

Wastewater Monitoring System

MES 1003 Installation Guide



Table of Contents

1. Safety	4
1.1. Safety Message Types.....	4
1.2. General Safety.....	4
2. Introduction	5
2.1. Purpose of the Manual	5
2.2. Abbreviations and Definitions	5
3. Product Description	6
3.1. Washwater Monitoring System MES 1003 working principle.....	6
3.2. System Overview	7
3.2.1. WMS system with 1 WSU	7
3.2.2. WMS system with 2 WSUs.....	8
3.2.3. WMS system with 3 WSUs.....	9
3.2.4. WMS system with 4 WSUs.....	10
3.2.5. Component description and scope	11
3.3. Dimensions	12
3.3.1. WAU.....	12
3.3.2. WSU	13
4. Mechanical Installation.....	15
4.1. General Installation Requirements.....	15
4.1.1. Installation principles illustrated.....	16
4.2. Preparation	16
4.2.1. Preparing the Installation Site.....	16
4.3. Mounting the WAU and WSU cabinets.....	16
4.3.1. Mounting the WAU Cabinet	17
4.3.2. Mounting the WSU Cabinet	18
4.4. WSU inlet installation.....	19
4.4.1. Mounting the Filter Element	20
4.5. WAU and WSU interfaces	21
4.5.1. Interface Plate WAU	21
4.5.2. Interfaces WSU	22
4.6. pH sensor installation	23
5. Electrical Installation	24
5.1. Overview of Electrical Wiring of the WMS	24
5.2. General Electrical Installation Requirements.....	24
5.2.1. Power supply cable for WSU.....	24
5.2.2. Power supply cable for WAU	25
5.2.3. Signal cable between WAU and WSU	25
5.2.4. Dimensioning of power supply cables	25
5.2.5. Dimensioning of signal cables between WAU and WSU	25
5.2.6. Shield Installation in EMC Cable Glands.....	25
5.3. Electrical Installation of WSU	26
5.3.1. Connection of Power Supply Cable and Signal Cable on WSU Termination Points.....	26
5.4. Electrical Installation of WAU	27
5.4.1. Connection of WSU Signal Cables on Termination Points in WAU Controller box	28
5.4.2. Power Supply for WMS Controller.....	29
5.5. Fuse Specifications and Installation.....	29
5.6. Ethernet Connection.....	29

6. Before operating the WMS system.....	30
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1. Safety

1.1. Safety Message Types

The following symbols are used in this manual.

Definitions



Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation, which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTICE

Indicates important information, including situations which may result in damage to equipment or property.

1.2. General Safety



This manual contains important instructions that must be followed during installation and maintenance of the Washwater Monitoring System.

NOTICE

BEFORE INSTALLATION

Check for damage to equipment and packaging. If in doubt, contact the supplier before commencing installation.



External personnel conducting maintenance must be:

- Trained and authorized in general safety rules for work on electrical equipment.
- Familiar with local requirements, rules, and regulations for the installation.

NOTICE

When planning the installation site, ensure that the product label and warning labels remain visible.

NOTICE

Handle the Washwater Monitoring System with care. Ensure safe mounting by lifting and moving Washwater Monitoring System carefully. Lifting equipment can be necessary to carry the unit.

The weight of the components in the Washwater Monitoring System is considerable and may cause injury if dropped. Wear safety boots.

2. Introduction

2.1. Purpose of the Manual

The Installation Guide provides information required to install the Washwater Monitoring System cabinets and requirements to the system. Detailed installation drawings are available upon request.

2.2. Abbreviations and Definitions

Abbreviation	Description
EGCS	Exhaust Gas Clean System
PAH	Polycyclic Aromatic Hydrocarbons
TCP	Transmission Control Protocol
WMS	Washwater Monitoring System
WAU	Washwater Analyzing Unit
WSU	Washwater Sample Unit

Table 1: Abbreviations

Term	Description
De-bubbler	A unit that ensures no air particles (bubbles) are left in the system, ensuring that the turbidity sensor is measuring correctly.

Table 2: Definitions

3. Product Description

3.1. Wastewater Monitoring System MES 1003 working principle

The MES1003 operating principle is based on the standard MEPC259(58), which in overall terms defines how to measure the three required substances: PAH, turbidity and pH. From a product conceptual perspective, the MES1003 distinguishes itself from other wastewater monitoring systems as it is based on a sampling principle. The concept reduces the number of expensive sensors and offers a better measurement reliability.

The system consists of Wastewater Analyzing Unit (WAU) and a number of Wastewater Sample Units (WSU). The MES 1003 supports from 1–4 WSU depending on the application.

The WAU contains all components which control the sampling and perform the measurements. This includes the computer which controls all operations in the system, a set of three-way valves connected to the WSUs and the measurement chamber with the three sensors measuring PAH, turbidity and pH. The computer selects which WSU should supply water to the measurement chamber and water will then flow to the chamber. When a WSU is not supplying water to the measurement chamber, it is instead circulating water which bypasses the measurement chamber. The measured values will be recorded and reported to the user when they have stabilized, and that allows the computer to switch to the next WSU. After the “last” WSU in any given system, the sequence will start over again.

The WSU contains the de-bubbler, the pump and a temperature sensor. The latter is used to report the temperature in the sampling point. The de-bubbler is a passive component which removes any bubbles in the sample water as they interfere with the turbidity measurement. Turning the pump on/off is controlled by the computer in the WAU. Two protection devices are built into the WSU in order to protect the pump and motor from breaking down in case of lack of sample water and motor overload.

The MES1003 interfaces to external systems through Modbus TCP/IP. A local display enables the user to perform setup and control the system.

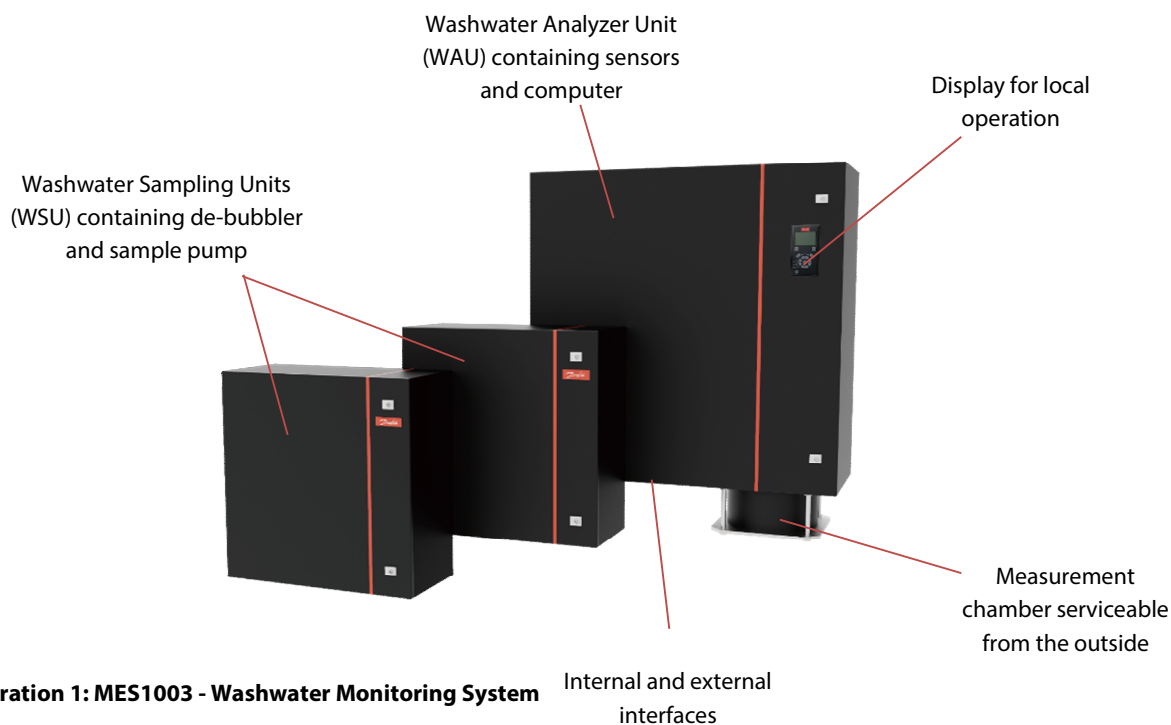


Illustration 1: MES1003 - Wastewater Monitoring System

3.2. System Overview

In the following section system overviews are illustrated showing both Danfoss IXA and costumer scope of supply.

Components inside the red dotted lines are supplied by Danfoss IXA, and it is up to the costumer to supply the rest of the components to complete the WMS system.

Components inside the blue dotted lines are accessories that Danfoss IXA can supply on request thereof.

NOTICE

Ensure that all costumer scope materials that are in contact with washwater are made of stainless steel.

3.2.1. WMS system with 1 WSU

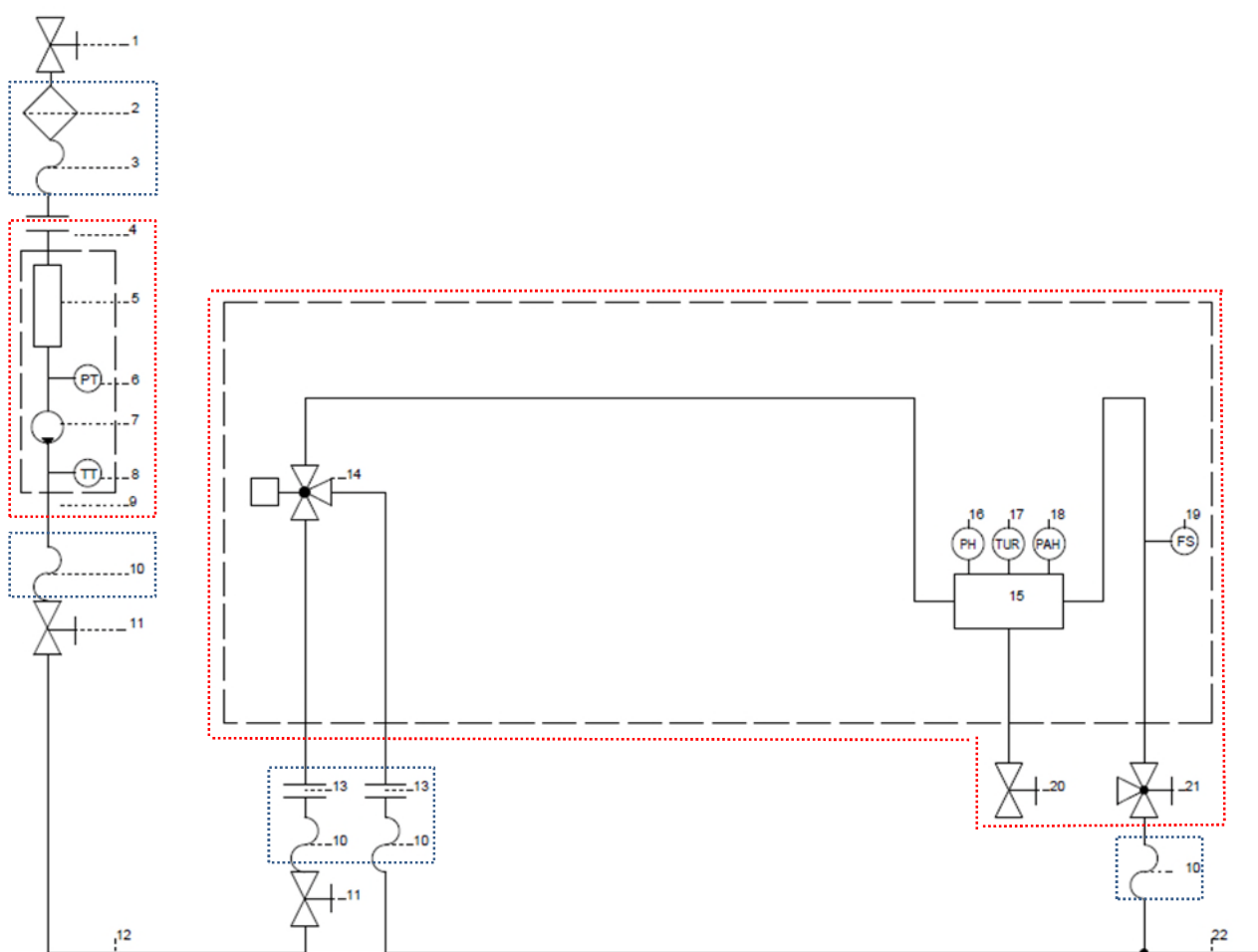


Illustration 2: System overview - WMS system with 1 WSU

3.2.2. WMS system with 2 WSUs

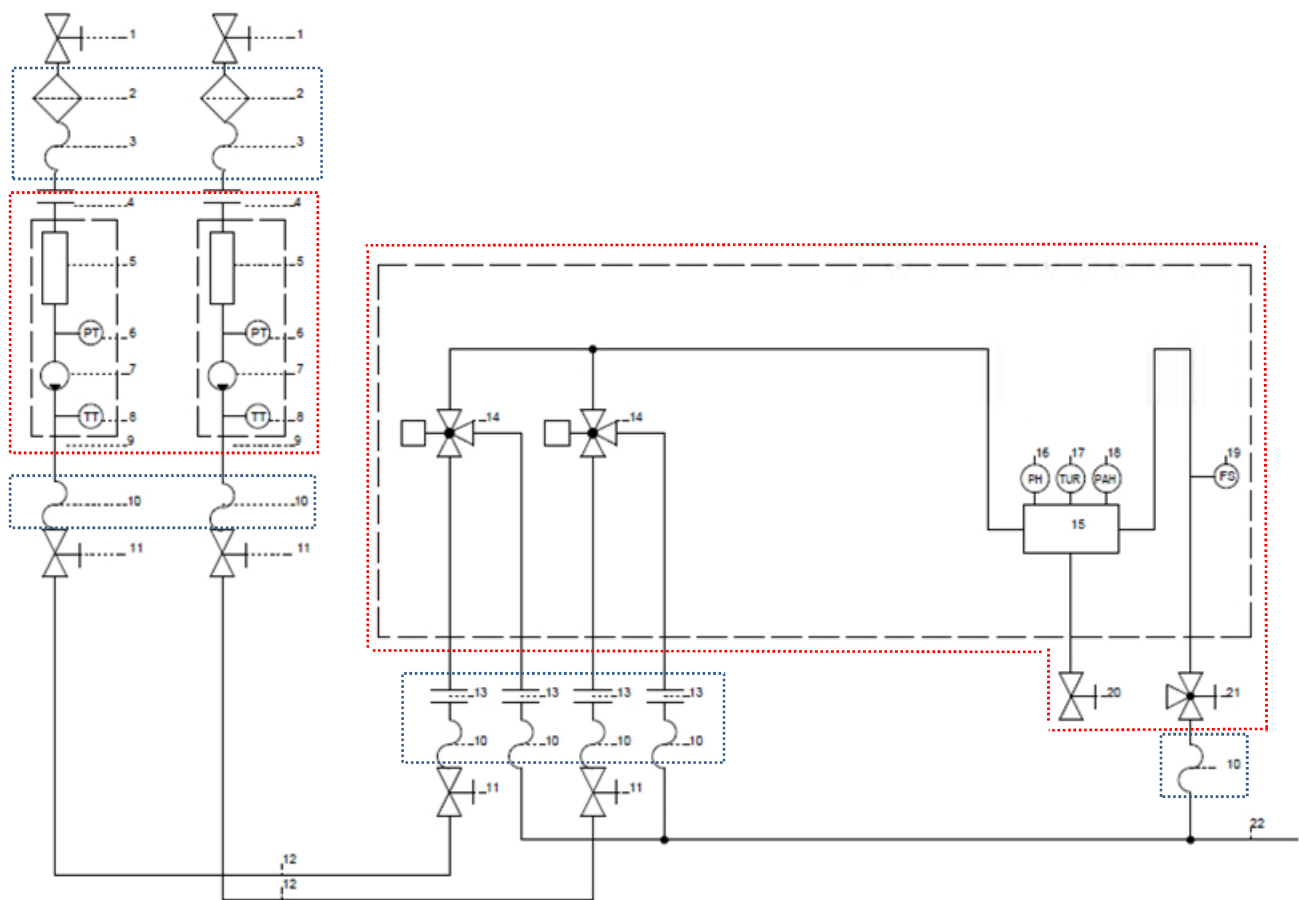


Illustration 3: System overview - WMS system with 2 WSUs

3.2.3. WMS system with 3 WSUs

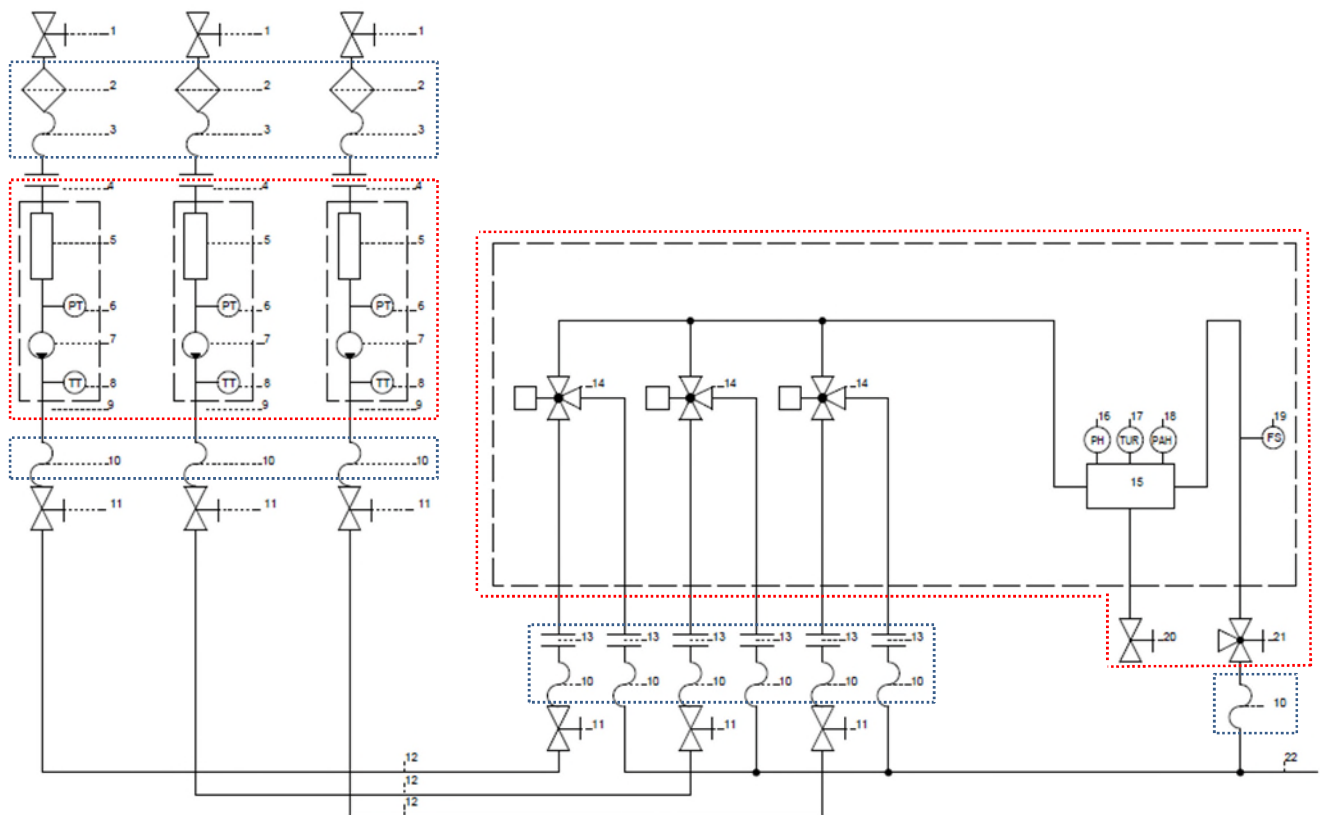


Illustration 4: System overview - WMS system with 3 WSUs

3.2.4. WMS system with 4 WSUs

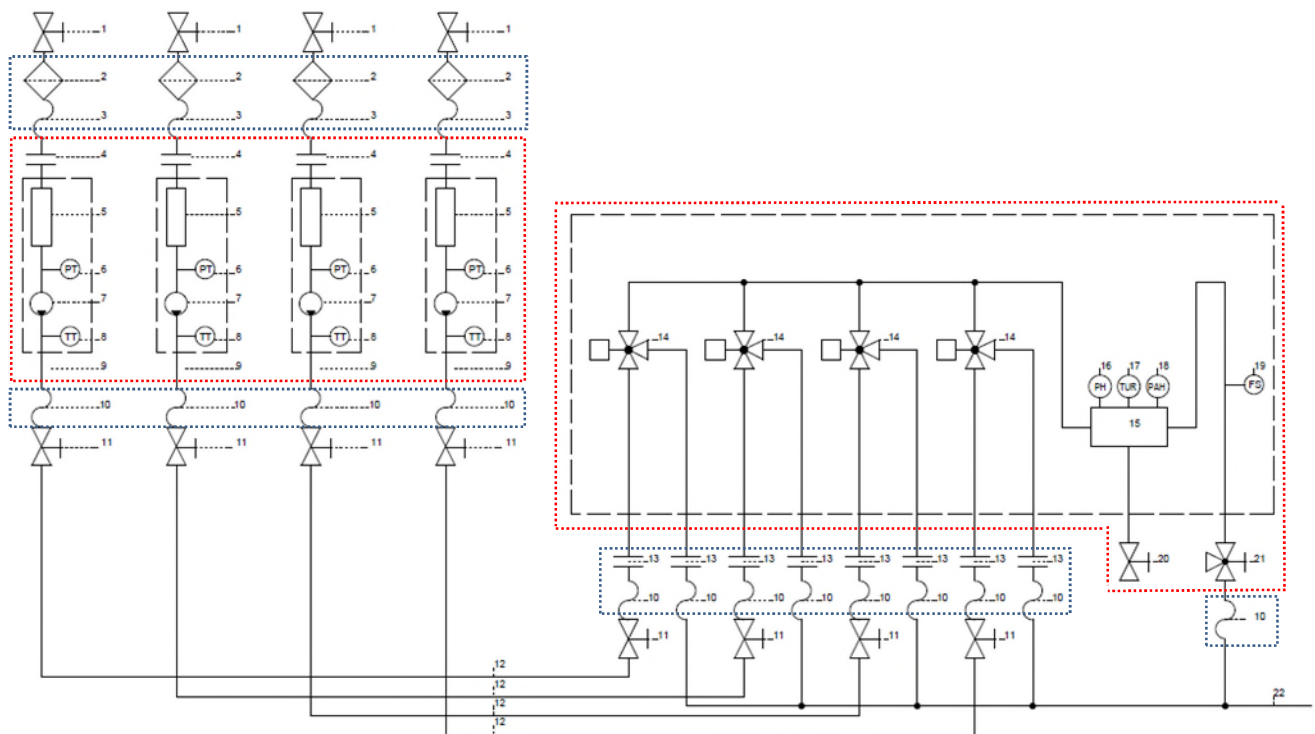


Illustration 5: System overview - WMS system with 4 WSUs

3.2.5. Component description and scope

Item	Description	Size	Scope
0	Manual Ball Valve	DN65	Customer
1	WSU inlet piping	DN65	Customer
2	Filter Unit	DN65	Customer or Danfoss IXA - Accessory
3	Flexible Connection	DN65	Customer or Danfoss IXA - Accessory
4	WSU Inlet Flange	DN65	Danfoss IXA
5	De-bubbler	-	Danfoss IXA
6	Pressure Transmitter	-	Danfoss IXA
7	WSU Pump	-	Danfoss IXA
8	Temperature Transmitter	-	Danfoss IXA
9	WSU Outlet Muff	½" thread	Danfoss IXA
10	Flexible connection	DN15	Customer or Danfoss IXA - Accessory
11	Manual Ball Valve	DN15	Customer
12	WSU to WAU Pipe	DN15	Customer
13	WAU Inlet/Outlet Muff	½" thread	Danfoss IXA
14	WAU Three Way Valve	-	Danfoss IXA
15	Measurement Chamber	-	Danfoss IXA
16	pH Sensor	-	Danfoss IXA
17	Turbidity Sensor	-	Danfoss IXA
18	PAH Sensor	-	Danfoss IXA
19	Flow Switch	-	Danfoss IXA
20	Manual Ball Valve	DN15	Danfoss IXA
21	Manual Three-Way Sampling Valve	DN15	Danfoss IXA
22	WAU Discharge pipe	DN25	Customer

Table 3: System Overview – Scope of supply

3.3. Dimensions

3.3.1. WAU

NOTICE

Weight: 85 kg.

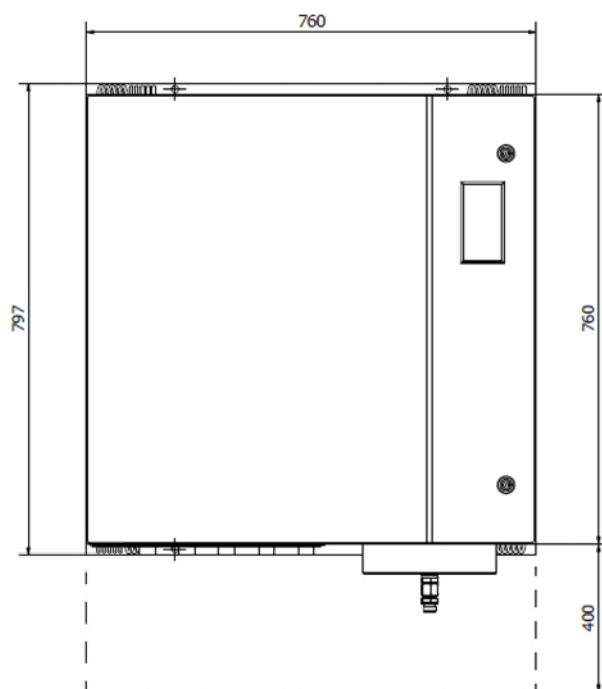


Illustration 6: General space requirements for WAU cabinet

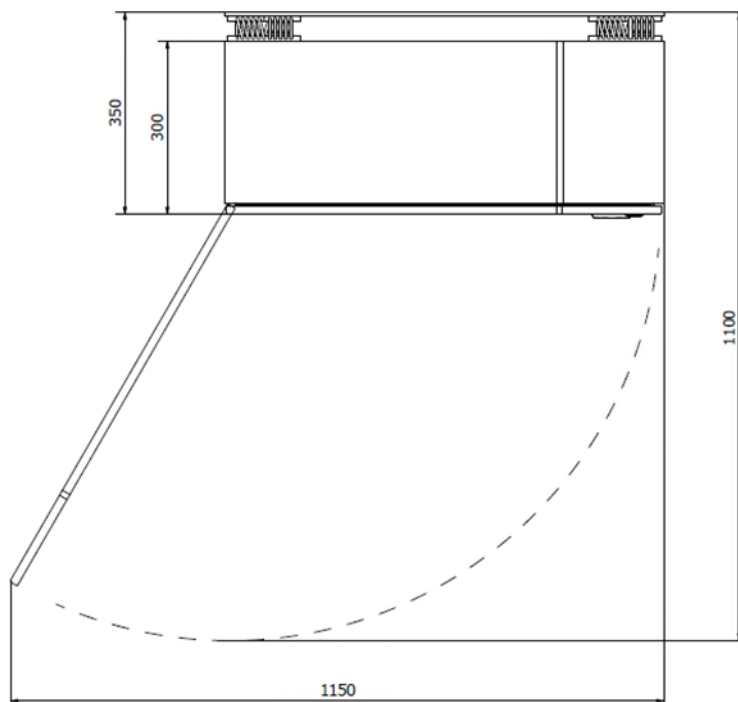


Illustration 7: WAU Cabinet Opening Radius

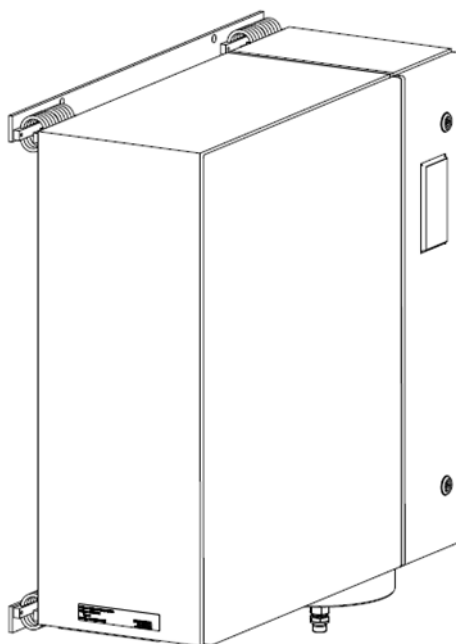


Illustration 8: WAU Cabinet Visual Name Plate

3.3.2. WSU

NOTICE

Weight: 40 kg.

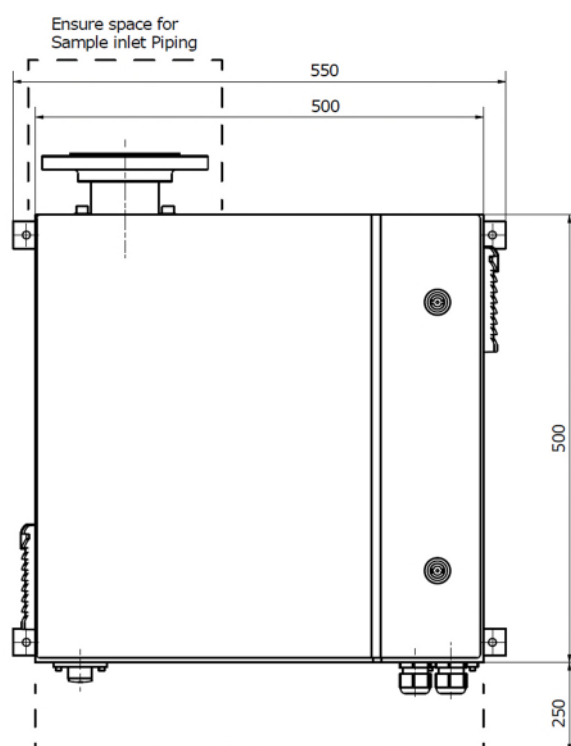


Illustration 9: General Space Requirements for WSU Cabinet

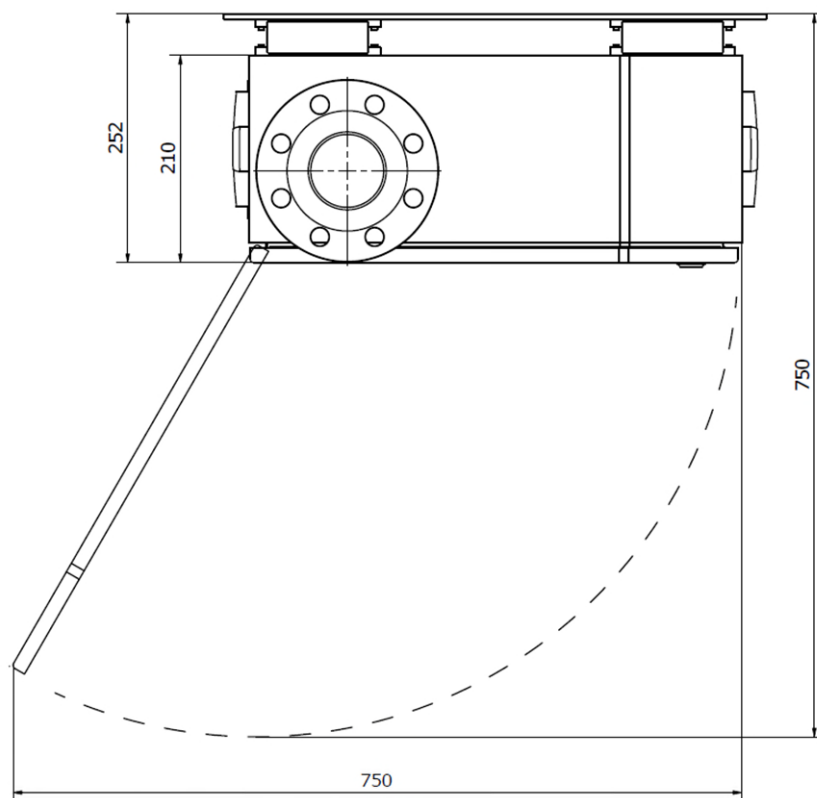


Illustration 10: WSU Opening Radius

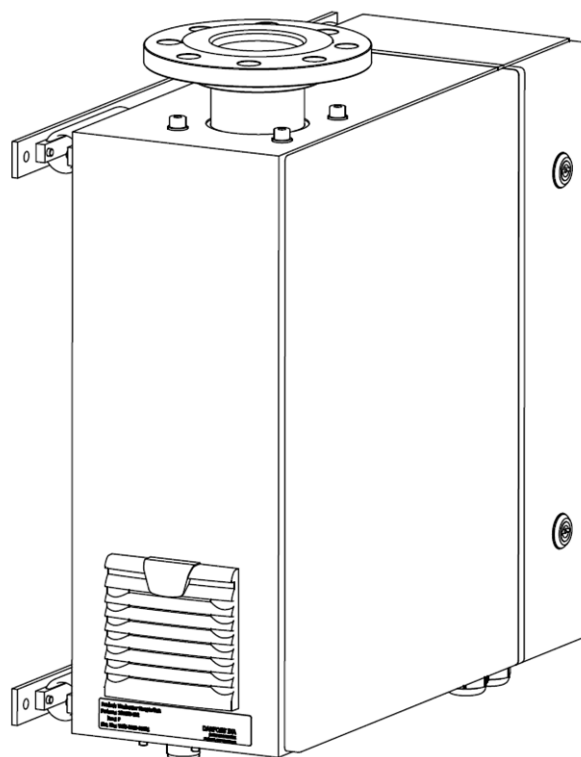


Illustration 11: WSU Cabinet Visual Name Plate

4. Mechanical Installation

4.1. General Installation Requirements

CAUTION

Read the installation guide before installing the cabinets. Failure to follow the recommendations could result in personal injury or system failure.

CAUTION

It is important to plan the installation of the cabinets. Neglecting to plan may result in extra work during and after installation.

NOTICE

When receiving the cabinets, make sure that the packaging is intact. Also check for any damage that might have occurred to the WMS during transport. In case damage has occurred, immediately contact the shipping company to claim the damage.

NOTICE

Danfoss IXA does not provide any materials (piping connections, wiring etc.) used for connecting the WMS to the exhaust gas cleaning system.

Consider and obey the following requirements when mounting and installing the cabinets, piping and filters. The following list refers to Illustration 12: .

- Ensure the name plates on the cabinets are visible and readable.
- Ensure at least a 5° slope on the piping between the installation point and WSU (WSU cabinets must always be placed below installation point level).
- The inlet piping to the WSU including the WSU cabinet must always be below its installation point.
- The WSU at scrubber inlet must have its installation point prior to the scrubber inlet pumps.
- The installation point must be placed in a way that prevents sedimentation from entering the WSU inlet piping.
- The WAU discharge pipe must be connected to the scrubber discharge pipe above water line at heavy ship condition.
- Pressure drop in the WMS's piping system must not exceed 1.3 bar.
- Minimum required flow in the system is 6 l/min.
- Ensure that the WSU de-gas pipe ends in a free vent above the main deck of the ship.
- Ensure that no foreign objects can enter the system through the de-gas pipe.
- Always make sure that there is a filter installed in the WSU inlet pipe. For further information see 4.4 - *WSU inlet installation*
- Ensure that the filters are mounted in a reachable and visible position for easy cleaning.
- Ensure using flexible connections with a maximum length of 1 m at inlets and outlets from WSU and WAU to minimize vibrations.
- Ensure obeying applicable legal requirements when working with electrical equipment.
- Ensure that the thermal relay(s) in the WSU junction boxes are adjusted according to the supplied voltage.

4.1.1. Installation principles illustrated

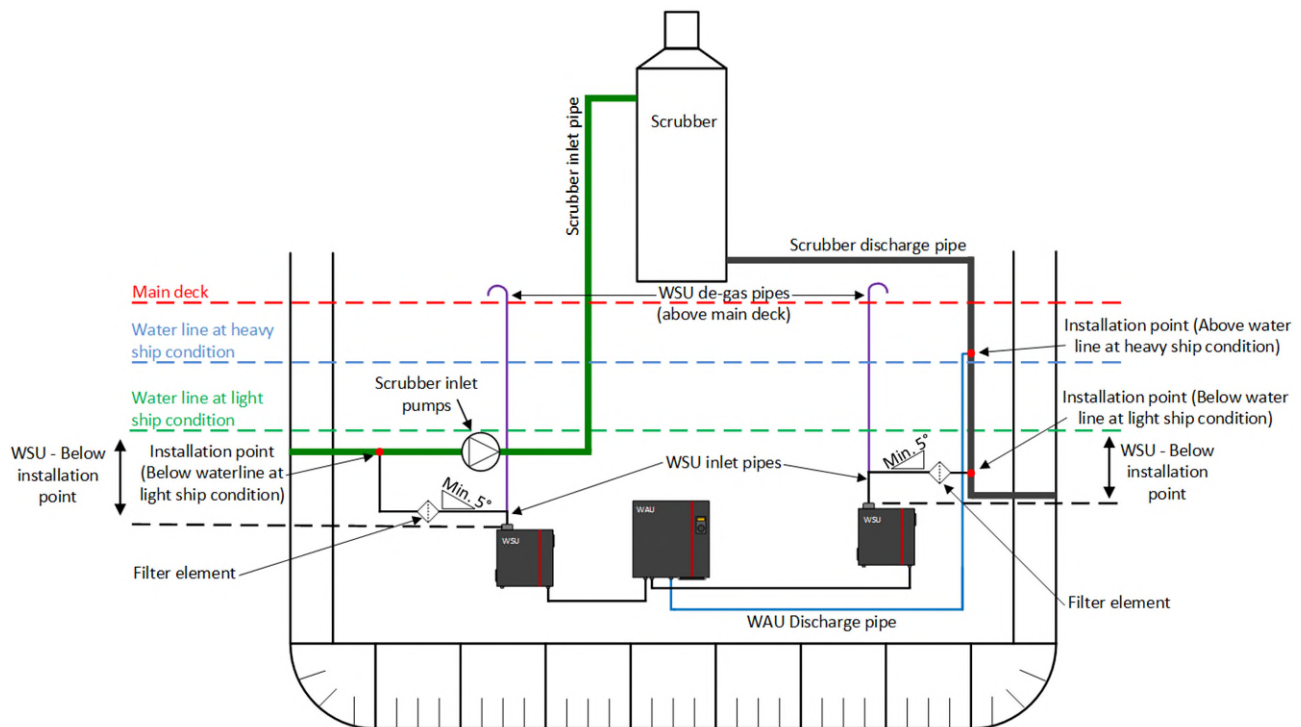


Illustration 12: Installation principles illustrated

4.2. Preparation

4.2.1. Preparing the Installation Site

NOTICE

Determine the installation locations, ensuring that all requirements stated in 4.1 - General Installation *Requirements* are obeyed.

Observe that the space requirements are fulfilled and that there is easy access for any maintenance work.

4.3. Mounting the WAU and WSU cabinets

This section describes how to prepare and mount the WSU/WAU cabinets and filter.

NOTICE

All cabinets must be mounted horizontally, levelled and aligned.

NOTICE

The distance between the WSU and WAU cabinets should be minimal. Minimize the distance between the cabinets when possible.

CAUTION

The cabinets are heavy! Use lifting equipment.

4.3.1. Mounting the WAU Cabinet

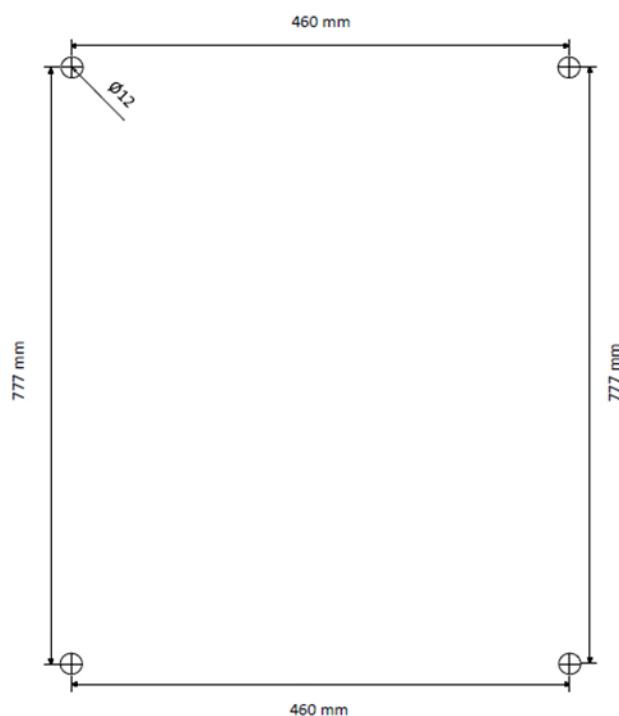


Illustration 13: WAU Cabinet Hole Distances

- Drill four $\varnothing 12$ holes according to Illustration 13.
- Ensure alignment and level correspond to those of the acceptance criteria.
- Mount the WAU cabinet using four $\varnothing 12$ bolts (3), four washers (2) and four nuts (1) – Material: Stainless steel
- Tighten all bolts with torque 50 Nm.

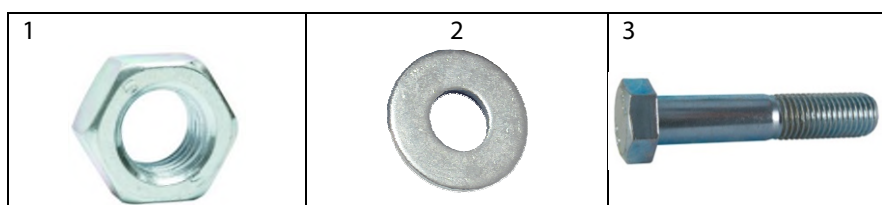


Table 4 Bits and Pieces for WAU Cabinet Mounting

4.3.2. Mounting the WSU Cabinet

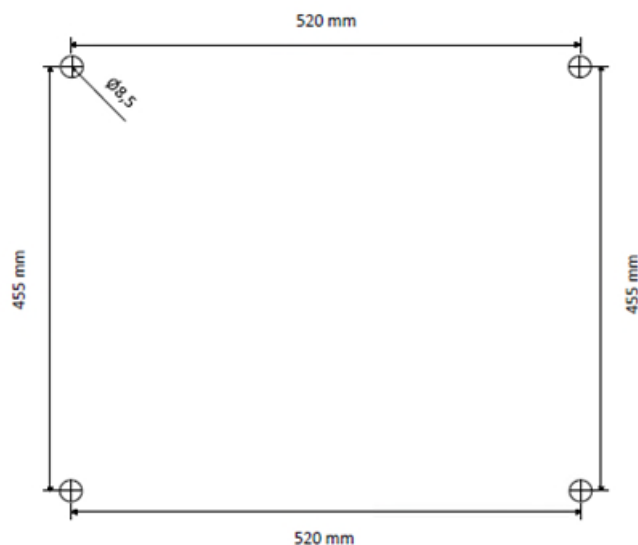


Illustration 14: WSU Cabinet Hole Distances

- Drill four $\varnothing 8$ holes, see Illustration 14.
- Ensure alignment and level correspond to those of the acceptance criteria.
- Mount the WAU cabinet using four $\varnothing 8$ bolts (3), four washers (2) and four nuts (1) – Material: Stainless steel
- Tighten all bolts with torque 17 Nm.



Table 5 Bits and Pieces for WSU Cabinet Mounting

4.4. WSU inlet installation

NOTICE

It is important that the installation of the WSU inlet piping is done according to the requirements in 4.1 - *General Installation Requirements*.

When installing the WSU inlet please follow the principle in Illustration 15.

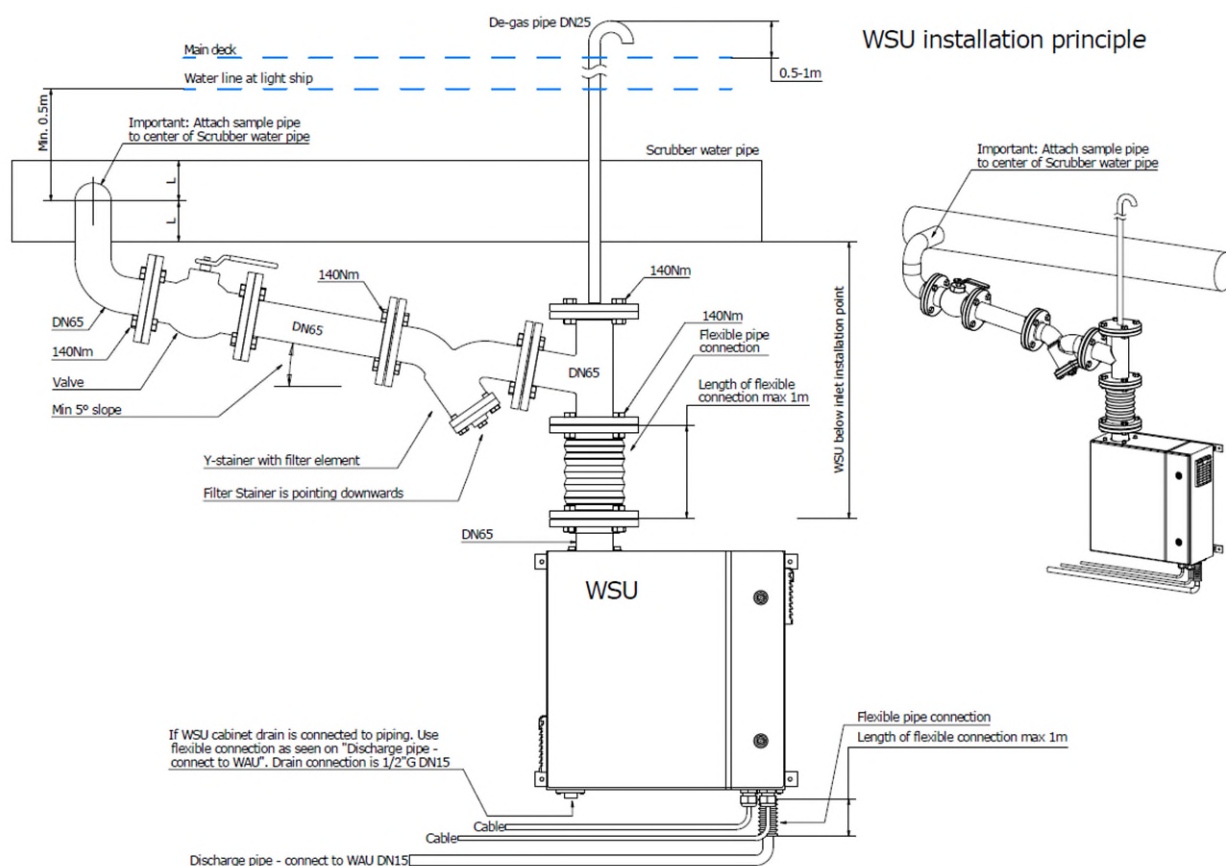


Illustration 15: Principle illustration of WSU installation

4.4.1. Mounting the Filter Element

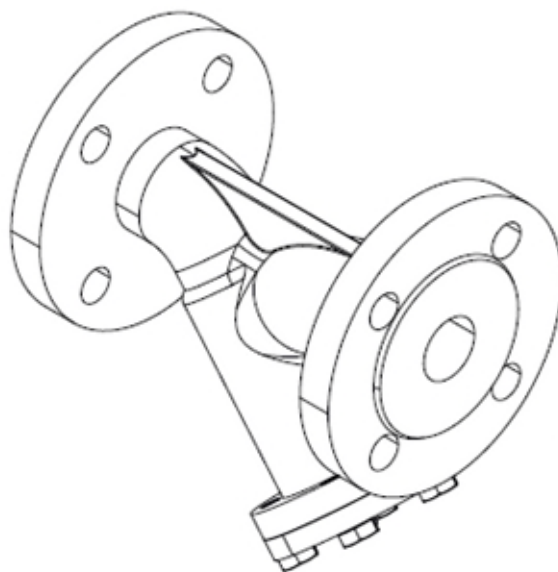


Illustration 16: Filter Element

NOTICE

The filter element should be located before the flex-piping and after the WSU inlet valve at each WSU.

- Ensure that the filter strainer is pointing down as shown on Illustration 16: Filter Element.
- Mount the filter element with 3 Ø16 bolts (4), 3 nuts (1) and 3 washers (2) at each end.
- Mount the gasket (3) at both ends.
- Mount the fourth bolt (4), fourth nut (1) and fourth washer (2).
- Bolts, nuts and washer's material: Stainless steel
- Tighten all bolts with torque 140 Nm

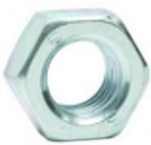



1		2		3		4	
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Table 6: Bits and Pieces for Filter Mounting

4.5. WAU and WSU interfaces

4.5.1. Interface Plate WAU

For details, see Table 7: Bottom View of WAU Cabinet

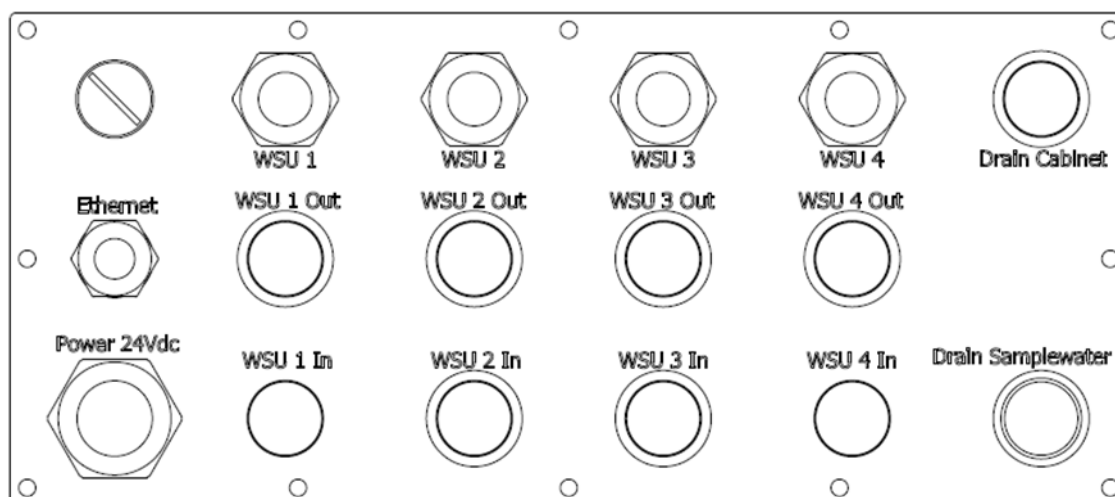


Illustration 17: Bottom View of WAU Cabinet

Name	Description	Size
WSU 1	For signal cable between WSU 1 and WAU	Cable gland M25
WSU 2	For signal cable between WSU 2 and WAU	Cable gland M25
WSU 3	For signal cable between WSU 3 and WAU	Cable gland M25
WSU 4	For signal cable between WSU 4 and WAU	Cable gland M25
Drain cabinet	Drain for WAU cabinet (only for spillage or leakage inside the cabinet)	G½"
Ethernet	For communication cable between WAU and the ships control system	Cable gland M20
WSU 1 Out	Discharge of sample water – bypass from WSU 1	G½"
WSU 2 Out	Discharge of sample water – bypass from WSU 2	G½"
WSU 3 Out	Discharge of sample water – bypass from WSU 3	G½"
WSU 4 Out	Discharge of sample water – bypass from WSU 4	G½"
Power 24 Vdc	For power supply of the WAU	Cable gland M32
WSU 1 In	Inlet of sample water from WSU 1	G½"
WSU 2 in	Inlet of sample water from WSU 2	G½"
WSU 3 in	Inlet of sample water from WSU 3	G½"
WSU 4 in	Inlet of sample water from WSU 4	G½"
Drain sample water	Discharge of sample water – from measurement chamber	G½"

Table 7: Bottom View of WAU Cabinet

4.5.2. Interfaces WSU

For details see, Table 8: WSU Cabinet Top

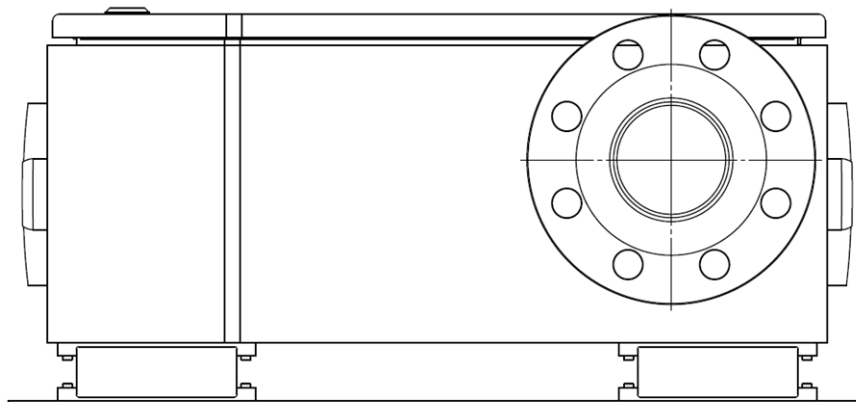


Illustration 18: WSU Cabinet Top

Name	Description	Size
WSU inlet	For connecting WSU inlet pipe	2½" flange (DN65)

Table 8: WSU Cabinet Top

For details see, Table 9: Bottom View of WSU Cabinet.

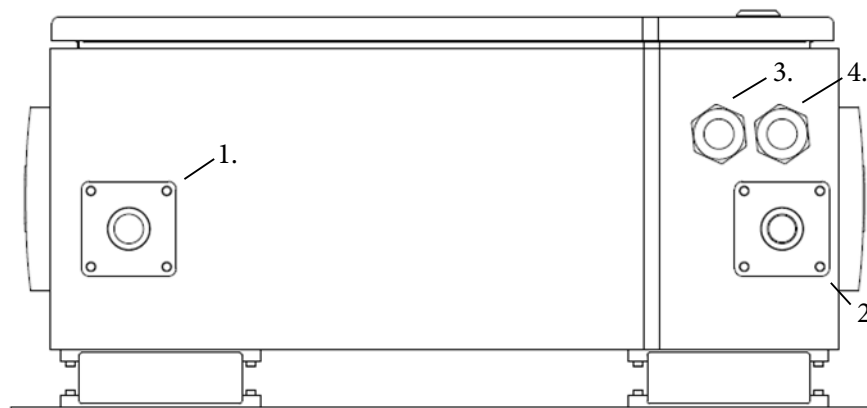


Illustration 19: Bottom View of WSU Cabinet

Name	Description	Size
1. Cabinet drain	Drain for WSU cabinet (only for spillage or leakage inside the cabinet)	G½"
2. WSU outlet	For piping between WSU and WAU	G½"
3. Cable gland	For power supply cable	Cable gland M25
4. Cable gland	For signal cable between WSU and WAU	Cable gland M25

Table 9: Bottom View of WSU Cabinet

4.6. pH sensor installation

When receiving the WAU the pH sensor is not yet installed. Installation of the pH sensor must be done on site. Please see Illustration 20 for installation of the pH sensor.

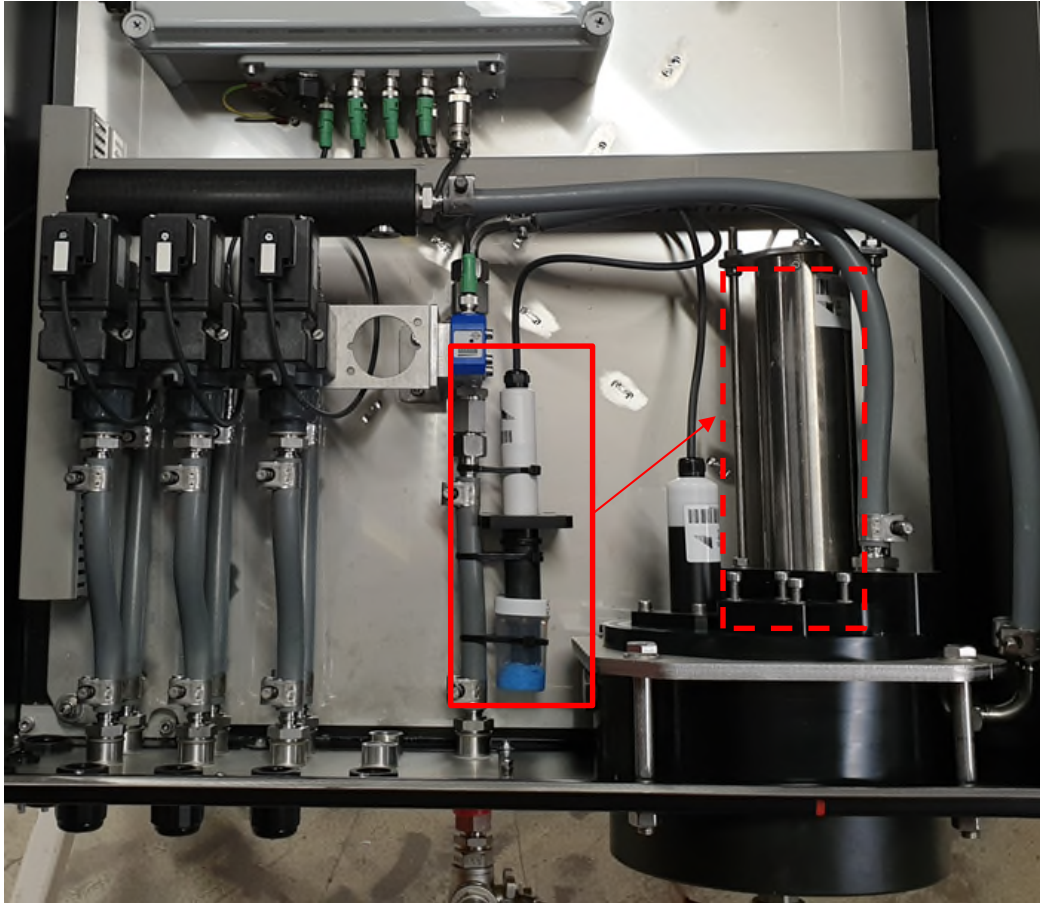


Illustration 20: Placement of pH sensor when receiving the WAU

When installing the pH sensor remove the protective cap by holding the sensor vertically downwards and unscrewing the cap. The sensor is supplied with a filled protective cap containing a solution of pH4 buffer and potassium chloride. Therefore, the sensor does not need to be activated in order to achieve optimum measurements.

NOTICE

If the sensor is dry, it must first be conditioned for several hours (>12h) in pH4 buffer. The measurement chamber must be filled with water immediately after installing the pH sensor to prevent the sensor from drying out.

When installing the pH sensor tighten the bolts with torque 0.35 Nm. Make sure that the sealing is placed correctly.

5. Electrical Installation

5.1. Overview of Electrical Wiring of the WMS

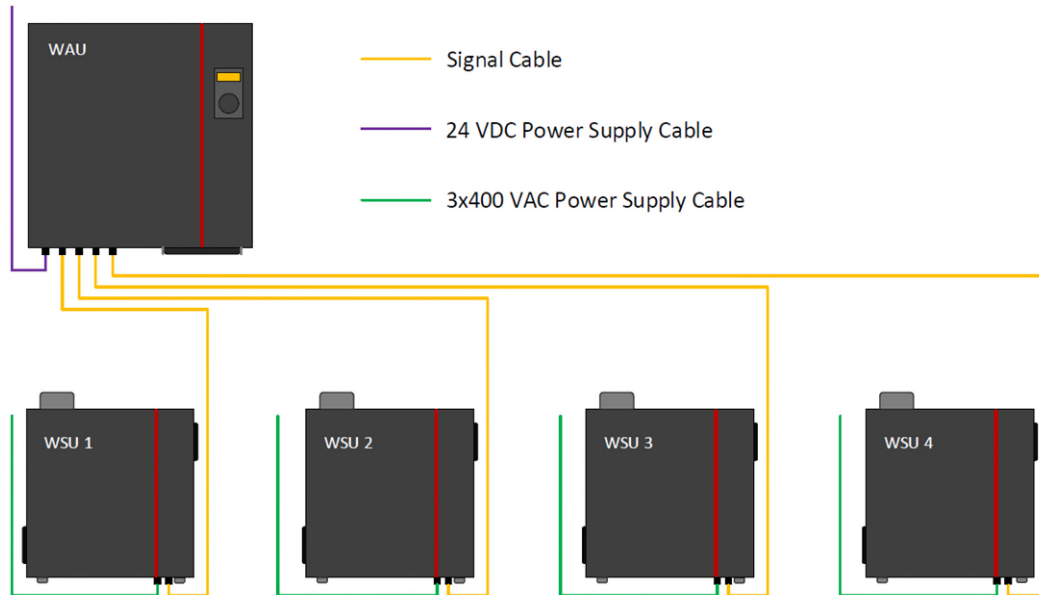


Illustration 21: Overview of Electrical Wiring of the WMS with four WSUs (Note that number of WSUs may vary across installations)

NOTICE

Power supply cables and signal cables for the WMS are not included in the Danfoss IXA scope of delivery and therefore not supplied by Danfoss IXA.

5.2. General Electrical Installation Requirements

Connect all required cables. Ensure correct cable connections.

CAUTION

Do not apply power before cables are properly connected. Hold cables in place with cable ties.

NOTICE

Allow enough excess cable length between the cabinets and the first fixation point for the cabinets to move freely in vibrating environments.

5.2.1. Power supply cable for WSU

The power supply cable for the WSU pumps should be a shielded marine cable with four conductors, and the termination points are limited to a minimum conductor cross-section of 0.14 mm² and a maximum conductor cross-section of 1.5 mm².

5.2.2. Power supply cable for WAU

The power supply cable for the WMS Controller should be a shielded marine cable with two conductors, and the termination points are limited to a minimum conductor cross-section of 0.5 mm² and a maximum conductor cross-section of 10 mm².

5.2.3. Signal cable between WAU and WSU

The signal interface cable between the WAU cabinet and WSU cabinets should be a shielded marine cable with four conductor pairs (e.g. 4x2x0.75 mm²), and the termination points are limited to a minimum conductor cross-section of 0.14 mm² and a maximum conductor cross-section of 1.5 mm².

5.2.4. Dimensioning of power supply cables

For dimensioning of power supply cable for WSU please refer to Table 11: WSU pump motor for WSU power consumption.

For dimensioning of power supply cables for WAU please refer to Table 13: WMS Controller Power Supply Specification for WAU power consumption.

5.2.5. Dimensioning of signal cables between WAU and WSU

For dimensioning the signal cables between the WAU and WSU the maximum power consumption for each conductor pair is 3 W with a supply voltage of 24 VDC.

5.2.6. Shield Installation in EMC Cable Glands

The WMS systems contains EMC cable glands. Illustration 22 shows the correct installation of the shield in the EMC cable.

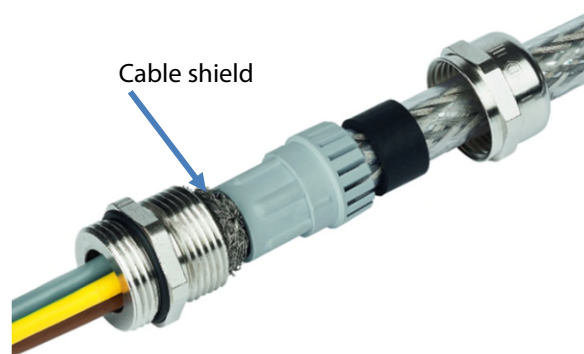


Illustration 22: Correct Installation of the Shielded Cable in the EMC Cable Gland

NOTICE

Incorrect mounting of the cable shielding in the EMC cable gland may cause the WMS to malfunction.

5.3. Electrical Installation of WSU

Each WSU cabinet requires the installation of two cables. A power supply cable and a signal cable. These two cables are installed in the junction box inside the WSU cabinet. Illustration 23 shows the WSU cabinet with the junction box inside the red square and the termination points in the yellow square. The green arrow on the illustration marks the cable gland for the power supply cable and the orange arrow marks the cable gland for the signal cable. The termination points are divided into two termination blocks. Table 10 specifies the two termination blocks.

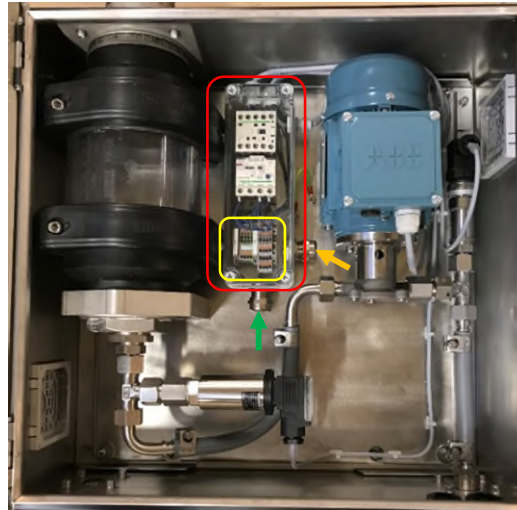


Illustration 23: WSU Cabinet with the Junction Box inside the Red Square and the Termination Points inside the Yellow Square

Termination block	Specification
-X1	Termination points for power supply of sample pump
-X2	Termination points for signal interface cable from WSU to WAU

Table 10: Terminations blocks in WSU junction box

5.3.1. Connection of Power Supply Cable and Signal Cable on WSU Termination Points

Illustration 24 shows how to connect the WSU power supply cable and WSU signal cable on the termination points in the WSU junction box.

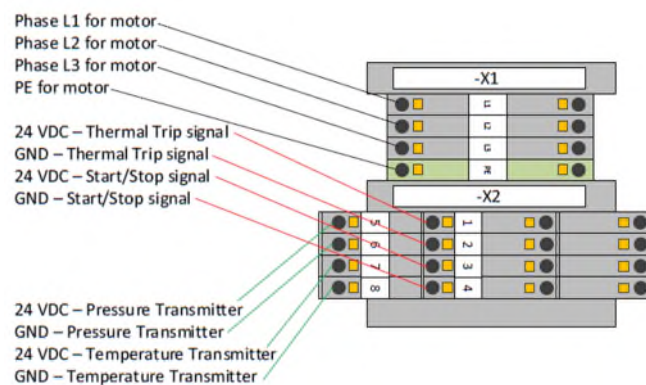


Illustration 24: Connection of Power Supply Cable and Signal Cable on WSU Termination Points

NOTICE

The cable for the WSU pump motor and the interface signal cable should have a minimum conductor cross-section of 0.14 mm² and the maximum conductor cross-section should be 1.5 mm². Table 11: WSU pump motor shows the specifications of the WSU pump motor.

WSU Pump motor specifications					
V	Hz	Rpm	kW	A	Cosφ
230D	50	1370	0,18	1,16	0,61
400Y	50	1370	0,18	0,67	0,61
460Y	60	1700	0,18	0,61	0,55

Table 11: WSU pump motor

5.4. Electrical Installation of WAU

The termination points for installing the power supply cable for the WAU and the signal cables from the WSU cabinets are in the controller box inside the WAU. Illustration 25 shows the WAU Controller Box with the termination points within the red square. The yellow arrow in Illustration 25 marks the cable gland for the power supply cable and the orange arrows mark the cable gland for the signal cables. Cable glands for signal cables from WSU 3 and WSU 4 are placed on a flange beneath the cable glands in Illustration 25, if the WMS has three or four WSU cabinets.

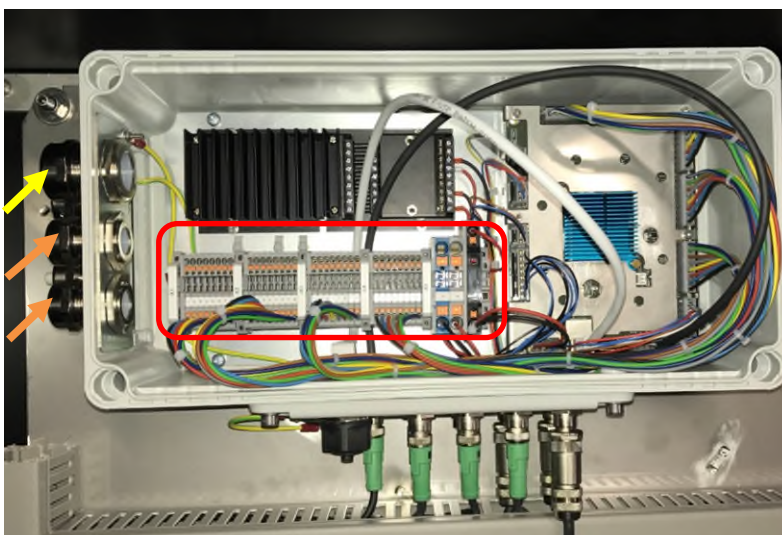


Illustration 25: WAU Controller Box with the Termination Points inside the Yellow Square

The termination points are divided in five termination blocks and Table 12 shows the specifications of the five termination blocks.

Termination block	Specification
-X1	Thermal relay trip signals
-X2	Sample pump start/stop signals
-X3	WSU pressure transmitter signals
-X4	WSU temperature transmitter signals
-X5	Power supply for WMS Controller

Table 12: Termination blocks in WAU Controller Box

5.4.1. Connection of WSU Signal Cables on Termination Points in WAU Controller box.

Illustration 26 shows how to connect the WAU power supply cable and the WSU signal cables from WSU1, WSU2, WSU3 and WSU4.

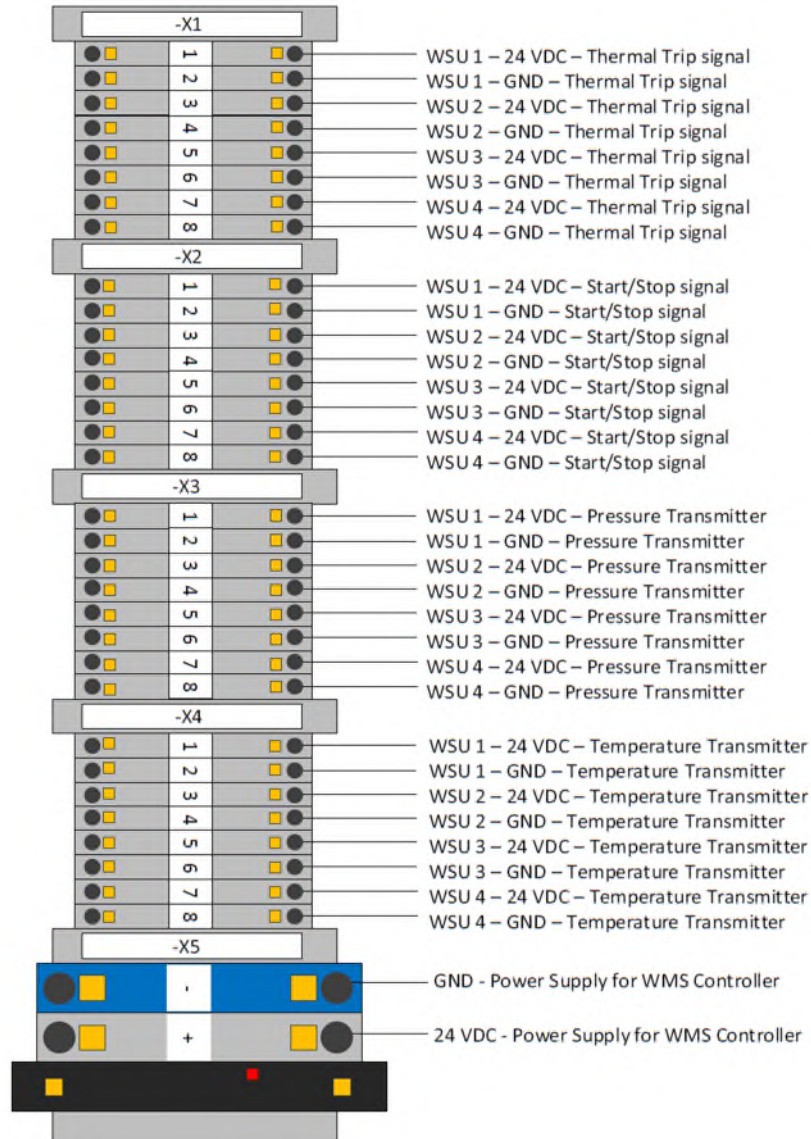


Illustration 26: Connection of Power Supply Cable and Signal Cables on WAU Termination Points in WMS Controller Box

NOTICE

The interface signal cable should have a minimum conductor cross-section of 0.14 mm^2 and the maximum conductor cross-section is 1.5 mm^2 .

NOTICE

The power supply cable for the WMS controller should have a minimum conductor cross-section of 0.5 mm^2 and the maximum conductor cross-section is 10 mm^2 .

5.4.2. Power Supply for WMS Controller

Table 13 shows the technical specifications of the power supply for the WMS controller.

Parameter	Specification
Input Voltage Range	9-36 VDC
Output Voltage	24 VDC
Output Current Full Load	6.3 A
Rated Power Output	150 W

Table 13: WMS Controller Power Supply Specification

5.5. Fuse Specifications and Installation

The WMS Controller is protected by a fuse and Table 14 shows the technical specifications of the fuse. The fuse is installed in the black terminal shown on Illustration 27: Termination Points for Power Supply of WMS Controller. A red LED indicator on the terminal with fuse indicates the condition of the fuse.

Parameter	Specification
Rated current	6.3 A
Class	T (Time-lag)
Size	G / 5 x 20 mm
Insulating tube	Ceramic, non-transparent with extinguishing filler

Table 14: Fuse Specifications

Terminal with fuse

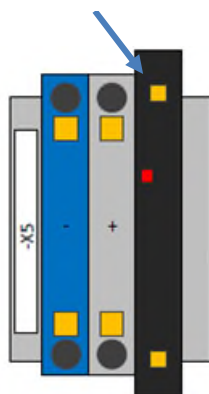


Illustration 27: Termination Points for Power Supply of WMS Controller

5.6. Ethernet Connection

Illustration 28 shows the connection socket for connecting the RJ 45 connector to communicate with the WMS Controller.



Illustration 28: Bottom Flange on WAU Controller Box with the Ethernet Connection Socket in the Red Circle

6. Before operating the WMS system

NOTICE

When the entire piping system for the WMS is installed and is in place make sure that all pipes are flushed free from dirt, dust, welding remains and everything else than can end up in the piping system during construction. If flushing of the pipes is not performed before operating, the WMS system will malfunction.

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