

MHI CHILLER

Two Stage
Centrifugal Chiller
Variable Speed Drive

AART-I
series



Capacity range: 809 - 14,066 kW [230 - 4,000 RT]

 **MITSUBISHI**
HEAVY INDUSTRIES, LTD.

Our Technologies, Your Tomorrow

Variable Speed Drive Two Stage Centrifugal Chiller

AART-I series

<230 RT ~ 4,000 RT>

The Highest Part Load Performance in the World!

Speed Control for Compressor

Optimum compressor speed control utilizing change of cooling water temperature influenced according to season

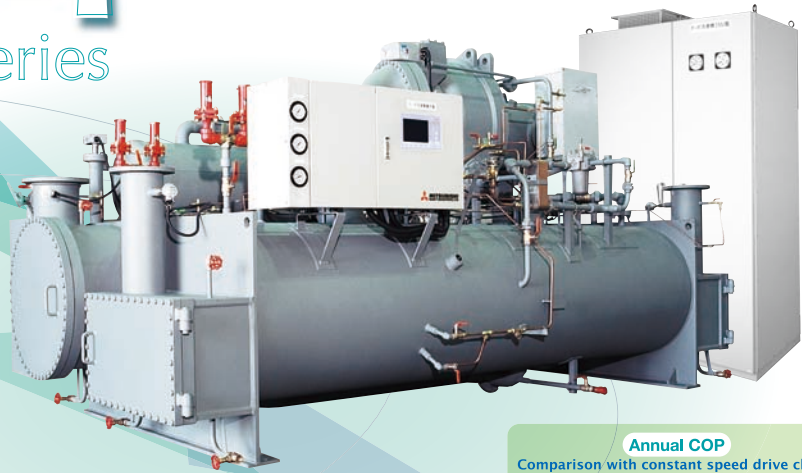
Extremely High Efficiency

Operating with extremely high part load performance at entering temperature of low cooling water

Save Cost & CO₂

Annual COP Comparison with constant speed drive chiller (AART series)

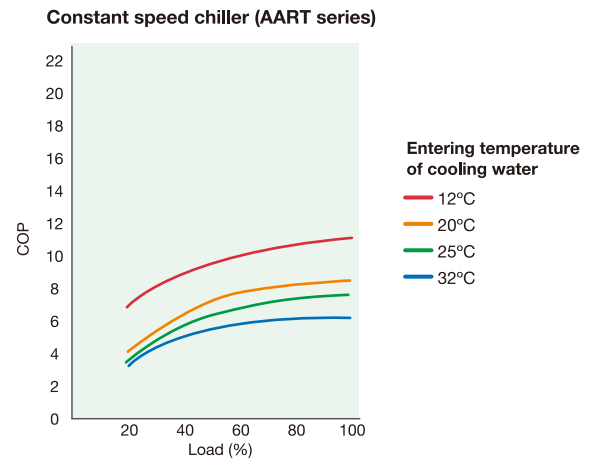
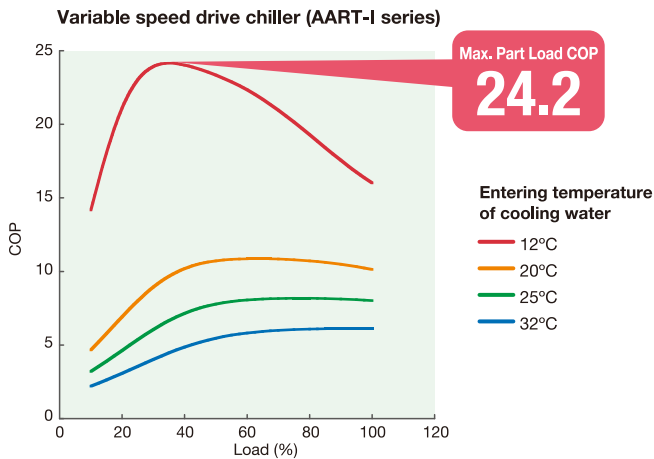
About **60%UP**
(AART-1001 cooling water 12°C, Industrial use pattern)



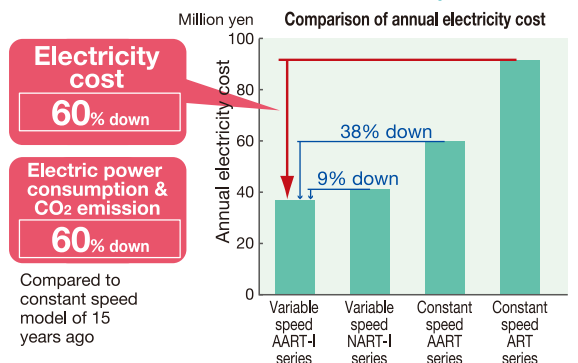
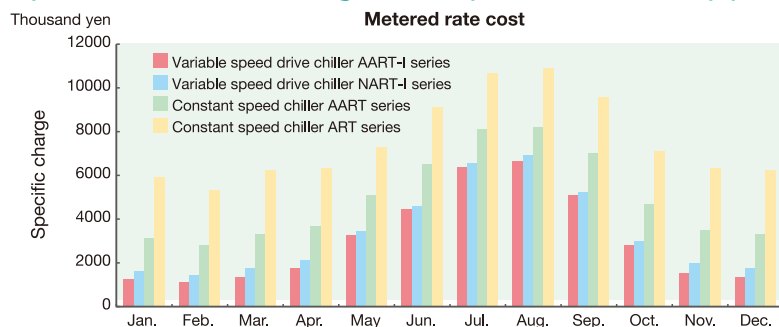
FEATURES

Max. Part Load COP 24.2

Performance characteristics (Leaving temperature of chilled water is 7°C, 1000 RT, in Japan)



Operation cost according to load pattern for factory process use (1000 RT x 3 units, in Japan)



OPERATION RANGE

Suitable for customer's demand (* As option)

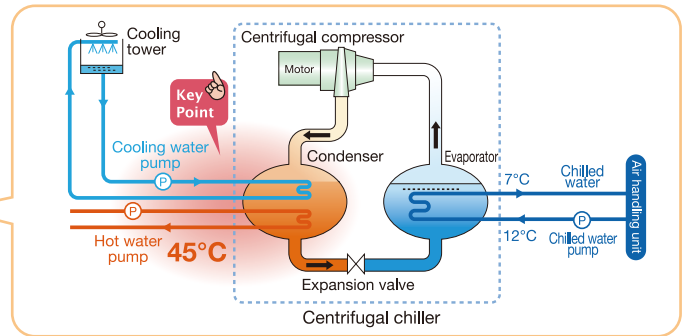
Temperature

Chilled water leaving temperature Lower limit: **-5 °C** *

Low temperature use (Brine)

Cooling water entering temperature Lower limit: **12 °C**
(Chilled water temperature: 7 °C)

Hot water leaving temperature Higher limit: **45 °C** *
Heat recovery use



Load

Capacity control range in a continuous operation 100% – close to **0 %** *
(Standard: 100%–20%)

Flow Rate

Chilled water / Cooling water flow rate control range **50% – 100%** *
(Standard: 100%)

Chilled water flow rate control range **100% – 150%** *
(Standard: 100%)

Excess flow rate

MICROCOMPUTER CONTROL PANEL

More improved microcomputer control panel **NEW**

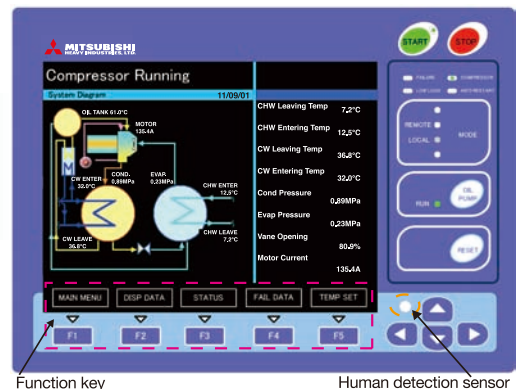
10.4 inch Display **Big**
Digital Display **Clear**
Quick Response **Smooth** **Save Energy**

Liquid Crystal Display (LCD) with automatic lighting-up function

Relight-up by human detection sensor without touching panel

For environmental standards

Realize lead-free substrate
RoHS compliant



Followings are displayed

- Operation data
- Setup schedule operation condition
- Failure data
- Real time trend (max. 5 operational data and max. 3 situational data)

Other Features

Control Function (Option)

- Meeting with BAS (Building Automation System) requirement. Our chiller is compatible with LonWorks® networks.
* LonWorks® is the registered trademark of Echelon company in the United States of America and other countries.
- Meeting with control monitoring equipment
- In case of instantaneous power failure, chiller restarts automatically.

Reliability

- Stability of lubrication oil level and oil temperature improved with oil-cooler for refrigerant and high efficient oil recovering system.
- Chillers are produced at our factory certificated authentication ISO 9001 and 14001.

Maintenance

- Overhaul interval is 50,000 hour in operating time or 7 years in elapsed time, which comes earlier.
- Marine type water box with hinge is provided as standard scope of supply for easier maintenance and inspection. Please contact with MHI about overhaul. The above overhaul time and operation time is for reference only.

Application to Low Brine Temperature Cooling

- Applicable for industrial use and ice storage system by adopting two stage compressor.

Standard Ratings

ARI 550-98 Condition

Item (unit)	Model	AART-	25 I	30 I	35 I	40 I	45 I	50 I	60 I	70 I	90 I	100 I	120 I	145 I	180 I	200 I
Cooling capacity	RT		250	300	355	425	500	590	710	830	1,000	1,200	1,420	1,700	1,800	2,130
	kW		879	1,055	1,248	1,494	1,758	2,075	2,497	2,919	3,516	4,220	4,993	5,978	6,329	7,490
Chilled water	Entering temperature	°C	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
	Leaving temperature	°C	6.7													
	Flow rate	m ³ /h	137	165	195	233	274	324	389	455	548	658	779	932	987	1,168
	Pressure drop	kPa	102	107	102	108	114	107	54	55	53	54	57	56	82	90
	Piping connection / Nozzle size	inch	6	6	6	8	8	8	10	10	12	14	14	14	16	18
	No. of pass	-	3	3	3	3	3	3	2	2	2	2	2	2	2	2
	Cooling water	Entering temperature	°C	29.4												
Leaving temperature		°C	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5
Flow rate		m ³ /h	173	208	245	294	344	405	487	570	687	825	974	1,167	1,231	1,459
Pressure drop		kPa	95	110	113	117	107	108	57	54	55	55	61	65	99	109
Piping connection / Nozzle size		inch	6	6	8	8	8	10	10	12	12	14	14	14	16	18
No. of pass		-	3	3	3	3	3	3	2	2	2	2	2	2	2	2
Inverter input	50Hz	kW	142	173	195	238	271	316	380	446	538	652	757	914	939	1,126
	60Hz	kW	146	177	199	242	275	320	383	450	543	657	766	922	949	1,136
Motor output	50Hz	kW	118	145	165	202	233	276	329	389	464	567	659	803	830	1,003
	60Hz	kW	118	146	165	202	233	277	329	390	464	567	660	804	830	1,004
COP	50Hz		6.18	6.10	6.39	6.28	6.48	6.57	6.57	6.55	6.53	6.47	6.60	6.54	6.74	6.65
	60Hz		6.01	5.95	6.28	6.19	6.40	6.49	6.52	6.49	6.48	6.42	6.52	6.48	6.67	6.59

Notes:

- This specification is based on AHRI STANDARD 550/590-2003 conditions for temperature and fouling factor of chilled water and cooling water.
- Max. working pressure (Chilled water and Cooling water): 1 MPa (G)
- Unit capacity of over 2,000 RT up to 4,000 RT with dual compressors are available.
- The above specification is not data of max. cooling capacity.

5. Power source applicable is as follows.

Voltage	Chiller capacity	
	Less than 700 RT (Does not include 700)	More than 700 RT
380 V-440 V	○	Option ^{*1}
3000 V/3300 V	○ ^{*2}	○ ^{*2}
6000 V/6600 V		○ ^{*2}

*1: Consult with MHI in case chiller capacity is more than 700 RT with 400 V class because it depends of motor output.

*2: Consult with MHI

6. Design and specifications are subject to change without notice.

Options

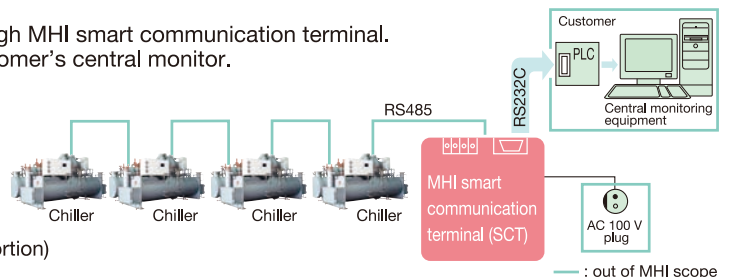
Central Monitoring Program Connect to customer's central monitoring equipment

Features

- Output operation data at customer's central monitor through MHI smart communication terminal.
- Operation data can be used for the following items at customer's central monitor.
 - Trend
 - Operation status of chillers
 - Daily report and monthly report etc.
- Total connection/transmission distance of RS485 with max. 500 m

Feature of MHI specialized communication tool

- Compact size (W230 x H50 x D244 mm: excluding projection portion)
- Connected to AC 100 V plug
- High speed data processing by 32 bit CPU



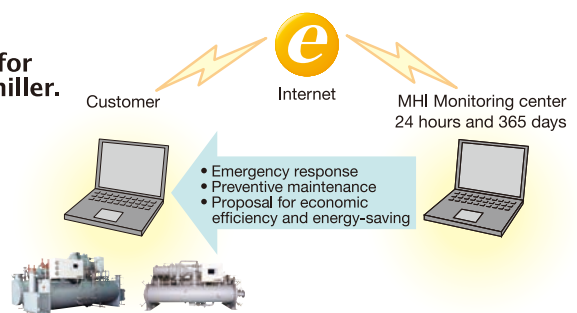
Remote Monitoring Program

24-hour and 365-day remote monitoring program is suitable for maintaining the performance and function of the centrifugal chiller.

Features

The remote monitoring program enables various performances.

- Monitoring the operation status
- Emergency response/treatment and report of the result
- Submission of monthly report of data and customer's observation
- Proposal for preventive maintenance and economical use based on the result of the analysis of accumulated data



Chilled Water Leaving Temperature 5°C

Item (unit) \ Model	AART-	25 I	30 I	35 I	40 I	45 I	50 I	60 I	70 I	90 I	100 I	120 I	145 I	180 I	200 I	
Cooling capacity	RT	215	260	310	380	430	530	600	750	850	1,050	1,300	1,500	1,800	2,000	
	kW	756	914	1,090	1,336	1,512	1,864	2,110	2,637	2,989	3,692	4,571	5,274	6,329	7,033	
Chilled water	Entering temperature	°C	10	10	10	10	10	10	10	10	10	10	10	10	10	
	Flow rate	m³/h	130	157	187	229	259	319	362	452	512	633	784	904	1,085	1,205
	Pressure drop	kPa	94	100	96	107	105	106	62	55	61	52	59	53	98	97
	Piping connection / Nozzle size	A	150	150	150	200	200	200	250	250	300	350	350	350	400	450
	No. of pass	-	3	3	3	3	3	3	2	2	2	2	2	2	2	2
Cooling water	Entering/Leaving temperature	°C	Entering 32°C / Leaving 37°C													
	Flow rate	m³/h	156	188	223	273	309	379	430	535	609	751	929	1,071	1,282	1,426
	Pressure drop	kPa	77	90	95	101	87	94	62	61	61	62	55	55	106	104
	Piping connection / Nozzle size	A	150	150	200	200	200	250	250	300	300	350	350	350	400	450
	No. of pass	-	3	3	3	3	3	3	2	2	2	2	2	2	2	2
Inverter input	kW	50Hz	145	171	200	243	275	326	379	460	539	653	812	924	1,099	1,219
		60Hz	148	175	204	246	278	330	382	465	546	658	822	931	1,109	1,231
Motor output	kW	50Hz	120	143	169	206	235	286	327	404	464	567	709	811	976	1,088
		60Hz	120	144	170	206	235	286	327	404	466	567	711	811	977	1,090
COP	50Hz	5.21	5.35	5.45	5.50	5.50	5.72	5.57	5.73	5.55	5.65	5.63	5.71	5.76	5.77	
	60Hz	5.11	5.22	5.34	5.43	5.44	5.65	5.52	5.67	5.47	5.61	5.56	5.67	5.71	5.71	

Chilled Water Leaving Temperature 7°C

Item (unit) \ Model	AART-	25 I	30 I	35 I	40 I	45 I	50 I	60 I	70 I	90 I	100 I	120 I	145 I	180 I	200 I	
Cooling capacity	RT	230	260	320	370	450	530	680	750	1,000	1,100	1,350	1,500	1,800	2,000	
	kW	809	914	1,125	1,301	1,582	1,864	2,391	2,637	3,516	3,868	4,747	5,274	6,329	7,033	
Chilled water	Entering temperature	°C	12	12	12	12	12	12	12	12	12	12	12	12	12	
	Flow rate	m³/h	139	157	193	223	272	320	410	453	603	664	815	905	1,086	1,207
	Pressure drop	kPa	104	99	100	101	112	105	52	55	52	65	62	50	97	96
	Piping connection / Nozzle size	A	150	150	150	200	200	200	250	250	300	350	350	350	400	450
	No. of pass	-	3	3	3	3	3	3	2	2	2	2	2	2	2	2
Cooling water	Entering/Leaving temperature	°C	Entering 32°C / Leaving 37°C													
	Flow rate	m³/h	165	186	228	263	319	375	481	530	707	778	955	1,060	1,268	1,410
	Pressure drop	kPa	86	88	99	94	93	92	55	60	58	60	58	54	104	101
	Piping connection / Nozzle size	A	150	150	200	200	200	250	250	300	300	350	350	350	400	450
	No. of pass	-	3	3	3	3	3	3	2	2	2	2	2	2	2	2
Inverter input	kW	50Hz	143	158	192	218	267	302	396	428	584	636	782	855	1,017	1,126
		60Hz	147	162	196	220	270	305	399	433	589	641	792	862	1,028	1,136
Motor output	kW	50Hz	118	132	162	185	228	264	343	373	505	551	682	749	903	1,003
		60Hz	119	133	163	185	228	264	343	374	505	551	684	749	904	1,004
COP	50Hz	5.66	5.79	5.86	5.97	5.93	6.17	6.04	6.16	6.02	6.08	6.07	6.17	6.22	6.25	
	60Hz	5.50	5.64	5.74	5.91	5.86	6.11	5.99	6.09	5.97	6.03	5.99	6.12	6.16	6.19	

Notes:

- Chilled/Cooling water fouling factor: 0.000086 m²K/W (0.0001 m²h °C/kcal)
- Max. working pressure (Chilled water and Cooling water): 1 MPa (G)
- Unit capacity of over 2,000 RT up to 4,000 RT with dual compressors are available.
- The above specification is not data of max. cooling capacity.

5. Power source applicable is as follows.

Voltage	Chiller capacity	
	Less than 700 RT (Does not include 700)	More than 700 RT
380 V-440 V	○	Option ^{*1}
3000 V/3300 V	○ ^{*2}	
6000 V/6600 V	○ ^{*2}	

*1: Consult with MHI in case chiller capacity is more than 700 RT with 400 V class because it depends of motor output.

*2: Consult with MHI

6. Design and specifications are subject to change without notice.

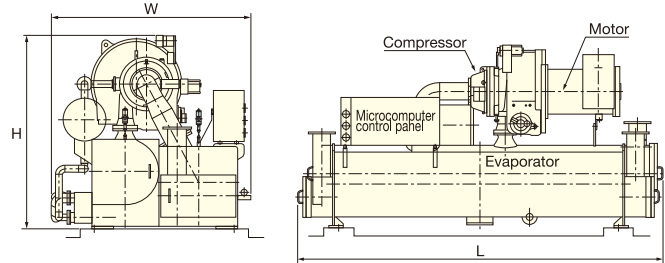
Dimensions and Weights

Chiller

Item (unit)	Model	AART-	25 I	30 I	35 I	40 I	45 I	50 I	60 I	70 I	90 I	100 I	120 I	145 I	180 I	200 I
Dimension	Length (L)	m	4.5	4.5	4.6	4.6	4.6	4.7	5.4	5.5	5.5	5.5	5.6	5.6	6.4	6.4
	Width (W)	m	2.2	2.3	2.3	2.4	2.5	2.7	2.8	2.9	3.3	3.5	3.5	3.5	3.8	4.2
	Height (H)	m	2.2	2.2	2.3	2.4	2.4	2.5	2.6	2.6	2.9	2.9	3.1	3.2	3.5	3.6
Shipping weight	t	8.4	8.6	9.6	10.1	11.1	11.9	15.2	15.9	19.6	21.8	24.7	26.9	32.2	34.5	

Notes:

- The above shipping weight of chiller is weight of 1 piece shipment.
- Design and specifications are subject to change without notice.

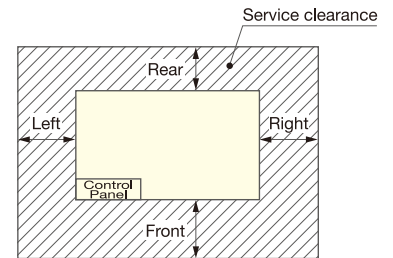


Service Clearance for Chiller

Chiller model	AART-	25 I	30 I	35 I	40 I	45 I	50 I	60 I	70 I	90 I	100 I	120 I	145 I	180 I	200 I
Front	m	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Both end	m	0.9	0.9	0.9	1	1	1	1.1	1.2	1.3	1.4	1.45	1.6	1.7	1.7
Rear	m	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

Notes:

- Service clearance must be provided more than above.
- Tube removal space must be provided at either end.
- The piping must be arranged with offsets for flexibility, and adequately supported and balanced independently to avoid strain and vibration transmission on the unit.
- Plumbing connections of the chilled water and the cooling water are made by welding flanges rating: JIS 10K.
- Thermometers of chilled water and cooling water are furnished by purchaser.
- Prepare the hook for raising compressor and motor unit.
- Refer to this figure to plan suitable and adequate entrance for machine installation, enough clearance should be provided. (Caution: This plan shows the size without insulation. After insulation, the size will increase by the thickness of insulator.)
- Rubber bushing and rubber pad are MHI scope. Scope of foundation bolts, washers and nuts may refer to specification.
- The construction of foundation bed and installation work of foundation bolt are purchaser's scope.
- The piping from the safety valve to outdoor are purchaser's scope.

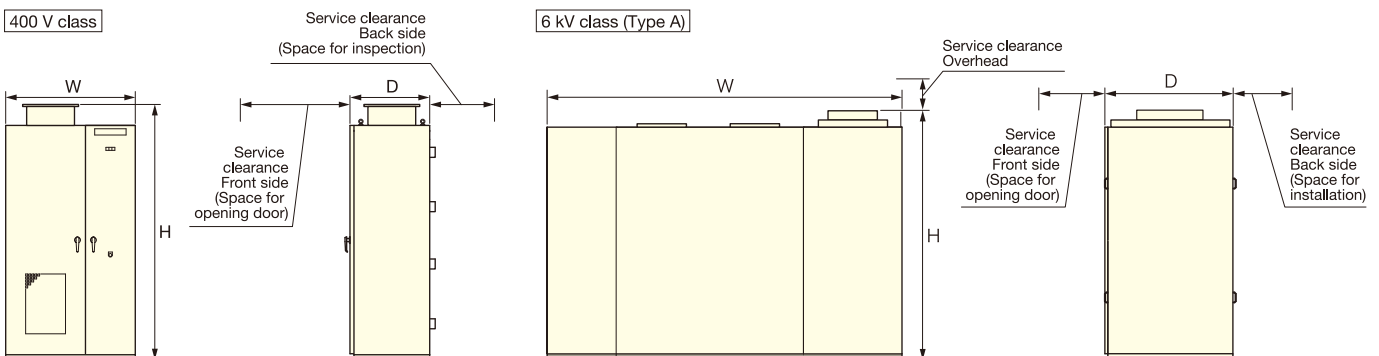


Inverter Panel

Chiller model	AART-	25 I	30 I	35 I	40 I	45 I	50 I	60 I	70 I	90 I	100 I	120 I	145 I	180 I	200 I
Voltage	—	400 V class	400 V class	400 V class	400 V class	400 V class	6 kV class	400 V class	6 kV class	400 V class	6 kV class	400 V class	6 kV class	6 kV class	6 kV class
Type of inverter panel	—	—	—	—	—	A B	—	A B	—	A B	A B	A B	A B	A B	A B
Dimension	Width (W)	m	1.30	1.30	1.30	1.30	1.80	3.71	4.10	1.80	3.71	4.10	2.10	3.71	4.10
	Depth (D)	m	0.97	0.97	0.97	0.97	1.30	0.90	0.97	1.30	0.90	0.97	1.30	0.90	1.30
	Height (H)	m	2.60	2.60	2.60	2.60	2.81	2.84	2.60	2.81	2.84	2.60	2.81	2.84	2.81
Shipping weight	t	0.65	0.65	0.80	0.80	1.20	5.10	4.70	1.35	5.10	4.70	1.40	5.10	5.10	5.10
Service clearance	Front	m	1.10	1.10	1.10	1.10	1.60	0.70	1.10	1.60	0.70	1.10	1.60	0.70	1.60
	Back	m	0.65	0.65	0.65	0.65	0.60	—	0.65	0.60	—	0.65	0.60	—	0.60
	Overhead	m	0.55	0.55	0.55	0.55	1.10	1.60	0.55	1.10	1.60	0.55	1.10	1.60	1.10

Notes:

- MHI have 2 type inverter panel in 6 kV and 3 kV class.
Type A: Small space type for width Type B: Small space type for depth
- Please contact with MHI about 3 kV class.



Notes:

- Refer to MHI drawing "MACHINE LAYOUT" and "INVERTER PANEL OUTLINE" at installation.
- Service clearance must be provided more than above.
- Shipping weight of inverter panel is approximate weight of standard specification.
- Design and specifications are subject to change without notice.

Scope of Supply

○: Standard scope of supply △: To be supplied as option
 x: Not within scope of work of supply —: Not available

Item		Specifications	
Equipment	Chiller Assembly	Indoor type (including control panel)	○
		Outdoor type (including control panel)	△
	Compressor	Hermetic, two-stage, centrifugal type	○
	Compressor Motor	Liquid refrigerant cooled, hermetic, squirrel cage, 3-phase, induction type motor, 2 pole, insulated grade B	○
	Step-up Gear	Integrated inside compressor housing, single helical gear	○
	Lubrication System	Trochoid pump with submerged motor, refrigerant cooled oil cooler, single oil filter, oil heater with temperature control	○
		Double oil filter	△
	Evaporator & Condenser	Japanese High Pressure Gas Safety Law and JIS	○
		Horizontal shell and tube type with copper tube (3/4"OD) Design pressure of water box: 1.0 MPa (G)	○
		Marine type water box with hinge	○
		Tube material other than copper (ex: cupronickel, admiralty brass, titanium)	△
		Tube sheet material other than steel (ex: naval brass clad steel, titanium clad steel)	△
	Safety Device	Design pressure of water box: Over 1.0 MPa (G)	△
		High condensing pressure, Low evaporating pressure, Low oil pressure, Low chilled water outlet temperature, Low chilled water flow rate, Low cooling water flow rate, High oil temperature, High compressor motor coil temperature, Low voltage, Compressor motor over load	○
	Microcomputer Control Panel	Mounted on heat exchanger, indoor non hazardous type with color liquid crystal display, lamps and control switches on microcomputer operation board *Prepare 200/220 V three-phase as an auxiliary power. In case of other voltage, consult with MHI.	○
	Inverter Panel	Self standing, indoor, non hazardous type with a multi meter	○
		Self standing, outdoor, hazardous type with a multi meter	—
		Power fuse medium voltage	△
		Capacitor for power factor improvement	△
		380 V power for compressor motor (less than 710 kW)	○
Refrigerant	10, 11 kV/50 Hz power for compressor motor	△	
	Tie transformer for control power (ex: 400/200 V)	—	
Lubrication Oil	HFC134a in pressure bottles for one (initial) charge	○	
Accessory	Ester oil in can for one (initial) charge	○	
	A thermometer of oil reservoir, Sight glasses, Pressure gauges of condenser, evaporator and oil pressure, Rubber pad of vibration isolating, Special insulation tape of compressor motor terminal, Flow switch of chilled water and cooling water	○	
	Foundation bolt	△	
	Spring pad for vibration isolating	△	
	Thermometer for chilled water and cooling water	△	
	Charging hose for refrigerant	△	
	General tool and tool box	△	
Spare Parts	An oil filter element, A filter drier, A fuse for control panel	○	
Test	Shop Test	Test in accordance with JIS B8621	○
	Witness Test	Test in accordance with AHRI STANDARD 550/590-2003 (depend on temperature condition)	△
Painting	Chiller	Witness test at manufacture's (MHI) site	△
	Control Panel	Rust preventing paint	○
		Finish coat	△
Inverter Panel	Rust preventing and finish coat (color: Munsel 5Y7/1)	○	
Insulation of Chiller	Not provided (Purchaser's scope. Instruction for insulation to be submitted.) Please follow our INSULATION PROCEDURE. Polystylen form covered by Colored steel sheet 0.3 mm		—
			△
			△
Delivery	FOB Kobe port in Japan		○
	Ex warehouse at Kobe port in Japan (on truck)		△
	CIF port near Site		△
Shipping Style of Chiller	Integrated style		○
	Divided style		△
Site Works	Foundation	Customer's scope	x
	Installation	Chiller installation, setting of anchor bolt, water pipe and piping works, and cable and wiring works at site	△
	Commissioning	Supervisor for site installation	x
Others	Code and Standard	JIS (Japan Industrial Standard), JEC (Japanese Electrotechnical Committee), JEM (The Standard of Japan Electrical Manufacture's Association)	○
		ASME ASTM (Steel Material only)	—
		100-20%, Controlling compressor inlet guide vane (1st & 2nd stage) and hot gas bypass valve	○
	Capacity Control	100-0%, Larger hot gas bypass valve than standard	△
		Interface and communication to Building Control System (Available only for LonWORKS®)	△
	Drawings	Interface and communication to Building Control System (Available only for LonWORKS®)	△
		Specification and scope of supply	○
		General arrangement (including foundation)	○
Documents	Outline of control panel	○	
	Sequence diagram	○	
	Operation and maintenance instruction	○	
	Test and inspection record	△	

Two Stage Centrifugal Chiller AART-I series

ISO 9001



Certificate number: JQA-0709
Date of certificate: December 16, 1994

Our Air-Conditioning & Refrigeration Systems Headquarters is an ISO (International Organization for Standardization) 9001 quality management system certified organization.

PED



Certificate: PED97/23/EC Module H1
Certificate number: 01 202J/Q-010001
Certified by: TÜV CERT (Germany)
Date of certificate: April 22, 2001

Our Air-Conditioning & Refrigeration Systems Headquarters is a PED (Pressure Equipment Directive) 97/23/EC Module H1 certified organization.

ISO 14001



Certificate number: YKA 0771887
Date of certificate: June 26, 1998

Our Production Shop, Centrifugal & Absorption Chiller Dept., Air-Conditioning & Refrigeration Systems Headquarters is an ISO (International Organization for Standardization) 14001 environmental management system certified organization.

www.mhi.co.jp/en/products/category/centrifugal_chiller.html

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· Because of our policy of continuous improvement, we reserve right to make changes in all specifications without notice.
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