



M&SM



ADVANCED HEAT EXCHANGERS

SHELL & TUBE MARINE CONDENSERS



SHELL & TUBE MARINE CONDENSERS

GENERAL INFORMATION

By using the latest design philosophy and special materials Onda has produced the new "M" series water cooled shell and tube condensers, specifically designed for marine applications.

The new "M" series specification is as follow:

- End covers with larger internal water volume
- Two liquid refrigerant outlet connections
- Possibility of tubes removing
- Protection against electrolytic corrosion
- Easy of access for inspection and replacement of anodes
- Innovative internal coating of end covers and tube sheet
- Compact design, with internal volume for liquid refrigerant

TECHNICAL INFORMATION

The main applications of the marine "M" shell and tube condensers series are for condensing refrigerant gas in air conditioning packages and refrigeration plants using sea water as medium.

Suitable for use with HCFCs, HFCs and other refrigerants compatible with construction materials and according to national laws and/or regulations.

At Eurovent rating conditions the "M" series marine condensers have an heat rejection capacity range from 10 to 210 Tons.

All the condensers are provided with safety valve connection, spare/vent connection to the shell.

For air purge and water drain have to be used anodes connection ports.

According to condensers models, refrigerant connections are supplied with welding, brazing or rotalock type connections.

Flanged connections are also available on request.

Dimensional details contained in this catalogue are to be intended as approximate only allowing for manufacturing tolerances. Onda S.p.A reserves the right to make changes to this catalogue without prior notice.

MATERIALS

Standard type construction of type "M" series shell & tube condensers comprise:

headers: carbon steel with protective sea water resistant coating

ring: SBR

tubesheets: carbon steel with protective sea water resistant coating

shell: carbon steel

refrigerant connections: carbon steel

tubes: CuNi 90/10 alloy

Alternative materials are available within our production facilities and can be supplied on request.

Other condensers with higher capacity and different number of passes can be also manufactured.

Please contact Onda S.p.A Sales Department.

CORRECT SELECTION PROCEDURE

Use of the correct fouling factor (f.f.) is essential for a correct selection of water cooled condensers. Onda suggests use of the following value in order to obtain the right selection:

$$f.f. = 0,00025 \text{ ft}^2\text{h}^\circ\text{F}/\text{Btu}$$

It is recommended to limit water tubeside velocity between 3,2 and 7,5 ft/s m/s.

INSTALLATION AND MAINTAINANCE

A proper earth grounding of the system is necessary to minimize the risk of galvanic corrosion due to stray currents.

Anyway, it is necessary to inspect periodically the anode rod, at least once every year. Some pitting and surface corrosion are normal and to be expected, large chunks of metal coating missing from the surface indicate that it should be replaced.

To ensure a long service life of CuNi tubes, and therefore a good corrosion resistance, it is recommended of not interrupting the water flow for the first two months after start-up, in order to avoid corrosion under deposits (pitting corrosion), and to facilitate the build-up a homogeneous protection layer.

TESTS, VESSEL CODES, WORKING LIMITS

Each condensers is pressure tested by procedures specified by the respective certifying bodies.
 Assembling, installation and/or permanent joining of the accessories must be in compliance with current Laws and/or Regulations in force.
 All marine condensers are CE marked and comply with the full requirements

of the directive PED covering the materials, design, manufacturing, pressure test, issue of certificates and final documentation.
 Condensers according to RINA and ASME code are also available; please contact our Sales Dept. for selection and prices.
 Design temperature and pressure limits are listed in the table below.

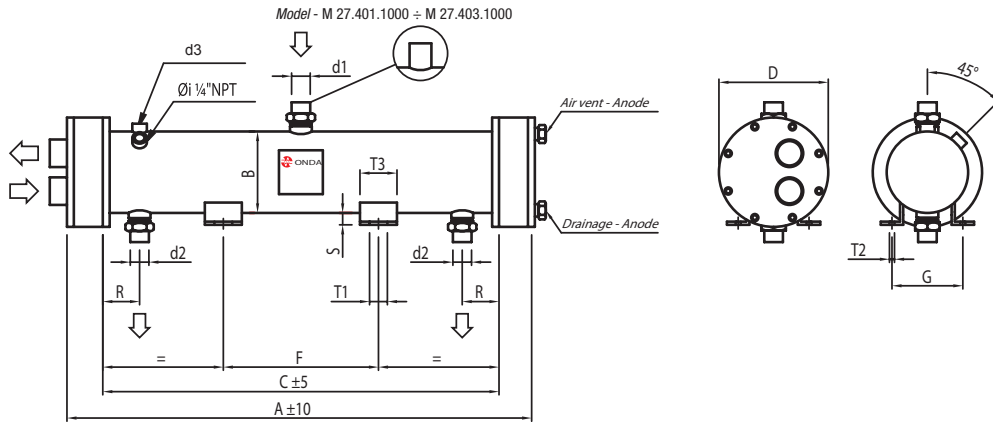


M condensers			
Approval	Design temperature (°F)	Design pressure (psi)	
		Shell side	Tubes side
ASME	14/194	435	116
RINA et al.			

NOMENCLATURE	
OD	Outer diameter
ID	Inner diameter
ODS	Soldering outer diameter
FL	Flange connection
RTLK	“Rotalock” connection
NPT	American national pipe thread taper
G	ISO 228/1 pipe threads without pressure-tight joint on the thread

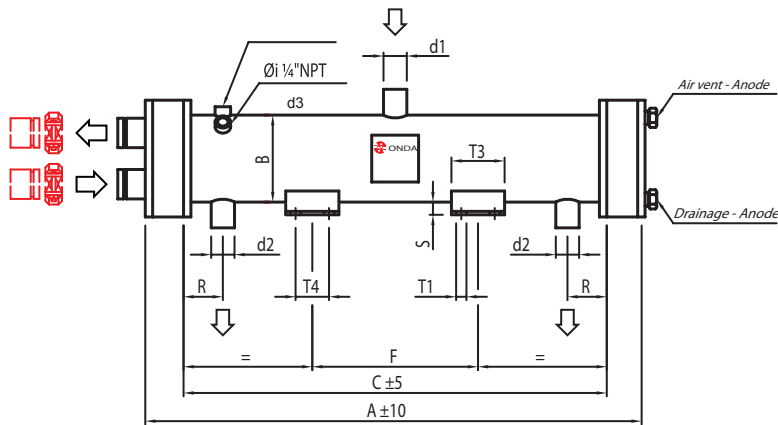


SHELL & TUBE MARINE CONDENSERS



MODEL	M	17.401.1000	17.402.1000	19.401.1000	27.401.1000	27.402.1000	27.403.1000
Performance data - Sea water							
Capacity	\	\	\	\	\	\	\
	Tons (RT)	10,5	14,8	18,7	25	31	36,9
Flow rate	gpm	29	40	51	68	84	101
Pressure drop	psi	4,49	4,64	4,49	4,20	4,20	4,20
Max Flow Rate	gpm	34,00	48,00	62,50	83,20	104,00	125,00
Passes	n	4					
Refrigerant side volume	US gal	3,64	3,09	4,23	10,30	9,48	8,63
Water side volume		1,53	1,90	2,50	4,22	4,83	5,40
Dimensions in	A	44 7/8		44 7/8	46 7/8		
	B	6 1/3		7 5/8	10 3/4		
	C	39 1/4		39 1/4	39 1/4		
	D	8 2/3		9 4/9	12 5/8		
	F	17 2/3		17 2/3	17 2/3		
	G	7 1/2		8 1/4	9 8/9		
	R	3 7/8		3 7/8	3 7/8		
	S	1 1/3		1 1/8	1 1/4		
	T1	1 1/8		1 1/8	1 1/8		
	T2	1/2"		1/2	1/2		
T3	3 7/8		3 7/8	3 7/8			
Weight	lbs	134	145	176	304	321	339
Refrigerant connections	d1	RTLK 1" 3/4		RTLK 1" 3/4	ODS 54		
	d2	RTLK 1" 1/4 ODS 18		RTLK 1" 1/4 ODS 22	RTLK 1" 3/4 ODS 35		
	d3	1/2" NPT		1/2" NPT1	1/2" NPT		
Water connections	See table on page 6 for position and type						

Nominal working conditions		Sea water
Refrigerante	--	R134a
Temp. ingresso acqua	°F	86
Water outlet temp.	°F	95
Temp. Condensazione	°F	104
Sottoraffreddamento	K	3
Fouling factor	ft ² h°F/Btu	0,00025

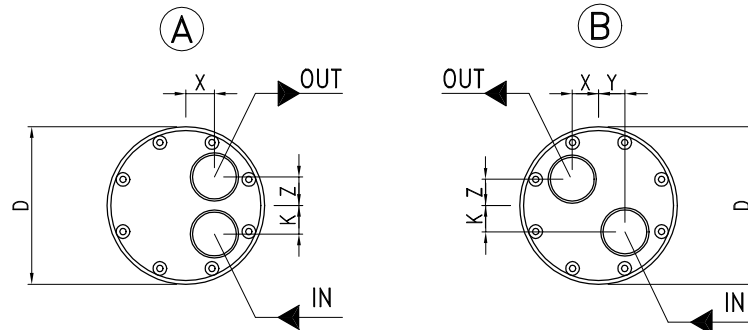


MODEL	M	27.401.2000 2P	27.402.2000 2P	27.403.2000 2P	27.404.2000 2P	32.401.2000 2P	41.401.2000 2P	41.402.2000 2P	41.403.2000 2P	
Performance data										
Capacity	KW	\	\	267	332	\	\	\	\	
	Tons	50,8	63,3	75,8	94,3	125,5	154,8	197,1	224,1	
Flow rate	gpm	139,0	173,0	207,0	258,0	343,0	423,0	539,0	613,0	
Pressure drop	psi	3,9	4,0	4,0	4,3	3,9	3,7	3,9	4	
Max Flow Rate	gpm	166,0	208,0	250,0	313,5	417,0	515,0	661,0	752,0	
Passes	n	2,0								
Refrigerant side	US gal	21,3	19,5	17,8	15,2	21,1	39,9	33,8	30,0	
Water side volume		6,5	7,7	8,9	10,6	14,4	18,7	22,8	25,4	
Dimensions	A	86 1/4				86 1/4		86 5/8		
	B	10 1/2				12 3/4		16		
	C	78 3/4				78 3/4		78 3/4		
	D	12 5/8				14 5/8		18 1/8		
	F	39 3/8				39 3/8		39 3/8		
	G	11				11 3/4		13 3/4		
	R	3 7/8				5 7/8		5 7/8		
	S	1 3/4				1 7/8		1 5/9		
	T1	1 1/5				1 1/5		1 1/5		
	T2	2/3				2/3		2/3		
T3	6 1/3				6 1/3		6 1/3			
T4	3 7/8				3 7/8		3 7/8			
Weight	lbs	451	491	529	588	848	1153	1289	1375	
Refrigerant connections	d1	OD 760				OD 88,90		OD 114,30		
	d2	ODS 42				ODS 54		OD 76		
	d3	1" NPT1				1" NPT1		1" NPT1		
Water connection	See table on page 6 for position and type									

Nominal working conditions		Sea water
Refrigerant	--	R134a
Water inlet temp.	°F	86
Water outlet temp.	°F	95
Condensing temp.	°F	104
Subcooling	K	3
Fouling factor	ft ² h°F/Btu	0,00025

M CONNECTIONS

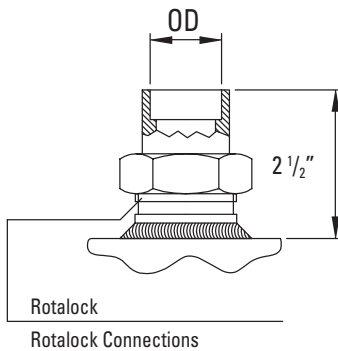
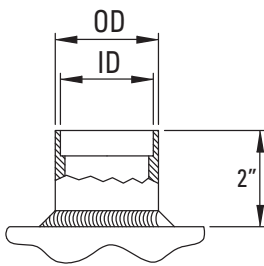
WATER CONNECTIONS



Diameter D	in	8 2/3	9 4/9	12 5/8		14 4/7	18 1/8
Passes		4	4	2	4	2	2
Figure		A	A	\	\	B	B
X	in	1 3/8	1 4/7	1 4/7	2	1 4/7	2 3/8
Y	in	-	-	40	-	40	60
Z	in	1 4/7	1 3/4	2 3/8	2 3/8	3	3 4/7
K	in	1 4/7	1 3/4	2 3/8	2 3/8	3	3 4/7
IN (diameter)		G 1 1/4"	G 1 1/2"	DN 80 (*)	G 2 1/2"	DN 100 (*)	DN 125 (*)
OUT (diameter)		G 1 1/4"	G 1 1/2"	DN 80 (*)	G 2 1/2"	DN 100 (*)	DN 125 (*)

(*) Victaulic Connections

REFRIGERANT CONNECTIONS



ODS		ID	OD	
mm	inch	mm	mm	inch
14	-	14,2	17 1/3	3/8"
18	-	18,2	21 1/3	1/2"
22	-	22,3	26 8/9	3/4"
28	-	28,3	33 5/7	1
35	1" 3/8	35,3	42 2/5	1" 1/4
42	-	42,3	48 2/7	1" 1/2
54	2" 1/8	54,3	60 2/7	2"
64	-	64,4	76	-
67	2" 5/8	67,5	76	-
70	-	70,5	76,1 (*)	-
82	-	82,5	88,9	3"
89	-	89,5	101,6	3" 1/2
100	-	100,5	114,3	4"

(*) Standard version for M 32.401.200 2P - M41.403.200 2P model

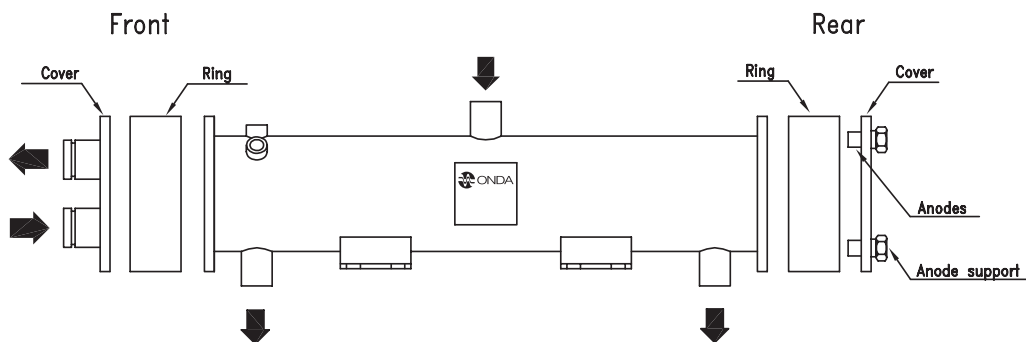
RTLK Connection	ODS		ID
	mm	inch	mm
RTLK 1" UNS	14	-	14,2
	16	5/8"	16,2
RTLK 1/4 UNF	18	-	18,2
	22	7/8"	22,5
	28	-	28,2
RTLK 3/4 UN	28	-	28,2
	35	1" 3/8	35,3
	42	-	42,3

STANDARD HEADERS KIT				
<i>mode</i>	<i>diameter D</i>	<i>passes</i>	<i>code</i>	
front	8 2/3	4	F8013005	
rear			F8013015	
front	9 4/9		F8013015	
rear			F8013115	
front	12 5/8	2	F8013205	
rear			F8013215	
front		4	F8013225	
rear			F8013235	
front	14 4/7	4	F8013305	
rear			F8013315	
front	18 1/8		2	F8013405
rear				F8013415

Front header kit includes: Cover + ring + screws

Rear header kit includes: Cover + anodes + ring+ screws

			STANDARD COVER	RING	ANODE KIT	
<i>mode</i>	<i>diameter D</i>	<i>passes</i>	<i>code</i>	<i>code</i>	<i>code</i>	
front	8 2/3	4	G8010603 0002	F7500003	F7010010	
rear			G8010603 0003	F7500004		
front	9 4/9		G8010703 0002	F7500007		
rear			G8010703 0003	F7500008		
front	12 5/8	2	G8010803 0002	F7500009	F7010011	
rear			G8010803 0004	F7500010		
front		4	G8010803 0003	F7500011		
rear			G8010803 0004	F7500012		
front	14 4/7	2	G8010903 0002	F7500013		
rear			G8010903 0003	F7500014		
front	18 1/8		2	G8011003 0002		F7500017
rear				G8011003 0003		F7500018



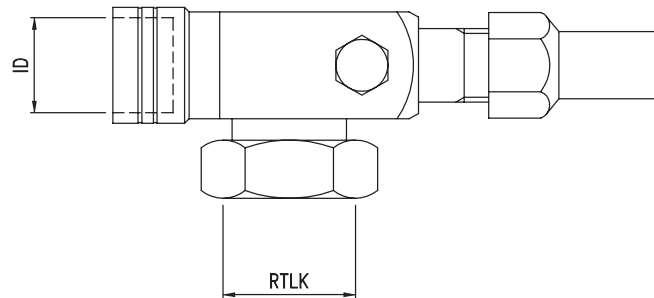


ACCESSORIES ON REQUEST

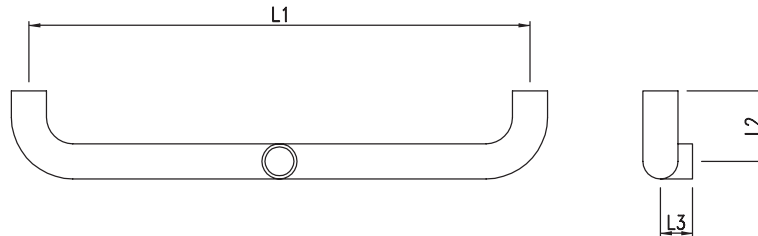
SIGHT GLASSES KIT		
model	dimensions mm	code
SG4 C€	OD x ID = 90 x 45	gpm
SGR 5 RTLK 1" 1/4 UNF	OD x ID = 40 x 18	F7020003
SGR 7 RTLK 1" 3/4 UN	OD x ID = 55 x 28	F7020002

SUPPORTS	
condenser model	code
M 17.401.1000 ÷ M 27.403.1000	S2500205
M 27.401.2000 2P ÷ M 41.403.2000 2P	44 7/8

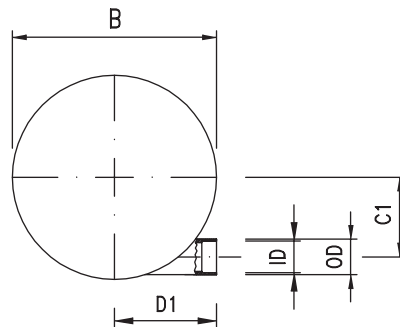
ROVALOCK VALVES



ROVALOCK VALVES		
Type	ID mm	code
RTLK 1" UNS	16,2	M4100012
	18,2	M4100013
RTLK 1" 1/4 UNF	22,2	M4100021
	28,2	M4100022
RTLK 1" 3/4 UN	28,2	M4100030
	35,2	M4100031
	42,2	M4100032

COLLECTING PIPE FOR REFRIGERANT OUTLET


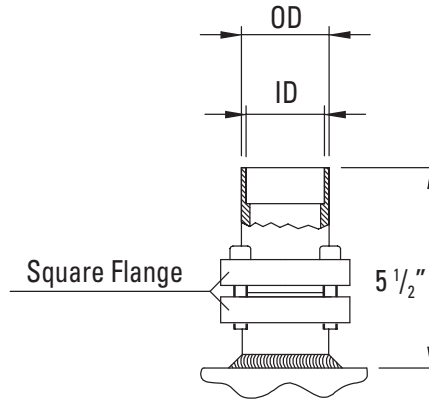
Material	ODS	L1	L2	L3	Code
Dimensions mm					
Copper	2/3	31 ½	1 ½	4/7	S1240005
Copper	7/8	31 ½	1 ½	4/7	S1240010
Copper	1 3/8	31 ½	3 1/8	1 1/5	S1240005
carbon steel	OD 48,30	71	3	2 3/8	S1240020
carbon steel	OD 60,30	67	3 4/7	2 ½	S1240025
carbon steel	OD 76,10	67	4 1/3	3	S1240030

TANGENTIAL REFRIGERANT OUTLET CONNECTION


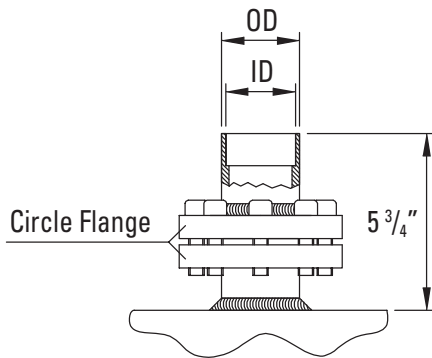
shell diameter B	ODS		ID	OD		C1	D1
	mm	inch	mm	mm	inch	mm	mm
141	14	--	14,2	17,3	3/8 "	56	100
168	28	--	28,3	33,7	1"	62	120
194	35	1" 3/8	35,3	42,4	1" ¼	70	135
219	35	1" 3/8	35,3	42,4	1" ¼	83	140
273	42	--	42,3	48,3	1" ½	107	160
324	54	2" 1/8	54,3	60,3	2"	123	180
406	70	-	70,5	76,1	-	157	215



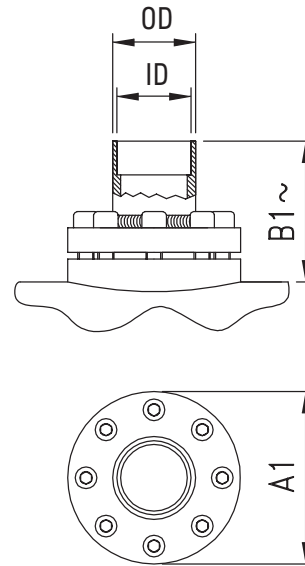
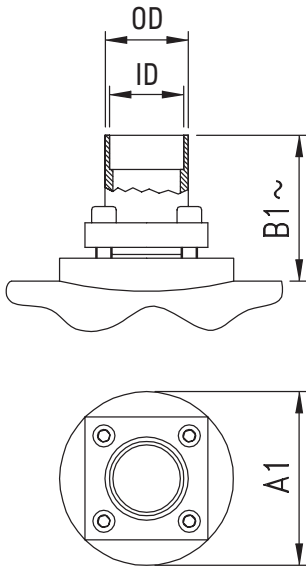
ACCESSORIES ON REQUEST



Flange	ODS		ID	OD	
	mm	inch		mm	inch
70 x 70	22	\	\	\	\
	28	1" 1/8	28,9	34	1"
	35	gpm	40,0	68	84
75 x 75	28	1" 1/8	28,9	34	1"
	35	1" 3/8	35,3	42,5	1" 1/4
	42	--	42,3	48	1" 1/2
	42	1" 5/8	41,7	48	1" 1/2
90 x 90	28	1" 1/8	28,9	34	1"
	35	1" 3/8	35 2/7	42 1/2	1" 1/4
	42	--	42 2/7	48	1" 1/2
	54	2" 1/8	54 1/2	61	2"
100 x 100	54	2" 1/8	54 1/2	61	2"
	64	--	64 2/5	76	--
	67	2" 5/8	67 1/5	76	--
120 x 120	54	2" 1/8	54 1/2	61	2"
	64	-	64 2/5	76	-
	67	2" 5/8	67 1/5	76	-
	76	-	76 1/2	82 1/2	-
	80	3" 1/8	80 2/5	90	3"



diameter	ODS	ODS	ID	OD	OD
	mm	inch	mm	mm	inch
6 11/16	-	-	-	114,3	4"
7 1/2	-	-	-	141,3	5"



shell diameter B	A1	Flange	ODS		ID	OD		B1
			mm	inch		mm	inch	
10 3/4	Ø 99	70 x 70	\	\	22,5	\	3/4"	
			28	1" 1/81	28,9	34	1"	
			gpm	29	35,3	40	1/4"	
10 3/4	Ø 106	75 x 75	28	1" 1/8	28,9	34	1"	\
			35	1" 3/8	35,3	42,5	1" 1/4	
			42	--	42,3	48	1" 1/2	
			42	1" 5/8	41,7	48	1" 1/2	
12 3/4 16	Ø 127	90 x 90	28	1" 1/8	28,9	34	1"	88
			35	44 7/8	35 2/7	42 1/2	1" 1/4	
			42	--	42 2/7	48	1" 1/2	
			54	2" 1/8	54 1/2	61	2"	
	Ø 141	100 x 100	54	2" 1/8	54 1/2	61	2"	87
			64	--	64 2/5	76	--	
			67	2" 5/8	67 1/5	76	--	
	Ø 170	120 x 120	54	2" 1/8	54 1/2	61	2"	86
			64	-	64 2/5	76	-	
			67	2" 5/8	67 1/5	76	-	
			76	-	76 1/2	82 1/2	-	
	Ø 170	Ø 170	-	-	-	90	3"	92
80			3" 1/8	80 2/5	90	3"		
16	Ø 190	Ø 190	-	-	-	114,3	4"	92
-	Ø 190	Ø 190	-	-	-	141,3	5"	

SM SHELL & TUBE MARINE CONDENSERS

TECHNICAL INFORMATION

The main applications of the marine "SM" shell and tube condensers series are for condensing refrigerant gas in air conditioning packages and refrigeration plants using sea water as medium.

Suitable for use with HCFCs, HFCs and other refrigerants compatible with construction materials and according to national laws and/or regulations.

At catalogue rating conditions the "SM" series marine condensers have an heat rejection capacity range from 10 to 210 Tons.

All the condensers are provided with safety valve, spare/vent connection to the shell.

Air purge and water drainage connections are placed in the rear header.

Refrigerant connections are supplied with rotalock type connections.

Soldering connections are also available on request.

Dimensional details contained in this catalogue are to be intended as approximate only allowing for manufacturing tolerances.

Onda S.p.A reserves the right to make changes to this catalogue without prior notice.

MATERIALS

Standard type construction of type "SM" series shell & tube condensers comprise:

headers: cast iron with protective sea water resistant coating

tubesheets: stainless steel AISI 316L

shell: carbon steel

refrigerant connections: carbon steel

tubes: CuNi 90/10 alloy

Alternative materials are available within our production facilities and can be supplied on request to our sales office (i.e. STAINLESS STEEL AISI 316L and COPPER-NIKEL 70/30).

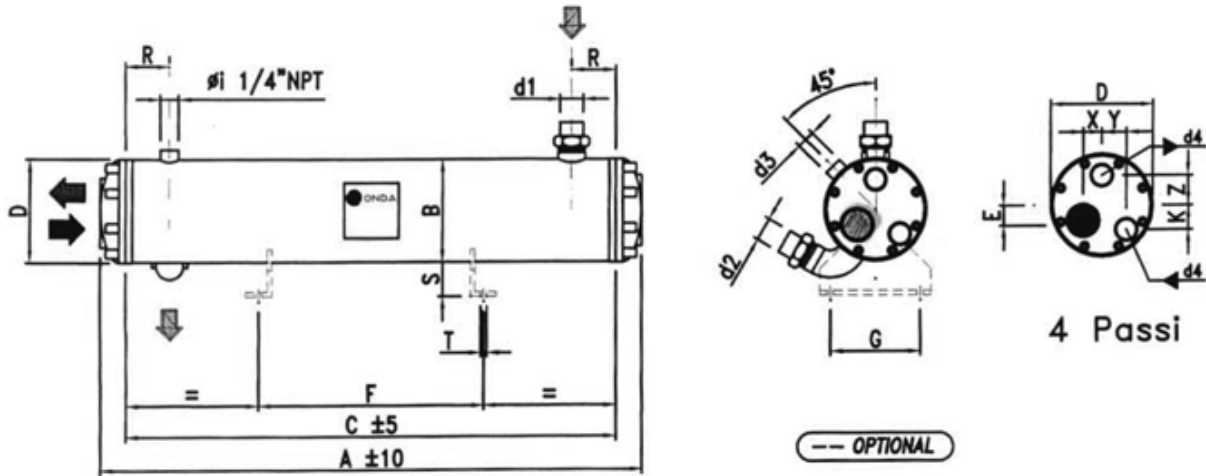
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TESTS, VESSEL CODES, WORKING LIMITS

Each condensers is pressure tested by procedures specified by the respective certifying bodies. Assembling, installation and/or permanent joining of the accessories must be in compliance with current Laws and/or Regulations in force. All marine condensers are CE marked and comply with the full requirements of the directive PED covering the materials, design, manufacturing, pressure test, issue of certificates and final documentation. Condensers according to RINA code are also available; please contact our Sales Dept. for selection and prices. Temperature and pressure design limits are listed in the table below.

SM condensers			
Approval	Design temperature (°F)	Design pressure (psi)	
		Shell side	Tubes side
ASME	14/248	435	145
RINA et al.	14/248	391	145

NOMENCLATURE	
OD	Outer diameter
ID	Inner diameter
ODS	Soldering outer diameter
FL	Flange connection
RTLK	"Rotalock" connection
NPT	American national pipe thread taper
G	ISO 228/1 pipe threads without pressure-tight joint on the thread



MODEL	SMS	7	10	12	16	20	24	32
Capacity	Tons(RT)	2,0	2,8	3,4	4,5	5,7	6,8	9,1
Flow rate	gpm	8,0	10,5	11,9	15,8	20,2	24,2	31,7
Pressure drop	psi	3,6	3,2	4,6	4,6	4,8	4,8	4,6
Max Flow Rate	gpm	9,2	14,0	14,0	18,5	23,3	27,8	36,9
Passes	n	4		4	4			
Refrigerant side	US gal	2,7	2,6	3,5	4,8	4,6	4,5	4,2
Water side volume		0,4	0,5	0,6	0,8	1,0	1,1	1,3
Dimensions [in]	A	27 8/9		35 4/5	35 4/5			
	B	6 1/3		6 1/3	7 5/8			
	C	23 5/8		31 1/2	31 1/2			
	D	6 2/3		6 2/3	7 2/3			
	F	11 3/4		21 5/8	21 5/8			
	G	6 1/3		6 1/3	8 2/3			
	R	3 1/2		3 1/2	3 1/2			
	S	2 1/4		2 1/4	2 5/8			
	T	1/2		1/2	1/2			
	E	3/4		3/4	1			
	X	1 5/8		1 5/8	1 1/2			
Y	1 3/8		1 3/8	2				
Z	2		2	2 3/8				
K	1 1/8		1 1/8	1 1/8				
Weight	lbs	53	57	83	90	90	95	101
Refrigerant connections	d1	(RTLK) ODS 16			(RTLK) ODS 22			
	d2	(RTLK) ODS 16			(RTLK) ODS 16			
	d3	1/2" NPT			1/2" NPT			
Water connections	d4	G1"			G1" 1/2			

NOMINAL DATA	REFRIGERANT R 507	
	Inlet water temperature	30 °F
	Outlet water temperature	35 °F
	Condensing temperature	40 °F
	Subcooling	3
Fouling factor	0,0005 ft ² h ² F/Btu	

WARRANTY

A - Onda S.p.A. warrants that the Products shall be free from defects in material and workmanship for a period of 18 months from the date of the delivery.

Therefore, should Onda S.p.A., within the warranty period, acknowledge and recognise in writing the existence of the defects in the products and said defects be materially grounded, Onda S.p.A. shall, at its discretion, repair the defective Products at no costs for the Client or replace them by delivering the substitutive products Ex works (Incoterms 2000) at Onda S.p.A.'s premises (Via Lord Baden Powell, 11 – 36045 Lonigo (VI) – Italy).

B - Subject to loss of the warranty, notice of any defect shall be given by the Client in writing with return receipt registered letter within, and not later than, 10 (ten) days from the date of receipt of the products or from the start up of the plant. Subject to loss of the warranty, notice of any latent defect of the Products by the Client shall be given in writing, by return receipt registered letter, within and not later than 10 (ten) days from the date of the relevant discovery. It is hereby understood that the burden of the proof of the date of the discovery shall be borne by the Client.

C - Onda S.p.A. also warrants that the Products are manufactured in compliance with the Italian and European Laws and Regulations in force on the date of the confirmation by Onda S.p.A. of the relevant Client's order. Unless otherwise expressly agreed in writings by the parties, Client shall bear any other additional expenses related to the operations of repairing or replacing of the defective products.

D - This warranty shall not apply should the defects of the Products be caused by:

- Natural wear and tear.
- Unauthorised repairs, interventions or modifications.
- Unsuitable use or application.
- Thermal overexposure, also when occasional.
- Electrical or mechanical over-stress.
- Failure of respecting the functional and environmental parameters suggested by Onda S.p.A. for the correct use and exploitation of the products.

- Installation of the products not in compliance with the technical specifications provided by Onda S.p.A.
- Missing earth grounding.
- Any other cause due to the Client's negligence.

E - This warranty shall also not apply in case of:

- Non compliance of the Products with Italian and European Laws and/or Regulations entered in force after the date of transmission of the order confirmation by Onda S.p.A..
- Non compliance of the Products with Laws and/or Regulations in force in the place where the Products are installed and/or assembled by the Client and/or in the place of their final use, should the Client not expressly require the conformity of the Products to said Laws and Regulations and not duly inform Onda S.p.A. of their content before the date of transmission of the latter's order confirmation.

This limitation of the warranty is also applicable with reference to peculiar Laws and Regulations valid and binding in States of the European Union independently of the European Laws and Regulations.

F - The Client shall not sell or market Products not in compliance with the Laws and Regulations mentioned under letter E above. In the negative, the Client shall keep ONDA S.p.A. harmless of any damage or loss suffered by the latter, due to any third party's and/or authority's claim raised as a consequence of the manufacture by ONDA S.p.A. of Products not in compliance with the above mentioned Laws and Regulations.

G - Without prejudice to the application of DPR 224/1988 on product liability and liability for gross negligence or wilful misconduct, Onda S.p.A. shall never be liable for direct, indirect or occasional damages which in any manner derived from defective products.