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Fuel type	Execution
Natural Gas (NG)	PAAD379556
Natural Gas (NG) + Volatile organic compounds (VOCs)	PAAD379557

Net Weight									
0,001	0,001								
1	1	004	PAAD149646	ENGINE SAFETY CONCEPT DF ENGINE SAFETY CONCEPT	DAAD046594				0,001
1	1	003	PAAD278947	FLUSHING INSTRUCTION PIPING	DAAD094163				0,001
-	1	002	PAAD379502	GAS FUEL SYSTEM NG	DAAD142474				0,001
1	-	001	PAAD379514	GAS FUEL SYSTEM NG/VOC	DAAD142481				0,001

SEE TABLE

Quantity PER ENGINE	SEQ NO	Material ID	Material Name	Dimension, Occ	Standard or Drawing	Basic Material Material Standard	Weight GR./NET						
PAAD379557	PAAD379556	Free space for lic.				Q-Code XXXXXX Standard ISO; JIS	Main Drw. H						
Modif.	Number	Drawn date	Number	Drawn date	Number	Drawn date	Number	Drawn date					
Units		mm kg	NX		Basic Material			Net Weight					
SURFACE PROTECTION SEE GROUP 0344		Made	09.04.2021 dki021 DH.Kim		Scale	-	Size	A3	Page	1/1	Material ID		
TOLERANCING PRINCIPLE ISO8015		Chkd	26.04.2021 jpi101 Pickup		Design Group		9727		Drawing ID		DAAD142490	Rev.	-
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Appd	26.04.2021 mhu019 Hug										



Product
W5-8X52DF-S1.0

GAS FUEL SYSTEM
with iGPR
Gas Brennstoffsystem

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DID - DIMENSIONAL DRAWING - Confidential

SPECIFICATIONS 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 specification in the Marine Installation Manual (MIM).
Gas pressure: Design pressure based on GTD requirement for the selected rating and selected minimum LHV plus system pressure drop. Operational variation via engine control system possible.
Permissible gas pressure fluctuation: ± 0.6 bar (across all frequencies).
Mass flow: According to GTD.
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 upstream to the iGPR right after the master gas fuel supply valve to enable purging of the whole system+engine piping
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) - 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").

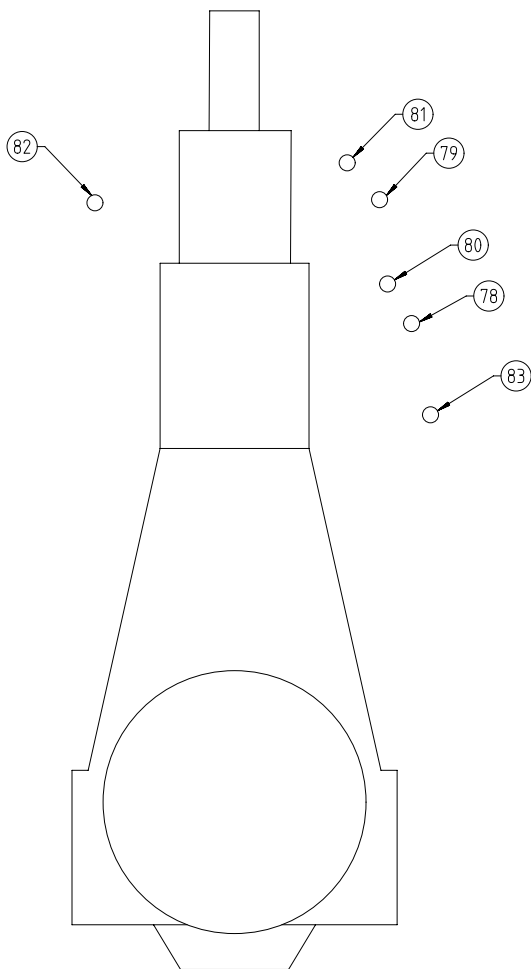
Gas detection: A gas detector must be installed in the venting line, at a max. distance of 2 m from the engine inlet, and must be placed right next to the outer pipe (annular space) connection on the side closest to / furthest from the engine inlet.
 Interruption of gas supply: The main gas supply line to each consumer or set of consumers 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
 - Location and execution according to "2-S Dual Fuel Safety Concept" as linked in MIM.
 - Ventilation air dew point must be lower than the gas temperature. If the ambient air is not sufficiently dry, dry air must be supplied. Please refer to the remarks / 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 ME internal and external piping.
 - Volume for ventilation air on engine side: refer to table 1 on page 2.

X52DF-S1.0



Free space for ILC	Q-Code XXXXX				Main Drw.			
	Standard ISO; JIS							
Modif.	Number	Drawn date	Number	Drawn date	Number	Drawn date	Number	Drawn date
		Product 5-8X52DF-S1.0		GAS FUEL SYSTEM Gas Supply System: NG Gas Brennstoffsystem Gas Pressure Regulation: iGPR		Units mm kg NX		
SURFACE PROTECTION SEE GROUP 034.4		Made 09.04.2021 dki021 DH.Kim		Scale -		Size A2 Page 1/3		Material ID PAAD379502
TOLERANCING PRINCIPLE ISO8015		Chkd 26.04.2021 jpr101 Pickup		Design Group		Drawing ID DAAD142474		Rev. -
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Appd 26.04.2021 mhu019 Hug		9727		Net Weight 0,001		

SYSTEM PROPOSAL

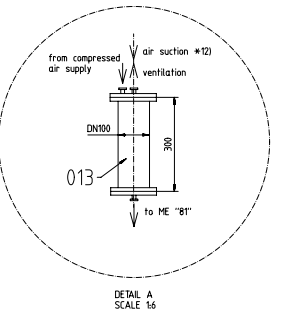
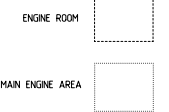
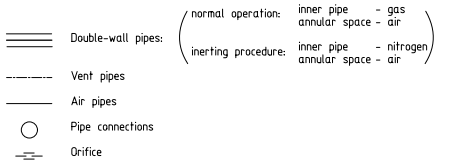


Table 1: Volume of ME internal gas piping

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

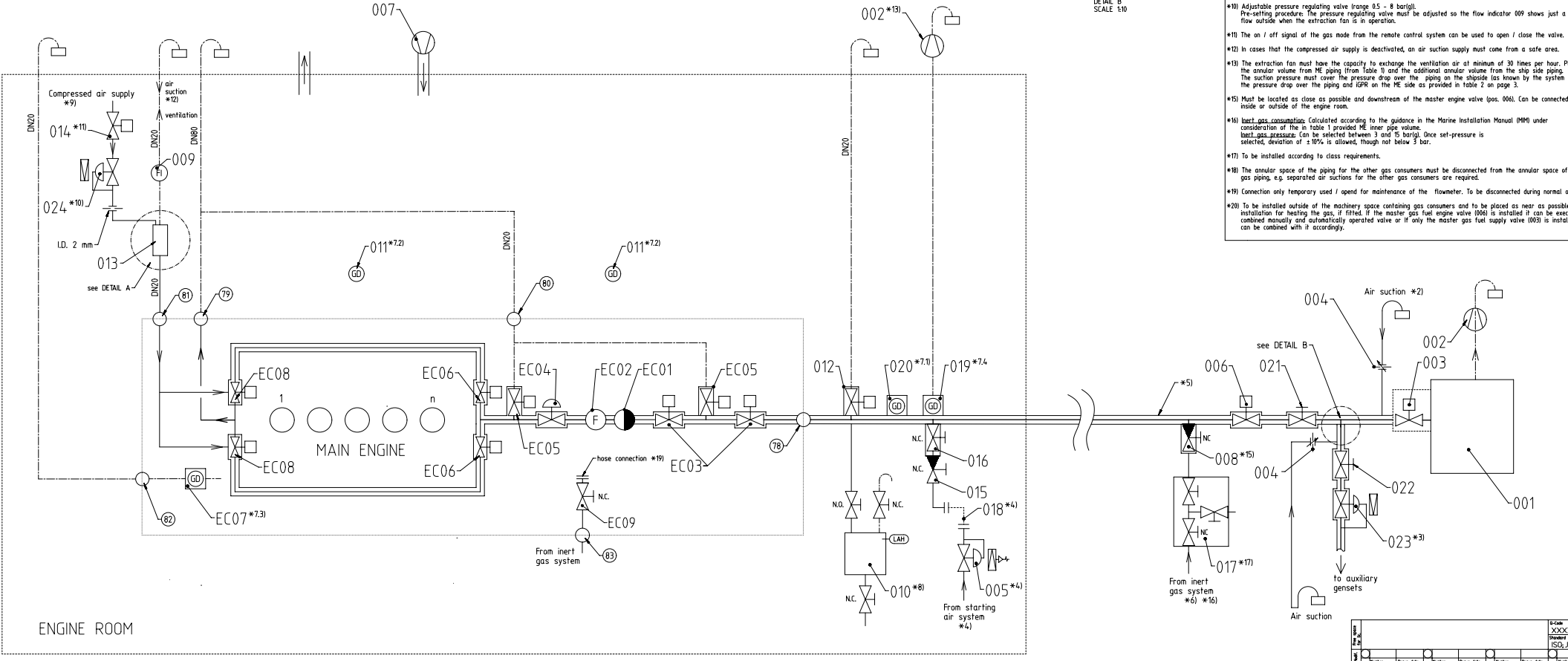
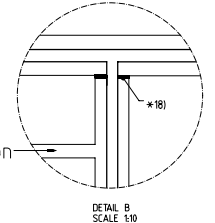
* Reference data for inert gas and ventilation air calculation. Ship side piping shall be considered in addition.

Pos.	System Components
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 *3)
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)
017	Double-block and bleed valve
018	intermediate piece
019	Gas detector ship side *7.4)
020	Gas detector engine side *7.1)
021	Manual stop valve engine gas supply *20)
022	Manual stop valve ancillary gas supply
023	Pressure regulating valve ancillary gas supply
024	Pressure regulating valve annular space air supply

Pos.	Engine Components
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

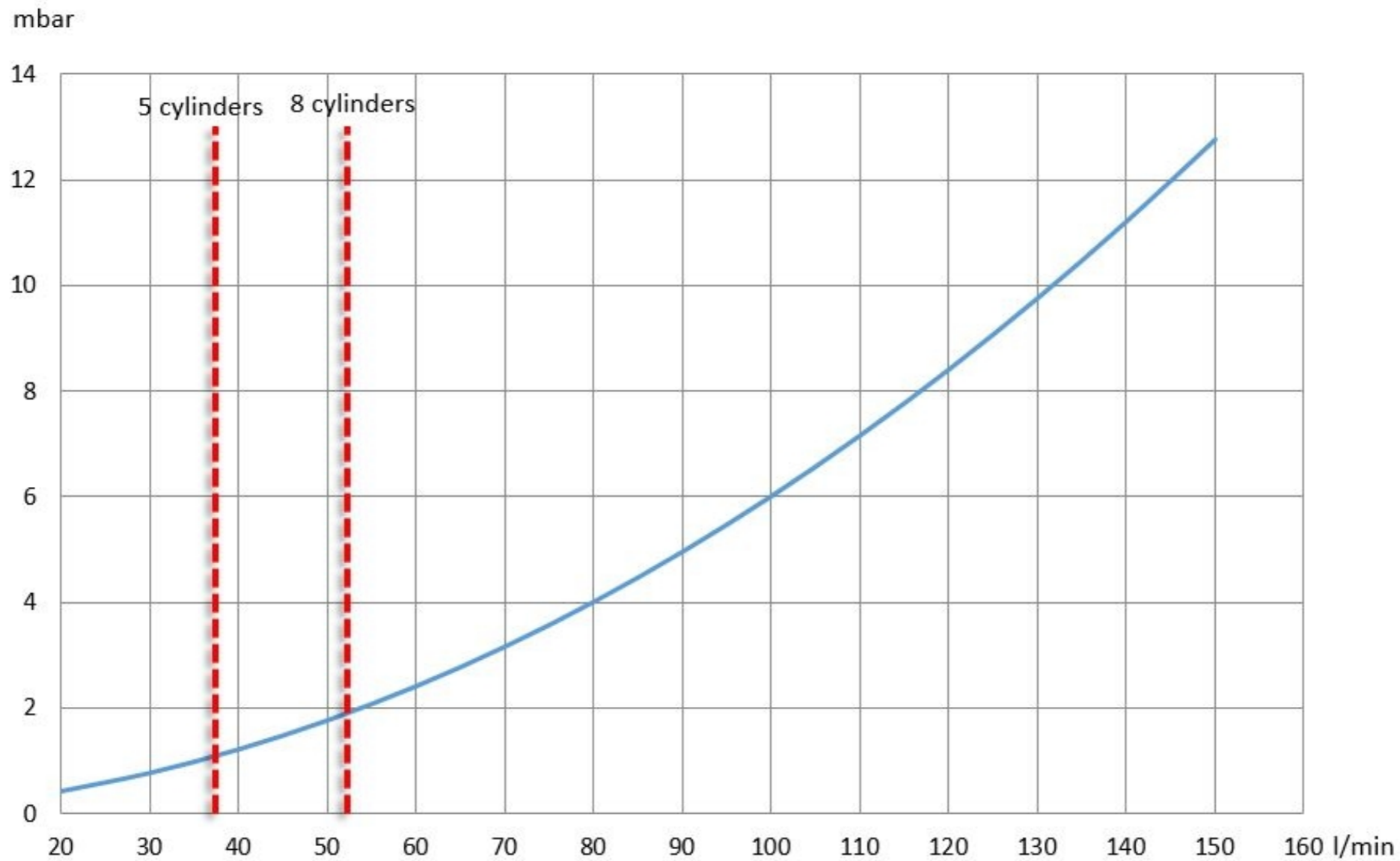
Pos.	Engine Connections*9)
78)	INLET - Gas Supply
79)	OUTLET - Gas / Inert gas release, engine driving end
80)	OUTLET - Gas / Inert gas release, engine free end
81)	INLET - Ventilation air annular space
82)	OUTLET - Gas monitoring, piston underside
83)	INLET - Inert gas filling Flowmeter *19)

- Remarks:
- *1) The exact position and pipe connection execution please refer to the "Pipe Connection Plan".
 - *2) 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 ME gas piping.
 - *3) Conditional requirement - Only to be installed if there is a branch pipe to the other gas consumers.
 - *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 (018) 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 (inward of the cooler-flange is provided in the "Pipe Connection Plan").
Double-wall pipe with inner pipe diameter of DN50 and outer pipe diameter of DN80 is recommended.
Pipe section installed above the main deck / weather deck.
Single-wall pipe with diameter of DN50 is recommended, if the position fulfills the rule requirements of non-hazard zone.
 - *6) Inert gas quality: According to the specification in MIM.
 - *7.1) Gas detector for annular space, with feedback to engine control system, mandatory.
Must be installed with a distance of max. 2m to engine inlet.
 - *7.2) Gas detector in engine room above ME and IGR: Required according to WinGD "2-S Dual-Fuel Engine Safety Concept".
 - *7.3) Gas detector for piston underside (PUS), with feedback to engine control system, mandatory.
 - *7.4) Gas detector for annular space, on ship side Optional - to distinguish between system and engine side leaks.
If the optional gas detector is not installed, the ventilation line with extraction fan has to be connected to gas detector 020.
 - *8) Conditional requirement - If the gas temperature is not always higher than the ambient air temperature, condensate may accumulate in 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.
 - *9) Conditional requirement - No condensate is allowed in the ME 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 control air supply (thatful the ISO 8573-1, class x-4-x, i.e. dew point ≤ 3 °C),
- from air dryer (thatful the ISO 8573-1, class x-4-x, i.e. dew point ≤ 3 °C),
- from working air supply (at long air gas temperature is always above 20 °C).
 - *10) Adjustable pressure regulating valve range 0.5 - 8 barg(1).
Pre-setting procedure: The pressure regulating valve must be adjusted so 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 mode 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 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 IGR on the ME side as provided in Table 2 on page 3.
 - *15) Must be located as close as possible and downstream of the master engine valve (pos. 006). Can be connected inside or outside of the engine room.
 - *16) **Inert 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.
Inert gas pressure: Can be selected between 3 and 15 barg(1). Once set-pressure is selected, deviation of ± 10% is allowed, though not below 3 bar.
 - *17) To be installed according to class requirements.
 - *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 temporary used / opened for maintenance of the flowmeter. To be disconnected during normal operation.
 - *20) To be installed outside of the machinery space containing gas consumers and to be placed as near as possible to the installation for heating the gas, if fitted. If the master gas fuel engine valve (006) is installed it can be executed as combined manually and automatically operated valve or if only the master gas fuel supply valve (003) is installed it can be combined with it accordingly.



		5-BXS20F-S10 GAS FUEL SYSTEM Gas Supply System: NG Gas Brennstoffsystem Gas Pressure Regulation: IGR	
Date: 02.04.2021 Design: PAAD3795.02 Scale: 1/10	No. 11 Rev. 1 No. 11 Rev. 1	Date: 02.04.2021 Design: PAAD3795.02 Scale: 1/10	No. 11 Rev. 1 No. 11 Rev. 1

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.	○	○	○	○	○
	Number	Drawn date	Number	Drawn date	Number
		Product 5-8X52DF-S1.0		GAS FUEL SYSTEM Gas Supply System: NG Gas Brennstoffsystem Gas Pressure Regulation: iGPR	
Units	mm kg	NX	Basic Material		Net Weight 0,001
SURFACE PROTECTION SEE GROUP 0344		Made	09.04.2021 dki021 DH.Kim	Scale	-
TOLERANCING PRINCIPLE ISO8015		Chkd	26.04.2021 jpi101 Pickup	Design Group	9727
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Appd	26.04.2021 mhu019 Hug	Size	A3
				Page	3/3
				Material ID	PAAD379502
				Drawing ID	DAAD142474
				Rev.	-

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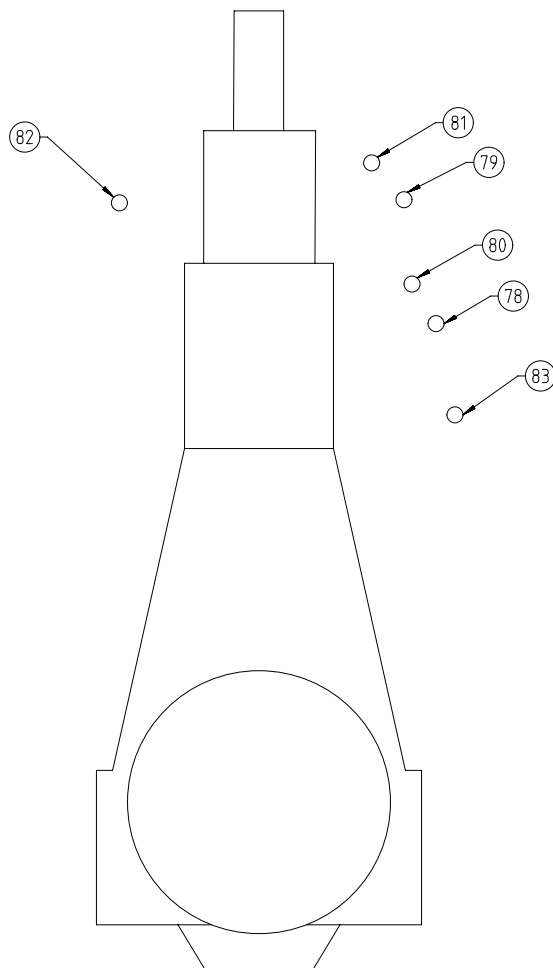
SPECIFICATIONS which must be met:

(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 a 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 must 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 consumers 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.

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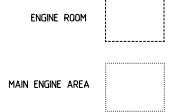
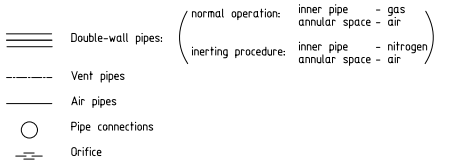
(79) OUTLET - Gas / Inert gas release, engine driving end
 - Can be connected to gas / inert gas release, engine free end (connection 80), but must not be connected to other venting pipes.
 - No additional valves allowed in the venting pipeline.
 - Gas release to safe area outside of engine room.
 - 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.	Free space for ill.						Q-Code	XXXXX	Main
							Standard	ISO; JIS	Drw.
Number	Drawn date	Number	Drawn date	Number	Drawn date	Number	Drawn date		
		Product		5-8X52DF-S1.0		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 034.4		Made	09.04.2021 dki021 DH.Kim		Scale	-	Size	A2	
TOLERANCING PRINCIPLE ISO8015		Chkd	26.04.2021 jpr101 Pickup		Design Group		Page	1/3	
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Appd	26.04.2021 mhu019 Hug		9727		Material ID	PAAD379514	
							Drawing ID	DAAD142481	
							Rev.	-	

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 (006) 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 (009) 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 4.0 - 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 / open for maintenance of the flowmeter. To be disconnected during normal operation.
 - *11) Inert 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. **INLET gas pressure:** Can be selected between 3 and 15 barg! Once set-pressure is selected, deviation of ±10% is allowed, though not below 3 barg.

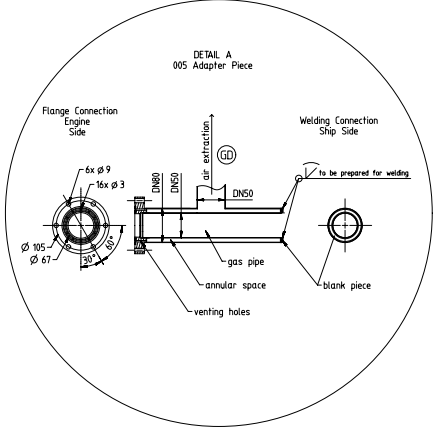
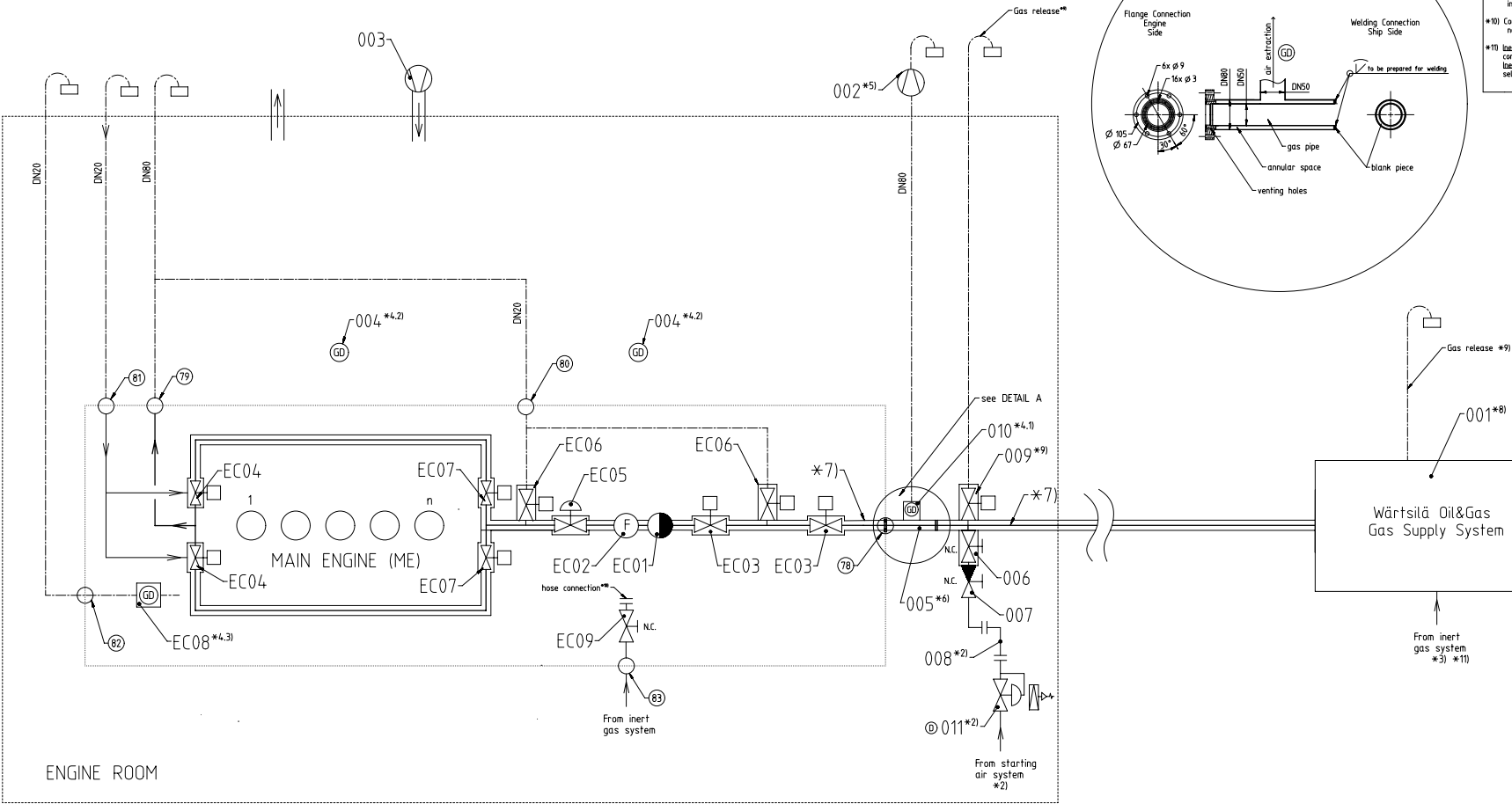


Table 1: Volume of ME internal gas piping

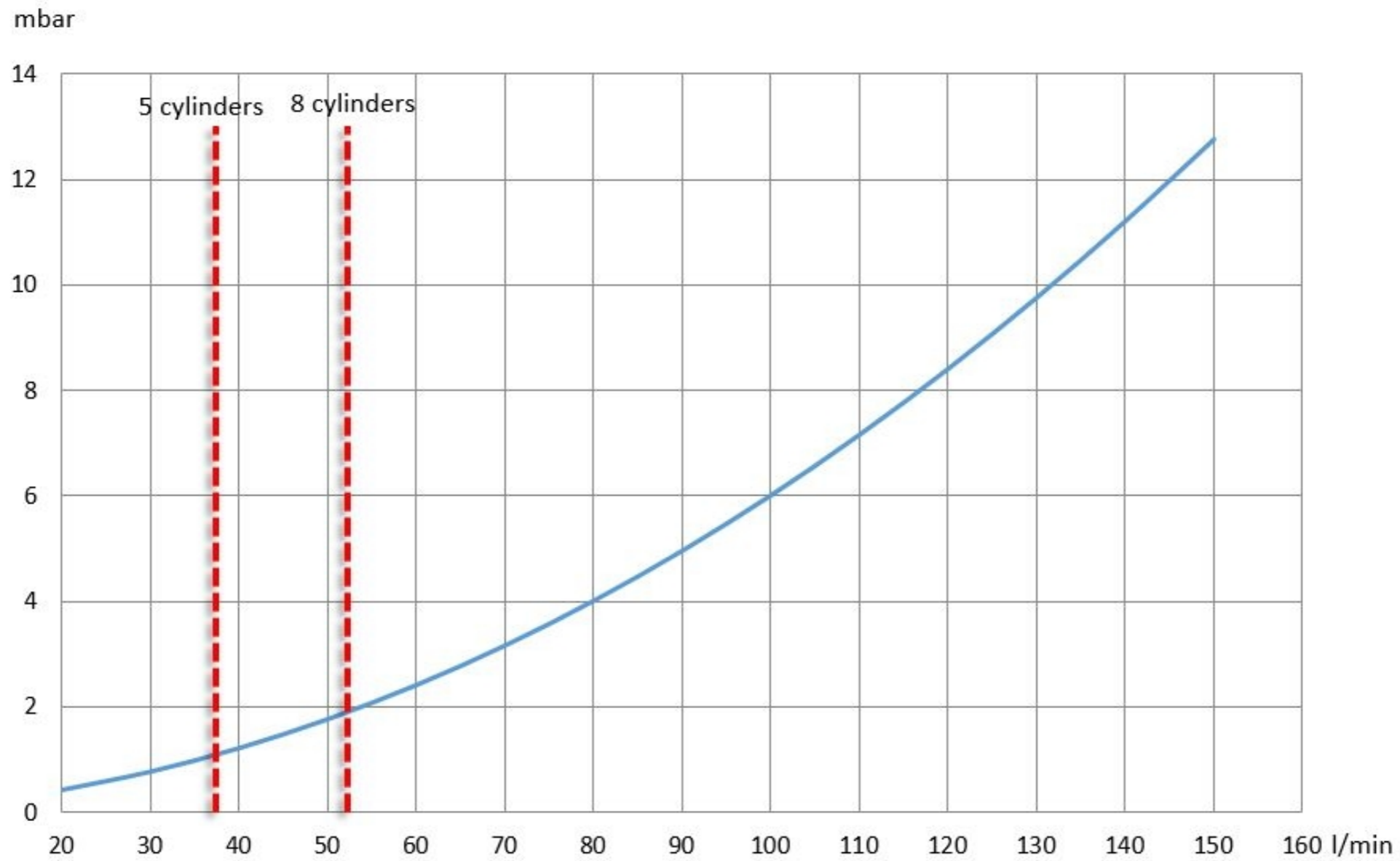
Cylinder	Volume of inner pipe (l)*	Volume of annular space (l)*
5 cyl.	110 l	75 l
6 cyl.	125 l	85 l
7 cyl.	140 l	95 l
8 cyl.	150 l	105 l

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



Project No.	02.04.2021	Rev.	01
Design Group	3727	Scale	1:1
Sheet No.	PAAD379514	Sheet Title	GAS FUEL SYSTEM
Client	Wärtsilä Oil&Gas	Project Name	5-BXS20F-S10
Standard	ISO, JIS	Material	Steel, Stainless
System	GAS FUEL SYSTEM	Supply System	NG-VOC
	Gas Brennstoffsystem	Gas Pressure Regulation	IGPR

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.	○		○		○		○	
	Number	Drawn date	Number	Drawn date	Number	Drawn date	Number	Drawn date
		Product 5-8X52DF-S1.0		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 09.04.2021 dki021 DH.Kim		Scale -		Size A3 Page 3/3		Material ID PAAD379514
TOLERANCING PRINCIPLE ISO8015		Chkd 26.04.2021 jpi101 Pickup		Design Group 9727		Drawing ID DAAD142481		Rev. -
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Appd 26.04.2021 mhu019 Hug						

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Fuel type	Execution
Natural Gas (NG)	PAAD381085
Natural Gas (NG) + Volatile organic compounds (VOCs)	PAAD381086

Net Weight									
0,001	0,001								
1	1	004	PAAD149646	ENGINE SAFETY CONCEPT DF ENGINE SAFETY CONCEPT	DAAD046594				0,001
1	1	003	PAAD278947	FLUSHING INSTRUCTION PIPING	DAAD094163				0,001
1	-	002	PAAD379576	GAS FUEL SYSTEM Gas Supply System: NG+VOC	DAAD142497				0,001
-	1	001	PAAD379598	GAS FUEL SYSTEM Gas Supply System: NG	DAAD142503				0,001

SEE TABLE

Quantity PER ENGINE	SEQ NO	Material ID	Material Name	Dimension, Occ	Standard or Drawing	Basic Material Material Standard	Weight GR./NET				
PAAD381086	PAAD381085	Free space for lic.				Q-Code XXXXXX Standard ISO; JIS	Main Drw. H				
Modif.	Number	Drawn date	Number	Drawn date	Number	Drawn date	Number	Drawn date			
Units		mm kg	NX		Basic Material	Net Weight					
SURFACE PROTECTION SEE GROUP 0344		Made	27.04.2021 dki021 DH.Kim	Scale	-	Size	A3	Page	1/1	Material ID	
TOLERANCING PRINCIPLE ISO8015		Chkd	27.04.2021 jpi101 Pickup	Design Group	9727	Drawing ID	DAAD143295		Rev.	-	
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Appd	27.04.2021 mhu019 Hug								

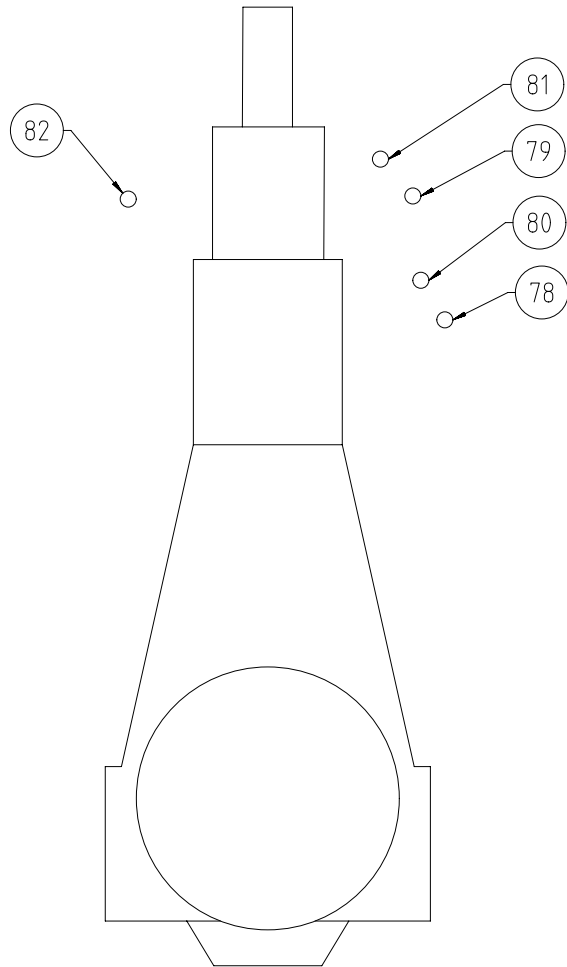


Product
W5-8X52DF-S1.0

GAS FUEL SYSTEM
Gas Pressure Regulation: GVU
Gas Brennstoffsystem

Approved
DID - DIMENSIONAL DRAWING - Confidential

X52DF-S1.0



SPECIFICATIONS which must be met:

78	<p>INLET - Gas supply</p> <p>INNER GAS PIPE</p> <p><u>Gas quality:</u> According to specification in the Marine Installation Manual (MIM).</p> <p><u>Gas pressure:</u> Controlled by GVU, load depended.</p> <p><u>Mass flow:</u> According to GTD.</p> <p><u>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 (for counter-flange execution 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 from GVU via flange connection (for counter-flange execution refer to the "Pipe Connection Plan").</p> <p>Gas detection: A gas detector must be installed in the double wall pipe a distance of max. 2 m to the engine inlet connection.</p>
79	<p>OUTLET - Gas / Inert gas release, engine side</p> <ul style="list-style-type: none"> - 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	<p>OUTLET - Gas / Inert gas release, system side</p> <ul style="list-style-type: none"> - 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.
81	<p>INLET - Ventilation air annular space</p> <ul style="list-style-type: none"> - Location and execution according to "2-S Dual Fuel Engine Safety Concept" as linked in the Marine Installation Manual (MIM). - Ventilation air dew point must be lower than the gas temperature. If the ambient air is not sufficiently dry, dry air must be supplied. Refer to the remarks / proposals on page 3. - Sufficient ventilation air (min. 30 air exchanges per hour) must be sucked by an 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 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 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.

Free space for ILC	Q-Code XXXXXX						Main Drw.				
	Standard ISO; JIS										
Modif.	Number	Drawn date	Number	Drawn date	Number	Drawn date	Number	Drawn date			
		Product 5-8X52DF-S1.0		GAS FUEL SYSTEM Gas Pressure Regulation: GVU Gas Brennstoffsystem Gas Supply System: NG							
Units	mm kg	NX	Basic Material	Net Weight 0,001							
SURFACE PROTECTION SEE GROUP 034.4	Made	09.04.2021	dk1021 DH.Kim	Scale	-	Size	A2	Page	1/4	Material ID	PAAD379598
TOLERANCING PRINCIPLE ISO8015	Chkd	26.04.2021	jpr101 Pickup	Design Group		Drawing ID	DAAD142503	Rev.	-		
GENERAL TOLERANCES ACCORDING TO ISO2768-mK	Appd	26.04.2021	mhu019 Hug	9727							

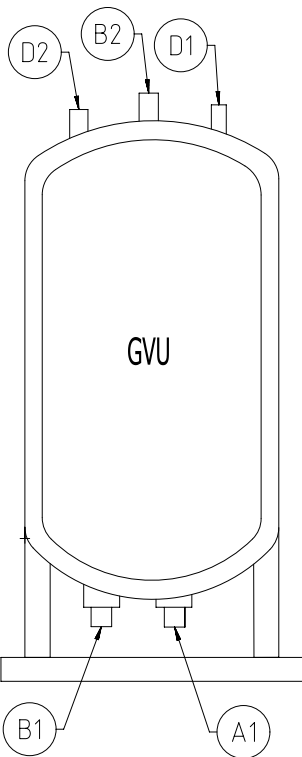
SPECIFICATION requirements for GUV connections

D1	<p>OUTLET - Gas / Inert gas release</p> <p><u>Inerting / gas venting procedure / flow path:</u> Inert gas inlet in the tank room connection > the piping between the tank room connection and GUV inlet (connection A1) > the GUV internal piping between inlet (connection A1) and venting outlet (connection D1) > gas / inert gas release to outside of engine room. <u>Pipe connection:</u> Connected to a venting line for gas / inert gas release outside of engine room.</p>
D2	<p>OUTLET - Ventilation air annular space</p> <p><u>Ventilation procedure / flow path:</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). <u>Pipe connection:</u> Connected to a ventilation line with extraction fan to suck the ventilation air and release to outside of engine room. The ventilation fan suction capacity has to be sufficient for 30 air exchanges per hour. The ventilation line must be equipped with a gas detector.</p>

A1	<p>INLET - Gas / Ventilation air to GUV</p> <p>INNER GAS PIPE <u>Gas quality:</u> According to specification in the Marine Installation Manual (MIM). <u>Gas pressure:</u> Design pressure based on GTD requirement for the selected rating and selected minimum LHV plus system pressure drop. Operational variation via engine control system is possible. <u>Permissible gas pressure fluctuation:</u> ± 0.6 bar (across all frequencies). <u>Mass flow:</u> According to 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 welding connection.</p> <p>OUTER PIPE (annular space) - ventilation air inlet - Location and execution according to "2-S Dual Fuel Safety Concept" as linked in the MIM. - 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 ME internal and external piping. <u>Pipe connection:</u> Outer pipe connected to the annular space of the supply pipe via welding connection.</p>
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B1	<p>OUTLET - Gas / Ventilation air to 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 connected to the gas supply line either via welding or flange connection.</p> <p>OUTER PIPE (annular space) <u>Pipe connection:</u> Outer pipe connected to the annular space of the supply line either via welding 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 / flow path:</u> GUV inert gas inlet (connection B2) > GUV piping > Piping between GUV outlet (connection B1) and gas / inert gas release on engine (outlet connection 79 and 80). <u>Inert gas quality:</u> According to specification in the Marine Installation Manual (MIM). <u>Inert gas pressure:</u> Can be selected between 5 - 15 bar(g). Once the set-pressure is selected, deviation of ±10% is allowed. <u>Inert gas consumption:</u> According to guidance in MIM. <u>Pipe connection:</u> Connected to the inert gas supply system.</p>
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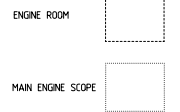
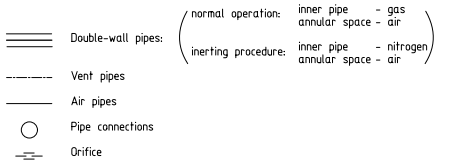
Cyl. Number	GUV Type	GUV INNER PIPE VOLUME	GUV ENCLOSURE VOLUME
5 cylinder	DN80	32.3 l	1200 l
6 cylinder	DN80	32.3 l	1200 l
7 cylinder	DN80	32.3 l	1200 l
8 cylinder	DN100	57.8 l	2270 l

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.

Modif.	Free space for ill.						Q-Code XXXXX	Main Drw.
	Number	Drawn date	Number	Drawn date	Number	Drawn date	Standard ISO; JIS	
		Product 5-8X52DF-S1.0		GAS FUEL SYSTEM Gas Pressure Regulation: GUV Gas Brennstoffsystem Gas Supply System: NG				
Units	mm kg	NX	Basic Material	Net Weight 0,001				
MADE	09.04.2021	dk1021	DH.Kim	Scale	-	Size	A2	
CHKD	26.04.2021	jpr101	Pickup	Design Group		Page	2/4	
APPD	26.04.2021	mhu019	Hug	9727	Drawing ID	DAAD142503	Material ID PAAD379598	
SURFACE PROTECTION SEE GROUP 034.4				GENERAL TOLERANCES ACCORDING TO ISO2768-mK				Rev. -

SYSTEM PROPOSAL



Pos.	System Components
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 (*3) (*14)
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)
017	Double-block and bleed valve
018	Intermediate piece
019	GVU (e.g. Wärtsilä enclosed type (GVU-ED) in vertical execution)
020	GVU extraction fan

Pos.	Engine Components
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.

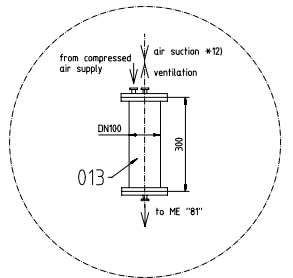
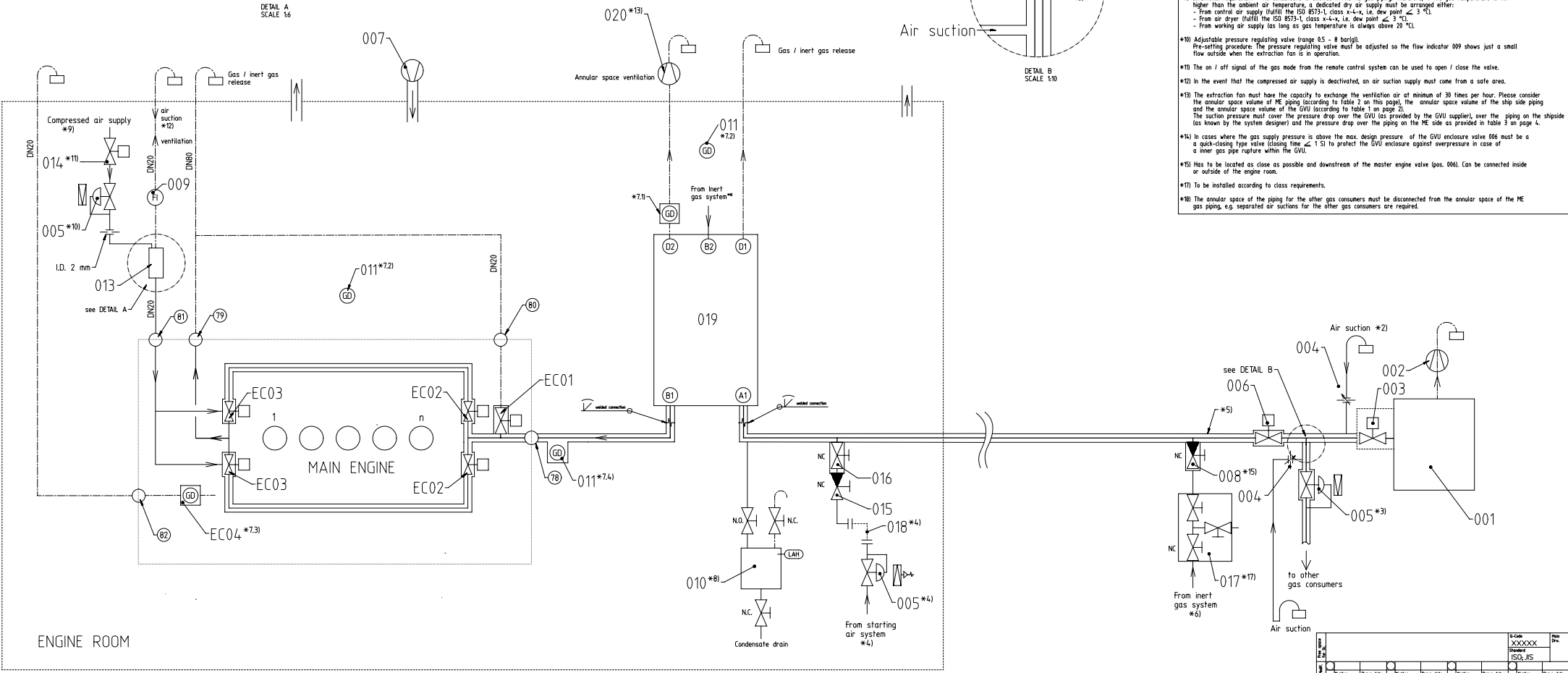
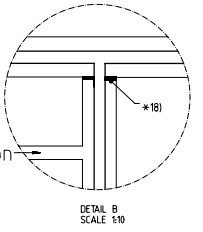


Table 1: Volume of ME internal gas piping

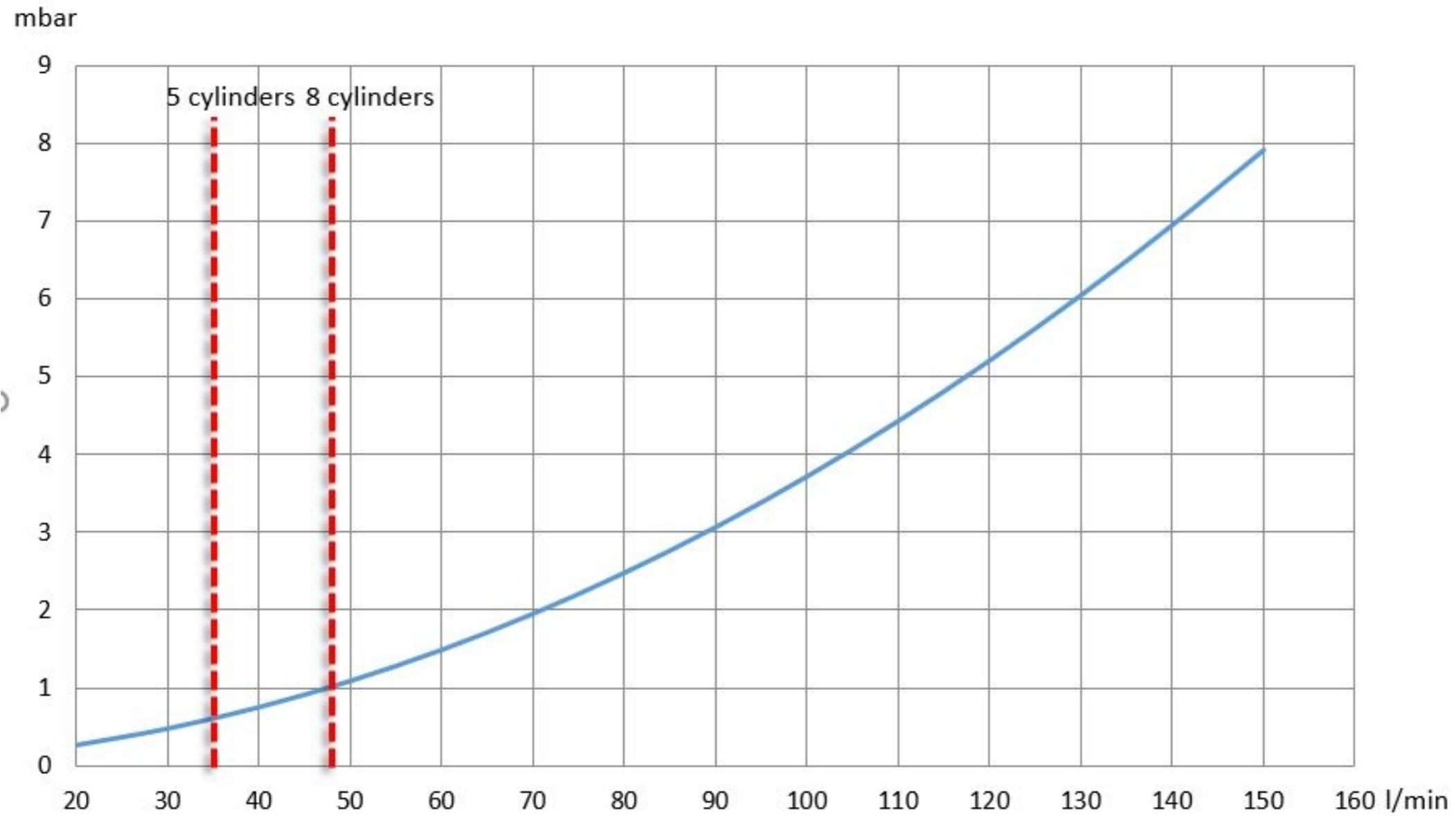
* Reference data for inert gas and ventilation air calculation. Ship side piping shall be considered in addition.



- *1) For the exact position and pipe connection execution refer to the "Pipe Connection Plan".
- *2) 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 ME gas piping.
- *3) Conditional requirement - Only to be installed if there is a branch pipe to the other gas consumers.
- *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 (018) must be removed during normal ME operation (only to be installed for commissioning / maintenance) and the connection blinded off.
- *5) Piping between the gas handling / cargo room 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. Pipe section installed above the main deck / ventilation duct: Single-wall pipe with diameter of DN50 is recommended, if the position fulfills the rule requirements of non-hazard zone.
- *6) 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 GVU volume as provided in table 2 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 set-pressure is selected, deviation of ±10% is allowed, though not below 5 bar.
- *7) Gas detection for annular space, with feedback to engine control system: Mandatory.
- *7.2) Gas detection in engine room above ME and GVU: 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) Conditional requirement - If the gas temperature is not always higher than the ambient air temperature, condensate may accumulate in annular space. In this case, condensate trap 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 (indicated NC on the drawing) must be closed. Then the venting valve and drain valve (indicated NC on the drawing) is opened. When the trap has been drained, all valves are to be returned to their normal position.
- *9) Conditional requirement - No condensate is allowed in the ME 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 control air supply (fulfill the ISO 8573-1, class x-4-x, i.e. dew point ≤ 3 °C).
 - From air dryer (fulfill the ISO 8573-1, class x-4-x, i.e. dew point ≤ 3 °C).
 - From working air supply (as long as 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 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 node from the remote control system can be used to open / close the valve.
- *12) In the event 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 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 GVU (according to table 1 on page 2). The suction pressure must cover the pressure drop over the GVU (as provided by the GVU 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) In cases where the gas supply pressure is above the max. design pressure of the GVU enclosure valve 006 must be a quick-closing type valve (closing time ≤ 1 s) to protect the GVU enclosure against overpressure in case of a inner gas pipe rupture within the GVU.
- *15) This to be located as close as possible and downstream of the master engine valve (pos. 006). Can be connected inside or outside of the engine room.
- *17) To be installed according to class requirements.
- *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.

	5-BX520F-S10 GAS FUEL SYSTEM Gas Pressure Regulation: GVU Gas Brennstoffsystem Gas Supply System: NG	Scale: 1:10 Date: 02.04.2021 Design Group: 3727 PAAD379598 PAAD142503
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Table 3: Pressure drop over the annular space on engine side



Free space for lit.	Q-Code XXXXXX						Main Drw.
	Standard ISO; JIS						
Modif.	○		○		○		○
	Number	Drawn date	Number	Drawn date	Number	Drawn date	Number
		Product 5-8X52DF-S1.0		GAS FUEL SYSTEM Gas Pressure Regulation: GVU Gas Brennstoffsystem Gas Supply System: NG			
		Units mm kg NX		Basic Material		Net Weight 0,001	
SURFACE PROTECTION SEE GROUP 0344		Made 09.04.2021 dki021 DH.Kim		Scale -		Size A3 Page 4/4	
TOLERANCING PRINCIPLE ISO8015		Chkd 26.04.2021 jpi101 Pickup		Design Group 9727		Material ID PAAD379598	
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Appd 26.04.2021 mhu019 Hug		Drawing ID DAAD142503		Rev. -	

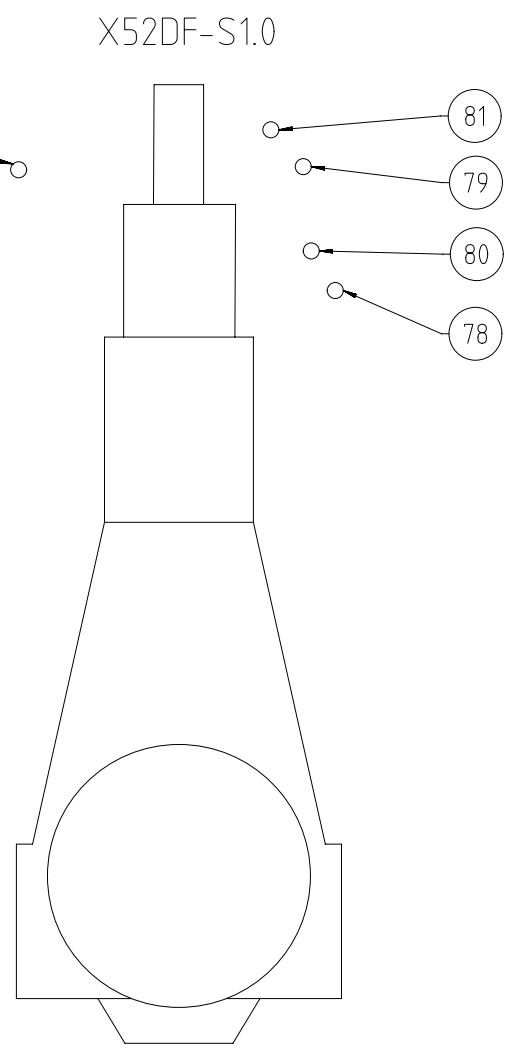
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DID - DIMENSIONAL DRAWING - Confidential

SPECIFICATIONS which must be met:

81	<p>INLET - Ventilation air annular space</p> <ul style="list-style-type: none"> - 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 GUV 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 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	<p>INLET - Gas supply</p> <p>INNER GAS PIPE</p> <p><u>Gas quality:</u> According to project specific definition</p> <p><u>Gas pressure:</u> Controlled by GUV, load depended</p> <p><u>Mass flow:</u> According to project specific definition</p> <p><u>Gas temperature:</u> 40 - 60 °C for pure NG and for the mixture of NG and VOC up to max. 25% of VOC.</p> <p><u>Pipe connection:</u> Inner pipe connected to the gas supply pipe from GUV via flange connection. For execution of the flange refer to the "Pipe Connection Plan"</p> <p><u>Inert gas supply:</u> An inert gas supply must be connected upstream to the GUV 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).</p> <p><u>Inert gas quality:</u> According to specification in Marine Installation Manual (MIM).</p> <p><u>Inert gas pressure:</u> Can be selected between 5 and 15 bar(g). Once set-pressure is selected, deviation of ±10% is allowed, though not below 5 bar.</p> <p><u>Inert gas volume engine side:</u> Provided in table 1 on page 3.</p> <p>OUTER PIPE (annular space) - annular space ventilation air outlet</p> <p><u>Ventilation air quantity and quality:</u> same specification as for connection 81, "INLET - Ventilation air annular space".</p> <p><u>Pipe connection:</u> Outer pipe connected to the annular space of the gas supply pipe / GUV via flange connection. For execution of the flange please refer to the "Pipe Connection Plan"</p> <p><u>Gas Detection:</u> 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 side</p> <ul style="list-style-type: none"> - 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	<p>OUTLET - Gas / Inert gas release, system side</p> <ul style="list-style-type: none"> - 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.



Free space for IIC		Q-Code XXXXXX		Main Drw.				
Standard ISO; JIS								
Modif.	Number	Drawn date	Number	Drawn date	Number	Drawn date	Number	Drawn date
Product 5-8X52DF-S1.0		GAS FUEL SYSTEM Gas Pressure Regulation: GUV Gas Brennstoffsystem Gas Supply System: NG+VOC		Units mm kg NX		Basic Material		Net Weight 0,001
SURFACE PROTECTION SEE GROUP 034.4		Made 09.04.2021 dki021 DH.Kim		Scale -		Size A2 Page 1/4		Material ID PAAD379576
TOLERANCING PRINCIPLE ISO8015		Chkd 26.04.2021 jpi101 Pickup		Design Group		Drawing ID DAAD142497		Rev. -
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Appd 26.04.2021 mhu019 Hug		9727				

SPECIFICATION requirements for GUV connections

D1	<p>OUTLET - Gas / Inert gas release</p> <p><u>Inerting / gas venting procedure / flow path:</u> Inert gas inlet in the fuel gas supply system ▷ the piping between the fuel gas supply system connection and GUV inlet (connection A1) ▷ the GUV internal piping between inlet (connection A1) and venting outlet (connection D1) ▷ gas / inert gas release to outside of engine room. <u>Pipe connection:</u> Connected to a venting line for gas / inert gas release to a safe area outside of engine room.</p>
D2	<p>OUTLET - Ventilation air annular space</p> <p><u>Ventilation procedure / flow path:</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). <u>Pipe connection:</u> Connected to a ventilation line with an extraction fan to suck the ventilation air and release to outside of engine room. The ventilation fan suction capacity has to be sufficient for 30 air exchanges per hour. The ventilation line must be equipped with a gas detector.</p>

INLET - Gas / Ventilation air to GUV

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 a 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: Aligned with the specification on page 1.
Pipe connection: Inner pipe connected to the fuel supply pipe from the fuel gas supply system (FGSS) via welding connection.

OUTER PIPE (annular space) - ventilation air inlet
 - Disconnected / separated by a blind flange from the annular space of the fuel gas supply system (Wärtsilä fuel gas supply system utilizes the vacuum concept for inner pipe leakage detection)
 - A dedicated air suction pipe with orifice must be connected to the annular space of the GUV. Sufficient ventilation air (min. requirement of 30 air exchanges per hour) must be sucked by extraction fan from a safe area
Pipe connection: Outer pipe connected to the blind flange via welding connection.

OUTLET - Gas / Ventilation air from the engine

INNER GAS PIPE
Gas pressure: Adjusted by the GUV gas pressure regulating valve according to engine demand.
Pipe connection: Inner pipe is connected to the gas supply line via welding connection.

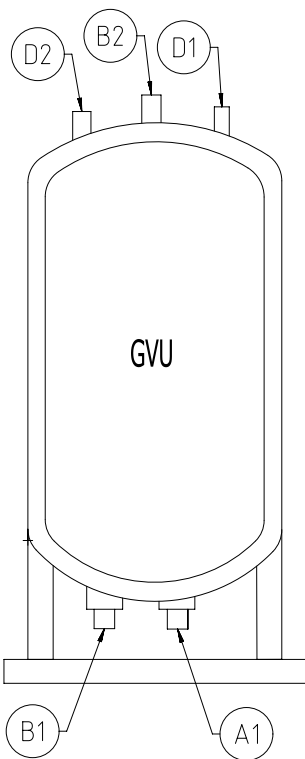
OUTER PIPE (annular space)
Pipe connection: Outer pipe is connected to the annular space of the supply line via welding connection. The connection pipe to the engine must be kept as short as possible and never longer than 30 m.

INLET - Inert gas

Inerting procedure / flow path:
GUV inert gas inlet (connection B2) ▷ GUV piping ▷ Piping between GUV outlet (connection B1) and gas / inert gas release on engine.
Inert gas quality: According to specification in the Marine Installation Manual (MIM)
Inert gas pressure: Can be selected between 5 - 15 bar(g). Once the set-pressure is selected, deviation of ±10% is allowed.
Inert gas consumption: According to guidance in MIM
Pipe connection: Connected to the inert gas supply system.

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	DN100	57.8 l	2270 l

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



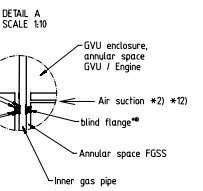
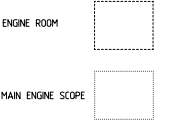
Schematic outline view of the the GUV-ED type. For detailed dimensions of the GUV please refer to the GUV supplier layout drawing.

Other designs are possible, e.g. GUV-OD type.

Modif.	Free space for ill.						Q-Code	Main
							XXXXXX	Drw.
						Standard		
						ISO; JIS		
Number	Drawn date	Number	Drawn date	Number	Drawn date	Number	Drawn date	
		Product 5-8X52DF-S1.0		GAS FUEL SYSTEM Gas Pressure Regulation: GUV Gas Brennstoffsystem Gas Supply System: NG+VOC				
Units	mm kg	NX	Basic Material		Net Weight 0,001			
SURFACE PROTECTION SEE GROUP 034.4		Made	09.04.2021 dki021 DH.Kim		Scale	-	Size A2	
TOLERANCING PRINCIPLE ISO8015		Chkd	26.04.2021 jpi101 Pickup		Design Group		Page 2/4	
GENERAL TOLERANCES ACCORDING TO ISO2768-mK		Appd	26.04.2021 mhu019 Hug		9727	Material ID	PAAD379576	
					Drawing ID	DAAD142497		
					Rev.	-		

SYSTEM PROPOSAL

Double-wall pipes: (normal operation: inner pipe - gas, annular space - air)
 (inerting procedure: inner pipe - nitrogen, annular space - air)
 Vent pipes
 Air pipes
 Pipe connections
 Orifice



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

Pos.	Engine Connections**1)
(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

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.

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 (MMI) **inert gas consumptions** calculated according to the guidance in MMI 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 set-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-VOC) 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 MMI.

#7) 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, engine side. Mandatory, to be installed with a distance of max. 2 m to engine inlet.

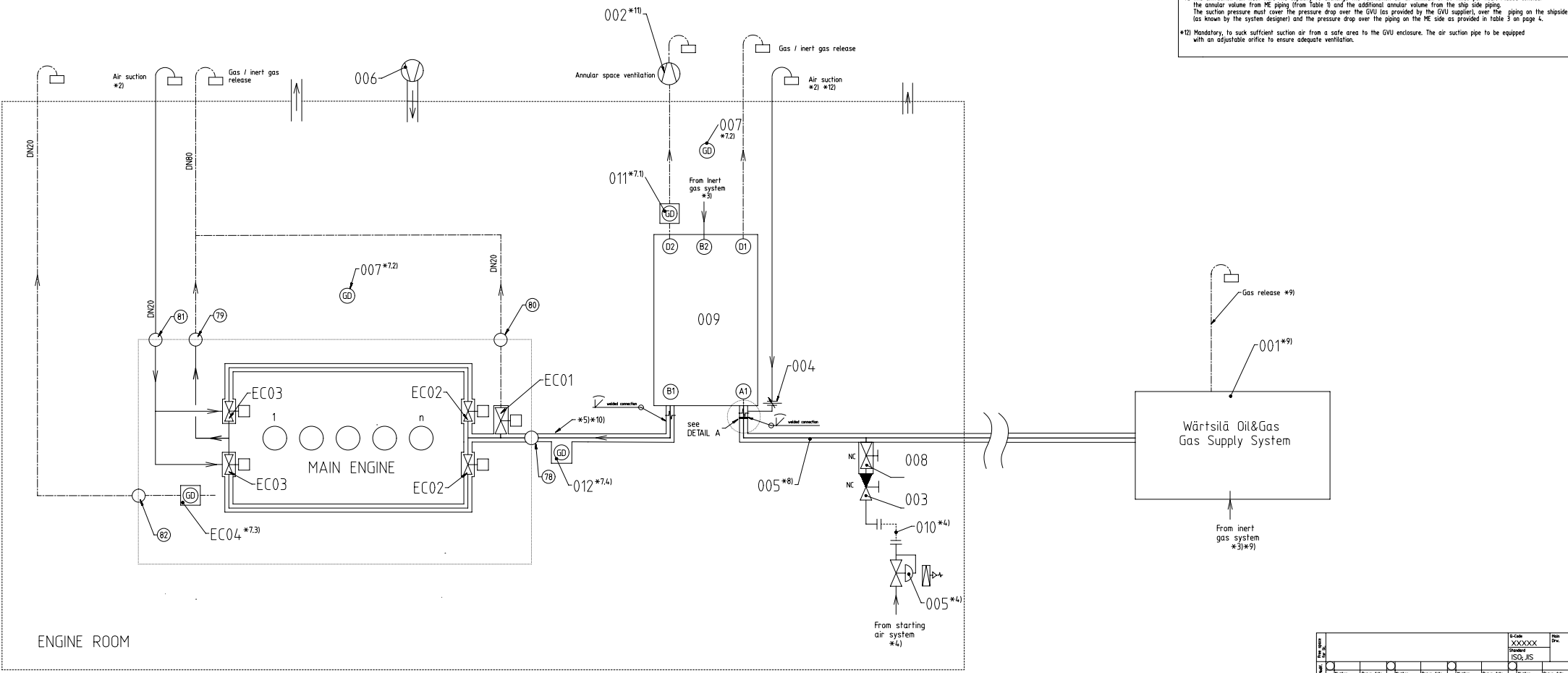
#8) A blind flange has to be installed in the double wall pipe just before the inlet to the GUV enclosure to separate the annular space of the FGSS from the annular space of the GUV / main engine (refer to view "Detail A").

#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.

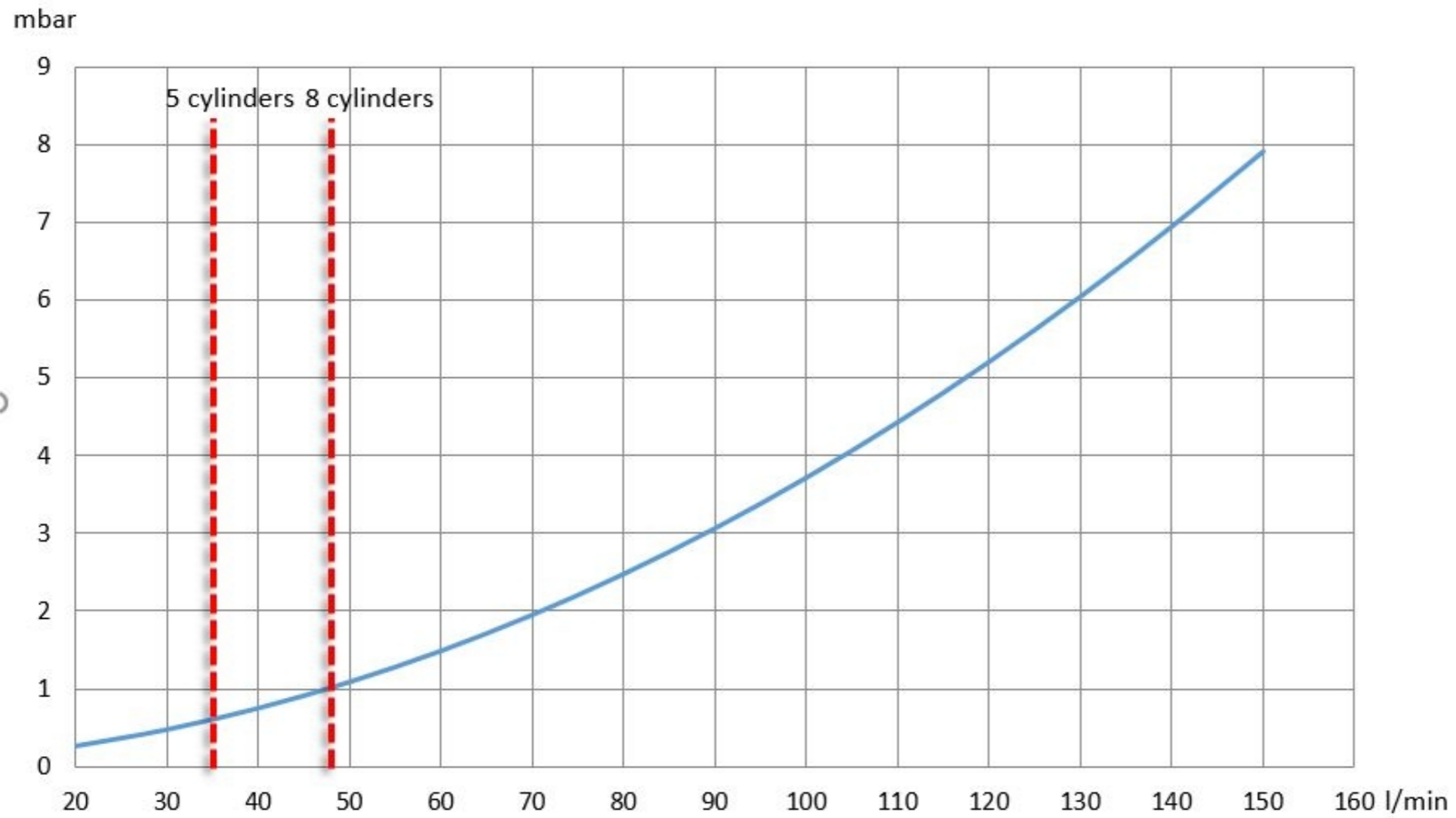
#11) The extraction fan must have the capacity to exchange the ventilation air at minimum of 30 times per hour. Please consider the annular volume from ME piping (from Table 1) and the additional annular volume from the ship side piping. The suction pressure must cover the pressure drop over the GUV (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.



DWG No. 100000 Standard ISO/JIS		Scale 1:1 Drawing Date 2021.09.01		Sheet No. 24/10 Total Sheets 10	
WINGO Wärtsilä Oil & Gas		Project Name GAS FUEL SYSTEM Gas Pressure Regulation: GUV Gas Brennstoffsystem Gas Supply System: NG-VOC		Drawing No. PAAD379576	
Date: 2021.09.01 Design: [Signature] Check: [Signature]	Date: 2021.09.01 Design: [Signature] Check: [Signature]	Date: 2021.09.01 Design: [Signature] Check: [Signature]	Date: 2021.09.01 Design: [Signature] Check: [Signature]	Date: 2021.09.01 Design: [Signature] Check: [Signature]	Date: 2021.09.01 Design: [Signature] Check: [Signature]

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



Free space for litc.	Q-Code XXXXXX				Main Drw.
	Standard ISO; JIS				
Modif.	○	○	○	○	○
	Number	Drawn date	Number	Drawn date	Number
		Product 5-8X52DF-S1.0		GAS FUEL SYSTEM Gas Pressure Regulation: GVU Gas Brennstoffsystem Gas Supply System: NG+VOC	
Units	mm kg	NX	Basic Material		Net Weight 0,001
SURFACE PROTECTION SEE GROUP 0344		Made	09.04.2021 dki021 DH.Kim	Scale	-
TOLERANCING PRINCIPLE ISO8015		Chkd	26.04.2021 jpi101 Pickup	Design Group	9727
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				Page	4/4
				Material ID	PAAD379576
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MIDS - WinGD X52DF-S1.0 – Gas Fuel System (DG9727)

TRACK CHANGES

DATE	SUBJECT	DESCRIPTION
2021-05-10	DRAWING SET	First web upload

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