



High **PERFORMANCE**

How standards can optimize electrotechnical
manufacturing potential

Introduction

With multiplying sources of electromagnetic radiation, equipment must be designed to operate in so-called 'noisy' environments as well as prevent disturbance in other devices.

Electromagnetic compatibility (EMC) testing, is therefore very important for manufacturers, and standards provide vital guidelines for these processes.

Further to this, consumers are increasingly concerned with a product's energy efficiency, and today's manufacturers must consider how a device performs in all of its operating modes – including 'standby' and 'off', as well as to satisfy design directives. This is another area in which standards use pays dividends.

Finally, this report looks ahead to future opportunities in terms of both technological advances and growing markets. BSI has been working to facilitate standards developments in emergent areas like the Internet of Things (IoT), digital manufacturing and electric vehicles (EVs) ●



Electromagnetic compatibility and testing

With ever more sources of electromagnetic radiation, equipment must be designed to operate in noisy environments. It's also important that devices don't cause disturbance in other equipment.

The discipline of controlling emissions of, and immunity to, electromagnetic disturbances is known as EMC. Inadequate EMC can result in errors and the incorrect operation of electronic devices, and safety systems, which could lead to increased health and safety risk.

The EMC and safety divisions within an organisation tend to use different skills and methods, and often operate independently. Important issues of EMC-related functional safety may be overlooked and not be correctly addressed. Standards can help manufacturers ensure that their products will operate safely and effectively in the real world.

The best approach is to consider potential electromagnetic interference (EMI) from the very beginning of the design process, as unforeseen problems can be difficult and expensive to resolve once manufacture is underway. Standards can help electrical manufacturers introduce the right testing procedures to ensure their products operate safely and effectively, maintaining full EMC.

The BS EN 61000 series of standards provides a comprehensive set of guidelines and specifications for manufacturers around EMC. The first standard in the family [BS EN 61000-1-2](#) establishes a methodology for functional EMC safety in electrical and electronic systems.

The series continues with over 50 standards for different applications and scenarios. For example, [BS EN 61000-6-3](#) provides generic emissions standards limits for the protection of radio services in residential, commercial and light-industrial environments, while [BS EN 61000-6-4](#) deals with industrial settings.

[BS EN 61000-3-3](#) is concerned with limiting voltage fluctuations and flicker impressed on any public low-voltage systems, while [BS EN 61000-4-11](#) deals with immunity tests for voltage dips, variation and short interruptions.

Other standards in the BS EN 61000 series help electrical manufacturers test in relation to surge, fast transient, electrostatic discharge and burst immunity, different environmental requirements and conducted disturbances.

[BS EN 55011](#) relates to industrial, scientific and medical (ISM) electrical equipment, specifying limits and methods of measurement of radio-

frequency disturbance characteristics. When protecting sound and television broadcast receivers, and associated multimedia equipment, manufacturers can consult [BS EN 55035](#) for immunity characteristics, limits and methods of measurement.

[BS EN 55014-1](#) and [BS EN 55015](#) specify requirements for manufacturers when testing household appliances, tools and lighting equipment to help ensure these items don't cause interference to radio reception.

Manufacturers also have a responsibility to consider the harmonic currents introduced into any low-voltage mains electricity supply systems by the equipment they design and manufacture. [BS EN IEC 61000-3-2](#) specifies limits for harmonic components of input current which can be produced by equipment tested under specified conditions ●

EMC testing essentials

EMC testing includes checks for emissions and susceptibility testing. Most standards refer to tests conducted in open-area test sites (OATS).

These sites are useful for the emissions testing of large equipment systems. Testing a physical prototype is usually carried out indoors, in a specialised EMC test chamber. It's also possible to use digital simulations to test models.

The test equipment, environment and any software used must be suitable, and properly calibrated and maintained. Usually a schedule of EMC testing is produced in advance, with the results documented in a subsequent report.

Emissions are typically measured for radiated field strength, with antennas used to detect emissions from all directions. A spectrum analyzer is often used to measure cross-frequency emission levels. An oscilloscope may be used to visualize and characterize pulse emission waveforms.

For radiated field susceptibility testing, a high-powered radio frequency (RF) signal is directed at the device under test (DUT). Conducted voltage and current susceptibility testing, however, may require the use of a high-powered signal generator and a current clamp to inject the signal.



Power considerations in appliance design

Consumers have long expected household appliances to be safe and reliable. Today's manufacturers must also survive market scrutiny when it comes to a product's energy efficiency.

Power consumption during every operating state must be considered in appliance design. For example, the way a device consumes energy in its 'standby' and 'off' modes. Thankfully there are many standards which producers can use to ensure their devices perform properly. For example, [BS EN 50564](#) covers the measurement of lower power operational states for electrical and electronic household and office equipment.

The EU Ecodesign Directive (Directive 2009/125/EC) requires producers to consider energy reduction and environmental impact at the product design stage. It also covers other environmental considerations such as materials and water use, emissions, waste and recycling. Non-compliant products can't be sold in the EU.

There are [several standards](#) which manufacturers can use to make sure their products comply with the directive. BS EN ISO 14006 provides guidelines for incorporating Ecodesign requirements, while the BS 8887 series of standards informs design for manufacture, assembly, disassembly and end-of-life processing (MADE).

In addition, BS EN 62430 gives requirements for environmentally conscious design for electrical and electronic products, while [PD CLC/TR 50674](#) provides guidelines for the verification of household appliances under Ecodesign and energy labelling directives.

Incorporating best practice from standards during product design helps manufacturers define safety and power consumption parameters, as well as assisting with legislative compliance.

Safety is also an ongoing consideration for manufacturers, given that every electrical appliance poses some level of risk to users. There is a well-developed family of standards with precisely this focus - the [BS EN 60335](#) series. This group includes over 100 different standards outlining design safety requirements for everything from coffee grinders to household irons.

A central piece of manufacturing safety legislation is the Low Voltage Directive (LVD 2014/35/EU), which outlines essential requirements for electrical equipment with an operating voltage of 50-1000V for alternating current, and 75-1500V for direct current. The directive applies to all electrical product manufacturers who intend to sell their products in Europe, with satisfactory items earning the right to use the CE Mark.

Harmonized standards and specifications should ideally be regarded as a minimum when it comes to product design for intended use. Beyond this is the issue of foreseeable use (or misuse), particularly by vulnerable groups such as children, the elderly and disabled.

Standards can help manufacturers address foreseeable use possibilities at the product design and risk assessment stages, as well as encourage a culture of continual improvement to go beyond minimum safety levels.

A crucial element for every appliance or device is the plug. The BS 1363 series gives requirements for plug and socket safety, construction, electrical and mechanical testing, dimensional accuracy and markings.

All BS 1363 plugs contain a fuse, and [BS 1362](#) provides the specification for plug fuse links. The series ensures that plugs, sockets and adaptors in use in the UK and overseas, regardless of manufacturer, will function correctly, safely and reliably.

For alternative plug and socket systems manufacturers can also use [BS EN 60309-2](#) and [IEC 60309-2](#) to understand dimensional interchangeability requirements for pin and contact-tube accessories.

For couplers and connectors from the power supply to the appliance the [BS EN 60320](#) series of standards specifies non-locking appliance and interconnection couplers for power supply cords. The series provides specifications for varying connector types as well as different combinations of current, temperature and earthing requirements.

When it comes to measuring and testing appliance performance and conformance, manufacturers can call upon over 40 several specific standards, depending on the nature of the product.

For example, BS EN 60704 is a multi-part standard which provides test codes for household appliances to determine airborne acoustical noise, while [PD IEC/TS 62950](#) sets out a reference framework for testing smart device capabilities and operating modes ●



Standards and opportunity: connected manufacturing, IoT and electric vehicles

The medium and long-term future presents electronics manufacturers with opportunities from technological advances and growing market areas. BSI has been working to facilitate standards developments in emergent areas like the Internet of Things (IoT), digital manufacturing and electric vehicles (EVs).

Digital manufacturing will impact all sectors and supply chains, largely powered by IoT connectivity. In terms of electrical and electronics manufacturing, it will influence the design, process, production, infrastructure, safety, connection and power supply areas.

BSI's [IoT community](#) is focused on shaping new opportunities and best practice, as well as increasing confidence and trust to benefit the wider market. The community connects IoT buyers and suppliers across multiple industries and applications.

We've also invested in the capability to provide independent verification of security and interoperability for connected devices, through a purpose-built IoT laboratory.

Discussions around the growth of digital manufacturing across electrical appliance supply chains range from simply automating parts and inventory replenishment from suppliers, through to a fully automated and digitized factory, and beyond to managing product use.

Digital manufacturing offers companies more personalised, customised products and improved process efficiencies. It also promises to optimize inventory management, logistics and productivity.

BSI is working with key partners to develop [standards and recommendations](#) to help manufacturers operate in a more connected and digital manner, while overcoming barriers to adoption.

Important issues include the interoperability of machines and data, determining the type and format of shared information, as well as the greater adoption of data-centric business models to inform decision-making. Standards will aid electrical device design in an ever-more connected and collaborative environment - as well as support improved IP governance and security.

Finally, the increasing presence of IoT technology in manufacturing scenarios has led to the development of international standards around compatibility requirements and models for devices within industrial IoT systems (ISO/IEC TR 30166 ED1 and ISO/IEC 30162 ED1) ●



Standards and EVs

Manufacturers of EVs and their components can use standards to ensure they reach expected quality, safety and efficiency levels - regardless of their position on the supply chain.

There are many standards that manufacturers can use to inform EV design and aid legislative compliance. For example, ISO 6469 is a wide-ranging standard, over three parts, which provides:

1. Safety specifications for rechargeable energy storage systems for EVs.
2. Functional and operational safety means.
3. Specific protection against electrical hazards.

It's vital that systems and components involved in EV charging are safe and efficient. [BS EN IEC 61851-1](#) outlines general requirements for EV conductive charging systems. The standard covers characteristics, specifications and safety requirements for the power supply, and the connection between this charging equipment and the vehicle.

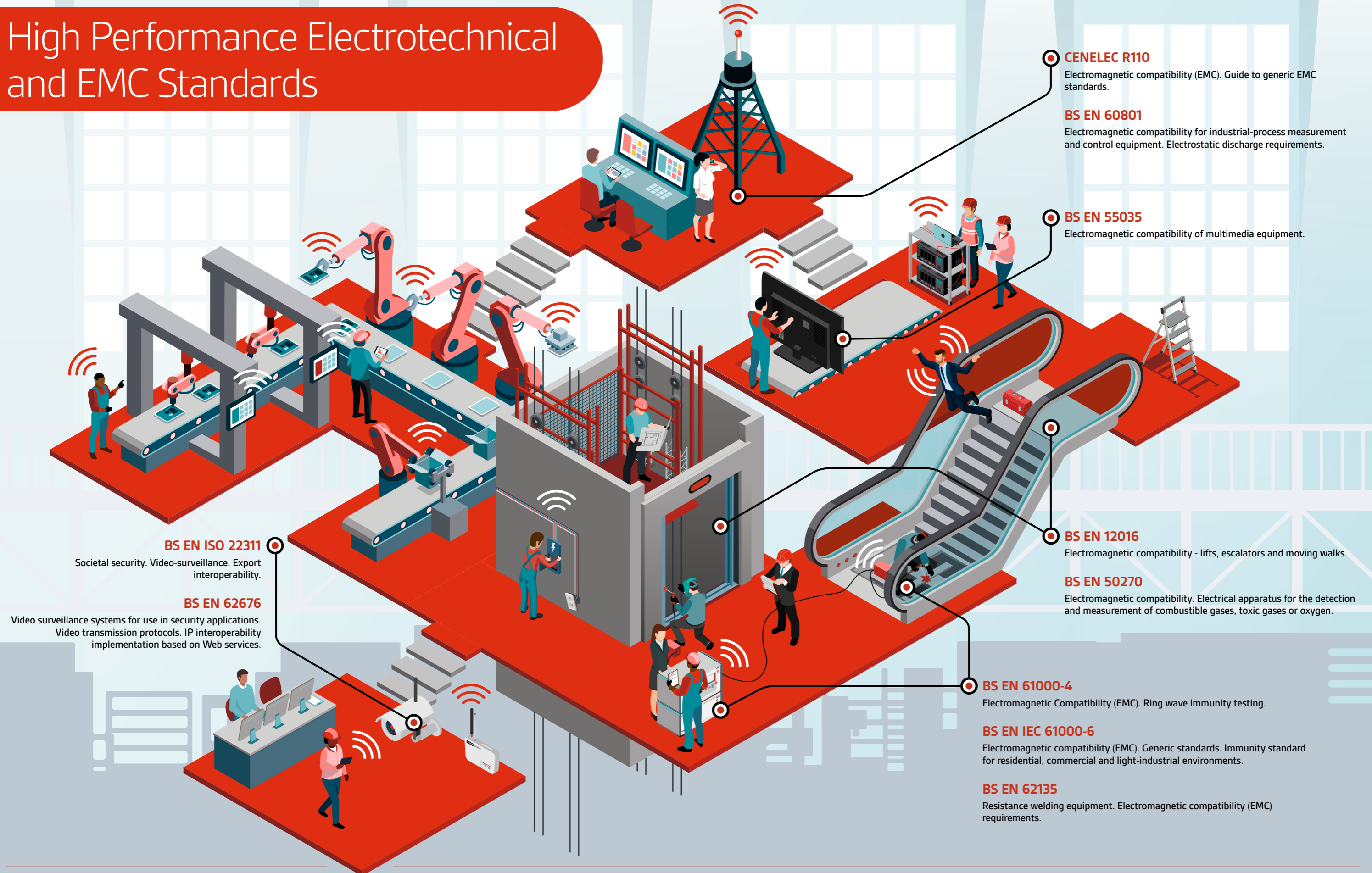
[DD CLC/TS 50457-2](#), meanwhile, provides a communication protocol between the off-board charger and EV in conductive charging situations. [IEC TS 61980-2](#) gives requirements around the communication between vehicle and wireless power transfer (WPT) systems connected to the supply network.

Another fundamental standard for manufacturers in this area is [BS EN 62196-2](#), which provides requirements for plugs, socket-outlets, vehicle connectors and vehicle inlets in terms of dimensional compatibility and interchangeability requirements for pin and contact-tube accessories.

Once a satisfactory connection can be achieved, the vehicle must communicate with the power grid. [BS EN ISO 15118-3](#) provides requirements for a physical vehicle-to-grid communication interface, as well as data link requirements and basic signalling. Similarly, [BS EN ISO 15118-8](#) offers requirements for wireless communication interfaces.

There are also standards around battery swapping scenarios – when a discharged battery is replaced with a full one to avoid charging delays. [IEC TS 62840-1](#) provides manufacturers with overarching guidance on such systems, while [BS EN IEC 62840-2](#) outlines specific safety requirements.

High Performance Electrotechnical and EMC Standards



CENELEC R110

Electromagnetic compatibility (EMC). Guide to generic EMC standards.

BS EN 60801

Electromagnetic compatibility for industrial-process measurement and control equipment. Electrostatic discharge requirements.

BS EN 55035

Electromagnetic compatibility of multimedia equipment.

BS EN 12016

Electromagnetic compatibility - lifts, escalators and moving walks.

BS EN 50270

Electromagnetic compatibility. Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen.

BS EN 61000-4

Electromagnetic Compatibility (EMC). Ring wave immunity testing.

BS EN IEC 61000-6

Electromagnetic compatibility (EMC). Generic standards. Immunity standard for residential, commercial and light-industrial environments.

BS EN 62135

Resistance welding equipment. Electromagnetic compatibility (EMC) requirements.

BS EN ISO 22311

Societal security. Video-surveillance. Export interoperability.

BS EN 62676

Video surveillance systems for use in security applications. Video transmission protocols. IP interoperability implementation based on Web services.



The reassuringly easy way to work with standards

BSOL is a simple online tool that gives you instant access to the standards you need, making life a lot easier. It's easy to build your own database of relevant standards. Then you can find what you need fast and stay right up to date – so you can avoid costly errors and work with confidence.

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