



British Standards for Welding

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Welding

BSI welding standards cover specifications, procedures and tests for use by welders, quality controllers and manufacturers.

The safety, reliability and cost effectiveness of welded products requires the welds to be of adequate quality. Failing to control welding correctly can result, in the worst case scenario, catastrophic failure and loss of life, and at the least, delays, related costs and contractual issues.

Welding is one of the most regulated occupations in the world and welders are subject to a strict regime of testing and re-testing in accordance with British, European and/or international standards. A reasonable assurance of competence of welders, together with ensuring a 'best practice' system for quality control, is achieved by adopting appropriate standards and ensuring welders are qualified, trained and tested appropriately.

Welding standards can help qualify welding procedures, monitor production/site activities, as well as regulate the personnel for welding coordination and supervision.

BSI publishes standards, guidelines and specifications to help companies meet welding requirements. These publications cover a wide range of welding disciplines and areas including welder qualification and procedures, welding equipment, consumables, Non-Destructive Testing (NDT) and much more.

The following are the most common industries using welding standards:

- Oil & Gas
- Power
- Aerospace
- Engineering & Fabrication
- Automotive
- Rail
- Shipbuilding
- Defence
- Off Highway
- Electronics
- Medical
- Equipment, consumables & materials
- Nuclear
- Structural Steel & Construction

British Standards for Welding

Visit shop.bsigroup.com/welding to browse all welding standards and publications relating to:

- General welding including arc, stud and aerospace
- Definitions & Symbols for welding
- Destructive Testing of welds
- Electric arc welding equipment
- Gas welding and cutting appliances
- Brazing and braze welding
- Pipework welding
- Resistance welding
- Qualification of welding personnel and procedures
- Acceptance levels for flaws in welds
- Welding consumables
- Health & Safety
- Prefabrication of primers
- Welding of steel for concrete enforcement & stainless steel
- Non-Destructive Testing including ultrasonic, radiographic, guided wave etc.

The majority of weld testing and inspection can be separated into two categories: Destructive Testing and Non-Destructive Testing.

Destructive testing is usually a cheaper method of inspection. It is more widely used for testing mass produced parts where sacrificing one or two components for testing is acceptable.

There are numerous methods of NDT some of which are simple and others which require specialist operators and expensive equipment such as x-ray testing. It is also an area of growth and innovation in the industry.



General welding – Key standards

These general standards are an important supplement to the more specific welding standards listed under the other categories. They include standards for quality in arc welding, aerospace, stud welding and other allied processes.

BS EN 1011 Series – Welding guidelines

BS EN ISO 5817 Welding in steel – quality levels

BS EN ISO 3834 Series – quality for welding

Definitions and symbols for welding**– Key standards**

These standards also support many other welding standards providing general definitions, symbols and references, illustrations and vocabulary/glossary for the welding standards portfolio.

BS EN ISO 2553 Welding and allied processes. Symbolic representation on drawings. Welded joints

BS 499-1 Welding terms and symbols. Glossary for welding, brazing and thermal cutting

BS EN ISO 4063 Welding and allied processes. Nomenclature of processes and reference numbers

Destructive testing of welds**– Key standards**

This is usually used for testing mass produced parts where sacrificing one or two components for testing is acceptable.

BS EN ISO 5173 Destructive tests on welds in metallic materials – Bend tests

BS EN ISO 9015 Parts 1 & 2 Destructive tests on welds in metallic materials – Hardness and micro-hardness testing.

Electric arc welding equipment**– Key standards**

BS EN 60974 Series. Arc welding equipment.

BS EN 50504 Validation of arc welding equipment

Gas welding and cutting appliances**– Key standards**

BS EN ISO 9013 Thermal cutting. Classification of thermal cuts. Geometrical product specification and quality tolerances

BS EN ISO 3281 Gas welding equipment. Rubber hoses for welding, cutting and allied processes

BS EN 13622 Gas welding equipment. Terminology. Terms used for gas welding equipment

Brazing and braze welding – Key standards

BS EN ISO 17672 Brazing. Filler materials

BS EN 14324 Brazing. Guidance on the application of brazed joints

BS EN 13134 Brazing. Procedure approval.

BS EN 13585 Qualification test of brazers and brazing operators

Pipework welding – Key standards

BS 4515-1 Specification for welding of steel pipelines on land and offshore - Carbon and carbon manganese steel pipelines

BS 4515-2 Specification for welding of steel pipelines on land and offshore - Duplex stainless steel pipelines

BS 2633 Specification for Class I arc welding of ferritic steel pipework for carrying fluids

BS 2971 Specification for class II arc welding of carbon steel pipework for carrying fluids

Resistance welding & equipment**– Key standards**

These standards outline methods and quality requirements for all resistance welding

BS 7670 Steel nuts and bolts for resistance projection welding - Specification for welding of weld nuts and weld bolts

BS 1140 Specification for resistance spot welding of uncoated and coated low carbon steel

Qualification of welding personnel and welding procedures – Key standards

To provide a well-defined basis for planning welding operations and to ensure a system for quality control during welding, organizations need to issue the relevant welding procedure specifications, and ensure that welders are qualified and appropriately trained and tested. Standards help organizations achieve this.

BS EN ISO 15614 Series. Specification and qualification of welding procedures for metallic materials. Welding procedure tests.

BS EN 287-1 Qualification test of welders. Fusion welding – Steels

BS EN ISO 9606 Series. Qualification test of welders. Fusion welding

BS EN ISO 14731 Welding coordination. Tasks and responsibilities

BS EN ISO 14732 Specification and qualification of welding procedures for metallic materials. General rules.

Acceptance levels for flaws in welds**– Key standards**

BS 7910 Guide to methods for assessing the acceptability of flaws in metallic structures

BS 7608 Code of practice for fatigue design and assessment of steel structures.

Welding consumables – Key standards

The standards cover all types of welding consumables including covered electrodes, cored wires, solid wires, rods, strips and fluxes.

BS EN ISO 14341 Welding consumables. Wire electrodes and weld deposits for gas shielded metal arc welding of non alloy and fine grain steels. Classification

BS EN ISO 14343 Welding consumables. Wire electrodes, strip electrodes, wires and rods for arc welding of stainless and heat resisting steels. Classification

BS EN ISO 2560 Welding consumables. Covered electrodes for manual metal arc welding of non-alloy and fine grain steels. Classification

BS EN ISO 14175 Welding consumables. Gases and gas mixtures for fusion welding and allied processes



Health & safety - Key standards

Welding and allied processes produce airborne particles and gaseous by-products that can be harmful to our health. Knowledge of the quantity and composition of the airborne particles and gases emitted can be useful for occupational hygienists in assessing workplace exposure and determining appropriate control measures. The following standards assist in ensuring best practice and risk reduction:

BS EN ISO 15011 Series. Health and safety in welding and allied processes. Laboratory methods for sampling fume and gases

BS EN ISO 10881 Parts 1 & 2 Health and safety in welding and allied processes. Sampling of airborne particles and gases in the operator's breathing zone

BS EN ISO 15012 Parts 1 & 2 Health and safety in welding and allied processes

Pre-fabrication primers for welding – Key standards

Pre-fabrication primers are usually applied to steel plates and sections prior to fabrication eg welding/gas cutting.

BE EN ISO 17652-2 Test for shop primers in relation to welding and allied processes

Welding of steel for concrete reinforcement & stainless steel – Key standards

BS EN ISO 17660 Series. Welding of reinforcing steel

Welding of stainless steel – Key standards

BS EN 1011-3 Arc welding of stainless steels - Recommendations

Welding thermoplastics & thermoplastic moulded components – Key standards

This is an emerging area of technology and new projects are in the pipeline. Standards are being developed specifically for the joining of thermoplastic materials using the following welding processes: laser, linear vibration, spin, orbital, hot plate, infrared, hot gas convection and ultrasonic; and the following staking processes: ultrasonic, heat, hot air and infrared.

BS EN 13067 Qualification testing of welders – welded assemblies

BS EN 1778 Characteristics for welded thermoplastic constructions

PD CEN TR 16862 responsibilities, knowledge, skills and competence

BS EN 12814 Series. Testing of welded joints

New work: Welding of thermoplastic moulded components & Specification of thermal joining processes.



Non-destructive Testing (NDT)

By definition, non destructive testing is the testing of materials for surface or internal flaws or metallurgical condition, without interfering with the integrity of the material or its suitability for service. The technique can be applied on a sampling basis for individual investigation or may be used for complete checking of material in a production quality control system. There are several different methods:

- **Ultrasonics** - Ultrasonic Testing (UT) is a family of non-destructive testing techniques based in the propagation of ultrasonic waves in the object or material tested. This technique is used for the detection of internal and surface (particularly distant surface) defects in sound conducting materials. In most common UT applications, very short ultrasonic pulse-waves with centre frequencies ranging from 0.1-15 MHz, and occasionally up to 50 MHz, are transmitted into materials to detect internal flaws or to characterize materials. A considerable degree of skill is required to assess the results but this method is useful for thickness of metals up to 300mm, and results are instant and detailed. There is currently work being undertaken to develop standards for ultrasonic phased array equipment.

Key standards

- BS EN ISO 17640** Ultrasonic testing. Techniques, testing levels and assessment.
- BS EN ISO 11666** Ultrasonic testing. Acceptance levels
- BS EN ISO 23279** Ultrasonic testing. Characterization of indications in welds.
- BS EN ISO 2400** Ultrasonic testing. Specification for calibration block No.1
- BS EN ISO 16811** Ultrasonic testing. Sensitivity and range setting
- BS EN ISO 16810** Ultrasonic testing. General principles
- BS EN ISO 16827** Ultrasonic testing. Characterization and sizing of discontinuities
- BS EN 12668 Parts 1, 2 & 3** Characterization and verification of ultrasonic examination equipment: Instruments and Probes
- BS EN ISO 18563 Series.** Non-destructive testing - Characterization and verification of ultrasonic phased array equipment

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➤ **Radiographic testing** - X-ray & Gamma - Industrial radiography is a method of inspecting materials for hidden flaws by using the ability of short wavelength electromagnetic radiation (high energy photons) to penetrate various materials. This method is useful for thin sections and is suitable for any material. However there are health risks involved.

Key standards

BS EN ISO 17635 Parts 1 & 2 Radiographic testing. X & Gamma ray techniques with film and digital detectors

BS EN ISO 19232 Series. Image quality of radiographs

BS EN 16407-1 Radiographic inspection of corrosion and deposits in pipes by X and gamma rays

BS EN ISO 10675 Parts 1 & 2 Acceptance levels for radiographic testing

BS EN ISO 11699 Parts 1 & 2 Industrial radiographic film

➤ **Industrial computed tomography** (CT) scanning is any computer-aided tomographic process, usually x-ray computed tomography, that (like its medical imaging counterparts) uses irradiation (usually with x-rays) to produce three-dimensional representations of the scanned object both externally and internally. Industrial CT scanning has been used in many areas of industry for internal inspection of components. Some of the key uses for CT scanning have been flaw detection, failure analysis, metrology, assembly analysis and reverse engineering applications.

Key standards

BS EN 16016 Parts 1-4: Radiation methods. Computed tomography: Terminology; Principle, equipment and samples; Operation and interpretation; Qualification

BS EN 14784 Parts 1 & 2: Industrial computed radiography with storage phosphor imaging plates

➤ **Infrared thermography** - Infrared thermography, thermal imaging, and thermal video are examples of infrared imaging science. Thermographic cameras detect radiation in the infrared range of the electromagnetic spectrum and produce images of that radiation, called thermograms.

Key standards

BS ISO 10878 Infrared thermography. Vocabulary

➤ **Magnetic particle inspection** - Magnetic particle inspection (MPI) is a process for detecting surface and slightly subsurface discontinuities in ferromagnetic materials such as iron, nickel, cobalt, and some of their alloys.

Key standards

BS EN ISO 17638 Magnetic particle testing

BS EN ISO 23278 Magnetic particle testing of welds. Acceptance levels

BS EN ISO 3059 Penetrant & magnetic particle testing. Viewing conditions

BS EN ISO 9934 Series Magnetic particle testing. General principles; Detection media; Equipment (Revision ongoing – publication 2015)

➤ **Penetration testing** - This method is frequently used for the detection of surface breaking flaws in non-ferromagnetic materials.

Key standards

BS EN ISO 3452 Series 2013 Penetrant testing. General principles; Testing of penetrant materials; Reference test blocks; Equipment; Penetrant testing at temperatures.

BS EN ISO 23277 Penetrant testing of welds. Acceptance levels

BS EN ISO 12706 Penetrant testing. Vocabulary

➤ **Eddy current methods** - An electromagnetic NDT method based on the process of inducing electrical currents into a conductive material and observing the interaction between the currents and the material. Suitable for the determination of a wide range of conditions of conducting material, such as defect detection, composition, hardness, conductivity, permeability etc. in a wide variety of engineering metals.

Key standards

BS EN ISO 12718 Eddy current testing. Vocabulary

BS EN ISO 15548 Series. Equipment for eddy current examination

BS EN ISO 15549 Eddy current testing. General principles

BS EN 1711 2000 Eddy current examination of welds by complex plane analysis.

➤ **Acoustic emission/ Leak detection** -

Acoustic emission (AE) is the sound waves produced when a material undergoes stress (internal change), as a result of an external force. The technique is used, for example, to study the formation of cracks during the welding process, as opposed to locating them after the weld has been formed with the more familiar ultrasonic testing technique. It is also valuable for detecting cracks forming in pressure vessels and pipelines transporting liquids under high pressures.

Key standards

BS EN 1330-9 Terminology. Terms used in acoustic emission testing

BS EN 15856 Acoustic emission. General principles of AE testing for the detection of corrosion within metallic surrounding filled with liquid.

BS EN 15495 Acoustic emission. Examination of metallic pressure equipment during proof testing.

BS EN ISO 18081 Draft for public comment 2014. Acoustic emission. Leak detection by means of acoustic emission.

BS EN ISO 18249 Draft for public comment 2014. Acoustic emission testing. Testing of fibre reinforced polymers. Specific methodology and general evaluation criteria

Standards can help organizations improve corporate reputation, comply with legislation, improve efficiency and safety, and identify cost savings.

The British Standards Institution acts as the NSB (National Standards Body) for the UK and is one of the world's leading developers of Standards. Eight out of ten of the most used and implemented Standards worldwide are Standards of UK origin – such as ISO 9001 *Quality management systems – Requirements*, which was based on the BS 5750 series *Quality systems*, first published in 1979.

We develop Standards in committees that are made up of manufacturers, users, research organizations, government departments and consumers who all work together to address industry challenges. Over 9,000 UK experts volunteer their knowledge and time to participate in BSI committees and contribute to the drafting of Standards. All new or revised Standards are made available for public comment, via BSI's Draft Review System, allowing input from any member of the general public who has an interest in the content of the Standard.

Get Involved!

Participating in a BSI committee has its benefits. These include:

- Influencing the content of Standards that will support economic growth, innovation, consumer protection and safety, both nationally and internationally
- Networking with peers in your industry and expanding your circle of contacts
- Developing your skills in communication, negotiation and diplomacy as well as your technical expertise – it's great professional development.

Committee membership work is rewarding. Your expertise, sustained effort and judgment will help derive substantial benefits for the UK and for the people you represent.

How to get involved:

If you are interested in participating in any of the Welding Committees please contact Sarah.Meagher@bsigroup.com.



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