



# Brazing —

## Part 4: Methods for specifying brazing procedure and operator approval testing

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  
 Institute of Refrigeration  
 Joint Industry Board for Plumbing Mechanical Engineering Services in England and Wales  
 Plumbing Trades Union  
 Society of British Aerospace Companies Limited  
 Welding Institute  
 Coopted member

This British Standard, having been prepared under the direction of the Welding Standards Committee, was published under the authority of the Board of BSI and comes into effect on 30 December 1988

© BSI 03-1999

The following BSI references relate to the work on this standard:  
 Committee reference WEE/19  
 Draft for comment 86/77418 DC

ISBN 0 580 16721 6

### Amendments issued since publication

Amd. No.	Date of issue	Comments

# Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
<hr/>	
Section 1. General	
1.1 Scope	1
1.2 Definitions	1
<hr/>	
Section 2. Method for specifying approval testing of brazing procedures for brazing various parent materials	
2.1 General	3
2.2 Items to be specified in a brazing procedure test	3
2.3 Changes affecting approval	4
2.4 Extent of approval	4
2.5 Test samples	5
2.6 Examination and testing	5
2.7 Statement of results	5
<hr/>	
Section 3. Method for specifying approval testing of brazing operators working to approved brazing procedures	
3.1 General	6
3.2 Information to be given to the brazing operator	6
3.3 Items to be recorded	6
3.4 Changes not affecting approval	6
3.5 Extent of approval	6
3.6 Test samples	6
3.7 Submission of test sample	7
3.8 Examination and testing	7
3.9 Statement of results	7
<hr/>	
Section 4. Method for specifying approval testing of brazing operators when brazing procedure approval is not required	
4.1 Information to be given to the brazing operator	8
4.2 Reapproval of the brazing operator	8
4.3 Test samples	8
4.4 Submission of test sample	8
4.5 Assessment of test samples	8
4.6 Statement of results	8
<hr/>	
Appendix A Recommended record of approval test of brazing procedure: BS 1723-4	10
Appendix B Recommended record of approval test of brazing procedure test results	11
Appendix C Recommended record of brazing operator approval	12
Appendix D Fundamental brazing positions	13
Appendix E Recommended record of statement of continuity of brazing operator approval	14
<hr/>	
Figure 1 — Test sample for manual torch brazing	9
Figure 2 — Horizontal position	13
Figure 3 — Vertical position, down flow	13
Figure 4 — Vertical position, up flow	14
Figure 5 — Vertical position, horizontal flow	14
<hr/>	
Publications referred to	Inside back cover
<hr/>	

## Foreword

This Part of BS 1723 has been prepared under the direction of the Welding Standards Committee. 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: Methods for non-destructive and destructive testing;*
- *Part 4: Methods for specifying brazing procedure and operator approval testing.*

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. Part 4 of the standard includes approval testing of brazing operators and procedure approval for brazing various parent materials. The latter having a bearing on the former. The brazing operator test approval also calls upon the non-destructive and destructive tests specified in BS 1723-3.

This Part of BS 1723 covers the following approval procedures which are a matter for agreement between the contracting parties at the time of placing the order:

- a) approval testing of brazing procedures for brazing various parent materials;
- b) approval testing of brazing operators working to approved brazing procedures;
- c) approval testing of brazing operators when brazing procedure approval is not required.

Brazing operators who work on, and satisfactorily produce, samples as required in a) should be considered as approved in accordance with the requirements of b) for the same test conditions without undergoing further tests.

When non-destructive testing is used for the examination of test brazes, the acceptance levels should be set so that the single or multiple defects are in line with those that are non-rejectable in the manufactured component to which the test relates.

The size and distribution of defects in brazed joints are not universal in character and acceptance or rejection will depend upon the criteria set for defect size, type and distribution as agreed between the contracting parties.

As this Part of BS 1723 is based on requirements to be agreed between the contracting parties, it has been published as a method for specifying and not as a specification. For this reason it is not appropriate for it to be claimed that a brazing procedure or a brazing operator has complied with this Part of BS 1723. A claim of compliance can only be made against the criteria procedures agreed in accordance with this Part of BS 1723.

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 14, 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.

# Section 1. General

## 1.1 Scope

This Part of BS 1723 describes methods for specifying the approval testing of brazing procedures and approval testing of brazing operators as follows.

- a) Section 2 covers the approval testing of brazing methods described in BS 1723-2, using filler metals specified in 6.1 of BS 1723-1:1986.

Approval of a brazing procedure in accordance with this Part of BS 1723 does not imply that the procedure is suitable for all conceivable conditions of service. It may be necessary for the contracting parties to agree to additional test procedures to validate the quality of the product and the procedure by which it is manufactured.

- b) Section 3 covers the approval testing of brazing operators who are to be engaged in the joining of test samples and brazed constructions by the methods described in BS 1723-2 for which an approved brazing procedure is employed.

NOTE 1 The operator carrying out successful brazing procedure approval testing is automatically approved as a brazing operator for that procedure.

NOTE 2 When a brazing procedure has been approved, it is the responsibility of the manufacturer to ensure the procedure is used on the contract where specified and for the ability of the brazing operators to apply the agreed brazing procedure.

- c) Section 4 covers the approval testing of brazing operators who will be engaged in the production of brazed constructions using the methods described in BS 1723-2, and for which the brazing procedure does not have to be approved.

NOTE 3 Users of this standard should be aware of the specific problems associated with joining by brazing some combinations of parent materials and the application of special processes may be necessary to prevent cracking or brittleness of both the parent materials and the filler metal forming the joint. Consideration should always be given to the provision of a detailed brazing procedure with the corresponding approval by the appropriate route.

NOTE 4 The titles of the publications referred to in this standard are listed on the inside back cover.

## 1.2 Definitions

For the purposes of this Part of BS 1723 the definitions given in BS 1723-1 and BS 499-1 apply together with the following.

### 1.2.1 brazing procedure

a specific course of action followed when brazing, including a list of materials and the brazing process used

### 1.2.2 brazing procedure test

the making and testing of a brazed joint, representative of that to be used in production, in order to prove the feasibility of a brazing procedure

NOTE 1 This term is not usually applied to any tests that may have been made during the development of a brazing procedure.

NOTE 2 Sometimes additional joints of different designs are brazed in order to obtain necessary test data and to establish the tolerance limits of the process.

### 1.2.3 approved brazing procedure

a documented brazing procedure that has been approved by an inspecting authority (1.2.7), either by means of a brazing procedure test or as a result of authentic documented experience gained with the brazing of joints similar to that to which the brazing procedure applies

### 1.2.4 test

a critical trial (often involving stress) or examination of one or more properties of a material, product or set of observations

### 1.2.5 test sample

an assembly brazed in accordance with an approved brazing procedure. It may be one of the following:

- a brazed construction, either taken from production or made specifically for test purposes;
- a brazed joint detached from a brazed construction;
- a simulation that will adequately replicate the brazed joint in the production assembly, e.g. for approval testing.

### 1.2.6 test piece

a portion detached from a test sample and prepared for testing

NOTE This term is synonymous with the term "test specimen".

### 1.2.7 inspecting authority

that competent independent body or association which verifies compliance with this Part of BS 1723

NOTE In some circumstances, a competent person delegated by the purchaser may be acceptable.

### 1.2.8 brazing operator approval test

a documented test which has been approved by an inspecting authority (1.2.7) and carried out by a brazing operator working to an approved brazing procedure

**1.2.9**

**brazing operator**

any person preparing and making brazed joints or constructions by one of the following brazing processes: flame, induction, resistance, furnace, immersion, infra-red, electron beam and laser brazing

## Section 2. Method for specifying approval testing of brazing procedures for brazing various parent materials

### 2.1 General

The need for a brazing procedure to be approved in accordance with this Part of BS 1723 shall be specified and agreed between the contracting parties, if possible at the time of placing the contract.

The tests applied for the approval of a brazing procedure are frequently the non-destructive and destructive tests specified in BS 1723-3. However, the tests required by the customer may be different from those which might be specified for work on which brazing procedures will be employed, and will depend to some extent upon the parent metal/filler metal composition and the basic design and operating requirements of the component parts to which the approved brazing procedures apply.

**NOTE** All brazed components should be produced to a quality compatible with the life-limiting processes to which they will be subjected.

All brazed components shall be categorized in accordance with clause 4 of BS 1723-2:1986, the categorization of the brazed component being agreed between the contracting parties at the time of placing the contract.

The approval of brazing procedures to be applied in any specific case shall be covered by the following alternatives.

- a) Each individual contractor (or subcontractor) may have proved, by actual brazed test samples, each joint incorporated in the design of the assembly. These joints will have been made in the materials and thicknesses and by the brazing processes to be used.
- b) Each individual contractor (or subcontractor) need not make individual test pieces according to the agreed brazing procedure, providing that he can prove by documentation of an authentic and independently approved nature, by an inspecting authority, that he has previously produced satisfactory assemblies brazed by the agreed procedures, using materials of the same thickness and composition and of the designed joint configurations.

In the case of a), once the brazing procedures have produced satisfactory results, the tests may never need repeating unless there is a change in variables which requires revalidation of certain aspects of the design or process. In the case of b), it may be possible, by agreement between the contracting parties, for fully documented brazing procedures which have been developed independently, to be used without recourse to further approval tests. However, even in this situation it is usual for replicas to be manufactured prior to a production run.

### 2.2 Items to be specified in a brazing procedure test

#### 2.2.1 General

All the items listed in 2.2.2 and those items in 2.2.3 relevant to the particular brazing process shall be recorded for each brazing procedure test.

**NOTE 1** Not all of these items need to be included in the approved brazing procedure documentation.

**NOTE 2** Appendix A gives a recommended method of recording brazing procedure details and Appendix B gives a recommended method of recording the results obtained when testing the brazing procedure.

#### 2.2.2 Items for all brazing processes

The following information shall be recorded for all of the brazing processes:

- a) brazing process or processes (when more than one is used to manufacture an engineering assembly);
- b) parent material or materials (specification (see clause 6 of BS 4778-2:1979) and certification conformity);
- c) brazing filler metal (specification (BS 1845 or an agreed alternative allowed in BS 1723-1) certification conformity limits of compositional ranges and allowable limits of detrimental trace elements);
- d) brazing filler metal form, e.g. rod, wire, sheet, preforms (size and tolerance), powder (particle size range), filler metal plastic rod, sheet, or paste (density and binder type), (certification conformity);
- e) flux type and method of application;
- f) assembly design (lap or butt joint) and joint orientation;
- g) component configuration (fabrication dimensional tolerances producing correct fit up);
- h) operation location (brazing shop or site fabrication);
- i) work area (clean working conditions, segregation of materials, storage, shelf life, bonded store);
- j) jigs and fixtures (allowable fixturing operations);
- k) cleaning of component parts (acceptable abrasives, degreasing fluids, post cleaning, storage);
- l) post-brazing cleaning (including flux removal where appropriate) and assembly handling;
- m) post-brazing heat treatment;
- n) quality plan (see BS 4778-2);
- o) test procedures (see BS 1723-3);
- p) acceptable quality level (see BS 4778).



### 2.2.3 Items for specific brazing processes

The information relevant to the particular brazing process listed in 2.2.3 a) to 2.2.3 f) shall be recorded for those particular processes in addition to the items in 2.2.2.

- a) *Flame brazing* (i.e. hand torch brazing and mechanized flame brazing:
  - 1) nozzle size;
  - 2) gas type, system and pressures;
  - 3) flame characteristic (oxidizing, reducing, neutral);
  - 4) process details (see BS 1723-2).
- b) *Induction brazing*:
  - 1) power source and frequency;
  - 2) induction coil design;
  - 3) induction coil position relative to joint;
  - 4) atmosphere;
  - 5) time-temperature cycle;
  - 6) temperature measurement.
- c) *Resistance brazing*:
  - 1) power source;
  - 2) electrode design and material;
  - 3) process details (see BS 1723-2).
- d) *Furnace brazing*:
  - 1) furnace type;
  - 2) process atmosphere (type and purity) backfill gas in the case of vacuum;
  - 3) temperature measurement and control: position of temperature monitoring thermocouples;
  - 4) time-temperature cycle.
- e) *Immersion brazing*:
  - 1) bath composition;
  - 2) preheat of components before brazing;
  - 3) temperature control;
  - 4) time-temperature cycle.
- f) *Special methods*: any requirements specific to the special method of brazing being employed. These include infra-red brazing, electron beam brazing, laser brazing.

### 2.3 Changes affecting approval

A brazing procedure test shall be required when any of the following changes, which shall be reported to the purchaser, are made to an approved brazing procedure:

- a) any change in the brazing process, such as change in the method of heating, including fuel gas, or the time-temperature cycle, or change from hand torch brazing to mechanized flame brazing;
- b) any change in parent material thickness or other dimensions that will change the heat sink characteristics and the capillary joint gap size;
- c) any change in material<sup>1)</sup> having a direct impact on the brazing process (e.g. new furnace windings);
- d) when the calibration procedure(s) has detected any significant error in control instruments;
- e) any change in the post-braze heat treatment temperature.

As well as the items a) to e), any other changes in the approved procedure shall be reported to the purchaser.

NOTE By agreement between the contracting parties, reapproval because of these other changes may be waived.

In the absence of any of the changes set out above, an approved brazing procedure shall remain in force indefinitely, provided that the acceptable quality level (see 2.6.2) is maintained.

### 2.4 Extent of approval

#### 2.4.1 Parent materials and filler metals

Parent materials with similar metallurgical and brazing characteristics have been grouped in Table 4 of BS 1723-2:1986. To minimize unnecessary duplication of technically identical procedure tests, this grouping is acceptable for brazing procedure approval for the manufacture of category 3<sup>2)</sup> and category 4 brazing quality joints. However, for category 1 and 2 brazing quality joints, and whenever doubt exists about achieving the acceptable quality level, a brazing procedure approval test shall be carried out.

<sup>1)</sup> This term refers to equipment, stores, supplies and spares that form the subject of a contract.

<sup>2)</sup> The categories of brazed joints are defined in clause 4 of BS 1723-2:1986.

### 2.4.2 Lap joints

The approval of a brazing procedure for an overlap length of  $3T^3)$  (or the designed overlap length if greater than  $3T$ ) shall extend to lengths of greater than  $3T$  (or the designed length) provided that the non-destructive testing quality criteria are met in these joints with a greater overlap and, when destructively tested, no unacceptable defects are observed.

## 2.5 Test samples

Each type of joint to which the brazing procedure will relate in production shall be represented by making an appropriate test sample or samples. The dimensions and number of test samples produced shall be sufficient to provide the test pieces required for the tests agreed by the contracting parties.

## 2.6 Examination and testing

### 2.6.1 General

For a brazing procedure to be approved, the test pieces representing the brazing procedure test shall comply with the requirements of test pieces for agreed non-destructive and destructive tests described in BS 1723-3. The number of test pieces prepared shall be agreed between the contracting parties.

No modifications shall be made to the test pieces that will affect the quality of the results obtained from destructive and non-destructive tests, and no repair or modification procedures shall be carried out on a test piece at any stage in its manufacture. Procedures such as surface grinding shall be allowed for non-destructive tests where non-critical surface imperfections affect the results of the test.

If the test piece(s) fails to comply with any of the agreed criteria (see 2.6.2) for non-destructive tests, a further test piece(s) shall be prepared.

If there is again non-compliance with the agreed criteria, the brazing procedure shall not be approved.

If any test piece fails to comply with the agreed criteria (see 2.6.2) for destructive testing of the brazed joint test piece, two further test pieces shall be prepared for each one that failed, either from the same test sample or from a newly prepared test sample. These shall be subjected to the same test. If there is again non-compliance with the agreed criteria for these additional test pieces the brazing procedure shall be regarded as not capable of satisfying the approved test procedure as agreed.

### 2.6.2 Acceptance levels

Criteria shall be agreed by the contracting parties or the inspecting authority for the assessment of defects detected by non-destructive examination. The existence of defects greater than the maximum size, or unacceptable multiple defects shall be a cause for the rejection of the brazing procedure. Similarly, criteria shall be agreed as above for the assessment of defects detected by the destructive tests and failure to meet these shall be cause for rejection of the brazing procedure.

## 2.7 Statement of results

A statement of the results of assessing each test piece, including repeat tests, shall be made for the brazing procedure approval test.

NOTE 1 This statement should include any features that are rejectable by not meeting the agreed criteria.

If no rejectable features or test results are found, a statement that the test samples made by the brazing procedure satisfy the agreed criteria in respect of that type of sample and the tests conducted shall be signed by the certifying officer.

NOTE 2 It is recommended that the form given in Appendix A is used to record details of the approval test of brazing procedure and the form given in Appendix B is used to record details of the results of such a test, in order to facilitate uniform presentation and assessment of data.

NOTE 3 It is recommended that brazing procedure tests carried out in accordance with this Part of BS 1723 and witnessed by an independent inspecting authority be accepted by other inspecting authorities provided that all the provisions have been fulfilled.

<sup>3)</sup>  $T$  is the thickness of the parent material.

## Section 3. Method for specifying approval testing of brazing operators working to approved brazing procedures

### 3.1 General

A brazing operator working to an approved procedure or a procedure being approved is considered to be sufficiently experienced in the appropriate brazing process, i.e. in the operation and control of brazing plant used for the manufacture of brazed components by the methods described in BS 1723-2, or, in the case of operators employed in manual torch brazing, to have sufficient training and experience in brazing the materials being joined and in the methods being applied.

It might be possible, by agreement between the contracting parties (provided that evidence is supplied by the contractor or manufacturer that approved operators have brazed similar components and that these approved operators will be used in this work), to accept the ability of the contracting firm and its brazing procedures without recourse to individual operators carrying out approval tests.

If a plant is largely automated or mechanical in nature and there are suitable quality control procedures it will often be inappropriate for individual brazing operators to be approved.

### 3.2 Information to be given to the brazing operator

The brazing operator shall be provided with full written details as specified in 2.2 and, in addition, any information considered necessary for the operator to be able to perform the approval test.

### 3.3 Items to be recorded

The items tabulated in Appendix C shall be recorded for each brazing operator approval test.

NOTE Details of the brazing procedure used should have been recorded in accordance with Appendix A.

### 3.4 Changes not affecting approval

The following changes of the approved brazing procedure and the procedure used for the brazing operator approval test shall *not* be the cause for reapproval of the brazing operator.

- a) A change not directly affecting the brazing operator's method of working.
- b) A change in parent materials or filler metal that does not affect the procedures carried out by the brazing operator.
- c) Changes that the contracting parties agree shall not require a revalidation of the brazing procedure approval.

NOTE Items a) and b) may require revalidation of the brazing approval procedure, but not necessarily a retest of the brazing operator.

### 3.5 Extent of approval

**3.5.1** The approval of a brazing operator for any of the processes described in BS 1723-2 shall give approval for brazing constructions of a similar type using that process.

NOTE Because of the possible variations in thickness of parent materials it is recommended that the extent of approval should not exceed  $0.75 t$  to  $1.25 t$ , where  $t$  is the thickness of either component.

**3.5.2** The approval of a manual torch brazing operator engaged on brazing in any one of the fundamental torch brazing positions (see Appendix D) shall be demonstrated by his ability to produce brazed joints of a quality to be agreed between the contracting parties which shall be tested by methods specified in BS 1723-3. The test samples shall be produced by the approved brazing procedure. This approval extends to joints made in similar positions.

**3.5.3** If a period of longer than 6 months has elapsed since the operator was employed on the approved brazing procedure, then his approval shall have lapsed and he shall submit test samples as required for reapproval.

**3.5.4** If the brazing operator produces substandard constructions when working on approved procedures, he shall be required to submit test samples for reapproval.

### 3.6 Test samples

The brazing operator shall manufacture either a test sample (or a sufficient number of test samples) representative of each type of joint to which the brazing procedure shall relate in production, or a brazed construction using the brazing approval procedure, and from which test pieces shall be prepared.

The number of test samples shall be agreed between the contracting parties.

The test samples shall be essentially the same as the joint(s) to be manufactured in production, incorporating the design features, constraint, jiggling, heat sink effects and restrictions on access for the brazing operator.

The type of test piece(s) prepared from the test samples shall be agreed between the contracting parties, at the time of placing the contract.

The test sample shall not be repaired in any way before testing. Surface preparation for non-destructive testing shall be allowed.

### 3.7 Submission of test sample

If the brazing operator realizes that, for some reason, the test sample he has made is likely to fail the subsequent agreed examination and testing, it shall be permissible for him to withhold the test sample and submit a second test sample that shall be made by the approved brazing procedure by which the first sample was made. If the brazing operator does choose to make a second test sample, it is this sample that shall be tested. The first sample shall be destroyed.

### 3.8 Examination and testing

The test methods to be used shall be agreed between the contracting parties at the time of placing the contract. The methods of non-destructive and destructive examination shall be as described in BS 1723-3 or any other tests agreed between the contracting parties.

Whenever possible the samples used for non-destructive examination shall subsequently be used for destructive examination. All samples shall be visually examined and a report made on the visual appearance. Any lack of reproducibility between samples shall be brought to the notice of the inspecting authority.

### 3.9 Statement of results

A statement of the results of assessing each test piece, including repeat tests, shall be made for each brazing operator.

If no rejectable features are found, a statement signifying that the test sample produced by that brazing operator satisfies the criteria agreed in accordance with this Part of BS 1723 shall be approved by the certifying officer. If features are found that are a cause for rejection, these shall be reported.

NOTE 1 The employer of the brazing operator should hold and maintain records of all approval tests for each brazing operator. It is recommended that the form given in Appendix C is used to record details of the approval tests and the results in order to facilitate uniform presentation and assessment of results and the form given in Appendix E is used to record continuity of approval.

NOTE 2 It is recommended that the brazing operator approval tests carried out in accordance with this Part of BS 1723 and witnessed by an independent inspecting authority should be accepted by other inspecting authorities provided that all the provisions have been fulfilled.

## Section 4. Method for specifying approval testing of brazing operators when brazing procedure approval is not required

### 4.1 Information to be given to the brazing operator

The brazing operator shall be given instructions and information appropriate to the process being used and, as described in BS 1723-2, the following details shall be included:

- a) parent materials;
- b) brazing filler metal and flux;
- c) the brazing process to be used;
- d) component and assembly design;
- e) quality required of the final assembly;
- f) safety precautions.

Other factors shall be left to the decision of the brazing operator.

### 4.2 Reapproval of the brazing operator

The reapproval of the brazing operator shall be required if any of the following apply:

- a) 6 months or more have elapsed since the brazing operator was employed on work for which he was approved;
- b) the brazing operator produces substandard constructions when being employed on work for which he holds an approval.

### 4.3 Test samples

**4.3.1** The test braze shall be typical of the assembly on which the brazing operator will be employed. The equipment used to produce the test samples shall be the same as that used in production. A sufficient number of test samples to meet the agreed test requirements shall be manufactured.

**4.3.2** For brazing operators employed on manual torch brazing, a brazing test sample similar either to the design detailed in Figure 1, or some other suitable configuration, shall be used.

**NOTE** This design is used by the Heating and Ventilating Contractors' Association and specified in their Code of Practice TR3.

**4.3.3** For tests on materials other than copper or for approval when multi-positional brazed joints are not required, either the test positions detailed in Appendix D shall be used or, for the approval test, a test sample of a design approved by the contracting parties at the time of placing the contract shall be used.

### 4.4 Submission of test sample

If the brazing operator realizes that for some reason the test sample he has made is likely to fail the subsequent examination and testing, it shall be permissible for him to withhold the test sample and submit a second test sample. If the brazing operator does choose to make a second test sample, it is this that shall be examined and tested. The first test sample shall be destroyed.

Test samples shall be submitted in the as-brazed condition and shall then be prepared for testing by the methods described in BS 1723-3.

### 4.5 Assessment of test samples

The test samples shall be assessed by the appropriate methods described in BS 1723-3 as agreed between the contracting parties.

Whenever possible, the same samples shall be used for non-destructive and destructive examination.

In the case of a brazed test sample failing to meet the agreed criteria, the option of submitting two further test samples shall be given to the brazing operator; both shall be satisfactory. In the case of manual torch brazing, failure to meet the criteria indicates that the operator is not capable of satisfying the approval test agreed in accordance with this Part of BS 1723 without further training.

For operators employed on other brazing processes, the failure of test pieces to meet the agreed criteria indicates the necessity to modify the instructions given to the brazing operator or that the basic process parameters need revision.

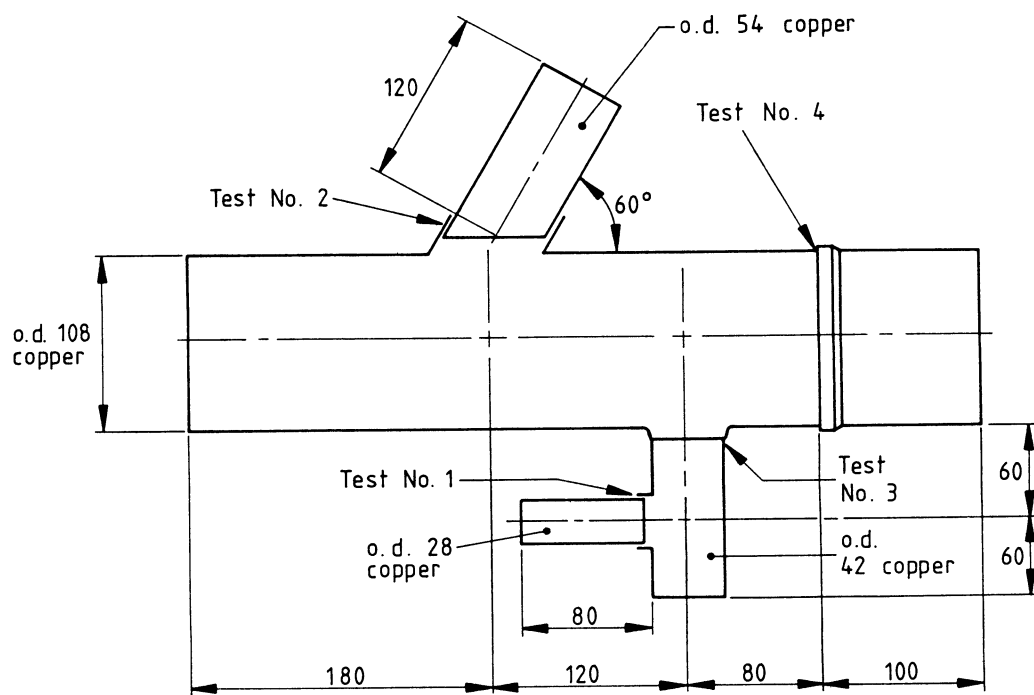
### 4.6 Statement of results

A statement of the results of assessing each test piece, including repeat tests shall be made for each brazing operator.

If no rejectable features are found, a statement signifying that the test sample produced by that brazing operator satisfies the criteria agreed in accordance with this standard shall be signed by the certifying officer. If features are found that are a cause for rejection, these shall be reported.

**NOTE 1** The employer of the brazing operator should hold and maintain records of all approval tests for each brazing operator. It is recommended that the form given in Appendix C is used to record details of the approval tests and the results in order to facilitate uniform presentation and assessment of results and the form given in Appendix E is used to record continuity of approval.

**NOTE 2** It is recommended that the brazing operator approval tests carried out in accordance with this Part of BS 1723 and witnessed by an independent inspecting authority should be accepted by other inspecting authorities provided that all the provisions have been fulfilled.



NOTE Lengths given are approximate only but should be adhered to  $\pm 5$  mm.

Linear dimensions are in millimetres.

**Figure 1 — Test sample for manual torch brazing**

## Appendix A Recommended record of approval test of brazing procedure: BS 1723-4

Procedure details		
Company		Test record no.
Manufacturer	Location of test shop or site	Manufacturer's procedure no. and revision no.
Brazing Process	<i>Filler metal</i>	
Joint type	Type and composition	
Test sample type	Form	
Joint designs (dimensioned sketches) (show position of joint in relation to the vertical)	Preform type and specification	
Preparation and cleaning schedule	Cleaning	
Handling procedures	<i>Brazing schedule</i>	
Jigs/Fixtures	Torch type } Induction coil design } Flux	
Parent material(s)	Atmosphere } Bath type }	
Specification	Brazing cycle (time-temperature)	
Component manufacturing route	Temperature measurement	
Other information	Cooling rate	
Originator	Date	Operator name
Extent of approval	Remarks	

## Appendix B Recommended record of approval test of brazing procedure test results

<b>Test results</b>									
Company					Test record no.				
For the tests below state "acceptable" or "non-acceptable" (attach reasons for non-acceptance)									
<i>Non-destructive tests</i>									
Visual					Ultrasonic				
Proof test					Radiographic				
Pressure/Vacuum					Thermographic				
Dye penetrant									
<i>Destructive tests</i>									
Tensile strength (units)			Elongation		Reduction of area		Failure location		Test temp
Impact					Peel		Bend		
Specimen		Notch	Temp	Results		Observation		Former diam.	Results
Hardness					Metallographic				
(Parent material : Brazing filler metal)					Observation				
:									
:									
<i>Additional tests:</i> stress rupture, corrosion, etc.									
Results									
The statements in this record are correct. Brazing and testing were carried out in accordance with BS 1723-4.									
Manufacturer's representative .....					Inspecting authority .....				
Date .....					Date .....				

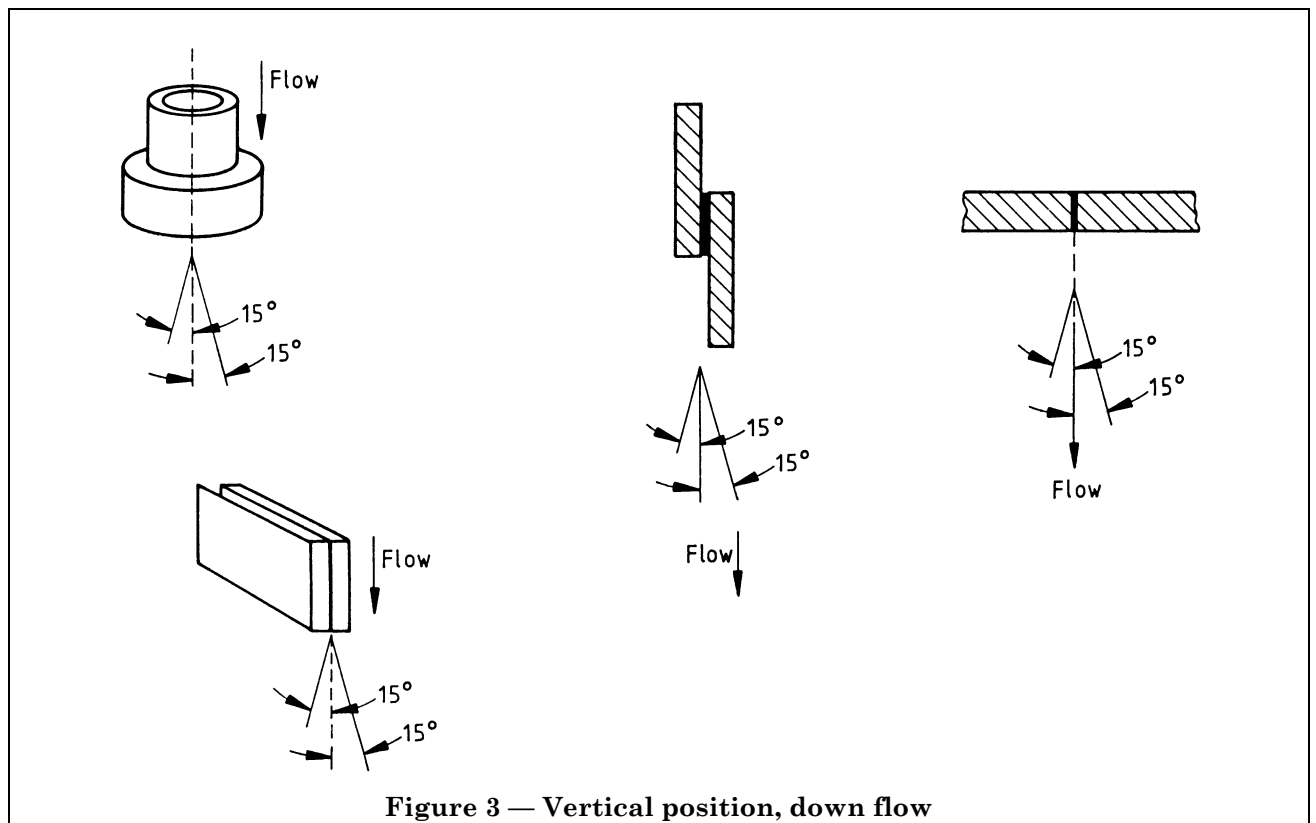
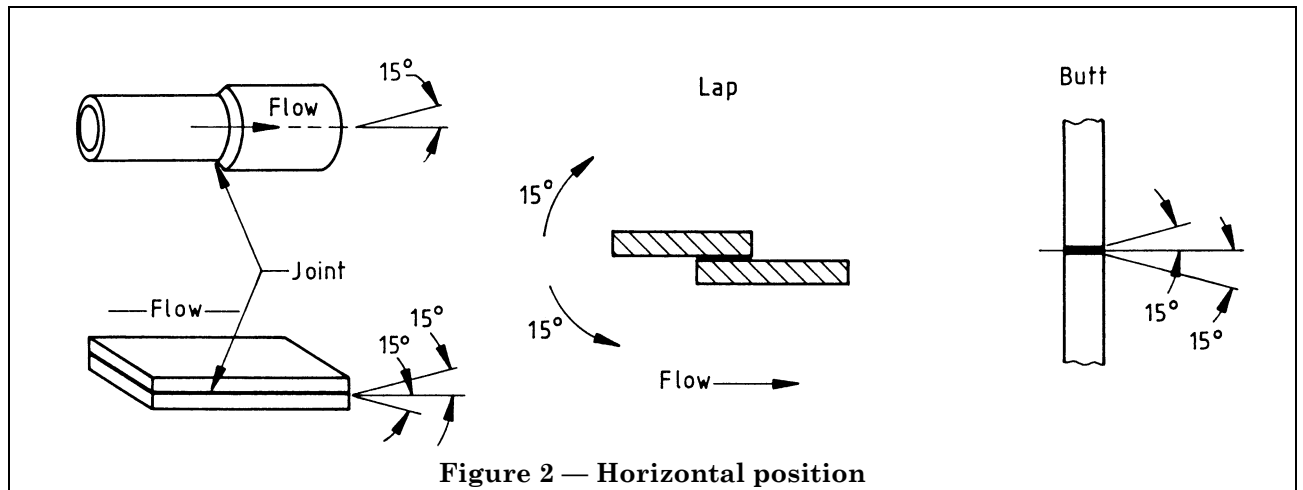


## Appendix C Recommended record of brazing operator approval

<b>Test certificate</b>	
Organization's symbol	Test record no. Date
Manufacturer's name	Brazing operator's identity      Issue no.
Manufacturer's procedure no. <sup>a</sup>	
<i>Test sample details</i>	<i>Extent of approval</i>
Process	1. Type of equipment
Parent materials	2. Brazing position
Filler metal	3. Category of joint (BS 1723-2)
Flux/atmosphere	4. Quality requirements (non-destructive and destructive tests)
Safety precautions	
<i>Test sample design</i> (include flow direction)	<i>Comments</i>
<i>Other factors</i> (operator's choice)	
<i>Test results</i> State acceptable, not acceptable (with reasons) or not required	
<i>Visual examination and non-destructive tests</i>	
<i>Destructive tests</i>	
The statements in this certificate are correct. Brazing and testing were carried out in accordance with BS 1723-4.	
Manufacturer's representative .....	Inspecting authority .....
Position .....	Witnessed by .....
Date .....	Date .....
<sup>a</sup> If working to an approved brazing procedure in which case items under "Test sample details", "Test sample design" and "Other factors" need not be completed.	

## Appendix D Fundamental brazing positions

Figure 2 to Figure 5 illustrate fundamental brazing positions.



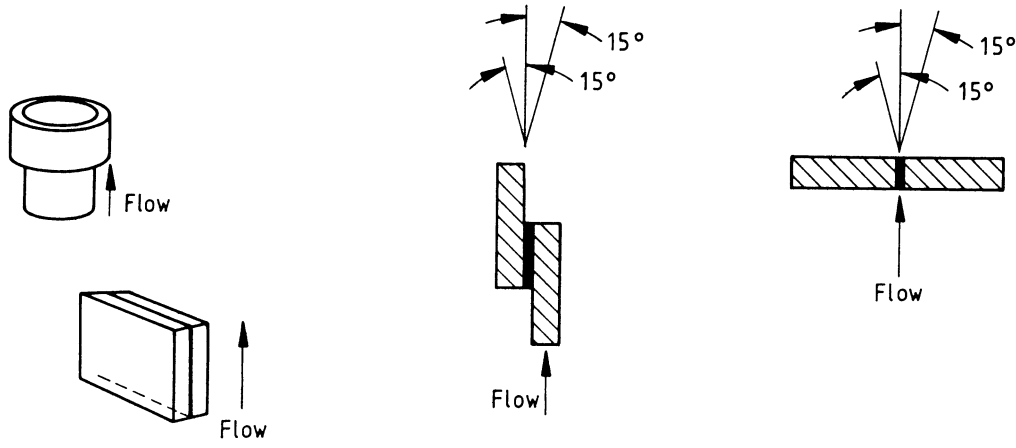


Figure 4 — Vertical position, up flow



Figure 5 — Vertical position, horizontal flow

**Appendix E Recommended record of statement of continuity of brazing operator approval**

Organization's symbol		Test record no.	
Manufacturer's name		Brazing operator's name	Issue no.
<i>Declaration.</i> The brazing operator named above has been regularly and satisfactorily employed on work covered by this test certificate during the 6 months preceding the date of my signature.			
Date	Signature	Position	Comments

Licensed Copy: opu-jwb94 opu-jwb94, Open University The JISC, 01 November 2004, Uncontrolled Copy, (c) BSI

---

## Publications referred to

BS 499, *Welding terms and symbols*.

BS 499-1, *Glossary for welding, brazing and thermal cutting*.

BS 1723, *Brazing*.

BS 1723-1, *Specification for brazing*.

BS 1723-2, *Guide to brazing*.

BS 1723-3, *Methods for non-destructive and destructive testing*.

BS 1845, *Specification for filler metals for brazing*.

BS 4778, *Quality vocabulary*.

BS 4778-2, *National terms*.

---

# BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

## Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

## Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

## Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

## Copyright

Copyright subsists in all BSI publications. BSI also holds the copyright, in the UK, of the publications of the international standardization bodies. Except as permitted under the Copyright, Designs and Patents Act 1988 no extract may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, photocopying, recording or otherwise – without prior written permission from BSI.

This does not preclude the free use, in the course of implementing the standard, of necessary details such as symbols, and size, type or grade designations. If these details are to be used for any other purpose than implementation then the prior written permission of BSI must be obtained.

If permission is granted, the terms may include royalty payments or a licensing agreement. Details and advice can be obtained from the Copyright Manager. Tel: 020 8996 7070.