooler, a buffer vessel of sufficient capacity must be fitted.
2. The set-up of the vessels will be such that inspection, maintenance and repairs can be carried out without the need to remove other equipment.

3.7 Scrapping of cooling equipment

1. Old and disassembled equipment must be presented for scrapping. At the installation site of the equipment, the contractor must drain the refrigerant and oil from the equipment. The oil-containing compressor must be disassembled in its entirety. A demolition form for the F-gases operations must be made immediately.
2. Manual and lifting equipment with loose compressors may be placed in the appropriate containers after the demolition form has been issued. After the demolition form is issued, the assembly coordinator/supervisor provides an accompanying note for large and heavy equipment fitted with a loose compressor, after which the contractor must dispose of the equipment via Waste Management (WMA). Oil-containing compressors must be placed in liquid-tight containers at WMA.

4 Air-conditioning

4.1 Air Handling Units

4.1.1 General

1. Air handling units must comply with the applicable ERP regulations.
2. Measuring and control components and cable guide devices must be fitted by the manufacturer of the air handling unit cabinet during production and must not be fitted on the construction site.
3. Support parts for pipes, control equipment and the like will be fitted in such a way that doors and inspection parts can be opened without further disassembly.
4. No cable ducts, pipes and the like may be attached to the air handling unit casing if this casing needs to be dismantled for maintenance work (cleaning). All facilities for fixing servo motors, frequency controllers, control equipment, temperature and differential pressure meters will be fitted by the manufacturer of the air handling unit.
5. The casing of the air handling unit must be earthed.
6. The connection of air ducts to the air handling unit must be done with the intermediate positioning of flexible connections. Flexible connections must be fitted to the cabinet at the factory.
7. In places where condensation can occur in or on the air handling unit, the cabinet parts must be completely thermal bridge-free (TB1).
8. When the air handling unit is installed indoors, a plenum must be installed behind the rain-free grille (in the suction channel after the plenum up to 4 m/s). Rain impact must be prevented by a drip tray, connected to a frost-free drain behind the suction grille. In addition, the outside air intake channel must fall (angle <40°) from the outside air plenum to the suction opening of the air handling unit. The air handling unit must be positioned higher than the air duct. This is to prevent unwanted water entry at the suction opening of the air handling unit.
9. The plenum must include:
    a. A drain with the correct type of siphon (underpressure or overpressure).
    b. An inspection hatch for cleaning and sampling for air quality.
10. Condensate drains must be connected to the wastewater drainage pipe.
11. When commissioning the air handling unit, the condensate drains and siphons must be tested for proper operation. It is also necessary to determine whether the over or underpressure siphon has been fitted in accordance with the design (including siphon height). Condensation collectors and siphons must be cleaned and filled before delivery.
12. There must be sufficient space for maintenance on the air handling unit.

4.1.2 Project-specific composite air handling units

1. Before starting manufacture, the technical specifications prepared by the manufacturer and the composition drawings must be presented to the client for approval.
2. Minimum casing properties according to NEN-EN 1886: Strength Class D2, Airtightness Class L2, Thermal Class T2, Thermal Bridge Factor Class TB2.
3. The air handling units must be supported in such a way that the whole unit can be placed on a flat, horizontal floor. If a flat floor cannot be guaranteed due to the construction method, a concrete upstand must be provided.
4. The free space between the underside of the air handling unit and the floor should be large enough to allow a condensation discharge to be installed. The condensation discharge must be of sufficient height to bridge the over or underpressure from the air handling unit.
5. Vibration damping mats must be fitted between the floor and the cabinet.
6. All cabinet parts to be reached for inspection and maintenance must be fitted with an airtight closing entrance door. Splash-proof LED lighting with a switch on the outside of the air handling unit cabinet will be included in walkable filter sections, humidification sections and in fan sections. In the case of cabinets for outdoor installation, these doors must be equipped with devices so that the wind (even during maintenance work) cannot create unwanted movements

of these doors.
7. It should be possible to remove filters from the air entry side.
8. A readable temperature sensor must be included in each channel connecting to an air handling unit.
9. Cooling and humidification sections will be fitted with a plastic or stainless steel 316L drip tray with condensation discharge.
10. The construction of the fan section must be such that the fan is easily removable.
11. The air handling unit must be delivered clean and without burrs and dirt.
12. In the case of stacked air handling units, to facilitate access to the upper section, structural facilities should be installed on the outside of the air handling unit in accordance with the current occupational health and safety laws and recommendations.
13. The space for maintenance should constitute at least the width and depth of the air handling unit, so it is possible to replace the battery. At the rear of the air handling unit, at least 0.5 m of maintenance space must be available (unless otherwise agreed).

4.1.3 Operational air-conditioning appliances (self-contained units)

This includes standard heat recovery units;

1. The air supply (and discharge in the case of a heat recovery unit) must be equipped with easy-to-exchange bag filters.
2. Air handling units must not be placed above suspended ceilings and all components must be easily accessible for maintenance.
3. The connection of any air ducts to the unit must be done with intermediate placing of flexible connections. Design the ducts in such a way that disassembly and disposal of the unit are easily possible.
4. When using an electric heating element, a maximum thermostat and a differential pressure heater must be fitted in addition to the inlet temperature control in or near the self-contained unit.
5. A duct thermometer must be installed in the air supply duct.

4.2 Outdoor air supply and exhause louvres

1. There must be sufficient distance between the air supply opening and air exhaust opening and/or flue gas discharges and sewer vents in accordance with the calculation for dilution distances according to NEN 1087 or a plume calculation according to NEN 2757.
2. Outdoor grilles, suction and vent caps, as well as their connections, supports and fasteners must be made of corrosion and weatherproof material.
3. Outdoor grilles must be fitted with rain-resistant blades with a water bar, behind which stainless steel 316 chicken wire with mesh size 10 mm is mounted. The mesh should be easy to clean.
4. The speed over the supply surface of air supply grilles should not exceed 2.0 m/s.
   Suction grilles must be positioned at least 1 metre above ground level and/or vegetation to prevent dirt, leaves or other possible contaminants from being sucked in.

4.3 Fans

1. Fans must comply with the applicable ERP guideline.
2. Fan must run on DC motors and must be directly driven.
3. The pressure side of a fan (box) in a free arrangement must be fitted with a flexible connection.
4. Free arrangement fans must be fitted with mesh grilles on the suction and/or pressure side, depending on their arrangement.
5. Roof fans should be made of plastic, complete with feed sleeve and roof upstand, as well as a butterfly valve, depending on the application. The fans must be vibration-insulated in their casing.
6. Fans must be fitted with an operating switch placed in the immediate vicinity or by means of a

CEE-form plug.

7. Adjust the fan selection to the design airflow, taking into account the required airflow for ventilation, heating, cooling, heat recovery, humidification, dehumidification, permissible noise and filtering in relation to the total static head at final resistance in the case of permissible filter pollution.

4.4 Air filters

1. Dust collection and efficiency figures must be determined in accordance with NEN-EN-ISO 16890.
2. Filters for cleaning outside air and recirculation air:
    a. The filter must be made up of bag filters, material Viledon.
    b. The bags must be vertically installed in a horizontal airflow in stainless steel 316L frames. Filters fitted with 4 stainless steel mounting clips; for more than 2 filters, stainless steel reinforcement strips must be fitted. Only the following filter sizes may be used:

1/1	592x592	lengths 330/510/625-650 mm
5/6	492x592	lengths 330/510/625-650 mm
1/2	289x592	lengths 330/510/625-650 mm
1/4	289x289	lengths 330/510/625-650 mm

    c. Filters must be accessible from the dirty air side in order to change the bags (unless otherwise specified).
    d. The filter wall must be sealed airtight.
    e. A pressure differential meter, Dwyer type Magnehelic (scale 0 - 500 Pa) must be fitted with each filter wall.
    f. Filters will be fitted with a clearly visible or clearly audible clogged filter alarm;
3. Filters must be selected in such a way that the design air quantity does not deviate by more than 15% between the initial resistance and dirt filter resistance.
4. The initial resistance of the filters may not exceed 60 Pa.
   The maximum pollution resistance is 250 Pa. The maximum final resistance of the filter is 310 Pa (initial resistance + pollution resistance). Any deviations in consultation with the client.
5. Filter class at least ISO ePM2.5 70% (formerly F7) for air-conditioning systems in situations such as offices, driver's cabins in production environments or relatively clean spaces (switch rooms) in production conditions.
6. Depending on the pollution in the supply air, apply a prefiltering with a maximum ISO ePM10 55% (formerly F5) filter class. For filters with filter class 80% ISO ePM1 (F9) or higher, a prefilter must be applied of at least 55% ISO ePM1 (F7).

4.5 Cooling and heating coils

4.5.1 General

1. Cooling and heating coils in an air handling unit must be placed behind a filter element, with the exception of preheaters to prevent the filter from getting wet.
2. The batteries – consisting of horizontal copper tubes with vertical aluminium slats – must be coated in pigmented titanium dioxide, supplier Conpro (progreen), Altena (Alu coat 507 Basis W) or Blygold (PoluAl XT or MC).
3. The fin spacing of the cooling or heating coil must be at least 2 mm.
4. The coil must be connected in counterflow.
5. Air heating and cooling coils where there is a risk of freezing must be equipped with a frost protection thermostat. This frost protection thermostat should be fitted over the entire surface of the element, possibly several thermostats should be fitted to larger elements. If these elements are part of an air handling unit, the frost protection thermostat(s) must be built by the manufacturer of this air handling unit.

6. Cooling and heating coils must be installed in such a way that they can be easily inspected for contamination and also easily cleaned.
7. Include an inspection device between the heating element and the cooling coil.
8. Venting of the element by correctly installing the water connections: supply connection at the bottom and return connection at the top. A vent device must be included outside the unit at the highest point of the system.

4.5.2 Heating coils

1. The heating coils must be connected in counterflow. If it can not be guaranteed that the coil does not freeze, connect the heating coil in coflow instead of counterflow current, so the warmest water comes into contact with the cold air.
2. If a preheater is used to prevent a wet filter, the following applies:
    a. Install the preheater for the filter;
    b. Select the preheater at outdoor temperature + 3K
    c. Adjust the preheater to a maximum humidity of 80% (at outside temperature + 3K) for the filter.
    d. Apply a separate system with water-glycol mixture, equipped with pump and fittings. The preheater should be set up at the medium temperatures available at higher outdoor temperatures (due to the effectiveness of the preheater during humid periods in the early and late seasons).
    e. Fit the preheater with copper slats with a minimum slat distance of 8 mm, copper headers and a stainless steel 316 or plastic frame.
3. Electrical heating elements must be protected by a maximum thermostat, a differential pressure switch and a device to prevent contact with the heating element.

4.5.3 Cooling coils

1. Cooling sections, including drip traps, must be fitted with a plastic or stainless steel 316L drip tray with condensate drain.
2. After a cooling coils, a plastic drip trap must be used, complete with drain, which is equipped with an underpressure or overpressure siphon of sufficient size.
3. To prevent freezing, the cooling coil must be placed in an air handling unit behind a heat exchanger.
4. In the case of outdoor installation, the cooled water connection must be established in the cabinet.
5. If a cooling coil is installed behind heat recovery, a frost protection thermostat must be used.

4.6 Heat recovery

4.6.1 General

1. The heat recovery must be positioned behind a filter (both on the air supply and exhaust side).
2. The material of the heat recovery must be suitable for a marine climate.
3. For inspection and maintenance, an opening panel/door must be included both before and after heat recovery.
4. A temperature sensor must be included before and after the exchanger.
5. It should be possible to perform differential pressure measurements over the exchanger.
6. Heat recovery should be selected for different operating situations.

4.6.2 Thermal wheel

1. The motor of a thermal wheel must be equipped with a speed controller and a lockable operating switch.
2. The thermal wheel will be equipped with a pulse-pause control so it operates regularly for a short period of time in idling mode.
3. The seal between the two different air currents and the sealing of the flush section must be

adjusted correctly to prevent short-circuit air and efficiency losses.
4. During the functional test, the speed control should be tested in different operating conditions.

4.6.3 Crossflow heatexchanger

1. The crossflow heatexchanger must be equipped with a plastic or stainless steel 316L drip tray with the correct type of siphon and a condensate drain.
2. Fans are preferably placed in the air direction after the exchanger.
3. To minimise air leakage from one air section to another, a good seal must be achieved.
4. Freezing of the crossflow heatexchanger should be prevented. This is possible by one of the following measures:
5. Preheating air for the exchanger.
6. Outside air over the bypass in the supply. The after heater must be set up at a higher capacity.
7. A crossflow heat exchanger always has a bypass. The operation and correct control of the bypass valve must be tested during commissioning and during the maintenance period.

4.6.4 Twin coil

1. The heating or cooling battery will be subject to the requirements of Chapter 4.5.
2. Depending on the operating situations of the system, the exchangers must be equipped with a drip trap and a plastic or stainless steel 316L drip tray with the correct type of siphon and condensation discharge.
3. For air handling units in an outdoor installation, place the twin coil in the return at the end of the cabinet.
4. To prevent freezing of the twin coil system, the glycol percentage should provide at least a protection of -15°C (>33 volume% glycol). The glycol percentage should be tested and reported upon delivery. In the event of failure or malfunction of the pump, an alarm message must be realised.

4.7 Humidification sections

1. The humidification section will be provided with a plastic or stainless steel 316L drip tray with condensate drain.
2. For humidification sections, sufficient installation length must be present in the air handling unit or air duct. The section (also for duct installation) must be equipped with a viewing glass and a waterproof lighting fixture.
3. For protection purposes, the controller must always be equipped with a maximum hygrostat (5 m away after the humidification section) with hardware locking outside the controller. The limit value to be set also depends on the design condition of the humidifier.
4. In the case of water humidification, water treatment should always be applied on the basis of reverse osmosis. In addition, the humidification system must be equipped with legionella protection by means of a flush and drain function.
5. The water supply must be equipped with a solenoid valve that closes when water is detected in the plant room or in the vicinity of the installation site. The control and alarm of this system are also part of the delivery.

4.8 Dampers

1. The leakage loss of the dampers must meet the requirements of air tightness class C and the dampers must be equipped with Teflon bearings.
2. The position of the dampers must be visible on the outside by means of a position indicator.
3. In the case of dampers built into an air handling unit, the operating servo motor must be fitted outside the air handling unit.

4.9 Air ducts

1. The complete air transport route, both supply and exhaust between the air handling unit and the grilles/diffusers including plenums and other fittings), must be delivered and assembled according to the quality and execution standards as laid down in the Luka Quality Manual. Airtightness class "C" must be met as a standard. The contractor must provide a valid Luka quality certificate for this purpose.
2. Unless otherwise specified in the specifications, ductwork must be carried out in circular spiral-wound or rectangular galvanised sheet steel.
3. There must be no sharp edges, parts and fasteners on both the outside and inside of air ducts that reduce the passage, contribute to dirt accumulation or cause injury.
4. Air ducts must be mounted voltage-free and have sufficient expansion capability, so the installed or built-in equipment can be removed without the ducts being able to move.
5. Of all ducts parallel to each other and to other system components, the distance between the finished (insulated) surfaces and the distance to structural elements must be the same everywhere and be at least 50 mm. For intersecting system components, this distance is 30 mm.
6. When air ducts are run through structures, no vibrations may be transmitted to these structures and vice versa. Where walls or floors are passed, the space between the recessed hole and the air duct must be filled with rock wool or equivalent. All ducts must at least meet the requirements of the relevant structure in the field of acoustic and fire protection aspects.

7. Outside air inlet ducts, as well as ducts running outdoors, must be coated with coating system T2, in accordance with Tata Steel Standard S3105601.
8. Fire-resistant ducts must be finished in such a way that they comply with the applicable fire resistance.
9. The outside air inlet duct must have a liquid-tight coating on the inside, which is resistant to acidic liquids (PH<7). At least the bottom and vertical part of this part will be coated on the inside over a length of at least 3 metres up to 10 cm from the bottom.
10. The support and fasteners form part of the technical specification. Suspension and fasteners for use outside a building must be coated in hot-dip galvanised steel.
11. All components installed in the air duct systems, such as control and fire dampers, measuring points, measuring sensors and indicators, will be situated in such a way that they are easily accessible and operated, also in the future.
12. The flexible connection between the air duct and the connected air handling unit/fan or other components obstructs proper earthing. Therefore, the air duct must be connected to the earthing device by means of contacts.

4.10 Air distribution components

1. All air distribution equipment to be used must be equipped with a control valve. Duct grilles must be equipped with a built-in volume control. The volume control may normally be used to regulate a maximum of 30 Pa, if a greater adjustment is necessary, an additional device must be fitted to the duct. Control valves must be counter-rotating.
2. Connections of air supply or exhaust grilles should be carried out with insulated flexible aluminium ducts with a maximum length of approx. 1000 mm.
3. Ceiling supply or recirculation/discharge grilles should be equipped with a plenum box and a round duct connection. The plenum box must be connected to the duct with an acoustic hose and a control valve placed on the duct.
4. Discharge grilles for the ventilation of sanitary areas may be carried out for direct connection to a circular flexible duct. A maximum of 100 Pa may be adjusted with these discharge grilles.
5. Grilles should be easy to clean and can be easily placed back in the original setting after cleaning.

4.11 Fan coil units

1. The fan coil unit must be selected at the mid-speed.
2. The fan coil unit must be placed between lockable fittings and fitted with a drainer with hose nozzle and a vent valve.
3. The fan coil unit must be suspended vibration-free by means of rubbers.

4.12 Adjustment valves

1. Manual air flow adjustment valves must be provided with a fixable adjustment handle with scale in % open.
2. Flow rate, position, pressure loss must be available from adjustment valves.
3. Automatic mechanically acting constant air flow controllers must be suitable for a variable prepressure of 50 to 300 Pa and are equipped with a fixable adjustment handle in m^3/s or m^3/h with an accuracy of +/- 10%.
4. Motor-operated variable or constant air flow controllers will be equipped with devices for measuring the current air flow rate and pressure.
5. If these controllers are equipped with an acoustic casing, the servo motor and the connection box of the measuring sensors must be fitted outside the casing.
6. Control valves must be easily accessible. To this end, the necessary facilities, for example in existing suspended ceilings, must be specified by the contractor.

4.13 Fire dampers

1. A Document of Performance (DoP) of the appropriate fire dampers must be presented. In order to achieve the stated performance of this fire damper, it is necessary to follow the manufacturer's installation instructions. In the event of a different installation, equivalence must be demonstrated.
2. Where ducts pass through fire-resistant partitions, fire dampers must be fitted with the same fire resistance as the fire-resistant partition in question.
3. If a melting-patterned fire damper is used, it must be activated at a temperature of 70°C.
4. Fire dampers, and the corresponding inspection hatch, must always be easily accessible. To this end, the necessary facilities, for example in existing suspended ceilings, must be specified by the contractor.
5. When using smoke dampers, they must be equipped with a servo motor.

4.14 Switching ventilation devices

1. When the temporary closure of ventilation with fresh outside air (shut-off of outside air suction valves and shut-off of supply and discharge fans) is desirable due to emission of gases harmful to our health, Dräger gas detection equipment (type Polytron 7000) should be used. This equipment and these sensors must be taken into administration by the HTD on the basis of an inspection which is part of the contractor's work. In addition, a certificate of commissioning must be issued (issued by Tata Steel department SPME-ESS-HTD-LOG-IKA-GKI).
2. If a room is equipped with a sprinkler and/or smoke detection system, the ventilation and cooling units installed in this room must be switched off in the event of an alarm notification when they get their air from another compartment. In this case, a fire damper (controlled from the fire alarm system) must also close the supply duct. In the case of a recirculation unit, it need not be switched off when the fire alarm system is activated.

5 Sanitary appliances

5.1 General

1. The sanitary appliances referred to in this chapter must be used.
2. 'Wet groups' will be lockable per floor and per group by placing ball shut-off valves, if possible, above the suspended ceiling.
3. Horizontal pipes must NEVER be milled. If vertical hot and cold water pipes are milled, the following provisions will apply:
    a. In the wall, to which the sanitary facilities to be installed are attached, the milled pipes must be fitted symmetrically in relation to the centre of the wall plate to be installed.
    b. For each connection point, the pipe will be milled vertically above the system ceiling distance without connection.
    c. All wall plates must be bricked in with an adjusting bracket.
    d. Horizontal pipes will be fitted above the ceiling.
    e. All milled pipes must be fitted with a plastic sheath tube, with the exception of Wicu tube.
4. If not otherwise specified, all sanitary appliances must be connected to the wastewater sewer.

5.2 Mounting heights for sanitary appliances

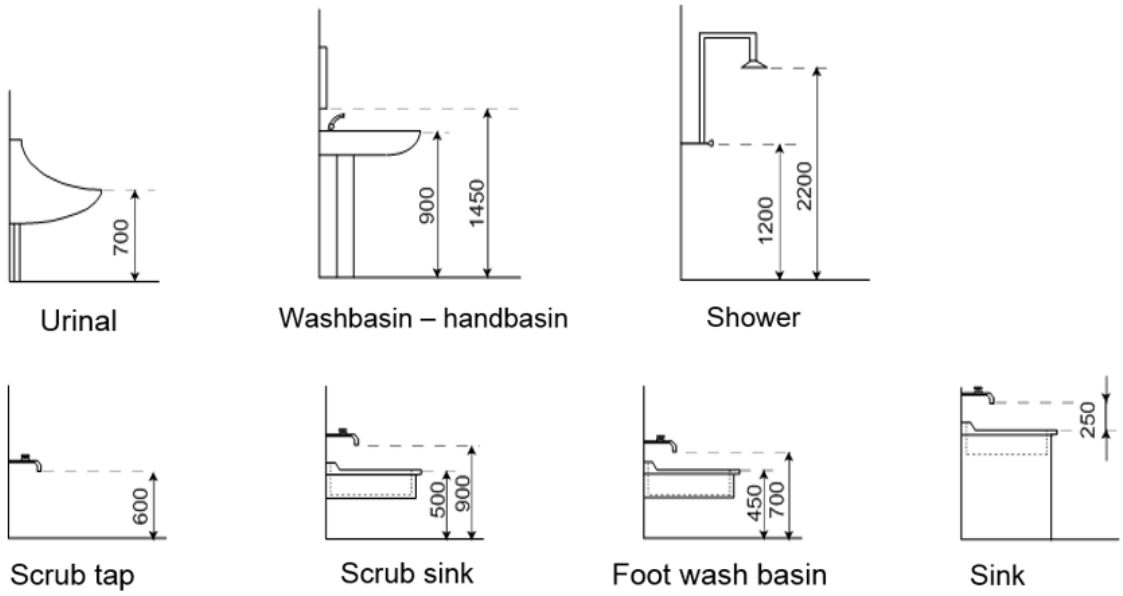

Figure 2: Mounting heights for sanitary appliances

5.3 Closet combination

- 1 washdown wall closet, make Geberit/Sphinx, type 300 Basic 22, S8200100000.
- 1 wall built-in frame, make Geberit, type GIS, complete with control panel with 3 / 6-litre rinse selection.
- 1 closet seat with lid, make Pressalit, with metal continuous hinge attachment, for offices with lid (colour white).
- 1 closet seat without lid, make Pagette, with metal continuous hinge attachment, for factories (colour white).

5.4 Urinal combination

- 1 urinal, make Geberit/Sphinx 300 Urinal, type 70 (wall inlet) or 75 (upper inlet), (colour white).
- 1 wall installation frame, make Geberit, type GIS.
- 1 rinsing tap, make Schell, type Schellomat Basic 024840699 - incl. stop valve and complete with chrome-plated brass sink pipe.
- 1 drain fitting 5/4", chrome-plated brass.
- Modesty panels to be used make Geberit 115.202, (colour white).

5.5 Washbasin combination

- 1 washbasin, make Geberit/Sphinx, type 300 Basic compact, size 600 x 400 mm, (colour white).
- 1 washbasin faucet with ceramic upper, make Grohe, type Costa S (20405001).
- 1 plug cup 5/4" chrome-plated brass, with screw-off cup and adjustable drain height, equipped with Simplex plug and floor pipe.
- 1 mirror 630 x 400 mm, VVA quality, 67 mm thick complete with chrome-plated brass mirror clamps.

5.6 Handbasin with accessories

- Handbasin, make Geberit/Sphinx, type 300 Basic compact, size 360 x 250 mm, (colour white).
- Washbasin tap with ceramic upper, make Grohe, type Costa S (20405001), low model.
- Plug cup siphon 5/4" chrome-plated brass, with screw-off cup and adjustable drain height, equipped with Simplex plug and floor pipe.

5.7 Showers

5.7.1 Connection showers

Showers must be connected flowing (distance between branch of a well-flowing pipe and the connection point up to 150 mm). Additional requirements such as weekly rinsing or automating the rinsing cycle should also be included in the legionella management plan.

Shower groups must be connected and automated in a flow-through way, so that they are rinsed automatically. The maintenance plan should include checking the rinsing cycle.

5.7.2 Shower combinations

Combination 1:

- 1 shower mixer tap with ceramic upper, make Grohe, 1/2", model Costa S (26318001), equipped with check valve (EB).
- 2 wall plate couplings 3/4" x 15mm (for surface-mounted).
- 1 shower pipe, according to Tata Steel model, made of stainless steel pipe 1/2", equipped with a chrome-plated brass (or stainless steel), coupling 1/2" x 3/4" on the mixer side.
- 1 shower head, make Grohe, model New Tempesta 100 (28419002).

Combination 2:

- 1 shower mixer tap, make Grohe, model Grohtherm 2000, equipped with check valve (EB).
- 2 wall plate couplings 3/4" x 15mm (for surface-mounted).
- 1 shower bar combination, make Grohe, model New Tempesta 100 (27600001), colour chrome, shower bar length 600mm, hose length 1500mm, jet type normal-jet massage.

Combination 3

- When used in baths and changing rooms, different rules apply; for this, the client must be contacted.

5.8 Scrub sink combination

- 1 scrub sink with bumper, make Geberit/Sphinx, model 300 Basic, dim. 610 x 460 mm, (colour white) (S8A00200000), complete with consoles.
- 1 bucket grille, foldable, chrome-plated brass.
- 1 Simplex plug 1.1/2".
- 1 siphon, make Mcalpine, 1.1/2"x 40mm.
- 1 wall mixer tap, make Grohe, 1/2", model Costa S with rotating underflow (31195001).

5.9 Washing troughs

- Washing troughs with accompanying yokes must be supplied in stainless steel fabricate and design in consultation with the client.
- 1 wall mixer tap, make Grohe, 1/2", model Costa S with rotating underflow (31195001).

5.10 Laboratory sink combination

- 1 sink, make Geberit / Keramag, model Wohnstätte, dim. 600 x 130 x 400 mm (360060) complete with wall console (500250).
- 1 plug cup siphon, make Geberit, 1.1/2", with unscrewed cup and adjustable drain height, equipped with Simplex plug and drain pipe.
- 1 wall mixer tap, make Grohe, 1/2", model Costa S with rotating underflow (31195001).
- 2 wall plates 3/4" x 15 mm.

5.11 Filling point for central heating or cooling system

Connect the filling point flowing (branch at a maximum of 150 mm from the filling point) to a well-flowing main network. If flow-through connection is not possible, a check valve will be used at a distance of no more than 150 mm from the branch.

- 1 aerated tap (DA), equipped with check valve (EB), fabric VSH, 1/2" (B3551) or 3/4" (B3515, extended with EB check valve, Watts Ocean type NN).
- If it is not possible to connect the pipe flowing, apply the following check valves:
  - P < 45 kW, EA security, type CC55.1.
  - check valve: P > 45 kW, protection CA, type CA9C.

5.12 Exterior wall tap

Frost-free exterior wall tap, equipped with check valve (EB) and aerator (DA), make VSH GK116.
Connect the exterior wall tap flowing (branch at a maximum of 150 mm from the exterior wall tap) to a well-flowing main network. If flow-through connection is not possible, a check valve (EA) must be used at a distance of up to 150 mm from the branch.

5.13 Connection point drinks machine

- Aerated tap (DA), equipped with check valve (EB), fabric VSH, 1/2", with 3/4" swivel connection (B3551).
- Stop valve. 15 mm
- Wall plate 1/2" mounting height of the wall plate depends on the type and manufacture of the coffee maker.
- Insert a controllable check valve (EA) and a ball valve into the connection line to the connection point of the drinks machine.

5.14 Delivery point

Place a controllable check valve (EA) and drainable ball valve at the delivery point.

5.15 Fire hose reels

Fire hose reels equipped with manual valve. Design:

- KIWA-approved 3/4" (or 1") reels.
- Sheet steel reel leaf, powder coated red RAL 3000.
- Eurojet nozzle with rubber bumper ring.
- Anti-kink reel hose.
- Hose guide and nozzle holder.
- Reel insert with standpipe or swivel arm.
- Swivel arm with flexible supply hose.
- Quick shut-off with pinch fittings.
- Working pressure up to 12 bar.
- Including mounting set.
- In the context of Legionella prevention and according to the Water worksheets, fire hose reels must be connected to a well-flowing main network with a maximum distance of 0.15 metres from this main pipe (without check valve) (see Figure 3). If this is not feasible, please contact the client.

5.16 Cleaning reels

Reels for cleaning in the shower and changing rooms equipped with manual valves. Version:

- KIWA-approved Heavy Duty galvanized steel interior with brass aquifers.
- Sheet steel, powder coated green RAL 6010.
- Reinforced reel blade, equipped with folding handle.
- Eurojet nozzle with rubber bumper ring.
- Black-Duty wear-resistant reel hose.
- Reel insert with swivel arm.
- Swivel arm with flexible supply hose.
- Quick shut-off with pinch fittings.
- Working pressure up to 12 bar.
- Including mounting set.
- Mounting height: heart reel 800 mm above the floor.
- In the context of Legionella prevention and according to the Water worksheets, cleaning reels should always be connected to a well-flowing main network with a maximum distance of 0.15 metres from this main pipe (with EA check valve, type CC55.1) (see Figure 3). If this is not feasible, please contact the client.

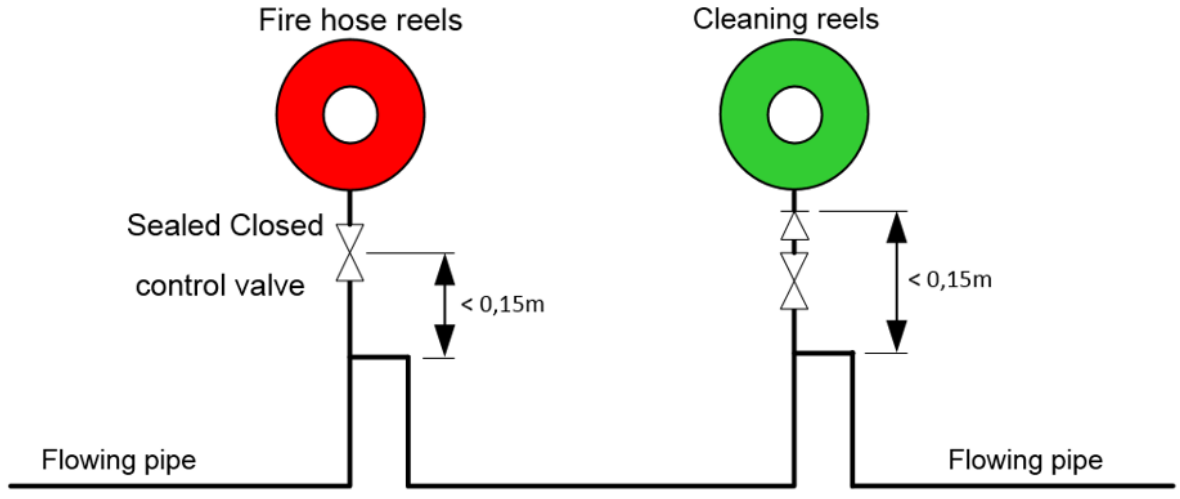

Figure 3: Connection method for connecting fire hose and cleaning reels.

5.17 Emergency and eye showers

1. Water nuisance must be taken into account during periodic checks when designing an emergency and/or eye shower. Facilities must be provided to dispose of the water safely and in a controlled way.
2. Connection to the water system is not permitted.
3. To recognise piping for emergency and eye showers, the insulated piping must bear self-adhesive marking tape, in turn in the colours green – 57 mm wide – and white – 38 mm wide.
4. In the case of a combined arrangement (emergency and eyebath), the need for its simultaneous use should first be established. If necessary, in the case of a combined system of an emergency and eye shower, the emergency shower will be located above the eye shower, so that simultaneous use by one person is possible. Simultaneous use should not affect the operation of both systems individually.
5. The capacity of emergency showers is 60 litres per minute.
6. In the context of Legionella prevention and according to the Water Worksheets, emergency and eye showers must be connected to a well-flowing main network, with the emergency shower itself becoming part of the main pipe (in accordance with *Figure 4).*

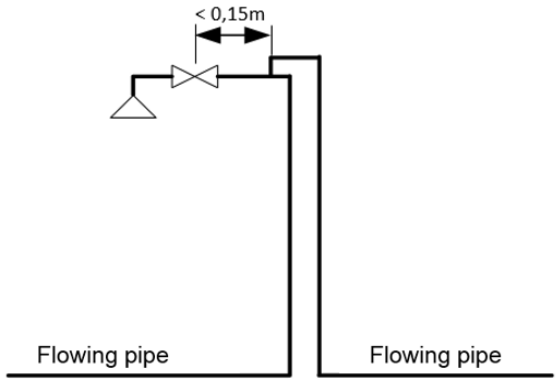

Figure 4: Connections for emergency showers.

7. If emergency showers cannot be connected in a flow-through way, they must be equipped with an automatic flushing machine with an adjustable cycle and flushing quantity (flush the entire pipe section once every 3 days).
8. Eye showers should always be supplied with fresh drinking water. Eye showers should be equipped with an automatic flushing machine with an adjustable cycle and flushing quantity (flushing the entire pipe section once every 3 days), see *Figure 5*.
9. As an automatic flushing machine, use a solenoid valve(JP Fluid Control type STSA) with a digital timer (JP Fluid Control type AF-TD).
10. The water temperature of an eyebath must be guaranteed at 25°C. The eye shower must be equipped with a flow-through water heater (a minimum of 50 litres) in order to heat the water to the desired temperature, see *Figure 5*.

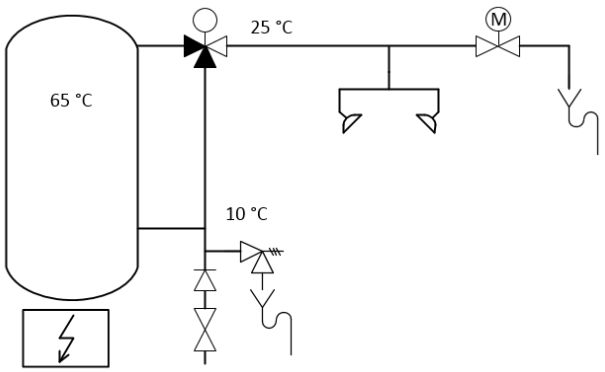

Figure 5: Connection of eyebath with electric water heater and automatic flushing machine.

11. The electrical connection for the eye showers can be equipped with CEE-form socket with operating switch, manufacture Mennekes, type 5613A and equipped with 25A earth leakage switch and 10A automatic system for the power supply of the automatic flushing valve.
12. Eye and emergency showers should be fitted with the warning signs, see
13. Figure 6

Figure 6: Warning signs for eye and emergency showers.

6 Piping and accessories

6.1 General

Metal pipes must receive corrosion-resistant treatment in accordance with Tata Steel Standard S3105601.

6.2 General installation instructions

1. The pipes and fittings to be used must be suitable for the expected highest operating pressure (at least 11/2 times the working pressure) and temperature.
2. The mains must be equipped in such a way that expansion and shrinkage can take place without causing nuisance noise or damage.
3. All pipe ducts through walls and floors must be equipped with plastic feed sleeves – for floors, up to approximately 1 cm above finished floor. In the case of cooled water pipes, the size of the sheath should be suitable for the passage of an insulated pipe.
4. Before pipes are fitted to the work, measures must be taken to prevent contamination of the pipes during the execution of the work.
5. In order to prevent hot-work in buildings and systems on the Tata Steel site, welding, grinding and soldering work should, if possible, be carried out in a suitable space. If possible, the connecting of pipes should be carried out by means of press, pinch, electro-sleeve or mirror weld connection. Welding, grinding and soldering work in buildings and installations on the Tata Steel site may only be carried out after agreement and permission from the client.
6. In accordance with QHSE 3.16 (only in Dutch), the use, transport and storage of acetylene gas are not permitted. When the application of an alternative gas is not possible, an exemption from this prohibition may be obtained.

6.3 Welding instructions

1. Welding joints must be carried out and checked according to Tata Steel standard S1450401. For pressurised appliances, reference is also made to the rules for pressurised appliances (steam equipment). If the regulations of the Gasunie apply, these are considered decisive.
2. All (destructive and non-destructive) research costs, costs for repairing rejected welds and the recheck, which are necessary to achieve a good end result, are at the expense of the contractor.

6.4 Pipes for central heating and refrigerated water systems

1. For central heating and cooled water systems:
    a. Up to and including DN (11/4") passage: welded steel wire 32 mm tube according to EN 10255 (DIN 2440) EN 10241 (NEN 3257 medium), with smooth ends, externally radiated.
    b. From DN (40 mm11/2") passage: Seamless steel flame tube in the quality P235TR2 (St 37.0), according to EN 10220/10216-1 (DIN 2448/1629), radiated externally, with smooth ends.
2. For pipes for WRK (leak) water systems, pipe materials must be used according to the Tata Steel pipe specs.
3. Welding connections for heating and cooling water systems fall under welding category 3 of Tata Steel standard S1450401, provided that the piping does not exceed DN150 and the operating pressure does not exceed 3 bar.
4. Fit work on pipes of DN 32 and larger is not allowed.
5. Steel pipes that have collapsed must be fitted with a conduit.

6. In addition, for central heating systems:
    a. Thin-walled central heating pipes (up to DN 32) according to NEN-EN 10305-3. Make connections in the pipework by means of compression joints or press joints. Generate bends in tube with size 15 and 22 mm by cold deformation as much as possible.
    b. Plastic pipes (if no exposed brick). Plastic pipe systems must comply with DIN4726 and come with KOMO certificate in accordance with BRL 5605, 5606, 5607, 5610 or 5611, provided that they are suitable for the temperature trajectory of the system.

6.5 Pipes for drinking water systems

1. Pipe materials to be used and construction in accordance with the Water worksheets.
2. Pipes must be delivered clean and drained. Open connections should be drained during installation to prevent dirt entering the water pipe.
3. When entering a building or factory, a controllable checkable check valve (type EA) must be fitted immediately after the main valve – a second valve must be placed directly after this check valve.
4. In principle, sanitary appliances must be connected from above and the pipes milled vertically where possible. If there is a risk of frost in the outer walls, milling is not permitted. Horizontal pipes must never be milled. Milled pipes may be carried out in Wicu tube.
5. If there is no exposed brickwork, the use of plastic pipes is allowed up to a maximum diameter of 32 mm, provided that it has a KIWA quality mark and is suitable for its application. The use of plastic pipes as a hot water recirculation pipe is not permitted.
6. Piping (except plastic piping) which has collapsed must be fitted with a conduit.

6.6 Pipes for indoor sewerage systems

1. The design, the pipe materials to be fitted and the construction of indoor sewerage systems must comply with NEN 3215 and NTR-3216.
2. The inner sewer ends at 1 metre outside the façade with an inspection fitting and a flexible coupler. The exact dimensions of this location must be shown on the As-built drawings.
3. Pipes concealed under the ground floor or in the ground must be tested for leak tightness before they are concealed.
4. The diameter of condensation drains must be at least 32 mm.

6.7 Pipes for refrigerant

Version in red copper and/or stainless steel duplex. The least possible couplings, welds or solderings must be used. Pressing refrigerant pipes is not permitted. Refrigerant pipes must be mounted vibration-free. Piping should be protected with insulation where there may be a risk of contact.

6.8 Pipelines for natural gas systems

1. Apply pipe, gasket materials and connection techniques in accordance with Annex A to NPR 3378 Part 5.
2. If welding is necessary, this falls under welding category 2 in accordance with Tata Steel standard S1450401.
3. A pressing point must be included in the pipe network and the mains must be painted in the colour RAL 1004 (yellow).

6.9 Pipes for steam and boiler supply systems

1. Pipe materials to be used according to the Tata Steel pipe specs.
2. Bends to be carried out with a large radius (R= 2.5 p.)
3. All design and work on steam and condensate pipes must be carried out by an ISO-NEN3834-certified company.

4. The design, materials used and isometric diagram must be approved in advance by Tata Steel's responsible department SPME PTC CTY KDT.
5. The steam system must be designed in such a way that any condensation that may have arisen in the pipe is sufficiently drained (sufficient slope, at least 2%, with sufficient condensation drainage facilities at the lowest points).

6.10 Pumps

1. Pumps to be used:
    a. centrifugal pumps without gasket bush for heating and cooling.
    b. Foundation pumps (centrifugal pumps with shaft sealing).
    c. Centrifugal pumps without gasket bush for drinking water, with KIWA approval and briefly suitable up to a water temperature of 100°C.
2. When applying foundation pumps, compensators must be fitted.
3. Pumps must be mounted between valves.
4. Each pump must be equipped with a lockable pressure measuring point on the suction and pressing side.

6.11 Thermometers

The thermometer must be supplied in bar model, complete with pockets. If the thermometer is used in a drinking water system, the pocket must be made of stainless steel.

7 Insulation

7.1 Standards and regulations

With regard to insulation materials and their processing on pipe material, the Tata Steel technical directive R1327301 applies, as well as the installation and processing regulations of the CINI (Commissie Isolatie Nederlandse Industrie, dutch abbreviation for Dutch Industry Insulation Committee).

7.2 General

1. Before the insulation is applied, the system must have been successfully tested for density, including purchase and agreement by the client.
2. The insulation material to be processed must be dry and protected from weather influences during transport or storage.
3. The contractor must observe the instructions and instructions of the supplier of the insulation materials. The preservation of the pipe to be insulated must in particular be carried out in accordance with Tata Steel Standard S3105601.
4. If operating conditions are to be expected where the wall temperature of the pipe or duct drops below the dew point of the ambient air, it must be insulated vapour-proof.
5. When using vapour-proof insulation, insulated pipe carriers should be used for horizontal pipes.
6. All systems must be insulated separately, including the insulation of intersecting ducts and/or pipes.
7. Where insulated duct or piping passes structures, the insulation must be continuously extended.
8. Servo motors for valve control, measuring sensors and the like must be fitted outside the insulation.
9. Pressure and flow measuring points must remain accessible from the outside of the insulation and be clearly marked.
10. In order to prevent energy loss or risk of burns, insulation must be applied to buffer vessels.

7.3 Air ducts

1. The ducts for the supply and discharge of air must be insulated in accordance with the requirements of the Luka Quality Manyal (only in Dutch).
2. With the exception of lattice plenums of ceiling grilles, internal insulation may not be applied.

7.4 Finishing of the insulation

1. Insulation of pipe and/or ductwork in a production environment, must be finished with aluminium cladding of 0.8 mm.
2. For outdoor pipes and air ducts, the insulation must be finished with seaworthy aluminium 5083 (ALMg4.5) plating.

7.5 Risk of freezing

1. For systems where there is a risk of freezing (outside and in large units) heating (tracing) must be installed before installing the insulation.
2. If tracing is applied, it must be switched on temperature-dependent at an ambient temperature of < 4°C. The tracing must be self-regulating. A voltage monitoring relay will be installed at the end of the tracing line, which will give an alarm in the event of a failure of the tracing voltage.

8 Acoustic facilities

8.1 General

1. For each system, the contractor must provide a statement in the frequency bands 63 - 8000 Hz of the sound power level (dB ref. 1pW) and of the generated sound pressure level (dB ref 20 µPa). The client may request the contractor to provide this sound data for other sound-producing devices as well.
2. For noise pollution from technical facilities in or on the building to the surrounding area, at least the target values must be adhered to. The sound power (reference 1 pW) and the sound pressure level at 1 metre (reference µ20 Pa) will not exceed the value of 80 and 70 dB(A) respectively.
3. The maximum permissible noise level ($L_{eaq)}$ resulting from the HVAC systems in office buildings is subject to the above noise levels in Table 1.
4. For project-specific noise requirements, reference will be made to the design conditions as defined in the technical specification or technical description. The noise production resulting from mechanical systems will not exceed the relevant value in its entirety.
5. The sound levels listed in Table 1 will be demonstrated by means of a sound calculation.

Space:	**Lp dB(A)***
Single-person office	<35
Multi-person room	<40
Open-plan office	50-55
Boardroom, meeting room, library/reading room, instruction room	<30
Canteen	<45
Shared space	<40
Traffic area	<45

*Starting point of this value is a room absorption of 10 dB.

Table 1: Maximum permissible noise level ($L_{aeq)}$ due to HVAC systems.

8.2 Sound attenuators and acoustic insulations

1. The absorbent material used will be fire-retardant and flame-extinguishing and will be fitted with an erosion-protective glass fibre cloth.
2. Noise production and attenuation values will be guaranteed by the manufacturer under all operating conditions.

8.3 Check

1. In the case of doubt about the result obtained, control measurements can be carried out after delivery and commissioning of the systems. This measurement must be carried out by the contractor in accordance with the following measurement methods:
2. When measuring noise outside the building, measurements must be made according to ILHR1301 (Manual measuring and calculating industrial noise).
3. When measuring noise in the building, measurements must be made according to NEN 1070 (noise insulation in buildings) with additions C1 and C2.

9 Electrical system and control equipment

9.1 General

1. Electrical, measuring and control systems must be designed according to the Tata Steel General EIC engineering and construction requirements and all standards mentioned in this requirement. The requirements set out in this document are additions to the EIC requirements.
1. The electrical system must be designed by a guaranteed installer, who must be approved in accordance with the "Regeling voor de erkenning van Elektrotechnische Installateurs" (REI 2008, Regulation for the Approval of Electrical Contractors) and have a certificate from an institute approved by the Accreditation Board. A copy of this certificate should be available for consultation.
2. Tata Steel does not have a public grid, but is responsible for its own energy supply. This also means that the contractor can not assume the distribution grid meets the standards set by energy companies. This mainly concerns the voltage variation (-15% and +10%) and the higher harmonic (variation frequency -2% and +2% (49Hz - 51Hz)).

9.2 Norms, Standards and Guidelines

1. The materials mentioned in the standards must always be used. Materials to be used that are not specifically prescribed, must be in stock at the wholesaler (Technical Union).
2. The following standards should always be applied:
    - NEN 1010: Safety provisions for low-voltage systems.
    - NEN 3140: Safety provisions relating to work on or in the vicinity of low-voltage systems and grids.
    - NEN 5152: Electrotechnical symbols.
    - NEN 3157: Measurement and control technology.
    - EN 50081-1: General emission standard for household, commercial and light industrial environment.
    - EN 50081-2: General emission standard for industrial environment.
    - EN 50082-1: General immunity standard for household, commercial and light industrial environment.
    - EN 50082-2: General immunity standard for industrial environment.
3. Before the start of the project, the client must determine whether the system belongs to the industrial or light-industrial environment.

9.3 Scope of delivery

1. In the case of projects where a subdivision is necessary, a power cable (declaration of required power before the start of the project) will be made available by third parties. The contractor must then feed the sub-systems as much as possible from a halyester distribution, and the contractor must also supply the power cables with corresponding power switches. Cable diameter, voltage loss, power and short circuit calculations (and other relevant calculations) must be submitted. This includes the supply, assembly and wiring of all corrective organs, sensors, directors, link and signalling equipment.

9.4 Specific requirements

1. Control cabinets must be equipped with one potential-free idle and operating current collection contact, carried out on the terminal strip, for reports of malfunctions.
2. Control cabinets must be equipped with a possibility of shutdown in the event of a fire carried out on the terminal strip. The fire alarm command (potential-free contact) will be made available by the client.
3. The contractor is not permitted to project and lay cables in the ground. If it is absolutely

necessary to lay cables in the ground, this must always be done with the approval of the client by a company to be stipulated by the client.

4. The following requirements apply to cabling (in accordance with EIC directive):
    a. Used cables must be fire retardant according to EN-IEC 60332-3-24 cat. C or better.
    b. Cables must be halogen-free according to EN 50267, IEC 60754.
    c. Cables and wiring must be suitable for the environment; e.g. oil resistant.
    d. Cables for analogue signals (e.g.: 0-10 V, 4-20 mA) must be of the shielded twisted pair type with a separate core diameter ≥0.75 mm2 (in terms of mechanical strength).
    e. Cables for control networks with lengths ≤ 90 m must be of the type FTP Cat6; glass fibre is used for longer distances.
5. All power cables must be provided by the contractor with a cable number registered with Tata Steel. To be requested from the client. The cable numbers must be stamped on the cables.
6. No two cores under one clamp will be fitted to the terminal strip in the switch/control cabinet.
7. Adapter sleeves should be suitable for the application:
    a. do not run multiple cables through one adapter sleeve.
    b. on the underside of the junction box or control cabinet to prevent dust entry.
8. Do not use an operating switch for servo motor-controlled control valves.
9. AC drives should be equipped with an RFI filter. In order to prevent disruptions in the supply grid, all necessary provisions will have to be made to keep grid pollution below the standards of Energie-Nederland in all circumstances.
10. Power cables for frequency-controlled motors must be equipped in a symmetrically shielded cable.
11. If the contractor cannot use cable ducts and mounting options for the operating switch on the devices to be set up on roofs, the contractor must apply a roof duct according to the so-called "walking stick", entirely made of stainless steel 316L (see figure 7).

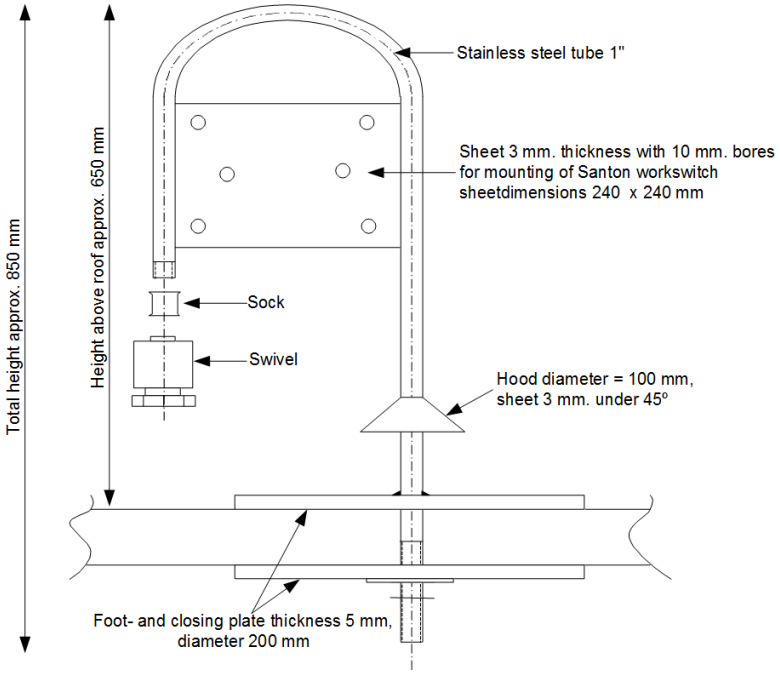

Figure 7: Detail roof duct for cables

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9.5 Various, common connections

1. Minimum degree of protection:
   - Outside: ≥ IP65.
   - In production units: ≥ IP54.
   - Within E rooms: ≥ IP31.
2. Electrical power supplies more than 3.6 kW must be equipped with a mechanically lockable operating switch suitable for a padlock (8 mm).
3. The operating switch must be equipped with a CEE wall socket with screw clamp.
4. Small systems such as split units, circulation pumps and small fans can be connected up to 3.6 kW of electrical power without an operating switch with a CEE plug.
5. CEE plugs to be used:
   a. Plug: 3 pole, (1x230V-zero+earth; blue version; maximum 16A).
   b. Plug: 5 pole (3x400V-zero+earth; red version; maximum 63A).
6. The sockets must be mounted in the immediate vicinity, within easy reach and in direct view of the device.
7. Small air-conditioning equipment used in computer rooms must be supplied without zero-voltage relays. These units must automatically restart in the event of voltage waste.
8. Electrical power supplies for eye showers to be equipped with CEE-form socket with operating switch, manufacture Mennekes, type 5613A and equipped with 25A earth leakage switch and 10A automatic system for the power supply of the automatic flushing valve.

9.6 Earthing

1. In accordance with the NEN-1010, the following will apply with regard to earthing.
   a. All metal components must be equipped with one or more earthing points so that they can be connected to the earthing system.
   b. It must be possible to connect all electrical conductors and air ducts to the earthing system. The contractor must include provisions for this.
   c. If there are interruptions in the pipe or duct work, these must be bridged.
   d. Depending on the application specification, the contractor or a third party must connect the earthing points to the earthing system. .

9.7 Provisions for central control devices

If systems are equipped with a building management system, this chapter applies.

1. Measuring and control system with a central control capability and automatic fault transmission must be of the Priva BLUE ID model (minimum software version 8.6). They must be equipped with an installed network driver with Ethernet connection.
2. One touchpoint control cabinet must be supplied per control box.
3. From the new measuring and control system to be realized, cabling must be installed to the nearest patch cabinet.
4. The "Priva" project name must be determined in consultation with the client before the project is notified to Priva. Below is the analogy of the project name (example a project /building has control cabinets at two locations, with 2 and 1 substations respectively):
   - Project name: K4500394
   - Control cabinet 1: K4500394.1
   - Substation 1 in control cabinet 1: K4500394.1.1
   - Substation 2 in control cabinet 1: K4500394.1.2
   - Control cabinet 2: K4500394.2
   - Substation 3 in control cabinet 2: K4500394.2.3

5. Notification list of notification groups contains the following notification groups with names:
    - MG1: High-urgent failures are reported 24/7, on consignment by SMS, during day shift in SAP by means of M2 notifications.
    - MG2: Low-urgent failures are reported 8/5, during day shift in SAP by means of M2 notifications.
    - MG3: Low urgency, service (e.g. filters) malfunctions are reported 8/5, during day shift in SAP by means of Z1 notifications.
    - MG4: No urgency, reserve.
    - MG5: No urgency, no reporting; failures are not reported.
    - To correctly pass on the notifications, the option "print notifications" when commissioning must be checked.
6. For the manufacture of control/switch cabinet must be handed over to the client for assessment:
    - Notification list of notification groups.
    - Module overview.
    - Settings structure.
    - Graphic, dynamic picture images/diagrams.

10 Services

10.1 Drawing regulations

1. For all drawings, the Tata Steel guidelines R1058001, R1058003 and R1058004 apply.
2. The contractor will at all times verify in the work that the drawings of the existing situation made available by Tata Steel correspond to reality. Any additional costs arising from deviations from the drawing provided will not be eligible for reimbursement.

10.2 Working and outline drawings

1. Floor plan drawings (scale 1:50), drawings of plant rooms (scale 1:20), isometric projections (of sanitary, steam and gas systems) and outline diagrams must be made.
2. The work and as-built drawings must clearly display the following information:
   a) Location and arrangement of equipment, fittings and the like.
   b) Pipes with dimensions and fixed point and/or sliding attachment points, insulation type and thickness to be used, group and adjustment valves, measuring points, etc.
   c) Air ducts with dimensions, insulation type and thickness to be used, adjustment and fire attenuators, measuring points, etc.
   d) Type of medium, flow rates and speeds, with flow direction and pipe gradient, material types used, input pressures, resistors, temperatures, speeds, power, voltage and control codes.
   e) Horizontal and vertical dimensions of all system components in relation to each other and of the structures.
   f) Control components (motors, sensors and the like, which are located outside the control cabinet).
   g) Any mounting and support structures.
   h) Coding of components in accordance with the outline diagrams.
3. On the outline diagrams, state all the necessary data of the equipment (air and water quantity, temperature, capacity) and the equipment with a code, which is reflected on the floor plan drawings. All corresponding drawing numbers must also be indicated on the outline diagram.
4. Separate working drawings of mechanical, control, sanitary and gas systems must be produced. An isometric diagram must also be made for the sanitary, steam and/or gas system.
5. For the purpose of the layout of ceilings, shafts and the like, the contractor must count on the production of drawings for coordination with third-party systems.
6. A system cannot be installed until the client has checked the working drawings.
7. Working drawings initialled by the client do not relieve the contractor of his obligations in any way.
8. During the installation period, the contractor must keep track of the adjustments to the system on a special set of working drawings so that, for example, the system parts concealed in ceilings and shafts can also be indicated in the correct location on the drawings.

10.3 Documents for control systems

A complete set of documents, consisting of:

a) Outline diagram of the system (P&ID);
b) Functional description of each system, including detailed software description per control cabinet describing all the control strategies used, including Functional Logical Diagrams (FLDs) for the freely programmable controllers;
c) Circuit diagrams;
d) Function lists (I/O diagrams);
e) List of settings not included in the function lists;
f) Cable and clamping frames;

g) Control cabinet view – and layout drawings;
h) GBS images;
i) Overview of the gas line at a gas-fired system.
j) A pneumatic diagram if pneumatics are applied.

10.4 Drawings indicating openings, architectural facilities and coordination

1. The drawings indicating openings and other architectural facilities must be manufactured by the contractor in a timely manner on the basis of a schedule and offered to the client.
2. The contractor must check in the work whether all openings, concrete upstands and the like necessary for his systems have been correctly marked and fitted.
3. Coordination must take place with other contractors at work in order to obtain optimal implementation of the installation work.

10.5 Calculations

1. Regardless of obligations in the specifications to produce detailed calculations, the contractor must carry out test calculations with regard to the static back pressure of pumps, fan capacity, pipe dimensioning, Kvs value of control valves and the like. The following calculations must be submitted to the management board in good time for approval:
   a) All mains calculations.
   b) Heat loss calculation according to NEN-EN 12831 and ISSO 53/57.
   c) Cooling load calculation according to NEN 5067.
   d) Air duct calculation according to ISSO Publication 17.
   e) Tap water calculation according to NEN 1006.
   f) Gas pipeline calculation according to NEN 1078/2078.
   g) Rainwater and wastewater drainage calculations according to NEN 3215 and NTR 3216, as well as separators for grease and petrol/diesel.
   h) Noise calculations.
   i) The cable calculations for the power supplies of the control system in accordance with the provisions of NEN 1010.
   j) All necessary calculations to show that the design meets the set principles (requirements) must be carried out. These calculations must demonstrably underlie the dimensions of the system (components). This guarantees that the system choices made and the calculated capacities and dimensions are (theoretically) able to realize all the requirements. The results of the test calculations are part of the revision documents.

10.6 System specifications

1. A data sheet will be submitted for each system component, indicating at least the following characteristics:
   a) Dimensions.
   b) Weight.
   c) Capacity.
   d) Technical data.
   e) Material.
   f) Surface finish.

11 Commissioning

11.1 Quality plan and commissioning (performance guarantee)

A quality plan should be submitted, showing the definition and the responsibilities overview of commissioning. It should be clear that sufficient time, money and manpower has been set aside for the commissioning of the systems. A commissioning manager must be appointed by the contractor during the design phase. A commissioning manager is a specialist who is qualified to inspect, test and control complex heating, cooling and ventilation systems and measurement and control technology under operating conditions. His responsibilities include:

- Drawing up the inspection and test plan.
- Commissioning the system.
- Providing input commissioning during design, execution, delivery and maintenance period.

11.2 Factory Acceptance Tests (FAT)

Prior to the purchase/supply of specifically named equipment, checks must be performed at the manufacturer's factory for at least the following:

- Completeness (also correct order of components);
- Proper assembly (e.g. correct system lengths, radius of bends, etc.);
- Finishing.

These checks should be documented, with the controlled parts being marked on the basis of outline diagrams or system drawings. Deviations found should be recorded, stating component, description of the deviation and deadline for repair of the deviation.

11.3 Site Acceptance Tests (SAT)

Prior to 'adjustment', the system must be checked after installation/assembly in the work for at least the following:

- Completeness (also correct order of components);
- Proper assembly (e.g. correct system lengths, radius of bends, etc.);
- Finishing.

These checks should be documented, with the controlled parts being marked on the basis of outline diagrams or system drawings. Deviations found should be recorded, stating component, description of the deviation and deadline for repair of the deviation.

11.4 Measuring and adjusting

11.4.1 General

1. In order to be able to carry out good control measurements, measuring points must be installed by the contractor, including:
   - Lockable measuring points for differential pressure measurement in all water supply and return lines to equipment in technical areas, such as: boilers, chillers, heating and cooling batteries for air handling units, boilers, pumps and the like. The measuring points must be taken outside the insulation.
   - In the air supply and exhaust ducts on site of air handling units, fans and control valves.
   - Fixed temperature measuring points with a calibrated thermometer in all supply and return lines to air-conditioning equipment, boilers, chillers, as well as in air supply and exhaust ducts at the air handling units location.
2. The location of each measuring point will be indicated on the drawing.
3. The measurements must be carried out with clean filters.
4. Heating lines must be set in accordance with ISSO publication 68, Energetically optimal heating and cooling lines for climate systems.

11.4.2 Measurement and adjustment programme

1. Adjustment takes place in accordance with the procedures described in ISSO publication 31 'Measuring points and measurement methods for air-conditioning systems', ISSO publication 52 'Air-side adjustment of air-conditioning systems' and ISSO publication 65 'Adjusting design volume flows in hot water systems'.
2. Measurement and adjustment must be carried out at both partial load and full load of the relevant system part.
3. The measurement and adjustment programme for the contractor includes:
   - Adjusting and checking all capacities and efficiency of boilers, chillers, fans, pumps and the like.
   - Adjusting air distribution and extraction quantities to required quantities, pressures and speeds.
   - Adjusting all water circuits to the calculated water quantities and pressures, including all customers.
   - Adjusting and adjusting all control and security equipment.
4. After adjustment, test and adjustment reports must be submitted in singular form to the client.
5. Measured and set quantities, as well as set values on adjustment valves and valves, will be indicated on the as-built drawings.
6. The following deviation is considered acceptable (unless otherwise indicated in a design or specifications): -5%, +5%. In the case of larger deviations, the cause is detected and the air or water quantity is restored.

11.4.3 Balancing report air-side

1. The air-side measurement report must include:
   - Name of client;
   - Name of adjustment company;
   - Date of measurement;
   - Measuring instruments used;
   - Calibration report measuring instruments;
   - Party responsible for the measurement;
2. The following aspects are reported per grille, section, measuring point and system:
   - Coding measuring point;
   - Position measuring point in outline diagram;
   - Design air quantity;
   - Measured air quantity;
   - Temperature and humidity with which adjustment is made;
   - Position of the adjustment valve;
   - For duct measurements: Diameter or length x width;
   - Air velocity;
   - Static pressure;
   - Deviation air quantity as a percentage.

11.4.4 Balancing report water-side

1. The water-side measurement report will include:
   - Name of client;
   - Name of adjustment company;
   - Date of measurement;
   - Measuring instruments used;
   - Calibration report measuring instruments;
   - Party responsible for the measurement;
2. Per component, section, measuring point and system, the following are reported:

- Coding measuring point;
- Position measuring point in outline diagram;
- Design water quantity;
- Measured water quantity;
- Composition of the medium (type of glycol and percentage if applicable);
- Temperature of the medium;
- For pipe measurements: Diameter;
- Static pressure;
- Kv value valve;
- Deviation of water quantity as a percentage.

11.5 Testing measuring and control systems

1. Adjustments of mechanical systems should be tested for functionality. In doing so, all control circuits of the system are demonstrably tested according to the control technical description by varying setpoints and checking all monitors and alarms. Where necessary, it must be possible to temporarily influence measurement values before testing.
2. All sensors are tested for functional operation and rated with a calibrated meter. Deviations from values in control engineering are reported and tracked in lists.

11.6 Testing sytem for safety and density

11.6.1 General

1. All systems must be tested for the proper functioning and delivery of sufficient performance in all common operating situations. Among other things, the following must be tested:
   - Proper execution of all system components.
   - Leak tightness and press tests of pipes, ducts and associated components.
   - Proper operation of the equipment under normal operation and in the event of malfunctions.
   - Adequate operation of the control system.
2. Before testing a system or system part (pressure-testing and the like), the contractor must warn the client in good time, so that he can be present on site if desired.
3. Before commissioning the systems, the pipes must first be completely flushed to remove any internal contamination.
4. The contractor must make available all equipment necessary for the test and make provisions in the systems for carrying out the test.
5. The method of pressure-testing of steam and boiler power plants must be carried out in consultation with the client.
6. The results of the tests should be recorded in a report.

11.6.2 Central heating and cooled water systems

1. The systems must be pressure-tested before the insulation is installed.
2. The systems must be pressure-tested at a pressure of 1.5 times the operating pressure.
3. After the press pump has been removed, the test pressure must remain constant for one hour.

11.6.3 Hot and cold tap water systems

1. The hot and cold tap water systems must be pressure-tested Water worksheet 2.3.
2. Before these systems are put into operation, they must be flushed in accordance with Water Worksheet 2.4.

11.6.4 Refrigerants

1. The cooling pipes must be tested in accordance with the latest edition of the F-gases regulation.

11.6.5 Natural gas systems

1. Natural gas systems will be tested and put into service in accordance with NPR 3378, Parts 1, 2 and 9.
2. In order to demonstrate that the system complies with NEN 1078, a report of the check of the construction and execution of the gas system, including the strength test and leak density test, must be provided.

11.6.6 Vessels

1. For all pressure vessels, the contractor must give the client 3 pressure certificates of the relevant vessel.
2. The permitted pressures must be indicated on the certificate.
3. A measurement letter must be submitted of the venting devices.

11.6.7 Air ducts

1. For the density of air ducts, refer to Luka requirements Class C, see Luka Quality Manyal (only in Dutch).

11.6.8 Steam pipes

1. Pressure-testing must be carried out in consultation with the client.
2. After the steam system has been in operation for 24 hours, all connections must be checked.

11.7 Revision documents, operating and maintenance instructions

11.7.1 General

1. Upon delivery, a draft of the revision documents/operating documents and maintenance instructions (installation file) must be submitted, as well as a draft copy of the as-built drawings. Within 1 month of receiving the corrected draft, the contractor must submit all final documents.
2. All documents must be delivered digitally and in the Dutch language.
3. Maintenance plan/maintenance budget/spares list.
4. The revision documents/operating documents and maintenance instructions of the systems must be compiled in the following order of subject:
    - Table of contents (PDF format).
    - Design and operation of the systems (PDF format).
    - Operation of the systems and the elimination of malfunctions (PDF format).
    - Lists of applied materials or equipment with setting data (PDF format).
    - Maintenance instructions (PDF format).
    - Documentation of applied equipment (PDF format).
    - Overview of the as-built drawings (DWG and PDF format).
    - Commissioning reports system components.
    - Measurement and adjustment reports.
    - Machine guideline (PDF format).
    - Risk Inventory drinking water (PDF format).
    - Logbook F-gases regulation (PDF format).
    - SCIOS control fuel supply lines and combustion appliances (PDF format).
    - Design starting points and calculations (PDF format).

11.7.2 Design and operation of the systems

1. These descriptions include the outline diagrams of the systems or system components concerned.

2. The description should briefly indicate which components each of the systems is made of and which climate conditions and the like can be realized.
3. In addition, it is necessary to describe how the systems are controlled, switched on or off (e.g. by central timer or manually), indicating the operating times and on which control cabinet signalling and operation take place.

11.7.3 Operation of the systems

1. A point-by-point description for each system must be provided, explaining how it should be put into operation and taken out of service.
2. It is also necessary to indicate which measures must be observed before the systems are put into operation (e.g. checking water level, possibly filling and aerating and how this should be done, checking the manual valves, etc.).
3. It must be clearly explained which manual circuits should be made on the relevant control cabinets or control panels.

11.7.4 List of materials and equipment used

1. A list of system components must be added, showing the manufacturer, type number, size and supplier.
2. The list must be arranged in such a way that measuring range and settings can be indicated, for example, of adjustment valves and measuring and control equipment.

11.7.5 Maintenance instructions

1. In principle, the maintenance instructions must come from the supplier or manufacturer of the relevant system components.
2. If the client believes the legibility is insufficient, the contractor may be required to compile the maintenance regulations himself.

11.7.6 Documentation of equipment used

1. Documentation of all equipment used must be added to the operating instructions. If this documentation indicates more than one type, the equipment used must be clearly indicated.

11.7.7 As-built drawings

1. All drawings mentioned in paragraphs 10.2 to 10.4 must be delivered as an as-built drawing.
2. Upon delivery, the contractor must provide as-built drawings of the installations to the client for approval. Upon delivery, the as-built drawings must be digitally handed over in original file format according to the drawing regulations.

11.7.8 As-built documents of control systems

1. All documents mentioned in section 10.3 must be delivered as as-built documents.

11.7.9 Machine guideline

1. If the Machine Directive applies, a copy of the risk assessment and of the Technical Construction Dossier must be handed over to the client upon delivery.

11.7.10 Risk Inventory drinking water

1. In the context of legionella prevention, a risk analysis and a management plan must be drawn up by the contractor of the drinking water system in accordance with ISSO 55.1.

11.7.11 Logbook F-gases regulation

1. For the installation of the heating system, a logbook must be available at the location of the system (digital or hardcopy), in which the technician can keep track of the leak checks, work and changes. To this end, the logbook/equipment register to be obtained from the NVKL must

be used and must contain at least the mandatory data from the regulations of the F-gas regulation.

11.7.12 SCIOS control of fuel supply lines and combustion appliances

1. Fuel supply lines with a gas pressure < 500mBar to space heating systems will be provided with an installation file containing a basic fuel pipeline report and a certificate of entry into service issued by a competent inspection body, according to the SCIOS scheme, scoop 7a.
2. Gas-fired appliances with a rated heating capacity exceeding 100kW will, in accordance with the SCIOS scheme, be provided with an installation file containing a basic report, a copy of the first special inspection (ECI) drawn up by a competent authority, a certificate of entry into service, electrical diagrams, installation, operating and maintenance requirements and information on the connected equipment.

11.7.13 Design starting points and calculations

1. Provide the approved and applicable design starting points and calculations applicable to the work carried out. This includes the calculations mentioned in section 10.5.

11.8 Instructions and training

1. Depending on the complexity of the systems, the contractor must for one or two days instruct the designated technical personnel of the client or the user with regard to the operation and maintenance of the systems. This ensures that the current optimal configuration of the systems remains available in the future (and for others) and that swift and adequate action is taken in the event of a possible deviation, so that a less than ideal situation is ended as soon as possible.

11.9 Transfer

1. Transfer can only take place when all documents to be delivered by the contractor have been handed over to the client and the client has approved them.

11.10 Warranty

1. The statutory warranty period starts after transfer to the client.