

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

Available executions

Execution No.	Material ID	Cylinder No.	Attribute 1: Gas pressure regulation		Attribute 2: Gas supply system	
			iGPR	GVU	NG	NG+VOC
1	PAAD341069	5-8		X	X	
2	PAAD341070	5-8		X		X
3	PAAD255495	5-8	X		X	
4	PAAD308988	5-8	X			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.									
Change History									
	-	sde101	mhu019	10.11.2021	CNAA000934	new Design		-	-
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Approved	Activity Code	E C



FUEL GAS 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	PTAA016475		Drawing Page/s	1/1			

SEQ NO	QTY	Item ID	Item Name	Dimension	Standard-ID	Basic Material	Net Weight
001	1	PAAD270710	FUEL GAS SYSTEM	Gas Pressure Regulation: iGPR			0.001
003	1	PAAD278947	FLUSHING INSTRUCTION PIPING				0.001
004	1	PAAD149646	ENGINE SAFETY CONCEPT	DF ENGINE SAFETY CONCEPT			0.001

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Prod.	5,6,7,8 X52DF		5,6,7,8 X52DF-2.1					
Change History	E	sde101	mhu019	10.11.2021	EAAD093769	Main Design/Drawing Introduced	4	3
	D	sde101	mhu019	04.09.2020	EAAD094556	Legacy information. See corresponding ChangeNotice	4	3
	C	sde101	dst009	14.08.2020	EAAD093769	Legacy information. See corresponding ChangeNotice	4	3
	-	dkl021	mhu019	18.08.2017		-	-	-
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Approved	Activity Code

	<h1>FUEL GAS SYSTEM</h1> <h2>PAAD255495</h2>
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Bill Of Material		Dimension						
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	Main Design	Yes	Design Group	9727	Q-Code	XXXXX	Standard	WDS
	Qty per	Engine	A4	Item ID	PAAD255495		BOM Page/s	01/01

SPECIFICATIONS which must be met:

82
J
OUTLET - Gas monitoring, piston underside
- Must not be connected to other venting pipes.
- Gas release to safe area outside of the engine room.
- At the end of the vent pipe, safety devices such as flame arrestors must be installed according to the respective class specification and requirement.

83
J
INLET - Inert gas filling flowmeter
Pipe connection: Only to be used / connected for maintenance of the flowmeter.
To be kept closed / blinded off during normal operation
Inert gas quality: According to the specification in the MIM.

78
J
INLET - Gas supply
INNER GAS PIPE
Gas quality: According to the specification in the MIM.
Gas pressure: Design pressure based on GTD requirement for the selected rating and selected minimum LHV plus system pressure drop. Operational variation via the engine control system possible.
Permissible gas pressure fluctuation: ± 0.6 bar (across all frequencies).
Mass flow: According to GTD.
For the gas temperature: 0 - 60°C
NOTE: Regarding gas temperature vs. ventilation air temperature and methods to avoid / handle condensation in the annular space, refer to the specification for connection 81 and remarks on page 2.
Pipe connection: Inner pipe connected to the gas supply line from gas storage / handling system via flange connection (please refer to the "Pipe Connection Plan").

Inert gas supply: An inert gas supply must be connected piping to the iGPR right after the master gas fuel supply valve to enable purging of the whole system and engine piping
Inert gas quality: According to the specification in the MIM.
Inert gas pressure: Can be selected between 3 and 15 bar(g). Once set-pressure is selected, deviation of ±10% is allowed, though not below 3 bar.
Inert gas volume engine side: Provided in Table 1 on page 2.

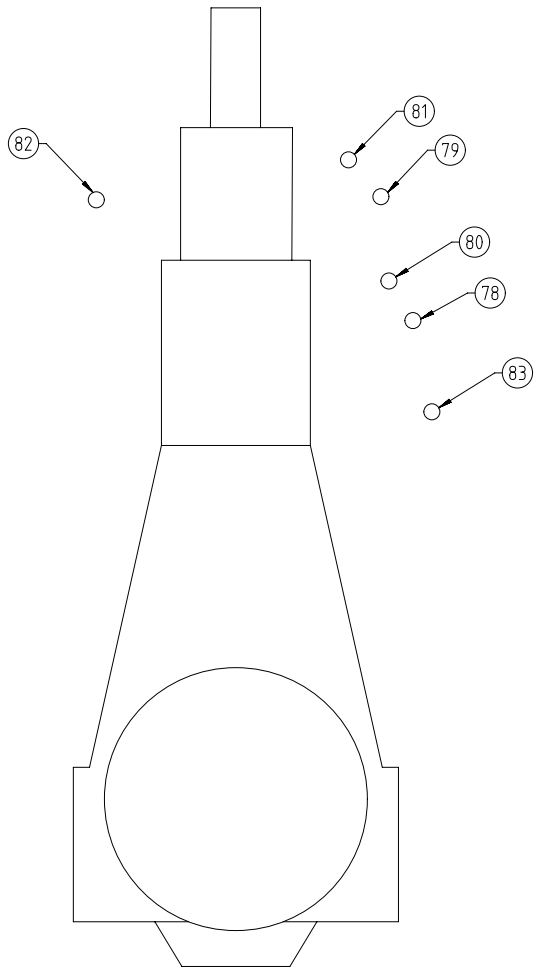
OUTER PIPE (annular space) - ventilation air outlet
Ventilation air quantity and quality: Refer to the connection 81, "INLET - Ventilation air annular space".
Pipe connection: Outer pipe is connected to the annular space of the supply pipe via flange connection (please refer to the "Pipe Connection Plan").

Gas detection: A gas detector must be installed in the venting line, at a max. distance of 2 m from the engine inlet, and has to be placed right next to the outer pipe (annular space) connection on the side closest to the engine inlet.
Interruption of the gas supply: The main gas supply line to each consumer or set of consumers must be equipped with a manually operated stop valve and an automatically operated "master gas valve". The stop valve and the "master gas valve" can be installed either in series or can be executed as a combined manually and automatically operated valve. The valves must be located in the part of the piping, which is situated outside of the machinery space that contains gas.

79
J
OUTLET - Gas / inert gas release, engine driving end
- Can be connected to the gas / inert gas release, engine free end (connection 80), but must not be connected to other venting pipes.
- No additional valves are allowed in the venting pipeline.
- Gas release to the safe area outside of the engine room.
- At the end of the vent pipe, safety devices such as flame arrestors must be installed according to the respective class specification and requirement.

80
J
OUTLET - Gas / inert gas release, engine free end
- Can be connected to the gas / inert gas release, engine driving end (connection 79), but must not be connected to other venting pipes.
- No additional valves are allowed in the venting pipeline.
- Gas release to the safe area outside of the engine room.
- At the end of the vent pipe, safety devices such as flame arrestors must be installed according to the respective class specification and requirement.

81
J
INLET - Ventilation air annular space
- Location and execution according to the "2-S Dual-Fuel Safety Concept" as linked in the MIM.
- The ventilation air dew point must be lower than the gas temperature. If the ambient air is not sufficiently dry, then dry air must be supplied. Please refer to the remarks and proposals on page 2.
- Sufficient ventilation air (min. 30 air exchanges per hour) must be sucked by the extraction fan from a safe area into the annular space of the main engine's internal and external piping.
- For the volume of the ventilation air on the engine side, refer to Table 1 on page 2.



Prod.	X5ZDF										
	X5ZDF-2.1										
Change History	J	sde101	mhu09	01.12.2021	0A000089	Drawing Updated			4	3	
	I	sde101	mhu09	26.04.2021	EAAD095579	Legacy information. See corresponding ChangeNotice			4	3	
	H	sde101	mhu09	04.09.2020	EAAD094556	Legacy information. See corresponding ChangeNotice			4	3	
Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis			Approved	Activity Code	E	G

WIN GD
Winterthur Gas & Diesel

FUEL GAS SYSTEM
Gas Pressure Regulation: iGPR

Dimension: Gas Pressure Regulation: iGPR

Scale: - [Symbol] NX Units [mm] [kg] Basic Material Net Weight 0.001

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TOLERANCING PRINCIPLE ISO8015		Main Design	Design Group 9727 Q-Code XXXXX Standard WDS
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Qty per	A2 Item ID PAAD270710 Drawing Pages 1/3

SYSTEM PROPOSAL

NOTE ①
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".

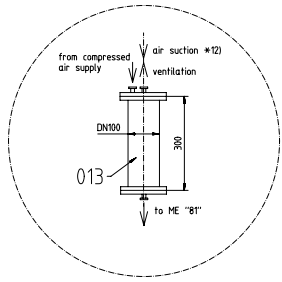
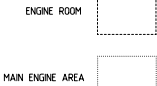
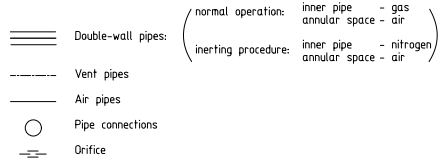


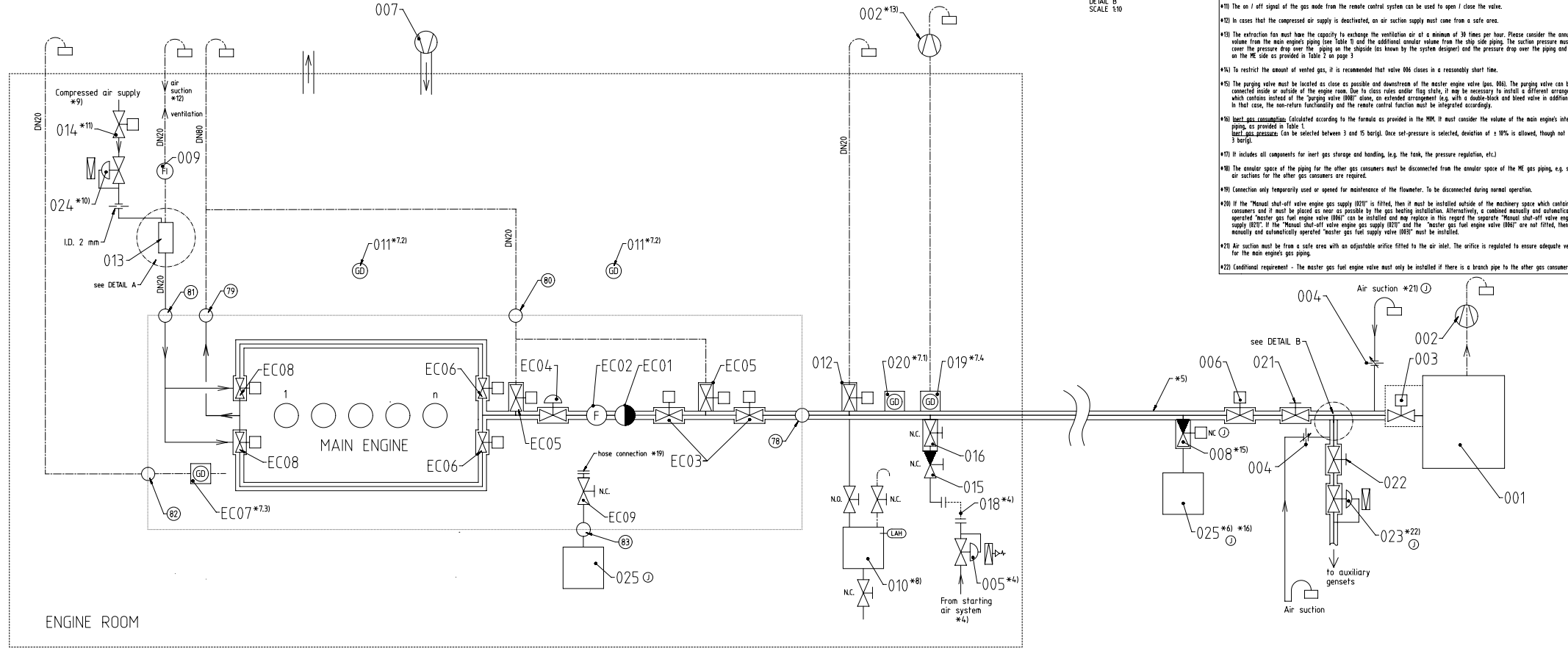
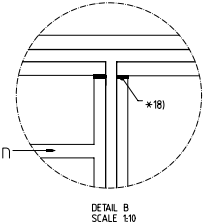
Table 1: Volume of ME internal gas piping

Cylinder	Volume of inner pipe (l)*	Volume of annular space (l)*
5 cyl.	110 l	75 l
6 cyl.	125 l	85 l
7 cyl.	140 l	95 l
8 cyl.	150 l	105 l

* Reference data for inert gas and ventilation air calculation. Ship side piping shall be considered in addition.

Pos.	System Components *2) ①
001	Gas handling room/cargo machinery room
002	Extraction fan
003	Master gas fuel supply valve
004	Adjustable orifice
005	Pressure regulating valve air supply for pressure test
006	Master gas fuel engine valve *22) *14)
007	Engine room ventilation fan
008	Purging valve
009	Flow indicator
010	Condensate water trap
011	Gas detector engine room *7.2)
012	Bleeding / vent valve
013	Venting box
014	Shut-off valve, compressed air supply
015	Non-return valve
016	Shut-off valve (double well execution)
018	Intermediate piece
019	Gas detector ship side *7.4)
020	Gas detector engine side *7.1)
021	Manual shut-off valve engine gas supply *20)
022	Manual shut-off valve ancillary gas supply
023	Pressure regulating valve ancillary gas supply
024	Pressure regulating valve annular space air supply
025	Inert gas supply system *17)

Pos.	Engine Components *3) ①
EC01	Gas filter
EC02	Flowmeter
EC03	Shut-off valve
EC04	Pressure regulating valve
EC05	Bleeding / vent valve
EC06	Shut-off valve gas rail pipe
EC07	Gas detector piston underside
EC08	Vent valve
EC09	Inert gas shut-off valve

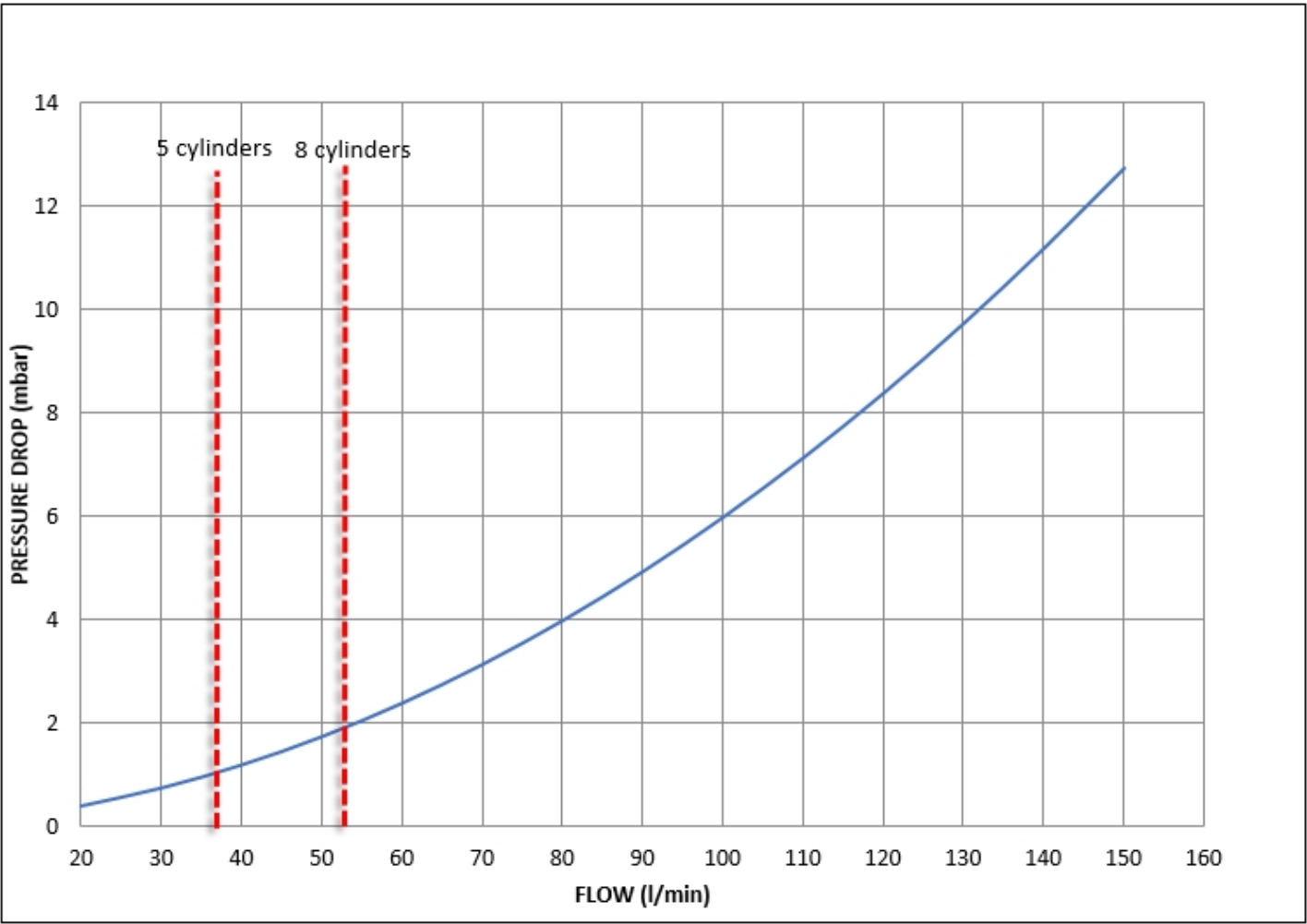


Pos.	Engine Connections *1)
78	INLET - Gas Supply
79	OUTLET - Gas / Inert gas release, engine driving end
80	OUTLET - Gas / Inert gas release, engine free end
81	INLET - Ventilation air annular space
82	OUTLET - Gas monitoring, piston underside
83	INLET - Inert gas filling, flowmeter *19)

- Remarks:** ①
- *1) For the exact position and pipe connection execution, please refer to the "Pipe Connection Plan".
 - *2) To be installed by the shipyard.
 - *3) To be delivered by the engine builder, i.e. already equipped on the engine side.
 - *4) Compressed air supply is required for leakage testing of the gas fuel system pipelines and components. Air is supplied from the starting air system, then air pressure is reduced by the regulating valve (005) to the design gas pressure. The intermediate piece (006) must be removed during normal ME operation only to be installed for commissioning / maintenance and the connection blocked off.
 - *5) Piping between the gas handling / cargo room and engine is supplied by the shipyard and is connected to the inlet flange on the engine side (layout of the counter-flange is provided in the "Pipe Connection Plan").
Pipe section installed below the main deck in the engine room air cargo machinery room.
Double-wall pipe with inner pipe diameter of DN50 and outer pipe diameter of DN60 is recommended.
Pipe section installed above the main deck on weather deck.
Single-wall pipe with diameter of DN65 is recommended, if the position fulfills the rule requirements of the non-hazard zone.
 - *6) Inert gas quality: According to the specification in the MIM.
 - *7.1) Gas detection for annular space with feedback to the engine control system: Mandatory.
*7.2) Gas detection in the engine room above ME and the GPR: Required according to the "WinGD 2-S Dual-Fuel Engine Safety Concept".
*7.3) Gas detection for piston underside (PUS) with feedback to the engine control system: Mandatory.
*7.4) Gas detection for annular space on the side (AIS) - to distinguish between system and engine side leaks. If the optional gas detector is not installed, the ventilation line with the extraction fan must be connected to gas detector 018.
 - *8) Conditional requirement: If the gas temperature is not always higher than the ambient air temperature, condensate may accumulate in the condenser space. In this case, condensate traps must be arranged at the low points of the ship side gas piping. If the condensate water trap LAH is triggered, the trap must be manually drained. To do this, the inlet valve (010) on the draught must be closed, the venting valve and drain valve (016) on the draught is opened. When the trap has been drained, all valves are to be returned to their normal position. For the tank size, it is recommended to consider the volume under tropical conditions; the larger the tank capacity, the lower the drainage requirement. Recommended draining is two times per day.
 - *9) Condition requirement: No condensate is allowed in the main engine's gas piping. Therefore, if the gas temperature is not higher than the ambient air temperature, a dedicated dry air supply must be arranged either:
- From the control air supply (must comply with the ISO 6733-1, class 4+3, i.e. dew point $\leq 3^{\circ}\text{C}$).
- From the air dryer (must comply with the ISO 6733-1, class 4+3, i.e. dew point $\leq 3^{\circ}\text{C}$).
- From the working air supply (as long as the gas temperature is always above 10 °C).
 - *10) Adjustable pressure regulating valve range 0.5 - 8 barg. Pre-setting procedure: The pressure regulating valve must be adjusted so that the flow indicator 009 shows just a small flow outside when the extraction fan is in operation.
 - *11) The on / off signal of the gas made from the remote control system can be used to open / close the valve.
 - *12) In cases that the compressed air supply is deactivated, an air suction supply must come from a safe area.
 - *13) The extraction fan must have the capacity to exchange the ventilation air at a minimum of 30 times per hour. Please consider the annular volume from the main engine's piping (see Table 1) and the additional annular volume from the ship side piping. The suction pressure must cover the pressure drop over the piping on the shipside (as known by the system designer) and the pressure drop over the piping and GPR on the ME side as provided in Table 2 on page 3.
 - *14) To restrict the amount of vented gas, it is recommended that valve 006 closes in a reasonably short time.
 - *15) The purging valve must be located as close as possible and downstream of the master engine valve (pos. 003). The purging valve can be connected inside or outside of the engine room. Due to class rules and/or flag state, it may be necessary to install a different arrangement, which contains instead of the "purging valve (008)" alone, an extended arrangement (e.g. with a double-block and bleed valve in addition). In that case, the non-return functionality and the remote control function must be integrated accordingly.
 - *16) Inert gas consumption: Calculated according to the formula as provided in the MIM. It must consider the volume of the main engine's internal gas piping, as provided in Table 1.
Inert gas pressure: Can be selected between 3 and 15 barg. Once set-pressure is selected, deviation of $\pm 10\%$ is allowed, though not below 3 barg.
 - *17) It includes all components for inert gas storage and handling, (e.g. the tank, the pressure regulation, etc.).
 - *18) The annular space of the piping for the other gas consumers must be disconnected from the annular space of the ME gas piping, e.g. separated air suction for the other gas consumers are required.
 - *19) Connection only temporarily used or opened for maintenance of the flowmeter. To be disconnected during normal operation.
 - *20) If the "Manual shut-off valve engine gas supply (021)" is fitted, then it must be installed outside of the machinery space which contains gas consumers and it must be placed as near as possible by the gas handling installation. Alternatively, a combined manually and automatically operated "master gas fuel engine valve (006)" can be installed and may replace in this regard the separate "Manual shut-off valve engine gas supply (021)". If the "Manual shut-off valve engine gas supply (021)" and the "master gas fuel engine valve (006)" are not fitted, then a combined manually and automatically operated "master gas fuel supply valve (003)" must be installed.
 - *21) Air suction must be from a safe area with an adjustable orifice fitted to the air inlet. The orifice is regulated to ensure adequate ventilation for the main engine's gas piping.
 - *22) Conditional requirement - The master gas fuel engine valve must only be installed if there is a branch pipe to the other gas consumers.

J

Table 2: Pressure drop over the annular space on engine side (iGPR + piping)




SURFACE PROTECTION SEE GROUP 0344	Change	J	sde101	mhu019	10.11.2021	CNA000939	Drawing Updated			4	3		
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis			Approved	Activity Code	E	C	
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GENERAL TOLERANCES ACCORDING TO ISO2768-mK									NX				

SEQ NO	QTY	Item ID	Item Name	Dimension	Standard-ID	Basic Material	Net Weight
002	1	PAAD286665	GAS FUEL SYSTEM	Gas Pressure Regulation: iGPR			0.001
003	1	PAAD278947	FLUSHING INSTRUCTION PIPING				0.001
004	1	PAAD149646	ENGINE SAFETY CONCEPT	DF ENGINE SAFETY CONCEPT			0.001

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Prod.	5,6,7,8 X52DF		5,6,7,8 X52DF-2.1					
Change History	C	sde101	mhu019	10.11.2021	EAAD093769	Main Design/Drawing Introduced	4	3
	B	sde101	mhu019	04.09.2020	EAAD094556	Legacy information. See corresponding ChangeNotice	4	3
	A	sde101	dst009	14.08.2020	EAAD093769	Legacy information. See corresponding ChangeNotice	4	3
	-	sde101	mhu019	01.10.2018	EAAD089573	Legacy information. See corresponding ChangeNotice	4	3
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Approved	Activity Code

	<h2>FUEL GAS SYSTEM</h2> <h3>PAAD255495</h3>
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Bill Of Material		Dimension						
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	Main Design	Yes	Design Group	9727	Q-Code	XXXXX	Standard	WDS
	Qty per	Engine	A4	Item ID	PAAD308988		BOM Page/s	01/01

SPECIFICATION which must be met:

(82) OUTLET - Gas monitoring, piston underside
 - Must not be connected to other venting pipes.
 - Gas release to safe area outside of engine room.
 - At the end of the vent pipe, safety devices e.g. flame arrestors have to be installed according to respective class specification and requirement.

(83) INLET - Inert gas filling flowmeter
Pipe connection: Only to be used / connected for maintenance of the flowmeter. To be kept close / blinded off during normal operation
Inert gas quality: According to specification in Marine Installation Manual (MIM).

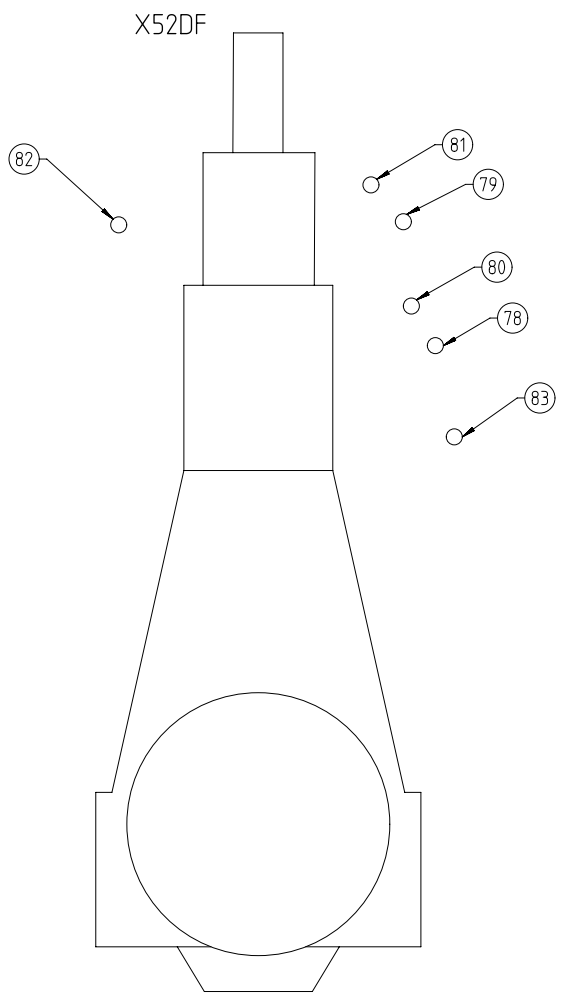
(78) INLET - Gas supply
 INNER GAS PIPE
Gas quality: According to project specific definition
Gas pressure: Project specific as defined by the system designer, considering the heat value of the fuel gas mixture (NG+VOC). The minimum required NG pressure needed for an reliable ME operation is provided by GTD.
Permissible gas pressure fluctuation: ± 0.6 bar (across all frequencies).
Mass flow: according to project specific definition
Gas temperature:
 40 - 60 °C for pure NG and for the mixture of NG and VOC up to max. 25% of VOC.
Pipe connection: Inner pipe connected to the gas supply system via adapter piece.
Inert gas supply: An inert gas supply must be connected upstream to the iGPR right after the master gas fuel supply valve to enable purging of the whole system+engine piping (in the Wärtsilä Fuel Supply System both componets are already included).
Inert gas quality: According to specification in Marine Installation Manual (MIM).
Inert gas pressure: Can be selected between 3 and 15 bar(g). Once set-pressure is selected, deviation of ± 10% is allowed, though not below 3 bar.
Inert gas volume engine side: Provided in table 1 on page 2.

OUTER PIPE (annular space) - annular space ventilation air outlet
Ventilation air quantity and quality: same specification as for connection 81, "INLET - Ventilation air annular space".
Pipe connection: Outer pipe connected to the annular space venting via an adapter piece.
 Gas detection: A gas detector must be installed in the venting line, at a max. distance of 2 m from the engine inlet, and has to be placed right next to the outer pipe (annular space) connection on the side closest to / furthest from the engine inlet.
 Interruption of gas supply: The main gas supply line to each consumer or set of consumer must be equipped with a manually operated stop valve and an automatically operated "master gas valve" coupled in series or executed as a combined manually and automatically operated valve. The valves shall be situated in the part of the piping that is outside the machinery space containing gas.

(79) OUTLET - Gas / Inert gas release, engine driving end
 - Can be connected to gas / inert gas release, engine free end (connection 80), but must not be connected to other venting pipes.
 - No additional valves allowed in the venting pipeline.
 - Gas release to safe area outside of engine room.
 - At the end of the vent pipe, safety devices e.g. flame arrestors must be installed according to respective class specification and requirement.

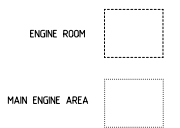
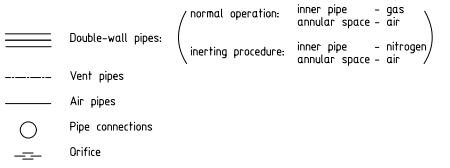
(80) OUTLET - Gas / Inert gas release, engine free end
 - Can be connected to gas / inert gas release, engine driving end (connection 79), but must not be connected to other venting pipes.
 - No additional valves allowed in the venting pipeline.
 - Gas release to safe area outside of engine room.
 - At the end of the vent pipe, safety devices e.g. flame arrestors must be installed according to respective class specification and requirement.

(81) INLET - Ventilation air annular space
 - Air suction from a gas safe area
 - Execution of the air suction pipe according to the concept as provided in the "2-S Dual Fuel Safety Concept" (linked on the main drawing of this design group)
 - Ventilation air flow on ME side: min. 30 air exchanges per hour
 Annular space volume for calculation of extraction fans capacity: see table 1 on page 2.



Modif.	C	EAAD092228	27.02.2020	D	EAAD093769	14.08.2020	E	EAAD094556	04.09.2020	F	EAAD095579	26.11.2020		
		Number	Drawn date		Number	Drawn date		Number	Drawn date		Number	Drawn date		
Free space for file											Q-Code XXXXXX Standard ISO; JIS	Main Drw.		
		Product 5-8X52DF		GAS FUEL SYSTEM Gas Supply System: NG+VOC Gas Brennstoffsystem Gas Pressure Regulation: iGPR				Units mm kg NX		Basic Material		Net Weight 0,001		
SURFACE PROTECTION SEE GROUP 0344		Made	15.03.2018	mhu019	M.Hug	Scale	-	Size	A2	Page	1/3	Material ID	PAAD286665	
TOLERANCING PRINCIPLE ISO8015		Chkd	28.09.2018	wwa008	Wang	Design Group		Appd	28.09.2018	dst009	Strödecke	727	Drawing ID	DAAD097363
GENERAL TOLERANCES ACCORDING TO ISO2768-mK													Rev.	F

SYSTEM PROPOSAL



Pos.	System Components
001	Fuel Gas Supply System (FGSS)
002	Extraction fan
003	Engine room ventilation fan
004	Gas detector engine room *4.2)
005	Adapter piece *6)
006	Shut-off valve (double-wall execution)
007	Non-return valve
008	Intermediate piece
009	Bleeding valve
010	Gas detector annular space, gas supply pipe
011	Pressure reduction valve

Pos.	Engine Components
EC01	Gas filter
EC02	Flowmeter
EC03	Shut-off valve
EC04	Vent valve
EC05	Pressure regulating valve
EC06	Bleeding / vent valve
EC07	Shut-off valve gas rail pipe
EC08	Gas detector piston underside
EC09	Inert gas shut-off valve

Pos.	Engine Connections**
(78)	INLET - Gas Supply
(79)	OUTLET - Gas / Inert gas release, engine driving end
(80)	OUTLET - Gas / Inert gas release, engine free end
(81)	INLET - Ventilation air annular space
(82)	OUTLET - Gas monitoring, piston underside
(83)	INLET - Inert gas filling flowmeter *10)

- Remarks:
- *1) The exact position and pipe connection execution please refer to the "Pipe Connection Plan".
 - *2) Compressed air supply is required for leakage testing of gas fuel system pipelines and components. Air is supplied from the starting air system, then air pressure is reduced by the regulating valve (011) to the design gas pressure. The intermediate piece (008) must be removed during normal ME operation (only to be installed for commissioning / maintenance) and the connection blinded off.
 - *3) Inert gas quality according to the specification in the Marine Installation Manual (MIM).
 - *4.1) Gas detection for annular space, with feedback to engine control system: mandatory. Must be installed with a distance of max. 2 m to engine inlet.
 - *4.2) Gas detection in engine room above ME and IGPR: Required according to WinGD "2-S Dual-Fuel Engine Safety Concept".
 - *4.3) Gas detection for piston underside (PUS), with feedback to engine control system: mandatory.
 - (5) The extraction fan must have the capacity to exchange the ventilation air at minimum of 30 times per hour. Please consider the annular volume from ME piping (from Table 1) and the additional annular volume from the ship side piping. The suction pressure must cover the pressure drop over the piping on the shipside (as known by the system designer) and the pressure drop over the piping and IGPR on the ME side as provided in table 2 on page 3.
 - *6) The adapter piece (005) in between the FGSS (001) and ME connection flange has to be prepared by the shipyard / gas pipe supplier accordingly. It must provide the following functions:
 - ME annular space ventilation air outlet with gas detector
 - Separation of the ME annular space from the annular space of the FGSS.
 - *7) In order to keep the temperature of the fuel gas mixture (NG+VOC) in the specified range of 40 - 60°C it is recommended to apply on the piping in the fuel gas supply line and on ME side insulation.
 - *8) The master gas fuel supply valve, inert gas inlet and venting outlet is included the gas supply system.
 - *9) Depending on the requirements / setup to be installed either on system side and / or included in the gas supply system.
 - *10) Connection only temporary used / opened for maintenance of the flowmeter. To be disconnected during normal operation.
 - *11) **last gas consumption:** (calculated according to the guidance in the Marine Installation Manual (MIM) under consideration of the in table 1 provided ME inner pipe volume. **last gas pressure:** Can be selected between 3 and 15 barg). Once set-pressure is selected, deviation of ±10% is allowed, though not below 3 bar.

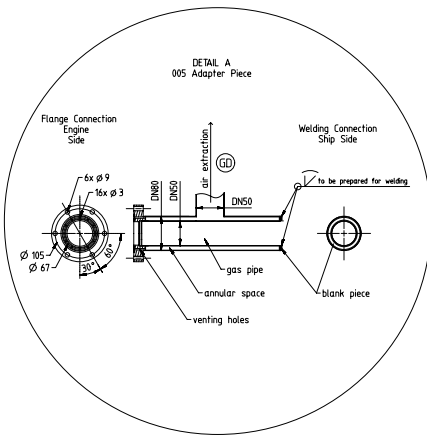
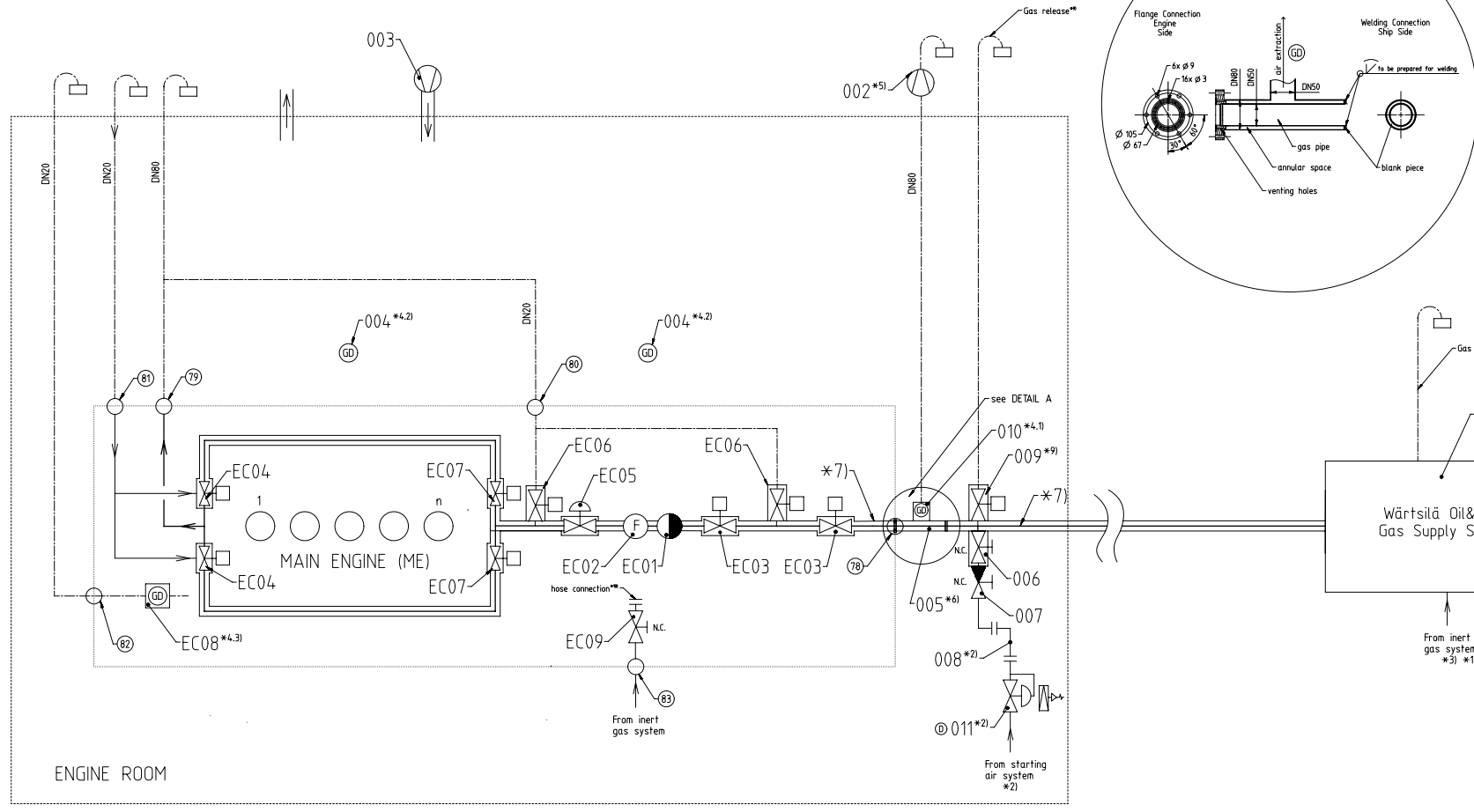


Table 1: Volume of ME internal gas piping

Cylinder	Volume of inner pipe (l)*	Volume of annular space (l)*
5 cyl.	110 l	75 l
6 cyl.	125 l	85 l
7 cyl.	140 l	95 l
8 cyl.	150 l	105 l

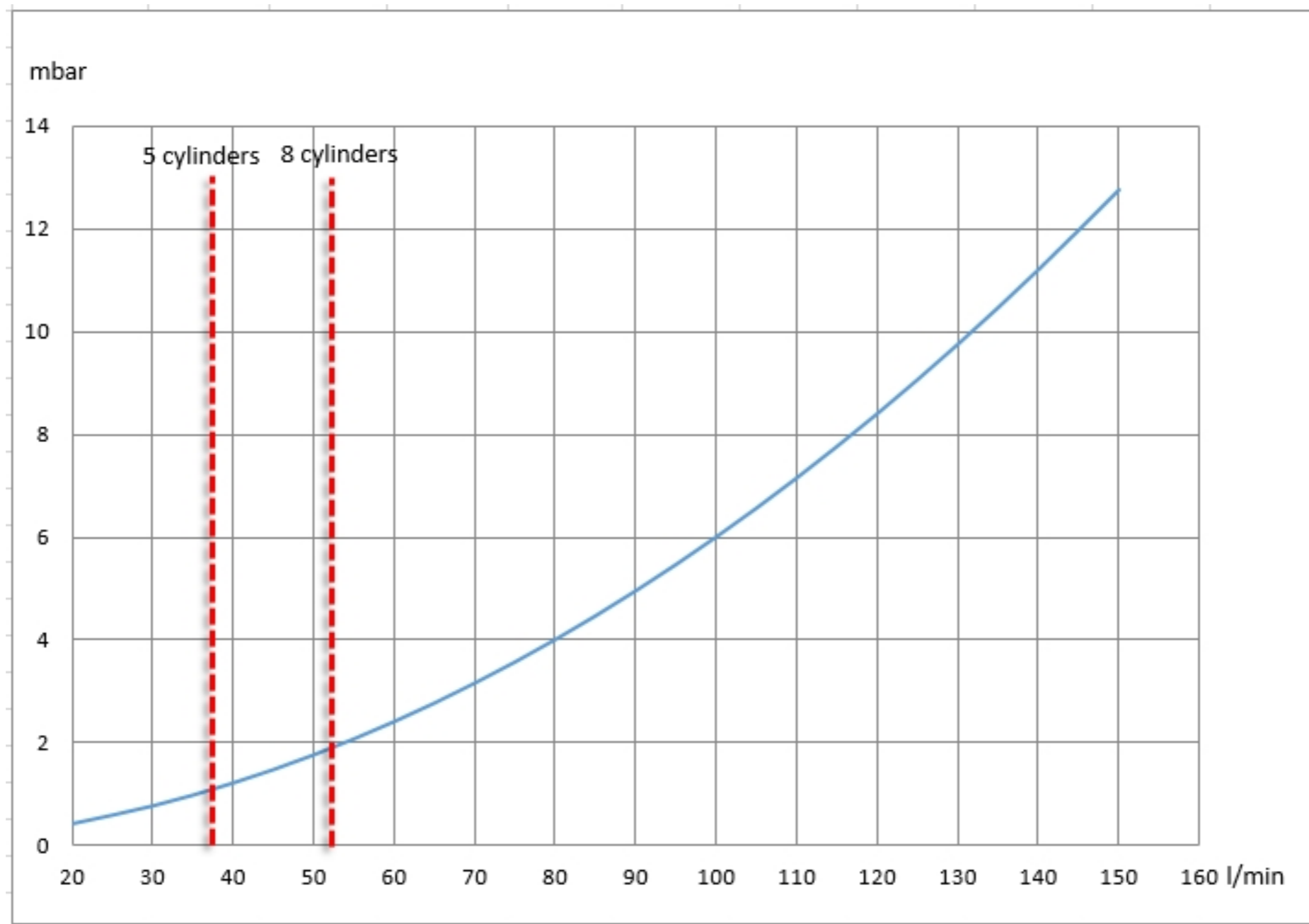
* Reference data for inert gas and ventilation air calculation. Ship side piping shall be considered in addition.



Project No.	15.83.2018	Rev.	01
Client	Wärtsilä	Scale	1:20
Design Group	01727	Sheet No.	PAAD286665
Project Name	GAS FUEL SYSTEM		
System	Gas Supply System: NG-VOC		
Standard	Gas Brennstoffsystem: IGPR		
Manufacturer	WINGD		

(F)

Table 2: Pressure drop over the annular space on engine side (iGPR + piping)



Free space for litc.	Q-Code XXXXXX						Main Drw.						
	Standard ISO; JIS												
Modif.	(C) EAAD092228	27.02.2020	(D) EAAD093769	14.08.2020	(E) EAAD094556	04.09.2020	(F) EAAD095579	26.11.2020					
	Number	Drawn date	Number	Drawn date	Number	Drawn date	Number	Drawn date					
		Product 5-8X52DF		GAS FUEL SYSTEM Gas Supply System: NG+VOC Gas Brennstoffsystem Gas Pressure Regulation: iGPR									
Units	mm kg	NX			Basic Material		Net Weight 0,001						
SURFACE PROTECTION SEE GROUP 0344		Made	15.03.2018	mhu019	M.Hug	Scale	-	Size	A3	Page	3/3	Material ID	PAAD286665
TOLERANCING PRINCIPLE ISO8015		Chkd	28.09.2018	wwa008	Wang	Design Group	9727	Drawing ID	DAAD097363		Rev.	F	
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Appd	28.09.2018	dst009	Strödecke								

Approved

DID - DIMENSIONAL DRAWING - Confidential

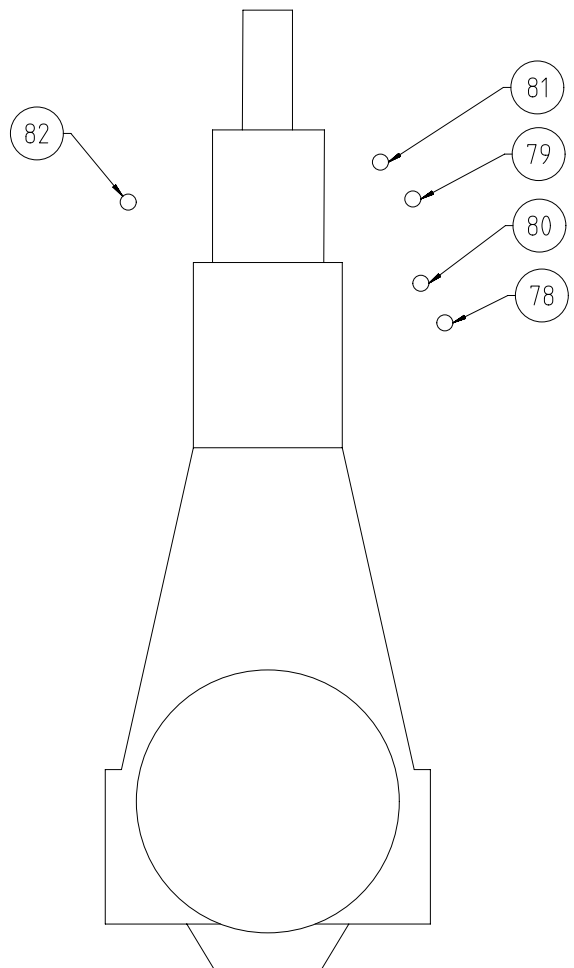
SEQ NO	QTY	Item ID	Item Name	Dimension	Standard-ID	Basic Material	Net Weight
001	1	PAAD340986	FUEL GAS SYSTEM	Gas Supply System: NG			0.001
003	1	PAAD278947	FLUSHING INSTRUCTION PIPING				0.001
004	1	PAAD149646	ENGINE SAFETY CONCEPT	DF ENGINE SAFETY CONCEPT			0.001

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Prod.	5,6,7,8 X52DF 5,6,7,8 X52DF-1.1			5,6,7,8 X52DF-2.1			
Change History							
	A	sde101	mhu019	10.11.2021	CNAA000939	Main Design/Drawing Introduced	4 3
	-	mhu019	dst009	22.10.2019	EAAD784961	-	- -
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Activity Code E C

	<h2>FUEL GAS SYSTEM</h2> <h3>Gas Pressure Regulation: GVU</h3>
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Bill Of Material		Dimension Gas Pressure Regulation: GVU					
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	Main Design	Yes	Design Group	9727	Q-Code	XXXXX	Standard WDS
	Qty per	Engine	A4	Item ID	PAAD341069		BOM Page/s 01/01



SPECIFICATIONS requirements for ENGINE connections

78	<p>INLET - Gas supply</p> <p>INNER GAS PIPE</p> <p><u>Gas quality:</u> According to the specification in the MIM.</p> <p><u>Gas pressure:</u> Controlled by GVU, load depended.</p> <p><u>Mass flow:</u> According to GTD.</p> <p><u>For the gas temperature:</u> 0 - 60°C</p> <p>NOTE: Regarding gas temperature vs. ventilation air temperature and methods to avoid / handle condensation in the annular space, refer to the specification for connection 81 and remarks on page 3.</p> <p><u>Pipe connection:</u> Inner pipe connected to the gas supply line from GVU via flange connection (please refer to the "Pipe Connection Plan").</p> <p>OUTER PIPE (annular space) - ventilation air outlet</p> <p><u>Ventilation air quantity and quality:</u> Refer to the connection 81, "INLET - Ventilation air annular space".</p> <p><u>Pipe connection:</u> Outer pipe is connected to the annular space of the supply pipe via flange connection (please refer to the "Pipe Connection Plan").</p> <p>Gas detection: A gas detector must be installed in the double wall pipe with a distance of max. 2 m to the engine inlet connection.</p>
79	<p>OUTLET - Gas / inert gas release, engine driving end</p> <ul style="list-style-type: none"> - Can be connected to the gas / inert gas release, engine free end (connection 80), but must not be connected to other venting pipes. - No additional valves are allowed in the venting pipeline. - Gas release to the safe area outside of the engine room. - At the end of the vent pipe, safety devices such as flame arrestors must be installed according to the respective class specification and requirement.
80	<p>OUTLET - Gas / inert gas release, engine free end</p> <ul style="list-style-type: none"> - Can be connected to the gas / inert gas release, engine driving end (connection 79), but must not be connected to other venting pipes. - No additional valves are allowed in the venting pipeline. - Gas release to the safe area outside of the engine room. - At the end of the vent pipe, safety devices such as flame arrestors must be installed according to the respective class specification and requirement.
81	<p>INLET - Ventilation air annular space</p> <ul style="list-style-type: none"> - Location and execution according to the "2-S Dual-Fuel Safety Concept" as linked in the MIM. - The ventilation air dew point must be lower than the gas temperature. If the ambient air is not sufficiently dry, then dry air must be supplied. Please refer to the remarks and proposals on page 3. - Sufficient ventilation air (min. 30 air exchanges per hour) must be sucked by the extraction fan from a safe area into the annular space of the main engine's internal and external piping. - For the volume of the ventilation air on the engine side: Refer to Table 2 on page 3. - For the volume of the ventilation air on the GVU side: Refer to Table 1 on page 2.
82	<p>OUTLET - Gas monitoring, piston underside</p> <ul style="list-style-type: none"> - Must not be connected to other venting pipes. - Gas release to safe area outside of the engine room - At the end of the vent pipe, safety devices such as flame arrestors must be installed according to the respective class specification and requirement.

Prod.	X52DF	X52DF-M-1.0								
	X52DF-2,1									
Change History	C	npa101	mhu019	26.01.2023	CNA003130	Drawing Updated			4	3
	B	sde101	mhu019	10.11.2021	CNA000939	Drawing Updated			4	3
	A	sde101	mhu019	26.04.2021	EAA0095579	Legacy information. See corresponding ChangeNotice			4	3
	-	mhu019	dst009	22.10.2019		-			-	-
Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Approved	Activity Code	E	C	

WIN GD
Winterthur Gas & Diesel

FUEL GAS SYSTEM
Gas Pressure Regulator: GVU

Dimension Gas Supply System: NG

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

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TOLERANCING PRINCIPLE ISO8015		Main Design Group	9727
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Q-Code	XXXXX
Qty per	A2	Item ID	PAAD340986
		Standard	WDS
		Drawing Pages	1/4

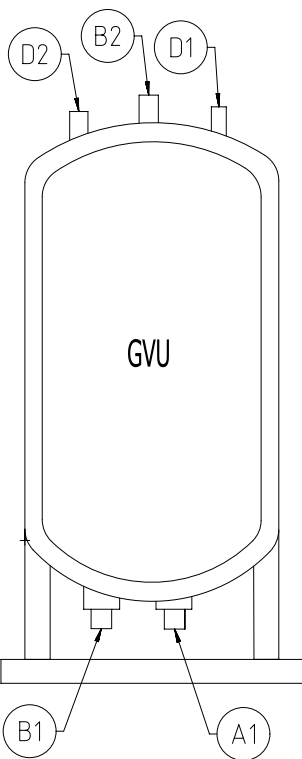
SPECIFICATIONS for GUV connections

D1	<p>OUTLET - Gas / Inert gas release</p> <p><u>Inerting / gas venting procedure:</u> The following areas are vented with air, and in the following order:</p> <ol style="list-style-type: none"> 1) The ventilation air is sucked from a safe area 2) The annular space of the piping between the air suction connection and the GUV inlet (connection A1) is vented 3) The GUV enclosure or room is vented 4) The air is released via the GUV air ventilation outlet (connection D2) <p><u>Pipe connection:</u> Connected to a venting line for Gas / inert gas release outside of the engine room.</p>
D2	<p>OUTLET - Ventilation air annular space</p> <p><u>Ventilation procedure:</u> Ventilation air from a safe area - The annular space of the piping between the air suction connection and GUV inlet (connection A1) - the GUV enclosure / room - air release via GUV air ventilation outlet (connection D2).</p> <p><u>Pipe connection:</u> Connected to a ventilation line with an extraction fan to suck the ventilation air and to release it outside of the engine room. The ventilation fan suction capacity must be sufficient to ensure 30 air exchanges per hour. The ventilation line must be equipped with a gas detector.</p>

A1	<p>INLET - Gas / ventilation air to the GUV</p> <p>INNER GAS PIPE <u>Gas quality:</u> According to the specification in the MIM. <u>Gas pressure:</u> The design pressure is based on the GTD output, which is determined by the selected rating, the minimum LHV, and the system pressure drop. Operational variation via the engine control system is possible. <u>Permissible gas pressure fluctuation:</u> ± 0.6 bar(g) (across all frequencies). <u>Mass flow:</u> According to the GTD. <u>Gas temperature:</u> Aligned with the specification on page 1. <u>Pipe connection:</u> Inner pipe is connected to the gas supply line from gas storage / handling system via flange connection (please refer to the "Pipe Connection Plan").</p> <p>OUTER PIPE (annular space) - ventilation air inlet - Location and execution according to the "2-S Dual-Fuel Safety Concept" as linked in the MIM. - The ventilation air dew point must be lower than the gas temperature. - Sufficient ventilation air (min. requirement of 30 air exchanges per hour) must be sucked by the extraction fan from a safe area into the annular space of the main engine's internal and external piping. <u>Pipe connection:</u> The outer pipe is connected to the annular space of the supply pipe via the flange or the welding connection.</p>
----	--

B1	<p>OUTLET - Gas / ventilation air to the engine</p> <p>INNER GAS PIPE <u>Gas pressure:</u> Adjusted by the GUV gas pressure regulating valve according to engine demand. <u>Pipe connection:</u> Inner pipe is connected to the gas supply line either via a welding or a flange connection.</p> <p>OUTER PIPE (annular space) <u>Pipe connection:</u> Outer pipe is connected to the annular space of the gas supply line either via a welding or a flange connection. The connection pipe to the engine must be kept as short as possible and never longer than 30 m.</p>
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B2	<p>INLET - Inert gas</p> <p><u>Inerting procedure:</u> The following areas are vented with inert gas, and in the following order:</p> <ol style="list-style-type: none"> 1) The GUV inert gas inlet (connection B2) and the GUV inert gas outlet (connection B1) 3) The piping between the GUV outlet (connection B1) and the gas / inert gas release on the engine. <p><u>Inert gas quality:</u> According to the specification in the MIM. <u>Inert gas pressure:</u> Can be selected between 5 - 15 bar(g). Once the set-pressure is selected, deviation of $\pm 10\%$ is allowed. <u>Inert gas consumption:</u> According to guidance in the MIM. <u>Pipe connection:</u> Connected to the inert gas supply system.</p>
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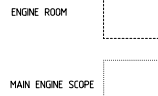
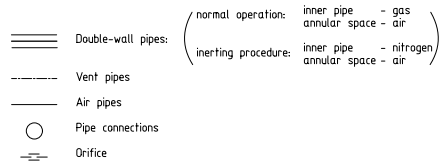
Cyl. Number	GUV Type	GUV INNER PIPE VOLUME	GUV ENCLOSURE VOLUME
5 cylinder	DN80	32.3 l	1200 l
6 cylinder	DN80	32.3 l	1200 l
7 cylinder	DN80	32.3 l	1200 l
8 cylinder	DN80	57.8 l	2270 l

Table 1: GUV-ED VOLUME (values to be used for calculating inerting gas consumption and ventilation air flow.)

Schematic outline view of the the GUV-ED type. For detailed dimensions of the GUV please refer to the GUV supplier layout drawing. Other designs are possible, e.g. GUV-OD type.

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".



Pos.	System Components *#2)
001	Gas handling room / cargo machinery room
002	Extraction fan
003	Master gas fuel supply valve
004	Adjustable orifice
005	Pressure regulating valve
006	Master gas fuel engine valve *#20) *#4)
007	Engine room ventilation fan
008	Purging valve
009	Flow indicator
010	Condensate water trap
011	Gas detector
013	Venting box
014	Shut-off valve, compressed air supply
015	Non-return valve
016	Shut-off valve (double well execution)
018	Intermediate piece
019	GUV (e.g. Wärtsilä enclosed type (GUV-ED) in vertical execution)
020	GUV extraction fan
021	Inert gas supply system *#17)

Pos.	Engine Components *#3)
EC01	Vent / Purging Valve
EC02	Shut-off valve gas rail pipe
EC03	Vent valve
EC04	Gas detector piston underside

Pos.	Engine Connections**)
(78)	INLET - Gas Supply
(79)	OUTLET - Gas / inert gas release, engine side
(80)	OUTLET - Gas / inert gas release, system side
(81)	INLET - Ventilation air annular space
(82)	OUTLET - Gas monitoring, piston underside

Table 2: Volume of ME internal gas piping

Cylinder	Volume of inner pipe (l)*	Volume of annular space (l)**
5 cyl.	85 l	70 l
6 cyl.	100 l	75 l
7 cyl.	110 l	85 l
8 cyl.	125 l	95 l

* Reference data for inert gas and ventilation air calculation. Ship side piping shall be considered in addition.

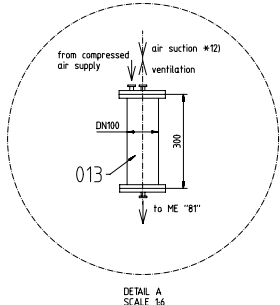
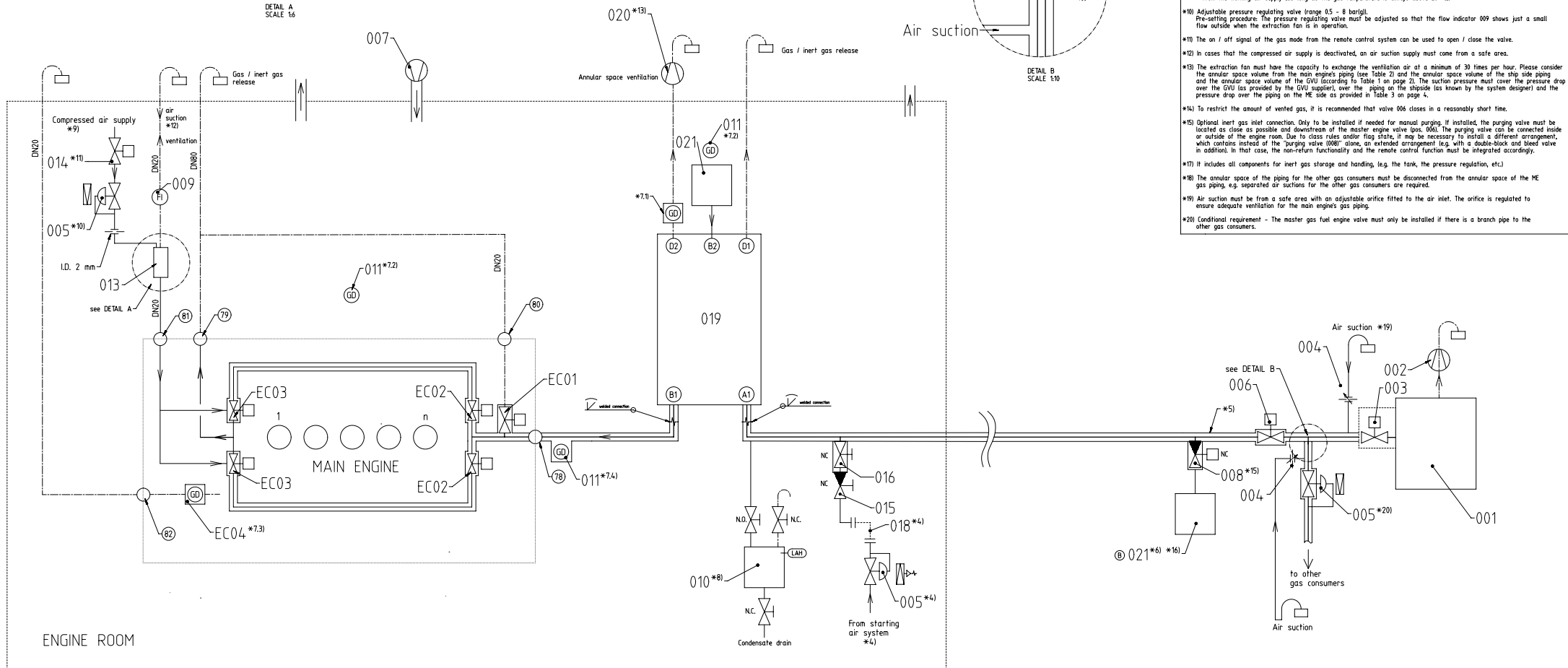
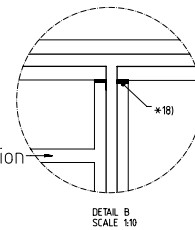


Table 1: Volume of ME internal gas piping

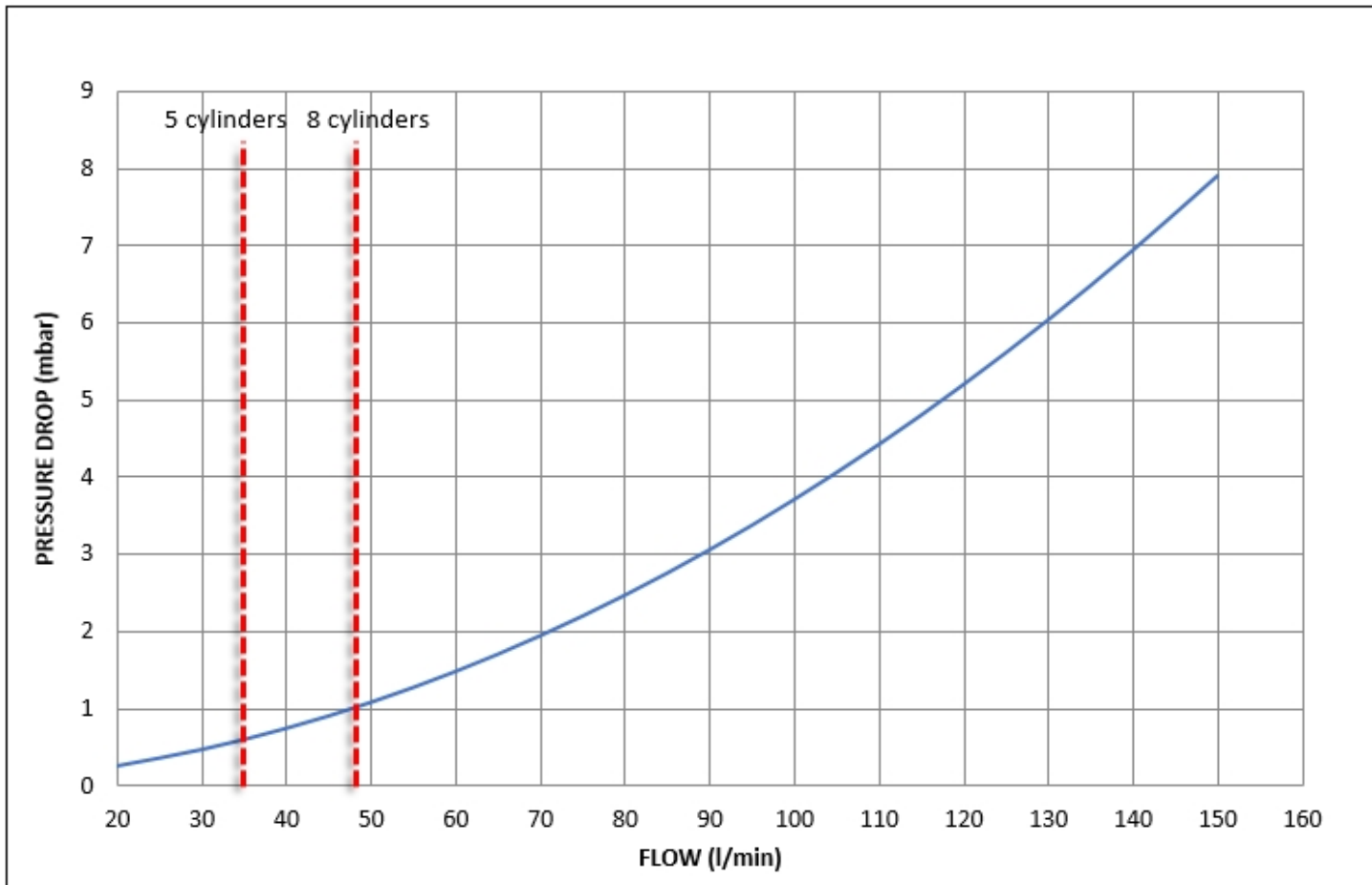
* Reference data for inert gas and ventilation air calculation. Ship side piping shall be considered in addition.



Remarks:

- *#1) For the exact position and pipe connection execution, please refer to the "Pipe Connection Plan".
- *#2) To be installed by the shipyard.
- *#3) To be delivered by the engine builder, i.e. already equipped on the engine side.
- *#4) Compressed air supply is required for leakage testing of the gas fuel system pipelines and components. Air is supplied from the starting air system, then air pressure is reduced by the regulating valve (005) to the design gas pressure. The intermediate piece (018) must be removed during normal ME operation (only to be installed for commissioning / maintenance and the connection blined off).
- *#5) Piping between the gas handling / cargo room and engine is supplied by the shipyard and is connected to the inlet (flange on the engine side layout of the counter-flange is provided in the "Pipe Connection Plan").
Pipe section installed below the main deck in the engine room or cargo machinery room.
Double-wall pipe with inner pipe diameter of DN50 and outer pipe diameter of DN80 is recommended.
Pipe section installed above the main deck or weather deck.
Single-wall pipe with diameter of DN50 is recommended, if the position fulfills the rule requirements of the non-hazardous zone.
- *#6) Inert gas consumption is calculated according to the guidance in the MIM.
- *#7) Gas detection for annular space with feedback to the engine control system: Mandatory.
- *#7.1) Gas detection in the engine room above the ME and the GUV. Required according to class rules.
- *#7.2) Gas detection for piston underside (PUS) with feedback to the engine control system: Mandatory.
- *#7.3) Gas detection for annular space, on system side: Mandatory, to be installed with a distance of max. 2 m to engine inlet.
- *#7.4) Gas detection for annular space, on engine side: Mandatory, to be installed with a distance of max. 2 m to engine inlet.
- *#8) Conditional requirement: If the gas temperature is not always higher than the ambient air temperature, condensate may accumulate in the annular space. In this case, condensate traps must be arranged at the low points of the ship side gas piping. If the condensate water trap (LAH) is triggered, the trap must be manually drained. To do this, the inlet valve (marked N.O. on the drawing) must be closed. Then the venting valve and drain valve (marked N.C. on the drawing) is opened. When the trap has been drained, all valves are to be returned to their normal position. For the tank size, it is recommended to consider the volume under tropical conditions; the larger the tank capacity, the lower the drainage requirement. Recommended draining is two times per day.
- *#9) Conditional requirement: No condensate is allowed in the main engine's gas piping. Therefore, if the gas temperature is not higher than the ambient air temperature, a dedicated dry air supply must be arranged either:
- From the control air supply (must comply with the ISO 8573-1, class x-4-x, i.e. dew point ≤ 3 °C).
- From the air dryer (must comply with the ISO 8573-1, class x-4-x, i.e. dew point ≤ 3 °C).
- From the working air supply (as long as the gas temperature is always above 20 °C).
- *#10) Adjustable pressure regulating valve (range 0.5 - 8 barg).
Pre-setting procedure: The pressure regulating valve must be adjusted so that the flow indicator 009 shows just a small flow outside when the extraction fan is in operation.
- *#11) The on / off signal of the gas made from the remote control system can be used to open / close the valve.
- *#12) In cases that the compressed air supply is deactivated, an air suction supply must come from a safe area.
- *#13) The extraction fan must have the capacity to exchange the ventilation air at a minimum of 30 times per hour. Please consider the annular space volume from the main engine's piping (see Table 2) and the annular space volume of the ship side piping and the annular space volume of the GUV (according to Table 1 on page 2). The suction pressure must cover the pressure drop over the GUV (as provided by the GUV supplier), over the piping on the shipside (as known by the system designer) and the pressure drop over the piping on the ME side as provided in Table 3 on page 4.
- *#14) To restrict the amount of vented gas, it is recommended that valve 006 closes in a reasonably short time.
- *#15) Optional inert gas inlet connection. Only to be installed if needed for manual purging. If installed, the purging valve must be located as close as possible and downstream of the master engine valve (pos. 006). The purging valve can be connected inside or outside of the engine room. Due to class rules and/or flag state, it may be necessary to install a different arrangement, which contains instead of the "purging valve (008)" alone, an extended arrangement (e.g. with a double-block and bleed valve in addition). In that case, the non-return functionality and the remote control function must be integrated accordingly.
- *#17) It includes all components for inert gas storage and handling, (e.g. the tank, the pressure regulation, etc.).
- *#18) The annular space of the piping for the other gas consumers must be disconnected from the annular space of the ME gas piping, e.g. separated air suction for the other gas consumers are required.
- *#19) Air suction must be from a safe area with an adjustable orifice fitted to the air inlet. The orifice is regulated to ensure adequate ventilation for the main engine's gas piping.
- *#20) Conditional requirement - The master gas fuel engine valve must only be installed if there is a branch pipe to the other gas consumers.

Table 3: Pressure drop over the annular space on engine side



SURFACE PROTECTION SEE GROUP 0344	Change	C	npa101	mhu019	26.01.2023	CNAA003130	Drawing Updated			4	3	
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis			Approved	Activity Code	E	C
TOLERANCING PRINCIPLE ISO8015	Copyright Wintertur Gas & Diesel Ltd. All rights reserved. By taking possession of the drawing the recipient recognizes and honours these rights. Neither the whole nor any part of this drawing may be used in any way for construction, fabrication, marketing or any other purpose nor copied in any way nor made accessible to third parties without the previous written consent of Wintertur Gas & Diesel Ltd.					[mm] [kg]	-	A4	Item ID	PAAD340986	Drawing Page/s	4 / 4
GENERAL TOLERANCES ACCORDING TO ISO2768-mK								NX				

SEQ NO	QTY	Item ID	Item Name	Dimension	Standard-ID	Basic Material	Net Weight
002	1	PAAD339556	GAS FUEL SYSTEM	Gas Supply System: NG+VOC			0.001
003	1	PAAD278947	FLUSHING INSTRUCTION PIPING				0.001
004	1	PAAD149646	ENGINE SAFETY CONCEPT	DF ENGINE SAFETY CONCEPT			0.001

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Prod.	5,6,7,8 X52DF						
	5,6,7,8 X52DF-2.1						
Change History							
	A	sde101	nm019	10.11.2021	0110000939	Main Design/Drawing Introduced	4 3
	-	mhu019	dst009	22.10.2019		-	- -
	Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Approved Activity Code E C

	<h2>FUEL GAS SYSTEM</h2> <h3>Gas Pressure Regulation: GVU</h3>
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Bill Of Material		Dimension Gas Pressure Regulation: GVU							
Copyright Winterthur Gas & Diesel Ltd. All rights reserved. By taking possession of the document the recipient recognizes and honours these rights. Neither the whole nor any part of this document may be used in any way for construction, fabrication, marketing or any other purpose nor copied in any way nor made accessible to third parties without the previous written consent of Winterthur Gas & Diesel Ltd.		Units	[m] [kg]	Basic Material			Net Weight	0.001	
		Main Design	Yes	Design Group	9727	Q-Code	XXXXX	Standard	WDS
		Qty per	Engine	A4	Item ID	PAAD341070		BOM Page/s	01/01

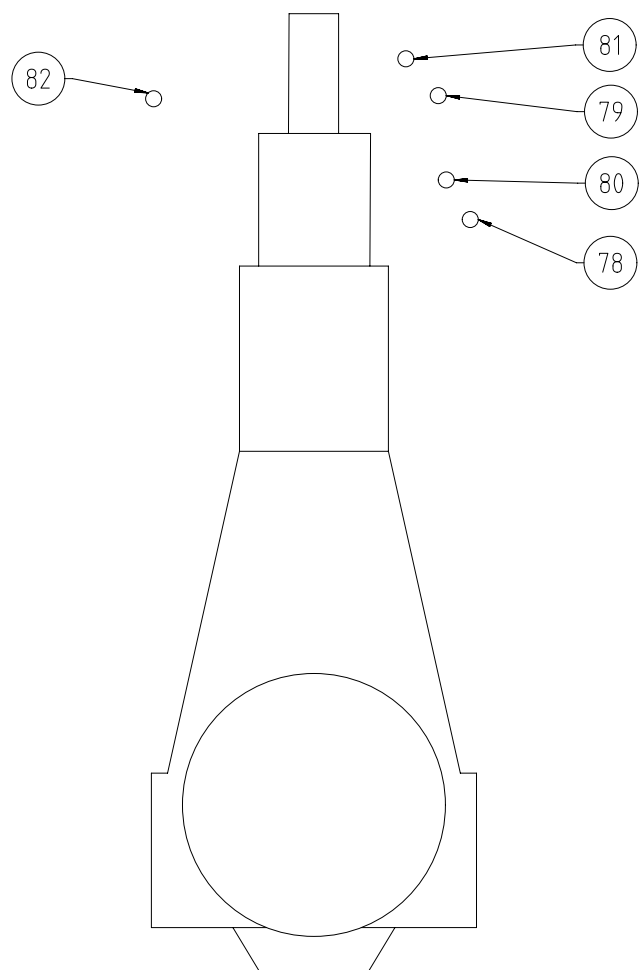
SPECIFICATION which must be met:

- 81 INLET - Ventilation air annular space
 - Location and execution according to "2-S Dual Fuel Engine Safety Concept" as linked in the Marine Installation Manual (MIM).
 - Sufficient ventilation air (min. 30 air exchanges per hour) must be sucked by the extraction fan from a safe area into the annular space of ME internal and external piping.
 - Volume of ventilation air on engine side: refer to table 2 on page 3.
 - Volume of ventilation air on GVV side: refer to table 1 on page 2.
- 82 OUTLET - Gas monitoring, piston underside
 - Must not be connected to other venting pipes.
 - Gas release to safe area outside of engine room.
 - At the end of the vent pipe, safety devices (e.g. flame arrestors) have to be installed according to respective class specification and requirement.

- 78 INLET - Gas supply
 - INNER GAS PIPE
 - Gas quality: According to project specific definition
 - Gas pressure: Controlled by GVV, load depended
 - Mass flow: According to project specific definition
 - Gas temperature: 40 - 60 °C for pure NG and for the mixture of NG and VOC up to max. 25% of VOC.
 - Pipe connection: Inner pipe connected to the gas supply pipe from GVV via flange connection. For execution of the flange refer to the "Pipe Connection Plan"
 - Inert gas supply: An inert gas supply must be connected upstream to the GVV directly after the master gas fuel supply valve to enable purging of the entire system (In the Wärtsilä Fuel Gas Supply System the inert gas supply connection as well as the master gas fuel supply valve are already included).
 - Inert gas quality: According to specification in Marine Installation Manual (MIM).
 - Inert gas pressure: Can be selected between 5 and 15 bar(g). Once set-pressure is selected, deviation of ±10% is allowed, though not below 5 bar.
 - Inert gas volume engine side: Provided in table 1 on page 3.
 - OUTER PIPE (annular space) - annular space ventilation air outlet
 - Ventilation air quantity and quality: same specification as for connection 81, "INLET - Ventilation air annular space".
 - Pipe connection: Outer pipe connected to the annular space of the gas supply pipe / GVV via flange connection. For execution of the flange please refer to the "Pipe Connection Plan"
 - Gas Detection: A gas detector must be installed in the double wall pipe with a distance of max. 2 m to the engine inlet connection.

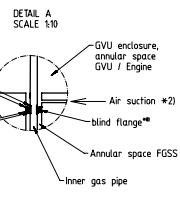
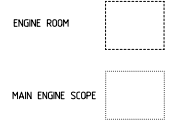
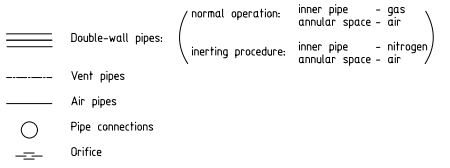
- 79 OUTLET - Gas / Inert gas release, engine side
 - Can be connected to gas / inert gas release, system side (connection 80), but must not be connected to other venting pipes.
 - No additional valves allowed in the venting pipeline.
 - Gas release to safe area outside of engine room.
 - At the end of the vent pipe, safety devices (e.g. flame arrestors) must be installed according to respective class specification and requirement.

- 80 OUTLET - Gas / Inert gas release, system side
 - Can be connected to gas / inert gas release, engine side (connection 79), but must not be connected to other venting pipes.
 - No additional valves allowed in the venting pipeline.
 - Gas release to safe area outside of engine room.
 - At the end of the vent pipe, safety devices (e.g. flame arrestors) must be installed according to respective class specification and requirement.



Prod.	X52DF	X52DF-M-1.0											
	X52DF-2,1												
Change History	C	npa101	mhu019	26.01.2023	CNA003130	Drawing Updated					4	3	
	B	sde101	mhu019	26.04.2021	EAAD095579	Legacy information. See corresponding ChangeNotice					4	3	
	A	sde101	mhu019	27.02.2020	EAAD092228	Legacy information. See corresponding ChangeNotice					4	3	
	-	mhu019	dst009	22.10.2019							-	-	
Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis	Approved	Activity Code	E	C				
WIN GD Winterthur Gas & Diesel		GAS FUEL SYSTEM Gas Pressure Regulator: GVV											
Dimension											Gas Supply System: NG+VOC		
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	9727	Q-Code	XXXXX	Standard	WDS				
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Qty per	A2	Item ID	PAAD339556			Drawing Pages	1/4				

SYSTEM PROPOSAL



Pos.	System Components
001	Fuel gas supply system (FGSS)
002	Extraction fan
003	Non-return valve
004	Adjustable orifice
005	Pressure regulating valve
006	Engine room ventilation fan
007	Gas detector engine room *7.2)
008	Shut-off valve (double well execution)
009	GUV (Wärtsilä enclosed type (GUV-ED))
010	Intermediate piece
011	Gas detector annular space, ship side (GUV) *7.1)
012	Gas detector engine side *7.4)

Pos.	Engine Components
EC01	Vent / Purging Valve
EC02	Shut-off valve gas rail pipe
EC03	Vent valve
EC04	Gas detector piston underside

Table 2: Volume of ME internal gas piping

Cylinder	Volume of inner pipe (l)*	Volume of annular space (l)**
5 cyl.	85 l	70 l
6 cyl.	100 l	75 l
7 cyl.	110 l	85 l
8 cyl.	125 l	95 l

* Reference data for inert gas and ventilation air calculation.
Ship side piping shall be considered in addition.

Pos.	Engine Connections**
78	INLET - Gas Supply
79	OUTLET - Gas / Inert gas release, engine side
81	INLET - Ventilation air annular space
80	OUTLET - Gas / Inert gas release, system side
82	OUTLET - Gas monitoring, piston underside

- Remarks:
- *1) For the exact position and pipe connection execution please refer to the "Pipe Connection Plan".
 - *2) Air suction must be from a safe area.
 - *3) Inert gas quality: According to the specification in the Marine Installation Manual (MIM) inert gas consumption (calculated according to the guidance in MIM under consideration of the GUV volume as provided in table 1 on page 2, the ME inner pipe volume as provided in table 2 of this page and the volume in the system piping). Inert gas pressure: Can be selected between 5 and 15 barg. Once self-pressure is selected, deviation of ± 10% is allowed, though not below 5 bar.
 - *4) Compressed air supply is required for leakage testing of gas fuel system pipelines and components. Air is supplied from the starting air system, then air pressure is reduced by the regulating valve (005) to the design gas pressure. The intermediate piece (010) must be removed during normal ME operation (only to be installed for commissioning / maintenance) and the connection blinded off.
 - *5) In order to keep the temperature of the fuel gas mixture (NG-WO2) in the specified range of 40 - 60 °C insulation must be applied on the piping from the GUV to ME inlet and on ME side.
 - *6) Inert gas consumption is calculated according to the guidance in the MIM.
 - *7.1) Gas detection for annular space, with feedback to engine control system. Mandatory.
 - *7.2) Gas detection in engine room, above ME and GUV. Required according to class rules.
 - *7.3) Gas detection for piston underside (PUS), with feedback to engine control system. Mandatory.
 - *7.4) Gas detection for annular space, on system side. Mandatory, to be installed with a distance of max. 2 m to engine inlet.
 - *8) A blind flange has to be installed in the double wall pipe just before the inlet to the GUV enclosure to separate the annular space of the FGSS from the annular space of the GUV / main engine (refer to view "Detail A").
 - *9) The master gas fuel supply valve, inert gas inlet and venting outlet is integrated in the Wärtsilä Fuel Gas Supply System. If these components / connections are not included they must be considered on system side.
 - *10) Piping between the GUV and engine: Supplied by the shipyard and is connected to the inlet flange on the engine side (layout of the counter-flange is provided in the "Pipe Connection Plan"). Pipe section installed below the main deck in engine room or cargo machinery room. Double-wall pipe with inner pipe diameter of DN50 and outer pipe diameter of DN80 is recommended.
 - *11) The extraction fan must have the capacity to exchange the ventilation air at minimum of 30 times per hour. Please consider the annular space volume of ME piping (according to table 2 on this page), the annular space volume of the ship side piping and the annular space volume of the GUV (according to table 1 on page 2). The suction pressure must cover the pressure drop over the GUV (as provided by the GUV supplier), over the piping on the shipside (as known by the system designer) and the pressure drop over the piping on the ME side as provided in table 3 on page 4.
 - *12) Mandatory, to suck sufficient suction air from a safe area to the GUV enclosure. The air suction pipe to be equipped with an adjustable orifice to ensure adequate ventilation.

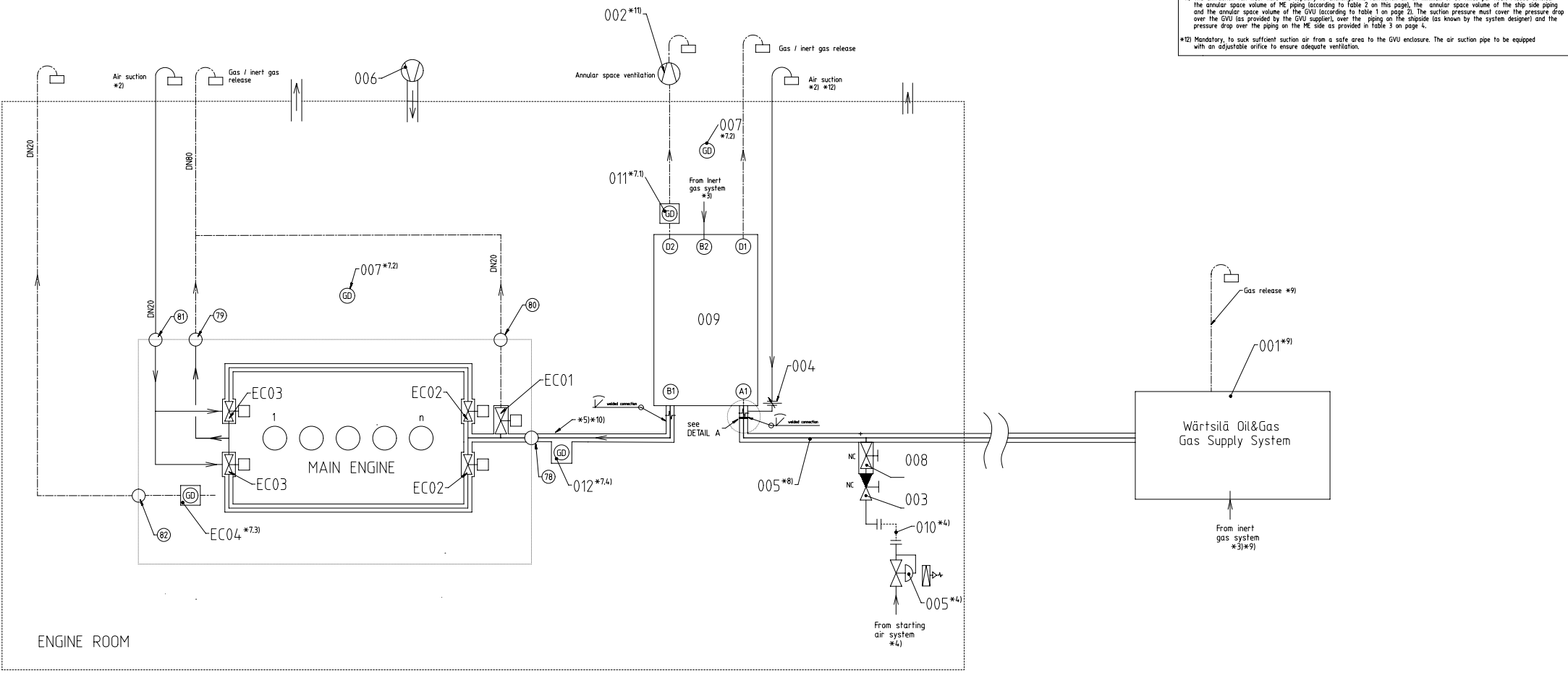
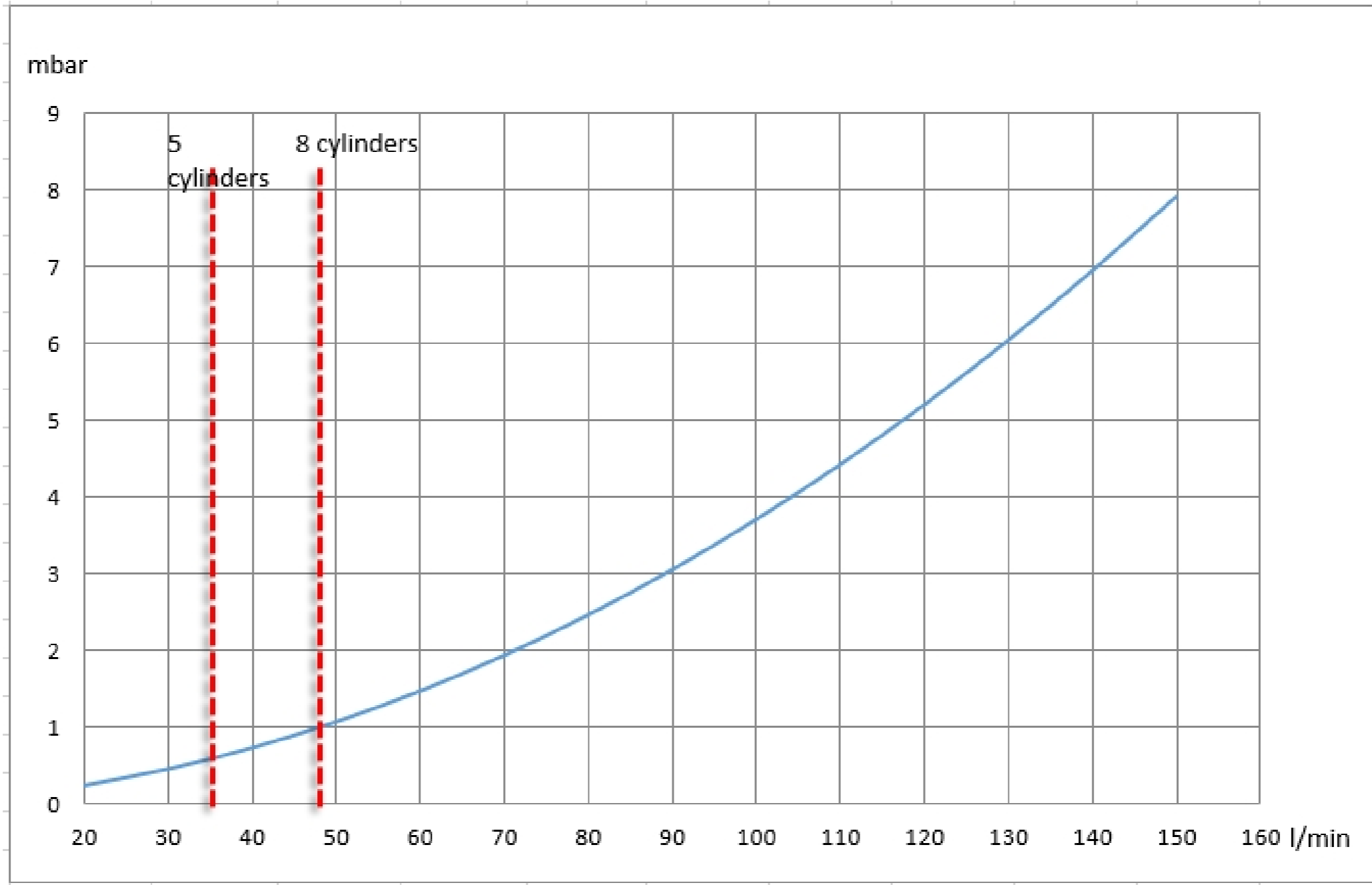


Table 3: Pressure drop over the annular space on engine side



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

Change	C	npa101	mhu019	26.01.2023	CNAA003130	Drawing Updated			4	3	
Rev.	Creator	Approver	Approval Date	Change ID	Change Synopsis			Approved	Activity Code	E	C
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						NX					

MIDS - WinGD X52DF/DF-1.1_FUEL- GAS- SYSTEM (DG9727)

TRACK CHANGES

DATE	SUBJECT	DESCRIPTION
2017-08-18	DRAWING SET	First web upload
2017-12-22	DAAD087980 DAAD091645	Main drg – new revision System drg – new revision
2018-04-19	DAAD091645	System drg – new revision
2018-10-01	DAAD087980 DAAD097363 DAAD091645	Main drg – Execution for operation on NG + VOC introduced by adding of a new system drawing. System drg – new revision
2019-01-31	DAAD091645 DAAD097363	System drgs – new revision
2019-06-24	DAAD091645 DAAD097363	System drgs – new revision
2019-11-04	DAAD122361 DAAD121541 DAAD122296	Main and system drgs (GVU execution) - added
2020-02-28	DAAD091645 DAAD097363 DAAD121541	System drgs. – new revision
2020-08-19	DAAD087980 DAAD091645 DAAD097363	Main and system drg – new revision
2020-09-08	DAAD087980 DAAD091645 DAAD097363	Main and system drgs – new revision
2021-04-27	DAAD091645 DAAD097363 DAAD121541 DAAD122296	System drgs. – new revision
2021-11-29	MIDs MASTER PAAD255495 PAAD308988 PAAD270710 PAAD340986 PAAD341070	System drgs. – new revision
2023-02-02	PAAD340986-C PAAD339556-C	System drgs. – new revision

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