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Technical support for the performance test of air conditioners in ASEAN testing laboratories

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Tatsuya Tani, Ryota Hirata
Japan Air Conditioning And Refrigeration Testing Laboratory, Japan

Andy Tirta, Adhityo Gilang Bhaskoro
ASEAN Centre for Energy, Indonesia

About us

➢JATL : Japan Air Conditioning And Refrigeration Testing Laboratory

- ✓ JATL is the third-party testing laboratory that became independent of JRAIA*[1] in 2011, which specializes in air conditioning and refrigeration appliances.

**1 JRAIA: The Japan Refrigeration and Air conditioning Industry Association*

➢ACE : ASEAN Center for Energy

- ✓ The ASEAN Center for Energy is an intergovernmental organization that independently represents the 10 ASEAN Member States interests in the energy sector.

Background

- ASEAN*[1] Member State to increase energy security, reduce dependency on imported fuels, reduce emissions of GHGs*[2], reduce energy intensity through greater energy efficiency and enhanced regional cooperation (ASEAN Plan of Action for Energy Cooperation).

  [1]) Association of Southeast Asian Nations

  [2]) Greenhouse Gas

- Accelerating the deployment of higher efficiency air conditioners (ACs) through the removal of non-tariff barriers to trade and active policy support were required.

- Annual electricity savings potential from transition to energy efficient residential air conditioners (RACs) in ASEAN countries is expected.

Start of ASEAN CSPF project (Phase I)

- Regional Policy Roadmap to promote higher efficiency air conditioners indicated that ASEAN countries would report the performance of ACs as Cooling Seasonal Performance Factor (CSPF) with a common evaluation method.
- The timetable for the enforcement of the level of Minimum Energy Performance Standards (MEPS) for RACs was indicated in the roadmap.

ASEAN Center for Energy (ACE) established the project of
"Promotion of higher efficient air conditioners in ASEAN through harmonization of standards and strengthening of market verification and enforcement capabilities (Phase I)"
founded by Japan ASEAN Integration Fund (JAIF).

Japan Air Conditioning And Refrigeration Testing Laboratory

Outline of ASEAN CSPF project

PHASE I

PHASE II

WP 1	WP 2	WP 3	WP 4	WP 5
Technical Recommendation of adoption of harmonized standard for the Cooling Seasonal Performance Factor (CSPF) of air conditioners	Updated ASEAN Regional Policy and National Policy Roadmap on Promotion of Higher Efficiency Air Conditioners	**Round Robin Test and Capacity Building* for ASEAN testing laboratories Training and Self-Assessment**	Established ASEAN Market Monitoring, Verification, and Enforcement	Consumer Awareness Campaign

- ✓ Capacity Building : Improving the technical capability of performance test of ACs
- ✓ JATL was in charge of **Work Package 3 (WP3)** in the Phase I of the project

Goal of WP3 of the project

- Technical improvement of the performance test of higher efficiency ACs
  - ✓ Using the common standard
  - ✓ No difference in the test results between the participating laboratories
  - ✓ Reproducibility and repeatability in the performance tests
- Participants are testing laboratories from ASEAN countries

Indonesia	CENTER FOR MATERIAL ANDTECHNICAL PRODUCT（B4T）
	The National Agency for Research and Innovation（BRIN）
Malaysia	SIRIM QAS International Sdn Bhd （SIRIM QAS）
Philippines	OMNI SOLID SERVICES,INC.- Solid Test laboratory（OSSI-STL）
	Department Of Energy - Lighting and Appliance Testing Laboratory（DOE-LATD）
Thailand	ELECTRICAL AND ELECTRONICS INSTITUTE（EEI）
Vietnam	Quality Assurance and Testing Center 3（QUATEST3）
	Laboratory for testing energy efficiency（Labftee） Testing and Verification Center for Industry（TVCI）

Round Robin Test

- ✓ Participating laboratories were divided into three groups due to efficient test
- ✓ Using the same EUT* in each group *) Equipment under testing
- ✓ JATL tested the EUT at the first in each group
- ✓ JATL's test result was positioned as the reference value based on the evaluation method in the previous project International Standard Innovation Technology Research Association (IS-INOTEK) from 2012 to 2017.
- ✓ Although JATL usually witness the test in person, due to pandemic of COVID-19, JATL attended the RRT online.
- ✓ Tolerance of difference between the performance test results of participating laboratories and the JATL's is usually set for ±3% from JATL's experience.

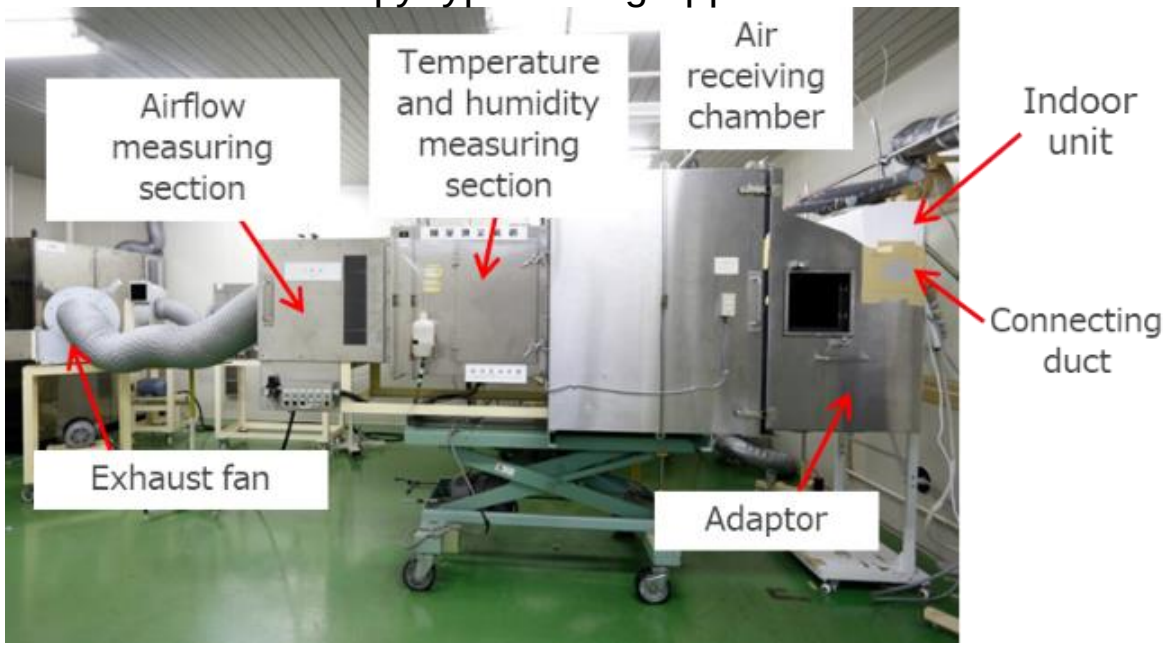
Key point of performance test

✓ Reviewing of test process in RRT

Confirming test process is important to obtain the valid results.

Installation	According to installation manual Having own manual for each facility
Test run	No abnormal sound and vibration from the EUT* (*Equipment Under Test)
Condition setting	Stability of test condition Right settings of the EUT
Measuring	Understanding the test methods for two type of test facilities
Pump down	Close attention for leakage of refrigerant in atmosphere
Reporting	Required test data including the evidence of test results

<Air enthalpy type testing apparatus >



Outdoor unit

Online Training

- ✓ Technical improvement of performance test and equalizing the ability of testing with higher level by JATL's own program
- ✓ Although JATL usually demonstrate the performance test procedure, three lectures were set with the original video and textbook due to COVID-19 pandemic.
- ✓ Contents of the online training
  - ➢ **Lecture 1: Points and requirements to introduce ISO 16358-1(CSPF)**
  - ➢ **Lecture 2: ISO/IEC 17025 requirements and examples of activities in air conditioner testing Laboratories**
  - ➢ **Lecture 3: Details of air conditioner testing work in the Round Robin Test**
- ✓ Setting question & answer period

Online witness

- ✓ Due to COVID-19 pandemic, JATL witnessed online using internet meeting system and mobile phones for all the participating laboratories at the beginning and end of performance test during the RRT.
- ✓ Online witness carried out for every participating laboratory.
  - JATL and the participating laboratories used the internet meeting system and mobile phone with camera to confirm the condition of the EUT.
- ✓ JATL paid attention to the following items.
  - Heat balance and temperature stability in the performance test of half capacity using balanced-type room calorimeter
  - Duct connection in the air-enthalpy measuring apparatus
  - Weight measurement of outdoor unit before refrigerant charging
  - The EUT settings (fan speed, louver position of indoor unit and etc.)

Online witness

✓ Case Sturdy : Duct connection to the facility ＜Air-enthalpy type＞

- The following device was inside the duct of the indoor unit connection to the facility and needed to be corrected.
  - ✓ Temperature sensor for intake air
  - ✓ Test operation button
  - ✓ Remote control receiver

- Potential problems with each device being in the connecting duct
  - ✓ Improper temperature of intake air
  - ✓ Impossible to set for the test operation

Test results of RRTs

- Results of cooling capacity (full and half load) , power input and CSPF in the teams

<Team A>

	Cooling Full Load		Cooling Half Load		CSPF
	Capacity(W)	Power input(W)	Capacity(W)	Power input(W)	
Lab Ⅰ	3210 (-0.2%)	868 (+0.7%)	1691 (+1.8%)	336 (-0.0%)	5.47 (+1.3%)
Lab Ⅱ	3231 (+0.5%)	860 (-0.3%)	1614 (+1.5%)	329 (-2.0%)	5.57 (+3.1%)
Lab Ⅲ	3214 (-0.0%)	861 (-0.1%)	1591 (+0.0%)	329 (-2.0%)	5.50 (+1.9%)
JATL	3215	862	1590	336	5.40

<Team B>

	Cooling Full Load		Cooling Half Load		CSPF
	Capacity(W)	Power input(W)	Capacity(W)	Power input(W)	
Lab Ⅳ	3605 (+0.1%)	979 (-0.1%)	1696 (+1.7%)	317 (+0.6%)	6.01 (+1.0%)
Lab Ⅴ	3795 (+5.4%)	975 (-0.5%)	1791 (+7.4%)	312 (-1.2%)	6.44 (+8.2%)
Lab Ⅵ	3609 (+0.2%)	983 (+0.3%)	1698 (+1.8%)	319 (+1.2%)	5.98 (+0.5%)
JATL	3600	980	1667	315	5.95

<Team C>

	Cooling Full Load		Cooling Half Load		CSPF
	Capacity(W)	Power input(W)	Capacity(W)	Power input(W)	
Lab Ⅶ	3616 (+0.5%)	781 (+0.4%)	1772 (+1.0%)	282 (+0.6%)	7.12 (+0.3%)
Lab Ⅷ	3586 (-0.3%)	783 (+0.6%)	1730 (-1.4%)	284 (+1.2%)	6.92 (-2.5%)
Lab Ⅸ	3555 (-1.2%)	772 (-0.8%)	1760 (+0.4%)	277 (-1.2%)	7.18 (+1.1%)
JATL	3597	778	1754	280	7.10

Discussion about the test results

✓ Test result of cooling capacity in one laboratory was out of tolerance.

	Cooling Full Load		Cooling Half Load		CSPF
	Capacity(W)	Power input(W)	Capacity(W)	Power input(W)	
Lab Ⅳ	3605（+0.1%）	979（-0.1%）	1696（+1.7%）	317（+0.6%）	6.01（+1.0%）
Lab Ⅴ	3795（+5.4%）	975（-0.5%）	1791（+7.4%）	312（-1.2%）	6.44（+8.2%）
Lab Ⅵ	3609（+0.2%）	983（+0.3%）	1698（+1.8%）	319（+1.2%）	5.98（+0.5%）
JATL	3600	980	1667	315	5.95

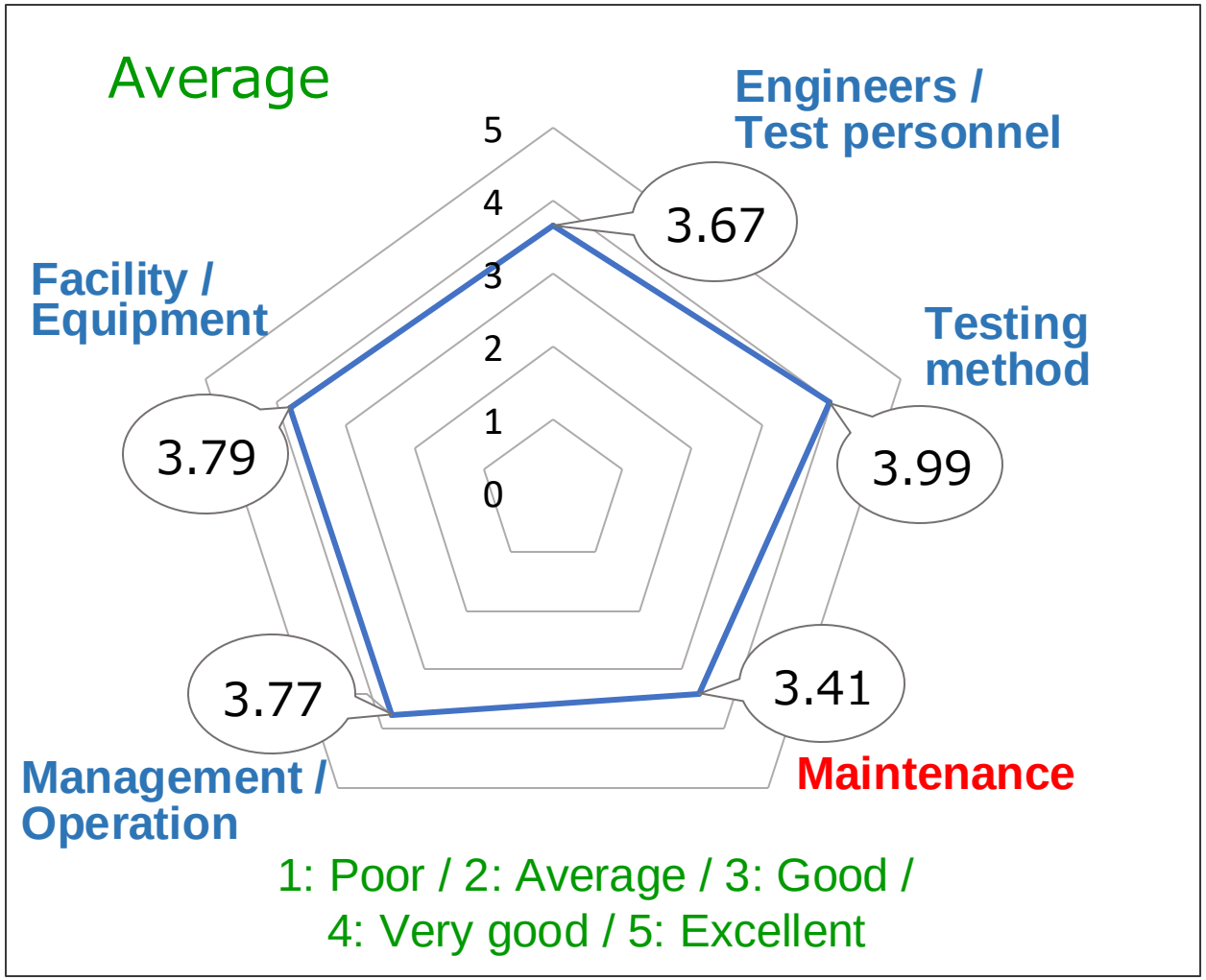
✓ Cause analysis and sharing with the participating laboratories

- Check to values in the data sheet → Calculated value in the airflow rate was big
- Cause estimation → Improper parameter in the calculation of airflow rate

Self-Assessment and results

- Self-assessment of 40 items from 5 viewpoints in total
  - ✓ Understanding of the current status
  - ✓ Identification and Recognition of the problems about testing
  - ✓ Consideration of improvement plans
- Develop effective support plan for each laboratory

- The result of maintenance was somewhat poor



Summary of Maintenance (excerpt)

Summary / excerpt of answers	Comment, Points of improvement
✓ Most labs are able to calibrate major measuring instruments, but some are not traceable to national (or international) standards.	✓ Calibration is always required for measuring instruments that affect capacity measurements. ✓ This calibration must be traceable to national or international standards.
✓ Most laboratories seem to be able to evaluate the measurement uncertainty.	✓ JATL would like to review the specific uncertainty evaluation budget sheet at the next opportunity.

Traceability in calibration

➢ Traceability of calibration for measuring instruments

- An unbroken chain of comparisons (calibration) relating instrument readings to known standards → **National / International standard**
- The chain ends up with national or international standards
- Measurement results are traceable to the SI units

Example (mass)

International prototype of the kilogram of BIPM

＜BIPM : International Bureau of Weights and Measures＞

Note: Effective 5/20/2019,
the international kilogram standard was
discontinued and became the defined value.

Concept of uncertainty

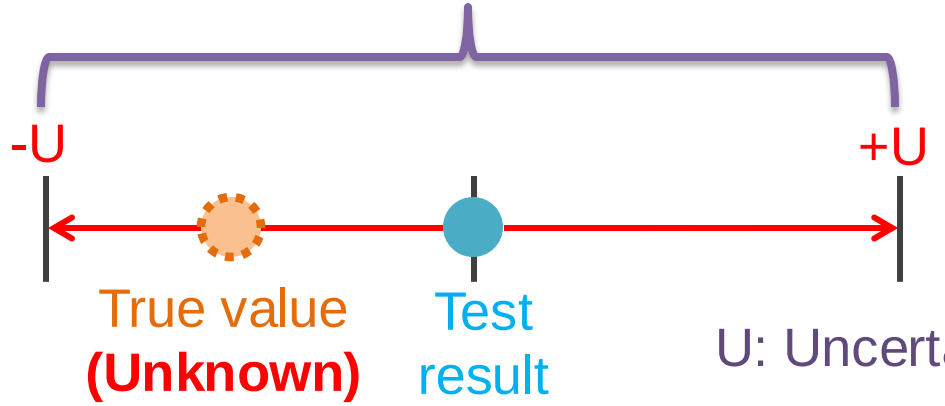
➢ Understanding of measurement uncertainty

Uncertainty

On the assumption that the ‘True value’ can NOT be known.
(There are limits of knowledge which human can obtain)

＜Concept＞

True value must lie within this range
(at a probability of approx. 95 %)



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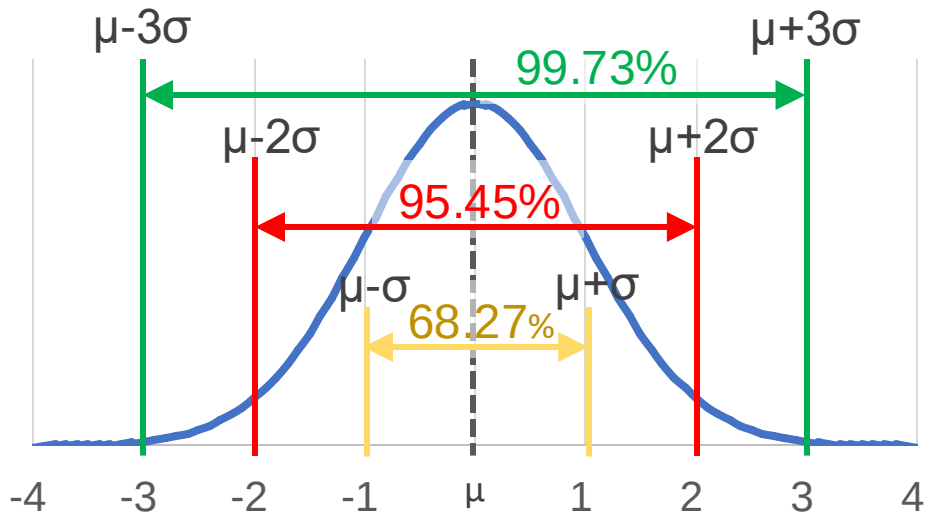

Evaluation of uncertainty

➢ Uncertainty in measuring capacity of air conditioners

- ✓ The capacity of air conditioners is determined by calculation based on various measurements such as temperature, pressure, and flow rate.
- ✓ The uncertainty of the capacity measurement is obtained by determining the uncertainty of each measurement item and combining them.

⇒ specified by

ISO/TS 16491：Guidelines for the evaluation of uncertainty of measurement in air conditioner and heat pump cooling and heating capacity tests

⇒ required by

ISO/IEC 17025：General requirements for the competence of testing and calibration laboratories

Outcome of the project (Phase I)

- ASEAN Member State (ASM) have pledged to adopt the harmonized evaluation method standard for RACs using CSPF
- The technical and policy recommendation reports from the project have received official endorsement at the ASEAN Ministers on Energy Meeting for promoting energy efficiency
- Efforts to promote higher efficiency RACs are gaining traction and enhancing the MEPS level in ASM

Summary and conclusion

- The spread of heigh efficiency RACs into ASEAN market was ready
  - ✓ Realizing the performance test utilizing the CSPF for the higher efficiency inverter-type ACs
  - ✓ Confirming the improvement of performance test capability of ACs in the participating laboratories
- Reviewing the own performance testing technique and recognizing issues and countermeasures in the participating laboratories
- Almost no difference of the tests result between the participating laboratories
  - ✓ The almost same test result will be obtained no matter where the performance test is carried out in the participating laboratories.

Acknowledgement

We would like to thank the experts from ASEAN Centre for Energy (ACE), the participating testing laboratories in ASEAN countries and The Institute of Energy Economics, Japan (IEEJ) for leading this project to completion.

Thank you for your attention