GREEN EARTH Vietnam Co., Ltd
P.501, tầng 5, tòa Cotana Group - Lô CC5A, Bán Đảo Linh Đàm, Phường Hoàng Liệt, Quận Hoàng Mai, Thành phố Hà Nội, Việt Nam
E-mail : fukuoka @green-earth.asia

Verification of SPACON/HB366 Performance

1. Introduction:

Green Earth Vietnam deals with SPACON (hereafter "SPC") and New Refrigerants (hereafter "HB366") that can significantly reduce electricity consumption as its main products.
SPC stands for super condenser and is a product that can reduce the amount of electricity consumption by approximately 10% by installing it in existing outdoor units. By installing the SPC, the refrigerant passing through the SPC can be cooled by a further 2°C to 5°C, and by reducing the pressure in the refrigerant pipes, the compressor's power consumption can be reduced. In addition, the liquefaction of the refrigerant can be promoted and the cooling ability can be improved. The above shows that the purpose of using the SPC is to reduce electricity consumption, but it is therefore also effective in reducing the high pressure cut-off of outdoor units under severe temperature conditions.

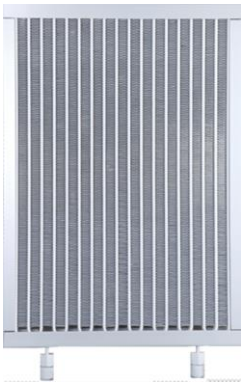


Table 1.1 SPACON

Table 1.2 SPACON - Section

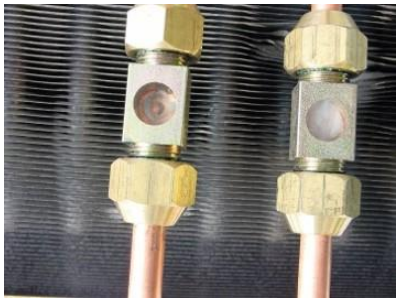


Table 1.3
Improvement of Liquefaction

The HB366 dealt by GREEN EARTH VIETNAM reduce the pressure in the refrigerant pipes without reducing the cooling ability, and the high pressure in the refrigerant pipes can be 15% to 20% lower than that of refrigerants normally used. The effects of HB366 can reduce electricity consumption by more than 10%.

2. Testing Method

In this verification, two split-type air conditioners (by Mitsubishi Heavy Industries) will be prepared, one with the SPC/HB366 installed and the other in normal operation (no SPC/R410A) at the same time, and the power consumption of the two air conditioners will be compared. In order to conduct a fairer verification, we will first check individual performance errors in the products themselves.

Table 2.1 Two split-type air conditioners

Table 2.2 Verification of Operation Status

GREEN EARTH Vietnam Co., Ltd
P.501, tầng 5, tòa Cotana Group - Lô CC5A, Bán Đảo Linh Đàm, Phường Hoàng Liệt, Quận Hoàng Mai, Thành phố Hà Nội, Việt Nam
E-mail : fukuoka @green-earth.asia

3. Testing Equipment:

Electrical Logger - KYORITSU KEW LOGGER 5020, Logger Clump Sensor – KEW 8122
Temperature Logger - KN Laboratories, Inc.

Table 3.1 Current Logger

Table 3.2 Logger Clump

Table 3.3 Temp. Logger

Table 3.4 Temp. Logger

4. Investigation

4.1 Basic Verification for Characteristic of the unit

First, as a basic verification, the pre-filled refrigerant is taken out of both Models A and B and filled with 0.54 kg of R410A refrigerant in the same quantity as required by the manufacturer. The intake air temperature of the outdoor unit, the intake air temperature of the indoor unit, the blowout temperature of the indoor unit, and the outdoor temperature was then measured at one-minute intervals, while the current values were compared when the units were operated at 18°C for 24 hours under similar operating conditions as far as possible.

Table 4.1.1 Removal of existing refrigerant

Table 4.1.2 Vacuuming

Table 4.1.3 R410A filling

Table 4.1.4 24-hour measurement

GREEN EARTH Vietnam Co., Ltd
P.501, tầng 5, tòa Cotana Group - Lô CC5A, Bán Đảo Linh Đàm, Phường Hoàng Liệt, Quận Hoàng Mai, Thành phố Hà Nội, Việt Nam
E-mail : fukuoka @green-earth.asia

4.2 Besic Verification Result

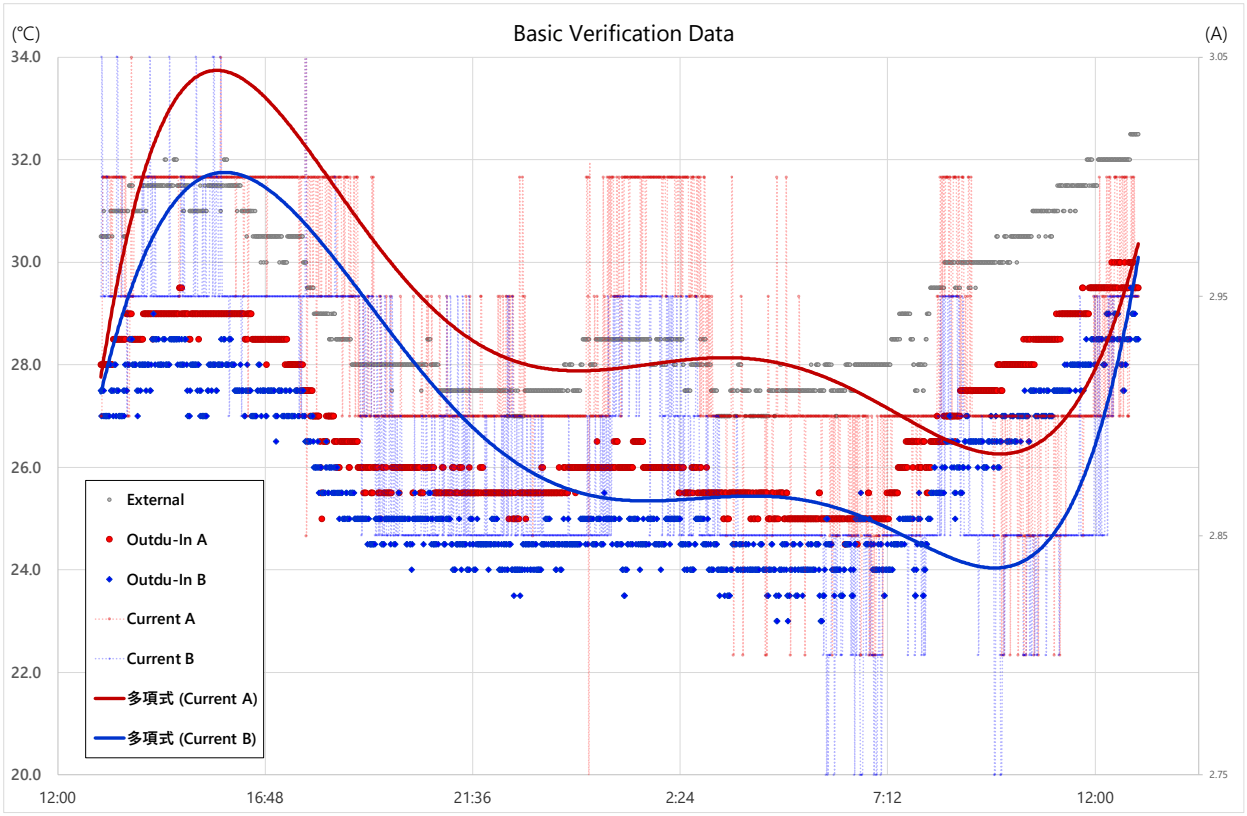


Fig. 4.2.1 Basic Data Conditions

Please refer to Fig 4.2.1 which is the Basic Data and Monitoring Data.

Gray-Dot is showing “External Temperature”.
Red-Dot is showing “Intake Air Temperature” for Machine A.
Blue-Dot is showing “Intake Air Temperature” for Machine B.
Red-Dot-Line is showing “Current Value” for Machine A.
Blue-Dot-Line is showing “Current Value” for Machine B.

From the above, it was realized that the current value is greatly affected by the intake air temperature for outdoor unit.

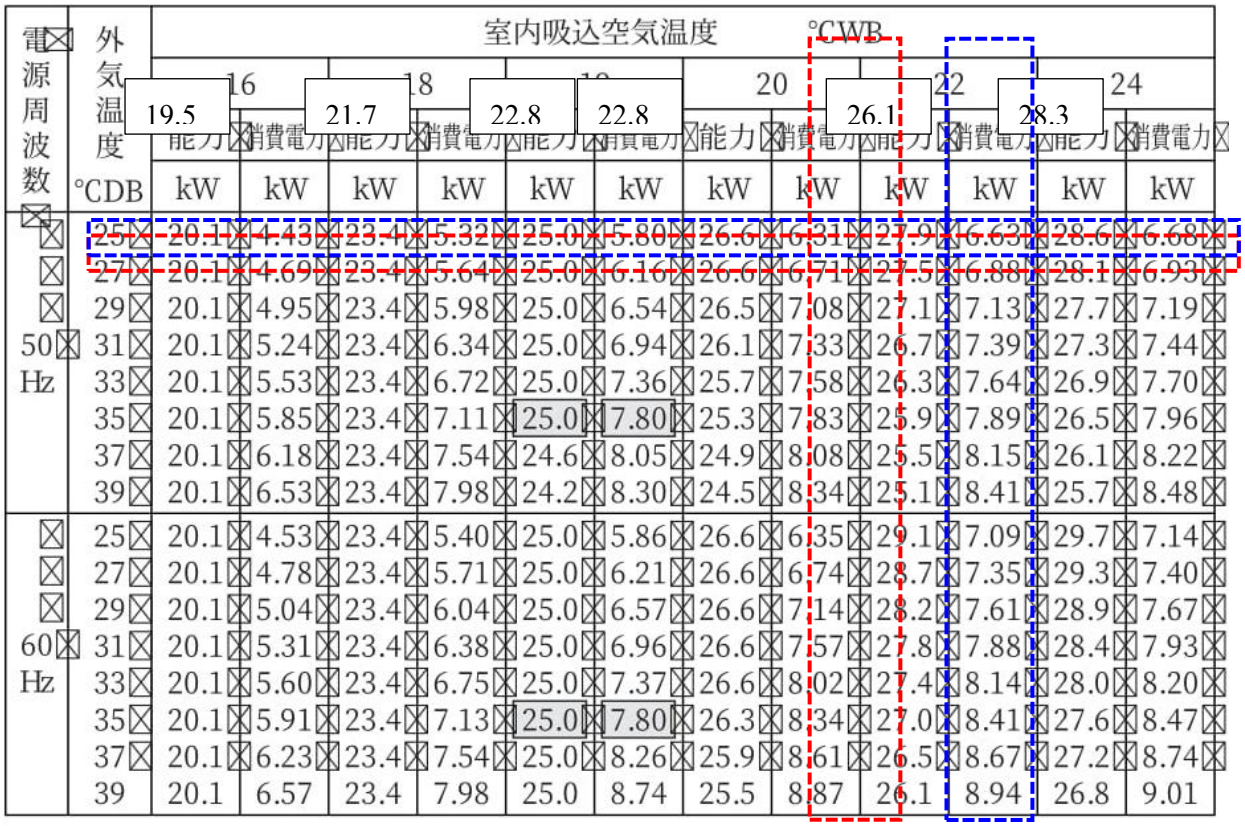
The number of measured data: 1441 (for each).

	Outside Temperature Average	Indoor unit Intake air temperature	Indoor unit Blowout temperature	Outdoor unit Intake air temperature	Current value
Machine A	29.1°C	25.0°C	13.3°C	26.8°C	2.94A
Machine B		26.5°C	13.9°C	25.7°C	2.90A

The current value difference between target machines A and B is 1 - (2.94/2.90) = **-1.38% ----- α.**

GREEN EARTH Vietnam Co., Ltd
P.501, tầng 5, tòa Cotana Group - Lô CC5A, Bán Đảo Linh Đàm, Phường Hoàng Liệt, Quận Hoàng Mai, Thành phố Hà Nội, Việt Nam
E-mail : fukuoka @green-earth.asia

On the other hand, power consumption at each intake air temperature according to the cooling performance characteristics table: (Reference cooling performance characteristics table: refrigerant R410A, 10 hp, manufactured by DAIKIN)



電源周波数	外気温度 °CDB	室内吸込空気温度 °CWB 16 能力 kW	16 消費電力 kW	18 能力 kW	18 消費電力 kW	19 能力 kW	19 消費電力 kW	20 能力 kW	20 消費電力 kW	22 能力 kW	22 消費電力 kW	24 能力 kW	24 消費電力 kW
		19.5		21.7		22.8	22.8			26.1		28.3	
50 Hz	25	20.1	4.43	23.4	5.32	25.0	5.80	26.6	6.31	27.9	6.63	28.6	6.68
	27	20.1	4.69	23.4	5.64	25.0	6.16	26.6	6.71	27.5	6.88	28.1	6.93
	29	20.1	4.95	23.4	5.98	25.0	6.54	26.5	7.08	27.1	7.13	27.7	7.19
	31	20.1	5.24	23.4	6.34	25.0	6.94	26.1	7.33	26.7	7.39	27.3	7.44
	33	20.1	5.53	23.4	6.72	25.0	7.36	25.7	7.58	26.3	7.64	26.9	7.70
	35	20.1	5.85	23.4	7.11	25.0	7.80	25.3	7.83	25.9	7.89	26.5	7.96
	37	20.1	6.18	23.4	7.54	24.6	8.05	24.9	8.08	25.5	8.15	26.1	8.22
	39	20.1	6.53	23.4	7.98	24.2	8.30	24.5	8.34	25.1	8.41	25.7	8.48
60 Hz	25	20.1	4.53	23.4	5.40	25.0	5.86	26.6	6.35	29.1	7.09	29.7	7.14
	27	20.1	4.78	23.4	5.71	25.0	6.21	26.6	6.74	28.7	7.35	29.3	7.40
	29	20.1	5.04	23.4	6.04	25.0	6.57	26.6	7.14	28.2	7.61	28.9	7.67
	31	20.1	5.31	23.4	6.38	25.0	6.96	26.6	7.57	27.8	7.88	28.4	7.93
	33	20.1	5.60	23.4	6.75	25.0	7.37	26.6	8.02	27.4	8.14	28.0	8.20
	35	20.1	5.91	23.4	7.13	25.0	7.80	26.3	8.34	27.0	8.41	27.6	8.47
	37	20.1	6.23	23.4	7.54	25.0	8.26	25.9	8.61	26.5	8.67	27.2	8.74
	39	20.1	6.57	23.4	7.98	25.0	8.74	25.5	8.87	26.1	8.94	26.8	9.01

Target machine A: 6.80 kW
Target machine B: 6.76 kW

Assumed power difference due to difference intake air temperature to Outdoor Unit in accordance with the cooling performance characteristics table between subject machines A and B would be assumed as followed.

1 - (6.80/6.76) = **-0.59% ----- β.**

4.3 Consideration for Basic Verification

The basic verification of individual characteristics machines A and B confirmed the following.

1. The verifications were carried out side by side and showed a slight difference in the outdoor units' intake air temperature (approx. 1 °C), which impacts power consumption.
2. In verifying the individual characteristics, it would be more indicative of the characteristics of each individual if the verification was carried out at around 35°C, the outdoor unit intake air temperature, which is the air-conditioner design standard, but the outdoor temperature at the time of verification was lower than this.

3. Although this is reference data, an error of approximately less than 1% (∵ α-β) was identified, taking into account the difference between the actual power consumption due to the difference in intake air temperature and the assumed current value as inferred from the cooling performance characteristics table.
4. From the above, it can be assumed that each of the split types of machines A and B prepared in this study will show almost equal performance.
5. The model used for this basic verification was a new split-type air conditioner from Mitsubishi Heavy Industries, which is assumed to be within the performance error range of the product as shipped.

From the above, it can be inferred that the difference due to the individual characteristics of every machine used for verification in any cases would be less than about 1% and that the performance is almost identical.

4.4 Verification of SPACON/HB366 Performance

Next, SPACON is installed in target machine A and filled with the HB366 0.54kg instead of R410A.

Table 4.4.1 Fill-Up HB366 after installation SPC

Table 4.4.2 Trial Operating

Table 4.4.3 SPC Effect 01

Table 4.4.4 SPC Effect 02

SPACON – In 37.6℃ SPACON – Out 32.2℃

GREEN EARTH Vietnam Co., Ltd
P.501, tầng 5, tòa Cotana Group - Lô CC5A, Bán Đảo Linh Đàm, Phường Hoàng Liệt, Quận Hoàng Mai, Thành phố Hà Nội, Việt Nam
E-mail : fukuoka @green-earth.asia

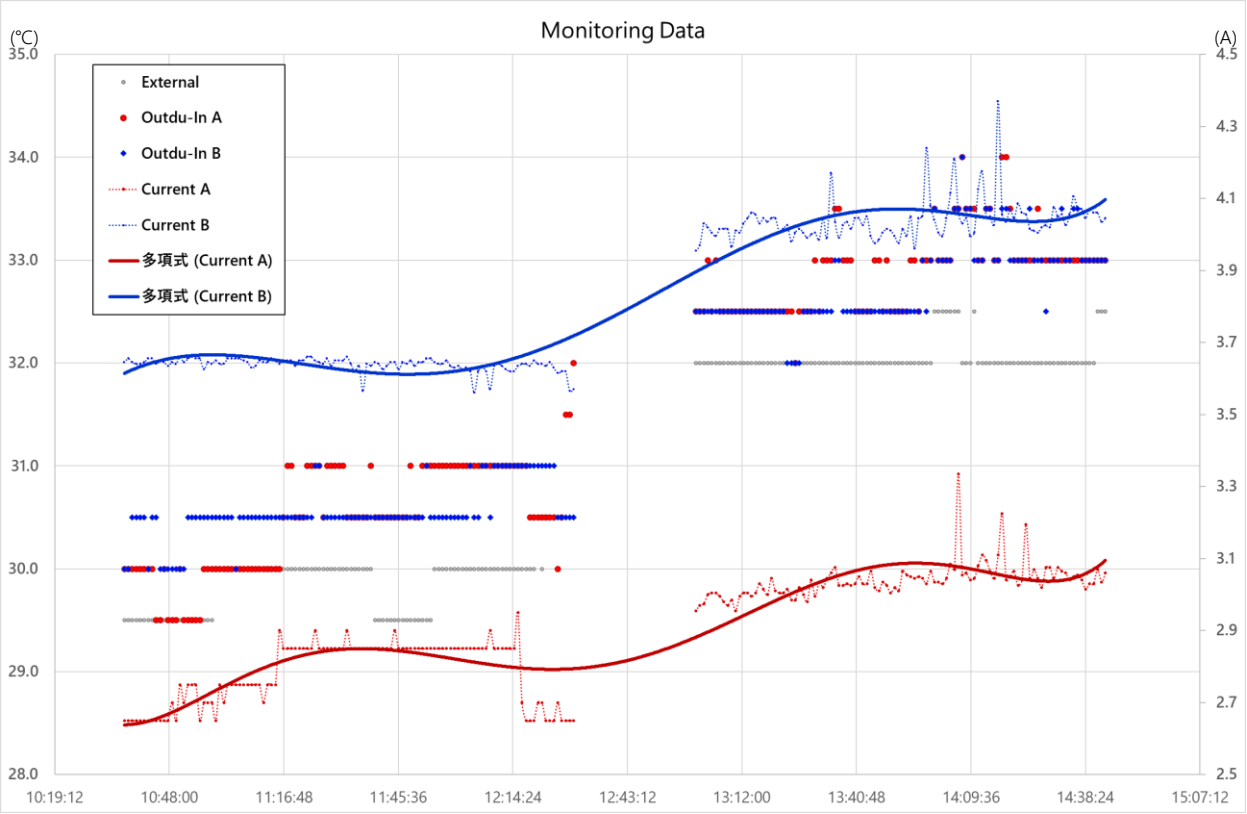


Fig. 4.4.1 SPACON/HB366 Performance Data

Please refer to Fig 4.4.1 which is Verification of SPACON/HB366 Performance Monitoring Data.

Gray-Dot is showing “External Temperature”.
Red-Dot is showing “Intake Air Temperature” for Machine A (SPACON w/HB366).
Blue-Dot is showing “Intake Air Temperature” for Machine B (No-SPACON w/R410A).
Red-Dot-Line is showing “Current Value” for Machine A.
Blue-Dot-Line is showing “Current Value” for Machine B.

The intake air temperature of the outdoor unit, which is considered to have a significant impact on the amount of electricity used, is the same under the above operating conditions, and the current values when two split-type air conditioners are operated at the same time are compared as follows. (Please refer to the Table 4.4.5)

Table 4.4.5 The number of measured data: 218 (for each).

	Outside Temperature Average	Indoor unit Intake air temperature	Indoor unit Blowout temperature	Outdoor unit Intake air temperature	Current value
Machine A	30.9 °C	30.4°C	19.9°C	31.6°C	2.90A
Machine B		30.5°C	19.8°C	31.6°C	3.83A

The current value difference between target machines A and B is 1 - (2.90/3.83) = **-24.28%**

GREEN EARTH Vietnam Co., Ltd
P.501, tầng 5, tòa Cotana Group - Lô CC5A, Bán Đảo Linh Đàm, Phường Hoàng Liệt, Quận Hoàng Mai, Thành phố Hà Nội, Việt Nam
E-mail : fukuoka @green-earth.asia

5. Conclusion

Machine A (SPACON + HB366): 2.90 A
Machine B (No SPACON + R410A): 3.83 A
Power Consumption Savings: 1 - (2.4/3.1) = 24.28%

The electricity savings in the Hybrid System with SPACON + HB366 can be said to be around **20%**.

Kenichi FUKUOKA
Director
Green Earth Vietnam