

Structuring and preparation of a lesson: **EAS module 5 (The bonding process)**

time	Theme, core information, statements or questions	Learning objectives ¹	Methods (e.g. presentation/ discussion/group work)	Media/ training material
0,5h	<p><u>Introduction to the Bonding Process</u></p> <p>Overview over the necessary steps to achieve a bond</p> <p>Surface treatment</p> <p>Adhesive application</p> <p>Steps for achieving the adhesive strength</p> <p>Adhesive curing</p>	<p>Be able to interpret and describe the fundamental principles and concepts surface treatment. (1)</p> <p>Be able to describe the fundamental principles to apply an adhesive(1)</p> <p>Be able to describe the fundamental steps to achieve adhesive strength (1)</p> <p>Be able to describe the fundamental principle of curing adhesives</p> <p>To be able to know how to perform a bonding process (2)</p>	<p>Presentation of necessary steps to apply a bonding process: Repetition of different surface preparations</p> <p>Presentation of an overview of application technologies</p> <p>Presentation of an overview of checklist for the bonding process</p>	<p>Slides presentation</p> <p>White board.</p> <p>Examples with videos</p>
0,5h	<p><u>Sourcing and Storing Adhesives:</u></p> <p>Sourcing Adhesives and Supplies</p>	<p>Be able to identify the criteria of sourcing adhesives and supplies on a particular bonding process (1)</p>	<p>Demonstration of parameters and criteria of sourcing and storing</p>	<p>Slides presentation.</p> <p>Examples with videos</p> <p>White board.</p>

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	<p>Durability guarantee Predelivery check Safety data sheet</p> <p>Storing Adhesives Temperature Time Moisture Light dispersion adhesive barrel forms</p>	<p>Be able to interpret the parameters of durability guarantees and safety datasheets (1)</p> <p>Be able to identify the main influence factors of storing adhesives and the necessary storing conditions (1)</p> <p>Be able to identify the advantages and disadvantages of different barrel forms (1)</p> <p>Be able to order and control adhesives and supplies (2)</p> <p>Be able to check and control storage environment that corresponds with the necessary requirements of a certain adhesive and supply (3)</p>	<p>Discussion about sourcing and storing problems within the companies of the participants</p> <p>Demonstration and Discussion about contents and parameters of durability guarantee and datasheets</p>	
2,5h	<p><u>Preparation and application of the Adhesives</u> Procedure and equipment for:</p> <ul style="list-style-type: none"> • Conditioning • Dosing & Mixing • Metering 	<p>Be able to name the different procedures of conditioning like tempering, drying, stirring and cutting (1)</p>	<p>Demonstration of the procedures of preparation of adhesives</p> <p>Discussion about the (dis-)</p>	<p>White board.</p> <p>Slides presentation.</p>

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	<ul style="list-style-type: none"> • Dispensing • Control <p>Methods of Adhesive Application</p> <ul style="list-style-type: none"> • Brushing • Flowing • Spraying • Roll coating • Knife coating • Silk screening • Melting <p>Other</p>	<p>Be able to name the different parameters, procedures and equipment of dosing and mixing (Volumetric dosing, time pressure dosing, manual dosing, pneumatic dosing) (1)</p> <p>Be able to name the different metering valves, their application and (dis-) advantages (1)</p> <p>Be able to name the different dosing valves, their application and (dis-) advantages (1)</p> <p>Be able to name the different mixing technologies, their application and (dis-) advantages (2K mixing, hand mixing, tumbling mixing, statically mixing, static- dynamically mixing, dynamic mixing) (1)</p> <p>Be able to name the different dispensing equipment, their</p>	<p>advantages and when which preparation methode has to be applied</p> <p>Demonstration of the equipment of preparation of adhesives</p> <p>Discussion about the (dis-) advantages and when which equipment of preparation of adhesives</p> <p>Demonstration of application methods and their parameters</p>	
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		<p>application and (dis-) advantages (Transfer pumps, drum pumps, bung-mounted pumps, submersible pumps, piston pumps, membrane dispensing valves, needle dispensing valves, high-speed valves, spray valves) (1)</p> <p>Be able to name the different control equipment, their application and (dis-) advantages (flow controllers, needle stroke detection systems, flow meters, cameras, thermographie) (1)</p> <p>Be able to name the different methods of applying adhesives, their application and (dis-) advantages (brushing, blowing, spraying, roll coating, knife coating, silk screening, melting,</p>		
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		<p>others)</p> <p>Be able to layout a coordinate an adhesive application process (1)</p> <p>Be able to evaluate different methods of applying adhesives (3)</p> <p>Be able to operate various control devices and dispensing equipment (2)</p> <p>Be able to operate with various application methods (2)</p> <p>Be able to operate with dispensing equipment (2)</p>		
2h	<p><u>Assembly</u></p> <p>Order of Assembly</p>	<p>Be able to clarify how the joint design must enable a simple assembly process. (3)</p> <p>Be able to apply the correct and easiest clamping method on a bond. (2)</p> <p>Be able to apply the correct geometrical assembly of specific</p>	<p>Demonstration of various ways of assembly order</p> <p>Discussion about the (dis-) advantages and differences of assembly order</p> <p>Demonstrations how the ease of assemblies can be</p>	<p>Slides presentation.</p> <p>Demonstration objects (e.g. different types of hybrid joints).</p> <p>Examples with videos</p>

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	<p>Ease of assembly</p> <p>Methods of Adhesive Bonding</p> <ul style="list-style-type: none"> • Wet bonding • Reactivation bonding • Pressure sensitive bonding • Other methods of bonding <p>Tooling</p> <p>Environmental Aspects</p> <ul style="list-style-type: none"> • Thermal effects • Moisture effects 	<p>bonds (2)</p> <p>Be able to outline the different influences on adhesive bonding in regards of the environment (thermal effects, moisture effects). (1)</p> <p>Be able to outline the correct practical considerations that are related to manufacture process of an adhesively bonded structure. (1)</p> <p>Be able to outline the different methods of adhesive bonding (wet bonding, reactivation bonding, pressure sensitive bonding, Others). (1)</p> <p>Be able to identify and choose the correct way of tooling a bond. (2)</p> <p>Be able to prevent the bond from negative</p>	<p>reached</p> <p>Presentation of bonding methods and their parameters</p> <p>Discussion about differences of bonding methods and advantages</p> <p>Demonstration of environmental effects and discussion on how to prevent the effects</p>	
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		influences. (2)		
0,25h	<u>Bonding Pressure</u> Bonding Pressure Equipment: <ul style="list-style-type: none"> • Hydraulic presses • Hydraulic pads • Weight loading • Clamps • Vacuum bag application Autoclave vessels	Be able to name the different methods of applying pressure on a bond (1) Be able to identify which adhesives need pressure at the curing process(1) Be able to evaluate pressure values and pressure equipment for specific bonds (3)	Demonstration of bonding pressure equipment Practical demonstration of available pressure equipment	Slides presentation. Demonstration objects (e.g. different types of hybrid joints).
1,5	<u>Adhesive Curing</u> Room temperature Direct heat curing Radiation curing <ul style="list-style-type: none"> • UV curing • Visible light curing • Infrared curing Moisture curing Electric heaters Induction heating	Be able to describe the different mechanisms of curing (1) Be able to describe the processes with which curing can be induced(1) Be able to supervise curing processes (2) Be able to determine curing parameters for a certain process (2)	Demonstration of curing procedures Practical demonstration of results of different curing processes Discussion about differences of the bonds	Slides presentation. Demonstration objects (e.g. different types of cured bonds). Examples with videos

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0,75h	<p><u>Inspection</u> Process control and quality assurance Evaluation of fabricated parts Standards</p>	<p>To be able to name which parameters can be observed and evaluate how deviations of the specified values will influence the process (pneumatic pressure monitoring, level monitoring, bubble detection, input pressure monitoring, drive, monitoring, optical sensors and cameras, thermographs) (1)</p> <p>To be able to name how parameters can be observed and controlled (pressure sensors, reed contacts, capacitive sensors, ultrasonic sensors, paddlewheels, inspection of adhesives lines and mixing quotients by cameras) (1)</p> <p>To be able to name which control mechanisms make sense in regards to quality management and process stability and cost</p>	<p>Demonstration of process- control equipment</p> <p>Practical demonstration of results of process-control (measurement data, camera- , thermography pictures, ...)</p> <p>Demonstration of evaluation criteria</p> <p>Demonstration of standards</p>	<p>Slides presentation.</p> <p>Demonstration objects</p> <p>Discussion of various measured data in combination with bonding results.</p>
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		<p>effectiveness (1)</p> <p>To know which standards have to be applied on a specific bonding process and how and be able to interpret them (1)</p> <p>Be able to evaluate the values of controlling devices of an adhesive application (3).</p> <p>Be able to execute the right quality assurance including evaluation and standards</p>		
1	<p><u>Repair</u></p> <p>Repair concepts</p> <p>Surface preparation for adhesive bonded repair</p> <p>Surface contamination considerations</p> <p>Examples for several applications</p> <p style="padding-left: 40px;">Repair on automotive applications</p> <p style="padding-left: 40px;">Repair on aerospace applications (aluminum structures, advanced composite structure e.g.)</p> <p style="padding-left: 40px;">Repair on industrial applications</p>	<p>Be able to describe the different concepts of repairing workpieces and parts (1).</p> <p>Be able to identify surface preparation methods for workpieces to repair (1)</p> <p>Be able to identify problem which could be caused by contaminated surfaces (1).</p> <p>Be able to outline various repair examples from automotive, aerospace</p>	<p>Demonstration of various concepts of repair bonds</p> <p>Demonstration of practical examples in industrial applications</p>	<p>Slides presentation.</p> <p>Demonstration objects (e.g. different types of repaired parts).</p> <p>Examples with videos</p>

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		and other industrial applications (2) Be able to perform a repair bond (2)		
2,5h	<u>Automation and Robotics</u> Automation Principles of automated systems: <ul style="list-style-type: none"> • Kinematics • Drives • Sensors • Controllers and systems • Coordinate systems and programming Applications	Be able to name the various kinematics of automated systems and their (dis-)advantages (1) Be able to name (dis-)advantages of different drives (1) Be able to identify (dis-)advantages of controller-features (1) Be able to outline the most common application failures caused by automated systems (1) Be able to name application examples and their (dis-)advantages (1) Be able to outline the fundamental principles and concepts for designing joint for automated	Demonstration of principles of automated systems Practical demonstration of programming a automated system Practical demonstration of designing a suitable joint for automation Discussion of other ways to design this joint	Slides presentation. Offline Robot Programming Software Videos CAD Programs

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		<p>manufacturing.</p> <p>Be able to detect production instabilities caused by the automation of the process (1)</p> <p>Be able to design joints suitable for implementation in automated manufacturing procedures. (2)</p>		
1h	<p><u>Factory Layout</u></p> <p>Production layout</p> <p>Process planning</p> <p>Production flow</p> <p>Value analysis</p> <p>Costing and economics</p>	<p>Be able to outline the fundamental principles and concepts for designing a factory layout in regards of effectiveness, safety and production stability (1).</p> <p>Be able to list the costs associated with bonded joints and to summarize the methods that allow the reduction of these production costs (1).</p> <p>Be able to apply the advantages of adhesive joints to improve</p>	<p>Practical demonstration of different production layouts</p> <p>Demonstration of process planning and production flow systematic</p> <p>Perform a value and cost analyses</p>	<p>Slides presentation.</p> <p>Calculation sheets</p> <p>Videos</p> <p>CAM Programs</p>

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		processes and products (2).		
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