SURFACE PROTECTION SEE GROUP 0344

TOLERANCING PRINCIPLE ISO8015

Available executions

Execution No.	Material ID	Attribute 1: Turbocharger amount	
		2	3
001	PTAA051372	X	
002	PTAA044722		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.

Prod. X92DF-2.0

Change History

Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E	C
A	sde101				Drawing Updated			
-	sna102	mhu019	19.12.2022	CNAA002926	new Design		-	-

Winterthur Gas & Diesel

EXHAUST SYSTEM

MIDS master drawing

separate BOM available

Dimension

Scale	-	NX	Units [mm] [kg]	Basic Material	Net Weight	0.001
Main Design			Design Group	9726	Q-Code XXXXX	Standard WDS
Qty per			A4	Item ID PTAA026440		Drawing Page/s 1/1

SEQ NO	QTY	Item ID	Item Name Dimension	Standard-ID	Basic Material	Net Weight
1	1	PTAA051371	Exhaust System with two turbocharger			0
2	1	PAAD327310	SPECIFICATION FOR WASTE GATE SELECTION			0.001
3	1	DAAD139643	GUIDELINES			

Prod.	6,7,8,9,10,11,12 X92DF-2.0			

Change History

Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E	C
-	npa101	mhu019	21.12.2022	CNAA003005	Main Design/Drawing Introduced		-	-

WIN GD
Winterthur Gas & Diesel

EXHAUST SYSTEM
WITH TWO TURBOCHARGERS

Bill Of Material

Dimension

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	PTAA051372	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

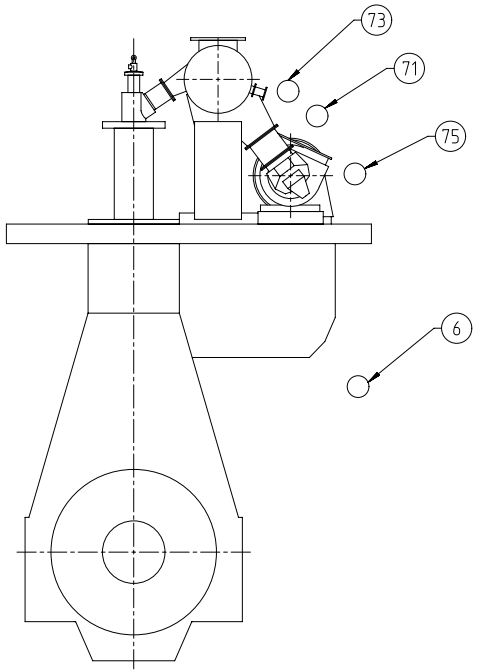
Exhaust gas piping:

- 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.
- 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

(B)



(71) OUTLET - Exhaust gas turbocharger

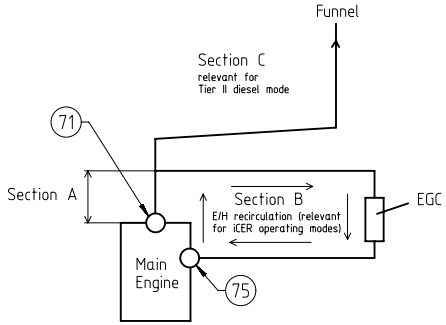
- Exhaust gas temperature and volume flow: according to GTD
- If the iCER diesel option is selected a NOx sensor must be installed in the exhaust gas pipe between Back Pressure Valve (BPV) and turbocharger.
- The total back pressure of the exhaust gas system must be kept within the following ranges:

  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 personeel 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. X92DF-2.0

Change History

Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E	C
B	dki021	mhu019	05.02.2024	CNAA005211	Drawing Updated		4	3
A	sde101	mhu019	24.03.2023	CNAA003456	Drawing Updated		4	3
–	npa101	mhu019	21.12.2022	CNAA003005	new Design		–	–

Approved

WIN GD Winterthur Gas & Diesel

Exhaust System
2 TC, iCER off-engine

Dimension	2 TC, iCER off-engine		
Scale – NX	Units [mm] [kg]	Basic Material	Net Weight 0.001
Main Design	Design Group 9726	Q-Code X X M	Standard WDS
Qty per	A2	Item ID PTAA051371	Drawing Page/s 1/3

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

SYSTEM PROPOSAL

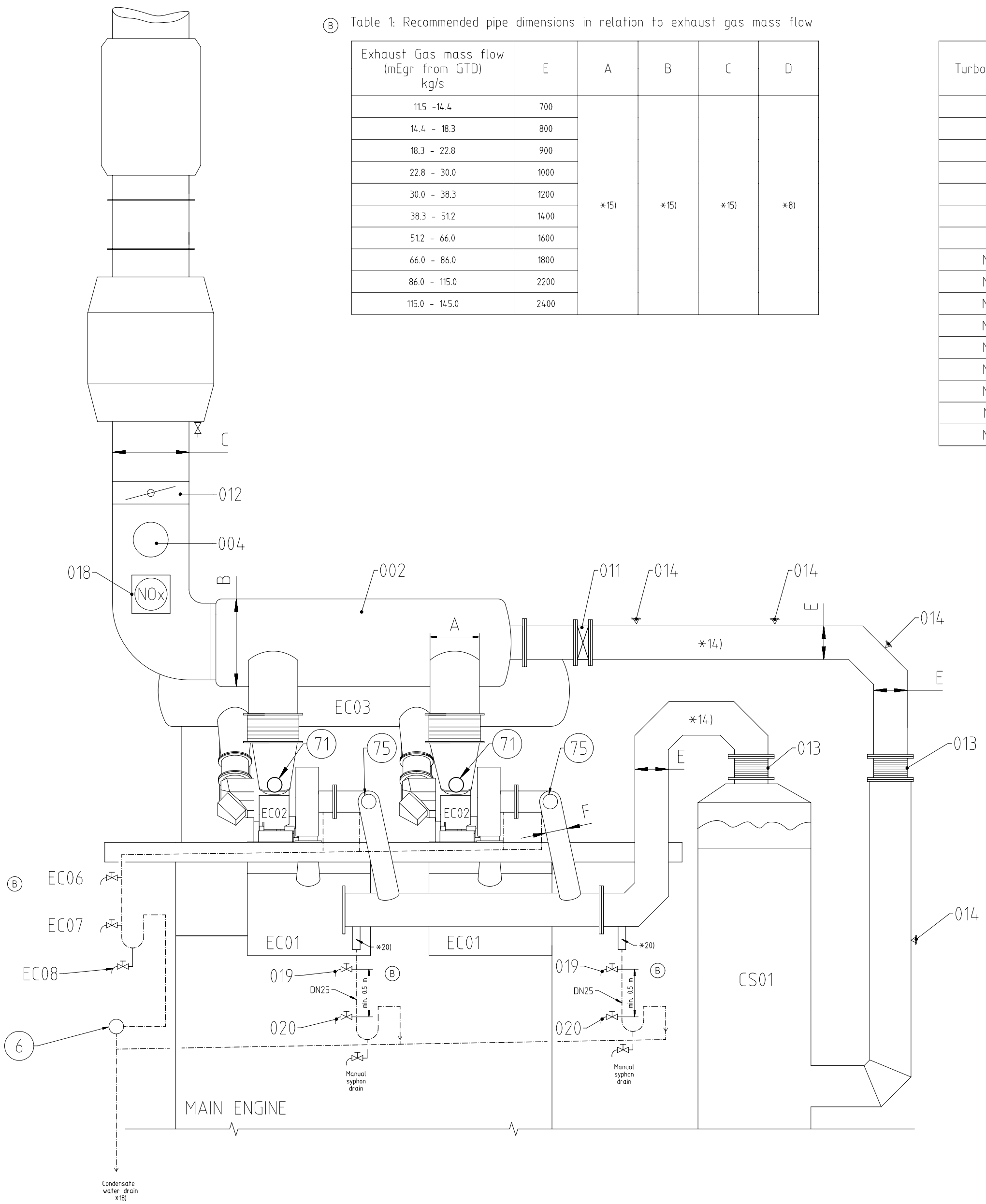
NOTE
Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

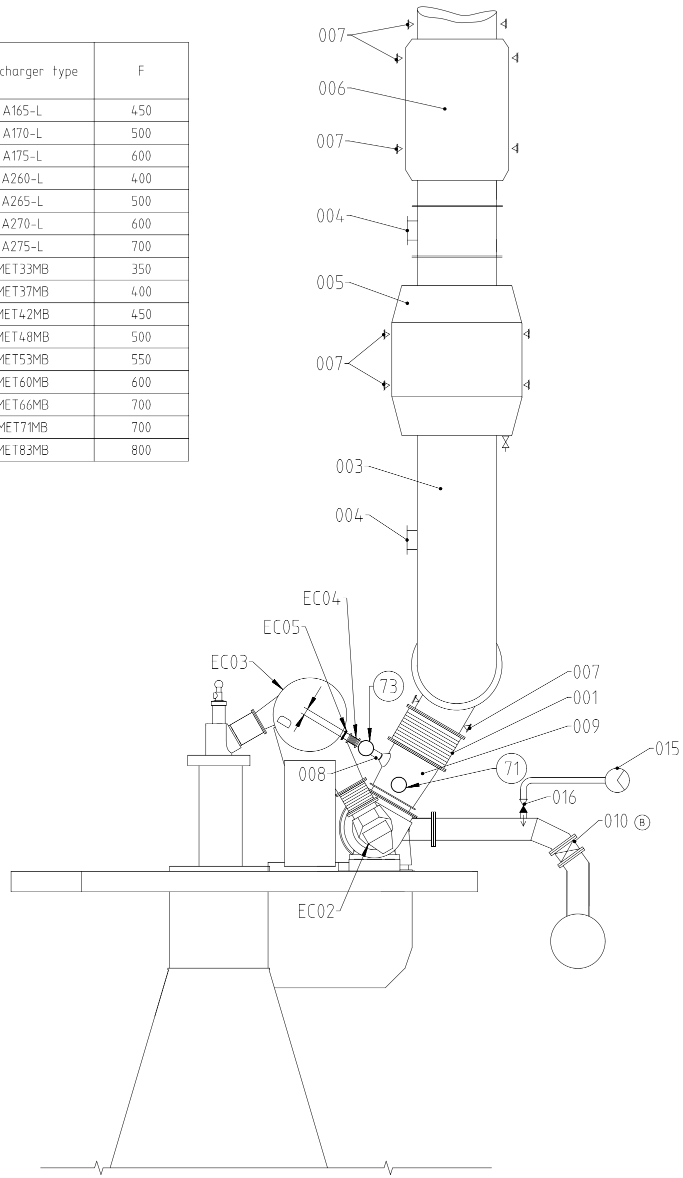
Short Route
- Exhaust gas branch-off after turbocharger

(B) 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	*15)	*15)	*15)	*8)
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				
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)

(B)

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 chock 1 *16)
020	Test chock 2 *17)

(B)

Pos.	Engine Connections *2)
6	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 chock 1 *15)
EC07	Test chock 2 *16)
EC08	Manual syphon drain

(B) 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...1.6, taper angle $\leq$ 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) Optional, to be installed if the backpressure from the EGC exceeds the limit.
*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.
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.
*16) By opening of test cock 1 the following conditions can be ckecked:
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 ckecked:
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 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 [1:7:2].

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

Change	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E	C
	B	dki021	nhu019	05.02.2024	CNAA005211	Drawing Updated		4	3

[mm] [kg] - NX A0 Approved
Item ID PTAA051371

SYSTEM PROPOSAL

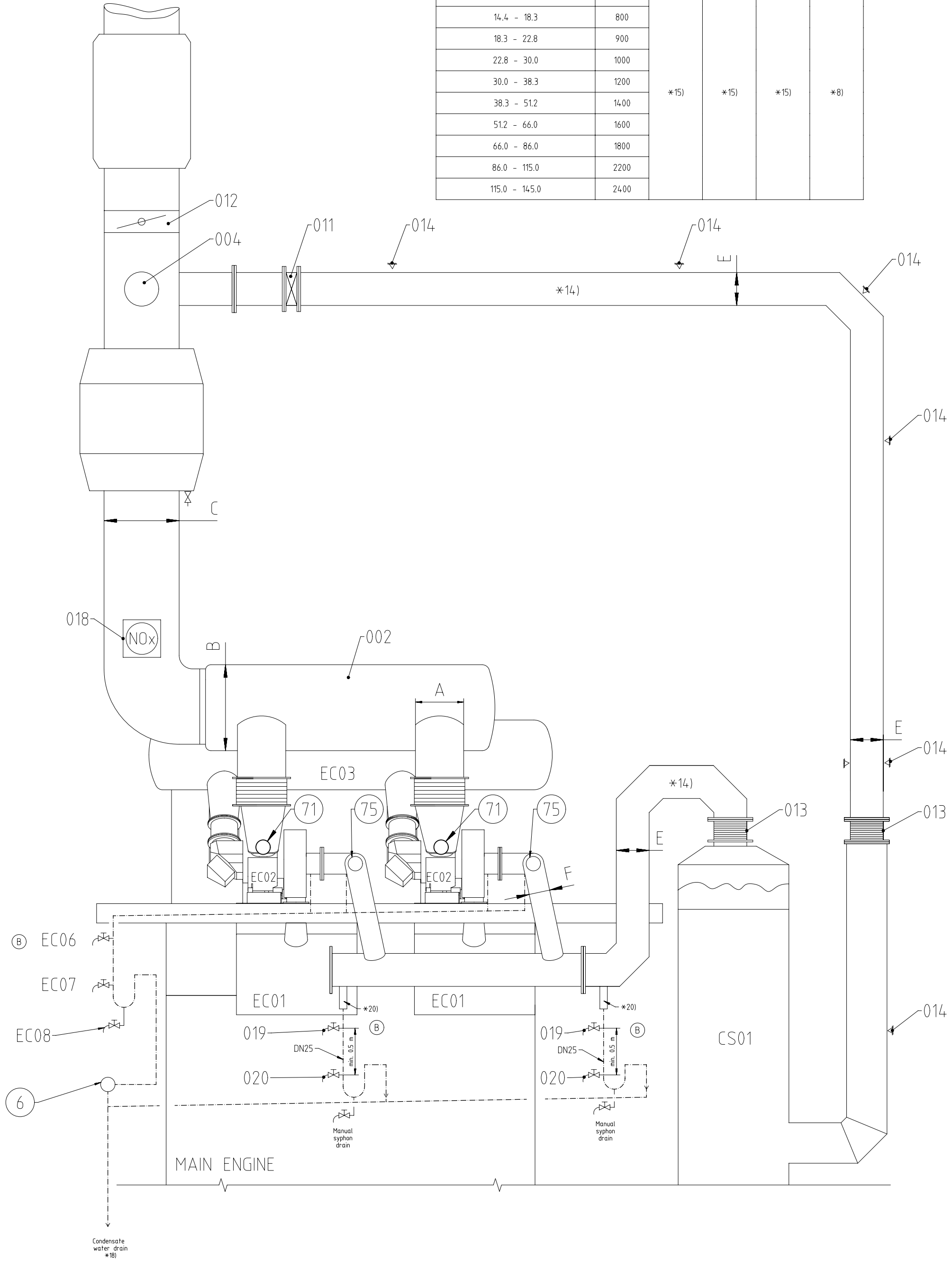
NOTE
Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

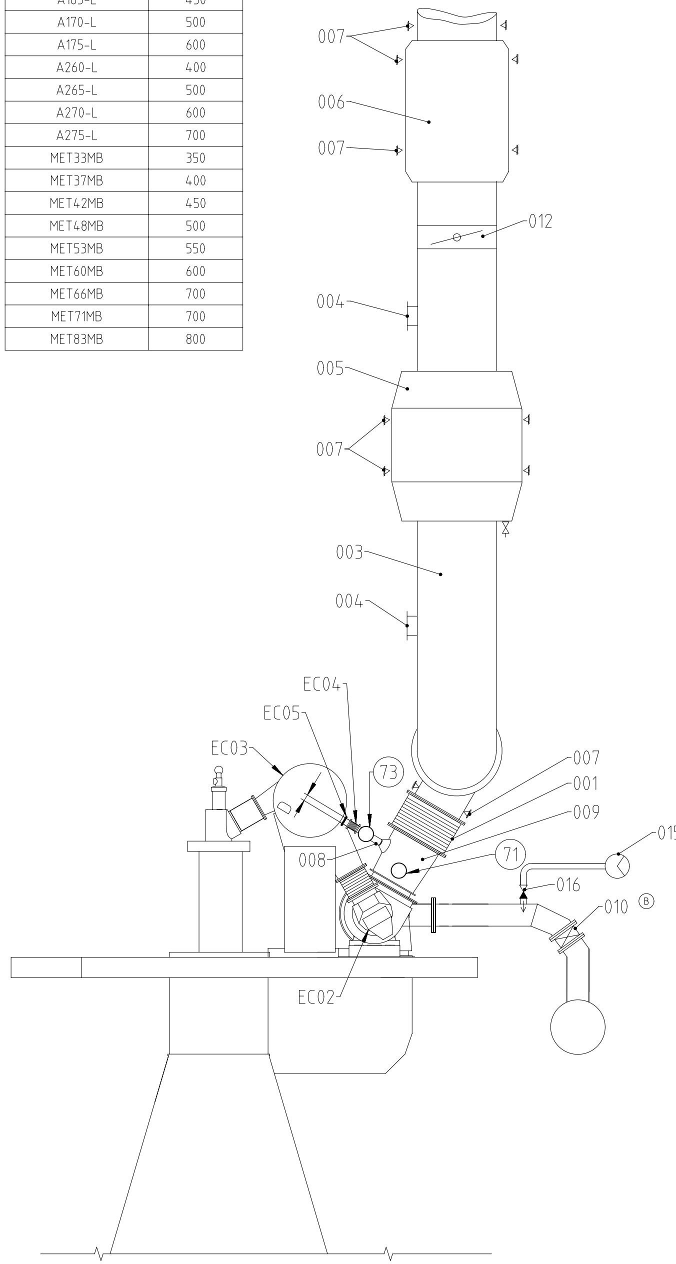
Long Route
- Exhaust gas branch-off after economizer

(B) 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	*15)	*15)	*15)	*8)
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				
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 chock 1 *16)
020	Test chock 2 *17)

Pos.	Engine Connections *2)
6	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 chock 1 *15)
EC07	Test chock 2 *16)
EC08	Manual syphon drain

(B) 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...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 "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.
*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.
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.
*16) By opening of test cock 1 the following conditions can be ckecked:
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 ckecked:
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 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 [1:7:2].

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

B	dk021	mtu019	05.02.2024	CNAA005211	Drawing Updated

[mm] [kg] NX A0 PTAA051371 Drawing Pages 3/3 Approved

SEQ NO	QTY	Item ID	Item Name Dimension	Standard-ID	Basic Material	Net Weight
1	1	PTAA044714	EXHAUST SYSTEM with three turbocharger			0
2	1	PAAD327310	SPECIFICATION			0.001
3	1	DAAD139643	GUIDELINES			

Prod.	6,7,8,9,10,11,12 X92DF-2.0			

Change History

Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E	C
-	dki021	mhu019	23.11.2022	CNAA002662	Main Design/Drawing Introduced		-	-

WIN GD
Winterthur Gas & Diesel

EXHAUST SYSTEM

WITH THREE TURBOCHARGERS

Bill Of Material

Dimension

Units	[m] [kg]	Basic Material				Net Weight	0
Main Design	Yes	Design Group	9726	Q-Code	XXXXX	Standard	WDS
Qty per	Engine	A4	Item ID	PTAA044722		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:

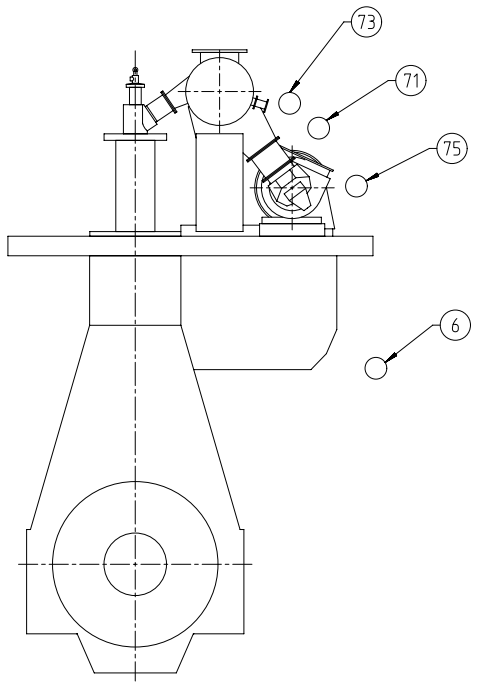
- Controlled by the EGC
- Must be always below the scavenge air temperature

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.
- 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

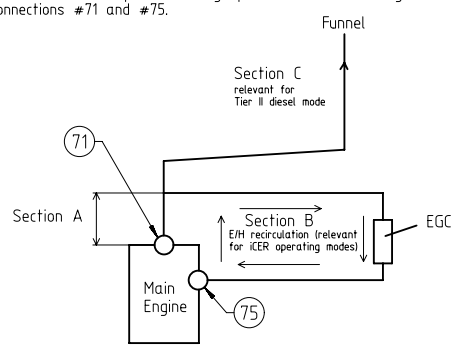
- Exhaust gas temperature and volume flow: according to GTD
- If the iCER diesel option is selected a NOx sensor must be installed in the exhaust gas pipe between Back Pressure Valve (BPV) and turbocharger.
- The total back pressure of the exhaust gas system must be kept within the following ranges:

  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 for 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 personeel 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. X92DF-2.0

Change History

Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E	C
C	dki021	dst009	15.12.2023	CNAA004864	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
–	dki021	mhu019	23.11.2022	CNAA002662	new Design		–	–

Approved

WIN GD Winterthur Gas & Diesel

EXHAUST SYSTEM
3 TC, iCER off-engine

Dimension	3 TC, iCER off-engine		
Scale – NX	Units [mm] [kg]	Basic Material	Net Weight 0.000
Main Design	Design Group 9726	Q-Code X X M	Standard WDS
Qty per	A2	Item ID PTAA044714	Drawing Page/s 1/3

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

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) *22)

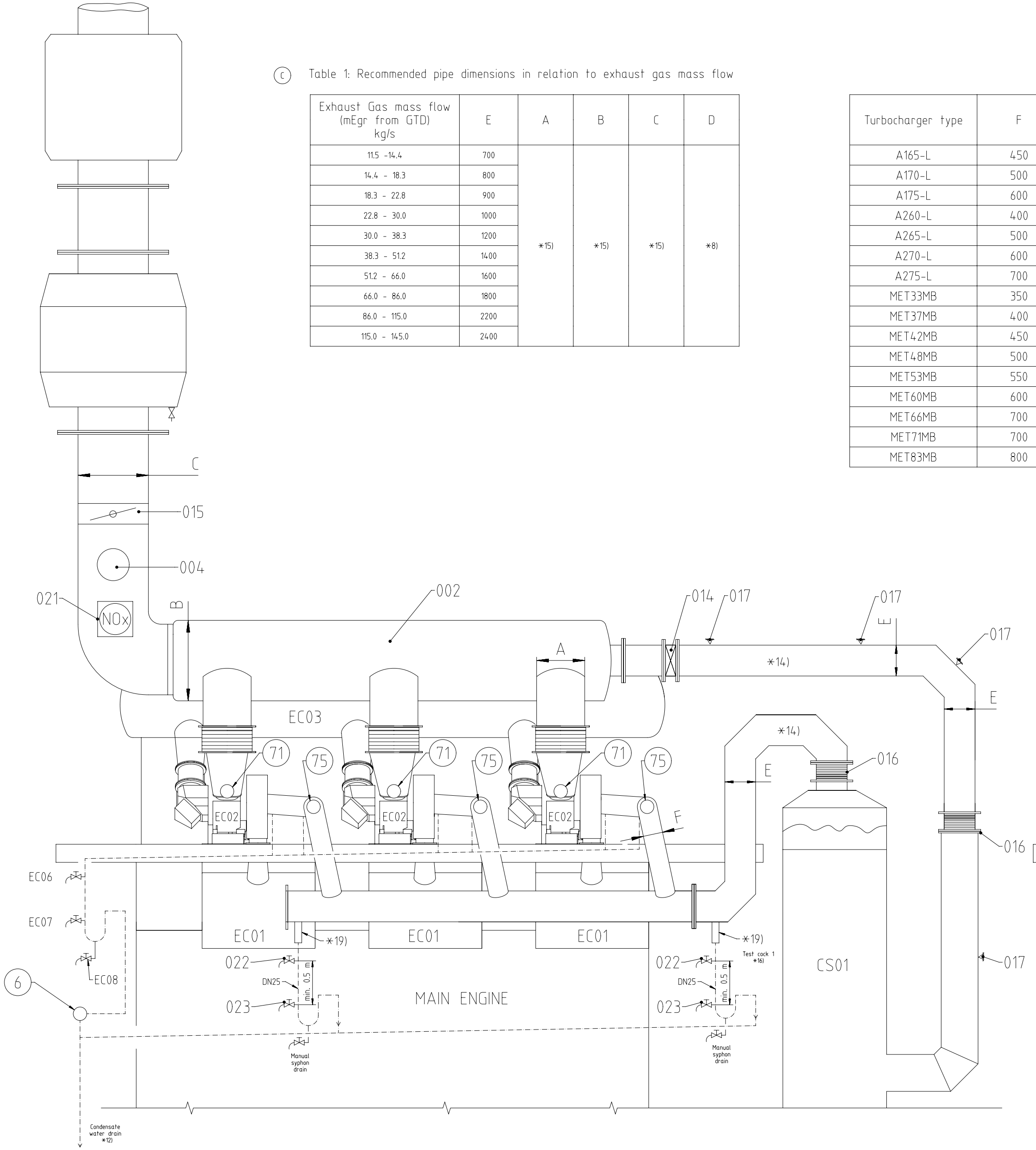
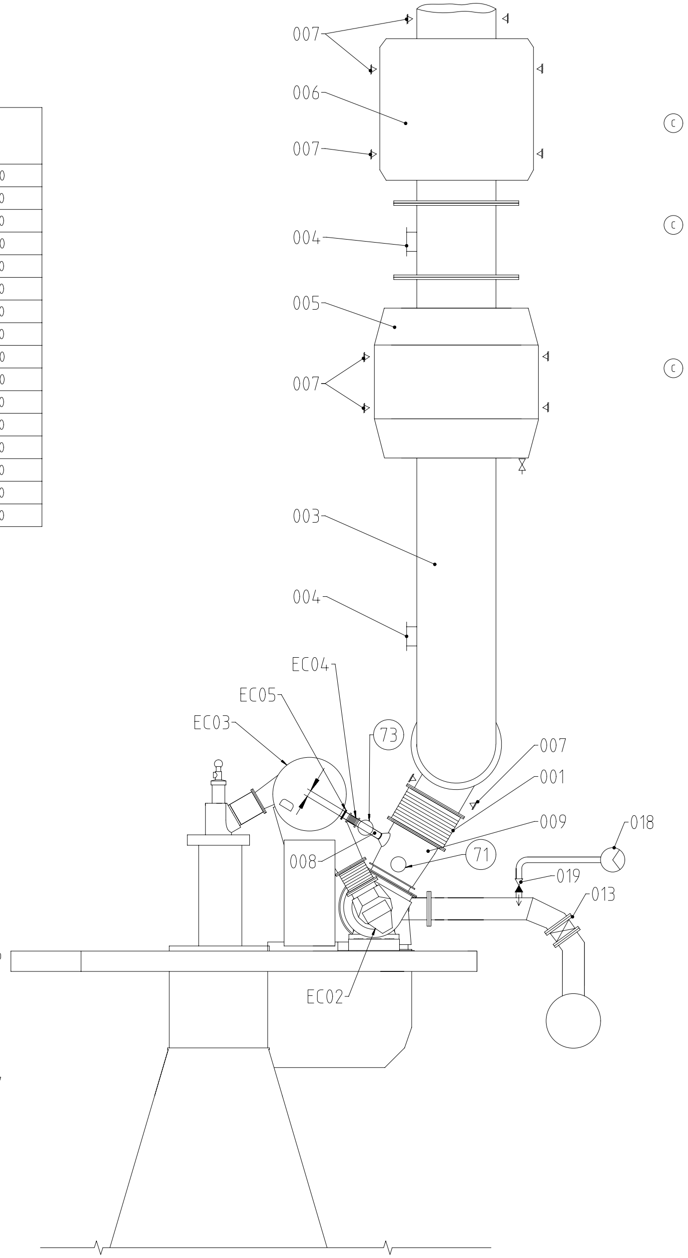


Table 1: Recommended pipe dimensions in relation to exhaust gas mass flow

Exhaust Gas mass flow (mEgr from GTD) kg/s	E	A	B	C	D
11.5 - 14.4	700	*15)	*15)	*15)	*8)
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				
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 (SOV)
015	Back Pressure Valve (BPV)
016	Compensator in the exhaust system *13)
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 chock 1 *16)
023	Test chock 2 *17)

Pos.	Engine Connections *2)
6	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 chock 1 *16)
EC07	Test chock 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...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 "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.
*11) Optional, to be installed if the backpressure from the EGC exceeds the limit.
*12) Condensate water drain to the iCER waste water holding tank.
*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.
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.
*16) By opening of test cock 1 the following conditions can be ckecked:
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 ckecked:
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) 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 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 [1:7:2].
*22) To be supplied by a certified supplier. Ordering to be coordinated between shipyard and engine builder.

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

Change Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	
C	dki021	dst009	15.12.2023	CNAA004854	Drawing updated.	4 E	3 C

[mm] [kg] – NX A0 Approved Item ID PTAA044714 Drawing Page/s 2/3

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".

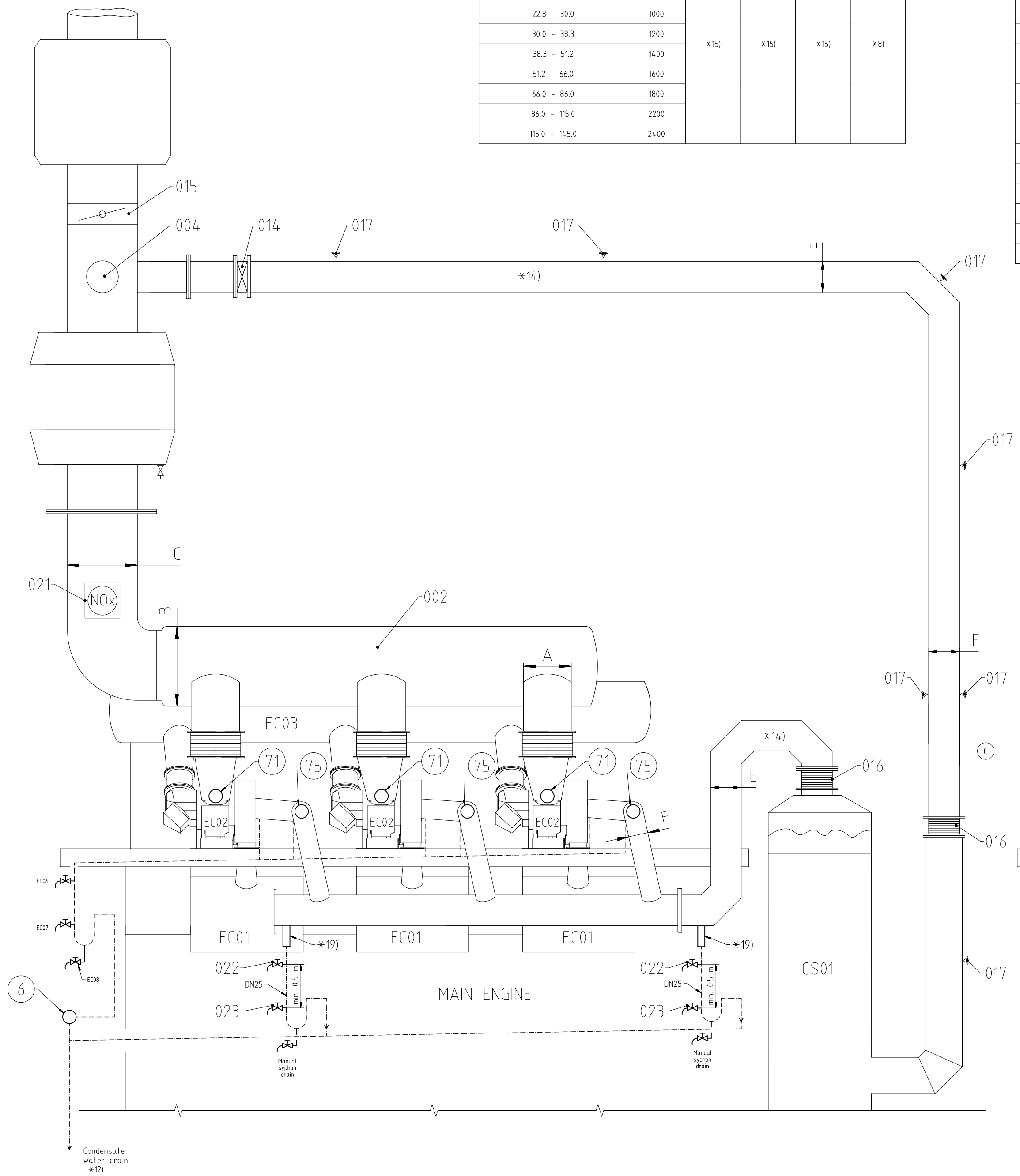
Long Route
- Exhaust gas branch-off after economizer

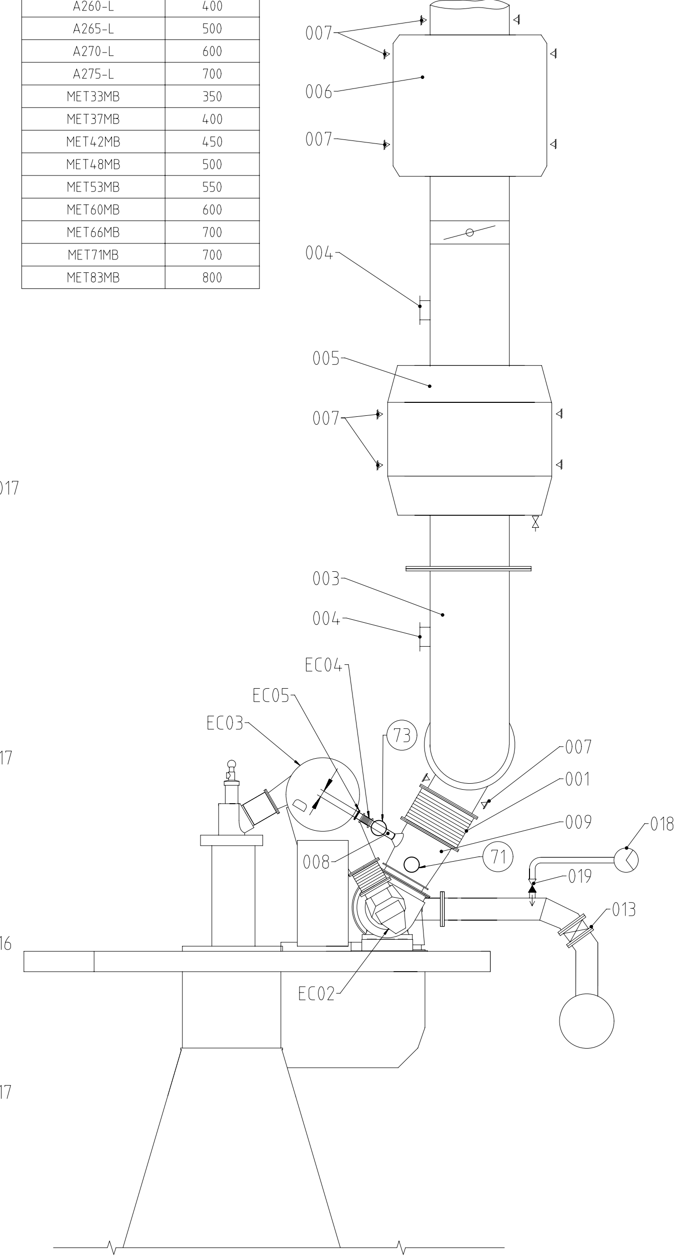
(C) Table 1: Recommended pipe dimensions in relation to exhaust gas mass flow

Exhaust Gas mass flow (mEgr from GTD) kg/s	E	A	B	C	D
11.5 -14.4	700	*15)	*15)	*15)	*8)
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				
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 *13)
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 chock 1 *16)
023	Test chock 2 *17)

Pos.	Engine Connections *2)
6	OUTLET - EGC condensate water
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 chock 1 *16)
EC07	Test chock 2 *17)
EC08	Manual syphon drain

(C) 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...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 "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.
*11) Optional, to be installed if the backpressure from the EGC exceeds the limit.
*12) To be directed to the bilge water tank. Can be connected to the SAC drain pipe from engine connection 16.
*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.
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.
*16) By opening of test cock 1 the following conditions can be ckecked:
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 ckecked:
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) 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 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 [1:7:2].

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

Change	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E	C
	C	dki021	dst009	15.12.2023	CNAA004854	Drawing updated.	Approved	4	3

[mm] [kg] - NX A0 Item ID PTAA044714 Drawing Page/s 3/3

NOT VALID for new projects

The following pages are provided only as reference
for projects which had been contracted before April 2022

NOT VALID for new projects

SURFACE PROTECTION SEE GROUP 0344

TOLERANCING PRINCIPLE ISO8015

GENERAL TOLERANCES ACCORDING TO ISO2768-mK

Available executions

Execution No.	Material ID	Cylinder No.	Attribute 1: Turbocharger amount	
			2	3
001	PTAA004355	6-9	X	
002	PTAA004356	9-12		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.

Prod.	X92DF-2.0						

Change History

Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E	C
–	sna102				new Design			

WIN GD
Winterthur Gas & Diesel

EXHAUST SYSTEM

MIDS master drawing

separate BOM available

Dimension

Scale	–	NX	Units [mm] [kg]	Basic Material	Net Weight	0.001
Main Design			Design Group	9726	Q-Code XXXXX	Standard WDS
Qty per			A4	Item ID PTAA026440	Drawing Page/s	1/1

SEQ NO	QTY	Item ID	Item Name Dimension	Standard-ID	Basic Material	Net Weight
1	1	PTAA004290	Exhaust System with two turbocharger			0.001
2	1	PAAD327310	SPECIFICATION			0.001
3	1	DAAD139643	GUIDELINES			

Prod.	6,7,8,9 X92DF-2.0		

Change History

Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis		Activity Code	E	C
-	dki021	dst009	22.12.2021	CNAA001288	Main Design/Drawing Introduced	Approved		-	-

WIN GD
Winterthur Gas & Diesel

EXHAUST SYSTEM
WITH TWO TURBOCHARGERS

Bill Of Material

Dimension

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	PTAA004355		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:

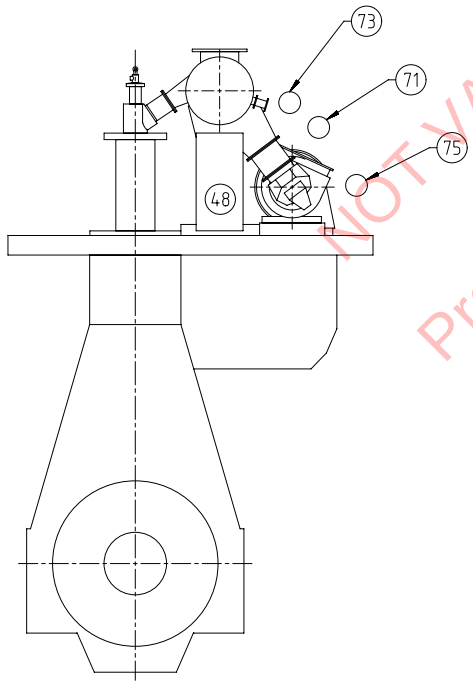
- Controlled by the EGC
- Must be always below the scavenge air temperature

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.
- (A) 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.



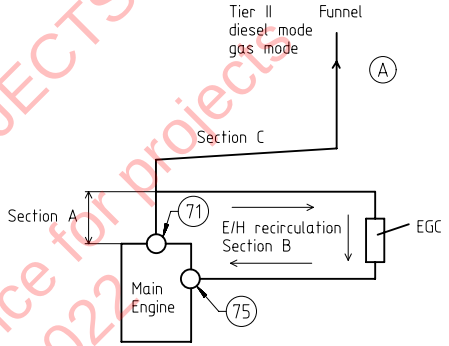
(71) OUTLET - Exhaust gas turbocharger

- 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.
- (A) 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 personeel 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.	X92DF-2.0								
Change History									
A	sde101	mhu019	08.03.2022	CNAA001599	Drawing Updated			4	3
–	dki021	dst009	20.12.2021	CNAA001054	new Design			–	–
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 0.001

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

Main Design	Design Group	9726	Q-Code XXXXX	Standard WDS
Qty per	A2	Item ID PTAA004290		Drawing Page/s 1/3

SYSTEM PROPOSAL

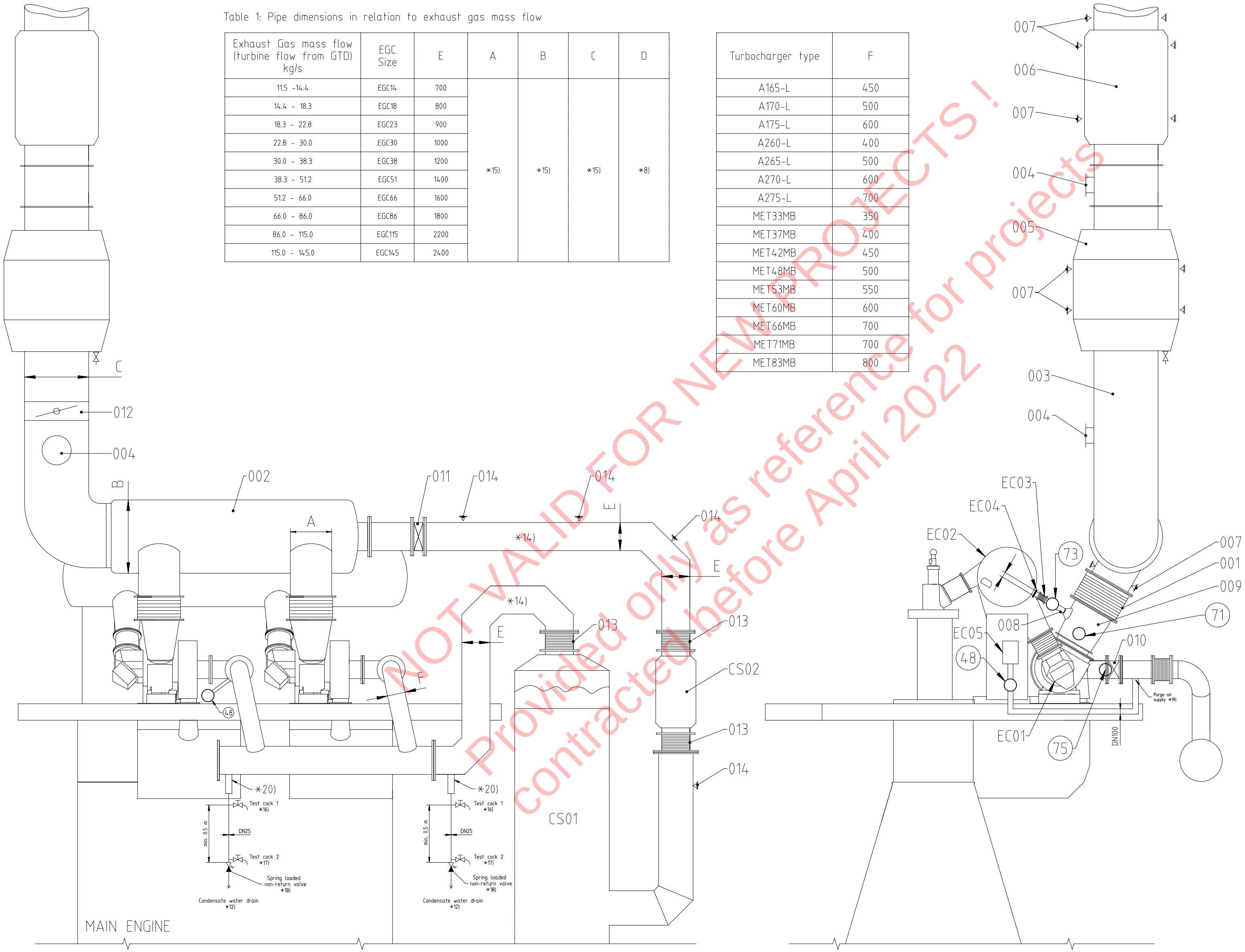
NOTE
Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

Short Route
- Exhaust gas branch-off after turbocharger

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	*15)	*15)	*15)	*8)
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				
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)
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)
011	Shut-off valve (SOV)
012	Back Pressure Valve (BPV)
013	Compensator in the exhaust system *13)
014	iCER 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

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...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 "DAAD116127" 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) To be directed to the bilge water tank. Can be connected to the SAC drain pipe from engine connection 16.
*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.
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.
*16) By opening of test cock 1 the following conditions can be ckecked:
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 ckecked:
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) The purge air supply must be connected upstream from the flow regulating (010) in the aftmost exhaust gas return branch.
*20) The condensate water collection pocket must be connected at the lowest point of the horizontal return manifold pipe.

Change	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis
	A	sde101	mhu019	08.03.2022	CNAA001599	Drawing Updated

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

[mm] [kg] - NX A0 Approved Activity Code 4 3 E C

Item ID PTAA004290

Drawing Page/s 2/3

SYSTEM PROPOSAL

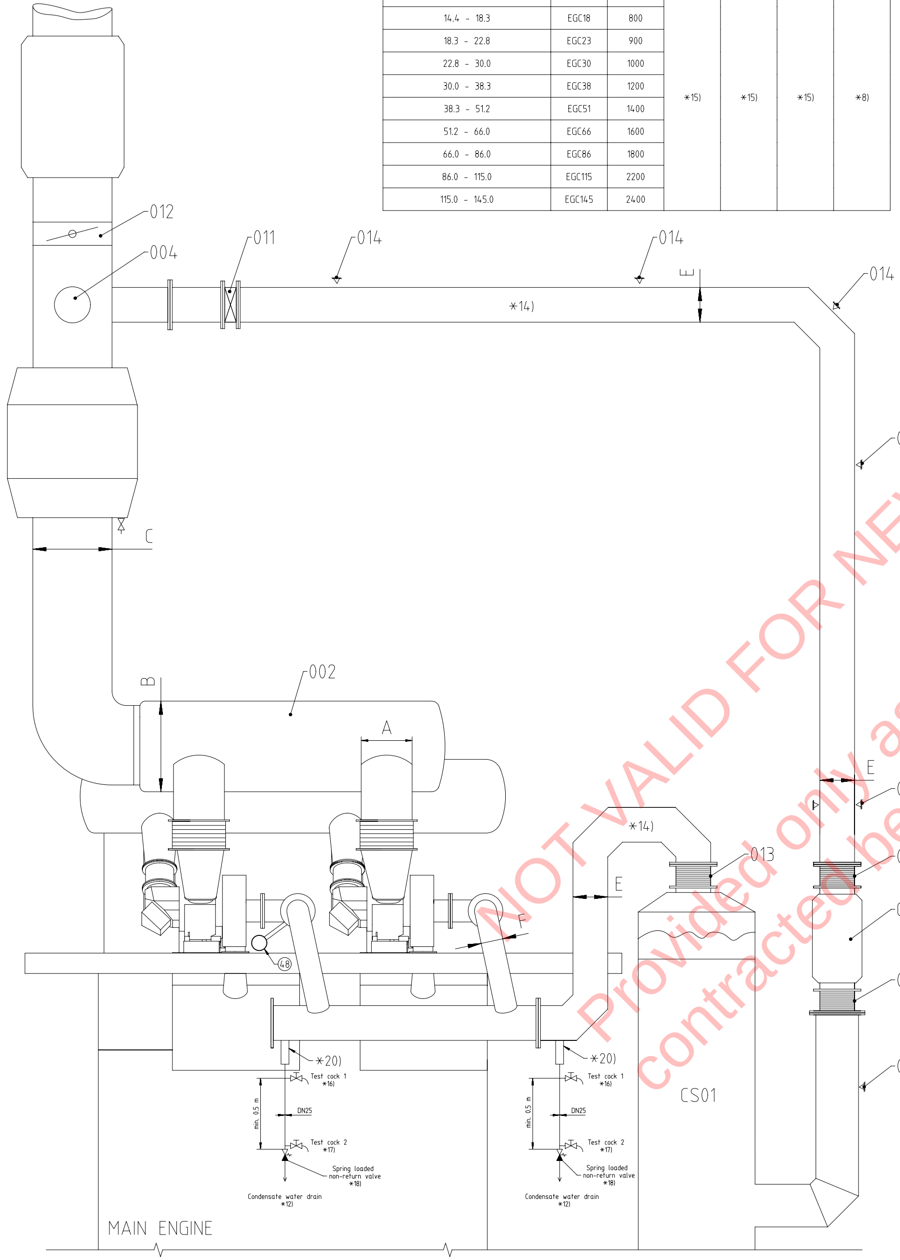
NOTE
Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

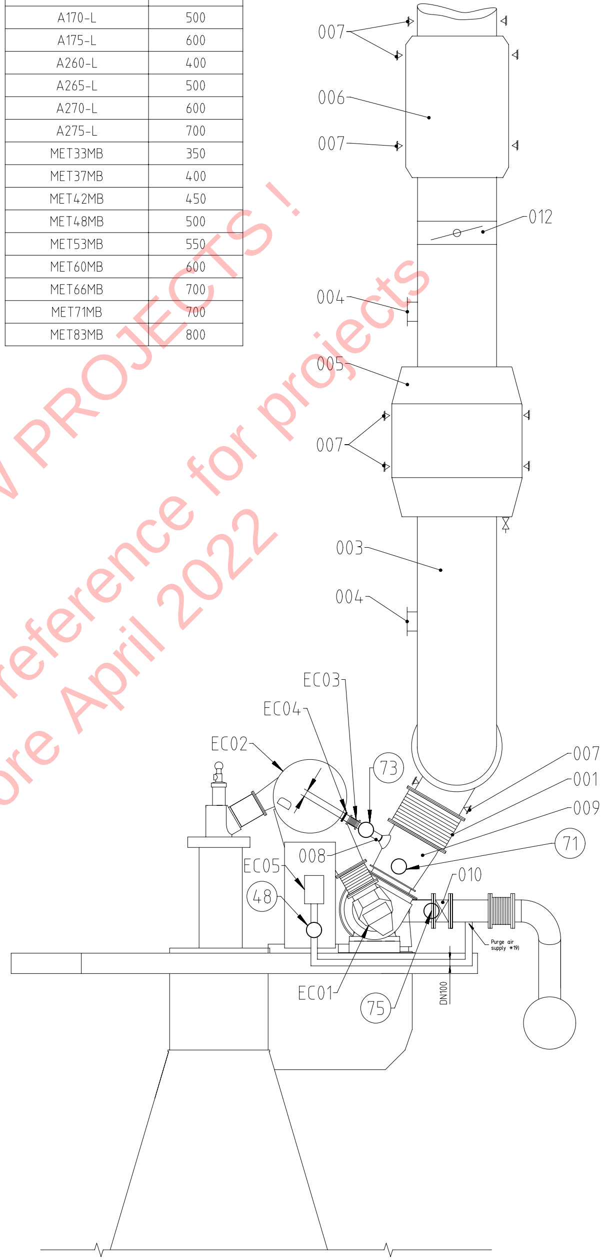
Long Route
- Exhaust gas branch-off after economizer

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

Exhaust Gas mass flow (turbine flow from GTD) kg/s	EGC Size	E	A	B	C	D
11.5 - 14.4	EGC14	700	*15)	*15)	*15)	*8)
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				
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)
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)
011	Shut-off valve (SOV)
012	Back Pressure Valve (BPV)
013	Compensator in the exhaust system *13)
014	iCER 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

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...1.6, taper angle $\leq$ 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 "DAAD116127" 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) To be directed to the bilge water tank. Can be connected to the SAC drain pipe from engine connection 16.
*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.
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.
*16) By opening of test cock 1 the following conditions can be ckecked:
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 ckecked:
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) The purge air supply must be connected upstream from the flow regulating (010) in the aftmost exhaust gas return branch.
*20) The condensate water collection pocket must be connected at the lowest point of the horizontal return manifold pipe.

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

Change	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	
	A	sde101	mhu019	08.03.2022	CNAA001599	Drawing Updated	4 E	3 C

Approved

[mm] [kg] - NX A0 Item ID PTAA004290 Drawing Page/s 3/3

SEQ NO	QTY	Item ID	Item Name Dimension	Standard-ID	Basic Material	Net Weight
1	1	PAAD363091	Exhaust System with three turbocharger			0.001
2	1	PAAD327310	SPECIFICATION			0.001
3	1	DAAD139643	GUIDELINES			

Prod.	9,10,11,12 X92DF-2.0		

Change History

Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis		Activity Code	E	C
-	dki021	dst009	22.12.2021	CNAA001288	Main Design/Drawing Introduced	Approved		-	-

WIN GD
Winterthur Gas & Diesel

EXHAUST SYSTEM
WITH THREE TURBOCHARGERS

Bill Of Material

Dimension

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	PTAA004356		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:

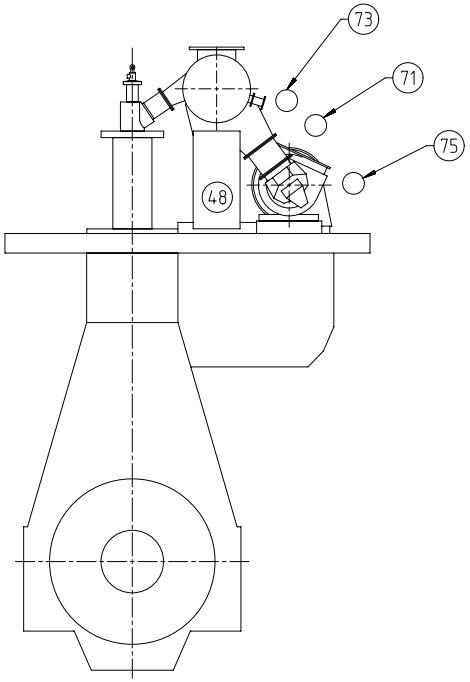
- Controlled by the EGC
- Must be always below the scavenge air temperature

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) (C) OUTLET - Exhaust gas turbocharger

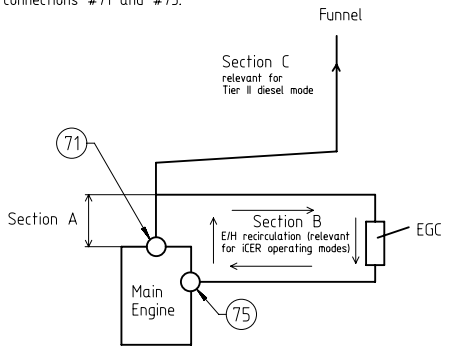
- Exhaust gas temperature and volume flow: according to GTD
- The total back pressure of the exhaust gas system must be kept within the following ranges:

  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 personeel 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.								
Change History	C	npa101	dst009	20.12.2022	CNAA002993	Drawing Updated	4	3
	B	dki021	mhu019	23.11.2022	CNAA002662	Drawing Updated	4	3
	A	sde101	mhu019	08.03.2022	CNAA001599	Drawing Updated	4	3
	–	dki021	dst009	20.12.2021	CNAA001054	new Design	–	–
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code	E C

WIN GD Winterthur Gas & Diesel

EXHAUST SYSTEM

Dimension: with three turbocharger

Scale – | NX | Units [mm] [kg] | Basic Material | Net Weight 0.000

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

Main Design	Design Group	9726	Q-Code XXXXX	Standard	WDS
Qty per	A2	Item ID	PAAD363091	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

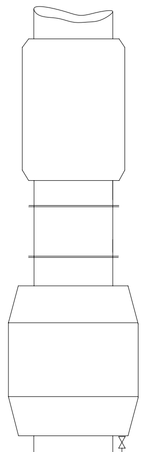
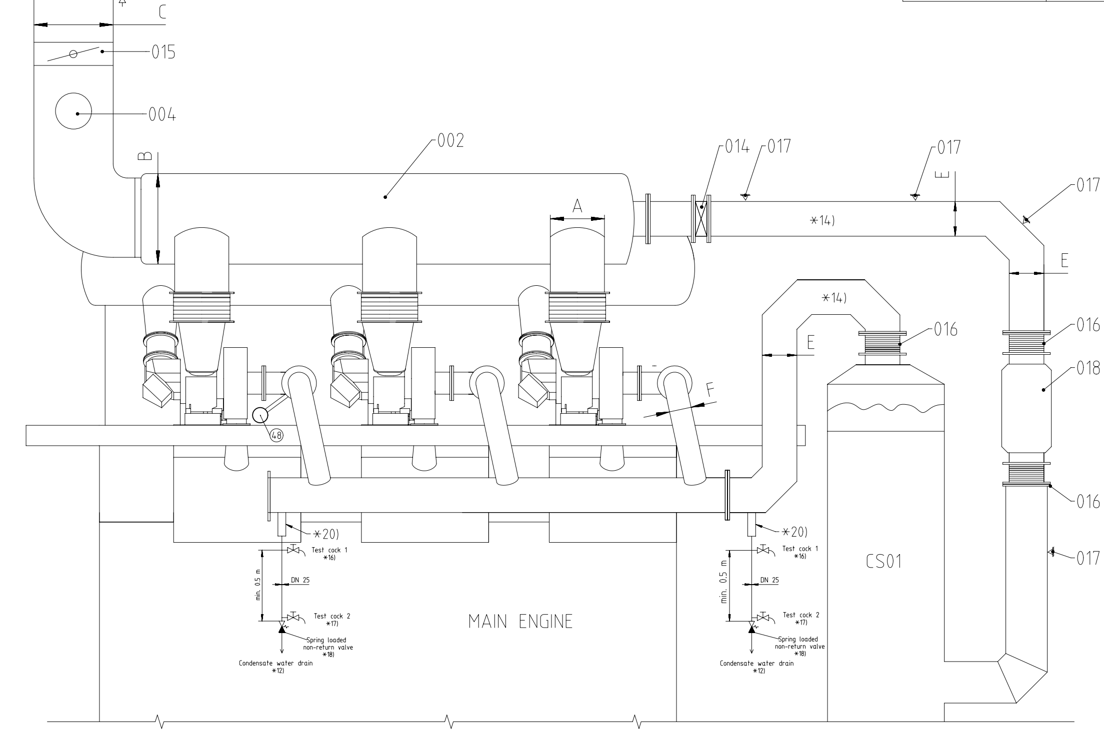
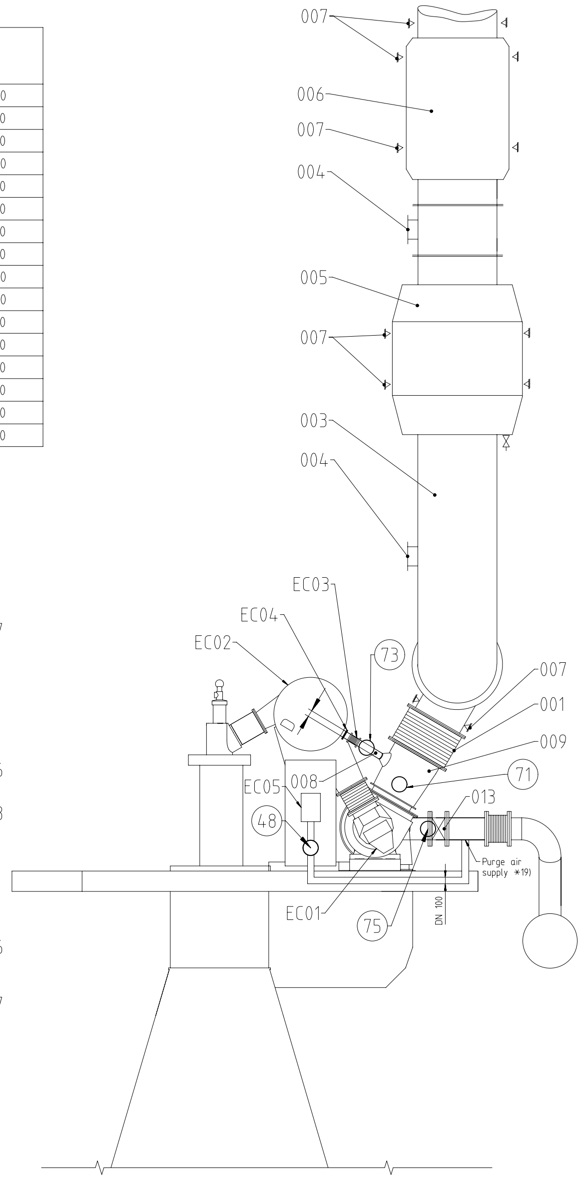


Table 1: Recommended pipe dimensions in relation to exhaust gas mass flow

Exhaust Gas mass flow (turbine flow from GTD) kg/s	EGC Size	E	A	B	C	D
11.5 -14.4	EGC14	700	*15)	*15)	*15)	*8)
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				
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)
013	Flow Regulating Valve (FRV)
014	Shut-off valve (SOV)
015	Back Pressure Valve (BPV)
016	Compensator in the exhaust system *13)
017	iCER 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 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...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 "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) To be directed to the bilge water tank. Can be connected to the SAC drain pipe from engine connection 16.
*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.
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.
*16) By opening of test cock 1 the following conditions can be ckecked:
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 ckecked:
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) The purge air supply line must be connected upstream from flow regulating valve (013) to the EGC exhaust gas return pipe.
*20) The condensate water collection pocket must be connected at the lowest point of the horizontal return manifold pipe.

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

Change	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code		
	C	npa101	dst009	20.12.2022	CNAA002993	Drawing Updated		4	3
						Approved		E	C

[mm] [kg] – NX A0 Item ID PAAD363091 Drawing Page/s 2/3

SYSTEM PROPOSAL

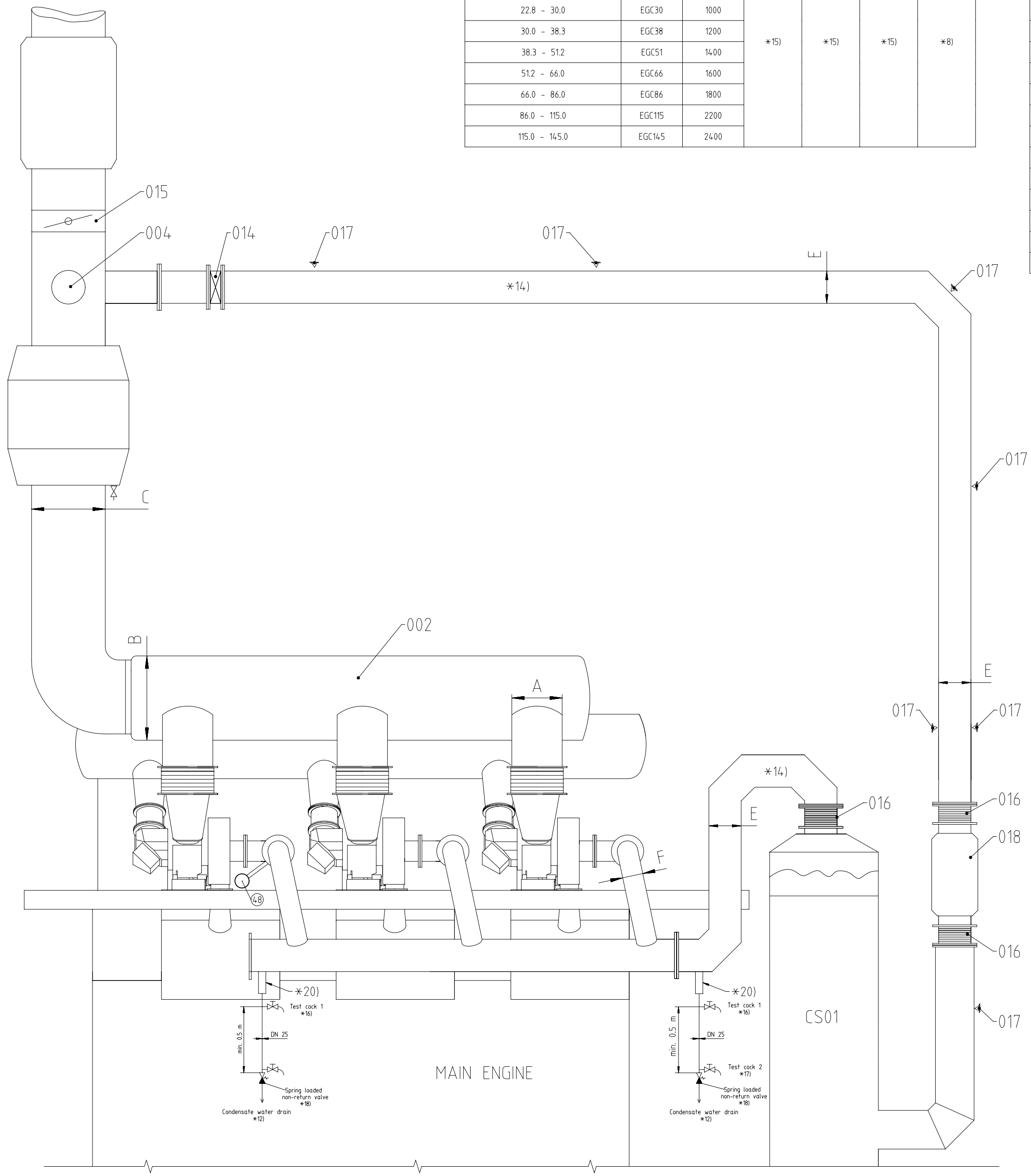
NOTE
Further installation details and variants can be found listed in the Marine Installation Manual (MIM), which provides also the acronyms used in this drawing set. The piping symbols are explained by the piping symbol key as included in the drawing set "Various Installation Items".

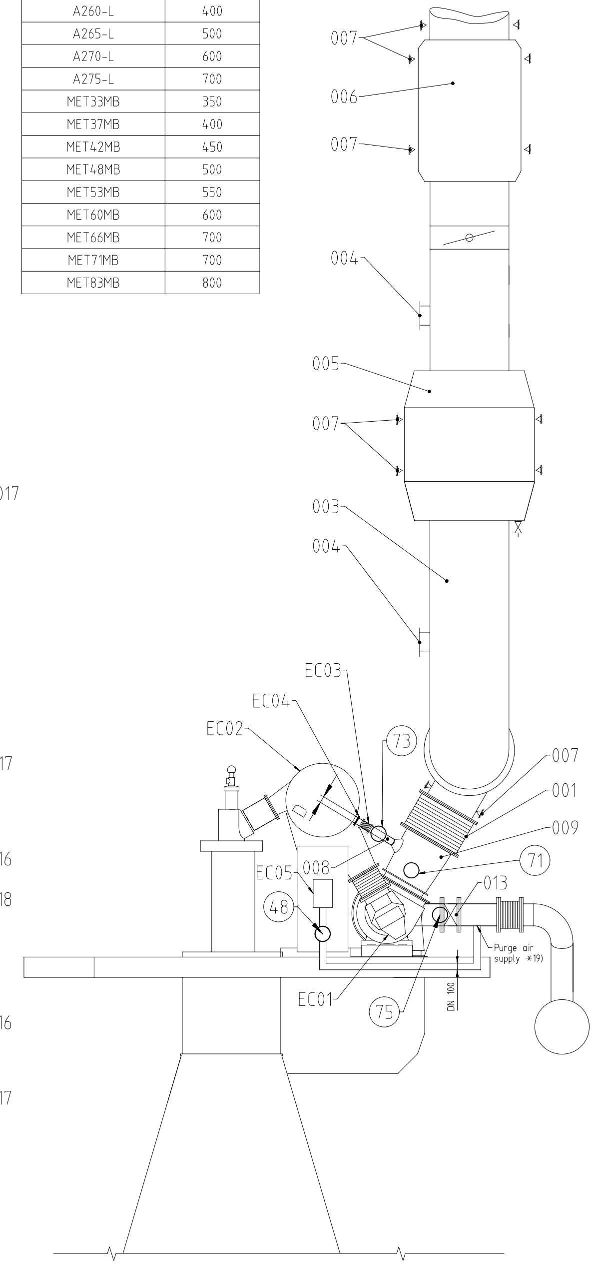
Long Route
- Exhaust gas branch-off after economizer

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

Exhaust Gas mass flow (turbine flow from GTD) kg/s	EGC Size	E	A	B	C	D
11.5 -14.4	EGC14	700	*15)	*15)	*15)	*8)
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				
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)
013	Flow Regulating Valve (FRV)
014	Shut-off valve (SOV)
015	Back Pressure Valve (BPV)
016	Compensator in the exhaust system *13)
017	iCER 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:

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*1) Refer to the "Pipe Connection Plan" for the execution and location of the engine pipe connections.
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*3) To be delivered by the engine builder, i.e. already equipped on engine side
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*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 "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) To be directed to the bilge water tank. Can be connected to the SAC drain pipe from engine connection 16.
*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.
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Normal condition:
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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) The purge air supply line must be connected upstream from flow regulating valve (013) to the EGC exhaust gas return pipe.
*20) The condensate water collection pocket must be connected at the lowest point of the horizontal return manifold pipe.

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

Change	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis		
	C	npa101	dst009	20.12.2022	CNAA002993	Drawing Updated	4	3

Approved | Activity Code | E | C

[mm] [kg] | - | NX | A0 | Item ID PAAD363091 | Drawing Page/s 3/3

MIDS – Exhaust System (DG9726)

WinGD X92DF-2.0

TRACK CHANGES

DATE	SUBJECT	DESCRIPTION
2021-08-31	DRAWING SET	First web upload
2021-12-22	PTAA004290 PAAD363091	System drgs – new revision
2022-03-14	PTAA004290 PAAD363091	System drgs – new revision
2022-12-01	PTAA004290 PAAD363091 PTAA044722	System drgs – new revision New drawing set as replacement of the previous one - added
2022-12-20	PTAA004290 PAAD363091 PTAA044714	System drgs – new revision
2023-03-27	PTAA051371 PTAA044714	System drgs – new revision
2023-12-19	PTAA044714	System drgs – new revision
2024-02-08	PTAA051371B	New revision

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