LEVEL 1

AIRCRAFT STRUCTURAL REPAIR

FIXED WING

ACRATS

DETAILED COURSE OUTLINE ATS2172

FIXED WING STRUCTURE: INSPECTION, DAMAGE ASSESSMENT AND REPAIR, LEVEL 1

Course Title
Fixed Wing Structure: Inspection, Damage Assessment and Repair, Level 1

Course Tag
Fixed Wing Structure Training Level 1

Course ID
ATS2172

Course Duration
25 Working Days

Prerequisites
Prior sheetmetal training or experience is not required

Learning Hours
Classroom: 62 Hours
Practical 138 Hours

Highest Standards
Meets EASA, FAA and OEM SRM Standards

Scope and Purpose

This course brings the best that ACRATS has to offer together in one program. The (future) fixed wing structure technician must have knowledge of the structure of the aircraft and its components, whether they are fully made of metal or composites, or like most aircrafts out there: a bit of both. The participant of this program must also acquire a specific skillset to enable him or her to perform repairs on aircraft structures and components. This program is designed to fulfill those requirements to the fullest. Furthermore, this program will focus in-depth on working with the technical documentation needed in the process, the most important being; the Structural Repair Manual.

Course Part Overview

1. Aircraft Metallic Structure: Manufacturing, Assembly, Inspection, Damage Assessment and Repair
2. General Composite Structural Bonded Repair (SAE AIR4938 Part 1)
3. Understanding and Interpreting the Structural Repair Manual (SRM), Inspection, Damage Recognition and Assessment

Selection of the Learning Goals

Upon successful completion of this training, the student will be able to:

- Understand aircraft structural components: Participants will gain a solid understanding of the various structural components of fixed-wing aircraft, including the fuselage, wings, empennage, control surfaces, and landing gear.
- Identify structural damage: Participants will learn how to identify different types of structural damage, such as cracks, dents, corrosion, and fatigue, through visual inspections and non-destructive testing techniques.
- Assess structural damage severity: Participants will be trained to assess the severity of structural damage and determine the appropriate repair techniques based on industry guidelines and regulations.
- Perform structural repairs: Participants will acquire hands-on skills in performing structural repairs using various methods, including riveting, composite patching, sheet metal forming, and adhesive bonding. They will learn the proper use of tools and equipment specific to structural repair.
- Understand repair documentation: Participants will learn how to interpret and use repair manuals, service bulletins, and engineering drawings to ensure compliance with aircraft manufacturers' guidelines during the repair process.
- Apply repair techniques: Participants will gain practical experience in applying repair techniques to real-world scenarios, simulating common structural damage encountered in fixed-wing aircraft. They will work on mock-up structures and actual aircraft components to develop their skills.
- Follow safety protocols: Safety is paramount in aircraft maintenance. Participants will be trained on safety procedures, including proper handling of hazardous materials, personal protective equipment usage, and adherence to industry safety standards.
- Conduct quality inspections: Participants will learn how to conduct quality inspections to verify the integrity and effectiveness of completed structural repairs. They will understand the importance of documentation and record-keeping for regulatory compliance.
- Collaborate effectively: The course emphasizes the importance of effective communication and collaboration among team members. Participants will develop skills in working as part of a repair team, coordinating tasks, and maintaining clear and concise communication.
- Stay updated on industry best practices: Participants will be introduced to the latest developments in structural repair techniques, materials, and technologies. They will be encouraged to stay abreast of industry trends and standards to ensure ongoing professional growth.

Detailed Module Overview

Part 1 - Aircraft Metallic Structure: Manufacturing, Assembly, Inspection, Damage Assessment And Repair

	Topic	Teaching Level	Classroom Hours	Practical Hours
1	Introduction	1	1,5	
2	Metallic Materials Part 1	1	2	
3	Basic Measuring Techniques and Marking	2	1,5	
4	Metal Forming- and Machining Operations (including Tooling and Equipment) Part 1	2	3	
5	Bending of Sheet Metal Parts	2	3	
6	Hole Preparation (Drilling and Countersinking)	2	2	
7	Assembly of Sheet Metal Parts	1	2	
8	Aircraft Solid Shank Rivets and Riveting	2	3	
9	Basic Aircraft Fasteners	2	2	
10	Aircraft General Knowledge: Introduction to Aircraft Metallic Structures	1	2	
11	Source Documentation Part 1	1	0,5	
12	Standard Repair Principles	2	2	
13	Structural Repair Part 1	2	1,5	
14	Practical Exercises	3	-	85

Part 2 - General Composite Structural Bonded Repair (SAE AIR4938 Part 1)

1	Introduction to Composites	1	1,5	
2	Human Factors	1	1	
3	Reinforcement Fibers	1	1	
4	Metal Forming- and Machining Operations (including Tooling and Equipment) Part 1	1	1	
5	Matrix Systems	1	1,5	
6	Safety and Environment	1	1	
7	Pre-Impregnated Materials	1	1	
8	Adhesives	1	1	
9	Structural Design Considerations	1	0,5	
10	Material Handling and Storage	1	2	
11	Facilities and Equipment	1	1,5	
12	Vacuum Bagging	1	1,5	
13	Heating Devices	1	2,5	
14	Source Documents	1	0,5	
15	Protective Coatings and Finishes	1	1,5	
16	Repair Selection Considerations	2	0,5	
17	Inspection Techniques	2	0,5	
18	Hands-on Exercises	3	-	45

Part 3 - Understanding and Interpreting the Structural Repair Manual (SRM), Inspection, Damage Recognition and Assessment

1	Introduction/About the Structural Repair Manual	1	2	
2	Navigating the Structural Repair Manual	1	2	
3	Key Definitions in Aircraft Structural Repair and the Structural Repair Manual	1	2	
4	Inspection and Damage Assessment (Theoretical- and Practical Cases)	2	2	
5	Damage Reporting	3	2	2
6	Case Studies	3	6	6

	Total Hours	-	**62**	**138**
	Course Length		200 Hours	

Detailed Module Overview *continued*

Teaching Level 1

Teaching level 1 includes the transferring of knowledge from the instructor to the student, through instruction, lecture, demonstration and by having topic-related discussions. Knowledge transfer can take place in a classroom (physical training) as well as through online learning (Computer Based Training (CBT)). The content of e-learning modules should be structured in such a way, keeping in mind that discussions are not possible (it is classified as passive learning), and the participant should be able to understand the material without the intervention of an instructor. Online classes or e-learning modules should be arranged in such a way that the participant has the opportunity to ask questions to the designated instructor or to provide (general) comments. Teaching level A does not include a practical application (hands-on) or the development of practical skills.

Teaching Level 2

Teaching level 2 includes the transferring of knowledge from the instructor to the student, through instruction, lecture, demonstration, topic-related discussions, and limited practical application, but does not include the development of sufficient manipulative skill to perform basic operations. Knowledge transfer can take place in a classroom (physical training) as well as through online learning (Computer Based Training (CBT)). The content of e-learning modules should be structured in such a way, keeping in mind that discussions are not possible (it being classified as passive learning), that the participant should be able to understand the material without the intervention of an instructor. Online classes or e-learning modules should be arranged in such a way that the participant has the opportunity to ask questions to the designated instructor, o to provide (general) comments. Online classes or e-learning modules must contain sufficient demonstration by means of explanatory videos. A high degree of interaction must be built in. Teaching level B requires some hands-on manipulative skills, or practical demonstration of the skills and their accompanying actual or simulated components/equipment, but still may be taught primarily in the classroom environment.

Teaching Level 3

Teaching level 3 includes the transferring of knowledge from the instructor to the student, through instruction, lecture, demonstration, having topic related discussions and a high degree of practical application to develop sufficient manipulative skill to accomplish return to service (normal operation). Teaching level C requires hands-on skill, as well as sufficient and appropriate instructional aides to train the participants to develop manipulative skills sufficient to simulate return to service mechanical skill. At this level, the teaching aids must be similar to or be the actual items of equipment on which the participant is expected to develop the required skill levels. A teaching level C subject cannot be taught solely by instruction or lecture in the classroom; the appropriate training aids and hands-on experience must be used. E-learning modules can be used as a guide through practical assignments. Teaching level C includes a high degree of practical application (hands-on) and a strong focus on the development of practical skills.

Module 1 - Introduction

In Module 1, you'll learn about the roles and responsibilities of a sheet metal worker, especially in aircraft maintenance. You'll find out what you need to do before, during, and after working on an aircraft to ensure its safety and structural integrity. We'll talk about what's expected from you in terms of attitude, behavior, and professionalism. You'll also learn the right way to work, both personally and professionally. On top of that, you'll learn about potential health and safety risks and how to choose and use the right personal protective equipment (PPE). By the end of this module, you'll have a clear understanding of your role and how to work safely and responsibly.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Explain the roles and responsibilities of a sheet metal worker before, during, and after aircraft maintenance;
- Understand the importance of restoring the integrity of an aircraft and/or its components;
- Explain the required and desired attitude, behavior, and professionalism;
- Understand the morally correct way of working in the field;
- Recognize potential health and safety hazards and risks;
- Select and use the appropriate personal protective equipment (PPE).

Topics

1. Course Introduction
2. Introduction to the Profession of sheetmetal worker
3. Job Description
4. Responsibilities
5. Way of Working
    a. Required Mindset and Attitude (Ethics)
    b. Hazardous Materials and Chemicals
    c. Accuracy and Precision (Including Working with Tight Tolerances)
    d. Scratch & Damage Prevention
6. Quality Awareness
7. Health, Safety and Environmental Precautions
    a. Fumes, Vapor and Dust
    b. Safety Data Sheets (SDS)
    c. Personal Protective Equipment (PPE)
8. FOD Awareness & Prevention
9. Tool Control
10. Human Factors in Aircraft Maintenance
11. Quality Awareness
12. Traceability Awareness
13. Order and Tidiness in the Sheetmetal Shop ACRATS Training-/House Rules)

Module 2 - Materials & Hardware

In Module 2, you'll focus on metallic materials, especially aluminum. You'll learn about the different types of aluminum, including pure aluminum and various aluminum alloys. We'll cover the properties of these materials and why each type is used. We'll discuss the vulnerabilities of aluminum alloys, such as scratches and damages, and how to prevent them. Additionally, you'll learn about the proper handling and storage requirements to avoid any damages.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe the classification of light and heavy metals;
- Understand the position of aluminum within these classifications;
- Describe the properties of pure aluminum;
- Explain the different aluminum alloys designated by the Aluminum Association;
- Understand the differences and purposes of each aluminum alloy series;
- Recognize the vulnerabilities of aluminum alloys, including scratches and damages;
- Understand the consequences of damage to the alclad layer;
- Learn ways to prevent damages and proper handling and storage requirements.

Topics

1. Introduction
2. Ferrous- and Non-Ferrous Metals
3. Light & Heavy Metals
4. Properties of Pure Aluminum
5. Alloys & Alloy Elements
6. Aluminum Alloys
    a. Aluminum Association Series Designation
    b. 1000- through 8000 Series
    c. 2024 vs. 7075
    d. Identification of Metals
    e. Chemical Difference
    f. Practical Difference
7. Product Forms
    a. Sheet
    b. Extruded and Formed
8. Processing
    a. Marking
    b. Cutting
    c. Sawing
    d. Filing
    e. Sanding
    f. Deburring
    g. Drilling
    h. Cold forming
9. Materials and State (Condition) Indication
10. Sheet Thickness Indications
11. Alclad Layer
12. Application of Protective Treatment to Metallic Sheets and Parts
13. Scratches & Scratch Prevention
14. Storage, Transportation & Handling (incl. Damage Prevention)


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Module 3 - Basic Measuring Techniques and Marking

In Module 3, you'll learn about basic measuring techniques and marking. You'll get hands-on experience with basic measuring tools, understanding how to use them correctly and which tools to avoid to prevent scratches. Additionally, you'll learn about the restrictions on certain tools to ensure proper and safe handling and prevent damage to both the product and the tools.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Understand and describe the techniques for measuring with basic tools;
- Demonstrate the correct application of basic measuring tools;
- Identify tools used for marking and those that should be avoided to prevent scratches;
- Apply techniques to ensure precise and accurate measurements in various scenarios;
- Comprehend the importance of tolerance levels and how they affect measurements and overall quality.

Topics

1. Introduction
2. Basic Measuring Tooling
    a. Ruler
    b. Sliding Caliper (inches and millimeters)
    c. Try-Square and Framing Square
    d. Half-Circle- and Universal Bevel Protractor
3. Basic Measuring Techniques
4. Marking and Layout Tooling
    a. Pencil
    b. Ink Marker: Use and Restrictions
    c. Metal Scriber: Use and Restrictions
5. Marking and Layout on Sheet Metal Materials
    a. Marking for Product Outlining
    b. Marking for Hole Pattern Lay-out
    c. Scratch Prevention
6. Tolerances

Module 4 - Metal Forming- and Machining Operations (including Tooling and Equipment) *Part 1*

In Module 4, you'll learn about metal forming and machining operations, including the tools and equipment used. You'll get an introduction to various methods for cutting, filling, sanding, grinding, milling, sawing, and slip roll forming sheet metal through interactive discussions and live demonstrations. You'll also learn how to properly care for and maintain these tools and equipment. Additionally, you'll understand the post-processing steps like edge smoothing and deburring to ensure high-quality finishes.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe and demonstrate various sheet metal operations, including cutting, filling, sanding, grinding, milling, sawing, and slip roll forming;
- Describe and demonstrate the processes and operations for each metal forming and machining task, including tooling and equipment preparation, operation, and quality control;
- Describe and demonstrate proper care and maintenance of the tooling and equipment;
- Describe and demonstrate the post-processing steps, such as edge smoothing and edge and hole deburring;
- Identify the correct tools and equipment for various metal forming and machining operations;
- Understand and apply quality control techniques to ensure the integrity and accuracy of formed and machined parts;
- Recognize and implement safety practices to prevent accidents and injuries during metal forming and machining operations;
- Develop problem-solving skills to address common issues encountered during metal forming and machining processes.

Topics

1. Introduction
2. Cutting
    a. Tooling (Various)
    b. Process/Operation
    c. Tooling & Equipment Maintenance
3. Filling and Sanding
    a. Tooling
    b. Process/Operation
    c. Tooling & Equipment Maintenance
4. Grinding
    a. Tooling (Various)
    b. Process/Operation
    c. Tooling & Equipment Maintenance
5. Milling and Routing
    a. Tooling (Various)
    b. Process/Operation
    c. Tooling & Equipment Maintenance
6. Hole Saw
    a. Tooling (Various)
    b. Process/Operation
    c. Tooling & Equipment Maintenance
7. (Band) Sawing
    a. Tooling (Various)
    b. Process/Operation
    c. Tooling & Equipment Maintenance
8. Edge Deburring
    a. Tooling (Various)
    b. Process/Operation
9. Slip Roll Forming
    a. Tooling (Various)
    b. Process/Operation
    c. Tooling & Equipment Maintenance
10. Shrinking and Stretching (Eckhold) (Practical Demonstration)
    a. Tooling (Various)
    b. Process/Operation
    c. Tooling & Equipment Maintenance

Module 5 - Bending of Sheet Metal Parts

In Module 5, you'll learn about bending sheet metal parts. You'll understand how to bend sheet metal into single and multiple angled parts with 90º angles through interactive discussions and live demonstrations. You'll also learn about the formulas and charts used for calculating developed lengths and determining bend lines. Additionally, you'll learn about important considerations and precautionary measures to take before bending, such as minimum bend radius, the need for heat treatment, and edge smoothing. You'll also learn about the care and maintenance of bending equipment.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe and demonstrate how to bend sheet metal into single and multiple angled parts with 90º angles;
- Explain the different formulas and charts used for developed length calculation and bend line determination;
- Describe the considerations and precautionary measures to take before bending, such as minimum bend radius, the need for heat treatment, and edge smoothing;
- Identify the restrictions and requirements related to sheet metal bending, including edge smoothing, deburring, and handling primed/painted parts;
- Explain how material type, thickness, hardness, condition, and grain direction affect the bending process.

Topics

1. Introduction
2. Restrictions, Requirements and Considerations
    a. Sheet Requirements: Edge Smoothing and Deburring
    b. Primed/Paint parts and their Restriction regarding Bending
    c. Minimum Bend Radius
    d. Material Type, Thickness, Hardness and Condition
    e. Grain (Rolling) Direction
3. Tooling and Equipment
    a. Purpose and use (Operation)
    b. Maintenance
4. Developed Length Calculation (Flat Pattern Lay-out)
    a. Bend Allowance Formulas
    b. Empirical Formula
    c. Use of tables, graphs, and charts (for e.g. Set Back Determination)
    d. 90º degree bends
5. Bend Lines (Sight Lines)
6. Quality Control Finished Part

Module 6 - Hole Preparation (Drilling and Countersinking)

In Module 6, you'll learn about hole preparation, including drilling and countersinking. You'll understand the different types of drills and drill bits, their purposes, and the correct way to use them. Through interactive discussions and live demonstrations, you'll see the proper methods of drilling, including set-up and preparation, drill bit selection, and RPM determination. You'll also learn about hole rework operations, from mandatory deburring to countersinking with various angles and depths using common countersinking tools, including the microstop.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe the different types of drills and the differences between them;
- Explain the different types of drill bits, their purposes, and correct usage;
- Demonstrate proper drilling methods, including set-up and preparation;
- Select appropriate drill bits according to tolerance requirements and determine the correct RPM;
- Demonstrate hole deburring and countersinking operations with various angles and depths;
- Use common countersinking tools, including the microstop, correctly;
- Perform quality control checks on drilled and countersunk holes to ensure proper shape, dimension, and tolerance;
- Explain the importance of avoiding the knife effect and ensuring flush requirements.

Topics

1. Introduction
2. Types of (Rotary) Drills
    a. Pneumatic Vs. Electrical
    b. Drill Press
    c. Tool Pressure
3. Types of Drill Bits
    a. Millimeters
    b. Inches
    c. Numbers
4. RPM Determination
5. The Drilling Process
    a. Preparation
    b. Center Punch
    c. Prohibition
    d. Exceptions and Restrictions
    e. The Process
    f. Quality Control
    g. Shape, Dimension & Dimension
    h. Tolerance
6. Deburring of holes
    a. Tooling
    b. Restrictions
7. Countersinking Tooling
    a. Microstop & Countersinking Bits
    b. 82º and 100º Angles
8. Countersinking for Different Head Styles
    a. Tension Loads (“Full” Head)
    b. Shear Loads (Reduced Head)
9. The Countersinking Process
    a. Preparation
    b. The Process
    c. Quality Control
10. (The importance of) Avoiding Knife Effect
11. Flush Requirements


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Module 7 - Assembly of Sheet Metal Parts

In Module 7, you'll learn about the assembly of sheet metal parts. You'll understand how to properly drill, temporarily fasten, and assemble sheet metal parts in the correct order to prevent tension during manufacturing or structural repairs. Through interactive discussions and live demonstrations, you'll see which tools can and must be used for temporary fastening, including the use of clecos and blind rivets. You'll also learn methods for copying holes into other sheet metal parts when access from the backside is not available. Additionally, you'll cover considerations and precautionary measures to take before assembly, such as hole and edge deburring and smoothing.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe and demonstrate how to drill, temporarily fasten, and assemble sheet metal parts in the correct order;
- Explain and demonstrate the use of various temporary fasteners, including clecos and blind rivets;
- Describe and demonstrate methods for copying holes into other sheet metal parts, especially in situations with no access from the backside;
- Describe and demonstrate the considerations and precautionary measures to take before assembly, such as hole and edge deburring and smoothing;
- Explain the importance of tolerances in single parts versus assembled parts;
- Demonstrate methods to prevent damage during the assembly process.

Topics

1. Introduction
2. Drilling Order
3. Hole Deburring
4. Edge Deburring
5. Use of (various types of) Clecos
6. Temporary Fasteners
7. Riveting (Fastening) Order
8. Tolerances of Single Parts vs. Assembled Parts/Assemblies
9. Damage Prevention

Module 8 - Aircraft Solid Shank Rivets and Riveting

In Module 8, you'll learn about aircraft solid shank rivets and riveting. You'll understand the philosophy behind using solid shank rivets, the different types of rivets, and their applications. Through interactive discussions and live demonstrations, you'll learn how to select the correct rivet, calculate the suitable length, and install rivets using common tools like rivet guns and squeezers. You'll also cover fastener removal without affecting hole integrity, and the importance of heat treatment for solid rivets. Finally, you'll learn how to conduct quality inspections on riveted joints.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Understand the philosophy of fastening with solid shank rivets, including where and why they are commonly used;
- Describe the types of rivets, their head shapes, and how to identify them;
- Select the correct rivet using source documentation and calculate the suitable length using formulas;
- Demonstrate the correct installation of rivets using tools like rivet guns and squeezers;
- Understand when to use each type of tooling for the best results;
- Describe and demonstrate the removal of various types of fasteners without damaging the hole;
- Explain the reasons for and methods of heat-treating solid rivets;
- Perform quality inspections on riveted joints, including checking for proper placement, fitting, and absence of damage.

Topics

1. Introduction
2. Philosophy of The Solid Rivet Fastening Method
3. Rivet Material and Corresponding Coding (Identification and rivet-head markings)
4. Solid Rivet Types and Head Shapes/Styles
5. Heat Treatment and Post Requirements
6. Diameter Indication
7. Length Indication
8. Length (Dash No.) Determination/Selection (Grip Gauges)
9. Rivet Cutters
10. Drilling, drill Bit and Hole requirements
11. Rivet Gun- and Rivet Set Selection
12. Bucking Bar Selection (by Shape, Dimension and Weight)
13. Squeezer and Squeezer (Rivet) Set Selection
14. Riveting of Solid Rivets
    a. Manual - Process/Operation
    b. Manual - Limitations
15. Squeezer
    a. Manual - Process/Operation
    b. Manual - Limitations
16. Rivet Gun and Bucking Bar
    a. Manual - Process/Operation
    b. Manual - Limitations
17. Shaving of Countersunk Rivet Heads
18. Quality Control:
    a. Placement, Fitting and (absence of) Damages
    b. Measurements Upset head
    c. Flush Requirements
19. Solid Rivet Removal

Module 9 - Basic Aircraft Fasteners

In Module 9, you'll learn about basic aircraft fasteners. You'll understand the different fastening methods using various common fasteners and the tools needed for their installation. Through interactive discussions and live demonstrations, you'll see how to correctly install and remove these fasteners without damaging the hole. You'll also learn how to select the correct diameter and length of fasteners using grip gauges. Additionally, you'll cover how to conduct quality inspections on fastened joints and recognize signs of incorrect connections, even with limited access to the backside.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Understand the philosophy of fastening methods using various common fasteners;
- Demonstrate the correct installation of each type of fastener;
- Describe and demonstrate fastener removal without affecting hole integrity;
- Describe and demonstrate how to select the correct fastener diameter and length using grip gauges;
- Perform quality inspections on fastened joints;
- Recognize signs of incorrect connections with limited access to the backside.

Topics

1. Introduction
2. Permanent vs. Non-Permanent (Temporary) Fasteners
3. Fastener Call-Up and Designation
4. Fastener Symbols
5. Friction-Lock Self Plugging
    a. Use and Restriction
6. Mechanical-Lock Self Plugging
    a. Cherry Max
    b. Cherry Lock
7. Screws and Bolts and Nuts
    a. Removing Screws and Bolts with Reverse-Thread Taps and Extractors
    b. Torque Tightening and Safety Locking
8. Bolt/Nut Type Connection
    a. Hi-Lok
9. Length (Dash No.) Determination/Selection (Grip Gauges)
10. Hole requirements
11. Procedure for Fastener Hole Preparation
12. Anchor Nuts (Nutplates)
13. Wet Installation of Fasteners
14. Fastener Removal (of all discussed types)

Aircraft General Knowledge: Introduction to Aircraft Metallic Structures

In Module 10, you'll get an introduction to aircraft metallic structures. You'll learn about the build-up of an aircraft structure, the functions of various structural members, and the terminology used by different aircraft manufacturers. Through interactive discussions and live demonstrations, you'll also understand the different types of loads and stresses on structural members and how they influence aircraft and component design.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Understand the build-up of an aircraft structure and the function of various structural members;
- Use the terminology for structural members as used by different aircraft manufacturers;
- Explain the different types of loads and stresses that act on structural members and how these influence the design of aircraft and components;
- Classify structural components into primary and secondary structures;
- Identify and describe the purpose of key structural members such as skin, frames, and stringers.

Topics

1. Introduction
2. Structure Classification
    a. Primary- and Secondary Structure
3. Structure Breakdown (Build-up)
    a. ATA 52 through 57
4. Structural Members: Definition, Purpose and Identification
    a. Skin
    b. Frames
    c. Stringers


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Module 11 - Source Documentation *Part 1*

In Module 11, you'll learn about the key source documents used in aircraft structural maintenance and repair. You'll understand how aircraft blueprints are built, including picture sheets, parts lists, and engineering notes. Through interactive discussions and live demonstrations, you'll learn to interpret this information correctly. You'll also cover the purpose and use of the NAS512 rivet code. Additionally, you'll explore the Structural Repair Manual (SRM), learning how to navigate it quickly and accurately, even under time pressure, and how to handle "gray areas" responsibly.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe the two most important source documents used for aircraft structural maintenance and repair;
- Explain how aircraft blueprints are built, including the picture sheet, parts list, and engineering notes;
- Demonstrate correct interpretation of the information provided in blueprints;
- Explain the purpose of the NAS512 rivet code and demonstrate its correct usage;
- Explain the purpose of the SRM and the information it provides;
- Navigate the SRM to find accurate information quickly, even under time pressure;
- Be aware of how SRM information can be interpreted differently and handle "gray areas" responsibly.

Topics

1. Introduction
2. Drawings (blueprints)
    a. Blueprint System
    b. Picture Sheet
    c. Parts List
    d. Projection Methods
    e. NAS512 Rivet Code
    f. Tolerances
    g. Meaning and Purpose of Lines
3. Introduction to the Structural Repair Manual (SRM)

Module 12 - Standard Repair Principles

In Module 12, you'll learn about the standard repair principles essential to almost every type of aircraft metallic structure repair. Through interactive discussions and live demonstrations, you'll understand and demonstrate the correct and careful application of these principles. You'll also learn about the necessity and purpose behind each principle to ensure high-quality and reliable repairs.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Understand the essential principles that must be applied during aircraft metallic structure repairs;
- Demonstrate correct and careful compliance with all standard repair principles;
- Fully understand the necessity and purpose of standard repair principles;
- Apply general repair requirements effectively in various scenarios;
- Correctly use techniques related to fastener to edge distance, edge margin, fastener pitch distance, and hole pattern layout.

Topics

1. General Repair Requirements
2. (Fastener to) Edge distance
3. (Fastener to) Edge Margin
4. (Fastener) Pitch Distance
5. Hole Pattern Layout
6. Edge Chamfer
7. Cut-outs
    a. Radius
    b. Smoothness
8. Gap
9. Sealant Application

Module 13 - Structural Repair *Part 1*

In Module 13, you'll be introduced to the principles and procedures involved in structural repair within the context of aircraft maintenance. You'll gain foundational knowledge about identifying allowable and negligible damage, inspecting and removing damage, and repair techniques for minor damage. Through interactive discussions and live demonstrations, you'll also learn about part replacement, key structural repair definitions, miscellaneous metallic materials for repair, consumable materials, and the basic equipment and tools used in repair processes.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Gain foundational knowledge of structural repair concepts within aircraft maintenance;
- Identify allowable and negligible damage on aircraft structures;
- Understand the procedures for inspecting and removing damage from aircraft structures;
- Learn and demonstrate repair techniques for minor damage, including repairing small dents, dressing out dents, ensuring aerodynamic smoothness, blending, rework, and removing scratches;
- Perform stop drilling of cracks;
- Understand the process of part replacement in structural repair;
- Identify and use miscellaneous metallic materials, consumable materials, and the basic equipment and tools required for structural repair.

Topics

1. Allowable Damage
2. Negligible Damage
3. Inspection and Removal of Damage
4. Repair of Minor Damage
    a. Repair of Small Dents
    b. Dress out of Dents
    c. Aerodynamic Smoothness
    d. Blending and Rework
5. Removal of Scratches
6. Stop Drilling of Cracks
7. Part Replacement
8. Structural Repair Definitions
9. Miscellaneous Metallic Materials for Repair
10. Consumable Materials
11. Equipment and Tools for Repair


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Module 14 - Practical Exercises

Manufacturing of Stringers, Frames, Brackets and Skin Plates
Participant will manufacture sheet metal parts in accordance with aircraft technical drawings (or blueprints) and will ensure that the products exactly meet the dimensions specified by the drawing, or within the applicable tolerances. Participant shall, among other things fabricate parts from aluminum sheet (by e.g. cutting, bending and rolling) and drill and countersink holes within, as well as the other operations and processes discussed in module 3 through 6.

Assembly of Manufactured Sheetmetal Parts
Participant will assembly (previous) manufactured sheetmetal parts by means of riveting with solid rivets and other commonly used fasteners (e.g. hi-lok, cherry max and bolt/anchor nuts). Participant needs, among other things take drilling- and fastening order into account, make use of the sufficient amount of clecos for temporary fastening and install countersunk- and protruding solid rivets and other types of fasteners as well as the other operations and processes discussed in module 7 through 9.

Removal of Nicks, Scratches and Gouges
Participants will engage in hands-on exercises focused on the removal of nicks, scratches, and gouges from aircraft surfaces. Through visual inspection and practical application, they will learn to identify and assess surface imperfections. Utilizing appropriate techniques and tools, participants will practice repairing damaged areas to improve the surface condition. Quality assessment and finishing will ensure that repaired surfaces meet required standards and blend seamlessly with the surrounding material.

Stop Drilling of Cracks
During this exercise, participants will learn techniques for halting the propagation of cracks in aircraft structures. Through hands-on practice and guidance, they will understand the importance of accurately identifying crack endpoints and determining appropriate drilling locations. Participants will use specialized equipment and procedures to drill stop holes at precise locations along the crack path, effectively arresting its progression. Emphasis will be placed on ensuring structural integrity and preventing further damage through meticulous drilling and inspection techniques.

Rework or Fill Allowable Dents
In this exercise, participants will gain proficiency in reworking or filling allowable dents on aircraft surfaces to restore structural integrity and aerodynamic efficiency. Through hands-on training, they will learn to assess dent severity and determine whether rework or filling is the appropriate corrective action. Participants will utilize specialized tools and materials to carefully reshape or fill dented areas, ensuring smooth surfaces and minimal disruption to airflow.

Repair of Lighting strike damage by solid rivet installment
Participants will learn the procedures for repairing lightning strike damage on aircraft structures using solid rivets. They will be trained to identify and assess lightning strike damage accurately, considering both visible and hidden effects.

(Non-Critical) Aerodynamic Surface Skin (external) Patch Repair (between stringers and frames, with solid rivets)
Participant will perform a patch repair on a skin according to structural repair manual. Participant shall, among other things, cut out the damaged part with careful precision, manufacture a patch, drill new holes- and copy existing rivet rows within. Participant shall consider the appropriate edge chamfer on the repair patch, as well as all the other standard repair principles as discussed in module 13. Participant will install the repair patch with protruding (head style) solid rivets, for as the skin is a non-critical aerodynamic surface.

Flush Repair of a Small Hole
Participants will be trained in the procedure for conducting a flush repair of a small hole in aircraft structures. Through practical exercises, participants will gain proficiency in removing damaged material, preparing the repair area, and fabricating and installing flush repair patches. Attention will be given to achieving a smooth and aerodynamically sound surface while ensuring structural integrity. Additionally, participants will understand the importance of meticulous finishing and post-repair inspections to verify the effectiveness and quality of the repair.

Module 15 – Assessment Criteria

- ✓ Order and Tidiness (as discussed in module 1);
- ✓ Sufficient knowledge of metallic materials (as discussed in module 2);
- ✓ Showing the ability and potential of forming and machining (including hole preparation) metallic parts to meet the requirements given by source documentation (as discussed in module 3 through 6);
- ✓ Correct assembly of sheetmetal parts (as discussed in module 7);
- ✓ Sufficient knowledge- and the ability and potential to install and remove all discussed fasteners (as discussed in module 8 and 9);
- ✓ Sufficient knowledge of aircraft metallic structures (as discussed in module 10);
- ✓ Showing the ability and potential of correct usage of discussed source documentation (as discussed in module 11);
- ✓ Correct Application of Standard Repair Principles (including repair preparation) (as discussed in module 13).

Module 16 - Examination

The written examination shall contain a minimum of 30 multiple choice questions.

Module 1 - Introduction to Composites

In Module 1, you'll be introduced to the basics of composite materials technology and their applications in various industries, including aerospace, marine, automotive, civil, energy, and consumer products. You will learn about the definition and history of composites, as well as their advantages and disadvantages compared to other materials. Additionally, you'll explore the conductivity of composites, their various applications, and the different product forms they come in. You will also discuss the merits and general failure modes of composite materials, allowing for a comparison between metallic and composite structures.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe the basics of composite materials technology and their applications in aerospace, marine, automotive, civil, energy, and consumer products;
- Explain the definition and history of composites;
- Discuss the advantages and disadvantages of composite materials compared to other materials;
- Understand the conductivity of composite materials;
- Identify various applications of composite materials;
- Recognize different product forms of composite materials;
- Discuss the merits and general failure modes of composite materials and compare them with metallic structures.

Topics

1. Definition of Composites
2. History of Composites
3. Advantages/Disadvantages
4. Conductivity
5. Applications
6. Product Forms

Module 2 - Human Factors

In Module 2, you'll learn about the concept of "Human Factors" in aviation. You will understand how personal minimums and various human factors can influence safety and contribute to accidents and incidents. You will learn that personal minimums are individual thresholds set by aviation professionals to ensure safe operations. These minimums can include factors like fatigue, workload, environmental conditions, and experience with specific tasks. Additionally, you'll explore resources provided by FAA and EASA to help manage and mitigate these factors effectively.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Explain the concept of "Human Factors" in aviation;
- Describe the concept of "personal minimums," which are individual thresholds set by aviation professionals to ensure safe operations;
- Identify at least two human factors that are likely causes of accidents and incidents;
- Utilize FAA and EASA resources to manage and mitigate human factors in aviation.

Topics

1. Definition of Human Factors
2. FAA/EASA Resources
3. Personal Minimums

Module 1 - Introduction to Composites

In Module 1, you'll be introduced to the basics of composite materials technology and their applications in various industries, including aerospace, marine, automotive, civil, energy, and consumer products. You will learn about the definition and history of composites, as well as their advantages and disadvantages compared to other materials. Additionally, you'll explore the conductivity of composites, their various applications, and the different product forms they come in. You will also discuss the merits and general failure modes of composite materials, allowing for a comparison between metallic and composite structures.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe the basics of composite materials technology and their applications in aerospace, marine, automotive, civil, energy, and consumer products;
- Explain the definition and history of composites;
- Discuss the advantages and disadvantages of composite materials compared to other materials;
- Understand the conductivity of composite materials;
- Identify various applications of composite materials;
- Recognize different product forms of composite materials;
- Discuss the merits and general failure modes of composite materials and compare them with metallic structures.

Topics

1. Definition of Composites
2. History of Composites
3. Advantages/Disadvantages
4. Conductivity
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6. Product Forms

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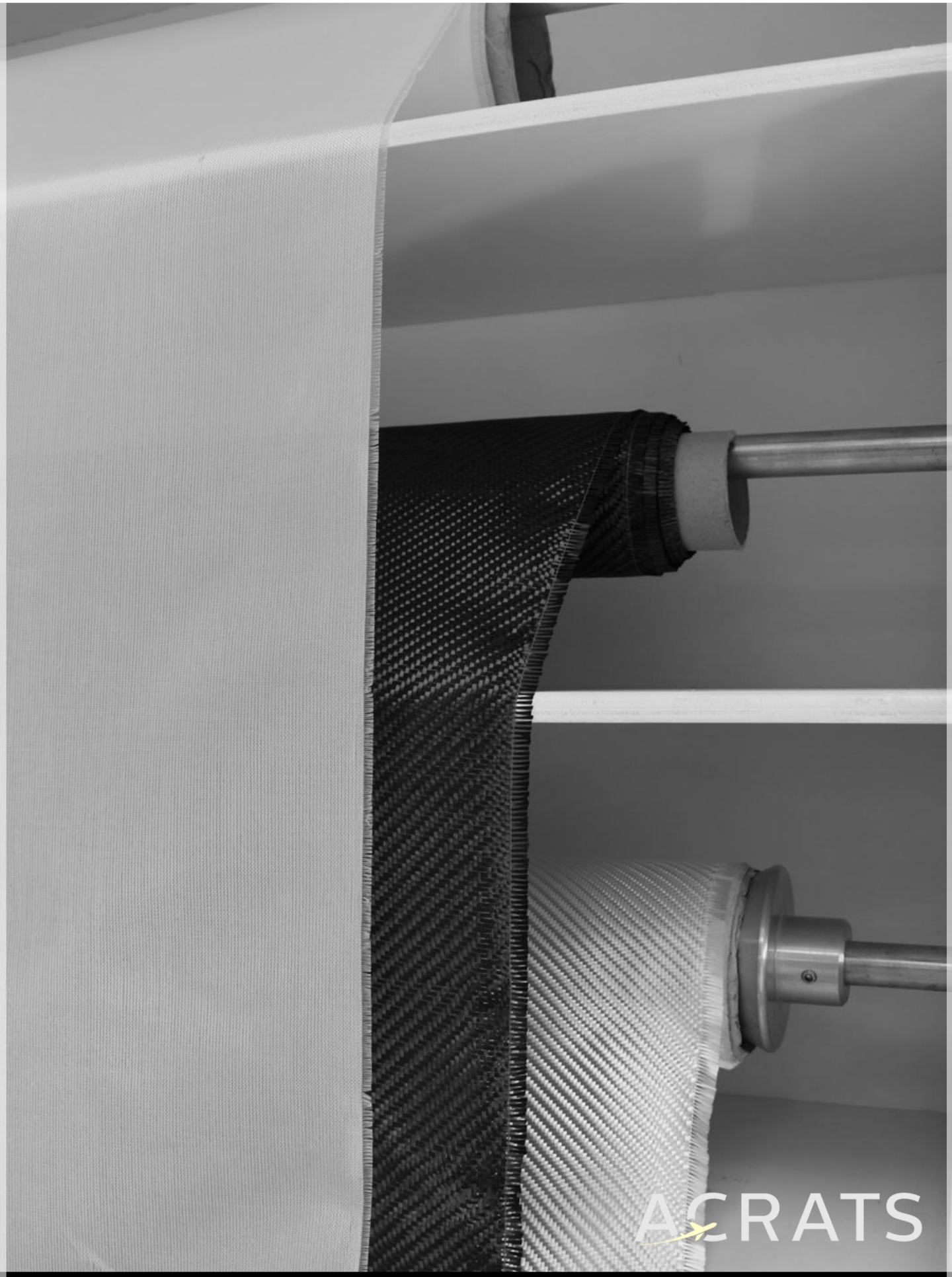
Topics

1. Definition of Human Factors
2. FAA/EASA Resources
3. Personal Minimums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Module 3 - Reinforcement Fibers

In Module 3, you'll learn about the various reinforcement fibers used in composite materials. You'll gain the ability to visually recognize common composite fibers such as fiberglass, aramid, carbon, ceramics, and hybrids. You will learn to list their properties and understand the terminology related to the fabric manufacturing process. Additionally, you'll explore the fiber placement levels used during the manufacturing and repair of composite structures, including fabric weaves, warp direction, and part warp clock. You'll also delve into different forms and configurations of fibers, such as unidirectional tape, non-woven mats, and woven fabrics, and understand the importance of fiber sizing, finishes, balance, and symmetry.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Visually recognize common composite fibers such as fiberglass, aramid, carbon, ceramics, and hybrids;
- List the properties of these fibers and understand the terminology related to their manufacturing processes;
- Describe the fiber placement levels used during manufacturing and repairing of composite structures, including fabric weaves, warp direction, and part warp clock;
- Identify and differentiate between various forms and configurations of fibers, such as unidirectional tape, non-woven mats, and woven fabrics;
- Explain the significance of fiber sizing and finishes in composite materials;
- Understand the concepts of balance and symmetry in fiber placement, including warp clock, tracers, ply orientation, and nesting.

Topics

1. Materials
    a. Fiberglass
    b. Aramid
    c. Carbon
    d. Ceramics
    e. Hybrids
2. Forms Terminology
    a. Filament
    b. Strand
    c. Tow
    d. Yarn
3. Unidirectional Tape
4. Non-Woven
    a. Mat
    b. Chopped
    c. Continuous Filament
    d. Stitched
5. Woven
    a. Plain
    b. Twill
    c. Harness Satin
    d. Biaxial
    e. Triaxial
6. Fiber Sizing and Finishes
7. Balance and Symmetry
    a. Warp Clock
    b. Tracers
    c. Ply Orientation
    d. Nesting

Module 4 - Matrix Systems

In Module 4, you'll learn about matrix systems used in composite materials. You will understand the difference between thermoplastic and thermosetting matrix materials, describe the roles and limitations of matrix materials, and learn about their storage and handling requirements. You'll also determine and calculate various mix ratios, understand the cure cycle, and describe matrix cross-linking terminologies. Additionally, you'll learn to describe and select appropriate filler materials and calculate a given resin system mix ratio with filler materials using an established ratio.

Learning Goals

Upon successful completion of this module, the student will be able to:

- State the difference between thermoplastic and thermosetting matrix materials;
- Describe the roles and limitations of matrix materials;
- Explain the storage and handling requirements for matrix materials;
- Determine and calculate various mix ratios by weight and volume, and understand the mixing process;
- Describe the cure cycle of resins, including the A, B, and C stages, flow versus gelation, glass transition, viscosity, and curing reactions;
- Describe and select appropriate filler materials and calculate mix ratios with fillers.

Topics

1. Thermoplastics
2. Thermosets
3. Mixing and Mix Ratios
    a. Weight
    b. Volume
    c. Mixing Process
4. Curing of Resins
    a. A, B, and C Stages
    b. Flow versus Gelation
    c. Glass Transition
    d. Viscosity
    e. Curing Reactions
5. Potting
    a. Fillers
    b. Micro-Balloons
    c. Chopped Fiber
    d. Fumed Silica

Module 5 - Introduction to Composites

In Module 5, you'll learn about safety and environmental considerations when working with polymeric materials. You will understand the personal hazards associated with these materials and describe the four common paths of entry into the body. You'll evaluate a typical Safety Data Sheet (SDS) and demonstrate how to select proper personal protection equipment (PPE). Additionally, you'll learn about waste disposal procedures, exothermic reactions, and the flammability of materials.

Learning Goals

Upon successful completion of this module, the student will be able to:

- State the personal hazards of working with polymeric materials and describe the four common paths of entry;
- Evaluate a typical Safety Data Sheet (SDS) and select proper personal protection equipment (PPE);
- Describe waste disposal procedures for polymeric materials;
- Understand the risks of fumes, vapors, and dust, and the importance of avoiding skin contact;
- Explain exothermic reactions and their implications for safety;
- Understand the flammability of polymeric materials and appropriate safety measures.

Topics

1. Fumes, Vapors, and Dust
2. Skin Contact
3. Safety Data Sheet (SDS)
4. Personal Protective Equipment (PPE)
5. Exothermic Reactions
6. Waste Disposal
7. Flammability

Module 6 - Human Factors

In Module 6, you'll learn about pre-impregnated (pre-preg) materials used in composite manufacturing. You will describe the pre-impregnation manufacturing levels and state the stages of the matrix material. You'll also understand the storage and handling requirements, re-certification, and disposal procedures for pre-preg materials. By the end of this module, you'll be able to state the correct handling procedures for pre-preg materials.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe the pre-impregnation manufacturing levels, including resin bath and hot melt processes;
- State the stages of matrix materials in pre-preg composites;
- Understand the storage and handling requirements for pre-preg materials;
- Explain the re-certification procedures for pre-preg materials;
- Describe the disposal procedures for pre-preg materials;
- State the matrix cure temperatures and their importance in handling pre-preg materials.

Topics

1. Levels
    a. Resin Bath
    b. Hot Melt
    c. Stages
2. Matrix Cure Temperatures


AlphaTec
2000
3M
N95
Particulate Respirator N95
粒狀物防護口罩, N95
Partikulat Respirator N95
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Module 7 - Adhesives

In Module 7, you'll learn about the properties and usage of adhesives in composite materials. You will explore different types of adhesives, including film, liquid, and paste, as well as supported and unsupported forms. You'll understand the differences between chemical and mechanical bonding, and the importance of surface preparation and bond line control. Additionally, you'll learn about common failure modes of adhesives and how to select appropriate adhesive materials based on repair documentation.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Explain the properties and usage of various types of adhesives, including film, liquid, and paste;
- Understand the difference between supported and unsupported adhesives;
- Compare chemical bonding to mechanical bonding;
- Describe the importance of surface preparation and the concept of surface energy;
- Understand bond line control techniques, including the use of micro beads and carriers like scrim cloth, knit, and veil;
- Identify common failure modes of adhesives, including adhesion and cohesion failures;
- Explain the use of foams in adhesives, such as core splice applications.

Topics

1. Film
2. Liquid
3. Paste
4. Supported/Unsupported
5. Chemical Bonding Compared to Mechanical Bonding
6. Surface Preparation
7. Surface Energy
8. Bond Line Control
    a. Micro Beads
    b. Carriers
    c. Scrim Cloth
    d. Knit
    e. Veil
9. Failure Modes
    a. Adhesion
    b. Cohesion
    c. Core Splice

Module 8 - Structural Design Considerations

In Module 8, you'll learn about structural design considerations for composite materials. You will describe the differences between sandwich structures and solid laminate structures (including monolithic structures). You'll explore the various materials used in construction, including wood, foam, and honeycomb. Additionally, you'll learn about the advantages and disadvantages of different structural designs, typical sandwich design, solid laminate and monolithic design, and various joint types such as bolted and bonded joints.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe the differences between sandwich structures and solid laminate structures (including monolithic structures);
- Explain the advantages and disadvantages of sandwich and solid laminate designs;
- Identify and describe typical sandwich designs;
- Understand solid laminate and monolithic design concepts;
- Describe various joint types, including bolted and bonded joints;
- Understand the materials used in composite structures, including wood, foam, and honeycomb;
- Describe honeycomb materials, including types, densities, cell shapes and sizes, ribbon direction, filleting, cleanliness, and splices.

Topics

1. Advantages/Disadvantages
2. Typical Sandwich Design
3. Solid Laminate and Monolithic Design
4. Joint Types
    a. Bolted
    b. Bonded
5. Wood
6. Foam
7. Honeycomb
    a. Material Types
    b. Densities
    c. Cell Shapes and Sizes
    d. Ribbon Direction
    e. Filleting
    f. Cleanliness
    g. Splices
    h. Septum
    i. Peg/Crush

Module 9 - Material Handling and Storage

In Module 9, you'll learn about the importance of proper storage and handling of materials used in various composites industries. You will explore the requirements for storage containers such as refrigerators, freezers, and flammable storage cabinets, as well as storage life, handling concerns, out times, recertification, and disposal procedures. This module will provide you with a comprehensive understanding of how to manage composite materials to ensure their integrity and safety.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Explain the importance of proper storage and handling of materials used in the composites industries;
- Describe the requirements for storage containers, including flammable storage cabinets, refrigerators, and freezers;
- Understand the shipping, handling, and temperature requirements for composite materials;
- Explain the significance of storage temperatures, thawing procedures, and kitting;
- Describe the concepts of out time, storage life (shelf life), mechanical life, and handling life;
- Understand the handling procedures for polymeric materials and dry goods;
- Explain the process of recertifying polymeric materials and the proper disposal methods.

Topics

1. Flammable Storage Cabinets
2. Refrigerators/Freezers
3. Shipping: Handling and Temperature Requirements
4. Storage Temperatures
5. Thawing
6. Kitting
7. Out Time
8. Storage Life (Shelf Life)
9. Mechanical Life and Handling Life
10. Handling of Polymeric Materials
11. Handling of Dry Goods
12. Recertifying of Polymeric Materials
13. Disposal

Module 10 - Facilities and Equipment

In Module 10, you'll learn about the facilities and equipment necessary for operating a composite facility effectively. You'll explore the various types of equipment needed, including tools, dust extraction systems, trim rooms, and Controlled Contamination Areas (CCA). This module will provide you with a comprehensive understanding of how to manage and maintain a composite facility to ensure safety and efficiency.

Learning Goals

Upon successful completion of this module, the student will be able to:

- List the various equipment needed to properly operate a composite facility;
- Describe the function and setup of trim rooms;
- Understand the different levels of dust extraction equipment, including booths, vacuums, and downdraft tables;
- Explain the importance and maintenance of a Controlled Contamination Area (CCA);
- Describe the requirements for resin mixing areas, including mixing booths and disposal equipment;
- Understand the components and operation of vacuum equipment, including ports, pumps, hoses, and gauges.

Topics

1. Trim Rooms
2. Dust Extraction Levels
    a. Booths
    b. Vacuums
    c. Downdraft Tables
3. Controlled Contamination Area (CCA)
4. Resin Mixing Areas
    a. Mixing Booth
    b. Disposal Equipment
5. Vacuum Equipment
    a. Ports
    b. Pumps
    c. Hoses
    d. Gauges

Module 11 - Vacuum Bagging

In Module 11, you'll learn about the importance of vacuum bagging in the composite manufacturing process. You will understand the principles of vacuum and how it affects laminate properties. Additionally, you'll explore the various materials used in the vacuum bagging process and their specific functions. You'll also learn about different types of vacuum bags and the process of bleeding to control fiber resin ratio, void content, and thickness, as well as ply compaction requirements.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Explain the importance of vacuum bagging and how vacuum/pressure affects laminate properties;
- Understand the principles of vacuum and its relation to altitude;
- Identify and describe the materials used in the vacuum bagging process, including peel ply, bleeders/breathers, release films, bagging films, bag sealant, and cauls;
- Differentiate between types of vacuum bags, including bag to part, bag to tool, and envelope bags;
- Explain the bleeding process and its impact on fiber resin ratio, void content, and thickness;
- Understand the requirements for ply compaction in the vacuum bagging process.

Topics

1. Theory
    a. Vacuum/Pressure
    b. Altitude
2. Materials
    a. Peel Ply
    b. Bleeders/Breather
    c. Release Films
    d. Bagging Films
    e. Bag Sealant
    f. Cauls
3. Types of Bags
    a. Bag to Part
    b. Bag to Tool
    c. Envelope
4. Bleeding
    a. Fiber Resin Ratio
    b. Void Content
    c. Thickness
5. Ply Compaction Requirements

Module 12 - Heating Devices

In Module 12, you'll learn about the different types of heating devices used in the composite industry. You will explore their primary uses, advantages and disadvantages, limitations, and any concerns associated with each device. By the end of this module, you'll have a comprehensive understanding of how these heating devices are applied in composite manufacturing and repair processes.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Explain the primary uses, advantages, and disadvantages of different heating devices used in the composite industry;
- Describe the limitations and concerns associated with various heating devices;
- Understand the applications and functionalities of autoclaves, ovens, hot bonders, heat blankets, hot air blowers, heat lamps, infrared devices, and heat guns.

Topics

1. Autoclave
2. Oven
3. Hot Bonders
4. Heat Blankets
5. Hot Air Blowers
6. Heat Lamps
7. Infrared
8. Heat Guns


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Module 13 - Source Documents

In Module 13, you'll learn about the use of repair manuals and documents for composite structures. You will understand how to navigate and utilize various types of documentation, including structural repair manuals, component maintenance manuals, engineering orders, and regulatory documents. Additionally, you'll explore the limitations of using these documents and the importance of adhering to specified guidelines and standards.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe the use of repair manuals and documents for composite structures;
- Understand the limitations of using various repair manuals and documents;
- Navigate and utilize ATA iSpec 2200/S1000D and Original Equipment Manufacturer (OEM) manuals, including structural repair manuals and component maintenance manuals;
- Interpret and apply information from engineering orders, SAE AMS-CACRC ARPs, and regulatory documents;
- Understand the role and application of drawing systems, process specifications, material specifications, data sheets, and vendor manuals.

Topics

1. ATA iSpec 2200/S1000D
2. Original Equipment Manufacturer (OEM)
    a. Structural Repair Manuals
    b. Component Maintenance Manual
3. Engineering Orders
4. SAE AMS-CACRC ARPs
5. Regulatory Documents
6. Drawing Systems
7. Process Specifications
8. Material Specifications
9. Data Sheets
10. Vendor Manuals

Module 14 - Protective Coatings and Finishes

In Module 14, you'll learn about protective coatings and finishes for composite structures. You will discuss the requirements for protective coatings, their handling procedures for fiber-reinforced plastic structures, and how to determine the type, application, and restoration procedures using approved manuals. This module will cover various types of sealants, primers, and finishes, as well as conductive coatings and materials.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Discuss the requirements for protective coatings on composite structures;
- Understand the handling procedures for protective coatings involving fiber-reinforced plastic structures;
- Determine the type, application, and restoration procedures for protective coatings using approved manuals;
- Identify and describe various types of sealants, primers, and finishes;
- Understand the use and application of conductive materials, including metal foil, flame spray, metal-coated fabrics, metal meshes, anti-static paint, and interwoven-wire.

Topics

1. Sealants
2. Primers
3. Finishes
4. Conductive
    a. Metal Foil
    b. Flame Spray
    c. Metal Coated Fabrics
    d. Metal Meshes
    e. Anti-Static Paint
    f. Interwoven-Wire

Module 15 - Repair Selection Considerations

In Module 15, you'll learn about repair selection considerations for composite structures. You will be able to describe the differences between prepreg repairs, wet lay-up repairs, and bolted repairs. Additionally, you'll explore various aspects of repair design, including support tooling requirements, doubler overlays, pre-cured patches, and nonstructural (cosmetic) repairs. You'll also learn about taper sanding, step sanding, part drying requirements, and ply stack-up techniques.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe the differences between prepreg repairs, wet lay-up repairs, and bolted repairs;
- Understand the various aspects of repair design, including support tooling requirements, doubler overlays, pre-cured patches, and nonstructural (cosmetic) repairs;
- Explain taper sanding and step sanding techniques;
- Understand part drying requirements, including physical water and absorbed moisture;
- Describe ply stack-up techniques, including small ply down and large ply down.

Topics

1. Repair Design
    a. Prepreg
    b. Wet Lay-Up
    c. Support Tooling Requirements
    d. Doubler Overlay
    e. Pre-Cured Patch
    f. Bolted
    g. Nonstructural (cosmetic)
2. Taper Sanding and Step Sanding
3. Part Drying Requirements
    a. Physical Water
    b. Absorbed Moisture
4. Ply Stack Up
    a. Small Ply Down
    b. Large Ply Down (optional)
5. Repair Area Limitations

Module 16 - Inspection Techniques

In module 16, you'll learn about various Non-Destructive Inspection (NDI) techniques used in the manufacture and repair of composite structures. You will explore the limitations of these techniques and gain practical experience in performing visual and tap test inspections. You will also learn to correctly map damaged areas on sandwich-constructed parts.

Learning Goals

Upon successful completion of this module, the student will be able to:

- List the various types of Non-Destructive Inspection (NDI) techniques and their limitations during the manufacture and repair of composite structures;
- Perform a visual and tap test inspection on a sandwich-constructed part;
- Correctly map the damaged area as evaluated by the instructor;
- Understand the types of damage that can occur in composite structures;
- Conduct pre- and post-repair inspections to ensure structural integrity;
- Compare NDI techniques for metal and composite structures.

Topics

1. Types of Damage
2. Mapping of Damage
3. Pre- and Post-Repair Inspection
4. Visual
5. Tap Testing
6. Ultrasonic (Pulse-Echo, TTU, Bondtesters)
7. Thermography
8. X-Ray
9. Comparison of NDI Techniques for Metal and Composite Structure


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COMPOSITES

Module 17 - Machining of Composites

In module 17, you'll learn how to select and safely operate various air-powered tools, including drill motors, die grinders, and dual orbital sanders, for machining composite materials. You will determine recommended grinding materials, as well as the appropriate speeds and feeds for machining carbon and fiberglass materials. You will gain practical experience by drilling holes and taper sanding a four-ply face sheet, ensuring no fiber breakout or bond ply damage.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Select and safely operate air-powered tools, including drill motors, die grinders, and dual orbital sanders;
- Determine the recommended grinding materials for machining carbon and fiberglass materials;
- Understand the appropriate speeds and feeds for drilling and grinding composite materials;
- Drill a minimum of 10 holes to the correct size without causing fiber breakout damage;
- Taper sand a four-ply face sheet without causing bond ply damage;
- Describe the techniques and considerations for sanding, drilling, trimming, and core machining of composites.

Topics

1. Sanding
2. Drilling
    a. Speeds and Feeds
    b. Types of Drills
    c. Reamers
3. Tools and Equipment
4. Trimming
5. Core Machining

Module 18 - Hands-on Exercises

In this extensive hands-on module, you'll develop the basic skills necessary to repair fiber-reinforced structures using wet-lay and prepreg materials, vacuum bagging techniques, and hot bond equipment. You'll learn to wear personal protective equipment correctly and accomplish repairs using approved documentation to ensure airworthiness. Through practical exercises, you'll gain experience in symmetrical and asymmetrical lay-ups, core repairs, and scarf repairs with fiberglass, hybrid, or carbon materials.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Develop the basic skills necessary to repair fiber-reinforced structures using wet-lay and prepreg materials;
- Apply vacuum bagging techniques and operate hot bond equipment;
- Wear personal protective equipment correctly during repair processes;
- Perform repairs using approved documentation and ensure the repairs are airworthy;
- Execute symmetrical and asymmetrical lay-up exercises;
- Conduct wet lay-up processes, including resin mixing and bleeder exercises;
- Perform prepreg lay-up, including panel building;
- Conduct core repairs using foaming adhesives, film adhesive, and potting techniques;
- Execute scarf repairs on fiberglass, hybrid, or carbon materials using both wet lay-up and prepreg methods.

Topics

1. Symmetrical/Asymmetrical Lay-Up Exercise
2. Wet Lay-Up
    a. Resin Mixing
    b. Bleeder Exercise
3. Prepreg Lay-Up
    a. Panel Build
4. Core Repair
    a. Foaming Adhesives
    b. Film Adhesive
    c. Potting
5. Scarf Repairs - Fiberglass, Hybrid, or Carbon
    a. Wet Lay-Up
    b. Prepreg

19 - Assessment Criteria

- ✓ Core removed without causing additional damage to far side inner skin;
- ✓ Taper sanding meets repair document requirements;
- ✓ Correct material and orientation of original plies identified;
- ✓ Repair plies are positioned and oriented correctly;
- ✓ Cure cycle(s) meets repair document requirements;
- ✓ Repair meets post repair inspection requirements.

20 - Examination

The written examination consists of 50 multiple choice questions. The examination contains questions from each of the topics listed in the outline for each part. The examination will be closed book.

Module 1 - Introduction/About the Structural Repair Manual

In Module 1, you'll gain a comprehensive understanding of aircraft technical manuals, focusing specifically on the Structural Repair Manual (SRM). This module covers the breakdown and contents of the SRM, including its purpose and how it is organized. You will learn about the different sections within the SRM, such as the Frontmatter and Chapter 51, which are crucial for understanding the structure and repair processes of aircraft. Additionally, you will explore Chapters 52 through 57, gaining insights into their specific purposes and contents.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe the three groups in which aircraft technical manuals can be divided;
- Describe the purpose and contents of the SRM;
- Describe the purpose and contents of the Frontmatter;
- Describe the purpose and contents of Chapter 51 within the SRM;
- Describe the primary aircraft structure chapters within the SRM.

Topics

1. Introduction
2. Introduction to Maintenance Documentation
3. Introduction to the Structural Repair Manual
4. About the Structural Repair Manual
5. Breakdown of the Structural Repair Manual
6. Contents of the Structural Repair Manual
7. Frontmatter
    a. Purpose
    b. Breakdown
    c. Content
8. Chapter 51
    a. Purpose
    b. Breakdown
    c. Content
9. Chapter 52 Thru 57
    a. Purpose
    b. Breakdown
    c. Content

Module 2 - Navigating the Structural Repair Manual

In Module 2, you'll delve into the numbering systems used in aircraft technical data, from ATA 100 and A4A iSpec 2200 to S1000D. This module will provide you with a clear understanding of how these numbering systems are organized and how they facilitate the management and retrieval of technical information. You will learn about the three elements system within the SRM, including identification, allowable damage limits, and repair procedures. Additionally, you will learn about the use of different page blocks within SRM chapters, enhancing your ability to navigate and interpret the manual effectively.

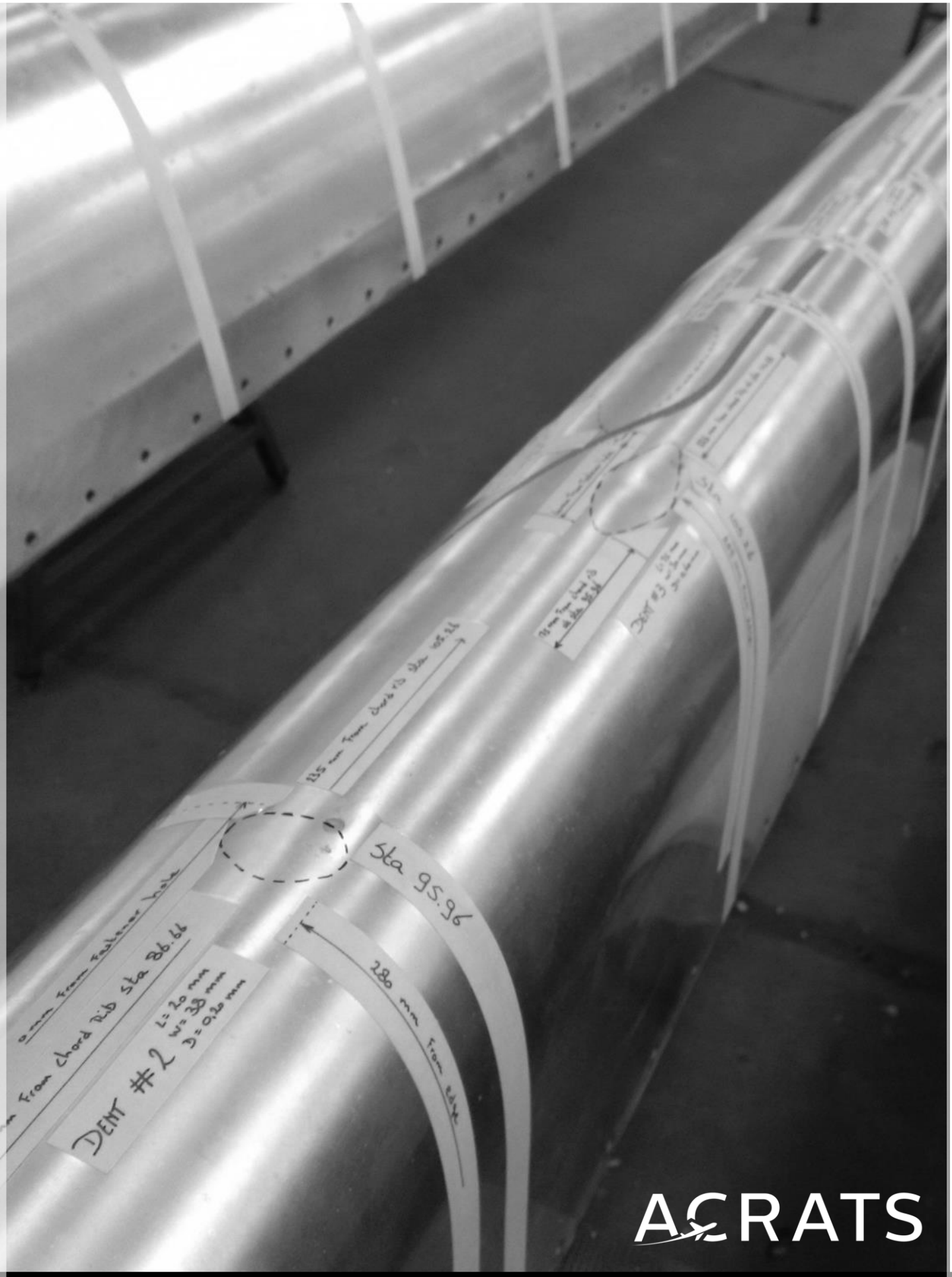
Learning Goals

Upon successful completion of this module, the student will be able to:

- Explain the numbering system used in aircraft technical data;
- Explain the chapter numbering system accordance ATA100, A41 iSpec 2200 and S1000D;
- Describe the three elements system within the SRM;
- Describe the use of different page blocks within the SRM chapter.

Topics

a. Introduction
b. Chapter Numbering System
    a. ATA 100
    b. A4A iSpec 2200
    c. S1000D
c. Segments of SRM Chapters
    a. Identification
    b. Allowable Damage Limits
    c. Repair
d. Pageblocks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Module 3 - Key Definitions in Aircraft Structural Repair and the Structural Repair Manual

In Module 3, you'll gain a deep understanding of essential definitions and concepts related to aircraft structural repair used in the structural repair manual. This module will clarify the differences and significance of primary and secondary structures, as well as the meaning of Fatigue Critical Baseline Structure (FCBS). You will learn about the three possible outcomes of damage assessments—allowable damage, repairable damage, and replacement—and the distinctions between various repair categories. Additionally, you will understand the importance of flight cycles and hours in the context of aircraft maintenance and repair.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Describe the difference and meaning of primary and secondary structure;
- Describe the meaning of Fatigue Critical Baseline Structure (FCBS);
- Describe the three possible outcomes of damage assessments (allowable damage, repairable damage, and part replacement);
- Describe the difference in repair categories;
- Describe the meaning of flight cycles and hours.

Topics

1. Introduction
2. Primary Structure
3. Secondary Structure
4. Fatigue Critical Baseline Structure (FCBS)
5. Damage Classification
6. Allowable Damage
7. Repairable Damage
8. Part Replacement
9. Repair Categories
10. Flight Cycles & Flight hours

Module 4 - Inspection and Damage Assessment (Theoretical- and Practical Cases)

In Module 4, you'll learn the critical steps involved in assessing damage on the aircraft structure and components. This module will guide you through the process of finding the correct effectivity for the aircraft, including understanding cumulative line numbers, weight variants, manufacturer serial numbers, modifications, and service bulletins. You will learn how to accurately identify the damaged part and its location, as well as how to identify the nature and extent of the damage. Additionally, you will learn how to find the allowable damage limits and select the appropriate repair procedure. Furthermore, you will learn to check the correct effectivity of chapters and demonstrate the correct use of inspection tooling for both metallic and composite structures. This module ensures that you can perform thorough and accurate damage assessments, ensuring the safety and integrity of the aircraft.

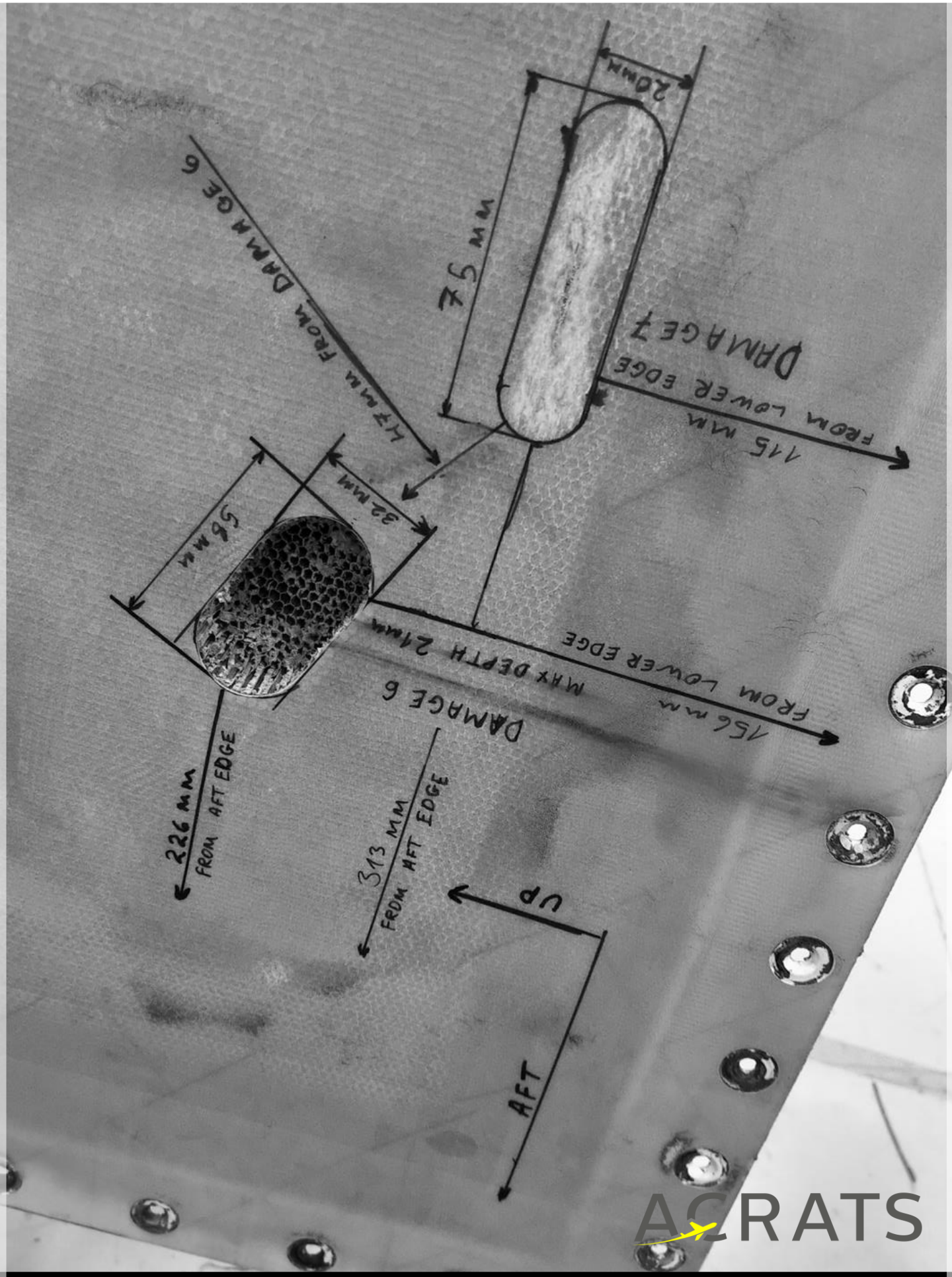
Learning Goals

Upon successful completion of this module, the student will be able to:

- Check if effectivity is applicable and know how to find the applicable effectivity for the aircraft, including cumulative line numbers, weight variants, manufacturer serial numbers, modifications, and service bulletins;
- Demonstrate the correct use of inspection tooling to be used on metallic structures;
- Demonstrate the correct use of inspection tooling to be used on composite structures;
- Identify the damaged part and location;
- Determine the exact location of a damage;
- Identify the type and dimensions of the damage;
- Perform the procedure of damage mapping;
- Find the allowable damage limits;
- Explain when the damage needs to be rework prior to assessment
- Select the applicable repair procedure (corrective action).

Topics

1. Introduction
2. Human Factors
3. Check Effectivity
    a. Cumulative Line Numbers
    b. Weight Variant
    c. Manufacturer Serial Number
    d. Modifications
    e. Service Bulletins
4. Identification of the Damaged Part & Location
    a. Nomenclatures
    b. General (LH, RH, FWD, AFT, DOF, etc.)
    c. Stringers
    d. Stations
    e. Frames
    f. Zones
5. Inspection Tooling
    a. Tooling for Metallic Structures
    b. Tooling for Composite Structure (Including the Automated Tap-Tester (Woodpecker)
6. Identification of the Damage
    a. Types of Damage (Damage Classification)
        i. Damage on Metallic Structure (including corrosion)
        ii. Damage on Composite Structure
    b. Dimensions of the Damage
        i. Measuring Tooling
        ii. Damage Mapping
7. Damage Rework
    a. Applicability
    b. Restriction
8. Find the Allowable Damage Limits
9. Find the Applicable Repair Procedure


20MM
94 MM
DAMAGE 7
FROM LOWER EDGE
145 MM
147MM FROM DAMAGE 6
32MM
55MM
MAX DEPTH 24MM
FROM LOWER EDGE
156 MM
DAMAGE 6
226 MM
FROM AFT EDGE
313 MM
FROM AFT EDGE
UP
AFT

Module 5 - Damage Reporting

In Module 5, you will learn the essential aspects of damage reporting in the process of damage assessment. This module covers how to accurately describe damage, identify and report the exact location, and the importance of uniformity in reporting. You will also learn the correct methods for making and adding photos or sketches to a damage report, and the procedures for reporting to your engineering department or OEM. Additionally, you will understand the importance of regulatory compliance and traceability in aviation and therefore in damage reporting.

Learning Goals

Upon successful completion of this module, the student will be able to:

- Form an accurate and correct finding description;
- Describe the steps to narrow down the exact damage location;
- Describe the reason why uniformity in reporting is important;
- Describe the correct method of making and adding photo(s) and/or sketches to a damage report;
- Describe the correct way of reporting to your own engineering department and/or OEM;
- Explain the importance of regulatory compliance and standards in damage reporting;
- Ensure traceability in damage reports for future reference and audits.

Topics

1. Introduction
2. Documentation and Damage Reporting
3. Essential Information/Minimal Requirements
4. Damage Location Determination
5. Adding Visual Evidence to Reports
6. Reporting Protocols
7. Regulatory Compliance and Standards
8. Traceability
9. Practical Examples

6 - Case Studies

- ✓ Identify specific airplane parts and locations
- ✓ Find allowable damage limits in the structural repair manual (SRM).
- ✓ Identify types of damage that can be repaired using the SRM.
- ✓ Identify the differences between repair types.
- ✓ Nose Cowl Skin Damage
- ✓ Door Skin Damage and Operating Limits
- ✓ Nacelle Structure Damage
- ✓ Composite Structure Damage
- ✓ Fuselage Interior Structure Damage
- ✓ Fuselage and Door Exterior Structure Damage
- ✓ Identify the composite ply materials, sequences and orientations for composite strucucture

LEVEL 1

AIRCRAFT STRUCTURAL REPAIR

FIXED WING

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FIXED WING STRUCTURE: INSPECTION, DAMAGE ASSESSMENT AND REPAIR, LEVEL 1