MITSUBISHI HEAVY INDUSTRIES

Presentation Outline

- ✓ Basic Air conditioning system.
- ✓ Understanding of overall VRF and architectural system and benefits of this system.
- ✓ Outdoor ventilation spaces.
- ✓ VRF system operation flow circuit.
- ✓ Understanding and making use of system parameter reading and interpretation of system condition for maintenance purposes.
- ✓ After sales service support that IMZ Sdn Bhd provide.

Basic Air conditioning system

Air conditioning

- Required to achieve comfortable indoor environment :temperature, air flow humidity, air cleanness.
- Human comfort temperature 24+-1 ^{0}C humdity 55+-5%.
- Objective can be achieve via creating differential compression pressure by using compressors

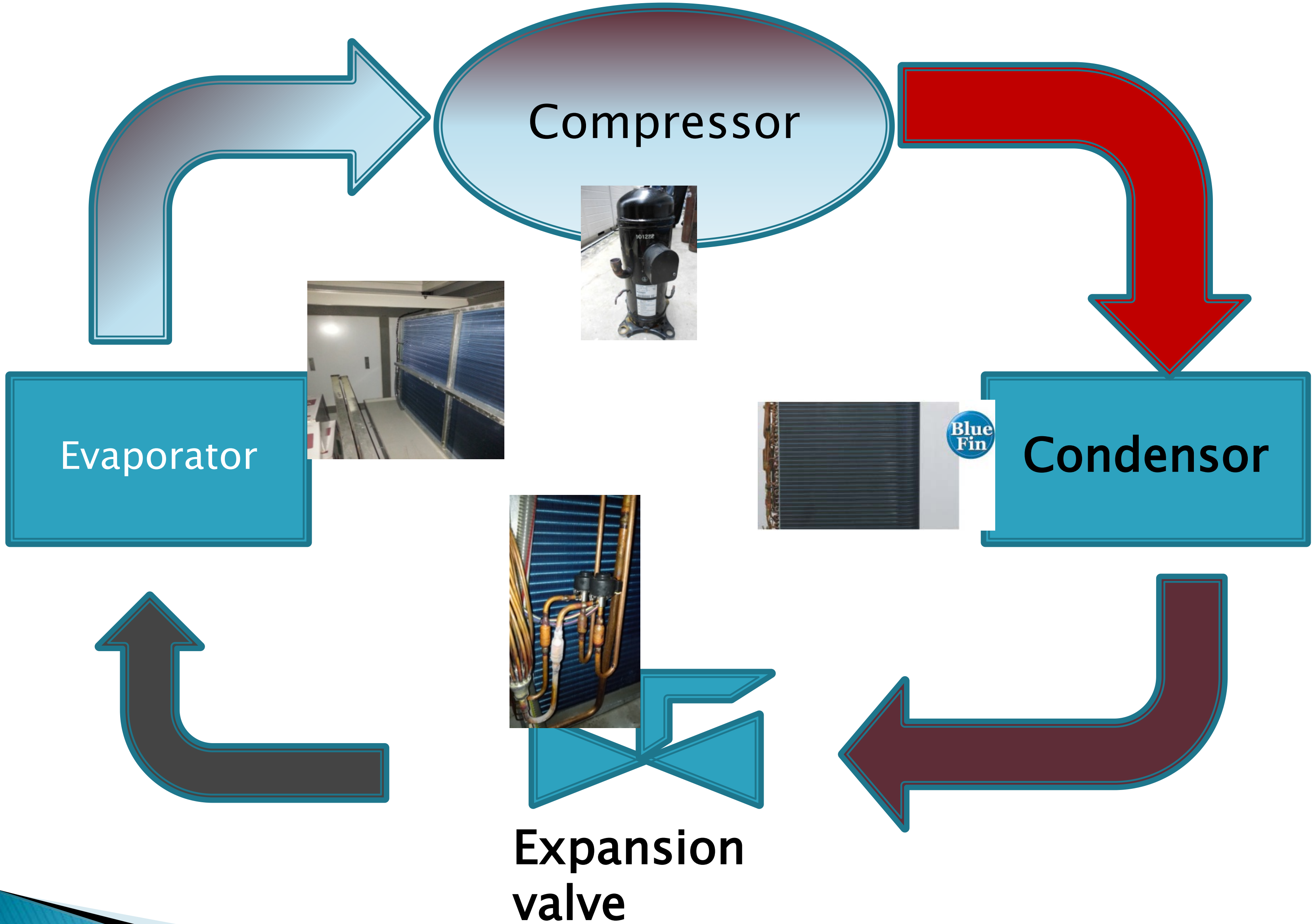
Air conditioning process cycle

- Vaporization of Refrigerant
- Compression of refrigerant
- Liquefaction of refrigerant

Refrigerant cycle

- 4 necessary components

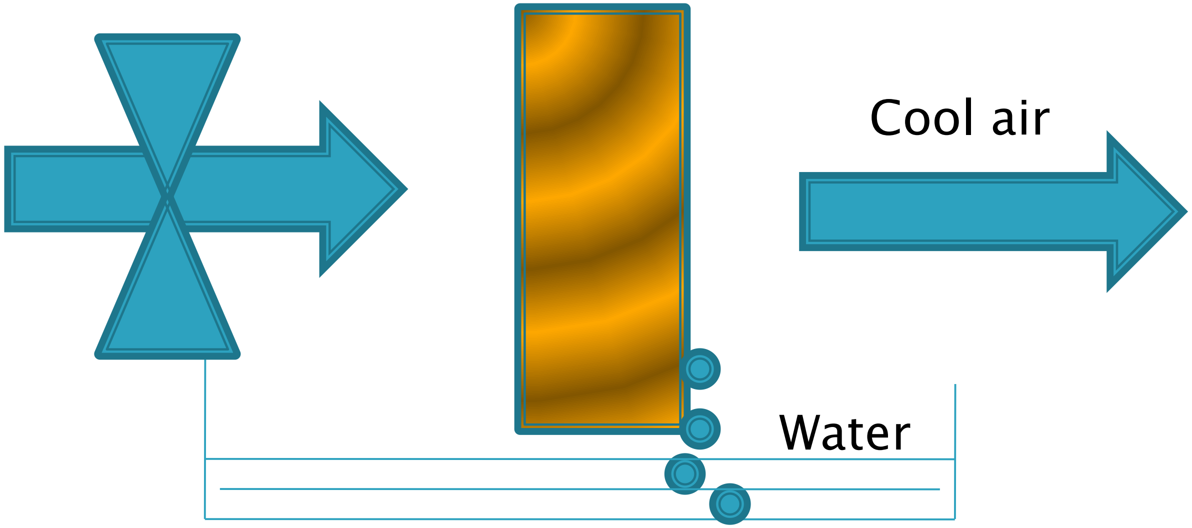
Compressor
Condenser
Expansion valve
Evaporator


Compressor
Condensor
Blue Fin
Expansion valve
Evaporator

Vaporization of refrigerant

- To make temperature drop, it have to absorb energy from the air.
- The air conditioning absorb heat from the air by means of vaporization of refrigerant.
- When vaporization,medium change state.
- Vaporization= Liquid $\Rightarrow$ Gas.
- The device absorb surrounding heat through vaporization of refrigerant is called Evaporator.

Evaporator



Indoor high temperature gas passes through the evaporator, the heat is absorb by refrigerant. Temperature drop and discharge as low temperature gas, after the air cool down, vapor in the air will turn the air will turn into liquid water and stay in the condensate pan.

Compression of refrigerant

- Condenser makes gases refrigerant release heat and become liquid state.
- Device make gases refrigerant become liquid is called compressor. When pressure rises, temperature rises, heat can be transfer out from liquid.

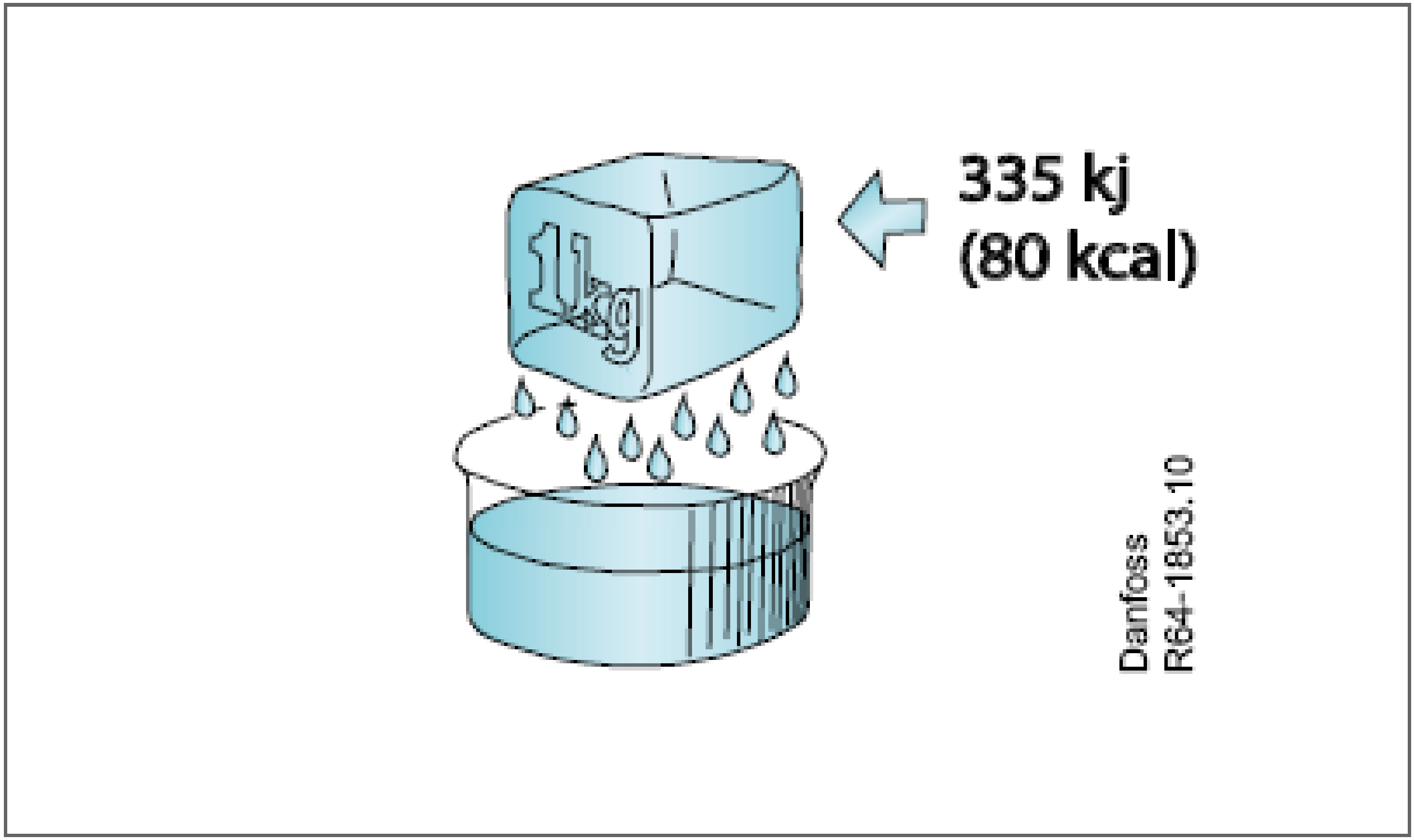
Liquefaction of refrigerant

- Condensation=Gas → Liquid.
- Condensation is a process of changing the gases state to liquid state.
- The device changes the gas into liquid is called condenser .
- Device uses air to cool down the condenser is called air cool condenser. Device uses water cool to cool down condenser is called water cool condenser.

Types of Heat

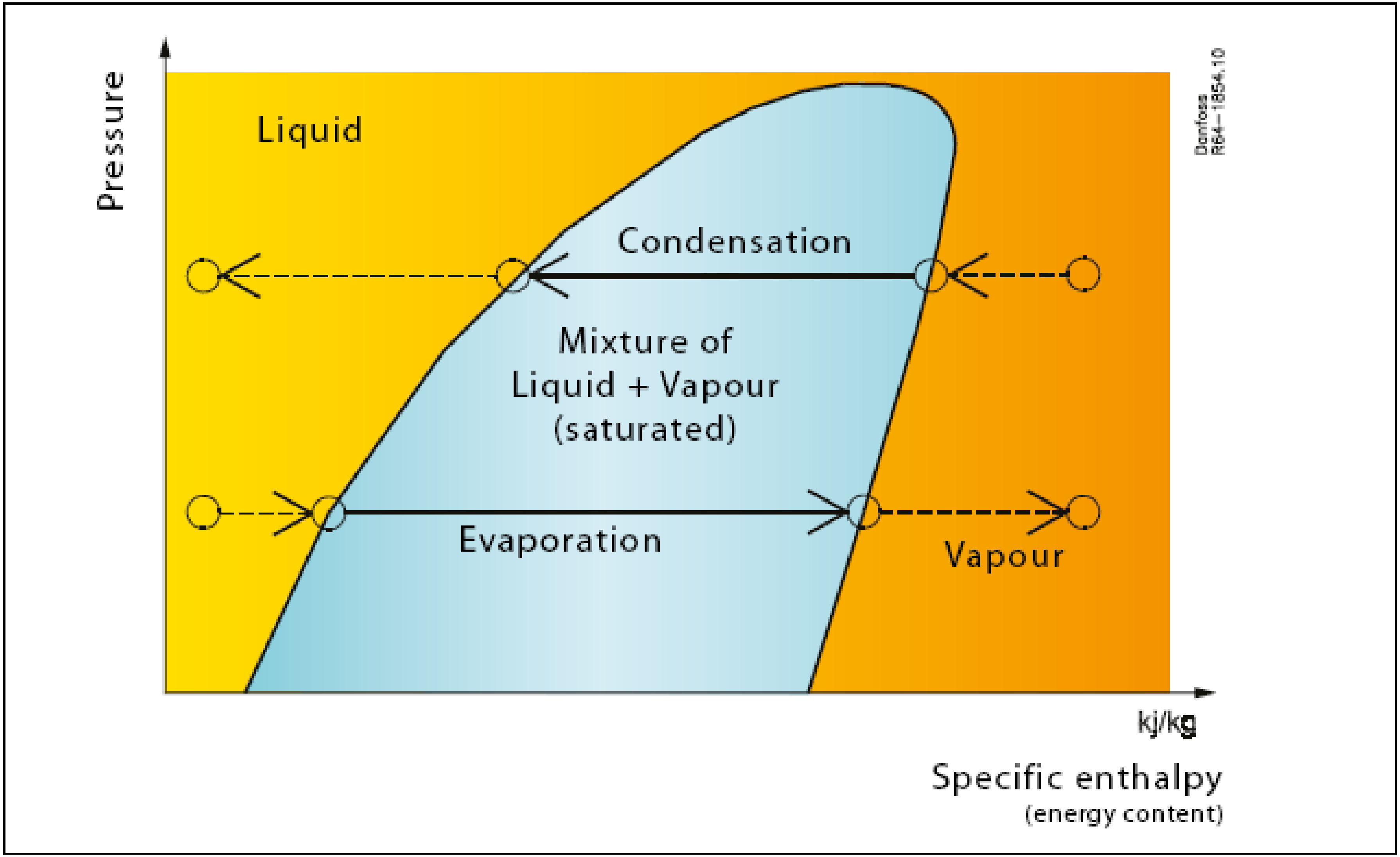
- Latent Heat = Amount of heat required for conformational of changing the substance
- Sensible Heat = Amount of heat required for temperature change of substance.
- Air conditioning uses two types of latent heat
- Liquid-→ Gas (vaporisation heat of liquid-gas conversion)
- Gas--→ liquid (Condensation heat of gas-liquid conversion)

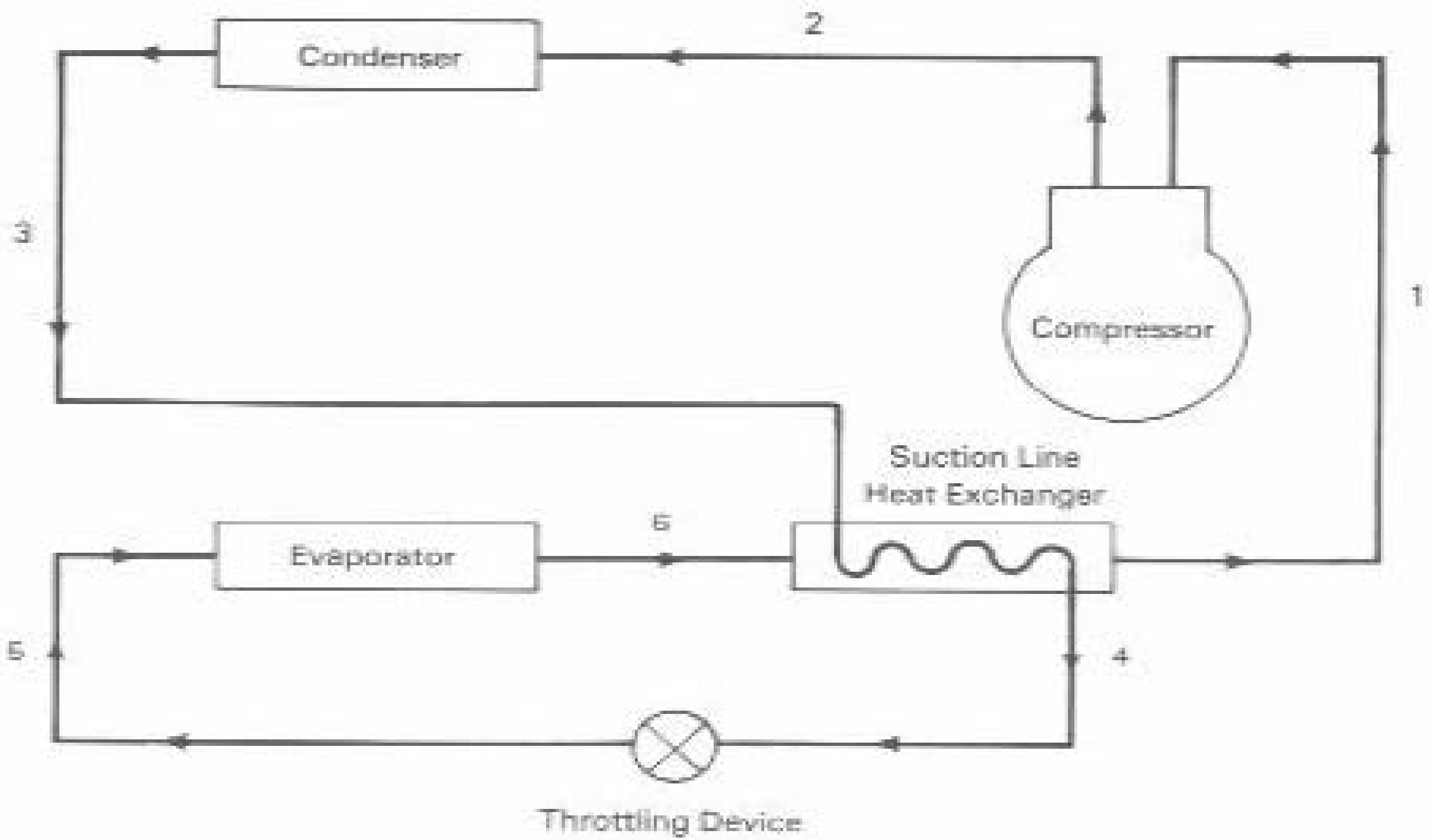
Latent heat of ice



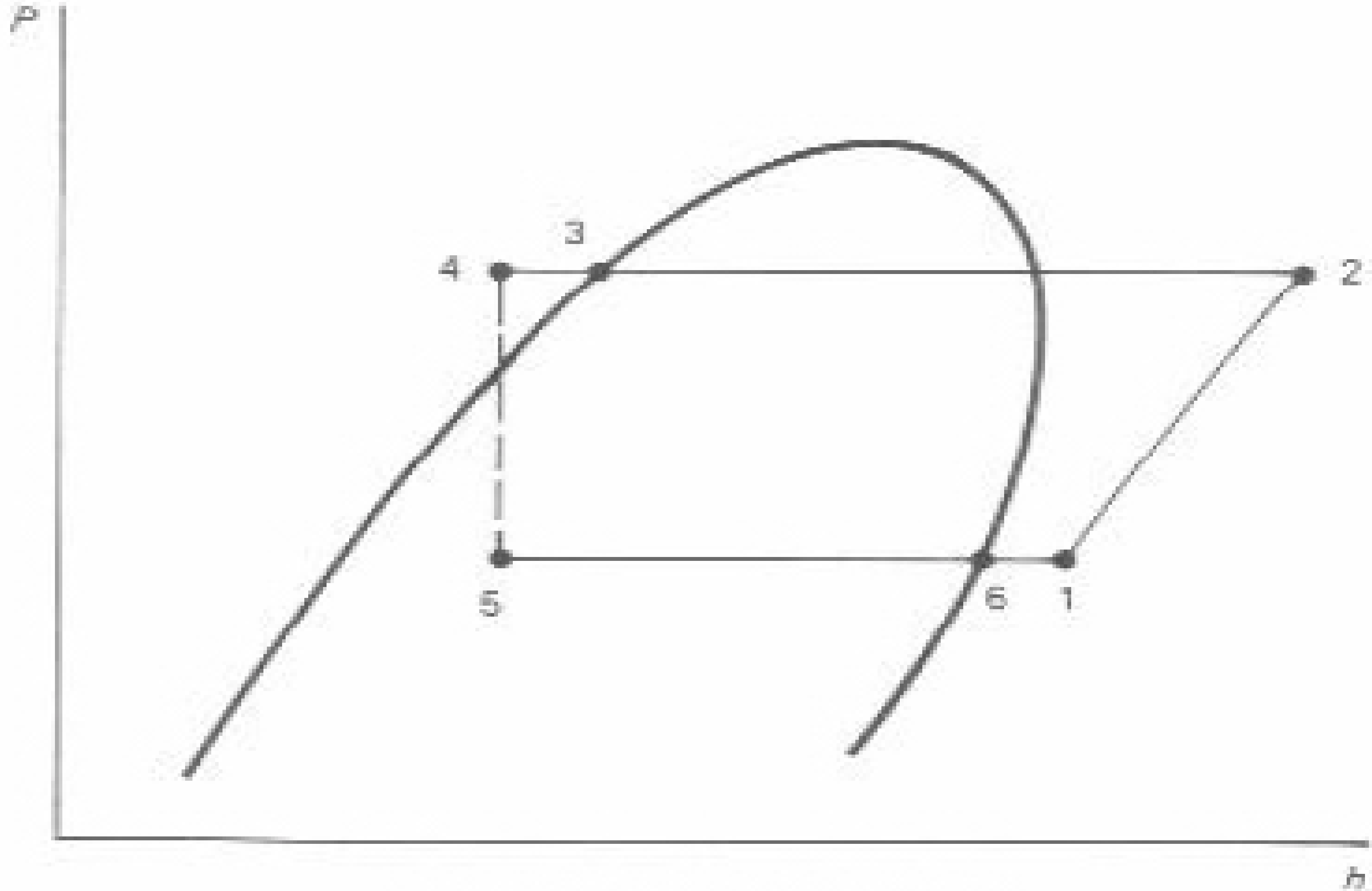
Expansion of refrigerant

- Liquid in the condenser generated in the condenser flow into evaporator, it absorbs the surrounding heat and again vaporize.
- Temperature of liquid refrigerant in the condenser must drop to the lower vaporizable temperature.
- To achieve this , expansion valve has to be installed.


Pressure
Liquid
Condensation
Mixture of
Liquid + Vapour
(saturated)
Evaporation
Vapour
kj/kg
Specific enthalpy
(energy content)
Danfoss
R64—1854.10



(a) Flow Diagram

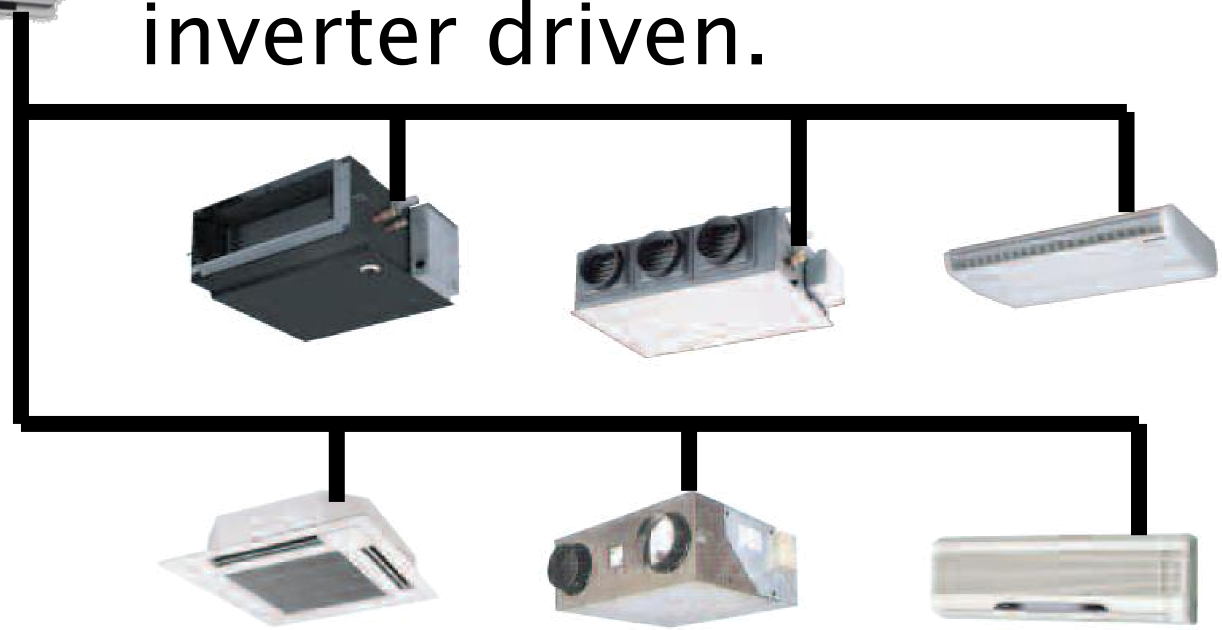


(b) Pressure-Enthalpy Diagram

Understanding of Overall VRF architectural system

VRF system outline

Air cooled outdoor units with single or multiple variable speed DC compressors with inverter driven.

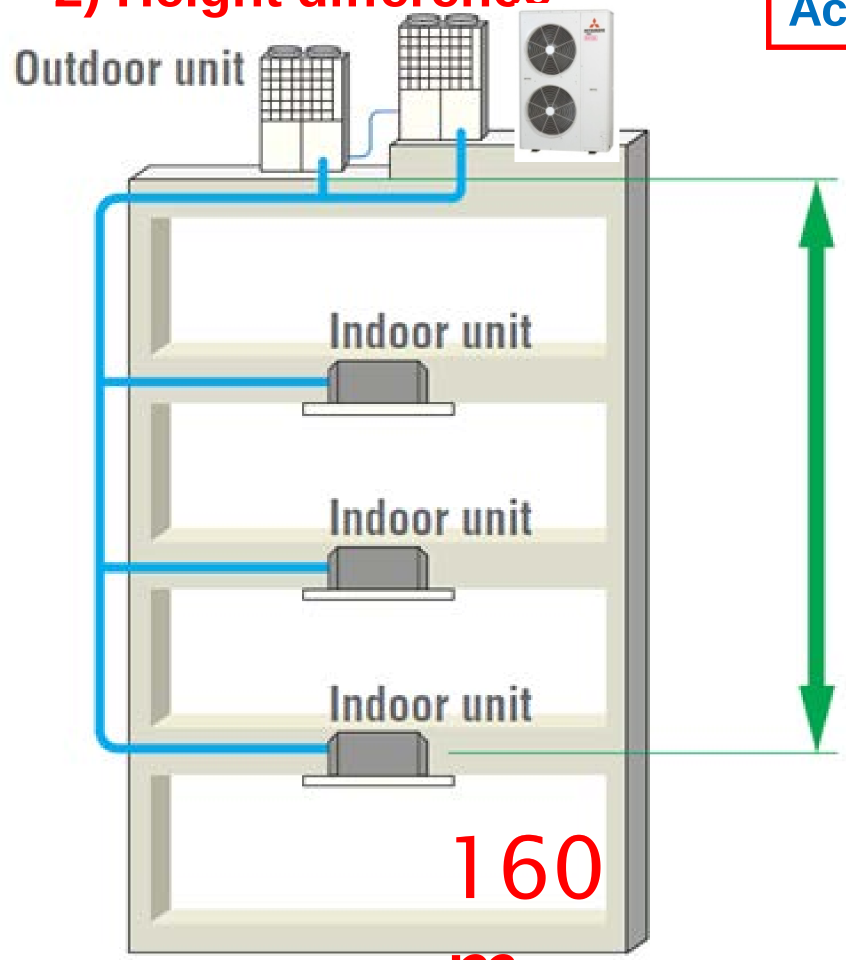


VRF system outline

- Indoors unit equipped with temperature sensing devices
- System with self diagnostic and with supervisory control ,networking capability

Limitation of VRF system functionality

2) Height difference



160 m

Activate by SW6-4=ON

- In case of outdoor unit above

  50m → 70m **Expanding**

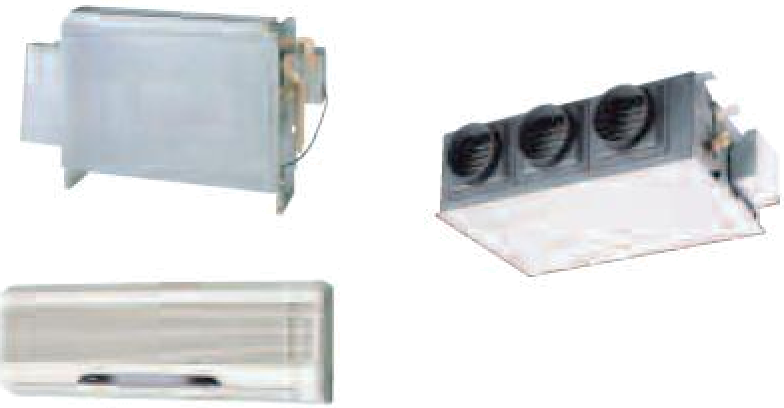
- In case of outdoor unit below

  40m (Same as KX6)

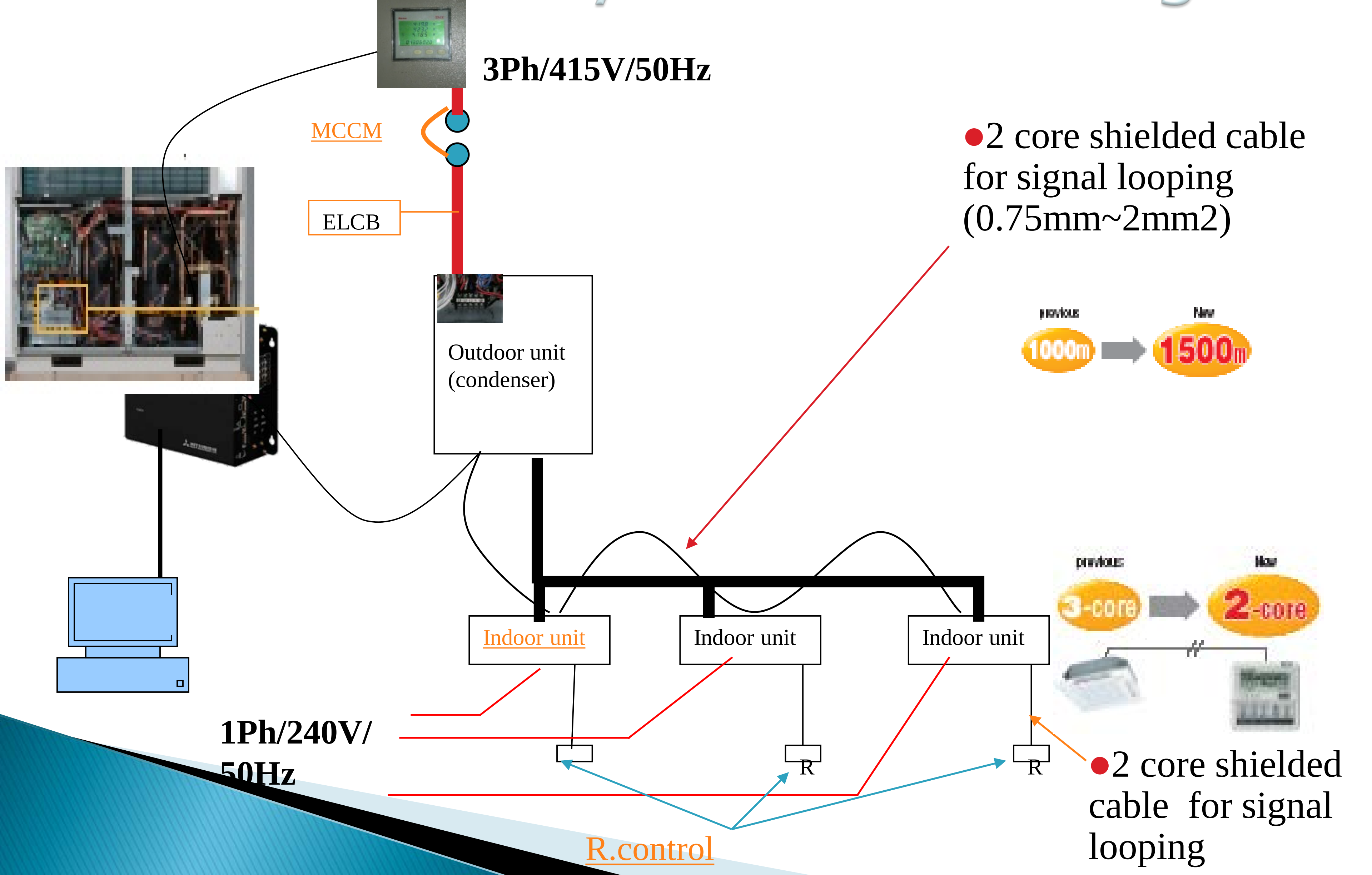
FDC-KXZ

1. General Information

Indoor
unit

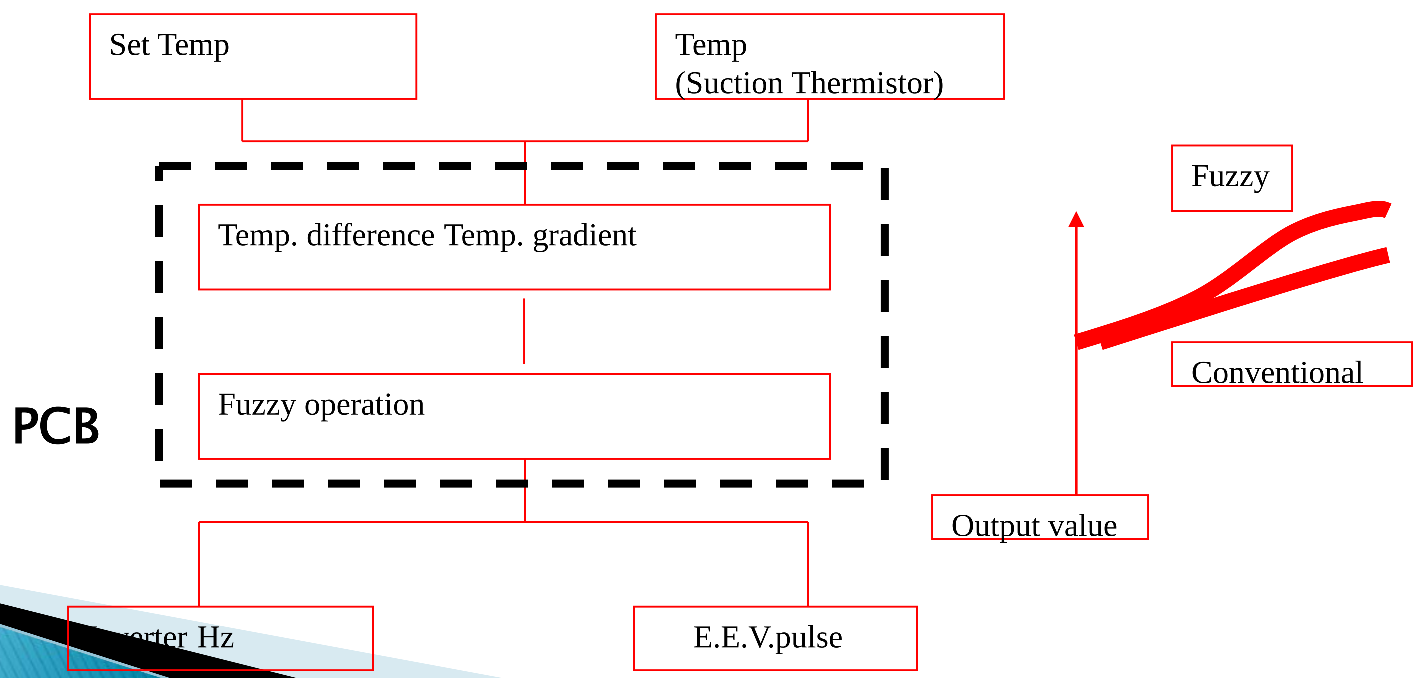


Features KXZ system field wiring



Features of KXZ System

- Fuzzy Logic Control,
  - Fast response,
  - Optimum energy Utilisation.

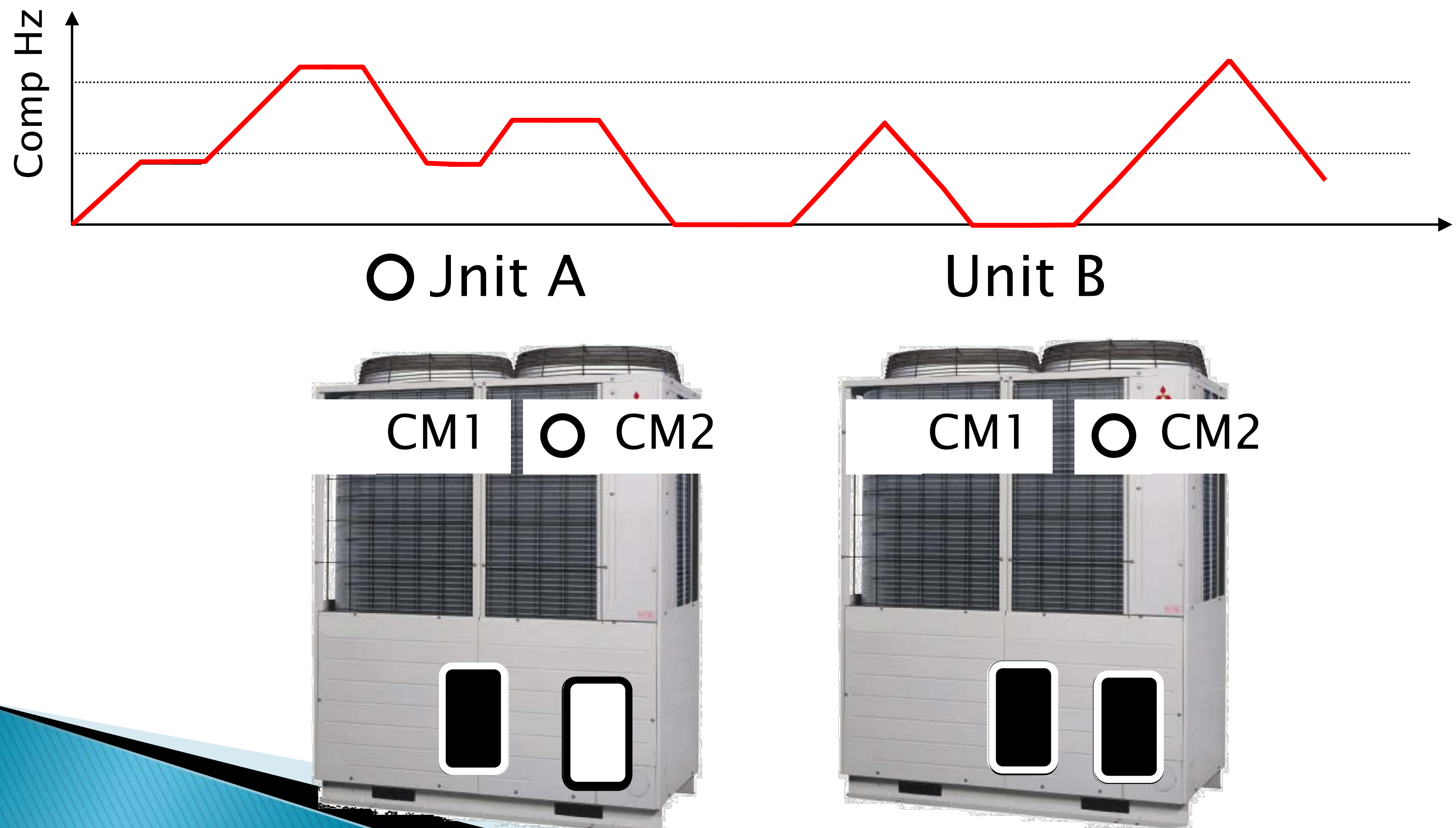


FDC-KXZ

3. Characteristic Controls

<Compressor control>

starting order of the compressors



Benefits of VRF system

- DC inverter vector compressors , contribute to the saving of electrical panel:- Size, internal components.
- Inverter driven not required Star delta, Auto transformer to start up.
- Incoming cable not necessary to oversize thus reduce the first cost.

Advantages of KXZsystem

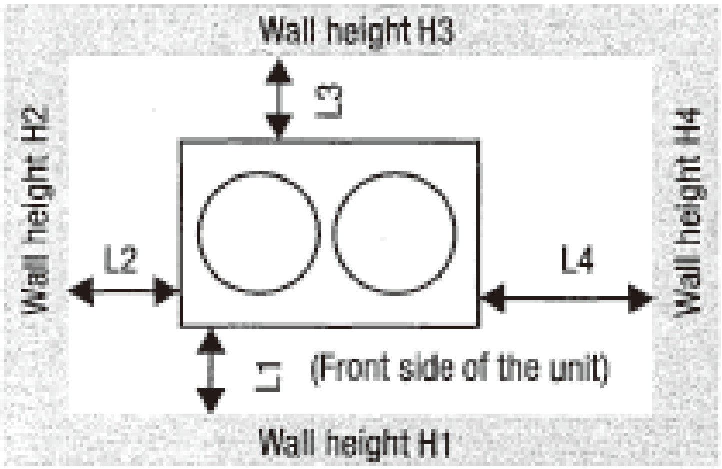
- DC Inverter Vector driven reaches comfort temperature much faster.
- No voltage peaks- avoid cycling of the compressors.
- Energy consumption and start up time reduced by 1/3 compared to non inverter unit.
- Inverter driven VRF with fuzzy logic control help in optimizing the energy usage. Generally energy optimization can be reaching 30-40%.
- Case Studies:(UTM01, case study 2-research, case study 3)

Outdoor Ventilation space

14 – 60HP

Installation Space

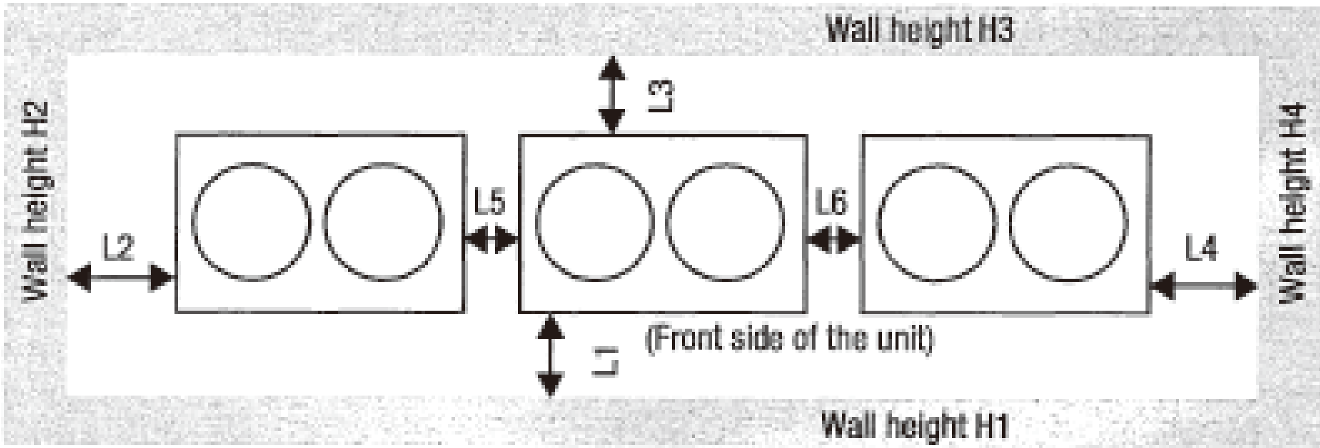
①When one unit is installed



Dimensions \ Example installation	I	II	III
L1	500	500	Open
L2	10	50	10
L3	100	50	100
L4	10	50	Open
H1	1500	1500	Open
H2	No limit	No limit	No limit
H3	1000	1000	No limit
H4	No limit	No limit	Open

Please secure sufficient clearance (room for maintenance work, passage, draft and piping). (If your installation site does not fulfill the installation condition requirements set out on this drawing, please consult with your distributor or the manufacturer)

② When more than one unit are installed



Dimensions \ Example installation	I	II
L1	500	Open
L2	10	200
L3	100	300
L4	10	Open
L5	10 (0)	400
L6	10 (0)	400
H1	1500	No limit
H2	No limit	No limit
H3	1000	No limit
H4	No limit	No limit

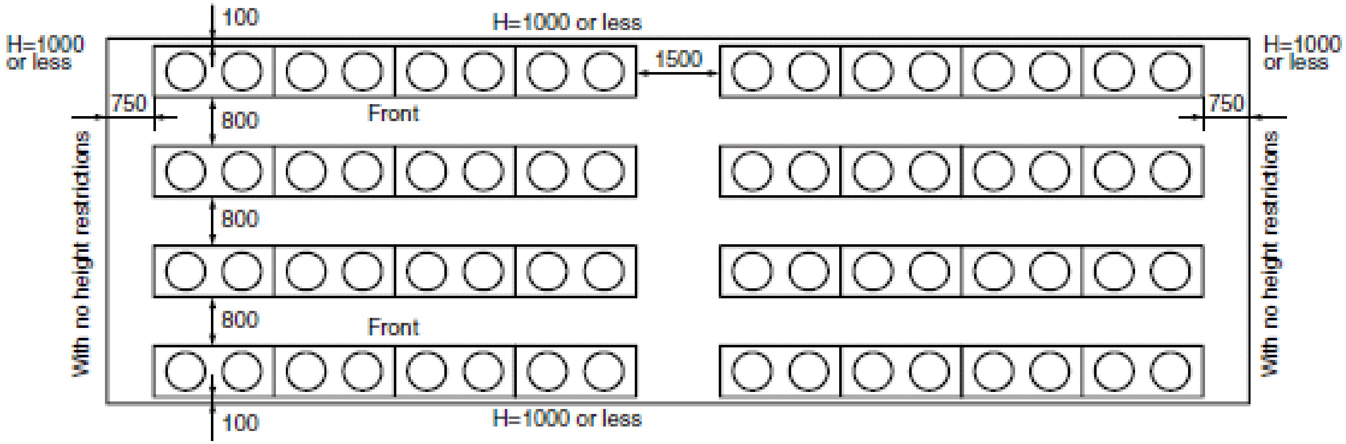
For a normal installation, leave a 10 mm or wider space on both sides of the unit (L5 and L6) as workspace. It is also possible to install at a 0mm interval (continuous installation) with future renewal, etc. in mind.

For your information:
the footprint of an outdoor unit is 1350x720 for all models throughout the series (335–K–680).

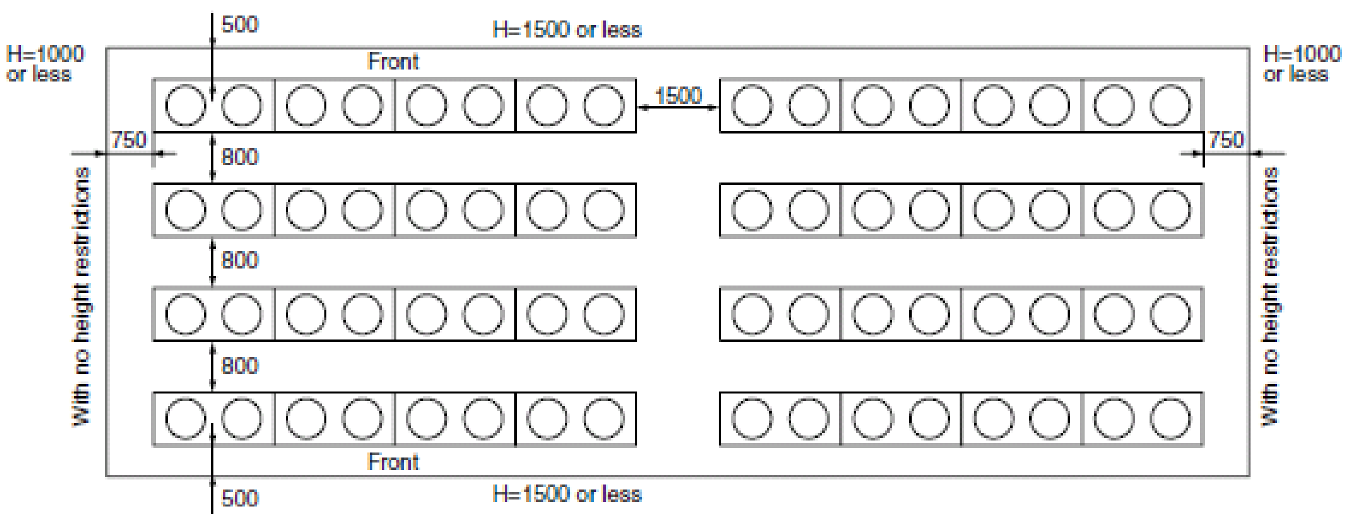
3. Multiple units installed in vertical and horizontal rows

■ [Ex.1]

Unit : mm

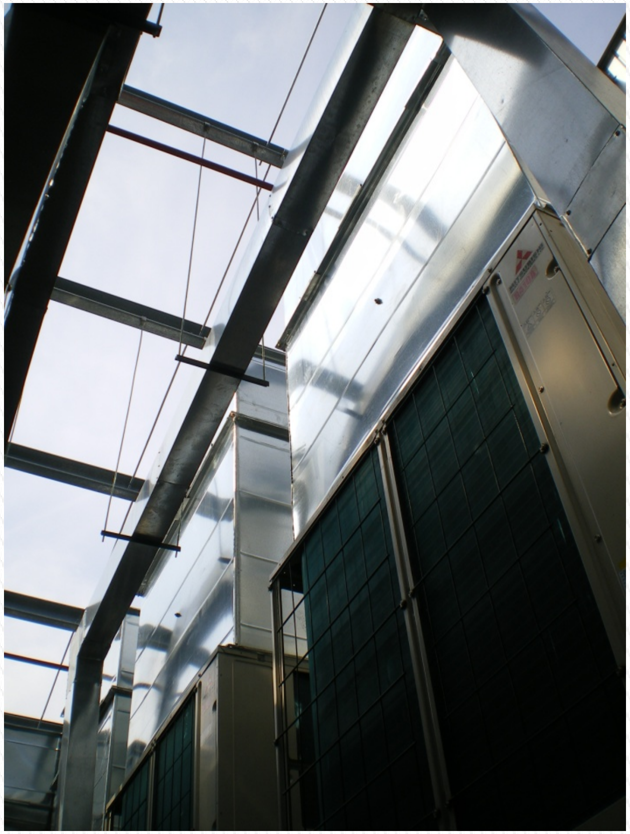


■ [Ex.2]



Problems of hot air bounds back

Solution

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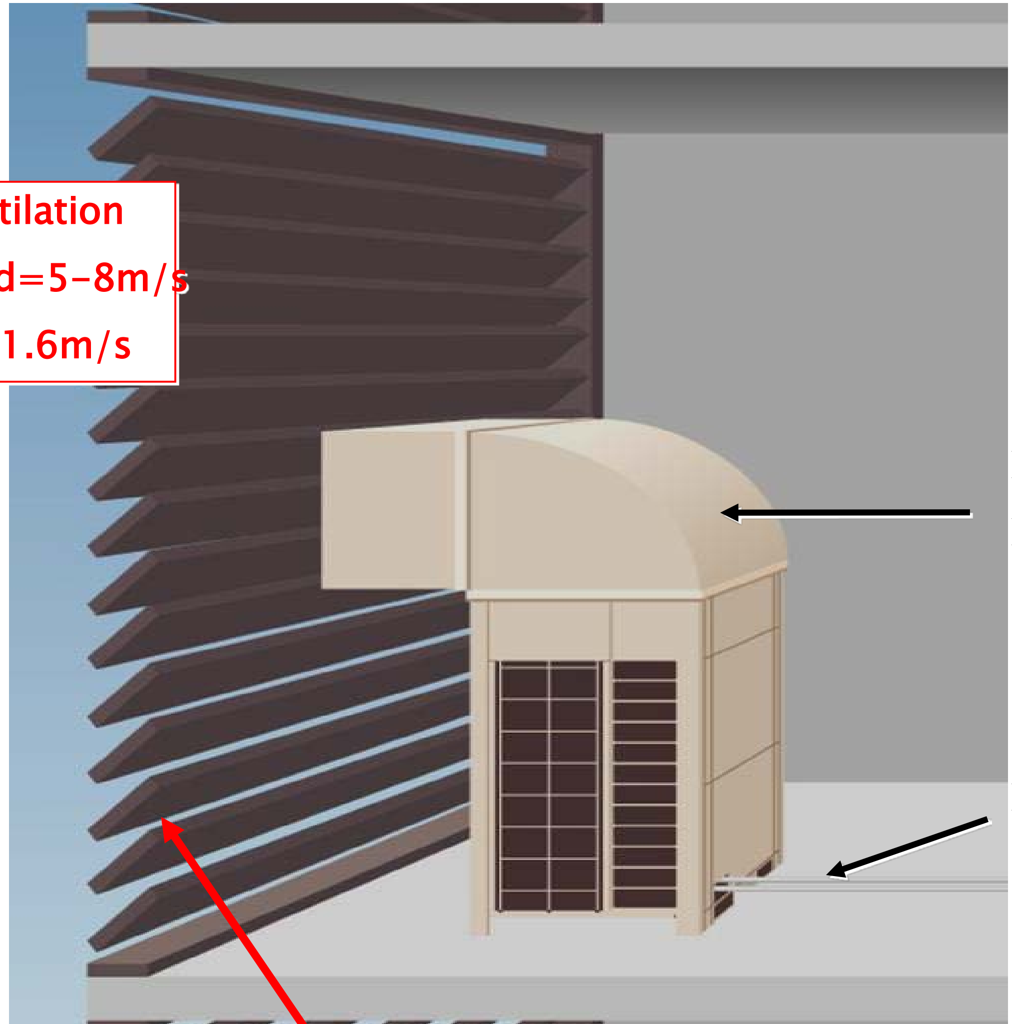
case study
data

8. Outdoor Unit Installation

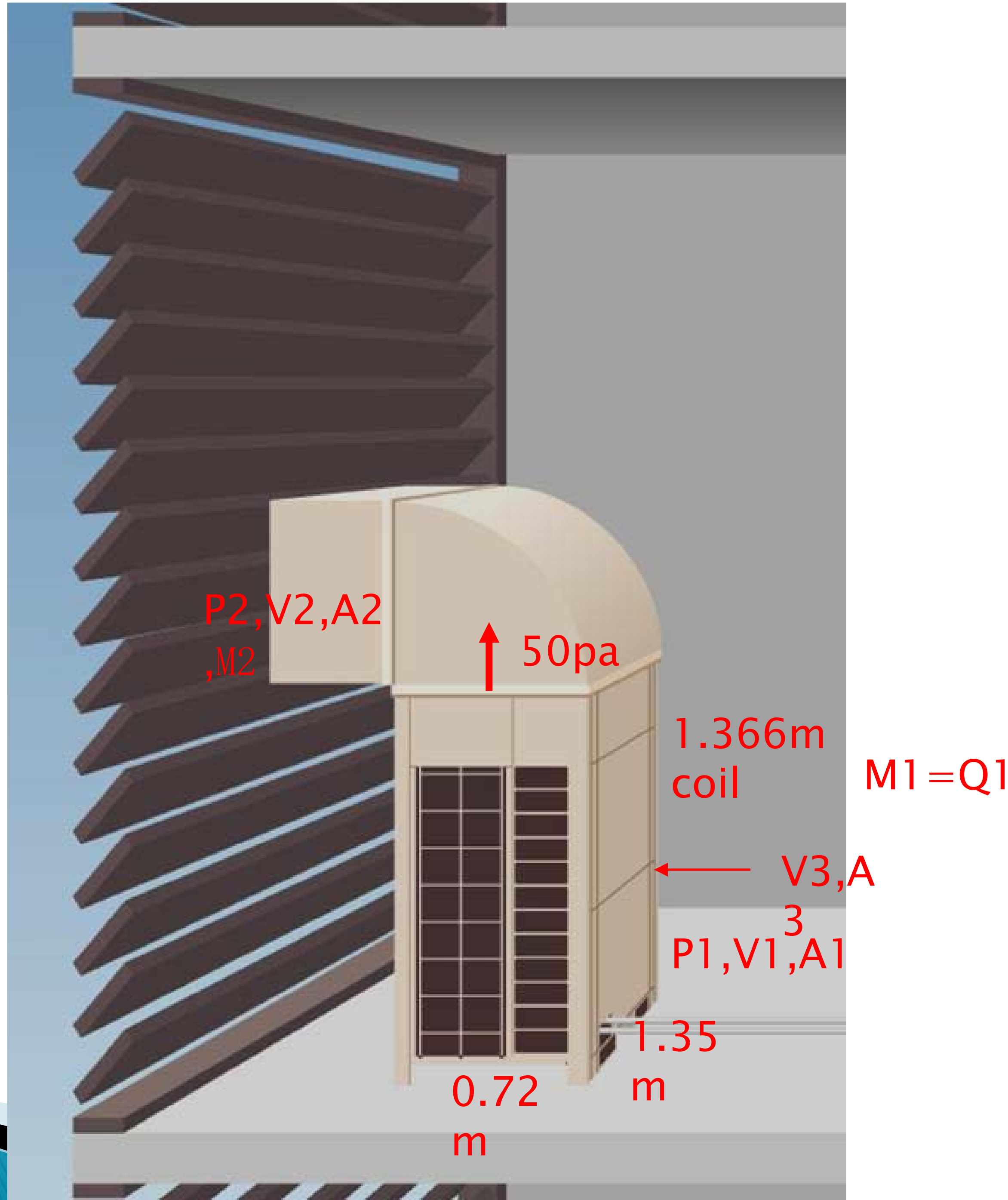
Example of on-site exhaust air duct installation:

- Ensure efficient ventilation
  - Discharge speed=5-8m/s
  - Suction speed≤1.6m/s



- Exhaust air duct
- High static pressure setting of outdoor fan motor.
- Water drain processing

Grille open rate > 70%, louver tilting angle < 20 °



P2,V2,A2
,M2
50pa
1.366m
coil
M1＝Q1
V3,A
3
P1,V1,A1
1.35
m
0.72
m

- $Q=M=AV$
- $Q \propto V \propto A$
- If given Areduce has been reduced by half net free area ie (louvre application)
- Ie $2 \times A2=A1$
- Q also reduce by half; so
- At point 2, $M2=Q2 = Q1/2 =2.25\ m^3/s$
- When flow rate Q reduces by half, velocity also reduces by half $V2= V1/2 = 2.31m/s$

- At the point of louvre,the minor losses
- ^P= (£ x $V^2{}_2$ x § $_{AIR}$) /2 Pa
- ^P= (5 x 2.31^2 x 1.2)/2 =6.93 Pa ------(2)
- Pressure losses across the 90° bend at static of 50 Pa ~0.25 inWg (refer to duct design equivalent length 55/100 x 0.17 ~0.093 inWg = 18.7 Pa--------(3)
- Total Pressure losses => P2
- P2= 50Pa-18.7Pa-6.93Pa
-     =24.37Pa

- For perfact gas per unit gas (Isothermal process)
- $PV' = M_1\ R\ ^\wedge T_1$-----------(4)
- $P\ _2V' = M_2\ R\ ^\wedge T_2$----------(5)
- Work done per unit volume
- $W = M\ R\ T\ Log_e\ (P1/P2)$
- $(P1V1)\ /\ P2\ V2\ = (50 \times 4.5) / (24.37 \times 2.31)$

  $= 225/56.29$
- % losses in efficiency

(225-56.29)/225 x 100%

75% losses in efficiency

Component or Fitting Minor Loss Coefficient – ξ –

Grilles, 0.7 ratio free area to total surface	*3*
Grilles, 0.6 ratio free area to total surface	*4*
Grilles, 0.5 ratio free area to total surface	*6*
Grilles, 0.4 ratio free area to total surface	*10*
Grilles, 0.3 ratio free area to total surface	*20*
Grilles, 0.2 ratio free area to total surface	*50*

Minor Loss *(Pa, N/m²)*										
Flow Velocity *(m/s)*	Minor Loss Resistance Coefficient - *ξ*									
	1	2	3	4	5	6	7	8	9	10
2	2.4	4.8	7.3	9.7	12.1	14.5	16.9	19.4	21.8	24.2
2.5	3.8	7.6	11.3	15.1	18.9	22.7	26.5	30.3	34.0	37.8
3	5.4	10.9	16.3	21.8	27.2	32.7	38.1	43.6	49.0	54.5
3.5	7.4	14.8	22.2	29.6	37.1	44.5	51.9	59.3	66.7	74.1
4	9.7	19.4	29.0	38.7	48.4	58.1	67.8	77.4	87.1	96.8
4.5	12.3	24.5	36.8	49.0	61.3	73.5	85.8	98.0	110	122
5	15.1	30.3	45.4	60.5	75.6	90.8	105	121	136	151
5.5	18.3	36.6	54.9	73.2	91.5	109	128	146	164	183
6	21.8	43.6	65.3	87.1	108	130	152	174	196	217
6.5	25.6	51.1	76.7	102	127	153	178	204	230	255
7	29.6	59.3	88.9	118	148	177	207	237	266	296
7.5	34.0	68.1	102	136	170	204	238	272	306	340
8	38.7	77.4	116	154	193	232	271	309	348	387
8.5	43.7	87.4	131	174	218	262	306	349	393	437
9	49.0	98.0	147	196	245	294	343	392	441	490
9.5	54.6	109	163	218	273	327	382	436	491	546
10	60.5	121	181	242	302	363	423	484	544	605
10.5	66.7	133	200	266	333	400	466	533	600	667
11	73.2	146	219	292	366	439	512	585	658	732
11.5	80.0	160	240	320	400	480	560	640	720	800
12	87.1	174	261	348	435	522	609	697	784	871
12.5	94.5	189	[illegible]	378	472	567	661	756	850	945

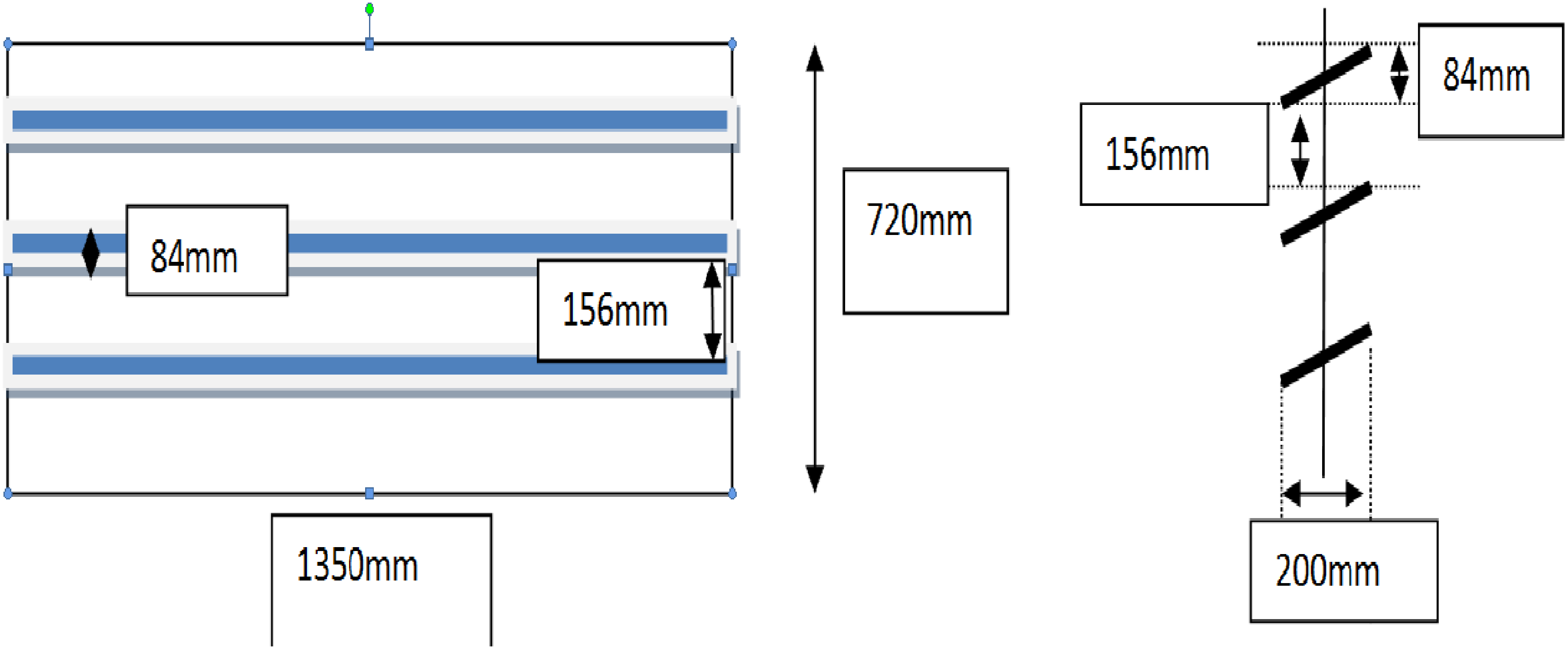
Louvre net free area estimation

In order for the unit to operate in normal condition, P2 shall not smaller than 2/3 of P1

- For isothermal process
- $P\dot{V} = \dot{M}RT$ ($\dot{M}$= mass flow rate kg/s)
- P is proportional to $\dot{M}$, where $\dot{M} = \dot{\rho}\, Q = \dot{\rho} \times A \times V$ ($\dot{\rho}$= density of air = 1.2 kg/m3)
- $P \propto A \propto V$
- At P2 , P2= 2/3 P1
- P2= 2/3 x 50Pa =33.33Pa

- P1/A1 = P2/A2,
- A2= P2 x A1/P2
- Where A1=original air discharge(1.35x0.72=0.972m2),P1= Original EXP=50Pa.
- =>A2= 33 x (0.972 m2)/ 50= 0.631 m2
- Area losses due to blockage = A1-A2
- 0.972- 0.641 m2= 0.33 m2
- % area losses= 0.33/0.972 x100%= 35%
- i.e net free area remaining is 65%

To decide the louvre angle , view the cross section of discharge area as below



- Since the net free area is 65%, then the louvre angle is tan β= 84/200
- β = 22 degree measured from the horizontal

Data`

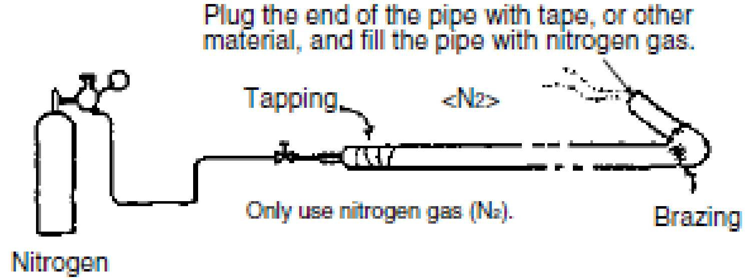
Result

System Flushing

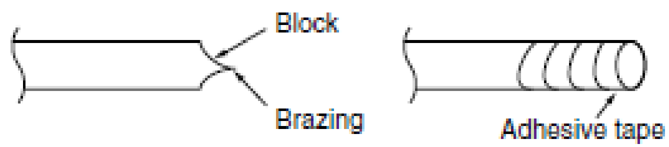
System flushing with nitrogen for a pressure of 0.02MPa

Operation procedure

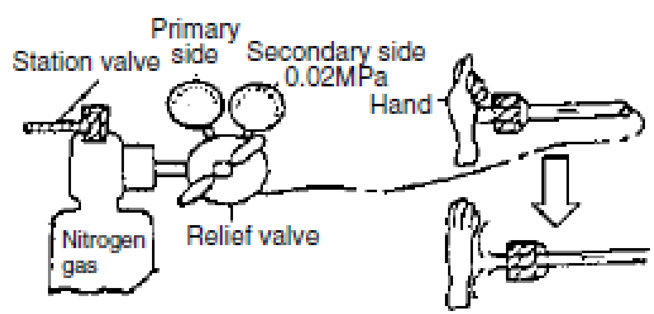
a) Brazing must be performed under a nitrogen gas flow. Without nitrogen gas, a large quantity of foreign matters (oxidized film) are created, causing a critical failure from capillary tube or expansion valve clogging.



b) Give sufficient protections (compressed and brazed) so that water or foreing matters may not enter the piping.



c) Perform flushing. To flush the piping. charge nitrogen gas at about 0.02 MPa with a pipe end closed with a hand. When pressure inside builds up to a sufficient level, remove the hand to flush. (in flushing a pipe, close the other end of the pipe with a plug).



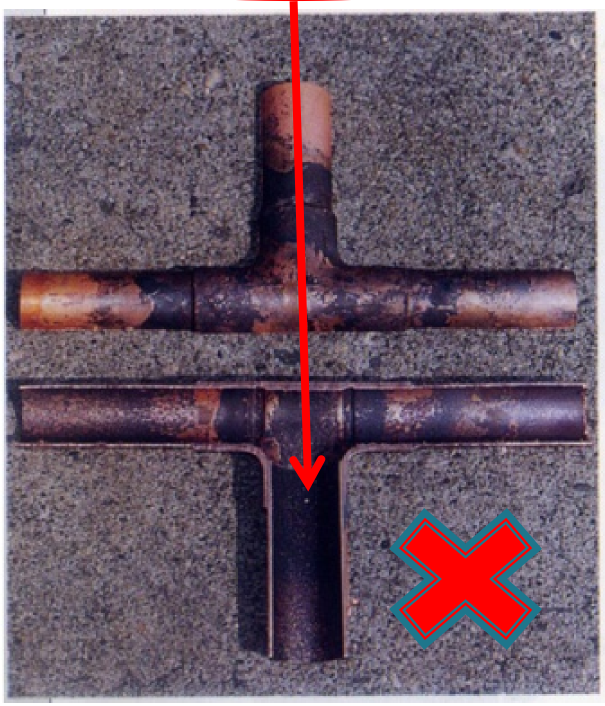
d) In laying pipes on the installation site, keep the service valves shut all the time.

⚠ **Caution** : Please make sure that the operation valve is in the state of the "close" before waxing. If the flame touches the refrigerant gas, the noxious gas is generated, and it is likely to become poisoned.

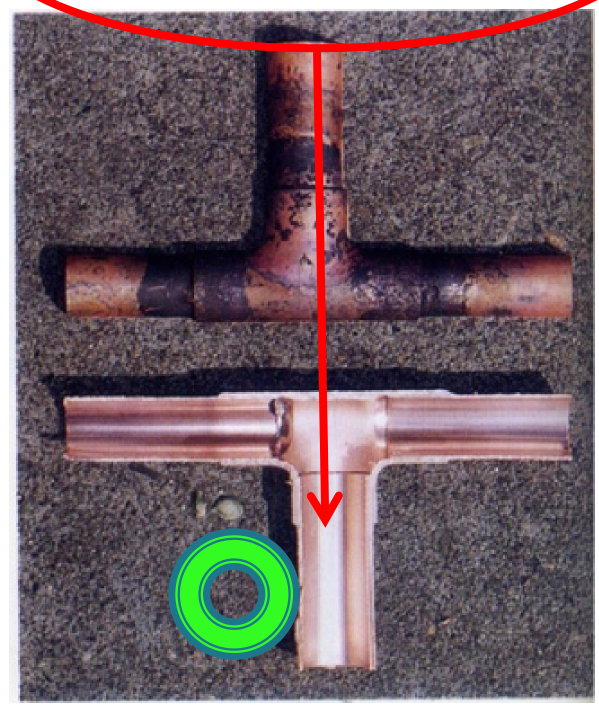
3. Refrigerant Piping Work

12) Brazing the refrigerant piping should be done under N2 gas flowing in order to prevent from oxidation.

Oxidized film generated without N2 gas flowing



No oxidization, brazing under N2 gas flowing



Very Important I: Oxidized film in the refrigerant pipe can cause the damage of compressor.

Very Important II: The T-junction shown in the photo should never be used in the MHI air-conditioning system.

Outdoor strainner

Failure due to non nitrogen brazing

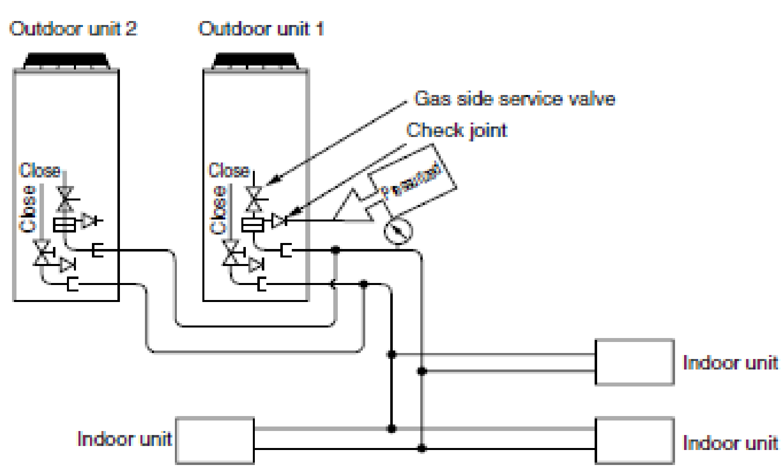
System pressure testing

Pressure testing up to 500psig holding for at least 24hours

Air Tightness Test

⚠ **Caution** : Please make an airtightness test using nitrogen gas and make sure no leakage after the refrigerant piping operation. When the refrigerant gas leaks in narrow indoor by any chance and the limiting concentration is exceeded, it might cause the hypoxia accident.

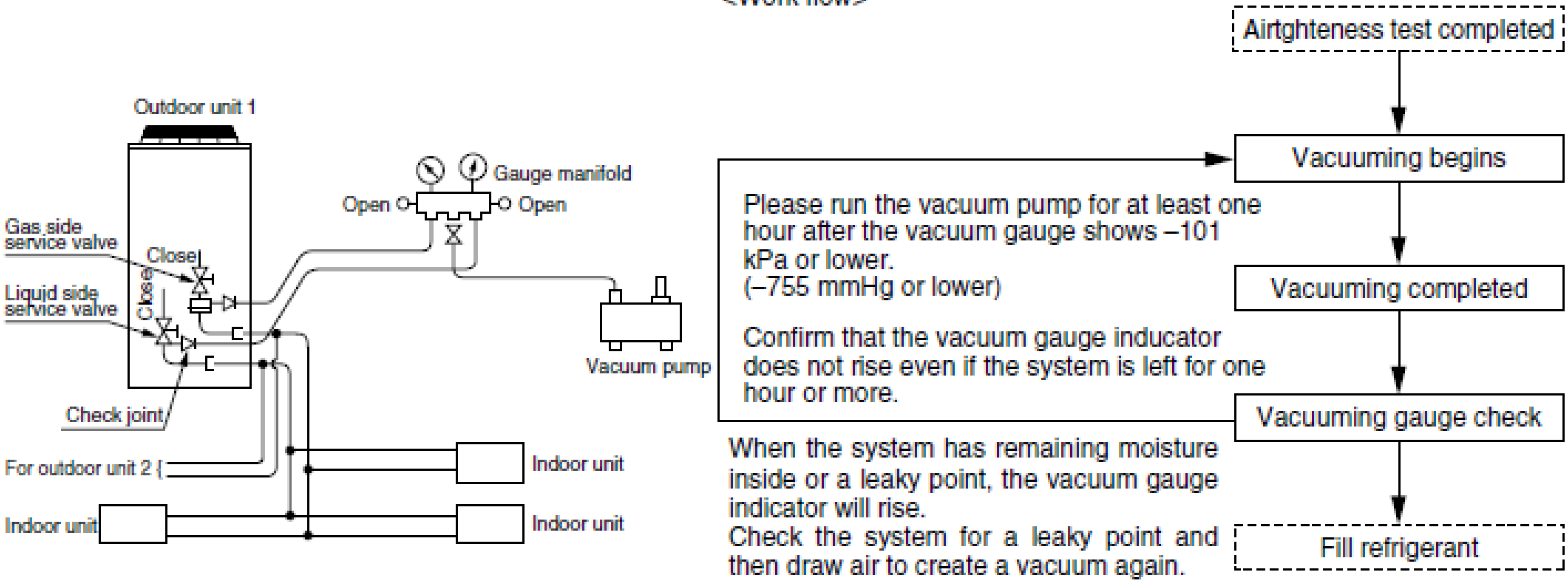
1. Although an outdoor unit itself has been tested for air tightness at the factory, please check the connected pipes and indoor units for air tightness from the check joint of the service valve on the outdoor unit side. While conducting a test, keep the service valve shut all the time.
2. Since refrigerant piping is pressurized to the design pressure of a unit with nitrogen gas for testing air tightness, please connect instruments according the drawing below.
   Under no circumstances should chorine-based refrigerant, oxygen or any other combustible gas be used to pressurize a system keep the service valve shut all the time. Do not open it under any circumstances.
   Pressurize all of the liquid, gas and oil equalization pipes.
3. In pressurizing the piping, do not apply the specified level of pressure all at once, but gradually raise pressure.
   a) Raise the pressure to 0.5 MPa, and stop. Leave it for five minutes to see if the pressure drops.
   b) Then raise the pressure to 1.5 MPa, and stop. Leave it for five more minutes to see if the pressure drops.
   c) Then raise the pressure to the specified level (4.15 MPa), and record the ambient temperature and the pressure.
   d) If no pressure drop is observed with an installation pressurized to the specifed level and left for about one day, It is acceptable. When the ambient temperature changes 1°C, the pressure also changes approximately 0.01 MPa. The pressure, if changed, should be compensated for.
   e) If a pressure drop is observed in checking e) and a) - d), a leak exists somewhere. Find a leak by applying bubble test liquid to welded parts and flare joints and repair it. After repair, conduct an air-tightness test again.
4. Always evacuate the pipes after the airtightness test.



System Vacumming

Vacuuming for 4~6 hours at –101KPa or lower
(–755mmHg or lower)

<Work flow>



Pay attention to the following points in addition to the above for the R410A and compatible machines.

- To prevent a different oil from entering, please assign dedicated tools, etc. to each refrigerant type. Under no circumstances must a gauge manifold and a charge hose in particular be shared with other refrigerant types (R22, R470C, etc.).
- Use a counterflow prevention adapter to prevent vacuum pump oil from entering the refrigerant system.

VRF system operation Refrigerant Flow circuit

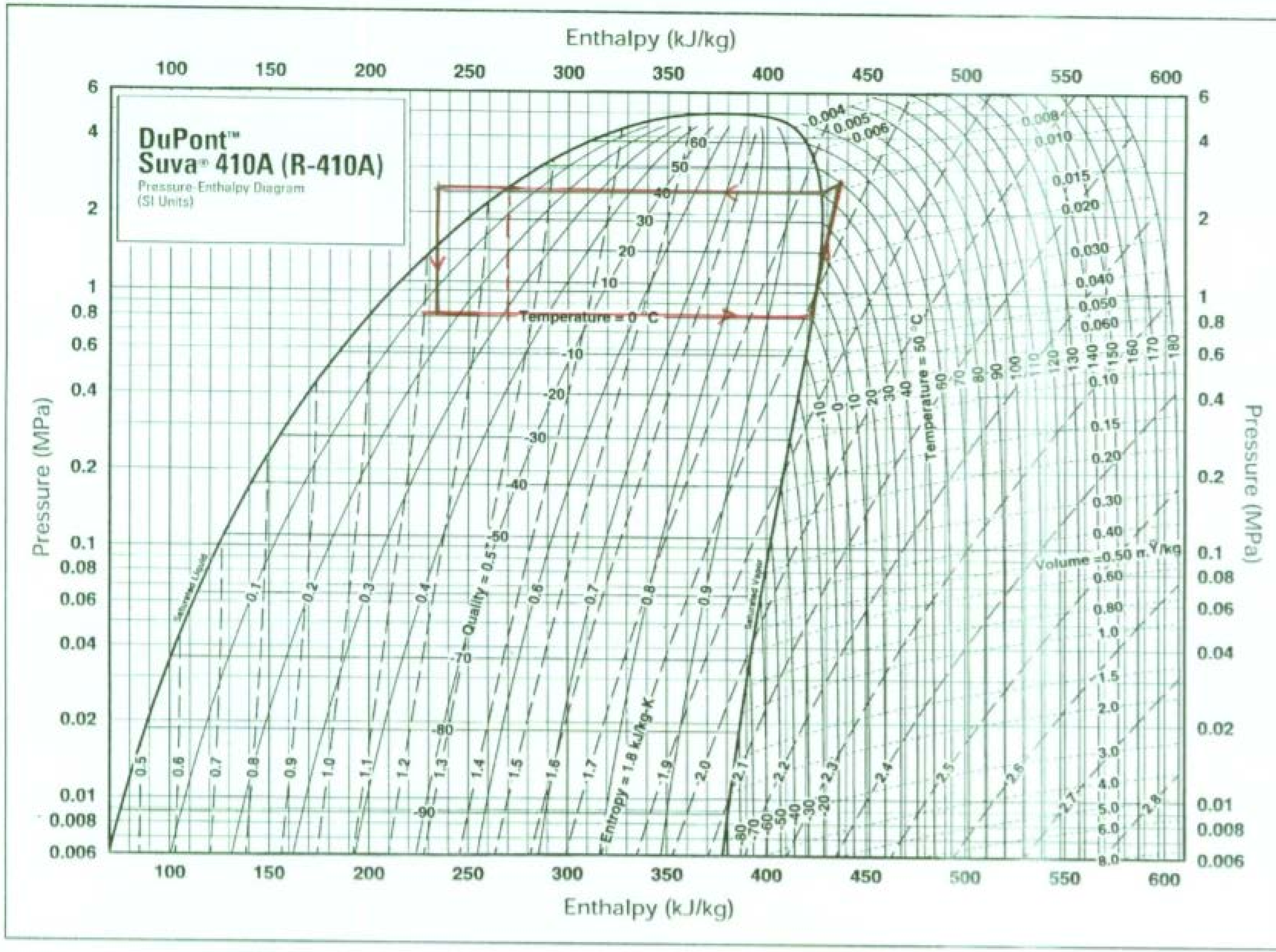
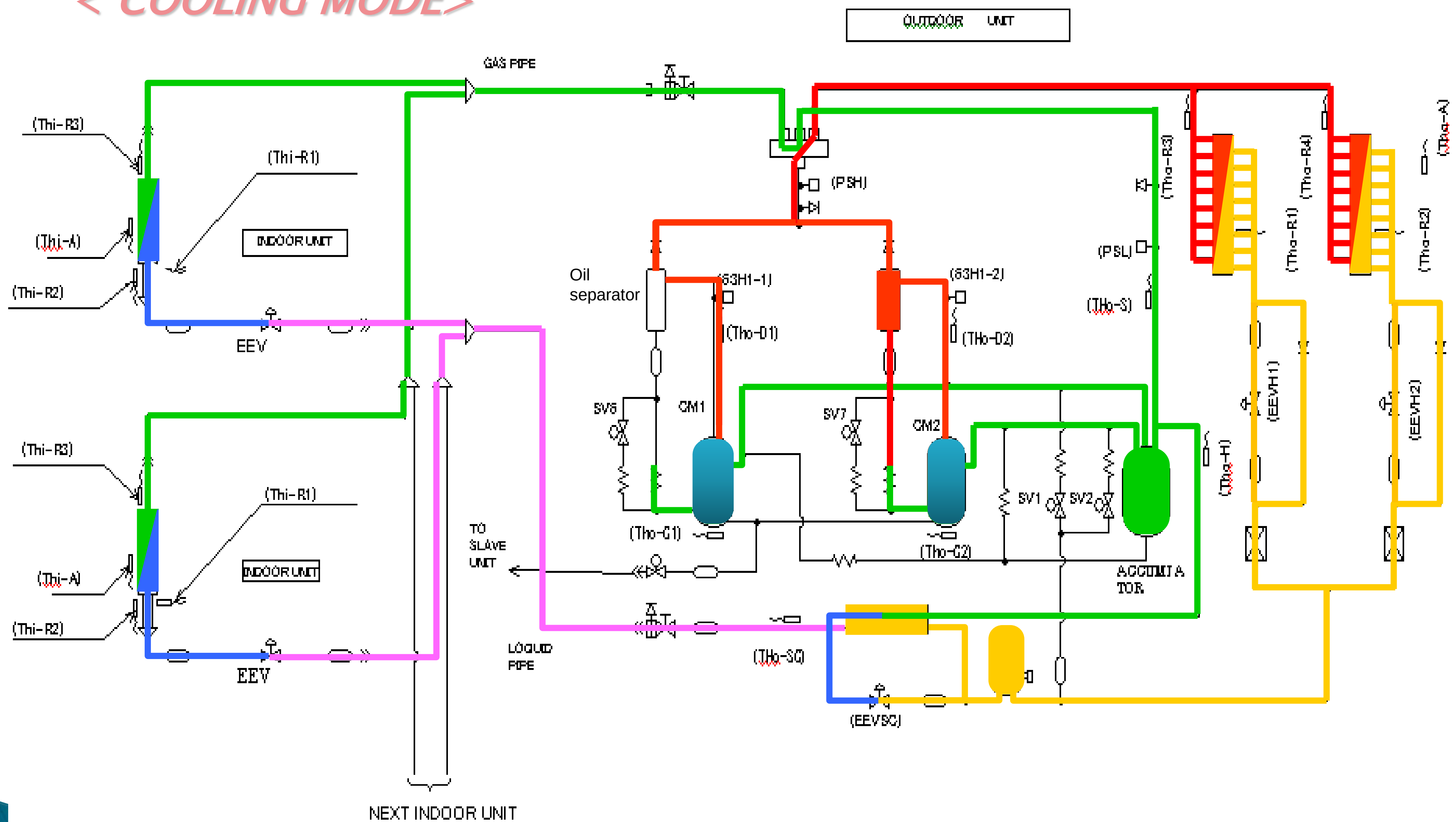


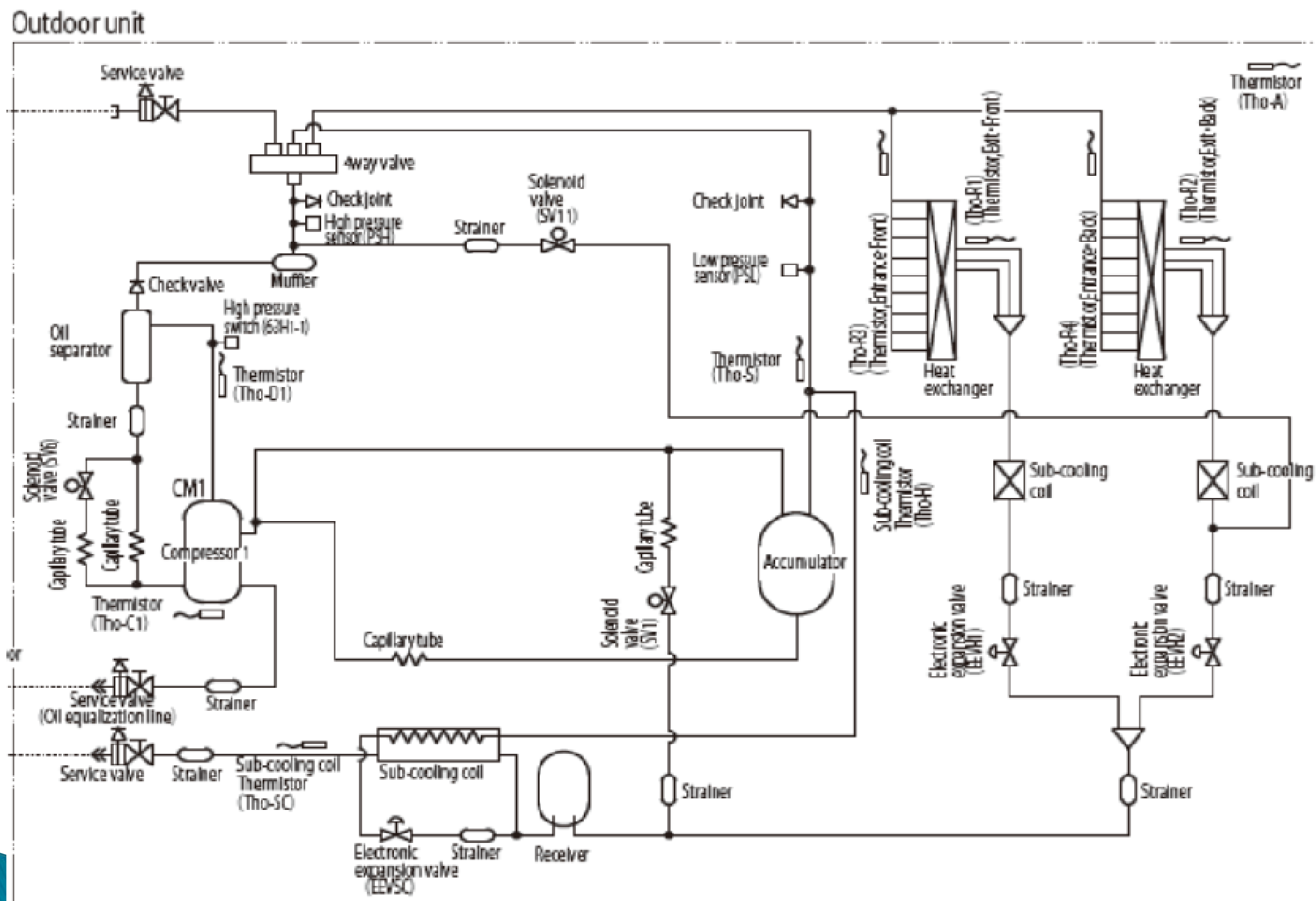
Figure 4. Pressure-Enthalpy Diagram for DuPont™ Suva® 410A (SI Units)

REFRIGERANT FLOW

< COOLING MODE>

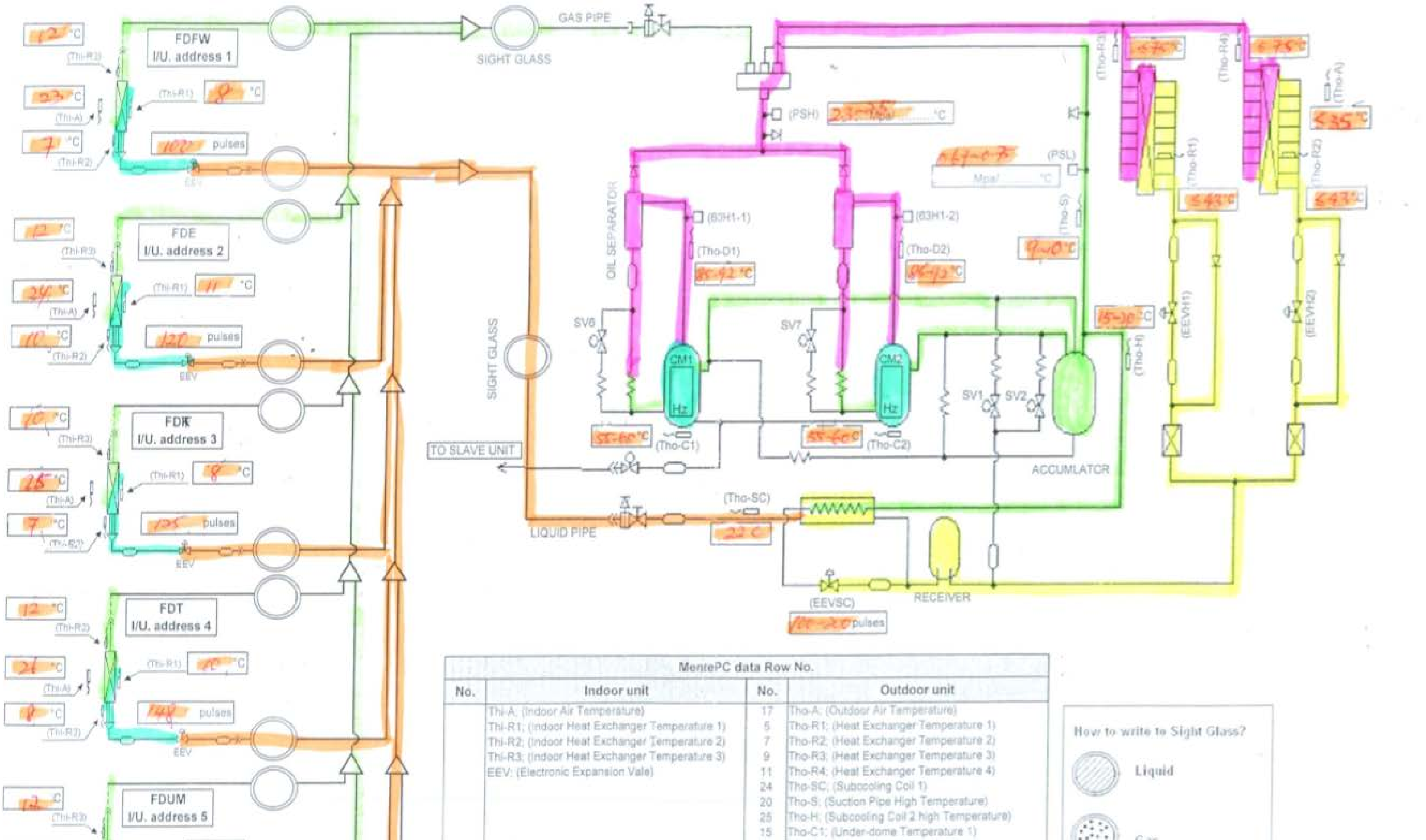


Models FDC280KXZE1, 335KXZE1



NAME : ....
COMPANY : ....
DATE : ....

CASE : Full load condition
RUN MODE : cooling mode



MentePC data Row No.			
No.	Indoor unit	No.	Outdoor unit
	Thi-A; (Indoor Air Temperature)	17	Tho-A; (Outdoor Air Temperature)
	Thi-R1; (Indoor Heat Exchanger Temperature 1)	5	Tho-R1; (Heat Exchanger Temperature 1)
	Thi-R2; (Indoor Heat Exchanger Temperature 2)	7	Tho-R2; (Heat Exchanger Temperature 2)
	Thi-R3; (Indoor Heat Exchanger Temperature 3)	9	Tho-R3; (Heat Exchanger Temperature 3)
	EEV: (Electronic Expansion Vale)	11	Tho-R4; (Heat Exchanger Temperature 4)
		24	Tho-SC; (Subcooling Coil 1)
		20	Tho-S; (Suction Pipe High Temperature)
		25	Tho-H; (Subcooling Coil 2 high Temperature)
		15	Tho-C1; (Under-dome Temperature 1)

Outdoor Parameter

- Tho-A (outdoor Temp)
- Tho-R1 (Heat Exhange Temp1)
- Tho-R2 (Heat Exhange Temp2)
- Tho-R3 (Heat Exhange Temp3)
- Tho-R4 (Heat Exhange Temp4)
- Tho-SC (Subcooling coil 1)
- Tho-S (Suction pipe Temp)
- Tho-H (Suction coil2 Temp
- Tho-C1 (under dome Temp1)

- 35C and below
- 43C and below
- 43C and below
- Around 75C
- Around 75C
- Around 22C
- Around 9-10C
- Around 15-20C
- Around55-60C

Outdoor Parameter continue....

Tho-C2(under dome Temp2)	Around 55-60C
Tho-D1 (Discharge pipe Temp1)	Around 85-92C
Tho-D1 (Discharge pipe Temp2)	Around 85-92C
CM1(Hz) (Inverter operation freq)	80 to112Hz subj to model
CM2(Hz) (Inverter operation freq)	80 to112Hz subj to model
EEVSC(EEV valve sub cool)	100-200Hz
PSH, (High Pressure)	2.3-2.5MPa
PSL (Low Pressure)	0.67-0.75MPa

Wired Remote controller load functions

KXX wired remote controller

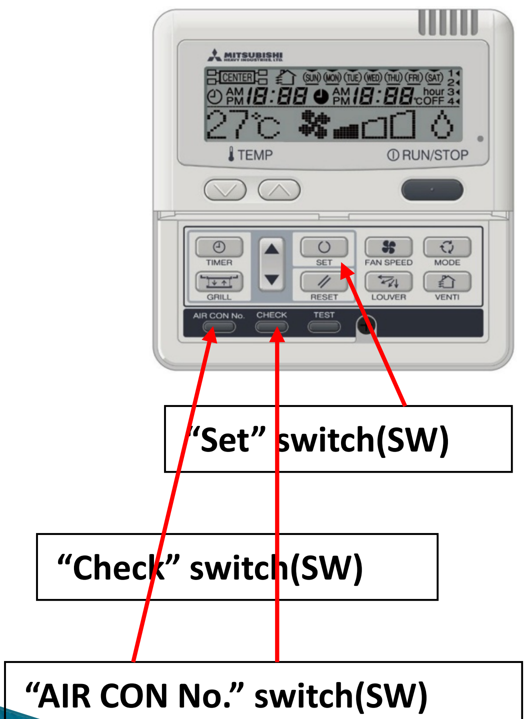
RCE-5 **new wired controller packed with control and diagnostic functions**

KX Series

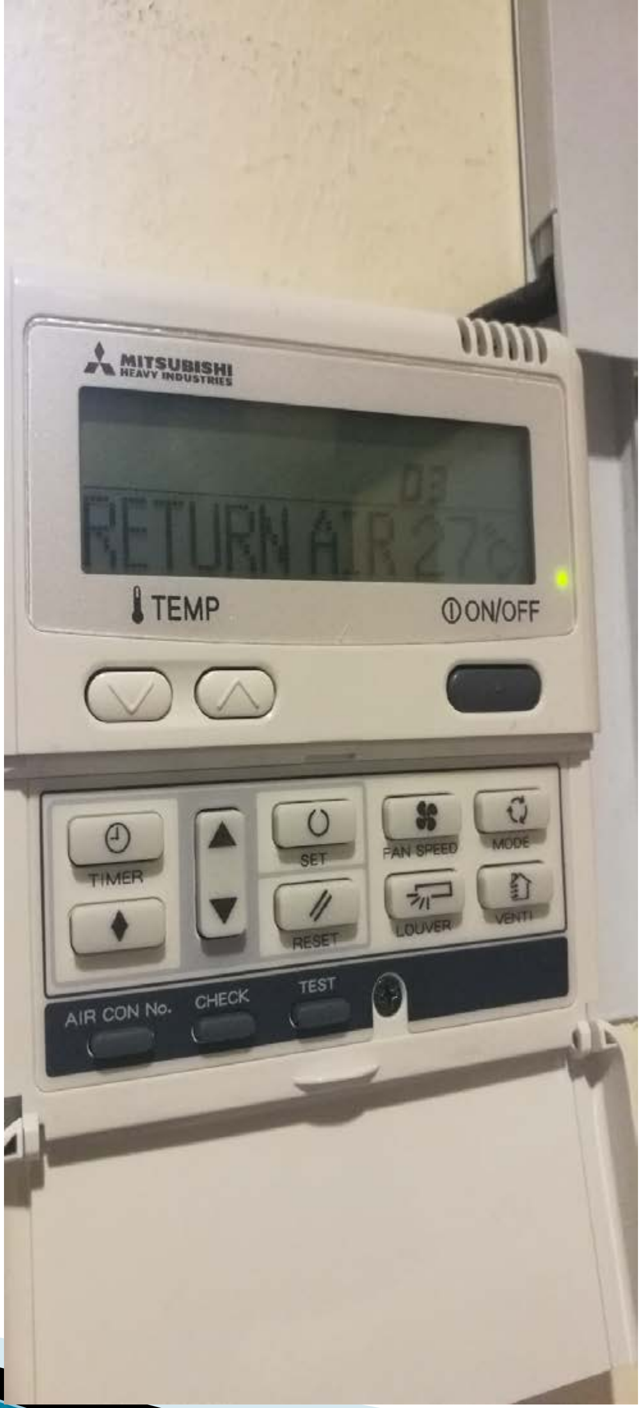
8. Unit evaluation by test run switch (5)

<Monitoring by remote controller >

The list of “ operation data” displayed by remote controller

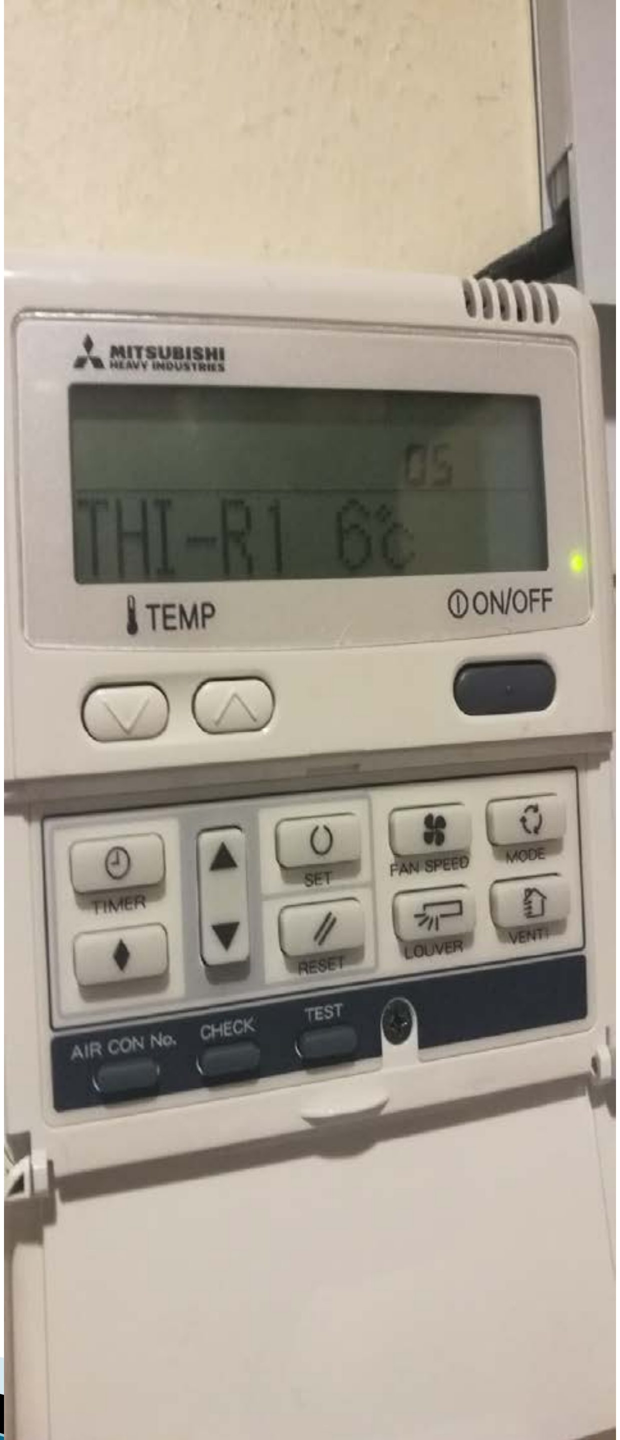


No.	Data items of indoor units	Display range	No.	Data items of indoor units	Display range
01	Operation mode	Cooling / heating / drying / air supply	21	Outdoor air temperature	-20 ~ (°C)
02	Set temperature	18 ~ 30 (°C)	22	Outdoorunit heat exchanger temperature (Main unit)	-20 ~ (°C)
03	Air return temperature	0°C or more	23	Outdoorunit heat exchanger temperature (Main unit)	-20 ~ (°C)
04	Inner heat exchanger temperature 1	The same as above	24	Operation Hz (Main unit CM1)	0 ~ 100 (Hz)
05	Inner heat exchanger temperature 2	The same as above	25	High pressure	0.0 ~ (MPa)
06	Inner heat exchanger temperature 3		26	Low pressure	0.00 ~ (MPa)
07	Indoor fan speed		27	Dischargepipetemperature (Main unit CM1)	30 ~ (°C)
08	Required frequency		28	Compressor dome lower part temperature (Main unit CM1)	-20 ~ (°C)
09	Response frequency		29	CT current (Main unit CM1)	0 ~ (A)
10	Expansion valve opening	0 ~ 480 (pulse)	37	Expansion valve opening 1 (Main unit)	0 ~ 500 (pulse)
11	Indoor operation time	0 ~ 25500h	38	Expansion valve opening 2 (Main unit)	0 ~ 500 (pulse)


MITSUBISHI
HEAVY INDUSTRIES
03
RETURN AIR 27°C
TEMP
ON/OFF
TIMER
SET
RESET
FAN SPEED
MODE
LOUVER
VENTI
AIR CON No.
CHECK
TEST


MITSUBISHI
HEAVY INDUSTRIES
09
DEMAND 20.0Hz
TEMP
ON/OFF
TIMER
SET
RESET
FAN SPEED
MODE
LOUVER
VENTI
AIR CON No.
CHECK
TEST

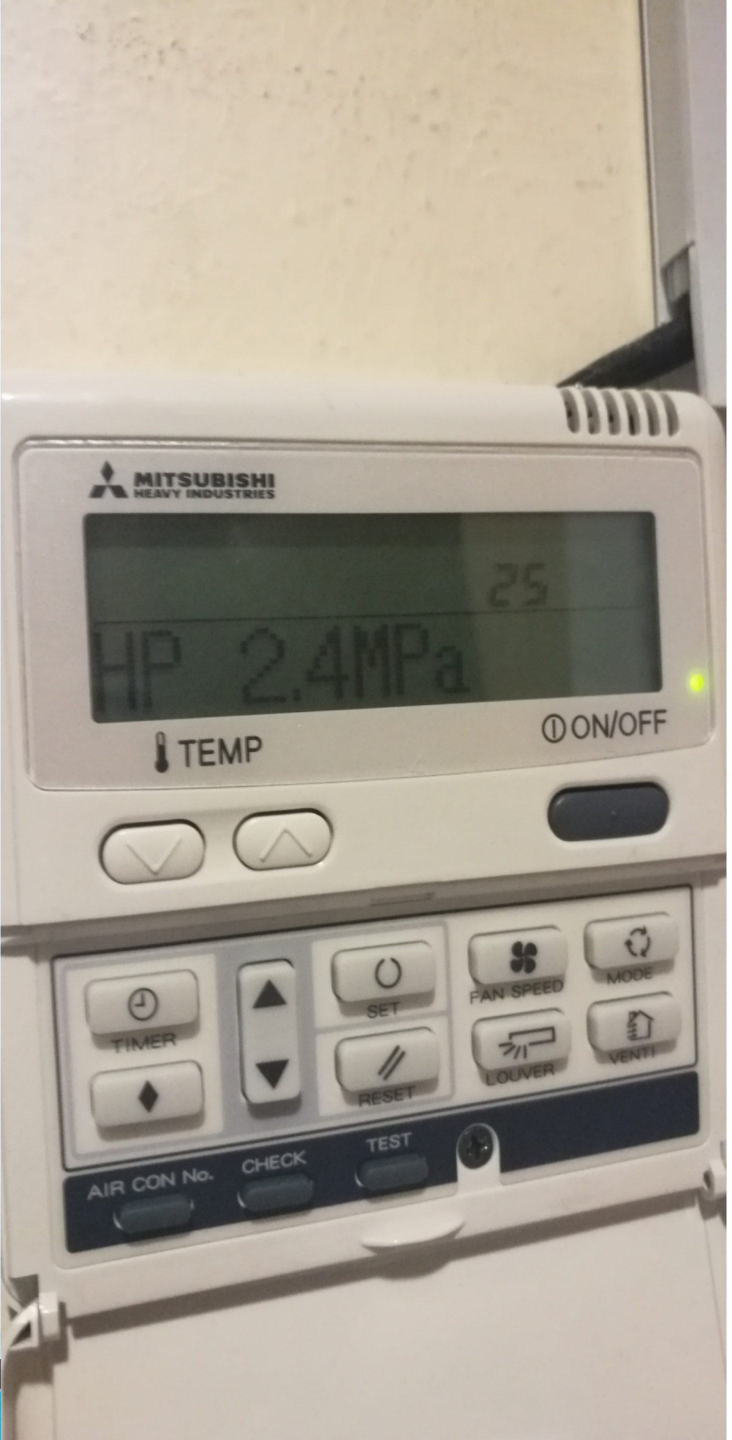

MITSUBISHI
HEAVY INDUSTRIES
ANSWER 25Hz
TEMP
ON/OFF
TIMER
SET
RESET
FAN SPEED
MODE
LOUVER
VENTI
AIR CON No.
CHECK
TEST

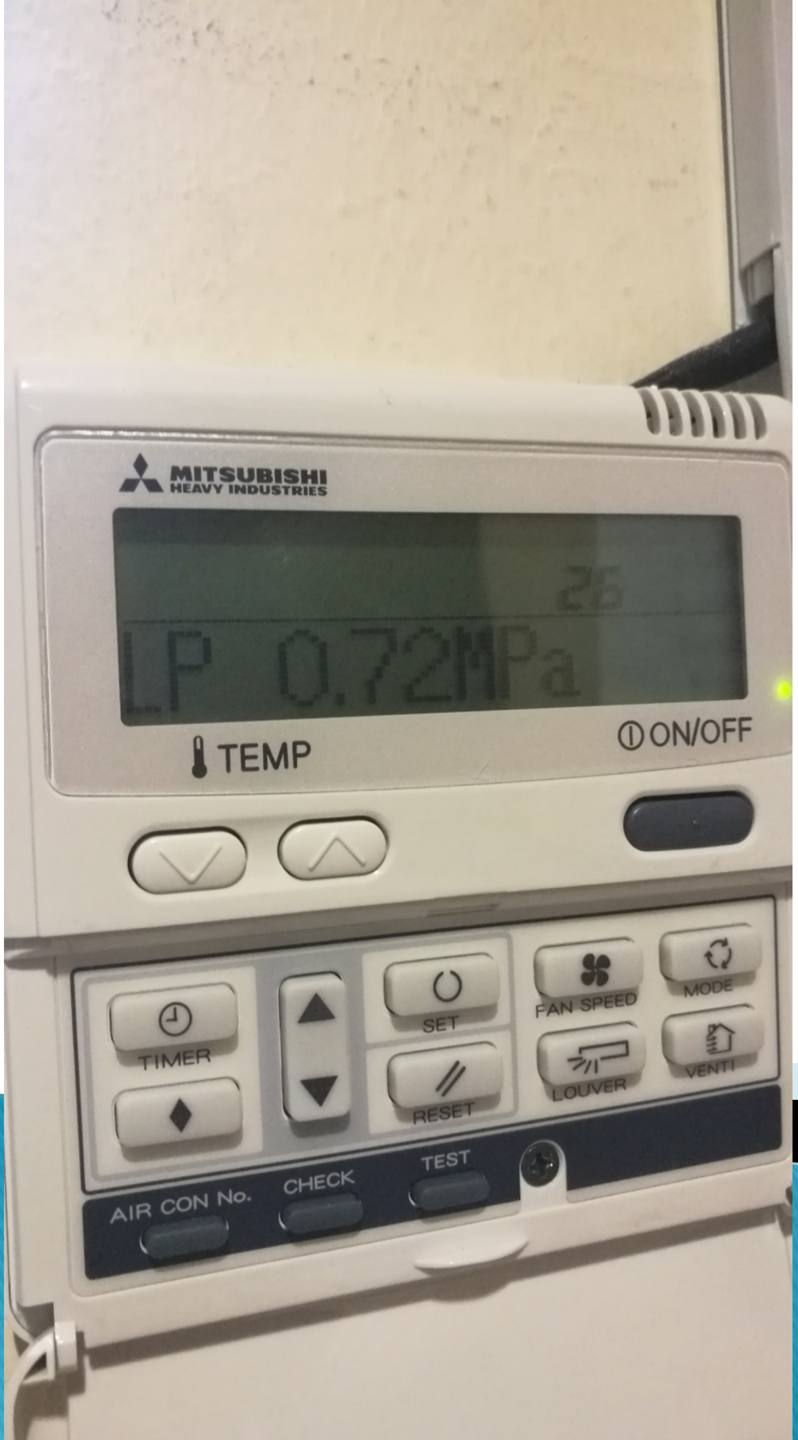

MITSUBISHI
HEAVY INDUSTRIES
05
THI-R1 6°c
TEMP
ON/OFF
TIMER
SET
FAN SPEED
MODE
RESET
LOUVER
VENTI
AIR CON No.
CHECK
TEST

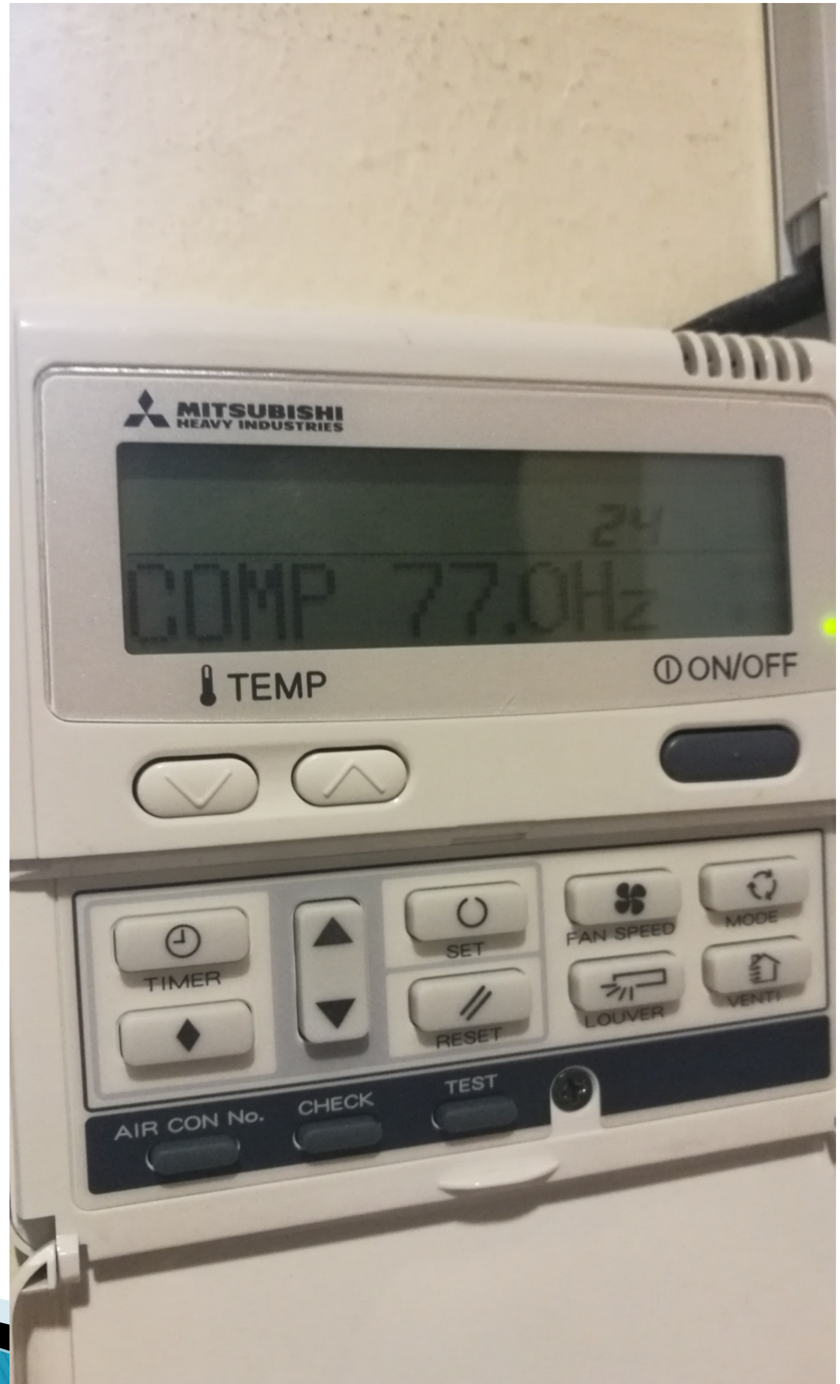

MITSUBISHI
HEAVY INDUSTRIES
THI-R2 5°C
TEMP
ON/OFF
TIMER
SET
RESET
FAN SPEED
MODE
LOUVER
VENTI
AIR CON No.
CHECK
TEST


MITSUBISHI
HEAVY INDUSTRIES
THI-R3 6°c
TEMP
ON/OFF
TIMER
SET
RESET
FAN SPEED
MODE
LOUVER
VENTI
AIR CON No.
CHECK
TEST

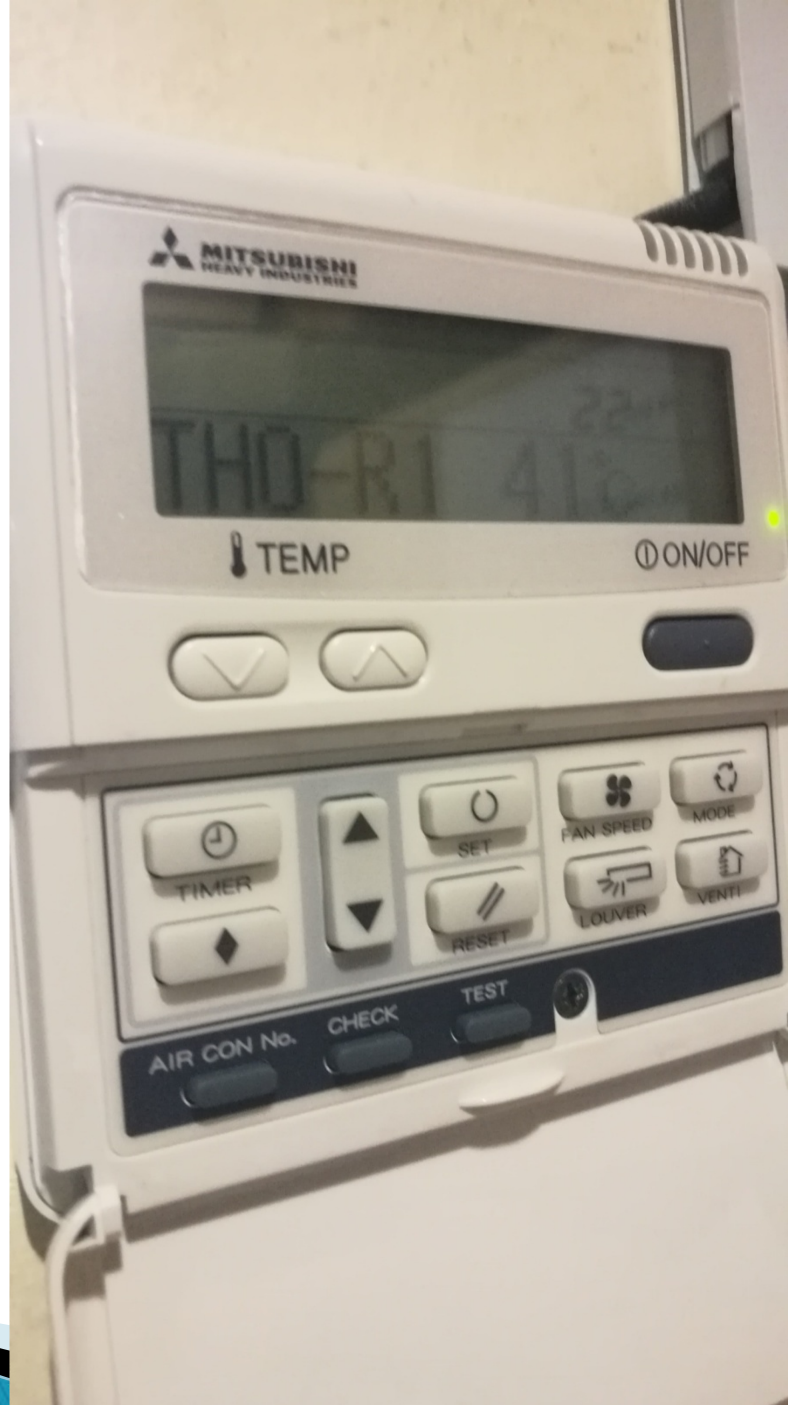

MITSUBISHI
HEAVY INDUSTRIES
I/U EEV 81P
TEMP
ON/OFF
TIMER
SET
RESET
FAN SPEED
MODE
LOUVER
VENTI
AIR CON No.
CHECK
TEST


MITSUBISHI
HEAVY INDUSTRIES
25
HP 2.4MPa
TEMP
ON/OFF
TIMER
SET
RESET
FAN SPEED
MODE
LOUVER
VENTI
AIR CON No.
CHECK
TEST


MITSUBISHI
HEAVY INDUSTRIES
26
LP 0.72MPa
TEMP
ON/OFF
TIMER
SET
RESET
FAN SPEED
MODE
LOUVER
VENTI
AIR CON No.
CHECK
TEST


MITSUBISHI
HEAVY INDUSTRIES
24
COMP 77.0Hz
TEMP
ON/OFF
TIMER
SET
RESET
FAN SPEED
MODE
LOUVER
VENTI
AIR CON No.
CHECK
TEST


MITSUBISHI
HEAVY INDUSTRIES
OUTDOOR 32°C
TEMP
ON/OFF
TIMER
SET
RESET
FAN SPEED
MODE
LOUVER
VENTI
AIR CON No.
CHECK
TEST


MITSUBISHI
HEAVY INDUSTRIES
THO-R1 41
TEMP
ON/OFF
TIMER
SET
RESET
FAN SPEED
MODE
LOUVER
VENTI
AIR CON No.
CHECK
TEST

Analyzing MentePC Data

June 2010

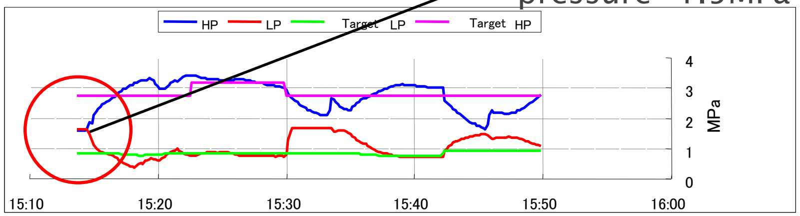
MITSUBISHI HEAVY INDUSTRIES, LTD.

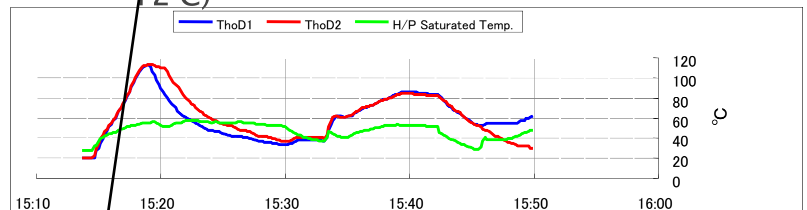
Ver. 2

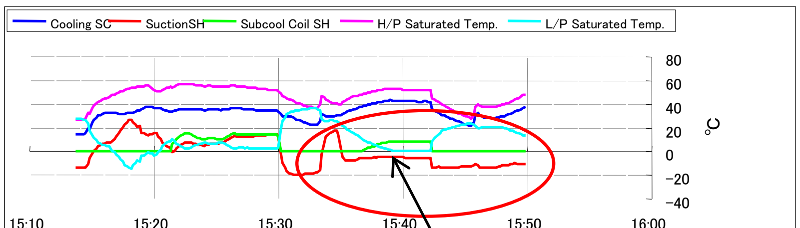
Example 1

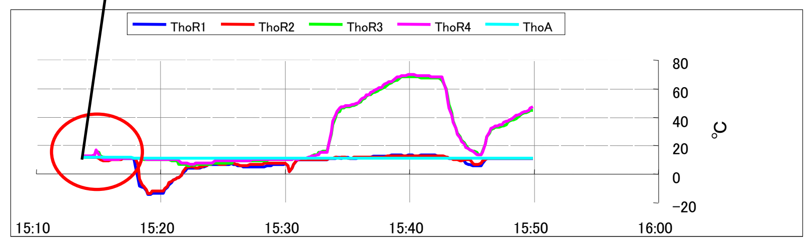
Cooling

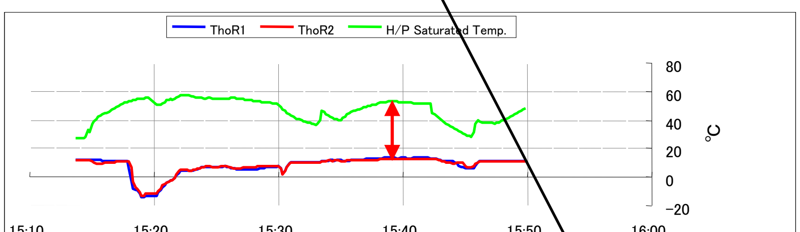
Balancing pressure=1.5MPa > Saturated pressure≒1.15MPa (at 12℃)

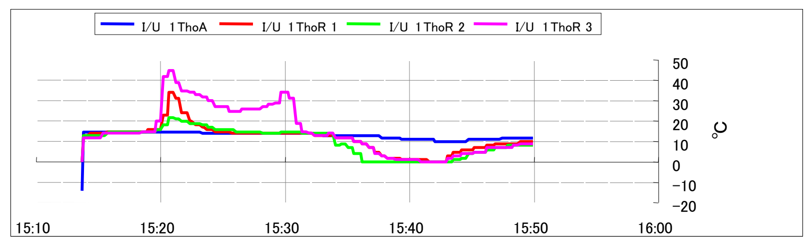












Suction superheat≦0

Point

1. Balancing pressure is higher than the saturated pressure of outdoor air temperature.
2. [High pressure saturated temperature (55℃)]−[Outdoor heat exchanger temperature (ThoR1, R2≒10～12℃≒ThoA)] ≧10deg
3. Suction superheat is minus.

When stopping operation, basically saturated temperature of balancing pressure (L/P=H/P) becomes equal to outdoor air temperature.

[Presumable Cause]
Noncondensable gas (Nitrogen gas) is mixed in.

Mixing air or N2 gas in refrigeration system

How to find mixing air or N2 gas

Dalton's law

Each partial pressure of mixed gas is in proportion to the proportion of each gas component.

Only refrigerant in the system

Outside temperature: 30°C

Refrigerant
Temperature: 30°C
Pressure:1.78MPa

Refrigerant & air in the system

Outside temperature: 30°C

Refrigerant
Temperature: 30°C
Pressure:1.78MPa

Air (no condensation gas)
Temperature:30°C
Pressure:0.50MPa

mixing

Refrigerant & Air
Temperature: 30°C
Pressure:2.28MPa

Please take note that the pressure is higher than the saturated temp. pressure of refrigerant before operation, air or N2 gas may be mixed.

Example 1

[Question]

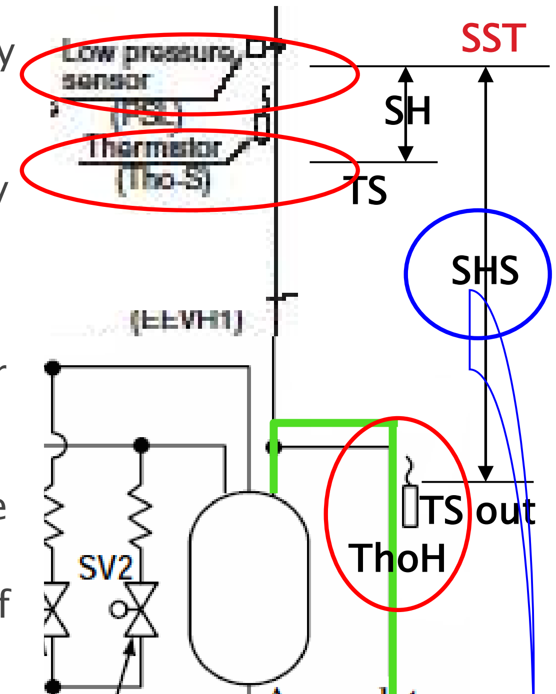
If noncondensable gas is mixed into the refrigerant circuit, why does the suction superheat become minus?

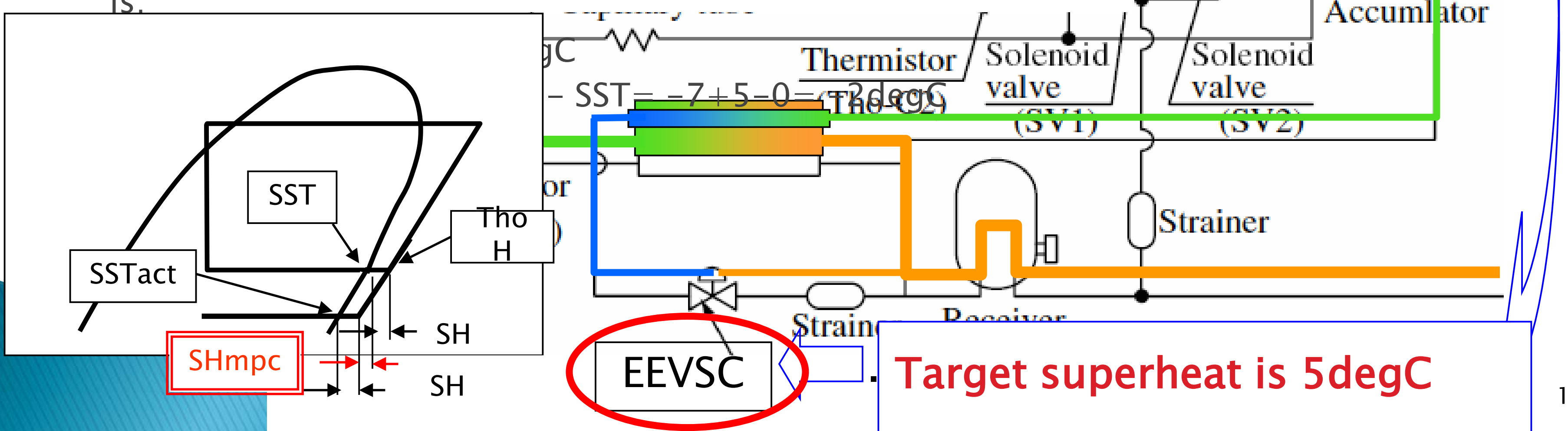
[Answer]

Suction superheat is controlled at around 5degC with EEVSC by calculating with the calculated value of suction saturated temperature (SST) from low pressure and with the detected value by ThoH.

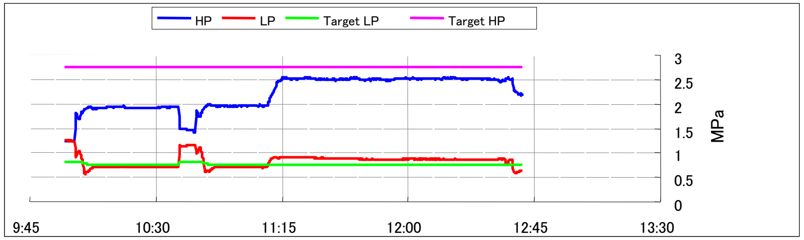
However if the detected low pressure(0.8MPa) is 0.2MPa higher than the actual pressure(0.6MPa) due to the affection of mixed noncodensable gas, the actual saturated temperature (SSTact) is -7℃ and the saturated temperature at detected low pressure (SST) is 0℃.

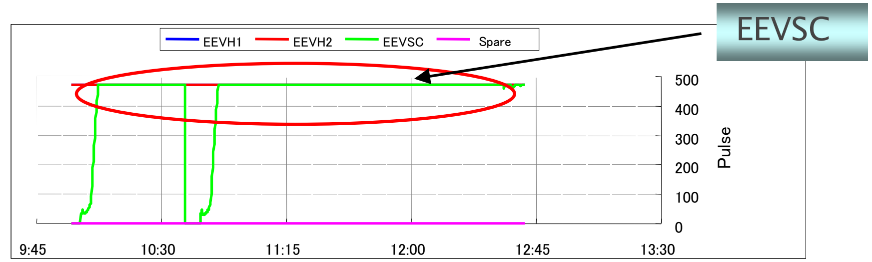
Even if the suction gas temperature is controlled with 5degC of superheat (SH), the superheat shown in MentePC data (SHmpc) is:

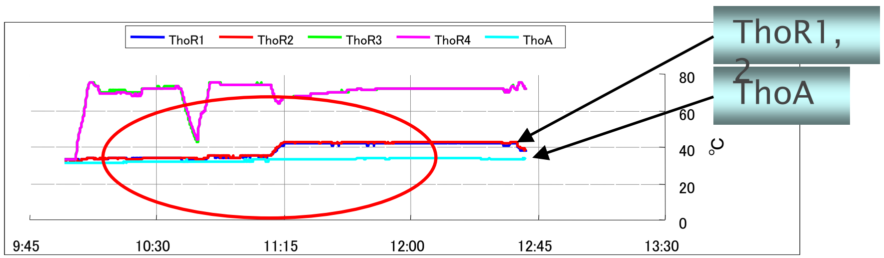


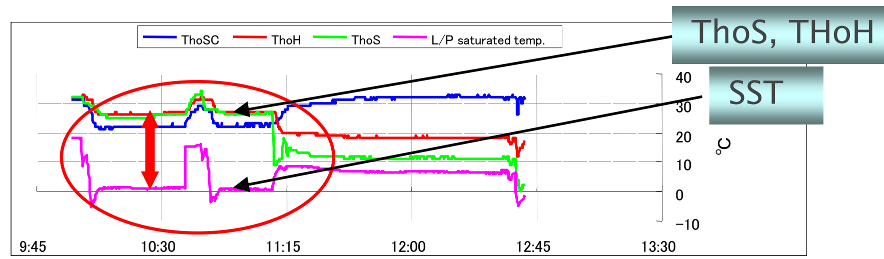


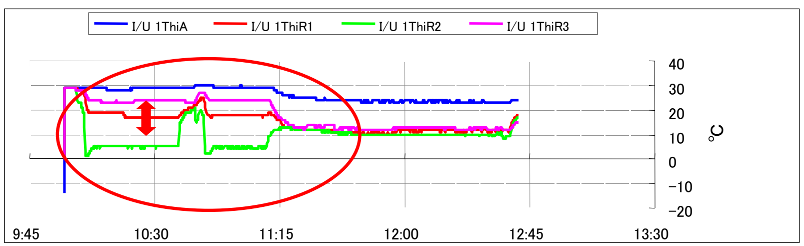
Example 2 *Cooling*

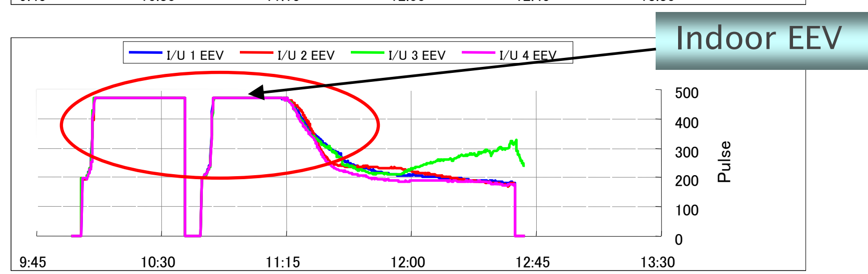












Point

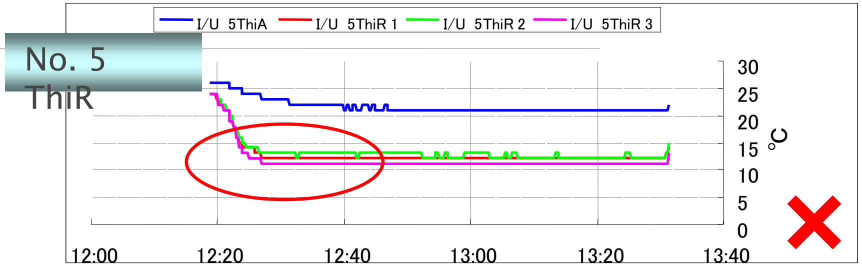
1. EEVSC is fully opened (470Pulse)
2. The outlet temperature of outdoor heat exchanger is close to the outdoor air temperature.
3. Suction superheat is too high.
4. Indoor EEV is fully opened (470Pulse), but the superheat at the outlet of indoor heat exchanger is too high.

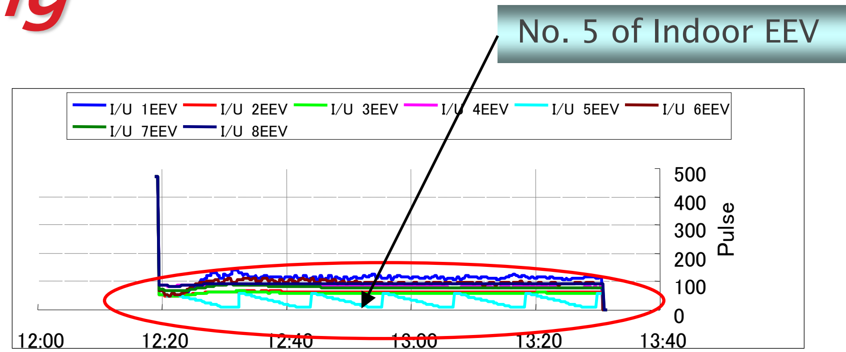
EEVSC and indoor EEV are fully opened due to excessive superheat, that may cause very little refrigerant flow.

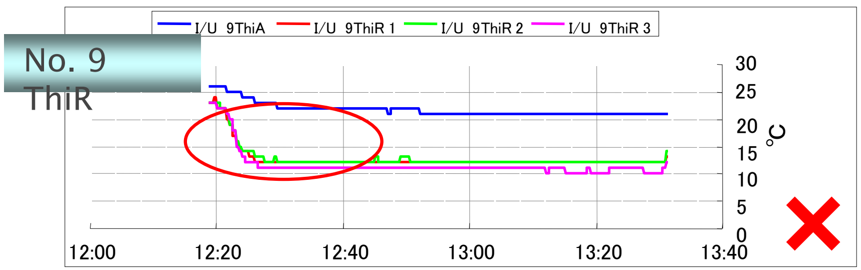
[Presumable Cause]

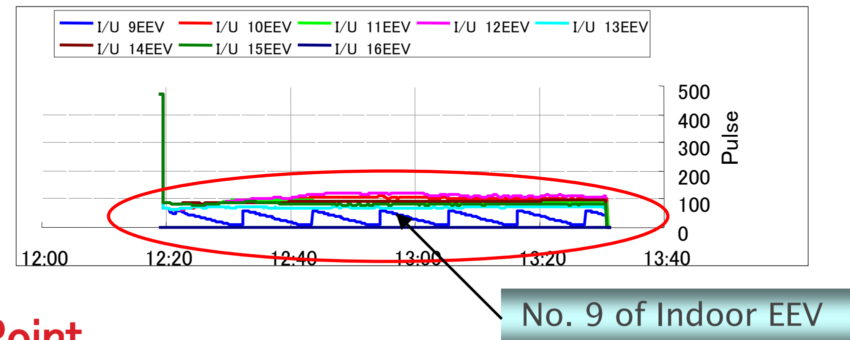
Insufficient refrigerant
(Leakage of refrigerant)

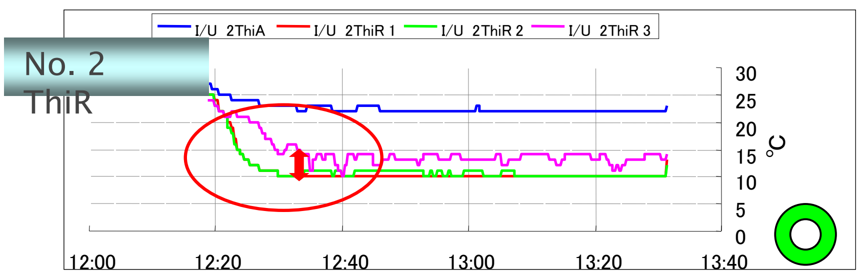
Example 3 Cooling











Point

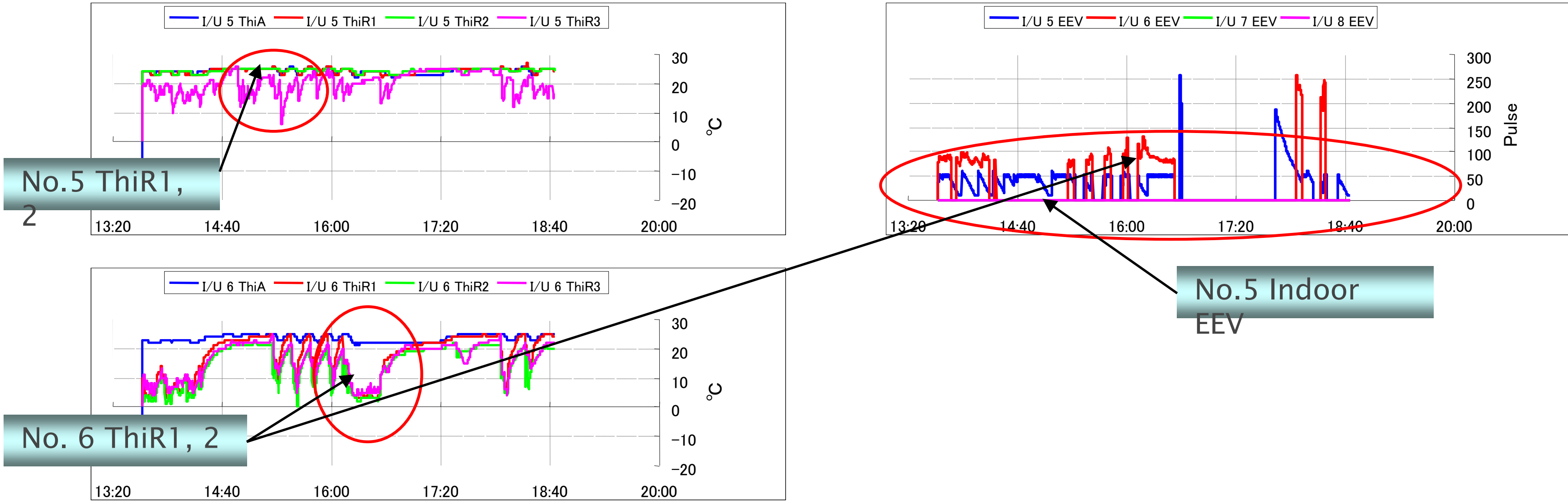
1. No.5 and 9 of Indoor EEV are behaving like fully closed detecting control.
2. No.5 and 9 of indoor heat exchanger temperature do not have enough superheat like No2.

Closing command is given to the indoor EEV, that means the indoor EEV is kept fully opened.
(EEV opening pulse shown in the graph is just a indicated opening pulse and not an actual opening pulse.)

If EEV is kept fully opened (470Pulse), Indicated pulse acts to close EEV fully in order to prevent excessive refrigerant from flowing in.

[Presumable Cause]
Disconnection of EEV coil or wire
(EEV locked at fully opening position、EEV coil anomaly, indoor control PCB anomaly)

Example 7 Cooling



Point

1. No. 5 indoor EEV is behaving like fully closed detecting control such as example 3.
2. ThiR1and ThiR2 of No.5 indoor heat exchanger do not link the behavior of No.5 indoor EEV .

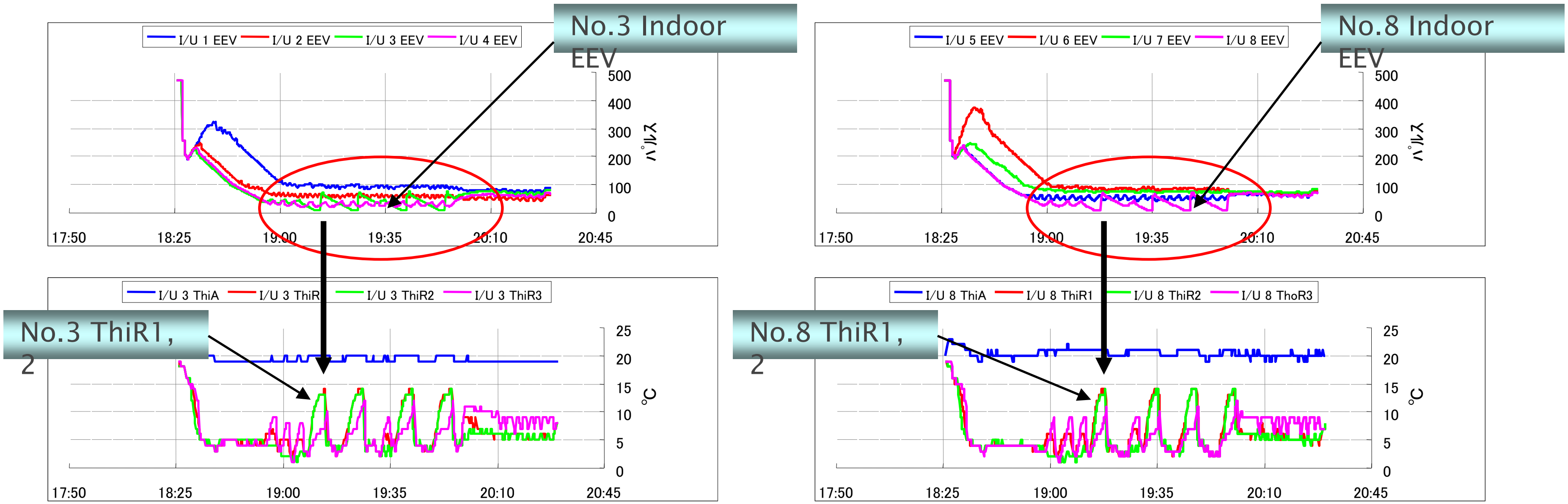
It is rather difficult to see due to the data taken at transition period, but the ThiR1 and ThiR2 of indoor unit No. 6 are decreasing according to the behavior of EEV.

[Presumable Cause]

Indoor EEV is locked

(Clogged with foreign matters or kept fully closed due to the fault of indoor EEV itself)

Example 8 Cooling



Point

1. No. 3 and No.8 of indoor EEV are behaving like fully closed detecting control such as example 7.
2. ThiR1 and ThiR2 of indoor unit No. 3 and 8 link the behavior of No. 3 and No.8 EEV respectively.

It can be judged No. 3 and No. 8 of indoor EEV have no anomaly, because the indoor heat exchanger temperatures (ThiR1, 2) link the EEV behavior that is different from the example 7,

[Presumable Cause]

Filter of indoor unit is clogged.

Or indoor Fan motor is anomalous. (Indoor fan is locked)

Example 10

[Question]

In case of wrong connection of refrigerant piping, why does the indoor heat exchanger temperature not increased in spite of opening indoor EEV fully ?

[Answer]

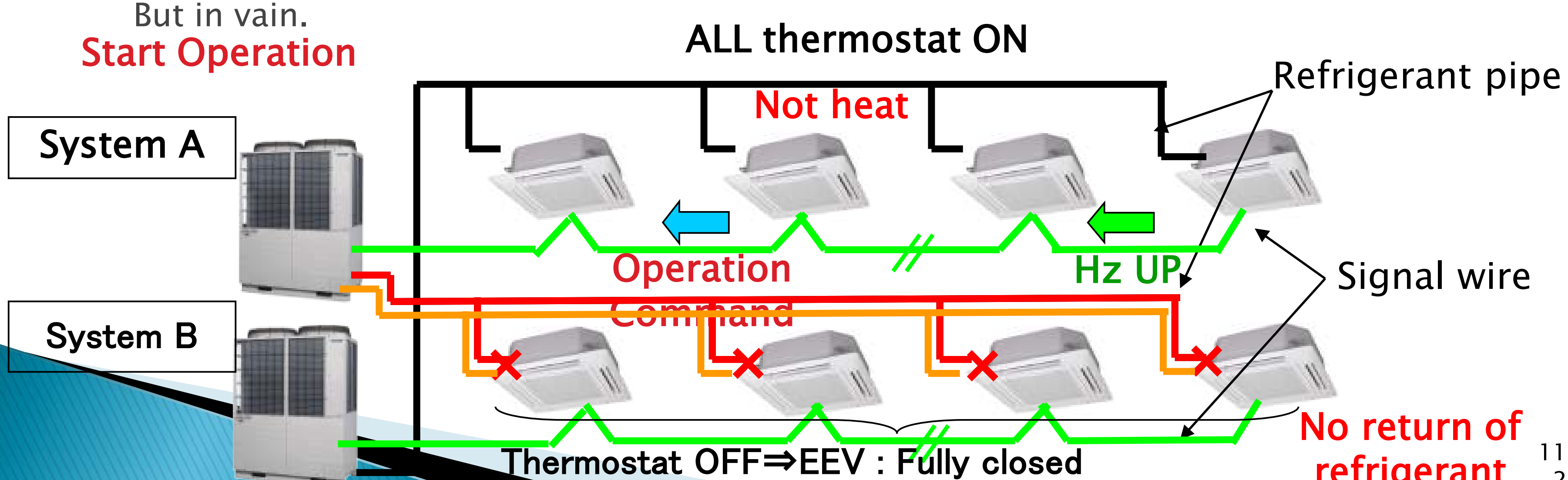
If the refrigerant piping for system A is connected to the outdoor unit in system B;

When the indoor units in system A give operation command to the outdoor unit in system A, the outdoor unit in system A starts operation.

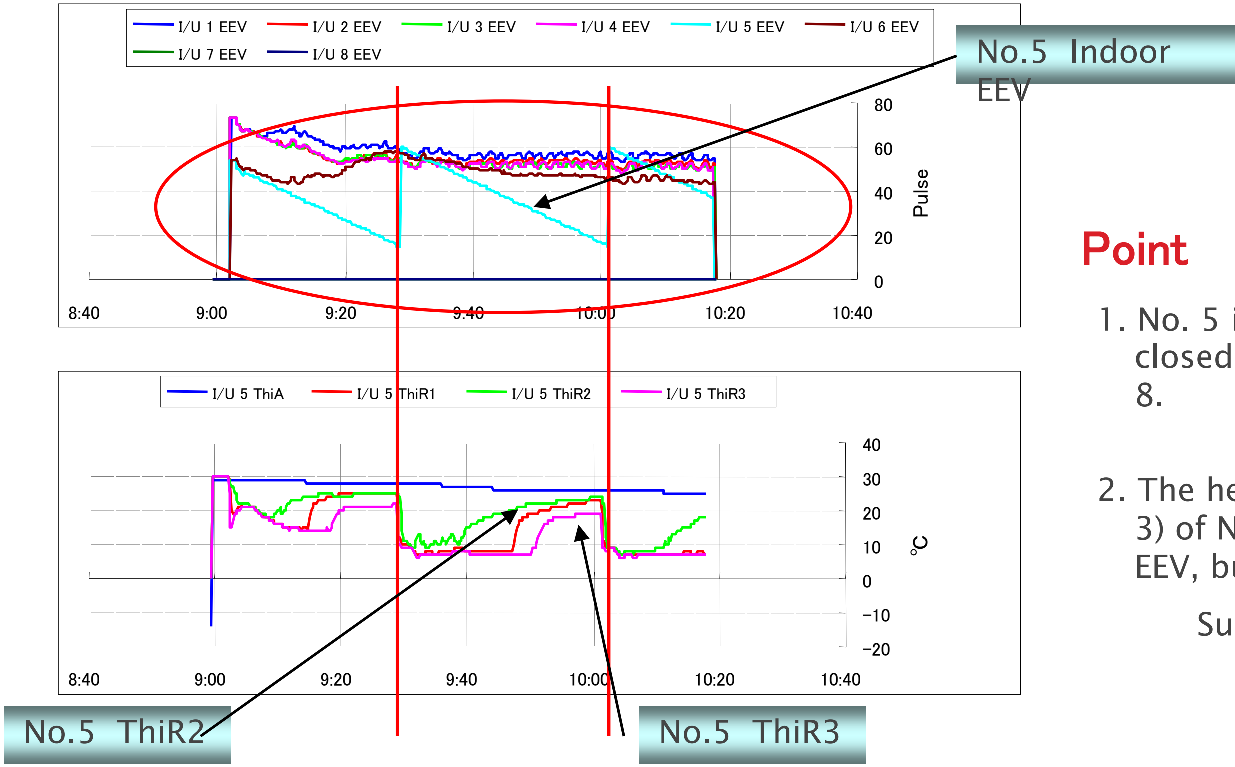
However as the refrigerant piping is connected to the indoor units in system B, the refrigerant flow is blocked at the indoor EEV so that the high pressure is rapidly increased in spite of low compressor Hz.

On the other hand the temperature of all indoor heat exchanger in system A are not increased so that Hz up command is given to the outdoor unit and indoor EEV is opened fully.

But in vain.



Example 11 Cooling



Point

1. No. 5 indoor EEV is behaving like fully closed detecting control such as example 8.

2. The heat exchanger temperatures (ThiR1, 2, 3) of No.5 indoor unit link the behavior of EEV, but there is not enough superheat.

   Superheat = ThiR3 – (ThiR1 or ThiR2) whichever bigger

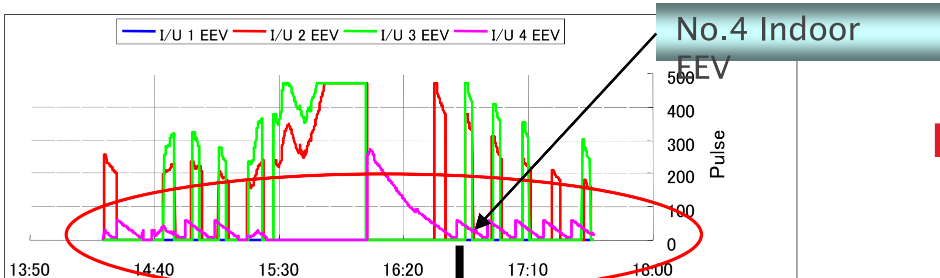
Ordinarily ThiR3 is highest in comparison with ThiR2 or ThiR1 at cooling.

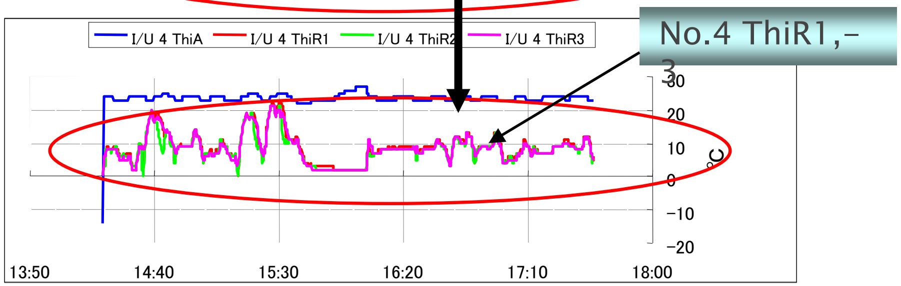
In this case ThiR2＞ThiR1＞ThiR3. Accordingly it is judged to close EEV fully, because the superheat is minus (ThiR3-ThiR2＜0).

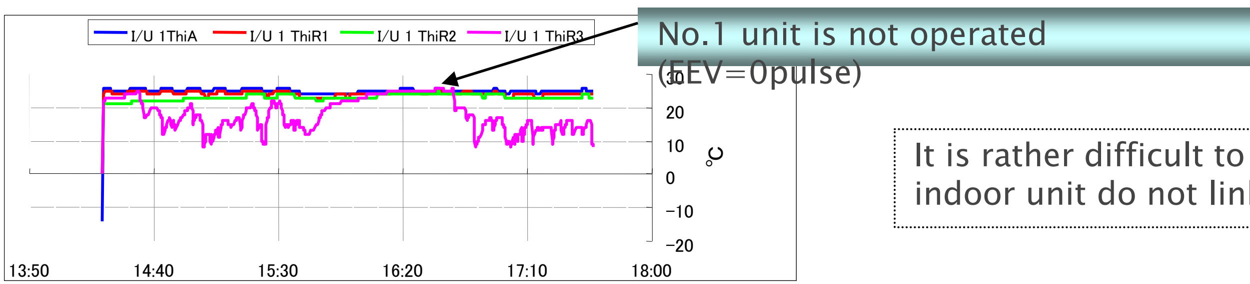
[Presumable Cause]

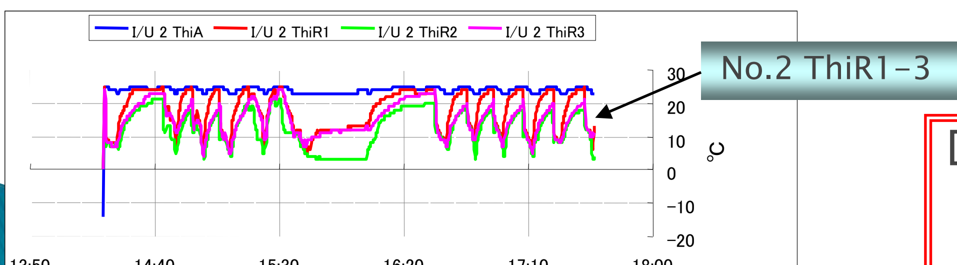
Wrong connection of ThiR2 and ThiR3

Example 12 Cooling









Point

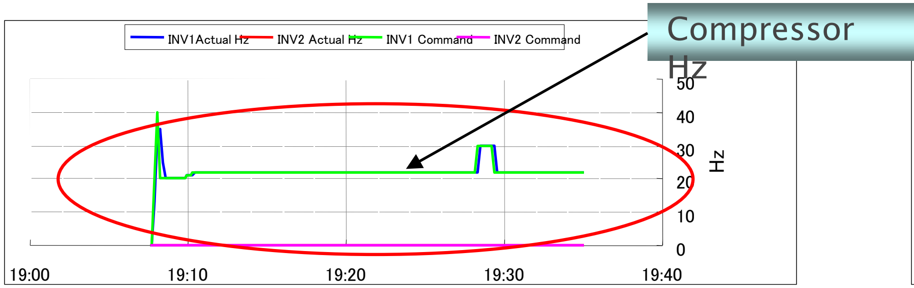
1. No. 4 indoor EEV is behaving like fully closed detecting control such as example 8.
2. ThiR1-3 of No.4 indoor heat exchanger do not link the behavior of No.4 indoor EEV .
3. ThiR1-3 of No.4 indoor heat exchanger are almost same temperature.

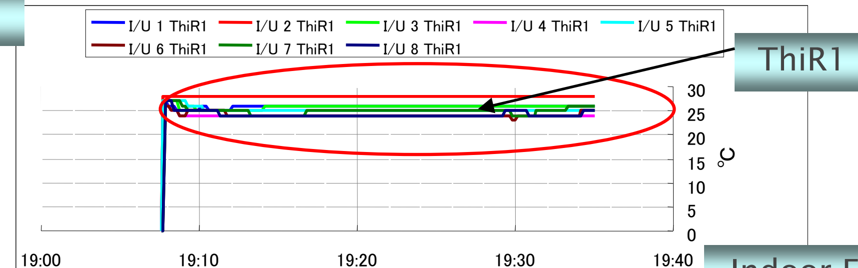
It is rather difficult to see but the ThiR1-3 of No. 4 indoor unit do not link the behavior of EEV.

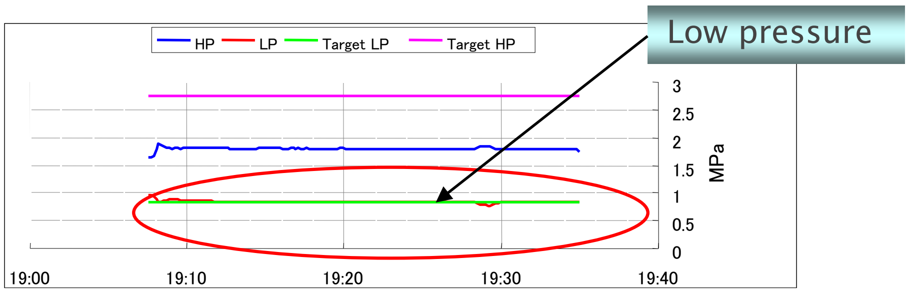
[Presumable Cause]

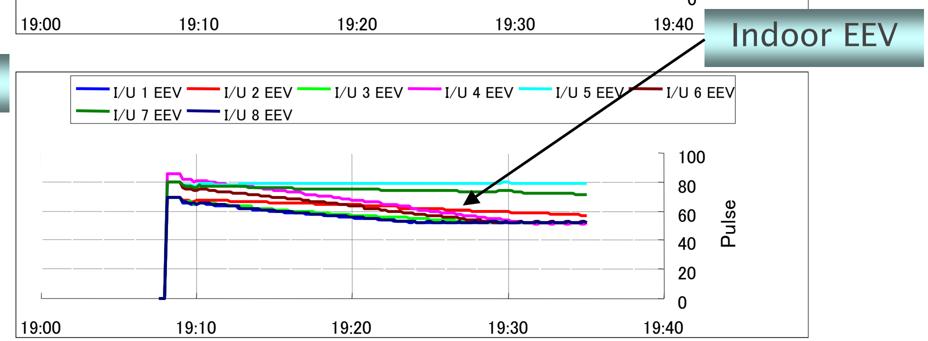
No.4 indoor EEV is locked at fully opened position.

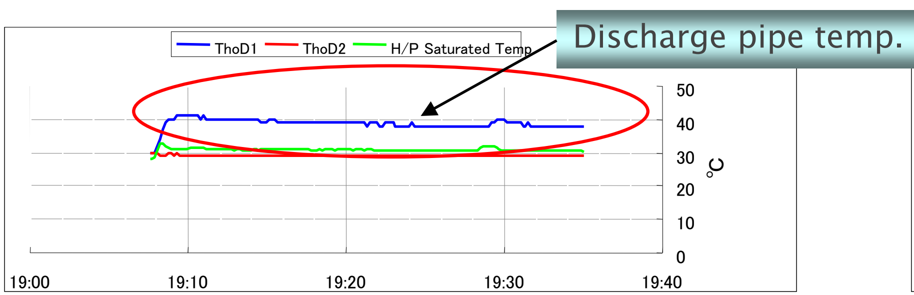
Example 13 Cooling

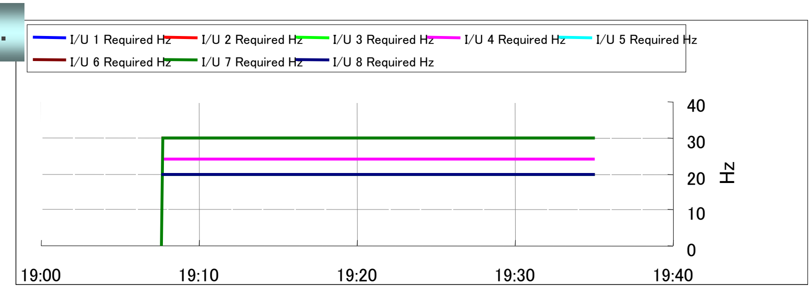












Point

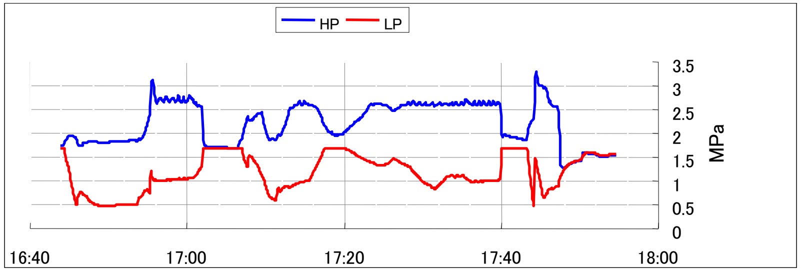
1. Low pressure reaches target pressure but compressor Hz is still low.
2. ThiR1 of all indoor units do not decrease, even though indoor EEV open appropriately.

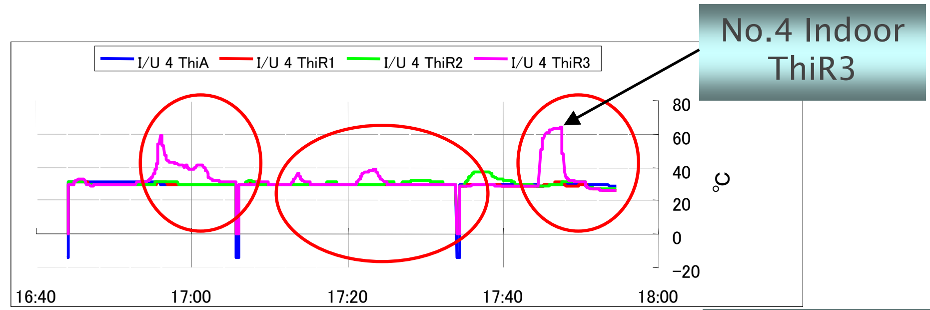
Insufficient refrigerant is suspicious, but discharge pipe temperature is not so high that may be other cause than insufficient refrigerant.

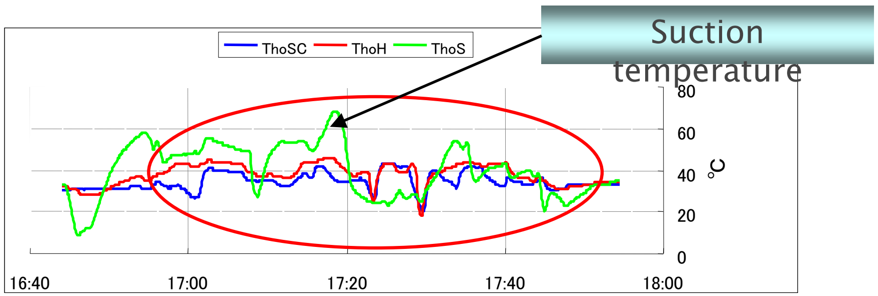
[Presumable Cause]

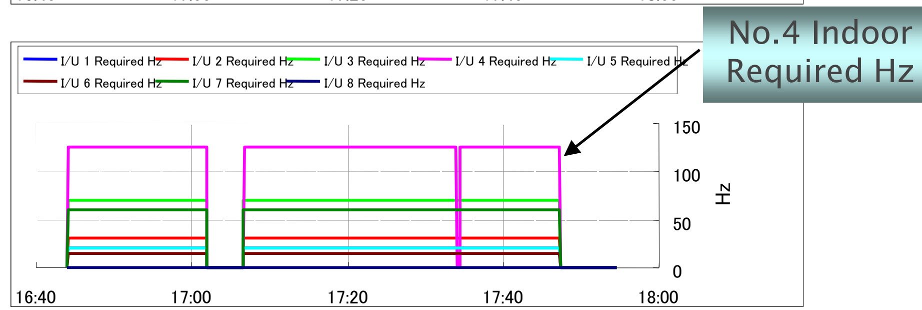
Low pressure sensor anomaly
(When it detects lower than the actual pressure)

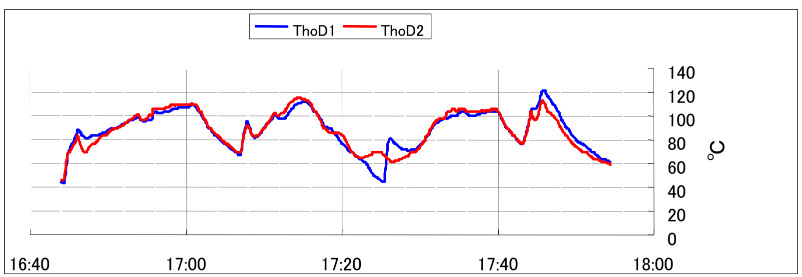
Example 16 KXR

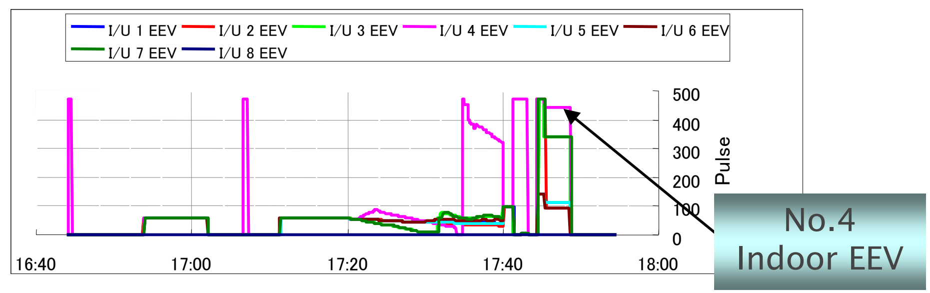












Point

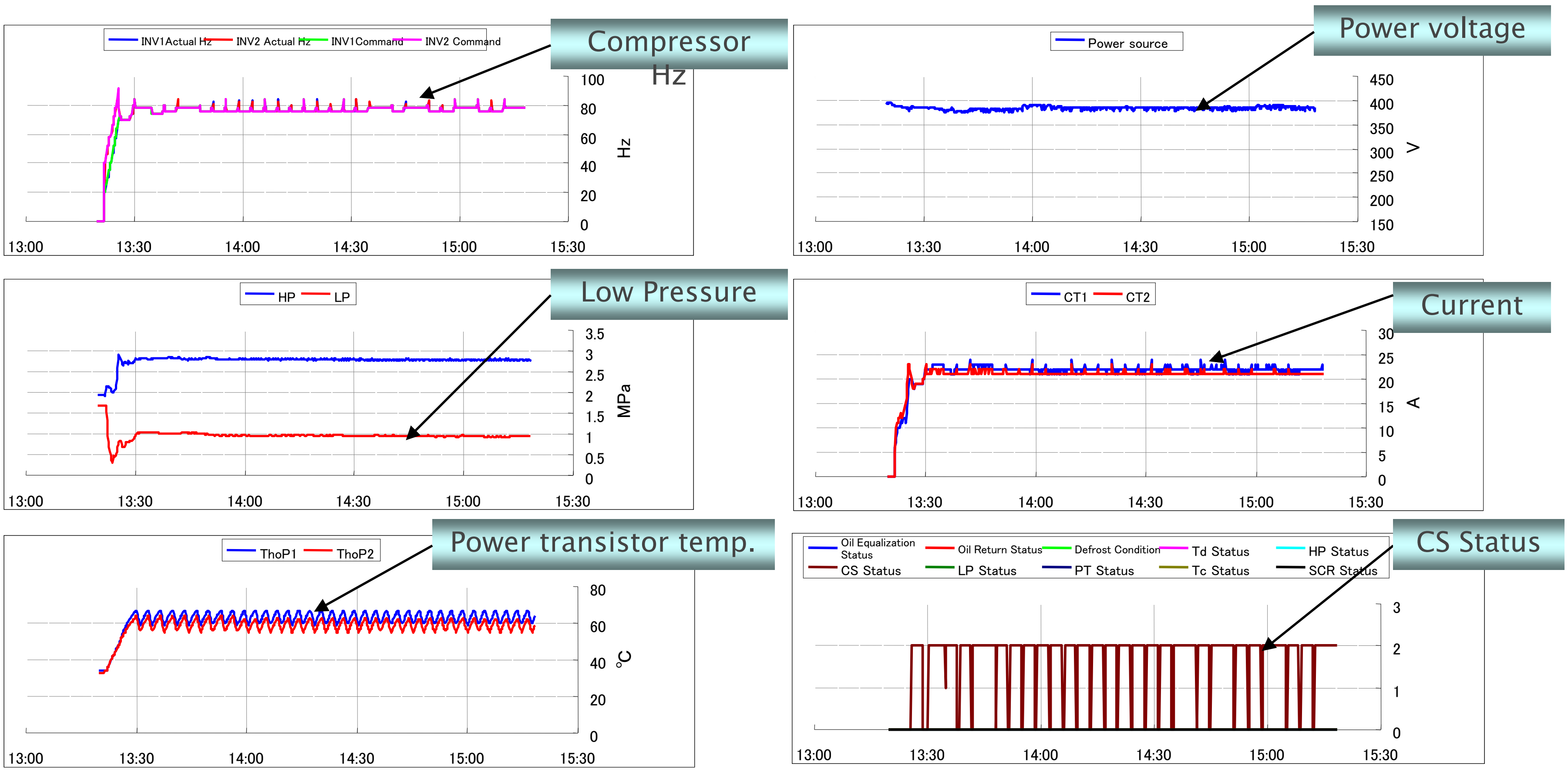
1. No.4 indoor heat exchanger temperature is high, and especially ThiR3 (at outlet port) is increased anomalously
2. No.4 indoor required frequency is high and EEV is opened fully frequently.
3. Suction temperature (ThoS) is too high.

It is easy to judge by checking indoor heat exchanger temperature.

[Presumable cause]

Wrong connection of discharge gas pipe and suction gas pipe for branching controller

Example 17 Cooling



Point

1. Compressor Hz does not reach maximum Hz and low pressure does not reach target pressure.
2. CS status is counted frequently
3. Power voltage and current are normal (No voltage drop)
4. Power transistor temperature is not so high.

Software problem

[Presumable Cause]

Wrong Setting of CS (Current Safe) value

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