



SAFETY ASSESSMENT
FEDERATION

Guidelines

Brazing Procedures and Brazer/Brazing Operator Approval Testing

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1. FOREWORD

This guideline WMC11 has been prepared under the direction of SAFed Technical Committee No. 4 (TC4). It serves to offer instruction and guidance in a technical manner using practical knowledge and experience gained in the use of the standards cited herein.

SAFed member organisations should abide by the principles and practices referenced in WMC11.

WMC11 does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

2. Introduction

2.1. Brazing Procedure Qualification

The primary purpose of Brazing Procedure Qualification is to demonstrate that the joining process proposed for construction can produce joints having the required mechanical properties for the intended application. When qualifying brazers the emphasis is placed on the brazers ability to manually manipulate the device used for heating the brazing area by hand (brazer), or in the case of an operator, the ability to prepare and set up the joint and brazing equipment (brazing operator).

2.2. Terminology and Definitions

The more commonly used terms associated with Brazing Procedure and Brazer/Operator Qualification Testing (definitions taken from ISO 857-2, PD ISO/TR 25901, BS EN 13134 & BS EN ISO 13585 where applicable)

- **Preliminary Brazing Procedure Specification (pBPS)**

Tentative BPS, which is assumed to be adequate by the manufacturer, but which has not been approved. Brazing of test pieces needed for the approval of a BPS has to be carried out on the basis of a pBPS

- **Brazing procedure Test**

Making and testing of a brazed joint in order to prove the feasibility of a brazing procedure

(NB. This may be performed on a standardized test piece or a pre-production test piece which better reflects the production work to be completed)

- **Brazing Procedure Specification (BPS)**

Document providing the designations or values of the required variables necessary to achieve consistent brazing for the defined application

- **Brazing**

Joining process in which a molten filler material is used that has a liquidus temperature above 450 °C but lower than the solidus temperature of the parent material(s)

- **Brazer**

Person who holds and manipulates the device for heating the brazing area by hand

- **Brazing Operator**

Person who prepares the joint and sets up brazing equipment and thereby has direct influence on the brazed joint quality

- **Brazing Procedure Approval Record**

Record comprising all the necessary data needed for qualification of a preliminary brazing procedure specification (pBPS)

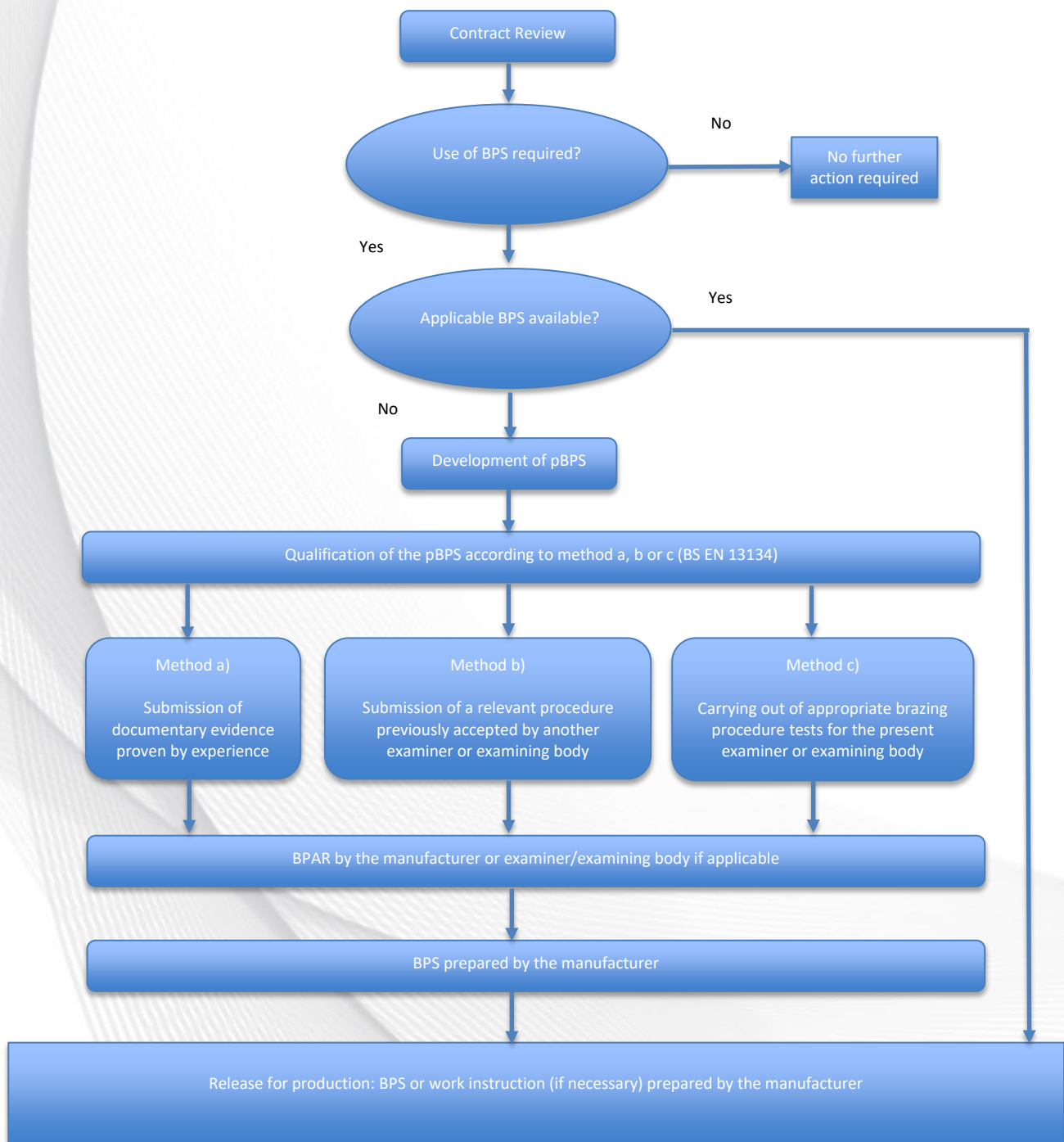
2.3. Commonly used Brazing Standards in the United Kingdom

- **BS EN ISO 13585 – *Qualification test of brazers and brazing operators***
- **BS EN 13134 – *Brazing Procedure approval***

Normative References

- ISO 857-2 – *Welding and allied processes – Vocabulary – Part 2: Soldering and brazing processes and related terms*
- ISO 17672 – *Brazing – Filler Metals*
- ISO 18279 – *Brazing – Imperfections in brazed joints*
- ISO/TR 25901 – *Welding and related processes – Vocabulary*
- EN 12797 – *Brazing – Destructive tests of brazed joints*
- EN 12799 – *Brazing – Non-destructive examination of brazed joints*

3. Obtaining Brazing Certification



3.1. Initial Investigation – Contract Review

A contract is an agreement between two parties. Each party is asking for and receiving something in exchange from the other party. If a problem were to arise, both parties can refer to the contract and pinpoint exactly what is expected of them.

NB. With brazing qualification this stage is paramount to the outcome, and the importance of undertaking a meaningful review of the requirements should not be underestimated, especially when choosing a method of approval which involves previous experience.

The SAFed member organization should seek access to the contract documentation to confirm what standards are involved. This will subsequently lead to being able to work with the manufacturer to determine the relevant ranges of approval, essential variables, and the selection of appropriate tests/test pieces. Unlike welding, it is more usual to braze a production assembly or devise an assembly which simulates fairly closely the work to be carried out, although standardized test pieces can still be used.

In some cases, end user 'application standards' or National 'product standards' may also be applicable, and the manufacturer should work with the SAFed member organization to ensure that these are adhered to.

3.2. Pre-Visit preparation

Prior to the SAFed member organization arriving on site, it is advisable that the manufacturer completes, agrees and documents the following:

- Thorough/meaningful contract review
- The application standards to be used, if any, together with any supplementary requirements
- Preparation of pBPS (see para 1.2)
- Machining of test pieces (in accordance with pBPS)
- Procurement of all consumables (including any inserts and fluxes)
- Collation of all relevant documentation including material/consumable certification and any historic documentation relevant to the test or qualification (this includes any traceable and verifiable evidence for brazing procedure approval based on experience)
- The types of tests, if any, to be carried out on brazing consumables
- The types of additional tests, if any, to be carried out on the brazed joint
- Brazing test trials – This can be performed as part of the pBPS development

- Brazer/Brazing Operator briefing – This will explain the role the Brazer/Operator to the individual(s) testing
- Manufacturer briefing – The SAFed member organization should make the manufacturer aware of their role during the visit

The SAFed member organization should pass on as much information and provide as much guidance as possible, based on experiences within the industry. Note – This does not extend to offering consultancy services.

3.3. Examining Bodies

An Organisation that has been appointed to verify compliance with the applicable standard.

It is the responsibility of the manufacturer to ensure that the Examining Body is acceptable to all contracting parties.

An examining Body which holds national accreditation and international notifications (approvals) is recommended as acceptability can vary between industry sectors.

Where authority to issue brazing certification is not fully defined by legislation, the major UK Examining Bodies generally utilise notification under relevant European Union (EU) Directives as the criteria by which to assess potential Examining Bodies. This approach provides assurances of the Examining Body's quality system, technical competence, and adequacy of liability insurance. SAFed members adopt the above approach to assess the capability of members and other bodies to issue brazing certification.

The United Kingdom Accreditation Service (UKAS) is the sole national accreditation body recognized by government to assess against internationally agreed standards. Organizations that provide brazing certification and testing services should have such described in their schedules of accreditation.

4. Brazing of Test Pieces

4.1. Compliance Verification

A SAFed member organisation should be contacted directly so that a suitable location, date and time can be arranged. The SAFed member/examining body is contracted by a manufacturer and appointed to verify compliance with the applicable standards. SAFed member organisations shall verify compliance by being present for the duration of the brazing activity. The brazing activity includes, but is not limited to, the following:

- Brazing preparations, joint type and configuration
- “Setting” of joint into jig/fixture
- Jig/fixture detail
- Pre braze cleaning
- Confirmation of material to be brazed
- Confirmation of consumables (type, form)
- Confirmation of Flux (type, form)
- Confirmation of heating gases (types and pressures)
- Nozzle/burner size number
- Power Source (if relevant to process)
- Time-temperature cycle
- Temperature measurement (control and position of sensors)
- Brazer/Operator identification
- Filler material method and point of application
- Flux method and point of application
- Furnace type
- Internal purge monitoring
- Post-braze cleaning method
- Post-braze heat treatment (temperature-time cycle)
- Specific pBPS/BPS requirements

Some of the above are applicable to BPAR and or Brazer/Brazing Operator qualifications as relevant.

The examiner/examining body shall satisfy themselves that brazing has been conducted in accordance with the relevant standard (see Para 2.1).

During brazer/brazing operator qualification tests, the individual testing will be expected to show adequate practical experience and knowledge of the brazing process, materials and safety

requirements for which approval is being sought. The examiner/examining body may stop the test if the brazing conditions are not correct or if it appears the brazer/brazing operator does not have the skill or understanding to fulfil the requirements, e.g. where there is a lack of knowledge in using the equipment supplied to perform the test or, there are excessive and/or systematic repairs.

4.2. Job Knowledge Testing

Testing a brazers/brazing operators job knowledge is non-mandatory, but it may be specifically required by some European countries. Job knowledge testing can be performed by the SAFed member organisation and would be an additional activity carried out by the engineer surveyor.

5. Testing

On completion of brazing, and in accordance with the applicable standard(s), the test pieces shall undergo nondestructive and/or destructive testing. The type of testing selected (during contract review stage) may be different and more extensive than the minimum requirements of the standard and may reflect, more suitably, the assembly to be brazed and its required service properties.

Suitable facilities are provided by laboratories accredited by the United Kingdom Accreditation Service (UKAS) against the requirement of ISO/IEC 17025 - General requirements for the competence of testing and calibration laboratories.

The examiner/examining body shall ensure that the scope of accreditation covers the required tests.

It may be that a non 17025 accredited NDT/test facility is used, where this is the case the examiner/examining body shall ensure that such a facility is competent to perform the applicable testing. The examiner/examining body shall also identify during a contract review process with the client if a 17025 facility should be used to ensure contract compliance.

6. Certification

6.1. Description of Certification

When Certification is issued by the SAFed member organisation it will be in a standard format bearing the SAFed logo and watermark.

If manufacturers wish to use their own certificates, such certificates will be endorsed by a SAFed member company provided they are presented in a format that is both technically and factually correct (to the relevant Standard).

In all cases, certification will only be issued on satisfactory completion of the approval process and will only be valid when bearing the SAFed member company stamp and signature of a SAFed member organisation representative.

6.2. Validity, Renewal and Prolongation of Brazer/Brazing Operator Qualification Certification

Brazing Procedures, once approved, remain valid indefinitely within the range of approval stated and so long as they continue to meet the requirements of the most current version of the applicable standard

For the most common Brazer/Brazing Operator Approval Standard in the United Kingdom, BS EN ISO 13585, the initial period of validity for brazer/brazing operator qualification is 3 years providing that the following conditions are fulfilled and confirmed every 6 months by a responsible person of the employer signing the certificate:

- a) The brazer or brazing operator shall be engaged with reasonable continuity in brazing work within the range of qualification. An interruption for a period of no longer than 6 months is permitted.
- b) The work of the brazer or brazing operator shall be in general accordance with the technical conditions under which the qualification test is carried out.
- c) There shall be no specific reason to question the skill and knowledge of the brazer or brazing operator (if applicable).

The validity of the qualification on the certificate may be prolonged for further periods of 3 years provided that each of the following conditions, in addition to those specified in 9.1, are fulfilled.

- a) The production brazed joints made by the brazer or brazing operator are continuously of the required quality.
- b) Records of tests, e.g. documentation of volumetric non-destructive or destructive tests, from brazing within the original range of qualification during the immediately previous 6 month period shall be filed together with the qualification certificate of the brazer. Acceptance criteria for the production test piece are according to Clause 7.

The examiner or examining body shall verify compliance with conditions a) and b), and sign or issue the prolongation of the qualification test certificate for the brazer/brazing operator.

7. SAFed Member Organisation Services

SAFed member companies are providers of brazing certification in the United Kingdom. Considerable experience and expertise is available to make the whole process of obtaining Brazing Procedure Qualifications and Brazer/Brazing Operator Approvals easier for manufacturers. SAFed member companies can share experiences and knowledge relating, but not limited to:

- Product and brazing standards
- Test methods, regimes and programmes
- Qualification process

The above not only ensures technical accuracy but reduces costs and maximises the future worth of the approvals gained. SAFed member companies, via a nation-wide network of engineer surveyors, can deal with all aspects of brazing approvals including:

- Examiner/Examining Body Services (Surveillance, Witnessing and Inspection)
- Testing (Non-Destructive and Destructive)
- Issue and revalidation/prolongation of certification

SAFed member organisations have considerable technical involvement in the drafting and issuing of British, European and International Brazing Specifications/Standards, thus providing the ability to give advice on known or anticipated future developments. SAFed has a technical committee infrastructure that assists uniform application of the relevant Standards and provides authoritative interpretations of key issues within the Standards to aid the fabrication industry.

8. Appendix I

Brazing Procedure and Brazer/Brazing Operator Qualification Certification

It is essential, for the validity of the certificates, that the details entered are accurate and complete. (Examples are shown in the next section).

Brazing certificates, correctly completed, potentially span many projects and can therefore have a long life: they are valuable documents and their accuracy is of the utmost importance. Brazing Procedure and Brazer/Brazing Operator Qualification Certification takes the form of one, or a combination of, the following:

Part 1 – Procedure approval certificate

This document shows the method of approval taken to qualify the BPAR along with the range of approval (if any) and document reference numbers to justify.

Part 2 – Approved brazing procedure

This details the actual brazing data recorded during the brazing of the BPAR test coupon, including jigs, fixtures used and any sketches of the joint or set up.

Part 3 – Test Results

This document is used to record the results of the relevant Non-Destructive and Destructive Testing that has been agreed by the contracting parties. For Brazer/Brazing Operator Qualification Certification, it is not necessary to issue such a document as a summary table showing acceptability is included on the Brazer/Brazing Operator Qualification Test Certificate.

Application Standards or End User Requirements may dictate the need for additional information to be included within a BPAR package such as, but not limited to:

- Material certification
- Consumable certification
- Pre/PWHT graphs and reports
- NDT Reports
- Documentation supporting any agreed range of approval

Brazer Qualification Test Certificate

This single certificate will include details of the individual (brazer) who is gaining qualification, the pBPS/BPS followed during the test, test piece details, range of qualification gained, test results, validity date and SAFed member organization signatures and stamps.

Brazing Operator Qualification Test Certificate

As per the Brazer Qualification Test Certificate

NB: - As there is no manual manipulation of a heating device during the Brazing Operator qualification test, there are less skill based variables involved and the range of approval on the certificate reflects this. The test is less about the skill of the individual and is based more on their ability to understand, set up and use the equipment correctly.

EN 13134:2000

Annex B
(informative)

Brazing procedure approval record (BPAR) form - Part 1: Procedure approval certificate

Manufacturer
name and address:

Examiner or examining body
name and address:

Manufacturer's brazing procedure
reference No.:

Examiner or examining body
reference No.:

Method of approval:

- a) Submission of documentary evidence that a relevant procedure proven by experience is already in existence.
- b) Submission of a relevant procedure previously accepted by another examiner or examining body.
- c) Carrying out of appropriate brazing procedure tests for the present examiner or examining body.

(Delete as appropriate)

In the case of a) or b), reference numbers
of the documents submitted:

Range of approval, if any:

Reference numbers of documents
submitted to justify range of approval:

Certified that this brazing procedure complies with the requirements of the following standards or any equivalent documents:

Name of examiner or examining body's representative, signature and date:

Name of manufacturer's representative, signature and date:

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EN 13134:2000

Annex C
(informative)

Brazing procedure approval record (BPAR) form - Part 2: Approved brazing procedure

Manufacturer's brazing procedure reference No.:

Examiner or examining body reference No.:

Details of approved brazing procedure:

Brazing process:

Joint type(s):

Joint design
(Dimensional sketches or drawing reference, including position of joint in relation to the vertical, room temperature fit up and joint gap at brazing temperature and restrictions on access)

Parent material(s) and specification(s)

Brazing filler metal:

Type and specification:

Form:

Method of filler metal supply:

Flux:

Type and specification:

Form:

Method of flux metal supply:

Jig/fixture details:

Method of pre-braze cleaning:

Method of post-braze cleaning:

Post-braze heat treatment (temperature-time cycle)

Brazing procedure details relevant to the process involved (see Table A.1):

Name of manufacturer's representative, signature and date:

Name of examiner or examining body's representative, signature and date:

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EN 13134:2000

Annex D
(informative)

Brazing procedure approval record (BPAR) form - Part 3: Test results

Manufacturer's brazing procedure
reference No.:

Examiner or examining body
reference No.:

Results of non-destructive tests agreed by the contracting parties

Test	Results
(to be filled as appropriate)	(statement of compliance or non-compliance with reasons for any non-compliance)

Results of destructive tests agreed by the contracting parties

Test	Results
(to be filled as appropriate)	(statement of compliance or non-compliance with reasons for any non-compliance)

Tests carried out in accordance with the following standards or other agreed documents:

Laboratory report reference numbers:

Name of manufacturer's representative, signature and date:

Name of examiner or examining body's representative, signature and date:

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BS EN ISO 13585:2012
ISO 13585:2012(E)

Annex A
(informative)

Brazer qualification test certificate

Designation(s):
 Manufacturer's name and address:
 Certificate reference No:
 BPS reference No:
 Brazer's name:
 Identification/Method of identification:
 Date and place of birth:
 Employer:
 Testing standard:
 Job knowledge: Acceptable/Not tested (delete as necessary)

Photograph (if required)

Variables	Test piece	Range of qualification
Brazing process		
Material thickness(es) (mm)		
Outside pipe diameter (mm)		
Overlap length (mm)		
Parent material(s)		
Brazing filler type, work temperature		
Brazing filler application		
Product type		
Filler metal flow direction		
Degree of mechanization		
Other		

Further information is stated in the attached document or in the specification for brazing procedure No:

Type of testing	Performed and accepted	Not tested	Name of examiner or examining body: Place, date and signature of examiner or examining body: Date of brazing: Qualification valid until:
Visual testing			
Radiographic testing			
Ultrasonic testing			
Peel testing			
Other test method:			

Confirmation of qualification by employer or other responsible person (every six months), required for the validity of the certificate.			Prolongation of qualification by examiner or examining body (every three years).		
Date	Signature	Position or title	Date	Signature	Position or title

BS EN ISO 13585:2012
ISO 13585:2012(E)

Annex B
 (informative)

Brazer operator qualification test certificate

Designation(s):
 Manufacturer's name and address:
 Certificate reference No:
 BPS reference No:
 Brazer's name:
 Identification/Method of identification:
 Date and place of birth:
 Employer:
 Testing standard:
 Job knowledge: Acceptable/Not tested (delete as necessary)

Photograph (if required)

Variables	Test piece	Range of qualification
Brazing process		
Type of brazing equipment		

Further information is stated in the attached document or in the specification for brazing procedure No:

Type of testing	Performed and accepted	Not tested	
Visual testing			Name of examiner or examining body:
Radiographic testing			Place, date and signature of examiner or examining body:
Ultrasonic testing			Date of brazing:
Peel testing			Qualification valid until:
Other test method:			

Confirmation of qualification by employer or other responsible person (every six months), required for the validity of the certificate.			Prolongation of qualification by examiner or examining body (every three years).		
Date	Signature	Position or title	Date	Signature	Position or title