



## **Asia-Pacific Economic Cooperation**

**Differences / synergies between energy efficiency  
test methods for refrigerators in APEC region**

**and with the new IEC 62552**



# **Project Final Report**

**Energy Working Group**

**March, 2016  
China**



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## Summary

The project aims to facilitate energy saving technology innovation for refrigerators and free trade in the APEC by helping harmonizing current testing methods with the IEC 62552:2015. Commonalities and differences between the new IEC 62552 and economies' standards have been investigated; key impacting factors contribution to energy consumption, volume and energy efficiency have been identified and analyzed by desktop research and laboratory testing, and they are ambient temperature, target temperature, storage plan and temperature sensor and product adaptability for twice tests at different temperatures. Meanwhile, potential pathways as classified into Group A, B and C for the harmonization of energy efficiency testing methods for refrigerators are proposed. Training and results dissemination workshops on testing capacities and familiarization with the new IEC standard have been organized to expand the promotion of the IEC60552.

## 1. Introduction

The project of Technical Reference on Harmonization of Energy Efficiency Test Methods of Refrigerators toward the New IEC 62552 among APEC Region (EWG 04 2014A) is funded by APEC EWG and implemented from Sep, 2014 to Apr, 2016. It is overseen by China Standard Certification Co., Ltd.

Activities in below table have been organized to achieve objectives of

Objective 1: to identify commonalities and differences between the new IEC 62552 standard and energy efficiency testing standards for refrigerators currently used in APEC economies;

Objective 2: to determine potential pathways for the harmonization of energy efficiency testing methods of APEC economies and the new IEC 62552-3 for refrigerators;

Objective 3: to build capacity and awareness of APEC region's stakeholders and synergize their efforts related to the harmonization of testing standards for refrigerators.

Then fundamentally to facilitate energy saving technology innovation for refrigerators and free trade in the APEC region by helping harmonizing current national energy efficiency testing methods for refrigerators with the IEC 62552 standard, and by supporting the development of an effective management and inspection environment in APEC.

Activities	Outputs
STEP 1: Establish technical working group	On Oct 21st, 2014, the 1st project workshop was held in Beijing. Technical working group members are Mr Pierre Cazelles, from ICA (International Cooper Association), Mr Hong Wei, from VDE Institute, Mr Yang Yuzhai and Ms Qi Yun, from CSC. the role and work plan of the technical working group were approved
STEP 2: Investigate existing energy efficiency testing methods for refrigerators and their preliminary potential to be adapted to the IEC 62552 standard, in APEC region (Sep, 2014 to Mar, 2015)	Desktop Research Report -- Differences / synergies between energy efficiency testing methods for refrigerators in APEC region and with IEC 62552 are identified Survey Results.

Activities	Outputs
STEP 3: Laboratory testing on different applied testing methods and the IEC standard in energy efficiency	Laboratory Test Report - Differences / synergies between energy efficiency testing methods for refrigerators in APEC region and with the new IEC 62552
STEP 4 and STEP 5: Prepare and Organize 1 training workshop respectively for manufactures, laboratories, and standardization authorities	<ul style="list-style-type: none"> <li>✓ A 0.5 day workshop in Hefei, China has been organized to train Chinese experts from laboratory of testing institutes and manufacturers (2015-10-29).</li> <li>✓ A one-day training workshop in Guiyang, China, has been organized to train engineers and policy consultants of refrigerators in APEC region (2015-12-02).</li> </ul>
STEP 6: Compile recommendations for the harmonization of testing methods within APEC economies with IEC 62552	Part 4 of this report is the recommendation for the harmonization of testing methods within APEC economies with the new IEC 62552.
STEP 7: Organize 1 workshop for the dissemination of the results	<ul style="list-style-type: none"> <li>✓ The dissemination workshop on Mar 9, 2016 has been organized in Shanghai, China.</li> <li>✓ The APEC dissemination workshop on Apr 11, 2016 in Taichung of Chinese Taipei will be organized.</li> </ul>

## 2. Overview of Energy Efficiency (EE) Standards and Labelling and Test Methods for Refrigerators

Among the 21 economies in APEC, 18 economies deploy EE policies of laws or standards to regulate their market, and EE labelling scheme based on EE standards are mandatory implemented in those 18 economies except Indonesia since it is developing the EE labelling program. Brunei, Papua New Guinea and Peru have not taken EE policies according to their economy circumstance.

For economies that have EE labelling, EEI (SRI) +MEPS or EEI (SRI) or MEPS are three different ways to evaluate products EE level. The indexes are determined by factors of testing energy consumption, total volume and calculation method related to compartment/appliances category regulated in the EE standards.

Detailed comparison of energy consumption and volume test methods with below four points have been conducted with reference to the following standards: *IEC 62552:2015, IEC 62552:2007, AS/NZS 4474.1:2007+A1:2008+A2:2011, and US Standard, which are more representative in the APEC.*

- Test conditions, including ambient temperature, humidity, air circulation, vertical ambient temperature gradient and so on;
- Measuring instruments, including temperature probes, humidity, watt-hour meters, measurement of storage temperature (fresh-food, cellar, chill and frozen-food storage), test packages and M-packages;
- Installation of refrigerators, temperature device setting, anti-condensation heaters setting, power supply voltage and frequency, all shelves setting, accessories setting;
- Determination method of the energy, target temperature conditions, storage plan of test packages, storage plan of all storage temperature sensors and test period.

Specific comparison on the four EE test methods groups have been concluded in table 3-2 of the Desktop Research Report. To further identify main impacting factors and their quantities contributions, laboratory tests have been organized in the project.

### 3. Laboratory Testing on Identifying Key Impacting Factors for EE Test Methods for Refrigerators in APEC

Four samples of the most representative types of refrigerator in use in APEC economies were selected to compare their EE levels in different economies: upright refrigerator, upright refrigerator-freezer, chest freezer and upright frost-free refrigerator-freezer. It has been found that within economies, for the same product, EE level are different. These four types of refrigerator have been again extended in laboratory tests to research key impacting factors in EE test methods in the region.

#### Methodologies for the laboratory testing are:

- Samples of upright refrigerator, upright refrigerator-freezer, chest freezer and upright frost-free refrigerator-freezer were all purchased from the market.
- China Vkan Certification Co., Ltd has been sub-contracted following APEC rules to carry out the laboratory tests
- China Standard Certification (project overseer) has organized the technical working group to analyse the differences between EE test methods and identify key impacting factors on energy consumption in the standards.
- Four standards being used to test for EE are:
- IEC 62552:2015 Household refrigerating appliances – Characteristics and test methods (test method) ;
- IEC 62552:2007 Household refrigerating appliances – Characteristics and test methods;
- USA test method standard

Appendix A1 To Subpart B Of 10 CFR Part 430 / Appendix A To Subpart B Of 10 CFR Part 430 Uniform Test Method For Measuring The Energy Consumption Of Electric Refrigerators And Electric Refrigerator-Freezers

Appendix A1 To Subpart B Of 10 CFR Part 430 / Appendix B To Subpart B Of 10 CFR Part 430 Uniform Test Method For Measuring The Energy Consumption Of Electric Freezers

USA EE Directive-ENERGY STAR® Program Requirements for Residential Refrigerators And / Or Freezers Partner Commitments

- AU test method standard-AS/NZS 4474.1:2007+A1:2008+A2:2011  
AU EE standard-AS/NZS 4474.2:2009+A1:2011+A2:2014
- Testing items are daily energy consumption, annual energy consumption, volume; calculated items are EE Index, EE Grade, MEPS. With load processing test for annual energy consumption has been tested with IEC 62552-2015 as well.
- The philosophy of analyzing key impacting factors of energy consumption test methods is to choose two standards with similar certain testing conditions but one or two main different testing conditions, and then to understand the different testing condition's impacts on energy consumption.

#### Results analysis are summarized as below:

- Testing results of the four selected sample have shown that for the same product, different energy consumption testing results have been found according to the 4 testing standards. Furthermore, the deviations of three standards from IEC 62552:2015 are different for the four appliances. For the chest freezer the deviations are very small and for the upright refrigerator and upright frost-free refrigerator-freezer the deviations are remarkable.



- Differences of volume testing results are not that significant among the 4 samples with the applied 4 standards.
- EE evaluation methods of EE grades and MEPS are also compared on the basis of testing results of energy consumption and volume for the 4 samples.
- What needs to be mentioned is when economies making EE standards or directions reflected as EE Grade and MEPS, energy consumption and volume are not the only contributions to the energy efficiency evaluation, parameters of reflecting economy EE policy are also important.
- Moreover, key impacting factors - ambient temperature, target temperature, storage plan and temperature sensor and product adaptability for twice tests at different temperatures - have been identified. Overall summary for all above impacting factors and their contribution quantities have been concluded in table 4-20 of the Laboratory Test Report.

When ambient temperature of refrigerator increases 1K, the energy consumption will be increased by 4.5%, 3.0%, and 2.4% respectively for refrigerator, chest freezer and refrigerator-freezer. For fresh food compartment, if the target temperature increases 1K, energy consumption will increase 9%, and for frozen food compartment, the energy consumption will decrease 6.5%. Storage plan of temperature sensor in fresh food compartment has 2.3% impacts on energy consumption, while for frozen food compartment, its impacts is (-3.9%). Again in frozen food compartment, impact of determination of storage temperature on energy consumption is (-4.2%). Impacts of product adaptability to the twice different ambient temperature conditions on energy consumption are 1.7%, 13.2% and 5.2% respectively for refrigerator, refrigerator-freezer, and frost refrigerator freezer respectively.

- Other differences of test conditions required in IEC 62552:2015, such as requirements for test room, the distance of rear of appliance, position of cylinder for ambient temperature, etc. which have little effect on the energy consumption results have not been analyzed. And other requirements for calculation of energy consumption in IEC 62552:2015 help to improve the accuracy is not considered in the results analysis.

#### 4. Recommendation Roadmap for the Harmonization of Testing Methods within APEC Economies with IEC 62552

It is commonly understood that government is playing the key role in energy efficiency policies, as the 'policy push'. Nevertheless, due to different economic and political circumstance for different economies, such as development level of economies products manufacturing, consumers priority concerns as well as power of government in each economy, to have a harmonized timeline for economies in APEC region to adopt the new IEC standard is not realistic other than to take it step by step according to situation of each economy. Therefore, different Groups have been proposed in the project as harmonized roadmap for the new IEC 62552 adoption in APEC region.

- **Group A** with characteristic of more developed market and more mature EE policy implementation circumstance, have been or can be the first group to be harmonized. For example, China and Japan have finished modifying their EE test method standards according to IEC 62552:2015.

For economies in this Group A, even further motivations can be coordinated to mobilize the adoption of the IEC 62552:2015. For example, Round Robin Test (RRT) among them to have a uniform understanding for the standard will be a good option.

- **Group B** can be those economies with medium level of development of their market and EE policies, and export business to Group A is more valued. Harmonization roadmap for EE test methods can be:
  - Difference between their current EE test method and IEC 62552:2015 should be studied. The Desktop Research of this project can be helpful.

- Investigation should be further studied on how much impacts of IEC 62552:2015 on their products' EE Grade compared with the current EE test method standard. The table 4-20 in Laboratory Test Report of this project is kind of good reference.
- Based on the above two steps, EE policy revision or amendment for the government departments will be necessary.
- In between above three steps, policy consultation and training of test methods understanding on the new IEC62552 can be supported by Group A.
- Market preparation like products design improvement, testing personnel training shall be then the last step for adopting the new IEC 62552 standard.
- **Group C** is more in the stage of shaping their EE policies and actions, the harmonization shall also fit their pace that may move slower than the Group A and B. Harmonization roadmap for EE test methods can be:
  - Taking into experience of Group A and B and their own circumstance, EE policies shall be more shaped at first.
  - After the EE policy going smoothly, the Group B's roadmap can be referred.

Possibly a technical committee with qualified experts from Group A and economies who have matured EE policies but owns their EE standards and test methods can be acted as trainers for Group B and Group C for test methods capacity building and EE policy consultation, and also a alliance to have mutual recognition of testing results can be initiated in future to save testing cost and improve trade efficiency in the APEC Region.

**APEC Project: [EWG 04 2014A - Technical Reference on Harmonization of Energy Efficiency Test Methods of Refrigerators Toward the New IEC 62552 among APEC Region]**



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