



Aerospace/Aircraft Assembly (AAA) Standard

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NCATT Aerospace/Aircraft Assembler Standard

Subject, Performance and Task Knowledge Requirements

I. General

- Aircraft Structures and Terminology
- Shop Mathematics
- Hand Tools
- Shop Tools
- Shop Practices (General)
- Quality Processes

II. Technical Drawings Principles and Use

- Aircraft Drawings, Prints and Engineering Documents
- Allowance / Tolerance and Tolerance Buildups
- Geometric Dimensioning & Tolerancing (GD&T)

III. Materials and Processes

- Aircraft Composite Materials
- Sheet Metal Layout, Marking, Measurements and Spacing
- Corrosion Recognition, Treatment and Preventative Methods
- Sealants and Epoxy
- Wiring and Fiber Optics Installation
- Hydraulic and Pneumatic Tubing Installation
- Structural Assembly –Metallic / Composite

There are nineteen (16) *Subject Knowledge, Task Performance and Task Knowledge* activities and functions within the NCATT Aerospace / Aircraft Assembler Standard. The Aerospace / Aircraft Assembler Standard was identified and defined by aerospace industry Subject-Matter-Experts (SMEs) through an NCATT facilitated occupational analysis workshop. NCATT workshops focus on the “job” an individual performs in relation to an identified topic or career field.

The NCATT Aerospace / Aircraft Assembler Standard can be used by Aerospace Industry education and training entities to develop lesson plans as part of a complete education and training program focused on aerospace vehicle or aerospace component assembly. The Standard can also be used to develop specialized and/or targeted education and training needs.

The depth, complexity and detail of task performance, task knowledge and subject knowledge, required for *NCATT Accredited* programs, can be determined by referring to the NCATT Level Definitions provided below.

Educational entities that wish to align their programs with the NCATT Standards (and required teaching levels) should refer to the NCATT webpage (www.ncatt.org) for additional guidance.

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NCATT Level Definitions

	Scale Value	Definition: The Individual
Task Performance Levels	1	IS EXTREMELY LIMITED. (Can do simple parts of the task. Needs to be told or shown how to do most of the task)
	2	IS PARTIALLY PROFICIENT. (Can do most parts of the task. Needs only help on hardest parts.)
	3	IS COMPETENT. (Can do all parts of the task. Needs only a spot check of completed work.)
	4	IS HIGHLY PROFICIENT. (Can do the complete task quickly and accurately. Can tell or show others how to do the task.)
Task Knowledge Levels	a	KNOWS NOMENCLATURE. (Can name parts, tools, and simple facts about the task.)
	b	KNOWS PROCEDURES. (Can determine step-by-step procedures for doing the task.)
	c	KNOWS OPERATING PRINCIPLES. (Can identify why and when the task must be done and why each step is needed.)
	d	KNOWS ADVANCED THEORY. (Can predict, isolate, and resolve problems about the task.)
*Subject Knowledge Levels	A	KNOWS FACTS. (Can identify basic facts and terms about the subject.)
	B	KNOWS PRINCIPLE. (Can identify relationship of basic facts and state general principles about the subject.)
	C	KNOWS ANALYSIS. (Can analyze facts and principles and draw conclusions about the subject.)
	D	KNOWS EVALUATION. (Can evaluate conditions and make proper decisions about the subject.)

Explanations

A task knowledge scale value may be used alone or with a task performance scale value to define a level of knowledge for a specific task. (Example: b and 1b)

*A subject knowledge scale value is used alone to define a level of knowledge for a subject not directly related to any specific task, or for a subject common to several tasks.

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Subject, Performance and Task Knowledge Requirements

I. General

1. Aircraft Structures and Terminology NCATT Level B

Outcome: A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who knows and can identify the relationship of basic facts and state general principles about “Aircraft Structures” and be able to recognize and use “Terminology” related to this subject.

The following is a minimum list of common titles and terms associated with this subject and should be used as a base vocabulary list in the education and training needs of the individual.

- Major Structural Stresses
 - Tension
 - Compression
 - Torsion
 - Shear
 - Bending
- Fixed-Wing Aircraft Structures
 - Cockpit
 - Fuselage
 - Wing Structure
 - Nacelles or Pods
 - Empennage
 - Flight Control Surfaces (Primary)
 - Landing Gear
 - Skin and Fairing
 - Access and Inspection Panels / Doors
- Helicopter Structures (Minimum Listing)
 - Main Rotor
 - Tail Rotor (Rotary Rudder / Anti-Torque Rotor)
 - Tail Boom (Tail Cone)

2. Shop Mathematics NCATT Level 4c

Outcome: A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who is highly proficient in the performance of each mathematic computation activity and application identified herein. For each mathematic computation activity and application, the individual will be able to do the complete calculation quickly and accurately and can tell or show others how to do the calculation. In addition, they will know the mathematical operating principles used, and can identify why and when the calculations must be done and why each step is needed.

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Subject, Performance and Task Knowledge Requirements

The following is a base-line list of mathematics subjects and terms to be covered in this section.

- Decimal System
 - Place Value
 - Addition and Subtraction
 - Multiplication and Division
- Fractions
 - Proper and Improper
 - Common and Uncommon
 - Conversion (Fractions)
 - Conversion (Fractions to Decimal)
 - Conversion (Decimal to Fraction)
 - Reduction
- Mixed Numbers
- Protractor Use
- Roots and Powers of Numbers
- Areas and Volumes of Various Geometrical Shapes
- Ratio, Proportion, and Percentage Problems
- Algebraic Operations

3. Hand Tools

NCATT Level 4a

Outcome: A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who is highly proficient in the performance of “Hand Tool” selection and use. The individual will be able to select and use hand tools quickly and accurately and can tell or show others how to do the same. In addition, they can name component parts, as applicable, of hand tools and simple facts about the selection and use of these tools.

As general information, the following is a list of *typical* base-line hand tool knowledge requirements.

- Selection of Personal Protective Equipment (PPE)
- Tool Identification
 - Common
 - Specialized
- Tool Selection
- Tool Use Safety Precaution
- Tool Inspection for Condition and Operation
- Tool Adjustments in Accordance with Operating Instructions

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Subject, Performance and Task Knowledge Requirements

4. Shop Tools

NCATT Level 3b

Outcome: A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who is competent in the performance task of “Shop Tool” selection and use. The individual will be able to do all parts of the shop tools selection process and will need only a spot check of the completed selections. In addition, they will know the task procedures, and can determine step-by-step procedures for doing the task.

As general information, the following is a list of *typical* base-line shop tool knowledge requirements.

- Selection of Personal Protective Equipment (PPE)
- Tool Identification
 - Common
 - Specialized
- Tool Selection
- Tool Use Safety Precaution
- Tool Inspection for Condition and Operation
- Tool Adjustments in Accordance with Operating Instructions

5. Shop Practices (General)

NCATT Level B

Outcome: A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who knows and can identify relationships of basic facts and state general principles about aerospace industry “Shop Practices”.

As general information, the following is a *typical* list of subjects and terms associated with shop practices.

Note: NCATT provides educational resources on FOE. See NCATT website at www.ncatt.org.

- Electrostatic Discharge (ESD)
 - ESD Sources
 - Transporting
 - Storing
 - Handling
 - Protected Workstations
 - ESD Bags
 - Labels / Signs
 - Grounding Straps
- Foreign Object Elimination (FOE / FOD) Awareness
 - Basic Terms & Definitions
 - Principles of Housekeeping

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Subject, Performance and Task Knowledge Requirements

- Tool Accountability
- Hardware Accountability
- Lost Item Control
- Physical Entry & Personnel Control
- Reporting & Investigating
- Parts Protections
- Hazardous Materials
- Wildlife / Environment as FOD
- FOD Effects
- Utilize Safety Practices
 - Ergonomics in the Workplace
 - Hazardous Materials Awareness and Disposal
 - Use of Personal Protective Equipment (PPE)
 - Material Safety Data Sheets (MSDS)
 - Occupational Safety and Health Administration (OSHA) Requirements (as they relate to the manufacturing and assembly processes and workplace)
 - Pneumatic Shop Safety
 - Power-feed Motors and/or Equipment
 - Principles of Lock Out / Tag Out
 - Relationship of Human Factors
- Non Destructive Inspection (NDI)
 - Types of NDI
 - Use and Limitations on NDI
 - Safety Considerations

6. Quality Processes

NCATT Level A

Outcome: A successful education or training outcome for this task/subject will produce an individual who can identify basic facts and terminology related to “Quality Processes”.

Note: Quality and Value must not be confused. “Quality” and “Value” **are not** synonymous. Quality is defined as, “The degree or excellence which a thing possesses”. Quality remains constant. Value of a thing is its worth in money or goods at a given time. Value of a thing can, and will change.

As general information, the following terms are *typically* associated with quality processes.

- Quality Elements
 - Quality Materials
 - Quality Personnel
 - Quality Processes
 - Quality Training

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Subject, Performance and Task Knowledge Requirements

- Quality Assurance / Control / Checks / Inspections
 - External Standards (i.e. ASTM, ISO, ASME, ICAO)
 - Quality Management / Total Quality Management (TQM)
 - Review specs / engineering drawings
 - Verify Work Meets Specs / Engineering Drawings
- Work to Approved Data
 - Review Approved Data
 - Verify Currency of Approved Data
- Team Building and Human Factors
 - Continuous improvement
 - Customer Defines Value
- Agency Oversight
- Corrective Action Processes

II. Technical Drawings Principles and Use

7. Aircraft Drawings, Prints and Engineering Documents

NCATT Level B

Outcome: A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who can analyze facts and principles and draw conclusions about “Aircraft Drawings” and their use. The following is a non-inclusive list of aircraft drawing and blue print subjects, terms and titles that education and training programs should consider for inclusion when addressing this subject.

As general information, the following terms, titles and drawing lines are *typically* associated with technical drawings.

- Drawing Types (Drawing Titles)
 - Detail
 - Assembly
 - Installation
 - Sectional
 - Exploded-view
 - Block Diagrams
 - Logic Flowcharts
 - Electrical Wiring
 - Pictorial
 - Schematic
- Illustration Methods
 - Orthographic Projection
 - Auxiliary Drawings
 - Isometric Drawings
 - Oblique Drawings
 - Perspective Drawings

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Subject, Performance and Task Knowledge Requirements

- Drawing Practices
 - Lines
 - Visible
 - Hidden
 - Center
 - Extension
 - Dimension
 - Cutting-plane
 - Phantom
 - Short Break
 - Long Break
 - Leader
 - Section
 - Aircraft Production Drawings
 - Title Block
 - Title Box
 - Size
 - Drawing Number
 - Scale
 - Page
 - Responsibility
 - Standards
 - Bill of Material
 - Application
 - Revision Block
 - Zones
 - Reference Planes
 - Fastener Code Block
 - Flag and General Notes
 - Parts List
 - Tolerance Block
 - Drawing Effectively
 - Engineering Change Authorization
 - Drawing Revisions

8. Allowance / Tolerance and Tolerance Buildups

NCATT Level 2c

Outcome: A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who is partially proficient in the performance of tasks and steps associated with the application of “Allowance, Tolerances and Tolerance Buildups”. For each task or step, the individual will be able to do most parts of the task or step and will need help only on the hardest parts. In addition, they will know the operating principles used with allowance, tolerances and tolerance buildup applications and can identify why and when these operating principles must be done and why each task or step is needed.

As general information, the following terms and activities are *typically* associated with determining allowance, tolerance and tolerance buildup dimensions.

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Subject, Performance and Task Knowledge Requirements

- Allowance
 - Difference between the nominal (basic) dimension and the upper/lower limit
- Tolerance
 - Difference between the extreme permissible dimensions
- Application of Tolerance
- Location of Reference Points
- Measurement (from a single point)
- Cumulative Measurement (Tolerance Buildup)

9. Geometric Dimensioning & Tolerancing (GD&T)

NCATT Level A

Outcome: A successful education or training outcome for this task/subject will produce an individual who can identify basic facts and terminology related to “Geometric Dimensioning and Tolerancing” (GD&T).

Note: GD&T is a symbolic engineering drawing language and design tool that utilizes symbols, rules and definitions to define the geometry of mechanical parts. The following is a non-inclusive, basic list of subjects and terms associated with GD&T.

- Current Standard for GD&T
 - American Society of Mechanical Engineers (ASME) Y14.5-2009
- ASME Y14.5-2009 Identifies, Defines and Establishes
 - Engineering Drawing and Related Documentation Practices
 - Definitions, and General Dimensioning
 - General Tolerancing and Related Principles
 - Symbolology
 - Datum Referencing
 - Tolerances of Location
 - Tolerances of Form, Profile, Orientation, and Runout
- GD&T Common Terms
 - Basic Dimension
 - Feature
 - Datum
 - Datum Feature
 - Feature of Size
 - True Position
 - Virtual Condition
 - Feature Control Frame
 - Datum References (by order of relative importance)
 - Modifier (letter codes centered within a circle)
 - “Profile of the Surface” (controls shape which is defined by basic dimensions)
 - “Tolerance Zone” (based on the geometrical shape of the feature, part or assembly)
 - Geometric Characteristic Symbols (five categories)
 - Form Controls (four subjects)
 - Profile Controls (two subjects)
 - Orientation Controls (three subjects)
 - Location Controls (three subjects)

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Subject, Performance and Task Knowledge Requirements

- Runout Controls (two subjects)
- Modifier Symbols
 - Maximum Material Condition (MMC); (M)
 - Least Material Condition (LMC); (L)
 - Regardless of Feature Size (RFS); (S)
 - Projected Tolerance Zone (P)
 - Diameter (∅)

III. Materials and Process

10. Aircraft Composite Materials

NCATT Level B

A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who knows and can identify the relationship of basic facts and state general principles about “Aircraft Composite Materials” and be able to recognize and use “Terminology” related to this subject.

The following is a minimum list of common titles and terms associated with this subject and should be used as a base vocabulary list in the education and training needs of the individual.

- Definition of Basic Composite Materials
 - Matrix
 - Reinforcing Materials
- Advanced Composites Materials
 - Fiberglass
 - Carbon Graphite
 - Aramid
 - Boron
 - Ceramic
- Typical Composite Applications
- Advantages of Composite Materials
- Disadvantages of Composite Materials
- Common Composite Part Fabrication Methods
 - Layup (e.g. Hand Layup)
 - Cure (e.g. Vacuum Bag/Autoclave)
 - Automated Systems (e.g. Winding Machine)
- Typical Composite Material Elements for Consideration in Construction
 - Core Materials
 - Sandwich Construction
 - Balsa
 - Foam
 - Honeycomb
 - Material Orientation
 - Wet Layup
 - Preimpregnated Fabric (Prepreg)

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Subject, Performance and Task Knowledge Requirements

- Health and Safety
 - Proper Personal Protective Equipment
 - Proper Storage and Handling of Materials
 - Proper Use Of Materials
 - Proper Disposal of Materials

11. Sheet Metal Layout, Marking, Measurements and Spacing

NCATT Level 4c

Outcome: A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who is highly proficient in the performance of “Sheet Metal Layout, Marking, Measurement and Spacing” functional tasks or activities. For each task or activity the individual will be able to do the complete task or activity quickly and accurately and can tell or show others how to do the task or activity. In addition, the individual will know the operating principles and procedures for each task or activity and can identify why each is important and needed.

As general information, the following terms and activities are *typically* associated with sheet metal layout, measurements and spacing.

- Working Surface Selection and Preparation
 - Smooth Surface (flat layout table)
 - Appropriate Size (avoid bending)
 - Clean Surface (avoid damage to materials)
 - Well Lighted
- Selection of appropriate marking tool(s)
 - Scriber
 - Prick Punch (**Do Not Confuse** with Center Punch)
 - Automatic Prick Punch
 - Transfer Punch
 - Hole Finder (Location Device)
 - Dividers
 - Calipers – Inside/outside
 - Felt Tip Markers (e.g. Ultra-fine point Sharpie ®)
 - Layout Fluids
- Edge Margin (Distance) and Spacing
 - Review Engineering Drawings
 - Apply Data to All Edge Margin
 - Verify Accuracy
- Basic and Precision Measurement
 - Verify Dimensions as per Engineering Drawings
 - Locate Reference Points
 - Take Measurement
 - Verify Accuracy of Layout

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Subject, Performance and Task Knowledge Requirements

- Precision Instruments (Recognition and Use)
 - Machinist Scale
 - Micrometer
 - Go No-Go Gauge
 - Dial Caliper
 - Vernier Caliper

12. Corrosion Recognition, Treatment and Preventative Methods

NCATT Level 2b

Outcome: A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who is partially proficient in the performance of the tasks of “Corrosion Recognition, Treatment and Preventative Methods”. The individual will be able to do most parts of each task and will need help only on the hardest parts. In addition, they will know the procedures for the task, and can determine step-by-step procedures for doing task.

As general information, the following terms and activities are *typically* associated with corrosion recognition, treatment and preventative methods.

- Corrosion Causes
- Types of Corrosion
- Effects of Corrosion
- Dissimilar Materials
- Corrosion Prevention Methods
 - Chemical Cleaning
 - Anodizing
 - Alodizing
 - Chromic Acid Inhibitor
 - Sodium Dichromate Solution
 - Prime and Paint Touchup
- Material Handling in Manufacturing
 - Use of Personal Protective Equipment
 - Review of relevant specifications and application procedures
 - Application of corrosion preventative compounds
 - Post application inspection
- Dispose of waste in accordance with the applicable governing agency

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Subject, Performance and Task Knowledge Requirements

13. Sealants and Epoxy

NCATT Level 2c

Outcome: A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who is partially proficient in the performance of tasks and steps associated with the use of “Sealants and Epoxy” on aerospace vehicles and components. For each task, the individual will be able to do most parts of the task and will need help only on the hardest parts. In addition, they will know the operating principles used with this subject, and can identify why and when the task must be done and why each step is needed.

As general information, the following terms and activities are *typically* associated with sealants and epoxies, and their application.

- Sealant Terminology
- Sealant Tools and Equipment
- Types of Seals (i.e., Faying, Fillet, Dome)
- Mixing Sealants and Epoxy products
 - Identify Materials
 - Review relevant specifications and instructions
 - Mix per instructions
- Sealant / Epoxy Application
 - Use of Personal Protective Equipment
 - Determine Type of Sealant / Epoxy, Tools and Application Methods
 - Prepare Surface
 - Apply Sealant / Epoxy
 - Perform post application inspection
 - Post Assembly Rework
 - Dispose of waste in accordance with the applicable governing agency

14. Wiring and Fiber Optics Installation

NCATT Level 2b

Outcome: A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who is partially proficient in the performance of the task of “Wiring and Fiber Optics Installation” in an aerospace vehicle or component. The individual will be able to do most parts of the task and will need help only on the hardest parts. In addition, they will know the procedures for the task, and can determine step-by-step procedures for doing task.

As general information, the following terms and activities are *typically* associated with wiring and fiber optics installation.

- Wiring and Fiber Optics
 - Review specifications
 - Route and install wiring / fiber optics per specifications
 - Verify the completed installation through inspection or operational checks as appropriate

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Subject, Performance and Task Knowledge Requirements

15. Hydraulic and Pneumatic Tubing Installation

NCATT Level 2b

Outcome: A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who is partially proficient in the performance of the task of “Hydraulic and Pneumatic Tubing Installation” in an aerospace vehicle or component. The individual will be able to do most parts of the task and will need help only on the hardest parts. In addition, they will know the procedures for the task, and can determine step-by-step procedures for doing task.

As general information, the following terms and activities are *typically* associated with hydraulic and pneumatic tubing installation.

- Hydraulic and Pneumatic Tubing Installation
 - Review specifications
 - Selection of the appropriate Personal Protective Equipment (PPE) for the task
 - Route and install hydraulic and pneumatic tubing per specifications
 - Verify the completed installation through inspection or operational checks as appropriate

16. Structural Assembly – Metallic / Composite

NCATT Level 2c

Outcome: A successful education or training outcome for this task/subject in manufacturing and assembly operations will produce an individual who is partially proficient in the performance of tasks and steps associated with “Structural Assembly – Metallic / Composite” of aerospace vehicles or components. For each task the individual will recognize the need for application of specific methods and techniques used with metallic and/or composite structures. For each task, the individual will be able to do most parts and will need help only on the hardest parts. In addition, they will know the operating principles used with this standard, and can identify why and when the task must be done and why each step is needed.

As general information, the following terms and activities are *typically* associated with metallic and composite aircraft structural assembly.

- Drill a Hole to Specification (hole size and depth)
 - Select drill according to specifications
 - Set depth
 - Perform test on scrap material
 - Verify for correct hole diameter and depth (blind hole) on test piece
 - Drill hole
 - Debur
 - Verify for accuracy of hole depth and diameter
- Cleco Installation
 - Select Size / Color
 - Installation / Application

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Subject, Performance and Task Knowledge Requirements

- Ream hole to size
 - Select reaming tool
 - Perform test on scrap material
 - Verify hole size from test piece
 - Ream hole
 - Inspect reamed hole for accuracy
- Hole Countersinking
 - Select countersink tool
 - Set depth
 - Perform test on scrap material
 - Verify countersink depth and diameter from test piece
 - Countersink hole
 - Inspect countersink for accuracy
- Dimpling – Hot and Cold
 - Select Dimple Dye
 - Adjust tool
 - Perform test dimple on scrap material
 - Verify dimple depth from test piece
 - Dimple hole
 - Verify for accuracy of dimple
- Fastener Installation and Removal
(Threaded Fastener, Blind Fastener, Lock Bolt, Rivet)
 - Fastener Selection (as per engineering drawings)
 - Fastener Control (Foreign Object Elimination)
 - Fastener Tool Selection
 - Fastener Installation (as per engineering drawings)
 - Verification of Fastener Installation
- Torquing and Safetying
 - Review specifications
 - Select Torquing or Safetying tool
 - Set torquing value
 - Apply torque and safety
 - Verify safety Fastener Removal
(Threaded Fastener, Blind Fastener, Lock Bolt, Rivet)
 - Select tool
 - Remove fastener
 - Inspect hole for damage
- Electrical Ground and Bonding
 - Select tool
 - Prepare and protect surface
 - Test as applicable
 - Perform bonding / grounding

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Subject, Performance and Task Knowledge Requirements

Tool List:

1. Huck Gun
2. Inspection Mirrors
3. Lock Bolt Gun
4. Measurement Devices
5. Mounted Belt and Disk Sander
6. Nibblers
7. Nut Plate Jigs
8. Pliers
9. Punches
10. Ratchets
11. Rivet Gun
12. Rivet Sets
13. Rivet Tape
14. Riv-Nut Puller
15. Snips / Shears
16. Sockets
17. Torque Wrenches
18. Vice
19. Winslow Gun
20. Wire Crimpers
21. Wire Strippers
22. Wrenches