Electricity access
More than a promise: LVDC

Challenging the status quo

Over the last two decades three megatrends have created a groundswell of demand for low voltage direct current (LVDC):

1. Solar photovoltaics (PV) based power generation has become far more reasonably priced and is growing exponentially
2. LED lighting has taken the world by storm, making the conventional incandescent lamp a thing of the past
3. Perhaps most importantly: the renewed and urgent focus on energy efficiency and sustainability taking power generation increasingly away from fossil fuels

Today these trends, combined, challenge the traditional model of electricity distribution via alternating current (AC), and lead us to ask why we still carry on distributing electricity via AC when generation and consumption, both are increasingly direct current (DC).

This very question forms the basis for the work by a broad group of global experts in the International Electrotechnical Commission (IEC) which is currently preparing the technical foundation needed for the broad roll-out of LVDC.

Better and more efficient

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The world has started with LVDC and yet, today LVDC is considered to be a highly disruptive technology.

The applications for LVDC are wide and varied and apply in every country in the world. They range from residential and business buildings, to data centres, hospitals, retail, transportation, lighting, agriculture or fish farming. In fact, it is hard to find an application, where LVDC will not effectively replace AC in delivering electricity more efficiently to more people and businesses.

Last but not least, LVDC is also one of the most important technologies to enable broad energy access in the consistently developing economies.

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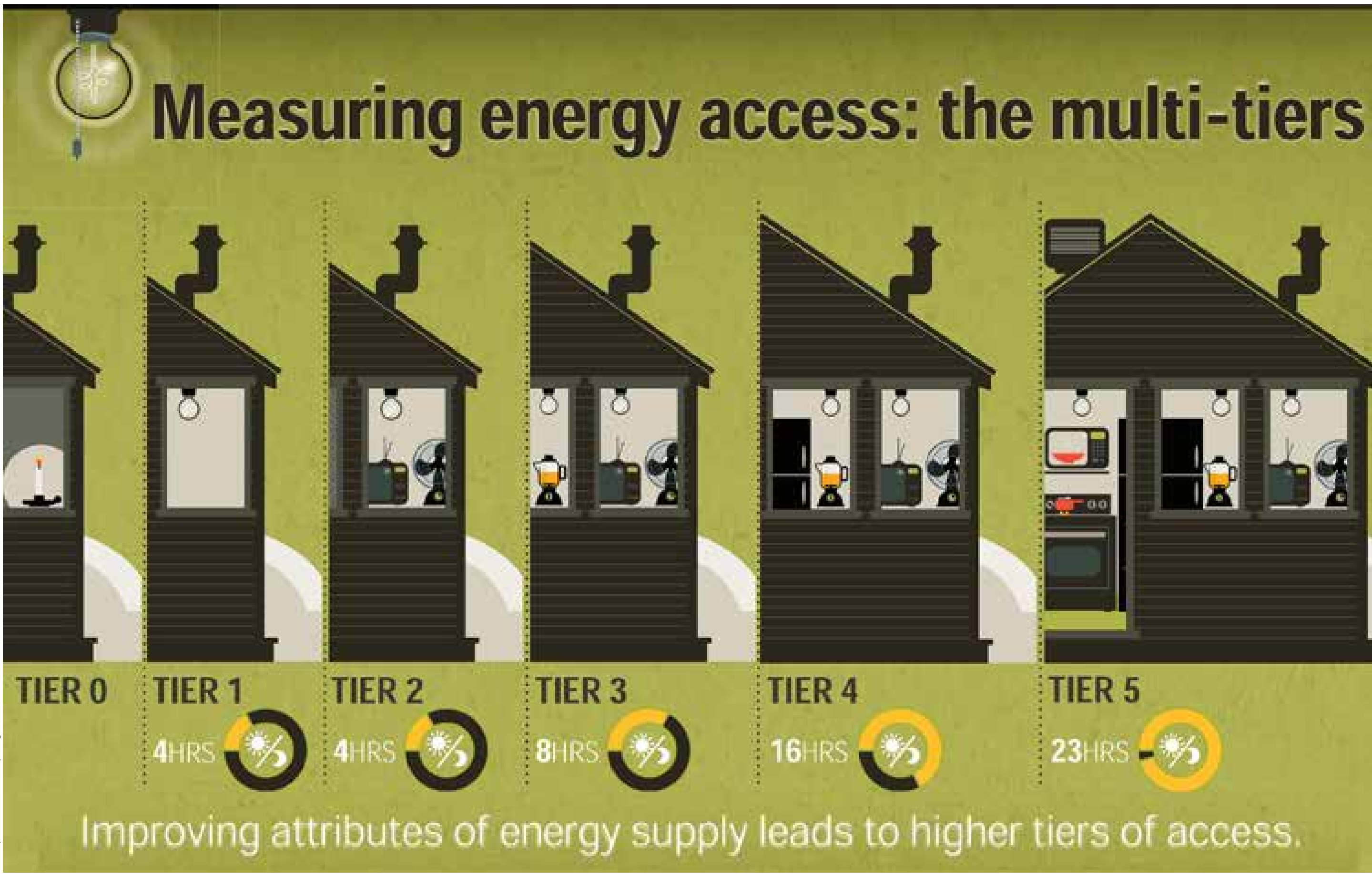
What is electricity access



@ https://www.esmap.org/node/55526

Over 1,2 billion people have no access to electricity. Electricity is a key driver of economies. The UN recognizes electricity access as a cornerstone for economic development, facilitating poverty and hunger reduction efforts, improving education and providing better quality healthcare.

But electricity is not an off-on promise. For electricity to truly impact people's lives and enable economic development it needs to be reliable and available in sufficient quantity when needed.

The World Bank has grouped electricity access into five classes.

The fact is: energy access should not be counted in the number of grid connections. A household which receives electricity only during two or three hours a day, at irregular intervals and with only enough to drive one or two devices is mostly left in the dark. Available quantity, quality, reliability, affordability, timeliness and legality of electricity are crucial factors that determine real energy access.

SUSTAINABLE ENERGY FOR ALL

Alliance for Rural Electrification
Shining a Light for Progress

IRENA
International Renewable Energy Agency

Achieving higher tier access

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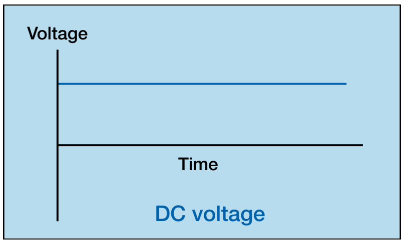
In an effort to go beyond theoretical connections, LVDC can help achieve progressively higher tiers of energy access. IEC work for LVDC provides the technical foundation for on-grid and off-grid energy generation, including mini-grids, and will promote solutions such as solar lanterns, solar home systems, LVDC appliances and more.

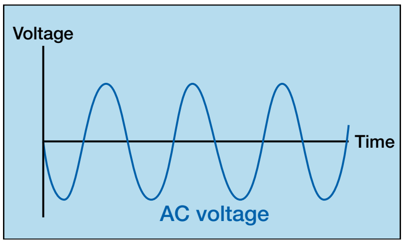
Most countries are committed to enable energy access to all by 2030. This means that many developing economies are now aiming to take their populations from one tier to the next level so as to reach tier 5 level access of their entire population by 2030.

IEC work is a key enabling factor for electricity access and 12 out of the 17 Sustainable Development Goals (SDGs).

What is LVDC

Direct current (DC) is constant and flows in one direction. In opposition, alternating current (AC) periodically reverses direction in a wave-like pattern. In the up-curve the current flows in a positive direction and in the down curve it moves in a negative direction.





Solar cells and other renewable power technologies, produce DC power. Batteries receive, store and deliver DC power. All electronics and battery driven devices use DC power, which today is often transformed from AC.

LVDC voltages: from 0 V up to 1 500 V

3,6 – 5 V	Mobile phone charging (USB)
9 V	Battery
12 V	Car battery, lighting, indoor farming
24 – 36 V	Electric scooters, electric bikes, high-power cordless tools, truck battery
48 V	Telecom power and power over Ethernet
400 V	Data centres, office buildings, hospitals, EV fast charging
Up to 1500 V	Urban railways

Why AC won

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Today, in most countries, electricity is delivered as alternating current (AC) in different voltages. The reason is historical. When power grids were built some 150 years ago, DC and AC were competing. Direct current electricity needed to be produced close to where it was consumed, at voltage levels which were the same as those used by lamps or household appliances. This limited the size of power plants. Additionally, at that time, DC required large and costly wires. AC won out because it was cheaper, more convenient and safer. It could be produced in much bigger power stations at the outskirts of cities and transported over long distances with less expensive cables at different voltages that were able to power different types of devices. But things have fundamentally changed since then.


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Why LVDC today

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We live in a DC world

Without realizing it, we are today living in a direct current world. Our electronic and battery driven devices all use DC: think multimedia, mobile phones, IT equipment, LED lighting, electric vehicles, and soon washing machines, fridges, fans and cooling systems.

Today, many of these devices are delivered with adapters which convert AC from the wall socket to DC, and in the conversion process energy is unnecessarily wasted.

From centralized to decentralized

Historically electricity was produced in large power plants and then transported through a network of high voltage overhead lines to substations, where it was converted to lower voltages and distributed to individual households and buildings. This traditional top-down approach is now challenged by the emergence of so-called distributed power generation.

With the proliferation of solar panels on roofs and the installation of small wind or micro-hydro turbines, electricity can now be generated very closely to where it is consumed. With DC power generation and storage, households or businesses can achieve autonomy from the public electricity grid. They can trade-in surplus power or buy additional electricity as needed.

Renewable energy

Solar, wind and water energy all yield DC electricity. Currently this electricity is converted to AC to be converted back to DC for use by DC driven devices, sometimes multiple times. Using renewable energy as DC electricity is more efficient and generates less e-waste in the form of transformers and power adaptors.

Overcoming technical hurdles

Many of the technical issues that blocked the development of DC grids are no longer an obstacle and in today's world DC offers significant benefits over AC in terms of energy efficiency and power quality. Efficient DC converters are now able to deliver the right voltage levels for individual devices.

The cost reduction in PV panels, the development of LED lighting, and the recent availability of low cost high performance batteries all encourage the rapid development of power installations in rural and peri-urban areas.

Sustainable and clean

In developing countries LVDC will encourage increased use of renewable energies in rural, off-grid energy generation. LVDC can be generated anywhere, even in remote and isolated locations like islands. The main drivers are energy efficiency, sustainability and energy access because often grid connection remains a hope for the far future.

Combined with some form of energy storage LVDC has the potential of bringing millions of people out of the dark. For areas where grid connection is too expensive, LVDC is the only economic way to provide electricity access to everyone: it is clean, safe and affordable.

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Standards for LVDC

The IEC is leading efforts to make LVDC technology safe for use in rural electrification but also in data centres, hospitals, office buildings and other areas where a lot of energy could be used directly without losses in energy conversion.

Technical work

While AC benefits from over 100 years of standardization work, DC is a relatively new kid on the block. That doesn't mean that standardization needs to start from scratch. Most AC Standards were developed in the IEC by over 30 technical committees. They are now being modified for DC use by adding provisions and updating requirements. These updated Standards provide guidelines that inform power quality, wiring rules and installations. They also explore how to reuse parts of existing AC installations for DC use.

The aim is to make DC at least as safe as AC currently is. Standards help protect users from electric shock, burns and other effects, and devices from electric discharges that would otherwise destroy their integrity. Additionally, DC Standards address power voltages and the detection of faults.

For the first time in 100 years, DC also offers the opportunity to fully standardize a new set of plugs and sockets with the promise to end the need for travel adaptors.

Guidance

The standardization of various aspects of LVDC will also provide a framework for benchmarking different LVDC installations in terms of key performance indicators, minimum performance levels and safety. This will provide important guidelines to funding agencies and regulators, allowing them to compare products and installations from different suppliers.

IEC LVDC International Standards also provide the technical foundation for manufacturers who wish to build safe DC products and guide installers of LVDC systems both in developed and developing countries. They facilitate the broad roll-out and application of LVDC technologies and accelerate commercialization. Last but not least standardization helps open up markets to fair competition which benefits the end consumer.

New economic opportunities

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LVDC is a disruptive technology that fundamentally changes and accelerates energy access. It is expected to provide opportunities for the growth of local economic activities, for example in the development and production of DC household appliances, including washing machines, fans, cooling systems, etc.

Get engaged

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Standardization work for LVDC is perhaps one of the biggest societal impact initiatives undertaken by the IEC. It requires a concerted effort by all stakeholders. We invite you to track developments and engage with the topic of LVDC and its standardization.

If you are interested in learning more about LVDC: join the LVDC discussion on LinkedIn go.iec.ch/lvdcin, visit www.iec.ch/lvdc or email us lvdc@iec.ch

Fact

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↗ Solar irrigation for farming

Overview of IEC work relevant to LVDC

International Standards, Technical Reports and Technical Specifications for components, systems and applications are central to LVDC; they are prepared by dozens of IEC technical committees and subcommittees (TC/SCs).

All inclusive Standards

More than 110 such publications directly relevant for LVDC are available currently, with dozens more being developed. In addition many more Standards apply not only to DC, but also to AC equipment and applications.

These publications cover the entire LVDC chain from components to complete systems, and include also tests and ratings of these. One must bear in mind that HVDC equipment and systems are also often relevant to LVDC.

They span energy generation (from renewable sources such as hydropower, solar or wind power), energy transmission and distribution (T&D) equipment and installations, and countless and expanding applications in domains, such as lighting, powering electronic, information and communication technology (ICT) equipment, transportation (rail and a growing number of electric vehicles).

Though listing all LVDC-related International Standards and other publications would be difficult and confusing, owing to their sheer number and to overlaps with applications in other areas, such as HVDC and AC, it is important to list the main (if not all) IEC TCs involved in standardization for LVDC-related domains, such as power generation, T&D, systems and applications. Individual SCs and working groups for these TCs are not listed here.

Electricity generation

International Standards for energy generated from renewable sources are developed by:

- → **IEC TC 4: Hydraulic turbines**, which prepares Standards and reports for hydraulic turbines and equipment associated with hydro-power development
- → **IEC TC 82: Solar photovoltaic (PV) energy systems**, which develops Standards for systems of PV conversion of solar energy into electrical energy, including for instance power converters and inverters
- → **IEC TC 88: Wind energy generation systems**, prepares Standards for all aspects of wind energy generation systems and their interaction with the electrical system(s) to which energy is supplied
- → Energy generation calls also on systems and equipment that rely on Standards from **IEC TC 2: Rotating machinery**

Transmission and Distribution

Once produced, electrical energy must be transmitted and distributed. International Standards for equipment and systems necessary for T&D (many apply to AC as well) are prepared by the following IEC TCs and their SCs, among others:

- → **IEC TC 7: Overhead electrical conductors**, these include types of overhead ground wires, hardware directly connected to conductors for the purpose of maintaining electrical/ mechanical continuity
- → **IEC TC 8: Systems aspects for electrical energy supply**, supply systems include T&D networks and connected user installations with their network interfaces
- → **IEC TC 11: Overhead lines**, above 1 kV AC and 1,5 kV DC nominal voltage, excluding railway traction supports and line materials
- → **IEC TC 14: Power transformers**
- → **IEC TC 20: Electric cables**, prepares Standards for the design, testing and end-use recommendations (including current ratings) for insulated electrical power and control cables, their accessories and cable systems, for use in wiring and in power generation, T&D and end-use
- → **IEC TC 21: Secondary cells and batteries**, and its SCs prepare Standards for secondary (rechargeable) batteries. These are essential to store energy when used directly
- → **IEC TC 22: Power electronic systems and equipment**, prepares Standards regarding systems, equipment and their components for electronic power conversion and electronic power switching. This includes, for instance, direct DC converters
- → **IEC TC 23: Electrical accessories**, e.g. circuit-breakers for AC and DC operation (IEC SC 23E: Circuit-breakers and similar equipment for household use)
- → **IEC TC 32: Fuses**
- → **IEC TC 112: Evaluation and qualification of electrical insulating materials and systems**
- → **IEC TC 121: Switchgear and controlgear and their assemblies for low voltage**

Applications

Beyond energy generation, transmission and distribution, and storage, LVDC applications rely also on IEC International Standards developed by the same or other IEC TCs.

They cover many domains including lighting, small household appliances and ICT equipment.

Access for all

One of the most interesting and useful benefits of LVDC is to provide access to electricity to the hundreds of millions in the world not connected to grids. Large-scale grids relying on centralized generation and distribution can be difficult/impossible to install because of costs, technical and political obstacles.

On the other hand small-scale off-grid installations based on renewable sources, such as solar PV, can give large numbers of people access to services/technologies, such as lighting, that improve many aspects of their lives.

For more than 15 years, IEC TC 82 has been developing publications that set out recommendations aimed at guiding the introduction and use of renewable energy (solar PV) in rural decentralized electrification. It has issued 18 publications in the IEC 62257 series for small renewable energy and hybrid systems for rural electrification. This series, available at a discounted price in a joint initiative with the World Bank Group and the United Nations Foundation, includes, among other things, general requirements for the design, erection and operation of microgrids and micropower plants; recommendations for small renewable energy and hybrid systems; and the selection of components.

One of the most important benefits of off-grid small-scale electrification is to give access to lighting.

LED-based lighting using LVDC (for either LED lamps or small LED lanterns) in homes and dwellings, allows children and young people to read and study at home, small businesses to work and remain open longer, and improves individual safety.

LED technology can provide light at a fraction of the cost of running kerosene lamps, without any of the health, safety or environmental dangers – or the need for major investment in infrastructure.

An additional very significant benefit is avoiding the use of kerosene for lighting as it presents major health risks, and is reported to lead to the death of 1,5 million people every year.

- **IEC TC 34: Lamps and related equipment** and its SCs develop International Standards for lamps and their auxiliaries.

As for other applications in countries where access is provided by LVDC systems:

- **IEC TC 59** and **IEC TC 61**, prepare, respectively, Standards for the performance and safety of household and similar appliances.
- **IEC TC 9: Electrical equipment and systems for railways**, develops also Standards for railway equipment that relies on DC.

Other IEC TCs prepares Standards that are relevant to LVDC-related equipment across several domains, such as electromagnetic compatibility (EMC) or certain safety aspects.

All this shows that International Standards developed by a myriad of IEC TCs and their SCs is central to the operation of LVDC equipment.

@ Bruno Déméocq, Lighting Africa

Overview of IEC International Standards relevant to LVDC

IEC Standard	Description
IEC 60034-1	Rotating electrical machines (motors) - Part 1: Rating and performance
IEC 60038	IEC standard voltages
IEC 60050-112	International Electrotechnical Vocabulary - Part 112: Quantities and units
IEC 60050-614	International electrotechnical vocabulary - Part 614: Generation, transmission and distribution of electricity - Operation
IEC 60050-826	International Electrotechnical Vocabulary - Part 826: Electrical installations
IEC 60071-5	Insulation coordination - Part 5: Procedures for high-voltage direct current (HVDC) converter stations
IEC TR 60269-5	Low-voltage fuses - Part 5: Guidance for the application of low-voltage fuses
IEC 60269-6	Low-voltage fuses - Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems
IEC 60308	Hydraulic turbines - Testing of control systems
IEC 60364 series	Low-voltage electrical installations
IEC 60375	Conventions concerning electric and magnetic circuits
IEC 60432-3	Incandescent lamps - Safety specifications - Part 3: Tungsten halogen lamps (non-vehicle)
IEC 60479 series	Effects of current on human beings and livestock
IEC 60598 series	Luminaires
IEC 60664 series	Insulation coordination for equipment within low-voltage systems
IEC 60809	Lamps for road vehicles - Dimensional, electrical and luminous requirements
IEC 60810	Lamps for road vehicles - Performance requirements
IEC TS 60815-4	Selection and dimensioning of high-voltage insulators intended for use in polluted conditions - Part 4: Insulators for d.c. systems
IEC 60850	Railway applications - Supply voltages of traction systems
IEC 60891	Photovoltaic devices - Procedures for temperature and irradiance corrections to measured I-V characteristics
IEC 60898 series	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations
IEC 60904 series	Photovoltaic devices
IEC 60947-2	Low-voltage switchgear and controlgear - Part 2: Circuit-breakers
IEC 60947-3	Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units
IEC 61008 series	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs)
IEC 61009 series	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)
IEC 61140	Protection against electric shock - Common aspects for installation and equipment
IEC 61180	High-voltage test techniques for low-voltage equipment - Definitions, test and procedure requirements, test equipment

@ http://www.smainverted.com/farm-from-a-box-offers-rural-communities-local-food-production/

IEC Standard	Description
IEC 61215 series	Terrestrial photovoltaic (PV) modules - Design qualification and type approval
IEC TS 61245	Artificial pollution tests on high-voltage ceramic and glass insulators to be used on d.c. systems
IEC 61345	UV test for photovoltaic (PV) modules
IEC 61347 series	Lamp controlgear
IEC 61362	Guide to specification of hydraulic turbine governing systems
IEC 61378-2	Convertor transformers - Part 2: Transformers for HVDC applications
IEC 61378-3	Converter transformers - Part 3: Application guide
IEC 61643-31	Low-voltage surge protective devices - Part 31: Requirements and test methods for SPDs for photovoltaic installations
IEC 61643-311	Components for low-voltage surge protective devices - Part 311: Performance requirements and test circuits for gas discharge tubes (GDT)
IEC 61643-312	Components for low-voltage surge protective devices - Part 312: Selection and application principles for gas discharge tubes
IEC 61643-32	Low-voltage surge protective devices - Part 32: Surge protective devices connected to the DC side of photovoltaic installations - Selection and application principles
IEC 61643-321	Components for low-voltage surge protective devices - Part 321: Specifications for avalanche breakdown diode (ABD)
IEC 61643-331	Components for low-voltage surge protective devices - Part 331: Specification for metal oxide varistors (MOV)
IEC 61660 series	Short-circuit currents in d.c. auxiliary installations in power plants and substations
IEC 61683	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency
IEC 61701	Salt mist corrosion testing of photovoltaic (PV) modules
IEC 61724 series	Photovoltaic system performance
IEC 61725	Analytical expression for daily solar profiles
IEC 61727	Photovoltaic (PV) systems - Characteristics of the utility interface
IEC 61730 series	Photovoltaic (PV) module safety qualification
IEC 61829	Photovoltaic (PV) array - On-site measurement of current-voltage characteristics
IEC TS 61836	Solar photovoltaic energy systems - Terms, definitions and symbols
IEC 61850 series	Communication networks and systems for power utility automation
IEC TS 61851-3 series	Electric vehicles conductive power supply system *
IEC 61851-23	Electric vehicle conductive charging system - Part 23: DC electric vehicle charging station
IEC 61853 series	Photovoltaic (PV) module performance testing and energy rating
IEC 61858 series	Electrical insulation systems - Thermal evaluation of modifications to an established electrical insulation system (EIS)
IEC 61869-6	Instrument transformers - Part 6: Additional general requirements for low-power instrument transformers
IEC 61869-9	Instrument transformers - Part 9: Digital interface for instrument transformers
IEC 61869-14	Instrument transformers - Part 14: Additional requirements for current transformers for DC applications
IEC 61869-15	Instrument transformers - Part 15: Additional requirements for voltage transformers for DC applications
IEC 61992 series	Railway applications - Fixed installations - DC switchgear
IEC 62031	LED modules for general lighting - Safety specifications
IEC 62040-5-1	Uninterruptible power systems (UPS) - Part 5-1: DC output UPS - Safety requirements *

* To be published

IEC Standard	Description
IEC 62040-5-3	Uninterruptible power systems (UPS) - Part 5-3: DC output UPS - Performance and test requirements
IEC 62053-41	Electricity metering equipment (DC direct current) - Particular requirements - Part 41 - Static meter for active energy (class 0,5 and 1) *
IEC 62093	Balance-of-system components for photovoltaic systems - Design qualification natural environments
IEC 62108	Concentrator photovoltaic (CPV) modules and assemblies - Design qualification and type approval
IEC 62109 series	Safety of power converters for use in photovoltaic power systems
IEC PAS 62111	Specifications for the use of renewable energies in rural decentralised electrification
IEC 62115	Electric toys - Safety
IEC 62116	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures
IEC 62124	Photovoltaic (PV) stand alone systems - Design verification
IEC 62128 series	Railway applications - Fixed installations - Electrical safety, earthing and the return circuit
IEC 62196-1	Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 1: General requirements
IEC 62196-3	Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 3: Dimensional compatibility and interchangeability requirements for d.c. and a.c./d.c. pin and contact-tube vehicle couplers
IEC 62253	Photovoltaic pumping systems - Design qualification and performance measurements
IEC TS 62257 series	Recommendations for renewable energy and hybrid systems for rural electrification
IEC 62446-1	Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance - Part 1: Grid connected systems - Documentation, commissioning tests and inspection
IEC 62509	Battery charge controllers for photovoltaic systems - Performance and functioning
IEC 62548	Photovoltaic (PV) arrays - Design requirements
IEC 62589	Railway applications - Fixed installations - Harmonisation of the rated values for converter groups and tests on converter groups
IEC 62590	Railway applications - Fixed installations - Electronic power converters for substations
IEC 62619	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications
IEC 62620	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for use in industrial applications
IEC 62670 series	Photovoltaic concentrators (CPV) - Performance testing
IEC 62680 series	Universal serial bus interfaces for data and power
IEC 62716	Photovoltaic (PV) modules - Ammonia corrosion testing
IEC TS 62727	Photovoltaic systems - Specification for solar trackers
IEC TS 62735 series	Direct current (DC) plugs and socket-outlets for information and communication technology (ICT) equipment installed in data centres and telecom central offices
IEC 62759-1	Photovoltaic (PV) modules - Transportation testing - Part 1: Transportation and shipping of module package units
IEC 62772	Composite hollow core station post insulators for substations with a.c. voltage greater than 1 000 V and d.c. voltage greater than 1 500 V - Definitions, test methods and acceptance criteria
IEC TS 62782	Photovoltaic (PV) modules - Cyclic (dynamic) mechanical load testing
IEC 62788 series	Measurement procedures for materials used in photovoltaic modules
IEC TS 62789	Photovoltaic concentrator cell documentation

IEC Standard	Description
IEC 62790	Junction boxes for photovoltaic modules - Safety requirements and tests
IEC TS 62804-1	Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation - Part 1: Crystalline silicon
IEC 62817	Photovoltaic systems - Design qualification of solar trackers
IEC 62848-1	Railway applications - DC surge arresters and voltage limiting devices - Part 1: Metal-oxide surge arresters without gaps
IEC 62852	Connectors for DC-application in photovoltaic systems - Safety requirements and tests
IEC 62894	Photovoltaic inverters - Data sheet and name plate
IEC 62895	High voltage direct current (HVDC) power transmission - Cables with extruded insulation and their accessories for rated voltages up to 320 kV for land applications - Test methods and requirements
IEC TS 62896	Hybrid insulators for a.c. and d.c. for high-voltage applications - Definitions, test methods and acceptance criteria
IEC TS 62910	Utility-interconnected photovoltaic inverters - Test procedure for low voltage ride-through measurements
IEC 62924	Railway applications - Fixed installations - Stationary energy storage system for DC traction systems
IEC 62925	Concentrator photovoltaic (CPV) modules - Thermal cycling test to differentiate increased thermal fatigue durability
IEC TS 62941	Terrestrial photovoltaic (PV) modules - Guideline for increased confidence in PV module design qualification and type approval
IEC 63002	Identification and communication interoperability method for external power supplies used with portable computing devices
IEC TS 63066	Low-voltage docking connectors for removable energy storage units

About the IEC

The IEC, headquartered in Geneva, Switzerland, is the world's leading publisher of International Standards for electrical and electronic technologies. It is a global, independent, not-for-profit, membership organization (funded by membership fees and sales). The IEC includes 171 countries that represent 99% of world population and energy generation.

The IEC provides a worldwide, neutral and independent platform where 20 000 experts from the private and public sectors cooperate to develop state-of-the-art, globally relevant IEC International Standards. These form the basis for testing and certification, and support economic development, protecting people and the environment.

IEC work impacts around 20% of global trade (in value) and looks at aspects such as safety, interoperability, performance and other essential requirements for a vast range of technology areas, including energy, manufacturing, transportation, healthcare, homes, buildings or cities.

The IEC administers four Conformity Assessment Systems and provides a standardized approach to the testing and certification of components, products, systems, as well as the competence of persons.

IEC work is essential for safety, quality and risk management. It helps make cities smarter, supports universal energy access and improves energy efficiency of devices and systems. It allows industry to consistently build better products, helps governments ensure long-term viability of infrastructure investments and reassures investors and insurers.

A global network of 171 countries that covers 99% of world population and electricity generation

Offers an Affiliate Country Programme to encourage developing countries to participate in IEC work free of charge

Develops International Standards and runs four Conformity Assessment Systems to verify that electronic and electrical products work safely and as they are intended to

IEC International Standards represent a global consensus of state-of-the-art know-how and expertise

A not-for-profit organization enabling global trade and universal electricity access

Key figures

171
Members and Affiliates

>200
Technical Committees and Subcommittees

20 000
Experts from industry, test and research labs, government, academia and consumer groups

>10 000
International Standards in catalogue

4
Global Conformity Assessment Systems

>1 million
Conformity Assessment Certificates issued

>100
Years of expertise

Further information

Please visit the IEC website at www.iec.ch for further information. In the "About the IEC" section, you can contact your local IEC National Committee directly. Alternatively, please contact the IEC Central Office in Geneva, Switzerland or the nearest IEC Regional Centre.

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