

T5.5 Case study for Problem-Based Learning (PBL)

Title of Case Study / Problem-based learning case:

Qualification Range Definition for Aerospace Heat Exchanger Components

Author: Iván García Arrizabalaga

Background

An aerospace supplier has developed a procedure qualification test for furnace brazing of stainless steel heat exchanger components using a nickel-based filler metal.

- The process has been successfully applied in production trials, but the qualification range of the procedure is not yet clearly defined.
- The company must:
 - Establish the validity range of the WPS, based on brazing classification principles (aligned with ISO 17779 terminology and concepts)
 - Ensure compliance with aerospace quality requirements

You can find the corresponding variables for the process:

Process and general variables:

- **Brazing process:** Vacuum furnace brazing
- **Product type:** Tube
- **Method of filler metal supply:** Preplaced foil

Joint-related variables

- **Type of joint:** Lap joint
- **Filler metal flow direction:** Horizontal capillary flow
- **Overlap length:** 4 mm
- **Joint gap:** 0.05 mm

Material variables

- **Parent material:** AISI 304 (austenitic stainless steel)
- **Material group:** Austenitic stainless steels
- **Thickness:** 1.5 mm



T5.5 Case study for Problem-Based Learning (PBL)

Consumables

- **Filler metal (class):** BNi-2
- **Filler metal form:** Foil
- **Flux:** None

Process conditions

- **Atmosphere:** Vacuum ($<10^{-4}$ mbar)
- **Post brazing heat treatment:** None

Technical challenge

You are part of the qualification engineering team.

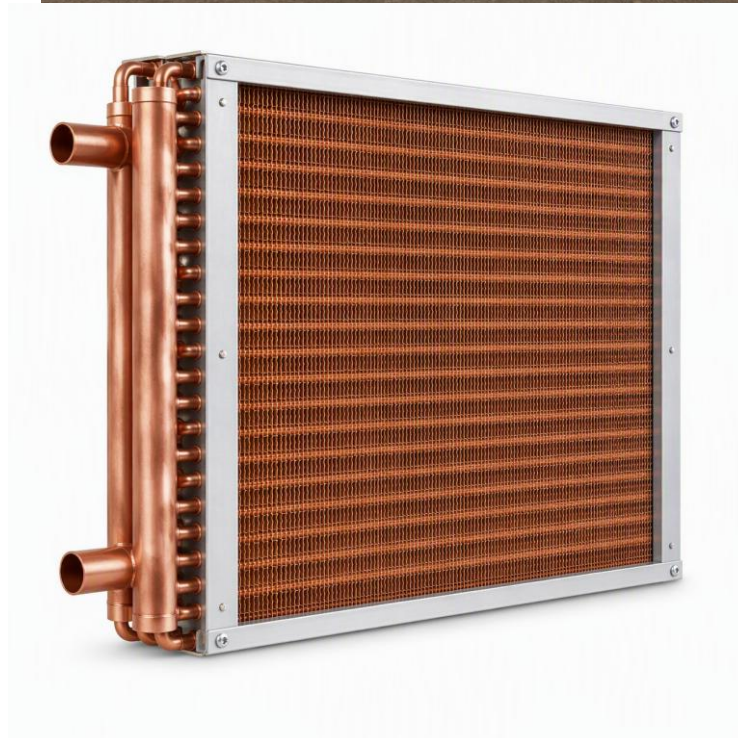
Based on the provided data and ISO 17779 standard:

- Define and justify:
 1. Which essential variables affect the qualification range
 2. The range of qualification for the process
- 3. Identify limits beyond which requalification is required
- 4. Propose a qualification matrix to optimize testing effort



T5.5 Case study for Problem-Based Learning (PBL)

Illustration of the case study

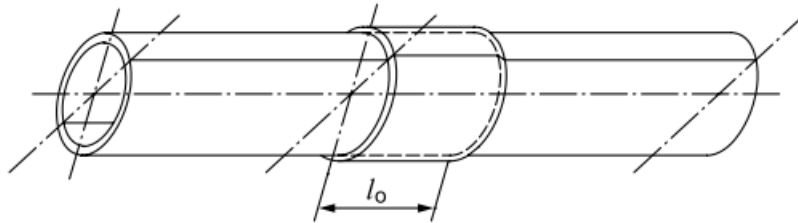


Co-funded by the
Erasmus+ Programme
of the European Union

ERASMUS-EDU-2022-PEX-COVE

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them. PROJECT REFERENCE NO. 101103507

T5.5 Case study for Problem-Based Learning (PBL)



Detailed solution/ process

Using ISO 17779 all the ranges of qualification for essential variables can be determined.

Variable	Range of qualification
Brazing process	922
Product type	Plate and Tube
Type of joint	Lap joint
Parent material	130, 140, 150, 160, 180
Filler metal	Class Ni
Shape of filler material	Foil
Flux	-
Atmosphere	Vacuum ($<10^{-4}$ mbar)
Filler application	Pre-placed
Thickness	0.75 - 3 mm
Overlap	>4 mm
Joint gap	0.05 mm
Filler metal flow	Horizontal Flow and vertical down-flow
Post braze heat treatment	None



T5.5 Case study for Problem-Based Learning (PBL)

Competence unit coverage:

AILEEN competence units		Covered CU
AW_01	Welding: Advanced Metallic Materials in Aerospace and Defence Sectors	
AW_02	Welding: Advanced Welding Processes and Equipment in Aerospace and Defence Sectors	
AW_03	Welding: Advanced Welding Applications in Aerospace and Defence Sectors	
AW_04	Welding: Introduction to brazing technology Knowledge for quality brazed joints	X
AW_05	Welding: Fundamentals of Industrial Brazing: Main Processes, Quality Standards & Applications	
AI_01	Inspection: Non-Destructive Testing (NDT) in Additive Manufacturing for metals and polymers	
AI_02	Inspection: Metrology in Additive Manufacturing for metals and polymers	
AI_03	Inspection: Inspection of AM parts. Material Quality	
AAM_01	AM: Qualification, Certification and Standards for AM in A&D	
AAM_02	AM: Quality Assurance & Quality Control for AM in Aerospace & Defence	
AAM_02/3	AM: Design of AM parts for A&D (2 courses - for DED & PBF)	
AD_01	Digital: Introduction to Digital Technologies in Advanced Manufacturing	
AD_02	Digital: Data Acquisition and Analysis	
AD_03	Digital: Industrial Internet of Things (IIoT) and Advantages in Advanced	
AD_04	Digital: Artificial Intelligence and Advantages in Advanced	
AD_05	Digital: Automation and Advantages in Advanced Manufacturing	
AD_06	Digital: Potentials of Advanced Simulation and Modelling in Advanced	
AD_07	Digital: Potentials of Digital Twins and Smart Factory Automation in Advanced Manufacturing	
AD_08	Digital: Unlocking the Potential of 3D Models Beyond Technical Drawings in the Aerospace and Defence Sector	
AG_02	Green: Sustainable Design and Environmental Compliance in Aerospace and Defence	

