British Standard

BRITISH STANDARD

BS 1723-1: 1986

Brazing —

Part 1: Specification for brazing

UDC 621.791.36

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Welding Standards Committee (WEE/-) to Technical Committee WEE/19 upon which the following bodies were represented:

BNF Metals Technology Centre
British Association for Brazing and Soldering
British Non-Ferrous Metals Federation
Electricity Supply Industry in England and Wales
Heating and Ventilating Contractors' Association
Joint Industry Board for Plumbing Mechanical Engineering Services in England and Wales
Ministry of Defence
Plumbing Trades Union
Society of British Aerospace Companies Limited
Welding Institute
Coopted member

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Contents

Foreword

This Part of BS 1723 has been prepared under the direction of the Welding Standards Committee and supersedes BS 1723:1963 which is withdrawn.
BS 1723 was originally published as one standard but this revision has been divided into four Parts as follows:

— *Part 1: Specification for brazing;*

— *Part 2: Guide to brazing;*

— *Part 3: Destructive testing and non-destructive evaluation (in preparation);*

— *Part 4: Procedure and operator approval (in preparation).*

This format has allowed the aspects covered in the guide (see BS 1723-2) to be widened and approvals (both procedure and operator) and methods of testing are included for the first time. This is the first revision in which metric units have been used throughout.

It has been assumed in the drafting of this British Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 6, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 1723 specifies requirements for the brazing of joints between any parent materials that are capable of being brazed by one of the processes listed in clause **5**.

In addition to the definitive requirements given, it also requires the items detailed in clause **3** to be documented. For compliance with this standard, both the definitive requirements and the separately documented requirements have to be satisfied.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purpose of this British Standard the definitions given in BS 499-1 apply together with the following.

2.1
brazing filler metal

the metal added during brazing (or pre-applied during preparation) which is to flow between the faying surfaces (see **2.2**) and complete the joint

2.2
faying surfaces[1)]

the surfaces that are to be joined in an assembly

2.3
fillet[1)]

the meniscus formed by the brazing filler metal at a joint edge

2.4
witness

evidence of brazing filler metal flow as seen at a joint edge remote from the point of application

2.5
continuous fillet

a fillet with no breaks or pores visible at low magnification (up to × 5)

2.6
partial fillet

a fillet with pores or discontinuities

NOTE A specification may limit the maximum length of any allowable discontinuity or pore, individually or in total.

2.7
percentage fill

the percentage of nominal joint that is filled with brazing filler metal as judged by an agreed non-destructive test method

NOTE See BS 1723-3[2)].

2.8
lap joint[1)]

overlapping faying surfaces

2.9
butt joint[1)]

abutting faying surfaces

2.10
preform

brazing filler metal fabricated into a suitable shape for pre-placement

NOTE Wire, foil, plastic bonded sheet and adhesive tape are suitable for manufacturing preforms.

2.11
loading groove (pre-placement groove)

a formed groove to locate pre-placed brazing filler metal

2.12
brazing gap

the separation between faying surfaces *at the brazing temperature*

2.13
fit-up

the clearance between the faying surfaces at the assembly temperature. This becomes the brazing gap at the brazing temperature

2.14
parent material

the material(s) to be joined

NOTE The expression "base metal" is to be avoided because of danger of misconception when noble metal brazing filler metals are used.

2.15
liquation

the selective separation at slow heating rates of low melting temperature filler metal phases

3 Information and requirements to be agreed and to be documented

3.1 Information to be supplied by the purchaser

The following information to be supplied by the purchaser shall be fully documented. Both the definitive requirements specified throughout the standard and the documented items shall be satisfied before a claim of compliance with the standard can be made and verified.

a) The application standards to be used, if any, together with any supplementary requirements.

b) Specification of the parent material.

[1)] This definition differs from that given in BS 499-1.

[2)] In preparation.

c) Types of test to be carried out on brazing filler metal.

d) Whether a written brazing procedure is required (see clause **10**).

e) Types of tests to be carried out on brazed joints (see clause **12**).

3.2 Requirements to be agreed

The following items to be agreed between the contracting parties, which are specified in the clauses referred to, shall be fully documented. Both the definitive requirements specified throughout the standard and the following documented items shall be satisfied before a claim of compliance with the standard can be made and verified.

a) The brazing process to be used (see clause **5**).

b) The brazing filler metal to be used in the absence of a relevant application standard [see **6.1** c)].

c) The joint design if it is not specified in a relevant application standard [see clause **7** c)].

d) The brazed joint category, destructive and non-destructive tests and acceptance criteria (see clause **13**).

4 Parent materials

Parent materials shall be capable of being brazed [see also **3.1** b)].

NOTE Guidance on the brazeability of parent materials using different brazing processes is given in BS 1723-2.

5 Processes

The brazing process shall be one or more of the following as agreed between the contracting parties:

hand torch brazing

mechanical flame brazing

induction brazing

resistance brazing

furnace brazing (including protective atmosphere, vacuum and open furnace)

immersion brazing

infra-red brazing

electron beam brazing

laser brazing

6 Brazing consumables

6.1 Filler metal

The composition of the brazing filler metal shall:

a) be in accordance with the relevant application standard; or

b) comply with BS 1845; or

c) be selected by agreement between the contracting parties in the absence of an application standard.

NOTE Guidance on the selection of filler metals is given in BS 1723-2. BS 1845 covers the following groups of filler metals:

Group AL	Aluminium brazing filler metals
Group AG	Silver brazing filler metals
Group CP	Copper-phosphorus brazing filler metals
Group CU	Copper brazing filler metals
Group CZ	Copper-zinc brazing filler metals
Group HTN	Nickel and cobalt brazing filler metals
Group PD	Palladium bearing brazing filler metals
Group AU	Gold bearing brazing filler metals

BS 1845 also covers particular requirements of filler metals for vacuum applications.

Some filler metals are available in one specific form only, and this should be ascertained when joint design is considered. The available forms are wire, shim, strip, foil, powder, paste, clad sheet, preforms and deposited coatings.

General information on the melting ranges of these types of filler metal is given in BS 1845.

The minimum volume of brazing filler metal applied shall be 25 % in excess of that required to fill the widest gap possible with the permitted component tolerances. When using a composite filler material due allowance shall be made for the presence of a flux or a binding agent.

6.2 Flux

NOTE Fluxes may be gaseous, liquid, paste or powder in form.

6.2.1 Where a flux is used to assist in making a joint it shall be in accordance with the recommendations of the supplier of the filler metal.

Special care shall be taken with fluxes, as many are corrosive and hygroscopic.

NOTE They should be stored according to the manufacturer's recommendations.

6.2.2 Where a flux has been used, any active residue shall be removed by chemical or mechanical means.

NOTE Guidance on flux removal is given in BS 1723-2.

7 Joint design

Joint designs shall be one of the following:

a) in accordance with the relevant application standard;

b) in accordance with the guidance given in BS 1723-2; or

c) by agreement between the contracting parties, in the absence of an application standard.

The fit-up of the parts to be joined shall lie between that which will permit adequate penetration by the molten brazing filler metal and that which will adequately retain it.

NOTE The fit-up will depend upon the parent material(s), the filler metal used, the brazing process to be applied and the properties required of the finished assembly. It is impracticable in this standard to specify limits of clearance to cover every case. Guidance is given in Table 2 of BS 1723-2:1986.

8 Joint preparation

To ensure satisfactory brazing, all components shall be properly fitted and the faying surfaces shall be clean immediately prior to brazing. All surface scale, oxides, grease, oil, cleaning fluid and dirt shall be removed either by chemical or mechanical means which do not of themselves leave a residue.

Cleaned parts shall not be contaminated during storage, assembly or application of the brazing filler metal. The shelf life of a cleaned part shall be determined and adequate controls established to provide re-cleaning when it is exceeded.

When stopping-off agents are used to contain the flow of filler metal within the joint area the stopping-off agent shall be prevented from encroaching on the faying surfaces.

Where pre-placed filler metal is not visible after assembly, verification of placement shall be made.

Storage and handling of assembled components shall not affect filler metal placement or component alignment.

9 Jigging

If used, jigs shall maintain the required brazing gap and shall not cause distortion during the heating or cooling cycle.

NOTE The thermal capacity of the jig should be taken into account when considering the method and rate of heating. Recommendations on jigging are given in BS 1723-2.

10 Brazing procedure approval[3)]

When a written brazing procedure is required it shall contain such of the following items as are appropriate:

a) company identification;

b) brazing procedure serial number;

c) method of brazing;

d) parent materials specification;

e) filler metal specification;

f) flux;

g) cleaning and preparation;

h) fit-up (drawing/detail) and component tolerances;

i) jigging;

j) brazing cycle;

k) post-brazing treatment (flux removal, heat treatment, etc.);

l) any special features;

m) testing procedures;

n) quality control procedures.

11 Quality control[4)]

The manufacturer shall have a quality control system to ensure that all brazed joints supplied satisfy the requirements of this Part of BS 1723. The system shall be documented and provide for the ready detection of discrepancies and for timely and positive corrective action. The system shall provide records such that the identification number of each batch shall provide references to the manufacturer's own documented records.

Tests and inspections shall be performed during manufacture so that continuous quality control of production is maintained and any departure from the accepted quality will be detected before despatch. From each batch of brazed joints a sufficient quantity of finished components or replica joints shall be taken to allow execution of the quality control tests defined in the manufacturer's system.

The contractor shall satisfy the purchaser that brazing operators are suitable for the work upon which they will be employed[3)].

NOTE Details of any approval obtained by the operators under any appropriate standard laying down approval tests may be submitted as evidence of their competence.

The names of all operators approved in accordance with this clause, together with particulars of any tests passed by each, should be recorded, and made available as and when required.

12 Testing procedure

Tests on brazed joints shall be one or more of the following types as specified by the purchaser or his representative and carried out in accordance with BS 1723-3[5)]:

a) visual examination;

b) non-destructive tests;

c) destructive tests.

13 Acceptance criteria

Brazed joint category (see clause **4** of BS 1723-2:1986) and acceptance criteria shall be agreed between the purchaser and the supplier at the time of placing the order.

[3)] Further information will be given in BS 1723-4 which is in preparation.
[4)] Further guidance on general principles may be obtained from BS 4891.
[5)] In preparation.

14 Requirements specific to the method of brazing[6)]

14.1 Flame brazing

14.1.1 *Hand torch brazing*

14.1.1.1 The heat input from the flame shall be adequate to ensure rapid heating of the joint but overheating of parent material, brazing filler metal, or flux shall be avoided.

14.1.1.2 The components shall be heated to a temperature at which the brazing filler metal is able to flow through the joint before application of hand fed rod.

NOTE Where the components are pre-fluxed, some indication can be obtained by the melting and flow of the flux.

Where possible the flame shall not impinge on the brazing filler metal which shall not be melted by the flame when it is not in contact with the components.

14.1.1.3 Hand feeding to supplement a preform shall not be used when the flow of molten metal from the hand fed rod is in the opposite direction from the insert (and this is normally the case), as flux and gas will be entrapped and the joint will be unsound.

14.1.2 *Mechanized flame brazing*

14.1.2.1 The number and type of burners selected shall be such as to ensure that the joint is rapidly raised to brazing temperature, in order to avoid the danger of liquation of pre-placed brazing filler metal, or exhausting the flux.

14.1.2.2 Local overheating shall be avoided, particularly when using intense flames to heat metals of low thermal conductivity.

14.1.2.3 Where possible, burners shall be positioned so that the flames do not impinge directly on pre-placed brazing filler metal.

14.1.2.4 Jigs used to locate and transfer assemblies to the burners shall ensure correct burner/assembly positioning and good component alignment. The jig design shall minimize restrictions on burner access and heat sink effects, yet be sufficiently robust to withstand continual thermal cycling and the corrosive effect of any brazing fluxes.

14.2 Induction brazing

14.2.1 Brazing filler metal, and flux if required, shall be pre-placed.

14.2.2 Manufacturers' instructions shall be followed and advice sought from competent designers and manufacturers of equipment for information regarding power sources, coil design, processes and automation.

14.2.3 Care shall be taken when high frequency current is passing through the coil to ensure that personal metal objects, e.g. rings, do not contact or come in close proximity (danger of burns). No part of the operator shall touch the coil.

14.3 Resistance brazing

14.3.1 All current carrying surfaces shall be clean, bright and free from any high resistance films, in order to maintain good thermal and electrical continuity.

14.3.2 Where fluxes are used, placement shall ensure that they do not prevent the passage of thermal and/or electrical energy.

14.3.3 Electrode pressures shall be adjusted to ensure a sound braze whilst retaining the component parts in their proper position.

14.4 Furnace brazing

14.4.1 The furnace shall have instrumentation to ensure consistency of operation.

14.4.2 The quality of vacuum or purity of the atmosphere shall be defined.

14.4.3 If possible, components shall be self-jigging. The components shall not be disturbed when moved into or through the furnace. Brazing filler metal shall be pre-placed.

14.4.4 Acceptable ranges of brazing temperature shall be defined, as shall sub-solidus dwells, to ensure temperature uniformity. Maintenance procedures for equipment shall be established and followed to ensure process repeatability.

14.5 Immersion brazing

14.5.1 The assembly shall be preheated prior to immersion to avoid the danger of explosion caused by damp or contaminated parts.

14.5.2 Care shall be taken when immersing the assembly to avoid splashing the bath medium.

14.5.3 The bath temperature and immersion time shall be closely controlled to avoid either overheating of components or inadequate melting and flow of brazing filler material.

NOTE When materials are heated close to their melting temperatures there is a tendency for distortion to occur.

14.5.4 When flux bath brazing, the condition of the flux shall be monitored and adjusted when required.

14.5.5 Components shall be either self-jigging or firmly held together to resist the effects of floatation.

14.5.6 For all methods of immersion brazing, except dip bath brazing, pre-placed brazing filler metals shall be used.

[6)] Guidance on various methods of brazing is given in BS 1723-2.

14.6 Infra-red brazing

14.6.1 The array of lamps shall be mounted in a reflective insulated holder designed to contour the heat pattern required. Care shall be taken to focus the lamps. Lamp terminals shall be adequately cooled.

14.6.2 Filler metal shall be pre-placed. If flux is used, it shall be pre-placed and in all other cases the assembly shall be protected by an inert gas or vacuum.

14.6.3 Eye protection shall be provided and worn.

14.7 Electron beam brazing and laser brazing

Electron beam or laser brazing shall only be used by competent personnel under the guidance of qualified engineering personnel.

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Publications referred to

BS 499, *Welding terms and symbols.*
BS 499-1, *Glossary for welding, brazing and thermal cutting.*
BS 1723, *Brazing.*
BS 1723-2, *Guide to brazing.*
BS 1723-3, *Destructive testing and non-destructive evaluation*[7)].
BS 1723-4, *Procedure and operator approval*[7)].
BS 1845, *Specification for filler metals for brazing.*
BS 4891, *A guide to quality assurance.*

[7)] In preparation.

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