

Wind Turbine Certification- Electrical

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Electrical Testing and Certification



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Introduction to Certification

NFPA 70; NEC (brief)

UL 6142

Other Markets – Canada

Compliance Approach

Product Certification

Field Labeling



Introduction to certification



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- **Certification** - the determination by a third party that a product, process or service meets a defined set of requirements.
- Third party certification involves an **independent** assessment declaring that specified requirements have been met.
- In most cases, the specified requirements are consensus standards.



Certification Components



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- **Accreditation body:** authority that entitles the certification body as impartially and technically competent to conduct certification.
- **Certification System:** entity that defines the approach to perform certification.
- **Certification body:** entity that conducts the certification procedure.
- **Certification applicant/holder:** entity that manufactures the product.



NFPA 70 - National Electrical Code 2014 Edition

Intertek

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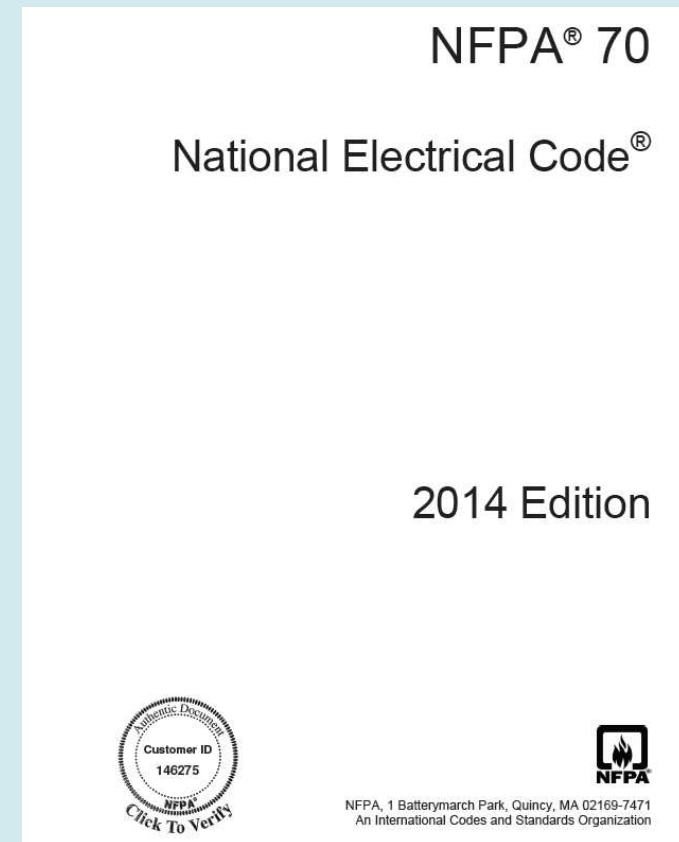
Article 694 Wind Electric Systems – Some highlights:

694.7 Installation – “Systems covered by this article shall be installed only by qualified persons.” (Defined in Article 100)

(B) Equipment – “Wind electric systems shall be listed and labeled for the application.”

694.23 Turbine Shutdown – “Shall be required to have readily accessible manual shutdown button or switch.”
(exception swept area < 50 m²)

(B) “The shutdown procedure for a wind turbine shall be defined and permanently posted at the location of a shutdown means and at the location of the turbine controller or disconnect, if the location is different.”



UL 6142 - Small Wind Turbine Systems



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Published November 20, 2012

Scope:

- Small wind turbines and subassemblies
- Small wind turbines are “...wind turbines where a user or service person cannot or is not intended to enter the turbine to operate it or perform maintenance.”
- Stand alone and utility interactive applications
- Products are intended to be installed per NFPA 70
- Covers turbines rated 1500 VAC or less



UL 6142

STANDARD FOR SAFETY

Small Wind Turbine Systems



UL 6142 - Content and Requirements



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- Special components and Subassemblies of Wind Turbines:

General requirements

Wiring

Splices and Connections in Power Cables

Cable drip loop

Bus bars

Switchgear

Panelboards

Transformers

Hub

Converter/Inverter – UL 1741

**Lightning protection systems – NFPA 780
and IEC 61400-24**

Slip rings – UL 508

Gearboxes

Hoists and winches

Fire alarms

Emergency stop

Cable trays and wireways

Hydraulic electromechanical components

**Alternators, generators and motors – UL
1004 series**

Energy storage units

Disconnect devices

Charge controllers – UL 1741

Inverters/Converters



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Inverter/Converter – converts the DC (inverter) or “wild” AC (converter) from the distributed generation source to AC at the required voltage and frequency of the grid.

- North American standards:
 - USA: UL 1741 – “Inverters, converters, controllers and interconnection system equipment for use with distributed energy resources”
 - Canada: CAN/CSA C22.2 No 107.1 – “General Use Power Supplies”
- Elements of the standards
 - Electrical Safety – construction and performance
 - Functionality – grid connection or standalone mode
 - Power quality



Inverters/Converters



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- Electrical Safety

- Construction – component qualification and ratings, enclosure, mounting, accessibility of live parts, stored energy, disconnect devices, separation of circuits, spacings, bonding and grounding, insulating materials, overcurrent protection, etc.
- Performance
 - Temperature
 - Dielectric voltage withstand
 - Input and output ratings
 - Overload
 - Output short circuit
 - Ventilation
 - Component faults
 - Loss of control
 - Environmental ratings



Inverters/Converters



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- Grid connection
 - References **IEEE 1547** “Standard for Interconnecting Distributed Resources With Electric Power Systems” and **IEEE 1547.1** “Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems”
 - Applies both in the USA and Canada
 - Grid Disconnection
 - Abnormal Voltage
 - Abnormal Frequency
 - Unintentional Islanding
 - Grid Connection
 - Synchronization
 - Reconnection time
 - Power quality
 - DC injection
 - Harmonics
 - Power factor
 - Transient voltage
 - Flicker



Rotating Electrical Machines

North American standards:

- USA: UL 1004 series
 - UL 1004-1 “Rotating Electrical Machines – General Requirements”
 - UL 1004-4 “ Electric Generators”
 - UL 1004-2, -3, -6, -7, -8 – depending on the type of motor and the method of protection
- Canada: CAN/CSA C22.2 No 100 – “Motors and Generators”
- Elements of the standards
 - Electrical Safety – construction and performance
 - Power quality for generators

Generators and Motors



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- Electrical Safety

- Construction – component qualification and ratings, enclosure, mounting, accessibility of live parts, separation of circuits, spacing, bonding and grounding, insulating materials, overload protection, etc.
- Performance
 - Ratings (motor ratings and generator output)
 - Temperature and dielectric voltage withstand
 - Mechanical (enclosure, environmental)
 - Short circuit
 - Locked rotor
 - Overspeed (generators)
 - Output waveform distortion (generators)
 - Surge tests (generators)



Generators and Motors



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- Electrical Insulation Systems (EIS)

- Require a thermal rating – maximum normal operating temperature that doesn't result in the degradation of the electrical insulation system such that it is likely to fail before its intended life
- Certified EIS – combination of insulating materials that has been subjected to long term thermal aging testing together to establish chemical compatibility
- EIS testing can take 3-6 months or even longer depending on the thermal class needed
- UL 1446 or IEEE 1776 depending on the voltage rating of the motor or generator
- CAN/CSA C22.2 No 100 also gives the option of a much quicker “Integral Insulation” test but not valid for US compliance



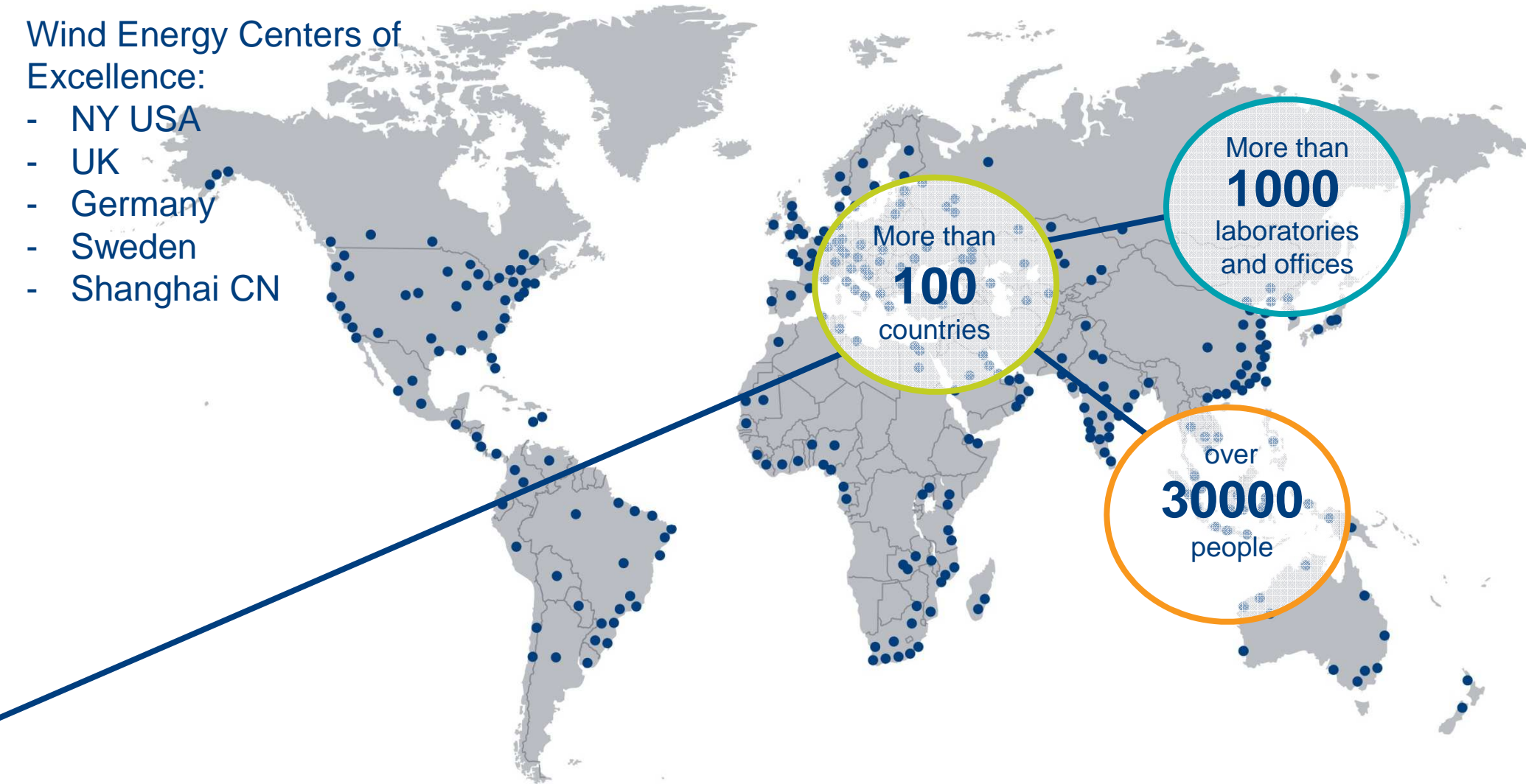
International Markets – Intertek's global network



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Wind Energy Centers of Excellence:

- NY USA
- UK
- Germany
- Sweden
- Shanghai CN



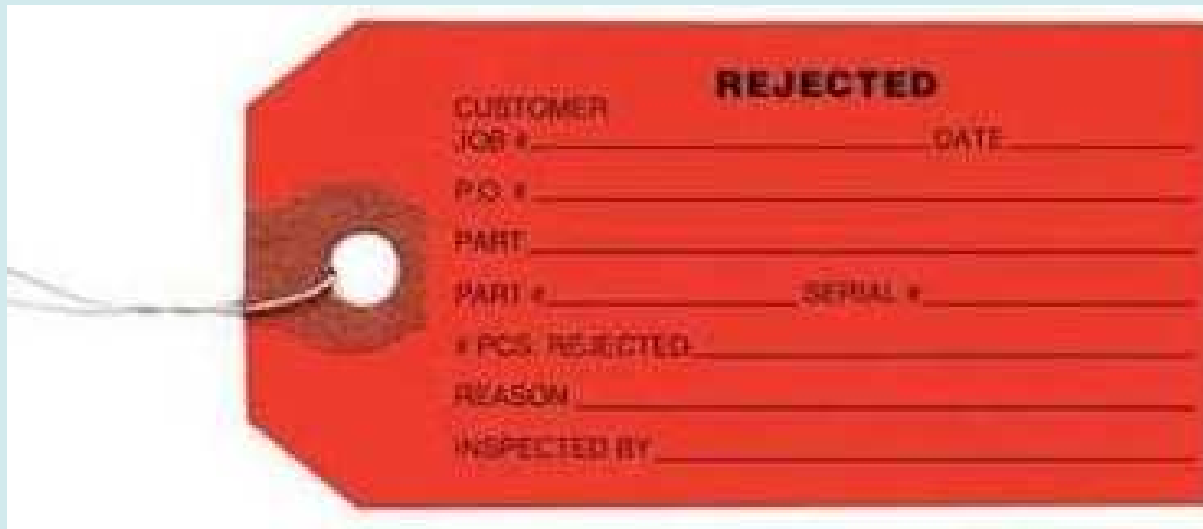
- Similar codes and requirements to US
- CAN/CSA C22.2 No 272 – Issued in 2014
 - Large and small turbines
 - System level certification with component certification assumption
- Special inspections
 - SPE 1000 – 2013
 - Similar considerations as UL 6142 and CSA No 272
 - Enforced in all provinces

Compliance Approach; Roadblocks



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- Q: Why is this important?
- A: Ever seen one of these?



Compliance Approach; General



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- It should be noted that often it is the Local Electrical Inspector, or the Authority Having Jurisdiction (AHJ), that authorizes the connection of the wind turbine to the grid. The AHJ is also responsible for the enforcement of the Electrical Codes.
- CBs and NRTLs are able to assist the AHJs with those determinations and are often enlisted to perform Field Labeling assessment activities on units already installed in the field that do not bear an accredited third party certification mark.



Product Certification (proactive)

- Documentation review
- Construction review
- Laboratory testing
- Factory assessment
- Annual follow-up
- Listing and Labeling of model(s)
- Labels applied in factory

Field Labeling (reactive)

- Variability from jurisdiction to jurisdiction
- Understand the specific requirements
- Field inspection
 - UL 6142
 - NFPA 70; NEC
 - SPE 1000-13
 - CSA C22.2 No.272
- Apply single use label in field
- Repeat for other jurisdictions/installations

UL 6142 - Content and Requirements



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Impact of Certification on Electrical Design



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The current codes and standards activities will provide a better defined set of compliance criteria that will be useful in the following ways:

- AHJs gain industry guidance from the Electrical Codes and Standards.
- CBs and NRTLs will have a coherent set of requirements based on the consensus standards on which to base field evaluations.
- The standards that have been, or will be, published soon will provide a basis for wind turbine electrical system certification pending the accreditation of the CBs and NRTLs to those standards.
- OEMs, installers, and operators will have better visibility as to what the regulatory requirements are. The codes and standards will be available on which to base equipment selection and overall system design and implementation.

Contact Information



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