

Test Project

Part B – Specifications, drawings, and
information

Refrigeration and Air Conditioning

Competitor's

Name _____

Country _____

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Independent Test Project Validator: Chris MacDonald

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Introduction

This Test Project was developed by Independent Test Project Designers.

Part A Module descriptions and Competitor instructions will be released by WorldSkills International to the Experts, Interpreters, and Competitors one (1) month prior to the competition to enable it to be translated into the competitors preferred language.

Part B Specifications and drawings will be released by the Skill Competition Manager to the:

Experts at the Competition (C-4)

Competitors at the Competition (C-2)

This Test Project reflects international best practice as described by the Technical Description and the WorldSkills Occupational Standards. The Test Project's Marking Scheme will only assess and allocate marks to those skills that are set out in the WorldSkills Occupational Standards.

Description of project and tasks

The Test Project is a series of standalone modules.

There are four (4) modules to complete in the 16-hour competition.

- Module A - Refrigeration System Installation and Commissioning - Time allowed 12 hours
- Module B - Air Conditioning System Electrical Fault Finding - Time allowed 1 hour
- Module C - Component Fabrication and Brazing - Time allowed 1.5 hours
- Module D - Air Conditioning System Refrigeration Fault Finding and Repair -Time allowed 1.5 hours

Test Project documentation

The Test Project documentation is a series of standalone modules and consists of the following two (2) parts:

Part A – Module descriptions and Competitor instructions

This contains all of the competition details for each module, including the task description, time limits, and instructions to the Competitor. (this document)

Part B – Module specifications drawings and information

This contains the Test Project drawings, information, and specifications including the following:

- WSC2024_TP38_MA_01_en – Refrigeration system piping diagram

- WSC2024_TP38_MA_02_en – Electrical circuit diagram
- WSC2024_TP38_MA_03_en – Refrigeration system components layout
- WSC2024_TP38_MA_04_en – Refrigeration system installation specifications
- WSC2024_TP38_MB_01_en – Fault finding system's specification and drawings
- WSC2024_TP38_MC_01_en – Component fabrication drawing

This will be provided to all Experts at the Competition at C-4 to enable it to be translated into the Competitor's language and presented with translations to the Competitor at C-2.

Equipment manufacturers' drawings and instructions

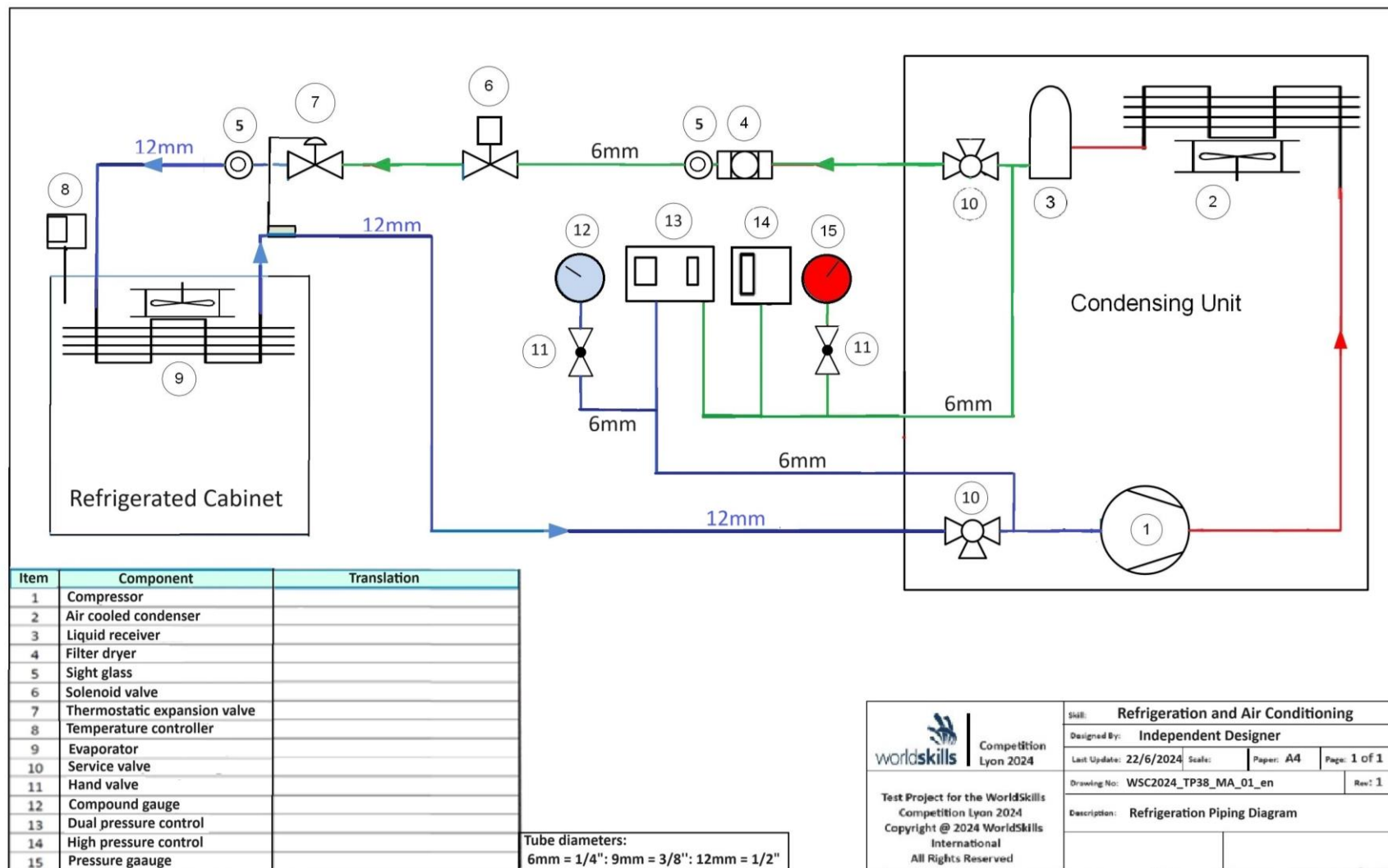
The details of the most equipment were released on the WorldSkills Infrastructure List to the participating Members in June 2024 in preparation for WS2024 Lyon to enable relevant manufacturers' instructions to be sourced by the Experts and translated into the Competitor's language if needed and provided to Competitors prior to the competition.


Additional Information

Any additional information will be provided to all Competitors at the familiarization prior to start of the competition.

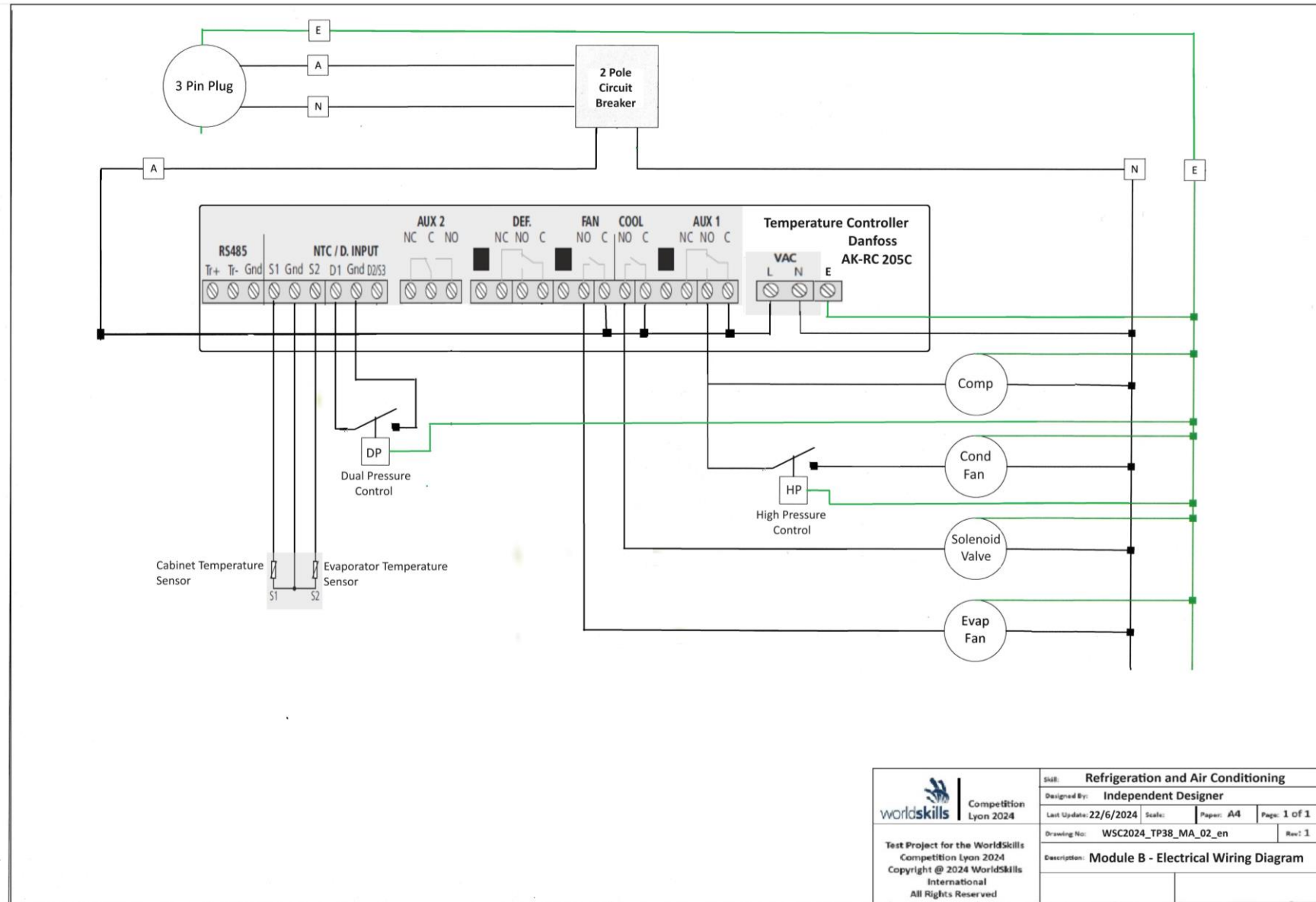
Module A Refrigeration System Installation and Commissioning

- WSC2024_TP38_MA_01_en. - Refrigeration system piping diagram

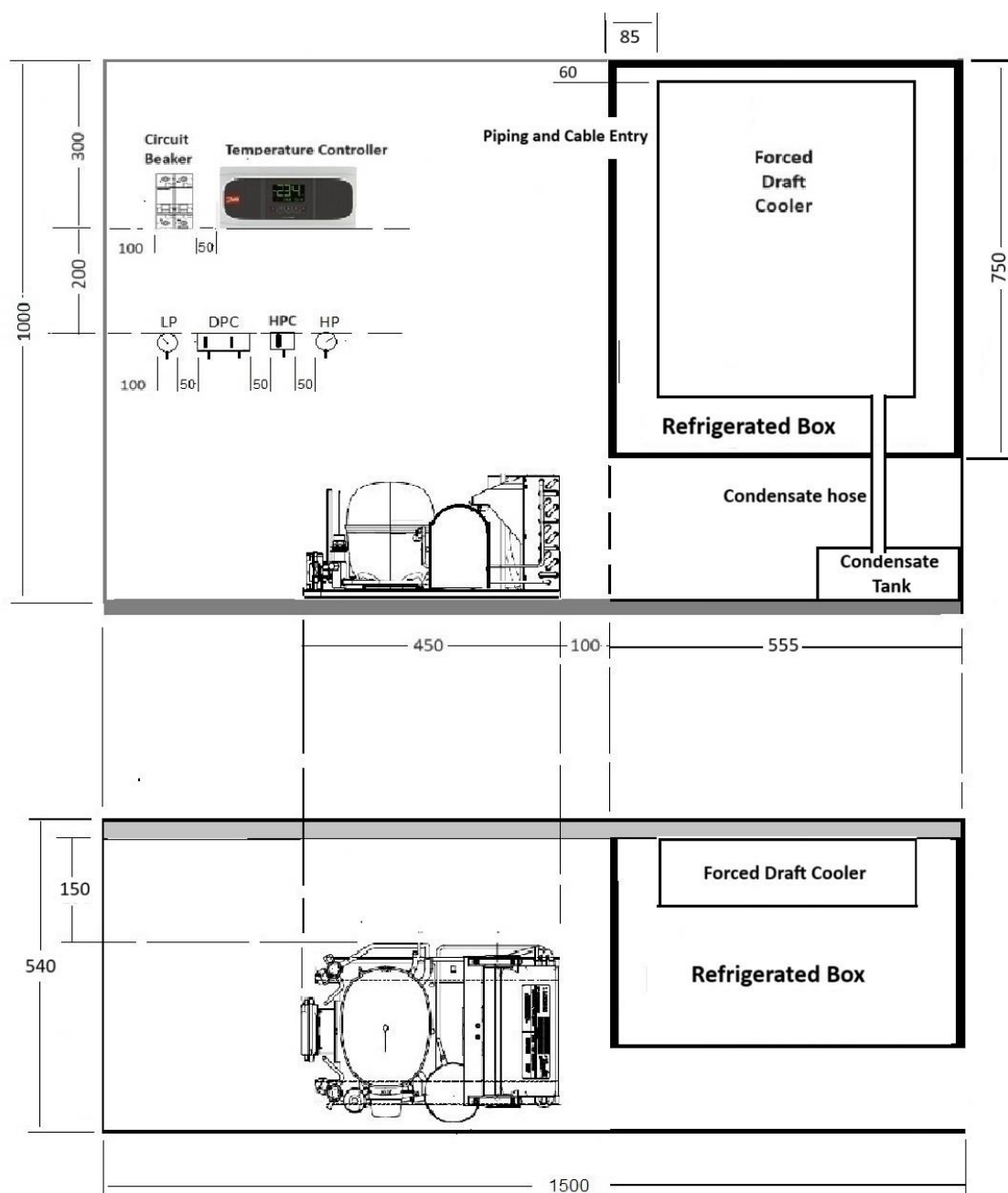


 Competition Lyon 2024	Skill: Refrigeration and Air Conditioning		
	Designed By: Independent Designer		
	Last Update: 22/6/2024	Scale:	Paper: A4 Page: 1 of 1
	Drawing No: WSC2024_TP38_MA_01_en		Rev: 1
	Description: Refrigeration Piping Diagram		

• WSC2024_TP38_MA_02_en. – Electrical circuit diagram



- WSC2024_TP38_MA_03_en. - Refrigeration system components layout



Dimensions
Condensing Unit: 450mm x 320mm x 225mm high

• WSC2024_TP38_MA_04_en. - Refrigeration system installation specifications

System Design Specification

The following system design specifications for the installation should be used for commissioning and control setting and are as follows:

- System Type: Refrigerated cabinet
- Refrigerant = R513A
- Design cabinet space temperature = 2°C +/- 1K (36°F +/-2°F)
- Maximum ambient temperature = 35°C Db, 28°C Wb (95°F Db, 82°F)
- Cabinet temperature controller is to cut out at 1°C (34°F) and cut in at 3°C (37°F)
- Design saturated suction temperature (SST) = -4°C (25°F)
- Suction line pressure drop = 1 K (2°F)

Control and safety settings

- Temperature Controller
 - The Controller is to set up to operated the system on a Pump-down cycle with off cycle defrost with the evaporator fans operating continuously
 - S1 probe is to be installed to sense the temperature of the air on to the evaporator coil.
 - S2 probe is to be installed to sense the temperature of the evaporator coil.
 - Settings
 - **Initial Configuration**
 - Type of Installation Number: 5
 - SP - Set Point Temperature : 1°C (34°F)
 - **Condensed Programming Menu**
 - C1 – Probe 1 differential: 2K (4°F)
 - **Expanded Programming Menu**
 - dEF – Defrost, D7 Type of Defrost: 1 Air/fans
 - Bcn - Basic configuration: Unit: 0 = °C
 - In0 Inputs and Outputs
 - 100 Connected probes: 2
 - 110 Configuration of digital input 1: 7 Low pressure control
 - 111 Polarity of digital input 1: 1 Activates in open contact

Dual Pressure Control

- Low Pressure cut off 20K (35°F) lower than design saturated suction temperature (SST) and cut in at 3°C (37°F) saturated suction temperature
- High Pressure cut out when the condensing temperature reaches 55°C (130°F). The differential is factory set.
- High Pressure Control
 - Cycles the condenser fan. Cut-in pressure equals saturated temperature of 45°C (113°F) and Cut-out pressure equals saturated temperature of 35°C (95°F)

Pressure Test

The high-pressure side of the system is to be pressure tested for leaks at the same pressure as the low-pressure side which is to be equivalent to 32°C (90°F) saturation temperature.

The pressure test is to be carried out in two stages, the first between 50 and 55% of the required test pressure and the second between at 100% and 110% of the required test pressure.

Pressure test must be satisfied before the evacuation can commence.

Insulation cannot be fitted until the pipework has been marked by Experts.

Evacuation

- Evacuate the complete system including the compressor to achieve a vacuum of at least 1000 microns (133 kPa or 1,333 mbar absolute of mercury).
- After the vacuum pump is isolated from the system under test, wait for the deep vacuum to settle below 1000 micron and then start the vacuum rise test for ten (10) minutes.
- The evacuation pressure MUST NOT rise above 1,500 microns in the Ten (10) minutes.

Evacuation rise test must be satisfied before refrigerant charging can be carried out.

Electrical installation must be completed and tested before charging can be carried out.

Module B Electrical Fault Finding and Module D Refrigeration Fault Finding

- **WSC2024_TP38_MC_01_en – Fault Finding Unit’s Specifications and Drawings**

SYSTEM DESIGN SPECIFICATIONS

Below are system design specifications and drawings for the air conditioning unit that will be used for the following:

- Module B Electrical Fault Finding
- Module D Refrigeration Fault Finding and Repair

Split System Air Conditioner:

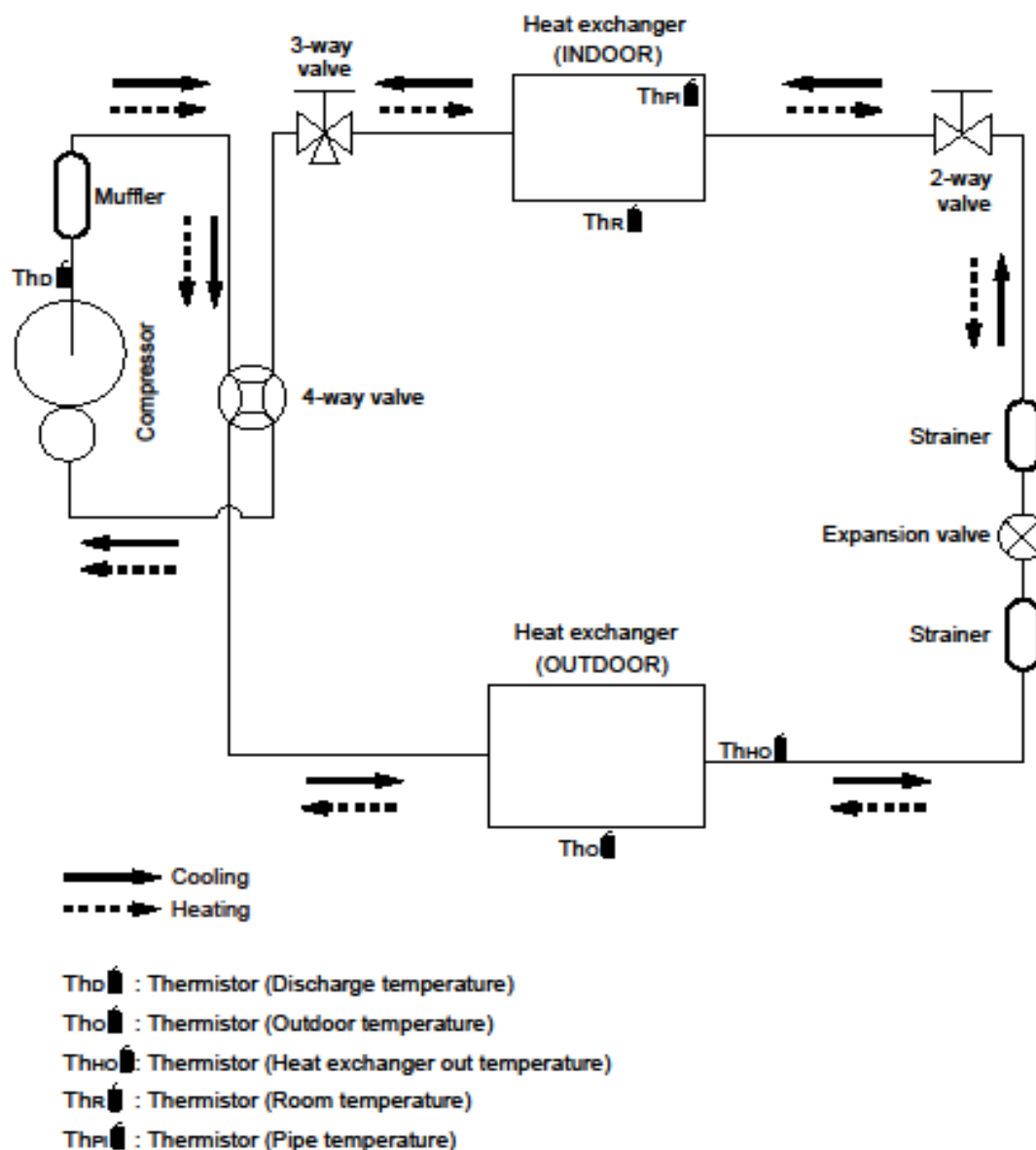
- Make: Fujitsu
- Rated Capacity (Cooling) 2.0 kW, (Heating) 2.50 kW
- Indoor unit: Model No: ASYGO7KMCC
- Outdoor unit: Model No: AOYGO7KMCC
- Electrical Rating: 1 phase, 220~240-volt AC, 50 Hertz, 10 amp

Design Conditions

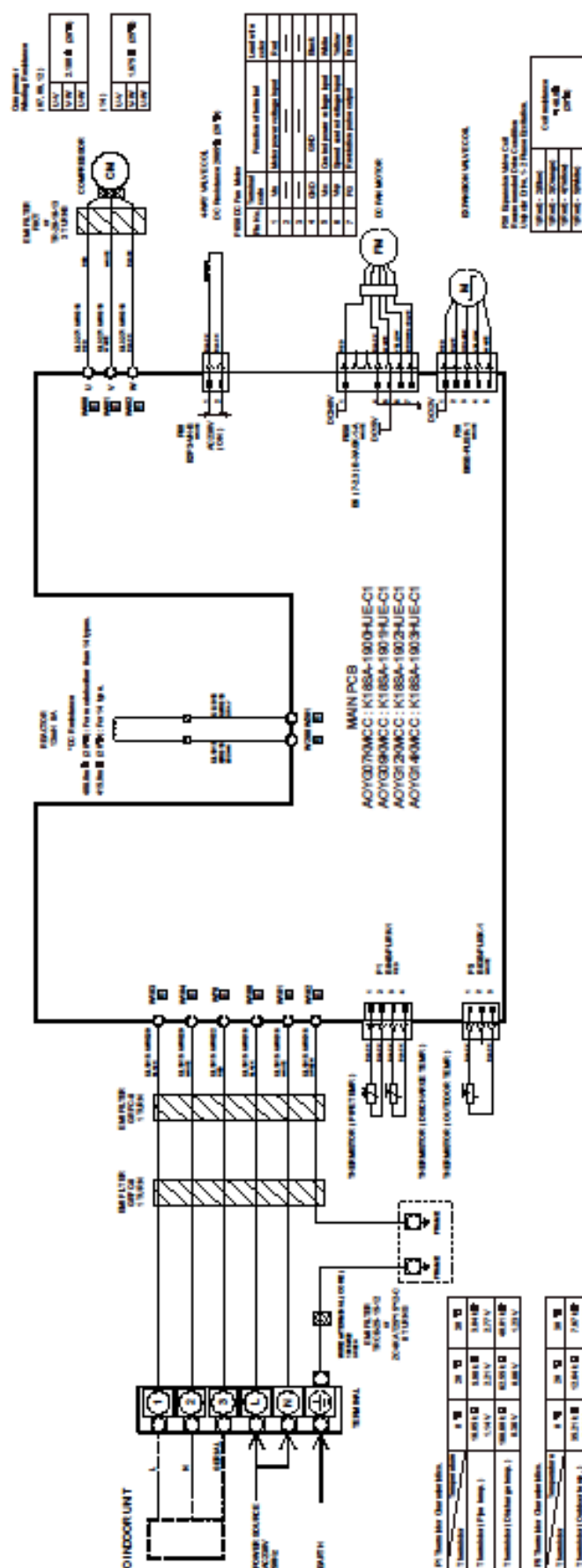
- Refrigerant = R32
- Refrigerant Charge = 600 grams (21.2 ounces)
- Maximum ambient temperature = 35°C (95°F)
- Design saturated suction temperature = 5°C (41°F)
- Difference between the air-entering and the evaporation temperature = 20 Kelvin (35°F)
- Suction line pressure drop = 1 Kelvin (2°F)
- Condensing temperature = 45°C (113°F)
- Difference between the air-entering and the condensing temperature = 10 Kelvin (20°F)

Refrigerant circuit

Models: ASYG07KMCC/AOYG07KMCC, ASYG09KMCC/AOYG09KMCC, and ASYG12KMCC/AOYG12KMCC



[illegible]



Error detection

If you see a status/monitoring, the lamp on the photo detector unit will output error codes by any of following patterns. If you use a wired remote controller, error codes will appear on the remote control display. Refer to the lamp lighting patterns and error codes in the table. An error display is displayed only during operation.

Error display			Error code	Description
OPERATION lamp (green)	TIMER lamp (orange)	ECONOMY lamp (green)		
●(1)	●(1)	◇	11	Serial communication error
●(1)	●(1)	◇	12	• Micro remote controller authentication error • Power source control communication error
●(1)	●(1)	◇	15	Check the wireless Automatic stop adjustment error
●(1)	●(1)	◇	16	Pair/reset with transmission POC communication error
●(1)	●(1)	◇	18	Internal communication error
●(1)	●(1)	◇	21	Unit number or Refrigerant circuit address setting error (Flammable leak)
●(1)	●(1)	◇	22	Indoor unit capacity error
●(1)	●(1)	◇	23	Correlation error
●(1)	●(1)	◇	24	• Operation will resume error (Indoor unit capacity error) (Flammable leak) • Operation will resume error (Indoor unit or branch unit) (Flammable leak)
●(1)	●(1)	◇	26	Indoor unit address setting error
●(1)	●(1)	◇	27	Primary unit, secondary unit setup error (Flammable leak)
●(1)	●(1)	◇	29	Correction unit number error in micro remote controller system
●(1)	●(1)	◇	31	Power supply interruption error
●(1)	●(1)	◇	32	Indoor unit PCB model information error
●(1)	●(1)	◇	33	Indoor unit sensor electricity consumption detection error
●(1)	●(1)	◇	35	Micro remote control error
●(1)	●(1)	◇	39	Indoor unit power supply error for fan motor
●(1)	●(1)	◇	3A	Indoor unit communication circuit (wired remote control) error
●(1)	●(1)	◇	41	Flame temp. sensor error
●(1)	●(1)	◇	42	Indoor unit heat ex. middle temp. sensor error
●(1)	●(1)	◇	44	Flame sensor error
●(1)	●(1)	◇	51	Indoor unit fan motor error
●(1)	●(1)	◇	53	Cond pump error
●(1)	●(1)	◇	54	Electric air pressure sensor VDC error
●(1)	●(1)	◇	55	Filter not error
●(1)	●(1)	◇	57	Drainage error
●(1)	●(1)	◇	58	Indoor grille cover
●(1)	●(1)	◇	59	Indoor unit fan motor 2 error (Left side fan)
●(1)	●(1)	◇	5A	Indoor unit fan motor 3 error (Right side fan)
●(1)	●(1)	◇	5U	Indoor unit error
●(1)	●(1)	◇	61	Outdoor unit overvoltage/phase and wiring error

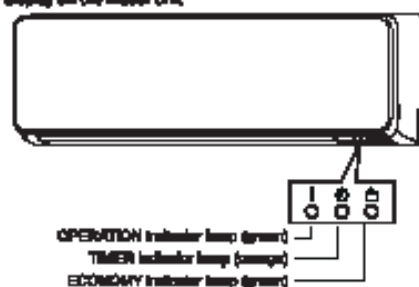
Error display			Error code	Description
OPERATION lamp (green)	TIMER lamp (orange)	ECONOMY lamp (green)		
●(1)	●(1)	◇	62	Outdoor unit main PCB model information error or communication error
●(1)	●(1)	◇	63	Inverter error
●(1)	●(1)	◇	64	Active filter error, PFC circuit error
●(1)	●(1)	◇	65	Trip terminal L error
●(1)	●(1)	◇	68	Outdoor unit main current limiting outdoor temp. rise error
●(1)	●(1)	◇	6A	Display PCB microcomputer communication error
●(1)	●(1)	◇	71	Discharge temp. sensor error
●(1)	●(1)	◇	72	Compressor temp. sensor error
●(1)	●(1)	◇	73	Outdoor unit Heat Ex. liquid temp. sensor error
●(1)	●(1)	◇	74	Outdoor temp. sensor error
●(1)	●(1)	◇	75	Evaporator temp. sensor error
●(1)	●(1)	◇	76	• 3-way valve temp. sensor error • 2-way valve temp. sensor error
●(1)	●(1)	◇	77	Heat sink temp. sensor error
●(1)	●(1)	◇	82	• Rele-coil Heat Ex. gas inlet temp. sensor error • Rele-coil Heat Ex. gas outlet temp. sensor error
●(1)	●(1)	◇	83	Liquid pipe temp. sensor error
●(1)	●(1)	◇	84	Current sensor error
●(1)	●(1)	◇	86	• Discharge pressure sensor error • Suction pressure sensor error • High pressure switch error
●(1)	●(1)	◇	94	Trip detection
●(1)	●(1)	◇	95	Compressor motor position detection error (summarized error)
●(1)	●(1)	◇	97	Outdoor unit fan motor 1 error
●(1)	●(1)	◇	98	Outdoor unit fan motor 2 error
●(1)	●(1)	◇	99	4-way valve error
●(1)	●(1)	◇	9A	Coil temperature sensor error
●(1)	●(1)	◇	A1	Discharge temp. error
●(1)	●(1)	◇	A3	Compressor temp. error
●(1)	●(1)	◇	A4	High pressure error
●(1)	●(1)	◇	A5	Low pressure error
●(1)	●(1)	◇	12	Search mode error (Flammable leak)

Display mode ● : 0.1s ON / 0.1s OFF

◇ : 0.1s ON / 0.1s OFF

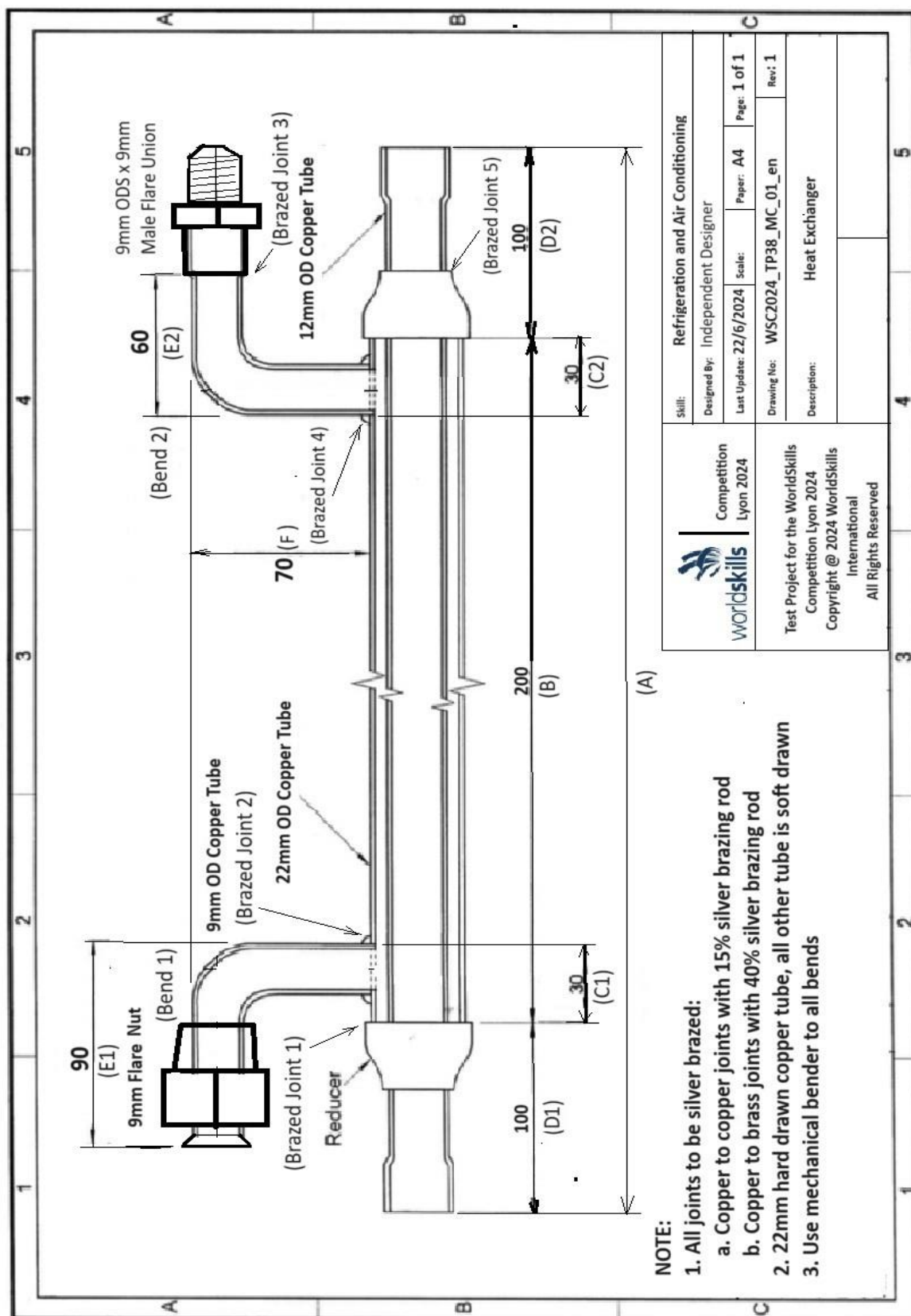
() : Hold of lighting

■ Error display on the indoor unit



Module C Component Fabrication

- WSC2024_TP38_MC_01_en – Component fabrication drawing



Pressure/Temperature Chart

SATURATION TEMPERATURE		R513A		R32	
Temp (°C)	Temp (°F)	Pressure (kPaG)	Pressure (PSIG)	Pressure (kPaG)	Pressure (PSIG)
-40	-40.0	-39	-5.7	76	11.0
-38	-36.4	-33	-4.8	93	13.5
-36	-32.8	-26	-3.8	111	16.1
-34	-29.2	-19	-2.7	130	18.8
-32	-25.6	-11	-1.5	150	21.7
-30	-22.0	-2	-0.3	172	24.9
-28	-18.4	7	1.1	195	28.3
-26	-14.8	17	2.5	220	31.9
-24	-11.2	28	4.1	247	35.8
-22	-7.6	39	5.7	275	39.9
-20	-4.0	52	7.5	304	44.1
-18	-0.4	65	9.4	336	48.7
-16	3.2	78	11.4	369	53.5
-14	6.8	93	13.5	405	58.7
-12	10.4	109	15.8	442	64.1
-10	14.0	125	18.2	481	69.7
-8	17.6	143	20.7	523	75.8
-6	21.2	161	23.4	567	82.2
-4	24.8	181	26.3	613	88.9
-2	28.4	202	29.2	661	95.9
0	32.0	224	32.4	712	103.2
2	35.6	247	35.8	765	110.9
4	39.2	271	39.3	821	119.1
6	42.8	297	43.0	880	127.6
8	46.4	324	46.9	941	136.5
10	50.0	352	51.0	1006	145.9
12	53.6	382	55.4	1073	155.6
14	57.2	413	59.9	1143	165.8
16	60.8	446	64.6	1217	176.5
18	64.4	480	69.6	1293	187.5
20	68.0	516	74.7	1373	199.1
22	71.6	553	80.2	1457	211.3
24	75.2	592	85.8	1544	223.9
26	78.8	633	91.8	1634	237.0
28	82.4	675	97.9	1728	250.6
30	86.0	720	104.4	1826	264.8
32	89.6	768	111.1	1928	279.6
34	93.2	814	118.1	2034	295.0
36	96.8	865	125.4	2144	311.0
38	100.4	917	132.9	2258	327.5
40	104.0	971	140.8	2377	344.8
42	107.6	1028	149.0	2500	362.6
44	111.2	1086	157.5	2628	381.2
46	114.8	1147	166.4	2760	400.3
48	118.4	1828	175.5	2898	420.3
50	122.0	1276	185.0	3040	440.9

SATURATION TEMPERATURE		R513A		R32	
Temp (°C)	Temp (°F)	Pressure (kPaG)	Pressure (PSIG)	Pressure (kPaG)	Pressure (PSIG)
<u>52</u>	<u>125.6</u>	<u>1344</u>	<u>194.9</u>	<u>3187</u>	<u>462.2</u>
<u>54</u>	<u>129.2</u>	<u>1415</u>	<u>205.2</u>	<u>3340</u>	<u>484.4</u>
<u>56</u>	<u>132.8</u>	<u>1488</u>	<u>215.7</u>	<u>3498</u>	<u>507.4</u>
<u>58</u>	<u>136.4</u>	<u>1564</u>	<u>226.7</u>	<u>3662</u>	<u>531.1</u>
<u>60</u>	<u>140.0</u>	<u>1642</u>	<u>238.1</u>	<u>3833</u>	<u>555.9</u>

1 Bar – 100 kPa