

Trainer Manual
Module B
Joining Technologies

Objectives:	<p>Participants acquire knowledge in:</p> <ol style="list-style-type: none"> 1. Describe and use state of the art technologies and general accepted code of practices for detachable and non-detachable refrigerant circuit joining methods 2. Know about observation and application of measures for occupational health and safety (OHS) and accident prevention regulations. 3. Know about observation and application of environmental protection and rational use of material resources and energy 4. Understanding of the legislations and standards applicable in the region of installation and operation 5. Know how to carry out an assessment, be able to demonstrate the safe use and handling with considering the characteristics of subjects like piping, joints, valves and pipe supports. 6. Acquire understanding of risks related to the use of fuel gases and compressed gases and develop basic understanding of safety precautions required for the handling of materials, tools and equipment. 7. Learn how to fill in the equipment records with all relevant information concerning the work specific task. <p>Participants will be able to:</p> <ol style="list-style-type: none"> 1. Weld or braze leak-free joints on metallic tubes, pipes and components that can be used in refrigeration, air- conditioning or heat-pump systems 2. Use of brazing fuels and oxygen 3. Create piping and components joining connections with the use of pressing equipment 4. Use of Oxygen Free and Dry Nitrogen (OFDN) 5. Make/check pipe and component supports 	
Duration:	B1 – Joining Technologies	20’
	B2 – Brazing	40’
	B3 – Brazing safety and tools	45’
	B4 – Brazing operation	25’
	B5 – Brazers’ competence certification	10’
	B6 - Lokring	60’
	TOTAL	200’

Material:	PPT presentation, projector, white-board, supporting information B_HO_Table of copper tubes B_HO_Standard tightening torque values B_HO_Last minute risk assessment B_HO_Permit to work – hot work B_HO_MSDS acetylene B_HO_MSDS propane B_HO_MSDS oxygen B_HO_MSDS nitrogen B_MSDS_Lokprep Vulkan
Demonstration equipment	See as specified in sections B1 to B6 Various fittings including K65 Examples of brazed joints Example of brazing specimen Demonstration material Lokring Pressing specimen example
Tools & equipment:	See as specified in sections B1 to B6 Commonly used PPE Brazing unit with fuel gas and oxygen (complete set) Swaging and expanding tools Pressing tools

Each session contains of several sub-sessions.

Please note that it is advisable to adapt each course according to specific local circumstances.

Abbreviations:

PPT: Presentation slides; TM: Trainer manual; HO: Handout; DM: Demonstration material

Summary – Session Overview

Chapter: B1_ Joining Technologies				
Time	Content	Objectives	Training material / demonstration equipment	Description of training sessions and trainer notes
	Mechanical joining technologies	<ul style="list-style-type: none"> Understand the differences between positive locking connection, frictional or non-positive connection and substance to substance material connections Learn the applicability for the RAC sector 	Module B_Joining technologies-B1-B5 Module B_TM_Joining Technologies B_HO_Table of copper tubes B_HO_Standard tightening torque values	<u>Plenary session:</u> Trainer should start the session with questions regarding participants experience to assess previous knowledge in brazing. <ul style="list-style-type: none"> How do you distinguish the different pipes and components of different joining technologies? What do you know about thermal pipe and components of the joining methods? What are the challenges with flared connections for refrigeration? Trainer uses PPT to fill gaps in knowledge and highlights the importance of brazing for the RAC sector.
	Thermal joining methods	<ul style="list-style-type: none"> Understand the differences of different joining technologies and learn which ones are most suitable for refrigeration and air conditioning 		
	Refrigerant transfer tube joining processes	<ul style="list-style-type: none"> Understand the important considerations if flared connections are used Know about the importance of thermal joining processes with flame brazing 		
	International standards	<ul style="list-style-type: none"> Know which standards have relevance for brazing 		
20 min	Total time			

Chapter: B2_ Brazing

Time	Content	Objectives	Training material / demonstration equipment	Description of training sessions and trainer notes
	Basics of brazing	Definition of brazing	Module B_Joining technologies-B1-B5	<u>Plenary session:</u> Trainer should start the session with questions regarding participants experience to assess previous knowledge in brazing. If available, show demonstration tools <ul style="list-style-type: none"> • What are your commonly used brazing equipment and tools? • How do you commonly maintain branches in refrigerant transfer pipes? Trainer uses PPT to fill gaps in knowledge and highlights the importance of brazing for the RAC sector.
	Brazing equipment and components	<ul style="list-style-type: none"> • Copper tubes and their preparation • Flux agent • Filler material: Be able to choose a suitable material • Understand capillary action 	Module B_TM_Joining Technologies	
	Brazing with fittings	<ul style="list-style-type: none"> • Know how to choose fittings for brazing • Know how to identify certified fittings 	Various fittings including K65 Swaging and expanding tools	
	Brazing without fittings	<ul style="list-style-type: none"> • Swaging • Expanding • Joint extraction 		
40 min	Total time			

Chapter: B3_ Brazing safety and tools

Time	Content	Objectives	Training material / demonstration equipment	Description of training sessions and trainer notes
	Safety requirements and PPE	<ul style="list-style-type: none"> • Understand the dangers of bad joints • Learn which PPE is necessary • Know necessary preparations for brazing 	Module B_Joining technologies-B1-B5 Module B_TM_Joining Technologies	<u>Plenary session:</u> Trainer should start the session with questions regarding participants experience to assess previous knowledge in brazing.

Chapter: B3_ Brazing safety and tools				
Time	Content	Objectives	Training material / demonstration equipment	Description of training sessions and trainer notes
	Brazing tools	<ul style="list-style-type: none"> Oxygen-propane & oxygen-acetylene brazing units Use of oxygen free dry nitrogen Igniting and adjusting the torch flame 	B_HO_Last minute risk assessment B_HO_Permit of work – hot work B_HO_MSDS acetylene B_HO_MSDS propane B_HO_MSDS oxygen B_HO_MSDS nitrogen	If available, show demonstration tools and PPE <ul style="list-style-type: none"> What kind of PPE do we need for brazing activities? What kind of brazing gases do you use for field services and construction works? Trainer uses PPT to fill gaps in knowledge and highlights the importance of brazing for the RAC sector.
	Acetylene decomposition	<ul style="list-style-type: none"> Understand the dangers of acetylene decomposition Know how to prevent it Know how to act in case of acetylene decomposition 	Commonly used PPE Brazing unit with fuel gas and oxygen (complete set)	
	Handling oxygen	<ul style="list-style-type: none"> Know the dangers of handling oxygen in a workplace environment Learn to handle it safely 		
45 min	Total time			

Chapter: B4_ Brazing operation				
Time	Content	Objectives	Training material / demonstration equipment	Description of training sessions and trainer notes
	Steps of good brazing practice	Learn the correct order of the steps of good brazing practice to achieve high quality brazed joints	Module B_Joining technologies-B1-B5	<u>Plenary session</u> Trainer should start the session with questions regarding participants experience to assess previous knowledge in brazing.
	Brazing Dos and Don'ts		Module B_TM_Joining Technologies	

Chapter: B4_ Brazing operation				
Time	Content	Objectives	Training material / demonstration equipment	Description of training sessions and trainer notes
	Key take-aways	Participants recap the most important points of the session in preparation for practical exercises	Examples of brazed joints	<ul style="list-style-type: none"> What kind of preparational steps are necessary to ensure an acceptable leak-free brazing joint? Using PPT/available demonstration tools/objects to explain the steps in preparation for practical exercise If available, show demonstration tools If available show examples for good/bad joints and common mistakes
25 min	Total time			

Chapter: B5_ Brazers' competence certification				
Time	Content	Objectives	Training material / demonstration equipment	Description of training sessions and trainer notes
	Standard ISO 13585-2012	<ul style="list-style-type: none"> Learn about requirements for brazers qualification 	Module B_Joining technologies-B1-B5 Module B_TM_Joining Technologies Example of brazing specimen	<u>Plenary session</u> Trainer should start the session with questions regarding participants experience to assess previous knowledge in brazing. <ul style="list-style-type: none"> What kind of theoretical and practical content is necessary for brazers qualification according to ISO 13585-2012? Use PPT to introduce topic If available, present example test specimen Introduce practical exercise, for example B_PE_1 Practical exercise or equivalent.
10 min	Total time			

Chapter: B6_ Lokring

Time	Content	Objectives	Training material / demonstration equipment	Description of training sessions and trainer notes
	Area of application and comparison to brazing	<ul style="list-style-type: none"> Understand the differences to brazing and the resulting advantages and applications Understand the limits of Lokring applications 	Module B_Joining technologies-B6	<u>Plenary session</u> Trainer should start the session with questions regarding participants experience to assess previous knowledge in pressing applications. <ul style="list-style-type: none"> Who has already gained experiences with pipes and components joining by pressing (Lokring) Use PPT to introduce topic If available, present example test specimen Introduce appropriate exercise if Lokring parts are available.
	Functional principle and repair possibilities	<ul style="list-style-type: none"> Understand the option of repair for refrigerators with Lokring 	Module B_TM_Joining Technologies	
	Accessories and tools	<ul style="list-style-type: none"> Get to know the different necessary accessories and tools 	B_MSDS_Lokprep Vulkan	
	Assembly instructions	<ul style="list-style-type: none"> Understand the importance of always following OEM instructions 	Pressing tools Demonstration material Lokring Pressing specimen example	
60 min	Total time			