
Special Processes (Brazing, Welding)

VA 7.3-4

1 Purpose

The regulations for special processes such as brazing and welding ensure that the pre-determined quality requirements are fulfilled.

2 Scope

Valid for the production processes brazing and welding in all MAHLE Behr Industry GmbH & Co. KG plants (group).

Section 5.1.2 Manual Brazing is valid for manufacturing at MAHLE Behr Industry as well as purchased parts manufactured by suppliers.

Planning the production processes (and therefore the special processes) and the corresponding default documents are described in AA 6.5.2-6. Planning is conducted within the framework of project processing (Industrialization phase).

3 Terms and Definitions:

Special Processes: Processes that cannot be verified to the full extent by a follow-up quality inspection on the product (without destroying the product). Special processes in the manufacturing of MBI products are brazing and welding.

MBI: MAHLE Behr Industry

MS: Management System

4 Responsibilities

Production is responsible for the control of the special processes.

5 Procedures

5.1 Brazing

5.1.1 Oven Brazing

Preliminary activities and work flows are detailed and specified in work instructions, work plans or in the MBI plant standards (i. e. VN AR.00077), for example regarding the surface condition and pre-treatment of materials, operating equipment, brazing work plan, inspections and after treatment.

The production parameters specified in the form "Lot Documentation FM-Brazing" such as:

- Brazing program number
- Oven charging
- Thermo-element plan (for measuring the object temperature during the brazing process)

ensure consistent brazing quality. The temperature records (with reference to the braze lot) are kept in order to analyze the source and implement corrective measures.

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All heat exchangers with thermo elements are labelled with batch numbers for the purpose of ensuring traceability.

Further inspection specifications are contained in:

- General inspection instructions for brazing
- Form "Core Building – Brazing" (Dimensional inspection before / after brazing)
- If needed additional in-process inspection plans with documentation.

Only authorized personnel are permitted to operate the brazing oven. A list of authorized personnel is available from the responsible production process leader.

Preventative oven maintenance (according to VA 7.4) helps to avoid disturbances and ensure consistent brazing quality.

5.1.2 Manual Brazing

Braze connections that are manufactured manually, may only be performed by trained, qualified employees. Brazing personnel for manual brazing must also complete an additional brazing exam according to DIN EN 13133 (see below). Verification of the completed training and exams must be maintained.

In addition to the qualifications of the employees, work instructions can be used for certain braze connections. Work instructions provide a detailed description of the work steps.

The qualifications for brazing must be clearly defined in the job descriptions and maintained within the qualification matrix. The production leader must ensure that only certified brazing personal are employed for manual brazing (work area matrix per VA 3.4.2).

5.1.2.1 Completion of Brazing Exam

- For completing a brazing test, brazing instructions (BPS) must be present per DIN EN 13134.
- Test personnel responsible for conducting the tests is the internal SAP or the production supervisor. Alternatively the test can be completed at a recognized test center (SLV or TÜV).
- The brazing test is completed according to DIN EN 13133. A one-time completion of the braze test per brazing instruction for each brazing operator is sufficient.
- The minimum scope of the test must include: Visual inspection and metallographic inspection. For braze connections on pipelines, an additional visual inspection must be completed.
- Production supervision or the SAP ist responsible for maintaining the brazing qualification. Maintaining the qualification includes regular training using the the current production instructions / inspection plans.

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5.1.2.2 Braze Instructions (BPS)

Material or process-specific braze instructions are created / maintained by each production supervisor or work prep and must be available for all pressurized parts > 10 bar operating pressure. The determination of further braze instructions occurs within the framework of inspection planning (AA 6.3.2-6).

The braze instructions are recognized according to DIN EN 13134 via a braze process inspection as a work sample prior to the start of production (at least once per product for first sampling on the first piece). Minimum inspection scope is a visual inspection and a metallographic examination. For braze connections on pipelines an additional lead test is required.

5.1.2.3 Production (Inspection / Documentation)

Depending on the request, the following specification documents are required:

- Drawing / parts lists
- If need braze instructions (BPS), at least for > 10 bar operating pressure
- Shop / production order or transportation / production ticket
- Standards (i.e. DIN EN ISO 18279)

These documents must be available to braze personnel.

The visual inspection of brazed components with regard to completeness, dimensional accuracy, seam appearance, form and limit of tolerances is completed by the brazing personnel according to the specifications in inspection plans / production instructions.

Brazing personnel must confirm all completed inspections for parts with specific inspection plans by signing the inspection plan. In addition (according to the specification) the production supervisor's signature may also be required on the inspection plan.

5.1.3 Wave Soldering and Dip Soldering

Prepared tasks and work procedures are detailed in work plans and work instructions. For example the pre-treatment of parts, the operation of equipment, the procedure, inspection and after-treatment.

Only trained and instructed employees are authorized to operate soldering equipment. Verification of training and instructions should be well-documented and stored.

5.2 Welding

Regulations for ensuring weld quality are contained in AA 7.3-4.

6 Further Applicable Documents

Procedural and work instructions for MBI locations are assigned to the respective process (MS).

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VA 7.4: Maintenance and repair and Service of Equipment

AA 6.5.2-6: Product / Process Planning

AA 7.3-4: Welding

VN AR.00077: FM-Brazing Process

Forms "Lot Documentation for FM-Brazing"

Forms "Core Building - Brazing"