

Test Project

Refrigeration and Air Conditioning

Part B – Specifications drawings and
information

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Introduction

This Test Project was developed by Independent Designers.

Part A Description of the Modules and Competitor Instructions will be released by WorldSkills International to the Experts, Interpreters and Competitors prior to their arrival at 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-3)
- 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 Standards Specification.

Description of project and tasks

The Test Project is a series of standalone modules.

There are four (4) Modules to complete in the 18-hour competition.

A) Component Fabrication	13 Marks Time Allowed 2 Hrs
B) Refrigeration System Installation and Commissioning	62 Marks Time Allowed 14 Hrs
C) Refrigeration System Electrical Fault Finding	14 Marks Time Allowed 1 Hr
D) Refrigeration System Refrigeration Fault Finding	11 Marks Time Allowed 1 Hr

Test Project Documentation

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

Part A - Description of the modules and Competitor's instructions

This contains all of the competition details for each module, including the task description, time limits and instructions to competitor.

Part B – Test Project, specifications drawings, and information

This contains the test project drawings, information and specifications including the following:

1. WSC2022SE_TP38_BB_A4_01_EN.pdf - Refrigeration system piping diagram
2. WSC2022SE_TP38_BB_A4_02_EN.pdf – Electrical circuit diagram
3. WSC2022SE_TP38_BB_A4_05_EN.pdf - Refrigeration system components layout
4. WSC2022SE_TP38_BB_A4_06_EN.pdf - Ice rink coil drawing
5. WSC2022SE_TP38_BB_A4_07_EN.pdf – Refrigeration sign drawing
6. WSC2022SE_TP38_BB_A4_08_EN.pdf - Refrigeration system installation specifications
7. WSC2022SE_TP38_BB_A4_09_EN.pdf - Fault finding system's specification and drawings

This will be provided to all participating Experts at the Competition C-3 to enable it to be translated into the Competitor's language and presented to the Competitor at C-2.

Equipment manufacturers' drawings and instructions

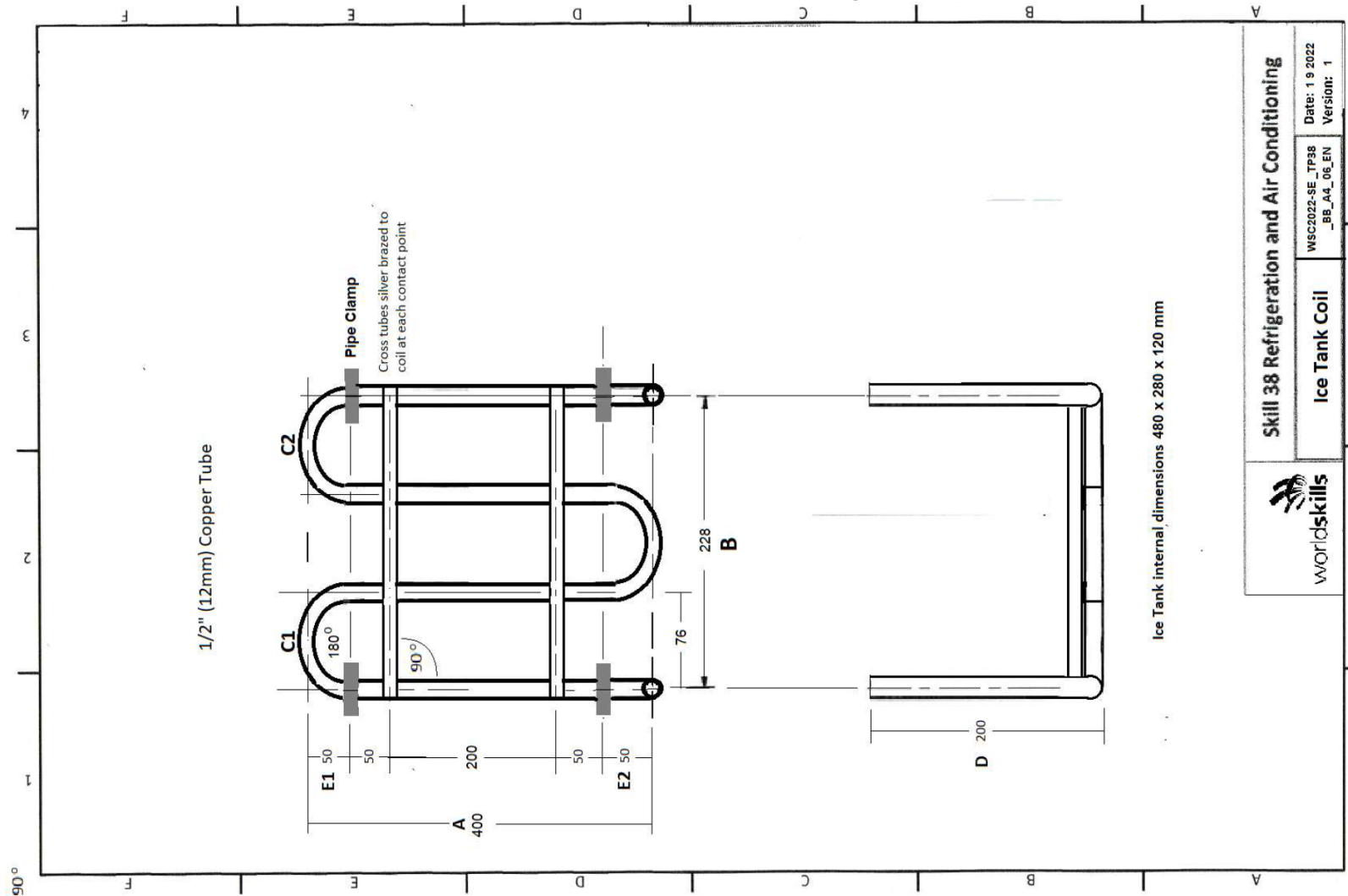
The details of the most equipment was released online by WorldSkills to the participating countries February 2022 in preparation for WS2022 Shanghai to enable relevant manufacturers' instructions to be sourced by the Experts and translated into the Competitor's language if needed and provided to Competitors prior to the competition.

Additional Information

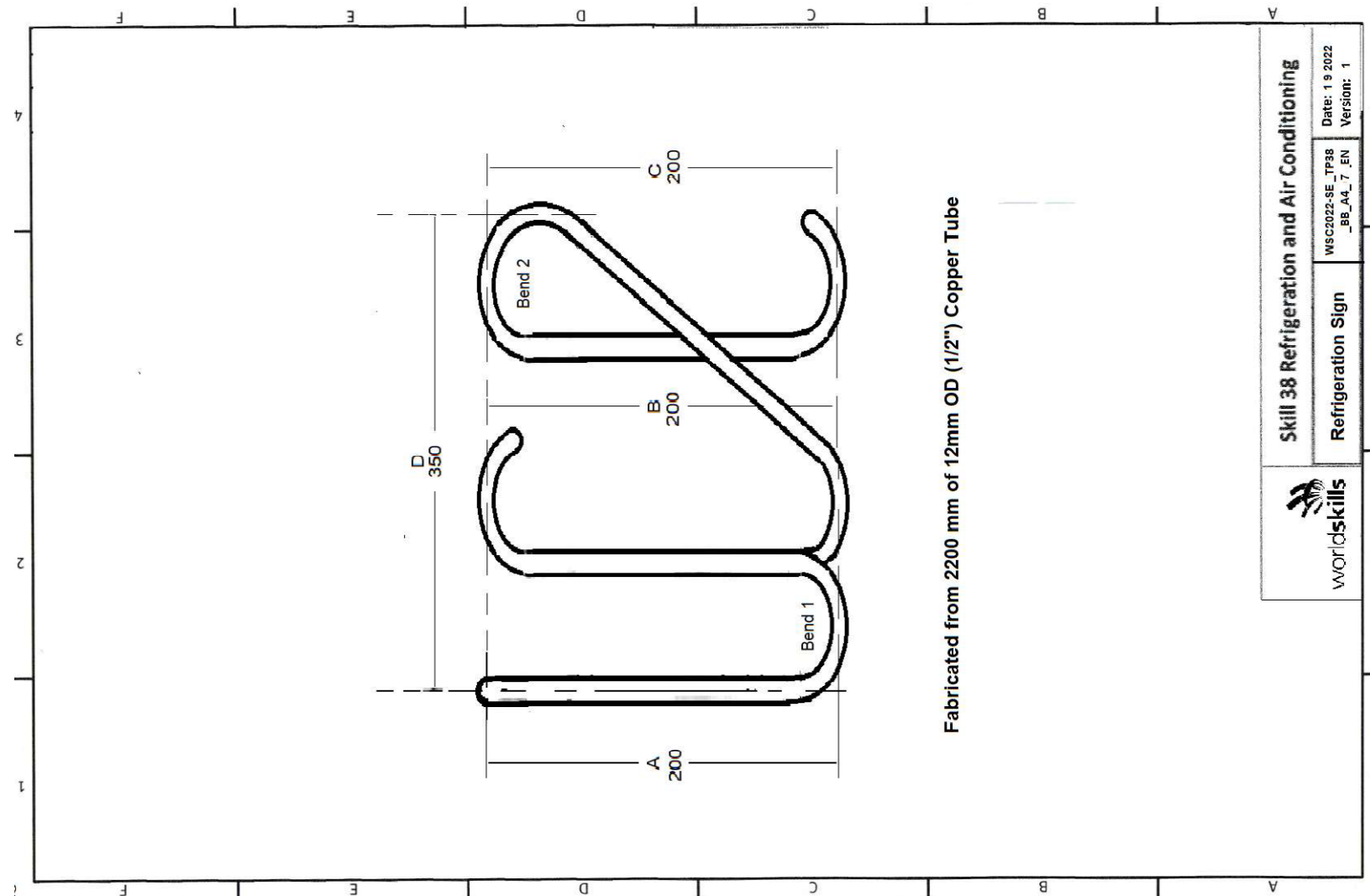
Any additional information will be provided to all Competitors at the Familiarization Session prior to start of the competition, including the Competitor's competition timetable.

Module A Component Fabrication

WSC2022SE_TP38_BB_A4_06_EN.pdf - Ice rink coil drawing

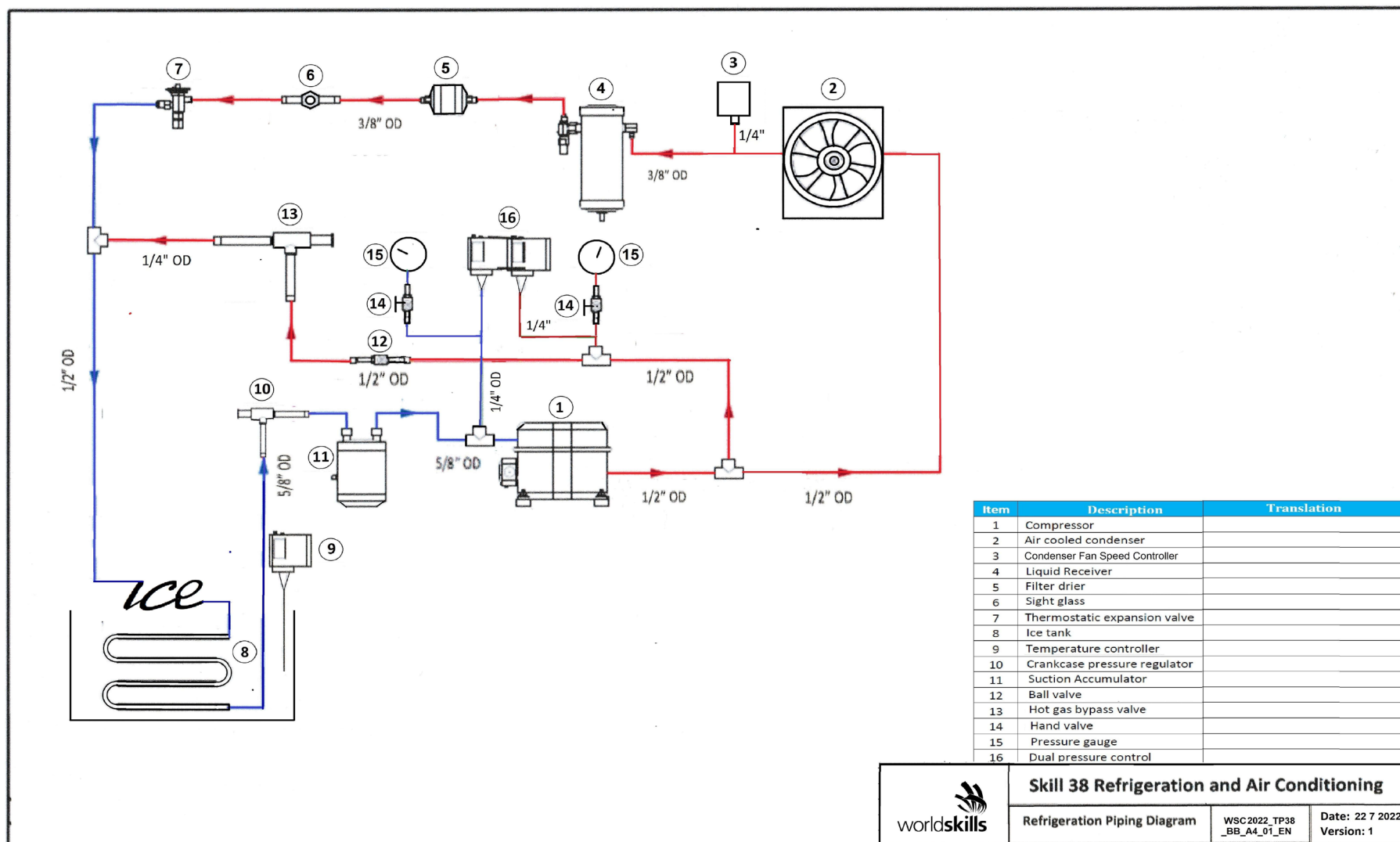


WSC2022SE_TP38_BB_A4_07_EN.pdf – Refrigeration sign drawing

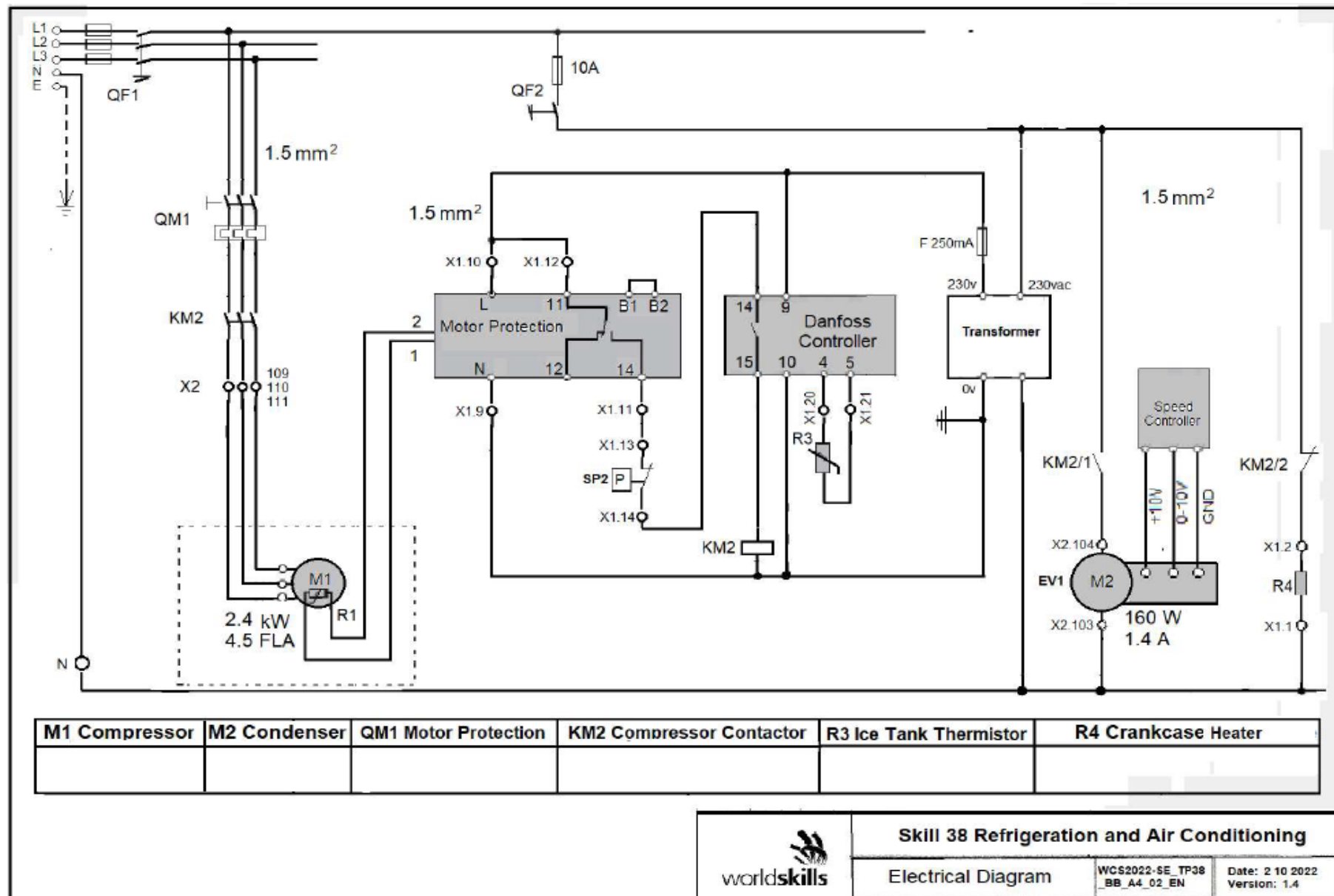


Module B Refrigeration System Installation and Commissioning

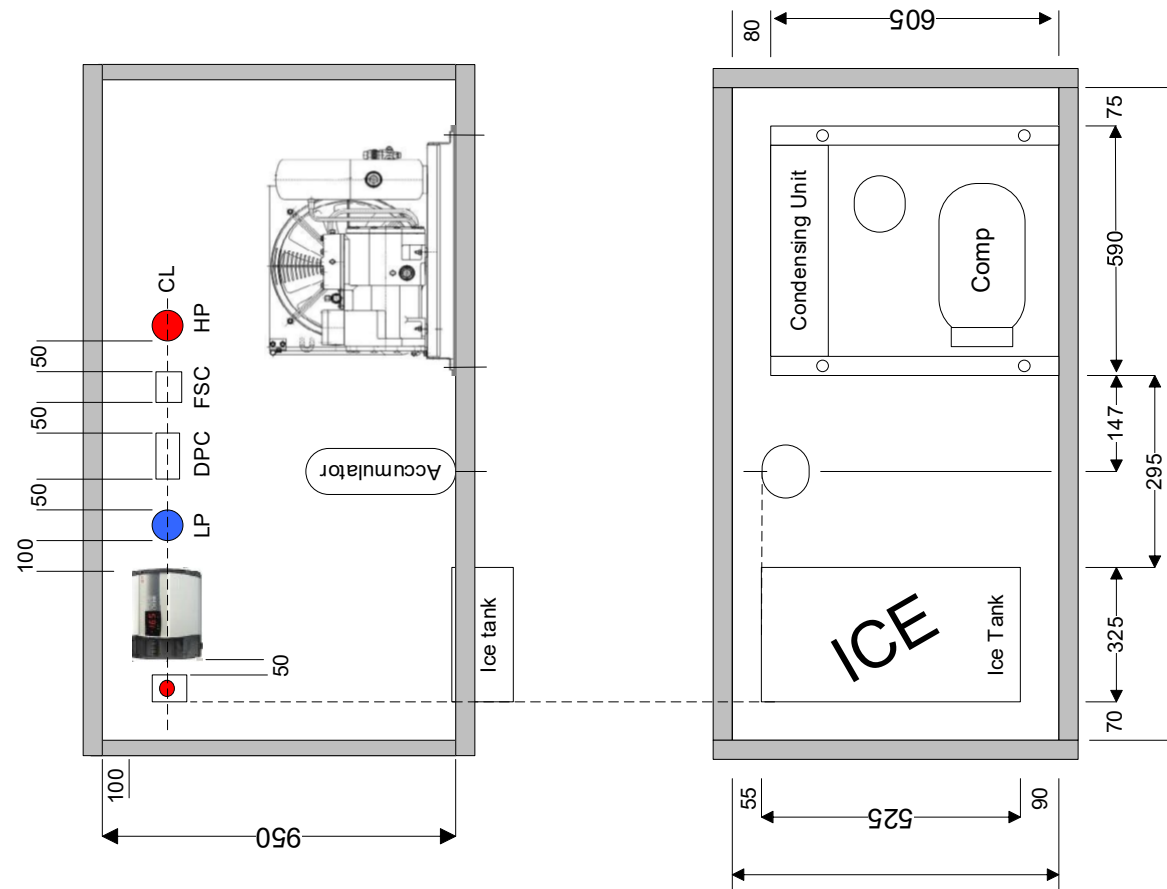
WSC2022SE_TP38_BB_A4_01_EN.pdf - Refrigeration system piping diagram




WSC2022SE_TP38_BB_A4_02_EN.pdf – Electrical circuit diagram



WSC2022SE_TP38_BB_A4_05_EN.pdf - Refrigeration system components layout



 worldskills	Skill 38 Refrigeration and Air Conditioning	
	Refrigeration Component Layout	WSC2022-SE_TP38_BB_A4_05_EN Date: 06.10.2022 Version 1.2

WSC2022SE_TP38_BB_A4_08_EN.pdf - Refrigeration system installation specifications

- A crankcase pressure regulator is used to prevent excessive compressor current on start up.
- A hot gas bypass valve is used to ensure suction pressure does not drop below the design pressure.
- Competitors are required to connect all components to a prewired electrical panel.

SYSTEM DESIGN SPECIFICATIONS

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

- Refrigerant = R134a
- Maximum ambient temperature = 35°C Db, 28°C Wb
- Design saturated suction temperature (SST) = -15 °C
- Suction line pressure drop = 1 K

CONTROL AND SAFETY SETTINGS

- Dual Pressure Control
 - Low Pressure cut off 5K lower than design saturated suction temperature (SST) and cut in at -10°C saturated suction temperature
 - High Pressure cut out when the condensing temperature reaches 55°C. The differential is factory set.
- The Pressure Controller for the variable speed condenser fan must provide maximum voltage when the condensing temperature reaches 45 °C.
- Crankcase Pressure Regulator is to limit the compressor current to a maximum of 4 amps
- Hot Gas Bypass Valve is to maintain -15°C saturated suction temperature and limit temperature cycling to safety only. The unit should run continually and not cycle on and off.
- Ice Tank Temperature controller is to cut out at -17 °C and cut in at -10 °C

PRESSURE TEST

Note: The wall mounted low pressure gauge is rated at 1,000 kPa and the low side the Dual Pressure Control is rated at 2,000 kPa

- The compressor must be isolated from this pressure during the pressure test.
- The low pressure gauge can not be tested higher than 32°C saturation temperature.
- The remaining system must be pressure tested to the equivalent to 55°C saturation temperature.

EVACUATION

- The system must hold 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 and evacuation pressure above MUST NOT rise above 1500 microns above the vacuum test point in the Ten (10) minutes after the vacuum pump is isolated from the system under test.

Example,

Start test 300micron,

Vacuum level after 10 minutes = 1501micron

Test has failed

Module C Electrical Fault Finding

Module D Refrigeration Fault Finding

WSC2022SE_TP38_BB_A4_09_EN.pdf - Refrigeration Fault Finding Unit's Specifications and Drawings

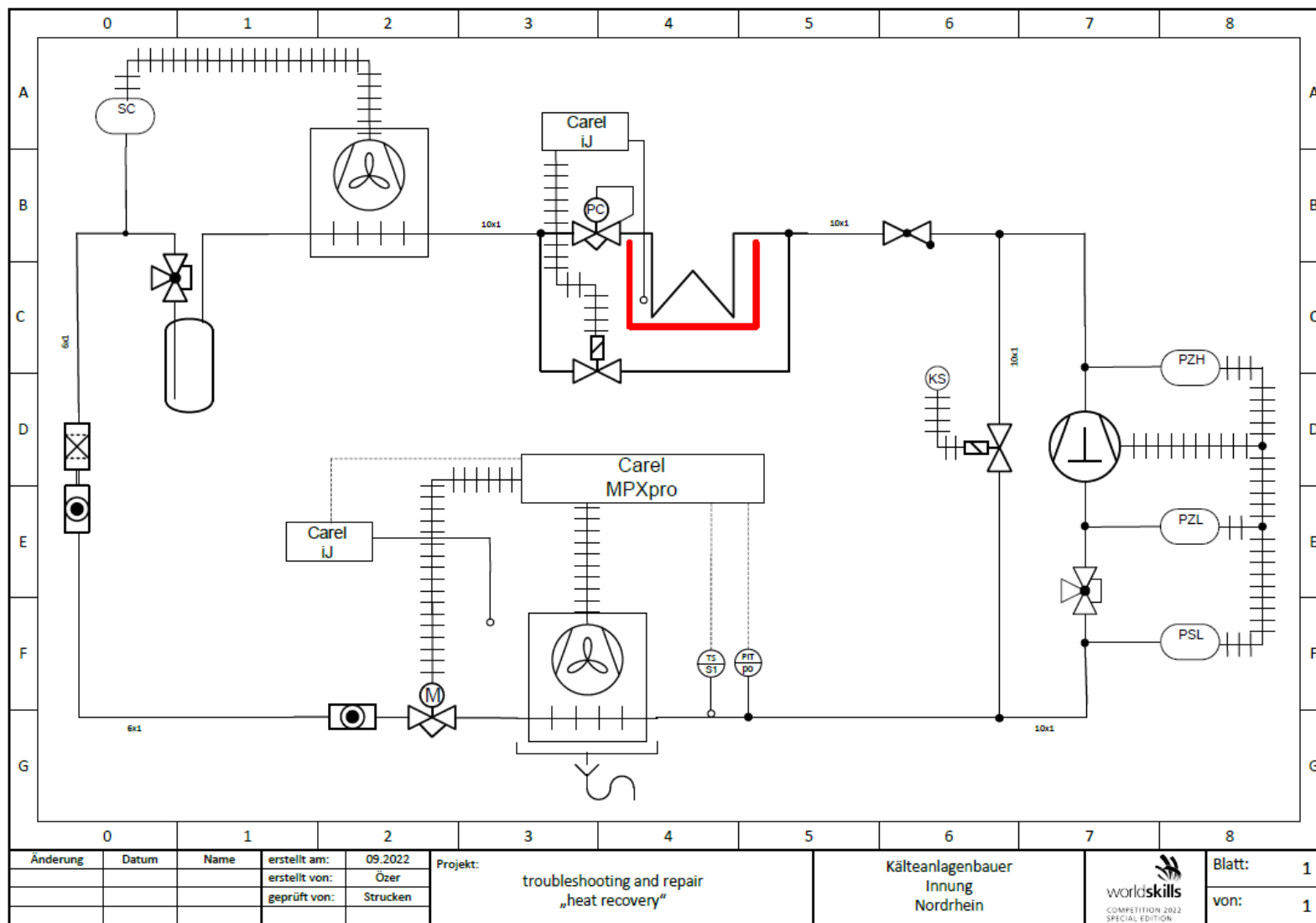
SYSTEM DESIGN SPECIFICATIONS

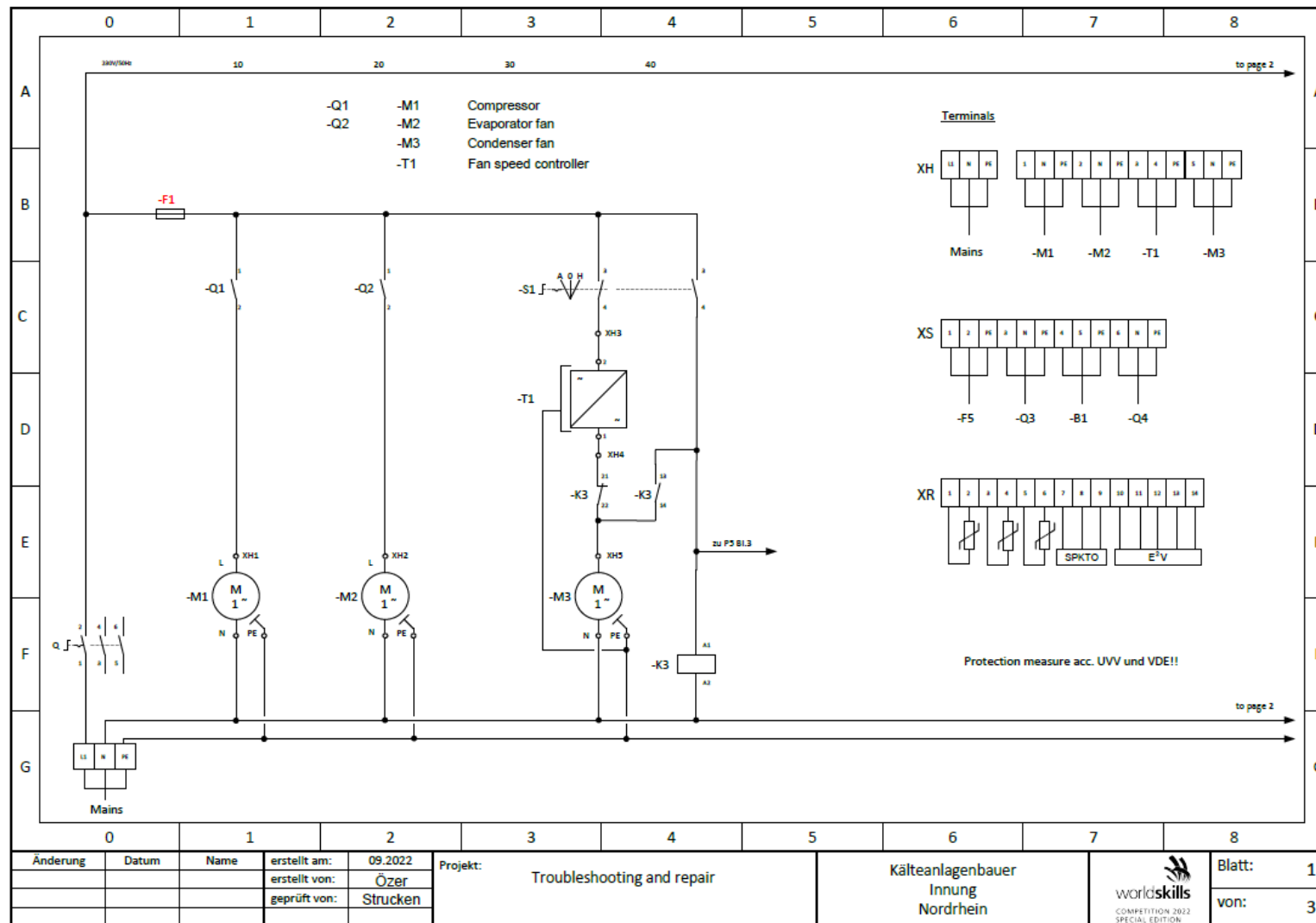
Below are system design specifications and drawings for the refrigeration unit that will be used for the following:

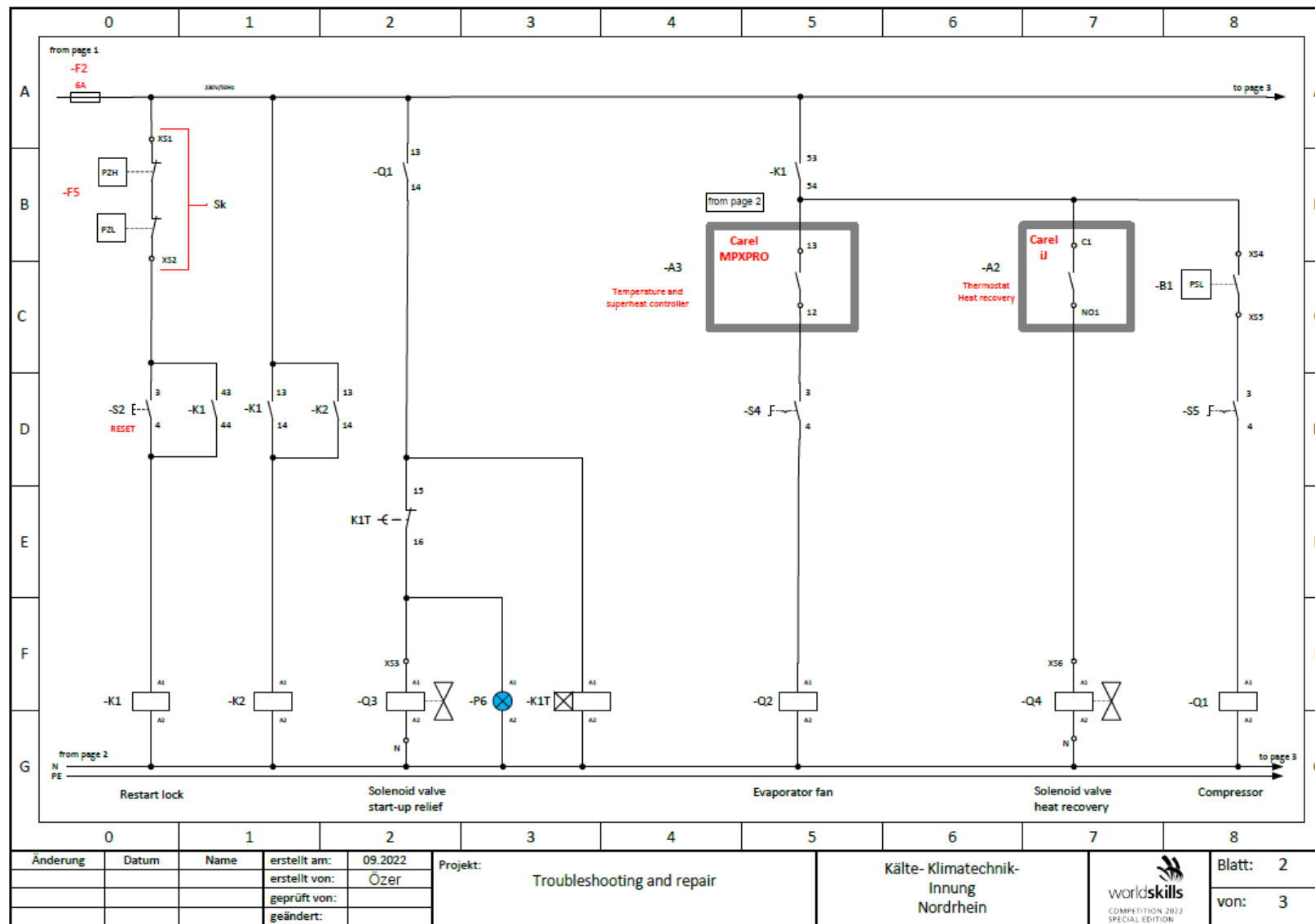
- Module C Electrical Fault Finding
- Module D Refrigeration Fault Finding

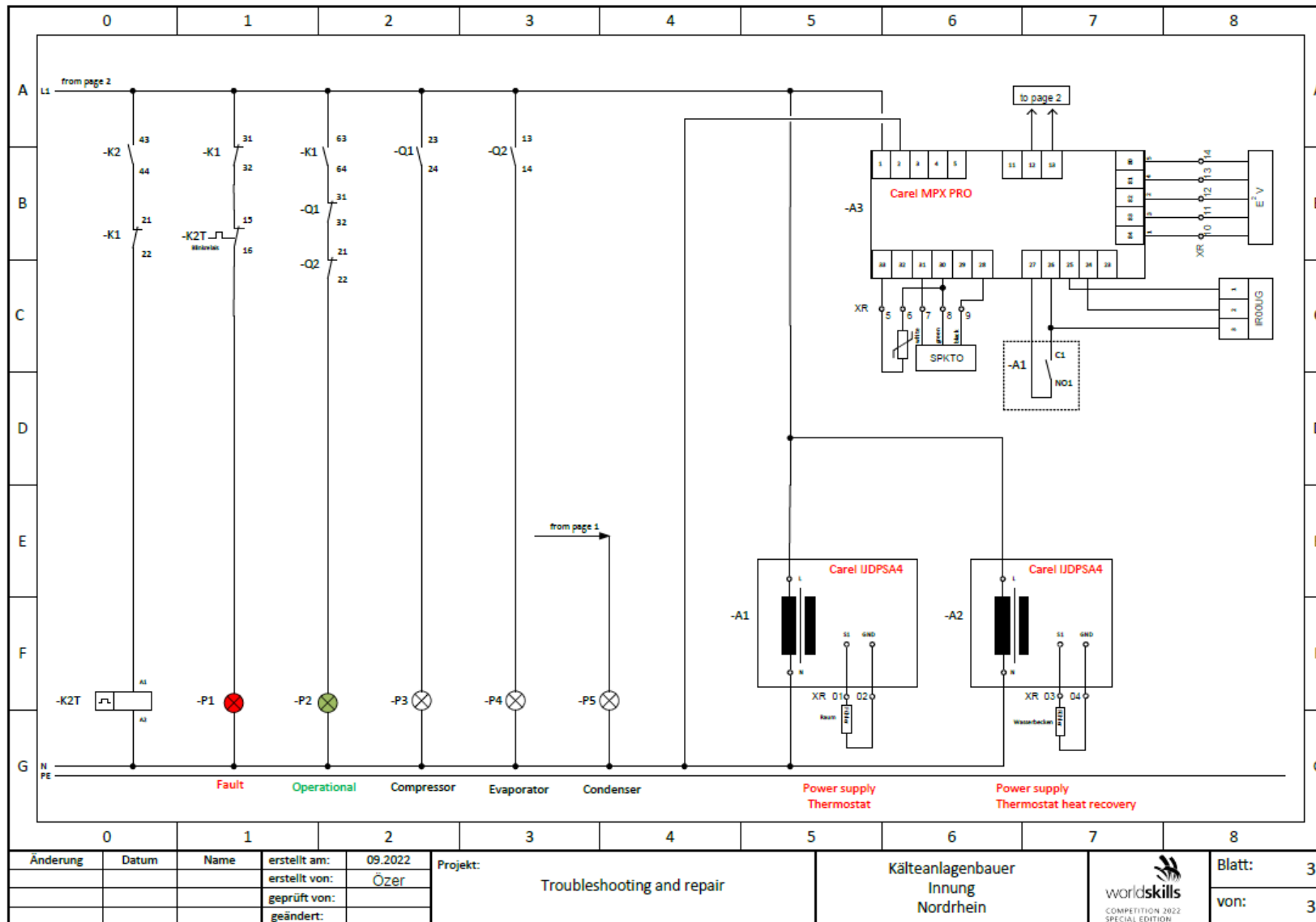
Design Conditions

- Refrigerant = R449A
- Maximum ambient temperature = 35°C
- Design saturated suction temperature = 5°C
- Difference between the air-entering and the evaporation temperature = 20 Kelvin
- Suction line pressure drop = 1 Kelvin
- Condensing temperature = 45°C
- Difference between the air-entering and the condensing temperature = 10 Kelvin
- Hot water temperature = 50°C
- Dual Pressure Control
 - Low Pressure cut off 5K lower than design saturated suction temperature (SST) and cut in at 15°C saturated suction temperature
 - High Pressure cut out when the condensing temperature reaches 55°C. The differential is factory set.









Pressure/Temperature Charts

R-134a

Degrees F	Degrees C	PSIG	BARS		Degrees F	Degrees C	PSIG	BARS
-40	-40.0	14.50	1.00		56	13.3	52.30	3.61
-38	-38.9	13.70	0.95		58	14.4	55.00	3.80
-36	-37.8	12.80	0.88		60	15.6	57.50	3.97
-34	-36.7	11.80	0.81		62	16.7	60.10	4.15
-32	-35.6	10.80	0.75		64	17.8	62.70	4.33
-30	-34.4	9.70	0.67		66	18.9	65.50	4.52
-28	-33.3	8.60	0.59		68	20.0	68.30	4.71
-26	-32.2	7.70	0.53		70	21.1	71.20	4.91
-24	-31.1	6.20	0.43		72	22.2	74.20	5.12
-22	-30.0	4.90	0.34		74	23.3	77.20	5.33
-20	-28.9	3.60	0.25		76	24.4	80.30	5.54
-18	-27.8	2.30	0.16		78	25.6	83.50	5.76
-16	-26.7	0.80	0.06		80	26.7	86.80	5.99
-14	-25.6	0.30	0.02		82	27.8	90.20	6.22
-12	-24.4	1.10	0.08		84	28.9	93.60	6.46
-10	-23.3	1.90	0.13		86	30.0	97.10	6.70
-8	-22.2	2.80	0.19		88	31.1	100.70	6.95
-6	-21.1	3.60	0.25		90	32.2	104.40	7.20
-4	-20.0	4.50	0.31		92	33.3	108.20	7.47
-2	-18.9	5.50	0.38		94	34.4	112.10	7.73
0	-17.8	6.50	0.45		96	35.6	116.10	8.01
2	-16.7	7.50	0.52		98	36.7	120.10	8.29
4	-15.6	8.50	0.59		100	37.8	124.30	8.58
6	-14.4	9.60	0.66		102	38.9	128.50	8.87
8	-13.3	10.80	0.75		104	40.0	132.90	9.17
10	-12.2	12.00	0.83		106	41.1	137.30	9.47
12	-11.1	13.10	0.90		108	42.2	142.80	9.85
14	-10.0	14.40	0.99		110	43.3	146.50	10.11
16	-8.9	15.70	1.08		112	44.4	151.30	10.44
18	-7.8	17.00	1.17		114	45.6	156.10	10.77
20	-6.7	18.40	1.27		116	46.7	161.10	11.12
22	-5.6	19.90	1.37		118	47.8	166.10	11.46
24	-4.4	21.40	1.48		120	48.9	171.30	11.82
26	-3.3	22.90	1.58		122	50.0	176.60	12.19
28	-2.2	24.50	1.69		124	51.1	182.00	12.56
30	-1.1	26.10	1.80		126	52.2	187.50	12.94
32	0.0	27.80	1.92		128	53.3	193.10	13.32
34	1.1	29.50	2.04		130	54.4	198.90	13.72
36	2.2	31.30	2.16		132	55.6	204.70	14.12
38	3.3	33.20	2.29		134	56.7	210.70	14.54
40	4.4	35.10	2.42		136	57.8	216.80	14.96
42	5.6	37.00	2.55		138	58.9	223.00	15.39
44	6.7	39.10	2.70		140	60.0	229.40	15.83
46	7.8	41.10	2.84		142	61.1	235.80	16.27
48	8.9	43.30	2.99		144	62.2	242.40	16.73
50	10.0	45.50	3.14		146	63.3	249.20	17.19
52	11.1	47.70	3.29		148	64.4	256.00	17.66
54	12.2	50.10	3.46		150	65.6	263.00	18.15

Underlined Values Indicate Vacuum (IN of HG, MM of Mercury)

1 Bar equals 100 kPa

R449A (XP40) Pressure Temperature Chart

R449A Temperature (°C)	Liquid			Vapour		
	Pressure (barA)	Pressure (barg)	Pressure (psig)	Pressure (barA)	Pressure (barg)	Pressure (psig)
-70	0.24	-0.77	-11.18	0.16	-0.85	-12.34
-68	0.27	-0.74	-10.71	0.19	-0.83	-12.00
-66	0.31	-0.70	-10.19	0.21	-0.80	-11.62
-64	0.35	-0.66	-9.62	0.24	-0.77	-11.19
-62	0.39	-0.62	-8.99	0.27	-0.74	-10.73
-60	0.44	-0.57	-8.30	0.31	-0.70	-10.21
-58	0.49	-0.52	-7.54	0.35	-0.66	-9.63
-56	0.55	-0.46	-6.71	0.39	-0.62	-9.00
-54	0.61	-0.40	-5.80	0.44	-0.57	-8.31
-52	0.68	-0.33	-4.81	0.49	-0.52	-7.55
-50	0.75	-0.26	-3.74	0.55	-0.46	-6.72
-48	0.84	-0.18	-2.58	0.61	-0.40	-5.81
-46	0.92	-0.09	-1.32	0.68	-0.33	-4.82
-44	1.02	0.00	0.04	0.75	-0.26	-3.75
-42	1.12	0.10	1.50	0.83	-0.18	-2.58
-40	1.23	0.21	3.08	0.92	-0.09	-1.32
-38	1.34	0.33	4.78	1.02	0.00	0.04
-36	1.47	0.46	6.60	1.12	0.10	1.52
-34	1.60	0.59	8.56	1.23	0.21	3.10
-32	1.75	0.73	10.65	1.34	0.33	4.81
-30	1.90	0.89	12.88	1.47	0.46	6.64
-28	2.07	1.05	15.27	1.61	0.59	8.61
-26	2.24	1.23	17.81	1.75	0.74	10.71
-24	2.43	1.41	20.51	1.91	0.89	12.96
-22	2.63	1.61	23.39	2.07	1.06	15.37
-20	2.84	1.82	26.44	2.25	1.24	17.93
-18	3.06	2.05	29.68	2.44	1.42	20.66
-16	3.30	2.28	33.10	2.64	1.63	23.56
-14	3.55	2.53	36.73	2.85	1.84	26.65
-12	3.81	2.80	40.56	3.08	2.06	29.92
-10	4.09	3.08	44.61	3.32	2.30	33.39
-8	4.38	3.37	48.88	3.57	2.56	37.06
-6	4.69	3.68	53.37	3.84	2.82	40.95
-4	5.02	4.01	58.10	4.12	3.11	45.05
-2	5.36	4.35	63.08	4.42	3.41	49.38
0	5.72	4.71	68.31	4.73	3.72	53.95
2	6.10	5.09	73.79	5.07	4.05	58.77
4	6.50	5.49	79.55	5.42	4.40	63.83
6	6.92	5.90	85.58	5.78	4.77	69.16
8	7.35	6.34	91.90	6.17	5.16	74.76
10	7.81	6.79	98.51	6.57	5.56	80.65
12	8.28	7.27	105.42	7.00	5.99	86.82

1 Bar equals 100 kPa

R449A (XP40) Pressure Temperature Chart

14	8.78	7.77	112.64	7.45	6.43	93.29
16	9.30	8.29	120.17	7.91	6.90	100.07
18	9.84	8.83	128.04	8.40	7.39	107.17
20	10.41	9.40	136.24	8.92	7.90	114.59
22	11.00	9.99	144.78	9.45	8.44	122.36
24	11.61	10.60	153.67	10.01	9.00	130.47
26	12.25	11.24	162.92	10.60	9.58	138.95
28	12.91	11.90	172.55	11.21	10.19	147.80
30	13.60	12.59	182.56	11.84	10.83	157.02
32	14.32	13.31	192.95	12.51	11.49	166.65
34	15.07	14.05	203.75	13.20	12.18	176.67
36	15.84	14.82	214.95	13.92	12.91	187.12
38	16.64	15.63	226.56	14.67	13.66	198.00
40	17.47	16.46	238.61	15.45	14.44	209.31
42	18.33	17.32	251.08	16.26	15.25	221.10
44	19.22	18.21	264.02	17.11	16.09	233.33
46	20.14	19.13	277.39	17.98	16.97	246.07
48	21.10	20.09	291.23	18.90	17.88	259.30
50	22.09	21.07	305.56	19.84	18.83	273.05
52	23.11	22.09	320.36	20.83	19.82	287.33
54	24.16	23.15	335.68	21.85	20.84	302.17
56	25.25	24.24	351.48	22.92	21.90	317.58
58	26.38	25.37	367.81	24.02	23.01	333.57
60	27.54	26.53	384.67	25.16	24.15	350.19
62	28.74	27.73	402.07	26.35	25.34	367.43
64	29.98	28.97	420.02	27.59	26.58	385.34
66	31.26	30.24	438.52	28.87	27.86	403.96
68	32.57	31.56	457.61	30.21	29.19	423.28
70	33.93	32.92	477.27	31.59	30.58	443.40

The information contained within this website is for guidance only, for further system specific advice please call A-Gas directly.