


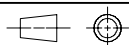
Available executions

Execution No.	Material ID	Attribute: Turbocharger amount	
		2TC	3TC
001	PTAA044721	X	
002	PTAA060532		X

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.	X82DF-2.0									
Change History	B	sde101	mhu019	23.03.2023	CNAA003400	Drawing Updated		4	3	
	A	dki021	mhu019	19.12.2022	CNAA002926	Drawing Updated		-	-	
	-	dki021	dst009	09.06.2022	CNAA000807	new Design		-	-	
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Approved	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	PTAA015882		Drawing Page/s	1/1

SEQ NO	QTY	Item ID	Item Name	Dimension	Standard-ID	Basic Material	Net Weight
1	1	PTAA044713	EXHAUST SYSTEM	with two turbocharger			0
2	1	PAAD327310	SPECIFICATION				0.001
3	1	DAAD139643	GUIDELINES				



Prod.	6,7,8,9 X82DF-2.0							
Change History								
	-	dkl021	mhu019	23.11.2022	CNAA002662	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	Standard WDS
	Qty per	Engine	A4	Item ID	PTAA044721		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".
- 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:

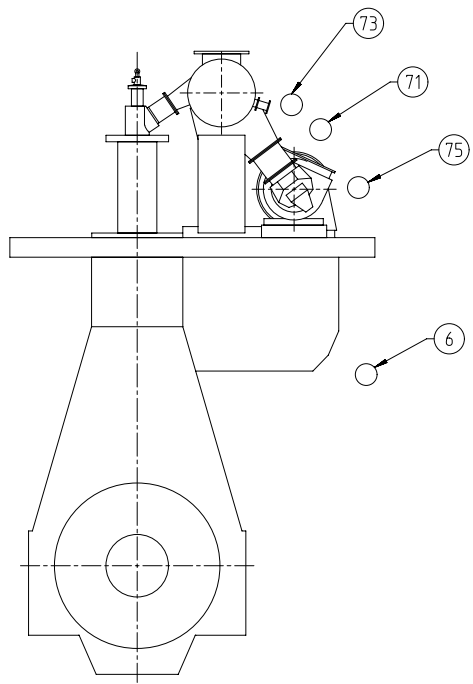
- Controlled by the EGC
- Must be always below the scavenge air temperature

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.

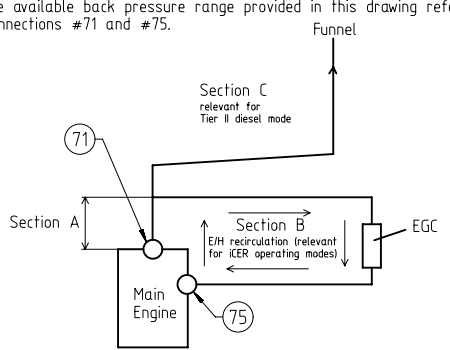
6 OUTLET - Exhaust gas return pipe condensate water drain

- 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 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).

6 OUTLET - Exhaust gas return pipe condensate water drain

- Drain to the iCER waste water holding tank

Prod.	X82DF-2.0							
Change History	C	dkl021	ch009	15.12.2023	0A004854	Drawing updated.	4	3
	B	sde101	mhu019	24.03.2023	CNAA003456	Drawing Updated	4	3
	A	npa101	dst009	21.12.2022	CNAA002993	Drawing Updated	4	3
	-	dkl021	mhu019	23.11.2022	CNAA002662	new Design	-	-
Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Approved	Activity Code	E C

WIN GD
Winterthur Gas & Diesel

EXHAUST SYSTEM
2 TC, iCER off-engine

Dimension: 2 TC, iCER off-engine

Scale: - [Symbol] NX Units [mm] [kg] Basic Material Net Weight 0.000

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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 PTA0044713 Drawing Pages 1/3

SYSTEM PROPOSAL

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

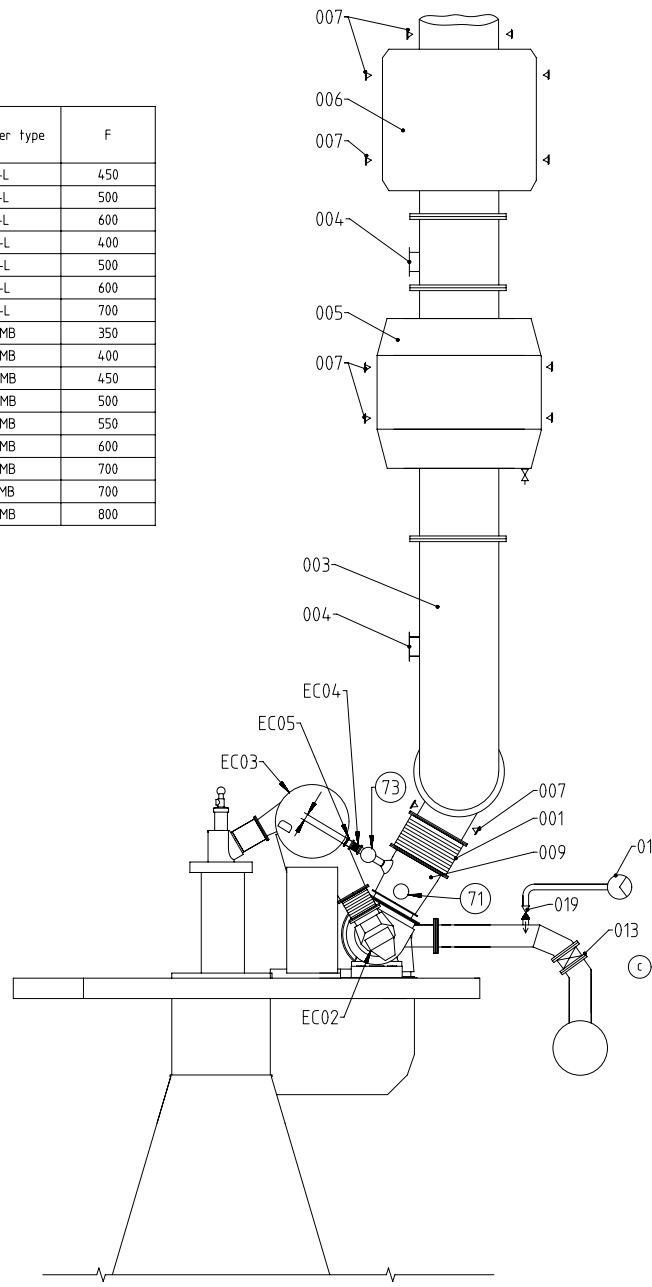
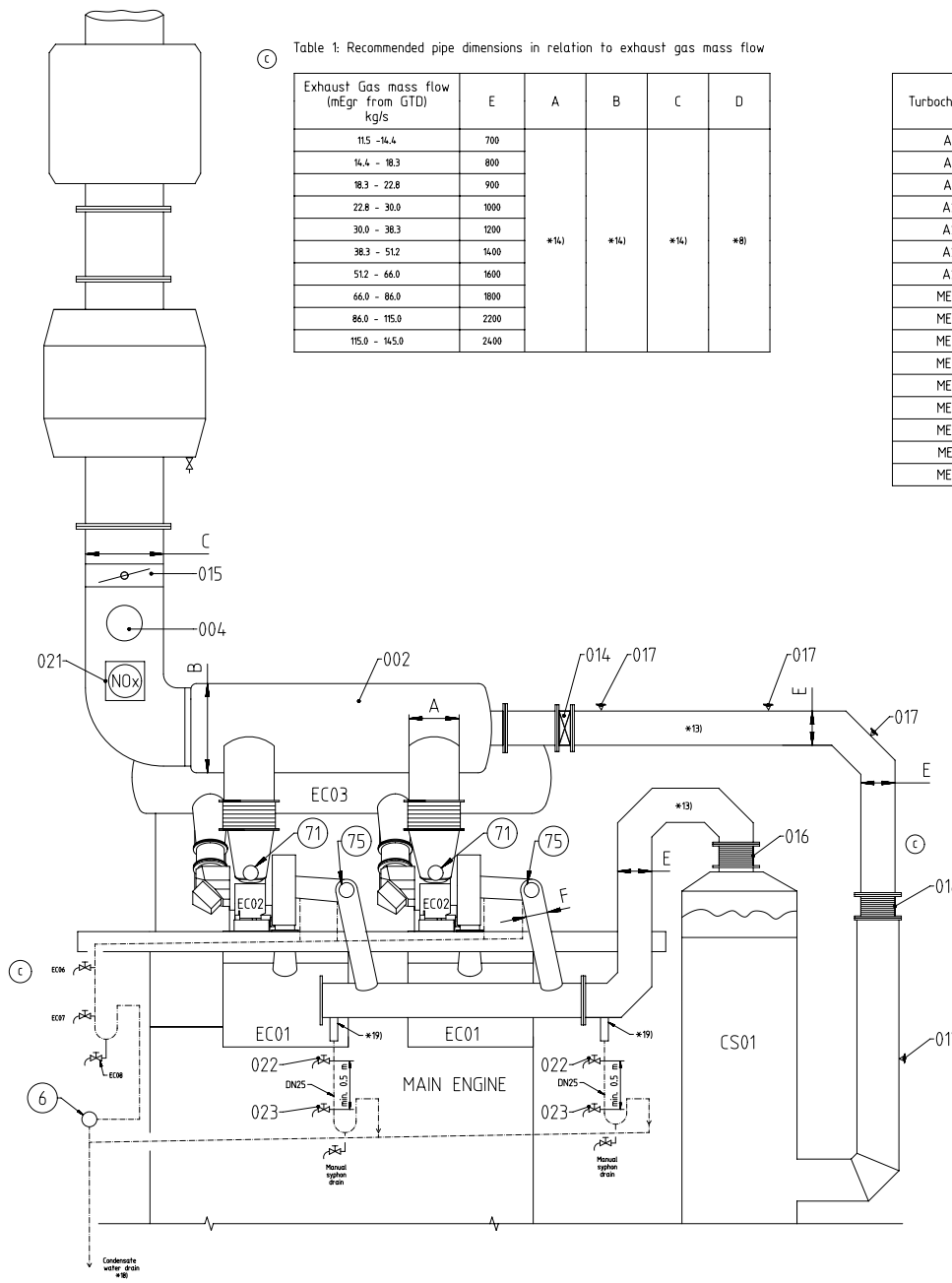
NOTE
 Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

Short Route
 - Exhaust gas branch-off after turbocharger

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

Exhaust Gas mass flow (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	*14	*14	*14	*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. 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)
 - 013 Flow Regulating Valve (FRV)
 - 014 Shut-off valve (SDV)
 - 015 Back Pressure Valve (BPV)
 - 016 Compensator in the exhaust system *12)
 - 017 ICER support *4)
 - 018 Purging and sealing air blower *20)
 - 019 Non-return valve
 - 021 NOx Sensor (as delivered by the engine builder) *21)
 - 022 Test cock 1 *15)
 - 023 Test cock 2 *16)
- Pos. Engine Connections *2)**
- ④ 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 *15)
 - EC07 Test cock 2 *16)
 - 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 aftercast).
 - *5) 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 arrester must be used. This would remove the peak pressure of an explosion, while ensuring that the exhaust gas does not continuously flow out.
 - *7) 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

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

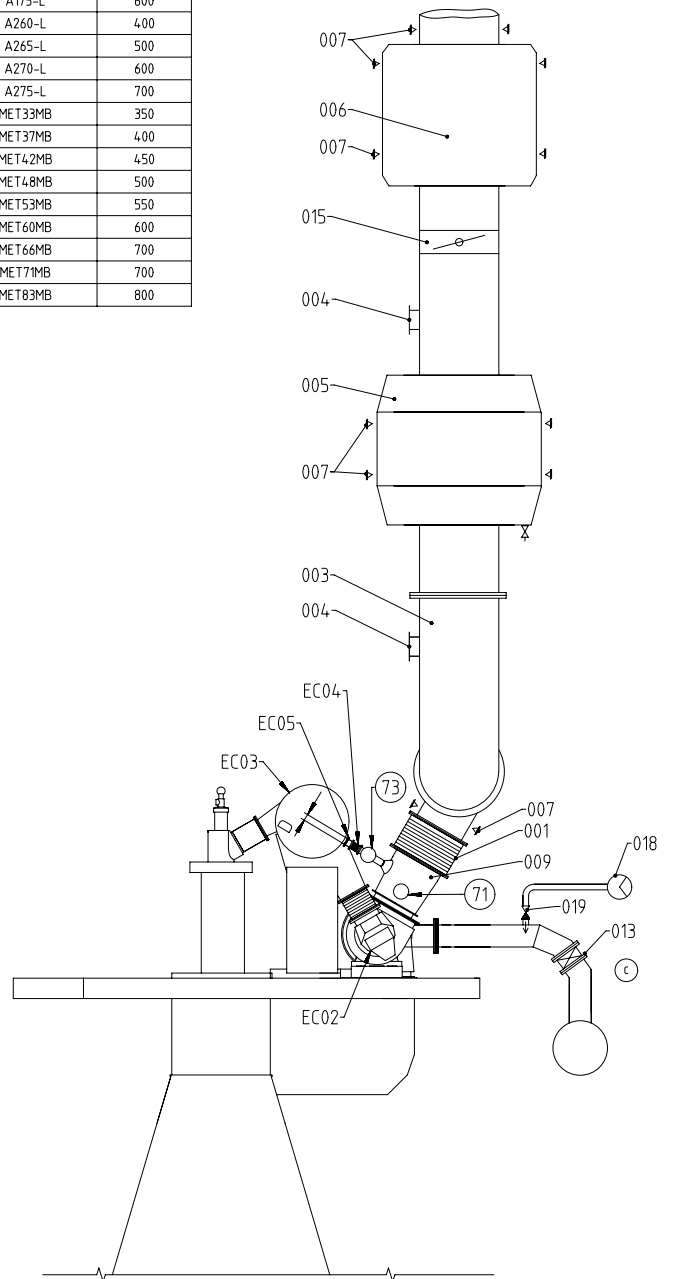
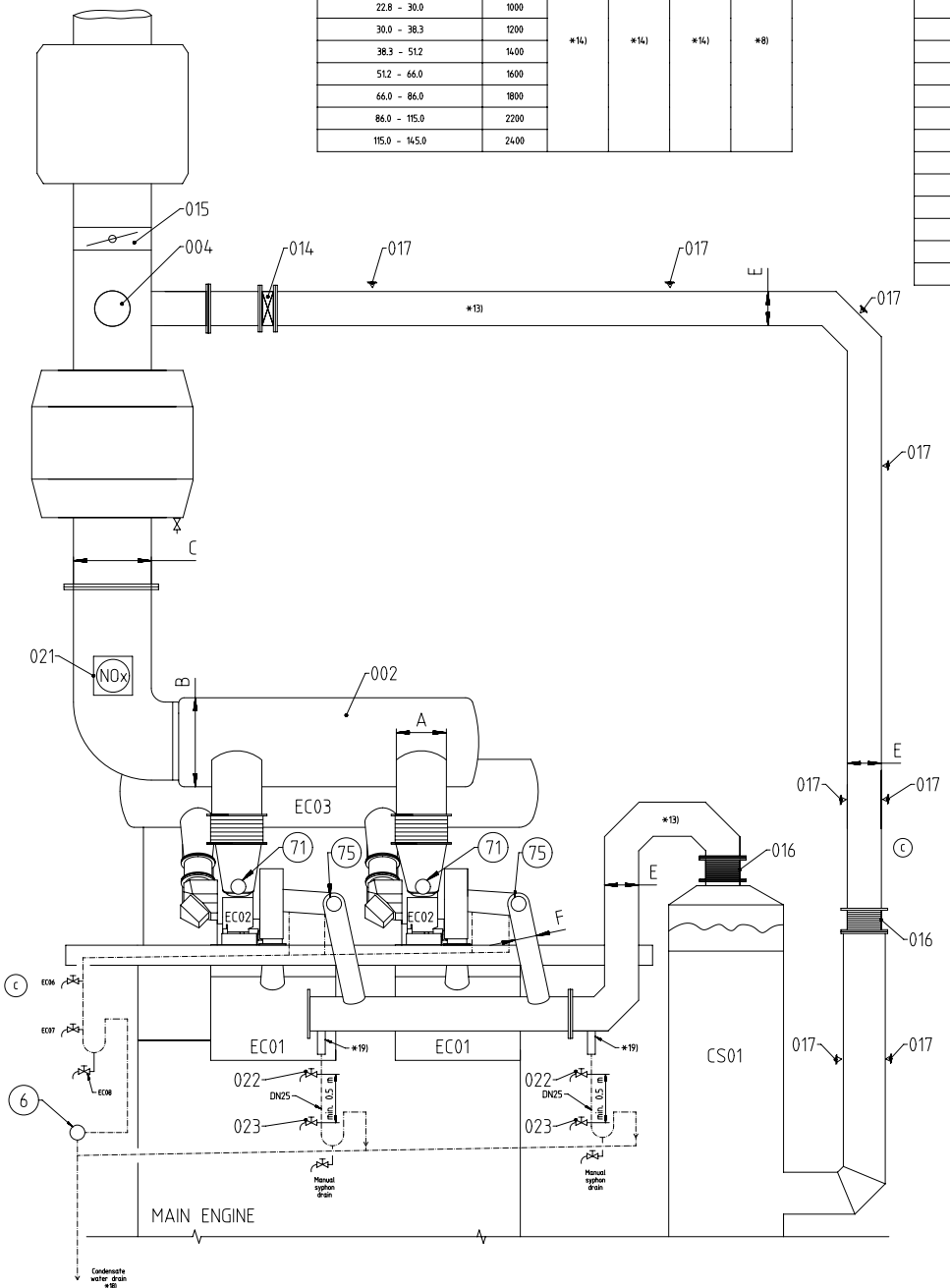
Table 1: Recommended pipe dimensions in relation to exhaust gas mass flow

Exhaust Gas mass flow (mEgr from GTD) kg/s	E	A	B	C	D
115 - 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	*14)	*14)	*14)	*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)
013	Flow Regulating Valve (FRV)
014	Shut-off valve (SOV)
015	Back Pressure Valve (BPV)
016	Compensator in the exhaust system *12)
017	ICER support *4)
018	Purging and sealing air blower *20)
019	Non-return valve
021	NOx Sensor (as delivered by the engine builder) *21)
022	Test cock 1 *15)
023	Test cock 2 *15)



Pos.	Engine Connections *2)
④	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 *15)
EC07	Test cock 2 *16)
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 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 $\leq 40^\circ$
 - *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 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.
 - *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 pipes upstream and downstream of the EGC must be insulated.
 - *14) The exhaust pipe dimension must be selected in accordance with the specific exhaust gas mass flow, as given by the GTD.
 - *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.
 - *18) Condensate water drain to the ICER waste water holding tank.
 - *19) The condensate water collection packet must be connected at the lowest point of the horizontal return manifold pipe.
 - *20) 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.
 - *21) 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 (15:7:2).

SEQ NO	QTY	Item ID	Item Name	Dimension	Standard-ID	Basic Material	Net Weight
1	1	PTAA060522	EXHAUST SYSTEM	with three turbocharger			0
2	1	PAAD327310	SPECIFICATION				0.001
3	1	DAAD139643	GUIDELINES				



Prod.	6,7,8,9 X82DF-2.0							
Change History								
	-	sde101	mhu019	21.03.2023	CNAA003392	New MainDesign	-	-
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	Standard WDS
		Qty per	Engine	A4	Item ID	PTAA060532		BOM Page/s

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

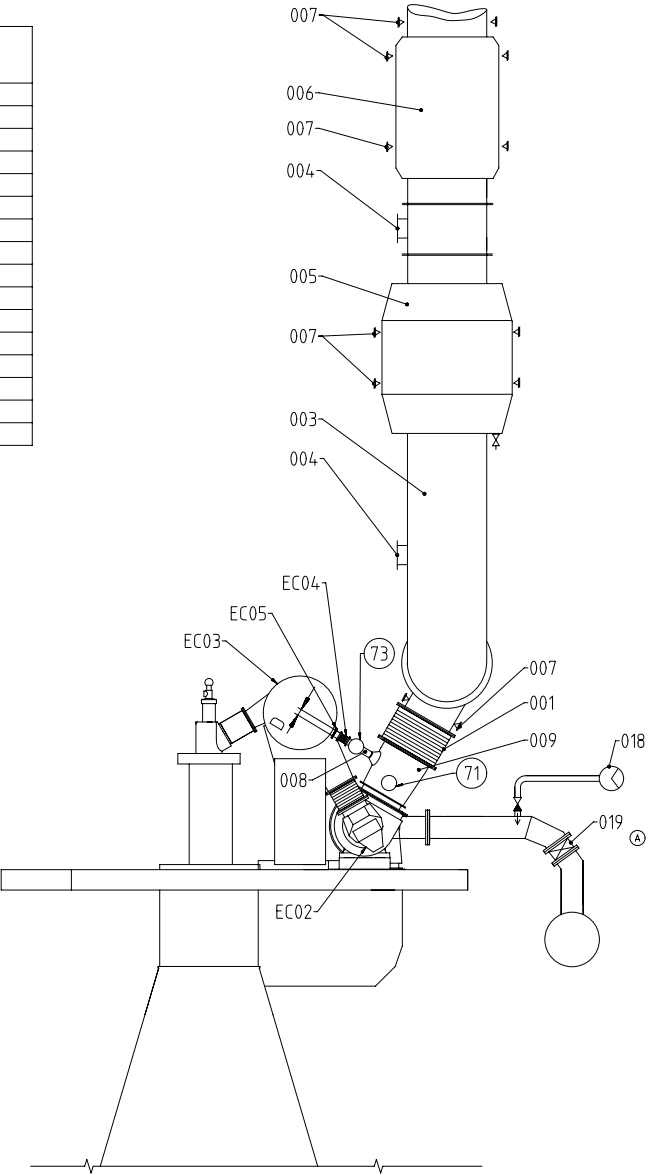
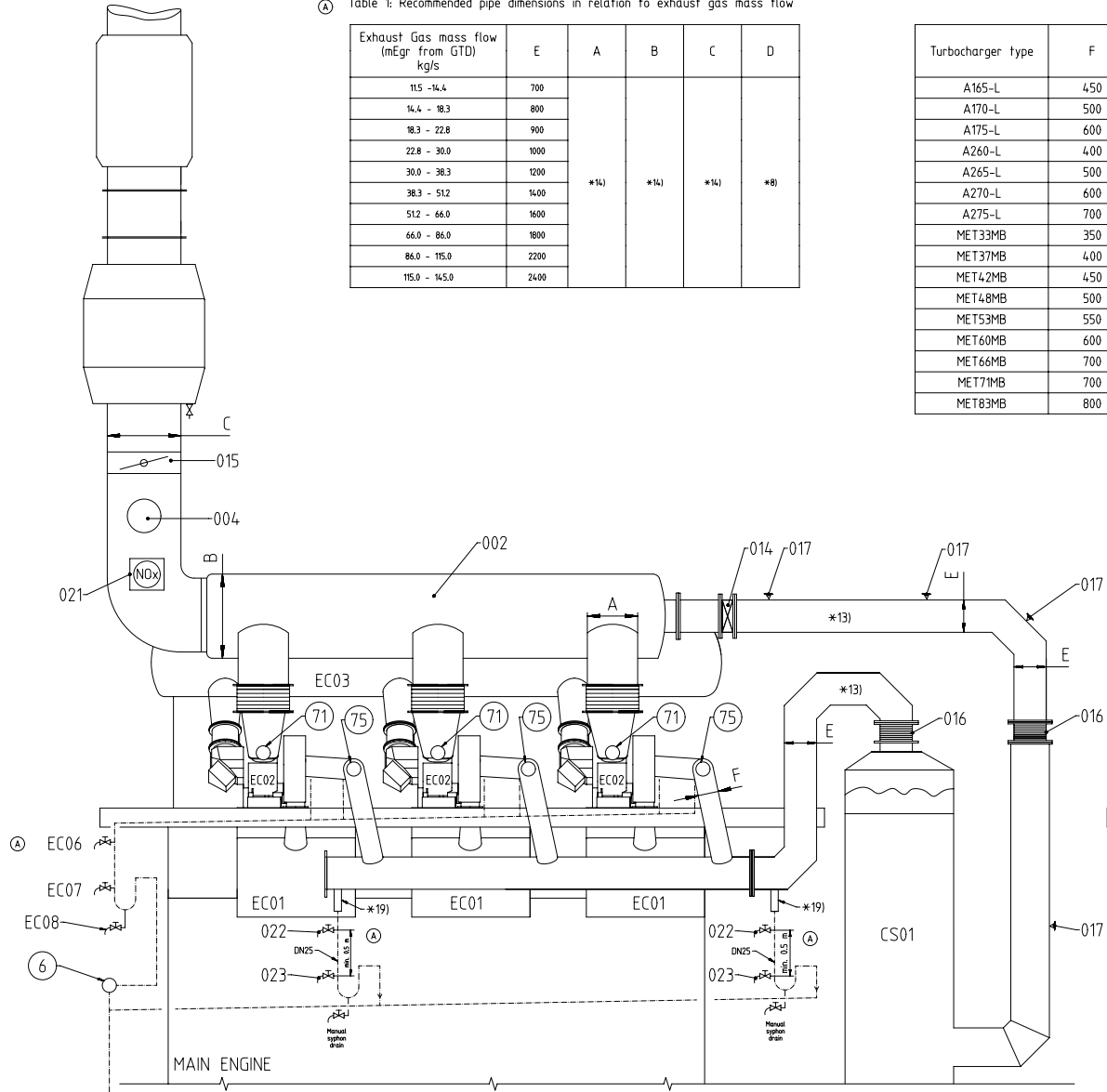
Pos.	COMPONENTS from certified suppliers
CS01	Exhaust Gas Cooler (EGC)

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 #12)
017	ICER support #4)
018	Purging and sealing air blower #20)
019	Non-return valve
021	NDx Sensor (as delivered by the engine builder) #21)
022	Test cock 1 #15)
023	Test cock 2 #16)

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	*14)	*14)	*14)	*8)
38.3 - 51.2	1400				
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)
- OUTLET - Exhaust gas return pipe condensate water drain
- OUTLET - Exhaust gas turbocharger
- OUTLET - Exhaust gas manifold waste gate
- INLET - Recirculated exhaust gas turbocharger

- Pos. Engine Components *3)
- Scavenge air receiver
- Turbocharger (TC)
- Exhaust gas manifold
- Waste gate compensator #7) #8)
- Waste gate valve
- Test cock 1 #15)
- Test cock 2 #16)
- Manual syphon drain

- Remarks:
- Drain plugs and drain cocks to be installed where necessary.
 - Refer to the "Pipe Connection Plan" for the execution and location of the engine pipe connections.
 - To be installed by the shipyard.
 - To be delivered by the engine builder, i.e. already equipped at engine side
 - 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 afterwall).
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.
 - When rupture discs are installed, preventive 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.
 - Area ratio between outlet/inlet = 1:1.16, taper angle $\le 40^\circ$
 - 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 RMS (root mean square).
 - 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).
 - Optional, installed as required to meet noise requirements.
 - Optional, to be installed if the backpressure from the EGC exceeds the limit.
 - The final amount and position have to be defined by the shipyard considering the system layout and requirements based on installation specific calculation.
 - The exhaust gas pipes upstream and downstream of the EGC must be insulated.
 - The exhaust pipe dimension must be selected in accordance with the specific exhaust gas mass flow, as given by the GTD.
 - 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.
 - 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.
 - Condensate water drain to the ICER waste water holding tank.
 - 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.
 - 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.
 - 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 (1,3,2)

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 in the drawing set "Various Installation Items".

Long Route
- Exhaust gas branch-off after economizer

(A) 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	*14)	*14)	*14)	*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)

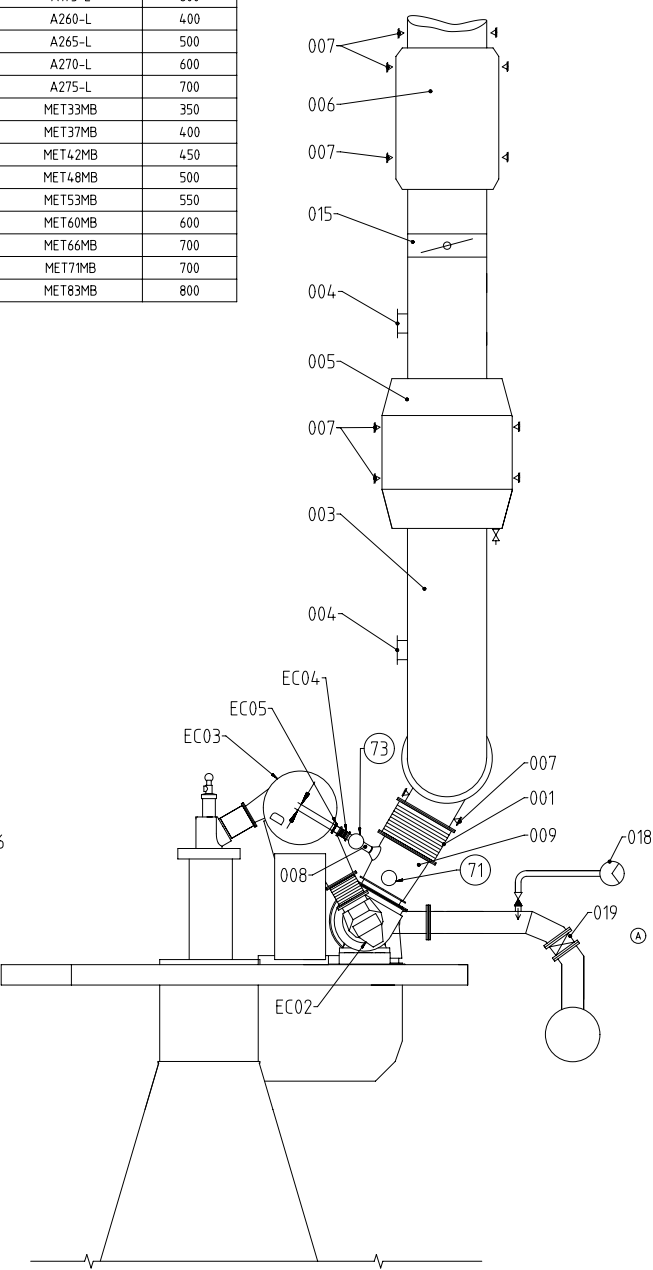
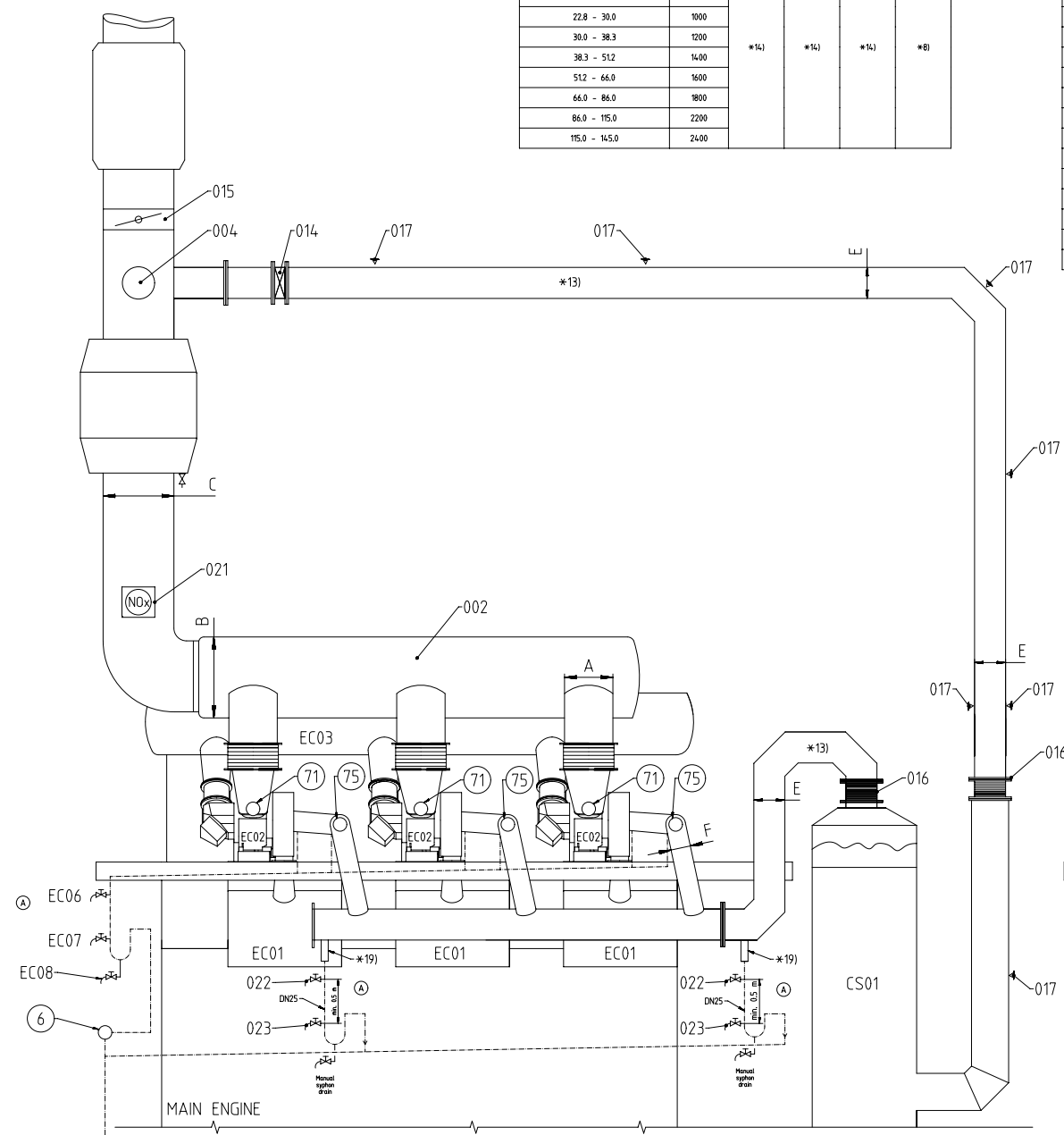
Pos.	System Components *1)
001	Compensator *4)
002	Exhaust gas collector
003	Exhaust gas pipe
004	Explosion relief device (rupture discs or spring-loaded valves) *5)
005	Main Economiser
006	Silencer (with spark arrester *9)
007	Support *4)
008	Waste gate pipe
009	Transition piece *6)
010	Flow Regulating Valve (FRV)
014	Shut-off valve (SDV)
015	Back Pressure Valve (BPV)
016	Compensator in the exhaust system *12)
017	ICER support *4)
018	Purging and sealing air blower *20)
019	Non-return valve
021	NDx Sensor (as delivered by the engine builder) *21)
022	Test cock 1 *15)
023	Test cock 2 *16)

Pos.	Engine Connections *2)
(6)	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 *15)
EC07	Test cock 2 *16)
EC08	Manual syphon drain

(A) 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 at 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 afterwall). 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 = 1:1.14, 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.
- *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 pipes upstream and downstream of the EGC must be insulated.
- *14) The exhaust pipe dimension must be selected in accordance with the specific exhaust gas mass flow, as given by the GTD.
- *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.
- *18) Condensate water drain to the ICER waste water holding tank.
- *19) The condensate water collection pocket must be connected at the lowest point of the horizontal return manifold pipe.
- *20) 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 supply is controlled by the engine control system.
- *21) 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 (1,1,1).



Available executions

Execution No.	Material ID	Cylinder No.	Attribute 1: Turbocharger amount	
			1	2
001	PTAA004288	6-9		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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 Provided only as reference for projects
 contracted until April 2022

Prod.	X82DF-2.0								
Change History									
	-	dki021				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	0.006		
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				Qty per	A4	Item ID	PTAA015882		Drawing Page/s

SEQ NO	QTY	Item ID	Item Name	Dimension	Standard-ID	Basic Material	Net Weight
1	1	PAAD363030	Exhaust System				0.001
2	1	PAAD327310	SPECIFICATION				0.001
3	1	DAAD139643	GUIDELINES				

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 Provided only as reference for projects
 contracted before April 2022

Prod.	6,7,8,9 X82DF-2.0							
Change History								
	-	dkl021	dst009	29.09.2021	CNAA000267	new Drawing	-	-
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E C

	Exhaust System
--	----------------

Bill Of Material		Dimension	
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	Main Design	Yes	Design Group 9726 Q-Code XXXXX
	Qty per	Engine A4	Item ID PTAA004288
			Net Weight 0.001
			Standard WDS
			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"
- 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:

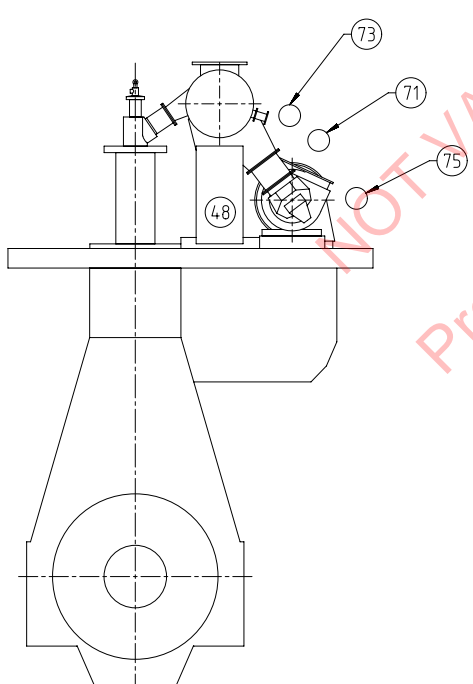
- Controlled by the EGC
- Must be always below the scavenge air temperature

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.

(48) OUTLET - EGC purge air supply

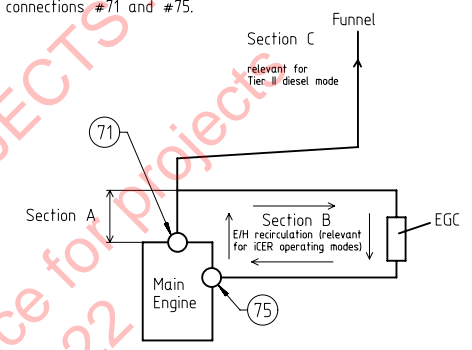
- The purge air supply must be connected upstream from the flow regulating valve in the aftmost exhaust gas return branch.



(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:
 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. 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.	X82DF-2.0								
Change History	D	npa101	dst009	20.12.2022	CNAA002993	Drawing Updated		4	3
	C	dk021	mhu019	23.11.2022	CNAA002662	Drawing Updated		4	3
	B	sna102	mhu019	08.03.2022	CNAA001599	Drawing Updated		4	3
	-	dk021	dst009	29.09.2021	CNAA000267			-	-
Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Approved	Activity Code	E	C

WIN GD
Winterthur Gas & Diesel

EXHAUST SYSTEM

Dimension: with two turbocharger

Scale: - NX

Units: [mm] [kg]

Basic Material: _____ Net Weight: 0.000

SURFACE PROTECTION SEE GROUP 0344		Copyright Winterthur Gas & Diesel Ltd. All rights reserved. By taking possession of the drawing the recipient recognizes and assumes 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.					
TOLERANCING PRINCIPLE ISO8015	Main Design	Design Group	9726	Q-Code	XXXXX	Standard	WDS
GENERAL TOLERANCES ACCORDING TO ISO2768-mK	Qty per	A2	Item ID	PAAD363030	Drawing Pages	1/3	

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)
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)
018	Additional Economiser *10)

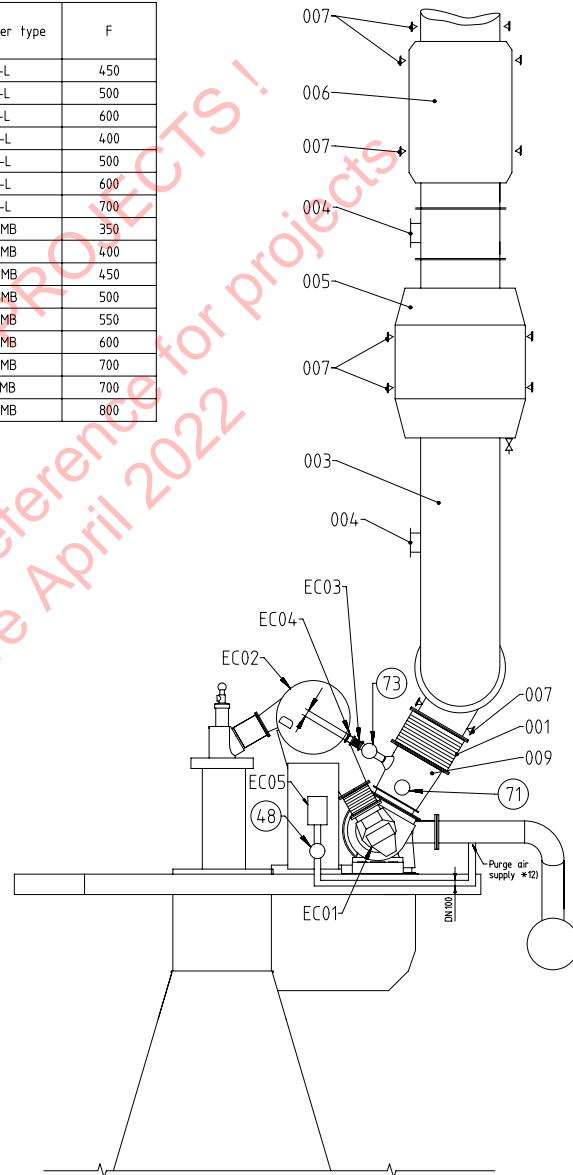
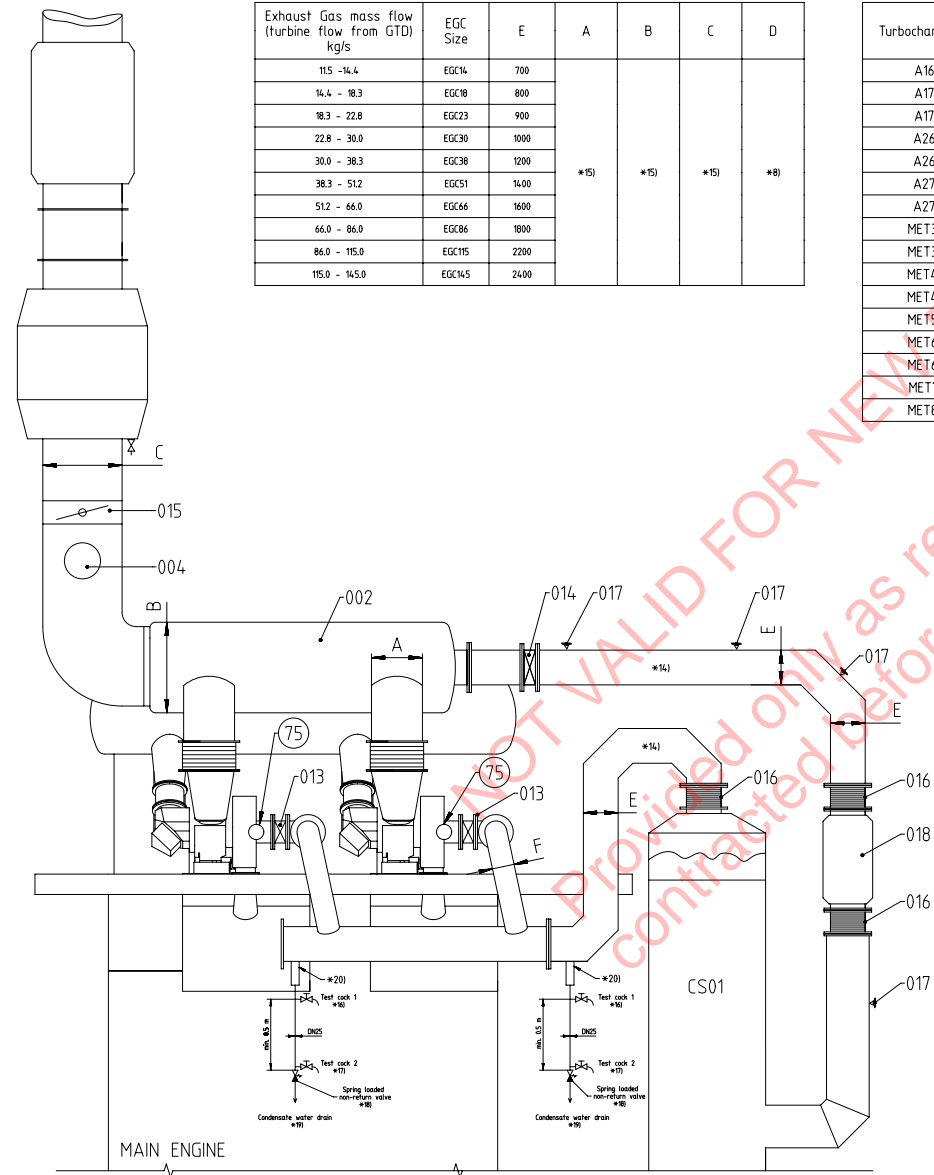
NOTE
Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

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	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				
38.3 - 51.2	EGC51	1400	*15)	*15)	*15)	*8)
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
MET71MB	700
MET83MB	800



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	Engine mounted purging and sealing air blower

- 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 alternatively).
 - *5) 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 arrester must be used. This would remove the peak pressure of an explosion, while ensuring that the exhaust gas does not continuously flow out.
 - *7) Area ratio between outlet/inlet = 1.1..1.6, taper angle $\le 40^\circ$
 - *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 "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).
 - *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) Optional, to be installed if the backpressure from the EGC exceeds the limit.
 - *13) The purge air supply line must be connected upstream from flow regulating valve (FRV) to the EGC exhaust gas return pipe.
 - *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) The exhaust gas pipes upstream and downstream of the EGC must be insulated.
 - *16) The exhaust pipe dimension must be selected in accordance with the specific exhaust gas mass flow, as given by the GTD.
 - *17) 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.
 - *18) 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.
 - *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: Recommended 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				
38.3 - 51.2	EGC51	1400	*15)		*15)	*8)
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
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)
014	Shut-off valve (SOV)
015	Back Pressure Valve (BPV)
016	Compensator in the exhaust system *13)
017	KEER support *4)
018	Additional Economiser *10)

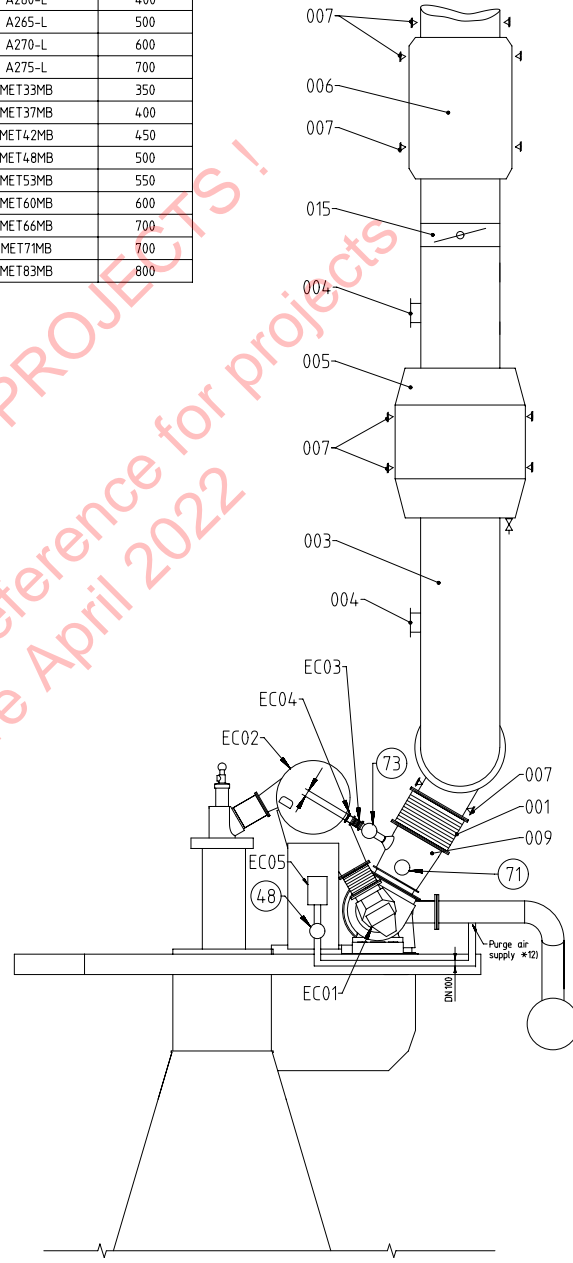
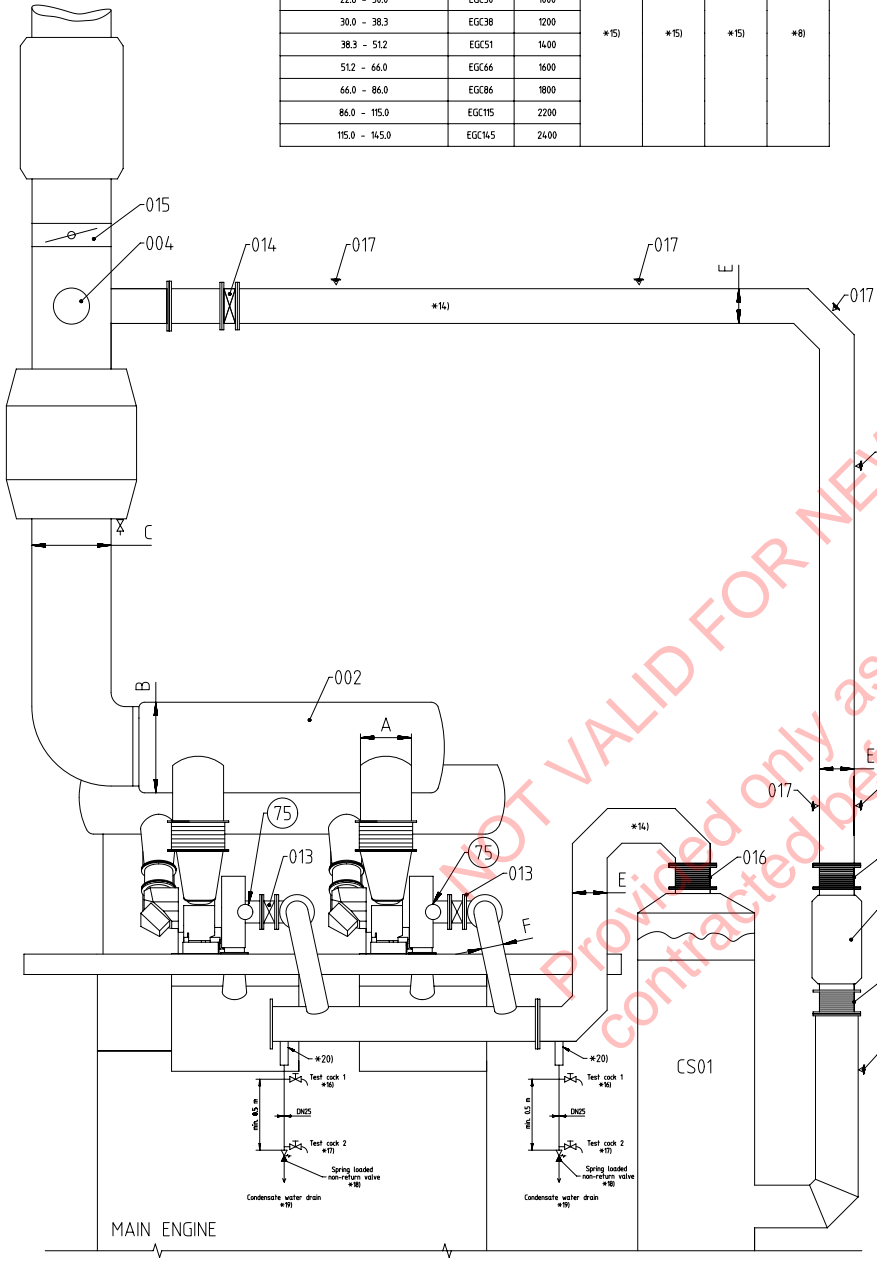
Pos.	Engine Connections *2)
(48)	OUTLET - EGC purge air supply
(71)	OUTLET - Exhaust gas turbocharger
(73)	OUTLET - Exhaust gas manifold waste gate
(75)	INLET - Recirculated exhaust gas turbocharger

Pos.	Engine Components *3)
EC01	Turbocharger
EC02	Exhaust gas manifold
EC03	Waste gate compensator *7) *8)
EC04	Waste gate valve
EC05	Engine mounted purging and sealing air blower

- 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 alternately). 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) 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.
 - 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 of 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.

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



MIDS – Exhaust System (DG9726)

WinGD X82DF-2.0

TRACK CHANGES

DATE	SUBJECT	DESCRIPTION
2021-07-30	DRAWING SET	First web upload
2021-12-22	PAAD363030	System drg – new revision
2022-03-11	PAAD363030	System drg – new revision
2022-12-01	PAAD363030 PTAA044721	System drg – new revision New drawing set as replacement of previous one - added
2022-12-21	PAAD363030 PTAA044713	System drgs – new revision
2023-03-23	PTAA060532	New execution with 3TC added
2022-03-27	PTAA044713B	System drgs – new revision
2023-12-19	PTAA044713C	System drgs – new revision
2024-02-08	PTAA060522A	New revision

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