Domestic Air Conditioner Test Standards and Harmonization: Summary of Findings

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Overview and Goal of Research Project

- Test procedures are foundational to national regulatory energy efficiency programs.
- This project's goal was to identify key differences to facilitate potential harmonization efforts and areas for improvement.
- Improved harmonization can reduce test burden, share best practices internationally, and allow for better comparison of equipment across countries.
- Cadeo and Stem Integration Services reviewed and compared a selection of international test methodologies for domestic air conditioners designed to provide cooling or heating and cooling.





Test Procedure Review & Findings

This research reviewed and compared the test procedures shown in this table, with primary focus on:

- Scope of Products Covered
 - Ductless Split System Air Conditioners
- Test Method
 - Two test methods allowed in almost every test procedure
- Secondary Energy Uses Tested
 - All test procedures rated some for of secondary energy use
- Ability to Rate Fixed & Variable Capacity Equipment
 - All test procedures had a method for testing and rating both fixed and variable capacity equipment.

Country	Referenced Test Procedure
Australia/ New Zealand	AU/NZS 3823.1.1:2012 AU/NZS 3823.4.1:2014 AU/NZS 3823.4.2:2014
China	GB/T 7725-2004
EU	BS EN 14511:2018
Japan	JIS B 8615-1:2013 JIS B 9612:2013
Korea	KS C 9306 2017
US	10 CFR 430 Subpart B Appendix M/Appendix M1
International	ISO 5151



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Efficiency Metrics & Test Conditions Findings

- Most countries require some form of seasonal energy efficiency metric to rate equipment efficiency
- Seasonal metrics rely on multiple temperatures
 - Test condition temperatures
 - High temperature test condition is nearly fully aligned with ISO 5151 across all test procedures studied
 - Low temperature (part load) test conditions vary, with some countries calculating energy consumption at temperatures lower than the low temperature test condition
 - Extrapolation of performance to low temperatures can be inaccurate
 - Local climate rating temperatures
 - Since local climates vary, these temperatures are not standardized
 - Regional weighted temperatures used to calculate SEER don't appear to directly correlate to SEER values



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Harmonization opportunities

Standardization of low temperature test conditions represents an opportunity for harmonization.

- May also help seasonal efficiency metrics be more relatable between countries
- A lower test temperature would minimize extrapolation of load curve during seasonal energy efficiency calculation

Standardize secondary energy uses considered

Results in more comprehensive and consistent assessment of energy performance

Other opportunities for harmonization:

- Standardize refrigerant line length and/or charge
- Standardize equipment nomenclature & terms



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Opportunities for Improvement

All countries include Variable Capacity Testing, but approaches could be improved to better characterize performance, especially at part load conditions.

- Current procedure fixes compressor speed at part load condition
 - Does not accurately represent field operation
 - Load-based test procedures have been developed to dynamically test variable capacity equipment
 - Questions about ensuring reproducibility of results
- Current seasonal efficiency calculations vary between fixing degradation coefficient and measuring it
 - Accurately characterizing degradation coefficient is important for correctly anticipating seasonal efficiency





Summary

- Reviewed test procedures from 6 countries + international standard
- Generally aligned, but some opportunities for harmonization of test methods
- Also opportunity to improve testing of variable capacity equipment
- Improved harmonization can reduce test burden, share best practices internationally, and allow for better comparison of equipment across countries

Next Steps: Further evaluating test methodologies for variable speed air conditioners and heat pumps

