Installation Planning Instructions

Document ID	DMCA00030076-
Date of issue	23 November 2020
Installation	CCG College
Product	Wärtsilä 26
Project ID	SP/04235
Version	a3

WÄRTSILÄ

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Preface

Wärtsilä as supplier and the yard as contractor need to communicate installation specific information to build an installation that is both reliable and economical in use. During the years this information has evolved into what we today are calling the Installation Planning Instruction (IPI).

Instructions included in this file are installation specific and based on the best of our experience and knowledge. The instructions shall be used as a recommendation with general guidelines. However, project specific deviations can be accepted based on special consideration. Alternative solutions and design should be separately agreed with Wärtsilä.

The level of content maintained in the IPI is based on the assumption that the receiving contractor maintains the workmanship required to design and build high quality ship installations.

The IPI is a living document that is updated according to the proceeding project and as far as technically possible reflect the actual situation. Each updated issue of the IPI is identified by its own unique version number (e.g. "project xx" - a1) which should be referred to in any correspondence or discussion related to the specific projects.

Issuing the first or any new version of IPI is proceeded by our internal quality assurance and approval by the Project Manager. To ensure further development in our common interest we appreciate your comments forwarded to us via the Project Manager.

Wärtsilä, Marine Business

Version History

Version	Date	History
a3	2020-11-23	
a2	2020-06-04	
a1	2019-11-11	

List of Changes

List of updated text in this version

See section		Page
1.5	Information in section "Wärtsilä scope of supply for project CCG College" has been updated.	1-4
6.4.5	Information in section "Dyno cooler (4E08b)" has been added.	6-8
6.4.6	Information in section "1-Circuit radiator(4E08a)" has been updated.	6-8
6.4.7	Information in section "Dyno pump (4P15)" has been updated.	6-8
6.4.8	Information in section "Radiator Circulation Pump (4P15)" has been updated.	6-8
8.4.1	Information in section "Exhaust gas bellows (5H01)" has been updated.	8-6
8.4.3	Information in section "Exhaust gas pipe bellows (5H03)" has been added.	8-6
8.4.4	Information in section "Exhaust gas pipe support" has been added.	8-6
10.8.5	Information in section "Communication box (8N39)" has been added.	10-16

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DMTA00019918 - Installation of Wärtsilä 26 generating sets	new	2-17
DAAF472577 - Connection flywheel / flexible coupling	new	2-22
DBAD671345 g Factory acceptance test	revised from f to g	2-39
DBAF092245 a Recommended fuel oil system	revised from - to a	3-9
DBAF154697 a Main equipment list	revised from - to a	3-10
DBAF115744 a Oily water system	revised from - to a	3-15
DBAF115705 a Recommended lubricating oil system	revised from - to a	4-12
DBAF154729 a Main equipment list	revised from - to a	4-13
DBAF326690 a Condensate trap	revised from - to a	4-15
DBAF115729 a Recommended starting air system	revised from - to a	5-5
DBAF154513 a Main equipment list	revised from - to a	5-6
DMCA00070534 - 3F02 - Air filter (starting air inlet), dimensional drawing	new	5-9
DBAF154283 a 3N02 - Starting air compressor , (manual)	revised from - to a	5-11
DMCA00024057 - 1-Circuit radiator (4E08a), manual	new	6-12
DBAF115731 a Recommended cooling water system	revised from - to a	6-40
DBAF155109 a Main equipment list	revised from - to a	6-41
DBAF115735 a Recommended charge air and exhaust gas system	revised from - to a	8-9
DBAF155033 a Main equipment list	revised from - to a	8-10

DAAF054137 - 5H03 - Exhaust gas pipe bellows, dimensional drawing	new	8-19
DMCA00070577 - Dyno transformer	new	10-31
DMCA00026530 a 9N03 - Motor Starter for Pre-lube oil pump	revised from - to a	10-39
DMCA00004817 b Engine modbus list RTU	revised from a to b	10-74
DMCA00070680 - Ethernet connection box	new	10-115
DBAF115752 - Recommended water distribution system	removed	-
tobeadded Connection flywheel / flexible coupling	removed	-
DAAB726284 - 3F02 - Air filter (starting air inlet), dimensional drawing	removed	-
DBAF105332 - Engine room arrangement	removed	-
DMCA00030004 - Installation of Wärtsilä 26 generating sets	removed	-
DBAF154802 - Water distribution system - Main equipment list	removed	-

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1. Project Information

1.1 Project administration

Wärtsilä internal order number:	SP/04235	
Wärtsilä project name:	CCG College	
Wärtsilä project organisation:		
Project manager:	Kalle Kolhi	
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Mechanical design engineer:	Claudio Gazzin	
Electrical design engineer:	Tom Källskog	

1.2 Project technical data

1.2.1 Ambient conditions

The equipment is designed for the following conditions:

Maximum ambient air temperature	45	°C
Maximum LT cooling water temperature before engine	38	°C
Maximum sea water temperature	32	°C
Relative humidity	60	%

1.2.2 Fuel oil specification

This installation is designed for MDF operation according to ('ISO8217:2010')(E) with the viscosity of 11.0 cSt at 40°C.

Table 1-1 ISO-F-DMB

Property	Limit	Unit
Density at 15°C, max.	900	kg/m^3
Viscosity at 40°C, max.	11	cSt
Flash point, min	60	°C
Pour point (upper) - winter quality, max - summer quality, max	 0 6	 °C °C
Sulphur, max.	2	% mass

Property	Limit	Unit
Carbon residue, max.	0.3	% mass
Ash, max.	0.01	% mass
Total sediment existent, max.	0.1	% mass
Water, max.	0.3	% mass
Acid number, max.	0.5	mg KOH/g

More detailed fuel oil requirements are specified in chapter "*Fuel Oil System*".

1.2.3 Classification

The equipment meets the requirements of DNV GL for unrestricted service at the date of order.

1.2.4 Electric power supply

If not specially mentioned, all electrical equipment delivered with the engine is designed to operate with:

Main voltage (V) 3x600

Frequency (Hz) 60

Control voltage (VDC) 24

1.2.5 Painting

The generating set(s) will be painted with factory standard colour RAL 5019 Capri Blue.

1.2.6 Factory acceptance test

A description of the procedure during factory acceptance test is enclosed in document "*Factory acceptance test*".

1.3 Documents in this project

1.3.1 Comments to this document

Any comments to the material enclosed in this IPI-file have to be sent within one (1) month after receipt, if not stated differently in contract.

1.3.2 Shipyard drawings

The following drawings are subject to review and should be forwarded as soon as available in 2 copies, one of which will be returned with comments:

- Fuel oil piping diagram, including fuel treatment system and piping
- Lubricating oil piping diagram, including separating system
- Cooling water piping diagram, fresh and sea-water
- Starting air piping diagram
- Charge air and exhaust gas piping diagram showing the entire length of the pipes and details of the pipe supports

- Auxiliary engine foundation
- Crankcase vent piping diagram
- Electric power generation system single line diagram (when main switchboard is not Wärtsilä scope of supply)

1.4 Arrival inspection

The purpose of this section is to give instructions and requirements for arrival inspection and for reporting the events of any abnormalities like losses and damages. The Wärtsilä Customer / Buyer or their representative (=receiver) at the shipyard shall inspect the goods/products/material shipped to the shipyard. An early detection of possible abnormalities like damages helps preventing delays to the overall project schedule.

1.4.1 Responsibilities

The receiver at the shipyard is responsible for the inspection of the shipment to ascertain that all items are in good condition and that the shipment is complete without missing items.

The receiver is also responsible for immediate reporting of damages, as described later on, to Wärtsilä Project Manager and informing the transport company and the corresponding insurance company if the transport is not arranged by Wärtsilä.

1.4.2 Inspection

The inspection must be carried out at the earliest opportunity to ensure that damages or material shortages can be specified to avoid delays during installation or commissioning phase of the project.

Before opening the packing cases, special attention shall be taken to ensure that the storage location must be such that it gives protection against rain, dust, direct sunlight, theft, vandalism, etc. The damages or losses due to these reasons are not covered by Wärtsilä.

Material received shall be inspected for:

- transport damages
- water accumulation, moisture
- equivalence with specified types as stated in the packing lists
- quantity (comparison with the packing lists, ordered quantity and the actual contents delivered)

NOTE

When the packing case is opened, take care of adequate and tight closing, because most of packages are protected by shelf acting volatile corrosion inhibitor VCI.

If the goods are stored over three months before usage, condition checking and required actions must be performed according to the product specific instructions (especially engine, turbocharger).

1.4.3 Instructions to be followed in case of loss or damages

In the event of loss or damage the receiver must give immediate notice to their own insurance company if the transport is not arranged by Wärtsilä.

The receiver is requested to fill out the attached Wärtsilä Damage Report form accurately and sends it with enclosures to Wärtsilä Project Manager as soon as the damages or defects are found. Photographs taken of the damages will help in handling claims with the sub suppliers and / or the insurance company.

If the loss or damage is apparent at the time of receiving the delivery, Wärtsilä representative, ship owners, other carriers, forwarding agents, customs and port authorities must be requested to attend a joint survey, asked to certify the loss or damage and held liable in the form of written notice of loss by the receiver.

If the loss or damage was not apparent at the time of receiving the delivery, the receiver fills the Damage Report form within stipulated time.

Sea transport	at the latest 3 days after receipt
Road transport	at the latest 7 days after receipt
Air transport	at the latest 14 days after receipt
Rail transport	at the latest 7 days after receipt

NOTE

The claims made after the time limits mentioned above are not taken into account; all corrections made will be invoiced to the Buyer.

1.5 Wärtsilä scope of supply for project CCG College

Below is the scope of supply listed for this installation. More details about the scope are found in each system chapter.

Description	Qty/Set	
W26B - Wärtsilä 8L26	1	
1E04 - Cooler (MDF)	1	
3F02 - Air filter (starting air inlet)	1	FIG34
3T01 - Starting air receiver	1	500 L / DN38
3N02 - Starting air compressor unit	1	
4N01 - Preheating unit	1	
4V01 - Thermostatic Valve	1	
4V03 - Thermostatic Valve	1	
Temperature control valve (LT)	1	04GGSDBS32EABCA-AA
4E08a - 1-Circuit radiator	1	FBLGC-1000-12-5E8-96DN80S6
4E08b - Dyno Cooler	1	TL10-BFG
4P15 - Water break loop pump	1	
4P15 - Radiator loop pump	1	
5Z03 - Turbocharger cleaning device	1	Dosing unit
5H01 - Exhaust gas bellows	1	Double
5R02 - Exhaust gas silencer with spark arrestor (CSS)	1	MS-CPWAEXG-WSA NS550/ 35 DB(A)
9I05 - Transformer	1	
9N01- Starter for Radiator fan	5	
9N03 - Starter for engine pre lubricating oil pump	1	

Description	Qty/Set	
9N15 - Starter for engine turning gear	1	
9N05 - Starter for water break loop pump	1	
9N27 - Starter for radiator loop pump	1	
9N36 - Power Unit	1	
6H01 - Flexible pipe connections spare set	1	
6N01 - Common base frame	1	
6H01 - Flexible pipe connections	1	
7C01 - Flexible coupling (flywheel)	1	
7B01 - Flexible coupling fitting materials	1	
0Y01 - Lifting tool set	1	
0Z12 - VCI-coating	1	
0Z11 - Tarpaulin	1	
0J10 - Engine manuals	1	
0J21 - Inventory of Hazardous Materials (IHM)	1	
0J26 - Online Services	1	
Tools set	1	
Spares set	1	
Dyno Omega 3000 S2	1	

1.6 List of Documents

WÄRTSILÄ

Arrival Inspection Damage Report

Wärtsilä	Marine Solutions

Form Doc ID: DBAA042536

General information

Name of installation: (Yard + NB no.)		Project number: (Wärtsilä ID)	
		Shipment concerned:	
Type of Equipment:		Case no(s):	
		Damage Report number:	
Reported by:			

Description of damage

Probable cause

Witness statement and contact information

Use block letters for filling this form

Actions taken

Damage photographed	Yes ☐ No ☐ N/A ☐	Photographs enclosed	Yes ☐ No ☐
Insurance claim submitted	Yes ☐ No ☐ N/A ☐	Claim enclosed	Yes ☐ No ☐
Separate report submitted	Yes ☐ No ☐ N/A ☐	Report enclosed	Yes ☐ No ☐

Inspection performed by: Date: Verified by (Wärtsilä) : Date:

(Signature) (Signature)

MAINTENANCE DURING STORAGE

Document ID	DBAB317120
Installation	
Engine type	4-stroke engines
Engine number	
Project	

This manual is intended for the personal use of engine operators and should always be at their disposal. The content of this manual shall neither be copied nor communicated to a third person.

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Introduction

1. Introduction

V2

Note!
This document is a guideline for requirements to be followed, not a complete work instruction that gives a detailed description on, for example, the measures to be taken, needed oil quantities, recycling possibilities of oils. Therefore competent professionals should be used. Wärtsilä Service is recommended.

Prior to shipment from production factory, engines are corrosion protected according to the Wärtsilä standard program.

Wärtsilä factory protection provides a protection durability of 12 months with no need for maintenance or internal inspections.

The owner of the engine is responsible for storing the engine as well as for inspecting the engine externally at least once a month.

When the 12–month storage period is coming to a close, Wärtsilä must be contacted and certain maintenance procedures performed.

2. Engine storage requirements

2.1. Requirements for storage site V2

- Store the engines and generating sets as well as possible spare parts and tools primarily in a dry and well-ventilated facility free from dust and dirt. If not stored indoors, the machines must be completely covered by a roof.
- Place the engine and generating set on a flat, horizontal and vibration-free surface. If vibrations can be suspected to exist, take precautions to isolate the machines, for example, by placing rubber blocks under the feet at two-meter intervals.
- Place all corrosion sensitive spare parts and tools possibly delivered along with the engine/generating set at a height of one meter in minimum, due to the impact of relative humidity.
- Check that the storage location provides sufficient space around the machines for performing routine maintenance and headroom to allow the overall protective covers to be both removed and re-placed.

A pre-lubricating pump with required filters must be available on site, especially when the storage time is longer than 12 months. The pre-lubricating pump should be movable so that it can be used for several engines when necessary.

Corrective actions

3. Storage period inspections

V1

If it is necessary to store the engine for an extended period of time, the protection and the external condition of the engine must be inspected regularly during storage.

Check the engine externally monthly. If the environmental conditions and storage site requirements are not met, check the engine more frequently.

If abnormalities, such as tears or dislocation of the protective covers, signs of condensation water or rust, are found in the external inspection, check the engine internally.

3.1. Inspecting the engine externally

V1

1. Open the tarpaulin and check the engine externally.
2. Check the temperature and relative humidity and record the values in the preservation log.
3. Check that there are no harmful compounds at the storage site.
4. Check the vapor corrosion inhibitor (VCI) covers for condensation. If condensation is considerable, check under the VCI covers. If necessary, check the engine internally, repair any damages caused by rust, and install a new VCI cover.
5. Replace the tarpaulin.
6. Check that the protective covers are in place and the ropes are properly fastened.
7. Inform Wärtsilä about any abnormalities found during the inspection.

Storage period inspections

3.2. Inspecting the engine internally

V2

Check the engine internally, if abnormalities, such as tears or dislocation of the protective covers, signs of condensation water or rust, are found in the external inspection.

Note!
Do not let the engine be affected by weather conditions during the inspection.

1. Open the crankcase covers of the first and last cylinder, the corresponding covers of the camshaft and cylinder head, and the covers of the hot box.
2. Check the rocker arms, valve heads, springs, fuel valves, and push rods.
3. Check the shaft, bearings, cams, rollers, and gear wheels in the camshaft space.
4. Check the crankshaft, bearing covers, and gear wheels in the crankcase.
5. Check the external surfaces of the flexible coupling and the resilient mountings.
6. Take appropriate measures to improve the protection of any parts affected by corrosion.
7. Renew the VCI chips, VCI capsules and desiccant bags.
8. Inform Wärtsilä about any abnormalities found during the inspection.
9. Inspection of cooling water system:
    - Thermostat housing on engine
    - End cover opened for multi-duct
    - Cooling water pumps
    - CAC drain plug (see that it is properly sealed when assembly, otherwise there will come air to CW system on high load)

4. Corrective actions

4.1. Repairing surfaces damaged by rust

V1

If rust is found in the inspections, repair the damaged surfaces.

1. Remove all rust and oxidized surfaces.
2. Polish and clean the repaired surface.
3. Apply anti-corrosive agent approved by Wärtsilä on the repaired surface.

Corrective actions

4.2. Approved anti-corrosive agents V1

Table 4-1 A n t i -corrosive agents for the engine

Component	Anti-corrosive agent
• Camshaft • Crankshaft • Connecting rods • Cylinder liners • Main bearings • Gear wheels • Valve mechanism	Shell Ensis DW 2455 An oil-based corrosion inhibitor forming a thin, transparent, grease-like film. Dissolves into most lubricating oils.
• Unpainted surfaces on the cylinder head • Cylinder head screw threads • Hot box (i.e. injection pumps, control shaft, fuel pipes, other unpainted surfaces)	Tectyl 502 C An oil- and wax-based corrosion inhibitor forming a thick grease-like film. Dissolves into most lubricating and hydraulic oils.
• Internal surfaces of cylinders • Injection valves • Internal surfaces of high-pressure fuel pipes	Shell Calibration Fluid S An oil-based corrosion inhibitor forming a thin, transparent, grease-like film. Dissolves into most lubricating oils.
• Unpainted external surfaces • Flywheel • Indicator valves	Tectyl 506 EH A wax-based corrosion inhibitor forming a non-smudging, hard, brown, transparent film.

Table 4-2 Anti-corrosive agents for the generator

Component	Anti-corrosive agent
• Unpainted external surfaces of the generator	Tectyl 506 EH
• Shaft • Bearing seals	Refer to the supplier's documentation.
• Bearings	Refer to the supplier's documentation.
• Shaft extension • Coupling halves • Jacking screws	Refer to the supplier's documentation.

Corrective actions

Table 4-3 Anti-corrosive agents for the turbocharger

Component	Anti-corrosive agent
• Connecting flanges of the turbocharger cleaning system	Tectyl 506 EH
• Bearing surfaces	Refer to the supplier's documentation.
• Oil passages • Thrust faces	Refer to the supplier's documentation.

5. Extending the storage period every 12 months

V3

If the storage period is going to exceed 12 months, contact Wärtsilä at least 30 days before that and settle the following issues:

- Annual inspection.
- Rotation of the crankshaft and the rotor.
- Preservation/ anti-corrosive agents renewal.
- Interval for the external and internal inspections.

Contact Wärtsilä to settle *turbocharger* maintenance separately.

Note!
Regardless of the length of the storage period, perform the required external and internal inspections and take the necessary corrective actions.

Extending the storage period every 12 months

5.1. Annual inspection V1

The annual inspection consists of:

- Inspecting the crank pin.
- Checking the LT and HT pumps for rust and deposits.
- Checking the turbocharger for corrosion.
  - Cleaning and treating the components with protective oil for corrosion inhibition.
  - Sealing all openings.
  - Removing the turbocharger from the engine if instructed by Wärtsilä.
- Protecting the Wärtsilä-supplied generators against corrosion if there have been problems in storing.
  - Treating the shaft and bearing seals with a suitable anticorrosive agent.
  - Filling the bearings with the same protective oil that the manufacturer has used.
  - Improving the protection of unpainted surfaces such as shaft extension, coupling halves and jacking screws.
- Renewing the VCI capsules, VCI chips and desiccant bags and checking that the appropriate warning labels are in place.

5.2. Rotating the crankshaft and the rotor V2

1. Circulate engine oil in the lubricating system for approximately 15 minutes using a pre-lubricating pump with required filters.
2. Open the rocker arm covers and check that all parts of the valve mechanism are lubricated.
3. Check that the self-lubricating bearings of the generator are filled with oil. If needed, refill the bearings with the protective oil used by the generator manufacturer.

Note!
If the generator is equipped with flood-lubricated bearings instead of self-lubricating bearings, connect and actuate the lubricating system before rotating.

4. Check that there are no transportation devices or locking devices attached to the engine or the generator.

Extending the storage period every 12 months

5 Turn the flywheel of the engine six to ten times during the procedure.

Caution!
Rotating the crankshaft may damage the protective film on the bearing and cylinder liner surfaces. Also, atmospheric air may penetrate the crankcase and combustion chamber. Check the components and re-apply the appropriate anti-corrosive agents if necessary.

5.3. Wärtsilä factory protection renewal V1

After the crankshaft and the rotor have been rotated, Wärtsilä proceeds with the factory protection renewal.

6. Taking the engine into use

V1

1. Prepare the engine for transportation at the storage site.
   a) Drain any oil out of the crankcase.
   b) Attach the locking device to the generator.
2. Transport the engine to the installation site.
3. Install the engine.
4. Remove all protective covers and VCI products.

Note!
Make sure that the engine remains protected as long as possible.

5. Remove the desiccant bags. The desiccant bags are located behind the covers marked with red warning labels.
6. Remove the protective oil from unpainted external surfaces.
7. Reinstall any equipment removed from the engine during storage.
8. Commission the engine.

7. Keeping a preservation log

V3

The inspection and maintenance work on the engine or generating set should be documented in the preservation log.

The log should contain the following information about the inspection:

- Date and time for each action
- Temperature and relative humidity
- Abnormalities (e.g. tears or dislocation of the protective covers, signs of condensation water or rust) found
- Corrective actions performed
- Maintenance actions performed

The preservation log should be available to the installation and commissioning personnel when the engine or generating set is installed and taken into use after storage.

Preservation log

Date and time	Inspection	Temp.	Rel. humid.	Abnormalities (specify the component)	Corrective actions	Maintenance actions	Remarks

Preservation log

Date and time	Inspection	Temp.	Rel. humid.	Abnormalities (specify the component)	Corrective actions	Maintenance actions	Remarks

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2. Generating Set

2.1 About the generating set

The generating set comprises the diesel engine and the generator which are rigidly mounted on a common base frame. The common base frame is a welded steel structure. The complete generating set is installed on resilient mounts on the foundation in the ship.

The main dimensions, locations of pipe connections, location of sensors, space required for maintenance, weight and centre of gravity are shown in enclosed drawings.

2.1.1 Definitions

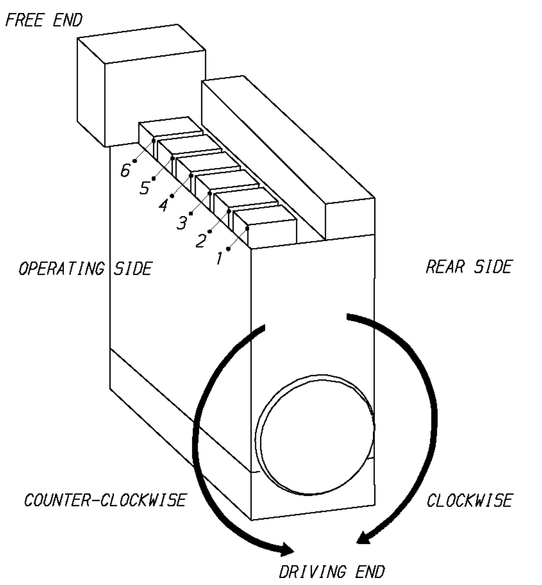


Fig 2-1 In-line engine definitions

2.1.2 Recommendations for operation

2.1.2.1 Starting and stopping

The engine can be started and stopped provided that:

- The engine and the fuel system are pre-heated to operating temperature. The HT-water temperature must be min. 60°C and the lubricating oil temperature min. 40°C.
- The pre-lubricating oil pump is running.

2.1.2.2 Recommendations for idling and low load operation

Absolute idling (unloaded generator):

- Max. 10 minutes, if the engine is to be stopped after the idling. 3-5 minutes idling before stop is recommended.
- Max. 6 hours if the engine is to be loaded after the idling.

Operation below 20% load:

- Max. 100 hours continuous operation. At intervals of 100 operating hours the engine must be loaded to minimum 70% of the rated output.

Operation above 20% load:

- No restrictions.

NOTE

For operation profiles involving prolonged low load operations, please contact Wärtsilä.

2.1.3 Maximum loading rate

Controlled load increase is essential for highly supercharged diesel engines, because the turbocharger needs time to accelerate before it can deliver the required amount of air. A slower loading ramp than the maximum capability of the engine also permits a more even temperature distribution in engine components during transients.

The load increase ramps presented in this document apply to all available outputs.

If the control system has only one load increase ramp, then the ramp for a preheated engine should be used. In case a ramp without knee-point is used, it must not achieve 100% load in shorter time than the ramp in the figure. The HT-water temperature in a preheated engine must be at least 60 °C, preferably 70 °C, and the lubricating oil temperature must be at least 40 °C. The ramp for normal loading applies to engines that have reached normal operating temperature.

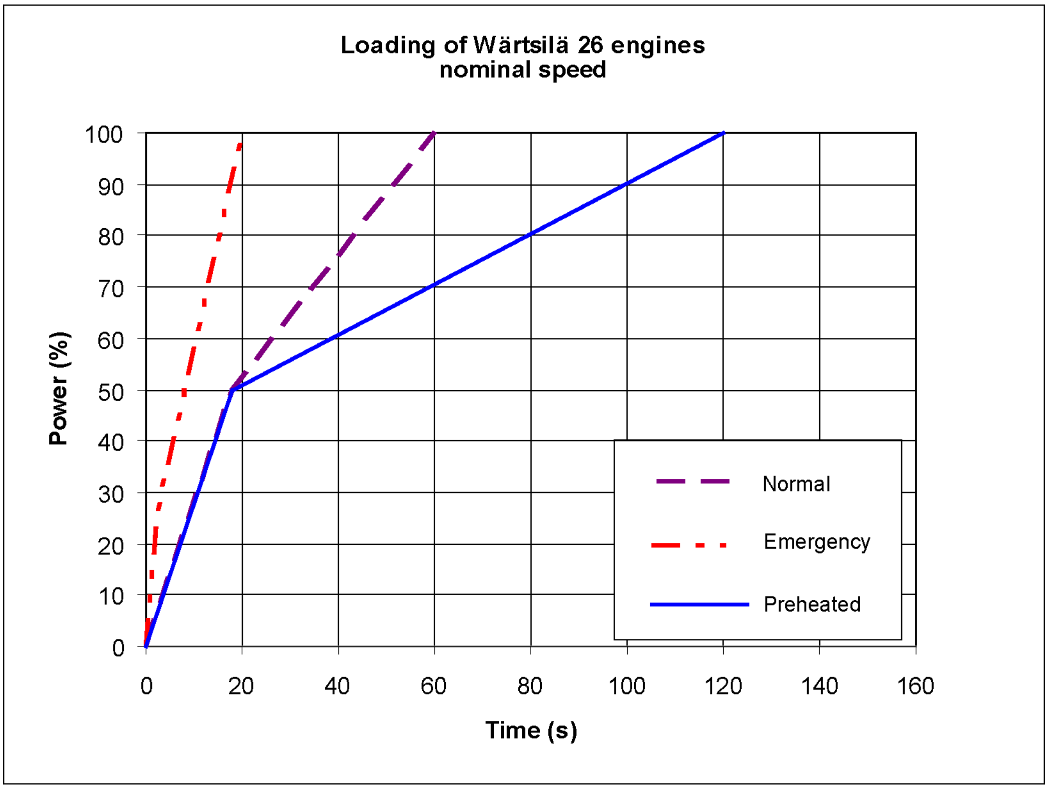


Fig 2-2 Maximum recommended load increase rates for engines operating at nominal speed

The “emergency” curve is close to the maximum capability of the engine and it shall not be used as the normal limit. In dynamic positioning applications maximum loading ramps corresponding to 20-30 seconds from zero to full load are however normal. If the vessel has also other operating modes, a slower loading ramp is recommended for these operating modes.

Load reductions should also be performed gradually in normal operation. The load should not be reduced from 100% to 0% in less than 15 s. In installations with frequent fast unloading from high load to low load special arrangements may have to be considered. In an emergency situation the full load can be thrown off instantly.

2.1.4 Maximum load steps

The electrical system must be designed so that tripping of breakers can be safely handled. This requires that the engines are protected from load steps exceeding their maximum load acceptance capability. The maximum permissible load step is 30% MCR. The resulting speed drop is less than 10% and the recovery time to within 1% of the steady state speed at the new load level is max. 5 seconds.

The engine must be allowed to recover for at least 7 seconds before applying the following load step, if the load is applied in maximum steps.

In normal operation the load should always be applied gradually according to a ramp or in small increments.

2.2 Technical information

2.2.1 Technical specification

The engine Wärtsilä 8L26 is a 4-stroke, non-reversible, turbocharged and intercooled diesel engine with direct injection of fuel.

Main particulars	
Type designation	Wärtsilä 8L26
Number of cylinders	8
Configuration	in-line engine
Max. continuous rating	2200 kW
Max. reverse power	5% of continuous rating
Nominal speed	900 rpm
Direction of rotation	Clockwise
Turbocharger	KBB ST6

2.2.2 Technical data

Wärtsilä 8L26		
Engine output	2200	kW
Cylinder configuration	8 L	
Engine speed	900	rpm
Bore	260	mm
Stroke	320	mm
Mean effective pressure	2.55 (25.5)	MPa (bar)

Wärtsilä 8L26		
Mean piston speed	9.6	m/s
Combustion air system (Note 1)		
Flow of air at 100% load	4.95	kg/s
Temperature at turbocharger intake, max.	45	°C
Air temperature after air cooler	50...60	°C
Exhaust gas system (Note 2)		
Exhaust gas flow at 100% load	5.12	kg/s
Exhaust gas flow at 85% load	4.4	kg/s
Exhaust gas flow at 75% load	4.0	kg/s
Exhaust gas flow at 50% load	2.96	kg/s
Exhaust gas temperature after turbocharger at 100% load	329	°C
Exhaust gas temperature after turbocharger at 85% load	326	°C
Exhaust gas temperature after turbocharger at 75% load	337	°C
Exhaust gas temperature after turbocharger at 50% load	342	°C
Exhaust gas backpressure, max	3 (0.03)	kPa (bar)
Exhaust gas pipe diameter, min	550	mm
Calculated exhaust diameter for 35 m/s	562	mm
Heat balance (Note 3)		
Jacket water	440	kW
Charge air (LT-circuit)	848	kW
Lubrication oil	376	kW
Exhaust gases	0	kW
Radiation etc.	120	kW
Fuel system (Note 4)		
Pressure before engine driven fuel feed pump, min	30 (0.3)	kPa (bar)
Pressure before injection pumps	700±50 (7±0.5)	kPa (bar)
Viscosity before engine (MDF), min	2.0	cSt
Max. MDF temperature before engine (TE 101)	45	°C
MDF low-pressure engine driven pump capacity	3.7	m^3/h
Pump capacity (MDF), engine driven	3.7	m^3/h
Fuel consumption at 100% load	188.2	g/kWh
Fuel consumption at 85% load	186.8	g/kWh

Wärtsilä 8L26		
Fuel consumption at 75% load	190.6	g/kWh
Fuel consumption 50% load	199.9	g/kWh
Leak fuel quantity (MDF), clean fuel at 100% load	10.3	kg/h
Lubricating oil system		
Pressure before engine, nom	450 (4.5)	kPa (bar)
Priming pressure, nom. (PT 201)	80 (0.8)	kPa (bar)
Temperature before engine, nom	68	°C
Temperature after engine, about	78	°C
Pump capacity (main), engine driven	81	m^3/h
Suction height of engine driven pump, max	4	m
Pump capacity (main), separate	75	m^3/h
Priming pump capacity	19.0	m^3/h
Suction height of priming pump, max	3.5	m
Oil volume, nom	1.6	m^3
Filter fineness	30	microns
Filter difference pressure alarm	80 (0.8)	kPa (bar)
Oil consumption at 100% load, approx.	0.5	g/kWh
Crankcase ventilation flow rate at 100% load	1350	l/min
Crankcase ventilation backpressure in external piping, max	0.3	kPa
HT cooling water system		
Pressure at engine inlet, after pump, nom (+ static pressure)	360 (3.6)	kPa (bar)
Pressure at engine inlet, after pump, max	500 (5.0)	kPa (bar)
Temperature before engine, about	81	°C
Temperature at the engine outlet, nom	91	°C
Pump capacity, nom	45	m^3/h
Pressure drop over engine	220 (2.2)	kPa (bar)
Water volume in engine	0.4	m^3
Pressure from expansion tank	70...150 (0.7...1.5)	kPa (bar)
Pressure drop in external system, max	60 (0.6)	kPa (bar)
Delivery head of stand-by pump	0 (0.0)	kPa (bar)
LT cooling water system		
Pressure at engine inlet, after pump, nom (+ static pressure)	270 (2.7)	kPa (bar)
Pressure at engine inlet, after pump, max	500 (5.0)	kPa (bar)
Temperature before engine, max	38	°C

Wärtsilä 8L26		
Temperature before engine, min	25	°C
Pump capacity, nom	56	m^3/h
Pressure drop over charge air cooler	0 (0.0)	kPa
Pressure drop over oil cooler	18 (0.2)	kPa (bar)
Pressure drop over central cooler, max	60 (0.6)	kPa (bar)
Pressure from expansion tank	70...150 (0.7...1.5)	kPa (bar)
Delivery head of stand-by pump	0 (0.0)	kPa (bar)
Starting air system (Note 5)		
Air pressure, nom	3000 (30)	kPa (bar)
Air consumption per start at 20°C	1.8	Nm^3

Notes:	
Note 1	At ISO 15550 conditions (ambient air temperature 25°C, LT-water 25°C) and 100% load. Flow tolerance 5%.
Note 2	At ISO 15550 conditions (ambient air temperature 25°C, LT-water 25°C). Flow tolerance 5% and temperature tolerance 20°C.
Note 3	The heat balances are made for ISO 15550 standard reference conditions. The heat balances include engine driven pumps (two water pumps and one lube oil pump).
Note 4	According to ISO 15550, lower calorific value 42700 kJ/kg at constant engine speed, with engine driven pumps (two cooling water + one lubricating oil pumps). Tolerance 5%.The fuel consumption at 85 % load is guaranteed and the values at other loads are given for indication only.
Note 5	At manual starting the consumption may be 2...3 times lower.

2.3 Recommendations for generator

The generator is not supplied by Wärtsilä, please note the enclosed recommendations.

Table 2-1 Generator recommendation documents

Description	Drawing no
Generator feet design, with vibracon	9506ZT733
Directive for designing of shaft end of generator, keeway	9506ZT734
Generator design considering vibrations	4V92F0141
Flexible connection between generator frame and cooler housing	4V92F0152

2.4 Design of the engine room

2.4.1 Engine room arrangement

Sufficient space for operation and maintenance has to be provided around the generating sets. For minimum centreline distance between the generating sets refer to the engine room arrangement drawing. The required service space around the generating set is stated in the service space drawing. No obstructive structures should be located close to the engine driven pumps nor crankcase or camshaft doors.

2.4.1.1 Maintenance space

Working space around the engine

The required working space around the engine is mainly determined by the dismounting dimensions of engine components, and space requirement of some special tools. It is especially important that no obstructive structures are built next to engine driven pumps, as well as camshaft and crankcase doors.

However, also at locations where no space is required for dismounting of engine parts, a minimum of 1000 mm free space is recommended for maintenance operations everywhere around the engine.

Engine room height and lifting equipment

The required engine room height is determined by the transportation routes for engine parts. If there is sufficient space in transverse and longitudinal direction, there is no need to transport engine parts over the rocker arm covers or over the exhaust pipe and in such case the necessary height is minimized.

2.4.2 Vibrations

Wärtsilä 26B generating sets comply with vibration levels according to ISO 8528-9.

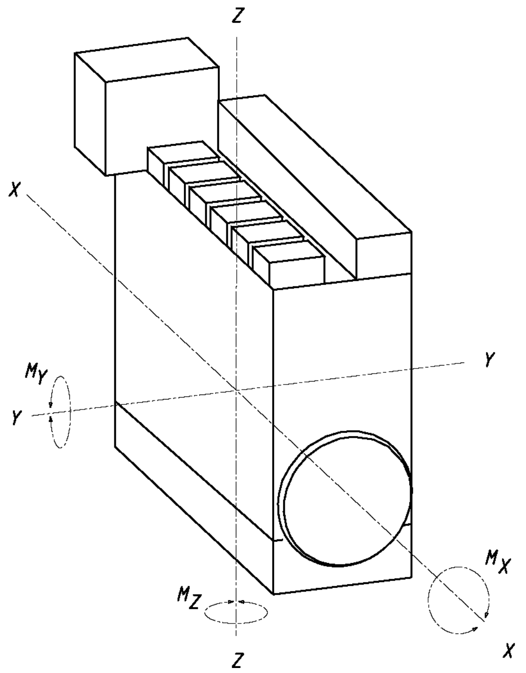


Fig 2-3 Coordinate system

2.4.2.1 External forces and couple

The ship designer should avoid natural frequencies of decks, bulkheads and superstructures close to the excitation frequencies. The double bottom should be stiff enough to avoid resonances especially with the rolling frequencies.

Table 2-2 External forces and couples

Engine	Speed [rpm]	Frequency [hz]	F_Y [kN]	F_Z [kN]	Frequency [hz]	M_Y [kNm]	M_Z [kNm]	Frequency [hz]	M_Y [kNm]	M_Z [kNm]
W 8L26	900	15	5.0	5.0	15	4.5	4.5	30	0.5	-

- = couples are zero or insignificant

2.4.2.2 Torque variations

Table 2-3 Torque variation at 100% load

Engine	Speed [rpm]	Frequency [hz]	M_X [kNm]	Frequency [hz]	M_X [kNm]
W 8L26	900	60	31.4	120	4.7

2.4.3 Noise levels

The airborne noise level of the engine is measured as a sound power level acc. to ISO 9614-2. The diagram is based on measured noise levels. The lower figures represent the lowest levels found in the measurements, while 90 % of the measured values are below the higher figures.

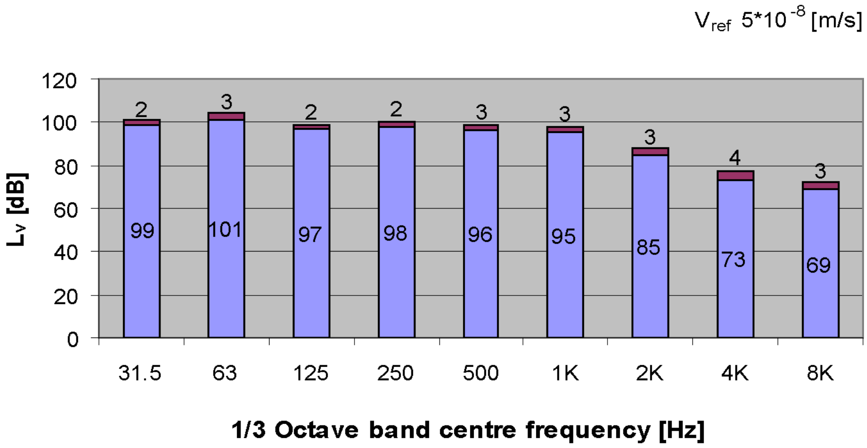


Fig 2-4 **Typical structure borne noise levels**

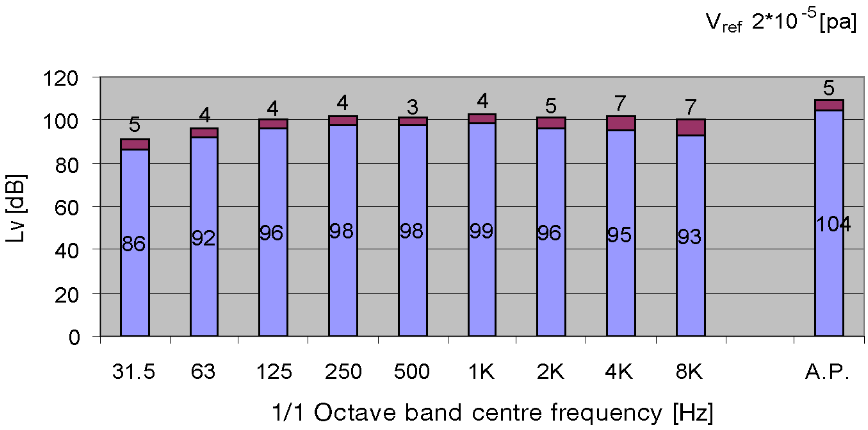


Fig 2-5 **Typical surface radiated noise levels**

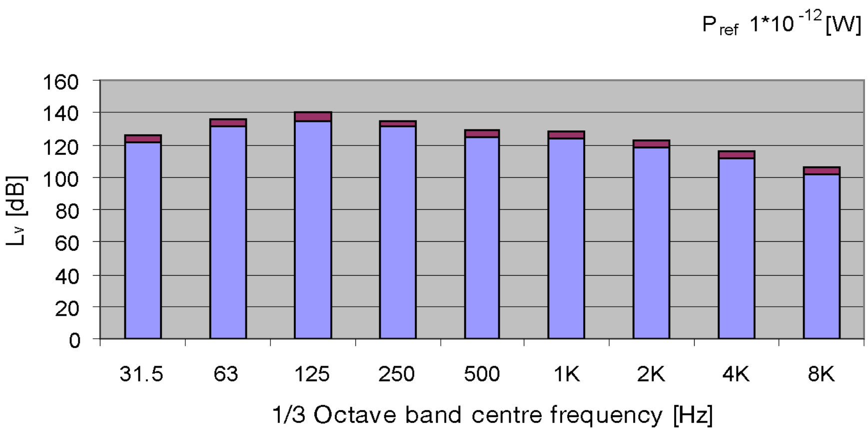


Fig 2-6 **Typical exhaust noise levels**

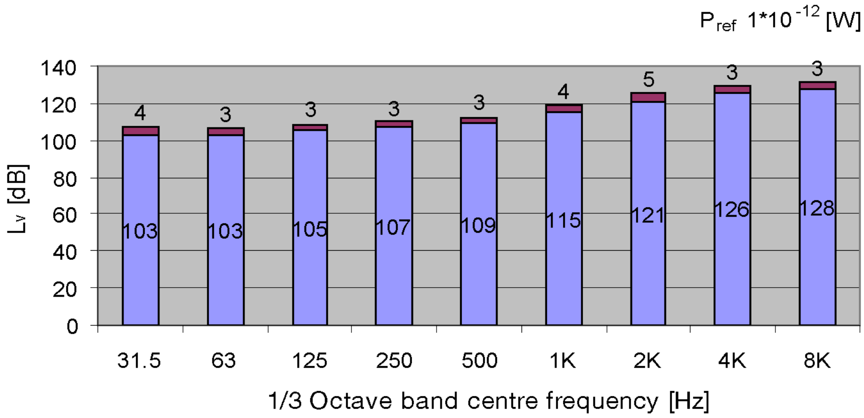


Fig 2-7 **Typical inlet air noise levels**

2.5 Installation of the generating set

2.5.1 Lifting the generating set

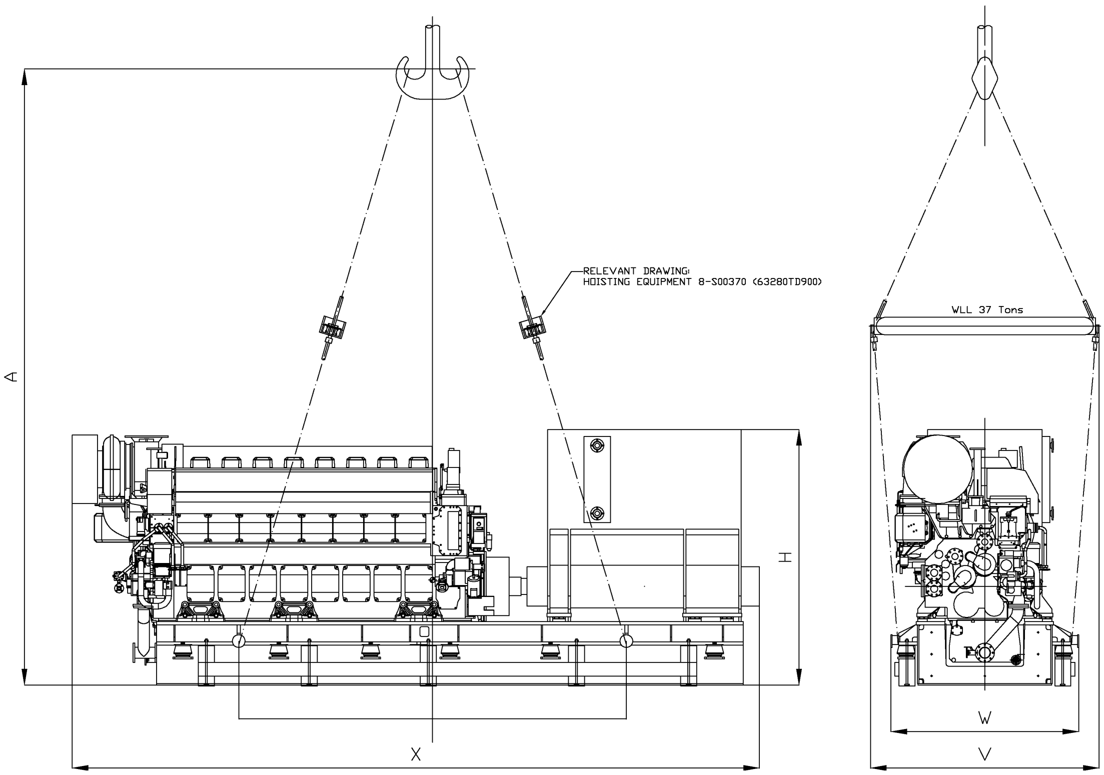


Fig 2-8 **Lifting the generating set**

Engine	Overall dimensions [mm]					Weights [t]		
	A	X	H	V	W	Genset	Hoisting tool	Transport support
W 8L26	7700	8560	3160	2780	2200	44.3	1.7	0.5

2.5.2 Installation procedure

Documents to help you with the installation of the genset(s) can be found from enclosed drawings.

2.6 Commissioning responsibility matrix

Act. Nr.	Main activities related to Wärtsilä scope of supply	Execu-tion by	Guidence provider	Wit-nessed by Wärt-silä
	A. Pre-Commissioning			
A.1	Installation of the engine	Buyer	IPI	No
A.2	Installation of external pipe systems	Buyer	IPI	No
A.3	Installation of flexible pipe connections and supports	Buyer	IPI	No
A.5	Installation of auxiliaries delivered by Wärtsilä	Buyer	IPI	No
A.6	Removal of all warning stickers and conservation material from engines and engine oil sump	Buyer	IPI	No
A.7	Installation of electrical grounding between engines and hull	Buyer	Buyer	No
A.8	Installation of external cabling to engine & auxiliaries	Buyer	IPI	No
A.9	Installation of interface cabling between Wärtsilä supplied equipment	Buyer	IPI	No
A.10	Alternator megger test	Buyer	Buyer	NO
A.11	Cleaning, flushing, testing and inspection of fuel oil pipe systems, including expansion and day tanks	Buyer	IPI	No
A.12	Cleaning, flushing, testing and inspection of lube oil pipe systems, including sump tank	Buyer	IPI	No
A.13	Cleaning, testing and inspection of compressed air system	Buyer	IPI	No
A.14	Cleaning, testing and inspection of cooling water system	Buyer	IPI	No
A.15	Cleaning, and inspection of combustion air and exhaust gas system	Buyer	IPI	No
A.16	External cable loop checks (ref. A7 and A 8)	Buyer	Buyer	No
A.17	Power supplies available (ref. A7 and A 8)	Buyer	Buyer	No
A.18	Installation readiness check sheets to be sent to Wärtsilä *(To be sent to Commissioning coordinator and SP PM before Wärtsilä commissioning work start)*	Buyer	Buyer	
	B. Commissioning			
B.1	Inspection of resilient mounts installation and filling-in of the related form	Buyer	IPI	Yes
B.2	Inspection of (flexible) pipe connections to engine	Buyer	IPI	Yes
B.3	Inspection of (flexible) connections in exhaust gas system	Buyer	IPI	Yes
B.4	Inspection of (flexible) connections in charge air system	Buyer	IPI	Yes
B.5	Filling of systems (water, oil and fuel), verify cooling water treatment	Buyer	IPI	Yes
B.6	Sampling and analysis of lube oil, fuel oil and cooling water *(If reuse of lube oil after flushing)*	Buyer	IPI	Yes

Act. Nr.	Main activities related to Wärtsilä scope of supply	Execu-tion by	Guidence provider	Wit-nessed by Wärt-silä
B.8	Cold alignment of coupling and diesel generating set	Buyer	IPI	Yes
B.9	Cold crankshaft deflection	Buyer / Wärtsilä	IPI	Yes
B.10	Spot check of lube oil, fuel, air and water system cleanness	Buyer	Wärtsilä	Yes
B.11	Signal interface checking between equipments /systems between Wärtsilä and Buyer scope	Buyer / Wärtsilä	Buyer	Yes
B.12	Alarm testing	Buyer	Buyer	Yes
B.13	Powering up and start up of auxiliary equipment	Wärtsilä		Yes
B.14	Prechecking of engine shut down functions	Wärtsilä		Yes
B.15	First start of engine, bearing run (5 min)	Wärtsilä		Yes
B.16	Engine shut down function test	Wärtsilä		Yes
B.17	Phase sequence check of generator	Buyer		Yes
B.18	Loading of engine to verify functionality of all external systems *(Scope of supply depending)*	Buyer / Wärtsilä	Buyer	Yes
B.19	Verification of flow rates	Buyer / Wärtsilä	Buyer	Yes
B.20	Completion of Commissioning Certificate	Buyer / Wärtsilä	Wärtsilä	Yes
C. Dock & Sea Trials				
C.2	Load acceptance test (Quay Trials)	Buyer / Wärtsilä	Buyer / Wärtsilä	Yes
C.3	Synchronizing & parallel run test and tuning	Buyer / Wärtsilä	Buyer / Wärtsilä	Yes
C.4	Verification of safe loading of engines (e.g. loading ramps, combinator curve, etc.) *(Tuning of propulsion plant or PMS)*	Buyer / Wärtsilä	Buyer / Wärtsilä	Yes
C.5	Check of crankshaft deflection in hot condition	Buyer / Wärtsilä	IPI	Yes
C.6	Check alignment of coupling in hot condition	Buyer / Wärtsilä	IPI	Yes
C.9	Removal of running-in filters (when applicable)	Wärtsilä		Yes
C.10	50 hrs maintenance (when applicable)	Wärtsilä		Yes

2.7 Component data, Wärtsilä scope of supply

2.7.1 Flexible pipe connections (6H01)

Table 2-4 Wärtsilä 8L26

Code	Pipe connection	Connection size	Qty/engine	Refer to drawing
101	Fuel inlet	DN32/PN25	1	DBAA748321
102	Fuel outlet	DN32/PN25	1	DBAA748321
103	Leak fuel drain, clean fuel	OD22	1	W165-0095-6b
104	Leak fuel drain, dirty fuel	OD22	2	W165-0095-6b
105	Fuel stand-by pump	DN32/PN40	1	DBAA841528
111	Drain from fuel filter tray	OD22	1	W165-0095-6b
114	Fuel from starting/day tank	DN32/PN40	1	DBAA841528
207	Lube oil to el.driven pump	DN125/PN16	1	DAAB761727
208	Lube oil from el.driven pump	DN80/PN16	1	DAAB761717
213	Lube oil from separator and filling	DN40/PN40	1	W165-0093-9a-HD
214	Lube oil to separator and drain	DN40/PN40	1	W165-0093-9a-HD
221	Lube oil overflow	DN80/PN16	1	DAAB761717
301	Starting air inlet	DN40/PN40	1	W165-0093-9a-HD
401	HT-water inlet	DN80/PN16	1	DAAB761661
402	HT-water outlet	DN80/PN16	1	DAAB761661
404	HT-water air vent	OD12	1	W165-0095-23d
405	HT- water to preheater	DN80/PN16	1	DAAB761661
406	Water from preheater to HT-circuit	DN80/PN16	1	DAAB761661
407	HT-water to stand-by pump	DN80/PN16	1	DAAB761661
408	HT-water from stand-by pump	DN80/PN16	1	DAAB761661
451	LT-water inlet	DN100/PN16	1	DAAB761664
452	LT-water outlet	DN80/PN16	1	DAAB761661
454	Lt-water air vent	OD10	1	W165-0095-25b
456	LT-water to stand-by pump	DN100/PN16	1	DAAB761664
457	LT-water from stand-by pump	DN80/PN16	1	DAAB761661
460	LT-water to waterbrake	DN100/PN16	1	DAAB761664
461	LT-water from waterbrake	DN100/PN16	1	DAAB761664
483	LT-water air vent	OD10	1	W165-0095-25b
607	Condensate after air cooler	OD8	1	W165-0095-22a

Code	Pipe connection	Connection size	Qty/engine	Refer to drawing
701	Crankcase air vent	DN80/PN16	1	W165-0093-5c

2.7.2 Spare set of flexible pipe connections (6H01)

The spare set include one flexible pipe connection of each kind listed in section "*Flexible pipe connections (6H01)*"

2.7.3 Power transmission

Component	Qty	Installation documents
7C01 - Flexible coupling (flywheel)	1 / engine	
7B01 - Flexible coupling fitting materials	1 set / engine	

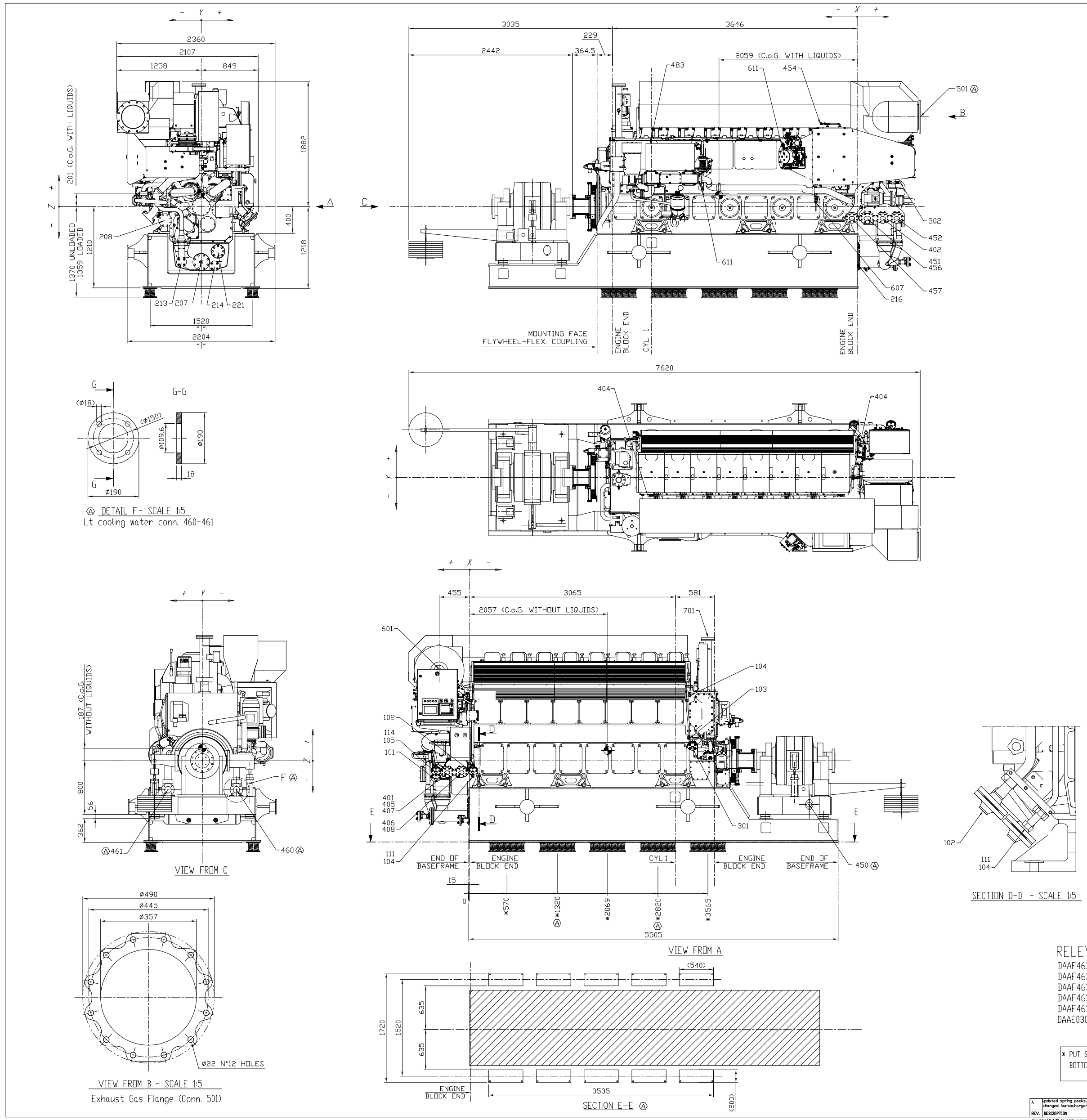
2.7.4 Packing and transportation

Component	Qty	Description
0Z11 - Tarpaulin	1 / engine	For protection during transport
0Z12 - VCI-coating	1 / engine	For rust protection of the engine(s).
0Y01 - Lifting tool	1	

2.7.5 Technical documentation

Publication	Language	Media	Qty
Installation Planning Instructions	English	A4 binder	3 / vessel
Engine manuals, Wärtsilä 8L26	English	A4 binder	3
Record Book of Engine Parameters	English	Paper	1 / engine
Classification certificates for equipment subject to class approval	English	Paper	1 / vessel

2.8 List of Documents



	CODE	DESCRIPTION	TYPE	STANDARD	PN	SIZE	ADV. PIPE	X	Y	Z
	101	FUEL INLET (LFO)	FLANGE	DIN2633/DIN2513 R13	40	DN32	42.4x2.6	+505	+680	-245
	102	FUEL OUTLET	FLANGE	DIN2633/DIN2513 R13	40	DN32	42.4x2.6	-45	+785	-145
	103	LEAKFUEL DRAIN CLEAN FUEL	FITTING	DIN2353	-	OD22	22x2	-3266	+613	+335
	104	LEAKFUEL DRAIN DIRTY FUEL	FITTING	DIN2353	-	OD22	22x2	-45	+645	-225
	104	LEAKFUEL DRAIN DIRTY FUEL	FITTING	DIN2353	-	OD22	22x2	-3280	+528	+971
	105	FUEL STAND-BY PUMP	FLANGE	DIN2633/DIN2513 R13	40	DN32	42.4x2.6	+505	+785	-145
	111	DRAIN FROM FUEL FILTER TRAY	FITTING	DIN2353	-	OD22	22x2	-45	+645	-225
	114	FUEL FROM STARTING/DAY TANK	FLANGE	DIN2633/DIN2513 R13	40	DN32	42.4x2.6	+505	+785	-145
	207	LUBE OIL TO EL. DRIVEN PUMP	FLANGE	DIN2576	10	DN125	139.7x4	+572	0	-825
	208	LUBE OIL FROM EL. DRIVEN PUMP	FLANGE	DIN2576	10	DN80	88.9x3.2	+681	-535	-203
	213	LUBE OIL FROM SEPARATOR AND FILLING	FLANGE	ISO7005-1 Type 01	40	DN40	48.3x2.9	+755	-293	-825
	214	LUBE OIL TO SEPARATOR AND DRAIN	FLANGE	ISO7005-1 Type 01	40	DN40	48.3x2.9	+140	+200	-885
	216	LUBE OIL PURIFIER	PLUG	DIN910	-	-	G1 1/2"	+4	-200	-885
	221	LUBE OIL OVERFLOW	FLANGE	DIN2576	16	DN80	88.9x3.2	0	+250	-666
	301	STARTING AIR INLET	FLANGE	ISO7005-1	40	DN40	48.3x2.9	-3320	+653	+191
	401	HT COOLING WATER INLET	FLANGE	DIN2576	16	DN80	88.9x3.2	+335	+714	-176
	402	HT COOLING WATER OUTLET	FLANGE	DIN2576	16	DN80	88.9x3.2	+381	-802	-176
	404	HT WATER AIR VENT	FITTING	DIN2353	250	OD12	12x1.5	-150	-267	+1470
	404	HT WATER AIR VENT	FITTING	DIN2353	250	OD12	12x1.5	-3105	-267	+1470
	405	HT WATER TO PREHEATER	FLANGE	DIN2576	10	DN80	88.9x3.2	+335	+714	-176
	406	HT WATER FROM PREHEATER	FLANGE	DIN2576	10	DN80	88.9x3.2	+125	+714	-176
	407	HT WATER TO STAND-BY PUMP	FLANGE	DIN2576	10	DN80	88.9x3.2	+335	+714	-176
	408	HT WATER FROM STAND-BY PUMP	FLANGE	DIN2576	10	DN80	88.9x3.2	+125	+714	-176
A	450	WATER DRAINAGE	FLANGE	DIN 2558-B65	-	R2 1/2"	-	-5060	+818	-650
	451	LT WATER INLET	FLANGE	DIN2576	10	DN100	114.3x3.6	+151	-802	-176
	452	LT WATER OUTLET	FLANGE	DIN2576	10	DN80	88.9x3.2	+591	-802	-176
	454	LT WATER AIR VENT	FITTING	DIN2353	250	OD10	10x1.5	-585	-971	+1233
	456	LT WATER TO STAND-BY PUMP	FLANGE	DIN2576	10	DN100	114.3x3.6	+151	-802	-176
	457	LT WATER FROM STAND-BY PUMP	FLANGE	DIN2576	16	DN80	88.9x3.2	-79	-802	-176
A	460	LT-COOLING WATER TO WATER BRAKE	FLANGE	SEE DETAIL F	10	DN100	108x3.6	-5372	-510	-431
A	461	LT-COOLING WATER FROM WATER BRAKE	FLANGE	SEE DETAIL F	10	DN100	108x3.6	-5372	+510	-431
	483	LT WATER AIR VENT	FITTING	DIN2353	250	OD10	10x1.5	-3070	-740	+984
A	501	EXHAUST GAS OUTLET	FLANGE	DIN2573	6	DN350	355.6x5	+965	-1013	+1343
	502	CLEANING WATER TO TURBINE	QUICK CONN. FITTING	-	20	ADAPTER 4V37C1273	-	+700	-882	+360
	601	AIR INLET TO TURBOCHARGER	-	-	-	-	-	+455	+262	+1343
	607	CONDENSATE FROM COOLER	PIPE	DIN2391	-	OD8	8x1	-354	-722	+194
	611	WASTEGATE FOR CHARGE AIR	SILENCER	-	-	-	-	-1070	-1025	+742
	611	WASTEGATE FOR CHARGE AIR	FITTING	DIN2353	100	OD28	28x3	-2308	-749	+220
	701	CRANKCASE AIR VENT	FLANGE	DIN2577	16	DN80	88.9x3.2	-3554	-35	+1830
	-	INTERFACE CABLES ENTRY	-	-	-	-	-	+182	+525	+905

	PROJECT NAME	IOS NUMBER	DIRECTION OF ENGINE ROTATION LOOKING AT THE FLYWHEEL END	ENGINE NUMBERS	GENERATOR NUMBERS (DOCUMENT NO.)
A	CCG COLLEGE	SP/04235.1.S.FS1-P11	CLOCKWISE	XAAB390984	0341859

ENGINE W8L26F	22510	Kg
ENGINE LIQUIDS (WATER+OIL)	2050	Kg
COMMON BASE FRAME	4910	Kg
WATERBRAKE	2910	Kg
FLEXIBLE COUPLING	131	Kg
MISCELLANEOUS	0	Kg
TOTAL WEIGHT	32511	Kg
TOLERANCE	±5	%

WARNING:
BEFORE CONNECTING THE PIPELINES, THEY MUST BE CLEANED FROM DUST, WELD-DROPS, ETC.
ANY DAMAGE OR BREAKDOWN IN CONSEQUENCE OF THE ABOVE MENTIONED IMPURITIES
DO NOT BELONG TO THE RESPONSIBILITY OF WARTSILA.

ALL NECESSARY COUNTERFLANGES AND FITTINGS ARE SUPPLIED.
ONLY THE SPECIFIED DIMENSIONS ARE BINDING.
MEASURING ANY NOT INDICATED DIMENSION IS INADMISSIBLE.
NO FORCE SHALL BE EXERCISED ON THE TURBOCHARGER GAS OUTLET, ON THE OIL SUMP
AND ON ANY ENGINE SYSTEM FLANGE.

C.O.G. (CENTER OF GRAVITY)

RELEVANT DRAWINGS
DAAF463394 FUEL OIL SYSTEM
DAAF463398 LUBE OIL SYSTEM
DAAF463396 START/STOP AIR SYSTEM
DAAF463397 COOLING WATER SYSTEM
DAAF463395 AIR INL./EXH. GAS SYSTEM
DAAE030871 REQUIRED SPACE FOR MAINTENANCE

* PUT SOME WELDING SPOTS BETWEEN SPRING MOUNTING BOTTOM PLATES AND STEEL FOUNDATIONS

REV.	DESCRIPTION	DATE	INITIALS	APPROVED	D-MESSAGE
A	Updated spring packs, updated conn. 501, conn. 450, added section E-E and detail F changed turbocharger inclination, updated notes.	12/09/2019	CPI-ENG DES.	15/09/2019	CN-A132322

WÄRTSILÄ
Product W8L26
DG Set GENERAL ARRANGEMENT
Project: CCG GOLLEGE
Units mm kg ACA
Basic Material –
Net Weight –
Made 04/09/2019 CPI-ENG DESIGNER
Chkd 04/09/2019 CPI-ENG DESIGNER
Appd 04/09/2019 cga005 Gazzin
Scale 1:20
Design Group 58B0
Size A0 Page 1/1 Material ID –
Drawing ID DAAF472404 Rev. A
CONFIDENTIAL
draft

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<table>
<tr><td rowspan="1">WÄRTSILÄ</td><td>Wärtsilä
Italy S.p.a
Marine Solutions</td><td colspan="7">INSTALLATION OF W26 DG-SET
ON SPRING ELEMENTS</td></tr>
<tr><td colspan="9">This document is the property of Wärtsilä Finland Oy and shall not be copied, shown or communicated to a third party without the consent of the owner.</td></tr>
<tr><td rowspan="2">Subtitle
SP/ 04235
CCG COLLEGE -</td><td rowspan="2">Product
W26</td><td>Made</td><td>MMA051</td><td>29-11-2019</td><td rowspan="2">Page
1 (5)</td><td rowspan="2">Document No.
DMTA00019918</td><td rowspan="2">Rev.
-</td></tr>
<tr><td>Apprvd</td><td>MTU009</td><td>29-11-2019</td></tr>
</table>

Rev.	Date	Made	Approved	Explanation

1. INDEX

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2. INTRODUCTION

This document describes how to install flexible mounted DG-set's with steel springs packages on a steel plate foundation insert over a concrete base.

The DG-set is delivered as a complete set, with both the engine and the water-brake mounted on the common base frame (later CBF).

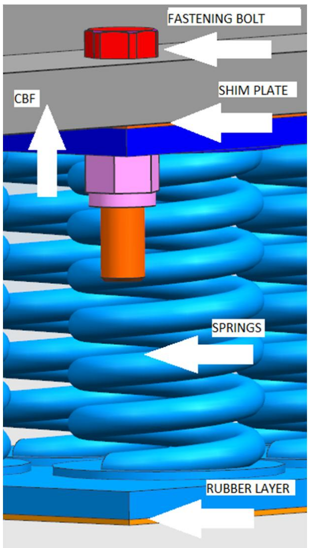
3. SPRING ELEMENT PACKAGE

Delivery terms and condition are related to installation scope of supply.

Steel spring packages are mounted to the bottom plate of the CBF by means of hexagon head bolts (fastening bolt).

The delivered spring package counts of a rubber layer, a steel spring element, shim plates (2 mm or 5 mm thickness) and two M16 hexagon head bolt sets (bolts/nuts/washers). There are three distance plates for each spring package in the delivery.

If present rubber layers have to be removed during installation phase while the shims are used to level the DG-set and control the spring compression (see figure 1).



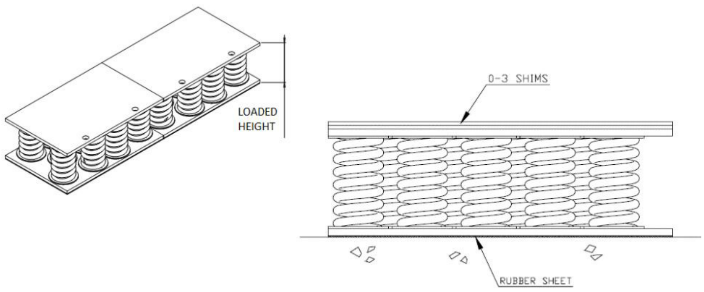


Figure 1. Spring elements

Compression values are in accordance with project specific calculation and shown on order related General Arrangement drawing.

Spring packages amount and location along the DG-set sides can be found in the General Arrangement order related drawing.

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4. STEEL PLATE FOUNDATION PREPARATION

The DG-set is installed on spring elements on a steel plate foundation with no side/vertical stoppers.

The steel plate foundation is insert over a concrete base and must be cleaned from dust and oil as well as rusty spots must be removed especially were spring elements will be located.

Mark the locations of the spring elements carefully.

Measure the elevation of the steel plate foundation at the location of the spring packages using theodolite or similar equipment, and record the measurement results.

Make a foundation level map. Mark the highest point of the steel plate foundation with zero and mark the differences at the other positions with negative numbers.

Calculate and put the altitude differences on the map too (see figure 2). Surface level difference between any two points has to be ≤ 8 mm.

The areas underneath the spring elements should be machined to guarantee a horizontal flatness tolerance of 0.1 mm.

The altitude differences of the foundation must be balanced with shims which thickness are 2 mm or 5 mm. The measurement record is used when determining the amount of distance plates required to get the same load level for every steel spring package.

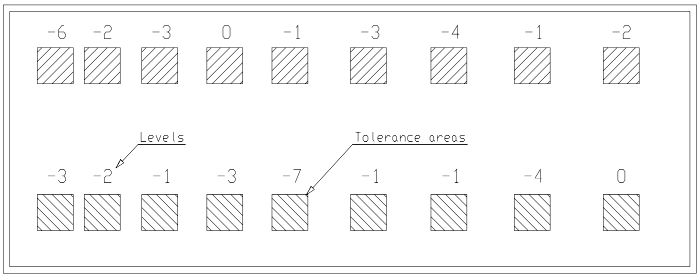

Figure 2. Foundation level map sample

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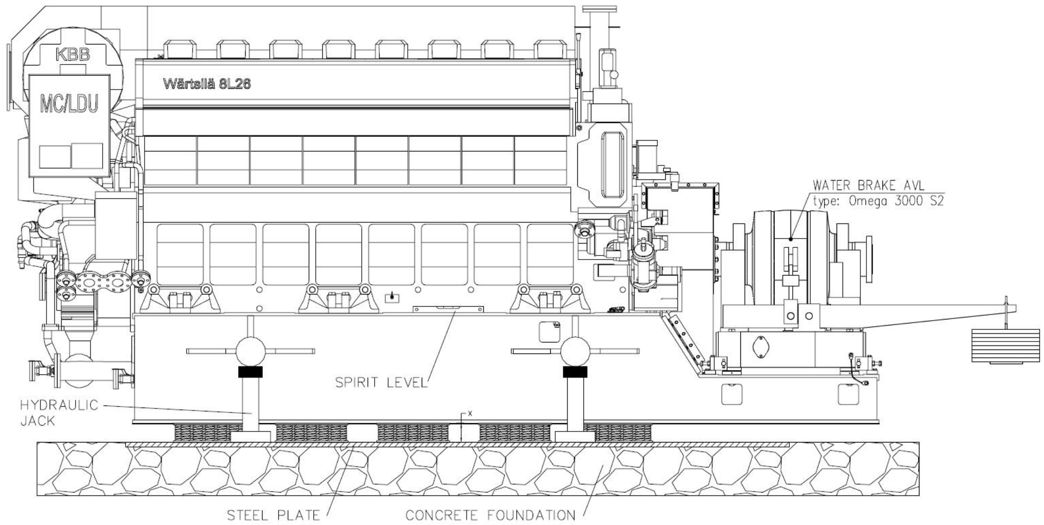


Figure 3. Installation

5. INSTALLATION PROCEDURE

1. Check the height of the received steel springs and record the data for reference.
2. Haul the DG-set in the correct position on the steel plate foundation according to the project drawings.
3. Lift up the DG-set using hydraulic jacks and remove the hauling equipment.
4. Level the DG-set by means of a spirit level. Place the spirit level only on the machined surfaces.
5. Measure and record the distance X (see figure 3) between CBF bottom plate and steel plate foundation at each spring package location. The maximum allowed difference in compression between any steel spring packages is 4 mm.
6. Mount the spring packages on the CBF according General Arrangement drawing.
7. Using the measurement record, determine the amount of steel plates (2 mm or 5 mm) to add for each spring package to achieve the above indicated value.
8. Bolt the steel spring packages (and shims if needed) to the CBF tightening them according value indicated in the General Arrangement order related drawing.
9. If present remove rubber layer from the bottom of each spring package.
10. Lower the DG-set and remove the hydraulic jacks.
11. Check all the spring element are evenly compressed measuring the loaded height. The compressed height is indicated in the order related documentation. The maximum permissible difference in compression between

mounts (two extremes of the installation) is 2 mm; however, the difference should be as small as possible. When the above-mentioned values are not met, the compression of individual mount has to be adjusted by adding steel shims to the element (preferably between the element and the DG-Set). If needed shims can also be machined and the minimum thickness is 0.5 mm and must cover the complete mounting surface of the spring element.

12. Proceed tack welding together steel plate foundation and spring packages (i.e.: tack welding 50/200 – use shorter side centre as reference point for tack welding centre).

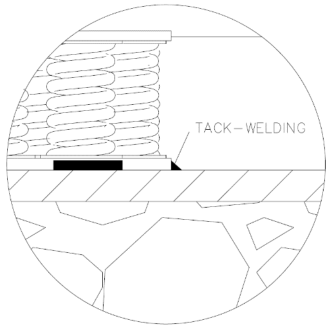


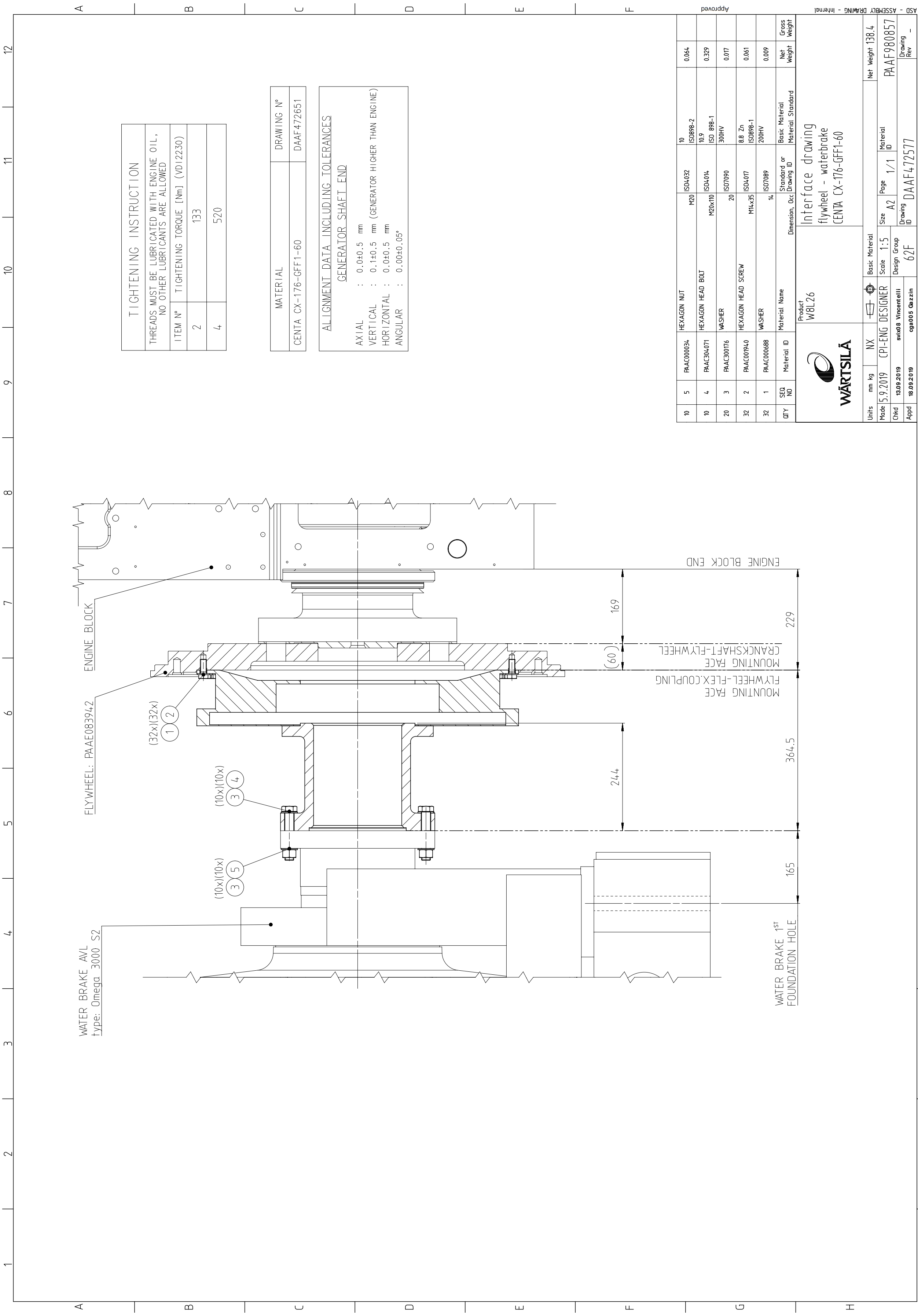
Figure 4: Tack Welding

13. Check compression values of the spring elements and levelling of the DG-set once the welding phase is complete.

6. REPLACE SPRING PACKAGE

Periodically checks for possible damages/wear and in case of maintenance / replacement of one ore more spring elements proceed according below indications;

a. Ease the fastening bolts at the spring element to be replaced.
b. Lift the DG-set by means of hydraulic jack.
c. Remove tack welding and remove the spring element.
d. If needed grind the steel plate foundation surface to remove every possible chip still present.
e. Mount new element and the shims (if present) using the fastening bolts. Do not thigh the fastening bolts.
f. Lower the DG-set so the elements get compressed.
g. Tightening torque values indicated in the General Arrangement order related drawing.
h. Remove the hydraulic jacks.
i. Proceed tack welding together steel plate foundation and spring element packages.
j. Check compression values of the spring elements and levelling of the DG-set once the welding phase is complete.


TIGHTENING INSTRUCTION
THREADS MUST BE LUBRICATED WITH ENGINE OIL, NO OTHER LUBRICANTS ARE ALLOWED
ITEM N° TIGHTENING TORQUE [Nm] (VDI2230)
2 133
4 520
MATERIAL DRAWING N°
CENTA CX-176-GFF1-60 DAAF472651
ALIGNMENT DATA INCLUDING TOLERANCES
GENERATOR SHAFT END
AXIAL : 0.0±0.5 mm
VERTICAL : 0.1±0.5 mm (GENERATOR HIGHER THAN ENGINE)
HORIZONTAL : 0.0±0.5 mm
ANGULAR : 0.00±0.05°
ENGINE BLOCK
FLYWHEEL: PAAE083942
WATER BRAKE AVL
type: Omega 3000 S2
ENGINE BLOCK END
CRANCKSHAFT-FLYWHEEL MOUNTING FACE
FLYWHEEL-FLEX.COUPLING MOUNTING FACE
WATER BRAKE 1ST FOUNDATION HOLE
169
229
(60)
244
364.5
165
(32x)(32x) 1 2
(10x)(10x) 3 4
(10x)(10x) 3 5
10 5 PAAC000034 HEXAGON NUT M20 ISO4032 10 ISO898-2 0.064
10 4 PAAC304071 HEXAGON HEAD BOLT M20x110 ISO4014 10.9 ISO 898-1 0.329
20 3 PAAC300176 WASHER 20 ISO7090 300HV 0.017
32 2 PAAC001940 HEXAGON HEAD SCREW M14x35 ISO4017 8.8 Zn ISO898-1 0.061
32 1 PAAC000688 WASHER 14 ISO7089 200HV 0.009
QTY SEQ NO Material ID Material Name Dimension, Occ Standard or Drawing ID Basic Material Material Standard Net Weight Gross Weight
WÄRTSILÄ
Product W8L26
Interface drawing
flywheel - waterbrake
CENTA CX-176-GFF1-60
Units mm kg NX
Made 5.9.2019 CPI-ENG DESIGNER
Chkd 13.09.2019 avix08 Vincentelli
Appd 18.09.2019 cga005 Cazzin
Basic Material
Scale 1:5 Size A2 Page 1/1
Design Group 62F
Drawing ID DAAF472577
Material ID PAAF980857
Net Weight 138.4
Drawing Rev -
ASD - ASSEMBLY DRAWING - Internal
Approved

WÄRTSILÄ

Guideline

Title:	**GLOBAL FACTORY ACCEPTANCE TEST FOR WARTSILA MARINE SOLUTION AND ENERGY SOLUTION ENGINES**		**Doc.ID:**	DBAE170142
			Revision:	
Author:	Lorenzo Sterni	19.6.2017	**Status:**	approved
Checked by:	Harri Kytöharju, Andrea Nobile	26.6.2017	**Pages:**	1 (16)
Owner and approver by:	Harri Kytöharju, Andrea Nobile	26.6.2017	**Business:**	Marine Solutions
Last modified by:			**Company:**	
File Name:				

GLOBAL FACTORY ACCEPTANCE TEST
FOR WARTSILA MARINE SOLUTION AND ENERGY SOLUTION ENGINES

Rev.	*Date*	*Revision Description*

TABLE OF CONTENT

1. SCOPE

The present document is meant as FAT guideline, valid for all Wartsila delivery centres and Join Ventures for all 4-stroke engines (diesel, dual fuel, gas).

Scope is to define standard activities and technical details related to Factory acceptance tests performed in Test run department.

This guideline have to be integrated by site-specific addendum documentation, wherever there are peculiar procedures per site, engine type and/or Classification society requirement.

2. REFERENCES

- ISO 15550 “Internal combustion engines – Determination and method for the measurement of engine power – General requirements”
- ISO 3046-1 “Reciprocating internal combustion engines – Performance“

3. ABBREVIATIONS AND DEFINITIONS

- ISO: International Organization for Standardization
- FAT: Factory Acceptance Test

4. INTRODUCTION AND APPLICABLE DOCUMENTS

The test is carried out as an overall check of the manufacturing quality and to establish that the contractual commitments have been fulfilled. The Factory Acceptance Test (FAT) is preceded by the running-in of the engine, carried out internally.

The test is performed in accordance with ISO 15550. The function of built on ancillary systems and the performance of the engine is checked according to ISO 15550. Results are recorded in a test protocol signed by Wärtsilä, customer and third party inspector or representative of a classification society.

Test run will perform following activities according to site/product specific procedures:

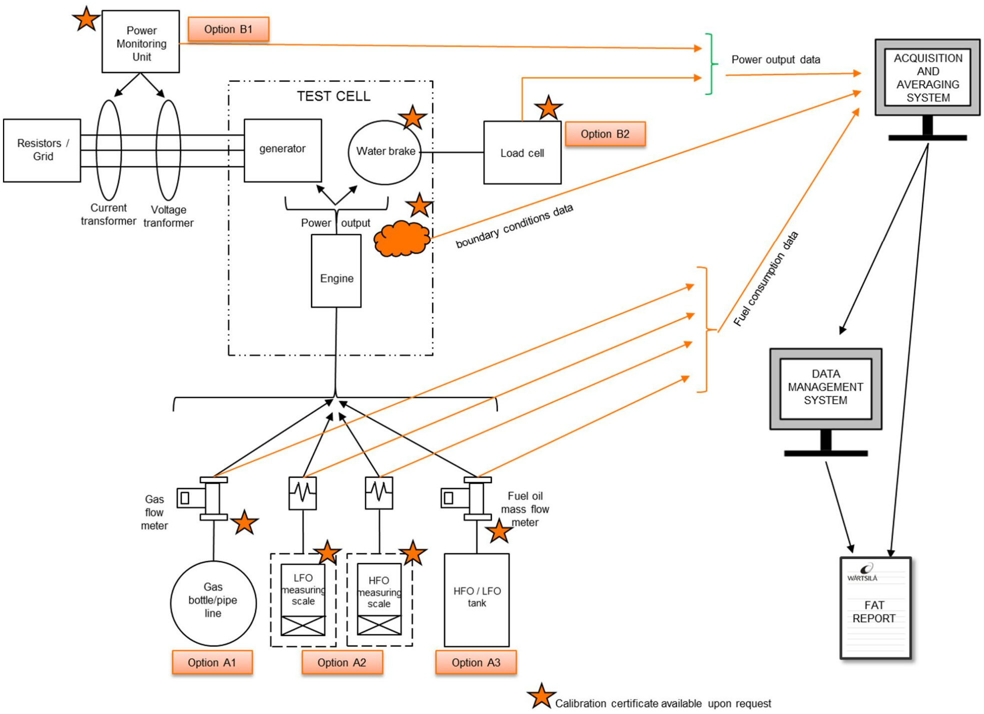
Checks before starting
Checks with running engine
Automation checks
Testing of safeties with running engine
Running in
FAT
Firing pressure measurements
Exhaust-gas temperature after cylinders
Charge air pressure measurements
Functional checks
Special tests
Crankshaft alignment check in hot conditions (when applicable)
Inspection of engine
Finishing
Health and safety during FAT

The above information is available in a separate product specific FAT procedure documents.

Document ID: DBAE170142 Revision: a 4 (16)

5. TEST BED LAYOUT AND MEASUREMENTS

In the following picture it is reported a general layout of main measuring equipment used during FAT.



Fuel oil consumption can be measured both by:

Weight tank (option A2).

Flowmeter (option A3).

Gas consumption is always measured by flowmeter (option A1).

Power output can be measured by:

Power monitoring unit (option B1) in case the engine is connected to a generator (in-house or project specific) against resistors or grid.

Load cell (option B2) in case the engine is connected to a water brake.

All options reported in the layout above and described in the following chapters are equivalent and ensure a high quality product delivered to Customers. Each Delivery Centre and Joint Venture has freedom to select and use the optimized option for the relevant engines produced and tested.

6.1 CALIBRATION OF MEASURING EQUIPMENT

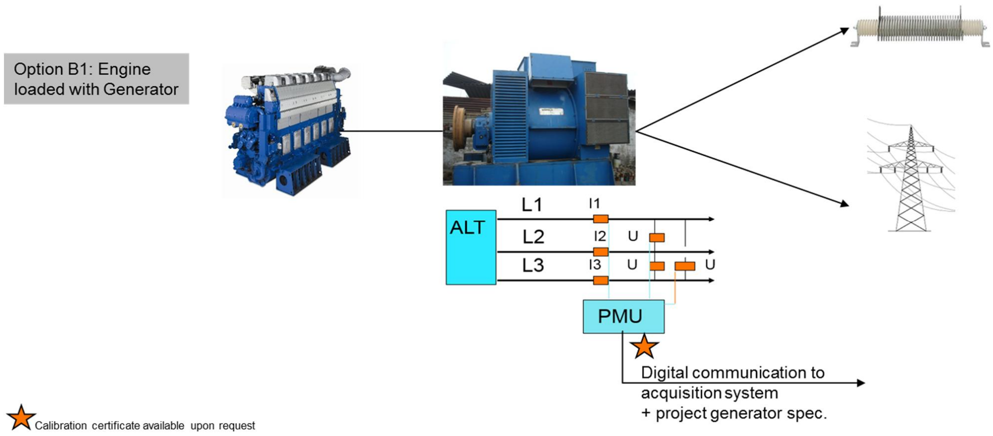
Measuring equipment related to calculation of fuel consumption is calibrated according to the manufacturer's specifications and the certificates are available on request.

6.2 BRAKE POWER

The power an engine is producing is measured with alternator or water brake.

6.2.1 BRAKE POWER WITH GENERATOR

The power measurement system contains 3 current transformers and 3 voltage transformers, the PMU (Power Monitoring Unit) measures 3 currents, 3 voltages and provides total power output to the test bed acquisition system.



The measured power also needs to be calculated to shaft power by compensating for the alternator efficiency.

Loading system in all facilities is pure resistive (cosine fi=1.0) as resistors or frequency converters are used.

If a customer generator is used and the losses for cosine fi = 1.0 is missing, it needs to be requested from supplier.

6.2.2 BRAKE POWER WITH WATER BRAKE

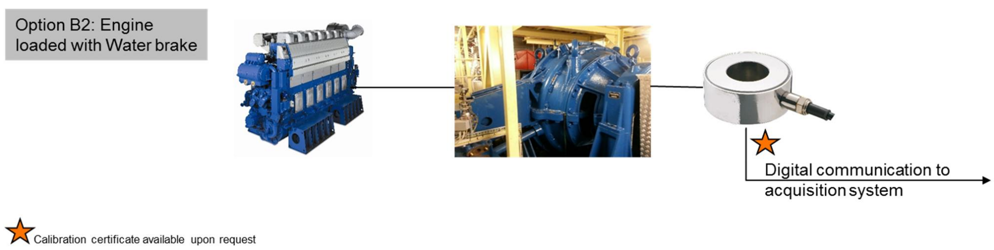
Power output is measured by a load cell connected to water brake. It provides torque data output to test run data acquisition system; is transformed into power output through following formula:

$P = \frac{(T \cdot n)}{k}$[Kw] where:

T = torque [kN]

n = engine speed [round/min]

k = water brake constant (according to water brake datasheet)



6.3 SPECIFIC FUEL OIL CONSUMPTION

The (liquid) fuel an engine is consuming, can be measured with weight tank or flow meters; choice of the measurement chain depends on site specific needs.

The fuel flow to engine should be 4 - 5 times the maximum consumption of the engine, this to ensure enough flow to all cylinders.

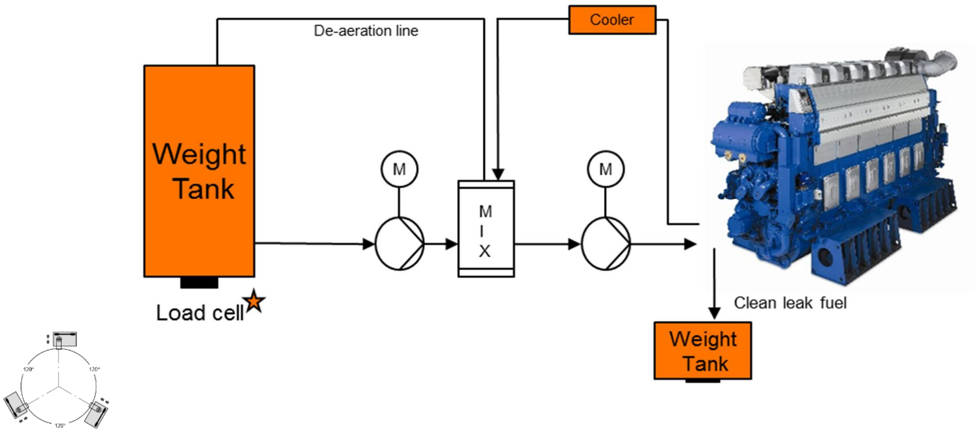
6.3.1 FUEL CONSUMPTION MEASUREMENT WITH WEIGHT TANK

Weight tank volume should be 2 … 3 times what the biggest engine consumes during the maximum measurement time.

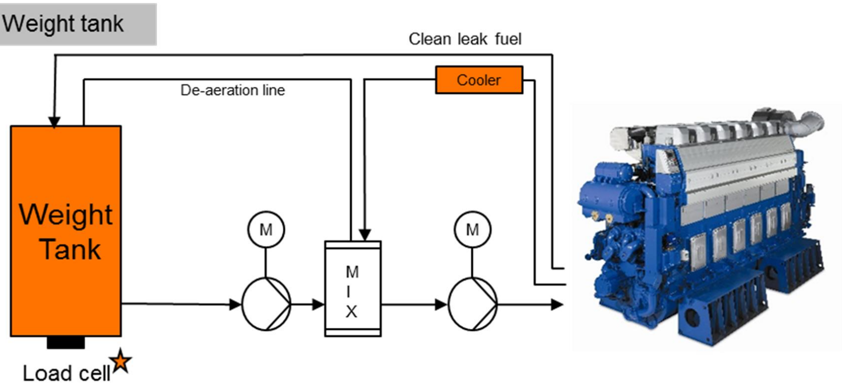
Weight tank should be designed to 1 or 3 sensors. This ensures that centre of gravity will be in the middle of the weight tank.

The communication with the scale electronics should be digital in order to achieve best accuracy.

Option A2-a: Weight tank



Option A2-b: Weight tank



★ Calibration certificate available upon request

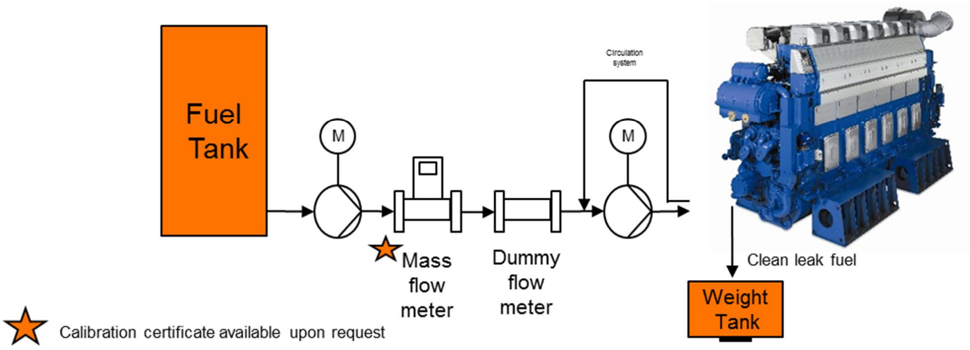
6.3.2 LIQUID FUEL CONSUMPTION MEASUREMENT WITH FLOW METER

If flow meter is used for consumption measurement high accuracy flow meters needs to be used. Mass flow meter is to be used. Note also that a smaller diameter size flow meter is more accurate but is giving a higher delta pressure in the fuel line.

The position where the flow meter is to be installed is after feeder pump and before engine fuel circulation system. The flow meter is to be installed according to supplier's specification.

A Dummy flowmeter can be installed in fuel line in order to allow a further verification of the instrument in use in real working conditions.

Option A3-a: Mass flow meter



6.4 GAS CONSUMPTION FOR DF OR GAS ENGINES

Engine gas consumption is measured by a Flow meter installed in the supply line to the engine. Flow meter has to provide measurement data to test run data acquisition system via digital communication in order to achieve high accuracy level.

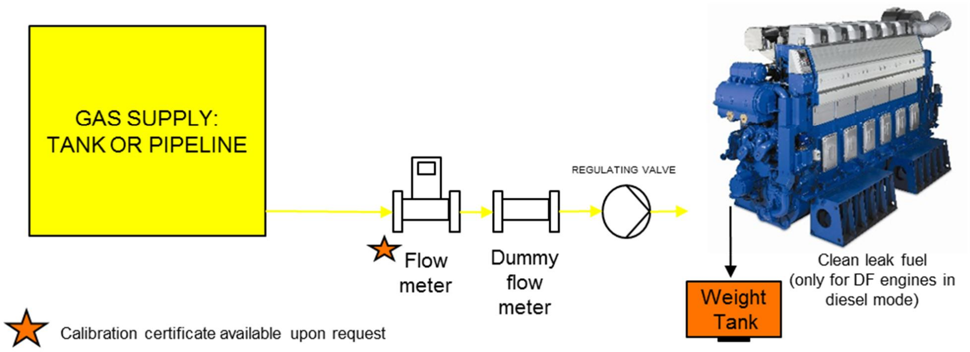
The flow meter has to be installed according to supplier’s specification.

If different engine sizes are tested in the same test bed, it can be needed two flow meters for keeping up the accuracy of the flow measurement.

- o Small flow meter for smaller engines
- o Large flow meter (bigger tube diameter) for larger engines

The reference values (and boundary ambient conditions) for the gas consumption are stated in the contract. Gas analysis on factory supply gas pipeline are provided daily by gas supplier (in case of pipeline) or for every new delivery (in case of gas bottles). The analysis is available at the test run department. There are no corrections for ambient conditions, since the control of the exhaust waste gate is compensating for changing ambient conditions.

Option A1: Flow meter



6.5 PILOT FUEL FOR DF AND PP ENGINES

The pilot fuel consumption is measured with a scale or flow meter.

7 BOUNDARY CONDITION MEASUREMENTS

The following boundary conditions are measured around the engine during FAT:

Barometric pressure

Suction air temperature

Charge air coolant inlet temperature

and used for ISO correction on diesel engines.

8. ENGINE PERFORMANCE PARAMETERS

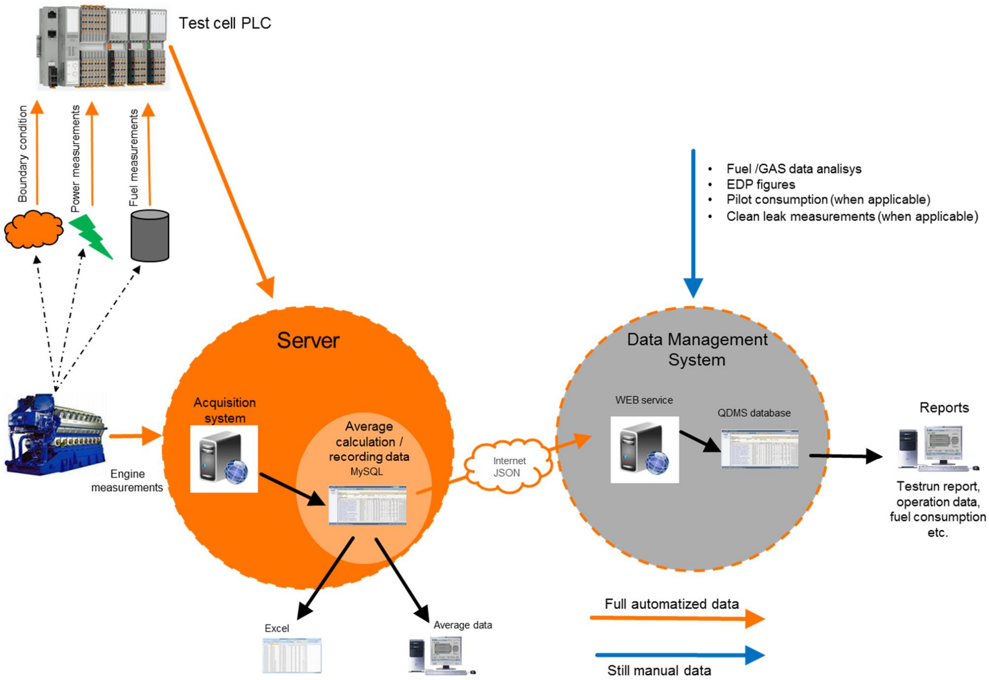
Performance data is recorded at all load points. The record of measurement for each load point start after reaching the steady state condition. According to ISO 15550 for engine group n.4, following parameters are recommended to be measured:

List A – Test Measurements (ISO 15550)	
A1	Barometric pressure, humidity and ambient temperature
A2	Engine speed or cycle frequency
A3	Engine brake torque and/or fuel pump or governor
A4	Throttle control rod setting
A5	Fuel consumption
A6	Lubricating oil pressure
A7	Temperature and pressure of exhaust gas leaving the engine
A8	Air inlet pressure and temperature at the engine or pressure charger inlet
A9	Exhaust gas temperature at the turbine inlet
A10	Boost pressure in the air manifold
A11	Turbocharger speed
A12	Coolant mean temperature in and out of the cylinder block
A13	Lubricating oil temperature at the engine inlet and outlet
A14	Boost pressure drop through the charge air cooler
A15	Boost pressure after charge air cooler
A16	Charge air temperature after charge air cooler
A17	Coolant mean temperature at the inlet and outlet of the charge air cooler
A18	Maximum cylinder pressure
A19	Exhaust-gas pressure at the turbine inlet
A20	Exhaust-gas temperature of each cylinder
A21	Individual coolant circuit temperatures and pressures
A22	Lubricating oil pressure in individual circuits
A23	Lubricating oil pressure before and after filters and coolers
A24	Secondary coolant and lubricating oil temperatures in and out of the heat exchangers
A25	Fuel supply pressure and temperature
A26	Compression pressure

The detailed list of performance parameters of every product is recorded according to specific engine-related FAT procedure.

9. MEASUREMENT OF ENERGY CONSUMPTION

When measuring energy consumption and related variables (Engine speed, torque, power, fuel flows, ambient pressure, suction air temperature and LT-water temperature), they all must be measured simultaneously and recorded as minimum 10 minutes average with a minimum 1Hz sampling frequency at guarantee load point. Automated data entry should be used; when not available manual data entry must be verified by a supervisor.



Engine need to be stabilised after load change. Engine must run minimum 15min on steady load before measurement at the guarantee load point.

9.1 SCALE & FLOW METER OPERATION

Fuel measurements to be started after settling time has passed once weight tank has been completely filled.

The settling time means the needed time before the scale value is stable.

Measurement time must be minimum 10 minutes for guarantee point and it has to be performed at the same time as the other 10 min measurements of engine power and boundary conditions are made. The measurement time is directly corresponding to measurement quantity.

9.2 CLEAN LEAKAGE FUEL

Clean leakage should are deducted from fuel consumption, hence it is reusable fuel.

- In case clean leak system is connected back to fuel tank then nothing has to be deducted: $M_{leak} = 0$;
- In case clean leak system is separately collected then a measurement has to be carried out with a weight scale and then deducted to fuel consumption $M_{leak} \neq 0$.

10. FUEL QUALITY

10.1 LIQUID FUEL QUALITY

LHV (Lower Heating Value) of the fuel has direct impact on energy consumption results.

There is a schematic picture of different storage tanks and fuel sampling arrangements in figure 10.1 Tank number 1 represents a large storage tank at supplier premises. Number 2 tanks are storage tanks at factory area and tank number 3 is an optional day tank, typically used for heavy fuel. Fuel sampling point is in the pipe line before test cells. Especially on heavy fuel operation the sampling point need to be after fuel separator. It need to be secured, that day tank content represents the tank number 2 fuel quality before taking fuel sample.

In case same supplier and the same large tank nr. 1 is in use, sample before test cells are taken at least every three months and every time the supplier storage tank nr. 1 is refilled.

In case supplier cannot guarantee stable quality from tank 1 or more than one supplier tank is in use or many suppliers are used for one fuel type (e.g. LFO), sample need to be taken every time a new batch arrives to factory area.

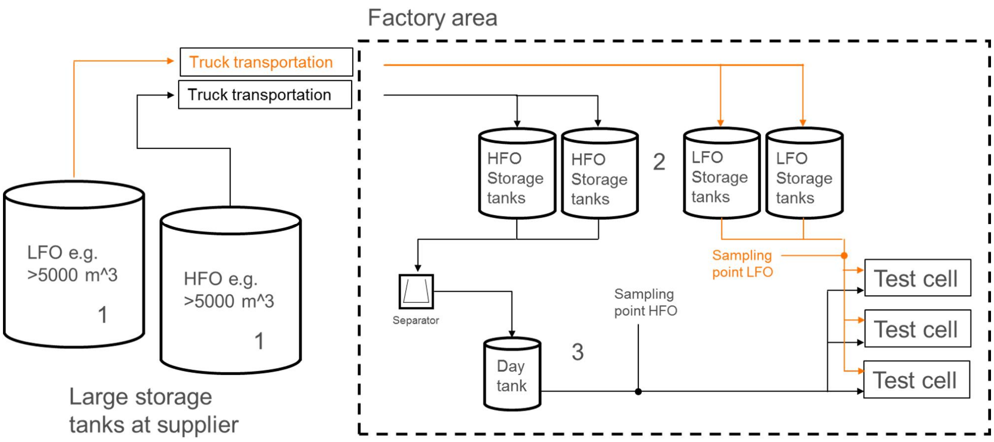


Figure 10.1 Schematic picture of the fuel storage and tank arrangements

10.2 GAS QUALITY

LHV (Lower Heating Value) of the gas has direct impact on energy consumption results. Therefore the gas quality need to be stable to have accurate and correct LHV for the gas that the engine is using.

Furthermore, it must be ensured that the gas analyse is representative for the whole duration of the energy consumption measurement. Fluctuating gas composition to be avoided. Gas composition measurements are typically not continuous. Therefore it’s necessary to have stable gas composition (LHV) during the consumption measurement.

10.2.1 GAS BOTTLES

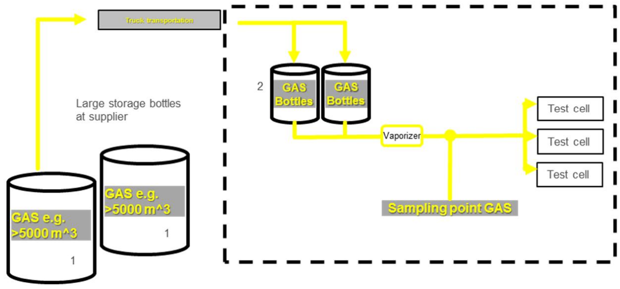
The most stable gas quality during a measurement is achieved with a buffer tank, e.g. LNG tank. In this case the composition only changes when the tank is filled and the content left in the tank mixes with the new supply. It's enough to measure gas composition from the tank after each tank filling.

With several buffer tanks (LNG tanks) in the factory area the situation is comparable to figure 9.4.1 for LFO. If the gas supplied to a multi tank system is of various quality the LHV will be different in each tank depending on how they are filled. In this situation it must be ensured that LHV of the correct tank is used for engine efficiency calculation.

Gas quality figures are always representative of fuel used during FAT

Option 1: LNG Gas tanks

- Analysis from supplier for each batch.
- Samples upon request with gaschromatograph or from external laboratory.

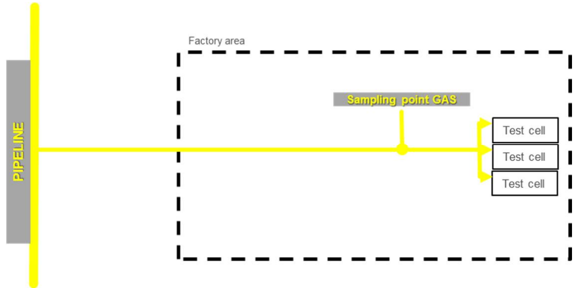


10.2.2 GAS PIPELINE

In case of gas supply from a **pipeline** the gas quality is normally stable during the consumption measuring period of 10 minutes. In this case a gas analyse taken during the consumption measurement is representative for the whole measurement period.

Option 2: Pipeline

- Daily analysis from supplier.
- Samples upon request with gaschromatograph or from external laboratory.



11 TEST RESULTS AND CALCULATIONS (ISO 15550)

The reference values (and boundary ambient conditions) for the engine fuel consumption are stated in the contract. The analysis of the fuel sample from the supplier or from external laboratory have to be used.

To correct for ambient conditions during test differing from ISO 15550 standard reference conditions, conversion formula as stated by ISO 3046-1, are used to obtain the specific fuel consumption. See following formula.

11.1 DIESEL ENGINES

Formula used:

$$\alpha = k - 0.7 \cdot (1 - k) \cdot \left(\frac{1}{\eta_m} - 1\right)$$

$$k = \left(\frac{p_y}{p_r}\right)^m \cdot \left(\frac{T_r}{T_y}\right)^n \cdot \left(\frac{T_{cra}}{T_{cy}}\right)^s$$

$$B = \left(\frac{M}{t_{fuel}} - \frac{M_{leak}}{t_{leak}}\right) \cdot 3600$$

If Fuel scale is used

$$B = F_{in} - \frac{M_{leak} \cdot 3600}{t_{leak}}$$

If Flowmeter is used

$$b_y = \frac{1000 \cdot B}{P_y}$$

$$b_r = \frac{\alpha}{k} \cdot \frac{LHV_{test}}{LHV_{ISO}} \cdot b_y$$

$$BSFC_{FAT} = \frac{(b_r) - EDP}{(1 + Tol)}$$

11.2 DF ENGINES IN DIESEL MODE

Formula used:

$$\alpha = k - 0.7 \cdot (1 - k) \cdot \left(\frac{1}{\eta_m} - 1\right)$$

$$k = \left(\frac{p_y}{p_r}\right)^m \cdot \left(\frac{T_r}{T_y}\right)^n \cdot \left(\frac{T_{cra}}{T_{cy}}\right)^s$$

$$B_{main} = \left(\frac{M}{t_{fuel}} - \frac{M_{leak}}{t_{leak}}\right) \cdot 3600$$

If Fuel scale is used

$$B_{main} = F_{in} - \frac{M_{leak} \cdot 3600}{t_{leak}}$$

If Flowmeter is used

$$b_{y\,main} = \frac{1000 \cdot B_{main}}{P_y}$$

$$B_{pilot} = \frac{M_{pilot}}{t_{fuel}} \cdot 3600$$

$$b_{r\,main} = \frac{\alpha}{k} \cdot \frac{LHV_{main}}{LHV_{ISO}} \cdot b_{y\,main}$$

$$b_{r\,pilot} = \frac{B_{pilot}}{P_y} \cdot \frac{LHV_{pilot}}{LHV_{ISO}} \cdot 1000$$

$$b_r = b_{r\,main} + b_{r\,pilot}$$

$$BSFC_{FAT} = \frac{b_r - EDP}{(1 + Tol)}$$

11.3 DF ENGINES IN GAS MODE

Formula used:

$$BSEC_{y\,gas} = \frac{B_{gas} \cdot LHV_{gas}}{P_y} \cdot 1000$$

$$B_{pilot} = \frac{M_{pilot}}{t_{fuel}} \cdot 3600$$

If Fuel scale is used

B_{pilot} is direct measurement result of the flow meter with possible unit conversion.

If Flowmeter is used

$$BSEC_{y\,pilot} = \frac{B_{pilot} \cdot LHV_{pilot}}{P_y} \cdot 1000$$

$$BSEC_y = BSEC_{y\,gas} + BSEC_{y\,pilot}$$

$$BSEC_{FAT} = \frac{BSEC_y - EDP_{BSEC}}{(1 + Tol)}$$

11.4 PURE GAS ENGINES

Formula used:

$$BSEC_y = \frac{B_{gas} \cdot LHV_{gas}}{P_y} \cdot 1000$$

B_{gas} is direct measurement result of the flow meter with possible unit conversion.

$$BSEC_{FAT} = \frac{BSEC_y - EDP_{BSEC}}{(1 + Tol)}$$

Symbol	Description	Unit	Symbol	Description	Unit
α	Power adjustment factor	-	M	Measured fuel mass of the engine during test with weight scale	kg
k	Ratio of indicated power	-	M_{leak}	Measured clean leakage fuel mass of the engine	kg
η_m	Mechanical efficiency. Values can be found from Performance Documents and Performance Manuals. Typically [0.9]	-	M_{pilot}	Measured pilot fuel mass during test with weight scale	kg
p_y	Ambient total barometric pressure during test	hPa	t_{fuel}	Time of fuel mass measurement	s
p_r	Standard reference total barometric pressure	hPa	t_{leak}	Time of leakage fuel mass measurement	s
T_r	Standard reference ambient air thermodynamic temperature	K	s	Exponent of the charge air coolant thermodynamic temperature ratio [1]	-
T_y	Ambient air thermodynamic temperature during test	K	F_{in}	Liquid fuel mass flow to engine. Measured with flow meter	kg/h

T_{cra}	Substitute reference charge air coolant thermodynamic temperature	K	b_y	Specific fuel consumption of the main fuel under test ambient conditions	g/kWh
T_{cy}	Ambient charge air coolant thermodynamic temperature during test	K	$b_{y\ main}$	Specific fuel consumption of the main fuel under test ambient conditions	g/kWh
m	Exponent of the dry air pressure ratio or total barometric pressure ratio [0.7]	-	$b_{y\ pilot}$	Specific fuel consumption of the pilot fuel under test ambient conditions	g/kWh
n	Exponent of the ambient air thermodynamic temperature ratio [1.2]	-	b_r	Specific fuel consumption under standard reference conditions	g/kWh
LHV_{test}	Lower heating value of the test fuel	MJ/kg	$b_{r\ main}$	Specific fuel consumption of the main fuel under ISO reference conditions and LHV corrected	g/kWh
LHV_{ISO}	Reference lower heating value of the fuel oil according to ISO 3046 (=42.7MJ/kWh)	MJ/kg	$b_{r\ pilot}$	Specific fuel consumption of the pilot fuel under test ambient conditions, LHV corrected value	g/kWh
LHV_{main}	Lower heating value of the main test fuel	MJ/kg	B_{main}	Liquid main fuel mass flow	kg/h
LHV_{pilot}	Lower heating value of the pilot test fuel	MJ/kg	B_{gas}	Gas mass flow	kg/h
LHV_{gas}	Lower heating value of the test gas fuel	MJ/kg	B	Mass of fuel consumed by the engine per unit of time	kg/h
$BSEC_{y\ gas}$	Brake specific energy consumption of gas fuel under test ambient conditions	kJ/kWh	B_{pilot}	Liquid pilot fuel mass flow	kg/h
$BSEC_{y\ pilot}$	Brake specific energy consumption of pilot fuel under test ambient conditions	kJ/kWh	EDP	Engine driven pump consumption in diesel mode	g/kWh
$BSEC_y$	Brake specific energy consumption of all fuels under test ambient conditions	kJ/kWh	EDP_{BSEC}	Engine driven pump consumption in gas mode	kJ/kWh
$BSEC_{FAT}$	FAT comparison value for BSEC	kJ/kWh	P_y	Brake power under ambient conditions during test	kW
$BSFC_{FAT}$	FAT comparison value for BSFC	g/kWh	Tol	ISO 3046-1:2002 allowed tolerance. Value in this case is 5% (=0.05)	%

11.5 ENGINE DRIVEN PUMPS

Engine driven pump (EDP) specific fuel consumption depends on specific engine configuration i.e. on the number of EDP built on engine according to contract specification and must be taken into account for final fuel consumption calculation.

Marine Solution Engines:

If *EDP* configuration on the engine under test is same as in the Customer delivery project contract specifications *EDP* =0.
If *EDP* configuration on the engine under test is different from the Customer delivery project contract specifications *EDP* must be set according to project contract.

Energy Solution Engines:

EDP are included as standard, so *EDP* must set to 0 (zero), if not otherwise specified in the contract specifications.

De-rated Engines:

In case of de-rated engine (New output = Z), also EDP consumption changes. Then new EDP consumption need to be interpolated between the existing output points 1 and 2 (Stated in Performance Manual) according to linear interpolation formula below.

$$EDP = \frac{(EDP_2 - EDP_1)}{(P_2 - P_1)} \cdot (P_Z - P_2) + EDP_2$$

Work Instruction

Title:	W26 Main Engines Diesel Electric and Auxiliary Engines - FAT procedure	**Doc.ID:**	DBAD671345
		Revision:	g
Author:	BRESCELLI, ALESSANDRO (ABR020); SALVI, SABRINA (SSA030)	**Status:**	Approved
Approver:	UGHI, ALESSANDRO (AUG001)	**Pages:**	1 (9)

FACTORY ACCEPTANCE TEST FOR WARTSILA 26 MARINE MAIN ENGINES DIESEL ELECTRIC / AUXILIARY ENGINES

Rev.	*Date*	*Revision Description*
-	02.10.2015	Instruction has been inserted in IDM system with new code DBAD671345. Previous code was DAAE002460 rev-e. All changes done in respect to previous revision are highlighted in grey. Main changes regard: - test set up (6.2) - engine performance parameters (6.3.1) - functional checks (6.3.3) - criteria of acceptability (6.3.2.1, 6.3.1.2, 6.3.1.3) - specific fuel oil consumption (6.3.2.1, 6.3.2.2).
a	18.02.2016	In the chapter 6.2 “Test set up” it has been specified that measurement of cold alignment of the crankshaft are included in the Test Protocol. The phrase in chapter 6.2.1 related to splash guards has been slightly modified. In chapter 6.3 “Test run” the description of FAT program has been modified and the description of SOLAS verifications has been inserted. In chapter 6.4 it has been specified that hot deflections are measured and included in the Test Protocol.
b	06.04.2016	Added some notes which covers genset test without alternator. Done some adjustments in chapter 6.3.4 “load application test”
c	26.07.2016	Some adjustments have been done in following chapters: 6.2.2, 6.3, 6.3.1, 6.3.2.2
d	30.06.2017	Added reference to Global FAT procedure DBAE170142; adjustments have been done in following chapters: 6.3.1, 6.3.2.1, 6.3.2.2.
e	06.11.2017	Done some adjustments in chapter 6.3.3
f	17.01.2019	In chapter 6.3 added the specification that a spot check of SOLAS hot spots is also required: refer to document “Infrared Thermography (IRT) SOLAS measurements - DBAE964935”. Document DBAE964935 also inserted among "references" in chapter 3
g	26.10.2020	No changes in the content, document only moved from legacy M-file vault to production vault; for that reason need to make a new revision

Name	*Brescellli A.*	*Salvi S.*	*Doddis G.*	*Ughi A.*
Dept. / Func.	DCT Test Run	DCT Quality QMS	DCT Engine Quality	DCT Test Run
Role	*Issue*	*Verification*	*Verification*	*Approval*

1. SCOPE

This instruction describes how Factory Acceptance Test (FAT) is performed on W26 Marine Main Engines Diesel Electric and Auxiliary Engines.

2. APPLICATION FIELD

Wärtsilä 26 Marine Main Engines Diesel Electric and Auxiliary Engines

3. REFERENCES

- WI DBAD333952 (B9350) ”Engine Painting”
- WI DBAD286405 (B9006) “Engines preservation for shipment or in store”
- ISO 15550 “Internal combustion engines -- Determination and method for the measurement of engine power -- General requirements”
- ISO 3046-1 “Reciprocating internal combustion engines - Performance“
- BS OHSAS 18001:2007 “Occupational Health and Safety Management”
- DBAE170142 “Global Factory Acceptance Test”
- DBAE964935 "Infrared Thermography (IRT) SOLAS measurements"

4. APPLICABLE DOCUMENTS

- Test Protocol

5. ABBREVIATIONS AND DEFINITIONS

- DCT: Delivery Centre Trieste
- IDM Integrated Document Management
- ISO International Organization for Standardization
- FAT Factory Acceptance Test
- EXW Ex works
- SFOC Specific fuel oil consumption

6. RESPONSIBILITIES AND WAY OF WORKING

6.1 INTRODUCTION

The test is carried out as an overall check of the manufacturing quality and to establish that the contractual commitments have been fulfilled. The Factory Acceptance Test (FAT) comprises of a running-in part and an official FAT part.

The test is carried out in accordance with ISO 15550. The function of built on ancillary systems and the performance of the engine is checked according to ISO 15550. Results are recorded in a test protocol signed by Wärtsilä, customer (if present) and a representative from a classification society.

At the end of the factory acceptance test, the engine is inspected by the same representatives above mentioned.

After inspection, the engines are preserved against corrosion, cleaned and painted before packing and shipment.

6.2 TEST SETUP

Marine Main Engines Diesel Electric and Auxiliary Engines are tested as generating sets, i.e. mounted on a common base frame together with the generator. The generator is loaded with resistive load banks.

In some cases engines can be tested connected to the water brake or in-house generator.

The generator power cables are connected to the switchboard. In all cases its Automatic Voltage Regulator (AVR) is used. The common base frame of the generating set is mounted on the same flexible mounts that will be delivered for installation on board. Necessary pipe connections between the engine and the test bed systems are made using in-house flexible hoses.

The cold alignment of the crankshaft is checked in the generator assembly cell. The measurement record is included in the test protocol.

If the engine is equipped with a mechanical governor and a speed setting motor, the motor is connected to an external speed control unit from which raise and lower commands can be given and the running speed selected. If the engine is fitted with an actuator and electronic governor, the running speed is controlled by a mA-signal from its Digital Control Governor.

If the engine is equipped with Wärtsilä Engine Control System (WECS) or Wärtsilä UNIC automation system, the measurement logics and safety functions are located in the engine mounted control system. If the engine is equipped with Basic Engine Automation System (BEA) the engine mounted sensors are connected to the in-house PLC. In either case all engine mounted measurements are shown in the control room operator station and customer facility display.

Note: the current standard automation system for Wärtsilä 26 Engines is UNIC C2.

6.2.1 Checks before starting

Firing sequence between cylinders within the same crank is checked.

Check that measurements values in operator station are updated and that they are normal for standstill condition. Check that there is no leakage when lubricating oil, fuel oil and cooling water systems have been filled. Check that splash guards on flammable fluid pipe lines are installed according Product Specification.

Check that there is no leakage in starting- and control air systems and that the engine starts rotating when pressing the starting air solenoid valve.

Blow the engine by rotating it with starting air while keeping indication cocks open.

6.2.2 Checks with running engine

Check that there is no leakage in lubricating oil, fuel oil and cooling water systems.

Testing of surge margin: propulsion engines with a turbocharger which is served by cylinder groups with combined power in excess of 2 500 kW shall be tested with regard to surge margins. The below mentioned tests may be waived if successfully tested earlier on an identical configuration of engine and turbocharger.

For 4-stroke engines, the following test shall be performed without indication of surging:

- at rated power, the speed shall be reduced with constant torque (fuel index) down to 90% power
- with 50% power at 80% speed (propeller characteristic for fixed pitch), the speed shall be reduced to 72% while keeping constant torque (fuel index).

Only for DNVGL classed engine: In case of engines driving electrical generators, it shall be verified that the rated electrical power as specified by manufacturer shall be covered by rated power of engine.

6.2.3 Testing of instruments and functions (UNIC_C2/WECS engines)

Check the function of the local control buttons (start, stop and shutdown reset).

Check the function of the remote control buttons (start, stop and shutdown reset).

Verify that the engine and turbo speed are shown on the LCP.

Verify that the backup meters are working and show correct values.

Verify that the waste gate works properly:

- by overriding the charge air pressure sensor (WECS);
- by forcing via software (UNIC_C2).

Verify that the:

- "normal status" LED on the Oil Mist Detector is ready (WECS);
- OMD is showing E05 on the display (UNIC_C2).

Verify the function of turning gear safety switch and air cut off valve.

Verify the function of manual stop lever switch.

6.2.3 Testing of instruments and functions (UNIC_C1/Basic automation engines)

Check the function of the local control buttons (Emergency stop, start, stop and shd. reset).

Verify that the meters are working and show correct values.

Verify that the waste gate works properly by overriding the charge air pressure sensor.

Verify that the engine and turbo speed are shown on the Local Control Panel.

Verify that the OMD is showing E05 on the display.

Verify the function of turning gear safety switch and air cut off valve.

Verify the function of manual stop lever switch.

6.2.4 Testing of safeties with running engine

Check the first lube oil pressure trip (sensor PT201 over and below 600 rpm) (WECS).

Check the backup lube oil pressure trip:

- Sensor PSZ201.1 over 600 rpm, PSZ201.2 below 600 rpm (WECS);
- Sensor PTZ201 (UNIC).

Check the first overspeed trip (1.15 x nominal speed, sensor ST173) by manually increasing the fuel rack.

Check the second overspeed trip:

- by disabling the first overspeed trip and manually increasing the fuel rack (1.18 x nominal speed, sensor ST174) (WECS);
- by disabling the first overspeed trip and manually increasing the fuel rack (1.15 x nominal speed, sensor ST174) (UNIC).

Check the oil mist detector trip (if present).

Check other safeties according Class. Rules (PSZ401, TEZ402, etc.)

Notes:

Analogue sensors and set-points of pressure switches have factory settings and are not recalibrated.

It is a classification society requirement that all shutdown functions and alarm set-points are verified during ship commissioning, regardless of any previous tests.

6.2.5 Calibration of measuring equipment

Measuring equipments related to calculation of fuel consumption are calibrated according to the manufacturer’s specifications and the certificates are available on request.

6.3 TEST RUN

The test run is started with a running-in phase The purpose of the running-in is to correct possible manufacturing defects, eliminate leakages and run in smoothly all bearing surfaces and piston rings before the engine is delivered.

The first step of the running in is the bearing run. The engine idles for a few minutes then it is stopped to verify the temperature of the bearings and inspect crankcase.

During the following running in process the engine is loaded in steps up to 110% load, the fuel oil is normally the same used during the official FAT program.

After running-in the test run is followed by the official FAT phase according to the program stated in the contract and to the requirements by the classification society concerned.

A standard program generally includes 25 – 50 – 75 – 85 – (90) – 100 - 110% load points. Normally the duration of load point of 100% is 60 minutes, while at the other load points is 30 minutes. In any case, the durations and the loads are dependent on the requirements by the classification society concerned and particulars requests of the customer stated in the contract. The engine speed shall be in accordance, on the basis of engine application, to class requirements. Depending of the installation either LFO or HFO fuel oil is used during FAT.

A spot check of SOLAS hot spots is also required: refer to document “Infrared Thermography (IRT) SOLAS measurements - DBAE964935”.

6.3.1 Engine Performance Parameters

Performance data is recorded at all load points according to ISO 15550 for engine group n.4 (see chapter 8 of the Global FAT Guideline). Some parameters are not recorded/completely recorded: A7, A13, A14, A17, A19, A21, A22, A23, A24, and A26.

6.3.1.1 Firing pressure

The firing pressure of each cylinder is measured by a Kistler pressure indicator. The acceptance criteria at 100% load are:

- The firing pressure is to be within:

See performance data document DBAB179116

- The maximum deviation for any cylinder from the mean value is 6 bar
- The difference in firing pressure between any two cylinders to be within 10 bar

Main reasons for deviations are:

- The fuel injection timing.
- Variations of air receiver pressure.
- Disturbances in injection pump or nozzle function.

Note: *Values might vary on derated engine*

6.3.1.2 Exhaust-gas temperature after cylinders

The exhaust-gas temperature is measured for each cylinder. The acceptance criteria at 100% load are:

- Maximum deviation between cylinders is 85°C (for 8L26 and 16V26 120°C).

The temperature before the turbocharger is:

See performance data document DBAB179116

Note: The priority order for exhaust gas temp / firing pressure that the firing pressure is more important.

Note: Values might vary on derated engine

6.3.1.3 Charge air pressure

The charge air pressure is measured using the engine mounted pressure sensor.

- The readings at 100% load to be within:

See performance data document DBAB179116

Note: Values might vary on derated engine.

All alarm values are typically set according to the operating conditions of the engine, which is optimized for the range 0% - 100% MCR, and not for overload condition (e.g. 110%) MCR, according to IACS M35 and ISO 3046-1:2002.

6.3.2 Test results

List B - Test Results, Parameters to be Calculated (ISO 15550)	
B1	Brake power
B2	Specific fuel consumption

6.3.2.1 Brake power

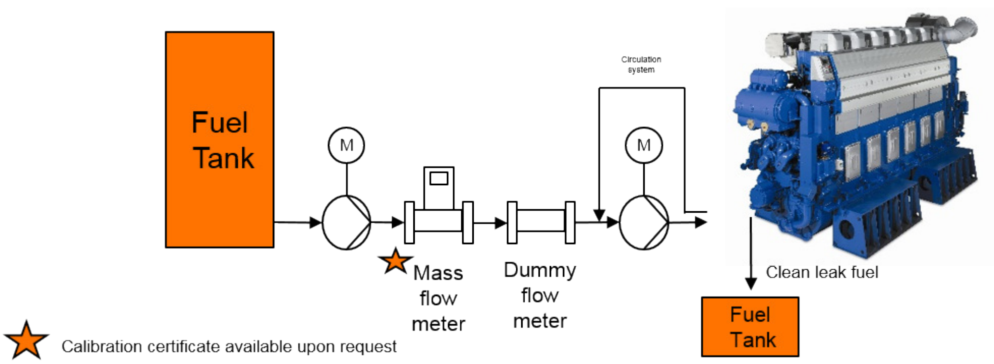
The brake power for the engine is calculated from the measured electrical power and the generator electrical efficiency. The efficiency of the generator is available from the manufacturer's data sheet and is provided by the marine department. The electrical power can be read directly from the operator station. When using water brake power is calculated with formulas of the water brake used (see chapter 6.2 of the Global FAT Guideline).

6.3.2.2 Specific fuel oil consumption

The fuel oil consumption is measured by a Coriolis Mass Flow Measuring System. The unit provides a Modbus signal as input to the test bed control system, which shows the actual value in kg/h and calculate the average consumption on a desired time window.

See chapter 6.3.2 of the Global FAT Guideline for general description of measurement with flow meter.

Option A3-a: Mass flow meter



The acceptance criteria for the engine fuel consumption are stated in the contract.

The fuel oil quality is checked according to "DCT Fuel oil management and Gas procedure DBAE223942".

See chapter 9 of the Global FAT Guideline for description of the consumption measurement process and the paragraph 11.1 and 11.5 for the relevant formulas used.

6.3.3 Functional checks

[ISO 15550] “Functional checks which may additionally be carried out. Selection from list C shall be made by agreement between the manufacturer and customer.”

List C - Functional checks, functions to be verified (ISO 15550)	
C1	The correct functioning of the overspeed limiting device in accordance with ISO 3046-6
C2	The correct functioning of the speed governing system in accordance with ISO 3046-4
C3	The ability of all malfunction protection and warning devices to respond correctly to the fault conditions in which they should operate (e.g., low lubricating oil pressure, high lubricating oil temperatures, high coolant temperatures, pressure rise in the crankcase, etc.)
C4	The correct functioning of all automatic pressure and temperature controls
C5	The ability of the starting system to perform prior to and/or after the acceptance test conditions of the engine are reached, subject to agreement between the manufacturer and customer
C6	The correct functioning of the reversing mechanism, built-in reverse reduction gear and couplings
C7	That the temperatures of important components are satisfactory
C8	That the crank web deflection is within the given limits
C9	Stability of the engine on its support
C10	The condition after test of one or more piston and one cylinder assemblies and bearings, chosen randomly for inspection
Note: Points C1, C3 (low lube oil pressure shutdown), C8 and C10 are included in Wärtsilä standard FAT procedures. See section 6.2.4 and 6.5 of this document. Point C2 may only be performed if engine is tested coupled to the project specific generator. Point C6 is not applicable. All other points can be performed only if agreed between manufacturer and costumer prior to factory acceptance test date.	

6.3.4 Load Application Test

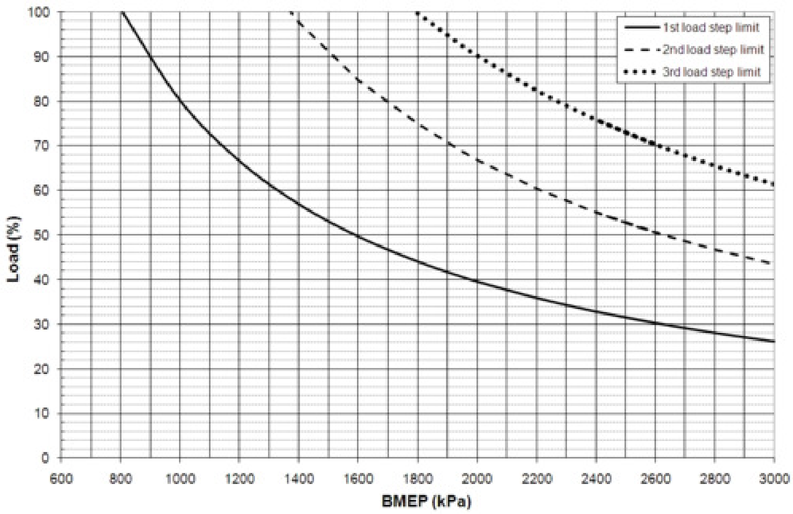
This test could be performed only if the engine are tested with project specific generator, no in case of water brake or in-house generator.

The speed governor and load acceptance of the generating set are tested by making rapid load changes. The load is normally applied in three steps, 0-33-66-100%, or other values, according to the rules of the classification societies. The instantaneous speed drop may not exceed 10 % of rated speed, the recovery time is 5 seconds, which means that the speed must be within 1% of the rated speed after 5 seconds. The minimum load steps recommended by the International Association of Classification Societies (IACS) and by ISO 8528-5 are presented in the figure below.

The individual classification societies may specify different a load application scheme, but three steps can normally be accepted by most classification societies if the load management system onboard will be built accordingly. The customer has to clarify this with the classification society concerned.

Load application tests onboard must be performed with the contracted fuel in order to achieve the same performance as in the factory test run.

The speed governor performance can be followed in the historical trends in the operator station where engine speed and generator output are graphically recorded.



6.3.5 Special tests

Other tests or checks can be done in combination to the factory acceptance test if specifically stated in the contract, i.e. noise-, vibration- or emission measurement.

6.4 CRANKSHAFT ALIGNMENT CHECK IN HOT CONDITION

For engines tested with the in-house generator or water brake, no hot deflection test is done, since the installation is only temporary. For generating sets a hot crankshaft alignment is done when the test run is finished, the control is done to check the straightness of the crankshaft when it is in running (hot) condition and thereby verify correct installation on the common base frame. The measurement record is included in the test protocol. The alignment in hot condition is to be verified after final installation on site.

6.5 INSPECTION OF ENGINE

After the official test run, the customer and the representative of Classification Society are invited to supervise the inspection of the engine. Standard inspections are:

- Opening of one cylinder unit:
  - Cylinder head with valves and injector disassembled;
  - Piston;
  - Big end bearing;
  - Cylinder liner;
- Opening of one main bearing;
- Visual inspection of the crank case and camshaft compartment;

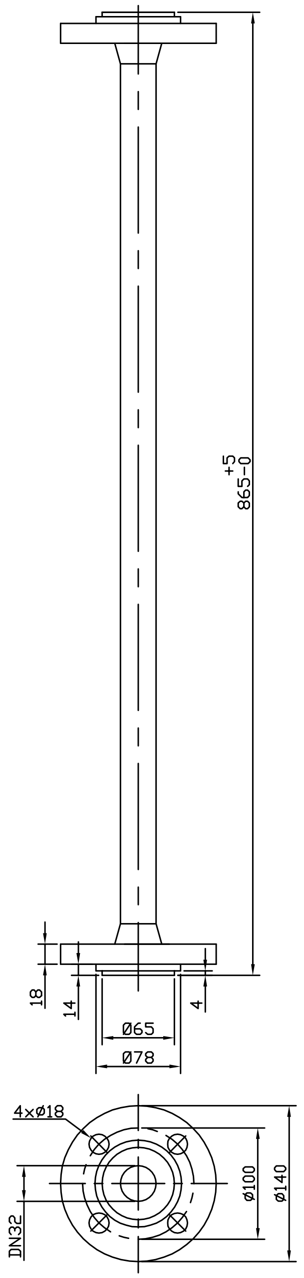
Any special request regarding this inspection should be agreed upon, latest at the time of confirmation of participation in the FAT.

6.6 FINISHING

After the inspection of the engine, there are a number of different items checked before delivery. The instructions WI DBAD333952 (B9350) ”Engine Painting” and WI DBAD286405 (B9006) “Engines preservation for shipment or in store” describe the details and other routines after the test run, as well as the internal and external anticorrosion protection treatment of the engine.

6.7 HEALTH AND SAFETY DURING FAT

The tests are made according to the factory internal health and safety instructions and way of working. These are governed by the OHSAS 18001 standard.



LAPPED FLANGES: ISO 7005-1

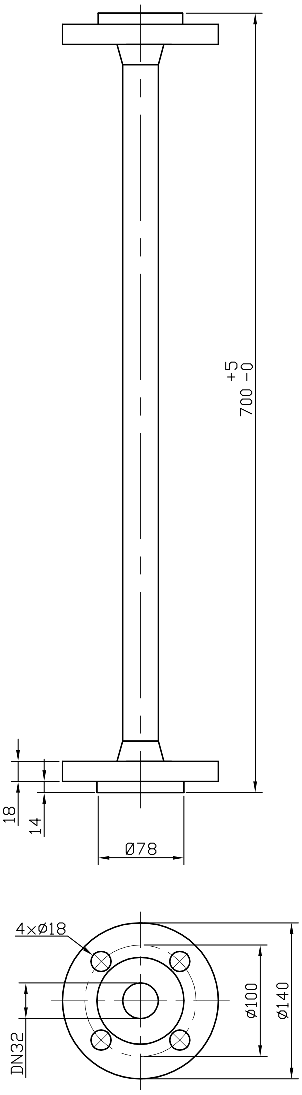
JOINT FACE: DIN 2513 - Shape V13

MAX WORKING PRESSURE: 16bar

HOSE TO BE INSTALLED WITH AN ANGLE BETWEEN 30° AND 90°.

WÄRTSILÄ		Wärtsilä Finland Oy Ship Power –		FLEXIBLE HOSE FOR FUEL OIL DN32 –
PRODUCT	–	ACAD	UNITS mm kg	
MADE	14 08 2008	D SJÖHOLM	DESIGN GROUP 35A	MAT.NO. xx–xx MAT.CLASS. 320–040–020
CHKD	14 08 2008	T.STÅHLBERG	SCALE 1: 5 / SIZE A4	PAGES –/– DRG.NO. DBAA748321 REV. a
APPD	14 08 2008	L.BACKLUND		

This drawing is the property of Wärtsilä Finland Oy and shall not be copied, shown or communicated to a third party without the consent of the owner.



LAPPED FLANGES: ISO 7005-1

JOINT FACE: DIN 2656

MAX WORKING PRESSURE: 16bar

HOSE TO BE INSTALLED WITH AN ANGLE BETWEEN 30° AND 90°.

WÄRTSILÄ		Wärtsilä Finland Oy Ship Power		FLEXIBLE HOSE FOR FUEL OIL DN32
		–		
PRODUCT	–	ACAD	UNITS mm kg	–
MADE	25 11 2008	M. UOTILA	DESIGN GROUP 35A	MAT.NO. xx–xx MAT.CLASS. 320–040–020
CHKD	25 11 2008	K. KOLKKA	SCALE 1: 5 / SIZE A4	PAGES –/– DRG.NO. DBAA841528 REV. –
APPD	25 11 2008	H. HARJU		

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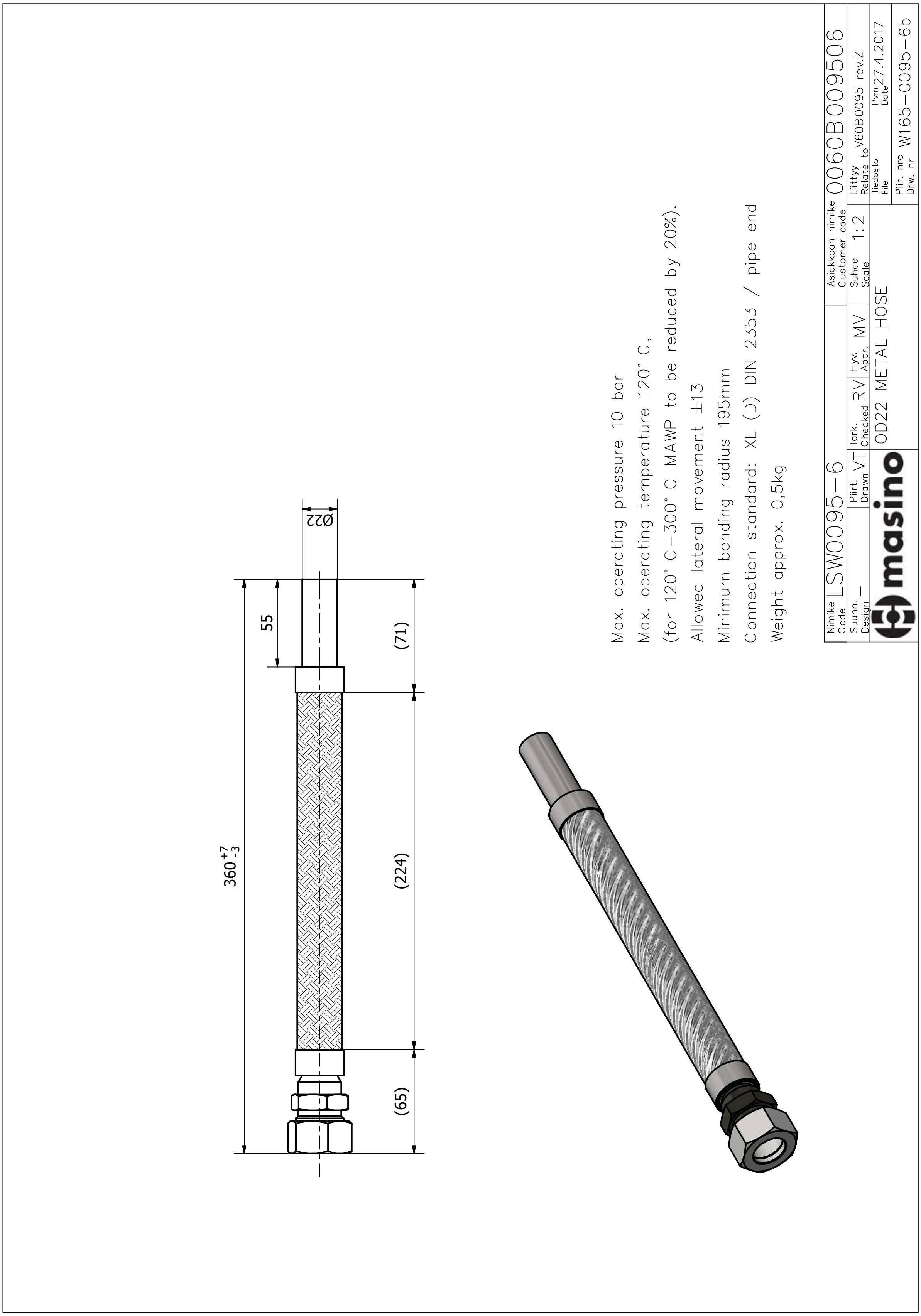
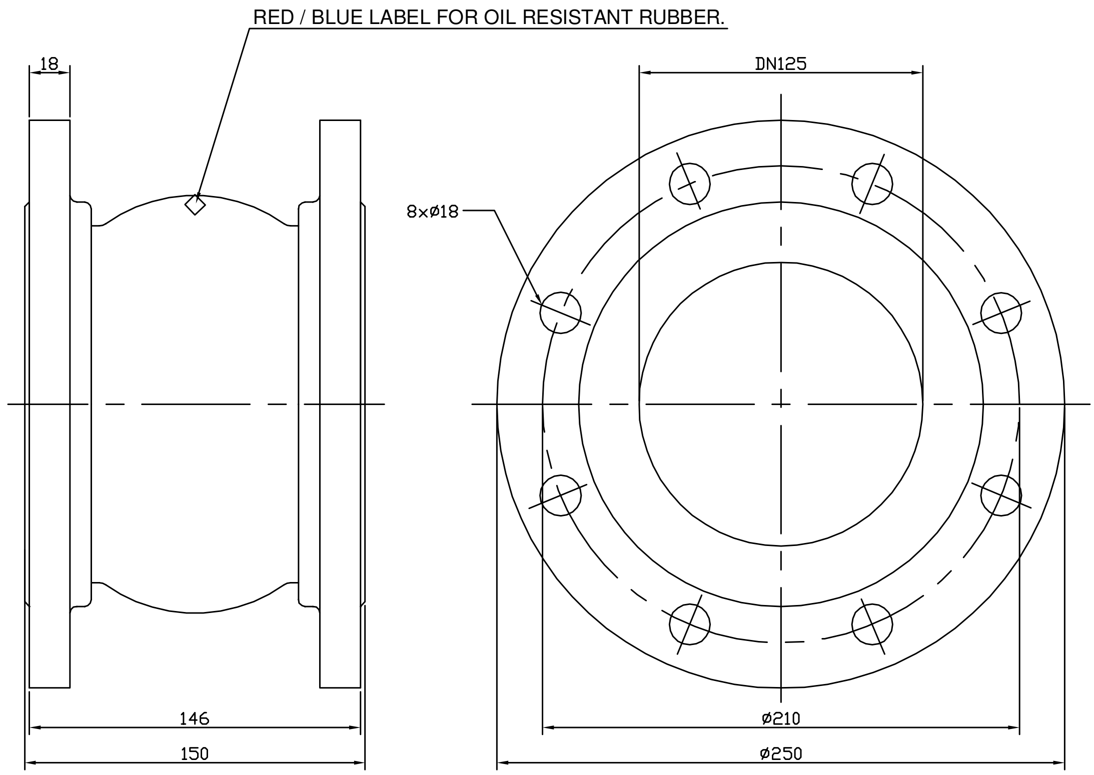

Max. operating pressure 10 bar
Max. operating temperature 120° C,
(for 120° C – 300° C MAWP to be reduced by 20%).
Allowed lateral movement ±13
Minimum bending radius 195mm
Connection standard: XL (D) DIN 2353 / pipe end
Weight approx. 0,5kg
Ø22
55
(71)
360 +7 -3
(224)
(65)
Nimike Code LSW0095-6
Suunn. Design –
Piirt. Drawn VT
Tark. Checked RV
Hyv. Appr. MV
Asiakkaan nimike Customer code 0060B009506
Suhde Scale 1:2
Liittyy Relate to V60B0095 rev.Z
Tiedosto File
Pvm Date 27.4.2017
Piir. nro Drw. nr W165-0095-6b
OD22 METAL HOSE
masino



ALLOWED MOVEMENT		
AXIAL mm	LATERAL mm	ANGULAR
- 40 / +10	± 15	± 15°

Weight: 9,1kg

TORQUE: 90Nm

REV.	DATE	MADE	APPVD.	MEMO NO.	EXPLANATION
c	09 05 2016	C.Grannas	T.Vesterbacka	–	Lateral movement changed from 10 to 15mm. Torque changed from 15 to 90Nm
b	01 12 2008	M.Storäng	T.Ståhlberg	–	Drawing updated

WÄRTSILÄ

Wärtsilä Finland Oy
Marine Solutions

–

FLEXIBLE RUBBER BELLOW
FOR LUBE OIL PIPES
WITH VACUUM RING
DN125

–

PRODUCT –

ACAD

UNITS mm kg

MADE	07 07 2006	M.STORÄNG
CHKD	01 08 2006	T.STÅHLBERG
APPD	07 07 2006	L.BACKLUND

DESIGN GROUP 60B

SCALE 1: 2,5

SIZE A4

MAT.NO. xx–xx

MAT.CLASS. 320-040-010

PAGES –/–

DRG.NO. DAAB761727

REV. C

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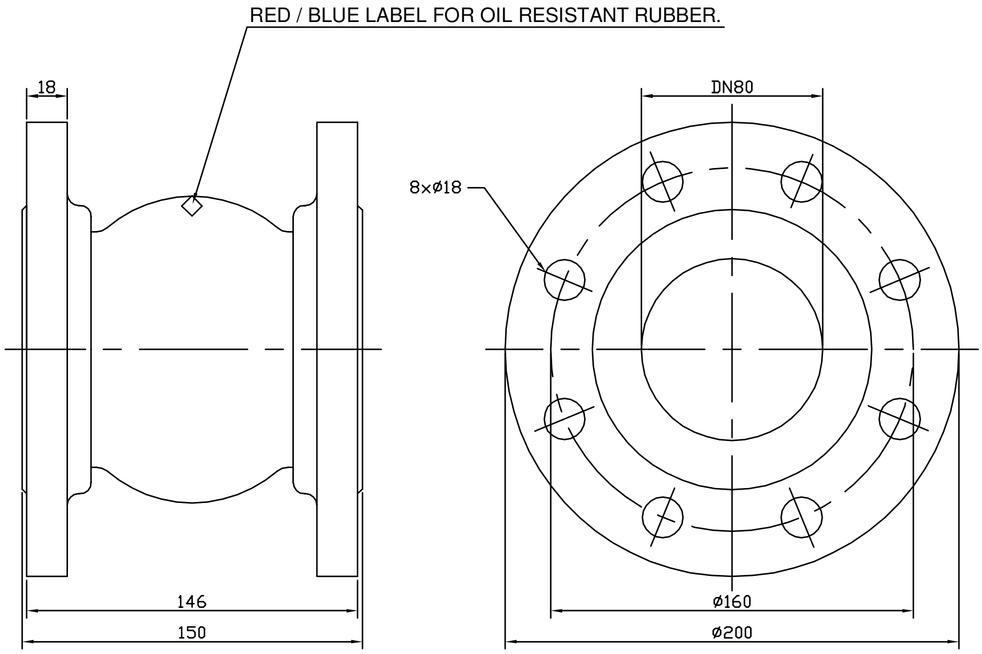

ALLOWED MOVEMENT		
AXIAL mm	LATERAL mm	ANGULAR
- 40 / +10	± 15	± 20°

Weight: 5,9kg

TORQUE: 90Nm

REV.	DATE	MADE	APPVD.	MEMO NO.	EXPLANATION
c	09 05 2016	C.Grannas	T.Vesterbacka	–	Lateral movement changed from 10 to 15mm. Torque changed from 15 to 90Nm
b	01 12 2008	M.Storäng	T.Ståhlberg	–	Drawing updated

WÄRTSILÄ

Wärtsilä Finland Oy
Marine Solutions

–

FLEXIBLE RUBBER BELLOW
FOR LUBE OIL PIPES
WITH VACUUM RING
DN80

–

PRODUCT –   ACAD   UNITS mm kg

MADE	07 07 2006	M.STORÄNG	DESIGN GROUP 60B	MAT.NO. xx–xx MAT.CLASS. 320–040–010
CHKD	01 08 2006	T.STÅHLBERG	SCALE 1: 2,5 / SIZE A4	PAGES –/– DRG.NO. DAAB761717 REV. C
APPD	07 07 2006	L.BACKLUND		

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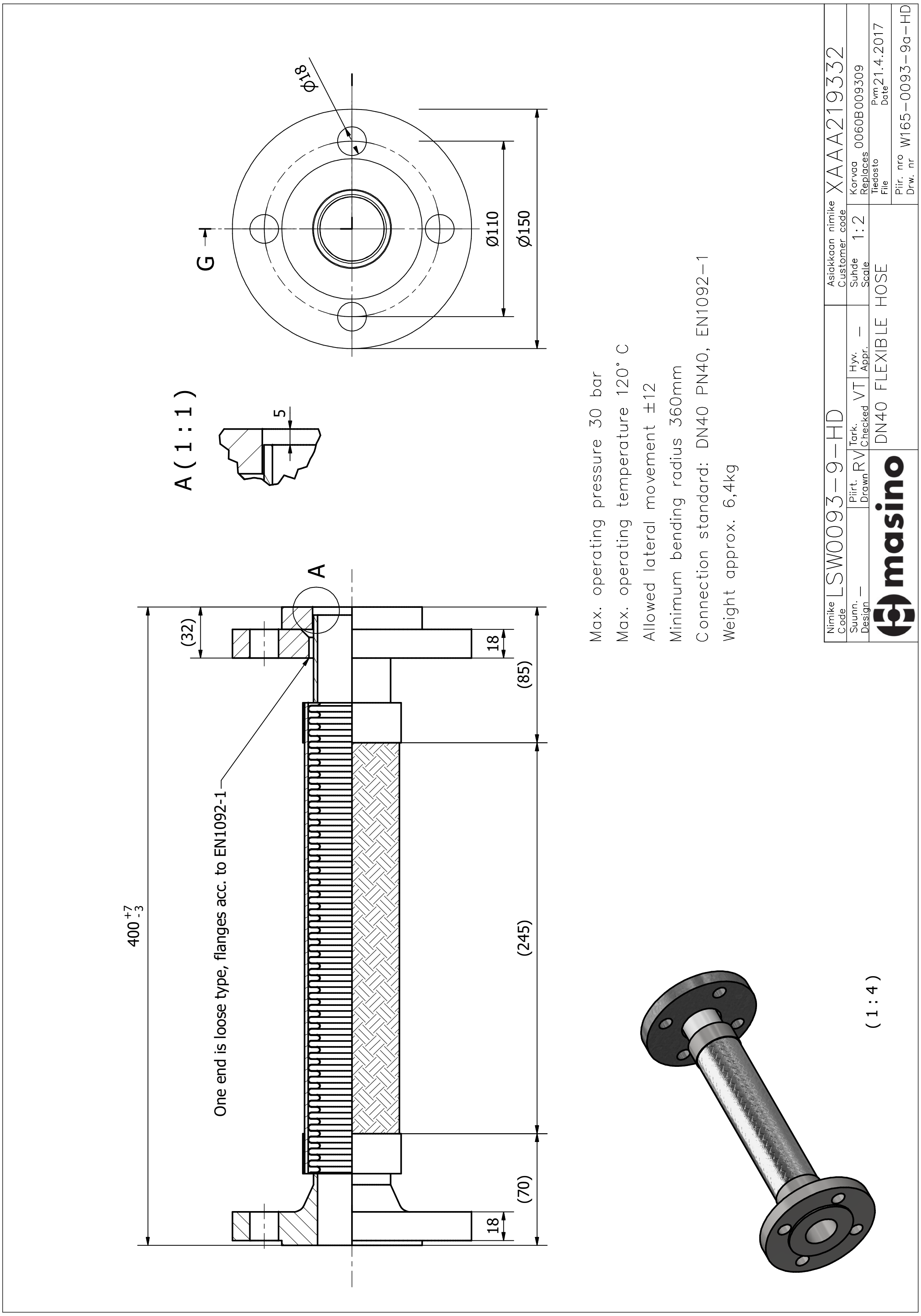
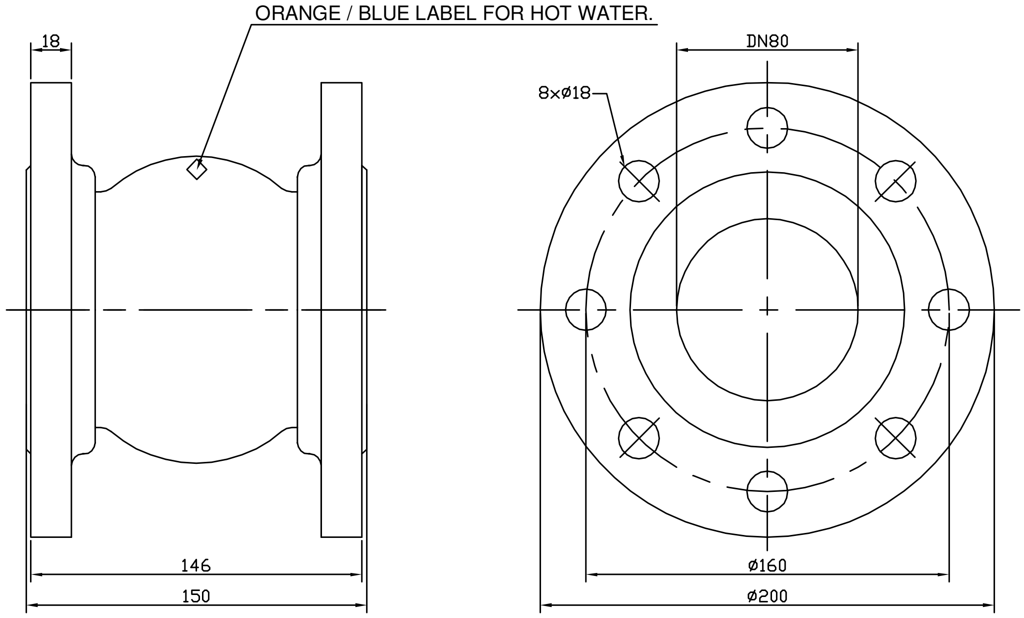

Max. operating pressure 30 bar
Max. operating temperature 120° C
Allowed lateral movement ±12
Minimum bending radius 360mm
Connection standard: DN40 PN40, EN1092-1
Weight approx. 6,4kg
One end is loose type, flanges acc. to EN1092-1
A (1 : 1)
(1 : 4)
Ø110
Ø150
ϕ18
400 +7 -3
(32)
(85)
(245)
(70)
18
18
5
A
G
Nimike Code LSW0093-9-HD
Asiakkaan nimike Customer code XAAA219332
Suunn. Design –
Piirt. Drawn RV
Tark. Checked VT
Hyv. Appr. –
Suhde Scale 1:2
Korvaa Replaces 0060B009309
Tiedosto File
Pvm Date 21.4.2017
DN40 FLEXIBLE HOSE
Piir. nro Drw. nr W165-0093-9a-HD
masino



ALLOWED MOVEMENT		
AXIAL mm	LATERAL mm	ANGULAR
- 40 / +10	± 15	± 20°

Weight: 5,9kg

TORQUE: 90Nm

REV.	DATE	MADE	APPVD.	MEMO NO.	EXPLANATION
b	27.02.2017	C.Grannas	V.Häggblom	–	Lateral movement changed from 10 to 15mm. Torque changed to 90Nm.
a	17.07.2008	D.Sjöholm	L.Backlund	–	Drawing updated

WÄRTSILÄ

Wärtsilä Finland Oy
Marine Solutions

–

FLEXIBLE RUBBER BELLOW
FOR WATER PIPES
DN80

PRODUCT	–	ACAD	UNITS mm kg	–
MADE	07 07 2006	M.STORÄNG	DESIGN GROUP 60D	MAT.NO.WITHOUT VACUUM RING: 006190045. MAT.NO.WITH VACUUM RING: PAAE026974 MAT.CLASS. 320-040-010
CHKD	01 08 2006	T.STÅHLBERG	SCALE 1: 2,5 / SIZE A4	PAGES –/– / DRG.NO. DAAB761661 / REV. b
APPD	07 07 2006	L.BACKLUND		

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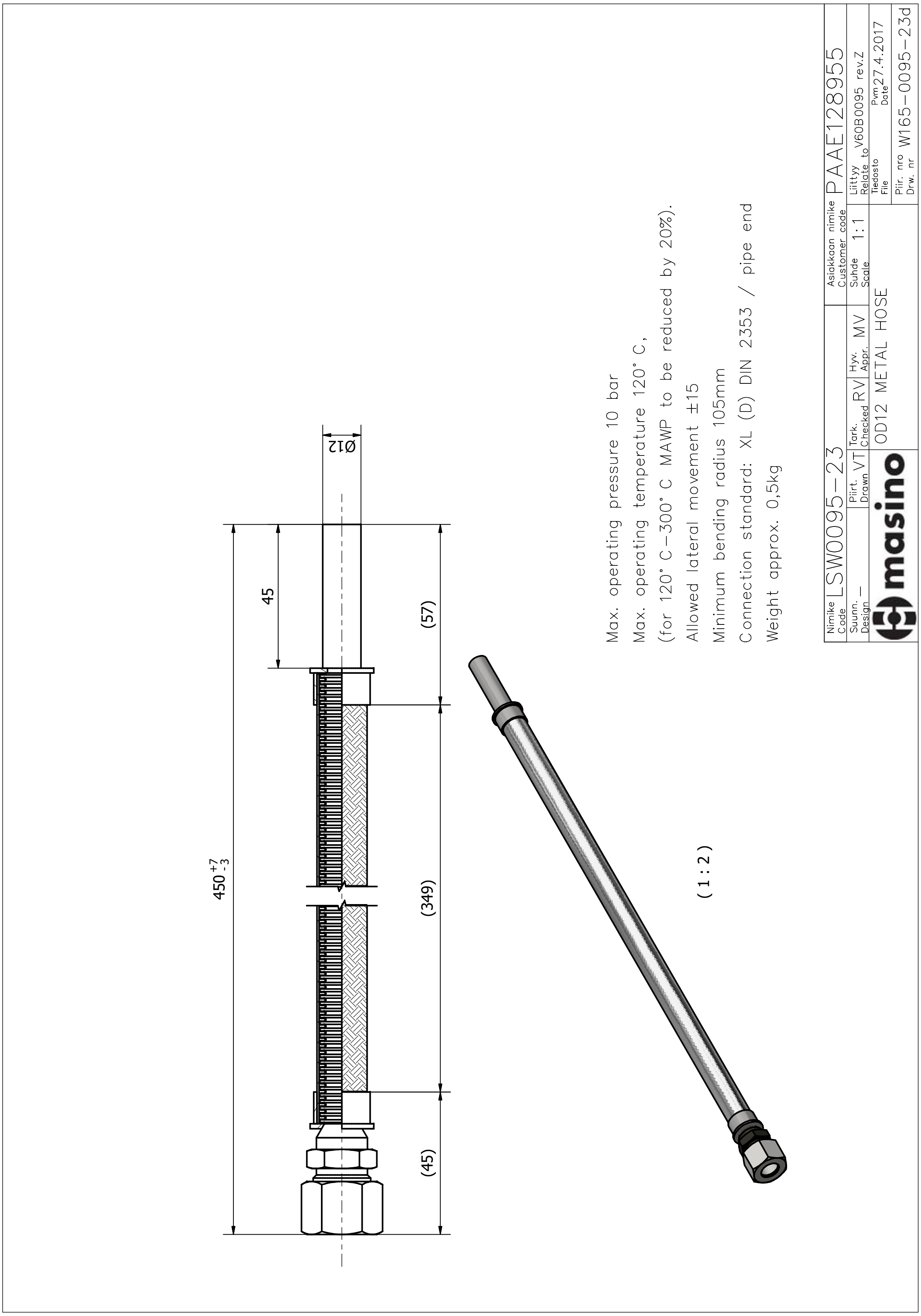
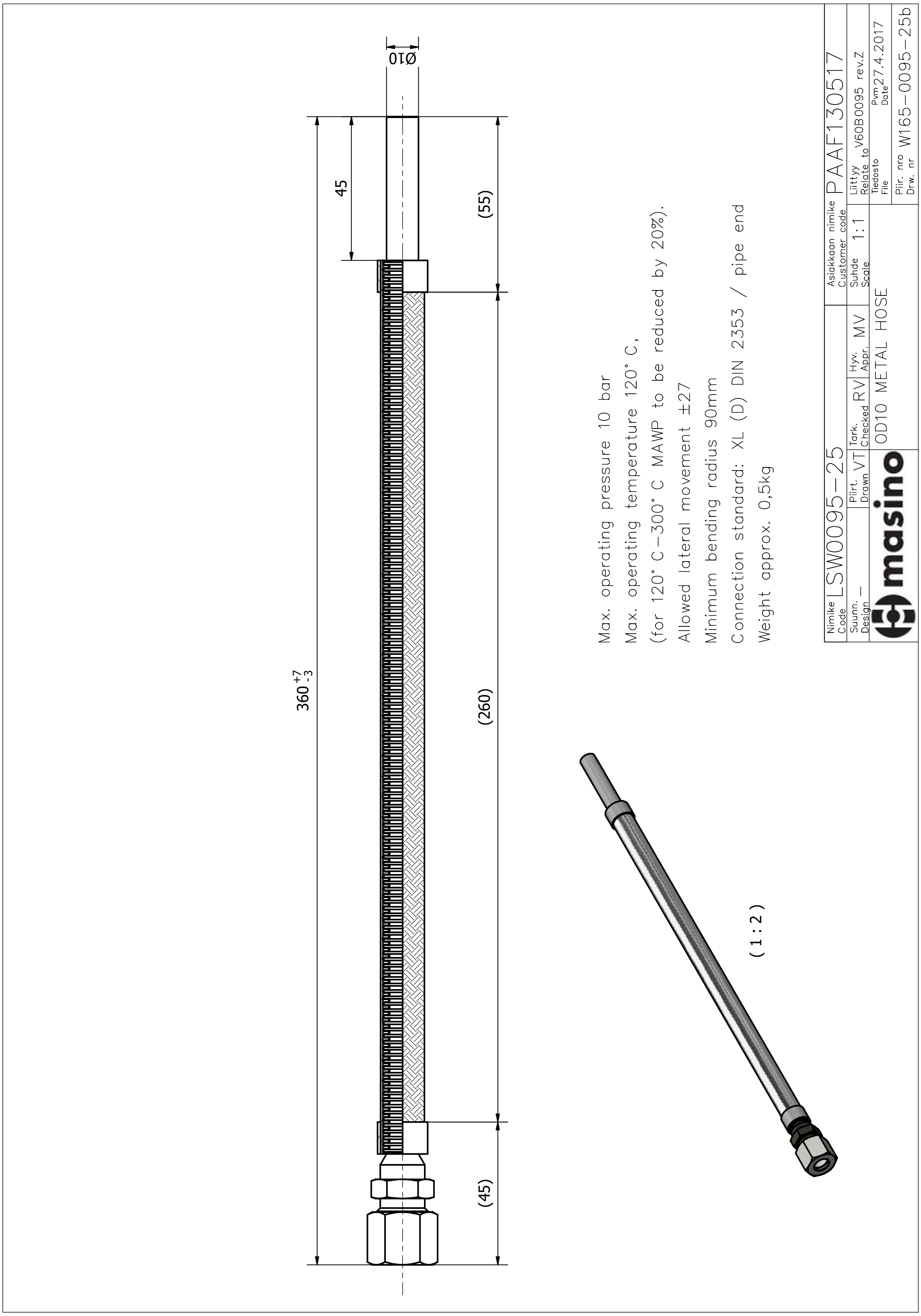
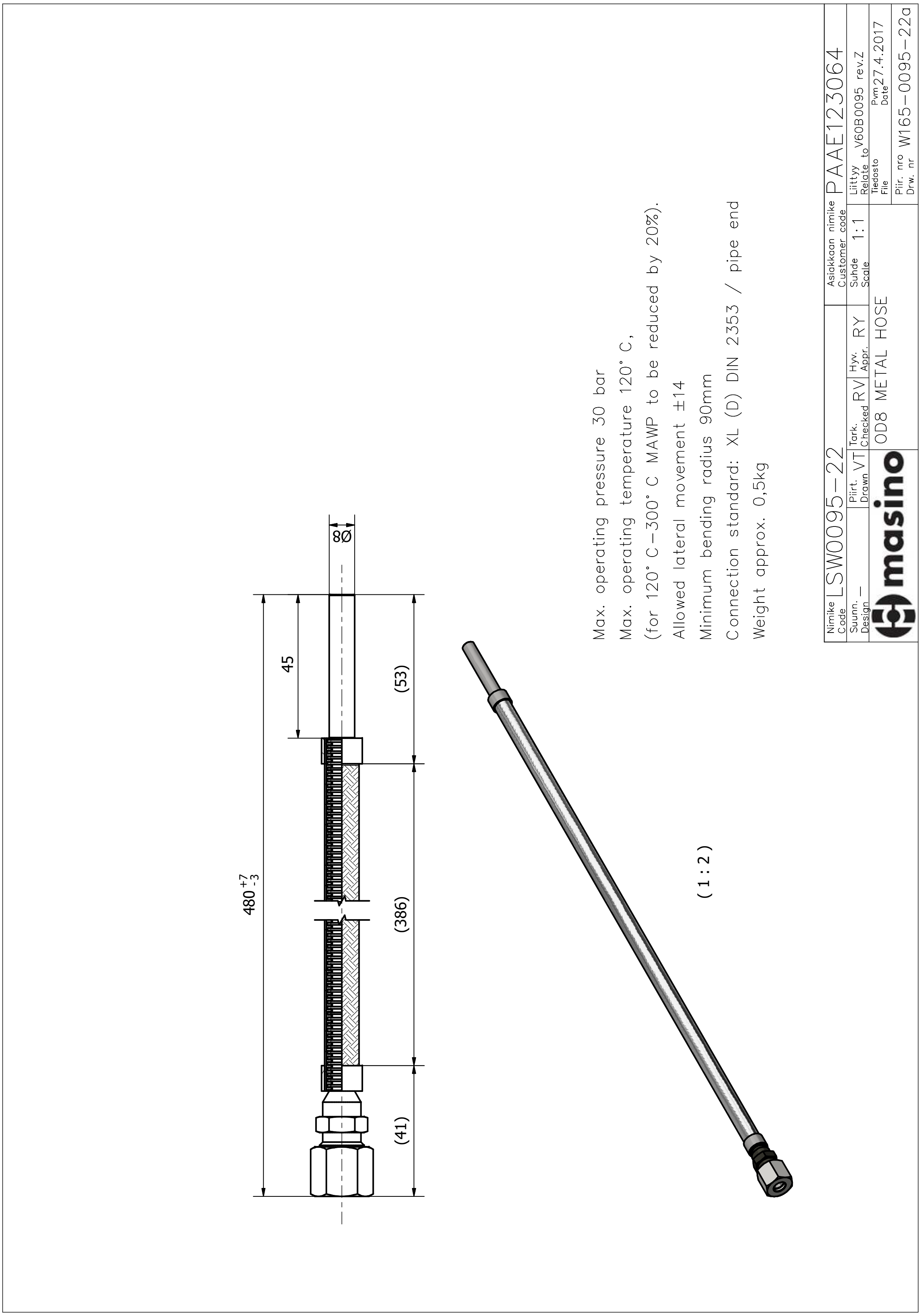
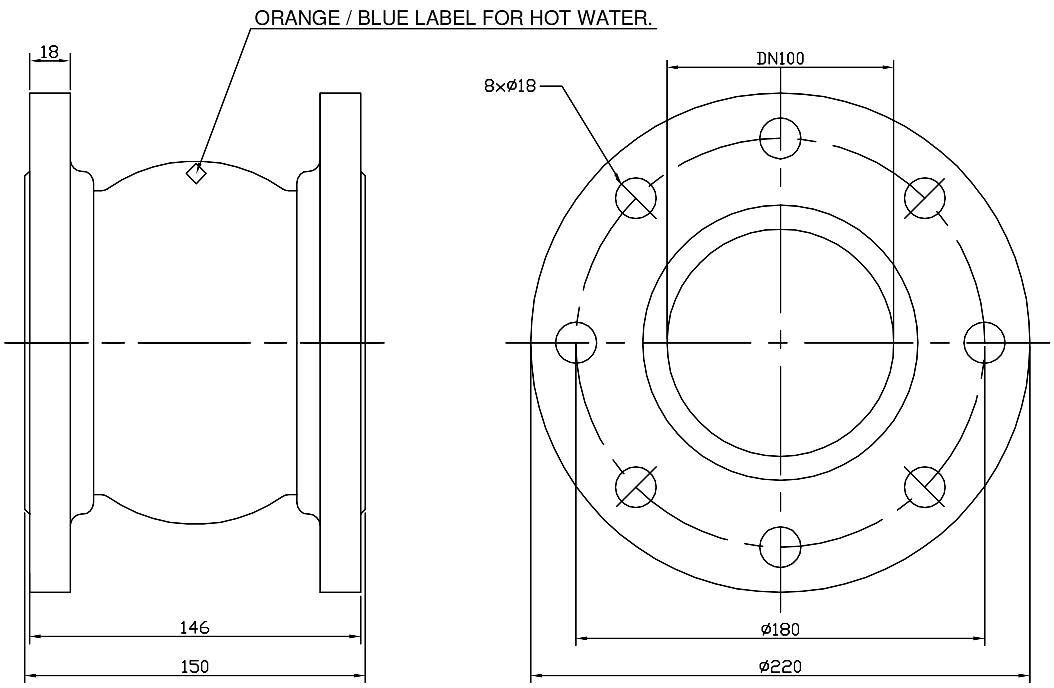

Max. operating pressure 10 bar
Max. operating temperature 120° C,
(for 120° C−300° C MAWP to be reduced by 20%).
Allowed lateral movement ±15
Minimum bending radius 105mm
Connection standard: XL (D) DIN 2353 / pipe end
Weight approx. 0,5kg
Ø12
45
(57)
450 +7 -3
(349)
(45)
(1 : 2)
Nimike Code LSW0095−23
Asiakkaan nimike Customer code PAAE128955
Suunn. Design −
Piirt. Drawn VT
Tark. Checked RV
Hyv. Appr. MV
Suhde Scale 1:1
Liittyy Relate to V60B0095 rev.Z
Tiedosto File
Pvm Date 27.4.2017
masino
OD12 METAL HOSE
Piir. nro Drw. nr W165−0095−23d


Ø10
45
(55)
360 +7 -3
(260)
(45)
Max. operating pressure 10 bar
Max. operating temperature 120° C,
(for 120° C–300° C MAWP to be reduced by 20%).
Allowed lateral movement ±27
Minimum bending radius 90mm
Connection standard: XL (D) DIN 2353 / pipe end
Weight approx. 0,5kg
(1 : 2)
Nimike Code LSW0095–25
Asiakkaan nimike Customer code PAAF130517
Suunn. Design –
Piirt. Drawn VT
Tark. Checked RV
Hyv. Appr. MV
Suhde Scale 1:1
Liittyy Relate to V60B0095 rev.Z
Tiedosto File
Pvm Date 27.4.2017
OD10 METAL HOSE
Piir. nro Drw. nr W165–0095–25b


Max. operating pressure 30 bar
Max. operating temperature 120° C,
(for 120° C –300° C MAWP to be reduced by 20%).
Allowed lateral movement ±14
Minimum bending radius 90mm
Connection standard: XL (D) DIN 2353 / pipe end
Weight approx. 0,5kg
(1 : 2)
8Ø
45
(53)
(386)
(41)
480 +7 -3
Nimike Code LSW0095-22
Suunn. Design –
Piirt. Drawn VT
Tark. Checked RV
Hyv. Appr. RY
masino
OD8 METAL HOSE
Asiakkaan nimike Customer code PAAE123064
Suhde Scale 1:1
Liittyy Relate to V60B0095 rev.Z
Tiedosto File
Pvm Date 27.4.2017
Piir. nro Drw. nr W165-0095-22a



ALLOWED MOVEMENT		
AXIAL mm	LATERAL mm	ANGULAR
- 40 / +10	± 15	± 15°

Weight: 7,2kg

TORQUE: 90Nm

REV.	DATE	MADE	APPVD.	MEMO NO.	EXPLANATION
b	27.02.2017	C.Grannas	V.Häggblom	–	Lateral movement changed from ±10 to ±15mm. Torque changed to 90Nm.
a	17.07.2008	D.Sjöholm	L.Backlund	–	Drawing updated

WÄRTSILÄ

Wärtsilä Finland Oy
Marine Solutions

–

FLEXIBLE RUBBER BELLOW
FOR WATER PIPES
DN100

–

PRODUCT –

ACAD

UNITS mm kg

MADE	07 07 2006	M.STORÄNG	DESIGN GROUP 60D	MAT.NO. WITHOUT VACUUM RING: 006190046 MAT.NO. WITH VACUUM RING: PAAE026975 · MAT.CLASS. 320–040–010
CHKD	01 08 2006	T.STÅHLBERG	SCALE 1: 2,5 · SIZE A4	PAGES –/– · DRG.NO. DAAB761664 · REV. b
APPD	07 07 2006	L.BACKLUND		

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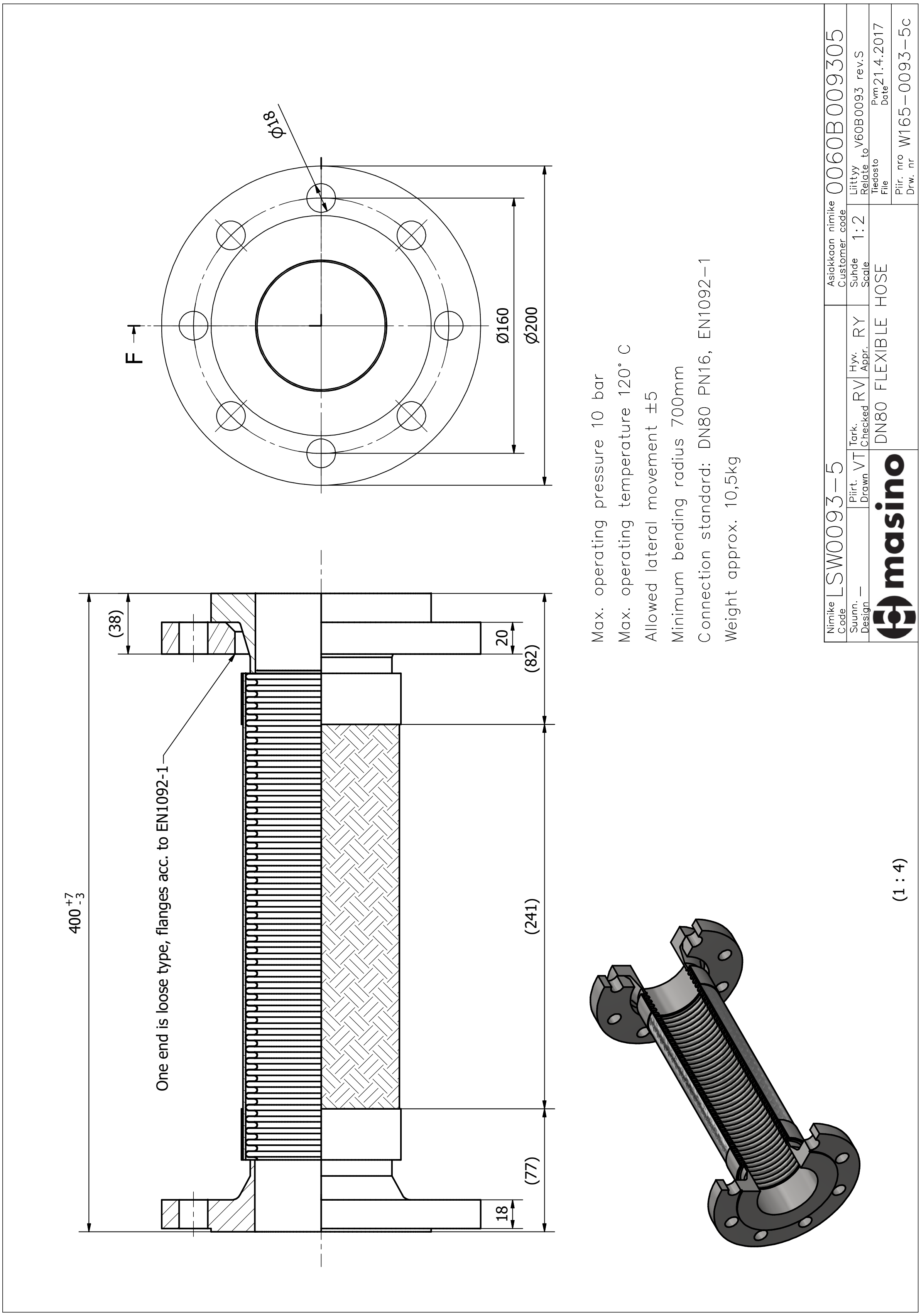

Ø18
F
Ø160
Ø200
(38)
20
(82)
(241)
(77)
18
400^{+7}_{-3}
One end is loose type, flanges acc. to EN1092-1
(1 : 4)
Max. operating pressure 10 bar
Max. operating temperature 120° C
Allowed lateral movement ±5
Minimum bending radius 700mm
Connection standard: DN80 PN16, EN1092-1
Weight approx. 10,5kg
Nimike Code LSW0093-5
Asiakkaan nimike Customer code 0060B009305
Suunn. Design –
Piirt. Drawn VT
Tark. Checked RV
Hyv. Appr. RY
Suhde Scale 1:2
Liittyy Relate to V60B0093 rev.S
Tiedosto File
Pvm Date 21.4.2017
masino
DN80 FLEXIBLE HOSE
Piir. nro Drw. nr W165-0093-5c

Internal

Doc. Name	Estimated dynamic forces		
Doc. ID	DSCA00116475	**Revision**	-.1
Doc. Type	Requirement Specification	**Pages**	1 (1)
Author	Jansson, Krister - Wärtsilä Marine Business	**Status**	Draft
Reviewed by **Approved by**	- -		

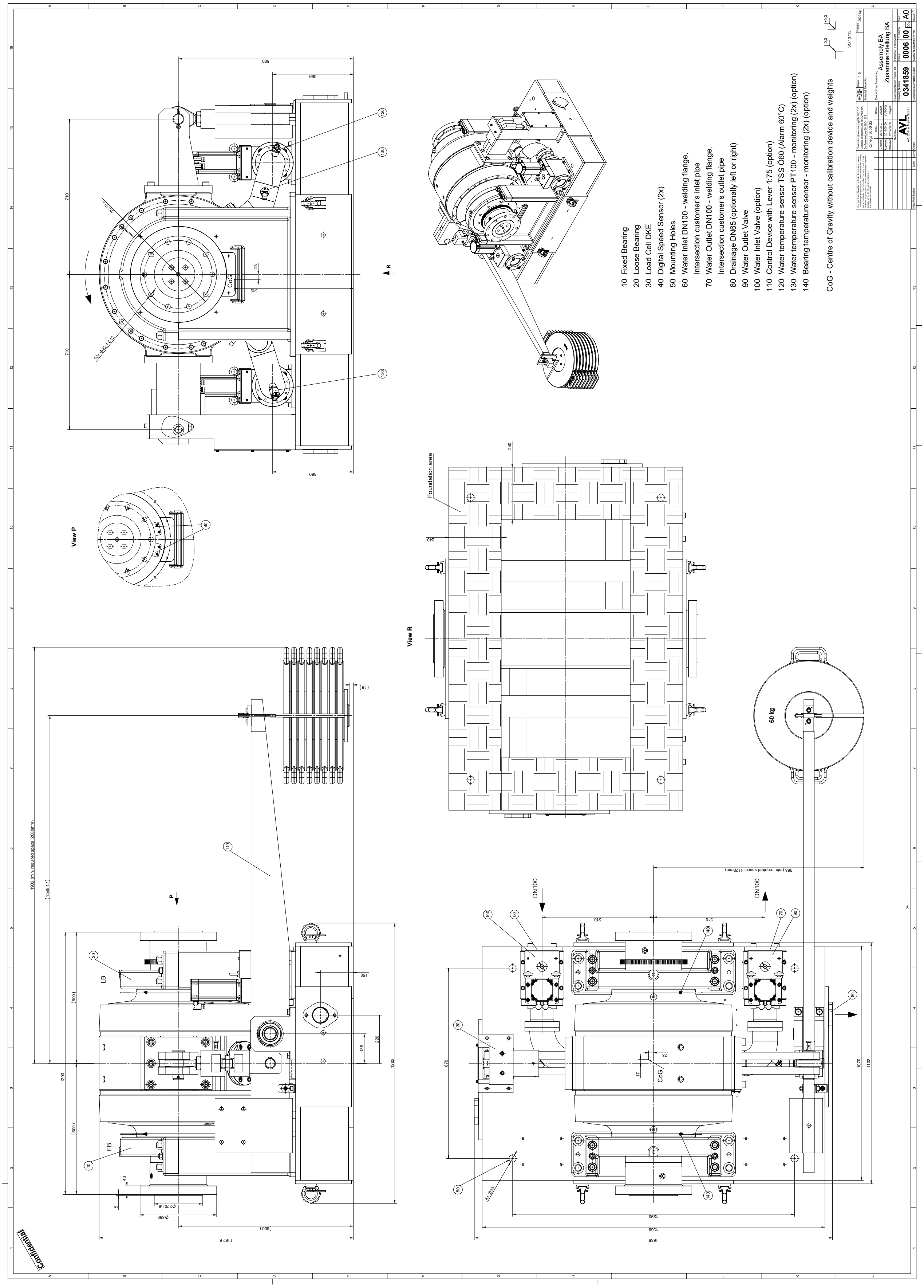
Estimated dynamic forces

Estimated dynamic force to be consider on each spring pack.

	Engine order 0.5 7.5 Hz	Engine order 1.0 15 Hz
Vertical dynamic force [kN]	2.5	1.3
Radial dynamic force [kN]	1.8	1

*** Estimated transmitted force per spring pack**

On top of the static vertical force of about 35 kN per spring pack.


10 Fixed Bearing
20 Loose Bearing
30 Load Cell DKE
40 Digital Speed Sensor (2x)
50 Mounting Holes
60 Water Inlet DN100 - welding flange, Intersection customer's inlet pipe
70 Water Outlet DN100 - welding flange, Intersection customer's outlet pipe
80 Drainage DN65 (optionally left or right)
90 Water Outlet Valve
100 Water Inlet Valve (option)
110 Control Device with Lever 1:75 (option)
120 Water temperature sensor TSS O60 (Alarm 60°C)
130 Water temperature sensor PT100 - monitoring (2x) (option)
140 Bearing temperature sensor - monitoring (2x) (option)
CoG - Centre of Gravity without calibration device and weights
View P
View R
Foundation area
50 kg
DN100
DN100
LB
FB
CoG
Assembly BA
Zusammenstellung BA
0341859
AVL
Confidential

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3. Fuel Oil System

3.1 System overview

When running on MDF proper measures have to be taken to ensure that the fuel oil viscosity at the engine inlet does not fall below the minimum limit. Furthermore the inlet temperature shall not exceed 50°C. This may require an external MDF cooler to be installed.

The lay-out of the fuel oil system is shown in drawing "*recommended fuel oil system*". If fuel oil system components are included in our scope of supply they are listed in section "*Component data, Wärtsilä scope of supply*".

3.1.1 Engine internal system

The following equipment is built on the engine (Wärtsilä 8L26):

- fuel injection pumps
- injection valves
- engine driven fuel feed pump
- duplex fine filter
- pressure relief valve in the outlet pipe

Clean leak fuel from the injection valves and the injection pumps is drained to atmospheric pressure (Clean leak fuel system). The clean leak fuel can be reconducted to the system without treatment. The quantity of leak fuel is given in the section "*Technical data*". Possible dirty leak fuel, spilled water and oil is separately drained from the hot-box and shall be led to a sludge tank (“Dirty” leak fuel system).

The arrangement of the built-on system is shown in the drawing "*internal fuel system*".

3.2 System design data

3.2.1 Fuel oil quality

NOTE

This installation is designed for the fuel specified in section "*Fuel oil specification*". The limits below are general for MDF operation.

Distillate fuel grades are ISO-F-DMA, DMZ, DMB. These fuel grades are referred to as MDF (Marine Diesel Fuel).

Table 3-1 MDF specifications

Property	Unit	ISO-F-DMA	ISO-F-DMZ	ISO-F-DMB	Test method ref.
Viscosity, before injection pumps, max. 1)	cSt	24	24	24	
Viscosity at 40°C, min.	cSt	2	3	2	
Viscosity at 40°C, max.	cSt	6	6	11	ISO 3104
Density at 15°C, max.	kg/m³	890	890	900	ISO 3675 or 12185

Property	Unit	ISO-F-DMA	ISO-F-DMZ	ISO-F-DMB	Test method ref.
Cetane index, min.		40	40	35	ISO 4264
Sulphur, max.	% mass	1.5	1.5	2	ISO 8574 or 14596
Flash point, min.	°C	60	60	60	ISO 2719
Hydrogen sulfide. max. 2)	mg/kg	2	2	2	IP 570
Acid number, max.	mg KOH/g	0.5	0.5	0.5	ASTM D664
Total sediment by hot filtration, max.	% mass	—	—	0.1 3)	ISO 10307-1
Oxidation stability, max.	g/m^3	25	25	25 4)	ISO 12205
Carbon residue: micro method on the 10% volume distillation residue max.	% mass	0.30	0.30	—	ISO 10370
Carbon residue: micro method, max.	% mass	—	—	0.30	ISO 10370
Pour point (upper) , winter quality, max. 5)	°C	-6	-6	0	ISO 3016
Pour point (upper) , summer quality, max. 5)	°C	0	0	6	ISO 3016
Appearance	—	Clear and bright 6)		3) 4) 7)	
Water, max.	% volume	—	—	0.3 3)	ISO 3733
Ash, max.	% mass	0.01	0.01	0.01	ISO 6245
Lubricity, corrected wear scar diameter (wsd 1.4) at 60°C , max. 8)	μm	520	520	520 7)	ISO 12156-1

Remarks:

1) Additional properties specified by Wärtsilä, which are not included in the ISO specification.

2) The implementation date for compliance with the limit shall be 1 July 2012. Until that the specified value is given for guidance.

3) If the sample is not clear and bright, the total sediment by hot filtration and water tests shall be required.

4) If the sample is not clear and bright, the test cannot be undertaken and hence the oxidation stability limit shall not apply.

5) It shall be ensured that the pour point is suitable for the equipment on board, especially if the ship operates in cold climates.

6) If the sample is dyed and not transparent, then the water limit and test method ISO 12937 shall apply.

7) If the sample is not clear and bright, the test cannot be undertaken and hence the lubricity limit shall not apply.

8) The requirement is applicable to fuels with a sulphur content below 500 mg/kg (0.050 % mass).

9) Additional properties specified by the engine manufacturer, which are not included in the ISO 8217:2017(E) standard. The min. fuel temperature has to be always at least 10 °C above fuel's pour point, cloud point and cold filter plugging point.

10) Additional note not included in the ISO 8217:2017 (E) standard: Low min. viscosity of 1,400 mm^2/s can prevent the use of ISO-F-DMX category fuels in Wärtsilä engines unless a fuel can be cooled down enough to meet the injection viscosity limits.

11) There doesn't exist any minimum sulphur content limit for Wärtsilä DF engines and also the use of Ultra Low Sulphur Diesel (ULSD) is allowed provided that the fuel quality fulfils other specified requirements.

12) Additional note not included in the ISO 8217:2017 (E) standard: Low flash point (min.43°C) can prevent the use ISO-F-DMX category fuels in Wärtsilä engines in marine applications unless the ship's fuel system is built according to special requirements allowing the use or that the fuel supplier is anle to guarantee that flash point of the delivered fuel batch is above 60°C being a requirement of SOLAS and classification societies.

3.2.2 Calculation formulas

The total fuel oil consumption is calculated as follows. This formula shall be used when calculation the consumption for selecting sizes of pumps, valves, separators etc. related to the fuel oil system before the engines.

$$F_E = \left(F_{SH} \times \frac{42.7}{Q_N} \right) \times \frac{P_S}{1000}$$

where:

F_E = Fuel oil consumption for the engine, site fuel [kg/h]

F_{SH} = Fuel oil consumption for the engine at ISO conditions [g/kWh]. See section "*Technical data*". Add a tolerance of 5%.

Adjust the stated fuel consumption according to the following:

- Add 1 g/kWh since the fuel oil pump is built on the engine

Q_N = Site fuel caloric value [MJ/kg]

P_S = Shaft output for the engine [kW]

Minimum flow requirement for a fuel oil system component or unit is calculated as follows:

$$Q = F_E \times \frac{C_F}{\rho_{FUEL}}$$

where:

Q = Min. required capacity at injection temperature [m^3/h] (for one engine)

F_E = Fuel consumption for the engine, site fuel [kg/h]

C_F = Circulation factor = 6:1

ρ_{FUEL}= Fuel oil density at injection temperature [kg/m^3]

3.3 Recommended functions

The following functions are not included in Wärtsilä scope of supply. We recommend you to design these functions as follows.

3.3.1 MDF separator unit (1N05)

3.3.1.1 General remarks

The fuel treatment system should comprise a settling tank and separators to supply the engine(s) with sufficiently clean fuel. The recommendations for the design of the separator should be closely followed.

3.3.1.2 Settling of marine diesel fuel

The settling tank (1T10) should normally be dimensioned to ensure fuel supply for min. 24 operating hours when filled to maximum. The tank should be designed to provide the most efficient sludge and water rejecting effect.

The temperature in the settling tank should be between 20...40°C. The min. level in the settling tank should be kept as high as possible. In this way the temperature will not decrease too much when filling up with cold bunker.

3.3.1.3 Separator system

Also marine diesel fuel must be cleaned in an efficient centrifugal separator before entering the day tank as fuel may be contaminated in the storage tanks.

3.3.1.4 Separator feed pump (1P02)

The use of a screw pump is recommended. The pump should be separate from the separator and electrically driven.

The pump should be dimensioned for the actual fuel quality and recommended throughput through the separator.

Design data:	
Pressure, max	0.5 MPa (5 bar)
Temperature	40 °C

A suction filter should be fitted to protect the feed pump. The filter can be either a duplex filter with change over valves or two separate simplex filters. Fineness 0.5 mm.

3.3.1.5 Separator heater (1E01)

The preheater is normally dimensioned according to the pump capacity and a given settling tank temperature. The heater surface temperature must not be too high in order to avoid cracking of the fuel. The heating should be thermostatically controlled for maintaining the fuel temperature within ±2°C. The recommended preheating temperature for MDF is 20-40°C depending on the viscosity.

The required minimum capacity of the heater is:

$$P = \frac{m \times \Delta t}{1700}$$

where:	
P =	heater capacity [kW]
m =	capacity of the separator feed pump [l/h]
Δt =	temperature rise in heater [°C]

3.3.1.6 Separator (1S01)

The fuel oil separator should be sized according to the recommendations of the separator maker. The lower the flow rate, the better the efficiency. The required service throughput of the separator is:

$$Q_{LFOS} = \frac{F_E}{\rho_{FUEL}} \times \left(1 + \frac{C_S}{100}\right)$$

where:	
Q_{LFOS} =	Required capacity at 15°C [m³/h] (for one engine)
F_E =	Fuel consumption for the engine, site fuel [kg/h]
ρ_{FUEL} =	Density of the fuel at 15°C [kg/m³]
C_S =	Separator safety factor, e.g. 15%.

3.3.2 Sludge tank (1T05)

The sludge tank shall be placed below the separators as close as possible. The sludge pipe shall be continuously falling without any horizontal parts.

The principal lay-out of the transfer and separating system is shown in drawing "*recommended transfer and separating system*".

3.3.3 MDF day tank (1T06)

Two marine diesel fuel day tanks should normally be dimensioned to ensure fuel supply for 8 operating hours each when filled to maximum. The design of the tanks should be such that water and dirt particles do not collect in the suction pipe. The day tanks must be placed at a sufficient height for positive head at the engine inlet.

An overflow pipe should be installed from the day tank to the settling tank. The overflow pipe should be connected to the lower part of the day tank to recirculate water that may get into the fuel after the separators.

3.3.4 MDF Suction strainer (1F07)

A suction strainer with a fineness of 0.5 mm should be installed for protecting the feed pumps.

3.3.5 MDF Flow meter (1I03)

If a totalizer fuel consumption meter is accepted, it can be installed in the feed line to the day tank.

In case of continuous engine fuel consumption indication is required, it can be arranged either using two flow meters per engine (one in the feed line, the second in the return line) or by installing only one flow meter between the day tank and a fuel return tank. The flow meter in the feed line to the engine shall be installed after the suction strainer.

3.3.6 Automatic filter (1F04)

It is recommended to select an automatic filter with a manually cleaned filter in the bypass line. The coarser by-pass filter is only intended for temporary use, while the automatic filter is maintained.

Design data	
Fuel viscosity	According to fuel specification

Design data	
Design temperature	50°C
Design flow	Equal to feed pump capacity
Design pressure	1.6 MPa (16 bar)
Maximum permitted pressure drop for normal filters at 14 cSt:	
For clean filter	20 kPa (0.2 bar)
Alarm limit	80 kPa (0.8 bar)

3.3.7 MDF cooler (1E04)

The fuel viscosity may not drop below the minimum value stated in *Technical data*. When operating on MDF, the practical consequence is that the fuel oil inlet temperature must be kept below 45...50°C. Very light fuel grades may require even lower temperature.

The MDF cooler is to be installed in the return line after the engine(s). LT-water is normally used as cooling medium.

Design data:	
Heat to be dissipated	2 kW/cyl
Max. pressure drop, fuel oil	80 kPa (0.8 bar)
Max. pressure drop, water	60 kPa (0.6 bar)
Margin (heat rate, fouling)	min. 15%
Design temperature	50°C

3.3.8 Collection leak fuel

3.3.8.1 Leak fuel tank, clean fuel (1T04)

Clean leak fuel draining from the injection equipment can, if desired, be re-used without repeated treatment. The fuel should then be drained to a separate leak fuel tank and, from there, be pumped to the day tank. Alternatively, the clean leak fuel tank can be drained to another tank for clean fuel, e.g. the bunker tank, the overflow tank etc. The pipes from the engine to the drain tank should be arranged continuously sloping.

3.3.8.2 Leak fuel tank, dirty fuel (1T07)

Any leakage of fuel oil or water at the engine top is collected into the dirty leak fuel system. Normally no leakage occurs during operation.

3.4 Component data, Wärtsilä scope of supply

3.4.1 Fuel cooler (MDF) (1E04)

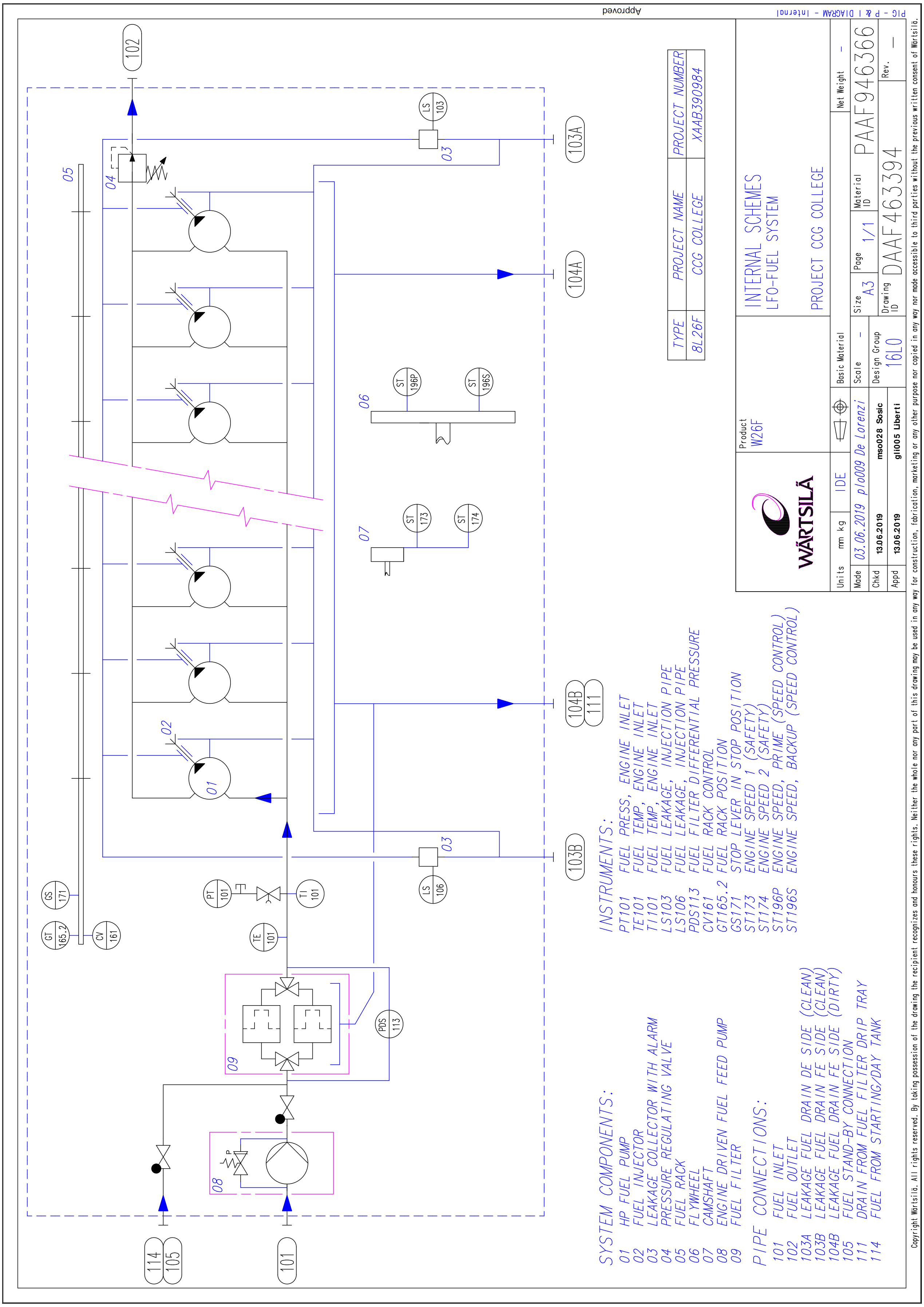
Quantity	1
Type	KS10-BCV-413B L1100
Fuel flow, max. (m^3/h)	5.00
Pressure drop, LT water, max. (kPa)	9.00

Pressure drop, fuel, max. (kPa)	8.00
Heat load (kW)	22.5
Outlet temperature, fuel max. (°C)	45
Inlet temperature, fuel max. (°C)	55
Inlet temperature, LT water max. (°C)	38
Cooling media	FW
Dimensional drawing	KS10-0164

3.4.2 Suction strainer (MDF) (1F07)

Quantity	1
Type	2.04.5
Fuel flow, max. (m^3/h)	4.5
Connection (DN)	40
Fineness, absolute (micron)	320
Dimensional drawing	Z102346

3.5 List of Documents


SYSTEM COMPONENTS:
01 HP FUEL PUMP
02 FUEL INJECTOR
03 LEAKAGE COLLECTOR WITH ALARM
04 PRESSURE REGULATING VALVE
05 FUEL RACK
06 FLYWHEEL
07 CAMSHAFT
08 ENGINE DRIVEN FUEL FEED PUMP
09 FUEL FILTER
PIPE CONNECTIONS:
101 FUEL INLET
102 FUEL OUTLET
103A LEAKAGE FUEL DRAIN DE SIDE (CLEAN)
103B LEAKAGE FUEL DRAIN FE SIDE (CLEAN)
104B LEAKAGE FUEL DRAIN FE SIDE (DIRTY)
105 FUEL STAND-BY CONNECTION
111 DRAIN FROM FUEL FILTER DRIP TRAY
114 FUEL FROM STARTING/DAY TANK
INSTRUMENTS:
PT101 FUEL PRESS, ENGINE INLET
TE101 FUEL TEMP, ENGINE INLET
TI101 FUEL TEMP, ENGINE INLET
LS103 FUEL LEAKAGE, INJECTION PIPE
LS106 FUEL LEAKAGE, INJECTION PIPE
PDS113 FUEL FILTER DIFFERENTIAL PRESSURE
CV161 FUEL RACK CONTROL
GT165.2 FUEL RACK POSITION
GS171 STOP LEVER IN STOP POSITION
ST173 ENGINE SPEED 1 (SAFETY)
ST174 ENGINE SPEED 2 (SAFETY)
ST196P ENGINE SPEED, PRIME (SPEED CONTROL)
ST196S ENGINE SPEED, BACKUP (SPEED CONTROL)
TYPE 8L26F
PROJECT NAME CCG COLLEGE
PROJECT NUMBER XAAB390984
Product W26F
INTERNAL SCHEMES
LFO-FUEL SYSTEM
PROJECT CCG COLLEGE
Units mm kg IDE
Made 03.06.2019 plo009 De Lorenzi
Chkd 13.06.2019 mso028 Sosic
Appd 13.06.2019 gli005 Liberti
Scale -
Design Group 16L0
Size A3
Page 1/1
Material ID PAAF946366
Drawing ID DAAF463394
Rev. -
Net Weight -
PIG - P & I DIAGRAM - Internal
Approved
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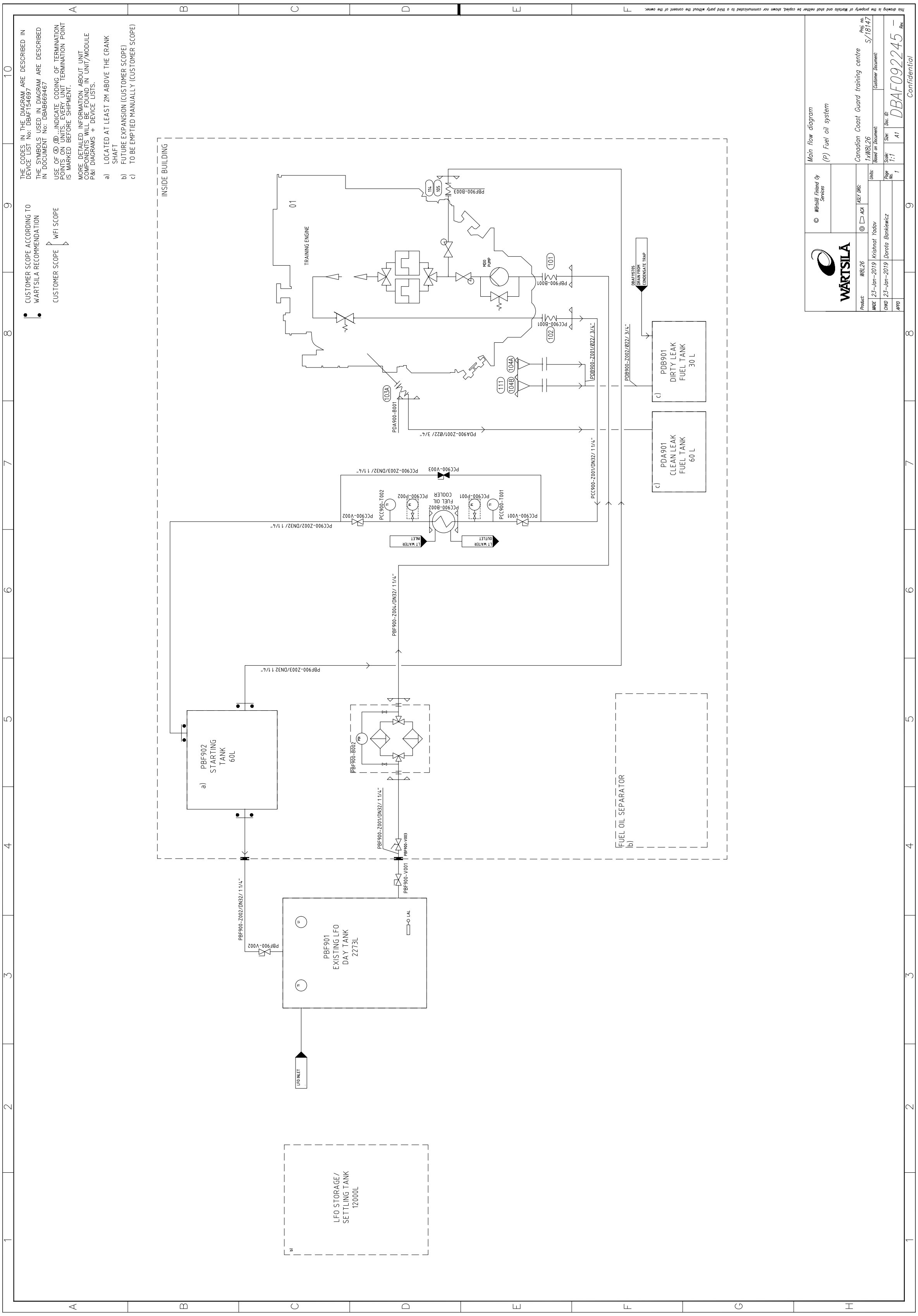
INSIDE BUILDING
TRAINING ENGINE
PDB901 DIRTY LEAK FUEL TANK 30 L
PDA901 CLEAN LEAK FUEL TANK 60 L
PBF902 STARTING TANK 60L
FUEL OIL SEPARATOR
PBF901 EXISTING LFO DAY TANK 2273L
LFO STORAGE/ SETTLING TANK 12000L
Main flow diagram
(P) Fuel oil system
Canadian Coast Guard training centre
DBAF092245
Confidential

MAIN EQUIPMENT LIST

Tag	Description	Detail P&ID	Device list No	Dim DWG No	El. Panel	L (m)	W (m)	H (m)	Weight (kg)	Scope	Notes
PBF901	EXISTING LFO DAY TANK									CUST.	
PBF902	LFO STARTING TANK									CUST.	
PDA901	CLEAN LEAK FUEL TANK									CUST.	
PDB901	DIRTY LEAK FUEL TANK									CUST.	

System design data:

Fuel Oil, LFO: Maximum allowed temperature: 80°C/ 176°F, Maximum allowed pressure: 10 bar(g)/ 145 psi(g), Test pressure: 12 bar(g)/ 174 psi(g), ASTM A179, ASTM A106, ASTM A53

Notes:

Refer dwg no:

Equipment coded 90_ is for engine one.

Coding: The coding system is explained in Power Plants grouping & coding of processes & signals document no: 4V75L0112

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(P) Fuel oil system**	Classification **Confidential**	Made By **Zulfikar Bamne**	Date **20-Sep-2019**	Document ID **DBAF154697**	Page **1/4**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF092245**	Approved by: **Krister Jansson**	Date **20-Sep-2019**	Revision **-**	

DN = Diameter Nominal
PN = Pressure Nominal

Nom. t = Nominal temperature
Oper. t = Operating temperature

DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
PBF900-B001	FLEXI HOSE FUEL INLET TO ENGINE	V			DN32/ 1 1/4"						WFI -	IPI
PBF900-B002	MDF FILTER (SUCTION STRAINER FOR) FUEL INLET TO ENGINE	E									WFI -	IPI
PBF900-B003	FLEXI HOSE FUEL INLET TO ENGINE	V			DN32/ 1 1/4"						WFI -	IPI
PBF900-V001	BALL VALVE OUTLET FROM LFO DAY TANK	V		CARBON STEEL	DN32/ 1 1/4"						CUST. -	
PBF900-V002	BALL VALVE INLET LFO DAY TANK	V		CARBON STEEL	DN32/ 1 1/4"						CUST. -	
PBF900-V003	QUICK CLOSING VALVE	V		CARBON STEEL	DN32/ 1 1/4"						CUST. -	
PBF900-Z001	STEEL PIPE FO TO ENGINE	L		CARBON STEEL ASTM A106 Gr.B	DN 32/ 1 1/4"						CUST. -	
PBF900-Z002	STEEL PIPE LFO STARTING TANK OUTLET TO EXISTING LFO DAY TANK	L		CARBON STEEL ASTM A106 Gr.B	DN 32/ 1 1/4"						CUST. -	
PBF900-Z003	STEEL PIPE LFO STARTING TANK OUTLET	L		CARBON STEEL ASTM A106 Gr.B	DN 32/ 1 1/4"						CUST. -	
PBF900-Z004	STEEL PIPE FUEL OUTLET FROM FO FILTER TO ENGINE	L		CARBON STEEL ASTM A106 Gr.B	DN 32/ 1 1/4"						CUST. -	
PCC900-B001	FLEXI HOSE FUEL OUTLET FROM ENGINE	V			DN32/ 1 1/4"						WFI -	IPI

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(P) Fuel oil system**	Classification **Confidential**	Made By **Zulfikar Bamne**	Date **20-Sep-2019**	Document ID **DBAF154697**	Page **2/4**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF092245**	Approved by: **Krister Jansson**	Date **20-Sep-2019**	Revision **-**	

DN = Diameter Nominal
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DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
PCC900-B001	FLEXI HOSE FUEL OUTLET FROM ENGINE	V			DN32/ 1 1/4"						WFI -	 IPI
PCC900-B002	HEAT EXCHANGER FUEL OIL COOLER	E									WFI -	 IPI
PCC900-P001	MANOMETER ASSEMBLY FUEL OUTLET FROM ENGINE TO FO COOLER PCC900-B002	I			G 1/2"						CUST. -	
PCC900-P002	MANOMETER ASSEMBLY FUEL OUTLET FROM FO COOLER PCC900-B002 TO STARTING TAK	I			G 1/2"						CUST. -	
PCC900-T001	THERMOMETER FUEL OUTLET FROM ENGINE TO FO COOLER PCC900-B002	I			G 1/2"						CUST. -	
PCC900-T002	THERMOMETER FUEL OUTLET FROM FO COOLER PCC900-B002 TO STARTING TAK	I			G 1/2"						CUST. -	
PCC900-V001	BALL VALVE FUEL INLET TO FO COOLER	V		CARBON STEEL	DN32/ 1 1/4"						CUST. -	
PCC900-V002	BALL VALVE FUEL OUTLET FROM FO COOLER PCC900-B002 TO STARTIG TANK	V		CARBON STEEL	DN32/ 1 1/4"						CUST. -	
PCC900-V003	BALL VALVE FO COOLER PCC900-B002 BYPASS	V		CARBON STEEL	DN32/ 1 1/4"						CUST. -	
PCC900-Z001	STEEL PIPE FUEL OUTLET FROM ENGINE TO FO COOLER PCC900-B002	L		CARBON STEEL ASTM A106 Gr.B	DN 32/ 1 1/4"						CUST. -	
PCC900-Z002	STEEL PIPE FUEL OUTLET FROM FO COOLER PCC900-B002 TO STARTIG TANK	L		CARBON STEEL ASTM A106 Gr.B	DN 32/ 1 1/4"						CUST. -	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(P) Fuel oil system**	Classification **Confidential**	Made By **Zulfikar Bamne**	Date **20-Sep-2019**	Document ID **DBAF154697**	Page **3/4**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF092245**	Approved by: **Krister Jansson**	Date **20-Sep-2019**	Revision **-**	

DN = Diameter Nominal
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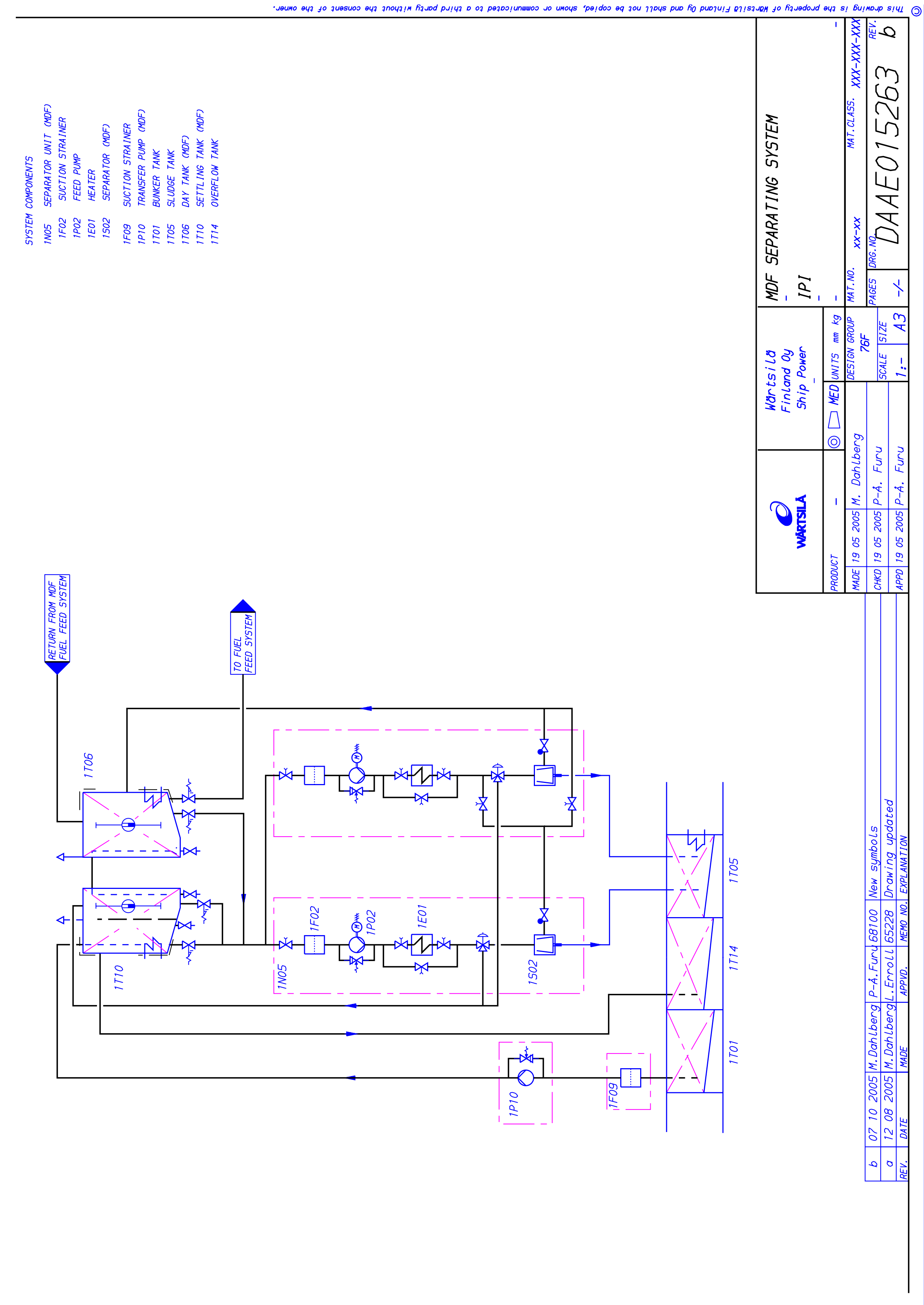
DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
PCC900-Z003	STEEL PIPE FO COOLER PCC900-B002 BYPASS	L		CARBON STEEL ASTM A106 Gr.B	DN 32/ 1 1/4"						CUST. -	
PDA900-B001	FLEXI HOSE CLEAN FUEL OUTLET FROM ENGINE	V			Ø22/ 3/4"						WFI -	IPI
PDA900-Z001	STEEL PIPE CLEAN FUEL OUTLET FROM ENGINE	L		CARBON STEEL ASTM A179	Ø22/ 3/4"						CUST. -	
PDB900-Z001	STEEL PIPE DIRTY FUEL OUTLET FROM ENGINE	L		CARBON STEEL ASTM A179	Ø22/ 3/4"						CUST. -	
PDB900-Z002	STEEL PIPE DIRTY FUEL OUTLET FROM ENGINE	L		CARBON STEEL ASTM A179	Ø22/ 3/4"						CUST. -	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(P) Fuel oil system**	Classification **Confidential**	Made By **Zulfikar Bamne**	Date **20-Sep-2019**	Document ID **DBAF154697**	Page **4/4**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF092245**	Approved by: **Krister Jansson**	Date **20-Sep-2019**	Revision **-**	


SYSTEM COMPONENTS
1N05 SEPARATOR UNIT (MDF)
1F02 SUCTION STRAINER
1P02 FEED PUMP
1E01 HEATER
1S02 SEPARATOR (MDF)
1F09 SUCTION STRAINER
1P10 TRANSFER PUMP (MDF)
1T01 BUNKER TANK
1T05 SLUDGE TANK
1T06 DAY TANK (MDF)
1T10 SETTLING TANK (MDF)
1T14 OVERFLOW TANK
RETURN FROM MDF FUEL FEED SYSTEM
TO FUEL FEED SYSTEM
MDF SEPARATING SYSTEM
IPI
Wärtsilä Finland Oy Ship Power
DAAE015263
b
A3
76F
b 07 10 2005 M.Dahlberg P-A.Furu 68100 New symbols
a 12 08 2005 M.Dahlberg L.Erroll 65228 Drawing updated
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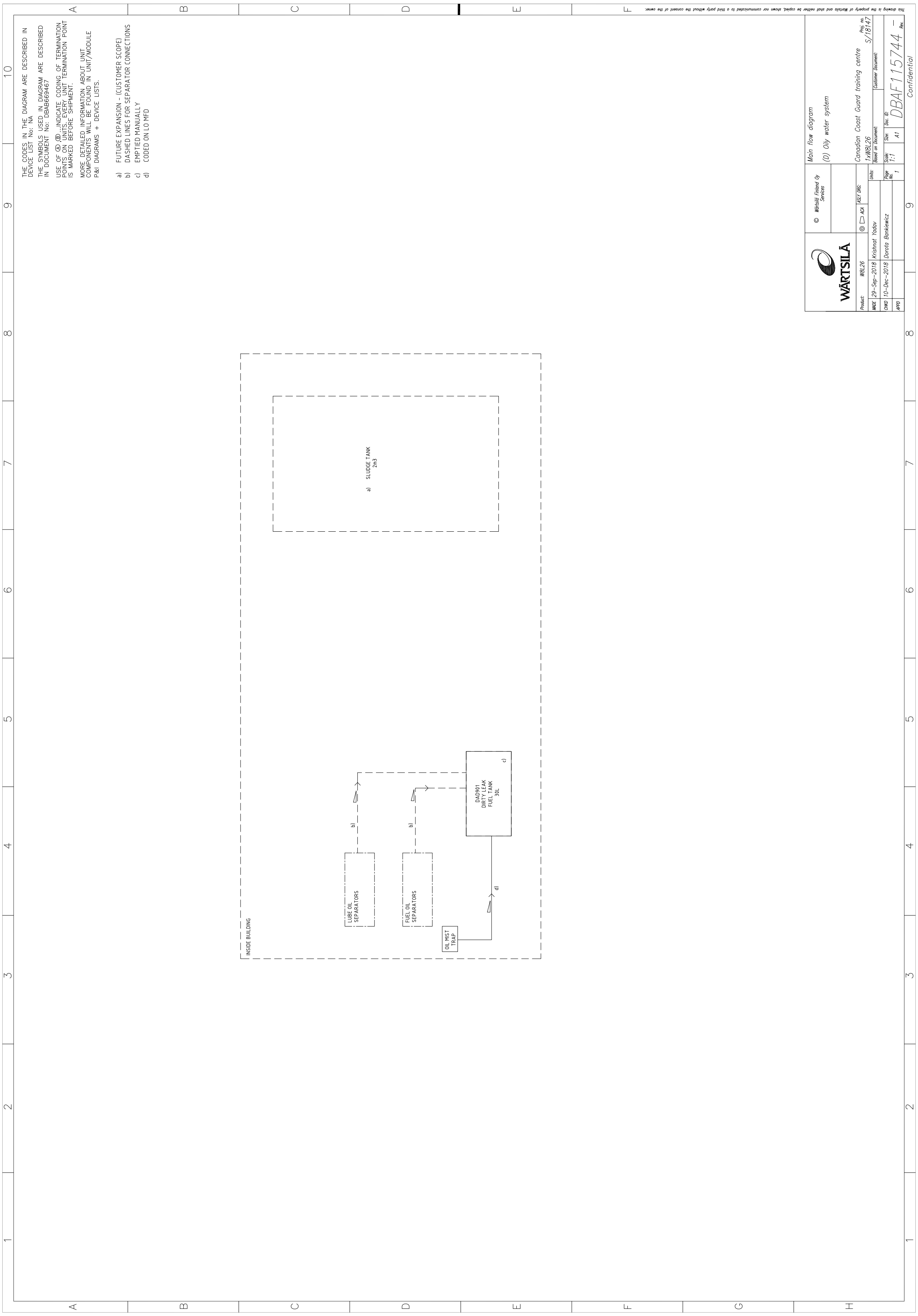
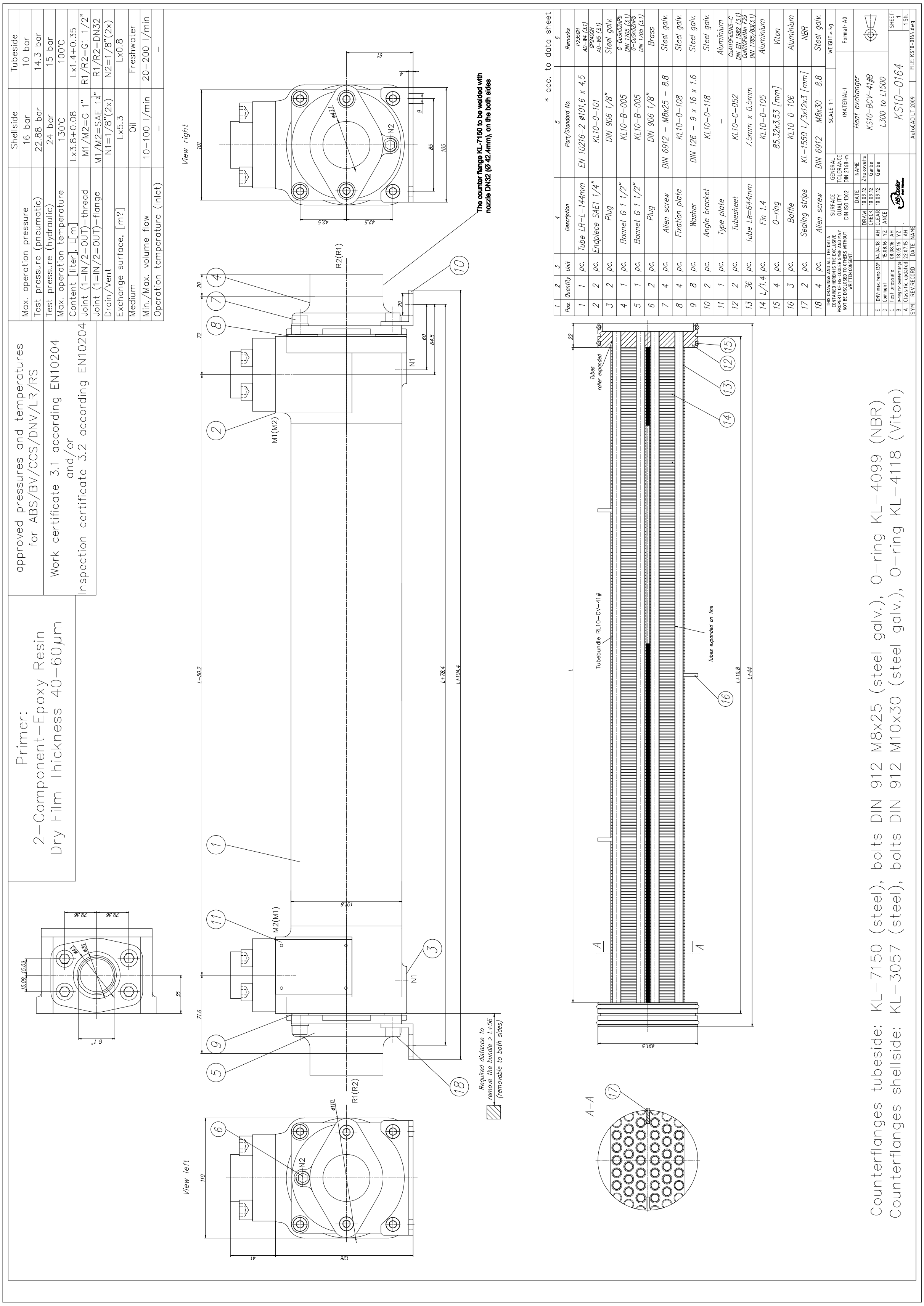
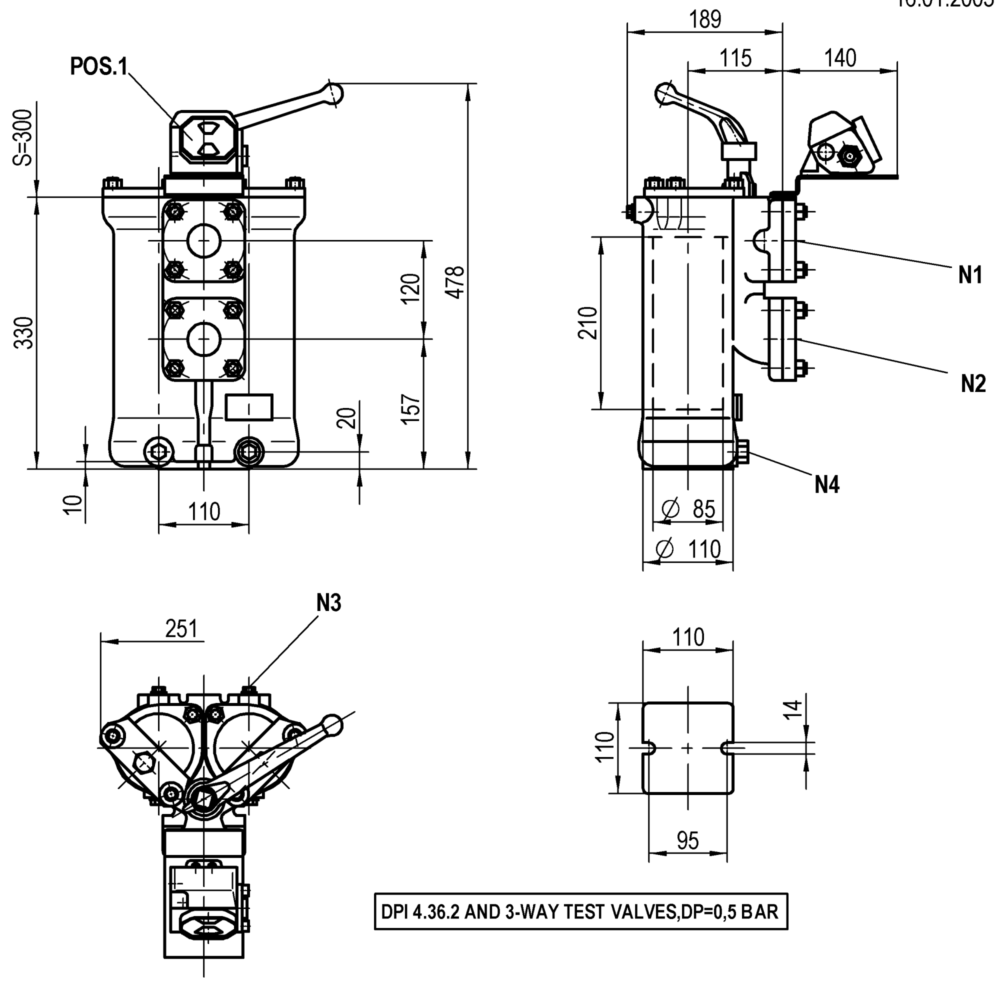

THE CODES IN THE DIAGRAM ARE DESCRIBED IN DEVICE LIST No: NA
THE SYMBOLS USED IN DIAGRAM ARE DESCRIBED IN DOCUMENT No: DBAB669467
USE OF A, B ...INDICATE CODING OF TERMINATION POINTS ON UNITS. EVERY UNIT TERMINATION POINT IS MARKED BEFORE SHIPMENT.
MORE DETAILED INFORMATION ABOUT UNIT COMPONENTS WILL BE FOUND IN UNIT/MODULE P&I DIAGRAMS + DEVICE LISTS.
a) FUTURE EXPANSION - (CUSTOMER SCOPE)
b) DASHED LINES FOR SEPARATOR CONNECTIONS
c) EMPTIED MANUALLY
d) CODED ON LO MFD
a) SLUDGE TANK 2m3
DA0901 DIRTY LEAK FUEL TANK 30L
c)
b)
b)
d)
LUBE OIL SEPARATORS
FUEL OIL SEPARATORS
OIL MIST TRAP
INSIDE BUILDING
This drawing is the property of Wärtsilä and shall neither be copied, shown nor communicated to a third party without the consent of the owner.
© Wärtsilä Finland Oy Services
Product: W8L26
MADE 29-Sep-2018 Krishnat Yadav
CHKD 10-Dec-2018 Dorota Bankiewicz
APPD
ACA
ASLY DRG:
Units:
Page No. 1
Main flow diagram
(D) Oily water system
Canadian Coast Guard training centre
1xW8L26
Proj. no. S/18147
Based on Document:
Customer Document:
Scale: 1:1
Size: A1
Doc. ID: DBAF115744
Rev. –
Confidential


Primer:
2-Component-Epoxy Resin
Dry Film Thickness 40-60µm
approved pressures and temperatures for ABS/BV/CCS/DNV/LR/RS
Work certificate 3.1 according EN10204 and/or Inspection certificate 3.2 according EN10204
Shellside Tubeside
Max. operation pressure 16 bar 10 bar
Test pressure (pneumatic) 22.88 bar 14.3 bar
Test pressure (hydraulic) 24 bar 15 bar
Max. operation temperature 130°C 100°C
Content [liter], L[m] Lx3.8+0.08 Lx1.4+0.35
Joint (1=IN/2=OUT)-thread M1/M2=G 1" R1/R2=G1 1/2"
Joint (1=IN/2=OUT)-flange M1/M2=SAE 1¼" R1/R2=DN32
Drain/Vent N1=1/8"(2x) N2=1/8"(2x)
Exchange surface, [m?] Lx5.3 Lx0.8
Medium Oil Freshwater
Min./Max. volume flow 10-100 l/min 20-200 l/min
Operation temperature (Inlet) - -
View left
View right
M2(M1)
M1(M2)
R1(R2)
R2(R1)
N1
N2
Required distance to remove the bundle > L+56 (removable to both sides)
The counter flange KL-7150 to be welded with nozzle DN32 (Ø 42.4mm), on the both sides
A-A
Tubebundle RL10-CV-41#
Tubes roller expanded
Tubes expanded on fins
* acc. to data sheet
Pos. Quantity Unit Description Part/Standard No. Remarks
1 1 pc. Tube LR=L-144mm EN 10216-2 ø101,6 x 4,5 P235GH AD-W4 (3.1)
2 2 pc. Endpiece SAE1 1/4" KL10-0-101 GP240GH AD-W5 (3.1)
3 2 pc. Plug DIN 906 1/8" Steel galv.
4 1 pc. Bonnet G 1 1/2" KL10-B-005 G-CuSn5ZnPb DIN 1705 (3.1)
5 1 pc. Bonnet G 1 1/2" KL10-B-005 G-CuSn5ZnPb DIN 1705 (3.1)
6 2 pc. Plug DIN 906 1/8" Brass
7 4 pc. Allen screw DIN 6912 - M8x25 - 8.8 Steel galv.
8 4 pc. Fixation plate KL10-0-108 Steel galv.
9 8 pc. Washer DIN 126 - 9 x 16 x 1.6 Steel galv.
10 2 pc. Angle bracket KL10-0-118 Steel galv.
11 1 pc. Type plate - Aluminium
12 2 pc. Tubesheet KL10-C-052 CuAl10Fe5Ni5-C DIN EN 1982 (3.1)
13 36 pc. Tube LR=644mm 7.5mm x 0.5mm CuNi10Fe1Mn 1.29 DIN 1785/83(3.1)
14 L/1.4 pc. Fin 1.4 KL10-0-105 Aluminium
15 4 pc. O-ring 85.32x3.53 [mm] Viton
16 3 pc. Baffle KL10-0-106 Aluminium
17 2 pc. Sealing strips KL-1550 L/3x12x3 [mm] NBR
18 4 pc. Allen screw DIN 6912 - M8x30 - 8.8 Steel galv.
Heat exchanger KS10-BCV-41#B L300 to L1500
KS10-0164
Counterflanges tubeside: KL-7150 (steel), bolts DIN 912 M8x25 (steel galv.), O-ring KL-4099 (NBR)
Counterflanges shellside: KL-3057 (steel), bolts DIN 912 M10x30 (steel galv.), O-ring KL-4118 (Viton)

BOLLFILTER
Protection Systems

Z102346
TYP2.04.5
16.01.2003



N1 FILTEREINTRITT DN40
FILTER INLET
ENTRÉE DE FILTRE

N2 FILTERAUSTRITT DN40
FILTER OUTLET
SORTIE DU FILTRE

N3 ENTLÜFTUNG G1/4
AIR ESCAPE
DÉSAÉRATION

N4 ENTLEERUNG G3/8
DRAIN
VIDANGE

S SIEBAUSBAU
DISMOUNTING OF THE FILTERELEMENT
DÉMONTAGE DU PANIER

GEHÄUSE GEGOSSEN, EN-GJS-400-15
HOUSING CASTED, EN-GJS-400-15
CORPS MOULÉ, EN-GJS-400-15

ALLGEMEINTOLERANZEN DIN ISO 2768-V
TOLERANCE DIN ISO 2768-V
TOLÉRANCE DIN ISO 2768-V

BETRIEBSÜBERDRUCK: 16 BAR BEI 150°C
WORKING PRESSURE: 16 BAR AT 150°C
PRESSION DE SERVICE: 16 BAR À 150°C

VOLUMEN 2x2 dm³
VOLUME
VOLUME

LEERGEWICHT 29 kg
EMPTY WEIGHT
POIDS NET

POS.1 DIFFERENZDRUCKANZEIGER
DIFF. PRESSURE INDICATOR
INDICATEUR DE DIFF. DE PRESSION

MIT KORBSIEBEINSATZ
WITH BASKET ELEMENT
AVEC PANIERS À CORBEILLE

SUBJECT TO ALTERATIONS — **ÄNDERUNGEN VORBEHALTEN** — MODIFICATIONS RÉSERVÉES

DUPLEX FILTER — **DOPPELFILTER 2.04.5.110.210 DN40** — FILTRE DOUBLE

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4. Lubricating Oil and Crankcase Ventilation Systems

4.1 System overview

Each engine should have a lubricating oil system of its own. The lubricating oil must not be mixed between different systems.

The lay-out of the lubricating oil system is shown in drawing "*recommended lubricating oil system*". If lubricating oil system components are included in our scope of supply they are listed in section "*Component data, Wärtsilä scope of supply*".

Oil vapours formed in the crankcase of the engine have to be ventilated out of the engine room via the crankcase ventilation system. The outlet is to be equipped with a condensate trap.

4.1.1 Engine internal system

The following equipment is built on the engine (Wärtsilä 8L26):

- engine driven lubricating oil pump
- stand-by connection for the engine driven lubricating oil pump
- electric motor driven prelubricating pump
- lubricating oil cooler
- thermostat valve
- automatic filter
- centrifugal filter
- pressure control valve
- wet sump

The prelubricating oil pump is used for:

- filling of the lubricating oil system before starting
- continuous prelubrication of a stopped engine in a multi-engine installation always when one of the engines is running

The arrangement of the built-on system is shown in the drawing "*internal lubricating oil system*".

4.2 System design data

4.2.1 Lubricating oil quality

NOTE
Contact Wärtsilä before using a non-validated lubricating oil. Lubricating oils that are not validated have to be tested according to our procedures. Should non-validated lubricating oils be used during the engine warranty period, and there exist no agreement with the engine manufacturer about testing, the engine guarantee does not hold.

4.2.1.1 Validated lubricating oils for the engine

The lubricating oil viscosity class is SAE 40 (ISO VG 150), minimum viscosity index is 95. The required lubricating oil alkalinity is tied to the fuel specified for the engine, see table below.

Table 4-1 Fuel standards and lubricating oil requirements.

Category	Fuel standard		BN	S content [% mass]
A	ASTM D 975-17 BS MA 100: 1996 CIMAC 2003 ISO 8217: 2017(E)	GRADE NO. 1-D, 2-D, 4-D DMX, DMA, DMB DX, DA, DB ISO-F-DMX -> DMB, DFA -> DFB	10...30	< 0.4
B	ASTM D 975-17 BS MA 100: 1996 CIMAC 2003 ISO 8217: 2017(E)	GRADE NO. 1-D, 2-D, 4-D DMX, DMA, DMB DX, DA, DB ISO-F-DMX -> DMB, DFA -> DFB	15...30	0.4...1,5
C	ASTM D 975-17 ASTM D 396-17 BS MA 100: 1996 CIMAC 2003 ISO 8217: 2017(E)	GRADE NO. 4-D GRADE NO. 5-6 DMC, RMA10-RMK55 DC, A30-K700 RMA 10-RMK 700	30...55	≤ 3.5 or statutory requirements
D	ISO 8217: 2017(E)	RMA 10 - RMK 700	20	≤ 0.1

In case a low sulphur (S max. 0.2 % mass) MDF is used, it's recommended to use a lubricating oil with BN of 10...15.

It is recommended to use in the first place BN 50...55 lubricants when operating on HFO. This recommendation is valid especially for engines having wet lubricating oil sump and using HFO with sulphur content above 2.0 % mass. BN 40 lubricants can be used when operating on HFO as well if experience shows that the lubricating oil BN equilibrium remains at an acceptable level.

In HFO operation BN 30 lubricants are recommended to be used only in special cases, such as installations equipped with an SCR catalyst. Lower BN products eventually have a positive influence on cleanliness of the SCR catalyst.

With BN 30 oils lubricating oil change intervals may be rather short, but lower total operating costs may be achieved because of better availability provided that the maintenance intervals of the SCR catalyst can be increased.

If both MDF and HFO are used periodically as fuel, lubricating oil quality has to be chosen according to instructions being valid for HFO operation, i.e. BN 30 is the minimum. Optimum BN in this kind of operation depends on the length of operating periods on both fuel qualities as well as of sulphur content of fuels in question. Thus in particular cases BN 40 or even higher BN lubricating oils should be used.

The intervals between lubricating oil changes may be extended by adding oil daily to keep the oil level constantly close to the maximum level

Validated lubricating oils for fuel oil categories A and B

If MDF oil is used as fuel, lubricating oils with a BN of 10...20 are recommended to be used. Lubricating oils having fresh oil BN below 15 can be used only if fuel sulphur content is below 0.4 % mass. Also BN 30 lubricating oils stated later in this chapter can be used on MDF operation, though not preferred in the first place.

Table 4-2 Validated lubricating oils for fuel oil categories A and B.

Supplier	Brand name	Viscosity	BN
BP	Energol HPDX 40 Energol IC-HFX 204	SAE 40 SAE 40	12 20

Supplier	Brand name	Viscosity	BN
Castrol	HLX 40 MHP 154 Seamax Extra 40 TLX Plus 204	SAE 40 SAE 40 SAE 40 SAE 40	12 15 15 20
Chevron (Texaco + Caltex)	Delo 1000 Marine 40 Taro 12 XD 40 Taro 20 DP 40 Taro 20 DP 40X	SAE 40 SAE 40 SAE 40 SAE 40	12 12 20 20
ExxonMobil	Delvac 1640 Mobilgard ADL 40 Mobilgard 412 Mobilgard 1 SHC	SAE 40 SAE 40 SAE 40 SAE 40	12 12 15 15
Conqord Oil	Q8 Marine D 1000 SAE 40	SAE 40	12
ENI S.p.A.	Cladium 140 S	SAE 40	14
Indian Oil Corporation	Servo Marine 1040 Servo Marine 2040	SAE 40 SAE 40	10 20
Petrobas	Marbrax CCD-410-AP Marbrax CCD-415 Marbrax CCD-420	SAE 40 SAE 40 SAE 40	12 15 20
Shell	Gadinia Oil 40	SAE 40	12
Statoil	MarWay 1040	SAE 40	10.6
Total / Lubmarine	Disola M 4015 Disola M 4020	SAE 40 SAE 40	14 20

Validated lubricating oils for fuel category C

Validated system oils - fuel category C, recommended in the first place when operating on HFO in order to reach full service intervals. BN 50...55 lubricating oils are preferred in the first place.

Table 4-3 Validated lubricating oils for fuel category C.

Supplier	Brand name	Viscosity	BN
ADNOC Distribution	Voyager Marine 440 Voyager Marine 450 Voyager Marine 455 Voyager Mallah 440 Voyager Mallah 450 Voyager Mallah 455	SAE 40 SAE 40 SAE 40 SAE 40 SAE 40 SAE 40	40 50 55 40 50 55
Aegean Marine Petroleum S.A.	Alfamar 440 Alfamar 450 Alfamar 455 Alfamar GII 440 Alfamar GII 450 Alfamar GII 455	SAE 40 SAE 40 SAE 40 SAE 40 SAE 40 SAE 40	40 50 55 40 50 55
Avin Oil S.A.	Avin Argo S 40 SAE 40 Avin Argo S 50 SAE 40 Avin Argo S 55 SAE 40	SAE 40 SAE 40 SAE 40	40 50 55

Supplier	Brand name	Viscosity	BN
Castrol	TLX Plus 404 TLX Plus 504 TLX Plus 554 TLX Xtra 404 TLX Xtra 504 TLX Xtra 554	SAE 40 SAE 40 SAE 40 SAE 40 SAE 40 SAE 40	40 50 55 40 50 55
Cepsa	Troncoil 4040 PLUS Troncoil 4050 PLUS Larus 4040 Larus 5040	SAE 40 SAE 40 SAE 40 SAE 40	40 50 40 50
Chevron (Texaco + Caltex)	Taro 40 XL 40 Taro 50 XL 40 Taro 40 XL 40X Taro 50 XL 40X	SAE 40 SAE 40 SAE 40 SAE 40	40 50 40 50
CCPC Corporation	Marilube Oil W 404 Marilube Oil W 504	SAE 40 SAE 40	40 50
ENI S.p.A.	Cladium 400 S SAE 40 Cladium 500 S SAE 40 Cladium 550 S SAE 40	SAE 40 SAE 40 SAE 40	40 50 55
ENOC	Strata MSD 440 Strata MSD 450 Strata MSD 455 Strata MSDO 440 Strata MSDO 450 Strata MSDO 455 EPPCO Bahri MSD 440 EPPCO Bahri MSD 450 EPPCO Bahri MSD 455	SAE 40 SAE 40 SAE 40 SAE 40 SAE 40 SAE 40 SAE 40 SAE 40 SAE 40	40 50 55 40 50 55 40 50 55
ExxonMobil	Mobilgard M440 Mobilgard M50	SAE 40 SAE 40	40 50
Fuchs Petrolub SE	Titan PSW 40 SAE 40 Titan PSW 55 SAE 40	SAE 40 SAE 40	40 55
Gulf Oil International	Gulfgen Supreme 440 Gulfgen Supreme 455 Gulfgen Supreme Plus 440 Gulfgen Supreme Plus 455	SAE 40 SAE 40 SAE 40 SAE 40	40 55 40 55
Gulf Oil Marine / Sealub Alliance	GulfSea Power 4040 GulfSea Power 4055 GulfSea Power II 4040 GulfSea Power II 4055	SAE 40 SAE 40 SAE 40 SAE 40	40 55 40 55
Indian Oil Corporation	Servo Marine K-4040 Servo Marine K-5040 Servo Marine K-5540	SAE 40 SAE 40 SAE 40	40 50 55
Irving Blending & Packaging	Irving Marine MTX 4040 Irving Marine MTX 5040	SAE 40 SAE 40	40 50
JXTG Nippon Oil & Energy Corporation	Marine T404 Marine T504	SAE 40 SAE 40	40 50
Kuwait Petroleum	Q8 Mozart TM 40 SAE 40 Q8 Mozart TM 55 SAE 40	SAE 40 SAE 40	40 55
LPC S.A.	Cyclon Poseidon HT 4040 Cyclon Poseidon HT 4050 Cyclon Poseidon HT 4055	SAE 40 SAE 40 SAE 40	40 50 55

Supplier	Brand name	Viscosity	BN
Lukoil	Navigo TPEO 40/40 Navigo TPEO 50/40 Navigo TPEO 55/40	SAE 40 SAE 40 SAE 40	40 50 55
Morris Lubricants	Aquamor 140MD Aquamor 150MD	SAE 40 SAE 40	40 50
Motor Oil (Hellas)	Emo Argo S 40 SAE 40 Emo Argo S 50 SAE 40 Emo Argo S 55 SAE 40	SAE 40 SAE 40 SAE 40	40 50 55
Pertamina	Martron 440 Martron 450 Medripal 440 Medripal 450 Salyx 440 Salyx 450	SAE 40 SAE 40 SAE 40 SAE 40 SAE 40 SAE 40	40 50 40 50 40 50
Petrobras	Marbrax CCD-440 Marbrax CCD-450	SAE 40 SAE 40	40 50
Petro Gulf Oil Manufacturing LLC	Marine TPEO 4040 Marine TPEO 4050 Marine TPEO 4055	SAE 40 SAE 40 SAE 40	40 50 55
Petromin Corporation	Petromin Petropower Plus 3-40 Petromin Petropower Plus 4-40 Petromin Petropower Plus 5-40 Petromin Petropower 3-40 Petromin Petropower 4-40 Petromin Petroshield 3-40 Petromin Petroshield 4-40	SAE 40 SAE 40 SAE 40 SAE 40 SAE 40 SAE 40 SAE 40	40 50 55 40 55 40 55
Petron	Petromar XC 4040 Petromar XC 5540 Petromar HF 4040 Petromar HF 5040 Petromar HF 5540	SAE 40 SAE 40 SAE 40 SAE 40 SAE 40	40 55 40 50 55
Petronas Lubricants International	Disrol 400 SAE 40 Disrol 500 SAE 40 MAEO 4040 MAEO 4050	SAE 40 SAE 40 SAE 40 SAE 40	40 50 40 50
Repsol YPF	Neptuno W NT 4000 SAE 40 Neptuno W NT 5500 SAE 40	SAE 40 SAE 40	40 55
Shell	Argina S4 40 Argina S4 X 40 Argina S5 40	SAE 40 SAE 40 SAE 40	40 50 55
Sinopec	TPEO 4040 TPEO 4050	SAE 40 SAE 40	40 50
SK Lubricants	Supermar 40TP40 Supermar 50TP40	SAE 40 SAE 40	40 50
Total / Lubmarine	Aurelia TI 4040 Aurelia TI 4055	SAE 40 SAE 40	40 55
Valvoline	HFO 4040 HFO 4050 HFO 4055	SAE 40 SAE 40 SAE 40	40 50 55

Validated lubricating oils for fuel categories A, B, C and D

Validated system oils - fuel oil categories A, B, C and D. In HFO installations BN 30 lubricants have eventually a positive influence on cleanliness of the SCR catalyst. However, due to low lubricating oil consumption, with BN 30 oils lubricating oil change intervals will be shorter than with higher BN lubricating oils.

Table 4-4 Validated lubricating oils for fuel category A, B, C and D.

Supplier	Brand name	Viscosity	BN
ADNOC Distribution	Voyager Marine 430 Voyager Mallah 430	SAE 40 SAE 40	30 30
Aegean Marine Petroleum S.A.	Alfamar 430 Alfamar GII 430	SAE 40 SAE 40	30 30
Avin Oil S.A.	Avin Argo S 30 SAE 40	SAE 40	30
Castrol	TLX Plus 304 TLX Xtra 304	SAE 40 SAE 40	30 30
Cepsa	Troncoil 3040 PLUS Larus 3040	SAE 40 SAE 40	30 30
Chevron (Texaco + Caltex)	Taro 30 DP 40 Taro 30 DP 40X	SAE 40 SAE 40	30 30
CPC Corporation	Marilube Oil W 304	SAE 40	30
ENI S.p.A.	Cladium 300 S SAE 40	SAE 40	30
ENOC	Strata MSD 430 Strata MSDO 430 EPPCO Bahri MSD 430	SAE 40 SAE 40 SAE 40	30 30 30
ExxonMobil	Mobilgard M430	SAE 40	30
Fuchs Petrolub SE	Titan PSW 30 SAE 40	SAE 40	30
Gulf Oil International	Gulfgen Supreme 430 Gulfgen Supreme Plus 430	SAE 40 SAE 40	30 30
Gulf Oil Marine / Sealub Alliance	GulfSea Power 4030 GulfSea Power II 4030	SAE 40 SAE 40	30 30
Indian Oil Corporation	Servo Marine K-3040	SAE 40	30
Irving Blending & Packaging	Irving Marine MTX 3040	SAE 40	30
JXTG Nippon Oil & Energy Corporation	Marine T304	SAE 40	30
Kuwait Petroleum	Q8 Mozart TM 30 SAE 40	SAE 40	30
LPC S.A.	Cyclon Poseidon HT 4030	SAE 40	30
Lukoil	Navigo TPEO 30/40	SAE 40	30
Morris Lubricants	Aquamor 130MD	SAE 40	30
Motor Oil (Hellas)	Emo Argo S 30 SAE 40	SAE 40	30
Pertamina	Martron 430 Medripal 430 Salyx 430	SAE 40 SAE 40 SAE 40	30 30 30
Petrobras	Marbrax CCD-430	SAE 40	30
Petro Gulf Oil Manufacturing LLC	Marine TPEO 4030	SAE 40	30

Supplier	Brand name	Viscosity	BN
Petromin Corporation	Petromin Petropower Plus 2-40 Petromin Petropower 2-40 Petromin Petroshield 2-40	SAE 40 SAE 40 SAE 40	30 30 30
Petron	Petromar XC 3040 Petromar HF 3040	SAE 40 SAE 40	30 30
Petronas International Lubricants	Disrol 300 SAE 40	SAE 40	30
Shell	Argina S3 40	SAE 40	30
Sinopec	TPEO 4030	SAE 40	30
SK Lubricants	Supermar 30TP40	SAE 40	30
Total / Lubmarine	Aurelia TI 4030	SAE 40	30
Valvoline	HFO 4030	SAE 40	30

Validated lubricating oils for fuel category D

Validated SAE 40 lubricating oils - fuel category D. Lubricating oils with BN 20 are allowed to be used when operating engines on max. 0,10 % m/m sulphur fuels (ULSFO) which are categorized as residual fuels. Such fuels were introduced to cope with the tightened SOx emission legislation being valid on the specific SECA areas.

Table 4-5 Validated lubricating oils for fuel category D.

Supplier	Brand name	Viscosity	BN
Castrol	TLX Plus 204 TLX Xtra 204	SAE 40 SAE 40	20 20
Chevron (Texaco + Caltex)	Taro 20 DP 40 Taro 20 DP 40X	SAE 40 SAE 40	20 20
ExxonMobil	Mobilgard M 420	SAE 40	20
Gulf Oil Marine / Sealub Alliance	GulfSea Power MDO 4020	SAE 40	20
Irving Blending & Packaging	Irving Marine MTX 2040	SAE 40	20
Lukoil	Navigo TPEO 20/40	SAE 40	20
Petrobras	Marbrax CCD-420	SAE 40	20
Shell	Argina S2 40	SAE 40	20
Total / Lubmarine	Aurelia TI 4020	SAE 40	20

4.2.1.2 Approved lubricating oil for engine turning device

It is recommended to use EP-gear oils, viscosity 414 - 506 cSt at 40°C (ISO VG 460) as lubricating oils for the turning device.

Table 4-6 Approved lubricating oils for engine turning device.

Supplier	Brand name	Viscosity (cSt at 40°C)	Viscosity (cSt at 100°C)	Viscosity index (VI)
BP	Energol GR-XP 460	460	30.5	95
Castrol	Alpha SP 460	460	30.5	95
Chevron (Texaco + Caltex + FAMM)	Meropa 460	460	31.6	100
ENI S.p.A	Blasia 320	300	23.0	95
ExxonMobil	Mobilgear 600 XP 460 Mobilgear 634	460 437	30.6 27.8	96 96
Shell	Omala Oil 460	460	30.8	97
Total / Lubmarine	Carter EP 460 / Epona Z 460	470	30.3	93

4.2.1.3 Approved lubricating oils for governor

An oil of viscosity class SAE 30 or SAE 40 is suitable and usually the same oil can be used as in the engine. Turbocharger oil can also be used in the governor. In low ambient conditions it may be necessary to use a multigrade oil (e.g. SAE 5W-40) to get a good control during start-up.

4.3 Recommended functions

The following functions are not included in Wärtsilä scope of supply. We recommend you to follow these guidelines.

4.3.1 Lubricating oil system

For engines with wet sump, the lubricating oil may be filled into the engine using a hose or an oil can, through the crankcase cover or through the separator pipe. The system should be arranged so that it is possible to measure the filled oil volume.

4.3.1.1 Separator unit (2N01)

Auxiliary engines operating on a fuel having a viscosity of max. 380 cSt/50°C may have a common separator for intermittent separation. In installations with four or more auxiliary engines two separators shall be installed. The separators shall be dimensioned for continuous operation.

Design data:	
Separating temperature	90…95 °C

Capacity according to the formula below:

$$Q = \frac{1.36 \times P \times n}{t}$$

where:

Q = actual flow through the separator [l/h]

P = total engine output [kW]

where:

n = number of through-flows of the oil volume/day (4 for engines operated on MDF)

t = Separating time/day [h]
23h for separators with total discharge, 24h for separators with partial discharge

Separator pump (2P03)

The separator pump may be directly driven by the separator or separately driven by an electric motor. The flow shall be adapted to achieve the above mentioned optimal flow.

Separator heater (2E02)

The preheater may be a steam or an electric heater. The surface temperature of the heater coils must not exceed 150 °C in order to avoid coking of the oil.

For auxiliary engines with oil separation on a stopped engine, the heater shall be dimensioned large enough to allow separation at the optimal rate without heat supply from the diesel engine.

4.3.1.2 Renovating oil tank (2T04)

For engines with wet sump the oil sump content can be drained to this tank prior to separation.

4.3.1.3 Renovated oil tank (2T05)

This tank contains renovated oil ready to be used as a replacement of the oil drained for separation.

4.3.1.4 New oil tank (2T03)

For engines with wet sump the lubricating oil may be filled into the engine using the separator pipe or the filling connection on the engine. The system shall be arranged so that it is possible to measure the filled oil volume.

4.3.1.5 Stand-by (2P04)

The lubricating oil stand-by pump is normally of screw type and should be provided with an overflow valve

Design data:	
Capacity	see *Technical data*
Design pressure	1.0 MPa (10 bar)
Max. pressure (safety valve)	800 kPa (8 bar)
Design temperature	100°C
Viscosity for dimensioning the electric motor	500 cSt

4.3.1.6 Sludge/waste oil tank (2T06)

The sludge/waste oil tank can be used for the storage of used lubricating oil, in addition to the sludge coming from the LO separator unit.

4.3.2 Crankcase ventilation system

The purpose of the crankcase ventilation system is to evacuate gases from the crankcase in order to keep the pressure in the crankcase within acceptable limits. As indicated in drawing

"*Recommended lubricating oil system*" each engine must have its own crankcase ventilation pipe into open air. The connection between engine and pipe is to be made flexible. The ventilation pipe may not be combined with pipes from other engines or from oil tanks.

A condensate trap shall be fitted on the ventilation pipe within 1...2 m from the engine.

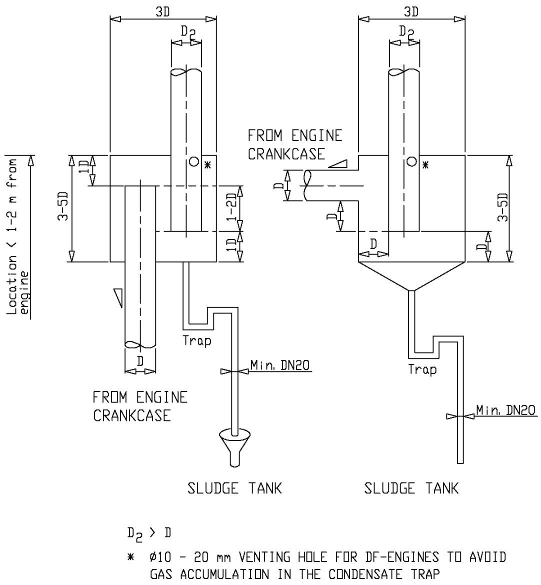
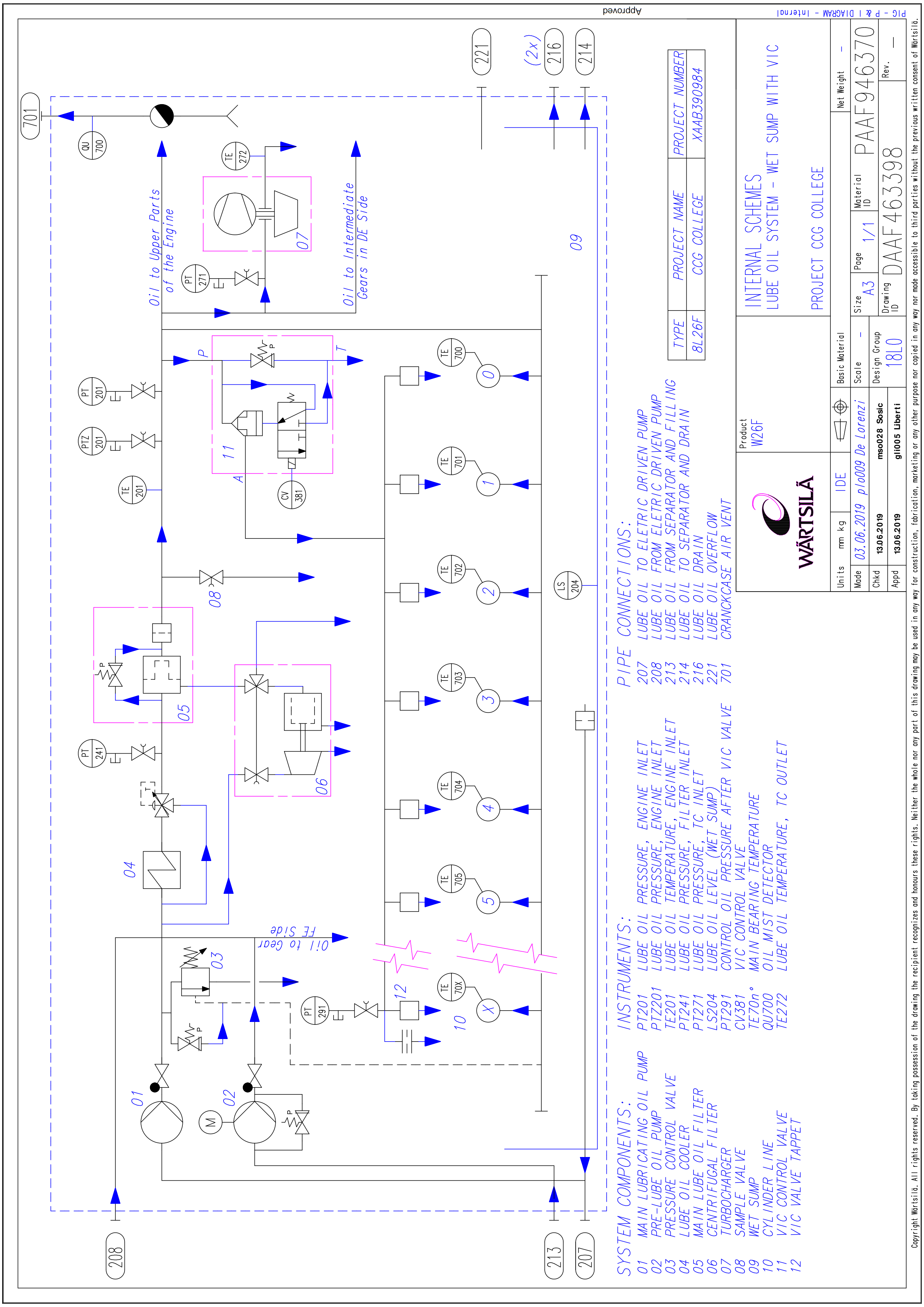


Fig 4-1 Recommended condensate trap design (DAAF369903)

The size of the ventilation pipe (D2) out from the condensate trap should be bigger than the ventilation pipe (D) coming from the engine.
For more information about ventilation pipe (D) size, see the lubricating oil system drawing.
The max back-pressure must be considered when selecting the ventilation pipe size.
The ventilation pipe should be led out of the engine room in such a way that the risk of water condensation in the pipe is minimized.

Design data:	
Flow	see section "*Technical data*"
Back-pressure, max.	see section "*Technical data*"
Temperature	80°C

4.4 List of Documents


SYSTEM COMPONENTS:
01 MAIN LUBRICATING OIL PUMP
02 PRE-LUBE OIL PUMP
03 PRESSURE CONTROL VALVE
04 LUBE OIL COOLER
05 MAIN LUBE OIL FILTER
06 CENTRIFUGAL FILTER
07 TURBOCHARGER
08 SAMPLE VALVE
09 WET SUMP
10 CYLINDER LINE
11 VIC CONTROL VALVE
12 VIC VALVE TAPPET
INSTRUMENTS:
PT201 LUBE OIL PRESSURE, ENGINE INLET
PTZ201 LUBE OIL PRESSURE, ENGINE INLET
TE201 LUBE OIL TEMPERATURE, ENGINE INLET
PT241 LUBE OIL PRESSURE, FILTER INLET
PT271 LUBE OIL PRESSURE, TC INLET
LS204 LUBE OIL LEVEL (WET SUMP)
PT291 CONTROL OIL PRESSURE AFTER VIC VALVE
CV381 VIC CONTROL VALVE
TE70n° MAIN BEARING TEMPERATURE
QU700 OIL MIST DETECTOR
TE272 LUBE OIL TEMPERATURE, TC OUTLET
PIPE CONNECTIONS:
207 LUBE OIL TO ELETRIC DRIVEN PUMP
208 LUBE OIL FROM ELETRIC DRIVEN PUMP
213 LUBE OIL FROM SEPARATOR AND FILLING
214 LUBE OIL TO SEPARATOR AND DRAIN
216 LUBE OIL DRAIN
221 LUBE OIL OVERFLOW
701 CRANKCASE AIR VENT
Oil to Upper Parts of the Engine
Oil to Intermediate Gears in DE Side
Oil to Gear FE Side
(2x)
TYPE 8L26F
PROJECT NAME CCG COLLEGE
PROJECT NUMBER XAAB390984
INTERNAL SCHEMES
LUBE OIL SYSTEM - WET SUMP WITH VIC
PROJECT CCG COLLEGE
Product W26F
WÄRTSILÄ
Units mm kg
Made 03.06.2019 plo009 De Lorenzi
Chkd 13.06.2019 mso028 Sosic
Appd 13.06.2019 gli005 Uberti
Scale -
Design Group 18L0
Size A3
Page 1/1
Drawing ID DAAF463398
Material ID PAAF946370
Net Weight -
Rev. -
PIG - P & I DIAGRAM - Internal
Approved
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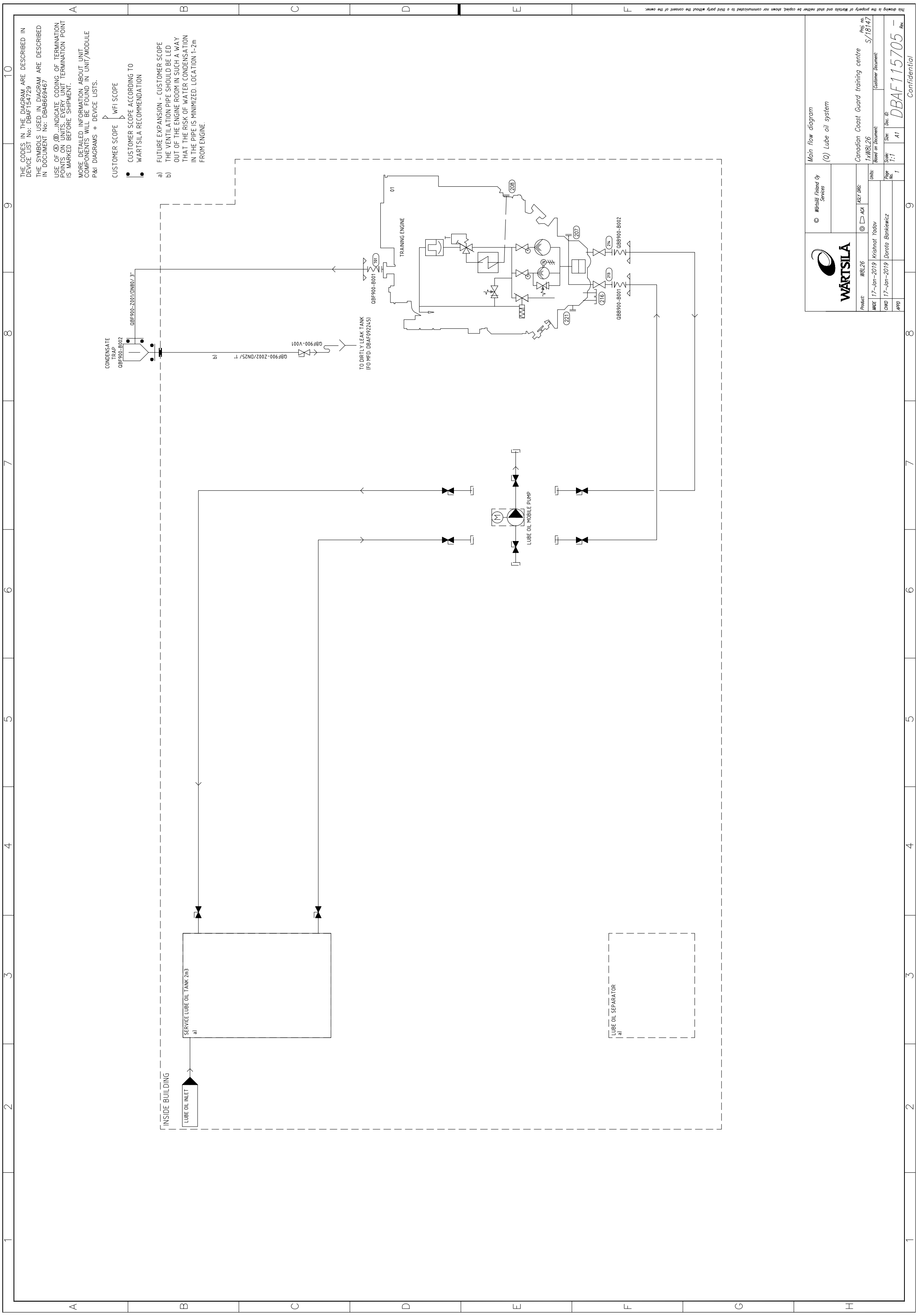

Main flow diagram
(Q) Lube oil system
Canadian Coast Guard training centre
DBAF115705
Confidential
TRAINING ENGINE
LUBE OIL MOBILE PUMP
CONDENSATE TRAP
SERVICE LUBE OIL TANK 2m3
LUBE OIL SEPARATOR
INSIDE BUILDING
LUBE OIL INLET

MAIN EQUIPMENT LIST

Tag	Description	Detail P&ID	Device list No	Dim DWG No	El. Panel	L (m)	W (m)	H (m)	Weight (kg)	Scope	Notes

System design data:

Lube Oil System: Maximum allowed temperature: 85°C/ 185°F, Maximum allowed pressure: 6 bar(g)/ 87 psi(g), Test pressure: 12 bar(g)/ 174 psi(g), ASTM A179, ASTM A106, ASTM A53

Notes:

Refer dwg no:

Equipment coded 90_ is for engine one.

Coding: The coding system is explained in Power Plants grouping & coding of processes & signals document no: 4V75L0112

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(Q) Lube oil system**	Classification **Confidential**	Made By **Zulfikar Bamne**	Date **20-Sep-2019**	Document ID **DBAF154729**	Page **1/2**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115705**	Approved by: **Krister Jansson**	Date **20-Sep-2019**	Revision **-**	

DN = Diameter Nominal
PN = Pressure Nominal

Nom. t = Nominal temperature
Oper. t = Operating temperature

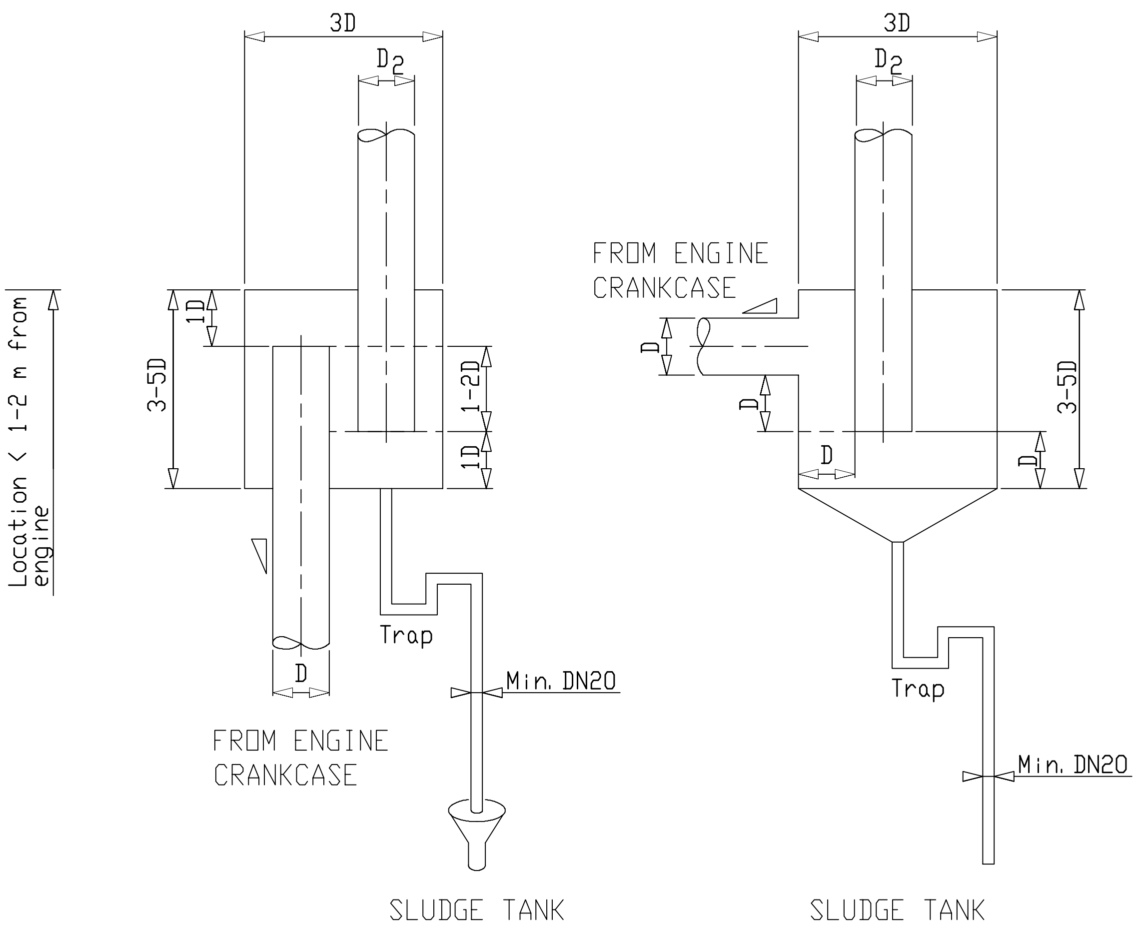
DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
QBB900-B001	FLEXI HOSE LO TO ENGINE	V			DN 40/ 1 1/2"						WFI -	IPI
QBB900-B002	FLEXI HOSE LUBE OIL RETURN FROM ENGINE	V			DN 40/ 1 1/2"						WFI -	IPI
QBF900-B001	FLEXI HOSE CRANK CASE VENT FROM ENGINE	V			DN 80/ 3"						WFI -	IPI
QBF900-B002	CONDENSATE TRAP CONDENSATE TRAP	E			DN 80/ 3" / DN100/ 4"						CUST. -	DESIGN T=80C. CRANKCASE FLOW VENTILATION AT 100% LOAD=1350 L/MIN CRANKCASE VENTILATION BACK-PRESSURE MAX=0.3 KPa
QBF900-V001	BALL VALVE CONDENSATE TRAP DRAIN	V		CARBON STEEL	DN 25/1"						CUST. -	
QBF900-Z001	STEEL PIPE CRANK CASE VENT FROM ENGINE	L		CARBON STEEL ASTM A53 GR B	DN80/ 3"						CUST. -	
QBF900-Z002	STEEL PIPE CONDENSATE TRAP DRAIN	L		CARBON STEEL ASTM A179	DN25/ 1"						CUST. -	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(Q) Lube oil system**	Classification **Confidential**	Made By **Zulfikar Bamne**	Date **20-Sep-2019**	Document ID **DBAF154729**	Page **2/2**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115705**	Approved by: **Krister Jansson**	Date **20-Sep-2019**	Revision **-**	

REV.	DATE	MADE	APPVD.	MEMO NO.	EXPLANATION
A	10 02 2014	J. Björkman	V. Kallioniemi	-	Bilge changed to sludge tank
B	23 09 2015	M. Dahlberg	K. Kojola	CN-A027790	Dimensions added

CRANKCASE VENT



$D_2 > D$

WÄRTSILÄ	Wärtsilä Finland Oy Ship Power -	Kampikammion tuuletus - CRANKCASE VENTILATION -	
PRODUCT -	ACA	UNITS mm kg	- -
MADE 16 06 2006 TRM / Rosenholm		DESIGN GROUP 76E	MAT. NO. xx-xx MAT. CLASS. XXX-XXX-XXX
CHKD 16 06 2006 HD / Dahl		SCALE 1:1 SIZE A4	PAGES -/- DRG. NO. DAAE032780 REV. B
APPD 16 06 2006 KOR / Rönnback			

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5. Compressed Air System

5.1 System overview

Compressed air is used to start engines and to provide actuating energy for safety and control devices. Compressed air is used onboard also for other purposes with different pressures. The use of starting air supply for these other purposes is limited in the classification regulations.

To ensure the functionality of the components in the compressed air system, the compressed air has to be free from solid particles and oil.

The design of the starting air system is partly determined by the rules of the classification societies. Most classification societies require the total capacity to be divided over two roughly equally sized starting air receivers and starting air compressors. The rule requirements of some classification societies are not precise for multiple engine installations.

The lay-out of the compressed air system is shown in the drawing "*recommended starting air system*". If compressed air system components are included in our scope of supply they are listed in section "*Component data, Wärtsilä scope of supply*".

5.1.1 Engine internal system

All engines, independent of cylinder number, are started by means of compressed air with a maximum pressure of 3 MPa (30 bar). The start is performed by direct injection of air into the cylinders through the starting air valves in the cylinder heads. The master starting valve, built on the engine, can be operated both manually and electrically. All engines have built-on non-return valves and flame arresters. As a precaution the engine can not be started when the turning gear is engaged.

The components built on the engine are shown in the drawing "*internal starting air system*".

5.2 System design data

5.2.1 Starting air consumption

The starting air consumption stated in technical data is for a successful start. During a remote start the main starting valve is kept open until the engine starts, or until the max. time for the starting attempt has elapsed. A failed remote start can consume 2...3 times the air volume stated in technical data. If the ship has a class notation for unattended machinery spaces, then the starts may have to be demonstrated as remote starts, usually so that only the last starting attempt is successful.

This must be checked, by the ship builder, with the classification society.

5.3 Recommended functions

The following functions are not included in Wärtsilä scope of supply. We recommend you to design these functions as follows.

5.3.1 Starting air vessel (3T01)

The starting air receiver should be dimensioned for a nominal pressure of 3 MPa (30 bar).

The starting air receivers are to be equipped with at least a manual valve for condensate drainage. If the air receivers are mounted horizontally, there must be an inclination of 3...5° towards drain valve to ensure efficient draining

The following formula shall be used to calculate the total air volume:

$$V_{AIR} = \frac{Q_{ST,i} \times n_{ST}}{\Delta p}$$

where:

V_{AIR} =	Total air volume required [m^3]
n_{ST} =	Number of starts [pcs]
Δp =	Allowed pressure difference [bar], max start pressure (30 bar) - min air pressure (18 bar).
$Q_{ST,\,i}$ =	Consumption for one start for engine i [Nm^3]

The number of starts is specified in the classification societies rules.

5.3.2 Starting air compressor unit (3N02)

The recommended size of the starting air compressor is calculated according to the following formula:

$$Q_C = \frac{V_{SAV} \times n_{SAV} \times p_N}{n_C \times t}$$

where:

Q_C =	Recommended capacity [m^3/h]
V_{SAV} =	Starting air vessel volume [m^3]
n_{SAV} =	Number of starting air vessels of equal size [pcs]
n_C =	Number of starting air compressors [pcs]
p_N =	Nominal pressure [bar]
t =	Time for filling from atmospheric pressure to nominal pressure [h]

At least two starting air compressors must be installed. It is recommended that the compressors are capable of filling the starting air receiver from minimum to maximum pressure in 15...30 minutes. For exact determination of the minimum capacity, the rules of the classification societies must be followed.

5.3.2.1 Separator (3S01)

An oil and water separator should always be installed in the pipe between the compressor and the air vessel. Depending on the operating conditions of the installation, an oil and water separator may be needed in the pipe between the air vessel and engine. The starting air pipes should always be drawn with slope and be arranged with manual or automatic draining at the lowest points.

5.4 Component data, Wärtsilä scope of supply

5.4.1 Air filter (starting air inlet) (3F02)

Quantity 1

Type FIG34

Air flow, max. (Nm^3) 2.4

Working pressure, max. (kPa) 3000

Connection (DN) 50

Filter mesh (μm) 40

Dimensional drawing DAAB726284

5.4.2 Starting air receiver (3T01)

Quantity 1

Type .... 500 L / DN38

Tag number TSB901

Working pressure (bar) 30

Design pressure (bar) 33

Connection (DN) 38

Dimensional drawing .... Db_30200

5.4.3 Starting air compressor unit (3N02)

Quantity 1

Tag number TSA901

Flow (m^3/h) 55

Working pressure (bar) 30

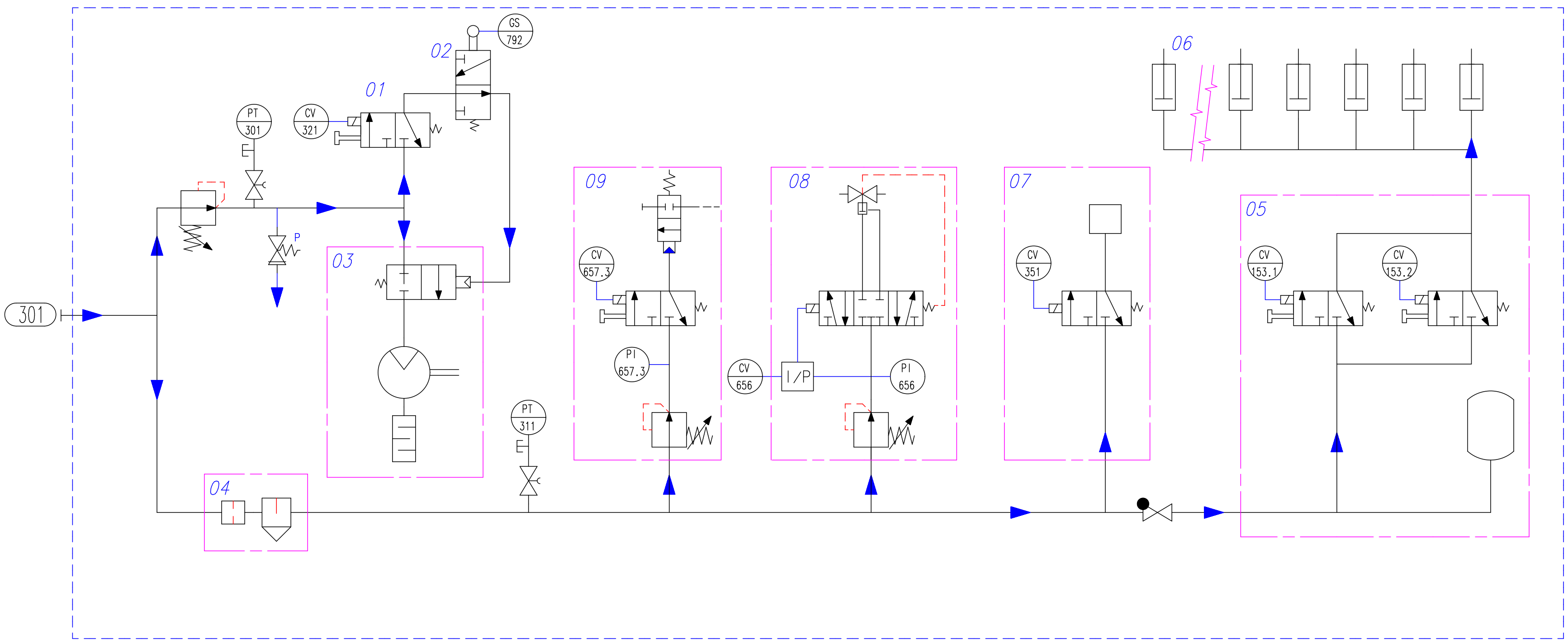
Electric motor power (kW) 18.5

Frequency (Hz) 60

Speed (rpm) 1750

Dimensional drawing .... Q212085_5

5.5 List of Documents



PIPE CONNECTIONS:

301 STARTING AIR INLET

INSTRUMENTS:

PT301 STARTING AIR PRESSURE ENGINE INLET
PT311 CONTROL AIR PRESSURE ENGINE INLET
CV321 STARTING SOLENOID VALVE
CV351 BOOSTER VALVE FOR GOVERNOR
CV153.1 STOP SOLENOID 1
CV153.2 STOP SOLENOID 2
CV656 AIR WASTE GATE VALVE CONTROL
PI656 AIR PRESSURE AIR WASTE GATE INLET
GS792 TURNING GEAR ENGAGED
CV657.3 AIR WASTE GATE VALVE CONTROL
PI657.3 AIR PRESSURE AIR WASTE GATE INLET

SYSTEM COMPONENTS:

01 STARTING SOLENOID VALVE WITH MANUAL SWITCH
02 BLOCKING VALVE TURNING GEAR ENGAGED
03 TURBINE STARTER
04 AIR FILTER AND WATER SEPARATOR
05 STOP UNIT
06 PNEUMATIC STOP CYLINDER IN EACH HP FUEL PUMP
07 STARTING BOOSTER FOR SPEED GOVERNOR ARRANGEMENT
08 AIR WASTE GATE ARRANGEMENT
09 AIR WASTE GATE ARRANGEMENT ARCTIC PACKAGE

TYPE	PROJECT NAME	PROJECT NUMBER
8L26F	CCG COLLEGE	XAAB390984

Approved

WÄRTSILÄ

Product W26F

INTERNAL SCHEMES
START/STOP SYSTEM

PROJECT CCG COLLEGE

Units mm kg	IDE		Basic Material			Net Weight –
Made	12.04.2018	plo009 De Lorenzi	Scale –	Size A3	Page 1/1	Material ID PAAF946368
Chkd	13.06.2019	mso028 Sosic	Design Group 21L0	Drawing ID DAAF463396		Rev. –
Appd	13.06.2019	gli005 Liberti				

PIG - P & I DIAGRAM - Internal

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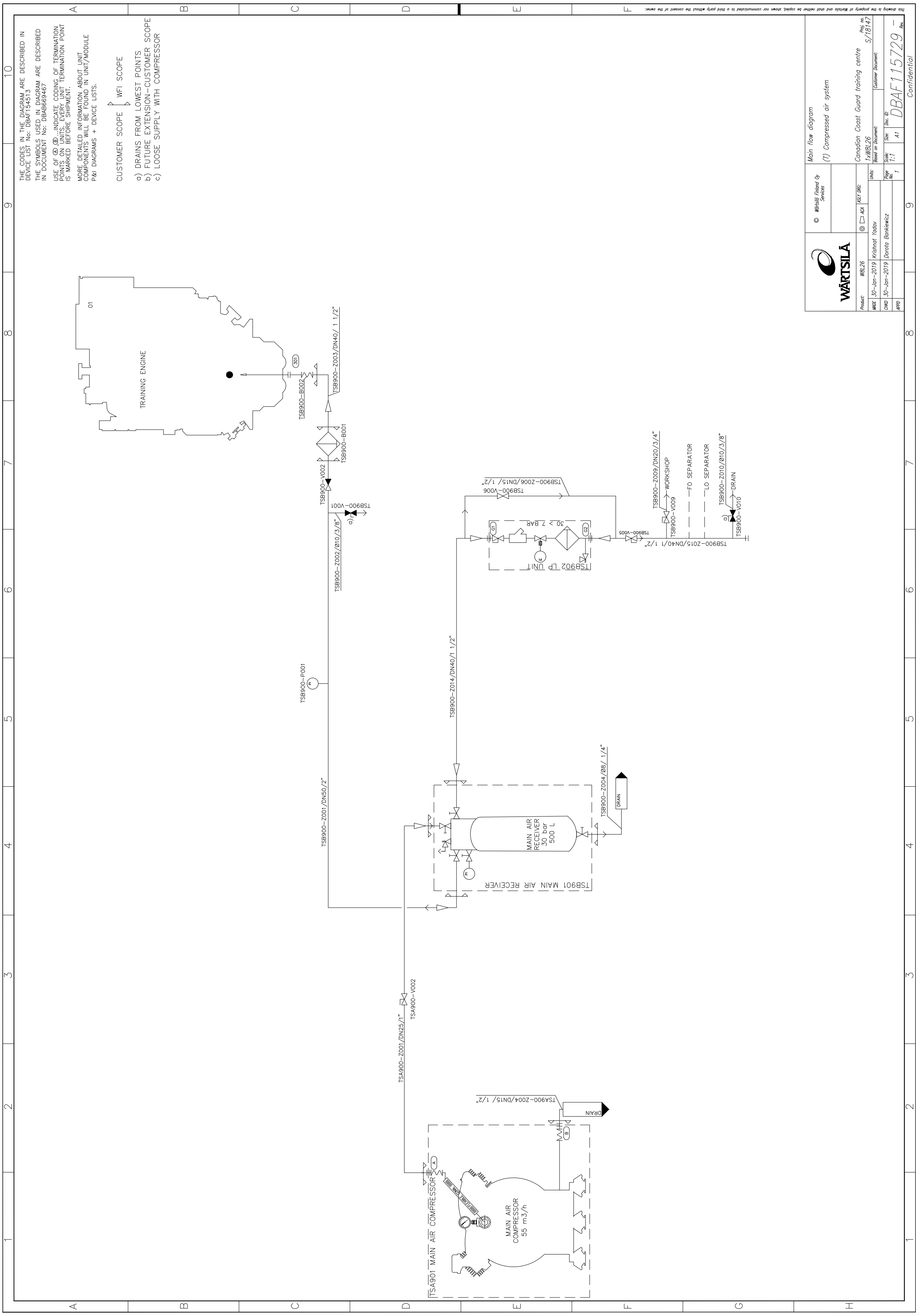

THE CODES IN THE DIAGRAM ARE DESCRIBED IN DEVICE LIST No: DBAF154513
THE SYMBOLS USED IN DIAGRAM ARE DESCRIBED IN DOCUMENT No: DBAB669467
MORE DETAILED INFORMATION ABOUT UNIT COMPONENTS WILL BE FOUND IN UNIT/MODULE P&I DIAGRAMS + DEVICE LISTS.
CUSTOMER SCOPE
WFI SCOPE
a) DRAINS FROM LOWEST POINTS
b) FUTURE EXTENSION-CUSTOMER SCOPE
c) LOOSE SUPPLY WITH COMPRESSOR
TRAINING ENGINE
TSB900-Z001/DN50/2"
TSB900-P001
TSB900-Z014/DN40/1 1/2"
TSB902 LP UNIT
30 > 7 BAR
WORKSHOP
FO SEPARATOR
LO SEPARATOR
DRAIN
MAIN AIR RECEIVER 30 bar 500 L
TSB901 MAIN AIR RECEIVER
TSA900-Z001/DN25/1"
TSA900-V002
TSA900-Z004/DN15/ 1/2"
MAIN AIR COMPRESSOR 55 m3/h
TSA901 MAIN AIR COMPRESSOR
WÄRTSILÄ
Main flow diagram
(1) Compressed air system
Canadian Coast Guard training centre
DBAF115729
Confidential

MAIN EQUIPMENT LIST

Tag	Description	Detail P&ID	Device list No	Dim DWG No	El. Panel	L (m)	W (m)	H (m)	Weight (kg)	Scope	Notes
TSA901	MAIN AIR COMPRESSOR			DBAF154283						WFI	IPI
TSB901	MAIN AIR RECEIVER			DBAF154285						WFI	IPI
TSB902	LP UNIT									CUST.	

System design data:

Starting Air System: Maximum allowed temperature: 60°C/ 140°F, Maximum allowed pressure: 33 bar(g)/ 479 psi(g), Test pressure: 49 bar(g)/ 708 psi(g), ASTM A179, ASTM A106

Working Air System: Maximum allowed temperature: 60°C/ 140°F, Maximum allowed pressure: 8 bar(g)/ 116 psi(g), Test pressure: 12 bar(g)/ 159 psi(g), ASTM A179, ASTM A106

Notes:

Refer dwg no:

Equipment coded 90_ is for engine one.

Coding: The coding system is explained in Power Plants grouping & coding of processes & signals document no: 4V75L0112

WÄRTSILÄ	Project Name	System / Name	Classification	Made By	Date	Document ID	Page
	Canadian Coast Guard training centre	**(T) Compressed air system**	**Confidential**	**Zulfikar Bamne**	**27-Sep-2019**	**DBAF154513**	**1/3**
	Project Number	Description	Ref.Doc.No.	Approved by:	Date	Revision	
	P/18147	**Device list**	**DBAF115729**	**Krister Jansson**	**27-Sep-2019**	**-**	

DN = Diameter Nominal
PN = Pressure Nominal

Nom. t = Nominal temperature
Oper. t = Operating temperature

DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
TSA900-V002	Ball Valve SA OUTLET FROM TSA901 COMPRESSOR	V		CARBON STEEL	DN 25/ 1"						CUST. -	
TSA900-Z001	STEEL PIPE SA OUTLET FROM TSA901 COMPRESSOR	L		CARBON STEEL ASTM A179"	1"						CUST. -	
TSA900-Z004	STEEL PIPE TSA901 DRAIN	L		CARBON STEEL ASTM A179"	1/2"						CUST. -	
TSB900-B001	FILTER SA TO ENGINE	E			DN 50/2"						WFI -	IPI
TSB900-B002	FLEXI HOSE SA TO ENGINE	V			DN40/ 1 1/2"						WFI -	IPI
TSB900-P001	MANOMETER ASSEMBLY SA TO ENGINE	I			G 1/2"						CUST. -	
TSB900-V001	BALL VALVE DRAIN	V		CARBON STEEL	Ø10/3/8"						CUST. -	
TSB900-V002	SDNR GLOBE VALVE SA TO ENGINE	V		CARBON STEEL	DN 50/2"						CUST. -	
TSB900-V005	BALL VALVE WORKING AIR FOR CONSUMERS	V		CARBON STEEL	DN 40 / 1 1/2"						CUST. -	
TSB900-V006	BALL VALVE TSB 902 BYPASS VALVE	V		CARBON STEEL	DN 15 1/2"						CUST. -	
TSB900-V009	BALL VALVE WORKSHOP	V		CARBON STEEL	DN20/ 3/4"						CUST. -	

WÄRTSILÄ	Project Name	System / Name	Classification	Made By	Date	Document ID	Page
	Canadian Coast Guard training centre	**(T) Compressed air system**	**Confidential**	**Zulfikar Bamne**	**27-Sep-2019**	**DBAF154513**	**2/3**
	Project Number	Description	Ref.Doc.No.	Approved by:	Date	Revision	
	P/18147	**Device list**	**DBAF115729**	**Krister Jansson**	**27-Sep-2019**	**-**	

DN = Diameter Nominal
PN = Pressure Nominal

Nom. t = Nominal temperature
Oper. t = Operating temperature

DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
TSB900-V010	BALL VALVE WORKSHOP	V		 CARBON STEEL	Ø10/ 3/8"						CUST. -	
TSB900-Z001	STEEL PIPE SA TO ENGINE	L		CARBON STEEL ASTM A106 Gr.B"	2"						CUST. -	
TSB900-Z002	STEEL PIPE DRAIN	L		CARBON STEEL ASTM A179"	3/8"						CUST. -	
TSB900-Z003	STEEL PIPE SA TO ENGINE	L		CARBON STEEL ASTM A106 Gr.B"	1 1/2"						CUST. -	
TSB900-Z004	STEEL PIPE TSB901 DRAIN	L		CARBON STEEL ASTM A179"	1/2"						CUST. -	
TSB900-Z006	STEEL PIPE TSB902 BYPASS VALVE	L		CARBON STEEL ASTM A179"	1/2"						CUST. -	
TSB900-Z009	STEEL PIPE WORKSHOP	L		CARBON STEEL ASTM A179"	3/4"						CUST. -	
TSB900-Z010	STEEL PIPE DRAIN	L		CARBON STEEL ASTM A179"	3/8"						CUST. -	
TSB900-Z014	STEEL PIPE WORKING AIR FOR CONSUMERS	L		CARBON STEEL ASTM A106 Gr.B"	1 1/2"						CUST. -	
TSB900-Z015	STEEL PIPE WORKING AIR FOR CONSUMERS	L		CARBON STEEL ASTM A106 Gr.B"	1 1/2"						CUST. -	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(T) Compressed air system**	Classification **Confidential**	Made By **Zulfikar Bamne**	Date **27-Sep-2019**	Document ID **DBAF154513**	Page **3/3**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115729**	Approved by: **Krister Jansson**	Date **27-Sep-2019**	Revision **-**	

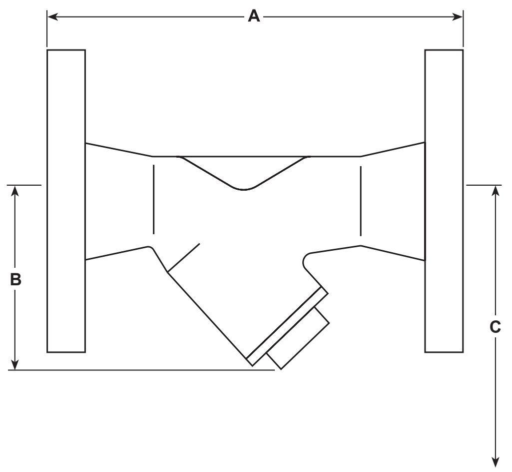
K_v values

Size	DN15	DN20	DN25	DN32	DN40	DN50	DN65	DN80	DN100	DN125	DN150	DN200
Perforations 0.8, 1.6 and 3 mm	5	8	13	22	29	46	72	103	155	237	340	588
Mesh 40 and 100	5	8	13	22	29	46	72	103	155	237	340	588
Mesh 200	4	6	10	17	23	37	58	83	124	186	268	464

For conversion:
C_v (UK) = K_v x 0.963
C_v (US) = K_v x 1.156

Dimensions/weights (approximate) in mm and kg

Size	ASME 150 A	ASME 300 A	JIS/KS 20 A	B	C	Screening area cm²	Weight
DN15	120	127	126	70	110	27	2.1
DN20	144	150	150	80	130	43	2.9
DN25	154	160	159	95	150	73	3.8
DN32	180	180	178	130	235	135	6.5
DN40	200	208	202	146	260	164	9.0
DN50	230	240	232	180	320	251	10.5
DN65	290	289	278	200	325	327	17.5
DN80	310	311	297	205	330	361	24.0
DN100	351	351	333	255	405	545	30.0
DN125	401	401	383	315	510	843	49.0
DN150	473	478	461	345	560	1 117	68.0
DN200	593	600	577	440	710	1 909	128.0



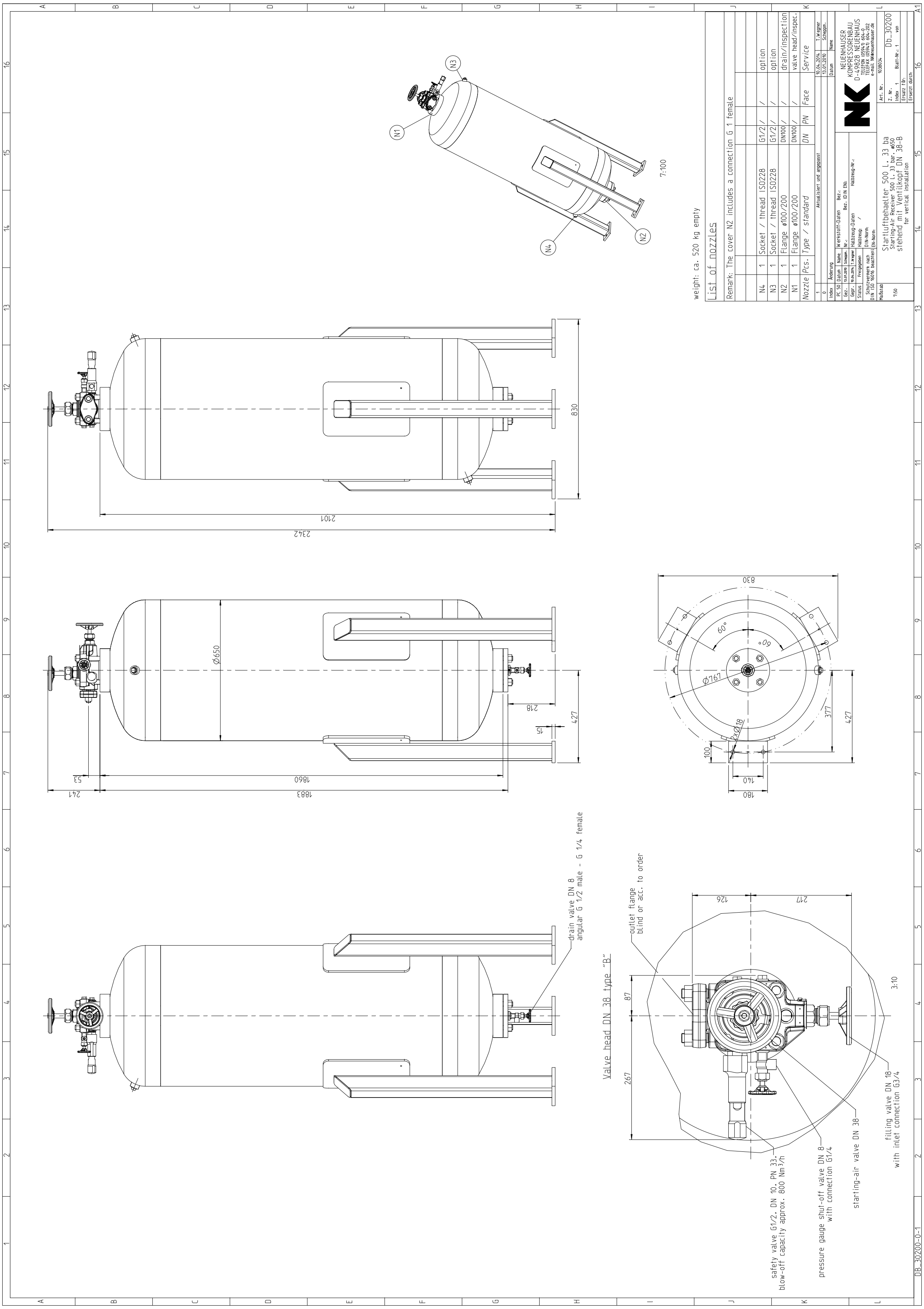
DN15 to DN25

Withdrawal distance

Page 4 of 5

TI-P064-02
CMGT Issue 12

Fig 34 Carbon Steel Strainer - ASTM Material


weight: ca. 520 kg empty
List of nozzles
Remark: The cover N2 includes a connection G 1 female
N4 1 Socket / thread ISO228 G1/2 / / option
N3 1 Socket / thread ISO228 G1/2 / / option
N2 1 Flange ø100/200 DN100 / / drain/inspection
N1 1 Flange ø100/200 DN100 / / valve head/inspec.
Nozzle Pcs. Type / standard DN PN Face Service
Startluftbehaelter 500 l, 33 bar, ø650
Starting-Air Receiver 500 l, 33 bar, ø650
stehend mit Ventilkopf DN 38-B
for vertical installation
Db_30200
NEUENHAUSER KOMPRESSORENBAU
Valve head DN 38 type "B"
drain valve DN 8
angular G 1/2 male - G 1/4 female
outlet flange
blind or acc. to order
safety valve G1/2, DN 10, PN 33,
blow-off capacity approx. 800 Nm³/h
pressure gauge shut-off valve DN 8
with connection G1/4
starting-air valve DN 38
filling valve DN 18
with inlet connection G3/4
2342
2101
830
1883
1860
241
53
218
15
427
377
Ø650
Ø767
60°
140
180
100
126
217
87
267
DB_30200-0-1

Sperre Compressors

Technical documentation

CUSTOMER:	WÄRTSILÄ FINLAND OY - SERVICES
CUSTOMER P.O.:	4504770760 S/18147.M
HULL/POWERPLANT:	CCG College
SPERRE ORDER NO.:	541151

No.	DESCRIPTION	TYPE	COLOUR
A.	STARTING AIR COMPRESSORS	1 x HL2/105A	RAL 7040
	Z-CONTROLLER		RAL 7035

-	22.10.2020	Issued for approval	KKG	BMN
Rev No.	**Issued date**	**Description**	**Prep.By**	**Checked By.**

Doc. no.:541151
Revision: -
Originator: KKG
Date: 22.10.20

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www.sperre.com
Tel. +47 70 16 11 00
Ellingsøyvegen 740
N-6057 Ellingsøy
Norway

Installation Guidelines

For Sperre compressors

Compressor installation

All deliveries of compressor installations are accompanied by documentation of the installation's dimensions and mounting points, (ref General arrangement drawing).

To achieve problem-free operation, it is important that the base-plate is sufficiently rigid and free from vibrations caused by other machinery. The base of the compressor must lie flat on the base-plate. All our units must always be installed in a dry location with a ventilated room.

Always use approved nuts and bolts with at least (8.8) quality or higher when securing the isolators and tighten to the correct/standard torque for the bolt/nut size.

The compressor installation must not be closely surrounded by other equipment, which could inhibit maintenance performances. The recommended maintenance space on all sides is 600 mm.

Hose/piping installation

All hoses are delivered loose and can easily be connected to the in/outlet positions Marked with their respective labels.
Below is a correct and incorrect illustration in how to install flexible hoses to avoid mechanical straining (ref fig.1).

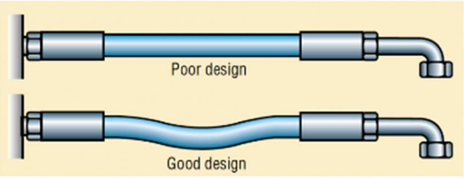

Fig.1 Flexible hose installation.

Electrical equipment

Controller/starter panels are normally loose supplied, and installation is performed by the yard/customer. Our documentation contains all necessary electrical diagrams and drawings confirming size and installation method.

The pressure transmitter PT11 (1/2" BSPP male connector) is loose supplied. To insure the correct start/stop pressure is obtained we always recommend in installing the pressure transmitter directly to the air receiver. All wiring from the pressure transmitter is performed by the yard and needs to be connected to our controller/starter panel, (ref electrical drawings).

All X-range compressors are delivered with a signal cable with pre-wired transmitters for low/high air pressure, oil level/pressure and temperature transmitters within the compressor covers. This cable is a "plug & play" type and is connected to the controller/starter panel with a pre-fixed connector, so no additional installation is needed, (Ref fig.2).

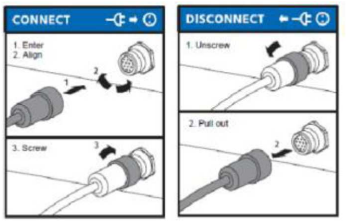

Fig.2 X-14 cable.

Document no.: DM1057 Revision: A
Originator: TOP
Date: 15.05.19
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Norway

Sperre Compressors

Technical documentation

STARTING AIR COMPRESSORS 1 x HL2/105A

No.	Description	Item no.	Doc. no.
A1	General arrangement		G02-0366
A2	Installation diagram		HL2/77A-90A-105A-P&ID
A3	Compressor data sheet		DM1211
A4	El. motor data sheet	8922W13110M0	
A5	Control cabinet data sheet		Z52110210
A6	Control cabinet part list		Z52110210
A7	Wiring diagrams		Z52110210
A8	Terminal diagram		
A9	Dimension drawing, Z-Controller		65000
A10	Vibration Isolator	8458	
A11	Part list – Internal instruments		DM1014
A12	Flexible hoses	4597/4595	DM1013
A13	Recommended oil list		DM1019

Doc. no.:541151 Originator: KKG
Revision: - Date: 22.10.20

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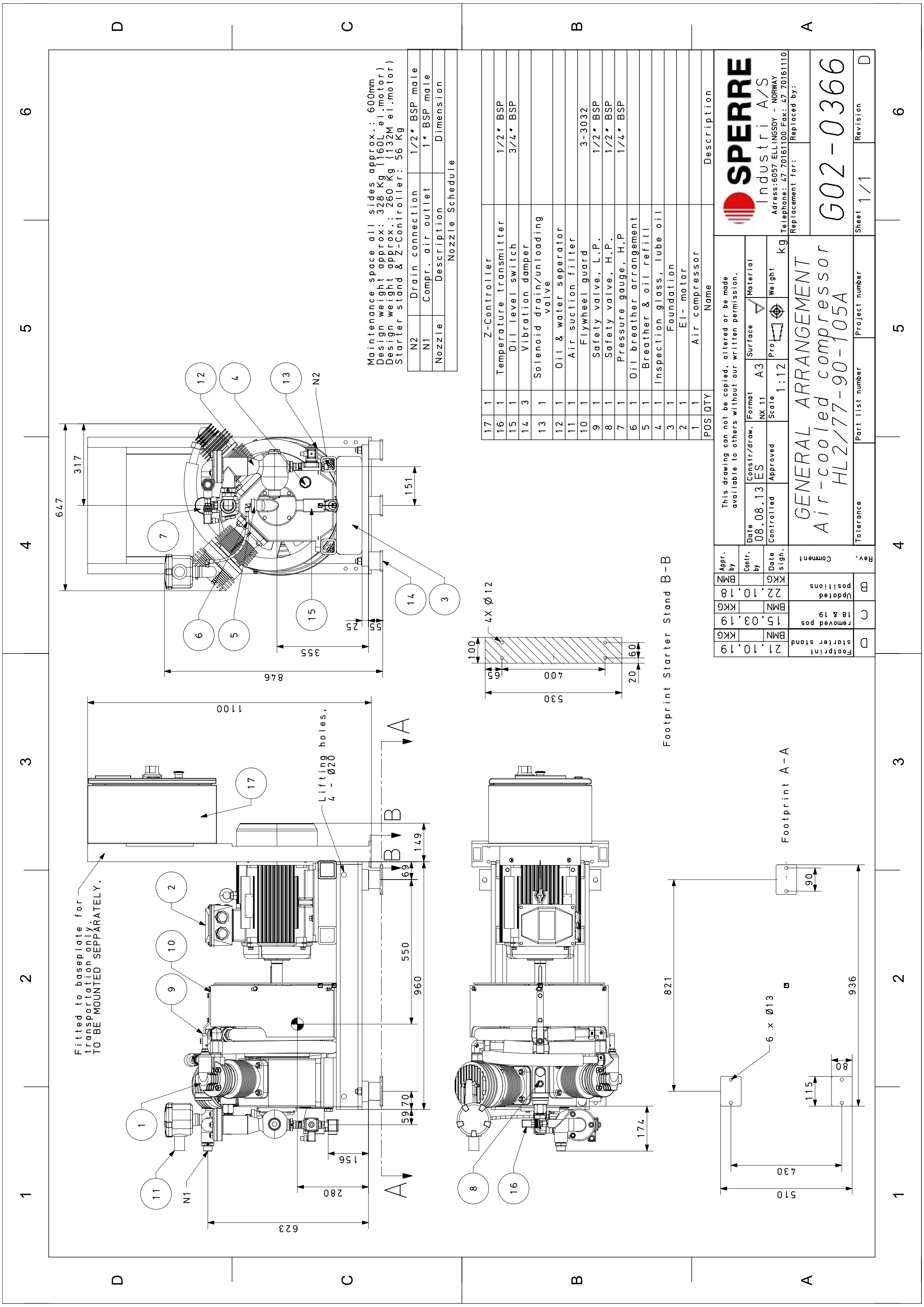
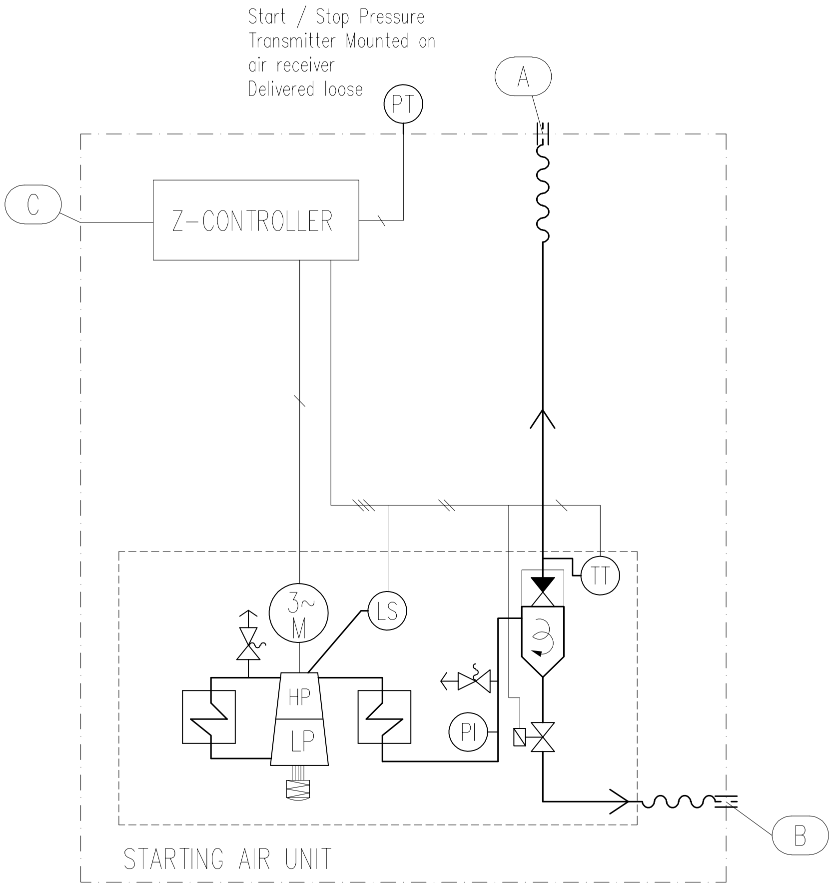

Maintenance space all sides approx.: 600mm
Design weight approx: 328 Kg (160L el.motor)
Design weight approx.: 260 Kg (132M el.motor)
Starter stand & Z-Controller: 56 Kg
N2 Drain connection 1/2" BSP male
N1 Compr. air outlet 1" BSP male
Nozzle Description Dimension
Nozzle Schedule
17 1 Z-Controller
16 1 Temperature transmitter 1/2" BSP
15 1 Oil level switch 3/4" BSP
14 3 Vibration damper
13 1 Solenoid drain/unloading valve
12 1 Oil & water seperator
11 1 Air suction filter
10 1 Flywheel guard 3-3032
9 1 Safety valve, L.P. 1/2" BSP
8 1 Safety valve, H.P. 1/2" BSP
7 1 Pressure gauge, H.P 1/4" BSP
6 1 Oil breather arrangement
5 1 Breather & oil refill
4 1 Inspection glass, lube oil
3 1 Foundation
2 1 El- motor
1 1 Air compressor
POS QTY Name Description
SPERRE Industri A/S
Adress:6057 ELLINGSOY - NORWAY
Telephone: 47 70161100 Fax: 47 70161110
GENERAL ARRANGEMENT
Air-cooled compressor
HL2/77-90-105A
G02-0366
Sheet 1/1
Revision D
Date 08.08.13
Constr/draw. ES
Scale 1:12
Format A3
Fitted to baseplate for transportation only.
TO BE MOUNTED SEPPARATELY.
Lifting holes, 4 - Ø20
Footprint Starter Stand B-B
Footprint A-A
4X Ø12
6 x Ø13
D 21.10.19 BMN KKG Footprint starter stand
C 15.03.19 KKG BMN removed pos 18 & 19
B 22.10.18 BMN KKG Updated positions

LS OIL LEVEL SWITCH	SAFETY VALVE	AIR COOLER
PT PRESSURE TRANSMITTER	NON-RETURN VALVE	OIL & WATER SEPARATOR
PI PRESSURE GAUGE	SOLENOID VALVE	FLEX.HOSE
TT TEMPERATURE TRANSMITTER	AIR SUCTION FILTER	
LP LOW PRESSURE CYLINDER	HP HIGH PRESSURE CYLINDER	



Note:
External Connections According to Order Confirmation

CONNECTIONS			
	DESCRIPTION	DIMENSION	FLANGE CONNECTION
A	STARTING AIR TO AIR RECEIVER	1" BSP	DN25/PN40
B	DRAIN OUTLET	1/2" BSP	DN15/PN40
C	POWER SUPPLY		

Cad system: AutoCad	Scale: –	Format: A4	Rev.index No. / Date	P & ID Diagram
Drawn	04.01.19	TOP		Air-cooled Air Compressor
Approved				Type HL2/77A, HL2/90A, HL2/105A
SPERRE Sperre Industri AS N-6057 Ellingsøy, Norway				Working Pressure 11 – 40 bar
			Former dwg.: / New dwg.:	Drawing no. HL2/77A-90A-105A-P&ID / Revision A

This drawing is the property of Sperre Industri AS and can not be made public, copied or otherwise used, without our written consent.

Datasheet

SPERRE

Compressor HL2/105A – 30 barg – 1750 rpm

Charging capacity at 1750 RPM	55 m^3/h
Power requirements 1750 RPM	14 kW
Heat dissipation 1750 RPM	10836 kCal/h
Weight complete (standard motor)	328 kg
Dimensions	1200 x 650 x 780 mm (L x W x H)
Oil volume	4 litres
Lubrication system	Splash
Oil type	Fully synthetic, ISO 68 or 100, Reciprocating piston compressors
All compressors tested and delivered with	Mobil Rarus 827

Design

No. of cylinders / Cylinder arrangement	2 / 90°V
No. of compression stages	2
Cooling	Air cooled
Valve LP / Valve HP	1 Plate valve /1 Reed valve

Operation parameters

Delivery pressure	30 bar
Safety valve LP/ HP	9 barg/ 31.5 barg
Max. ambient temp. compressor	55°C
Max. ambient temp. controller	55°C
Max. ambient temp. electric motor	45°C (above on request)
Normal working pressure LP	2-4 bar
Normal temperature outlet air	Approx. 15-30 ºC above ambient
Safety valves set point, H.P.	5% above stage pressure
Transmitter temp outlet	Alarm 85°C, shutdown 90°C
Maximum speed	1800 RPM
Rotation	Counter-clockwise (looking at the drive end)
Max noise levels	84 dBA
Max vibration levels	40 mm/s-RMS

Mechanical components

Non return valve air outlet	Integrated
Oil & water separator HP	Integrated
Safety valve LP / HP	Integrated
Oil level sight glass	Integrated
Air suction filter	Integrated
Inter- and after-cooler	Integrated
Oil level switch	Integrated
Temperature transmitter	Integrated
Vibration isolators, 3 pc.	Loose
Flexible tube, Air outlet	Loose
Flexible tube, Drain /unloading	Loose
When compressor mounted on air receiver	
Vibration isolators, 4 pc.	Integrated

Document no.: DM1211	Originator:	TOP	**©Sperre Industri AS**	Ellingsøyvegen 740
Revision: B	Date:	10.08.18	www.sperre.com	N-6057 Ellingsøy
			Tel. +47 70 16 11 00	Norway

DATA SHEET

Three Phase Induction Motor - Squirrel Cage

Customer	:
Product line	: W22 - IE3 Premium Efficiency

Frame	: 160M	Locked rotor time	: 13 s (hot) 23 s (cold)
Output	: 15 kW	Temperature rise[4]	: 75 K
Poles	: 4	Duty cycle	: S1
Frequency	: 60 Hz	Ambient temperature	: -20 °C to +45 °C
Rated voltage	: 600 V	Altitude	: 1000 m.a.s.l
Rated current	: 18.8 A	Degree of protection	: IP55
L. R. Amperes	: 170 A	Cooling method	: IC411 - TEFC
LRC (p.u.)	: 9.0	Mounting	: B3T
No load current	: 7.85 A	Direct of rotation[1]	: Both
Rated speed	: 1775 rpm	Noise level[2]	: 64.0 dB(A)
Slip	: 1.39 %	Starting method	: Direct On Line
Rated torque	: 8.23 kgfm	Approx. weight[3]	: 133 kg
Locked rotor torque	: 320 %	Design	: N
Pull up torque	: 270 %		
Breakdown torque	: 340 %		
Insulation class	: F		
Service factor	: 1.25		
Moment of inertia (J)	: 0.1471 kgm²		

Output	Start	50%	75%	100%	Load type	: Parabolic torque
Efficiency (%)	-	91.6	93.2	93.4	Load torque	: 8.23 kgfm
Power factor	0.49	0.64	0.75	0.82	Load inertia (J=GD²/4)	: 0.1471 kgm²

	Drive end	Non drive end	Foundation loads	
Bearing type	6309-ZZ-C3	6209-ZZ-C3	Maximum traction	: 374 kgf
Lubrication interval	-	-	Maximum compression	: 507 kgf
Lubricant amount	-	-		
Lubricant type	MOBIL POLYREX EM			

Notes:

Standards

Specification	: IEC 60034-1	Vibration	: IEC 60034-14
Tests	: IEC 60034-2	Tolerance	: IEC 60034-1
Noise	: IEC 60034-9		

This revision replaces and cancels the previous one, which must be eliminated.
(1) When viewed from the drive end.
(2) Measured at 1m and with tolerance of +3dB(A).
(3) Approximate weight subject to changes after manufacturing process.
(4) At the rated point.

These are average values based on tests with sinusoidal power supply, subject to the tolerances stipulated in IEC 60034-1.

Rev.	Summary of changes	Performed	Checked	Date

Performed by	georgiana		026313/2020	
Checked by			Page	Revision
Date	31/01/2020		1/1	0

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Datasheet

Cabinet Z52110210

Manufacturer data

Manufacturer	Sperre Industri AS
Compressor Type	Piston compressor
Part Nr	Z52110210

Supply

Main Voltage	600-690 V
Frequency	50-60 Hz
Current	16-24 A

Technical Data

Protection	IP54 (equivalent to Nema 3S)
Size	H500/W400/D250 [mm]
Weight	33 kg
Color	RAL 7035
Max Ambient Temp	45°C
Additional function	Short circuit protection

Item no: Z52110210

Originator: CG
Date: 2020-10-22

Sperre Industri AS
www.sperre.com
tel. +47 70 16 11 00

Ellingsøyvegen 740
N-6057 Ellingsøy
Norway

Partlist

Cabinet type: Z52110210

Voltage: 600-690
Current: 16-24A
Frequency: 50-60 Hz

Ref	Description	PartNr
A1	Sperre Control Unit	67031-A
S7	Emergency start switch	67051
S0	Emergency stop button	67040
S0	Emergency stop cover	67045
	Door stopper	2490191
K1	Contactor 40A 230V	66240
K1	AuxBlock on contactor	66730
F1	Thermal relay 16-24A	66314
P1	Amperemeter 0-50A	8050-02
T1	Current transformer 50/5A	805-050
T2	Transformer 220VA 46/230/24	67132-UL
Q1	Aux Contact	66185
Q1	Extended rotary handle S/M	66170
F20/F21	Fuse holder	68290
F20/F21	Fuse 690V 2A gG	68272
Q30	Circuit breaker 1P 2A	68300-102-UL
Q31	Circuit breaker 1P 0,5A	68300-1005-UL
Q1	50A Circuit breaker	66071

Item no: Z52110210

Originator: CG
Date: 2020-10-22

Sperre Industri AS
www.sperre.com
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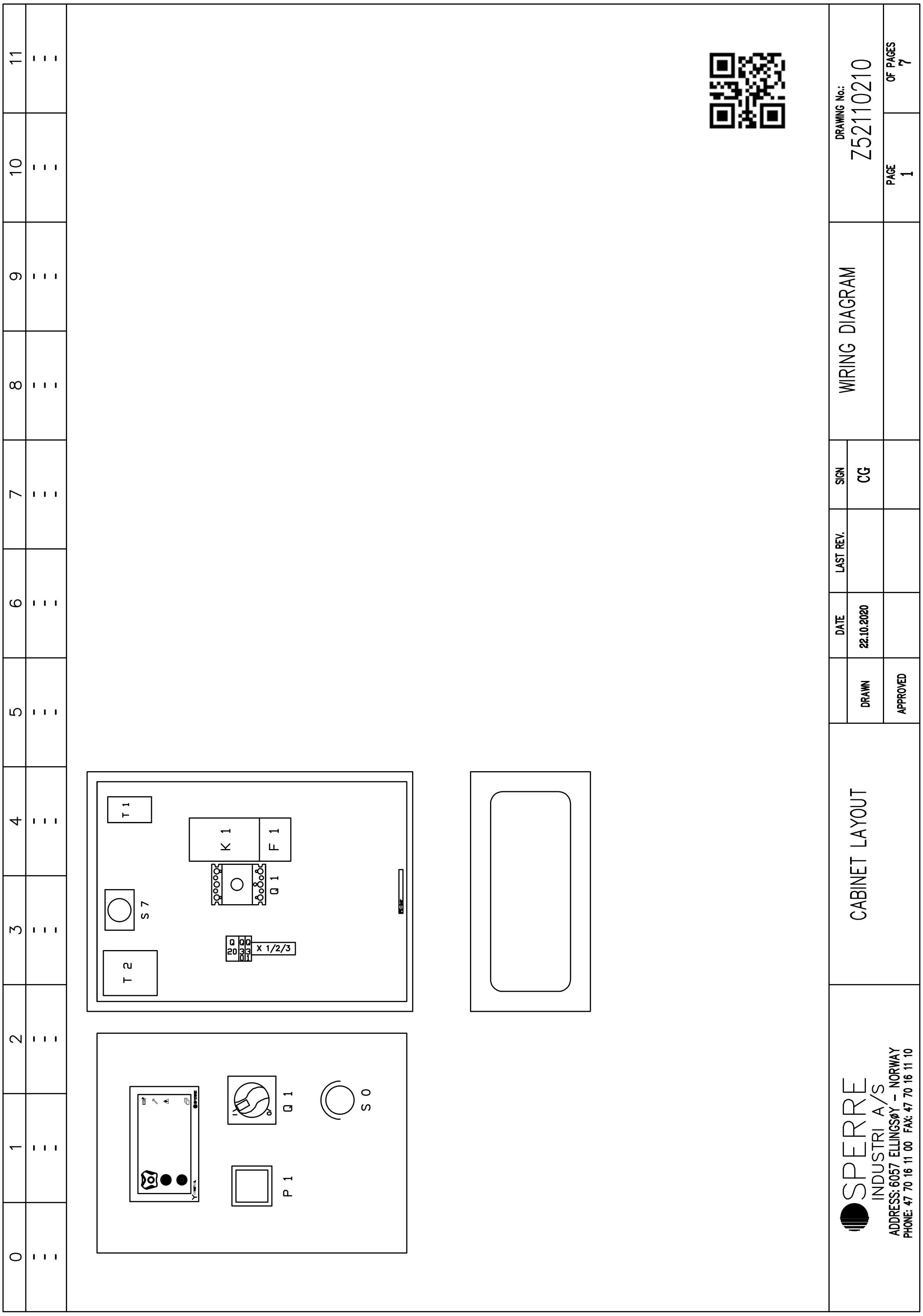
Ellingsøyvegen 740
N-6057 Ellingsøy
Norway


0
1
2
3
4
5
6
7
8
9
10
11
P 1
Q 1
S 0
T 1
T 2
K 1
F 1
S 7
X 1/2/3
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CABINET LAYOUT
DRAWN
APPROVED
DATE
22.10.2020
LAST REV.
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CG
WIRING DIAGRAM
DRAWING No.:
Z52110210
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OF PAGES
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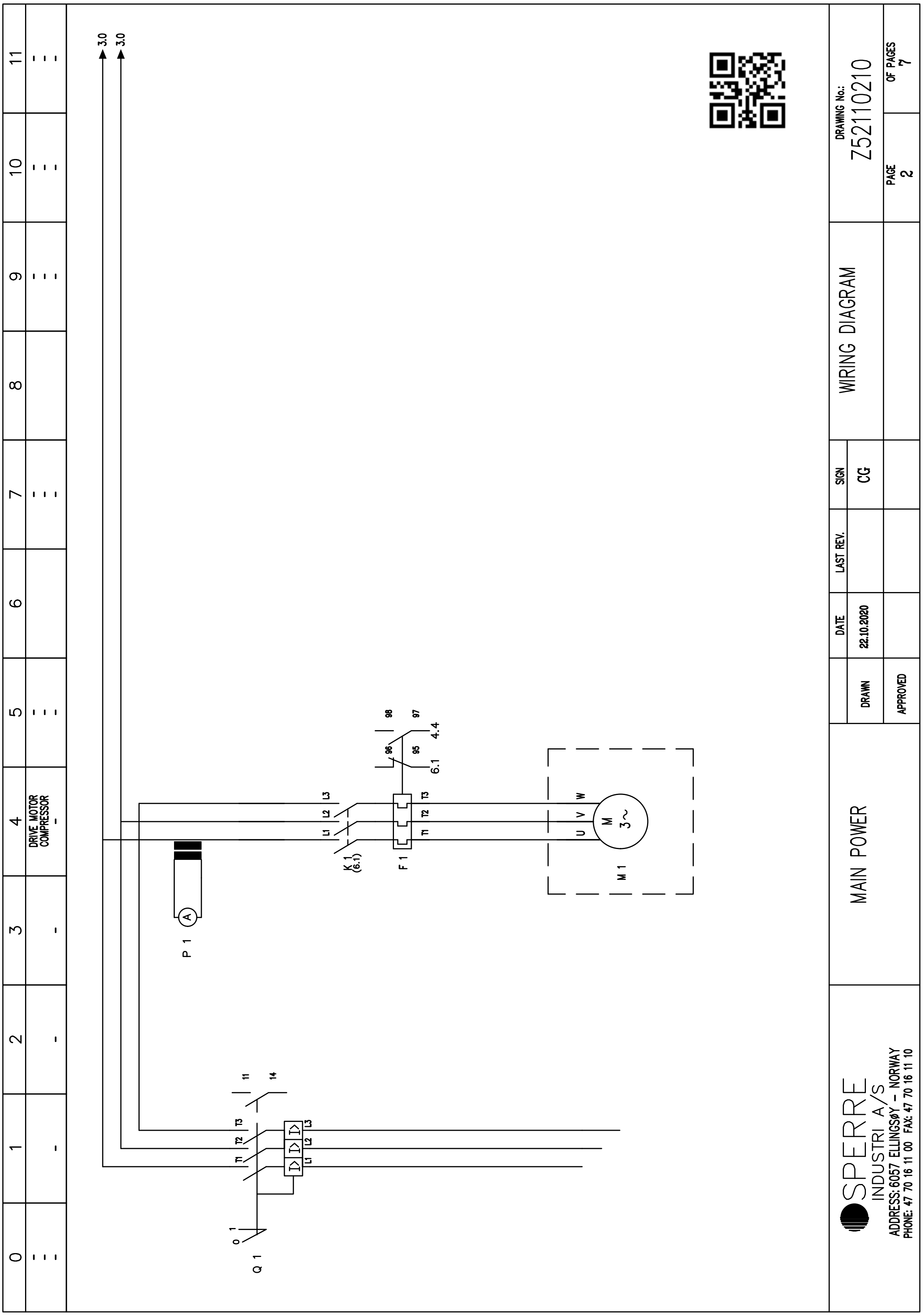
DRIVE MOTOR COMPRESSOR
Q 1
P 1
K 1 (6.1)
F 1
M 1
M 3~
6.1
4.4
3.0
3.0
MAIN POWER
WIRING DIAGRAM
DRAWING No.: Z52110210
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OF PAGES 7
DRAWN
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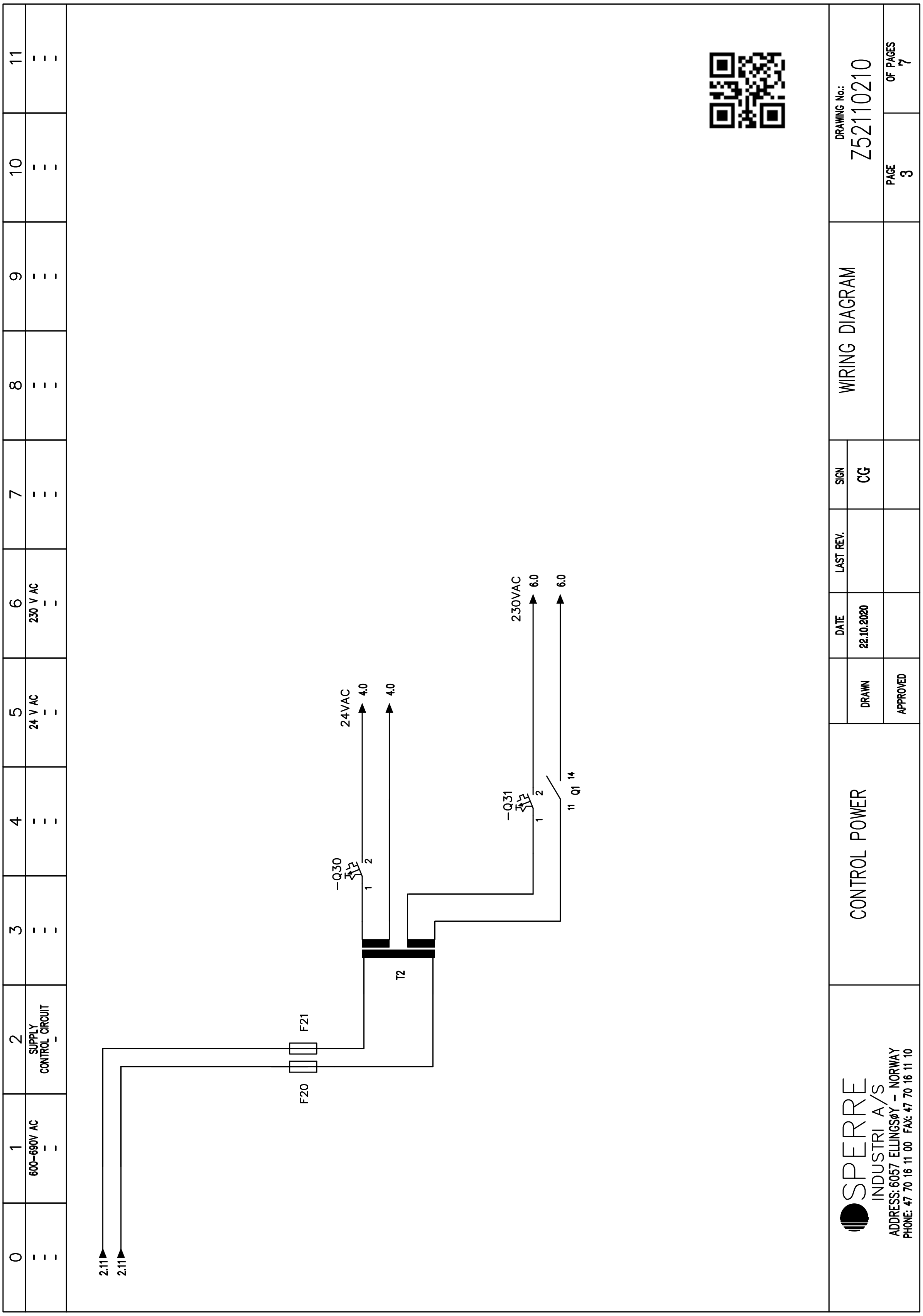
0
1
600–690V AC
2
SUPPLY CONTROL CIRCUIT
3
4
5
24 V AC
6
230 V AC
7
8
9
10
11
2.11
2.11
F20
F21
T2
-Q30
24VAC
4.0
4.0
-Q31
Q1
230VAC
6.0
6.0
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CONTROL POWER
DRAWN
APPROVED
DATE
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DRAWING No.:
Z52110210
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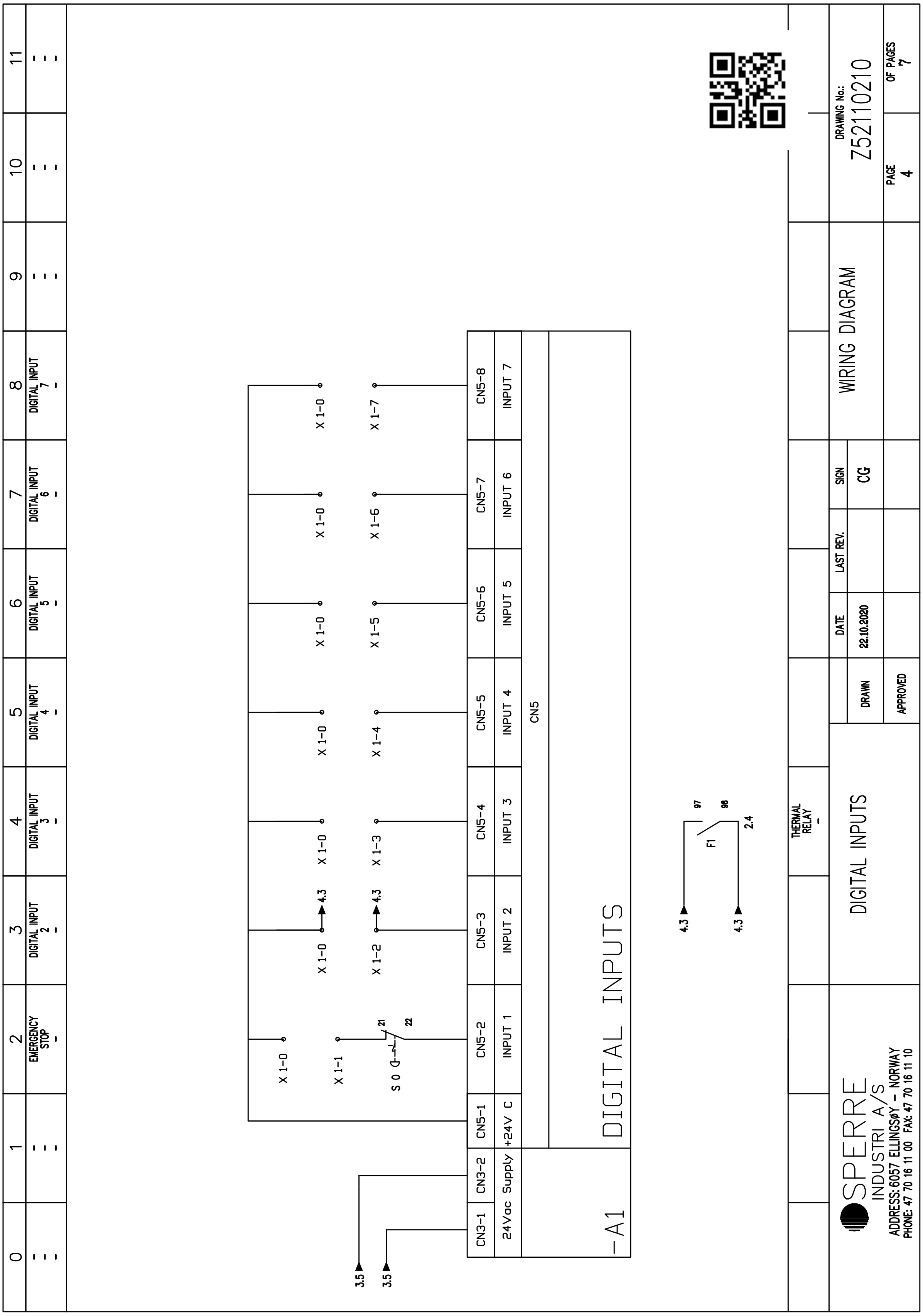
DIGITAL INPUTS
-A1
24Vac Supply
+24V C
CN3-1
CN3-2
CN5-1
CN5-2
CN5-3
CN5-4
CN5-5
CN5-6
CN5-7
CN5-8
INPUT 1
INPUT 2
INPUT 3
INPUT 4
INPUT 5
INPUT 6
INPUT 7
CN5
EMERGENCY STOP
DIGITAL INPUT 2
DIGITAL INPUT 3
DIGITAL INPUT 4
DIGITAL INPUT 5
DIGITAL INPUT 6
DIGITAL INPUT 7
THERMAL RELAY
F1
WIRING DIAGRAM
DRAWING No.: Z52110210
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OF PAGES 7
DRAWN CG
DATE 22.10.2020
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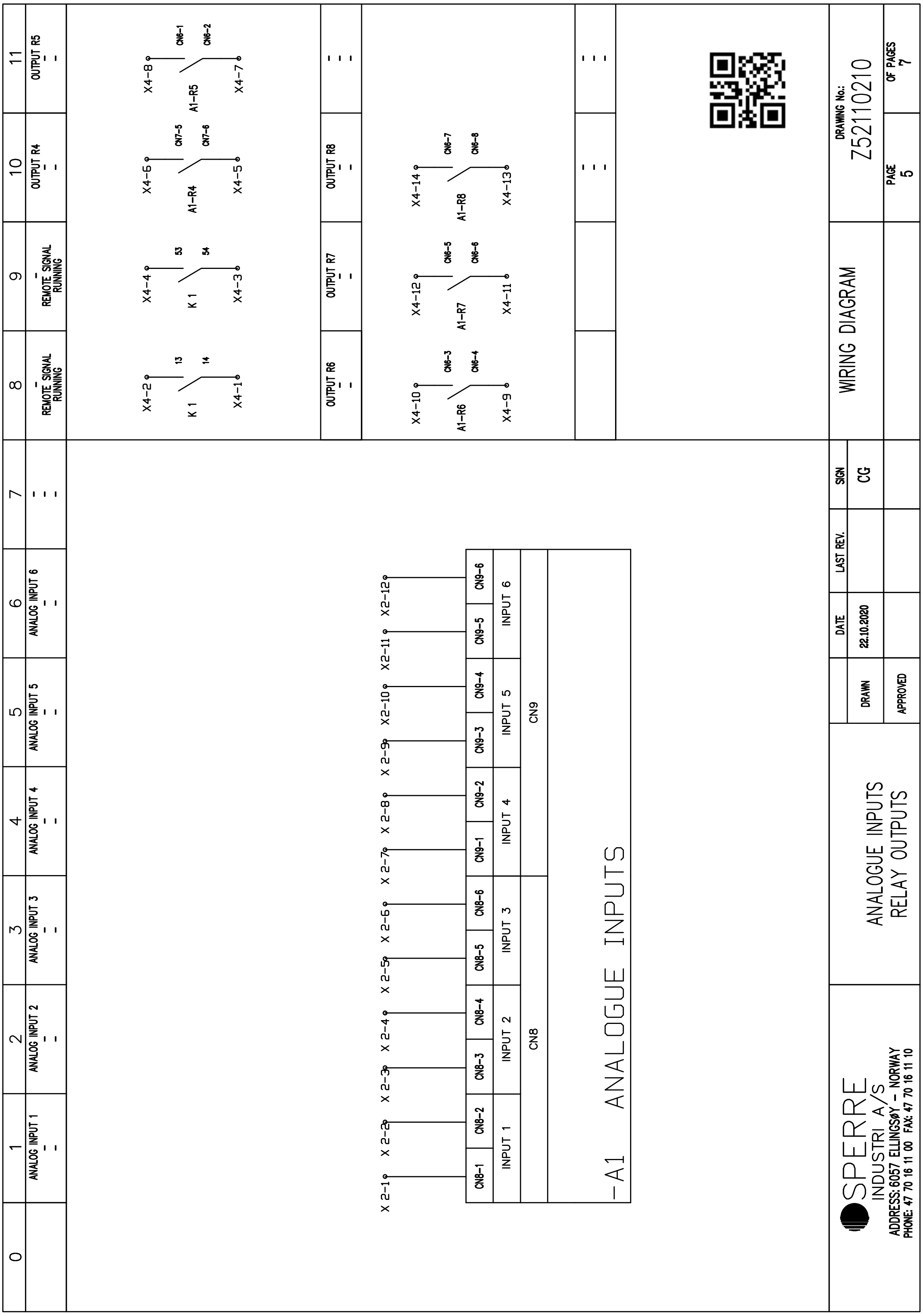
ANALOG INPUT 1
ANALOG INPUT 2
ANALOG INPUT 3
ANALOG INPUT 4
ANALOG INPUT 5
ANALOG INPUT 6
REMOTE SIGNAL RUNNING
REMOTE SIGNAL RUNNING
OUTPUT R4
OUTPUT R5
OUTPUT R6
OUTPUT R7
OUTPUT R8
X 2-1 X 2-2 X 2-3 X 2-4 X 2-5 X 2-6 X 2-7 X 2-8 X 2-9 X2-10 X2-11 X2-12
CN8-1 CN8-2 CN8-3 CN8-4 CN8-5 CN8-6 CN9-1 CN9-2 CN9-3 CN9-4 CN9-5 CN9-6
INPUT 1
INPUT 2
INPUT 3
INPUT 4
INPUT 5
INPUT 6
CN8
CN9
-A1 ANALOGUE INPUTS
X4-2 K 1 13 14 X4-1
X4-4 K 1 53 54 X4-3
X4-6 A1-R4 CN7-5 CN7-6 X4-5
X4-8 A1-R5 CN6-1 CN6-2 X4-7
X4-10 A1-R6 CN6-3 CN6-4 X4-9
X4-12 A1-R7 CN6-5 CN6-6 X4-11
X4-14 A1-R8 CN6-7 CN6-8 X4-13
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PHONE: 47 70 16 11 00 FAX: 47 70 16 11 10
ANALOGUE INPUTS
RELAY OUTPUTS
DRAWN
APPROVED
DATE
22.10.2020
LAST REV.
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DRAWING No.:
Z52110210
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OF PAGES
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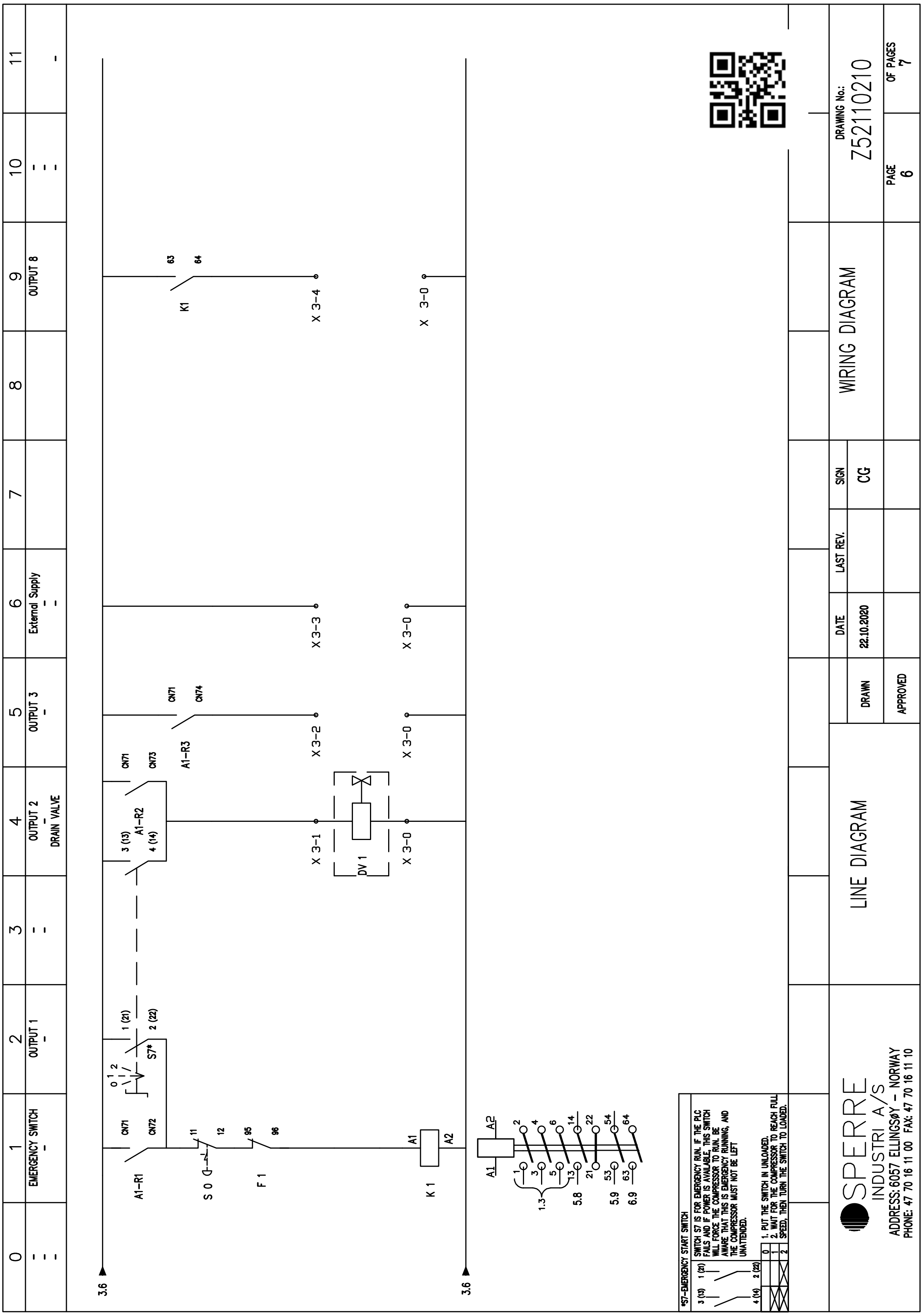
EMERGENCY SWITCH
OUTPUT 1
OUTPUT 2
DRAIN VALVE
OUTPUT 3
External Supply
OUTPUT 8
A1-R1
A1-R2
A1-R3
S7*
K1
F 1
DV 1
X 3-0
X 3-1
X 3-2
X 3-3
X 3-4
*S7-EMERGENCY START SWITCH
SWITCH S7 IS FOR EMERGENCY RUN. IF THE PLC FAILS AND IF POWER IS AVAILABLE, THIS SWITCH WILL FORCE THE COMPRESSOR TO RUN. BE AWARE THAT THIS IS EMERGENCY RUNNING, AND THE COMPRESSOR MUST NOT BE LEFT UNATTENDED.
1. PUT THE SWITCH IN UNLOADED.
2. WAIT FOR THE COMPRESSOR TO REACH FULL SPEED, THEN TURN THE SWITCH TO LOADED.
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LINE DIAGRAM
DRAWN
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SIGN
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WIRING DIAGRAM
DRAWING No.:
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OF PAGES
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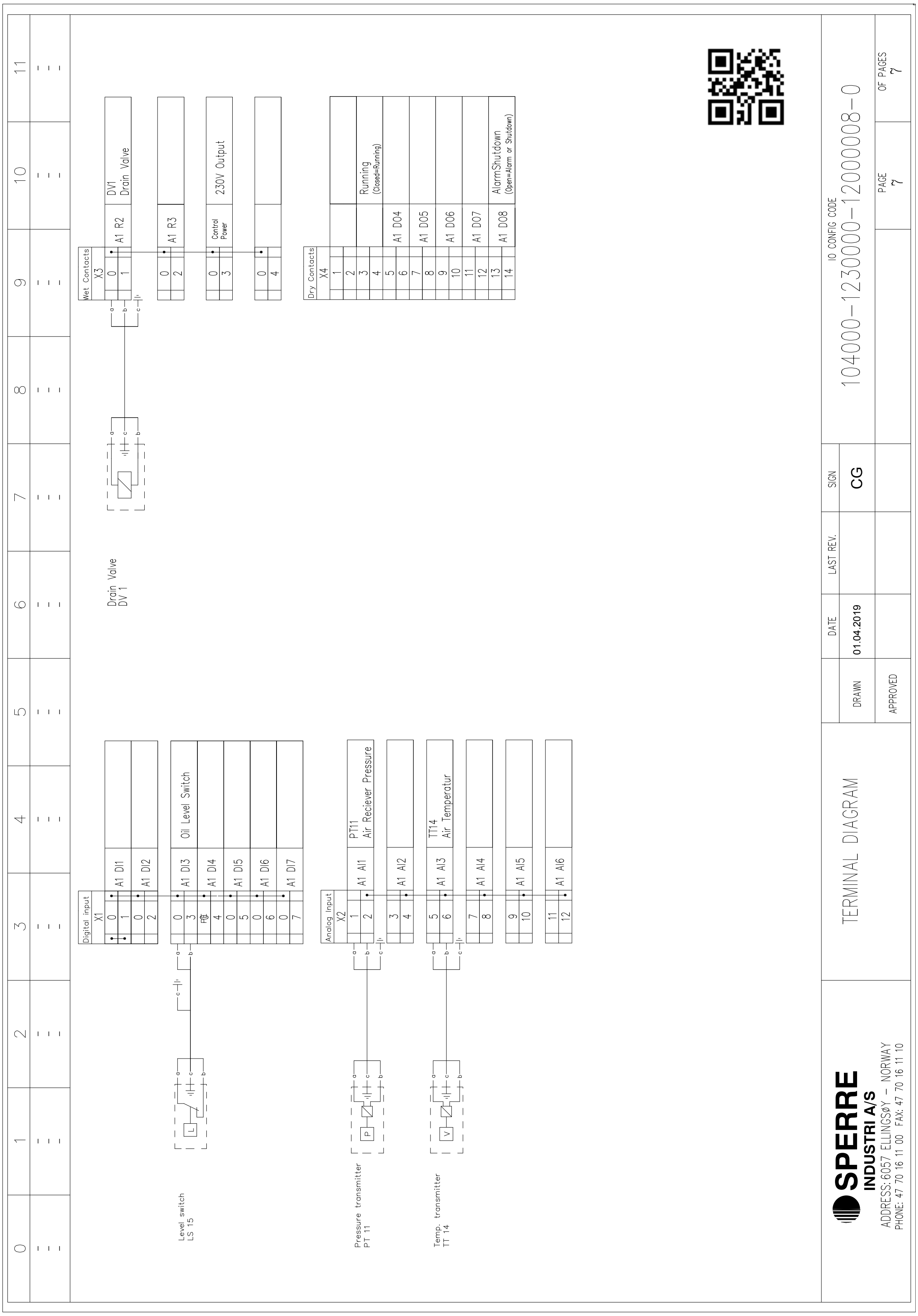
TERMINAL DIAGRAM
Level switch LS 15
Pressure transmitter PT 11
Temp. transmitter TT 14
Drain Valve DV 1
Digital input X1
Analog Input X2
Wet Contacts X3
Dry Contacts X4
A1 DI1
A1 DI2
A1 DI3
A1 DI4
A1 DI5
A1 DI6
A1 DI7
Oil Level Switch
A1 AI1
A1 AI2
A1 AI3
A1 AI4
A1 AI5
A1 AI6
PT11 Air Reciever Pressure
TT14 Air Temperatur
A1 R2
A1 R3
DV1 Drain Valve
Control Power
230V Output
Running (Closed=Running)
A1 DO4
A1 DO5
A1 DO6
A1 DO7
A1 DO8
AlarmShutdown (Open=Alarm or Shutdown)
IO CONFIG CODE
104000-1230000-12000008-0
PAGE 7
OF PAGES 7
DRAWN
APPROVED
DATE 01.04.2019
LAST REV.
SIGN CG
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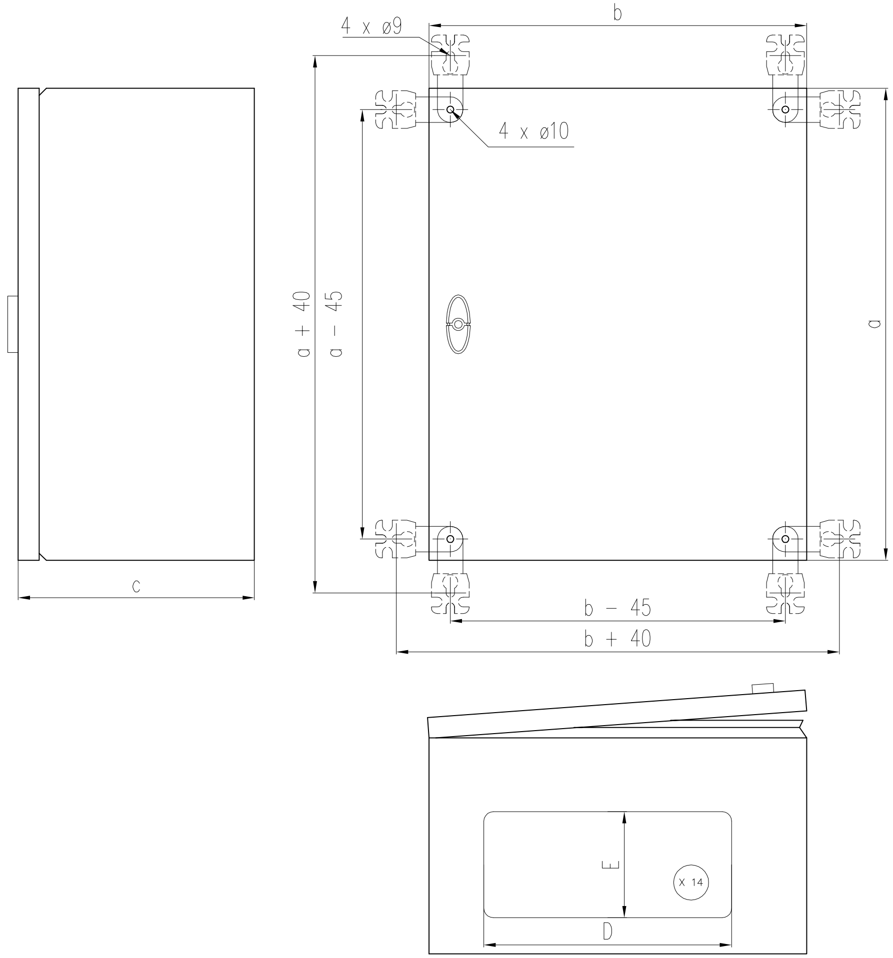

a	b	c	d	e
400	300	200	220	105
400	400	200	320	105
500	300	200	220	105
500	400	250	320	105
500	500	250	420	105
600	400	250	320	105
700	500	250		
600	600	250		
600	600	300		
800	800	250		

Mounting instructions:
When mounted with mounting lugs , mounting lugs may be mounted either horisontal or vertical.
Use measure a+40 , b−45 or a−45 , b+40

Degree of protection: IP−54 or higher

Other painting colors for additional cost.

Gland plate provided.
X14 signal can be unscrewed from the outside and gland plate removed for punching (X−range only).

If glands are to be provided by Sperre, sizes must be informed during approval stage before deadline date.

	DATE	SIGN		DRAWING No.:	
DRAWN	20.01.2016	CAD	DIMENSION SKETCH	65000−REV2	
APPROVED	27.03.17	JLS	Classic & X−range	PAGE 1	OF PAGES 1

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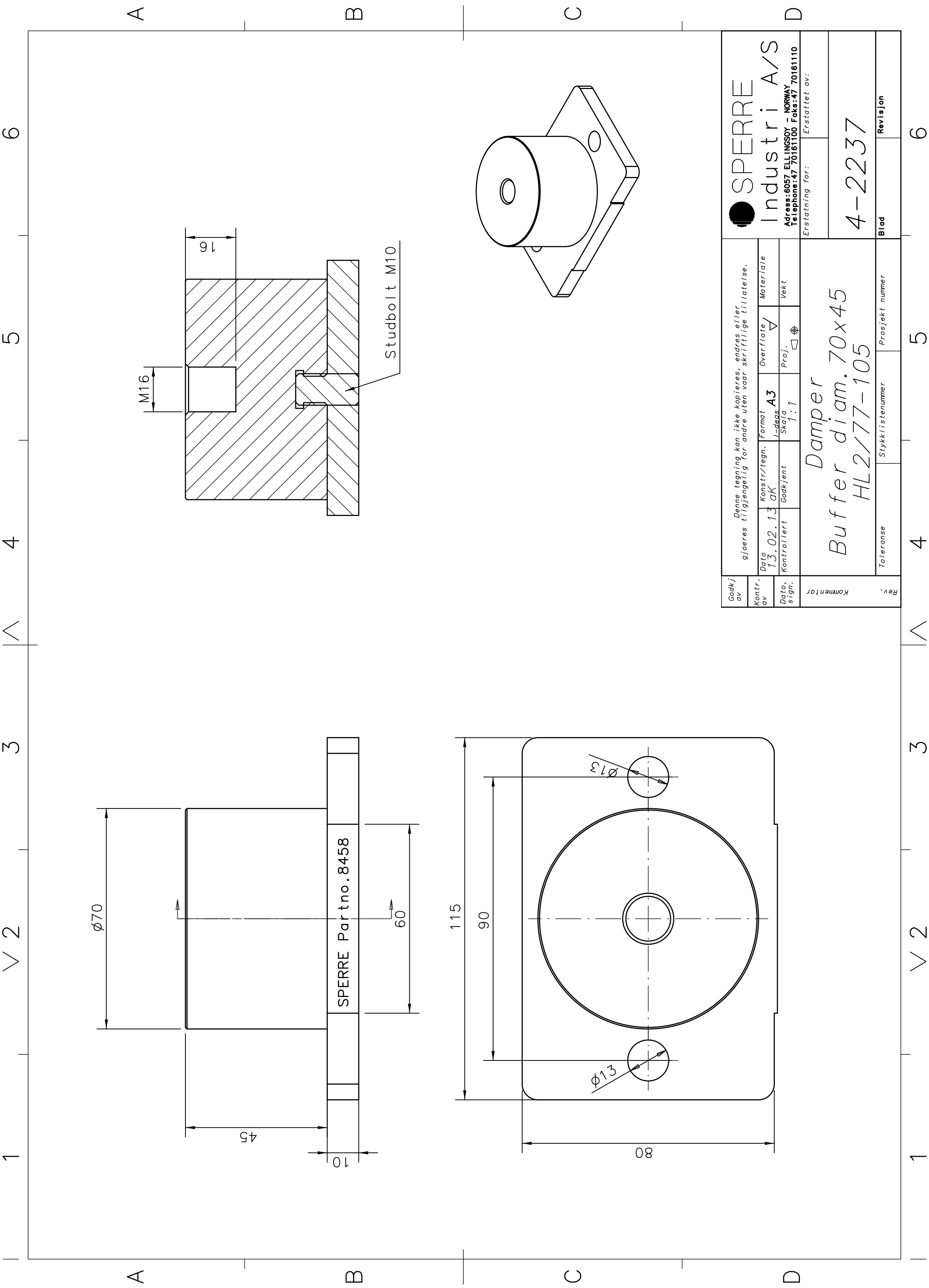
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Dato 13.02.13
Konstr/tegn. aK
Format A3
Skala 1:1
Damper
Buffer diam.70x45
HL2/77-105
4-2237
Studbolt M10
SPERRE Partno.8458
M16
16
ø70
60
115
90
ø13
45
10
80

Technical description

SPERRE

Part list Internal Instruments, Classic models HL2/77-90-105A

Part	**Description**	**Part no.**	**Part/kit no. with gasket**
 TT14	Temperature Transmitter HP Alarm & Shut down	64140	56481
 LS15	Oil Level Switch Shut down	4356	4356
 DV1/DV2	Drain Valve, HP/LP	64212	3578
 DV1* / DV2*	*Coil for valves 220V 50/60 Hz	64310	64310
 PT11	Pressure Transmitter Loose supplied for Air receiver	64130	56551
	Safety Valves High pressure (31,5 bar) Low Pressure (9 bar)	4420 4421	4420 4421

Document no.: DM1014
Revision: D
Originator: TOP
Date: 20.09.19

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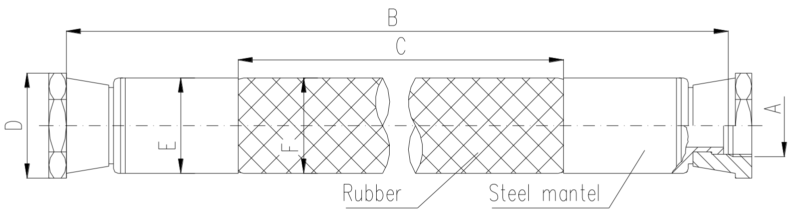
Datasheet

Flexible hoses

(1)

(2)



A (inch)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	Opening of the spanner (mm)	Minimum bending radius (mm)	Sperre part no. (1)	Sperre part no. w/ one end flange (2) PN40
½”	600	500	ø31	ø25	ø22	27	180	4595	4666 (DN15)
¾”	600	470	ø38	ø33	ø29	33	240	4596	4667 (DN20)
1”	800	670	ø43	ø38	ø38	38	300	4597	4668 (DN25)
1 ¼”	800	600	ø57	ø50	ø50	50	420	4598	4669 (DN32)
1 ½”	800	600	ø70	ø57	ø54	60	500	4599	4687 (DN40)
2”	800	580	ø80	ø70	ø66	70	635	4601	

Hose construction :

Tube : Oil resistant synthetic rubber
Reinforcement : Two high tensile steel wire braids
Cover : Abrasion and weather resistant synthetic rubber
Temperatur range : - 40°C to + 100°C
Flexible hoses acc. to SAE 100 R2
Max. working press. 80 to 400 bar (Size dependent)

Document no.: DM1013	Originator:	TOP	**©Sperre Industri AS**	Ellingsøyvegen 740
Revision: B	Date:	08.06.18	www.sperre.com	N-6057 Ellingsøy
			Tel. +47 70 16 11 00	Norway

Datasheet

Oil types & recommendations for Sperre Piston Compressors

Only fully synthetic ISO Viscosity Grade 68-100 piston compressor oils are to be used in **X-range and Classic A type** compressors.
All compressors are tested and delivered with Mobil Rarus 827.
Our air compressors are mechanically not a challenge to lubricates and most synthetic oils can be used without problems.
High temperatures create formations of carbon deposits in the air coolers and valves that can result in problems if the oil is not of good quality.
Compressors are working in different environments around the world with temperature differences exceeding 50 degrees Celsius leaving us with the following advice. Always use a high quality fully synthetic oil with ISO grade 68-100 as listed Below.

Technical department
Sperre Industri AS
industri@sperre.com

SYNTHETIC OIL

SHELL CORENA S4P 100
MOBIL RARUS 827
BP ENERSYN RX 100
CASTROL AIRCOL SN 100
COSMO RECIPRO SX 100
DAPHNE MARINE COMPR. 100
ESSO / EXXON ZERICE S 100
CHEVRON CETUS DE 100
NIPPON OIL CO. FAIRCOL SA 100
STATOIL FRIDGEWAY S 100
CORENA S4 P100
TOTAL LUBMARINE BARELF CH 100
AGIP DICREA ESX 100
GULFSEA DE COMPRESSOR OIL 100
LUKOIL NAVISYN DE 100
LUKOIL RENOLIN SE 100

Document no.: DM1019 Originator: TOP
Revision: C Date: 03.08.2020
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6. Cooling Water System

6.1 System overview

Only treated fresh water containing approved corrosion inhibitors may be circulated through the engines. It is important that water of acceptable quality and approved corrosion inhibitors are used directly when the system is filled after completed installation.

The lay-out of the cooling water system is shown in the drawing "*recommended cooling water system*". If cooling water components are included in our scope of supply they are listed in section "*Component data, Wärtsilä scope of supply*".

6.1.1 Engine internal system

The cooling water system consists of a high temperature (HT) and a low temperature (LT) circuit, both cooled by treated fresh water. The HT-circuit is cooling the jackets and cylinder heads and the LT-circuit is cooling the charge air and lubricating oil.

The following equipment is built on the engine (Wärtsilä 8L26):

- engine driven HT circulating pump with non-return valve
- stand-by pump connection for the HT engine driven circulating pump
- HT thermostatic valve of self actuating type for controlling the outlet temperature from the engine
- charge air cooler
- engine driven LT circulating pump with non-return valve
- stand-by pump connection for the LT engine driven circulating pump

The arrangement of the built-on system is shown in the drawing "*internal system*".

6.2 System design data

6.2.1 Raw water quality

Raw water quality to be used in the closed cooling water circuits of engines has to meet the following specification.

Table 6-1 Raw water specification

Property	Unit	Limits for chemical use	Test method ref.
pH 1)	-	6.5...8.5	ASTM D 1287 or D 1293
Hardness	°dH	max. 10	ASTM D 1126
Chlorides 1)	mg/l	max. 80	ASTM D 512 or D 4327
Sulphates	mg/l	max. 150	ASTM D 516 or D 4327

Use of raw water produced with an evaporator as well as a good quality tap water will normally ensure that an acceptable raw water quality requirement is fulfilled, but e.g. sea water and rain water are unsuitable raw water qualities.

1) If a Reverse Osmosis (RO) process is used, min. limit for pH is 6.0 based on the RO process operational principle. The use of water originating from RO process further presumes that a max. content of 80 mg/l for chloride content is achieved.

6.2.2 Cooling water treatment

Table 6-2 Validated cooling water additives

Manufacturer	Additive name	Additive type
Alm International S.A.	Diaprosim RD11 (RD11M)	Sodium nitrite + borate
S.A. Arteco N.V.	Havoline XLI	Organic Acid Technology
Drew Marine	Liquidewt Maxigard	Sodium nitrite + borate Sodium nitrite + borate
Chevron (Texaco + Caltex)	Havoline XLI XL Corrosion Inhibitor Concentrate	Organic Acid Technology Organic Acid Technology
GE Water and Process	CorrShield NT 4293 CorrShield NT 4200	Sodium nitrite + borate Sodium nitrite + borate
Korves Oy	Pekar J	Organic Acid Technology
Kuwait Petroleum (Danmark) AS	Q8 Corrosion Inhibitor Long-Life	Organic Acid Technology
Marine Care B.V.	Caretreat 2 Diesel	Sodium nitrite + borate
Maritech AB	Marisol CW	Sodium nitrite + borate
Nalco Chemical Company	TRAC102 TRAC118	Sodium nitrite + borate Sodium nitrite + borate
Solenis	Drewgard 4109	Sodium nitrite + borate
Total	WT Supra	Organic Acid Technology
Vecom Marine Alliance B.V.	Cool Treat NCLT	Sodium nitrite + borate
Wilhelmsen Chemicals AS	Dieselguard NB Rocor NB liquid Cooltreat AL Engine Water Treatment 9-108 Nalfleet 2000	Sodium nitrite + borate Sodium nitrite + borate Organic Acid Technology Sodium nitrite + borate Sodium nitrite + borate

In order to prevent corrosion in the cooling water system, the instructions of right dosage and concentration of active corrosion inhibitors should always be followed. The information can be found in the table below.

Table 6-3 Dosage instructions

Product designation	Dosage per 1 m³ of system capacity		Concentration of active corrosion inhibitor
Diaprosim RD11 (RD11M)	5	kg	1250 ppm as NO_2
XL Corrosion Inhibitor Concentrate	50...100	litres	1.8...3.7 Brix° of active compounds measured with a supplier's refractometer
Drewgard 4109	16...30	litres	640...1200 ppm as NO_2

Product designation	Dosage per 1 m³ of system capacity		Concentration of active corrosion inhibitor
Liquidewt Maxigard	8...12 16...30	litres litres	470...700 ppm as NO_2 640...1200 ppm as NO_2
Havoline XLI	50...100	litres	1.8...3.7 Brix° of active compounds measured with a supplier’s refractometer
Corrshield NT 4293 CorrShield NT 4200	10 10	litres litres	670...1000 ppm as NO_2 670...1000 ppm as NO_2
Pekar J	20	litres	30 ppm as Mo
Q8 Corrosion Inhibitor Long-Life	50...100	litres	1.8...3.7 Brix° of active compounds measured with a supplier’s refractometer
Caretreat 2 Diesel	6...10	litres	1500...2500 ppm as NO_2
Marisol CW	6...9	litres	1000...1500 ppm as NO_2
TRAC102 TRAC118	32...48 2.25...3.4	litres litres	1000...1500 ppm as NO_2 670...1000 ppm as NO_2
WT Supra	50...100	litres	1.8...3.7 Brix° of active compounds measured with a supplier’s refractometer
Cool Treat NCLT	6...10	litres	1500...2500 ppm as NO_2
Dieselguard NB Rocor NB Liquid Cooltreat AL Engine Water Treatment 9-108 Nalfleet 2000	2.0...4.8 9.5...24 50...100 2.25...3.4 32...48	kg litres litres litres litres	1000...2400 ppm as NO_2 1000...2400 ppm as NO_2 1.8...3.7 Brix° of active compounds measured with a supplier’s refractometer 670...1000 ppm as NO_2 1000...1500 ppm as NO_2

Note 1 For many products the recommended minimum and maximum limits are listed in the table above. Since the amount of active corrosion inhibitors, especially nitrites, is decreasing during the service of engines, the engine manufacturer recommends to start the dosage from the upper level of indicated range.

Note 2 The nitrite content of nitrite-based cooling water additives tends to decrease in use. The risk of local corrosion increases substantially when nitrite content goes below the recommended limit.

Note 3 Cooling water additive manufacturers can indicate the required nitrite content measured either as sodium nitrite, $NaNO_2$ or as nitrite, NO_2. 1 mg/l as NO_2 equals to 1.5 mg/l as $NaNO_2$.

Note 4 Nitrite based cooling water additives are not offering a good protection against corrosion for aluminium and its alloys and thus the use of such products can’t recommended for cooling systems containing those construction materials.

Note 5 Different cooling water additives shall not be mixed with each other, but if it is desired to start to use another cooling water additive, the one being used shall be drained from the system before filling another product. If the cooling water system is dirty, it shall be flushed with good quality water or if needed use additional chemicals to remove possible deposits, like grease, oil, rust, etc. Though many cooling water additives are chemically compatible with each other, these can contain e.g. polymers which can loosen existing deposits from the cooling water system. When the loose deposits become suspended in the cooling water, they can attach to engine component surfaces, e.g. cylinder head and will then cause detrimental effects in terms of heat transfer decline, clogging of small diameter water channels and deposit formation leading to local overheating and corrosion.

6.2.2.1 Glycol

Use of glycol in the cooling water is not recommended unless it is absolutely necessary. Starting from 20% glycol the engine is to be de-rated 0.23 % per 1% glycol in the water. Max. 50% glycol is permitted.

Corrosion inhibitors shall be used regardless of glycol in the cooling water.

6.3 Recommended functions

The following functions are not included in Wärtsilä scope of supply. We recommend you to design these functions as follows.

6.3.1 Central cooler (4E08)

The fresh water cooler can be of either tube or plate type. Due to the smaller dimensions the plate cooler is normally used. The fresh water cooler can be common for several engines, also one independent cooler per engine is used.

Design data:	
Heat to be dissipated/engine	see "*Technical data*" and drawing "*Recommended cooling water system*"
Fresh water flow/engine	see "*Technical data*" and drawing "*Recommended cooling water system*"
Pressure drop on the FW side, max.	60 kPa (0.6 bar)
FW temp. after cooler, max	38 °C
Sea water flow	acc. to makers standard, normally 1.2...1.5 x FW flow
Pressure drop on the SW side, norm	80...140 kPa (0.8...1.4 bar)
Margin for fouling and safety, min	15%

6.3.2 Preheating unit (4N01)

Engines started and stopped on heavy fuel and all engines on which high load will be applied immediately after start (stand-by generating sets) have to be preheated as close to the actual operating temperature as possible, or minimum 60°C. Preheating is however, recommended for all engines, also engines running on MDF only.

The energy required for heating of the HT-cooling water in the main and auxiliary engines can be taken from a running engine or a separate source. In both cases a separate circulating pump should be used to ensure the circulation. If the cooling water systems of the main and auxiliary engines are separated from each other in other respects, the energy is recommended to be transmitted through heat exchangers.

For installations with several engines in a common system where at least one engine is running all the time, the preheater unit can be chosen for heating up one engine. The heat from a running engine can be used and therefore the power consumption of the heater will be less than the nominal capacity.

If all engines are stopped and have to be ready for start, e.g. if shaft generator, the preheating capacity has to be dimensioned for all engines in stand-by.

6.3.2.1 Heater, preheating unit (4E05)

Steam, electrical or thermal oil heaters can be used.

Design data:	
Preheating temperature, min	60°C
Required heating power to warm up engine from 20°C to 60°C in 10...15 hours	3 kW/cyl
Capacity to keep hot engine warm	1.5 kW/cyl
Engine coefficient	0.75 kW
Capacity needed for heating up engine to min. preheating temperature:	

$$P = \frac{(T_1 - T_0)(m_{eng} \times 0.14 + V_{LO} \times 0.48 + V_{FW} \times 1.16)}{t} + k_{eng} \times n_{cyl}$$

where:	
$P =$	Preheater output [kW]
$T_1 =$	Min. preheating temperature [°C]
$T_0 =$	Ambient temperature [°C]
$m_{eng} =$	Engine weight [ton]
$V_{LO} =$	Lubricating oil volume [m^3]
$V_{FW} =$	HT water volume [m^3]
$t =$	Preheating time [h]
$k_{eng} =$	Engine coefficient [kW]
$n_{cyl} =$	Number of cylinders

The formula above should not be used for P < 2.5 kW/cyl.

6.3.2.2 Circulating pump, preheating unit (4P04)

Design data:	
Capacity	0.45 m^3/h per cyl
Delivery pressure	80...100 kPa (0.8...1.0 bar)

6.3.3 Expansion tank (4T05)

The expansion tank compensates for thermal expansion of the coolant, serves for venting of the circuits and provides a sufficient static pressure for the circulating pumps.

Design data:	
Pressure from the expansion tank at pump inlet	70 - 150 kPa (0.7...1.5 bar)
Volume	min. 10% of the system

Concerning the water volume in the engine, see *Technical data*.

The expansion tank should be equipped with an inspection hatch, a level gauge, a low level alarm and necessary means for dosing of cooling water additives.

The vent pipes should enter in the top of the tank and continue below the water level. The vent pipes must be drawn separately to the tank (see section *Air venting and air separator (4S01)*) and the pipes should be provided with labels at the expansion tank.

The balance pipe down from the expansion tank must be dimensioned for a flow velocity not exceeding 1.0...1.5 m/s in order to ensure the required pressure at the pump inlet with engines running. The flow through the pipe depends on the number of vent pipes to the tank and the size of the orifices in the vent pipes. The table below can be used for guidance

Table 6-4 Minimum diameter of balance pipe

Nominal pipe size	Max. flow velocity (m/s)	Max. number of vent pipes with ø5 mm orifice
DN 32	1.1	3
DN 40	1.2	6
DN 50	1.3	10
DN 65	1.4	17
DN 80	1.5	28

6.3.4 Drain tank (4T04)

It is recommended to provide a drain tank to which the engines and coolers can be drained for maintenance so that the water and cooling water treatment can be collected and reused. For the water volume in the engine, see the section for Technical data (HT-circuit).

Most of the cooling water in the engine can be recovered from the HT-circuit, whereas the amount of water on the LT side is small.

Condense water drain pipes from several engines shall not be connected before drain tank because of risk to get reverse flow into a stopped engine.

6.3.5 Air venting and air separator (4S01)

Air may be entrained in the system after an overhaul, or a leak may continuously add air or gas into the system. The engine is equipped with vent pipes to evacuate air from the cooling water circuits. The vent pipes should be drawn separately to the expansion tank from each connection on the engine.

Vent pipes to the expansion tank are to be installed at all high points in the piping system, where air or gas can accumulate. The vent pipes must be continuously rising.

As indicated in drawing "Recommended cooling water system", it is strongly recommended to install efficient air separators in addition to the vent pipes from the engine to ensure fast evacuation of entrained air.

6.3.6 Orifices

An orifice must be mounted in each cooling water circuit branch to be able to correctly balance the flow. An orifice shall also be installed in each venting pipe directed to the expansion tank.

When a thermostatic valve is used to bypass a cooler, an orifice should be mounted in the bypass line so that the valve "sees" equal back pressures in the cooler and the bypass line.

6.4 Component data, Wärtsilä scope of supply

6.4.1 Preheating unit (4N01)

Quantity 1

Type .... KVE 30kW

Pressure, max. (kPa) 100

Temperature Max (°C) 95

Dimensional drawing .... 33968_KVE8-30

6.4.2 HT valve(4V01)

Quantity 1

Tag number VCL900-V06

Type 33BOCB17501-00-AZA

Model .... Amot/ Mechanical

Flow, max. (m^3/h) 46.0

Pressure, max. (kPa) 600.0

Pressure drop (kPa) 50.0

Connection (DN) 10

Dimensional drawing B/SK3189/1

6.4.3 LT valve(4V03)

Quantity 1

Tag number VCL900-V02

Type 33BOCB09001-00-AZA

Model .... Amot / Mechanical

Flow, max. (m^3/h) 46.0

Pressure, max. (kPa) 600.0

Pressure drop (kPa) 50.0

Connection (DN) 10

Dimensional drawing B/SK3189/1

6.4.4 Temperature control valve (LT) (4V03)

Quantity 1

Type 04GGSDBS32EABCA-AA

Model .... Electrical

Flow, max. (m^3/h) 113.0

Pressure, max. (kPa) 1000.0

Pressure drop (kPa) 30.0

Connection (DN) 100

Dimensional drawing .... 04GGS_1

Additional drawing .... Technical data_04GGS_100V_mA

6.4.5 Dyno cooler (4E08b)

Quantity 1

Dimensional drawing TL10-BFG

6.4.6 1-Circuit radiator(4E08a)

Quantity 3

Type FBLGC-1000-12-5E8-96DN80S6

Capacity (kW) 1400

Pressure drop (bar) 0.65

Air Inlet Temperature (°C) 30.0

Air Massflow (kg/s) 84

Max working pressure (bar) 6

Test Pressure (bar) 9

Connection (DN) 80

Dimensional drawing 190201THI1

6.4.7 Dyno pump (4P15)

Quantity 1

Type 3GBP 132 260-BFK

Voltage 600

Frequency 60

Rated output (kW) 5.5

Flow (m^3/h) 67

Impeller diameter (mm) 285

6.4.8 Radiator Circulation Pump (4P15)

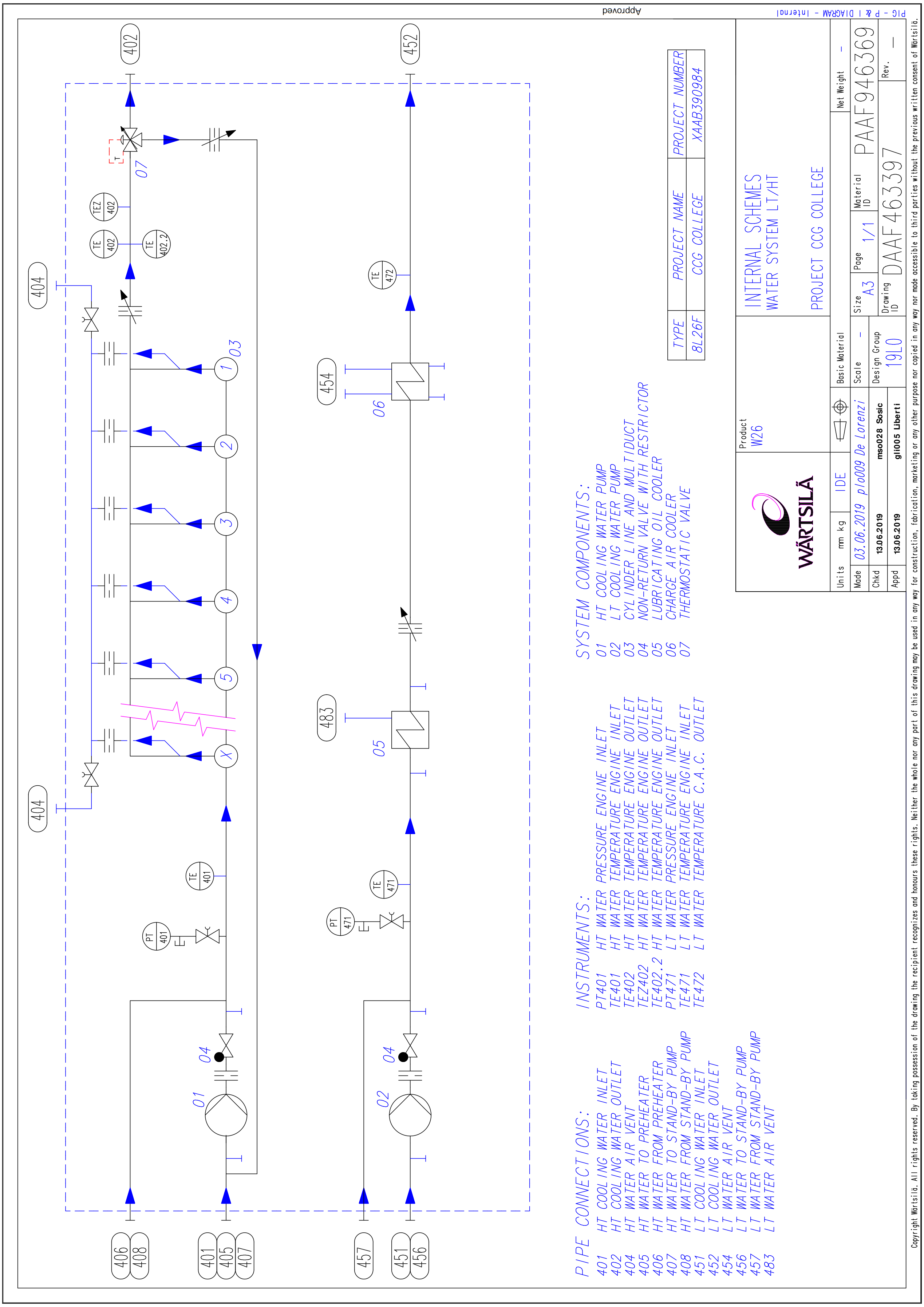
Quantity 1

Type 3GBP 182 410-BEK

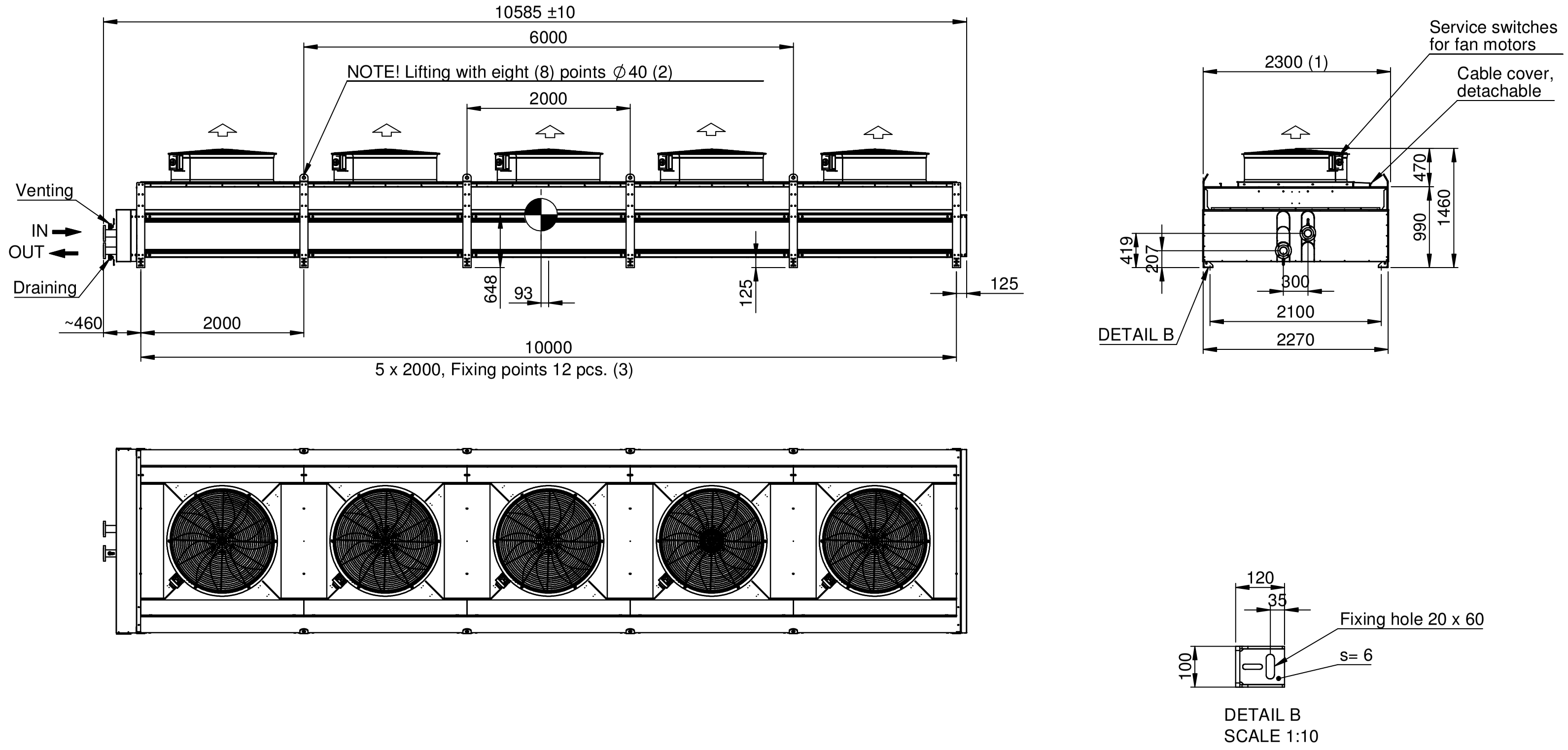
Voltage 600

Frequency	60
Rated output (kW)	18.5
Flow (m^3/h)	140
Impeller diameter (mm)	240

6.5 List of Documents


PIPE CONNECTIONS:
401 HT COOLING WATER INLET
402 HT COOLING WATER OUTLET
404 HT WATER AIR VENT
405 HT WATER TO PREHEATER
406 HT WATER FROM PREHEATER
407 HT WATER TO STAND-BY PUMP
408 HT WATER FROM STAND-BY PUMP
451 LT COOLING WATER INLET
452 LT COOLING WATER OUTLET
454 LT WATER AIR VENT
456 LT WATER TO STAND-BY PUMP
457 LT WATER FROM STAND-BY PUMP
483 LT WATER AIR VENT
INSTRUMENTS:
PT401 HT WATER PRESSURE ENGINE INLET
TE401 HT WATER TEMPERATURE ENGINE INLET
TE402 HT WATER TEMPERATURE ENGINE OUTLET
TEZ402 HT WATER TEMPERATURE ENGINE OUTLET
TE402.2 HT WATER TEMPERATURE ENGINE OUTLET
PT471 LT WATER PRESSURE ENGINE INLET
TE471 LT WATER TEMPERATURE ENGINE INLET
TE472 LT WATER TEMPERATURE C.A.C. OUTLET
SYSTEM COMPONENTS:
01 HT COOLING WATER PUMP
02 LT COOLING WATER PUMP
03 CYLINDER LINE AND MULTIDUCT
04 NON-RETURN VALVE WITH RESTRICTOR
05 LUBRICATING OIL COOLER
06 CHARGE AIR COOLER
07 THERMOSTATIC VALVE
TYPE 8L26F
PROJECT NAME CCG COLLEGE
PROJECT NUMBER XAAB390984
INTERNAL SCHEMES WATER SYSTEM LT/HT
PROJECT CCG COLLEGE
Product W26
WÄRTSILÄ
Units mm kg
Made 03.06.2019 pl0009 De Lorenzi
Chkd 13.06.2019 mso028 Sosic
Appd 13.06.2019 gli005 Liberti
Scale -
Size A3
Page 1/1
Design Group 19L0
Drawing ID DAAF463397
Material ID PAAF946369
Rev. -
Net Weight -
PIG - P & I DIAGRAM - Internal
Approved
Copyright Wärtsilä. All rights reserved. By taking possession of the drawing the recipient recognizes and honours these rights. Neither the whole nor any part of this drawing may be used in any way for construction, fabrication, marketing or any other purpose nor copied in any way nor made accessible to third parties without the previous written consent of Wärtsilä.

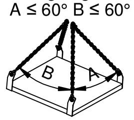
Flange tightening torque DN80/AN3: 18.9 MB0 (Nm)
- Use std washers (DIN125) both in the bolt and nut side !
- The tightening of bolts in three steps (30%, 50% and 100%)
- Ensure torques within 24 hours, when the unit is taken into operation
- Otherwise follow the general rules for flange tightening



1) Total width with bold heads.
2) See manual for instruction on lifting.
3) All fixing points to be tightened firmly.

Casing material	Hot dip galvanized and zinc-coated sheet steel
Coil material	Cu-tubes / Al-fins
Fin spacing	2,5 mm
Motors	5 x 8,6 kW 870 rpm 13,3 A (nominal values)
Electrical network	3/600 V 60 Hz
Fan size	Ø1240 mm
Internal volume	520 L
Net weight	3500 kg
Max working / Test pressure	6 / 9 bar (g)
Connection size	ANSI 3", ASTM A182 F304/304L
Venting / draining	Ball valve G 1/2", ASTM A351 CF8M

Lifting angles:
A ≤ 60° B ≤ 60°



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REV	Date	Modifications	Revisor	Approved by
00	08.10.2020	First emission	P. Mattila	U. Martins

ALFA LU-VE alfa.luvegroup.com	Drawn by: P. Mattila	Date: 01.10.2020	Approved by: U. Martins	Date: 8.10.2020	Treatment
Scale 1:50	Format A3	Wärtsilä Finland Oy, Service S/18147.M - CCG College	6030827_10223960	Weight: .	Dimensions: mm

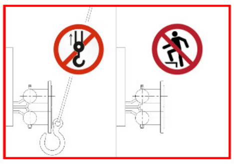
FBLGC-1000-12-5E8-96AN3S6 — 3 pcs radiators / engine. Total 3 pcs.
1 - CIRCUIT RADIATOR — Dimension drawing
Tolerance class M EN 22768-1 22768-2
Assosiated / References to
Replaces
Article number 10223960 REV -00

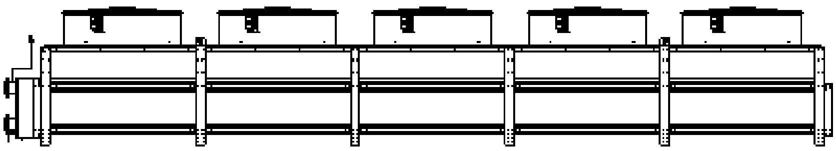
D. Installation Instructions FBL

1. General

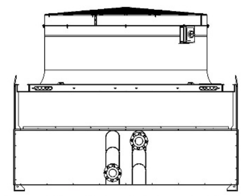
Before starting installation see “Residual risks” in this instruction manual.

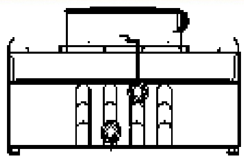
During installation, appropriate personal protection equipment (PPE) shall be worn.
The customer is responsible for the use of the most suitable PPE.
Installation shall be carried out by qualified personnel.





- Check possible transport damages before installation. The supplier is not responsible for the costs caused by broken equipment as a result of faulty handling or transport damage.
- Check dimensions from dimension drawing.
- Install radiators so that tubes of the heat transfer section are in horizontal position.
- Use all fixing points. If base or concrete is not even (max 2 mm variation between fixing points next to each other), use filling under leg.
- Oval shaped fixing holes in the short legs allow heat expansion (look at the dimension drawing). Use fixing that allows movement to lengthwise direction.
- Trouble free operation of radiators demands good air venting in the system.
- Drain the water circulated radiators or use non- freezing liquid in the temperatures under 0°C.
- Standard model radiators do not feature gravity draining.





2. Transport and Storage

- Transport the radiators in a horizontal position (without legs).
- Use support under every leg or every leg fixing beam when storing at site (max 10 mm variation between legs next to each other).
- Long storage may cause damage to motor bearings. Look at the chapter D 3.c

NOTE!
Long storage may cause damage to motor bearings. Look at the chapter D 3.c

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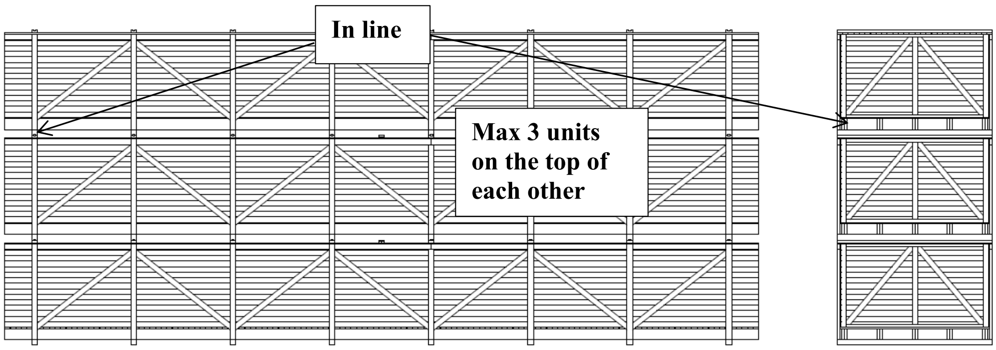
Long-term storage of radiators:

a) In seaworthy packages

A seaworthy package protects best the radiator during long-term storage. If possible, keep the packages in dry room with even temperature. If the radiator is kept outdoors take care that there is no snow etc. on the package to avoid impressions, water-logging or decay, and to prevent water running into the package. Also take care that the vent holes of the package are clean to enable inside moisture evaporation. If there is moisture between the radiator and the plastic cover, some white rust will form on the hot dip galvanized surfaces. Often this is an aesthetical harm only.



WARNING!

To avoid falling of a seaworthy package

- Max 3 unit on top of each other.
- The packages must be placed in line.
- Store packages always in flat straight area.

More detailed instructions about seaworthy packing handling are in the separate instruction included to delivery list (Appendix 1).

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b) Unpacked

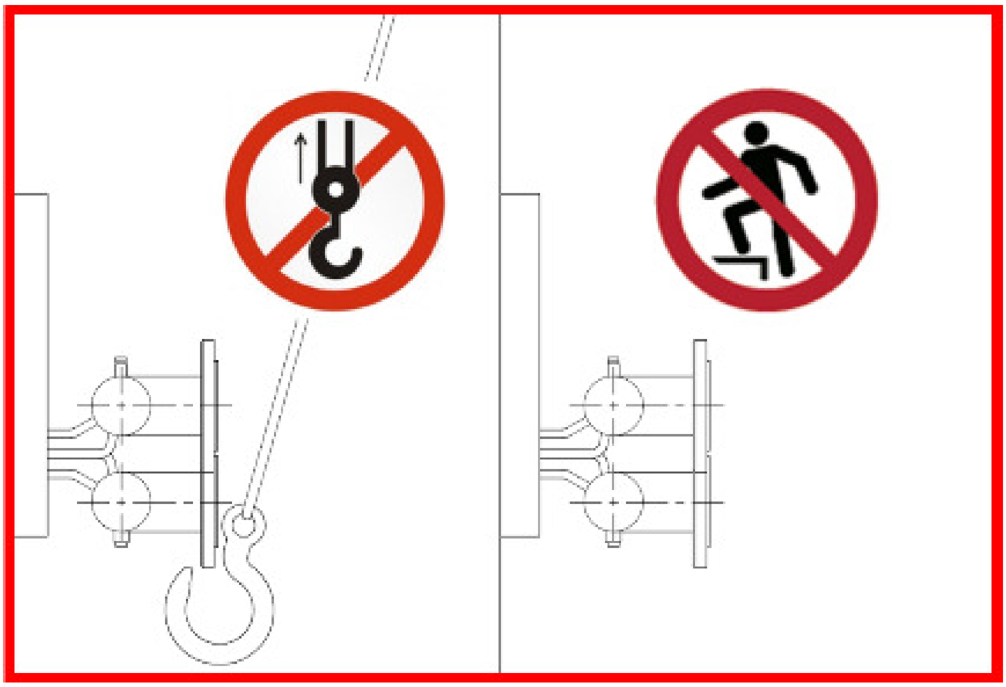
The units shall be stored in dry spaces with even temperature.
If units are stored in humid outdoor spaces, where water may condensate inside their fan motors, it can cause corrosion and damages of fan motors (functional problem). In humid conditions, where the unit will not keep dry, some "white rust" can exist on the unit surface (visual harm).

During long term storage in humid outdoor space, to protect fan motors, they must be driven for at least 3-4 hours once a month or a continuous low voltage must be lead into the fan motors to keep their surface temperature higher than the air dew point temperature.

WARNING!
Before lifting please check from the transport documents or from the product nameplate the unit weight and make sure that the lifting device, crane or truck are appropriate.

1. Attach belts or hooks, only to the equipment is equipped with
2. Be sure that the belts or slings with hooks will lift the equipment in balanced way

Do not stay under the unit being hanged!



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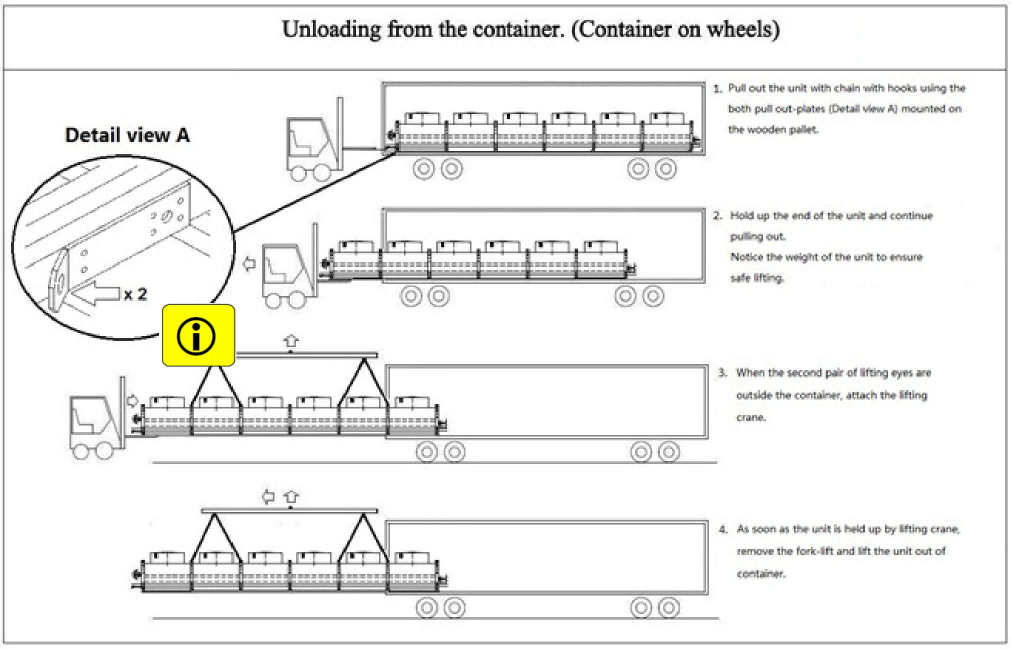
3. Unloading from the container

WARNING!
Before lifting please check from the transport documents or from the product nameplate the unit weight and make sure that the lifting device, crane or truck are appropriate.

1. Attach belts or hooks, only to the equipment is equipped with
2. Be sure that the belts or slings with hooks will lift the equipment in balanced way

Do not stay under the unit being hanged!

3.1 Container on wheels



1. Open the container and double check. Damages should be claimed immediately to the transportation company in writing in the Delivery Note before being signed. Please check also that nothing is missing. In case of damages, please take photos.
2. Pull out radiator with a fork-lift. Please note: attach cargo straps to the wooden pallet under the radiator.

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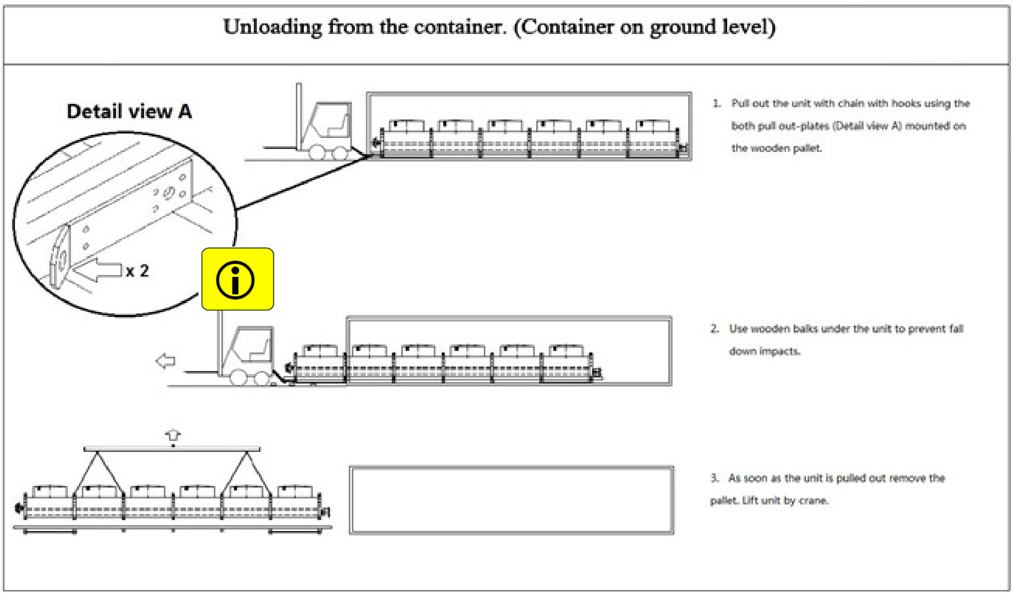
3. Hold up the end of the radiator and continue pulling out. Please pay attention to the weight of the radiator to ensure safe lifting procedure.
4. When the second pair of lifting points is outside the container, attach the crane.
5. As soon as the unit is held up by crane, remove the fork-lift and lift out the radiator.

3.2 Container on ground level



1. Open the container and double check. Damages should be claimed immediately to the transportation company in writing in the Delivery Note before being signed. Please check also that nothing is missing. In case of damages, please take photos.
2. Pull out radiator with a fork-lift. Please note: attach cargo straps to the wooden pallet under the radiator.
3. Use wooden support balks under the unit to prevent fall down impacts.
4. As soon as the unit is pulled out remove the palette and lift the unit by crane.

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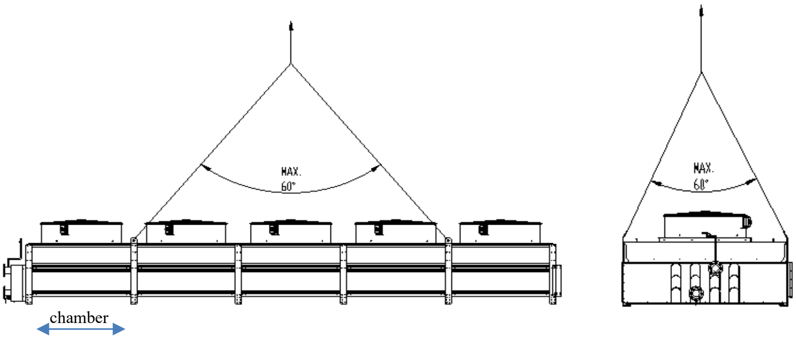
4. Lifting

WARNING!
Before lifting please check from the transport documents or from the product nameplate the unit weight and make sure that the lifting device, crane or truck are appropriate.

1. Attach belts or hooks, only to the equipment is equipped with
2. Be sure that the belts or slings with hooks will lift the equipment in balanced way

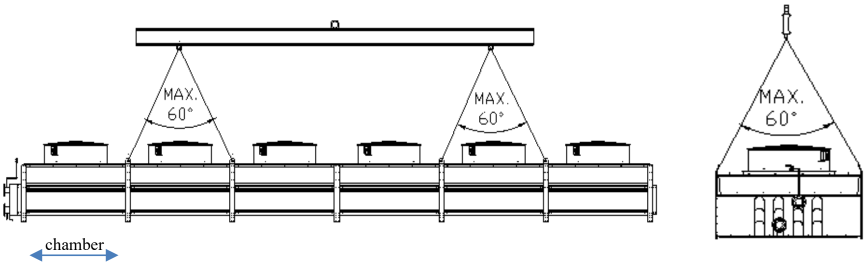
Do not stay under the unit being hanged!

4.1 Radiators with 1.2 m fans ≤ 4 chambers (with 4 lifting points)



- Use lifting lugs for lifting the radiators. Use a lifting device long enough and a beam so that lifting angles are not exceeded. The minimum length of a lifting chain, when no lifting beam is used= distance of lifting points. See order specific dimensional drawing for details.

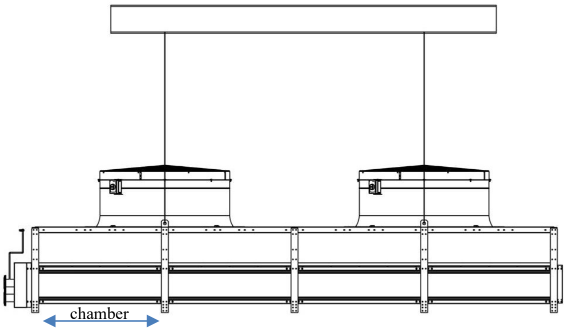
4.2 Radiators with 1.2 m fans > 5 chambers (with 8 lifting points)



- Use lifting lugs for lifting the radiators. Use a lifting device long enough and a beam so that lifting angles are not exceeded. The minimum length of a lifting chain, when no lifting beam is used= distance of lifting points. See order specific dimensional drawing for details.

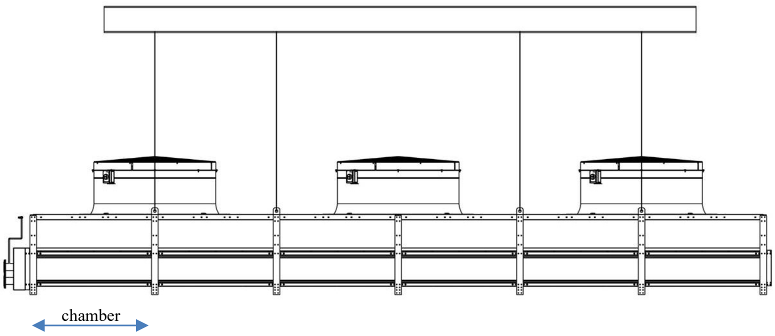
D. Installation Instructions FBL

4.3 Radiators with 1,8 m fans, max number of chamber ≤ 4 (with 4 lifting points)



- Use lifting lugs for lifting the radiators. Use a lifting device long enough. Use straight beams for lifting. If the amount of lifting lugs exceeds 4, follow 4.4 guideline. See order specific dimensional drawing for details.

4.4 Radiators with 1,8 m fans, max number of chamber > 4 (with 8 lifting points)



- Use lifting lugs for lifting the radiators. Use a lifting device long enough. Use straight beams for lifting. See order specific dimensional drawing for details.

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5. Pipe Connections

	WARNING! In operation the heat transfer section and pipe temperatures exceed 45ºC. Contact may cause burns. Use hand protection.
	WARNING! Breaks in pressure pipes or components may cause injuries. Do not exceed the unit design pressure. Only perform maintenance work on pressurized parts when the unit is empty
	WARNING! Fluid recovery and filling of the units may be performed by an authorized contractor only. Follow fluid suppliers instructions to prevent injuries and damages to environment and property.

Mount external tube lines so that their weight or heat expansion or vibration will not strain the tubes of the heat transfer section. Ensure allowable external moments and forces for inlet and outlet connections. You can use flexible couplings to ensure this. Alfa LU-VE can offer flexible joint solution See chapter: Expansion Joints (optional).

6. Tightening Torques

Size	Torque (Nm)
M6	*9.5*
M8	*20.0*
M10	*30.0*
M12	*50.0*
M16	*120*

The recommended torque for tightening the bolts is presented in the table D.1. All bolts used are grade 8.8 according to ISO 898-1. Do not use other type of bolts. For motors and related components follow torques presented in the separate motor manual. **For bolts fastening impeller to motor shaft the max 50 Nm torque must use!**

Table D.1 Tightening tongues for bolts grade 8.8 (ISO 898-1)

7. Electric Connections

	WARNING! The electric connections may be performed by an authorized electrician only.

- Motors are wired to service switches, which can be locked.

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- If separately specified, motors can be wired to a junction box at the radiator end.
- Connections to service switch with and without anticondensate heaters are shown in figures D.8 and D.9 below (standard units with 1.2 m and 1.8 m fans).

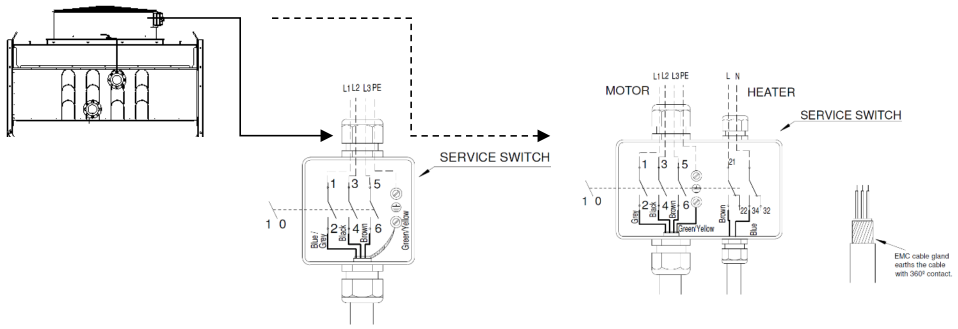

Figure D.8: Service switch (SW) cable connections with 1.2 m fans Fans´ inner connection works as follows: When phases L1, L2 and L3 are connected to SW (junction box), the airflow direction is same as shown in the dimension drawing. Normal fan rotating direction is **counter clockwise**.

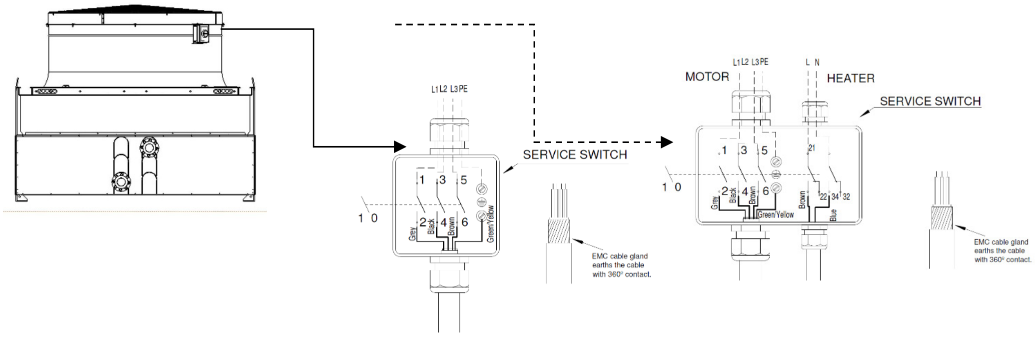

Figure D.9: Service switch (SW) cable connections with 1.8 m fans Fans´ inner connection works as follows: When phases L1, L2 and L3 are connected to SW (junction box), the airflow direction is same as shown in the dimension drawing. Normal fan rotating direction is **clockwise**.

When using frequency converter with the fan motors, make sure that the recommended cable lengths are not exceeded and the fan motors are sufficiently protected.

8. Grounding

Radiator is grounded by the earth wires of motors. It's possible to earth the unit also through the leg.

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9. Checking

The equipment has been pressure-tested and the motors test-run at factory.

- Check possible transport damages before installation.
- Check that the fans start properly and their rotation direction is correct.
- Check that the airflow direction is in accordance with dimension drawing.
- Pressure test the tube connections. Use non-freezing liquid in temperatures under 0°C.

NOTE!
Ensure that possible installed fan transportation fixing belts and weather covers are removed before the first startup.

It is possible that the whole system (a radiator, a base and fixing flexibility) has natural frequency somewhere in operational speed range. If you use frequency converter for fan speed control, it is recommended to check critical frequencies and possible vibration peaks before start up. These frequencies can be avoided by using frequency by-pass.

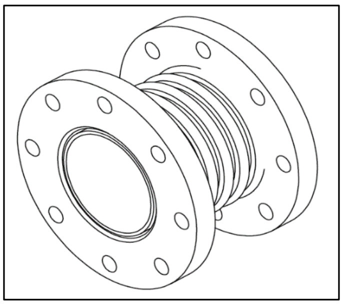
10. Mounting Legs and Handrails (optional)

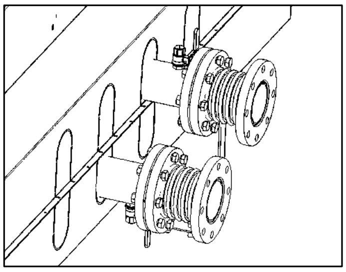
See separate instructions for installing FBL Mounting legs and Handrails.

11. Expansion Joints (optional)

Benefits of using stainless steel expansion joints:

- Reduce harmful loads from piping to flange connection / manifolds of coolers
- Compensate heat expansion movements
- Reduce possible vibrations of piping
- Gives flexibility and more tolerances for installation
- Wider temperature range up to +125 °C
- Excellent corrosion resistance in different climates





Size	Item Id.	Size	Item Id.
DN65	9460080147	ANSI 2½	9460080145
DN80	9460080148	ANSI 3”	9460080146
DN100	9460080149	ANSI 4”	9460065882
DN125	9460080143	ANSI 5”	9460065883

Table D.2 Available expansion joint sizes

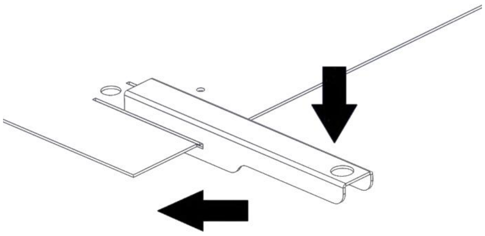
D. Installation Instructions FBL

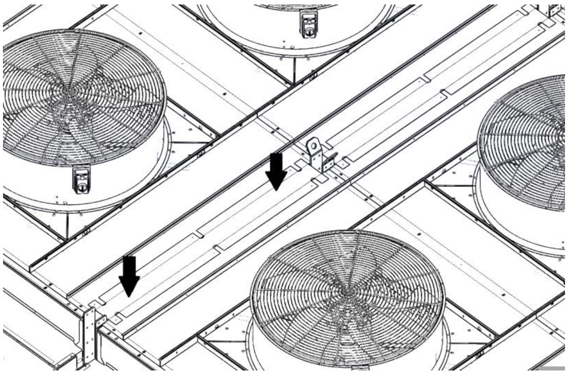
12. Cover plates between radiators (optional)

	WARNING! Sharp edges, use protection glasses, safety gloves, shoes and clothes!

NOTE!
If cover plates are painted, handle painted plates with care without scratching the painted surfaces!

- If multiple unit delivery includes cover plates, follow these instructions to cover gap between the radiators. Delivery includes a bend tool and drilling screws for cover plates.
- Before mounting cover plates bend the edges as shown in the picture left below with bending tool.
- Picture right above shows how cover plates between radiators are mounted. Mount with 6 drilling screw / cover plate.

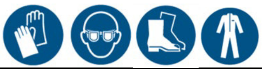




D. Installation Instructions FBL

13. Cable covers (optional)

WARNING!
Sharp edges, use protection glasses, safety gloves, shoes and clothes!



NOTE!
Painted cable cover plates are not mounted; handle painted plates with care without scratching the painted surfaces!

Radiator cable covers are already mounted on their places between deck plate bendings, as shown in the below.

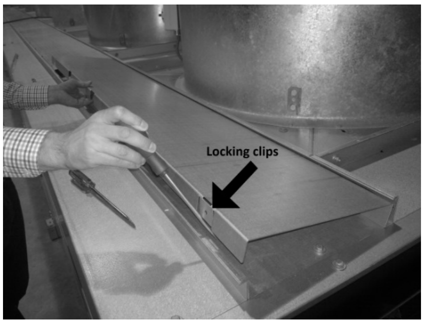
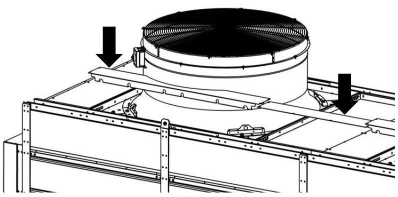


Figure: For units with 1.2 m fans: Before wiring the radiator, cable cover plates need to be removed. Loosen the locking bend using 2 screwdrivers as shown on the left picture. When mounting the cable covers, make sure the cover plate is under the edge of deck plate. Make sure the cable cover bending clips around the rivets.



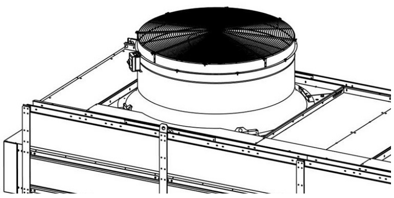


Figure: For units with 1.8 m fans: Before wiring the radiator, cable cover plates need to be removed. Open M8 hex-screws with tool. Remove cable covers. Install cables through plastic cable glands installed to casing and screw cover plates again to its positions.

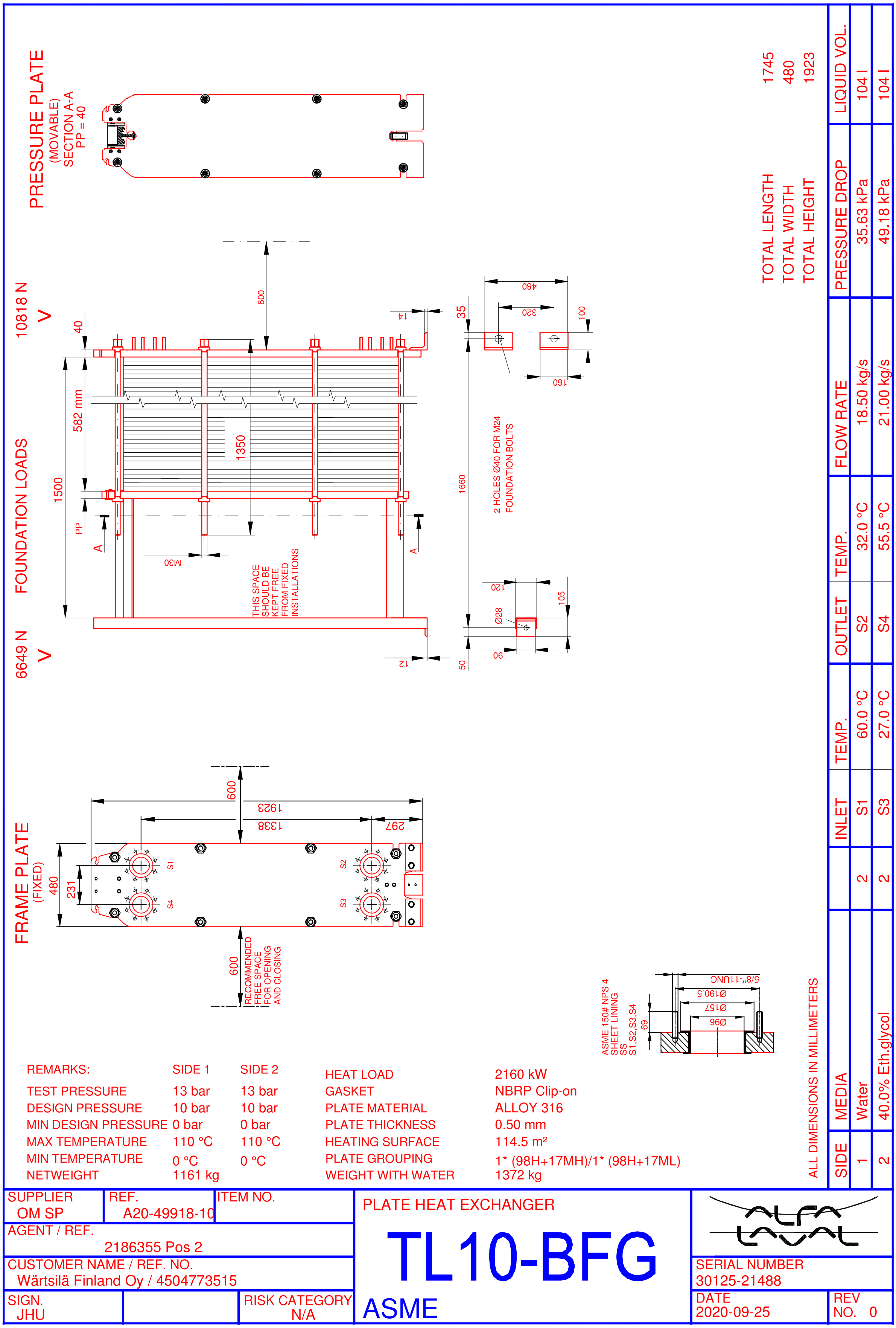

PRESSURE PLATE
(MOVABLE)
SECTION A-A
PP = 40
FOUNDATION LOADS
10818 N
6649 N
FRAME PLATE
(FIXED)
TOTAL LENGTH 1745
TOTAL WIDTH 480
TOTAL HEIGHT 1923
THIS SPACE SHOULD BE KEPT FREE FROM FIXED INSTALLATIONS
2 HOLES Ø40 FOR M24 FOUNDATION BOLTS
RECOMMENDED FREE SPACE FOR OPENING AND CLOSING
ASME 150# NPS 4 SHEET LINING SS S1,S2,S3,S4
ALL DIMENSIONS IN MILLIMETERS
SIDE | MEDIA | INLET | TEMP. | OUTLET | TEMP. | FLOW RATE | PRESSURE DROP | LIQUID VOL.
1 | Water | 2 | S1 | 60.0 °C | S2 | 32.0 °C | 18.50 kg/s | 35.63 kPa | 104 l
2 | 40.0% Eth.glycol | 2 | S3 | 27.0 °C | S4 | 55.5 °C | 21.00 kg/s | 49.18 kPa | 104 l
REMARKS: SIDE 1 SIDE 2
TEST PRESSURE 13 bar 13 bar
DESIGN PRESSURE 10 bar 10 bar
MIN DESIGN PRESSURE 0 bar 0 bar
MAX TEMPERATURE 110 °C 110 °C
MIN TEMPERATURE 0 °C 0 °C
NETWEIGHT 1161 kg
HEAT LOAD 2160 kW
GASKET NBRP Clip-on
PLATE MATERIAL ALLOY 316
PLATE THICKNESS 0.50 mm
HEATING SURFACE 114.5 m²
PLATE GROUPING 1* (98H+17MH)/1* (98H+17ML)
WEIGHT WITH WATER 1372 kg
SUPPLIER OM SP
REF. A20-49918-10
ITEM NO.
AGENT / REF. 2186355 Pos 2
CUSTOMER NAME / REF. NO. Wärtsilä Finland Oy / 4504773515
SIGN. JHU
RISK CATEGORY N/A
PLATE HEAT EXCHANGER
TL10-BFG
ASME
SERIAL NUMBER 30125-21488
DATE 2020-09-25
REV NO. 0

Plate Heat Exchanger

Technical specification

Customer : **Wärtsilä Finland Oy**
Model : **TL10-BFG**
Project: :
Item : **CAN - VCL900-B010** **Date** : **22-10-2019**

		Hot side	**Cold side**
Fluid		Water	40.0% Eth.glycol
Density	kg/m³	988.3	1049
Specific heat capacity	kJ/(kg*K)	4.17	3.61
Thermal conductivity	W/(m*K)	0.638	0.451
Viscosity inlet	cP	0.466	2.41
Viscosity outlet	cP	0.767	1.20
Mass flow rate	kg/s	18.50	21.00
Inlet temperature	°C	60.0	27.0
Outlet temperature	°C	32.0	55.5
Pressure drop	kPa	36.4	49.8
Heat Exchanged	kW	2160	
L.M.T.D.	K	4.7	
O.H.T.C clean conditions	W/(m²*K)	4564	
O.H.T.C service	W/(m²*K)	3803	
Heat transfer area	m²	120.0	
Effective duty margin	%	20.0	
Relative directions of fluids		Countercurrent	
Nozzle orientation		S1 -> S2	S4 <- S3
Connections S1, S2, S3, S4:		Flange ASME B16.5 150# NPS 4, lining SS	
No. of plates		242	
Plate material/ Thickness		ALLOY 316 0.50 mm	
Sealing material		NBRP Clip-on	NBRP Clip-on
Pressure vessel code		PED, Category 0	
Fluid danger group		No Danger	No Danger
Has risky vapour pressure		No	No
Design pressure	bar	6.0	6.0
Test pressure	bar	8.6	8.6
Design temperature	°C	110.0	110.0
Overall length x width x height	mm	1745 x 480 x 1923	
Liquid volume	dm³	108.60	109.50
Net weight, empty / operating/ Flooded	kg	1190 / 1410 / 1410	
Packed weight	kg	1224	
Type of package		SKID BASE LYING	
volume	m³	2.6	
length x width x height	mm	2100 x 635 x 1950	

The performance of the equipment is conditioned by the process media and process parameters being consistent with the provided customer data.

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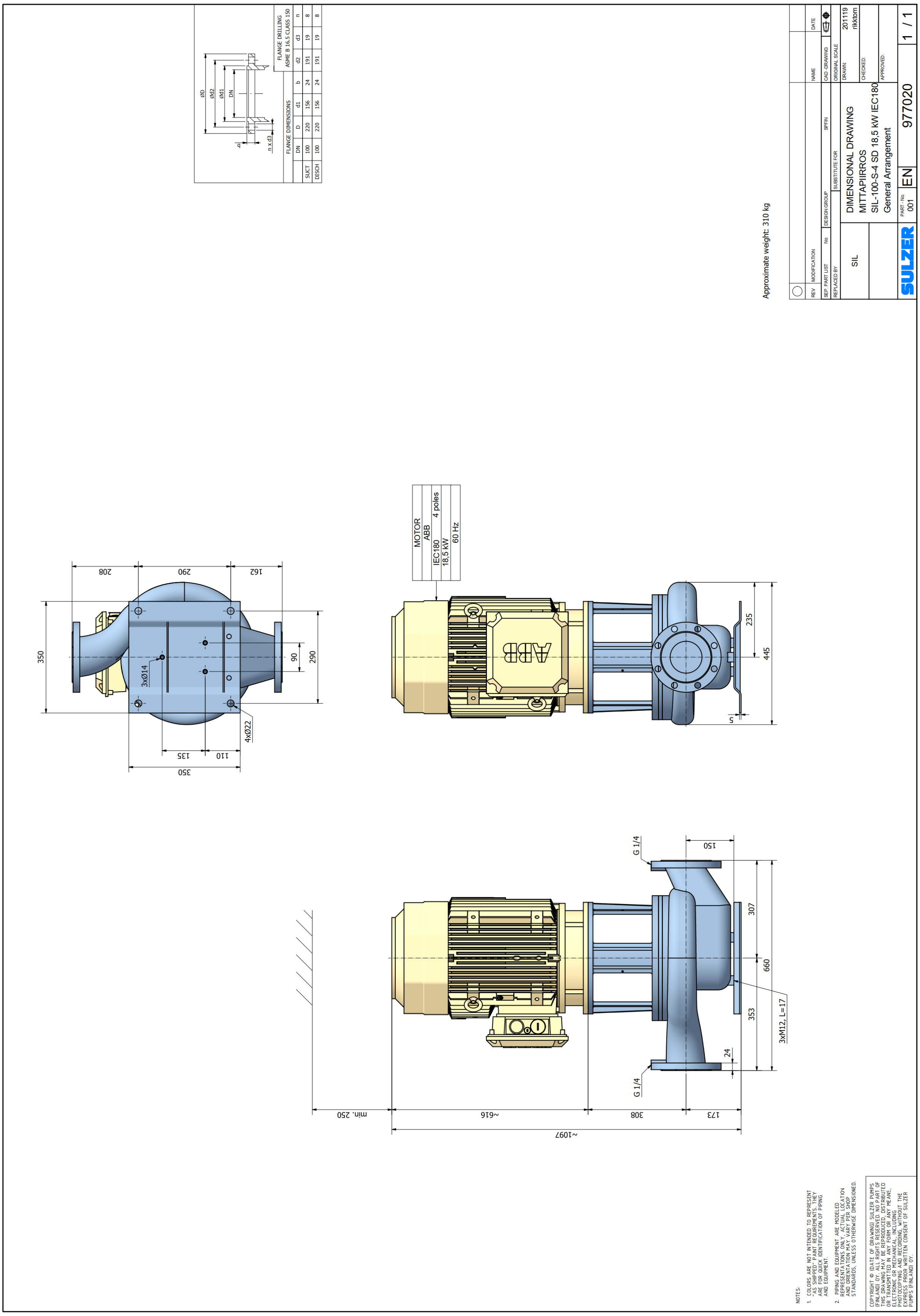
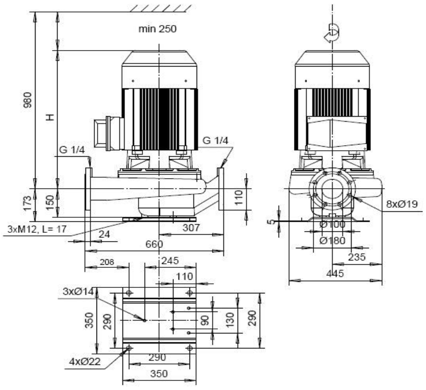
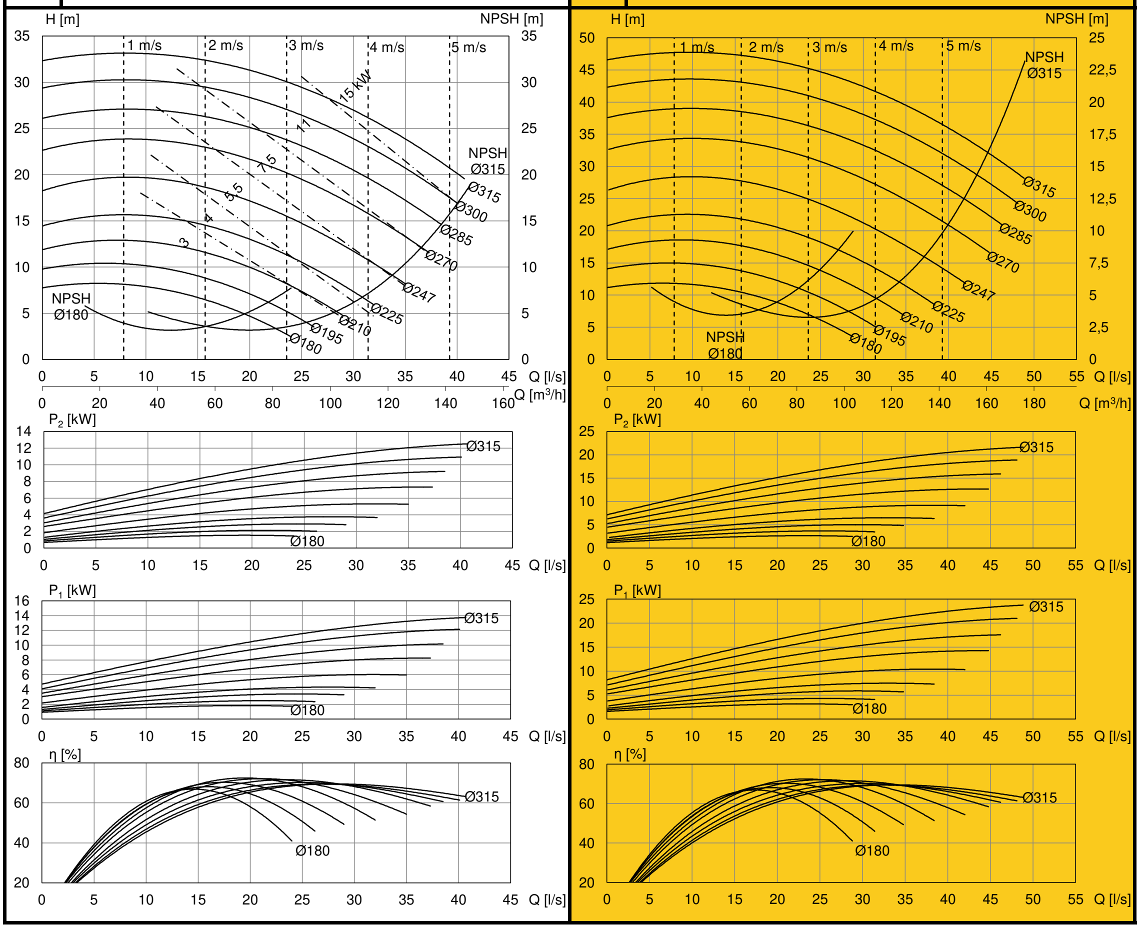

Approximate weight: 310 kg
DIMENSIONAL DRAWING
MITTAPIIRROS
SIL-100-S-4 SD 18,5 kW IEC180
General Arrangement
SIL
SULZER
PART - No.
001
EN
977020
1 / 1
DRAWN:
201119
rikktom
CHECKED:
APPROVED:
MOTOR
ABB
IEC180
4 poles
18,5 kW
60 Hz
FLANGE DIMENSIONS
FLANGE DRILLING
ASME B 16.5 CLASS 150
3xØ14
4xØ22
G 1/4
3xM12, L=17
min. 250
~616
~1097

SIL-100-S-4 **SILH-100-S-4** **SILP-100-S-4**



	Motor 400V	P_{2N} [kW]	I_N [A]	[kg]	H [mm]
50Hz	KH-112 E2 F31	3	6,25	140	440
	KH-132 C2 F31	4	8,13	165	510
	KH-132 E2 F31	5,5	10,95	175	510
	KP-134 H2 F31	7,5	14,58	203	610
	KP-166 G2 F31	11	22,51	260	700
	KP-166 G2 F31	15	28,86	265	700
60Hz	Motor ~~380-400V(460-480V)~~	P_{2N} [kW]	I_N [A]	[kg]	H [mm]
	KH-112 E2 F31	3 (3,6)	6,15 (6,25)	140	440
	KH-132 C2 F31	4 (4,8)	8,17 (8,30)	165	510
	KH-132 E2 F31	~~5,5 (6,6)~~	~~11,00 (11,15)~~	175	510
	KP-134 H2 F31	7,5 (9)	14,23 (15,21)	203	610
	KP-166 G2 F31	11 (13)	22,32 (22,78)	260	700
	KP-166 G2 F31	15 (18)	28,06 (29,43)	265	700
	KP-187 K2 BF31	18,5 (22)	34,2 (34,7)	330	780
	KP-187 K2 BF32	22 (26)	39,4 (40,3)	335	780

50 Hz	1500r/min	DN 100	60 Hz	1800r/min	DN 100



Subject to change without prior notice 22.11.2015

SIL Inline Single Stage Centrifugal Pumps

Products and operation fulfill versatile international standards and directives

	Standard	Description
Legislation	Directive 2006/42/EC	Machinery directive
	Directive 93/68/EEC	CE Marking
	Directive 2009/125/ EU Regulation 547/2012 prEN16480	Eco-design requirements for water pumps Implementing eco-design requirements for water pumps Pumps – Minimum required efficiency of rotodynamic water pumps
Product safety	EN 809:1998 + A1:2009	Pumps and pump units for liquids - Common safety requirements
	EN ISO 12100-2010	Safety of machinery - General principles for design. Risk assessment and risk reduction.
Quality system	EN ISO 9001:2008	Quality management systems. Requirements.
Environmental system	EN ISO 14001:2004	Environmental management systems - Requirements with guidance for use
Design	EN ISO 5199:2002	Technical specifications for centrifugal pumps - Class II

ABB Motors and Generators	Technical Data Sheet - DOL			
	Project **Wärtsilä Kanada**		Location	
Department/Author **Antti Uusitalo**	Customer name **Sulzer Pumps Finland Oy**		Customer ref.	Item name **3**
Our ref. **CQ410699**	Rev/Changed by **A**	Date of issue **1.11.2019**	Saving ident **untitled.xls**	Pages **1(3)**

No.	Definition	Data	Unit	Remarks	
1	Product	***TEFC, 3-phase, squirrel cage induction motor***			
2	Product code	***3GBP 132 260-BFK***		Calc. ref.	3GZF021013-308
3	Type/Frame	***M3BP 132SMF 4***			
4	Mounting	***IM3011, V1(flange)***			
5	Rated output P_N	***5,5***	kW		
6	Service factor	***1***			
7	Type of duty	***S1(IEC) 100%***			
8	Rated voltage U_N	***600***	VY	± 5 % (IEC 60034-1)	
9	Rated frequency f_N	***60***	Hz	± 2 % (IEC 60034-1)	
10	Rated speed n_N	***1770***	r/min		
11	Rated current I_N	***7,4***	A		
12	No-load current	***3,4***	A		
13	Starting current I_s/I_N	***8,9***		Meet IEC 60034-12, N,(H at 60 Hz)	
14	Nominal torque T_N	***29,7***	Nm		
15	Locked rotor torque T_S/T_N	***2,9***			
16	Maximum torque T_{max}/T_N	***4,3***			
17	Minimum torque T_{min}/T_N	***2,2***			
18	Speed at minimum torque	***0***	r/min		
	Load characteristics (IEC 60034-2-1:2014)	Load %	Current A	Efficiency %	Power factor
19	PLL determined from residual loss	*100*	**7,4**	**91,9 / IE3**	**0,78**
20		*75*	**6,1**	**91,9**	**0,71**
21		*50*	**5,0**	**90,8**	**0,58**
22		*Start*	**66**		**0,41**
23	Maximum starting time from hot	***6***	s		
24	Maximum starting time from cold	***10***	s		
25	Insulation class / Temperature class	***F / B***			
26	Ambient temperature	***40***	°C		
27	Altitude	***1000***	m.a.s.l.		
28	Enclosure	***IP55***			
29	Cooling system	***IC411 self ventilated***			
30	Bearing DE/NDE	***6208-2Z/C3 - 6208-2Z/C3***			
31	Type of Grease				
32	Sound pressure level (LP dB(A) 1m)	***70***	dB(A)	at load	
33	Moment of inertia J = ¼ GD2	***0,0401***	kg-m2		
34	Balancing				
35	Vibration class				
36	Position of terminal box	***Top***			
37	Terminal box entries; no, dimens.				
38	Number of power terminals				
39	Direction of rotation	***CW or CCW***			
40	Weight of rotor	***21***	kg		
41	Total weight of motor	***81***	kg		
42	Dimension drawing no.				
43	Winding insulation	***Special***			
44		***Stamped from: 575 V - 60 Hz***			
45					
Ex-motors					
46					
47					
48					
Option	Variant Codes / Definition				
49	+066 Modified for non-standard mounting position				
50	+405 Special winding insulation for frequency converter supply, Calc. ref. in datasheet is for std.				
51	+002 Restamping voltage, frequency and output, continuous duty				
52					

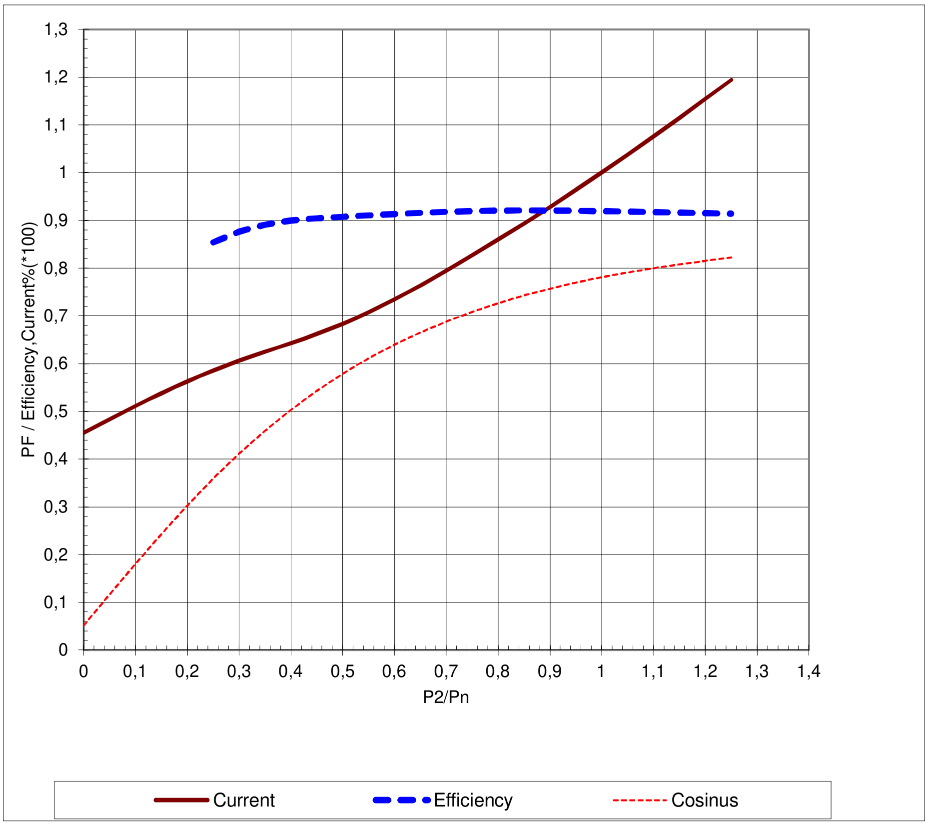
Remarks:

Data based on situation 26.5.2017
All data subject to tolerances in accordance with IEC
Guaranteed values on request

ABB Motors and Generators	Load Curves			
	Project **Wärtsilä Kanada**		Location	
Department/Author **Antti Uusitalo**	Customer name **Sulzer Pumps Finland Oy**		Customer ref.	Item name **3**
Our ref. **CQ410699**	Rev/Changed by **A**	Date of issue **1.11.2019**	Saving ident **untitled.xls**	Pages **2(3)**

Product	**TEFC, 3-phase, squirrel cage induction motor**			
Type/Frame	**M3BP 132SMF 4**		Calc. ref.	**3GZF021013-308**
Product code	**3GBP 132 260-BFK**			
Rated output P_N	**5,5**	kW		
Type of duty	**S1(IEC) 100%**			

Voltage (V)	**600**	Current I_N (A)	**7,4**	Power factor at P_N	**0,78**
Frequency (Hz)	**60**	Speed (r/min)	**1770**	Efficiency (%) at P_N	**91,9**



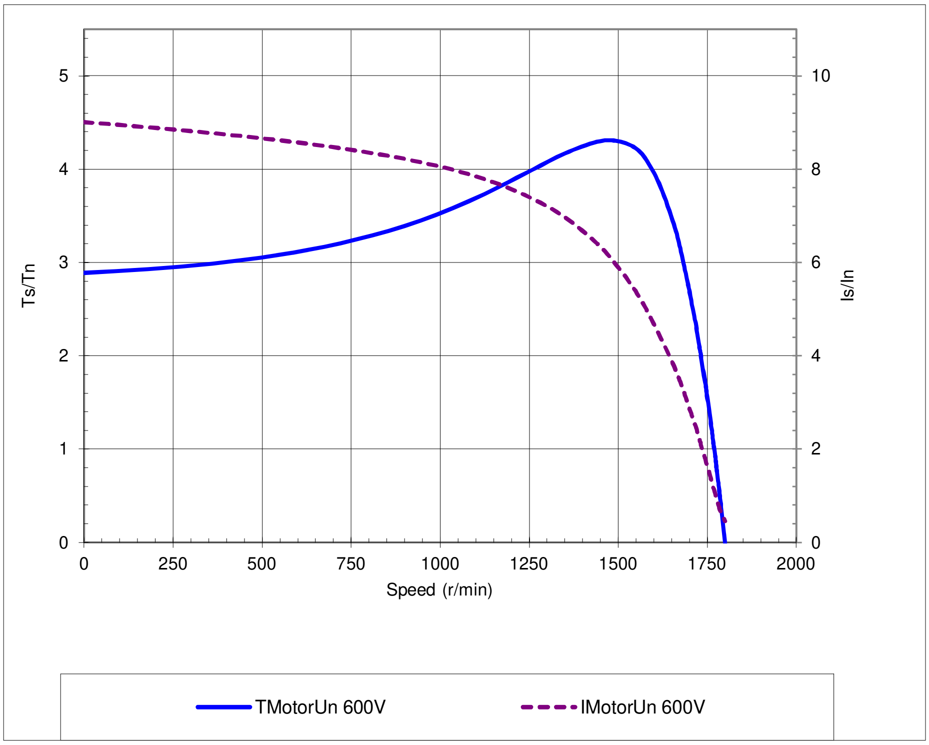
Load characteristics (IEC 60034-2-1:2014)
Data based on situation 26.5.2017

All data subject to tolerances in accordance with IEC

ABB Motors and Generators	**Starting Curves**		ABB
	Project **Wärtsilä Kanada**	Location	
Department/Author **Antti Uusitalo**	Customer name **Sulzer Pumps Finland Oy**	Customer ref.	Item name **3**
Our ref. **CQ410699**	Rev/Changed b Date of issue **A 1.11.2019**	Saving ident **untitled.xls**	Pages **3(3)**

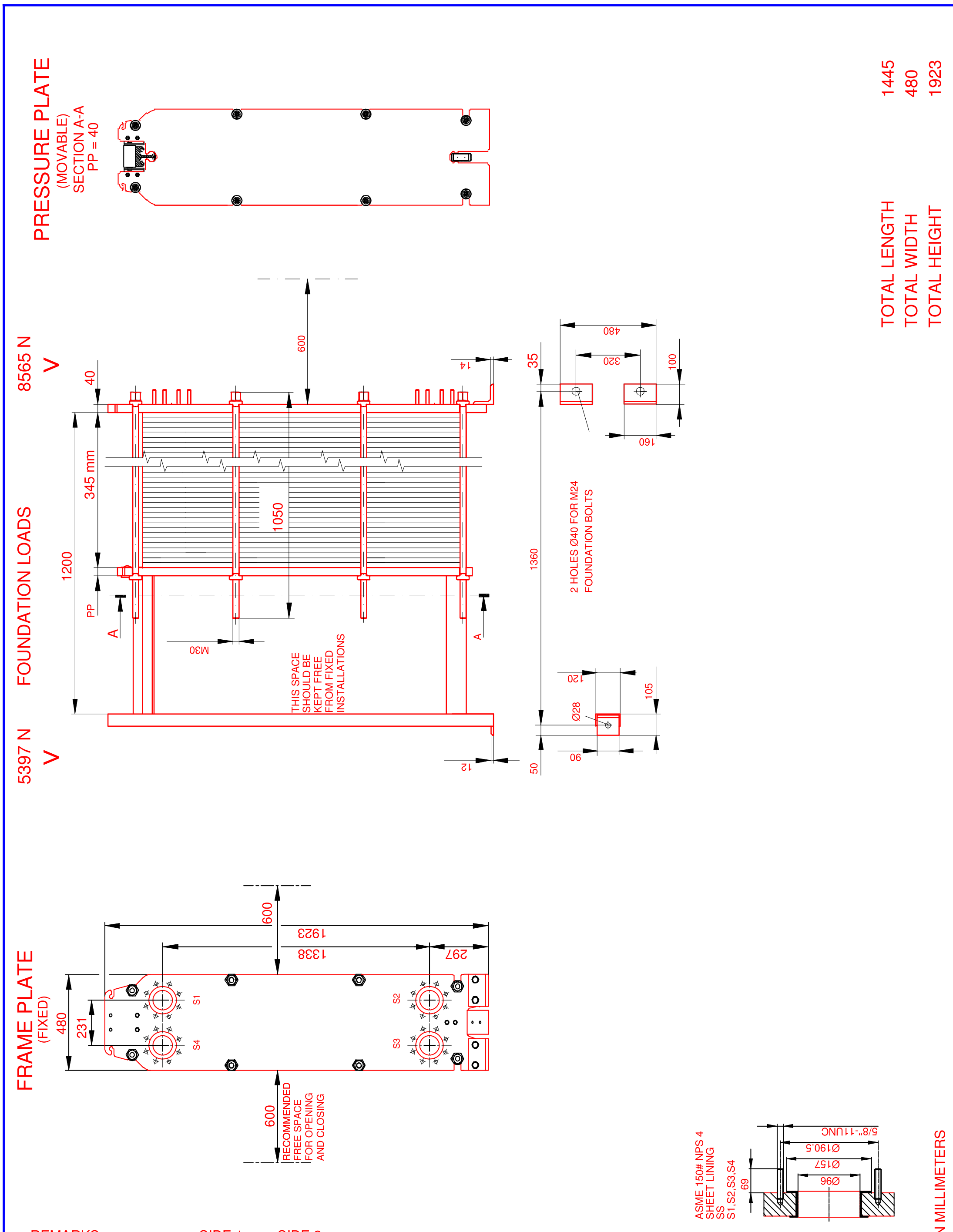
Type of product	**TEFC, 3-phase, squirrel cage induction motor**				
Type/Frame	**M3BP 132SMF 4**		Calc. ref.	3GZF021013-308	
Product code	**3GBP 132 260-BFK**		Frequency (Hz)	**60**	
Rated output P_N	**5,5**	kW	Rated current I_N	**7,4**	A
Type of duty	**S1(IEC) 100%**				

J_{motor} (kgm2)	**0,0401**	Voltage (V) 100%	***600***	Voltage (V)	***600V(100%)***
J_{load} (kgm2)		T_{start}/T_N	***2,9***	T_{start}/T_N	
Speed (r/min)	**1769**	Starting time (s)	***0,1***	Starting time (s)	
T_N (Nm)	**29,7**	Speed (r/min)		Speed (r/min)	
T_{load} (Nm)		I_s/I_n	***8,9***	I_s/I_n	
Nbr. of Consecutive Sta	**Hot: 110 Cold: 199**	T_{max}/T_n	***4,3***	T_{max}/T_n	



Load characteristics (IEC 60034-2-1:2014)
Data based on situation 26.5.2017

All data subject to tolerances in accordance with IEC



SIDE	MEDIA		INLET	TEMP.	OUTLET	TEMP.	FLOW RATE	PRESSURE DROP	LIQUID VOL.
1	Water	2	S1	60.0 °C	S2	32.6 °C	15.60 kg/s	28.53 kPa	61,8 l
2	40.0% Eth.glycol	2	S3	27.0 °C	S4	51.9 °C	19.90 kg/s	49.46 kPa	61,8 l

REMARKS:	SIDE 1	SIDE 2
TEST PRESSURE	13 bar	13 bar
DESIGN PRESSURE	10 bar	10 bar
MIN DESIGN PRESSURE	0 bar	0 bar
MAX TEMPERATURE	110 °C	110 °C
MIN TEMPERATURE	0 °C	0 °C
NETWEIGHT	927 kg	

HEAT LOAD	1786 kW
GASKET	NBRP Clip-on
PLATE MATERIAL	ALLOY 316
PLATE THICKNESS	0.50 mm
HEATING SURFACE	67.5 m²
PLATE GROUPING	1* (41ML+27L)/1* (41MH+27L)
WEIGHT WITH WATER	1051 kg

SUPPLIER OM SP	REF. A20-49917-10	ITEM NO.	PLATE HEAT EXCHANGER
AGENT / REF. 2186355 Pos 1			**TL10-BFG**
CUSTOMER NAME / REF. NO. Wärtsilä Finland Oy / 4504773515			SERIAL NUMBER 30125-21487
SIGN. JHU		RISK CATEGORY N/A	ASME
DATE 2020-09-24	REV NO. 0		

Plate Heat Exchanger

Technical specification

Customer : **Wärtsilä Finland Oy**
Model : **TL10-BFG**
Project: :
Item : **CAN - VCL900-B009** **Date** : **22-10-2019**

		Hot side	Cold side
Fluid		Water	40.0% Eth.glycol
Density	kg/m³	988.8	1050
Specific heat capacity	kJ/(kg*K)	4.17	3.60
Thermal conductivity	W/(m*K)	0.636	0.451
Viscosity inlet	cP	0.465	2.41
Viscosity outlet	cP	0.758	1.30
Mass flow rate	kg/s	15.60	19.90
Inlet temperature	°C	60.0	27.0
Outlet temperature	°C	32.6	51.9
Pressure drop	kPa	28.5	49.5
Heat Exchanged	kW	1786	
L.M.T.D.	K	6.8	
O.H.T.C clean conditions	W/(m²*K)	4501	
O.H.T.C service	W/(m²*K)	3914	
Heat transfer area	m²	67.5	
Effective duty margin	%	15.0	
Relative directions of fluids		Countercurrent	
Nozzle orientation		S1 -> S2	S4 <- S3
Connections S1, S2, S3, S4:		Flange ASME B16.5 150# NPS 4, lining SS	
No. of plates		137	
Plate material/ Thickness		ALLOY 316 0.50 mm	
Sealing material		NBRP Clip-on	NBRP Clip-on
Pressure vessel code		PED, Category 0	
Fluid danger group		No Danger	No Danger
Has risky vapour pressure		No	No
Design pressure	bar	6.0	6.0
Test pressure	bar	8.6	8.6
Design temperature	°C	110.0	110.0
Overall length x width x height	mm	1445 x 480 x 1923	
Liquid volume	dm³	61.80	61.80
Net weight, empty / operating/ Flooded	kg	927 / 1050 / 1050	
Packed weight	kg	965	
Type of package		SKID BASE LYING	
volume	m³	2.2	
length x width x height	mm	2100 x 635 x 1650	

The performance of the equipment is conditioned by the process media and process parameters being consistent with the provided customer data.

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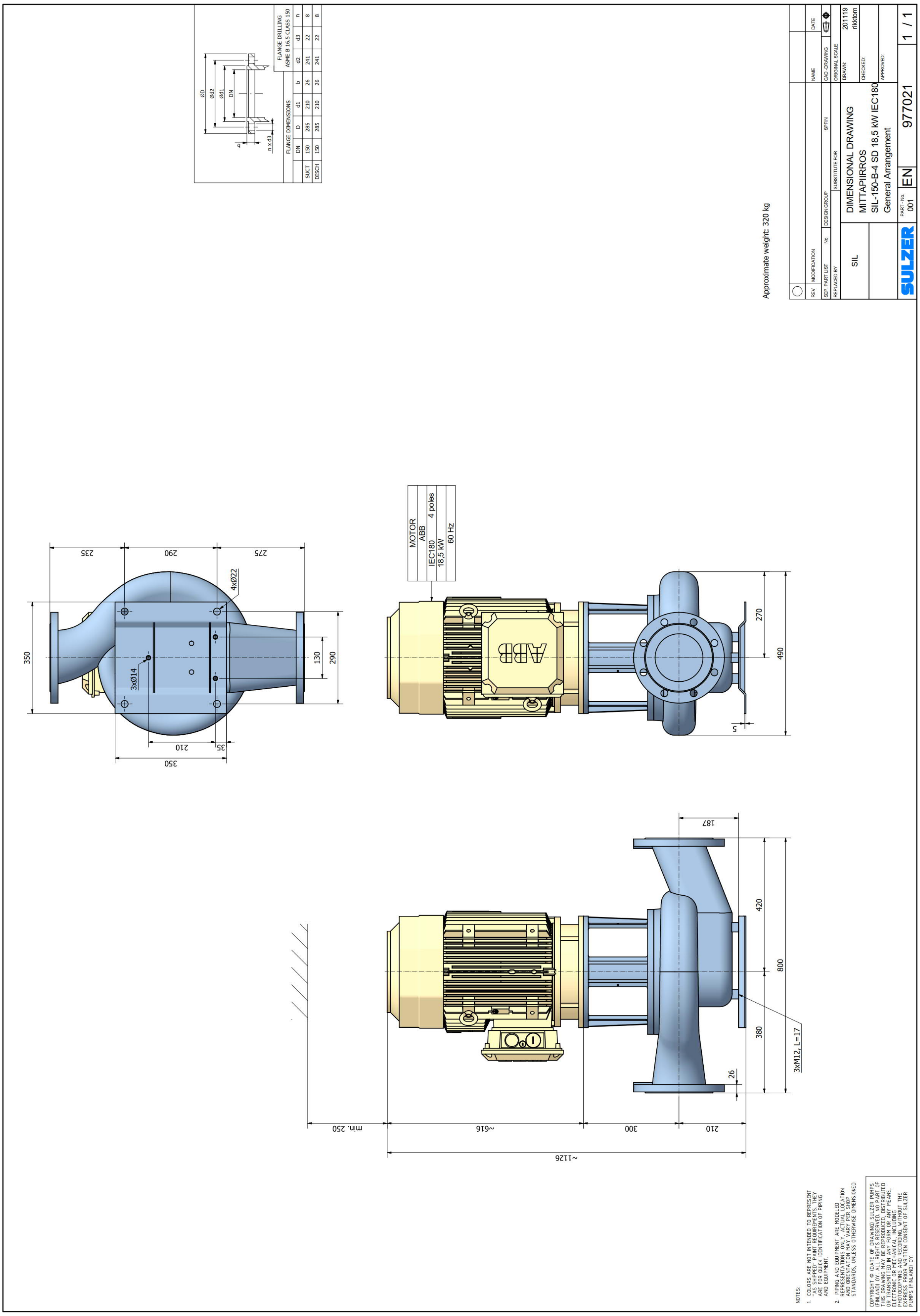
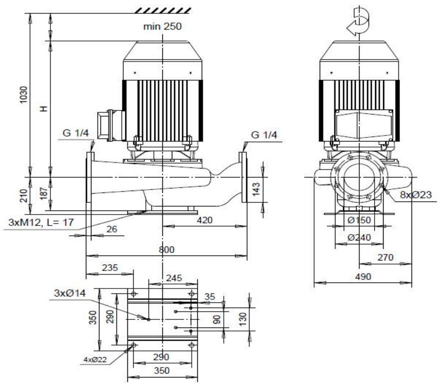
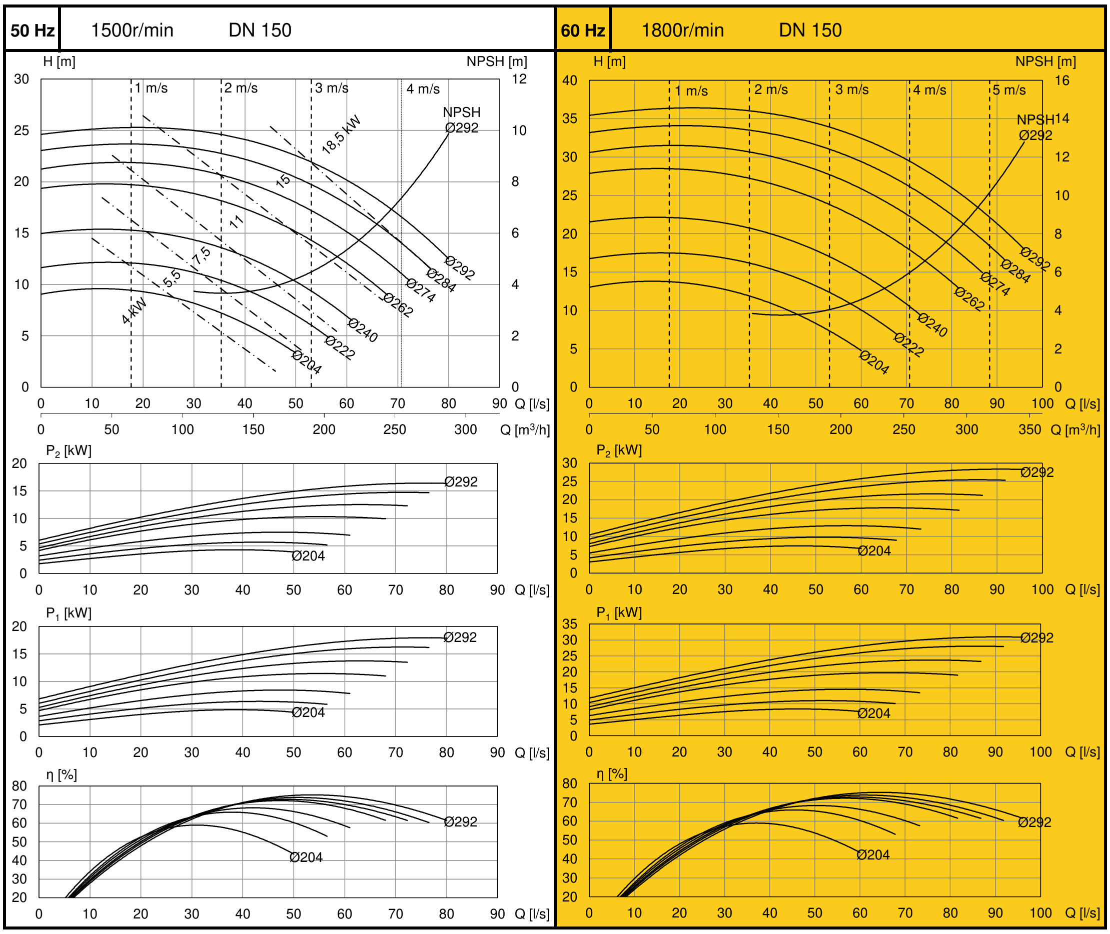


	DN	D	d1	b	d2	d3	n
SUCT	150	285	210	26	241	22	8
DISCH	150	285	210	26	241	22	8

SIL-150-B-4 **SILH-150-B-4** **SILS-150-B-4** **SILX-150-B-4** **SILM-150-B-4**



	Motor 400V	P_{2N} [kW]	I_N [A]	[kg]	H [mm]
50Hz	KH-132 C2 F31	4	8,13	177	500
	KH-132 E2 F31	5,5	10,95	184	500
	KP-134 H2 F31	7,5	14,58	214	600
	KP-166 G2 F31	11	22,51	270	690
	KP-166 G2 F31	15	28,86	275	690
	KP-187 K2 BF31	18,5	34,40	335	770
60Hz	**Motor ~~380-400V(460-480V)~~**	**P_{2N} [kW]**	**I_N [A]**	**[kg]**	**H [mm]**
	KH-132 C2 F31	4 (4,8)	8,17 (8,30)	177	500
	KH-132 E2 F31	5,5 (6,6)	11,00 (11,15)	184	500
	KP-134 H2 F31	7,5 (9)	14,23 (15,21)	214	600
	KP-166 G2 F31	11 (13)	22,32 (22,78)	270	690
	KP-166 G2 F31	15 (18)	28,06 (29,43)	275	690
	KP-187 K2 BF31	18,5 (22)	34,20 (34,70)	335	770
	KP-187 K2 BF32	22 (26)	39,40 (40,30)	340	770
	KP-205 K2 F32	30 (36)	54,20 (56,50)	400	780



Subject to change without prior notice

23.11.2015

SIL Inline Single Stage Centrifugal Pumps

Products and operation fulfill versatile international standards and directives

	Standard	Description
Legislation	Directive 2006/42/EC	Machinery directive
	Directive 93/68/EEC	CE Marking
	Directive 2009/125/ EU Regulation 547/2012 prEN16480	Eco-design requirements for water pumps Implementing eco-design requirements for water pumps Pumps − Minimum required efficiency of rotodynamic water pumps
Product safety	EN 809:1998 + A1:2009	Pumps and pump units for liquids - Common safety requirements
	EN ISO 12100-2010	Safety of machinery - General principles for design. Risk assessment and risk reduction.
Quality system	EN ISO 9001:2008	Quality management systems. Requirements.
Environmental system	EN ISO 14001:2004	Environmental management systems - Requirements with guidance for use
Design	EN ISO 5199:2002	Technical specifications for centrifugal pumps - Class II

ABB Motors and Generators	Technical Data Sheet - DOL		ABB
	Project **Wärtsilä Kanada**	Location	
Department/Author **Antti Uusitalo**	Customer name **Sulzer Pumps Finland Oy**	Customer ref.	Item name **1 & 2**
Our ref. **CQ410699**	Rev/Changed by **A** · Date of issue **1.11.2019**	Saving ident **untitled.xls**	Pages **1(3)**

No.	Definition	Data	Unit	Remarks	
1	Product	***TEFC, 3-phase, squirrel cage induction motor***			
2	Product code	***3GBP 182 410-BEK***		Calc. ref.	3GZF021018-651
3	Type/Frame	***M3BP 180MLA 4***			
4	Mounting	***IM3011, V1(flange)***			
5	Rated output P_N	***18,5***	kW		
6	Service factor	***1***			
7	Type of duty	***S1(IEC) 100%***			
8	Rated voltage U_N	***600***	VD	± 5 % (IEC 60034-1)	
9	Rated frequency f_N	***60***	Hz	± 2 % (IEC 60034-1)	
10	Rated speed n_N	***1785***	r/min		
11	Rated current I_N	***23,6***	A		
12	No-load current	***9,1***	A		
13	Starting current I_S/I_N	***9,1***		Meet IEC 60034-12, NE,(HE at 60 Hz)	
14	Nominal torque T_N	***99***	Nm		
15	Locked rotor torque T_S/T_N	***3,5***			
16	Maximum torque T_{max}/T_N	***3,8***			
17	Minimum torque T_{min}/T_N	***1,9***			
18	Speed at minimum torque	***1170***	r/min		
	Load characteristics (IEC 60034-2-1:2014)	Load %	Current A	Efficiency %	Power factor
19	PLL determined from residual loss	*100*	**23,6**	**93,6 / IE3**	**0,81**
20		*75*	**18,8**	**93,6**	**0,76**
21		*50*	**14,7**	**92,4**	**0,66**
22		*Start*	**215**		**0,37**
23	Maximum starting time from hot	***9***	s		
24	Maximum starting time from cold	***15***	s		
25	Insulation class / Temperature class	***F / B***			
26	Ambient temperature	***40***	°C		
27	Altitude	***1000***	m.a.s.l.		
28	Enclosure	***IP55***			
29	Cooling system	***IC411 self ventilated***			
30	Bearing DE/NDE	***6310/C3 - 6209/C3***			
31	Type of Grease				
32	Sound pressure level (LP dB(A) 1m)	***68***	dB(A)	at load	
33	Moment of inertia J = ¼ GD2	***0,219***	kg-m2		
34	Balancing				
35	Vibration class				
36	Position of terminal box	***Top***			
37	Terminal box entries; no, dimens.				
38	Number of power terminals				
39	Direction of rotation	***CW or CCW***			
40	Weight of rotor	***58***	kg		
41	Total weight of motor	***235***	kg		
42	Dimension drawing no.				
43	Winding insulation	***Special***			
44		***Stamped from: 575 V - 60 Hz***			
45					
Ex-motors					
46					
47					
48					
Option	Variant Codes / Definition				
49	+066 Modified for non-standard mounting position				
50	+405 Special winding insulation for frequency converter supply, Calc. ref. in datasheet is for std.				
51	+002 Restamping voltage, frequency and output, continuous duty				
52					

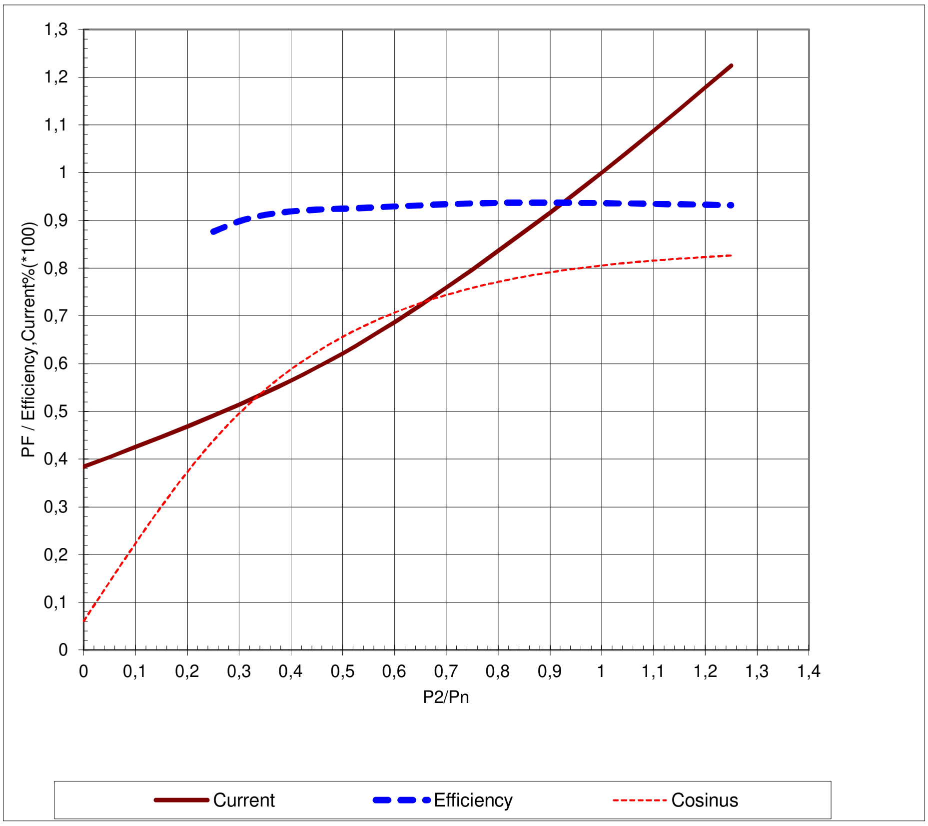
Remarks:

Data based on situation 7.10.2019
All data subject to tolerances in accordance with IEC
Guaranteed values on request

ABB Motors and Generators	Load Curves		ABB
	Project **Wärtsilä Kanada**	Location	
Department/Author **Antti Uusitalo**	Customer name **Sulzer Pumps Finland Oy**	Customer ref.	Item name **1 & 2**
Our ref. **CQ410699**	Rev/Changed by **A**	Date of issue **1.11.2019** / Saving ident **untitled.xls**	Pages **2(3)**

Product	**TEFC, 3-phase, squirrel cage induction motor**		
Type/Frame	**M3BP 180MLA 4**	Calc. ref.	**3GZF021018-651**
Product code	**3GBP 182 410-BEK**		
Rated output P_N	**18,5** kW		
Type of duty	**S1(IEC) 100%**		

Voltage (V)	**600**	Current I_N (A)	**23,6**	Power factor at P_N	**0,81**
Frequency (Hz)	**60**	Speed (r/min)	**1785**	Efficiency (%) at P_N	**93,6**



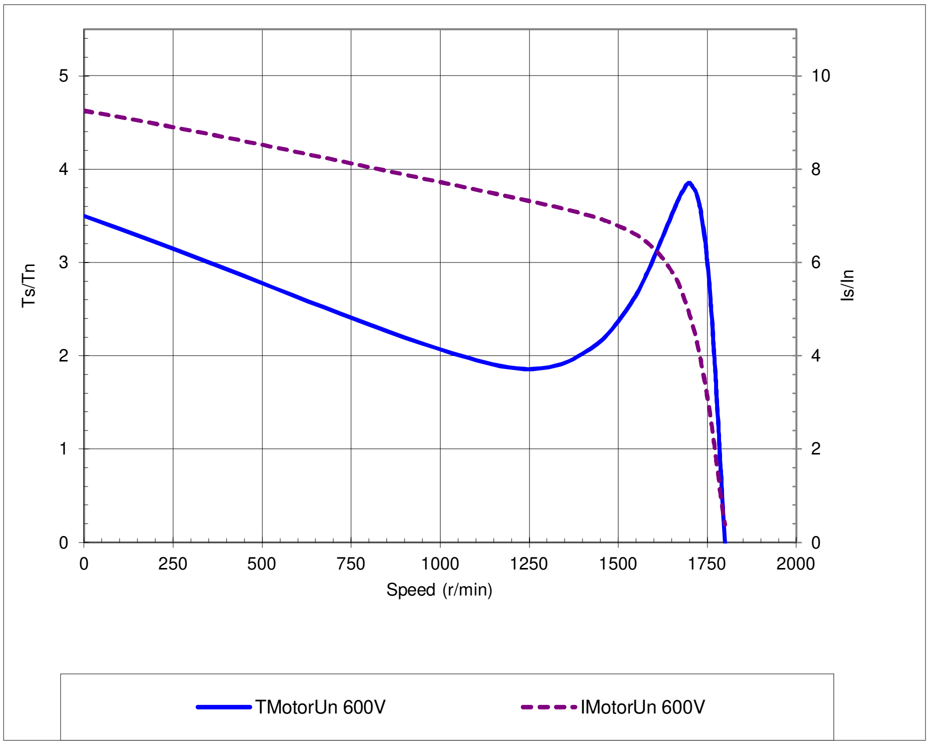
Load characteristics (IEC 60034-2-1:2014)
Data based on situation 7.10.2019

All data subject to tolerances in accordance with IEC

ABB Motors and Generators	Starting Curves		ABB
	Project **Wärtsilä Kanada**	Location	
Department/Author **Antti Uusitalo**	Customer name **Sulzer Pumps Finland Oy**	Customer ref.	Item name **1 & 2**
Our ref. **CQ410699**	Rev/Changed by Date of issue **A 1.11.2019**	Saving ident **untitled.xls**	Pages **3(3)**

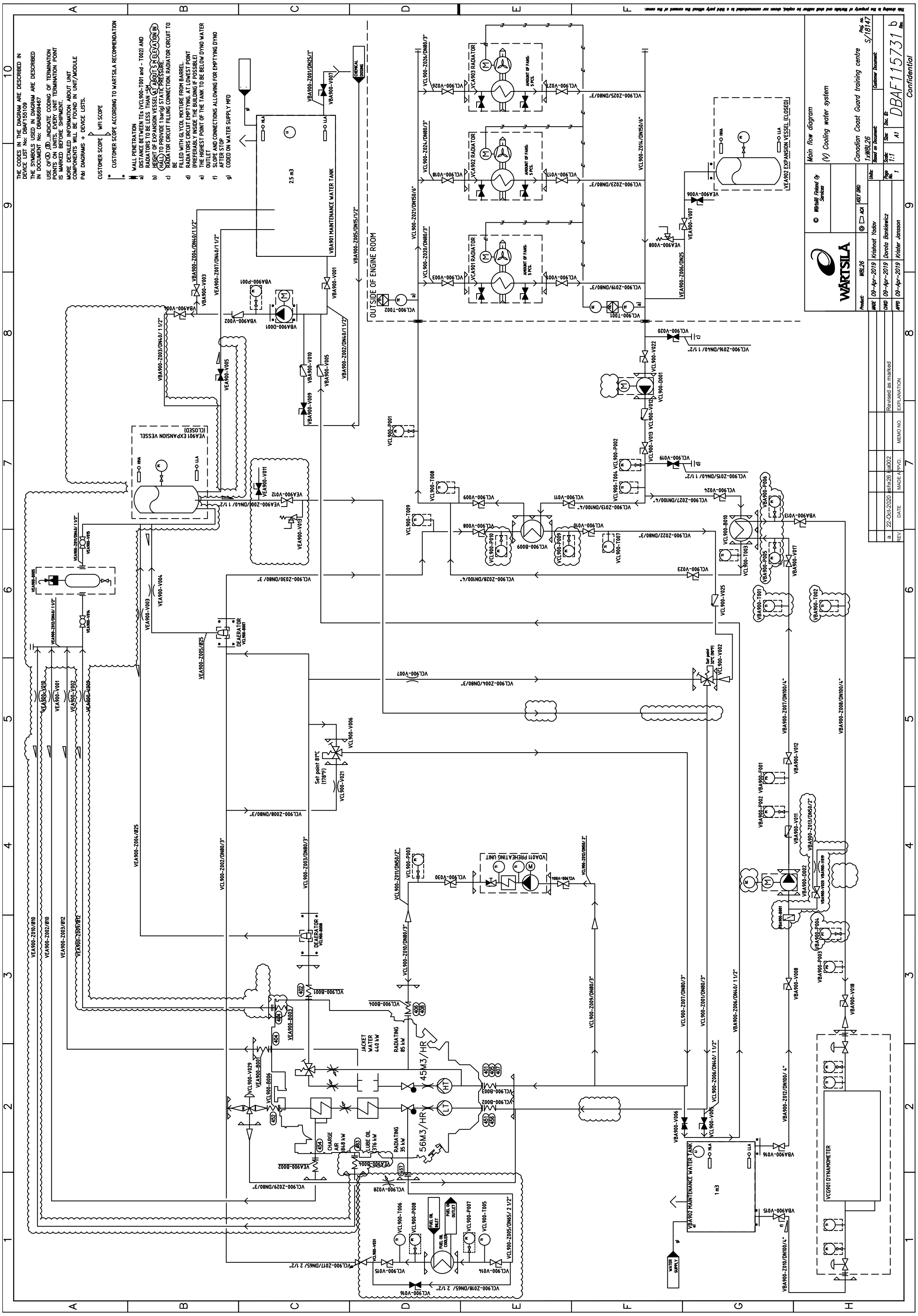
Type of product	**TEFC, 3-phase, squirrel cage induction motor**			
Type/Frame	**M3BP 180MLA 4**	Calc. ref.	3GZF021018-651	
Product code	**3GBP 182 410-BEK**	Frequency (Hz)	**60**	
Rated output P_N	**18,5** kW	Rated current I_N	**23,6**	A
Type of duty	**S1(IEC) 100%**			

J_{motor} (kgm2)	**0,22**	Voltage (V) 100%	***600***	Voltage (V)	***600V(100%)***
J_{load} (kgm2)		T_{start}/T_N	***3,5***	T_{start}/T_N	
Speed (r/min)	**1784**	Starting time (s)	***0,2***	Starting time (s)	
T_N (Nm)	**99**	Speed (r/min)		Speed (r/min)	
T_{load} (Nm)		I_s/I_n	***9,1***	I_s/I_n	
Nbr. of Consecutive Sta	**Hot: 85 Cold: 154**	T_{max}/T_n	***3,8***	T_{max}/T_n	



Load characteristics (IEC 60034-2-1:2014)
Data based on situation 7.10.2019

All data subject to tolerances in accordance with IEC



MAIN EQUIPMENT LIST

Tag	Description	Detail P&ID	Device list No	Dim DWG No	El. Panel	L (m)	W (m)	H (m)	Weight (kg)	Scope	Notes
VBA901	MAINTENANCE WATER TANK									CUST.	
VBA902	MAINTENANCE WATER TANK									CUST.	
VCA901	RADIATOR									WFI	
VCA902	RADIATOR									WFI	
VCA903	RADIATOR									WFI	
VCG901	DYNAMOMETER									WFI	
VDA011	PREHEATING UNIT									WFI	
VEA901	EXPANSION VESSEL (CLOSED)									CUST.	
VEA902	EXPANSION VESSEL (CLOSED)									CUST.	

System design data:

Cooling System: Maximum allowed temperature: 110°C/ 230°F, Maximum allowed pressure: 6 bar(g)/ 87 psi(g), Test pressure: ASME B31.3

Notes:

Refer dwg no:

Equipment coded 90_ is for engine one.

Coding: The coding system is explained in Power Plants grouping & coding of processes & signals document no: 4V75L0112

WÄRTSILÄ	Project Name	System / Name	Classification	Made By	Date	Document ID	Page
	Canadian Coast Guard training centre	**(V) Cooling water system**	**Confidential**	**Arbeyaz Shaikh**	**22-Oct-2020**	**DBAF155109**	**1/16**
	Project Number	Description	Ref.Doc.No.	Approved by:	Date	Revision	
	P/18147	**Device list**	**DBAF115731**	**Krister Jansson**	**23-Oct-2020**	**a**	

DN = Diameter Nominal
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Nom. t = Nominal temperature
Oper. t = Operating temperature

DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
VBA900-B001	STRAINER WATER INLET TO PUMP VBA900-D002	P			DN 100 / 4"						CUST. a	
VBA900-D001	CENTRIFUGAL PUMP ASSEMBLY MWT OUTLET TO PUMP VBA900-D001	E		PUMP + MOTOR	DN40/ 1 1/2"				, ,	,	CUST. -	2800 rpm, 1.8 kW
VBA900-D002	CENTRIFUGAL PUMP ASSEMBLY WATER INNLET TO HEAT EXCHANGE VCL900-B010	E			DN100/ DN100		66.6 m3/h		, ,	,	WFI -	Shaft power: 9.5 kW, Hydraulic power: 5.7 kW
VBA900-F001	FLOW SWITCH WATER INNLET TO HEAT EXCHANGER VCL900-B010	I			G 1/2"				,	,	CUST. -	
VBA900-P001	MANOMETER ASSEMBLY MWT OUTLET TO PUMP VBA900-D001	I			G 1/2"				,	,	CUST. -	
VBA900-P002	MANOMETER ASSEMBLY WATER INNLET TO HEAT EXCHANGER VCL900-B010	I			G 1/2"				,	,	CUST. -	
VBA900-P003	PRESSURE SWITCH WATER INLET TO DYNAMOMETER VCG901	I			G1/2"				,	,	CUST. -	
VBA900-P004	PRESSURE TRANSMITTER WATER INNLET TO HEAT EXCHANGER VCL900-B010	I			G 1/2"				,	,	CUST. a	
VBA900-P005	MANOMETER ASSEMBLY WATER INLET TO HEAT EXCHANGER VCL900-B010	I			G 1/2"				,	,	CUST. a	
VBA900-P006	MANOMETER ASSEMBLY WATER OUTLET FROM HEAT EXCHANGER VCL900-B010	I			G 1/2"				,	,	CUST. a	
VBA900-T001	THERMOMETER WATER INLET TO HEAT EXCHANGER VCL900-B010	I			G1/2"				,	,	CUST. a	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(V) Cooling water system**	Classification **Confidential**	Made By **Arbeyaz Shaikh**	Date **22-Oct-2020**	Document ID **DBAF155109**	Page **2/16**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115731**	Approved by: **Krister Jansson**	Date **23-Oct-2020**	Revision **a**	

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DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
VBA900-T002	THERMOMETER WATER OUTLET FROM HEAT EXCHANGER VCL900-B010	I			G1/2"				,	,	CUST. a	
VBA900-V001	BALL VALVE MWT OUTLET TO PUMP VBA900-D001	V		CARBON STEEL	DN40/ 1 1/2"						CUST. -	
VBA900-V002	NON-RETURN VALVE PUMP VBA900-D001 OUTLET	V		CARBON STEEL	DN 40/ 1 1/2"						CUST. -	
VBA900-V003	BALL VALVE PUMP VBA900-D001 OUTLET TO MWT	V		CARBON STEEL	DN40/ 1 1/2"						CUST. -	
VBA900-V004	BALL VALVE PUMP VBA900-D001 OUTLET TO EXPANSION VESSEL VEA901	V		CARBON STEEL	DN40/ 1 1/2"						CUST. -	
VBA900-V005	NON-RETURN VALVE TO/FROM WATER FROM ENGINE TO MWT	V		CARBON STEEL	DN 40/ 1 1/2"						CUST. -	
VBA900-V006	BALL VALVE TO/FROM WATER FROM ENGINE TO MWT	V		CARBON STEEL	DN40/ 1 1/2"						CUST. -	
VBA900-V007	BALL VALVE MAINTENANCE WATER TANK DRAIN	V		CARBON STEEL	DN25/ 1"						CUST. -	
VBA900-V008	BALL VALVE WATER INLET TO PUMP VBA900-D002	V		CARBON STEEL	DN 100 / 4"						CUST. -	
VBA900-V009	BALL VALVE CHEMICAL DOSING TO MWT VBA901	V		CARBON STEEL	DN15/ 1/2"						CUST. -	
VBA900-V010	NON-RETURN VALVE CHEMICAL DOSING TO MWT VBA901	V		CARBON STEEL	DN 15/ 1/2"						CUST. -	

	Project Name	System / Name	Classification	Made By	Date	Document ID	Page
WÄRTSILÄ	Canadian Coast Guard training centre	(V) Cooling water system	Confidential	Arbeyaz Shaikh	22-Oct-2020	DBAF155109	3/16
	Project Number	Description	Ref.Doc.No.	Approved by:	Date	Revision	
	P/18147	Device list	DBAF115731	Krister Jansson	23-Oct-2020	a	

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DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
VBA900-V011	NON-RETURN VALVE WATER OUTLET FROM PUMP VBA900-D002	V		CARBON STEEL	DN 100 / 4"						CUST. -	
VBA900-V012	BALL VALVE WATER OUTLET FROM PUMP VBA900-D002	V		CARBON STEEL	DN 100 / 4"						CUST. -	
VBA900-V013	BALL VALVE WATER OUTLET FROM HEAT EXCHANGER VCL900-B010	V		CARBON STEEL	DN 100/ 4"						CUST. -	
VBA900-V015	BALL VALVE DYNAMOMETER WATER OUTLET TO MWT VBA902	V		CARBON STEEL	DN 100 / 4"						CUST. -	
VBA900-V016	BALL VALVE WATER OUTLET FROM MWT VBA902	V		CARBON STEEL	DN 100 / 4"						CUST. -	
VBA900-V017	BALL VALVE WATER INLET TO HEAT EXCHANGER VCL900-B010	V		CARBON STEEL	DN 100 / 4"						CUST. -	
VBA900-V018	BALL VALVE WATER INLET TO DYNAMOMETER VCG901	V		CARBON STEEL	DN 100 / 4"						CUST. -	
VBA900-V019	ORIFICE VBA900-D002 CIRCULATION	P		CARBON STEEL	DN 50 / 2"						CUST. a	
VBA900-V020	BALL VALVE VBA900-D002 CIRCULATION	V		CARBON STEEL	DN 50 / 2"						CUST. a	
VBA900-Z001	STEEL PIPE MAINTENANCE WATER TANK DRAIN	L		, CARBON STEEL ASTM A179	1"						CUST. -	
VBA900-Z002	STEEL PIPE MWT OUTLET TO PUMP VBA900-D001	L		, CARBON STEEL ASTM A106 Gr.B	1 1/2"						CUST. -	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(V) Cooling water system**	Classification **Confidential**	Made By **Arbeyaz Shaikh**	Date **22-Oct-2020**	Document ID **DBAF155109**	Page **4/16**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115731**	Approved by: **Krister Jansson**	Date **23-Oct-2020**	Revision **a**	

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DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
VBA900-Z003	STEEL PIPE PUMP VBA900-D001 OUTLET TO EXPANSION VESSEL VEA901	L		, CARBON STEEL ASTM A106 Gr.B	1 1/2"						CUST. -	
VBA900-Z004	STEEL PIPE PUMP VBA900-D001 OUTLET TO MWT	L		, CARBON STEEL ASTM A106 Gr.B	1 1/2"						CUST. -	
VBA900-Z005	STEEL PIPE CHEMICAL DOSING TO MWT VBA901	L		, CARBON STEEL ASTM A179	1/2"						CUST. -	
VBA900-Z006	STEEL PIPE TO/FROM WATER FROM ENGINE TO MWT	L		, CARBON STEEL ASTM A106 Gr.B	1 1/2"						CUST. -	
VBA900-Z007	STEEL PIPE WATER INLET TO HEAT EXCHANGE VCL900-B010	L		, ASTM A53 Gr.B ASTM A53 Gr.B	DN 100 / 4"						CUST. -	Pipe surface temp. =60°C (=140°F). Protective insulation needed.
VBA900-Z008	STEEL PIPE WATER OUTLET FROM HEAT EXCHANGER VCL900-B010	L		, CARBON STEEL ASTM A53 Gr.B	DN 100 / 4"						CUST. -	
VBA900-Z010	STEEL PIPE DYNAMOMETER WATER OUTLET TO MWT VBA902	L		, CARBON STEEL ASTM A53 Gr.B	DN 100 / 4"						CUST. -	Pipe surface temp. =60°C (=140°F). Protective insulation needed.
VBA900-Z012	STEEL PIPE WATER INLET TO PUMP VBA900-D002	L		, CARBON STEEL ASTM A53 GR B	DN 100 / 4"						CUST. -	Pipe surface temp. =60°C (=140°F). Protective insulation needed.
VBA900-Z013	STEEL PIPE VBA900-D002 CIRCULATION LINE	L		, CARBON STEEL ASTM A106 Gr.B	DN 50 / 2"						CUST. a	Pipe surface temp. =60°C (=140°F). Protective insulation needed.
VCL900-B001	FLEXI HOSE HT WATER OUTLET	V			DN80/ 3"						WFI -	IPI
VCL900-B002	FLEXI HOSE LT WATER INLET TO ENGINE	V			DN80/ 3"						WFI -	IPI

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(V) Cooling water system**	Classification **Confidential**	Made By **Arbeyaz Shaikh**	Date **22-Oct-2020**	Document ID **DBAF155109**	Page **5/16**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115731**	Approved by: **Krister Jansson**	Date **23-Oct-2020**	Revision **a**	

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DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
VCL900-B003	FLEXI HOSE HT WATER INLET TO ENGINE	V			DN80/ 3"						WFI -	IPI
VCL900-B004	FLEXI HOSE PREHEATING WATER TO ENGINE	V			DN80/ 3"						WFI -	IPI
VCL900-B006	FLEXI HOSE LT WATER OUTLET FROM ENGINE	V			DN80/ 3"						WFI -	IPI
VCL900-B007	DEAERATOR WATER DEAREATOR	E			DN80/ 3"				, ,	,	CUST. -	Vent Ø25 / 1"
VCL900-B008	DEAERATOR WATER DEAREATOR	E			DN80/ 3"				, ,	,	CUST. -	Vent Ø25 / 1"
VCL900-B009	HEAT EXCHANGER	E							, ,	,	WFI -	Radiator side: 68 m3/h, LT-side: 56 m3/h, 1786 kW
VCL900-B010	HEAT EXCHANGER	E							, ,	,	WFI -	Radiator side: 72 m3/h, Dynamometer side: 66.6 m3/h. 2160 kW
VCL900-D001	PUMP ASSEMBLY RADIATOR OUTLET, LT WATER INLET TO VCL900-B009	E		PUMP + MOTOR			140 m3/h		, ,	,	WFI -	Shaft power: 12 kW, Hydraulic power: 7.2 kW
VCL900-P001	MANOMETER ASSEMBLY RADIATOR INLET	I			G 1/2"				,	,	CUST. -	
VCL900-P002	MANOMETER ASSEMBLY LT WATER FROM RADIATORS	I			G 1/2"				,	,	CUST. -	
VCL900-P003	MANOMETER ASSEMBLY HT WATER FROM PREHEATER TO ENGINE	I			G 1/2"				,	,	CUST. -	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(V) Cooling water system**	Classification **Confidential**	Made By **Arbeyaz Shaikh**	Date **22-Oct-2020**	Document ID **DBAF155109**	Page **6/16**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115731**	Approved by: **Krister Jansson**	Date **23-Oct-2020**	Revision **a**	

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DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
VCL900-P007	MANOMETER ASSEMBLY LT WATER TO FO COOLER	I			G 1/2"				,	,	CUST. -	
VCL900-P008	MANOMETER ASSEMBLY LT WATER FROM FO COOLER	I			G 1/2"				,	,	CUST. -	
VCL900-P009	MANOMETER ASSEMBLY LT WATER AFTER HEAT EXCHANGER VCL900-B009	I			G 1/2"				,	,	CUST. a	
VCL900-P010	MANOMETER ASSEMBLY LT/HT WATER INLET TO HEAT EXCHANGER VCL900-B009	I			G 1/2"				,	,	CUST. a	
VCL900-T001	TEMPERATURE SENSOR ASSEMBLY RADIATOR OUTLET	I			G 1/2"				,	,	CUST. -	
VCL900-T002	TEMPERATURE SENSOR ASSEMBLY RADIATOR INLET	I			G 1/2"				,	,	CUST. -	
VCL900-T003	THERMOMETER LT WATER AFTER HEAT EXCHANGER VCL900-B010	I			G1/2"				,	,	CUST. -	
VCL900-T004	THERMOMETER LT WATER AFTER RADIATOR	I			G1/2"				,	,	CUST. -	
VCL900-T005	THERMOMETER LT WATER TO FO COOLER	I			G 1/2"				,	,	CUST. -	
VCL900-T006	THERMOMETER LT WATER FROM FO COOLER	I			G 1/2"				,	,	CUST. -	
VCL900-T007	THERMOMETER LT WATER AFTER HEAT EXCHANGER VCL900-B009	I			G1/2"				,	,	CUST. -	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(V) Cooling water system**	Classification **Confidential**	Made By **Arbeyaz Shaikh**	Date **22-Oct-2020**	Document ID **DBAF155109**	Page **7/16**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115731**	Approved by: **Krister Jansson**	Date **23-Oct-2020**	Revision **a**	

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DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
VCL900-T008	THERMOMETER WATER OUTLET FROM HEAT EXCHANGER VCL900-B009	I			G1/2"				,	,	CUST. -	
VCL900-T009	THERMOMETER LT WATER INLET TO HEAT EXCHANGER VCL900-B009	I			G1/2"				,	,	CUST. -	
VCL900-V001	GLOBE VALVE VCA901 RADIATOR OUTLET	V		CARBON STEEL	DN80/ 3"						CUST. -	With hand lever
VCL900-V002	TEMPRATURE CONTROL VALVE LT THERMOSTATIC VALVE	V			DN80/ 3"		56 m3/h				WFI -	Set point 32°C (90°F)
VCL900-V003	GLOBE VALVE VCA901 RADIATOR INLET	V		CARBON STEEL	DN80/ 3"						CUST. -	With hand lever
VCL900-V004	BALL VALVE WATER INLET TO PREHEATER	V		CARBON STEEL	DN50/ 2"						CUST. -	
VCL900-V005	BALL VALVE WATER TO/FROM ENGINE TO MWT	V		CARBON STEEL	DN40/ 1 1/2"						CUST. -	
VCL900-V006	TEMPRATURE CONTROL VALVE HT THERMOSTATIC VALVE	V			DN80/3"		45 m3/h				WFI -	Set point 81°C (178°F)
VCL900-V007	ORIFICE WATER TO LT THERMOSTATIC VALVE VCL900-V002	P			DN80/ 3"						CUST. -	
VCL900-V008	BALL VALVE LT/HT WATER INLET TO HEAT EXCHANGER VCL900-B009	V		CARBON STEEL	DN 80/ 3"						CUST. -	
VCL900-V009	BALL VALE WATER OUTLET FROM HEAT EXCHANGER VCL900-B009	V		CARBON STEEL	DN 150/ 6"						CUST. -	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(V) Cooling water system**	Classification **Confidential**	Made By **Arbeyaz Shaikh**	Date **22-Oct-2020**	Document ID **DBAF155109**	Page **8/16**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115731**	Approved by: **Krister Jansson**	Date **23-Oct-2020**	Revision **a**	

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Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
VCL900-V010	BALL VALVE LT WATER OUTLET FROM HEAT EXCHANGER VCL900-B009	V		CARBON STEEL	DN 80/ 3"						CUST. -	
VCL900-V011	BALL VALVE WATER INLET TO VCL900-B009	V		CARBON STEEL	DN 100 / 4"						CUST. -	
VCL900-V012	NON-RETURN VALVE VCL900-D001 PUMP OUTLET	V		CARBON STEEL	DN 100 / 4"						CUST. -	
VCL900-V013	BALL VALVE WATER INLET TO VCL900-B009 / VCL900-B010	V		CARBON STEEL	DN 100 / 4"						CUST. -	
VCL900-V014	BALL VALVE LT WATER TO FO COOLER	V		CARBON STEEL	DN65/ 2 1/2"						CUST. -	
VCL900-V015	BALL VALVE LT WATER FROM FO COOLER	V		CARBON STEEL	DN65/ 2 1/2"						CUST. -	
VCL900-V016	BALL VALVE LT WATER FO COOLER BYPASS	V		CARBON STEEL	DN65/ 2 1/2"						CUST. -	
VCL900-V017	GLOBE VALVE VCA902 RADIATOR OUTLET	V		CARBON STEEL	DN80/ 3"						CUST. -	With hand lever
VCL900-V018	GLOBE VALVE VCA902 RADIATOR INLET	V		CARBON STEEL	DN80/ 3"						CUST. -	With hand lever
VCL900-V019	BALL VALVE RADIATOR CIRCUIT EMPTYING CONNECTION	V		CARBON STEEL	DN40/ 1 1/2"						CUST. -	
VCL900-V020	BALL VALVE RADIATOR CIRCUIT FILLING CONNECTION	V		CARBON STEEL	DN40/ 1 1/2"						CUST. -	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(V) Cooling water system**	Classification **Confidential**	Made By **Arbeyaz Shaikh**	Date **22-Oct-2020**	Document ID **DBAF155109**	Page **9/16**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115731**	Approved by: **Krister Jansson**	Date **23-Oct-2020**	Revision **a**	

DN = Diameter Nominal
PN = Pressure Nominal

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DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
VCL900-V021	ORIFICE WATER TO LT THERMOSTATIC VALVE	P			DN80/ 3"						CUST. -	
VCL900-V022	BALL VALVE RADIATOR OUTLET, WATER INLET TO PUMP VCL900-D001	V		CARBON STEEL	DN 150 / 6"						CUST. -	
VCL900-V023	BALL VALVE WATER OUTLET FROM HEAT EXCHANGER VCL900-B010	V		CARBON STEEL	DN 100 / 4"						CUST. -	
VCL900-V024	BALL VALVE WATER INLET TO HEAT EXCHANGER VCL900-B010	V		CARBON STEEL	DN 100/ 4"						CUST. -	
VCL900-V025	NON-RETURN VALVE VCL900-B009 HEAT EXCHANGER OUTLET	V		CARBON STEEL	DN80/3"						CUST. -	
VCL900-V026	GLOBE VALVE VCA903 RADIATOR INLET	V		CARBON STEEL	DN80/ 3"						CUST. -	 With hand lever
VCL900-V027	GLOBE VALVE VCA903 RADIATOR OUTLET	V		CARBON STEEL	DN80/ 3"						CUST. -	 With hand lever
VCL900-V028	ORIFICE LT WATER BY-PASS	P		CARBON STEEL	DN100/ 4"						CUST. -	
VCL900-V029	3 WAY VALVE LT WATER OUTLET FROM ENGINE	V		CARBON STEEL	DN100/ 4"						WFI -	 IPI
VCL900-V030	BALL VALVE WATER OUTLET FROM PREHEATER VDA011	V		CARBON STEEL	DN50/ 2"						CUST. -	
VCL900-V031	MANUAL CONTROL VALVE LT WATER FROM FO COOLER	V		CARBON STEEL	DN65/ 2 1/2"						CUST. a	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(V) Cooling water system**	Classification **Confidential**	Made By **Arbeyaz Shaikh**	Date **22-Oct-2020**	Document ID **DBAF155109**	Page **10/16**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115731**	Approved by: **Krister Jansson**	Date **23-Oct-2020**	Revision **a**	

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Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
VCL900-Z001	STEEL PIPE LT WATER TO ENGINE	L		, CARBON STEEL ASTM A106 Gr.B	3"						CUST. -	
VCL900-Z002	STEEL PIPE LT COOLING WATER OUTLET FROM ENGINE	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	
VCL900-Z003	STEEL PIPE HT COOLING WATER OUTLET FROM ENGINE	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	Pipe surface temp. =60°C (=140°F). Protective insulation needed.
VCL900-Z004	STEEL PIPE LT/HT WATER TO LT THERMOSTATIC VALVE VCL900-	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	
VCL900-Z005	STEEL PIPE LT WATER TO FO COOLER	L		, CARBON STEEL ASTM A106 Gr.B	DN65/ 2 1/2"						CUST. -	
VCL900-Z006	STEEL PIPE TO/FROM WATER FROM ENGINE TO MWT	L		, CARBON STEEL ASTM A106 Gr.B	1 1/2"						CUST. -	
VCL900-Z007	STEEL PIPE HT WATER INLET TO ENGINE	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	Pipe surface temp. =60°C (=140°F). Protective insulation needed.
VCL900-Z008	STEEL PIPE HT WATER TO LT VALVE VCL900-V006	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	
VCL900-Z009	STEEL PIPE WATER INLET TO PREHEATER	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	
VCL900-Z010	STEEL PIPE HT WATER FROM PREHEATER TO ENGINE	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	
VCL900-Z011	STEEL PIPE HT WATER FROM PREHEATER TO ENGINE	L		, CARBON STEEL ASTM A106 Gr.B	DN 50 / 2"						CUST. -	Pipe surface temp. =60°C (=140°F). Protective insulation needed.

WÄRTSILÄ	Project Name	System / Name	Classification	Made By	Date	Document ID	Page
	Canadian Coast Guard training centre	(V) Cooling water system	Confidential	Arbeyaz Shaikh	22-Oct-2020	DBAF155109	11/16
	Project Number	Description	Ref.Doc.No.	Approved by:	Date	Revision	
	P/18147	Device list	DBAF115731	Krister Jansson	23-Oct-2020	a	

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Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
VCL900-Z012	STEEL PIPE WATER INLET TO PREHEATER	L		, CARBON STEEL ASTM A106 Gr.B	2"						CUST. -	
VCL900-Z013	STEEL PIPE WATER INLET TO VCL900-B009	L		, CARBON STEEL ASTM A53 Gr.B	DN 100 / 4"						CUST. -	
VCL900-Z014	STEEL PIPE LT WATER OUTLET FROM RADIATORS	L		, CARBON STEEL ASTM A53 Gr.B	DN 150 / 6"						CUST. -	
VCL900-Z015	STEEL PIPE RADIATOR CIRCUIT EMPTYING CONNECTION	L		, CARBON STEEL ASTM A106 Gr.B	1 1/2"						CUST. -	
VCL900-Z016	STEEL PIPE RADIATOR CIRCUIT FILLING CONNECTION	L		, CARBON STEEL ASTM A106 Gr.B	1 1/2"						CUST. -	
VCL900-Z017	STEEL PIPE LT WATER FROM FO COOLER	L		, CARBON STEEL ASTM A106 Gr.B	DN65 2 1/2"						CUST. -	
VCL900-Z018	STEEL PIPE LT WATER FO COOLER BYPASS	L		, CARBON STEEL ASTM A106 Gr.B	DN65 2 1/2"						CUST. -	
VCL900-Z019	STEEL PIPE VCA901 RADIATOR OUTLET	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	
VCL900-Z020	STEEL PIPE VCA901 RADIATOR INLET	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	
VCL900-Z021	STEEL PIPE WATER INLET TO RADIATORS	L		, CARBON STEEL ASTM A53 Gr.B	DN 150 / 6"						CUST. -	
VCL900-Z022	STEEL PIPE LT WATER OUTLET FROM HEAT EXCHANGER VCL900-B009	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(V) Cooling water system**	Classification **Confidential**	Made By **Arbeyaz Shaikh**	Date **22-Oct-2020**	Document ID **DBAF155109**	Page **12/16**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115731**	Approved by: **Krister Jansson**	Date **23-Oct-2020**	Revision **a**	

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VCL900-Z023	STEEL PIPE VCA902 RADIATOR OUTLET	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	
VCL900-Z024	STEEL PIPE VCA902 RADIATOR INLET	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	
VCL900-Z025	STEEL PIPE VCA903 RADIATOR OUTLET	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	
VCL900-Z026	STEEL PIPE VCA903 RADIATOR INLET	L		, CARBON STEEL ASTM A53 Gr.B	3"						CUST. -	
VCL900-Z027	STEEL PIPE VCL900-B010 WATER INLET	L		, CARBON STEEL ASTM A53 Gr.B	DN 100 / 4"						CUST. -	
VCL900-Z028	STEEL PIPE WATER OUTLET FROM HEAT EXCHANGER VCL900-B010	L		, CARBON STEEL ASTM A53 Gr.B	DN 100 / 4"						CUST. -	
VCL900-Z029	STEEL PIPE LT WATER BY-PASS	L		, CARBON STEEL ASTM A53 Gr.B	DN100/ 4"						CUST -	
VCL900-Z030	STEEL PIPE LT COOLING WATER OUTLET FROM ENGINE	L		, CARBON STEEL	3"						CUST. -	
VEA900-B001	FLEXI HOSE HT WATER AIR VENT	V			Ø12/ 3/8"						WFI -	IPI
VEA900-B002	FLEXI HOSE LT WATER AIR VENT	V			Ø10/ 3/8"						WFI -	IPI
VEA900-B003	FLEXI HOSE HT WATER AIR VENT	V			Ø12/ 3/8"						WFI -	IPI

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(V) Cooling water system**	Classification **Confidential**	Made By **Arbeyaz Shaikh**	Date **22-Oct-2020**	Document ID **DBAF155109**	Page **13/16**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115731**	Approved by: **Krister Jansson**	Date **23-Oct-2020**	Revision **a**	

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DEVICE LIST

Tag / Customer tag	Device name / Description	C	Drawing No. / Material No.	Model Number / Type / Manufacturer	Size / PN	Enclosure / Standard	O.flow / O.pres.	Nom.t / Oper.t	Range / PED	Power / Voltage	Scope / Rev.	Mat.Remarks / Additional Remarks
VEA900-B004	FLEXI HOSE LT WATER AIR VENT	V			Ø10/ 3/8"						WFI -	IPI
VEA900-B005	AIR AND DIRT SEPERATOR	E			DN 40 / 1 1/2"				, ,	,	CUST. a	
VEA900-V001	ORIFICE LT WATER AIR VENT	P		CARBON STEEL	Ø10/ 3/8"						CUST. -	
VEA900-V002	ORIFICE HT WATER AIR VENT	P		CARBON STEEL	Ø12/ 3/8"						CUST. -	
VEA900-V003	ORIFICE HT WATER AIR VENT	P		CARBON STEEL	Ø25/ 1"						CUST. -	
VEA900-V004	ORIFICE LT WATER AIR VENT	P		CARBON STEEL	Ø25/ 1"						CUST. -	
VEA900-V005	BALL VALVE EXPANSION VESSEL VEA901 OUTLET TO MWT	V		CARBON STEEL	DN40/ 1 1/2"						CUST. -	
VEA900-V006	BALL VALVE VEA902 EXPANSION VESSEL INLET	V		CARBON STEEL	DN15/ 1/2"						CUST. -	
VEA900-V007	BALL VALVE VEA902 EXPANSION VESSEL INLET	V		CARBON STEEL	DN25/ 1"						CUST. -	
VEA900-V008	PRESSURE RELIEF VALVE VEA902 INLET PSV	V		CARBON STEEL	G 1/2"						CUST. -	
VEA900-V009	ORIFICE HT WATER AIR VENT	P		CARBON STEEL	Ø12/ 3/8"						CUST. a	

WÄRTSILÄ	Project Name	System / Name	Classification	Made By	Date	Document ID	Page
	Canadian Coast Guard training centre	**(V) Cooling water system**	**Confidential**	**Arbeyaz Shaikh**	**22-Oct-2020**	**DBAF155109**	**14/16**
	Project Number	Description	Ref.Doc.No.	Approved by:	Date	Revision	
	P/18147	**Device list**	**DBAF115731**	**Krister Jansson**	**23-Oct-2020**	**a**	

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VEA900-V010	ORIFICE LT WATER AIR VENT	P		CARBON STEEL	Ø10/ 3/8"						CUST. a	
VEA900-V011	BALL VALVE VEA901 EXPANSION VESSEL INLET	V		CARBON STEEL	DN15/ 1/2"						CUST. a	
VEA900-V012	BALL VALVE VEA901 EXPANSION VESSEL INLET	V		CARBON STEEL	DN40 / 1 1/2"						CUST. a	
VEA900-V013	PRESSURE RELIEF VALVE VEA901 INLET PSV	V		CARBON STEEL	G 1/2"						CUST. a	
VEA900-V014	BALL VALVE INLET TO DEAERATOR	V		CARBON STEEL	DN40/ 1 1/2"						CUST. a	
VEA900-V015	BALL VALVE OTLET TO DEAERATOR	V		CARBON STEEL	DN40/ 1 1/2"						CUST. a	
VEA900-Z001	STEEL PIPE LT WATER TO ENGINE HEADER VENT TO VEA901	L		, CARBON STEEL ASTM A106 Gr.B	DN 40 / 1 1/2"						CUST. -	
VEA900-Z002	STEEL PIPE LT WATER AIR VENT	L		, CARBON STEEL ASTM A179	3/8"						CUST. -	Pipe surface temp. =60°C (=140°F). Protective insulation needed.
VEA900-Z003	STEEL PIPE HT WATER AIR VENT	L		, CARBON STEEL ASTM A179	3/8"						CUST. -	
VEA900-Z004	STEEL PIPE HT WATER AIR VENT	L		, CARBON STEEL ASTM A179	1"						CUST. -	
VEA900-Z005	STEEL PIPE LT WATER AIR VENT	L		, CARBON STEEL ASTM A179	Ø25 / 1"						CUST. -	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(V) Cooling water system**	Classification **Confidential**	Made By **Arbeyaz Shaikh**	Date **22-Oct-2020**	Document ID **DBAF155109**	Page **15/16**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115731**	Approved by: **Krister Jansson**	Date **23-Oct-2020**	Revision **a**	

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Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
VEA900-Z006	STEEL PIPE VEA902 INLET	L		, CARBON STEEL ASTM A179	DN 25 / 1"						CUST. -	
VEA900-Z007	STEEL PIPE EXPANSION VESSEL VEA901 DRAIN TO MWT	L		, CARBON STEEL ASTM A106 Gr.B	1 1/2"						CUST. -	
VEA900-Z009	STEEL PIPE HT WATER AIR VENT	L		, CARBON STEEL ASTM A179	3/8"						CUST. a	
VEA900-Z010	STEEL PIPE LT WATER AIR VENT	L		, CARBON STEEL ASTM A179	3/8"						CUST. a	Pipe surface temp. =60°C (=140°F). Protective insulation needed.
VEA900-Z011	STEEL PIPE OTLET TO DEAERATOR	L		, CARBON STEEL ASTM A179	DN 40 / 1 1/2"						CUST. a	
VEA900-Z012	STEEL PIPE INLET TO DEAERATOR	L		, CARBON STEEL ASTM A179	DN 40 / 1 1/2"						CUST. a	

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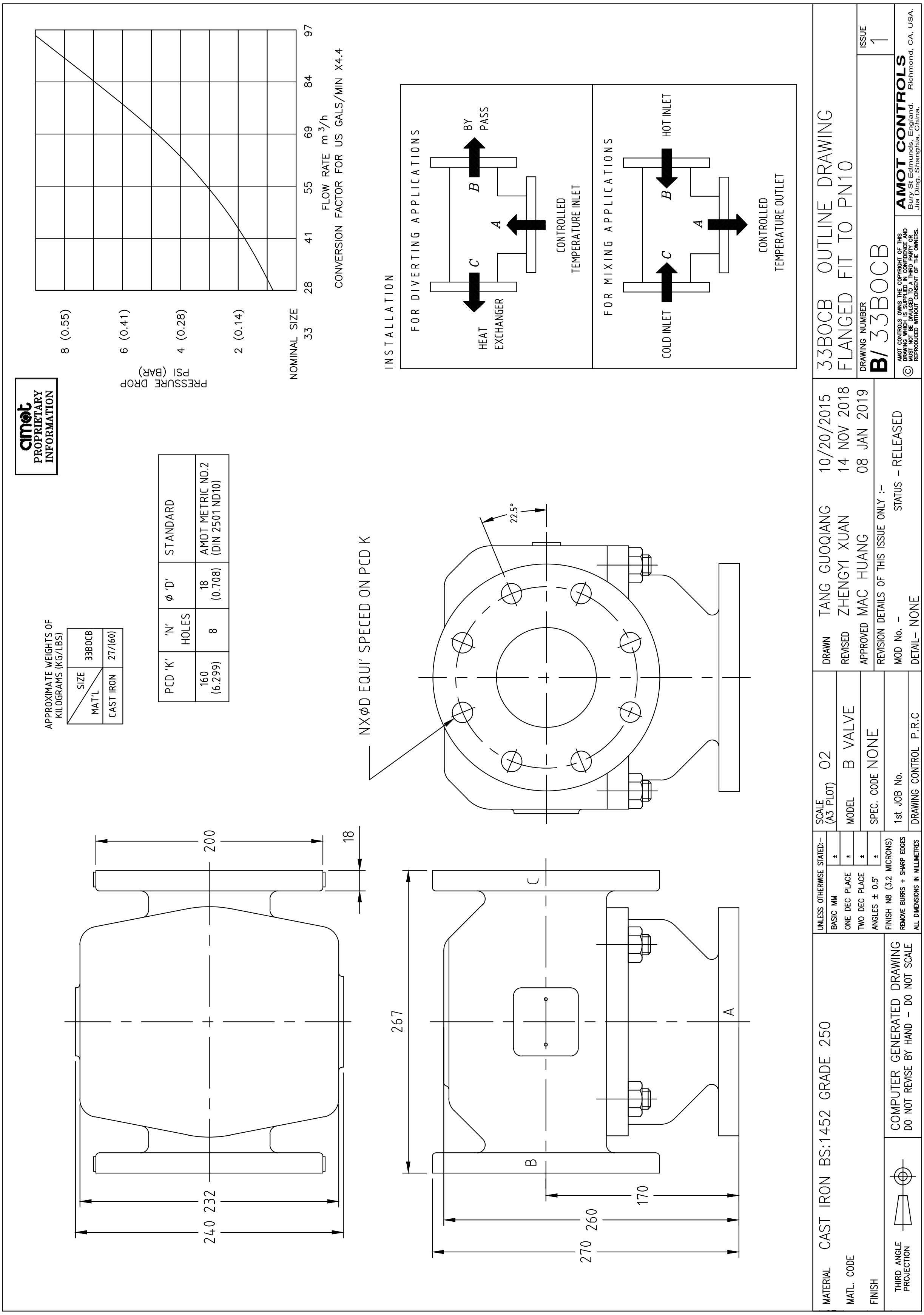
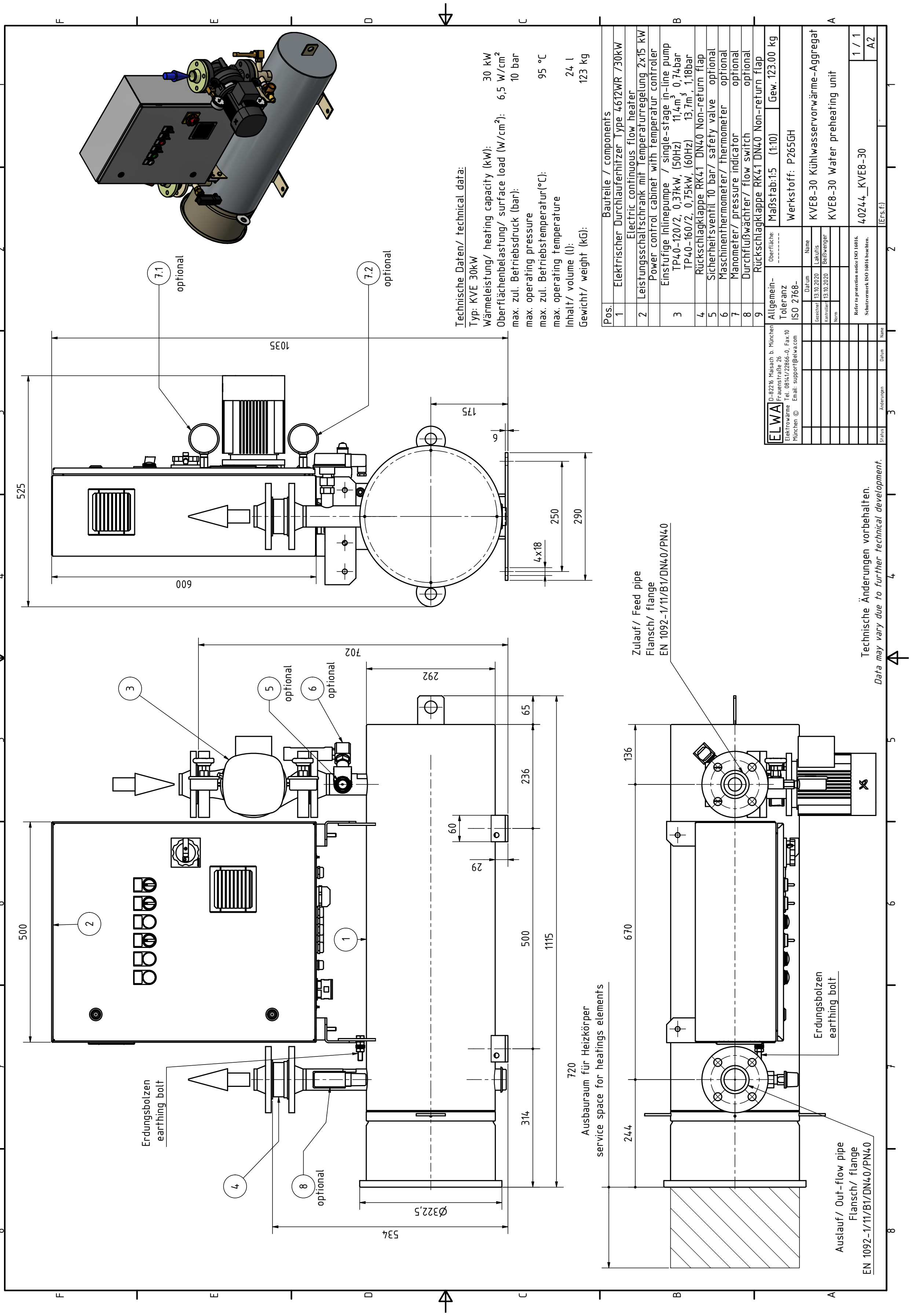
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115731**	Approved by: **Krister Jansson**	Date **23-Oct-2020**	Revision **a**	


amot PROPRIETARY INFORMATION
PRESSURE DROP PSI (BAR)
8 (0.55)
6 (0.41)
4 (0.28)
2 (0.14)
NOMINAL SIZE 33
28 41 55 69 84 97
FLOW RATE m³/h
CONVERSION FACTOR FOR US GALS/MIN X4.4
INSTALLATION
FOR DIVERTING APPLICATIONS
HEAT EXCHANGER
BY PASS
CONTROLLED TEMPERATURE INLET
FOR MIXING APPLICATIONS
COLD INLET
HOT INLET
CONTROLLED TEMPERATURE OUTLET
APPROXIMATE WEIGHTS OF KILOGRAMS (KG/LBS)
SIZE 33BOCB
MAT'L CAST IRON 27/(60)
PCD 'K' 160 (6.299)
'N' HOLES 8
φ 'D' 18 (0.708)
STANDARD AMOT METRIC NO.2 (DIN 2501 ND10)
NXφD EQUI' SPECED ON PCD K
22.5°
200
18
267
240 232
260
270
170
MATERIAL CAST IRON BS:1452 GRADE 250
MATL. CODE
FINISH
THIRD ANGLE PROJECTION
COMPUTER GENERATED DRAWING
DO NOT REVISE BY HAND - DO NOT SCALE
UNLESS OTHERWISE STATED:-
BASIC MM ±
ONE DEC PLACE ±
TWO DEC PLACE ±
ANGLES ± 0.5°
FINISH N8 (3.2 MICRONS)
REMOVE BURRS + SHARP EDGES
ALL DIMENSIONS IN MILLIMETRES
SCALE (A3 PLOT) 02
MODEL B VALVE
SPEC. CODE NONE
1st JOB No.
DRAWING CONTROL P.R.C
DRAWN TANG GUOQIANG 10/20/2015
REVISED ZHENGYI XUAN 14 NOV 2018
APPROVED MAC HUANG 08 JAN 2019
REVISION DETAILS OF THIS ISSUE ONLY :-
MOD No. -
STATUS - RELEASED
DETAIL- NONE
33BOCB OUTLINE DRAWING
FLANGED FIT TO PN10
DRAWING NUMBER
B/33BOCB
ISSUE 1
AMOT CONTROLS
Bury St Edmunds, England. Richmond, CA, USA.
Jia Ding, Shanghai, China.
AMOT CONTROLS OWNS THE COPYRIGHT OF THIS DRAWING WHICH IS SUPPLIED IN CONFIDENCE AND MUST NOT BE DIVULGED TO A THIRD PARTY OR REPRODUCED WITHOUT CONSENT OF THE OWNERS.


Technische Daten/ technical data:
Typ: KVE 30kW
Wärmeleistung/ heating capacity (kW): 30 kW
Oberflächenbelastung/ surface load (W/cm²): 6,5 W/cm²
max. zul. Betriebsdruck (bar): 10 bar
max. operating pressure
max. zul. Betriebstemperatur(°C): 95 °C
max. operating temperature
Inhalt/ volume (l): 24 l
Gewicht/ weight (kG): 123 kg
Pos. Bauteile / components
1 Elektrischer Durchlauferhitzer Type 4612WR /30kW
Electric continuous flow heater
2 Leistungsschaltschrank mit Temperaturregelung 2x15 kW
Power control cabinet with temperatur controler
3 Einstufige Inlinepumpe / single-stage in-line pump
TP40-120/2, 0,37kW, (50Hz) 11,4m³ 0,74bar
TP40-160/2, 0,75kW, (60Hz) 13,7m³ 1,18bar
4 Rückschlagklappe RK41 DN40 Non-return flap
5 Sicherheitsventil 10 bar/ safety valve optional
6 Maschinenthermometer/ thermometer optional
7 Manometer/ pressure indicator optional
8 Durchflußwächter/ flow switch optional
9 Rückschlagklappe RK41 DN40 Non-return flap
Maßstab:1:5 (1:10)
Gew. 123.00 kg
Werkstoff: P265GH
KVE8-30 Kühlwasservorwärme-Aggregat
KVE8-30 Water preheating unit
40244_KVE8-30
1 / 1
A2
ELWA
Allgemein-Toleranz ISO 2768-
Gezeichnet 13.10.2020 Lakufis
Kontrolliert 13.10.2020 Beißwenger
Zulauf/ Feed pipe
Flansch/ flange
EN 1092-1/11/B1/DN40/PN40
Auslauf/ Out-flow pipe
Flansch/ flange
EN 1092-1/11/B1/DN40/PN40
Erdungsbolzen
earthing bolt
Ausbauraum für Heizkörper
service space for heatings elements
optional
Technische Änderungen vorbehalten.
Data may vary due to further technical development.

1 2 3 4 5 6 7 8 9 10

VERDRAHTUNGSHINWEISE

- Ferderzugklemmen bis 4mm² mit Aderendhülsen
- Schraubklemmen generell mit Aderendhülsen
- Twin-Aderendhülsen sind zu vermeiden
- Leistungsverdrahtung nicht in Kabelkanal
- vorgeschriebenes Drehmoment der geschraubten Klemmstellen berücksichtigen

VERDRAHTUNGS-FARBEN

Leistung	L1,L2,L3	schwarz
Schutzleiter	PE / PEN	gelb-grün
Steuerspannung	230V AC	rot
Steuerspannung	0V AC	rot
Steuerspannung	24V AC	dunkelblau
Steuerspannung	24V DCplus	dunkelblau
Steuerspannung	24V DCminus	dunkelblau
Fremdspannungen	allgemein	braun

2

ELWA	Date	07.10.2020
	Editor	M.Holzner
	Certif. by	
	Certif. dat.	

KVE8
Heater Controlling ATHF-2
30kW(2x15kW) / 36kW(2x18kW)
600±20VAC/ 60Hz/ max.38A

ELWA Elektro-Wärme
GmbH & Co. KG
Frauenstrasse 26
D-82216 Maisach / Germany

Verdrahtungshinweise
Project start: 05.11.2016
Rules: DIN EN 61439-1

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36000_V2
KVE\KVE-Wärtsilä
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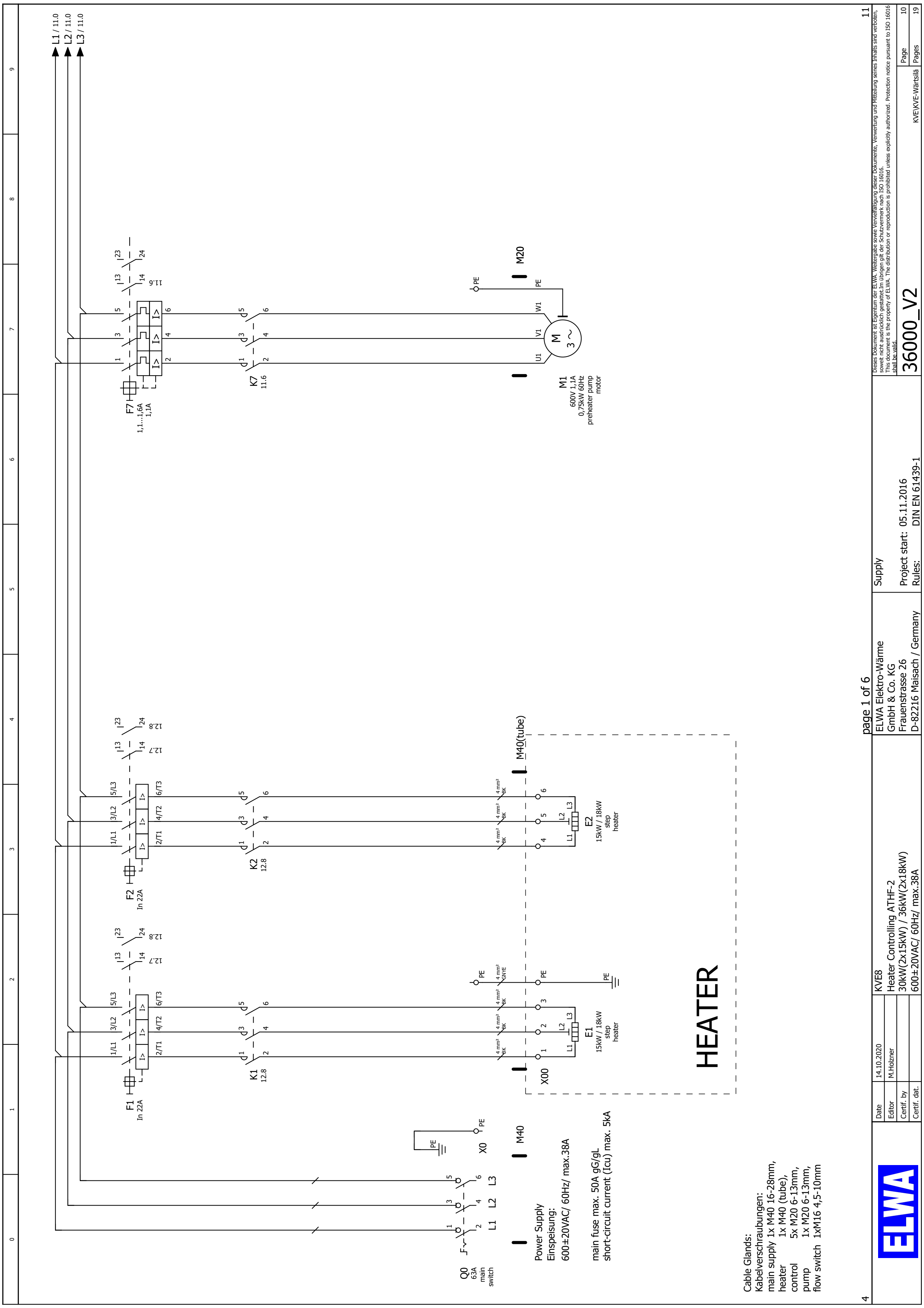
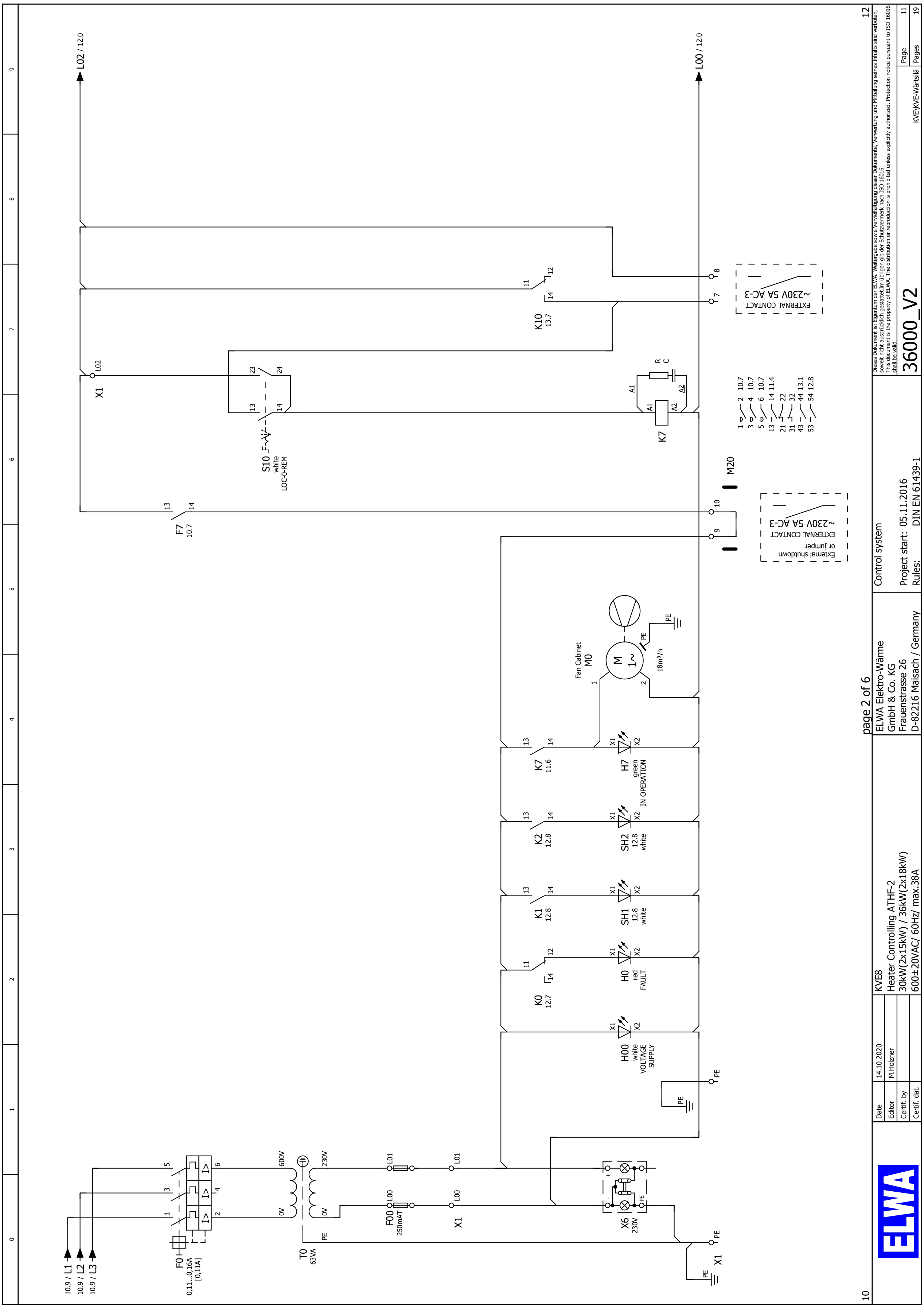
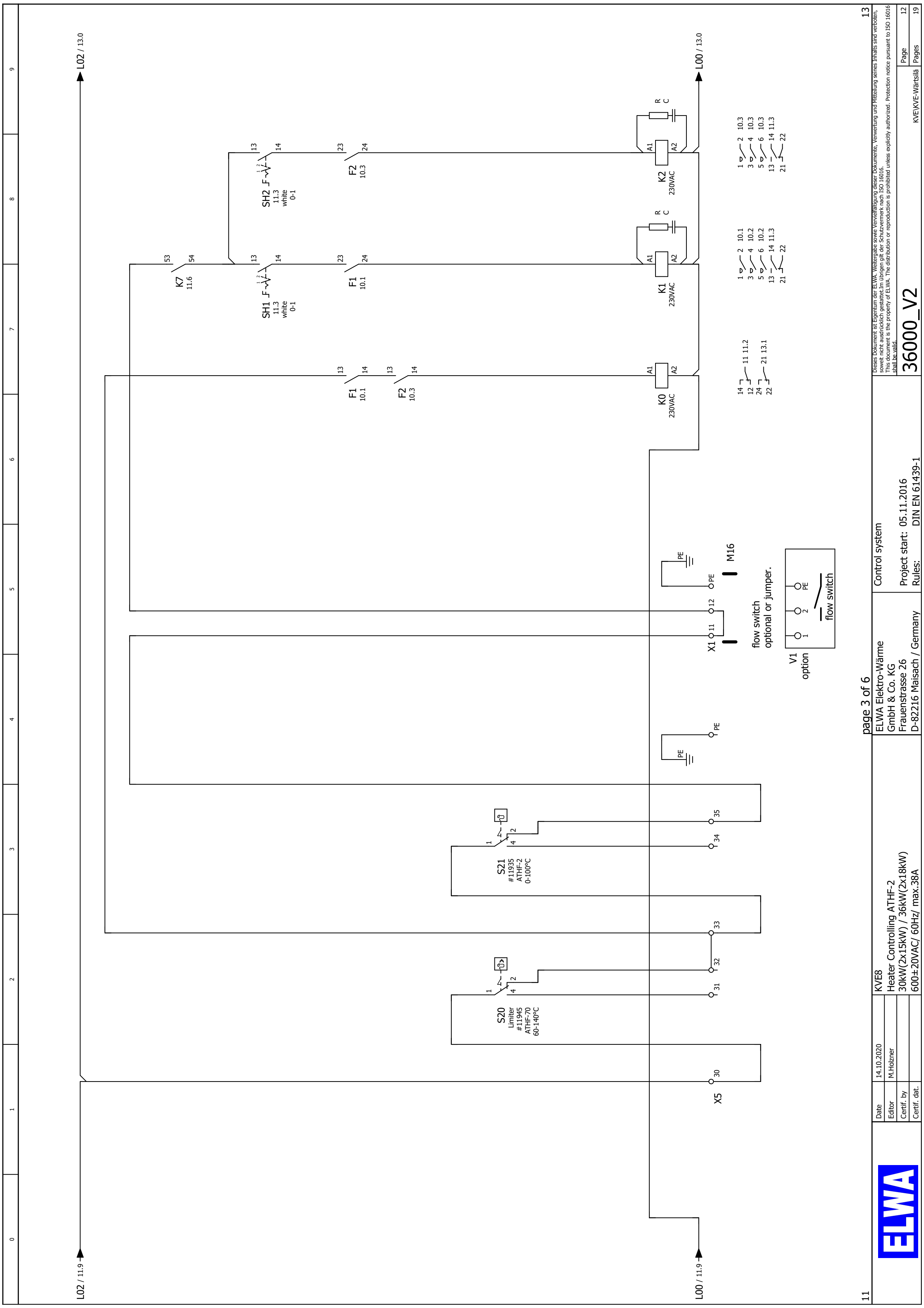
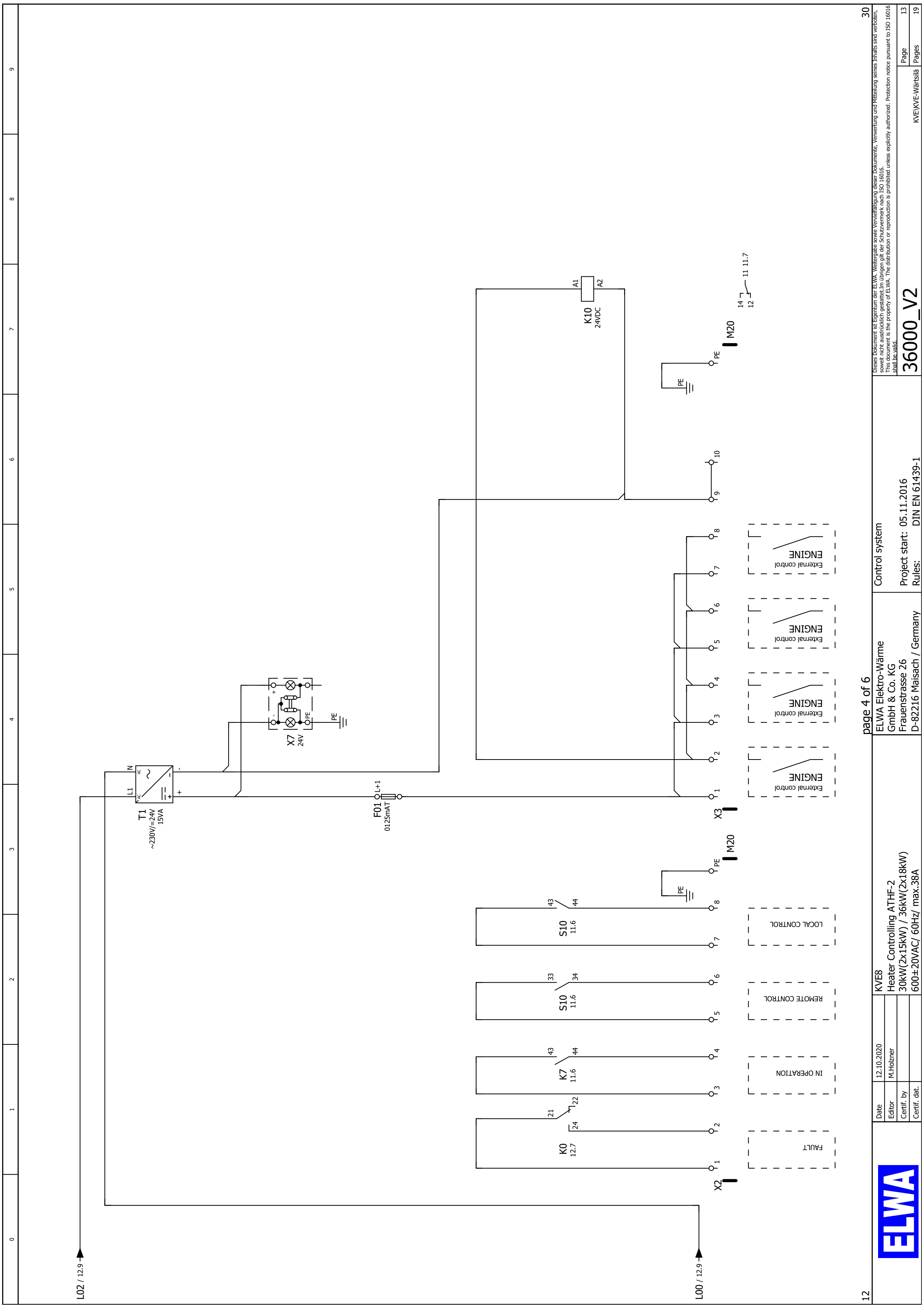

L1 / 11.0
L2 / 11.0
L3 / 11.0
Q0
63A
main switch
L1 L2 L3
X0
M40
Power Supply
Einspeisung:
600±20VAC/ 60Hz/ max.38A
main fuse max. 50A gG/gL
short-circuit current (Icu) max. 5kA
F1
In 22A
K1
12.8
F2
In 22A
K2
12.8
X00
E1
15kW / 18kW
step
heater
E2
15kW / 18kW
step
heater
HEATER
M40(tube)
F7
1,1...1,6A
1,1A
K7
11.6
M1
600V 1,1A
0,75kW 60Hz
preheater pump
motor
M20
Cable Glands:
Kabelverschraubungen:
main supply 1x M40 16-28mm,
heater 1x M40 (tube),
control 5x M20 6-13mm,
pump 1x M20 6-13mm,
flow switch 1xM16 4,5-10mm
ELWA
Date 14.10.2020
Editor M.Holzner
Certif. by
Certif. dat.
KVE8
Heater Controlling ATHF-2
30kW(2x15kW) / 36kW(2x18kW)
600±20VAC/ 60Hz/ max.38A
page 1 of 6
ELWA Elektro-Wärme
GmbH & Co. KG
Frauenstrasse 26
D-82216 Maisach / Germany
Supply
Project start: 05.11.2016
Rules: DIN EN 61439-1
36000_V2
KVE\KVE-Wärtsilä
Page 10
Pages 19


ELWA
KVE8
Heater Controlling ATHF-2
30kW(2x15kW) / 36kW(2x18kW)
600±20VAC/ 60Hz/ max.38A
page 2 of 6
ELWA Elektro-Wärme
GmbH & Co. KG
Frauenstrasse 26
D-82216 Maisach / Germany
Control system
Project start: 05.11.2016
Rules: DIN EN 61439-1
36000_V2
Date 14.10.2020
Editor M.Holzner
EXTERNAL CONTACT
~230V 5A AC-3
External shutdown
or Jumper
Fan Cabinet
M0
18m³/h
L02 / 12.0
L00 / 12.0


L02 / 11.9
L02 / 13.0
L00 / 11.9
L00 / 13.0
X5
S20
Limiter
#11945
ATHF-70
60-140°C
S21
#11935
ATHF-2
0-100°C
X1
flow switch
optional or jumper.
M16
V1
option
flow switch
K0
230VAC
K1
230VAC
K2
230VAC
F1
F2
K7
SH1
SH2
white
page 3 of 6
ELWA Elektro-Wärme
GmbH & Co. KG
Frauenstrasse 26
D-82216 Maisach / Germany
KVE8
Heater Controlling ATHF-2
30kW(2x15kW) / 36kW(2x18kW)
600±20VAC/ 60Hz/ max.38A
Control system
Project start: 05.11.2016
Rules: DIN EN 61439-1
36000_V2
Date
14.10.2020
Editor
M.Holzner
Certif. by
Certif. dat.
Page
12
Pages
19


L02 / 12.9
L00 / 12.9
X2
K0 12.7
K7 11.6
S10 11.6
FAULT
IN OPERATION
REMOTE CONTROL
LOCAL CONTROL
M20
T1 ~230V/=24V 15VA
F01 0125mAT
X3
X7 24V
PE
ENGINE
External control
K10 24VDC
A1
A2
page 4 of 6
Date 12.10.2020
Editor M.Holzner
Certif. by
Certif. dat.
KVE8
Heater Controlling ATHF-2
30kW(2x15kW) / 36kW(2x18kW)
600±20VAC/ 60Hz/ max.38A
ELWA Elektro-Wärme
GmbH & Co. KG
Frauenstrasse 26
D-82216 Maisach / Germany
Control system
Project start: 05.11.2016
Rules: DIN EN 61439-1
36000_V2
KVE\KVE-Wärtsilä
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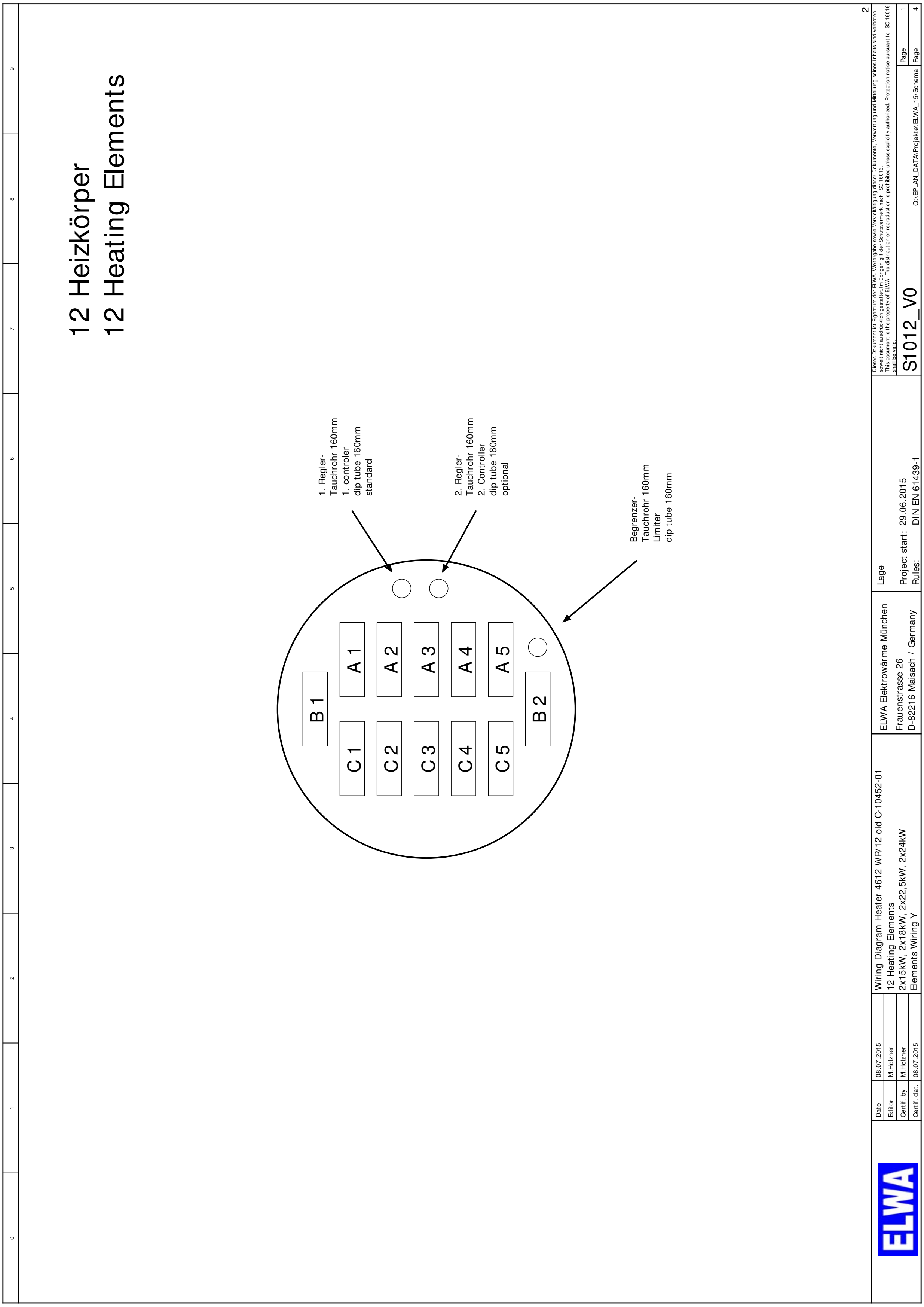
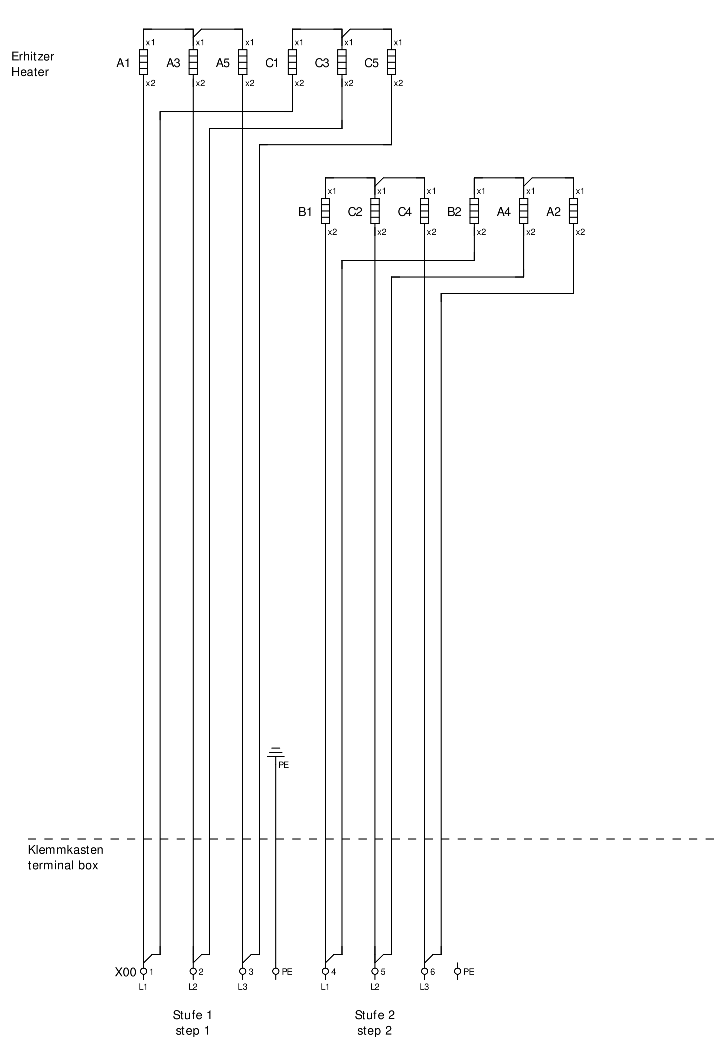
ELWA


12 Heizkörper
12 Heating Elements
1. Regler-
Tauchrohr 160mm
1. controler
dip tube 160mm
standard
2. Regler-
Tauchrohr 160mm
2. Controller
dip tube 160mm
optional
Begrenzer-
Tauchrohr 160mm
Limiter
dip tube 160mm
A 1
A 2
A 3
A 4
A 5
B 1
B 2
C 1
C 2
C 3
C 4
C 5
Date 08.07.2015
Editor M.Holzner
Certif. by M.Holzner
Certif. dat. 08.07.2015
Wiring Diagram Heater 4612 WR/12 old C-10452-01
12 Heating Elements
2x15kW, 2x18kW, 2x22,5kW, 2x24kW
Elements Wiring Y
ELWA Elektrowärme München
Frauenstrasse 26
D-82216 Maisach / Germany
Lage
Project start: 29.06.2015
Rules: DIN EN 61439-1
S1012_V0
Page 1
Page 4



12 Heizkörper / Heating Elements

Heizleistung Heating Power	Betriebsspannung Voltage Supply	Heizstufe 1 Heating Step 1	Heizstufe 2 Heating Step 2	Heizkörper Heating Elements
30kW	3/PE 380-415V	15kW 25A	15kW 25A	2500W 230V
30kW	3/PE 440-460V	15kW 25A	15kW 25A	2500W 254V
30kW	3/PE 480V	15kW 20A	15kW 20A	2500W 277V
30kW	3/PE 600V	15kW 16A	15kW 16A	2500W 330V
30kW	3/PE 690V	15kW 16A	15kW 16A	2500W 400V
36kW	3/PE 380-415V	18kW 25A	18kW 25A	3000W 230V
36kW	3/PE 440-460V	18kW 25A	18kW 25A	3000W 254V
36kW	3/PE 480V	18kW 25A	18kW 25A	3000W 277V
36kW	3/PE 600V	18kW 20A	18kW 20A	3000W 345V
36kW	3/PE 690V	18kW 20A	18kW 20A	3000W 400V
45kW	3/PE 380-415V	22,5kW 25A	22,5kW 25A	3750W 230V
48kW	3/PE 480V	24kW 35A	24kW 35A	4000W 400V
48kW	3/PE 690V	24kW 25A	24kW 25A	4000W 400V

ELWA

Date	26.09.2017	Wiring Diagram Heater 4612 WR/12 old C-10452-01	ELWA Elektrowärme München	Schema
Editor	M.Holzner	12 Heating Elements	Frauenstrasse 26	Project start: 29.06.2015
Certif. by	M.Holzner	2x15kW, 2x18kW, 2x22,5kW, 2x24kW	D-82216 Maisach / Germany	Rules: DIN EN 61439-1
Certif. dat.	08.07.2015	Elements Wiring Y		

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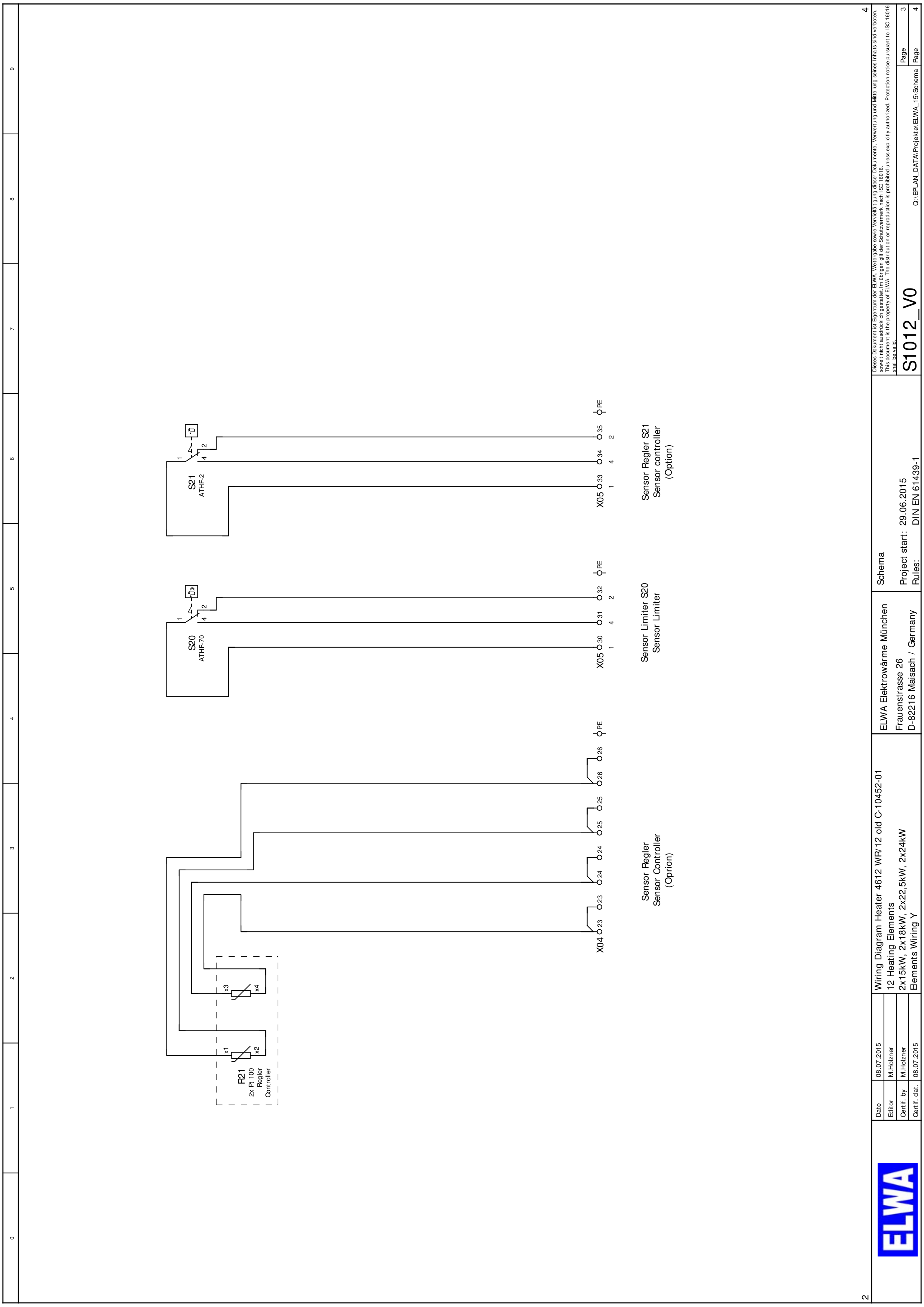
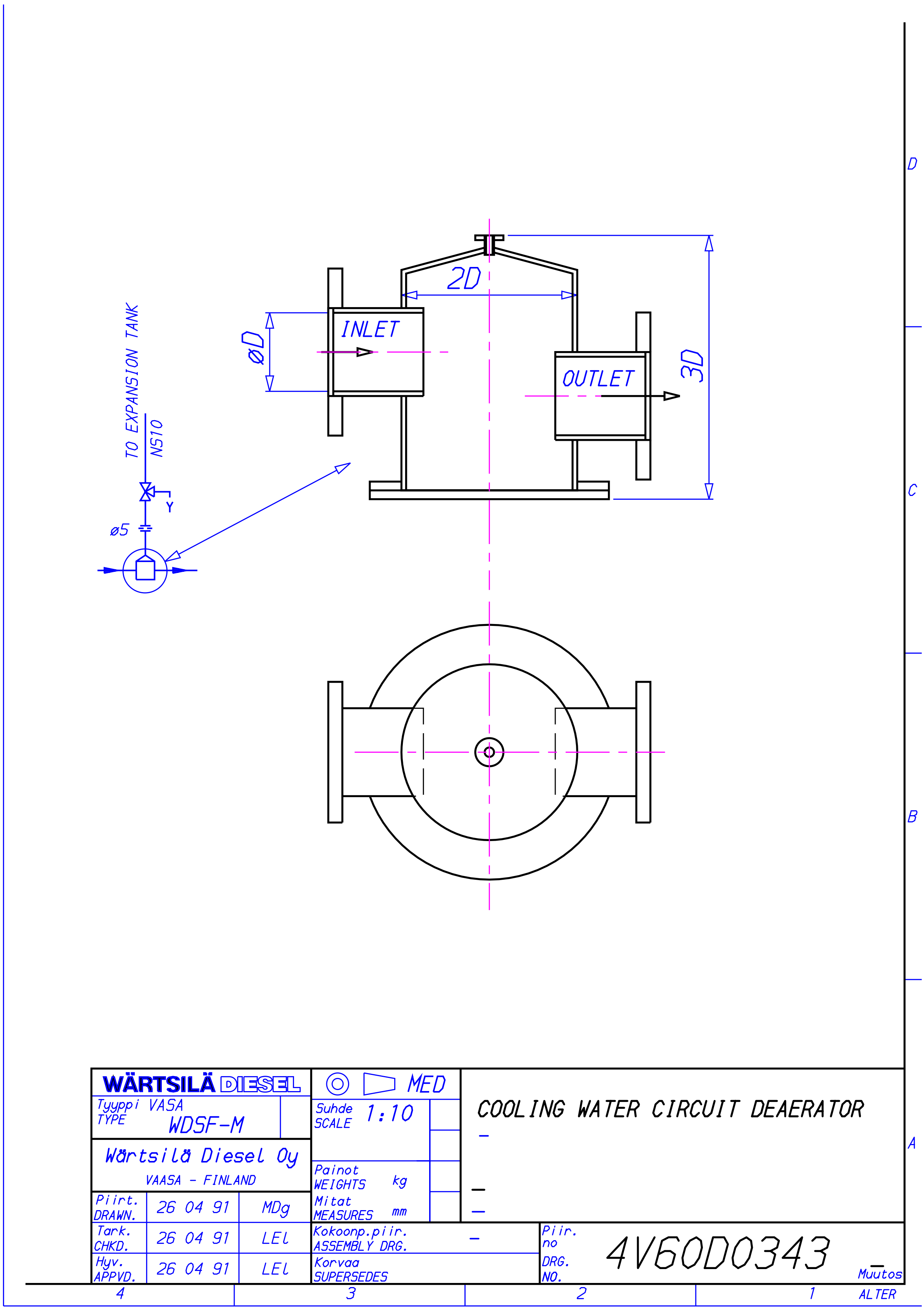
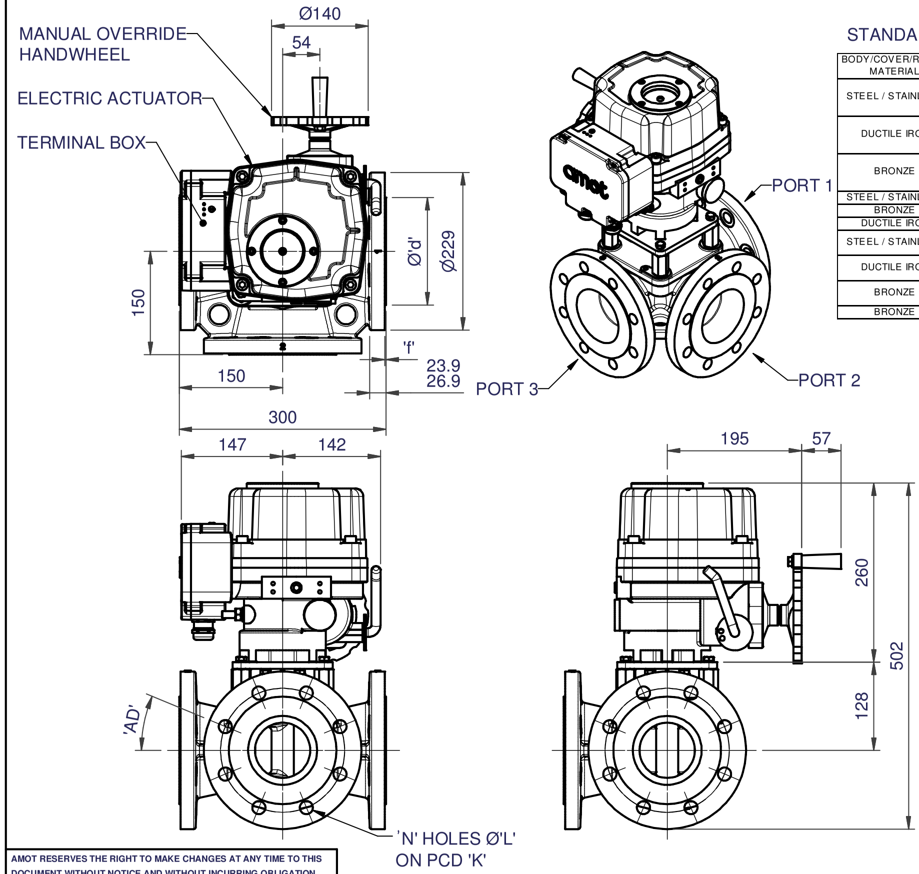
S1012_V0 Q:\EPLAN_DATA\Projekte\ELWA_15\Schema Page 2 Page 4


R21
2x Pt 100
Regler
Controller
x1
x2
x3
x4
X04
23
24
25
26
PE
Sensor Regler
Sensor Controller
(Oprion)
S20
ATHF-70
X05
30
31
32
Sensor Limiter S20
Sensor Limiter
S21
ATHF-2
33
34
35
Sensor Regler S21
Sensor controller
(Option)
ELWA
Date 08.07.2015
Editor M.Holzner
Certif. by M.Holzner
Certif. dat. 08.07.2015
Wiring Diagram Heater 4612 WR/12 old C-10452-01
12 Heating Elements
2x15kW, 2x18kW, 2x22,5kW, 2x24kW
Elements Wiring Y
ELWA Elektrowärme München
Frauenstrasse 26
D-82216 Maisach / Germany
Schema
Project start: 29.06.2015
Rules: DIN EN 61439-1
S1012_V0
Q:\EPLAN_DATA\Projekte\ELWA_15\Schema
Page 3
Page 4


2D
INLET
ØD
OUTLET
3D
TO EXPANSION TANK
N510
Y
ø5
D
C
B
A
WÄRTSILÄ DIESEL
MED
Tyyppi VASA
TYPE
WDSF-M
Suhde
SCALE
1:10
COOLING WATER CIRCUIT DEAERATOR
-
Wärtsilä Diesel Oy
VAASA - FINLAND
Painot
WEIGHTS
kg
Mitat
MEASURES
mm
Piirt.
DRAWN.
26 04 91
MDg
Tark.
CHKD.
26 04 91
LEL
Hyv.
APPVD.
26 04 91
LEL
Kokoonp.piir.
ASSEMBLY DRG.
-
Korvaa
SUPERSEDES
Piir.
no
DRG.
NO.
4V60D0343
-
Muutos
ALTER
4
3
2
1



STANDARD RANGE FLANGE SPECIFICATIONS

BODY/COVER/ROTOR MATERIAL	FLANGE STANDARD	FLANGE RATING	RAISED / FLAT FACE	PCD 'K'	DIA 'L'	No OF HOLES 'n'	ANGULAR DEVIATION 'AD'	RAISED FACE DIA 'd'	RAISED FACE DEPTH 'f'
STEEL / STAINLESS	EN 1092-1	PN 6	RAISED	170	18	4	45	148	2
		PN 10	RAISED	180	18	8	22.5	158	2
		PN 16	RAISED	180	18	8	22.5	158	2
DUCTILE IRON	EN 1092-2	PN 6	RAISED	170	19	4	45	144	3
		PN 10	RAISED	180	19	8	22.5	156	3
		PN 16	RAISED	180	19	8	22.5	156	3
BRONZE	EN 1092-3	PN 6	FLAT	170	18	4	45	N/A	N/A
		PN 10	FLAT	180	18	8	22.5	N/A	N/A
		PN 16	FLAT	180	18	8	22.5	N/A	N/A
STEEL / STAINLESS	ASME B16.5	CLASS 150	RAISED	190.5	19.05	8	22.5	157.2	1.524
BRONZE	ASME B16.24	CLASS 150	FLAT	190.5	19.05	8	22.5	N/A	N/A
DUCTILE IRON	ASME B16.42	CLASS 150	FLAT	190.5	19.05	8	22.5	N/A	N/A
STEEL / STAINLESS	JIS B 2220	CLASS 5K	RAISED	165	19	8	22.5	141	2
		CLASS 10K	RAISED	175	19	8	22.5	151	2
DUCTILE IRON	JIS B 2239	CLASS 5K	FLAT	165	19	8	22.5	N/A	N/A
		CLASS 10K	FLAT	175	19	8	22.5	N/A	N/A
BRONZE	JIS B 2240	CLASS 5K	FLAT	165	19	8	22.5	N/A	N/A
		CLASS 10K	FLAT	175	19	8	22.5	N/A	N/A
BRONZE	MIL-PRF-20042E	CLASS 150	FLAT	166.7	14.3	8	22.5	N/A	N/A

NOTES

1. PRODUCT SPECIFICATIONS:
   - BORE SIZE - DN100 (4")
   - ACTUATION - ELECTRIC
   - TOTAL APPROX WEIGHT - WITH DUCTILE IRON BODY ASSY - 56kg
     - WITH BRONZE BODY ASSY - 65kg
     - WITH STEEL BODY ASSY - 59kg
     - WITH STAINLESS STEEL BODY ASSY - 60kg

   SEE ABOVE TABLE FOR STANDARD RANGE OF FLANGE TYPES

2. ACTUATOR MOUNTED WITH CONDUIT ENTRIES POSITIONED ABOVE PORT CLOSED IN COLD CONDITION

3. FOR PNEUMATICALLY OPERATED VALVES, SEE SHEETS 2 & 3.

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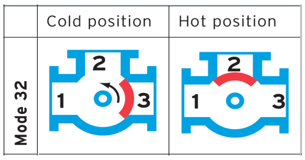
MATERIAL
FINISH
MATERIAL CODE No. MASS (kg) =
TOLERANCES (mm) UNLESS OTHERWISE STATED :-
BASIC ± ONE DEC PLACE ±
ANGLES ± 0.5° TWO DEC PLACES ±
UNLESS STATED OTHERWISE :-
ALL DIMENSIONS IN MILLIMETRES
FINISH N8 (3.2 MICRONS)
REMOVE SHARP EDGES & BURRS
SCALE (A3 PLOT) 1:6
MODEL G VALVE
SPEC. CODE
1st JOB No.

DRAWN BY Varney, Graeme 10/12/2009
REVISED
APPROVED Varney, Graeme 27/01/2010
REVISION DETAILS FOR THIS ISSUE ONLY :-
MOD No. STATUS Released
FIRST ISSUE
DRAWING CONTROL - U.K.
LINKED MODEL - 04GGSDBS32EBAAA-AA REV 1

amot
Bury St Edmunds, UK; Richmond, California, USA & Shanghai, China
TITLE
OUTLINE DRAWING
DN100 (4") G VALVE, STANDARD FLOW
SIZE A3 DRAWING NUMBER 04GGS SHT 1 OF 3 ISSUE 1

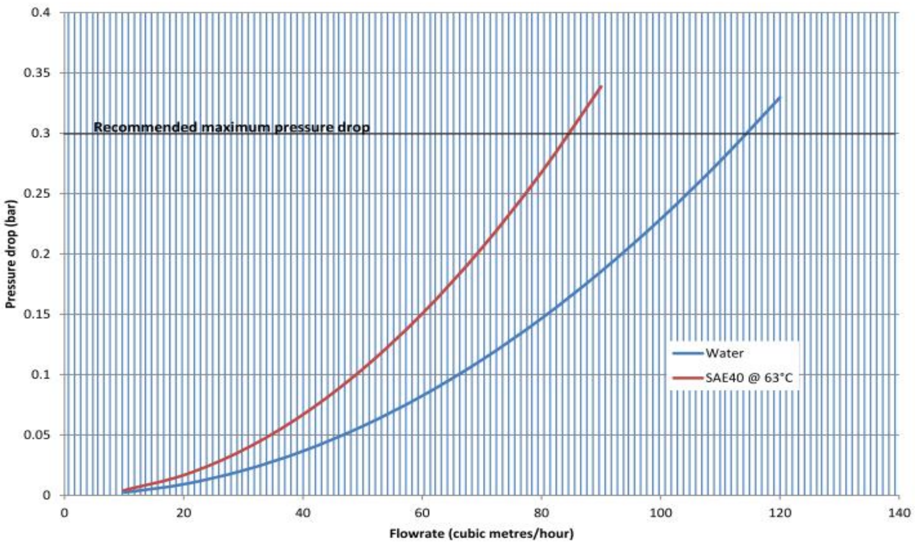
Temperature Control Valve (AMOT)

Technical Specification



Size and Model		DN100
Maximum flow		113 m³/h @ 0,3 bar
Body		Ductile iron
Flanges		PN10, EN1092
Rotor		Standard
Operating mode		Turning anticlockwise from cold position
Actuator		Electric
Actuator power supply		100 - 120 VAC 50/60 Hz
Actuator control input		4 - 20 mA
Actuator feedback		Position retransmit
Special option		Standard product
Kv	209	m3/h, & bar & SG
Cv	242	US gal / min & PSI & SG
Weight	56 kg	

Valve Flowrate Selection Type 04GGS



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7. Combustion Air System

7.1 System overview

The combustion air is delivered to the engine through a dedicated duct which is connected to the air intake with a flexible connection piece. The protect the turbocharger a filter must be built into the air duct. For the required amount of combustion air, see the section for "*Technical data*".

7.2 System design data

7.2.1 Combustion air quality

During normal operating conditions the air temperature at the turbocharger inlet should be kept between 15°C and 35°C. Max. 45°C is allowed.

7.3 Recommended functions

7.3.1 Engine room ventilation

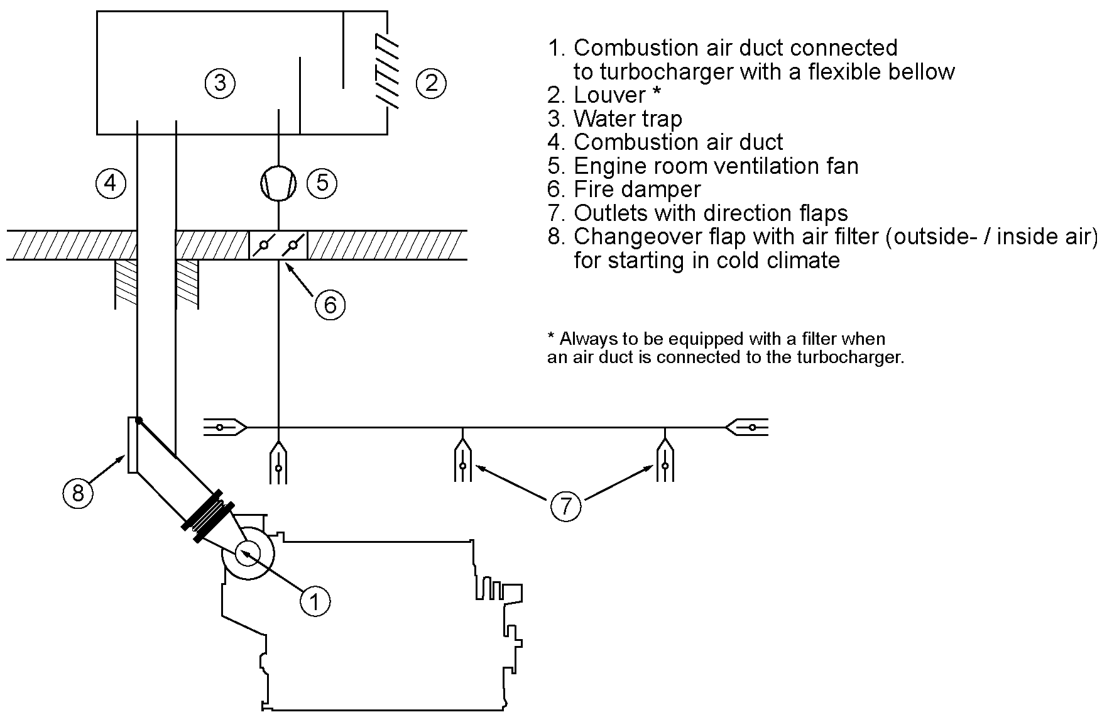


Fig 7-1 Engine room ventilation, air duct connected to the turbocharger.

To maintain acceptable operating conditions for the engines and to ensure trouble free operation of all equipment, attention shall be paid to the engine room ventilation and the supply of combustion air. The air intakes to the engine room must be located in a way that water spray, rain water, dust and exhaust gases cannot enter the ventilation ducts and the engine room. The dimensioning of blowers and extractors should ensure that an over pressure of about 5 mmWC is maintained in the engine room in all running conditions.

For the minimum requirements concerning the engine room ventilation and more details, see applicable standards, such as ISO 8861.

The amount of air required for ventilation is calculated from the total heat emission Φ to evacuate. To determine Φ, all heat sources shall be considered, e.g.:

- main and auxiliary diesel engines
- exhaust gas piping
- generators
- electric appliances and lighting
- boilers
- steam and condensate piping
- tanks
- other auxiliary equipment

It is recommended to consider an outside air temperature of not less than 35°C and a temperature rise of 11°C for the ventilation air.

The amount of air required for ventilation is then calculated from the formula:

$$q_V = \frac{\Phi}{\rho \times c \times \Delta T}$$

where:

q_v = Amount of ventilation air [m^3/s]

Φ = total heat emission to be evacuated [kW]

ρ = density of ventilation air 1.13 kg/m^3

c = Specific heat capacity of the ventilation air 1.01 kJ/kgK

ΔT = Temperature rise in engine room [°C]

The engine room ventilation has to be provided by separate ventilation fans. These fans should preferably have two-speed electric motors (or variable speed). Thus flexible operation is possible, e.g. in port the capacity can be reduced during overhaul of the main engine when it is not preheated (and therefore not heating the room). The ventilation air is to be equally distributed in the engine room considering air flows from points of delivery towards the exits. This is usually done so that the funnel serves as an exit for the majority of the air. To avoid stagnant air, extractors can be used. It is good practice to provide areas with significant heat sources, such as separator rooms with their own air supply and extractors.

For very cold conditions a preheater in the system should be considered. Suitable media could be thermal oil or water/glycol to avoid the risk for freezing. If steam is specified as a heating system for the ship the preheater should be in a secondary circuit.

7.3.2 Combustion air for engines

The combustion air shall be supplied by separate combustion air fans, with a capacity slightly higher than the maximum air consumption. For the required amount of combustion air, see the section "*Technical data*". The combustion air mass flow stated in technical data is defined for an ambient air temperature of 25°C. Calculate with an air density corresponding to 30°C or more when translating the mass flow into volume flow. The expression below can be used to calculate the volume flow.

$$q_c = \frac{m'}{\rho}$$

where:

q_c = combustion air volume flow [m³/s]

m' = combustion air mass flow [kg/s]

ρ = air density 1.15 kg/m³

The fans should preferably have a two-speed electric motors (or variable speed) for enhanced flexibility. In multi-engine installations each main engine should preferably have its own combustion air fan. Thus the air flow can be adapted to the number of engines in operation.

The combustion air should be delivered through a dedicated duct close to the turbocharger, directed towards the turbocharger air intake connected to the turbocharger with a flexible connection piece. To protect the turbocharger a filter must be built into the air duct. The permissible pressure drop in the duct is max. 1.5 kPa. The outlet of the duct should be equipped with a flap for controlling the direction and amount of air. Also other combustion air consumers like other engines, gas turbines and boilers shall be served by dedicated combustion air ducts.

In special cases the duct can be connected directly to the turbocharger, with a stepless change-over flap to take the air from the engine room or from outside depending on engine load.

NOTE

During sudden load decrese or emergency stops, the turbocharger compressor may stall. This means a temporary change in direction of flow of combustion air. The change of direction can result in a overpressure up to 0.5 bar. This phenomena is referred to as “turbocharger surging” and can be recognized by a sound bang.

With these arrangements the normally required minimum air temperature to the main engine, see section "*Recommendations for operation*", can typically be maintained. For lower temperatures special provisions are necessary.

7.3.3 Condensation of charge air coolers

Condensed water from the charge air coolers is normally drained to the bilge. The condensation can be estimated according to the example below.

Example, according to the diagram:

At an ambient air temperature of 35°C and a relative humidity of 80%, the content of water in the air is 0.029 kg water/ kg dry air. If the air manifold pressure (receiver pressure) under these conditions is 2.5 bar (= 3.5 bar absolute), the dew point will be 55°C. If the air temperature in the air manifold is only 45°C, the air can only contain 0.018 kg/kg. The difference, 0.011 kg/kg (0.029 - 0.018) will appear as condensed water.

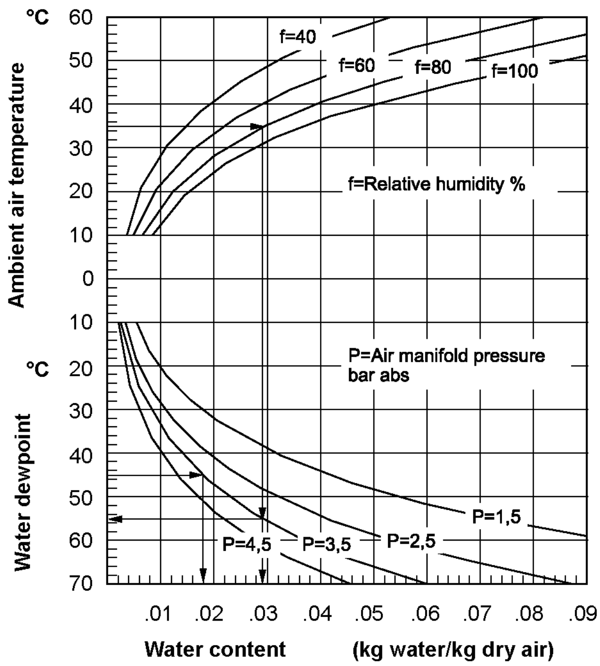


Fig 7-2 Condensation in charge air coolers

8. Exhaust Gas System

8.1 System overview

Each engine should have its own exhaust pipe into open air.

8.1.1 Engine internal system

The equipment built on the engine is shown in the drawing "*internal charge air & exhaust gas system*".

8.2 Recommendations and design data

8.2.1 Exhaust gas piping

The piping should be as short and straight as possible. Pipe bends and expansions should be smooth to minimize the back pressure, the max. back pressure is stated in section "*Technical data*". The diameter of the exhaust pipe should be increased directly after the bellows on the turbocharger. Pipe bends should be made with the largest possible bending radius; the bending radius should not be smaller than 1.5 x D.

The recommended flow velocity in the pipe is maximum 35…40 m/s at full output. If there are many resistance factors in the piping, or the pipe is very long, then the flow velocity needs to be lower. The exhaust gas mass flow given in the section for Technical data can be translated to velocity using the formula:

$$v = \frac{4 \times m'}{1.3 \times \left(\frac{273}{273 + T}\right) \times \pi \times D^2}$$

where:	
v =	gas velocity [m/s]
m' =	exhaust gas mass flow [kg/s]
T =	exhaust gas temperature [°C]
D =	exhaust gas pipe diameter [m]

Each exhaust pipe should be provided with a connection for measurement of the back pressure. The connection must be accessible outside the insulation. The recommended location of the connection is close to the engine, but not closer than 3...5 pipe diameters from the transition to larger pipe diameter after the bellows on the turbocharger. Neither should the connection be closer than 3...4 pipe diameters after a 90 degree pipe bend. In cases where the recommended location is impossible, make the connection as close as possible to the recommended location. The connection should be installed while the exhaust gas outlet on the turbocharger is protected with a cover.

The exhaust gas pipe should be provided with water separating pockets and drainage.

The exhaust pipe must be insulated with insulation material approved for concerned operation conditions, minimum thickness 30 mm considering the shape of engine mounted insulation. Insulation has to be continuous and protected by a covering plate or similar to keep the insulation intact.

Closest to the turbocharger the insulation should consist of a hook on padding to facilitate maintenance. It is especially important to prevent the airstream to the turbocharger from detaching insulation, which will clog the filters.

After the insulation work has been finished, it has to be verified that it fulfils SOLAS-regulations. Surface temperatures must be below 220°C on whole engine operating range.

8.2.2 Sampling port for gaseous emissions

If exhaust gas emissions are to be analyzed the sampling probes shall be fitted at least 10 pipe diamenters after the last exhaust gas aftertreatment device. If no exhaust gas aftertreatment device is used, the probes should be at least 0,5 meters or 3 pipe diameters (whichever is greater) upstream of the exit of the exhaust gas system. It is recommended to have a 0,5" sampling port with a threaded plug sticking out from the insulation (with threads on the outside of the pipe).

8.2.3 Supporting

It is very important that the exhaust pipe is properly fixed to a support rigid in all directions directly after the bellows on the turbocharger. The bellows on the turbocharger may not be used to absorb thermal expansion from the exhaust pipe. The first fixing point must direct the thermal expansion away from the engine and be located max. 3 diameters (bellows) away from the bellows on the turbocharger. There should be a fixing point on both sides of the pipe at the support. Absolutely rigid mounting between the pipe and the support is recommended at the first fixing point after the turbocharger. Resilient mounts can be accepted for resiliently mounted engines with long bellows, provided that the mounts are self-captive; maximum deflection at total failure being less than 2 mm radial and 4 mm axial with regards to the bellows. The natural frequencies of the mounting should be on a safe distance from the running speed, the firing frequency of the engine and the blade passing frequency of the propeller. The resilient mounts can be rubber mounts of conical type, or high damping stainless steel wire pads. Adequate thermal insulation must be provided to protect rubber mounts from high temperatures. When using resilient mounting, the alignment of the exhaust bellows must be checked on a regular basis and corrected when necessary.

After the first fixing point resilient mounts are recommended. The mounting supports should be positioned at stiffened locations within the ship’s structure, e.g. decklevels, framewebs or specially constructed supports.

The supporting must allow thermal expansion and ship’s structural deflections.

8.2.4 Back pressure

The back pressure in the system must be calculated by the shipyard based on the actual piping design and the resistance of the components in the exhaust system. The exhaust gas mass flow and temperature given in section "*Technical data*" may be used for the calculation.

The back pressure must be measured by the shipyard during the sea trial. The measurement can be done according to the following arrangement.

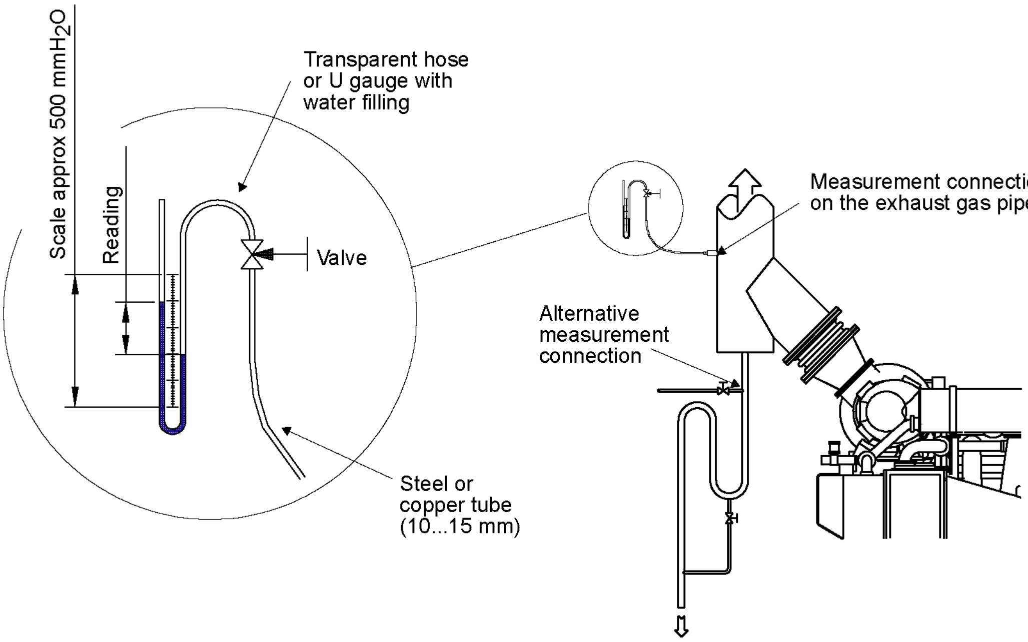


Fig 8-1 Exhaust gas back pressure measurement

8.2.5 Exhaust gas bellows (5H01)

Bellows must be used in the exhaust gas piping where thermal expansion or ship's structural deflections have to be segregated. The flexible exhaust gas bellows mounted directly on the turbocharger outlet serves to minimise the external forces on the turbocharger and thus prevent vibrations and possible damage. All exhaust gas bellows must be of an approved type.

8.2.6 Selective Catalytic Reduction (11N03)

If SCRs will be installed, the exhaust gas piping must be straight at least 3...5 meters in front of the SCR. If both an exhaust gas boiler and a SCR unit will be installed, then the exhaust gas boiler shall be installed after the SCR. Arrangements must be made so that when cleaning the exhaust gas boiler with water, the cleaning water cannot spill down into the SCR.

8.2.7 Exhaust gas silencer (5R02)

Yard/designer should take into account that unfavorable layout of the exhaust system (length of straight parts in the exhaust system) might cause amplification of the exhaust noise between engine outlet and the silencer. Hence the attenuation of the silencer does not give any absolute guarantee for the noise level after the silencer.

8.2.8 Exhaust gas boiler

If exhaust gas boilers will be installed, each engine should have a separate exhaust gas boiler. Alternatively, a common boiler with separate gas sections for each engine is acceptable.

For dimensioning the boiler, the exhaust gas quantities and temperatures given in section "*Technical data*" may be used.

8.3 Installation instructions

8.3.1 Exhaust gas bellow (5H01)

The exhaust gas bellow shall be installed directly on the turbocharger outlet, to compensate for thermal expansion and prevent damages to the turbocharger due to vibrations.

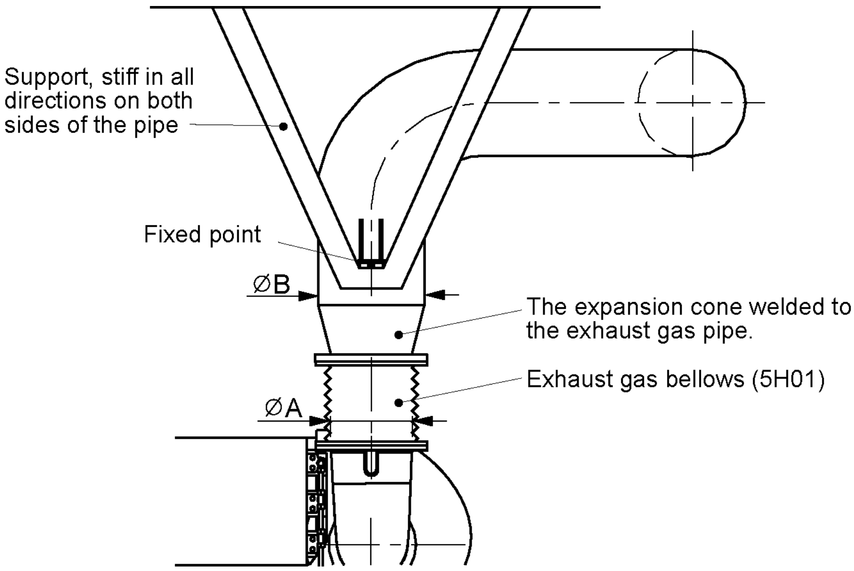


Fig 8-2 Overview of exhaust gas pipe installation.

Dimension A in the figure above is stated in the engine drawing.

Installation procedure:

1 The engine or generating set should be installed in its final position before any external pipes are connected.

2 Remove the protection cover from the exhaust gas outlet on the turbocharger. Be very careful while there is no cover. Dirt or foreign object may absolutely not drop into the turbocharger.

3 In order to achieve the correct installation length for the bellows a new cover with approximately the same thickness as the gasket has to be prepared. This cover will be used between the turbocharger and the bellows while welding and cutting is being performed on the exhaust pipe.

4 Check the flow direction of the bellows from the dimensional drawing and install it on the turbocharger with the recently prepared protection cover between the flanges. Fasten the bellows temporarily with at least four screws. Tighten the screws sufficiently to ensure that the flanges are pulled together properly.

NOTE

Do not remove the supports between the flanges of the bellows until all parts have been installed and the exhaust gas pipe is rigidly fixed.

5 Manufacture an adapter piece (expansion cone) that will fit both the flange on the flexible bellows and the exhaust pipe diameter. The minimum recommended diameter of the exhaust pipe is always larger than the diameter of the flexible bellows. The pipe expansion must be made as a cone with a diffuser angle not larger than 30° (max.15° between centerline and wall).

6 Weld the flange that connects to the bellows to the expansion cone.

7 Trim or extend the exhaust pipe so that the expansion cone fits between the bellows and the exhaust pipe (gap between parts should not be larger than suitable for welding).

8 Install the expansion cone on the bellow, using the correct gasket between the flanges. Connect the flanges temporarily with a number of screws. Use a sufficient number of screws to ensure that the flanges are pulled together properly. If the exhaust gas outlet of the turbocharger is in a tilted or horizontal position, then

temporary supporting of the expansion cone and the bellows is needed during the installation.

9 Align the exhaust gas pipe to the expansion cone. Do not force the expansion cone in any direction.

NOTE

The exhaust gas outlet of a resiliently mounted engine will usually be displaced due to the torque reaction as the engine load increases. In some cases it is necessary to compensate for the torque reaction by installing the exhaust gas pipe with an initial lateral offset. Thus, if the engine is resiliently mounted, please refer to the alignment instructions of the engine.

In the case of a flexibly mounted generating set, which has a common base frame, there is no lateral displacement due to the torque reaction.

10 Anchor the exhaust gas pipe to the ship structure as close as possible to the flange of the expansion cone. The supports must be made very rigid in order to prevent vibration and movement of the exhaust gas pipe.

11 Weld the expansion cone to the exhaust gas pipe.

12 Remove the temporary supports between the flanges of the flexible bellow.

13 Remove the flexible bellows. Keep the protection cover over the turbocharger outlet all the time.

14 Clean the exhaust gas pipe from slag and particles developed during the welding. Again, remember to keep the entry into the turbocharger covered.

15 Remove the protection cover and install the bellows with the appropriate gaskets.

16 Lubricate the threads of all screws with heat resistant grease and tighten in a diagonal sequence.

Refer to the drawing "*exhaust gas bellows*" drawing for dimensions and flow direction.

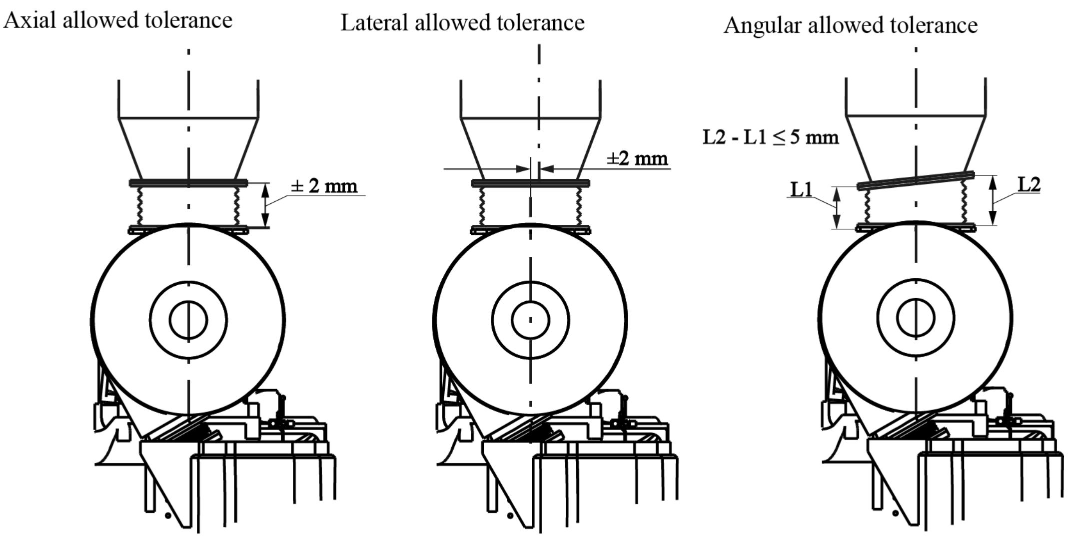


Fig 8-3 Installation tolerances for exhaust gas bellows

8.4 Component data, Wärtsilä scope of supply

8.4.1 Exhaust gas bellows (5H01)

Quantity 1

Type .... Single

Lenght, installation (mm) 280.0

Connection (DN) 350

Counter flanges .... Without

Dimensional drawing DAAB761886

8.4.2 Exhaust gas silencer with spark arrestor (CSS) (5R02)

Quantity 1

Type .... MS-CPWAEXG-WSA NS550/ 35 DB(A)

Connection (DN) NS550

Attenuation (dB(A)) 35

Mounting bracket .... With

Dimensional drawing 3ES12541

Installation instruction 4ES0061

Engine type W26, W32

8.4.3 Exhaust gas pipe bellows (5H03)

Quantity 1

Type .... Double

Lenght, installation (mm) 560.0

Connection (DN) 550

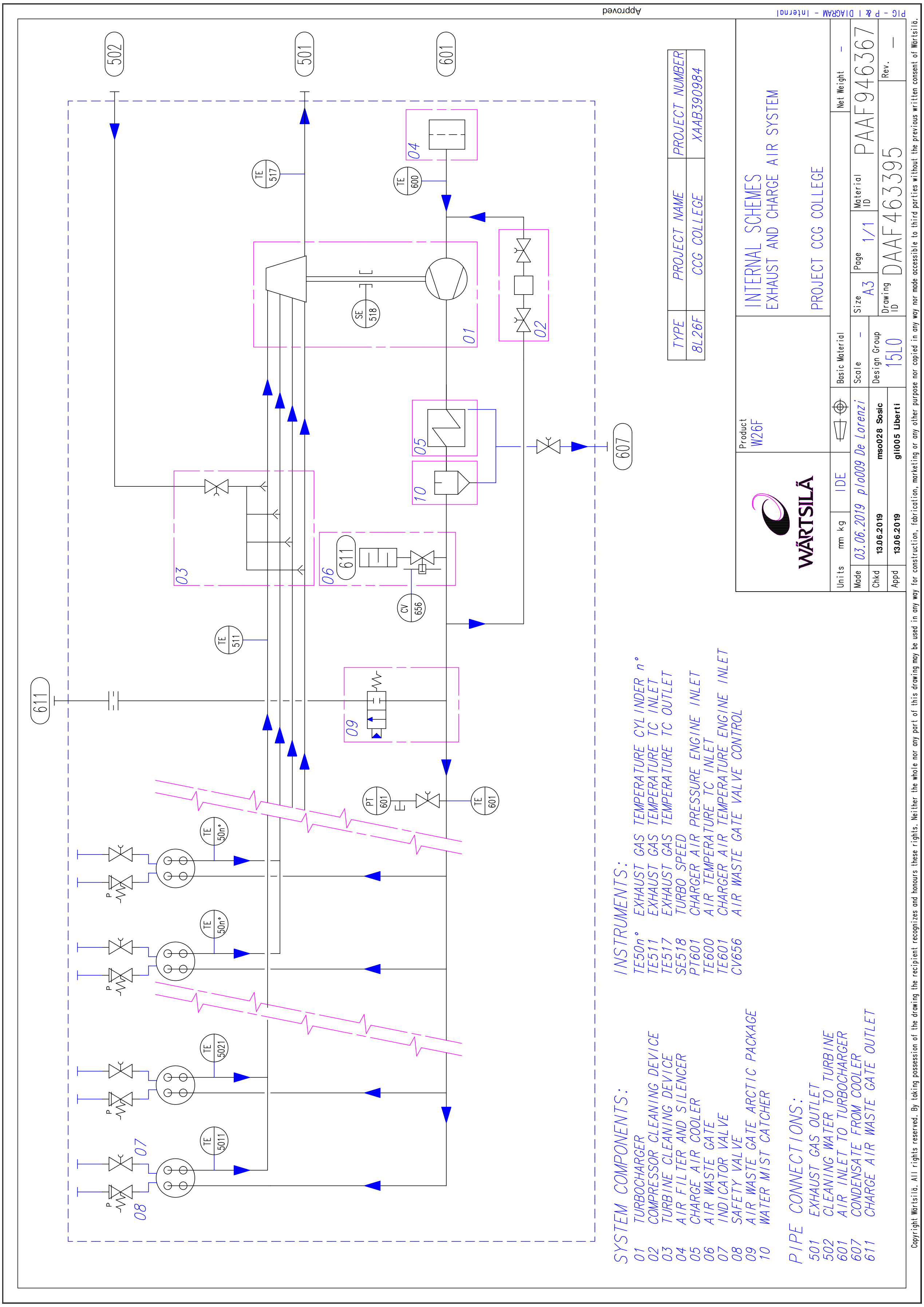
Dimensional drawing DAAF054137

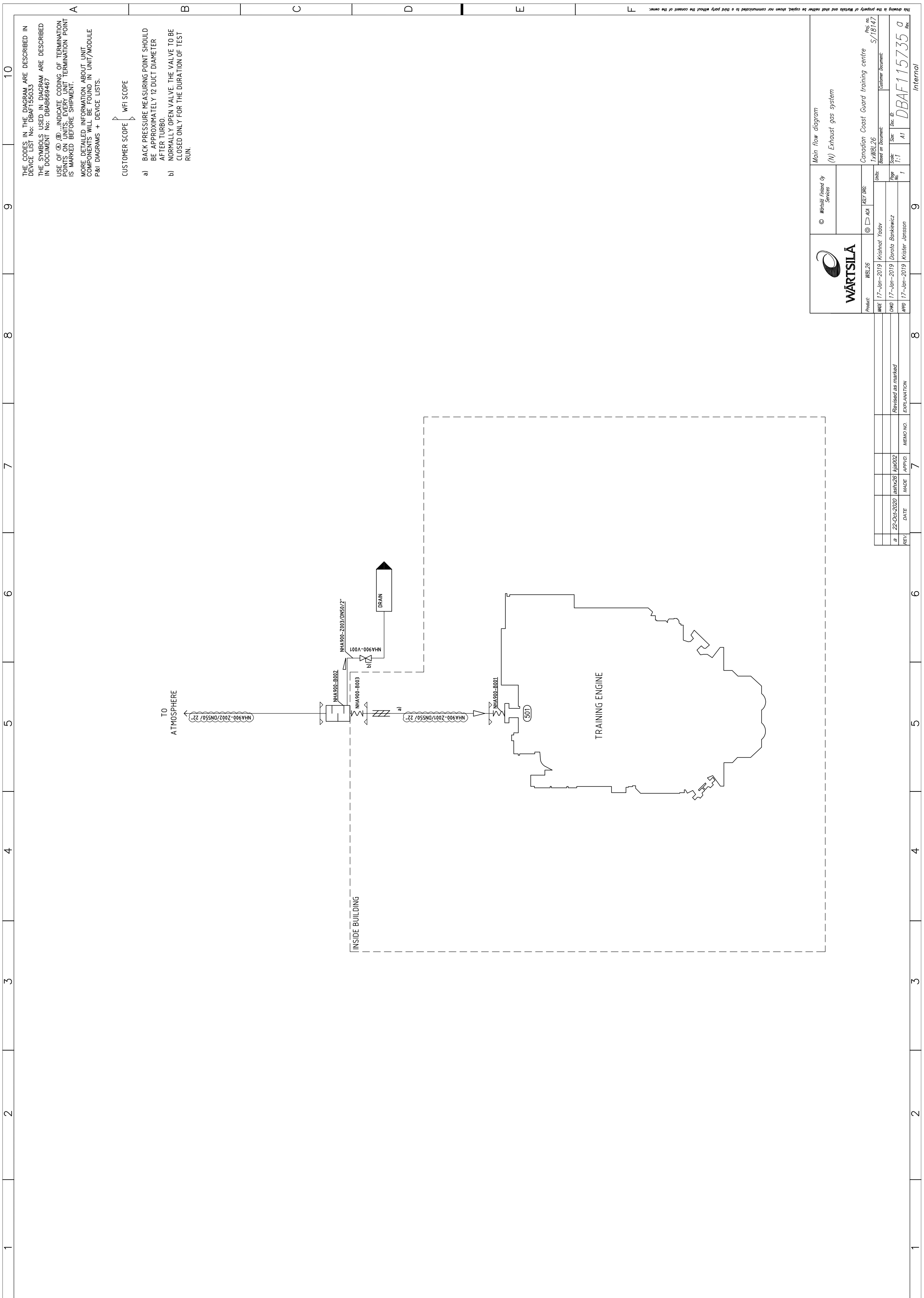
8.4.4 Exhaust gas pipe support

Quantity 2

Type .... DN550 Horizontal supports for exhaust pipe

8.5 List of Documents


SYSTEM COMPONENTS:
01 TURBOCHARGER
02 COMPRESSOR CLEANING DEVICE
03 TURBINE CLEANING DEVICE
04 AIR FILTER AND SILENCER
05 CHARGE AIR COOLER
06 AIR WASTE GATE
07 INDICATOR VALVE
08 SAFETY VALVE
09 AIR WASTE GATE ARCTIC PACKAGE
10 WATER MIST CATCHER
INSTRUMENTS:
TE50n° EXHAUST GAS TEMPERATURE CYLINDER n°
TE511 EXHAUST GAS TEMPERATURE TC INLET
TE517 EXHAUST GAS TEMPERATURE TC OUTLET
SE518 TURBO SPEED
PT601 CHARGER AIR PRESSURE ENGINE INLET
TE600 AIR TEMPERATURE TC INLET
TE601 CHARGER AIR TEMPERATURE ENGINE INLET
CV656 AIR WASTE GATE VALVE CONTROL
PIPE CONNECTIONS:
501 EXHAUST GAS OUTLET
502 CLEANING WATER TO TURBINE
601 AIR INLET TO TURBOCHARGER
607 CONDENSATE FROM COOLER
611 CHARGE AIR WASTE GATE OUTLET
TYPE 8L26F
PROJECT NAME CCG COLLEGE
PROJECT NUMBER XAAB390984
INTERNAL SCHEMES
EXHAUST AND CHARGE AIR SYSTEM
PROJECT CCG COLLEGE
Product W26F
WÄRTSILÄ
Units mm kg
Made 03.06.2019 pl0009 De Lorenzi
Chkd 13.06.2019 mso028 Sosic
Appd 13.06.2019 gli005 Liberti
Basic Material -
Scale -
Size A3
Page 1/1
Design Group 15L0
Drawing ID DAAF463395
Material ID PAAF946367
Net Weight -
Rev. -
PIG - P & I DIAGRAM - Internal
Approved


THE CODES IN THE DIAGRAM ARE DESCRIBED IN DEVICE LIST No: DBAF155033
THE SYMBOLS USED IN DIAGRAM ARE DESCRIBED IN DOCUMENT No: DBAB669467
USE OF A, B ...INDICATE CODING OF TERMINATION POINTS ON UNITS. EVERY UNIT TERMINATION POINT IS MARKED BEFORE SHIPMENT.
MORE DETAILED INFORMATION ABOUT UNIT COMPONENTS WILL BE FOUND IN UNIT/MODULE P&I DIAGRAMS + DEVICE LISTS.
CUSTOMER SCOPE
WFI SCOPE
a) BACK PRESSURE MEASURING POINT SHOULD BE APPROXIMATELY 12 DUCT DIAMETER AFTER TURBO.
b) NORMALLY OPEN VALVE. THE VALVE TO BE CLOSED ONLY FOR THE DURATION OF TEST RUN.
TO ATMOSPHERE
DRAIN
INSIDE BUILDING
TRAINING ENGINE
501
Main flow diagram
(N) Exhaust gas system
Canadian Coast Guard training centre
1xW8L26
S/18147
DBAF115735 a
Internal
Product: W8L26
MADE 17-Jan-2019 Krishnat Yadav
CHKD 17-Jan-2019 Dorota Bankiewicz
APPD 17-Jan-2019 Krister Jansson
Scale: 1:1
Size: A1
Page No. 1
a 22-Oct-2020 Revised as marked
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MAIN EQUIPMENT LIST

Tag	Description	Detail P&ID	Device list No	Dim DWG No	El. Panel	L (m)	W (m)	H (m)	Weight (kg)	Scope	Notes

System design data:

Exhaust Gas System, Gas: Maximum allowed temperature: 480°C, Maximum allowed pressure: 0.5 bar(g), Test pressure: -

Notes:

Refer dwg no:

Equipment coded 90_ is for engine one.

Coding: The coding system is explained in Power Plants grouping & coding of processes & signals document no: 4V75L0112

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(N) Exhaust gas system**	Classification **Confidential**	Made By **Arbeyaz Shaikh**	Date **26-Oct-2020**	Document ID **DBAF155033**	Page **1/2**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115735**	Approved by: **Krister Jansson**	Date **27-Oct-2020**	Revision **a**	

DN = Diameter Nominal
PN = Pressure Nominal

Nom. t = Nominal temperature
Oper. t = Operating temperature

DEVICE LIST

Tag Customer tag	Device name Description	C	Drawing No. Material No.	Model Number / Type Manufacturer	Size PN	Enclosure Standard	O.flow O.pres.	Nom.t Oper.t	Range PED	Power Voltage	Scope Rev.	Mat.Remarks Additional Remarks
NHA900-B001	EXHAUST GAS BELLOW EXHAUST GAS FROM ENGINE	V			DN 350/14"						WFI -	IPI
NHA900-B002	EXHAUST GAS SILENCER EXHAUST GAS FROM ENGINE	S			DN 550/ 22"						WFI a	IPI
NHA900-B003	EXHAUST GAS BELLOW EXHAUST GAS INLET TO SILENCER	V			DN 550/ 22"						WFI a	IPI
NHA900-V001	BALL VALVE DRAIN FROM SILENCER	V		STAINLESS STEEL	DN 50/2"						CUST -	
NHA900-Z001	STEEL DUCT EXHAUST GAS FROM ENGINE	L		, Cor-Ten A ASTM A606	DN 550/ 22"						CUST. a	
NHA900-Z002	STEEL DUCT EXHAUST GAS FROM ENGINE	L		, Cor-Ten A ASTM A606	DN 550/ 22"						CUST. a	
NHA900-Z003	STEEL PIPE DRAIN FROM SILENCER	L		, STAINLESS STEEL ASTM A312	DN50/2"						CUST. -	

WÄRTSILÄ	Project Name **Canadian Coast Guard training centre**	System / Name **(N) Exhaust gas system**	Classification **Confidential**	Made By **Arbeyaz Shaikh**	Date **26-Oct-2020**	Document ID **DBAF155033**	Page **2/2**
	Project Number **P/18147**	Description **Device list**	Ref.Doc.No. **DBAF115735**	Approved by: **Krister Jansson**	Date **27-Oct-2020**	Revision **a**	

WÄRTSILÄ	© Wärtsilä Finland Oy Marine Solutions	**Installation of exhaust gas temperature sensor in the exhaust gas pipe system**

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Subtitle	Product	Made	D Klemets	9.1.2019	Page	Document No.	Rev.
	-	Apprvd	T Södö	18.2.2019	1 (4)	DMTA00001210	**A**

Rev.	Date	Made	Approved	Explanation
A	27.8.2019	dkl004	mtu009	Document converted to multifile (word + pdf)

Introduction

This installation instruction is applicable for Wärtsilä engines equipped with exhaust gas temperature sensors that shall be installed in the exhaust gas pipe system after the turbo charger outlet. Depending on the engine design there are two different temperature sensor configurations:

- one sensor, TE517
- two sensors, TE517, TE527 or TE537

The sensor(s) are pre-wired at the factory and are temporarily located close to the turbo charger during the delivery of the engine. The length of the included cable is project specific. For additional information see separate instructions in the project specific documentation.

The engine will only pass commission checking if cable and sensor(s) are installed according to instructions.

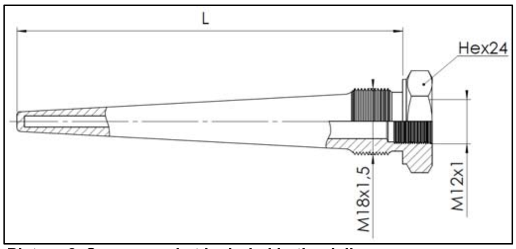
Picture 1. Example of a pre-wired sensor including the cable temporarily located close to the turbo charger

Page	Document No.	Rev.
2 (4)	DMTA00001210	A

Installation of the sensor at the site

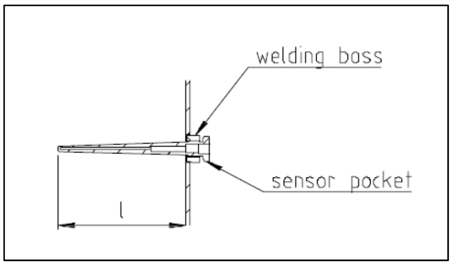
The sensor(s) should be installed at the same time as the exhaust gas pipe and exhaust gas bellows (5H01) are installed at the site.

The sensor is installed inside a M18x1.5 pocket at the factory. Grease, Loctite LB 8009, should be applied to the pocket threads and sensor threads before installation. Grease is to be applied to the threads only. Fastening torque for the pocket max 90 Nm and for the sensor max 15 Nm.



Picture 2. Sensor pocket included in the delivery

The cable is routed outside of the insulation and sensor and pocket installed in a M18x1.5 boss welded to the exhaust gas pipe. The welding boss is provided by the customer. The sensor pocket should be inserted as deep as possible into the exhaust gas pipe without any additional distance piece between the sensor pocket and welding boss. Maximized length “l” is shown in picture 3.



Picture 3. Welding boss and installed sensor pocket

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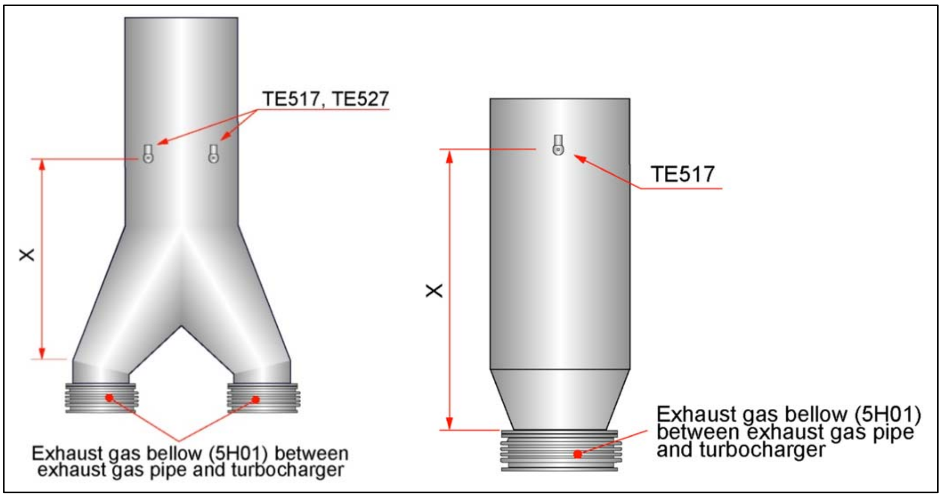
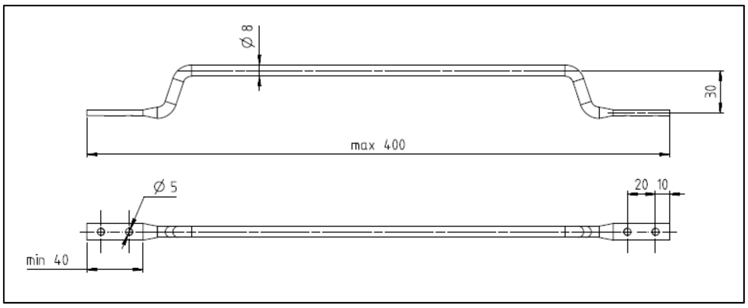
3 (4)	DMTA00001210	A

The sensor(s) shall be located according to recommended distance (“X” picture 4) in the project specific documentation.



Picture 4. Exhaust gas temperature sensor location example

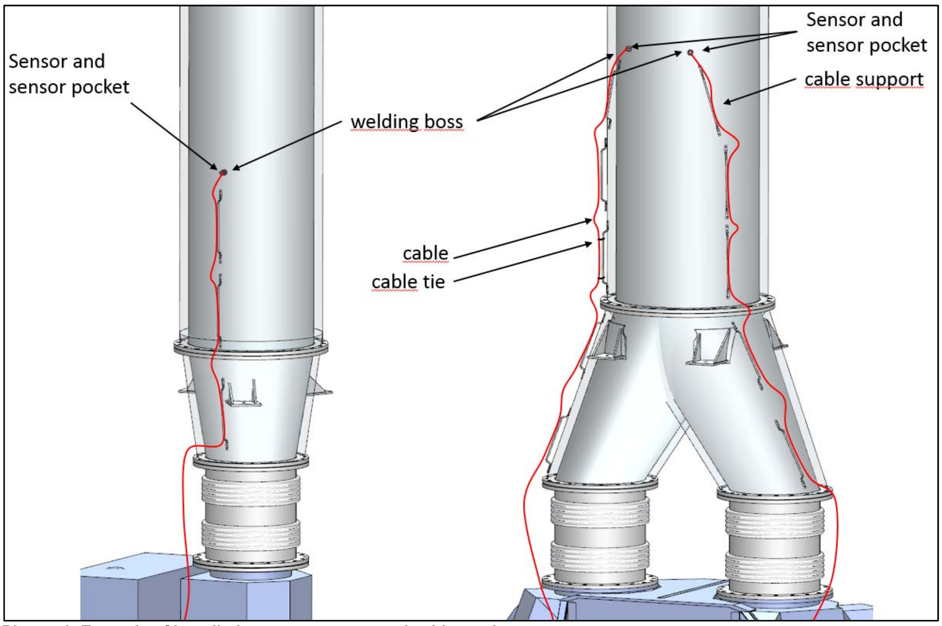
The cable should be installed using supports made of metal, e.g. flat bars, steel pipes bent and flattened or similar. The supports are fastened to the insulation cover steel plates with steel rivets and the cable is firmly fastened to the supports with metal cable ties.



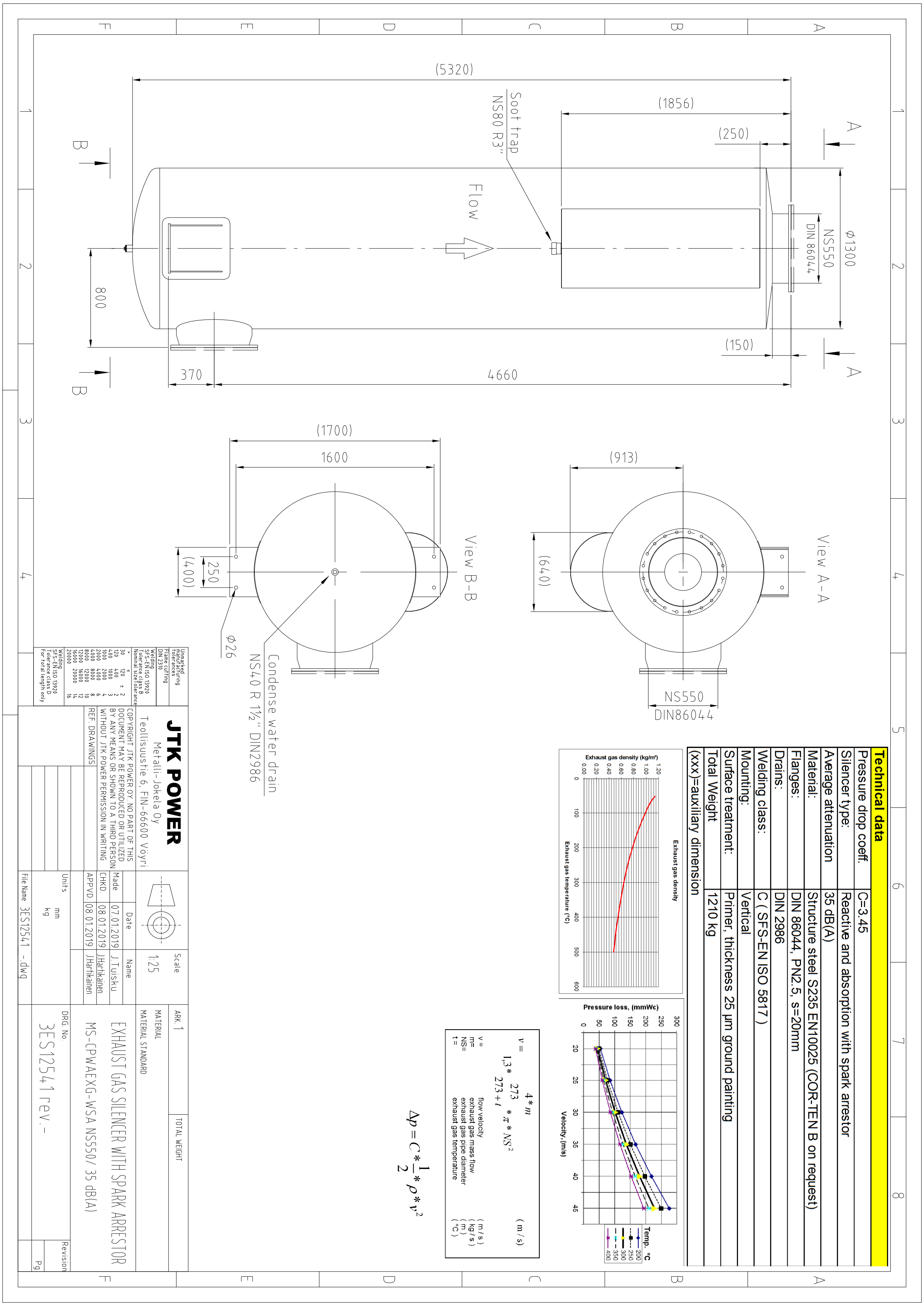
Picture 5. Example of cable support

Page	Document No.	Rev.
4 (4)	DMTA00001210	A

The edge of the first support above the flexible bellows should be located approximately 50mm from the edge of the bellows flange. Note to reserve some extra cable length over the exhaust gas bellows to overcome movements between the engine and the exhaust gas pipe.



Picture 6. Example of installed sensor supports and cable routing


(5320)
(1856)
(250)
(150)
Soot trap
NS80 R3"
Flow
Φ1300
NS550
DIN 86044
800
370
4660
(1700)
1600
(400)
250
Φ26
View B-B
Condense water drain
NS40 R 1½" DIN2986
(913)
(640)
View A-A
NS550
DIN86044
Technical data
Pressure drop coeff.: C=3.45
Silencer type: Reactive and absorption with spark arrestor
Average attenuation: 35 dB(A)
Material: Structure steel S235 EN10025 (COR-TEN B on request)
Flanges: DIN 86044, PN2.5, s=20mm
Drains: DIN 2986
Welding class: C (SFS-EN ISO 5817)
Mounting: Vertical
Surface treatment: Primer, thickness 25 µm ground painting
Total Weight: 1210 kg
(xxx)=auxiliary dimension
Exhaust gas density (kg/m³)
Exhaust gas temperature (°C)
Pressure loss, (mmWc)
Velocity,(m/s)
Temp. °C
$\Delta p = C * \frac{1}{2} \rho * v^2$
v = flow velocity (m/s)
m= exhaust gas mass flow (kg/s)
NS= exhaust gas pipe diameter (m)
t= exhaust gas temperature (°C)
JTK POWER
Metalli-Jokela Oy
Teollisuustie 6, FIN-66600 Vöyri
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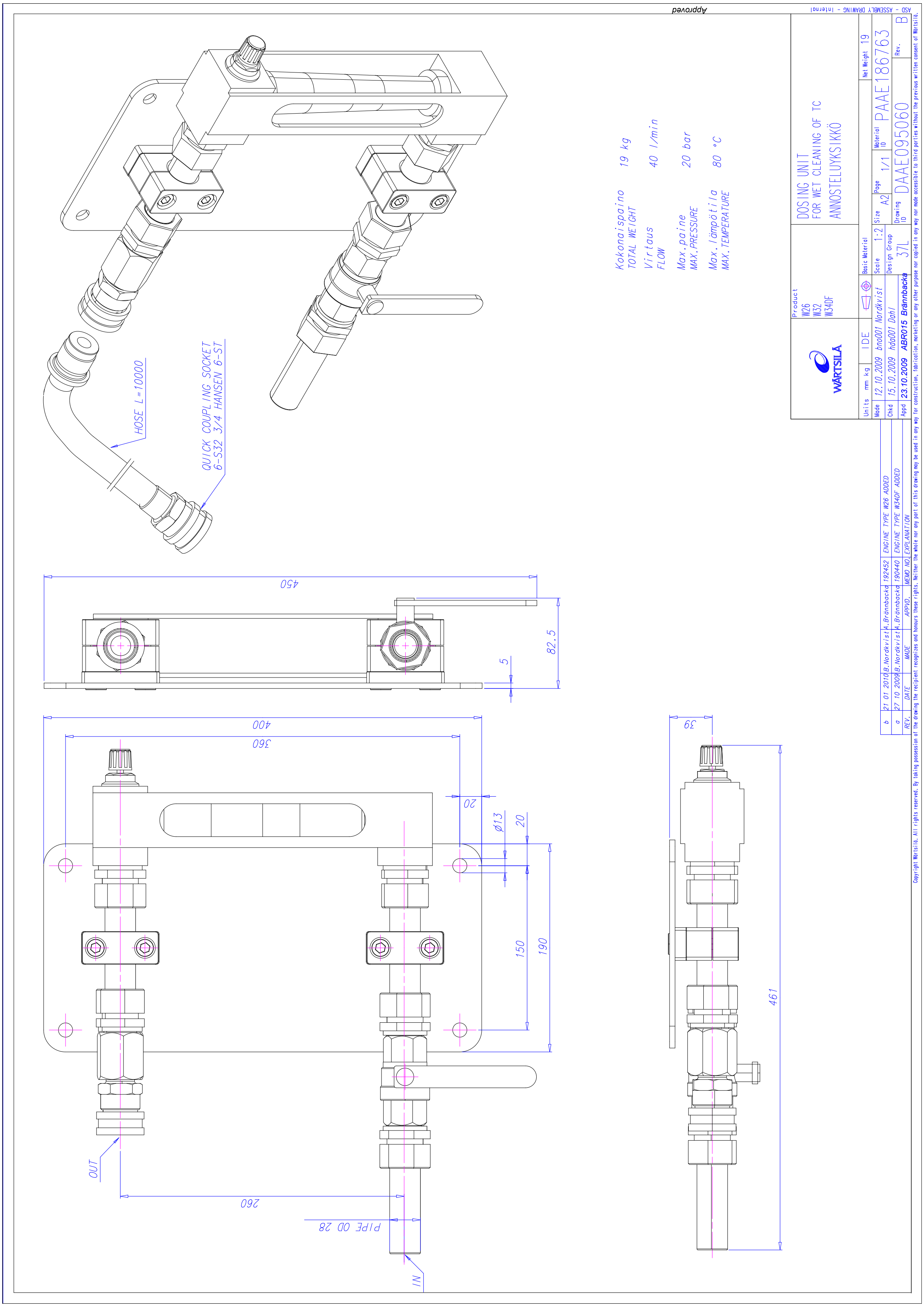
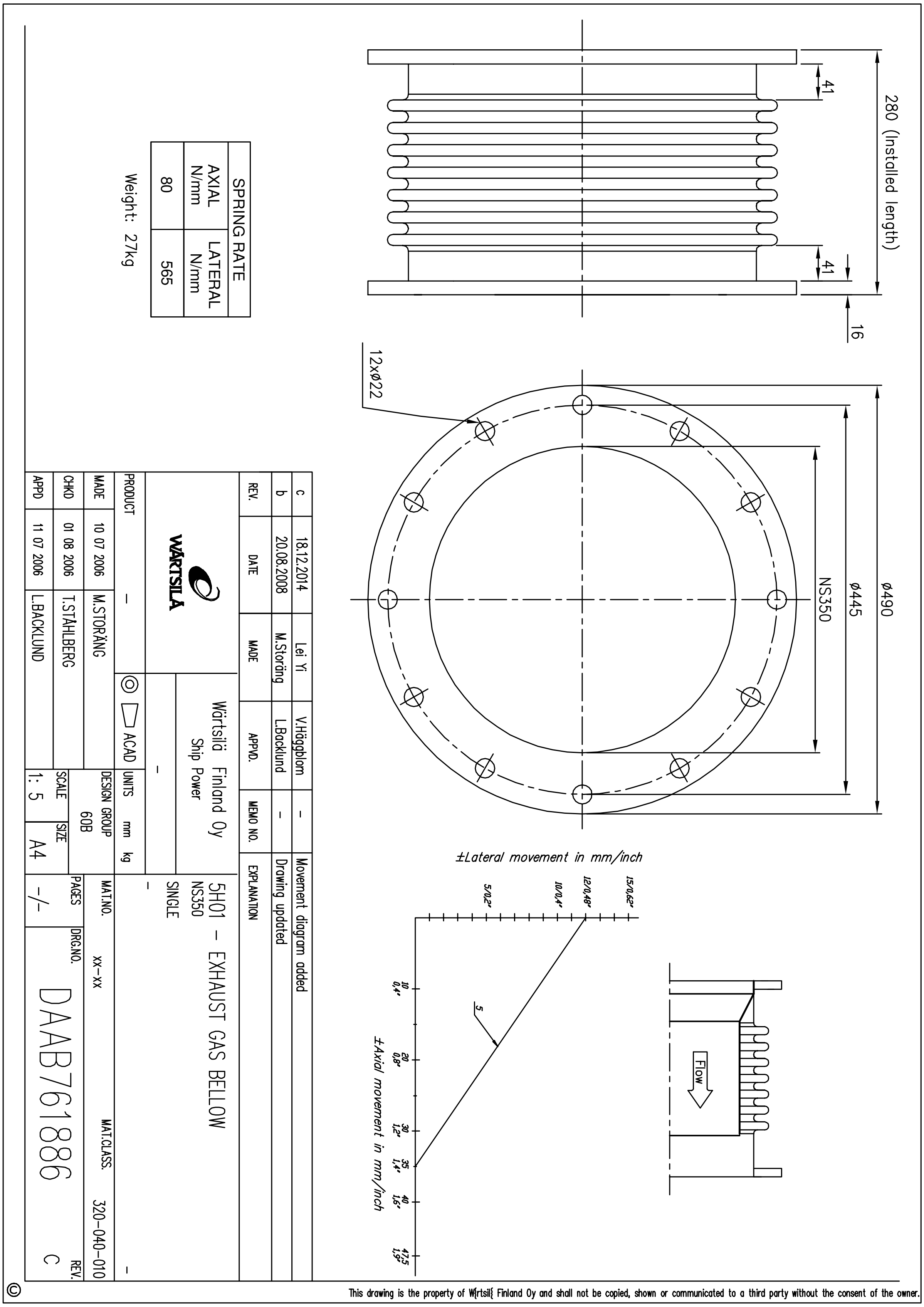
REF. DRAWINGS
Made 07.01.2019 J.Tuisku
CHKD. 08.01.2019 J.Harlikainen
APPVD 08.01.2019 J.Harlikainen
Scale 1:25
Units mm kg
EXHAUST GAS SILENCER WITH SPARK ARRESTOR
MS-CPWAEXG-WSA NS550/ 35 dB(A)
DRG. No.
3ES12541 rev.-
File Name 3ES12541 -.dwg


DOSING UNIT
FOR WET CLEANING OF TC
ANNOSTELUYKSIKKÖ
Kokonaispaino
TOTAL WEIGHT
19 kg
Virtaus
FLOW
40 l/min
Max.paine
MAX.PRESSURE
20 bar
Max.lämpötila
MAX.TEMPERATURE
80 °C
HOSE L=10000
QUICK COUPLING SOCKET
6-S32 3/4 HANSEN 6-ST
OUT
IN
PIPE OD 28
450
400
360
260
82.5
461
WÄRTSILÄ
PAAE186763
DAAE095060


280 (Installed length)
41
41
16
12xØ22
Ø490
Ø445
NS350
SPRING RATE
AXIAL N/mm
LATERAL N/mm
80
565
Weight: 27kg
Flow
±Lateral movement in mm/inch
5/0,2"
10/0,4"
12/0,48"
15/0,62"
±Axial movement in mm/inch
10 0,4"
20 0,8"
30 1,2"
35 1,4"
40 1,6"
47,5 1,9"
c 18.12.2014 Lei Yi V.Häggblom – Movement diagram added
b 20.08.2008 M.Storäng L.Backlund – Drawing updated
REV. DATE MADE APPD. MEMO NO. EXPLANATION
WÄRTSILÄ
Wärtsilä Finland Oy
Ship Power
5H01 – EXHAUST GAS BELLOW
NS350
SINGLE
PRODUCT –
MADE 10 07 2006 M.STORÄNG
CHKD 01 08 2006 T.STÅHLBERG
APPD 11 07 2006 L.BACKLUND
ACAD UNITS mm kg
DESIGN GROUP 60B
MAT.NO. xx-xx
MAT.CLASS. 320-040-010
SCALE 1: 5
SIZE A4
PAGES -/-
DRG.NO. DAAB761886
REV. c
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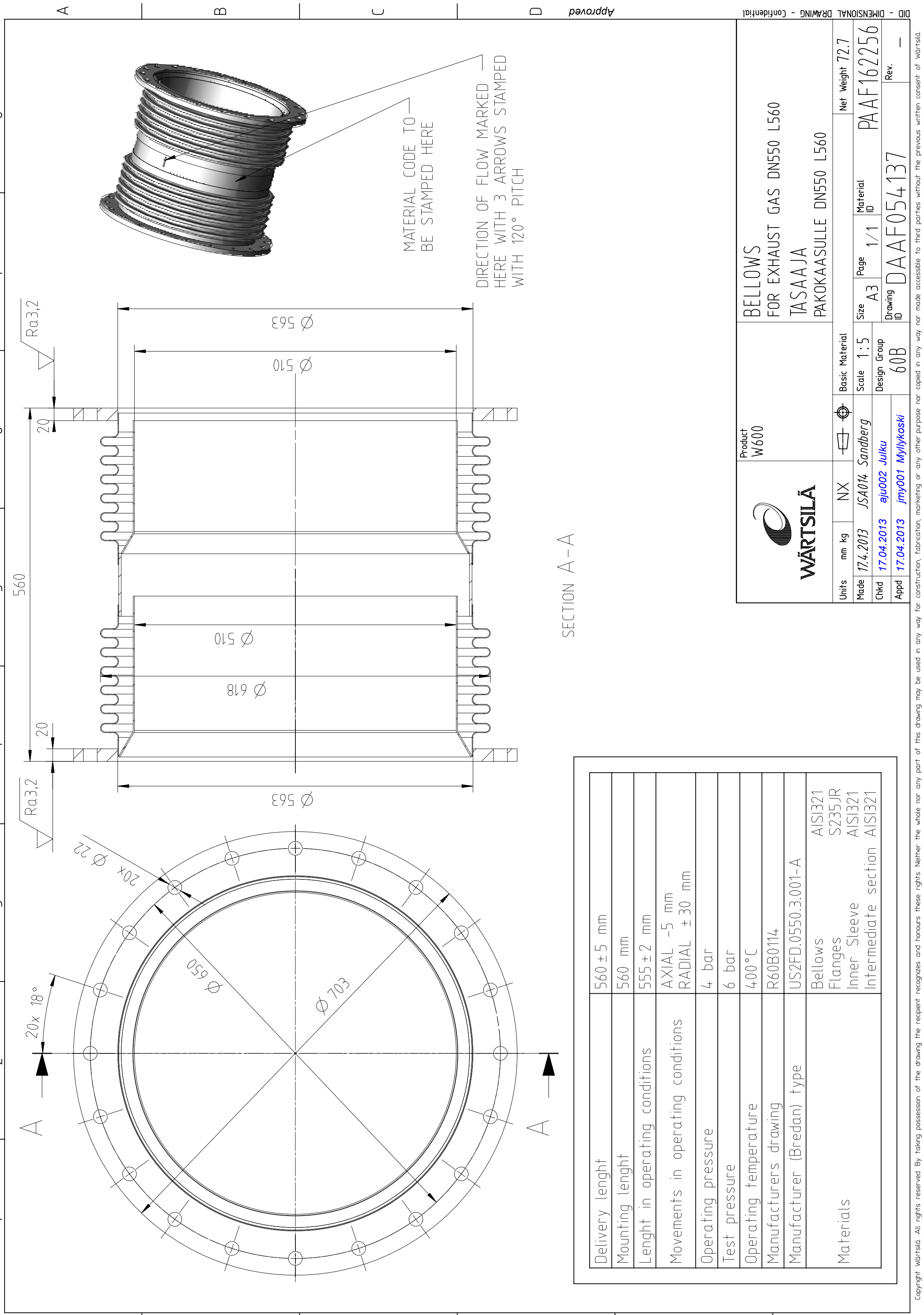
A
A
20x 18°
20x Ø 22
Ø 650
Ø 703
Ra3,2
Ra3,2
560
20
20
Ø 563
Ø 618
Ø 510
Ø 510
Ø 563
SECTION A-A
MATERIAL CODE TO BE STAMPED HERE
DIRECTION OF FLOW MARKED HERE WITH 3 ARROWS STAMPED WITH 120° PITCH
Delivery lenght 560 ± 5 mm
Mounting lenght 560 mm
Lenght in operating conditions 555 ± 2 mm
Movements in operating conditions AXIAL -5 mm RADIAL ± 30 mm
Operating pressure 4 bar
Test pressure 6 bar
Operating temperature 400°C
Manufacturers drawing R60B0114
Manufacturer (Bredan) type US2FD.0550.3.001-A
Materials Bellows AISI321 Flanges S235JR Inner Sleeve AISI321 Intermediate section AISI321
WÄRTSILÄ
Product W600
BELLOWS
FOR EXHAUST GAS DN550 L560
TASAAJA
PAKOKAASULLE DN550 L560
Units mm kg NX
Basic Material
Net Weight 72.7
Made 17.4.2013 JSA014 Sandberg
Chkd 17.04.2013 aju002 Julku
Appd 17.04.2013 jmy001 Myllykoski
Scale 1:5
Size A3
Page 1/1
Material ID PAAF162256
Design Group 60B
Drawing ID DAAF054137
Rev. –
Approved
DID - DIMENSIONAL DRAWING - Confidential
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9. Piping Arrangements

Fuel, lubricating oil, fresh water and compressed air piping is usually made in seamless carbon steel (DIN 2448) and seamless precision tubes in carbon or stainless steel (DIN 2391), exhaust gas piping in welded pipes of corten or carbon steel (DIN 2458). Sea-water piping should be in Cunifer or hot dip galvanized steel.

NOTE

The pipes in the freshwater side of the cooling water system must not be galvanized!

Attention must be paid to fire risk aspects. Fuel supply and return lines shall be designed so that they can be fitted without tension. Flexible hoses must have an approval from the classification society. If flexible hoses are used in the compressed air system, a purge valve shall be fitted in front of the hose(s).

It is recommended to make a fitting order plan prior to construction.

The following aspects shall be taken into consideration:

- Pockets shall be avoided. When not possible, drain plugs and air vents shall be installed
- Leak fuel drain pipes shall have continuous slope
- Vent pipes shall be continuously rising
- Flanged connections shall be used, cutting ring joints for precision tubes

Maintenance access and dismounting space of valves, coolers and other devices shall be taken into consideration. Flange connections and other joints shall be located so that dismounting of the equipment can be made with reasonable effort.

9.1 Pipe dimensions

When selecting the pipe dimensions, take into account:

- The pipe material and its resistance to corrosion/erosion.
- Allowed pressure loss in the circuit vs delivery head of the pump.
- Required net positive suction head (NPSH) for pumps (suction lines).
- In small pipe sizes the max acceptable velocity is usually somewhat lower than in large pipes of equal length.
- The flow velocity should not be below 1 m/s in sea water piping due to increased risk of fouling and pitting.
- In open circuits the velocity in the suction pipe is typically about 2/3 of the velocity in the delivery pipe.

Table 9-1 Recommended maximum velocities on pump delivery side for guidance

Piping	Pipe material	Max velocity [m/s]
Fuel oil piping (MDF and HFO)	Black steel	1.0
Lubricating oil piping	Black steel	1.5
Fresh water piping	Black steel	2.5
Sea water piping	Galvanized steel	2.5
	Aluminum brass	2.5
	10/90 copper-nickel-iron	3.0
	70/30 copper-nickel	4.5
	Rubber lined pipes	4.5

NOTE

The diameter of gas fuel piping depends only on the allowed pressure loss in the piping, which has to be calculated project specifically.

Compressed air pipe sizing has to be calculated project specifically. The pipe sizes may be chosen on the basis of air velocity or pressure drop. In each pipeline case it is advised to check the pipe sizes using both methods, this to ensure that the alternative limits are not being exceeded.

Pipeline sizing on air velocity: For dry air, practical experience shows that reasonable velocities are 25...30 m/s, but these should be regarded as the maximum above which noise and erosion will take place, particularly if air is not dry. Even these velocities can be high in terms of their effect on pressure drop. In longer supply lines, it is often necessary to restrict velocities to 15 m/s to limit the pressure drop.

Pipeline sizing on pressure drop: As a rule of thumb the pressure drop from the starting air vessel to the inlet of the engine should be max. 0.1 MPa (1 bar) when the bottle pressure is 3 MPa (30 bar).

It is essential that the instrument air pressure, feeding to some critical control instrumentation, is not allowed to fall below the nominal pressure stated in chapter "*Compressed air system*" due to pressure drop in the pipeline.

9.2 Trace heating

The following pipes shall be equipped with trace heating (steam, thermal oil or electrical). It shall be possible to shut off the trace heating.

- All heavy fuel pipes
- All leak fuel and filter flushing pipes carrying heavy fuel

9.3 Pressure class

The pressure class of the piping should be higher than or equal to the design pressure, which should be higher than or equal to the highest operating (working) pressure. The highest operating (working) pressure is equal to the setting of the safety valve in a system.

The pressure in the system can:

- Originate from a positive displacement pump

- Be a combination of the static pressure and the pressure on the highest point of the pump curve for a centrifugal pump
- Rise in an isolated system if the liquid is heated

Within this publication there are tables attached to drawings, which specify pressure classes of connections. The pressure class of a connection can be higher than the pressure class required for the pipe.

Example 1:

The fuel pressure before the engine should be 0.7 MPa (7 bar). The safety filter in dirty condition may cause a pressure loss of 0.1 MPa (1.0 bar). The viscosimeter, automatic filter, preheater and piping may cause a pressure loss of 0.25 MPa (2.5 bar). Consequently the discharge pressure of the circulating pumps may rise to 1.05 MPa (10.5 bar), and the safety valve of the pump shall thus be adjusted e.g. to 1.2 MPa (12 bar).

- A design pressure of not less than 1.2 MPa (12 bar) has to be selected.
- The nearest pipe class to be selected is PN16.
- Piping test pressure is normally 1.5 x the design pressure = 1.8 MPa (18 bar).

Example 2:

The pressure on the suction side of the cooling water pump is 0.1 MPa (1 bar). The delivery head of the pump is 0.3 MPa (3 bar), leading to a discharge pressure of 0.4 MPa (4 bar). The highest point of the pump curve (at or near zero flow) is 0.1 MPa (1 bar) higher than the nominal point, and consequently the discharge pressure may rise to 0.5 MPa (5 bar) (with closed or throttled valves).

- Consequently a design pressure of not less than 0.5 MPa (5 bar) shall be selected.
- The nearest pipe class to be selected is PN6.
- Piping test pressure is normally 1.5 x the design pressure = 0.75 MPa (7.5 bar).

Standard pressure classes are PN4, PN6, PN10, PN16, PN25, PN40, etc.

9.4 Pipe class

Classification societies categorize piping systems in different classes (DNV) or groups (ABS) depending on pressure, temperature and media. The pipe class can determine:

- Type of connections to be used
- Heat treatment
- Welding procedure
- Test method

Systems with high design pressures and temperatures and hazardous media belong to class I (or group I), others to II or III as applicable. Quality requirements are highest on class I.

Examples of classes of piping systems as per DNV rules are presented in the table below.

Table 9-2 Classes of piping systems as per DNV rules

Media	Class I		Class II		Class III	
	MPa (bar)	°C	MPa (bar)	°C	MPa (bar)	°C
Steam	> 1.6 (16)	or > 300	< 1.6 (16)	and < 300	< 0.7 (7)	and < 170
Flammable fluid	> 1.6 (16)	or > 150	< 1.6 (16)	and < 150	< 0.7 (7)	and < 60
Other media	> 4 (40)	or > 300	< 4 (40)	and < 300	< 1.6 (16)	and < 200

9.5 Insulation

The following pipes shall be insulated:

- All trace heated pipes
- Exhaust gas pipes
- Exposed parts of pipes with temperature > 60°C

Insulation is also recommended for:

- Pipes between engine or system oil tank and lubricating oil separator
- Pipes between engine and jacket water preheater

9.6 Local gauges

Local thermometers should be installed wherever a new temperature occurs, i.e. before and after heat exchangers, etc.

Pressure gauges should be installed on the suction and discharge side of each pump.

9.7 Cleaning procedures

Instructions shall be given at an early stage to manufacturers and fitters how different piping systems shall be treated, cleaned and protected.

9.7.1 Cleanliness during pipe installation

All piping must be verified to be clean before lifting it onboard for installation. During the construction time uncompleted piping systems shall be maintained clean. Open pipe ends should be temporarily closed. Possible debris shall be removed with a suitable method. All tanks must be inspected and found clean before filling up with fuel, oil or water.

Piping cleaning methods are summarised in table below:

Table 9-3 Pipe cleaning

System	Methods
Fuel oil	A,B,C,D,F
Lubricating oil	A,B,C,D,F
Starting air	A,B,C
Cooling water	A,B,C
Exhaust gas	A,B,C
Charge air	A,B,C

[1)] In case of carbon steel pipes

Methods applied during prefabrication of pipe spools

A = Washing with alkaline solution in hot water at 80°C for degreasing (only if pipes have been greased)

B = Removal of rust and scale with steel brush (not required for seamless precision tubes)

D = Pickling (not required for seamless precision tubes)

Methods applied after installation onboard

C = Purging with compressed air

F = Flushing

9.7.2 Fuel oil pipes

Before start up of the engines, all the external piping between the day tanks and the engines must be flushed in order to remove any foreign particles such as welding slag.

Disconnect all the fuel pipes at the engine inlet and outlet . Install a temporary pipe or hose to connect the supply line to the return line, bypassing the engine. The pump used for flushing should have high enough capacity to ensure highly turbulent flow, minimum same as the max nominal flow. Heaters, automatic filters and the viscosimeter should be bypassed to prevent damage caused by debris in the piping. The automatic fuel filter must not be used as flushing filter.

The pump used should be protected by a suction strainer. During this time the welds in the fuel piping should be gently knocked at with a hammer to release slag and the filter inspected and carefully cleaned at regular intervals.

The cleanliness should be minimum ISO 4406 © 20/18/15, or NAS 1638 code 9. A measurement certificate shows required cleanliness has been reached there is still risk that impurities may occur after a time of operation.

Note! The engine must not be connected during flushing.

9.7.3 Lubricating oil pipes

Flushing of the piping and equipment built on the engine is not required and flushing oil shall not be pumped through the engine oil system (which is flushed and clean from the factory).

It is however acceptable to circulate the flushing oil via the engine sump if this is advantageous. Cleanliness of the oil sump shall be verified after completed flushing and is acceptable when the cleanliness has reached a level in accordance with ISO 4406 © 21/19/15, or NAS 1638 code 10. All pipes connected to the engine, the engine wet sump or to the external engine wise oil tank shall be flushed. Oil used for filling shall have a cleanliness of ISO 4406 © 21/19/15, or NAS 1638 code 10.

Note! The engine must not be connected during flushing

9.7.4 Pickling

Prefabricated pipe spools are pickled before installation onboard.

Pipes are pickled in an acid solution of 10% hydrochloric acid and 10% formaline inhibitor for 4-5 hours, rinsed with hot water and blown dry with compressed air.

After acid treatment the pipes are treated with a neutralizing solution of 10% caustic soda and 50 grams of trisodiumphosphate per litre of water for 20 minutes at 40...50°C, rinsed with hot water and blown dry with compressed air.

Great cleanliness shall be approved in all work phases after completed pickling.

9.8 Flexible pipe connections

All external pipes must be precisely aligned to the fitting or the flange of the engine to minimize causing external forces to the engine connection.

Adding adapter pieces to the connection between the flexible pipe and engine, which are not approved by Wärtsilä are forbidden. Observe that the pipe clamp for the pipe outside the flexible connection must be very rigid and welded to the steel structure of the foundation to prevent vibrations and external forces to the connection, which could damage the flexible connections and transmit noise. The support must be close to the flexible connection. Most problems with bursting of the flexible connection originate from poor clamping.

Proper installation of pipe connections between engines and ship's piping to be ensured.

- Flexible pipe connections must not be twisted
- Installation length of flexible pipe connections must be correct
- Minimum bending radius must be respected
- Piping must be concentrically aligned
- When specified, the flow direction must be observed
- Mating flanges shall be clean from rust, burrs and anticorrosion coatings
- If not otherwise instructed, bolts are to be tightened crosswise in several stages
- Painting of flexible elements is not allowed
- Rubber bellows must be kept clean from oil and fuel
- The piping must be rigidly supported close to the flexible piping connections.

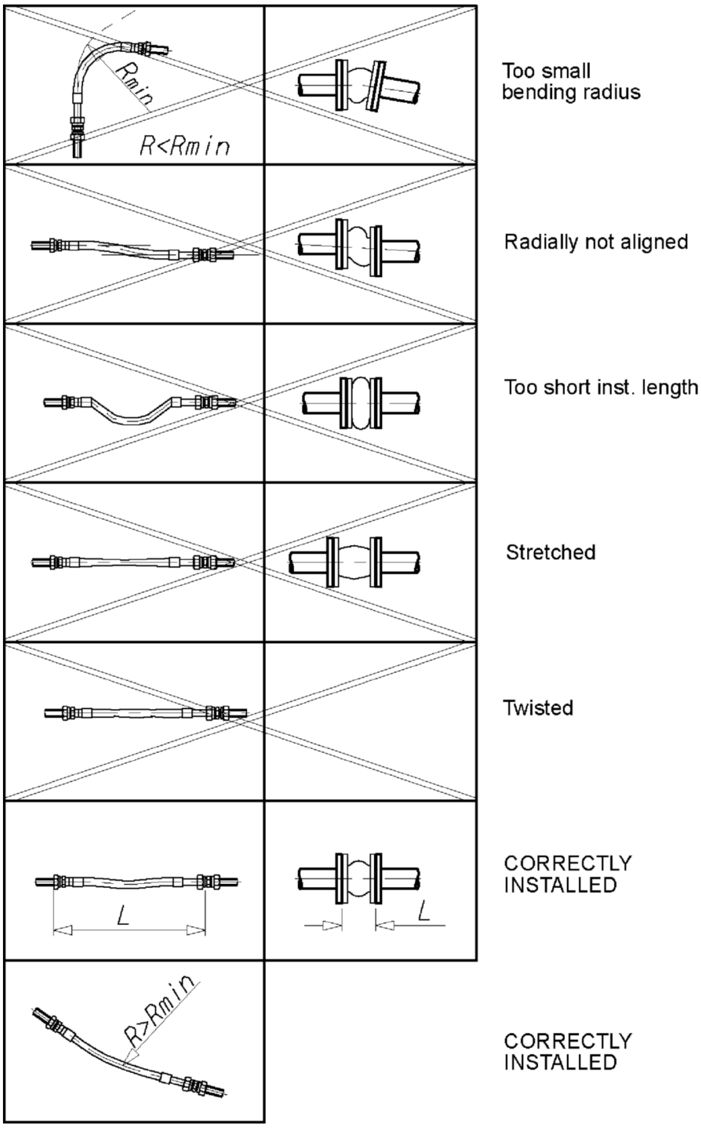


Fig 9-1 Flexible hoses

NOTE

Pressurized flexible connections carrying flammable fluids or compressed air have to be type approved.

9.9 Installing flexible pipe connections

9.9.1 General

The generating set shall be installed in its final position before any external pipe is connected to the engine.

Different types of loads that should be observed when designing pipes and pipe supports are: pressure inside pipe, own weight and fluid weight, thermal expansion, pressure shocks, vibrations, fluid flow rate and external forces.

9.9.2 Pipe supporting

Never weld supports directly to the pipe. Supports shall be located so that different pipe loads do not cause too high tension to equipment or flexible bellows.

9.9.2.1 Fixed supports

Fixed supports are used:

- Nearby equipment connections to protect equipment and flexible bellows from high tensions. Maximum distance between unit/component flange to the support is 3xDN size.
- To direct thermal expansion in directions where it can be received.
- To receive different forces acting on the pipeline.

9.9.2.2 Sliding supports

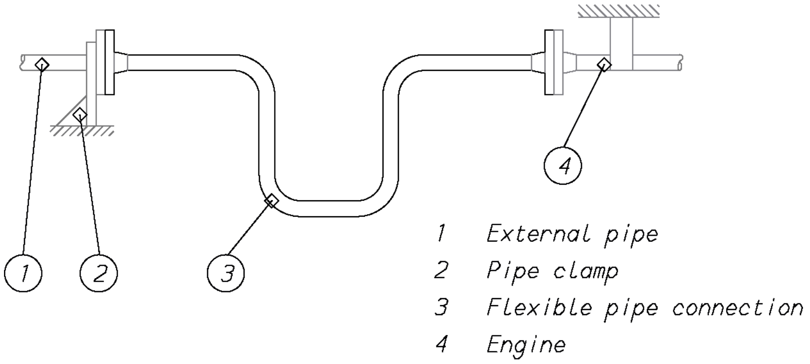
Sliding supports are used:

- Sliding supports should be located to protect the pipeline, equipment and flexible bellows from high tensions coming from thermal expansion.
- To allow thermal expansion in directions where it can be received.
- To receive different forces acting on the pipeline.

9.9.3 Fuel pipes

Fuel pipes are exposed to fluctuating pressure disturbances from the injection pumps. These pressure pulses must be taken into account when pipe supporting for fuel pipes are designed. Fuel pipes should be rigidly supported not only nearby the engine, but also far away from the engine in the external fuel system. The distance between supports should be positioned with the shortest value mentioned in the section below.

9.9.4 Omega pipes



Installation procedure

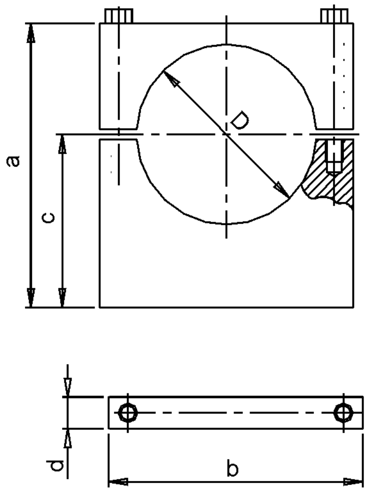
1. The generating set (or engine) should be installed in its final position before any external pipes are connected.
2. Fasten the flexible pipe connection to the connection on the engine according to the following procedure:
   - 2.1 If there is a counter flange, remove it.
   - 2.2 Fasten the flexible pipe connection to the engine side with a gasket between the flanges.
   - 2.3 Oil the threads of the screws and nuts, tighten first all screws until finger tight.
   - 2.4 Tighten screws in a crosswise sequence using a socket wrench. Increase the tightening torque gradually until the final torque is acheived.
3. Connect the free end of the flexible pipe connectionto the external pipe.
   - 3.1 The flange of the external pipe should be in line with the flange of the engine. No twisting, compression or elongation of the flexible pipe connection is allowed, i.e. it should fit in between the flanges in a straight position without reshaping. Align the external pipe and weld the counter flange to the pipe.
   - 3.2 Bolt the flexible pipe connection to the flange of the external pipe as described in item 2.
4. Anchor the external pipe to the steel structure of the ship close to the flange. Observe that the pipe clamping must be very rigid in order to prevent vibration and movement of the flexible pipe connection. Most problems with bursting of the flexible connection originate from poor clamping.
5. The flexible pipe connection must be protected from external mechanical damage.

NOTE

The curved part of the pipe should always be installed downwards. It may be installed upwards only when protected, stepping on an omega pipe instantly makes the connection leak.

9.9.5 Pipe support nearby the diesel engine

The first three supports on the same pipeline next to the diesel engine are definitively exposed to vibration that comes from the engine oscillation. Therefore it is very important that they are positioned and fastened carefully and rigidly so that no resonant vibration can occur in any direction. Pipe supports should be made of steel, <u>supports made of plastic or similar materials are not allowed</u>. Rigid supporting of pipes will also prevent vibration and movement of the flexible pipe connection.



DN	d_u [mm]	D [mm]	a [mm]	b [mm]	c [mm]	d [mm]	BOLTS
25	33.7	35	150	80	120	25	M10x50
32	42.4	43	150	75	120	25	M10x50
40	48.3	48	154.5	100	115	25	M12x60
50	60.3	61	185	100	145	25	M12x60
65	76.1	76.5	191	115	145	25	M12x70
80	88.9	90	220	140	150	30	M12x90
100	114.3	114.5	196	170	121	25	M12x100
125	139.7	140	217	200	132	30	M16x120
150	168.3	170	237	240	132	30	M16x140
200	219.1	220	295	290	160	30	M16x160
250	273.0	274	355	350	190	30	M16x200

d_u = Pipe outer diameter

Fig 9-2 Typical supports after bellows.

The first support after flexible bellows should be positioned as close as possible to the bellows. If the first support is to far away from the bellows then the bellows lifetime will be shortened considerably, the pipe is also exposed to increased forces that may injure the pipeline.

The second support should be positioned about 0.3...0.5 meter from the first support, the reason why it should be so close to the first support is that this will reduce the vibrations of the pipe end.

The third support can be positioned about 0.8...1.1 meter from the second support. Pipe supports further in the pipeline can be placed with the same distance from each other.

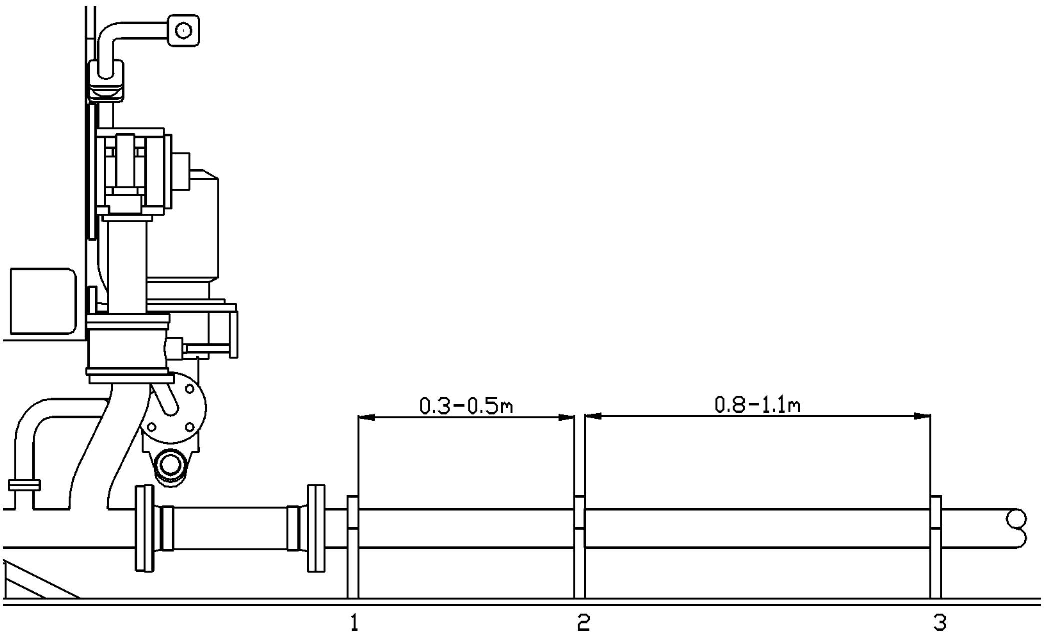


Fig 9-3 The supports after flexible bellows.

9.10 Cleaning and flushing instructions

Refer to section "*Cleaning procedures*" for cleaning methods.

9.10.1 Fuel oil pipes

Before start up of the engines the external piping between the day tanks and the engines must be flushed in order to remove any foreign particles such as welding slag.

The possibility to install a temporary flushing oil filter shall be considered in the piping design.

Disconnect the fuel pipes at the engine inlet and outlet (connections 101 and 102). Install a temporary pipe or hose to connect the supply line to the return line, bypassing the engine.

The piping should be flushed through a flushing filter with mesh size 34 microns or finer.

The inserts of the filters should be removed. Heaters, automatic filters and the viscosimeter should be bypassed to prevent damage caused by debris in the piping. The automatic fuel filter must not be used as flushing filter.

The pump used should be protected by a suction strainer. The recommended flushing time is min. 6 hours. During this time the welds in the fuel piping should be gently knocked at with a hammer to release slag and the filter inspected and carefully cleaned at regular intervals.

9.10.2 Lubricating oil pipes

9.10.2.1 Piping and equipment built on the engine

Flushing of the piping and equipment built on the engine is not required and flushing oil shall not be pumped through the engine oil system (which is flushed and clean from the factory). It is however acceptable to circulate the flushing oil via the engine sump if this is advantageous. Cleanliness of the oil sump shall be verified after completed flushing.

9.10.2.2 External lubricating oil system

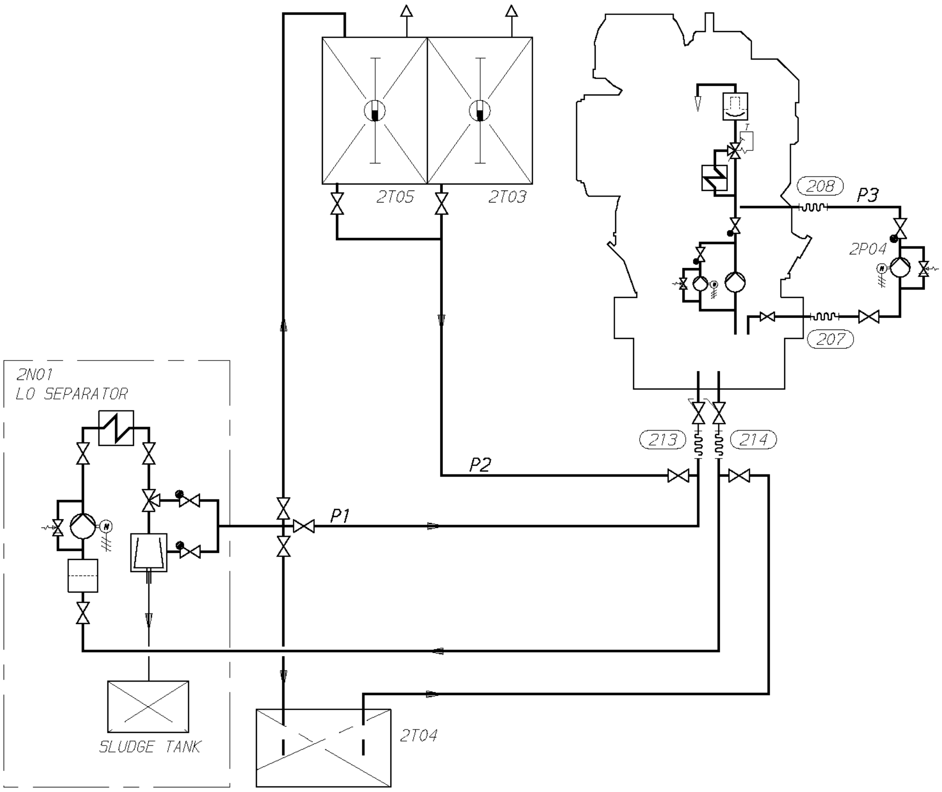


Fig 9-4 Flushing of lubricating oil pipes

The external oil tanks, new oil tank (2T03), renovating oil tank (2T04) and renovated oil tank (2T05) shall be verified to be clean before bunkering oil.

Especially pipes leading from the separator unit (2N01) directly to the engine (P1 and P2) shall be ensured to be clean for instance by disconnecting from engine and blowing with compressed air.

The external piping shall be cleaned by running the separator unit for not less than 24 hours. All branches of the separator piping to be used.

If an electric motor driven stand-by pump (2P04) is installed off the engine this pipe branch (P3) shall be flushed running the pump circulating engine oil through a temporary external oil filter (recommended mesh 34 microns) returning the oil to the oil sump through a crankcase door. The pump shall be protected by a suction strainer (2F06).

Whenever possible the separator unit shall be in operation during the flushing to remove dirt. The separator unit is to be left running also after the flushing procedure, this to ensure that any remaining contaminants are removed.

9.10.2.3 Type of flushing oil

Viscosity

In order for the flushing oil to be able to remove dirt and transport it with the flow, ideal viscosity is 10...50 cSt. The correct viscosity can be achieved by heating engine oil to about 65°C or by using a separate flushing oil which has an ideal viscosity in ambient temperature.

Flushing with engine oil

The ideal is to use engine oil for flushing. This requires however that the separator unit is in operation to heat the oil. Engine oil used for flushing can be reused as engine oil provided that no debris or other contamination is present in the oil at the end of flushing.

Flushing with low viscosity flushing oil

If no separator heating is available during the flushing procedure it is possible to use a low viscosity flushing oil instead of engine oil. In such a case the low viscosity flushing oil must be disposed of after completed flushing. Great care must be taken to drain all flushing oil from pockets and bottom of tanks so that flushing oil remaining in the system will not compromise the viscosity of the actual engine oil.

Lubricating oil sample

To check the cleanliness a LO sample shall be taken by the shipyard after the flushing is completed. The properties to be analyzed are Viscosity, BN, AN, Insolubles, Fe and Particle Count.

Commissioning procedures shall in the meantime be continued without interruption unless the commissioning engineer believes the oil is contaminated.

10. Automation System

10.1 System overview

The engine automation system consist of control of the running parameters, monitoring of the sensors and automatic safety operations.

10.1.1 Internal el & automation system

The engine is equipped with a distributed, built-on engine management system. It is an embedded system which handles all strategic functionality such as engine start, stop, speed control and engine safety.

The system is totally distributed in terms of physical modules. The modules communicate with each other over an inter-module communication bus based on the CAN protocol. CAN is a communication bus specifically developed for compact local networks, where high speed data transfer and safety are of very high importance. The CAN-bus is physically doubled on the engine, resulting in redundant communication in case of a failure of the primary bus communication. In the same manner the power supply distribution is doubled on the engine. *Figure 10-1* shows the overall architecture of the system built on the engine.

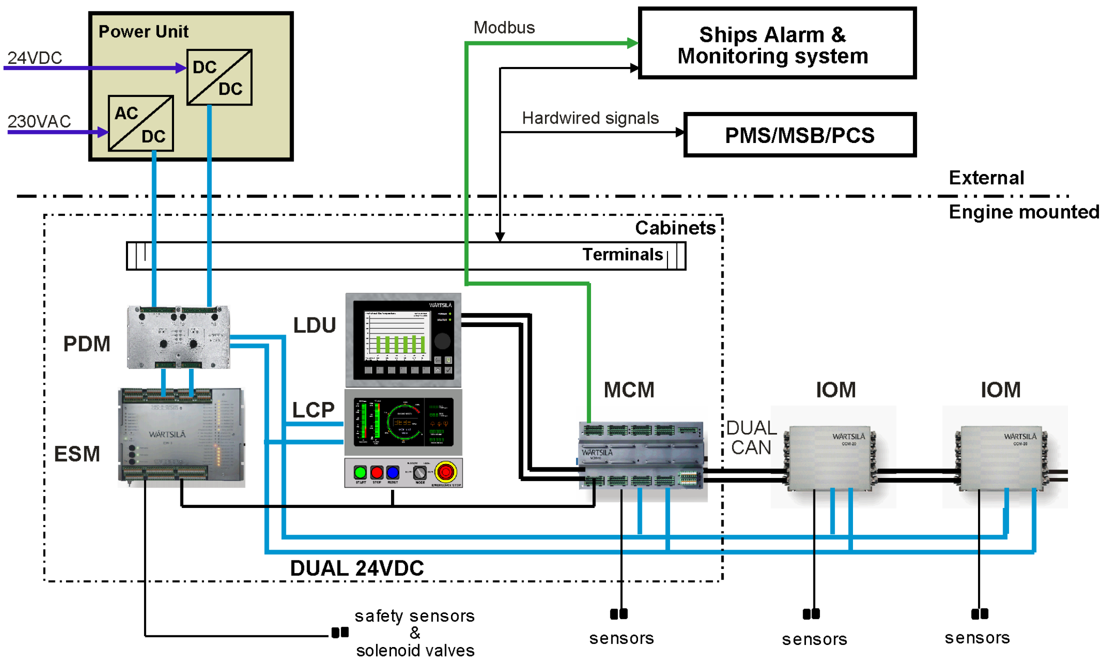


Fig 10-1 System overall architecture

Short explanation of the modules used in the system:

MCM Main Control Module. Handles all strategic control functions (such as start/stop sequencing and speed/load control) of the engine.

IOM Input/Output Module handles measurements and limited control functions in a specific area on the engine.

ESM Engine Safety Module. Handles fundamental engine safety, and is the interface to the engine's shutdown devices and backup instruments.

LCP	Local Control Panel is equipped with push buttons and switches for local engine control, as well as indication of running hours and safety-critical operating parameters.
LDU	Local Display Unit offers a set of menus for retrieval and graphical display of operating data, calculated data and event history.
PDM	Power Distribution Module handles fusing, power distribution, earth fault monitoring and EMC filtration in the system. It provides two fully redundant 24 VDC supplies to all modules, sensors and control devices.

The system comprises the following major control/monitoring categories:

- Engine start- & stop management.
  - starting of the engine
  - stopping of the engine
  - start blocking
  - automatic shutdown of the engine
  - load reduction request
  - local control through local command buttons
- Speed and load control.
- Measuring engine speed and turbocharger speed.
- Measuring and signal processing of monitoring- and safety sensors.
- Readout of engine measurements on a local graphical display.
- Hardwired interface signals with external systems (e.g. with power management system, main switchboard and propulsion control system).
- Modbus communication with ships alarm & monitoring system.
- System diagnostics.

The system ingress protection class is IP54.

The main connection box contains terminal strips for external interface connections. The yard cables shall enter the connection box through cable glands and be connected to terminals.

10.1.1.1 Local controls & indications

The following operational functions are available in the LCP:

- Local start (HS721).
- Local stop (HS722).
- Local emergency stop (HS723).
- Local shutdown reset (HS725).
- Local mode selector switch (HS724) with the following positions:
  - Local: Engine start and stop can be done only at the local control panel.
  - Remote: Engine can be started and stopped only remotely.
  - Blow: In this position it is possible to perform a “blow” (an engine rotation check with indicator valves open and disabled fuel injection) by the start button.
  - Blocked: Normal start of the engine is not possible.

The following backup indications are available in the LCP:

- Engine speed.

- Turbocharger speed.
- Running hour counter.
- Lubricating oil pressure.
- HT cooling water temperature.

The graphical Local Display Unit shows on a set of menus all measurements and calculations and provides various engine status indications as well as an event history.

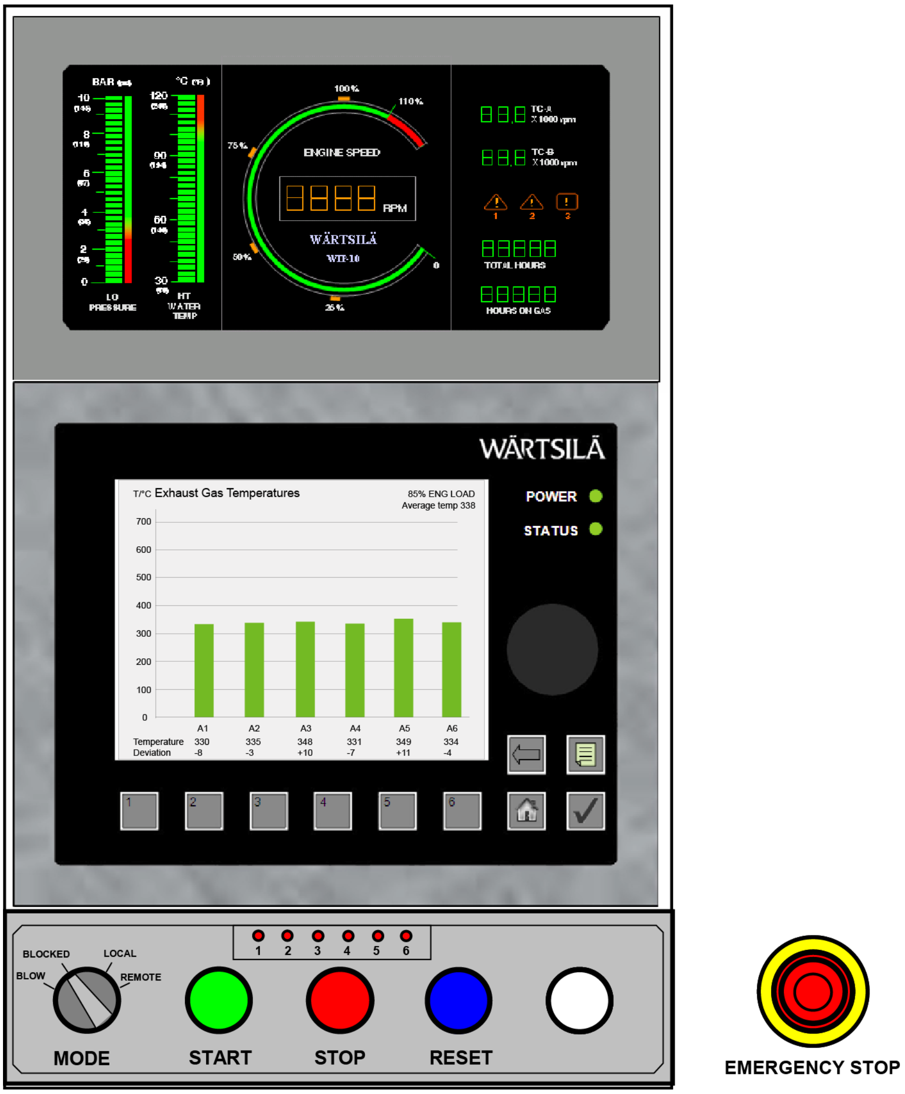


Fig 10-2 Local controls and indications

10.2 Control signals

The following chapter provides information of the signals between the engine with its related engine automation and other systems onboard the ship. The signals listed below may be in excess of what is needed for this installation. For more exact recommendation of typical use- and routing of the signals and yard cabling see drawing "*Block/Interconnection diagram*" included in this chapter.

Digital input signals are powered from the engine (24 VDC), i.e. a potential free contact is required in the external system.

Digital output signals are, unless otherwise specified below, potential free opto relay output signals with contact rating of 24 VDC / 0.2 A.

Analogue input signals have, unless otherwise specified below, an input load of 200 Ohm.

10.2.1 Output signals

10.2.1.1 IS 872 Engine ready for start

The signal is closed when the engine is ready for start and no internal or external start blockings are active.

10.2.1.2 IB 726 Remote control indication

This is a potential free contact from the local/remote operation mode selection switch, closed contact = remote mode. In local mode all starting and stopping can only be done locally at the engine. In remote mode all starting and stopping can only be done from the remote control system.

10.2.1.3 IS 181 Speed switch 1 (Engine running)

The signal is closed when the engine is above 40% of rated speed.

10.2.1.4 IS 184 Speed switch 4

The signal is closed when the engine is above 95% of rated speed plus a delay of 2 seconds. The signal can be used e.g. to turn on the generator excitation via the Automatic Voltage Regulator or to initiate the synchronization of the generator breaker.

10.2.1.5 IS 875 Start failure indication

The signal is activated (closed contact) if the engine has not reached firing speed in abt. 20 sec. after the start signal has been activated. The output is automatically reset after the engine has come to standstill.

This will set the engine “ready for start” again, and allow the power management system to initiate a new start attempt.

However, in case of a start failure, if there is another generating set in standby ready for start, it is recommended to initiate a start on that generating set rather than a second start attempt on the one with a failed start.

10.2.1.6 OS 7315 Loadreduction request

The signal is activated (closed contact) when a process value (e.g. temperature or pressure) is outside acceptable limits for normal operation. The power management system should reduce the load on this generating set and allow the other generating sets to take on more load or alternatively reduce the total load on the network. It is also recommended to start a standby generating set when this signal is activated. Once the new generating set is on line and the load has been ramped up, the failing generating set can be unloaded, disconnected and stopped.

10.2.1.7 IS 7323 Shutdown prewarning

The signal is activated (closed contact) when a shutdown limit has been exceeded but 3 seconds prior to the execution of the engine shutdown.

The signal is typically used for tripping non-essential consumers in case the load step would exceed the acceptance limit of the remaining generating sets.

10.2.1.8 IS 7602 Stop / shutdown status 1

The signal is closed when the engine is being stopped (locally or remote) or shutdown by the safety system and remains on as long as the stop signal is active. I.e. in case of normal stop, until the stop timer has expired and the engine has come to complete standstill and in case of shutdown until the engine has come to complete standstill, the shutdown cause is cleared and manually reset.

The signal is typically used for opening the generator main breaker in the MSB.

10.2.1.9 OS 7602 Generator breaker open command

The signal is closed when the engine, after having received an “unload command”, has been unloaded to a predefined level (abt 5% load). Unloading is initiated by input signal *OS 7321 Engine unload*.

10.2.1.10 NS 881 Engine control system minor alarm

The signal is activated when there is an internal fault in the engine control system. At a healthy condition the contact is closed.

The signal is activated by:

- Failure in any of the electronic modules
- Failure in Engine Safety Module
- Failure in local control panel
- Loss of one redundant power supply
- Loss of one redundant CAN communication bus

10.2.1.11 NS 886 Engine control system major failure

The signal is activated (open contact) when there is serious fault in the control system.

When the major failure signal is activated, the engine will be shut down.

10.2.1.12 IB 7324 Engine shutdown status

The graphical Local Display Unit shows on a set of menus all measurements and calculations and provides various engine status indications as well as an event history.

The signal is activated (closed contact) when a shutdown function is activated. The signal can be used as a common shutdown indication. (Individual shutdown reasons are identified via the modbus link and locally on the LDU.)

10.2.1.13 NS 885 Common engine alarm

The signal is activated (open contact) when there is an abnormal process value (e.g. temperature or pressure). The individual alarm reason is transmitted over the modbus link. This hardwired signal can be used as a backup in case the modbus communication fails. To avoid duplicate alarm indication it is recommended that this signal is disabled while the modbus communication is healthy.

10.2.1.14 IS 7331 Tripped to speed droop control

The signal is activated (open contact) when an engine, due to a failure in the isochronous loadsharing, automatically switch to speed droop mode.

10.2.1.15 OS 441 Pre-lubrication pump control / Pre-heater control

This signal is closed when the engine speed is below 40% speed, which is the limit below which the pre-lubricating pump and cooling water pre-heater pump shall continuously run. This output can ONLY be used for DC control voltage. I.e. this is typically connected to the ships automation system as reference signal in case the motor starters are controlled from the ships automation system.

10.2.1.16 CV 223 Pre-lubrication pump control / Pre-heater control

This signal is closed when the engine speed is below 40% speed, which is the limit below which the pre-lubricating pump and cooling water pre-heater pump shall continuously run. This output can ONLY be used for AC control voltage. I.e. this is typically connected directly to the control circuit of the motor starter. The contact rating is 255 VAC / 0.6 A. However, in order to keep a safe voltage level in the main cabinet on the engine, the control voltage of the motor starter is required to be 24 VAC.

For further details of wiring see drawing “*prelubricating pump starter*".

10.2.1.17 SI 196 Engine speed

This is a galvanically isolated analogue output signal. The signal type is 4-20 mA and max external load is 500 Ω.

Range 0 – 1200 rpm.

10.2.1.18 SI 518 TC A speed

This is a galvanically isolated analogue output signal. The signal type is 4-20 mA and max external load is 500 Ω.

Range 0 – 75000 rpm.

10.2.2 Input signals

10.2.2.1 OS 7302 Remote start

Activating this input (closed contact) will activate the engine starting sequence, if no start blockings are active and the local/remote switch is in remote mode. The input should be activated for about 1 second.

10.2.2.2 OS 7304 Remote stop

Activating this input (closed contact) will activate the engine stop sequence if the local/remote selector switch is in remote. The input should be activated for about 1 second.

10.2.2.3 OS 7312 External start blocking 1

Opening the contact to this input will block the starting of the engine. This input is typically used for start blocking signals from the ships control system or switchboard.

10.2.2.4 OS 7313 External start blocking 2

Opening the contact to this input will block the starting of the engine. This input is typically used for start blocking signals from the ships control system or switchboard.

10.2.2.5 OS 163 Speed/load increase

Activating this input (closed contact) will increase the speed reference of the generating set. The speed increase rate is 0.05 Hz/sec when the input is active. This input is typically connected to power management systems, load-sharing systems, switchboards or synchronizers.

10.2.2.6 OS 164 Speed/load decrease

Activating this input (closed contact) will decrease the speed reference of the generating set. The speed decrease rate is 0.05 Hz/sec when the input is active. This input is typically connected to power management systems, load-sharing systems, switchboards or synchronizers.

10.2.2.7 OS 7309 External shutdown 1

This shutdown input is activated by a closed contact. The external contact should be equipped with a 22 kΩ resistor for wire break monitoring. There is a shutdown delay as explained under output signal *IS 7323 Shutdown prewarning*.

10.2.2.8 OS 7310 External shutdown 2

This shutdown input is activated by a closed contact. The external contact should be equipped with a 22 kΩ resistor for wire break monitoring. Any signal that requires a fast shutdown of the generating set should be connected to this input. Such signal could be e.g. generator protection. This shutdown does not include the delay explained under output signal *IS 7323 Shutdown prewarning*.

10.2.2.9 OS 7311 External shutdown 3

This shutdown input is activated by a closed contact. The external contact should be equipped with a 22 kΩ resistor for wire break monitoring. There is a shutdown delay as explained under output signal *IS 7323 Shutdown prewarning*. The signal is typically used in case shutdown from the ships automation system is needed.

10.2.2.10 OS 7305 External shutdown 4 (Emergency stop)

This shutdown input is activated by a closed contact. The external contact should be equipped with a 22 kΩ resistor for wire break monitoring. This signal is typically used for e.g. emergency stop buttons or ships emergency shutdown (ESD) system.

10.2.2.11 OS 7308 Remote shutdown reset

Activating this input (closed contact) will reset a shutdown and enable re-start of the engine. A shutdown can be reset only if the engine has come to full stop and the shutdown is not active anymore. Before re-start the reason for the shutdown must be carefully checked and corrected.

10.2.2.12 GS 798 Generator breaker status

This input shall be activated (closed contact) when the generator breaker is closed. The signal is used to optimize the engine dynamic response and is part of the isochronous load sharing logic.

10.2.2.13 OS 7329 Isochronous loadsharing enable

Activating this input will enable isochronous loadsharing. The input is typically connected to the power management system or ships automation system, where the operating mode selection is done.

10.2.2.14 OS 7327 Emergency loading rate

When a generator is connected to the switchboard, if isochronous loadsharing is enabled, the load will be ramped up according to a predefined normal loading ramp in order to share the load equally with the other engines. If OS7327 is closed the load will be ramped up according another predefined faster ramp. It is not desirable to use the emergency loading ramp as part of a normal operation, but only if the situation so requires (e.g. if required when connecting multiple engines in sequence for recovery from a temporary blackout). In the same way OS7327 can be used for selecting a faster unloading ramp.

10.2.2.15 OS 7321 Engine unload

Activating this input will cause the engine to unload to a predefined load level. This shall be done prior to opening the generator breaker. See also output *OS 7602 Generator breaker open command*.

10.2.2.16 IT 796 Asymmetric loadsharing bias

The asymmetric loadsharing bias input provides means for the power management system or operator to offset the load of an engine being part of an isochronous loadsharing system.

The signal range of the IT796 asymmetric load sharing bias input is 4-20 mA. If the input is used, a value of 4 mA results in equal load sharing with the other engines. A value of 20 mA means no load on this engine (= relative load on this engine is 100% less than the relative system load.)

10.2.2.17 OS 160 Analogue synchroniser enable

Activating this input (closed contact), the engine speed reference will be ramped according to input OT 160 Analogue synchroniser.

10.2.2.18 OT 160 Analogue synchronizer

This is an analog input with signal range -5...+5 VDC, which can be used for generator breaker synchronizing as an alternative to the traditional increase/decrease speed control. When input *OS 160 Analogue synchroniser enable* is closed, the engine speed reference will be ramped according to input OT 160 Analogue synchroniser. See further details in the section "*Speed control / CB Open control / Synchronising of a genset circuit breaker*".

10.2.2.19 OS 7326 Fixed speed select

Activating this input will cause the engine speed to ramp to a pre-defined speed (which for a generating set normally is the same as rated speed). Thereafter the speed can be adjusted by the *OS 163 Speed/load increase* and *OS 164 Speed/load decrease* inputs. In isochronous loadsharing mode, selecting fixed speed on one engine will switch the other engines running in parallel on the same busbar to follow the speed reference of this engine. This is typically used for synchronizing bus-tie breakers.

10.2.2.20 GS 771 Busbar breaker status, before

This input shall be activated (closed contact) when a certain busbar breaker (tie-breaker) is closed. See further details in section "*Isochronous control and loadsharing*".

10.2.2.21 GS 772 Busbar breaker status, after

This input shall be activated (closed contact) when a certain busbar breaker (tie-breaker) is closed.

See further details in section "*Isochronous control and loadsharing*".

10.2.2.22 OS 7320 Blackout start mode

Activating this input (closed contact) will override startblock functions which are “by default” activated in case of a blackout. E.g. the prelubricating oil pressure which is naturally lost when the prelubricating pump stops at a blackout. A closed contact will allow starting within 30 minutes after loss of prelubricating oil pressure. This shall be seen as re-starting after blackout and the start sequence is initiated by the normal start command (*OS 7302 Remote start*).

If blackout start is required, provisions for securing fuel supply and starting air in blackout situations must be made. Starting after an extended blackout period normally requires manual intervention for start-up of emergency generating sets for restoring the power.

10.2.2.23 UT 793 Generator load

This is an analogue 4-20 mA input signal. The signal shall be unfiltered and galvanically isolated external to the engine. Total signal processing time shall be **less than** 150 ms and accuracy within ± 1%. The signal shall be from a kW transducer, which is typically part of the main switchboard.

The range of the signal 4-20 mA = ?? - ?? kW (typically -15%...130% engine load) shall be informed to Wärtsilä during the project stage, prior to FAT of the engine.

10.3 Bus communication

The main interface with the ships alarm & monitoring system is a bus communication through which all measured values, alarm- and status indications are transmitted. For details, see drawing “*Modbus list*”.

10.4 Functional description of start/stop

10.4.1 Start function

The engine is equipped with a pneumatic starting motor, which drives the engine through a gear rim on the flywheel.

The engine can be started locally by the start button HS721, or remotely if applicable for the installation e.g. from the power management system. A generating set reaches the nominal speed typically in abt. 20 seconds after issuing the start command.

For functions causing start blocking, see drawing “*Modbus list*”.

10.4.2 Stop and shutdown function

A normal stop can be initiated locally by button HS722, or remotely if applicable for the installation. At normal stop the stop sequence is active by a timer function until the engine has come to standstill. Thereafter the system automatically returns to “ready for start” mode in case no start block functions are active, i.e. there is no need for manually resetting a normal stop.

The safety of the engine is mainly handled by the Engine Safety Module (ESM). The ESM performs sensor failure detection on the shutdown sensors and solenoids. A safety shutdown must be manually reset (either locally by shutdown reset button HS725, or remotely if applicable). Reset is possible only when the engine has come to full stop and the shutdown is not active anymore. Before re-start the reason for the shutdown must be carefully checked and corrected.

At a stop or shutdown the actuator/governor is driving the fuel rack control shaft to zero position. Additionally, pneumatic cylinders on each fuel injection pump are forcing the fuelracks to zero position by means of compressed air, thereby disabling the fuel injection.

For functions causing safety shutdown, see drawing “*Modbus list*”.

10.5 Speed control functions & loadsharing

10.5.1 General

10.5.1.1 Introduction

This instruction describes the functionality of the UNIC speed controller. The controller is a software module in the Main Control Module.

In the speed control algorithm the speed reference is compared with the measured engine speed. The difference between these signals constitutes the input to a PID-controller. The regulation output of the MCM controller will accordingly change, to sustain the reference level. This output will set the position request of the fuel actuator, i.e. control the diesel fuel rack position. In case of common rail engines or dual fuel engines the fuel injection duration is controlled. Two speed sensors are simultaneously used by the controller, and if one of them fails, an alarm is raised and the engine continues operation without interruption.

10.5.1.2 Dynamics

The PID-controller uses different sets of dynamic parameters for operation under acceleration, under no-load conditions and under loading conditions, to obtain optimal stability at all times. The PID settings are speed dependent for start acceleration and for open breaker conditions, and load/speed dependent when the engine is loaded.

10.5.1.3 Limiters

Three fuel limiters are available.

- A start fuel limiter is active during the engine start. The start fuel limiter is speed dependent, and the limiter works in combination with a speed reference ramp, used at engine start. The acceleration ramp is set for an optimal acceleration rate.
- A charge air pressure limiter is used to reduce overfuelling and black smoke at load steps at low engine load levels.
- A load dependent fuel limiter is used to set an envelope of the max. fuelling at various engine loads. This feature will improve the engine's load acceptance, but is also used as a limiter for the engine max. load output.

10.5.1.4 Control modes

The speed controller has different sub-control modes, which in brief are described below:

- **CB open control mode**, active during engine start and in run mode until the generator breaker has been closed. Start fuel limiter set to be used in this mode. Binary/analogue inputs are enabled for synchronisation purpose.
- **Speed droop control and load sharing mode**, active after closure of the generator breaker. The load sharing based on a built-in droop curve, which means that the engine speed will decrease proportionally to the load. Control of the speed reference from the power management system is necessary.
- **Isochronous control and load sharing mode**, active after closure of the generator breaker when isochronous load sharing has been selected. The load sharing is provided over LS-CAN and the engine speed remains unaffected by a droop slope at all load levels without speed reference adjustments from the power management system.
- **True kW control mode**, active after closure of the generator breaker when kW control has been selected.

These control modes will be further described in the following paragraphs.

For more exact recommendation of typical use- and routing of signals and yard cabling see drawing "*Block/interconnection diagram*" included in this chapter.

10.5.2 CB open control mode

10.5.2.1 Engine start

When an engine is started the speed is ramped up to rated speed and the control operates in CB open control mode.

While a ramping is active, the *OS 163 speed/load increase*, *OS 164 speed/load decrease* & *OT 160 analogue synchroniser* inputs are disabled, thus not able to affect the speed reference.

10.5.2.2 Synchronising of a genset circuit breaker

- Synchronising using increase/decrease commands: For the entire duration that the *OS 163 speed/load increase* and *OS 164 speed/load decrease* inputs remains true, the speed reference is biased up- or down according to the pre-set ramp rate.
- Synchronising using analogue synchroniser signal
  The analogue synchronisation functionality provides means to synchronise a genset circuit breaker, as an alternative to increase/decrease pulses which are normally used for synchronisation. When the input *OS 160 analogue synchroniser* enable input is closed the engine speed reference is biased according to the *OT 160 analogue synchronizer* input. The range of this input is -5 - 5 VDC, where a value of 0 VDC corresponds to the target speed reference . The resulting analogue synch value, positive or negative, is added to the target speed reference. Thereafter the speed reference is ramped to the result according to analog synch speed ramp rate.

10.5.3 Speed droop control and load sharing mode

10.5.3.1 Description

When the engine is operated in this mode, load sharing with other engines is provided with the use of speed droop. Droop control is a basic load sharing method, by which parallel running engines share their load by decreasing their internal speed reference proportionally to an increase engine load. The speed control is adjusted to 4% speed droop

In systems with speed droop as the primary load sharing method it is necessary to actively transfer load to a recently connected generator from parallel generators in order to achieve even load on all generators. Before disconnecting a generator it must be correspondingly unloaded. Loading and unloading is normally performed automatically by a power management system. The power management system commonly also corrects the frequency to eliminate the speed droop offset, which is proportional to the system load. The power management system performs load balancing and frequency correction by adjusting the speed references of the individual engines. (*OS 163 speed/load increase* and *OS 164 speed/load decrease*).

The controlling system (power management system) should not perform adjustments with shorter intervals than the controlled system (generating sets) responds. In order to achieve smooth load sharing it is important to implement suitable dead bands in the control.

If the power management system performs continuous load balancing and frequency correction, it should include the following features:

- Pulse length and time between pulses shall be adjustable. If the same control system also handles automatic synchronization, then pulse length, time between pulses and dead band shall be separately adjustable for synchronisation.
- The time between pulses shall be sufficiently long. After a correction it can take up to 30 seconds before the actual adjustment has reached 95% of the set point change. The control system should therefore wait at least 10 seconds before giving a new pulse.
- The control system should preferably determine the length of the pulse based on the size of the desired correction and then wait for 30 seconds or more before performing a new correction.
- A control dead band should be implemented, allowing for an uneven load of min ±2% of nominal power and a frequency drift of min ±1%.
- The corrections should not be based on instantly sampled values. The corrections should be based on the average value over several seconds. 10 seconds is a suitable time span.

Automatic unloading

Input *OS 7321 engine unload* provides an alternative instead of using the *OS 164 speed/load decrease* command for unloading an engine before opening the generator breaker.

When input *OS 7321 engine unload* becomes true, the speed reference will ramp down according to a predefined rate. Activation of the *OS 163 speed/load increase* and *OS 164 speed/load decrease* binary inputs cannot affect the speed reference during this ramping, with the exception if *OS 7321 engine unload* is de-activated before the unloading ramping is finished. When reaching the unload trip level, the *OS 7602 generator breaker open command* output will activate. The engine then transfers to CB open control mode when *GS 798 generator breaker* CB status becomes false.

10.5.4 Isochronous control and load sharing mode

10.5.4.1 Description

An engine operating in isochronous mode, will regulate the speed to the speed reference, regardless of the load level of the system.

Load sharing in isochronous mode is provided with communication over a loadsharing CAN bus, LS-CAN, which is interconnected between all engines. Each engine monitors the relative load of the other engines connected to the system, and calculates a relative system load. The unit compares its own relative load with the relative system load, and biases its internal speed reference, until the two loads are equal.

The relative load is calculated based on the *UT 793 generator load* input.

Isochronous control activation

The system transfers to this mode from CB open control mode, speed droop control and load sharing mode or true kW control mode, provided that *OS 7329 isochronous control enable* is true, and *GS 798 generator breaker status* is true and that the LS-CAN communication is healthy.

Uploading in isochronous load sharing mode

Always when a new engine is added to the load sharing network it is softly uploaded. In order to provide this a load sharing ramp is used.

If the *OS 7327 emergency loading rate* input is true, the ramp rate is emergency uploading ramp rate.

Unloading in isochronous load sharing mode

Unloading of an engine running in isochronous control and load sharing mode is achieved by setting the input *OS 7321 Engine unload* to true. When the input is activated the unloading is performed by ramping the load sharing ramp similarly to the uploading case. If the *OS 7327 emergency loading rate* input is true, the ramp rate is emergency unloading ramp rate.

If, during unloading of the engine the *OS 7321 Engine unload*, is again set false, the unloading of the engine will be interrupted and the load will again be ramped back to load sharing.

When the relative engine load reaches the unload trip level, the binary output *OS 7602 generator breaker open command* will be set true. The engine then transfers to CB open control mode when *GS 798 generator breaker* CB status becomes false.

Asymmetric load sharing bias

The asymmetric loadsharing bias input provides means for the power management system or operator to offset the load of an engine being part of an isochronous loadsharing system.

The signal range of the *IT 796 asymmetric load sharing bias* input is 4-20 mA. A value of 4 mA results in equal load sharing with the other engines. A value of 20 mA means no load on this engine (= relative load on this engine is 100% less than the relative system load.)

Busbar logic

The plant can consist of a number of separated busbars which are connected together through busbar breakers (tie breakers), see example in the figure as follows. Each engine has two inputs for status feedback from tie breakers. The physical locations of these busbar breakers are arranged such that the same breaker is defined as “*GS 772 busbar breaker status, after*” for one engine and “*GS 771 busbar breaker status, before*” for the next engine. If binary input GS772 and GS771 for two adjoining engines are both true, these engines are tied together and share their load in isochronous control and load sharing mode, as soon as this condition goes true.

The status for all busbar breakers is sent over the LS-CAN. If two adjoining engines have busbar status from the same breaker which is in conflict with each other, or in case of failure of the LS-CAN, the engines will trip to speed droop control and load sharing mode.

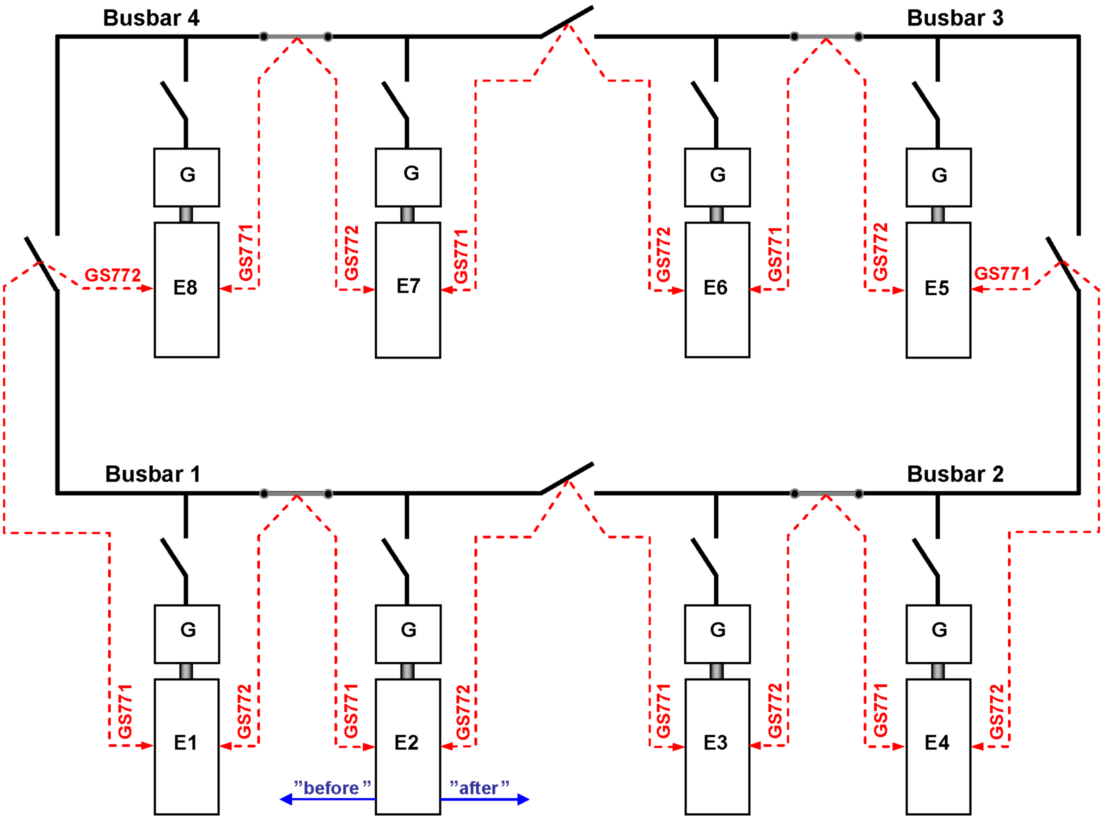


Fig 10-3 Busbar configuration example with busbar breaker status signals.

Tie-breaker synchronisation

If a tie-breaker between two busbars is open, selecting *OS 7326 fixed speed select* on one engine in any busbar, will switch all the other engines on that busbar to follow the speed reference of that engine. Synchronisation of the busbars can now be performed by *OS163 speed/load increase* and *OS164 speed/load decrease* binary inputs.

The speed reference as determined by the fixed speed engine will always remain valid until the *OS 7326 fixed speed select* has been set false.

If *OS 7326 fixed speed select* is true on more than one engine, the highest speed reference wins in this case.

At closing of a busbar breaker between two adjoining busbars (islands), the busbar defined as after the other one ramps itself to equalise its load with the other busbar.

10.5.5 True kW control mode

True kW control mode is normally not used in marine applications, but may be of interest in certain applications, e.g. for parallel running with significantly larger generating sets. The description is therefore included here for information purpose. If desired to use, please inform Wärtsilä concerning reasons as well as modes of operation.

10.5.5.1 Description

In this mode, the control loop is a true load control loop, where the engine speed is only used for safety purpose.

This mode is enabled by the input *OS7328 kW control enable*. The load is ramped up/down according to the externally given reference *OT795 kW reference* as soon as the engine is connected to the power distribution network, i.e. when this mode becomes active. (note that OS163 speed/load increase and OS164 speed/load decrease both must be active in order to enable OT795 kW reference).

When entering this mode from CB open control mode, the load reference is initially set to kW base load in order to avoid risk of reverse power of the genset. The load reference is always limited to kW base load level, when ramped down.

When entering this mode from speed droop control mode or isochronous control and load sharing, the initial load reference will be the *UT793 generator load*. From this load level the load will thereafter be ramped towards *OT795 kW reference* according to a predefined rate.

If input *OS 7321 engine unload* is activated, the load reference is ramped down to the unload trip level and when reaching this level, the *OS 7602 generator breaker open command* output will activate and CB open control mode will be entered. If *OS 7321 engine unload* is de-activated and the unload ramping is still unfinished, the load reference is again ramped to the *OT795 kW reference*.

If the bus frequency (speed) is not within a pre-defined speed window or if the *UT 793 generator load* signal fails, the control mode will automatically trip to droop mode.

When the engine operates in true kW mode, the internal speed reference is continuously calculated and updated to match equal load level in speed droop control and load sharing mode.

10.6 Power unit

For each engine a power supply cabinet is delivered for providing the 24 VDC power supply required by the engine and for providing isolation from other DC systems on board.

The cabinet is designed for bulkhead mounting, protection degree IP44, max ambient temp 50 °C.

The power unit is designed for two incoming power supplies, of which at least one is to be supplied from a UPS.

For further information see drawings “Power Unit” and “Block/Interconnection diagram” included in this chapter.

10.7 Precautions

The automation system contains circuit boards that are sensitive both to damage by electrostatic discharge (ESD) and mechanical damage. Therefore, the following precautions can significantly reduce the risk of system failure or malfunction:

- Protect all modules against moisture and uncleanness by using moisture proof covering during storing at yard/site. If exposed to humidity during these stages, the components must be carefully dried. Otherwise wiring connections may become unreliable.
- Avoid ESD to modules by not touching circuit boards and module connectors without ESD protection.
- Locate the communication cables between engine and control panels as far away as possible, at least 300 mm, from power and high voltage cables. If this is not possible, pull the communication cables in grounded steel conduits.
- Make sure the engine is well grounded, not connected to external systems and that the power is switched off before installation work is done near the engine. This is especially important during electrical welding in the engine room.
- When welding ensure that welding earth is close to the welding point.
- Power-on of the automation system must not be done until a Wärtsilä Service Engineer has checked and approved the cabling/connections.
- Cabling/connections should be done according to Wärtsilä project specific drawings. Important is to use shields and cable-pairs accordingly.
- Keep cabinets and modules closed at all time, as far as practically possible. If opened for some reason, avoid touching circuit boards and connector pins.
- Avoid using RF-equipment near modules when covers are open or there are unconnected connectors or wires.

WARNING

Arc welding on or close to the engine must be avoided if cables are connected to the automation system.

10.8 Component data, Wärtsilä scope of supply

10.8.1 Starter for engine pre lubricating oil pump (9N03)

Quantity 1

10.8.2 Starter for radiator fan (9N03)

Quantity 1

Drawing DMCA00026709

10.8.3 Starter for radiator loop pump (9N03)

Quantity 1

Drawing DMCA00026700

10.8.4 Starter for engine turning gear (9N15)

Quantity 1

10.8.5 Communication box (8N39)

Quantity	1
Dimensional drawing	DAE200179

10.8.6 Transformer for dyno

Quantity	1
Type	3PUK 7kVA 600V//400-480V Dyn11 IP23
Primary (V)	600
Secondary (V)	460
Rating (kVA)	7

10.8.7 Dyno Control System

Quantity	1
Type	AVL Omega 3000 S2

10.8.8 Dyno loop pump frequency drive

Quantity	1
Type	VACON0100-3L-0011-6+EMC4+LS60+FBIE
Motor Power High Overload [kW]	5.5
Continuous Current IH [A]	9
Motor Power Low Overload [kW]	7.5
Continuous Current IL [A]	11
Dimensions WxHxD [mm]	144x419x214
Weight [kg]	10
Frame	MR05
Voltage [V]	6 - 525 - 600

10.8.9 Power Unit

Quantity	1
Drawing	DMCA00026526

10.9 List of Documents

INDEX: BLOCK / INTERCONNECTION DIAGRAM

(REV. = LAST REVISED)

PAGE	DESCRIPTION	REV.
1.	INDEX PAGE	-
2.	OVERVIEW DIAGRAM	-
3.	POWER UNIT	-
4.	IAS	-
5.	PRELUBE PUMP STARTER	-
6.	TURNING GEAR STARTER, COMPRESSOR	-
7.	PREHEATING UNIT, LT VALVE	-
8.	WATER BRAKE LOOP PUMP	-
9.	RADIATOR LOOP PUMP	-
10.	RADIATOR FANS	-
11.	RADIATOR FANS	-
12.	RADIATOR FANS	-
13.	WATER BRAKE	-

CONTACT SYMBOL DESCRIPTION

MECHANICAL CONTACT
NO POLARITY

SOLID STATE RELAY CONTACT
NO POLARITY

SOLID STATE RELAY CONTACT
POLARITY

Rev.	Date	Created by	Appr. by	Revision text
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-

Project name	CCG College
Project id	SP/04235
Product id	W8L26
Based on document id	
Customer document id	
Title	Index page
	Block / interconnection diagram
Created by	TKA
Create date	17 Oct 2019
Reviewed by	RSJ
Review date	17 Oct 2019
Approved by	SKL
Approval date	17 Oct 2019
Language	EN
Object designation	
Sheet size	A3
Page	1 / 13
Document Id:	DMCA00026873
Rev.	-

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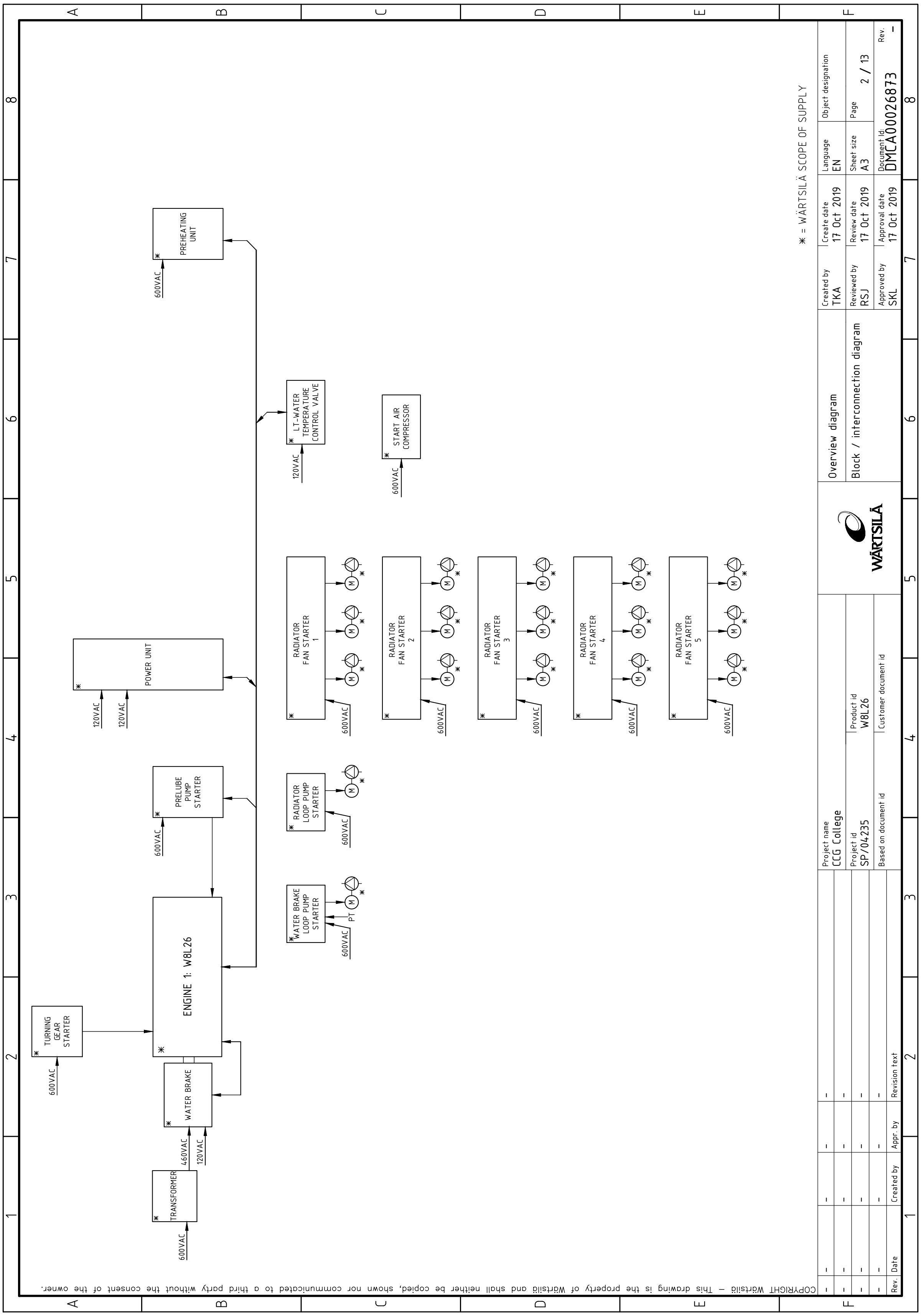
* = WÄRTSILÄ SCOPE OF SUPPLY
TRANSFORMER
600VAC
460VAC
120VAC
WATER BRAKE
TURNING GEAR STARTER
ENGINE 1: W8L26
PRELUBE PUMP STARTER
POWER UNIT
PREHEATING UNIT
LT-WATER TEMPERATURE CONTROL VALVE
START AIR COMPRESSOR
WATER BRAKE LOOP PUMP STARTER
RADIATOR LOOP PUMP STARTER
RADIATOR FAN STARTER 1
RADIATOR FAN STARTER 2
RADIATOR FAN STARTER 3
RADIATOR FAN STARTER 4
RADIATOR FAN STARTER 5
PT
M
Overview diagram
Block / interconnection diagram
WÄRTSILÄ
Created by TKA
Reviewed by RSJ
Approved by SKL
Create date 17 Oct 2019
Review date 17 Oct 2019
Approval date 17 Oct 2019
Language EN
Sheet size A3
Object designation
Page 2 / 13
Document Id: DMCA00026873
Rev. -
Project name CCG College
Project id SP/04235
Product id W8L26
Based on document id
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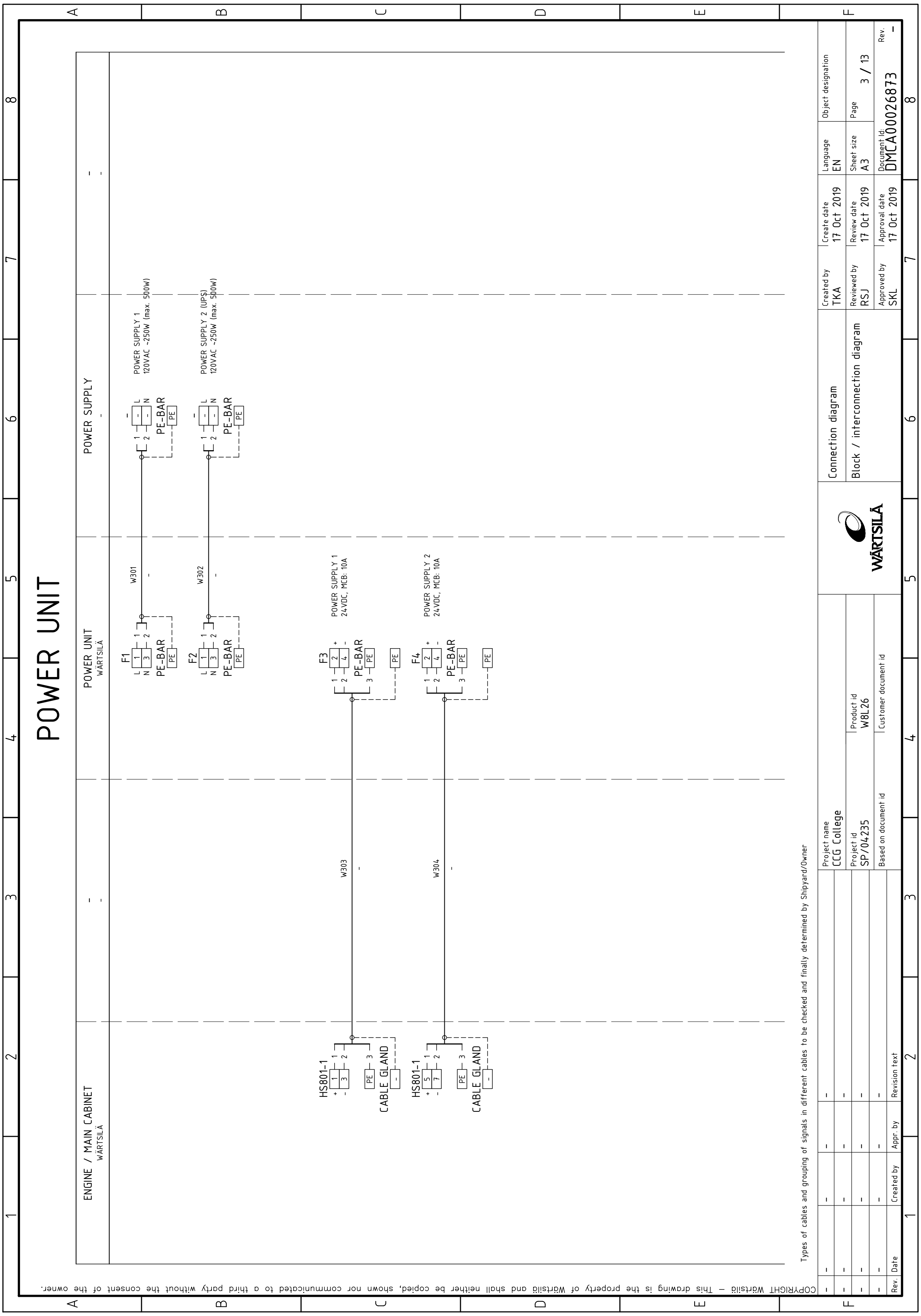
POWER UNIT
ENGINE / MAIN CABINET
WÄRTSILÄ
POWER UNIT
WÄRTSILÄ
POWER SUPPLY
POWER SUPPLY 1
120VAC ~250W (max. 500W)
POWER SUPPLY 2 (UPS)
120VAC ~250W (max. 500W)
POWER SUPPLY 1
24VDC, MCB: 10A
POWER SUPPLY 2
24VDC, MCB: 10A
F1
F2
F3
F4
PE-BAR
HS801-1
CABLE GLAND
W301
W302
W303
W304
Types of cables and grouping of signals in different cables to be checked and finally determined by Shipyard/Owner
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Project name
CCG College
Project id
SP/04235
Product id
W8L26
Connection diagram
Block / interconnection diagram
Created by
TKA
Reviewed by
RSJ
Approved by
SKL
Create date
17 Oct 2019
Review date
17 Oct 2019
Approval date
17 Oct 2019
Language
EN
Sheet size
A3
Page
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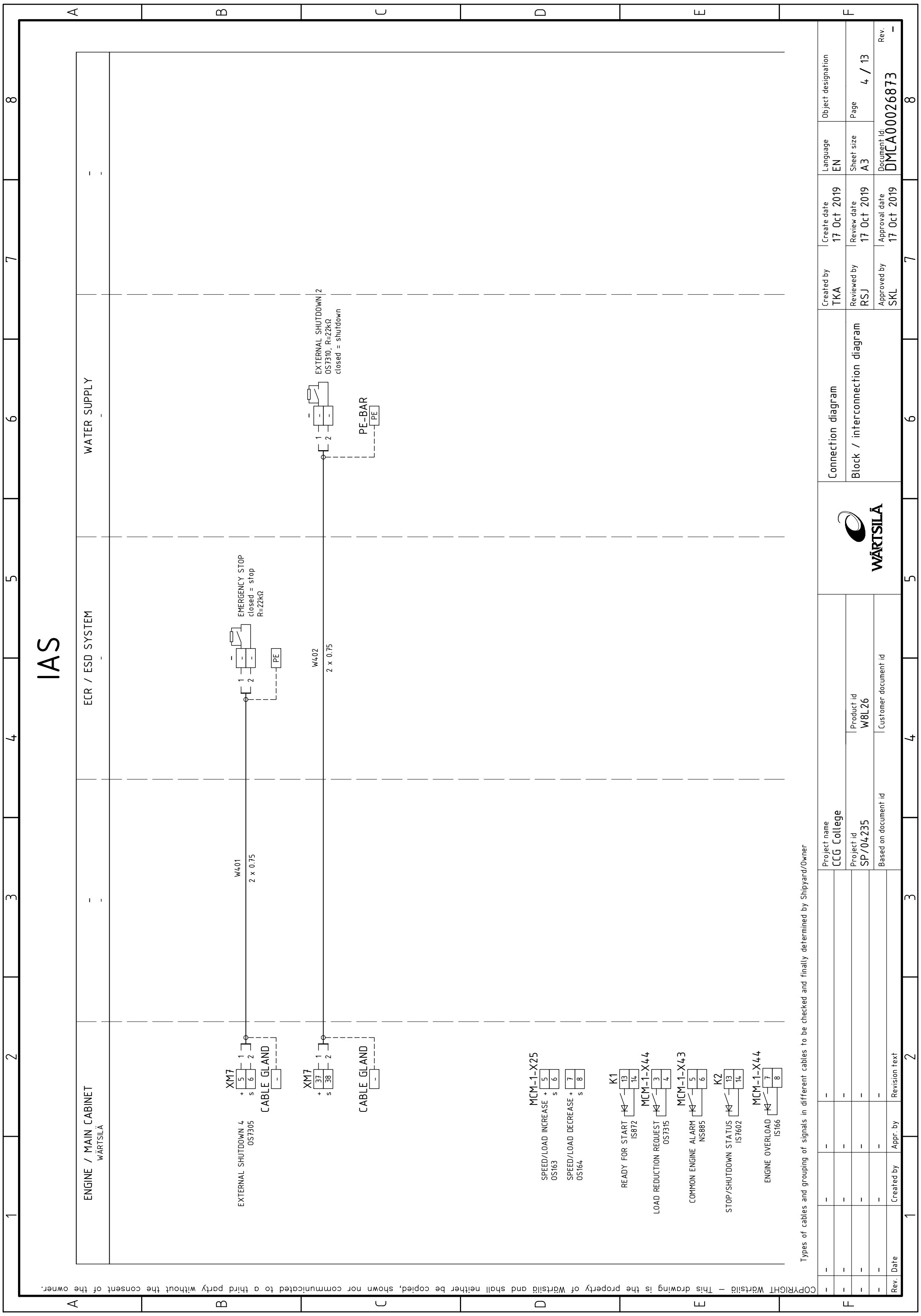
Document id
DMCA00026873
WÄRTSILÄ


IAS
ENGINE / MAIN CABINET
WÄRTSILÄ
ECR / ESD SYSTEM
WATER SUPPLY
EXTERNAL SHUTDOWN 4
OS7305
XM7
CABLE GLAND
W401
2 x 0.75
W402
2 x 0.75
EMERGENCY STOP
closed = stop
R=22kΩ
PE
EXTERNAL SHUTDOWN 2
OS7310, R=22kΩ
closed = shutdown
PE-BAR
SPEED/LOAD INCREASE
OS163
SPEED/LOAD DECREASE
OS164
MCM-1-X25
READY FOR START
IS872
K1
LOAD REDUCTION REQUEST
OS7315
MCM-1-X44
COMMON ENGINE ALARM
NS885
MCM-1-X43
STOP/SHUTDOWN STATUS
IS7602
K2
ENGINE OVERLOAD
IS166
MCM-1-X44
Types of cables and grouping of signals in different cables to be checked and finally determined by Shipyard/Owner
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Rev. Date Created by Appr. by Revision text
Project name
CCG College
Project id
SP/04235
Product id
W8L26
Based on document id
Customer document id
WÄRTSILÄ
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17 Oct 2019
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SKL
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17 Oct 2019
Language
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Sheet size
A3
Object designation
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Document id
DMCA00026873
Rev.
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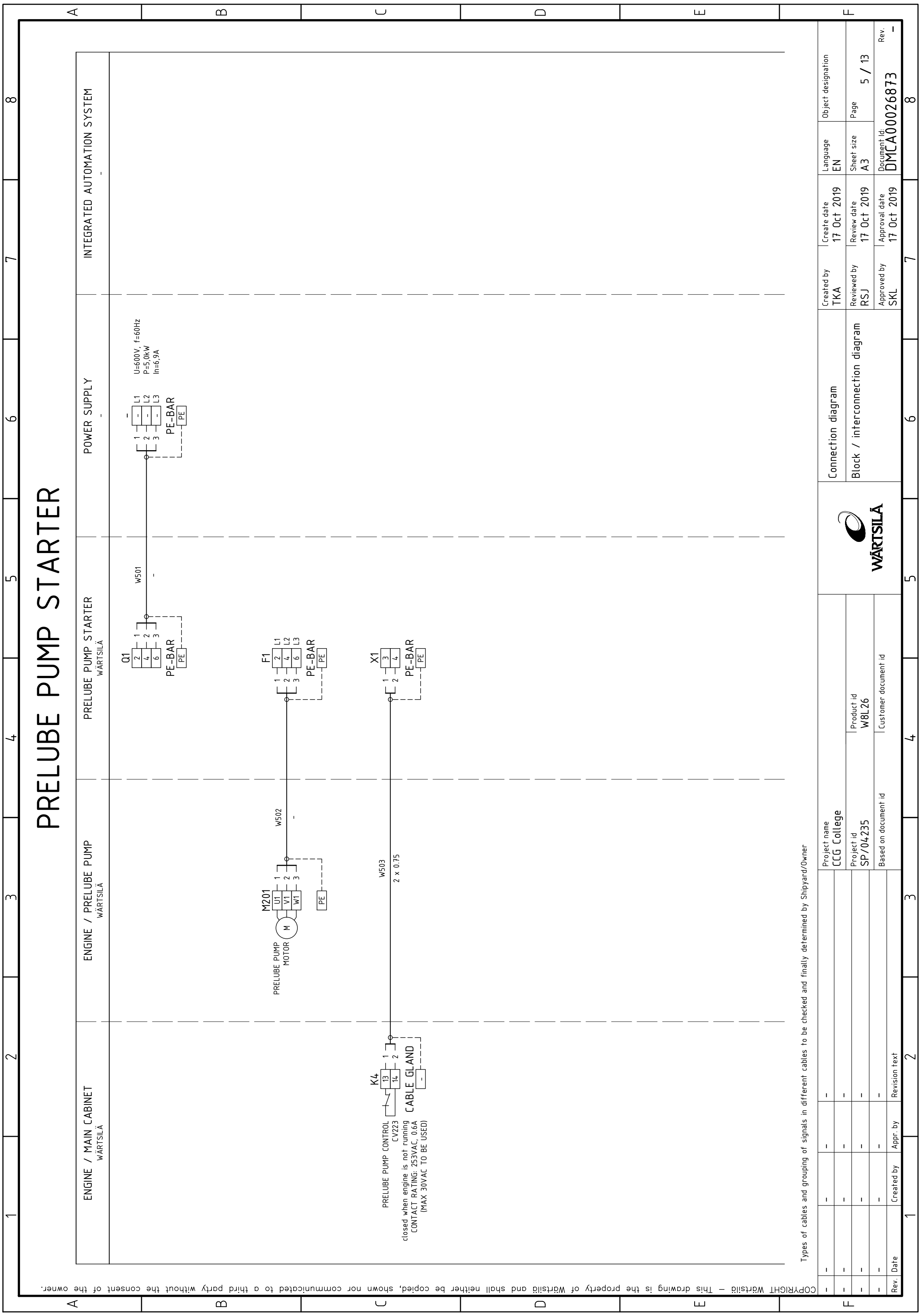
PRELUBE PUMP STARTER
ENGINE / MAIN CABINET
WÄRTSILÄ
ENGINE / PRELUBE PUMP
WÄRTSILÄ
PRELUBE PUMP STARTER
WÄRTSILÄ
POWER SUPPLY
-
INTEGRATED AUTOMATION SYSTEM
-
PRELUBE PUMP CONTROL
CV223
closed when engine is not running
CONTACT RATING: 253VAC, 0.6A
(MAX 30VAC TO BE USED)
K4
CABLE GLAND
PRELUBE PUMP
MOTOR
M201
PE
W502
W503
2 x 0.75
Q1
PE-BAR
F1
X1
W501
U=600V, f=60Hz
P=5,0kW
In=6,9A
Types of cables and grouping of signals in different cables to be checked and finally determined by Shipyard/Owner
Project name
CCG College
Project id
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Based on document id
Customer document id
Connection diagram
Block / interconnection diagram
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Rev. Date Created by Appr. by Revision text
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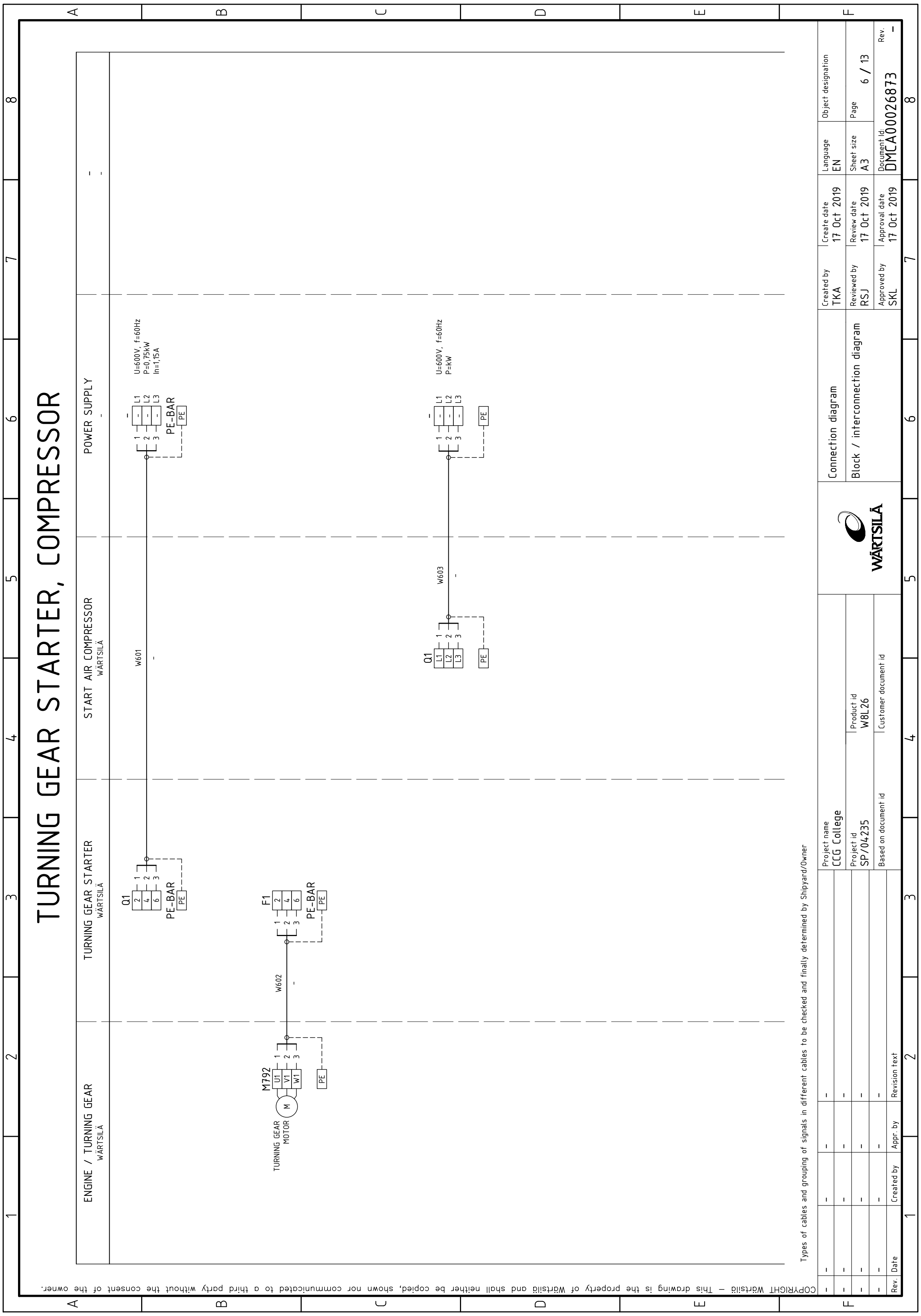
TURNING GEAR STARTER, COMPRESSOR
ENGINE / TURNING GEAR
WÄRTSILÄ
TURNING GEAR STARTER
WÄRTSILÄ
START AIR COMPRESSOR
WÄRTSILÄ
POWER SUPPLY
TURNING GEAR MOTOR
M792
Q1
F1
PE-BAR
W601
W602
W603
U=600V, f=60Hz
P=0,75kW
In=1,15A
U=600V, f=60Hz
P=kW
Types of cables and grouping of signals in different cables to be checked and finally determined by Shipyard/Owner
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Project name
CCG College
Project id
SP/04235
Product id
W8L26
Based on document id
Customer document id
Connection diagram
Block / interconnection diagram
Created by
TKA
Create date
17 Oct 2019
Reviewed by
RSJ
Review date
17 Oct 2019
Approved by
SKL
Approval date
17 Oct 2019
Language
EN
Sheet size
A3
Object designation
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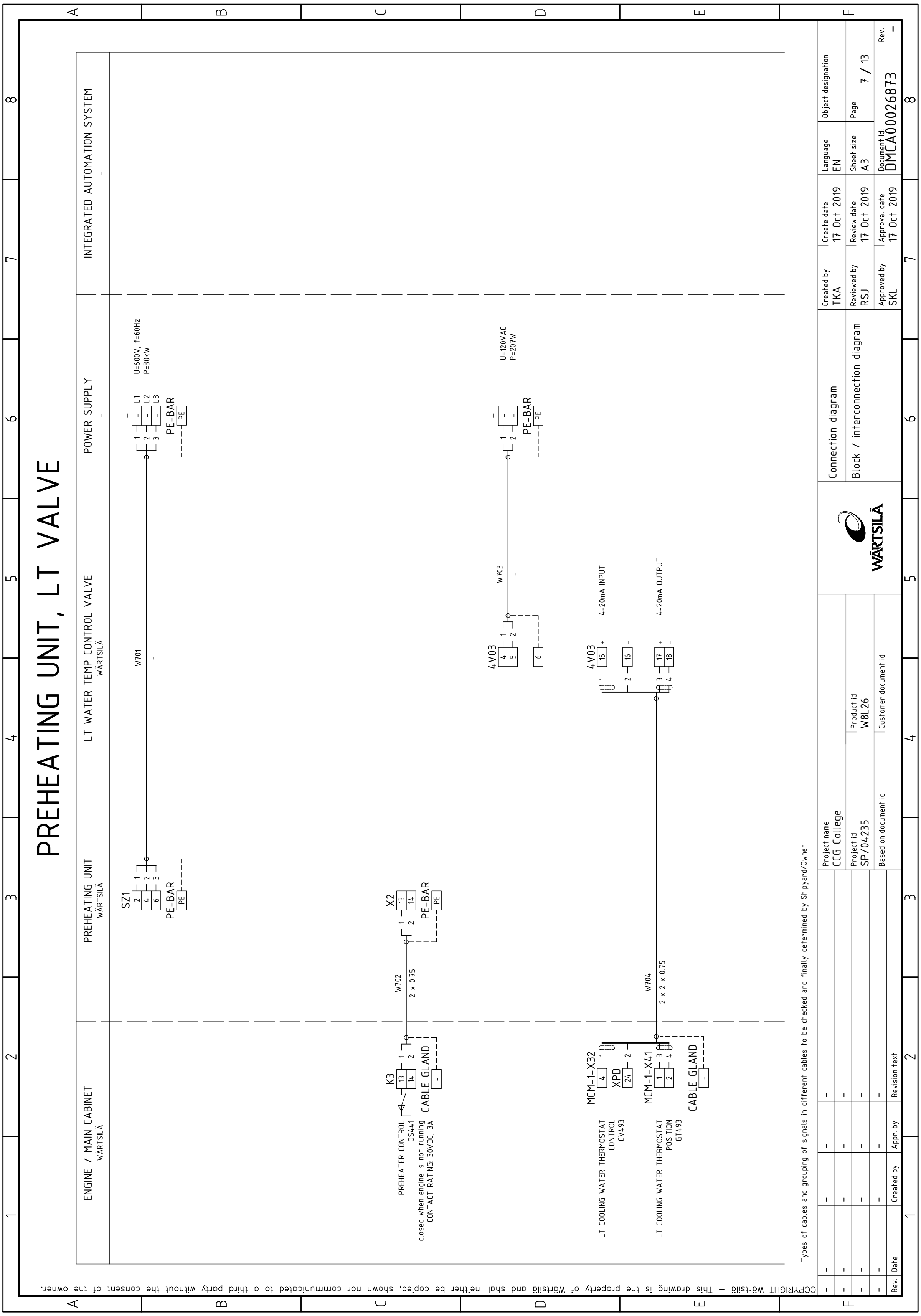
Document id
DMCA00026873
Rev.
Rev. Date Created by Appr by Revision text


PREHEATING UNIT, LT VALVE
ENGINE / MAIN CABINET
WÄRTSILÄ
PREHEATING UNIT
WÄRTSILÄ
LT WATER TEMP CONTROL VALVE
WÄRTSILÄ
POWER SUPPLY
INTEGRATED AUTOMATION SYSTEM
SZ1
PE-BAR
W701
U=600V, f=60Hz
P=30kW
4V03
W703
U=120VAC
P=207W
4-20mA INPUT
4-20mA OUTPUT
PREHEATER CONTROL
OS441
closed when engine is not running
CONTACT RATING: 30VDC, 3A
K3
CABLE GLAND
W702
2 x 0.75
X2
LT COOLING WATER THERMOSTAT
CONTROL
CV493
MCM-1-X32
XPD
LT COOLING WATER THERMOSTAT
POSITION
GT493
MCM-1-X41
W704
2 x 2 x 0.75
Types of cables and grouping of signals in different cables to be checked and finally determined by Shipyard/Owner
Project name
CCG College
Project id
SP/04235
Product id
W8L26
Based on document id
Customer document id
Connection diagram
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Rev.
Rev. Date Created by Appr. by Revision text
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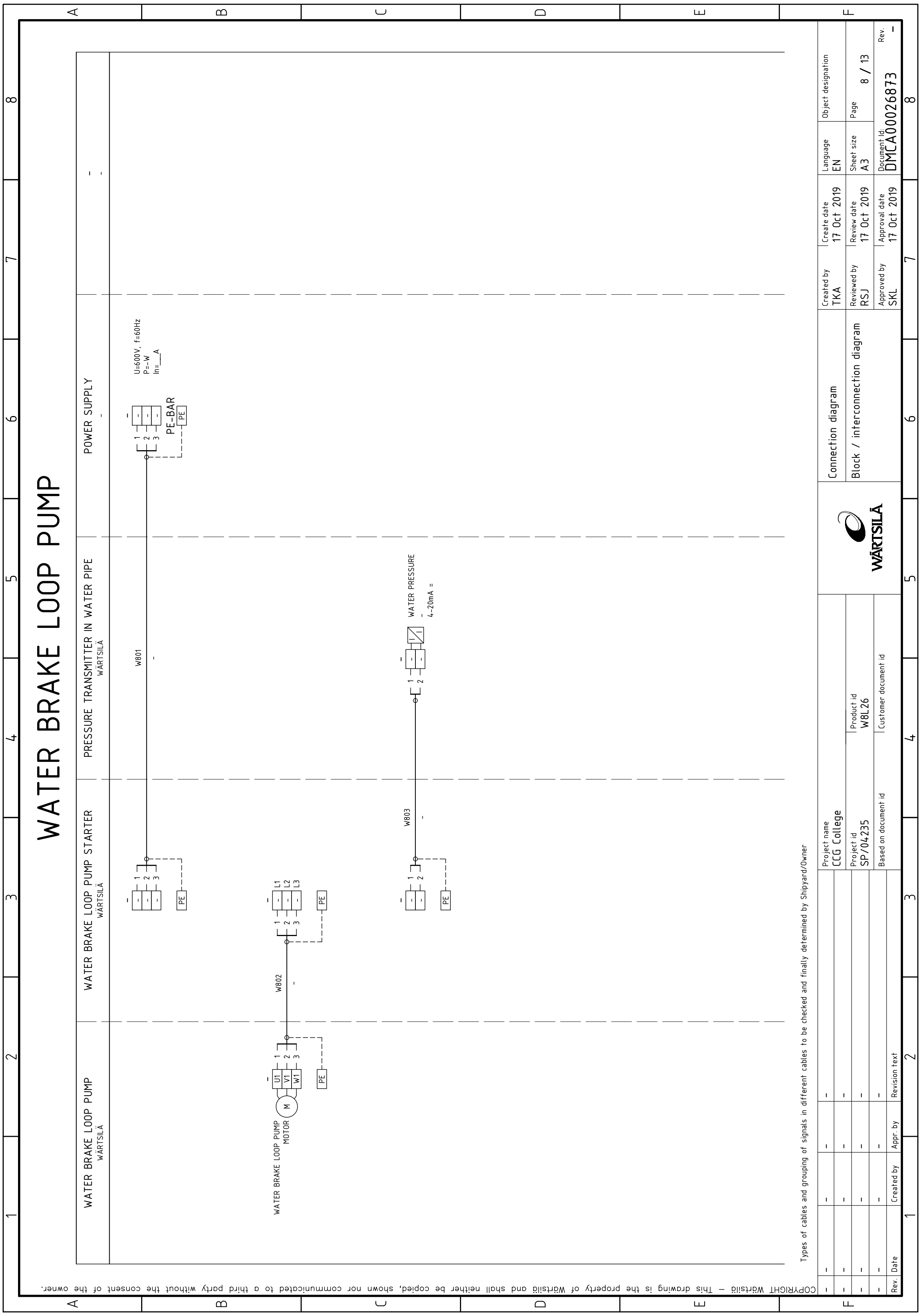
WATER BRAKE LOOP PUMP
WATER BRAKE LOOP PUMP
WÄRTSILÄ
WATER BRAKE LOOP PUMP STARTER
WÄRTSILÄ
PRESSURE TRANSMITTER IN WATER PIPE
WÄRTSILÄ
POWER SUPPLY
WATER BRAKE LOOP PUMP
MOTOR
U1
V1
W1
PE
L1
L2
L3
W801
W802
W803
WATER PRESSURE
4-20mA =
PE_BAR
U=600V, f=60Hz
P=-W
In=__A
Types of cables and grouping of signals in different cables to be checked and finally determined by Shipyard/Owner
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Rev.
Date
Created by
Appr. by
Revision text
Project name
CCG College
Project id
SP/04235
Product id
W8L26
Based on document id
Customer document id
WÄRTSILÄ
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Block / interconnection diagram
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Review date
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Approval date
17 Oct 2019
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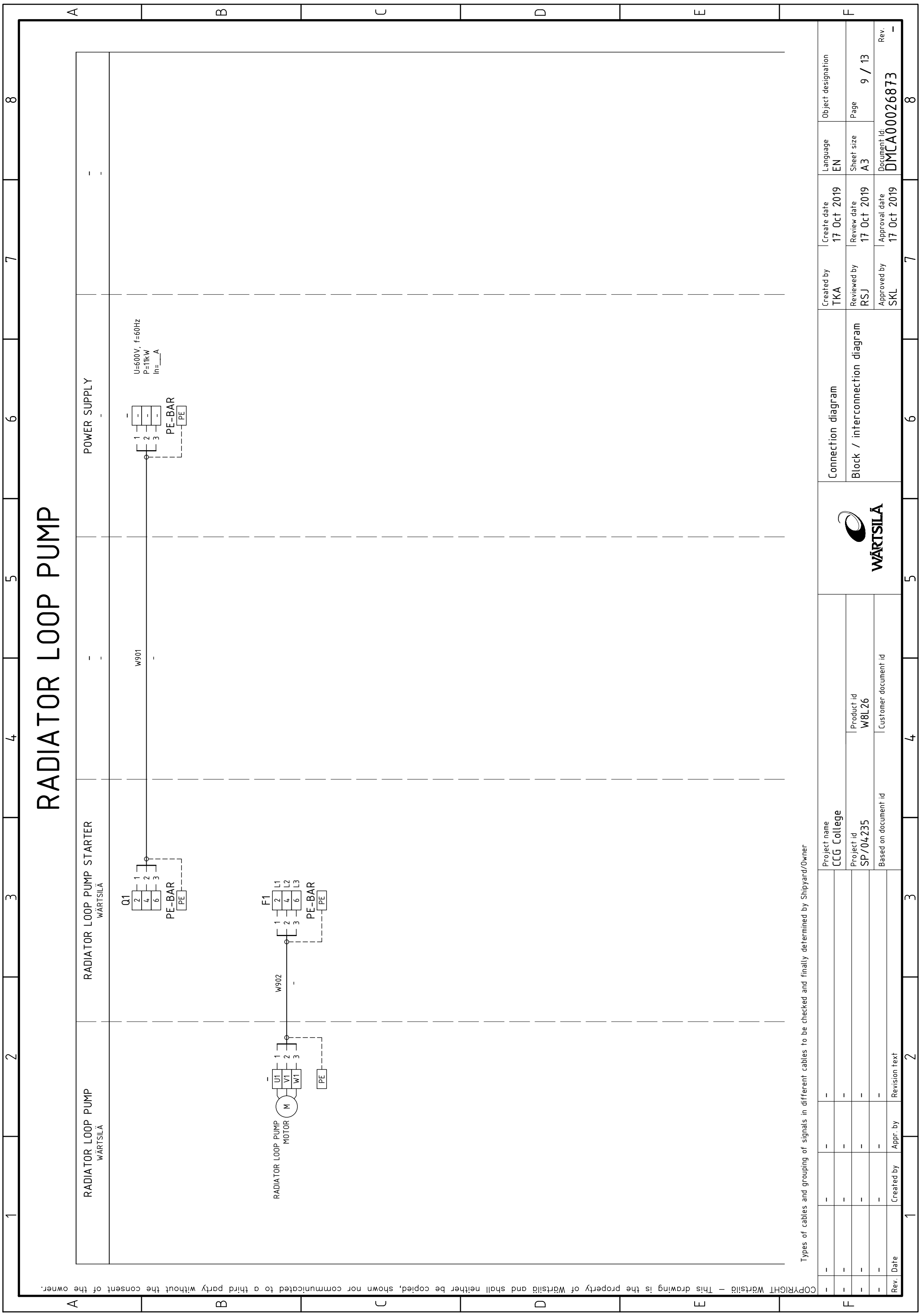
RADIATOR LOOP PUMP
RADIATOR LOOP PUMP
WARTSILA
RADIATOR LOOP PUMP STARTER
WARTSILA
POWER SUPPLY
RADIATOR LOOP PUMP MOTOR
M
U1
V1
W1
PE
W902
F1
PE-BAR
Q1
W901
U=600V, f=60Hz
P=1kW
In=__A
Types of cables and grouping of signals in different cables to be checked and finally determined by Shipyard/Owner
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Date
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Appr. by
Revision text
Project name
CCG College
Project id
SP/04235
Product id
W8L26
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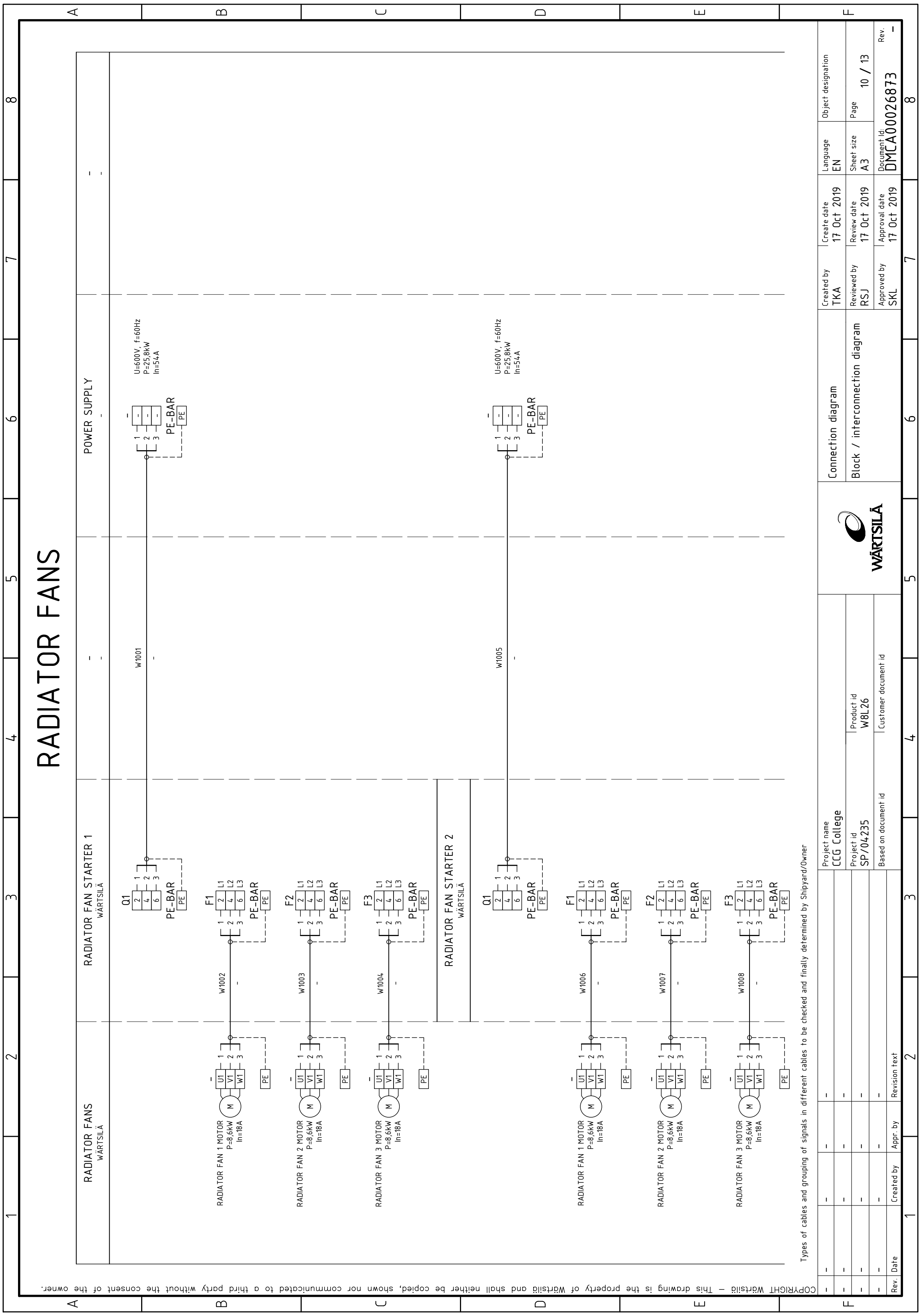
RADIATOR FANS
RADIATOR FANS
WÄRTSILÄ
RADIATOR FAN STARTER 1
WÄRTSILÄ
RADIATOR FAN STARTER 2
WÄRTSILÄ
POWER SUPPLY
U=600V, f=60Hz
P=25,8kW
In=54A
W1001
W1002
W1003
W1004
W1005
W1006
W1007
W1008
Q1
F1
F2
F3
PE-BAR
PE
RADIATOR FAN 1 MOTOR
RADIATOR FAN 2 MOTOR
RADIATOR FAN 3 MOTOR
P=8,6kW
In=18A
Types of cables and grouping of signals in different cables to be checked and finally determined by Shipyard/Owner
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Project name
CCG College
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SP/04235
Product id
W8L26
Based on document id
Customer document id
WÄRTSILÄ
Connection diagram
Block / interconnection diagram
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Language
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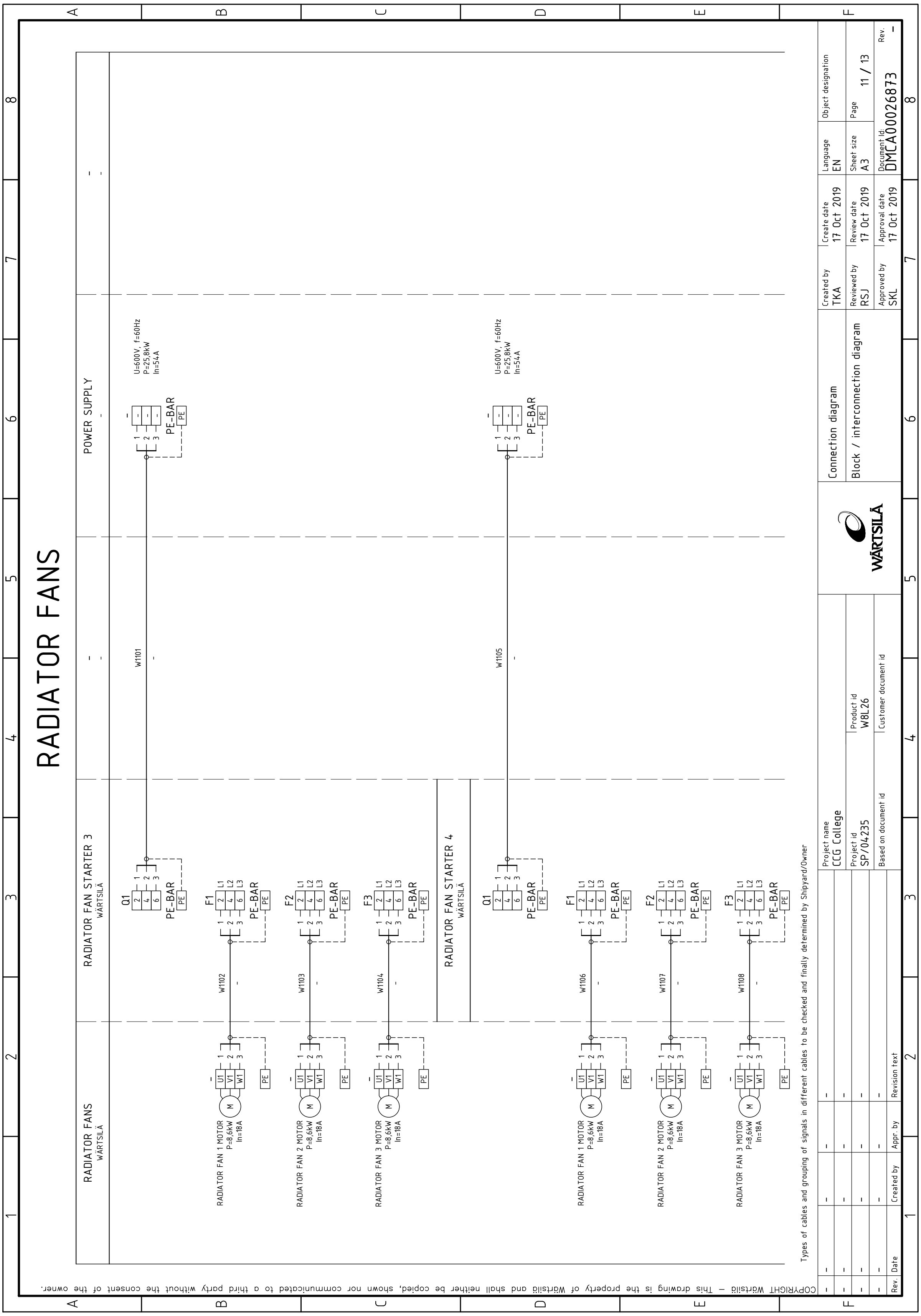
Date
Created by
Appr. by
Revision text


RADIATOR FANS
RADIATOR FANS
WÄRTSILÄ
RADIATOR FAN STARTER 3
WÄRTSILÄ
RADIATOR FAN STARTER 4
WÄRTSILÄ
POWER SUPPLY
RADIATOR FAN 1 MOTOR
P=8,6kW
In=18A
RADIATOR FAN 2 MOTOR
P=8,6kW
In=18A
RADIATOR FAN 3 MOTOR
P=8,6kW
In=18A
U1 V1 W1
PE
Q1
F1
F2
F3
PE-BAR
W1101
W1102
W1103
W1104
W1105
W1106
W1107
W1108
U=600V, f=60Hz
P=25,8kW
In=54A
Types of cables and grouping of signals in different cables to be checked and finally determined by Shipyard/Owner
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Rev. Date Created by Appr. by Revision text
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SP/04235
Product id
W8L26
Based on document id
Customer document id
WÄRTSILÄ
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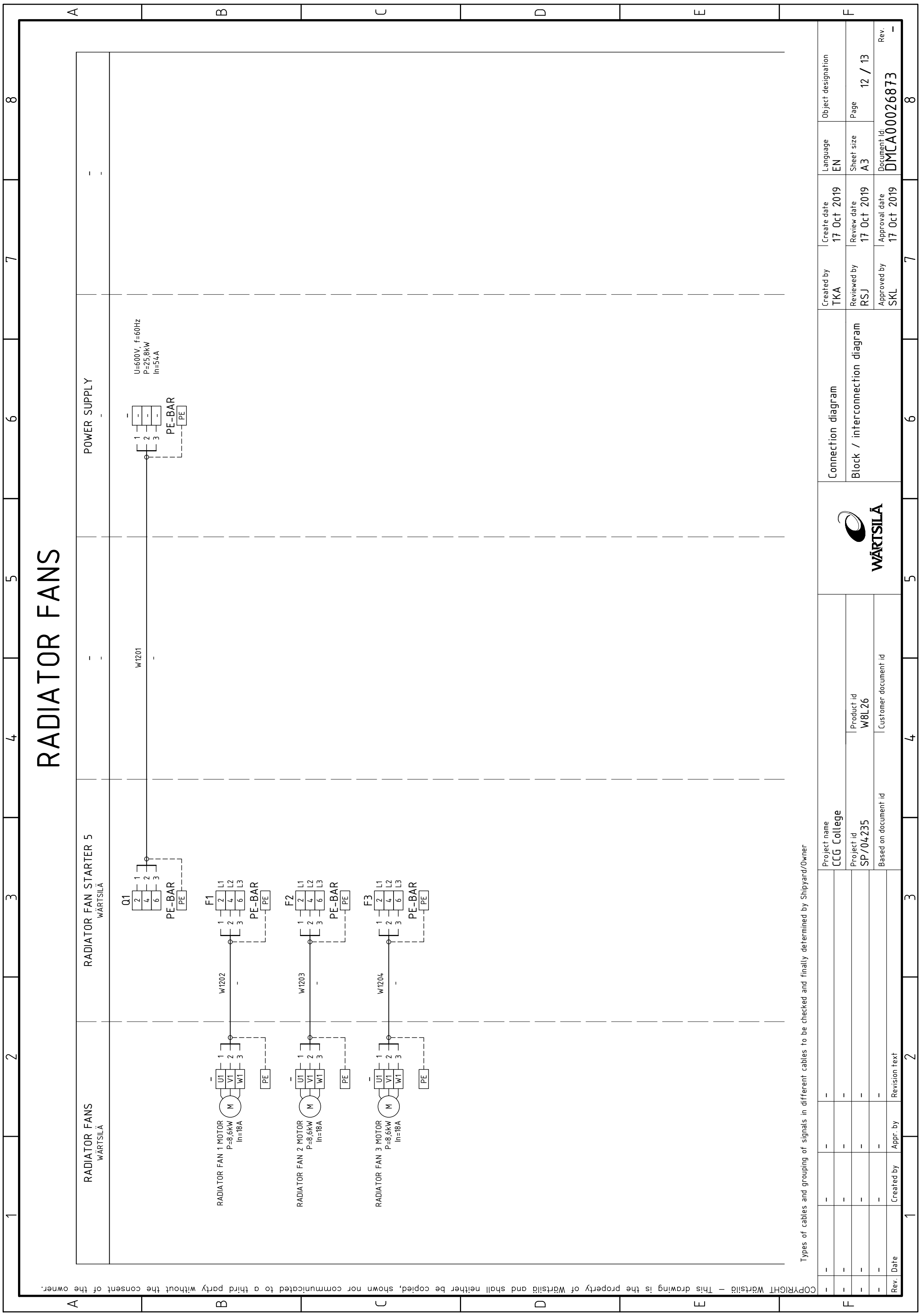
RADIATOR FANS
RADIATOR FANS
WÄRTSILÄ
RADIATOR FAN STARTER 5
WÄRTSILÄ
POWER SUPPLY
RADIATOR FAN 1 MOTOR
P=8,6kW
In=18A
RADIATOR FAN 2 MOTOR
P=8,6kW
In=18A
RADIATOR FAN 3 MOTOR
P=8,6kW
In=18A
W1201
W1202
W1203
W1204
Q1
F1
F2
F3
PE-BAR
U=600V, f=60Hz
P=25,8kW
In=54A
Types of cables and grouping of signals in different cables to be checked and finally determined by Shipyard/Owner
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Based on document id
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17 Oct 2019
Language
EN
Sheet size
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Document id
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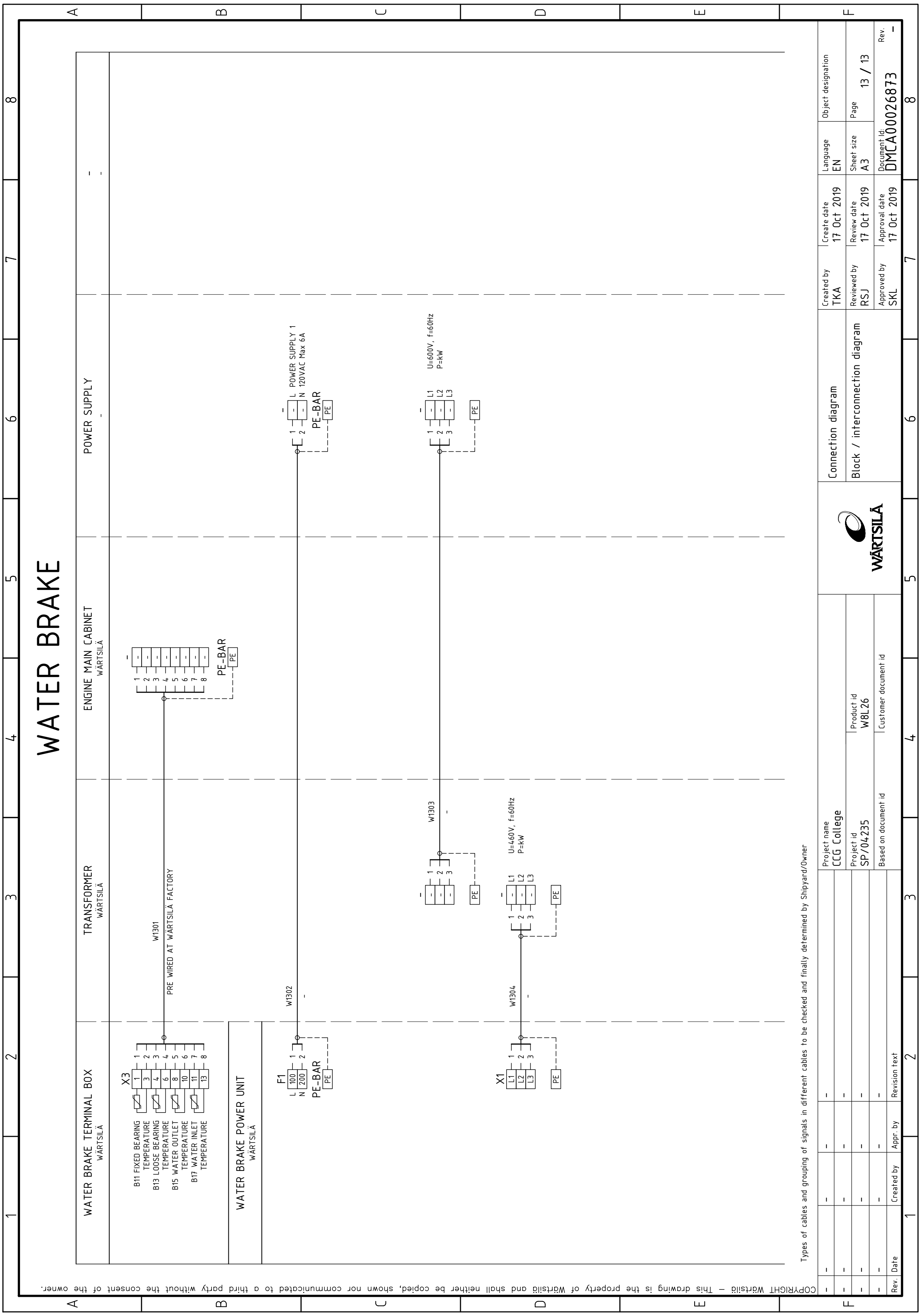
Rev.
Rev. Date Created by Appr. by Revision text


WATER BRAKE
WATER BRAKE TERMINAL BOX
WARTSILA
TRANSFORMER
WARTSILA
ENGINE MAIN CABINET
WARTSILA
POWER SUPPLY
WATER BRAKE POWER UNIT
WARTSILA
B11 FIXED BEARING TEMPERATURE
B13 LOOSE BEARING TEMPERATURE
B15 WATER OUTLET TEMPERATURE
B17 WATER INLET TEMPERATURE
X3
F1
X1
PE-BAR
PE
W1301
PRE WIRED AT WARTSILA FACTORY
W1302
W1303
W1304
POWER SUPPLY 1
120VAC Max 6A
U=600V, f=60Hz
P=kW
U=460V, f=60Hz
P=kW
Types of cables and grouping of signals in different cables to be checked and finally determined by Shipyard/Owner
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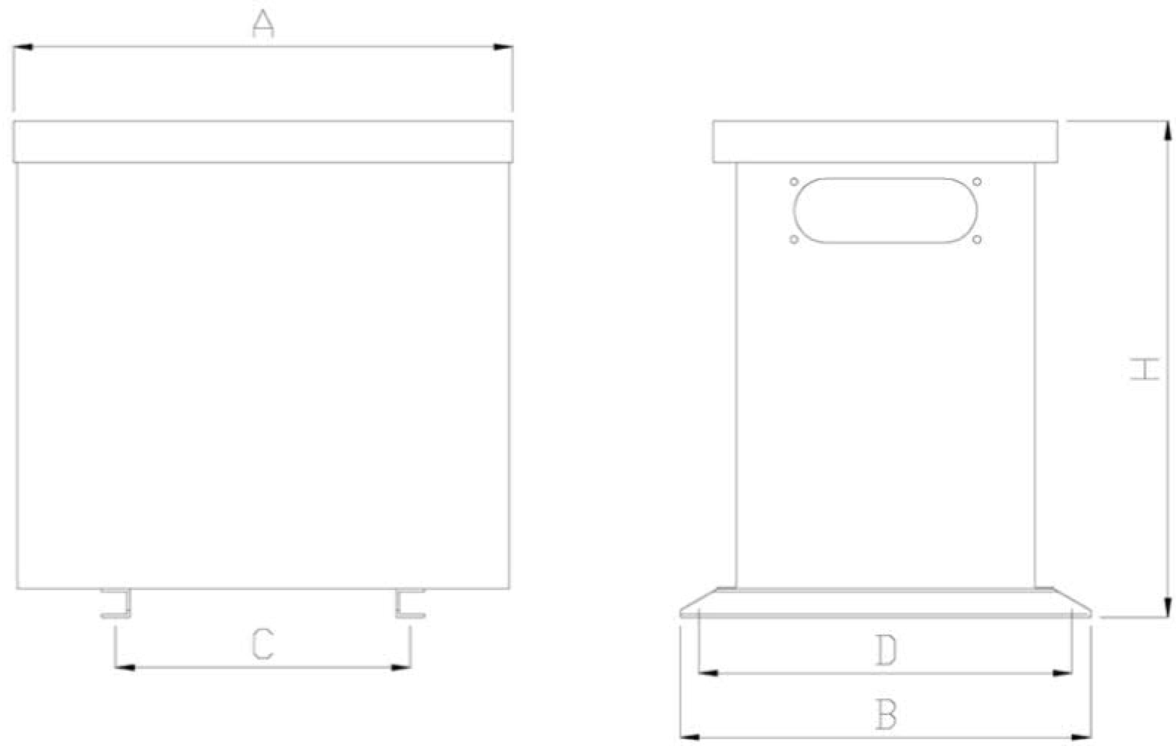

S [kVA]	Enclosure	A [mm]	B [mm]	C [mm]	D [mm]	H [mm]	Ø [mm]	m [kg]
1,0	3PUK23 114-150	410	380	173	340	390	12x18	26
1,6	3PUK23 114-150	410	380	173	340	390	12x18	30
2,0	3PUK23 114-150	410	380	173	340	390	12x18	32
2,5	3PUK23 114-150	410	380	190	340	390	12x18	32
3,0	3PUK23 114-150	410	380	190	340	390	12x18	42
4,0	3PUK23 114-150	410	380	220	340	390	12x18	42
5,0	3PUK23 114-150	410	380	220	340	390	12x18	52
6,0	3PUK23 114-150	410	380	220	340	390	12x18	60
6,3	3PUK23 180-210	535	440	264	400	535	12x18	65
8,0	3PUK23 180-210	535	440	264	400	535	12x18	78

0	1	2	3	4	5	6	7	8	9

ARNON.

Hyllilänkatu 15
33730 Tampere, Finland
Tel: +358 10 526 5000
www.ARNON.fi

Customer	WÄRTSILÄ
Project description	DMCA00026526 POWER UNIT
Job number	3014255 (DAE200171)

AC Input: 120V
Frequency: 60Hz
DC Input: -
Degree of protection: NEMA 4
FLA: 2x10A
Largest motor: -
SCCR: -

Created on 20.10.2020
Edit date 11.11.2020 by (short name) MHe

Number of pages: 7

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			Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Title page / cover sheet	DAE200171	= 3	
			User	MHe					+	
			Checked		DMCA00026526 POWER UNIT			3014255 (DAE200171)	Page	1
Revision	Date	User	Approved						Page	7

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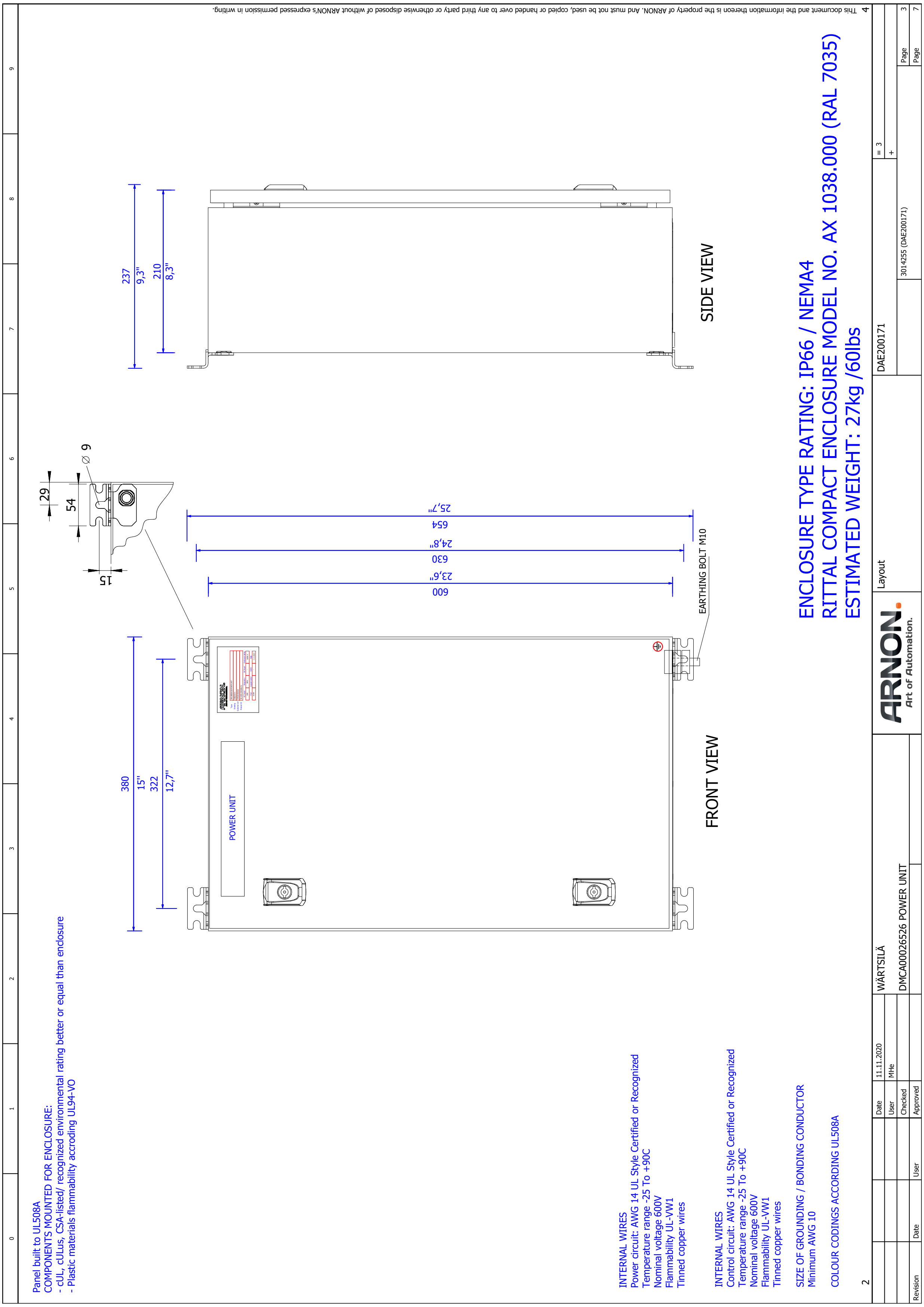
			Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Table of contents : /1 - =LAYOUT DIM/4	= 3
			User	MHe				+
			Checked		DMCA00026526 POWER UNIT		3014255 (DAE200171)	Page 2
Revision	Date	User	Approved					Page 7


Panel built to UL508A
COMPONENTS MOUNTED FOR ENCLOSURE:
- cUL, cULus, CSA-listed/ recognized environmental rating better or equal than enclosure
- Plastic materials flammability accroding UL94-VO
INTERNAL WIRES
Power circuit: AWG 14 UL Style Certified or Recognized
Temperature range -25 To +90C
Nominal voltage 600V
Flammability UL-VW1
Tinned copper wires
INTERNAL WIRES
Control circuit: AWG 14 UL Style Certified or Recognized
Temperature range -25 To +90C
Nominal voltage 600V
Flammability UL-VW1
Tinned copper wires
SIZE OF GROUNDING / BONDING CONDUCTOR
Minimum AWG 10
COLOUR CODINGS ACCORDING UL508A
ENCLOSURE TYPE RATING: IP66 / NEMA4
RITTAL COMPACT ENCLOSURE MODEL NO. AX 1038.000 (RAL 7035)
ESTIMATED WEIGHT: 27kg /60lbs
FRONT VIEW
SIDE VIEW
POWER UNIT
EARTHING BOLT M10
380
15"
322
12,7"
237
9,3"
210
8,3"
600
23,6"
630
24,8"
654
25,7"
29
54
Ø 9
15
WÄRTSILÄ
DMCA00026526 POWER UNIT
Layout
DAE200171
3014255 (DAE200171)
ARNON. Art of Automation.
Date 11.11.2020
User MHe
Checked
Approved
Revision
Date
User
= 3
+
Page 3
Page 7
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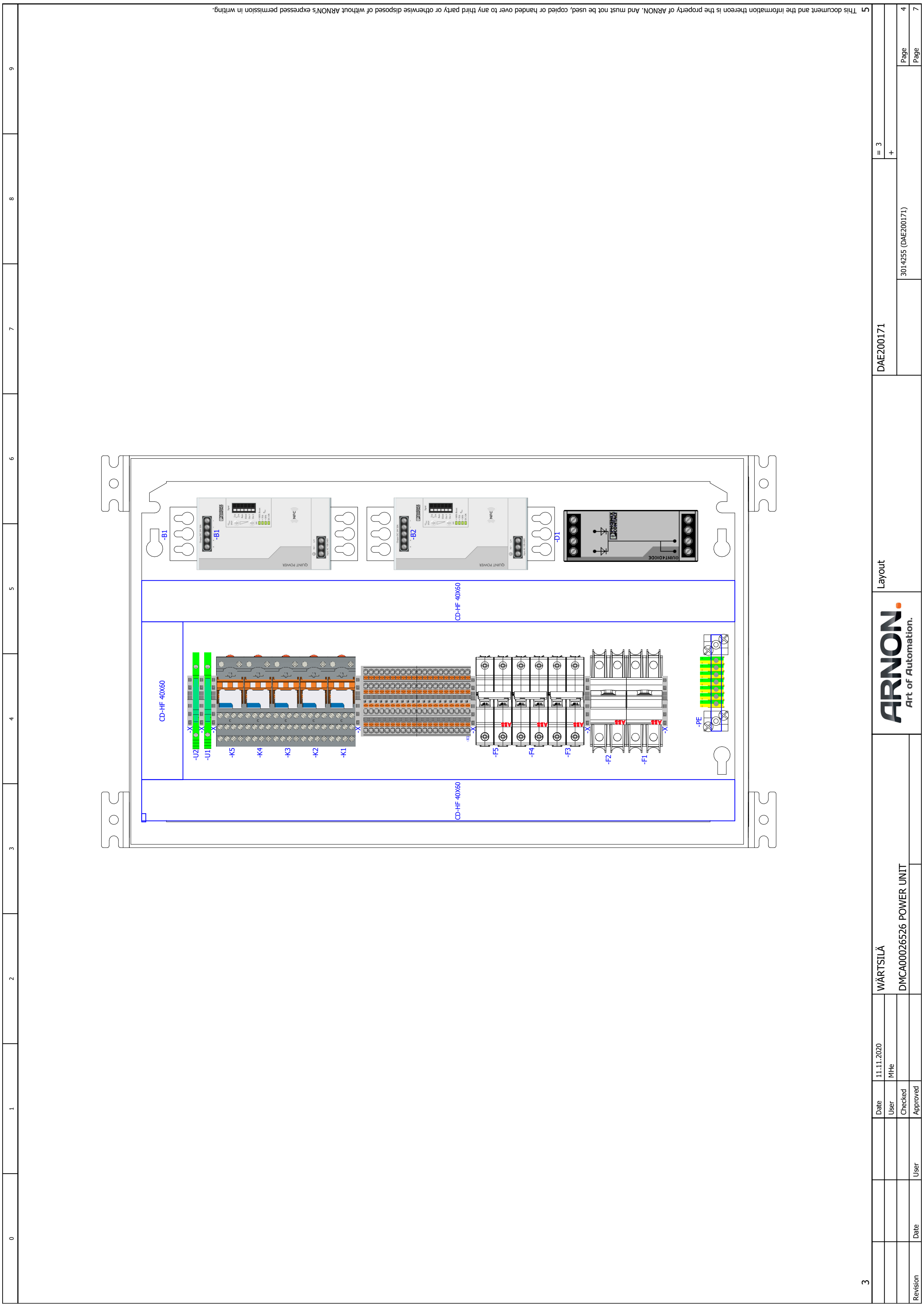
This document and the information thereon is the property of ARNON. And must not be used, copied or handed over to any third party or otherwise disposed of without ARNON's expressed permission in writing.
CD-HF 40X60
-B1
-B2
-D1
-U2
-U1
-K5
-K4
-K3
-K2
-K1
-F5
-F4
-F3
-F2
-F1
-PE
-X
ARNON
Art of Automation.
Layout
WÄRTSILÄ
DMCA00026526 POWER UNIT
DAE200171
3014255 (DAE200171)
Date
11.11.2020
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MHe
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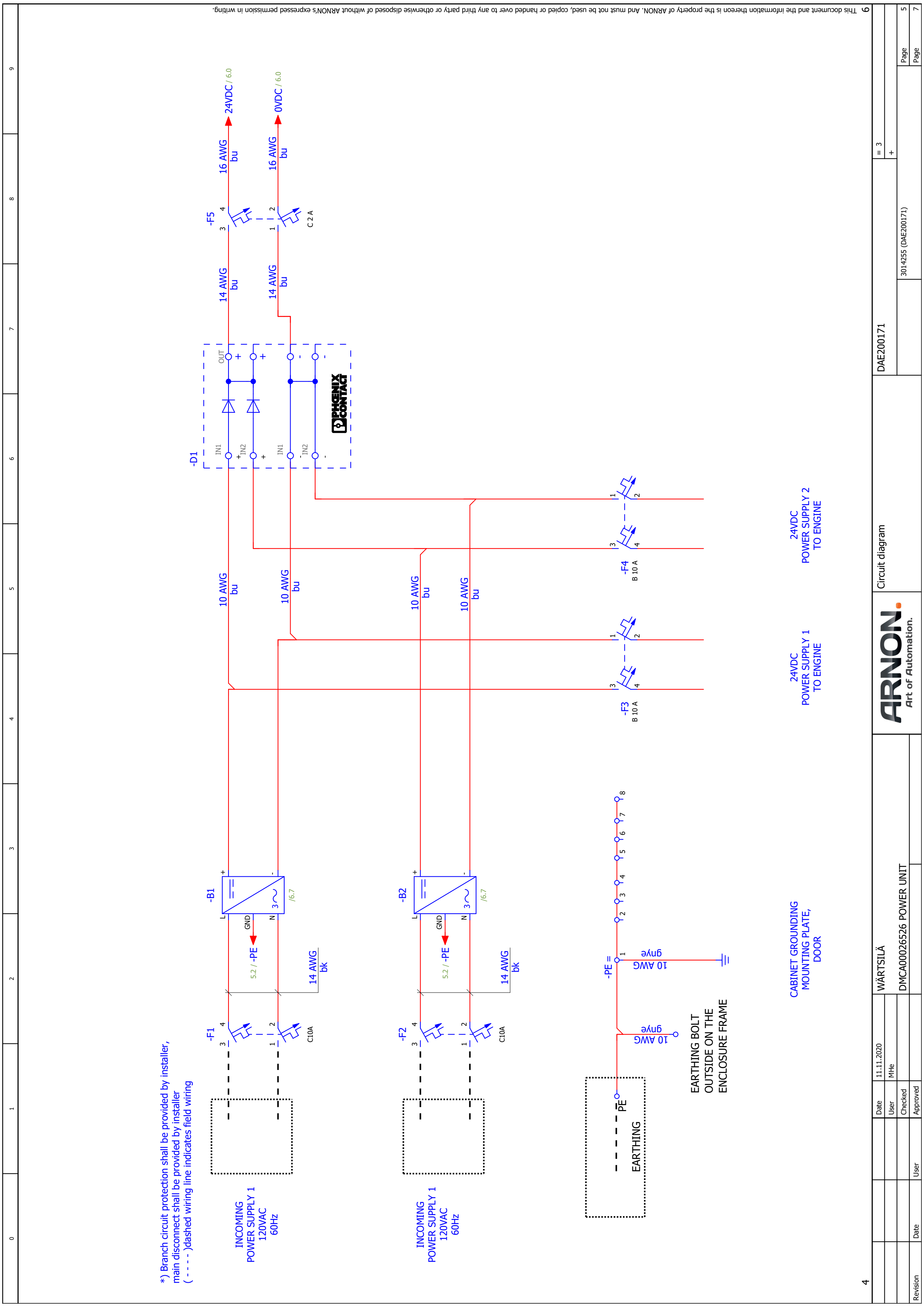
This document and the information thereon is the property of ARNON. And must not be used, copied or handed over to any third party or otherwise disposed of without ARNON's expressed permission in writing.
*) Branch circuit protection shall be provided by installer,
main disconnect shall be provided by installer
(- - - -)dashed wiring line indicates field wiring
INCOMING
POWER SUPPLY 1
120VAC
60Hz
-F1
C10A
-F2
C10A
-B1
-B2
GND
5.2 / -PE
/6.7
14 AWG
bk
10 AWG
bu
EARTHING
PE
-PE =
10 AWG
gnye
EARTHING BOLT
OUTSIDE ON THE
ENCLOSURE FRAME
CABINET GROUNDING
MOUNTING PLATE,
DOOR
-F3
B 10 A
-F4
B 10 A
24VDC
POWER SUPPLY 1
TO ENGINE
24VDC
POWER SUPPLY 2
TO ENGINE
-D1
IN1
IN2
OUT
PHOENIX CONTACT
14 AWG
bu
-F5
C 2 A
16 AWG
bu
24VDC / 6.0
0VDC / 6.0
Date
11.11.2020
User
MHe
Checked
Approved
Revision
WÄRTSILÄ
DMCA00026526 POWER UNIT
ARNON
Art of Automation.
Circuit diagram
DAE200171
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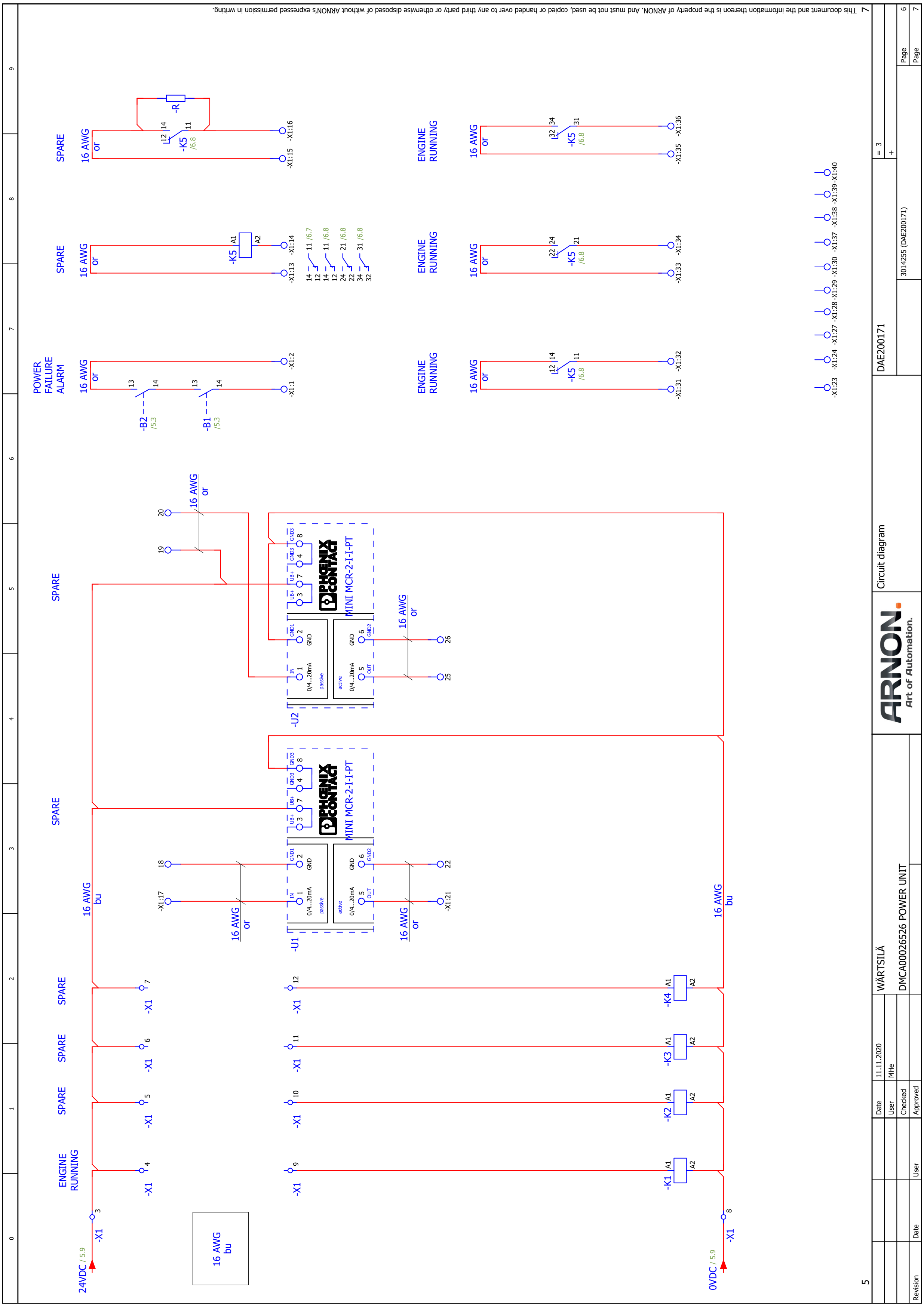
Circuit diagram
WÄRTSILÄ
DMCA00026526 POWER UNIT
DAE200171
MINI MCR-2-I-I-PT
ENGINE RUNNING
SPARE
POWER FAILURE ALARM
16 AWG

0	1	2	3	4	5	6	7	8	9

Parts list

F01_001

Device tag	Quantity	Designation	Type number	Supplier	Part number
	1	DIN rail perforated	NS 35/15 ZN PERF 2000MM	PXC	PXC.1206599
	1	AX Rail for interior installation, for D: 210 mm,	AX.2393210		RIT.2393210
	1	AX Compact enclosure, WHD: 380x600x210 mm, sheet steel	AX.1038000	RIT	RIT.1038000
	1	Cable duct	CD-HF 40X60	PXC	PXC.3240349
-B1	2	Assembly adapters	UWA 182/52	PXC	PXC.2938235
-B1	1	Power supply unit	QUINT4-PS/1AC/24DC/20	PXC	PXC.2904602
-B2	1	Assembly adapters	UWA 182/52	PXC	PXC.2938235
-B2	1	Power supply unit	QUINT4-PS/1AC/24DC/20	PXC	PXC.2904602
-CABINET	1	SZ Wiring plan pocket, plastic, DIN A4, portrait	SZ.2514000	RIT	RIT.2514000
-CABINET	4	Wall mounting bracket	AX.2508020	RIT	RIT.2508020
-CABINET	1	Door stay for AX	AX.2519010	RIT	RIT.2519010
-D1	1	Diode	QUINT4-DIODE/12-24DC/2X20/1X40	PXC	PXC.2907719
-F1	1	Miniature Circuit Breaker - SU200M - 2P - C - 10 A	SU202M-C10		ABB.2CDS272337R0104
-F2	1	Miniature Circuit Breaker - SU200M - 2P - C - 10 A	SU202M-C10		ABB.2CDS272337R0104
-F3	1	Miniature Circuit Breaker - S200 - 2P - B - 10 A	S202-B10		ABB.2CDS252001R0105
-F4	1	Miniature Circuit Breaker - S200 - 2P - B - 10 A	S202-B10		ABB.2CDS252001R0105
-K1	1	Relay Module	RIF-2-RSC-LDP-24DC/4X21	PXC	PXC.2903320
-K2	1	Relay Module	RIF-2-RSC-LDP-24DC/4X21	PXC	PXC.2903320
-K3	1	Relay Module	RIF-2-RSC-LDP-24DC/4X21	PXC	PXC.2903320
-K4	1	Relay Module	RIF-2-RSC-LDP-24DC/4X21	PXC	PXC.2903320
-K5	1	Relay Module	RIF-2-RSC-LDP-24DC/4X21	PXC	PXC.2903320
-PE	3	Connection terminal block	AKG 16 GNYE	PXC	PXC.0423027
-PE	12	Connection terminal block	AKG 4 GNYE	PXC	PXC.0421029
-PE	1	Neutral busbar	NLS-CU 3/10 SN 1000MM	PXC	PXC.0402174
-PE	2	Support bracket	AB/SS	PXC	PXC.0404428
-PE	2	Support bracket	AB/SS	PXC	PXC.0404428_Ver.2
-PE	1	Neutral busbar	NLS-CU 3/10 SN 2000MM	PXC	PXC.0402006
-R	1	Film resistor 22kohm, 0.6W	MF60SS22K0LF		VEK.MF60SS22K0LF
-U1	1	Signal conditioner	MINI MCR-2-I-I-PT	PXC	PXC.2901999
-U2	1	Signal conditioner	MINI MCR-2-I-I-PT	PXC	PXC.2901999
-X	7	End clamp	CLIPFIX 35-5 V0	PXC	PXC.3032350
-X1	1	End clamp	CLIPFIX 35-5 V0	PXC	PXC.3032350
-X1	1	Terminal strip marking	KLM 3	PXC	PXC.0811969
-X1	1	End cover	D-PTTB 2,5	PXC	PXC.3211634
-X1	20	Double-level terminal block	PTTB 2,5	PXC	PXC.3210567

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=LAYOUT DIM/3

			Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Parts list : PXC.1206599 - PXC.3210567	DAE200171	= 3
			User	MHe					+
			Checked		DMCA00026526 POWER UNIT			3014255 (DAE200171)	Page 7
Revision	Date	User	Approved						Page 7

ARNON.

Hyllilänkatu 15
33730 Tampere, Finland
Tel: +358 10 526 5000
www.ARNON.fi

Customer	WÄRTSILÄ
Project description	DMCA00026530 STARTER PRELUBE OIL PUMP
Job number	3014256 (DAE200172)

AC Input: 600V
Frequency: 60Hz
DC Input: -
Degree of protection: NEMA 12
FLA: 6,9A
Largest motor: 5kW
SCCR: 3kA

Created on 19.10.2020
Edit date 11.11.2020 by (short name) MHe

Number of pages: 7

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			Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Title page / cover sheet	DAE200172	= 3
			User	MHe					+
			Checked		DMCA00026530 STARTER PRELUBE OIL PUMP			3014256 (DAE200172)	Page 1
Revision	Date	User	Approved						Page 7

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Sheet	Page description	Date	REV.
1	Summarized parts list : RIT.1039000 - ABB.1SBN010110R1010		
2	Summarized parts list : ABB.1SBN010110R1001 - PXC.3210567		
1	Title page / cover sheet		
2	Table of contents : /1 - =3/9		
3	Layout		-
4	Layout		-
5	Circuit diagram		-
6	Circuit diagram		-
7	Parts list : RIT.1039000 - PXC.0421029		
8	Summarized parts list : RIT.1039000 - ABB.1SBN010110R1010		
9	Summarized parts list : ABB.1SBN010110R1001 - PXC.3210567		

1 3

			Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Table of contents : /1 - =3/9	DAE200172	= 3
			User	MHe					+
			Checked		DMCA00026530 STARTER PRELUBE OIL PUMP			3014256 (DAE200172)	Page 2
Revision	Date	User	Approved						Page 7

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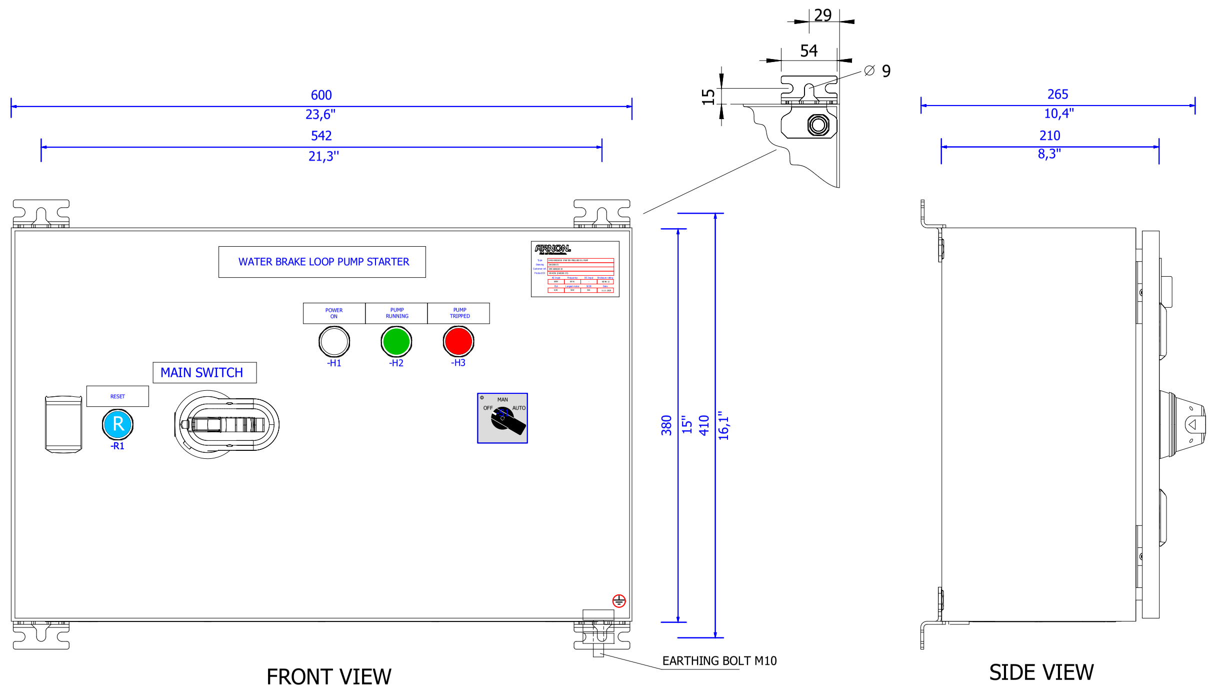
Panel built to UL508A
COMPONENTS MOUNTED FOR ENCLOSURE:
- cUL, cULus, CSA-listed/ recognized environmental rating better or equal than enclosure
- Plastic materials flammability accroding UL94-VO

LIST OF LABELS.
L 1 PRE-LUBE OIL PUMP ST ARTER
0.1 MAIN SWITCH
R1 RESET
H1 POWER ON (WHITE)
H2 PUMP RUNNING (GREEN)
H3 PUMP TRIPPED (RED)
S1 POWER



INTERNAL WIRES
Power circuit: AWG 10 UL Style Certified or Recognized
Temperature range -25 To +90C
Nominal voltage 600V
Flammability UL-VW1
Tinned copper wires

INTERNAL WIRES
Control circuit: AWG 14 UL Style Certified or Recognized
Temperature range -25 To +90C
Nominal voltage 600V
Flammability UL-VW1
Tinned copper wires

SIZE OF GROUNDING / BONDING CONDUCTOR
Minimum AWG 10

COLOUR CODINGS ACCORDING UL508A

ENCLOSURE TYPE RATING: IP66 / NEMA4
RITTAL COMPACT ENCLOSURE MODEL NO. AX 1039.000 (RAL 7035)
ESTIMATED WEIGHT: 23kg /51lbs

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Date	11.11.2020	WÄRTSILÄ	Layout	DAE200172
User	MHe			
Checked		DMCA00026530 STARTER PRELUBE OIL PUMP		3014256 (DAE200172)
Approved				
Revision	Date	User		

ARNON. Art of Automation.

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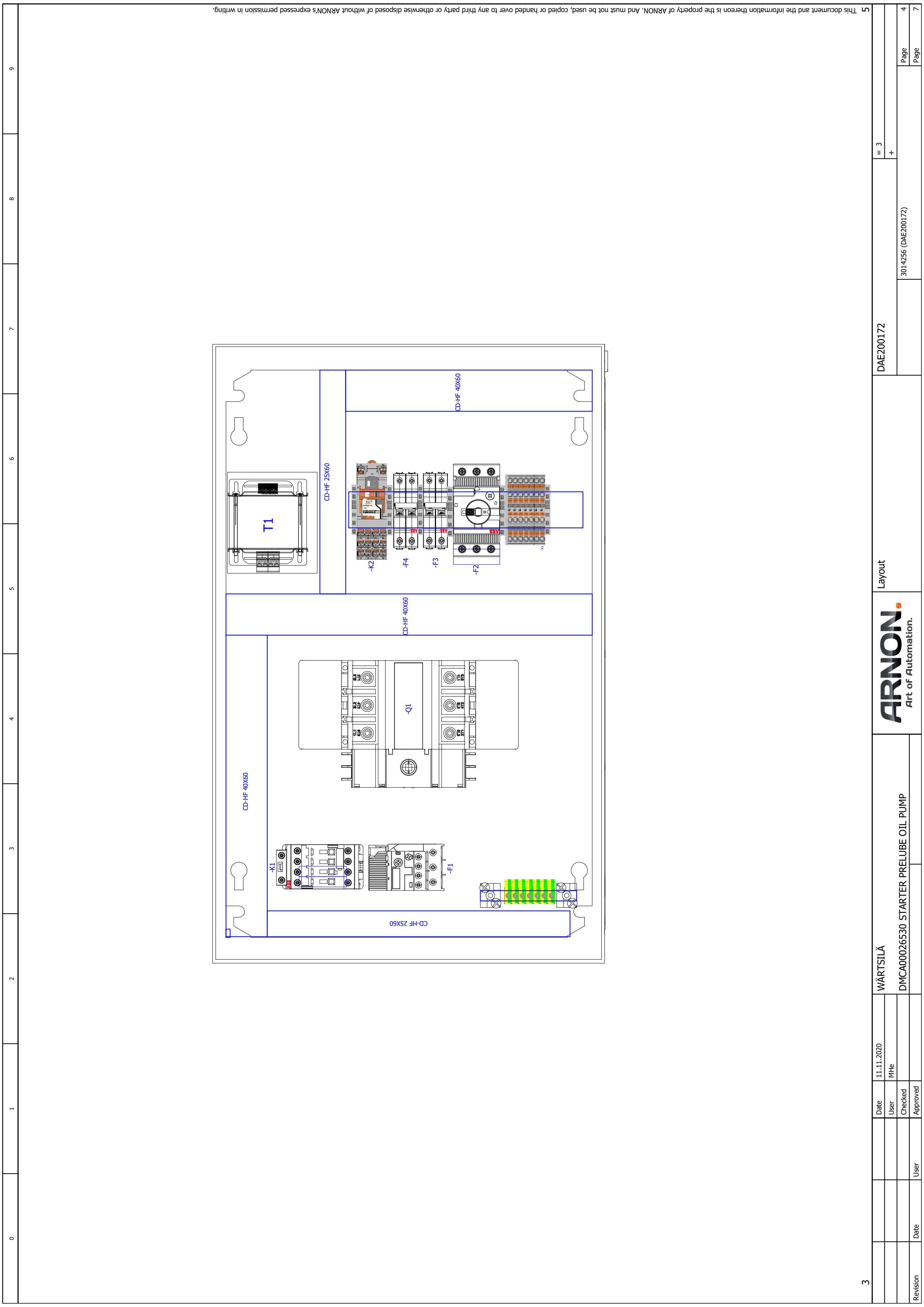
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T1
CD-HF 25X60
CD-HF 40X60
-K2
-F4
-F3
-F2
-Q1
-K1
-F1
Layout
DAE200172
3014256 (DAE200172)
ARNON. Art of Automation.
WÄRTSILÄ
DMCA00026530 STARTER PRELUBE OIL PUMP
Date 11.11.2020
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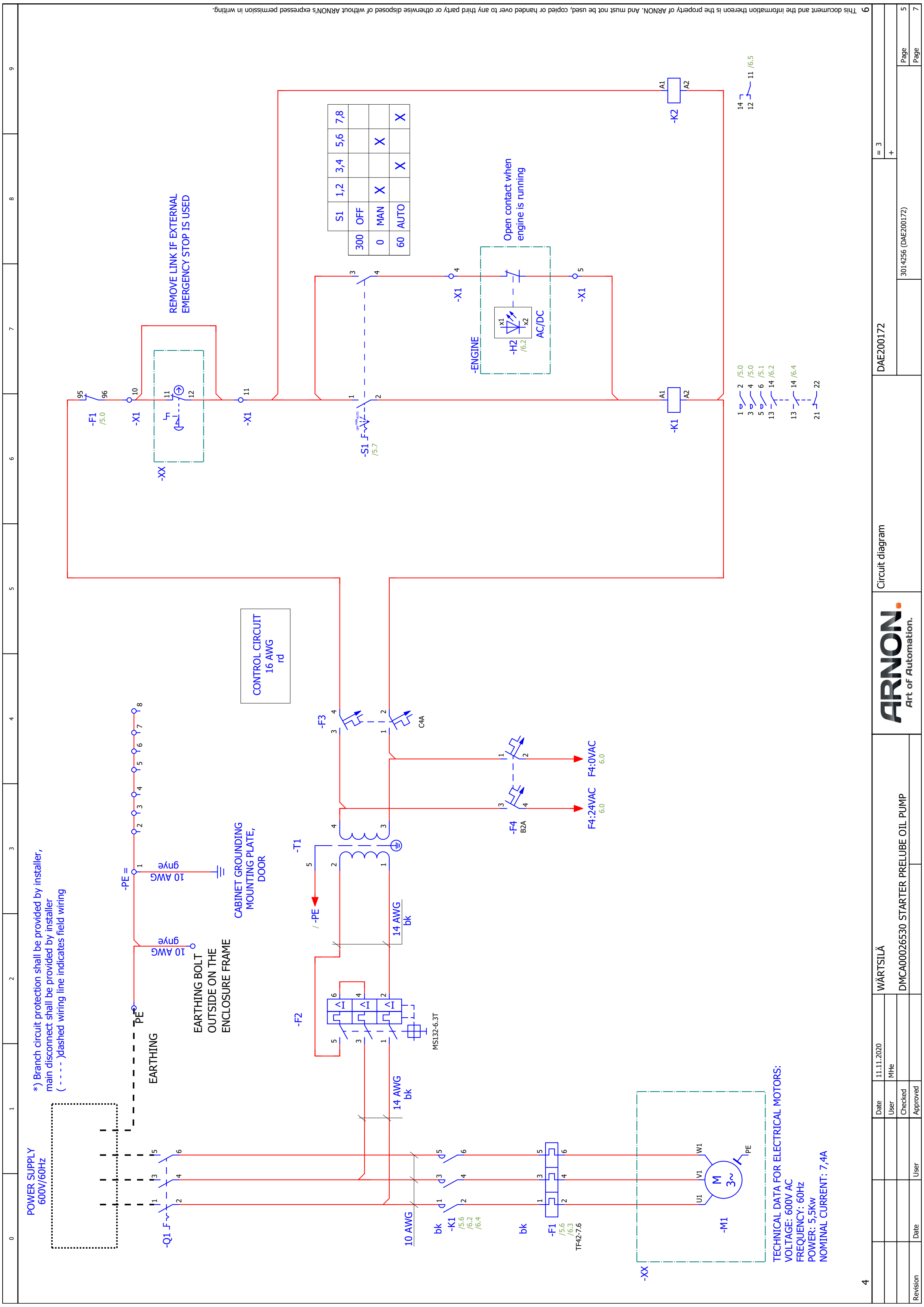
POWER SUPPLY
600V/60Hz
*) Branch circuit protection shall be provided by installer, main disconnect shall be provided by installer
(- - - -)dashed wiring line indicates field wiring
EARTHING
EARTHING BOLT
OUTSIDE ON THE
ENCLOSURE FRAME
CABINET GROUNDING
MOUNTING PLATE,
DOOR
10 AWG
gnye
-PE =
14 AWG
bk
-T1
-F2
MS132-6.3T
-F3
C4A
-F4
B2A
F4:24VAC
F4:0VAC
CONTROL CIRCUIT
16 AWG
rd
REMOVE LINK IF EXTERNAL
EMERGENCY STOP IS USED
-XX
-X1
-F1
-S1
-K1
-K2
-ENGINE
-H2
AC/DC
Open contact when
engine is running
S1
300
0
60
OFF
MAN
AUTO
1,2
3,4
5,6
7,8
-Q1
-M1
TF42-7.6
TECHNICAL DATA FOR ELECTRICAL MOTORS:
VOLTAGE: 600V AC
FREQUENCY: 60Hz
POWER: 5,5Kw
NOMINAL CURRENT: 7,4A
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ARNON
Art of Automation
Circuit diagram
DAE200172
WÄRTSILÄ
DMCA00026530 STARTER PRELUBE OIL PUMP
3014256 (DAE200172)
Date
User
Checked
Approved
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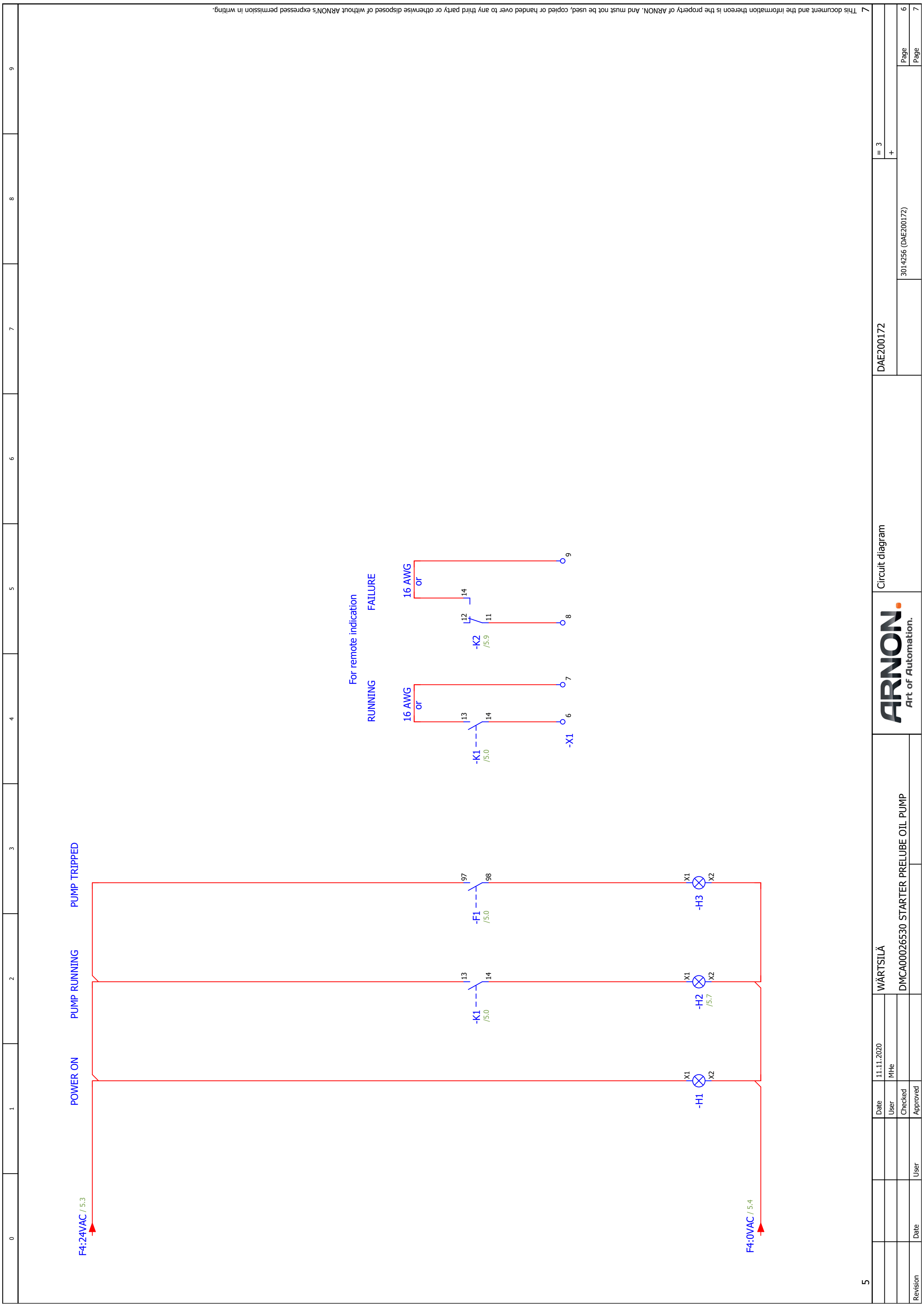
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F4:24VAC / 5.3
POWER ON
PUMP RUNNING
PUMP TRIPPED
-K1 /5.0
-F1 /5.0
-H1
-H2 /5.7
-H3
F4:0VAC / 5.4
For remote indication
RUNNING
FAILURE
16 AWG or
-K2 /5.9
-X1
WÄRTSILÄ
DMCA00026530 STARTER PRELUBE OIL PUMP
ARNON
Art of Automation.
Circuit diagram
DAE200172
3014256 (DAE200172)
Date 11.11.2020
User MHe
Checked
Approved
Revision
Page 6
Page 7

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Parts list

F01_001

Device tag	Quantity	Designation	Type number	Supplier	Part number
	1	Compact enclosure AX, WHD: 600x380x210 mm, sheet steel, with mounting plate	AX.1039000		RIT.1039000
	4	KA1-8120 Legend plate holder (15x27mm)	KA1-8120	ABB	ABB.1SFA616920R8120
	1	AX Rail for interior installation, for D: 210 mm,	AX.2393210		RIT.2393210
	4	Wall mounting bracket	AX.2508020	RIT	RIT.2508020
	1	Door stay for AX	AX.2519010	RIT	RIT.2519010
	6	Connection terminal block	AKG 4 GNYE	PXC	PXC.0421029
	1	Cable duct	CD-HF 40X60	PXC	PXC.3240349
-4	1	Neutral busbar	NLS-CU 3/10 SN 2000MM	PXC	PXC.0402006
-5	1	Support bracket	AB/SS	PXC	PXC.0404428_Ver.2
-6	1	Support bracket	AB/SS	PXC	PXC.0404428_Ver.2
-CABINET	1	SZ Wiring plan pocket, plastic, DIN A4, portrait	SZ.2514000	RIT	RIT.2514000
-F1	1	TF42-7.6 Thermal Overload Relay	TF42-7.6	ABB	ABB.1SAZ721201R1040
-F2	1	MS132-6.3T Circuit-breaker for primary transformer protection	MS132-6.3T	ABB	ABB.1SAM340000R1009
-F3	1	Miniature Circuit Breaker - S200 - 2P - C - 4 A	S202-C4	ABB	ABB.2CDS252001R0044
-F4	1	Miniature Circuit Breaker - S200 - 2P - B - 2 A	S202-B2		ABB.2CDS252001R0025
-H1	1	Compact Pilot Light Clear LED 24V AC/DC	CL2-502C	ABB	ABB.1SFA619403R5028
-H2	1	Compact Pilot Light Green LED 24V AC/DC	CL2-502G	ABB	ABB.1SFA619403R5022
-H3	1	Compact Pilot Light Red LED 24V AC/DC	CL2-502R	ABB	ABB.1SFA619403R5021
-K1	1	AF16-30-10-11 24-60V50/60HZ 20-60VDC Contactor	AF16-30-10-11	ABB	ABB.1SBL177001R1110
-K1	1	CA4-10 Auxiliary Contact Block	CA4-10	ABB	ABB.1SBN010110R1010
-K1	1	CA4-01 Auxiliary Contact Block	CA4-01	ABB	ABB.1SBN010110R1001
-K2	1	Relay Module	RIF-2-RPT-LV-24AC/4X21	PXC	PXC.2903306
-PE	3	Connection terminal block	AKG 16 GNYE	PXC	PXC.0423027
-PE	5	Connection terminal block	AKG 4 GNYE	PXC	PXC.0421029
-PE	1	Neutral busbar	NLS-CU 3/10 SN 1000MM	PXC	PXC.0402174
-PE	2	Support bracket	AB/SS	PXC	PXC.0404428
-Q1	1	OT160G03P switch-disconnector	OT160G03P	ABB	ABB.OT160G03P
-Q1	2	OTS160G1L3 Terminal shroud	OTS160G1L3		ABB.1SCA140414R1001
-R1	1	KPR1-101L Modular Reset Pushbutton	KPR1-101L	ABB	ABB.1SFA616160R1014
-R1	1	KA1-8046 SHAFT for KPR1-101L Modular Reset Pushbutton	KA1-8046	ABB	ABB.1SFA616920R8046
-S1	1	Step switch, (OFF-MAN-AUTO)	CA10 SF8738 -600FT2+F*SFA1972	KN	KN.CA10 SF8738 -600FT2+F*SFA1972
-T1	1	Transformer 600V/24V 50-60Hz, 160VA	600V/24V 50-60Hz, 160VA	Intertrafo	ITR.600V/24V 50-60Hz, 160VA
-U2	1	DIN rail perforated	NS 35/15 ZN PERF 2000MM	PXC	PXC.1206599
-X	5	End clamp	CLIPFIX 35-5 V0	PXC	PXC.3032350
-X1	1	End cover	D-PTTB 2,5	PXC	PXC.3211634
-X1	7	Double-level terminal block	PTTB 2,5	PXC	PXC.3210567
-X1	1	End clamp	CLIPFIX 35-5 V0	PXC	PXC.3032350
-X2	1	Connection terminal block	AKG 4 GNYE	PXC	PXC.0421029

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6 =LAYOUT DIM/3

Revision	Date	User			
Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Parts list : RIT.1039000 - PXC.0421029	DAE200172
User	MHe	DMCA00026530 STARTER PRELUBE OIL PUMP			= 3
Checked				3014256 (DAE200172)	+
Approved					Page 7 / Page 7

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Hyllilänkatu 15
33730 Tampere, Finland
Tel: +358 10 526 5000
www.ARNON.fi

Customer	WÄRTSILÄ	AC Input: 600V Frequency: 60Hz DC Input: - Degree of protection: NEMA 12 FLA: 54A Largest motor: 8.6kW SCCR: 3kA
Project description	DMCA00026709 MOTOR STARTER RADIATOR FAN	
Job number	3014259 (DAE200175)	

Created on 20.10.2020
Edit date 11.11.2020 by (short name) MHe Number of pages: 8

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			Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Title page / cover sheet	DAE200175		= 3
			User	VHa						+
			Checked		DMCA00026709 MOTOR STARTER RADIATOR FAN				3014259 (DAE200175)	Page 1
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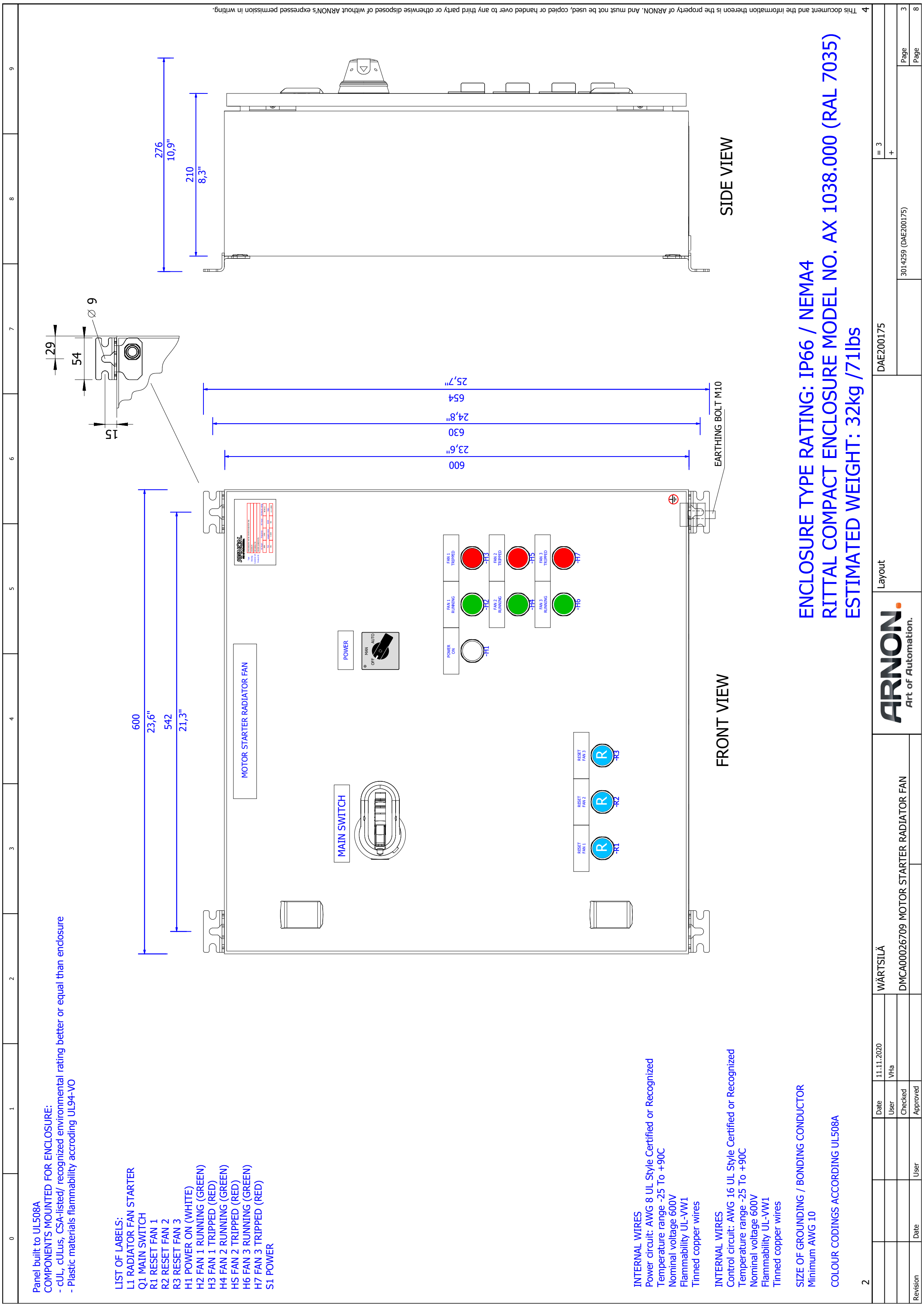
			Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Table of contents : /1 - =3/10	DAE200175	= 3
			User	VHa					+
			Checked		DMCA00026709 MOTOR STARTER RADIATOR FAN			3014259 (DAE200175)	Page 2
Revision	Date	User	Approved						Page 8


Panel built to UL508A
COMPONENTS MOUNTED FOR ENCLOSURE:
- cUL, cULus, CSA-listed/ recognized environmental rating better or equal than enclosure
- Plastic materials flammability accroding UL94-VO
LIST OF LABELS:
L1 RADIATOR FAN STARTER
Q1 MAIN SWITCH
R1 RESET FAN 1
R2 RESET FAN 2
R3 RESET FAN 3
H1 POWER ON (WHITE)
H2 FAN 1 RUNNING (GREEN)
H3 FAN 1 TRIPPED (RED)
H4 FAN 2 RUNNING (GREEN)
HS FAN 2 TRIPPED (RED)
H6 FAN 3 RUNNING (GREEN)
H7 FAN 3 TRIPPED (RED)
S1 POWER
MOTOR STARTER RADIATOR FAN
MAIN SWITCH
POWER
600
23,6"
542
21,3"
630
24,8"
654
25,7"
29
54
⌀ 9
15
276
10,9"
210
8,3"
EARTHING BOLT M10
FRONT VIEW
SIDE VIEW
INTERNAL WIRES
Power circuit: AWG 8 UL Style Certified or Recognized
Temperature range -25 To +90C
Nominal voltage 600V
Flammability UL-VW1
Tinned copper wires
INTERNAL WIRES
Control circuit: AWG 16 UL Style Certified or Recognized
Temperature range -25 To +90C
Nominal voltage 600V
Flammability UL-VW1
Tinned copper wires
SIZE OF GROUNDING / BONDING CONDUCTOR
Minimum AWG 10
COLOUR CODINGS ACCORDING UL508A
ENCLOSURE TYPE RATING: IP66 / NEMA4
RITTAL COMPACT ENCLOSURE MODEL NO. AX 1038.000 (RAL 7035)
ESTIMATED WEIGHT: 32kg /71lbs
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Revision
Date
User
Date 11.11.2020
User VHa
Checked
Approved
WÄRTSILÄ
DMCA00026709 MOTOR STARTER RADIATOR FAN
ARNON. Art of Automation.
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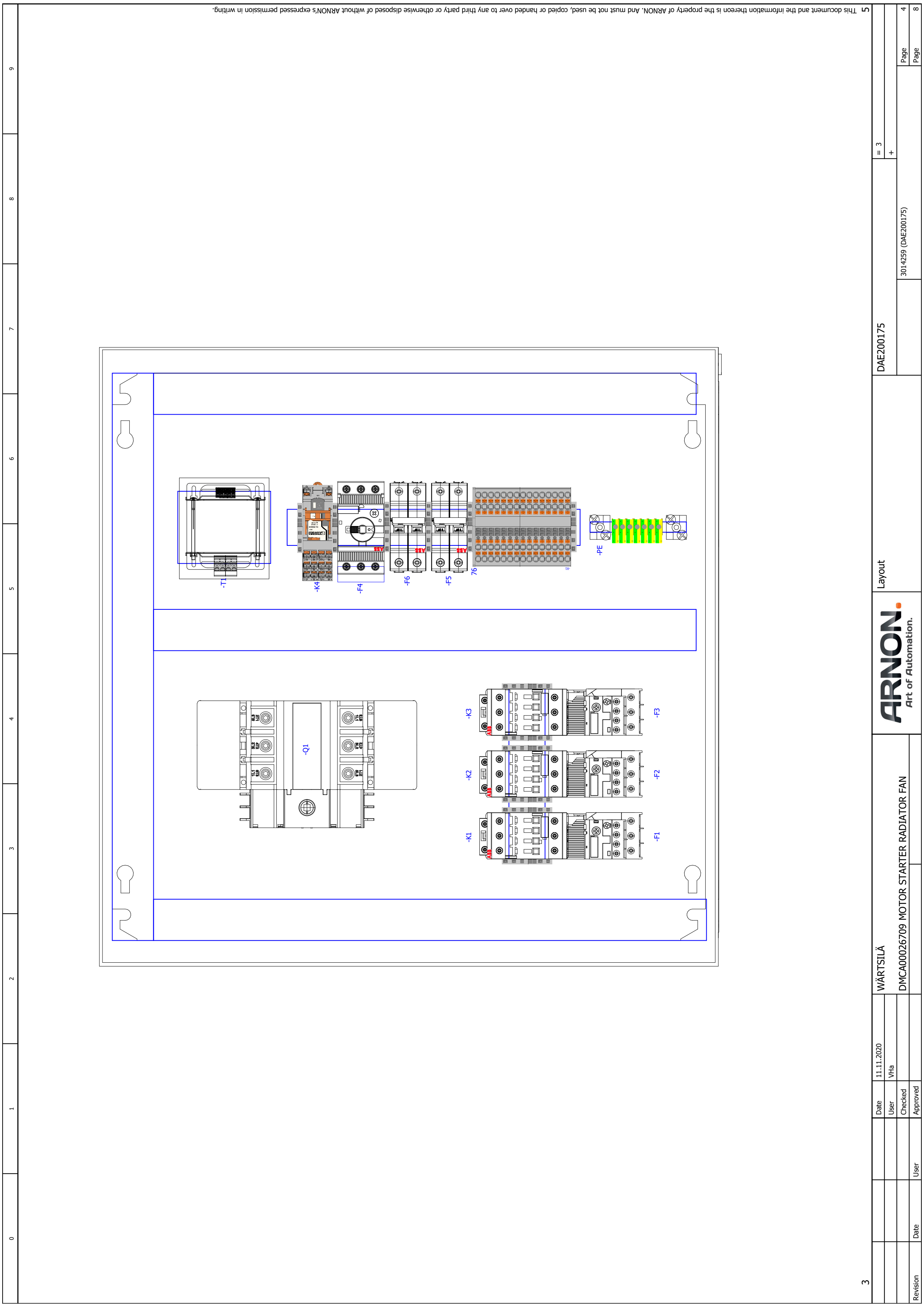
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-T1
-K4
-F4
-F6
-F5
-X6
-PE
-Q1
-K3
-K2
-K1
-F3
-F2
-F1
ARNON
Art of Automation.
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WÄRTSILÄ
DMCA00026709 MOTOR STARTER RADIATOR FAN
Date 11.11.2020
User VHa
Checked
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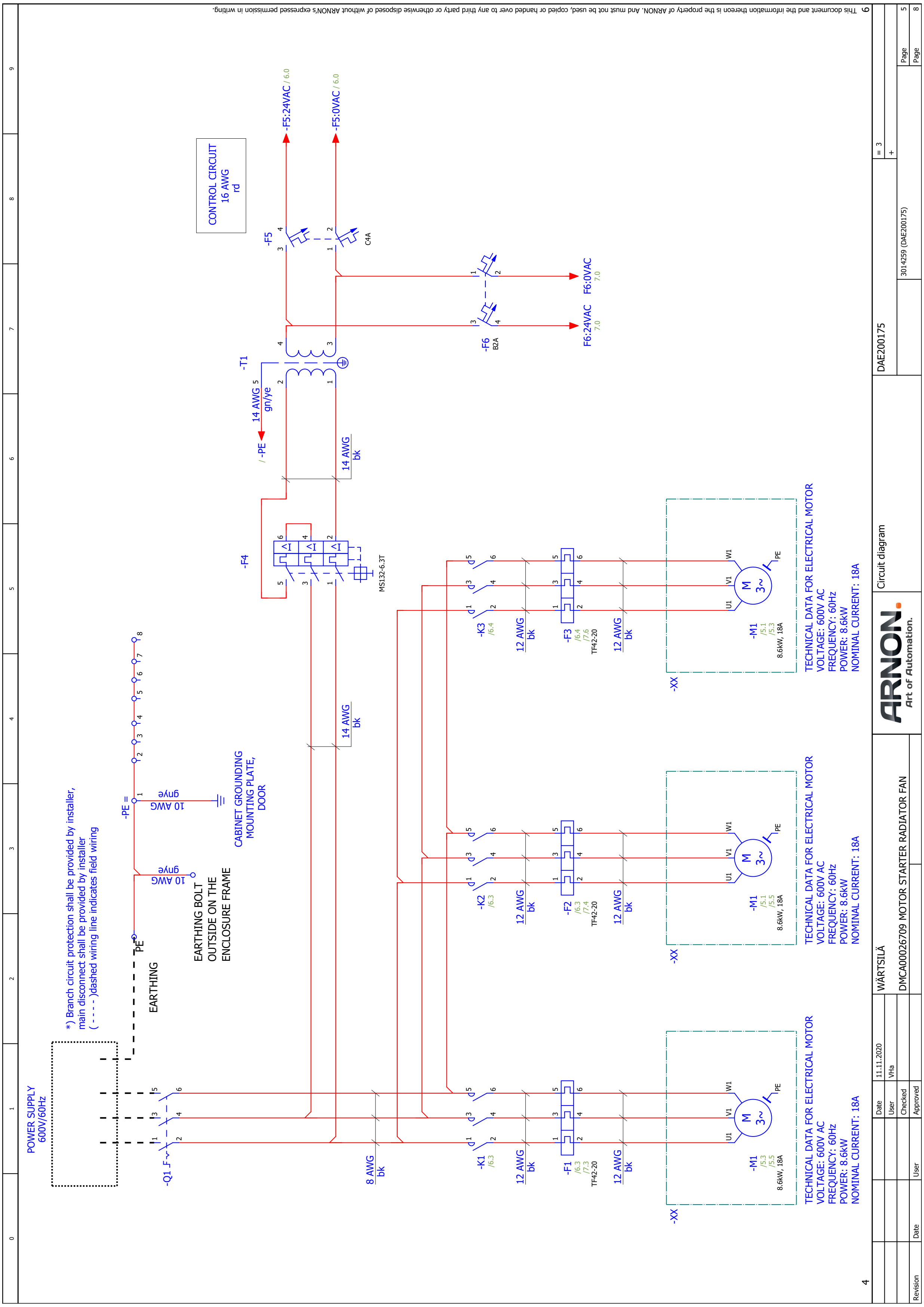
User


POWER SUPPLY
600V/60Hz
*) Branch circuit protection shall be provided by installer,
main disconnect shall be provided by installer
(- - - -)dashed wiring line indicates field wiring
EARTHING
EARTHING BOLT
OUTSIDE ON THE
ENCLOSURE FRAME
CABINET GROUNDING
MOUNTING PLATE,
DOOR
CONTROL CIRCUIT
16 AWG
rd
-F5:24VAC / 6.0
-F5:0VAC / 6.0
F6:24VAC
F6:0VAC
TECHNICAL DATA FOR ELECTRICAL MOTOR
VOLTAGE: 600V AC
FREQUENCY: 60Hz
POWER: 8.6kW
NOMINAL CURRENT: 18A
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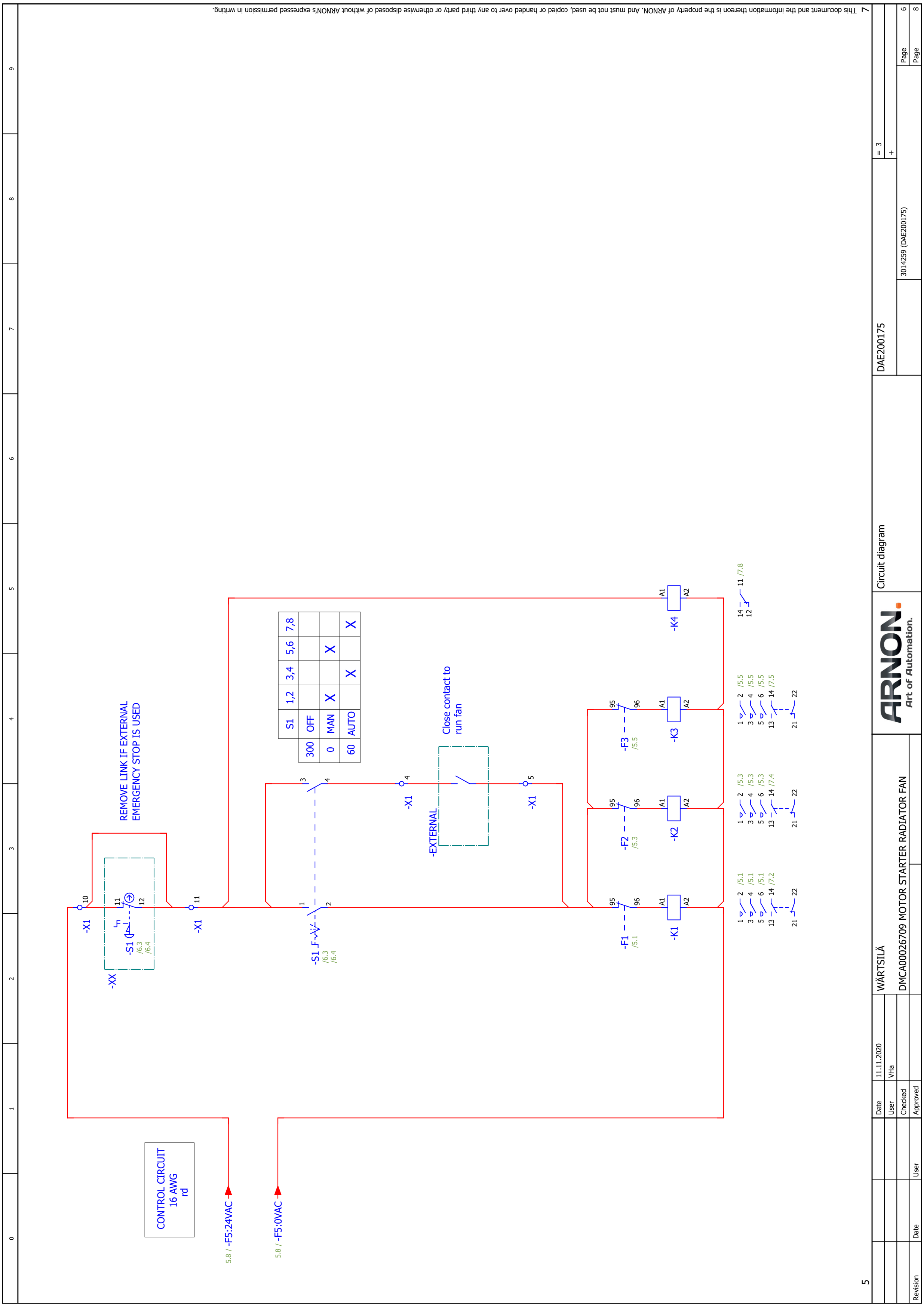
ARNON
Art of Automation
Circuit diagram
DAE200175
WÄRTSILÄ
DMCA00026709 MOTOR STARTER RADIATOR FAN
11.11.2020


This document and the information thereon is the property of ARNON. And must not be used, copied or handed over to any third party or otherwise disposed of without ARNON's expressed permission in writing.
CONTROL CIRCUIT
16 AWG
rd
5.8 / -F5:24VAC
5.8 / -F5:0VAC
REMOVE LINK IF EXTERNAL
EMERGENCY STOP IS USED
-XX
-S1
-X1
-EXTERNAL
Close contact to
run fan
S1 | 1,2 | 3,4 | 5,6 | 7,8
300 OFF
0 MAN | X | | X |
60 AUTO | | X | | X
-F1
-F2
-F3
-K1
-K2
-K3
-K4
WÄRTSILÄ
DMCA00026709 MOTOR STARTER RADIATOR FAN
Circuit diagram
DAE200175
3014259 (DAE200175)
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User VHa
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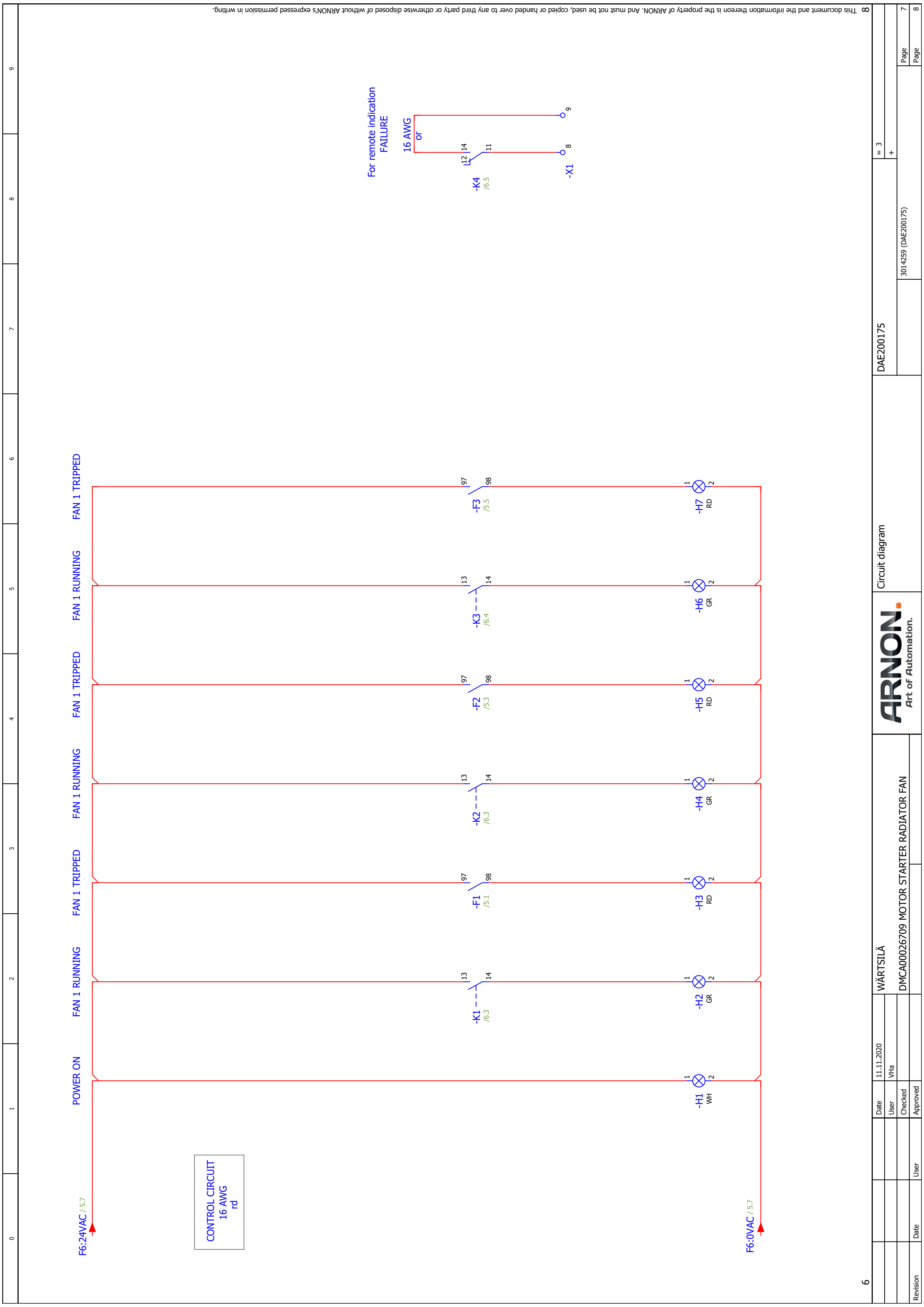
Art of Automation.


F6:24VAC / 5.7
CONTROL CIRCUIT
16 AWG
rd
F6:0VAC / 5.7
POWER ON
FAN 1 RUNNING
FAN 1 TRIPPED
FAN 1 RUNNING
FAN 1 TRIPPED
FAN 1 RUNNING
FAN 1 TRIPPED
-K1 /6.3
-F1 /5.1
-K2 /6.3
-F2 /5.3
-K3 /6.4
-F3 /5.5
-H1 WH
-H2 GR
-H3 RD
-H4 GR
-H5 RD
-H6 GR
-H7 RD
For remote indication
FAILURE
16 AWG
or
-K4 /6.5
-X1
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Date 11.11.2020
User VHa
Checked
Approved
Revision
WÄRTSILÄ
DMCA00026709 MOTOR STARTER RADIATOR FAN
ARNON. Art of Automation.
Circuit diagram
DAE200175
3014259 (DAE200175)
= 3
+
Page 7
Page 8

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Parts list

F01_001

Device tag	Quantity	Designation	Type number	Supplier	Part number
	1	AX Rail for interior installation, for D: 210 mm,	AX.2393210		RIT.2393210
	1	Cable duct	CD-HF 40X60	PXC	PXC.3240349
-ENCLOSURE	1	SZ Wiring plan pocket, plastic, DIN A4, portrait	SZ.2514000	RIT	RIT.2514000
-ENCLOSURE	4	Wall mounting bracket	AX.2508020	RIT	RIT.2508020
-ENCLOSURE	1	Door stay for AX	AX.2519010	RIT	RIT.2519010
-ENCLOSURE	1	Compact enclosure AX	AX.1060000		RIT.1060000
-F1	1	TF42-20 Thermal Overload Relay	TF42-20	ABB	ABB.1SAZ721201R1049
-F2	1	TF42-20 Thermal Overload Relay	TF42-20	ABB	ABB.1SAZ721201R1049
-F3	1	TF42-20 Thermal Overload Relay	TF42-20	ABB	ABB.1SAZ721201R1049
-F4	1	MS132-6.3T Circuit-breaker for primary transformer protection	MS132-6.3T	ABB	ABB.1SAM340000R1009
-F5	1	Miniature Circuit Breaker - S200 - 2P - C - 4 A	S202-C4	ABB	ABB.2CDS252001R0044
-F6	1	Miniature Circuit Breaker - S200 - 2P - B - 2 A	S202-B2		ABB.2CDS252001R0025
-H1	1	Compact Pilot Light Clear LED 24V AC/DC	CL2-502C	ABB	ABB.CL2-502C
-H2	1	Compact Pilot Light Green LED 24V AC/DC	CL2-502G	ABB	ABB.CL2-502G
-H3	1	Compact Pilot Light Red LED 24V AC/DC	CL2-502R	ABB	ABB.CL2-502R
-H4	1	Compact Pilot Light Green LED 24V AC/DC	CL2-502G	ABB	ABB.CL2-502G
-H5	1	Compact Pilot Light Red LED 24V AC/DC	CL2-502R	ABB	ABB.CL2-502R
-H6	1	Compact Pilot Light Green LED 24V AC/DC	CL2-502G	ABB	ABB.CL2-502G
-H7	1	Compact Pilot Light Red LED 24V AC/DC	CL2-502R	ABB	ABB.CL2-502R
-K1	1	AF26-30-00-11 24-60V50/60HZ 20-60VDC Contactor	AF26-30-00-11	ABB	ABB.1SBL237001R1100
-K1	1	CA4-10 Auxiliary Contact Block	CA4-10	ABB	ABB.1SBN010110R1010
-K1	1	CA4-01 Auxiliary Contact Block	CA4-01	ABB	ABB.1SBN010110R1001
-K2	1	AF26-30-00-11 24-60V50/60HZ 20-60VDC Contactor	AF26-30-00-11	ABB	ABB.1SBL237001R1100
-K2	1	CA4-10 Auxiliary Contact Block	CA4-10	ABB	ABB.1SBN010110R1010
-K2	1	CA4-01 Auxiliary Contact Block	CA4-01	ABB	ABB.1SBN010110R1001
-K3	1	AF26-30-00-11 24-60V50/60HZ 20-60VDC Contactor	AF26-30-00-11	ABB	ABB.1SBL237001R1100
-K3	1	CA4-10 Auxiliary Contact Block	CA4-10	ABB	ABB.1SBN010110R1010
-K3	1	CA4-01 Auxiliary Contact Block	CA4-01	ABB	ABB.1SBN010110R1001
-K4	1	Relay Module	RIF-2-RPT-LV-24AC/4X21	PXC	PXC.2903306
-PE	3	Connection terminal block	AKG 16 GNYE	PXC	PXC.0423027
-PE	12	Connection terminal block	AKG 4 GNYE	PXC	PXC.0421029
-PE	1	Neutral busbar	NLS-CU 3/10 SN 1000MM	PXC	PXC.0402174
-PE	2	Support bracket	AB/SS	PXC	PXC.0404428
-PE	2	Support bracket	AB/SS	PXC	PXC.0404428_Ver.2
-PE	1	Neutral busbar	NLS-CU 3/10 SN 2000MM	PXC	PXC.0402006
-Q1	2	OTS160G1L3 Terminal shroud	OTS160G1L3		ABB.1SCA140414R1001
-Q1	1	OT160G03P switch-disconnector	OT160G03P	ABB	ABB.OT160G03P
-R1	1	KPR1-101L Modular Reset Pushbutton	KPR1-101L	ABB	ABB.1SFA616160R1014
-R1	1	KA1-8046 SHAFT for KPR1-101L Modular Reset Pushbutton	KA1-8046	ABB	ABB.1SFA616920R8046
-R2	1	KPR1-101L Modular Reset Pushbutton	KPR1-101L	ABB	ABB.1SFA616160R1014
-R2	1	KA1-8046 SHAFT for KPR1-101L Modular Reset Pushbutton	KA1-8046	ABB	ABB.1SFA616920R8046
-R3	1	KPR1-101L Modular Reset Pushbutton	KPR1-101L	ABB	ABB.1SFA616160R1014
-R3	1	KA1-8046 SHAFT for KPR1-101L Modular Reset Pushbutton	KA1-8046	ABB	ABB.1SFA616920R8046
-S1	1	Step switch, (OFF-MAN-AUTO)	CA10 SF8738 -600FT2+F*SFA1972	KN	KN.CA10 SF8738 -600FT2+F*SFA1972
-T1	1	Transformer 600V/24V 50-60Hz, 160VA	600V/24V 50-60Hz, 160VA	Intertrafo	ITR.600V/24V 50-60Hz, 160VA
-U1	1	DIN rail perforated	NS 35/15 ZN PERF 2000MM	PXC	PXC.1206599
-X1	15	Feed-through terminal block	PT 4-QUATTRO	PXC	PXC.3211797
-X1	13	End clamp	CLIPFIX 35-5 V0	PXC	PXC.3032350
-X1	1	End cover	D-PT 4-QUATTRO	PXC	PXC.3208979

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=LAYOUT DIM/1

			Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Parts list : RIT.2393210 - PXC.3208979	DAE200175	= 3
			User	VHa					+
			Checked		DMCA00026709 MOTOR STARTER RADIATOR FAN			3014259 (DAE200175)	Page 8
Revision	Date	User	Approved						Page 8

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ARNON.

Hyllilänkatu 15
33730 Tampere, Finland
Tel: +358 10 526 5000
www.ARNON.fi

Customer	WÄRTSILÄ	AC Input: 600V Frequency: 60Hz DC Input: - Degree of protection: NEMA 12 FLA: 18A Largest motor: 11kW SCCR: 3kA
Project description	DMCA00026700 RADIATOR LOOP PUMP	
Job number	3014258 (DAE200174)	

Created on	20.10.2020		
Edit date	11.11.2020	by (short name) MHe	Number of pages: 7

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			User	VHa					+	
			Checked		DMCA00026700 RADIATOR LOOP PUMP			3014258 (DAE200174)	Page	1
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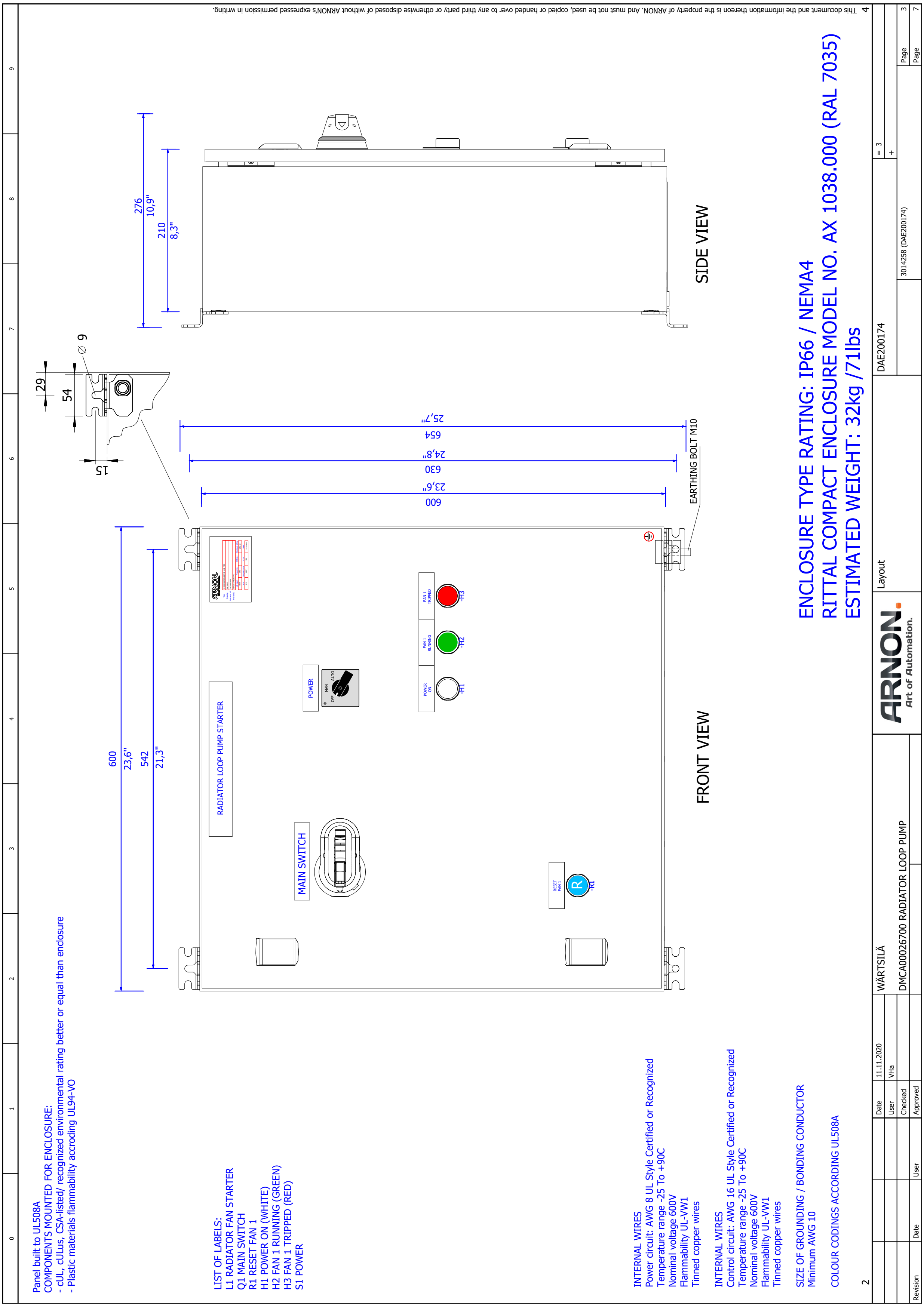
			User	VHa					+	
			Checked		DMCA00026700 RADIATOR LOOP PUMP			3014258 (DAE200174)	Page	2
Revision	Date	User	Approved						Page	7


Panel built to UL508A
COMPONENTS MOUNTED FOR ENCLOSURE:
- cUL, cULus, CSA-listed/ recognized environmental rating better or equal than enclosure
- Plastic materials flammability accroding UL94-VO
LIST OF LABELS:
L1 RADIATOR FAN STARTER
Q1 MAIN SWITCH
R1 RESET FAN 1
H1 POWER ON (WHITE)
H2 FAN 1 RUNNING (GREEN)
H3 FAN 1 TRIPPED (RED)
S1 POWER
INTERNAL WIRES
Power circuit: AWG 8 UL Style Certified or Recognized
Temperature range -25 To +90C
Nominal voltage 600V
Flammability UL-VW1
Tinned copper wires
INTERNAL WIRES
Control circuit: AWG 16 UL Style Certified or Recognized
Temperature range -25 To +90C
Nominal voltage 600V
Flammability UL-VW1
Tinned copper wires
SIZE OF GROUNDING / BONDING CONDUCTOR
Minimum AWG 10
COLOUR CODINGS ACCORDING UL508A
600
23,6"
542
21,3"
RADIATOR LOOP PUMP STARTER
MAIN SWITCH
POWER
-H1
-H2
-H3
R
-R1
FRONT VIEW
600
23,6"
630
24,8"
654
25,7"
EARTHING BOLT M10
15
29
54
⌀ 9
276
10,9"
210
8,3"
SIDE VIEW
ENCLOSURE TYPE RATING: IP66 / NEMA4
RITTAL COMPACT ENCLOSURE MODEL NO. AX 1038.000 (RAL 7035)
ESTIMATED WEIGHT: 32kg /71lbs
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Date 11.11.2020
User VHa
Checked
Approved
Revision
Date
User
WÄRTSILÄ
DMCA00026700 RADIATOR LOOP PUMP
ARNON
Art of Automation.
Layout
DAE200174
3014258 (DAE200174)
= 3
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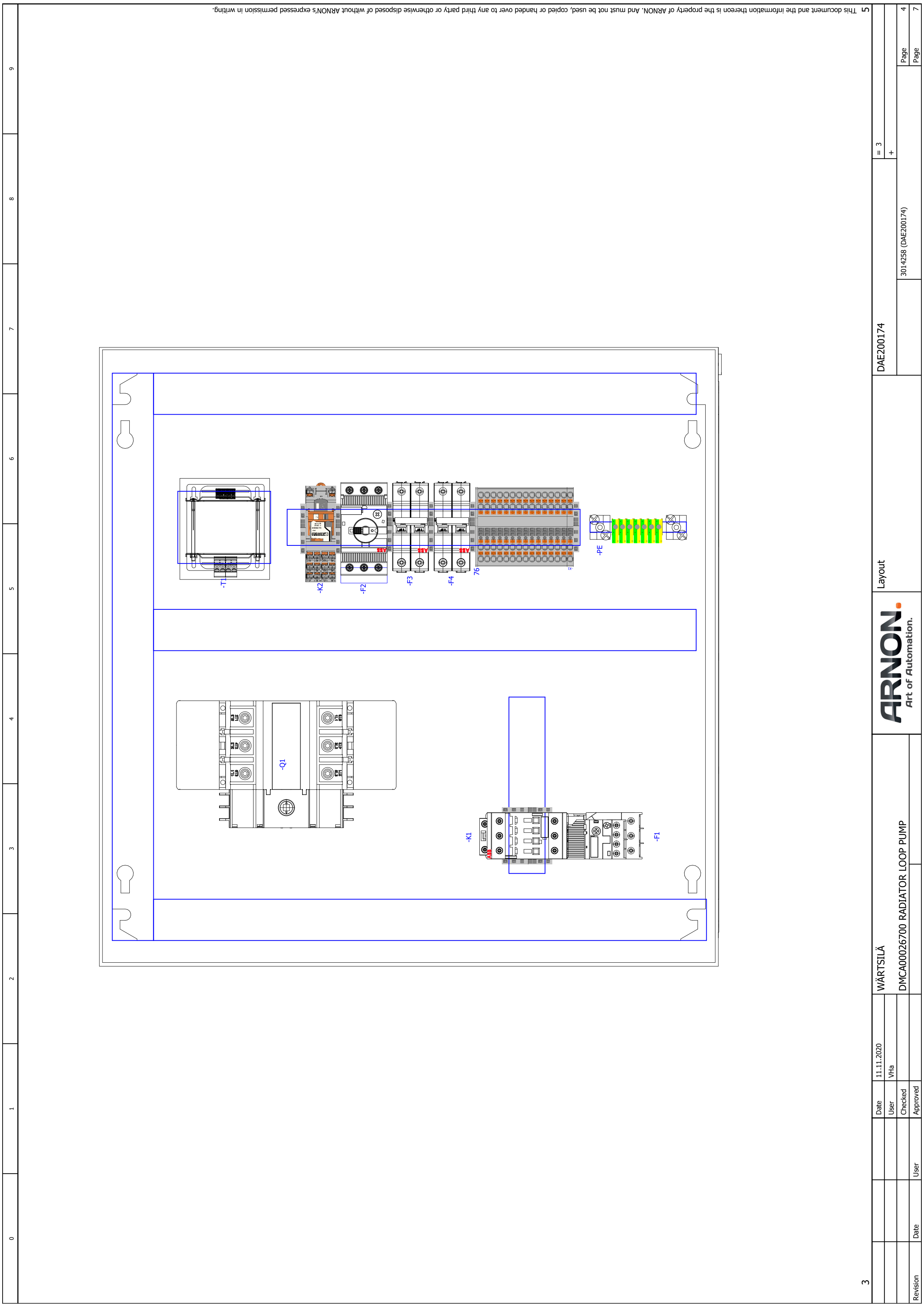
This document and the information thereon is the property of ARNON. And must not be used, copied or handed over to any third party or otherwise disposed of without ARNON's expressed permission in writing.
-T1
-K2
-F2
-F3
-F4
-PE
-Q1
-K1
-F1
ARNON.
Art of Automation.
Layout
DAE200174
3014258 (DAE200174)
WÄRTSILÄ
DMCA00026700 RADIATOR LOOP PUMP
Date
11.11.2020
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VHa
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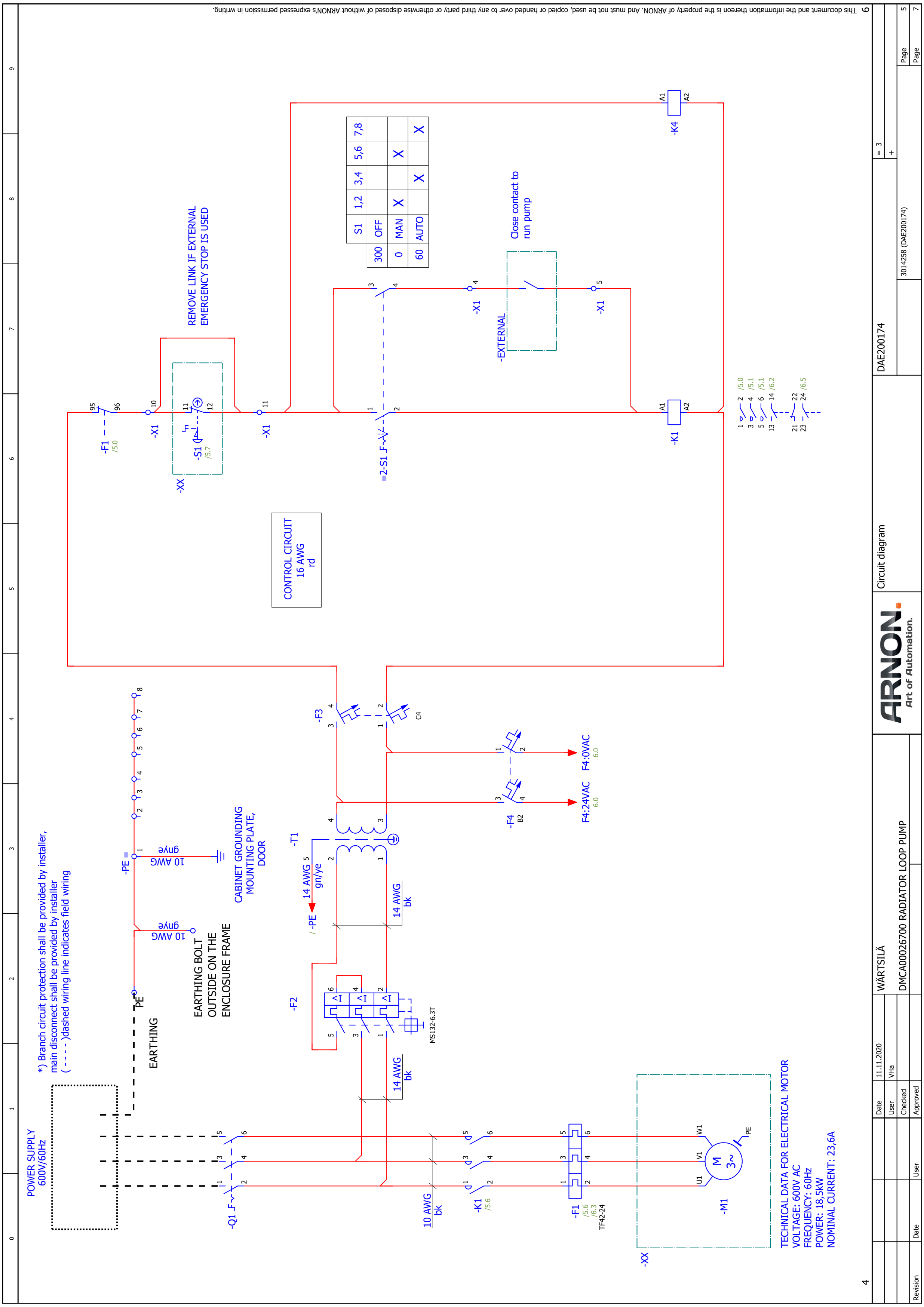
POWER SUPPLY
600V/60Hz
*) Branch circuit protection shall be provided by installer,
main disconnect shall be provided by installer
(- - - -)dashed wiring line indicates field wiring
EARTHING
PE
EARTHING BOLT
OUTSIDE ON THE
ENCLOSURE FRAME
10 AWG
gn/ye
-PE =
CABINET GROUNDING
MOUNTING PLATE,
DOOR
-Q1
-F2
MS132-6.3T
14 AWG
bk
-T1
14 AWG
gn/ye
-PE
-F3
C4
-F4
B2
F4:24VAC
F4:0VAC
10 AWG
bk
-K1
-F1
TF42-24
-M1
M
3~
-XX
TECHNICAL DATA FOR ELECTRICAL MOTOR
VOLTAGE: 600V AC
FREQUENCY: 60Hz
POWER: 18,5kW
NOMINAL CURRENT: 23,6A
CONTROL CIRCUIT
16 AWG
rd
-X1
-S1
REMOVE LINK IF EXTERNAL
EMERGENCY STOP IS USED
=2-S1
S1
OFF
MAN
AUTO
1,2
3,4
5,6
7,8
Close contact to
run pump
-EXTERNAL
-K4
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ARNON
Art of Automation.
Circuit diagram
DAE200174
WÄRTSILÄ
DMCA00026700 RADIATOR LOOP PUMP
3014258 (DAE200174)
Date
11.11.2020
User
VHa
Checked
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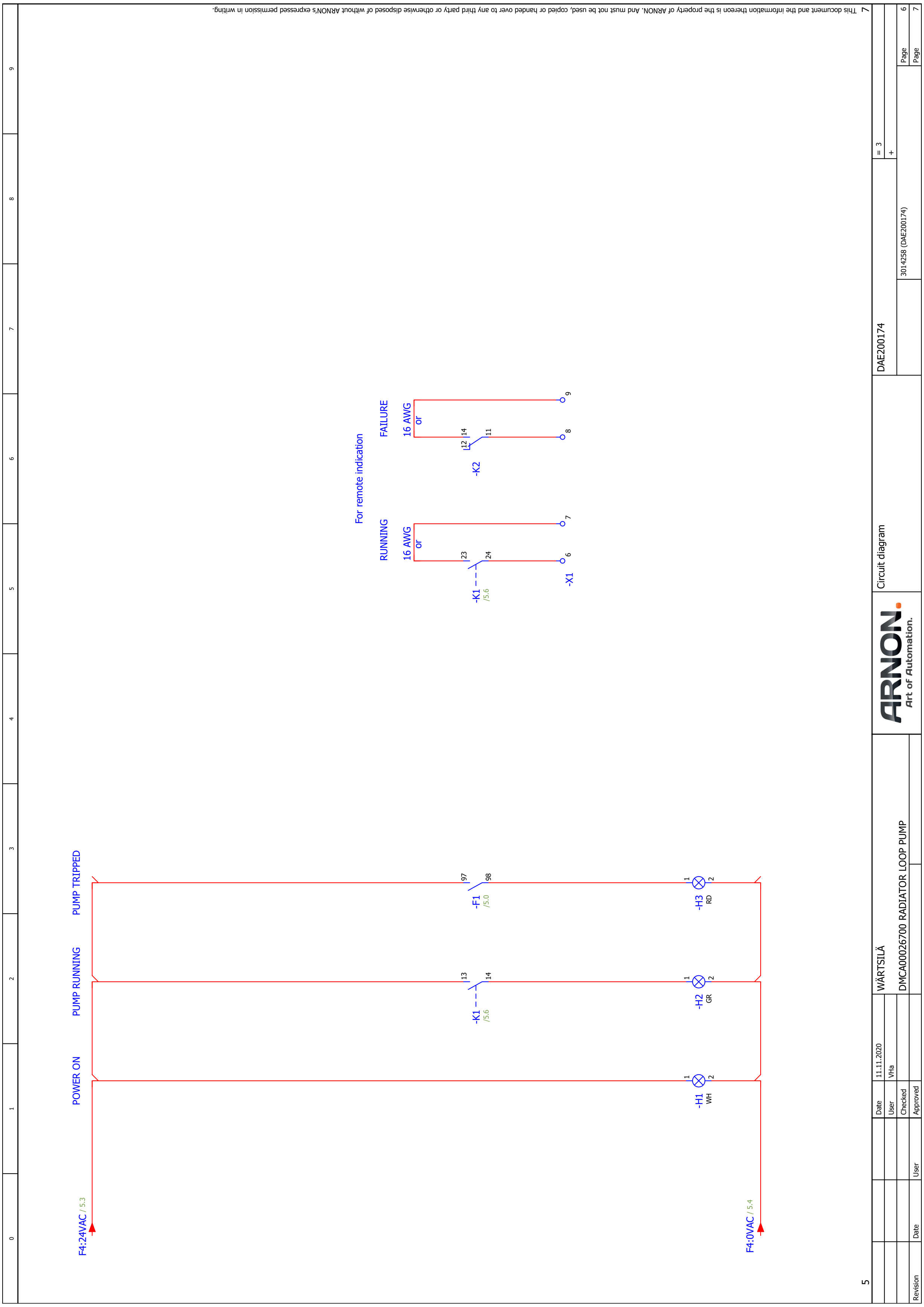
POWER ON
PUMP RUNNING
PUMP TRIPPED
F4:24VAC / 5.3
F4:0VAC / 5.4
-H1 WH
-H2 GR
-H3 RD
-K1 /5.6
-F1 /5.0
For remote indication
RUNNING
FAILURE
16 AWG or
16 AWG or
-K1 /5.6
-K2
-X1
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ARNON. Art of Automation.
Circuit diagram
DAE200174
WÄRTSILÄ
DMCA00026700 RADIATOR LOOP PUMP
Date 11.11.2020
User VHa
Checked
Approved
3014258 (DAE200174)
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Page 6
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User

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Parts list

F01_001

Device tag	Quantity	Designation	Type number	Supplier	Part number
	4	Wall mounting bracket	AX.2508020	RIT	RIT.2508020
	1	AX Rail for interior installation, for D: 210 mm,	AX.2393210		RIT.2393210
	1	Door stay for AX	AX.2519010	RIT	RIT.2519010
	1	Cable duct	CD-HF 40X60	PXC	PXC.3240349
=2-S1	1	Step switch, (OFF-MAN-AUTO)	CA10 SF8738 -600FT2+F*SFA1972	KN	KN.CA10 SF8738 -600FT2+F*SFA1972
-ENCLOSURE	1	SZ Wiring plan pocket, plastic, DIN A4, portrait	SZ.2514000	RIT	RIT.2514000
-ENCLOSURE	1	Compact enclosure AX	AX.1060000		RIT.1060000
-F1	1	TF42-24 Thermal Overload Relay	TF42-24	ABB	ABB.1SAZ721201R1051
-F2	1	MS132-6.3T Circuit-breaker for primary transformer protection	MS132-6.3T	ABB	ABB.1SAM340000R1009
-F3	1	Miniature Circuit Breaker - S200 - 2P - C - 4 A	S202-C4	ABB	ABB.2CDS252001R0044
-F3	1	Miniature Circuit Breaker - S200 - 2P - B - 2 A	S202-B2		ABB.2CDS252001R0025
-F4	1	Miniature Circuit Breaker - S200 - 2P - B - 2 A	S202-B2		ABB.2CDS252001R0025
-F4	1	Miniature Circuit Breaker - S200 - 2P - C - 4 A	S202-C4	ABB	ABB.2CDS252001R0044
-H1	1	Compact Pilot Light Clear LED 24V AC/DC	CL2-502C	ABB	ABB.CL2-502C
-H2	1	Compact Pilot Light Green LED 24V AC/DC	CL2-502G	ABB	ABB.CL2-502G
-H3	1	Compact Pilot Light Red LED 24V AC/DC	CL2-502R	ABB	ABB.CL2-502R
-K1	1	AF26-30-00-11 24-60V50/60HZ 20-60VDC Contactor	AF26-30-00-11	ABB	ABB.1SBL237001R1100
-K1	1	CA4-10 Auxiliary Contact Block	CA4-10	ABB	ABB.1SBN010110R1010
-K1	1	CA4-01 Auxiliary Contact Block	CA4-01	ABB	ABB.1SBN010110R1001
-K2	1	Relay Module	RIF-2-RPT-LV-24AC/4X21	PXC	PXC.2903306
-K4	1	Relay Module	RIF-2-RPT-LV-24AC/4X21	PXC	PXC.2903306
-PE	3	Connection terminal block	AKG 16 GNYE	PXC	PXC.0423027
-PE	12	Connection terminal block	AKG 4 GNYE	PXC	PXC.0421029
-PE	1	Neutral busbar	NLS-CU 3/10 SN 1000MM	PXC	PXC.0402174
-PE	2	Support bracket	AB/SS	PXC	PXC.0404428
-PE	2	Support bracket	AB/SS	PXC	PXC.0404428_Ver.2
-PE	1	Neutral busbar	NLS-CU 3/10 SN 2000MM	PXC	PXC.0402006
-Q1	1	OT160G03P switch-disconnector	OT160G03P	ABB	ABB.OT160G03P
-Q1	2	OTS160G1L3 Terminal shroud	OTS160G1L3		ABB.1SCA140414R1001
-R1	1	KPR1-101L Modular Reset Pushbutton	KPR1-101L	ABB	ABB.1SFA616160R1014
-R1	1	KA1-8046 SHAFT for KPR1-101L Modular Reset Pushbutton	KA1-8046	ABB	ABB.1SFA616920R8046
-T1	1	Transformer 600V/24V 50-60Hz, 160VA	600V/24V 50-60Hz, 160VA	Intertrafo	ITR.600V/24V 50-60Hz, 160VA
-U1	2	DIN rail perforated	NS 35/15 ZN PERF 2000MM	PXC	PXC.1206599
-X1	8	End clamp	CLIPFIX 35-5 V0	PXC	PXC.3032350
-X1	1	End cover	D-PT 4-QUATTRO	PXC	PXC.3208979
-X1	15	Feed-through terminal block	PT 4-QUATTRO	PXC	PXC.3211797

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			Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Parts list : RIT.2508020 - PXC.3211797	DAE200174	= 3
			User	VHa					+
			Checked		DMCA00026700 RADIATOR LOOP PUMP			3014258 (DAE200174)	Page 7
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ARNON.
Hyllilänkatu 15
33730 Tampere, Finland
Tel: +358 10 526 5000
www.ARNON.fi

Customer	WÄRTSILÄ	AC Input: 600V
Project description	DBAE907803 MOTOR STARTER TURNING GEAR	Frequency: 60Hz
Job number	3014257 (DAE200173)	DC Input: -
		Degree of protection: NEMA 12
		FLA: 6,9A
		Largest motor: 5kW
		SCCR: 3kA

Created on	03.11.2020		
Edit date	11.11.2020	by (short name) MHe	Number of pages: 7

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			User	MHe					+		
			Checked		DBAE907803 MOTOR STARTER TURNING GEAR				3014257 (DAE200173)	Page	1
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			User	MHe					+
			Checked		DBAE907803 MOTOR STARTER TURNING GEAR			3014257 (DAE200173)	Page 2
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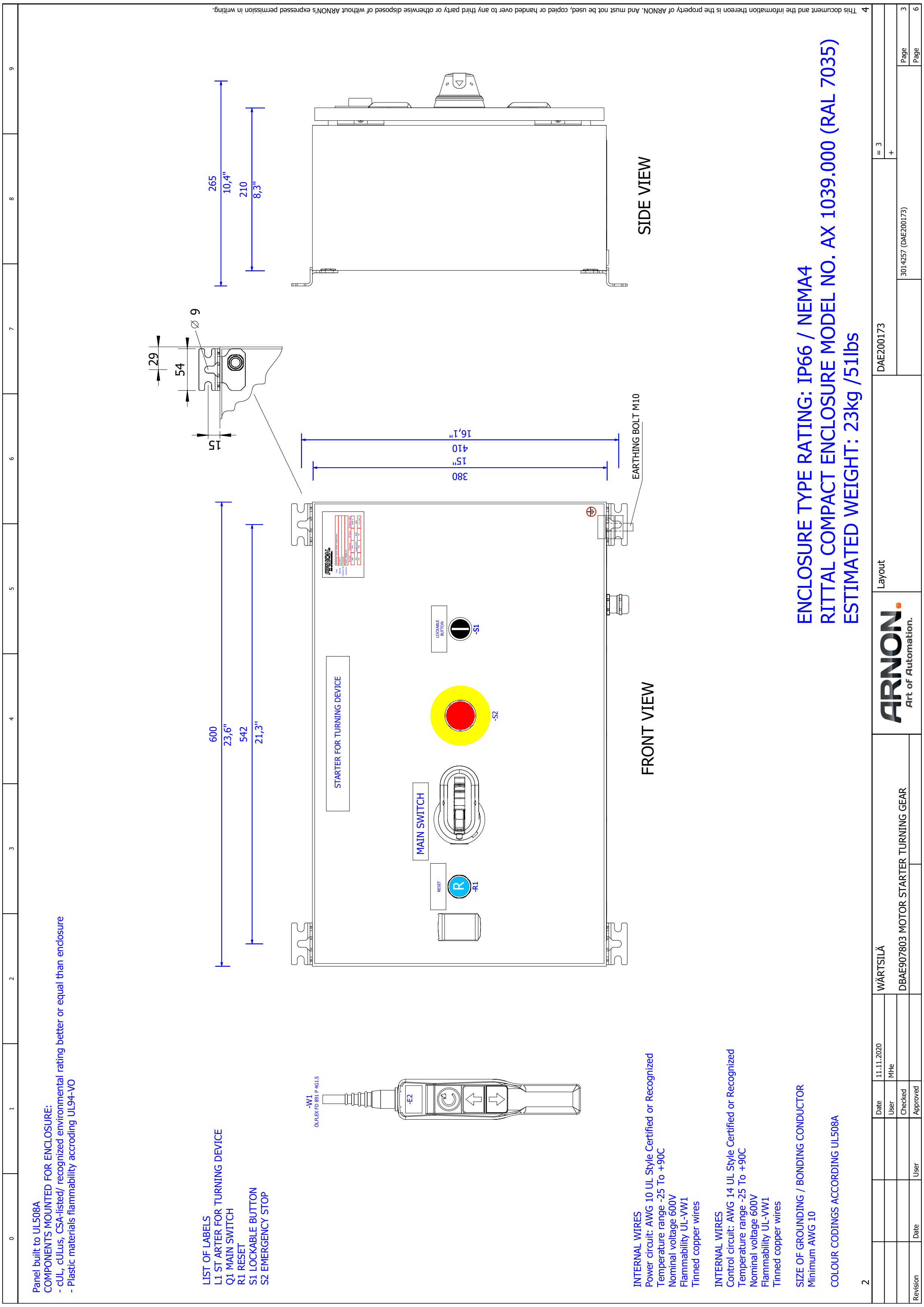
Panel built to UL508A
COMPONENTS MOUNTED FOR ENCLOSURE:
- cUL, cULus, CSA-listed/ recognized environmental rating better or equal than enclosure
- Plastic materials flammability accroding UL94-VO
LIST OF LABELS
L1 ST ARTER FOR TURNING DEVICE
Q1 MAIN SWITCH
R1 RESET
S1 LOCKABLE BUTTON
S2 EMERGENCY STOP
INTERNAL WIRES
Power circuit: AWG 10 UL Style Certified or Recognized
Temperature range -25 To +90C
Nominal voltage 600V
Flammability UL-VW1
Tinned copper wires
INTERNAL WIRES
Control circuit: AWG 14 UL Style Certified or Recognized
Temperature range -25 To +90C
Nominal voltage 600V
Flammability UL-VW1
Tinned copper wires
SIZE OF GROUNDING / BONDING CONDUCTOR
Minimum AWG 10
COLOUR CODINGS ACCORDING UL508A
-W1
-E2
STARTER FOR TURNING DEVICE
MAIN SWITCH
-R1
-S2
-S1
600
23,6"
542
21,3"
380
15"
410
16,1"
15
54
29
⌀ 9
265
10,4"
210
8,3"
EARTHING BOLT M10
FRONT VIEW
SIDE VIEW
ENCLOSURE TYPE RATING: IP66 / NEMA4
RITTAL COMPACT ENCLOSURE MODEL NO. AX 1039.000 (RAL 7035)
ESTIMATED WEIGHT: 23kg /51lbs
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Date 11.11.2020
User MHe
Checked
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Revision
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DBAE907803 MOTOR STARTER TURNING GEAR
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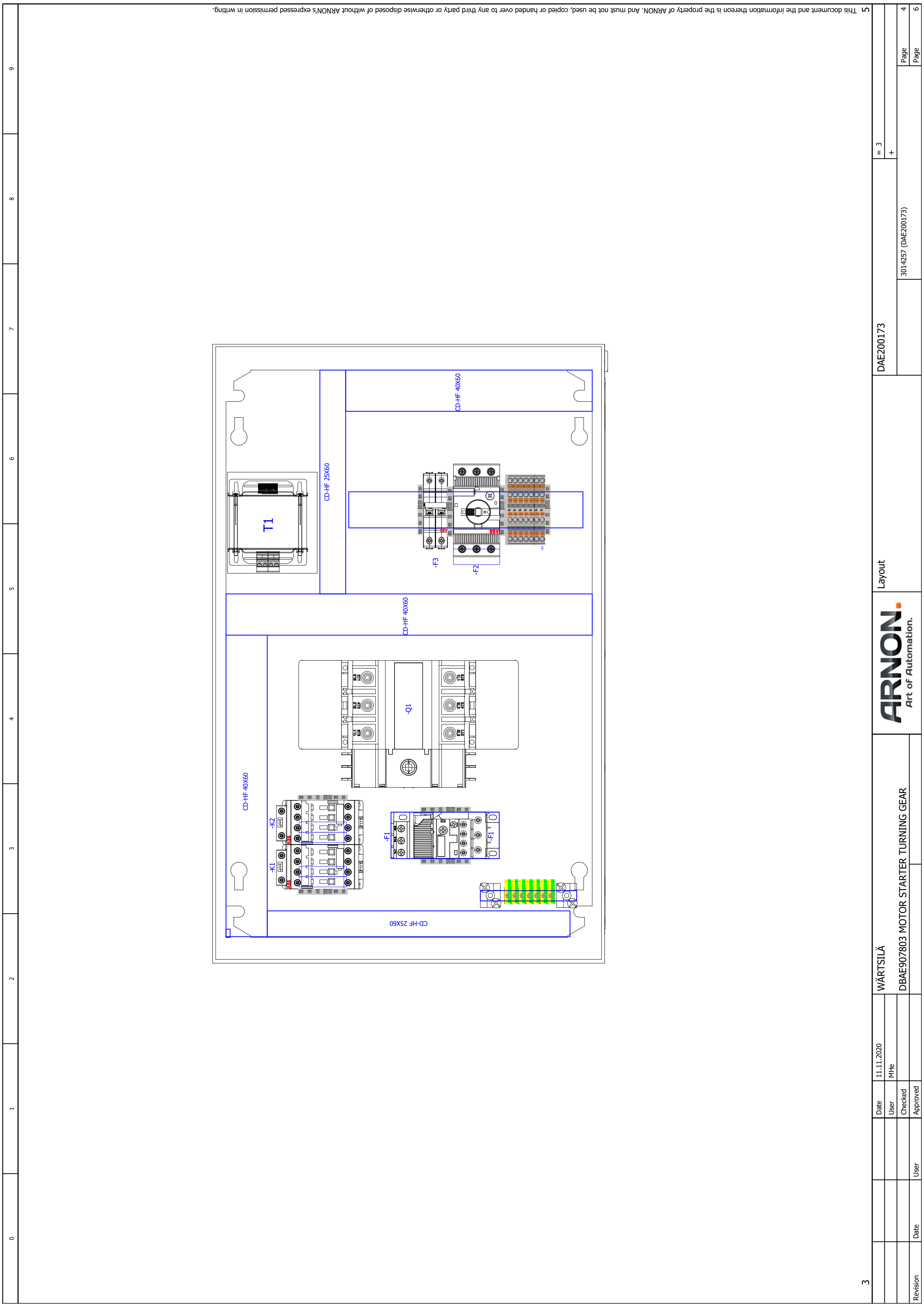
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T1
CD-HF 25X60
CD-HF 40X60
-F3
-F2
CD-HF 40X60
-Q1
CD-HF 40X60
-K2
-K1
-F1
-F1
CD-HF 25X60
Date 11.11.2020
User MHe
Checked
Approved
Revision
Date
User
WÄRTSILÄ
DBAE907803 MOTOR STARTER TURNING GEAR
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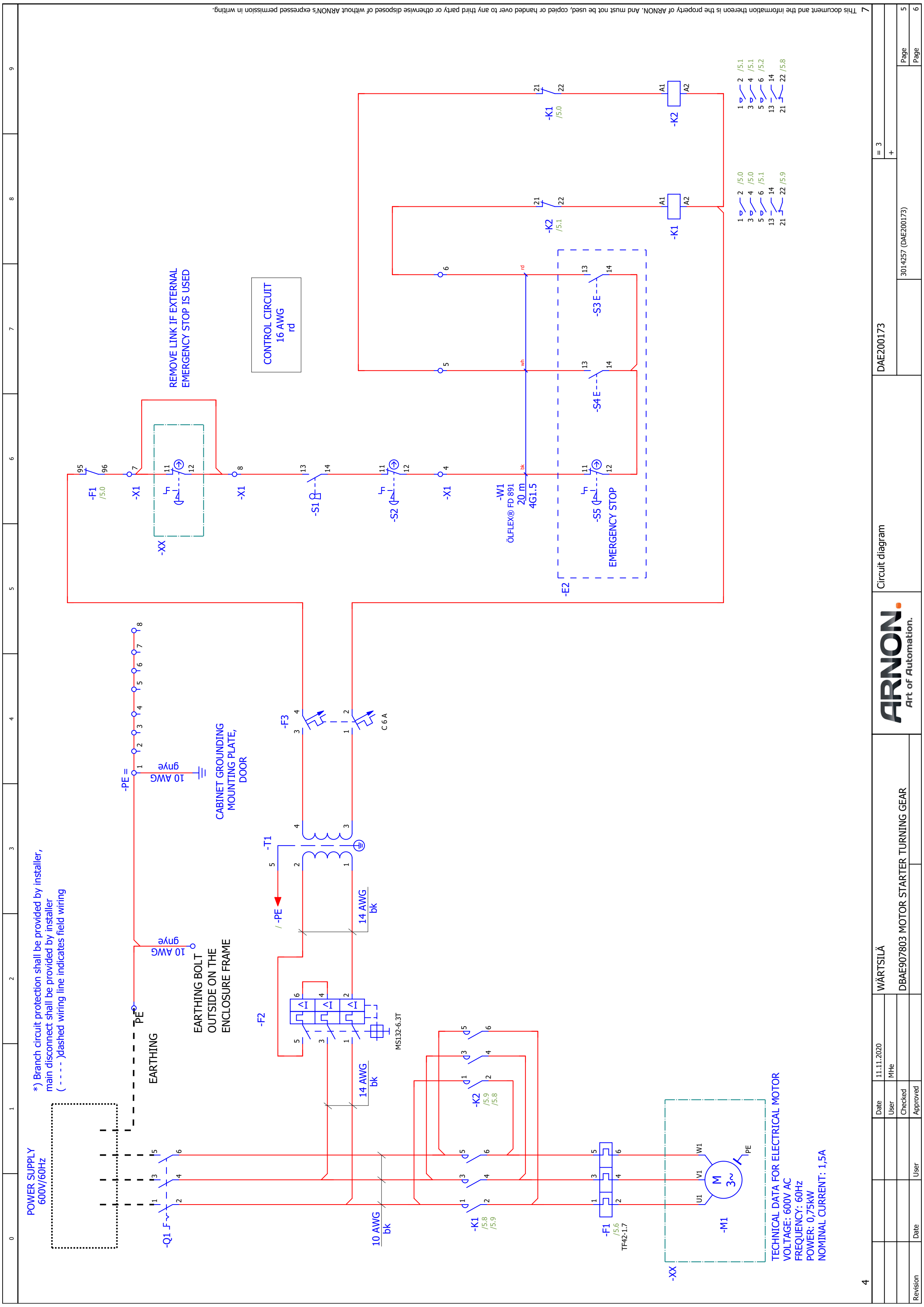
POWER SUPPLY
600V/60Hz
*) Branch circuit protection shall be provided by installer,
main disconnect shall be provided by installer
(- - - -)dashed wiring line indicates field wiring
EARTHING
PE
EARTHING BOLT
OUTSIDE ON THE
ENCLOSURE FRAME
10 AWG
gnye
-PE =
CABINET GROUNDING
MOUNTING PLATE,
DOOR
-Q1
10 AWG
bk
14 AWG
bk
-F2
MS132-6.3T
-PE
-T1
-F3
C 6 A
-K1
-K2
-F1
TF42-1.7
-M1
M
3~
-XX
TECHNICAL DATA FOR ELECTRICAL MOTOR
VOLTAGE: 600V AC
FREQUENCY: 60Hz
POWER: 0,75kW
NOMINAL CURRENT: 1,5A
REMOVE LINK IF EXTERNAL
EMERGENCY STOP IS USED
CONTROL CIRCUIT
16 AWG
rd
-X1
-S1
-S2
-W1
ÖLFLEX® FD 891
20 m
4G1.5
-S5
EMERGENCY STOP
-E2
-S4
-S3
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ARNON
Art of Automation
Circuit diagram
WÄRTSILÄ
DBAE907803 MOTOR STARTER TURNING GEAR
DAE200173
3014257 (DAE200173)
11.11.2020
MHe
Date
User
Checked
Approved
Revision
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0	1	2	3	4	5	6	7	8	9

Parts list

F01_001

Device tag	Quantity	Designation	Type number	Supplier	Part number
	1	Compact enclosure AX, WHD: 600x380x210 mm, sheet steel, with mounting plate	AX.1039000		RIT.1039000
	1	AX Rail for interior installation, for D: 210 mm,	AX.2393210		RIT.2393210
	4	Wall mounting bracket	AX.2508020	RIT	RIT.2508020
	1	Door stay for AX	AX.2519010	RIT	RIT.2519010
	6	Connection terminal block	AKG 4 GNYE	PXC	PXC.0421029
	1	Cable duct	CD-HF 40X60	PXC	PXC.3240349
-4	1	Neutral busbar	NLS-CU 3/10 SN 2000MM	PXC	PXC.0402006
-5	1	Support bracket	AB/SS	PXC	PXC.0404428_Ver.2
-6	1	Support bracket	AB/SS	PXC	PXC.0404428_Ver.2
-CABINET	1	SZ Wiring plan pocket, plastic, DIN A4, portrait	SZ.2514000	RIT	RIT.2514000
-E2	1	Pendant station XAC-A pistol grip - 2 push buttons 1 Emergency stop	XACA2174	SE	SE.XACA2174
-F1	1	TF42-1.7 Thermal Overload Relay	TF42-1.7	ABB	ABB.1SAZ721201R1028
-F1	1	DB42 Single Mounting Kit for TF42	DB42	ABB	ABB.1SAZ701902R0001
-F2	1	MS132-6.3T Circuit-breaker for primary transformer protection	MS132-6.3T	ABB	ABB.1SAM340000R1009
-F3	1	Miniature Circuit Breaker - S200 - 2P - C - 6 A	S202-C6	ABB	ABB.2CDS252001R0064
-K1	1	AF16-30-10-11 24-60V50/60HZ 20-60VDC Contactor	AF16-30-10-11	ABB	ABB.1SBL177001R1110
-K1	1	CA4-01 Auxiliary Contact Block	CA4-01	ABB	ABB.1SBN010110R1001
-K2	1	AF16-30-10-11 24-60V50/60HZ 20-60VDC Contactor	AF16-30-10-11	ABB	ABB.1SBL177001R1110
-K2	1	CA4-01 Auxiliary Contact Block	CA4-01	ABB	ABB.1SBN010110R1001
-PE	3	Connection terminal block	AKG 16 GNYE	PXC	PXC.0423027
-PE	5	Connection terminal block	AKG 4 GNYE	PXC	PXC.0421029
-PE	1	Neutral busbar	NLS-CU 3/10 SN 1000MM	PXC	PXC.0402174
-PE	2	Support bracket	AB/SS	PXC	PXC.0404428
-Q1	1	OT160G03P switch-disconnector	OT160G03P	ABB	ABB.OT160G03P
-Q1	2	OTS160G1L3 Terminal shroud	OTS160G1L3		ABB.1SCA140414R1001
-R1	1	KPR1-101L Modular Reset Pushbutton	KPR1-101L	ABB	ABB.1SFA616160R1014
-R1	1	KA1-8046 SHAFT for KPR1-101L Modular Reset Pushbutton	KA1-8046	ABB	ABB.1SFA616920R8046
-S1	1	M2SSK1-101 Selector Switch	M2SSK1-101	ABB	ABB.1SFA611280R1001
-S1	1	MCBH-00 Contact block holder	MCBH-00	ABB	ABB.1SFA611605R1100
-S1	1	MCB-10 Contact block	MCB-10	ABB	ABB.1SFA611610R1001
-S2	1	EMERGENCY STOP CE4T-10R-11	CE4T-10R-11	ABB	ABB.1SFA619550R1071
-T1	1	Transformer 600V/24V 50-60Hz, 160VA	600V/24V 50-60Hz, 160VA	Intertrafo	ITR.600V/24V 50-60Hz, 160VA
-U2	1	DIN rail perforated	NS 35/15 ZN PERF 2000MM	PXC	PXC.1206599
-W1	1	Cable gland, M20x1,5 (7 - 13mm)	SKINTOP MS-M20X1,5 BRASS	Lapp	Lapp.53112020
-W1	1	Locknut for M20 cable gland, brass	SKINDICHT SM-M20X1,5 BRASS	Lapp	Lapp.52103020
-X	7	End clamp	CLIPFIX 35-5 V0	PXC	PXC.3032350
-X1	1	End cover	D-PTTB 2,5	PXC	PXC.3211634
-X1	7	Double-level terminal block	PTTB 2,5	PXC	PXC.3210567
-X1	1	End clamp	CLIPFIX 35-5 V0	PXC	PXC.3032350
-X2	1	Connection terminal block	AKG 4 GNYE	PXC	PXC.0421029
-W1	1	ÖLFLEX® FD 891	1026304	LAPP	LAPP.1026304

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			Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Parts list : RIT.1039000 - PXC.0421029	DAE200173	= 3
			User	MHe					+
			Checked		DBAE907803 MOTOR STARTER TURNING GEAR			3014257 (DAE200173)	Page 7
Revision	Date	User	Approved						Page 6

WÄRTSILÄ	Wärtsilä Italia		Modbus TCP/IP List for W8L26F UNIC C2 - CCG COLLEGE					Generated with: WCT 2.2
	Made	MLA026	Date	Product	WBS Element	Engine number	Document	Revision
	Checked	MLA026	13.03.2019	W8L26 F	SP/02879	XAAB390984	DMCA00004813	a
	Approved	MLA026						

Modbus/TCP communication info	
Commands in use:	3, 16, 101
Communication mode:	TCP
TCP Port:	502
Modbus Slave number:	5
Error value in case Sensor failure:	-32765
Error value in case not updated:	-32767

Instructions

Function code:	PV=Process Value, SF=Signal/Sensor Failure, STB=Start Blocked, ALM=Alarm, LR=Load Reduction, SHD=Shut Down, EMG=Emergency Stop

Revision

Made	Checked	Description	Rev	Date
MLA026	MLA026	Removed Alternator signals.	a	23.7.2019

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Modbus/TCP		Direction: Output									
Address	Bit	Function	Description	ISO code	Range, min	Range, max	Unit	Set Point data	Scale	Bus data	Remark
41001	4	ALM HIGH	ALM, High FO leakage, clean primary, A-bank	LS103A	0	1	-	= 1	-	0/1	-
41002	0	ALM	ALM, FO filter press diff sw	PDS113	0	1	-	= 1	-	0/1	-
41003	2	STB	SBL, Stop lever in stop position	GS171	0	1	-	= 1	-	0/1	-
41003	3	SHD HIGH	SHD, High Stop lever in stop position	GS171	0	1	-	= 1	-	0/1	-
41004	2	SF	SF, Engine speed, primary	ST196P	0	1	-	-	-	0/1	-
41004	3	SF	SF, Engine speed, secondary	ST196S	0	1	-	-	-	0/1	-
41004	6	EMG HIGH	E-EMG, High Overspeed shutdown 1 status	IS1741	0	1	-	= 1	-	0/1	-
41051		PV	FO press, engine inlet	PT101	0.00	16.00	bar	-	0.01	0 - 1600	-
41052	0	SF	SF, FO press, engine inlet	PT101	0	1	-	-	-	0/1	TCP-only
41052	1	ALM LOW	ALM, Low FO press, engine inlet	PT101	0	1	-	< 5.5	-	0/1	-
41054		PV	FO temp, engine inlet	TE101	0.0	160.0	C	-	0.1	0 - 1600	-
41055	0	SF	SF, FO temp, engine inlet	TE101	0	1	-	-	-	0/1	TCP-only
41055	2	ALM HIGH	ALM, High FO temp, engine inlet	TE101	0	1	-	> 50.0 **1)**	-	0/1	-
41181	0	SF	SF, Fuel rack control	CV161	0	1	-	-	-	0/1	TCP-only
41195		PV	Fuel rack position	GT165_2	0	40	mm	-	1	0 - 40	-
41196	0	SF	SF, Fuel rack position	GT165_2	0	1	-	-	-	0/1	TCP-only
41219		PV	Engine speed	STY196	0.0	1200.0	rpm	-	1	0 - 1200	-
41220	6	SF EMG	E-EMG SF, Engine speed	STY196	0	1	-	1	-	0/1	-
41231		PV	Torsional vibration level, peak	WY196_2	0	2	deg	-	0.01	0 - 200	-
41232	2	ALM HIGH	ALM, High Torsional vibration level, peak	WY196_2	0	1	-	**8)**	-	0/1	-
41339		PV	Engine load, relative BMEP	GTY1624	0.0	120.0	%	-	0.1	0 - 1200	-
41340	2	ALM HIGH	ALM, High Engine load, relative BMEP	GTY1624	0	1	-	> 102.0	-	0/1	-
41341	1	LR HIGH	LR, High Engine load, relative BMEP	GTY1624	0	1	-	> 111.0	-	0/1	-

Modbus/TCP		Direction: Output									
Address	Bit	Function	Description	ISO code	Range, min	Range, max	Unit	Set Point data	Scale	Bus data	Remark
42001	1	SHD **9)**	SHD, LO press shutdown status	IS2011	0	1	-	1	-	0/1	-
42001	3	ALM LOW	ALM, Low LO low level, wet sump	LS204	0	1	-	1	-	0/1	-
42001	11	ALM	ALM, LO press shutdown status	IS2011	0	1	-	= 1	-	0/1	-
42051		PV	LO press, engine inlet	PT201	0.00	10.00	bar	-	0.01	0 - 1000	-
42052	0	SF	SF, LO press, engine inlet	PT201	0	1	-	-	-	0/1	TCP-only
42052	1	ALM LOW	ALM, Low LO press, engine inlet	PT201	0	1	-	VSP **10)**	-	0/1	-
42053	0	LR LOW	LR, Low LO press, engine inlet	PT201	0	1	-	< 2.50	-	0/1	-
42053	6	STB LOW	STB, Low LO press, engine inlet	PT201	0	1	-	< 0.50	-	0/1	-
42054		PV	LO temp, engine inlet	TE201	0.0	160.0	C	-	0.1	0 - 1600	-
42055	0	SF	SF, LO temp, engine inlet	TE201	0	1	-	-	-	0/1	TCP-only
42055	2	ALM HIGH	ALM, High LO temp, engine inlet	TE201	0	1	-	> 75.0	-	0/1	-
42055	5	SHD HIGH	SHD, High LO temp, engine inlet	TE201	0	1	-	> 85.0	-	0/1	-
42056	1	LR HIGH	LR, High LO temp, engine inlet	TE201	0	1	-	> 80.0	-	0/1	-
42063		PV	LO press, filter inlet	PT241	0.00	10.00	bar	-	0.01	0 - 1000	-
42064	0	SF	SF, LO press, filter inlet	PT241	0	1	-	-	-	0/1	TCP-only
42066		PV	LO filter press diff	PDY243	0.00	2.00	bar	-	0.01	0 - 200	-
42067	0	SF	SF, LO filter press diff	PDY243	0	1	-	-	-	0/1	TCP-only
42067	2	ALM HIGH	ALM, High LO filter press diff	PDY243	0	1	-	> 1.00	-	0/1	-
42069		PV	LO press, TC A inlet	PT271	0.00	10.00	bar	-	0.01	0 - 1000	-
42070	0	SF	SF, LO press, TC A inlet	PT271	0	1	-	-	-	0/1	TCP-only
42070	1	ALM LOW	ALM, Low LO press, TC A inlet	PT271	0	1	-	< 1.30	-	0/1	-
42072		PV	LO, temp, TC A outlet	TE272	0.0	160.0	C	-	0.1	0 - 1600	-
42073	0	SF	SF, LO temp, TC A outlet	TE272	0	1	-	-	-	0/1	TCP-only
42073	2	ALM HIGH	ALM, High LO temp, TC A outlet	TE272	0	1	-	> 120.0	-	0/1	-
42097	0	SF	SF, Ctrl oil press aft VIC valve A-bank	PT291A	0	1	-	-	-	0/1	TCP-only

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42097	1	ALM LOW	ALM, Low Ctrl oil press aft VIC valve A-bank	PT291A	0	1	-	**3)**	-	0/1	-
42098	1	LR HIGH	LR, High Ctrl oil press aft VIC valve A-bank	PT291A	0	1	-	**4)**	-	0/1	-
Modbus/TCP		**Direction: Output**									
Address	**Bit**	**Function**	**Description**	**ISO code**	**Range, min**	**Range, max**	**Unit**	**Set Point data**	**Scale**	**Bus data**	**Remark**
43051		PV	Starting air press, engine inlet	PT301	0.00	16.00	bar	-	0.01	0 - 1600	-
43052	0	SF	SF, Starting air press, engine inlet	PT301	0	1	-	-	-	0/1	TCP-only
43052	1	ALM LOW	ALM, Low Starting air press, engine inlet	PT301	0	1	-	< 7.00	-	0/1	-
43054		PV	Control air press	PT311	0.00	40.00	bar	-	0.01	0 - 4000	-
43055	0	SF	SF, Control air press	PT311	0	1	-	-	-	0/1	TCP-only
43055	1	ALM LOW	ALM, Low Control air press	PT311	0	1	-	< 16.00	-	0/1	-
Modbus/TCP		**Direction: Output**									
Address	**Bit**	**Function**	**Description**	**ISO code**	**Range, min**	**Range, max**	**Unit**	**Set Point data**	**Scale**	**Bus data**	**Remark**
44001	0	SHD **9)**	SHD, HT water temp shutdown status	IS4011	0	1	-	-	-	0/1	-
44001	5	ALM	ALM, HT water temp shutdown status	IS4011	0	1	-	-	-	0/1	-
44051		PV	HT water press, jacket inlet	PT401	0.00	6.00	bar	-	0.01	0 - 600	-
44052	0	SF	SF, HT water press, jacket inlet	PT401	0	1	-	-	-	0/1	TCP-only
44052	1	ALM LOW	ALM, Low HT water press, jacket inlet	PT401	0	1	-	VSP **5)**	-	0/1	-
44053	0	LR LOW	LR, Low HT water press, jacket inlet	PT401	0	1	-	VSP **6)**	-	0/1	-
44054		PV	HT water temp, jacket inlet	TE401	0.0	160.0	C	-	0.1	0 - 1600	-
44055	0	SF	SF, HT water temp, jacket inlet	TE401	0	1	-	-	-	0/1	TCP-only
44055	1	ALM LOW	ALM, Low HT water temp, jacket inlet	TE401	0	1	-	< 60.0	-	0/1	-
44057		PV	HT water temp, jacket outlet A-bank	TE402	0.0	160.0	C	-	0.1	0 - 1600	-
44058	0	SF	SF, HT water temp, jacket outlet A-bank	TE402	0	1	-	-	-	0/1	TCP-only
44058	2	ALM HIGH	ALM, High HT water temp, jacket outlet A-bank	TE402	0	1	-	> 105.0	-	0/1	-
44072		PV	LT water press, LT CAC inlet	PT471	0.00	6.00	bar	-	0.01	0 - 600	-
44073	0	SF	SF, LT water press, LT CAC inlet	PT471	0	1	-	-	-	0/1	TCP-only
44073	1	ALM LOW	ALM, Low LT water press, LT CAC inlet	PT471	0	1	-	VSP **5)**	-	0/1	-
44078		PV	LT water temp, LT CAC inlet	TE471	0.0	160.0	C	-	0.1	0 - 1600	-
44079	0	SF	SF, LT water temp, LT CAC inlet	TE471	0	1	-	-	-	0/1	TCP-only
44079	2	ALM HIGH	ALM, High LT water temp, LT CAC inlet	TE471	0	1	-	> 50.0	-	0/1	-
44081		PV	LT water temp, LT CAC outlet	TE472	0.0	160.0	C	-	0.1	0 - 1600	-
44082	0	SF	SF, LT water temp, LT CAC outlet	TE472	0	1	-	-	-	0/1	TCP-only
44087		PV	LT cooling water thermostat control	CV493	0	100.0	%	-	0.1	0 - 1000	-
44088	0	SF	SF, LT cooling water thermostat control	CV493	0	1	-	-	-	0/1	TCP-only
44090		PV	LT cooling water thermostat pos.	GT493	0	100.0	%	-	0.1	0 - 1000	-
44091	0	SF	SF, LT cooling water thermostat pos.	GT493	0	1	-	-	-	0/1	TCP-only
44093		PV	HT water temp, engine outlet	TE402_2	0.0	160.0	C	-	0.1	0 - 1600	-
44094	0	SF	HT water temp, engine outlet	TE402_2	0	1	-	-	-	0/1	TCP-only
44095	1	LR HIGH	HT water temp, engine outlet	TE402_2	0	1	-	>108.0	-	0/1	-
Modbus/TCP		**Direction: Output**									
Address	**Bit**	**Function**	**Description**	**ISO code**	**Range, min**	**Range, max**	**Unit**	**Set Point data**	**Scale**	**Bus data**	**Remark**
45051		PV	Engine exh gas avg temp	TY500	0.0	750.0	C	-	0.1	0 - 7500	-
45054		PV	Exh gas temp, cyl 01A	TE5011A	0.0	750.0	C	-	0.1	0 - 7500	-
45055	0	SF	SF, Exh gas temp, cyl 01A	TE5011A	0	1	-	-	-	0/1	TCP-only
45055	2	ALM HIGH	ALM, High Exh gas temp, cyl 01A	TE5011A	0	1	-	> 580.0	-	0/1	-
45056	1	LR HIGH	LR, High Exh gas temp, cyl 01A	TE5011A	0	1	-	> 595.0	-	0/1	-
45060		PV	Exh gas temp deviation, cyl 01A **7)**	TY5017A	-200.0	200.0	C	-	0.1	-2000 - 2000	-
45061	2	ALM HIGH	ALM, High Exh gas temp deviation, cyl 01A	TY5017A	0	1	-	±90/±50	-	0/1	-
45062	1	LR HIGH	LR, High Exh gas temp deviation, cyl 01A	TY5017A	0	1	-	±110/±60	-	0/1	-
45066		PV	Exh gas temp, cyl 02A	TE5021A	0.0	750.0	C	-	0.1	0 - 7500	-

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45067	0	SF	SF, Exh gas temp, cyl 02A	TE5021A	0	1	-	-	-	0/1	TCP-only
45067	2	ALM HIGH	ALM, High Exh gas temp, cyl 02A	TE5021A	0	1	-	> 580.0	-	0/1	-
45068	1	LR HIGH	LR, High Exh gas temp, cyl 02A	TE5021A	0	1	-	> 595.0	-	0/1	-
45072		PV	Exh gas temp deviation, cyl 02A **7)**	TY5027A	-200.0	200.0	C	-	0.1	-2000 - 2000	-
45073	2	ALM HIGH	ALM, High Exh gas temp deviation, cyl 02A	TY5027A	0	1	-	±90/±50	-	0/1	-
45074	1	LR HIGH	LR, High Exh gas temp deviation, cyl 02A	TY5027A	0	1	-	±110/±60	-	0/1	-
45078		PV	Exh gas temp, cyl 03A	TE5031A	0.0	750.0	C	-	0.1	0 - 7500	-
45079	0	SF	SF, Exh gas temp, cyl 03A	TE5031A	0	1	-	-	-	0/1	TCP-only
45079	2	ALM HIGH	ALM, High Exh gas temp, cyl 03A	TE5031A	0	1	-	> 580.0	-	0/1	-
45080	1	LR HIGH	LR, High Exh gas temp, cyl 03A	TE5031A	0	1	-	> 595.0	-	0/1	-
45084		PV	Exh gas temp deviation, cyl 03A **7)**	TY5037A	-200.0	200.0	C	-	0.1	-2000 - 2000	-
45085	2	ALM HIGH	ALM, High Exh gas temp deviation, cyl 03A	TY5037A	0	1	-	±90/±50	-	0/1	-
45086	1	LR HIGH	LR, High Exh gas temp deviation, cyl 03A	TY5037A	0	1	-	±110/±60	-	0/1	-
45090		PV	Exh gas temp, cyl 04A	TE5041A	0.0	750.0	C	-	0.1	0 - 7500	-
45091	0	SF	SF, Exh gas temp, cyl 04A	TE5041A	0	1	-	-	-	0/1	TCP-only
45091	2	ALM HIGH	ALM, High Exh gas temp, cyl 04A	TE5041A	0	1	-	> 580.0	-	0/1	-
45092	1	LR HIGH	LR, High Exh gas temp, cyl 04A	TE5041A	0	1	-	> 595.0	-	0/1	-
45096		PV	Exh gas temp deviation, cyl 04A **7)**	TY5047A	-200.0	200.0	C	-	0.1	-2000 - 2000	-
45097	2	ALM HIGH	ALM, High Exh gas temp deviation, cyl 04A	TY5047A	0	1	-	±90/±50	-	0/1	-
45098	1	LR HIGH	LR, High Exh gas temp deviation, cyl 04A	TY5047A	0	1	-	±110/±60	-	0/1	-
45102		PV	Exh gas temp, cyl 05A	TE5051A	0.0	750.0	C	-	0.1	0 - 7500	-
45103	0	SF	SF, Exh gas temp, cyl 05A	TE5051A	0	1	-	-	-	0/1	TCP-only
45103	2	ALM HIGH	ALM, High Exh gas temp, cyl 05A	TE5051A	0	1	-	> 580.0	-	0/1	-
45104	1	LR HIGH	LR, High Exh gas temp, cyl 05A	TE5051A	0	1	-	> 595.0	-	0/1	-
45108		PV	Exh gas temp deviation, cyl 05A **7)**	TY5057A	-200.0	200.0	C	-	0.1	-2000 - 2000	-
45109	2	ALM HIGH	ALM, High Exh gas temp deviation, cyl 05A	TY5057A	0	1	-	±90/±50	-	0/1	-
45110	1	LR HIGH	LR, High Exh gas temp deviation, cyl 05A	TY5057A	0	1	-	±110/±60	-	0/1	-
45114		PV	Exh gas temp, cyl 06A	TE5061A	0.0	750.0	C	-	0.1	0 - 7500	-
45115	0	SF	SF, Exh gas temp, cyl 06A	TE5061A	0	1	-	-	-	0/1	TCP-only
45115	2	ALM HIGH	ALM, High Exh gas temp, cyl 06A	TE5061A	0	1	-	> 580.0	-	0/1	-
45116	1	LR HIGH	LR, High Exh gas temp, cyl 06A	TE5061A	0	1	-	> 595.0	-	0/1	-
45120		PV	Exh gas temp deviation, cyl 06A **7)**	TY5067A	-200.0	200.0	C	-	0.1	-2000 - 2000	-
45121	2	ALM HIGH	ALM, High Exh gas temp deviation, cyl 06A	TY5067A	0	1	-	±90/±50	-	0/1	-
45122	1	LR HIGH	LR, High Exh gas temp deviation, cyl 06A	TY5067A	0	1	-	±110/±60	-	0/1	-
45126		PV	Exh gas temp, cyl 07A	TE5071A	0.0	750.0	C	-	0.1	0 - 7500	-
45127	0	SF	SF, Exh gas temp, cyl 07A	TE5071A	0	1	-	-	-	0/1	TCP-only
45127	2	ALM HIGH	ALM, High Exh gas temp, cyl 07A	TE5071A	0	1	-	> 580.0	-	0/1	-
45128	1	LR HIGH	LR, High Exh gas temp, cyl 07A	TE5071A	0	1	-	> 595.0	-	0/1	-
45132		PV	Exh gas temp deviation, cyl 07A **7)**	TY5077A	-200.0	200.0	C	-	0.1	-2000 - 2000	-
45133	2	ALM HIGH	ALM, High Exh gas temp deviation, cyl 07A	TY5077A	0	1	-	±90/±50	-	0/1	-
45134	1	LR HIGH	LR, High Exh gas temp deviation, cyl 07A	TY5077A	0	1	-	±110/±60	-	0/1	-
45138		PV	Exh gas temp, cyl 08A	TE5081A	0.0	750.0	C	-	0.1	0 - 7500	-
45139	0	SF	SF, Exh gas temp, cyl 08A	TE5081A	0	1	-	-	-	0/1	TCP-only
45139	2	ALM HIGH	ALM, High Exh gas temp, cyl 08A	TE5081A	0	1	-	> 580.0	-	0/1	-
45140	1	LR HIGH	LR, High Exh gas temp, cyl 08A	TE5081A	0	1	-	> 595.0	-	0/1	-
45144		PV	Exh gas temp deviation, cyl 08A **7)**	TY5087A	-200.0	200.0	C	-	0.1	-2000 - 2000	-
45145	2	ALM HIGH	ALM, High Exh gas temp deviation, cyl 08A	TY5087A	0	1	-	±90/±50	-	0/1	-
45146	1	LR HIGH	LR, High Exh gas temp deviation, cyl 08A	TY5087A	0	1	-	±110/±60	-	0/1	-
45174		PV	Exh gas temp TC A inlet	TE511	0.0	750.0	C	-	0.1	0 - 7500	-
45175	0	SF	SF, Exh gas temp TC A inlet	TE511	0	1	-	-	-	0/1	TCP-only
45175	2	ALM HIGH	ALM, High Exh gas temp TC A inlet	TE511	0	1	-	> 590.0	-	0/1	-
45176	1	LR HIGH	LR, High Exh gas temp TC A inlet	TE511	0	1	-	> 640.0	-	0/1	-
45177		PV	Exh gas temp TC A outlet	TE517	0.0	750.0	C	-	0.1	0 - 7500	-

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45178	0	SF	SF, Exh gas temp TC A outlet	TE517	0	1	-	-	-	0/1	TCP-only
45178	2	ALM HIGH	ALM, High Exh gas temp TC A outlet	TE517	0	1	-	> 490.0	-	0/1	-
45180		PV	TC A speed	SE518	0	50000	rpm	-	10	0 - 5000	-
45181	0	SF	SF, TC A speed	SE518	0	1	-	-	-	0/1	TCP-only
45181	2	ALM HIGH	ALM, High TC A speed	SE518	0	1	-	> 32551	-	0/1	-
45182	1	LR HIGH	LR, High TC A speed	SE518	0	1	-	> 32880 **11)**	-	0/1	-
Modbus/TCP		**Direction: Output**									
Address	**Bit**	**Function**	**Description**	**ISO code**	**Range, min**	**Range, max**	**Unit**	**Set Point data**	**Scale**	**Bus data**	**Remark**
46051		PV	Air temp, TC inlet	TE600	-50.0	100.0	C	-	0.1	-500 - 1000	-
46052	0	SF	SF, Air temp, TC inlet	TE600	0	1	-	-	-	0/1	TCP-only
46052	2	ALM HIGH	ALM, High Air temp, TC inlet	TE600	0	1	-	> 45	-	0/1	-
46054		PV	CA press, engine inlet	PT601	0.00	6.00	bar	-	0.01	0 - 600	-
46055	0	SF	SF, CA press, engine inlet	PT601	0	1	-	-	-	0/1	TCP-only
46055	2	ALM HIGH	ALM, High CA press, engine inlet	PT601	0	1	-	> 3.70	-	0/1	-
46055	15	SF LR	LR SF, CA press, engine inlet	PT601	0	1	-	-	-	0/1	-
46056	1	LR HIGH	LR, High CA press, engine inlet	PT601	0	1	-	> 3.85	-	0/1	-
46057		PV	CA temp, engine inlet	TE601	0.0	160.0	C	-	0.1	0 - 1600	-
46058	0	SF	SF, CA temp, engine inlet	TE601	0	1	-	-	-	0/1	TCP-only
46058	1	ALM LOW	ALM, Low CA temp, engine inlet	TE601	0	1	-	< 25.0	-	0/1	-
46058	2	ALM HIGH	ALM, High CA temp, engine inlet	TE601	0	1	-	> 70.0	-	0/1	-
46059	1	LR HIGH	LR, High CA temp, engine inlet	TE601	0	1	-	> 75.0	-	0/1	-
46132		PV	Air WG control	CV656	0	100	%	-	1	0 - 100	-
46133	0	SF	SF, Air WG control	CV656	0	1	-	-	-	0/1	TCP-only
Modbus/TCP		**Direction: Output**									
Address	**Bit**	**Function**	**Description**	**ISO code**	**Range, min**	**Range, max**	**Unit**	**Set Point data**	**Scale**	**Bus data**	**Remark**
47001	1	ALM	ALM, OMD failure	NS700	0	1	-	= 1	-	0/1	-
47001	3	ALM	ALM, OMD alarm	QS700	0	1	-	= 1	-	0/1	-
47001	8	LR	LR, OMD alarm	QS700	0	1	-	= 1	-	0/1	-
47001	9	SHD **9)**	SHD, OMD shutdown	QS701	0	1	-	= 1	-	0/1	-
47001	12	ALM	ALM, OMD shutdown	QS701	0	1	-	= 1	-	0/1	-
47001	13	STATUS **2)**	Local control indication	IB724	0	1	-	-	-	0/1	-
47001	15	STATUS **2)**	Waiting for reset	IB725	0	1	-	-	-	0/1	-
47002	0	STATUS **2)**	Remote control indication	IB726	0	1	-	-	-	0/1	-
47003	4	EMG	E-EMG, Engine external shutdown 4 status	IS7305	0	1	-	= 1	-	0/1	-
47003	10	SHD **9)**	SHD, Ext Sd2 from Switchboard shutdown	IS7310	0	1	-	= 1	-	0/1	-
47003	13	STB	SBL, Ext Sb1 from switchboard	OS7312	0	1	-	= 1	-	0/1	-
47004	0	STATUS **2)**	Load reduction request/indication	OS7315	0	1	-	-	-	0/1	-
47004	3	STATUS **2)**	Blackout start mode	OS7320	0	1	-	-	-	0/1	-
47005	2	STATUS **2)**	Engine blow	OS7343	0	1	-	-	-	0/1	-
47005	4	STATUS	Generator cooling water leakage 1	LS7506	0	1	-	-	-	0/1	-
47005	5	ALM	ALM, Generator cooling water leakage 1	LS7506	0	1	-	= 1	-	0/1	-
47006	6	STB	STB, High Turning gear engaged	GS792	0	1	-	= 1	-	0/1	-
47007	6	ALM HIGH	ALM, High Turning gear engaged	GS792	0	1	-	= 1	-	0/1	-
47007	10	ALM	ALM, PDM system supply earth fault	NS7799_1	0	1	-	= 1	-	0/1	-
47007	12	ALM	ALM, PDM system supply failure	NS7800_1	0	1	-	= 1	-	0/1	-
47007	15	ALM HIGH	ALM, High ESM failure	NS718	0	1	-	= 1	-	0/1	-
47008	3	STB	SBL, Engine blocked	OS7344	0	1	-	= 1	-	0/1	-
47008	4	ALM	ALM, System control supply failure	NB7801	0	1	-	= 1	-	0/1	-
47009	14	ALM	ALM, Ext Sd2 from Switchboard shutdown	IS7310	0	1	-	= 1	-	0/1	-
47010	9	STATUS	Generator oil filter clogging, DE	IS7523	0	1	-	-	-	0/1	-
47010	10	ALM	ALM, Generator oil filter clogging, DE	IS7523	0	1	-	= 1	-	0/1	-

47010	11	STATUS	Generator oil filter clogging, NDE	IS7524	0	1	-	-	-	0/1	-
47010	12	ALM	ALM, Generator oil filter clogging, NDE	IS7524	0	1	-	= 1	-	0/1	-
47011	0	STATUS 2)	Stop / shutdown status 1	IS7602	0	1	-	-	-	0/1	-
47054		PV	Main bearing 00 temp	TE700	0.0	160.0	C	-	0.1	0 - 1600	-
47055	0	SF	SF, Main bearing 00 temp	TE700	0	1	-	-	-	0/1	TCP-only
47055	2	ALM HIGH	ALM, High Main bearing 00 temp	TE700	0	1	-	> 110.0	-	0/1	-
47055	5	SHD HIGH	SHD, High Main bearing 00 temp	TE700	0	1	-	> 130.0	-	0/1	-
47056	1	LR HIGH	LR, High Main bearing 00 temp	TE700	0	1	-	> 120.0	-	0/1	-
47078		PV	Main bearing 01 temp	TE701	0.0	160.0	C	-	0.1	0 - 1600	-
47079	0	SF	SF, Main bearing 01 temp	TE701	0	1	-	-	-	0/1	TCP-only
47079	2	ALM HIGH	ALM, High Main bearing 01 temp	TE701	0	1	-	> 110.0	-	0/1	-
47079	5	SHD HIGH	SHD, High Main bearing 01 temp	TE701	0	1	-	> 130.0	-	0/1	-
47080	1	LR HIGH	LR, High Main bearing 01 temp	TE701	0	1	-	> 120.0	-	0/1	-
47099		PV	Main bearing 02 temp	TE702	0.0	160.0	C	-	0.1	0 - 1600	-
47100	0	SF	SF, Main bearing 02 temp	TE702	0	1	-	-	-	0/1	TCP-only
47100	2	ALM HIGH	ALM, High Main bearing 02 temp	TE702	0	1	-	> 110.0	-	0/1	-
47100	5	SHD HIGH	SHD, High Main bearing 02 temp	TE702	0	1	-	> 130.0	-	0/1	-
47101	1	LR HIGH	LR, High Main bearing 02 temp	TE702	0	1	-	> 120.0	-	0/1	-
47120		PV	Main bearing 03 temp	TE703	0.0	160.0	C	-	0.1	0 - 1600	-
47121	0	SF	SF, Main bearing 03 temp	TE703	0	1	-	-	-	0/1	TCP-only
47121	2	ALM HIGH	ALM, High Main bearing 03 temp	TE703	0	1	-	> 110.0	-	0/1	-
47121	5	SHD HIGH	SHD, High Main bearing 03 temp	TE703	0	1	-	> 130.0	-	0/1	-
47122	1	LR HIGH	LR, High Main bearing 03 temp	TE703	0	1	-	> 120.0	-	0/1	-
47141		PV	Main bearing 04 temp	TE704	0.0	160.0	C	-	0.1	0 - 1600	-
47142	0	SF	SF, Main bearing 04 temp	TE704	0	1	-	-	-	0/1	TCP-only
47142	2	ALM HIGH	ALM, High Main bearing 04 temp	TE704	0	1	-	> 110.0	-	0/1	-
47142	5	SHD HIGH	SHD, High Main bearing 04 temp	TE704	0	1	-	> 130.0	-	0/1	-
47143	1	LR HIGH	LR, High Main bearing 04 temp	TE704	0	1	-	> 120.0	-	0/1	-
47162		PV	Main bearing 05 temp	TE705	0.0	160.0	C	-	0.1	0 - 1600	-
47163	0	SF	SF, Main bearing 05 temp	TE705	0	1	-	-	-	0/1	TCP-only
47163	2	ALM HIGH	ALM, High Main bearing 05 temp	TE705	0	1	-	> 110.0	-	0/1	-
47163	5	SHD HIGH	SHD, High Main bearing 05 temp	TE705	0	1	-	> 130.0	-	0/1	-
47164	1	LR HIGH	LR, High Main bearing 05 temp	TE705	0	1	-	> 120.0	-	0/1	-
47183		PV	Main bearing 06 temp	TE706	0.0	160.0	C	-	0.1	0 - 1600	-
47184	0	SF	SF, Main bearing 06 temp	TE706	0	1	-	-	-	0/1	TCP-only
47184	2	ALM HIGH	ALM, High Main bearing 06 temp	TE706	0	1	-	> 110.0	-	0/1	-
47184	5	SHD HIGH	SHD, High Main bearing 06 temp	TE706	0	1	-	> 130.0	-	0/1	-
47185	1	LR HIGH	LR, High Main bearing 06 temp	TE706	0	1	-	> 120.0	-	0/1	-
47204		PV	Main bearing 07 temp	TE707	0.0	160.0	C	-	0.1	0 - 1600	-
47205	0	SF	SF, Main bearing 07 temp	TE707	0	1	-	-	-	0/1	TCP-only
47205	2	ALM HIGH	ALM, High Main bearing 07 temp	TE707	0	1	-	> 110.0	-	0/1	-
47205	5	SHD HIGH	SHD, High Main bearing 07 temp	TE707	0	1	-	> 130.0	-	0/1	-
47206	1	LR HIGH	LR, High Main bearing 07 temp	TE707	0	1	-	> 120.0	-	0/1	-
47225		PV	Main bearing 08 temp	TE708	0.0	160.0	C	-	0.1	0 - 1600	-
47226	0	SF	SF, Main bearing 08 temp	TE708	0	1	-	-	-	0/1	TCP-only
47226	2	ALM HIGH	ALM, High Main bearing 08 temp	TE708	0	1	-	> 110.0	-	0/1	-
47226	5	SHD HIGH	SHD, High Main bearing 08 temp	TE708	0	1	-	> 130.0	-	0/1	-
47227	1	LR HIGH	LR, High Main bearing 08 temp	TE708	0	1	-	> 120.0	-	0/1	-
47246		PV	Main bearing 09 temp	TE709	0.0	160.0	C	-	0.1	0 - 1600	-
47247	0	SF	SF, Main bearing 09 temp	TE709	0	1	-	-	-	0/1	TCP-only
47247	2	ALM HIGH	ALM, High Main bearing 09 temp	TE709	0	1	-	> 110.0	-	0/1	-
47247	5	SHD HIGH	SHD, High Main bearing 09 temp	TE709	0	1	-	> 130.0	-	0/1	-
47248	1	LR HIGH	LR, High Main bearing 09 temp	TE709	0	1	-	> 120.0	-	0/1	-

Modbus/TCP		Direction: Output									
Address	**Bit**	**Function**	**Description**	**ISO code**	**Range, min**	**Range, max**	**Unit**	**Set Point data**	**Scale**	**Bus data**	**Remark**
48003	13	STATUS 2)	Engine status, start mode	IS871	0	1	-	-	-	0/1	-
48003	14	STATUS 2)	Engine ready for start	IS872	0	1	-	-	-	0/1	-
48003	15	STATUS 2)	Start failure indication	IS875	0	1	-	-	-	0/1	-
48004	0	STATUS 2)	Engine status, stop mode	IS878	0	1	-	-	-	0/1	-
48004	1	STATUS 2)	Engine status, shutdown mode	IS879	0	1	-	-	-	0/1	-
48004	2	STATUS 2)	Engine start block active	IS880	0	1	-	-	-	0/1	-
48004	5	STATUS 2)	Engine status, run mode	IS883	0	1	-	-	-	0/1	-
48004	11	STATUS 2)	Engine status, emergency stop mode	IS889	0	1	-	-	-	0/1	-

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48007	2	ALM	ALM, WIP failure	NS869	0	1	-	= 1	-	0/1	-
48008	15	ALM	ALM, CAN failure in system	NS8100	0	1	-	= 1	-	0/1	-
48049	2	ALM	ALM, Control system high temperature	NS803	0	1	-	= 1	-	0/1	-
48052	2	ALM HIGH	ALM, High Internal temp MCM 1	TE802-1	0	1	-	> 85.0	-	0/1	-
48094	2	ALM HIGH	ALM, High Internal temp IOM A1	TE804-1	0	1	-	> 85.0	-	0/1	-
48121	2	ALM HIGH	ALM, High Internal temp IOM DE	TE804-9	0	1	-	> 85.0	-	0/1	-
48124	2	ALM HIGH	ALM, High Internal temp IOM FE	TE804-10	0	1	-	> 85.0	-	0/1	-
48105		PV	Modbus counter	KY870	1	1000	-	-	1	1 - 1000	-

Notes:
1) High temperature alarm if TE101 > 50°C used on engines not operating at all on HFO. Otherwise, TE101 dependent set points, low and high temperature alarms to be generated in external alarm system.
2) Status information, not to be treated as an alarm.
3) PT291A/B ALM activated if PT291A/B < 0.8 bar and CV381 = ON.
4) PT291A/B LR activated if PT291A/B > 0.8 bar and CV381 = OFF. Delay 10s when VIC setpoint changes, 1s during steady state operation.
5) Variable set point: 2 bar at nominal speed, 1 bar at 50% speed and at all RPMs below 50% speed. Linear between speeds 50% to 100%. Assumed static pressure 1 bar.
6) Variable set point: 1.6 bar at nominal speed, 0.8 bar at 50% speed and at all RPMs below 50% speed. Linear between speeds 50% to 100%. Assumed static pressure 1 bar.
7) TY50*7A=((sum TE50*1A/cyl)-TE50*1A). For alarm limits see also Chart 1.
8) Activated if STY196 > 300 rpm and WY196_2 > 1.05 deg.
9) Shutdown mode becomes active when IS7602 also becomes active (additional Shutdown prewarning delay configured in ESM).
10) Variable set point: 2.7 bar at engine speed 450-600 rpm, 3.0 bar at engine speed 601-1000 rpm
11) Immediate LR (0.1s delay) if SE518 > LR SP; delayed LR (300s delay) if ALM SP < SE518 < LR SP

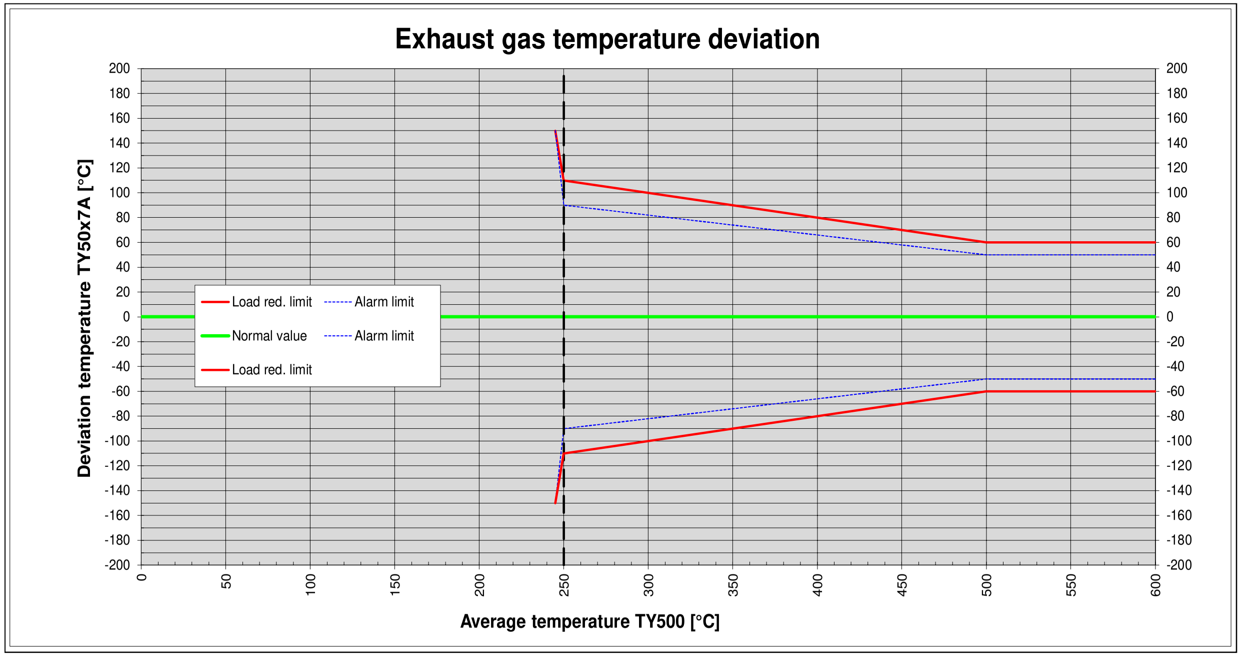

Chart 1

Modbus communication link
Communication speed: 19200 bits/s
Communication mode: RTU
Data bits: 8
Parity: NONE
Stop bits: 1
Commands in use: 02 (Input status), 03 (Holding register)
Polling delay: 200 ms (recommended)
Physical interface: RS-485 2-wire

Title	Explanation
Code	Sensor code
Name	Signal name
BL	Alarm is blocked in stop mode
Type	Signal type
Range / Unit	Signal range and unit
Set point - Alarm	Set point for alarm condition
Set point - L.red.	Set point for load reduction request condition
Set point - Stop	Set point for stop / shutdown condition
Alarm cond.	Condition for alarm / stop / load reduction activation
Modbus addresses – Anal.	On analog addresses (40xxx) integer value multiplied by Scale is shown
Modbus addresses - Alarm	On alarm addresses (10xxx) 0 = normal and 1 = alarm ON
Modbus addresses - L.red.	On load reduction addresses (12xxx) 0 = normal and 1 = load reduction request ON
Modbus addresses - Stop	On stop addresses (11xxx) 0 = normal and 1= stop ON
Scale	Division factor
Error values	-32767 = value not update (not configured) and -32765 = sensor failure

Rev.	Date	Made	Checked	
b	14.11.2019	GGIX02	MLA026	Added water break signals ,Updated WY196_2 ALM, Removed TE402-2 and added TEZ402-1, Removed IS7310 and added IS7311, Removed OS7312
a	23.7.2019	MLA026	MLA026	Removed Alternator signals.
-	13.3.2019	MLA026	MLA026	First release, copy of DBAE942348 rev.-

MODBUS SLAVE ID	ENGINE NUMBER
1	XAAB390984

WÄRTSILÄ — Wärtsilä Italia

MODBUS SERIAL LIST FOR W8L26 F UNIC C2
CCG College

Proj.no	Product	Made: Massimo Lazari	D-message	Date	Alias	Pages	Document No	Rev.
SP/04235	W26 L-ENGINE UNIC C2	Approved: Massimo Lazari		13.3.2019	MLA026	5	DMCA00004817	B

CCG college

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		B	Type	Range /	Set point						Alarm	Modbus Addresses				
Code	Name	L		Unit	Alarm	Delay (s)	L.red.	Delay (s)	Stop	Delay (s)	cond	Anal.	Alarm	L.red.	Stop	Scale
Fuel oil																
PT101	Fuel oil pressure, inlet	X	4-20 mA	0 - 16 bar	< 5.5	3					low	40001	10001			100
TE101	Fuel oil temp., inlet		Pt100	0 - 160 °C	**1)**	5						40002	10002			10
LS103A	Fuel oil leakage, injection pipes		NC-switch	0/1	1	5					open		10003			1
PDS113	FO filter press diff sw		NC-switch	0/1	> 1.5 bar	5					open		10005			1
Lub. oil																
PT201	Lub. oil pressure, inlet	X	4-20 mA	0 - 10 bar	VSP **10)**	5	< 2.5	5			low	40006	10006	12006		100
TE201	Lub. oil temp., inlet		Pt100	0 - 160 °C	> 75	5	> 80	5	> 85	5	high	40007	10007	12007	11007	10
LS204	Lub. oil level, wet sump		NC-switch	0/1	1	20					closed		10008			1
PT241	Lub. oil pressure, filter inlet		4-20 mA	0 - 10 bar								40014				100
PDY243	Lub. oil filter differential pressure		calculated	0 - 2 bar	> 1	5					high	40009	10009			100
PT271	Lub. oil pressure at turbocharger	X	4-20 mA	0 - 10 bar	< 1.30	10					low	40010	10010			100
PT291A	Ctrl oil press aft VIC valve		4-20 mA	0 - 10 bar	**3)**	5	**4)**	1 - 10					10025	12025		100
TE272	Lub. oil temp. at turbo charger outlet		Pt100	0 - 160 °C	> 120	10					high	40011	10011			10
Starting air																
PT301	Starting air pressure		4-20 mA	0 - 16 bar	< 7	15					low	40016	10016			100
PT311	Control air pressure		4-20 mA	0 - 40 bar	< 16	5					low	40017	10017			100
Cooling water																
PT401	HT-water pressure, jacket inlet	X	4-20 mA	0 - 6 bar	VSP **5)**	5	VSP **6)**	5			low	40019	10019	12019		100
TE401	HT-water temp, jacket inlet	X	Pt100	0 - 160 °C	< 60	5					low	40020	10020			10
TE402	HT-water temp, jacket outlet	X	Pt100	0 - 160 °C	> 105	5					high	40021	10021			10
TEZ402-1	HT water temp, jacket outlet A-bank	X	Pt100	0 - 160 °C			> 108	5			high			12022		10
PT471	LT-water pressure, inlet	X	4-20 mA	0 - 6 bar	VSP **5)**	5					low	40023	10023			100
TE471	LT-water temp, inlet	X	Pt100	0 - 160 °C	> 50	30					high	40024	10024			10
TE472	LT water temp, LT CAC outlet		Pt100	0 - 160 °C								40026				10
CV493	LT cooling water thermostat control		4-20 mA	0 - 100%								40018				10
GT493	LT cooling water thermostat position		4-20 mA	0 - 100%								40027				10
Exhaust gas																
TE511	Exhaust gas temp. TC inlet 1		NiCr/Ni	0 - 750 °C	> 590	10	> 640	20			high	40028	10028	12028		10
TE517	Exhaust gas temp. TC outlet		NiCr/Ni	0 - 750 °C	> 490	30					high	40029	10029			10
TE5011A	Exhaust gas temp. cylinder 1		NiCr/Ni	0 - 750 °C	> 580	10	> 595	10			high	40030	10030	12030		10
TE5021A	Exhaust gas temp. cylinder 2		NiCr/Ni	0 - 750 °C	> 580	10	> 595	10			high	40031	10031	12031		10
TE5031A	Exhaust gas temp. cylinder 3		NiCr/Ni	0 - 750 °C	> 580	10	> 595	10			high	40032	10032	12032		10
TE5041A	Exhaust gas temp. cylinder 4		NiCr/Ni	0 - 750 °C	> 580	10	> 595	10			high	40033	10033	12033		10
TE5051A	Exhaust gas temp. cylinder 5		NiCr/Ni	0 - 750 °C	> 580	10	> 595	10			high	40034	10034	12034		10
TE5061A	Exhaust gas temp. cylinder 6		NiCr/Ni	0 - 750 °C	> 580	10	> 595	10			high	40035	10035	12035		10
TE5071A	Exhaust gas temp. cylinder 7		NiCr/Ni	0 - 750 °C	> 580	10	> 595	10			high	40036	10036	12036		10
TE5081A	Exhaust gas temp. cylinder 8		NiCr/Ni	0 - 750 °C	> 580	10	> 595	10			high	40037	10037	12037		10
TY500	Exhaust gas temperature average		calculated	0 - 750 °C								40039				10
TY5017A **7)**	Exhaust gas temp. deviation 01A	X	calculated	-200 - 200 °C	±90/±50	10	±110/±60	20			high	40040	10040	12040		10
TY5027A **7)**	Exhaust gas temp. deviation 02A	X	calculated	-200 - 200 °C	±90/±50	10	±110/±60	20			high	40041	10041	12041		10
TY5037A **7)**	Exhaust gas temp. deviation 03A	X	calculated	-200 - 200 °C	±90/±50	10	±110/±60	20			high	40042	10042	12042		10
TY5047A **7)**	Exhaust gas temp. deviation 04A	X	calculated	-200 - 200 °C	±90/±50	10	±110/±60	20			high	40043	10043	12043		10
TY5057A **7)**	Exhaust gas temp. deviation 05A	X	calculated	-200 - 200 °C	±90/±50	10	±110/±60	20			high	40044	10044	12044		10
TY5067A **7)**	Exhaust gas temp. deviation 06A	X	calculated	-200 - 200 °C	±90/±50	10	±110/±60	20			high	40045	10045	12045		10

CCG college

		B	Type	Range /	Set point						Alarm	Modbus Addresses				
Code	Name	L		Unit	Alarm	Delay (s)	L.red.	Delay (s)	Stop	Delay (s)	cond	Anal.	Alarm	L.red.	Stop	Scale
TY5077A **7)**	Exhaust gas temp. deviation 07A	X	calculated	-200 - 200 °C	±90/±50	10	±110/±60	20			high	40046	10046	12046		10
TY5087A **7)**	Exhaust gas temp. deviation 08A	X	calculated	-200 - 200 °C	±90/±50	10	±110/±60	20			high	40047	10047	12047		10
Charge air																
PT601	Charge air pressure, inlet, sensor failure load reduction		calculated	0/1			= 1	1			active			12049		1
PT601	Charge air pressure, inlet		4-20 mA	0 - 6 bar	> 3.7	5	> 3.85	5			high	40050	10050	12050		100
TE601	Charge air temperature, inlet	X	Pt100	0 - 160 °C	> 70	5	> 75	5			high	40051	10051	12051		10
TE601	Charge air temperature, inlet	X	Pt100	0 - 160 °C	< 25	5					low		10052			1
TE600	Air temp, TC inlet		Pt100	-50 - 100 °C	> 45	5					high	40054	10054			10
Crankcase																
TE700	Main bearing temp. 0		NiCr/Ni	0 - 160 °C	> 110	5	> 120	1	> 130	1	high	40057	10057	12057	11057	10
TE701	Main bearing temp. 1		NiCr/Ni	0 - 160 °C	> 110	5	> 120	1	> 130	1	high	40058	10058	12058	11058	10
TE702	Main bearing temp. 2		NiCr/Ni	0 - 160 °C	> 110	5	> 120	1	> 130	1	high	40059	10059	12059	11059	10
TE703	Main bearing temp. 3		NiCr/Ni	0 - 160 °C	> 110	5	> 120	1	> 130	1	high	40060	10060	12060	11060	10
TE704	Main bearing temp. 4		NiCr/Ni	0 - 160 °C	> 110	5	> 120	1	> 130	1	high	40061	10061	12061	11061	10
TE705	Main bearing temp. 5		NiCr/Ni	0 - 160 °C	> 110	5	> 120	1	> 130	1	high	40062	10062	12062	11062	10
TE706	Main bearing temp. 6		NiCr/Ni	0 - 160 °C	> 110	5	> 120	1	> 130	1	high	40063	10063	12063	11063	10
TE707	Main bearing temp. 7		NiCr/Ni	0 - 160 °C	> 110	5	> 120	1	> 130	1	high	40064	10064	12064	11064	10
TE708	Main bearing temp. 8		NiCr/Ni	0 - 160 °C	> 110	5	> 120	1	> 130	1	high	40065	10065	12065	11065	10
TE709	Main bearing temp. 9		NiCr/Ni	0 - 160 °C	> 110	5	> 120	1	> 130	1	high	40066	10066	12066	11066	10
NS700	Oil mist detector failure		NO-switch	0/1	1	3					high		10069			1
QS700	Oil mist detector alarm & load reduction	X	NO-switch	0/1	1	1	1	5			high		10070	12070		1
Miscellaneous																
NS8100	CAN failure in system		calculated	0/1	1	3					high		10164			1
NS803	Control system high temperature		calculated	0/1	1	0					high		10165			1
GS792	Turning gear engaged	X	NC-switch	0/1	1	0,1							10072			1
GS171	Stop lever in stop position	X	NO-switch	0/1					1	0,1	closed				11073	1
GT165_2	Fuel rack position		4-20 mA	0 - 40 mm								40074				1
SE518	Turbo charger speed		Mg 0-1000Hz	0 - 50000 rpm	> 32551	5	> 32880	VSP **11)**			high	40075	10075	12075		0,1
KY870	Modbus counter		calculated	1 - 1000								40076				1
STY196	Engine speed		calculated	0 - 1200 rpm								40077				1
ST196P	Engine speed sensor failure primary	X	calculated	0/1	1	3							10078			1
ST196S	Engine speed sensor failure secondary	X	calculated	0/1	1	3							10079			1
WY196_2	Torsional vibration level, peak	X	calculated	0 - 2 deg	**8)**	10					high	40080	10080			100
GTY1624	Engine load, relative BMEP		calculated	0 - 120 %	> 102	10	> 111	10			high	40219	10219	12219		10
UT793	Engine load feedback	X	4-20 mA	-330 - 2860kW								40220				1
Engine status																
IS871	Engine status, start mode		SW-function	0/1	1						active		10100			1
IS872 **2)**	Engine ready for start		SW-function	0/1	1						active		10081			1
IS880 **2)**	Engine start block active		SW-function	0/1	1						active		10082			1
IB724 **2)**	Local control mode		switch	0/1	1						active		10083			1
IB725 **2)**	Waiting for reset		SW-function	0/1	1						active		10101			1
IB726 **2)**	Remote control indication		SW-function	0/1	1						active		10102			1
IS875	Start failure		SW-function	0/1	1						active		10084			1

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Page 3 (5)

Code	Name	B L	Type	Range / Unit	Set point Alarm	Delay (s)	L.red.	Delay (s)	Stop	Delay (s)	Alarm cond	Modbus Addresses Anal.	Alarm	L.red.	Stop	Scale
IS878 **2)**	Engine status, stop mode		SW-function	0/1	1						active		10103			1
IS879	Engine status, shutdown mode		SW-function	0/1	1						active		10104			1
IS883	Engine status, run mode		SW-function	0/1	1						active		10105			1
IS889	Engine status, emergency stop mode		SW-function	0/1	1						active		10106			1
OS7315 **2)**	Load reduction request		SW-function	0/1	1						active		10085			1
IS7602 **2)**	Stop/shutdown		switch	0/1	1						active		10086			1
OS7320 **2)**	Blackout start mode		switch	0/1	1						active		10088			1
OS7343 **2)**	Engine blow		switch	0/1	1						active		10089			1
Status of start blockings 2)																
OS223/PT201	Engine not pre-lubricated		switch	0/1	< 0.5 bar	0					active		10090			1
GS792	Turning gear engaged		switch	0/1	1	0					active		10091			1
GS171	Stop lever in stop position		switch	0/1	1	0					active		10092			1
OS7344	Local selector in blocked position		switch	0/1	1	0					active		10093			1
IS7311	Ext Sd3 from Waterbrake SBL		switch	0/1	1	0					active		10099			1
Status of shutdowns																
STY196	Engine speed sensor failure emergency		switch	0/1					1	0,1	active				11109	1
IS4011 **9)**	HT temp shutdown status from ESM (TEZ402)		switch	0/1	1	0,1			> 110 °C	0,1	active		10110		11110	1
IS1741	Overspeed shutdown status from ESM		switch	0/1					> 115 %	0,1	active				11111	1
IS2011 **9)**	Lube oil press shutdown status from ESM (PTZ201)		switch	0/1	1	0,1			< 2 bar	0,1	active		10112		11112	1
QS701 **9)**	OMD shutdown		switch	0/1	1	0,1			1	0,1	active		10113		11113	1
IS7311 **9)**	Ext Sd3 from Waterbrake		switch	0/1	1	0			1	0	active		10118		11118	1
IS7305	Emergency stop from ESM		switch	0/1					1	0,1	closed				11119	1
Automation system																
TE802-1	Temperature in, MCM-1		Pt100	0 - 160 °C	> 85	5					high		10121			1
TE804-9	Temperature in,IOM-DE		Pt100	0 - 160 °C	> 85	5					high		10123			1
TE804-10	Temperature in, IOM-FE		Pt100	0 - 160 °C	> 85	5					high		10124			1
TE804-1	Temperature in, IOM-A1		Pt100	0 - 160 °C	> 85	5					high		10126			1
Extra codes																
EC_General_05	B11 water break - Fixed bearing temp.		Pt100	0 - 160 °C	> 55	5			> 60	1	high	40145	10145		11145	10
EC_General_06	B13 water break - Loose bearing temp.		Pt100	0 - 160 °C	> 55	5			> 60	1	high	40146	10146		11146	10
EC_General_07	B15 water break - Water Outlet		Pt100	0 - 160 °C	> 55	5			> 60	1	high	40147	10147		11147	10
EC_General_08	B17 water break - Water Inlet		Pt100	0 - 160 °C	> 30	5					high	40148	10148			10
Others																
CV656	Air WG control		Control valve	0 - 100%								40130				1
NS7799-1	PDM System supply earth fault		SW-function	0/1	1	0,1					active		10138			1
NS718	ESM alarm		SW-function	0/1	1	0,1					active		10139			1
NS7800-1	PDM system supply failure		SW-function	0/1	1	0,1					active		10140			1
NS869	WIP failure		SW-function	0/1	1	3					active		10141			1
NB7801	System control supply failure		SW-function	0/1	1	0,1					active		10166			1

CCG college

		B	Type	Range /	Set point						Alarm	Modbus Addresses				
Code	Name	L		Unit	Alarm	Delay (s)	L.red.	Delay (s)	Stop	Delay (s)	cond	Anal.	Alarm	L.red.	Stop	Scale

Notes:
1) High temperature alarm if TE101 > 50°C used on engines not operating at all on HFO. Otherwise, TE101 dependent set points, low and high temperature alarms to be generated in external alarm system.
2) Status information, not to be treated as an alarm.
3) PT291A/B ALM activated if PT291A/B < 0.8 bar and CV381 = ON.
4) PT291A/B LR activated if PT291A/B > 0.8 bar and CV381 = OFF. Delay 10s when VIC setpoint changes, 1s during steady state operation.
5) Variable set point: 2 bar at nominal speed, 1 bar at 50% speed and at all RPMs below 50% speed. Linear between speeds 50% to 100%. Assumed static pressure 1 bar.
6) Variable set point: 1.6 bar at nominal speed, 0.8 bar at 50% speed and at all RPMs below 50% speed. Linear between speeds 50% to 100%. Assumed static pressure 1 bar.
7) TY50*7A=((sum TE50*1A/cyl)-TE50*1A). For alarm limits see also Chart 1.
8) Activated if STY196 > 300 rpm and WY196_2 > 700mdeg
9) Shutdown mode becomes active when IS7602 also becomes active (additional Shutdown prewarning delay configured in ESM).
10) Variable set point: 2.7 bar at engine speed 450-600 rpm, 3.0 bar at engine speed 601-1000 rpm
11) Immediate LR (0.1s delay) if SE518 > LR SP; delayed LR (300s delay) if ALM SP < SE518 < LR SP

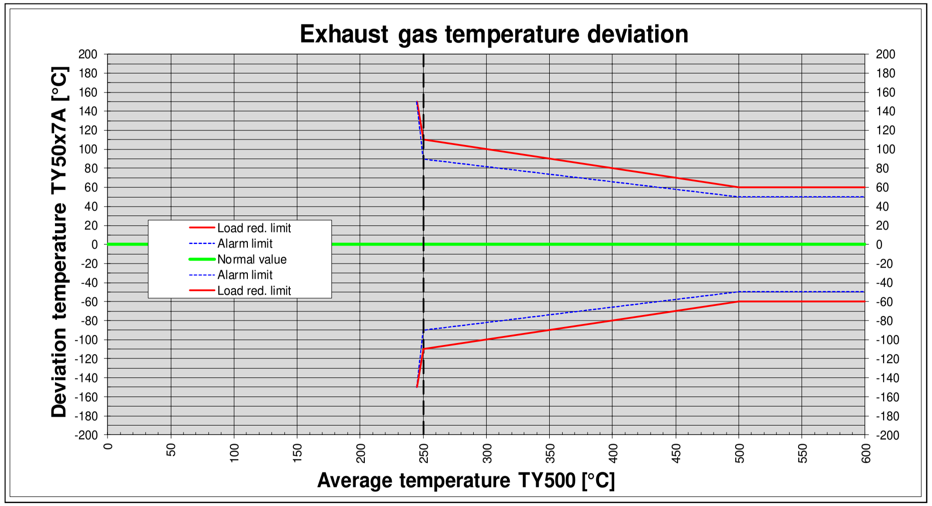

Chart 1

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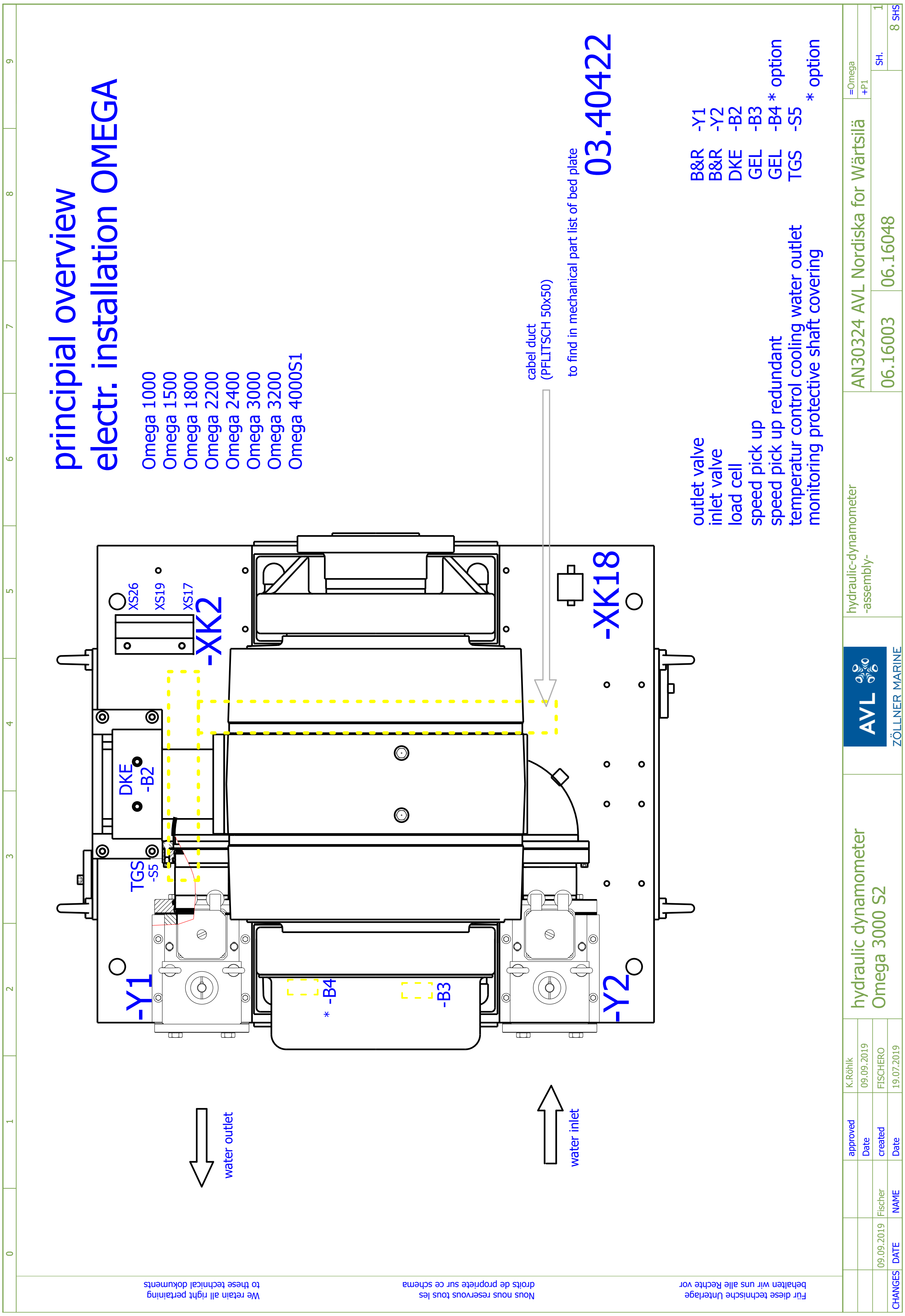
Page 5 (5)


principial overview
electr. installation OMEGA
Omega 1000
Omega 1500
Omega 1800
Omega 2200
Omega 2400
Omega 3000
Omega 3200
Omega 4000S1
cabel duct
(PFLITSCH 50x50)
to find in mechanical part list of bed plate
03.40422
outlet valve B&R -Y1
inlet valve B&R -Y2
load cell DKE -B2
speed pick up GEL -B3
speed pick up redundant GEL -B4 * option
temperatur control cooling water outlet TGS -S5
monitoring protective shaft covering
* option
XS26
XS19
XS17
-XK2
-XK18
DKE
-B2
TGS
-S5
-Y1
-Y2
* -B4
-B3
water outlet
water inlet
AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
=Omega
+P1
SH.
1
8 SHS
hydraulic-dynamometer
-assembly-
AVL
ZÖLLNER MARINE
hydraulic dynamometer
Omega 3000 S2
approved
K.Röhlk
Date
09.09.2019
created
FISCHERO
Date
19.07.2019
09.09.2019
Fischer
CHANGES
DATE
NAME
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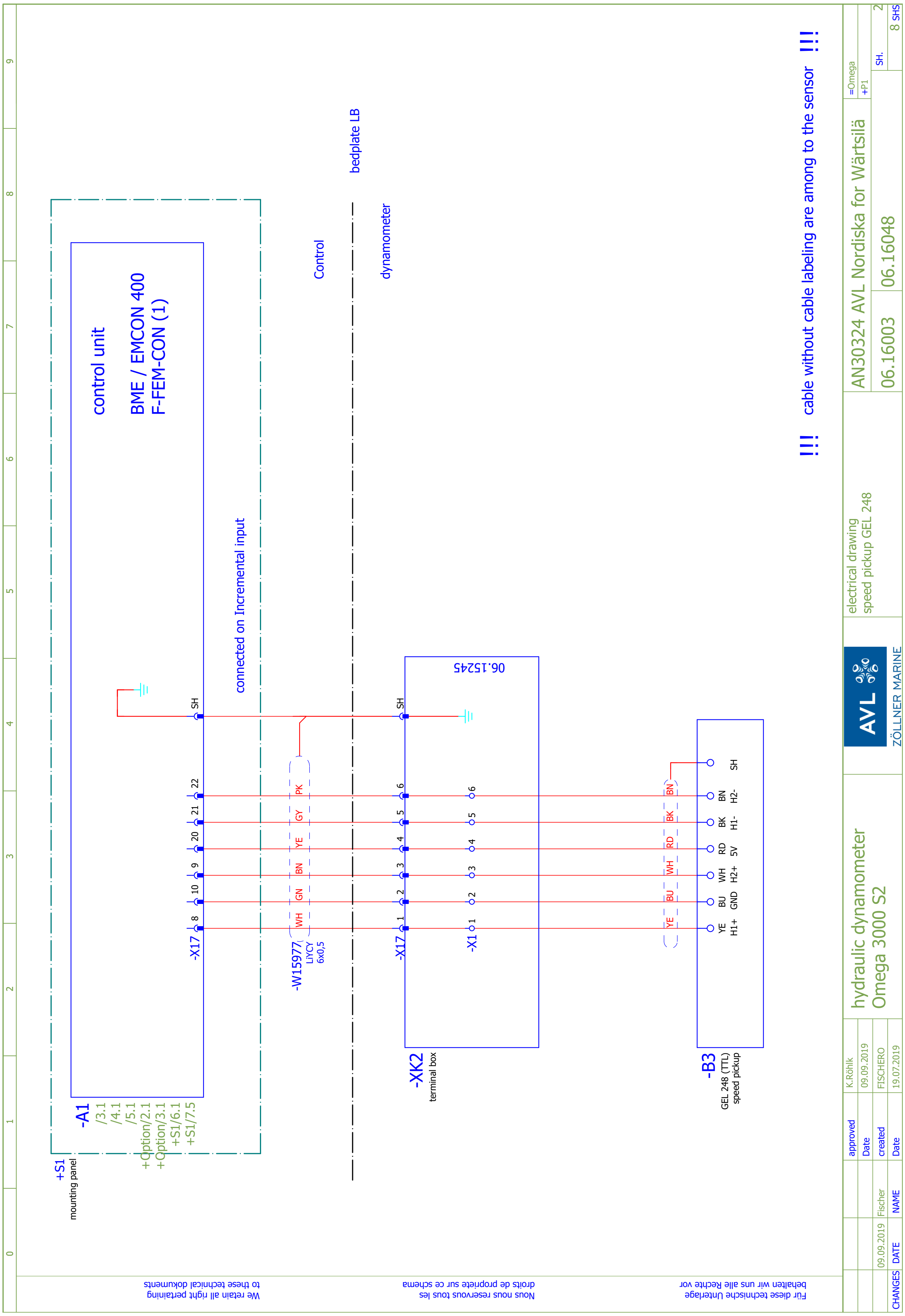
control unit
BME / EMCON 400
F-FEM-CON (1)
-A1
+S1
mounting panel
connected on Incremental input
Control
dynamometer
bedplate LB
-X17
-W15977
LiYCY
6x0,5
-XK2
terminal box
06.15245
-X1
-B3
GEL 248 (TTL)
speed pickup
!!! cable without cable labeling are among to the sensor !!!
hydraulic dynamometer
Omega 3000 S2
electrical drawing
speed pickup GEL 248
AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
AVL
ZÖLLNER MARINE
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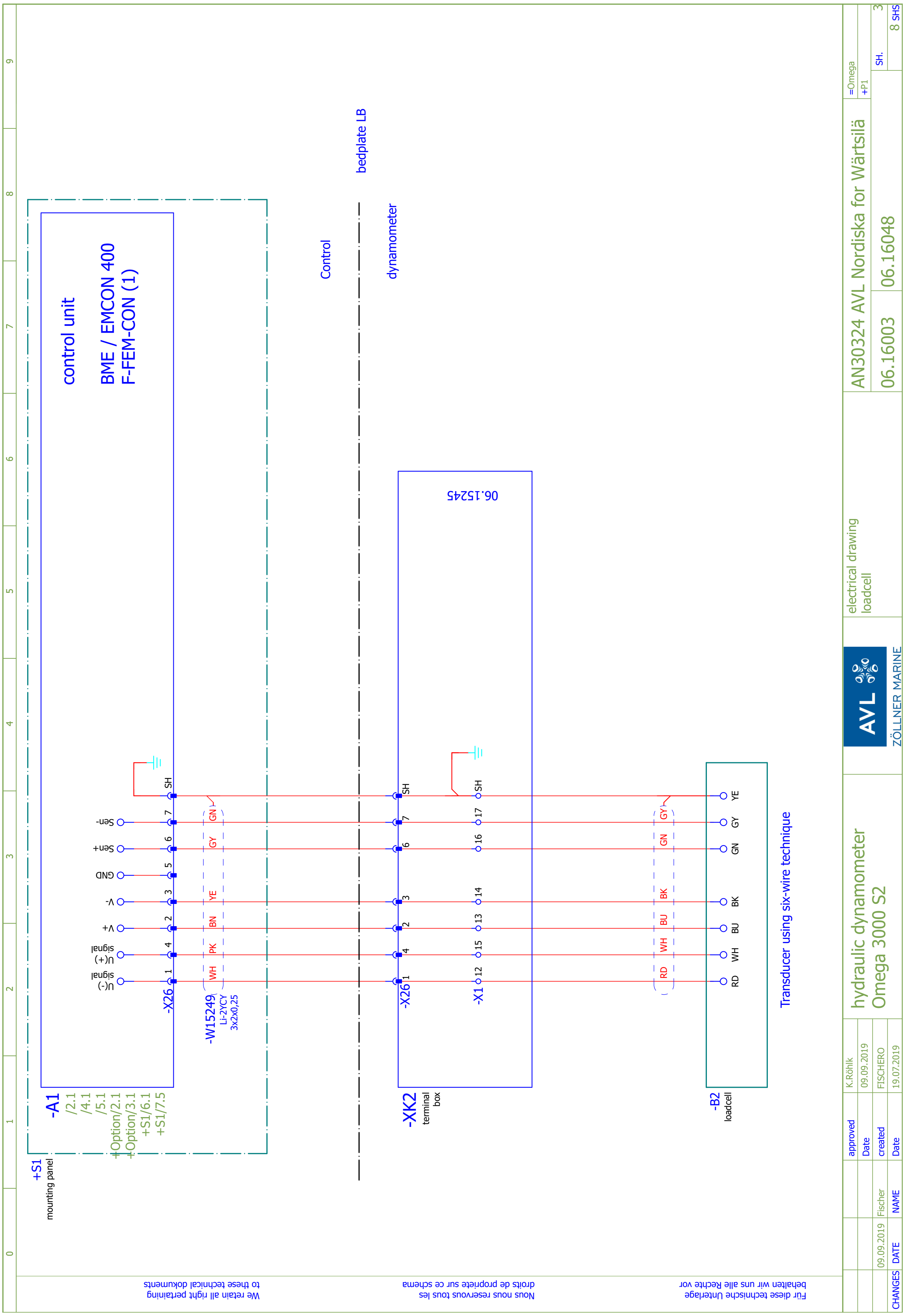
control unit
BME / EMCON 400
F-FEM-CON (1)
-A1
+S1
mounting panel
Control
bedplate LB
dynamometer
06.15245
-XK2
terminal box
-X26
-W15249
Li-2YCY
3x2x0,25
-X1
-B2
loadcell
Transducer using six-wire technique
U(-) signal
U(+) signal
V+
V-
GND
Sen+
Sen-
hydraulic dynamometer
Omega 3000 S2
electrical drawing
loadcell
AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
AVL
ZÖLLNER MARINE
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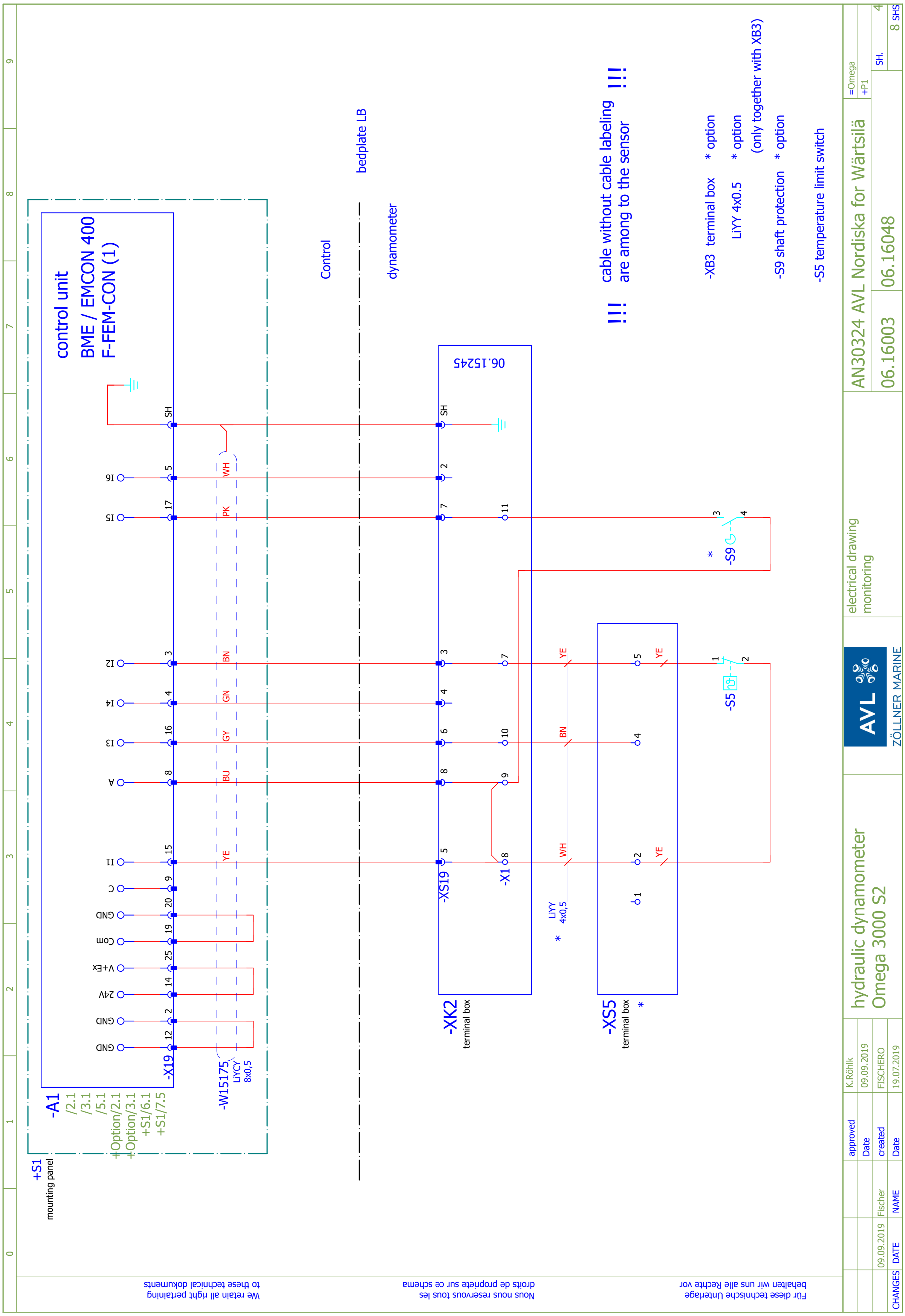
control unit
BME / EMCON 400
F-FEM-CON (1)
-A1
-X19
+S1
mounting panel
-W15175
LiYCY
8x0,5
Control
dynamometer
bedplate LB
06.15245
-XS19
-X1
-XK2
terminal box
-XS5
terminal box
!!! cable without cable labeling are among to the sensor !!!
-XB3 terminal box * option
LiYY 4x0.5 * option
(only together with XB3)
-S9 shaft protection * option
-S5 temperature limit switch
hydraulic dynamometer
Omega 3000 S2
AVL
ZÖLLNER MARINE
electrical drawing
monitoring
AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
=Omega
+P1
SH.
4
8 SHS
approved
K.Röhlik
Date
09.09.2019
created
FISCHERO
Date
19.07.2019
CHANGES
DATE
NAME
09.09.2019
Fischer
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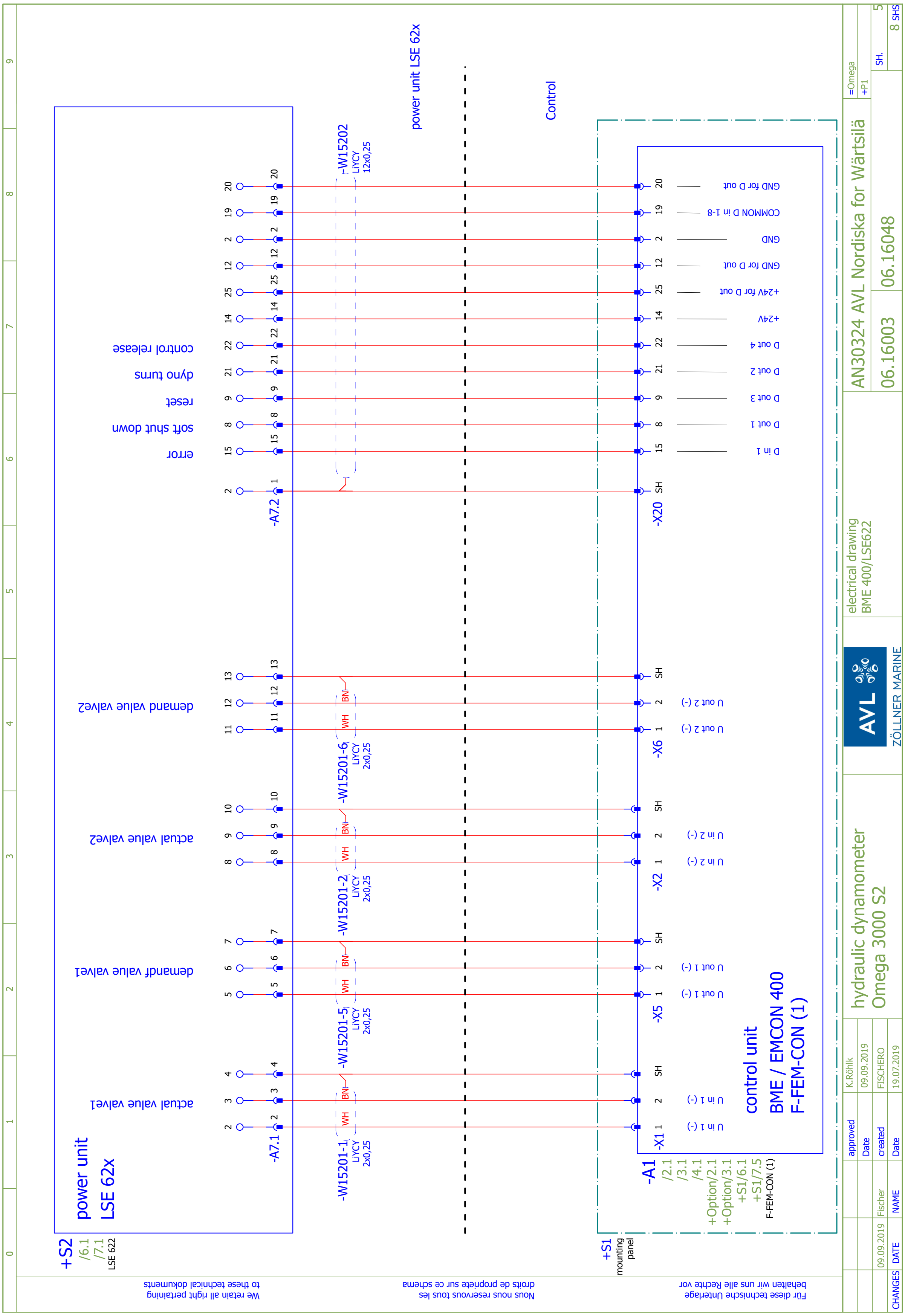
power unit
LSE 62x
+S2
/6.1
/7.1
LSE 622
-A7.1
-A7.2
actual value valve1
demand value valve1
actual value valve2
demand value valve2
error
soft shut down
reset
dyno turns
control release
-W15201-1
-W15201-5
-W15201-2
-W15201-6
-W15202
LIYCY
2x0,25
12x0,25
WH
BN
power unit LSE 62x
Control
-A1
/2.1
/3.1
/4.1
+Option/2.1
+Option/3.1
+S1/6.1
+S1/7.5
F-FEM-CON (1)
+S1
mounting panel
-X1
-X5
-X2
-X6
-X20
U in 1 (-)
U out 1 (-)
U in 2 (-)
U out 2 (-)
D in 1
D out 1
D out 3
D out 2
D out 4
+24V
+24V for D out
GND for D out
GND
COMMON D in 1-8
control unit
BME / EMCON 400
F-FEM-CON (1)
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hydraulic dynamometer
Omega 3000 S2
AVL
ZÖLLNER MARINE
electrical drawing
BME 400/LSE622
AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
=Omega
+P1
SH.
5
8 SHS
approved
K.Röhlk
Date
09.09.2019
created
FISCHERO
19.07.2019
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DATE
NAME
09.09.2019
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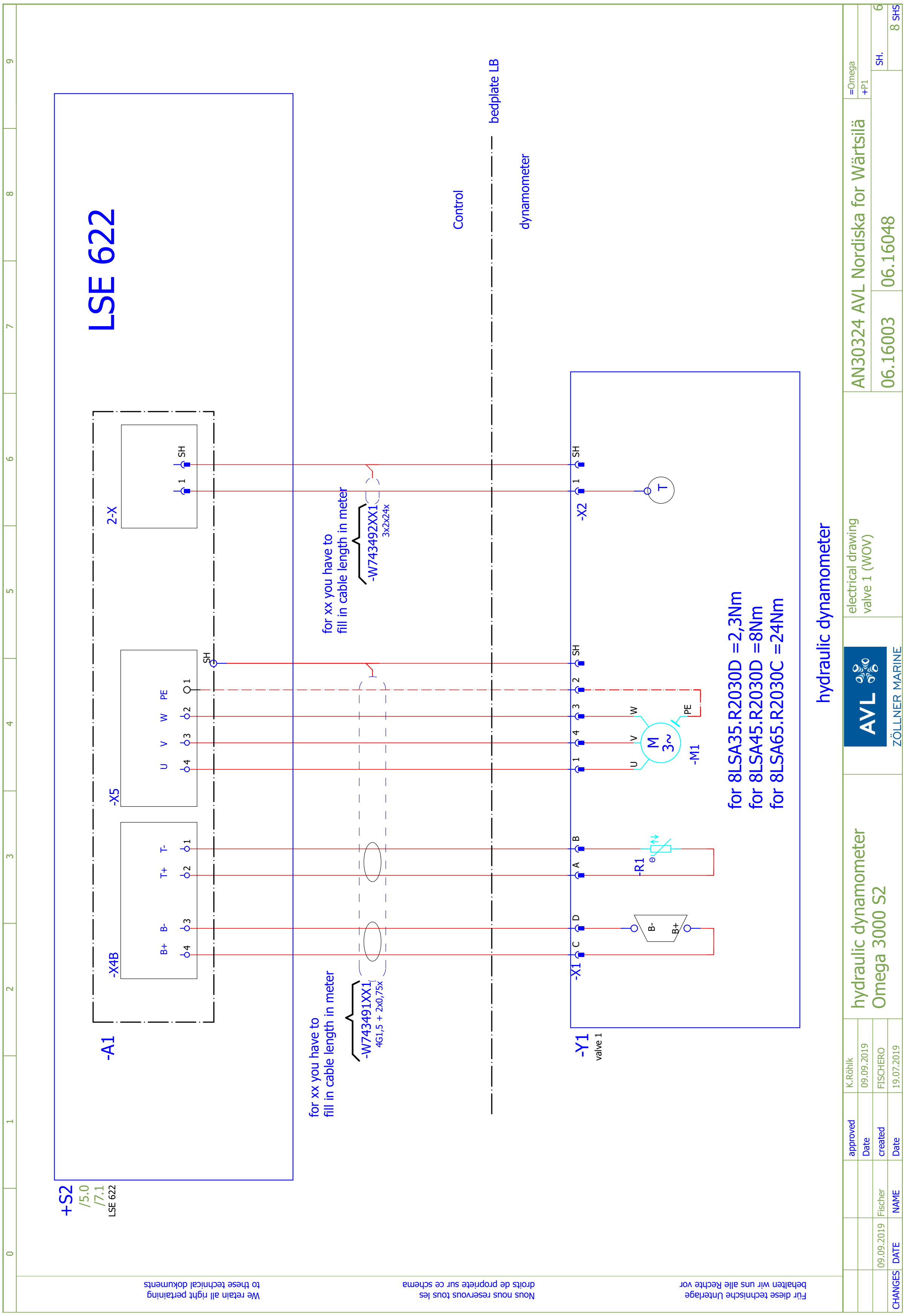
LSE 622
+S2
/5.0
/7.1
LSE 622
-A1
-X4B
B+ B- T+ T-
-X5
U V W PE
2-X
SH
Control
bedplate LB
dynamometer
for xx you have to
fill in cable length in meter
-W743491XX1
4G1,5 + 2x0,75x
for xx you have to
fill in cable length in meter
-W743492XX1
3x2x24x
-Y1
valve 1
-X1
-X2
-R1
-M1
M
3~
T
for 8LSA35.R2030D =2,3Nm
for 8LSA45.R2030D =8Nm
for 8LSA65.R2030C =24Nm
hydraulic dynamometer
hydraulic dynamometer
Omega 3000 S2
AVL
ZÖLLNER MARINE
electrical drawing
valve 1 (WOV)
AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
=Omega
+P1
SH.
6
8 SHS
approved
K.Röhlk
Date
09.09.2019
created
FISCHERO
Date
19.07.2019
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Fischer
CHANGES
DATE
NAME
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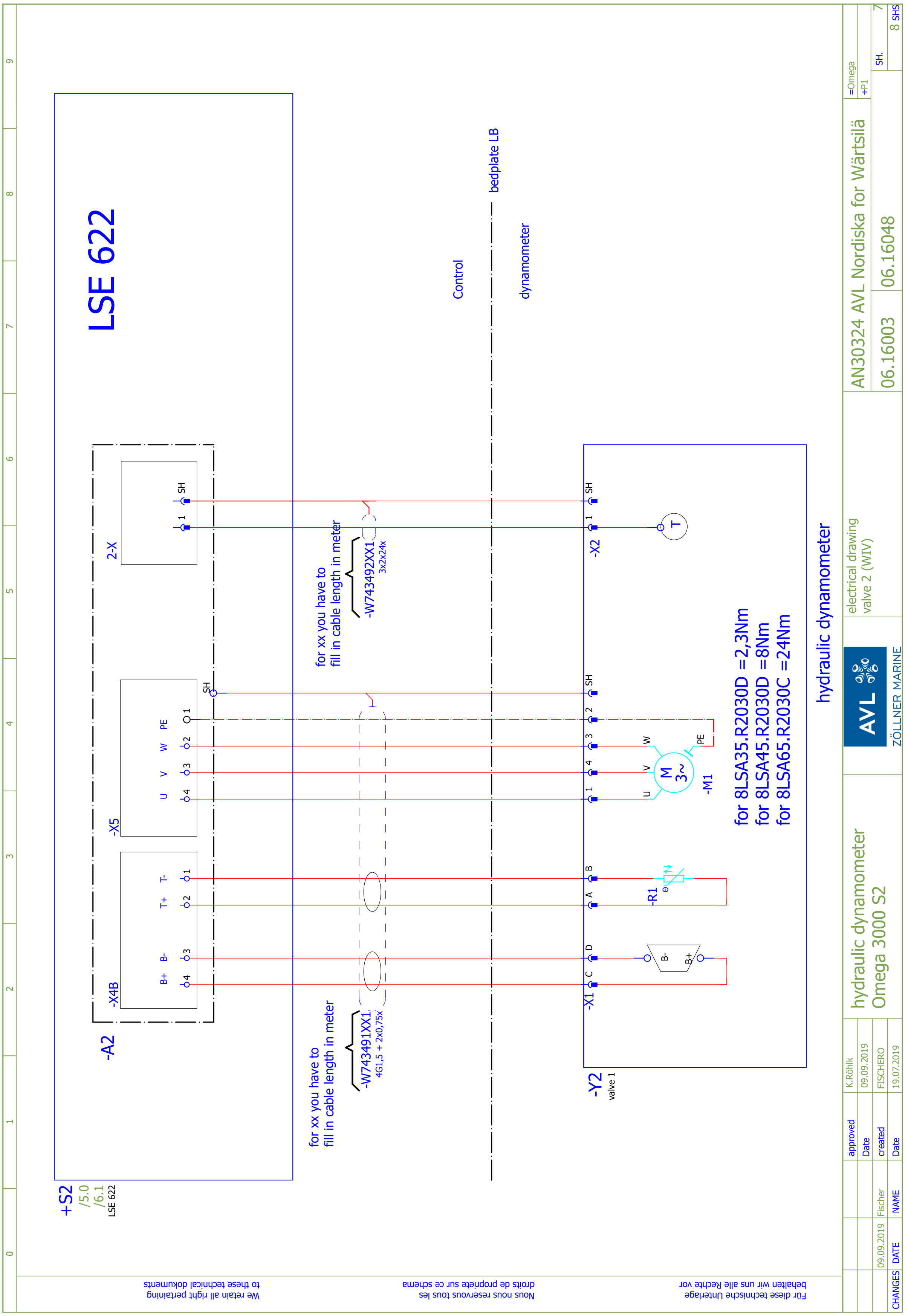
LSE 622
+S2
/5.0
/6.1
LSE 622
-A2
-X4B
-X5
2-X
Control
bedplate LB
dynamometer
for xx you have to
fill in cable length in meter
-W743491XX1
4G1,5 + 2x0,75x
-W743492XX1
3x2x24x
-Y2
valve 1
-X1
-X2
-R1
-M1
M
3~
T
hydraulic dynamometer
for 8LSA35.R2030D =2,3Nm
for 8LSA45.R2030D =8Nm
for 8LSA65.R2030C =24Nm
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to these technical dokuments
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hydraulic dynamometer
Omega 3000 S2
AVL
ZÖLLNER MARINE
electrical drawing
valve 2 (WIV)
AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
=Omega
+P1
SH.
7
8 SHS
approved
K.Röhlk
Date
09.09.2019
created
FISCHERO
Date
19.07.2019
CHANGES
DATE
NAME
09.09.2019
Fischer

labeling-set for OMEGA'S

from BME to HLB

	BME side	dyno side	sensor side	language
SPEED	-X17 F-FEM-CON1 -W15977	-X17 XK2 -W15977	B3 speed pickup GEL 248	english
Drehzahl	-X17 F-FEM-CON1 -W15977	-X17 XK2 -W15977	B3 Drehzahlauf- nehmer GEL 248	deutsch
FORCE	-X17 F-FEM-CON1 -W15249	-X17 XK2 -W15249	B2 Load cell DKE	english
Drehmoment	-X17 F-FEM-CON1 -W15249	-X17 XK2 -W15249	B2 Load cell DKE	deutsch
ALARMS	-X19 F-FEM-CON1 -W15175	-X19 XK2 -W15175	-S5 PLS	english
Alarme	-X19 F-FEM-CON1 -W15175	-X19 XK2 -W15175	-S5 TGS	deutsch

from BME to LSE

	LSE side	BME side
VALVES	-A7.1 LSE 622 -W15201	-X1 F-FEM-CON1 -W15201-1
		-X5 F-FEM-CON1 -W15201-5
		-X2 F-FEM-CON1 -W15201-2
		-X6 F-FEM-CON1 -W15201-6
	-A7.2 LSE 622 -W15202	-X20 F-FEM-CON1 -W15202

have to cut it for cabeling layout

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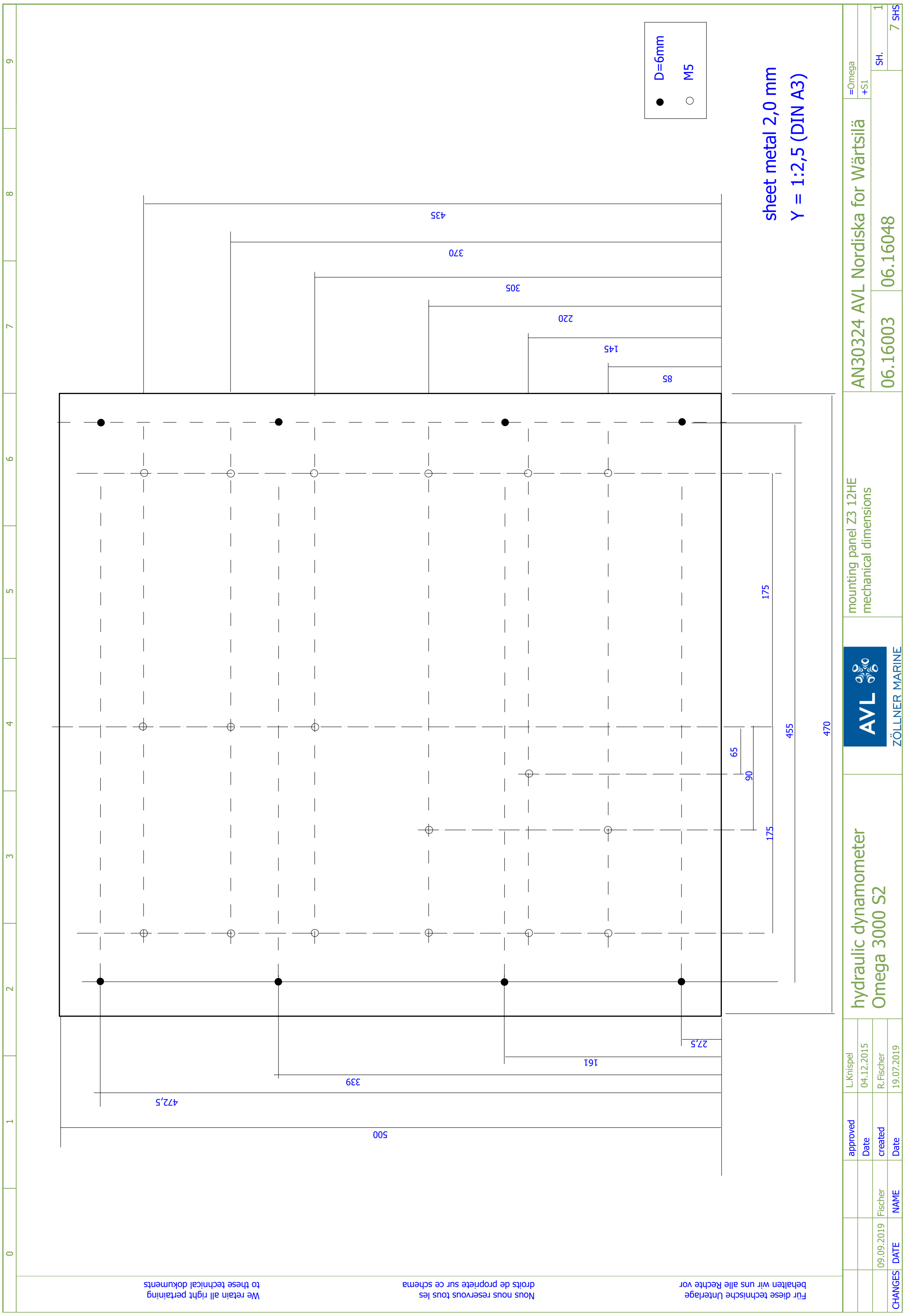
CHANGES	DATE	NAME							
	09.09.2019	Fischer	approved: K.Röhlk Date: 09.09.2019 created: FISCHERO Date: 19.07.2019	hydraulic dynamometer Omega 3000 S2	AVL ZÖLLNER MARINE	set of labeling OMEGA	AN30324 AVL Nordiska for Wärtsilä 06.16003 06.16048	=Omega +P1	SH. 8 8 SHS


D=6mm
M5
sheet metal 2,0 mm
Y = 1:2,5 (DIN A3)
435
370
305
220
145
85
175
455
470
65
90
175
27,5
161
339
472,5
500
AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
mounting panel Z3 12HE
mechanical dimensions
AVL
ZÖLLNER MARINE
hydraulic dynamometer
Omega 3000 S2
=Omega
+S1
SH. 1
7 SHS
approved L.Knispel
Date 04.12.2015
created R.Fischer
Date 19.07.2019
09.09.2019 Fischer
CHANGES DATE NAME
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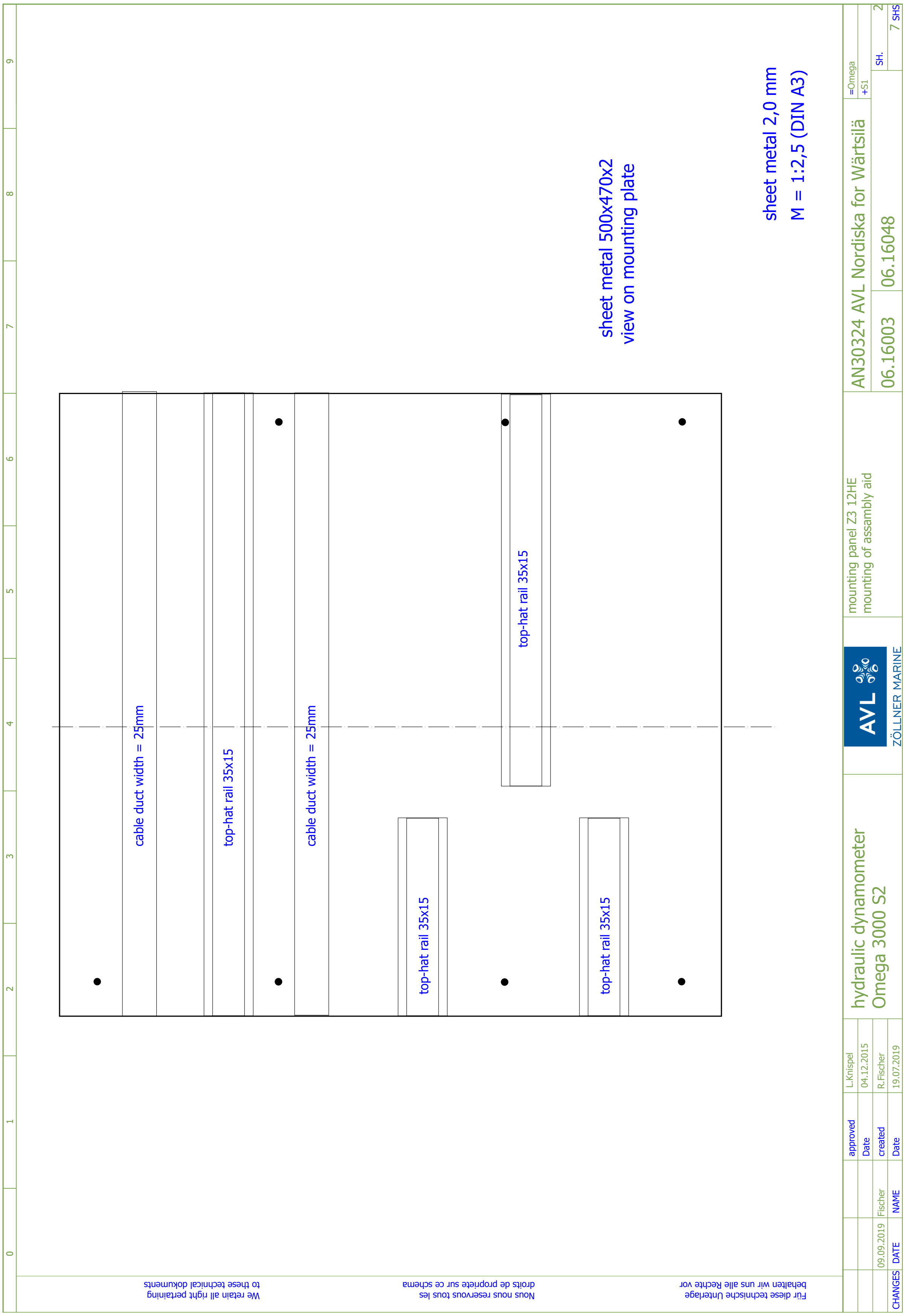
sheet metal 500x470x2
view on mounting plate
sheet metal 2,0 mm
M = 1:2,5 (DIN A3)
cable duct width = 25mm
top-hat rail 35x15
cable duct width = 25mm
top-hat rail 35x15
top-hat rail 35x15
top-hat rail 35x15
hydraulic dynamometer
Omega 3000 S2
mounting panel Z3 12HE
mounting of assambly aid
AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
=Omega
+S1
SH. 2
7 SHS
AVL
ZÖLLNER MARINE
approved L.Knispel
Date 04.12.2015
created R.Fischer
Date 19.07.2019
09.09.2019 Fischer
CHANGES DATE NAME
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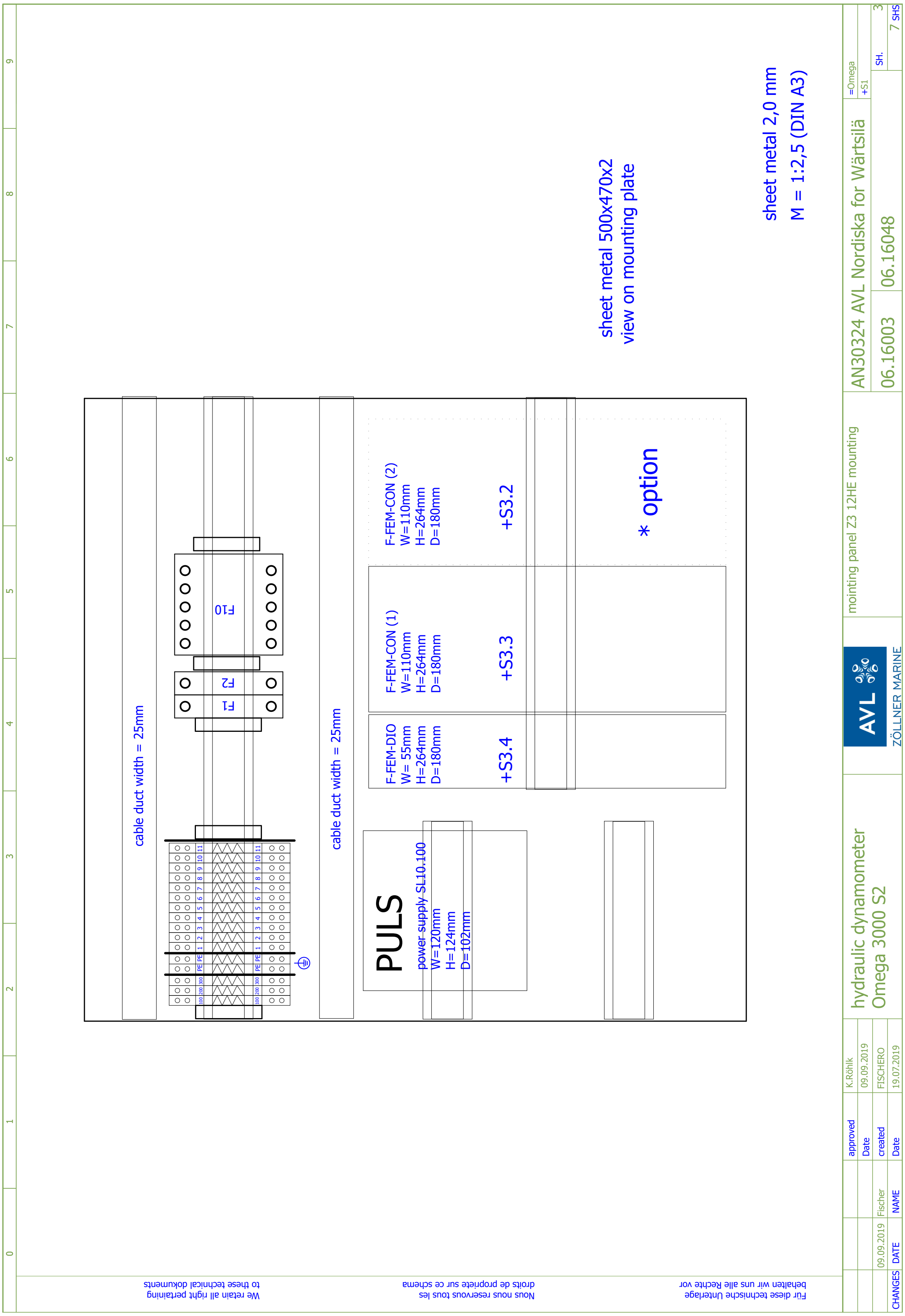
cable duct width = 25mm
F10
F2
F1
cable duct width = 25mm
F-FEM-CON (2)
W=110mm
H=264mm
D=180mm
+S3.2
F-FEM-CON (1)
W=110mm
H=264mm
D=180mm
+S3.3
F-FEM-DIO
W= 55mm
H=264mm
D=180mm
+S3.4
PULS
power supply SL10.100
W=120mm
H=124mm
D=102mm
* option
sheet metal 500x470x2
view on mounting plate
sheet metal 2,0 mm
M = 1:2,5 (DIN A3)
mointing panel Z3 12HE mounting
AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
hydraulic dynamometer
Omega 3000 S2
AVL
ZÖLLNER MARINE
=Omega
+S1
SH.
3
7 SHS
approved
K.Röhlk
Date
09.09.2019
created
FISCHERO
Date
19.07.2019
09.09.2019
Fischer
CHANGES
DATE
NAME
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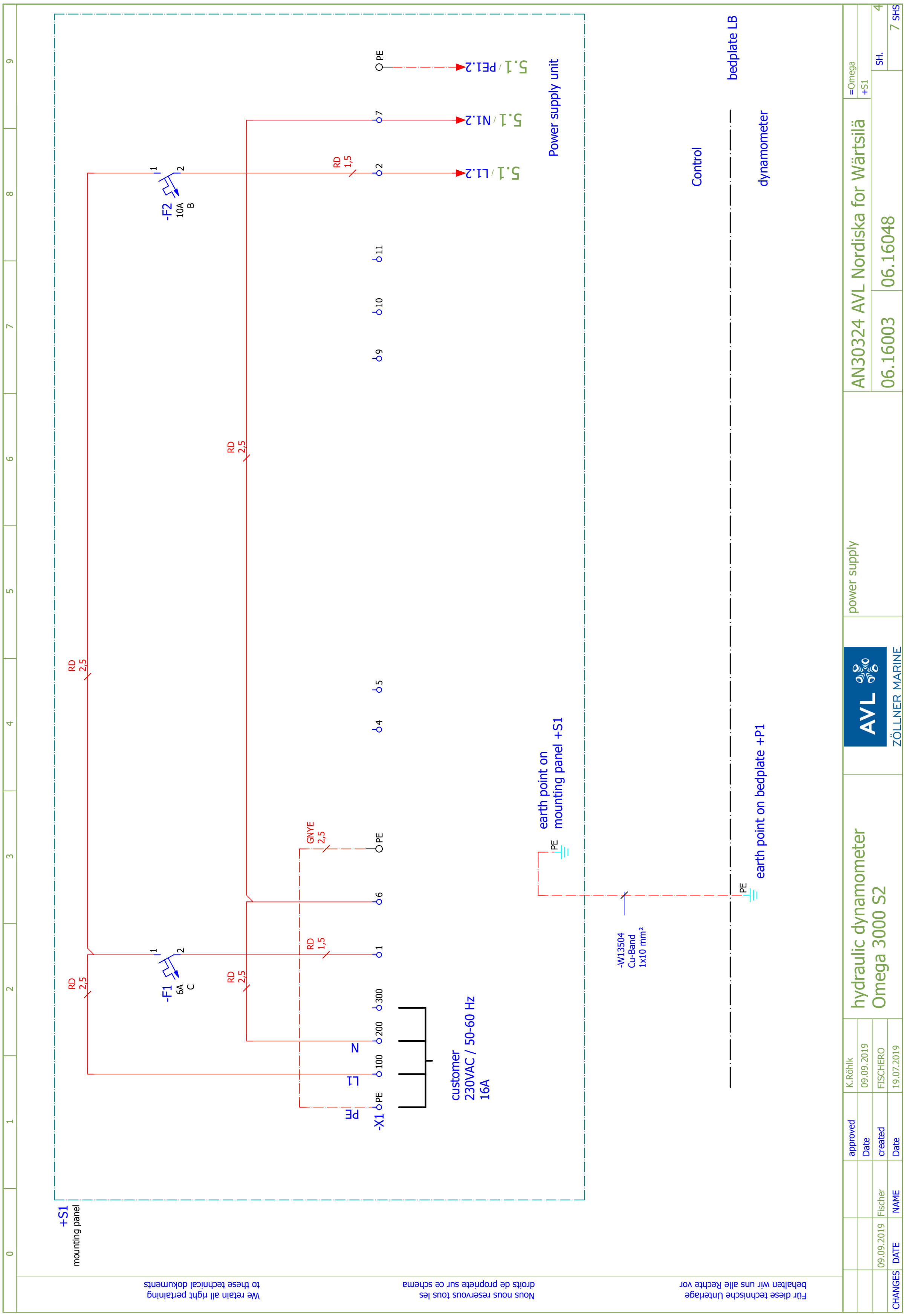
+S1
mounting panel
-X1
PE
L1
N
PE
100
200
300
1
6
PE
4
5
9
10
11
2
7
PE
customer
230VAC / 50-60 Hz
16A
-F1
6A
C
-F2
10A
B
RD
2,5
RD
1,5
GNYE
2,5
5.1 / L1.2
5.1 / N1.2
5.1 / PE1.2
Power supply unit
earth point on
mounting panel +S1
-W13504
Cu-Band
1x10 mm²
earth point on bedplate +P1
Control
dynamometer
bedplate LB
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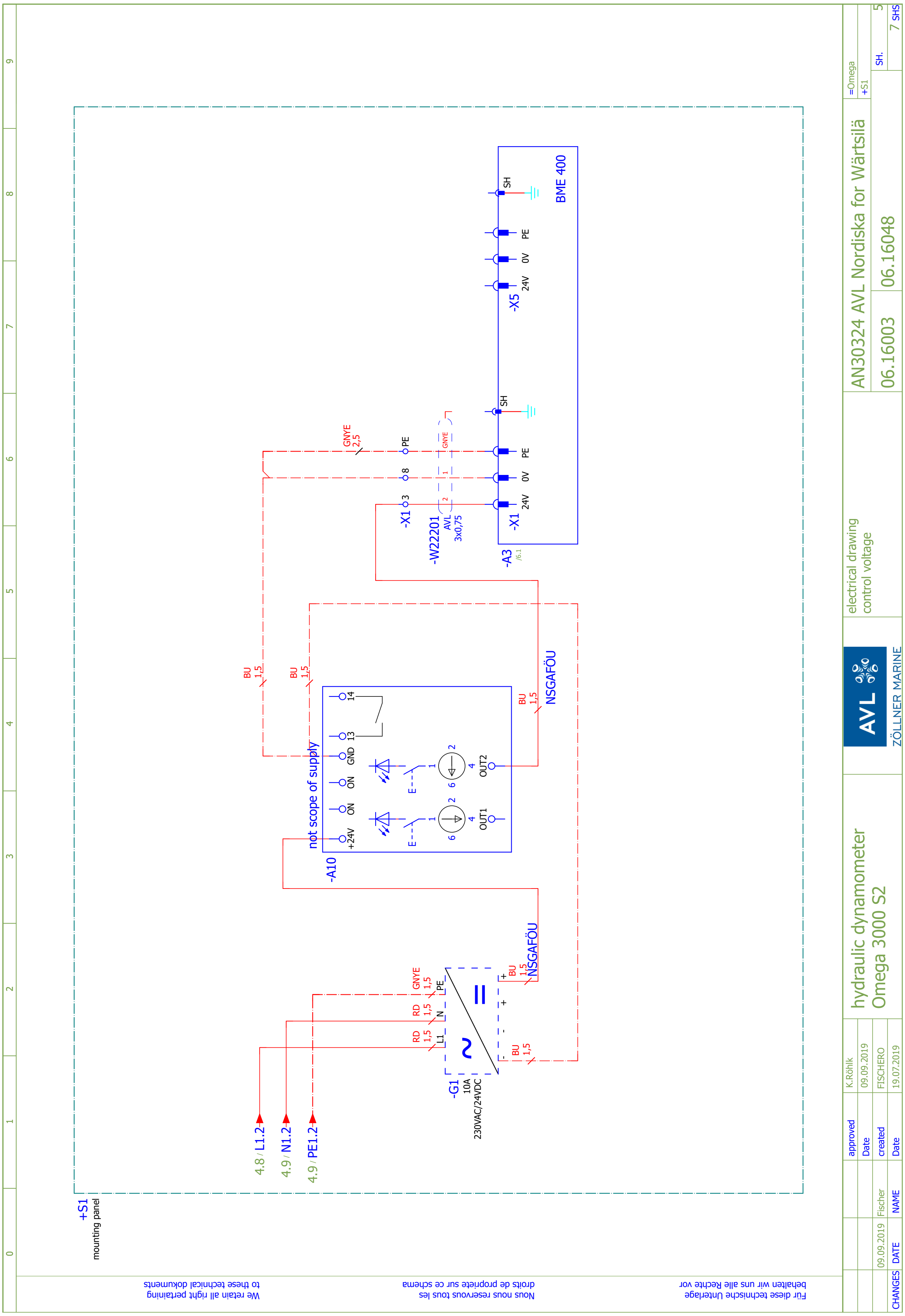
CHANGES
DATE
NAME
09.09.2019
Fischer
approved
Date
created
Date
K.Röhlik
09.09.2019
FISCHERO
19.07.2019
hydraulic dynamometer
Omega 3000 S2
AVL
ZÖLLNER MARINE
power supply
AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
=Omega
+S1
SH.
4
7 SHS


AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
electrical drawing
control voltage
AVL
ZÖLLNER MARINE
hydraulic dynamometer
Omega 3000 S2
=Omega
+S1
SH.
5
7 SHS
K.Röhlk
09.09.2019
FISCHERO
19.07.2019
approved
Date
created
Date
09.09.2019
Fischer
CHANGES
DATE
NAME
+S1
mounting panel
4.8 / L1.2
4.9 / N1.2
4.9 / PE1.2
-G1
10A
230VAC/24VDC
-A10
not scope of supply
+24V
ON
ON
GND
13
14
OUT1
OUT2
NSGAFÖU
-W22201
AVL
3x0,75
-X1
-A3
BME 400
-X5
24V
0V
PE
SH
GNYE
2,5
BU
1,5
RD
1,5
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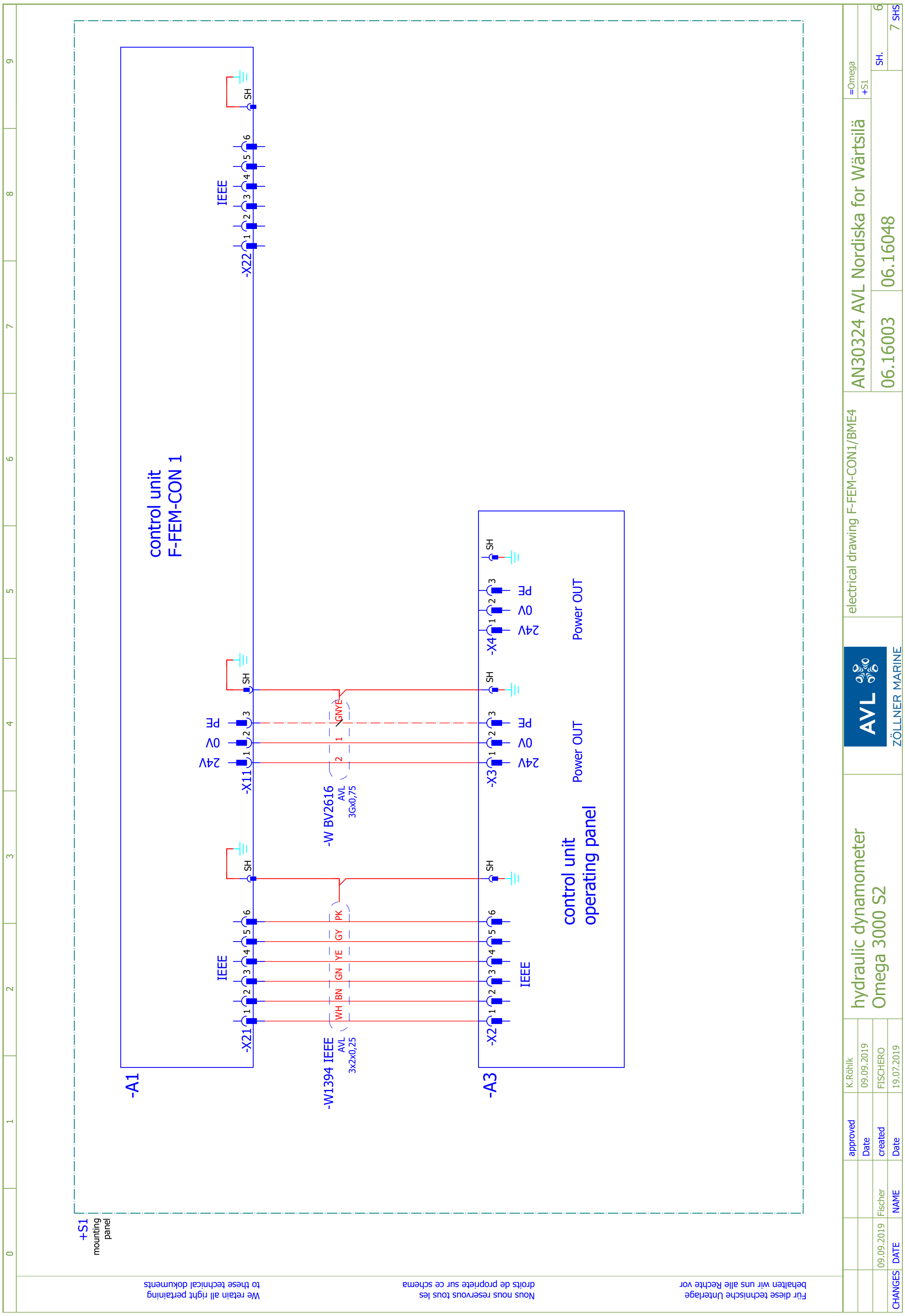
control unit
F-FEM-CON 1
-A1
IEEE
-X22
-X21
-X11
24V
0V
PE
SH
-W1394 IEEE
AVL
3x2x0,25
-W BV2616
AVL
3Gx0,75
WH
BN
GN
YE
GY
PK
GNYE
control unit
operating panel
-A3
-X2
-X3
-X4
Power OUT
+S1
mounting
panel
hydraulic dynamometer
Omega 3000 S2
electrical drawing F-FEM-CON1/BME4
AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
AVL
ZÖLLNER MARINE
=Omega
+S1
SH.
6
7 SHS
approved
K.Röhlk
Date
09.09.2019
created
FISCHERO
Date
19.07.2019
CHANGES
DATE
NAME
09.09.2019
Fischer
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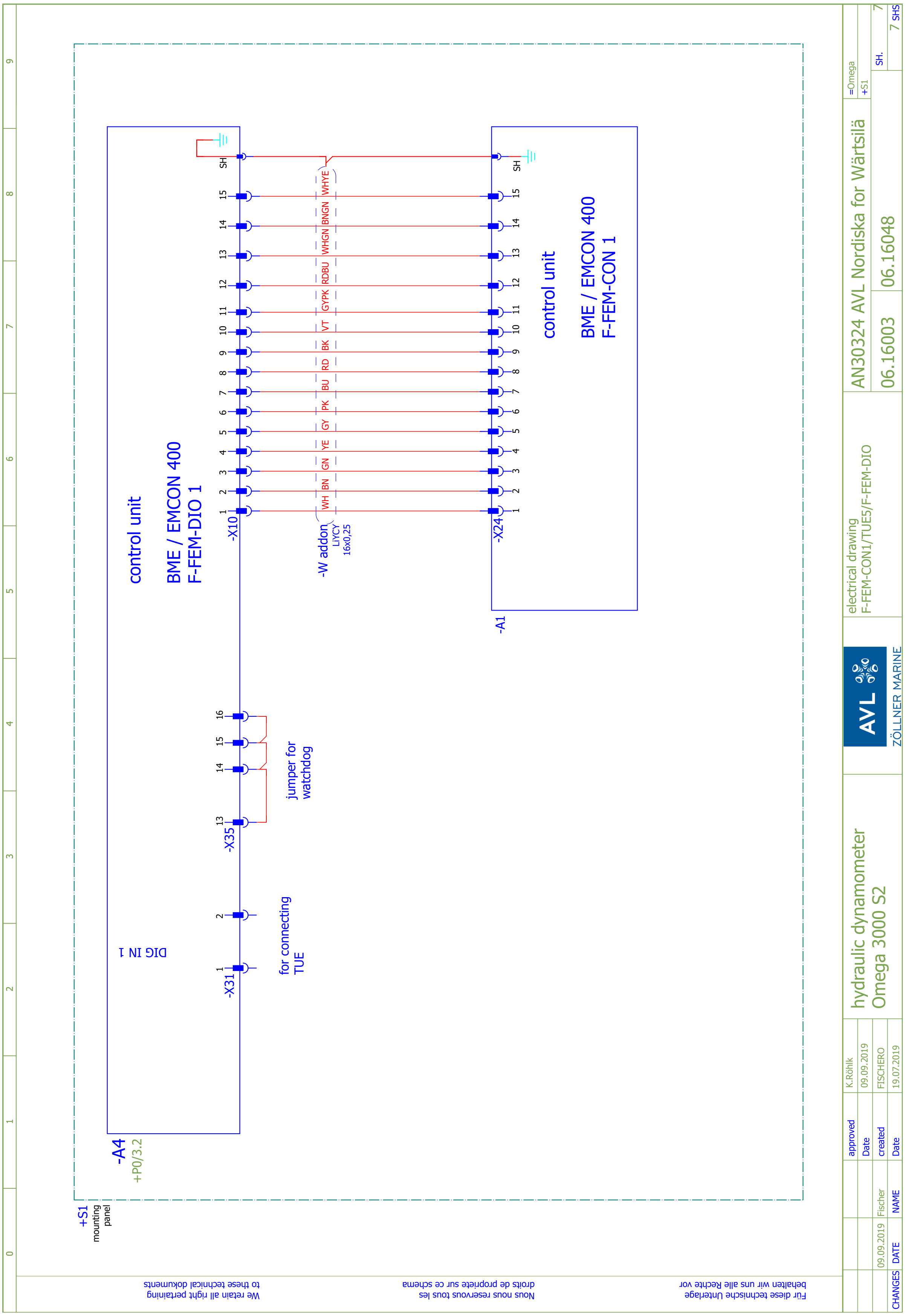
control unit
BME / EMCON 400
F-FEM-DIO 1
-A4
+P0/3.2
DIG IN 1
-X10
-X35
-X31
jumper for watchdog
for connecting TUE
-W addon
LiYCY
16x0,25
WH BN GN YE GY PK BU RD BK VT GYPK RDBU WHGN BNGN WHYE
SH
control unit
BME / EMCON 400
F-FEM-CON 1
-A1
-X24
+S1
mounting panel
hydraulic dynamometer
Omega 3000 S2
AVL
ZÖLLNER MARINE
electrical drawing
F-FEM-CON1/TUE5/F-FEM-DIO
AN30324 AVL Nordiska for Wärtsilä
06.16003
06.16048
=Omega
+S1
SH.
7
7 SHS
approved
Date
created
Date
K.Röhlk
09.09.2019
FISCHERO
19.07.2019
CHANGES
DATE
NAME
09.09.2019
Fischer
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ZÖLLNER MARINE GmbH

Speckenbeker Weg 143
24113 Kiel
+49 431 88702 – 0

project :	hydraulic dynamometer Omega 3000 S2
commission :	AN30324 AVL Nordiska for Wärtsilä
serial number :	FN 6134
manufacturer (cie) :	AVL ZÖLLNER Marine GMBH
Edited:	FISCHERO
date:	09.09.2019
number of pages :	36

			approved	Knispel L.	hydraulic dynamometer Omega 3000 S2	ZÖLLNER MARINE	Title page/cover sheet	AN30324 AVL Nordiska for Wärtsilä
			Date	13.01.2014				=Omega +S2
Rev.1	09.09.2019	Fischer	created	FISCHERO				06.16048
CHANGES	DATE	NAME	Date	19.07.2019				SH. 1 11 SHS

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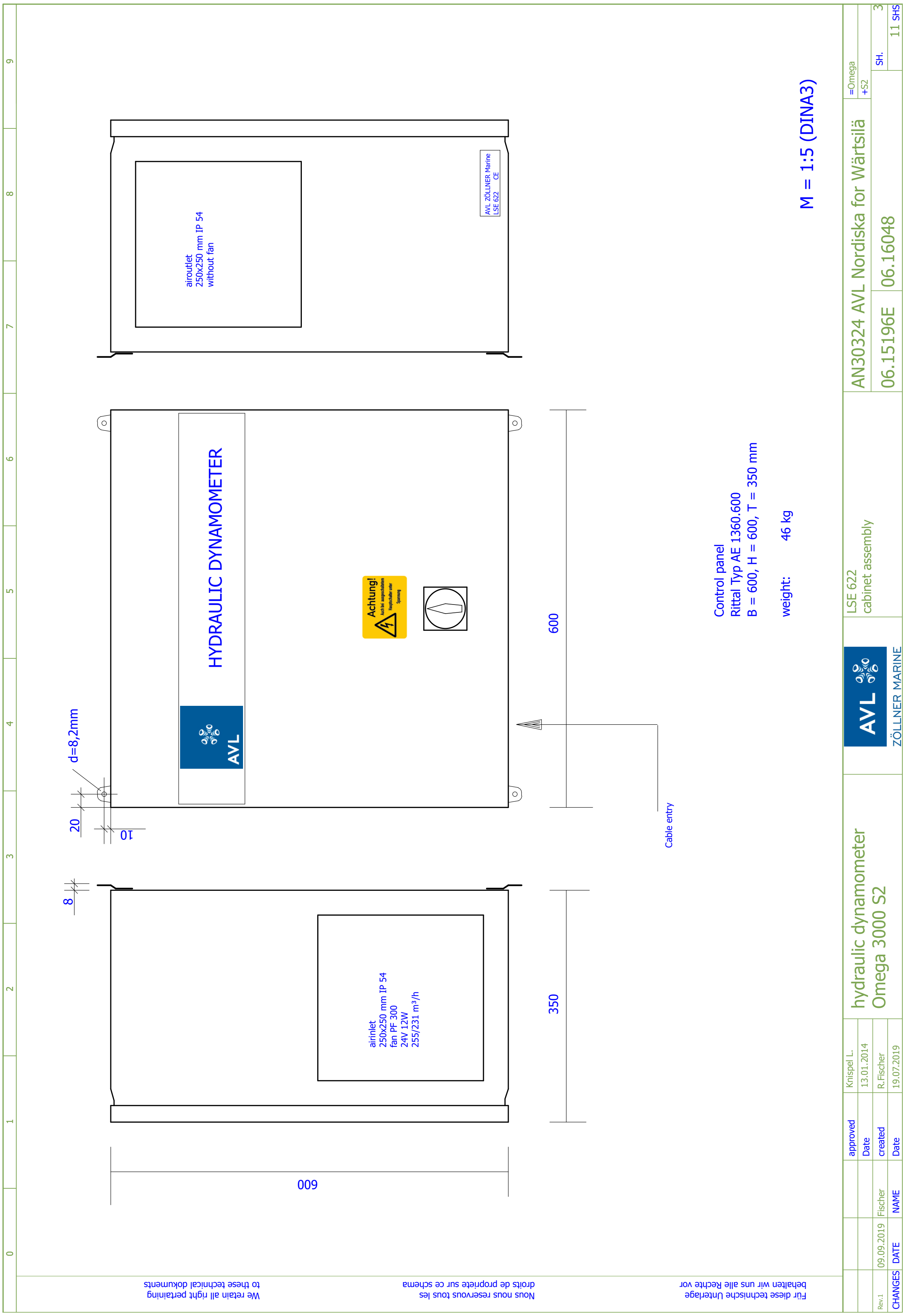
cabinets:

protection class:	IP 54	
ambient temperature:	0 to 45°C	
inside temperature:	5 - 45°C	
color:	RAL 7035	
cable conduit:	from upper with cable bushings	
feed in:	switch box valve controlling	
	with main switch and motor overload switch	
	400-480VAC 3Ph/PE	
	netform: TT or TN (starpoint earthed)	
	in unearthd IT network configuration have to use current transformer the secondary star point have to connect to earthing equipment conductor of ACCOPOS	
connectors:	electric supply on terminal	
	control conection on sub min D 25pin/ female	
	connection dynamometer direct to the servoamplifer	
length of cable:	AC power cable	5,0 m
	LSE 62. - BME 4	15,0 m
	dyno - servoamplifer	15,0 m

			approved	Knispel L.	hydraulic dynamometer Omega 3000 S2	AVL ZÖLLNER MARINE	specification of LSE 622	AN30324 AVL Nordiska for Wärtsilä	=Omega +S2
			Date	13.01.2014					
Rev.1	09.09.2019	Fischer	created	R.Fischer				06.15196E 06.16048	SH. 2
CHANGES	DATE	NAME	Date	19.07.2019					11 SHS


M = 1:5 (DINA3)
airoutlet
250x250 mm IP 54
without fan
AVL ZÖLLNER Marine
LSE 622 CE
HYDRAULIC DYNAMOMETER
AVL
Achtung!
600
d=8,2mm
20
10
8
Cable entry
Control panel
Rittal Typ AE 1360.600
B = 600, H = 600, T = 350 mm
weight: 46 kg
airinlet
250x250 mm IP 54
fan PF 300
24V 12W
255/231 m³/h
350
600
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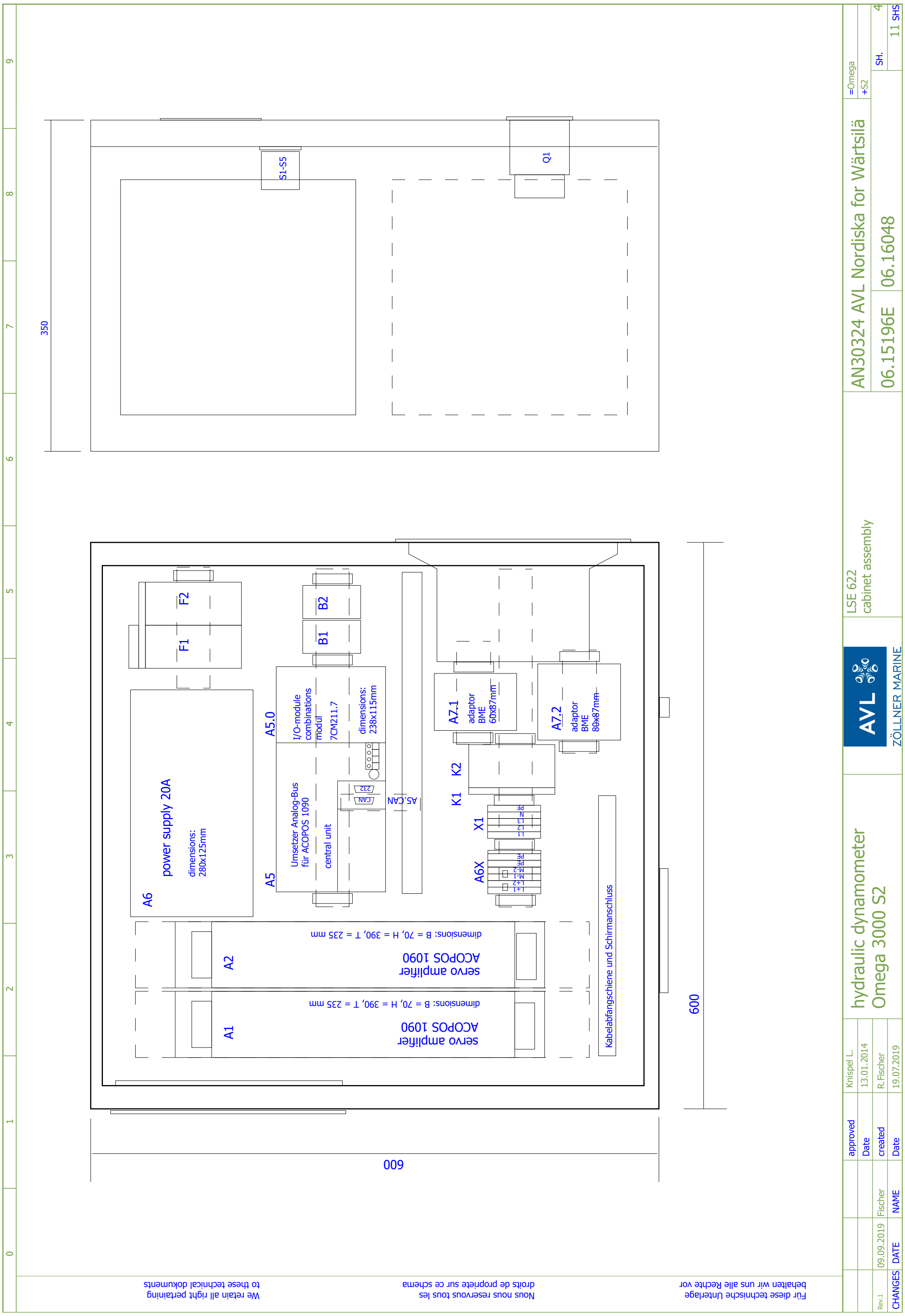
AN30324 AVL Nordiska for Wärtsilä
06.15196E 06.16048
=Omega
+S2
SH. 3
11 SHS
LSE 622
cabinet assembly
AVL
ZÖLLNER MARINE
hydraulic dynamometer
Omega 3000 S2
approved Knispel L.
Date 13.01.2014
created R.Fischer
Date 19.07.2019
Rev.1 09.09.2019 Fischer
CHANGES DATE NAME


350
S1-S5
Q1
600
600
F1
F2
B1
B2
A6
power supply 20A
dimensions:
280x125mm
A5.0
I/O-module
combinations
modul
7CM211.7
dimensions:
238x115mm
A5
Umsetzer Analog-Bus
für ACOPOS 1090
central unit
A5.CAN
A7.1
adaptor
BME
60x87mm
A7.2
adaptor
BME
80x87mm
K1
K2
X1
A6X
A2
servo amplifier
ACOPOS 1090
dimensions: B = 70, H = 390, T = 235 mm
A1
servo amplifier
ACOPOS 1090
dimensions: B = 70, H = 390, T = 235 mm
Kabelabfangschiene und Schirmanschluss
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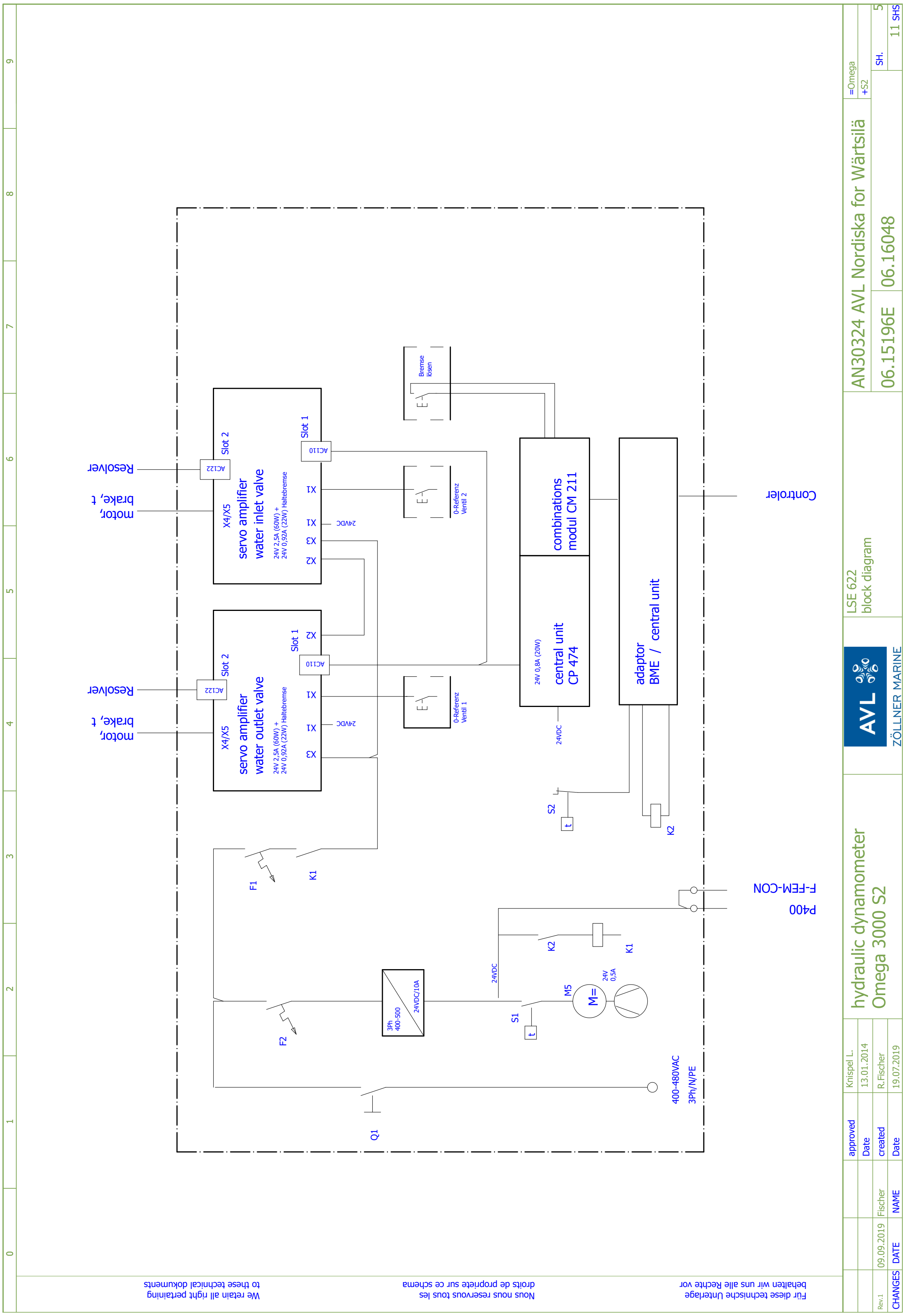
to these technical dokuments
AN30324 AVL Nordiska for Wärtsilä
06.15196E
06.16048
LSE 622
cabinet assembly
AVL
ZÖLLNER MARINE
hydraulic dynamometer
Omega 3000 S2
approved
Knispel L.
Date
13.01.2014
created
R.Fischer
Date
19.07.2019
Rev.1
09.09.2019
Fischer
CHANGES
DATE
NAME
=Omega
+S2
SH.
4
11 SHS


AN30324 AVL Nordiska for Wärtsilä
06.15196E
06.16048
LSE 622
block diagram
hydraulic dynamometer
Omega 3000 S2
AVL
ZÖLLNER MARINE
=Omega
+S2
SH.
5
11 SHS
approved
Knispel L.
Date
13.01.2014
created
R.Fischer
Date
19.07.2019
Rev.1
09.09.2019
Fischer
CHANGES
DATE
NAME
servo amplifier
water inlet valve
servo amplifier
water outlet valve
X4/X5
Slot 1
Slot 2
AC110
AC122
Resolver
motor,
brake, t
24V 2,5A (60W) +
24V 0,92A (22W) Haltebremse
24VDC
combinations
modul CM 211
central unit
CP 474
24V 0,8A (20W)
adaptor
BME / central unit
Controler
F-FEM-CON
P400
0-Referenz
Ventil 1
0-Referenz
Ventil 2
Bremse
lösen
F1
F2
K1
K2
S1
S2
Q1
M5
M=
24V
0,5A
3Ph
400-500
24VDC/10A
400-480VAC
3Ph/N/PE
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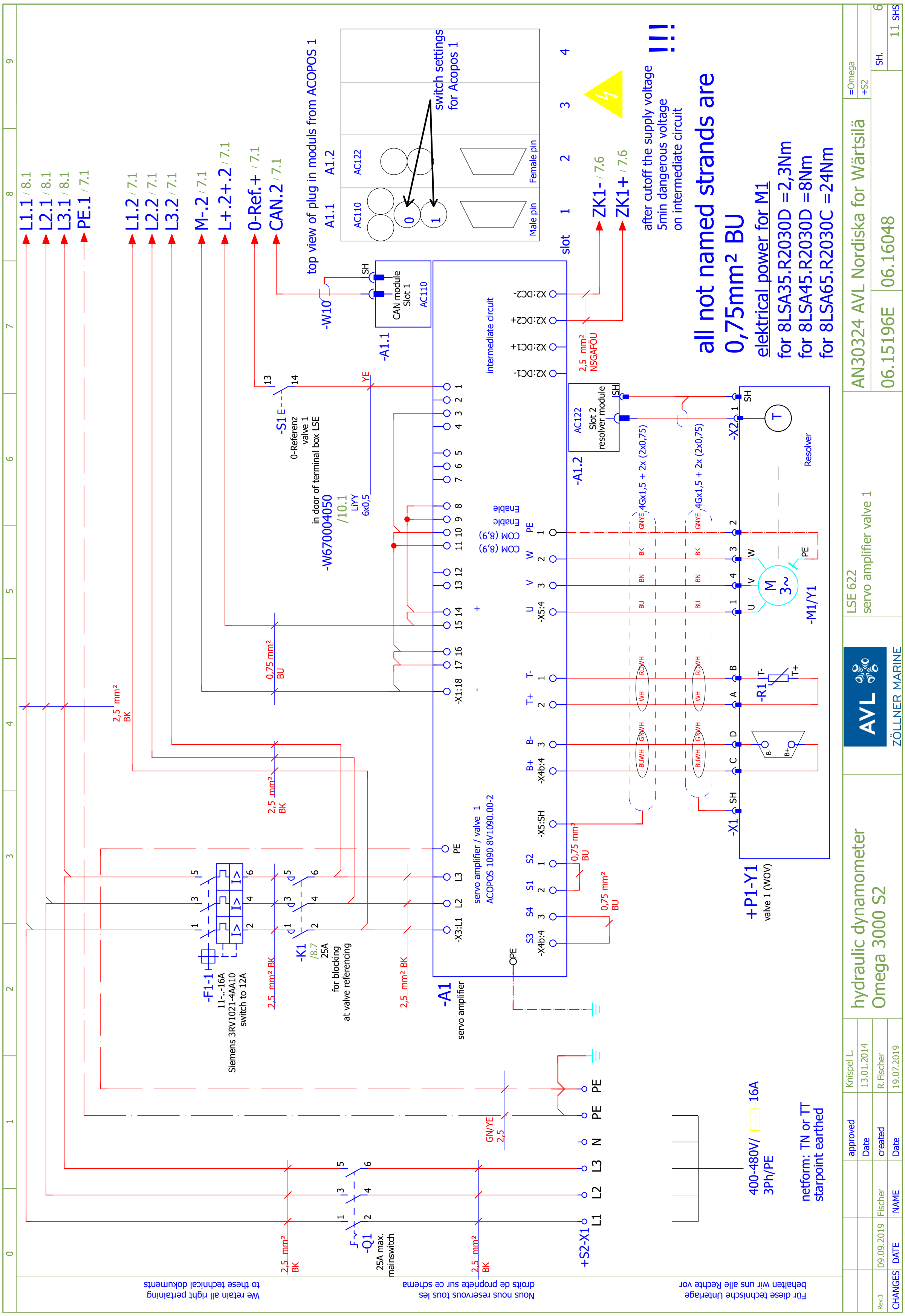
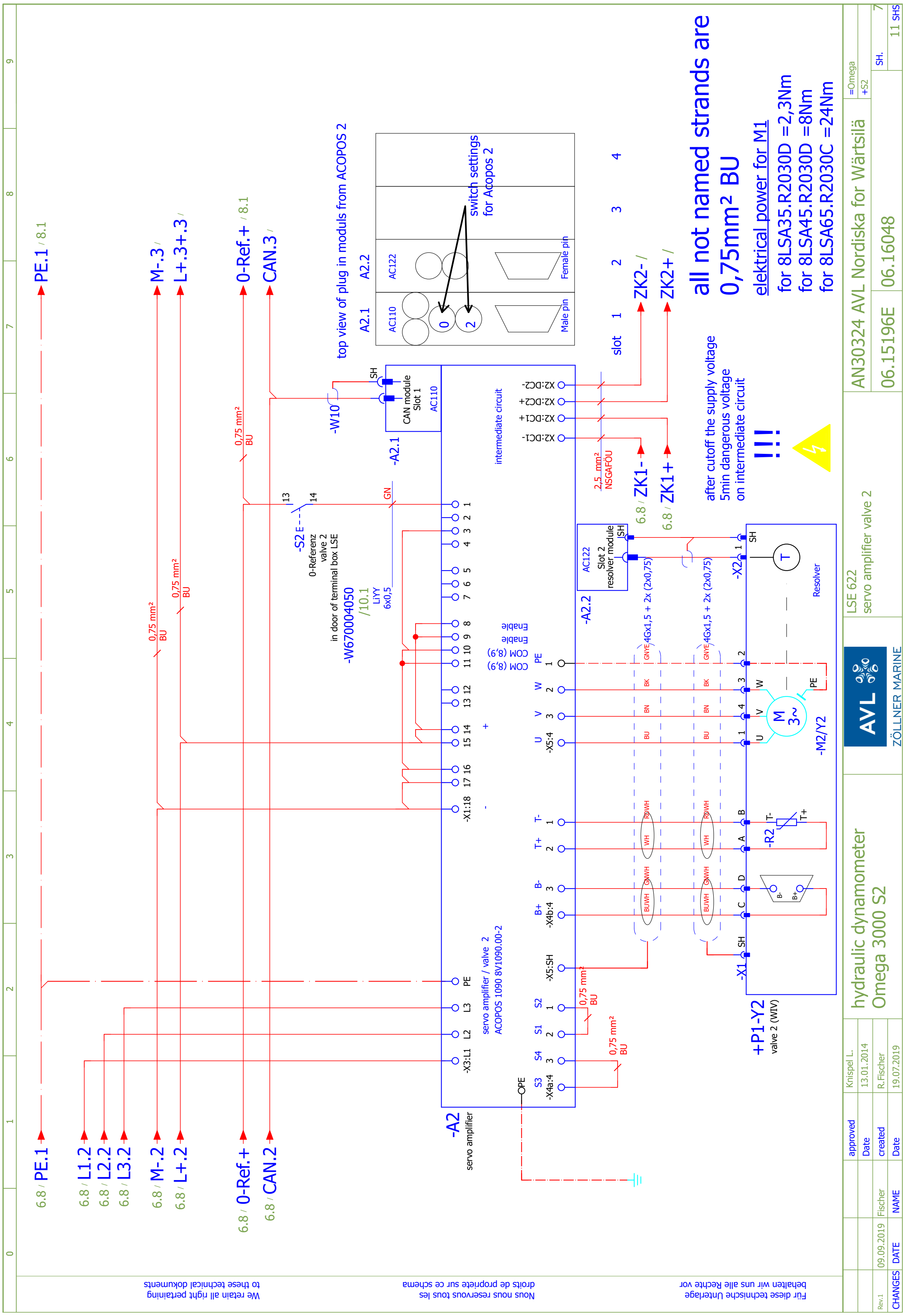

hydraulic dynamometer
Omega 3000 S2
LSE 622
servo amplifier valve 1
AN30324 AVL Nordiska for Wärtsilä
06.15196E
06.16048
all not named strands are 0,75mm² BU
elektrical power for M1
for 8LSA35.R2030D =2,3Nm
for 8LSA45.R2030D =8Nm
for 8LSA65.R2030C =24Nm
after cutoff the supply voltage 5min dangerous voltage on intermediate circuit
!!!
top view of plug in moduls from ACOPOS 1
switch settings for Acopos 1
netform: TN or TT starpoint earthed
400-480V/ 3Ph/PE
16A
AVL
ZÖLLNER MARINE


top view of plug in moduls from ACOPOS 2
switch settings for Acopos 2
all not named strands are 0,75mm² BU
elektrical power for M1
for 8LSA35.R2030D =2,3Nm
for 8LSA45.R2030D =8Nm
for 8LSA65.R2030C =24Nm
after cutoff the supply voltage 5min dangerous voltage on intermediate circuit
!!!
-A2
servo amplifier
servo amplifier / valve 2
ACOPOS 1090 8V1090.00-2
LSE 622
servo amplifier valve 2
hydraulic dynamometer
Omega 3000 S2
AN30324 AVL Nordiska for Wärtsilä
06.15196E
06.16048
AVL
ZÖLLNER MARINE
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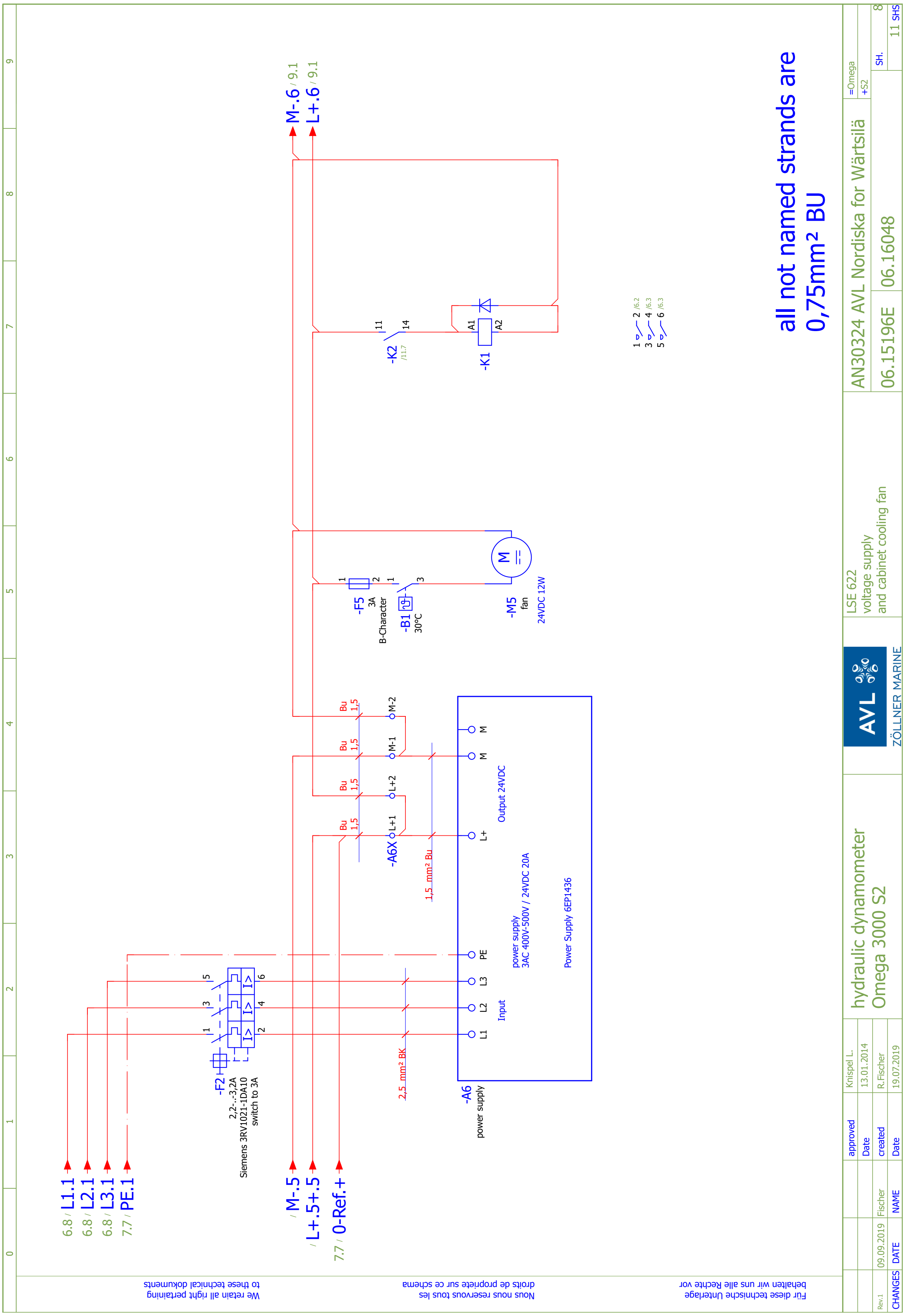
all not named strands are 0,75mm² BU
L1.1
L2.1
L3.1
PE.1
M-.5
L+.5+.5
0-Ref.+
M-.6
L+.6
-F2
2,2-..3,2A
Siemens 3RV1021-1DA10
switch to 3A
2,5 mm² BK
1,5 mm² Bu
-A6
power supply
Input
Output 24VDC
power supply
3AC 400V-500V / 24VDC 20A
Power Supply 6EP1436
-A6X
-F5
3A
B-Character
-B1
30°C
-M5
fan
24VDC 12W
-K2
-K1
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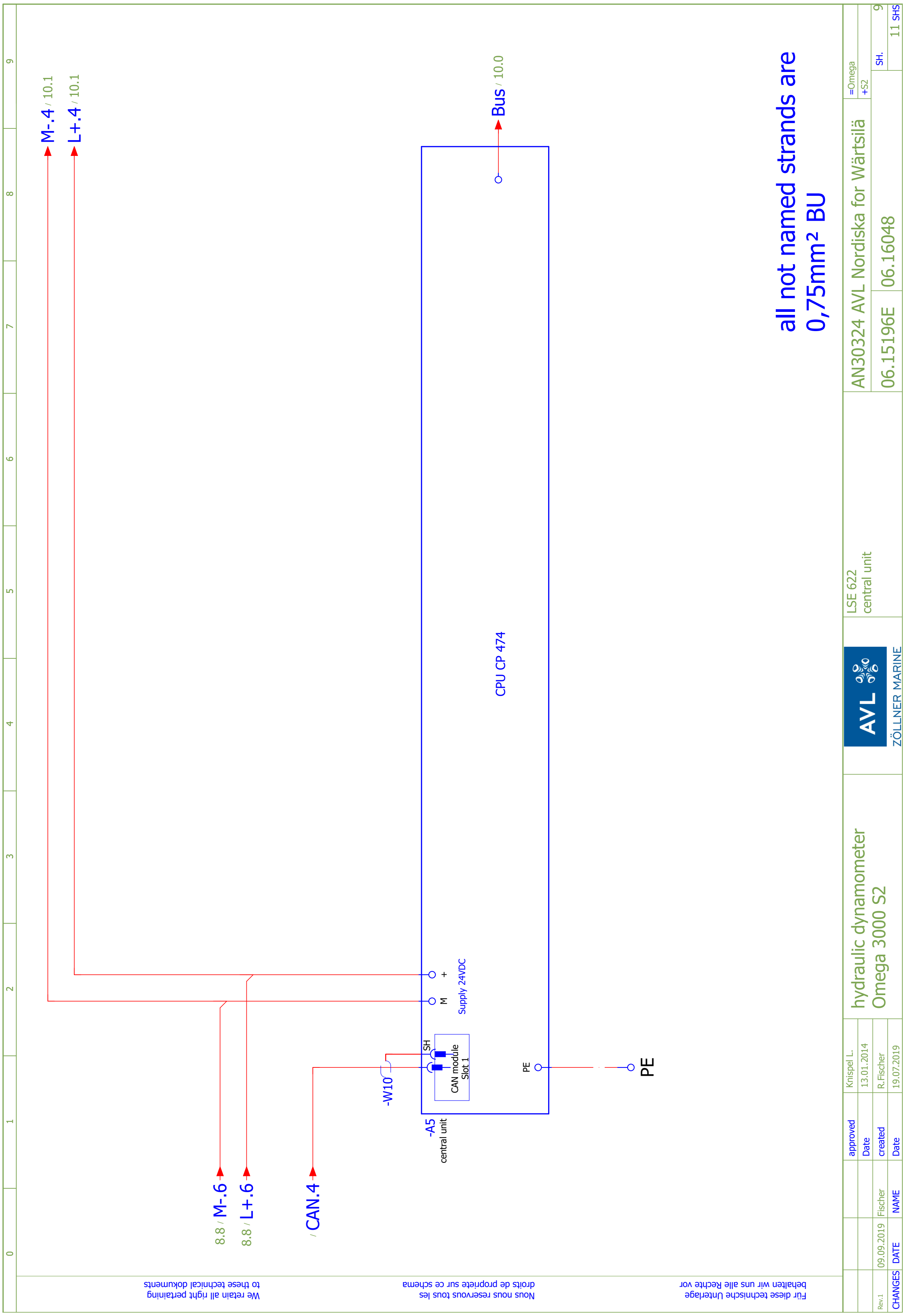
hydraulic dynamometer
Omega 3000 S2
LSE 622
voltage supply
and cabinet cooling fan
AN30324 AVL Nordiska for Wärtsilä
06.15196E
06.16048
AVL
ZÖLLNER MARINE
approved
Knispel L.
Date
13.01.2014
created
R.Fischer
Date
19.07.2019
CHANGES
DATE
NAME
09.09.2019
Fischer
=Omega
+S2
SH.
8
11 SHS


M-.4 / 10.1
L+.4 / 10.1
Bus / 10.0
CPU CP 474
Supply 24VDC
CAN module
Slot 1
SH
-W10
-A5
central unit
PE
8.8 / M-.6
8.8 / L+.6
/ CAN.4
all not named strands are
0,75mm² BU
AN30324 AVL Nordiska for Wärtsilä
06.15196E
06.16048
LSE 622
central unit
AVL
ZÖLLNER MARINE
hydraulic dynamometer
Omega 3000 S2
=Omega
+S2
SH.
9
11 SHS
Knispel L.
13.01.2014
R.Fischer
19.07.2019
approved
Date
created
Date
09.09.2019
Fischer
CHANGES
DATE
NAME
Rev.1
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to these technical dokuments
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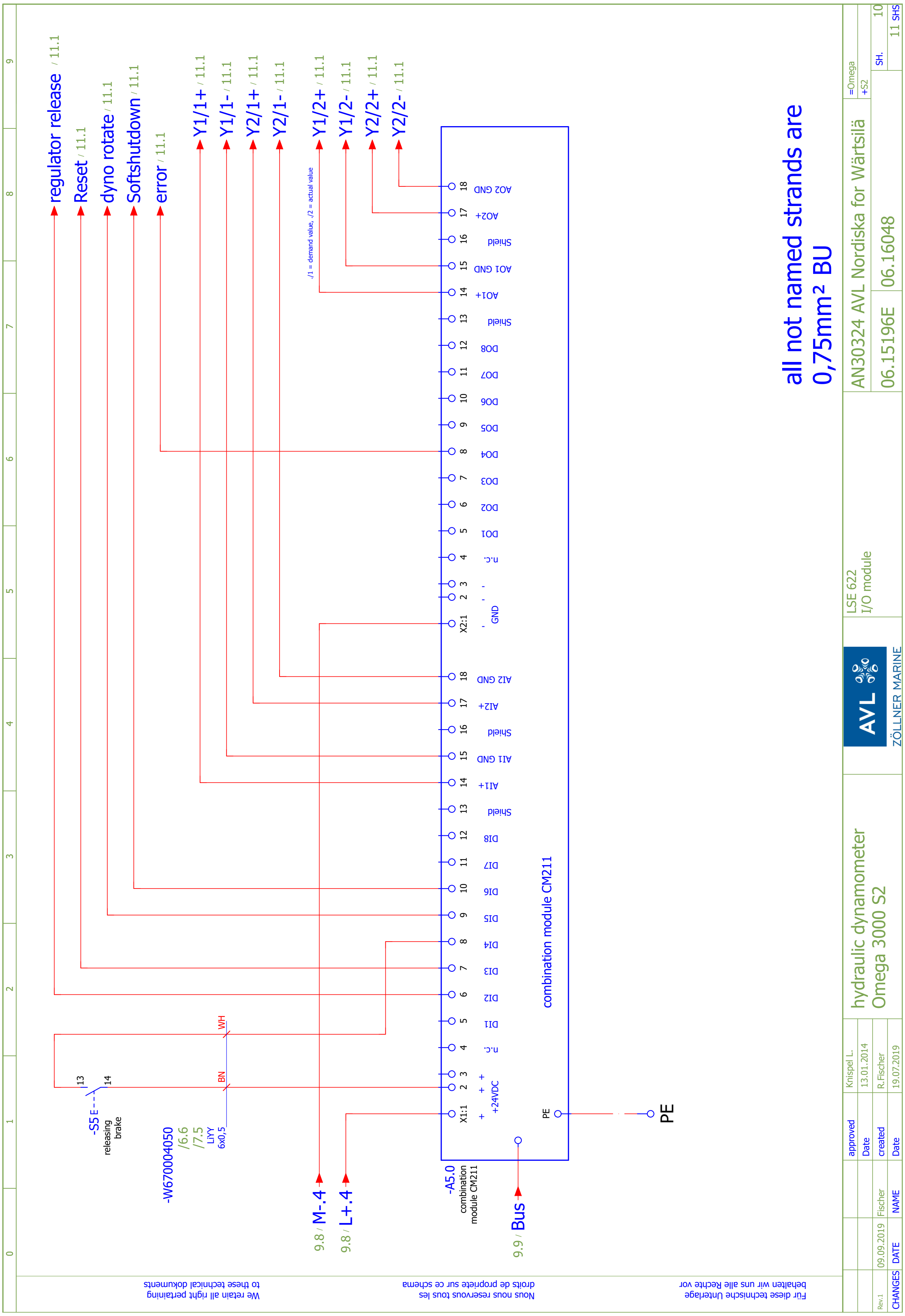
regulator release / 11.1
Reset / 11.1
dyno rotate / 11.1
Softshutdown / 11.1
error / 11.1
Y1/1+ / 11.1
Y1/1- / 11.1
Y2/1+ / 11.1
Y2/1- / 11.1
Y1/2+ / 11.1
Y1/2- / 11.1
Y2/2+ / 11.1
Y2/2- / 11.1
./1 = demand value, ./2 = actual value
combination module CM211
-A5.0 combination module CM211
-S5 releasing brake
-W670004050 /6.6 /7.5 LiYY 6x0,5
WH
BN
9.8 / M-.4
9.8 / L+.4
9.9 / Bus
PE
all not named strands are 0,75mm² BU
hydraulic dynamometer Omega 3000 S2
LSE 622 I/O module
AVL ZÖLLNER MARINE
AN30324 AVL Nordiska for Wärtsilä
06.15196E 06.16048
=Omega +S2
SH. 10
11 SHS
approved Date created Date
Knispel L. 13.01.2014 R.Fischer 19.07.2019
Rev.1 09.09.2019 Fischer
CHANGES DATE NAME
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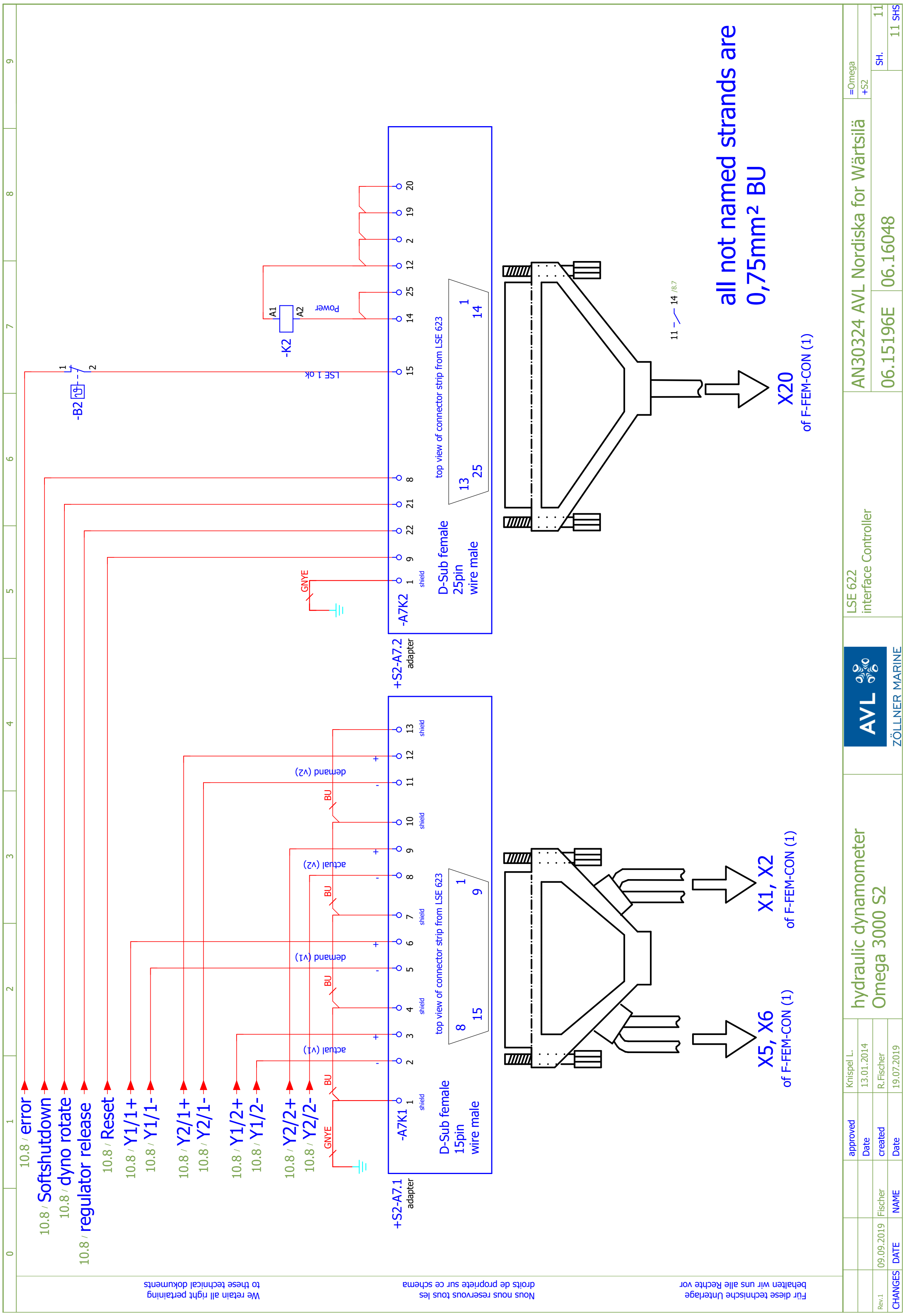
10.8 / error
10.8 / Softshutdown
10.8 / dyno rotate
10.8 / regulator release
10.8 / Reset
10.8 / Y1/1+
10.8 / Y1/1-
10.8 / Y2/1+
10.8 / Y2/1-
10.8 / Y1/2+
10.8 / Y1/2-
10.8 / Y2/2+
10.8 / Y2/2-
-B2
LSE 1 ok
-K2
Power
+S2-A7.1
adapter
-A7K1
D-Sub female
15pin
wire male
top view of connector strip from LSE 623
actual (v1)
demand (v1)
actual (v2)
demand (v2)
+S2-A7.2
adapter
-A7K2
D-Sub female
25pin
wire male
X5, X6
of F-FEM-CON (1)
X1, X2
of F-FEM-CON (1)
X20
of F-FEM-CON (1)
all not named strands are
0,75mm² BU
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hydraulic dynamometer
Omega 3000 S2
AVL
ZÖLLNER MARINE
LSE 622
interface Controller
AN30324 AVL Nordiska for Wärtsilä
06.15196E
06.16048
=Omega
+S2
SH. 11
11 SHS

ZÖLLNER MARINE GmbH

Speckenbeker Weg 143
24113 Kiel
+49 431 88702 – 0

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project	:	hydraulic dynamometer Omega 3000 S2
commission	:	AN30324 AVL Nordiska for Wärtsilä
serial number	:	FN 6134
manufacturer (cie)	:	AVL ZÖLLNER Marine GMBH

Edited: FISCHERO
date: 09.09.2019
number of pages : 36

			approved		hydraulic dynamometer Omega 3000 S2	AVL ZÖLLNER MARINE	Title page/cover sheet	AN30324 AVL Nordiska for Wärtsilä
			Date					=DOKU +Deckblatt
	09.09.2019	Fischer	created	FISCHERO				06.16048
CHANGES	DATE	NAME	Date	19.07.2019				SH. 1 2 SHS

0 1 2 3 4 5 6 7 8 9

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item designation

+P0 overview (cable layout)
+P1 hydraulic dynamometer (wiring layout)
+S1 mounting plate for controling (wiring layout)

additional documents

+S2 power unit LSE 62x
with dimensions and wiring layout
(drawing number: 06.15196)

explanation of symbols

(plug symbol)	plug connection
o	clamp connection
***	are included in delivery (comments in cable layout P0)
ooo	are not included in delivery
-W12...	cable labeling with -W and number from part list
	cable without cable labeling are among to the sensor
!!!	note safty regulations at mounting

overwiev of actuators and sensors

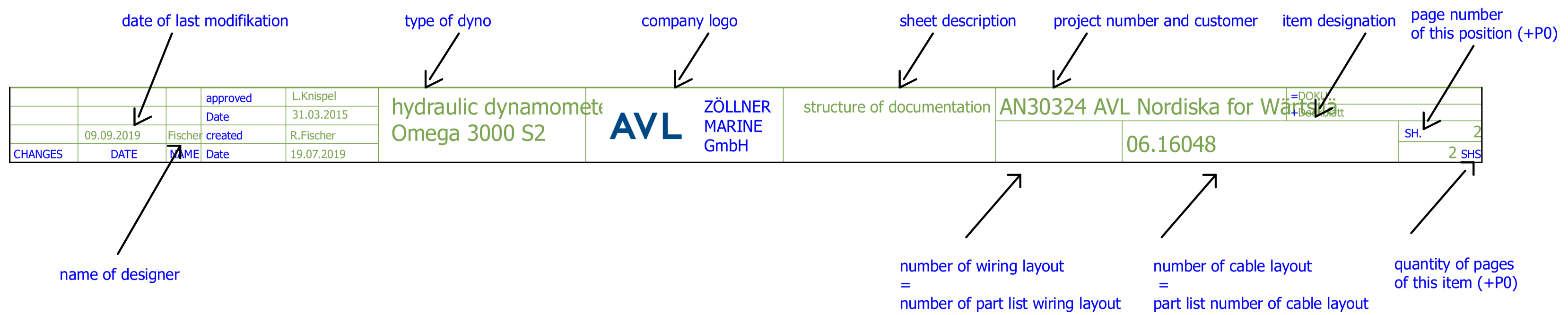
+P1	-Y1	B&R outlet valve1	=WO FB
	-Y2	B&R inlet valve 1	=WI FB
	-Y3	B&R outlet valve 2	=WO LB
	-Y4	B&R inlet valve 2	=WI LB
	-B2	DKE load cell	
	-B3	GEL speed pick up	
	-S5	TGS temperatur control cooling water outlet 1	
	-S6	TGS temperatur control cooling water outlet 2	

!!!

overwiev of instrumentation

+S1	-A1	F-FEM-CON 1
	-A2	F-FEM-CON 2
	-A3	controller / operating panel P400
	-A4	F-FEM-DIO
	-G1	power supply contol
	-G2	power supply lubrication

explanation of title block



			approved	L.Knispel	hydraulic dynamometer Omega 3000 S2	AVL ZÖLLNER MARINE	structure of documentation	AN30324 AVL Nordiska for Wärtsilä	=DOKU +Deckblatt
			Date	31.03.2015					
	09.09.2019	Fischer	created	R.Fischer				06.16048	SH. 2
CHANGES	DATE	NAME	Date	19.07.2019					2 SHS

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column X: automaticlly generated page was manually reworked

WUPJ007D 24.02.1994

D.- / U.-Art	attachment	installation place	page	page naming	page add on	date	editor	X
	DOKU	Deckblatt	1	Title page/cover sheet		09.09.2019	FISCHERO	
	DOKU	Deckblatt	2	structure of documentation		09.09.2019	R.Fischer	
	DOKU	Inhalt	1			09.09.2019	FISCHERO	
	DOKU	Inhalt	2			09.09.2019	FISCHERO	
	Omega	P0	1	interconnection diagram Dyno BME/EMCON 400 LSE 622		09.09.2019	FISCHERO	
	Omega	P0	2	interconnection diagram Dyno BME/EMCON 400 LSE 622		09.09.2019	FISCHERO	
	Omega	P0	3	interconnection diagram Dyno BME/EMCON 400 LSE 622		09.09.2019	FISCHERO	
	Omega	P1	1	hydraulic-dynamometer -assembly-		09.09.2019	FISCHERO	
	Omega	P1	2	electrical drawing speed pickup GEL 248		09.09.2019	FISCHERO	
	Omega	P1	3	electrical drawing loadcell		09.09.2019	FISCHERO	
	Omega	P1	4	electrical drawing monitoring		09.09.2019	FISCHERO	
	Omega	P1	5	electrical drawing BME 400/LSE622		09.09.2019	FISCHERO	
	Omega	P1	6	electrical drawing valve 1 (WOV)		09.09.2019	FISCHERO	
	Omega	P1	7	electrical drawing valve 2 (WIV)		09.09.2019	FISCHERO	
	Omega	P1	8	set of labeling OMEGA		09.09.2019	FISCHERO	
	Omega	S1	1	mounting panel Z3 12HE mechanical dimensions		09.09.2019	R.Fischer	
	Omega	S1	2	mounting panel Z3 12HE mounting of assambly aid		09.09.2019	R.Fischer	
	Omega	S1	3	mointing panel Z3 12HE mounting		09.09.2019	FISCHERO	
	Omega	S1	4	power supply		09.09.2019	FISCHERO	
	Omega	S1	5	electrical drawing control voltage		09.09.2019	FISCHERO	
	Omega	S1	6	electrical drawing F-FEM-CON1/BME4		09.09.2019	FISCHERO	
	Omega	S1	7	electrical drawing F-FEM-CON1/TUE5/F-FEM-DIO		09.09.2019	FISCHERO	
	Omega	S2	1	Title page/cover sheet		09.09.2019	FISCHERO	
	Omega	S2	2	specification of LSE 622		09.09.2019	R.Fischer	
	Omega	S2	3	LSE 622 cabinet assembly		09.09.2019	R.Fischer	
	Omega	S2	4	LSE 622 cabinet assembly		09.09.2019	R.Fischer	
	Omega	S2	5	LSE 622 block diagram		09.09.2019	R.Fischer	
	Omega	S2	6	LSE 622 servo amplifier valve 1		09.09.2019	R.Fischer	
	Omega	S2	7	LSE 622 servo amplifier valve 2		09.09.2019	R.Fischer	
	Omega	S2	8	LSE 622 voltage supply and cabinet cooling fan		09.09.2019	R.Fischer	

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CHANGES	DATE	NAME	Date	19.07.2019

hydraulic dynamometer
Omega 3000 S2

AVL ZÖLLNER MARINE

AN30324 AVL Nordiska for Wärtsilä

06.16048

=DOKU
+Inhalt

SH. 1
2 SHS

0 1 2 3 4 5 6 7 8 9

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CHANGES	DATE	NAME	Date	19.07.2019

hydraulic dynamometer
Omega 3000 S2

AVL
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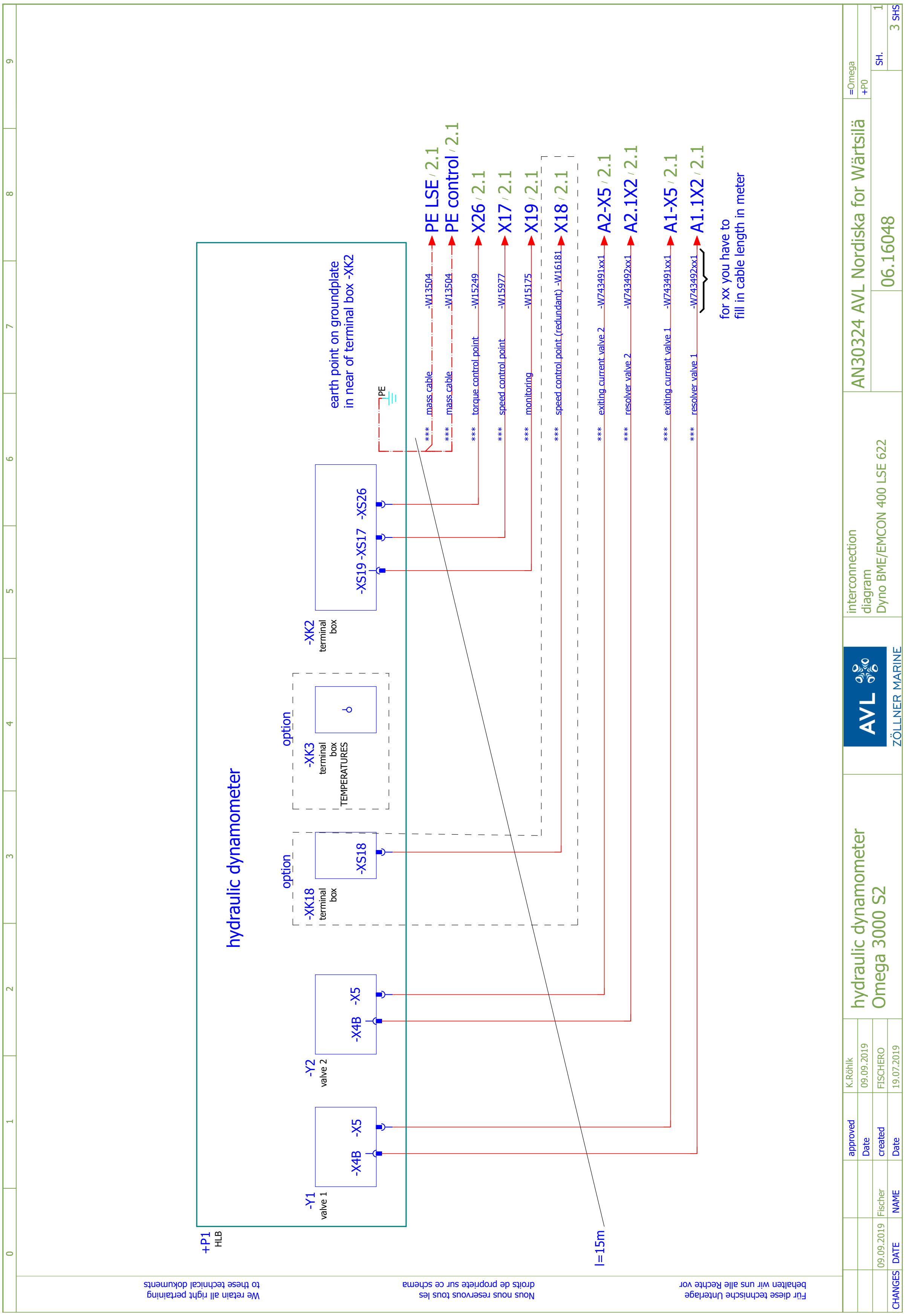
06.16048

=DOKU
+Inhalt
SH. 2
2 SHS


hydraulic dynamometer
+P1
HLB
-Y1
valve 1
-X4B -X5
-Y2
valve 2
-X4B -X5
option
-XK18
terminal
box
-XS18
option
-XK3
terminal
box
TEMPERATURES
-XK2
terminal
box
-XS19 -XS17 -XS26
earth point on groundplate
in near of terminal box -XK2
PE
*** mass cable -W13504 PE LSE / 2.1
*** mass cable -W13504 PE control / 2.1
*** torque control point -W15249 X26 / 2.1
*** speed control point -W15977 X17 / 2.1
*** monitoring -W15175 X19 / 2.1
*** speed control point (redundant) -W16181 X18 / 2.1
*** exiting current valve 2 -W743491xx1 A2-X5 / 2.1
*** resolver valve 2 -W743492xx1 A2.1X2 / 2.1
*** exiting current valve 1 -W743491xx1 A1-X5 / 2.1
*** resolver valve 1 -W743492xx1 A1.1X2 / 2.1
for xx you have to
fill in cable length in meter
l=15m
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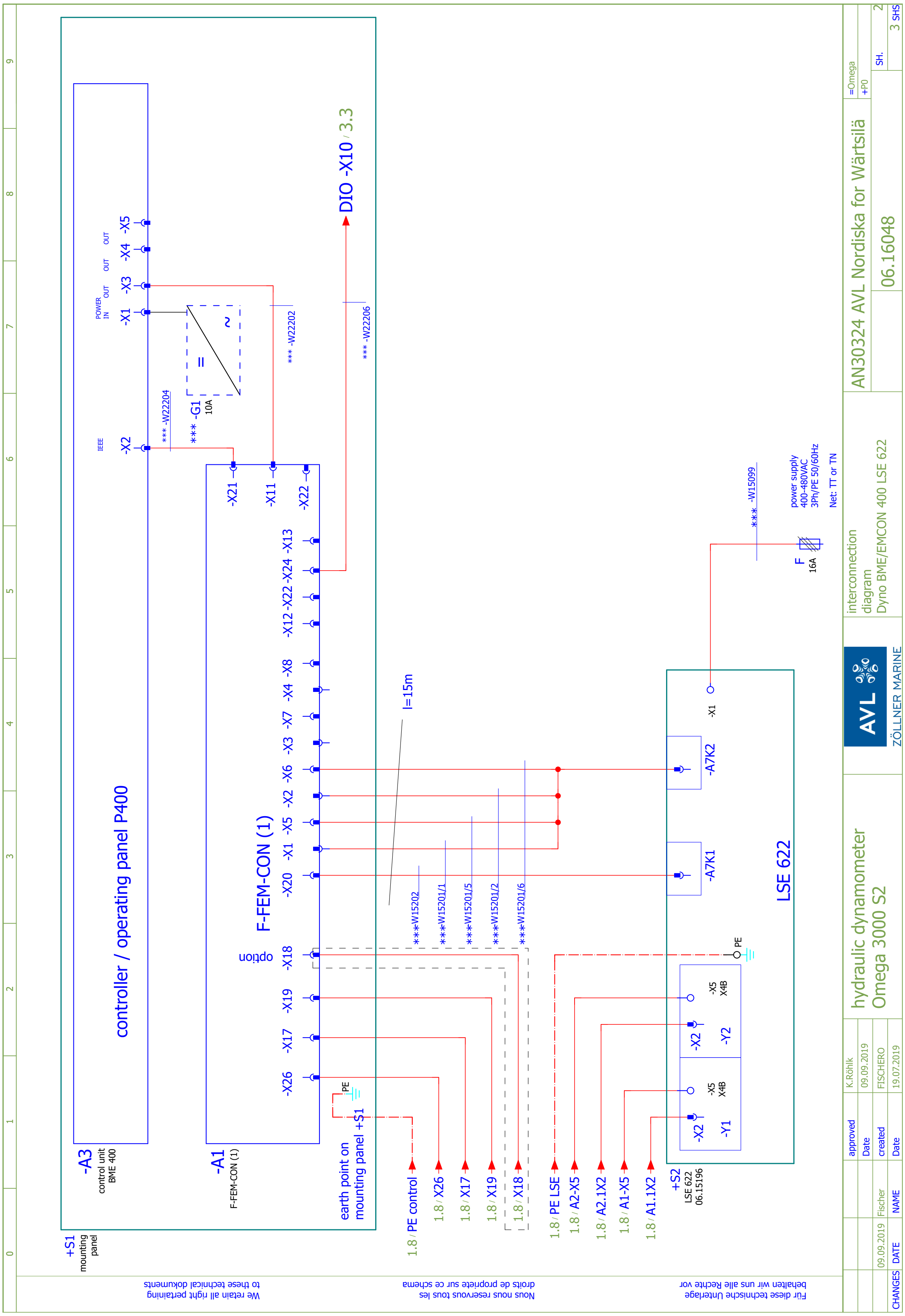
CHANGES DATE NAME
09.09.2019 Fischer
approved K.Röhlk
Date 09.09.2019
created FISCHERO
Date 19.07.2019
hydraulic dynamometer
Omega 3000 S2
AVL
ZÖLLNER MARINE
interconnection
diagram
Dyno BME/EMCON 400 LSE 622
AN30324 AVL Nordiska for Wärtsilä
06.16048
=Omega
+P0
SH. 1
3 SHS


controller / operating panel P400
-A3
control unit
BME 400
-A1
F-FEM-CON (1)
F-FEM-CON (1)
option
DIO -X10 / 3.3
l=15m
LSE 622
-A7K1
-A7K2
+S1
mounting panel
earth point on
mounting panel +S1
+S2
LSE 622
06.15196
power supply
400-480VAC
3Ph/PE 50/60Hz
Net: TT or TN
F
16A
1.8 / PE control
1.8 / X26
1.8 / X17
1.8 / X19
1.8 / X18
1.8 / PE LSE
1.8 / A2-X5
1.8 / A2.1X2
1.8 / A1-X5
1.8 / A1.1X2
hydraulic dynamometer
Omega 3000 S2
AVL
ZÖLLNER MARINE
interconnection
diagram
Dyno BME/EMCON 400 LSE 622
AN30324 AVL Nordiska for Wärtsilä
06.16048
=Omega
+P0
SH. 2
3 SHS
approved K.Röhlik
Date 09.09.2019
created FISCHERO
Date 19.07.2019
CHANGES DATE 09.09.2019 NAME Fischer
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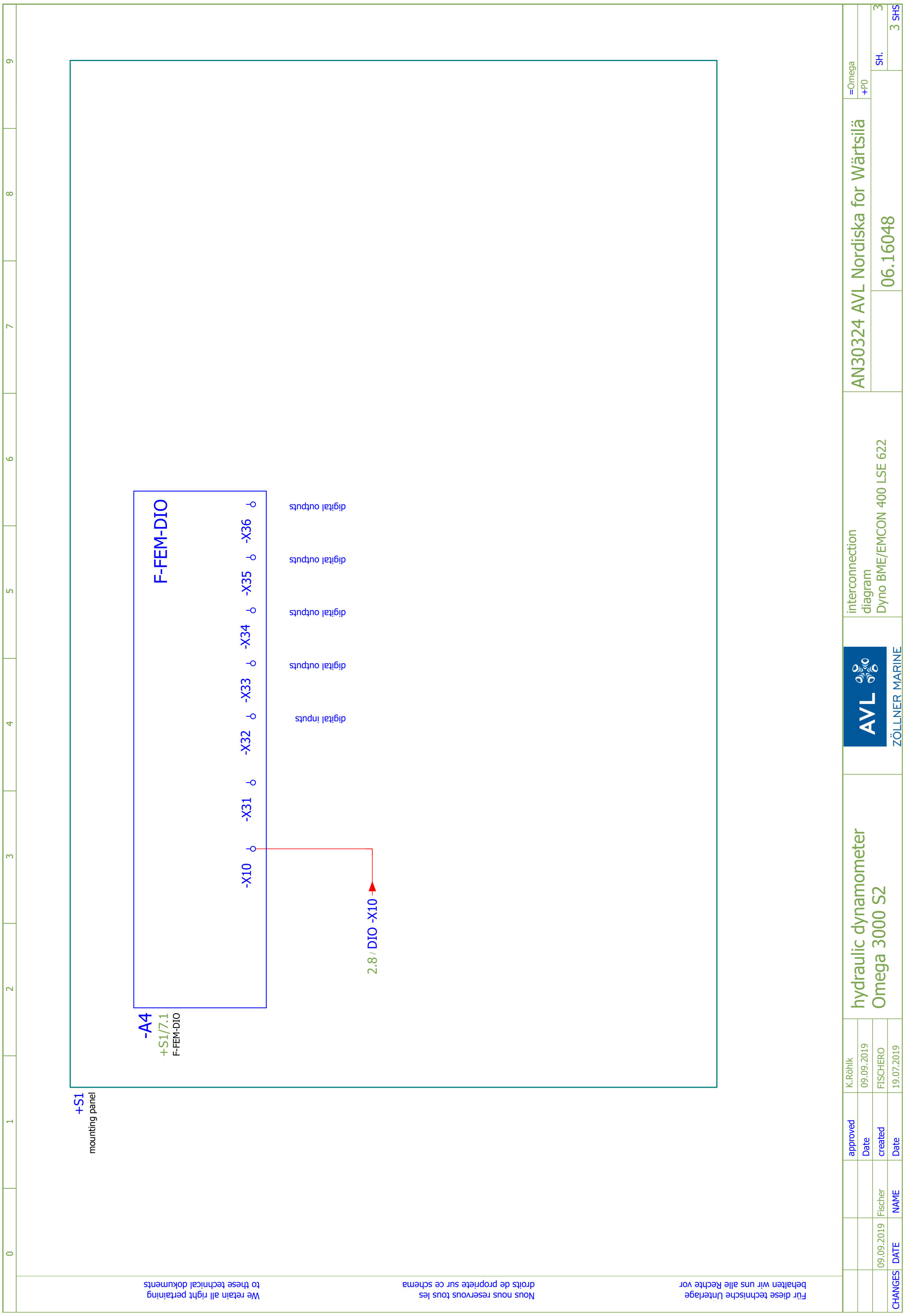
+S1
mounting panel
-A4
+S1/7.1
F-FEM-DIO
F-FEM-DIO
-X10
-X31
-X32
-X33
-X34
-X35
-X36
digital inputs
digital outputs
digital outputs
digital outputs
digital outputs
2.8 / DIO -X10
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CHANGES
DATE
NAME
09.09.2019
Fischer
approved
Date
created
Date
K.Röhlk
09.09.2019
FISCHERO
19.07.2019
hydraulic dynamometer
Omega 3000 S2
AVL
ZÖLLNER MARINE
interconnection
diagram
Dyno BME/EMCON 400 LSE 622
AN30324 AVL Nordiska for Wärtsilä
06.16048
=Omega
+P0
SH.
3
3 SHS

0 1 2 3 4 5 6 7 8 9

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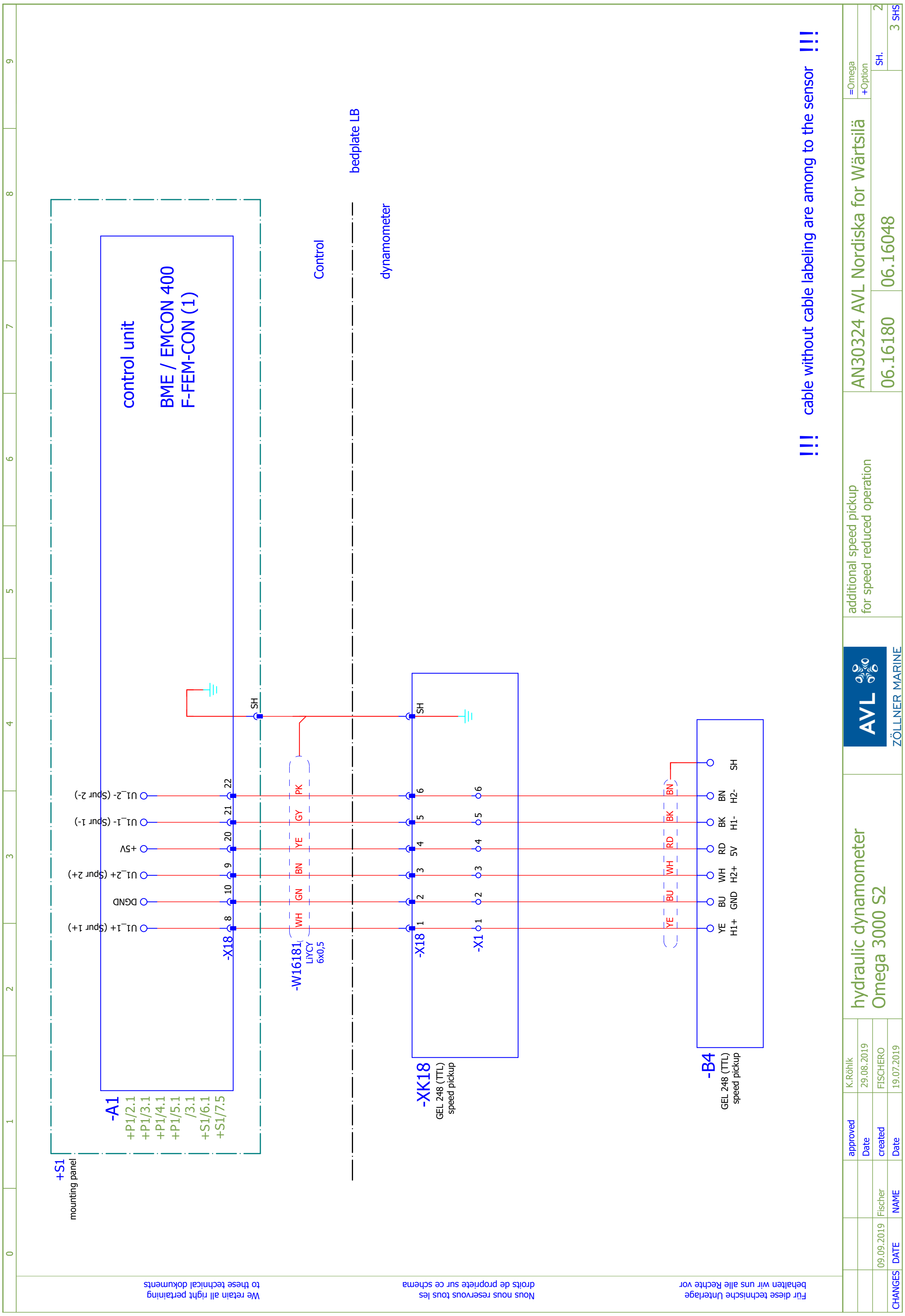
Speckenbeker Weg 143
24113 Kiel
+49 431 88702 – 0

project	:	hydraulic dynamometer Omega 3000 S2
commission	:	AN30324 AVL Nordiska for Wärtsilä
serial number :		FN 6134
manufacturer (cie)	:	AVL ZÖLLNER Marine GMBH

Edited: FISCHERO

date: 09.09.2019   number of pages : 36

			approved	K.Röhlk	hydraulic dynamometer Omega 3000 S2	AVL ZÖLLNER MARINE	Title page/cover sheet	AN30324 AVL Nordiska for Wärtsilä	=Omega +Option
			Date	29.08.2019					
	09.09.2019	Fischer	created	FISCHERO				06.16048	SH. 1
CHANGES	DATE	NAME	Date	19.07.2019					3 SHS


control unit
BME / EMCON 400
F-FEM-CON (1)
-A1
+P1/2.1
+P1/3.1
+P1/4.1
+P1/5.1
/3.1
+S1/6.1
+S1/7.5
+S1
mounting panel
UI_1+ (Spur 1+)
DGND
UI_2+ (Spur 2+)
+5V
UI_1- (Spur 1-)
UI_2- (Spur 2-)
-X18
SH
-W16181
LiYCY
6x0,5
WH GN BN YE GY PK
Control
dynamometer
bedplate LB
-XK18
GEL 248 (TTL)
speed pickup
-X1
-B4
GEL 248 (TTL)
speed pickup
YE BU WH RD BK BN
H1+ GND H2+ 5V H1- H2-
!!! cable without cable labeling are among to the sensor !!!
hydraulic dynamometer
Omega 3000 S2
additional speed pickup
for speed reduced operation
AVL
ZÖLLNER MARINE
AN30324 AVL Nordiska for Wärtsilä
06.16180
06.16048
=Omega
+Option
SH. 2
3 SHS
approved
K.Röhlk
Date
29.08.2019
created
FISCHERO
Date
19.07.2019
09.09.2019
Fischer
CHANGES
DATE
NAME
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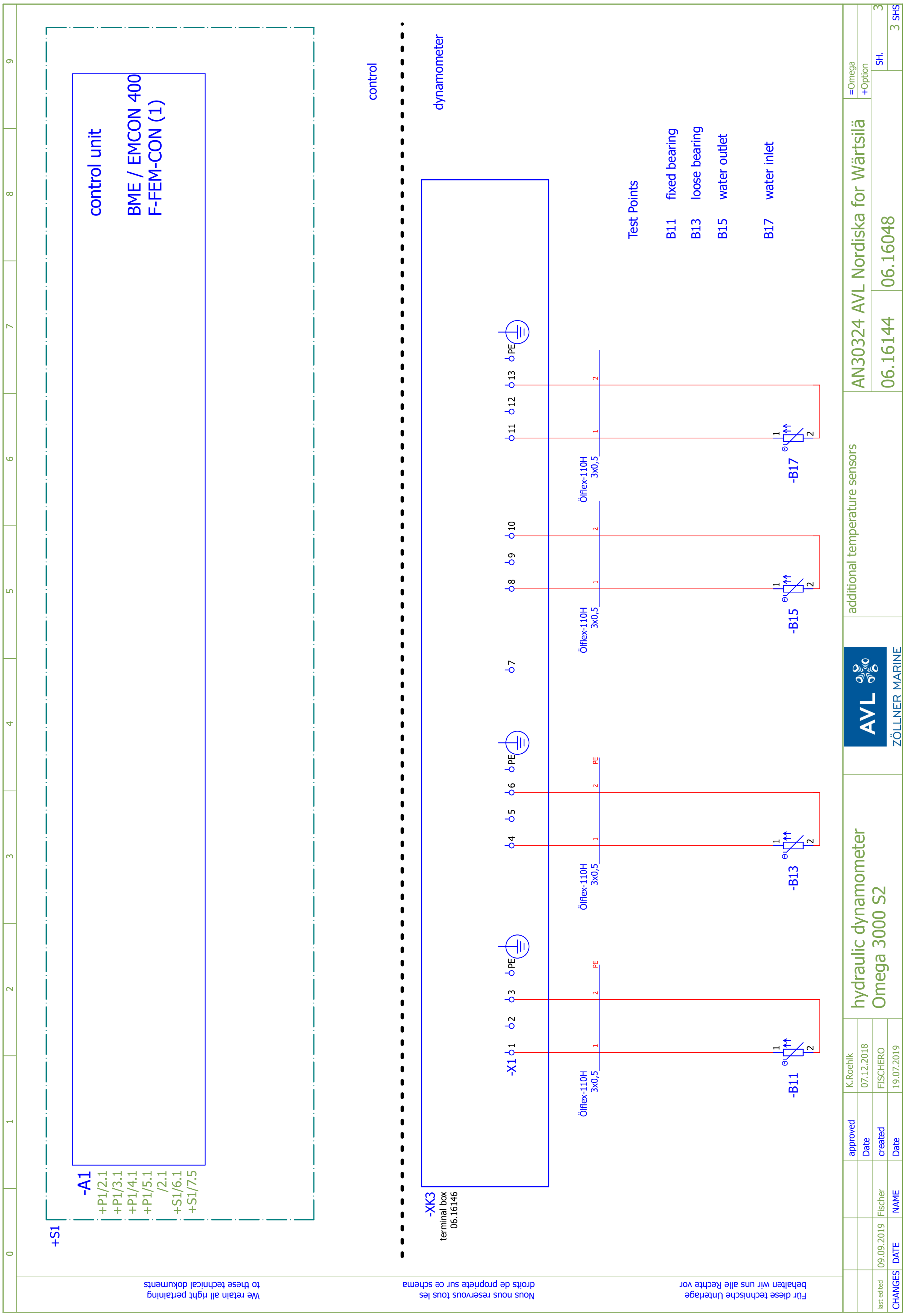
control unit
BME / EMCON 400
F-FEM-CON (1)
-A1
+P1/2.1
+P1/3.1
+P1/4.1
+P1/5.1
/2.1
+S1/6.1
+S1/7.5
+S1
control
dynamometer
-XK3
terminal box
06.16146
-X1
1
2
3
PE
4
5
6
PE
7
8
9
10
11
12
13
PE
Ölflex-110H
3x0,5
-B11
-B13
-B15
-B17
Test Points
B11 fixed bearing
B13 loose bearing
B15 water outlet
B17 water inlet
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last edited 09.09.2019 Fischer
CHANGES DATE NAME
approved K.Roehlk
Date 07.12.2018
created FISCHERO
Date 19.07.2019
hydraulic dynamometer
Omega 3000 S2
AVL
ZÖLLNER MARINE
additional temperature sensors
AN30324 AVL Nordiska for Wärtsilä
06.16144
06.16048
=Omega
+Option
SH. 3
3 SHS

0	1	2	3	4	5	6	7	8	9

ARNON.

Hyllilänkatu 15
33730 Tampere, Finland
Tel: +358 10 526 5000
www.ARNON.fi

Customer	WÄRTSILÄ	AC Input: -
Project description	DMCASBUI505-A, FIREWALL UNIT CCG COLLEGE	Frequency: -
Job number	3014490 (DAE200179)	DC Input: 24VDC
		Degree of protection: NEMA 4
		FLA: -
		Largest motor: -
		SCCR: -

Created on	27.10.2020		
Edit date	11.11.2020	by (short name) MHe	Number of pages: 8

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			Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Title page / cover sheet	DAE200179	= 3	
			User	MHe					+	
			Checked		DMCASBUI505-A, FIREWALL UNIT CCG COLLEGE			3014490 (DAE200179)	Page	1
Revision	Date	User	Approved						Page	8

0 1 2 3 4 5 6 7 8 9

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Sheet	Page description	Date	REV.
1	Summarized parts list : RIT.2393210 - PXC.3209549		
2	Summarized parts list : PXC.3030488 - PXC.1417274		
1	Title page / cover sheet		
2	Table of contents : /1 - =3/10		
3	Layout		JoM
4	Layout		JoM
5	Circuit diagram		JoM
6	Circuit diagram		JoM
7	Circuit diagram		JoM
8	Parts list : RIT.2393210 - PXC.1417274		
9	Summarized parts list : RIT.2393210 - PXC.3209549		
10	Summarized parts list : PXC.3030488 - PXC.1417274		

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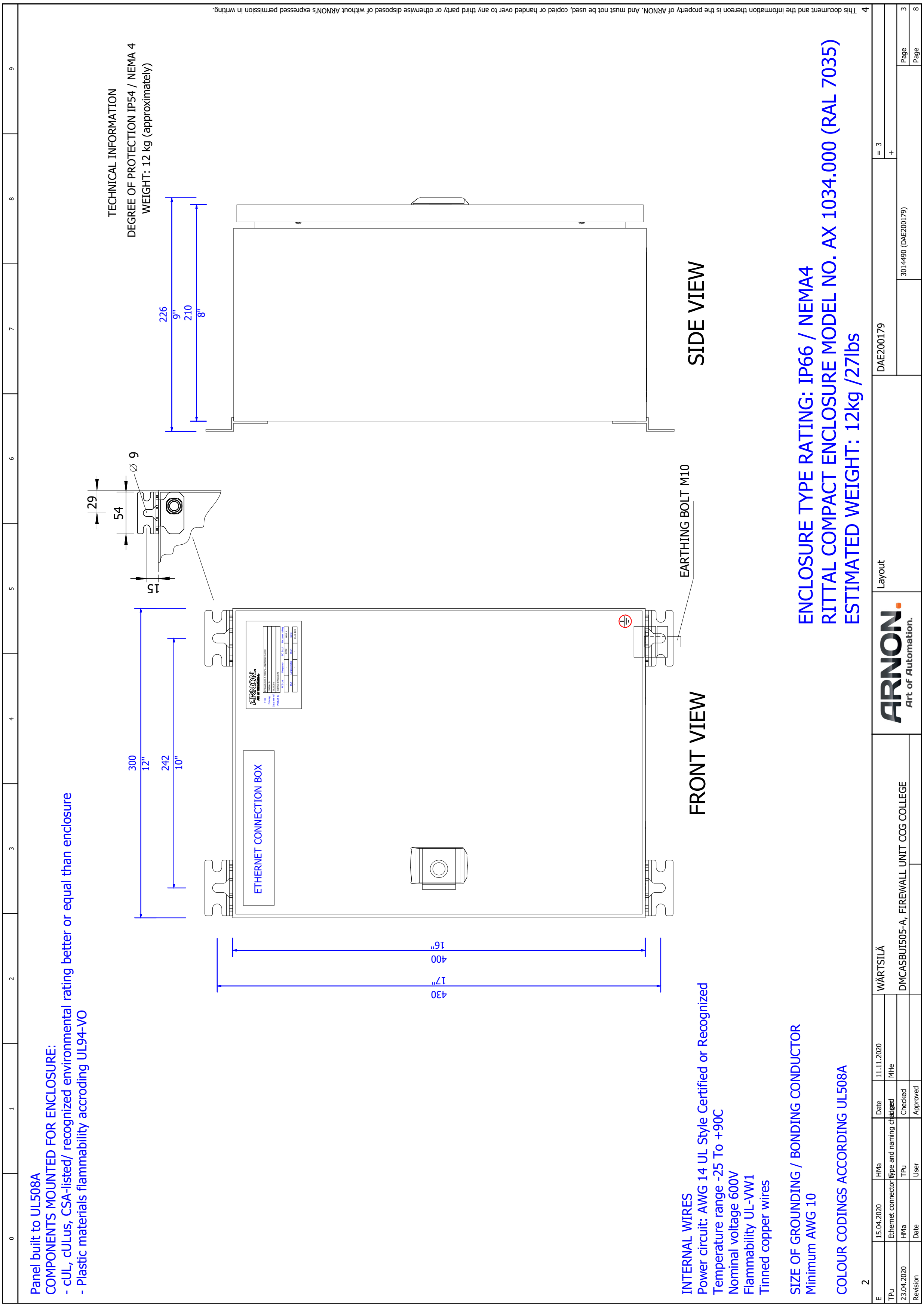
1 3

			Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Table of contents : /1 - =3/10	DAE200179 = 3
			User	MHe				+
			Checked		DMCASBUI505-A, FIREWALL UNIT CCG COLLEGE			3014490 (DAE200179) Page 2
Revision	Date	User	Approved					Page 8


Panel built to UL508A
COMPONENTS MOUNTED FOR ENCLOSURE:
- cUL, cULus, CSA-listed/ recognized environmental rating better or equal than enclosure
- Plastic materials flammability accroding UL94-VO
TECHNICAL INFORMATION
DEGREE OF PROTECTION IP54 / NEMA 4
WEIGHT: 12 kg (approximately)
226
9"
210
8"
29
54
⌀ 9
15
300
12"
242
10"
ETHERNET CONNECTION BOX
16"
400
17"
430
EARTHING BOLT M10
FRONT VIEW
SIDE VIEW
INTERNAL WIRES
Power circuit: AWG 14 UL Style Certified or Recognized
Temperature range -25 To +90C
Nominal voltage 600V
Flammability UL-VW1
Tinned copper wires
SIZE OF GROUNDING / BONDING CONDUCTOR
Minimum AWG 10
COLOUR CODINGS ACCORDING UL508A
ENCLOSURE TYPE RATING: IP66 / NEMA4
RITTAL COMPACT ENCLOSURE MODEL NO. AX 1034.000 (RAL 7035)
ESTIMATED WEIGHT: 12kg /27lbs
ARNON. Art of Automation.
WÄRTSILÄ
DMCASBUI505-A, FIREWALL UNIT CCG COLLEGE
Layout
DAE200179
3014490 (DAE200179)
= 3
+
Page 3
Page 8
15.04.2020 HMa
Date 11.11.2020
Ethernet connector type and naming changed
MHe
23.04.2020 HMa TPu
Revision Date User Checked Approved
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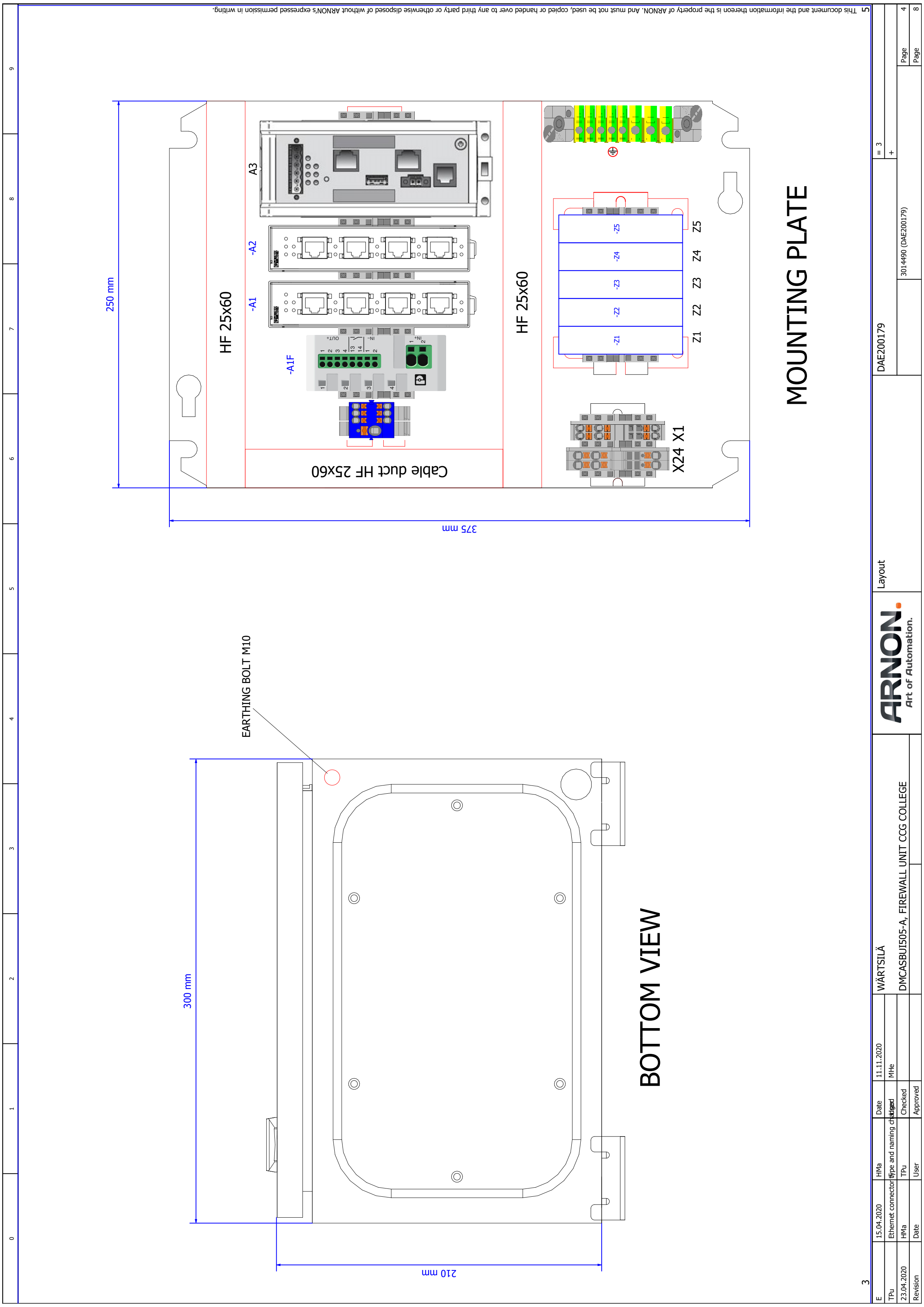
MOUNTING PLATE
BOTTOM VIEW
250 mm
375 mm
300 mm
210 mm
HF 25x60
HF 25x60
Cable duct HF 25x60
A3
-A2
-A1
-A1F
Z1
Z2
Z3
Z4
Z5
X24 X1
EARTHING BOLT M10
Layout
DAE200179
WÄRTSILÄ
DMCASBUI505-A, FIREWALL UNIT CCG COLLEGE
ARNON Art of Automation.
3014490 (DAE200179)
Date
11.11.2020
15.04.2020
HMa
MHe
TPu
Ethernet connector type and naming changed
23.04.2020
Checked
Approved
Revision
Date
User
Page
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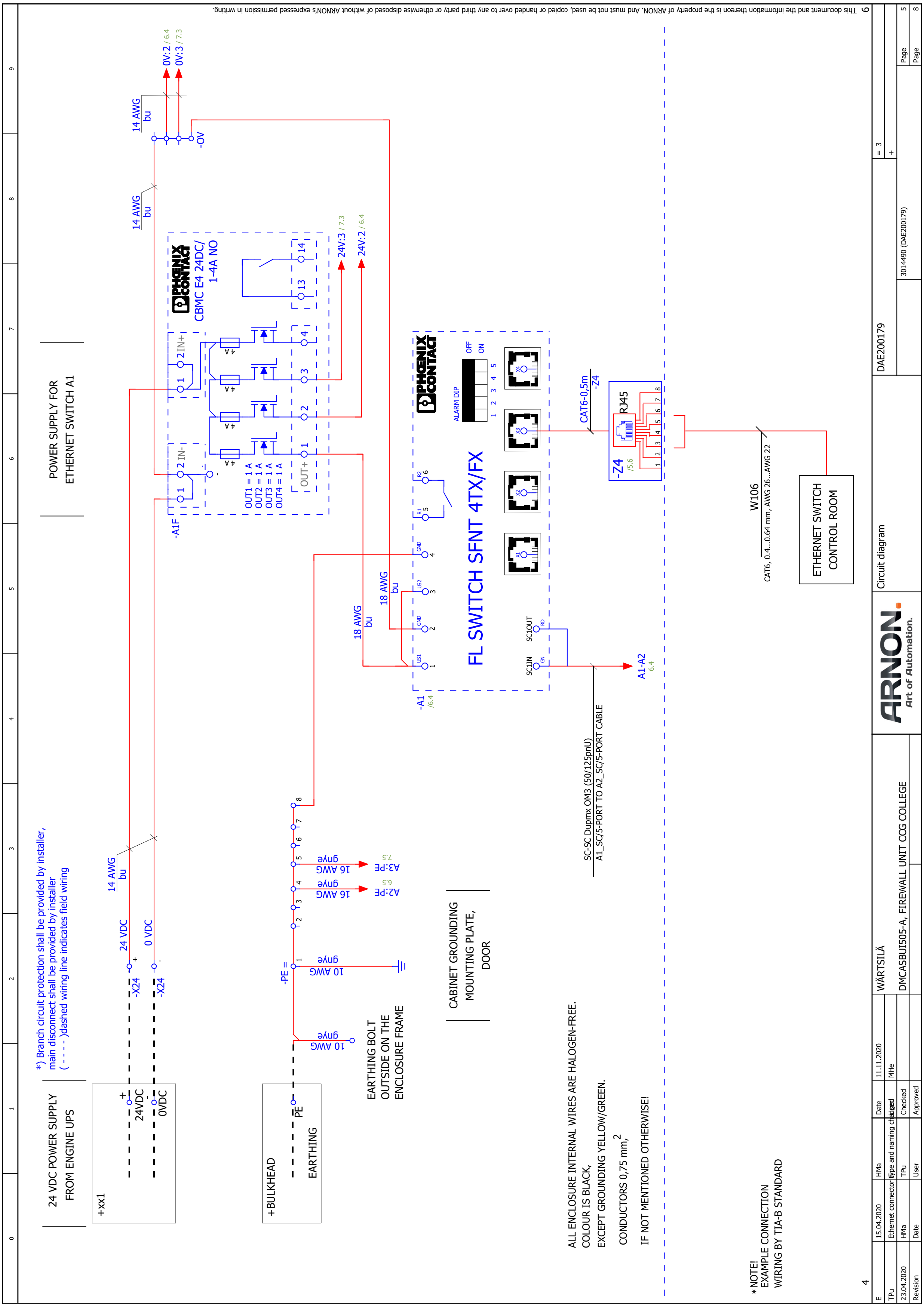
POWER SUPPLY FOR ETHERNET SWITCH A1
24 VDC POWER SUPPLY FROM ENGINE UPS
*) Branch circuit protection shall be provided by installer, main disconnect shall be provided by installer (- - - -)dashed wiring line indicates field wiring
+xx1
24VDC
0VDC
-X24
24 VDC
0 VDC
14 AWG
bu
+BULKHEAD
EARTHING
PE
-PE
10 AWG
gnye
16 AWG
A2:PE
A3:PE
EARTHING BOLT OUTSIDE ON THE ENCLOSURE FRAME
CABINET GROUNDING MOUNTING PLATE, DOOR
-A1F
PHOENIX CONTACT
CBMC E4 24DC/ 1-4A NO
OUT1 = 1 A
OUT2 = 1 A
OUT3 = 1 A
OUT4 = 1 A
24V:3
24V:2
0V:2
0V:3
-0V
18 AWG
-A1
FL SWITCH SFNT 4TX/FX
ALARM DIP
OFF
ON
SCIIN
SCIOUT
A1-A2
SC-SC Dupmx OM3 (50/125µm) A1_SC/5-PORT TO A2_SC/5-PORT CABLE
CAT6-0,5m
-Z4
RJ45
W106
CAT6, 0.4...0.64 mm, AWG 26...AWG 22
ETHERNET SWITCH CONTROL ROOM
ALL ENCLOSURE INTERNAL WIRES ARE HALOGEN-FREE. COLOUR IS BLACK, EXCEPT GROUNDING YELLOW/GREEN. CONDUCTORS 0,75 mm², IF NOT MENTIONED OTHERWISE!
* NOTE! EXAMPLE CONNECTION WIRING BY TIA-B STANDARD
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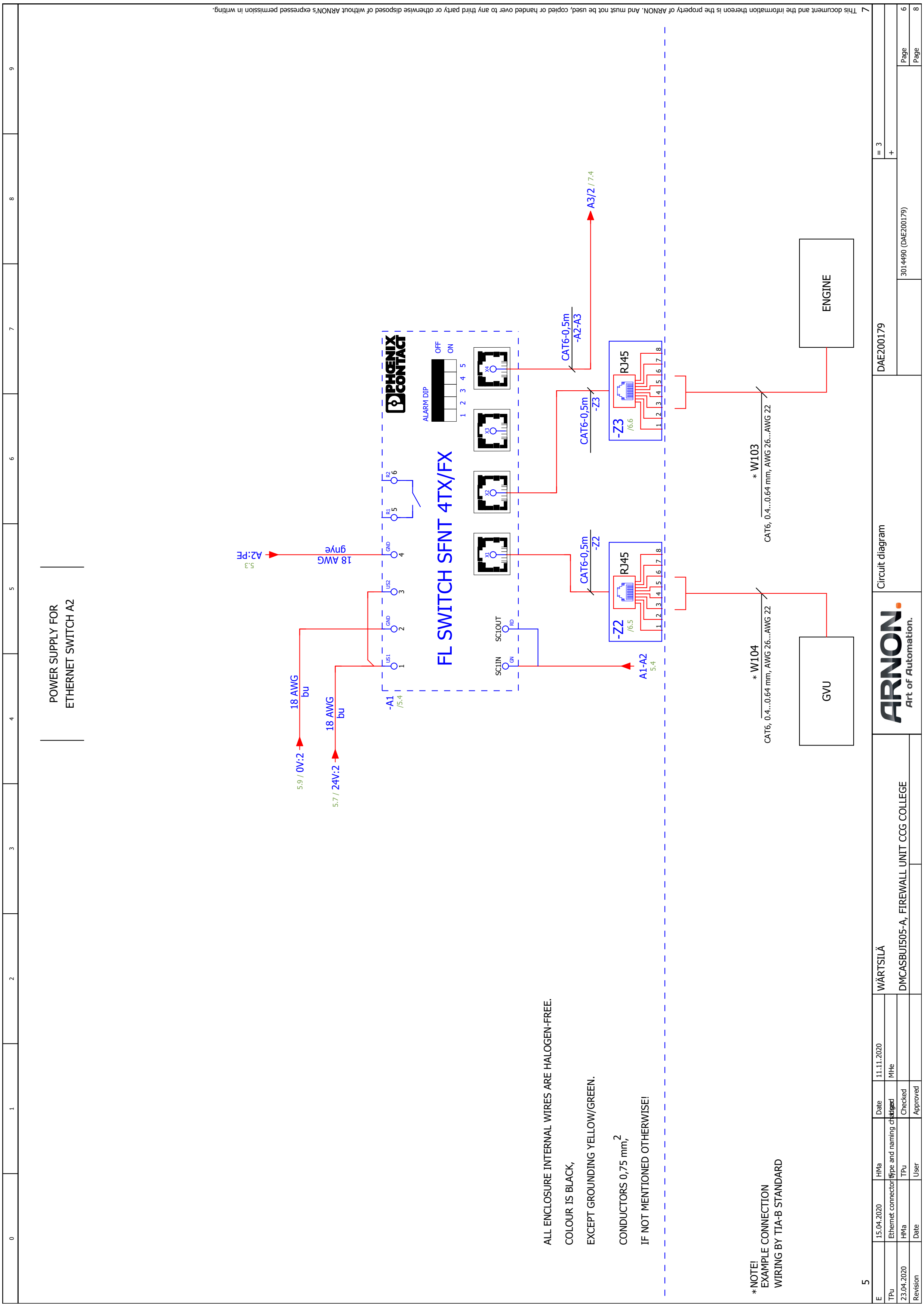
ARNON Art of Automation
WÄRTSILÄ
DMCASBUI505-A, FIREWALL UNIT CCG COLLEGE
Circuit diagram
DAE200179
3014490 (DAE200179)
Ethernet connection type and naming changed
15.04.2020
11.11.2020
23.04.2020
HMa
MHe
TPu
Date
Checked
Approved
Revision
User
Page


POWER SUPPLY FOR
ETHERNET SWITCH A2
FL SWITCH SFNT 4TX/FX
PHOENIX CONTACT
ALARM DIP
OFF
ON
-A1
/5.4
18 AWG
bu
0V:2
5.9
24V:2
5.7
18 AWG
gnye
A2:PE
5.3
A1-A2
5.4
CAT6-0,5m
-Z2
CAT6-0,5m
-Z3
CAT6-0,5m
-A2-A3
A3/2
7.4
-Z2
/6.5
RJ45
-Z3
/6.6
RJ45
* W104
CAT6, 0.4...0.64 mm, AWG 26...AWG 22
* W103
CAT6, 0.4...0.64 mm, AWG 26...AWG 22
GVU
ENGINE
ALL ENCLOSURE INTERNAL WIRES ARE HALOGEN-FREE.
COLOUR IS BLACK,
EXCEPT GROUNDING YELLOW/GREEN.
CONDUCTORS 0,75 mm²
IF NOT MENTIONED OTHERWISE!
* NOTE!
EXAMPLE CONNECTION
WIRING BY TIA-B STANDARD
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ARNON Art of Automation.
Circuit diagram
DAE200179
WÄRTSILÄ
DMCASBUI505-A, FIREWALL UNIT CCG COLLEGE
3014490 (DAE200179)
15.04.2020
HMa
Ethernet connector type and naming changed
23.04.2020
TPu
Date 11.11.2020
MHe
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Date
User
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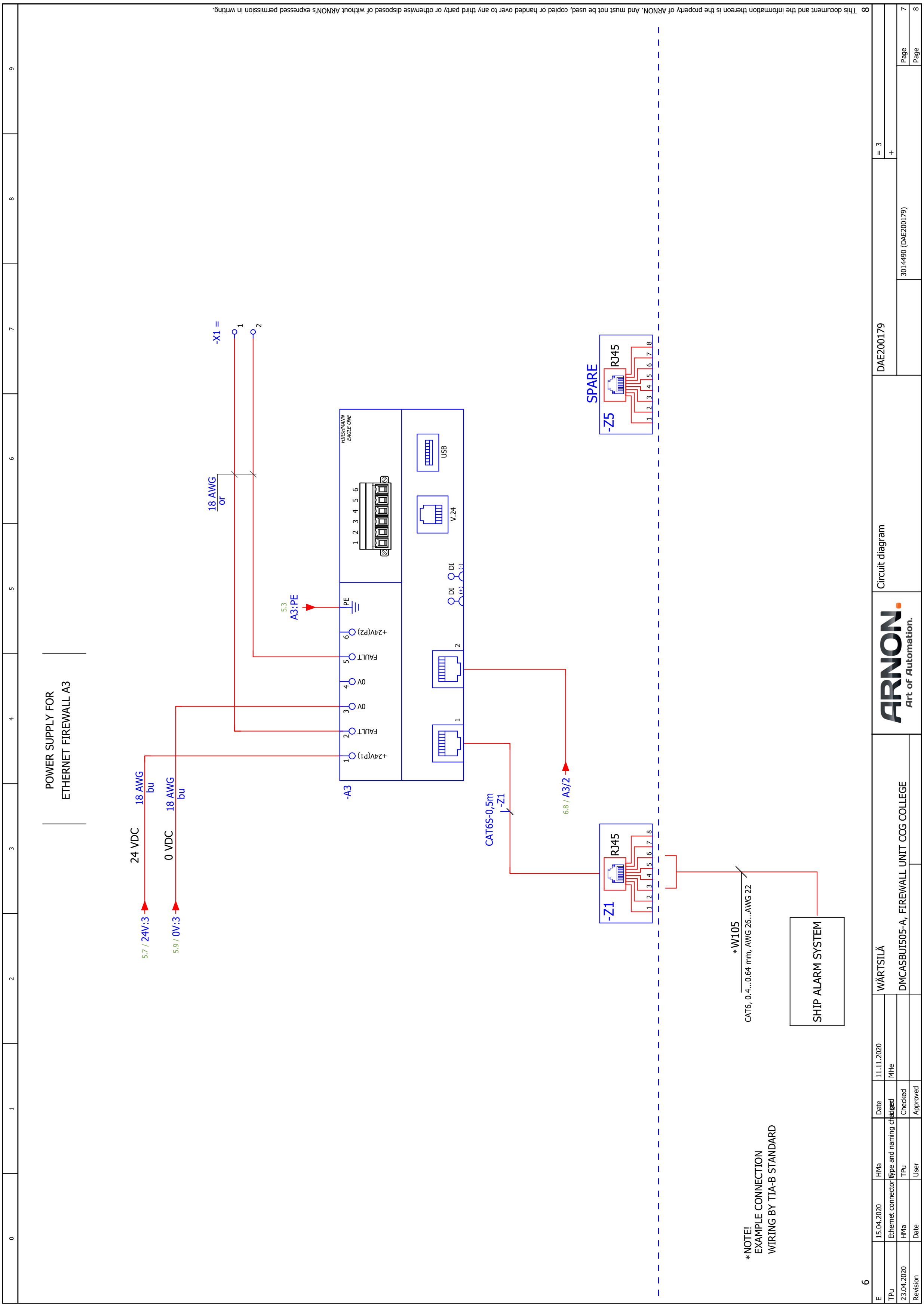
POWER SUPPLY FOR
ETHERNET FIREWALL A3
24 VDC
0 VDC
18 AWG
bu
18 AWG
bu
5.7 / 24V:3
5.9 / 0V:3
-A3
+24V(P1)
FAULT
0V
0V
FAULT
+24V(P2)
PE
5.3
A3:PE
18 AWG
or
-X1 =
HIRSCHMANN
EAGLE ONE
USB
V.24
DI
DI
CAT6S-0,5m
-Z1
6.8 / A3/2
-Z1
RJ45
-Z5
SPARE
RJ45
*W105
CAT6, 0.4...0.64 mm, AWG 26...AWG 22
SHIP ALARM SYSTEM
*NOTE!
EXAMPLE CONNECTION
WIRING BY TIA-B STANDARD
WÄRTSILÄ
DMCASBUI505-A, FIREWALL UNIT CCG COLLEGE
Circuit diagram
DAE200179
3014490 (DAE200179)
Art of Automation.
15.04.2020
HMa
Date
11.11.2020
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Ethernet connector type and naming changed
TPu
23.04.2020
Revision
Date
User
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= 3
+
Page 7
Page 8
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0	1	2	3	4	5	6	7	8	9

Parts list

F01_001

Device tag	Quantity	Designation	Type number	Supplier	Part number
	1	AX Rail for interior installation, for D: 210 mm,	AX.2393210		RIT.2393210
-*SBUI505	1	AX Compact enclosure, WHD: 300x400x210 mm, sheet steel	AX.1034000	RIT	RIT.1034000
-*SBUI505	4	Wall mounting bracket	AX.2508020	RIT	RIT.2508020
-*SBUI505	1	AX Rail for interior installation, for D: 210 mm,	AX.2393210		RIT.2393210
-*SBUI505	1	Door stay for AX	AX.2519010	RIT	RIT.2519010
-*SBUI505	1	Cable duct	CD-HF 25X60	PXC	PXC.3240342
-*SBUI505	2	Angled brackets	BG/S		PXC.1201086
-*SBUI505	1	DIN rail perforated	NS 35/15 ZN PERF 2000MM	PXC	PXC.1206599
-*SBUI505	12	End clamp	CLIPFIX 35-5 V0	PXC	PXC.3032350
-A1	2	Industrial Ethernet Switch	FL SWITCH SFNT 4TX/FX	PXC	PXC.2891004
-A1	1	Industrial Ethernet Switch	FL SWITCH SFNT 4TX/FX	PXC	PXC.2891004(Arnon layout)
-A1F	1	Electronic device circuit breaker	CBMC E4 24DC/1-4A NO	PXC	PXC.2906031
-A2	1	Industrial Ethernet Switch	FL SWITCH SFNT 4TX/FX	PXC	PXC.2891004(Arnon layout)
-A3	1	Industrial firewall and security router	EAGLE ONE	HIRSCHMANN	HIR.EAGLE ONE
-ENCLOSURE	1	SZ Wiring plan pocket, plastic, DIN A4, portrait	SZ.2514000	RIT	RIT.2514000
-PE	3	Connection terminal block	AKG 16 GNYE	PXC	PXC.0423027
-PE	5	Connection terminal block	AKG 4 GNYE	PXC	PXC.0421029
-PE	1	Neutral busbar	NLS-CU 3/10 SN 1000MM	PXC	PXC.0402174
-PE	2	Support bracket	AB/SS	PXC	PXC.0404428
-X1	1	Terminal strip marking	KLM 3	PXC	PXC.0811969
-X1	2	Feed-through terminal block	PT 2,5-TWIN	PXC	PXC.3209549
-X1	1	End cover	D-ST 2,5-TWIN	PXC	PXC.3030488
-X24	2	Feed-through terminal block	PT 4-TWIN	PXC	PXC.3211771
-X24	2	End cover	D-PT 4-TWIN	PXC	PXC.3208977
-X26	1	Distribution block	PTFIX 6/6X2,5-NS35A BU	PXC	PXC.3273200
-Z1	1	DIN rail adapter	NBC-PP-G1PGY		PXC.1041740
-Z1	1	RJ45 socket insert	CUC-I-J1ZNI-S/R4IDC8		PXC.1417274
-Z2	1	DIN rail adapter	NBC-PP-G1PGY		PXC.1041740
-Z2	1	RJ45 socket insert	CUC-I-J1ZNI-S/R4IDC8		PXC.1417274
-Z3	1	DIN rail adapter	NBC-PP-G1PGY		PXC.1041740
-Z3	1	RJ45 socket insert	CUC-I-J1ZNI-S/R4IDC8		PXC.1417274
-Z4	1	DIN rail adapter	NBC-PP-G1PGY		PXC.1041740
-Z4	1	RJ45 socket insert	CUC-I-J1ZNI-S/R4IDC8		PXC.1417274
-Z5	1	DIN rail adapter	NBC-PP-G1PGY		PXC.1041740
-Z5	1	RJ45 socket insert	CUC-I-J1ZNI-S/R4IDC8		PXC.1417274

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7

=LAYOUT DIM/1

			Date	11.11.2020	WÄRTSILÄ	ARNON. Art of Automation.	Parts list : RIT.2393210 - PXC.1417274	DAE200179		= 3
			User	MHe						+
			Checked		DMCASBUI505-A, FIREWALL UNIT CCG COLLEGE				3014490 (DAE200179)	Page 8
Revision	Date	User	Approved							Page 8

11. ANNEX

11.1 Unit conversion tables

The tables below will help you to convert units used in this product guide to other units. Where the conversion factor is not accurate a suitable number of decimals have been used.

Table 11-1 Length conversion factors

Convert from	To	Multiply by
mm	in	0.0394
mm	ft	0.00328

Table 11-2 Mass conversion factors

Convert from	To	Multiply by
kg	lb	2.205
kg	oz	35.274

Table 11-3 Pressure conversion factors

Convert from	To	Multiply by
kPa	psi (lbf/in^2)	0.145
kPa	lbf/ft^2	20.885
kPa	inch H_2O	4.015
kPa	foot H_2O	0.335
kPa	mm H_2O	101.972
kPa	bar	0.01

Table 11-4 Volume conversion factors

Convert from	To	Multiply by
m^3	in^3	61023.744
m^3	ft^3	35.315
m^3	Imperial gallon	219.969
m^3	US gallon	264.172
m^3	l (litre)	1000

Table 11-5 Power conversion factors

Convert from	To	Multiply by
kW	hp (metric)	1.360
kW	US hp	1.341

Table 11-6 Moment of inertia and torque conversion factors

Convert from	To	Multiply by
kgm^2	lbft^2	23.730
kNm	lbf ft	737.562

Table 11-7 Fuel consumption conversion factors

Convert from	To	Multiply by
g/kWh	g/hph	0.736
g/kWh	lb/hph	0.00162

Table 11-8 Flow conversion factors

Convert from	To	Multiply by
m^3/h (liquid)	US gallon/min	4.403
m^3/h (gas)	ft^3/min	0.586

Table 11-9 Temperature conversion factors

Convert from	To	Calculate
°C	F	F = 9/5 *C + 32
°C	K	K = C + 273.15

Table 11-10 Density conversion factors

Convert from	To	Multiply by
kg/m^3	lb/US gallon	0.00834
kg/m^3	lb/Imperial gallon	0.01002
kg/m^3	lb/ft^3	0.0624

11.1.1 Prefix

Table 11-11 The most common prefix multipliers

Name	Symbol	Factor
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}

11.2 Abbreviations

NOTE

The abbreviation list below are common abbreviations used in Wärstilä Coorporation documentation.

Not all abbreviations listed here will be found in your document.

Abbreviations	Explanations
A	
ABB	ASEA Brown Boveri
ABP	Air By-Pass ventilation
AC	Aftercooler
ASD	Anti-surge device
AWG	Air Wastegate
B	
BDC	Bottom Dead Centre
BFO	Bunker fuel oil

Abbreviations	Explanations
BN	Base Number
BMEP	Break Mean Effective Pressure
BSEC	Brake Specific Energy Consumption
BWT	Ballast Water Treatment
C	
CAC	Charge Air Cooler
CASS	Combustion Air Saturation System
CBF	Common base frame
CBM	Condition Based Operation and Maintenance
CCAI	Calculated Carbon Aromaticity Index
CCW	Counter Clockwise rotating
CD	Compressor drive
CPP	Controllable pitch propeller
CR	Common Rail
CRO	Crude Oil
CS	Constant speed
CSR	Continuos Service Rating
cSt	centi-Stoke (kinematic viscosity)
CW	Clockwise rotating
D	
DDS	Document Delivery Schedule
DE	Driving End or Diesel Electric
DF	Dual-Fuel
DWI	Direct Water Injection
E	
EAS	Extension Alarm System
ECA	Emission Control Area
ECR	Engine Control Room
EIAPP	Engine International Air Pollution Prevention
ESD	Emergency Shutdown
EWG	Exhaust Gas Wastegate
F	
FCV	Flow Control Valve
FE	Free End
FO	Fuel Oil
FPP	Fixed Pitch Propeller
FTC	Field Termination Cabinet

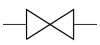
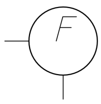
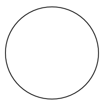
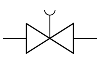
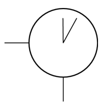
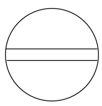
Abbreviations	Explanations
FWE	Flywheel End
G	
GD	Gas Diesel
GVU	Gas valve unit
GW	Glycol water
H	
HAM	Humid Air Motor
HC	Hot Combustion
HFO	Heavy Fuel Oil
HMI	Human Machine Interface
HT	High Temperature
HP	High Pressure
I	
IC	Intercooler
IHM	Inventory of Hazardous Material
IM	Installation Manual
IMO	International Maritime Organisation
I/O	Input/Output
IPI	Installation Planning Insructions
ISO	International Standard Organisation
L	
LBF	Liquid Bio Fuel
LCP	Local Control Panel
LD	Location Driving end (turbocharger)
LF	Location Free end (turbocharger)
LFO	Light Fuel Oil
LI	Level Indicator
LN	Low Nox
LNG	Liquefied Natural Gas
LO	Lubricating Oil
LOC	Lubricating Oil Cooler
LOM	Lubricating Oil Module
LP	Low Pressure
LPG	Liquefied Petroleum Gas
LT	Low Temperature
N	
NA	Napier turbocharger

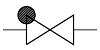
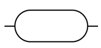
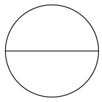
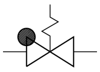
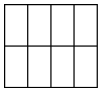
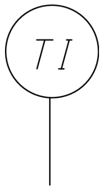
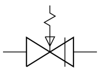
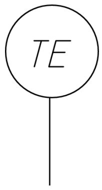
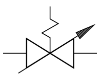
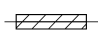
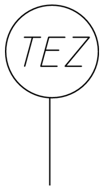
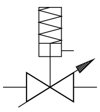
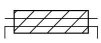
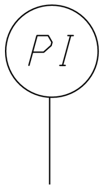
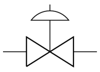
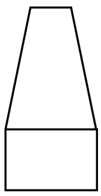
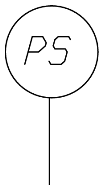
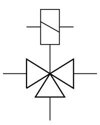
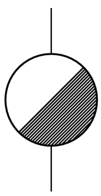
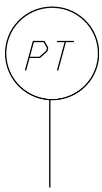
Abbreviations	Explanations
NECA	NOx Emission Control Area
NG	Natural Gas
M	Maximum allowable relief valve setting
MARVS	
MCR	Maximum Continuous Rating
MDF	Marine Diesel Fuel
MDO	Marine Diesel Oil
MGE	Main gas evaporator
MGO	Marine Gas Oil
MN	Methane Number
O	
ORI	Orimulsion
P	
Pa	Pascal
PBE	Pressure build-up evaporator
PG	Product Guide
PI	Pressure Indicator
PLC	Programmable Logic Controller
PM	Performance Maual
PMS	Power Management System
POPRV	Pilot operated pressure relief valve
ppm	parts per million
PRV	Pressure relief valve
PTI	Power take-in
PTO	Power take-off
R	
RO	Reverse Osmosis
S	SOx Emission Control Area
SCR	Selective Catalytic Reduction
SD	System Description
SECA	
SFOC	Specific Fuel Oil Consumption
SG	Spark-ignited Gas
SLOC	Specific Lubricating Oil Consumption
SOI	Start of Injection
SPEX	Single Pipe Exhaust System
SSV	Start-up and Safety Valve

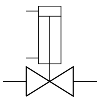
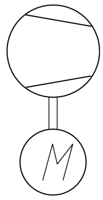
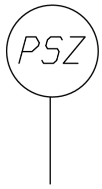
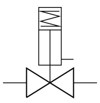
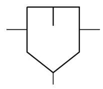
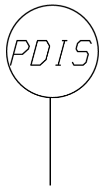
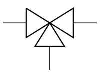
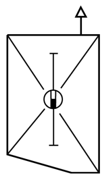
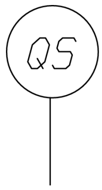
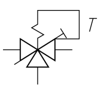
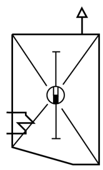
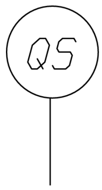
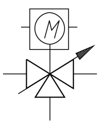
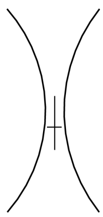
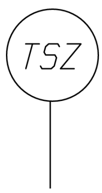
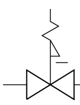
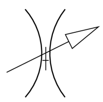
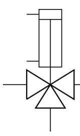
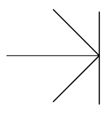
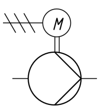
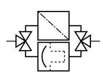
Abbreviations	Explanations
STID	Steam Injection
T	
TBO	Time Between Overhauls
TC	Turbocharger
TCS	Tank connection space
TDC	Top Dead Centre
TI	Temperature Indicator
TP	Twin Pump
TRV	Thermal relief valve
TS	Two-Stage turbocharging
TVC	Torsional Vibration Calculation
U	
UNIC	Wärtsilä Unified Controls
V	
VEC	Variable Exhaust valve Closing
VIC	Variable Inlet valve Closing
VIT	Variable Injection Timing
VS	Variable Speed
VTG	Variable Turbine Geometry
W	
WISE	Wärtsilä Integrated Automation System
WOIS	Wärstilä Operator's Interfaace System.

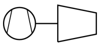
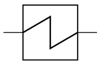
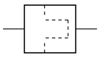
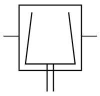
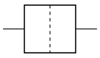
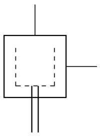
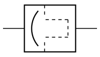
11.3 Collection of drawing symbols used in drawings

Table 11-12 List of symbols (DAAE000806c)

Symbol	Name	Symbol	Name	Symbol	Name
	Valve, general valve		Flow meter		Local Instrument
	Manually operated valve		Viscosimeter		Local panel

Symbol	Name	Symbol	Name	Symbol	Name
	Non-return valve (Flow from left to right)		Receiver, pulse damper		Signal to control board
	Spring-loaded overflow valve, straight, angle		Flame arrester		Temperature indicator
	Spring-loaded safety shut-off valve		Flexible hose		Temperature sensor
	Pressure control valve (Spring loaded)		Insulted pipe		Temperature sensor shutdown
	Pressure control valve (Remote pressure sensing)		Insulated and heated pipe		Pressure indicator
	Pneumatically actuated valve (Diaphragm actuator)		Deaerator		Pressure switch
	Solenoid actuated valve		Self-operating release valve (for example steam trap or air vent)		Pressure transmitter

Symbol	Name	Symbol	Name	Symbol	Name
	Pneumatically actuated valve (Cylinder actuator)		Electrically driven compressor		Pressure switch shutdown
	Pneumatically actuated valve (Spring loaded cylinder actuator)		Settling compressor		Differential pressure indicator and alarm
	Three-way valve		Tank		Level switch
	Self contained thermostatic valve		Tank with heating		Flow switch
	Three-way valve with electric motor actuator		Orifice		Temperture switch
	Quick-closing valve		Adjustable restrictor		
	Three-way valve with double-acting actuator		Quick-coupling		
	Electrically driven pump		Automatic filter with bypass filter		

Symbol	Name	Symbol	Name	Symbol	Name
	Turbochager		Heat exchanger		
	Filter		Separator (Centri-fuge)		
	Strainer		Centrifugal filter		
	Automatic filter				

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