

Available executions

Execution No.	Material ID	Attribute 1: Turbocharger amount	
		1	2
001	PTAA051379		X
002	PTAA051384	X	

SURFACE PROTECTION SEE GROUP 0344
 TOLERANCING PRINCIPLE ISO8015
 GENERAL TOLERANCES ACCORDING TO ISO2768-mK

NOTE

The above executions can be configured using the Engine Configurator. Detailed guidance for the executions is provided within the Marine Installation Manual (MIM). If a specific execution of interest is not shown in the above table, then it may still be under development or not available. For further information or in case of a project-specific request, WinGD must be contacted directly.

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Prod.	X52DF-S2.0										
Change History											
	-	sna102					new Design				
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis			Activity Code	E	C



EXHAUST SYSTEM
 MIDS master drawing

separate BOM available


Dimension

Scale	-		NX	Units [mm] [kg]	Basic Material	Net Weight	0.001		
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				Qty per	A4	Item ID	PTAA023256		Drawing Page/s

SEQ NO	QTY	Item ID	Item Name	Dimension	Standard-ID	Basic Material	Net Weight
1	1	PTAA051376	Exhaust System	with two turbocharger			0
2	1	PAAD327310	SPECIFICATION	FOR WASTE GATE SELECTION			0.001
3	1	DAAD139643	GUIDELINES				



Prod.	5,6,7,8 X52DF-S2.0							
Change History								
	-	npa101	mhu019	21.12.2022	CNAA003005	Main Design/Drawing Introduced	-	-
Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E	C

	<h1>EXHAUST SYSTEM</h1> <h2>WITH TWO TURBOCHARGERS</h2>
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Bill Of Material		Dimension	
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	Main Design	Yes	Design Group 9726 Q-Code XXXXX
	Qty per	Engine A4	Item ID PTAA051379

Specifications which must be met:

73 OUTLET - Exhaust gas manifold waste gate

- Size and layout of connection flange is provided in the "Pipe Connection Plan"
- The pipe diameter must be selected according to the guidance as provided on the drawing "Specification for waste gate selection"
- Waste gate connection pipe to main exhaust gas pipe must be kept as short as possible to avoid swirl and extensive back pressure.

75 INLET - Recirculated exhaust gas turbocharger

Exhaust temperature:

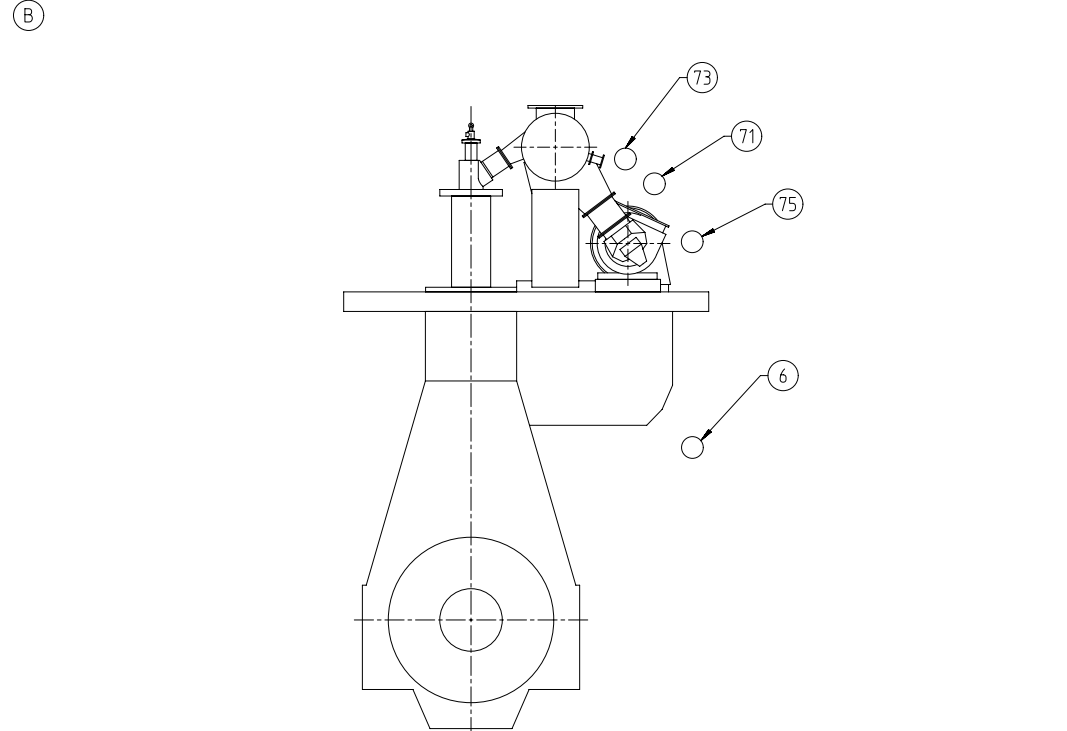
- Controlled by the EGC
- Must be always below the scavenge air temperature

Exhaust gas piping:

- Piping with cones, bends and pipe connections must be flow optimised and arranged in a way to avoid condensation draining to the turbocharger suction.
- The piping between the exhaust gas cooler outlet and turbocharger inlet must be insulated to avoid condensation of the humid recirculating exhaust gas on the pipe wall. The same insulation standard, as used on the hot side before the cooler, must be applied on the exhaust gas return pipe accordingly.
- To prevent water droplets in the exhaust gas flow, or water condensate on the pipe wall, from being carried over to the turbocharger, the exhaust gas return pipe must be routed below the level of the turbochargers. Condensate water drains must be arranged at the lowest point of the horizontal return manifold pipe. Different vessel trim conditions must be considered.
- The exhaust gas return pipe must be purged by air in the counterflow direction through the SOV. The purging flow must be the total iCER casing volume, to be exchanged 4.5 times per hour with a maximum back pressure of 80 mbar.

6 OUTLET - Exhaust gas return pipe condensate water drain

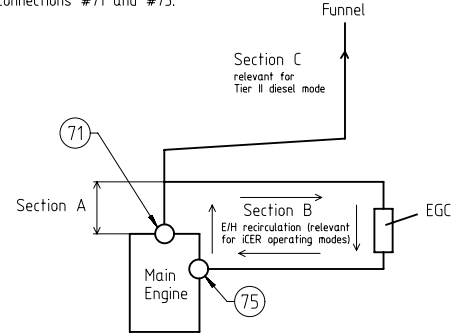
- Drain to the iCER waste water holding tank



71 OUTLET - Exhaust gas turbocharger

- Exhaust gas temperature and volume flow: according to GTD
- If the iCER diesel option is selected a NOx sensor must be installed in the exhaust gas pipe between Back Pressure Valve (BPV) and turbocharger.
- The total back pressure of the exhaust gas system must be kept within the following ranges:
 Diesel Tier II mode in section A and C
 Design limit: From max. 30 mbar to max. 60 mbar
 Operational limit: max. 80 mbar
 iCER gas Tier III mode in section A and B
 Design limit: From max. 30 mbar to max. 45 mbar
 Operational limit: max. 55 mbar
 iCER diesel Tier III mode in section A and B
 Design limit: Not relevant in layout
 Operational limit: max. 55 mbar

Remark: The available back pressure range provided in this drawing refers to the differential pressure between the pipe connections #71 and #75.



- The exhaust gas pipe must be insulated according to applicable rules, e.g. SOLAS.
- Pipe dimensions in relation to the exhaust gas mass flow rates are provided by table 1 on page 2.
- The exhaust piping with cones, bends and pipe connections must be flow optimised and arranged in a way to avoid gases from accumulating.
- The piping layout must consider the thermal expansion and vibration from the turbocharger (TC) and main engine (ME). Thermal expansion of the ME is to be calculated according to the formula in MM. TC specific thermal expansion is provided by the TC supplier.
- Explosion relief devices, examined and certified by the maker, with flameless pressure relief (rupture discs or self-closing, spring-loaded valves) must be selected and installed within the exhaust system in accordance with class requirements. The exact position and number of explosion relief devices must be determined by the system designer or the shipyard through calculation. Independently, which type of explosion relief devices is selected, the distance of the explosion relief device to gangways, working areas and system components must be at least 3 m to not endanger personnel and/or to avoid material damage.
- A continuous (extensive) exhaust gas leakage must be avoided.
- Supports (fixation points) for the mass of piping and exhaust gas system components must be installed in sufficient size and amount. Inadmissible tensions in the piping and forces acting on the turbocharger are not acceptable.
- Exhaust gas pipes of several engines must not be connected.
- Drains of adequate size and amount must be installed in the exhaust gas piping.
- When the noise level on the bridge wing exceeds the class requirement (normally 60 - 70 dB(A)) a silencer must be applied.
- During iCER operation, the recirculated exhaust gas must be cooled by EGC circulation water. This water must be cleaned and treated by the water treatment unit to fulfill the following requirements: A maximum solids content of 150 mg/l and a proper pH value (e.g. above pH 6).

Prod.	XS2DF-S2.0								
Change History	B	dkl021	mhu09	05.02.2024	CNA00521	Drawing Updated		4	3
	A	sde101	mhu019	24.03.2023	CNAA003456	Drawing Updated		4	3
	-	npa101	mhu019	21.12.2022	CNAA003005	new Design		-	-
Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Approved		Activity Code	E C
						Exhaust System 2 TC, iCER off-engine			
Dimension						2 TC, iCER off-engine			
Scale	-			NX	Units [mm] [kg]	Basic Material	Net Weight 0.001		

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TOLERANCING PRINCIPLE ISO8015		Main Design	Design Group	9726	Q-Code	X X M	Standard	WDS	
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Qty per	A2	Item ID	PTAA051376		Drawing Pages	1/3	

NOTE
Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

Short Route
- Exhaust gas branch-off after turbocharger

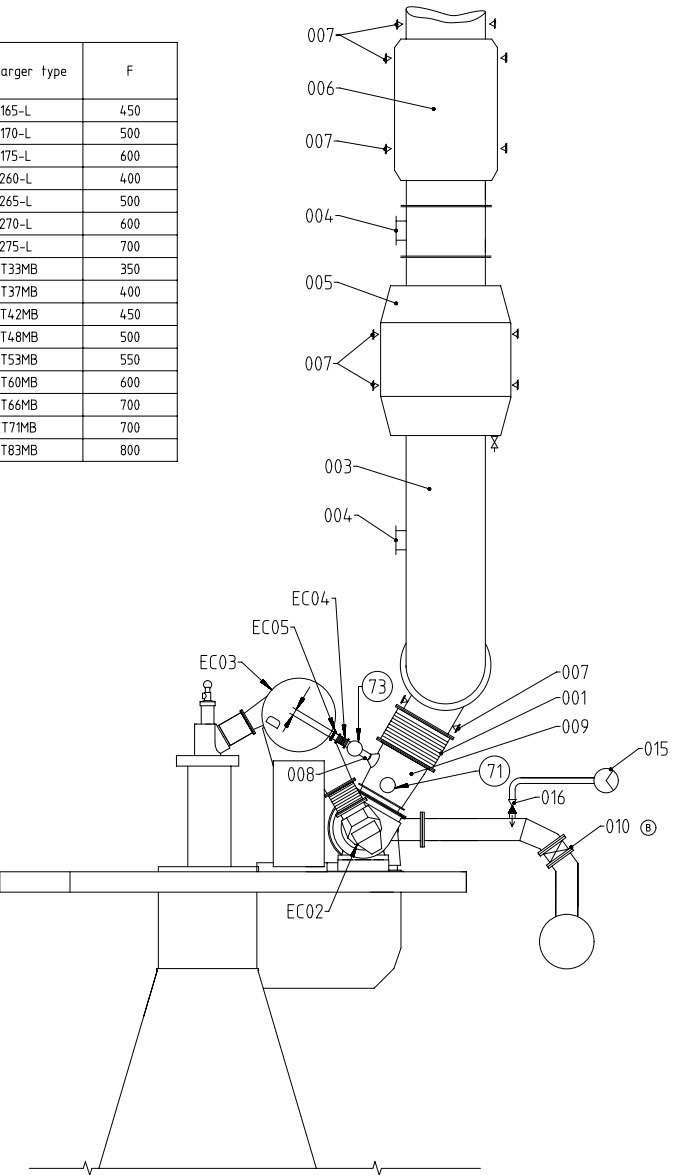
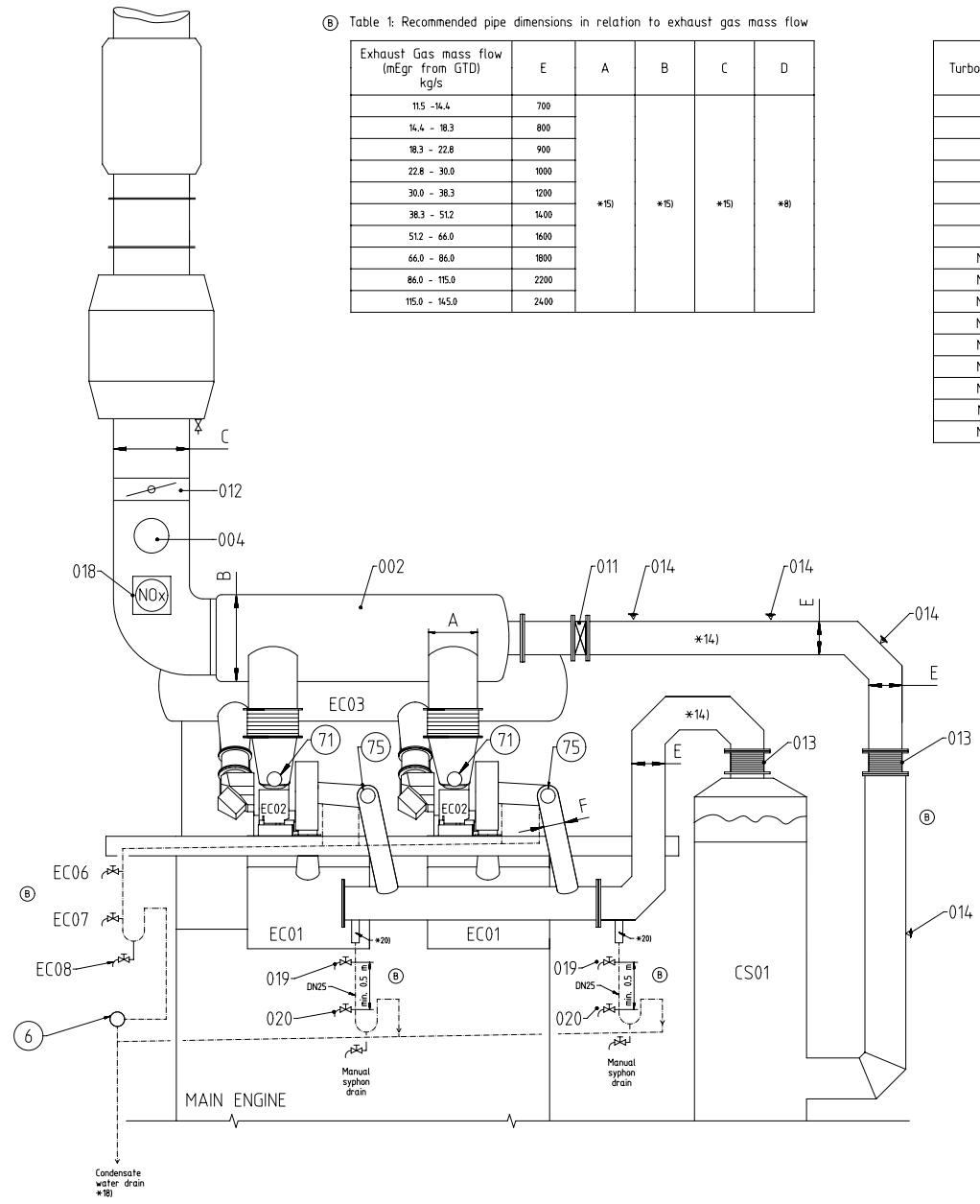
Pos.	COMPONENTS from certified suppliers
CS01	Exhaust Gas Cooler (EGC)

Pos.	System Components *1)
001	Compensator *4)
002	Exhaust gas collector
003	Exhaust gas pipe
004	Explosion relief device (rupture discs or spring-loaded valves) *5)
005	Main Economiser
006	Silencer (with spark arrester *9)
007	Support *4)
008	Waste gate pipe
009	Transition piece *6)
010	Flow Regulating Valve (FRV)
011	Shut-off valve (SDV)
012	Back Pressure Valve (BPV)
013	Compensator in the exhaust system *13)
014	ICER support *4)
015	Purging and sealing air blower *20)
016	Non-return valve
018	NOx Sensor (as delivered by the engine builder) *21)
019	Test cock 1 *16)
020	Test cock 2 *17)

Table 1: Recommended pipe dimensions in relation to exhaust gas mass flow

Exhaust Gas mass flow (mEgr from GTD) kg/s	E	A	B	C	D
11.5 - 14.4	700				
14.4 - 18.3	800				
18.3 - 22.8	900				
22.8 - 30.0	1000				
30.0 - 38.3	1200				
38.3 - 51.2	1400	*15)	*15)	*15)	*8)
51.2 - 66.0	1600				
66.0 - 86.0	1800				
86.0 - 115.0	2200				
115.0 - 145.0	2400				

Turbocharger type	F
A165-L	450
A170-L	500
A175-L	600
A260-L	400
A265-L	500
A270-L	600
A275-L	700
MET33MB	350
MET37MB	400
MET42MB	450
MET48MB	500
MET53MB	550
MET60MB	600
MET66MB	700
MET71MB	700
MET83MB	800



- Pos. Engine Connections *2)
- 0) OUTLET - Exhaust gas return pipe condensate water drain
 - 71) OUTLET - Exhaust gas turbocharger
 - 73) OUTLET - Exhaust gas manifold waste gate
 - 75) INLET - Recirculated exhaust gas turbocharger
- Pos. Engine Components *3)
- EC01 Scavenge air receiver
 - EC02 Turbocharger (TC)
 - EC03 Exhaust gas manifold
 - EC04 Waste gate compensator *7) *8)
 - EC05 Waste gate valve
 - EC06 Test cock 1 *16)
 - EC07 Test cock 2 *17)
 - EC08 Manual syphon drain
- Remarks:
- Drain plugs and drain cocks to be installed where necessary.
 - *1) Refer to the "Pipe Connection Plan" for the execution and location of the engine pipe connections.
 - *2) To be installed by the shipyard.
 - *3) To be delivered by the engine builder, i.e. already equipped on engine side
 - *4) The piping of the exhaust gas system must be structurally supported to withstand the mass and to minimise vibrations across the system (e.g. by connecting the support to the ship hull or otherwise). The type of these supports (fixed or sliding type), their final amount and position have to be defined by the shipyard under consideration of system layout and requirements based on installation specific calculation.
 - *5) When rupture discs are installed, preventative measures must be taken to ensure that exhaust gas does not continuously flow to the out after rupture. This can be achieved with an exhaust gas duct leading to the open deck, or in the case of a twin-engine installation, by sending a control signal that initiates a shutdown of the engine. If either of these options are not possible, a self-closing, spring-loaded valve with flame arrestor must be used. This would remove the peak pressure of an explosion, while ensuring that the exhaust gas does not continuously flow out.
 - *6) Area ratio between outlet/inlet = 1:1.16, taper angle $\leq 40^\circ$
 - *7) The dimension of the expansion piece (compensator) must be defined by the shipyard in accordance with the thermal growth of the exhaust manifold and the exhaust pipe. Vibrations of the pipe after the compensator must be lower than 45 mm/s RMS (root mean square).
 - *8) Guidance regarding the selection of the waste gate pipe size is provided by the drawing "Specification for waste gate selection". The waste gate pipe on the shipside is one nominal pipe size larger than the waste gate pipe on the engine side (before the compensator).
 - *9) Optional, installed as required to meet noise requirements.
 - *10) Optional, to be installed if the backpressure from the EGC exceeds the limit.
 - *11) The final amount and position have to be defined by the shipyard considering the system layout and requirements based on installation specific calculation.
 - *12) The exhaust gas pipes upstream and downstream of the EGC must be insulated.
 - *13) The exhaust pipe dimension must be selected in accordance with the specific exhaust gas mass flow, as given by the GTD. The pipe size selection must be coordinated respectively agreed in between the shipyard and the engine builder as the valve size selection on engine side must comply accordingly.
 - *14) By opening of test cock 1 the following conditions can be checked:
Normal condition:
No water flow but air suction.
Abnormal condition:
Water flow, which is the indication that the drain valve is blocked in closed position.
 - *15) By opening of test cock 2 the following conditions can be checked:
Normal condition:
Water flow, water samples can be taken.
Abnormal condition:
No water flow but air suction, which is the indication that the drain valve is blocked in open position.
 - *16) Condensate water drain to the ICER waste water holding tank.
 - *17) The condensate water collection pocket must be connected at the lowest point of the horizontal return manifold pipe.
 - *18) For the selection of the blower capacity and the arrangement of the purging and sealing air supply line refer to the guidance as provided in the RMV and ICER Installation Guidelines. The purging and sealing air system is controlled by the engine control system.
 - *19) A dedicated air supply must be connected to the sensor to provide compressed air for cleaning, with air quality level of ISO 8573-3:2010 15.2.2.

SYSTEM PROPOSAL

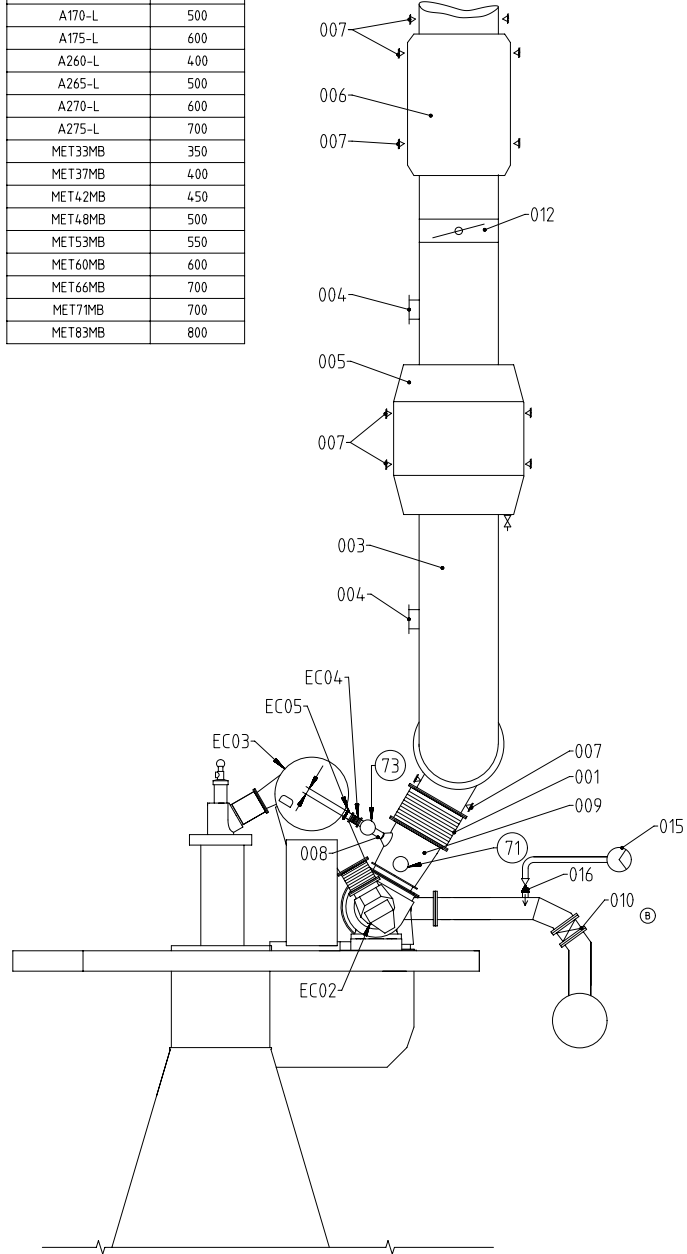
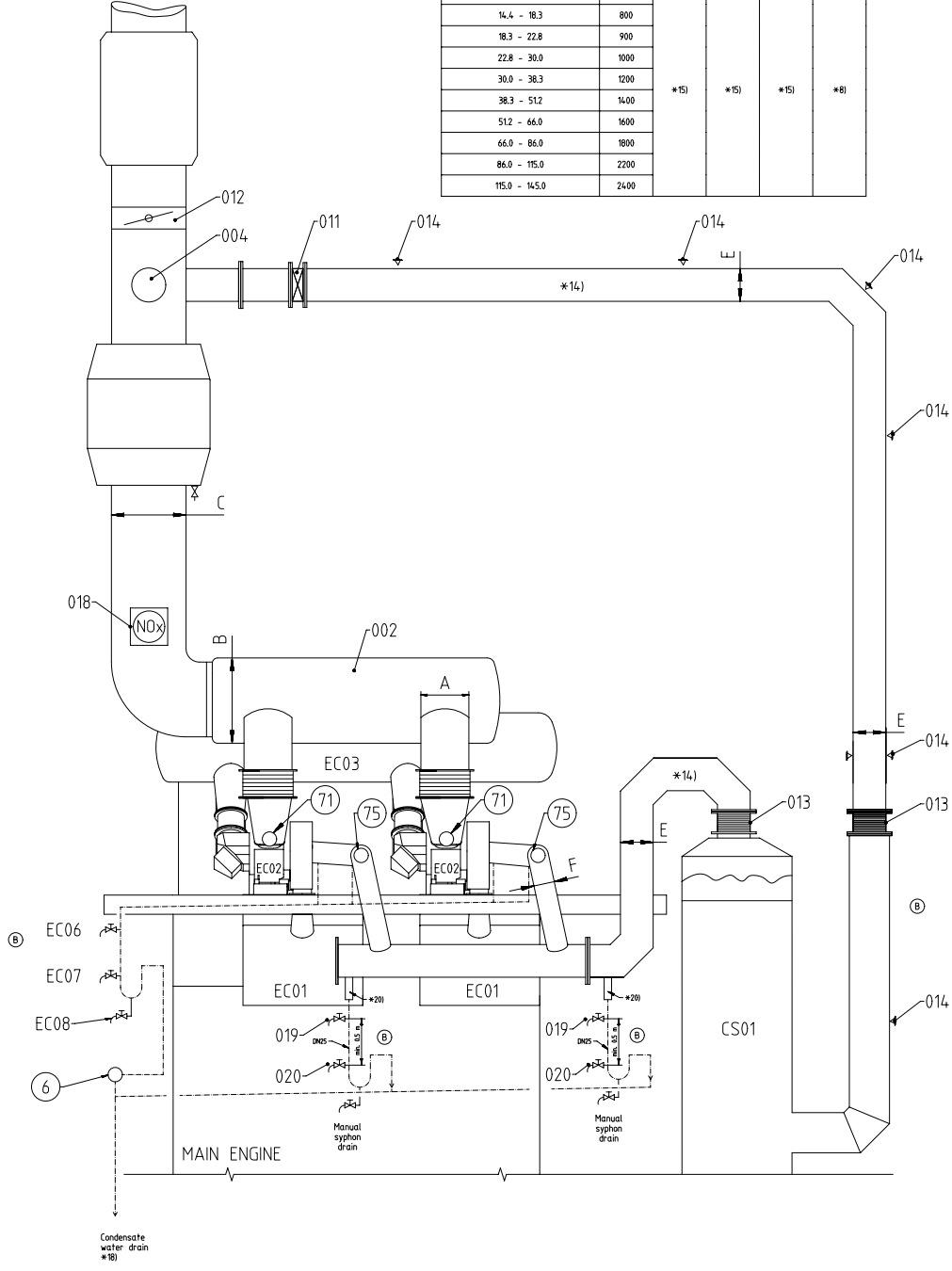
NOTE
Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

Long Route - Exhaust gas branch-off after economizer

Table 1: Recommended pipe dimensions in relation to exhaust gas mass flow

Exhaust Gas mass flow (mEgr from GTD) kg/s	E	A	B	C	D
11.5 - 14.4	700				
14.4 - 18.3	800				
18.3 - 22.8	900				
22.8 - 30.0	1000				
30.0 - 38.3	1200				
38.3 - 51.2	1400	*15)	*15)	*15)	*8)
51.2 - 66.0	1600				
66.0 - 86.0	1800				
86.0 - 115.0	2200				
115.0 - 145.0	2400				

Turbocharger type	F
A165-L	450
A170-L	500
A175-L	600
A260-L	400
A265-L	500
A270-L	600
A275-L	700
MET33MB	350
MET37MB	400
MET42MB	450
MET48MB	500
MET53MB	550
MET60MB	600
MET66MB	700
MET71MB	700
MET83MB	800



Pos.	COMPONENTS from certified suppliers
CS01	Exhaust Gas Cooler (EGC)

Pos.	System Components *1)
001	Compensator *4)
002	Exhaust gas collector
003	Exhaust gas pipe
004	Explosion relief device (rupture discs or spring-loaded valves) *5)
005	Main Economiser
006	Silencer (with spark arrester *9)
007	Support *4)
008	Waste gate pipe
009	Transition piece *6)
010	Flow Regulating Valve (FRV)
011	Shut-off valve (SOV)
012	Back Pressure Valve (BPV)
013	Compensator in the exhaust system *13)
014	ICER support *4)
015	Purging and sealing air blower *20)
016	Non-return valve
018	NOx Sensor (as delivered by the engine builder) *21)
019	Test cock 1 *16)
020	Test cock 2 *17)

Pos.	Engine Connections *2)
①	OUTLET - Exhaust gas return pipe condensate water drain
⑦	OUTLET - Exhaust gas turbocharger
⑦③	OUTLET - Exhaust gas manifold waste gate
⑦⑤	INLET - Recirculated exhaust gas turbocharger


Pos.	Engine Components *3)
EC01	Scavenge air receiver
EC02	Turbocharger (TC)
EC03	Exhaust gas manifold
EC04	Waste gate compensator *7) *8)
EC05	Waste gate valve
EC06	Test cock 1 *16)
EC07	Test cock 2 *17)
EC08	Manual syphon drain

- Remarks:
- *1) Drain plugs and drain cocks to be installed where necessary.
 - *2) Refer to the "Pipe Connection Plan" for the execution and location of the engine pipe connections.
 - *3) To be installed by the shipyard.
 - *4) To be delivered by the engine builder, i.e. already equipped on engine side.
 - *5) The piping of the exhaust gas system must be structurally supported to withstand the mass and to minimise vibrations across the system (e.g. by connecting the support to the ship hull or otherwise). The type of these supports (fixed or sliding type), their final amount and position have to be defined by the shipyard under consideration of system layout and requirements based on installation specific calculation.
 - *6) When rupture discs are installed, preventative measures must be taken to ensure that exhaust gas does not continuously flow to the out after rupture. This can be achieved with an exhaust gas duct leading to the open deck, or in the case of a twin-engine installation, by sending a control signal that initiates a shutdown of the engine. If either of these options are not possible, a self-closing, spring-loaded valve with flame arrestor must be used. This would remove the peak pressure of an explosion, while ensuring that the exhaust gas does not continuously flow out.
 - *7) The dimension of the expansion piece (compensator) must be defined by the shipyard in accordance with the thermal growth of the exhaust manifold and the exhaust pipe. Vibrations of the pipe after the compensator must be lower than 45 mm/s RMS (root mean square).
 - *8) Guidance regarding the selection of the waste gate pipe size is provided by the drawing "Specification for waste gate selection". The waste gate pipe on the shipside is one nominal pipe size larger than the waste gate pipe on the engine side (before the compensator).
 - *9) Optional, installed as required to meet noise requirements.
 - *10) Optional, in combination with the main economiser if ship's steam demand cannot be covered by the economiser in the upper exhaust gas pipe after the back-pressure valve.
 - *11) Optional, to be installed if the backpressure from the EGC exceeds the limit.
 - *12) The final amount and position have to be defined by the shipyard considering the system layout and requirements based on installation specific calculation.
 - *13) The exhaust gas pipe dimension must be selected in accordance with the specific exhaust gas mass flow, as given by the GTD. The pipe size selection must be coordinated respectively agreed in between the shipyard and the engine builder as the valve size selection on engine side must comply accordingly.
 - *14) By opening of test cock 1 the following conditions can be checked:
Normal condition:
No water flow but air suction.
Abnormal condition:
Water flow, which is the indication that the drain valve is blocked in closed position.
 - *15) By opening of test cock 2 the following conditions can be checked:
Normal condition:
Water flow. Water samples can be taken.
Abnormal condition:
No water flow but air suction, which is the indication that the drain valve is blocked in open position.
 - *16) Condensate water drain to the ICER waste water holding tank.
 - *17) The condensate water collection pocket must be connected at the lowest point of the horizontal return manifold pipe.
 - *18) For the selection of the blower capacity and the arrangement of the purging and sealing air supply line refer to the guidance as provided in the MM and ICER Installation Guideline. The purging and sealing air system is controlled by the engine control system.
 - *19) A dedicated air supply must be connected to the sensor to provide compressed air for cleaning, with air quality level of ISO 8573-1:2004 (1:1:1).

SEQ NO	QTY	Item ID	Item Name	Dimension	Standard-ID	Basic Material	Net Weight
1	1	PTAA051381	Exhaust System				0
2	1	PAAD327310	SPECIFICATION FOR WASTE GATE SELECTION				0.001
3	1	DAAD139643	GUIDELINES				



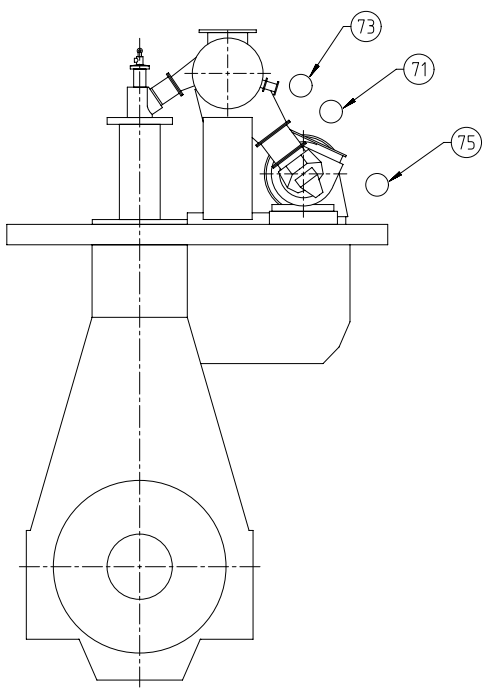
Prod.	5,6,7,8 X52DF-S2.0							
Change History								
	-	npa101	mhu019	21.12.2022	CNAA003005	Main Design/Drawing Introduced	-	-
Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E	C

	<h1>EXHAUST SYSTEM</h1>
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Bill Of Material		Dimension					
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	Main Design	Yes	Design Group	9726	Q-Code	XXXXX	Standard WDS
	Qty per	Engine	A4	Item ID	PTAA051384		BOM Page/s

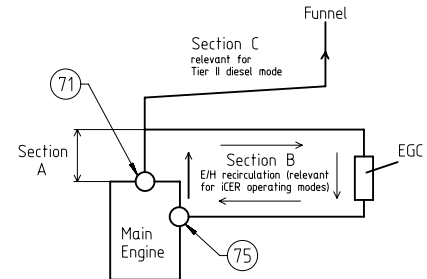
Specifications which must be met:

- 73** OUTLET - Exhaust gas manifold waste gate
- Size and layout of connection flange is provided in the "Pipe Connection Plan"
 - The pipe diameter must be selected according to the guidance as provided on the drawing "Specification for waste gate selection".
 - The waste gate connection pipe, as connected to the main exhaust gas pipe, must be kept as short as possible to avoid swirl and extensive back pressure.
- 75** INLET - Recirculated exhaust gas turbocharger
- Exhaust temperature:
- Controlled by the EGC
 - Must be always below the scavenge air temperature
- Exhaust gas piping:
- Piping with cones, bends and pipe connections must be flow optimised and arranged in a way to avoid condensation draining to the turbocharger suction.
 - The piping between the exhaust gas cooler outlet and turbocharger inlet must be insulated to avoid condensation of the humid recirculating exhaust gas on the pipe wall. The same insulation standard, as used on the hot side before the cooler, must be applied on the exhaust gas return pipe accordingly.
 - The exhaust gas return pipe must be purged by air in the counterflow direction through the SOV. The purging flow must be the total iCER casing volume, to be exchanged 4.5 times per hour with a maximum back pressure of 80 mbar.



- 71** OUTLET - Exhaust gas turbocharger
- Exhaust gas temperature and volume flow: according to GTD
 - If the iCER diesel option is selected a NOx sensor must be installed in the exhaust gas pipe between Back Pressure Valve (BPV) and turbocharger.
 - The total back pressure of the exhaust gas system must be kept within the following ranges:
 Diesel Tier II mode in section A and C
 Design limit: From max. 30 mbar to max. 60 mbar
 Operational limit: max. 80 mbar
 iCER gas Tier III mode in section A and B
 Design limit: From max. 20 mbar to max. 35 mbar
 Operational limit: max. 45 mbar
 iCER diesel Tier III mode in section A and B
 Design limit: Not relevant in layout
 Operational limit: max. 55 mbar

Remark: The available back pressure range provided in this drawing refers to the differential pressure between the pipe connections #71 and #75. An additional layout back pressure of 10 mbar is caused by the water mist catcher which is integrated into the engine. In the GTD, the available back pressure range refers specifically to the back pressure between the turbocharger inlet and outlet. As a result, the GTD provides a back pressure range which is 10 mbar higher.



- The exhaust gas pipe must be insulated according to applicable rules, e.g. SOLAS.
- Recommended pipe dimensions in relation to the exhaust gas mass flow rates are provided by table 1 on page 2.
- The exhaust piping with cones, bends and pipe connections must be flow optimised and arranged in a way to avoid gases from accumulating.
- The piping layout must consider the thermal expansion and vibration from the turbocharger (TC) and main engine (ME). Thermal expansion of the ME is to be calculated according to the formula in MIM. TC specific thermal expansion is provided by the TC supplier.
- Explosion relief devices, examined and certified by the maker, with flameless pressure relief (rupture discs or self-closing, spring-loaded valves) must be selected and installed within the exhaust system in accordance with class requirements. The exact position and number of explosion relief devices must be determined by the system designer or the shipyard through calculation. Independently, which type of explosion relief devices is selected, the distance of the explosion relief device to gangways, working areas and system components must be at least 3 m to not endanger personnel and/or to avoid material damage.
- A continuous (extensive) exhaust gas leakage must be avoided.
- Supports (fixation points) for the mass of piping and exhaust gas system components must be installed in sufficient size and amount. Inadmissible tensions in the piping and forces acting on the turbocharger are not acceptable.
- Exhaust gas pipes of several engines must not be connected.
- Drains of adequate size and amount must be installed in the exhaust gas piping.
- When the noise level on the bridge wing exceeds the class requirement (normally 60 - 70 dB(A)) a silencer must be applied.
- During iCER operation, the recirculated exhaust gas must be cooled by EGC circulation water. This water must be cleaned and treated by the water treatment unit to fulfill the following requirements: A maximum solids content of 150 mg/l and a proper pH value (e.g. above pH 6).

Prod.	X52DF-S2.0								
Change History	B	sde101	mhu09	24.03.2023	CNA003016	Drawing Updated		4	3
	A	sde101	mhu019	23.12.2022	CNA003013	Drawing Updated		4	3
	-	npa101	mhu019	21.12.2022	CNA003005	new Design		-	-
Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis				

WIN GD
Winterthur Gas & Diesel

Exhaust System

with one turbocharger

Scale: - NX

Units: [mm] [kg]

Basic Material: _____ Net Weight: 0.000

Main Design: _____ Design Group: 9726 Q-Code: XXXXX Standard: WDS

Qty per: _____ Item ID: PTAA051381 Drawing Page/s: 1/3

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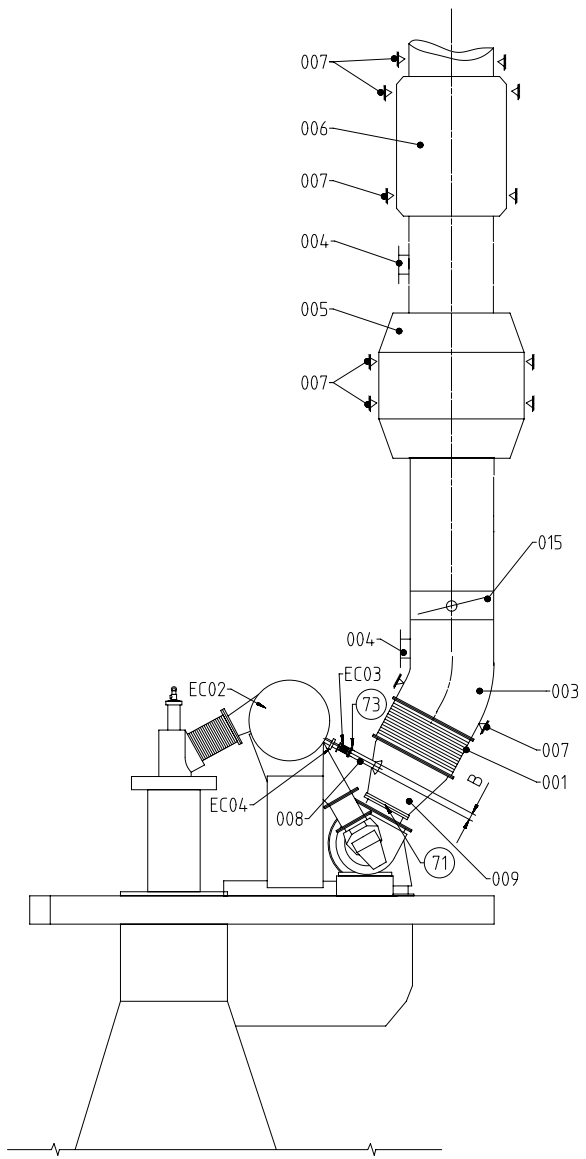
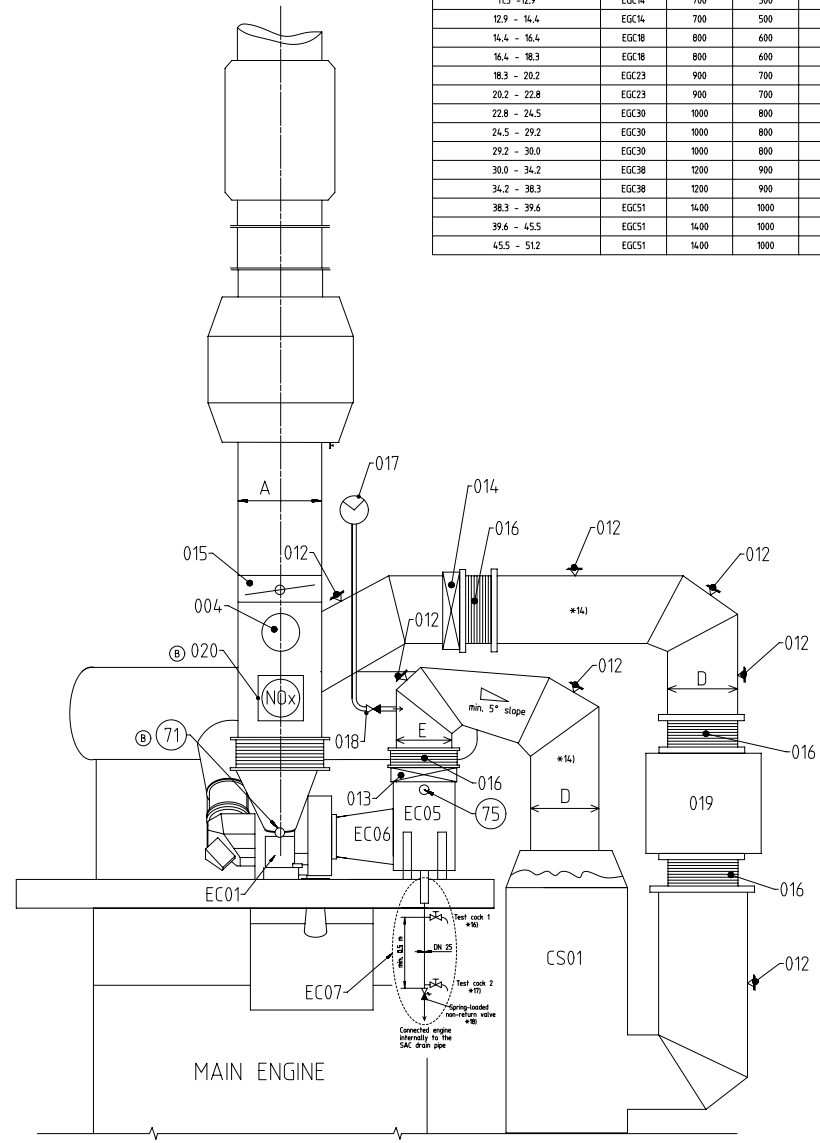
SURFACE PROTECTION SEE GROUP 0344
TOLERANCING PRINCIPLE ISO8015

NOTE
 Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

Short Route
 - Exhaust gas branch-off after turbocharger

Table 1: Recommended pipe dimensions in relation to exhaust gas mass flow

Exhaust Gas mass flow (turbine flow from GTD) kg/s	EGC Size	D	E	A**18	B
11.5 - 12.9	EGC14	700	500	800	*8)
12.9 - 16.4	EGC14	700	500	900	
16.4 - 16.4	EGC18	800	600	1000	
16.4 - 18.3	EGC18	800	600	1000	
18.3 - 20.2	EGC23	900	700	1000	
20.2 - 22.8	EGC23	900	700	1100	
22.8 - 24.5	EGC30	1000	800	1100	
24.5 - 29.2	EGC30	1000	800	1200	
29.2 - 30.0	EGC30	1000	800	1300	
30.0 - 34.2	EGC38	1200	900	1300	
34.2 - 38.3	EGC38	1200	900	1400	
38.3 - 39.6	EGC51	1400	1000	1400	
39.6 - 45.5	EGC51	1400	1000	1500	
45.5 - 51.2	EGC51	1400	1000	1600	



Pos.	SYSTEM COMPONENTS *2)
001	Compensator between engine and exhaust gas system *7)
003	Exhaust gas pipe
004	Explosion relief device (rupture discs or spring-loaded valves) *5)
005	Main Economiser
006	Silencer (with spark arrester) *9)
007	Support *4)
008	Waste gate pipe
009	Transition piece *6)
012	ICER support *4)
013	Flow Regulating Valve (FRV) *11)
014	Shut-off valve (SOV) *11)
015	Back Pressure Valve (BPV) *11)
016	Compensator in the exhaust system *15)
017	Purging and sealing air blower *19)
018	Non-return valve
019	Additional Economiser *10)
020	NOx Sensor (as delivered by the engine builder) *20)

Pos.	ENGINE CONNECTIONS *1)
(71)	OUTLET - Exhaust gas turbocharger
(73)	OUTLET - Exhaust gas manifold waste gate
(75)	INLET - Recirculated exhaust gas turbocharger

Pos.	ENGINE COMPONENTS *3)
EC01	Turbocharger
EC02	Exhaust gas manifold
EC03	Waste gate compensator *7) *8)
EC04	Waste gate valve
EC05	Water mist catcher (WMC)
EC06	Turbocharger connection piece (cone)
EC07	Condensate drain collection pocket with drain pipe, check valves and relief valve

Pos.	COMPONENTS from certified suppliers *12)
CS01	Exhaust Gas Cooler (EGC)

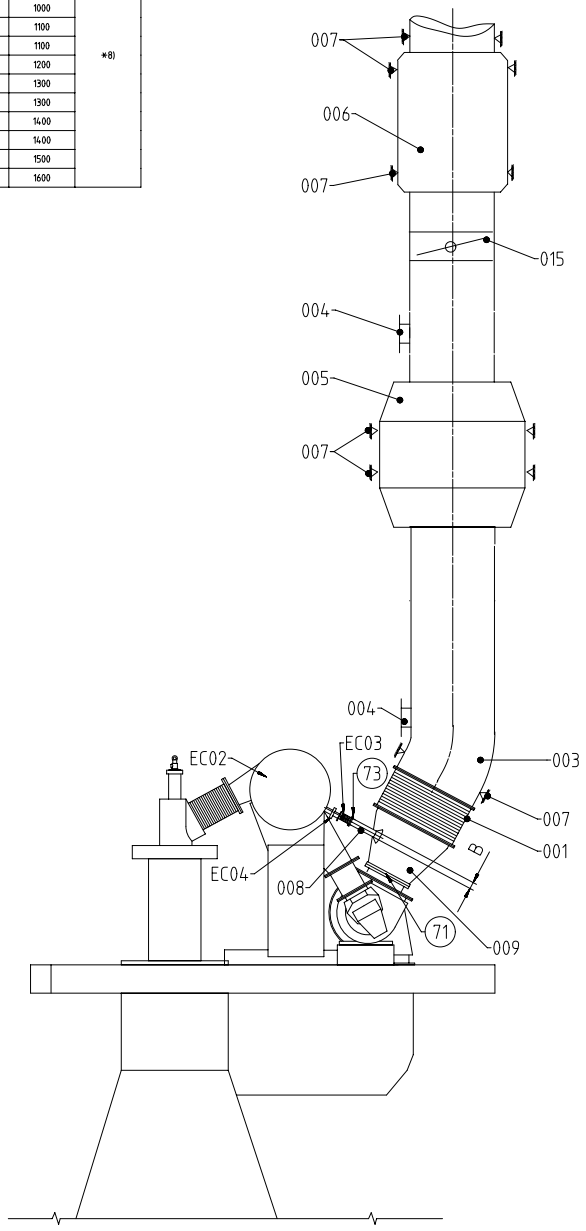
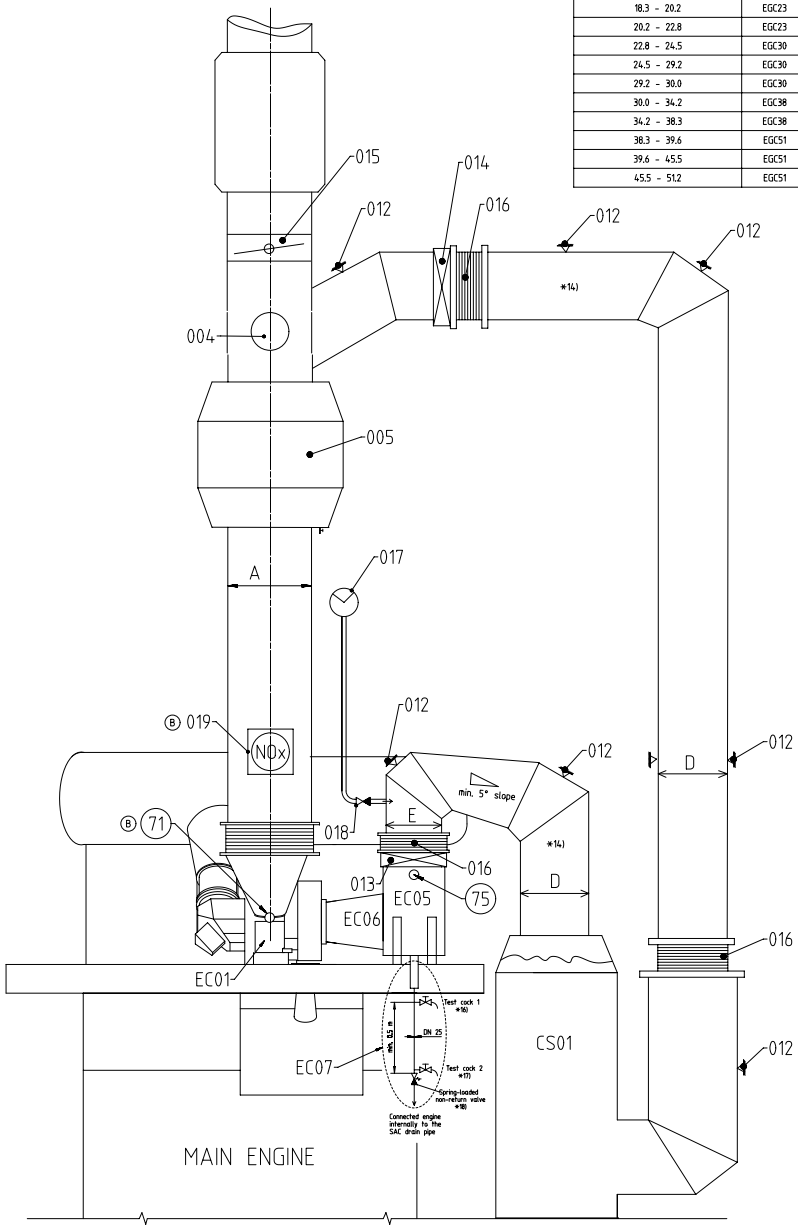
- Remarks:**
- Drain plugs and drain cocks to be installed where necessary.
 - *1) Refer to the "Pipe Connection Plan" for the execution and location of the engine pipe connections.
 - *2) To be installed by the shipyard.
 - *3) To be delivered by the engine builder, i.e. already equipped on engine side.
 - *4) The piping of the exhaust gas system must be structurally supported to withstand the mass and to minimise vibrations across the system (e.g. by connecting the support to the ship hull or otherwise). The type of these supports (fixed or sliding type), their final amount and position have to be defined by the shipyard under consideration of system layout and requirements based on installation specific calculation.
 - *5) When rupture discs are installed, preventative measures must be taken to ensure that exhaust gas does not continuously flow to the out after rupture. This can be achieved with an exhaust gas duct leading to the open deck, or in the case of a twin-engine installation, by sending a control signal that initiates a shutdown of the engine. If either of these options are not possible, a self-closing, spring-loaded valve with flame arrester must be used. This would remove the peak pressure of an explosion, while ensuring that the exhaust gas does not continuously flow out.
 - *6) Area ratio between outlet/inlet = 1:1.16, taper angle ≤ 40°
 - *7) The dimension of the expansion piece (compensator) must be defined by the shipyard in accordance with the thermal growth of the exhaust manifold and the exhaust pipe. Vibrations of the pipe after the compensator must be lower than 45 mm/s RMS (root mean square).
 - *8) Guidance regarding the selection of the waste gate pipe size is provided by the drawing "Specification for waste gate selection". The waste gate pipe on the shipside is one nominal pipe size larger than the waste gate pipe on the engine side (before the compensator).
 - *9) Optional, installed as required to meet noise requirements.
 - *10) Optional, in combination with the main economiser if ship's steam demand cannot be covered by the economiser in the upper exhaust gas pipe after the back pressure valve.
 - *11) Valve size to be selected in accordance with actual exhaust gas mass flow.
 - *12) To be supplied by a certified supplier. Ordering to be coordinated between shipyard and engine builder.
 - *13) Based on a design velocity of max. 4.0 m/s
 - *14) The exhaust gas pipes upstream and downstream of the EGC must be insulated.
 - *15) The final amount and position have to be defined by the shipyard considering the system layout and requirements based on installation specific calculation.
 - *16) By opening of test cock 1 the following conditions can be checked:
 Normal condition:
 No water flow but air suction.
 Abnormal condition:
 Water flow, which is the indication that the drain valve is blocked in closed position.
 - *17) By opening of test cock 2 the following conditions can be checked:
 Normal condition:
 Water flow. Water samples can be taken.
 Abnormal condition:
 No water flow but air suction, which is the indication that the drain valve is blocked in open position.
 - *18) Valve opening at 25 mbar.
 - *19) For the selection of the blower capacity and the arrangement of the purging and sealing air supply line refer to the guidance as provided in the MIM and ICER Installation Guideline. The purging and sealing air system is controlled by the engine control system.
 - *20) A dedicated air supply must be connected to the sensor, with air quality level of ISO 8573-12:00 (1:1,2).

NOTE
Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

Long Route
- Exhaust gas branch-off after economizer

Table 1: Recommended pipe dimensions in relation to exhaust gas mass flow

Exhaust Gas mass flow (turbine flow from GTD) kg/s	EGC Size	D	E	A** ¹²	B
11.5 - 12.9	EGC14	700	500	800	*8)
12.9 - 14.4	EGC14	700	500	900	
14.4 - 16.4	EGC18	800	600	1000	
16.4 - 18.3	EGC18	800	600	1000	
18.3 - 20.2	EGC23	900	700	1000	
20.2 - 22.8	EGC23	900	700	1100	
22.8 - 24.5	EGC30	1000	800	1100	
24.5 - 29.2	EGC30	1000	800	1200	
29.2 - 30.0	EGC30	1000	800	1300	
30.0 - 34.2	EGC38	1200	900	1300	
34.2 - 38.3	EGC38	1200	900	1400	
38.3 - 39.6	EGC51	1400	1000	1400	
39.6 - 45.5	EGC51	1400	1000	1500	
45.5 - 51.2	EGC51	1400	1000	1600	



Pos.	SYSTEM COMPONENTS *2)
001	Compensator between engine and exhaust gas system *7)
003	Exhaust gas pipe
004	Explosion relief device (rupture discs or spring-loaded valves) *5)
005	Main Economiser
006	Silencer (with spark arrester) *9)
007	Support *4)
008	Waste gate pipe
009	Transition piece *6)
012	ICER support *4)
013	Flow Regulating Valve (FRV) *11)
014	Shut-off valve (SOV) *11)
015	Back Pressure Valve (BPV) *11)
016	Compensator in the exhaust system *15)
017	Purging and sealing air blower *19)
018	Non-return valve
019	NDx Sensor (as delivered by the engine builder) *19)

Pos.	ENGINE CONNECTIONS *1)
⑦1	OUTLET - Exhaust gas turbocharger
⑦3	OUTLET - Exhaust gas manifold waste gate
⑦5	INLET - Recirculated exhaust gas turbocharger

Pos.	ENGINE COMPONENTS *3)
EC01	Turbocharger
EC02	Exhaust gas manifold
EC03	Waste gate compensator *7) *8)
EC04	Waste gate valve
EC05	Water mist catcher (WMC)
EC06	Turbocharger connection piece (cone)
EC07	Condensate drain collection pocket with drain pipe, check valves and relief valve

Pos.	COMPONENTS from certified suppliers *10)
CS01	Exhaust Gas Cooler (EGC)

- Remarks:
- Drain plugs and drain cocks to be installed where necessary.
 - *1) Refer to the "Pipe Connection Plan" for the execution and location of the engine pipe connections.
 - *2) To be installed by the shipyard.
 - *3) To be delivered by the engine builder, i.e. already equipped on engine side.
 - *4) The piping of the exhaust gas system must be structurally supported to withstand the mass and to minimise vibrations across the system (e.g. by connecting the support to the ship hull or otherwise). The type of these supports (fixed or sliding type), their final amount and position have to be defined by the shipyard under consideration of system layout and requirements based on installation specific calculation.
 - *5) When rupture discs are installed, preventative measures must be taken to ensure that exhaust gas does not continuously flow to the out after rupture. This can be achieved with an exhaust gas duct leading to the open deck, or in the case of a twin-engine installation, by sending a control signal that initiates a shutdown of the engine. If either of these options are not possible, a self-closing, spring-loaded valve with flame arrester must be used. This would remove the peak pressure of an explosion, while ensuring that the exhaust gas does not continuously flow out.
 - *6) Area ratio between outlet/inlet = 1.1, 1.6, taper angle $\leq 40^\circ$
 - *7) The dimension of the expansion piece (compensator) must be defined by the shipyard in accordance with the thermal growth of the exhaust manifold and the exhaust pipe. Vibrations of the pipe after the compensator must be lower than 45 mm/s RMS (root mean square).
 - *8) Guidance regarding the selection of the waste gate pipe size is provided by the drawing "Specification for waste gate selection". The waste gate pipe on the shipside is one nominal pipe size larger than the waste gate pipe on the engine side (before the compensator).
 - *9) Optional, installed as required to meet noise requirements.
 - *10) Valve size to be selected in accordance with actual exhaust gas mass flow.
 - *11) To be supplied by a certified supplier. Ordering to be coordinated between shipyard and engine builder.
 - *12) Based on a design velocity of max. 40 m/s
 - *13) The exhaust gas pipes upstream and downstream of the EGC must be insulated.
 - *14) The final amount and position have to be defined by the shipyard considering the system layout and requirements based on installation specific calculation.
 - *15) By opening of test cock 1 the following conditions can be checked:
Normal condition:
No water flow but air suction.
Abnormal condition:
Water flow, which is the indication that the drain valve is blocked in closed position.
 - *16) By opening of test cock 2 the following conditions can be checked:
Normal condition:
Water flow, water samples can be taken.
Abnormal condition:
No water flow but air suction, which is the indication that the drain valve is blocked in open position.
 - *17) Valve opening at 25 mbar.
 - *18) For the selection of the blower capacity and the arrangement of the purging and sealing air supply line refer to the guidance as provided in the MIM and ICER Installation Guideline. The purging and sealing air system is controlled by the engine control system.
 - *19) A dedicated air supply must be connected to the sensor to provide compressed air for cleaning, with air quality level of ISO 8573-1:2010 (1:7:2).

Available executions

Execution No.	Material ID	Cylinder No.	Attribute 1: Turbocharger amount	
			1	2
001	PTAA023260	5-7	X	
002	PTAA023261	7-8		X

SURFACE PROTECTION SEE GROUP 03/44
 TOLERANCING PRINCIPLE ISO8015
 GENERAL TOLERANCES ACCORDING TO ISO2768-mK

NOTE

The above executions can be configured using the Engine Configurator. Detailed guidance for the executions is provided within the Marine Installation Manual (MIM). If a specific execution of interest is not shown in the above table, then it may still be under development or not available. For further information or in case of a project-specific request, WinGD must be contacted directly.

This publication is designed to provide accurate and authoritative information with regard to the subject-matter covered as it was available at the time of printing. However, the publication deals with complicated technical matters suited only for specialists in the area, and the design of the subject-products is subject to regular improvements, modifications and changes. Consequently, the publisher and copyright owner of this publication cannot accept any responsibility or liability for any eventual errors or omissions in this document or for discrepancies arising from the features of any actual item in the respective product being different from those shown in this publication. The publisher and copyright owner shall under no circumstances be held liable for any financial consequential damages or other loss, or any other damage or injury, suffered by any party making use of this publication or the information contained herein.

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Prod.	X52DF-S2.0											
Change History												
	-	sna102								new Design		
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis				Activity Code	E	C



EXHAUST SYSTEM
 MIDS master drawing

separate BOM available


Dimension

Scale	-		NX	Units [mm] [kg]	Basic Material			Net Weight	0.001	
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Qty per		A4	Item ID	PTAA023256			Drawing Page/s	1/1		

SEQ NO	QTY	Item ID	Item Name	Dimension	Standard-ID	Basic Material	Net Weight
1	1	PTAA023235	Exhaust System	with one turbocharger			0.001
2	1	PAAD327310	SPECIFICATION				0.001
3	1	DAAD139643	GUIDELINES				

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Proc.	5,6,7 X52DF-S2.0							
Change History								
	-	sna102	mhu019	16.03.2022	CNAA001365	Main Design/Drawing Introduced	-	-
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E C

	Exhaust System
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Bill Of Material			Dimension				
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	Main Design	Yes	Design Group		9726	Q-Code	XXXXX
	Qty per	Engine	A4	Item ID	PTAA023260		BOM Page/s

Specifications which must be met:

- 73** OUTLET - Exhaust gas manifold waste gate
 - Size and layout of connection flange is provided in the "Pipe Connection Plan"
 - Pipe diameter according to parameter "B" on page 2.
 - The waste gate connection pipe, as connected to the main exhaust gas pipe, must be kept as short as possible to avoid swirl and extensive back pressure
- 75** INLET - Recirculated exhaust gas turbocharger

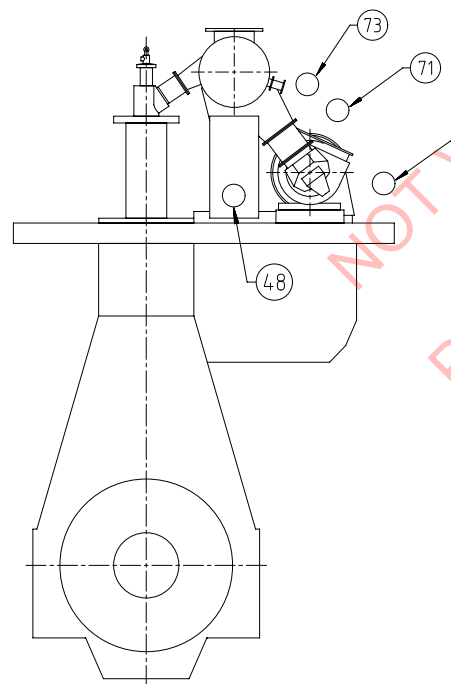
Exhaust temperature:

 - Controlled by the EGC
 - Must be always below the scavenge air temperature

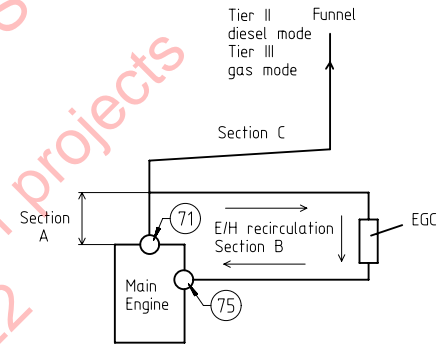
Exhaust gas piping:

 - Piping with cones, bends and pipe connections must be flow optimised and arranged in a way to avoid condensation draining to the turbocharger suction.
 - The piping between the exhaust gas cooler outlet and turbocharger inlet must be insulated to avoid condensation of the humid recirculating exhaust gas on the pipe wall. The same insulation standard, as used on the hot side before the cooler, must be applied on the exhaust gas return pipe accordingly.
- 48** OUTLET - EGC purge air supply

The purge air supply line must be connected upstream from the water mist catcher to the EGC exhaust gas return pipe. For the detailed layout of the connection and installation variants please refer to "The iCER Installation Guideline"



- 71** OUTLET - Exhaust gas turbocharger
 - Exhaust gas temperature and volume flow: according to GTD
 - The total back pressure of the exhaust gas system must be kept within the following ranges:
 - Total back pressure in diesel mode, in section A and C:
 - ≤ 30 mbar in layout condition, ≤ 50 mbar in operation
 - Tier III ≤ 60 mbar in layout condition, ≤ 80 mbar in operation
 - Total back pressure in gas mode, in section A and B, considering the back pressure valve position and a re-circulation rate of 50%, with iCER operation:
 - Nominal for design (in reference to GTD performance): 20 mbar
 - ≤ 35 mbar in layout condition, ≤ 45 mbar in operation



- The exhaust gas pipe must be insulated according to applicable rules, e.g. SOLAS.
- Pipe dimensions in relation to the exhaust gas mass flow rates are provided by table 1 on page 2.
- The exhaust piping with cones, bends and pipe connections must be flow optimised and arranged in a way to avoid gases from accumulating.
- The piping layout must consider the thermal expansion and vibration from the turbocharger (TC) and main engine (ME). Thermal expansion of the ME is to be calculated according to the formula in MIM. TC specific thermal expansion is provided by the TC supplier.
- Explosion relief devices, examined and certified by the maker, with flameless pressure relief (rupture discs or self-closing, spring-loaded valves) must be selected and installed within the exhaust system in accordance with class requirements. The exact position and number of explosion relief devices must be determined by the system designer or the shipyard through calculation. Independently, which type of explosion relief devices is selected, the distance of the explosion relief device to gangways, working areas and system components must be at least 3 m to not endanger personnel and/or to avoid material damage.
- A continuous (extensive) exhaust gas leakage must be avoided.
- Supports (fixation points) for the mass of piping and exhaust gas system components must be installed in sufficient size and amount. Inadmissible tensions in the piping and forces acting on the turbocharger are not acceptable.
- Exhaust gas pipes of several engines must not be connected.
- Drains of adequate size and amount must be installed in the exhaust gas piping.
- When the noise level on the bridge wing exceeds the class requirement (normally 60 - 70 dB(A)) a silencer must be applied.

Prod.															
Change History															
Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Approved	Activity Code	E	C						
-	snq102	mhu019	16.03.2022	CNA001365	new Design										
WIN GD Winterthur Gas & Diesel		Exhaust System													
		Dimension with one turbocharger													
Scale	-	NX		Units [mm] [kg]	Basic Material	Net Weight		0.001							
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TOLERANCING PRINCIPLE ISO8015		Main Design		Design Group		9726		Q-Code		XXXXX		Standard		WDS	
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Qty per		A2		Item ID		PTAA023235		Drawing		Pages		1/3	

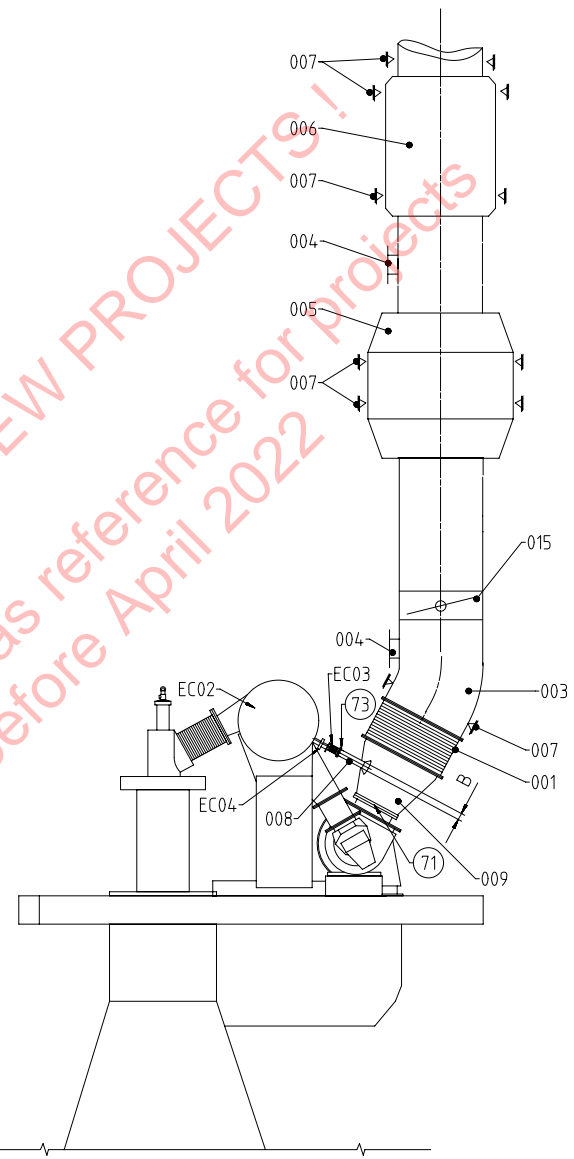
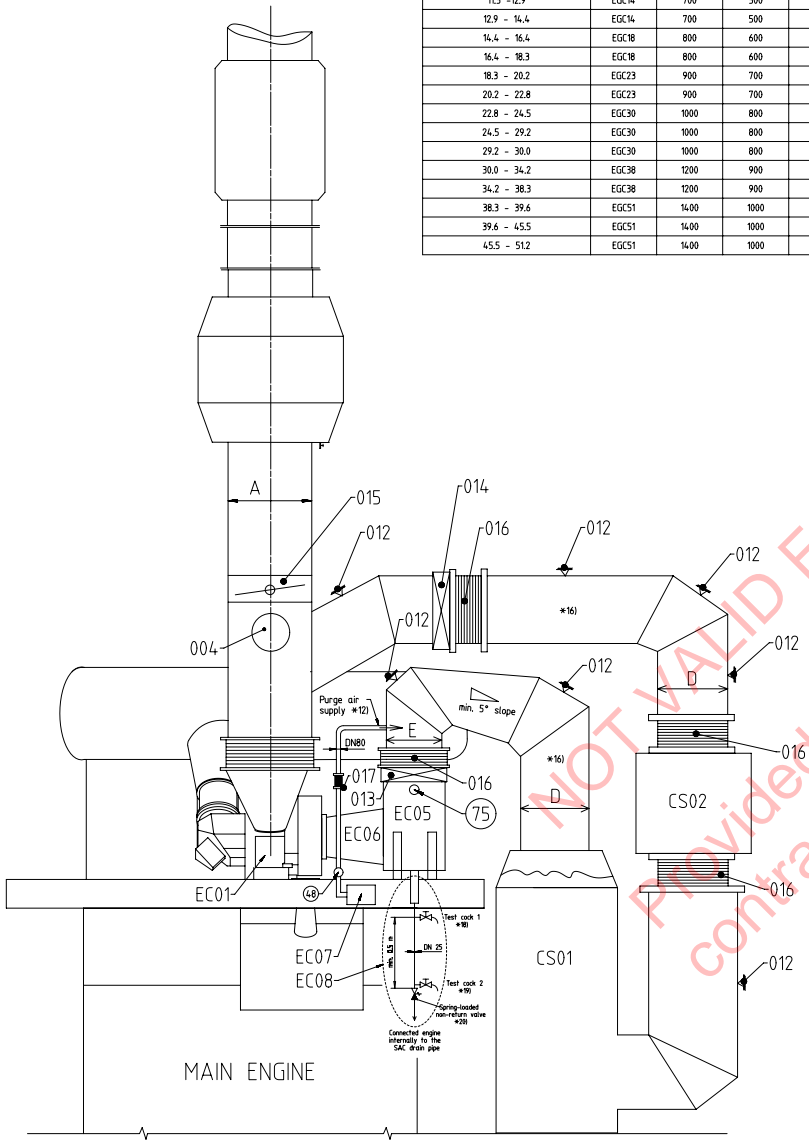
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NOTE
Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

Short Route
- Exhaust gas branch-off after turbocharger

Table 1: Pipe dimensions in relation to exhaust gas mass flow

Exhaust Gas mass flow (turbine flow from GTD) kg/s	EGC Size	D	E	A**9)	B
11.5 - 12.9	EGC14	700	500	800	*9)
12.9 - 14.4	EGC14	700	500	900	
14.4 - 16.4	EGC18	800	600	1000	
16.4 - 18.3	EGC18	800	600	1000	
18.3 - 20.2	EGC23	900	700	1000	
20.2 - 22.8	EGC23	900	700	1100	
22.8 - 24.5	EGC30	1000	800	1100	
24.5 - 29.2	EGC30	1000	800	1200	
29.2 - 30.0	EGC30	1000	800	1300	
30.0 - 34.2	EGC38	1200	900	1300	
34.2 - 38.3	EGC38	1200	900	1400	
38.3 - 39.6	EGC51	1400	1000	1400	
39.6 - 45.5	EGC51	1400	1000	1500	
45.5 - 51.2	EGC51	1400	1000	1600	



Pos.	SYSTEM COMPONENTS *2)
001	Compensator between engine and exhaust gas system *8)
003	Exhaust gas pipe
004	Explosion relief device (rupture discs or spring-loaded valves) *5)
005	Main Economiser
006	Silencer (with spark arrester) *10)
007	Support *4)
008	Waste gate pipe
009	Transition piece *6)
012	(KER support) *4)
013	Flow Regulating (shut-off) Valve *13)
014	Shut-off valve *13)
015	Back Pressure Valve (BPV) *13)
016	Compensator in the exhaust system *17)
017	Compensator in the purge air supply pipe *12)

Pos.	ENGINE CONNECTIONS *1)
①	OUTLET - Exhaust gas turbocharger
②	OUTLET - Exhaust gas manifold waste gate
③	INLET - Recirculated exhaust gas turbocharger
④	OUTLET - EGC purge air supply

Pos.	ENGINE COMPONENTS *3)
EC01	Turbocharger
EC02	Exhaust gas manifold
EC03	Waste gate compensator *8) *9)
EC04	Waste gate valve
EC05	Water mist catcher
EC06	Turbocharger connection piece (cone)
EC07	Purging control
EC08	Condensate drain collection pocket with drain pipe, check valves and relief valve

Pos.	COMPONENTS from certified suppliers *14)
CS01	Exhaust Gas Cooler (EGC)
CS02	Micro Economiser *11)

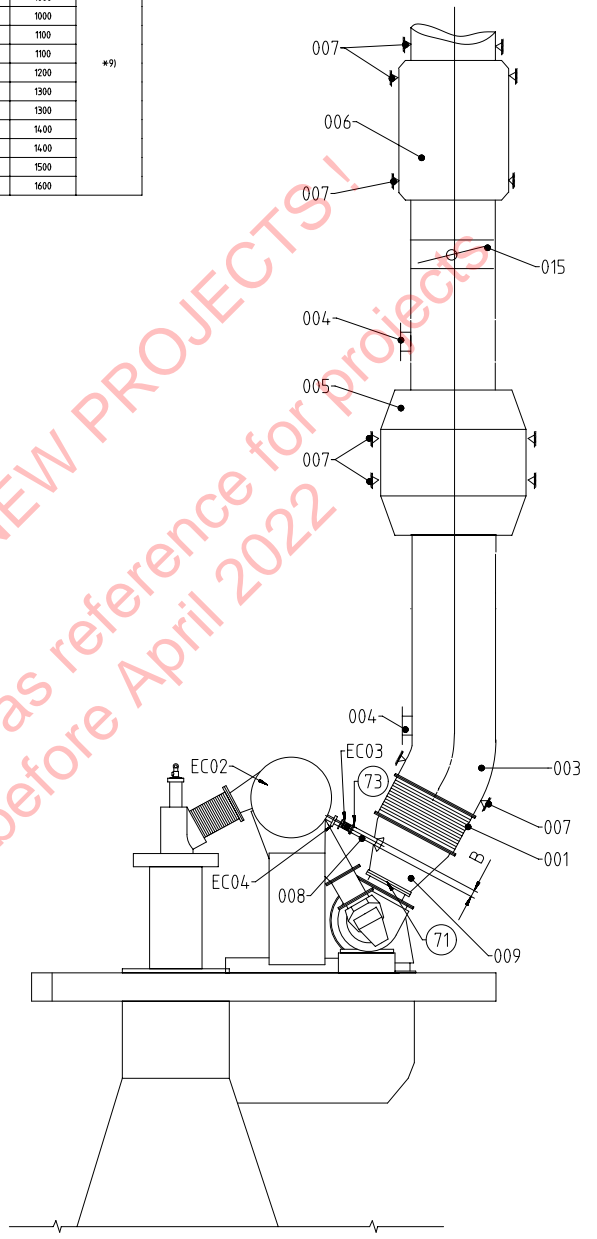
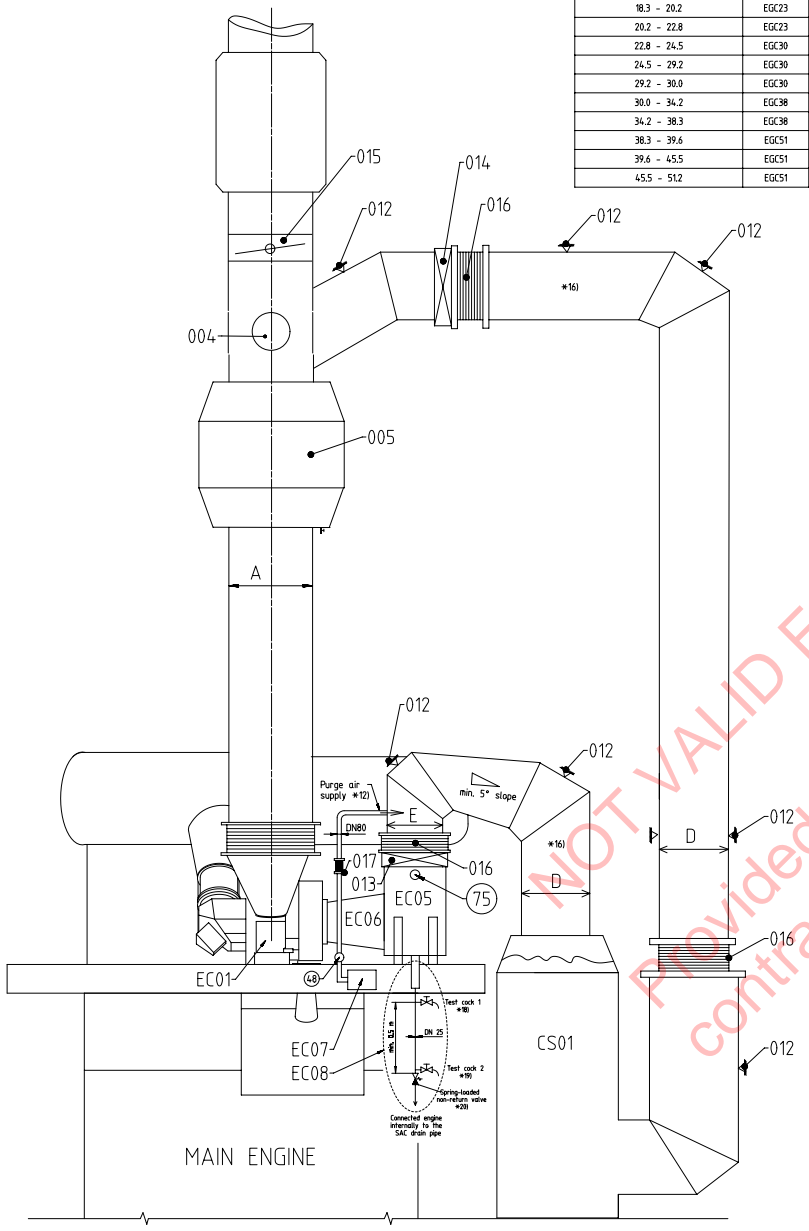
- Remarks:
- Drain plugs and drain cocks to be installed where necessary.
 - *1) Refer to the "Pipe Connection Plan" for the execution and location of the engine pipe connections.
 - *2) To be installed by the shipyard.
 - *3) To be delivered by the engine builder, i.e. already equipped on engine side.
 - *4) The piping of the exhaust gas system must be structurally supported to withstand the mass and to minimise vibrations across the system (e.g. by connecting the support to the ship hull or otherwise). The type of these supports (fixed or sliding type), their final amount and position have to be defined by the shipyard under consideration of system layout and requirements based on installation specific calculation.
 - *5) When rupture discs are installed, preventative measures must be taken to ensure that exhaust gas does not continuously flow to the out after rupture. This can be achieved with an exhaust gas duct leading to the open deck, or in the case of a twin-engine installation, by sending a control signal that initiates a shutdown of the engine. If either of these options are not possible, a self-closing, spring-loaded valve with flame arrester must be used. This would remove the peak pressure of an explosion, while ensuring that the exhaust gas does not continuously flow out.
 - *6) Area ratio between outlet/inlet = 1:1.16, taper angle ≤ 40°
 - *8) The dimension of the expansion piece (compensator) must be defined by the shipyard in accordance with the thermal growth of the exhaust manifold and the exhaust pipe. Variations of the pipe after the compensator must be lower than 45 mmis RMS (root mean square).
 - *9) Guidance regarding the selection of the waste gate pipe size is provided by the drawing "DA0116127" as linked on the main drawing of this design group. The waste gate pipe on the shipside is one nominal pipe size larger than the waste gate pipe on the engine side (before the compensator).
 - *10) Optional, installed as required to meet noise requirements.
 - *11) Optional, in combination with the main economiser if ship's steam demand cannot be covered by the economiser in the upper exhaust gas pipe after the back pressure valve.
 - *12) The purge air supply line must be connected upstream from the water mist catcher to the EGC exhaust gas return pipe. A compensator must be applied with the shown layout. Other installation variants, as shown in "The (KER Installation Guideline)", e.g. with connection via intermediate piece between water mist catcher and exhaust pipe and without compensator, are possible.
 - *13) Valve size to be selected in accordance with actual exhaust gas mass flow.
 - *14) To be supplied by a certified supplier. Ordering to be coordinated between shipyard and engine builder.
 - *15) Based on a design velocity of max. 40 m/s
 - *16) The exhaust gas pipes upstream and downstream of the EGC must be insulated.
 - *17) The final amount and position have to be defined by the shipyard considering the system layout and requirements based on installation specific calculation.
 - *18) By opening of test cock 1 the following conditions can be checked:
Normal condition:
No water flow but air suction.
Abnormal condition:
Water flow, which is the indication that the drain valve is blocked in closed position.
 - *19) By opening of test cock 2 the following conditions can be checked:
Normal condition:
Water flow. Water samples can be taken.
Abnormal condition:
No water flow but air suction, which is the indication that the drain valve is blocked in open position.
 - *20) Valve opening at 25 mbar.

NOTE
Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

Long Route
- Exhaust gas branch-off after economizer

Table 1: Pipe dimensions in relation to exhaust gas mass flow

Exhaust Gas mass flow (turbine flow from GTD) kg/s	EGC Size	D	E	A**9)	B
11.5 - 12.9	EGC14	700	500	800	*9)
12.9 - 14.4	EGC14	700	500	900	
14.4 - 16.4	EGC18	800	600	1000	
16.4 - 18.3	EGC18	800	600	1000	
18.3 - 20.2	EGC23	900	700	1000	
20.2 - 22.8	EGC23	900	700	1100	
22.8 - 24.5	EGC30	1000	800	1100	
24.5 - 29.2	EGC30	1000	800	1200	
29.2 - 30.0	EGC30	1000	800	1300	
30.0 - 34.2	EGC38	1200	900	1300	
34.2 - 38.3	EGC38	1200	900	1400	
38.3 - 39.6	EGC51	1400	1000	1400	
39.6 - 45.5	EGC51	1400	1000	1500	
45.5 - 51.2	EGC51	1400	1000	1600	



Pos.	SYSTEM COMPONENTS *2)
001	Compensator between engine and exhaust gas system *8)
003	Exhaust gas pipe
004	Explosion relief device (rupture discs or spring-loaded valves) *5)
005	Main Economiser
006	Silencer (with spark arrester) *10)
007	Support *4)
008	Waste gate pipe
009	Transition piece *6)
012	(KER support *4)
013	Flow Regulating (shut-off) Valve *13)
014	Shut-off valve *13)
015	Back Pressure Valve (BPV) *13)
016	Compensator in the exhaust system *7)
017	Compensator in the purge air supply pipe *12)

Pos.	ENGINE CONNECTIONS *1)
①	OUTLET - Exhaust gas turbocharger
②	OUTLET - Exhaust gas manifold waste gate
③	INLET - Recirculated exhaust gas turbocharger
④	OUTLET - EGC purge air supply

Pos.	ENGINE COMPONENTS *3)
EC01	Turbocharger
EC02	Exhaust gas manifold
EC03	Waste gate compensator *8) *9)
EC04	Waste gate valve
EC05	Water mist catcher
EC06	Turbocharger connection piece (cone)
EC07	Purging control
EC08	Condensate drain collection pocket with drain pipe, check valves and relief valve

Pos.	COMPONENTS from certified suppliers *14)
CS01	Exhaust Gas Cooler (EGC)


- Remarks:**
- Drain plugs and drain cocks to be installed where necessary.
 - *1) Refer to the "Pipe Connection Plan" for the execution and location of the engine pipe connections.
 - *2) To be installed by the shipyard.
 - *3) To be delivered by the engine builder, i.e. already equipped on engine side.
 - *4) The piping of the exhaust gas system must be structurally supported to withstand the mass and to minimise vibrations across the system (e.g. by connecting the support to the ship hull or otherwise).
The type of these supports (fixed or sliding type), their final amount and position have to be defined by the shipyard under consideration of system layout and requirements based on installation specific calculation.
 - *5) When rupture discs are installed, preventative measures must be taken to ensure that exhaust gas does not continuously flow to the sea after rupture. This can be achieved with an exhaust gas duct leading to the open deck, or in the case of a twin-engine installation, by sending a control signal that initiates a shutdown of the engine. If either of these options are not possible, a self-closing, spring-loaded valve with flame arrester must be used. This would remove the peak pressure of an explosion, while ensuring that the exhaust gas does not continuously flow out.
 - *6) Area ratio between outlet/inlet = 1:1.16, taper angle $\leq 40^\circ$
 - *8) The dimension of the expansion piece (compensator) must be defined by the shipyard in accordance with the thermal growth of the exhaust manifold and the exhaust pipe. Vibrations of the pipe after the compensator must be lower than 45 mm/s RMS (root mean square).
 - *9) Guidance regarding the selection of the waste gate pipe size is provided by the drawing "DAAD16127" as linked on the main drawing of this design group. The waste gate pipe on the shipside is one nominal pipe size larger than the waste gate pipe on the engine side (before the compensator).
 - *10) Optional, installed as required to meet noise requirements.
 - *12) The purge air supply line must be connected upstream from the water mist catcher to the EGC exhaust gas return pipe. A compensator must be applied with the shown layout. Other installation variants, as shown in "The KER Installation Guideline", e.g. with connection via intermediate piece between water mist catcher and exhaust pipe and without compensator, are possible.
 - *13) Valve size to be selected in accordance with actual exhaust gas mass flow.
 - *14) To be supplied by a certified supplier. Ordering to be coordinated between shipyard and engine builder.
 - *15) Based on a design velocity of max. 40 m/s
 - *16) The exhaust gas pipes upstream and downstream of the EGC must be insulated.
 - *17) The final amount and position have to be defined by the shipyard considering the system layout and requirements based on installation specific calculation.
 - *18) By opening of test cock 1 the following conditions can be checked:
Normal condition:
No water flow but air suction.
Abnormal condition:
Water flow, which is the indication that the drain valve is blocked in closed position.
 - *19) By opening of test cock 2 the following conditions can be checked:
Normal condition:
Water flow. Water samples can be taken.
Abnormal condition:
No water flow but air suction, which is the indication that the drain valve is blocked in open position.
 - *20) Valve opening at 25 mbar.

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SEQ NO	QTY	Item ID	Item Name	Dimension	Standard-ID	Basic Material	Net Weight
1	1	PTAA023236	Exhaust System	with two turbocharger			0.001
2	1	PAAD327310	SPECIFICATION				0.001
3	1	DAAD139643	GUIDELINES				

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Proc.	8 X52DF-S2.0							
Change History								
	-	sna102	mhu019	16.03.2022	CNAA001365	Main Design/Drawing Introduced	-	-
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E C

	Exhaust System
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Bill Of Material				Dimension						
Copyright Winterthur Gas & Diesel Ltd. All rights reserved. By taking possession of the document the recipient recognizes and honours these rights. Neither the whole nor any part of this document 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 Winterthur Gas & Diesel Ltd.		Units	[m] [kg]	Basic Material			Net Weight	0.001		
		Main Design	Yes	Design Group		9726	Q-Code	XXXXX	Standard	WDS
		Qty per	Engine	A4	Item ID	PTAA023261		BOM Page/s	01/01	

Specifications which must be met:

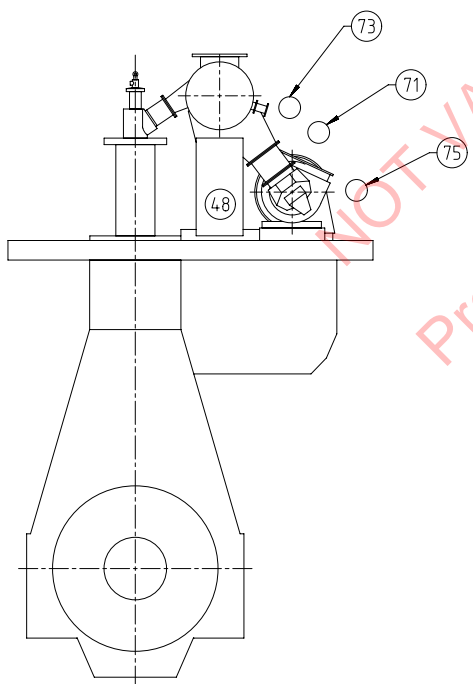
- 73** OUTLET - Exhaust gas manifold waste gate
 - Size and layout of connection flange is provided in the "Pipe Connection Plan"
 - Pipe diameter according to parameter "C" on page 2.
 - Waste gate connection pipe to main exhaust gas pipe must be kept as short as possible to avoid swirl and extensive back pressure.
- 75** INLET - Recirculated exhaust gas turbocharger

Exhaust temperature:

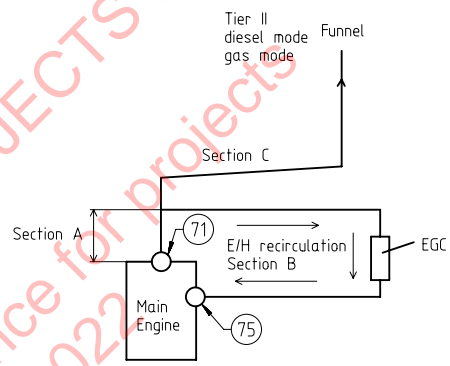
 - Controlled by the EGC
 - Must be always below the scavenge air temperature

Exhaust gas piping:

 - Piping with cones, bends and pipe connections must be flow optimised and arranged in a way to avoid condensation draining to the turbocharger suction.
 - The piping between the exhaust gas cooler outlet and turbocharger inlet must be insulated to avoid condensation of the humid recirculating exhaust gas on the pipe wall. The same insulation standard, as used on the hot side before the cooler, must be applied on the exhaust gas return pipe accordingly.
 - To prevent water droplets in the exhaust gas flow, or water condensate on the pipe wall, from being carried over to the turbocharger, the exhaust gas return pipe must be routed below the level of the turbochargers. Condensate water drains must be arranged at the lowest point of the horizontal return manifold pipe. Different vessel trim conditions must be considered.
- 48** OUTLET - EGC purge air supply
 - The purge air supply must be connected upstream from the flow regulating valve in the aftmost exhaust gas return branch.



- 71** OUTLET - Exhaust gas turbocharger
 - Exhaust gas temperature and volume flow: according to GTD
 - The total back pressure of the exhaust gas system must be kept within the following ranges:
 - Total back pressure in diesel mode, in section A and C:
 - ≤ 30 mbar in layout condition, ≤ 50 mbar in operation
 - Tier III ≤ 60 mbar in layout condition, ≤ 80 mbar in operation
 - Total back pressure in gas mode, in section A and B, under the following conditions:
 - Recirculation rate during iCER operation 50 % depending on the back pressure valve position.
 - No condensate water trap is installed.
 - Nominal for design (in reference to GTD performance): 30 mbar
 - ≤ 45 mbar in layout condition, ≤ 55 mbar in operation
- The exhaust gas pipe must be insulated according to applicable rules, e.g. SOLAS.
- Pipe dimensions in relation to the exhaust gas mass flow rates are provided by table 1 on page 2.
- The exhaust piping with cones, bends and pipe connections must be flow optimised and arranged in a way to avoid gases from accumulating.
- The piping layout must consider the thermal expansion and vibration from the turbocharger (TC) and main engine (ME). Thermal expansion of the ME is to be calculated according to the formula in MIM. TC specific thermal expansion is provided by the TC supplier.
- Explosion relief devices, examined and certified by the maker, with flameless pressure relief (rupture discs or self-closing, spring-loaded valves) must be selected and installed within the exhaust system in accordance with class requirements. The exact position and number of explosion relief devices must be determined by the system designer or the shipyard through calculation. Independently, which type of explosion relief devices is selected, the distance of the explosion relief device to gangways, working areas and system components must be at least 3 m to not endanger personnel and/or to avoid material damage.
- A continuous (extensive) exhaust gas leakage must be avoided.
- Supports (fixation points) for the mass of piping and exhaust gas system components must be installed in sufficient size and amount. Inadmissible tensions in the piping and forces acting on the turbocharger are not acceptable.
- Exhaust gas pipes of several engines must not be connected.
- Drains of adequate size and amount must be installed in the exhaust gas piping.
- When the noise level on the bridge wing exceeds the class requirement (normally 60 - 70 dB(A)) a silencer must be applied.



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Prod.													
Change History													
Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Approved	Activity Code	E	C				
-	snq102	mhu019	16.03.2022	QNA001365	new Design								
				WIN GD Winterthur Gas & Diesel				Exhaust System					
				Dimension				with two turbocharger					
Scale	-	NX		Units [mm] [kg]	Basic Material	Net Weight		0.001					
SURFACE PROTECTION SEE GROUP 0344				Copyright Winterthur Gas & Diesel Ltd. All rights reserved. By taking possession of the drawing the recipient recognizes and transfers 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 Winterthur Gas & Diesel Ltd.				Main Design		Design Group		9726	
TOLERANCING PRINCIPLE ISO8015				GENERAL TOLERANCES ACCORDING TO ISO2768-mK				Qty per		A2		Item ID	
								P-TAA023236		Drawing Page/s		1/3	

SYSTEM PROPOSAL

NOTE
Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

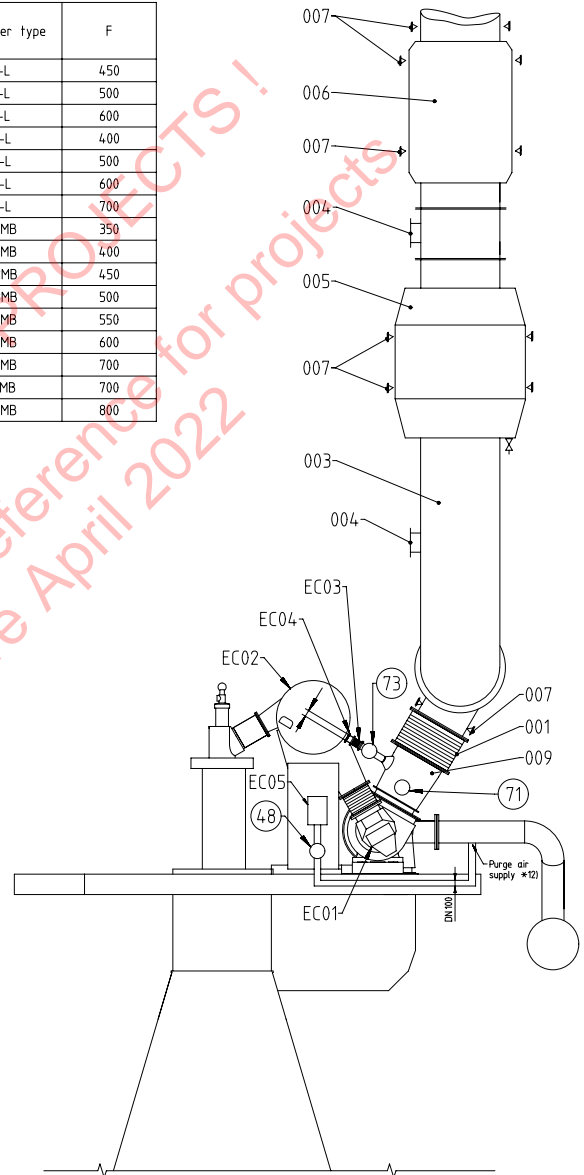
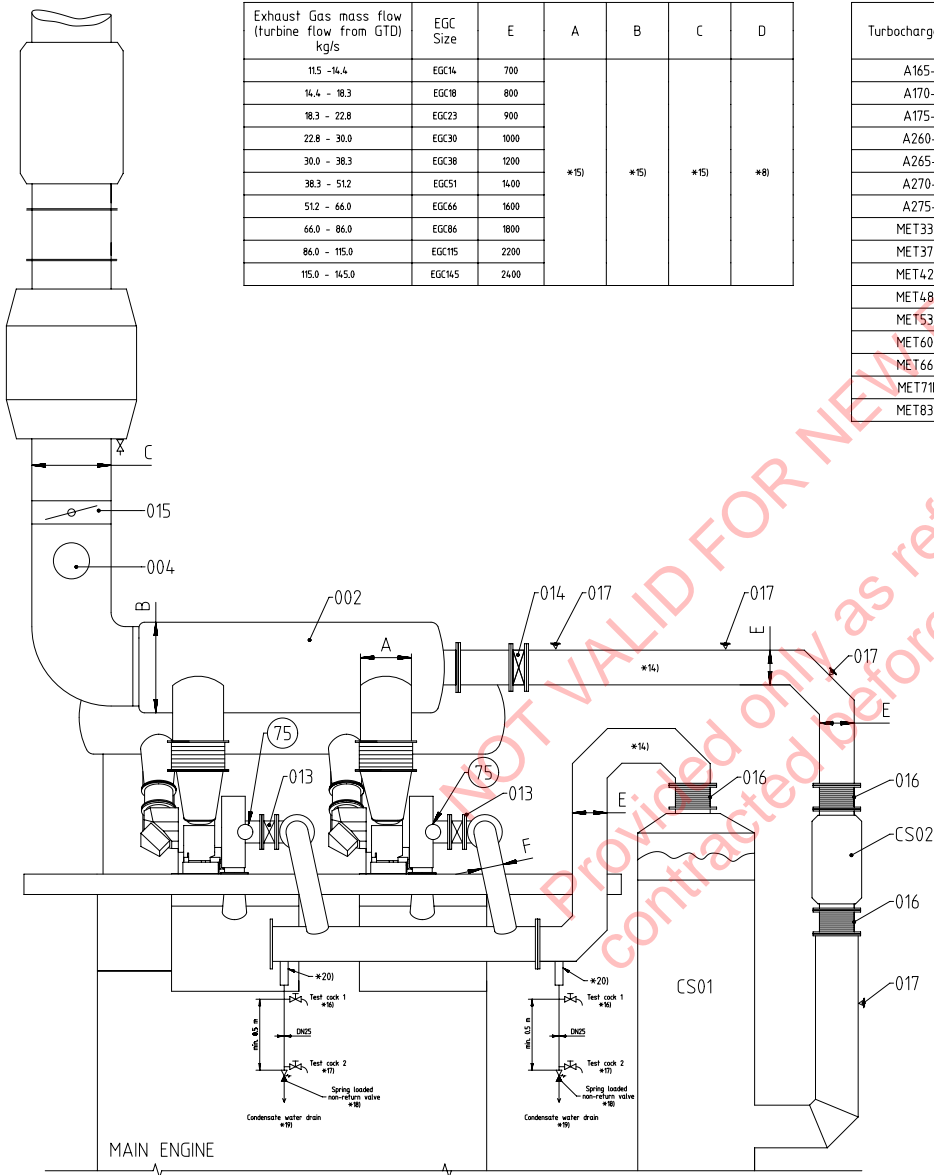
Short Route
- Exhaust gas branch-off after turbocharger

Pos.	COMPONENTS from certified suppliers
CS01	Exhaust Gas Cooler (EGC)
CS02	Micro Economiser *10

Pos.	Engine Components *1)
001	Compensator *4)
002	Exhaust gas collector
003	Exhaust gas pipe
004	Explosion relief device (rupture discs or spring-loaded valves) *5)
005	Main Economiser
006	Silencer (with spark arrester *9)
007	Support *4)
008	Waste gate pipe
009	Transition piece *4)
013	Flow Regulating Valve (FRV)
014	Shut-off valve (SOV)
015	Back Pressure Valve (BPV)
016	Compensator in the exhaust system *13)
017	KEER support *4)
Pos. Engine Connections *2)	
(48)	OUTLET - EGC purge air supply
(71)	OUTLET - Exhaust gas turbocharger
(73)	OUTLET - Exhaust gas manifold waste gate
(75)	INLET - Recirculated exhaust gas turbocharger
Pos. Engine Components *3)	
EC01	Turbocharger
EC02	Exhaust gas manifold
EC03	Waste gate compensator *7) *8)
EC04	Waste gate valve
EC05	Purging control

Table 1: Pipe dimensions in relation to exhaust gas mass flow

Exhaust Gas mass flow (turbine flow from GTD) kg/s	EGC Size	E	A	B	C	D	Turbocharger type	F
11.5 - 14.4	EGC14	700					A165-L	450
14.4 - 18.3	EGC18	800					A170-L	500
18.3 - 22.8	EGC23	900					A175-L	600
22.8 - 30.0	EGC30	1000					A260-L	400
30.0 - 38.3	EGC38	1200					A265-L	500
38.3 - 51.2	EGC51	1400	*15)	*15)	*15)	*8)	A270-L	600
51.2 - 66.0	EGC66	1600					A275-L	700
66.0 - 86.0	EGC86	1800					MET33MB	350
86.0 - 115.0	EGC115	2200					MET37MB	400
115.0 - 145.0	EGC145	2400					MET42MB	450
							MET48MB	500
							MET53MB	550
							MET60MB	600
							MET66MB	700
							MET71MB	700
							MET83MB	800



- Remarks:
- Drain plugs and drain cocks to be installed where necessary.
 - *1) Refer to the "Pipe Connection Plan" for the execution and location of the engine pipe connections.
 - *2) To be installed by the shipyard.
 - *3) To be delivered by the engine builder, i.e. already equipped on engine side.
 - *4) The piping of the exhaust gas system must be structurally supported to withstand the mass and to minimise vibrations across the system (e.g. by connecting the support to the ship hull or otherwise).
The type of these supports (fixed or sliding type), their final amount and position have to be defined by the shipyard under consideration of system layout and requirements based on installation specific calculation.
 - *5) When rupture discs are installed, preventative measures must be taken to ensure that exhaust gas does not continuously flow to the out after rupture. This can be achieved with an exhaust gas duct leading to the open deck, or in the case of a twin-engine installation, by sending a control signal that initiates a shutdown of the engine. If either of these options are not possible, a self-closing, spring-loaded valve with flame arrester must be used. This would remove the peak pressure of an explosion, while ensuring that the exhaust gas does not continuously flow out.
 - *6) Area ratio between outlet/inlet = 1.1..1.6, taper angle $\le 40^\circ$
 - *7) The dimension of the expansion piece (compensator) must be defined by the shipyard in accordance with the thermal growth of the exhaust manifold and the exhaust pipe.
Vibrations of the pipe after the compensator must be lower than 45 mm/s RMS (root mean square).
 - *8) Guidance regarding the selection of the waste gate pipe size is provided by the drawing "DAAD16127" as linked on the main drawing of this design group.
The waste gate pipe on the shipside is one nominal pipe size larger than the waste gate pipe on the engine side (before the compensator).
 - *9) Optional, installed as required to meet noise requirements.
 - *10) Optional, in combination with the main economiser if ship's steam demand cannot be covered by the economiser in the upper exhaust gas pipe after the back-pressure valve.
 - *11) Optional, to be installed if the backpressure from the EGC exceeds the limit.
 - *12) The purge air supply line must be connected upstream from flow regulating valve (013) to the EGC exhaust gas return pipe.
 - *13) The final amount and position have to be defined by the shipyard considering the system layout and requirements based on installation specific calculation.
 - *14) The exhaust gas pipes upstream and downstream of the EGC must be insulated.
 - *15) The exhaust pipe dimension must be selected in accordance with the specific exhaust gas mass flow, as given by the GTD.
 - *16) By opening of test cock 1 the following conditions can be checked:
Normal condition:
No water flow but air suction.
Water flow, which is the indication that the drain valve is blocked in closed position.
Abnormal condition:
No water flow but air suction, which is the indication that the drain valve is blocked in open position.
 - *17) By opening of test cock 2 the following conditions can be checked:
Normal condition:
Water flow. Water samples can be taken.
Abnormal condition:
No water flow but air suction, which is the indication that the drain valve is blocked in open position.
 - *18) Valve opening at 25 mbar.
 - *19) To be directed to the bilge water tank. Can be connected to the SAC drain pipe from engine connection 16.
 - *20) The condensate water collection pocket must be connected at the lowest point of the horizontal return manifold pipe.

Table 1: Pipe dimensions in relation to exhaust gas mass flow

Exhaust Gas mass flow (turbine flow from GTD) kg/s	EGC Size	E	A	B	C	D
11.5 - 14.4	EGC14	700				
14.4 - 18.3	EGC18	800				
18.3 - 22.8	EGC23	900				
22.8 - 30.0	EGC30	1000				
30.0 - 38.3	EGC38	1200	*15)	*15)	*15)	*8)
38.3 - 51.2	EGC51	1400				
51.2 - 66.0	EGC66	1600				
66.0 - 86.0	EGC86	1800				
86.0 - 115.0	EGC115	2200				
115.0 - 145.0	EGC145	2400				

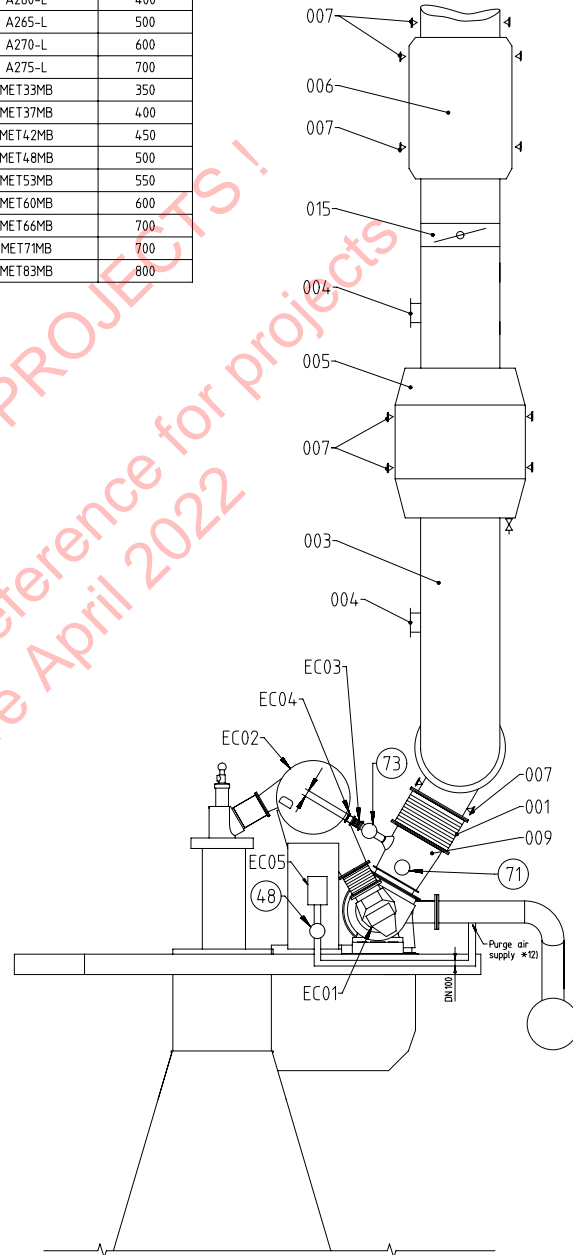
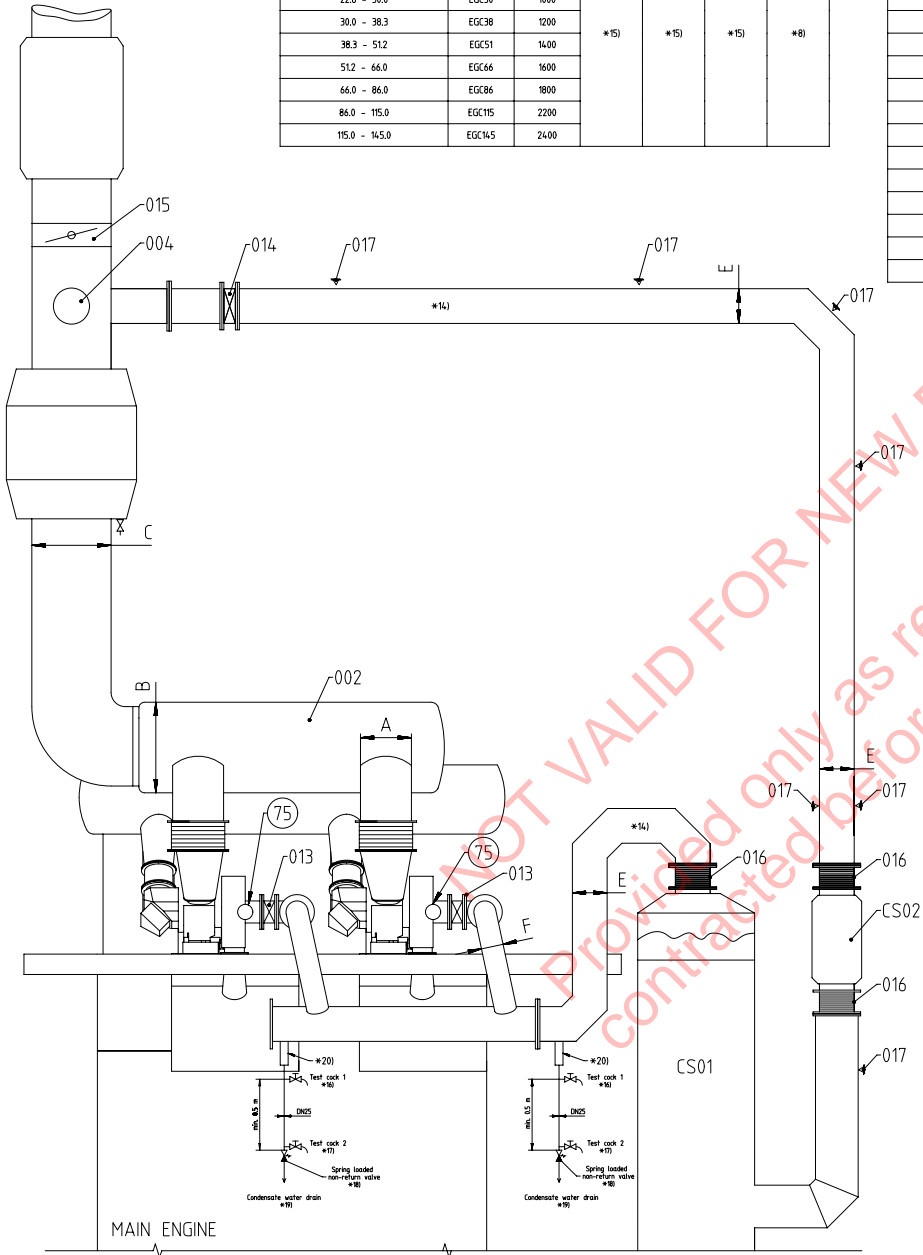
Turbocharger type	F
A165-L	450
A170-L	500
A175-L	600
A260-L	400
A265-L	500
A270-L	600
A275-L	700
MET33MB	350
MET37MB	400
MET42MB	450
MET48MB	500
MET53MB	550
MET60MB	600
MET66MB	700
MET77MB	700
MET83MB	800

Pos.	COMPONENTS from certified suppliers
CS01	Exhaust Gas Cooler (EGC)
CS02	Micro Economiser *10

Pos.	System Components *1)
001	Compensator *4)
002	Exhaust gas collector
003	Exhaust gas pipe
004	Explosion relief device (rupture discs or spring-loaded valves) *5)
005	Main Economiser
006	Silencer (with spark arrester *9)
007	Support *4)
008	Waste gate pipe
009	Transition piece *6)
010	Flow Regulating Valve (FRV)
014	Shut-off valve (SOV)
015	Back Pressure Valve (BPV)
016	Compensator in the exhaust system *13)
017	KEER support *4)
Pos. Engine Connections *2)	
48	OUTLET - EGC purge air supply
71	OUTLET - Exhaust gas turbocharger
73	OUTLET - Exhaust gas manifold waste gate
75	INLET - Recirculated exhaust gas turbocharger
Pos. Engine Components *3)	
EC01	Turbocharger
EC02	Exhaust gas manifold
EC03	Waste gate compensator *7) *8)
EC04	Waste gate valve
EC05	Purging control

NOTE
Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

Long Route
- Exhaust gas branch-off after economizer



- Remarks:
- Drain plugs and drain cocks to be installed where necessary.
 - *1) Refer to the "Pipe Connection Plan" for the execution and location of the engine pipe connections.
 - *2) To be installed by the shipyard.
 - *3) To be delivered by the engine builder, i.e. already equipped on engine side.
 - *4) The piping of the exhaust gas system must be structurally supported to withstand the mass and to minimise vibrations across the system (e.g. by connecting the support to the ship hull or otherwise).
The type of these supports (fixed or sliding type), their final amount and position have to be defined by the shipyard under consideration of system layout and requirements based on installation specific calculation.
 - *5) When rupture discs are installed, preventative measures must be taken to ensure that exhaust gas does not continuously flow to the out after rupture. This can be achieved with an exhaust gas duct leading to the open deck, or in the case of a twin-engine installation, by sending a control signal that initiates a shutdown of the engine. If either of these options are not possible, a self-closing, spring-loaded valve with flame arrester must be used. This would remove the peak pressure of an explosion, while ensuring that the exhaust gas does not continuously flow out.
 - *6) Area ratio between outlet/inlet = 1.1..1.6, taper angle < 40°
 - *7) The dimension of the expansion piece (compensator) must be defined by the shipyard in accordance with the thermal growth of the exhaust manifold and the exhaust pipe.
Vibrations of the pipe after the compensator must be lower than 45 mm/s RMS (root mean square).
 - *8) Guidance regarding the selection of the waste gate pipe size is provided by the drawing "DAAD161527" as linked on the main drawing of this design group.
The waste gate pipe on the shipside is one nominal pipe size larger than the waste gate pipe on the engine side (before the compensator).
 - *9) Optional, installed as required to meet noise requirements.
 - *10) Optional, in combination with the main economiser if ship's steam demand cannot be covered by the economiser in the upper exhaust gas pipe after the back-pressure valve.
 - *11) Optional, to be installed if the backpressure from the EGC exceeds the limit.
 - *12) The purge air supply line must be connected upstream from flow regulating valve (010) to the EGC exhaust gas return pipe.
 - *13) The final amount and position have to be defined by the shipyard considering the system layout and requirements based on installation specific calculation.
 - *14) The exhaust gas pipes upstream and downstream of the EGC must be insulated.
 - *15) The exhaust pipe dimension must be selected in accordance with the specific exhaust gas mass flow, as given by the GTD.
 - *16) By opening of test cock 1 the following conditions can be checked.
Normal condition:
No water flow but air suction.
Water flow, which is the indication that the drain valve is blocked in closed position.
Abnormal condition:
No water flow but air suction, which is the indication that the drain valve is blocked in open position.
 - *17) By opening of test cock 2 the following conditions can be checked.
Normal condition:
Water flow. Water samples can be taken.
Abnormal condition:
No water flow but air suction, which is the indication that the drain valve is blocked in open position.
 - *18) Valve opening at 25 mbar.
 - *19) To be directed to the bilge water tank. Can be connected to the SAC drain pipe from engine connection 16.
 - *20) The condensate water collection pocket must be connected at the lowest point of the horizontal return manifold pipe.

MIDS – Exhaust System (DG9726)

WinGD X52DF-S2.0

TRACK CHANGES

DATE	SUBJECT	DESCRIPTION
2022-03-14	DRAWING SET	First web upload
2022-12-02	PTAA023235 PTAA023236	System drgs. – new revision
2022-12-22	PTAA051379 PTAA051384	New drawing set as replacement of previous one - added
2023-03-27	PTAA051376A PTAA051381B	System drgs. – new revision
2024-02-08	PTAA051376B	New execution

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