REVIEW OF ENERGY EFFICIENCY TEST STANDARDS AND REGULATIONS IN APEC MEMBER ECONOMIES

MAIN REPORT

ASIA-PACIFIC ECONOMIC COOPERATION

APEC Energy Working Group

November 1999

REVIEW OF ENERGY EFFICIENCY TEST STANDARDS AND REGULATIONS IN APEC MEMBER ECONOMIES

by

Energy Efficient Strategies, Australia

with assistance from

Paul Waide Consulting, UK

George Wilkenfeld & Associates, Australia

International Institute for Energy Conservation, Bangkok

Rafael Friedmann, USA & CENEF, Russia

Main Report

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APEC Secretariat
438 Alexandra Road
#14-00 Alexandra Point
Singapore 119958

Tel: +65 2761880
Fax: +65 2761775

Email: info@mail.apecsec.org.sg
Website: http://www.apecsec.org.sg

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Foreword

This project is one of a number of projects managed by the APEC Steering Group on Energy Standards (SGES) to address the requests of APEC Energy Ministers to strengthen cooperation on energy efficiency standards. The Steering Group is a task group reporting to the APEC Energy Working Group.

The Energy Working Group is one of ten APEC working groups. Its goal is to maximise the energy sector's contribution to the region's economic and social well being through activities in five areas of strategic importance:

- energy supply and demand,
- energy and the environment,
- energy efficiency and conservation,
- energy research, development and technology transfer, and
- minerals and energy exploration and development.

This report was commissioned by the APEC Steering Group on Energy Standards for the APEC Energy Working Group.

A large amount of complex analysis has been required for this report. Some errors may be included in the final report and some information is missing due to slow or incomplete responses from some parties during the data collection process. While the authors have offered their opinions on a range of issues, these are intended to illicit comment and stimulate discussion, rather than necessarily set the direction of future APEC policies in this area.

This report is available as an electronic file for distribution to interested parties via the APEC Energy Working Group web site which can be reached via the APEC Secretariat web site http://www.apecsec.org.sg

Files can be downloaded with a standard web browser – right click the mouse button on the file name at the above web site and "Save File/Link As" on your local computer. The electronic version of this report is in PDF format and has been formatted for double sided printing on A4 paper, with odd pages on the right hand side and even pages on the left. This report is in two sections:

Main report - executive summary, introduction, review of program by APEC Economy, recommendations on future directions, index of standards, references, web sites, contacts. (file EWG0398T-main.PDF)

Technical Annexes A to G - technical review of the test procedures for those products regulated in APEC Economies. (file EWG0398T-annex A-G.PDF)

This document is the Main Report.

Energy Efficient Strategies

Warragul, Australia, November 1999

Executive Summary

Background

The Energy Ministers of the APEC member economies have issued a declaration noting both the role of standards in accomplishing energy efficiency goals and the scope for reducing the cost of trade in products subject to energy efficiency standards. The Steering Group on Energy Standards has been asked to:

- develop firm proposals for establishing a base on which mutual acceptance of accreditation of energy efficiency testing facilities and the results of test performed at these facilities can be achieved;
- work towards the establishment of bases of comparison of the outcomes of testing to different standards so that the need to test to multiple standards can be reduced or removed;
- develop a general policy framework that would allow for the progressive development and implementation of harmonised standards on a bilateral or multilateral basis, and product by product, as technical details are established and mutually agreed upon.

This review is intended to address the second of these requests.

The brief for the study stated that it was to include electrical products for which a legal condition of sale or distribution of the product is that the product's energy performance be tested to, or complies with, a specified test standard or similar requirement. All 21 of the APEC economies (as of mid 1999) are covered. Note that many APEC Economies also regulate non-electric products for energy efficiency, but these are not within the scope of this study and therefore have not been included in this report.

Approach

Copies of relevant documents (regulations, test procedures etc) were obtained in either printed or electronic form. Most economies were able to provide material (or at least summaries of material) in English. There were a number of cases where source documents were only available in local languages. In these cases, related documents were sometimes used to interpret the data contained therein. In cases where no related documents existed, it was not possible to undertake an analysis of the product test procedures where these were not in English. Some of the test procedures reviewed are largely self contained and give a good insight into the methods used to determine energy consumption and energy efficiency. Other standards or regulations make widespread use of a wide range of external standards to specify conditions and test methods for specific products. In cases where these external references are extensive and have not been supplied by the relevant APEC Member Economy, it has not been possible to review these test procedures nor compare test procedures directly.

For each product in each economy, the report indicates whether any of the following programs apply:

A. Comparison label: a label giving data about the specific energy consumption and/or efficiency of a model of a product in a way that allows comparison with other models of that product, and/or relating that data to an efficiency scale;

B. Endorsement label: a label that indicates that a model of a product meets a specified level of energy efficiency and/or has a characteristic that is considered relevant to energy efficiency;

C. Minimum Energy Performance Standard (MEPS): a requirement that all models in product class must meet a specified level of energy efficiency;

D. Industry target: a requirement that the average of all products sold must meet a specified level of energy efficiency; and

E. Other: any other programs that may have an impact on trade.

Mandatory programs are likely to vary greatly in their market impact according to the level of compliance by suppliers, the level of enforcement by regulators and, in the case of labelling programs, the level of awareness and motivation among product buyers. There has been no attempt to assess the effectiveness of any mandatory programs. Nor is it intended to make any judgements about the scope or direction of any APEC economy's appliance energy efficient policies or programs.

The approaches adopted by APEC member economies range from the publication of all requirements for the test procedure through to the regulatory requirements for energy labelling and MEPS within government regulations, to approaches where little technical information is included in regulations and all of the technical requirements for testing as well as regulatory requirements for energy labelling and MEPS are published in local standards. There is of course a continuum between these two approaches and the precise approach is different in every economy. The aim of this report is to examine and determine the "net effect" of relevant regulations and test procedures when considered *in toto.*

As noted, each economy has a different approach to these program elements, although there is of course much in common between all of them.

Key Issues

It is not possible to summarise the details of the energy programs by economy in the executive summary as these are far too numerous and extensive. The level of regulation also varies considerably, with some economies having no current or proposed energy related regulations while others regulate as many 20 or more product types. However, it is clear that there is a huge range of test procedures in use within APEC Member Economies for the purposes of energy related regulations and programs. While there is a degree of similarity and even harmonisation in some areas and for some products, there is generally a complex mix of requirements in force, both in terms of regulatory requirements and testing requirements. This obviously has the potential to, and most likely already is, restricting free trade between APEC member economies.

Conversion algorithms, where feasible, will provide reduced costs of testing for manufacturers, which will in turn reduce costs of trade. This will have potential benefits of allowing the most efficient products available on the market to move more freely which will in turn reduce the demand for energy consumption. However, the development of conversion algorithms that are accurate and reliable is not simple for some products and probably not even necessary or feasible for others.

Alignment of test procedures and the development of conversion algorithms both achieve the same net effect. These are to:

- facilitate international trade
- decrease testing and approval costs for manufacturers
- allow the free movement of the most efficient products (noting that products with a low energy efficiency may still be barred if they do not meet local MEPS levels)
- facilitate international comparisons
- assist in the diffusion of advanced energy saving technologies.

Conversion algorithms have the added advantage of being able to provide a more accurate estimate of the impact of local usage patterns, better ranking of products under conditions of actual use and may also allow the retention of local or traditional test conditions. They would also facilitate direct international comparisons, which are of increasing importance. However, in cases where a particular product test procedure is clearly technically superior and already characterises products to the level that is necessary, alignment would probably be a preferable medium term option. It is only worth aligning with a standard that is technically superior and competent – aligning to a poor test procedure serves little purpose. Either alignment of test procedures or development of suitable conversion algorithms provides an acceptable outcome in terms of APEC policy requirements and future directions (provided that economies accept the results of a conversion algorithm as credible).

In terms of the major product groups, the key report findings are as follows:

Refrigerators

- large world trade
- large number of different test procedures
- widely regulated across APEC economies
- no test procedure is clearly superior to others
- some prospects for a conversion algorithm (through computer modelling), but this is likely to be complex and is yet to be proved
- little prospect of alignment in the short to medium term.

Air conditioners

- large world trade
- mostly similar test procedures, but with many small variations
- widely regulated across APEC economies
- ISO test procedure is used widely but is currently inadequate for modelling actual use, a range of climatic conditions or part load operation.
- good prospects for a conversion algorithm, but there is still significant development work to be done

- reasonable prospects of alignment in the short to medium term, probably using ISO standard conditions, but there is a need to address outstanding issues such as part load and climate variations through a modelling approach.

Electric motors

- large world trade
- mostly similar test procedures, but with some significant differences
- some regulation in APEC economies, many under consideration
- IEC test procedure is used widely but currently inadequate. IEEE approach used in NAFTA and is the superior methodology
- conversion algorithm not necessary as proposed IEC standard is adequate
- good prospects of alignment in the short to medium term if current IEC draft incorporating IEEE methods proceeds to publication.

Lighting products

- large world trade
- mostly similar test procedures, mainly based on IEC performance standards, but with some significant differences with respect to measurement of efficacy of ballasts
- some regulation in APEC economies, some under consideration
- IEC test procedure is used widely but no suitable standard exist with respect to determination of efficacy of ballasts. There is a need to develop a new IEC ballast test procedure based on the superior methods now used in North America and Europe for determination of efficacy. IEC test methods for lamps are adequate.
- conversion algorithm not necessary as proposed standards for ballasts (if developed) will be adequate
- good prospects of alignment in the short to medium term if proposed IEC standards are developed.

Electric water heaters

- small but growing world trade
- many different test procedures, wide range of temperature requirements, both static and draw-off tests used. Task type tests (with draw-off) are essential for non electric technologies.
- regulation in many APEC economies, under consideration in some.
- current IEC test procedure is currently inadequate (only provides static heat loss measurement).
- conversion algorithm appears to be the most feasible option. A suitable computer based model (which has the facility to be calibrated with data from physical tests) has already been developed and is probably suitable and ready for adoption as a conversion algorithm test method. Should be able to provide suitable level of

accuracy for regulation, plus enough flexibility to accurately model the wide range of existing test procedures as well as actual use.

- Poor prospects for alignment.

Clothes washers

- large world trade
- wide range of test procedures, some home grown and others derived from IEC
- some regulation in APEC economies, some under consideration
- IEC test procedure is currently inadequate with respect to performance of top loading machines. Wide range of work is under way with respect to all aspects of the test, but it will be some time before all major issues are adequately progressed. IEC probably best of the existing test methods.
- conversion algorithm not likely to be feasible
- moderate prospects of alignment in the medium term if the IEC standard is developed further with the input of APEC member economies. Still likely to be some local variations as a result of wash temperature.

Dishwashers

- small world trade
- three main test procedures – IEC, AHAM, US DOE (also now CENELEC)
- some regulation in APEC economies, no more proposed
- current IEC test procedure is currently inadequate with respect to performance. Wide range of work is under way in IEC with respect to all aspects of the test with input from Europe, North America and Australasia – good progress to date.
- conversion algorithm not likely to be feasible
- good prospects of alignment in the short to medium term if the IEC standard development is completed and accepted within relevant participating APEC member economies.

Clothes dryers

- small world trade
- two main test procedures – IEC and AHAM (US DOE)
- some regulation in APEC economies, no more proposed
- current IEC test procedure is currently inadequate with respect to performance. Needs improvement in the area of energy correction. Also needs to be made more generic allow the estimation of energy consumption over a wide range of initial moisture contents without the need for retesting. Some work under way in IEC. Most existing dryer test procedures have the same inadequacies
- conversion algorithm probably not necessary if flexible new generic test procedure developed

- fair to good prospects of alignment in the medium term if the proposed IEC standard development is completed and accepted within relevant participating APEC member economies.

Office equipment and consumer electronics

- huge world trade, relatively short life, fast turnover, rapid change in technology
- few formal test procedures
- few regulations in APEC economies but widely covered by voluntary programs
- may be a case for the standardisation of some aspects of the testing of these products (eg instrumentation and accuracy). Most common measurement is for standby electricity consumption.
- conversion algorithm probably unnecessary
- global product specifications and program coverage suggests a strong case for alignment, whether these are formal or informal test procedures.

Report Recommendations by Product

Recommendations for Air Conditioners

For air conditioners the most promising approach would appear to be multi pronged:

- Provide some effort and resources into eliminating the currently somewhat arbitrary (but mostly small) differences in test conditions and tolerance for testing of air conditioners and heat pumps within APEC economies. Aligning to ISO5151 T1 would appear to be a feasible option, although this would obviously be subject to agreement;
- Work towards the development and adoption of international coding system of definitions for air conditioners within APEC economies to assist with the uniform treatment of air conditioning products in a regulatory sense;
- Examine options for modelling of small deviations from the ISO test method (eg changes in temperature and humidity requirements) and the development of an altitude correction algorithm;
- Undertake further investigations into the feasibility of developing a full simulation model for air conditions as a medium term goal (including a calibration process against actual tests). Such an approach should make particular reference to the accurate estimation of performance under standard rating conditions (for comparative and regulatory purposes), simulation of household usage under a range of climates and more realistically and accurately assessing the performance of variable speed drive compressor systems under conditions of actual use.

Recommendation for AC Electric Motors

Ensure active participation from APEC economies in the current development of the new IEC motor standard which incorporates the superior methods of IEEE and alignment with this standard once published.

Recommendations for Lighting Products

The following recommendations are made for lighting products:

- Active alignment with IEC standards for lighting products other than fluorescent lamp ballasts;
- Review and use of IEC performance standards for fluorescent ballasts where relevant;
- APEC participation in the development of a new IEC standard for the measurement of fluorescent lamp ballast efficacy;
- Alignment with the IEC ballast efficacy standard once developed, if acceptable.

Recommendations for Water Heaters

The prospects for alignment of water heater test procedures appear poor. The only feasible option appears to be the development of a complex computer algorithm which will allow accurate modelling and characterisation of a wide range of climate conditions and usage patterns. Such a computer model already exists in Australia and is in the process of being developed into an international standard. APEC should provide active assistance in this development, particularly with regard to the specification of input requirements for conventional water heater types.

Recommendations for Clothes Washers

- Active participation in IEC committee SC59D to assist in the development of a relevant international clothes washer performance standard;
- Medium term alignment to the IEC when this is deemed acceptable.

Recommendations for Dishwashers

- Active participation in IEC committee SC59A to assist in the development of a relevant international dishwasher performance standard;
- Short to medium term alignment to the IEC when this is deemed acceptable.

Recommendations for Clothes Dryers

- Active participation in IEC committee SC59D to assist in the development of a relevant international clothes dryer performance standard;
- Inclusion of an accurate correction method into the IEC standard;
- Longer term development of a more generalised IEC dryer standard which can accurately estimate energy consumption over a wide range of initial moisture contents;
- Medium term alignment to the generalised IEC standard when this is deemed acceptable.

Recommendations for Refrigerators

Alignment in the short term appears to be very unlikely for refrigerators. Further investigations should be undertaken into both simple and more complex computer modelling options for refrigerators to determine their feasibility as algorithms for use with refrigerator test procedures. More extensive use of a test procedure with dual energy temperature test points and controlled internal heat loads may provide some insight and data to assist with modelling and algorithm approaches.

Recommendations for Office Equipment

APEC should coordinate approaches for the measurement of standby energy consumption for their various voluntary and mandatory programs. APEC Economies with a direct interest in standby energy consumption should actively participate in the new IEC TC59 project to examine test methods for the determination of standby losses.

Conclusions

The general report conclusions are as follows:

- A plethora of local test standards are in use and these are likely to be restricting trade by increasing costs of trade
- Few international standards are "generic" at this stage and many require significant work to make them more applicable for regulatory purposes.
- For some product types, alignment appears to be the only feasible option in the medium term.
- Special attention needs to be paid to new and emerging "smart" products and control systems – while these have the potential to save substantial amounts of energy during actual use, there is also potential that they can "trick" test procedures into measuring fake energy savings which will appear only in the test procedure. Similarly, some products will achieve real energy savings in actual use but will obtain no credit for these in the test procedure.
- Conversion algorithms (computer modelling concept) appears to be a feasible and attractive option for some selected products (especially water heaters), yet this approach is very new and is yet to be proven and receive widespread acceptance.
- A big effort will be required to develop suitable conversion algorithm models to the required level of accuracy for regulatory purposes.
- For those products affected by climate (eg refrigerators, air conditioners and water heaters) a modelling approach is the only effective way of ensuring that products are ranked correctly with respect to energy efficiency under conditions of actual use.
- There is a need for change in direction with respect to energy policy within the IEC/ISO bodies – a long term view is needed and member organisations need to more effectively communicate their needs to these bodies.
- There needs to be an increased an ongoing input by APEC member economies into IEC/ISO standards development processes, especially for those products and those economies that regulate on the basis of energy and performance.

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Summary of Test Standards for Electrical Products in APEC Economies - current status and recommended strategies

Product	Level of Trade	Efficiency regulations	International Standard(s)	Preferred Standard(s)	Recommended Strategy	Current Alignment/ Prospects	Time Scale	Short term resources	Longer term resources	Issues/ Comments
Air conditioners	Large	Many, some proposed	ISO5151 ISO13253 [1]	ISO5151 ISO13253 New international coding system	Alignment to ISO + additional modelling for variations and climate/use effects	Fair/ Good	Short + medium	Moderate	Minimal + Substantial	Short term alignment to ISO, modelling required to deal with inverters and climate variations
Motors	Large	Some, some proposed	IEC60034-2	IEEE/NEMA, IEC60034-2 incorp. IEEE	Complete IEC revision, align to improved IEC	Poor/ Good	Short	Minimal	Minimal	New IEC standard will be aligned with IEEE, available soon
Lamps	Large	Some, some proposed	IEC60081 IEC60901	IEC60081 IEC60901	Align to IEC	Fair/ Good	Short	Minimal	Minimal	IEC widely used, requires active alignment in APEC
Ballasts for Fluorescent Lamps	Large	Many, some proposed	None	New IEC based on Nth American methods	Develop new IEC then align	Poor/ Good	Short to medium	Moderate	Minimal	Having no IEC has created problems, fast track proposed
Electric Water Heaters	Small	Many	IEC60379, technically limited	New IEC/ISO based on modelling, covering all fuel types including solar	Physical tests + modelling of use (complex algorithm)	Very poor/ Good if method accepted	Medium	Moderate	Minimal	Computer modelling algorithm already developed to handle diverse conditions of use & climate
Clothes Washers	Moderate	Some, some proposed	IEC60456	IEC60456, but current scope very restricted, many issues to resolve	Amend & develop IEC to make more universal	Very poor/ moderate	Medium to long	Moderate	Moderate	Work required to include top loading, develop and resolve performance issues
Dishwashers	Small	Some	IEC60436, obsolete	New IEC under development	Develop new IEC then align	Poor/ Good	Medium	Moderate	Minimal	Current IEC process appears promising
Clothes Dryers	Small	Some	IEC61121, technical flaws	IEC61121, improve correction, generalise method	Complete IEC revision, align to improved IEC	Poor/ Good	Medium	Moderate	Minimal	Making IEC standard generic will improve applicability
Refrigerators	Large	Many, many proposed	ISO5155 ISO7371 ISO8561 ISO8187	None, all methods have major limitations	Investigate use of dual temperature methods, investigate modelling options	Very poor/ moderate	Medium to long	Substantial	Substantial	Many technical issues, modelling is difficult and success is not certain

1 Other ISO standards for heat pumps include ISO13256.1 (water source to air) and a draft for multi-splits CD15042.

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Glossary

APEC – Asia Pacific Economic Cooperation

Comparative energy labelling program - label allows buyers to compare energy efficiency and/or energy consumption of labelled models.

Cooling only – air conditioner that can only cool, usually of the vapour compression type, although other types are possible (absorption, evaporative).

COP – coefficient of performance, measure of the efficiency for an air conditioner, usually in the heating mode. Units can vary, but usually Watts/Watt.

BTU – British Thermal Unit, measure of energy for heating mainly used in North America, 1 Wh = 3.412 BTU.

EER – Energy Efficiency Ratio – measure of energy efficiency, usually for an air conditioner in the cooling mode. Units can vary considerably – typically Watts/Watt, BTU/Watt hour or kCal/Watt hour. Care is required when comparing these variables.

EER – Energy Efficiency Rating – decimal version of the star rating for the energy labelling program in Australia (term is being amended to Star Rating Index).

EJ - Exajoule: measure of energy which is equal to 10^{18} Joules or 23.89 MToe

Endorsement Labelling Program - label tells buyers that the product meets a certain efficiency standard or is part of a “high efficiency” group, but does not directly compare efficiency against other models in the market.

EQV - term used to compare test procedures: equivalent in technical content but not fully corresponding in presentation ie with minor technical deviations that do not render unacceptable anything that was acceptable under the terms of the other standard and vice versa.

Heat pump – an air conditioner of the vapour compression type which is primarily configured to operate as a space heater rather than a cooling device.

IDT - Technically identical - any deviations are editorial changes that do not alter the technical content of the standard and do not change the clause structure and numbering.

kCal – kiloCalorie, non-SI metric measure of energy. Calorie is the measure of energy to raise 1 cc of water by 1°C. 1 kCal = 1.16222 Wh, or 4.186 kJ.

M - Mandatory program (law or regulation)

MEPS – minimum energy performance standard, also called minimum energy efficiency standard (or just “Standards”) in some economies. Products cannot be legally sold unless they meet the specified level of energy efficiency.

MFD – multi-function devices – usually combination of printer/fax/scanner and/or copier.

NAFTA – North American free trade agreement (Canada, Mexico, USA)

PJ - Petajoule: measure of energy which is equal to 10^{15} Joules or 0.0239 MToe

NEQ - term used to compare test procedures: not equivalent in terms of technical content although it is based on (or related to) that standard ie it contains technical and editorial deviations which make it unacceptable under the terms of the other standard and/or vice versa.

Reverse cycle air conditioners – an air conditioner of the vapour compression type that can heat and cool by internal reversal of the refrigeration process.

SEER - Seasonal Energy Efficiency Ratio, usually a composite weighted average of energy efficiency for a reverse cycle air conditioner over a range of heating and cooling tasks. Often involves part load testing. Sometimes may apply only to cooling only air conditioners over a range of part and full load conditions.

T12 - dimensional specification of tubular fluorescent lamps in eighths of an inch - eg T12 is 1.5 inches diameter (38mm) while T8 is 1 inch (25.4mm), T5 = 16mm.

V = Voluntary program

VL = Voluntary program with low potential impact on trade

VM = Voluntary program with medium potential impact on trade

VH = Voluntary program with high potential impact on trade

(19XX) or (200X) = Year of implementation

UC = Under consideration (not implemented)

1. INTRODUCTION

1.1 Background

1.1.1 General Situation

There is a recognised need to reduce inefficient use of energy, and to this end some individual APEC member economies have introduced regulatory requirements for minimum energy performance standards (MEPS) or energy performance labelling of selected products. Not all economies require MEPS or labelling for all products (some economies require none), and for many products, different requirements apply in different economies. Therefore there is potential for the energy efficiency regulatory requirements to impose a cost on trade in energy using products.

1.1.2 APEC Energy Ministers Declaration

The Energy Ministers of the APEC member economies have issued a declaration noting both the role of standards in accomplishing energy efficiency goals and the scope for reducing the cost of trade in products subject to energy efficiency standards. The APEC Steering Group on Energy Standards has been asked to:

- develop firm proposals for establishing a base on which mutual acceptance of accreditation of energy efficiency testing facilities and the results of tests performed at these facilities can be achieved;
- work towards the establishment of bases of comparison of the outcomes of testing to different standards so that the need to test to multiple standards can be reduced or removed;
- develop a general policy framework that would allow for the progressive development and implementation of harmonised standards on a bilateral or multilateral basis, and product by product, as technical details are established and mutually agreed upon.

This review is intended to address the second of these requests while also assessing the prospects for alignment of test procedures for a wide range of electrical products currently regulated for energy efficiency.

1.2 Project brief

The scope of work was as follows:

1. Identify subject product areas for examination within each APEC economy (i.e. those that are, or are potentially, subject to trade restrictions as a result of energy regulation).
2. Determine the nature of the technical and testing requirements of energy efficiency policies, i.e. whether these be standards (international or domestic, modified or unmodified) or other documents, and take particular note of any modifications to test procedures contained in local regulations.

3. Identify the nature of existing, or proposed, cooperative arrangements between APEC economies in the area of energy efficiency standards and labelling.

4. Undertake a detailed technical review of test procedures to identify differences and similarities between domestic standards of APEC member economies and relevant international standards.

5. Review the adequacy of international standards in terms of their ability to:
   • meet APEC regional requirements for testing (such as climatic variations, actual consumer use or behaviour and environmental requirements);
   • provide adequate performance data to meet the requirements of local regulations and labelling programs; and
   • form the basis of a uniform testing methodology within the APEC region.

6. Where possible, identify where it is feasible to overcome trade barriers by the development of conversion algorithms between domestic testing protocols (noting that the development of algorithms is not part of this study).

The brief for the study stated that it was to include products for which a legal condition of sale or distribution of the product is that the product's energy performance be tested to, or complies with, a specified test standard or similar requirement. A number of instances where energy performance testing and disclosure are voluntary, but compliance is so widespread that there is still potential for impact on trade, were also identified during the course of the study.

As required in the brief, the scope of the study was limited to electrical appliances and equipment, and did not cover safety or non-energy related products or requirements, except to the extent that these were directly linked to energy standards or tests. It should be noted that many economies regulate non-electrical products for energy efficiency and of course safety standard requirements are extensive for both electrical and non-electrical products. So there is an extensive body of test procedures and related regulations that could restrict trade but which has not been covered by this report.

As specified in the brief, the study covered all 21 APEC member economies:

Australia
Brunei Darussalam
Canada
Chile
China
Hong Kong, China
Indonesia
Japan
Korea
Malaysia
Mexico
New Zealand
Papua New Guinea
Peru
Philippines
Russian Federation
Singapore
Chinese Taipei

Thailand
United States of America
Vietnam

1.3 Approach to the Project

1.3.1 Data Gathering

The project was carried out in two stages:

1. a research and information gathering stage for each APEC economy, which made best use of each team member's special knowledge of and contacts in particular economies; and
2. an analysis and synthesis stage, which was structured along product lines, so that team members brought to bear their special expertise for each product type.

The project team already held extensive documentation on some APEC economies at the beginning of the project, so the information collection phase was restricted to filling in gaps, verifying that the documents held were still current, and checking with agencies in each economy for recent developments, proposed changes, etc.

For some economies, this could be done by accessing the Internet sites of key government agencies. In other cases it was necessary to send a detailed questionnaire to key agencies, and follow up with supplementary questions. Given the constraints of the project budget, special field trips were only undertaken where absolutely necessary, and were combined with travel for other purposes where possible.

Copies of relevant documents (regulations, test standards etc) were obtained in either printed or electronic form. Most economies were able to provide material (or at least summaries of material) in English. There were a number of cases where source documents were only available in local languages. In these cases, related documents were sometimes used to interpret the data contained therein. In cases where no related documents existed, it was not possible to undertake an analysis of the product test procedures where these were not in English (the cost of translations was not covered in the project contract).

Some of the test procedures reviewed are largely self contained and give a good insight into the methods used to determine energy consumption and energy efficiency. Other standards or regulations make widespread use of a wide range of external standards to specify conditions and test methods for specific products. In cases where these external references are extensive and have not been supplied by the relevant APEC Member Economy, it has not been possible to review these test procedures nor compare test procedures directly. However the external references are documented to allow future analysis should this be necessary. Covering all externally referenced standards would involve the review of some thousands of documents, most of which are beyond the scope of this project (note that a typical test standard references 5 to 10 other standards).

1.3.2 Products Covered

The questionnaires sent to each economy sought information on minimum energy performance standards (MEPS) and energy labelling requirements covering the following products in particular:

Refrigerators and refrigerator-freezers intended mainly for household use
Separate freezers intended mainly for household use
Automatic ice makers
Refrigerated display cabinets
Room air conditioners (ie window-wall) and heat pumps (ie types with heating capability as well)
Split system air conditioners and heat pumps
Packaged (central) air conditioners (ie with ducting) and heat pumps
Non air heat pumps (ie where heat is extracted from or transferred to earth or to water)
Packaged terminal air conditioners
Water chillers
Dehumidifiers
Electric space heaters
AC electric motors (3 phase)
AC electric motors (single phase)
Incandescent lamps (reflector and GLS)
Fluorescent lamps
Fluorescent lamp ballasts
Compact fluorescent lamps
Indoor luminaires and lighting systems
External luminaires and lighting systems
Electric water heaters
Clothes washers
Dishwashers
Clothes dryers
Office equipment (eg computers, monitors, photocopiers, faxes etc.)
Televisions
Video cassette recorders
Other home electronics (eg radios, digital versatile disc players)
Cooking appliances (eg cooktops, thermal ovens, microwave ovens)
Rice Cookers
Irons
Fans & ventilating fans
Various pumps
Power transformers
Other products

The definition of product types and the sizes or capacity ranges covered by regulations often varies between economies, and this is covered in the text. Some product types are broken down by further categories: for example, there are sometimes different requirements for refrigerator-freezers and freezers according to whether they are frost-free (sometimes called "automatic defrost") or not.

The report only covers electrical appliances and equipment. Numerous APEC economies have or are considering regulations covering gas, oil or wood-burning equipment. These are not covered in this report.

1.3.3 Types of Programs Considered

The brief required the identification of "subject product areas for examination within each APEC economy (i.e. those that are, or are potentially, subject to trade restrictions as a result of energy regulation)." However it is apparent that in some economies there are programs which are "voluntary" in that they do not have the force of law, but nevertheless have a major impact on the market because of strong support from utilities or government agencies. Some examples of this are the refrigerator energy labelling in Thailand, the Energy Star office equipment labelling program in the USA and the forthcoming Top Runner program in Japan (noting that the latter two are initiated by governments but are not enforced by regulation). Therefore voluntary programs have also been covered (although the depth of analysis for lower impact programs is occasionally somewhat less).

For each product in each economy, the report indicates whether any of the following programs apply:

F. Comparison label: a label giving data about the specific energy consumption and/or efficiency of a model of a product in a way that allows comparison with other models of that product, and/or relating that data to an efficiency scale;

G. Endorsement label: a label that indicates that a model of a product meets a specified level of energy efficiency and/or has a characteristic that is considered relevant to energy efficiency;

H. Minimum Energy Performance Standard (MEPS): a requirement that all models in product class must meet a specified level of energy efficiency;

I. Industry target: a requirement that the average of all products sold must meet a specified level of energy efficiency (this allows some sales to be below the average of energy efficiency); and

J. Other: any other programs that may have an impact on trade. For example, in Canada some provinces have their own MEPS programs which are not pre-empted by Federal government programs covering the same products (as is the case in the USA), so these are listed under "Other". For each economy however, only national or federal programs are analysed in any detail.

If one of the above program type applies to a given product, the following additional information is given:

- Whether it is mandatory (M), voluntary (V) or under consideration (UC). If it is known that there is only one type of program under consideration then this is indicated as (M-UC) or (V-UC).
- If the program is already in place, the year of implementation: eg V(1995) or M(1997). If more than one date is shown, this may indicate that the program took effect at different times for different categories of that product, or requirements were changed or updated at those times.

- For some voluntary programs in some economies, there has been a subjective indication of the level of impact on the market, depending on how strongly the program is supported and the likely effect, eg VL (voluntary with low market impact), VM (voluntary with moderate market impact) and VH (voluntary with high market impact, ie comparable in impact to a mandatory program). This is only a subjective rating by the authors with respect to impact on trade and is not intended to be in any way a comment on the merit of the program.

Mandatory programs are also likely to vary greatly in their market impact according to the level of compliance by suppliers, the level of enforcement by regulators and, in the case of labelling programs, the level of awareness and motivation among product buyers. There has been no attempt to assess the effectiveness of any mandatory programs. Nor is it intended to make any judgements about the scope, direction or merit of any APEC economy's appliance energy efficient policies or programs.

1.3.4 Elements in Product Energy Testing, Standards and Labelling

An energy labelling or MEPS program for any given product will include the following elements:

- A description of the energy consumption test that must be performed on the product in order to produce an energy consumption value (eg kWh/24 hrs, or kWh/yr);
- A description of any other tests that must be performed to establish the product's capacity (eg kW cooling capacity for air conditioners, litres internal volume for refrigerators) or function (eg washing and drying index for dishwashers);
- Rules for ensuring that values reported by tests are within acceptable error bands, are rules for retesting and resolving any apparent differences in results;
- For labelling programs, a description of the energy label (size, colour, typefaces etc), rules for how the energy consumption information for a specific model is to be presented on the label (eg how to calculate and indicate the number of stars), and rules for the placement of the label on products;
- For MEPS programs, the minimum energy efficiency level (or maximum energy consumption) that a product must achieve in order to be legally offered for sale.

These tests and rules may be published as formal standards by an economy's standards-setting agency or by an international agency such as the International Standards Organisation (ISO) or International Electrotechnical Commission (IEC) or both. Alternatively, they may be described in government regulations or in bulletins issued by government agencies. It should be noted that some test procedures make extensive use of external references in order to set test conditions, instrumentation or materials. In these cases, determining the details of the test procedures was not always possible.

The approaches adopted by APEC member economies range from that used in the USA, where nearly all energy related requirements from the test procedure through to the regulatory requirements for energy labelling and MEPS are published in government regulations, to approaches used in economies like Australia where little technical information is now included in regulations and all of the technical requirements for testing as well as regulatory requirements for energy labelling and MEPS are published in local standards (some of which are published by the Standards body for the government). There is of course a continuum between these two approaches and the precise approach is different in every economy. Also the level of program documentation and its clarity and availability varies considerably by economy. The aim of this report is to examine and determine the "net effect" of relevant regulations and test standards when considered *in toto.*

As noted, each economy has a different approach to these program elements, although there is of course much in common between all of them. It should be noted that there is a distinction between "minimum energy performance standards" (MEPS – sometimes termed "minimum energy standards" for short) and "standards" or "technical standards" (also called test procedures) – the actual documents which described the energy tests, performance and, sometimes, the MEPS levels and labelling requirements.

1.4 Structure of Report

Chapter 2 gives an account of the situation in each APEC economy, organised in the following way:

- A description of the regulatory and administrative frameworks for energy labelling and/or MEPS programs in that economy;
- A description of general principles and approaches applying to those programs;
- A summary table indicating the products covered and the programs applying to each (using the terminology described in the previous section);
- For each product covered in that economy;

- program regulation and coverage: the description of the product (which may vary between economies) and the classes and capacities of that product covered;
  - criteria and requirements: the MEPS levels and/or the energy labelling rules;
  - testing standards and procedures: the technical standards, regulations or other documents where the energy tests are described, and any special features of those tests (eg local variants test described in international standards).
- References to documents and personal communications relevant to that economy.

Chapter 3 looks at future directions, issues associated with test procedures and briefly discusses the feasibility of overcoming trade barriers by the development of conversion algorithms between domestic testing protocols. It also examines the prospects for alignment and outlines key issues by product type and provides some recommended actions to assist APEC achieve its goals.

The remaining chapters are dedicated to documentation such as references, lists of referenced standards, related web sites and contacts for the project.

Technical Annexes A to G (available as a separate volume) analyse the energy test procedures on a product by product basis, identifies where economies use the same tests for the same products, and reviews the adequacy of international standards in terms of their ability to:

- meet APEC regional requirements for testing (such as climatic variations, actual consumer use or behaviour and environmental requirements);
- provide adequate performance data to meet the requirements of local regulations and labelling programs; and
- form the basis of a uniform testing methodology within the APEC region.

Products are organised into the following types by Annex:

- Annex A – refrigerator products (mainly refrigerators and/or freezers)
- Annex B – space conditioning products (mainly air conditioners)
- Annex C – electric motors
- Annex D – lighting products
- Annex E – hot water and "wet" appliances (clothes washers, dryers, dishwashers)
- Annex F – office equipment and consumer electronics
- Annex G – miscellaneous appliances and equipment (not covered above).

All of the technical Annexes are available for download in electronic format from the APEC web site (see Foreword).

1.5 Project Team & Acknowledgments

The project was led by Mr Lloyd Harrington, principal of Energy Efficient Strategies (Australia). Mr Harrington coordinated the project, carried out the research and analysis for several APEC economies, analysed the standards for many of the products, and assembled and edited the report. Energy Efficient Strategies was responsible for printing and distribution of the report in paper and electronic formats.

Dr Paul Waide, the principal of Paul Waide Consulting (United Kingdom) carried out the research and analysis for several APEC economies and analysed the standards for several of the products.

Dr George Wilkenfeld, principal of George Wilkenfeld and Associates (Australia) carried out the analysis for several APEC economies and analysed the standards for some products.

The International Institute for Energy Conservation (IIEC) carried out the research and analysis for several APEC economies. The IIEC input was coordinated by Dr Peter du Pont, Managing Director of the Asia Regional Office in Bangkok, Thailand, and the IIEC team included Mr Sood Na Phuket.

Mr Rafael Friedmann, an energy consultant based in the USA, carried out the research and analysis for several APEC economies.

Ms Svetlana Sorokina of the Centre for Energy Efficiency (CENEF) based in Moscow undertook extensive research with respect to Russia, made contact with local officials and provided data for the report.

The project team gratefully acknowledges the assistance of all those who provided information regarding each of the APEC economies. Their names are acknowledged in the list of references for each economy in the back of this report.

The team also gratefully acknowledges the assistance, guidance and direction of the contract manager Mr Yang Yafei of APEC Secretariat in Singapore and of the Project Manager, Eur. Ing. David Cogan of the Energy Efficiency and Conservation Authority, New Zealand.

2. Detailed Requirements by APEC Economy

2.1 Introduction

This chapter outlines the energy efficiency requirements by APEC Economy. Each APEC economy is covered in alphabetical order. The specific energy efficiency requirements for electrical products contained within regulation or agreements are detailed in this chapter (as far as possible), together with references (where known or applicable) to the relevant test procedure. However, details of the test procedures themselves are provided in the Technical Annexes (separate volume) which are grouped by product type. Note that many economies have additional requirements for non-electrical products.

In this chapter, the following symbols and terms apply:

Program Type:

A. *Comparative* Labelling Program (label allows buyers to compare energy efficiency an/or energy consumption of labelled models)

B. *Endorsement* Labelling Program (label tells buyers that the product meets a certain efficiency standard or is part of a "high efficiency" group, but does not directly compare efficiency against other models in the market)

C. Minimum Energy Performance Standard (MEPS) Program (where products cannot be legally sold unless they meet a specified level of energy efficiency)

D. Industry Average Efficiency Target

E. Other requirements (details specified in the section)

M = *Mandatory program (law or regulation)*

VL = *Voluntary program with low potential impact on trade*

VM = *Voluntary program with medium potential impact on trade*

VH = *Voluntary program with high potential impact on trade*

(19XX) = *Year of implementation*

(UC) = *Under consideration (not implemented)*

2.2 Australia

2.2.1 Regulatory and Administrative Framework

Overview of Framework

In Australia, energy labelling and MEPS are controlled by State rather than national legislation. The national (Commonwealth) parliament does not have the constitutional power to legislate in this area, although the Australian Greenhouse Office (associated with the Commonwealth Department of the Environment) works with State agencies in managing the program in a nationally coordinated way.

At present there is legislation to require energy labelling in five of Australia's six states (New South Wales, Victoria, Queensland, South Australia and Western Australia) and in one of the two Territories (the Northern Territory). The States and Territories plan to adopt new, uniform regulations in late 1999. The model regulations, when adopted by all jurisdictions, will have the effect of extending the mandatory labelling regime to the State of Tasmania and to the Australian Capital Territory.

The model regulations would be used to ensure uniform implementation of:

- MEPS for refrigerators, freezers and electric water heaters (which took effect in October 1999);
- energy labelling and MEPS for packaged air conditioners (under consideration for 2001), fluorescent lamp ballast MEPS (under consideration for 2002), electric motor MEPS (under consideration for 2002), and possibly other products in due course;
- new label designs and grading scales in 2000, to further increase the effectiveness of the comparative labelling program.

The program coverage is summarised in Table 1.

Most of the energy performance tests and the energy labelling requirements are covered by joint Australian and New Zealand (ANZ) standards, some of which are based on international standards as shown in Table 2.

Energy Labelling

The mandatory energy label indicates the kWh consumption derived from standard tests, scaled up for a specified number of operating cycles or hours of operation. It also indicates an energy efficiency grading from 1 to 6 stars, with 6 stars being the most efficient. The reference scale for the efficiency grading was adopted when labelling was introduced in the mid to late 1980s. As a result of technological change, many products are now graded at 5 or 6 stars and the scale no longer differentiates highly efficient products from moderately efficient ones.

There are plans to revise the reference scale in 2000 so that models which currently rate 5 to 6 stars will rate 2 to 4 stars. The new grading scales are scheduled to be published in Australian Standards in late 1999/early 2000, so the existing scales are given in this chapter.

In addition to the comparative label, the following endorsement labels are sometimes used on a voluntary basis in parts of Australia:

- The "Galaxy Award" label is available for selected high efficiency products that meet the criteria which are set annually. This has been used mainly in the State of Victoria, although the awards are now national;
- The "Energy Smart" label is available for the products which match the highest star ratings achieved in their category (which may be only 3 or 4 for some sub-classes), and is used mainly in the State of New South Wales;
- The US EPA "Energy Star" is used for office equipment, and its use for TVs and VCRs is under consideration.

2.2.2 Summary of Products Covered

Table 1: Energy Efficiency Programs, Australia

	Program Type				
Product Description	**A. Comparison label**	**B. Endorsement label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerators and/or Refrigerator-freezers	M(1986)(a)	V(b)	M(1999)		
Separate freezer	M(1987)(a)	V(b)	M(1999)		
Room air conditioners (<=7.5 kW cooling)	M(1987)(a)	V(b)			
Split-system air conditioners (<=7.5 kW cooling)	M(1987)(a)	V(b)			
Large packaged air conditioners (7.5 – 65 kW cooling)	UC(2001)		UC(2001)		
Electric motors	UC(2002)	UC(2002)	UC(2002)		
Fluorescent Lamp ballasts	V(UC)		UC(2002)		
Clothes washers	M(1990)(a)	V(b)			
Dishwashers	M(1987)(a)	V(b)			
Clothes dryers	M(1990)(a)	V(b)			
Electric water heaters			M(1999)		
Personal computers & VDUs		V(c)			
Printers		V(c)			
Fax machines		V(c)			
Photocopiers		V(c)			
Televisions & VCRs		V(UC)(c)			

M = mandatory, V = Voluntary, UC = under consideration

Sources: NAEEEC (1999), GWA (1998) (a) New comparative label design and grading scale to be introduced in 2000. (b) Galaxy label (mainly used in Victoria), Energy Smart label (mainly used in New South Wales). (c) Energy Star label (used nationally to some extent), coverage being expanded.

Table 2: Energy Test Procedures and Labelling Requirements, Australia

Product Description	Labelling and/or MEPS requirements(a)	Local Test Procedures(a)	Reference Test procedures
Refrigerators and/or Refrigerator-freezers	AS/NZS 4474.2-1997	AS/NZS 4474.1-1997	ISO7371, ISO8561, ISO8187 and ISO5155, US DOE procedures
Separate freezer	AS/NZS 4474.2-1997	AS/NZS 4474.1-1997	ISO7371, ISO8561, ISO8187 and ISO5155, US DOE procedures
Room air conditioners (<=7.5 kW cooling)	AS/NZS 3823.2-1998	AS/NZS 3823.1.1-1998	ISO5151
Split-system air conditioners (<=7.5 kW cooling)	AS/NZS 3823.2-1998	AS/NZS 3823.1.1-1998	ISO5151
Large packaged air conditioners (7.5 – 65 kW cooling)	Under consideration (amendment to AS/NZS 3823.2)	AS/NZS 3823.1.1-1998	ISO5151
Electric motors	Under consideration	AS1359.102.1 (b)	IEC 34.2
Fluorescent Lamp ballasts	Under consideration	AS3134, AS2643 + new test	IEC60921 IEC60929 + EN50294
Clothes washers	AS/NZS 2040.2-1998	AS/NZS 2040.1-1998	IEC60456
Dishwashers	AS/NZS 2007.2-1998	AS/NZS 2007.1-1998	IEC436
Clothes dryers	AS/NZS 2442.2-1996	AS/NZS 2442.1-1996	AHAM A197.6
Electric water heaters	AS1056.1-1991	AS1056.1-1991	
Personal computers & VDUs		US EPA tests	
Printers		US EPA tests	
Fax machines		US EPA tests	
Photocopiers		US EPA tests	
Televisions & VCRs		US EPA tests	

(a) Up to October 1999 the labelling requirements and some test procedures are in State regulations. Under the uniform regulations which all States plan to adopt in October 1999 all labelling requirements and test procedures will be in the standards listed.

(b) Also AS1359.102.2, new version AS1359.102.3 based on US IEEE method is in preparation.

Refrigerators/Freezers

Program regulation and coverage

The regulations cover refrigerators, freezers and refrigerator-freezers which are intended for household or similar use and which:

- operate using the vapour compression cycle; and
- use mains electricity (230/240 Volts at 50 Hz) as the primary power source

There are 9 specific groups of product, described in Table 3.

Table 3: Refrigerator and freezer groups, energy labelling and MEPS, Australia

Type	Group	Frozen food compartment temp (°C)(a)	Description
Refrigerator	1	Nil	Refrigerator without a low temperature compartment, automatic defrost (all refrigerator).
	2	≤–2°C	Refrigerator with or without an icemaking compartment, manual defrost
	3	≤–9°C	Refrigerator with a short or long term frozen food compartment, manual defrost
Refrigerator-freezer	4	≤–15°C	Refrigerator-freezer, fresh food compartment is automatic defrost, freezer manual defrost ("partial automatic defrost")
	5	≤–15°C	Refrigerator-freezer, both compartments automatic defrost (frost free), top or bottom mounted freezer
	5S	≤–15°C	Refrigerator-freezer, both compartments automatic defrost (frost free), side by side configuration (b)
Freezer	6C	≤–15°C	Separate chest freezer, all defrost types
	6U	≤–15°C	Separate vertical freezer, manual defrost
	7	≤–15°C	Separate vertical freezer, automatic defrost (frost free)

Source: AS/NZS 4474.1-1997 (a) Standard condition for energy test; the fresh food compartment test temperature is 3°C for Groups 1 to 5S.
(b) Groups 5 & 5S can have natural convection fresh food cooling but must be automatic defrost

Criteria and requirements

Refrigerators and freezers have to meet three groups of requirements before they can be legally sold.

1. The product must pass a "Pull Down Test" and a "Temperature Operation Test" (although the energy consumption during those tests is not measured);
2. An energy label indicating the comparative energy consumption (CEC) at a standard test condition for one year and the star rating must be registered for the product; and
3. (from October 1999) the CEC at the standard test condition must be no greater than the value determined by the MEPS formula corresponding to the product category.

The star rating for the energy label is determined in the following steps:

- Identify the product group (see Table 3);
- Calculate the Adjusted Volume (AV, litres) = Fresh food volume + (K x frozen food volume); the values of **K** for each product category are in Table 4;
- Determine the annual Comparative Energy Consumption in kWh/year (based on energy per 24 hours obtained during test - based on average of 3 units)

- The Energy Efficiency Rating and star rating are determined by the following equation;

EER = $23/3 - [\, 2 \times 1000 \times \text{CEC} \,] / [\, 3 \times 365 \times V_{adj} \,]$

Note: New rating formulae are to come into force during 2000

Table 4: Adjustment volume factors for refrigerators, Australia

Group	K
1	0
2	1.2
3	1.4
4	1.6
5	1.6
5S	1.6
6C	1.6
6U	1.6
7	1.6

Source: AS/NZS 4474.2-1997

From 1 October 1999, refrigerators, freezers and refrigerator-freezers manufactured in or imported into Australia must comply with a MEPS cut off level, determined as follows:

Maximum CEC (kWh/yr) under standard test conditioners

$$= Kf + (Kv \times V_{adj}) + Ad_{tot} + Awi \text{ (kWh/y)}$$

where:

Kf = Fixed allowance factor for that category (see Table 5);

Kv = Variable allowance factor for that category (see Table 5);

V_{adj} = Total adjusted volume (see previous formula);

Ad_{tot} = An allowance made where the number of external doors differs from the regular arrangement for that category (see AS/NZS 4474.2-1997 for details). The door allowance can be positive or negative.

Awi = An allowance of 120 kWh/y which applies where an appliance has a “through-the-door” ice or chilled water dispenser.

Table 5: Factors in MEPS formulae for refrigerators and freezers, Australia

Category	Fixed allowance factor (Kf)	Variable allowance factor (Kv)
1	368	0.892
2	300	0.728
3	330	0.800
4	424	1.020
5	424	1.256
5S	465	1.378
6C	248	0.670
6U	439	0.641
7	439	1.020

Source: AS/NZS 4474.2-1997: in effect from 1 October 1999

Testing standards and procedures

The energy consumption test and performances tests are in AS/NZS 4474.1-1997. These draw on both ISO and US AHAM tests.

In the Pull Down Test the unit is left off in an ambient temperature of 43°C with the doors open, the doors are then closed and the unit is switched on. The unit must reach the internal compartment temperatures specified for its Category after a period of 6 hours (including any compressor trips). This test is based on the US AHAM HRF-1 pull down test.

In the Temperature Operation Test the unit must be able to maintain the internal compartment temperatures specified for its Category under external ambient temperatures of 10°C, 32°C and 43°C. This test and the temperatures are identical to the ISO Temperature Operation Test, although these three test temperature conditions are more extreme than is required for any one ISO climate rating.

Energy consumption is then measured while the unit maintains the compartment target temperatures shown in Table 3 while operating at an ambient temperature of 32°C. During the energy consumption test, the freezer compartment does not contain test packages and any automatic defrost mechanism is allowed to operate (same is US DOE procedure). Energy consumption is measured over a whole number of defrost cycles and there are separate procedures for adaptive defrost systems (where time between defrosts exceeds 24 hours). There are no door openings in the test procedure. All tests are undertaken with a power supply at 240 Volts and 50 Hz.

Air conditioners

Program coverage

The energy efficiency labelling scheme covers non-ducted room air conditioners of the vapour compression type with a rated cooling capacity of less than 7.5 kW which are intended for household or similar use. It covers both window/wall and split systems but excludes multi-split systems at this stage.

Criteria and requirements

To be eligible for an energy label, air conditioners must meet an extreme temperature performance test (ISO maximum cooling test for condition T1), although the energy consumption during this test is not measured. The energy label indicates the kWh consumed over 500hrs full load operation at the unit's rated capacity, as well as the star rating. For "reverse cycle" (heat pump) units, to sets of kWh and star ratings are shown on the label. Note that the label energy value is being reduced to kW in 2000 and the EER/COP values for each star rating are also changing.

The star rating is determined from the EER and COP at full load, in accordance with Table 6.

Table 6: EER, COP & star ratings for air conditioners, Australia

Star rating	Cooling EER (W/W)	Heating COP (W/W)
1	< 2.10	< 2.30
2	2.10 - 2.29	2.30 – 2.49
3	2.30 - 2.49	2.50 – 2.69
4	2.50 - 2.69	2.70 – 2.89
5	2.70 - 2.89	2.90 – 3.09
6	> 2.89	> 3.09

Source AS/NZS 3823.2-1998: star rating scale revised for 2000

Testing standards and procedures

The energy test, described in AS/NZS 3823.1.1, is a clone of ISO 5151-1994. For energy labelling purposes, all tests must be carried out in a calorimeter (enthalpy method is not acceptable). The cooling capacity and energy consumption is determined at condition T1. Heating capacity and energy consumption is determined at condition H1 (ISO condition "high").

Large packaged air conditioners

Program coverage

The introduction of energy labelling (or mandatory disclosure of energy information in media other than labelling) and MEPS for packaged air conditioners in the cooling capacity range 7.5 to 65 kW is currently planned for March 2001. It is proposed to include both ducted and non-ducted designs.

Criteria and requirements

The MEPS criteria and labelling/information disclosure requirements are still being developed. The preliminary MEPS proposals set out in Table 7 are expressed in terms of minimum cooling EER at Test Condition T1 in AS/NZS 3823.1.1, which is modelled on ISO 5151-1994. Seasonal Energy Efficiency Ratings based on multiple tests are not being considered, but an option to test at part load is under consideration.

Table 7: MEPS proposals for large air conditioners, Australia

Cooling capacity (kW)	Minimum cooling EER (W/W)
7.6-10.0	2.25
10.1-12.5	2.30
12.6-15.5	2.35
15.6-18.0	2.40
18.1-25.0	2.45
25.1-30.0	2.50
30.1-37.5	2.55
37.6-45.0	2.60
45.6-65.0	2.65

Source: Unisearch (1998)

Test procedures

The test procedures are still being developed, but it is likely that they will be closely related to ISO 5151. It is planned to develop a computer simulation option as a supplement and in some cases a replacement for physical testing.

Electric motors

Program coverage

It is currently proposed to introduce, by 2002, the following programs for three-phase electric motors in the 0.75 to 150 kW range:

- Minimum energy performance standards set at a level which would impact on about 40% of the models on the Australian market;
- Mandatory efficiency labelling or information disclosure (which may not be in the form of a label); and
- A “high efficiency motors” endorsement label.

Criteria and requirements

The MEPS criteria and labelling/information disclosure requirements are still being developed. Separate MEPS levels have been proposed for 2, 4, 6 and 8 pole motors (Energetics 1997). The preliminary MEPS proposals are slightly less stringent than the US levels for motors above 11 kW, and considerably less stringent for smaller motors.

The efficiency level that would be required for “high efficiency” endorsement is similar to the US MEPS level.

Test procedures

The test procedures have not been finalised, but are likely to be based on AS1359.102.1 and 102.2 (which are based on IEC 34.2) with AS1359.102.3 (under development and which will be compatible with US IEEE method) as an alternative. MEPS levels to both test procedures will be provided.

Fluorescent lamp ballasts

Program coverage

It is proposed to introduce MEPS for fluorescent lamp ballasts in 2002. A voluntary efficiency label that is harmonised with the European CELMA scheme is also proposed.

Criteria and requirements

The criteria are still being developed. At present the Australian ballast market is segmented as follows:

- Standard "code" ballasts, consuming about 9.5 W in circuit with a 36W or 40W 1200mm linear tube account for most of the market;
- "Low loss" magnetic ballasts, consuming about 5.5 W in circuit with a 36W or 40W 1200mm linear tube;
- "Super low loss" magnetic ballasts, consuming about 3.5 W in circuit with a 36W or 40W 1200mm linear tube;
- Electronic ballasts, which account for only a small share of the market.

The current proposal is to set MEPS levels which would prevent the sale of any ballasts less efficient than the "low loss" type (Energetics 1997). Proposed levels are shown in Table 8.

Table 8: Proposed MEPS requirements for linear fluorescent lamp ballasts, Australia

Nominal lamp power W	ILCOS code	MEPS and B1 EEI - maximum total circuit power - watts	A3 EEI - max total circuit power - watts	A2 EEI - max total circuit power - watts
15	FD-15-E-G13-26/450	21.0	18.0	16.0
18	FD-18-E-G13-26/600	24.0	21.0	19.0
30	FD-30-E-G13-26/895	36.0	33.0	31.0
36	FD-36-E-G13-26/1200	41.0	38.0	36.0
38	FD-38-E-G13-26/1047	43.0	40.0	38.0
58	FD-58-E-G13-26/1500	64.0	59.0	55.0
70	FD-70-E-G13-26/1800	77.0	72.0	68.0

Notes: An allowance of 0.5W is added for 240V rated ferromagnetic ballasts, 1.0W for ≥250V
EEI of A1 is as per A3 above with the following additional requirements:

a) ballast shall be dimmable.
b) at 50% power input, light output shall exceed 25% of rated.
c) dimmable to 10% of rated light output.

Test procedures

The test procedures have not been finalised, but are likely to be based a new test method based on EN50294 which measure total circuit power and relative lamp power or light output using a reference lamp and reference ballast. The total circuit power is correct back to rated values. Other performance requirements are based on IEC standards.

Clothes washers

Program coverage

The labelling regulations cover drum type horizontal axis drum clothes washers (generally front-loading), vertical axis (generally top loading) and other types (eg twin-tubs) intended for domestic use.

Criteria and requirements

To qualify for an energy label, a unit must meet the following performance requirements during the energy consumption test:

- Wash performance – the soil removal from soiled swatches (type AS9) attached to a clothes load of the capacity rated for the unit must exceed 80% (also the soil removal less 2 times the standard deviation must be greater than 72%);
- Spin performance - the water extraction index (defined as the ratio of water remaining in the load after the final spin to the bone dry mass) must not exceed 1.1;
- Severity of washing - the severity of washing index must not exceed 0.35 after a single run;
- Water consumption - shall not exceed 110% of the value stated by the manufacturer;
- Water pressure - machine shall be capable of operating at the maximum and minimum water pressure stated by the manufacturer.

Energy consumption is measured on the program recommended for a normally soiled cotton load of rated capacity. The minimum wash temperature for the energy consumption test is 35°C.

The total energy consumption (E) is the sum of three elements:

1. The electrical energy consumption of the clothes washer itself;
2. The energy content of the imported hot water (if any), calculated with reference to a cold water supply temperature of 20°C. If the unit is connected only to the cold water supply, then this element is zero; and
3. An energy correction for cold water imported during a warm water operation, corrected to a reference cold water supply temperature of 20°C. If the inlet water temperature is maintained at exactly 20°C during the test, then this element is also zero.

The energy consumption indicated on the energy label (kWh/yr) = E $\times$ 365, representing one wash cycle per day.

The star rating for the label is determined by first calculating a specific energy consumption (es) in kWh/kg:

$$es = (E + Em)/m_d$$

where:

E = total energy consumption, in kWh (see above)

Em = the “energy equivalent” (ie kWh that would be used in a tumble dryer) of moisture not removed from the test load at the end of the final spin cycle

m_d = the mass of the bone dry test load (in kg)

The Energy Efficiency Rating is calculated as $6.9 \times (1 - es)$, and the star rating for the label is determined in accordance with Table 9. Note that the rating equation above has been revised for 2000.

Table 9: Correspondence between Energy Efficiency Rating and star rating, Australia

Energy Efficiency Rating	Star Rating
< 2.00	1
2.00 – 2.99	2
3.00 – 3.99	3
4.00 – 4.99	4
5.00 – 5.99	5
≥ 6.00	6

Source: AS/NZS 2040.2-1997: star rating scale revised for 2000

Test procedures

The energy test procedure is in AS/NZS 2040-1998 Part 1. The energy consumption measured under this procedure will be different from values measured under other test procedures, since the base temperature for the calculation of water energy is 20oC compared with 15oC under IEC60456. Hot water is supplied at 60oC. Dynamic water pressure is 320 kPa. All tests are undertaken with a power supply at 240V and 50 Hz.

Dishwashers

Program coverage

The labelling regulations cover electric dishwashers intended for household or similar use.

Criteria and requirements

To qualify for an energy label, a unit must meet the following performance requirements during the energy consumption test:

- Wash performance - the washing index of the test machine must exceed the specified value measured on the reference machine on the reference program which is tested in parallel. The reference machine is a dishwasher specially constructed and calibrated for this purpose (Miele G590).

- Drying performance - the drying index of the test machine must exceed 50%.
- Rated capacity - all specified load items shall be fully supported (to prevent the capacity being over-stated in order to claim a higher star rating).
- Water consumption - shall not exceed 110% of the value stated by the manufacturer.
- Water pressure - machine shall be capable of operating at the maximum and minimum water pressure stated by the manufacturer.

Energy consumption is measured on the program recommended by the manufacturer for energy labelling purposes, provided that the unit is capable of meeting the performance requirements on that program.

The total energy consumption (E) is the sum of three elements:

1. The electrical energy consumption of the dishwasher itself;
2. The energy content of the imported hot water (if any), calculated with reference to a cold water supply temperature of 20°C. If the unit is connected only to the cold water supply, then this element is zero; and
3. An energy correction for cold water imported during any hot operation, corrected to a reference cold water supply temperature of 20°C. If the inlet water temperature is maintained at 20°C during the test, then this element is also zero.

The energy consumption indicated on the energy label (kWh/yr) = E x 365, representing one wash cycle per day.

The star rating for the label is determined by first calculating a specific energy consumption (es) in kWh per place setting capacity per year.

The Energy Efficiency Rating is calculated as (es $\times$ -0.1) + 8.0, and the star rating for the label is also determined in accordance with Table 9. Note that the rating equation above has been revised for 2000.

Test procedures

The energy test procedure is in AS/NZS 2007.1-1998, which also describes the relationship between the Australian Standard and the IEC standard for dishwashers (IEC436-1981). The IEC has undertaken a major revision of dishwasher test procedures over the past few years and many of the proposed changes in the forthcoming Committee Draft (IEC SC59A) have been included in AS/NZS 2007-1998.

The ambient air temperature is $20^{o}C \pm 2^{o}C$ and the humidity is 60% ± 5%. All tests are undertaken with a power supply at 240V and 50 Hz.

Clothes dryers

Program coverage

The labelling regulations cover electric rotary clothes dryers intended for household or similar use.

Criteria and requirements

To qualify for an energy label, a unit must meet the following performance requirements during the energy consumption test:

- A timer dryer shall be capable of reaching the required final moisture content (6% of bone dry mass) for a load of rated capacity in a single timer setting.
- A dryer with automatic sensing shall have at least one program which is capable of drying to below the required final moisture content (6% of bone dry mass) for a load of rated capacity in one program setting.
- Maximum fabric temperature - when tested to the standard, the drum or fabric temperature shall not exceed 130°C under the worst conditions.
- Energy efficiency - the dryer tested energy consumption (kWh per kg of moisture removed) shall not exceed 1.36.

Although the last requirement is technically a form of MEPS, even the least efficient models on the Australian market are well below this kWh/kg level, so it has no real impact on the clothes dryer market and has not been treated as a distinct MEPS program for the purposes of this study.

The tested energy consumption Es = Ff × (Et/mr)

where:

Et = total energy consumption at end of drying cycle (kWh)

mr = mass of moisture removed from clothes (kg)

Ff = field use factor: this is set to 1.0 for autosensing dryers and 1.1 for timer/manual dryers

The Energy Efficiency Rating is calculated as 8 × (1.5 - Es), and the star rating for the label is also determined in accordance with Table 9. Note that the rating equation above has been revised for 2000.

The energy consumption indicated on the energy label (kWh/yr) = Et × 150. This is being reduced to 52 uses per year in 2000.

Test procedures

The energy test procedure is in AS/NZS 2442.1-1996. Energy consumption values determined under this standard will not be equivalent to energy determined under other test procedures due to differences in initial moisture content. This is currently set at 90% of bone dry mass (approximately 84% of normalised mass for cotton). Many of the current energy labelling registrations in Australia have been determined with an initial moisture content of 100%. Energy consumption is measured on the hottest program recommended for a cotton load of rated capacity. The ambient air temperature is 23°C ± 2°C and the humidity is 60% ± 5%. An proposal to change the ambient temperature for the test to 20°C has recently passed. All tests are undertaken with a power supply at 240 Volts and 50 Hz. The test was originally based on AHAM HLD-1 but has been modified significantly.

Electric water heaters

Program coverage

The program covers electric storage water heaters of the unvented (displacement) type, without an attached feed tank, with a hot water delivery of between 25 and 630 litres. (The "delivery" is the volume of hot water that can be drawn off before a 12^{o}C temperature drop occurs, so is somewhat less than the absolute storage volume). Heat exchanger models are not included.

Criteria and requirements

From 1 October 1999, electric storage water heaters manufactured in or imported into Australia will have to comply with the maximum standing heat losses are set out in Table 10.

Table 10: Maximum standing heat losses, electric storage water heaters, Australia

Hot Water Delivery (litres)	Maximum Allowable Standing Heat Loss (kWh/day)
25	1.4
31.5	1.5
40	1.6
50	1.7
63	1.9
80	1.47
100	1.61
125	1.75
160	1.96
200	2.17
250	2.38
315	2.66
400	2.87
500	3.15
630	3.43

Source: AS1056.1-1991 Amendment 3

Test procedures

The test procedure is set out in Appendix B of AS1056.1-1991. Unlike most other appliance standards, this applies to Australia only. New Zealand has a separate standard for storage water heaters (NZS 4606.1) which specifies different allowable heat losses.

The standing heat loss is measured at a nominal 20^{o}C ambient air temperature and a water storage temperature of 75^{o}C (for most tanks), giving a ambient air/hot water ΔT of 55°C. The test measures the energy consumed over a number of complete thermostat cycles, and this is normalised to a heat loss per 24 hour period. No hot water is drawn off during the test (ie it is a static standing heat loss test).

IEC60379 for water heaters uses a ΔT of 45°C, so European heat loss values will appear to be lower than those measured in Australia. The US Department of Energy MEPS are defined in terms of "Energy Factors", which are task based with 6 drawoffs of 40.6 litres (total 243.4 litres) per at a ΔT of 37.5°C. These test results are not directly comparable with the AS1056 standing heat loss test results.

Office equipment and home electronics

Program coverage

One of the State energy agencies, the Sustainable Energy Development Authority of NSW, has made arrangements with the US EPA to promote the Energy Star endorsement label for personal computers (PCs), visual display units (VDUs), printers, plain paper fax machines and photocopiers. It is considering extending its program coverage to televisions and video cassette recorders (VCRs).

Criteria and requirements

All products which comply with the power management requirements specified for that product category by the US EPA Energy Star program are entitled to carry the Energy Star label.

Test procedures

The test procedures are as specified by the US EPA. The voltage and frequency differences are covered in the US EPA procedure, which states that:

> "If products will be sold in Europe or Asia, testing should also be performed at the appropriate machine-rated voltage and frequency. For example, products destined for the European markets might be tested at 230V and 50 Hz." (US EPA 1996)

2.3 Brunei Darussalam

2.3.1 Overview of the Regulatory Framework

Brunei Darussalam has not implemented any energy efficiency standards or regulations. However, the Department of Electrical Services indicated that Brunei Darussalam is interested in learning about energy efficiency regulations, programs, and testing procedures and that such information would be very useful in their deliberations.

2.3.2 Summary of Regulated Products

No energy regulations have been imposed on electrical products in Brunei Darussalam.

2.4 Canada

2.4.1 Regulatory and Administrative Framework

Minimum Energy Performance Standards

The *Energy Efficiency Act* passed in 1992 provides for the making and enforcement of regulations concerning minimum energy performance standards (MEPS) for energy-using products, as well as the labelling of energy-using products and the collection of data. The first Regulations under the Act came into affect in 1995, following extensive consultations with the provincial governments, affected industries, utilities, environmental groups and others. (Labelling had commenced in 1978 under earlier legislation – see below). The Regulations established MEPS for a wide range of energy-using products, with the objective of eliminating the least energy-efficient models from the Canadian market.

The Regulations apply to dealers (manufacturers or importers) who import regulated products into Canada or ship them from one Canadian province to another. The Federal Regulations do not apply to products that are manufactured and sold within the one Province. However, most provinces have their own energy efficiency regulations, which may differ from the Federal Regulations or may apply to other classes of equipment. The Federal Regulations do not take precedence over provincial regulations for locally made and sold products.

Table 11 summarises the products covered by the Federal Energy Efficiency Regulations, which are administered by Natural Resources Canada (NRCan). It also indicates those products for which there are separate provincial regulations. Table 12 indicates the products for which MEPS regulations are in place or under consideration in one or more provinces, but which are not presently covered by the Federal Regulations.

For the products covered in the Federal Regulations, the MEPS levels apply equally where the products are incorporated into other products (eg where fluorescent lamps and ballasts are sold as part of a complete luminaire). Exports and products which are shipped between provinces only in order to be exported from Canada are exempt from the Federal Regulations.

All regulated energy-using products imported into Canada or shipped between provinces must carry an energy efficiency verification mark from a certification organisation accredited by the Standards Council of Canada. The mark, which must be placed on the outside of the product, indicates that the energy performance of the product has been verified.

Before importing products or shipping them between provinces, dealers must ensure than an energy efficiency report for that product has been filed with NRCan. The data in the report are used to verify compliance with MEPS, and also to develop energy labels and directories of labelled products (see below).

Energy Labelling and Information

The Canadian EnerGuide labelling program commenced in 1978, making it the oldest such program in the world. The products for which the Energy Efficiency Regulations mandate EnerGuide labelling are indicated in . A dealer who imports one of these products or ships it from one province to another must ensure that it is properly labelled, and that the label remains on the product until it is sold at the retail level or leased.

The label shows the energy consumption in kWh/month (for air conditioners the label indicates the EER) derived from the standard tests. It also shows:

- a bar scale comparing the model's energy consumption (or EER) to other models on the market that are in the same product group;
- the energy consumption (or EER) of the most and least energy efficient models on the market that are in the same product group;
- the product group type and size category (cooling capacity category in the case of air conditioners) and
- the model number.

The Energy Efficiency Regulations specify the exact format, size, shape and colour of the EnerGuide label and how it is to be placed on the product.

Information on all labelled appliances is collected in two EnerGuide directories, one for appliances and one for air conditioners. The EnerGuide program also has extensive support through Internet sites and retailer liaison and training programs.

2.4.2 Summary of Products Covered

This section describes in detail the categories and MEPS criteria for all products covered by the Federal program. For products covered only by provincial MEPS programs (see Table 12), the test procedure references are given in Table 14 but not the product categories covered or the MEPS levels, which may differ from province to province.

Table 11: Federal Energy Efficiency Programs in Canada

	Program Type				
Product Description	**A. Comparison label**	**B. Endorsement label**	**C. Federal MEPS**	**D. Industry target**	**E. Other (a)**
Refrigerators and/or Refrigerator-freezers	M (1978)		M(1995)		O,BC,Q,NSNB
Separate freezer	M (1978)		M(1995)		O,BC,Q,NSNB
Room air conditioners	M (1978)		M(1995)		O,BC,Q,NS,NB
Packaged terminal air conditioners and heat pumps			M(1998)		O,BC
Large Air conditioners, heat pumps and condensing units			M(1998)		O,BC,NS, NB
Internal water-loop heat pumps			M(1995)		O,BC,NS, NB
Single-packaged central air conditioners and heat pumps	V (1998)		M(1998)		O,BC
Split-system central air conditioners and heat pumps	V (1998)		M(1998)		O,BC
Ground- or water-source heat pumps			M(1995)		O,BC,Q,NS,NB
Electric motors			M(1997)		O,BC,Q,NS,NB
Incandescent reflector lamps			M(1996)		O,BC
Fluorescent Lamps			M(1996)		O
Fluorescent Lamp ballasts			M(1995)		O,BC,Q,NS,NB
Clothes washers	M		M(1995)		O,BC,Q,NS,NB
Integrated washer-dryers	M		M(1995)		O,BC,Q,NS,NB
Dishwashers	M		M(1995)		O,BC,Q,NS,NB
Clothes dryers	M		M(1995)		O,BC,Q,NS,NB
Electric ranges	M		M(1995)		O,BC,Q,NS,NB
Electric water heaters			M(1995)		O,BC,Q,NS,NB
Automatic icemakers			M(1998)		O,BC
Dehumidifiers			M(1998)		O,BC
Transformers			UC(1999)		O,NB

Sources: NRCan (1999) (a) Existing standards programs in one or more Provinces, in addition to Federal program: provinces where additional programs are under consideration are not indicated. (O=Ontario, BC=British Columbia, Q=Quebec, NS=Nova Scotia, NB=New Brunswick)

Table 12: Province-only MEPS, Canada

	Province (a)				
Product Description	**Ontario**	**British Columbia**	**Quebec**	**Nova Scotia**	**New Brunswick**
Chillers	M(1999)	M(1998)			UC(1999)
Cobra-head type luminaires	M(1999)	M(1996)			UC(1999)
Compact fluorescent lamps	M(1996)	M(1996)			UC(1999)
Direct expansion GSHP	M(1993)	M(1995)			UC(1999)
Dusk-to-dawn area luminaires	M(1999)	M(1996)			UC(1999)
Electric water heaters (>120 US Gallons)	M(1999)	M(1996)			UC(1999)
Refrigerated display cabinets					UC(1999)
Transformers(b)	M(1999)				UC(1999)

Sources: NRCan (1999) (a) Standards programs in one or more Provinces, but no Federal program (b)Federal program under consideration

Table 13: Federal energy test procedures, Canada

Product Description	Test Procedures	Reference Test procedures
Refrigerators and/or Refrigerator-freezers	CSA C300-M91	Similar to US DOE
Separate freezer	CSA C300-M91	Similar to US DOE
Room air conditioners	CSA 368.1-M90	ASHRAE 90-1-1989
Packaged terminal air conditioners and heat pumps	CSA C744-93	Jointly published as ARI 310/380-93
Large Air conditioners, heat pumps and condensing units	CSA C746-98	
Internal water-loop heat pumps	CSA C655-M91	
Single-packaged central air conditioners and heat pumps	CSA C656-M92	ARI 210/240-89 ASHRAE 37-1988
Split-system central air conditioners and heat pumps	CSA C273.3-M91	
Ground or water-source heat pumps	CSA C446-94	
Electric motors	CSA C390-93	Similar to US DOE
Incandescent reflector lamps	CSA C862-95	Similar to US DOE
Fluorescent Lamps	CSA C819-95	ANSI C78.1,78.3, C78.385, CIE 13.3, IES LM9,LM16,LM58
Fluorescent Lamp ballasts	CSA C654-M91	Similar to US DOE
Clothes washers	CSA C360-98	Similar to US DOE
Integrated washer-dryers	CSA C361-92, CSA C360-98	
Dishwashers	CSA C373-92	Similar to US DOE
Clothes dryers	CSA C361-92	Similar to US DOE
Electric ranges	CSA-C358-95	
Electric water heaters	CSA C191.1-M90 CSA C745-95	
Automatic icemakers	CSA C742-98	
Dehumidifiers	CSA C749-94	

Table 14: Province-only energy test procedures, Canada

Product Description	Test Procedures
Chillers	CSA C743-93
Cobra-head type luminaires	CSA C653-94
Compact fluorescent lamps	CSA C861-95
Direct expansion GSHP	CSA C748-94
Dusk-to-dawn area luminaires	CSA C239-94
Electric water heaters (>120 US Gallons)	CSA C745-95
Refrigerated display cabinets	CSA C657-95
Transformers(b)	CSA C802-94

Refrigerators/Freezers

Program regulation and coverage

The Regulations cover household refrigerators or refrigerator-freezers with a capacity of not more than 1100 L (39 cu ft), and freezers with a capacity of not more than 850 L (30 cu ft). The product categories, shown in Table 15, are completely aligned with the US program (except that there are no "compact" product categories).

Table 15: Refrigerator and freezer categories, Canada

Product Class	Description	Maximum annual energy consumption (kWh/yr)
1	Refrigerators and refrigerator-freezers with manual defrost	13.5 AV + 299
2	Refrigerator-freezers with partial automatic defrost	10.4 AV + 398
3	Refrigerator-freezers with automatic defrost with top-mounted freezer, no through-the-door ice service; and all refrigerators with automatic defrost	16.0 AV + 355
4	Refrigerator-freezers with automatic defrost with side-mounted freezer, no through-the-door ice service	11.8 AV + 501
5	Refrigerator-freezers with automatic defrost with bottom-mounted freezer, no through-the-door ice service	16.5 AV + 367
6	Refrigerator-freezers with automatic defrost with top-mounted freezer, and with through-the-door ice service	17.6 AV + 391
7	Refrigerator-freezers with automatic defrost with side-mounted freezer, with through-the-door ice service	16.3 AV + 527
[8](a)	Upright freezers with manual defrost	10.3 AV + 264
[9](a)	Upright freezers with automatic defrost	14.9 AV + 391
[10](a)	Chest freezers and all other freezers	11.0 AV + 160

Source: NRCan (1999) AV=Adjusted volume in cubic feet. (a) Not given a product number in Canadian regulations; this is the corresponding class number in US regulations.

Criteria and requirements

The MEPS criteria, adopted in February 1995, are identical with those which became effective in the US in January 1993. It is not known whether or when Canada proposes to adopt the next round of US MEPS for these products, which are due to take effect in July 2001 in the USA. MEPS levels for each product class are defined in terms of adjusted volume.

AV (Adjusted volume, cu ft) = Volume of fresh food compartment (cu ft) + (K × volume of freezer compartment (cu ft)).

The values of K are:

- 1.0 for a refrigerator without a freezing compartment;
- 1.44 for a single-door refrigerator with an internal freezing compartment
- 1.63 for a combination refrigerator-freezers
- 1.73 for a freezer.

Testing standards and procedures

The test procedure is in CAN/CSA-C300-M91. It is essentially harmonised with US 10 CFR Part 430. The test is carried out at an ambient temperature is 32.3°C (90°F) with the doors closed and with the following target internal temperatures:

- 3.3°C (38°F) in the fresh food compartment of a refrigerator
- ≤ 7.22°C (45°F) in the fresh food compartment of a refrigerator-freezer;
- -9.4°C (15°F) in the freezer compartment for a refrigerator (Product Class 1);
- -15.0°C (5°F) in the freezer compartment for a refrigerator-freezer (Class 2 to 7);
- -17.8°C (0°F) for a separate freezer.

Room air conditioners

Program regulation and coverage

The Regulations cover single-phase air conditioners that are not "packaged terminal air conditioners" (see later), with a cooling capacity up to 10.55 kW (36,000 BTU/hr). Products with and without louvred sides are defined as distinct categories.

Criteria and requirements

The MEPS requirements for air conditioners, summarised in Table 16, were adopted in February 1995. They are identical with those which became effective in the US in January 1990. It is not known whether or when Canada proposes to adopt the next round of US MEPS for these products, which are due to take effect in October 2000.

Table 16: MEPS levels for air conditioners, Canada

	Cooling capacity range	Minimum EER (BTU/Wh)	Minimum EER (W/W)(a)
Units with louvred sides	Less than 6,001 BTU/hr (1.76 kW)	8.0	2.34
	6,001 – 7,999 BTU/hr (1.76-2.34 kW)	8.5	2.49
	8,000 – 13,999 BTU/hr (1.76-4.10 kW)	9.0	2.64
	14,000 – 19,999 BTU/hr (4.10-5.86)	8.8	2.58
	20,000 – 36,000 BTU/hr (4.10-10.55 kW)	8.2	2.40
Units without louvred sides	Less than 5,999 BTU/hr (1.76 kW)	8.0	2.34
	6,000 – 19,999 BTU/hr (1.76-5.86 kW)	8.5	2.49
	20,000 – 36,000 BTU/hr (5.86-10.55 kW)	8.2	2.40

Source: NRCan (1999) (a) MEPS levels specified in terms of Btu/Wh: Metric given for information.

Testing standards and procedures

The test procedure is in CAN/CSA-C368.1-M90. It is based on ASHRAE standard 90-1-1989, which is also used in the USA.

Packaged terminal air conditioners and heat pumps

Program regulation and coverage

The Regulations cover factory-assembled packaged terminal air conditioners and heat pumps intended for use in residential, commercial and industrial heating and cooling systems.

Criteria and requirements

The MEPS requirements summarised in Table 17 became mandatory at the end of 1998.

Table 17: MEPS for packaged terminal air conditioners and heat pumps, Canada

Product Class	Minimum EER (BTU/Wh)	Minimum COP (W/W)
Cooling	9.115 – 0.0000638 x CAPc	
Heating		2.75-0.00001 x CAPh

Source: NRCan (1999) CAPc = sensible and latent cooling capacity in BTU/hr
CAPh = heating capacity in BTU/hr

Testing standards and procedures

The test procedure is in CAN/CSA-C744-93, which is identical to ARI-310/380-93.

Large air conditioners, heat pumps and condensing units

Program regulation and coverage

The Regulations cover factory-assembled commercial and industrial unitary air conditioners, heat pumps and air-conditioning condensing units with a cooling capacity of between 19 kW (65,000 BTU/hr) and 73 kW (250,000 BTU/hr).

Criteria and requirements

The MEPS requirements summarised in Table 18 became mandatory at the end of 1998.

Table 18: MEPS for large air conditioners, heat pumps and condensing units, Canada

ARI(a) Type classification	Cooling capacity range, kW (BTU/hr)	EER	COP at 8.3°C	COP at -8.3°c	IPLV (b)
SP-A, RC-A	>19≤40 (65,000-135,000)	8.9			8.3
	>40<73 (135,000-250,000)	8.5			7.5
RCU-A-C	>19≤40 (65,000-135,000)	8.9			8.3
SPY-A, RCY-A	>19≤40 (65,000-135,000)	8.9			8.3
	>40<73 (135,000-250,000)	8.3			7.5
RCU-A-CB, RCUY-A-CB	>19≤40 (65,000-135,000)	8.9			8.3
	>40<73 (135,000-250,000)	8.3			7.5
SP-E, SP-W, RC-E, RC-W	>19≤40 (65,000-135,000)	10.5			9.7
	>40<73 (135,000-250,000)	9.6			9.0
SPY-E,SPY-W,RCY-E,RCY-W	>19≤40 (65,000-135,000)	10.5			9.7
	>40<73 (135,000-250,000)	9.6			9.0
RCU-E-C,RCU-W-C	>19≤40 (65,000-135,000)	10.5			9.7
RCU-E-CB,RCU-W-CB, RCUY-E-CB,RCUY-W-CB	>40<73 (135,000-250,000)	9.6			9.0
HSP-A	>19≤40 (65,000-135,000)	8.9	3.0	2.0	8.3
	>40<73 (135,000-250,000)	8.5	2.9	2.0	7.5
HRC-A-C,HRCU-A-C,HRC-A-CB	>19≤40 (65,000-135,000)	8.9	3.0	2.0	8.3
HRCU-A-CB	>19≤40 (65,000-135,000)	8.9	3.0	2.0	8.3
	>40<73 (135,000-250,000)	8.3	2.9	2.0	7.5.
RCU-E,RCU-W	>40<73 (135,000-250,000)	12.9			12.9
RCU-A	>40<73 (135,000-250,000)	9.9			11.0

Source: NRCan (1999) (a) Air-Conditioning and Refrigeration Institute. (b) Integrated Part Load Value: a single number “figure of merit” which represents part-load efficiency. Its calculation for each product type is described in the test standard.

Testing standards and procedures

The test procedure is in CAN/CSA-C746-98.

Internal water-loop heat pumps

Program regulation and coverage

The Regulations cover water-source heat pumps that are factory-built single packages or split-system matching assemblies that are intended for installation in internal water-loop systems and which do not exceed 40 kW (135,000 BTU/hr) in cooling or heating capacity.

Criteria and requirements

The MEPS levels summarised in Table 19 became mandatory in February 1998.

Table 19: MEPS levels for internal water-loop heat pumps, Canada

Product Class/Function	Minimum EER (BTU/Wh)	Minimum COP (W/W)
Cooling	10.0	2.9 (a)
Heating		3.8 (b)

Source: NRCan (1999) (a) Cooling MEPS is expressed in BTU/WH; COP value is calculated for information only. (b) Excludes any supplementary heat.

Testing standards and procedures

The test procedure is in CAN/CSA-C655-M91.

Single-packaged central air conditioners and heat pumps

Program regulation and coverage

The MEPS Regulations cover factory-assembled single-phase and three-phase single-package central air conditioners and heat pumps (air-sink and air-source only) with a rated cooling capacity of less than 19 kW (65,000 BTU/hr). There has also been a voluntary energy labelling program for these air conditioner types since December 1998 which includes both single and three phase units.

Criteria and requirements

The MEPS levels summarised in Table 20 became mandatory in February 1995 for single-phase units, and at the end if 1998 for three-phase units. The cooling SEER is the same as that adopted in the US in January 1993. The heating HSPF is less stringent than the US MEPS level.

Table 20: MEPS for single-package central air conditioners and heat pumps, Canada

Product Class/Function		Minimum SEER (a) (BTU/Wh)	Minimum HSPF (b) (BTU/Wh)
Air conditioners		9.7	
Heat pumps	Cooling mode	9.7	
	Heating mode (Region V)		5.7

Source: NRCan (1999) (a) SEER = Seasonal Energy Efficiency Ratio: total cooling output in BTU during nominal annual usage period for cooling divided by electric power input in Wh over the same period. (b) HSPF = Heating Seasonal Performance Factor: total heating output in BTU during nominal annual usage period for heating divided by electric power input in Wh over the same period.

Testing standards and procedures

The test procedure is in CAN/CSA-C656-M92, based on ARI 210/240-89 and ASHRAE 37-1988. US DOE climate region V is used to determine HSPF.

Split-system central air conditioners and heat pumps

Program regulation and coverage

The MEPS Regulations cover factory-assembled single-phase and three-phase split-system central air conditioners and heat pumps (air-sink and air-source only) with a rated cooling capacity of less than 19 kW (65,000 BTU/hr). There has also been a voluntary energy labelling program for these air conditioner types since December 1998 which includes both single and three phase units.

Criteria and requirements

The MEPS levels summarised in Table 21 became mandatory in February 1995 for single-phase units, and at the end of 1998 for three-phase units. The cooling SEER is the same as that adopted in the US in January 1992. The heating HSPF is less stringent than the US MEPS level.

Table 21: MEPS levels for single- and three-phase split-system central air conditioners and heat pumps, Canada

Product Class/Function		Minimum SEER (a) (BTU/Wh)	Minimum HSPF (b) (BTU/Wh)
Air conditioners		10.0	
Heat pumps	Cooling mode	10.0	
	Heating mode (Region V)		5.9

Source: NRCan (1999) (a) SEER = Seasonal Energy Efficiency Ratio: total cooling output in BTU during nominal annual usage period for cooling divided by electric power input in Wh over the same period. (b) HSPF = Heating Seasonal Performance Factor: total heating output in BTU during nominal annual usage period for heating divided by electric power input in Wh over the same period.

Testing standards and procedures

The test procedure is in CAN/CSA-C273.3-M91. North American climate region V is used to determine HSPF.

Ground- or water-source heat pumps

Program regulation and coverage

The Regulations cover factory-built ground- or water-source heat pumps intended for use in open- or closed-loop ground- or water-source systems. They may be single packages or split-systems matching assemblies rated at a capacity of less than 35 kW (120,000 BTU/hr).

Criteria and requirements

The MEPS levels summarised in Table 22 became mandatory in February 1995.

Table 22: Energy efficiency levels for ground- or water-source heat pumps, Canada

Product Class/Function		Minimum EER (BTU/Wh)	Minimum EER (W/W)
Cooling	All units (10°C)	11.0	3.2(a)
	Closed loop (25°C)	10.5	3.1(a)
Heating	All units (10°C)	NA	3.0(b)
	Closed loop (0°C)	NA	2.5(b)

Source: NRCan (1999) (a) Both units actually given in Regulations (b) Excludes supplementary heat.

Testing standards and procedures

The test procedure is in CAN/CSA-C446-94.

Electric motors

Program regulation and coverage

The Regulations cover continuous-duty single speed motors in the range 1 to 200 HP or 0.746 to 150 kW. There are separate specifications for motors that conform with National Electrical Manufacturers Association (NEMA) requirements, and those which conform with International Electrotechnical Commission (IEC) requirements, although the most significant difference is that motor sizes are expressed in HP in the former and kW in the latter. The requirements relating to NEMA motors are identical with the definitions of “electric motor” in the US Energy Policy Act of 1992. However, the Canadian program covers some motor types not regulated in the USA.

Criteria and requirements

Different minimum nominal full-load efficiency levels are specified for 2, 4 and 6 pole motors and for enclosed and open designs. The levels in Table 23 and Table 24 took effect in November 1997. The compliance date for explosion-proof motors and motors contained within an integral gear assembly is November 1999. The levels in Table 23 are identical with those which took effect in the US in October 1997.

Table 23: Minimum nominal energy efficiency standards for NEMA motors, Canada

Power	Open			Enclosed		
HP	2-Pole	4-Pole	6-Pole	2-Pole	4-Pole	6-Pole
1	75.5	82.5	80.0	75.5	82.5	80.0
1.5	82.5	84.0	84.0	82.5	84.0	85.5
2	84.0	84.0	85.5	84.0	84.0	86.5
3	84.0	86.5	86.5	85.5	87.5	87.5
5	85.5	87.5	87.5	87.5	87.5	87.5
7.5	87.5	88.5	88.5	88.5	89.5	89.5
10	88.5	89.5	90.2	89.5	89.5	89.5
15	89.5	91.0	90.2	90.2	91.0	90.2
20	90.2	91.0	91.0	90.2	91.0	90.2
25	91.0	91.7	91.7	91.0	92.4	91.7
30	91.0	92.4	92.4	91.0	92.4	91.7
40	91.7	93.0	93.0	91.7	93.0	93.0
50	92.4	93.0	93.0	92.4	93.0	93.0
60	93.0	93.6	93.6	93.0	93.6	93.6
75	93.0	94.1	93.6	93.0	94.1	93.6
100	93.0	94.1	94.1	93.6	94.5	94.1
125	93.6	94.5	94.1	94.5	95.0	95.0
150	93.6	95.0	94.5	94.5	95.0	95.0
175	94.5	95.0	94.5	95.0	95.0	95.0
200	94.5	95.0	94.5	95.0	95.0	95.0

Source: NRCan (1999)

Table 24: Minimum nominal energy efficiency standards for IEC motors, Canada

Power	Open			Enclosed		
kW	2-Pole	4-Pole	6-Pole	2-Pole	4-Pole	6-Pole
0.75	75.5	82.5	80.0	75.5	82.5	80.0
1.1	82.5	84.0	84.0	82.5	84.0	85.5
1.5	84.0	84.0	85.5	84.0	84.0	86.5
2.2	84.0	86.5	86.5	85.5	87.5	87.5
3.0	84.0	86.5	86.5	85.5	87.5	87.5
3.7	85.5	87.5	87.5	87.5	87.5	87.5
4.0	85.5	87.5	87.5	87.5	87.5	87.5
5.5	87.5	88.5	88.5	88.5	89.5	89.5
7.5	88.5	89.5	90.2	89.5	89.5	89.5
11	89.5	91.0	90.2	90.2	91.0	90.2
15	90.2	91.0	91.0	90.2	91.0	90.2
18.5	91.0	91.7	91.7	91.0	92.4	91.7
22	91.0	92.4	92.4	91.0	92.4	91.7
30	91.7	93.0	93.0	91.7	93.0	93.0
37	92.4	93.0	93.0	92.4	93.0	93.0
45	93.0	93.6	93.6	93.0	93.6	93.6
55	93.0	94.1	93.6	93.0	94.1	93.6
75	93.0	94.1	94.1	93.6	94.5	94.1
90	93.6	94.5	94.1	94.5	95.0	95.0
110	93.6	95.0	94.5	94.5	95.0	95.0
132	94.5	95.0	94.5	95.0	95.0	95.0
150	94.5	95.0	94.5	95.0	95.0	95.0

Source: NRCan (1999)

Testing standards and procedures

The test procedure is in CAN/CSA-C390-93. This is based on IEEE Method B.

Incandescent reflector lamps

Program regulation and coverage

The Regulations apply to general service incandescent reflector lamps:

- with an R bulb shape, a PAR bulb shape similar to R or PAR that is neither ER nor BR, as described in ANSI C79.1;
- with an E26 medium-screw base;

- with a nominal voltage or voltage range that lies at least partially between 100 volts and 150 volts;
- with a diameter greater than 70 mm (2.75 inches); and
- that has a nominal power of not less than 40W and not more than 205 W.

The Regulations do *not* apply to coloured, vibration- or impact-resistant lamps or certain other special purpose lamps.

Criteria and requirements

The minimum efficacy levels specified in Table 25 took effect on 1 April 1996.

Table 25: Energy efficiency standards, general service incandescent lamps, Canada

Rated lamp wattage	Minimum average lamp efficacy (lumens/W)
40 – 50	10.5
51 – 66	11.0
67 – 85	12.5
86 – 115	14.0
116 – 155	14.5
156 – 205	15.0

Source: NRCan (1999)

Testing standards and procedures

The test procedure is in CAN/CSA-C862-95. It is essentially the same as US DOE requirements.

Fluorescent lamps

Program regulation and coverage

The Regulations apply to the four main categories of general service fluorescent lamps described in Table 26 and excludes coloured, cold-temperature, reprographic and certain other special purpose lamps.

Criteria and requirements

The minimum efficacy levels specified in Table 26 took effect on 1 February1996. They are identical to the minimum requirements for the same product classes which took effect in the US in 1994 and 1995.

Table 26: Energy efficiency standards, general service fluorescent lamps, Canada

Lamp type	Nominal lamp wattage	Minimum average CRI (a)	Minimum average lamp efficacy (lumens/W)
1200 mm (48 in) straight, medium bi-pin base, rapid-start, nominal power >=28W	>35 W	69	75.0
	≤ 35 W	45	75.0
560–635 mm (22–25 in) U-shaped, recessed double-contact base nominal power >=28W	>35 W	69	68.0
	≤ 35 W	45	64.0
2400 mm (96 in) straight, recessed double-contact base, rapid start, high output nominal power >=95W	>100 W	69	80.0
	≤ 100 W	45	80.0
2400 mm (96 in) straight, single pin base, instant start, high output nominal power >=52W	>65 W	69	80.0
	≤ 65 W	45	80.0

Source: NRCan (1999) (a) CRI = Colour Rendering Index

Testing standards and procedures

The test procedures are in CSA C819-95, referring to American National Standards Institute (ANSI) standards ANSI C78.1, 78.3, C78.385, International Commission in Illumination (CIE) standard CIE 13.3, and Illuminating Engineering Society of North America (IES) standards IES LM9, LM16 and LM58.

Fluorescent lamp ballasts

Program regulation and coverage

The Regulations cover lamp ballasts for design voltages of 120, 277 and 347 V, and intended to operate with the lamp types listed in Table 27.

Criteria and requirements

The minimum efficiency standards in Table 27 are expressed in terms of ballast efficacy factors. The ballast efficacy factor (BEF) is determined as the ratio of the relative light output of the test ballast/reference lamp combination (in comparison with the reference lamp/ballast system) divided by the total system power. The relative light output is defined as the ratio of the light output of the test system to the light output of the reference system (expressed as 100 when they are equal).

The higher the BEF ratio, the higher the efficiency of the ballast under test. The standards in Table 27, which took effect in February 1995, are similar to the US standards for the same products, which took effect in 1990 (the US standards cover only 120V and 277V ballasts, but not 347V systems).

Table 27: Energy efficiency standards, fluorescent lamp ballasts, Canada

Application for operation of:	Ballast input voltage	Total nominal lamp watts (a)	Minimum ballast efficacy factor
One F40T12 lamp (also 34W/48T12/RS and 40W/48T10/RS lamps)	120 V	40 W	1.805
	227 V	40 W	1.805
	347 V	40 W	1.750
Two F40T12 lamps (also 34W/48T12/RS and 40W/48T10/RS lamps)	120 V	80 W	1.060
	227 V	80 W	1.050
	347 V	80 W	1.020
Two F96T12 lamps (also 60W/96T12/IS)	120 V	150 W	0.570
	227 V	150 W	0.570
	347 V	150 W	0.560
Two 110W F96T12HO lamps (also 95W/96T12/HO lamps)	120 V	226 W	0.390
	227 V	226 W	0.390
	347 V	226 W	0.380
Two F32T8 lamps	120 V	64 W	1.250
	227 V	64 W	1.250
	347 V	64 W	1.250

Source: NRCan (1990)

Testing standards and procedures

The test standard is CAN/CSA-C654-M91

Clothes washers and dryers

Program regulation and coverage

The Regulations cover:

- standard (≥ 45 L) or compact (<45 L) electrically operated household automatic clothes washers that are top- or front-loaded (but excluding wringer washers, twin-tub washers and spinners).
- standard (≥ 125 L) and compact (<125 L) electrically operated and electrically heated household tumble-type clothes dryers;
- integrated over/under washer-dryers, where the clothes dryer is located either above or below the clothes washer. The appliances have only one power source and controls on either the washer or dryer.

Both compliance with MEPS and EnerGuide labelling is required.

Criteria and requirements

The minimum "energy factors" (EF) for clothes washers are expressed in litres capacity/kWh per cycle. The criteria, shown in Table 28 took effect in May 1995. The minimum EF for clothes dryers are expressed in kg load capacity/kWh per cycle. The criteria, shown in Table 29 took effect in May 1995 for standard dryers and the end of 1998 for compact dryers. The Canadian washer and dryer standards are identical to the US standards which took effect in May 1994.

The minimum energy factors for the washer and dryer components of integrated washer-dyers, which also came into affect in May 1995, are identical with those for separate clothes washers and for standard dryers. (There are no specified minimum energy factors for compact dryers if part of an integrated washer-dryer).

Table 28: Minimum energy standards for clothes washers, Canada

Product Class	**Minimum EF**	
	L/kWh/cycle	cu ft/kWh/cycle
Compact (< 45 L capacity)	25.48	0.90
Standard (≥ 45 L capacity)	33.41	1.18

Source: NRCan (1999)

Table 29: Minimum energy standards for clothes dryers, Canada

Product Class		**Minimum EF**	
		kg/kWh	lbw/kWh
Compact (< 125 L capacity)	120 V	1.42	3.13
	240 V	1.31	2.90
Standard (≥ 125 L capacity)		1.36	3.01

Source: NRCan (1999)

The EnerGuide labels for clothes washers and dryers indicate the kWh used for 416 cycles per year.

Testing standards and procedures

The clothes washer tests are in CAN/CSA-C360-98, and the clothes dryer tests are in CAN/CSA-C361-92. These are essentially identical to the US 10CFR Part 430 requirements, although the US are proposing a number of changes in the future (with the next round of MEPS).

Dishwashers

Program regulation and coverage

The Regulations cover electrically operated automatic household dishwashers that are not commercial, industrial or institutional machines.

Criteria and requirements

The minimum energy factor (EF) requirements, expressed in cycles/kWh, are shown in Table 30. They took effect in February 1995, and are identical with the US dishwasher standards that took effect in May 1994.

Table 30: Minimum energy standards for dishwashers, Canada

Product Class	**Minimum EF (cycles/kWh)**
Compact (exterior width < 56 cm/22 in	0.62
Standard (exterior width ≥ 56 cm/22 in	0.46

Source: NRCan (1999)

The EnerGuide labels for dishwasher indicates the kWh used for 322 cycles per year.

Testing standards and procedures

The dishwasher tests are in CAN/CSA-C373-92. These are essentially identical to the US 10CFR Part 430 requirements.

Electric ranges

Program regulation and coverage

The Regulations cover:

- free-standing appliances equipped with one or more surface elements and one or more ovens;
- built-in appliances equipped with one or more surface elements and one or more ovens;
- wall-mounted appliances equipped with one or more ovens and no surface elements; and
- counter-mounted appliances equipped with one or surface elements and no ovens.

Microwave cooking appliances, appliances designed for 120V and appliances with one or more tungsten-halogen heating element are excluded.

Criteria and requirements

The minimum efficiency criteria (expressed as maximum kWh/month), which took effect in February 1995, are indicated in Table 31.

Table 31: Maximum energy use standards for electric ranges, Canada

Product Class	Maximum allowable energy consumption (kWh/month)
Free-standing or built-in appliances with one or more surface elements and one or more ovens	0.93V + 14.3
Wall-mounted appliances equipped with one or more ovens and no surface elements	38
Counter-mounted appliances with one or more conventional (ie not modular) surface elements and no ovens.	34
Counter-mounted appliances with one or more modular surface elements and no ovens (a)	43

Source: NRCan (1999) (a) Interchangeable surface elements that may be plugged into a receptacle on the range cooktop.

The EnerGuide labels for ranges indicates the kWh used annually.

Testing standards and procedures

The electric range tests are in CAN/CSA-C358-95.

Electric water heaters

Program regulation and coverage

The Regulations cover stationary electrically heated storage tank water heaters with a capacity of not less than 50 litres (11 imperial gallons) and not more than 450 litres (100 imperial gallons) that are intended for use on a pressure system.

Criteria and requirements

The maximum standing heat loss criteria, which took effect in February 1995, are indicated in Table 32.

Table 32: Maximum heat loss standards for electric storage water heaters, Canada

Product Class	Maximum allowable standby loss (W)
50 to 270 litres	61 + 0.20 x V
271 to 450 litres	$0.472 \times V - 12.5$

Source : NRCan (1999) V = volume of storage tank in litres

Testing standards and procedures

The electric water heater tests are in CAN/CSA-C191.1-M90. Canada also have a test method (CAN/CSA-C745-95) which is harmonised with the USA CFR 430 drawoff method which is being considered for introduction into the Canadian regulations.

Automatic icemakers

Program regulation and coverage

The Regulations cover factory-assembled ice-makers with standard capacity rating of between 23 and 1000 kg per day, including self-contained and split-system machines that produce cubed, flaked, crushed or fragmented ice, in either a batch or continuous process. The following categories are covered:

- Air cooled batch automatic ice makers ("cubers") in the capacity ranges 23 to <150 kg/d and 150–1000 kg/d;
- Water cooled batch automatic ice makers ("cubers") in the capacity ranges 23 to <150 kg/d and 150–1000 kg/d;
- Air cooled continuous automatic ice makers ("flakers") in the capacity ranges 23 to <300 kg/d and 300–1000 kg/d;
- Water cooled continuous automatic ice makers ("flakers") in the capacity ranges 23 to <300 kg/d and 300–1000 kg/d;

Ice-makers installed in household refrigerators, automatic ice-dispensing machines and cold-plate drink dispensers are excluded.

Criteria and requirements

The minimum energy efficiency standards (expressed as maximum energy per kg ice made) which took effect at the end of 1998, are indicated in Table 33.

Table 33: Maximum energy inputs, automatic icemakers, Canada

Product Class		**Capacity (kg ice per day)**	**Maximum Energy Input (kJ/kg ice)**
Batch automatic ice-makers (cubers)	Air Cooled	23 to < 150	1630 – 6.008 x capacity
		150 to 1000	807.2 – 0.5229 x capacity
	Water Cooled	23 to < 150	1234 – 4.381 x capacity
		150 to 1000	621.8 – 0.2985 x capacity
Continuous automatic ice-makers (flakers)	Air Cooled	23 to < 300	875.2 – 1.122 x capacity
		300 to 1000	538.6
	Water Cooled	23 to < 300	740.5 - 0.8976 x capacity
		300 to 1000	471.2

Source : NRCan (1999)

Testing standards and procedures

The automatic icemaker test requirements are in CAN/CSA-C742-98.

Dehumidifiers

Program regulation and coverage

The Regulations cover electrically operated, mechanically refrigerated dehumidifiers with a daily water-removal capacity of up to 30 litres (6.6 imperial gallons). Desiccant dehumidifiers, compressed air dehydrators and dehumidifiers used in commercial and industrial applications are excluded.

Criteria and requirements

For the minimum “Energy Factor” (litres removed per kWh) is 1.0. This requirement took effect at the end of 1998.

Testing standards and procedures

The dehumidifier test requirements are in CAN/CSA-C749-94.

2.5 Chile

2.5.1 Overview of the Economy Chile

Chile was the first Latin American country to move toward free trade and privatisation of its economy. Its GDP reached US$ 77 Billion in 1998 and was expected to continue to grow at about a 5% annual rate. Inflation was 6% in 1998. Exports totalled US$ 16 Billion (copper 42%, fresh fruit 7%, cellulose and paper 6%) while imports totalled US$ 19 Billion (intermediate goods 55%, capital goods 27%, consumer goods 18%) in 1998. About 1/3 of exports used to go to Asia before the economic downturn in that region. The official import tariff rate is 11%. The effective average import tariff rate is about 9% due to various bilateral and multilateral trade agreements. Trade legislation recently approved by the Senate calls for further reductions of 1% annually of the 11% tariff rate over the next five years.

Chile has close to 15 million inhabitants. Most live in cities, with 30% living in the greater metropolitan area of Santiago, the capital. Over 90% of households have electric service.

Current electric capacity is about 7 GW (60% hydro-electric). Electric consumption is expected to more than double by 2006. The Comisión Nacional de Energía - CNE (National Energy Commission) planned to add another 5 GW of capacity by 2006, of which 3.9 GW would be combined cycle plants. The CNE is in charge of central planning and tariff regulations. The power sector is otherwise totally private.

No recent data exists on appliance saturation levels, sales, technical characteristics, unit energy consumption values, etc. Despite an awareness of the importance of having this data, the CNE has yet to sponsor work to collect it. Instead, it hopes to collect this data as part of the work to enact minimum energy performance standards.

2.5.2 Overview of the Regulatory Framework

No MEPS or labelling exist in Chile at this stage. There are efforts under way to study the implementation of MEPS for mining industry motors and MEPS and energy efficiency labels for residential refrigerators. Neither the motor nor the refrigerator MEPS and labels would be obligatory at this stage. Only if a standard and/or label is part of a regulation does compliance become obligatory (this might happen in the future). There has been talk of an environmental label but nothing has happened.

The Instituto Nacional de Normalizacion - INN (National Standards Institute) is in charge of studying and elaborating standards. The INN elaborates a proposed standard and/or label based on its own research or a foreign standard and/or label. The proposed standard and/or label is then published in a national circulation newspaper for public comment. The INN sets up a committee to discuss the proposed standard and/or label among all institutions it decides are directly related to it and/or affected by it. Once the proposed standard and/or label is approved by the interested parties, it is returned to the INN's Council that can either adopt it or return it to the Committee. After the INN's Council approves the standard and/or label, it is sent to the Ministerio de Economía (Ministry of the Economy) for its publication. If it is a standard of specification, it is sent to the OMC.

The MEPS for electric motors is for squirrel-cage models used in the mining industry. The motor MEPS proposal is ready. It is based on the Mexican motor standard. INN needs to call a Committee to evaluate it, which should take between 8 to 12 months. Apparently the GEF supported part of this work.

A MEPS and energy efficiency label proposal for residential refrigerators was to be submitted to the INN in March 1999. It calls for the adoption of the Mexican refrigerator MEPS and label.

The National Energy Commission is concerned about the lack of indicative ratings to ensure energy efficiency criteria in national commerce and production. It is therefore developing ratings projects through its National Program for the Efficient Use of Energy and other public and private organisations. These voluntary programs will only affect companies who choose to differentiate their products from those of the competition by submitting them to an accreditation process in which recognised laboratories determine a product's ability to meet specific standards. Those with positive results will receive a seal of approval to be displayed on the product label, along with its energy efficiency ratings, to facilitate the consumer's decision-making process at the time of purchase. This way, all those involved - government, producer, vendor and consumer - share the responsibility of striving for greater levels of efficiency in the Chilean economy (Blazquez 1999).

For these reasons the technical and economic support from other APEC economies assists in the development of energy efficiency standards and other programs. In this context, APEC projects encourage the discussion of these themes in Chile.

2.6 China

2.6.1 Overview of the Regulatory Framework

China is the most populous APEC member economy with ~50% of the total APEC population and about 5% of total APEC GDP in 1995. Total primary energy consumption was 43.5 EJ (1038 Mtoe) in 1995 of which 3.3 PJ (928 TWh) was consumed in the form of electricity. Net primary energy exports were about 0.41 EJ (10 Mtoe) indicating that China was just energy self-sufficient in 1995. Energy consumption in China is estimated to have accounted for 3007 MT of CO_2 emissions in the same year that amounts to some 13.6% of global emissions and is equivalent to 2.51 T of CO_2 per capita. China has experienced annual GDP growth rates of approximately 5 to 8% throughout the 1990's a situation that has been matched by an equally rapid increase in the ownership levels of major household appliances. China's share of global electricity production had risen to 7.7% in 1995 from 2.7% in 1973 of which some 74.5% was coal-fired, 6.2% oil-fired, and 19.2% hydro. The IEA has forecast that China will require between 60 and 61 EJ (1439 and 1463 MToe) of total primary energy in 2010 which implies an increase of 39.8% over 1995 levels.

Overall electricity consumption grew by 31% from 1985 to 1992, but residential demand grew by 266.3% over the same period although it still only accounted for 17.5% of total consumption in 1992. As a result of rapid growth in energy demand and following concerns about a future shortfall in energy supply against demand China passed an Energy Conservation Law (ECL) in 1997 that aims to increase energy efficiency and promote energy conservation.

The 1997 Energy Conservation Law

The Law on Energy Conservation of China was approved at the 28th Session of the Standing Committee of the Eighth National People's Congress on 1 November 1997 and was promulgated and came into force on 1 January 1998. It supersedes earlier laws that in some instances indirectly dealt with energy conservation.

The Law aims to achieve the rational and efficient use of energy through: enhanced energy use management; the adoption of measures, which are technologically feasible, economically rational and environmentally and socially acceptable; and the reduction of loss and waste in the energy production and consumption chain. There are several articles that pertaining to energy using equipment as follows:

Article 14 of the law requires administrative agencies of the State Council in charge of standardisation formulates national standards of energy conservation. The resulting energy conservation standards should be technically advanced, economically rational, and subject to continuos improvement and perfection.

Article 15 Specifies that authorised energy conservation agencies of the State Council, in association with the relevant agencies of the State Council, should enhance supervision of sectors producing large numbers of widely used energy-consuming products, and urge them to apply energy conservation measures, make efforts to improve product design and manufacturing technology, and reduce energy consumption per physical unit of production within these sectors.

Article 18 states that enterprises may voluntarily apply to the product quality supervision and management agencies of the State Council or to the certification agencies assigned by sectoral agencies authorised by products quality supervision and management agencies of the State Council, in accordance with relevant national product certification regulations, for energy saving quality certification for their energy-consuming products. After successful certification, a certificate of energy saving quality shall be issued, and labels of energy saving quality certification can be affixed on the energy-using products and their packaging.

Article 24 States that entities producing energy-intensive products should comply with legal limits for energy consumption per physical unit of product..

Article 25 States that entities or individuals producing and selling energy-using products shall stop producing and selling energy-using products that the state has determined will be discontinued or discarded. Use of discontinued or discarded energy-using equipment beyond within the time limit set by energy conservation management departments and relevant departments of the State Council is prohibited. It is prohibited to transfer the discarded equipment to other users.

Article 26 states that organisations and individuals producing energy-using products shall display energy conservation labels or indicators on product specifications and product identification.

Article 34 affirms that the state encourages the introduction of advanced foreign energy conservation technology and equipment, and prohibits the introduction of outdated foreign energy-using technology, equipment, and materials.

Article 39 Affirms that with respect to the following common energy conservation technologies, the state will:

Achieve more-efficient operation of electric motors, fans, pumping equipment and systems; develop adjustable speed motor drives for energy conservation, along with electric-electronic power saving technology; develop, produce, and popularise high-quality and low-cost energy-efficient appliances and equipment; and increase the efficiency of electric power utilisation;

The various state agencies responsible for standardisation and certification are currently developing new measures to implement the ECL, these are:

China State Bureau of Quality and Technical Supervision (CSTBS) who are responsible for the development, implementation and supervision of MEPS.

The State Economic and Trade Commission (SETC) who are responsible, with CSBTS, for the development of energy labelling, certification labelling and quality marks.

The national appliance test centres:

- Guangzhou Testing and Inspection Station for Household Electric Appliances (GTIHEA)
- Beijing Testing and Inspection Station for Household Electric Appliances (BTIHEA)

2.6.2 Summary of Regulated Products

Table 34 lists products that are subject to energy efficiency programs in China, while Table 35 lists the relevant test procedures.

Table 34: Energy Efficiency Regulations and Programs in China

	Program Type				
Product Description	**A. Comparison label**	**B. Endorsement label**	**C. MEPS**	**D. Industry target**	**E. Other**
Household refrigerators	M (UC)		M (1989)		
Room air conditioners (window- and split-type)	M (UC)		M (1989)		
Fluorescent lamp ballasts		V (2000)	M (2000-2003)		
Household electric washing machines			M (1989)		
Electrical irons			M (1989)		
Automatic rice cookers			M (1989)		
Colour and monochromatic televisions			M (1989)		
Radio receivers and recorders			M (1989)		
Electric fans			M (1989)		

Table 35: Energy Performance Test Procedures in China

Product Description	Local Test Procedures	Reference Test Procedures
Refrigerators Refrigerator-Freezers Freezers Frost-free refrigerators/ freezers	GB 12021.2-89 refs: GB/T8059.1 GB/T8059.2 GB/T8059.3 GB/T8059.4	ISO 7371-95 ISO 8187-91 ISO 5155-95 ISO 8561-95
Air Conditioners (window- and split-type and ducted)	GB 12021.3-89 refs: GB/T7725	NEQ ISO 5151-94
Fluorescent lamp ballasts	GB/T15144-1994	EQV IEC60921 IEC60929 CSA-C654-M91
Household electric washing machines	GB 12021.4-89 refs: GB 4288 GB 2829	
Electrical irons	GB 12021.5-89 refs: GB 4706.2-86 GB 10154-88	IDT IEC335-2-3-86
Automatic rice cookers	GB 12021.6-89 refs: GB 8968	
Colour and monochromatic televisions	GB 12021.7-89 refs	
Radio receivers and recorders	GB 12021.8-89 refs: GB 2018 GB 6163	
Electric fans	GB 12021.9-89 refs:	

Refrigerator/Freezers

Regulation or program (effective date)

GB 12021.2-89: *The limited value and testing method of the energy consumption for household refrigerators* (1990)

Product category

All household refrigerators and refrigerator-freezers.

Criteria and requirements

New MEPS criteria are being considered by CSBTS but no release date is yet agreed. The currently applicable MEPS levels are defined in Table 36.

Table 36: MEPS requirements for refrigerators and refrigerator-freezers, China

Types	Volume (in litres)	The limited value of energy consumption (kWh)/24h
Refrigerators (N and ST climatic class)1, [2, 3, 4]	≤ 100	≤ 0.5
	100 –129	≤ 0.6
	130 –149	≤ 0.7
	150 – 179	≤ 0.8
	180 – 209	≤ 0.85
	210 – 250	≤ 0.95
Refrigerator-freezers and refrigerators with 3-star frozen food compartment (N, ST climatic class) [3, 4]	100 – 139	≤ 1.0
	140 – 159	≤ 1.1
	160 – 179	≤ 1.2
	180 – 209	≤ 1.3
	210 – 249	≤ 1.4
	250 – 299	≤ 1.5
	300 – 350	≤ 1.6

1 The limited value of energy consumption of refrigerators with a 1-star frozen food compartment is 0.03 kWh/24h more than that for refrigerators with the same volume.
2 The limited value of energy consumption of refrigerators with a 2-star frozen food compartment is 0.10 kWh/24h more than that for refrigerators with the same volume.
3 If the volume of the frozen food compartment is more than 30% of the refrigerators volume the limited value of energy consumption is 0.10 kWh/24h more than that for refrigerators with the same volume.
4 The limited value of energy consumption of household frost-free refrigerators is 15% more than indicated in the table for those appliances with the same volume.

Refrigerators and refrigerator-freezers rated as belonging to the SN or T climatic class are not subject to the MEPS regulations, neither are pure freezers or cold appliances outside the specified volume ranges.

Testing standards and procedures

China's refrigerator and freezer test procedures are equivalent clones of the international test procedures as follows:

- GB/T8059.1 EQV ISO 7371-95: *Household refrigerating appliances – refrigerators with or without low-temperature compartments – characteristics and test methods*
- GB/T8059.2 EQV ISO 8187-91: *Household refrigerating appliances - refrigerator-freezers – characteristics and test methods*
- GB/T8059.1 EQV ISO 5155-95: *Household refrigerating appliances - frozen food storage cabinets and food freezers – characteristics and test methods*
- GB/T8059.1 EQV ISO 8561-95: *Household frost-free refrigerating appliances - Refrigerators, refrigerator-freezers, frozen food storage cabinets and food*

freezers cooled by internal forced air circulation – characteristics and test methods

Room air conditioners

Regulation or program (effective date)

GB 12021.3-89: *Limited values of energy consumption and method of testing for room air conditioners* (1990)

Product category

Cooling-only and reversible room air conditioners (non-ducted window and split-type) in the cooling mode

Criteria and requirements

Table 37 shows the MEPS requirements for room air conditioners applicable since 1990.

Table 37: MEPS for reversible and cooling-only room air conditioners, China

Product Class and cooling capacity (CC)	Minimum EER (W/W)
Single-packaged (Windows)	
CC ≤ 2.5 kW	2.20
2.5 kW < CC ≤ 4.5 kW	2.26
CC > 4.5 kW	2.32
Split-packaged (Splits)	
CC ≤ 2.5 kW	2.30
2.5 kW < CC ≤ 4.5 kW	2.37
CC > 4.5 kW	2.44

Values for operating in the cooling-mode only

New criteria and energy efficiency standard levels are being considered by CSBTS.

Testing standards and procedures

China uses the following test procedure for room air conditioners: GB/T7725 NEQ ISO 5151-94(E)

Fluorescent Lamp Ballasts

Regulation or program (effective date)

MEPS for fluorescent lamp ballasts, proposed for introduction during the period 2000 to 2003. A high efficiency endorsement program is also proposed for introduction during the same period. The criteria were finalised during 1999.

Product category

Fluorescent lamp ballasts of either the ferromagnetic or electronic type for use with linear or circular lamps.

Criteria and requirements

The criteria for MEPS and high efficiency endorsement labelling are shown in Table 38 and Table 39.

Table 38: Proposed MEPS Levels for Ballasts, China

Lamp Type	**Minimum BEF ferromagnetic**	**Minimum BEF electronic**
18W (T8)	3.154	4.778
20W (T12)	2.952	4.370
22W (annular)	2.770	3.998
30W (T12)	2.232	2.870
32W (annular)	2.146	2.678
36W (T8)	2.030	2.402
40W(T12)	1.992	2.270

Table 39: Proposed Ballast Efficiency Levels for Endorsement, China

Lamp Type	**Minimum BEF ferromagnetic**	**Minimum BEF electronic**
18W (T8)	3.686	5.518
20W (T12)	3.458	5.049
22W (annular)	3.248	4.619
30W (T12)	2.583	3.281
32W (annular)	2.461	3.043
36W (T8)	2.271	2.681
40W(T12)	2.152	2.473

Testing standards and procedures

The test method is set out in GB T15144-1994 *Method of determining efficacy of fluorescent lamp ballasts.* This references IEC60921 and IEC60929 but the method of test for the determination of ballast efficacy and the definition of Ballast Efficacy Factor (BEF) is the same as for the North American method (eg CSA-C654-M91).

Washing machines

Regulation or program (effective date)

GB 12021.4-89: *The limited value and testing method of energy consumption for household electric washing machines* (1990)

Product category

All household electric clothes washers.

Criteria and requirements

The currently applicable MEPS levels are defined in Table 40.

Table 40: MEPS for household electric washing machines, China

Types	Sub-type	The limited value of energy consumption per kilogram (Wh)/kg
Pulsator type	Single-tub washer	24.0
	Twin-tub washer	28.0
	Half-auto single-tub washer	29.0
	Half-auto twin-tub washer	32.0
	Auto washer	38.0
Drum type	Auto-washer without heating water	Not set
	Auto-washer with heating water	Not set
Spin dryer		4.0

Testing standards and procedures

China's washing machine test procedure is defined in the energy efficiency regulation: GB 12021.4-89 *The limited value and testing method of energy consumption for household electric washing machines*

This also references the following test standards: GB 4288, GB 2829

None of these test procedures is thought to be related to any international or regional test procedure.

Electric irons

Regulation or program (effective date)

GB 12021.5-89: *The limited value of energy consumption and method of testing for electrical iron* (1990)

Product category

Electric irons.

Criteria and requirements

The currently applicable MEPS levels are defined in Table 41.

Table 41: MEPS for household electric irons, China

Rated Power, P (W)	The limited energy consumption per hour while the iron is working under rated test conditions (kWh/h)
P < 300	0.10
300 ≤ P < 500	0.12
500 ≤ P < 750	0.14
750 ≤ P < 1000	0.17
P ≥ 1000	0.19

Testing standards and procedures

China's electric iron test procedure is defined in the energy efficiency regulation: GB 12021.5-89 *The limited value of energy consumption and method of testing for electrical iron*

This also references the following test standards: GB 4706.2-86, GB 10154-88

None of these test procedures is thought to be related to any international or regional test procedure.

Automatic rice cookers

Regulation or program (effective date)

GB 12021.6-89: *The limited value and testing method of efficiency and warming energy consumption for automatic rice cookers* (1990)

Product category

Automatic rice cookers.

Criteria and requirements

The currently applicable MEPS levels are defined in Table 42 and Table 43.

Table 42: MEPS for automatic rice cookers, China

Rated Power, P (W)	Minimum Heating efficiency (%) (a)
P < 400	70
400 ≤ P < 600	73
600 ≤ P < 800	75
800 ≤ P < 1000	76
1000 ≤ P < 2000	77

(a) The heating efficiency is the heat received in the cooker in W divided by the input power in W.

Table 43: MEPS for automatic rice cookers, China

Rated Power, P (W)	Maximum energy consumed to warm the food (Wh/h)
$P \leq 600$	60
$600 < P \leq 800$	70
$800 < P \leq 1000$	80
$1000 < P \leq 2000$	100

Testing standards and procedures

China's automatic rice cooker test procedure is defined in the energy efficiency regulation: GB 12021.6-89 *The limited value and testing method of efficiency and warming energy consumption for automatic rice cookers*

This also references the following test standards: GB 8968, GB 8969.

None of these test procedures is thought to be related to any international or regional test procedure.

Televisions

Regulation or program (effective date)

GB 12021.7-89: *The limited value and testing method of electrical energy consumption for broadcasting receiver of colour and monochromatic televisions* (1990)

Product category

Colour and black and white televisions.

Criteria and requirements

The currently applicable MEPS levels are defined in Table 44.

Table 44: MEPS for televisions, China

Type	Screen size (cm)	The maximum active sound output power (W)	The limited value of input power (W)
Colour	37	1	55
	41	1	55
	47	1.5	60
	51	1.5	60
	56	2	75
Monochromatic	31	0.5	30
	35	0.5	30
	44	0.5	40
	47	0.5	60

Testing standards and procedures

China's TV test procedure is defined in the energy efficiency regulation: GB 12021.7-89 *The limited value and testing method of electrical energy consumption for broadcasting receiver of colour and monochromatic television*

This also references the following test standard: GB 6831-86

None of these test procedures is thought to be related to any international or regional test procedure.

Radio receivers and recorders

Regulation or program (effective date)

GB 12021.8-89: *The limited value of efficiency and methods of measurement on radio receivers and recorders* (1990)

Product category

Radios and tape recorders

Criteria and requirements

It has not been possible to determine the currently applicable MEPS levels for this product (awaiting further information and translations).

Testing standards and procedures

China's radio receiver and recorder test procedure is defined in the energy efficiency regulation: GB 12021.8-89 *The limited value of efficiency and methods of measurement on radio receivers and recorders.*

This also references the following test standards: GB 2018, GB 6163.

None of these test procedures is thought to be related to any international or regional test procedure.

Electric fans

Regulation or program (effective date)

GB 12021.9-89: *The limited value of energy consumption of electric fans and its measurement method* (1990)

Product category

Electric fans.

Criteria and requirements

The currently applicable MEPS levels are defined in Table 45.

Table 45: MEPS for electric fans, China

	Fan motor input power (W)				
Size (mm)	table fan	wall-mounted fan	floor table fan	floor standard fan	ceiling fan
200	26				
250	30	30			
300	42	42	42	42	
350	51	51	51	51	
400	59	59	59	59	
500				72	
600				103	
900					46
1050					55
1200					66
1400					77
1500					81
1800					84

Testing standards and procedures

China's electric fan test procedure is defined in the energy efficiency regulation: GB 12021.9-89 *The limited value of energy consumption of electric fans and its measurement method*

This does not reference any external test standard and is not thought to be related to any international or regional test procedure.

2.7 Hong Kong, China

2.7.1 Regulatory and Administrative Framework

Overview of Framework

In 1995, the Hong Kong Electrical and Mechanical Services Department (EMSD) initiated a voluntary comparative energy efficiency labelling scheme (EELS) for refrigerators. It added room air conditioners to the scheme in 1996 and clothes washers in 1997. The Government of the Hong Kong Special Administrative Region of the People's Republic of China is monitoring the program, and will decide whether the EELS should become mandatory, and whether minimum energy performance standards should be implemented.

For the comparative label, data are presented in a format which is similar to the European label, but the colours and details are somewhat different. In particular, the range of possible efficiency grades is not shown, although this is stated on the label. There are five efficiency ratings, from grade 5 (least efficient) to grade 1 (most efficient).

In 1998 the government commissioned a feasibility study for the establishment of an eco-labelling program in Hong Kong, China (IIEC 1998). It is not known whether the program is to be implemented, and if so whether it covers any energy-using appliances. A voluntary endorsement label available to compact fluorescent lamps that met minimum efficacy levels was also introduced in December 1998.

2.7.2 Summary of Products Covered

Table 46: Energy Efficiency Programs in Hong Kong, China

	Program Type				
Product Description	**A. Comparison label**	**B. Endorsement label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerators and/or Refrigerator-Freezers	V(1995, 1999) M(UC)		M(UC)		
Room Air Conditioners (unitary- and split-type)	V(1996, 1997) M(UC)		M(UC)		
Compact Fluorescent Lamps		V(1998)	M(UC)		
Clothes Washers	V(1997) M(UC)		M(UC)		

Sources: EMSD. Year indicated are initiation of the program, and latest year of revision, if any

Table 47: Energy Test Procedures, Hong Kong, China

Product Description	Labelling requirements (most recent)	Local Test Procedures	Reference Test procedures
Refrigerators and/or Refrigerator-Freezers	EMSD (1999)	EMSD (1999)	ISO 8187, 8561, 7371,5155
Room Air Conditioners (unitary- and split-type)	EMSD (1996 – as revised in 1997)	EMSD (1996 – as revised in 1997)	ISO 5151–1994
Compact Fluorescent Lamps	EMSD (1998)	EMSD (1998)	
Clothes Washers	EMSD (1997)	EMSD (1997)	IEC60456, JISC9606-1987

See References for full titles of EMSD documents

Refrigerators/Freezers

Program regulation and coverage

The labelling scheme covers the 8 specific categories of product described in Table 48. All products are required to meet the criteria for the ST (Subtropical) class as defined in ISO 8187, including the ability to maintain the specified temperatures under an ambient temperature range of +18°C to +38°C (ISO operating performance test).

Table 48: Refrigerator categories for energy labelling, Hong Kong, China

Type	Category	Frozen food compartment temp (°C)	Description
Refrigerator	Category 1	Nil	Refrigerator without a frozen food compartment
	Category 2	≤–6°C	Refrigerator with a 1-star frozen food compartment
	Category 3	≤–12°C	Refrigerator with a 2-star frozen food compartment
	Category 4	≤–18°C	Refrigerator with a 3-star frozen food compartment
Refrigerator-freezer	Category 5	≤–18°C	Refrigerator with a 4-star frozen food compartment
	Category 6	≤–18°C	Category 5 refrigerator incorporating means to prevent the formation of frost
Freezer	Category 7	≤–18°C	Refrigeration appliance in which the entire storage volume is intended for freezing food
	Category 8	≤–18°C	Category 7 refrigeration appliance incorporating means to prevent the formation of frost

Source: EMSD (1999). All Categories must meet ISO ST class criteria. Categories 1 to 6 are required to maintain a fresh food compartment temperature of 5°C.

Criteria and requirements

The grading for the energy label is determined in the following steps:

- Identify the appliance category (see Table 48);
- Calculate the adjusted volume (see formula below);
- Calculate the "reference" annual energy consumption in accordance with Table 49;
- Calculate the "Energy Efficiency Index", which compares the actual tested energy consumption (see procedure below) with the reference value for that model;
- Determine grading from the value of the index (see Table 50).

AV (Adjusted volume, litres) = Refrigerator volume + (K × freezer volume).

K = (T1-T3)/(T1-T2) where:

T1 = test room temperature (25°C);
T2 = average refrigerator temperature (5°C);
T3 = average freezer temperature.

The value of K for each product category is summarised in Table 49, which also gives the formulae for calculating the "reference" annual energy consumption. (This is called "average" annual energy consumption in EMSD (1999), but in fact represents statistically derived values for products on the European market in 1993, rather than the Hong Kong, China market).

Table 49: Reference Rating Formulae for Refrigerators, Hong Kong, China

Category	Value of K for calculating AV	Reference ("average") annual energy consumption (kWh/yr)
Category 1	NA	AV × 0.233 + 245
Category 2	1.55	AV × 0.643 + 191
Category 3	1.85	AV × 0.450 +245
Category 4	2.15	AV × 0.657 + 235
Category 5	2.15	AV × 0.777 + 303
Category 6	2.15	1.35 × (AV × 0.777 + 303)
Category 7	2.15	Chest freezers: AV × 0.446 + 181 Upright freezer: AV × 0.472 + 286
Category 8	2.15	Chest freezers: 1.35 × (AV × 0.446 + 181) Upright freezer: 1.35 × (AV × 0.472 + 286)

Source: EMSD (1999).

The Energy Efficiency Index (EEI) of a model is defined as the ratio of the tested energy consumption (expressed as kWh/yr) to the reference annual energy consumption calculated using the AV for that model and the formula for its category in Table 49.

The lower the EEI the more efficient the model, and hence the higher the energy grading. If a tested model has less than 63% of the annual consumption of the reference value, it has the highest efficiency grade of 1.

Apart from the Energy Efficiency Grade, the energy label also displays the electricity consumption for a full year's operation.

Table 50: Efficiency index and grading for refrigerators, Hong Kong, China

Energy Efficiency Grade	Energy Efficiency Index
1	EEI<0.63
2	0.63<EEI<0.80
3	0.80<EEI<1.0
4	1.0<EEI<1.25
5	1.25<EEI

Source: EMSD (1999).

Testing standards and procedures

EMSD (1999) fully references the following ISO standards for measuring energy consumption for household refrigerating appliances:

- ISO 5155 applies to frozen food storage cabinets and food freezers not cooled by internal forced air circulation (ie Category 7);
- ISO 7371 applies to household refrigerators not cooled by internal forced air circulation (ie Category 1);
- ISO 8187 applies to household refrigerator-freezers not cooled by internal forced air circulation (ie Categories 2, 3, 4 and 5);
- ISO 8561 applies to household frost-free refrigerating appliances – refrigerators, refrigerator-freezers, frozen food storage cabinets and food freezers cooled by internal forced air circulation (ie Categories 6 and 8).

In all cases, energy consumption is measured at an ambient temperature of 25°C over a period of at least 24 hrs operation after stable operating conditions have been reached. The test load packages specified in the ISO standards are used.

Air conditioners

Program coverage

The energy efficiency labelling scheme covers electric air-cooled non-ducted air conditioners with rated cooling capacity up to 10kW. It covers includes both single unit and split systems, but excludes multi-split systems, fan-coil and water-cooled units. In the case of reverse cycle units, the energy efficiency grading is based on the cooling performance only.

The categories covered are summarised in Table 51.

Table 51: Air conditioner categories, Hong Kong, China

Type	Function	Category
Window	Cooling only	Category 1
	Reverse Cycle	Category 2
Split	Cooling only	Category 3
	Reverse Cycle	Category 4

Source: EMSD (1997).

Criteria and requirements

The grading for the energy label is determined in the following steps:

- Identify the appliance category (see Table 51);
- Determine the appliance energy consumption (see procedure below);
- Calculate the "Energy Consumption Index" (ECI) – the ratio of the actual tested energy consumption to the reference value for that category – and determine the grading from Table 52.

The "Average" (reference) Appliance Energy Consumption was determined by statistical analysis of 584 models on the Hong Kong, China market in 1997. It is expressed in terms of kW electricity per kW of cooling, ie the reciprocal of coefficient of performance (COP). It is intended that the analysis be repeated at the end of 1999, and if efficiency levels have increased the Energy Consumption Indices in Table 52 would be adjusted so that the efficiency required to obtain a given label grading would increase.

Table 52: Energy Consumption Index and label grading for air conditioners, Hong Kong, China

Energy Efficiency Grade(a)	Energy Consumption Index (a)	Corresponding EER: Categories 1 & 2 (b)	Corresponding EER: Categories 3 &4 (c)
1	ECI<0.85	>2.66	>3.04
2	0.85<ECI<0.95	2.38-2.66	2.72-3.04
3	0.95<ECI<1.05	2.15-2.38	2.46-2.72
4	1.05<ECI<1.20	1.89-2.15	2.15-2.46
5	1.20<ECI	<1.89	<2.15

Source: (a) EMSD (1997). (b) Reference Appliance Energy Consumption (kW electricity/kW cooling) for these categories is 0.442, equivalent to reference EER of 2.26W/W. EER ranges corresponding to Energy Efficiency Grades have been calculated accordingly. (c) Reference Appliance Energy Consumption (kW electricity/kW cooling) for these categories is 0.387, equivalent to reference EER of 2.58. EER ranges corresponding to Energy Efficiency Grades have been calculated accordingly.

The ECI for a given model is the ratio of the actual kW electricity per kW of cooling (determined by test) to the Average Appliance Energy Consumption for that category. For example, if a Category 2 model consumes 1.1 kW while providing 2.4 kW of cooling at the test condition, then its average consumption per kW cooling is 0.458. Its ECI is 0.458/0.442 = 1.036. so its energy efficiency grade is 3 (see Table 52).

The energy efficiency gradings can be readily expressed in terms of COP, and this has been included in Table 52 to assist with comparisons with other APEC economies.

Apart from the Energy Efficiency Grade, the energy label also displays the electricity consumption for 1200 hrs of cooling at the rated capacity.

Testing standards and procedures

The energy test, described in EMSD (1997), is modelled on ISO 5151-1994. The standard rating condition for use in the labelling scheme is Condition T1.

Compact fluorescent lamps

Program coverage

Suppliers of compact fluorescent lamps (CFLs) which meet specified efficacy levels (expressed in lumens/W) may register their products for the use of an endorsement label. This differs from the labelling schemes for refrigerators and air conditioners in that there are no energy efficiency grades.

The scheme covers electrically operated CFLs intended for general lighting purposes with a rated voltage of 220V, frequency of 50Hz and rated lamp wattage up to 60W.

Two classes are covered:

- Integrated CFLs with built-in control gear (for which the lumen/W efficacy calculation includes the lamp control gear loss); and
- Non-integrated CFLs without built-in control gear (for which the lumen/W efficacy calculation excludes the lamp control gear loss).

Criteria and requirements

The minimum allowable efficacies which CFLs of different wattage and type must meet to qualify for the endorsement label are summarised in Table 53.

Table 53: Minimum allowable luminous efficacy for labelled CFLs, Hong Kong, China

<table>
<tr><th colspan="2">Integrated CFLs with control gear</th><th colspan="2">Non-integrated CFLs without control gear</th></tr>
<tr><th>Rated Lamp Wattage</th><th>Minimum allowable luminous efficacy (lumens/W)</th><th>Rated Lamp Wattage</th><th>Minimum allowable luminous efficacy (lumens/W)</th></tr>
<tr><td>≤ 10W</td><td>45</td><td>≤ 10W</td><td>50</td></tr>
<tr><td>11 - 20 W</td><td>50</td><td rowspan="2">11 - 30 W</td><td rowspan="2">65</td></tr>
<tr><td>21 - 30 W</td><td>55</td></tr>
<tr><td>≥ 31 W</td><td>60</td><td>≥ 31 W</td><td>75</td></tr>
</table>

Source: EMSD (1998)

Other performance requirements for labelled CFLS are:

- All materials and workmanship to comply with the electrical Products (Safety) Regulation of the HKSAR and appropriate IEC safety standards;
- The rated average lamp life to be not less than 8,000 hrs; and

- Lumen maintenance at 2,000 hrs to be not less than 78%.

Test procedures

The testing standards for measurement of electrical and photometric performance are based on the following international standards:

- IEC 60969-1988, *Self-ballasted lamps for general lighting services – performance requirements;*
- IEC 60901-1996, *Single-capped fluorescent lamps – performance specifications,* and
- CIE 84 – 1989, *The measurement of luminous flux.*

The efficacy for rating purposes is to be measured after 100 hours of operation.

Clothes washers

Program coverage

The energy efficiency labelling scheme covers electrically operated household clothes washers with a wash capacity not exceeding 7kg. Appliances with a larger capacity, or for industrial use, are excluded.

The following categories are defined:

- Horizontal drum type (Category 1), in which the load is placed in a horizontal drum and partially immersed in washing water, and the mechanical action is produced by rotation of the drum about its axis; and
- Agitator or impeller type (Category 2 or 3), in which the load is substantially immersed in washing water and the mechanical action is produced by a device moving about or along its axis. Category 2 machines have built-in heaters, while Category 3 machines do not.

Criteria and requirements

The object of the energy test is to determine the electrical energy consumed by the washing machine for the wash program for cotton 60°C, with a specified test load and specified test detergent. The tested washing machine is also required to wash the test load to defined levels of cleanliness, and to reach a specified water extraction performance during spinning.

The grading for the energy label is determined in the following steps:

- Identify the appliance category (see above);
- Determine the appliance energy consumption (see procedure below);
- Calculate the "Energy Consumption Index" (ECI) – the ratio of the actual tested energy consumption to the reference value for that category given in Table 54 – and determine the grading from Table 55.

If a tested model has less than 80% of the annual consumption of the reference value, it has the highest efficiency grade of 1.

Table 54: "Average" reference values for clothes washers, Hong Kong, China

Product Category	Reference kWh/kg load
Category 1: drum type	0.26
Category 2: impeller or agitator machine with built-in heater	0.0264
Category 3: impeller or agitator machine without built-in heater	0.0264

Source: EMSD (1997)

Table 55: Index and label grading for clothes washers, Hong Kong, China

Energy Efficiency Grade	Energy Efficiency Index
1	ECI<0.80
2	0.80<ECI<0.95
3	0.95<ECI<11.0
4	1.10<ECI<1.25
5	1.25<ECI

Source: EMSD (1997).

Test procedures

The test procedures, detailed in EMSD (1997), are based on the following international test standards:

- For drum type machines: IEC60456-1994
- For agitator or impeller type machines: JIS C9606-1987.

2.8 Indonesia

2.8.1 Overview of the Regulatory Framework

In 1995, the Directorate General of Electricity and Energy Development (DGEED), under the Ministry of Mines and Energy (MME), completed a Master Plan for Energy Conservation for Indonesia. The plan included import tax reduction on high-efficiency equipment and soft loans for companies implementing energy efficiency improvements.

DGEED is also responsible for developing and establishing national energy standards. However, no minimum energy efficiency standards have been imposed on any electrical products in Indonesia. At present, Indonesia is in the process of drafting national standards for room air conditioners, electric water heaters, televisions and electric irons. When implemented, the standards will mandate minimum energy efficiency level for these products.

Since 1996, DGEED has been slowly developing a *voluntary* labelling program for Indonesia. The Indonesia Energy Labelling program, which is set to start in 1999, will cover only household refrigerators. The label is a combination of continuous and categorical comparison label. It is designed to provide consumers with enough information to compare energy consumption between models. The label has a bar graph showing the energy use of the particular model relative to other models on the market. This bar graph is similar to the scale on the U.S. and Canadian appliance energy labels. The label also has a categorical component: it ranks the product's efficiency by the number of stars (1 = lowest and 5 = highest) . The label will also indicate energy consumption (kWh/year) and the average energy price per year. The Indonesian government estimates that the refrigerator labelling program will lead to national savings of 9 GWh/year.

For the energy labelling program, the University of Indonesia will undertake the task of testing the energy consumption of refrigerators. Energy testing facilities for products that will be subjected to minimum energy efficiency standards have not been officially approved, except for Bandung Institute of Technology, which is designated to test electric irons. It is important to note that government-operated testing facilities in Indonesia have not been internationally accredited while some manufacturers already have certified testing facilities.

2.8.2 Summary of Regulated Products

Table 56: Energy Efficiency Regulations and Programs in Indonesia

Product Description	Program Type				
	A. Comparison label	**B. Endorsement label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerator and/or Refrigerator-Freezer	VL (1999)				
Room Air Conditioners (window wall)					V (UC)
Clothes Washers					V (UC)
Televisions					V (UC)
Irons					V (UC)

E. Indonesian National Standards (in draft)

Table 57: Energy Performance Testing in Indonesia

Product Description	Local Testing Procedures	Reference Procedures
Refrigerator and/or Refrigerator-Freezer	Using →	ISO 7371-1995
Room Air Conditioners (window- and split-type)	Considering →	ISO 5151-1994 AS/NZS3823.1-1998 JIS B8616-1984
Clothes Washers	Considering →	IEC60456 (1994) AS/NZS 2040.1
Televisions		
Irons	Considering →	IEC60311 AS 1805 (1975) [a]

Note a: AS1805-1975 has been withdrawn and replaced with AS60311-1999 which IDT to IEC

Refrigerators

Regulation or program (effective date)

Voluntary Energy Labelling Program (1999 target)

Product category

Manual defrost, one-door, non-CFC refrigerator of about 150 litres.

Criteria and requirements

Energy consumption is the main factor in determining the number of stars the product attains on its label. The average energy consumption for this category of refrigerators is estimated at 425.76 kWh/year. Labelling of products is voluntary, based on manufacturers' decision.

Testing standards and procedures

Manufacturers must send in product sample for testing at University of Indonesia Laboratory. The laboratory uses ISO 7371-1995 test procedure for refrigerator testing.

Room air conditioners

Regulation or program (effective date)

Indonesian National Standard (in draft)

Product category

All residential window-type and split-type air conditioners

Criteria and requirements

Criteria and minimum energy efficiency level have not been established.

Testing standards and procedures

The draft standard proposes to reference ISO 5151-1994 test procedure, as well as AS/NZS3823.1-1998 and JIS B8616-1984 test procedures.

Clothes washers

Regulation or program (effective date)

Indonesian National Standard (in draft)

Product category

Residential automatic washing machines

Criteria and requirements

Criteria and minimum energy efficiency level have not been established.

Testing standards and procedures

The draft standard proposes to reference IEC60456 (1994) test procedure, as well as AS/NZS 2040.1 test procedure (Australia).

Televisions

Regulation or program (effective date)

Indonesian National Standard (in draft)

Product category

This category will include television receivers, video recorder cassettes, and tuner units.

Criteria and requirements

Criteria and minimum energy efficiency level have not been established.

Testing standards and procedures

The draft standard proposes to reference a number of standards relating to safety and performance, but these have not been finalised.

Irons

Regulation or program (effective date)

Indonesian National Standard (in draft).

Product category

Residential thermostatic electric irons.

Criteria and requirements

Criteria and minimum energy efficiency level have not been established.

Testing standards and procedures

The draft standard proposes to reference IEC60311 test procedure, as well as AS1805-1975 test procedure (now withdrawn and replaced with IEC60311). The Bandung Institute of Technology is the designated test facility for electric irons.

2.9 Japan

2.9.1 Overview of the Regulatory Framework

Japan has been in the forefront of Asian economic development for more than 30 years. With a generating capacity of more than 150,000 MW, Japan supplies over 700,000 GWh to about 70 million customers (NREL 1993). High demand for energy-intensive technologies and equipment in Japan has led to a drain on foreign exchange, since Japan imports most of its energy supply and resources. To reduce the demand of energy, Japan developed and implemented an energy conservation law in 1979 to increase energy efficiency and promote energy conservation.

Law Concerning the Rational Use of Energy

The Ministry of International Trade and Industry (MITI) passed the Law Concerning the Rational Use of Energy (or Energy Conservation Law) in 1979. The Law established standards concerning plant energy management, heat insulation of homes, and automobile fuel consumption.

According to the Law, standards and labelling are *voluntary* for manufacturers and distributors (hereafter referred to as “manufacturers” only). However, if manufacturers fail to follow or fulfil MITI’s recommendations for efficiency improvement for certain equipment, MITI will notify the public of the failure. MITI may also order manufacturers to receive consultation from a council determined by a government ordinance in order to follow recommendations. These measures will publicly humiliate manufacturers, but in essence, they automatically make the standards and labelling regulations *effectively mandatory*, since Japanese manufacturers weigh their success heavily on company image, prestige, and pride.

In 1979, target efficiency standards for residential refrigerators and air conditioners were established. Refrigerator standards were removed from the Law in 1984, since all manufacturers had already exceeded the efficiency targets. Standards for fluorescent lamps, televisions, computers, magnetic disk drives, and copiers were added in 1994.

The Top Runner Program

The Energy Conservation Law was revised in June 1998 and put into force in April 1999. In the Law *target* efficiency standards and requirements for energy-consuming products were established. Within MITI, the Advisory Committee of Energy formed an Energy Efficiency Standard Subcommittee and assigned it to determine appropriate target efficiency levels for the future. A working group for each type of product, consisting of professors, manufacturers, consumers, and experts, performed market research in order to draft recommended target efficiency values for the product. The draft was submitted to the Energy Efficiency Standard Subcommittee for review, then to MITI for approval.

The revised Law introduced the *Top Runner Program*, which sets very high efficiency target standards for refrigerators, air conditioners, televisions, video cassette recorders (VCRs), fluorescent lamps, photocopiers, computers, and magnetic disk drives. It also includes efficiency targets for gasoline and diesel vehicles. This new program aims to dramatically improve energy efficiency of these products by *setting target values based on the current highest efficiency level of each type of product* instead of the current *average* efficiency level. Table 58 shows the expected improvement and the intended target year for each product. MITI made an official announcement of the program at the end of March 1999, in which they explained that the intention was to avoid 9.7MtC emissions per year from energy efficiency improvements in domestic and commercial appliances.

Table 58: Expected Efficiency Improvements under the Top Runner Program, Japan

Product	Absolute Efficiency Improvement (%)	Target Year
Air conditioner (heating and cooling)	63.0	2004
Air conditioner (cooling-only)	14.0	2007
Refrigerators, refrigerator-freezers and freezers	22.5%	2004
Television	16.4	2003
Video cassette recorder (standby power use)	58.7	2003
Fluorescent lamp	16.6	2005
Computer	83.0	2005
Magnetic disk drives	78.0	2005
Photocopier	30.0	2006

One of the unique characteristics of the Top Runner Program is the consideration of stand-by power loss for products such as televisions, VCRs, computers and monitors. For example, stand-by mode makes up about 85% of energy consumption in VCRs. Thus MITI has proposed to use stand-by energy consumption as the index of VCR energy efficiency. For other products, energy consumption in the operation mode is more dominant. Nevertheless, stand-by losses will still be included in calculation of annual energy consumption. The requirements for refrigerators were still being finalised in 1999.

Energy Star Labelling

The Energy Star endorsement labelling program was established in the U.S. in 1992 by the US Environmental Protection Agency to cover computers, monitor, and printers. Since then, it has expanded to cover other products such as fax machines and photocopiers. Europe and Japan have also adopted and implemented this *voluntary* program, using the same criteria as the US. Japan initiated the Energy Star labelling program for computers, monitor, printers, fax machines and photocopiers in 1995 with the first international agreement finalised with the US EPA for the use of Energy Star. Scanners and multi-function devices were added to the program in 1999.

2.9.2 Summary of Regulated Products

Table 59 lists products that are subject to energy efficiency programs in Japan.

Table 59: Energy Efficiency Regulations and Programs in Japan

	Program Type				
Product Description	**A. Comparison label**	**B. Endorsement label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerator and/or Refrigerator-Freezer					VH (1979 VH (2004)
Air Conditioners (window- and split-type and ducted)					VH (1979) VH (2004-2007)
Fluorescent Lamps					VH (1994) VH (2005)
Televisions					VH (1994) VH (2003)
Video Cassette Recorders					VH (2003)
Computers		VL (1995)			VH (1994) VH (2005)
Magnetic Disk (computer)					VH (1994) VH (2005)
Visual Display (computer)		VL (1995)			
Printers (computer)		VL (1995)			
Fax Machines		VL (1995)			
Photocopiers		VL (1995)			VH (1994) VH (2006)
Scanners		VL (1999)			
Multi-function devices (MFD)		VL (1999)			

E. Law Rational Use of Energy - Top Runner Program

Table 60: Energy Performance Testing in Japan

Product Description	Local Test Procedures	Reference Test Procedures
Refrigerator and/or Refrigerator-Freezer	JIS C9607	ISO 8561
Air Conditioners (window- and split-type and ducted)	JIS B8615 JIS B8616 JIS C9612	
Fluorescent Lamps	JIS C7601	IEC 60901
Televisions	JIS C6101	
Video Cassette Recorders	Not Determined	
Computers		US Energy Star
Magnetic Disk (computer)	Not Determined	
Visual Display (computer)		US Energy Star
Printers (computer)		US Energy Star
Fax Machines		US Energy Star
Photocopiers		US Energy Star
Scanners		US Energy Star
Multi-function devices (MFD)		US Energy Star

Refrigerators/Freezers

Regulation or program (effective date)

Law Concerning the Rational Use of Energy – *Effectively Mandatory* Minimum Energy Efficiency Standards (1979)

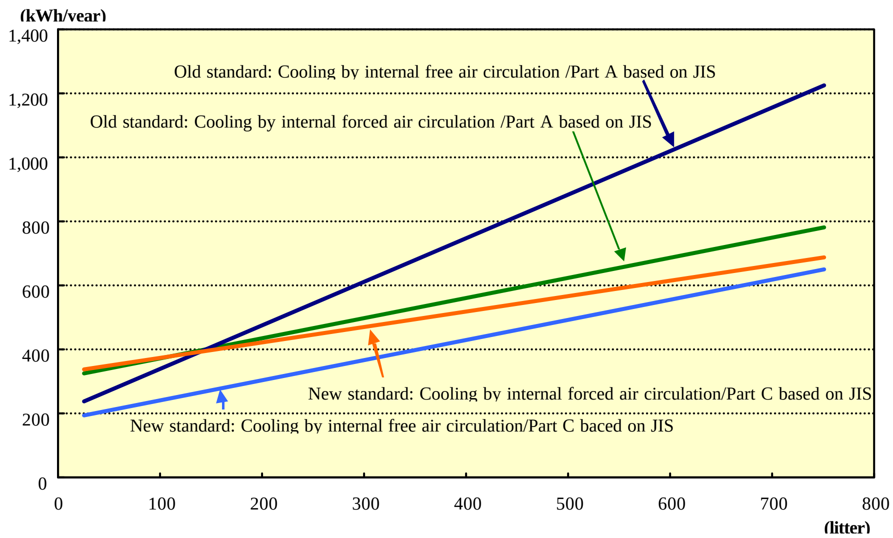
Product category

All household refrigerators and refrigerator-freezers

Criteria and requirements

New criteria and energy efficiency standard levels were announced by MITI under the Top Runner program during 1999 to come into force in 2004 - preliminary data is shown in Figure 1. Further details were not available at the time of writing this report.

Figure 1: Revised targets for refrigerator-freezers, from 2004, Japan



Testing standards and procedures

Japan uses its own national testing procedure JIS C9607-1993: Household Electric Refrigerators, Refrigerator-Freezers, and Freezers, which also references (Nordicity Group 1997) ISO 8561-1995: Refrigerators, refrigerator-freezers, frozen food storage cooled by internal forced air circulation. Note that there have been 3 versions of the JIS standard for refrigerators in recent years.

Room air conditioners

Regulation or program (effective date)

Law Concerning the Rational Use of Energy – *Effectively Mandatory* Minimum Energy Efficiency Standards (1979)

Product category

- Cooling and heating room air conditioners (window-type, split-type, and ducted)
- Cooling only room air conditioners (window-type, split-type, and ducted)

Criteria and requirements

For cooling and heating air conditioners, Table 61 shows the target efficiency values set for October 1997:

Table 61: Target efficiency values 1997 for heating and cooling air conditioners, Japan

Product Class	Minimum Cooling COP (a)	Minimum Heating COP
Utilised cooling capacity < 4kW	2.19	2.38
Separate cooling capacity < 4kW	2.67	3.20
Cooling capacity 4kW – 7.1kW	2.34	2.56
Cooling capacity > 7.1kW	2.45	2.62

Source: Egan and du Pont 1998, (a) COP = Coefficient of Performance = EER cooling W/W

Table 62 shows energy efficiency targets for cooling-only air conditioners set for October 1997.

Table 62: Target efficiency values 1997 for cooling-only air conditioners, Japan

Product Class	Minimum Cooling COP
Utilised cooling capacity < 4kW	2.45
Utilised cooling capacity 4kW – 7.1kW	2.20
Separate cooling capacity < 4kW	3.09
Separate cooling capacity 4kW – 7.1kW	2.42
Cooling capacity > 7.1kW	2.45

Source: Egan and du Pont 1998

New criteria and energy efficiency standard levels were announced by MITI under the Top Runner program during 1999 to come into force from 2004 and 2007 and are shown in Table 63 and Table 64.

Table 63: Revised targets for heat pump air conditioners up to 28 kW in 2004[a], Japan

Category	Cooling capacity ranges	Energy efficiency target
		Cooling and heating average
		$(EER_c + COP_h)/2$ (W/W)[b]
Split systems	CC ≤ 2.7 kW	5.27
	2.7 kW < CC ≤ 3.2 kW	4.90
	3.2 kW < CC ≤ 4.0 kW	3.65
	4.0 kW < CC ≤ 7.1 kW	3.17
	7.1 kW < CC ≤ 28 kW	3.10
Window systems	0 kW < CC ≤ 28 kW	2.85
Multi-split systems	CC ≤ 4.0 kW	4.12
	4.0 kW < CC ≤ 7.1 kW	3.23
	7.1 kW < CC ≤ 28 kW	3.07
Single-duct systems	0 kW < CC ≤ 28 kW	3.02
Other systems	CC ≤ 3.2 kW	3.96
	3.2 kW < CC ≤ 4.0 kW	3.20
	4.0 kW < CC ≤ 7.1 kW	3.12
	7.1 kW < CC ≤ 28 kW	3.06

CC = cooling capacity
Note a: Target value is weighted mean value of products shipped October 2003 to September 2004
Note b: In Japan the term EER_c is written as COP_c.

Table 64: Revised targets for cooling only air conditioners up to 28 kW, in 2007[c], Japan

Category	Cooling capacity ranges	Energy efficiency target
		EER_c [d]
		(W/W)
Split systems	CC ≤ 3.2 kW	3.64
	3.2 kW < CC ≤ 4.0 kW	3.08
	4.0 kW < CC ≤ 7.1 kW	2.91
	7.1 kW < CC ≤ 28 kW	2.81
Window systems	0 kW < CC ≤ 28 kW	2.67
Multi-split systems	CC ≤ 7.1 kW	3.23
	7.1 kW < CC ≤ 28 kW	2.47
Single-duct systems	CC ≤ 4.0 kW	2.72
	4.0 kW < CC ≤ 28 kW	2.71
Other systems	CC ≤ 4.0 kW	2.88
	4.0 kW < CC ≤ 28 kW	2.85

CC = cooling capacity
Note c: Target value is weighted mean value of products shipped October 2006 to September 2007
Note d: In Japan the term EER_c is written as COP_c.

Testing standards and procedures

For air-conditioners, Japan follows three main procedures (Nordicity Group 1997):

JIS B8615 Unitary air conditioners (this is now withdrawn)

JIS B8616: Unitary air conditioners (the new edition has been expanded with the previous requirements of JIS B8615)

JIS C9612: Air conditioners

Fluorescent lamps

Regulation or program (effective date)

Law Concerning the Rational Use of Energy – *Effectively Mandatory* Minimum Energy Efficiency Standards (1994)

Product category

All fluorescent lamps in two separate applications:

1. commercial and public lighting
2. residential lighting

Criteria and requirements

Japan set target efficiency (lamp efficacy) to be achieved by 2000 as follows:

Table 65: Target Efficiency Values for Fluorescent Lamps, Japan

Application	Target Efficacy (Lumens/watt)
Commercial and Public Lighting	75
Residential Lighting	65

Source: Egan and du Pont 1998

New criteria and energy efficiency standard levels were announced by MITI under the Top Runner program during 1999 to come into effect in 2005, see Table 66.

Table 66: Revised Target Values for Fluorescent Lamps in 2005, Japan

Fluorescent lamp type	Minimum efficacy (lm/W)
Luminaire with straight tubes	
110W rapid starter	79
40W high frequency	86.5
40W rapid starter	71
40W starter	60.5
20W starter (electronic ballast)	77
20W starter (magnetic ballast)	49
Luminaire with circle tubes	
>72W	81
62W-72W	82
<62W (electronic ballast)	75.5
<62W (magnetic ballast)	59
Table lamp with compact fluorescent lamps	62.5
Table lamp with straight tubes	61.5

Note: Target value is weighted mean value of products shipped April 2005 to March 2006

Energy consumption efficiency (1m/W) is given by the following ratio:

$$\frac{\Sigma(\text{Lamp luminous flux (1m)} \times \text{Ballast factor} \times \text{Temperature correction factor of lamp})}{\text{Power consumption (W)}}$$

Ballast factor is given by the following ratio:

$$\frac{\text{Light output of the ballast}}{\text{Light output of reference ballast}}$$

Examples of temperature correction factors for various types of lamps and conditions of operation in the luminaire are shown in Table 67.

Table 67: Temperature Correction Factors: various lamp types- Top Runner, Japan

Lamp Wall Temp ^{o}C	Other types	HF circular - single circle	HF circular double circle	CFL double tube	CFL other types
39 ^{o}C	-	-	1.000	-	-
40 ^{o}C	-	-	1.011	1.000	-
41 ^{o}C	1.000	1.000	1.030	1.007	-
45 ^{o}C	0.998	1.024	1.080	1.019	-
50 ^{o}C	0.970	1.041	1.096	0.996	-
55 ^{o}C	0.926	1.044	1.077	0.955	0.988
60 ^{o}C	0.875	1.031	1.039	0.906	0.944
65 ^{o}C	0.821	1.006	0.991	0.855	0.886
70 ^{o}C	0.767	0.970	0.943	0.808	0.829
75 ^{o}C	0.714	0.929	0.899	0.766	0.779

Note: Part of table only, original MITI table starts at 39^{o}C and ends at 90^{o}C in 1^{o}C intervals

Testing standards and procedures

Japan tests fluorescent lamps according to JIS C7601-1997: Fluorescent Lamps for General Lighting Purposes. (Ballasts are tested according to JIS C8108-1991: Ballasts for Fluorescent Lamps) It also references MITI notification No. 357 amendment to the procedure (Nordicity Group 1997) and IEC60901 international test standard.

Televisions

Regulation or program (effective date)

Law Concerning the Rational Use of Energy – *Effectively Mandatory* Minimum Energy Efficiency Standards (1994)

Product category

Japan designates four classes of televisions:

1. Standard Television 53cm (21”) and smaller
2. Standard Television larger than 53cm (21”)
3. Wide-Screen Television
4. HDTV

Criteria and requirements

Table 68 shows the target efficiency values for televisions set for 1998.

Table 68: Target Efficiency Values 1998 for Televisions, Japan

Product Class	Maximum energy Consumption (kWh/yr.)
Standard 21" and smaller	6.24S + 14.5 + A
Standard larger than 21"	6.24S + 34.2 + B
Wide-Screen Television	7.06S + 53.9 + B
HDTV	9.86S + 99.4

Where: S = screen size in inches
A = 16.4 (for built-in broadcast satellite reception)
44.6 (for built-in video deck)
61.0 (for built-in satellite reception and video deck)
0.0 (otherwise)
B = 44.6 (for built-in video deck)
0.0 (otherwise)
Source: Egan and du Pont 1998

New criteria and energy efficiency standard levels were announced by MITI under the Top Runner program during 1999 to come into effect in 2003, see Table 69.

Table 69: Revised Target Efficiency Values for TVs in 2003, Japan

Line Scan Frequency	Aspect ratio		Function	Maximum energy consumption (kWh/year)
Normal scan rate	4:3	Deviation angle at even or less than 100	Basic model	E_M=2.5S+32
			with VCR	E_M=2.5S+60
		Deviation angle at more than 100	Basic model	E_M=5.1S-4
			with VCR	E_M=5.1S+24
	16:9 (Wide Screen Type)		Basic model	E_M=5.1S-11
			with VCR	E_M=5.1S+17
			Additional (1)	E_M=5.1S+6
			Additional (2)	E_M=5.1S+13
			Additional (3)	E_M=5.1S+59
Double speed	16:9		Hi-Vision	E_M=5.1S+72
	16:9/4:3		Others	E_M=5.1S+41

Note: Target value is weighted mean value of products shipped April 2003 to March 2004

The parameter E_M in Table 69 is the annual electricity consumption of a TV calculated from:

$$E_M = \{ (P_0 - P_A / 4) \times 1642.5 + P_S \times 7117.5\} / 1000$$

P_0 = power consumed in the on-mode (W)

P_A = saved power through power saving (management) functions (W)

P_S = power consumed in the stand-by mode (W)

t_1 = estimated average on time (4.5 hours a day) (W)

t_2 = estimated average time in stand-by mode (19.5 hours a day) (W)

Testing standards and procedures

Japan uses the national test procedure JIS C6101: Measuring Methods of Receivers for Television Broadcast Transmission (Egan and du Pont 1998).

Video cassette recorders

Regulation or program (effective date)

Law Concerning the Rational Use of Energy – *Effectively Mandatory* Minimum Energy Efficiency Standards (1999)

Product category

New product categories have just been announced by MITI as shown in Table 70.

Criteria and requirements

New criteria and energy efficiency standard levels were announced by MITI under the Top Runner program during 1999 to come into effect in 2003, see Table 70.

Table 70: Target Efficiency Values for VCRs in 2003, Japan

VCR type	Maximum stand-by power level (W)
Super VHS with BS tuner	2.5
Super VHS	2
Normal VHS with BS tuner	2.2
Others	1.7

Note: Target value is weighted mean value of products shipped April 2003 to March 2004

Energy consumption efficiency (W) = $P_{don} - (P_{don} - P_{doff}) \times 0.2$

P_{don}: Power consumption in the stand-by mode on condition of indication (W)

P_{doff}: Power consumption in the stand-by mode on condition of non-indication (W)

Testing standards and procedures

The choice of test procedure is not yet known.

Computers

Regulation or program (effective date)

- Law Concerning the Rational Use of Energy – *Effectively Mandatory* Minimum Energy Efficiency Standards (1994)
- Energy Star Labelling Program (1995)

Product category

Law: All separate computer units (excluding display, printers,, and computers that are built into other equipment). Computers are categorised by computer speed (CS), which has units as million theoretical operations per second (MTOPS).

Energy Star: All computers

Criteria and requirements

Law: Minimum target efficiency values were set for 2005 as shown in Table 71.

Table 71: Target Efficiency Values for Computers in 2005, Japan

Product Classification	Number of I/O	Main Memory Capacity	Target Standard Value (W/MTOPS)
Server-type computer	32		21
	16 ~ 32		3.6
	18 ~ 16	16 GB ~	2.0
		4 GB ~ 16 GB	2.0
		~ 4 GB	1.4
	4 ~ 8	16 GB ~	1.8
		4 GB ~ 16 GB	0.41
		~ 4 GB	0.41
	~ 4	16 GB ~	1.8
		4 GB ~ 16 GB	0.41
		2 GB ~ 4 GB	0.28
		~ 2 GB	0.28
Client-type computer, other than battery-operated type	2 ~ 4	2 GB ~ 4 GB	0.19
		1 GB ~ 2 GB	0.19
		1 GB	0.16
	~2	2 GB ~ 4 GB	0.19
		1 GB ~ 2 GB	0.12
		1 GB	0.043
Client-type computer, battery-operated type			0.0065

Note: Target value is weighted mean value of products shipped April 2005 to March 2006

Energy consumption efficiency is expressed as the following ratio:

$$\frac{\text{Power consumption (W)}}{\text{Composite theoretical performance (MTOPS)}}$$

Where MTOPS: Million theoretical operations per second.

Energy Star: Criteria and requirements are the same as that of the US Energy Star program.

Testing standards and procedures

Law: Testing procedures are under consideration by MITI.

Energy Star: Same test procedures as used by the US Energy Star program

Magnet disks for computers

This product is also know as hard disk drives for computers.

Regulation or program (effective date)

Law Concerning the Rational Use of Energy – *Effectively Mandatory* Minimum Energy Efficiency Standards (1994)

Product category

Single magnetic disk drives and disk subsystems

Criteria and requirements

Japan established target efficiency values for 2000 as follows:

Table 72: Target Values for Magnetic Disk Drives, Japan

Type	Power Consumption (W) / Disk Size (MB)
Single Disk	≤ 0.01
Disk Subsystem	≤ 0.03

Source: Egan and du Pont 1998

New criteria and energy efficiency standard levels were announced by MITI under the Top Runner program during 1999 to be attained by 2005 as shown in Table 73.

Table 73: Revised Target Values for Magnetic Disks in 2005, Japan

[Single disk]

Disk size	Number of disks	Target standard value (W/GB)
75 mm ~	1	Exp (2.98 × In (N) - 25.6)
	2 ~ 3	Exp (2.98 × In (N) - 26.7)
	4 ~	Exp (2.98 × In (N) - 27.2)
40 mm ~ 75 mm	1	Exp (2.98 × In (N) - 25.6)
	2 ~ 3	Exp (2.98 × In (N) - 26.7)
	4~	Exp (2.98 × In (N) - 27.6)

[Subsystem]

Data transfer rate	Target standard value (W/GB)
160 MB/sec	Exp (2.00 × In (N) - 17.1)
~ 160 MB/sec	Exp (2.00 × In (N) - 17.2)

N: Speed of rotation (rpm)

Note: Target value is weighted mean value of products shipped April 2005 to March 2006

Testing standards and procedures

Testing procedures are under consideration by MITI.

Visual display units (monitors) for computers

Regulation or program (effective date)

Energy Star Labelling Program (1995)

Product category

All computer monitors

Criteria and requirements

Criteria and requirements are the same as that of the US Energy Star program.

Testing standards and procedures

Same test procedures as used by the US Energy Star program

Printers for computers

Regulation or program (effective date)

Energy Star Labelling Program (1995)

Product category

All printers

Criteria and requirements

Current criteria and requirements are the same as that of the US Energy Star program.

Testing standards and procedures

Same test procedures as used by the US Energy Star program

Fax machines

Regulation or program (effective date)

Energy Star Labelling Program (1995)

Product category

All fax machines

Criteria and requirements

Criteria and requirements are the same as that of the US Energy Star program.

Testing standards and procedures

Same test procedures as used by the US Energy Star program

Photocopiers

Regulation or program (effective date)

- Law Concerning the Rational Use of Energy – *Effectively Mandatory* Minimum Energy Efficiency Standards (1994)
- Energy Star Labelling Program (1995)

Product category

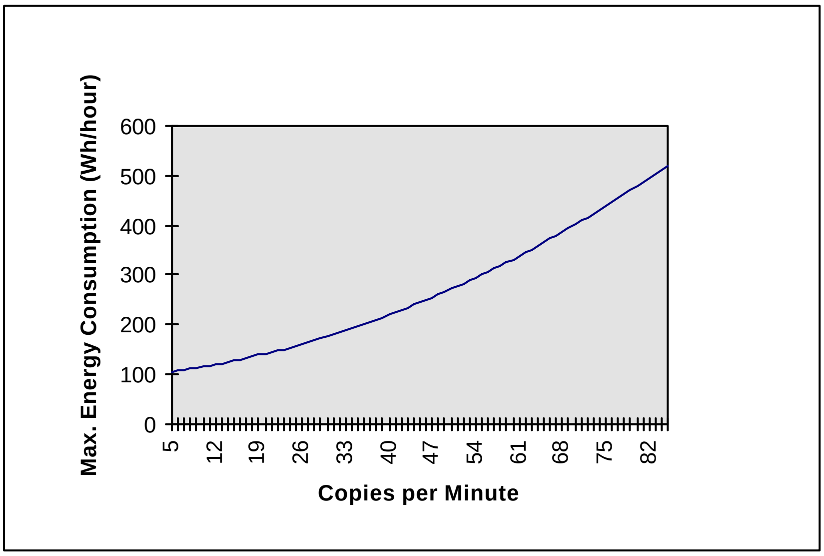
Law: All photocopiers

Energy Star: All photocopiers

Criteria and requirements

Law: Japan set target efficiency values for 2000 as shown in Figure 2:

Figure 2: Target Efficiency Values for Photocopiers, Japan



Source: Egan and du Pont 1998

New criteria and energy efficiency standard levels, expressed in terms of a maximum permitted energy consumption as a function of the number of copies per minute for various paper size formats were announced by MITI under the Top Runner program during 1999 to come into effect in 2006, see Figure 3 and Table 74 for details.

Figure 3: Revised Target Efficiency Values for Photocopiers for 2006, Japan

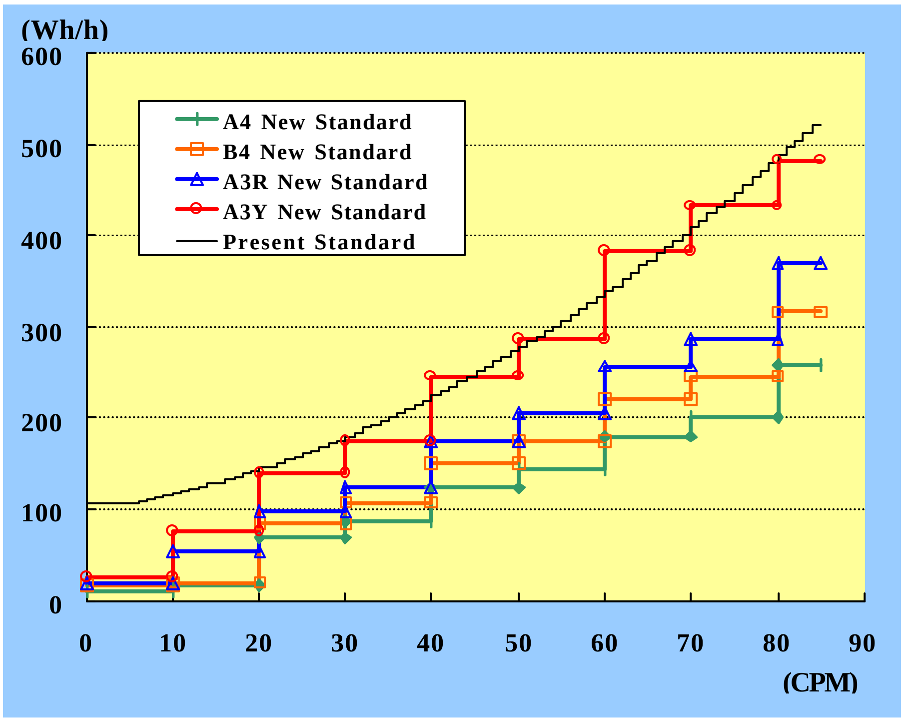


Table 74: Revised Target Efficiency Values for Photocopiers for 2006, Japan

Copying rate (CPM)	Tables standard value (Wh/h)			
	A4 Sideways	B4 sideways	A3 sideways	A3Y sideways
~10	11	17	19	27
11 ~ 20	17	20	55	77
21 ~ 30	69	85	99	139
31 ~ 40	88	108	125	175
41 ~ 50	123	151	176	245
51 ~ 60	144	175	205	287
61 ~ 70	180	221	257	383
71 ~ 80	200	246	288	433
81 ~ 85	258	317	369	483

Note: Target value is weighted mean value of products shipped April 2006 to March 2007

Energy consumption efficiency (Wh) = $A + 7 \times B / 8$

A: Power consumption during the first 1 hour after switching on (Wh)

B: Power consumption during next 1 hour after the first 1 hour (Wh)

Energy Star: Criteria and requirements are the same as those for the US Energy Star program.

Testing standards and procedures

Law: Testing procedures are under consideration by MITI.

Energy Star: Same test procedures as used by the US Energy Star program

2.9.3 Related Energy Efficiency Programs

Since 1978, the Agency of Industrial Science and Technology of MITI has been leading an energy conservation project called the New Sunshine Project. The project aims to save energy resources and rationalise energy policy through various sub-projects, for example:

(a) Large-scale energy conservation projects

(b) Basic-technology research projects at national research institutes

(c) International Cooperation Projects through the International Energy Agency (IEA)

(d) Evaluation Methods and policy for energy conservation technologies

(e) Standards for energy efficiency

(f) Conditional loans to private enterprise projects focusing on improving equipment to promoting alternative or more efficient use of energy

The Energy Conservation Centre of Japan (ECCJ) leads and supports energy conservation activities in Japan by holding national conferences and seminars to educate policymakers, manufacturers, consumers about energy efficiency.

Under MITI, the New Energy and Industrial Technology Development Organisation (NEDO) conducts large scale technical energy research and development projects and new energy development (renewable energy, biomass, etc.). NEDO also undertakes and funds new energy development projects in developing countries such as Thailand, Malaysia, Nepal, and Mongolia.

There are two other agencies that provide financial assistance to energy conservation and renewable energy projects in developing economies: the Overseas Economic Cooperation Fund (OECF) and the Japanese International Cooperation Agency (JICA).

2.10 Korea

2.10.1 Regulatory and Administrative Framework

Overview of Framework

Korea's effort to promote energy efficiency and conservation was triggered by the two oil crises of the 1970s. Korea, which has to import virtually all of its energy requirements (95% in 1995) faced the challenge of high energy prices and unstable supply. To overcome this the government developed energy efficiency and conservation policies while endeavouring to secure energy supplies. In Korea, the rapid growth in GNP has resulted in a corresponding increase in energy demand, more or less at the same rate as GNP growth, of about 8% per annum.

In 1978 the Ministry of Energy & Resources was established and in 1980 the Korean Energy Management Corporation (KEMCO) was founded to implement energy efficiency and conservation programs. In 1980 the government promulgated the Rational Energy Utilisation Act ("the Act") to serve as a basic law for energy efficiency and conservation.

In 1992 the Ministry of Commerce, Industry and Energy (MOCIE) is authorised by the Act to set MEPS levels on the basis of analyses carried out by agencies such as the Korean Institute of Energy Research (KIER). MOCIE establishes effective dates, specifies the energy test procedures and sets the rules for energy labelling.

The comparative label rates the product on one of 5 efficiency levels, and also provides energy consumption and other key data. A public agency, the Korean Energy Management Corporation (KEMCO), enforces these rules, supervises implementation and monitors the programs. The Act also covers passenger cars, and allows the designation of "efficiency-indicated equipment" for which efficiency must be shown, but not rated on a comparative scale as for other appliances. These include steel boilers, cast iron boilers, hot water boilers, oil fuelled heaters, LPG instantaneous water heaters, LNG fuelled water heaters and LPG fuelled hot water boilers.

MEPS levels and other aspects of the program are reviewed every three years and changed if necessary. In March 1999 the MOCIE mandated updated MEPS levels for fluorescent lamps and ballasts, and introduced MEPS for screw base compact fluorescent lamps. Other updates are planned, as indicated in Table 75.

In March 1999 a new three-stage process for extending the program to further products was adopted:

1. Announcement regarding new product, development of test methods, MEPS levels and energy ratings, data collection from manufacturers;
2. After one year, official announcement of MEPS levels and grading standards, and application of the grading standards;
3. After another year, MEPS take effect.

Clothes washers are currently within this process, with the aim of applying MEPS from 1 January 2001. Other electrical products under consideration for labelling and

MEPS include microwave ovens, electric radiant heaters and electric water heaters, but as they are not yet within the formal development process they are not covered by this report.

The energy tests are detailed in Korean Industrial Standards (KS), which appear to be generally based on an equivalent Japanese Industrial Standards (JIS) (sometimes with modification), or occasionally an IEC standard. The most significant differences are that KS refer to 110V and 220V while JIS refer to 100V, and KS refer to 60 Hz while JIS refer to 50 Hz and 60 Hz.

Apart from the mandatory energy labelling and MEPS programs, there is a voluntary "Energy Boy" endorsement label for office equipment, televisions and VCRs that meet the U.S. EPA Energy Star power management requirements. There is also an endorsement labelling program for high efficiency electric motors.

Relationship between MEPS levels and Energy Ratings

The Korean government publishes two energy efficiency levels or formulae for each product. The less stringent value defines the MEPS level – no product less efficient than this may be sold after the date the levels take effect. The more stringent value is the "target".

The energy ratings for the comparative energy labels are defined in relation to the "target" values (which may be expressed in terms of kWh/month, EER or other units depending in the product). For example, a product that consumes 80% of the energy of its target value (assuming this is expressed in kWh/yr) will get a higher energy rating than a product which consumes 110% of its target value energy. (Note that "1" is the highest, most energy-efficient grade and "5" is the lowest).

When the MEPS levels are made more stringent (about every 3 years) the target levels are also made more stringent. Since the energy rating scales refer to the target values, products must be more efficient to obtain the same energy rating after the revision of the target levels (ie the rating categories are being made more stringent on a regular basis). The new MEPS level is not raised all the way to the old target value, but sometimes to somewhere between the old MEPS level and the old target level.

2.10.2 Summary of Regulated Products

Table 75: Energy Efficiency Regulations and Programs in Korea

	Program Type				
Product Description	**A. Comp-arison label**	**B. Endorse-ment label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerators and/or Refrigerator-Freezers	M		M (1996, 1999)(a)		
Room Air Conditioners (unitary- and split-type)	M		M (1996, 1999)(a)		
Motors		V			
Incandescent Lamps	M		M(1992)		
Fluorescent Lamps	M		M (1999)		
Fluorescent Lamp Ballasts	M		M (1999, 2002)		
Clothes Washers	M (2000)		M (2001)		
Television, VCR		V(b)			
Computers and/or screens		V(b)			
Printers		V(b)			
Fax Machines		V(b)			
Photocopiers		V(b)			

Sources: Lee (1999) (a): Year current MEPS levels took effect and year of planned revisions indicated. (b) Energy Boy program

Table 76: References for MEPS levels and energy test procedures, Korea

Product Description	MEPS requirements (most recent)	Local Test Procedures	Reference Test procedures
Refrigerators and/or Refrigerator-Freezers	MOCIE Rule 24 of 1999	KS C 9305-96	JIS C 9607
Room Air Conditioners (unitary- and split-type)	MOCIE Rule 24 of 1999	KS C 6369-95 KS C 9306-97 KS B 6368-93	JIS B 8615-84 JIS C 9612-83 JIS B 8616-84
Motors		KS C 4202-97(a) KS 4004, KS 4005, KS 4204, KS 4002 KS 4205, KS 4210-13	IEC60034-2(b) IEEE 112(b)
Incandescent Lamps	MOCIE Rule 24 of 1999	KS C 7501-94	JIS C 7501
Fluorescent Lamps	MOCIE Rule 24 of 1999	KS C 7601-97 KS C 7621-97	JIS C 7601
Fluorescent Lamp Ballasts	MOCIE Rule 24 of 1999	KS C 8102-95 KS C 8100-97	JIS C 8108 IEC60929
Clothes Washers	MOCIE Rule 24 of 1999	KS C 9608-96	JIS C 9608
Television, VCR	MOCIE Rule 136 of 1999	US EPA Tests	
Microwave Ovens	UC (under consideration)		
Computers and/or screens	MOCIE Rule 136 of 1999	US EPA Tests	
Printers	MOCIE Rule 136 of 1999	US EPA Tests	
Fax Machines	MOCIE Rule 136 of 1999	US EPA Tests	
Photocopiers	MOCIE Rule 136 of 1999	US EPA Tests	

Source: Lee 1999, KIER 1997, Egan & du Pont 1998. (a) Defines "high efficiency". (b) Nordicity 1997

Refrigerators/Freezers

Program regulation and coverage

The MEPS and labelling requirements cover household refrigerators and refrigerator-freezers of all capacities.

Criteria and requirements

Table 77 indicates the present MEPS levels (expressed as maximum energy consumption) for the three different product categories. Table 78 relates the rating scale used in energy labelling to the "target" values in Table 77. All of these values are currently being reviewed.

Table 77: MEPS and targets for refrigerators and refrigerator-freezers, Korea

Type	Maximum Energy Consumption (kWh/month)(a)	Target Energy Consumption (kWh/month)(b)
Refrigerator, all sizes	0.041AV+20.82	0.033AV+16.86
Refrigerator-freezer, <500 litres AV	0.042AV+37.79	0.032AV+28.79
Refrigerator-freezer, ≥500 litres AV	0.145AV-14.15	0.110AV-10.74

Source: KIER (1997) Effective date I January 1996. (a) As of I January 1997 (b) By the end of 1998

AV (Adjusted volume, litres) = Refrigerator volume + (K × freezer volume).

$K = (T_1-T_3)/(T_1-T_2)$ where:

T_1 = ambient temperature (30°C);
T_2 = average refrigerator temperature (3°C);
T_3 = average freezer temperature.

K = 1.56 for 2 star freezers (where T_3 = -12°C), K = 1.67 for super 2 star freezers (where T_3 = -12°C). K= 1.78 for 3 and 4 star freezers (where T_3 = -18°C).

Table 78: Ratings for refrigerators and freezers, Korea

R	Grade
R ≤ 1.00	1
1.00 < R ≤ 1.20	2
1.20 < R ≤ 1.40	3
1.40 < R ≤ 1.50	4
1.50 < R	5

Testing standards and procedures

The energy consumption test, described in KS C 9305-1996, is a closed-door test at an ambient temperature of 30°C. For the test the freezers are loaded with packages containing approximately 23% cellulose (these are the same as ISO test packs).

Air conditioners

Program regulation and coverage

The program covers air conditioners with electrical power demand of up to 7.5kW, cooling capacities up to 17.5kW and with heating capacities up to 5kW for reversible units. Separate MEPS and target values are published for:

- Constant speed air conditioners and heat pumps of the unitary (“window”) type;

- Constant speed air conditioners and heat pumps of the split type;
- Variable speed air conditioners and heat pumps of the window type; and
- Variable speed air conditioners and heat pumps of the split type.

Multiple split types are not covered.

There are higher MEPS thresholds for variable speed air conditioners than for constant speed types, and lower performance criteria for higher capacity units (those above 4.13kW cooling capacity) than for lower capacity units. This is for two reasons:

a) sales are dominated by units with 2.5-4.13 kW cooling capacity, and

b) larger units often have sub-optimally sized condenser and evaporators in relation to their cooling capacities because of market imposed constraints on the size of the air handling units and unit cost.

Criteria and requirements

Table 79 and Table 80 indicate the present MEPS levels (expressed as minimum EERs) for the product categories covered by the program. Table 81 relates the rating scale used in energy labelling to the "target" values in Table 79 and Table 80. All of these values are currently being reviewed. (The requirements define EER in terms of kcal/h*W on cooling mode; the other units are give for information).

Table 79: MEPS levels for constant speed air conditioners, Korea

Product type	Cooling capacity	Minimum Efficiency Levels(a)			Target Efficiency Levels(b)		
		EER (kcal/ Wh)	EER (BTU/ Wh)	EER (W/W)	EER (kcal/ Wh)	EER (BTU/ Wh)	EER (W/W)
Window	<10.5 kW	2.2	8.7	2.56	2.5	9.9	2.91
Split	< 3550 kcal/h (<4.13 kW)	2.5	9.9	2.91	2.7	10.7	3.14
	3550 to 9000 kcal/h (4.13-10.50 kW)	2.2	8.7	2.56	2.5	9.9	2.91

Source: KIER (1997) Effective date 1 January 1996. (a) As of 1 January 1997 (b) By the end of 1998

Table 80: MEPS levels for variable speed air conditioners, Korea

Product type	Cooling capacity	Minimum Efficiency Levels (a)			Target Efficiency Levels (b)		
		SEER(c) (kcal/ Wh)	SEER (BTU/ Wh)	SEER (W/W)	SEER (c) (kcal/ Wh)	SEER (BTU/ Wh)	SEER (W/W)
Window	<10.5 kW	2.2	8.7	2.56	2.5	9.9	2.91
Split	< 3550 kcal/h (<4.13 kW)	2.5	9.9	2.91	2.7	10.7	3.14
	3550 to 9000 kcal/h (4.13-10.50 kW)	2.2	8.7	2.56	2.5	9.9	2.91

Source: KIER (1997) Effective date I January 1996. (a) As of I January 1997 (b) By the end of 1998
(c) This is a Seasonal Energy Efficiency Ratio, which implies that it is derived from more than one test point or condition – however, these additional test points are not clearly stated in the KS test procedure.

Table 81: Rating formulae for air conditioners, Korea

			EER (kcal/Wh) (EER W/W)				
			5	4	3	2	1
Constant speed	Window	<9000 kcal/h (<10.5 kW)	≤2.0 (≤2.33)	2.0 - 2.1 (2.33-2.45)	2.1-2.3 (2.45-2.68)	2.3-2.5 (2.68-2.92)	>2.5 (>2.92)
	Split	< 3550 kcal/h (<4.13 kW)	≤2.3 (≤2.68)	2.3-2.5 (2.68-2.92)	2.5-2.7 (2.92-3.15)	2.7-2.9 (3.15-3.38)	>2.9 (>3.38)
		3550 to 9000 kcal/h (4.13-10.50 kW)	≤2.0 (≤2.33)	2.0-2.2 (2.33-2.57)	2.2-2.4 (2.57-2.80)	2.4-2.6 (2.80-3.03)	>2.6 (>3.03)
Variable speed	Window	<10.5 kW	≤2.10 (≤2.45)	2.01-2.21 (2.45-2.58)	2.21-2.42 (2.58-2.82)	2.42-2.63 (2.82-3.07)	>2.63 (>3.07)
	Split	< 3550 kcal/h (<4.13 kW)	≤2.42 (≤2.82	2.42-2.63 (2.82-3.07)	2.63-2.84 (3.07-3.31)	2.84-3.0 (3.31-3.50)	>3.0 (>3.50)
		3550 to 9000 kcal/h (4.13-10.50 kW)	≤2.10 (≤2.45)	2.1-2.31 (2.45-2.69)	2.31-2.52 (2.69-2.94)	2.52-2.73 (2.94-3.18)	>2.73 (>3.18)

Source: KIER (1997)

Testing standards and procedures

The relevant standards are KS C 9306-83 (equivalent to JIS C9612-83), KS B6369-95 (equivalent to JIS B8615-84 – now withdrawn but included in JIS B8616) and KS B6368-93 (equivalent to JIS B8616-84). It is understood that the Korean test protocol incorporates tests at a number of rating conditions, including the ISO5151 T1 condition, and also includes part-load performance.

Electric motors

Program regulation and coverage

Only reference is Egan & du Pont 1998, as follows:

"The government also operates an endorsement labelling program for high efficiency motors that was introduced in late 1992. Korean standard KS C 4202 specified the high-efficiency standards for 3-phase 4-pole (1,800 rpm) induction motors with a power rating of less than 200kW (267 HP). Note that KS C 4202 was revised in 1997. Manufacturers that meet this requirement are eligible to put the Korean high efficiency label on their motor at the point of sale".

Criteria and requirements

Not determined.

Testing standards and procedures

The relevant standard is KS C 4202-97 (which includes references to IEC60034-1, IEC60034-9, IEC60034-12, IEC60072, NEMA 12-8C, NEMA MG 1-12), KS 4004, KS 4005, KS 4204, KS 4002, KS 4205 and KS 4210-13.

Lighting Equipment

Incandescent lamps

MEPS and target values are published for 110V and 220V lamps in the range 30 to 100W. The minimum and target values, expressed in terms of lumens/watt, are given in Table 82. Table 86 relates the rating scale used in energy labelling to the "target" values in Table 82. The test standard is KS C 7501-94, based on JIS C 7501.

Table 82: MEPS levels for incandescent lamps, Korea

Type	Watts	Minimum lumens/W (a)	Target lumens/W (b)
110 V	30 W	10.0	12.8
	60 W	13.0	15.0
	100 W	14.2	16.5
220V	30 W	8.0	10.0
	60 W	10.8	13.0
	100 W	12.5	14.6

Source: KIER (1997). Effective date I January 1996. (a) As of I January 1997 (b) By the end of 1998

Fluorescent lamps

MEPS and target values are published for linear tubular and circular lamps in the range 20 to 40W. Both T10 (32 mm) and (T8 26 mm) tubes are covered. The minimum and target values, expressed in terms of lumens/watt, are given in Table 83. Table 86 relates the rating scale used in energy labelling to the "target" values in Table 83.

The test standard is KS C 7601-97, based on JIS C 7601. The lumens/W values are calculated taking into account the power consumption of the circuit, including a reference ballast.

Table 83: MEPS levels for fluorescent lamps, Korea

Lamp Type		Lamp Wattage	Minimum lumens/W (a)	Target lumens/W (b)
Tubular (ie linear)	T10	20	55.0	76.0
		40	66.0	98.0
	T8	32	73.0	95.0
Circular		32	52.8	68.0
		40	58.0	76.0

Source: Lee (1999) Effective date July 1, 1999 (a) As of January 1, 2000 (b) By end of June 30, 2002

Compact fluorescent lamps

The requirements cover self-ballasted lamps (screw-base compact fluorescent lamps). Minimum and target values, expressed in terms of lumens/watt, are given in Table 84. Table 86 relates the rating scale used in energy labelling to the "target" values in Table 84. The test standards are KS C 7621-1997 based on KS 7601-1997 (covering fluorescent lamps) and KS C 8100-1997 (covering electronic ballasts for fluorescent lamps).

Table 84: MEPS levels for compact fluorescent lamps, Korea

Nominal Lamp Wattage	Minimum lumens/W (a)	Target lumens/W (b)
< 10	42.0	48.3
10 – 15	48.0	55.2
> 15	58.0	66.7

Source: Lee (1999) Effective date July 1, 1999 (a) As of January 1, 2000 (b) By end of June 30, 2002

Fluorescent lamp ballasts

The requirements for ballasts are listed in Table 85. They cover ballasts for all the fluorescent lamp types listed in Table 83. The performance of the test ballast with a reference lamp is compared with that of a reference ballast connected to the same reference lamp. The efficacy (lumens/watt) of the circuit with the ballast under test is compared with the lumens/watt of the circuit with the reference ballast in place. The ratio of the two ("R") must be above the minimum values specified.

Table 86 relates the rating scale used in energy labelling to the "target" values in Table 85. The test standards are KS C 8102-1995 based on JIS C8108 (covering magnetic ballasts) and KS C 8100-1997 (covering electronic ballasts and based broadly on IEC60929).

Table 85: MEPS levels for fluorescent lamp ballasts, Korea

Application for Operation of	Input Voltage	Minimum R value (a)	Target R value (b)
T10 20W lamp	220	0.83	1.15
T10 40W lamp		0.97	1.20
T8 32W lamp		0.97	1.18
Circular 32W lamp	220	0.97	1.18
Circular 40W lamp		0.97	1.18

Source: Lee (1999) Effective date July 1, 1999 (a) As of January 1, 2000 (b) By end of June 30, 2002

Energy ratings

For energy labelling purposes, lamps are graded according to the ratio R_1, which is:

$$\frac{\text{Target lumens/W (for a “high efficiency” reference lamp plus a reference ballast)}}{\text{Lumens/W of the lamp being tested (plus the reference ballast)}}$$

Hence the more efficient the lamp, the lower the ratio and the higher the grading number.

For energy labelling purposes, fluorescent lamp ballasts are graded according to a different ratio R_2, which is:

$$\frac{\text{The lumens/W of the circuit with the ballast being tested and the reference lamp}}{\text{The lumens/W of the circuit with the reference ballast and the reference lamp}}$$

In this case, the more efficient the ballast, the *higher* the ratio and the higher the grading number. The characteristics of the reference lamp and reference ballast are defined in the test standard.

The values of R for each of the 5 efficiency gradings are summarised in Table 86 (note that a rating of 1 is the best).

Table 86: Rating formulae for lighting equipment, Korea

Product	Type	5	4	3	2	1
Fluorescent lamp	Tubular 20 W (T10)	1.25-1.38	1.20-1.25	1.10-1.20	1.00-1.10	≤1
	Tubular 40 W (T10)	1.27-1.48	1.15-1.27	1.03-1.15	1.00-1.03	≤1
	Tubular 32W (T8)	1.25-1.30	1.20-1.25	1.10-1.20	1.00-1.10	≤1
Compact fluorescent lamps		1.12-1.15	1.09-1.12	1.06-1.09	1.00-1.06	≤1
Ballast for fluorescent lamp	For tubular 20 W (T10)	0.83-0.92	0.92-0.97	0.97-1.06	1.06-1.15	≥1.15
	For tubular 40 W (T10)	0.97-1.01	1.01-1.10	1.10-1.18	1.18-1.20	≥1.20
	For tubular 32W (T8)	0.97-1.01	1.01-1.05	1.05-1.09	1.09-1.18	≥1.18

Source: Lee (1999) All values are "R" ratios – see text for definition.

Office equipment

The voluntary "Energy Boy" endorsement label is available for use on office equipment, televisions and VCRs that meet the U.S. EPA Energy Star power management requirements.

2.11 Malaysia

2.11.1 Overview of the regulatory framework

The Ministry of Energy, Telecommunications and Multimedia (METM) is responsible for the implementation of energy efficiency policies in Malaysia. Under the METM, the Department of Electricity and Gas Supply (DEGS) oversees energy policy formulation and any energy efficiency activities. The regulatory framework lacks laws covering energy efficiency. In 1989, METM issued efficiency standards for electric motors; however, they are not mandatory and no related enforcement or promotional scheme has been implemented. There are no other existing standards, labelling, or energy testing programs to date.

The Standards and Industrial Research Institute of Malaysia (SIRIM) Berhad, a company wholly owned by the Malaysian government, provides electrotechnical testing services for numerous electrical equipment and devices. However, SIRIM's laboratories do not perform energy performance tests, but only safety and quality tests. Malaysia is in the process of developing Malaysian testing standards for energy performance testing of various electrical products, which will most probably reference ISO and IEC standards.

Energy efficiency regulations (proposed)

Under the Electricity Supply Act of 1990, DEGS develop the proposed *Energy Efficiency Regulations* which will most likely become effective in 1999. The Regulations will implement four main policies, as described below (Chong Cheong Yin 1998).

- <u>Specific installations</u> – The regulations require all installations with operating voltage of greater than 11kV and average monthly consumption exceeding 500,000 kWh to appoint an energy efficiency officer (EEO), keep record of energy consumption, set target plans for energy efficiency, audit and take actions to improve energy efficiency of the installation according to recommendations from the energy officer.
- <u>Energy efficiency officers</u> – One EEO will be appointed to each installation to encourage the owners to implement energy efficiency measures, investigate potential efficiency improvements of the installation, oversee record keeping, inspect and inform the DEGS by submitting annual reports on energy efficiency of the installation.
- <u>Scheduled products</u> – Regulations restrict the import, manufacture, display, sale, or advertise "scheduled products" that do not meet the required standards or have not been labelled. Scheduled products awaiting approval are ballasts, fans, household refrigerators, and room air conditioners.
- <u>Energy-using products</u> – Consumer information on energy efficiency or consumption for lamps, clothes washers, water heaters, television, video monitors, and vacuum cleaners must only be provided by DEGS, unless it complies with the standards and labels that DEGS requires.

2.11.2 Summary of regulated products

Table 87 summarises energy efficiency regulations and programs for electrical products in Malaysia.

Table 87: Energy efficiency regulations and programs in Malaysia

	Program Type				
Product Description	**A. Comparison label**	**B. Endorsement label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerator and/or Refrigerator-Freezer			M (UC)		
Separate Freezer	VM (UC)				
Room Air Conditioners			M (UC)		
Incandescent Lamps	VM (UC)				
Fluorescent Lamps	VM (UC)				
Fluorescent Lamp Ballasts			M (1999)		
Electric Water Heaters	VM (UC)				
Clothes Washers	VM (UC)				
Televisions	VM (UC)				
Computers and/or visual display units (screens)	VM (UC)				
Fans			M (UC)		
Vacuum cleaners			M (UC)		
Transformers for halogen lamps	VM (UC)				
Ballasts for other lamps	VM (UC)				

Table 88: Energy performance testing in Malaysia

Product Description	Local Test Procedures	Reference Test Procedures
Refrigerator and/or Refrigerator-Freezer	Not Determined	
Separate Freezer	Not Determined	
Room Air Conditioners	Not Determined	
Incandescent Lamps	Not Determined	
Fluorescent Lamps	Not Determined	
Fluorescent Lamp Ballasts	MS 141	IEC60921
Electric Water Heaters	Not Determined	
Clothes Washers	Not Determined	
Televisions	Not Determined	
Computers and/or visual display units (screens)	Not Determined	
Fans	Not Determined	
Vacuum cleaners	Not Determined	
Transformers for halogen lamps	Not Determined	
Ballasts for other lamps	Not Determined	

Refrigerator-freezers

Regulation or program (effective date)

Energy Efficiency Regulations (target 1999)

Product category

Refrigerator/freezers with internal capacity not exceeding 750 litres

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

Freezers

Regulation or program (effective date)

Energy Efficiency Regulations (target 1999)

Product category

Freezers with total capacity not exceeding 160 litres.

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

Room air conditioners (cooling, window-type, wall-mounted)

Regulation or program (effective date)

Energy Efficiency Regulations (target 1999)

Product category

Room air conditioners with input power not exceeding 3 kW.

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

Incandescent lamps

Regulation or program (effective date)

Energy Efficiency Regulations (target 1999)

Product category

Not determined yet.

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

Fluorescent lamps

Regulation or program (effective date)

Energy Efficiency Regulations (target 1999)

Product category

Not determined yet.

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

Ballasts for fluorescent lamps

Regulation or program (effective date)

Electricity Regulations (1994) and also proposed under Energy Efficiency Regulations (1999)

Product category

Electromagnetic ballasts.

Criteria and requirements

By 1 January 1999: maximum allowable loss = 10 watts

By 1 January 2000: maximum allowable loss = 8 watts

By January 2001: maximum allowable loss = 6 watts

Testing standards and procedures

SIRIM performs ballast loss test using according to the Malaysian Standard MS 141: part 2: 1993. MS141 is based on IEC60921 with only minor amendments which provides a method of test for the determination of ballast watts loss. However, a new method is under consideration so that electronic and rapid start ballast types can be included.

Electric water heaters

Regulation or program (effective date)

Energy Efficiency Regulations (target 1999)

Product category

Storage water heaters of capacity not more than 150 litres

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

Clothes washers

Regulation or program (effective date)

Energy Efficiency Regulations (target 1999)

Product category

Maximum load capacity not more than 7 kilograms.

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

Televisions

Regulation or program (effective date)

Energy Efficiency Regulations (target 1999)

Product category

All types.

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

Visual display units (computer monitors)

Regulation or program (effective date)

Energy Efficiency Regulations (target 1999)

Product category

All visual display units

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

Fans

Regulation or program (effective date)

Energy Efficiency Regulations (target 1999)

Product category

Box, stand, table, and wall fans not exceeding 41 cm. in diameter

Ceiling fans no exceeding 155 cm. in diameter

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

Vacuum cleaners

Regulation or program (effective date)

Energy Efficiency Regulations (target 1999)

Product category

Input power not exceeding 2 kW

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

Transformers for halogen lamps

Regulation or program (effective date)

Energy Efficiency Regulations (target 1999)

Product category

Step-down transformers for extra low voltage halogen lamps

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

Ballasts for other discharge lamps (not fluorescent)

Regulation or program (effective date)

Not determined.

Product category

For discharge lamps other than fluorescent lamps

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

2.11.3 Related Energy Efficiency Programs

Tenaga Nasional Berhad (TNB), the electric utility serving peninsular Malaysia, has initiated promotion of energy-efficient equipment and formed a DSM unit in September 1993. DSM efforts in Malaysia only focus on peak shaving, despite the large potential for savings from many other types of DSM activities. DSM has not received much attention elsewhere because Malaysia has large surplus capacity and currently exports energy resources.

The government has also established a national energy centre. The Malaysian Energy Centre (Pusat Tenaga Malaysia) has received substantial funding from the Global Environment Facility. One of the Centre's activities coves the energy rating of appliances and equipment. Additionally, the GEF allocation to Malaysia includes $3 million in funding to be used for the purchase of testing equipment and construction of an energy testing facility. The centre is currently planning at least 14 seminars, and local and foreign experts will form an expert panel to advise these programs.

2.12 Mexico

2.12.1 Background

With over 90 million inhabitants, Mexico has a large and diversified economy, where most industrial and consumer goods can be produced. Since 1987 the government has been privatising state owned companies and opening up the market to free trade. The economic recession of 1994-95 seems to have passed with GDP growth of 7% in 1997, reaching US$ 415 billion and 4-6% growth expected for 1998. Foreign trade has been a cornerstone of the economic model followed in the past decade. Exports reached US$ 110.4 billion (US$ 86 billion to the USA) and imports US$ 109.8 billion (US$ 71 billion from the USA) in 1997. Main exports (a significant portion of these from maquiladora plants) were crude oil and related products, coffee, silver, engines, motor vehicles, cotton, and consumer electronics. Main imports were metal working machines, steel mill products, agricultural machinery, electrical equipment, aircraft, motor vehicle and aircraft parts. The recent low oil prices (Mexico's main export) have forced reductions to the federal budget, dampening growth expectations.

Two public state owned corporations, the Comisión Federal de Electricidad (CFE) and Luz y Fuerza del Centro (LFC) dominate the electric sector with over 36 GW of generation capacity (70% thermal power plants, primarily fuel oil, natural gas and coal). Current policy calls for continued generation based on combined cycle natural gas fired power plants and conversion of most of the fuel oil plants to natural gas by 2005. Growth in electric demand has been around 5-6% in recent years. Since 1992 there has been some opening to private power generation. In early 1999, the President submitted for consideration a Constitutional amendment that would result in the complete privatisation of the electric sector. The proposal does not mention energy efficiency.

2.12.2 Regulatory and Administrative Framework

Mexico is among the most advanced of the developing countries in the enactment and implementation of MEPS and energy efficiency labelling. Much of the effort has borrowed from the USA experience, although a good deal has also been developed in response to local requirements.

The Ley Federal Sobre Metrología y Normalización (Federal Law of Metering and Standards) of July 16, 1992 defined two types of standards: Normas Mexicanas - NMX (Mexican Standards) of voluntary compliance, and Normas Oficiales Mexicanas - NOM (Official Mexican Standards) of compulsory compliance. The NOM are enacted by the Federal Secretariats according to their areas of competence. Before this law, the Secretaría de Comercio y Fomento Industrial - SECOFI (Secretariat of Commerce and Industrial Promotion) was the only entity enacting standards relating to energy.

The Secretaría de Energía – (SE - Energy Secretariat) has entrusted the Comisión Nacional de Ahorro de Energía (CONAE - National Energy Savings Commission) with the design and enactment of standards and labels related to energy efficiency. The CONAE presides over and defines membership in the Comité Consultivo Nacional de Normalización para la Preservación y Uso Racional de los Recursos

Energéticos (CCNNPURRE - National Standards Consultative Committee for the Preservation and Rational Use of Energy Resources). The CCNNPURRE typically has representatives from the SE, CONAE, SECOFI, Instituto de Investigaciones Eléctricas (IIE - Electric Research Institute, an independent government research centre closely linked to the CFE and that has done most of the technical support documentation on MEPS for CONAE), trade associations (ANFAD, ANFEEA, CANAME), and academics.

Enactment of a new standard typically takes about two years. Initially it takes 10 to 12 months to prepare a MEPS proposal and another 210 days to enact the standard. A MEPS proposal is presented to the CCNNPURRE who has 75 days to provide comments. The CCNNPURRE comments are incorporated within the next 30 days and the proposal is then published in the Diario Oficial de la Nación - DON (Federal Registry). A period of 60 days for public comment is followed by another 45 days of consultation within CCNNPURRE to incorporate the public comments and approve the final MEPS and/or label and its publication in the DON. MEPS have until now been Norma Oficial Mexicana - NOM (Oficial Mexican Standard) of compulsory compliance.

The NOM includes both the minimum energy performance levels required and the test procedure for determining the equipment performance.

Until recently, the Dirección General de Normas - DGN (General Standards Directorate) of SECOFI was in charge of certifying testing laboratories and verifying compliance with the MEPS and/or labelling requirements. The CONAE is now in charge of verifying compliance; which due to its limited budget, is operating at a reduced level.

The Asociación Nacional de Normalización y Certificación del Sector Eléctrico - ANCE (National Association of Standardisation and Certification of the Electric Sector) is in charge of elaborating the NMX related to the electric sector. It can also certify others and has its own laboratory for conducting various standardised test procedures.

The SECOFI enacts NOM related to user safety, commercial information (e.g., food labels) and practices. SECOFI through its DGN certifies testing laboratories. Besides the ANCE and IIE test laboratories, many manufacturers' laboratories have been certified to do the tests specified in the NOMs.

The reasons for the MEPS and energy labelling are mostly related to an interest at CONAE to reduce the growing demand for electricity. Energy labels are used to provide consumer information at point-of-purchase for selected products. Table 89 shows the expected electric energy savings from the MEPS enacted.

Table 89: Expected electric energy savings from the Mexican MEPS

NOM (MEPS)	Sales units/year	Reduction in electric consumption in %	First year estimated savings in GWh
Residential refrigerators and freezers	**1,050,000**	**41**	**579.0**
Room air conditioners	**182,108**	**20**	**323.0***
Central air conditioners	**4,000**	**3**	**18.5**
3-phase AC induction electric motors	**171,396**	**7**	**669.0***
Non-residential building lighting	**Not applicable**	**20**	**103.0**
Street and building exterior lighting	**Not applicable**	**2**	**10.0**
Clothes washers	**1,000,000**	**10**	**7.9**
Vertical pumps	**2,500**	**13**	**18.0**
Centrifugal residential water pumps	**300,000**	**18**	**6.0**
Electromechanical efficiency for deep well pumps	**4,500**	**30**	**578.0**
Submersible pumps	**1,100**	**3**	**11.4**

* These savings are after year three.

Mexico also has the Sello FIDE, a voluntary energy efficiency endorsement seal given by the Fideicomiso para el Ahorro de Energía Eléctrica (FIDE) since mid 1995. Current products that can seek Sello FIDE certification are: induction electric motors (three-phase up to 500 hp, one-phase up to 5 hp), lighting products (compact fluorescent lamps, fluorescent tubes, high-pressure sodium lamp ballasts, interior and exterior luminaires), residential appliances (refrigerators, freezers, air conditioners and televisions), water pumps (agriculture, clean and waste water, up to 200 hp), and energy saving controls (light sensors, photocells, dimmers, etc). Manufacturers have to submit certified test results on their products to confirm that these cover the Sello FIDE requirements. The product is selected and tested by a certified laboratory to verify manufacturer claims. If approved, manufacturers pay for certification and sign an agreement stipulating length of validity of the Sello FIDE endorsement, how it can be displayed, renovation and cancellation of certification, etc. Manufacturers can then display the Sello FIDE on their products. FIDE advertises the Sello FIDE in order to entice consumers to look for it when purchasing electrical equipment.

2.12.3 Summary of Products Covered

This section describes in detail the program types by product as well as the references to relevant test procedures. A summary of the energy efficiency programs that relate to electrical products in Mexico are provided in Table 90.

Table 90: Energy efficiency regulations and programs, Mexico

	Program Type				
Product Description	**A. Comparison label**	**B. Endorsement label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerator and/or Refrigerator-Freezer	M (1995)	V (1997)	M (1997)[1]		
Commercial refrigeration			M (UC)		
Room Air Conditioners	M (1995)	V (1997)	M (1995)		
Central Air Conditioners	M (1998)		M (1998)		
Electric Motors 3 phase		V (1997)	M (1998)[1]		
Electric Motors 1 phase		V (1997)	M (1998)		
Fluorescent lamps		V (1997)			
Compact fluorescent lamps		V (1997)	M (1998)		
Commercial building lighting		V (1997)	M (1996)		
Street & exterior lighting		V (1997)	M (1998)		
Clothes Washers	M (UC)		M (1997)		
Televisions		V (1997)			
Vertical pumps			M (1996)		
Centrifugal residential pumps	M (1996)		M (1996)		
Deep well pumps			M (1996)		
Submersible pumps			M (1998)		
Transformers			M		

Sello FIDE endorsement is also available for certain industrial pump types.
Note 1: First round of MEPS for 3 phase motors and refrigerators was 1995

Table 91 below shows the current Mexican MEPS and energy efficiency labelling requirements and dates of implementation. Some MEPS are in their second revision, having updated previous efficiency levels and slightly modified testing procedures to make them more similar to other international standards.

Table 91: MEPS and energy efficiency test methods, Mexico

Product	NOM	Date	Reference test procedures	Comments
Residential refrigerators and freezers	NOM-015-ENER-1997	1 August 1997	US CFR 430 for method and MEPS levels equal to USDOE 1993	Revision of NOM-072-SCFI-1994. Added use of adjusted volume, and freezers. Efficiency as USDOE 1993 and test done at 115 V; i.e., identical to USDOE 93
Commercial refrigeration	NOM-022-ENER	Under consideration		
Room air conditioners	NOM-073-SCFI-1994	1 January 1995	ANSI ASHRAE 16	Test method and consumption levels as USA. Being updated to concur with USDOE 2000 in 2001
Room air conditioners	NOM-021-ENER	Under consideration		Revision of NOM-073
Central air conditioners	NOM-011-ENER-1996	8 February 1998	ANSI ASHRAE 37 ARI and USDOE rules	Test method identical to ASHRAE 37, tolerances and efficiency per USA
3 phase AC induction electric motors	NOM-074-SCFI-1994	1 January 1995	CAN/CSA-C390 Canada 1995 IEEE 112 USA NEMA MG1 efficiency	Test method same as USA and Canada, minor tolerance differences. Efficiency as in NEMA
3-Phase electric motors	NOM-016-ENER-1998	18 June 1998	Based on IEEE method	Revision of NOM-074
1-Phase electric motors	NOM-014-ENER-1998	18 July 1998	IEEE-114 CAN/CSA C747	Test method based on standards mentioned, but efficiency values based on tests conducted with manufacturers
Compact fluorescent lamps	NOM-017-ENER-1997	23 June 1998	IEC60901-1987, revised in 1992	Differences to IEC not identified.
Transformers	Not determined			

Table 91: MEPS and energy efficiency test methods, Mexico (continued)

Product	NOM	Date	Reference test procedures	Comments
Non-residential building lighting	NOM-007-ENER-1995	September, 1996	ASHRAE/IES 90.1 CODE 9/13/93 (Energy efficient design of new buildings except residential buildings)	Use simplified structure of ASHRAE 90.1 that corresponds to interior lighting. The NOM sets a general value for each of the six building types (offices, hotels, hospitals, schools, restaurants, shopping centres) rather than dividing into sub-areas. Both credit reductions in power density due to lighting controls
Street and building exterior lighting	NOM-013-ENER-1996	16 May 1998	IES LEM-6-1987 (IES Guidelines for Unit Power Density UPD for New Roadway Lighting Installations)	To set limit values, NOM 013 only used illuminance and uniformity criteria (LEM-6 also uses luminance and shine). Thus refer values of W/m2 to illuminances instead of luminances. Also, NOM defined lighting in exterior parking lots, areas lit with large lightposts.
Clothes washers	NOM-005-ENER-1995	11 May 1997	No foreign standard used	IIE and manufacturers came up with test procedure for typical Mexican models and set efficiency levels on the basis of tests done
Vertical pumps	NOM-001-ENER-1995	June, 1996	ISO 3555 for vertical pumps	Basically identical
Centrifugal residential water pumps	NOM-004-ENER-1995	June 1996	ISO 3555-1997 Class B	Basically identical in both test procedure and efficiency levels
Electro-mechanic efficiency for deep well pumps	NOM-006-ENER-1995	November, 1996	No foreign standard used	Test method and efficiency levels determined for Mexico
Submersible pumps	NOM-010-ENER-1996	January, 1998	ISO 3555	Basically identical

Refrigerators and Freezers

Mexican residential refrigerators MEPS are currently specified by NOM-015-ENER-1997 in effect since 1 August 1997. This NOM substituted the previous NOM-071-SCFI-1994 that had been in effect since 1 January 1995.

The current standard is basically identical to USDOE 1993 MEPS for residential refrigerator/freezers. Tests are even conducted at 115 Volts (instead of the 127 Volts as previously stipulated). The test method is the same as CAN/CSA C300-M89 and US DOE CFR430 Subpart B Appendix A and B.

The NOM-015-ENER establishes MEPS limits for maximum yearly energy consumption as shown in Table 92. These limits are identical to those of USDOE 93.

Table 92. MEPS levels for refrigerators, Mexico

	Description of Electric Refrigerators	Maximum energy
1	Refrigerators &Refrigerator–freezers by manual/semiauto defrost	0.476 VA + 299
2	Refrigerator – Freezers - partial automatic defrost	0.367 VA + 398
3	Refrigerator – Freezers - automatic defrost with top-mounted freezer without through-the-door ice service and all-refrigerators-automatic defrost.	0.564 VA + 355
4	Refrigerator – Freezers – automatic defrost with side-mounted freezer without through-the-door ice service.	0.416 VA + 501
5	Refrigerator – Freezers – automatic defrost with bottom-mounted freezer without through-the-door ice service.	0.582 VA + 367
6	Refrigerator – Freezers – automatic defrost with top-mounted freezer with through-the-door ice service.	0.620 VA + 391
7	Refrigerator – Freezers – automatic defrost with side-mounted freezer with through-the-door ice service.	0.575 VA + 527
8	Upright Freezers with manual defrost.	0.364 VA + 264
9	Upright Freezers with automatic defrost.	0.526 VA + 391
10	Chest Freezers with manual defrost.	0.388 VA + 160

Maximum energy consumption in kWh/year; VA = Adjusted volume in litres, Source: NOM-015-ENER-1997. MEPS levels above are identical to US DOE 1993 (see CFR430 Subpart C 430.32)

NOM-015-ENER also requires that all residential refrigerators and freezers have the official yellow energy label for that product attached at the point of sale. The refrigerator label shows the energy savings of the actual energy consumption of that model relative to the MEPS for that model.

Air conditioners and heat pumps

There are two MEPS for air conditioners: NOM-073-SCFI-1994 applies to room air conditioners since 1 January 1995; and NOM-011-ENER-1996 applies to central air conditioners since 8 February 1998. NOM-073 is being revised and it is hoped that it will be replaced with NOM-021-ENER to take effect sometime in 2001. The new MEPS of NOM-021-ENER for room air conditioners are likely to be comparable to those published in the USA for room air conditioners to take effect in 2000 (refer to CFR430 Subpart C 430.32).

Room air conditioners MEPS are applied as described below in Table 93 (after Martinez 1997). These thresholds only apply to window/wall room air conditioners and or reversible heat pumps operating in the cooling mode, while split system room air conditioners and heat pumps are classified as central air conditioners as in the other NAFTA states.

The scope of the Mexican legislation for air conditioners is as follows:
'Units designed for installation in a window or to traverse a wall with the aim of conditioning the air of an enclosed space by means of a refrigeration source for chilling and dehumidification and possibly also having the capacity to ventilate, extract and heat the air.'

In addition the regulations only apply to room air conditioners having an air-cooled condenser, therefore units with water cooled condensers are exempt. The MEPS levels from applicable from 1996 are essentially identical to US DOE levels for cooling only window wall units with louvred sides (refer to CFR430 Subpart C 430.32).

The test procedure used for determining equipment efficiency follows ANSI/ASHRAE-16-1988 and is also the same as US DOE CFR430.

Table 93. Room air conditioner MEPS requirements in Mexico

Product class (Btu/h)	Minimum EER applicable from 1 Jan 1995 EER ({Btu/h}/W) (EER W/W)	Minimum EER applicable from 1 Jan 1996 EER ({Btu/h}/W) (EER W/W)
< 6000 (1.758kW)	8.0 (2.344)	8.0 (2.344)
6000-7999 (1.759-2.343kW)	8.5 (2.49)	8.5 (2.49)
8000-13999 (2.344kW-4.101kW)	8.5 (2.49)	9.0 (2.637)
14000-19999 (4.102kW – 5.859kW)	8.5 (2.49)	8.8 (2.578)
20000-36000 (5.860kW-10.548kW)	8.2 (2.40)	8.2 (2.40)

Source: NOM-073-SCFI-1994

Room air-conditioners are required to have an energy label showing the EER. The labelling classes used are shown in Table 94.

Table 94. Energy labelling classes for room air conditioners in Mexico

Labelling class	Labelling class criteria
A	from 100 to 110% of the minimum EER in Nom-073-SCFI-1994
B	from 110 to 120% of the minimum EER in Nom-073-SCFI-1994
C	from 120 to 130% of the minimum EER in Nom-073-SCFI-1994
D	from 130 to 140% of the minimum EER in Nom-073-SCFI-1994
E	from 140 to 150% of the minimum EER in Nom-073-SCFI-1994

Source: NOM-073-SCFI-1994

It is important to note that the room air conditioner label is somewhat different to both the central air conditioner and refrigerator labels. For both central air conditioners and refrigerators the percentage energy savings relative to the relevant MEPS level are shown on the label as an arrow with a % sign. While the air conditioner label is partly similar in style, it shows only grades A to E, with A grade being the *worst*, while E is the *best*. No indication is shown on the label with respect to the expected savings for each additional grade or for the model labelled. There appears to be some potential for misinterpretation, both because A is usually considered to be "better" than E on most objective rating scales, and because the vertical scale on the label is different to other products (meaning that learned interpretation for one product is not directly transferable to another).

Central air conditioners with cooling capacities from 10.54 kW to 17.58 kW are subject to the MEPS requirements specified in Table 95. Both split and packaged electrical central air conditioners are included in this regulation provided they use mechanical compression, have an air to air evaporator and an air or water-cooled condenser. Heat pumps or central air conditioner units with an additional space heating capability are exempt.

The test method used is ANSI/ASHRAE 37. The tolerances and efficiency levels are identical to that used by USDOE.

Table 95. Central air conditioner MEPS requirements in Mexico

Cooling capacity (W)	Minimum SEER (W/W) applicable from 8 Feb 1998
from 10540 to 17580	2.93

Source: NOM-011-ENER-1996, where SEER = seasonal energy efficiency ratio, this level is same as for US DOE SEER for "split system" central air conditioners (ie SEER = 10), see CFR430 Subpart C.

Table 96. Energy labelling classes for central air conditioners in Mexico

Labelling class	Energy savings in percent (a)
arrow 1	0 %
arrow 2	10 %
arrow 3	20 %
arrow 4	30 %
arrow 5	40 %
arrow 6	50 % or more

Source: NOM-011-ENER-1996; (a) Compared to the minimum EER threshold specified.

The central air conditioner label shows the savings of that model relative to the minimum allowable EER and is similar in appearance to the label for refrigerators.

Electric motors

There are two sets of MEPS for electric motors in Mexico. NOM-014-ENER-1997 is for single-phase, general use induction, squirrel cage motors of 0.180 to 1.5 kW nominal rated power. NOM-014-ENER-1997 replaces NOM-074-SCFI-1994 and has been in effect since 17 October 1998.

NOM-016-ENER-1997 is for three-phase general use, induction, squirrel cage motors of 0.746 to 149.2 kW nominal rated power. NOM-016-ENER-1997 has been in effect since 17 September 1998.

The MEPS levels for both single and three phase motors are defined using a two-stage process. First, the type, size, voltage and number of poles (as applicable) is used to determine the "nominal" efficiency for that motor size and type. The nominal efficiency is then used to determine the MEPS efficiency, which is based on a fixed relationship to the nominal efficiency.

The nominal efficiencies for single-phase motors are set out in Table 97. Three-phase motors are split into open and closed as well as standard and high efficiency types. The nominal efficiency for each of these types is set out in Table 98 to Table 101. The nominal efficiencies and the corresponding MEPS levels are set out in Table 102.

The nominal efficiency levels set out below for so called "high efficiency" motors (Table 100 and Table 101) are the same as for US 1997 MEPS levels for motors (which in turn are almost the same as for Canada). This in effect means that the actual MEPS levels for Mexico are somewhat below those set for the USA and Canada, even for high efficiency motors (as these nominal levels are adjusted downwards in accordance with Table 102). Note that Mexico also regulates 8 pole three-phase motors and single-phase motors for efficiency while Canada and the USA do not. The precise scope of motors covered by the various MEPS schemes for these economies also varies slightly as well.

The test procedure used for NOM-014-ENER-1997 for single-phase motors is based on the IEEE Standard 114 and CSA-C747. For the three-phase motors (NOM-016-ENER-1998), the test procedure is based on CAN/CSA-C390 and IEEE Standard 112 Method B.

Table 97: Nominal efficiency for single-phase induction motors, Mexico

Nominal Power from kW	Up to kW	115 V	127 V	200 V to 240 V
0.180	0.249	50.5	48.0	48.0
0.249	0.295	52.5	50.5	50.5
0.295	0.373	55.0	52.5	52.5
0.373	0.475	57.5	55.0	55.0
0.475	0.560	59.5	57.5	57.5
0.560	0.746	62.0	59.5	59.5
0.746	0.885	64.0	62.0	62.0
0.885	1.119	66.0	64.0	64.0
1.119	1.290	68.0	66.0	66.0
1.290	1.492	70.0	68.0	68.0
1.492	1.500	72.0	70.0	70.0

Source: NOM-014-ENER-1997, Nominal efficiencies shown as percentage at full load.

Table 98: Nominal efficiency for closed three-phase standard efficiency motors, Mexico

Nominal Power Rating kW	2 Poles	4 Poles	6 Poles	8 Poles
0.746	74.0	75.5	75.5	72.0
1.119	77.0	80.0	78.5	75.5
1.492	80.0	81.5	78.5	75.5
2.238	81.5	81.5	80.0	75.5
3.730	82.5	84.0	81.5	82.5
5.595	84.0	86.5	82.5	84.0
7.460	85.5	86.5	84.0	85.5
11.19	85.5	87.5	85.5	85.5
14.92	86.5	87.5	86.5	86.5
18.65	86.5	89.5	86.5	86.5
22.38	87.5	90.2	87.5	87.5
29.84	88.5	90.2	88.5	88.5
37.30	88.5	91.0	88.5	89.5
44.76	89.5	91.7	89.5	89.5
55.95	89.5	91.7	90.2	89.5
74.60	90.2	92.4	90.2	90.2
93.25	91.0	92.4	91.0	91.0
111.9	91.0	92.4	91.0	91.7
149.2	91.7	93.0	91.7	91.7

Source: NOM-016-ENER-1998, Nominal efficiencies shown as percentage, at full load.

Table 99: Nominal efficiency for open three-phase standard efficiency motors, Mexico

Nominal Power Rating kW	2 Poles	4 Poles	6 Poles	8 Poles
0.746	72.0	72.0	72.0	72.0
1.119	72.0	74.0	74.0	74.0
1.492	74.0	75.5	75.5	75.5
2.238	80.0	81.5	80.0	78.5
3.730	80.0	81.5	80.0	80.0
5.595	81.5	82.5	81.5	81.5
7.460	82.5	82.5	82.5	82.5
11.19	84.0	84.0	84.0	84.0
14.92	84.0	84.0	84.0	84.0
18.65	86.5	86.5	86.5	86.5
22.38	87.5	88.5	87.5	87.5
29.84	88.5	89.5	88.5	88.5
37.30	89.5	89.5	89.5	89.5
44.76	90.2	90.2	90.2	90.2
55.95	90.2	90.2	90.2	90.2
74.60	90.2	91.0	90.2	90.2
93.25	91.0	92.4	91.0	91.0
111.9	91.0	92.4	91.0	91.0
149.2	91.7	93.0	91.7	91.7

Source: NOM-016-ENER-1998, Nominal efficiencies shown as percentage, at full load.

Table 100: Nominal efficiency for closed high-efficiency three-phase motors, Mexico

Nominal Power Rating kW	2 Poles	4 Poles	6 Poles	8 Poles
0.746	75.5	82.5	80.0	74.0
1.119	82.5	84.0	85.5	77.0
1.492	84.0	84.0	86.5	82.5
2.238	85.5	87.5	87.5	84.0
3.730	87.5	87.5	87.5	85.5
5.595	88.5	89.5	89.5	85.5
7.460	89.5	89.5	89.5	88.5
11.19	90.2	91.0	90.2	88.5
14.92	90.2	91.0	90.2	89.5
18.65	91.0	92.4	91.7	89.5
22.38	91.0	92.4	91.7	91.0
29.84	91.7	93.0	93.0	91.0
37.30	92.4	93.0	93.0	91.7
44.76	93.0	93.6	93.6	91.7
55.95	93.0	94.1	93.6	93.0
74.60	93.6	94.5	94.1	93.0
93.25	94.5	94.5	94.1	93.6
111.9	94.5	95.0	95.0	93.6
149.2	95.0	95.0	95.0	94.1

Source: NOM-016-ENER-1998, Nominal efficiencies shown as percentage, at full load.

Table 101: Nominal efficiency open high-efficiency three-phase motors, Mexico

Nominal Power Rating kW	2 Poles	4 Poles	6 Poles	8 Poles
0.746	----	82.5	80.0	74.0
1.119	82.5	84.0	84.0	75.5
1.492	84.0	84.0	85.5	85.5
2.238	84.0	86.5	86.5	86.5
3.730	85.5	87.5	87.5	87.5
5.595	87.5	88.5	88.5	88.5
7.460	88.5	89.5	90.2	89.5
11.19	89.5	91.0	90.2	89.5
14.92	90.2	91.0	91.0	90.2
18.65	91.0	91.7	91.7	90.2
22.38	91.0	92.4	92.4	91.0
29.84	91.7	93.0	93.0	91.0
37.30	92.4	93.0	93.0	91.7
44.76	93.0	93.6	93.6	92.4
55.95	93.0	94.1	93.6	93.6
74.60	93.0	94.1	94.1	93.6
93.25	93.6	94.5	94.1	93.6
111.9	93.6	95.0	94.5	93.6
149.2	94.5	95.0	94.5	93.6

Source: NOM-016-ENER-1998, Nominal efficiencies shown as percentage, at full load.

Table 102: Mexican nominal motor efficiency and corresponding MEPS levels

Column A Nominal efficiency	Column B Minimum efficiency	Column A Nominal efficiency	Column B Minimum efficiency
99,0	98,8	90,2	88,5
98,9	98,7	89,5	87,5
98,8	98,6	88,5	86,5
98,7	98,5	87,5	85,5
98,6	98,4	86,5	84,0
98,5	98,2	85,5	82,5
98,4	98,0	84,0	81,5
98,2	97,8	82,5	80,0
98,0	97,6	81,5	78,5
97,8	97,4	80,0	77,0
97,6	97,1	78,5	75,5
97,4	96,8	77,0	74,0
97,1	96,5	75,5	72,0
96,8	96,2	74,0	70,0
96,5	95,8	72,0	68,0
96,2	95,4	70,0	66,0
95,8	95,0	68,0	64,0
95,4	94,5	66,0	62,0
95,0	94,1	64,0	59,5
94,5	93,6	62,0	57,5
94,1	93,0	59,5	55,0
93,6	92,4	57,5	52,5
93,0	91,7	55,0	50,5
92,4	91,0	52,5	48,0
91,7	90,2	50,5	46,0
91,0	89,5	48,0	43,0

Note: The nominal efficiency values of column A are obtained from 99%, with loss increments of 10%. The minimum associated efficiency values of column B are obtained taking 20% loss increments. The nominal efficiency is determined for the motor type and size and the MEPS level is them determined from this table.

Both electric single and three-phase motor NOMs require that the measured efficiency values of the motors be displayed on their nameplates.

Lighting

Mexico has three MEPS related to three lighting types: NOM-007-ENER-1995 (commercial buildings), NOM-013-ENER-1996 (exterior lighting) and NOM-017-ENER-1997 (compact fluorescent lamps).

NOM-007-ENER-1995 applies to interior and exterior lighting in new non-residential buildings with demand of more than 20 kW, or for expansions of more than 20 kW in currently existing non-residential buildings. Buildings covered by this MEPS are catalogued as: a) offices; b) schools and educational facilities; c) hospitals and clinics; d) hotels and motels; e) restaurants and cafeterias; and f) commercial establishments. Exempt from this MEPS are: dance centres, discotheques and other recreation areas requiring special illumination; interiors of freezer chambers; cinema studios; temporary areas used for exhibitions, expositions, conventions, or spectacles; stores selling lighting equipment, and lighting demonstration education centres. Also exempt are areas of: hospitals and clinics with special lighting needs such as: autopsy rooms, operation rooms, expulsion rooms, post-anaesthesia recuperation rooms (intensive therapy), resuscitation and emergency rooms. Other exempt situations are: new buildings located in artistic and cultural patrimony areas; independent emergency lighting systems; equipment for emergency and evacuation signals; lighting equipment that is an integral part of other equipment; lighting equipment used for preparation or heating of food; lighted advertisements; lighting for aviation; other buildings different than those expressly stated (such as airline terminals, public safety buildings, bus terminals, churches, industrial buildings, etc.).

The standard allows maximum values of lighting power density in Watts of lighting connected per square meter of building floor area. These values are given in Table 103.

Table 103: Maximum power density for lighting of non-residential buildings, Mexico

Building Type	Interior Lighting max power density W/m^2	Exterior Lighting max power density W/m^2
Offices	16.0	1.8
Schools	16.0	1.8
Hospitals	14.5	1.8
Hotels	18.0	1.8
Restaurants	15.0	1.8
Commerce	19.0	1.8
Warehouses or storage areas.*	8.0	
Interior parking lots.*	2.0	

* Only for areas in buildings covered by NOM-007-ENER-1995

To promote the use of lighting controls, the NOM credits the use of controls such as occupancy sensors, dimmers, day-lighting sensors and timers (and/or combinations). The lighting control credits are subtracted from the calculated lighting power density, depending on how they are used; varying from 5% up to 50% of the installed wattage.

When a building only includes one use, it will be subject to the values shown in Table 103. If the building comprises multiple uses, compliance will be required of each area according to the corresponding values indicated in Table 103. When there are areas that are not covered in the NOM, the prevalent use of the building will determine the maximum permissible lighting density.

Verification of compliance with the standard rests with the Energy Secretariat, both during the process of approval of the projects and once they are completed. No energy label is required.

The NOM-007-ENER-1995 is based on ASHRAE/IES 90.1 Code 9/13/93. It uses a simplified version for the interior lighting as it sets a general value for the six building types, without subdividing these into specific use areas.

NOM-013-ENER-1996 applies to street lighting, lighting in open parking lots and exterior building lighting. Exempt from this standard are: airport operations lights; emergency lighting; lighting within single and multi-family land; holiday lighting; marine platforms, lighthouses and other safety lights; temporary lighting for construction; lighted advertising signs; special surveillance areas; areas where labour agreements limit lighting levels (ports, storage and loading/unloading areas, etc.); mechanical games; bicycle storage areas; and street signs. It has been in effect since May 16, 1998.

The standard requires a minimum lighting efficacy of 22 lumens/Watt from exterior lighting systems used in building fronts and logos, lakes, waterfalls, fountains, monuments, sculptures, flags, parks, gardens, alamedas (promenades or boulevards) and kiosks. A minimum of 40 lumens/watt are required of lighting systems for sidewalks, bus stops, plazas and zocalos (main squares).

The standard also stipulates the maximum values of electric power density allowed for lighting as shown in Table 104 to Table 106.

Table 104: Maximum Power Density for Street Lighting, Mexico

Illuminance lux	Width 7.5m	Width 9.0m	Width 10.5m	Width 12.0m
3	0.26	0.23	0.19	0.17
4	0.32	0.28	0.26	0.23
5	0.35	0.33	0.30	0.28
6	0.41	0.38	0.35	0.31
7	0.49	0.45	0.42	0.37
8	0.56	0.52	0.48	0.44
9	0.64	0.59	0.54	0.50
10	0.71	0.66	0.61	0.56
11	0.79	0.74	0.67	0.62
12	0.86	0.81	0.74	0.69
13	0.94	0.87	0.80	0.75
14	1.01	0.95	0.86	0.81
15	1.06	1.00	0.93	0.87
16	1.10	1.07	0.99	0.93
17	1.17	1.12	1.03	0.97

Source: NOM-013-ENER-1996, Allowable power densities in W/m^2 depends on street width

Table 105: Maximum power density in open parking lots, Mexico

Area to illuminate m^2	Power Density W/m^2
<300	1.80
300 - 500	0.90
500 - 1 000	0.70
1 000 - 1 500	0.58
1 500 - 2 000	0.54
>2 000	0.52

Source: NOM-013-ENER-1996.

Table 106: Maximum Power Density in Street Lighting, Mexico

Area to illuminate m^2	Power density W/m^2
< 2500	0.52
2500 - 5000	0.49
5000 - 12 500	0.46
>12 500	0.44

Source: NOM-013-ENER-1996, applicable to super light-posts (over 18 metres tall)

The Energy Secretariat is in charge of verifying compliance with this NOM both, during the approval of public lighting projects and after completion of their construction.

The NOM is based on the IES LEM-6-1987 guidelines for unit power density for new roadway lighting installations.

NOM-017-ENER-1997 applies to compact fluorescent lamps and the ballasts used in them up to 28 watts total circuit power. The NOM took effect on 1 January 1999. The CFLs are tested using the procedure given by NMX-J-295-ANCE. Table 107 and Table 108 show the minimum efficacy values required for CFL lamps and their ballasts, respectively.

Table 107: Minimum efficacy values for CFLs, Mexico

Designation	Nominal power (W)	Nominal voltage of operation (V)	Nominal current of operation (mA)	Base	Bulb	Minimum efficacy (lm/W)
5W/5T4/T/G23/PH	5	38	180	G23	T-4	38
7W/5T4/T/G23/PH	7	45	180	G23		50
9W/6T4/T/G23/PH	9	59	180	G23		55
13W/T4/T/GX23/PH	13	59	285	GX23		52.5
9W/4T4/Q/G23-2/PH	9	59	180	G23-2	T-4	51
13W/5T4/Q/GX232/PH	13	59	285	G23-2		52
18W/7T4/Q/G24/PH	18	100	220	G24d-2		60.5
26W/8T4/Q/G24/PH	26	105	325	G24d-3		61.5

Nominal power, voltage, and current are specified to identify lamps. Source: NOM-017-ENER-1997.

Table 108: Minimum ballast efficacy values for CFLs, Mexico

Nominal Power Rating of the Lamp (W)	Minimum ballast factor (%)	Minimum BEF
7	92.5	9.00
9		7.80
13		5.10
18 (108 V_{OCV})		4.00
18 (198 V_{OCV})		3.30
26		2.50

BEF = ballast efficacy factor. Source: NOM-017-ENER-1997. Ballast factor = power factor

The lamp efficacy is determined using NMX-J-295-ANCE, while the ballast efficacy is determined using NMX-J-156-ANCE. NOM-017-ENER-1997 is partly based on IEC60901-1987, as amended in 1989 and 1992.

The Energy Secretariat and the Federal Consumer Advocate are the authorities in charge with the verification and certification that CFLs and ballasts sold comply with this standard.

Clothes washers

NOM-005-ENER-1996 sets the MEPS and test procedure for residential clothes washers sold in Mexico. It has been in effect since 11 April 1997. This MEPS and test procedure is unique and is not based on any foreign standards. It was developed in response to the growing commercialisation of USA-type top loading models in Mexico which were replacing the more efficiency and previously prevalent horizontal drum models. The standard sought to at least maintain current efficiency levels. A revision to this standard is under consideration.

The NOM-005-ENER-1996 does not apply to: clothes washers that do not use electricity, public service washers or commercial and industrial models.

The MEPS are set according to the clothes washer's physical characteristics (agitator, impulsor or barrel), operation characteristics (manual, semi-automatic, or automatic), and clothes capacity (small, medium, or large).

The maximum annual energy consumption level permitted in kWh/year is given in Table 109. It is determined by assuming 416 wash cycles per year and water at room temperature of 20^{o}C.

Table 109 MEPS for clothes washers in Mexico

Classification	Manual	Semiautomatic	Automatic
Impulsor up to 3.9 kg of clothes	30	36	
Impulsor from 4.0 to 5.9 kg of clothes	30	36	104
Impulsor from 6.0 to 10 kg of clothes	34		150
Agitator up to 3.9 kg of clothes	50	60	
Agitator from 4.0 to 5.9 kg of clothes	67	125	125
Agitator from 6.0 to 10 kg of clothes	121	221	218
Drum up to 3.9 kg of clothes			
Drum from 4.0 to 5.9 kg of clothes			227
Drum from 5.9 to 10 kg of clothes			

Source: NOM-005-ENER-1997, kWh/year for 416 cycles.

NOM-005-ENER-1997 also requires that the clothes washer's user manual provide information on the yearly electric energy consumption of the model and also of the maximum level permissible for that type of washer; based on the results of the test procedure stipulated in the NOM. Currently there is an effort to develop and require an energy label that would have to be attached to the outside of each clothes washer at the point of sale.

Fluid pumps

There are four MEPS for fluid pumps: NOM-001-ENER-1995, NOM-004-ENER-1995, NOM-006-ENER-1995, and NOM-010-ENER-1996.

NOM-001-ENER-1995 applies to vertical, external motor, turbine pumps used to pump clean water. It has been in effect since June 1996. The test method used to determine the pump efficiency follows that stipulated in ISO-3555-Class B. The minimum efficiency values required are shown in Table 110.

Table 110: MEPS values for vertical turbine external motor pumps, Mexico

Rated Power (kW)	Rated Power (hp)	Minimum Efficiency %
3.7-14.9	5 - 20	77
15.7-37.3	21 - 50	80
38-93.3	51 - 125	82
> 94	> 126	84

Source: NOM-001-ENER-1995

The efficiency of the pump at the guaranteed operation point (to one decimal place) needs to be displayed in the pump's nameplate.

NOM-004-ENER-1995 applies to centrifugal residential water pumps of 0.187 to 0.746 kW power rating. This MEPS attempts to limit the electric consumption of the millions of residential water pumps used in Mexico to fill rooftop water tanks due to the low water pressure in the water mains. It has been enforced since June 1996. The minimum efficiency levels required are shown in Table 111. These values are obtained using a test procedure similar to that of ISO-3555-1997-Class B.

Table 111. MEPS values for centrifugal residential water pumps, Mexico

Rated Power kW	Efficiency %
0,187	45
0,373	45
0,560	50
0,746	55

Source: NOM-004-ENER-1995

The NOM-004-ENER-1995 also stipulates that a yellow pump energy efficiency label be pasted or attached to the pump as shown in Figure 4.

Figure 4: Energy label for centrifugal water pumps, Mexico

NOM-006-ENER-1995 applies to electromechanical pumping systems of vertical turbine pumps with external or submersible motor of 5.5 kW to 261 kW (7.5 to 350 hp) used in deep agricultural wells. The purpose of the standard was to guide efforts to retrofit agricultural deep-well pumps and ensure that new wells use efficient equipment. Retrofit improvements could focus on the electric motor, the pump, the structure of the deep well, or a combination of these. It has been in effect since November 1996. The test method used to determine the pump system (not component) efficiency was designed in Mexico and does not follow any foreign standard test procedure. The minimum efficiency values required are shown in Table 112.

Table 112. MEPS values for deep-well pumping systems, Mexico

Rated Power kW	Rated Power hp	Electromechanical Efficiency %
5.6 - 14.9	7.5-20	52
15.7 - 37.3	21-50	56
38.0 - 93.3	51-125	60
94.0 - 261	126-350	64

Source: NOM-006-ENER-1995.

Operators of deep wells will have six months to improve their pump systems efficiency if it is found to be less than 40%. The Energy Secretariat is in charge of verifying compliance with this standard.

NOM-010-ENER-1996 applies to submersible clean water pumps. It has been enforced since January 1998. The submersible pumps are characterised in terms of their pump and electric motor efficiencies. The minimum efficiency levels required for each of these components are shown in Table 113 and Table 114. These values are obtained using a test procedure based on ISO-3555-1997-Class B.

Table 113: Pump efficiency values for submersible pumps, Mexico

Pump Capacity litres/second	Pump Efficiency %
Up to 2.0	48
From 2.0 to 5.0	61
From 5.0 to 15.0	71
From 15.0 to 25.0	72
From 25.0 to 30.0	74
From 30.0 to 60.0	77
Greater than 60.0	78

Source: NOM-010-ENER-1996.

Table 114: Electric motor efficiency values for submersible pumps, Mexico

Motor Rating kW	Motor Rating hp	Efficiency %
Up to 1.5	Up to 2.0	68
From 1.5 up to 2.2	From 2.0 up to 3.0	72
From 2.2 up to 3.7	From 3.0 up to 5.0	73
From 3.7 up to 5.6	From 5.0 up to 7.5	75
From 5.6 up to 7.5	From 7.5 up to 10.0	77
From 7.5 up to 11.2	From 10.0 up to 15.0	79
From 11.2 up to 14.9	From 15.0 up to 20.0	80
From 14.9 up to 22.4	From 20.0 up to 30.0	81
From 22.4 up to 29.8	From 30.0 up to 40.0	83
From 29.8 up to 44.7	From 40.0 up to 60.0	86
Greater than 44.7	Greater than 60.0	87

Source: NOM-010-ENER-1996.

The NOM requires that the overall efficiency at the guaranteed point (in percentage points to one decimal place) is included on the nameplate.

2.13 New Zealand

2.13.1 Regulatory and Administrative Framework

Overview of Framework

New Zealand's appliance and equipment energy efficiency programs have always been closely linked technically, commercially and administratively to those of Australia. The test procedures, comparative labelling and MEPS requirements for appliances are now mostly contained in joint Australian and New Zealand standards. For most products, the same manufacturers and importers supply the same model range into both markets, and even where different products are made for the two markets (eg storage electric water heaters), the same firms tend to dominate in both countries.

New Zealand's energy minister is a member of the Australian and New Zealand Minerals and Energy Council (ANZMEC – council of state and federal energy ministers) and New Zealand officials are members of its working groups, including the National Appliance and Equipment Energy Efficiency Committee (NAEEEC), which manages the Australian labelling and MEPS program.

Despite this convergence, the New Zealand appliance and equipment energy efficiency program has developed independently. Energy labelling is not mandatory, but labels sometimes appear on models imported from Australia, or on models manufactured locally for sale in both markets. In 1991 the NZ Electricity Development Association (EDA) introduced the "WaterMark" label for electric storage water heaters, a product which is not energy labelled in Australia. While not mandatory, the label has enjoyed high coverage because it is supported by the major utilities and manufacturers but in recent years has been less prominent.

A 1994 study of the feasibility of introducing MEPS in New Zealand recommended MEPS for water heaters, refrigerators and freezers, electric motors, fluorescent lamps and ballasts. It also recommended labelling of refrigerators and freezers, gas water heaters, gas space heaters, solid fuel space heaters and motors. (Energetics and GWA 1994). These proposals were further examined in subsequent studies (NZEIR et al 1996, Dialogue Consultants et al 1997).

As Table 115 shows, most of these possibilities are still under consideration. Draft legislation currently before the NZ Parliament, the *Energy Efficiency Bill*, would give the government the power to set MEPS levels for a range of products. While products suitable for MEPS have been identified, there are few detailed proposals at present.

The US EPA "Energy Star" is used for office equipment and there is a formal partnership arrangement with the US EPA for its use and promotion.

In this section, where New Zealand test procedures and (voluntary) labelling requirements are identical to (mandatory) labelling requirements in Australia, they are not detailed again but cross-referred to the section on Australia. Electricity supply voltage (230V) and frequency (50 Hz) are essentially the same as in Australia (although Australia is still nominally 240V).

2.13.2 Summary of Products Covered

Table 115: Energy Efficiency Programs in New Zealand

	Program Type				
Product Description	**A. Comparison label**	**B. Endorsement label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerators and/or Refrigerator-freezers	V(1986) M(UC)(a)		M(UC)(a)		
Separate freezer	V(1986) M(UC)(a)		M(UC)(a)		
Room air conditioners (<=7.5 kW cooling)	V(1987) M(UC)(a)				
Electric motors		V(UC)(b)	M(UC)(b)		
Fluorescent Lamps			M(UC)(b)		
Fluorescent Lamp ballasts			M(UC)(b)		
Clothes washers	V(1990) M(UC)(a)				
Dishwashers	V(1987) M(UC)(a)				
Clothes dryers	V(1990) M(UC)(a)				
Electric water heaters	V(1991)(c)		M(UC)(b)		
Personal computers & VDUs		V(d)			
Printers		V(d)			
Fax machines		V(d)			
Photocopiers		V(d)			

Sources: EECA (1999), GWA (1998) (a) Voluntary use of Australian energy labels; if RF MEPS implemented in NZ, Australian levels would be adopted. (b) New Zealand program being developed independently of Australia. (c) WaterMark label scheme. (d) Energy Star label.

Table 116: Energy Test Procedures and Labelling Requirements, New Zealand

Product Description	Labelling and/or MEPS requirements(a)	Local Test Procedures(a)	Reference Test procedures
Refrigerators and/or Refrigerator-freezers	AS/NZS 4474.2-1997	AS/NZS 4474.1-1997	ISO7371, ISO8561, ISO8187 and ISO5155 and US DOE
Separate freezer	AS/NZS 4474.2-1997	AS/NZS 4474.1-1997	ISO7371, ISO8561, ISO8187 and ISO5155 and US DOE
Room air conditioners (<=7.5 kW cooling)	AS/NZS 3823.2-1998	AS/NZS 3823.1.1-1998	ISO5151
Electric motors	Under consideration	No NZ standard: AS1359-1969 commonly used (a)	IEC60034.2
Fluorescent lamps	Under consideration	No NZ standard	CIE 25 IEC60081 IEC60901
Fluorescent Lamp ballasts	Under consideration	AS3134, AS2643 (b)	IEC60921
Clothes washers	AS/NZS 2040.2-1998	AS/NZS 2040.1-1998	IEC60456
Dishwashers	AS/NZS 2007.2-1998	AS/NZS 2007.1-1998	IEC60436
Clothes dryers	AS/NZS 2442.2-1996	AS/NZS 2442.1-1996	AHAM A197.6
Electric water heaters		NZS4602 NZS 4606	
Personal computers & VDUs		US EPA tests	
Printers		US EPA tests	
Fax machines		US EPA tests	
Photocopiers		US EPA tests	

(a) test method based on IEEE Method B is being developed jointly with Australia, including motor MEPS requirements. (b) test method based on total circuit power and light output/lamp power, including ballast MEPS requirements, is being jointly developed with Australia.

Refrigerators/Freezers

The labelling of refrigerators and freezers with the Australian comparative energy labels occurs on a voluntary basis in New Zealand. Product coverage, labelling criteria and requirements, test standards and procedures are therefore all identical to those detailed in the section on Australia. In the event that New Zealand should decide to adopt MEPS for refrigerators and freezers, it is highly likely that the requirements will also be identical to those in Australia.

Air Conditioners

The labelling of air conditioners with the Australian comparative energy labels occurs on a voluntary basis in New Zealand. Product coverage, labelling criteria and requirements, test standards and procedures are therefore all identical to Australia.

Electric Motors

Details of the MEPS and voluntary endorsement label currently under consideration are not known, but these are likely to be harmonised with the MEPS and voluntary endorsement label proposals currently under consideration in Australia (see section on Australia). There is no New Zealand test standard for motors, but Australian Standard AS1359-1969 is commonly used. A new joint standard incorporating the IEEE test method and MEPS for motors is being developed jointly with Australia.

Fluorescent Lamps

There are three main lamp technology groups on the NZ market: 38 mm diameter monophosphor, 26 mm monophosphor and 26 mm tri-phosphor. A 1994 study recommended that a minimum efficacy requirement of 80 lumens/watt should be adopted (Energetics and GWA 1994). This would have the effect of excluding all technology groups apart from 26 mm tri-phosphor. There is no New Zealand test standard for fluorescent lamps, but CIE 25 is commonly used to specify light attributes as well as IEC60081 and IEC60901.

Fluorescent Lamp Ballasts

The New Zealand ballast market is segmented in the same way as in Australia, which in fact supplies most of New Zealand's ballast market:

- Standard "code" ballasts, consuming about 9.5 W in circuit with or a 36W or 40W tube account for most of the market;
- "Low loss" magnetic ballasts, consuming about 5.5 W in circuit with or a 36W or 40W tube;
- "Super low loss" magnetic ballasts, consuming about 3.5 W in circuit with or a 36W or 40W tube;
- Electronic ballasts, which for only a small share of the market.

Details of the MEPS program currently under consideration in New Zealand are not known, but these are likely to be harmonised with the MEPS proposals currently under consideration in Australia, ie a level which would prevent the sale of any ballasts less efficient than the "low loss" type (see section on Australia). There is no New Zealand test standard for ballasts, but Australian Standards AS3134 and AS2643 are commonly used. A test method using total circuit power and light output (or lamp power) based on EN50294 is jointly under development with Australia together with a standard specifying MEPS for ballasts.

Clothes Washers

The labelling of clothes washers with the Australian comparative energy labels occurs on a voluntary basis in New Zealand. Product coverage, labelling criteria and requirements, test standards and procedures are therefore all identical to Australia.

Dishwashers

The labelling of dishwashers with the Australian comparative energy labels occurs on a voluntary basis in New Zealand. Product coverage, labelling criteria and requirements, test standards and procedures are therefore all identical to Australia.

Clothes Dryers

The labelling of clothes dryers with the Australian comparative energy labels occurs on a voluntary basis in New Zealand. Product coverage, labelling criteria and requirements, test standards and procedures are therefore all identical to Australia.

Electric Water Heaters

Program coverage

The New Zealand standards NZS4602 and NZS4606 set out maximum standing heat losses for electric storage water heaters of the vented and unvented types, as well as a range of other requirements relating to construction. The heat loss levels were made more stringent in 1988, but manufacturers were under no obligation to comply with them. In 1991 the Electricity Development Association (EDA) introduced a "Water Mark" label which indicated whether a water heater complied with the new heat loss levels ("Class A") or with less stringent heat losses (Classes B to D).

The label is effectively an endorsement label for Class A water heaters rather than a full comparative label, since it does not explain the entire range of ratings. The label is voluntary, although compliance among Class A product is high because of the publicity support given to the program by the EDA and the electricity utilities. There are now few Class B products on the market, and virtually no Class C or D.

Criteria and requirements

The standing heat loss limits in NZS 4602 and Water Mark Classes are shown in Table 117.

Table 117: Maximum heat losses, electric storage water heaters, New Zealand

Storage volume litres	Maximum Allowable Standing Heat Loss (kWh/day) for Water Mark Classes			
	A (a)	**B**	**C**	**D**
135	1.4	1.8	2.8	3.2
180	1.6	2.0	3.2	3.6
225	1.8	2.3	3.6	4.0
270	2.0	2.56	4.0	4.6
360	2.5	3.2	5.0	5.8
450	2.9	3.7	5.8	6.7

(a) Corresponds to maximum allowable standing heat loss in NZS4602-1988

There is a proposal to amend the New Zealand *Building Code* to require new electric water heaters to comply with the heat loss limits in NZS 4602 (ie Water Mark Class A). The *Code* would oblige the dwelling owner (ie the builder in the case of speculative or project housing) to install MEPS-compliant water heaters at the time of construction or refurbishment. The *Code* would also require replacement water heater installations to be brought up to the same standards.

If this change were made without introducing water heater MEPS under the *Energy Efficiency Act*, it would continue to be lawful to sell non-compliant water heaters, but effectively unlawful to install them.

Test procedures

The test procedure is set out in NZS4602 and NZS4606.1.

Office Equipment and Home Electronics

Program coverage

The Energy Efficiency and Conservation Authority (EECA) has made arrangements with the US EPA to promote the Energy Star endorsement label for personal computers (PCs), visual display units (VDUs), printers, plain paper fax machines and photocopiers.

Criteria and requirements

All products which comply with the power management requirements specified for that product category by the US EPA Energy Star program are entitled to carry the Energy Star label.

Test procedures

The test procedures are as specified by the US EPA. The voltage and frequency differences are covered in the US EPA procedure, which states that:

> "If products will be sold in Europe or Asia, testing should also be performed at the appropriate machine-rated voltage and frequency. For example, products destined for the European markets might be tested at 230V and 50 Hz." (US EPA 1996)

Transformers

Program coverage

It is believed that there are MEPS for distribution transformers in Mexico, but details have not been determined for this report.

2.14 Papua New Guinea

2.14.1 Overview of the Regulatory Framework

Papua New Guinea has not implemented any energy efficiency standards or regulations at the time of writing. However, the South Pacific Applied Geoscience Commission, who is responsible for the coordination of energy programs for the Pacific Island Nations (which includes Papua New Guinea), indicated that some Pacific Island Nations are considering some voluntary and mandatory energy programs such as energy labelling for appliances. They felt that the information collected for this study would assist them in the area of program development and testing procedures.

2.14.2 Summary of Regulated Products

No energy regulations have been imposed on electrical products in Papua New Guinea.

2.15 Peru

Peru has moved dramatically toward a free market economy since President Fujimori took office in 1990. Peru's economy has been growing at about 6%-7% since the early 1990s with GDP reaching US$ 61 billion in 1997 (EIA 1998b). Inflation has been reduced to about 7%-8% per annum. Exports were US$ 6.8 Billion in 1997 (copper 18%, fish-meal 14%, zinc 7%, oil 5%). Imports that year were US$ 8.3 Billion (raw materials 41%, capital goods 31%, consumer goods 23%).

In early 1996, Peru had a total installed electric generating capacity of 3.8 GW, of which 65% was hydro-electric. About half of the capacity is operated by state-owned companies, 30% by mining and industrial self-generators, and 20% by private electric generation companies. Decree Law No. 25844 of 1992 established a free-market legal framework for the electric sector. The government has also reduced subsidies to electric rates. About 65% of households and business had electricity in 1997 and it was expected that 75% would have electricity by 2000. The electric sector is expected to require investments in the order of US$ 300-350 million annually through 2000 to cover expected demand growth.

No data was found on current appliance saturation, sales, import and exports, and unit-energy consumption. Further research in this area will be needed if Peru is to develop programs in these areas.

2.15.1 Regulatory Framework in Peru

The Comisión de Reglamentos Técnicos y Comerciales (CRT - the Commission of Technical and Commercial Regulations) of the Instituto Nacional de Defensa de la Competencia y de la Protección de la Propiedad Intelectual (INDECOPI - the National Institute in Defence of Competition and Protection of Intellectual Property) is the government body officially entrusted with approving any technical standards in Peru (El Peruano 1993). The CRT creates (under recommendation from its own Technical Secretariat), Comités Técnicos de Normalización (CTN - Technical Standards Committees) that are responsible for elaborating the Peruvian standards. The CTN are staffed with experts in the field.

To select the background for the design of a standard proposal, international standards by ISO, IEC, CODEX, OIML are examined. If these do not exist for the product being considered, then regional standards CEN, CENELEC, COPANT, and ANDINAS are examined. Otherwise other countries' or internationally known associations' standards such as ASTM, SAE, NFPA, etc. Are reviewed. If none of the above exist, then consideration is given to developing technical specifications or association standards on a local basis.

The design of Peruvian standards goes through six stages: a) proposal; b) formulation; c) committee; d) public review; e) approval; and f) edition and finally publication. The first two stages take place within various committees and result in a proposed standard that needs to be approved by the Comisión de Supervisión de Normas Técnicas, Metrología, Control de Calidad y Restricciones Paraarancelarias (CNM of INDECOPI). If required, a thirty-day period for public comment follows before final approval of the standard.

There are four systems for developing a Peruvian standard. Under system 1, the Peruvian standard is basically the adoption of an already existing foreign standard. Under system 2, a foreign standard is modified, otherwise a standard is developed without reference to other existing ones. In this situation, a public comment period is required. System 3 refers to emergency situations. System 4 refers to the revision of past Peruvian standards. Here, public comment period is required if the standard being reviewed was developed initially under system 2.

No MEPS or energy labels exist at this point in Peru. In April 1996 CENERGIA convinced the Sociedad Nacional de Industrias (SNI - National Industries Society) to participate in the elaboration of MEPS. The INDECOPI agreed in September 19, 1996 to set up a Comité de Normas Técnicas para el Uso Racional de Energía (National Technical Committee for Rational Energy Use – referred to below as "the committee"). CENERGIA was given the Presidency and Technical Secretariat of the Committee.

At this time, as part of the Junta del Acuerdo de Cartagena del Pacto Andino (Andean Pact Cartagena Meeting Agreement), the Programa Andino de Integración Energética - PAIE (Andean Energy Integration Program) had a plan to develop and apply energy efficiency standards (MEPS) among member countries. The objective of the PAIE was to have harmonised MEPS that would facilitate commerce between member countries. The PAIE designated INDECOPI at the Technical Secretariat of the Andean Committee of Rational Energy Use, with CENERGIA being given a technical advisory role. An operative plan was formulated to harmonise standards, beginning with appliances, specifically household refrigerators and freezers, to define MEPS and labels. It was believed that the Andean MEPS would accelerate the process within Peru. Once the Rational Energy Use Committee had been installed, it was agreed that during 1996-1997 the elaboration of MEPS would be done in the following priority: a) residential refrigerators; b) residential lighting; and c) electric motors.

At the time, Peru was facing a potential shortfall in electric supply. To reduce the electric demand growth, the government had already instituted a national program to save energy based on a massive public advertisement campaign.

During 1996 and 1997, the Committee approved a pre-proposal for MEPS for household refrigerators (manual and automatic defrost) and freezers, and for residential lighting (incandescent, fluorescent, and electromechanical and electronic ballasts).

Refrigerator MEPS began with a proposal of the PAIE. This was adjusted by CENERGIA and submitted to the working group composed primarily by manufacturers. By April 1997, the Committee approved the proposed MEPS for refrigerators. The next step involved formatting the proposal according to INDECOPI requirements to seek their approval. The test method for household refrigerators is based on ISO 7371. The test method for automatic-defrost refrigerator/freezers is based on ISO 8571. The test method for freezers is based on ISO 5155.

For lighting, CENERGIA formed a subcommittee in early 1997 that proceeded to elaborate proposals for MEPS for incandescent lamps, fluorescent lamps (including compacts), and ballasts. To guide these efforts, they used the following foreign standards[2]: Anteproyecto de Norma Técnica Colombiana de Eficiencia Energética de Lámparas Fluorescentes. Métodos de Ensayo EN60064-1989 Lámparas de filamento

2 Note these EN standards are technically equivalent to IEC standards of the same number.

de wolframio para uso doméstico y alumbrado general similar. Requisitos de funcionamiento. EN60928-1994 Balastros electrónicos alimentados en corriente alterna para lámparas fluorescentes tubulares (safety of electronic ballasts). Prescripciones generales y seguridad (versión oficial EN60929-1991 - performance of electronic ballasts). IES Electrical and photometric Measurements of Single-End compact fluorescent lamps; Anteproyecto de Norma Técnica Costarricense. Lámparas de filamento incandescente para uso general. Medición de sus características eléctricas y fotométricas.

The work on a test method for electric motors did not progress. However, it will be probably be based on adopting an IEC standard.

During 1998 the Committee ceased working. It is still waiting for the INDECOPI to design a new Secretariat and provide resources to continue the elaboration of standards.

Early 1999 INDECOPI showed renewed interest in MEPS. But there is no clear indication from the Ministerio de Energía y Minas (MEM - Ministry of Energy and Mines), who oversees all activities in this sector, when activity will commence again. There is a new project for an Energy Efficiency Law (with the participation of INDECOPI, MEM, electric utilities, and SNI) under auspices of the ECLAC. This has included discussion on the possibility of regional labels, but INDECOPI was against them as thought they would distort the market and/or import barrier. At the time of writing, no further activity was in progress.

2.16 Philippines

2.16.1 Overview of the Regulatory Framework

The Philippines Department of Energy (DOE) manages most aspects of energy policy and planning in the Philippines, and chairs the DSM Working Group for the nation. Energy performance standards are developed by a Technical Committee constituted by representatives from all sectors of society including suppliers, manufacturers, consumers, academia, and government agencies.

Residential Air Conditioner Standards and Labelling

One of the Philippine DOE's greatest accomplishments in terms of energy efficiency is the Residential Air Conditioner Standards and Labelling program. After years of coordination with manufacturers and the Department of Trade and Industry's Bureau of Product Standards (BPS), the DOE launched the program in late 1993, and began energy labelling in early 1994.

The DOE, the Department of Trade and Industry, and the Association of Home Appliance Manufacturers jointly administer the program. The three parties signed a memorandum of agreement in July 1992. The Department of Trade and Industry's BPS is the Philippines' national standards body and is mandated to develop, implement, and coordinate standardisation activities in the Philippines. BPS also enforces MEPS for air conditioners, with technical and energy performance testing assistance from the Fuels and Appliance Testing Laboratory (FATL), which is operated under the DOE. FATL is a key component of the program, serving as a neutral testing laboratory to verify manufacturers' assertions of the efficiency of their units.

Before the initiation of the program, only half of the annual sales volume for small-sized window-type air conditioners met the MEPS level, and none of the larger units did. By forcing these units off the market, the program had an immediate and pronounced effect on the overall efficiency of air conditioners on the market. FATL analysis suggests that there was a 23 percent improvement in energy consumption of all air conditioning units between 1992 and 1997.

The government is now introducing energy labelling for refrigerators. There are also plans to expand the labelling program to cover fluorescent lamps, industrial motors and washing machines before the year 2000. The Philippines also plans to establish energy performance standards for ballast for fluorescent lamps.

2.16.2 Summary of Regulated Products

Table 118 below summarises current and planned energy-efficiency regulations and programs in the Philippines.

Table 118: Energy efficiency regulations and programs in Philippines

	Program Type				
Product Description	**A. Comp-arison label**	**B. Endorse-ment label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerator and/or Refrigerator-Freezer	M (target 1999)				
Separate Freezer	M (target 1999)				
Room Air Conditioners (window wall)	M (1994)		M (1994)		
Room Air Conditioners (other e.g. split systems)	M (1994)		M (1994)		
Packaged Air Conditioners (with ducting)	M (UC)				
AC Electric Motors	M (UC)				
Fluorescent Lamps	M (UC)				
Fluorescent Lamp Ballasts	M (target 1999)		M (1999)		
Clothes Washers	M (UC)				

Table 119: Energy test procedures in the Philippines

Product Description	Local Test Procedures	Reference Test Procedures
Refrigerator and/or Refrigerator-Freezer	PNS 1475 PNS 1476 PNS 1477	ISO 7371 ISO 8187 ISO 8561
Separate Freezer	PNS 1474	ISO 5155
Room Air Conditioners (window- and split-type)	PNS 240	ISO 5151
Packaged Air Conditioners (with ducting)	Not Determined	
AC Electric Motors	Not Determined	
Fluorescent Lamps	PNS 603-1 PNS 603-2	IEC60968 IEC60969
Fluorescent Lamp Ballasts	PNS 02 PNS 12-1 PNS 12-2	IEC60081 Amd. 5 IEC60920 IEC60921
Clothes Washers	Not Determined	

Refrigerators/Freezers

Regulation or program (effective date)

Labelling for refrigerators (target 1999).

Product category

All refrigerator/freezers.

Criteria and requirements

Label must display energy efficiency factor (EEF), power input, and volume (litres). Calculation of EEF not determined.

Testing standards and procedures

FATL uses the Philippine National Standard PNS 1474:1997, PNS 1475:1997, PNS 1476:1997, and PNS 1477:1997, which respectively reference (Zambala 1999):

- ISO 5155-1995: Frozen food storage cabinet and food freezer
- ISO 7371-1995: Refrigerators with or without low-temperature compartment
- ISO 8187-1991: Refrigerator-freezer
- ISO 8561-1995: Refrigerators, refrigerator-freezers, frozen food storage cooled by internal forced air circulation

Other standards which are relevant for refrigerators in the Philippines are:

- PNS 185:1989: Method for Determining the Energy Consumption, Freezer Temperature and Energy Efficiency Factor of Refrigerators and Freezers for Household Use (no longer in use)
- PNS 165:1998: Method of Computing Total Refrigerated Volume and Total Shelf Area of Refrigerators and Freezers for Household Use

Room air conditioners

Regulation or program (effective date)

Air Conditioner Standards and Labelling Program (1994)

Product category

Window-type and split-type residential air conditioners ≤36,000 kJ/h (8.6kW)

Criteria and requirements

Minimum Energy Efficiency Ratio (EER) requirement schedule for air conditioners:

Table 120: Minimum EER requirement for air conditioners, Philippines

A/C Capacity	1995	1996	1997	1998	1999	2000	2001	2002
Cooling Capacity < 12,000 kJ/h	8.3	8.3	8.3	8.7	8.7	8.7	9.1	9.1
Cooling Capacity ≥ 12,000 kJ/h	7.4	7.8	7.8	7.8	8.2	8.2	8.2	8.6

Note: 12,000 kJ/h is 2.9kW

These EER and energy labelling requirements are officially stated in the Philippine National Standard PNS 396:part 1:1991.

Testing standards and procedures

FATL follows the Philippine National Standard PNS 240:1989: Method for Testing and Rating Room Air Conditioners, which references:

- ISO 5151: Non-ducted air conditioners and heat pumps – Testing and rating for performance (with outdoor test conditions applicable to Philippines.

However, PNS240 varies the outdoor conditions of test from ISO5151 by setting a higher outdoor humidity.

Packaged air conditioners (ducted)

Regulation or program (effective date)

Labelling for Central Air Conditioning (Under Consideration).

Product category

Package type units up to 10 tons cooling capacity (up to 35.17 kW).

Criteria and requirements

Not determined yet.

Testing standards and procedures

Not determined yet.

Electric motors

Regulation or program (effective date)

Labelling for electric motors (Under Consideration).

Product category

AC electric motors – exact sizes not determined.

Criteria and requirements

Not determined yet.

Testing standards and procedures

Under development – most probably IEC60034-2.

Fluorescent lamps

Regulation or program (effective date)

Standards and labelling for fluorescent lamps and CFLs (Under Consideration).

Product category

Linear-tube fluorescent lamps and compact fluorescent lamps (CFLs).

Criteria and requirements

Label would need to show energy rating, lumens, and other electrical parameters.

Testing standards and procedures

FATL follows PNS 603-1:1993 and PNS 603-2:1993 national standards for fluorescent lamps – self-ballasted for general lighting services safety and performance requirements, respectively. The two PNS standards directly reference IEC standards (Zambala 1999):

- IEC60968:1998 - safety of CFLs
- IEC60969:1998 - performance of CFLs

Ballasts for fluorescent lamps

Regulation or program (effective date)

Standards and labelling for ballasts (target 1999).

Product category

Ferromagnetic ballasts.

Criteria and requirements

Ballasts will be tested and rated into four separate classes (A to D) based on their energy performance (loss in Watts) as shown in the following tables (Soriano 1998).

Table 121: Classification of preheated ferromagnetic ballasts, Philippines

	Preheat Maximum Ballast Loss Standard Classification			
Ballast Type	**A**	**B**	**C**	**D**
2 x 18/20 W or 1 x 36/40 W	≤ 7 W	> 7 W ≤ 8 W	> 8 W ≤ 10 W	>10 W ≤ 12 W

Table 122: Classification of rapid start ferromagnetic ballasts, Philippines

	Rapid Start Maximum Ballast Loss Standard Classification			
Ballast Type	**A**	**B**	**C**	**D**
2 x 18/20 W or 1 x 36/40 W	≤ 12 W	> 12 W ≤ 13 W	> 13 W ≤ 15 W	>15 W ≤ 18 W
2 x 36/40 W	≤ 17 W	> 17 W ≤ 18 W	> 18 W ≤ 20 W	> 20 W ≤ 30W

Testing standards and procedures

FATL uses the PNS 02:1994, PNS 12-1:1996, and PNS 12-2:1996 test procedures, which respectively reference (Zambala 1999):

- IEC60081(1984): Tubular Fluorescent Lamps for General Lighting Services

- IEC60920(1990-1995): Ballasts for tubular fluorescent lamps - general and safety requirements
- IEC60921 (1990): Ballasts for Tubular Fluorescent Lamp – Performance Requirements

Clothes washers

Regulation or program (effective date)

Standard and Labelling for Clothes Washers (Under Consideration).

Product category

All types of clothes washers.

Criteria and requirements

Not determined yet.

Testing standards and procedures

Under development - most probably IEC. BPS Test facility is available. It is currently used for safety testing of clothes washers.

2.16.3 Related Energy Efficiency Programs

After Thailand, the Philippines has the most developed framework for demand-side management programs in South East Asia. An Integrated Resource Planning (IRP) study has been completed and an efficiency-friendly regulatory and institutional framework exists, although IRP has not yet been formally adopted. The Philippine utilities (Napocor, Meralco, Cepalco, and others) have all developed DSM plans and submitted them to the government. Implementation of DSM is stalled, however, due to the current power glut and the uncertainty surrounding restructuring of the electricity sector. The future direction of energy efficiency policy in the Philippines will become clearer after the government passes an Omnibus Energy Bill, which is currently being debated in the House and Senate.

2.17 Russia

2.17.1 Overview of the Regulatory Framework

Russia has had a program of energy efficiency standards for energy consuming equipment for many years. The agencies concerned with their development are the Ministry of Fuel and Energy, GOSTANDART of Russia (the State Committee of Russian Federation for Standardisation and Meterology, also known as GOST) and ZNEENMash (an affiliate of GOST who are responsible for the development of product energy performance regulations). Product energy performance requirements are contained in the same GOSTANDART regulations, always prefixed with GOST, that describe the product's energy test procedure and are usually mandatory. Another state agency, Mintopenergo, are responsible for developing and overseeing voluntary energy efficiency requirements and targets.

2.17.2 Summary of Regulated Products

Table 123 lists products that are subject to energy efficiency programs in Russia. The test procedures for each program are shown in Table 124.

Table 123: Energy efficiency regulations and programs, Russia

Product Description	Program Type				
	A. Comparison label	**B. Endorsement label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerators and/or refrigerator-freezers			M (1987)		
Separate freezers			M (1987)		
Room air conditioners			M (1986)		
AC electric motors			M (UC)		
Electric water heaters			M (1984)		
Clothes washers			M (UC)		
Dishwashers			M (1987)		
Cooking ranges			M (1983)		
Televisions			M (1989)		
Domestic sound frequency signal amplifiers			M (1990)		
Personal computer video monitors			M (1989)		
General purpose digital computers			M (1989)		
Personal computers			M (1989)		
Printers			M (1989)		
Plotters			VL (1993)		
Graphical input devices			M (1989)		

Table 124: Energy performance test procedures, Russia

Product Description	Local Test Procedures	Reference Test Procedures
Refrigerators Refrigerator-Freezers Freezers Frost-free refrigerators/ freezers	GOST 16317-76 refs: CT C3B 608-77 CT C3B 1616-79 CT C3B 4672-84 GOST 14087-88 GOST 15009-86 GOST 15150-69 GOST 23511-79 GOST 17446-86 GOST 2750.1-87 GOST 26119-84 GOST 26828-86 GOST 24899-81 GOST 14192-77 GOST 21929-76 GOST 15846-79 GOST 18321-73 GOST 16842-82 GOST 26678-85 GOST 23216-78	ISO 7371-85 ISO 5155-83 ISO 3055
Air Conditioners (window- and split-type and ducted)	GOST 26963-86 (revised 1989)	None but has similarities with ISO 5151-94
Household electric water heaters	GOST 23110-84	NA
Household electric dish washers	GOST 27454-87	NA
Television receivers	GOST 18198-89	NA
Household electric washing machines	GOST 8051-93	NA
Electric ranges (cookers)	GOST 14919-83E	NA
Domestic sound frequency signal amplifiers	GOST 24388-88	NA
Personal computer video monitors	GOST 27954-88	NA
General purpose digital computers	GOST 16325-88	NA
Personal computers	GOST 27201-87	NA
Printers	GOST 21776-87	NA
Plotters	GOST 19098-87 (revised 1993)	NA
Graphical input devices	GOST 24593-87	NA
Car tape recorders	GOST 24796-87	NA

Refrigerator/Freezers

Regulation or program (effective date)

GOST 16317-87: Electric domestic refrigerating appliances. General specifications (1991)

Product category

All household refrigerators, refrigerator-freezers and freezers (including both vapour compression and absorption types)

Criteria and requirements

The MEPS levels, that have been applicable since 1991, are defined in Table 125.

Table 125: Refrigerator and freezer MEPS, Russia

Volume (litres)	Fridge no EFC	Fridge with 2-star EFC	Fridge with 3-star EFC	Fridge with 3-star EFC with 2-doors	Fridge with 3-star EFC with 3-doors	Refrigerat or-freezers	Freezers	Fridge with 1-star EFC	Fridge with 2-star EFC	Fridge with 3-star EFC	Fridge with 3-star EFC and 2 doors
	Vapour-compression models						Absorption models				
	Daily electricity consumption (kWh/day)										
80							0.864	1	1.25	1.5	
120		0.624	0.749				0.996	1.08	1.35	1.62	
140	0.588	0.686	0.823					1.05	1.3125	1.575	
160							1.136				
180	0.684	0.774	0.929								
200		0.780	0.936				1.2				1.56
220	0.704	0.770	0.924				1.254	1.1	1.375	1.65	1.65
240		0.792	0.950								
250				0.900							
260		0.832	0.998								1.69
270				0.918							
280		0.840	1.008	1.02							
300		0.840	1.008	1.12	1.02	1.05					
350					1.05	1.12					
400				1.2	1.2	1.28					
420						1.344					
450					1.26	1.44					

Testing standards and procedures

Russia's refrigerator and freezer test procedures are based on, but are not identical to, ISO international test procedures. The test procedure is given in the MEPS regulations:

- GOST 16317-87: Electric domestic refrigerators. General specifications (1991)

This procedure references the international procedures:

- ISO 7371-85: Household refrigerating appliances – refrigerators with or without low-temperature compartments – characteristics and test methods
- ISO 5155-83: Household refrigerating appliances - frozen food storage cabinets and food freezers – characteristics and test methods
- ISO 3055: Kitchen equipment - Coordinating sizes.

Room air conditioners

Regulation or program (effective date)

GOST 26963-86: Self-contained room air conditioners. General specifications (1989).

Product category

Cooling-only and reversible room air conditioners (non-ducted window and split-type) in the cooling mode.

Criteria and requirements

Table 126 shows the MEPS requirements for room air conditioners applicable since 1990.

Table 126: MEPS for room air conditioners (cooling-only or reversible), Russia

Cooling capacity (W)	Electrical power demand in the cooling-mode or the heating-mode (W)	Specific weight (kg/(kW*year))
1120	700	4.01
1400	800	3.38
1740	900	2.93
2240	1150	2.32
2800	1450	2.22
5600	2800	2.1-2.15

These standards apply to single-packaged (windows) units. Split-packaged units are subject to the same MEPS requirements but with the power demand increased by up to 15% and the specific weight increased by up to 20% for an identical cooling capacity.

Testing standards and procedures

The test procedure is given in the MEPS regulation:

- GOST 26963-86: Self-contained room air conditioners. General specifications

which is based on, but is not identical to, ISO R859 (now withdrawn – predecessor to ISO5151).

Electric water heaters

Regulation or program (effective date)

GOST 23110-84: Household electric water heaters. General specifications.

Product category

All electric storage water heaters.

Criteria and requirements

Table 127 shows the current MEPS requirements for electric storage water heaters in Russia.

Table 127: MEPS for household electric water heaters, Russia

Storage volume (litres)	Heater capacity (kW)	Time of a first water heating (hours)	Reheating time (hours)	Maximum Daily standing losses (kWh/24h)
heaters without heat insulation				
5	1.25	0.35		
10	1.25	0.95		
15	1.25	1.35		
heaters with heat insulation				
5	1.25		0.3	0.4
10	1.25		0.9	1.0
25	1.25		2.0	1.6
200	1.6		10.4	4.0

Testing standards and procedures

The test procedure is given in the MEPS regulation:

- GOST 23110-84: Household electric water heaters. General specifications.

Dishwashers

Regulation or program (effective date)

GOST 27454-87: Household electric dishwashers. Performance parameters and main dimensions.

Product category

All household electric dishwashers.

Criteria and requirements

The currently applicable MEPS levels are defined in Table 128.

Table 128: MEPS for dishwashers, Russia

Class	A	B	C
Minimum washing quality	0.9	0.8	0.6
Minimum drying quality	0.9	0.8	0.6
Maximum electricity consumption:			
total (kWh)	1.85	2.2	2.8
specific (kWh per dish set)	0.16	0.24	0.29
Maximum water consumption (litres)			
total (litres)	42	50	62
specific (litre per dish set)	3.5	4.3	6.5

Testing standards and procedures

The test procedure is given in the MEPS regulation:

- GOST 27454-87: Household electric dishwashers. Performance parameters and main dimensions.

Televisions

Regulation or program (effective date)

GOST 18198-89: Television receivers.

Product category

Colour and black and white televisions (non-portable or portable).

Criteria and requirements

The currently applicable MEPS levels are defined in Table 129.

Table 129: MEPS for televisions, Russia

Type	Screen diagonal size (cm)	Maximum on-mode power demand (W)	
		colour	black & white (a)
Stationary	67	80	
	61	80	50
	51-40	60	40
Portable	44-40	70	40
	32	60	
	31		35/22
	25	50	
	23		30/20
	16		18/8

(a) The second figure indicates the maximum power demand when using an autonomous power supply

Testing standards and procedures

The test procedure is given in the MEPS regulation:

- GOST 18198-89: Television receivers

Electric ranges

Regulation or program (effective date)

GOST 14919-83E: Electric ranges.

Product category

Electric ranges and built-in ovens.

Criteria and requirements

MEPS levels are set for the electric power demand (kW) and the electric burner (hot plate) efficiency of between 64% to 53%. MEPS are also set for electric built-in ovens, which must not consume more than 0.015 kWh/dm^3 to raise the oven temperature up to 250 °C. The specific power demand should not exceed 0.16W/cm^3 to maintain this temperature.

Testing standards and procedures

The test procedure is given in the MEPS regulation:

- GOST 14919-83E: Electric ranges.

Amplifiers

Regulation or program (effective date)

GOST 24388-88: Domestic sound frequency signal amplifiers. General specifications (1990).

Product category

Domestic sound-system amplifiers.

Criteria and requirements

The MEPS regulations apply to amplifiers grouped according to their frequency ranges as follows:

- group 0 – frequency range of 10-40000 Hz
- group 1 – frequency range of 20-25000 Hz
- group 2 – frequency range of 40-16000 Hz

The currently applicable MEPS levels are defined in Table 130.

Table 130: MEPS for amplifiers, Russia

	Nominal full resistance load (Ohms)	Maximum weight (kg)		Maximum input power (W)	
Type		group 0 (a)	group 1 (a)	Group 0	group 1 (a)
UP		6	4.5	20	15
UM	4	7+0.06 Pnom	5+0.05 Pnom	TU (b)	3.4 Pnom
	8	7+0.09 Pnom	5+0.07 Pnom	TU (b)	3.4 Pnom
U	4	8+0.08 Pnom	5.5+0.06Pnom	TU (b)	10+3.4 Pnom
	8	8+0.10 Pnom	5.5+0.08Pnom	TU (b)	10+3.4 Pnom

(a) Pnom- nominal output power of one channel of the amplifier.
(b) TU indicates it is an industry specified voluntary value
Where U-general amplifiers, UP – preliminary, UM – power amplifiers.

Testing standards and procedures

The test procedure is given in the MEPS regulation:

- GOST 24388-88: Domestic sound frequency signal amplifiers. General specifications

Personal computers

Regulation or program (effective date)

GOST 27201-87: Personal computers. Types, basic parameters, general requirements

Product category

Personal computers.

Criteria and requirements

The currently applicable MEPS levels are defined in Table 131. These MEPS are thought to be out of date but have not been repealed.

Table 131: MEPS for personal computers, Russia

Class	Memory (MBytes)	Maximum weight (kg)	Maximum power demand (W)
1	0.5 (floppy)	3	25
2	0.5 (floppy)	5	35
3	20	7	85
4	40	12	120
5	80	15	150

Testing standards and procedures

The test procedure is given in the MEPS regulation:

- GOST 27201-87: Personal computers. Types, basic parameters, general requirements

Printers

Regulation or program (effective date)

GOST 21776-87: *Printers. General specifications.* (Originally 1989 but new values have applied since 1991)

Product category

'Non percussive' printers (i.e. non dot matrix printers or non-daisy wheel).

Criteria and requirements

The currently applicable MEPS levels are defined in Table 132.

Table 132: MEPS for non-percussive printers, Russia

	Symbol printing			line printing		
Printing speed: symbols per second or rows per minute for A4 paper size	up to 100	100-200	More than 200	up to 200	200-1000	more than 1000
Maximum weight (kg)	4	4	12	20	15	20
Maximum power demand (V*A)	30	37.5	120	175	375	300

Testing standards and procedures

The test procedure is given in the MEPS regulation:

- GOST 21776-87: Printers. General specifications

Graphical input devices

Regulation or program (effective date)

GOST 24593-87: *Graphic input devices for electronic computers. General specifications* (since 1989 but new MEPS values have applied since 1992).

Product category

Graphical input devices for computers.

Criteria and requirements

Four types of graphical input device are defined in the MEPS regulations as shown in Table 133:

Table 133: Graphical device definitions, Russia

Types of graphical input device				
	1	2	3	4
"A" co-ordinate plotting accuracy (mm)	up to ±0.1	from ±0.1 to ±0.25	from ±0.2 to ±0.3	From ±0.3 to ±1.0
Discreteness (mm)	up to 0.025	0.025-0.1	0.05-0.25	up to 0.5

The currently applicable MEPS levels for graphical input devices are defined in Table 134.

Table 134: MEPS for graphical input devices, Russia

	Type of graphical input device								
Type	1		2			3		4	
Paper format	A0	A1	A0	A1	A2	A2	A3	A3	A4
Maximum weight (board, power pack, no stand) (kg)	85	60	50	30	20	20	10	10	6
Maximum power demand, (V*A)	50	50	45	45	45	45	35	35	20

Testing standards and procedures

The test procedure is given in the MEPS regulation:

- GOST 24593-87: Graphic input devices for electronic computers. General specifications

Plotters

Regulation or program (effective date)

GOST 19098-87: Plotters for electronic computers. General specifications.(applicable since 1989 but revised in 1993)

Product category

Plotters for computers.

Criteria and requirements

Industry has established voluntary power performance guidelines.

Testing standards and procedures

The test procedure is given in the regulation:

- GOST 19098-87: Plotters for electronic computers.

Personal computer video monitors

Regulation or program (effective date)

GOST 27954-88: Personal computer video monitors. Types, basic parameters, general technical requirements.

Product category

Monitors for PCs.

Criteria and requirements

Details not supplied.

Testing standards and procedures

The test procedure is given in the regulation:

- GOST 27954-88: Personal computer video monitors. Types, basic parameters, general technical requirements.

General purpose digital computers

Regulation or program (effective date)

GOST 16325-88: General purpose digital computers. General technical requirements.

Product category

Digital computers.

Criteria and requirements

Details not supplied.

Testing standards and procedures

The test procedure is given in the regulation:

- GOST 16325-88: General purpose digital computers. General technical requirements.

2.18 Singapore

2.18.1 Overview of the Regulatory Framework

Most energy standards for electrical equipment in Singapore are designed and implemented by the Singapore Productivity and Standards Board (PSB), which operates under the Ministry of Environment (MoE).

With the exception of Singapore's building code, which was implemented nearly more than 20 years ago, there has been little activity in implementing energy regulations for electrical equipment and appliances in Singapore. An energy efficiency standard for window-type room air-conditioners requires models of 9,000 Btu and greater (≥ 2.6 kW) to achieve an EER of at least 8.0 (metric 2.34 W/W). No other mandatory energy efficiency regulations exist for other products.

In a recent effort to promote the use of environment-friendly and energy-efficient products, Singapore established and put into effect two *voluntary* programs: the Singapore Green Labelling Scheme and the Scheme for 1-year Accelerated Depreciation Tax Incentive. These programs are described below.

Singapore Green Labelling

The Singapore Green Labelling Scheme was launched in May 1992 by the MoE. The voluntary scheme covers more than 30 types of general products, excluding only foods, drinks, and pharmaceutical's. The scheme was introduced to promote the use of environment-friendly products such as recycled paper, biodegradable batteries, CFC-free refrigerators and air-conditioners and energy-efficient electrical products.

For energy-consuming products, the scheme set energy consumption-based criteria for fluorescent lamps in 1993. The scheme expanded to include clothes washers (1994), computers and visual display units (1995), independent solar-powered calculators and watches (1997), refrigerators (1998) and room air-conditioners (1998). To obtain a Green Label, the products must not exceed a certain level of energy consumption. Energy consumption tests for the regulated products are performed by the Electrical & Electronics Test Centre (EETC) within the PSB.

One-year Accelerated Depreciation Tax Incentive

Singapore realises that the growth of its economy will lead to increased energy consumption, which depletes natural resources and produces pollution. Furthermore, most of Singapore's energy is imported. The purpose of this voluntary scheme is to encourage the use of energy-efficient equipment and technology in *businesses and industries* (individual consumers are not eligible).

Two categories of equipment are eligible for this tax incentive:

Category A: New equipment for replacement

Category B: Specialised energy-saving or energy-efficient equipment

For Category A, replacement equipment such as cooling systems, boilers, pumps, etc. must show energy savings when compared to the existing equipment. The proof must be analysed and ratified by a "professional engineer." Category B equipment such as solar heating and cooling systems, power factor controllers, high-efficiency motors, etc. is eligible for the tax incentive with or without replacing old equipment.

Under this scheme, if any business or industry replaces old, energy-consuming equipment with more efficient equipment or purchases specialised energy-saving and energy-efficient equipment, it may be granted a 1-year accelerated depreciation allowance. This scheme allows businesses and industries to gain a tax benefit by depreciating the value of the equipment within one year, instead of the normal three-year depreciation period for plant and machinery.

2.18.2 Summary of Regulated Products

Table 135 lists products that are subject to energy efficiency programs in Singapore.

Table 135: Energy efficiency regulations and programs in Singapore

	Program Type				
Product Description	**A. Comparison label**	**B. Endorsement label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerators and/or Refrigerator-Freezers		VL (1998)			
Industrial Refrigeration Systems					VL (1996)
Room Air Conditioners (all types)		VL (1998)			
Packaged Air Conditioners (with ducting)					VL (1996)
AC Electric Motors					VL (1996)
DC Electric Motors					VL (1996)
Compact Fluorescent Lamps		VL (1993)			
Fluorescent Lamp Ballasts					VL (1996)
Electric Water Heaters					VL (1996)
Clothes Washers		VL (1994)			VL (1996)
Clothes Dryers					VL (1996)
Computers and/or Visual Display Units (screens)		VL (1995)			
Solar Heating and Cooling Systems					VL (1996)
Solar Energy Storage Systems					VL (1996)
Power Factor Controllers					VL (1996)
Computerised Energy Management Systems					VL (1996)

E Other program is the Singapore accelerated depreciation scheme for businesses and industry.

Table 136: Energy performance testing in Singapore

Product Description	Local Test Procedures	Reference Test Procedures
Refrigerators and/or Refrigerator-Freezers	Using →	ISO 8187 ISO 8561
Industrial Refrigeration Systems	None Required	
Room Air Conditioners (all types)	Using →	ISO 5151
Packaged Air Conditioners (with ducting)	None Required	
AC Electric Motors	None Required	
DC Electric Motors	None Required	
Compact Fluorescent Lamps	Using →	CIE 84
Fluorescent Lamp Ballasts	None Required	
Electric Water Heaters	None Required	
Clothes Washers	Using →	IEC60456
Clothes Dryers	None Required	
Computers and/or Visual Display Units (screens)	See Text	
Solar Heating and Cooling Systems	None Required	
Solar Energy Storage Systems	None Required	
Power Factor Controllers	None Required	
Computerised Energy Management Systems	None Required	

Refrigerators/Freezers

Regulation or program (effective date)

Singapore Green Labelling Scheme (1998)

Product category

All residential household refrigerators and/or refrigerator-freezers

Criteria and requirements

The product is awarded the Green Label if the refrigerator/freezer meets both the following criteria:

Product shall not contain cholorofluorocarbons (CFCs).

The energy consumption shall not be higher than 0.72 kWh per 100 litres of equivalent capacity in 24 hours.

The "equivalent capacity" is defined as follows:

$$\text{Equivalent capacity} = Vr + 1.85 \cdot Vf$$

Vf = volume of freezer compartment

Vr = volume of all other compartments

Correction factor = $[32^{o}C - (-18\,^{o}C)]/[32\,^{o}C - 5\,^{o}C] = 1.85$

Testing standards and procedures

The Electrical & Electronics Test Centre conducts energy performance testing according to

- ISO 8187: Refrigerator-freezer
- ISO 8561: Refrigerators, refrigerator-freezers, frozen food storage cooled by internal forced air circulation

Refrigeration systems

Regulation or program (effective date)

Scheme for 1-year Accelerated Depreciation Tax Incentive (1996)

Product category

All commercial and industrial refrigeration systems (refrigerators, refrigerator-freezers, and separate freezers)

Criteria and requirements

New refrigeration system must replace the old system. An engineering analysis by a registered professional engineer must show that the new system will reduce energy consumption.

Testing standards and procedures

No energy testing is required.

Room air conditioners

Regulation or program (effective date)

Singapore Green Labelling Scheme (1998) and MEPS

Product category

All domestic room air-conditioners, including window-type, split-type (one condensing unit separated from one fan-coil unit), and multi-type (one condensing unit separated from two or more fan-coil units). MEPS applies to units up to 2.6kW cooling capacity.

Criteria and requirements

To obtain the Green Label, products must meet the following requirements:

Product shall not contain CFCs.

Product shall not have Ozone Depleting Potential (ODP) exceeding 0.055.

Product shall have an Energy Efficiency Rating (EER) of:

- or above for window-type
- 2.62 or above for split-type
- or above for multi-type

MEPS level for air conditioners is EER ≥ 2.34 W/W.

Testing standards and procedures

All energy performance testing is conducted by the EETC according to *ISO 5151: Non-ducted air conditioners and heat pumps - Testing and rating for performance*.

Packaged air conditioning systems

Regulation or program (effective date)

Scheme for 1-year Accelerated Depreciation Tax Incentive (1996)

Product category

Commercial and industrial air conditioning systems (ducted or central)

Criteria and requirements

New air conditioning system must replace the old system. An engineering analysis by a registered professional engineer must show that the new system will reduce energy consumption.

Testing standards and procedures

No energy testing is required.

Electric motors

Regulation or program (effective date)

Scheme for 1-year Accelerated Depreciation Tax Incentive (1996)

Product category

Category A: All *replacement* commercial and industrial motors and/or motor systems (including water pumping systems, lifts and escalators, etc.)

Category B: High-efficiency motors and/or motor systems and variable speed drives (VSDs)

Criteria and requirements

Category A: New motor and/or motor system must replace the old system. An engineering analysis by a registered professional engineer must show that the new system will reduce energy consumption.

Category B: Motor or motor system must be internationally accepted as a high-efficiency.

Testing standards and procedures

No energy testing is required.

Ballasts for fluorescent lamps

Regulation or program (effective date)

Scheme for 1-year Accelerated Depreciation Tax Incentive (1996)

Product category

Ballasts for commercial and industrial fluorescent lighting systems.

Criteria and requirements

New ballast or lighting system must replace old equipment. An engineering analysis by a registered professional engineer must show that the replacement will reduce energy consumption.

Testing standards and procedures

No energy testing is required.

Compact fluorescent lamps

Regulation or program (effective date)

Singapore Green Labelling Scheme (1993)

Product category

Two types of compact fluorescent lamps (CFLs):

1. Integral - ballast and adaptor in a single assembly
2. Modular - separate ballast and adaptor

Criteria and requirements

For Integral CFLs:

(a) Energy efficacy of the lamp must be at least 50 lumens/watt.

(b) The lamp must not contain more than 10 mg of mercury

(c) Cadmium and arsenic must not be used as raw materials

For Modular CFLs:

(a) Energy efficacy of the lamp must be:

- at least 50 lumens/watt for lamps < 10W
- at least 60 lumens/watt for 10W ≤ lamps ≤ 30W
- at least 75 lumens/watt for lamps > 30W

(b) The lamp must not contain more than 10 mg of mercury

(c) Cadmium and arsenic must not be used as raw materials

Testing standards and procedures

The EETC follows the CIE 84 standard test procedure for measurement of luminous flux.

Electric water heaters

Regulation or program (effective date)

Scheme for 1-year Accelerated Depreciation Tax Incentive (1996)

Product category

All commercial and industrial instant hot-water systems

Criteria and requirements

New water heating system must replace the old system. An engineering analysis by a registered professional engineer must show that the new system will reduce energy consumption.

Testing standards and procedures

No energy testing is required.

Clothes washer

Regulation or program (effective date)

Singapore Green Labelling Scheme (1994)

Product category

All household washing machines

Criteria and requirements

For cold-wash and normal-cycle, the washing machine must not used more than 0.04 kWh and 35 litres of water per kg of wash load.

Testing standards and procedures

The EETC conducts energy performance testing of washing machines according to IEC60456 procedures.

Commercial clothes washers and dryers

Regulation or program (effective date)

Scheme for 1-year Accelerated Depreciation Tax Incentive (1996)

Product category

All commercial and industrial clothes washing and drying machine systems

Criteria and requirements

New washing or drying system must replace the old system. An engineering analysis by a registered professional engineer must show that the new system will reduce energy consumption.

Testing standards and procedures

No energy testing is required.

Computers/visual display units

Regulation or program (effective date)

Singapore Green Labelling Scheme (1995)

Product category

This category includes:

- computer system unit – motherboard, CPU, power unit, hard disk drive and floppy disk drives
- computer monitor – external monitor or computer screen
- computer system with built-in monitor – computer system unit with a monitor in one casing.

Criteria and requirements

When idle or in low-power state, power consumption must be:

- computer system unit 30W or less
- computer monitor 30W or less
- computer system with built-in monitor 60W or less

Testing standards and procedures

The measured power can be obtained directly if a Wattmeter is used. If a combination of voltage, current and power factor meters are used, the measured power can be calculated as:

Power = V · I · PF

Where: *V* is voltage, *I* is current, and *PF* is power factor.

If a power factor is not used during the measurement, PF can be assumed to be 0.65 unless it is known that a "power factor correction" unit is installed in the switched-mode power supply system. In this case, the power factor can be assumed to be 0.85.

Before taking measurements, these conditioned must be achieved:

1. Total line impedance should be less than 0.25Ω.
2. Total AC source harmonic distortion should be less than 5%.

3. Input AC voltage should be in the range of 240V ± 5V.
4. The AC source frequency should be in the rage of 50 Hz ± 3 Hz.
5. The ambient temperature should be in the rage of $300^{o}K \pm 5^{o}K$ ($27^{o}C \pm 5^{o}C$)
6. During the test, both the system unit and the monitor should be in the idle state.
7. The monitor must be back instantly when keyboard or mouse activities are detected. The power management software/hardware should not interfere with the user program being executed.
8. During the test, the system should be fully equipped such as full capacity RAM, installed math co-processor, etc.

Solar heating and cooling systems

Regulation or program (effective date)

Scheme for 1-year Accelerated Depreciation Tax Incentive (1996)

Product category

All commercial and industrial solar heating and cooling systems

Criteria and requirements

No requirements except the system must be newly bought and installed.

Testing standards and procedures

No energy testing is required.

Solar energy storage systems

Regulation or program (effective date)

Scheme for 1-year Accelerated Depreciation Tax Incentive (1996)

Product category

All commercial and industrial solar energy storage systems

Criteria and requirements

No requirements except the system must be newly bought and installed.

Testing standards and procedures

No energy testing is required.

Power factor controller

Regulation or program (effective date)

Scheme for 1-year Accelerated Depreciation Tax Incentive (1996)

Product category

All commercial and industrial power factor (PF) controllers

Criteria and requirements

No requirements except the PF controller must be newly bought and installed.

Testing standards and procedures

No energy testing is required.

Computerised energy management system

Regulation or program (effective date)

Scheme for 1-year Accelerated Depreciation Tax Incentive (1996)

Product category

All commercial and industrial computerised energy management systems

Criteria and requirements

No requirements except the system must be newly bought and installed.

Testing standards and procedures

No energy testing is required.

2.18.3 Related Energy Efficiency Programs

Other energy programs in Singapore include:

Energy Audit Program (1982). The program provides *free* energy audit services for industrial plants, commercial buildings, residential condominiums, etc. Audits are conducted by the Energy Conservation Division of the Public Utilities Board (PUB). Since 1982, an average of 140 audits have been conducted each year.

Energy Conservation Program: Education and Information Dissemination (1985). Implemented by the Energy Conservation and Exhibition Centre of the PUB, this program aims to educate the public, especially school children, about energy conservation through exhibitions, pamphlets, mass media, short courses in schools, training courses, national/international forums, seminars, and workshops.

Energy Conservation Standards for Building Design in Building Control Design (1979). Building Regulations were implemented in July 1979 to promote energy conservation in all air-conditioned commercial buildings. The regulations apply to new buildings only. Buildings completed before 1979 are encouraged to retrofit the building envelope, and expenses are eligible for tax deductions.

Energy Pricing Policy (1982). There is no government subsidy for any form of energy. Electricity and gas tariffs , automotive fuels, and other fuels prices reflect fuel prices in the international market.

2.19 Chinese Taipei

2.19.1 Regulatory and Administrative Framework

The Energy Commission in the Ministry of Economic Affairs (MOEA) has developed MEPS for a number of products. In most cases the energy tests are detailed in Chinese National Standards (CNS) of Chinese Taipei, and the MEPS requirements are published by MOEA. The Bureau of Commodity Inspection and Quarantine is also involved in the implementation of the program.

Suppliers can test their own products or send them to a designated laboratory. Random checks on product performance are conducted by the Government.

In 1998 the Government announced an energy labelling program covering window-type air conditioners, refrigerators and washers. The program is still in the planning stage.

In August 1992 an eco-label program called “Greenmark”, was launched by the Environmental Protection Administration (EPA). This currently covers a large number of product categories including paper, water-using devices and several energy-using appliances. The Greenmark criteria cover the manufacturing process and packaging, as well as certain aspects of product performance.

2.19.2 Summary of Regulated Products

Table 137: Energy efficiency regulations and programs in Chinese Taipei

	Program Type				
Product Description	**A. Comparison label**	**B. Endorsement label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerators and/or Refrigerator-Freezers	UC(a)	V(b)	M (1996)		
Room Air Conditioners (unitary- and split-type)	UC(a)	V(b)	M (1991)		
Electric Motors (AC)			M(1981)(c)		
Fluorescent Lamps		V(b)			
Fluorescent Lamp Ballasts			M(1993)		
Electric Storage Water Heaters			M(1989)		
Clothes Washers	UC(a)	V(b)			
Computers and/or screens		V(b)			
Printers		V(b)			
Fax Machines		V(b)			
Photocopiers		V(b)			
Electric Fans (Table, Floor, Hanging, Ventilation types)			M(?1982)		
Transformers		V (b)			

Sources: MOEA(1999), except (a): IIEC (1998) (b) Green Mark program
(c) Considering the adoption of U.S. 1997 MEPS levels in 2002

Table 138: Energy performance testing in Chinese Taipei

Product Description	MEPS requirements (most recent)	Local Test Procedures	Reference Test procedures
Refrigerators and/or Refrigerator-Freezers	File of (85) energy 84462391 issued by MOEA, 3 Jan 1996	CNS 9577-89 CNS 2062-95	
Room Air Conditioners: < 3kW, unitary & split > 3 kW, air & water cooled	File of (80) energy 051500 issued by MOEA, 17 Sep 1991	CNS 3615-95 CNS 2725-95	
Electric Motors (AC)	File of (70) energy 30445 issued by MOEA, 28 Jul 1981	CNS 2934-93	IEEE IEC60034-2
Fluorescent Lamp Ballasts	File of (84) energy 8446093 issued by MOEA, 26 Apr 1995	CNS 927 CNS 3888	
Electric Storage Water Heaters	CNS 11010	CNS 3263	
Computers and/or screens	Greenmark logo requirements	Greenmark logo requirements	US Energy Star
Printers	Greenmark logo requirements	Greenmark logo requirements	US Energy Star
Photocopiers	Greenmark logo requirements	Greenmark logo requirements	US Energy Star
Electric Fans (Table, Floor, Hanging, Ventilation types)	File of (70) energy 30445 issued by MOEA, 28 Jul 1981	CNS 7778 and CNS 7779	AMCA 210, AMCA 300 ISO 5801

Source: MOEA (1999)

Refrigerators/Freezers

Program regulation and coverage

The reference for the MEPS levels is File (85) of energy 84462391 issued by MOEA on 3 January, 1996. The scope covers refrigerators and two types of refrigerator-freezer: “direct cooling” (assumed to be fan forced) and “indirect cooling”.

The test standard covers which covers refrigerators and refrigerator-freezers with net refrigerated volumes of 700 L or less and vertical freezers of 400 L or less, so it is assumed that this defines the scope for MEPS as well.

Criteria and requirements

Table 139 summarises the MEPS levels for three different product classes, expressed as minimum Energy Factors. The steps in determining whether a product meets the MEPS level are:

1. carry out the power consumption test
2. calculate the unit’s Energy Factor (litres equivalent internal volume per kWh/month)

3. calculate the Minimum Energy Factor using Table 139.
4. if the unit's Energy Factor is greater than the Minimum, the unit meets MEPS.

Table 139. Energy factors for refrigerators and refrigerator-freezers, Chinese Taipei

Type	Minimum Energy Factor (L/kWh/month)
Indirect cooling refrigerator-freezer	$EF = V/(0.067V+44.0)$
Direct cooling refrigerator-freezer	$EF = V/(0.058V+34.0)$
Refrigerator	$EF = V/(0.058V+27.2)$

Source: MOEA (1999)

Equivalent internal volume V = VR + K x VF, where:

VR is actual internal volume of refrigerator chamber (litres);
VF is actual internal volume of freezer chamber (litres).

$K = (T_1 - T_3)/(T_1 - T_2)$ where:

T_1 = ambient temperature (30°C);
T_2 = average refrigerator temperature (3°C);
T_3 = average freezer temperature.

K = 1.56 for 2 star freezers (where T_3 = -12°C), K = 1.67 for super 2 star freezers (where T_3 = -12°C). K= 1.78 for 3 and 4 star freezers (where T_3 = -18°C).

Testing standards and procedures

The energy tests are described in CNS 2062-95, which covers refrigerators and refrigerator-freezers with net refrigerated volumes of 700 L or less, and vertical freezers of 400 L or less. Four star freezers are tested with a test load of at least 4.5 kg per 100 L of effective volume. Energy consumption is recorded over 24 hours once steady state temperature conditions are reached.

Air conditioners

Program regulation and coverage

The reference for the MEPS levels is File (80) of energy 051500 issued by MOEA on September 1991. The scope covers air-cooled unitary and split types, and water-cooled unitary types.

Criteria and requirements

Table 140 summarises the MEPS levels for air cooled air conditioners below 3 kWe input power, and Table 141 summarises the MEPS levels for the other types covered by the program. The test standards define EER in terms of kcal/h*W; the other units are given for information.

Table 140. MEPS for air-cooled air conditioners below 3kWe input, Chinese Taipei

Model	Cooling capacity	Type	Minimum Efficiency Levels		
			EER (kcal/Wh)	EER (Btu/Wh)	EER (W/W)
Unitary type	Below 2000 kcal/h (<2.32 kW)	Including variable-frequency (60 Hz)	2.22	8.8	2.58
	2000 to 3550 kcal/h (2.32-4.13 kW)	Including variable-frequency (60 Hz)	2.27	9.0	2.64
	Above 3550 kcal/h (>4.13 kW)		2.07	8.2	2.41
Split type	Below 3550 kcal/h (<4.13 kW)	Typical type	2.43	9.6	2.82
		Variable-frequency (60 Hz)	2.27	9.0	2.64
	Above 3550 kcal/h (>4.13 kW)		2.18	8.6	2.53

Source: Energy Commission, Ministry of Economic Affairs

Table 141. MEPS for unitary air conditioners below 3kWe input, Chinese Taipei

Type	Minimum Efficiency Levels		
	EER (kcal/Wh)	EER (BTU/Wh)	EER (W/W)
Air cooled (above 3 kW)	2.22	8.81	2.58
Water-cooled	2.88	11.43	3.35

Source: Energy Commission, Ministry of Economic Affairs

Testing standards and procedures

CNS 3615-95 covers split unit air conditioners of power input less than 3kW.
CNS 2725-95 covers air-cooled unitary air conditioners of power input greater than 3kWe and cooling capacity up to 22,400 kcal/hr (26.0 kW), excluding special types (eg for cooling computer rooms).

Electric motors

Program regulation and coverage

The reference for the MEPS level is File of (70) energy 30445 issued by MOEA, 28 July 1981. The types of motor covered are:

- low voltage 3-phase typical squirrel cage induction motors, of 0.18 to 37 kW (1/4 to 50 HP) rated power output;
- low voltage 3-phase wire wound rotor induction motors, of 5.5 to 37 kW (7.5 to 50 HP) rated power output;
- low voltage single phase induction motors of electric condenser operation type (0.075 to 0.25 kW), divide phase starting type (0.18 to 0.37 kW), and electric condenser starting type (0.25 to 3.7 kW).

Criteria and requirements

The criteria are summarised in Table 142 to Table 145. According to MOEA, it is considering the adoption of new MEPS levels for 3-phase motors in 2002 that align with the equivalent MEPS levels in the U.S. in 1997.

Table 142: MEPS three phase typical squirrel cage induction motors, Chinese Taipei

Related Power Output		Pole	r.p.m.		Full load	
(kW)	Power (Hp) (for reference)		50(Hz)	60(Hz)	Efficiency n (%)	Power Factor pf (%)
0.18	¼	2	3000	3600	above 65.5	above 73.5
0.37	½				above 70.5	above 77.5
0.55	¾				above 72.0	above 78.5
0.75	1				above 74.0	above 80.5
1.1	1 1/2				above 75.5	above 81.5
1.5	2				above 78.0	above 83.0
2.2	3				above 79.5	above 84.0
3.7	5	4	1300	1800	above 82.0	above 85.0
0.18	1/4				above 67.0	above 60.0
0.37	1/2				above 71.5	above 66.5
0.55	3/4				above 73.0	above 64.5
0.75	1				above 75.0	above 73.0
1.1	1 ½				above 76.5	above 74.5
1.5	2				above 78.5	above 77.0
2.2	3				above 80.5	above 79.0
3.7	5				above 82.5	above 80.0
0.37	½	6	1000	1200	above 70.5	above 59.0
0.55	¾				above 72.0	above 62.5
0.75	1				above 74.0	above 66.5
1.1	1 ½				above 75.5	above 68.5
1.5	2				above 78.0	above 71.5
2.2	3				above 79.5	above 73.5
3.7	5				above 82.0	above 75.5
0.75	1	8	750	900	above 71.5	above 61.5
1.1	1 ½				above 74.0	above 65.0
1.5	2				above 76.0	above 68.0
2.2	3				above 78.0	above 71.0
3.7	5				above 80.0	above 72.0

Table 143: MEPS for three phase specific squirrel cage induction motors, Chinese Taipei

Related Power Output		Pole	r.p.m.		Full load	
(kW)	power (Hp) (for reference)		50(Hz)	60(Hz)	Efficiency n (%)	Power Factor pf (%)
5.5	7.5	2	3000	3600	above 83.0	above 82.5
7.5	10				above 84.0	above 83.5
11	15				above 85.0	above 84.5
15	20				above 86.0	above 85.0
18.5	25				above 86.5	above 85.5
22	30				above 87.0	above 86.0
30	40				above 87.5	above 86.5
37	50				above 88.0	above 87.0
5.5	7.5	4	1500	1800	above 82.5	above 78.5
7.5	10				above 83.5	above 79.5
11	15				above 84.5	above 80.5
15	20				above 85.5	above 81.0
18.5	25				above 86.0	above 81.5
22	30				above 86.5	above 82.0
30	40				above 87.0	above 82.5
37	50				above 87.5	above 83.0
5.5	7.5	6	1000	1200	above 82.0	above 73.5
7.5	10				above 83.0	above 74.5
11	15				above 84.0	above 76.0
15	20				above 85.0	above 77.0
18.5	25				above 85.5	above 78.0
22	30				above 86.0	above 78.5
30	40				above 85.5	above 79.5
37	50				above 87.0	above 80.0
5.5	7.5	8	750	900	above 81.0	above 69.0
7.5	10				above 82.0	above 70.0
11	15				above 83.5	above 71.5
15	20				above 84.0	above 72.5
18.5	25				above 85.0	above 73.5
22	30				above 85.5	above 74.0
30	40				above 86.5	above 75.0
37	50				above 87.0	above 75.5

Table 144: MEPS for three phase wire wound rotor induction motors, Chinese Taipei

Related Power Output		Pole	r.p.m.		Full load	
(kW)	power (Hp) (for reference)		50(Hz)	60(Hz)	Efficiency n (%)	Power Factor pf (%)
5.5	7.5				above 83.5	Above 79.5
7.5	10				above 84.5	above 80.0
11	15				above 85.5	above 81.5
15	20	4	1500	1800	above 86.5	above 82.5
18.5	25				above 87.0	above 83.0
22	30				above 87.5	above 83.5
30	40				above 88.0	above 84.5
37	50				above 88.0	above 84.5
5.5	7.5				above 83.0	above 76.5
7.5	10				above 84.0	above 78.5
11	15				above 85.0	above 80.0
15	20				above 85.5	above 81.0
18.5	25	6	1000	1200	above 86.0	above 81.5
22	30				above 86.5	above 82.0
30	40				above 87.5	above 82.5
37	50				above 87.5	above 83.0
5.5	7.5				above 82.0	above 71.0
7.5	10				above 83.0	above 72.0
11	15				above 84.5	above 73.5
15	20	8	750	900	above 85.0	above 74.5
18.5	25				above 85.5	above 75.5
22	30				above 86.0	above 77.0
30	40				above 87.0	above 77.5
37	50				above 87.0	above 78.0
5.5	7.5				above 81.5	above 66.0
7.5	10				above 82.5	above 68.0
11	15				above 83.5	above 70.0
15	20	10	600	720	above 84.5	above 71.5
18.5	25				above 84.5	above 72.0

Table 144: MEPS for three phase wire wound rotor induction motors (continued)

Related Power Output		Pole	r.p.m.		Full load	
(kW)	power (Hp) (for reference)		50(Hz)	60(Hz)	Efficiency n (%)	Power Factor pf (%)
22	30	12	500	600	above 85.0	Above 72.5
30	40				above 85.5	Above 73.0
37	50				above 86.0	Above 73.5
7.5	10				above 82.0	Above 62.0
11	15				above 83.0	above 64.0
15	20				above 83.5	above 66.0
18.5	25				above 84.0	above 67.5
22	30				above 84.5	above 68.5
30	40				above 85.0	above 69.5
37	50				above 85.5	above 70.0

Table 145. MEPS for low voltage single phase induction motors, Taipei

Type	Rated Power Output		Pole	r.p.m.		Full load		
	(kW)	Power (Hp) (for reference)		50(Hz)	60(Hz)	Efficiency n (%)	Power Factor pf (%)	Electric Current (I)
Electric Condenser Operation Type	0.075	1/10	2	3000	3600	above 50	above 90	below 1.5
	0.09	1/4				above 55	above 90	below 1.7
	0.25	1/4				above 60	above 90	below 4.2
Divide Phase Starting Type	0.18	1/4	2	3000	3600	above 56	above 63	below 4.6
	0.25	1/2				above 58	above 65	below 6.0
	0.37	1/2				above 62	above 67	below 8.0
	0.19	1/6	4	1500	1800	above 40	above 47	below 4.4
	0.18	1/4				above 49	above 54	below 6.1
Electrical Condenser Starting Type	0.25	1/2	2	3000	3600	above 53	above 57	below 7.5
	0.18	1/4				above 56	above 63	below 4.6
	0.25	1/3				above 58	above 65	below 6.0
	0.37	1/2				above 62	above 67	below 8.0
	0.55	3/4				above 65	above 70	below 9.5
	0.75	1				above 67	above 73	below13.3
	0.075	1/10	4	1500	1800			
	0.09	1/8				above 40	above 47	below 4.4
	0.12	1/6						
	0.18	1/4				above 49	above 54	below 6.1
	0.25	1/2				above 53	above 57	below 7.5
	0.37	1/2				above 57	above 60	below 9.4
	0.55	3/4				above 60	above 63	below12.5
	0.75	1				above 63	above 66	below 16
	1.1	1 1/2				above 64	above 67	below 23
	1.5	2				above 64	above 67	below 31
	1.8	2 1/2						
	2.2	3				above 65	above 68	below 44
	3	4						
	3.7	5				above 65	above 68	below 72
	0.18	1/4	6	1000	1200	above 45	above 49	below 7.4
	0.25	1/3				above 48	above 52	below 9.1
	0.37	1/2				above 51	above 55	below 1.9
	0.55	2/4				above 54	above 58	below 5.9
	0.75	1				above 57	above 60	below19.9

Testing standards and procedures

CNS 2934-93 covers low voltage (600 V or lower) 3-phase squirrel cage induction motors, rated frequency 60 Hz, of 0.18 to 200 kW (1/4 to 270 HP) rated power output.

Fluorescent lamp ballasts

Program regulation and coverage

Maximum allowable power consumption for fluorescent lamp ballasts were first specified in 1993 (File of (82) energy 082044). These were updated in 1995 by File of (84) energy 8446093 issued by MOEA, 26 April 1995), taking effect 1 January 1996. The program covers both pre-heat start and rapid start ballasts, and both 110V and 220V designs.

Criteria and requirements

Table 146 indicates the maximum allowable power levels for preheat start ballasts of various configurations (note that all are for linear fluorescent lamps except one).

Table 147 indicates the maximum allowable power levels for rapid start ballasts. All ballasts are required to have a power factor of not less than 90%.

Table 146: MEPS for preheat start ballasts, Chinese Taipei

Group	Description	Max Ballast Power 110V	Max Ballast Power 220V	Min Power Factor
1	FL10W	5	7	> 90%
2	FL15W	5	7	> 90%
3	FL20W	5	7	> 90%
4	FL30W	11	8	> 90%
5	FCL30W (circular tube)	8.5	10.5	> 90%
6	FL40W	11	7	> 90%

Source: MOEA (1999)

Table 147: MEPS for rapid start ballasts, Chinese Taipei

Group	Description	Max Ballast Power 110V	Max Ballast Power 220V	Min Power Factor
1	FLR20W	13	14	> 90%
2	FLR20W × 2	15	16	> 90%
3	FLR40W	19	19	> 90%
4	FLR40W × 2	20	20	> 90%
5	FLR60W	24	25	> 90%
6	FLR110W	32	33	> 90%

Source: MOEA (1999), also contained in CNS3888-1993 in Chinese (not in 1996)

Testing standards and procedures

CNS 3888 covers preheat start ballasts. CNS 927-96 covers rapid start ballasts.

Electric water heaters

Program regulation and coverage

The MOEA File number referring to water heater MEPS is not known.

Performance requirements for electric storage water heaters, including "energy efficiency" and "heat insulating efficiency" are specified in CNS 11010-89.

Criteria and requirements

CNS 11010-89 defines "energy efficiency" as "the ratio of the thermal energy absorbed by the water full in the tank to the electrical energy necessary to heat the water up to the set temperature". (Since the element is likely to be close to 100% efficient, this largely reflects the insulation value).

CNS 11010-89 also defines "heat insulating performance" in terms of the maximum permissible temperature drop in the water after 16 hours, and "service performance" in terms of the minimum permissible temperature of the water taken at the 12th draw-off sampling.

The requirements for each of these factors is summarised in Table 148.

Table 148: MEPS for electric storage water heaters, Chinese Taipei

	Tank capacity		
	Up to 100 L	>100-350 L	>350 L
Energy efficiency (minimum)	80%	85%	90%
Heat insulating performance: minimum temperature of hot water after 16 hrs	T_2-18°C	T_2-15°C	T_2-13°C
Service performance: minimum temperature of hot water taken at 12th sampling	T_2-45°C	T_2-35°C	T_2-30°C

Source: CNS 11010-89 T_2 is maximum thermostat temperature

Testing standards and procedures

The performance requirements are set out in CNS 11010-89, which covers household electric storage water heaters with rated power consumption not exceeding 12 kW. The energy tests are set out in CNS 3263.

Electric fans

Program regulation and coverage

Maximum power input and minimum air flow rates for electric fans and ventilation fans are referred to in File (70) of energy 30445 issued by MOEA dated July 28, 1991 with implementation date 1 January 1982. The requirements cover auto-rotating fans, table fans, floor fans and hanging fans and ventilating fans.

Criteria and requirements

The maximum power and minimum airflow rates for each type and diameter of fan are set out in Table 149.

Testing standards and procedures

The test procedures for commercial/industrial ventilating fans are set out in CNS 7778 and CNS 7779 but apparently are being replaced with AMCA 210, AMCA 300 and/or ISO 5801, depending on the application.

Endorsement label

Program regulation and coverage

In August 1992 an eco-label program called "GreenMark", was launched by the Environmental Protection Administration (EPA). This currently covers over 50 categories of products. (All details are taken from the GreenMark web site at www.epa.gov.tw/greenmark/eng/english/htm)

Criteria and requirements

The GreenMark logo label may be used on product packaging, brochures or on the products themselves itself if the performance of the product meets the stated criteria and the supplier registers with the Environmental Protection Administration (EPA). Each product has a different set of criteria, covering matters as diverse as:

- absence of certain materials (eg CFCs or toxic substances) in the product itself;
- absence of the use of certain materials in the production process;
- the use of recycled materials in packaging;
- the disclosure of information, and the accuracy of disclosed information;
- noise levels in operation;
- functional requirements; and
- energy performance requirements.

For the energy-using product covered by GreenMark, the following energy-related criteria need to be met:

- Refrigerators and freezers: energy consumption must be 85% of the MEPS level for "fan-type" refrigerator-freezers, 90% or less of the MEPS level for "direct cooling" refrigerator-freezers, and 90% or less of the MEPS level for refrigerators;
- Air conditioners: the EER must be at least 3% higher than the MEPS level for unitary air conditioners, at least 3% higher for split units up to 4.13 kW cooling capacity, and at least 10% higher for split units of more than 4.13 kW cooling capacity;

Table 149: Energy consumption and performance requirements for fans, Chinese Taipei

Type	Size (cm)	Maximum power input (W)	Minimum airflow rate (m3/minute)
Auto-rotating fan	35	85	40
	40	105	53
Upright floor fan	30	65	30
	35	80	40
	40	100	53
	50	145	75
	60	180	90
Floor fan	25	65	30
	30	80	50
	35	100	65
	40	125	85
Hanging fan	60	70	45
	90	100	85
	120	145	155
	130	160	170
	140	180	190
	150	200	215
Table Fan	18	28	10.5
	20	32	12.5
	23	40	15.5
	25	45	18.0
	30	60	28.0
	35	75	38.0
	40	100	54.0
Ventilating Fan	20	45	12.5
	25	60	18
	30	80	28
	35	100	38
	40	120	54
	45	150	64
	50	175	75

Source: MOEA (1999)

- Personal computers, monitors, printers, plain paper fax machines and monochrome photocopiers: the unit must satisfy the power management criteria specified by the U.S. EPA Energy Star program;
- Fluorescent lamps: lamp efficacy must be not less than 80 lumens/W for linear fluorescent lamps, and not less that 55-70 lumens/W for compact fluorescent lamps (depending on wattage);
- For clothes washers: electricity consumption must be not greater than 0.04 kWh per kg of wattled.
- For transformers: the criteria have not been determined.

Testing standards and procedures

Where the GreenMark criteria refer to MEPS levels, the criteria refer to the same test standards as are used to establish MEPS compliance. The criteria for other products do not nominate test standards and do not describe test procedures in detail.

2.20 Thailand

2.20.1 Overview of the Regulatory Framework

Thailand has one of the most active energy conservation frameworks in Asia. Several key governmental organisations and agencies are responsible for promoting, establishing, and implementing energy efficiency programs. They are:

1. Department of Energy Development and Promotion (DEDP), under the Ministry of Science, Technology and Environment (MoSTE)
2. National Energy Policy Office (NEPO)
3. Electricity Generating Authority of Thailand (EGAT)
4. Thailand Industrial Standards Institute (TISI)

Energy Conservation Promotion Act B.E. 2535 (1992)

In 1992, the Royal Thai Government issued the Energy Conservation Promotion Act B.E. 2535 (1992). The Act provides the main framework and support for energy efficiency activities in Thailand. It mandates energy efficiency measures in large buildings and factories, promotes rural and renewable energy projects, research and development, and energy policy projects. These projects are financed through one of the largest energy conservation funds in the world: Thailand's Energy Conservation Promotion Fund. The Fund has more than US $400 million in reserves and is maintained through mandatory contributions from petroleum and gas producers and importers, which add US $60-80 million to the Fund annually. The Fund is used to finance three main program sectors as described in Table 150.

Table 150: Efficiency activities financed by Thailand's Energy Conservation Promotion Fund

Program Sector	Compulsory Programs	Voluntary Programs	Complementary Programs
Scope of Programs	Energy efficiency in • Large buildings and factories • New buildings and factories • Government facilities	• Rural energy efficiency and renewable energy projects • Research and development • Demonstration projects	• Public relations • Training • Market research • Policy research • Monitoring and Evaluation
Primary Implementing Agency	DEDP	NEPO, DEDP	NEPO

DEDP manages the Compulsory part of the Energy Conservation Promotion Fund, and NEPO manages the remaining programs. Although the 1992 energy conservation law gives DEDP has the authority to develop and mandate minimum efficiency standards for electrical equipment and appliances, it has yet to do so. Recently, DEDP provided preliminary recommendations for energy efficiency standards to

NEPO. At the same time, NEPO has commissioned a major study, to be completed in mid-1999, which will make recommendations to the government for a comprehensive set of minimum efficiency performance standards (MEPS) for appliances and electrical equipment.. The study is likely to consider and recommend MEPS for the following products:

- refrigerators,
- air conditioners,
- electric motors,
- compact and regular fluorescent lamps, and
- ballasts for fluorescent lamps.

The Thailand Industrial Standards Institute is the agency responsible for establishing and policing product performance standards in Thailand. TISI has constructed an internationally accredited energy testing laboratory.   This is the only testing facility authorised for testing refrigerators and air conditioners for Thailand's voluntary energy labelling program. TISI established its appliance testing laboratory with financial and technical assistance from the Japanese government through JICA (Japan International Cooperation Association).

Thailand's DSM Program

In 1991, the Royal Thai Government approved a five-year master plan for demand-side management (DSM) in the power sector.   On December 3, 1991, the Prime Minister signed a memorandum of understanding entrusting EGAT, in cooperation with the Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA), with the task of implementing a large Demand Side Management (DSM) program. The purpose of the initiative was to reduce peak energy demand while maintaining system quality and to instil energy efficiency-oriented attitude within Thai consumers.

In 1992, EGAT updated and revised its 5-year DSM Master Plan. EGAT then established a DSM Office to manage the program in 1993. The budget for the DSM program is US$189 million: US$15.5 million comes from a GEF grant, which is supervised by the World Bank; US$25 million is financed by a soft loan from Japan's Overseas Economic Cooperation Fund (OECF); And the balance is funded by Thailand itself through the electricity tariff. Table 151 summarises DSM activities related to electricity-consuming products in Thailand.

Among the DSM programs, the most effective and successful programs have been the High-Efficiency Fluorescent Tube or the "Thin-Tube" program, the Energy-Efficient Refrigerator (labelling) program, and Energy-Efficient Air Conditioner (labelling) program. For all the DSM programs, TISI is the designated central testing authority.

Table 151: EGAT DSM activities related to electricity-consuming products, Thailand

Program	Program Type	Launch Date	Status & Notes
High-Efficiency Fluorescent Tubes	Voluntary market transformation	9/93	Completed. All production is now T8 (36W and 18W) thin tubes, and T12 tubes (40W and 20W) have been eliminated from market. 394 MW and 1,433 GWh savings achieved through 9/98 (far exceeding the program target)
Energy-Efficient Refrigerators	Voluntary energy labelling	9/94	On-going. Average energy consumption of single-door refrigerators participating in the program decreased from 435 kWh/year in 1/95 to 389 kWh/year in 9/98. Savings exceeded expectation. Expanding program to 2-door and larger sizes. *Mandatory labelling effective 3/99, plus minimum efficiency standards to be recommended in 1999.*
Energy-Efficient Air Conditioners	Voluntary energy labelling	9/95	On-going. Covers 6,000-24,000 Btu A/Cs. Weighted average EER of A/Cs participating in the program increased from 10.95 (12/96) to 11.00 (9/98). Note that during 96, A/Cs were required to become non-CFC, which decreased the average EER to 10.85 in 12/96. Program to expand to 30,000 Btu models. Also expected to eventually become *mandatory* labelling for all A/Cs and subject to minimum efficiency standards, to be recommended in 99.
High-Efficiency Electric Motors	Voluntary Loan incentive	12/96	On-going. Offered interest-free loans for the incremental cost of high-efficiency motor. Very low participation due to unattractive incentive, lack of testing facility, and drastic economic downturn. Savings only 1% of expectation. *Program stalled*.
Compact Fluorescent Lamps	Voluntary market transformation	10/96	On-going. EGAT offered bore the cost of advertisements in exchange for manufacturers' agreement to reducing the cost of CFLs by about 40%. Through the program, EGAT has sold more than 300,000 CFLs at participating 7-11 retails stores nationwide. Labelling and standards for CFLs are under consideration.
Energy-Efficient Ballasts	Voluntary energy labelling	2/96	On-going. EGAT tried to coordinate with 7-11 convenience stores to sell No. 5 ballasts, but failed to supply "safety ballasts" by 7/98. These ballasts were installed in buildings that participated in Green Building Program. Considering standards for ballasts.

EGAT's energy labels for refrigerators and air conditioners rank the products using a scale of 1 to 5, where 5 is the highest efficiency level and 3 is the average of all models tested. The label also shows consumers the average energy consumption per year (kWh/year) and the average electricity bill per year (Baht/year) for that unit under specified conditions. Since these programs are voluntary, none of the manufacturers or distributors have chosen to label their products if tests reveal that their products are less efficient than average. Thus, there are no products in the market carrying a number 1 or 2 label, and few with a rating of 3.

2.20.2 Summary of Regulated Products

Table 152 summarises energy efficiency regulations and programs in Thailand that have been implemented or are still under consideration.

Table 152: Energy efficiency regulations and programs, Thailand

	Program Type				
Product Description	**A. Comparison label**	**B. Endorsement label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerators and/or Refrigerator-Freezers	VH (1994) M (1999)		M (UC)		
Room Air Conditioners (window- and split-type)	VH (1995) M (UC)		M (UC)		
AC Electric Motors			M (UC)		
Fluorescent Lamps			M (UC)		
Fluorescent Lamp Ballasts	VL(1996)		M (UC)		
Compact Fluorescent Lamps			M (UC)		

Table 153: Energy performance testing in Thailand

Product Description	Local Test Procedures	Reference Test procedures
Refrigerator and/or Refrigerator-Freezer	TIS 455-2537	ISO 7371
Room Air Conditioners (window- and split-type)	TIS 1155-2536	ISO/R 859-1968 ARI 210/240-84 JIS B8615-1984 JIS B8616-1984
AC Electric Motors	TIS 866-2532 TIS 867-2532	IEC60034-1 (1983) IEC60034-2 (1972) JIS C4210-1984
Fluorescent Lamps	TIS 236-2533	IEC60081 (1984)
Fluorescent Lamp Ballasts	TIS 23-2521 TIS1506-2541	IEC60082-1973 IEC60929
Compact Fluorescent Lamps	TIS 236-2533	IEC60081 (1984)

Refrigerators/Freezers

Regulation or program (effective date)

- EGAT's Energy-Efficient Refrigerator (*Voluntary* Labelling) Program (1994)
- EGAT's Energy-Efficient Refrigerator (*Mandatory* Labelling) Program (target 1999)

- Minimum Energy Performance Standards (MEPS) set by NEPO and DEDP (target 1999).

Product category

For labelling: Single-door, 5-6 ft^3 (140-170 litre), manual-defrost refrigerator, but program to be expanded to 2-door and larger sizes in 1999.

For MEPS: All household refrigerator-freezers, refrigerators, and freezers are being considered.

Criteria and requirements

To obtain an energy label, 1 sample unit must be randomly selected from a pool of at least 30 units of the same model (same size and features) and sent to TISI for energy performance testing. Once the model has been tested, it is issued a numbered ranking between 1 to 5. The manufacturer/distributor may choose whether or not to request the labels for their products.

Table 154 shows the average "efficiency values" of Thai CFC and non-CFC refrigerators of various sizes. An "efficiency value" is defined as the ratio of the capacity of the refrigerator (volume; in litres) to the amount of energy consumption (kWh) per day (24 hours); thus the units are litres/kWh. A higher efficiency value indicates a more efficient refrigerator.

Table 154: Average refrigerator efficiency values in Thailand

Capacity or Volume (litre)	CFC Refrigerator Average Efficiency Value (litres/kWh)	Non-CFC Refrigerator Average Efficiency Value (litres/kWh)
Size < 90	59.98	53.98
90 < Size < 120	208.82	187.94
120 < Size < 150	210.86	189.77
150 < Size < 180	213.92	192.53
180 < Size < 210	245.25	220.73
Size > 210	260.80	234.72

A tested refrigerator may receive a ranking number of 1, 2, 3, 4, or 5 (5 being the most efficient) depending on its efficiency value compared to the average efficiency value within one of the size categories.

Number 1: A refrigerator will receive a number 1 label if its efficiency value is *at least 30% less than* the average efficiency value.

Number 2: A refrigerator will receive a number 2 label if its efficiency value is *15 to 30% less than* the average efficiency value.

Number 3: A refrigerator will receive a number 3 label if its efficiency value is *between –15% and +10%* of the average efficiency value.

Number 4: A refrigerator will receive a number 4 label if its efficiency value is *10 to 25% greater than* the average efficiency value.

Number 5: A refrigerator will receive a number 5 label if its efficiency value is *at least 25% greater than* the average efficiency value.

NEPO has commissioned a study to make recommendations to the Thai government for MEPS. For MEPS, a product must exceed the minimum energy efficiency level to be eligible for sale in the market. The minimum efficiency level has not been determined but will most probably be based on the capacity of the refrigerator or on level 3, 4, or 5 of the EGAT label.

Testing standards and procedures

For the labelling program and future MEPS testing, TISI uses the Thai national standard TIS 455-2537 (1994): Standard for household refrigerators, which references ISO 7371-1995: Performance of household refrigerating appliances (Amendment 1-1987: Refrigerators with or without low temperature compartment). Testing is undertaken for tropical conditions (32^{o}C ambient).

Room air conditioners

Regulation or program (effective date)

- EGAT's Energy-Efficient Air Conditioner (*Voluntary* Labelling) Program (1994)
- EGAT's Energy-Efficient Air Conditioner (*Mandatory* Labelling) Program (target 1999)
- Minimum Energy Performance Standards (MEPS) set by NEPO and DEDP (target 1999).

Product category

For labelling: Residential, split-type room air conditioners of 7,000-24,000 Btu (2.1kW to 7kW) (will expand to 30,000 Btu (8.8kW) in 1999).

For MEPS: All residential room air conditioners.

Criteria and requirements

To obtain an energy label, a sample unit must be randomly selected from a pool of at least 30 units of the same model (same size and features) and sent to TISI for energy performance testing. Once the model has been tested, it is issued a numbered ranking between 1 to 5. The manufacturer/distributor may choose whether or not to request labels for their products.

A tested air conditioner may receive a ranking number of 1, 2, 3, 4, or 5 depending on its energy efficiency ratio (EER – units in Btu/Watthour).

Number 1: An air conditioner will receive a number 1 label if its EER is *less than 7.6*.

Number 2: An air conditioner will receive a number 2 label if its EER is *between 7.6 to 8.6*.

Number 3: An air conditioner will receive a number 3 label if its EER is *between 8.6 to 9.6*.

Number 4: An air conditioner will receive a number 4 label if its EER is *between 9.6 to 10.6*.

Number 5: An air conditioner will receive a number 5 label if its EER is greate*r than 10.6*.

For MEPS, product must exceed the minimum energy efficiency level to allow sale in the market. The minimum efficiency level has not been determined but will most probably be based on level 3, 4, or 5 of the EGAT label.

Testing standards and procedures

TISI uses the TIS 1155-2536 (1993): Standard for air-cooled split-type room air conditioners test procedure, which references:

- ISO/R 859-1968: Testing and rating room air conditioners (now withdrawn - predecessor to ISO5151).
- ARI 210/240-84 (Air Conditioning & Refrigeration Institute): Unitary air conditioning and air source heat pump equipment.
- JIS B 8615-1984: Testing methods for unitary air conditioners.
- JIS B 8616-1984: Unitary air conditioners.

Electric motors

Regulation or program (effective date)

- High-Efficiency Motor (*Voluntary* Loan) Program (1996)
- Minimum Energy Performance Standards (target 1999)

Product category

For the loan program: standard and high-efficiency industrial motors.

For MEPS: motors within these characteristics are being considered:

1. 0.7 kW to 373 kW size
2. 2, 4, 6 and 8-pole motors
3. open and closed-types

Criteria and requirements

For the loan program, EGAT offered a 3-year interest-free loan to high efficiency motor buyers. The loan is essentially the amount of incremental cost of the high efficiency motor compared to the base-case motor. To qualify, motors must be tested and approved as high-efficiency according to 1997 NEMA high-efficiency levels by an accredited testing laboratory.

For MEPS, two standard levels of motors are proposed: high-efficiency and lower-efficiency.

Motors must exceed corresponding minimum energy efficiency levels in order to achieve a high-efficiency rating. The minimum efficiency levels have not been officially determined but will most probably be based on EGAT's definition and the U.S./Canadian minimum efficiency standards for high-efficiency motors.

Lower-efficiency level motors will be based on EGAT's definition and the current average motor efficiency in Thailand.

Testing standards and procedures

For the loan program, no motor testing was required. There is no internationally accredited motor testing facility in Thailand.

For MEPS, a motor testing facility must be constructed. However, the process has not been officially determined.

Although without a complete and accredited laboratory, Thailand has already established two national standards for motor testing: TIS 866-2532 (1989): Standard for single-phase induction motors and TIS 867-2532 (1989): Standard for three-phase induction motors. These test procedures were established with direct reference to:

- IEC60034-1 (1983): Rotating electrical machines (Part 1: Rating and performance)
- IEC60034-2 (1972): Rotating electrical machines (Part 2: Methods for determining losses and efficiency of rotating machinery from tests (excluding machines for traction vehicles)
- JIS C4210-1984: Low voltage three-phase squirrel-cage induction motor for general purposes

Fluorescent lamps

Regulation or program (effective date)

High-Efficiency Fluorescent Tube (*Voluntary* Market Transformation) Program (1993).

Minimum Energy Performance Standards (target 1999).

Product category

Market Transformation: All T12 40W (1200mm or 4-foot) and 20W (600mm or 2-foot) fluorescent lamps

MEPS: All T8 36W (4 foot), 18W (2-foot) fluorescent lamps and 32W circular ("circline") lamps are being considered.

Criteria and requirements

For labelling, there are no particular requirements. In exchange for EGAT's advertising expenses, lamp manufacturers/distributors in Thailand agreed to switch all production, import, and sales from T12 lamps to T8 lamps.

For MEPS, product must exceed the minimum energy efficiency level to allow sale in the market. The minimum efficiency level has not been determined but will most probably be based on the following parameters:

1. Efficacy (Lumens/watt)

2. Lamp Life
3. Lamp Lumen Depreciation

It may be proposed that the minimum level standards for these parameters will be based on a good quality, thin-tube (T8), halophosphor (e.g. cool white) fluorescent lamp.

Testing standards and procedures

TISI uses the national TIS 236-2533 (1990): Standard for fluorescent lamps, which references IEC60081 (1984): Tubular fluorescent lamps for general lighting service.

Ballasts for fluorescent lamps

Regulation or program (effective date)

- Energy-Efficient Ballast (*Voluntary* Labelling) Program (1996)
- Minimum Energy Performance Standards (target 1999)

Product category

Labelling: all magnetic ballasts for fluorescent lamps.

MEPS: all regular magnetic, low-loss magnetic and electronic ballasts for fluorescent lamps.

Criteria and requirements

To obtain an energy label, four sample units must be randomly tested at TISI from a pool of at least 10 units of the same model (same size and features). If all four tested ballasts that have losses less than 6 watts each, the model will obtain a “Safety Ballast Number 5” label. If any of the four ballasts tested has greater than 6 watts loss, a replacement can be chosen from the remaining 6 units. If the replacement ballast still has losses greater than 6 watts, the model will not receive the label.

For MEPS, a product must exceed the minimum energy efficiency level to allow sale in the market. The minimum efficiency level has not been determined. For magnetic ballasts, a maximum loss of 6W is being considered for standard. For electronic ballasts, research is being conducted to consider efficiency, power factor, total harmonic distortion, radio frequency interference, crest factor, and ballast life.

Testing standards and procedures

The test procedures and requirements for fluorescent lamp ballasts are set out in TIS23-2521 (1978). This is based on IEC 82 for ballasts which was withdrawn many years ago. It is assumed that the more recent version of this standard (IEC60921) is broadly equivalent to the TIS standard. A new standard for electronic ballasts TIS 1506-2541 has recently been released. This is broadly based on IEC60929. For verification of efficacy, the Thai system uses the nominal ballast watt loss and the rated lamp power to determine an allowable system Lumens per watt.

Compact fluorescent lamps

Regulation or program (effective date)

- Compact Fluorescent Lamp (*Voluntary* Market Transformation) Program (1996)
- Minimum Energy Performance Standards (target 1999)

Product category

Integral type only (with built-in electronic ballasts) compact fluorescent lamps.

Criteria and requirements

For the market transformation program, there were no particular requirements. EGAT established a public-private partnership with the three largest CFL importers/ assemblers. EGAT offered to pay for an extensive advertising program in return for participation of manufacturers in a program to sell the CFLs at a discount through 7-11 retail stores nationwide.

For MEPS, product must exceed the minimum energy efficiency level to allow sale in the market. The level has not been determined.

Testing standards and procedures

No quality or energy performance testing was required for the EGAT CFL program.

For MEPS, TISI will be the designated central testing facility. TISI will use TIS 236-2533 (1990) test procedure (same as fluorescent lamps).

2.20.3 Related Energy Efficiency Programs

EGAT has implemented and is preparing numerous other DSM programs besides those mentioned above. Other notable programs are:

- **Green Buildings (1995)** The program includes all commercial and residential buildings such as office buildings, condominiums, apartment buildings, department stores, hotels, hospitals, and schools. The program aims to make buildings "green" by retrofitting old electrical equipment with energy-efficient equipment (lighting, air conditioning, and motors), improve insulation, and introduce load management.
- **Thermal Energy Storage (1996)** The program promotes the use of thermal storage systems instead of central air conditioning systems during peak demand periods. Many of the planned pilot projects have been postponed due to budget shortage. Only one pilot project has been completed: EGAT headquarters – resulting in an estimated peak demand reduction of 500kW.
- **Attitude Creation (1994)** The program aims to instil in the public a positive attitude towards energy conservation and efficiency. The DSMO plans to implement "Green Learning" in 1,000 schools throughout the country by 2001. The Office has prepared 100 sets of learning tools and curricula during 1997-1998 period.
- **Industrial Cost Reduction (1997)** With cooperation from the Ministry of Industry, the program aims to reduce cost in industrial factories and plants.

Similar to the Green Buildings Program, energy audits of factories and plants will recommend retrofitting old equipment with energy-efficient equipment. The program also promotes the use of high-efficiency motors. However, without a budget to establish a motor testing laboratory, this high-potential project has been stalled since 1998.

The National Energy Policy Office has also implemented various energy conservation programs within the framework of the Energy Conservation Act of 1992. One of the most notable efforts is the Divide-by-Two campaign (*Ruam Palang Haan 2)*, which sets out to increase energy efficiency awareness in Thai consumers and encourage them to reduce use of electricity, water, and other materials by half. The campaign involves consumer education through massive advertising and information dissemination.

2.21 United States Of America

2.21.1 Regulatory and Administrative Framework

The regulatory framework for the US programs consists of:

- The National Energy Policy and Conservation Act (NEPCA) of 1978 (and subsequent amendments), which requires comparative labelling for household appliances and packaging disclosure panels for certain classes of lighting;
- The National Appliance Energy Conservation Act (NAECA) of 1987 (and subsequent amendments), which requires MEPS for a range of household appliances;
- The Energy Policy Act (EP Act) of 1992, which extended MEPS and labelling to certain classes of non-household products.

Minimum Energy Performance Standards

The legislation requires the US Department of Energy (DOE) to set MEPS for a wide range of named products, plus any other products that consume more than a specified amount of energy. However, MEPS can only be set after a prescribed process of research and consultation, and the MEPS levels must be demonstrated to be technically feasible and cost-effective. MEPS levels are reviewed by the DOE from time to time, and higher levels are set if the analysis justifies a revision.

Table 155 lists those product categories for which MEPS are currently in force. In some cases, it has been announced that more stringent MEPS levels will take effect at a set future date. In other cases, reviews are under way to determine if changed MEPS levels justified. These are discussed in relation to each appliance.

The Federal MEPS “pre-empt”, or override and State MEPS for the same product classes. Canada and, to a lesser extent, Mexico, have harmonised their MEPS regimes with the US for many products.

Comparative Energy Labelling

The National Energy Policy and Conservation Act of 1978 required the Federal Trade Commission (FTC) to mandate labels for appliances that indicate their energy consumption. The FTC issued guidelines for the comparative label in a rule promulgated in November 1979. This required manufacturers of the major home appliance types indicated in Table 155 to place energy labels on their appliances from mid-1980.

The label originally showed only the annual cost of operation with no direct indication of energy consumption. In 1994, the FTC revised the EnergyGuide labels so that annual energy use (in kWh) rather than average annual operating cost is the main comparative indicator. The label now shows:

- a bar scale with the highest and lowest energy use of all appliances of that type and size range, and indicating the comparative location of the model in relation to those extremes; and

- an estimated annual energy cost, based on the energy consumption of the model.

To enable manufacturers to produce the correct label, the FTC collects data on the range extremes from time to time, and the DOE publishes the average energy prices to be used in the calculations.

Other Labelling

There are two other types of labelling in use in the USA. For the lamp types indicated in Table 155, it is mandatory to include on the packaging a “display panel” showing the light output (in lumens), the energy use (W) and the operating life in hours. Where the product is also subject to MEPS, a symbol and text to indicate that it meets Federal minimum efficiency standards is also required.

The other labelling program, Energy Star, is managed jointly by the Environment Protection Agency (EPA) and the DOE. It is a voluntary endorsement label which began with office equipment, but now covers a wide range of appliances and equipment.

For office equipment such as personal computers and photocopiers, and household electronic equipment such as video cassette recorders, the Energy Star label indicates that the model has certain power management capabilities, and that the manufacturer has undertaken to supply the product with those capabilities turned on, or “enabled”.

For other types of equipment, the Energy Star label indicates that the product is among the most efficient of its type, either because it is in the top percentile of the range on the market, or because it exceeds the MEPS level by a specified margin.

Summary of products covered is shown in Table 155.

Table 155: Federal energy efficiency programs, USA

Product Description	Program Type: A. Comparison label	B. Endorsement label	C. Federal MEPS	D. Industry target	E. Other(a)
Refrigerators/Refrig.-freezers	M	V	M (1993) (c)		
Separate freezer	M		M (1993) (c)		
Room air conditioners	M	V	M (1990) (d)		
Central air cons and heat pumps	M	V	M (1995)		
Small commercial package air conditioners and heaters			M (1994)		
Large commercial package air conditioners and heaters			M (1995)		
Packaged terminal air conditioners and heat pumps			M (1994)		
Ground/water-source heat pumps		V			
Electric motors			M (1997)		
Incandescent non-reflector lamps					M
Incandescent reflector lamps			M (1995)		M
Compact fluorescent lamps					M
Fluorescent Lamps			M (1994/5)		
Fluorescent Lamp ballasts			M (1991)		
Clothes washers	M	V	M (1994)		
Dishwashers	M	V	M (1994)		
Clothes dryers			M (1994)		
Electric water heaters	M		M (1991)		
Microwave, range and oven			(b)		
Televisions, VCRs		V			
Home audio equipment		V			
Personal computers & VDUs		V			
Printers		V			
Fax machines		V			
Photocopiers		V			
Scanners		V			
Transformers		V			
Exit signs		V			

Source: Code Federal Regulations CFR16 Part 305, CFR10 Part 430. Comparative labels commenced in 1980, Endorsement label was progressive from 1993. (a) Mandatory disclosure (b) A recent DOE rule indicated that MEPS for microwaves, ovens and ranges were not justified so MEPS will not apply. (c) Current rule 1993, new rule effective 1 July 2001 published. (d) Current rule 1990, new rule effective 1 October 2000 published.

Table 156: Federal energy test procedures and labelling requirements, USA

Product Description	Test Procedures [a]	Reference Test procedures
Refrigerators and/or Refrigerator-freezers	CFR430 App A1	AHAM HRF-1-1979
Separate freezer	CFR430 App B1	AHAM HRF-1-1979
Room air conditioners	CFR430 App F	ANS Z234.1-1972
Central air conditioners and heat pumps	CFR430 App M	ASHRAE 90-1-1989
Packaged terminal air conditioners and heat pumps	ASHRAE 90-1-1989	ARI 210/240/320 ASHRAE 37-1988
Ground- or water-source heat pumps	ASHRAE 90-1-1989	
Electric motors	NEMA MG1-1987	
Incandescent non-reflector lamps	N/A	IES LM-45, LM-49
Incandescent reflector lamps	CFR430 App R	IES LM-45, LM-20
Compact fluorescent lamps	CFR430 App R	IES LM-66
Fluorescent Lamps	CFR430 App R	ANSI C78.375, C78.1, C-82.3, IES LM-9, LM-16 ,LM-58
Fluorescent Lamp ballasts	CFR430 App Q	ANSI C78.1, C-82.2
Clothes washers	CFR430 App J	AHAM HWL-1
Dishwashers	CFR430 App C	AHAM DW-1
Clothes dryers	CFR430 App D	AHAM HLD-1
Electric water heaters	CFR430 App E	
Microwave, range and oven	CFR430 App I	
Televisions	CFR430 App H	
Video cassette recorders	Energy Star	
Personal computers & VDUs	Energy Star	
Printers	Energy Star	
Fax machines	Energy Star	
Photocopiers	Energy Star	
Scanners	Energy Star	
Transformers	?	
Exit signs	?	

Note a: In all cases above, the test procedures referenced as an Appendix of CFR430 are located in US Code of Federal Regulations 10CFR430 Sub-part B

Refrigerators/Freezers

Program regulation and coverage

The MEPS regulations cover household refrigerators or refrigerator-freezers with a capacity of not more than 1100 L (39 cu ft), and freezers with a capacity of not more than 850 L (30 cu ft). Classes 1 to 10 in Table 157 were defined for the purposes of setting the first MEPS levels under the NAECA (which took effect on 1 January 1990) and those which took effect on January 1 1993, which still apply.

For the next round of MEPS, which take effect on 1 July 2001, where new classes of “compact” refrigerators and freezers have been defined. Compact refrigerators are those that are both less than 220 litres (7.75 cu ft) and less than 0.91 metres (36 inches) high.

Criteria and Requirements

MEPS levels for each product class are defined in terms of adjusted volume.

AV (Adjusted volume, cu ft) = Volume of fresh food compartment (cu ft) + (K × volume of freezer compartment (cu ft)).

The values of K are:

- 1.0 for a refrigerator without a freezing compartment;
- 1.44 for a single-door refrigerator with an internal freezing compartment
- 1.63 for a combination refrigerator-freezers
- 1.73 for a freezer.

The EPA’s Energy Star label may be used on models is currently available to refrigerator-freezers of Classes 3 to 7 where tested energy consumption is 20% or more below the MEPS level that will take effect in 2001.

Testing standards and procedures

The test procedure is specified in CFR Part 430, Subpart B, Appendix A1. The test is carried out at an ambient temperature of 90°F (32.3°C) with the doors closed and with the following target internal temperatures:

- 38°F (3.3°C) in the fresh food compartment of a refrigerator or a refrigerator-freezer;
- 15°F (-9.4°C) in the freezer compartment for a refrigerator (Product Class 1);
- 5°F (-15.0°C) in the freezer compartment for a refrigerator-freezer (Class 2 to 7);
- 0°F (-17.8°C) for a separate freezer.

Table 157: Refrigerator and Freezer categories, USA

Product Class	Description	Maximum annual energy consumption (kWh/yr)	
		Effective January 1, 1993	Effective July 1, 2001
1	Refrigerators and refrigerator-freezers with manual defrost	13.5 AV + 299	8.82 AV + 248.4
2	Refrigerator-freezers with partial automatic defrost	10.4 AV + 398	8.82 AV + 248.4
3	Refrigerator-freezers with automatic defrost with top-mounted freezer, no through-the-door ice service; and all refrigerators with automatic defrost	16.0 AV + 355	9.8 AV + 276
4	Refrigerator-freezers with automatic defrost with side-mounted freezer, no through-the-door ice service	11.8 AV + 501	4.91 AV + 501
5	Refrigerator-freezers with automatic defrost with bottom-mounted freezer, no through-the-door ice service	16.5 AV + 367	4.6 AV + 459
6	Refrigerator-freezers with automatic defrost with top-mounted freezer, and with through-the-door ice service	17.6 AV + 391	10.2 AV + 356
7	Refrigerator-freezers with automatic defrost with side-mounted freezer, with through-the-door ice service	16.3 AV + 527	10.1 AV + 406
8 (a)	Upright freezers with manual defrost	10.3 AV + 264	7.55 AV + 258.3
9 (a)	Upright freezers with automatic defrost	14.9 AV + 391	12.43 AV+ 326.1
10 (a)	Chest freezers and all other (non-compact) freezers	11.0 AV + 160	9.88 AV + 143.7
11 (b)	Compact Refrigerators and Refrigerator-Freezers with Manual Defrost	13.5 AV+ 299	10.70 AV+ 299.0
12 (b)	Compact Refrigerator-Freezer—partial automatic defrost	10.4 AV + 398	7.00 AV+ 398.0
13 (b)	Compact Refrigerator-Freezers automatic defrost with top-mounted freezer and compact all-refrigerators - automatic defrost	16.0 AV + 355	12.70 AV+ 355.0
14 (b)	Compact Refrigerator-Freezers - automatic defrost with side-mounted freezer	11.8 AV + 501	7.60 AV+ 501.0
15 (b)	Compact Refrigerator-Freezers - automatic defrost with bottom-mounted freezer	16.5 AV + 367	13.10 AV+ 367.0
16 (b)	Compact upright freezers with manual defrost	10.3 AV + 264	9.78AV + 250.8
17 (b)	Compact upright freezers with automatic defrost	14.9 AV + 391	11.4 AV + 152
18 (b)	Compact chest freezers	11.0 AV + 160	10.45 AV + 152

Source: CFR430, Subpart C, Clause 430.32. AV = Adjusted volume in cubic feet. (a) Not given a product class in Canadian regulations, but covered under "Freezers" (b) Compact products not separately defined under current Canadian regulations.

Room air conditioners

Program regulation and coverage

The Regulations cover single-phase air conditioners that are not “packaged terminal air conditioners” (see later). Products with and without louvred sides are defined as distinct categories, as indicated in Table 158. The existing MEPS levels were introduced on 1 January 1990. More stringent levels were published in October 1997 and are due to take effect on 1 October 2000. New product categories for units designed to be installed in casement windows (narrow vertical windows) have also been added.

Criteria and requirements

The present and impending MEPS requirements for each air conditioner category are summarised in Table 158. The MEPS requirements apply to cooling performance only, although different cooling MEPS may apply if the product heats as well as cools. The more stringent requirements due to take effect in are also shown.

Table 158: MEPS levels for room air conditioners, USA

	Product Class: Reverse Cycle?	Cooling capacity range	Min EER (BTU/ Wh)	Min EER (W/W) (a)	Min EER (BTU/ Wh)	Min EER (W/W) (a)
Units with louvred sides	1. No	Less than 6,001 BTU/hr (<1.76 kW)	8.0	2.34	9.7	2.84
	2. No	6,001 – 7,999 BTU/hr (1.76 -2.34 kW)	8.5	2.49	9.7	2.84
	3. No	8,000 – 13,999 BTU/hr (2.34 -4.10 kW)	9.0	2.64	9.8	2.87
	4. No	14,000 – 19,999 BTU/hr (4.10-5.86)	8.8	2.58	9.7	2.84
	5. No	≥ 20,000 BTU/hr (≥5.86 kW)	8.2	2.40	8.5	2.49
	11. Yes	< 20,000 BTU/hr (<5.86 kW)	8.5	2.49	9.0	2.64
	13. Yes	≥ 20,000 BTU/hr (≥5.86 kW)	8.5	2.49	8.5	2.49
Units without louvred sides	6. No	Less than 6,000 BTU/hr (<1.76 kW)	8.0	2.34	9.0	2.64
	7. No	6,000 – 7,999 BTU/hr (1.76 - 2.34 kW)	8.5	2.49	9.0	2.64
	8. No	8,000 – 13,999 BTU/hr (2.34 - 4.10 kW)	8.5	2.49	8.5	2.49
	9. No	14,000 – 19,999 BTU/hr (4.10 -5.86 kW)	8.5	2.49	8.5	2.49
	10. No	≥ 20,000 BTU/hr (≥5.86 kW)	8.2	2.40	8.5	2.49
	12. Yes	< 20,000 BTU/hr (<5.86 kW)	8.0	2.34	8.5	2.49
	14. Yes	≥ 20,000 BTU/hr (≥5.86 kW)	8.0	2.34	8.5	2.49
	15. Casement-only		(b)		8.7	2.55
	16. Casement-slider		(b)		9.5	2.78

Source: 10CFR430 Subpart C Part 430.32 (a) MEPS levels are specified in terms of EER: EER metric given for information only. (b) New classification introduced for 2001 MEPS.

Testing standards and procedures

The test procedure is in Part CFR 430 Subpart B, Appendix F, referencing ANSI/AHAM RAC-1-82, ASHRAE 16-83-RA88 and ASHRAE 90-1-1989.

Central air conditioners and heat pumps

Program regulation and coverage

NAECA and the EP Act define a “central air conditioner” as a single-phase product, other than a “packaged terminal air conditioner”, which is air-cooled, rated below 65,000 BTU/hr (19.1 kW) , and is not contained in the same cabinet as a furnace which is rated above 225,000 BTU/hr. It may be a cooling only unit or a heat pump.

Criteria and requirements

The cooling MEPS requirements summarised in Table 159 became mandatory at the beginning of 1992 (for split systems) and the beginning of 1993 (for single package systems).

Table 159: MEPS levels for central air conditioners and heat pumps, USA

Product Class	Minimum seasonal energy efficiency ratio (SEER) (d)		Heating seasonal performance factor (HSPF) (e)	
	BTU/Wh	**W/W (a)**	**BTU/Wh**	**W/W (a)**
Split systems	10.0 (b)	2.93	6.8 (b)	1.99
Single package systems	9.7 (c)	2.84	6.6 (c)	1.93

Source: CFR Part 430, Subpart C 430.32. (a) MEPS levels are specified in terms of SEER: Metric given for information only. (b) Effective January 1 1992 (c) Effective January 1 1993) (d) SEER = total cooling output in BTU during nominal annual usage period for cooling divided by electric power input in Wh over the same period. (e) HSPF = total heating output in BTU during nominal annual usage period for heating divided by electric power input in Wh over the same period.

Testing standards and procedures

The test procedure is in 10 CFR 430 Subpart B, Appendix M, which refers to ARI 310/380-93, and ARI 210/240-94 (applies to split-system room air conditioners (US definition) – see section on air conditioners for more detailed definitions).

Small commercial package air conditioning and heating equipment

Program regulation and coverage

The Regulations cover air-cooled, water-cooled, evaporatively-cooled or water source (not including ground water source) electrically operated, unitary central air conditioners and central air conditioning heat pumps for commercial applications which are rated below 135,000 BTU/hr (39.6 kW) cooling capacity

Criteria and requirements

The MEPS requirements summarised in Table 160 took effect for equipment manufactured on or after January 1 1994.

Table 160: MEPS levels for small commercial package air conditioners and heat pumps, USA

Product Class	Minimum EER	Minimum EER	Minimum SEER		Minimum HSPF	
	(Btu/Wh)	(W/W)	(Btu/Wh)	(W/W)	(Btu/Wh)	(W/W)
Air-cooled, 3-phase, split system, cooling capacity < 65,000 BTU/hr (19.1 kW)			10.0 (a)	2.93	6.8(a)	1.99
Air-cooled, 3-phase, single package, cooling capacity < 65,000 BTU/hr (19.1 kW)			9.7 (a)	2.84	6.6(a)	1.93
Air cooled, cooling capacity 65,000 – 135,000 BTU/hr (19.1 – 39.6 kW)	Cooling 8.9 (a) Heating 10.2	Cooling 2.61 Heating 3.0 (a)				
Water–cooled, evaporatively–cooled and water-source, cooling capacity < 65,000 BTU/hr (19.1 kW)	Cooling 9.3 (a) Heating 13.0	Cooling 2.73 Heating 3.8 (a)				
Water–cooled, evaporatively–cooled and water-source, cooling capacity 65,000 – 135,000 BTU/hr (19.1 – 39.6 kW)	Cooling 10.5(a) Heating 13.0	Cooling 3.08 Heating 3.8 (a)				

Source: AHAM (1993) (a) MEPS levels are specified in terms of Btu/Wh: conversion to other units given for information only.

Testing standards and procedures

The test procedure specified in the Energy Policy Act (1992) is ASHRAE 90.1, which in turn specifies a number of ANSI and ARI standards as the test methods. Chapter 10 of ASHRAE 90.1 provides details.

Large commercial package air conditioning and heating equipment

Program regulation and coverage

The Regulations cover air-cooled, water-cooled, evaporatively-cooled or water source (not including ground water source) electrically operated, unitary central air conditioners and central air conditioning heat pumps for commercial applications which are rated at between 135,000 and 250,000 BTU/hr cooling capacity (39.5kW to 73.2kW).

Criteria and requirements

The MEPS requirements summarised in Table 161 took effect for equipment manufactured on or after January 1 1995.

Table 161: MEPS levels for large commercial package air conditioners and heat pumps, USA

Product Class	Minimum EER	Minimum EER
	(BTU/Wh)	(W/W)
Air-cooled, cooling capacity 135,000 – 250,000 BTU/hr (39.6 – 73.3 kW)	Cooling 8.5 (a) Heating 9.9	Cooling 2.49 Heating 2.9 (a)
Water–cooled, evaporatively–cooled cooling capacity 65,000 – 135,000 BTU/hr (19.1 – 39.6 kW)	Cooling 8.9 (a)	Cooling 2.61

Source: AHAM (1993) (a) MEPS levels are specified in terms of Btu/Wh: conversion to other units given for information only.

Testing standards and procedures

The test procedure specified in the Energy Policy Act (1992) is ASHRAE 90.1, which in turn specifies a number of ANSI and ARI standards as the test methods. Chapter 10 of ASHRAE 90.1 provides details.

Packaged terminal air conditioners and heat pumps

Program regulation and coverage

The term “packaged terminal air conditioner” means a wall sleeve and a separate encased combination of heating and cooling assemblies specified by the builder and intended for mounting through the wall. It includes a prime source of refrigeration, separable outdoor louvres, forced ventilation and either hot water, steam or electricity as a heat source. A “packaged terminal heat pump” means a packaged terminal air conditioner on which reverse cycle refrigeration is the prime heat source, and either hot water, steam or electricity as a supplementary heat source.

Criteria and requirements

Each packaged terminal air conditioner and packaged terminal heat pump manufactured on or after January 1, 1994, shall meet the following standard levels:

(A) The minimum energy efficiency ratio (EER) of packaged terminal air conditioners and packaged terminal heat pumps in the cooling mode shall be 10.0 - (0.16 $\times$ Capacity (in thousands of Btu per hour at a standard rating of 95 degrees F DB, outdoor temperature)). If a unit has a capacity of less than 7,000 Btu per hour (2.05kW), then 7,000 Btu per hour shall be used in the calculation. If a unit has a capacity of greater than 15,000 Btu per hour (4.4kW), then 15,000 Btu per hour shall be used in the calculation.

(B) The minimum coefficient of performance (COP) of packaged terminal heat pumps in the heating mode shall be 1.3 + (0.16 $\times$ the minimum cooling EER as specified in subparagraph (A)) (at a standard rating of 47 degrees F DB).

Testing standards and procedures

The test procedure specified in the Energy Policy Act (1992) is ASHRAE 90.1, which in turn specifies a number of ANSI and ARI standards as the test methods. Chapter 10 of ASHRAE 90.1 provides details.

Electric motors

Program regulation and coverage

The Regulations cover “general purpose T-frame, single-speed, foot-mounting, polyphase squirrel-cage induction motor[s] of the National Electrical Manufacturers Association [NEMA] Design A and B, continuous rated, operating on 230/460 volts and constant 60 Hertz line power”, in the capacity range 1 to 200 HP (0.746-150 kW).

Criteria and requirements

Different minimum nominal full-load efficiency levels are specified for 2, 4 and 6 pole motors and for enclosed and open designs (8 pole motors are not covered). The levels in Table 162 took effect in October 1997, after a 5 year lead time.

Table 162: MEPS for NEMA motors, USA

Power	Open			Enclosed		
HP	2-Pole	4-Pole	6-Pole	2-Pole	4-Pole	6-Pole
1	75.5	82.5	80.0	75.5	82.5	80.0
1.5	82.5	84.0	84.0	82.5	84.0	85.5
2	84.0	84.0	85.5	84.0	84.0	86.5
3	84.0	86.5	86.5	85.5	87.5	87.5
5	85.5	87.5	87.5	87.5	87.5	87.5
7.5	87.5	88.5	88.5	88.5	89.5	89.5
10	88.5	89.5	90.2	89.5	89.5	89.5
15	89.5	91.0	90.2	90.2	91.0	90.2
20	90.2	91.0	91.0	90.2	91.0	90.2
25	91.0	91.7	91.7	91.0	92.4	91.7
30	91.0	92.4	92.4	91.0	92.4	91.7
40	91.7	93.0	93.0	91.7	93.0	93.0
50	92.4	93.0	93.0	92.4	93.0	93.0
60	93.0	93.6	93.6	93.0	93.6	93.6
75	93.0	94.1	93.6	93.0	94.1	93.6
100	93.0	94.1	94.1	93.6	94.5	94.1
125	93.6	94.5	94.1	94.5	95.0	95.0
150	93.6	95.0	94.5	94.5	95.0	95.0
175	94.5	95.0	94.5	95.0	95.0	95.0
200	94.5	95.0	94.5	95.0	95.0	95.0

Source: AHAM (1999)

Testing standards and procedures

The test procedure specified in the Energy Policy Act (1992) is NEMA MG1-1987.

Incandescent non-reflector lamps

Program regulation and coverage

The Regulations apply to incandescent lamps rated at between 30W and 199W and between 115V and 130V, and with an E26 medium-screw base.

Criteria and requirements

The following information must be included in a "principal display panel" on the lamp package:

- The number of lamps included in the package, if more than one;
- The design voltage of each lamp included in the package, if other than 120V:
- The light output of each lamp included in the package in average initial lumens;

- The electrical power consumed by each lamp in the package, in average initial wattage;
- The life of each lamp included in the package, in hours.

CFR Part 305 specifies the layout and size of the principal display panel.

Testing standards and procedures

The standard to be used for measuring light output is IES LM45, and the standard to be used for measuring operating life is IES LM49.

Incandescent reflector lamps

Program regulation and coverage

The Regulations apply to general service incandescent reflector lamps:

- with an R bulb shape, a PAR bulb shape similar to R or PAR that is neither ER nor BR, as described in ANSI C79.1;
- with an E26 medium-screw base;
- with a nominal voltage or voltage range that lies at least partially between 115 volts and 130 volts;
- with a diameter greater than 2.75 inches (70 mm); and
- that has a nominal power of between 40W and 205 W.

The Regulations do *not* apply to coloured, vibration- or impact-resistant or certain other special purpose lamps.

Criteria and requirements

Incandescent reflector lamps must labelled in the same way as incandescent non-reflectors. In addition, the label must carry a message that the lamp meets the minimum efficacy levels specified in Table 163, which took effect on 1 November 1995.

Table 163: MEPS for general service incandescent lamps, USA

Rated lamp wattage	Minimum average lamp efficacy (lumens/W)
40 – 50	10.5
51 – 66	11.0
67 – 85	12.5
86 – 115	14.0
116 – 155	14.5
156 – 205	15.0

Source: CFR430, Subpart C (1998)

Testing standards and procedures

The standard to be used for measuring light output is IES LM 20, and the standard to be used for measuring operating life is IES LM 49.

Compact fluorescent lamps

Program regulation and coverage

The Regulations apply medium base compact fluorescent lamps, which are integrally ballasted fluorescent lamp with a medium screw base and a rated input voltage of 115 to 130 volts and which is designed as a direct replacement for a general service incandescent lamp.

Criteria and requirements

The following information must be included in a "principal display panel" on the lamp package:

- The number of lamps included in the package, if more than one;
- The design voltage of each lamp included in the package, if other than 120V:
- The light output of each lamp included in the package in average initial lumens;
- The electrical power consumed by each lamp in the package, in average initial wattage;
- The life of each lamp included in the package, in hours.

CFR Part 305 specifies the layout and size of the principal display panel, and also specifies the wording of warning messages about deterioration in performance or life of compact fluorescent lamps is operated outside the design voltage.

Testing standards and procedures

The standard to be used for measuring light output is IES LM 66, and the standard to be used for measuring operating life is IES LM 40.

Fluorescent lamps

Program regulation and coverage

The Regulations apply to the four main categories of general service fluorescent lamps described in Table 164 and excludes coloured, cold-temperature, reprographic and certain other special purpose lamps.

Criteria and requirements

The minimum efficacy levels specified in Table 164 took effect in 1994 and 1995.

Table 164: MEPS for general service fluorescent lamps, USA

Lamp type	Nominal lamp wattage	Minimum average CRI (a)	Minimum average lamp efficacy (lumens/W)
4 foot (1200 mm) straight, medium bi-pin base, rapid-start, nominal power >=28W	>35 W	69	75.0 (b)
	≤ 35 W	45	75.0 (b)
2 foot (22–25 in; 560–635 mm) U-shaped, recessed double-contact base nominal power >=28W	>35 W	69	68.0 (b)
	≤ 35 W	45	64.0 (b)
8 foot (2400 mm) high output: straight, recessed double-contact base, rapid start, nominal power >=95W	>100 W	69	80.0 (c)
	≤ 100 W	45	80.0 (c)
8 foot (2400 mm) slimline: straight, single pin base, instant start, nominal power >=52W	>65 W	69	80.0 (c)
	≤ 65 W	45	80.0 (c)

Source: CFR430, Subpart C (1998) (a) CRI = Colour Rendering Index (b) Effective date 1 November 1995 (c) Effective date 1 May 1994

Testing standards and procedures

The test procedures are in American National Standards Institute (ANSI) standards ANSI C78.1, 78.3, C78.385, International Commission in Illumination (CIE) standard CIE 13.3, and Illuminating Engineering Society of North America (IES) standards IES LM9, LM16 and LM58.

Fluorescent lamp ballasts

Program regulation and coverage

The Regulations cover lamp ballasts for design voltages of 120 and 277 V, and intended to operate with the lamp types listed in Table 165.

Criteria and requirements

The minimum efficiency standards in Table 165 are expressed in terms of ballast efficacy factors. The ballast efficacy factor (BEF) is determined as the ratio of the relative light output of the test ballast/reference lamp combination (in comparison with the reference lamp/ballast system) divided by the total system power. The relative light output is defined as the ratio of the light output of the test system to the light output of the reference system (expressed as 100 when they are equal). The higher the ratio, the higher the efficiency of the ballast under test. The standards, which took effect on 1 January 1990, apply to ballasts with a power factor of 0.90 or greater.

Table 165: MEPS for fluorescent lamp ballasts, USA

Application for operation of:	Ballast input voltage	Total nominal lamp watts (a)	Minimum ballast efficacy factor
One F40T12 lamp	120 V	40 W	1.805
	227 V	40 W	1.805
Two F40T12 lamps	120 V	80 W	1.060
	227 V	80 W	1.050
Two F96T12 lamps	120 V	150 W	0.570
	227 V	150 W	0.570
Two F96T12HO lamps	120 V	226 W	0.390
	227 V	226 W	0.390

Source: CFR430, Subpart C (1998)

Testing standards and procedures

The test procedures are specified in DOE 10CFR430.27 Appendix Q which references ANSI C78.1 and ANSI C-82.2.

Clothes washers and dryers

Program regulation and coverage

The Regulations cover:

- Top-loading standard (≥1.6 ft^3) or compact (<1.6 ft^3) electrically operated household automatic clothes washers; top-loading semi-automatic, front loading and suds saving types do not have a MEPS level, but are required to have an unheated rinse water option;
- standard (≥ 4.4 ft^3) and compact (<4.4 ft^3) electrically operated and electrically heated household tumble-type clothes dryers (gas dryers, which are outside the scope of the present study, are also covered).

Compliance with MEPS is required for both products while comparative labelling is required only for clothes washers.

Criteria and requirements

The minimum "energy factors" (EF) for clothes washers are expressed in cubic foot capacity/kWh per cycle. The criteria, shown in Table 166 took effect on 14 May 1994. The minimum EF for clothes dryers are expressed in cubic foot load capacity/kWh (also measured per cycle). The criteria, shown in Table 167 took effect on 14 May 1994.

The EnergyGuide labels for clothes washers indicate the kWh used for 416 cycles per year. Clothes dryers do not carry an EnergyGuide label.

Table 166: MEPS for clothes washers, USA

Product Class	**Minimum EF**	
	L/kWh/cycle	cu ft/kWh/cycle(a)
Top loading compact (< 1.6ft^3 (45 L) capacity)	25.48	0.90
Top loading standard (>= 1.6ft^3 (45 L) capacity)	33.41	1.18

Source: CFR430, Subpart C (a) MEPS expressed in these units – other included for information only.

Table 167: MEPS for clothes dryers, USA

Product Class		**Minimum EF**	
		kg/kWh	lb/kWh(a)
Compact (<4.4 ft^3 (125 L) capacity)	120 V	1.42	3.13
	240 V	1.31	2.90
Standard (>= 4.4 ft^3 (125 L) capacity)		1.36	3.01

Source: CFR430, Subpart C (a) MEPS expressed in these units – other included for information only.

Testing standards and procedures

The clothes washer tests are in, to of CFR Part 430 Subpart B Appendix J, which references AHAM HWL-1 (although the new Appendix J1 will be self contained when it comes into force shortly). For clothes dryers tests are in CFR Part 430 Subpart B Appendix D which references AHAM HLD-1.

Dishwashers

Program regulation and coverage

The Regulations cover electrically operated automatic household dishwashers that are not commercial, industrial or institutional machines.

Criteria and requirements

The minimum energy factor (EF) requirements, expressed in cycles/kWh, in Table 168 took effect on 14 May 1994.

The EnergyGuide labels for dishwashers indicates the kWh used for 322 cycles per year.

Table 168: Minimum energy standards for dishwashers, USA

Product Class	Minimum EF (cycles/kWh)
Compact (exterior width < 22 in (56 cm))	0.62
Standard (exterior width ≥ 22 in (56 cm))	0.46

Source: CFR430, Subpart C (1998)

Testing standards and procedures

The dishwasher tests are in CFR Part 430 Subpart B Appendix C which references AHAM DW-1.

Electric water heaters

Program regulation and coverage

The Code of Federal Regulations cover the following types of electric water heaters (in addition to water heaters of other fuel types):

- electric storage water heaters with a capacity between 20 and 140 US gallons (76 to 530L) and an input of 12 kW or less and with a storage temperature of less than 180^{o}F; and
- electric instantaneous water heaters with an input of 12 kW or less; and
- heat pump type units with a maximum current rating of 24 Amps and a voltage no greater than 250V.

that are intended for use on a pressure system.

The Energy Policy Act (1992) covers electric commercial water heaters as follows:

- storage water heaters with an input rating of < 4,000 Btu per hour per US gallon of water stored;
- instantaneous water heaters with an input rating of ≥ 4,000 Btu per hour per US gallon of water stored;

Requirements are also specified for water heaters of other fuel types and unfired water heaters that use an external source of heating.

Criteria and requirements

Under CFR Part 430 for products manufactured after 15 April 1991, the Energy Factor shall be not less than:

$$0.93 - (0.00132 \times \text{rated storage volume in US gallons})$$

In CFR Part 430 Subpart B Appendix E, the Energy Factor is defined as “a measure of water heater overall efficiency” and is essentially the overall task efficiency for the delivery of 64.3 US gallons over a 24 hour period.

The MEPS requirements for commercial water heaters under the Energy Policy Act 1992 took effect on 1 January 1994 and are as follows for electric water heaters:

- Storage water heaters - maximum standing heat loss criteria, expressed in percent per hour,:

  0.30 + (27/measured storage volume in US gallons)

- Instantaneous water heaters with a storage of less than 10 US gallons (38 litres) shall have an efficiency of ≥ 80% (intended mainly for gas/oil);
- Instantaneous water heaters with a storage of greater than 10 US gallons (38 litres) shall have an efficiency of ≥ 77% (in addition the maximum standby losses for these units shall be 2.30 + (67 / volume in US gallons) (intended mainly for gas/oil);

Storage water heaters and hot water storage tanks having more than 140 gallons of storage capacity need not meet the standby loss requirements if the tank's surface is thermally insulated to R 12.5 (imperial units).

Testing standards and procedures

Under CFR430, electric water heaters are tested to CFR Part 430 Subpart B Appendix E. Under the Energy Policy Act 1992, water heater test procedures are referenced to ASHRAE 90.1, which in turn references ANSI Z21.10.3 (which is for gas water heaters, but presumably sets test conditions).

Products covered by Energy Star labelling

The Energy Star labelling program is managed by the Environment Protection Agency (EPA) and the DOE. It is a voluntary endorsement label which began with office equipment, but now covers a wide range of appliances, as shown in Table 169.

The type of criteria for Energy Star endorsement vary from product to product. In some cases (eg exit signs) there is a simple maximum power test. For office equipment (eg personal computers) the Energy Star label indicates that the model has certain power management capabilities, and that the manufacturer has undertaken to supply the product with those capabilities turned on, or "enabled". For photocopiers, the product must have certain paper handling as well as power management capabilities. The criteria and tests for Energy Star rated office equipment are described in the Annex on test procedures.

For other types of equipment, the Energy Star label indicates that the product is among the most efficient of its type, either because it is in the top percentile of the range on the market, or because it exceeds the MEPS level by a specified margin. For residential lighting products, the criteria appear to be the incorporation of one or more features designated by the EPA and DOE as contributing to greater efficiency in use.

Table 169: Energy Star labelling criteria, USA

Product Class	Energy Star Criteria
Refrigerators	Energy consumption at least 20% below MEPS
Room air conditioners	EER at least 15% above MEPS
Central air conditioners and heat pumps	Criteria not clear from EPA website
Geothermal heat pumps	Criteria not clear from EPA website
Clothes washers	All horizontal axis, and vertical axis with sensors and high-pressure spray systems; water use 20-25 gals/cycle
Dishwashers	Energy consumption at least 15% below MEPS
Exit signs	≤ 5 W per face
Residential lighting products	Incorporate CFLs, daylight or motion sensors; Criteria not clear from EPA website
Televisions	Standby power ≤ 3W
Video cassette recorder (VCR)	Standby power ≤ 4W
Digital versatile disc (DVD)	Standby power ≤ 3W (1 W from 2003)
Home audio products	Standby power ≤ 2W (1 W from 2003)
Transformers	Losses < 5% for building transformers, <2% for utility

2.22 Vietnam

2.22.1 Overview of the Regulatory Framework

Vietnam has recently moved into a period of fast economic development by opening its doors to the outside world. Along with economic development comes high demand for energy. However, Vietnam power sector is plagued with problems in almost every aspect. There is a significant shortfall in energy supply, especially in rural areas – only half of the 78 million people have access to consistent electricity supply (MoSTE 1998). Due to its limited indigenous energy resources, Vietnam depends heavily on imported energy, such as oil. In addition, the power infrastructure in Vietnam is faced with low efficiencies in energy exploitation, conversion, production, transmission, distribution, and end-uses.

In recognition of the above problems, Vietnam is developing policies and frameworks to restructure and improve the efficiency of the power sector. Vietnam has not forgotten the mistakes of many developing countries despite an overwhelming technological development that led to great increases in demand for energy. Vietnam has begun implementing a Master Plan for Energy Conservation and Efficiency (EC&E).

Master Plan for Energy Conservation and Efficiency

With funding and assistance from the Royal Netherlands Government, NEDO (Japan) and GTZ (Germany), Vietnam developed a Master Plan for Energy Conservation and Efficiency under the National Program for Sustainable Energy Development Policy, which was established by the Prime Minister's office in 1995. The development of the Master Plan has been the responsibility of the Department of Technology Management, under the Ministry of Science, Technology, and Environment (MoSTE).

The main purpose of the Master Plan is to balance energy security, environmental protection, and social growth to achieve sustainable development. The initial phase of the Master Plan (January 1995 – June 1997) has been completed, and the government is implementing the second phase of the program, which will continue through June 1999. The first phase of the Master Plan involved collection of information, assessment of energy efficiency potential, and formulation of action plan for the program. During the second phase, MoSTE is formulating energy conservation policies based on findings in the first phase and is developing plans to implement energy efficiency demonstration projects throughout the country.

Energy efficiency standards and labelling for electrical equipment and appliances is also being considered as a sub-program. With IIEC's assistance, MoSTE has developed a proposal for a project to establish a national energy efficiency standards regime for Vietnam. This proposal would determine appropriate energy efficiency testing procedures, standards, and labelling for electrical equipment and appliances in Vietnam. At present, no standards or labelling programs have been implemented in Vietnam.

2.22.2 Summary of Regulated Products

Vietnam is considering implementing energy efficiency standards and labelling for most products. Note that the government has neither officially proposed nor drafted standards for these products. The information presented in the table shows the type of programs that Vietnamese officials would like to implement for the corresponding products.

Table 170: Energy efficiency regulations and programs in Vietnam

	Program Type				
Product Description	**A. Comparison label**	**B. Endorsement label**	**C. MEPS**	**D. Industry target**	**E. Other**
Refrigerator and/or Refrigerator-Freezer	VL (UC)				
Separate Freezer	VL (UC)				
Room Air Conditioners (window wall)	VL (UC)		VH (UC)		
Room Air Conditioners (other e.g. split systems)	VL (UC)		VH (UC)		
Packaged Air Conditioners (with ducting)	VL (UC)		VH (UC)		
Electric Space Heaters	VL (UC)		VH (UC)		
Fluorescent Lamp Ballasts		VL (UC)	VH (UC)		
Electric Water Heaters		VL (UC)			
Clothes Washers		VL (UC)			
Dishwashers		VL (UC)			
Clothes Dryers		VL (UC)			
Televisions		VL (UC)			
Video Cassette Recorders		VL (UC)			
Computers and/or visual display units (screens)		VL (UC)			
Printers (computer)		VL (UC)			
Fax Machines		VL (UC)			
Photocopiers		VL (UC)			

It is important to note that Vietnam has no official plans for these products. Thus, no further details could be provided.

3. Future Directions

Clearly, on the documentation provided in the technical Annexes, there is a huge range of test procedures in use within APEC Member Economies. While there is a degree of similarity and even harmonisation in some areas and for some products, there is generally a complex mix of requirements in force. This obviously has the potential to, and most likely already is, restricting free trade between APEC member economies.

This chapter attempts to provide an overview, at least for the major product groups where there are many and varied test procedures and related regulations in operation, of the current level of "dis-harmonisation" or non-alignment within these test procedures and regulations. This chapter also examines the issues and prospects for conversion algorithms between test procedures so that future requirements for retesting are diminished. In particular, this chapter will attempt to address the last point in the terms of reference, which states:

Where possible, identify where it is feasible to overcome trade barriers by the development of conversion algorithms between domestic testing protocols (noting that the development of algorithms is not part of this study).

The issue of what constitutes a test procedure is briefly examined, then some background to conversion algorithms and benefits of alignment of test standards or development of conversion algorithms is provided. The final sections attempt to qualitatively summarise the status for each of the major product groups in terms of the degree of alignment currently in place, the prospects for alignment (is there an outstanding test procedure which is superior to all others?) and what are the prospects for conversion algorithms (and are these relevant).

3.1 Overview

3.1.1 What is a test procedure?

Test procedures (often also called "Test Standards") are the method of test used to determine appliance performance, energy consumption and hence energy efficiency. They are critical in that they allow the comparison of products on a fair basis.

For appliances and equipment, the energy test procedure is the foundation for minimum energy performance standards (MEPS), energy labels, and other related energy programs. It provides manufacturers, regulatory authorities, and consumers a way of consistently evaluating energy use and savings across different appliance models. A well-designed test procedure services the needs of its users economically and with an acceptable level of accuracy and correspondence to actual conditions. On the other hand, a poorly-designed energy test procedure can undermine the effectiveness of everything built upon it. Adapted from Meier (1998)

Energy test procedures are therefore a critical underpinning for all energy programs that seek to measure and improve the energy efficiency of appliance and equipment.

Test procedures cover all aspects of testing of the product, such as:

- ambient temperature
- water quality and temperature
- test loads
- instrumentation and equipment
- special materials and methods
- duty cycles and/or loading patterns

As appliances and equipment are becoming increasingly complex, test methods have to change to deal with new products and new technologies. Therefore, in the course of trying to reflect local conditions and dealing with new and innovative products, there is a large and growing potential for local test procedures to become unaligned across APEC member economies.

Ideally, a good test procedure should be able to deliver the following:

- Repeatability - get same result each time
- Reproducibility - get same result in different labs
- Reflective of consumer use
- Simple but effective
- Covers existing products and new and forthcoming technologies
- Able to represent cultural & climatic influences and user patterns

Unfortunately, it is rarely possible for a test procedure to meet all of these requirements simultaneously. Clearly, the requirement for repeatability and reproducibility is paramount in any test procedure that is used to regulate products or judge manufacturer claims. These are often regarded as a key and fundamental requirements for any test procedure and tend to take precedence over other aspects. They are of key importance to most groups but to regulators and consumer groups in particular.

The ability to be reflective consumer use is also a key requirement. The problem is that many consumer behave and act in different ways, so more often than not, there is a distribution of use rather than a single value. Variation in the frequency of use (for example of a clothes washer) is reasonably easy to determine and reflect in an energy label or an advisory brochure, but selection of different programs by consumers is more difficult to represent, as is variation in say washing temperatures.

While almost all parties would like test procedures to be simple, this is rarely possible, especially where complex technologies are involved. On the other hand, complexity is reflected in the cost of testing, which has to be limited to some degree.

The issue of new and emerging technologies is a critical one. Increasingly, product configurations and types are appearing that were never envisaged by the people that developed the test procedure for a product. The presence of load sensing devices (in products such as clothes washers), automatic dryness sensors (for clothes dryers), adaptive and smart controllers and fuzzy logic (adjusting and optimising the operation and performance on the basis of the previous day/week/month/year of use) make it increasingly difficult to test some product types, especially with outmoded procedures. Many of these devices and controls will actually save energy in actual use. In fact Meier argues that .... *There is good reason to believe that a large fraction of energy savings in future appliances will be achieved by the application of microcontrollers rather than with mechanical improvements. However, some of these savings will be fake, that is, they will appear only in the test procedure* (Meier 1998). The key issue is how to test a product without being tricked into thinking that it is more or less efficient than it is likely to be in actual use. A very interesting discussion of this issue is contained in Meier (1998) and Meier (1997).

Probably the biggest single issue with respect to the testing of appliances and equipment is the influence of climate and weather on products that are temperature sensitive (typically refrigeration products and air conditioners) and to a lesser extent the impact of cultural factors on the use of product. The range of local climatic conditions around the world (both indoor and outdoor) is immense and test procedures for these products are usually less than adequate, typically testing at a single temperature condition, which is clearly a poor reflection of actual use.

3.1.2 Measurement of Performance

The measurement of appliance performance in conjunction with energy consumption is an interesting one. Within a particular appliance model, the energy consumption and performance are related (eg, to make food colder in a particular refrigerator requires more energy, increasing the wash temperature of a clothes washer both increases the wash performance and the energy consumption). Performance of products is widely accepted as part of product test procedures. Things such as internal temperature control in a refrigerator, cooling or heating capacity of an air conditioner, shaft power output of an electric motor and volume of hot water delivered by a water heater are all measures of performance. In fact, consumers and businesses are not generally interested in the energy that is consumed by a product, but rather by the energy service that the product performs. Almost all test procedures measure the performance in some way, although there are a group of products in NAFTA economies where performance is not normally measured at this stage (washing products).

Performance is critical as the energy service and the energy consumption combine to provide a measure of the energy efficiency of the product – ie the “energy per unit of energy service”. Generally speaking, statements of energy efficiency are meaningless unless the level of performance is either specified or declared. One way to avoid the measurement of performance is to include prescriptive design requirements into test procedures to ensure that *de facto* the energy service is being provided. However, these often stifle manufacturer innovation in the design of their products. At the end of the day, performance of a product is of interest to consumers, not its design or how it provides the energy service.

Some performance attributes are clear cut and easy to specify in conjunction with energy consumption information. For example with clothes dryers, the standard test procedure specifies an initial and final moisture content for a clothes load and this constitutes a definition of “wet and dry clothes” for the purposes of comparative energy consumption and efficiency. In the case of refrigerators, the definition of suitably cooled space for the storage of food is a complex one but can be (and is) defined through a series of tests in the ISO refrigerator standards (operation temperature performance tests). For clothes washers and dishwashers, the issue of what constitutes clean clothes and dishes is a vexed one and to some extent subjective.

What is acceptable in one economy may not be acceptable in another. Hence the issue of performance is sometimes overlooked or avoided as being too difficult. However, it needs to be addressed in some form or the potential for energy programs to be undermined increases dramatically.

If there is no performance measurement in the test procedure, it is often necessary to prescribe attributes such as capacity and configuration. Some advanced products are able to trick a non-performance test procedure. For example, a dishwasher or clothes washer that has a soil sensor could terminate the washing operation prematurely if a soiled load is not used.. Such machines would only operate with very short program cycles and achieve inordinately high energy ratings under the test procedure, whereas in actual use the energy would be much higher (hence advice based on these tests could mislead consumers).

3.1.3 Characterising performance

Probably the single biggest issue with respect to test procedures is ensuring that it is able to deliver to its users what is required. Consumers, manufacturers and governments all use test procedures for a range of purposes and the information required for these uses varies somewhat. Ideally, a test procedure should be able to characterise the operation of a product (both in terms of its performance and energy consumption) under any "realistic" conditions of use.

Unfortunately, most test procedures do not address the issue of generic performance or actual conditions of use in a very innovative manner. Typically, a single (and often arbitrary) test condition is specified and this may or may not be close to actual use. For some product the point chosen has little real impact, but for others it is critical. Consequently, information from test procedures (such as energy consumption used to develop MEPS levels or energy shown on energy labels) may or may not rank products according to their efficiency in real use.

This is obviously a complex area and there is unlikely to be a "quick fix" solution. However, this report attempts to provide an overview of the situation within each product group and provide some suggestion regarding the path forward.

3.1.4 What is a conversion algorithm?

In its simplest form, a conversion algorithm is a simple "fudge" factor which will allow the measure of energy and/or performance under one test procedure to be converted to an equivalent and comparative value under a different test procedure without the need for additional retesting. In its most complex form, an algorithm could consist of a computer model which is used to simulate the performance and energy consumption under a range of conditions, including different test procedures, or conditions of actual use (say in a factory or household).

Conversion algorithms, where feasible, will provide reduced costs of testing for manufacturers, which will in turn reduce costs of trade. This will have potential benefits of allowing the most efficient products available on the market to move more freely which will in turn reduce the demand for energy consumption. However, the development of conversion algorithms that are accurate and reliable is not simple for some products and probably not even necessary or feasible for others.

If conversion algorithms are to be developed, they need to be credible, accurate and robust. In addition, there needs to be some agreement, at least in principle, for regulators to consider the use of such approaches should they prove to be successful. If regulators cannot or will not consider the use of such conversion algorithms, their development will be largely in vain, except for more exotic data analysis projects and international comparisons.

3.1.5 Conversion algorithms or alignment?

The development of suitable conversion algorithms has, in effect, the same impact as the alignment of test procedures – it avoids having to retest an exported product to range of local test procedures. So really, either alignment of test procedures or development of suitable conversion algorithms provides an acceptable outcome in terms of APEC policy requirements and future directions (provided that economies accept the results of a conversion algorithm as credible).

In some ways, developing an algorithm is even more attractive than alignment, as it lets everyone have their cake and eat it to – it allows free trade of products, but allows local test procedures (and the associated energy program activity) to be retained, thus providing much better program continuity. This is an important issue – the resistance to "change", however small, can be enormous, as manufacturers have made huge investments around production facilities which already meet the requirements of the various energy programs in which they are required to participate. However, a outward looking manufacturer will quickly see that advantages of a flexible system that allows exports to flourish without the need for extensive retesting.

However, in cases where there is a particular product test procedure that is clearly superior to others and is already "generic" to the extent that it already characterises products to the level that is necessary, alignment would tend to suggest itself as the preferable medium term option, as opposed to development of conversion algorithms.

In summary the alignment of test procedures and the development of conversion algorithms both achieve the same net effect. These are to:

- facilitate international trade
- decrease testing and approval costs for manufacturers
- allow the free movement of the most efficient products (noting that products with a low energy efficiency may still be barred if they do not meet local MEPS levels)
- facilitate international comparisons
- assist in the diffusion of advanced energy saving technologies.

Conversion algorithms have the added advantage of being able to provide a more accurate estimate of the impact of local usage patterns, better ranking of products under conditions of actual use and may also allow the retention of local or traditional test conditions. They would also facilitate direct international comparisons, which are of increasing importance. However, in cases where a particular product test procedure is clearly technically superior and already characterises products to the level that is necessary, alignment would probably be a preferable medium term option. It is only worth aligning with a standard that is technically superior and competent – aligning to a poor test procedure serves little purpose.

3.1.6 Special considerations

There are a range of issues that need to be considered before reading the following sections for the major product groups.

Few international test procedures are "Generic"

Despite the best intentions and efforts of standards committees and their members, the reality is that few, if any, of the commonly used international test procedures, are in a form that could be considered "generic", in that they can characterise the product under a range of typical uses. For some products, such a "generic" test procedure is quite feasible, but for others, the prospects of a generic test procedure are probably poor. In these cases, a conversion algorithm may be a more suitable option.

Climate considerations

Climatic considerations are critical for some products (especially air conditioners and refrigerators, and to some extent water heaters), and this is generally poorly handled in the existing test procedures for these product types. These products, which typically have widely varying temperature performance coefficients for different models, are usually tested under a single static temperature condition, which is neither representative nor facilitates the estimation of performance under other conditions (including real use). Of course, "real use" and a "representative test point" can never be developed – consider an economy such as Australia which has climate zones ranging from cool temperature to humid tropical; a single test condition can never be representative of such a range. For such products, a complex conversion algorithm (ie computer model) is probably the only feasible long term option.

Agreement to move forward

As outlined in previous sections, many economies regulate products. Unless there is some sort of plan or agreement with APEC on how to move forward, there is unlikely to be an progress in this area. Yet, APEC leaders have in fact agreed to some level of alignment in test standards by 2010/2020 (APEC 1997). For this to happen, there needs to be either credible test procedures which are worth aligning to or conversion algorithms developed that are credible and acceptable to regulators. There is little point in aligning with a standard that has a poor technical base or is otherwise unsuitable.

New "Smart" Products

The increasing prevalence of electronic controls in appliances and equipment will make testing more complicated and less repeatable. Features such as fuzzy logic, automatic programs and sensors (water level, load detection) and sensors for soil and dirt are becoming common. It is therefore important that test procedures move with the times to ensure that these smart products don't outsmart the test procedures.

A related issue is that where a test procedure specifies a single test point, it is well known that manufacturers tend to optimise for that test point rather than for real consumer use. This is of little service to the consumers who are supposed to be helped by programs such as energy labelling. Examining energy and performance over a range of conditions (which would typically need to be done in the development of a conversion algorithm) means that there is no advantage for manufacturers to optimise to a test single condition, hence products would hopefully become more versatile and better optimised for real use.

Global international standards

More often than not, international standards committees draw expertise from a narrow base of economies. Many committees which cover energy and performance of products draw heavily from European economies, while input from outside of Europe (including APEC) is usually minimal, if non existent. While it is fair to say (and it is often said) that many of these standard committees are dominated by Europe, it is also fair to say that few APEC economies (or those from other regions) provide any significant input or resources into these areas. So European domination, as such, tends to be by default rather through any systematic plan or conspiracy. Another problem area is that the composition of international standards committees tends to be from manufacturers and to a lesser degree material suppliers and test laboratories. Ironically, there is often a low level of input from regulatory agencies, who in fact are often charged with the ultimate use of these test procedures. If international standards are to become more relevant, regulators will need to provide coherent input and ongoing development resources into these areas.

Issues associated with the use of particular international standards is contained in the Annexes for each product group, so the issues will not be raised here again in any detail. However, in a general sense, international standards will need to become more flexible and generic to cope with climatic and usage variations. Where there is an option to develop a technically superior test procedure, this should be done and it should be adopted as far as is possible within APEC. Economies with energy related programs such as labelling and MEPS need to be consider becoming more involved in international standards processes.

3.2 Prospects and Recommendations by Product

This section provides an overview of the prospects, future directions and recommendations for test procedures of the major product groups covered by this study, viz:

- Air conditioners
- Electric motors
- Lighting products
- Water heaters
- Washing products
- Refrigerators
- Office equipment and consumer electronics.

An overview of the status of international test procedures is provided and some preliminary suggestions are made with respect to options for alignment of test methods and/or development of conversion algorithms as applicable.

3.2.1 Air conditioners

Overview

Room air conditioners are traded in large volumes internationally and despite differences in market traditions, the product types are usually essentially the same or very similar around the world. The inconvenience and expense of re-testing has led to some concerted efforts to align the testing practices and rating conditions required within the different test procedures which in turn has led to a high degree of commonality among them; however, many small differences continue to exist that in practice will usually oblige a manufacturer to re-test their products if they wish to sell them in a different member economy to their own. There is no theoretical reason why these small differences could not be fully aligned were there is sufficient institutional impetus to overcome them, but this would require a full review of the differences (not just those directly associated with energy performance testing), agreement on the optimum approaches and values and then a decision to fully align. Perhaps the simplest option would be to fully align to the ISO 5151-94 T1 test condition for cooling performance testing and to align tolerances in both the test temperatures and the declared EER and cooling capacity performance values; however, none of the existing test procedures is capable of giving a realistic representation of average in use performance (in either absolute or relative terms) and thus there is considerable need to improve the quality of all the procedures in the medium term.

In some areas major differences exist between the test procedures used in certain member economies, which is as much a result of differences in how identical products are classified, as it is through fundamental differences in the test conditions and testing practice. There appears to be a strong case for the alignment of product definitions used in test procedures and in efficiency regulations, as the existing differences in definitions currently constitute arbitrary barriers to the free flow of goods that are not prerequisites of the energy performance policy objectives. The development of an international coding system will assist considerably in this matter.

Differences in rating conditions

The main rating conditions used to rate the cooling capacity of room air conditioners is almost, but not quite, aligned among the various APEC member economy test procedures. This has probably occurred partly by default (partial or full adoption of ISO), but is also partly the result of some efforts to try and develop products with a common rating basis. However, there is certainly a case to remove the need for expensive re-testing, and even redesign, in order to sell a given product among member economies, which now exists in some cases.

Cooling tests

For capacity and EER rating tests for room air conditioners in the cooling mode, the majority of member economies have essentially adopted the ISO 5151-94 T1 test condition for air to air appliances, although sometimes with minor differences caused by rounding to the nearest whole number on the Fahrenheit or Celsius scale and sometimes with different test tolerances. Larger differences exist for water cooled air conditioners and heat pumps in the cooling mode where about half the member economies don’t have a rating requirement. Most of those who do, follow the ISO

5151 T1 condition which assumes that the condenser inlet water is recycled from the outlet and hence is at a relatively high 30°C – the main exception to this is the US test procedure, which has a significantly lower inlet temperature and presumably is based on an assumption of negligible water recycling within the condenser. Water cooled air conditioners and heat pumps are a niche product and so less attention has been paid to standards alignment due to comparatively low traded volumes; however, one of the difficulties in aligning the choice of inlet condenser water temperature is that there is very little field data on how these products are really used with which to base the assumptions in the test procedure.

Two member economies having room air conditioner energy efficiency regulations rate the cooling capacity and energy consumption used in their regulations exactly at the ISO 5151-94(E) T1 test condition (China and Hong Kong, China). The rating conditions used in Australia, Japan and Thailand only differ from T1 through minor variations in the accepted test condition tolerances. Several other economies (Canada, USA, Mexico, Korea and Chinese Taipei) have room air conditioner cooling mode test conditions that are within 0.5 °C of the T1 conditions. The Philippines is the only APEC member economy that makes a significant departure from T1 for air-cooled room air conditioners in the cooling mode as a result of using a higher outdoor wet-bulb temperature to reflect prevalent conditions in the Philippines.

The above information suggests that it would not be technically unreasonable to fully align the rating conditions for air cooled room air conditioners among APEC member economies, provided agreement could be reached over what product type qualified as room air conditioners.

Heating tests

There is more variation in heating capacity and energy performance conditions among the member economy test procedures. The principal reason is the change in the rating condition between the old ISO R859 and the current ISO 5151-94 test procedures. Many economies did not revise their test procedures after ISO 5151 replaced R859 in 1994 and hence have kept the 21°C indoor dry-bulb condition as opposed to the 20°C condition specified in ISO 5151. The new ISO condition also introduced indoor and outdoor wet-bulb requirements that were not in the old test procedure. It may be that those member economies that have not adopted the newer ISO conditions have technical objections to the new conditions but it is just as plausible that it is due to institutional inertia leading to delays in redrafting the procedures.

Alignment or conversion algorithm?

Although there is clearly a realistic potential for the alignment of test procedures and product definitions, the existing test procedures are all inadequate with respect to ranking air conditioner part-load performance, which is actually the most common operational state. With the exception of how the NAFTA economies treat split-systems, all the test procedures use a single steady state test to rate the cooling capacity, heating capacity and associated power consumption of room air conditioners. Invariably, this will encourage manufacturers to design products with performance optimised to the rating condition (nominally full load) and perhaps to the detriment of performance at non-rated conditions (more typical part load conditions). Even the test procedure used in the NAFTA economies only addresses this issue for split-systems or larger air conditioners (not windows or packaged terminal air conditioners) and even then by using a small subset of rating conditions that make a simplistic set of assumptions about actual use.

Even in the case of air conditioners that have fixed speed compressors, using a single steady state rating condition is already a major over simplification of reality, but for variable speed drive units, which are increasingly commonplace on the market and even the market leaders in some member economies, this is a very serious limitation. The EER of a variable speed drive air conditioner (or of multi-speed drive units) is strongly dependent on the cooling capacity such that the peak performance often occurs at about 60% of the rated cooling capacity, which is itself often about 75% of the maximum achievable capacity. The EER might typically vary by a factor of 1.6 across this range, which allows a wide margin for preferential selection of the rated cooling capacity for best EER performance.

Another very serious limitation of the current test procedures is their inability to address the air handling performance of the air conditioner, which has a large impact on the actual effective cooling performance of the appliance. This issue has been avoided due to the complexity of summarising real life air flow situations and because of practical difficulties in creating a repeatable and reproducible test addressing cool air distribution.

In summary, the current air conditioner test procedures are reasonably reproducible and repeatable, but do not come very close to reflecting actual in-use performance. Even those member economies that have modified the international test procedure to better reflect their local circumstances are not likely to have achieved conditions that either resemble real average in-use air conditioner energy consumption within their own economies or that necessarily correctly rank average in-use energy efficiency. To achieve this would require a much more extensive characterisation of the system under a broad range of operating conditions coupled through an algorithm to precise knowledge of actual local usage practice and conditions.

If enough details are known about an air conditioner, it is theoretically possible to simulate its performance under any given set of operating conditions. In theory it would be possible to design a cooling capacity test under a range of operating conditions that could allow the system to be characterised via a function or set of functions. The results could be used to:

a) Primarily convert performance ratings between operating conditions and hence between existing test procedures; and/or

b) Simulate a range of performance conditions (including selected standardised testing points) as well as provide options to calculate much more realistic in-use operating performance than is currently possible with the existing procedures.

The second option is ultimately more attractive because it is far more flexible in terms of potential application but also because the first option is likely to be less accurate and hence less acceptable from a regulatory perspective. The most likely “conversion algorithm” option for air conditioners is in fact a mixture of modelling (simulation of the key performance and construction characteristics) combined with physical testing of the unit to calibrate or align the simulation model with measured test data. There are a number of computer models for air conditioners that are used to simulate energy and performance and there is also extensive testing of air conditioners. What appears to be missing is the linking of the two aspects to provide a much more flexible and accurate tool for both energy regulations, modelling and analysis. It is even likely that some of the current standard rating points could be used as the basis for much of the calibration process to align to computer model.

It is reasonable to assume that the development of such an conversion algorithm would enable a fully international test method to be adopted that would could be applied to reflect performance under local usage circumstances far more realistically than any single set of weighted steady state conditions could do so. It could also be used to estimate performance and energy under most of the standardised rating conditions found in test procedures today. If nothing else, the development of such an algorithm or computer model would enable the magnitude of differences in the rated performance resulting from the differences in existing local test procedures to be quantified and for the impact of differences in individual parameters to be evaluated. This is likely to aid informed debate about test procedure alignment issues and the consequences of modifying any particular parameter. The computer modelling approach would also enable the impact of trade-offs caused by desirable simplifications of the test procedure against system characterisation accuracy to be quantified, that would substantially aid the discussions on how best to optimise development of the international ISO 5151 test procedure.

Recommendations for Air Conditioners

For air conditioners the most promising approach would appear to be multi pronged:

- Provide some effort and resources into eliminating the currently somewhat arbitrary (but mostly small) differences in test conditions and tolerance for testing of air conditioners and heat pumps within APEC economies. Aligning to ISO5151 T1 would appear to be a feasible option, although this would obviously be subject to agreement;
- Gradually work towards the development and adoption of international coding system of definitions for air conditioners within APEC economies to assist with the uniform treatment of air conditioning products in a regulatory sense;
- Examine options for modelling of small deviations from the ISO test method (eg changes in temperature and humidity requirements) and the development of an altitude correction algorithm;
- Undertake further investigations into the feasibility of developing a full simulation model for air conditions as a medium term goal (including a calibration process against actual tests). Such an approach should make particular reference to the accurate estimation of performance under standard rating conditions (for comparative and regulatory purposes), simulation of household usage under a range of climates and more realistically and accurately assessing the performance of variable speed drive compressor systems under conditions of actual use.

3.2.2 Electric motors

Overview

Motors are products which are already traded widely on the international market. The four main test procedures for motors which are in use in the world are:

IEC60034-2A Rotating electrical machines - Part 2: Methods for determining losses and efficiency of rotating electrical machinery from tests

NEMA MG 1-1987, Motors and Generators, Revision No. 2

ANSI/IEEE 112-1984, Test Procedure for Polyphase Induction Motors and Generators (Method B)

JIS C4210 Low voltage three phase squirrel cage motors for general purpose

The IEEE and NEMA methods are equivalent and either is generally acceptable for use in North America, so there are in fact only three main methods of test. While much of the content of these three main test methods is similar, there are some key differences.

While only a few APEC economies currently regulate motors on the basis of energy efficiency (mostly larger three phase motors, but also small single phase motors in some cases), there are many economies that are considering energy efficiency regulations or related programs. In addition, the declaration of motor efficiency (at full and/or part load) is a widely quoted and sought piece of information in the market place by suppliers and purchasers.

Alignment or conversion algorithm?

Most analysts regard the IEEE or NEMA methods (with the direct measurement of stray or additional losses) to be the superior test method of the main international methods (AGREE 1997, Batheld 1997). In late 1997, IEC initiated a new work item to review the IEC test procedure for motors with a view to considering the IEEE procedure and adopting the superior approaches as applicable. The resulting draft is very similar to the approach to IEEE with the exception that it allows “additional” losses to be either measured as per the IEEE Method B or estimated or “assigned” using an equation. The equation for estimating additional losses has been set at the high end of what is expected on the market, so a manufacturer with low additional losses has a strong incentive to measure these directly using the IEEE method. The estimation method was inserted essentially at the request of the Europeans who were concerned at the significant cost increase for tests under the proposed direct measurement method, as torque has to be measured under the IEEE procedure (which requires more sophisticated and expensive instrumentation).

A committee draft was prepared during 1998 and this went out to voting in early 1999, but subsequently failed to pass. The process has slowed due to a range of technical concerns raised by Europeans (some of which relate to the testing a large motors), but there still appear to be reasonable prospects for getting an accurate and robust IEC international standard based on IEEE published within the next few years.

If and when the IEC sort out the outstanding technical issues associated with the draft, an international standard that characterises motors over a range of conditions and that is accurate and competent will exist. As a preliminary recommendation (and subject to the normal technical caveats), APEC should consider the recommendation of using this standard as a suitable test method for future alignment.

Motors are relatively unusual, in that the test method is already suitable for a range of purposes and conditions and the test method already “characterises” the product to the extent that is required in the market place. Therefore, the development of a conversion algorithm is probably not necessary or recommended for this product (if the new IEC method is deemed to be acceptable).

Recommendation for AC Electric Motors

Ensure active participation from APEC economies in the current development of the new IEC motor standard which incorporates the superior methods of IEEE and alignment with this standard once published.

3.2.3 Lighting products

Overview

Lighting products are widely used in all sectors of the economy and there is already a huge international trade in these products and their components. The main types of equipment that are already regulated on the basis of energy efficiency are fluorescent lamps (mainly linear lamps), fluorescent lamp ballasts (most common product regulated), some incandescent lamp types and compact fluorescent lamps. A number of economies are also considering energy efficiency regulations for these products. Higher power discharge lamps (eg sodium or mercury vapour, metal halide) appear not be directly regulated (as they are mainly used in industrial or outdoor applications and their efficiency is generally quite high in any case), nor are (surprisingly) quartz halogen systems widely regulated (these are widely used in residential and commercial sectors).

Generally speaking, there is widespread use, either directly or through the adoption of local “clone” versions, of the IEC standards for the measurement of lighting performance. It appears that these standards are generally well regarded with respect to design, construction and performance of lighting components. Efficacy measurements for lamp components are well specified within IEC and these methods are widely accepted. Despite this, some APEC economies do not appear to use these IEC standards.

The issue of efficacy of fluorescent lamp ballasts is not addressed directly within any of the IEC standards, although most of the required information regarding reference ballasts and lamps and measurement of various parameters is contained in the relevant performance standards. However, a methodology for the determination of efficacy of ballasts is critical and the best approach is not necessarily “logical or obvious” to a non-expert in lighting performance. This is probably partly a case of lack of understanding or appreciation by the relevant IEC committees of how their standards are used on a day to day basis. It is also probably the result of a history of concentration on the performance of lighting components and their standardisation (eg construction, strength, size and dimensions, operation voltage and power, light output and so on) rather than concern with respect to efficacy.

The technical difficulty for fluorescent systems is that for some ballast/lamp circuit types (mainly those without a starter and those used with high frequency ballasts) it is not possible to accurately determine that lamp power or ballast power directly. The approach that is taken in North America and now Europe is that the relative light output and total power circuit power for a test lamp or ballast is compared to a reference system. This seems to be the most reliable method of measuring ballast efficacy. This is critical for high frequency systems (where the light output for a given lamp power input increases significantly) if they are to be compared on a fair and equitable basis to low frequency systems.

Alignment or conversion algorithm?

There is currently no IEC standard to measure the efficacy of ballasts. North America, out of necessity, has developed it own approaches to the measurement of lamp and ballast efficacy which appear to be technically competent. The approach is generally in line with the approaches for measuring the efficacy of fluorescent systems that are currently being developed in Europe. A number of APEC economies are developing or searching for an appropriate method for measurement of ballast efficacy.

There would appear to be an opportunity for the IEC to develop a new international test method for the measurement of the efficacy of ballasts. This could be done with both the input from the major APEC economies as well as Europe to develop a truly international test procedure. The existing methods in Europe and North America could be used as a basis for the development of the new standard. There are not likely to be many controversial issues, although minimum requirements for ballast lumen output may generate some discussion (these are generally higher in Europe than North America).

As a preliminary recommendation (and subject to the normal technical caveats), APEC should consider sponsoring the development of a new IEC standard for the determination of energy performance and efficacy of fluorescent lamp ballasts, which would complement the current suite of IEC lighting performance standards for lamps and ballasts. Once developed, consideration could be given to using this standard as a suitable test method for future alignment within APEC.

If a suitable IEC standard can be successfully developed, this test methods would be already suitable for a range of purposes and conditions and would “characterise” the product to the extent that is required in the market place. Therefore, the development of a conversion algorithm is probably not necessary or recommended for this product (if the new IEC test method is deemed to be acceptable).

Recommendations for Lighting Products

The following recommendations are made for lighting products:

- Active alignment with IEC standards for lighting products other than fluorescent lamp ballasts;
- Review and use of IEC performance standards for fluorescent ballasts where relevant;
- APEC participation in the development of a new IEC standard for the measurement of fluorescent lamp ballast efficacy;
- Alignment with the IEC standard once developed and if acceptable.

3.2.4 Water heaters

Overview

Electric water hearers are used in many APEC economies, although the ownership does vary substantially by member economy, ranging from negligible (eg Mexico) to well over 50% (eg Australia) in the residential sector. The level of trade in water heaters is not all that high as they are generally large bulky items with a relatively low manufactured value. However, many of the manufacturers have global operations and the level of trade is likely to increase with more liberalised trade arrangements.

Electric water heaters, being generally large consumers of a premium energy source (electricity), are often regulated where their use is common. The range of test procedures varies both in the details (typically reflecting local storage temperatures and ambient temperatures) and general approach with some economies using a static heat loss test (no hot water drawn off) with others using dynamic drawoff tests of specified temperatures and volumes over a set period. Within the test procedures for electric water heaters there is almost no alignment within APEC economies (not even within NAFTA economies – eg USA uses a drawoff test which covers all major fuel types, while Canada specifies a static heat loss test which is only applicable to electric systems while Mexico only regulates non-electric fuel types). Water heater test procedures are typical "home grown" in that that they seem to rarely draw on IEC tests or any other international method and almost always reflect "local conditions".

The IEC test method for water heaters is a static standing heat loss test, and while probably adequate for one particular class of product (electric storage models), is of little value to economies like the USA which regulates a range of fuel types (electric resistance, heat pump, gas, oil) and requires a common test procedure across these types. A task or draw-off test is required for non-electric water heater types.

Alignment or conversion algorithm?

On the face of it, the prospects for alignment of water heater standards are poor. Many product types are regulated, test procedures are many and different and there is a real need to cover product groups beyond simple electric storage models, meaning that the standard simple heat loss approach currently used in the IEC is of little value. But the more complex methods used (eg drawoff tests in the USA), while perhaps reflecting more accurately local use and conditions (but also perhaps not) and providing better product coverage, means that these are largely irrelevant to most other economies and climates.

On the other hand, water heaters would appear to be an ideal candidate for the development of a conversion algorithm. While the modelling required for a water is reasonably complex (thermodynamic heat flow modelling with the ability to characterise temperature stratification within the tank during drawoff and heating recovery characteristics), such an approach would appear feasible. Modelling of systems which have a strong interaction with the environment (eg heat pump models, solar water heaters), is somewhat more complex.

Fortunately, there appears to be a solution that has already been developed. Work undertaken in Australia, primarily for the modelling and rating of solar water heaters under AS4234, has resulted in the development of a computer model that can accurately characterise a wide range of water heater technologies.

Actual tests on solar and conventional systems has shown that the model provides a very accurate estimate of the task energy consumption (for any weather or climate pattern, any drawoff pattern and any energisation profile). The model can also be used to accurately simulate different test procedures (such as static heat loss tests and drawoff tests). This model could be used as a basis for APEC economies for the measurement of energy consumption and energy efficiency of water heaters. It is likely that tests under IEC60379-87 could provide the necessary input data for electric storage water heater for such a model. The data requirements for conventional systems are minimal and can be determined for simple tests, together with key physical characteristics. Heat pump and solar systems require more effort to determine the required input variables but this is quite feasible.

Although this computer model could possibly form the basis for a suitable generic water heater test procedure, it is yet to be published as a formal Australian or international standard. While some additional documentation and software development may be necessary before it is ready to be publish as a standard, the basic modelling engine appears to be sound and robust and suitable for widespread application. It is recommended that this model be investigated further as a possible conversion algorithm for APEC economies. This would provide a good test case for this type of approach within a test procedure.

Recommendations for Water Heaters

The prospects for alignment of water heater test procedures appear poor. The only feasible option appears to be the development of a complex computer algorithm which will allow accurate modelling and characterisation of a wide range of climate conditions and usage patterns. Such a computer model already exists in Australia and is in the process of being developed into an international standard. APEC should provide active assistance in this development, particularly with regard to the specification of input requirements for conventional water heater types.

3.2.5 Washing products

Washing or so called “wet” products are of three types: clothes washer, dishwasher and clothes dryers. Each of these are examined briefly.

Clothes washers

Overview

Clothes washers appear to be regulated in many APEC economies. Certainly the ownership of clothes washers is high in almost all APEC economies, but the energy consumption varies considerably due to local cultural factors (wash temperature, frequency of use). There is certainly a large trade in clothes washers within the APEC region and around the world.

The test procedures used in APEC economies appear to be an eclectic mix of procedures with some obviously “home grown” while others have drawn on IEC methods but had to adapt these for local and new technologies and cultural influences (particularly, types of washers, program selection and wash temperatures, but also test loads). A few economies use IEC methods without modification (or are considering this approach), but more often than not have to develop separate approaches to cover top loading machines. The measurement of performance also varies substantially, with NAFTA economies not measuring performance at all (some even test without a load for some products, although this is changing), while IEC, JIS and AN/NZS use a range of different measures to assess the washing performance. One of the problems associated with the IEC standard is the use of pig's blood as a stain on one of the soil swatches – this is a prohibited import into some countries with strict quarantine rules, such as Australia.

Alignment or conversion algorithm?

The IEC standard for clothes washers was, until recently, developed wholly within Europe, and as such, was only really applicable for drum (front loading) machine types. Recent work on the standard has meant that there is now at least a detergent and methodology that is applicable to non-drum machines (top loaders, which probably constitute the vast majority of clothes washers in the world), although there are many issues still to be resolved. There is much work to be done in the IEC on the alignment of various aspect of the test procedure such as water hardness and detergent composition, both which substantially affect the washing performance.

The washing process in a clothes washer is a complex one (a combination of chemical and mechanical action, water temperatures, water hardness, detergent composition and so on) and it is extremely unlikely that a conversion algorithm or computer model would be able to accurately characterise the performance and the energy consumption of a clothes washer. So the prospects for a conversion algorithm are very poor, if not negligible.

This suggests that efforts for clothes washers should perhaps concentrate on alignment of test methods. However, as noted above, the IEC standard is still in the development stage with respect to its treatment of top loading systems (as well as some of the other performance measures) and certainly there is a lot of development work under way with respect to detergents. In its current form, the IEC standard is not really worthy of alignment (although this should change as current work progresses), On the other hand, even it its current form it is probably superior to many of the test procedures currently in use in APEC economies (except perhaps the Australian standard which is based on IEC but has developed this further to deal with different technology types).

However, even if there could be agreement to align with a particular test method, there are many local and cultural factors which impact on the clothes washer performance and energy consumption: use of external hot water, water hardness, local detergent composition, program selection, wash temperature, typical load composition. While it is possible to specify all of these variables in an IEC or other international test procedure, this will move it away from "actual use". However, it is yet to be determined whether the correct ranking of machines (such as is required for energy labelling or MEPS) could be achieved using such "unrealistic" and highly standardised test conditions. Probably the biggest area of difficulty is the use of different wash temperature across (and within) APEC economies and the consequent impact on wash performance and energy consumption. It is not really possible or desirable to control this element of the test.

Other performance elements of the IEC are worthy of consideration, such as spinning and rinsing performance. The severity of washing index used in Australia to measure the harshness of the mechanical action is also an important consideration for non-drum machines.

There are certainly benefits to aligning to a methodology such as the IEC, even if this means that there is some retesting required for aspects such as wash temperature. At least the approaches and materials required by a test laboratory would be consistent.

It is recommended that APEC member economies become actively involved in the development of the IEC clothes washer standard, with a view to aligning with some or all of the IEC methodologies in the medium term.

Recommendations for Clothes Washers

- Active participation in IEC committee SC59D to assist in the development of a relevant international clothes washer performance standard;
- Medium term alignment to the IEC when this is deemed acceptable.

Dishwashers

Dishwashers are not all that common within APEC economies except in USA, Canada, Australia and New Zealand. These in fact are the only economies that regulate dishwashers for energy consumption (NZ is voluntary at this stage). Dishwashers are of course common in Europe as well (although that has not been examined for this report). Japan has a significant dishwasher market but this is not regulated at this stage.

Currently there are three main approaches to testing dishwashers – old IEC60436 used in Australia and New Zealand (but now modified significantly due to its technical limitations), the AHAM method used to assess performance (with a soiled load but mostly used for comparative testing) and the US DOE method specified in CFR430 which has no soil on the load for energy consumption testing. Europe is now using a regional standard EN50242 (based on the German DIN performance standard) which has also deviated substantially from the old IEC60436, which also has a soiled load for testing.

As for clothes washers, prospects for the development of conversion algorithms for dishwashers are poor, if not negligible. The washing process is complex and is affected by a wide range of variables.

Due to the lack of active work since its publication, IEC 60436-81 has fallen behind in its ability to adequately assess the performance of dishwashers now on the market. Increasingly, dishwashers are being equipped with adaptive controls that adjust performance in proportion to soil loads, so it is becoming necessary to test units for energy consumption with a soiled load to get an indicative result. The increasing requirements for accurate performance assessment (in terms of repeatability and reproducibility) for various program now also means that IEC 60436-81 is inadequate. During 1999 US DOE were developing a test method to assess the performance of soil sensing dishwashers.

Happily, there has been ongoing work within the IEC since 1996 to address the major issues associated with the IEC dishwasher test procedure. This should be finalised within the next few years. Given the active involvement of Australasia, Europe and North America in the development of the revised IEC60436, it is hoped that this could eventually provide a suitable international test procedure for dishwashers. Once this test method is available, it is recommended that APEC consider the feasibility of alignment with this test methodology. Therefore, the development of a conversion algorithm is probably not necessary or recommended for this product (if the new IEC test methods are deemed to be acceptable).

Recommendations for Dishwashers

- Active participation in IEC committee SC59A to assist in the development of a relevant international dishwasher performance standard;
- Short to medium term alignment to the IEC when this is deemed acceptable.

Clothes Dryers

Clothes washers are not all that common within APEC economies except in USA, Canada, Australia and New Zealand. These in fact are the only economies that regulate clothes dryers for energy consumption (NZ is voluntary at this stage). Clothes dryers are of course common in Europe as well (although that has not been examined for this report).

There are currently two major approaches used for clothes dryers: the AHAM style of approach and the IEC approach. In fact, the two test methods are not so different from each other and are certainly not irreconcilable. The major differences include different initial moisture contents, operation into the cool down period (or not), and test load composition.

From technical perspective, there are two issues outstanding with respect to clothes dryers. Firstly, all of the methodologies currently in use (including IEC) do not adequately correct the energy consumption to a target final moisture content (except in AS/NZS standard which deals with this issue specifically). The potential repeatability error in energy consumption arising from this poor methodology is potentially as high as 10%, which is unacceptable for regulatory purposes. A related issue is the treatment of timer dryers versus autosensing (or dryness sensing) controlled models. These are not handled in a consistent manner in the major methodologies (except again AS/NZS).

The second issue relates to initial moisture content of the load. This is clearly the variable that is likely to change in reality from household to household and from economy to economy, as it is dependent on the average spinning performance of the clothes washer used in a particular economy. Clearly the average spin performance in each member economy varies substantially. The range of initial moisture contents specified in current test procedures varies by a factor of up to 2, which is merely a reflection of the local clothes washer stock.

While a conversion algorithm is quite feasible, it will be necessary to change the measurement approach in the major methodologies to better characterise the performance of the clothes dryer over a range of initial moisture contents. This involves segmenting the drying curve into its component parts – start up characteristic, linear drying portion (down to about 30% moisture) and the non linear tail. By characterising each of three parts of the performance curve, the clothes dryer energy consumption (the major performance variable of interest) can be accurately estimated for a wide range of initial moisture contents. Ongoing work in this area is under way within IEC and it is hoped a suitable and accurate methodology can be developed within the next few years.

IEC61121 could eventually provide a suitable international test procedure for clothes dryers (once some of the outstanding issues are resolved). Substantial retesting because of local variations in initial moisture content could be avoided if the generic performance curve approach can be refined and accepted. It is recommended that this area of development receive some significant effort over the next few years. Once this test method is available, it is recommended that APEC consider the feasibility of alignment with this test methodology. Therefore, the development of a conversion algorithm is probably not necessary or recommended for this product (if the new IEC test methods are deemed to be acceptable).

Recommendations for Clothes Dryers

- Active participation in IEC committee SC59D to assist in the development of a relevant international clothes dryer performance standard;
- Inclusion of an accurate correction method into the IEC standard;
- Longer term development of a more generalised IEC dryer standard which can accurately estimate energy consumption over a wide range of initial moisture contents;
- Medium term alignment to the generalised IEC standard when this is deemed acceptable.

3.2.6 Refrigerators

Overview

Although refrigerators and freezers are produced in very large numbers, there has only been limited inter-regional trade in finished products until recently. This pattern is changing as manufacturers are increasingly moving beyond their traditional market boundaries and are either exporting their products, or more commonly, initiating manufacture in target export markets. Some APEC member economies use the ISO test procedures that are also used in Europe but there are a large number of economies that either use totally different test procedures or use procedures that only partially concur with ISO. None of the existing test procedures is clearly superior to the others and each represents trade-offs between ease of use, repeatability and reproducibility, cost and accuracy in representing performance during actual use.

Many APEC economies, as is the case around the world, regulate refrigerators and freezers for energy efficiency or include these in energy related programs. Refrigerators are probably the most regulated product within APEC (and in the world) with respect to energy efficiency and yet it is probably the product that has the most complex and diverse range of test procedures (sometimes with valid reasons) and therefore possibly the worst prospects for either alignment or conversion algorithms. Refrigerators are one of the most common products, both in businesses and households, and is one of the most affected in terms of energy consumption with respect to climatic and temperature conditions, which vary considerably by region.

Test procedure differences and limitations

The main differences in the major test procedures are for the choice of ambient temperature used for the steady state energy test, the interior design operating temperatures, the method of measuring the interior operating temperatures, whether frozen food compartments are loaded or not and whether door openings are included or not. The ambient test temperature is 25°C in ISO (or 32 °C if the unit is rated as a tropical class appliance), 32.2 °C under ANSI/AHAM and 32°C in AS/NZS. In Japan energy consumption is tested at two ambient temperatures (15°C and 30°C) and a weighted average value taken. Chinese Taipei and Korea use an ambient of 30^{o}C. Significant differences exist in the interior temperatures such that under ISO and JIS the fresh food compartment is 5°C, and the frozen food compartments either -6°C, -12°C or -18°C, while in the ANSI/AHAM the frozen food compartment is –17.8°C for a deep freezer but only -15 °C for a refrigerator-freezer frozen food compartment. Similar differences exist with the other procedures. As products are generally designed to perform best under the local test procedures, there is a significant difference between and difficulty in comparing the performance provided.

Other subtle differences exist which can have a major baring on the rated consumption. The most important are whether the freezer compartment is loaded (as in ISO) or not (as in AS/NZS) (or only sometimes as in North America) and how the compartment temperature is defined. For the latter, ISO is most concerned about ensuring that a minimum temperature performance is maintained for frozen food compartments and thus defines the compartment temperature as the highest temperature of the warmest test pack, as opposed to the AS/NZS which defines the compartment temperature as the average of all the temperature sensors in the non-loaded compartment (average of the warmest 4 of the 5 sensors). These differences mean that it is extremely difficult to directly compare compartment operating temperatures. It is likely that the ISO test procedures will be less reproducible than the procedures that don’t use freezer packs but it could be argued that they are more representative of actual usage conditions and give better guarantees of minimum temperature performance. The reproducibility of the ISO procedure is particularly in doubt for no-frost (forced-air) freezer compartments as it requires the freezer compartment to be fully loaded during testing, which necessarily leads to significant potential variations in convective heat transfer. Another important issue is the treatment of non-energy performance. The US DOE’s interpretation of the ANSI/AHAM standard sets no non-energy performance requirements and thus manufacturer’s can optimise their product’s performance to the single set of steady state conditions required under the energy test. This is not so simple under the ISO, JIS or AS/NZS tests as these also require various temperature and freezing performance tests to be passed which will necessarily make it more difficult to optimise the system performance to a single set of rating conditions. This is particularly true for refrigerator-freezers where ensuring the interior design temperature can be maintained under a wide range of ambient temperatures imposes severe constraints on the system balance.

Another key issue is the treatment of auxiliary energy loads and in particular the defrosting system. None of the existing procedures will reward adaptive defrost systems correctly, for example, and there are some important differences in how the defrost cycle should be initiated[3]. Lastly, the JIS procedure is the only one which uses door openings, which as it is performed under controlled humidity conditions, perhaps better represents actual ice build up and hence defrosting loads. But this is expensive and difficult to perform and may in fact reduce repeatability.

The ANSI/AHAM test procedure is likely to be quite reproducible but this is arguably achieved at the expense of over simplifying performance and involves some quite crude corrections (e.g. freezer energy consumption is reduced via a simple correction factor after measurement to give a more realistic in-use energy consumption – presumably this was obtained through empirical means). The older JIS standard has loaded freezer compartments, door openings and two ambient temperatures but is comparatively expensive and perhaps less reproducible than ANSI/AHAM. The AS/NZS and ISO standards fall somewhere in between these ranges. The new JIS standard has no freezer test packs but still has door openings, but energy consumption tests are undertaken at both 15^{o}C and 30^{o}C. In reality all the test procedures are a considerable simplification of reality as no cold appliance is ever operated under steady state environmental conditions for very long and none of them address warm food loading (except through the freezing capacity test, which is not very relevant), which is one of the regular in use factors shown to have a significant baring on cold appliance energy consumption.

Alignment or conversion algorithm?

In summary, the current refrigerator and freezer test procedures have varying levels of reproducibility and repeatability but are not likely to be very accurate at reflecting actual average in-use performance, even within a single economy’s borders. To be able to achieve this would require a much more extensive characterisation of the system under a broad range of operating conditions coupled with an algorithm that is primed using data of actual local usage practice and conditions.

If enough details are known about a refrigerator or freezer it is possible to simulate its performance under any given set of operating conditions using the appropriate model, although there are considerable complications in simulating energy performance to a high degree of accuracy when there are complex combinations of convective, radiative and conductive heat transfer that are sometimes sensitive to subtle design and operational differences. Developing such a model is a serious task and it is by no means certain that is feasible, at least to the level of accuracy required for energy efficiency regulation and related programs. A number of refrigerator models are currently in existence, but their accuracy is not either not very high (ERA model) or somewhat unclear at this stage. Work undertaken in recent years such as in the USA (Vineyard 1998) and at the *Ecole de Mines* in Paris may potentially form the basis for a suitable model. However, this research has generally been undertaken primarily for energy policy work, rather than as a test procedure so there is some question regarding its suitability. There is no clear process on how physical testing of refrigerators and computer simulation can be combined to increase the accuracy of results over a range of conditions, given the range of operating parameters, temperature ranges and

3 In fact, adaptive defrost is a good example of how smart controls and electronics can result in real energy savings in an appliance, but testing the product becomes more difficult (as the behaviour under test may change each time as the appliances assesses the conditions) and estimating the actual energy savings in actual use (rather than under test) is difficult (may require some elaborate in use monitoring).

loading conditions that are typical under the most common test procedures (not to mention real use).

Assuming that a sophisticated conversion algorithm (or computer model) combined with physical testing was feasible and suitably accurate, it would enable the magnitude of differences in the rated performance resulting from the differences in existing local test procedures to be quantified and for the impact of differences in individual parameters to be evaluated. This is likely to aid informed debate about test procedure alignment issues (as controversial as they may be) and the consequences of modifying any particular parameter. The computer modelling approach would also enable the impact of trade-offs caused by desirable simplifications of the test procedure against system characterisation accuracy to be quantified, that would substantially aid the discussions on how best to optimise development of the international test procedures.

In the case of refrigerators and freezers, the existence over many years of different interior design temperatures is likely to considerably complicate any efforts to align test procedures, as whole generations of products have been developed to perform optimally according to the local test requirements (as opposed to actual use). This means that changes in the test procedure would be likely to favour one tradition over another and hence be contentious; nonetheless the use of a computer model could quantify the likely impact and hence help guide an equitable transition to an aligned procedure should that be deemed desirable.

A computer model would also be capable of simulating actual use under a range of climate and temperature conditions and hence be much better placed to provide accurate and relevant advice to consumers (and even on energy labels) regarding the energy consumption of products. A computer simulation model would also assist in undertaking international comparisons of product performance and energy efficiency.

It is also certain that the efficiency ranking order of some products tested under standardised test conditions will be different to what a consumer experiences in actual use. So there is some potential (although probably not large at this stage) for consumers to be provided with inaccurate information under regulatory programs such as energy labelling. A computer simulation model has a much better probability of ranking models in their correct efficiency order when actual conditions of use are simulated.

In summary, for refrigerators and freezers, the way forward, at least in the short term, is unclear and most likely difficult. The differences in test procedures are so great and the number of economies involved is so large, that the prospects of alignment are small. In any case, all of the existing test procedures have strong and weak points in certain areas and there is no approach that is clearly superior to any other. There is also a huge amount of institutional (government and regulatory) and industrial inertia associated with existing test procedures for refrigerators in many economies, this also makes the prospects for changes somewhat dim.

Ultimately, a conversion algorithm (most likely a rather complex computer model with extensive calibration through physical tests) is the only medium term prospect to avoid (at least in part) the myriad of test methods that currently exist. However this is a complex and significant task and would require substantial resources merely to establish feasibility, let alone get it to an acceptable level of performance for regulatory purposes.

Recommendations for Refrigerators

Alignment in the short term appears to be very unlikely for refrigerators. Further investigations should be undertaken into both simple and more complex computer modelling options for refrigerators to determine their feasibility as algorithms for use with refrigerator test procedures. More extensive use of a test procedure with dual energy temperature test points and controlled internal heat loads may provide some insight and data to assist with modelling and algorithm approaches.

3.2.7 Office equipment and consumer electronics

In general terms, the sales of office equipment and consumer electronics around the world is enormous and there is already a huge trade in these products, both within APEC economies and internationally. The other special attributes of these products is that their life is generally quite short (of the order of 3 to 6 years) and ownership levels high and growing (both in the commercial and household sector) so the stock turnover is therefore generally very fast (at least in comparison with most commercial, industrial and household equipment). The pace of change of technology for these products is also very fast, which makes regulation difficult, but it also makes it difficult for test procedures to keep up with these technical changes.

While few APEC economies regulate these products directly in terms of energy consumption, there are numerous programs such as Energy Star (used in many economies directly or indirectly) and the Japanese Top Runner program which set out requirements and specifications for these products. The other important point is that many of these products are built for a world market, so therefore (by and large) they have uniform specifications the world over. Hence the global approach taken through the Energy Star program.

Currently test procedures for these products are not all that well specified (often in the form of guidelines rather than formal published international test procedures), but these appear to be adequate for the moment. In most cases, the tests required are relatively straight forward and the equipment and methodology not overly complicated.

There is probably no need for a conversion algorithm given the largely uniform approach for testing these products to date. The other issue is that much of the measurement required for these products relates to standby or sleep mode energy consumption, rather than the energy consumed during normal operation (therefore measurement of performance is not required). There is increasing international interest in the assessment and limitation of standby energy consumption for a wide range of electronic equipment (eg 1 Watt program within the IEA) which will also impact on these products.

There is an argument that there needs to be some formalisation of the test methods used to determine standby energy consumption for office equipment and consumer electronics. Issues such as standardised temperature and humidity, consistent approach to dealing with rated voltage and frequency ranges, adequate instrumentation (noting that often power consumption levels are very small and that the current waveforms are complex, requiring sophisticated measurement equipment) and generalised approaches for determining what is to be measured for new and unusual product types. Obviously such work would need to be international and would require input from major stakeholders (eg Energy Star partners, Japan, IEA, Swiss Federal Office of Energy and European GEA). It is unclear whether such work should progress inside or outside of the IEC. A new project within TC59 (household appliances) is to consider options for measurement of standby for a wide range of appliances and APEC Economies should consider contributing to this work. This issue should be further considered by APEC as matters develop.

Recommendations for Office Equipment

APEC should coordinate approaches for the measurement of standby energy consumption for their various voluntary and mandatory programs. APEC Economies with a direct interest in standby energy consumption should actively participate in the new IEC TC59 project to examine test methods for the determination of standby losses.

3.3 Conclusions

The general conclusions of this study are as follows:

- A plethora of local test standards are in use and these are likely to be restricting trade by increasing costs of trade
- Few international standards are "generic" at this stage and many require significant work to make them more applicable for regulatory purposes.
- For many product types, alignment appears to be the only feasible option in the medium term.
- Special attention needs to be paid to new and emerging "smart" products and control systems – while these have the potential to save substantial amounts of energy during actual use, there is also potential that they can "trick" test procedures into measuring fake energy savings which will appear only in the test procedure. Similarly, some products will achieve real energy savings in actual use but will obtain no credit for these in the test procedure.
- Conversion algorithms (computer modelling concept) appears to be a feasible and attractive option for a couple of products, yet this approach is very new and is yet to be proven and receive widespread acceptance.
- A big effort will be required to develop suitable conversion algorithm models to the required level of accuracy for regulatory purposes.
- For those products that are largely affected by climate (eg refrigerators and air conditioners) a modelling approach is the only effective way of ensuring that products are ranked correctly with respect to energy efficiency under conditions of actual use.
- There is a need for change in direction with respect to energy policy within the IEC/ISO bodies – a long term view is needed and member organisations need to more effectively communicate their needs to these bodies.
- There needs to be an increased an ongoing input by APEC member economies into IEC/ISO standards development processes, especially for those products and those economies that regulate on the basis of energy and performance.

4. REFERENCES

Note: This reference list does NOT include test standards, these are generally included in the Index of Standards used in APEC Member Economies.

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5. INDEX OF STANDARDS USED AND REFERENCED BY APEC MEMBER ECONOMIES – ENERGY EFFICIENCY OF ELECTRICAL PRODUCTS

Standards are grouped by the bodies that develop the standards. Within each body, standards are listed in number order. Bodies listed in this section are:

AHAM – Association of Home Appliance Manufacturers (USA)

AMCA - Air Movement and Control Association, International

ANSI – American National Standards Institute

ARI – Air-Conditioning and Refrigeration Institute (USA)

AS – Australian Standards

ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc.

CAN/CSA – Canadian Standards Association

CIE – Commission Internationale de L'Eclairage

CNS – Chinese National Standards of Chinese Taipei

CTI – Cooling Tower Institute (USA)

EN – European Norms

GB – China State Bureau of Quality and Technical Supervision

GOST – Russian Committee for Standardisation

IEC – International Electrotechnical Commission

IEEE – Institute of Electrical and Electronics Engineers

IES – Illuminating Engineering Society of North America (also IESNA)

ISO – International Standards Organisation

JIS – Japanese Industrial Standards

KS – Korean Standards

MS – Malaysian Standards

NEMA – National Electrical Manufacturer's Association (USA)

NOM – Official Mexican Norms

NZS – New Zealand Standards

PNS – Philippine National Standards

TIS – Thai Industrial Standards

5.1 AHAM – Association of Home Appliance Manufacturers (USA)

Web site: http://www.aham.org

AHAM DW-1 Performance Evaluation of Dishwashers

AHAM HLD-1 Performance Evaluation of Household Tumble Clothes Dryers, June 1974

AHAM HLD-2EC Test Method for Measuring Energy Consumption of Household Tumble Dryers, December 1975 (out of publication)

AHAM HLW-2EC Test Method for Measuring the Energy Consumption on Household Clothes Washers, December 1975 (out of publication)

AHAM HRF-1-1979 Electric Refrigerators and Electric Refrigerator-Freezers & Freezers: (revision of ANSI B 38.1.1970)

AHAM HWL-1 Performance Evaluation Procedure for Household Clothes Washers, December 1971 (also known as ANS Z224.1-1971)

ANSI/AHAM RAC-1-1982, Room Air Conditioners

5.2 AMCA - Air Movement and Control Association, International

Web site: http://www.amca.org

ANSI/AMCA 210 Laboratory methods of testing fans for aerodynamic performance rating (This ANSI/AMCA standard defines uniform methods for conducting laboratory tests on housed fans to determine airflow rate, pressure, power and efficiency, at a given speed of rotation.)

ANSI/AMCA 300 Reverberant room method for sound testing of fans (This is a revised and updated edition of the practical method for determining the sound levels of a fan or other air moving device in a room of prescribed acoustical performance using readily available sound measurement instrumentation.)

5.3 ANSI – American National Standards Institute

Web site: http://www.ansi.org

ANSI/AHAM RAC-1-1982, Room Air Conditioners

ANSI/ASHRAE 103-82 Methods of testing for heating seasonal efficiency of central furnaces and boilers

ANS C.16.13-1961 Method of Testing Monochrome Television Broadcasting Receivers

ANSI/IEEE C57.12.90 Test code for liquid immersed distribution, power and regulating transformers and guide for short circuit testing of distribution and power transformers

ANSI/IEEE C57.12.91 Test code for dry type distribution and power transformers

ANSI C78.1 Dimensional and Electrical Characteristics of Fluorescent Lamps – rapid start type

ANSI C78.21 Incandescent lamps – PAR and R shapes

ANSI C78.3 Dimensional and electrical characteristics of fluorescent lamps – instant start and cold cathode types.

ANSI C78.375 Guide for electrical measurements of fluorescent lamps

ANSI C78.379 Classification of the beam patterns of reflector lamps

ANSI C82.2 Methods of Measurement of Fluorescent Lamp Ballasts

ANSI C82.3 Standard for reference ballasts for fluorescent lamps

ANSI C136.10 Roadway lighting equipment – locking type photocontrol devices and mating receptacles – physical and electrical interchangeability and testing

ANSI/IEEE 112-1984, Test Procedure for Polyphase Induction Motors and Generators, Institute of Electrical and Electronics Engineers, New York, NY 10017 (Method B)

ANSI Z21.10.3 American National Standard for Gas Water Heater (used to set conditions of test for commercial electric water storage heaters in ASHRAE 90.1)

ANS Z234.1-1972 Room Air Conditioners (sections 4, 5, 6.1 and 6.5)

5.4 ARI – Air-Conditioning and Refrigeration Institute (USA)

Web site: http://www.ari.org

ARI 210/240 Unitary air-conditioning equipment and air-source unitary heat pump equipment

ARI 310/380 Packaged terminal air-conditioners

ARI 320 Water-source heat pumps

ARI 325 Ground water-source heat pumps

ARI 340 Commercial and industrial unitary heat pump equipment

ARI 550/590 Centrifugal or Rotary Water-Chilling Packages

ARI 820 Ice Storage Bins

5.5 AS – Australian Standards

Web site: http://www.standards.com.au

AS 1056.1-1991 Storage water heaters - General requirements (Specifies general construction and performance requirements for electric storage water heaters of 25 L to 630 L rated hot water delivery.

AS 1359.101 Rotating electrical machines – rating and performance (EQV IEC60034-1)

AS 1359.102.1 Rotating electrical machines – methods for determining losses and efficiency (general) (EQV IEC60034-2)

AS 1359.102.2 Rotating electrical machines – methods for determining losses and efficiency – calorific method (EQV IEC60034-2)

AS 1359.102.3 Rotating electrical machines – methods for determining losses and efficiency – three phase cage induction motors (draft in preparation, based on new draft IEC standard which will be compatible with IEEE)

AS 1805-1975 Electric irons for household use (withdrawn, replace with AS60311)

AS/NZS 2007.1:1998 Performance of household electrical appliances - Dishwashers - Energy consumption and performance (Specifies methods for determining performance characteristics, including energy consumption, of electric dishwashers intended for household and similar use. Sets minimum acceptable levels for some of these characteristics. Is based on IEC 60436:1981 but varies considerably from that document.)

AS/NZS 2007.2:1998 Performance of household electrical appliances - Dishwashers - Energy labelling requirements (Specifies energy labelling requirements for electric dishwashers intended for household and similar use, including those associated with machine performance, application for a label and specifications for the label.)

AS/NZS 2040.1:1998 Performance of household electrical appliances - Clothes washing machines - Energy consumption and performance (Specifies methods for determining performance characteristics, including energy consumption, of electric clothes washing machines intended for household and similar use. Sets minimum acceptable levels for some of these characteristics. Is based on IEC 60456:1994 but varies considerably from that document.)

AS/NZS 2040.2:1998 Performance of household electrical appliances - Clothes washing machines - Energy labelling requirements (Specifies energy labelling requirements for electric clothes washing machines intended for household and similar use, including those associated with machine performance, application for a label and specifications for the label.)

AS/NZS 2442.1:1996 Performance of household electrical appliances - Rotary clothes dryers - Energy consumption and performance (Specifies the method for determining performance characteristics, including moisture removal, maximum fabric temperature and water and energy usage. It sets out minimum acceptable values for some of these characteristics but does not specify safety requirements. Appendices include specification of the standard test load, required laboratory and equipment conditions and result recording sheets.)

AS/NZS 2442.2:1996 Performance of household electrical appliances - Rotary clothes dryers - Energy labelling requirements (Defines terms used to measure the energy efficiency and specifies the methods for calculation of all quantities which appear on the energy efficiency (i.e. 'star rating') label. It specifies the minimum performance criteria required for registration of a model in Australia and sets out requirements for the printing, placement and validation of the energy label. Appendices include example calculations for energy labelling and an approved registration application format. Calculations require data measured according to AS/NZS 2442.1, energy consumption and performance.)

AS 2643-1991 Fluorescent lamp ballasts of reactive type - Performance requirements (Specifies performance requirements for ballasts of the reactive type designed for use with tubular fluorescent lamps specified in AS 1201. Applies to complete ballasts and their component parts such as reactors, transformers and capacitors having a capacitance of not more than 0.1 micro F. EQV to IEC60921.)

AS/NZS 3823.1.1:1998 Performance of household electrical appliances - Room air conditioners - Non-ducted air conditioners and heat pumps - Testing and rating for performance (Specifies the testing Standards for room air conditioners. EQV ISO 5151:1994)

AS/NZS 3823.2:1998 Performance of household electrical appliances - Room air conditioners - Energy labelling requirements

AS 3963-1991 a.c. supplied electronic ballasts for tubular fluorescent lamps - Performance requirements (Specifies requirements for proper lamp operation and satisfactory operation of electronic ballasts associated with tubular fluorescent lamps specified in AS 1201. Applies to complete ballasts and their component parts including capacitors (having a capacitance of not more than 0.1 microF). EQV IEC60929.)

AS 4234-1994 Solar water heaters - Domestic and heat pump - Calculation of energy consumption (Sets out a method of determining the annual performance of domestic solar and heat pump water heaters using a combination of test results for component performance and a mathematical model to determine annual load cycle task performance. Together with the Standard a software disk is provided. It contains a program for evaluation of energy consumption of the solar water heaters under testing.)

AS/NZS 4474.1:1997 Performance of household electrical appliances - Refrigerating appliances - Energy consumption and performance (Specifies the method for determining performance characteristics, including pull down, automatic ice making capacity, operating temperature performance and rate of energy consumption. Sets out minimum acceptable values for some of these characteristics but does not specify safety requirements. Appendices include specification of the preparation of a machine prior to testing, required laboratory and test equipment conditions and results recording sheets.)

AS/NZS 4474.2:1997 Performance of household electrical appliances - Refrigerating appliances - Energy labelling and minimum energy standard requirements (Defines terms used to measure the energy efficiency and specifies the methods for calculation of all quantities which appear on the energy efficiency (i.e. 'star rating') label. Specifies the minimum performance criteria, including minimum energy performance standard (MEPS) levels required for registration of a model in Australia and sets out requirements for printing, placement and validation of the energy label. Appendices include example calculations for energy labelling and an approved registration application format. Calculations require data measured according to AS/NZS 4474.1.)

AS/NZS 50294 (draft) Performance of electrical lighting equipment – ballasts for fluorescent lamps: measurement method for total input power of ballast lamp circuits (EQV EN 50294 with minor amendments)

AS60311-1999 Electric Irons for household or similar use - Methods for measuring performance (IDT to IEC60311-1997)

5.6 ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc.

Web site: http://www.ashrae.org

ASHRAE 16-69 Method of testing for rating of air conditioners

ANSI/ASHRAE 23-1993 Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units (Supersedes ASHRAE Standard 14-1980 and ASHRAE Standard 23-1978R) (This standard covers common methods of testing for rating single-stage positive displacement refrigerant compressors and condensing units. This standard provides definitions, procedures, data, reporting requirements, references, applicable tests and instrumentation standards.)

ASHRAE 37-78 Methods of testing for rating unitary air conditioning and heat pump equipment)

ASHRAE 41.1 Standard measurement guide: section on temperature measurements

ASHRAE/IES 90.1 Energy efficient design of new buildings except low-rise residential buildings

ANSI/ASHRAE 103 Methods of testing for heating seasonal efficiency of central furnaces and boilers

5.7 CAN/CSA – Canadian Standards Association

Web site: http://www.csa.ca

CAN/CSA-C191-M90 Performance of electric storage tank water heaters

CAN/CSA-C191.1-M90 Performance options for electric storage tank water heaters

(soon to be superseded by CAN/CSA-C745-95)

CAN/CSA-C239-94 Performance standard for dusk to dawn luminaires (regulated only by selected Canadian Provinces)

CAN/CSA-C273.3-M91 Performance standard for split-system central air conditioners and heat pumps

CAN/CSA-C300-M91 Capacity measurement and energy consumption test methods for refrigerators, combination refrigerator-freezers and freezers (under revision)

CAN/CSA-C358-95 Energy consumption test methods for household electric ranges

(M89 version current, 1995 to be adopted during 1999)

CAN/CSA-C360-98 Test method for measuring water and energy consumption of automatic household clothes washers

CAN/CSA-C361-92 Test method for measuring energy consumption and drum volume of electronically heated household tumble-type clothes dryers

CAN/CSA-C368.1-M90 Performance standard for room air conditioners

CAN/CSA-C373-92 Energy consumption test methods for household dishwashers

CAN/CSA-C390-M85 Energy efficiency test methods for three phase induction motors

CAN/CSA-C390-93 Energy efficiency test methods for three phase induction motors

(under revision)

CAN/CSA-C446-94 Performance of ground source heat pumps

CAN/CSA-C653-94 Performance standard for roadway lighting luminaires (regulated only by selected Canadian Provinces)

CAN/CSA-C654-M91 Fluorescent lamp ballasts efficacy measurements

CAN/CSA-C655-M91 Performance standard for internal water-loop heat pumps

CAN/CSA-C656-M92 Performance standard for single-package central air conditioners and heat pumps

CAN/CSA-C657-95 Energy performance standard for commercial refrigerated display cabinets and merchandisers (regulated only by selected Canadian Provinces)

CAN/CSA-C742-98 Performance of automatic ice makers and ice storage bins

(1994 version current, 1998 version to be adopted in 1999)

CAN/CSA-C743-93 Performance standard for rating packaged water chillers (EQV to ARI 550/590) (regulated only by selected Canadian Provinces)

CAN/CSA-C744-93 Standard for packaged terminal air conditioners and heat pumps

(jointly published as ARI 310/380-93)

CAN/CSA-C745-95 Energy efficiency of electric storage tank water heaters and heat pump water heaters (C191 current, C745-95 may come into force during 1999)

CAN/CSA-C746-98 Performance standard for rating large air conditioners and heat pumps

CAN/CSA-C747-94 Energy efficiency for single and three phase small motors

CAN/CSA-C748-94 Performance of direct expansion (DX) ground source heat pumps (regulated only by selected Canadian Provinces)

CAN/CSA-C749-94 Performance of dehumidifiers

CAN/CSA-C802-94 Maximum losses for distribution, power and dry-type transformers (regulated only by selected Canadian Provinces)

CAN/CSA-C819-95 Performance of general service fluorescent lamps

(may come into force during 1999, currently reference US standards)

CAN/CSA-C861-95 Performance of compact fluorescent lamps and ballasted adaptors (regulated only by selected Canadian Provinces)

CAN/CSA-C862-95 Performance of general service incandescent reflector lamps

5.8 CIE – Commission Internationale de L'Eclairage

International Commission on Illumination

Web site: http://www.cie.co.at/cie/home.html

CIE 13.3 Method of measuring and specifying colour rendering properties of light sources.

CIE 84 Measurement of luminous flux (This technical report defines the terminology required for luminous flux measurements. It then deals with the principles of luminous flux measurements and describes methods for the evaluation of the illuminance distribution, the measurement of luminous flux by means of an integrating sphere photometer and the determination of luminous flux via luminance, luminous intensity and luminance measurements.)

5.9 CNS – Chinese National Standards of Chinese Taipei

CNS 927-96 Ballasts for Fluorescent Lamp

CNS 2602-95 Electric Refrigerators and Freezers

CNS 2725-95 Unitary air conditioners

CNS 2934-93 Low-Voltage Three-Phase Squirrel-Cage Induction Motors (for General Purpose)

CNS 3192 Three phase induction motors

CNS 3263-89 Electric water heaters

CNS 3615-95 Room air conditioners

CNS 3888-85 Method of test for Ballasts for Fluorescent lamp ballasts

CNS 4024 Single phase motors

CNS 7778 Industrial fans

CNS 7779 Industrial fans

CNS 9577-89 Method of Test for Electric Refrigerators and Freezers

CNS 11010-89 Electric water heaters

5.10 CTI – Cooling Tower Institute (USA)

Web site: http://www.cti.org

CTI 201 Certification Standard for Commercial Water Cooling Towers

5.11 EN – European Norms

European Committee for Electrotechnical Standardisation web site: http://www.cenelec.be

EN 50294-1998 Measurement method of total input power of ballast-lamp circuits.

5.12 GB – China State Bureau of Quality and Technical Supervision

China Standards Information Centre web site: http://www.cssn.net.cn

China State Bureau of Quality and Technical Supervision web site:

http://www.csbts.cn.net (not in English)

GB 12021.2-89 The maximum allowable value of the energy consumption and energy efficiency grade for household refrigerators
External References: Refrigerators - GB/T8059.1 (EQV? ISO 5155-1995) GB/T8059.2 (EQV? ISO 7371-1995) GB/T8059.3 (EQV? ISO 8187-1991) GB/T8059.4 (EQV? ISO 8561-1995) GB4706.13 GB/T2828 GB/T2829

GB 12021.2-XX (draft) The maximum allowable value of the energy consumption and energy efficiency grade for household refrigerators (Draft 1999)
External References: Refrigerators - GB/T8059.1 GB/T8059.2 GB/T8059.3 GB/T8059.4 GB4706.13 GB/T2828 GB/T2829

GB 12021.3-89 Limited values of energy consumption and method of testing for room air conditioners, Published 1989-12-25, In force 1990-12-01
External Reference: Air conditioners - GB 7725 (EQV? ISO 5151)

GB 12021.4-89 The limited value and testing method of energy consumption for household electric washing machines, Published 1989-12-25, In force 1990-12-01
External Reference: Clothes washers - GB 4288

GB 12021.5-89 The limited value of energy consumption and method of testing for electrical iron, Published 1989-12-25, In force 1990-12-01
External Reference: Irons - GB 4706.2-86 and GB 10154

GB 12021.6-89 The limited value and testing method of efficiency and warming energy consumption for automatic rice cookers, Published 1989-12-25, In force 1990-12-01
External Reference: Automatic rice cookers - GB 8968

GB 12021.7-89 The limited value and testing method of electrical energy consumption for broadcast receiver of colour and monochromic television, Published 1989-12-25, In force 1990-12-01, External reference: Televisions - GB 10239-88

GB 12021.9-89 The limited value of energy consumption of electric fans and it's measuring method, Published 1989-12-25, In force 1990-12-01, External Reference: none

GB T15144-1994 The method of determining efficacy of fluorescent lamp ballasts

5.13 GOST – Russian Committee for Standardisation

State Committee of the Russian Federation for Standardisation, Metrology and Certification web site: http://www.gost.ru/sls/gost.nsf

GOST 14919-83E: Electric ranges.

GOST 16317-87 Household electrical refrigerating appliance. General specifications. (ICS 97.040.30).

GOST 16325-88: General purpose digital computers. General technical requirements.

GOST 18198-89: Television receivers.

GOST 19098-87: Plotters for electronic computers. General specifications.

GOST 21776-87: Printers. General specifications

GOST 23110-84: Household electric water heaters. General specifications.

GOST 24388-88: Domestic sound frequency signal amplifiers. General specifications.

GOST 24593-87: Graphic input devices for electronic computers. General specifications

GOST 26963-86: Self-contained room air conditioners. General specifications.

GOST 27201-87: Personal computers. Types, basic parameters, general requirements.

GOST 27454-87: Household electric dishwashers. Performance parameters and main dimensions.

GOST 27954-88: Personal computer video monitors. Types, basic parameters, general technical requirements.

5.14 IEC – International Electrotechnical Commission

Note that as of late 1998 all IEC standards are numbered with five digits starting with the number 6. For example IEC 81 is now known as IEC60081. The new numbering convention has been used for all IEC standards in this report, irrespective of the date of publication (except for withdrawn standards).

Web site: http://www.iec.ch

IEC 60034-1:1996 Rotating electrical machines - Rating and performance (This part of IEC 34 is applicable to all rotating machines except those covered by other IEC standards- for example, IEC60349.)

IEC 60034-2A:1974 First supplement : Rotating electrical machines - Part 2: Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles) (Describes methods for measuring the efficiency of electrical rotating machines either by determining total losses on load or by determination of the segregated losses for air and water cooling mediums. Applies to large generators but may be used for other machines.) (various amendments)

IEC 60034-19:1995 Rotating electrical machines - Part 19: Specific test methods for d.c. machines on conventional and rectifier-fed supplies (This part of IEC 34 applies to d.c. machines of 1 kW rated output power and above on conventional and rectifier-fed supplies except those covered by other IEC standards, for example IEC 349. The object of this standard is to establish methods for determining characteristic quantities for conventional and rectifier-fed d.c. machines.)

IEC 60064:1993 Tungsten filament lamps for domestic and similar general lighting purposes- Performance requirements (Applies to tungsten filament incandescent lamps for general lighting services (GLS) which comply with the safety requirements in IEC 60432-1.)

IEC 60081:1997 Double-capped fluorescent lamps - Performance specifications (Specifies the performance requirements for double-capped fluorescent lamps for general light service. The requirements of this standard relate only to type testing.

Conditions of compliance, including methods of statistical assessment, are under consideration.)

IEC 60155:1993 Glow-starters for fluorescent lamps (Specifies interchangeable starters used with pre-heat type tubular fluorescent lamps and should be used in conjunction with the corresponding publications for tubular fluorescent lamps and their ballasts.)

IEC 60311:1997 Electric irons for household or similar use - Methods for measuring performance (Applies to electric irons for household or similar use. The purpose of this standard is to state and define the principal performance characteristics of electric irons for household or similar use which are of interest to the user, and to describe the standard methods for measuring these characteristics).

IEC 60349:1991 Electric traction- Rotating electrical machines for rail and road vehicles. (Applies to rotating electrical machines forming part of the equipment of electrically propelled rail and road vehicles. The vehicles may obtain power either from an external supply or from an internal source.)

IEC 60350:1999 Electric cooking ranges, hobs, ovens and grills for household use – Methods for measuring performance. (This publication states and defines the principal performance characteristics of these appliances and describes the standard methods for measuring performance characteristics.)

IEC 60379:1987 Methods for measuring the performance of electric storage water-heaters for household purposes (States and defines the principal performance characteristics of electric storage water-heaters which are of interest to the user and to describe the standard methods for measuring these characteristics. This standard is concerned neither with safety nor with performance requirements.)

IEC 60436:1981 Methods for measuring the performance of electric dishwashers (States and defines the characteristics of importance for determining the performance of household electric dishwashers in order to inform the consumer and describes the standard methods for measuring these characteristics.)

IEC 60456:1998 Clothes washing machines for household use - Methods for measuring the performance (Deals with the method for measuring the performance of clothes washing machines with or without heating devices, for household use. It also deals with appliances for water extraction by centrifugal force. It is also applicable to appliances for both washing and drying textiles (called washer-dryers) with respect to their washing performance. The object is to state and define the principal performance characteristics of household electric washing machines and spin extractions and to describe the standard methods for measuring these characteristics. This standard is concerned neither with safety nor with performance requirements.)

IEC 60675:1994 Household electric direct-acting room heaters- Methods for measuring performance (Applies to electric direct-acting room heaters. They may be portable, stationary, fixed or built-in. It does not apply to: thermal-storage room heaters; heating appliances incorporated in the building structure; central heating systems; heaters connected to an air duct; and wall-paper, carpets or drapes incorporating flexible heating elements.)

IEC 60901:1996 Single-capped fluorescent lamps - Performance requirements (Specifies the performance requirements for single-capped fluorescent lamps for general lighting service. The requirements of this standard relate only to type testing.

Conditions of compliance, including methods of statistical assessment, are under consideration.)

IEC 60920:1990 Ballasts for tubular fluorescent lamps. General and safety requirements (Specifies ballast, excluding resistance types for use on a.c supplies up to 1000 V at 50 Hz or 60 Hz, associated with tubular fluorescent lamps with or without a starter or starting device and having rated with or without a starter or starting device and having rated wattages, dimensions and characteristics as specified in IEC60081. A.C. supplied electronic ballasts for high frequency operation are excluded. These are specified in IEC60928.)

IEC 60921:1988 Ballasts for tubular fluorescent lamps- Performance requirements (Specifies performance requirements for ballasts excluding resistance types for use on a.c. supplies up to 1000 V at 50 Hz or 60 Hz, associated with tubular fluorescent lamps with pre-heated cathodes operated with or without a starter or starting device and having rated wattages, dimensions and characteristics as specified in IEC publications 60081 and 60901. It applies to complete ballasts and their component parts such as resistors, transformers and capacitors.)

IEC 60927:1996 Auxiliaries for lamps - Starting devices (other than glow starters). Performance requirements (Specifies performance requirements for starting devices (starters and igniters) for tubular fluorescent and other discharge lamps for use on a.c. supplies up to 1 000 V at 50 Hz or 60 Hz, which produce starting pulses not greater than 5 kV. Should be read in conjunction with IEC60926 for safety.)

IEC 60928:1995 Auxiliaries for lamps- A.C. supplied electronic ballasts for tubular fluorescent lamps. General and safety requirements (Specifies general and safety requirements for electronic ballasts for use on a.c. supplies up to 1 000 V at 50 Hz with operating frequencies deviating from the supply frequency, associated with tubular fluorescent lamps as specified in IEC 81 and other tubular)

IEC 60929:1990 A.C.-supplied electronic ballasts for tubular fluorescent lamps - Performance requirements (Specifies performance requirements for electronic ballasts for use on a.c. supplies up to 1 000 V at 50 Hz or 60 Hz with operating frequencies deviating from the supply frequency, associated with tubular fluorescent lamps as specified in IEC 81 and 901 with other tubular fluorescent lamps for high frequency operation.)

IEC 60969:1988 Self-ballasted lamps for general lighting services. Performance requirements (Specifies the performance requirements together with the test methods and conditions required to show compliance of tubular fluorescent and other gas-discharge lamps with integrated means for controlling starting and stable operation (self-ballasted lamps), intended for domestic and similar general lighting purposes.)

IEC 61121:1997 Tumble dryers for household use - Methods for measuring the performance (Is applicable to household electric tumble dryers of the automatic and non-automatic type, with or without a cold water supply and incorporating a heating device. The object is to state and define the principal performance characteristics of household electric tumble dryers of interest to users and to describe standard methods for measuring these characteristics. This standard is concerned neither with safety nor with performance requirements.)

IEC 61231:1993 International lamp coding system (ILCOS) - Covers all lamp categories. Coding for the main lamp types is specified.

IEC 61341:1994 Method of measurement of centre beam intensity and beam angle(s) of reflector lamps (Describes the method of measuring and specifying the centre beam intensity and the associated beam angle(s) of reflector lamps. It applies to incandescent, tungsten halogen and gas-discharge reflector lamps for general lighting purposes. It does not apply to lamps for special purposes such as projection lamps.)

5.15 IEEE – Institute of Electrical and Electronics Engineers

(North America)

Web site: http://www.ieee.org

ANSI/IEEE 112-1984, Test Procedure for Polyphase Induction Motors and Generators, Institute of Electrical and Electronics Engineers, New York, NY 10017 (Method B) (also available as NEMA MG1)

5.16 IES – Illuminating Engineering Society of North America (also IESNA)

Web site: http://www.iesna.org

IES LEM6 Guidelines for unit power density for new roadway lighting installations

IES LM9 Approved method for electrical and photometric measurements of fluorescent lamps.

IES LM10 Approved method for photometric testing of outdoor fluorescent luminaires

IES LM16 Colorimetry of light sources.

IES LM20 Approved method for photometric measuring and reporting tests on reflector type lamps

IES LM31 Approved method for photometric testing of roadway luminaires

IES LM35 Approved method for photometric testing of floodlights using incandescent filament or discharge lamps

IES LM40 Life performance testing of fluorescent lamps.

IES LM41 Approved method for photometric testing of indoor fluorescent luminaires

IES LM45 Approved method for photometric measuring and reporting tests on general service incandescent lamps

IES LM46 Approved method for photometric testing of indoor luminaires using high-intensity discharge lamps or incandescent filament lamps

IES LM49 Approved method for life testing of general lighting incandescent filament lamps.

IES LM54 IES guide to lamp seasoning.

IES LM58 Spectroradiometric measurements.

IES LM66 Approved method for photometric measuring and reporting tests on compact fluorescent lamps

IES RP8 Practice for roadway lighting (ANSI Approved)

5.17 ISO – International Standards Organisation

Web site: http://www.iso.ch

ISO 139 Textiles - Standard atmospheres for conditioning and testing

ISO 2548 Centrifugal, mixed flow and axial pumps - Code for acceptance tests - Class C

ISO 3555 Centrifugal, mixed flow and axial pumps - Code for acceptance tests - Class B

ISO 5151 Non-ducted air conditioners and heat pumps - Testing and rating for performance

ISO 5155 Household refrigerating appliances - Frozen food storage cabinets and food freezers - Characteristics and test methods

ISO 5801 Industrial fans - Performance testing using standardised airways

ISO 7371 Household refrigerating appliances - Refrigerators with or without low-temperature compartment - Characteristics and test methods

ISO 8187 Household refrigerating appliances - Refrigerator-freezers - Characteristics and test methods

ISO 8561 Household frost-free refrigerating appliances - Refrigerators, refrigerator-freezers, frozen food storage cabinets and food freezers cooled by internal forced air circulation - Characteristics and test methods

ISO 13253 Ducted air-conditioners and air-to-air heat pumps - Testing and rating for performance

ISO 13256-1 Water-source heat pumps - Testing and rating for performance - Part 1: Water-to-air and brine-to-air heat pumps

ISO 13256-2 Water-source heat pumps - Testing and rating for performance - Part 2: Water-to-water and brine-to-water heat pumps

5.18 JIS – Japanese Industrial Standards

Japanese Standards Association web site: http://www.jisc.org

JIS B8615 Central air conditioners (now withdrawn and replaced by JIS B8616)

JIS B8616 Unitary air conditioners

JIS C4210 Low voltage three phase squirrel cage motors for general purpose

JIS C6101 Measuring Methods of Receivers for Television Broadcast Transmissions

JIS C7501 Incandescent lamps for general lighting purpose

JIS C7601 Fluorescent lamps for general lighting service

JIS C8108 Magnetic ballasts for fluorescent lamps

JIS C9606 Electric Washing Machines (performance and safety)

JIS C9607 Household Electric Refrigerators, refrigerator-Freezers and Freezers

JIS C9612 Room air conditioners

5.19 KS – Korean Standards

Agency for Technology and Standards web site: http://www.ats.go.kr

KS B6369-1985 – Testing Methods for Unitary Air Conditioners (EQV JIS B8616)

KS C7501-1994 - Incandescent lamps for general lighting service (EQV JIS C7501)

KS C7601-1997 - Fluorescent lamps for general lighting service (EQV JIS C7601)

KS C7621-1997 - Self ballasted lamps (screw base CFLs) (NEQ IEC 60969)

KS C8100-1997 - Electronic ballasts for fluorescent lamps (EQV IEC 60928 & IEC 60929)

KS C8102-1995 - Magnetic ballasts for fluorescent lamps (EQV JIS C8108)

KS C9306-1997 – Room air conditioners (EQV JIS C9612)

KS C9305-1996 Household Electric Refrigerators, Refrigerator-Freezers and Freezers (EQV JIS C9607)

5.20 MS – Malaysian Standards

Department of Standards Malaysia web site: http://www.dsm.gov.my

MS 141 Fluorescent lamp ballasts

5.21 NEMA – National Electrical Manufacturer's Association (USA)

Web site: http://www.nema.org

NEMA MG 1-1987, Motors and Generators, Revision No. 2—May and November 1989, September and November 1990, January and March 1991, National Electrical Manufacturers Association, Washington, DC 20037

5.22 NOM – Official Mexican Norms

All available for download from CONAE web site: http://www.conae.gob.mx

Dirección General de Normas web site: http://www.secofi.gob.mx/normas/dgn1.shtml

(both sites not in English)

NOM-001-ENER-1995 Vertical pumps (EQV ISO 3555)

NOM-003-ENER-1995 Water heaters (only covers non electric, electric are unusual)

NOM-004-ENER-1995 Centrifugal residential water pumps (EQV ISO 3555)

NOM-005-ENER-1995 Clothes washers

NOM-006-ENER-1995 Electromechanical efficiency for deep well pumps

NOM-007-ENER-1995 Non-residential building lighting

NOM-010-ENER-1996 Submersible pumps (EQV ISO 3555)

NOM-011-ENER-1996 Central air conditioners

NOM-013-ENER-1996 Street and building exterior lighting

NOM-014-ENER-1998 Single-Phase electric motors

NOM-015-ENER-1997 Residential refrigerators and freezers

NOM-016-ENER-1998 Three-phase electric motors

NOM-017-ENER-1997 Compact fluorescent lamps

NOM-021-ENER – revision of NOM-073-SCFI-1994 for AC – under consideration

NOM-022-ENER Commercial refrigeration – under consideration.

NOM-073-SCFI-1994 Room air conditioners

NOM-074-SCFI-1994 Three-phase AC induction electric motors

5.23 NZS – New Zealand Standards

Web site: http://www.standards.co.nz

See AS (Australian Standards) for standards published jointly.

NZS 4606:Part 1:1989 Storage water heaters - Part 1: General requirements

5.24 PNS – Philippine National Standards

Bureau of Product Standards web site: http://www.dti.gov.ph/bps

PNS 02:1994 Tubular fluorescent lamps for general lighting services (EQV? IEC 60081)

PNS 12-2:1996 Ballasts for tubular fluorescent lamp – performance (EQV? IEC 60921)

PNS 165:1998: Method of computing total refrigerated volume and total shelf area of refrigerators and freezers for household use

PNS 185:1989: Method for determining the energy consumption, freezer temperature and energy efficiency factor of refrigerators and freezers for household use (superseded by PNS1475/1476/1477/1478)

PNS 240:1989: Method for testing and rating room air conditioners

PNS 396 Part 1:1991: Standard for energy efficiency ratio and labelling requirements of air conditioners

PNS 603-2:1993 Compact fluorescent lamps (EQV? to IEC 60969)

PNS 1475 Frozen food storage cabinet and food freezer (EQV? ISO 5155-1995)

PNS 1476 Refrigerators with or without low-temperature compartment (EQV? ISO 7371-1995)

PNS 1477 Refrigerator-freezers (EQV? ISO 8187-1991)

PNS 1474 Refrigerators, refrigerator-freezers, frozen food storage cooled by internal forced air circulation (EQV? ISO 8561-1995)

5.25 TIS – Thai Industrial Standards

Thai Industrial Standards Institute web site: http://www.tisi.go.th

TIS 23-2521 Fluorescent lamp ballasts

TIS 455-2537 Refrigerators

TIS 866-2532 (1989): Standard for single-phase induction motors

TIS 867-2532 (1989): Standard for three-phase induction motors

TIS 1155-2536 Room air conditioners

6. Government, Regulatory and Related Web Resources

All web sites have an English version except where noted. Note that the web sites of bodies that develop local and regional standards are generally included in the Index of Standards used in APEC Member Economies, where relevant.

6.1 WSSN – World Standards Services Network

(service provided by ISO and IEC)

Web site: http://www.wssn.net

Provides links to all major national, regional and international standards bodies world wide.

6.2 Australia

Residential energy web site: http://www.dpie.gov.au/netenergy

Energy labelling and MEPS web site (under development): http://www.energyrating.gov.au

Australian Greenhouse Office: http://www.greenhouse.gov.au

6.3 Canada

Natural Resources Canada Regulatory web site: http://regulations.nrcan.gc.ca

Natural Resources Canada EnergGuide web site: http://energuide.nrcan.gc.ca

Natural Resources Canada Office of Energy Efficiency: http://oee.nrcan.gc.ca

Standards Council of Canada web site: http://www.scc.ca

6.4 China

China Standards Information Centre web site: http://www.cssn.net.cn

China State Bureau of Quality and Technical Supervision web site: http://www.csbts.cn.net (not in English)

6.5 Hong Kong, China

Industry Department web site: http://www.info.gov.hk/id

6.6 Indonesia

Badan Standardisasi Nasional Web site: http://www.bsn.go.id
(National Standardisation Agency, Indonesia)

6.7 Japan

Japanese Standards Association web site: http://www.jisc.org

6.8 Korea

Korea Energy Management Corporation web site: http://www.kemco.or.kr/efficiency (not in English)

Agency for Technology and Standards: http://www.ats.go.kr

6.9 Malaysia

Department of Standards Malaysia web site: http://www.dsm.gov.my

6.10 Mexico

CONAE Web site: http://www.conae.gob.mx (not in English)
This site has a copy of all Mexican NOMS for energy efficiency available for download.

Dirección General de Normas web site: http://www.secofi.gob.mx/normas/dgn1.shtml (not in English)

6.11 Peru

Instituto Nacional de Defensa de la Competencia y de la Protección de la Propiedad Intelectual web site: http://www.indecopi.gob.pe (not in English)

6.12 Philippines

Bureau of Product Standards web site: http://www.dti.gov.ph/bps

6.13 Russia

State Committee of the Russian Federation for Standardisation, Metrology and Certification web site: http://www.gost.ru/sls/gost.nsf

6.14 Singapore

Singapore Productivity and Standards Board web site: http://www.psb.gov.sg

6.15 Chinese Taipei

Environmental Protection Administration Greenmark web site: http://www.epa.gov.tw/greenmark/eng/english/htm

6.16 Thailand

Thai Industrial Standards Institute web site: http://www.tisi.go.th

6.17 USA

10 CFR Part 430 – US Code of Federal Regulations: Energy Conservation Program for Consumer Products

Web site: http://www.gpo.gov and http://www.access.gpo.gov/nara/cfr/cfr-table-search.html

This regulation contains test procedures and MEPS levels for various regulated products (except those covered by the Energy Policy Act 1992) – fully downloadable, updated annually.

16 CFR305 – US Code of Federal Regulations: Rule concerning disclosures regarding energy consumption and water use of certain home appliances and other products required under the energy policy and conservation act (‘‘appliance labelling rule’’)

Web site: http://www.gpo.gov and http://www.access.gpo.gov/nara/cfr/cfr-table-search.html

This regulation contains the requirements for energy labelling for all products in USA– fully downloadable, updated annually.

US EPA Energy Star web site: www.energystar.gov

6.18 Vietnam

Directorate for Standards and Quality web site: http://tcvn.vnn.vn

7. KEY PROJECT CONTACTS

The project team gratefully acknowledges the assistance of those listed below who provided information regarding each of the APEC economies. Contact details are available on request.

The team also gratefully acknowledges the assistance, guidance and direction of the contract manager Mr Yang Yafei of APEC Secretariat in Singapore and of the Project Manager, Eur. Ing. David Cogan of the Energy Efficiency and Conservation Authority, New Zealand.

7.1 Australia

Department of Science, Industry and Resources – John Butterfield

Australian Greenhouse Office – Dr Tony Marker

7.2 Brunei Darussalam

Department of Electrical Services - Haji Zakaria bin Haji Abd Latif

7.3 Canada

Natural Resources Canada – John Cockburn

Natural Resources Canada – Valerie Whelan

7.4 Chile

Comisión Nacional de Energía de Chile - Daniel Blazquez

7.5 China

China State Bureau of Quality and Supervision (CSBTS) – Yin Minghan

China State Bureau of Quality and Supervision (CSBTS) – Shi Bao Quan

China State Bureau of Quality and Supervision (CSBTS) – Cheng Jianhong

China State Bureau of Quality and Supervision (CSBTS) – Yang Ze Shi

China State Bureau of Quality and Supervision (CSBTS) – Li Feng Wen

State Econimic and Trade Commission (SETC) – Bai Rongchun

State Econimic and Trade Commission (SETC) – Xie Ji

Beijing Energy Efficiency Centre (BECon) – Xin Dingguo

Beijing Energy Efficiency Centre (BECon) – Yu Cong

Beijing Energy Efficiency Centre (BECon) – Zhu Yuezhong

Guangzhou Testing & Inspection Station for Household Electric Appliances of CEEE (GTIHEA) – Wu Guoping

Guangzhou Testing & Inspection Station for Household Electric Appliances of CEEE (GTIHEA) – Fu Jie

Beijing Testing & Inspection Station for Household Electric Appliances of CEEE – (BTIHEA) Wu Yang

Beijing Testing & Inspection Station for Household Electric Appliances of CEEE – (BTIHEA) Lu Mei

China Standardisation and Information Classifying and Coding Institute (CSICCI) – Zhao Yue Jin

7.6 Hong Kong, China

Electrical and Mechanical Services Department – Ir. LAM Kam-kuen

7.7 Indonesia

Directorate General Electricity and Energy Development, Ministry of Mines and Energy - Ms. Emy Perdanahari

7.8 Japan

Energy Conservation Centre, Japan - Ms. Yukie Kawaguchi

Energy Conservation Centre, Japan - Ms. Ayako Sato

Ministry of International Trade and Industry – Ken Saito

Ministry of International Trade and Industry – Mr Noguchi

Jyukankyo Research Institute Inc - Hidetoshi Nakagami

7.9 Korea

Korea Institute of Energy Research – Dr Sun-Kuen Lee

Ministry of Commerce, Industry & Energy - Byung-Nae Yang

Korea Energy Management Corporation - Gyou-Cheol Hwang

Korea Testing Laboratory (KTL) - Jun Choi

7.10 Malaysia

Department of Electricity and Gas Supply - Ir. Chong Cheong Yin

SIRIM Berhad (Testing Facility) - Ir. Goh Tok Poie

7.11 Mexico

Sello FIDE - Ing. Efrain Aguado Rubio

Comisión Nacional de Ahorro de Energía - Ing. Fernando Hernandez Pensado

IIE (Electric Research Institute) - Ing. Rogelio Covarrubias

Consultants: Ing. Itha Sanchez, Ing. Higinio Acoltzi

Vitro/Whirlpool - Ing. Manuel Malacara

7.12 New Zealand

Energy Efficiency & Conservation Authority – Eur. Ing. David Cogan

7.13 Papua New Guinea

South Pacific Applied Geoscience Commission (Fiji) - Paul Fairbairn

7.14 Peru

Gerente General del Centro de Conservacion de Energia y del Ambiente - Sr. Jorge Aguinaga Diaz

Secretario Técnico de Eficiencia Energética - Programa Ahorro de Energia - Ministerio de Energia y Minas - Julio Cesar Romaní

Consultants: Juan Carlos Gamarra, Juan Miguel Coriat

7.15 Philippines

Department of Energy - Mrs. Mirna Campanano

7.16 Russia

Ministry of Fuel and Energy – Mr Misulin

Ministry of Fuel and Energy – Mr Victor Shakhin,

Ministry of Foreign Affairs – Mr Mikhail Kolombet

GOSTANDART – Mr D. A. Pankratov

GOSTANDART – Mr Vyacheslaz Goubenko

GOSTANDART – Mr Roman Ryazanov

GOSTANDART – Mr Bexintayev

ZNEENMash – Mr Yevgeny Titov

ZNEENMash – Mr Garry Dasko

Consultant: Centre for Energy Efficiency (CENEf) - Ms Svetlana Sorokina

7.17 Singapore

Singapore Productivity and Standards Board - Mr. Leong Weng Kwai

Singapore Productivity and Standards Board - Mr. Tan Heng Khoon

7.18 Chinese Taipei

Industrial Technology Research Institute – Dr Fanghei Tsau

Energy Commission of the Ministry of Economic Affairs - Mr Kung-Yuan Lin

7.19 Thailand

Department of Energy Development and Promotion - Mr. Supot Tadyu

National Energy Policy Office - Mr. Sa-Nguansak Keyuraphan

Thailand Industrial Standards Institute - Mr. Bundit Wuthirakchainunt

Consultant - ERM Siam: Phanu Kritiporn

7.20 USA

US Department of Energy – Carl Adams

US Department of Energy – Jim Raba

7.21 Vietnam

Ministry of Science Technology and Environment (MoSTE) - Mr. Nguyen Thuong

Vietnam Standard and Consumers Association - Mr. Do Gia Phan

Published by Energy Efficient Strategies, Australia
For APEC Secretariat
438 Alexandra Road
#14-00, Alexandra Point
Singapore 119958
Tel: +65 2761880 Fax: +65 2761775
Email: info@mail.apecsec.org.sg
Http://www.apecsec.org.sg

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