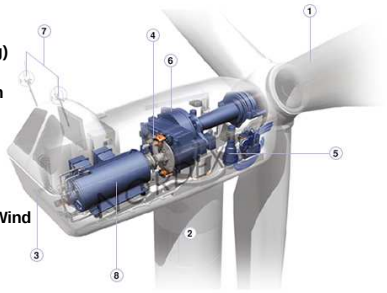
Wind Turbine Generating Systems

The NEC and applicable UL Standards

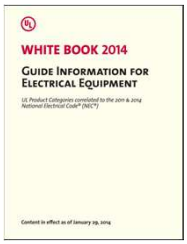
Wind Turbine Components

1. Blade
2. Tower
3. Nacelle (Housing)
4. Breaking System
5. Yaw Drive
6. Gear Box
7. Anemometer & Wind Vane
8. Generator



The UL White Book

The Companion Tool to the NEC



Some of the UL Product Categories for WTGS

UL Category	Topic
QIKH	STATIC INVERTERS, CONVERTERS AND ACCESSORIES FOR USE IN INDEPENDENT POWER SYSTEMS
ZGCP	WIND TURBINE SAFETY-RELATED CONTROL SYSTEM EQUIPMENT
ZGEN	SMALL WIND TURBINE GENERATING SYSTEMS
ZGFA	WIND TURBINE INVERTERS AND CONVERTERS
ZGZN	WIND TURBINE TRAY CABLE
KDER	GROUNDING AND BONDING EQUIPMENT
ZMVV	WIRE CONNECTORS AND SOLDERING LUGS

90.1 Purpose

(A) Practical Safeguarding. The purpose of this Code is the practical safeguarding of persons and property from **hazards arising from the use of electricity**. This Code is not intended as a design specification or an instruction manual for untrained persons.

(B) Adequacy. This Code contains provisions that are considered necessary for safety. Compliance therewith and proper maintenance results in an installation that is essentially free from hazard …..

The NEC addresses the necessary safety requirements that include protection against electric shock, against thermal effects, against overcurrent, against fault currents, and against overvoltage.

Wind Turbine Hazards



90.4 Enforcement

….. The authority having jurisdiction for enforcement of the Code **has the responsibility** for making interpretations of the rules, for deciding on the approval of equipment and materials, and for granting the special permission contemplated in a number of the rules.

90.7 Examination of Equipment for Safety

…. examinations for safety made under standard conditions provide a basis for approval where the record is made generally available through promulgation by organizations properly equipped and qualified for experimental testing, inspections of the run of goods at factories, and **service-value determination through field inspections**.

It is the intent of this Code that factory-installed internal wiring or the construction of equipment need not be inspected at the time of installation of the equipment, except to detect alterations or damage, **if** the equipment has been **listed** by a qualified electrical testing laboratory…

WTGS Listed or Field Evaluated

NEW UL Mark

Current UL Mark

UL Field Evaluation Mark

110.2 Approval

The conductors and equipment required or permitted by this Code **shall be** acceptable only if approved.

CE Mark

Statutory Instruments:	SI 2008/1597
Applicable EC Directives:	Machinery Directive 2006/42/EC
Applicable Standards:	ISO 12100-1:2003+A1:2009, EN ISO 12100-2:2003+A1:2009, EN 60204-1:2006+A1:2009, EN 14121-1:2007, EN 61400-1:2005+A1:2010, EN 61400-2:2006

- CE **is not** a mark that satisfies the NEC's requirements or OSHA's requirements for **Listed and Labeled**
- CE only means the product was **"self certified"** for ease of movement into and within European Union and was evaluated to European Union Directives
- CE **DOES NOT** demonstrate compliance to United States safety standards or our installation codes such as the NEC due to the Europeans having a different approach towards the protection of the health and safety of consumers and the environment.

CE Mark

- In an OSHA report dated 12/17/2010 testing of over 5000 products per year in Asia with CE marking and FCC regulatory requirements shows non compliance of US safety standards exceeding 50%.
- The CE marking system allows significant numbers of nonconforming products to reach the market whereas OSHA's NRTL program detects product noncompliance before products reach the market.
- OSHA prohibits the use of a Supplier's Declaration of Conformity (CE mark) as a means of ensuring the safety of products currently requiring approval by NRTL's.

Wind Turbine Generating Systems

UL 6142 - Small Wind Turbines – are considered to be wind turbines where a user or service person **cannot or is not intended** to enter the turbine to operate it or perform maintenance.

Wind Turbine Generating Systems

UL 6140 - Large Wind Turbines – are considered to be wind turbines where a user or service person **is intended or required** to enter the turbine to operate or perform maintenance on the turbine.

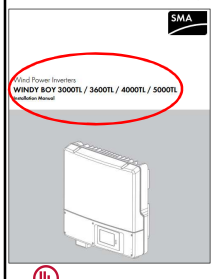
110.3 Examination, Identification, Installation, and Use of Equipment

(A) Examination. In judging equipment, considerations such as the following **shall be evaluated**:

(1) Suitability for installation and use in conformity with the provisions of this Code
(2) Mechanical strength and durability, including, for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided
(3) Wire-bending and connection space
(4) Electrical insulation
(5) Heating effects under normal conditions of use and also under abnormal conditions likely to arise in service
(6) Arcing effects
(7) Classification by type, size, voltage, current capacity, and specific use
(8) Other factors that contribute to the practical safeguarding of persons using or likely to come in contact with the equipment

110.3 Examination, Identification, Installation, and Use of Equipment

(B) Installation and Use. Listed or labeled equipment **shall be installed and used** in accordance with any instructions included in the listing or labeling.



- The mounting location **must not** be exposed to direct solar irradiation.
- **Do not** mount on flammable construction materials.
- **Do not** mount near areas containing highly flammable materials.
- **Do not** mount in potentially explosive areas.
- Overvoltage protection **must be** installed between the inverter and the rectifier.

NEC Requirements Pre-2011

Article 705

Interconnected Electric Power Production Sources

705.4 Equipment Approval.

All equipment **shall be approved** for the intended use. Utility-interactive inverters for interconnection systems **shall be** listed and identified for interconnection service.

2011 NEC Requirements

ARTICLE 694
Small Wind Electric Systems

I. General
II. Circuit Requirements
III. III. Disconnecting Means
IV. Wiring Methods
V. Grounding
VI. Marking
VII. Connection to Other Sources
VIII. Storage Batteries

2014 NEC Requirements

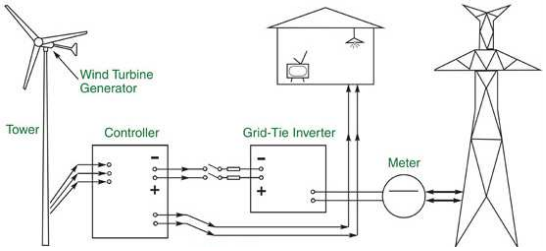
694.1 Scope
The provisions of this article apply to wind (turbine) electric systems that consist of one or more wind electric generators. These systems can include generators, alternators, inverters, and controllers.

694.2 Definitions

Charge Controller	Maximum Voltage
Diversion Charge Controller	Nacelle
Diversion Load	Rated Power
Diversion Load Controller	Tower
Guy	Wind Turbine
Inverter Output Circuit	Wind Turbine Output Circuit
Maximum Output Power	Wind Turbine System

694.3 Other Articles

Where the system is operated in parallel with primary sources of electricity, the requirements of Article 705 **shall apply**.



694.7 Installation

Systems covered by this article **shall be** installed only by qualified persons.

(A) Wind Electric Systems. A wind electric system(s) shall be permitted to supply a building or other structure in addition to other sources of supply.

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

PV Inverter for a Wind Turbine?

PV Inverter
SUNNY BOY 3000-US / 3800-US / 4000-US
Installation Manual

ONLINE CERTIFICATIONS DIRECTORY
Home Quick Guide Contact Us UL.com

QIKH.E210376
Static Inverters, Converters and Accessories for Use in Independent Power Systems

Page Bottom

Static Inverters, Converters and Accessories for Use in Independent Power Systems

See General Information for Static Inverters, Converters and Accessories for Use in Independent Power Systems

SMA SOLAR TECHNOLOGY AG
Sonnenallee 1
34266 Niestetal, GERMANY
E210376

Model No.	SB 4000US, WB 4000US, may also be provided with suffix "-12."	SB 3000US, WB 3000US, may also be provided with suffix "-12."
InputRatings:		
ST	WT, FC, B, MT, HT, GS, PV	PV, FC, MT, WT, HT, B, GS

PV Inverter for a Wind Turbine?

UL Product Category QIKH - Static Inverters, Converters and Accessories for Use in Independent Power Systems

Source Type	ST
Fuel Cell	FC
Photovoltaic	PV
Microturbine	MT
Wind Turbine	WT
Hydro Turbine	HT
Battery	B
Gen Set	GS
Other	O

694.7 Installation

(D) Surge Protective Devices (SPD). A surge protective device **shall be installed** between a wind electric system and any loads served by the premises electrical system.

- Type 3 SPD on a dedicated branch circuit serving a small wind electric system
- Type 2 SPD located anywhere on the load side of the service disconnect.

Surge protective devices **shall be installed** in accordance with Part II of Article 285.

694.7 Installation

(F) Metal or Nonmetallic Poles or Towers Supporting Wind Turbines Used as a Raceway. A metallic or non-metallic pole or tower shall be permitted to be used as a raceway **if** evaluated as part of the listing for the wind turbine or **otherwise shall be** listed or evaluated for the purpose.

694.10 Maximum Voltage

(A) Wind Turbine Output Circuits.

For wind turbines connected to one- and two- family dwellings, turbine output circuits shall be permitted to have a maximum voltage up to 600 volts.

(C) Circuits over 150 Volts to Ground.

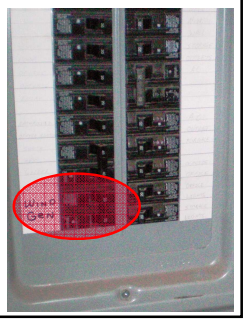
In one- and two-family dwellings, live part in circuits over 150 volts to ground **shall not be** accessible to other than qualified persons while energized.

694.15 Overcurrent Protection

(C) Direct-Current Rating. Overcurrent devices, either fuses or circuit breakers, used in any dc portion of a wind electric system **shall be listed** for use in dc circuits and **shall have** appropriate voltage, current, and interrupting ratings.

694.20 All Conductors

Means **shall be provided** to disconnect **all** current-carrying conductors of a wind electric power source from all other conductors in a building or other structure. A switch, circuit breaker, or other device, either ac or dc, **shall not be** installed in a grounded conductor if operation of that switch, circuit breaker, or other device leaves the marked, grounded conductor in an ungrounded and energized state.



694.22(C)(1) Disconnecting Means Location

The wind electric system disconnecting means **shall be installed** at a readily accessible location either on or adjacent to the turbine tower, on the outside of the building or structure or inside, at the point of entrance of the wind system conductors.

694.22(C)(2) Disconnecting Means Marking.

Each turbine system disconnecting means **shall be** permanently marked to identify it as a wind electric system disconnect. A plaque **shall be** installed in accordance with 705.10.

Directory shall be installed at service equipment and all electric power producing sources per 705.10.

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694.23 Turbine Shutdown

(A) Manual Shutdown. Wind turbines **shall be required** to have a readily accessible manual shutdown button or switch. Operation of the button or switch shall result in a parked turbine state that shall either stop the turbine rotor or allow limited rotor speed combined with a means to de-energize the turbine output circuit.

Exception: *Turbines with a swept area of less than 50 m² (538 ft²) shall not be required to have a manual shutdown button or switch.*

(B) Shutdown Procedure. 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.

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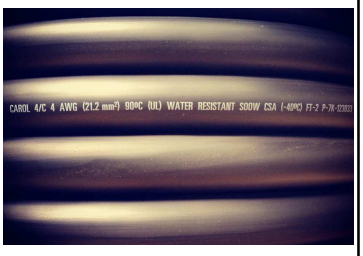
694.30 Permitted Methods

(A) Wiring Systems. All raceway and cable wiring methods included in this Code, and other wiring systems and fittings specifically intended for use on wind turbines, **shall be permitted**. In readily accessible locations, turbine output circuits that operate at voltages greater than 30 volts **shall be installed** in raceways.

694.30(B) Flexible Cords and Cables

- **Shall** comply with Article 400
- Identified as hard service cord or portable power cable, **shall be** suitable for extra-hard usage, **shall be listed** for outdoor use, and **shall be** water-resistant. Cables exposed to sunlight **shall be** sunlight resistant.
- Flexible, fine-stranded cables **shall be terminated only** with terminals, lugs, devices, or connectors in accordance with 110.14(A).



694.30 Permitted Methods

(C) Direct-Current Turbine Output Circuits Inside a Building. DC turbine output circuits installed inside a building or structure **shall be enclosed** in metal raceways or installed in metal enclosures or run in Type MC cable that complies with 250.118(10), from the point of penetration of the surface of the building or structure to the first readily accessible disconnecting means.

694.40 Equipment Grounding

(A) General. Exposed non–current-carrying metal parts of towers, turbine nacelles, other equipment, and conductor enclosures **shall be** grounded in accordance with Parts IV, V, and VI of Article 250. Attached metal parts, such as turbine blades and tails that are not likely to become energized, **shall not be required** to be grounded or bonded.

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694.40 Equipment Grounding

(B) Tower Grounding and Bonding.

(1) Grounding Electrodes and Grounding Electrode Conductors. A wind turbine tower **shall be** connected to a grounding electrode system. Where installed in close proximity to galvanized foundation or tower anchor components, galvanized grounding electrodes shall be used.

694.40 Equipment Grounding

(B) Tower Grounding and Bonding.

(3) Tower Connections. Equipment grounding conductors and grounding electrode conductors, where used, **shall be** connected to metallic towers using **listed means**. All mechanical elements used to terminate these conductors **shall be** accessible.

694.50 Interactive System Point of Interconnection

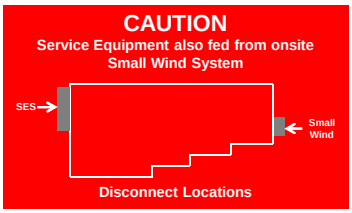
All interactive system points of interconnection with other sources **shall be marked** at an accessible location at the disconnecting means and with the rated ac output current and the nominal operating ac voltage.

Wind Turbine Source	
AC Output Current	30 amps
AC Nominal Voltage	240 volts

694.54 Identification of Power Sources

(B) Facilities with Utility Services and Wind Electric Systems. Buildings or structures with **both** utility service and wind electric systems **shall have a permanent plaque or directory** providing the location of the service disconnecting means and the wind electric system disconnecting means.

CAUTION
Service Equipment also fed from onsite Small Wind System



Directory shall be installed at service equipment and all electric power producing sources per 705.10.

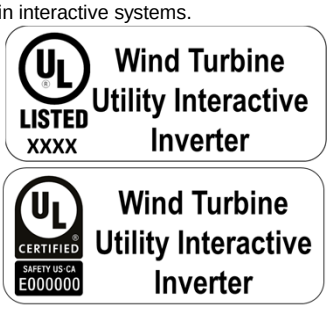
694.56 Instructions for Disabling Turbine

A plaque **shall be installed** at or adjacent to the turbine location providing basic instructions for disabling the turbine.

ATTENTION
To Disable Wind Turbine
Disconnect AC Power
AC Power Disconnect Located at:
Southeast Corner of Building

694.60 Identified Interactive Equipment

Only inverters **listed and identified** as interactive **shall be permitted** in interactive systems.



Only those products bearing the appropriate UL Mark should be considered as complying with the NEC's requirements for listed.

ONLINE CERTIFICATIONS DIRECTORY

Home Quick Guide Contact Us UL.com

Search results

You may choose to Refine Your Search.

Company Name	Category Name	Link to File
BONFIGLIOLI VECTRON GMBH	Static Inverters, Converters and Accessories for Use in Independent Power Systems	QIKH.E347746
CAPSTONE TURBINE CORP	Static Inverters, Converters and Accessories for Use in Independent Power Systems	QIKH.AU5040
DELTA ELECTRONICS INC	Static Inverters, Converters and Accessories for Use in Independent Power Systems	QIKH.E255963
EDS USA INC	Static Inverters, Converters and Accessories for Use in Independent Power Systems	QIKH.E353727
ELTEK AS	Static Inverters, Converters and Accessories for Use in Independent Power Systems	QIKH.E336452
GREEN POWER TECHNOLOGIES S L	Static Inverters, Converters and Accessories for Use in Independent Power Systems	QIKH.E336803
Guide Information	Static Inverters, Converters and Accessories for Use in Independent Power Systems	QIKH.GuideInfo
LG CHEMICAL LTD	Static Inverters, Converters and Accessories for Use in Independent Power Systems	QIKH.E359245
NEXTEK WEST INC	Static Inverters, Converters and Accessories for Use in Independent Power Systems	QIKH.E347706
SMA AMERICA PRODUCTION L L C	Static Inverters, Converters and Accessories for Use in Independent Power Systems	QIKH.E466978

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694.62 Installation

Wind electric systems, where connected to utility electric sources, **shall comply** with the requirements of Article 705.

I. General
- 705.1 Scope
- 705.2 Definitions
- 705.3 Other Articles
- 705.4 Equipment Approval
- 705.6 System Installation
- 705.10 Directory
- 705.12 Point of Connection
  - (A) Supply Side
  - (B) Integrated Electrical Systems
  - (C) Greater Than 100 kW
  - (D) Utility-Interactive Inverters
- 705.14 Output Characteristics
- 705.16 Interrupting and Short-Circuit Current Rating
- 705.20 Disconnecting Means, Sources
- 705.21 Disconnecting Means, Equipment
- 705.22 Disconnect Device
- 705.30 Overcurrent Protection
  - (A) Solar Photovoltaic Systems
  - (B) Transformers
  - (C) Fuel Cell Systems
  - (D) Utility-Interactive Inverters
  - (E) Generators
- 705.32 Ground-Fault Protection
- 705.40 Loss of Primary Source
- 705.42 Loss of 3-Phase Primary Source
- 705.50 Grounding

II. Utility-Interactive Inverters
- 705.60 Circuit Sizing and Current
  - (A) Calculation of Maximum Circuit Current
  - (B) Ampacity and Overcurrent Device Ratings
- 705.65 Overcurrent Protection
  - (A) Circuits and Equipment
  - (B) Power Transformers
- 705.70 Utility-Interactive Inverters Mounted in Not-Readily-Accessible Locations
- 705.80 Utility-Interactive Power Systems Employing Energy Storage
- 705.82 Hybrid Systems
- 705.95 Ampacity of Neutral Conductor
  - (A) Neutral Conductor for Single Phase, 2-Wire Inverter Output
  - (B) Neutral Conductor for Instrumentation, Voltage Detection and Phase Detection
- 705.100 Unbalanced Interconnections
  - (A) Single Phase
  - (B) Three Phase

III. Generators
- 705.130 Overcurrent Protection
- 705.143 Synchronous Generators

694.68 Point of Connection

Points of connection to interconnected electric power sources **shall comply** with 705.12.

Product Certification Requirements

UL 6140 Wind Turbine Generating Systems

These units are intended for use in stand-alone or utility interactive applications.

UL 6141 Wind Turbine Converters (WTC) and Interconnection Systems Equipment

These products include but are not limited to, generation of real and reactive power in parallel with the electric utility grid system.

UL 6142 Small Wind Turbine Systems

These products include small wind turbine systems and electrical subassemblies

UL 2277 Flexible Motor Supply Cable and Wind Turbine Tray Cable

These products include Wind Turbine Tray Cable rated 1000 volts, 90 - 200°C dry and optionally rated 90°C wet.

UL 6140 Requirements

Evaluated for the Risk of;

- Fire
- Shock
- Safety related control system electrical performance
- Utility grid-interconnect performance (for utility interactive models)

The products, systems, and subassemblies covered by these requirements are intended to be installed in accordance with the National Electrical Code, ANSI/NFPA 70.

UL 6140 does not cover

WTGS intended for off-shore installation.

Mechanical or structural integrity of the WTGS or subassemblies

Coordination of electrical and mechanical systems to maintain the WTGS within its safe mechanical and structural limits

Mechanical loading of ladders, scaffolding, personnel tie offs, or other personnel load bearing functional parts

UL 6140 does not cover off-shore installations

UL 6140 does not cover mechanical or structural integrity

UL 6140 does not cover ladders, scaffolding, etc…

UL 6140 Requirements for components and subassemblies

- Wiring
- Cable drip loop
- Busbars
- Switchgear
- Transformers
- Hub
- Converter/Inverter
- Lightning protection systems
- Slip rings
- Gear boxes
- Hoists and winches
- Fire alarms
- Emergency stop

Safety Related Control Systems

Evaluated to perform specific functions to maintain the overall system within the manufacturer's specified operational limits

Risk of shock, fire, and electrical response time

UL 6141 Requirements

Evaluated for the Risk of;

- Fire
- Shock
- Safety related control system electrical performance
- Utility grid-interconnect performance (for utility interactive models)

These products and assemblies are intended for installation in accordance with their ratings, installation instructions, the National Electrical Code, ANSI/NFPA 70, and applicable utility and model building codes.

UL 6141 Construction requirements

The construction **shall comply** with all applicable portions of the Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources, UL 1741, or the Standard for Power Conversion Equipment, UL 508C.

UL 1741 Inverter Types

- Stand-alone – operate independent of the utility grid
- Utility interactive – operate in parallel with the utility grid
- Multimode – can operate dependent or independent of the utility grid

UL 1741 Utility Interactive

Evaluation of the device's ability to

- Parallel two sources of power
- Operate during normal utility operating conditions
- Provide a minimum level of output power quality including DC injection
- Operate safely during abnormal utility grid conditions

Concerns Addressed for Utility Interaction

Prevention of exporting power after utility outage ("anti-islanding")

Addresses

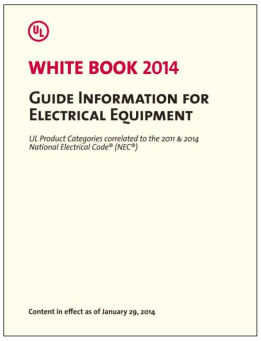
- Shock hazards to utility line crews
- Current contribution to the utility fault
- Potential problems in re-energizing the line
- Damage to equipment if line re-energized out of sync with the inverter

Inverter Installation

- Some need to be installed and operated with external transformer
- Some need external input or output overcurrent protection
- Refer to installation instructions

Certification Information

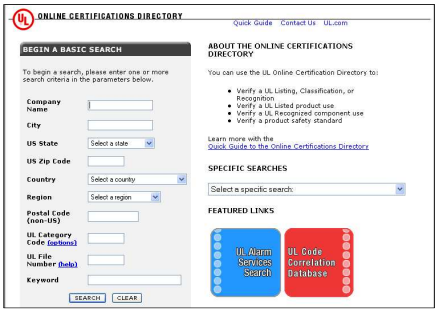
UL White Book



Certification Information

UL Online Certification Directory

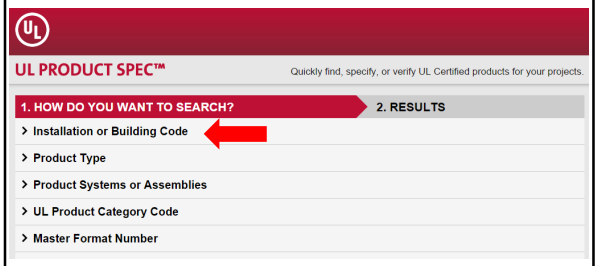
www.UL.com/database



Certification Information

UL.COM/PRODUCTSPEC

Works on Computers, Net Books, Tablets and Smart Phones



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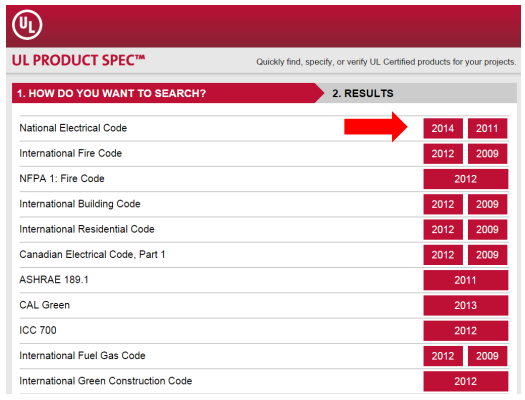

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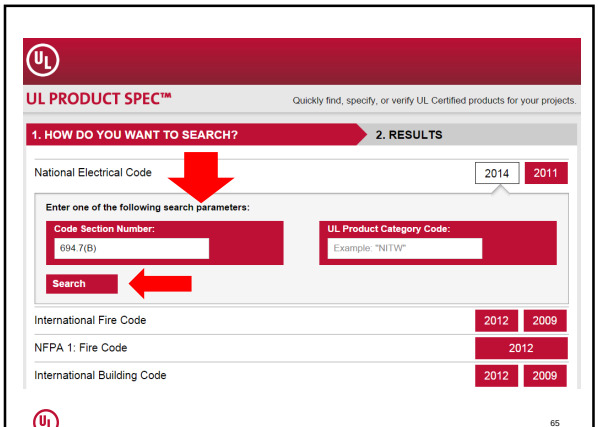

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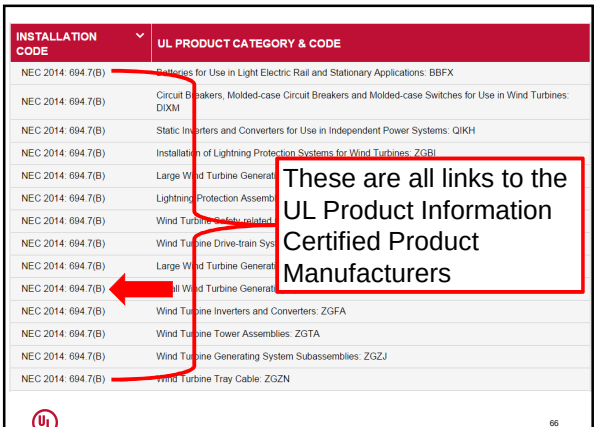

These are all links to the UL Product Information Certified Product Manufacturers

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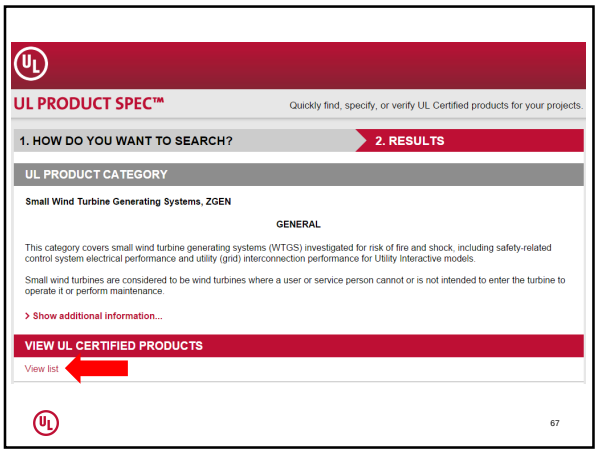
UL PRODUCT SPEC™
Quickly find, specify, or verify UL Certified products for your projects.
1. HOW DO YOU WANT TO SEARCH?
2. RESULTS
UL PRODUCT CATEGORY
Small Wind Turbine Generating Systems, ZGEN
GENERAL
This category covers small wind turbine generating systems (WTGS) investigated for risk of fire and shock, including safety-related control system electrical performance and utility (grid) interconnection performance for Utility Interactive models.
Small wind turbines are considered to be wind turbines where a user or service person cannot or is not intended to enter the turbine to operate it or perform maintenance.
› Show additional information...
VIEW UL CERTIFIED PRODUCTS
View list
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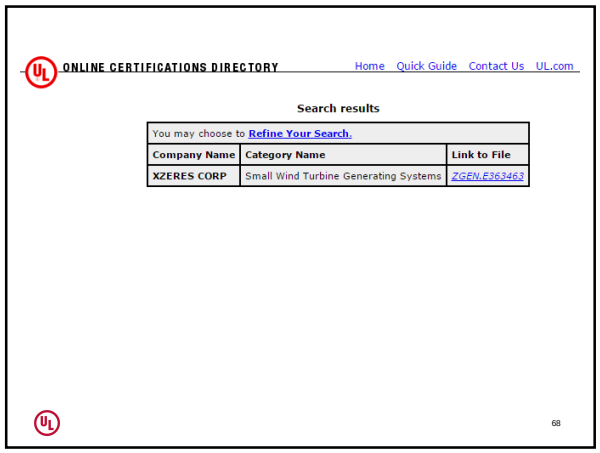
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Search results
You may choose to Refine Your Search.
Company Name | Category Name | Link to File
XZERES CORP | Small Wind Turbine Generating Systems | ZGEN.E363463
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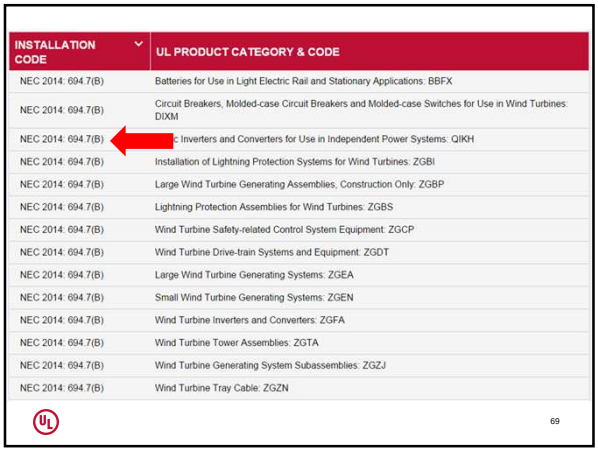
INSTALLATION CODE
UL PRODUCT CATEGORY & CODE
NEC 2014: 694.7(B) | Batteries for Use in Light Electric Rail and Stationary Applications: BBFX
NEC 2014: 694.7(B) | Circuit Breakers, Molded-case Circuit Breakers and Molded-case Switches for Use in Wind Turbines: DIXM
NEC 2014: 694.7(B) | c Inverters and Converters for Use in Independent Power Systems: QIKH
NEC 2014: 694.7(B) | Installation of Lightning Protection Systems for Wind Turbines: ZGBI
NEC 2014: 694.7(B) | Large Wind Turbine Generating Assemblies, Construction Only: ZGBP
NEC 2014: 694.7(B) | Lightning Protection Assemblies for Wind Turbines: ZGBS
NEC 2014: 694.7(B) | Wind Turbine Safety-related Control System Equipment: ZGCP
NEC 2014: 694.7(B) | Wind Turbine Drive-train Systems and Equipment: ZGDT
NEC 2014: 694.7(B) | Large Wind Turbine Generating Systems: ZGEA
NEC 2014: 694.7(B) | Small Wind Turbine Generating Systems: ZGEN
NEC 2014: 694.7(B) | Wind Turbine Inverters and Converters: ZGFA
NEC 2014: 694.7(B) | Wind Turbine Tower Assemblies: ZGTA
NEC 2014: 694.7(B) | Wind Turbine Generating System Subassemblies: ZGZJ
NEC 2014: 694.7(B) | Wind Turbine Tray Cable: ZGZN
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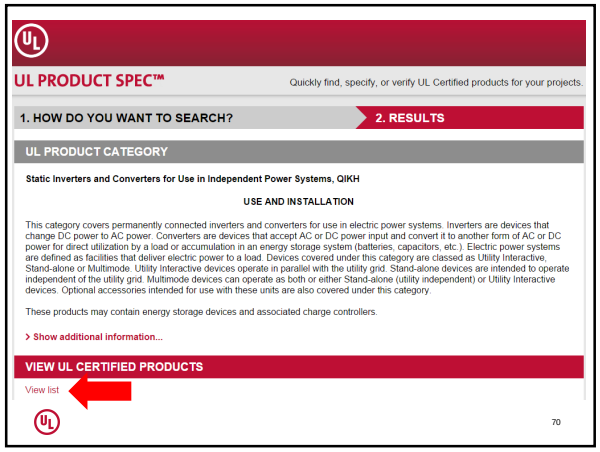
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UL PRODUCT CATEGORY
Static Inverters and Converters for Use in Independent Power Systems, QIKH
USE AND INSTALLATION
This category covers permanently connected inverters and converters for use in electric power systems. Inverters are devices that change DC power to AC power. Converters are devices that accept AC or DC power input and convert it to another form of AC or DC power for direct utilization by a load or accumulation in an energy storage system (batteries, capacitors, etc.). Electric power systems are defined as facilities that deliver electric power to a load. Devices covered under this category are classed as Utility Interactive, Stand-alone or Multimode. Utility Interactive devices operate in parallel with the utility grid. Stand-alone devices are intended to operate independent of the utility grid. Multimode devices can operate as both or either Stand-alone (utility independent) or Utility Interactive devices. Optional accessories intended for use with these units are also covered under this category.
These products may contain energy storage devices and associated charge controllers.
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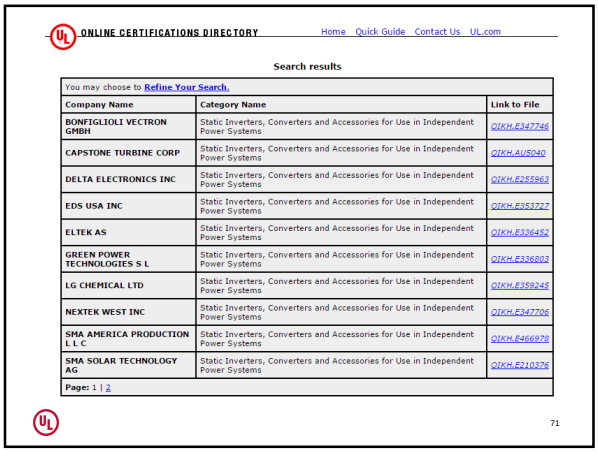
ONLINE CERTIFICATIONS DIRECTORY
Home Quick Guide Contact Us UL.com
Search results
You may choose to Refine Your Search.
Company Name | Category Name | Link to File
BONFIGLIOLI VECTRON GMBH | Static Inverters, Converters and Accessories for Use in Independent Power Systems | QIKH.E347746
CAPSTONE TURBINE CORP | Static Inverters, Converters and Accessories for Use in Independent Power Systems | QIKH.AU5040
DELTA ELECTRONICS INC | Static Inverters, Converters and Accessories for Use in Independent Power Systems | QIKH.E255963
EDS USA INC | Static Inverters, Converters and Accessories for Use in Independent Power Systems | QIKH.E353727
ELTEK AS | Static Inverters, Converters and Accessories for Use in Independent Power Systems | QIKH.E336452
GREEN POWER TECHNOLOGIES S L | Static Inverters, Converters and Accessories for Use in Independent Power Systems | QIKH.E336803
LG CHEMICAL LTD | Static Inverters, Converters and Accessories for Use in Independent Power Systems | QIKH.E359245
NEXTEK WEST INC | Static Inverters, Converters and Accessories for Use in Independent Power Systems | QIKH.E347706
SMA AMERICA PRODUCTION L L C | Static Inverters, Converters and Accessories for Use in Independent Power Systems | QIKH.E466978
SMA SOLAR TECHNOLOGY AG | Static Inverters, Converters and Accessories for Use in Independent Power Systems | QIKH.E210376
Page: 1 | 2
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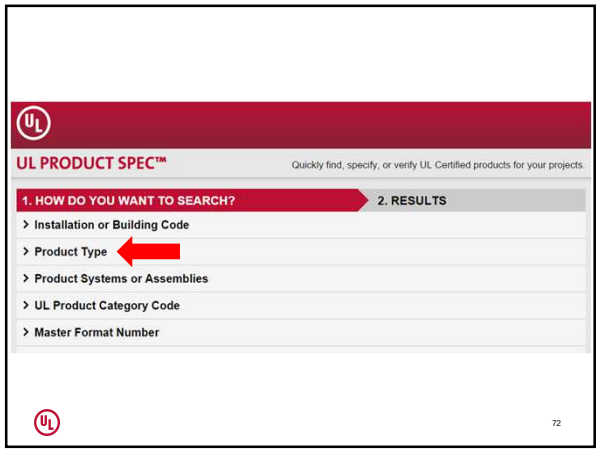
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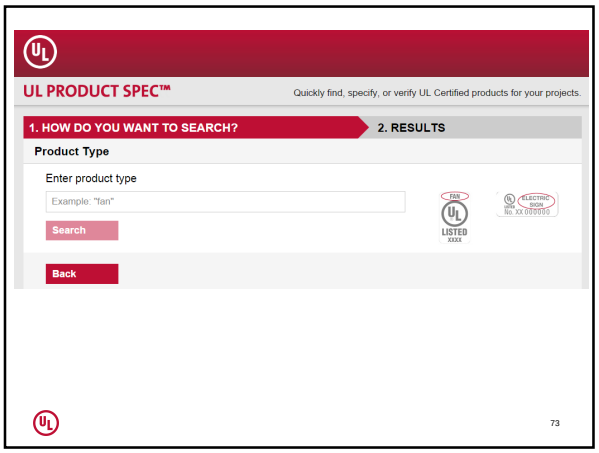
› Installation or Building Code
› Product Type
› Product Systems or Assemblies
› UL Product Category Code
› Master Format Number
72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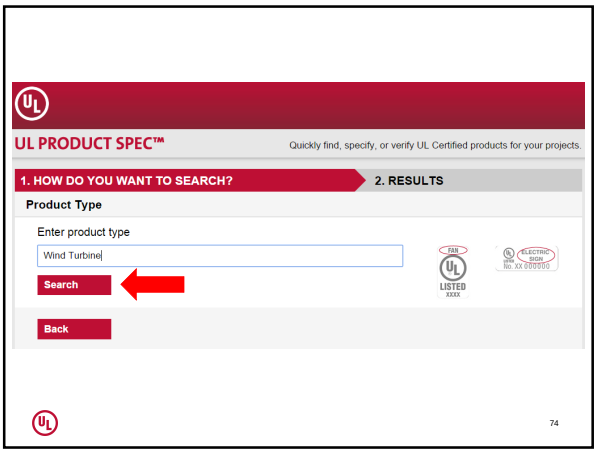
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Product Type
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Wind Turbine
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INSTALLATION CODE
UL PRODUCT CATEGORY & CODE
NEC 2014: 694.7(B) Batteries for Use in Light Electric Rail and Stationary Applications: BBFX
NEC 2014: 694.7(B) Circuit Breakers, Molded-case Circuit Breakers and Molded-case Switches for Use in Wind Turbines: DIXM
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NEC 2014: 694.7(B) Wind Turbine Safety-related Control System Equipment: ZGCP
NEC 2014: 694.7(B) Wind Turbine Drive-train Systems and Equipment: ZGDT
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NEC 2014: 694.7(B) Small Wind Turbine Generating Systems: ZGEN
NEC 2014: 694.7(B) Wind Turbine Inverters and Converters: ZGFA
NEC 2014: 694.7(B) Wind Turbine Tower Assemblies: ZGTA
NEC 2014: 694.7(B) Wind Turbine Generating System Subassemblies: ZGZJ
NEC 2014: 694.7(B) Wind Turbine Tray Cable: ZGZN
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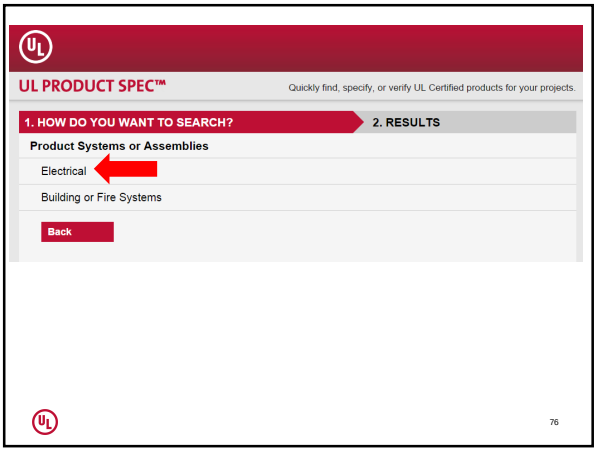
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Product Systems or Assemblies
Electrical
Building or Fire Systems
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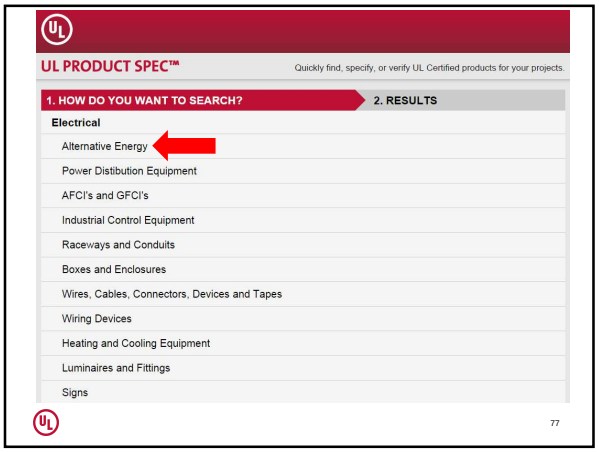
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2. RESULTS
Electrical
Alternative Energy
Power Distibution Equipment
AFCI's and GFCI's
Industrial Control Equipment
Raceways and Conduits
Boxes and Enclosures
Wires, Cables, Connectors, Devices and Tapes
Wiring Devices
Heating and Cooling Equipment
Luminaires and Fittings
Signs
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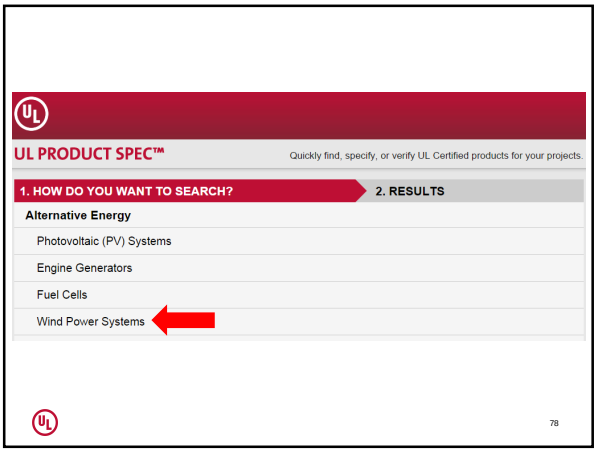
UL PRODUCT SPEC™
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1. HOW DO YOU WANT TO SEARCH?
2. RESULTS
Alternative Energy
Photovoltaic (PV) Systems
Engine Generators
Fuel Cells
Wind Power Systems
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Wind Power Systems

- Large Wind Turbine Generating Assemblies, Construction Only (ZGBP)
- Large Wind Turbine Generating Systems (ZGEA)
- Small Wind Turbine Generating Systems (ZGEN)
- Circuit Breakers, Molded-case Circuit Breakers and Molded-case Switches for Use in Wind Turbines (DIXM)
- Batteries for Use in Light Electric Rail an
- Installation of Lightning Protection Syste
- Lightning Protection Assemblies for Wind
- Wind Turbine Safety-related Control Sys
- Wind Turbine Drive-train Systems and E
- Wind Turbine Inverters and Converters (ZGFA)
- Wind Turbine Tower Assemblies (ZGTA)
- Wind Turbine Generating System Subassemblies (ZGZJ)
- Wind Turbine Tray Cable (ZGZN)

These are all links to the UL Product Information Certified Product Manufacturers

What do those UL labels mean?

UL Certification Services and Marks

Listing

Representative Product Samples are Tested and Evaluated to Nationally Recognized Safety Standards Regarding Fire, Electric Shock and Related Safety Hazards

Classification

Industrial, Commercial, or Other Products are Evaluated for Specific Hazards, Performance Under Specified Conditions, or Regulatory Codes

The Classification Mark does comply with the definition of Listed in the Codes.

Component Recognition

Products Incomplete in Construction or Restricted in Performance Capabilities

- Not intended for Field Installation
- Doesn't Comply With Code Definition of Listed

Field Evaluations

Evaluation for Products in The Field

1-877-UL-HELPS

(1-877-854-3577) Prompt #2

EVALUATED

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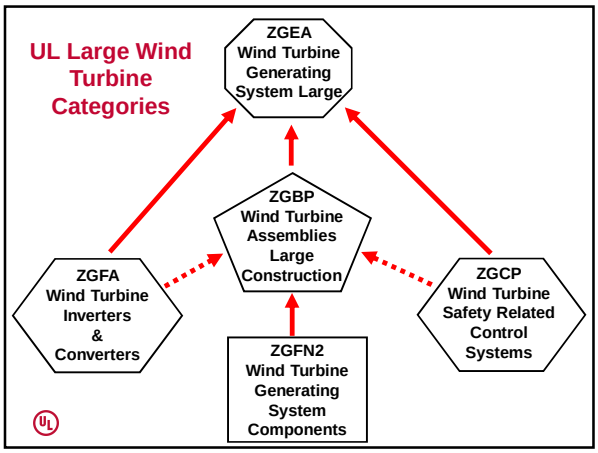
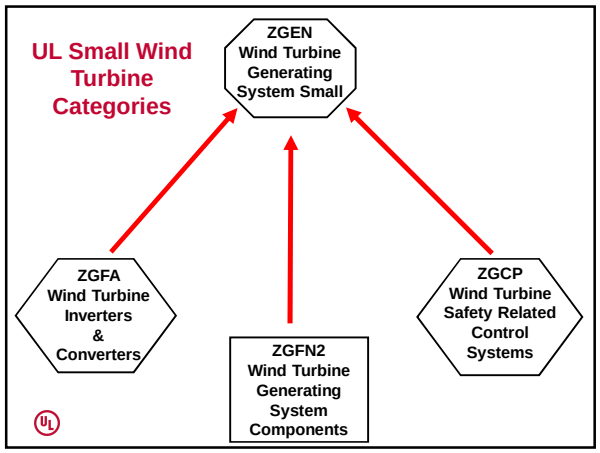
No. FE 00123456

This product has been evaluated in accordance with the procedures and limitations specified in the issued report

Contact UL 1.877.854.3577 #2 field@ul.com



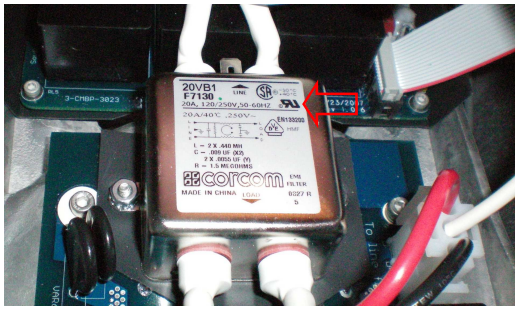


ZGFN2- Wind Turbine Generating System Components

Recognized Component

- Conditions of Acceptability specified in the individual Recognitions when these components are employed in the end-use equipment.
- UL Recognized Component Mark
- Common ZGFN2 products include: Wind turbine bus bar systems, drip loops, gear boxes, slip rings and other turbine components that do not fit within the constraints of traditional UL categories and standards.

Recognized Component



ZGFA - Wind Turbine Inverters and Converters

Listed Products for both large and small WTGS.

Permanently connected inverters and converters for both utility grid tied and stand alone applications.

Internal to or external from turbine.

Utility Grid Interconnection Options

- UL1741 and IEEE 1547 for distribution level
- Low voltage ride through LVRT for transmission level and wind farms
- Utility provided protection

ZGCP - Wind Turbine Safety Related Control Systems Equipment

The Safety Related Controls System, as defined in UL 6140, embodies the "Controls System."

Covers either large or small WTGS.

Evaluated to perform specific functions to maintain the overall system within the manufacturer's specified operational limits.

ZGEA - Large Wind Turbine Generating Systems

This category covers large wind turbine generating systems (WTGS) investigated for risk of fire and shock, including safety-related control system electrical performance and grid interconnection performance.

Large WTGS consist of various electrical hardware subassemblies and safety-related control systems constructed and interconnected in accordance with electrical safety requirements to create a complete wind turbine. These systems are typically assembled on-site in multiple sections.

ZGEN - Small Wind Turbine Generating Systems

This category covers small wind turbine generating systems investigated for risk of fire and shock, including safety-related control system electrical performance and utility (grid) interconnection performance for Utility Interactive models.

Small wind turbines are considered to be wind turbines where a user or service person cannot or is not intended to enter the turbine to operate it or perform maintenance.

ZGZN – Wind Turbine Tray Cable

Intended for use in accordance with NEC Article 336

Consists of

- One or more pairs of thermocouple extension wire or two or more insulated conductors,
- With or without one or more grounding conductors
- With or without one or more optical fiber members
- Covered with a nonmetallic jacket

Wind Turbine Tray Cable Ratings and Sizes

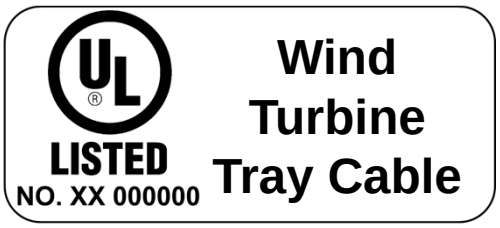
Rated 90 - 200°C dry and optionally rated 90°C wet, 1000 V

Conductor sizes

- 18 AWG to 1000 kcmil copper
- 12 AWG to 1000 kcmil aluminum or copper-clad aluminum
- Conductor sizes within a cable may be mixed
- Thermocouple extension conductors are Listed in sizes 24 to 12 AWG

Wind Turbine Tray Cable – UL Mark

On the attached tag, the reel, or the smallest unit container the cable is packaged, with or without the UL symbol on the product



Present and Future of UL Wind Certifications

Until manufacturers of these systems are found to comply with these new requirements, it may be some time before entire (ZGEA) Classified systems will be commercially available.

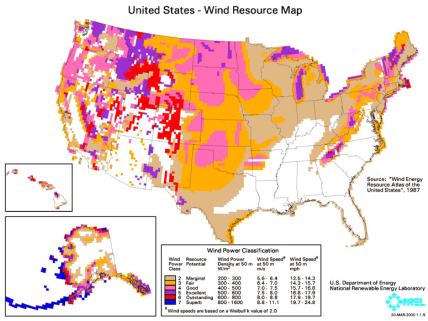
However, UL Field Evaluations are currently available to address fire and shock concerns, and determine proper functioning of basic safety controls.

Who is involved?

UL STPs (Standard Technical Panels) include:

- AHJs
- NFPA
- NREL (National Renewable Energy Laboratory)
- AWEA (American Wind Energy Association)
- GL (Germanischer Lloyd)
- SWCC (Small Wind Certification Council)
- Test labs
- Manufacturers
- Installers

Probable areas of installation



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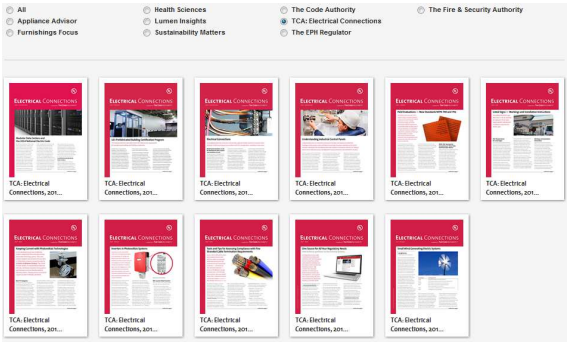

http://library.ul.com/?TCA_Electrical_Connections

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Thank You!

Any Questions?

Jeff Fecteau

(952) 838-5453

Jeffrey.Fecteau@ul.com